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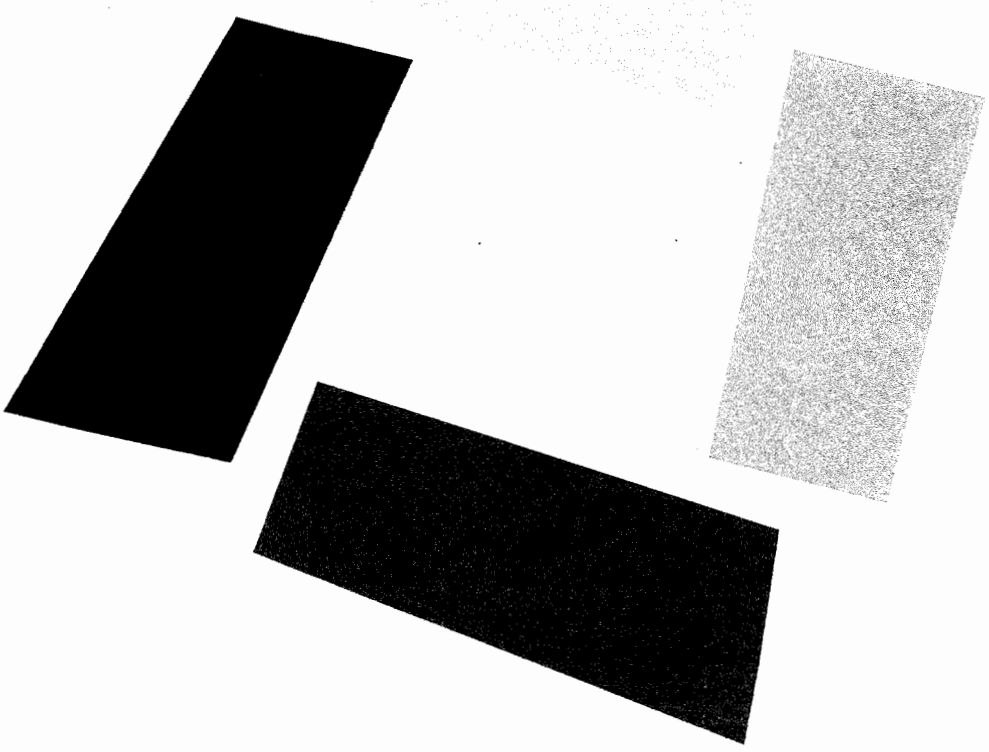
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OAB SERIES
OPTICAL AMPLIFIER

User's Manual



JDS Uniphase

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This product is subject to one or more of the following US patents listed under the applicable Product Series for the product:

For Product Series AC, AC0, ACF, AC-PM, WD-PM, LD, FA, FB, PL, PLR, PB, DCM:
US Patents
5,172,271 ; 5,222,171 ; 5,539,577 ; 5,594,825 ; 5,657,155 ; 5,701,375 ; 5,717,801 ; 5,745,626 ; 5,793,916 ; 5,757,993 ; 5,832,153

For Product Series IS (ISxxyy; xxISyy; xxyyIS), CR:
US Patents
5,172,271 ; 5,222,171 ; 5,539,577 ; 5,594,825 ; 5,657,155 ; 5,701,375 ; 5,717,801 ; 5,745,626 ; 5,793,916 ; 5,757,993 ; 5,832,153 ; 2,148,317 ; 5,471,340 ; 5,574,596 ; 5,588,078 ; 5,594,821 ; 5,768,005 ; 5,825,950 ; 5,608,825 ; 5,608,825 ; 5,748,363 ; 5,706,375

For Product Series GF, TB (except TB9), DC, WL, COADM:
US Patents
5,172,271 ; 5,222,171 ; 5,539,577 ; 5,594,825 ; 5,657,155 ; 5,701,375 ; 5,717,801 ; 5,745,626 ; 5,793,916 ; 5,757,993 ; 5,832,153 ; 5,283,845 ; 5,481,402 ; 5,557,468 ; 5,612,824 ; 5,615,289 ; 5,629,995 ; 5,657,155 ; 5,666,225 ; 5,680,237 ; 5,719,989 ; 5,748,363 ; 5,754,718 ; 5,790,314 ; 5,798,859 ; 5,799,121 ; 5,808,763 ; 5,841,918

For Product Series FBG, FBGDC, TB9, WDFG:
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For Product Series OA, OAB, ErFA, BNS:
US Patents
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For Product Series SB, SC, SK, SL, SN, SP, SR, SV, SW, SG, OXC, COADM:
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For Product Series MV, VCA, VCB, IA, HA, MTA:
US Patents
5,172,271 ; 5,222,171 ; 5,539,577 ; 5,594,825 ; 5,657,155 ; 5,701,375 ; 5,717,801 ; 5,745,626 ; 5,793,916 ; 5,757,993 ; 5,832,153 ; 1,249,152 ; 4,702,549 ; 5,506,731

For Product Series OCETS, SWS, DWDM-ATS, VB, BR, RM, PS, PR, PE, HD:
US Patents
5,172,271 ; 5,222,171 ; 5,539,577 ; 5,594,825 ; 5,657,155 ; 5,701,375 ; 5,717,801 ; 5,745,626 ; 5,793,916 ; 5,757,993 ; 5,832,153 ; 5,239,599 ; 5,481,402 ; 5,506,731 ; 5,440,117 ; 5,546,180 ; 5,594,820 ; 5,600,468 ; 5,608,825 ; 5,627,648 ; 5,629,993 ; 5,629,995 ; 5,699,468 ; 5,706,375 ; 5,748,363 ; 5,765,634 ; 5,781,318 ; 5,781,672 ; 5,798,859 ; 5,841,918

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JDS Uniphase Terms and Conditions of Sale

The Terms and Conditions of Sale and Software license (collectively "Agreement") contained herein constitute the entire agreement between JDS Uniphase Corporation, or its subsidiary, as set forth on the document referencing this Agreement, ("JDSU") and you ("Customer"). JDSU will not be bound by any terms of Customer's order. No form of acceptance except JDSU's written acknowledgment sent to Customer, or JDSU's commencement of performance shall constitute valid acceptance of Customer's order. Any such acceptance is expressly conditioned on assent to the terms hereof and the exclusion of all other terms. Customer shall be deemed to have assented to the terms hereof, whether or not previously received, upon accepting delivery of any Product (as defined herein) shipped by JDSU. If tender of these terms is deemed an offer; acceptance is expressly limited to the terms hereof.

1. PRODUCTS

1.1 "Products" shall mean any products or services identified on (a) any of JDSU's proposals, quotations or order acknowledgements, (b) current applicable price lists, (c) any of JDSU's invoices or (d) the document referencing this Agreement, in each case having the JDSU specification applicable to the relevant product.

1.2 Alterations to any Product which JDSU deems necessary to comply with specifications, changed safety standards or governmental regulations, to make a Product non-infringing with respect to any intellectual property or other proprietary interest, or to otherwise improve a Product may be made at any time by JDSU without prior notice to, or consent of, Customer and such altered Product shall be deemed fully conforming.

2. ORDERS: Customer shall purchase Products by issuing a written purchase order signed by an authorized representative, indicating specific Products, quantity, price, total purchase price, shipping instructions, requested delivery dates, bill-to and ship-to addresses, tax exempt certifications, if applicable, and any other special instructions. Any contingencies contained on such order are not binding upon JDSU. All orders are subject to acceptance by JDSU, who will accept or reject orders according to JDSU's then current processes.

3. PRICES: All prices are (a) firm for thirty (30) days from the date of quotation, (b) FCA JDSU factory [Incoterms, 2000] (shipping costs and risk of loss from the FCA point of shipment are the responsibility of Customer) and (c) exclusive of Taxes (as defined herein) and all handling or other charges including without limitation insurance, brokerage fees, transportation or special packaging ("Charges"). All sales are final. Title to Products (excluding services) shall pass from JDSU to Customer upon delivery to the shipping carrier at the FCA point. Any tax or other charge which JDSU is liable to collect on behalf of any governmental authority ("Taxes") as a result of the sale, use or delivery of Products, including without limitation, duties, value added and withholding taxes, is the responsibility of the Customer, and if paid by JDSU shall be charged to Customer as a separate item on the invoice, to the extent possible.

4. TERMS OF PAYMENT: Upon credit approval by JDSU, payment terms shall be net thirty (30) days from the date of the shipment, or in the case of services, net thirty (30) days from the date of completion. JDSU reserves the right to require alternative payment terms including, without limitation, letter of credit or payment in advance. If at any time Customer is delinquent in the payment of any invoice or is otherwise in breach of this Agreement, JDSU may, at its discretion, stop performance of services or withhold shipment (including partial shipments) of any order and may, at its option, require Customer to pre-pay for further performance or shipments. All payments not received when due shall be subject to an additional charge of one and one half percent (1.5%) per month (annual rate 19.56%) of the unpaid amount or the maximum rate permitted by law, whichever is less, until the date of payment. Customer grants JDSU a security interest in Products (excluding services) purchased under this Agreement to secure payment for those Products purchased. If requested by JDSU, Customer agrees to execute financing statements to perfect such security interest. There is no set-off right for the Customer.

5. PERFORMANCE AND SHIPPING: Performance and shipping dates specified or communicated by JDSU to the Customer are approximate dates only and the failure to perform or ship on such dates shall not be considered a breach by JDSU. Delivery shall be deemed made upon transfer of possession to the carrier at the FCA point. All claims for shortage of Products ordered or for incorrect charges must be presented to JDSU within ten (10) days after receipt by Customer of the particular shipment of Products. Customer shall be responsible for all Charges. Unless given written instruction, JDSU shall select the carrier. JDSU shall not be liable for damages or penalty for delay in delivery or for failure to give notice of any delay, and the carrier shall not be deemed to be an agent of JDSU. Notwithstanding any provision of this Agreement, each Product shall be deemed accepted by Customer upon delivery.

6. CANCELLATION: The Customer may not cancel, terminate, suspend performance of, or issue a hold on, any Customer order, in whole or in part, without the prior written consent of JDSU, which consent, if given, shall be upon terms that will compensate JDSU for any loss or damage therefrom, including but not limited to any work in process or services performed, the price of Products shipped to, manufactured for, or held separately for, the Customer, and loss of profits, incurred costs, and a reasonable allocation of general and administrative expenses relating to the Products.

7. LIMITED PRODUCT WARRANTY: Notwithstanding any provision to the contrary (but subject to the operation of any law to the extent it cannot be excluded), JDSU's sole and exclusive obligations to the Customer for any

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Product (other than Software, as defined and warranted below and services as warranted below) made by JDSU and sold hereunder are to repair returned Product or provide a replacement Product, at JDSU's sole option, for any Product which has been returned to JDSU under the RMA procedure (as defined below) and which in the reasonable opinion of JDSU is determined to be defective in workmanship, material or not in compliance with the JDSU specification applicable to the Product and has in fact failed under normal use on or before one (1) year from the date of original shipment of the Product. All Products, which are experimental Products, prototypes or Products used in field trials, are not warranted. All third parties' Products (including software) sold by JDSU carry only the original manufacturer's warranty applicable to Customer. JDSU will only accept for repair, replacement or credit under warranty Products made by third parties if expressly authorized to do so by the relevant third party. Any Product repaired or replaced under warranty is only warranted for the period of time remaining in the original warranty for the Product. JDSU reserves the right, at its sole option, to issue a credit note for any defective Product as an alternative to repair or replacement. The warranty provided herein shall extend to any Product which has proved defective and has failed through normal use, but excludes and does not cover any Product or parts thereof which has been accidentally damaged, disassembled, modified, misused, used in applications which exceed the Product specifications or ratings, neglected, improperly installed or otherwise abused or is used in hazardous activities. Customer must claim under the warranty in writing not later than thirty (30) days after the claimed defect is discovered. JDSU warrants that services will be performed in a good and workmanlike manner in accordance with standards reasonably applicable to the services, and will reperform any services which JDSU determines are not in compliance with this warranty which Customer brings to JDSU's attention, in writing, on or before thirty (30) days immediately following completion of the applicable service. The Customer must make all claims under these warranties and no claim will be accepted from any third party.

8. RETURN MATERIAL AUTHORIZATION PROCEDURES: JDSU will only accept Products returned under the JDSU Return Material Authorization process ("RMA"). Customer shall obtain a RMA number from JDSU prior to returning any Product and return the Product prepaid and insured to JDSU to the FCA point. Any Product which has been returned to JDSU but which is found to meet the applicable specification for the Product and not defective in workmanship and material, shall be subject to JDSU's standard examination charge in effect at the time which shall be charged to the Customer. Where any Product is returned without an itemized statement of claimed defects, JDSU will not evaluate the Product but will return it to the Customer at the Customer's expense.

9. SOFTWARE LICENSE AND WARRANTY: For software developed by JDSU and contained in any Product and all related documentation (collectively "Software"), JDSU does not transfer ownership (which shall remain solely with JDSU) but only grants the Customer a perpetual, non-exclusive license to use the Software restricted to use related only to the operation of the single Product. Such license is transferable only with the transfer of ownership of the Product in which it is used. Except for making a backup copy or as permitted by law, Customer shall not (a) modify, reproduce, copy, reverse engineer, decompile or disassemble all or any portion of the Software, (b) distribute, market, disclose, rent, lease or create derivative works, or sublicense the use of, the Software to any third party, or (c) permit or authorize anyone within Customer's reasonable control to do any acts in (a) or (b). JDSU warrants that the Software under normal use and service as originally delivered to Customer will function substantially in accordance with the functional description set out in the Product specification and/or user manual supplied with the Software for a period of ninety (90) days from the date of shipment. JDSU's sole liability and Customer's sole remedy for a breach of this Software warranty shall be JDSU's good faith efforts to rectify the non-conformity or, if after repeated efforts JDSU is unable to rectify the non-conformity, JDSU shall accept return of the Product containing the non-conforming Software and shall refund to Customer all amounts paid in by Customer in respect thereof. This warranty is void if failure of the Software has resulted from accident, misuse, abuse, misapplication or modification. JDSU's Software is provided to non-Department of Defense (DOD) agencies of the United States Government with RESTRICTED RIGHTS and its supporting documentation is provided with LIMITED RIGHTS. Use, duplication, or disclosure by the United States Government is subject to the restrictions as set forth in subparagraph "C" of the Commercial Computer Software - Restricted Rights clause at FAR 52.227-19. In the event the sale is to a DOD agency, the Government's rights in Software, supporting documentation, and technical data are governed by the restrictions in the Technical Data Commercial Items clause at DFARS 252.227-7015 and DFARS 227.7202.

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11. EXPORT RESTRICTIONS: Customer shall obtain all licenses, permits and approvals required by any government and shall comply with all applicable laws, rules, policies and procedures of the applicable government and other competent authorities. Customer will indemnify and hold JDSU harmless for any violation or alleged violation by Customer of such laws, rules, policies or procedures. Customer shall not transmit, export or re-export, directly or indirectly, separately or as part of any system, the Products or any technical data (including processes and services) received from JDSU, without first obtaining any licence required by the applicable government, including without limitation, the United States Government and/or any other applicable competent authority. Customer also certifies that none of the products or technical data supplied by JDSU under this Agreement will be sold or otherwise transferred to, or made available for use by or for, any entity that is engaged in the design, development, production or use of nuclear, biological or chemical weapons or missile technology.

12. RIGHTS IN INTELLECTUAL PROPERTY AND TOOLING: All right, title and interest in and to any inventions, discoveries, improvements, methods, ideas, computer and other apparatus programs and related documentation, other works of authorship fixed in any tangible medium of expression, mask works, or other forms of intellectual property, whether or not subject to statutory protection, which are made, created, developed, written, conceived or first reduced to practice by JDSU solely, jointly or on its behalf, in the course of, arising out of, or as a result of work performed under an order, and any related tooling, set-up, fitting-up and preparation charges whether or not invoiced, shall belong to and be the sole and exclusive property of JDSU. Customer agrees not to reverse engineer all or any portion of any Product nor allow or assist others to do so. Customer agrees not to remove, alter, erase, deface or cover over any markings on the Product or its packaging.

13 GENERAL TERMS:

13.1 The validity, interpretation and performance of this Agreement shall be governed by and construed under the applicable laws of the State of New York and the United States of America, as if performed wholly within the state and without giving effect to the principles of conflict of laws. The parties specifically disclaim the application of the United Nations Convention on Contracts for the International Sale of Goods. JDSU and Customer hereby irrevocably and unconditionally submit to the courts of the State of New York and all courts competent to hear appeal therefrom.

13.2 JDSU shall not be liable for any delay or failure in performance whatsoever due to acts of God, earthquakes, shortage of supplies, transportation difficulties, labor disputes, riots, war, fire, explosion, epidemics, or other occurrences beyond JDSU's reasonable control or due to unforeseen circumstances.

13.3 Waiver by JDSU of any provision herein must be in writing and shall not be deemed to be a waiver of such provision in the future or of any other provision.

13.4 Customer shall hold confidential and shall not use, disclose or permit others to use any confidential information identified as such in writing or orally by JDSU or information which Customer knows or ought to reasonably know is confidential, proprietary or trade secret information of JDSU, including, without limitation, trade secrets embodied in Products.

13.5 Neither this Agreement nor any rights under this Agreement, other than monies due or to become due, shall be assigned or otherwise transferred by Customer (by operation of law or otherwise) without the prior written consent of JDSU. This Agreement shall bind and inure to the benefit of the successors and permitted assigns of the parties.

13.6 In the event that any of the terms of this Agreement, apart from payment, become or are declared to be illegal by any court of competent jurisdiction, such terms shall be null and void and shall be deemed deleted from this Agreement, but only to the extent that such term is illegal, it being the intent and agreement of the parties that the Agreement shall be deemed amended by modifying such term to the extent necessary to make it legal while preserving its intent or, if that is not possible, by substituting therefor another term that is legal and achieves the same objective. All remaining terms of this Agreement shall remain in full force and effect.

13.7 Neither party has the right or authority to, and shall not, assume or create any obligation of any nature whatsoever on behalf of the other party or bind the other party in any respect whatsoever.

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13.8 JDSU neither assumes nor authorizes any third party, person or entity to assume or accept any liability or obligation, or to make any commitment for JDSU with regard to JDSU services or the Products.
13.9 This Agreement constitutes the entire agreement between the parties hereto concerning the subject matter of this Agreement, apart from existing non-disclosure agreements, and there are no understandings, agreements, representations, conditions, warranties, or other terms, express or implied, which are not specified herein. This Agreement may only be modified by a written document executed by authorized representatives of JDSU and Customer.

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Safety Information, Instructions, and Symbols

Safety Information

Classification

The unit consists of an exposed metal chassis that is connected directly to earth via a power cord and, therefore, is classified as a Class 1 instrument. Class 1 refers to equipment relying on ground protection as a means of shock protection.

The following symbol is used to indicate a protective conductor terminal in the unit.



Disconnecting from Line Power

Some of the circuits are powered whenever the unit is connected to the AC power source (line power). To ensure that the unit is not connected to the line power, disconnect the power cord from either the power inlet on the unit's rear panel or from the AC line-power source (receptacle). The power cord must always be accessible from one of these points. If the unit is installed in a cabinet, the operator must be able to disconnect the unit from the line power by the system's line-power switch.

Line Power Requirements

The unit can operate from any single-phase AC power source that supplies between 100 and 240 V at a frequency range of 50 to 60 Hz. The maximum power consumption is 90 VA.

Laser Specifications

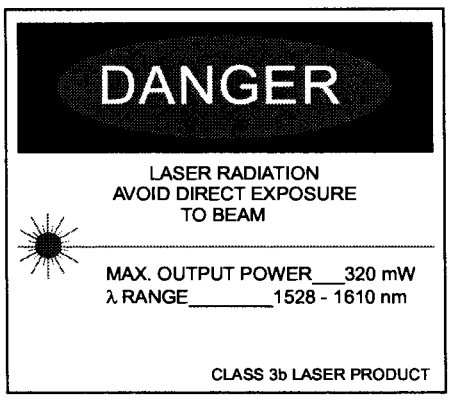
Laser specifications are outlined in Table 1.

Table 1: Laser Specifications

Parameter	Specification
Wavelength	1528-1610 nm
Class	IIIb
Output power	320 mW maximum

Under the laser classification of the US Food and Drug Administration (FDA) Center for Devices and Radiological Health (CDRH), the laser contained in the unit is a Class IIIb laser.

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	Warning Class IIIb lasers are hazardous to eyes and skin if exposed directly.

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Safety Instructions

The following safety instructions must be observed whenever the unit is operated, serviced, or repaired. Failure to comply with any of these instructions or with any precaution or warning contained in the user's manual is in direct violation of the standards of design, manufacture, and intended use of the unit. JDS Uniphase assumes no liability for the customer's failure to comply with any of these safety requirements.

Before Initializing and Operating the Unit

- Inspect the unit for any signs of damage, and read the user's manual thoroughly.
- Install the unit as specified in the **Getting Started** section.
- Ensure that the unit and any devices or cords connected to it are properly grounded.

Operating the Unit



Warning

To avoid the risk of injury or death, always observe the following precautions before initializing the unit:

If using a voltage-reducing autotransformer to power the unit, ensure that the common terminal connects to the earthed pole of the power source.

Use only the type of power cord supplied with the unit.

Connect the power cord only to a power outlet equipped with a protective earth contact. Never connect to an extension cord that is not equipped with this feature.

Willfully interrupting the protective earth connection is prohibited. Any such action can lead to a potential shock hazard that can result in serious personal injury.

Never look into the end of an optical cable connected to an optical output device that is operating. Laser radiation is invisible, and direct exposure can severely injure the human eye or skin. For more information, see the user's manual.

To prevent potential fire or shock hazard, do not expose the unit to any source of excessive moisture.

Do not operate the unit when its covers or panels have been removed.

Do not operate the unit if an interruption to the protective grounding is suspected. In this case, ensure that the unit remains inoperative.

Use only the type of fuse specified by the manufacturer as appropriate for this unit. Do not use repaired fuses, and avoid any situations that can short-circuit the fuse.

Repairs are to be carried out only by a qualified professional.

Operating the unit in the presence of flammable gases or fumes is extremely hazardous.

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	Do not perform any operating or maintenance procedure that is not described in the user's manual. Some of the unit's capacitors can be charged even when the unit is not connected to the power source.

Safety Symbols

The following symbols and messages can be marked on the unit (Table 2). Observe all safety instructions that are associated with a symbol.

Table 2: Safety Symbols

Symbol	Description
	Laser safety. See the user's manual for instructions on handling and operating the unit safely.
	**CAUTION** The procedure can result in serious damage to or destruction of the unit if not carried out in compliance with all instructions for proper use. Ensure that all conditions necessary for safe handling and operation are met before proceeding.
	Electrostatic discharge (ESD). See the user's manual for instructions on handling and operating the unit safely.
	Protective conductor terminal for electrical grounding to the earth.
	**WARNING** **The procedure can result in serious injury or loss of life if not carried out in proper compliance with all safety instructions. Ensure that all conditions necessary for safe handling and operation are met before proceeding.**

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Compliance

CE Compliance

The unit has been designed and tested to comply with directive 73/23/EEC and its subsequent amendments by the European Community (EC or CE). The directive relates to electrical equipment designed for use within certain voltage limits. It ensures that electrical equipment is constructed with good engineering practice in safety matters.

The unit has been designed and tested to comply with directive 89/336/EEC and its subsequent amendments. The directive relates to electromagnetic compatibility. It demands that electromagnetic disturbance does not exceed a prescribed level; that the equipment be immune to a prescribed level of ambient level of interference; that the equipment be protected against electrostatic discharges; and that the equipment be immune to all electrical shock wave disturbances. As of 1997, measures have been added to test for fire hazard, electric shock hazard, and also external exposure to other forms of energy.

The requirements specified by directive 89/336/EEC are as follows. CE compliance requires that the manufacturer or its authorized representative established within the Community affix the EC conformity mark to the apparatus or else to the packaging, instructions for use, or guarantee certificate. The EC conformity mark shall consist of the letters CE as specified and the figures of the year in which the mark was affixed. This mark should, where appropriate, be accompanied by the distinctive letters used by the notified body issuing the EC type-examination certificate. Where the apparatus is the subject of other Directives providing for the EC conformity mark, the affixing of the EC mark shall also indicate conformity with the relevant requirements of those other Directives.

FDA-CDRH Compliance

Under the US Food and Drug Administration (FDA) Center for Devices and Radiological Health (CDRH), the unit complies with the Code of Federal Regulations (CFR), Title 21, Chapter 1 Subchapter J, which pertains to laser safety and labeling.
See http://www.fda.gov/cdrh/radhlth/cfr/21cfr1000-1050.pdf for more information.

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General Information and Specifications

General Information

This user's manual for the OAB series optical amplifier contains complete operating instructions. The inspection report and a description of any customer-requested information are included in the **Customized Features and Test Data** section.

The OAB series optical amplifier is a high-power, optical amplifier instrument ideal for laboratory or manufacturing use.

Optics

The optics of the OAB amplifier consist of an erbium doped fiber amplifier (EDFA) gain block with supporting optical components specifically designed to achieve maximum output power at the bulkhead-mounted optical connector while minimizing input/output isolation.

Key Features

Saturated output power from 14 dBm to 24 dBm (depending on model)
High small signal gain 20 to 36 dB
Low noise figure (NF) 3.2 to 6.5 dB
Bulkhead optical output connectors (FC/HPC, FC/APC, SC/HPC, SC/APC)
Mid-stage access (depending on model)
RS 232 interface
Half width of a 19 inch (48.26 cm) rack
Remote interlock and key enable switch

Applications

The OAB amplifier can be used for pre-amplifier, in-line and booster amplifier emulation, optical network compliance tests, sensors, and imaging applications.

Figure 1 shows how an OAB amplifier can be interconnected for optical transmission system testing.

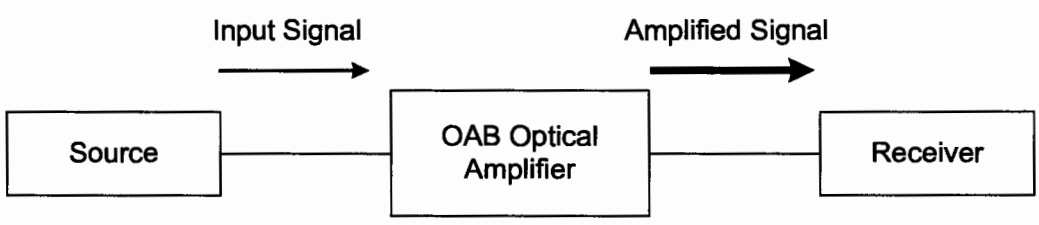


Figure 1: Transmission System Testing

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Standard Accessories

AC power cord
Remote interlock connector
Two keys
Rack-mount kit (ED000899-A-00)
User's manual
Software

Optional Accessories

Rack-mount kit (Japan) (ED000899-A-01)

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Specifications

The following optical specifications describe the guaranteed optical performance of the unit (Table 3 to 5). Supplementary specifications describe other specifications of the unit, and typical operating conditions (Table 5).

Table 3: OAB C-band Optical Specifications

Model	OAB1550	OAB1552			OAB1554	OAB1546	OAB1558
Test band	C-band						
Amplifier type	Pre-amp	Booster	Booster High Power	Booster High Power	Inline	Mid-span Access DWDM	Booster DWDM
Operating wavelength range	1528-1565 nm			1528-1563 nm	1528-1565 nm	1540-1560 nm	1528-1563 nm
Input signal	Single Channel					DWDM – Multi-channel	
Saturated output power [1] (min)	14 dBm	17 dBm	20 dBm	24 dBm	17 dBm	17 dBm	21 dBm
Noise figure (max) [2]	3.2 dB	4.5 dB	5 dB	5 dB	3.8 dB	5.5 dB	
Small signal gain/Gain (min)[3]	32 dB	30 dB	32 dB	36 dB	35 dB	23 dB (MS loss 10 dB)	25 dB (Pin = -4 dB)
Spectral gain flatness (max) (p-p)						1.4 dB (1540-1560) Pin= -6 dB	1.4 dB (1528-1563) Pin= -4 dB
PDL (max)	0.2 dB			0.3 dB	0.2 dB	0.3 dB	0.25 dB
PMD (max)	0.5 ps	0.4 ps	0.4 ps	0.45 ps	0.5 ps	0.6 ps	0.65 ps
Input/output isolation (typical)	Na/32 dB	46/32 dB			32/32 dB		
Optical interface	FC/HPC, FC/APC, SC/HPC, SC/APC						

All specifications guaranteed at 1550 nm and at 23 °C.

1. Measured at 1550 nm at P_{in} = -4 dBm
2. Noise figure measured at P_{in} = -20 dBm (pre-amp, inline), P_{in} = -4 dBm (booster), P_{in} = - 6 dBm (midspan)
3. Small signal gain measured at P_{in} = -20 dBm (pre-amp, inline and booster), P_{in} = -4 dBm (DWDM booster) and P_{in} = -6 (DWDM mid-span)

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Table 4: OAB L–band, and C+L-band Optical Specifications

Model	OAB1590	OAB1592		OAB1594	OAB1596	OAB1598	OAB1562	OAB1564
Test band	L-Band						C+L -Band	
Amplifier type	Pre-amp	Booster	Booster High Power	Inline	Mid-span Access DWDM	Booster DWDM	Booster	Inline
Operating wavelength range	1565-1610 nm				1570-1603 nm		1530-1560 nm 1570-1600 nm	
Input signal	Single Channel				DWDM Multi-channel		Single Channel	
Saturated output power (min) [1,2]	15 dBm	15 dBm	22 dBm	20 dBm	20 dBm	20 dBm	19 dBm	14 dBm
Noise figure (max) [3, 4]	5 dB	5.5 dB			5.8 dB	5.5 dB	6.5 dB	
Small signal gain /Gain (min) [5]	25 dB	22 dB	33 dB	29 dBm	22 dB (MS loss 7 dB)	23 dB (P_{in} = 0 dBm)	22 dB	20 dB
Spectral gain flatness (max) (p-p)					1.7 dB (1570-1603 nm) P_{in} = -2 dB	1.5 dB (1570-1603 nm) P_{in} = 0 dB		
PDL (max)	< 0.3 dB						< 0.4 dB	
PMD (max)	0.6 ps	0.6 ps	0.8 ps	0.6 ps	0.8 ps		0.7 ps	
Input/output isolation	na/46 dB	46/46 dB					40/40 dB	
Optical interface	FC/HPC, FC/APC, SC/HPC, SC/APC							

All specifications guaranteed at 23 °C.

1. Measured at 1590 nm at P_{in} = 0 dBm (pre-amp, inline, mid-span and booster)
2. C+L-band saturation power measured at P_{in} = -4 dBm (1550 nm), P_{in} = 0 dBm (1590 nm) (booster, inline)
3. Noise figure measured at: P_{in} = -20 dBm L-band(pre-amp, inline), P_{in} = -4 L-band (mid-span, booster)
4. Noise figure measured at: P_{in} = -20 dBm C+L-band (booster, inline)
5. Small signal gain measured at P_{in} = -20 dBm (pre-amp, inline and booster), P_{in} = -2 dBm (mid-span), P_{in} = 0 dBm (DWDM booster) and P_{in} = -2 (DWDM mid-span)

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Table 5: Supplementary Specifications

Electrical	
Input voltage	100 to 240 V AC, 50 to 60 Hz
Power consumption	90 VA maximum
Fuse	(5x20) mm 1.5 A (slow)
LCD Accuracy	0.2 dB, 5%
Physical	
Dimensions (W x H x D)	21.2 cm x 8.9 cm x 35.5 cm
Weight	<4 kg
Environmental	
Operating temperature	0 to 50 °C
Storage temperature	-40 to 70 °C
Humidity (max) (0 to 45 C)	95% RH non-condensing

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Getting Started

The OAB Series Optical Amplifier consists of the amplifier, an AC power cord, two keys, a rack-mount kit, and a user's manual.

Before Initializing and Operating the Unit

- Inspect the unit for any signs of damage.
- Read the user's manual thoroughly, and become familiar with all safety symbols and instructions to ensure that the unit is operated and maintained safely.

Initial Inspection



Warning

To avoid electrical shock, do not initialize or operate the unit if it bears any sign of damage to any portion of its exterior surface, such as the outer cover or panels.

Check that the unit and contents are complete:

1. Inspect the shipping container for any indication of excessive shock to the contents, and inspect the contents to ensure that the shipment is complete.
2. Inspect the unit for structural damage that may have occurred during shipping.
3. Keep the packaging.

Immediately inform JDS Uniphase and, if necessary, the carrier if the contents of the shipment are incomplete, if the unit or any of its components are damaged or defective, or if the unit does not pass the initial inspection.

Operating Environment

In order for the unit to meet the warranted specifications, the operating environment must meet the following conditions for temperature, humidity, and ventilation.

Temperature

The unit can be operated in the temperature range of 0 to 50 °C.

Humidity

The unit can be operated in environments with up to 95% humidity non condensing 0 to 45 C. Do not expose it to any environmental conditions or changes to environmental conditions that can cause condensation to form inside the unit.

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Ventilation

The unit contains a built-in cooling fan. Do not install it in any location where the ventilation is blocked. For optimum performance, the unit must be operated from a location that provides at least 75 mm (3 inches) of clearance at the rear and at least 12.5 mm (0.5 inch) of clearance at the bottom. Blocking the air circulation around the unit can cause the unit to overheat, compromising its reliability.



Warning

Do not use the unit outdoors.

To prevent potential fire or shock hazard, do not expose the unit to any source of excessive moisture.

Storing and Shipping

To maintain optimum operating reliability, do not store the unit in locations where the temperature falls below -40 °C or rises above 70 °C. Avoid any environmental condition that can result in internal condensation. Ensure that these temperature and humidity requirements can also be met whenever the unit is shipped.

Claims and Repackaging

Immediately inform JDS Uniphase and, if necessary, the carrier, if

The contents of the shipment are incomplete
The unit or any of its components are damaged or defective
The unit does not pass the initial inspection

In the event of carrier responsibility, JDS Uniphase will allow for the repair or replacement of the unit while a claim against the carrier is being processed.

Returning Shipments to JDS Uniphase

JDS Uniphase only accepts returns for which an approved Return Material Authorization (RMA) has been issued by JDS Uniphase sales personnel. This number must be obtained prior to shipping any material to JDS Uniphase. The owner's name and address, the model number and full serial number of the unit, the RMA number, and an itemized statement of claimed defects must be included with the return material.

Ship return material in the original shipping container and packing material. If these are not available, packaging guidelines are as follows:

1. Cover the front panel with a strip of foam.
2. Wrap the unit in anti-static packaging.
3. Pack the unit in a reliable shipping container.
4. Use enough shock-absorbing material (10 to 15 cm or 4 to 6 in on all sides) to cushion the unit and prevent it from moving inside the container. Pink poly anti-static foam is the recommended material.

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5. Seal the shipping container securely.

6. Clearly mark FRAGILE on its surface.

7. Always provide the model and serial number of the unit and the RMA number on any accompanying documentation.

8. Please contact the RMA department, using the contact information at the beginning of this document, to provide an RMA number and a shipping address.

Cleaning Connectors



Caution

Connecting damaged or dirty connectors to the unit can damage the connectors on the unit.

Never force an optical connector. Some connectors have a ceramic ferrule that can easily be broken.

Never clean the connectors when the unit is turned on.

Optical connectors need to be cleaned before using them with the unit.

The following items are required for cleaning:

Filtered compressed air or dusting gas
Lint-free pipe cleaners or lint-free swab
Lint-free towels
Optical grade isopropyl alcohol or optical grade 200° ethanol (do not use rubbing alcohol, which contains 30% water)

To clean the connectors:

1. Ensure that the unit is shut down (See Amplifier shut down).

2. Blow the sleeve with filtered compressed air (Figure 2).

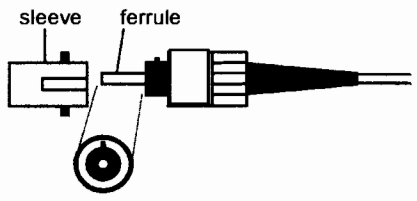


Figure 2: Connector Cleaning (connector type can vary)

3. Apply optical grade isopropyl alcohol or optical grade ethanol (do not use rubbing alcohol) to a small area of a lint-free towel and rub the end of the ferrule over the wet area.

4. Wipe the ferrule on a dry area of the lint-free towel.

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5. Using the dusting gas or compressed air, blow the end of the ferrule.

6. Apply the alcohol or ethanol to a lint-free pipe cleaner or swab and wipe off the remaining parts of the connector.

7. With the other end of the pipe cleaner or swab, dry the areas cleaned.

8. Using the dusting gas or compressed air, blow the areas cleaned.

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Front Panel – Booster

The front panel of the unit is shown in Figure 3 and described in Table 6.

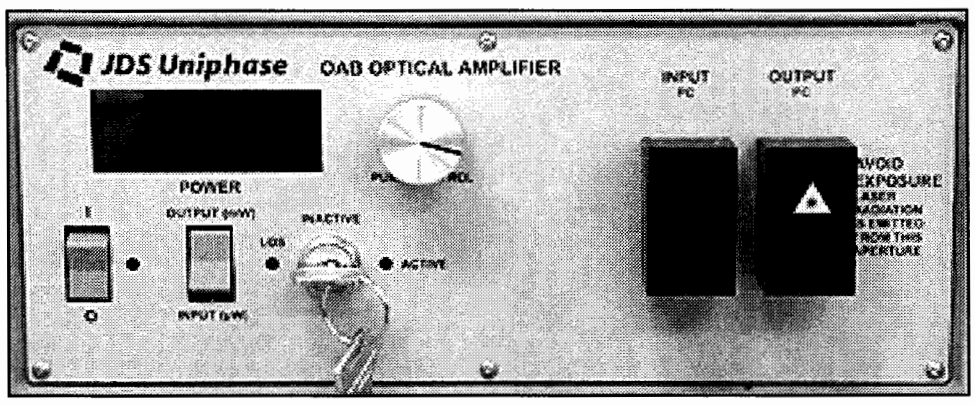


Figure 3: Front of Amplifier (Booster)

Table 6: Operating Controls and LEDs

Control or LED	Description
I/O	Power on (**I**) off (**O**) switch.
I/O LED indicator	Power-on LED--an illuminated green LED indicates amplifier is operating
LCD display	Display input power (W) and output (mW) power
Output/Input switch	Input power (W) / output (mW) power
Inactive/Active key switch	When Active, turns on current supply to laser diode. When Inactive, turns off the current supply to laser diode.
LOS Indicator	LOS (loss of signal) LED is illuminated when input signal is below preset limit (ex. –23 dBm)
Inactive/Active LED indicator	Power-on pump laser LED--an illuminated green LED indicates laser diode is active
Pump Control	Adjusts the amplifier laser diode pump current from 0 to maximum operating current
Input	Provides the input signal to the amplifier from optical signal source
Output	Provides the amplified output signal from the amplifier to the device under test (DUT)

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Front Panel – Inline and Pre-amp

The front panel of the unit is shown in Figure 4 and described in Table 7.

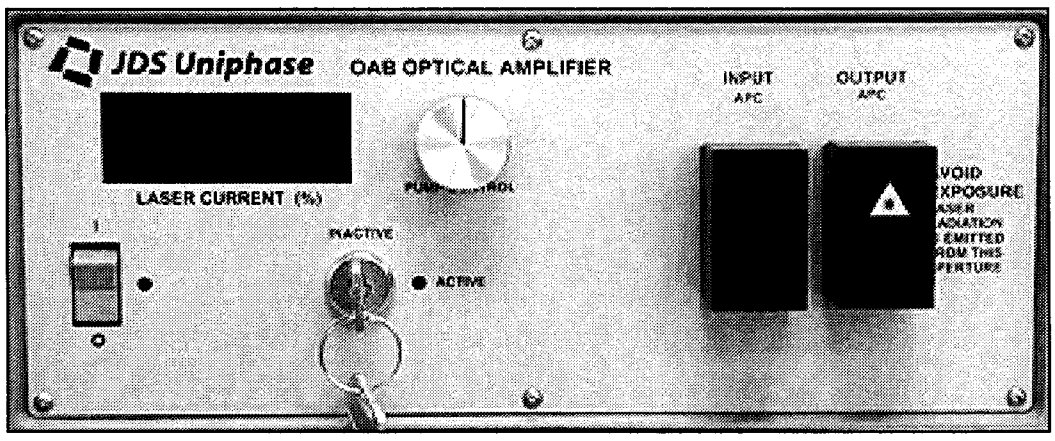


Figure 4: Front of Amplifier (Inline and Pre-amp)

Table 7: Operating Controls and LEDs

Control or LED	Description
I/O	Power on (**I**) off (**O**) switch.
I/O LED indicator	Power-on LED--an illuminated green LED indicates amplifier is operating
LCD display	Display percentage of operating current
Inactive/Active key switch	When Active, turns on current supply to laser diode. When Inactive, turns off the current supply to laser diode.
Inactive/Active LED indicator	Power-on pump laser LED--an illuminated green LED indicates laser diode is active
Pump Control	Adjusts the amplifier laser diode pump current from 0 to maximum operating current
Input	Provides the input signal to the amplifier from optical signal source
Output	Provides the amplified output signal from the amplifier to the device under test (DUT)

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Front Panel – Mid-span Booster

The front panel of the unit is shown in Figure 5, and is described in Table 8.

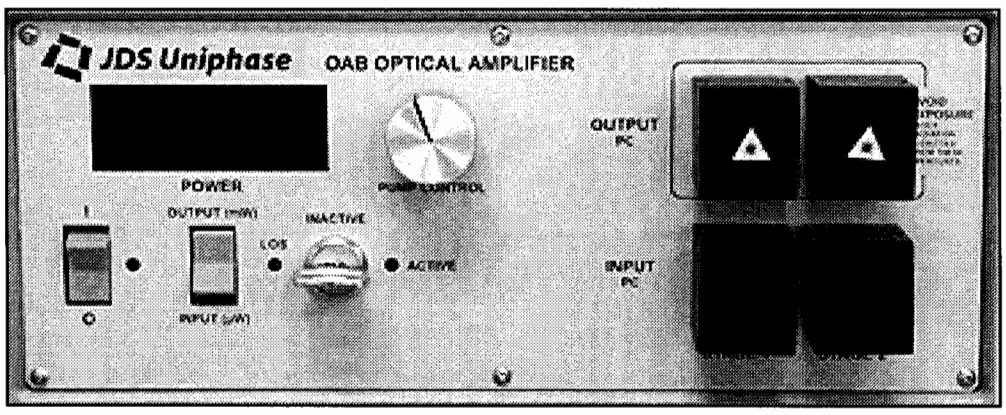


Figure 5: Front of Amplifier (Mid-span Booster)

Table 8: Operating Controls and LEDs

Control or LED	Description
I/O	Power on (**I**) off (**O**) switch.
I/O LED indicator	Power-on LED--an illuminated green LED indicates amplifier is operating
LCD display	Display input power (W) and output (mW) power
Output/Input switch	Input power (W) / output (mW) power
Inactive/Active key switch	When Active, turns on current supply to laser diode. When Inactive, turns off the current supply to laser diode.
Inactive/Active LED indicator	Power-on pump laser LED--an illuminated green LED indicates laser diode is active
Pump Control	Adjusts the amplifier laser diode pump current from 0 to maximum operating current
Input	Provides the input signal to the amplifier from optical signal source (STAGE 1) and (STAGE 2)
Output	Provides the amplified output signal from the amplifier to the device under test (DUT)

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Rear Panel

The back of the unit is shown in Figure 6 and described in Table 9.

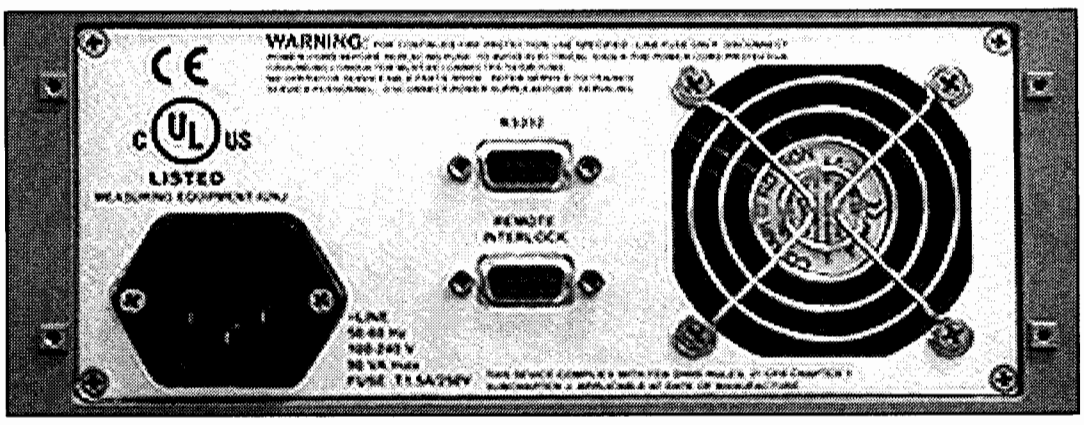


Figure 6: Rear Panel

Table 9: Rear Panel Details

Feature	Description
AC line connector	100 to 240 V AC, 50 to 60 Hz line cord interconnection
Remote Interlock	Pins 1 and 6 of the remote interlock connector must be interconnected to enable operation of the amplifier
RS232 Interface	Remote interface – see User interface section
Fuse	Located above power entry

Connecting the Remote Interlock

Before the OAB amplifier can be operated, the remote interlock must be connected. The remote interlock allows a connection for a remote on/off switch.

To connect the remote interlock:

1. Perform this remotely with an electrical relay circuit, or locally by utilizing the electrical connector supplied with the instrument, interconnecting pins 1 and 6 of the connector at the back of the amplifier.

Operating the Amplifier

	**Warning** Use of protective eyewear is recommended.

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To ensure optimum performance, allow the amplifier to warm up for a minimum of one hour.

1. Ensure that the amplifier is turned off (**O**), the key switch on the front panel is set to the Inactive position, and the control knob is turned counter clockwise or until display is (0).

2. Raise the protective cover of the output connector port to expose the output connector. Remove the protective optical connector cap.

3. Connect the source to the input connector and the DUT to the output connector on the front panel via a suitable connectorized optical fiber (Figure 7). Ensure that all connectors, if used, are mated to like connectors.

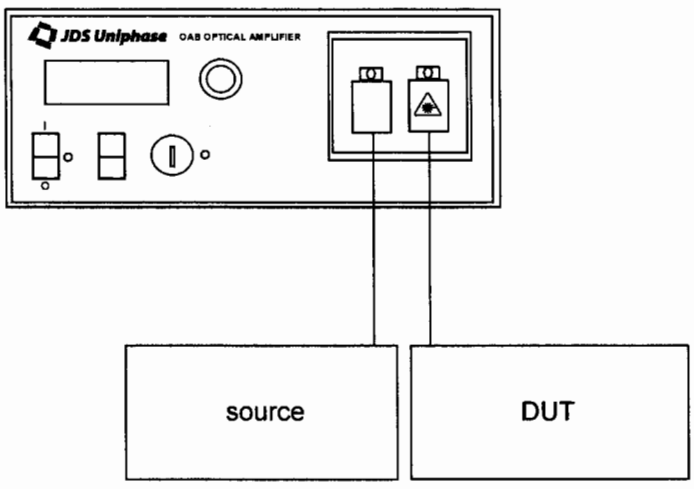


Figure 7: Setup

4. Turn the power switch on (**I**) and turn the key switch to the Active position. The Active LED lights and the laser starts emitting after approximately 5s. This delay is a safety feature that enables the user to turn off the unit quickly in an emergency situation during start-up.

User Interface

In addition to the manual control knob and disable switch, all OAB products are equipped with an RS232 interface. This allows for remote monitoring and control.

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Remote Interface

Monitoring

1. Pump laser(s) current levels
2. TEC current levels
3. Input power levels
4. Output power levels
5. Amplifier limit levels for Low Input Signal and Low Output Signal alarms
6. Ambient temperature

Control

1. Set pump laser current(s)
2. Set ALS, Automatic Laser Shutdown

Amplifier Shut Down

It is important to shut amplifier down before doing any maintenance, cleaning, or moving of the unit.

1. Adjust pump control to (0).

2. Switch Active/Inactive key switch to Inactive position.

3. Switch power to off (**O**) position.

4. Disconnect AC power source.



Caution

After turning off the unit, wait at least 30 seconds before powering it up again. Avoid switching off the unit before it is fully initialized.

Maintaining the Unit

Before every optical connector mating, thoroughly clean the connector end with a lint-free tissue and alcohol (see the **Cleaning Connectors** section).

When the unit is used in a high capacity environment, such as a manufacturing or quality assurance department, ensure that the front panel bulkhead optical connectors are cleaned daily with ethanol and a lint-free pipe cleaner or swab.

Calibration

The unit does not require routine calibration.

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Customized Features and Test Data

There are three attachments included in this manual:

OAB Benchtop Test Report
Output Power vs. Gain and Noise Figure plot
Input vs. Output plot

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Troubleshooting

Table 10: Troubleshooting

Problem	Cause	Corrective measure
Optical power is low, or no power output	Input / output connectors may be dirty	Clean connectors
	Input / output connectors may be the incompatible (ex. FC/APC – FC/HPC).	Change connectors
	Internal optical connectors may be damaged.	Factory service required
	Internal components are damaged.	Factory service required
Active indicator LED does not illuminate	Active/Inactive switch or power on switch is not turned to on (**I**) or Active	Turn switches to on (**I**) position
	Fuse is blown	Check and replace fuse if necessary
	Power line voltage is not correct or does not meet AC input requirements	Check the voltage
	Internal components are damaged	Factory service required
Active indicator LED illuminated at all times	Internal components are damaged	Factory service required

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Hardware Requirements

IBM compatible
Pentium 200 MHz or greater
32 MB of RAM
Windows 95, 98, Me, NT
Screen Resolution: 800x600 or greater
Video: Super VGA or higher resolution video card, capable of 256 colors or more

General Information

Communication between the amplifier and the computer is established with a cable connection of the serial ports. Use a Recommended Standard 232 (RS-232) cable with hybrid DB-9 connectors. Once communication through the cable is established, the remote interface supersedes the manual controls.

Installation

To install the software on a computer, follow the directions below.

1. Insert Setup Disk 1 in the floppy disk drive.
2. In the Start menu, click on the Run Command.
3. The screen below will appear.
4. Type A:\Setup.exe on the RUN Command dialog.
5. Now follow the instruction as they appear on your screen.

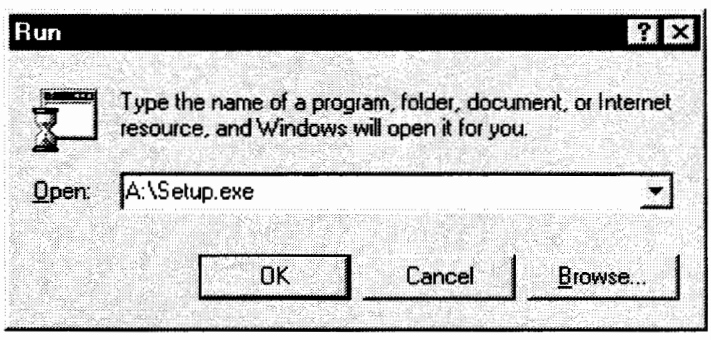


Figure 8: Run Dialog

The installation will create a shortcut in the programs group of the Start menu with a Sub-directory named OAB-BBS software.

You can run the program by clicking on the OAB_BBS_1.0 shortcut label.

Interface Screen

After the program has been initiated, the interface screen shown in Figure 9 will appear.

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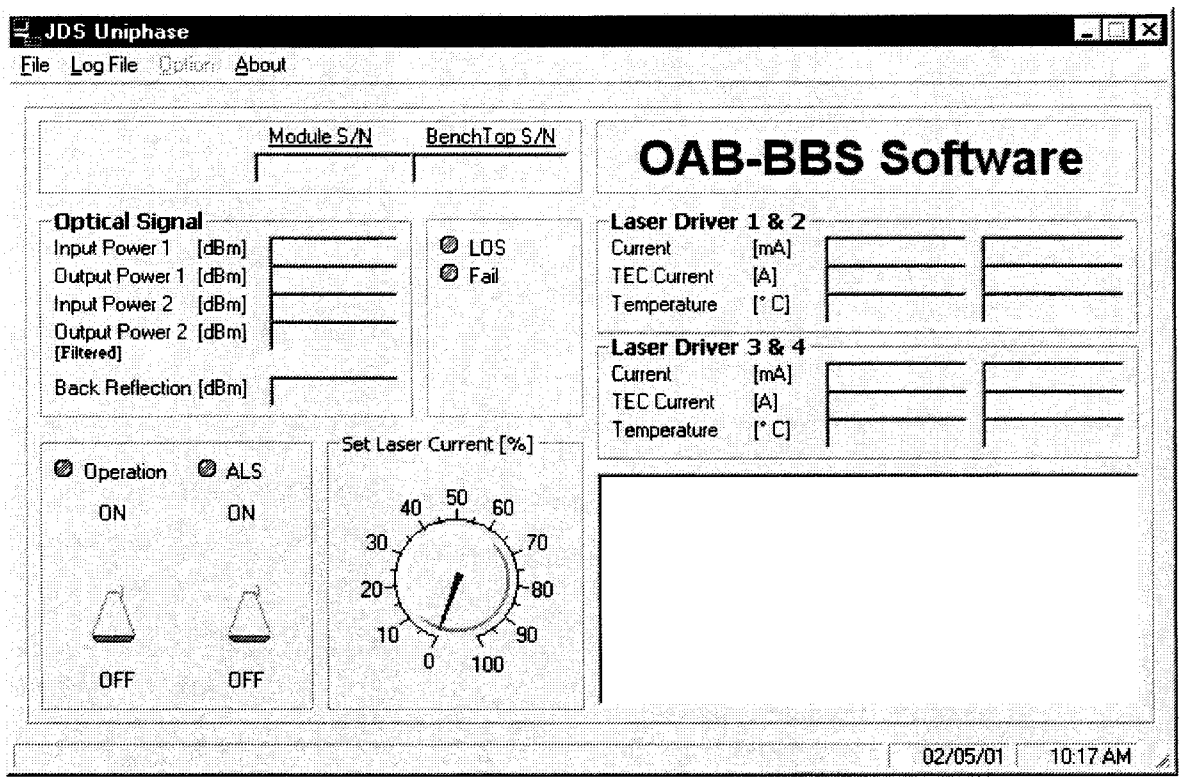


Figure 9: Main Dialog

The interface screen is divided into sections described below.

- The module or benchtop serial number
- List of amplifier operating parameters
- The parameters of laser driver 1-2-3 and 4
- Software LEDs showing the status of the alarm relays of the amplifier and the shelf temperature (right side)
- ALS button - Enable/Disable the Auto Laser Shutdown function
- Operational button - Enable/Disable the operation of the module
- Amplifier log file (Only available when the computer is connected to the amplifier)

Menu bar

The menu bar indicates the various options available to the user.

File menu

Four options are available, as shown in Table 11

Table 11: File Menu Commands

Connect	Connects the computer to the amplifier using a serial cable (COM 1-2-3 or 4)
Disconnect	Terminates the communication between the computer and the amplifier

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Display in	Selects the measurement unit of the input and output (mW or dB)
Exit	Closes the software

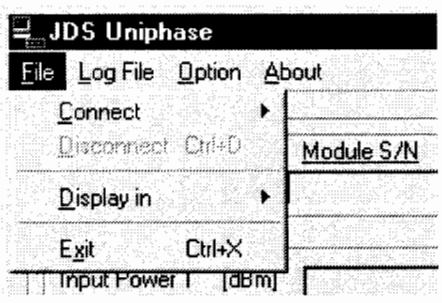


Figure 10: File Menu

NOTE: After establishing the connection to the module (using COM port settings: 9600, 8, N, 1), the user interface will display the amplifier operating parameters. To disconnect from the module, the Disconnect option in the File menu should be used. If the user exits the program without using Disconnect, the program will close the port and reset it to previous specifications.

Log File Menu

Table 12: Log File Menu Commands

Clear	Clears the Log File display
Print	Prints the Log File display
Save	Saves the Log File display

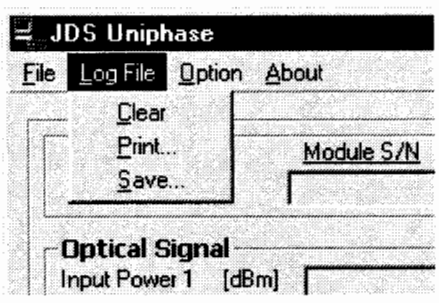


Figure 11: Log File Menu

Option Menu

Table 13: Option Menu

Alarm settings	Sets the Input LOS, Input Low and Output Low alarms
Amplifier specification	Displays the specifications and configuration of the amplifier
Laser current control	Sets the power to control to Local or Remote
Laser current setting	Sets the laser current (0 – 100 %)
Monitoring	Generates records of amplifier performance - this data can be exported to a spreadsheet software
Upgrade firmware	Changes version of amplifier firmware

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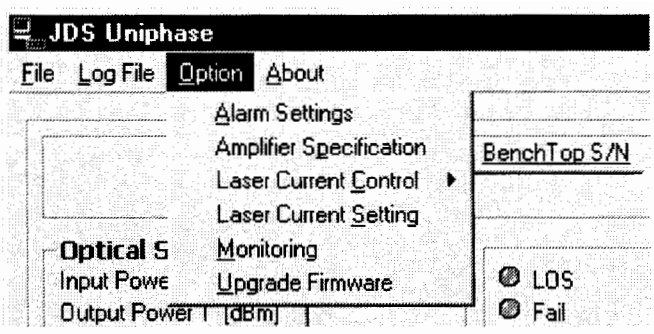


Figure 12: Option Menu

Alarm and Limits Settings

Selecting the Alarm Settings Command will display the dialog box shown in Figure 13. Enter the three alarm settings and press the SEND NEW VALUE Button. These values will be stored in the memory of the module. Change takes effect immediately.

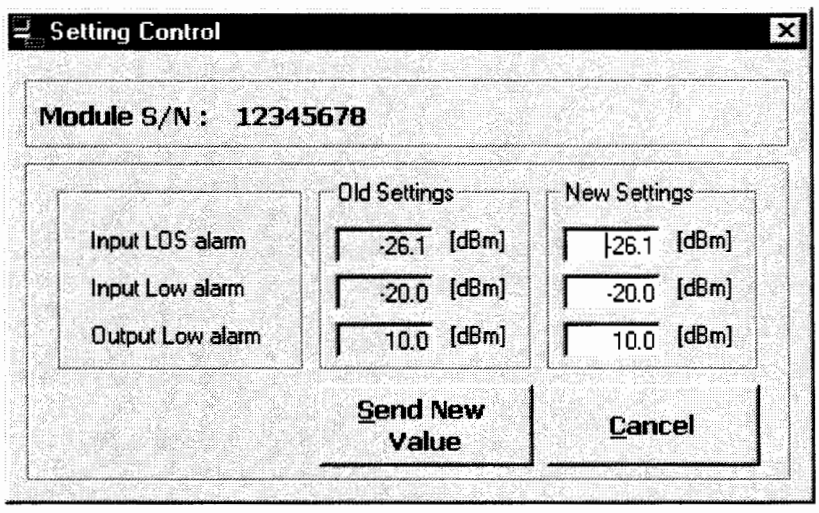


Figure 13: Setting Control Menu

Alarm indicators (software LED's)

Red light will indicate a "service" or a "Fail"

Yellow light will indicate a "loss of signal", signal low", or "output low"

Table 13: Alarms description

Ambient temperature high	The ambient temperature is higher than 50 C.
Ambient temperature low	The ambient temperature is lower than 0 C.
Input LOS	Yellow block and the software LED is ON when the optical input signal is below the preset limit (ex: -23dBm)
Input low	Yellow block is ON when the optical input signal is below the preset limit (ex: -20dBm)

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Output low	Yellow block is ON when the optical input signal is below the preset limit (ex: 15dBm)

Table 14: Fail description

Laser fail	The laser is not working properly (near the end of life)
Laser 1 temperature high	The temperature of the pump laser 1 is too high
Laser 2 temperature high	The temperature of the pump laser 2 is too high
Laser 3 temperature high	The temperature of the pump laser 3 is too high
Laser 4 temperature high	The temperature of the pump laser 4 is too high
Backreflection high	The backreflection level has been exceeded. (OPTIONAL)

Amplifier Specification Dialog Box

Selecting Amplifier Specification will display the data shown in Figure 14.

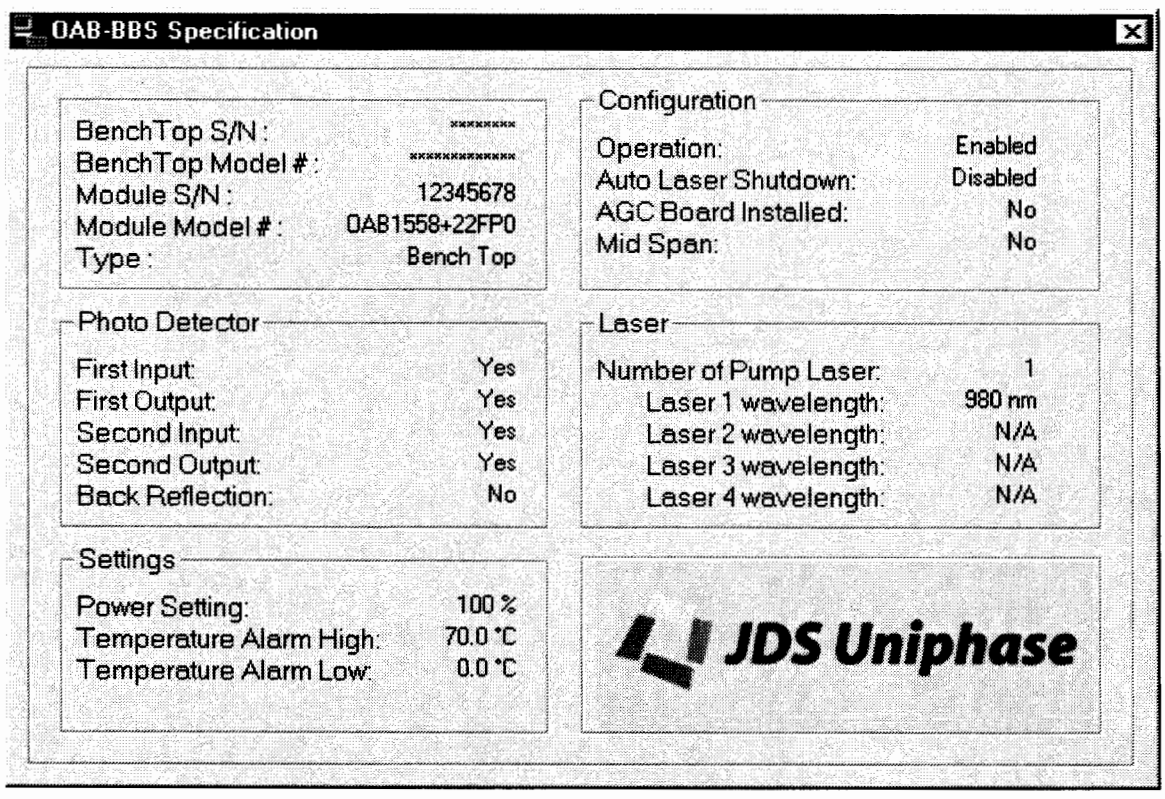


Figure 14: Amplifier Specification Dialog Box

This dialog may also be accessed by double clicking on the label of the Module S/N or on the text below, as indicated in Figure 15.

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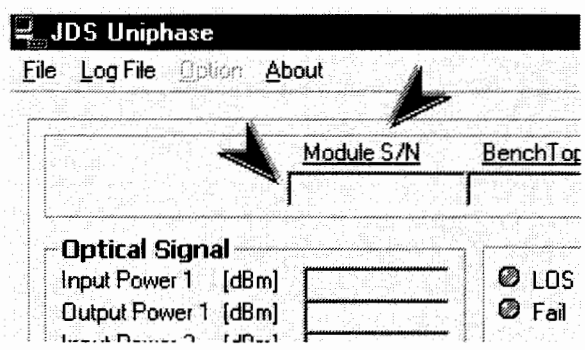


Figure 15: Specifications and Configuration Shortcut

The Laser Current control sets the configuration of the laser current so it may be accessed locally or remotely. Selecting Local will disable the access to the amplifier from the software. Selecting Remote will disable local control from the front panel.

Selecting the Laser Current Setting on the menu will display this dialog box.

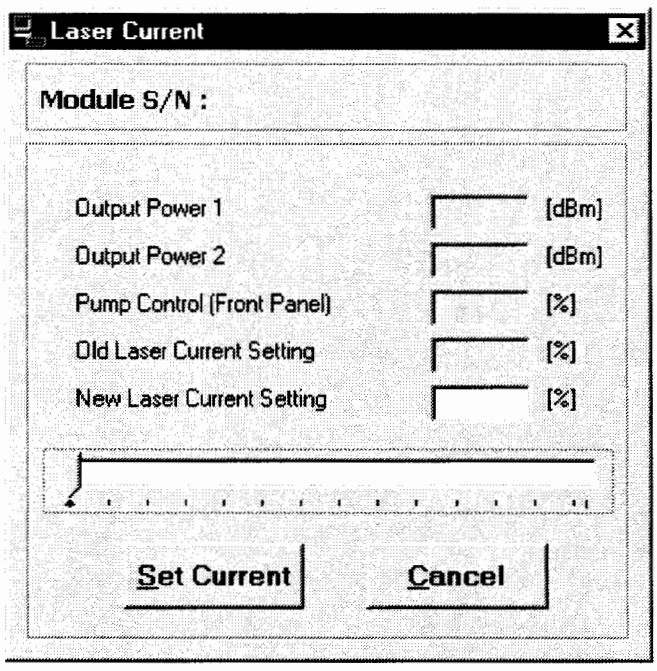


Figure 16: Laser Current Dialog Box

The top line indicates the serial number of the module. To make a modification to the Laser Current setting, the slider on the scale must be moved left or right. The value is displayed in the white text box. The value can be changed using the mouse or the arrow keys on the keyboard (to make large changes use Page Up and Page Down keys). After the value is entered properly, press the Set Current button to send the setting to the amplifier.

NOTE: The knob on the screen may also be used to perform this function.

Selecting the Monitoring option will display the screen shown in Figure 17.

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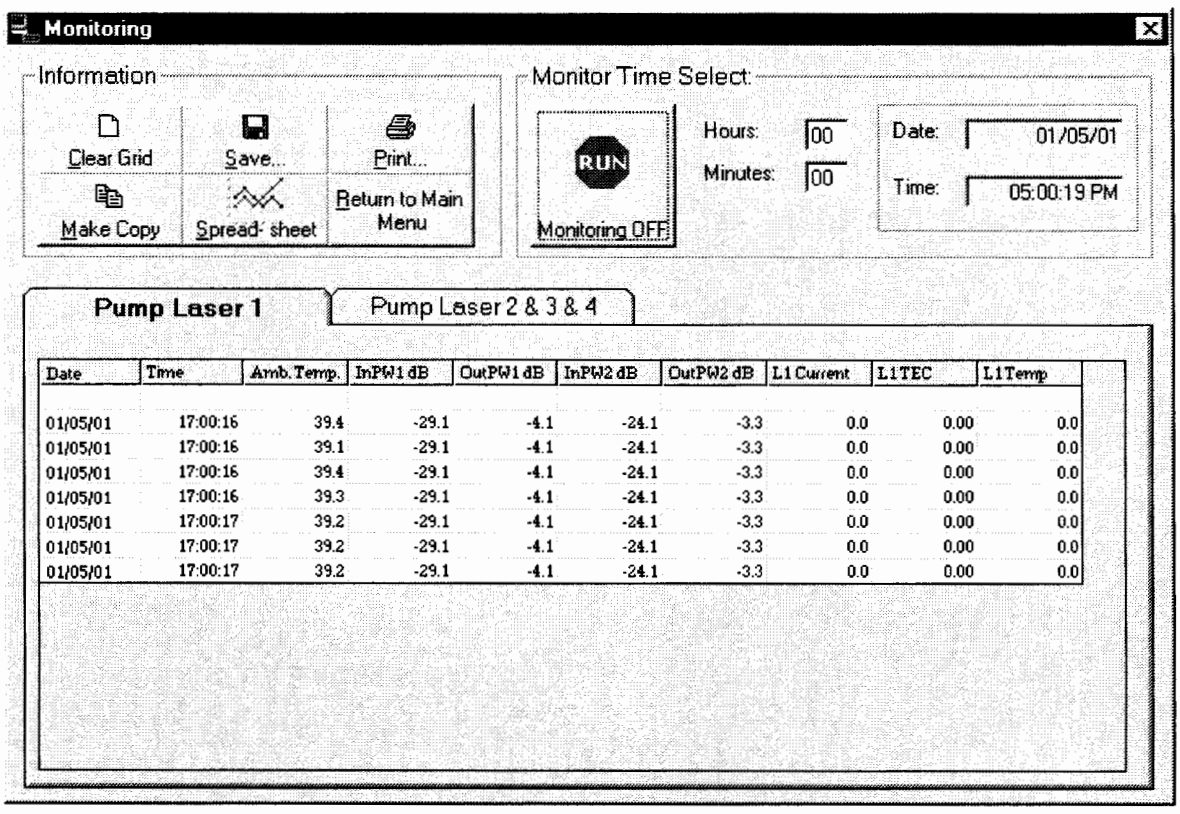


Figure 17: Monitoring Dialog Box

This dialog functions to create records of all parameters of the connected amplifier. Entering the desired value and pressing the RUN button sets the refresh rate of the time.

When the Clear Grid option is pressed, all data collecting in the grid will be erased. To save them or print them, press the appropriate button.

The Records Grid can be saved into two different formats:

MON format (*.MON).
Text format (*.txt)

Both formats can be opened, viewed and modified in Notepad or WordPad programs provided in Windows 95, 98, Me, or Windows NT 4.0, 2000.

About menu

Table 14: About Menu

Visit JDS Uniphase	Links to the JDS Uniphase web site
About	Displays the software version and, if the amplifier is connected; it will also display the firmware version

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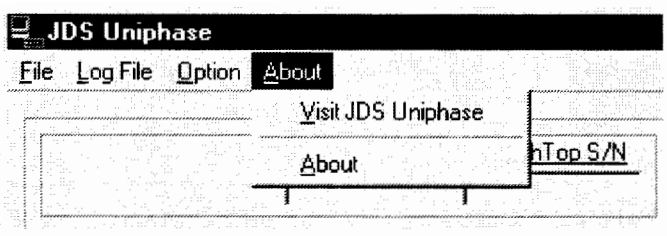


Figure 18: About Menu

Selecting About will display the dialog box in Figure 19.

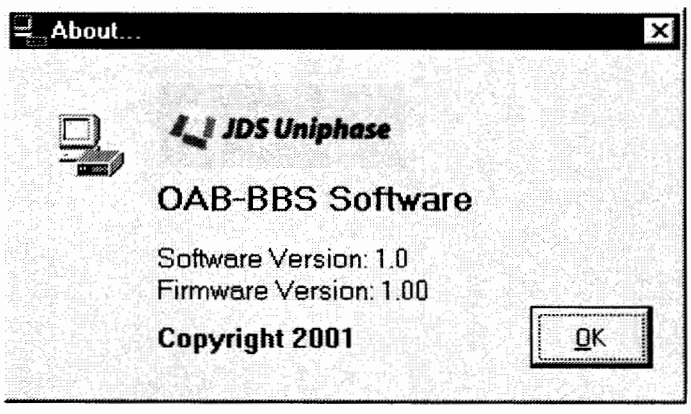


Figure 19: About Dialog

NOTE: The firmware version will appear only if an initailized instrument is connected to the software. Otherwise, the label and the version number of the instrument will not appear.

Keyboard Shortcuts

The following keyboard shortcuts allow easy access to several commands.

Table 15: Keyboard Shortcuts

Shortcut	Function
CTRL-F1	Connects to a Module using COM 1
CTRL-F2	Connects to a Module using COM 2
CTRL-F3	Connects to a Module using COM 3
CTRL-F4	Connects to a Module using COM 4
CTRL-D	Disconnects from COM port
CTRL-X	Exits the program
ALT-F	Opens the File menu
ALT-L	Open the Log File menu
ALT-O	Opens the Option menu
ALT-A	Opens the About menu

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Troubleshooting

Table 16: Troubleshooting

Problem	Cause	Corrective measure
Cannot establish connection with the amplifier	Serial cable is not connected properly Power supply is not active	• Check serial cable • Check power supply
Message: "COM port is already use by another device".	The computer is using the serial port for another device (mouse, backup disk, etc)	• Use another COM port, or disconnect the device
Message: "Error in the communication".	An event was transmitted from the amplifier to the computer Break was received Lost of Data Parity Error Change in the Data Set Ready line	• Check serial cable connection
When starting the communication, a Message: "Type mismatch 13" occurs	Windows NT 4.0 error	• If using Windows NT 4.0 International, Use the period (.) for decimal separation
When using the Monitoring function, the records are not recorded at the interval time specified.	Windows 98 and Me platforms Standby function interferes with the data recording settings Monitor On and Hard disk On functions are enabled Screen saver interferes with data recording settings	• If using Windows 98 or Me, remove the Standby function in the Power Option Properties • Use the Turn off monitor and Turn off hard disks functions • Removing the screen saver may also correct this problem.

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