THORLABS

EDFA100S and EDFA100P
Erbium Doped Fiber Amplifiers

Operating Manual



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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: Visible or Invisible 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 the unit on, 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 an explosive environment.

LASER WARNING

Avoid Exposure – Invisible Laser Radiation Emitted from Apertures. Do not look into the amplifier input or output apertures and avoid skin exposure to the laser radiation from the output aperture. Injury to the eye or skin may result.

Laser radiation is emitted from the output port when the unit is powered on, even if there is no optical input supplied to the amplifier. Laser radiation is emitted from the output port when a light source is connected to the input port, even if the amplifier is powered off.

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

The unit is supplied with a region-specific power cord. If using your own power cord, make sure it is IEC 320 compatible.

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 Section 4.2, Changing the Fuse). 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

Thorlabs' EDFA100S and EDFA100P are core-pumped Erbium-doped fiber amplifiers that offer high gain, low noise, and high output power (>100 mW over most of the wavelength range). The amplifiers are offered in a compact, turnkey benchtop package with FC/APC input and output connectors. The current of the amplifier's pump laser is adjustable through the instrument front panel, which allows the user to vary the output power and gain of the amplifier. The amplifiers feature low dispersion and low nonlinearity for applications involving femtosecond pulses.

The amplifiers include a USB connector that allows the amplifier to be enabled or disabled remotely, as well as allowing remote control of the pump current. For added safety, there is an interlock connector located on the rear panel that must be shorted in order for the output to be enabled. This can easily be configured to be triggered by doors to disable the fiber amplifier 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 amplifier, and a green LED indicator displays the current state of the unit. There is a 3 second delay before the fiber amplifier turns on, and the user is warned by the rapidly blinking LED.

The amplifiers include a universal power supply allowing operation over 100 to 240 VAC without the need for selecting the line voltage. The fuse access is conveniently located on the rear panel.

3.1. Shipping List

The EDFA100S and EDFA100P consist of the following components:

- Erbium-Doped Fiber Amplifier in Benchtop Package
- Amplifier Enable Key (Qty. 2)
- Interlock-Shorting Pin
- Region-Specific Power Cord
- FBC250 Connector and Bulkhead Cleaner
- This Manual

Chapter 4 Setup

CAUTION

Prior to using the EDFA systems, it is highly recommended to clean the input and output bulkheads as well as the connector facets to be connected to the bulkheads. Failure to clean the connectors can result in damage to the internal connectors in the EDFA as well as the connectors on fiber patch cables connected to the EDFA.

When cleaning the connectors, ensure that the EDFA is powered off by turning off the key switch. Never inspect optical connectors unless all light sources in your setup have been switched off. Please refer to Section 9.2 for further instructions regarding connector cleaning.

4.1. Setting the AC Line Voltage

The fiber amplifier 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 fuse (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 Setup

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 provided AC line cord into the IEC input receptacle on the rear of the unit. Plug the male end into a properly grounded AC socket.
4. Install the interlock pin. (See page 10 for details on the interlock circuitry.)
5. Connect the input to be amplified to the input fiber receptacle using a FC/APC fiber patch cable, carefully cleaning both the input FC bulkhead connector and the patch cable connector beforehand. Please note that a standard single mode (SM) 1550 nm cable should be used for the EDFA100S, while a standard polarization-maintaining (PM) 1550 nm cable should be used for the EDFA100P. Please also note that the input power entering the amplifier should not exceed 10 dBm (10 mW).
6. Carefully clean both the output FC bulkhead connector and the connectors on both ends of a second FC/APC patch cable (again, noting whether the cable is SM or PM).Connect one end of the cable to the output receptacle on the unit. Connect the other end to a power meter or another measurement instrument. The maximum output power from the amplifier – when observing the 10 dBm (10 mW) input power limit – is 23 dBm (200 mW). Care should be taken to avoid damage to the measurement instrument connected to the output port. Also note that when the amplifier is enabled, it generates amplified spontaneous emission even when there is no input light entering the amplifier. This should be considered when connecting measurement instruments to the output port of the amplifier and when inspecting the fiber connectors.

Chapter 5 Operation

5.1. Front and Back Panel Overview

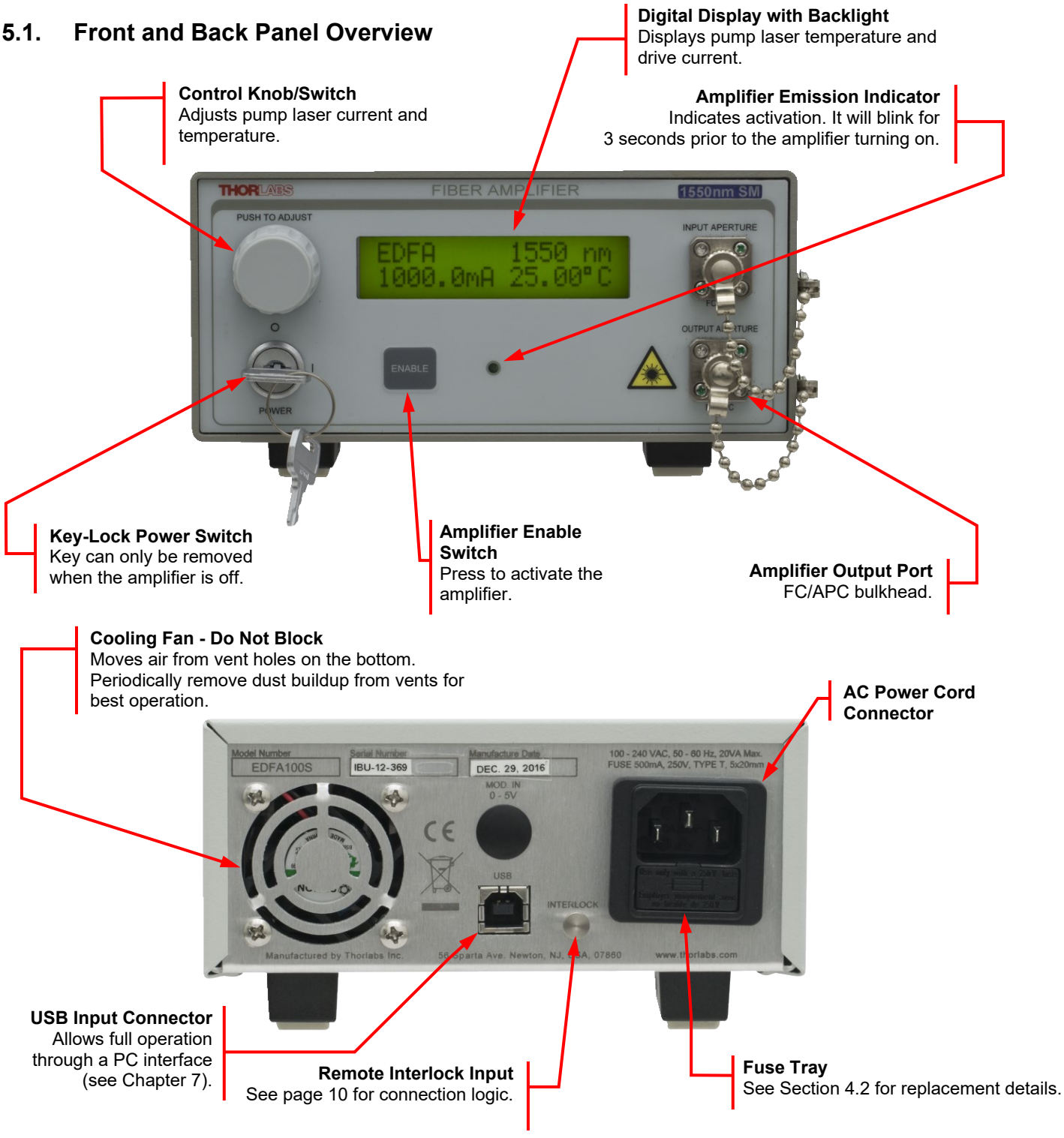


Figure 1 Front and Rear Panels of the Fiber Amplifier (EDFA100S Shown)

5.2. Turning On the Amplifier

1. Please consult with your organization's laser safety officer regarding proper operation of the amplifier at your institution.

LASER WARNING

The amplifier generates amplified spontaneous emission (ASE) even without any optical input. The power level of the ASE can be as high as 30 mW. Therefore, all laser safety measures should be followed even if the input light to the amplifier has been disconnected or switched off. Additionally, it should be noted that connecting a laser to the output port of the amplifier by mistake can cause damage to the laser due to the ASE light getting coupled into the laser source.

2. Turn the POWER key switch clockwise. The LCD display will scroll "Thorlabs EDFA" across the screen, followed by the software revision number.
3. Make sure the interlock input is short-circuited. See page 10 for detailed instructions.
4. Press and release the ENABLE switch to activate the fiber amplifier. There will be an approximately 3 second delay before the fiber amplifier powers up. During this time, the ENABLE indicator will light up and blink rapidly.
5. Readings for the fiber amplifier pump current (in mA) and temperature (in °C) will be activated when the unit turns on. The temperature will typically require 1 to 2 minutes to stabilize.

5.3. Viewing Information

The EDFA100S and EDFA100P use 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 (EDFA).
- Top Right – Indicates the amplification band of the device. This is set to 1550 nm for the EDFA100S and EDFA100P fiber amplifiers.
- Bottom Left – Indicates the pump current.
- Bottom Right – Indicates the actual temperature of the pump laser, in °C. The system defaults to a temperature that is set at the factory. The temperature control is always active and may require 1 to 2 minutes to fully stabilize.

5.4. Adjusting the Fiber Amplifier Gain

The fiber amplifier gain and output power are controlled by varying the pump current. The system specifications and the test data provided for each unit show the performance at a pump temperature of 25 °C and the maximum pump current of 1000 mA. A typical power scaling plot, at two different input power levels of 0 dBm and -20 dBm, is shown in Figure 2 below. This plot can be used as a reference to adjust the gain and power of the amplifier by varying the pump current.

To adjust the pump current, press the adjustment knob once. The bottom left indicator on the LCD screen, which shows the current in mA, will start blinking when the control knob is pressed. Adjust the control knob until the desired current is achieved. Adjusting the knob clockwise will incrementally increase the pump diode drive current, up to the maximum drive current of 1000 mA. Adjusting the knob counterclockwise will incrementally decrease the drive current. On system shutdown, the current setting will be remembered.

Note: The adjustment knob utilizes an intelligent speed control. Adjusting the knob slowly will increment values in small steps, while adjusting the knob quickly will cause larger movements. This allows both fine and coarse control.

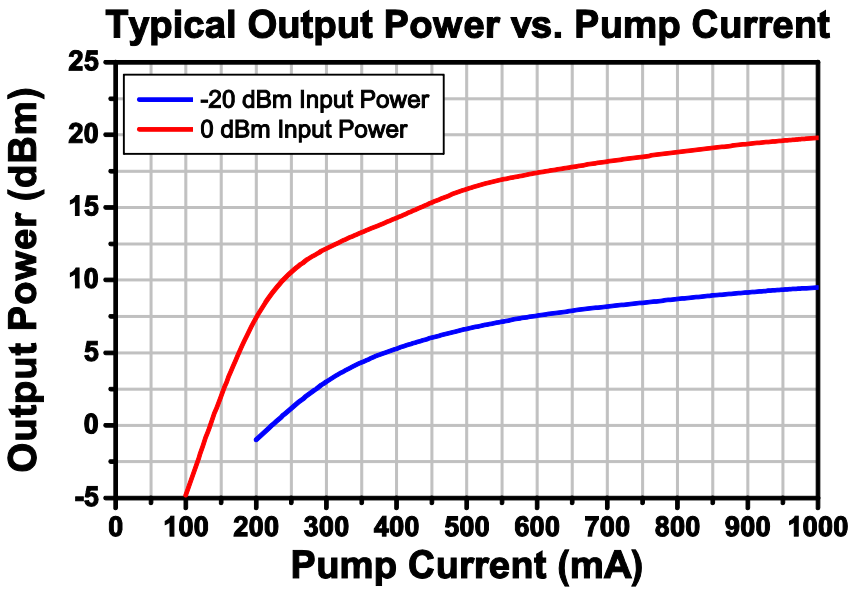


Figure 2 Output Power as a Function of Pump Current, for 0 dBm and -20 dBm Input Powers

Pressing the knob a second time after pump current adjustment has been completed will allow adjustment of the pump laser temperature in the 20 °C to 30 °C range. Temperature adjustment is typically not needed for the operation of the EDFA100S and EDFA100P; generally speaking, optimal performance will result when the pump temperature is kept at the factory default of 25 °C.

Pressing the control knob again (i.e., a third time) 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 display will adjust in real time to the new current setting.

5.5. Turning the Fiber Amplifier Off

- **Standby Mode** – By adjusting the control knob fully counterclockwise, the pump current will adjust down to the threshold current and then to standby mode.
- **Disable/Enable Mode** - The amplifier output can be turned off by pressing and releasing the ENABLE switch. The pump diode temperature will be maintained even when the amplifier 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 fiber amplifier will be disabled until the ENABLE switch is pressed. The pump current setting is retained when the amplifier is powered OFF.

Chapter 6 Making Safety Interlock Connections

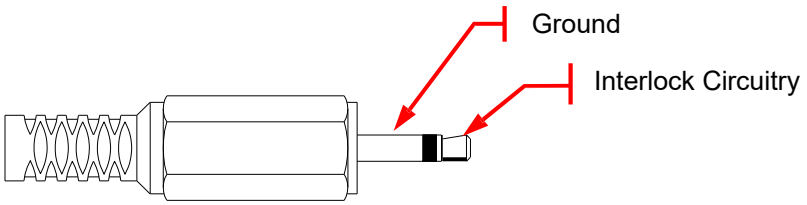
The EDFA100S and EDFA100P are equipped with a remote interlock connector located on the rear panel, as shown in Figure 1 on page 7. In order to enable the fiber amplifier, a short circuit must be applied across the terminals of the Remote Interlock connector. This connection is made available to allow the user to connect a remotely actuated switch to the connector (i.e. an open door indicator).

The switch that is connected to this interlock must be normally open (N.O.), meaning that it has to be closed in order for the unit to be enabled. If the switch is changed to an open state, the amplifier will automatically shut down. If the switch returns to a closed condition, the amplifier will not re-enable until the ENABLE switch is pressed or until the Set Enable command is entered in the command-line interface (see Section 7.3).

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 throughout this manual. If you wish to make use of the interlock feature you will need to acquire the appropriate mating connector (e.g., a 2.5 mm mono jack, available at most electronics stores) and wire it your remote interlock switch.

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

Specification	Value
Mating Connector	2.5 mm Mono Phono Jack
Open Circuit Voltage	Internal Pull Up to 5 VDC
Short Circuit Requirements	1.0 mA DC
Interlock Switch Requirements	Must be N.O. Dry Contacts Under No Circumstances Should Any External Voltages be Applied to the Interlock Input



Chapter 7 Remote Communications

7.1. Installing the USB Drivers

Prior to running the command line interface, the USB drivers must be installed. The EDFA100S or EDFA100P must not be connected to the PC while installing the drivers. To install the driver, locate the USB flash drive include in the shipment of the fiber amplifier. Run the executable file provided in the compressed folder on the flash drive. Follow the onscreen prompts to install the driver. After the driver is installed, attach the fiber amplifier to the PC and power it on. Your PC will then detect the new hardware and will prompt you when the installation is complete. Upon completion of the driver installation, the amplifier is recognized as a serial (COM) port on the PC. A terminal emulator can be used to send commands to the serial port.

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*	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 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.

* *All commands and queries are in lower case letters.*

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".

Chapter 8 Troubleshooting

CAUTION

Do not look directly into the fiber receptacle. Use a viewing card to help determine whether the fiber amplifier is generating an output.

The following table describes some typical problems that may be encountered while using the EDFA100S or EDFA100P 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 the 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 6 for information on replacing open fuses. If the problem persists, please return the unit to Thorlabs for evaluation.
Unit does not enable when pressing the ENABLE button.	1. Make sure the AC line cord is properly plugged in and the key switch is turned to the “ON” position. 2. Check to make sure the interlock “jumper” is installed on the rear panel. See page 10 for details.
Unit is enabled but there is no output.	1. Check to make sure you are using the correct type of fiber patch cable for the particular wavelength. 2. Disconnect the fiber patch cable and use a viewing card to check to see if there is light being output from the FC/APC connector. **Caution: Do Not Look Directly into the Fiber Bulkhead.**
I can’t connect to the unit over the USB COM port.	1. Make sure that the COM port is configured correctly for the unit. Refer to page 11 for the correct COM port settings. 2. Check that the correct COM port is selected on your terminal program. 3. Check that the USB driver is installed (see page 11).

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 in the unit, please contact Thorlabs for advice on returning the unit for evaluation.

Always clean fiber optic connectors that will be inserted into the system and install the dust cap whenever the source is not being used. Allowing dust and dirt onto the fiber end faces will degrade coupling efficiency and possibly damage the fiber patch cables, both inside and outside.

9.1. Cleaning

The housing can be cleaned using a soft, slightly damp cloth. Avoid using any solvents on or near the unit. Keep the vent holes located on the bottom of the unit and on the rear panel free of dust buildup. Restricted airflow will cause the temperature controls to operate inefficiently and, in extreme cases, loss of temperature control.

9.2. Connector Cleaning

Always clean the ferrule end of your fiber patch cables as well as the input and output FC bulkheads prior to inserting the fiber patch cables into the FC bulkheads. Your benchtop source comes with a fiber cleaning card. that can be used for cleaning the fiber connector on patch cables. In addition, each unit is shipped with a FBC250 Bulkhead and Connector Cleaner for cleaning the input and output bulkheads.



Figure 3 Fiber Cleaning Card



Figure 4 FBC250 Bulkhead and Connector Cleaner

To use the card, peel back and tear away one small blue strip. Holding the connector firmly, swipe the connector tip across the exposed cleaning strip. The connector tip should be flush against the card surface (i.e., held at a slight angle) for FC/APC connectors. If you need additional connector cleaners, Thorlabs offers the FCC-7020 Fiber Cleaning Cloth Spool.

To use the FBC250 Bulkhead and Connector Cleaner, please refer to the instructions shipped with the FBC250.

Chapter 10 Specifications

Item #	EDFA100S	EDFA100P
Amplifier Specifications (at 1000 mA Pump Current)		
Operating Wavelength Range[a]	1530 nm - 1565 nm	
Saturated Output Power (@ 3 dBm Input Power)[b,c]	>20 dBm	
Small Signal Gain (@ -20 dBm Input Power)[b]	>30 dB	>28 dB
Noise Figure (@ 3 dBm Input Power)[b]	<5 dB	
Output Power Stability (@ 3 dBm Input Power)	<±2% Over 24 Hours (After 15 Minute Warm-Up, for Ambient Temperature ±2 °C)	
Total Dispersion within Amplifier	<0.06 ps/nm	
Laser Class	3B	
Fiber Specifications		
Output Polarization	Random	Linear, Aligned to Slow Axis
Polarization Extinction Ratio	N/A	>25 dB
Polarization-Dependent Gain	<0.5 dB	N/A
Return Loss at Input Port	>50 dB	
Input / Output Isolation	>30 dB	
Input / Output Fiber Type	SMF-28-J9	PM1550-XP
Input / Output Fiber Connectors	FC/APC Compatible, 2.0 mm Narrow Key	

a. The wavelength range over which the output power (at 3 dBm input power) does not fall below 18 dBm.
b. Specified at 1550 nm. Please refer to published data on Thorlabs website' for typical curves showing the variation of each parameter.
c. Please refer to published data on Thorlabs website' on the scaling of the output power vs. the input power.

Absolute Maximum Ratings	
Absolute Maximum Input Power	10 dBm
Absolute Maximum Output Power	23 dBm
Operating Temperature	15 to 35 °C
Storage Temperature	0 to 50 °C

General Specifications	
Input Voltage	100 - 240 VAC, 50 - 60 Hz
Input Power	20 VA (Max)
Fuse Rating	500 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)	5.76" x 12.16" x 3.06" (146.3 mm x 308.9 mm x 77.7 mm)
Weight	2.08 kg (4.58 lbs)
Connections and Controls	
Interface Control	Optical Encoder with Push Button
Enable Select	Keypad Switch Enable with LED Indicator
Power On	Key Switch
Fiber Connectors	FC/APC Compatible, 2.0 mm Narrow Key
Display	LCD, 16x2, Alphanumeric Characters
Input Power Connector	IEC Connector
Interlock	2.5 mm Mono Jack (See Chapter 6)
Communications	
Communications Port	USB 2.0 Compatible
COM Connection	USB Type B Connector
Required Cable	USB Type A to Type B Cable (Replacement Item # USB-A-79)

Chapter 11 Mechanical Drawings

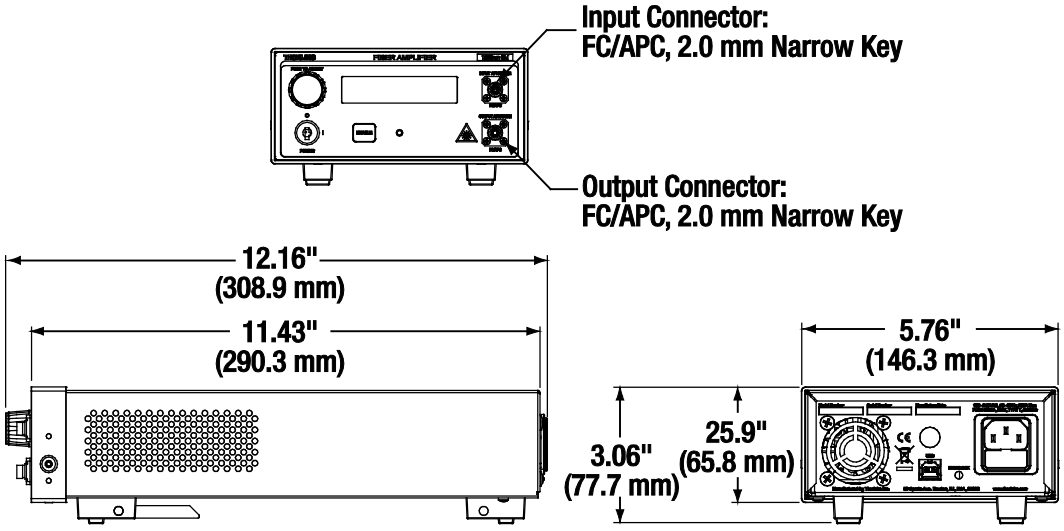


Figure 5 EDFA100S Mechanical Drawing

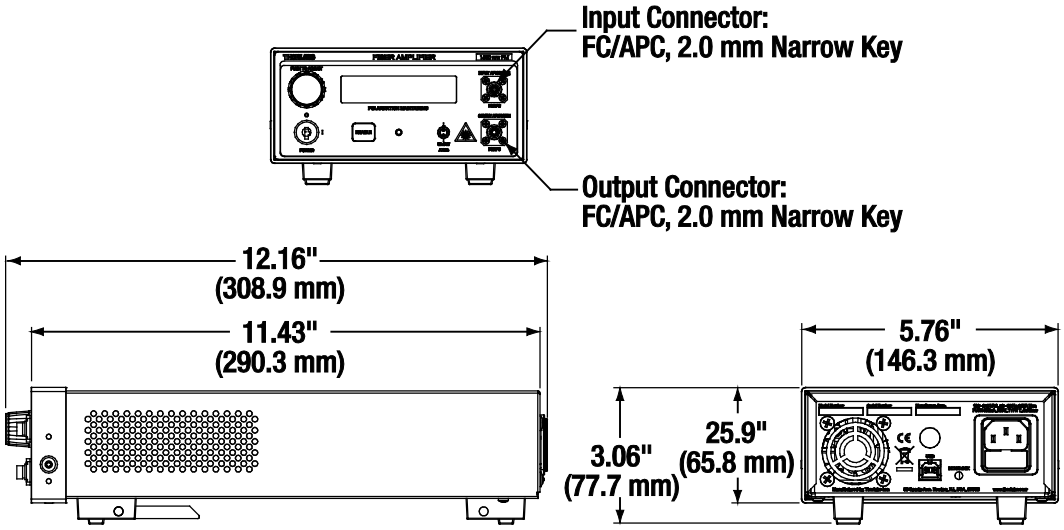


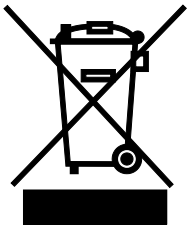
Figure 6 EDFA100P Mechanical Drawing

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 Declaration of Conformity



EU Declaration of Conformity

in accordance with EN ISO 17050-1:2010

We: Thorlabs Inc.

Of: 56 Sparta Avenue, Newton, New Jersey, 07860, USA

in accordance with the following Directive(s):

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

hereby declare that:

Model: ***EDFA100S & EDFA100P***

Equipment: ***Erbium doped fiber amplifier and Polarizing maintaining***

is in conformity with the applicable requirements of the following documents:

EN 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use.	2010
EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013

and which, issued under the sole responsibility of Thorlabs, is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8th June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, for the reason stated below:

does not contain substances in excess of the maximum concentration values tolerated by weight in homogenous materials as listed in Annex II of the Directive

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: *On:* 28 November 2016

Name: Ann Strachan

Position: Compliance Manager

EDC - EDFA100S & EDFA100P -2016-11-28

CE 16

Chapter 14 Thorlabs Worldwide Contacts

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