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**MODEL 320A
3 GHz O/E RECEIVER**

User's Manual



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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 25 W.


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






	<p>Warning</p> <p>To avoid the risk of injury or death, always observe the following precautions before initializing the unit:</p> <ul style="list-style-type: none">• 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.• 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. For more information, see the user's manual of the laser source in use.• Turning off the power to the device does not always block the externally supplied radiation to the connector at the output of the unit.• Do not use the unit outdoors.• 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 interrupt the protective earth grounding. Any such action can lead to a potential shock hazard that can result in serious personal injury.• 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-
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	<p>circuit the fuse.</p> <ul style="list-style-type: none">• Unless absolutely necessary, do not attempt to adjust or perform any maintenance or repair procedure when the unit is opened and connected to a power source.• Repairs are to be carried out only by a qualified professional.• Do not attempt any adjustment, maintenance, or repair procedure to the unit's internal mechanism if immediate first aid is not accessible.• Disconnect the power cord from the unit before adding or removing any components.• Operating the unit in the presence of flammable gases or fumes is extremely hazardous.• 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.
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Safety Symbols

The following symbols and messages can be marked on the unit (Table 1). Observe all safety instructions that are associated with a symbol.

Table 1: Safety Symbols

Symbol	Description
	Laser safety. See the user's manual for instructions on handling and operating the unit safely.
	See the user's manual for instructions on handling and operating the unit safely.
	Electrostatic discharge (ESD). See the user's manual for instructions on handling and operating the unit safely.
	Frame or chassis terminal for electrical grounding within the unit.
	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.
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.

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.

General Information and Specifications

General Information

This user's manual for the Model 320A 3 GHz O/E Receiver contains complete operating instructions. The inspection report and a description of any customer-requested information are found in the **Customized Features and Test Data** section.

The receiver (Figure 1) detects and converts optical signals into electrical signals for the purpose of transmitter waveform analysis and testing, including error rate testing. It is optimized for analysis of high-speed, low-level optical signals from single-mode fiber sources. The high bandwidth (3 GHz) and high gain (2500 V/W) enable detection and analysis of up to 2.5 Gb/s signals at levels down to below -30 dBm. The receiver is also equipped with a high-level input port for direct connection of laser sources at power levels up to +3 dBm without overload. The Model 320A 3 GHz O/E Receiver is the one solution that provides users with a low-cost, high-quality instrument for optical eye pattern analysis and testing at low to high power levels.



Figure 1: 320A Receiver

The receiver consists of a 3 GHz bandwidth optical-to-electrical (O/E) converter (1100 to 1600 nm) and a 3 Gb/s limiting amplifier. The detector out port for the O/E converter is DC coupled and automatically nulled to $<\pm 100 \mu\text{V}$ DC. The nulling is automatically performed when the receiver does not have an optical input. A typical OC-48 eye diagram for the detector output is shown in Figure 2.

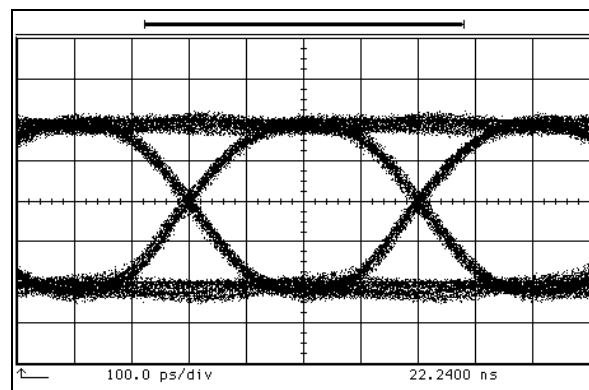


Figure 2: Detector Out Eye Diagram

The O/E detector's conversion gain is typically 2500 V/W and is a minimum of 2000 V/W (Figure 3).

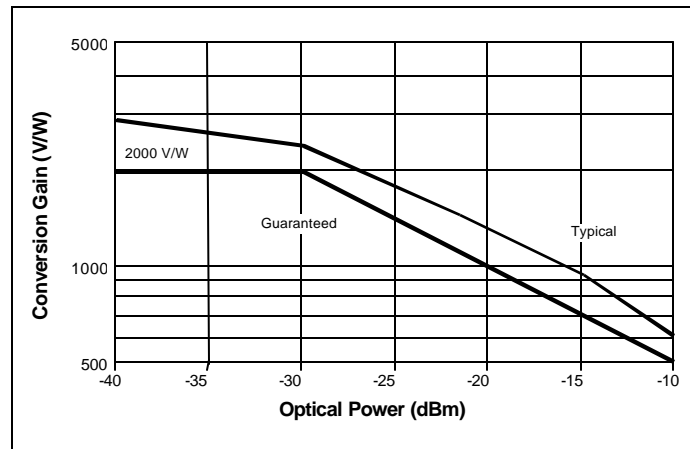


Figure 3: O/E Detector Conversion Gain

The input and both outputs of the limiting amplifier are AC-coupled.

Key Features

- Detector bandwidth DC 3 GHz
- High O/E gain (2500 V/W)
- Limiting amplifier included
- No gain or offset adjustments needed

Applications

- O/E conversion for transmitter testing

Standard Accessories

- AC power cord
- Two universal connector adapters
- User's manual

Optional Configuration

- Rack-mount version

Specifications

The following optical specifications describe the warranted characteristics of the unit (Table 2). Supplementary specifications describe the typical non-warranted performance of the unit (Table 3).

Table 2: Optical Specifications

Parameter	Specification
O/E Detector Section	
High power optical input	1.0 mW (0 dBm) maximum
Low power optical input	200 μ W (-7 dBm) maximum
Bandwidth (-3 dB)	DC to 2.5 GHz minimum 3.0 GHz typical
Maximum conversion gain ¹	2000 V/W minimum 2500 V/W typical For low power input; reduces as average input power increases
Wavelength	1200 to 1600 nm; InGaAs APD detector
Fiber interface	9/125 μ m single-mode
Optical input connector	Diamond universal screw-on adapter
Input optical return loss	30 dB minimum, 1310/1550 nm
Minimum detectable signal ² low power input high power input	100 nW (-40 dBm) 2000 nW (-27 dBm)
Polarity	Non-inverting (high input = high output)
DC offset, detector out	Automatically nulled to $<\pm 100$ μ V DC; automatic nulling is enabled when optical input power is removed
Overload indicator (flashing red LED)	Alarms at approximately 0.2 mW to indicate possible output overload distortion
Limiting Amplifier Section	
Limiting amplifier input	1.0 V peak-to-peak (pp) maximum
Bit rate ³	0.01 to 2.5 Gb/s minimum 3.0 Gb/s typical
Gain ³	24 dB minimum 26 dB typical
Rise/fall times	150 ps maximum, 20 to 80%, when in limiting region with 50 ohm termination

(table continued)

Parameter	Specification
Return loss (50 ohm) input output	10 dB minimum, frequency <2 GHz 10 dB minimum, frequency <2 GHz
Output amplitude (when in limiting region with 50 ohm termination)	0.45 Vpp minimum 0.60 Vpp typical
Input level for full limiting	30 mVpp minimum 500 mVpp maximum

¹ Gain self-adjusts to protect the sensitive avalanche detector.

² The minimum detectable signal is the minimum optical input power required for unity output peak-to-peak signal-to-root-mean-square (rms) noise ratio, measured in the full detector bandwidth.

³ Below limiting, the amplifier performs as a normal linear amplifier. Response is not guaranteed in the non-limiting linear region.

Table 3: Other Specifications

Electrical	
Input voltage	100 to 240 V AC, 50 to 60 Hz
Power consumption	25 W maximum
Electric input connectors	Female, SMA or N
Physical	
Dimensions (W x H x D)	25.7 x 11.5 x 26.4 cm (10.13 x 4.54 x 10.39 in)
Weight	2.7 kg (6 lbs)
Environmental	
Operating temperature	10 to 40 °C
Storage temperature	-20 to 70 °C
Humidity	95% RH from 10 to 40 °C non-condensing


Getting Started

The Model 320A 3 GHz O/E Receiver consists of the receiver unit, an AC power cord, and two universal adapters installed on the receiver.

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

	<p>Warning</p> <p>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.</p>
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Check that the unit and contents are complete:

1. Wear an anti-static wrist strap and work in an electrostatic discharge (ESD) controlled area.
2. Inspect the shipping container for any indication of excessive shock to the contents, and inspect the contents to ensure that the shipment is complete.
3. Inspect the unit for structural damage that can have occurred during shipping.
4. Connect the unit to a power source, using the AC power cord provided.
5. Set the power switch to **I** (on).
6. Apply an optical signal between -10 and -30 dBm to the Low Power Input port. Verify that the Input Status LED is green.
7. Turn the power switch off (**O**), then on (**I**). With the optical signal still connected, verify that the Input Status LED is flashing.
8. Remove the optical signal and verify that the Input Status LED is not lit.
9. 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 10 to 40 °C.

Humidity

The unit can be operated in environments with up to 95% humidity (10 to 40 °C). Do not expose it to any environmental conditions or changes to environmental conditions that can cause condensation to form inside the unit.

Ventilation

Do not block the rear and bottom vents. Blocking the air circulation around the unit can cause the unit to overheat, compromising its reliability.

	<p>Warning</p> <ul style="list-style-type: none">• Do not use the unit outdoors.• To prevent potential fire or shock hazard, do not expose the unit to any source of excessive moisture.
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Storing and Shipping

To maintain optimum operating reliability, do not store the unit in locations where the temperature falls below -20 °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, typical packaging guidelines are as follows:

1. Wear an anti-static wrist strap and work in an ESD controlled area.

2. Cover the front panel, if applicable, with a strip of cardboard.
3. Wrap the unit in anti-static packaging. Use anti-static connector covers, as applicable.
4. Pack the unit in a reliable shipping container.
5. 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 best material.
6. Seal the shipping container securely.
7. Clearly mark FRAGILE on its surface.
8. Always provide the model and serial number of the unit and, if necessary, the RMA number on any accompanying documentation.

Cleaning Connectors

	<p>Caution</p> <ul style="list-style-type: none"> • Connecting damaged or dirty fibers 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.
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Optical cable ends need to be cleaned before using them with the unit.

The following items are required for cleaning:

- Filtered compressed air or dusting gas (for example, Tech Spray Envi-Ro-Tech Duster 1671 gas, available at <http://www.techspray.com/1671.htm>)
- Lint-free pipe cleaners (for example, from 3M¹) or lint-free swab
- Lint-free towels (for example, 10 x10 cm or 4 x 4 in HydroSorb III wipers, available at http://www.focenter.com/acctech/hydrosobr_wipers.htm)
- Optical grade isopropyl alcohol or optical grade 200° ethanol (do not use rubbing alcohol, which contains 30% water)

To clean the connectors:

1. Blow the sleeve with filtered compressed air (Figure 4).

¹ 3M is a trademark of 3M.

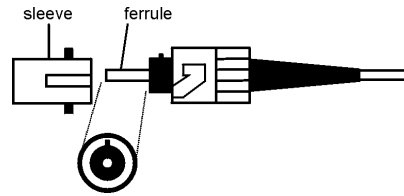


Figure 4: Connector Cleaning (connector type can vary)

2. 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.
3. Wipe the ferrule on a dry area of the lint-free towel.
4. Using the dusting gas or compressed air, blow the end of the ferrule.
5. Apply the alcohol or ethanol to a lint-free pipe cleaner or swab and wipe off the remaining parts of the connector.
6. With the other end of the pipe cleaner or swab, dry the areas cleaned.
7. Using the dusting gas or compressed air, blow the areas cleaned.

Operating and Maintenance Instructions

Front Panel

The front of the receiver is shown in Figure 5.

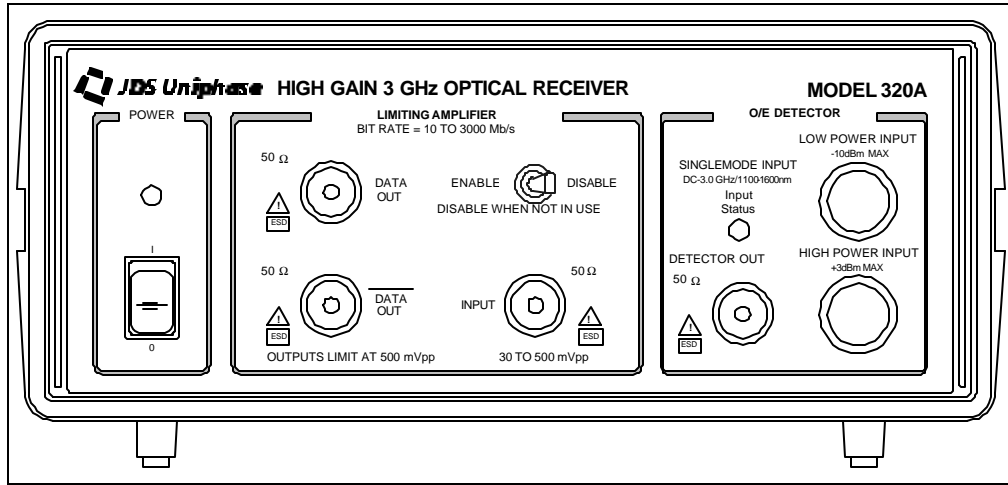


Figure 5: Front of Receiver

Power section	On-off (I/O) power switch and green LED power on indicator.
Data Out	One non-inverting electrical output (upper port) and one inverting electrical output (lower port).
Enable/Disable	The Enable position is engaged when using the limiting amplifier. When not in use, disable the limiting amplifier.
Input	Electrical input; it can be from the Detector Out port of the receiver or can originate elsewhere.
Input Status LED	<p>Green—optical input present (>-39 dBm at the Low Power Input or >-26 dBm at the High Power Input)</p> <p>Flashing green—the receiver was powered on with an optical input present, but nulling has not been performed. Remove the optical input for about 1 s.</p> <p>Flashing red—input overload—the electrical output can be distorted due to too much optical power. Reduce the optical power.</p> <p>Not lit—there is no optical input present</p>
Low Power Input	-10 dBm maximum input signal
High Power Input	3 dBm maximum input signal
Detector Out	This detector out port is DC coupled and automatically nulled to $\leq \pm 100 \mu\text{V}$ DC. The nulling is automatically performed when the receiver does not have an optical input.

Rear Panel

The back of the receiver is shown in Figure 6.

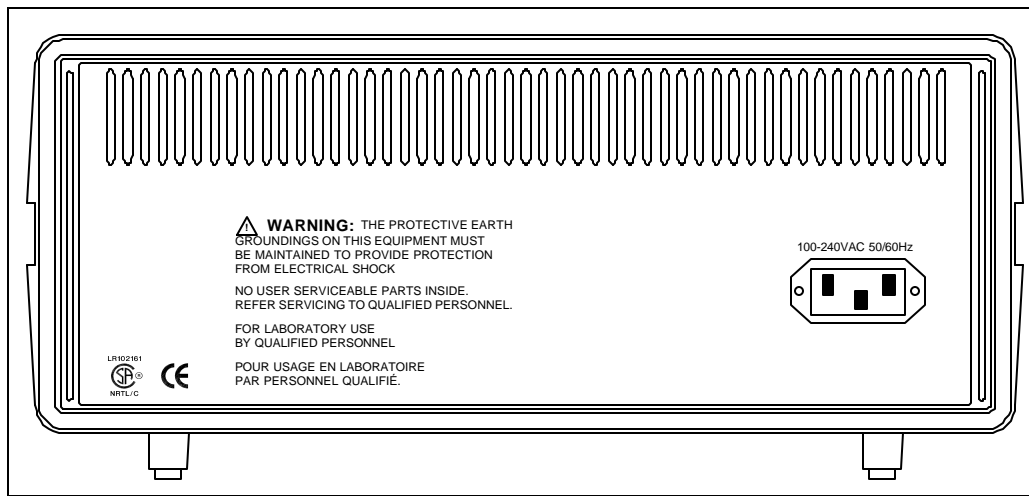


Figure 6: Back of Receiver

Testing a Transmitter

A source can be tested (waveform analysis) using the high power or low power optical input. Optical inputs of -10 dBm or less are connected to the low power input. Optical inputs up to 3 dBm are connected to the high power input. Levels greater than the maximum do not damage the receiver, but the input status LED flashes red to indicate optical overload. When in overload, the electrical output from the Detector Out port can be distorted. Do not operate the receiver in overload.

To test a source:

1. Set the power switch to I (on) and allow the receiver to stabilize thermally for approximately 15 minutes before applying an optical input. The DC content of the detector output is thermally sensitive and varies when the receiver is powered on. The automatic nulling circuitry operates at maximum effectiveness when stabilized.
2. Connect the source to the appropriate input and terminate the outputs (Figure 7). The limiting amplifier oscillates if an input is not connected and the outputs are not terminated. This oscillation introduces noise into the O/E Detector, reducing the signal-to-noise ratio of the output (Detector Out port).

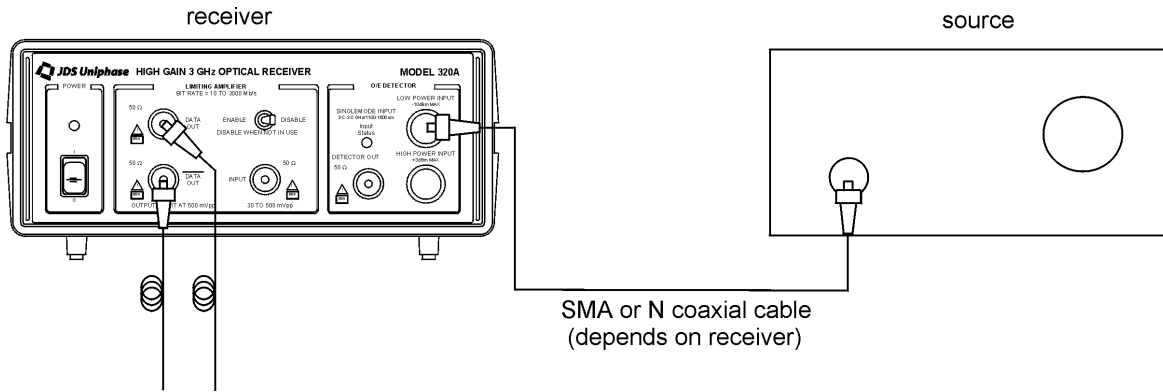


Figure 7: Testing a Source (connection to Low Power Input port shown)

3. For any measurement that relies on output nulling, remove the optical input momentarily before making the measurement. This action ensures that any changes in the DC offset due to thermal changes are nulled out.

Testing Bit Error Rate

The limiting amplifier output can be connected to a variety of equipment, including a bit error rate test set.

To use the receiver for BER testing:

1. Set up the equipment as shown in Figure 8. The O/E Detector's electrical output can be connected directly to the Input of the Limiting Amplifier section, so that the unit functions as a receiver.

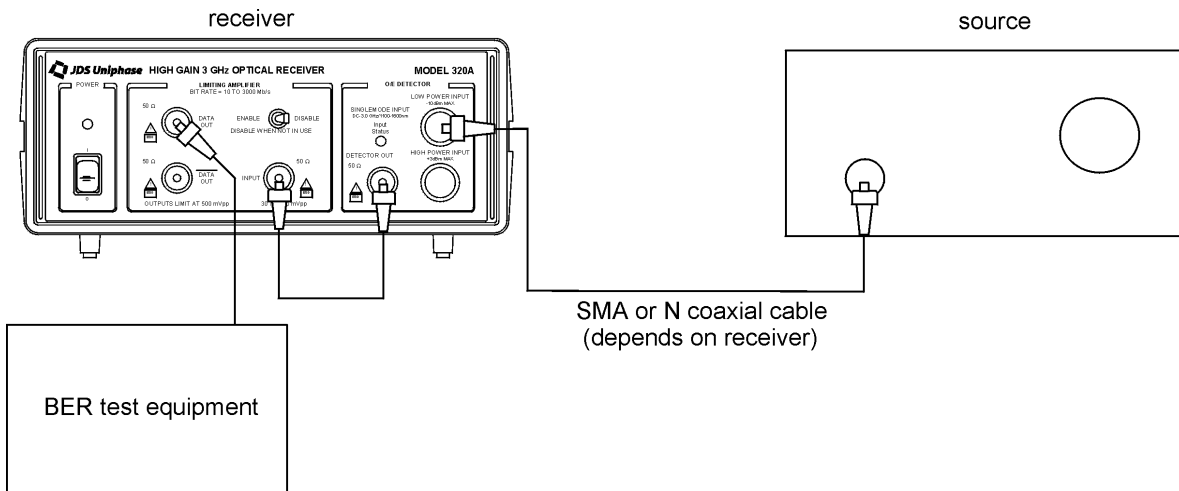


Figure 8: Bit Error Rate Testing Setup

2. Set the Enable/Disable switch to Enable. The amplifier is enabled. A typical output of the limiting amplifier at OC-48 is shown in Figure 9.

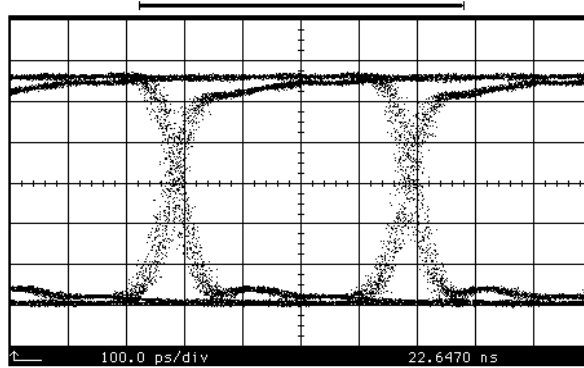


Figure 9: Limiting Amplifier Output

3. Disable the limiting amplifier by setting the Enable/Disable switch to Disable.

Maintaining the Receiver

With proper care and cleaning, the universal connectors on the receiver provide very low connection losses in normal laboratory use. High losses and permanent damage can result if proper care and cleaning are not done.

The following items are required for cleaning:

- Filtered compressed air or dusting gas (for example, Tech Spray Envi-Ro-Tech Duster 1671 gas, available at <http://www.techspray.com/1671.htm>)
- Lint-free pipe cleaners (for example, from 3M) or lint-free swab
- Lint-free towels (for example, 10 x10 cm or 4 x 4 in HydroSorb III wipers, available at http://www.focenter.com/acctech/hydrosobr_wipers.htm)
- Optical grade isopropyl alcohol or optical grade 200° ethanol (do not use rubbing alcohol, which contains 30% water)

To clean a connector and screw-on adapter (Figure 10):

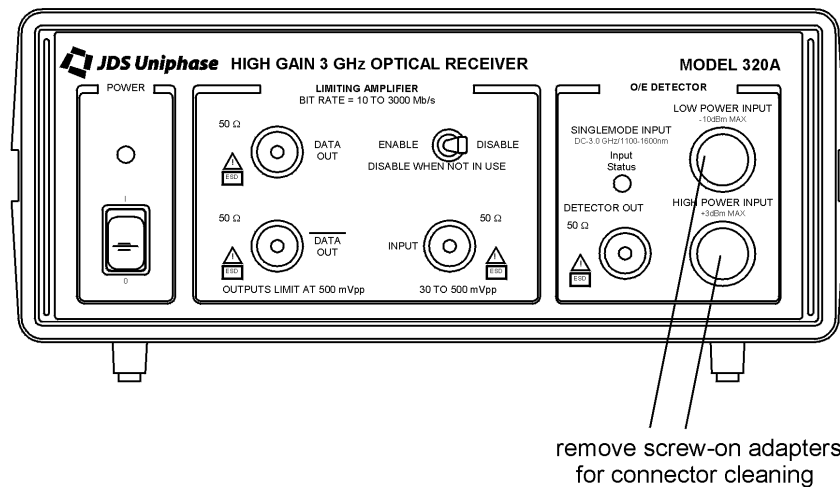


Figure 10: Connector Cleaning

1. Turn off the power to the receiver.
2. Remove the screw-on adapter from the universal connector on the front panel. The ferrule that is exposed contains the internal fiber.
3. Wet (do not saturate) the end of a cotton swab with a small amount of alcohol.
4. Wipe the end of the ferrule, gently swiping to remove any particles stuck to the end.
5. Wipe the side of the ferrule to remove buildup.
6. Dry the ferrule thoroughly using the compressed air.
7. Inspect the ferrule to ensure that no stray cotton fibers are present.
8. Using a small foam swab wet with alcohol, clean the inside of the screw-on adapter. Clean back and forth in the adapter, then rotate it.
9. Dry the adapter with compressed air.
10. Replace the adapter on the universal connector.
11. Clean the mating cable connector using the same procedure as for the universal connector.

Customized Features and Test Data



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