



OPERATING MANUAL

OAS 1501-16 A

OAS 1501-16 B

OptiCaT 1500 Series
Erbium-Doped Fiber Amplifier

Disclaimer

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1. GENERAL INFORMATION

1.1 Scope of this Manual

This document describes the form, fit, and function of the *OptiCaT* 1500 Series Erbium-Doped Fiber Amplifier (EDFA) and all acceptable standard options.

- Installing the unit
- Operating the unit
- Setting up the unit to suit individual needs
- Troubleshooting
- Theory of operation
- Repair Policy

1.2 General Description

The *OptiCaT* 1500 EDFA is an optical amplifier operating in the 1550 nm wavelength region. These units are intended to function as either a booster or line amplifier depending on the model.

980nm diode lasers are used to pump Erbium doped fiber to provide optical amplification. Depending on model, optical isolators are used at both the input and output of the amplifier. Tap couplers allow the measurement of the optical input and output powers.

The unit can be powered from AC, DC, or conditioned external DC supplies, configured as main or backup, depending on which powering option is ordered.

1.3 Physical Description

Figure 1-1 is an illustration of the *OptiCaT* 1500 EDFA, showing unit measurements. The Optical Amplifier is a rack mounted 1U unit.

Height	1.75" (44 mm), 1U
Width	19" (483 mm)
Depth	20" chassis (508 mm), 21" (533 mm) with fans
Weight	20 lbs (9 kgs) max.

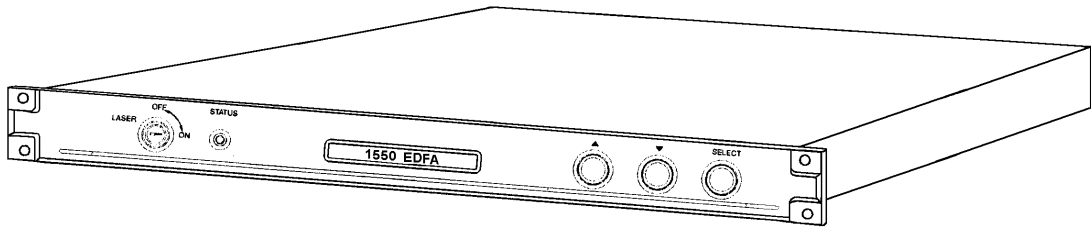


Figure 1-1 *OptiCaT* 1500 EDFA Unit

1.4 Features and Advantages of the 9100 Series

- Models available with a wide range of optical output power.
- Low Noise Figure.
- User adjustable output power.
- Front panel display of status and configuration of the Optical Amplifier.
- LED status indicator.
- Remote status monitoring function via RS485 Interface.
- Wide range of electrical power options available.
- High reliability and a 1-year warranty.

1.5 Specifications

Specifications for the specific *OptiCaT* 1500 Series model ordered are listed in section 6. MODEL SPECIFICATIONS.

1.6 Functional Description

Front Panel:

On/Off Key	Activate/De-activate optical gain
LED indicator	Indicates status of unit (Normal, Warning, or Alarm)
Display	Alphanumeric Dot Matrix LED, 1 line provides status and configuration information.
Scroll buttons	up/down/select push buttons are used to select menu items for display and to vary user adjustable parameters.

Rear Panel:

Power entry module	On/Off switch with standard 3-pin IEC AC (with AC option)
Terminal Block	4 post for DC power inputs
Ground Stud	
Communication port	Dual RJ-11 jacks for use with RS-485 protocol. Status monitoring with compatible Network Management Software
Optical connectors	fiber input/output options: FC/APC, SC/APC, E-2000 bulkhead connectors

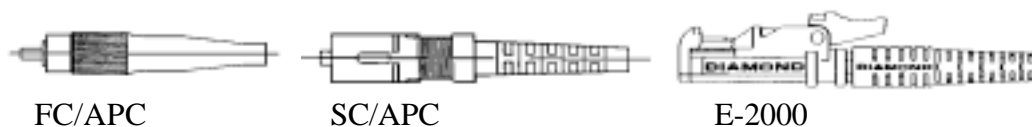


Figure 1-2 Optical Connectors Compatible with *OpitCaT* 1500 EDFA

1.7 Optical Connector Care and Handling

All optical connectors are shipped with end caps for protection and safety. Do not remove the end caps until installation.

The optical connector's surface is highly polished and free of foreign materials to ensure low loss coupling and back reflection. Do not allow the optical connectors to become dirty. Small traces of dirt will degrade transmission quality. Ensure that the caps are on the optical connectors at all times.

It is absolutely critical that fiber optic connectors be cleaned each and every time before connecting or reconnecting to anything.

Without proper maintenance practices, fiber optic systems will fail to function properly. These performance degradation's take many forms:

- Poor analog transmission quality
- Digital bit error rates increase
- Reduced optical power
- Receiver input power outside optimum operating range
- Dirty connectors may cause damage to their mated counterparts

It is recommended that RIFOCS Corporation 945/946 fiber optic connector cleaning system be used for cleaning the optical connectors.

1.8 Service

High power lasers are contained within this unit. Dangerous AC voltages may be present.

CAUTION

Do not attempt to modify or service any part of the system. If the system does not meet its warranted specifications, or if a problem is encountered that requires service, return the apparently faulty assembly to Hirschmann for evaluation in accordance with Hirschmann's warranty policy.

When returning an assembly for service, include the following information: Owner, Model Number, Serial Number, Return Authorization Number (obtained in advance from Hirschmann Corporation's Customer Service Department), service required and/or a description of the problem encountered.

1.9 If You Need Help

If you need additional help in installing or using the system, need additional copies of this manual, or have questions about system options, please call Hirschmann's Service Center at +49 / 7127 / 14-1301.

1.10 Safety Considerations

When installing or using this product, observe all safety precautions during handling and operation. Failure to comply with the following general safety precautions and with specific precautions described elsewhere in this manual violates the safety standards of the design, manufacture, and intended use of this product. Hirschmann GmbH & Co assumes no liability for the customer's failure to comply with these precautions.

CAUTION

Calls attention to a procedure or practice which, if ignored, may result in damage to the system or system component. Do not perform any procedure preceded by a CAUTION until described conditions are fully understood and met.

1.11 Electrostatic Sensitivity

Observe electrostatic precautionary procedures. (ESD = ElectroStatic Discharge)

The *OptiCaT* 1500 amplifier provides highly reliable performance when operated in conformity with its intended design. However, it may be damaged by an electrostatic charge inadvertently imposed by careless handling.

Static electricity can be conducted to the amplifier through the rear panel connectors. When unpacking and otherwise handling the amplifier, follow ESD precautionary procedures including use of grounded wrist straps, grounded workbench surfaces, and grounded floor mats.

Exposure to electrostatic charge is greatly reduced after the amplifier chassis is grounded.

2. INSTALLATION

To install the equipment, perform the following steps, each of which is described in detail in the rest of this section.

- Step 1. Examine the equipment for loss or damage that may have occurred during shipping.
- Step 2. Prepare the operating environment.
- Step 3. Install the *OptiCaT* 1500 EDFA
- Step 4. Make electrical connections
- Step 5. Make RF connections
- Step 6. Make optical connections

2.1 Examine the Equipment

- Carefully unpack the equipment. Be sure to check the packing material for small parts
- Check the contents of package against the following list:

Package Contents

- *OptiCaT* 1500 EDFA
- Operation Manual
- Factory test data
- AC power cord (If AC option selected)
- If any of the equipment is missing or damaged, please notify Hirschmann Corporation immediately.

2.2 Preparing the Equipment

2.2.1 Environmental Requirements

The *OptiCaT* 1500 EDFA has been designed to operate over a temperature range of 0°C to 50°C. Hirschmann GmbH & Co recommends operating it at an ambient temperature of 25°C (77°F).

The humidity should be kept below 95% non-condensing. If necessary, equipment should be installed to maintain the temperature and humidity within these limits.

Hirschmann GmbH & Co also recommends a low dust environment.

2.2.2 Equipment Mounting Requirement

The *OptiCaT* 1500 EDFA is 1 unit high and is designed to fit EIA standard 19 inch equipment cabinets. Hirschmann GmbH & Co recommends 1.75 inch space above and below the unit.

2.2.3 Power Requirements

Depending on the option purchased, the unit can be powered from AC, unregulated DC, or regulated external DC. If AC power is present, it will be the main supply. The DC inputs can be configured as a backup or as the main supply (if AC is not present).

Power Requirements are:

AC input	90- 264 VAC, 50-440 Hz
DC input	21-60 VDC, floating
external DC input	+24 VDC +/-0.5V
	Noise and ripple less than 100 mV-pp above 100 kHz, less than 20 mV _{pp} below 100 kHz
Power Consumption:	40 W max.

2.3 Install the Equipment

Mount the *OptiCaT* 1500 EDFA in the equipment cabinet in the desired location.

2.4 Make Electrical Connections



When AC power is present, it will be the main supply. The DC inputs can be configured as a backup or as the main supply (if AC is not present) depending on the powering option ordered.

The four available powering options of the unit are as follows:

- | | |
|------------------------|---|
| • AC only | AC input and 24V conditioned input only |
| • DC only | DC input and 24V conditioned input only |
| • AC and DC | AC input, DC input, and 24V conditioned input |
| • 24V conditioned only | 24V conditioned input only |

Note: Make heavy gauge wire connection between ground stud and chassis ground before making electrical connections.

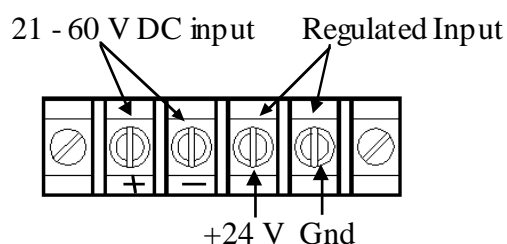


Figure 2-1 DC Power Connections

2.5 Make Optical Connections

Ensure optical input signal is present.

Make sure all connectors are clean before installing. Connect the input and output fiber cables to the appropriate connectors on the rear of the unit. Optical connector options are: FC/APC, E -2000, SC/APC with either pigtails or bulkhead connectors.

2.6 Make Communications Connections (Optional)

Status monitoring is available with compatible RS-485 Network Management System through dual RJ-11 phone Jacks.

3. OPERATION

The user front panel interface consists of a 16 character segmented LED display, a status indicating LED, and 3 push buttons. The status indicating LED indicates whether the conditions are normal, or whether a warning or alarm is active. The LED lights green, amber, or red, respectively to indicate these conditions.

The three push buttons are marked with an up arrow (up), a down arrow (down), or “select” (select, or enter). These buttons are used to navigate a menu (figure 3-3) that displays system information on the 16 character display. During normal operation, and when no buttons have been pressed, the display reads “Optical amplifier” When a warning or alarm condition is present, the display shows a description of the problem (table 3-1).

3.1 Front Panel Controls and Indicators

Key switch	Optical gain section enable/disable switch - (key not removable in on position)
Status LED	Tricolor (green, yellow, red) GREEN - indicates normal operation AMBER - indicates a warning condition RED - indicates an alarm condition
Display	Alphanumeric Dot Matrix LED - List of messages shown in Table 3-1.
Scroll buttons	up/down/select push buttons - Menu structure shown in Figure 3-1

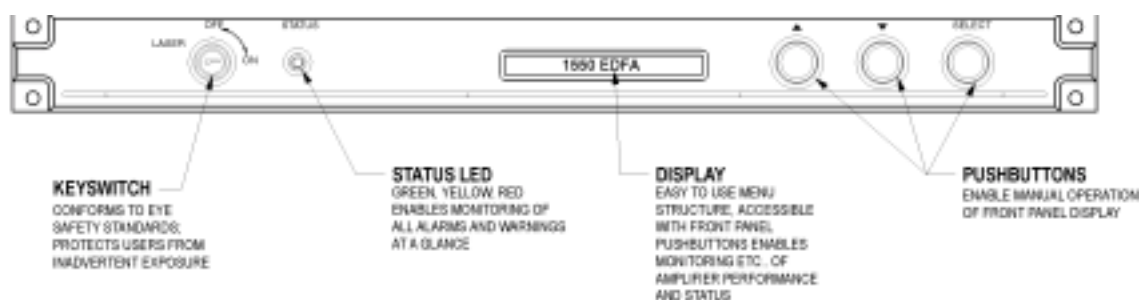


Figure 3-1. EDFA Front Panel

3.2 Rear Panel Connections

Power entry module
(If AC ordered)

On/Off switch with standard
3-pin IEC AC power socket integrated fuse holder

CAUTION

Make sure the Key switch on the front panel is in the “Off” position before turning the power on switch to the “On” position.

Optical connectors

fiber input/output
options: FC/APC, E-2000, SC/APC

Fan

dual with shields

Terminal Block

4 post for DC power inputs

Ground Stud

Communication port

dual RS-485 phone jacks

Communications:

Status monitoring with compatible Network Management Software

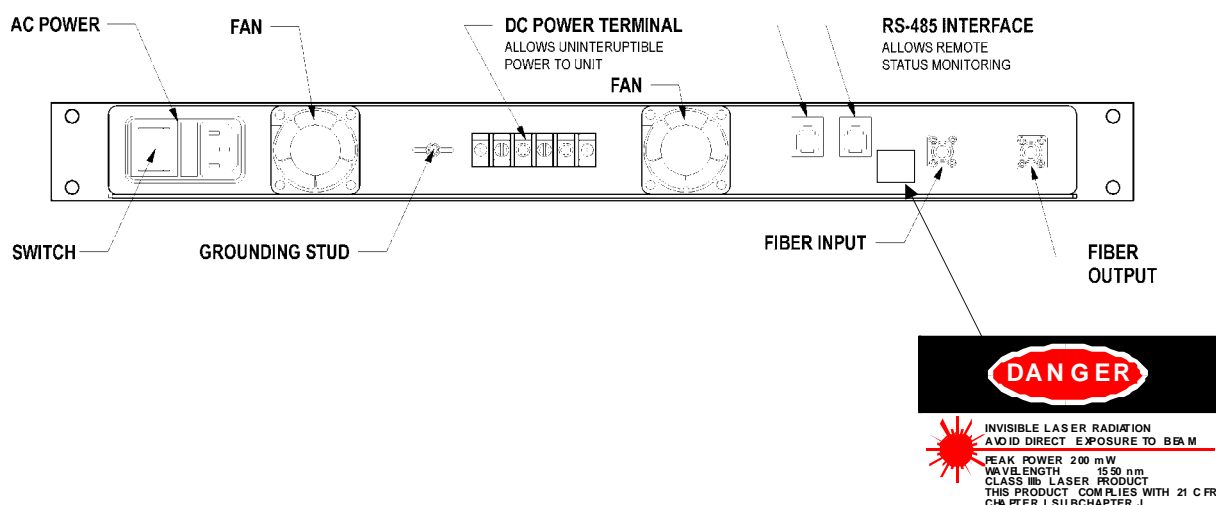


Figure 3-2. EDFA Rear Panel

3.3 Startup and Normal Operation

With the Laser key in the “Off” position, turn on the rear panel electrical power. When the EDFA is first powered up, it will go through a series of power-on self-tests. During the self-test period, the push buttons are disabled, the display flashes “Start-up,” and the LED is set to amber.

With the key in the “Off” position, the optical gain will be disabled and the input optical signal will be throughput without any amplification or degradation.

To enable the optical gain section, turn the key switch to the “On” position. The LED will switch to green and “1550 EDFA” will be displayed. If the EDFA does

not pass its self-test because of a warning or an alarm condition, then the EDFA changes the LED and display as described in table 4-1 in Section 4 Troubleshooting.

During normal operation, the EDFA displays “1550 EDFA.” When the “select” button is pressed, the display changes to show system information according to the menu structure of Fig. 3-1. By repeatedly pressing “select,” the display cycles through the menu headings “Optical,” “Pump 1,” “Pump 2,” on up to “Pump 4 if installed,” and “System.”

In EDFA’s where fewer pumps are installed, the menu headings for those lasers not installed are eliminated. The down button moves the display down in the menu structure; if the bottom of the menu is reached, the display wraps back to the top. For instance, if “Pump 1” is shown and the down button is pressed, then the display shows the pump 1 laser bias current. The up button moves the display up the menu structure.

3.4 Output Power Adjustment

To adjust the output power repeatedly press the “select” button until the “Optical” menu heading appears in the display. Press the down button until the display reads “Pwr Adj = xx.xdBm.” Press the “select” button and the display will start to flash. Use the up and down button to adjust the power to the desired setting. Press the select button again to save the adjustment.

Press the down button again, and the display will read “Update Adj. = Y/N.” Press the select button and the display will start to flash. Use the up/down buttons to select “Y” or “N.” Press the select button again to save your choice. If “Y” is chosen, the adjusted power setting will automatically come up each time the unit is turned on. If “N” is chosen, the power setting will change back to the previously updated value when power to the unit is cycled.

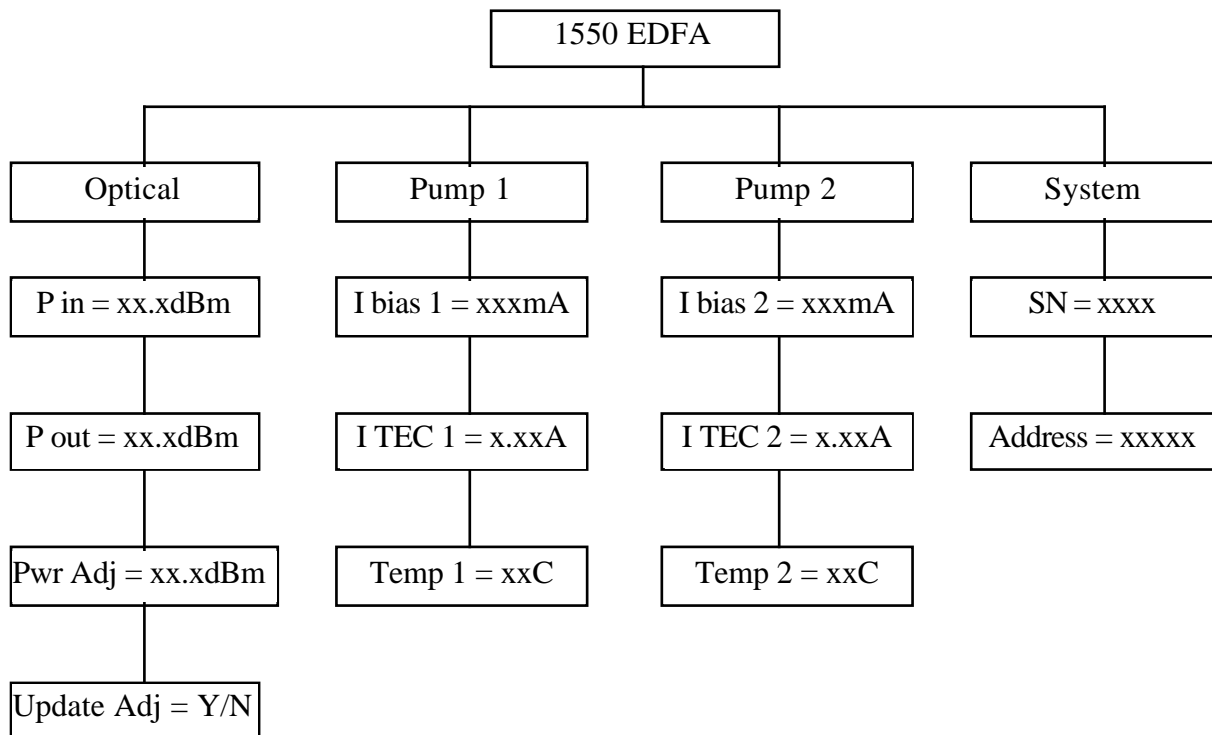


Figure 3-3. The Display Menu Structure

Heading	Item	Description
Optical	Pin=xx.xdBm	shows the optical power into the EDFA
	Pout=xx.xdBm	shows the optical power out of the EDFA
	Pwr Adj = xx.xdBm	shows the adjusted optical power out of the EDFA
	Update Adj = Y/N	saves adjusted power setting to non-volatile memory
Pump 1	I bias 1=xxxmA	shows the bias current to pump laser 1
	I TEC 1=x.xx A	shows the TEC current for pump laser 1
	Temp 1=xxC	shows the temperature of pump laser 1
Pump 2	I bias 2=xxxmA	shows the bias current to pump laser 2
	I TEC 2=x.xx A	shows the TEC current for pump laser 2
	Temp 2=xxC	shows the temperature of pump laser 2
Pump 3	I bias 3=xxxmA	shows the bias current to pump laser 3
	I TEC 3=x.xx A	shows the TEC current for pump laser 3
	Temp 3=xxC	shows the temperature of pump laser 3
Pump 4	I bias 4=xxxmA	shows the bias current to pump laser 4
	I TEC 4=x.xx A	shows the TEC current for pump laser 4
	Temp 4=xxC	shows the temperature of pump laser 4
System	SN = xxx	serial number of the transmitter
	Address=xxxxx	network address of the transmitter

Table 3-1. List of Display Messages and Meaning

4. TROUBLESHOOTING

There are two types of faults - **warnings** and **alarms**. Warnings are conditions that indicate problems, but do not necessarily result in a total loss of service. Alarms are conditions that indicate a total loss of service. Based on the condition of the alarm or warning, different indicators will be affected. These are described below.

4.1 Warning Conditions

When the EDFA is in the warning condition, the status LED will change to amber, and a brief description of the condition is listed on the display. Warnings generally do not halt operation of the unit, but correspond to a parameter that is slightly out of range. If the warning condition ceases, i.e. , the relevant parameter goes back into its allowable range, the display and LED will return to their normal state without user intervention.

4.2 Alarm Conditions

Alarms generally halt operation of the EDFA. They correspond to either a parameter that is far out of the acceptable range, or to a condition that could potentially cause damage to the EDFA. If the alarm persists after cycling power or toggling the keyswitch, then the alarm is activated again.

Table 4-1 defines the different warning and alarm conditions, the display readout, and how the conditions are cleared. Some critical alarms, such as “Alarm: self test,” can only be cleared by cycling power to the EDFA. Other alarms are cleared when the keyswitch is toggled off and then on again or are self clearing if the relevant parameter returns to a normal range. With warnings, the EDFA will simply continue to function while indicating the warning, or the warning will clear itself if the relevant parameter returns to a normal range.

Note: When the keyswitch is in the “off” position, the LED is amber and the display reads “Stand By” to indicate the standby mode

EDFA Condition	Display Readout	LED Color	Description
Power on/key on	1550 EDFA	Green	normal operation
	Warning		
Power on/key off	Standby	Amber	standby until keyswitch turned on
Initialization	Start Up	Amber	key and buttons disabled during start up
Ibias high	Warn: Ibias Y hi	Amber	Ibias is near the maximum rating for laser; laser may be degrading
Laser temperature low	Warn: pump Y cold	Amber	pump laser temperature low
Laser temperature hi	Warn: pump Y hot	Amber	pump laser temperature high
Input optical power low, key on	Warn: input low	Amber	low 1550nm input power, still operate amplifier
	Alarm		
Failed self test	Alarm:self test	Red	cycle power to clear
ITEC>ITEC_max	Alarm: TEC Y	Red	pump TEC failure, cycle power to clear
Ibias>Ibias_max	Alarm: Ibias Y	Red	pump bias failure, key switch reset
Input optical power off, key on	Alarm: no input	Red	disable optical gain section, self clear if optical power on
Optical output power low	Alarm: output low	Red	low output power, toggle keyswitch to clear

Table 4-1. Warnings and Alarms

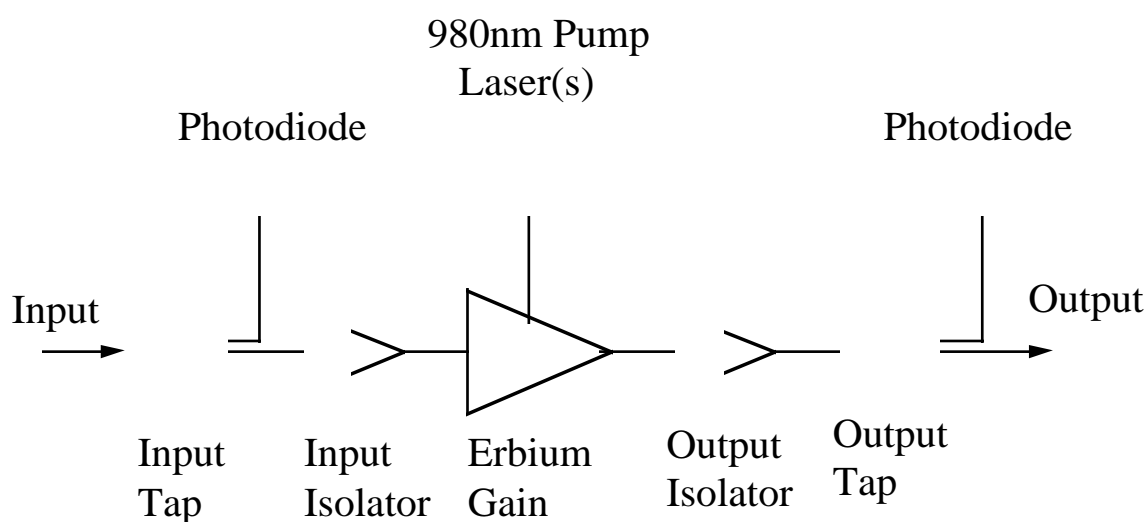
(Shows display and LED indications and what the system does in response.)

If any problems are encountered which cannot be corrected, please contact Hirschmann Corporation at +49 / 7127 / 14-1301

5. THEORY AND BLOCK DIAGRAM

The *OptiCaT 1500* EDFA block diagram is shown in Fig 5-1. Depending on model, isolators are used at both the input and output to prevent optical reflections from feeding back into the amplifier which can degrade performance. Tap couplers at both the input and output are used to monitor the power of the incoming and amplified output signal.

Gain occurs in a section of Erbium doped fiber which is “pumped” by light from 980 nm lasers. The erbium ions absorb the 980nm pump light and re-emit light which is in phase and at the same wavelength as the input signal. The amount of gain is dependent on both the incoming signal power and the pump power.



Note: Isolators may or may not be present.

Figure 5-1. *OptiCaT 1500* Amplifier Block Diagram

6. MODEL SPECIFICATIONS

Parameter	OAS 1501-16 A	OAS 1511-16 B
Output Power	16 dBm	16 dBm
Noise Figure (max) ¹⁾	5.5 dB	5.0 dB
Operating Wavelength	1540 - 1560 nm	
Polarization Sensitivity	<0.2 dB	
Input Optical Return Loss	>50 dB	No spec
Output Optical Return Loss	>50 dB	
Operating Temperature	0 - 50 C	
Power Consumption (max)	40 W	

1) : At 6 dBm input power

Table 6-1. Performance Specifications