O-Band Fiber Amplifier

Features

- >20 dB Small Signal Gain
- >16 dBm Saturation Power
- Distortion-Free Amplification Independent of Modulation Format or Speed
- Minimal Signal Latency
- Polarization-Independent Gain
- Ripple-Free Gain Spectrum

PDFA100

Applications

- Preamplifier or Booster Amplifier in Data Transmission
- Overload Testing for O-Band Data Receivers

Thorlabs' Praseodymium-Doped Fiber Amplifier (PDFA) provides high gain, high output power, and a low noise figure, making it ideal for use within optical networks as either a booster amplifier or preamplifier. It is designed and manufactured by Thorlabs using proprietary, military-grade, fluoride fiber technology.

This fiber amplifier offers key advantages over semiconductor optical amplifiers (SOAs) operating in the O-band wavelength range. Undesirable distortion effects typically associated with SOAs, such as cross-gain modulation and pattern dependence, are eliminated in the PDFA as a result of its high saturation energy and slow gain dynamics. These gain dynamics are independent of pulse shape or modulation format due to a long upper-state lifetime that leads to negligible cross-talk between adjacent channels. Featuring a ripple-free gain spectrum, the PDFA produces uniform gain over a number of channels, which eliminates channel mismatches at the end of a link. The resulting output is stable and ideal for improving the power budget in data center applications.

LASER RADIATION
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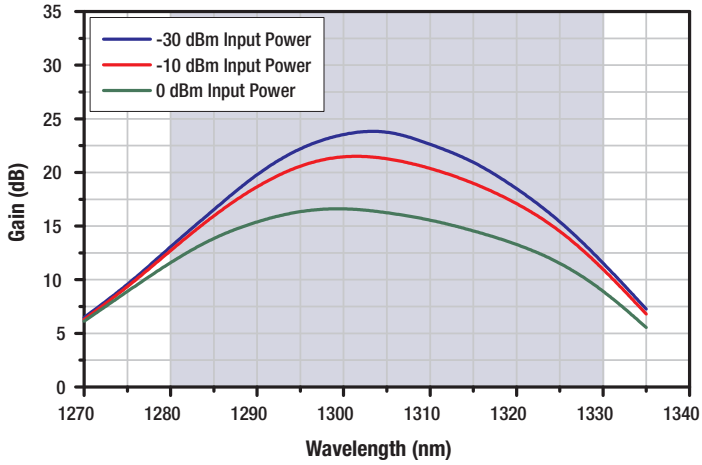
Typical PDFA100 Gain



The typical gain as a function of wavelength taken at 100% pumping. The blue-shaded region denotes the specified operating wavelength range.

Specifications

Item #	PDFA100
Amplifier Specifications (at 100% Pump Current)	
Small Signal Gain (at -30 dBm Input Power)[a]	>20 dB
Output Power (at 3 dBm Input Power)[a]	>16 dBm
Noise Figure[a]	<8 dB
Input Power Range	-30 to 10 dBm
Amplification Band[b]	1280 to 1330 nm (O-Band)
Control Modes	Constant Current, Gain, or Power
Fiber Specifications	
Input / Output Fiber Type	Single Mode
Input / Output Fiber Connectors	FC/APC Compatible, 2.0 mm Narrow Key

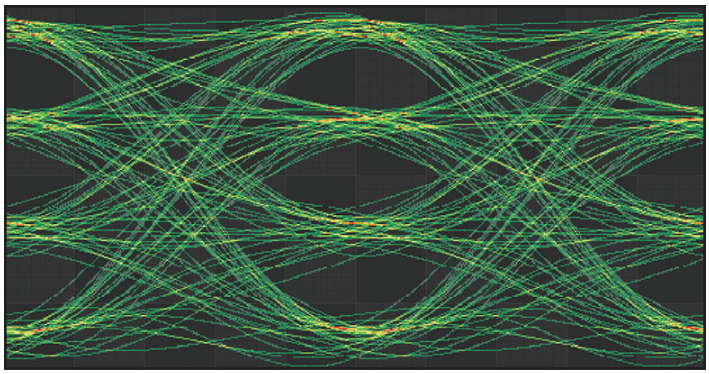
a. Specified at 1310 nm.
b. The wavelength range over which the small signal gain (at -30 dBm input power) does not fall below 10 dB.

Distortion-Free Amplification

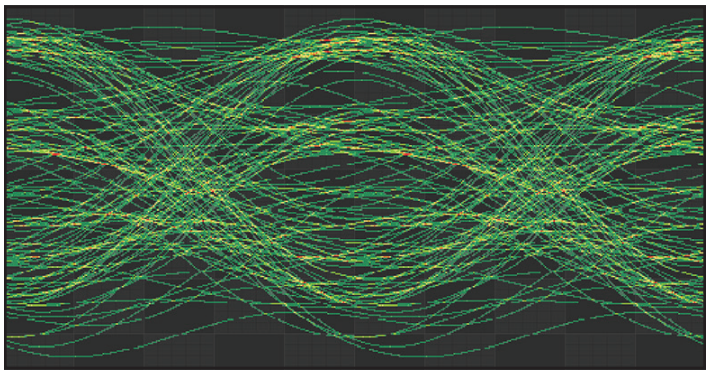
One advantage of the PDFA over semiconductor optical amplifiers (SOAs) stems from its slow gain dynamics. Communication signals include pulse sequences with random patterns, and the gain of the amplifier exhibits pattern dependence if the amplifier gain saturation has a time constant comparable to the bit period. This effect can result in severely distorted optical signals when the amplifier is driven into saturation.

Since SOAs typically have carrier lifetimes on the order of tens of picoseconds, pattern dependence is observed at standard communication data rates when they are driven into saturation. In contrast, the PDFA has an upper-state lifetime in the millisecond range, which makes it immune to this pattern dependence. This distinguishing characteristic between SOAs and fiber amplifiers has been previously studied for on-off keying (OOK) with return-to-zero (RZ) and non-return-to-zero (NRZ) modulation formats. Signal distortion becomes more severe for modern modulation formats, such as 4 level pulse amplitude modulation (PAM4), which we show experimentally in images to the right. The SOA (bottom) saturation dynamics cause significant distortion to the eye diagram while the PDFA (top) produces an open eye diagram with minimal distortion.

For OEM and customization options, please contact LaserSales@thorlabs.com.



Eye Diagram for Thorlabs' PDFA100 Fiber Amplifier



Eye Diagram for a Commercially Available SOA

The Thorlabs PDFA produces an open eye diagram, indicating distortion-free signal amplification, while the commercial SOA has a reduced eye opening due to signal distortions. These eye diagrams are measured by amplifying a 50 GBaud/s PAM4 signal with 2^7-1 pseudo-random bit sequence (PRBS).

O-Band Transmitters and Receivers

We offer high-speed transmitters and receivers that can be used with the PDFA optical amplifer for data transmission. To produce the eye diagrams above, the signal was sent from a Thorlabs MX65E-1310 Linear Reference Transmitter and received by a Thorlabs RXM40AF Ultrafast Receiver.

RXM40AF
Single Mode Ultrafast Receiver, 1250 - 1650 nm, 300 kHz - 40 GHz, FC/PC

MX65E-1310
65 GHz Linear Reference Transmitter, 1310 nm Internal Laser