S5FC Series Single Channel Fiber-Coupled SLD Sources

Operating Manual

Table of Contents

Chapter 1 Warning Symbol Definitions

Note: Throughout this manual, references to temperature are with respect to °C.

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

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly.

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 environment.

WARNING

Avoid Exposure – Radiation Emitted from apertures.

The unit is supplied with a 115 V parallel blade line cord for North American use only. For all other applications use an IEC 320 compatible line cord fitted with a plug appropriate for your particular AC wall socket.

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.

Do not operate in wet or damp conditions. Do not obstruct the air-ventilation slots in the housing!

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 SLD Sources provide easy coupling and simple control of Superluminescent Diode (SLD) driven fiber optics. Each system is equipped with a single fiber output and is available in 1050 nm, 1310 nm, and 1550 nm center wavelength. The benchtop unit for the 1050 nm SLD has a polarization-maintaining (PM) fiber output, while units containing an SLD with a 1310 nm and 1550 nm center wavelength are offered with either single mode (SM) or PM fiber.

Superluminescent Diodes are excellent high power broadband light sources for use as ASE Light Sources and in applications like Optical Coherence Tomography (OCT) Imaging Systems and Fiber Optic Gyroscopes (FOG). The SLDs offered here are indium phosphide (InP) devices manufactured by Thorlabs' Quantum Electronics Division.

The SLD operates from an independent, high-precision, low-noise, constant-current source and temperature control unit. An intuitive LCD interface allows the user to view and set the parameters for the SLD. The user can adjust the SLD current and temperature control independently. The display indicates the model type, output wavelength of the source, the operating power calculated from the SLD monitor diode, and the actual temperature the SLD is set to.

This device includes a microcontroller to fully control the SLDs optical power, temperature, and monitor the system for fault conditions. The S5FC source includes a USB connection that allows remote adjustment of power, temperature, and enabling. On the rear panel, an analog input is available to modulate the SLD with an external signal. This is added to the internal set point. To prevent damage, the microcontroller will disable the output if the analog input plus the internal set point exceeds the SLD limits.

For added safety, there is an interlock located on the rear panel that must be shorted in order for any SLD output to be enabled. This can easily be configured to be triggered by doors to disable the SLD in unsafe conditions. The power switch is a key-lock system to prevent accidental or unwanted use. An enable button must be set to activate the unit with a green LED indicator to easily determine its current state. There is a 3 second delay before the SLD turns on, and the user is warned by the rapidly blinking LED.

The S5FC includes a universal power supply allowing operation over 100 to 240 VAC without the need for selecting the line voltage. This unit is supplied with a US line cord as well as a standard European line cord. The fuse access is conveniently located on the rear panel.

Chapter 4 Setup

4.1. Setting the AC Line Voltage

The S5FC Series SLD Source has been shipped configured for 100 to 240 VAC operation. There is no end user adjustment of the line voltage for 110 or 220 VAC. The user needs to select the correct AC cord for their location.

4.2. Changing the Fuse

To change the power fuse, follow the following steps.

1. Remove the AC power cord if it is connected to the unit.
2. Locate the fuse tray directly below the AC power cord connection on the rear panel of the unit.
3. Carefully use a flat blade screwdriver to open the fuse tray.
4. Remove the existing fuse and install the appropriate 500 mA fuse. The replacement fuse must be a 5 mm x 20 mm, 250 VAC Type T Fuses (IEC 60127-2/III, low breaking capacity, slow blow)
5. Push the fuse tray back into place making sure that it snaps and seats correctly.
6. Connect the appropriate power cord into the AC receptacle and plug the unit in.

4.3. Initial Set-up

1. Set the unit on a dry, level working surface.
2. Make sure the POWER key switch on the front of the unit is in the OFF position (key perpendicular to working surface).
3. 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.
4. Install the interlock “shorting device” into the interlock connector located on the rear panel. See page 9 for details.
5. Connect a FC/APC Fiber Optic cable to the SLD output connector on the front panel of the unit.

Chapter 5 Operation

5.1. Front and Back Panel Overview

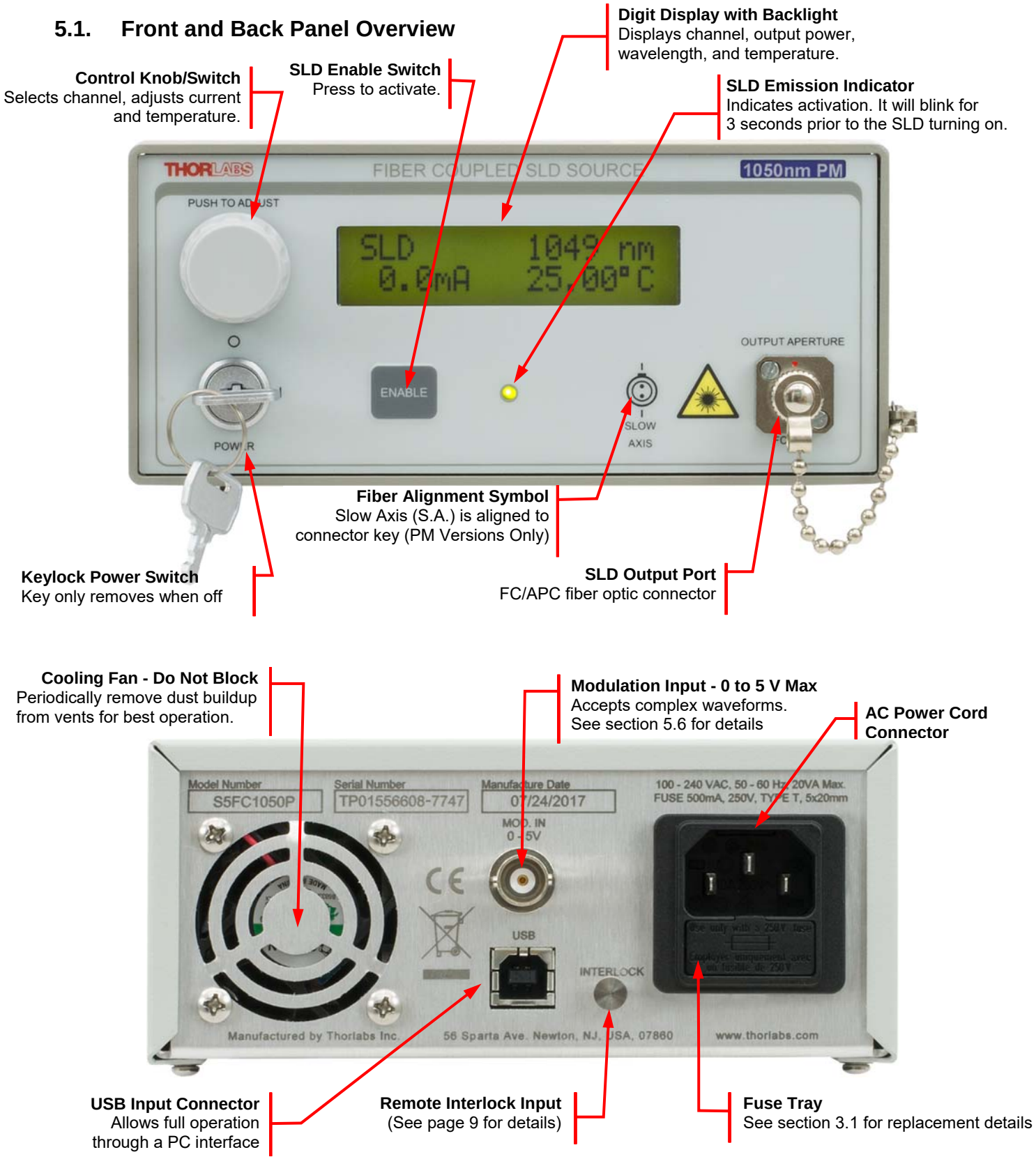


Figure 1 Front and Rear Panels of SLD Source

5.2. Turning On the Source

1. Turn the POWER key switch clockwise. The LCD display will scroll “Thorlabs” across the screen, followed by the software revision number.
2. Make sure the Interlock Input is short-circuited; see page 9 for detailed instructions.
3. Press and release the ENABLE switch to activate the SLD. There will be an approximately 3 second delay before the SLD powers up. During this time the ENABLE indicator will light up and blink rapidly.
4. SLD power (mW) and thermo-electric cooler readings will be activated when the unit turns on. The temperature will typically require 1 to 2 minutes to stabilize.

5.3. Viewing Information

The S5FC uses a single four quadrant LCD to display and access information. At any time, display variables can be adjusted by simply rotating the control knob located to the left of the display. The following information will be available:

- Top left – Indicates device type (SLD).
- Top Right – Indicates the wavelength of the SLD internal to the S5FC. This is set at the factory when the SLDs are installed.
- Bottom Left – If a monitor diode is included in the SLD package, a power reading in (mW) will be displayed. When enabled, the current power level determined from the monitor photodiode will indicate the approximate power level of the output. When disabled, the power level will read “0.00mW”. If a monitor diode is not included in the SLD package, a current reading in (mA) will be indicated instead.

Note: The power shown on the display is the optical power at the SLD output connector calibrated to the monitor photodiode. The actual power at the end of your fiber optic cable may be less, depending on the quality of the connection. All fiber optic cables installed should be cleaned first since dust and dirt particles in the connector will effect coupling efficiency and possibly damage the fiber connectors.

- Bottom Right – Indicates the actual temperature the SLD is stabilized to and is displayed in °C. The system defaults to a temperature of 25.00 °C until changed by the user. The temperature control is always active and may require 5 to 10 minutes to fully stabilize.

5.4. Adjusting the SLD Output Power and Temperature

Note: The adjustment knob utilizes an intelligent speed control. Adjusting the knob slowly will increment values at the maximum resolution while adjusting fast will make larger movements. This allows both a fine and course control.

1. The bottom left location will start blinking and will change to current, ex: xx.xx mA, when the control knob is pressed. Adjust the control knob until the desired current is achieved. The first time default setting will be current full off. Adjusting the knob clockwise will immediately set the current to the SLD threshold and then incrementally to the max operating current. Adjusting the knob counter clockwise will incrementally decrease the current until it hits the thresh old, and then immediately to SLD off. On system shut down, the current setting will be remembered.

Note that there is a timeout on the display, after which the display will revert back to the viewing mode. This is to prevent accidental adjustment of the power.

2. Press the knob again to switch to temperature adjustment. The set point temperature will be displayed and will be blinking; for example, 25.00 °C. Adjust the control knob to increase or decrease the temperature set point. The temperature default is 25.00 °C but can be adjusted over a range of 20.00 to 30.00 °C with a resolution of 0.01 °C.

Note, as above there is a timeout where the display will revert to the viewing display and lock out adjustment to the temperature.

3. Pressing the control knob again will exit the adjustment mode and revert back to the viewing mode, locking in the selected parameters. This can also be achieved by allowing the display to time out at any point in the process. The power display will adjust real-time to its new current setting and 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.

5.5. Turning the SLD Off

- **Standby Mode** – By adjusting the control knob fully counterclockwise the current/power will adjust down to the threshold current and then to standby mode. The threshold current is a user settable point at which the internal SLD diode can be set to operate within a desirable range. For convenience the system is set up to adjust from the threshold to the max current. In addition, when adjusting below the threshold, the current will be set to almost 0 mA. Since the system utilizes a constant current control, there will always be a minimum current to maintain the current control loop. The output emission is typically very low, or nonexistent. The SLD is still enabled and operating at the minimum possible current. This can be useful while using the external modulation. The full 5 V can be applied without compensating for the internal set point. However, the external signal will need to provide a DC offset to bias the SLD above the threshold current for best results. Input signals will see clipping on their lower edges below threshold.
- **Disable/Enable Mode** - The SLD output should be turned off by pressing and releasing the ENABLE switch. The SLD temperature will be maintained even when the SLD is disabled.
- **Power Down** - 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 SLD will be disabled until the ENABLE switch is pressed.

5.6. Modulating the SLD Output

The MOD IN input can be used to modulate the SLD output, or set the SLD output remotely using a 5 V power source. The 5 V maximum input correspond to the maximum calibrated power, which operates using a constant current drive technique. The resulting actual output power is dependent on the set current and 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 SLD diode. Adjusting the knob below threshold will immediately set the current to almost 0 mA, or Standby mode as described in section 4.5. Therefore, there are two modes of modulation available. First setting the control to “Standby” allows the analog modulation to utilize the full 0 to 5 V input range. The drawback is that a minimum voltage will be required to operate above the threshold current but allows more flexibility by the user. The second mode is to adjust the control knob so that the SLD is at threshold or above. The analog modulation voltage will be limited to less than 5 V, but a DC offset will not be required. This should be kept in mind when using the modulation input since it will limit the actual input voltage range.

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 for standby mode, or increase slightly to the threshold current mode.

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

4. **For Threshold Offset** - Apply the appropriate signal to the MOD IN input. If too much voltage is applied internal current limiting will prevent damage to the SLD diode and the SLD diode will be immediately disabled. If an internal threshold is set the acceptable drive voltage range will be less than 5 V. To calibrate your input apply a DC voltage to the MOD IN and slowly increase until the system disables. This will be the max voltage allowable.

   For Standby Operation – Apply an appropriate signal between 0 and 5 V to the MOD IN input. Determine the DC offset by increasing the voltage slowly until a large power jump is seen on the output. An easier method is to apply a 1 V_{pp} sinusoid and adjust the DC offset until the sinusoid appears and then the bottom edge is no longer clipping. This method requires applying the SLD output to a photodetector and monitoring with an oscilloscope. Next maximize the amplitude so that the peak is 5 V or less as desired.

Chapter 6 Making the Safety Interlock Connections

The S5FC series SLD 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 S5FC 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 S5FC source will automatically shut down. If the switch returns to a closed condition the S5FC 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 to 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	Internal Pull Up to 5 VDC
Short Circuit Current	10.0 mA DC
Interlock Switch Requirements	Must be N.O. Dry Contacts **Under no circumstances should any external voltages be applied to the Interlock input**

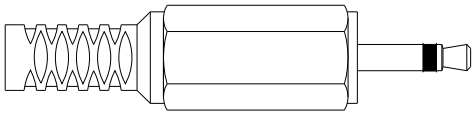


Figure 2 Remote Interlock Connector

Chapter 7 Remote Communications

7.1. Installing the USB Drivers

Prior to running the command line interface, the USB drivers must be installed. The S5FC must not be connected to the PC while installing the drivers. Insert the CD that was supplied with your unit into your PC. From the dialog box that is displayed, select the Install Drivers button. If the dialog box is not displayed, browse to the CD and run CD_Started.exe. Follow the onscreen prompts to install the driver. After the driver is installed, attach the S5FC to the PC and power it on. Your PC will then detect the new hardware and will prompt you when the installation is complete.

7.2. Command Line Interface

Once the USB drivers have been installed, the unit connected to the PC, and the power turned on, configure the terminal emulator as follows:

- Baud Rate = 115.2K Bits Per Second
- Data Bits = 8
- Parity = None
- Stop Bits = 1
- Flow Control = None

If the connection is correct you will see the following after pressing the “Enter” key.

Command error CMD_NOT_DEFINED

Followed immediately by the prompt:

<

The basic structure of the interface is a keyword followed by either an equals sign “=” or a question mark “?”. The “=” or “?” will determine if the string is a command or a query. All strings (commands and queries) must be terminated by a carriage return (CR) or pressing the ENTER key on the computer.

The command structure is as follows:

Keyword = argument (CR)

Where “keyword” defines the function and “argument” is a numerical value followed by a carriage return (CR). See listing below.

The query structure is a follows:

Keyword? (CR)

The “keyword” defines the function and the question mark (?) indicates a query. The string is terminated with a carriage return (CR). See listing below.

There are a few exceptions to this which are noted below, also noted are unique shortcut keys.

The prompt symbol “<” will appear on power up and after a command is accepted by the system indicating it is ready to receive another command line.

7.3. Keywords (Commands and Queries)

The following list shows all of the available commands and queries, and summarizes their functions:

Command	Syntax[1]	Description
Get ID	id?	Returns the model number and firmware version.
Get Commands	?	List the available commands
Set Target Temp.	target=*n*	Sets the target temperature in degrees Celsius.
Get Target Temp.	target?	Returns the target temperature.
Get Actual Temp.	temp?	Returns the actual temperature.
Set Current	current=*n*	Sets the current (*n*).
Get Current	current?	Returns the current.
Get Power	power?	If diode package contains a monitoring photodiode, returns the output power in mW.
Get Enable	enable?	Returns the current state of the Enable button.
Set Enable	enable=*n*	Sets the state of the Enable button (0: disabled, 1: enabled).
Get Specs	specs?	Returns the specifications.
Set Step	step=*n*	Sets the increment (*n*) used to adjust the temperature and current when the arrow keys are pressed.
Get Step	step?	Returns the increment used to adjust the temperature and current when the arrow keys are pressed.
Save Parameters	save	Saves target current and target temperature to EEPROM. Values are restored on device startup.
Get Status	statword?	Returns a string representation of an 8-bit number indicating the device's status. The right-most bit is '1' if the device is 'on' or 'pending on'. The other bits are unused.

If the keyword, format, or argument is incorrect or out of range, the unit will return an error string. The function is determined by the value set with the mode command in the above table.

In addition to the above commands there is also special functionality added to the arrow keys of the computer's keyboard.

- Up Arrow Key – Increments the current by *n*.
- Down Arrow Key – Decrements the current by *n*.
- Right Arrow Key – Increments the temperature by *n*.
- Left Arrow Key – Decrements the Temperature by *n*.

Where *n* is set by the command "Set Step".

[1] *All commands and queries are in lower case letters.*

Chapter 8 Troubleshooting

The following table describes some typical problems that may be encountered while using the S5FC and possible solutions to these problems.

Problem	Solution
Unit does not turn on when switching the power switch to the ON position.	1. Make sure AC line cord is fully inserted into the AC Input receptacle and plugged into an outlet providing 100 to 240 VAC. 2. Fuse(s) may be open. Refer to Page 4 for information on replacing open fuses. If the problem persists, please return the unit to Thorlabs for evaluation.
Unit does not enable the Source when pressing the ENABLE keypad.	1. Make sure that the AC Line Cord is properly plugged in and Key Switch is turned to “ON” position 2. Check to make sure the interlock “shorting device” is installed on the rear panel. See Page 9 for details.
Unit is enabled but there is no Output.	1. Check to make sure you are using the correct type of Fiber Patch Cord for the particular wavelength. 2. Disconnect the Fiber Patch Cord and check to see if there is Light Output from the FC/APC Connector. **Caution: Do Not Directly Look into the Fiber Key Slot.** Use a Viewing Card to safely determine SLD output.
Unit is enabled but there is no Output. (Analog Modulation)	1. Check the output of the modulating source and confirm the Output is “On”. 2. If using Analog Modulation make sure the 5FC is not operating in the dead zone. One may need to operate above the Threshold Current to see output. For further details refer to Page 7. For information regarding Threshold Current Limits refer to SLD documentation provided with the unit.
I can’t connect to the S5FC over the USB com port.	1. Make sure that the com port is configured correctly for the unit. Refer to page 10 for the correct com port settings. 2. The incorrect com port is selected on your terminal program or S5FC application. 3. USB driver was not installed. See Page 10

Chapter 9 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 your local Thorlabs Technical Support Office for advice on returning the unit for evaluation.

9.1. Cleaning

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

9.2. Connector Cleaning

It is necessary to clean the fiber patch cable and the connector tip inside the bulkhead connector every time you make the connection for both safety reasons and fiber care. Failure to do so may result in a damaged fiber connector on your user provided patch cord, the internal fiber connector, or both by burning the fiber end faces if the contaminates are over the fiber core.

WARNING

DO NOT connect a fiber patch cord to the laser's FC/PC bulkhead connector without cleaning the fiber tips first. DO NOT connect a fiber patch cord to the unit while the laser is enabled. Failure to follow these precautions may result in permanent damage to the unit.

Thorlabs recommends using our FCC-7020 (pictured below) to clean the fiber tip of your FC/PC patch cord. To clean your connector:

1. Open the door on top of the FCC-7020
2. Pull the white tape out until the perforations clear the window
3. Place the tip of the connector flat against the white tape on either the right or left side – it does not matter.
4. Drag the connector down the white tap front
5. Then repeat steps 3 – 4 on the opposite side.

Take care not to twist the connector while cleaning.

The instructions on how to use the FBC1 is located on the web on its product page, on the "Cleaning with FBC1" Tab.

FCC-7020
Fiber Cleaning Cloth Spool

FBC1
Bulkhead and
Connector Cleaner

You can find the complete line of Thorlabs' fiber optic cleaning products on the web at www.thorlabs.com.

Chapter 10 Specifications

Item #	S5FC1050P			S5FC1021S(P)		
Parameter	Min	Typ	Max	Min	Typ	Max
Operating Current (mA)	-	240	300	-	700	900
Center Wavelength (nm)	1030	1050	1070	1290	-	1330
Output Power (mW)	6	8	-	10	12.5	-
Optical Bandwidth @ -3 dB (nm)	40	50	- 80		85	-

Item #	S5FC1018S(P)		
Parameter	Min	Typ	Max
Operating Current (mA)	-	600	800
Center Wavelength (nm)	1290	-	1330
Output Power (mW)	22	30	-
Optical Bandwidth @ -3 dB (nm)	40	45	-

Item #	S5FC1550S(P)-A2			S5FC1005S(P)		
Parameter	Min	Typ	Max	Min	Typ	Max
Operating Current (mA)	-	550	600	-	600	800
Center Wavelength (nm)	1520	1550	1580	1530	1550	1570
Output Power (mW)	2	2.5	-	20	22	-
Optical Bandwidth @ -3 dB (nm)	85	90	- 45		50	-

General Specifications	
AC Input	100 - 240 VAC, 50 - 60 Hz
Input Power	20 VA Max
Fuse Ratings	250 mA
Fuse Type	IEC60127-2/III (250 VA, Slow Blow Type 'T')
Fuse Size	5 mm x 20 mm
Dimensions (W x H x D)	5.8" x 11.4" x 2.6" (147 mm x 290 mm x 66 mm)
Weight	1.96 kg (4.32 lbs) 4.13 kg (9.1 lbs) Shipped Weight
Operating Temperature	15 to 35 °C
Storage Temperature	0 to 50 °C
Connections and Controls	
Interface Control	Optical Encoder with Pushbutton
Enable Select	Keypad Switch Enable with LED Indicator
Power On	Key Switch
Fiber Port	FC/APC, 2.0 mm Narrow Key (Aligned to Slow Axis for PM Versions)
Display	LCD, 16x2, Alphanumeric Characters
Input Power Connection	IEC Connector
Modulation Input Connector	BNC (Referenced to Chassis)
Interlock	100 mil Header (see Part 5)
Communications	
Communications Port	USB 2.0 Compatible
Com Connection	USB Type B Connector
Required Cable	2 m USB Type A to Type B Cable (Replacement Item # USB-A-79)

Performance Specifications	
Current Set Point Resolution	0.1 mA
Temperature Adjust Range	20.00 to 30.00 °C
Temp Set Point Resolution	±0.01 °C
Output Power Noise	<0.1% Typical (Source Dependent)
Rise Time / Fall Time	1.4 µsec / 1.6 µsec (For a Square-Wave Modulation Input)
Analog Modulation Input	0 - 5 V (No Emission to Max Gain)
Analog Modulation Bandwidth	250 kHz for Full Depth of Modulation

Chapter 11 Mechanical Drawing

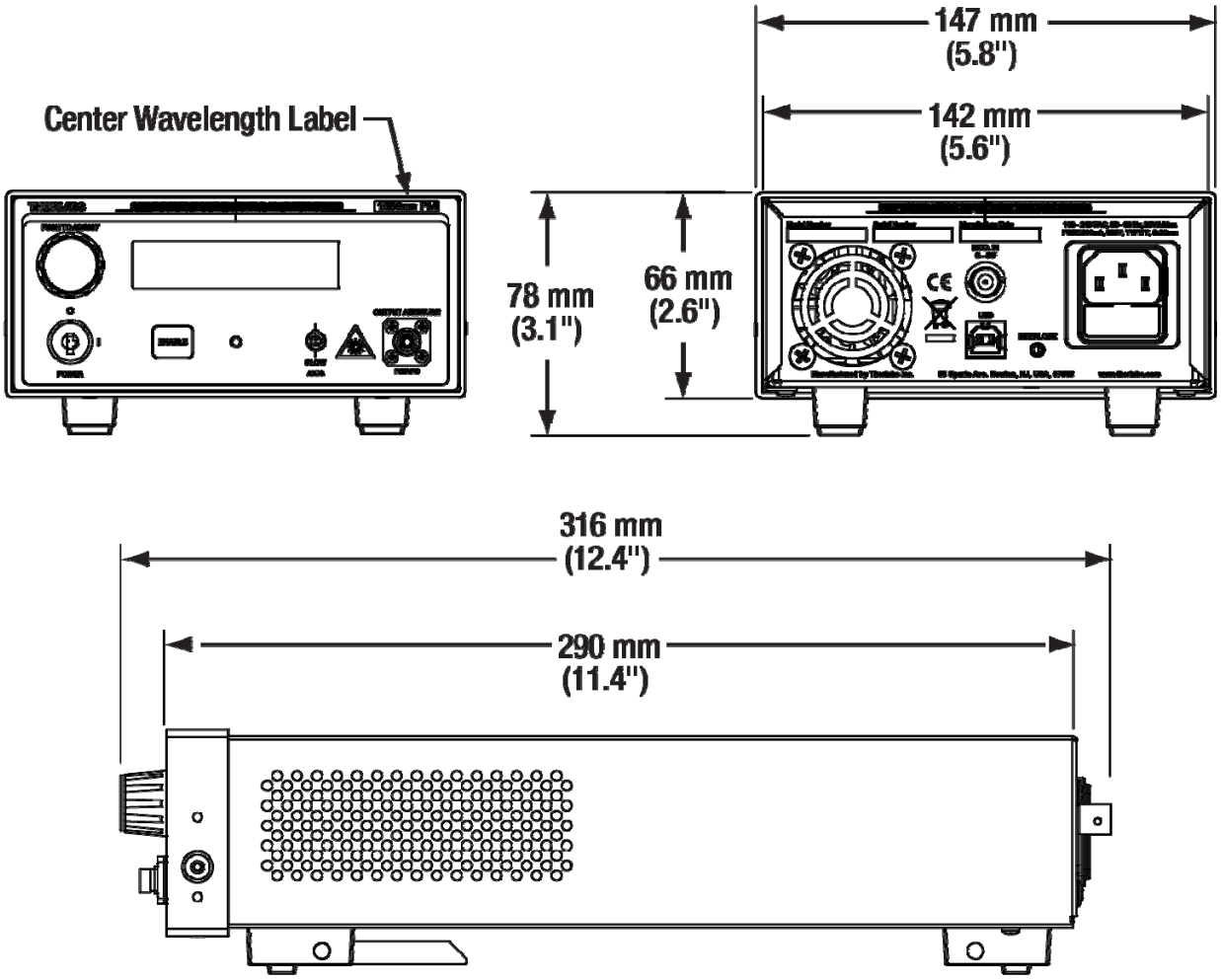
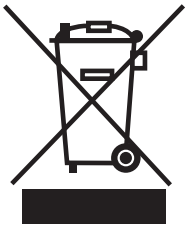


Figure 3 Mechanical Drawing

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.

12.1. 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.

12.2. 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.

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brasil@thorlabs.com

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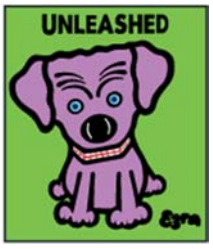
chinasales@thorlabs.com


UNLEASHED