

EYDFA-33-PM-R

Operation Manual

+33 dBm Erbium/Ytterbium Doped Fiber Amplifier



**CAUTION –
USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF
PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN
HAZARDOUS RADIATION EXPOSURE.**



**THE USER MUST READ THIS MANUAL BEFORE OPERATING THE
PRODUCT. OPERATIONS OTHER THAN THOSE DESCRIBED IN THIS
MANUAL MAY RESULT IN PERSONAL INJURY AND DAMAGE TO THE
PRODUCT.**



Note that any attempt to open or fix the equipment without prior approval by Optilab, LLC voids the warranty.

Revision History

Revision	Date (DD-MM-YYYY)	Summary
R1.00	08-08-2018	Manual introduced.

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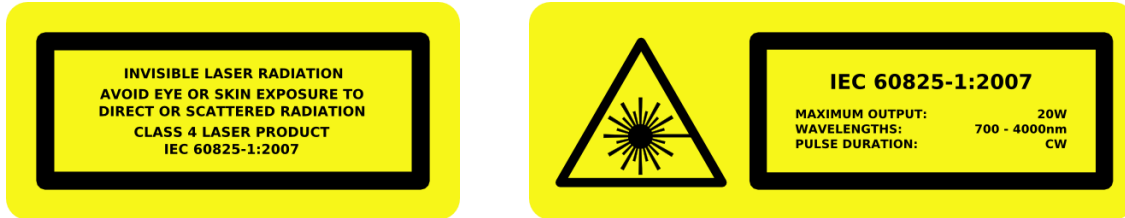
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1. General Information



1.1 Safety Precautions



This product emits high power invisible laser radiation from the optical connector(s) that classifies it to be a **CLASS 4** laser product accordingly to IEC 60825-1:2007. **The optical output is hazardous to eyes and skin. AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION.**



THE OPTICAL OUTPUT MUST BE DISABLED WHEN SWAPPING PATCHCORD CONNECTIONS.



NEVER USE ADAPTOR OR CONNECTOR TYPE OTHER THAN SPECIFIED IN THE TEST REPORT. If measurement instruments accept different connector type, use hybrid patchcords.



Ensure the optical input signal is within the range specified in the test report.



There MUST be an input signal present before turning on the optical output.



Do NOT use this product in HIGH PEAK PULSE POWER (>10W) applications unless with the consent from the manufacturer. Failing to following this instruction voids the warranty.



THE OPTICAL OUTPUT IS A POTENTIAL FIRE HAZARD. It is recommended that the product is used only in a secure and insulated environment.



Catastrophic failure (plasma formation) of optical fiber can occur at optical powers of even less than 1 W, CW. The optical fiber can become locally heated to high temperatures **at a sharp bend or dust at a fiber end**. When the fiber reaches these high temperatures it starts to absorb the laser radiation and catastrophic failure occurs. The high temperature failure region moves at about 1 m/s towards the source of laser radiation. **IT IS RECOMMENDED THAT AN EXTERNAL ISOLATOR OR LONG PATCHCORD BE PERMANENTLY CONNECTED TO THE OUTPUT RECEPTACLE TO PROTECT THE EQUIPMENT FROM BEING DAMAGED BY THIS PHENOMENON.**

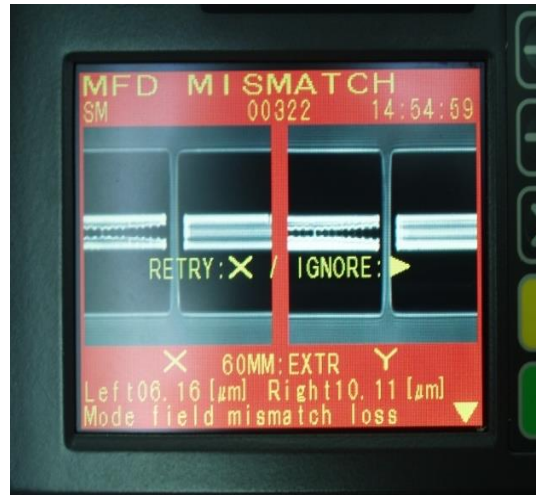
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In case when catastrophic failure (plasma formation) has occurred, **DO NOT** enable the lasers again. Otherwise the optical fiber will continue to burn towards the source of laser radiation at about 1m/s.



Plasma Formation (fiber on the left)



OPTICAL COMPONENTS CONNECTED TO THE OPTICAL OUTPUT MUST BE RATED FOR HIGH POWER USE. It is highly recommended that these components be properly cooled to dissipate heat.



FOR CONTINUED PROTECTION AGAINST FIRE, REPLACE ONLY WITH SAME TYPE AND RATING OF FUSE.



The equipment is certified for EMC requirements. **THE USER SHOULD NEVER OPEN THE EQUIPMENT CASE;** any attempt will void the warranty and may result in electric shock and EMI attack to equipment in the vicinity.



Avoid using any solvent or vaporizing chemical to clean the equipment panel or case. It may result in damage to the surface and internal circuits.

1.2 Laser Safety References

For more laser safety information, please refer to:

- 1) Laser Institute of America(LIA)
13501 Ingenuity Drive, Suite 128
Orlando, Florida 32826
Phone:407 380 1553, Fax: 407 380 5588
Toll Free:1 800 34 LAS ER

- 2) American National Standards Institute
ANSI Z136.1, American National Standard for the Safe Use of Lasers
(Available through LIA)
- 3) International Electro-technical Commission
IEC 60825-1, Edition 1.2

- 4) Center for Devices and Radiological Health
21 CFR 1040.10 - Performance Standards for Light-Emitting Products

- 5) US Department of Labor - OSHA
Publication 8-1.7 - Guidelines for Laser Safety and Hazard Assessment

- 6) Laser Safety Equipment
Laurin Publishing

- 7) Laser safety equipment and Buyer's Guides

1.3 Accessories



When you receive this product, verify the accessories specified in the **product packing list** are included. If there are any discrepancies, notify Optilab, LLC promptly.

This product was carefully inspected before it left the manufacturer. It should be in proper working order upon receipt. You should, however, inspect the product for any damage that may have occurred in transit. If the shipping container or the packing material is damaged, keep it until the contents of the shipment have been checked to be free of mechanical and electrical damages. Notify Optilab, LLC promptly if any notable damage is found.

2. Product Specifications

2.1 Product Overview

This product is a high power Erbium / ytterbium co-doped fiber amplifier designed for applications requiring high efficiency optical amplification in C-band for CW operations. It is a single stage booster amplifier delivering over 23 dB gain and up to +33 dBm saturation power at 1550 nm. It is a self-contained, turn-key rackmount designed to supply high and stable gain across the specified range of the wavelength window.

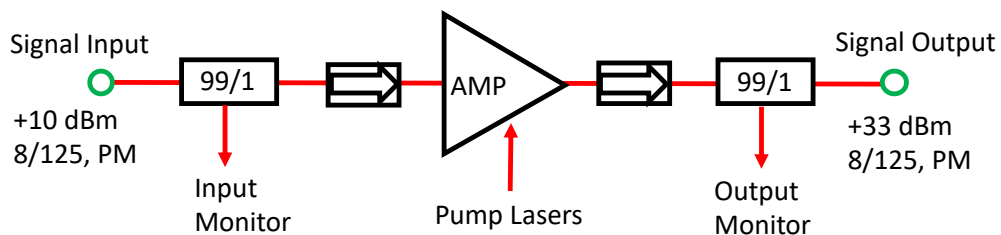
2.2 Features

- Up to +33 dBm saturation power
- Polarization maintained with high PER
- Collimated Output (Optional)
- Interlock safety feature

2.3 Function Diagram

In the following figure, a basic function diagram of the EYDFA-33-PM-R is given. This is a single stage amplifiers. It comes with input and output power monitoring, as well as isolations.

Function Diagram



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2.4 Specifications

Optical Specifications	
Wavelength Range	1545 nm to 1555 nm
Input Power Level	+7 dBm to +13 dBm
Input Laser Linewidth	> 200 kHz
Saturation Output Power	+ 33 dBm
Optical Gain	23 dB @ +10 dBm input
Optical Return Loss	30 dB min.
Input / Output Optical Isolation	27 dB min.
Output Power Stability	0.2 dB over 8 hours
Optical Input / Output Fiber Type	8/125, NA=0.12, PM
Optical Input / Output Connector	FC/APC, fast axis aligned to slow axis
Mechanical Specifications	
Operating Temperature	+5 °C to +40 °C
Storage Temperature	-10 °C to +70 °C
Power Supply	100 to 240 VAC, 50 to 60 Hz
Control	Pump laser current, enable switch
Monitoring	Pump laser current, input power
Remote Control	RS232 via USB port
Dimensions	3U Rackmount



When you receive this product, verify that a test report are included. These documents contain important parameters regarding to the optical and electrical specifications and operation conditions of the product.

3. Product Description

3.1 Panel Diagrams and Controls

Front Panel



Feature	Function
① Main Touch Display	The Touch LCD display shows the parameters and optical settings of the EYDFA rackmount unit. This is a touchscreen type display, see section 3.2.3 for more information.
② Output Power Enable Switch	This switch enables / disables the laser optical output for the pump lasers.
③ Optical Input Port	The optical input receptacle, FC/APC type.
④ Optical Output Port	High power amplifier output port pigtail. For PM model, key is aligned to the slow axis.

Rear Panel



Feature	Function
① AC Power Socket	The AC power socket is the input for the AC power source. A three-pin standard power cord should be used to connect this equipment to any 110 or 220 V main supply.
② Main AC Power Switch	This switch enables the electrical power to the DFB-B unit.
③ USB Female Socket	Using a USB cable, this port allows for remote control and monitoring through a PC workstation.
④ Ventilation Fans	The ventilation fans ensure proper ventilation inside the unit. The back panel and the two sides of this equipment should be placed at least 3 inches from the wall to dissipate heat effectively.
⑤ Interlock	This BNC female connector is a safety interlock. It must be shorted in order for the pump lasers to enable. Use the provided accessory to short this port or connect it to a compatible interlock device. If the interlock is open during normal operation, the pump lasers will be turned off. To re-enable the pump laser output, turn the output switch on the front panel to “OFF” position first and start over.

3.2 Operation Instructions

3.2.1 Preparation Procedure

1. Prior to the operation, read the user manual carefully and refer to laser safety information in Sec 1.2. Inappropriate operation may cause severe damage to the instrument and harm the health of the operators and people close by the amplifier instrument.
2. Prepare personal protective equipment (not included), e.g., safety goggles, curtains or enclosures, interlock protection systems (if applicable).
3. The amplifier output is pigtailed; however, **DO NOT MATE THE PIGTAIL TO ANOTHER FIBER. THIS IS NOT A HIGH-POWER CONNECTOR AND IF MATED TO A FIBER, SEVERE DAMAGE WILL RESULT.**
4. We recommend either splicing the fiber to another fiber or using the armored connector to couple light into free-space optical components (e.g. a collimator).

3.2.2 Start-up Procedure

Make sure main AC power switch on the rear panel is off and make sure the key switch on the front panel is also off. Interlock should be shorted using the provided accessory or connected to a compatible interlock device.

After plugging in the appropriate power plug into the AC Power Socket, flip the rear panel Main AC Power Switch to the On position to enable electrical power to the unit. The LED Main Display will turn on.

Connect the optical input port using an appropriate patch cord. For the best input coupling, use a PM1550 or equivalent fiber with FC/APC connector.

Enable the optical input. The optical input power should be in the range of +7 dBm to +13 dBm average power in order to achieve the output power level per specification. When the optical input power is less than +7 dBm, the pump lasers in the amplifier will automatically be disabled. The optical input signal should be a continuous wave (CW) or semi-continuous wave (> 1MHz) in the specified operating wavelength range.

To enable amplification, first turn the key switch to ON position. Next, turn on the booster stage pump lasers using the LCD touch screen settings or through back panel USB control. We recommend keeping the driving current setting of these pump lasers the same as specified in the test data.

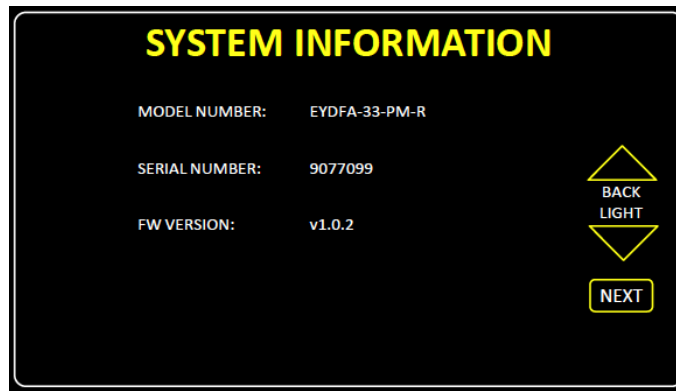
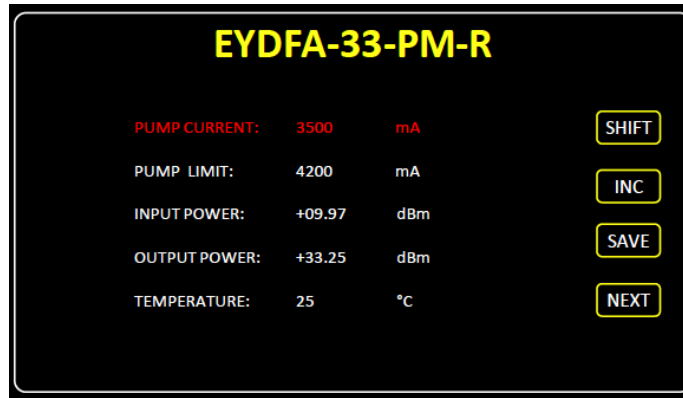
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3.2.3 Change Front Panel Setting

To toggle between operation modes or to adjust digits of the pump currents, use the shift key to highlight a parameter to change (it will turn yellow). When the parameter is highlighted, use the “INC” button to cycle through the options. For the pump current, adjust each digit, then press “SAVE” to engage the newest settings. The newest current setting value will not be displayed until the key switch is turned to ON position. The maximum currents of each diode are displayed but cannot be altered. The Input / output power read by the internal PD is also displayed. The “ESC” button will deselect your selection.



3.2.4 Turn-Off Procedure

1. It is recommended to turn off the booster stage pump current first before turning off the key switch.
2. Turn off the main AC power switch after the key switch is set to off position.

Note:

Optical input signal should be enabled before turning on pump lasers.

3.2.5 Interlock and Loss of Signal Protection

1. When the detected input signal is less than +7 dBm, all the pump lasers will be shut off for protection purposes. Once the automatic shut off is triggered, a start over procedure as described above is required to re-enable the amplifier output. It is recommended to use +10 dBm or higher input power.
2. A BNC female connector on the back panel is provided as the safety interlock. It must be shorted in order for the pump lasers to enable. Use the provided accessory to short this port or connect it to a compatible interlock device. If the interlock is open during normal operation, the pump lasers will be turned off. To re-enable the pump laser output, turn the output switch on the front panel to "OFF" position first and start over, including re-enabling the booster amplifier switch.

3.3 Remote Control (OPTIONAL)

As an optional feature, the EYDFA unit is capable connecting to an external PC to allow for parameter monitoring and pump level adjustments. To allow successful enabling of the amplifier, the key switch should be turned on and the interlock should be shorted to use the software control.

1. Using the USB port on the rear panel, connect the amplifier to a PC, directly to the USB port with an appropriate USB to USB cable.
2. By using the Device Manager (or other similar PC device tool), the amplifier should be recognized as COM Port device. If the amplifier does not appear as a COM Port device, you may need to install the necessary RS232 drivers included on the software package.
3. Once the device is recognized by the PC interface, check to see if the operating PC has a COM port communication software installed.

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Use the following RS232 settings:

Baud Rate = 9600

Data Bits: 8

Stop Bits: 1

Polarity: None

Append carrier return (CR) and line feed (LF) to each command.

The following commands can then be executed, with a corresponding confirmation of the command afterwards (Syntax is CMD:XX, case sensitive)

READ: This command displays system status, including the current settings of each pump and maximum current setting. Example of Response:

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Model Number: EYDFA-33-PM-M

Serial Number: 9077099

FW Version: v1.0.2

Pump Current: 2500 mA

Current Limit: 4200 mA

Input Power: +10.00 dBm

Output Power: +33.27 dBm

Temperature: 25 C

SETLD1:#### This command allows adjustment of the pump diodes drive current in the unit of mA. Range: 0001 to limit (See test datasheet). Example: SETLD1:0557 will set the drive current of pump LD to 557 mA. Must use four digits.

4. Maintenance and Care

4.1 Troubleshooting

Symptom	Possible Cause (C) and Solution (S)
No Optical Output	C: Interlock is open S: Close the interlock using the provided BNC connector or connect it to the compatible interlock system.
	C: Input power is low S: The pump lasers will not be enabled if the input power is lower than the threshold. Increase the input power to roughly +10 dBm.
	C: Key switch is off. S: Turn on the key switch.
Optical output is not high enough	C: Power or Current Setting not high enough S: Increase the Power Setting up to a maximum.
	C: No optical input or optical input power is too small. S: Check whether optical input is present or check optical input power is correct according to the test report.
	C: Optical connectors are dirty. S: Disable optical output and clean optical connectors.
	C: Use of incorrect optical adapters or connectors. S: Use only the optical adapters and connectors indicated in the test report. If measurement instruments accept different connector type, then use hybrid patchcords.
Optical output power is unstable.	C: Insufficient ventilation. S: Place unit in well ventilated area or supply additional fans for ventilation.
	C: Insufficient optical output isolation. S: Connect isolator of corresponding wavelength to optical output connector.
Unit resets or blinks on and off.	C: Power cord is loose. S: Plug power cord is firmly into the unit.
	C: Insufficient electrical voltage. S: Check that the electrical supply is at least the specified voltage on the label.

4.2 Care of Fiber-optic Connectors



Damage to optical connectors account for more than 70 percent of equipment performance degradation. To avoid such damage, the user should use only industrial grade 99% pure isopropyl alcohol and follow the procedures below to keep the connectors, adaptors and receptacles clean.

4.2.1 Cleaning Optical Connector End-face



WARNING:

Do NOT perform the Cleaning Optical Connector End-face procedure described below if the “DO NOT OPEN” stickers are affixed. Otherwise, the internal components will suffer from permanent damage.



To properly clean optical connectors utilizing lens tissue grade *wipes and alcohol* follow the procedure below.

- The moist wipe removes dust particles, oil and contaminants that may damage or blot the end-face of the connector during connection.
- The dry wipe removes residual alcohol that may be ignited by optical emission.



1. Disable the optical output and turn off the unit to prevent accidental exposure or damage to the optical connector by optical emission. **THE OPTICAL OUTPUT MUST BE DISABLED WHEN CLEANING THE CONNECTOR END-FACE.**
2. Moisten a wipe with alcohol by placing on top of the alcohol dispenser and push down to saturate the wipe.
3. Place the moist wipe on a work surface, and place a second dry wipe next to it.
4. Wipe the optical connector, end-face down on the moist wipe 3 times and then repeat on the dry wipe.
5. Visually inspect the end-face of the optical connector with an optical microscope to verify cleanliness. Repeat steps 5 to 8 as needed. Examples for damaged, dirty, and clean end-faces are shown in the figures that follow.

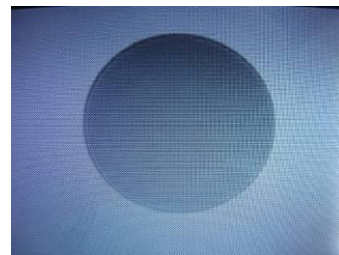
Single-mode Fiber (SMF)



Damaged: Replacement required



Dirty: Cleaning required



Clean: No cleaning required

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Polarization-maintaining Fiber (PMF)



Damaged: Replacement required



Dirty: Cleaning required



Clean: No cleaning required

4.2.2 Cleaning Optical Connector Sides, Receptacles, Adaptors

Dust or particles can adhere to the insides of receptacles and adaptors or the sides of the optical connector ferrule. Their presence can affect the alignment of the optical fiber connectors and increase connection loss. To properly clean optical connectors, receptacles, and adaptors utilizing a **swab and alcohol** follow the procedure as follows:

1. Disable the optical output and turn off unit to prevent accidental exposure or damage to the optical connector by optical emission.
2. Moisten the swab by placing it on top of the alcohol dispenser and push down to saturate the swab.
3. For receptacles, adaptors, or other connection points, insert the moistened swab and rotate the tip 1/2 turn clockwise and counter-clockwise 6 times while applying light but firm pressure.
4. For fiber connectors, rotate the tip of the moistened swab 5 revolutions around the connector while applying light but firm pressure.
5. Visually inspect the end face of the connector with an optical microscope to verify cleanliness. Clean end-face as needed.

5. Service and Support

5.1 Service and Calibration

Your product has been designed to provide years of trouble-free operation. No internal service is required provided that the equipment is properly handled, operated and kept away from contamination. For any questions regarding the operation and performance of the product, please contact Optilab, LLC.

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5.2 Warranty Policy

Optilab, LLC warrants each new product will be free from defective material and workmanship under normal use and service for a period of one (1) year for all products from date of shipment.

During the warranty, Optilab, LLC will either repair or replace, at its option, any defective product (hereafter refer to as Product) within thirty (30) days after its receipt, and Optilab, LLC shall return such repaired or replaced Product to the location from which it originated. Optilab, LLC will be responsible for both material and labor required to effect all repairs under terms of the warranty, providing the Product is returned to Optilab, LLC as specified in the warranty statement. The purchaser shall bear the freight charges incurred in returning the Product to Optilab, LLC for examination, replace and / or repair of the Product.

The warranty does not apply if the Product has been modified by purchaser or subjected to misuse, neglect, or accident, or if the Product has been repaired or altered by an unauthorized service depot so that its performance or reliability has been impaired, or if the Product has had the serial number altered, effaced or removed; or if it has been damaged by accessories, peripherals, and other attachments not approved by Optilab, LLC.

The warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to assume for Optilab, LLC any other liability in connection with the sale of the Product.