S3FC1310, S3FC1550

Fiber-Coupled Laser Source

User Guide

Table of Contents

Chapter 1 Warning Symbol Definitions

Below is a list of warning symbols you may encounter in this manual or on your device.

Symbol	Description
	Direct Current
	Alternating Current
	Both Direct and Alternating Current
	Earth Ground Terminal
	Protective Conductor Terminal
	Frame or Chassis Terminal
	Equipotentiality
	On (Supply)
	Off (Supply)
	In Position of a Bi-Stable Push Control
	Out Position of a Bi-Stable Push Control
	Caution: Risk of Electric Shock
	Caution: Hot Surface
	Caution: Risk of Danger
	Warning: Laser Radiation
	Caution: Spinning Blades May Cause Harm

Chapter 2 Safety

CAUTION

DO NOT apply TTL or square wave modulation to the MOD IN input. Due to response delays of the constant power control loop, damage to the integrated fiber coupled laser may occur!

SHOCK WARNING

High voltage inside. To avoid electrical shock, before powering unit, make sure that the protective conductor of the 3-conductor power cord is correctly connected to the protective earth contact of the socket outlet. Improper grounding can cause electric shock resulting in severe injury or even death. Do not operate without cover installed.

WARNING

This unit must not be operated in explosive environments

Thorlabs provides the proper power input cable for use in the United States. If using this unit anywhere else, the user will need to supply a properly grounded power cable to power the unit.

Do not obstruct the air-ventilation slots in the housing!

Make sure that the line voltage rating marked on the rear panel agrees with your local supply and that the appropriate fuses are installed. Changing of the mains fuse can be done by the user (see Setting the AC Line Voltage and Installing Fuses).

With the exception of the mains fuses, there are no user serviceable parts in this product.

This device can only be returned when packed into the complete original packaging, including all foam packing inserts. If necessary, ask for a replacement package.

Mobile telephones, cellular phones or other radio transmitters should not to be used within the range of three meters of this unit since the electromagnetic field intensity may exceed the maximum allowed disturbance values according to EN50082-1.

Chapter 3 Description

The Thorlabs Fiber Coupled Laser Sources provide easy coupling and simple control of laser diode driven fiber optics. These laser sources are available in two versions, Fabry-Perot and Distributed Feed Back (DFB). The Fabry-Perot version comes in five available wavelength choices from 635 nm to 1550 nm with standard single mode fiber or polarization maintaining fiber output. The DFB version comes equipped with a thermo-electric cooler to stabilize the output wavelength, and a 40 dB optical isolator to eliminate frequency jitter due to back-reflections. The DFB is available in 1310 nm and 1550 nm wavelengths.

Chapter 4 Setup

4.1. Setting the AC Line Voltage and Installing Fuses

Your S3FC Series Laser Source has been shipped from Thorlabs configured for 115 VAC operation. If you are planning to operate your unit using a 220/230 VAC input, or need to replace an open fuse, you must perform the following procedure.

1. Remove the AC power cord if it is connected to the unit.
2. Remove the cover of the unit by removing the two 4-40 Phillips-Head screws located on the bottom rear of the unit and slide the cover off. Refer to **Figure 1** on the following page.
3. Locate the AC Line Select Switch and Fuse Holder. They are located near the AC Input Module towards the back of the unit. Refer to **Figure 1**.
4. Using a flat blade screwdriver turn the Line Select Switch to the appropriate setting to match the AC input voltage you will be using.
5. Remove the cover to the fuse holder. You will find the fuse installed in the cover. Remove the existing fuse and install the appropriate fuse for the line voltage you will be using:
    - For 115 VAC operation use 250 mA
    - For 220/230 VAC operation use 160 mA
    - In all cases use only 5 mm x 20 mm 250 VAC Type T Fuses (IEC 60127-2/III, low breaking capacity, slow blow)
6. Reinstall the cover and replace the two 4-40 Phillips-Head screws.
7. Remove the small cap head screw indicating the previous voltage configuration located on the rear panel, above the AC input housing. Place the screw in the threaded hole indicating the new AC input configuration, see **Figure 2**.

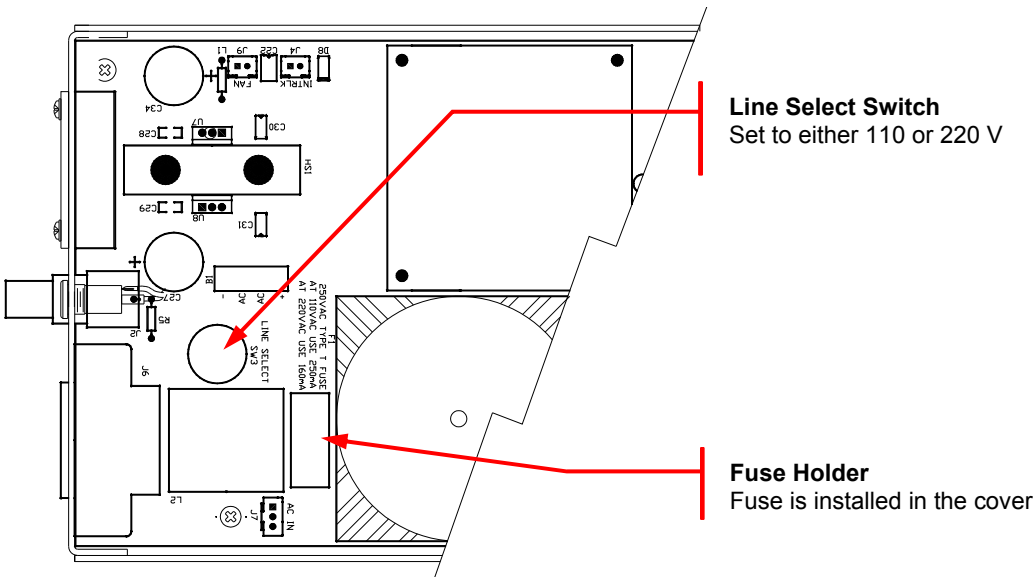


Figure 1 Locations of Line Select Switch and Fuse Holder

4.2. Initial Set-up

Perform the following steps for the initial set-up.

1. Determine the AC line voltage the unit will be connected to (either 115 VAC or 230 VAC) and set the AC Line Voltage Selector Switch to the appropriate position and install the proper fuse.

2. Locate the unit on a dry, level working surface.

3. Make sure the POWER key switch on the front of the unit is in the OFF position (key perpendicular to working surface).

4. Plug the female end of the AC line cord provided into the AC Input Receptacle on the rear of the unit. Plug the male end into a properly grounded AC socket.

5. Connect a Fiber Optic cable to the LASER APERTURE on the front panel of the unit.

Chapter 5 Operation

5.1. Front and Back Panel Overview

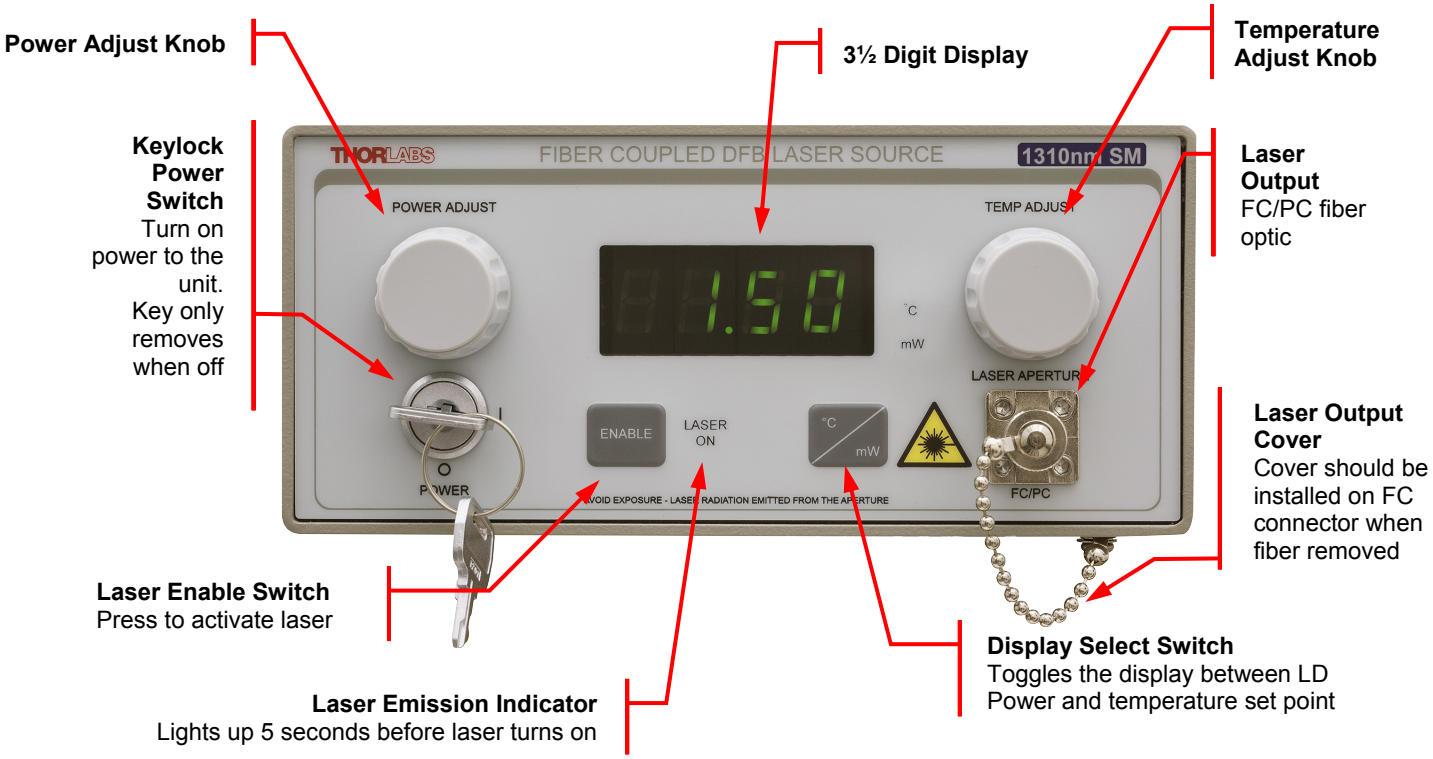


Figure 2 Front Panel of Laser Source

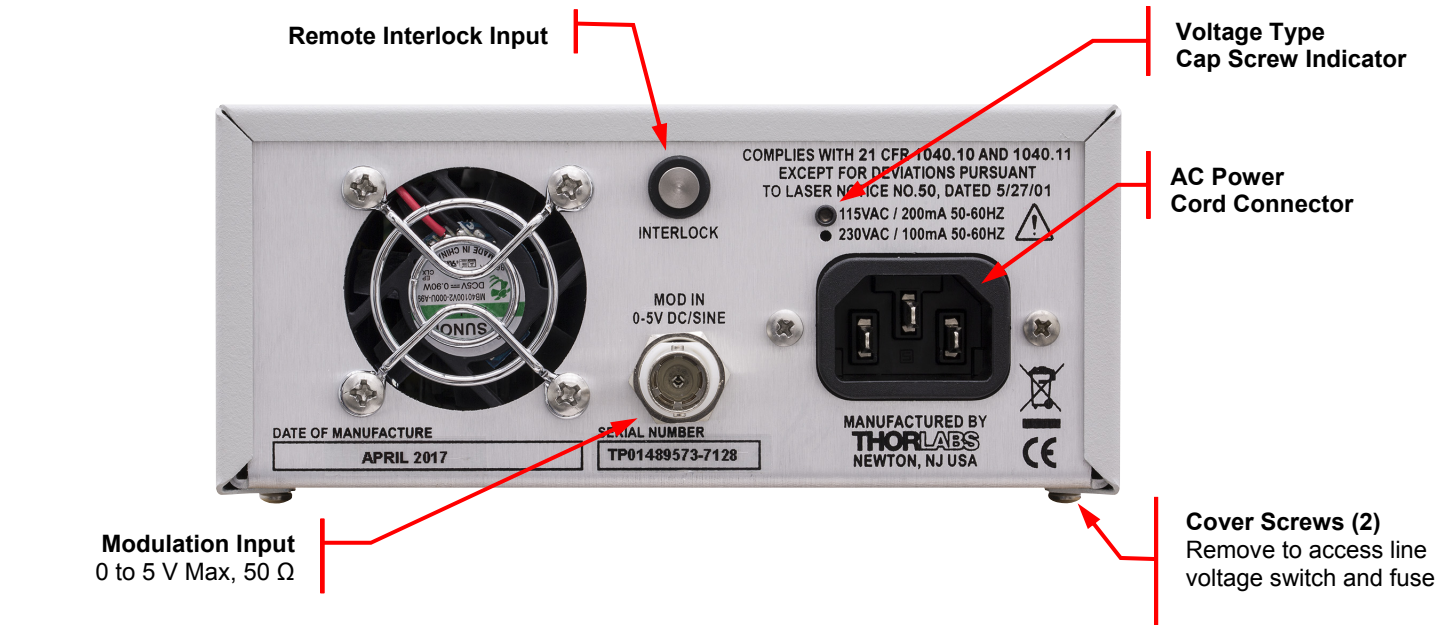


Figure 3 Rear Panel of Laser Source

5.2. Turning On the Source

SHOCK WARNING

High voltage inside. To avoid electrical shock, before powering unit, make sure that the protective conductor of the 3-conductor power cord is correctly connected to the protective earth contact of the socket outlet. Improper grounding can cause electric shock resulting in severe injury or even death. Do not operate without cover installed.

Perform the following steps for turning on the source.

1. Turn the POWER key switch clockwise. The unit is ON when the display lights up.
2. Make sure the Interlock Input is short-circuited, see Page 9.
3. Press and release the ENABLE switch to turn ON the laser. The LASER ON indicator will light up and after a delay of approximately 5 seconds, the source will begin to emit light.
4. The default display mode is laser power (mW), however the thermo-electric cooler is activated when the unit turns on.

5.3. Adjusting the Laser Output Power

The following describes how to adjust the laser output power.

1. Use the PWR ADJUST knob to adjust the output power to the desired level.
2. The power shown on the display is the optical power at the laser aperture. The actual power at the end of your fiber optic cable may be less, depending on the quality of the connection.

NOTE: Each unit is calibrated internally to limit the maximum operating power of the laser diode to a safe operating range. Please refer to the next section for instructions on optimizing the output of the laser.

5.4. Turning the Laser Off

Perform the following steps to turn the laser off.

1. The Laser output should be turned off by pressing and releasing the ENABLE switch.
2. When completely powering down an enabled unit, first press and release the ENABLE switch and then turn the POWER key switch counterclockwise, which will turn OFF the entire unit. Anytime the unit is turned OFF and then turned back ON, the Laser will be disabled until the ENABLE switch is pressed.

5.5. Adjusting the Temperature of the Laser Diode

The following describes how to adjust the temperature of the laser diode.

1. Pressing the °C/mW switch once will toggle the display from laser power (mW) to laser temperature (°C).
2. The display indicates the temperature set point of the thermo-electric cooler system.
3. Adjustments to the temperature are made with the TEMP ADJUST knob on the front of the unit. Clockwise increases the set point, counter-clockwise decreases it.
4. Depending on the magnitude of the change in temperature set point, it will take anywhere from a few seconds to a few minutes for the system to settle into the new operating temperature.

Please refer to “Maximizing the Output Stability” for helpful advice on improving the performance of your laser source.

5.6. Modulating the Laser Output

The MOD IN input can be used to modulate the laser output, or set the laser output remotely using a +5 V power source. The 5 V maximum input corresponds to the maximum calibrated power of the S3 Series DFB Laser Sources, which operate using a constant current drive technique and causes the actual output power to be dependent on the set operating temperature. That is, for a modulation input of 5 V the output power will vary depending on the operating temperature. In addition, in order to eliminate a dead zone in the power control knob, the output of the unit is offset to the threshold current of the coupled laser diode. Therefore, when the PWR ADJ knob is full counter clockwise, the drive current is not zero but actually at the threshold current. This should be kept in mind when using the modulation input.

1. Connect a signal generator or 0 to 5 V power source to the unit using a BNC type connector.

2. Set the PWR ADJ knot on the front panel to its full counter clockwise setting.

3. Press the ENABLE switch to turn on the laser, wait for the safety delay to time out.

4. Apply the appropriate signal to the MOD IN input. Signals above approximately 5.5 V will be clamped by internal circuits.

5. Adjusting the PWR ADJ knob will allow for a DC offset on the modulated output. Adjust the input signal accordingly to avoid clipping the output waveform, which will occur if the unit is driven to its current or power limits.

CAUTION

DO NOT apply TTL or square wave modulation to the MOD IN input. Due to response delays of the constant power control loop, damage to the integrated fiber coupled laser may occur!

Chapter 6 Making the Safety Interlock Connections

The S3 series laser sources are equipped with a remote interlock connector located on the rear panel, see Figure 2. All units have this feature regardless of their FDA and IEC classifications. In order to enable the laser source, a short circuit must be applied across the terminals of the Remote Interlock connector. In practice this connection is made available to allow the user to connect a remote actuated switch to the connector (i.e. an open door indicator). The switch (which must be normally open) has to be closed in order for the unit to be enabled. Once the switch is in an open state the laser source will automatically shutdown. If the switch returns to a closed condition the laser source must be re-enabled at the unit by pressing the ENABLE switch.

All units shipped from Thorlabs are configured with a shorting device installed in the Interlock connector. If you are not going to use this feature then you can leave the shorting device installed and the unit will operate normally as described in the procedures above.

If you wish to make use of the Interlock feature you will need to acquire the appropriate connector mate and wire it your remote interlock switch. Next, remove the shorting device by pulling it out with a pair of needle nose pliers and install the connector into the interlock input.

The interlock input only accepts a 2.5 mm mono phono jack. This connector is readily available at most electronics stores.

The electrical specifications for the interlock input are shown in the following table.

Specification	Value
Type of Mating Connector	2.5 mm Mono Phono Jack
Open Circuit Voltage	+5 VDC with Respect to Chassis Ground
Short Circuit Current	0.5 mA DC
Connector Polarity	Tip is +5 V, Barrel is Ground
Interlock Switch Requirements	Must be N.O. Dry Contacts Under no circumstances should any external voltages be applied to the Interlock input

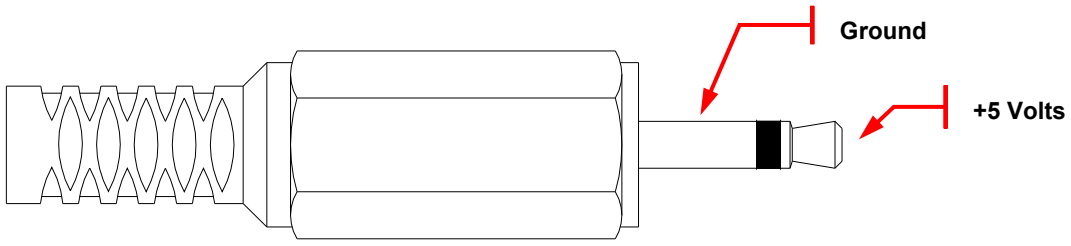


Figure 4 Remote Interlock Connector

Chapter 7 Maximizing the Stability

The benchtop laser source provides the ability to control not only the output power of the fiber coupled laser diode, it also allows for the precise control of the temperature at which the laser is operating. These two controls can be used to tune the fiber coupled laser diode to an optimum operating point, providing as stable an output as possible. The following graphs are from an OSA and a typical S3FC1550 laser.

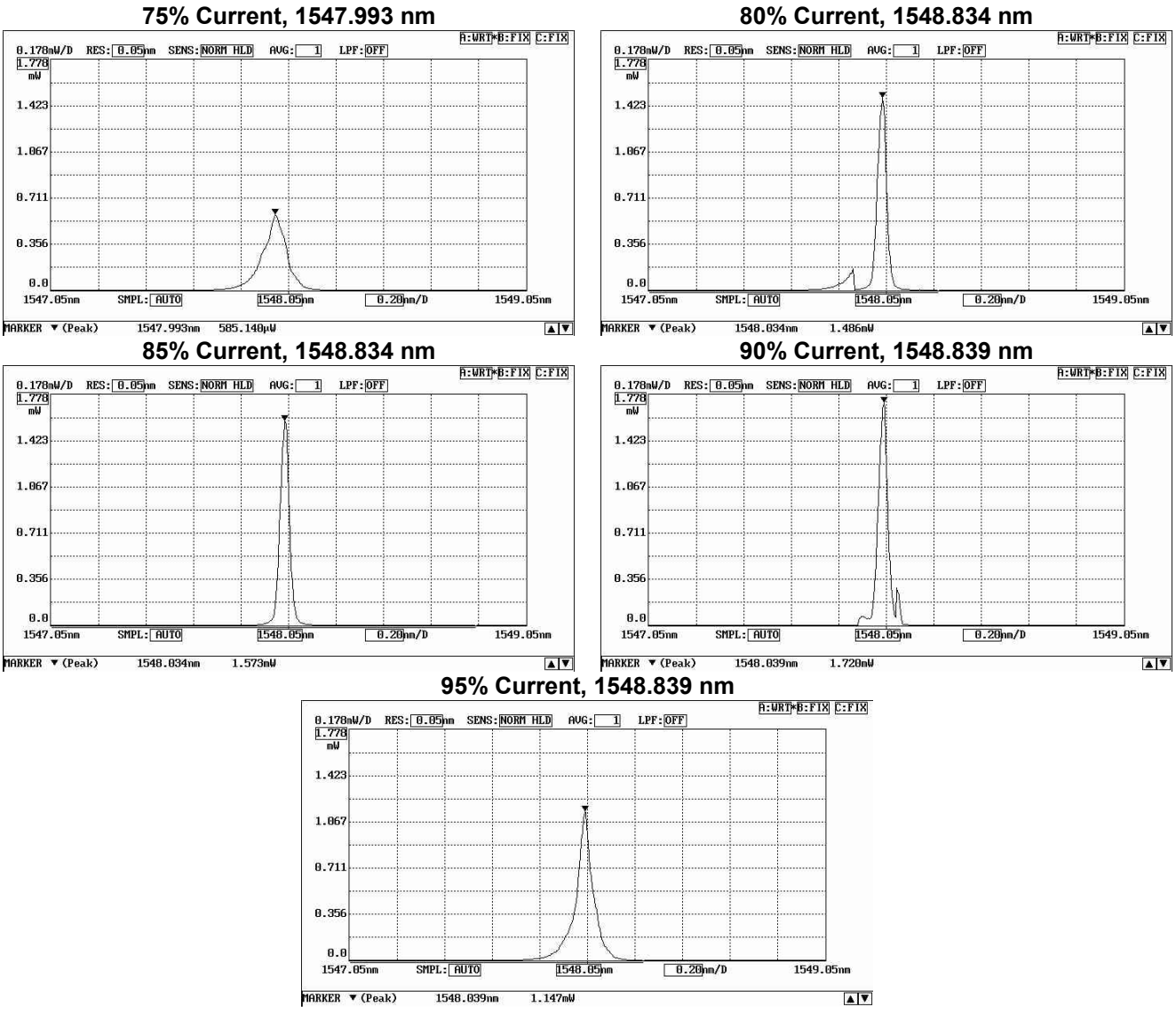
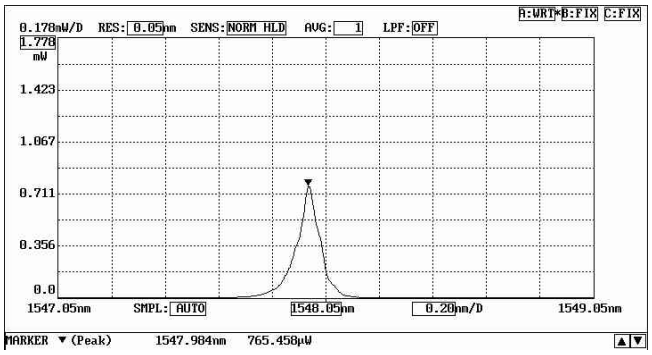


Figure 5 Wavelength vs. Power Plots – Variation in Current

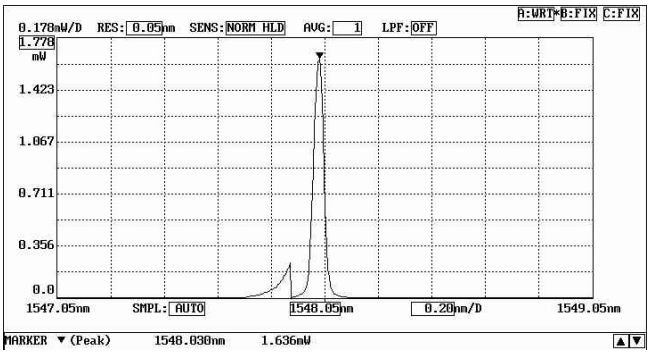
Figure 4 shows the effect of changing the operating current of the laser while maintaining a fixed operating temperature (in this case 24.5 °C). The first plot corresponds to a drive current of 75%. Notice the broad line width, the laser is not optimized but the output will appear to be stable. The next plot is at 80%. The laser is approaching a stable point but the second mode indicates the laser is not yet stable.

The laser will randomly mode hop, shifting the power from one peak to another resulting in erratic performance and power output. In the third plot, the current is at 85% and shows a typical optimized DFB output: a single, very narrow line width and very stable power. The last two plots, taken at 90% and 95%, show the laser passing through the optimum point and starting to ebb again.

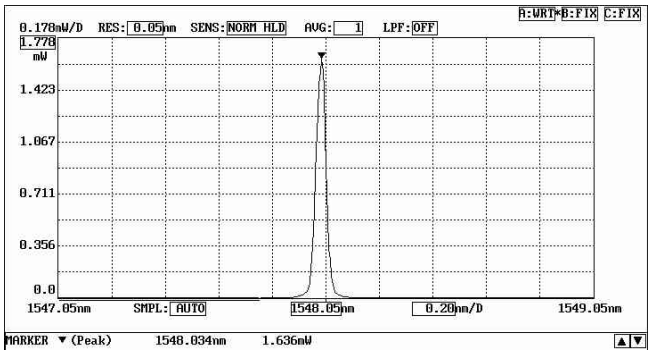
24.3 °C, 1547.994 nm



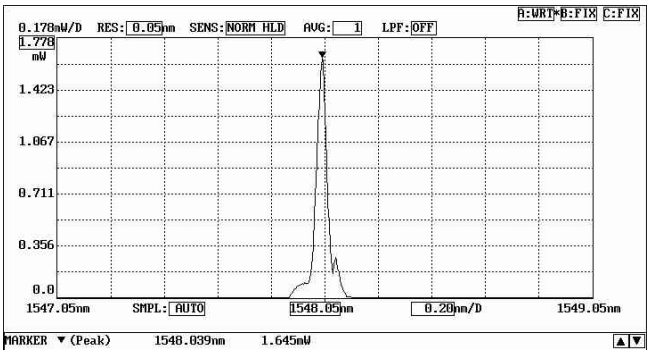
24.4 °C, 1548.830 nm



24.5 °C, 1548.834 nm



24.7 °C, 1548.839 nm



24.9 °C, 1548.839 nm

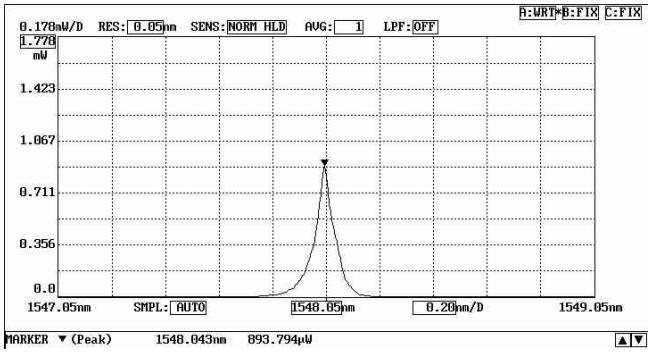


Figure 6 Wavelength vs. Power Plots – Variation in Temperature

The five plots in Figure 6 above, show the relationship of temperature verse stability. With the drive current fixed at 85% of maximum, the operating temperature was increased by 0.1°C per plot, starting at 24.3 °C. In the first plot, the laser appears stable but it can be improved. As the temperature is increased to 24.4 °C the laser enters a transition point between modes. At this temperature, the laser may mode hop resulting in erratic output. At 24.5 °C the laser has reached a stable operating point, indicated by the single narrow line width. The last two plots (24.7 °C and 24.9 °C) show the laser passing through the optimum point and decreasing in stability and desired output.

Some important points to note are:

- This is not the only setting capable of stable operation, there are many
- This combination of temperature and current may not produce stable operation with a different unit.

In both of the above examples (fixed temperature or fixed current) the instabilities are a direct result of the effect that current or temperature has on the peak wavelength of the laser, shifting it ever so slightly into regions that do not support good lasing.

Chapter 8 General Maintenance

Aside from the AC Input fuse there are no user serviceable parts in this product. If you suspect something has failed on the unit, please contact Thorlabs for advice on returning the unit for evaluation.

8.1. Cleaning

The unit can be cleaned using a soft, slightly damp cloth. Avoid using any solvents on or near the unit.

8.2. Connector Cleaning

Always clean the ferrule end of your fiber patch cable prior to inserting it into the output FC Adapter. Your benchtop source comes with a fiber-cleaning card (FCC-CLN4-1). This should be used before inserting the fiber connector into the mating barrel.

Figure 7 Fiber Cleaning Card (FCC-CLN4-1)

To use the card, peel back and tear away one small blue strip. Holding the connect firmly, swipe the connector tip across the exposed cleaning strip. The connector tip should be flush to the card surface for FC-PC connectors and at a slight angle with the key straight up for FC-APC connectors.

Chapter 9 Specifications

Item #		S3FC1310	S3FC1550
Wavelength		1310 nm	1550 nm
Full Output Power	**Min.**	1.5 mW	
	Typ.	2 mW	
Stability		15 min: ±0.05 dB, 24 hr:±0.1 dB (After 1 hr Warm-up at 25 ± 10 °C Ambient)	
Display Accuracy		±10%	
Setpoint Resolution		0.01 mW	
Adjustment Range		~0 mW to Full Power	
TEC			
Stability		0.005 °C/ 1 °C	
Setpoint Accuracy		±0.25 °C	
Setpoint Resolution		±0.1 °C	
Adjustment Range		20 ± 1 °C to 30 ± 1 °C	
Environmental			
Operating Temperature		15 to 35 °C	
Storage Temperature		0 to 50 °C	
AC Input		115 VAC/230 VAC (Switch Selectable) 50 - 60 Hz	
Modulation Input		0 - 5 V = 0 - Full Power, DC or Sine Wave Input Only	
Modulation Bandwidth		5 kHz Full Depth of Modulation 30 kHz Small Signal Modulation	
Fiber		SMF-28e+	

Chapter 10 Mechanical Drawing

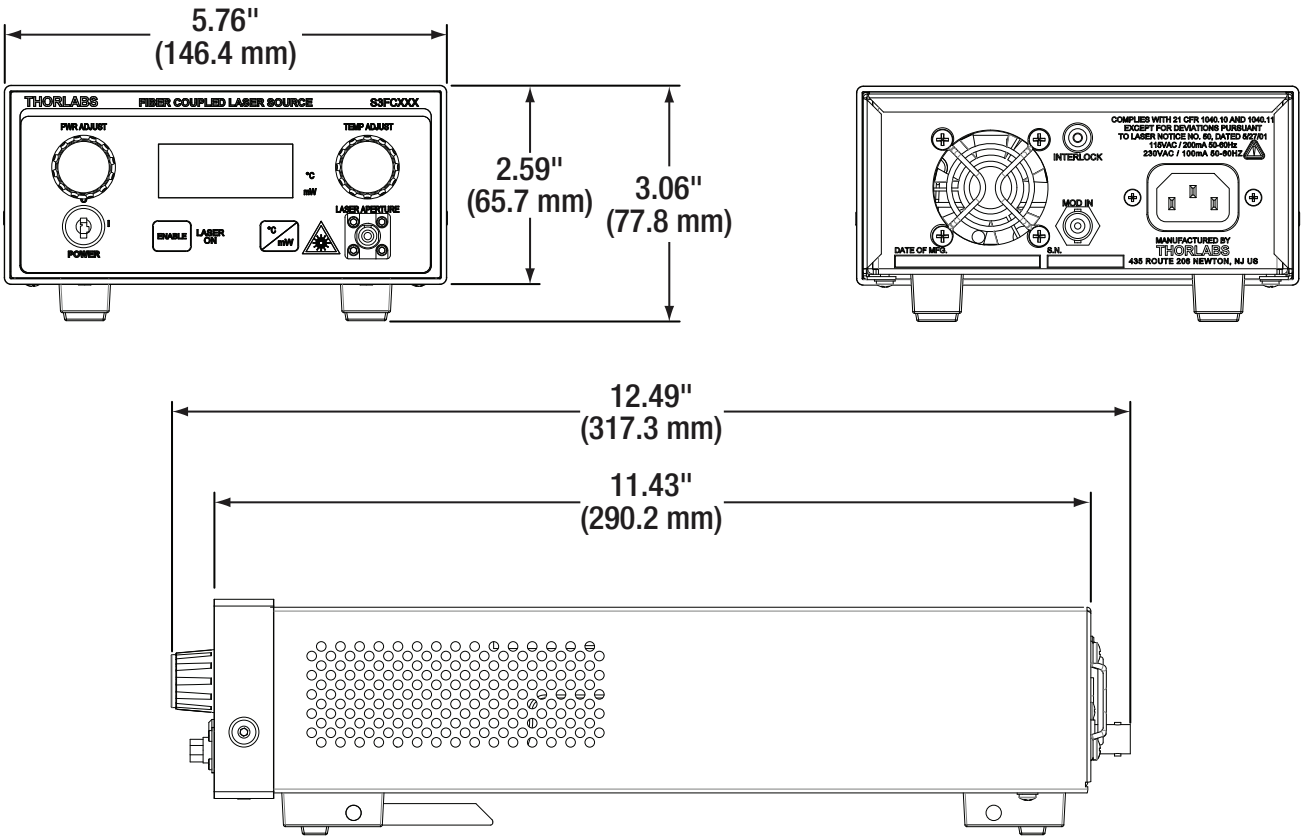


Figure 8 Mechanical Drawing

Chapter 11 FCC EMC Certificate of Compliance

Emissions comply with the Class A Limits of FCC Code of Federal Regulations 47, Part 15, Subpart B[1]

Konformitätserklärung
Declaration of Conformity
Declaration de Conformité

Thorlabs Inc
435 Rt 206
Newton, NJ
USA

erklärt in alleiniger Verantwortung, dass das Produkt:
declares under it's own responsibility, that the product:
declare sous notre seule responsabilité, que le produit:

S1FC635, S1FC670, S1FC780, S1FC1310, S1FC1550, S3FC1310, S3FC1550

mit den Anforderungen der Normen
fulfills the requirements of the standard
satisfait aux exigencies des norms

72/73/EEC	Low Voltage Directive 19.02.1973
93/68/EEC	Change of Low Voltage Directive
DIN EN 61010-1:2001	Safety of Test and Measurement Equipment
EN5031:2002	Safety of Magnetic Fields
DIN EN 61326:97 + A1:98 + A2:2001	EMC of Test and Measurement Equipment
DIN EN 61000-3-2:2000	Harmonic Current Emission
DIN EN 61000-3-3:95 + A1:2001	Voltage Fluctuations and Flickers
DIN EN 61000-4-2	Electrostatic Discharge Immunity
DIN EN 61000-4-3	Radiated RF Electromagnetic Field Immunity
DIN EN 61000-4-4	Electrical Fast Transient/Burst Immunity
DIN EN 61000-4-5	Power Line Surge Immunity
DIN EN 61000-4-6	Conducted RF Immunity (Criterion B)
DIN EN 61000-4-11	Voltage Dips and Interruptions Immunity (Criteron C)

übereinstimmt und damit den Bedingungen entspricht.
and therefore corresponds to the regulations of the directive.
et répond ainsi aux dispositions de a directive.

Karlsfeld, 3. May 2006 .....D. Ferrich.....

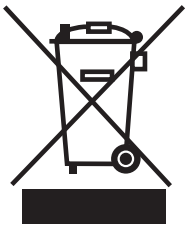
Ort und Datum der Ausstellung	Name und Unterschrift des Befugten
Place and date of issue	Name and signature of authorized person
Lieu et date d'établissement	Nom et signature de la personne autorisée

[1] *Using high-quality shielded interface cables.*

Chapter 12 Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

- This offer is valid for Thorlabs electrical and electronic equipment:
- Sold after August 13, 2005
- Marked correspondingly with the crossed out “wheelie bin” logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated



Wheelie Bin Logo

As the WEEE directive applies to self-contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

Waste Treatment is Your Own Responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

Ecological Background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

Chapter 13 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.

USA, Canada, and South America
Thorlabs, Inc.
sales@thorlabs.com
techsupport@thorlabs.com

Europe
Thorlabs GmbH
europe@thorlabs.com

France
Thorlabs SAS
sales.fr@thorlabs.com

Japan
Thorlabs Japan, Inc
sales@thorlabs.jp

UK and Ireland
Thorlabs Ltd.
sales.uk@thorlabs.com
techsupport.uk@thorlabs.com

Scandinavia
Thorlabs Sweden AB
scandinavia@thorlabs.com

Brazil
Thorlabs Vendas de Fotônicos Ltda.
brasil@thorlabs.com

China
Thorlabs China
chinasales@thorlabs.com


UNLEASHED