OA500 Series DWDM Erbium-Doped Fiber Amplifier

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The OA500 series is a family of low-noise, gain-flattened Erbium-Doped Fiber Amplifiers (EDFA) with variable gain settings and Automatic Gain Control (AGC) that's ideal for Metro and Long-Haul Dense Wavelength Division Multiplexing (DWDM) applications. The optical design, coupled with its sophisticated control circuit, allows this EDFA to provide constant gain as wavelengths are added or dropped in the network. Any fluctuations from 0 to 40 wavelengths can be handled with its ultra-fast transient suppression. With variable output power, diverse link lengths can be easily accommodated and system design changes can be managed remotely without network redesigns. This high-performance optical amplifier utilizes a proprietary formulation of erbium-doped fiber, which provides low-noise figure and an optimal gain curve for DWDM applications at all input powers. The amplifier is gain-flattened across the entire C-band, from 1530 nm to 1563 nm providing optimal Optical to Signal Noise Ratio (OSNR) characteristics when cascading multiple EDFAs to maximize link lengths. Full monitoring and configuration capabilities are supported through a local RS-232 interface and an Ethernet interface for remote network monitoring using Telnet and Simple Network Management Protocol (SNMP) with an option for TL1. The N1U-OA500 series is a 1RU rack-mount NEBS Level 3-certified unit with an integrated DC power supply. An AC power supply version is also available for enterprise environments. Other packaging options are available for the OA500 series.

This Erbium-Doped Fiber Amplifier with Automatic Gain Control is ideal for Metro and Long-Haul DWDM systems.

HIGHLIGHTS INCLUDE:

- Fast transient suppression time: less than 35 µs
- Gain flatness less than 1.0 dB across entire C-band and input power range
- Noise figure typically less than 5 dB at all input powers and gain settings
- Wide input power range up to 29 dB
- Optical output power controlled with integrated Variable Optical Attenuator (optional)
- Isolated optical input and output
- External optical output monitor port
- Front-panel status LEDs
- Field-upgradeable firmware
- AC or DC powering options
- NEBS III compliant

Groundbreaking Automatic Gain Control capabilities enable operators to design highly dynamic DWDM networks.

The OA500 has culminated from Motorola's experience in designing and manufacturing high-performance EDFAs for over a decade. From the proprietary formulation of erbium-doped fiber to the sophisticated control circuitry, this family of EDFAs is designed to meet the demanding requirements of the dynamic DWDM networks being deployed today and planned for the future.

Automatic Gain Control

The OA500 series Automatic Gain Control provides the intelligence necessary for operators to design DWDM networks that will dynamically maintain constant gain per wavelength channel across the entire band. It is crucial that the optimal optical power be kept constant to prevent the degradation of the optical link that can lead to detrimental bit errors in the network.

AGC is becoming increasingly important as DWDM networks become more intelligent through protection switching and dynamic wavelength routing. The optical gain provided by an EDFA is dependent on the optical power coming into the EDFA, the opto-geometric parameters of the erbium doped fiber and the optical pump power that excites the erbium ions. At low input powers, less optical pump power is required to maintain a specific gain. The opposite is required for high input powers. Automatic Gain Control maintains a constant gain by monitoring the input power and adjusting the optical pump power. The OA500 has sophisticated control circuitry that ensures an optimum pump power is applied to rapidly suppress any transients.

Transient Suppression

An optical transient is a fluctuation in the optical power of an individual wavelength in the network. Transients can be caused through an EDFA when the total input power changes, such as when wavelengths are added or dropped in a DWDM network. When wavelengths are dropped, the total EDFA gain is transferred to the remaining wavelengths causing a spike in optical power. Fast control circuitry is required to quickly adjust the optical pump powers and suppress these transients.

Transient control is typically measured by dropping wavelengths and measuring the response of the surviving channels. Transient suppression time is the amount of time that it takes for the surviving channel to return to an acceptable gain level. Overshoot and undershoot are the maximum deviations around the target gain during a transient event.

The OA500 provides ultra-fast transient suppression by controlling the overshoot and undershoot. The table below presents the OA500's typical response to various changes in total optical power. Performance is shown when the EDFA is operated away from the saturation point and when it is operated at the saturation point, the worse case situation.

OA500 TRANSIENT CONTROL

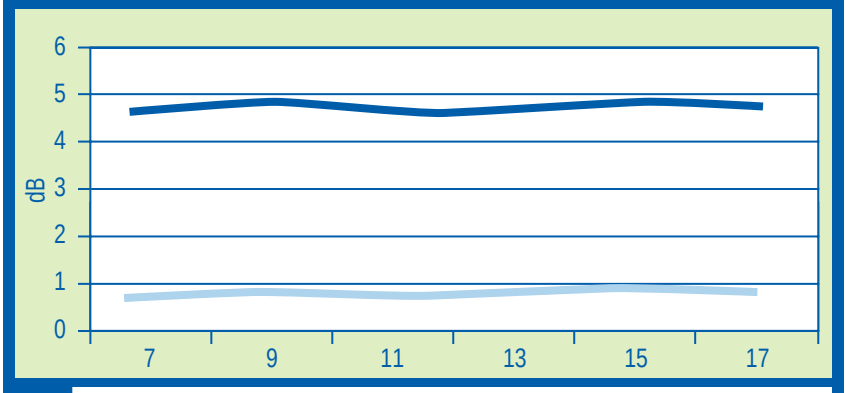
		Away from Saturation (Typical)		At Saturation (Worst Case)	
Optical Power Add/Drop	Channels Dropped	Overshoot/ Undershoot	Transient Suppression Time	Overshoot/ Undershoot	Transient Suppression Time
3 dB	50%	0.1 dB/0.1 dB	< 5 µs	0.2 dB/0.2 dB	< 7 µs
10 dB	90%	0.2 dB/0.3 dB	< 12 µs	0.8 dB/0.9 dB	< 32 µs
15 dB	97%	0.2 dB/0.3 dB	< 15 µs	0.9 dB/0.9 dB	< 72 µs
20 dB	99%	0.2 dB/0.3 dB	< 10 µs	1.1 dB/1.2 dB	< 120 µs

performance

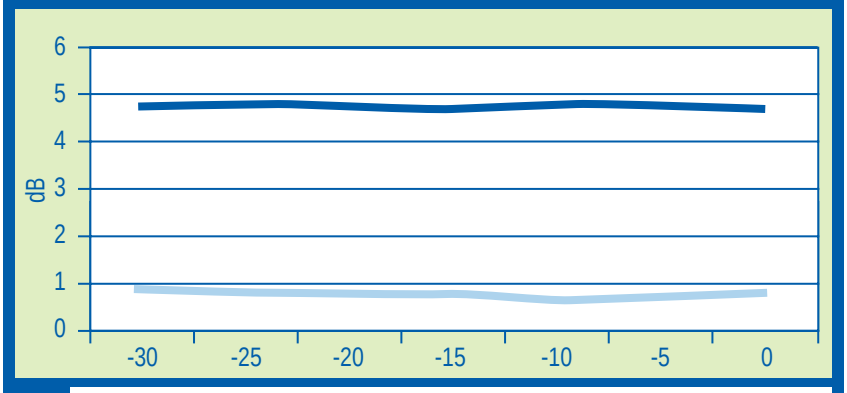
Variable Gain

The OA500 has an integrated variable optical attenuator that allows the gain to be adjusted up to 10 dB below the nominal EDFA gain. This further enhances the flexibility of the AGC EDFA to accommodate the link budgets for almost any application. The OA500 can be optimized for different input and output powers, and can be used as a pre-amplifier, in-line amplifier or booster. In cascades of EDFAs, the VOA can control the optical power going into the next EDFA to avoid saturation and the resulting gain tilt.

OA500 NOISE FIGURE/GAIN FLATNESS vs. GAIN



OA500 NOISE FIGURE/GAIN FLATNESS vs. INPUT POWER



Optical Performance

The OA500 uses a proprietary erbium-doped fiber formulation that provides low noise performance, approaching the theoretical minimum. The unit is gain-flattened to provide less than 1.0 dB uniformity across the C-band enabling long optical links by cascading multiple amplifiers while still providing excellent OSNR characteristics. The superior noise figure and gain flatness performance is maintained across all input powers and gain settings. The erbium-doped fiber is pumped with 980 nm lasers that are Telecordia qualified with a FIT rate of less than 100. This level of quality provides exceptional Mean Time Between Failure. The OA500 is polarization, modulation and frequency independent.

Embedded Intelligence and Network Management

The Motorola OA500 is a dual processor system with an inner core embedded controller and a network interface controller. The network controller provides redundant operating system images and is field upgradeable through T/FTP service. The unit provides full remote monitoring, configuration and upgrade capability through various common network interfaces including SNMP v2 and Command Line Interfaces (CLI) for local RS-232 connections or to run multiple telnet sessions. An option is available for a TL1 interface. The Ethernet port supports full or half duplex 10/100 Mb/s for remote connections to the network monitoring interfaces. This network-aware device allows level monitoring and alarm generation of all critical parameters including temperature, signal gain, system gain and input power. The alarm limits are fully settable by the operator. This remote control reduces the costly need for many infield service calls. An optical output monitoring port is also provided on the front panel of the chassis to facilitate local optical monitoring.

Form Factor Availability

The OA500 is available in a NEBS Level 3-certified rack mount unit with DC powering or in an AC-powered chassis for non-NEBS enterprise environments. The OA500 is shipped with mounting ears for 19", 21" and 23" racks. Other packaging options are available upon request to accommodate custom requirements including line cards.

SPECIFICATIONS

Model Number	Input Power	Saturated Output Power	Nominal Gain	Settable Variable Gain
N1U-OA530S17-x	-29 to -13 dBm	17.3 dBm +/-0.3 dB	30	20 to 30 dB
N1U-OA525S20-x	-29 to -5 dBm	20.3 dBm +/-0.3 dB	25	15 to 25 dB
N1U-OA523S17-x	-29 to -6 dBm	17.3 dBm +/-0.3 dB	23	13 to 23 dB
N1U-OA519S14-x	-29 to -5 dBm	14.3 dBm +/-0.3 dB	19	9 to 19 dB
N1U-OA517S17-x	-29 to 0 dBm	17.3 dBm +/-0.3 dB	17	7 to 17 dB
N1U-OA513S23-x	-15 to 10 dBm	23.3 dBm +/-0.3 dB	13	3 to 13 dB
N1U-OA510N20-x	-15 to 10 dBm	20.3 dBm +/-0.3 dB	10	Optional
N1U-OA507N17-x	-15 to 10 dBm	17.3 dBm +/-0.3 dB	7	Optional
N1U-OA504N14-x	-15 to 10 dBm	14.3 dBm +/-0.3 dB	4	Optional

x = powering version: A for AC powering; D for DC powering

Optical

Wavelength Range:	1530 to 1563 nm
Noise Figure	
Maximum:	5.5 dB
Typical:	4.8 dB
Gain Flatness, Maximum:	1.0 dB
Transient Suppression Time (10 dB Input Change)	
Away from Saturation:	< 12 µs
At Saturation:	< 35 µs
Optical Output Monitor Port:	-20 +/-1 dB From main output port
Backward Spontaneous Emission:	< -25 dBm
Input and Output Isolation:	> 30 dB
Optical Return Loss:	> 27 dB
Polarization Sensitivity:	< 0.5 dB
Optical Connector:	SC/UPC Standard or SC/APC

General

Source Power Voltage:	
DC Version	-48 VDC, 2 Amps max. Range: -40 to -60 VDC
AC Version	110 VRMS, 1 Amp 220 VRMS, 1 Amp
Power Consumption:	20 Watts maximum
Operating Temperature:	0 to +55˚ C*
Storage Temperature:	-40˚ to +75˚ C
Dimensions:	1.75" (1RU) H x 19.0" W x 10.0" D
Weight:	8.4 lbs (3.8 kg)
Communications:	
Interface, Local	RS-232 Port
Interface, Network	RJ-45 Port, 10/100Base-T
Alarm Contact	RJ-45 Port

* Wider operating temperature is available

REGULATORY STANDARDS COMPLIANCE

Safety

UL 1950
CAN/CSA-S22.2 No. 950
EN60950
IEC 60950
TS001
AS/NZS 3260
IEC 60825-1
IEC 60825-2
EN 60825-1
EN 60825-2
21 CFR 1040

EMC

FCC Part 15 (CFR 47) Class A
ICES-003 Class A
EN 55022 Class A
CISPR22 Class A
AS/NZS 3548 Class A
VCCI Class A
EN 55024
ETS 300 386
EN 50082-1
EN 61000-3-2
EN 61000-3-3

NEBS and ETSI Specifications (Applies to DC-powered units)

GR-63-Core NEBS Level 3 Requirements
GR-1089-Core NEBS Level 3 Requirements
ETS 300 019 Storage Class 1.1
ETS 300 019 Transportation Class 2.3
ETS 300 019 Stationary Use Class 3.1

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