

# EOT AMPLIFIED HIGH SPEED FIBER PHOTODETECTOR USER'S GUIDE

Thank you for purchasing your Amplified High Speed Fiber Photodetector from EOT. This user's guide will help answer any questions you may have regarding the safe use and optimal operation of your Photodetector.

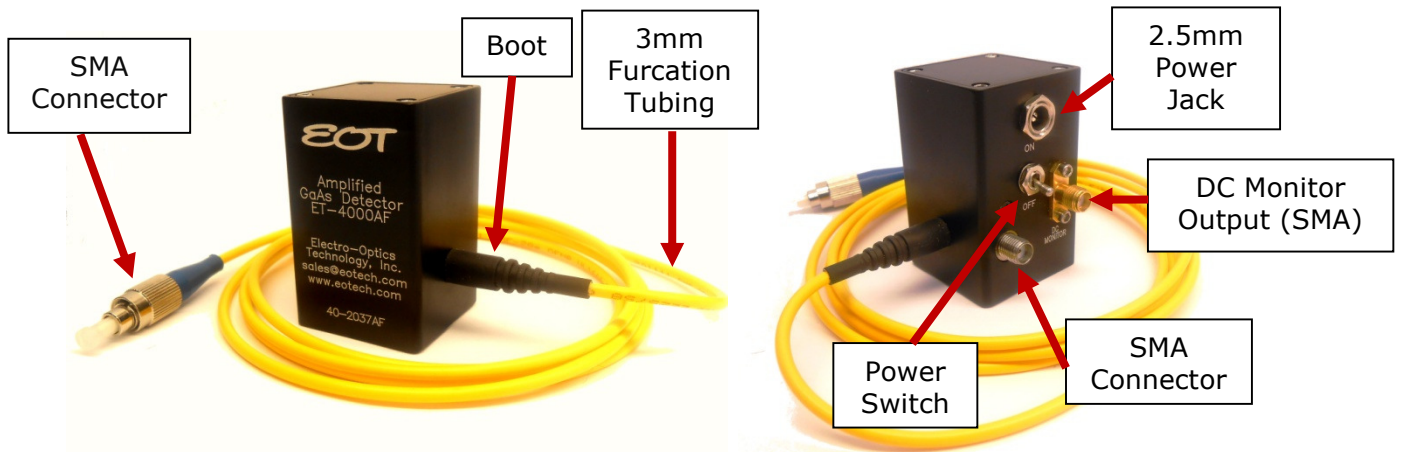
## TABLE OF CONTENTS

- I. Amplified High Speed Fiber Photodetector Overview..... 1
- II. Operation of your EOT Amplified High Speed Fiber Photodetector ..... 1
- III. Troubleshooting ..... 2
- IV. Drawings: Amplified High Speed Fiber Photodetectors ..... 3
- V. Specifications: Amplified High Speed Fiber Photodetectors ..... 3
- VI. Schematics: Amplified High Speed Fiber Photodetectors..... 4
- VII. Warranty Statement and Repair ..... 4
- VIII. Glossary of Terms..... 5

### I. Amplified High Speed Fiber Photodetector Overview

EOT's Amplified High Speed Fiber Photodetectors contain PIN photodiodes that utilize the photovoltaic effect to convert optical power into an electrical current and a fixed gain transimpedance amplifier allowing measurement of <math><1\text{mW}</math> input powers. Figure 1 below identifies the main elements of your Fiber Photodetector.

**Figure 1: EOT Amplified High Speed Fiber Photodetector**



When terminated into  $50\Omega$  into an oscilloscope, the pulsewidth of a laser can be measured. When terminated into a spectrum analyzer, the frequency response of a laser can be measured.

### II. Operation of your EOT Amplified High Speed Fiber Photodetector

A. Caution: Eye safety precautions must be followed when utilizing any equipment used in the vicinity of laser beams. Laser beams may reflect from the surface of the detector or the optical mount and caution must be exercised.



- B. Mount the detector to an optical stand by the mounting holes on the bottom of the detector housing.
- C. Clean the end of the fiber ferrule and connect to the laser.
- D. Connect the detector to the oscilloscope using a coaxial cable designed for 10GHz operation. The DC Monitor cable can be a general purpose cable.
- E. Use the 50Ω termination input of the oscilloscope.
- F. Connect the DC Monitor to a high impedance device, such as a multimeter. Set the device to millivolts or volts. The output of the DC Monitor converts the average photodiode current to a voltage output of 1mV/uA. The DC Monitor output has an offset voltage of less than 2mV.
- G. Note that the external power supply is a 5VDC regulated supply with a positive center pin. Using an unregulated power supply or any supply other than 5VDC could damage the detector.
- H. After being certain that the damage threshold of the detector is not exceeded, turn on the laser.

### **III. Troubleshooting**

#### **A. No signal is seen the first time the detector is used.**

1. Is the power switch on? Is the external power supply connected?
2. Is your signal a CW signal? If so, there will not be a signal output present because the detector is AC coupled. There would be an output from the DC Monitor.
3. Be certain that the signal is not high off scale on the oscilloscope.
4. Is the wavelength of the laser within the spectral range of the detector?
5. Has a 50Ω termination input been used?
6. Make sure the fiber radius is greater than 1 inch. Inspect fiber for damage.
7. Check the end of the fiber ferrule for cleanliness or damage.
8. Is there enough light (see sensitivity spec on the data sheet) incident on the detector to generate a signal?

#### **B. A signal has been previously obtained, but not currently.**

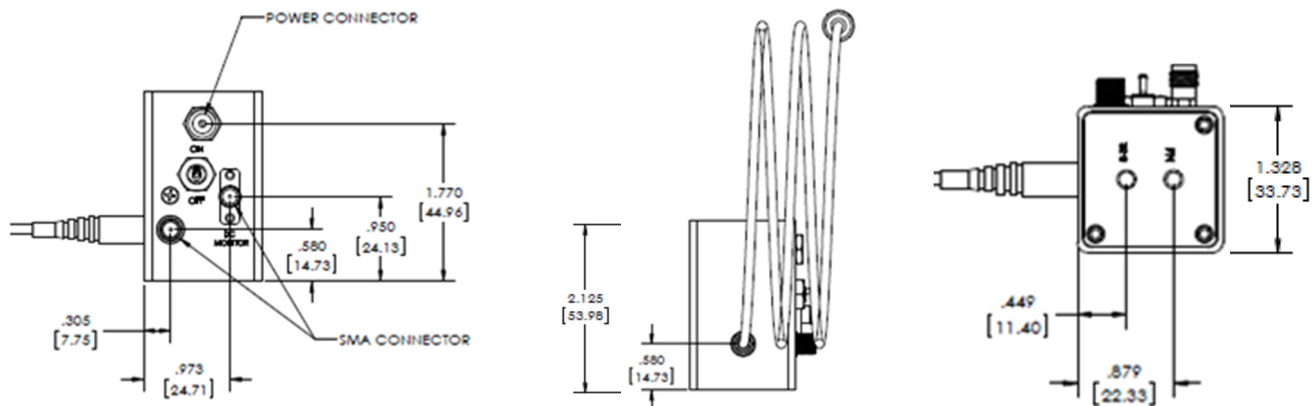
1. Try steps listed under A.
2. Recheck if the voltage is present at the external power supply plug.

**C. Increasing the power incident on the detector does not result in a higher voltage signal on the oscilloscope:**

1. The detector is probably saturated. You should lower the power incident on the detector to a level below the saturation point.

**IV. Drawings: Amplified High Speed Fiber Photodetectors**

**A. ET-3500AF, ET-4000AF, ET-5000AF Dimensions:**

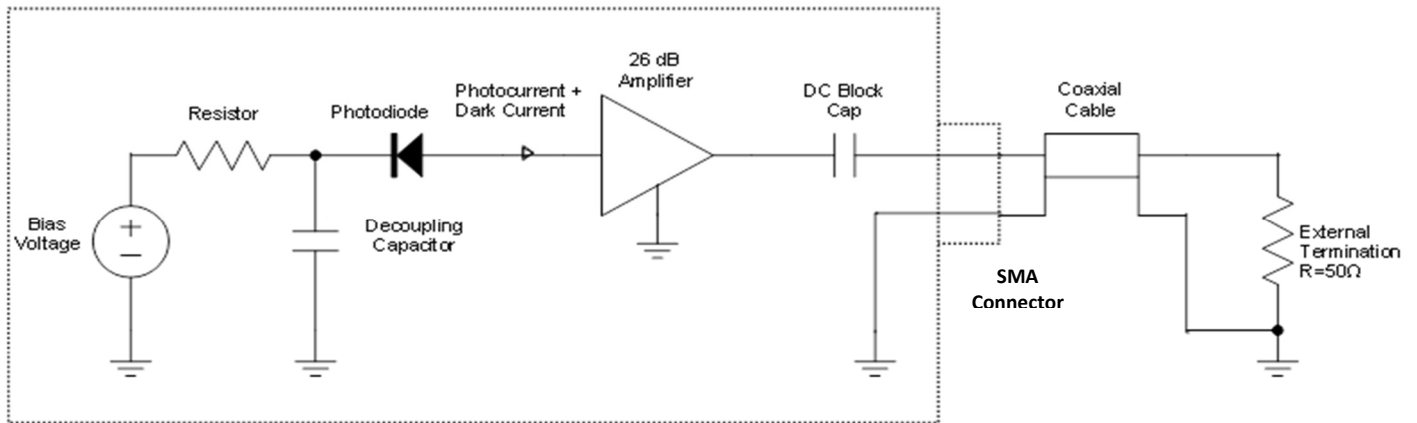


**V. Specifications: Amplified High Speed Fiber Photodetectors**

Part No. (Model)	120-10064-0001 <sup>a</sup> (ET-3500AF)	120-10077-0001 <sup>a</sup> (ET-4000AF)	120-10116-0001 <sup>a</sup> (ET-5000AF)
Detector Material	InGaAs	GaAs	InGaAs
Rise Time/Fall Time (ps)	<40/<40	<40/<40	<40/<40
Conversion Gain (V/W)	>650 at 1300nm	380 at 830nm	950 at 2000nm
Power Supply (VDC)	5	5	5
Bandwidth	20kHz-9GHz	20kHz-9GHz	20kHz-9GHz
Active Area Diameter (μm)	32	60	40
Noise Equivalent Power (pW/√Hz)	<25	<45	<17
Maximum Linear Rating (mVp-p)	450	450	450
Mounting (Tapped Holes)	8-32 or M4	8-32 or M4	8-32 or M4
Output Connector	SMA	SMA	SMA
Fiber Optic Connection	FC/UPC	FC/UPC	FC/UPC

<sup>a</sup> Not suitable for CW applications.

## VI. Schematics: Amplified High Speed Fiber Photodetectors



## VII. Warranty Statement and Repair

EOT warrants its products to be free from defects in material and workmanship and complies with all specifications. EOT will at its option, repair or replace any product or component found to be defective during the warranty period. This warranty applies only to the original purchaser and is not transferrable for a period of one year after date of original shipment. The foregoing warranties shall not apply, and EOT reserves the right to refuse warranty service, should malfunction or failure result from:

- a. Damage caused by improper installation, handling or use.
- b. Unauthorized product modification or repair.
- c. Operation outside the environmental or damage specifications of the product.
- d. Contamination not reported to EOT within 30 days of the original ship date.

This warranty is exclusive in lieu of all other warranties whether written, oral, or implied. EOT specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. In no event shall EOT be liable for an indirect, incidental, or consequential damages in connection with its products.

If the customer believes there is a problem with the photodetector, they should immediately contact EOT's Sales/Customer department at 231-935-4044 or [customerservice@eotech.com](mailto:customerservice@eotech.com). EOT's Customer Service department will either issue an RMA for the device, or provide the customer with a procedure and authorize the customer to modify the device. All returns should reference the RMA number on the outside of the shipping container and should be sent to:

Electro-Optics Technology, Inc.  
Attn: Sales/Customer Service  
5835 Shugart Lane  
Traverse City, MI 49684 USA

EOT reserves the right to inspect photodetectors returned under warranty to assess if the problem was caused by a manufacturer defect. If EOT determines the problem is not due to a manufacturer defect, repairs will be done at the customer's expense. EOT will always provide a written quote for repair prior to performing repairs at the customer's expense.



## VIII. Glossary of Terms

**Amplifier:** Provides a power gain of 26dB throughout the photodiode's bandwidth. The photodiode current is converted to an output voltage.

**Bandwidth:** The range of frequencies from 0Hz (DC) to the frequency at which the amplitude decreases by 3dB. Bandwidth and rise time can be approximately related by the equation:  
Bandwidth  $\approx$  0.35/rise time for a Gaussian pulse input.

**Bias Voltage:** The photodiode's junction capacitance can be modified by applying a reverse voltage. The bias voltage reduces the junction capacitance, which causes the photodiode to have a faster response.

**Conversion Gain:** The relative level of the optical input power that is amplified and converted into a voltage output.

**Dark Current:** When a termination is present, a dark current (nA range) will flow if the photodiode is biased. Disconnecting the coaxial cable will prevent this current from flowing.

**DC Block Capacitor:** Prevents the DC voltage that is supplied through the amplifier output from exiting the detector which would cause a large DC offset voltage. Therefore, the amplified detector is an AC coupled device and will have a low cut-off frequency as well as a high cut-off frequency.

**Decoupling Capacitor:** Maintains bias voltage when fast pulses cause the battery voltage to reduce (this would slow the response time of the photodiode); the capacitor allows the battery to recover to its initial voltage. It also acts as a filter for external power supplies.

**Noise Equivalent Power (NEP):** A function of responsivity and dark current and is the minimum optical power needed for an output signal to noise ratio of 1. Dark current is the current that flows through a reverse biased photodiode even when light is not present, and is typically on the order of nA. Shot noise (I<sub>shot</sub>) is a source of noise generated in part by dark current; in the case of reversed biased diodes it is the dominant contributor.

**Photodiode:** Converts photons into a photocurrent.

**Resistor:** Protects the photodiode from excessive current. This could occur if an external power supply was too high in voltage, or if its polarity were reversed; this happens when a customer uses their own power supply.

**Responsivity:** In amps per watt (A/W), responsivity is the current output of the photodiode for a given input power, and is determined by the diode structure. Responsivity varies with wavelength and diode material.

**Rise time/Fall time:** Rise Time is the time taken by a signal to change from a specified low value to a specified high value. Fall Time is the time taken for the amplitude of a pulse to decrease from a specified value to another specified value. A larger junction capacitance will slow the detector's response time.



**SMA Connector:** Used to connect the customer's coaxial cable for high frequencies.