Agilent Technologies E6053A, E6058B, E6059A, E6059B, E6060A, E6062A: Rack OTDR User's Guide

Agilent Technologies

Notices

Warranty

The material contained in this document is subject to change without notice. Agilent Technologies makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Agilent Technologies shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

Edition/Print Date

All Editions and Updates of this manual and their creation dates are listed below.

E6050-91011 Third Edition E0701

First Edition E0298
Second Edition E0498, E0199, E0599, E0500

Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies products.

For any assistance, contact your nearest Agilent Technologies Sales and Service Office (see *"Service and Support" on page 14*).

ISO 9001 Certification

Produced to ISO 9001 international quality system standard as part of Agilent Technologies' objective of continually increasing customer satisfaction through improved process control.

Bellcore Certification of Excellence

Agilent Technologies is officially designated Bellcore Certification Eligible, and is awarded Bellcore's Certification of Excellence for its OTDR Data Format.

Agilent Technologies GmbH
Herrenberger Str. 130
71034 Böblingen
Germany

Safety Summary

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

GENERAL

When the Rack OTDR is ordered without Option 004, this product is a Safety Class 3 instrument (no protective earth command and DC input voltages less than 60V DC.

NOTE When the Rack OTDR has option 004 (externally mounted DC/DC Converter, and is powered by the DC/DC switcher, the system complies to Safety Class 1 (for instruments provided with a protective earth terminal).

You must therefore ensure that the instrument has a protective ground connection (see safety notes below).

For more details, see *"Safety Considerations" on page 188*.

The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

All Light Emitting Diodes (LEDs) used in this product are Class 1 LEDs as per IEC 60825-1.

ENVIRONMENTAL CONDITIONS

This instrument is intended for indoor use in an installation category II, pollution degree 2 environment. It is designed to operate at a maximum relative humidity of 95% and at altitudes of up to 2000 meters. Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage, the correct fuse is installed, and all safety precautions are taken. Note the instrument's external markings described under Safety Symbols.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cover must be connected to an electrical protective earth ground. The instrument must be connected to the ac power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

FUSES

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuse holders. To do so could cause a shock or fire hazard.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes.

DO NOT REMOVE THE INSTRUMENT COVER

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified service personnel.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

Safety Symbols

Caution, refer to accompanying documents

Protective earth (ground) terminal

Hazardous laser radiation

Electromagnetic interference (EMI)

Initial Safety Information for Laser Source

	E6053A	E6058B 1310 nm	E6058B 1550 nm	E6059A
Laser Type	FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP
Laser Class				
According to IEC 825 (Europe)	3A	3A	3A	3A
According to 21 CFR 1040.10 (Canada, Japan, USA)	1	1	1	1
Output Power (Pulse Max)	50 mW	120 mW	200 mW	50 mW
Pulse Duration (Max)	10 µs	20 µs	20 µs	20 µs
Pulse Energy (Max)	500 nWs	2.4 µWs	4.0 µWs	500 nWs
Output Power (CW)	500 µW	500 µW	500 µW	500 µW
Beam Waist Diameter	9 µm	9 µm	9 µm	9 µm
Numerical Aperture	0.1	0.1	0.1	0.1
Wavelength	1310/1550 ±25nm	1310 ±25nm	1550 ±25nm	1550 ±25nm

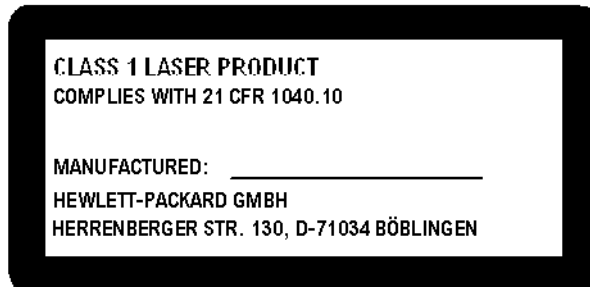|	E6059B	E6060A	E6062A	
			1550 nm	1625 nm
Laser Type	FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP	FP-Laser InGaAsP
Laser Class				
According to IEC 825 (Europe)	3A	3A	3A	3A
According to 21 CFR 1040.10 (Canada, Japan, USA)	1	1	1	1
Output Power (Pulse Max)	200 mW	200 mW	200 mW	200 mW
Pulse Duration (Max)	20 µs	10 µs	20 µs	10 µs
Pulse Energy (Max)	4.0 µWs	2.0 µWs	4.0 µWs	2.0 µWs
Output Power (CW)	500 µW	500 µW	500 µW	500 µW
Beam Waist Diameter	9 µm	9 µm	9 µm	9 µm
Numerical Aperture	0.1	0.1	0.1	0.1
Wavelength	1550 ±25nm	1625 ±20nm	1550 ±25nm	1625 ±20nm

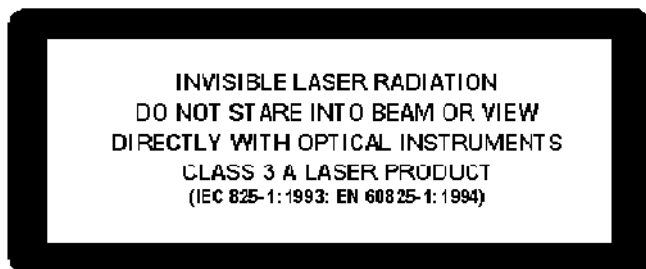|	E6007A
Laser Type	MQW-Laser AlGaInP
Laser Class	
According to IEC 825 (Europe)	2
According to 21 CFR 1040.10 (Canada, Japan, USA)	2
Output Power (Pulse Max)	n/a
Pulse Duration (Max)	n/a
Pulse Energy (Max)	n/a
Output Power (CW)	500 µW
Beam Waist Diameter	9 µm
Numerical Aperture	0.1
Wavelength	635 ±10nm

NOTE   All Rack OTDRs use two LED devices as indicator lamps on the front panel. These LED devices are measured to be to the AEL Class 1 Laser Products per EN60825-1 Standard.

NOTE   The following laser safety warning labels are fixed on the top of the Rack OTDR:

USA

CLASS 1 LASER PRODUCT
COMPLIES WITH 21 CFR 1040.10

MANUFACTURED: _____

HEWLETT-PACKARD GMBH
HERRENBERGER STR. 130, D-71034 BÖBLINGEN

Non-USA

INVISIBLE LASER RADIATION
DO NOT STARE INTO BEAM OR VIEW
DIRECTLY WITH OPTICAL INSTRUMENTS
CLASS 3 A LASER PRODUCT
(IEC 825-1:1993: EN 60825-1:1994)

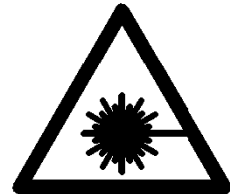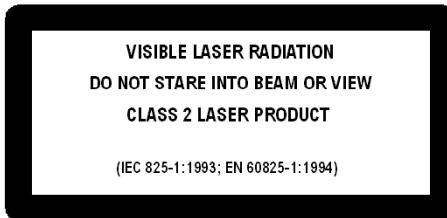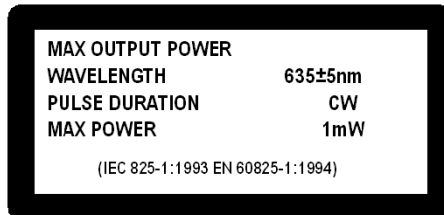The following symbol is fixed to the front panel, next to the laser output:

A sheet of laser safety warnings is included with the Rack OTDR. You *must* stick the labels in the local language onto the outside of the instrument, in a position where they are clearly visible to anyone using the instrument.

NOTE The following laser safety warning labels should be fixed to the E6007A submodule

Submodule E6007A

Non-USA

```
MAX OUTPUT POWER
WAVELENGTH              635±5nm
PULSE DURATION            CW
MAX POWER                 1mW

    (IEC 825-1:1993 EN 60825-1:1994)
```

```
VISIBLE LASER RADIATION
DO NOT STARE INTO BEAM OR VIEW
CLASS 2 LASER PRODUCT

(IEC 825-1:1993; EN 60825-1:1994)
```

The laser safety labels for the USA, according to 21 CFR 1040.10 Class II, are already attached to the module.

A sheet of laser safety warnings is included with the laser module. You *must* stick the labels in the local language onto the outside of the instrument, in a position where they are clearly visible to anyone using the instrument.

WARNING Use of controls or adjustments or performance of procedures other than those specified for the laser source may result in hazardous radiation exposure.

WARNING   Do not enable the laser when there is no fiber attached to the optical output connector.

The optical output connector is towards the top of the instrument's front panel, at the right hand side. There are 3 possible positions for the optical output connector, which are adjacent to each other. Only one connector is active on any device.

The laser is enabled by the remote command `INIT`, and disabled with `ABOR`. The laser is enabled when the red LED on the right side of the front panel is lit. The LED is marked with the label `laser active`.

WARNING   Under no circumstances look into the end of an optical cable attached to the optical output when the device is operational. The laser radiation can seriously damage your eyesight.

There is a safety circuit which monitors the average laser power output. If the average is greater than the limit for the Rack OTDR, the laser will be disabled.

WARNING   The use of optical instruments with this product will increase eye hazard.

NOTE   All Rack OTDRs should also have a CE class A label.

About This Manual

The Structure of this Manual

This manual is divided into two parts:

* Chapter 1 tells you how to set up your Rack OTDR.

* The appendices contain additional information not required for routine day-to-day use.

Related Publications

For more information, please consult the following publications

* E4310-91016 Agilent Technologies OTDRs Programming Guide

* E6000-91031 Agilent Technologies E6000C Mini-OTDR User's Guide

* E6091-91013 Agilent Technologies OTDR Toolkit II*Plus* Getting Started.

Service and Support

Any adjustment, maintenance, or repair of this product must be performed by qualified personnel. Contact your customer engineer through your local Agilent Technologies Service Center. You can find a list of local service representatives on the Web at:

http://www.agilent-tech.com/services/English/index.html

If you do not have access to the Internet, one of these centers can direct you to your nearest representative:

United States	Test and Measurement Call Center
	(800) 452-4844 (Toll free in US)
Canada	(905) 206-4725
Europe	(31 20) 547 9900
Japan	Measurement Assistance Center
	(81) 426 56 7832
	(81) 426 56 7840 (FAX)
Latin America	(305) 267 4245
	(305) 267 4288 (FAX)
Australia/New Zealand	1 800 629 485 (Australia)
	0800 738 378 (New Zealand)
Asia-Pacific	(852) 2599 7777
	(852) 2506 9285 (FAX)

Table of Contents

1 Getting Started

Table of Contents

B Accessories

C Specifications

Table of Contents

Table of Contents

D Performance Tests

Table of Contents

E Cleaning Information

Table of Contents

Table of Contents

Table of Contents

F Environmental Profile

G The DC/DC Adapter

List of Figures

List of Figures

List of Tables

List of Tables

1

Getting Started

Getting Started

This chapter introduces the features of the Agilent Technologies Rack OTDR.

Here you will find a quick description of the instrument, an explanation of how to insert a submodule and Optical Connector Interface, and a description of the main Rack OTDR screens.

1.1 Features of the Rack OTDR

Submodule Slot

VGA Connection

Keyboard
Connection

Power LED

Power On
button

Power supply

PCMCIA
Slot

Serial
Interfaces

Parallel
Interface

Optical Output
Connector

Laser Active
LED
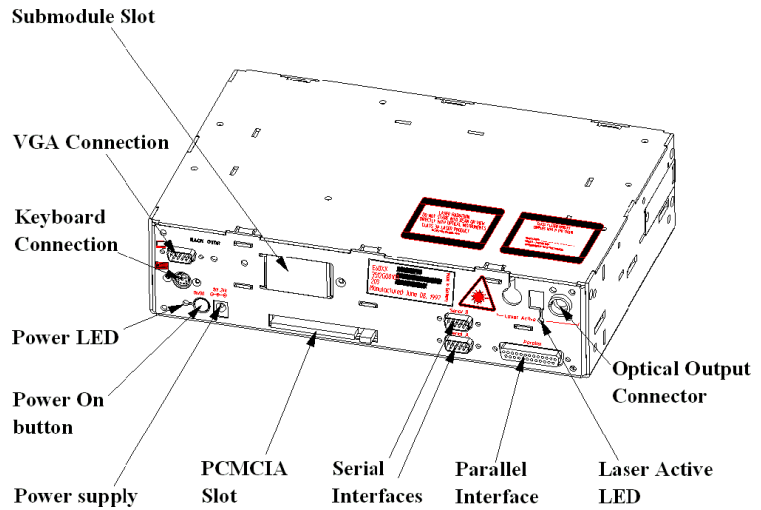
Figure 1-1   **The Rack OTDR Front panel**

Figure 1-1 shows the front panel of a Rack OTDR.

The various components of the front panel are discussed in more
detail below.

Power features

The features at the bottom left of the Rack OTDR are concerned with power (Figure 1-2).
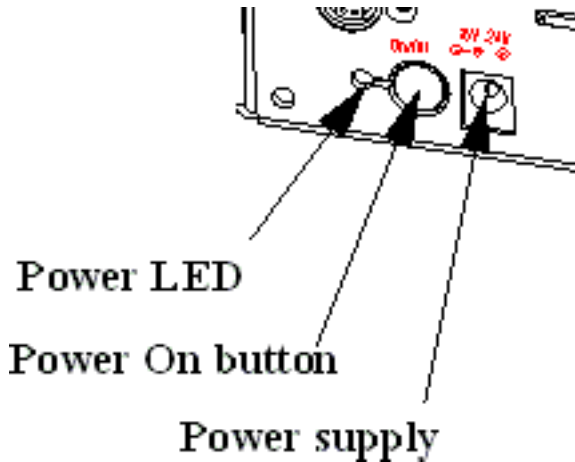
Figure 1-2   **Power features**

- The green Power LED is lit when the Rack OTDR is switched on.

- The Power On button switches the Rack OTDR on and off.

- Use the DC input connector to attach an AC/DC adapter or a DC/DC adapter to the power supply. When an adapter is connected, the instrument will boot automatically.

PC-Keyboard connections

You can attach a keyboard and a VGA-CRT using the connections at the top left of the Rack OTDR (Figure 1-3).
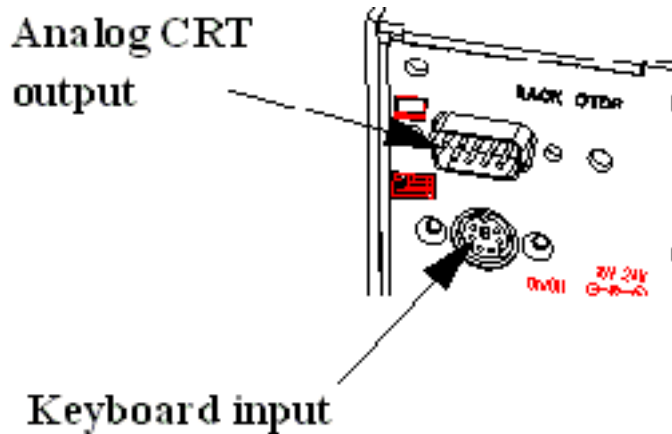
Figure 1-3   **Keyboard connections**

- Attach a VGA monitor to the analog CRT output using a standard 15-pin D-SUB connector.

NOTE   **The Sync signals on the analog CRT connection deliver 3.3V. This may cause problems with some monitors.**

- Attach a keyboard to the keyboard connection using a standard PS2 or keyboard with a mini-DIN connector (for example, the Agilent E6000-61901).

Optical Output Connectors

You can add an Agilent Connector Interface at the top right of the Rack OTDR (Figure 1-4).

Optical Output Connector

Laser Active LED
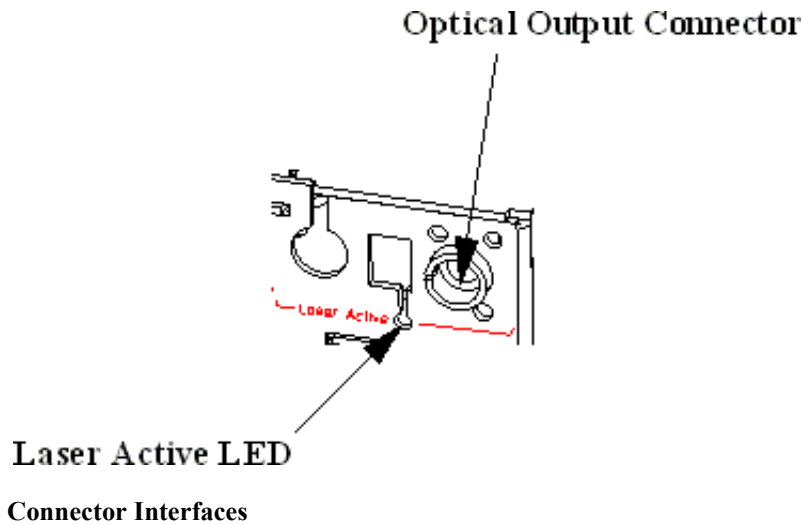
Figure 1-4   **Connector Interfaces**

- Attach a standard Output Connector (for example, Agilent 81000GI) to the right-hand optical output (Figure 1-5).

The other optical outputs currently have no function.
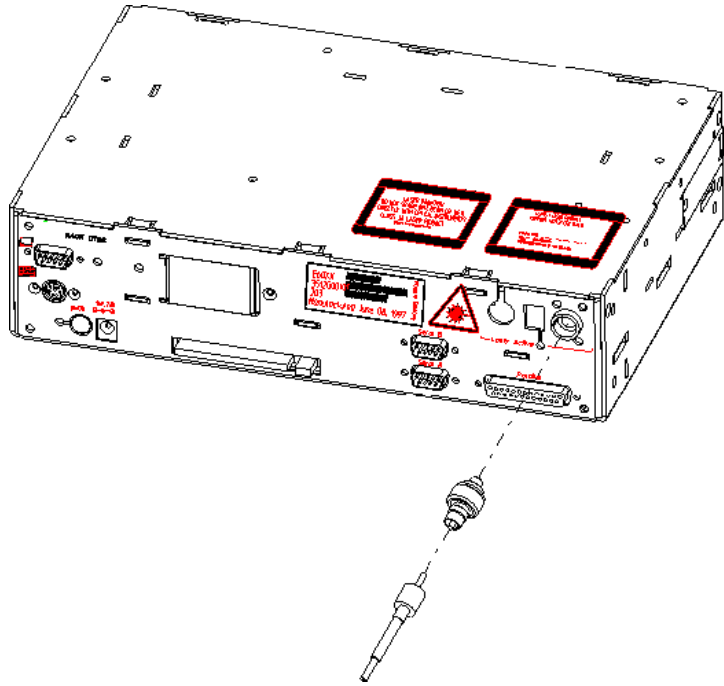
Figure 1-5   **Adding an Output Connector**

- The red LED beneath the Output Connectors is lit when the laser is active.

NOTE   **For a list of the available Output Connectors, see Appendix B "Accessories".**

Adding submodules

You can insert modules into the slots in the middle of the Rack
OTDR (Figure 1-6).
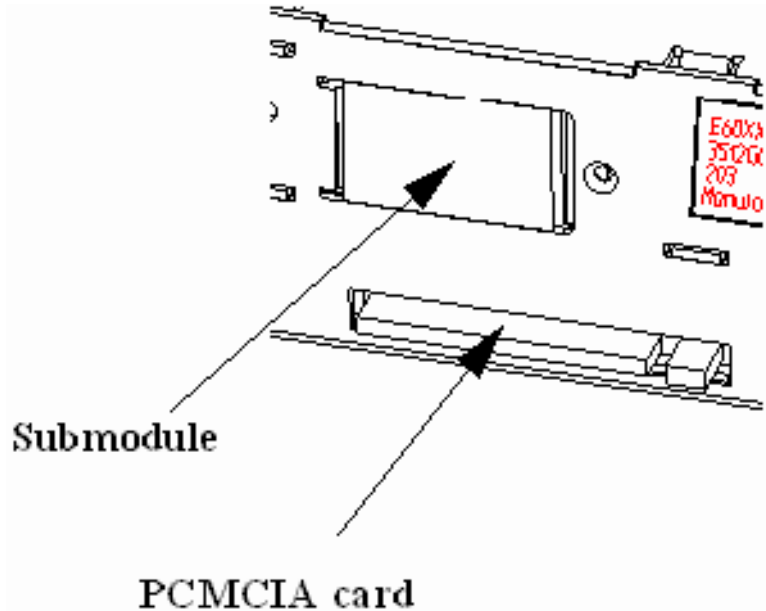
Figure 1-6   **Rack OTDR submodule slots**

- Insert an Agilent Technologies E6006A Power Meter
  submodule or an Agilent Technologies E6007A Visual Fault
  Finder submodule into the submodule slot.

• Attach an output connector to the submodule (Figure 1-7).
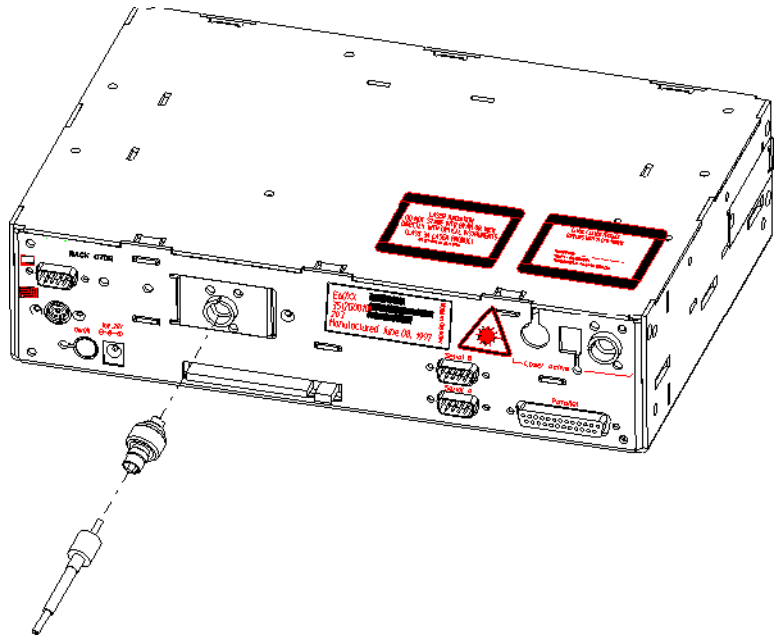
Figure 1-7   **Attaching an Output Connector to a Submodule**

NOTE   **You should only insert or remove a submodule when the Rack OTDR is turned off.**

PCMCIA Slot

• Insert an SRAM card or flash disk into the PCMCIA slot.
  You should enter the card face down.

Interfaces

You can connect cables to the serial and parallel interfaces at the bottom right of the Rack OTDR (Figure 1-8).
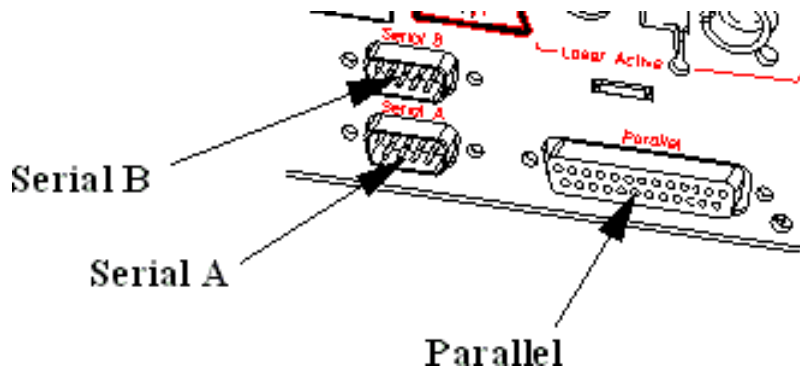
Figure 1-8   **Interfaces**

- Connect a 9-pin RS232 cable to the Serial A Interface.

  You can connect a second serial cable to Serial B. If you have option 006, you can connect an RS485 cable (see "How to Connect an RS 485 Cable" on page 45); if you do not have option 006, you can connect an RS232 cable.

NOTE   **You can only send SCPI commands to the Rack OTDR via Serial A.**

- To connect a parallel printer, connect a 25-pin Centronics cable to the Parallel Interface.

1.2 How to Insert the Rack OTDR into a Rack

You prepare the Rack OTDR to be inserted into a Rack using the Rack Mount Kit. This is delivered with your Rack OTDR if you have option 003.

WARNING **Please take care to avoid injury when you assemble the Rack Mount kit, and mount the Rack OTDR in a rack.**

The Rack Mount Kit consists of two flaps, the larger of which you attach to the left of the Rack OTDR, the smaller to the right.

1 Insert the flaps in the holes at the side of the Rack OTDR towards the front.

Turn the right flap clockwise until the front of the flaps is level with the front of the Rack OTDR, and the flap clicks into the holes in the Rack-OTDR (Figure 1-9, step 1, right)

Turn the left flap counter-clockwise until the front of the flaps is level with the front of the Rack OTDR, and the flap clicks into the holes in the Rack-OTDR (Figure 1-9, step 1, left).
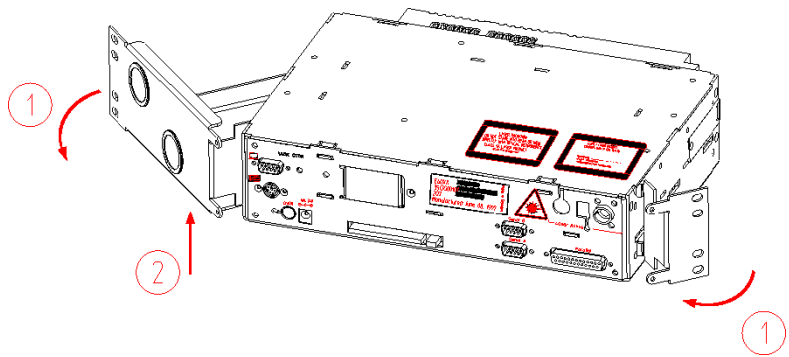
Figure 1-9 **Preparing a Rack OTDR to be inserted in a Rack**

2 Pull the left flap up, that is towards the top of the Rack OTDR (Figure 1-9, step 2).

3 Click the left flap into the holes at the front of the Rack OTDR (Figure 1-10, step 3).
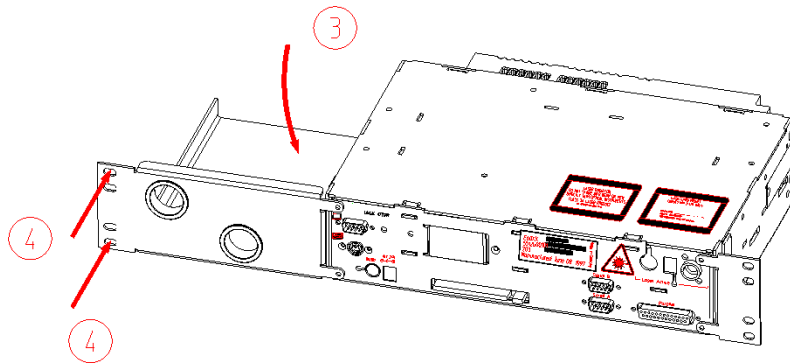
Figure 1-10   **Securing the flaps of a Rack OTDR**

4 Now screw the Rack OTDR into a Rack (Figure 1-10, step 4). Screws should be provided with your Rack.

NOTE   **To remove the Rack Mount Kit, first pull the flaps up (that is, towards the top of the Rack OTDR), then turn the left flap clockwise and the right flap counter-clockwise. It is easier to move the smaller, right flap if you put your fingers behind the flap.**

1.3 How to Attach an Adapter

You can attach a 110V power supply at the bottom left of the Rack OTDR (but, see "AC Line Power Supply Requirements" on page 52).

Attach a lead from a suitable AC/DC or DC/DC adapter to the input connector to the right of the power on button.(see Figure 1-2 "Power features").
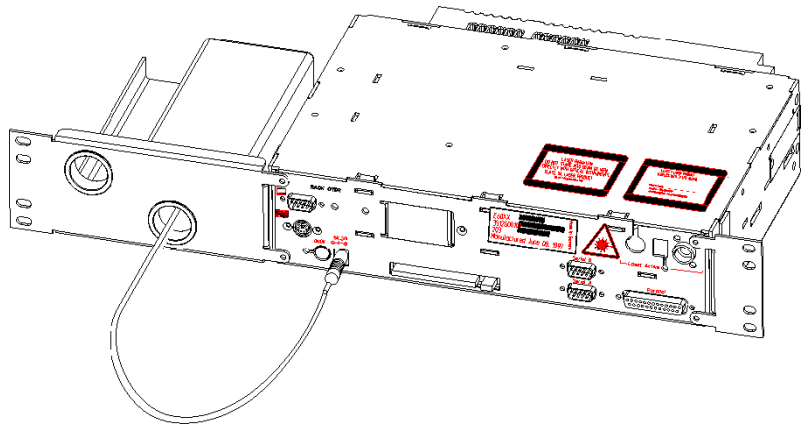
Figure 1-11   **Rack OTDR with power connector attached**

NOTE   **When you attach an AC connector, the Rack OTDR automatically boots.**

1.4 How to Operate the Rack OTDR

Programming user tasks on a PC

You can select Input/output commands for sending and receiving data from the serial interface and for initializing transmission parameters.

You should follow the following steps:

1   Initialize the Hardware Interface parameters

2   Check the automatic connection to the instrument

3   Send or receive commands to/from the Rack OTDR.

The *OTDR Programming Guide* shows how to perform steps 2 and 3. Step 1 depends strongly on the Operating system.

NOTE   **The programming and speed performance depend on the Operating system used on the PC. Generally speaking, speed and reliability are better with Windows NT and Windows 95 than with Windows 3.1.**

How to Operate the Rack OTDR from a Monitor and Keyboard

Attach a monitor and keyboard to the interfaces at the top left of the Rack OTDR (see Figure 1-3 "Keyboard connections").

When you now switch on the Rack OTDR, you can also use it as if it were a Mini-OTDR (for more details see the *Mini-OTDR User's Guide*: Agilent Technologies Product Number E6000-91011).

You can emulate the Mini-OTDR hardkeys with the following keyboard keys:

- RUN/STOP: *<f2>*

- CURSOR: Up, Down, Left, and Right arrows.

- SELECT: *<Enter>* or *<Return>* button.

- HELP: *<f1>*

You can also use your attached keyboard to enter text into the screen keyboard edit field (for example, to enter the text of a landmark or a filename).

NOTE   **If you are using your keyboard to enter text, you should use the Backspace key to delete characters.**

To exit the screen keyboard, must navigate to OK or Cancel, then press *<Enter>* or *<Return>*.

Instrument Configuration
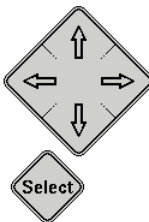
NOTE   **You should configure the instrument before you first make a measurement,**

The `Instrument Setup` screen in the Rack OTDR Instrument Configuration is different to that for the Mini-OTDR. This enables you to configure Serial A and serial B separately (Figure 1-12).

| Instrument Configuration | 15-Dec-97 10.38 |

Instrument Setup   Page 4 of 5

Config.

Baudrate RS 232 (A) — 19200

Baudrate RS 232 (B) — 19200

Parity — None

Parity — None

Handshake — Hardware

Handshake — None

☑ Color Mode

☑ Tone

29 %
1:22 h

Ok   Next Page   Save

Page Index   Prev Page   Load

Figure 1-12   **Rack OTDR Instrument Setup screen**

You do not need to set the parity if you do not want to, but you should set an appropriate baud rate and hardware handshaking.

You can either set the baudrate, handshaking and parity remotely, or you can use the SCPI commands
`SYSTem:COMMunicate:SERialN[:RECeive]:BAUD`,
`SYSTem:COMMunicate:SERialN[:RECeive]:PACE`, and
`SYSTem:COMMunicate:SERialN[:RECeive]:PARity`
`[:TYPE]` respectively.

`SERial1` refers to Serial A, and `SERial2` to Serial B.

See the *HP/Agilent OTDRs Programming Guide* for more details.

How to Operate the Rack OTDR with a Connected Serial Interface

Use an RS232 cable to connect a PC or other operating system to Serial A (see Figure 1-8 "Interfaces"). You can now operate the Rack OTDR using a variety of methods, explained below

Using Terminal mode

To use terminal mode, all you need is any computer system that supports a terminal - that is a keyboard to accept user inputs, and a screen to show system outputs. This can be, for example, a PC or a UNIX system.

Configure your PC's serial line, matching the configuration of the instrument.

To check that the serial line is correctly connected, enter `*idn?`.

You should see a response saying `HP E60xxA Rack Optical Time Domain Reflectometer .... <END>`.

NOTE   **For more information about the programming commands required to configure an instrument, please consult the *HP/Agilent OTDRs Programming Guide* (Agilent Technologies Product Number E4310-91016).**

Using a program

Connect a computer system to Serial A (see "Using Terminal mode" above), and run a program (for example a C program which sends SCPI commands and reacts to responses, or an HP VEE program).

Some example programs are given in Chapter 2 "Programming Examples", and in the *OTDR Programming Guide* (Agilent Technologies Product Number E4310-91016).

Using the HP/Agilent OTDR Toolkit software

If you have a PC running Windows 3.11, 95, or NT, you can also operate the Rack OTDR with the HP E6090A OTDR Toolkit or the Agilent Technologies E6091A OTDR Toolkit 2 software.

For more details about the Agilent OTDR Toolkit software, please contact your Agilent supplier, or consult the *Agilent Technologies OTDR Toolkit 2 Operating Instructions* (E6091-91013).

NOTE	**Chapter 2 "Programming Examples" gives some examples of programming the Rack OTDR.**

1.5 How to Operate a Second Instrument from the Rack OTDR

You can use the Rack OTDR to operate any instrument with a serial interface equal to the Rack OTDR serial B (RS232 or RS485 depending in the option number of your Rack OTDR).

For example, you can use an RS232 serial interface to connect the Rack OTDR to a second OTDR (if you do not have option 006). Attach a PC to Serial A and the second instrument to serial B of the Rack OTDR.

Configure serial B according to the second instrument. See "Instrument Configuration" on page 41.

Now, if you enter the SCPI command SYSTem:BRIDge, all SCPI characters are sent to the second instrument, whose responses are sent back to Serial A. This continues until you enter #SCPI.

For example, if you enter SYST:BRID, then *IDN?, you receive the identification string for the instrument attached to serial B.

1.6 How to Connect an RS 485 Cable

If you have option 006, you can connect an RS485 cable to serial B (see "Interfaces" on page 36).

Serial B has 9 pins (male), which you can number 1 to 9 from the top left pin (Figure 1-13).
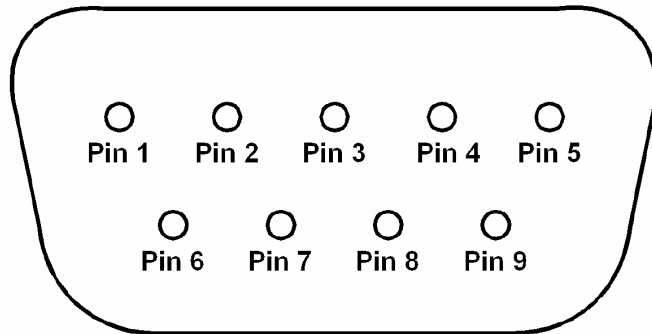
Figure 1-13   **Serial Connector Pins (view towards Serial B on the front panel)**

The way you connect the RS485 depends on whether you have a 2 wire RS485 or a 4 wire RS485.

Figure 1-14 shows how you should connect a 2 wire device to a single device,.
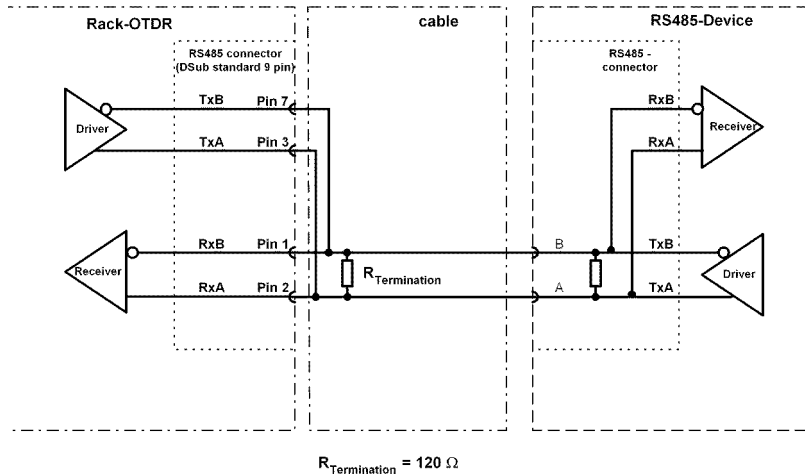
$R_{Termination} = 120\ \Omega$

Figure 1-14   **Two wire RS485 - connection to a single RS 485 device.**

NOTE   **If you are using a 2-wire RS485 line with 2 devices on it, you must make a termination using a resistor of R = 120 Ω (see Figure 1-14).**

You may also make AC-coupled terminations (typically realized with a 120 Ω resistor in serial with a 100nF capacitor instead of a single resistor).

Figure 1-15 shows how you should connect a 4 wire device to a single device.
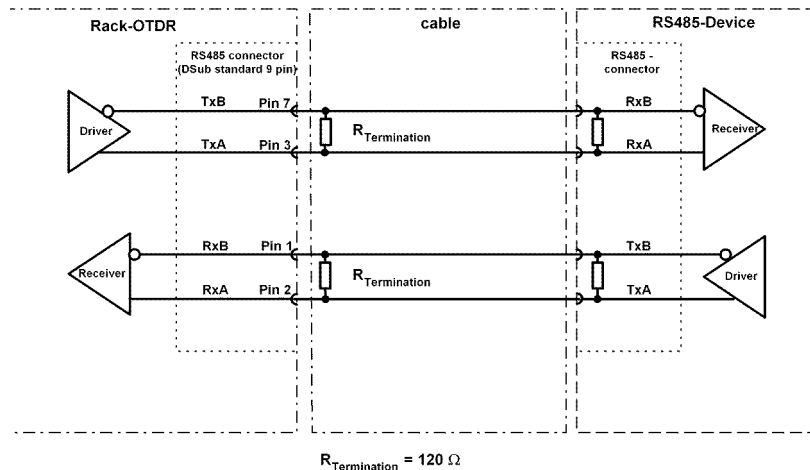
Figure 1-15 **Four wire RS485 - connection to a single RS 485 device.**

NOTE **If you are using a 4-wire RS485 line with 2 devices connected on it, you must use two termination resistors (see Figure 1-15).**

NOTE **Please ensure that the RS485 lines are terminated at both ends. For a 2 wire RS485 line you need 2 terminations, and for a 4 wire 485 line, you need 4 terminations.**

Terminations are typically realized in parallel, by resistors of 120 Ω (see Figure 1-14 and Figure 1-15). You may also make AC-coupled terminations (typically realized with a 120 Ω resistor in serial with a 100nF capacitor instead of a single resistor).

You must ensure that each RS485 line contains the same kind and the correct amount of terminations (2 terminations for 2 wire, 4 terminations for 4 wire.

Some RS485 devices may already have built-in termination resistors.

A

**Installation and
Maintenance**

Installation and Maintenance

This appendix provides installation instructions for the Rack OTDR. It also includes information about initial inspection and damage claims, preparation for use, packaging, storage, and shipment.

A.1 Safety Considerations

When the Rack OTDR is ordered without Option 004, this is a Safety Class 3 instrument (no protective earth command and DC input voltages less than 60V DC).

NOTE

When the Rack OTDR has option 004 (externally mounted DC/DC converter), and the Rack and DC/DC switcher are in use, the system complies to Safety Class 1 (for instruments provided with a terminal for protective grounding).

Before operation, review the instrument and manual for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

A.2 Initial Inspection

Inspect the shipping container for damage. If there is damage to the container or cushioning, keep them until you have checked the contents of the shipment for completeness and verified the instrument both mechanically and electrically.

Appendix D "Performance Tests" gives a procedure for checking the operation of the instrument.

If the contents are incomplete, mechanical damage or defect is apparent, or if an instrument does not pass the operator's checks, notify the nearest Agilent Technologies office.

WARNING

To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer housing.

Internal Back-Up Battery

This instrument contains a lithium battery. Replacing the battery should be carried out only by a qualified electrician or by Agilent Technologies service personnel.

There is a danger of explosion if the battery is incorrectly replaced. Replace only with the same or an equivalent type (PANASONIC CR 2477). Discard used batteries according to local regulations.

A.3 AC Line Power Supply Requirements

The Agilent Rack OTDR can operate through the supplied AC adapter between 100Vrms and 240Vrms ± 10%, at a frequency in the range from 50 to 60 Hz. The maximum power consumption is 20VA with all options installed.

Line Power Cable

According to international safety standards, the charger has a three-wire power cable.

The type of power cable shipped with each instrument depends on the country of destination. Refer to Figure A-1 for the part numbers of the power cables available.

NOTE	**You only need to use the line power cable to connect to the AC adapter.**

Australia
8120-1369

Denmark
8120-2956

Europe
8120-1689

Great Britain
8120-1351

South Africa
8120-4211

Switzerland
8120-2104

United States
8120-1378
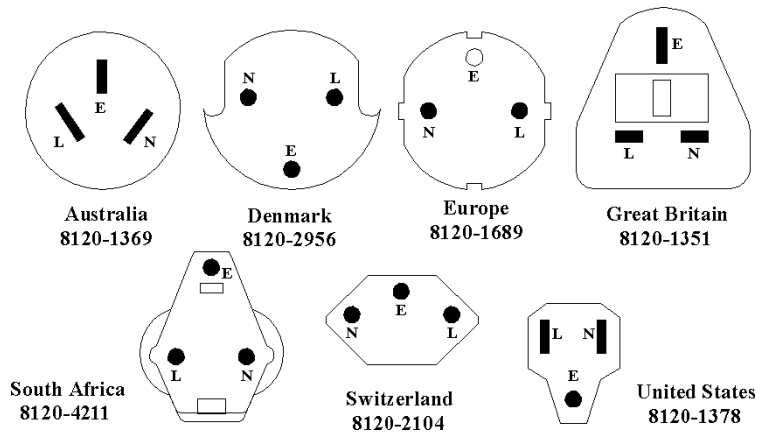
Figure A-1   **Line Power Cables – Plug Identification**

WARNING	**To avoid the possibility of injury or death, you must observe the following precautions before switching on the instrument.**

• **If this instrument is to be energized via an autotransformer for voltage reduction, ensure that the common terminal connects to the earth pole of the power source.**

• **Insert the power cable plug only into a socket outlet provided with a protective earth contact. Do not negate this protective action by the using an extension cord without a protective conductor.**

The following work must be carried out by a qualified electrician. All local electrical codes must be strictly observed. If the plug on the cable does not fit the power outlet, or if the cable is to be attached to a terminal block, cut the cable at the plug end and rewire it.

The color coding used in the cable depends on the cable supplied. If you are connecting a new plug, it should meet the local safety requirements and include the following features:

- Adequate load-carrying capacity (see table of specifications).

- Ground connection.

- Cable clamp.

WARNING   **The AC power supply is for indoor use only.**

A.4 DC Power Supply Requirements

WARNING   **When using a DC line supply, before switching on the instrument, make sure that the supply meets the local protection requirements.**

The Agilent Rack OTDR can operate from a DC power source that supplies between 16V and 24V. Typical power consumption is below 10W.

The maximum power consumption is 20VA (20W) with all options installed.

NOTE   **If you have option 004 (DC/DC Adapter), see also "Power Supply Requirements" on page 189.**

A.5 Operating and Storage Environment

The following summarizes the Agilent Rack OTDR operating environment ranges. In order for the Rack OTDR to meet

specifications, the operating environment must be within these limits.

Temperature and Humidity

Protect the instrument from temperature extremes and changes in temperature that may cause condensation within it.

The temperatures and the humidity for the Agilent Rack OTDR are given in the table below.

	Operating Temperature	**Storage Temperature**	**Humidity**
All/Complete Systems	0°C to 50°C	-40°C to 60°C	95% at 0°C to 40°C

Altitude

The Agilent Rack OTDR can be used up to 3300m (10800ft.)

Installation Category

The Agilent Rack OTDR has an Installation Category II and Pollution Degree 2 according to IEC 664

NOTE	**The AC Adapter is for indoor use only**

A.6 Parallel Interface

This is a CENTRONICS type parallel port for a parallel printer, with a DB-25 connector.

If you do not use an Agilent Technologies C3801-80073 Centronics cable, the EMI performance of the optical time domain reflectometer cannot be guaranteed.

A.7 Serial Interfaces

If your Rack OTDR has the option 006, there is one AT-compatible RS232 port with a DB9 connector (serial A) and one four wire RS485 port with DB9 connector (serial B).

Otherwise, there are two ST-compatible RS232 ports with DB9 connectors (serial A and serial B).

If you do not use an Agilent Technologies 5180-2477 RS232 cable or the RS232 cable supplied with the rack, the EMI performance of the optical time domain reflectometer cannot be guaranteed.

A.8 Analog CRT interface

There is an analog CRT interface with a DB15 connector. This port delivers VGA-resolution (640 x 480 dots at 62 Hz).

The EMI performance of the Optical Time Domain Reflectometer cannot be guaranteed if you do not use a recommended cable and monitor (see the note on page 31).

A.9 Keyboard Interface

There is a keyboard interface with a 6 pin mini-Din connector. This port supports standard PS2 and AT keyboards with a mini-D/N connector.

The EMI performance of the Optical Time Domain Reflectometer cannot be guaranteed if you do not use a recommended keyboard (see the note on page 31).

A.10 Claims and Repackaging

If physical damage is evident or if the instrument does not meet specification when received, notify the carrier and the nearest Agilent Technologies Service Office. The Sales/Service Office will arrange for repair or replacement of the unit without waiting for settlement of the claim against the carrier.

Return Shipments to Agilent Technologies

If the instrument is to be shipped to an Agilent Technologies Sales/ Service Office, attach a tag showing owner, return address, model number and full serial number and the type of service required.

The original shipping carton and packing material may be reusable, but the Agilent Technologies Sales/Service Office will provide information and recommendation on materials to be used if the original packing is no longer available or reusable.

General instructions for repacking are as follows:

- Put the Rack OTDR in the packaging provided. The packaging has the following part number:

E6050-49301	Cushion convoluted

- The shipping box uses single wall corrugated carton (Material 1.40 per DIN 55468), which is the equivalent of 200-pound bursting strength material.

- Inside the shipping box are 2 inserts. One insert is a folded separator to keep the power supply and the power cord. The second insert goes around the packaging. It is a corrugated part including convoluted foam on the outer side.

- If you do not have the original shipping box you must use an appropriate shock absorbing material.

- Seal the shipping container securely.

- Mark the shipping container FRAGILE to encourage careful handling.

- In any correspondence, refer to the instrument by model number and serial number.

CAUTION	**If you use foam to pack the box, make sure you use a soft foam. EPS and most other foams may be too hard.**

A.11 Installing New Firmware

To install firmware on the Rack OTDR, you need the following facilities:

- A PC running WIndows 3.11, 95, or NT, with a free serial port and hard disk space of at least 4 Mb.

- A serial cable.

Install the firmware following the instructions supplied with your upgrade kit

B

Accessories

Accessories

The Agilent Technologies Rack OTDR is a high performance time domain reflectometer. It is available in various configurations for the best possible match to the most common applications.

This appendix provides information on the available options and accessories.

B.1 Instrument and Options

Agilent Product No.	Opt	Description
E6053A		**1310/1550 nm High Performance Rack OTDR**
	002	Connector Interface
	003	Pigtail 3m with SC connector
	022	Angled contact output connector
E6058B		**1310/1550nm Ultra High Performance Rack OTDR**
	002	Connector Interface
	003	Pigtail 3m with SC connector
	022	Angled contact output connector
E6059A		**1550 nm High Performance Rack OTDR**
	002	Connector Interface
	003	Pigtail 3m with SC connector
	022	Angled contact output connector
E6059B		**1550 nm Ultra High Performance Rack OTDR**
	002	Connector Interface
	003	Pigtail 3m with SC connector
	022	Angled contact output connector
E6060A		**1625 nm Ultra High Performance Rack OTDR**
	002	Connector Interface
	003	Pigtail 3m with SC connector
	022	Angled contact output connector

Agilent Product No.	Opt	Description
E6062A		**1550/1625nm Ultra High Performance Rack OTDR**
	002	Connector Interface
	003	Pigtail 3m with SC connector
	022	Angled contact output connector
E6006A		Optical Power Meter submodule
E6007A		Visual Fault Finder submodule

Support Options

For all Agilent OTDR modules, the following support options are available.

W30	3 years of Customer Return Repair Service
W32	3 years of Customer Return Calibration Service
W50	5 years of Customer Return Repair Service
W52	5 years of Customer Return Calibration Service

All modules come with a commercial calibration certificate.

Accessories supplied

The following accessories are supplied with your Rack OTDR:

E6050-91011	Rack-OTDR User's Guide
E4310-91016	OTDR Programming Guide
	AC/DC power supply
	Upgrade CD

RS232 cable, 9-pin to 9-pin	
Rack Mount kit	

Other Accessories

The following accessories are also available. To order these products, please contact your Agilent Technologies representative.

Product	Description
E6000-68951	2 MByte SRAM Card
C2950A	Centronics cable
24542U	RS232 cable, 9-pin to 9-pin
0950-2813	Flash disk
E6000-61901	Keyboard

B.2 Connector Interfaces and Other Accessories

The Rack OTDR is usually supplied with a straight contact output connector interface.

Straight Contact Connector

To connect to the instrument, you must

1 attach your connector interface (see list of connector interfaces below) to the interface adapter,

2 then connect your fiber.

HP/Agilent Model No.	Description
81000AI	Diamond HMS/10 connector interface
81000FI	FC/PC/SPC connector interface
81000GI	NEC D4 connector interface
81000HI	E-2000 connector interface
81000KI	SC connector interface
81000NI	FC/APC connector interface
81000SI	DIN 47256 / 4108connector interface
81000VI	ST connector interface
81000WI	Biconic connector interface

B.3 Related Agilent Literature

Agilent Part Number	Title
5963-3538F	Cleaning Procedures for Lightwave Test and Measurement Equipment pocket guide
E6000-91017	OTDR Pocket Guide
E4310-91016	OTDRs Programming Guide

C

Specifications

Specifications

Specifications describe the instrument's warranted performance, measured with typical PC-type connectors. Uncertainties due to the refractive index of fiber are not considered.

The chapter contains both Specifications and Characteristics:

- *Specifications* describe the instrument's warranted performances.

- *Characteristics* and *typical data* provide information about the non-warranted instrument performance.

The Agilent Technologies Rack OTDR is produced to the ISO 9001 international quality system standard as part of Agilent's commitment to continually increasing customer satisfaction through improved quality control.

C.1 Definition of Terms / Measurement Conditions

Generally, the wavelengths are given by the specific OTDR module. Therefore, the measurement conditions do not contain the wavelength. Unless otherwise limited, all specifications are valid for the specified environmental conditions.

All data presented in the ± form are to be understood as peak-to-peak variation divided by 2.

Attenuation deadzone

The distance from the start of a reflective event to the point where the receiver has recovered to within a ±0.5 dB margin around the undisturbed and averaged backscatter trace.

Conditions: Reflective, lossless event with specified reflectance, at specified instrument settings.

±0.5 dB margin around averaged backscatter trace

Attenuation Deadzone

Distance
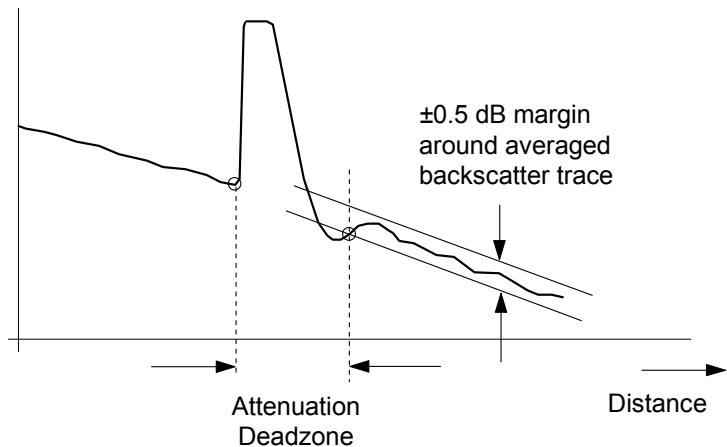
Figure C-1   **Attenuation deadzone definition**

Backscatter coefficient

The ratio of the optical pulse power (not energy) at the OTDR output to the backscatter power at the near end of the fiber ($z = 0$). This ratio is inversely proportional to the pulse width, because the optical pulse power is independent of the pulse width. The ratio is expressed in dB.

NOTE

A typical value is approximately 50 dB for 1 µs pulse width, depending on the wavelength and the type of fiber. The extrapolated backscatter trace is a measure of the near-end backscatter power. See Figure C-2.

Extrapolated backscatter trace
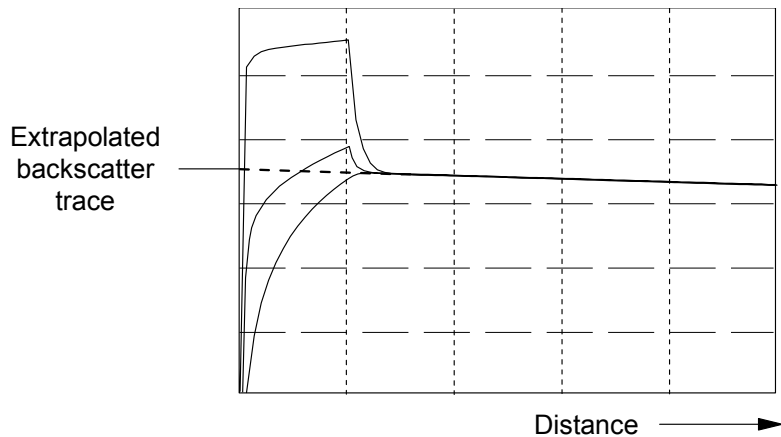
Distance

Figure C-2   **Determining the near-end backscatter level for three different near-end reflectances**

Backscatter linearity (longitudinal uniformity)

For a fiber with a constant attenuation coefficient (in other words, the attenuation is proportional to the length of fiber) the difference between the displayed OTDR trace and its least square approximation line.

Conditions: Continuous fiber with no discrete losses, for a power range from the beginning of the backscatter signal to the point where the specified →signal-to-noise ratio is reached, at specified instrument settings.

Center wavelength

The center wavelength is defined as the spectral center of gravity, at specified operating conditions:

$$\lambda_c \quad = \quad \frac{\sum P_i\ \lambda_i}{\sum P_i}$$

where:

P_i = power levels of the individual longitudinal lines

λ_i = wavelengths of the individual longitudinal lines

Distance accuracy

The largest error of the OTDR's distance measurement result.

Conditions: Generally, all distance accuracy specifications apply to reflective events only. For non-reflective events, an increased uncertainty applies because of the difficulty of locating the event precisely.

NOTE **Based on the IEC error model, the distance error depends on the distance and is given by the absolute value of the sum of three quantities:**

$$\Delta L\ (L) \quad = \quad \pm \left(\left| \Delta L_0 \right| + \left| \Delta S_L \right| \cdot L + \left| \Delta R \right| \right)$$

where

L = actual (true) distance

ΔL_0 = distance offset error

ΔS_L = distance scale error

ΔL_S = distance sampling error
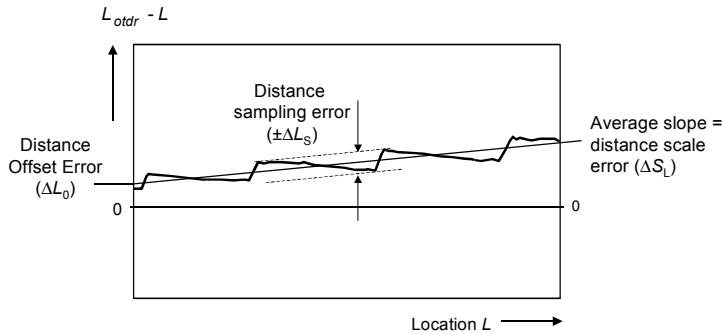
Figure C-3   Elements of the distance error $(L_{OTDR}$ = position measured with OTDR, L = actual position)

NOTE   **The distance uncertainty does not include the uncertainty of the $\rightarrow$group of the fiber under test, because the OTDR measures transit times and calculates distances by division by the user-defined fiber's group refractive index.**

Distance offset error

The displayed location of the OTDR's front panel connector on the instrument's distance scale, in meters. Symbol ΔL_0. See Figure C-3.

Condition: A possible influence from finite distance sample spacing is excluded.

Measurement: Select Optimize Resolution for best accuracy. Since the precise location of the front panel connector is usually not directly accessible, use a short reference fiber (for example, 100 m, to exclude any influence from distance scale error) with known length L and open end to create a reflective event. Then measure the

length of the fiber by determining the location of the reflective event L_{OTDR} as shown in Figure C-4. Then calculate the distance offset error ΔL_0 by subtracting the measured length from the known length, L.

$$\Delta L_0 = L_{ref} - L_{OTDR} \qquad \text{where} \qquad L = \frac{c\,T}{N}$$

and:

L = known length of the fiber = $(c\,T)/N$.

c = speed of light in vacuum

T = time of flight between the two locations on the reference fiber, measured at the wavelength of the OTDR

N = group index of the fiber (use the OTDR's →group index setting)

L_{OTDR} = the distance measured with the OTDR, at the given →group index setting

The influence of the finite sample spacing can be excluded by inserting additional fibers. Their lengths must be chosen so that they don't coincide with multiples of the distance sample spacing.

For each combination, use the total length of fiber to determine the distance offset error. Finally, average all distance offset results.

Best approximation to location of reflection =
last point on backscatter trace + 1/2 sample spacing
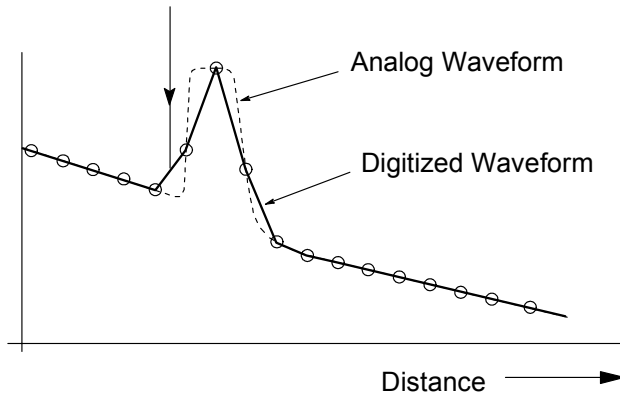
Figure C-4   **Determining the location of a reflective event**

Distance sampling error

The →distance uncertainty due to finite distance sample spacing, expressed as ±half the span between the maximum and minimum excursions from the straight line model, in meters. Symbol: ΔL_S. See Figure C-3.

Measurement: The measurement is similar to the measurement of distance offset error. Divide the calculated distance sampling interval in at least four distance increments and prepare incremental fibers to cover all these increments. For example, to divide a sampling interval of 10 m into 4 intervals, one needs two incremental fibers of 2.5 m and 5 m to generate increments of 2.5 m, 5 m and 7.5 m. Add each combination of incremental fibers to

the length L as described in clause "distance scale error" and record the individual differences

$$\Delta S_{L,i} \quad = \quad L_{otdr} - (L + i\,D)$$

where

L = known length of the fiber = $(c\,T)/N$.

i = current increment

D = length of the smallest increment (i.e. the difference between the increments).

Then calculate the distance sampling error ΔL_S by subtracting the smallest value of the $\Delta L_{S,i}$ set from the largest one. Express the result as ±half the difference.

Distance scale error

The difference between the average displayed distance between two distinct locations on the fiber, L_{OTDR}, and the correspondent actual (true) distance, L, divided by the actual distance, in meters per meter. See Figure C-3.

$$\Delta S_L \quad = \quad \frac{L_{otdr} - L}{L} \quad \text{where} \qquad L \quad = \quad \frac{cT}{N}$$

.and

c = speed of light in vacuum

L_{OTDR} = the distance measured with the OTDR, at the given OTDR group index setting

T = time of flight between the two locations on the fiber, measured at the wavelength of the OTDR

N = OTDR group index setting

NOTE	*R*elatively long lengths of fibers, for example, 10 km, are to be used to evaluate the distance scale error, in order to remove the influence from finite distance sampling spacing.

NOTE	The distance scale error excludes the uncertainty of the fiber's group index, *N*, because the same *N* is used in the calculation of *L* and L_{OTDR}.

Measurement: Measure the time of flight, *T*, with a pulse generator, a laser source, an opto-electronic converter, and a time interval counter by determining the time difference with and without the fiber of length *L* inserted. The laser source should have the same wavelength as the OTDR.

Dynamic range (RMS)

The amount of fiber attenuation that causes the backscatter signal to equal the →noise level (RMS).

Measurement: It is recommended to connect a standard single mode fiber with a length of more than 20 times the pulse width in meters to the OTDR. Then determine the difference between the extrapolated backscatter trace (as in Figure C-2) and the →noise level (RMS).

Conditions: standard single mode fiber, at specified averaging time, ambient temperature and instrument settings.

Event deadzone

The displayed length of a reflective event from the start to the point where the trace has fallen to 1.5 dB below the peak.

Conditions: Reflective, lossless event with specified reflectance, at specified instrument settings.
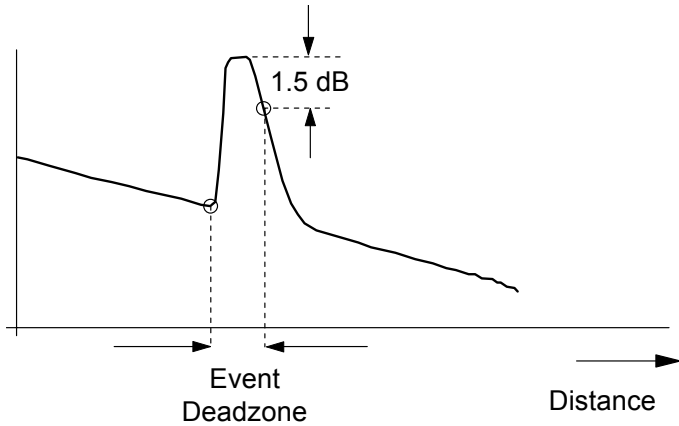
Figure C-5   **Definition of event deadzone**

Group index (of a fiber)

The refractive index of a fiber that corresponds to the velocity of the modulation content (group velocity) of an optical wave in a fiber. The group index is typically slightly higher than the refractive index of the fiber, because the group velocity is slightly lower than the speed of light in vacuum divided by the refractive index of the fiber. Symbol: *N*.

NOTE   **The group index setting of the OTDR will influence all distance measurements.**

Loss accuracy, backscatter measurements (1 dB steps)

The maximum loss error, in dB, for any fiber section with a loss of 1 dB, that is the maximum difference between the displayed loss, A_{otdr}, and actual loss, A, of the section.

$$Loss\ error_{dB} \quad = \quad \max \left\{ A_{otdr} - A \right\}$$

Conditions: Continuous fiber with no discrete losses >1 dB, for a power range from the beginning of the backscatter signal to the point where the specified →signal-to-noise ratio is reached, at specified instrument settings.

Measurement: Connect a long fiber, for example 50 km, to the OTDR and calculate the 1 dB loss error as follows. Generate two undisturbed backscatter traces with a 1 dB vertical difference. Measure this difference, A_{OTDR}, along the length of the fiber. Also, measure the power difference, A, with a calibrated optical power meter. Calculate the loss errors along the length of the fiber and

determine the maximum within specified power range as in the
formula above. See Figure C-6.
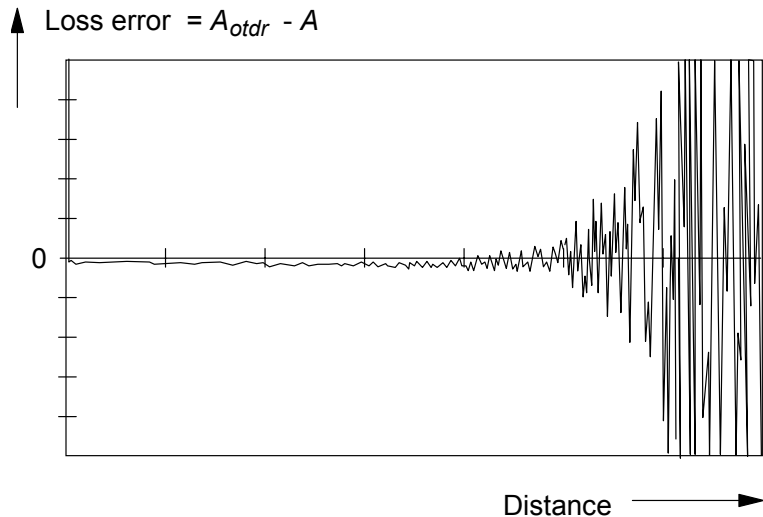
$$\text{Loss error} = A_{otdr} - A$$

Figure C-6   **Loss error samples for 1 dB loss (arbitrary units)**

Loss accuracy, reflectance measurements

The maximum difference between the reflectance of an event as
measured with the OTDR and the actual reflectance of the event.

Conditions: Correct backscatter coefficient for the fiber under test
entered into the OTDR prior to measurement, undisturbed
backscatter trace in front of the reflectance under test, for a given
reflectance range and a power range from the beginning of the
backscatter signal to the point where the specified →signal-to-noise
ratio is reached, at specified instrument settings

Noise level (98%)

The displayed power level such that 98% of the noise data points lie below this level.

Conditions: Noise data points from locations after which the OTDR receiver response disappears in random noise.

NOTE	This definition is needed to relate the →noise level (RMS) to practical measurements.

Noise level (RMS)

The displayed level which corresponds to + one standard deviation of the linear noise amplitude statistics.

Conditions: Noise data points from locations after which the OTDR receiver response disappears in random noise.

NOTE	For purely Gaussian noise statistics, the noise level (RMS) is approximately 1.9 dB below the →noise level (98%).

Output power (CW)

The attainable optical output power in CW mode.

Conditions: Jumper fiber attached to the OTDR port; output power measured with an optical power meter at the end of the jumper fiber.

Output power stability (CW)

Peak-to-peak variation of the output power in CW mode.

Conditions: Jumper fiber attached to the OTDR port; output power stability measured with an optical power meter at the end of the jumper fiber. Warmup-time and observation period as specified. Power meter averaging time 100 ms.

Reflectance accuracy

For the specified reflectance range, the maximum difference between the measured reflectance of a feature on the fiber and actual (true) reflectance, in dB.

Conditions: →signal-to-noise ratio larger than specified value, at specified instrument settings, →backscatter coefficient correctly set for the specific fiber used.

Sample spacing

The distance between consecutive data points.

Signal-to-noise ratio (SNR)

The difference between the actual backscatter level and the →noise level (98%) expressed in dB.

Definition of Terms - Power Meter Submodule

Noise: One half of the peak-to-peak change of displayed power level with constant input power level.

Conditions: Observation time as specified (drift effects excluded).

Power range: The power range is defined from the highest input power level to the smallest input power level that causes a noticeable change of displayed power level.

Conditions: Wavelength and Averaging Time as specified.

Reference conditions: The specified conditions during the spectral responsivity calibration, or conditions which are extrapolated from the conditions during calibration.

Conditions: Power level, beam diameter or fiber type, numerical aperture, wavelength, spectral width, ambient temperature as specified, at the day of calibration.
→Noise and drift observed over 15 min., with a temperature change of not more than 1 K.

Total uncertainty: The uncertainty for a specified set of operating conditions, including noise and drift.

Conditions: Power level, beam diameter or fiber type, numerical aperture, wavelength, spectral width, ambient temperature, recalibration period as specified.
→Noise and drift observed over 15 min., with a temperature change of not more than 1 K.

Definition of Terms - Visual Fault Finder Submodule

Output Power Level (CW) The output power at the specified wavelength, measured at the end of a jumper cable.

Center Wavelength The wavelength representing the center of mass of selected peaks. The power and wavelength of each used to calculate the mean wavelength $\overline{\lambda}$:

$$\overline{\lambda} = \Sigma\, P_i\, \lambda_i\, /\, \Sigma\, P_1$$

where: P_i is the power of a single peak.

C.2 Characteristics

Horizontal Parameters

- **Start:** 0 km to 400 km
- **Span:** 0.1 km to 400 km
- **Readout resolution**: 0.1 m
- **Minimum sample spacing:** 8 cm
- **Refractive index:** 1.00000 to 2.00000
- **Length unit:** km, ft, or miles
- **Measurement points:** up to 16000

Vertical Parameters

- **Vertical Scale**: 0.1 to 10.0 dB/Div
- **Readout resolution**: 0.001 dB
- **Reflectance range**: -14 dB to -60 dB

- **Backscatter coefficient:** 10 to 70 dB at 1 μs

Source Mode

- **CW Output power level**: -3 dBm

- **CW stability (15 min., T=constant after 10 minute warm-up)**: ±0.1 dB (±0.15 dB @ 1625 nm)

- **Modulation**: 270 Hz, 1 kHz, and 2 kHz squarewave.

Output Connector

- Optional Diamond HMS-10, FC/PC, DIN 47256, E2000, ST, FC/APC, Biconic, SC, NEC D4. All options are user-exchangeable.

Storage

- **Memory Card:**
  - PCMCIA Type II. SRAM up to 2 MB.
  - PCMCIA Type II. Flash Disk up to 20 MB.

- **Internal memory:** up to 200 traces (typical with 4000 data points selected).

- **Trace format:** Bellcore compliant to according Bellcore/Telcordia
  OTDR trace formats:
  - GR 196, Revision 1.0
  - GR 196, Revision 1.1
  - SR-4731, Revision 2

- **Flash disk:** 440 MB, with up to 13000 traces.

- **Trace Information:** five comment labels of up to 15 alpha-numeric characters, and five comments of up to 41 alpha-numeric characters are provided for each trace.

Scan Trace

- **Type of events:** reflective and non-reflective.

- **Maximum number of events:** 100.

- **Threshold for non-reflective events:** 0.0 to 5.0 dB, selectable in 0.01 dB steps.

- **Threshold for reflective events:** -14.0 to -65.0 dB, selectable in 0.1 dB steps, and 0.00dB (disabled).

- **Threshold for fiber breaks:** 0.1 to 10 dB, selectable in 0.1 dB steps, and 0.00dB (disabled).

Interfaces

There are two ST-compatible RS232 ports with DB9 connectors (serial A and serial B)

- **RS232C:** maximum baud rate: 115200 bps

  Transmission time at 115200 bps for trace data:
    1s (4000 data points); 4s (16000 data points)

- **Serial B RS232C**: can be used for optical switch control. This interface can be configured as RS485 (option 006).

- **Centronics:** standard parallel port (SPP).

- **CRT**: Standard analog VGA monitor

- **Keyboard**: PS2 (Mini-DIN). For English Standard, PS2, or AT keyboard (see note on page 31).

There is an analog CRT interface with a DB15 connector. This port delivers VGA resolution: 640 x 480 dots at 62 Hz (see note on page 31).

General

- **Laser Safety Class:** 21 CFR Class 1, IEC 825 Class 3A

- **Recommended recalibration period:** 2 years.

Appendix C. Specifications

- **Dimensions:** ca. 75 mm H, 194 mm D, 290 mm W (3" x 8" x 11.6").
  Rack mount kit width: 482mm (19")

- **Weight:** net 2.3 kg (5.1 lbs).

- **Traffic detection:** provided

- **Real time clock and date:** provided

- **Automatic setup and analysis**: provided

- **Instrument settings**: storage and recall of user-selectable instrument settings

Built-in Applications

- Automatic Multifiber test

- Pass/Fail Test

- Optical Return Loss

- Fiber Break Locator

Environmental

See "Operating and Storage Environment" on page 54

Power

See "AC Line Power Supply Requirements" on page 52 and "DC Power Supply Requirements" on page 54.

Submodule Port

The Rack OTDR includes a slot for the submodules of the E6000A program.

The E6006A Powermeter or E6007A Visual Fault Finder can be controlled with the remote (SCPI) commands or via CRT/keyboard.

C.3 Specifications/Characteristics

Specifications: Optical Performance

(see note 1)

Module	E6053A	E6058B
Central Wavelength	1310/1550 ±25 nm	1310/1550 ±25 nm
Fiber type	single-mode	single-mode
Pulsewidth	10ns 100ns 1µs 10µs 20µs	10ns 100ns 1µs 10µs **20µs**
Dynamic Range[2] [dB]	19/17 24/22 30/29 35/34 n/a	24/22 29/27 35/34 42/41 **45/43**
Event Deadzone[3]	5 m (**3 m**)	5 m (**3 m**)
Attenuation Deadzone[4]	**10/12 m**	**10/12 m**
Attenuation Deadzone[5]	20/25m	20/25m

Module	E6059A	E6059B
Central Wavelength	1550±25 nm	1550±25 nm
Fiber type	single-mode	single-mode
Pulsewidth	10ns 100ns 1µs 10µs **20µs**	10ns 100ns 1µs 10µs **20 µ**
Dynamic Range[2] [dB]	17 22 29 37 **39**	22 27 34 41 **43**
Event Deadzone[3]	5 m (**3 m**)	5 m (**3 m**)
Attenuation Deadzone[4]	**12 m**	**12 m**
Attenuation Deadzone[5]	25 m	25 m

Specifications/Characteristics

Module	E6060A					E6062A				
Central Wavelength	1625±20 nm					1550/1625 ± 25/20 nm				
Fiber type	single-mode					single-mode				
Pulsewidth	10ns	100ns	1μs	10μs	20μs	10ns	100ns	1μs	10μs	**20μs**
Dynamic Range[2] [dB]	18	24	30	37	n/a	22/18	27/24	34/30	41/37	
				40					/40	43/ -
Event Deadzone[3]	5 m (**3 m**)					5 m (**3 m**)				
Attenuation Deadzone[4]	**14 m**					**12/14 m**				
Attenuation Deadzone[5]	28 m					25/28 m				

In all Agilent OTDR single-mode modules, the following pulsewidths are selectable:

- 10 ns, 30 ns, 100 ns, 300 ns, 1 μs, 3 μs, 10 ʊs

20 μs is selectable with the E6058B, E6059A, E6059B, and the E6062A at 1550 nm

All Agilent OTDR modules are equipped with a CW Source capability at the selected wavelength.

Distance Accuracy [6]

Offset Error: ± 1 m
Scale Error: ± 10^{-4}
Sampling Error: ± 0.5 sampling spacing

Loss/Reflectance Accuracy [7]

Backscatter Measurements   ± 0.05 dB (1dB step)
Reflectance Measurements [8]   ± 2.0 dB, typical

Notes:

1 Guaranteed specification measured at 22 °C ± 3 °C. Bold values are typical specifications.

2 Measured with a standard single-mode fiber at SNR=1 noise level and with 3 minutes averaging time. Optimize mode: dynamic

Specifications/Characteristics

3 Reflectance ≤ -35 dB at 10 ns pulsewidth, and with span ≤ 4 km, Optimize mode: resolution.

Typical specification at Reflectance ≤ -35 dB at 10 ns pulsewidth, and with span ≤ 400 m at 8 cm sample spacing. Optimize mode: resolution.

4 Typical specification at reflectance ≤ -50 dB at 30 ns pulsewidth, and with span ≤ 4 km.

5 Guaranteed specification at reflectance ≤ -35 dB at 30 ns pulsewidth, and with span ≤ 4 km. Optimize mode: Resolution

6 Distance accuracy = offset error + scale error*distance + sampling error.

7 SNR ≥ 15 dB and with 1 μs, averaging time max. 3 minutes.

8 -20 dB to -60 dB

C.4 Agilent Technologies E6006A Power Meter Submodule

Characteristics

Sensor element:	InGaAs
Wavelength range:	800 - 1650 nm
Calibrated wavelengths:	850 nm, 1300 nm, 1310 nm, 1550 nm (special wavelength on request).
Power range:	+10 to -70 dBm
Max. input power (damage level)	+13 dBm / 20 mW
Display Resolution	0.01 dB
Display Units:	dBm, dB, mW, µW, nW, pW
Display Contents:	Calibrated λ in nm Modulation frequency in Hz Reference value in dB
Display Updates per second	3
Optical input:	User-exchangeable Connector Interface
Applicable fiber type	9/125 µm, 50/125 µm, 62.5/125 µm

Specifications

Uncertainty at reference conditions: ± 3%

> **Power level**: -20 dBm
> **Continuous wave** (CW)
> **Wavelength**: 1300±3 nm, 1310±3 nm, 1550±3 nm
> **Fiber type**: 50/125 µm graded index, Agilent/HMS-10
> connector
> **Spectral bandwidth**: up to 10 nm
> **Ambient temperature**: +18 to +28 °C
>
> **At day of calibration** (add 0.3% for aging of over one year;
> add 0.6% for aging of over two years).

Total uncertainty: ±5% ± 0.5 nW (1300, 1310, 1550 nm)
±10% ± 2.5 nW (850 nm)

> **Power level**: +0 to -50 dBm
> **Continuous Wave** (CW)
> **Wavelength**: 850±3 nm, 1300±3 nm, 1310±3 nm, 1550±3 nm
> **Fiber type**: SM to 50 µm graded index
> (add 2% to total uncertainty for fiber 62.5 µm).
> **Straight and angled connectors**
> **Ambient temperature**: +10 to +40 °C
>
> **Within 2 years after calibration**

Supplementary Performance Characteristics

- Automatic Zeroing Circuitry.

- Automatic Ranging.

- Modulation frequency recognition (270 Hz, 1 kHz, 2 kHz) is
  available at power levels between +10 and -45 dBm (peak
  amplitude).

Appendix C. Specifications

Agilent Technologies E6006A Power Meter Submodule

- Wavelength encoding recognition (350 Hz, 550 Hz) is available at power levels between +10 and -45 dBm (peak amplitude).

- Dual Wavelength measurement is available at power levels between +10 and -45 dBm (peak amplitude).

- Reference value is presettable from +30 to -80 dBm.

- Each calibrated wavelength has its own reference memory.

- The actual display content can be transferred to reference memory (DISP → REF).

- Hold Data functionality.

General Specifications:

Dimensions: ca. 120 mm H x 40 mm W x 25 mm D
(4.7" x 1.6" x 1.0")

Weight: < 130 g.

Operating Temperature: 0 to +50 °C

Storage Temperature: -40 to +60 °C

Humidity: 95% R.H. from 0 °C to 40 °C non cond.

Recommended Recalibration Period: 2 years

C.5 Agilent Technologies E6007A Visual Fault Finder Submodule

Characteristics

Source type: Laser diode

Center Wavelength: 635 nm ± 10 nm (visible red light)

Output power level (CW): 0 dBm maximum

**Output power level (CW)
into 9 μm fiber (typ.):** -3 dBm

Detection range: up to 5 km

Optical output: User-exchangeable Connector Interface

Laser Class II (21 CFR 1040), Class II (IEC 825-1)

Supplementary Performance Characteristics

- Continuous Wave and Blink Mode (1 Hz for better visibility).

- Single-Mode and multimode fibers applicable.

General Specifications:

Dimensions: ca. 120 mm H x 40 mm W x 25 mm D
(4.7" x 1.6" x 1.0")

Weight: < 100 g.

Operating Temperature: 0 to 40 °C

Storage Temperature: -40 to +60 °C

Humidity: 95% R.H. from 0 °C to 40 °C non cond.

C.6 Declaration of Conformity

Declaration of Conformity

DECLARATION OF CONFORMITY   C E
According to ISO/ IEC Guide 22 and CEN/ CENELEC EN 45014

Manufactur er' s Name: Agilent Technologies Deutschland GmbH
Man ufacturer's Ad dress: Optical Communication Measurement Division (OCMD)
                             Herrenberger Str. 130
                             D- 71034 Boeblingen

Decla res, tha t the pr oduct

Prod uct Name :	Rack -OTD R	
Mod el Numb er:	E6053A [1]	1310 nm/1 550 nm single-m ode Rack-OTDR
	E6058A [1]	1310 nm/1 550 nm single-m ode Rack-OTDR
	E6058B	1310 nm/1 550 nm single-m ode Rack-OTDR
	E6059A	1550 nm single-m ode Rack-OTDR
	E6059B	1550 nm single-m ode Rack-OTDR
	E6060A [1]	1625 nm single-m ode Rack-OTDR
	E6062A	1550 nm/1 625 nm single-m ode Rack-OTDR
Product Mo dules:	E6006A	Optical Power Meter module
	E6007A	635 nm Visual fault finder module

Conforms wit h the fo llowin g European Direct ives:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/E EC and the EMC Directive 89/336/E EC (inc luding 93/68/E EC) and carries the CE Marking accordingly.

Conf orms w ith the f ollow ing pr oduct s tandards:

	Stan dard	Limit
EMC	IEC 61326-1:1997+ A1:1998 / E N 61326-1:1997+ A1:1998	
	CISPR 11:1997 / EN 55011:1998	Group 1 Class A
	IEC 61000-4-2:1995+ A1:1998 / E N 61000-4-2:199 5	4 kV CD, 8 kV AD
	IEC 61000-4-3:1995 / E N 61000-4-3:1995	3 V/ m, 80-1000 MH z
	IEC 61000-4-4:1995 / E N 61000-4-4:1995	0.5 kV signal lines, 1 kV power lines
	IEC 61000-4-5:1995 / E N 61000-4-5:1995	0.5 kV line- line, 1 kV line-ground
	IEC 61000-4-6:1996 / E N 61000-4-6:1996	3 V, 0.15-80 MH z
	IEC 61000-4-8:1993 / E N 61000-4-8:1993	30 A/ m
	IEC 61000-4-11:1994 / E N 61000-4-11:19 94	1 cycle/100%
	Canada: ICES-001:1998	
	Australia/ New Zealand: AS/N ZS 2064.1	
Safe ty	IEC 61010-1:1990+ A1:1992+ A2:1995 /	
	EN 61010-1:1993+ A2:1995	
	IEC 60825-1:1993+ A1:1997 / E N 60825-1:1994+ A11:1996	
	Canada: CSA C22.2 No. 1010.1:1992	
	USA: UL 3111-1:1994; FDA 21CFR1040.10	

Supplem enta l Information:

The product was tested in a typical configuration with Agilent Technologies test systems.
[1] FDA accession number 8721422-16

2001- June-21
Date

Hans-Martin Fischer
Name

Product Regulations Engineer
Title

For further information, please contact your local Agilent Technologies sales office, agent or distributor.
Authorized EU-r epresentative: Agilent Technologies Deutschland GmbH, Herrenberger Strasse 130, D-71034 Boebling en, Germany

---

Revision: B   Issue Date: 2001-June -21

Appendix C. Specifications
Declaration of Conformity

D

Performance Tests

Performance Tests

The procedures in this section tests the optical performance of the instrument. The complete specifications to which the Rack OTDR is tested are given in Appendix C "Specifications".

All tests can be performed without access to the interior of the instrument. The performance tests refer specifically to tests using the Diamond HMS-10/Agilent connector.

These Performance Tests assume that you have attached a screen/monitor and a keyboard to your Rack OTDR. See "How to Operate the Rack OTDR from a Monitor and Keyboard" on page 40.

By attaching a keyboard, you can emulate a Mini-OTDR, using the following keyboard keys to emulate the Mini-OTDR hardkeys:

keyboard key	equivalent Mini-OTDR hardkey
<f2>	RUN/STOP
Up arrow	CURSOR UP
Down arrow	CURSOR DOWN
Left arrow	CURSOR LEFT
Right arrow	CURSOR RIGHT
<Enter> or *<Return>*	SELECT
<f1>	HELP

D.1 General

Equipment Required

Equipment required for the performance test is listed below. Any equipment meeting the same specifications can be used.

- Optical Attenuator Agilent 8156A #101
  (Return loss > 40 dB, Repeatability < 0.01 dB).

- Single-mode fiber with 3 dB coupler and known length
  (between 4 and 5 km), for example, the Agilent Technologies
  Recirculating Delay Line (P/N 08145-67900).

- 3× Optical Connector Interface Agilent 81000AI.

- Single-mode fiber: length 25 ± 2 km.

- Keyboard and VGA Monitor

Test Record

Results of the performance test may be noted in the performance test record. The test record can also be used as a permanent record and may be reproduced without written permission from Agilent Technologies.

Test Failure

If the Rack OTDR fails any performance test, return the instrument to the nearest Agilent Technologies Sales/Service Office for repair.

Instrument Specification

Specifications are the performance characteristics of the instrument that are certified. These specifications, listed in Appendix C "Specifications", are the performance standards or limits against that the Rack OTDR can be tested.

Appendix C "Specifications" also lists some supplemental characteristics of the Rack OTDR, and should be considered as additional information.

Any changes in the specifications due to manufacturing changes, design, or traceability to the National Bureau of Standards will be covered in a manual change supplement or revised manual. The specifications listed in such a change supersede any previously published.

Performance Tests

Perform each step in the tests in the order they are given, using the corresponding test equipment.

Make sure that all optical connections in the test setups given in the procedure are dry and clean. For cleaning use the procedure given in Appendix E "Cleaning Information".

D.2 Test I. Dynamic Range

1   Connect the equipment as shown in Figure D-1. Terminate the far end.

The fiber is terminated by wrapping it five times around the shaft of a screwdriver (or some similar object with a diameter of around 5 mm).

If you are using the Agilent Recirculating Delay line, connect port 1 to the Mini-OTDR.

NOTE   **The specific measurement techniques of the Agilent Rack OTDR require a fiber length which is adapted in attenuation and backscatter to the requirements of the selected pulsewidth. The fiber specified for**

this test is of general type and valid for all pulsewidths. A shorter fiber should not be used, as the uncertainty of the measurements would increase by some dB.
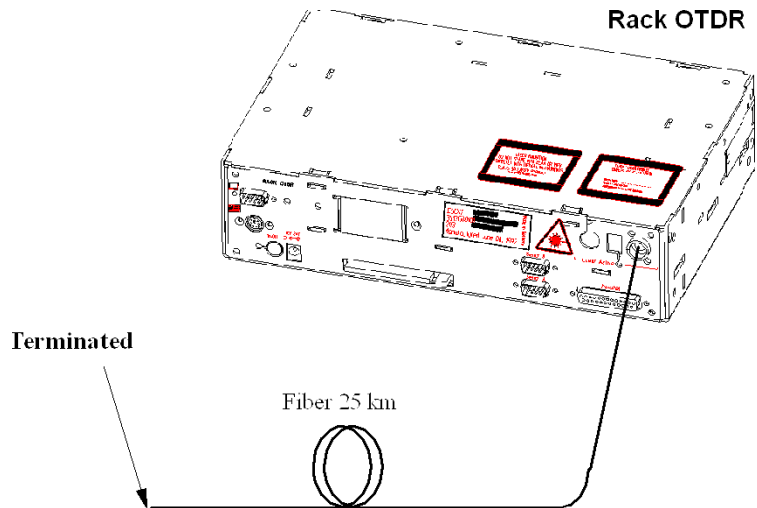
Figure D-1   **Dynamic Range Test Setup**

2 Turn on the OTDR, and after the selftest has passed, recall the default settings.

3 Set the OTDR:

[SETTINGS] menu:

- <RANGE> - select <RANGE INPUT...>:

  Start: - enter value ST from Table D-1. Confirm with <OK>.

  Span: - enter value SP from Table D-1. Confirm with <OK>.

- <PULSE WIDTH>: enter value PW from Table D-1.

- <WAVELENGTH>: If a dual wavelength module is installed, select the required wavelength

- <MEAS. MODE>: Averaging

Test I. Dynamic Range

- <Optimize Mode>: Dynamic
- <Avg. Time>: 3 min

NOTE

If the averaging parameter is listed for Number of Averages, you should do the following:

- **Exit the [Settings] menu**
  Press Ok.
- **Enter the Instrument Config screen.**
  Select [Config.]<Instrument Config>
- **Bring up the OTDR Settings page**
  Select [Page Index]<OTDR Settings>
- **Select Averaging time**
  Move to the Averaging Mode box and press select, select Averaging time from the menu you see.
- **Save this configuration**
  Select Save.
- **Exit the Instrument Config screen**
  Select Ok.
- **Return to the settings screen**
  Select [Settings].

You now see a box for Avg. Time.

[View] menu:
- <Event Table>: OFF
- <Clear V-Offset>
- <Clear H-Offset>
- <Preferences><Dotted Trace>: ON

[Analysis] menu

- <2 PT. LOSS>.

Table D-1	**Pulse Width dependent settings for Dynamic Range Test**				
Pulsewidth	**Start**	**Span distance**	**View start position of marker B**	**View end**	**Viewed distance**
PW	**ST**	**SP**	**Bpos**	**Vend**	**V**
10 µs	0 km	100 km	40 km	60 km	20 km
1 µs	0 km	100 km	40 km	60 km	20 km
100 ns	0 km	50 km	30 km	45 km	15 km
10 ns	0 km	50 km	30 km	45 km	15 km

4 Terminate the fiber, start the measurement and wait until measurement stops.

<f2>, wait while measuring

NOTE **After the measurement has stopped the fiber must not be terminated.**

5 View the complete trace. See Figure D-2.

NOTE	**If you can already see the full trace, please ignore this command**
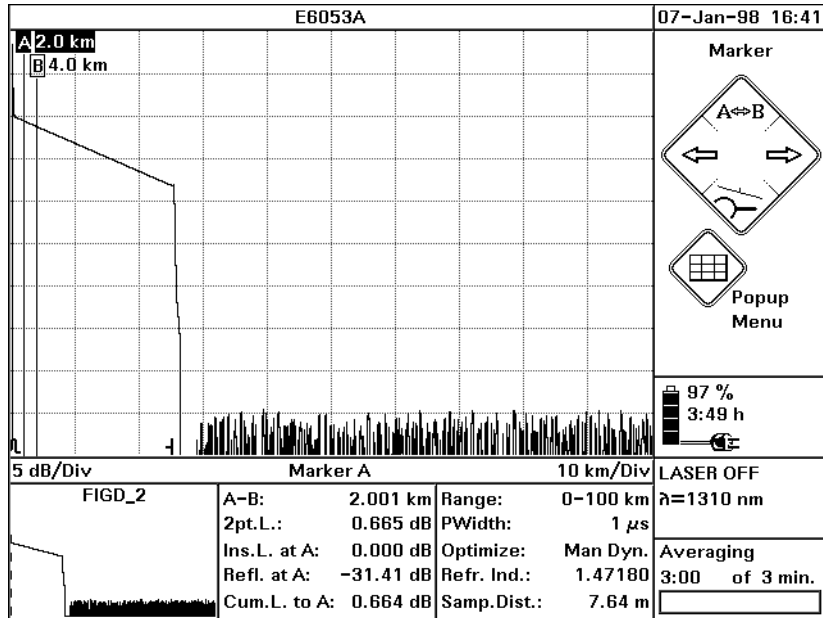
Figure D-2   **Dynamic Range Test: Full Trace View**

6 Use Cursor keys to position marker A and B at 2.5 km ± 0.5 km

7 Select marker B
UP until only B is highlighted.

8 Zoom to 0.5 dB/Div and 500m/Div
[ZOOM], then use cursors.
The current zooming figures are written below the trace to the left and right hand side.

9 Select offset

Appendix D. Performance Tests
Test I. Dynamic Range

[VIEW]<ADJUST V-OFFSET>

10 Offset the trace until the extrapolated beginning of the backscatter is on a horizontal grid line. The extrapolated beginning of the backscatter is the level that the backscatter would reach if it was continued back to 0 km from the OTDR, that is if there was no initial reflection.

Use the Left and Right cursors to offset by large increments, and the Up and Down cursors to 'fine tune'.

11 Close Offset

<SELECT>

12 Select Marker A

UP until only A is highlighted.

13 Use the cursor keys to position marker A at the end of the front reflection on the level of the extrapolated beginning of the backscatter (that is, the crossing of the frontreflection and the

horizontal grid line).

Figure D-3   **Dynamic Range Test: Position Marker at End of Frontreflection**

14 Position marker B at **Bpos** km. View the trace around marker B
and zoom the trace around marker B to 2 km/Div and 1 dB/Div.

The value for **Bpos** is given in Table D-1.

UP until only B is highlighted. Use LEFT/RIGHT keys → **Bpos**
km. Use DOWN (Around B) to get better resolution.

{<==> ZOOM} → 2 km/Div

{ZOOM} → 1dB/Div.

15 Note the value of the sample spacing, "Samp.Dist.". Calculate
the number of peak samples (dots) from the viewed distance V
divided by the sample spacing.

Calculate 2% thereof.

To get 98% Noise Level disregard 2% of the largest noise peaks samples (dots).

Example: PW = 1 μs → V = 20km, sample spacing = 7.64m.
→ number of peak samples = 20 km / 7.64m = 2618
→ 2% thereof = 52.

16 Check the calculated 2% of the highest peak samples within the viewed distance V: that is from *Bpos* to *Vend* according to the values given in Table D-1

NOTE   **To check out and disregard the 2% of the highest peak samples you need to zoom in further to get dots.You may have to change the color of the trace to view them more clearly.**

17 Position marker B at a point on the trace that equals the 98% Noise Level

18 Note 2-pt-loss between A and B as "Dynamic Range$_{98\%}$" at the actual pulsewidth.

19 Calculate the dynamic range as follows:
Dynamic Range = Dynamic Range$_{98\%}$ + 1.9 dB

20 Repeat steps 4 to 19 with all pulsewidths described in the test record.

D.3 Test II. Event Deadzone

NOTE   **The setup simulates a return loss of 35 dB. To care for the fact that – due to the coupler – the light pulse travels through the attenuator twice to sum up, the attenuator needs to be set to a value 3 dB larger than the simulated return loss, that is. 35 dB + 3 dB = 38 dB.**

Test II. Event Deadzone

1 Make sure that all optical connectors are clean and connect the equipment as shown in Figure D-4.

If you are using the Agilent Recirculating Delay Line, connect port 2 to the OTDR, port 1 to the input of the attenuator, and port 3 to the output of the attenuator

Be sure to use the appropriate Single-Mode/Multimode delay line for the module to be tested.
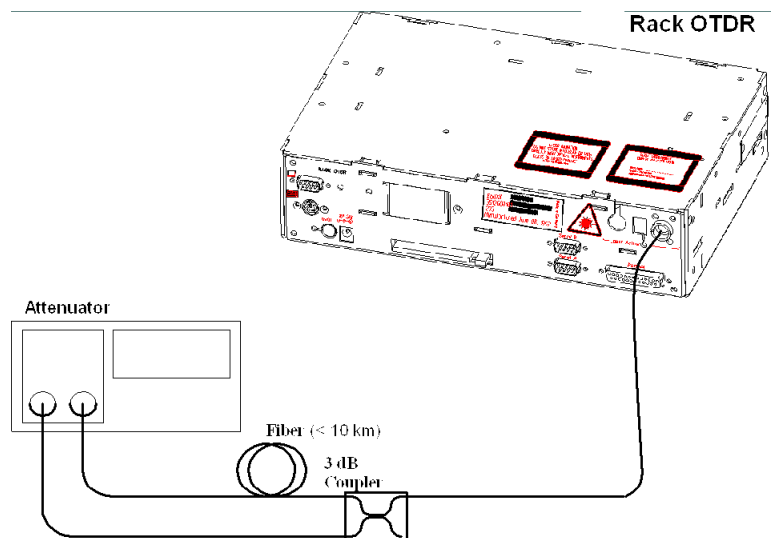
Figure D-4   **Event Deadzone Test Setup**

2 Turn on the OTDR, and after the self-test has passed, recall the default settings and the resolution mode.
[SETTINGS]<RECALL..><DEFAULT SETTING>
[SETTINGS]<OPTIMIZE MODE><RESOLUTION>

3 Set the linestyle to solid
{VIEW}<PREFERENCES><DOTTED TRACE>: OFF

4 Make sure that the length unit is set to meters.
[CONFIG]<LENGTH UNIT><METER [M]>

Test II. Event Deadzone

5 Set the Start and Span to 0.00–10.00 km, and the Averaging time
to 3 min.
[SETTINGS]<RANGE><0-10 KM>
[SETTINGS]<AVG TIME><3 MIN> (see THE NOTE ON PAGE 100).
[SETTINGS]<MEAS. MODE><AVERAGING>

6 Select the required wavelength.
[SETTINGS]<WAVELENGTH>

7 Set the pulsewidth to 10 ns.
[SETTINGS]<PULSEWIDTH><10 NS>

8 Set up the attenuator.

  a Set λ to the actual wavelength.

  b Set the attenuation to 38 dB (see Note on page 105).

  c Enable the attenuator output.

9 On the OTDR start the measurement.
<ƒ2>

10 Wait until the backscatter noise is reduced (about 10 s), then
position marker A close to the beginning of the first reflection
after the front reflection. See Figure D-5.

Select Marker A. Use LEFT/RIGHT keys
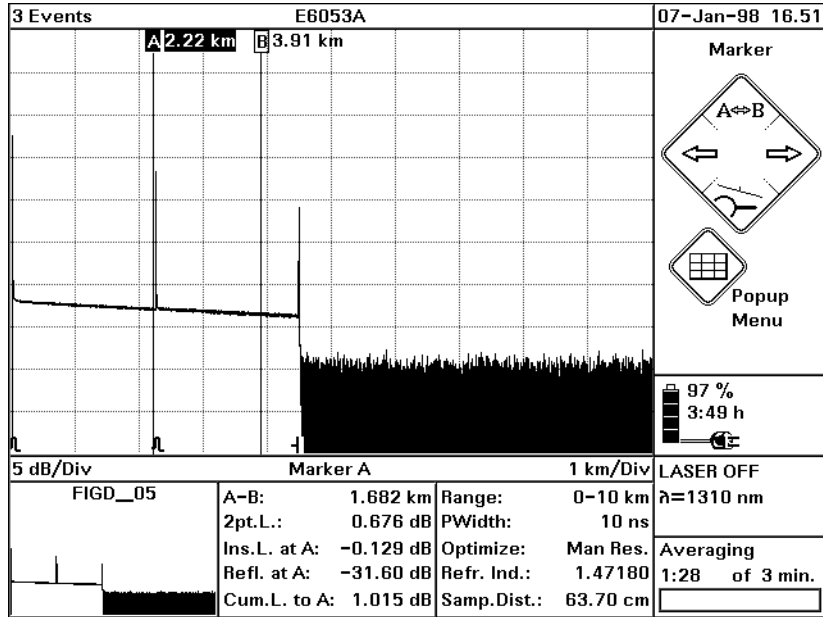
Figure D-5   **Event Deadzone Test: Position Marker A**

11 Set the start position close to the position of marker A. The start position should be just before the front edge of the reflection. Set the measurement span to start position+2 km.

[SETTINGS}<RANGE><RANGE INPUT...>. Use Cursor keys to specify Start and Span. Confirm with OK.

NOTE   **The start position should be a little before the front edge of the reflection. For example, if the reflection is at 2.2 km, use a start position of 2 km.**

12 Run the measurement.
<f2>

13 Position marker A on top of the first reflection on the trace.
Select Marker A. Use Left/Right keys.

14 Position marker B about 5 m right from marker A.
Select Marker B. Use Left/Right keys.
Select Marker A. Use LEFT/RIGHT keys. Use DOWN (Around
A) to get better resolution.

15 Set the y-axis scale to 0.5 dB/Div and the x-axis to 0.5 m/Div.
{<==> ZOOM} → 0.5 m/Div and [⇑ ⇓ Zoom] → 0.5 dB/Div.

16 Select offset, and move the peak of the reflection 3 divisions
(1.5 dB) above the center of the graph.
[VIEW}<ADJUST V-OFFSET>. Use LEFT/RIGHT keys. Press
SELECT to Confirm.
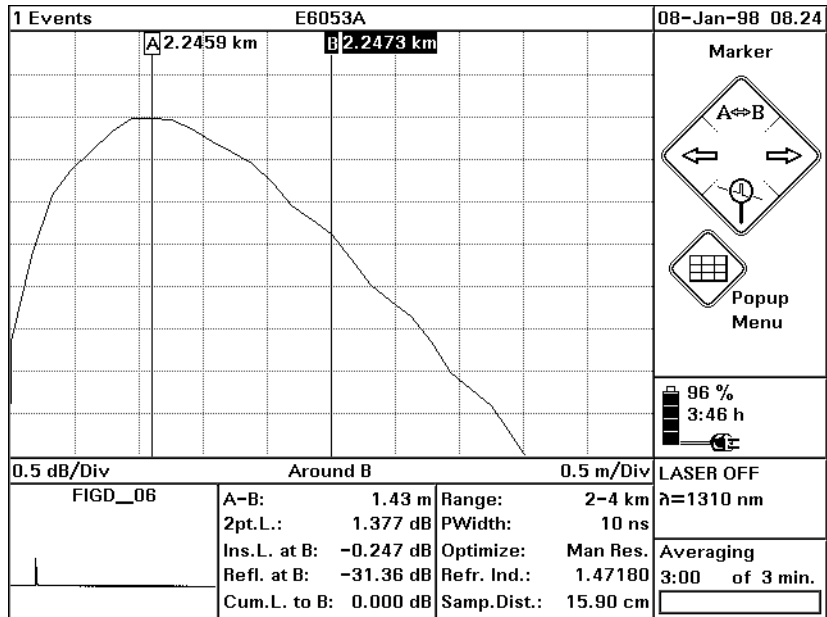
Figure D-6   **Event Deadzone Test: Position Marker B**

17 Use the LEFT/RIGHT keys to position marker B where the down slope of the reflection crosses the horizontal center line of the graph. See Figure D-6.

18 Position marker A at the beginning of the event.
Select Marker A. Use LEFT/RIGHT keys.
Use DOWN (Around A) to get better resolution.

19 Note the width of the reflection in the test record. The width is the distance between the markers A and B.

20 Stop the measurement.
<f2>

D.4 Test III. Attenuation Deadzone

NOTE **The setup simulates a return loss of 35 dB. To care for the fact that – due to the coupler – the light pulse travels through the attenuator twice to sum up, the attenuator needs to be set to a value 3 dB larger than the simulated return loss, that is. 35 dB + 3 dB = 38 dB.**

As this value includes the Insertion Loss of the attenuator, you may need to determine the Insertion Loss first.

1 Connect the equipment as for the event deadzone test (see Figure D-4).

2 Turn on the OTDR, and after the self-test has passed, recall the default settings and the resolution mode.
[SETTINGS]<RECALL..><DEFAULT SETTING>
[SETTINGS]<OPTIMIZE MODE><RESOLUTION>

3 Set linestyle to SOLID.
[VIEW]<PREFERENCES><DOTTED LINE>: OFF

4 Set 2 pt. loss

[ANALYSIS]<2 PT.LOSS>

5 Make sure that the length unit is set to meters.
[CONFIG]<LENGTH UNIT><METER [M]>

6 Set the Start and Span to 0.00–10.00 km.
[SETTINGS]<RANGE><0-10 KM>

7 Set the pulsewidth to 30 ns.
[SETTINGS]<PULSEWIDTH><30 NS>. Close by OK.

8 Set up the attenuator.

    a Set λ to the actual wavelength.

    b Set the attenuation to 38 dB (see Note on page 110).

    c Enable the attenuator output.

9 On the OTDR start the measurement.
<f2>

10 Wait until the backscatter noise is reduced (about 10 s), then position marker A close to the beginning of the first reflection after the front reflection.
Select Marker A. Use LEFT/RIGHT keys

11 Stop the measurement.
<f2>

12 Set the start position close to the position of marker A and the measurement span to 2 km.
[SETTINGS]<RANGE><RANGE INPUT...>. Use Cursor keys to specify Start and Span. Confirm with OK.

NOTE **The start position should be a little before the front edge of the reflection. For example, if the reflection is at 2.2 km, use a start position of 2 km.**

13 Start the measurement.
<f2>

14 Select marker B

UP until only B is highlighted.

15 Use the LEFT/RIGHT keys to position marker B on the peak of the event. You may choose DOWN (Around B) to get better resolution.

16 Select marker A

UP until only A is highlighted.

17 Position marker A 70 m ± 1 m to the right of marker B, that is after the event. Do this by checking A-B.

NOTE

When noise is seen on the trace, a position referring to the mean value of the trace should be selected.

1 Events	E6053A	08-Jan-98 08:43

Marker

A⇔B

Popup Menu

96 %
3:46 h

2 dB/Div	Marker A	50 m/Div	LASER OFF

FIGD_7

A-B:	70.50 m	Range:	2-4 km	λ=1310 nm
2pt.L.:	15.983 dB	PWidth:	10 ns	
Ins.L. at A:	-0.247 dB	Optimize:	Man Res.	Averaging
Refl. at A:	-31.36 dB	Refr. Ind.:	1.47180	3:00 of 3 min.
Cum.L. to A:	0.000 dB	Samp.Dist.:	15.90 cm	
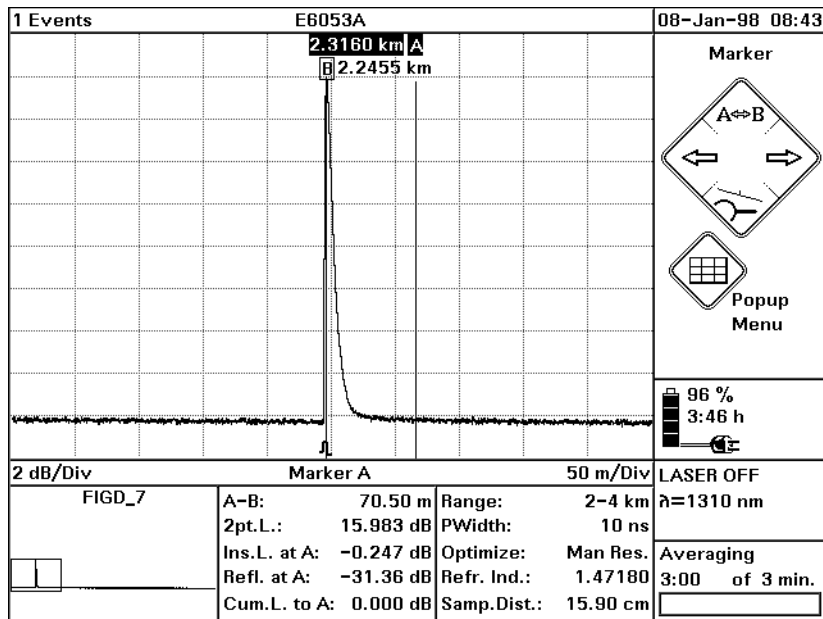
Figure D-7   **Attenuation Deadzone Test: Position Marker A**

18 Select marker B

UP until only B is highlighted.

19 Use the LEFT/RIGHT keys to position marker B on top of marker
A

20 Use the LEFT key to move marker B until the 2 pt. Loss shows
+0.5dB or -0.5dB.

N O T E   **When noise is seen on the trace, a position referring to the mean value
of the trace should be selected.**

| 1 Events | E6053A | 08-Jan-98 08:52 |

B 2.2637 km
2.3160 km A

Marker

A⇔B

Popup
Menu

96 %
3:46 h

| 2 dB/Div | Marker B | 50 m/Div | LASER OFF |

FIGD_8

A-B:	52.35 m	Range:	2-4 km	λ=1310 nm
2pt.L.:	0.589 dB	PWidth:	10 ns	
Ins.L. at B:	-0.247 dB	Optimize:	Man Res.	Averaging
Refl. at B:	-31.36 dB	Refr. Ind.:	1.47180	3:00 of 3 min.
Cum.L. to B:	0.000 dB	Samp.Dist.:	15.90 cm	
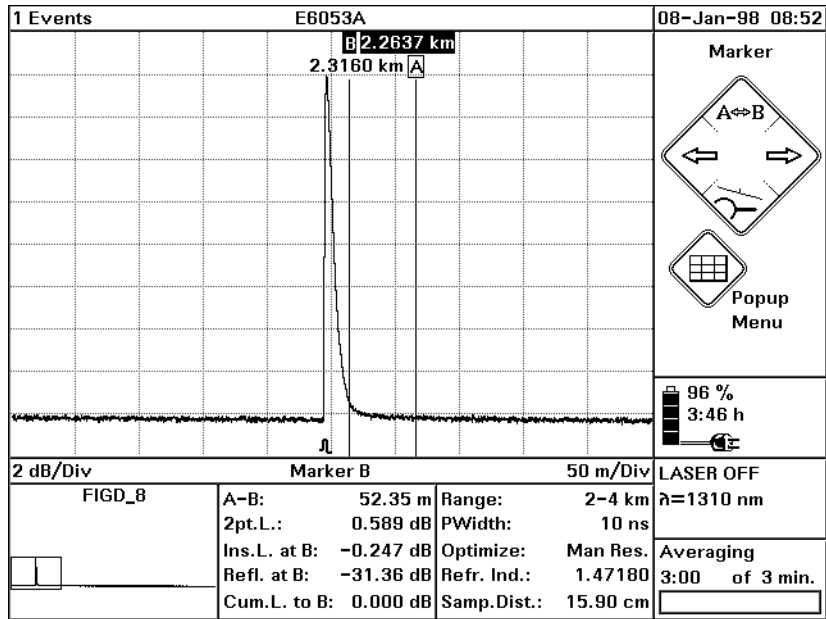
Figure D-8   **Attenuation Deadzone Test: Position Marker B at End of Reflection**

21 Set resolutions to: x-axis: .5m/Div, y-axis: 0.5dB
{<==> ZOOM} → 0.5 m/Div and [⇑⇓ Zoom] → 0.5 dB/Div.

22 Select marker A
UP until only A is highlighted.

23 Use the LEFT/RIGHT keys to move marker A to the start of the front reflex.

NOTE

The best approximation of the start position of the reflection is: last point on backscatter + half sample spacing, that is Sample Distance.
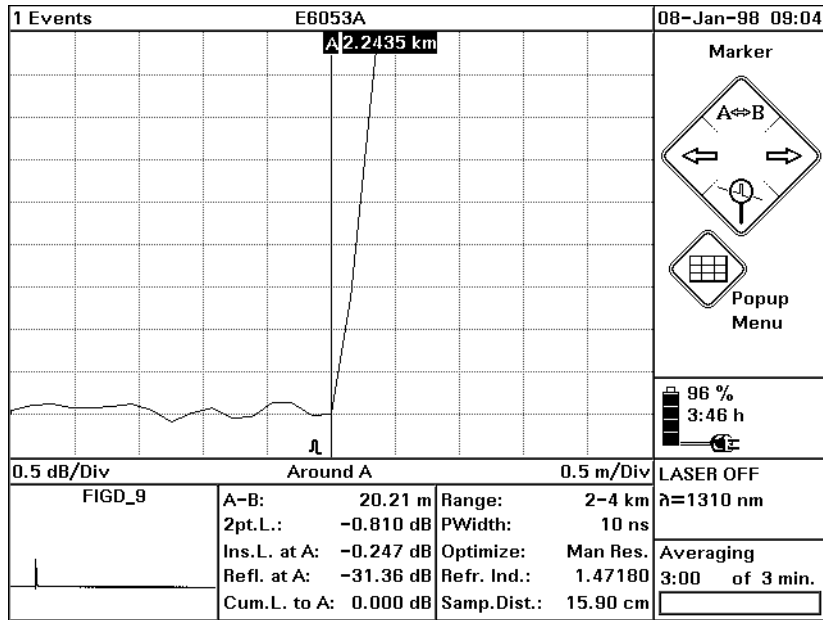
Figure D-9   **Attenuation Deadzone Test: Position Marker A at Start of Reflection**

24 Note the distance between the A-B markers as the attenuation deadzone in the test record.

D.5 Test IV. Distance Accuracy (Optional)

1 Connect the equipment as shown in Figure D-10.
If you are using an Agilent Recirculating Delay Line, connect port 2 to the OTDR, and leave port 1 open.

Figure D-10   **Distance Accuracy Test Setup**

2 Turn on the Mini-OTDR, and after the self-test has passed, recall the default settings and the standard mode.

3 Set the OTDR:
[SETTINGS] menu:

- <RANGE>: 0 - 10 km.
- <PULSE WIDTH>: 1 µs
- <WAVELENGTH>: If a dual wavelength module is installed, select the required wavelength
- <MEAS. MODE>: Averaging

Appendix D. Performance Tests

Test IV. Distance Accuracy (Optional)

- <OPTIMIZE MODE>: Resolution
- <AVG. TIME>: 3 min (see the note on page 100).
- <REFR. IND.>: 1.45800
- <DATA POINTS>: 16000

[VIEW] menu:
- <PREFERENCES><DOTTED TRACE>: OFF

[ANALYSIS] menu
- <2 PT. LOSS>

[CONFIG] menu
- <LENGTH UNIT><METER [M]>: ON

4   Run the measurement, wait 10 seconds, then stop the measurement
    <f2> ... <f2>

5   Move marker A to the beginning of the endreflection.
    Select Marker A. Use LEFT/RIGHT keys

6   Set the start position close to the position of marker A. The start position should be before the position of marker A (for example, if marker A is at 4.5 km, the start position should be 4.0 km).
    [SETTINGS}<RANGE><RANGE INPUT...>. Use Cursor keys to specify Start and Span. Confirm with OK.

7   Set the OTDR:
    [SETTINGS]<RANGE INPUT>: Start 4 km, Span 2 km

8   Run the measurement, and wait until the measurement has stopped.

9   Set marker to the beginning of the range (4.000 km).
    Select Marker A. Use LEFT/RIGHT keys.

10 Set marker B to the beginning of the end reflection

Select Marker B. Use LEFT/RIGHT keys.

Figure D-11   **Distance Accuracy Test: Position Markers**

11 Select DOWN (Around B).

12 Zoom the display to 0.1 m/Div and 0.2 dB/Div

13 Use the LEFT/RIGHT keys to reposition marker B to the

beginning of the endreflection.

1 Events		E6053A		08-Jan-98 09.12

```
1 Events              E6053A                08-Jan-98 09.12
              B 4.5221 km                        Marker

                                                   A⇔B
                                              ⇐        ⇒

                                                    Popup
                                                    Menu

                                                 96 %
                                                 3:46 h

0.2 dB/Div          Around B        0.1 m/Div LASER OFF
  FIGD_12     A-B:         522.08 m Range:      4-6 km λ=1310 nm
             2pt.L.:       0.193 dB PWidth:       1 μs
             Ins.L. at B:  -.--- dB Optimize:   Man Res. Averaging
             Refl. at B:  -18.82 dB Refr. Ind.: 1.45800 3:00   of 3 min.
             Cum.L. to B:  0.000 dB Samp.Dist.: 16.10 cm
```

Figure D-12   **Distance Accuracy Test: Around Marker View**

NOTE   **The true location of the beginning of the event cannot be determined by finite sample spacing. This is taken care of by the sampling error.**

The best approximation of the start position of the reflection is: last point on backscatter + half sample spacing, that is Sample Distance.

14 Note the distance between markers A and B (A <–>B) plus the position of marker A (4.000 m), as Measured Distance to the test record.

15 Repeat steps 12 to 14 with the pulsewidth set to 100ns.

16 Evaluate the measurement data.

Test IV. Distance Accuracy (Optional)

a Note the length of your optical fiber to the test record.

b Note the start position to the test record.

c Distance accuracy

The distance accuracy is defined as:

Distance accuracy = (Measured Distance × Scale Error + Offset Error ± 1/2 Sampling Spacing)

Sampling Error = Sample Spacing

Distance accuracy = ± Fiber Length × 10^{-4} ± 1 m ± 0.08 m

Measured Distance	Known Fiber Length of Delay Line
Offset Error	± 1 m
Scale Error	± 10^{-4}
Sample spacing with the 2km Span	0.161m

d Calculate the minimum and the maximum distances as described in the test record.
Note them in the test record and compare them with the measured distances.

D.6 Performance Test Form Sheets

Please use copies of the following form sheets for your individual performance tests

Performance Test for the Agilent Rack OTDR with Single-mode Modules, single wavelength
Page 1 of 6

Test Facility:

_____   Report No. _____

_____   Date: _____

_____   Customer: _____

_____   Tested By: _____

Model: _____

Serial No.   _____

Options   _____

Firmware Rev.   _____

Model   Agilent _____ Module

Serial No.   _____

Ambient temperature   _____ °C

Relative humidity   _____ %

Line frequency   _____ Hz

Special Notes:

_____

_____

_____

_____

_____

_____

_____

_____

_____

Performance Test for the Agilent Rack OTDR with Single-mode Modules, single wavelength

Model Agilent _____ Module Report No. _____   Date _____   Page 2 of 6

Test Equipment Used:

Description

	Model No.	Trace No.	Cal. Due Date
1. Optical Attenuator	_____	_____	__ / ___ /___
2. SM Fiber with 3 dB Coupler Recirculating Delay Line	08145-67900	_____	__ / ___ /___
3._____	_____	_____	__ / ___ /___
4._____	_____	_____	__ / ___ /___
5._____	_____	_____	__ / ___ /___
6._____	_____	_____	__ / ___ /___
7._____	_____	_____	__ / ___ /___
8. _____	_____	_____	__ / ___ /___
9. _____	_____	_____	__ / ___ /___
10._____	_____	_____	__ / ___ /___
11._____	_____	_____	__ / ___ /___
12._____	_____	_____	__ / ___ /___
13._____	_____	_____	__ / ___ /___
14. _____	_____	_____	__ / ___ /___

Performance Test for the Agilent Rack OTDR with Single-mode Modules, single wavelength

Model Agilent _____ Module   Report No. _____   Date _____   Page 3 of 6

No. Test Description

I. Dynamic Range 1550 nm Wavelength

Pulsewidth	Dynamic Range$_{98\%}$	**Dyn Range** = Dyn Range$_{98\%}$ + 1.9dB	Minimum Specification		Meas. Uncertainty
			E6059A	E6059B	
	dB	dB	dB	dB	dB
10 μs	_____	_____	37	41	_____
1μs	_____	_____	29	34	_____
100 ns	_____	_____	22	27	_____
10 ns	_____	_____	17	22	_____

II. Event Deadzone 1550 nm Wavelength

	Event Deadzone	Max Spec	Meas. Uncertainty
Return Loss ≥ 35dB			
Conditions: Meas. Span. 2km Pulsewidth 10ns			
E6059A, E6059B	_____ m	5m	_____ m

Performance Test for the Agilent Rack OTDR with Single-mode Modules, single wavelength

Model Agilent _____ Module Report No. _____   Date _____   Page 4 of 6

No. Test Description

III. Attenuation Deadzone 1550 nm Wavelength

		Maximum Specification		
	Attenuation Deadzone	E6059A	E6059B	Meas. Uncertainty
	m	m	m	m
Return Loss ≥ 35dB				
Conditions: Meas. Span. 2km Pulsewidth 30ns	_____	25	25	_____

IV. Distance Accuracy 1550 nm Wavelength (Optional test)

Fiber Length: _____ m   Sample Spacing: _____ m (as Δ on the screen)
Start Position: _____ m

| Distance Accuracy | = (Fiber Length x Scale Error + Offset Error +1/2 Sample Spacing)
|Distance Accuracy| = (_____ m x 10^{-4} +   1m   + _____ m)
|Distance Accuracy| = _____ m

Minimum Distance = Fiber Length - | Distance Accuracy|
Maximum Distance = Fiber Length +| Distance Accuracy|

		Minimum Distance (typical)	Measured Distance	Maximum Distance (typical)	Meas. Uncertainty
Meas.Span	Pulsewidth	m	m	m	m
4 to 6 km	1 μs		_____		
	100 ns	_____	_____	_____	_____

Performance Test for the Agilent Rack OTDR with Single-mode Modules, single wavelength

Model Agilent _____ Module   Report No. _____   Date _____   Page 5 of 6

No. Test Description

I.   Dynamic Range 1625 nm Wavelength

Pulsewidth	Dynamic Range$_{98\%}$	**Dyn Range** = Dyn Range$_{98\%}$ + 1.9dB	Minimum Specification E6060A	Meas. Uncertainty
	dB	dB	dB	dB
10 μs	_____	_____	40	_____
1μs	_____	_____	30	_____
100 ns	_____	_____	24	_____
10 ns	_____	_____	18	_____

II. Event Deadzone 1625 nm Wavelength

	Event Deadzone	Max Spec	Meas. Uncertainty
Return Loss ≥ 35dB			
Conditions: Meas. Span. 2km Pulsewidth 10ns			
E6060A	_____ m	5m	_____ m

Performance Test for the Agilent Rack OTDR with Single-mode Modules, single wavelength

Model Agilent _____ Module Report No. _____   Date _____   Page 6 of 6

No. Test Description

III. Attenuation Deadzone 1625 nm Wavelength

	Maximum Specification	
Attenuation Deadzone	E6060A	Meas. Uncertainty
m	m	m

Return Loss ≥ 35dB

Conditions:
Meas. Span. 2km
Pulsewidth 30ns

_____	28	_____

IV. Distance Accuracy 1625 nm Wavelength (Optional test)

Fiber Length: _____ m   Sample Spacing: _____ m (as Δ on the screen)
Start Position: _____ m

| Distance Accuracy | = (Fiber Length x Scale Error + Offset Error +1/2 Sample Spacing)
|Distance Accuracy| = (_____ m x 10^{-4} + 1m + _____ m)
|Distance Accuracy| = _____ m

Minimum Distance = Fiber Length - | Distance Accuracy|
Maximum Distance = Fiber Length +| Distance Accuracy|

	Minimum Distance (typical)	Measured Distance	Maximum Distance (typical)	Meas. Uncertainty
Meas.Span Pulsewidth	m	m	m	m
4 to 6 km				
1 μs		_____		
100 ns	_____	_____	_____	_____

Performance Test for the Agilent Rack OTDR with Single-mode Modules, Dual Wavelength
Page 1 of 8

Test Facility:

_____ Report No. _____

_____ Date: _____

_____ Customer: _____

_____ Tested By: _____

Model: _____

Serial No.   _____

Options   _____   Ambient temperature   _____ °C

Firmware Rev.   _____   Relative humidity   _____ %

Model   Agilent _____ Module   Line frequency   _____ Hz

Serial No.   _____

Special Notes:

_____

_____

_____

_____

_____

_____

_____

_____

_____

Performance Test for the Agilent Rack OTDR with Single-mode Modules, Dual Wavelength			
Model Agilent _____ Module Report No. _____ Date _____			**Page 2 of 8**

Test Equipment Used:

Description	Model No.	Trace No.	Cal. Due Date
1. Optical Attenuator	_____	_____	__ / ___ /___
2. SM Fiber with 3 dB Coupler Recirculating Delay Line	08145-67900	_____	__ / ___ /___
3._____	_____	_____	__ / ___ /___
4._____	_____	_____	__ / ___ /___
5._____	_____	_____	__ / ___ /___
6._____	_____	_____	__ / ___ /___
7._____	_____	_____	__ / ___ /___
8. _____	_____	_____	__ / ___ /___
9. _____	_____	_____	__ / ___ /___
10._____	_____	_____	__ / ___ /___
11._____	_____	_____	__ / ___ /___
12._____	_____	_____	__ / ___ /___
13._____	_____	_____	__ / ___ /___
14. _____	_____	_____	__ / ___ /___

Performance Test for the Agilent Rack OTDR with Single-mode Modules, Dual Wavelength

Model Agilent ___ Module   Report No. _____   Date _____   Page 3 of 8

No. Test Description

I.   Dynamic Range 1310 nm Wavelength

			Minimum Specification		
Pulsewidth	Dynamic Range$_{98\%}$	**Dyn Range** = Dyn Range$_{98\%}$ + 1.9dB	E6053A	E6058B	Meas. Uncertainty
	dB	dB	dB	dB	dB
10 μs	_____	_____	35	42	_____
1μs	_____	_____	30	35	_____
100 ns	_____	_____	24	29	_____
10 ns	_____	_____	19	24	_____

II.   Event Deadzone 1310 nm Wavelength

	Event Deadzone	Max Spec	Meas. Uncertainty
Return Loss ≥ 35dB			
Conditions: Meas. Span. 2km Pulsewidth 10ns			
E6053A, E6058B	_____ m	5 m	_____ m

Performance Test for the Agilent Rack OTDR with Single-mode Modules, Dual Wavelength

Model Agilent _____ Module Report No. _____   Date _____   Page 4 of 8

No. Test Description

III. Attenuation Deadzone 1310 nm Wavelength

	Attenuation Deadzone	Maximum Specification		Meas. Uncertainty
		E6053A	E6058B	
	m	m	m	m
Return Loss ≥ 35dB				
Conditions: Meas. Span. 2km Pulsewidth 30ns	_____	20	20	_____

IV. Distance Accuracy 1310 nm Wavelength (Optional test)

Fiber Length: _____ m   Sample Spacing: _____ m (as Δ on the screen)

Start Position: _____ m

| Distance Accuracy | = (Fiber Length x   Scale Error + Offset Error + 1/2 Sample Spacing)

| Distance Accuracy | = (_____ m x 10^{-4} + 1m   + _____ m)

| Distance Accuracy | = _____ m

Minimum Distance = Fiber Length - | Distance Accuracy|
Maximum Distance = Fiber Length +| Distance Accuracy|

		Minimum Distance (typical)	Measured Distance	Maximum Distance (typical)	Meas. Uncertainty
Meas.Span	Pulsewidth	m	m	m	m
4 to 6 km					
	1 μs		_____		
	100 ns	_____	_____	_____	_____

Performance Test Form Sheets

Performance Test for the Agilent Rack OTDR with Single-mode Modules, Dual Wavelength

Model Agilent _____ **Module**   **Report No.** _____   **Date** _____   **Page 5 of 8**

No. Test Description

I.   Dynamic Range 1550 nm Wavelength

Pulsewidth	Dynamic Range$_{98\%}$	**Dyn Range** = Dyn Range$_{98\%}$ + 1.9dB	Minimum Specification			Meas. Uncertainty
			E6053A	E6058B	E6062A	
	dB	dB	dB	dB	dB	dB
10 µs	_____	_____	34	39	41	_____
1µs	_____	_____	29	34	34	_____
100 ns	_____	_____	22	27	27	_____
10 ns	_____	_____	17	22	22	_____

II. Event Deadzone 1550 nm Wavelength

	Event Deadzone	Max Spec	Meas. Uncertainty
Return Loss ≥ 35dB			
Conditions: Meas. Span. 2km Pulsewidth 10ns			
E6053A, E6058B, E6062A	_____ m	5m	_____ m

Performance Test for the Agilent Rack OTDR with Single-mode Modules, Dual Wavelength

Model Agilent _____
Module   **Report No.** _____   **Date** _____   **Page 6 of 8**

No. Test Description

III. Attenuation Deadzone 1550 nm Wavelength

		Maximum Specification			
	Attenuation Deadzone	E6053A	E6058B	E6062A	Meas. Uncertainty
	m	m	m	m	m
Return Loss ≥ 35dB					
Conditions: Meas. Span. 2km Pulsewidth 30ns	_____	25	25	25	_____

IV. Distance Accuracy 1550 nm Wavelength (Optional test)

Fiber Length: _____ m   Sample Spacing: _____ m (as Δ on the screen)
Start Position: _____ **m**

| Distance Accuracy | = (Fiber Length x Scale   Offset Err +1/2 Sample Spacing)
Error + |Distance Accuracy| = (_____ m x   1m   + _____ m)
10^{-4} + |Distance Accuracy| = _____ m

Minimum Distance = Fiber Length - | Distance Accuracy|
Maximum Distance = Fiber Length +| Distance Accuracy|

		Minimum Distance (typical)	Measured Distance	Maximum Distance (typical)	Meas. Uncertainty
		m		m	
Meas.Span	Pulsewidth		m		m
4 to 6 km	1 μs	_____	_____	_____	
	100 ns		_____		_____

Performance Test for the Agilent Rack OTDR with Single-mode Modules, Dual Wavelength

Model Agilent _____ Module   Report No._____   Date _____   Page 7 of 8

No. Test Description

I.   Dynamic Range 1625 nm Wavelength

Pulsewidth	Dynamic Range$_{98\%}$	**Dyn Range** = Dyn Range$_{98\%}$ + 1.9dB	Minimum Specification E6062A	Meas. Uncertainty
	dB	dB	dB	dB
10 µs	_____	_____	40	_____
1µs	_____	_____	30	_____
100 ns	_____	_____	24	_____
10 ns	_____	_____	18	_____

II. Event Deadzone 1625 nm Wavelength

	Event Deadzone	Max Spec	Meas. Uncertainty
Return Loss ≥ 35dB			
Conditions: Meas. Span. 2km Pulsewidth 10ns			
E6062A	_____ m	5m	_____ m

Performance Test for the Agilent Rack OTDR with Single-mode Modules, Dual Wavelength

Model Agilent _____
Module   **Report No.** _____ **Date** _____ **Page 8 of 8**

No. Test Description

III. Attenuation Deadzone 1625 nm Wavelength

	Maximum Specification		
	Attenuation Deadzone	E6062A	Meas. Uncertainty
	m	m	m
Return Loss ≥ 35dB			
Conditions: Meas. Span. 2km Pulsewidth 30ns	_____	25	_____

IV. Distance Accuracy 1625 nm Wavelength (Optional test)

Fiber Length: _____ m   Sample Spacing: _____ m (as Δ on the screen)
Start Position: _____ m

| Distance Accuracy | = (Fiber Length x Scale   Offset Err +1/2 Sample Spacing)
Error + |Distance Accuracy| = (_____ m x   1m   + _____ m)
10^{-4} + |Distance Accuracy| = _____ m

Minimum Distance = Fiber Length - | Distance Accuracy|
Maximum Distance = Fiber Length +| Distance Accuracy|

	Minimum Distance (typical)	Measured Distance	Maximum Distance (typical)	Meas. Uncertainty
	m		m	
Meas.Span Pulsewidth		m		m
4 to 6 km				
1 μs	_____	_____	_____	
100 ns		_____		_____

D.7 Test V. E6006A Submodule

Test Equipment Required

Instrument or Accessories	qty	Recommended HP/Agilent Model	Required Characteristic
Lightwave Multimeter Meter	1	8153A	
Interface Module	1	81533B	
Optical Detector Head	1	81524A #C01	
Laser Source 1310/1550 nm	1	81554SM	1310 ± 10 nm 1550 ± 10 nm short term stability $< \pm 0.005$ dB
Optical attenuator	1	8156A #101	attenuation > 50 dB Return Loss > 45 dB repeatability $< \pm 0.01$ dB
Patchcord *(HMS10/HMS10, 9/50 μm, SM)*	1	81101AC	
Patchcord *(HMS10/HMS10, 50/125 mm)*	1	81501AC	
connector interface	4	81000AI	
connector adapter	1	81000AA	

Optional Test Equipment

Laser Source 850 nm	1	81551MM	850 ± 10 nm short term stability $< \pm 0.01$ dB

Uncertainty/Accuracy Test at Reference Conditions

NOTE	**Make sure that all equipment has warmed up, and all connectors are clean.**
	Make sure that all patchcords are fixed to the table and will not move during measurements.

Repeat each of the following steps for each of the specified wavelengths:

1 Connect the equipment as shown in Figure D-13.
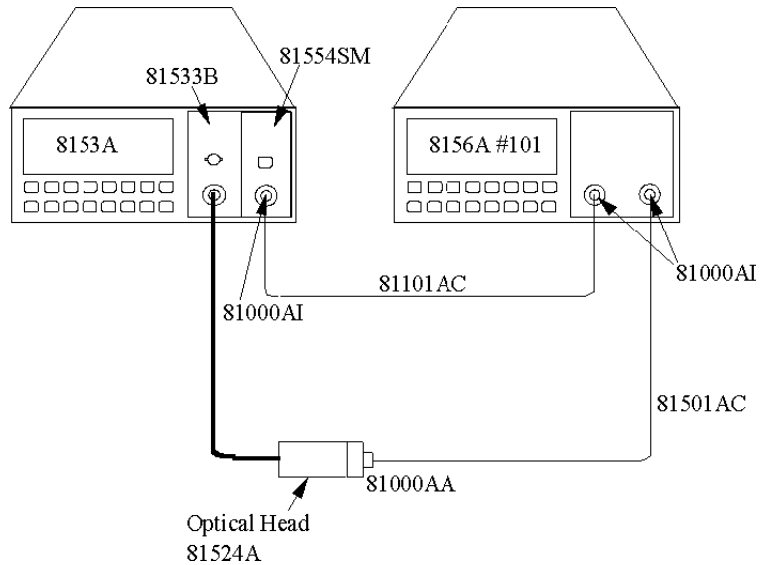
Figure D-13   **Test setup 1310 nm and 1550 nm: Reference Measurement**

2 Disable the laser source and attenuator; zero the power meter (press {Z ERO }).

Reference Measurement

3 Set the laser source to 1310 nm (nominal).

4 Set both the power meter and the attenuator to 1310.00 nm.

5 Set the power meter to M EASURE mode; select parameter T=100ms; switch AUTO range on.

6 Enable the Laser Source and the Agilent 8156A output, and wait 3 minutes until the laser has settled.

7 On the power meter, press [dBm W] to get the display reading in W.

8 Set the attenuation of the attenuator to a value where the power meter reads 10.00 µW

Measurement of DUT

9 Connect the attenuator output cable to the DUT, as shown in Figure D-14.

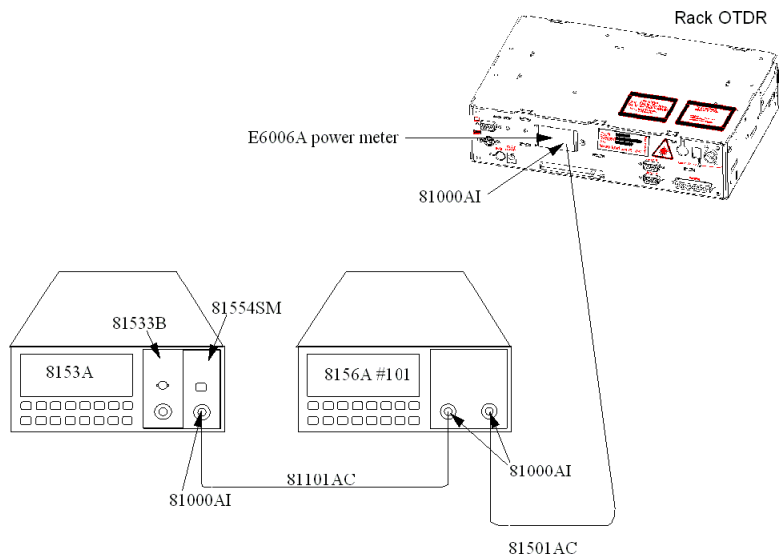**Figure D-14** **Test setup 1310 nm and 1550 nm: Measurement of the DUT**

10 Make sure that the E6006A DUT has warmed up.

11 Set the DUT to 1310.00 nm.

12 Enable the laser source and the Agilent 8156A output, and wait 3 minutes until the laser has settled.

13 Set the DUT to display power levels in W.

14 Note the displayed measured value on the DUT in the test

record.

Test of the other wavelength

15 Set the laser source to 1550 nm (nominal), and set the attenuator and the DUT to 1550.00 nm.

16 Repeat steps 1 to 14 for this wavelength, replacing all settings of 1310 nm/1310.00 nm by 1550 nm/1550.00 nm.

N O T E	**The Reference Power Meter 81524A and the DUT are both of the same type InGaAs. This means that the wavelength dependencies are equal. As long as both the Reference Power Meter and the DUT are set to the same wavelength, the actual wavelength of the source does not noticeably add to measurement uncertainties, if the source is within a ±20 nm limit of the measuring wavelength.**

Total Uncertainty/Accuracy Test

N O T E	**Make sure that all equipment has warmed up, and all connectors are clean.**
	Make sure that all patchcords are fixed to the table and will not move during measurements.

Repeat each of the following steps for each of the specified wavelengths.

1 Connect the equipment as shown in Figure D-13.

N O T E	**If you are performing the optional accuracy test at 850 nm, it is sufficient to measure at the highest power level. This means that you do not need to use an attenuator: you can connect the laser source directly to the optical head using an Agilent 81501AC patchcord.**

2 Disable the laser source and attenuator; zero the power meter (press {ZERO}).

Reference Measurement

3 Set the laser source to 1310 nm (nominal).

4 Set the Laser Source to `ATT=0`.

5 Set the power meter and the attenuator to 1310.00 nm.

6 Set the power meter to MEASURE mode; select parameter
T=100ms; switch AUTO range on.

7 Enable the Laser Source and the Agilent 8156A output, and wait
3 minutes until the laser has settled.

8 Set the attenuation of the attenuator to 0.00 dB.

9 On the power meter, press `[dBm W]` to get the display reading
in W.

10 Note the displayed reference measurement value on the power
meter in the test record.

11 Repeat steps 9 and 10 for all attenuation values listed in the test
record.

Measurement of DUT

12 Connect the attenuator output cable to the DUT, as shown in
Figure D-14.

NOTE   **If you are performing the optional accuracy test at 850 nm, it is
sufficient to measure at the highest power level. This means that you do
not need to use an attenuator: you can connect the laser source directly
to the optical head using an Agilent 81501AC patchcord.**

13 Make sure that the E6006A DUT has warmed up.

14 Set the DUT to 1310.00 nm.

15 Enable the laser source and the Agilent 8156A output, and wait
3 minutes until the laser has settled.

16 Set the attenuation of the attenuator to 0.00 dB.

17 Set the DUT to display power levels in W.

18 Note the displayed measured value on the DUT in the test record.

19 Repeat step 18 for all attenuation values listed in the test record.

Test of other wavelengths

20 Set the laser source to 1550 nm (nominal), and set the attenuator and the DUT to 1550.00 nm.

21 Repeat steps 1 to 19 for this wavelength, replacing all settings of 1310 nm/1310.00 nm by 1550 nm/1550.00 nm.

NOTE   **The Reference Power Meter 81524A and the DUT are both of the same type InGaAs. This means that the wavelength dependencies are equal. As long as both the Reference Power Meter and the DUT are set to the same wavelength, the actual wavelength of the source does not noticeably add to measurement uncertainties, if the source is within a ±20 nm limit of the measuring wavelength.**

<table>
<tr><td colspan="2" align="center">**Performance Test for the Agilent Rack OTDR with Power Meter submodule**</td></tr>
<tr><td></td><td align="right">**Page 1 of 3**</td></tr>
</table>

Test Facility:

_____ Report No. _____

_____ Date: _____

_____ Customer: _____

_____ Tested By: _____

Model: **Agilent E6006A Power Meter**

Serial No.   _____

Options   _____   Firmware Revision   _____
.

Agilent E6000 Mini-OTDR plus module
or Agilent Rack OTDR

Serial No.   _____   Serial No.   _____

Ambient Temperature   _____ °C
Relative Humidity   _____ %
Line Frequency   _____ Hz

Test Equipment used:

Description	Model No.	Trace No.	Cal. Due Date
1. Std. Lightwave Multimeter	_____	_____	____ / ____ / ____
2. Std. Optical Head Interface	_____	_____	____ / ____ / ____
3. Std. Optical Head	_____	_____	____ / ____ / ____
4. Laser Source	_____	_____	____ / ____ / ____
5. Attenuator	_____	_____	____ / ____ / ____
6. _____	_____	_____	____ / ____ / ____
7._____	_____	_____	____ / ____ / ____
8._____	_____	_____	____ / ____ / ____
9._____	_____	_____	____ / ____ / ____

Performance Test for the Agilent Rack OTDR with Power Meter Submodule				
Model: Agilent E6006A Module Report No. _____			Date: _____	**Page 2 of 3**

Uncertainty/Accuracy Test at Reference Conditions

Reference setting of power level 10.00 µW

Wavelength	Minimum Spec. (-3.6% of Ref.)	E6006A, DUT Measurement Results	Maximum Spec. (+3.6% of Ref.)	Measurement Uncertainty
1310.00 nm	9.640 µW	_____ µW	10.360 µW	_____ µW
1550.00 nm	9.640 µW	_____ µW	10.360 µW	_____ µW

Uncertainty/Accuracy Test

Wavelength 1310 nm

8156A setting	81524A Reference Measurement	Minimum Spec. (-5% of Ref. - 0.5 nW)	E6006A, DUT Measurement Results	Maximum Spec. (+5% of Ref. + 0.5 nW)	Measurement Uncertainty
0 dB	_____ µW	_____ µW	_____ µW	_____ µW	_____ W
5 dB	_____ µW	_____ µW	_____ µW	_____ µW	_____ W
15 dB	_____ µW	_____ µW	_____ µW	_____ µW	_____ W
25 dB	_____ µW	_____ µW	_____ µW	_____ µW	_____ W
35 dB	_____ nW	_____ nW	_____ nW	_____ nW	_____ W
45 dB	_____ nW	_____ nW	_____ nW	_____ nW	_____ W

Wavelength 1550 nm

8156A setting	81524A Reference Measurement	Minimum Spec. (-5% of Ref. - 0.5 nW)	E6006A, DUT Measurement Results	Maximum Spec. (+5% of Ref. + 0.5 nW)	Measurement Uncertainty
0 dB	_____ µW	_____ µW	_____ µW	_____ µW	_____ W
5 dB	_____ µW	_____ µW	_____ µW	_____ µW	_____ W
15 dB	_____ µW	_____ µW	_____ µW	_____ µW	_____ W
25 dB	_____ µW	_____ µW	_____ µW	_____ µW	_____ W
35 dB	_____ nW	_____ nW	_____ nW	_____ nW	_____ W
45 dB	_____ nW	_____ nW	_____ nW	_____ nW	_____ W

Performance Test for the Agilent Rack OTDR with Power Meter Submodule					
Model: Agilent E6006A Module Report No. _____			Date: _____		**Page 3 of 3**
Optional Test Wavelength 850 nm					
8156A setting	81524A Reference Measurement	Minimum Spec. (-10% of Ref. - 2.5 nW)	E6006A, DUT Measurement Results	Maximum Spec. (+10% of Ref. +2.5 nW)	Measurement Uncertainty
n/a	_____ μW	_____ μW	_____ μW	_____ μW	_____ W

D.8 Optional Test VI: E6007A Visual Fault Finder Submodule

Test Equipment Required

| Instrument or Accessories	qty	Recommended HP/Agilent Model	Required Characteristic
Lightwave Multimeter Meter	1	8153A	
Optical Power Sensor	1	81530A	
Patchcord *(HMS10/HMS10, 9/50 μm, SM)*	1	81101AC	
connector interface	2	81000AI	
Optical Spectrum Analyzer	1	75450A #101	

General

- Make sure that all equipment has warmed up, and all connectors are clean.

- Make sure that all patchcords are fixed to the table, and will not move during measurements.

Optional Test of Output Power Level (CW)

1   Connect the equipment as shown in Figure D-15.
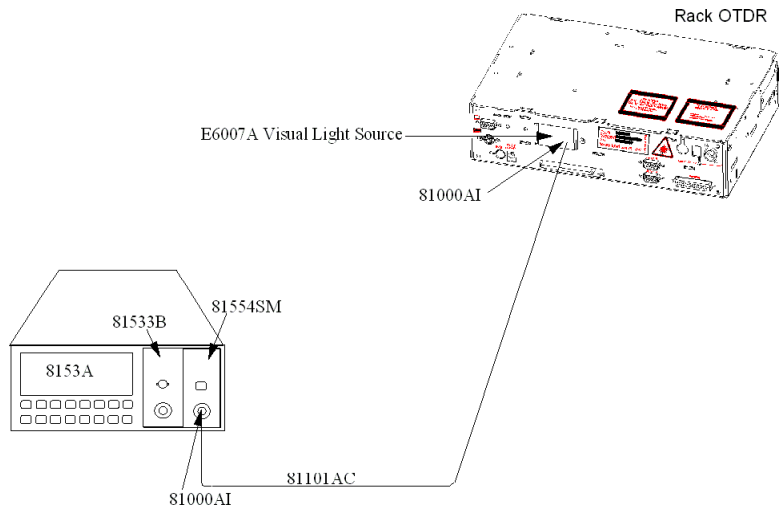
Figure D-15   **Measurement of the Output power**

2   Apply a 9/125 µm patchcord with HMS-10 connectors.

3   Set the 8153A:

dBm/W	dBm
wavelength	$\lambda = 635$ nm
sampling time	$T = 100$ ms
Range	AUTO

4   Before you switch on the DUT, zero the 8153A:
press {ZERO} on the 8153A.

5   On the DUT, select Visual Fault Finder:

> Select Mod   CW
>
> Select   ON

and allow to settle.

6   Note the displayed power level on the 8153A in the test report.

Optional test: Center Wavelength

NOTE	**The laser has been vendor tested, and specifications are purely typical. Therefore, this test is not mandatory.**

1   Connect the E6007A output to the Optical Spectrum Analyzer using an 81101A patchcord, and two 81000AI interface adapters:
   •   ensure that the OSA is switched on and has warmed up.
   •   ensure that the E6000A is switched on and has warmed up.
   •   enable the E6007A (DUT).

2   On the OSA:
   •   press INSTRPRESET
   •   press AUTO/MEAS and wait until `End of Automeasure` is displayed.
   •   choose USER and then select the type of source to be measured as FP (for Fabry-Perot Laser).

   To show the display in linear mode:
   •   press MENU
   •   select AMPT on the left side of the display
   •   press LINEAR on the right side of the display.

3   To ensure an interference free reading of the display, you should stop the steady repeating calculations:
   •   select USER.
   •   press SINGLE SWEEP.

4   If the presentation of the graphic is not suitable, you may change

the resolution using the SPAN key.

5 If the signal is clipped, increase the reference level.

6 From the displayed measurements, check for Mean Wavelength.

Performance Test for the Agilent Rack OTDR with Visual Fault Finder Submodule

Page 1 of 2

Test Facility:

_____ Report No. _____

_____ Date: _____

_____ Customer: _____

_____ Tested By: _____

Model: **Agilent E6007A Visual Light Source**

Serial No. _____

Options _____

Firmware
Revision _____

.

Agilent E6000 Mini-OTDR plus module
or Agilent Rack OTDR

Serial No. _____   Serial No. _____

Ambient Temperature _____ °C
Relative Humidity _____ %
Line Frequency _____ Hz

Test Equipment used:

Description	Model No.	Trace No.	Cal. Due Date
1. Std. Lightwave Multimeter	_____	_____	____ / ____ / ____
2. Std. Optical Power Sensor	_____	_____	____ / ____ / ____
3. _____	_____	_____	____ / ____ / ____
4. _____	_____	_____	____ / ____ / ____
5. _____	_____	_____	____ / ____ / ____

Performance Test for the Agilent Rack OTDR with Visual Fault Finder Submodule

Model: Agilent E6007A Module   Report No. _____   Date: _____   **Page 2 of 2**

Optional: Output Power Level (CW)

Wavelength 635 nm

fiber type	Minimum Specification	Measured value	Maximum Specification	Measurement Uncertainty
9/125 µm SM	-5.00 dBm (-3 dBm typ.)	_____ dBm	0 dBm	_____ dB

Optional: Center Wavelength

	Minimum Specification	Measured value	Maximum Specification	Measurement Uncertainty
Wavelength	615 nm (625 nm typ.)	_____ nm	655 nm (645 nm typ.)	_____ nm

Appendix D. Performance Tests
Optional Test VI: E6007A Visual Fault Finder Submodule

E

Cleaning Information

Cleaning Information

The following Cleaning Instructions contain some general safety precautions, which must be observed during all phases of cleaning. Consult your specific optical device manuals or guides for full information on safety matters.

Please try, whenever possible, to use physically contacting connectors, and dry connections. Clean the connectors, interfaces, and bushings carefully after use.

Agilent Technologies assume no liability for the customer's failure to comply with these requirements.

Cleaning Instructions for this Instrument

The Cleaning Instructions apply to a number of different types of Optical Equipment. The following section is relevant for this instrument.

- "How to clean instruments with a physical contact interface" on page 168

E.1 Safety Precautions

Please follow the following safety rules:

- Do not remove instrument covers when operating.

- Ensure that the instrument is switched off throughout the cleaning procedures.

- Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.

- Make sure that you disable all sources when you are cleaning any optical interfaces.

- Under no circumstances look into the end of an optical device attached to optical outputs when the device is operational. The laser radiation is not visible to the human eye, but it can seriously damage your eyesight.

- To prevent electrical shock, disconnect the instrument from the mains before cleaning. Use a dry cloth, or one slightly dampened with water, to clean the external case parts. Do not attempt to clean internally.

- Do not install parts or perform any unauthorized modification to optical devices.

- Refer servicing only to qualified and authorized personnel.

E.2 Why is it important to clean optical devices ?

In transmission links optical fiber cores are about 9 µm (0.00035") in diameter. Dust and other particles, however, can range from tenths to hundredths of microns in diameter. Their comparative size

means that they can cover a part of the end of a fiber core, and as a result will reduce the performance of your system.

Furthermore, the power density may burn dust into the fiber and cause additional damage (for example, 0 dBm optical power in a single mode fiber causes a power density of approximately 16 million W/m^2). If this happens, measurements become inaccurate and non-repeatable.

Cleaning is, therefore, an essential yet difficult task. Unfortunately, when comparing most published cleaning recommendations, you will discover that they contain several inconsistencies. In this section, we want to suggest ways to help you clean your various optical devices, and thus significantly improve the accuracy and repeatability of your lightwave measurements.

E.3 What do I need for proper cleaning?

Some Standard Cleaning Equipment is necessary for cleaning your instrument. For certain cleaning procedures, you may also require certain Additional Cleaning Equipment.

Standard Cleaning Equipment

Before you can start your cleaning procedure you need the following standard equipment:

- Dust and shutter caps

- Isopropyl alcohol

- Cotton swabs

- Soft tissues

- Pipe cleaner

- Compressed air

Cleaning Information

Dust and shutter caps

All of Agilent Technologies' lightwave instruments are delivered with either laser shutter caps or dust caps on the lightwave adapter. Any cables come with covers to protect the cable ends from damage or contamination.

We suggest these protected coverings should be kept on the equipment at all times, except when your optical device is in use. Be careful when replacing dust caps after use. Do not press the bottom of the cap onto the fiber too hard, as any dust in the cap can scratch or pollute your fiber surface.

If you need further dust caps, please contact your nearest Agilent Technologies sales office.

Isopropyl alcohol

This solvent is usually available from any local pharmaceutical supplier or chemist's shop.

If you use isopropyl alcohol to clean your optical device, do not immediately dry the surface with compressed air (except when you are cleaning very sensitive optical devices). This is because the dust and the dirt is solved and will leave behind filmy deposits after the alcohol is evaporated. You should therefore first remove the alcohol and the dust with a soft tissue, and then use compressed air to blow away any remaining filaments.

If possible avoid using denatured alcohol containing additives. Instead, apply alcohol used for medical purposes.

Never try to drink this alcohol, as it may seriously damage to your health.

Do not use any other solvents, as some may damage plastic materials and claddings. Acetone, for example, will dissolve the epoxy used with fiber optic connectors. To avoid damage, only use isopropyl alcohol.

Cotton swabs

We recommend that you use swabs such as Q-tips or other cotton swabs normally available from local distributors of medical and

hygiene products (for example, a supermarket or a chemist's shop). You may be able to obtain various sizes of swab. If this is the case, select the smallest size for your smallest devices.

Ensure that you use natural cotton swabs. Foam swabs will often leave behind filmy deposits after cleaning.

Use care when cleaning, and avoid pressing too hard onto your optical device with the swab. Too much pressure may scratch the surface, and could cause your device to become misaligned. It is advisable to rub gently over the surface using only a small circular movement.

Swabs should be used straight out of the packet, and never used twice. This is because dust and dirt in the atmosphere, or from a first cleaning, may collect on your swab and scratch the surface of your optical device.

Soft tissues

These are available from most stores and distributors of medical and hygiene products such as supermarkets or chemists' shops.

We recommend that you do not use normal cotton tissues, but multi-layered soft tissues made from non-recycled cellulose. Cellulose tissues are very absorbent and softer. Consequently, they will not scratch the surface of your device over time.

Use care when cleaning, and avoid pressing on your optical device with the tissue. Pressing too hard may lead to scratches on the surface or misalignment of your device. Just rub gently over the surface using a small circular movement.

Use only clean, fresh soft tissues and never apply them twice. Any dust and dirt from the air which collects on your tissue, or which has gathered after initial cleaning, may scratch and pollute your optical device.

Pipe cleaner

Pipe cleaners can be purchased from tobacconists, and come in various shapes and sizes. The most suitable one to select for

cleaning purposes has soft bristles, which will not produces scratches.

There are many different kinds of pipe cleaner available from tobacco shops.

The best way to use a pipe cleaner is to push it in and out of the device opening (for example, when cleaning an interface). While you are cleaning, you should slowly rotate the pipe cleaner.

Only use pipe cleaners on connector interfaces or on feed through adapters. Do not use them on optical head adapters, as the center of a pipe cleaner is hard metal and can damage the bottom of the adapter.

Your pipe cleaner should be new when you use it. If it has collected any dust or dirt, this can scratch or contaminate your device.

The tip and center of the pipe cleaner are made of metal. Avoid accidentally pressing these metal parts against the inside of the device, as this can cause scratches.

Compressed air

Compressed air can be purchased from any laboratory supplier.

It is essential that your compressed air is free of dust, water and oil. Only use clean, dry air. If not, this can lead to filmy deposits or scratches on the surface of your connector. This will reduce the performance of your transmission system.

When spraying compressed air, hold the can upright. If the can is held at a slant, propellant could escape and dirty your optical device. First spray into the air, as the initial stream of compressed air could contain some condensation or propellant. Such condensation leaves behind a filmy deposit.

Please be friendly to your environment and use a CFC-free aerosol.

Additional Cleaning Equipment

Some Cleaning Procedures need the following equipment, which is not required to clean each instrument:

Cleaning Information

What do I need for proper cleaning?

- Microscope with a magnification range about 50X up to 300X
- Ultrasonic bath
- Warm water and liquid soap
- Premoistened cleaning wipes
- Polymer film
- Infrared Sensor Card

Microscope with a magnification range about 50X up to 300X

A microscope can be found in most photography stores, or can be obtained through or specialist mail order companies. Special fiber-scopes are available from suppliers of splicing equipment.

Ideally, the light source on your microscope should be very flexible. This will allow you to examine your device closely and from different angles.

A microscope helps you to estimate the type and degree of dirt on your device. You can use a microscope to choose an appropriate cleaning method, and then to examine the results. You can also use your microscope to judge whether your optical device (such as a connector) is severely scratched and is, therefore, causing inaccurate measurements.

Ultrasonic bath

Ultrasonic baths are also available from photography or laboratory suppliers or specialist mail order companies.

An ultrasonic bath will gently remove fat and other stubborn dirt from your optical devices. This helps increase the life span of the optical devices.

Only use isopropyl alcohol in your ultrasonic bath, as other solvents may damage.

Warm water and liquid soap

Only use water if you are sure that there is no other way of cleaning your optical device without corrosion or damage. Do not use hot

What do I need for proper cleaning?

water, as this may cause mechanical stress, which can damage your optical device.

Ensure that your liquid soap has no abrasive properties or perfume in it. You should also avoid normal washing-up liquid, as it can cover your device in an iridescent film after it has been air-dried.

Some lenses and mirrors also have a special coating, which may be sensitive to mechanical stress, or to fat and liquids. For this reason we recommend you do not touch them.

If you are not sure how sensitive your device is to cleaning, please contact the manufacturer or your sales distributor.

Premoistened cleaning wipes

Use pre-moistened cleaning wipes as described in each individual cleaning procedure. Cleaning wipes may be used in every instance where a moistened soft tissue or cotton swab is applied.

Polymer film

Polymer film is available from laboratory suppliers or specialist mail order companies.

Using polymer film is a gentle method of cleaning extremely sensitive devices, such as reference reflectors and mirrors.

Infrared Sensor Card

Infrared sensor cards are available from laboratory suppliers or specialist mail order companies.

With this card you are able to control the shape of laser light emitted. The invisible laser beam is projected onto the sensor card, then becomes visible to the normal eye as a round spot.

Take care never to look into the end of a fiber or any other optical component, when they are in use. This is because the laser can seriously damage your eyes.

E.4 Preserving Connectors

Listed below are some hints on how best to keep your connectors in the best possible condition.

Making Connections

Before you make any connection you must ensure that all cables and connectors are clean. If they are dirty, use the appropriate cleaning procedure.

When inserting the ferrule of a patchcord into a connector or an adapter, make sure that the fiber end does not touch the outside of the mating connector or adapter. Otherwise you will rub the fiber end against an unsuitable surface, producing scratches and dirt deposits on the surface of your fiber.

Dust Caps and Shutter Caps

Be careful when replacing dust caps after use. Do not press the bottom of the cap onto the fiber as any dust in the cap can scratch or dirty your fiber surface.

When you have finished cleaning, put the dust cap back on, or close the shutter cap if the equipment is not going to be used immediately.

Keep the caps on the equipment always when it is not in use.

All of Agilent Technologies' lightwave instruments and accessories are shipped with either laser shutter caps or dust caps. If you need additional or replacement dust caps, contact your nearest Agilent Technologies Sales/Service Office.

Immersion Oil and Other Index Matching Compounds

Where it is possible, do not use immersion oil or other index matching compounds with your device. They are liable to impair

and dirty the surface of the device. In addition, the characteristics of your device can be changed and your measurement results affected.

E.5 Cleaning Instrument Housings

Use a dry and very soft cotton tissue to clean the instrument housing and the keypad. Do not open the instruments as there is a danger of electric shock, or electrostatic discharge. Opening the instrument can cause damage to sensitive components, and in addition your warranty will be voided.

E.6 Which Cleaning Procedure should I use ?

Light dirt

If you just want to clean away light dirt, observe the following procedure for all devices:

- Use compressed air to blow away large particles.
- Clean the device with a dry cotton swab.
- Use compressed air to blow away any remaining filament left by the swab.

Heavy dirt

If the above procedure is not enough to clean your instrument, follow one of the procedures below. Please consult "Cleaning Instructions for this Instrument" on page 300 for the procedure relevant for this instrument.

If you are unsure of how sensitive your device is to cleaning, please contact the manufacturer or your sales distributor

E.7 How to clean connectors

Cleaning connectors is difficult as the core diameter of a single-mode fiber is only about 9 µm. This generally means you cannot see streaks or scratches on the surface. To be certain of the condition of the surface of your connector and to check it after cleaning, you need a microscope.

In the case of scratches, or of dust that has been burnt onto the surface of the connector, you may have no option but to polish the connector. This depends on the degree of dirtiness, or the depth of the scratches. This is a difficult procedure and should only be performed by skilled personal, and as a last resort as it wears out your connector.

WARNING   **Never look into the end of an optical cable that is connected to an active source.**

To assess the projection of the emitted light beam you can use an infrared sensor card. Hold the card approximately 5 cm from the output of the connector. The invisible emitted light is project onto the card and becomes visible as a small circular spot.

Preferred Procedure

Use the following procedure on most occasions.

1   Clean the connector by rubbing a new, dry cotton-swab over the surface using a small circular movement.

2   Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the connector:

1 Moisten a new cotton-swab with isopropyl alcohol.

2 Clean the connector by rubbing the cotton-swab over the surface using a small circular movement.

3 Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.

4 Blow away any remaining lint with compressed air.

An Alternative Procedure

A better, more gentle, but more expensive cleaning procedure is to use an ultrasonic bath with isopropyl alcohol.

1 Hold the tip of the connector in the bath for at least three minutes.

2 Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.

3 Blow away any remaining lint with compressed air.

E.8 How to clean connector adapters

CAUTION   **Some adapters have an anti-reflection coating on the back to reduce back reflection. This coating is extremely sensitive to solvents and mechanical abrasion. Extra care is needed when cleaning these adapters.**

Preferred Procedure

Use the following procedure on most occasions.

1   Clean the adapter by rubbing a new, dry cotton-swab over the surface using a small circular movement.

2   Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the adapter:

1   Moisten a new cotton-swab with isopropyl alcohol.

2   Clean the adapter by rubbing the cotton-swab over the surface using a small circular movement.

3   Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.

4   Blow away any remaining lint with compressed air.

E.9 How to clean connector interfaces

CAUTION   **Be careful when using pipe-cleaners, as the core and the bristles of the pipe-cleaner are hard and can damage the interface.**

Do not use pipe-cleaners on optical head adapters, as the hard core of normal pipe cleaners can damage the bottom of an adapter.

Preferred Procedure

Use the following procedure on most occasions.

1   Clean the interface by pushing and pulling a new, dry pipe-cleaner into the opening. Rotate the pipe-cleaner slowly as you do this.

2   Then clean the interface by rubbing a new, dry cotton-swab over

the surface using a small circular movement.

3   Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the interface:

1   Moisten a new pipe-cleaner with isopropyl alcohol.

2   Clean the interface by pushing and pulling the pipe-cleaner into the opening. Rotate the pipe-cleaner slowly as you do this.

3   Moisten a new cotton-swab with isopropyl alcohol.

4   Clean the interface by rubbing the cotton-swab over the surface using a small circular movement.

5   Using a new, dry pipe-cleaner, and a new, dry cotton-swab remove the alcohol, any dissolved sediment and dust.

6   Blow away any remaining lint with compressed air.

E.10 How to clean bare fiber adapters

Bare fiber adapters are difficult to clean. Protect from dust unless they are in use.

CAUTION   **Never use any kind of solvent when cleaning a bare fiber adapter as solvents can damage the foam inside some adapters.**

They can deposit dissolved dirt in the groove, which can then dirty the surface of an inserted fiber.

Preferred Procedure

Use the following procedure on most occasions.

1 Blow away any dust or dirt with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the adapter:

1 Clean the adapter by pushing and pulling a new, dry pipe-cleaner into the opening. Rotate the pipe-cleaner slowly as you do this.

CAUTION	**Be careful when using pipe-cleaners, as the core and the bristles of the pipe-cleaner are hard and can damage the adapter.**

2 Clean the adapter by rubbing a new, dry cotton-swab over the surface using a small circular movement.

3 Blow away any remaining lint with compressed air.

E.11 How to clean lenses

Some lenses have special coatings that are sensitive to solvents, grease, liquid and mechanical abrasion. Take extra care when cleaning lenses with these coatings.

Lens assemblies consisting of several lenses are not normally sealed. Therefore, use as little alcohol as possible, as it can get between the lenses and in doing so can change the properties of projection.

Preferred Procedure

Use the following procedure on most occasions.

1 Clean the lens by rubbing a new, dry cotton-swab over the surface using a small circular movement.

2 Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the lens:

1 Moisten a new cotton-swab with isopropyl alcohol.

2 Clean the lens by rubbing the cotton-swab over the surface using a small circular movement.

3 Using a new, dry cotton-swab remove the alcohol, any dissolved sediment and dust.

4 Blow away any remaining lint with compressed air.

E.12 How to clean instruments with a fixed connector interface

You should only clean instruments with a fixed connector interface when it is absolutely necessary. This is because it is difficult to remove any used alcohol or filaments from the input of the optical block.

It is important, therefore, to keep dust caps on the equipment at all times, except when your optical device is in use.

If you do discover filaments or particles, the only way to clean a fixed connector interface and the input of the optical block is to use compressed air.

If there are fluids or fat in the connector, please refer the instrument to the skilled personnel of Agilent's service team.

CAUTION   **Only use clean, dry compressed air. Make sure that the air is free of dust, water, and oil. If the air that you use is not clean and dry, this can lead to filmy deposits or scratches on the surface of your connector interface. This will degrade the performance of your transmission system.**

Never try to open the instrument and clean the optical block by yourself, because it is easy to scratch optical components, and cause them to be misaligned.

E.13 How to clean instruments with an optical glass plate

Some instruments, for example, the optical heads from Agilent Technologies have an optical glass plate to protect the sensor. Clean this glass plate in the same way as optical lenses (see "How to clean lenses" on page 166).

E.14 How to clean instruments with a physical contact interface

Remove any connector interfaces from the optical output of the instrument before you start the cleaning procedure.

Cleaning interfaces is difficult as the core diameter of a single-mode fiber is only about 9 µm. This generally means you cannot see streaks or scratches on the surface. To be certain of the degree of pollution on the surface of your interface and to check whether it has been removed after cleaning, you need a microscope.

WARNING   **Never look into an optical output, because this can seriously damage your eyesight.**

To assess the projection of the emitted light beam you can use an infrared sensor card. Hold the card approximately 5 cm from the

interface. The invisible emitted light is project onto the card and becomes visible as a small circular spot.

Preferred Procedure

Use the following procedure on most occasions.

1 Clean the interface by rubbing a new, dry cotton-swab over the surface using a small circular movement.

2 Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the interface:

1 Moisten a new cotton-swab with isopropyl alcohol.

2 Clean the interface by rubbing the cotton-swab over the surface using a small circular movement.

3 Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.

4 Blow away any remaining lint with compressed air.

E.15 How to clean instruments with a recessed lens interface

WARNING   **For instruments with a deeply recessed lens interface (for example the Agilent Technologies 81633A and 81634A Power Sensors) do NOT follow this procedure. Alcohol and compressed air could damage your lens even further.**

Keep your dust and shutter caps on, when your instrument is not in use. This should prevent it from getting too dirty. If you must clean such instruments, please refer the instrument to the skilled personnel of Agilent's service team.

Preferred Procedure

Use the following procedure on most occasions.

1 Blow away any dust or dirt with compressed air. If this is not sufficient, then

2 Clean the interface by rubbing a new, dry cotton-swab over the surface using a small circular movement.

3 Blow away any remaining lint with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the interface, and using the procedure for light dirt is not sufficient. Using isopropyl alcohol should be your last choice for recessed lens interfaces because of the difficulty of cleaning out any dirt that is washed to the edge of the interface:

1 Moisten a new cotton-swab with isopropyl alcohol.

2 Clean the interface by rubbing the cotton-swab over the surface using a small circular movement.

3 Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.

4 Blow away any remaining lint with compressed air.

E.16 How to clean optical devices which are sensitive to mechanical stress and pressure

Some optical devices, such as the Agilent 81000BR Reference Reflector, which has a gold plated surface, are very sensitive to mechanical stress or pressure. Do not use cotton-swabs, soft-tissues or other mechanical cleaning tools, as these can scratch or destroy the surface.

Preferred Procedure

Use the following procedure on most occasions.

1 Blow away any dust or dirt with compressed air.

Procedure for Stubborn Dirt

To clean devices that are extremely sensitive to mechanical stress or pressure you can also use an optical clean polymer film. This procedure is time-consuming, but you avoid scratching or destroying the surface.

1 Put the film on the surface and wait at least 30 minutes to make sure that the film has had enough time to dry.

2 Remove the film and any dirt with special adhesive tapes.

Alternative Procedure

For these types of optical devices you can often use an ultrasonic bath with isopropyl alcohol. Only use the ultrasonic bath if you are sure that it won't cause any damage anything to the device.

1 Put the device into the bath for at least three minutes.

2 Blow away any remaining liquid with compressed air.

If there are any streaks or drying stains on the surface, repeat the cleaning procedure.

E.17 How to clean metal filters or attenuator gratings

This kind of device is extremely fragile. A misalignment of the grating leads to inaccurate measurements. Never touch the surface of the metal filter or attenuator grating. Be very careful when using or cleaning these devices. Do not use cotton-swabs or soft-tissues, as there is the danger that you cannot remove the lint and that the device will be destroyed by becoming mechanically distorted.

Preferred Procedure

Use the following procedure on most occasions.

1   Use compressed air at a distance and with low pressure to remove any dust or lint.

Procedure for Stubborn Dirt

Do not use an ultrasonic bath as this can damage your device.

Use this procedure particularly when there is greasy dirt on the device:

1   Put the optical device into a bath of isopropyl alcohol, and wait at least 10 minutes.

2   Remove the fluid using compressed air at some distance and with low pressure. If there are any streaks or drying stains on the surface, repeat the whole cleaning procedure.

E.18 Additional Cleaning Information

The following cleaning procedures may be used with other optical equipment:

- How to clean bare fiber ends
- How to clean large area lenses and mirrors

How to clean bare fiber ends

Bare fiber ends are often used for splices or, together with other optical components, to create a parallel beam. The end of a fiber can often be scratched. You make a new cleave. To do this:

1 Strip off the cladding.

2 Take a new soft-tissue and moisten it with isopropyl alcohol.

3 Carefully clean the bare fiber with this tissue.

4 Make your cleave and immediately insert the fiber into your bare fiber adapter in order to protect the surface from dirt.

How to clean large area lenses and mirrors

Some mirrors, as those from a monochromator, are very soft and sensitive. Therefore, never touch them and do not use cleaning tools such as compressed air or polymer film.

Some lenses have special coatings that are sensitive to solvents, grease, liquid and mechanical abrasion. Take extra care when cleaning lenses with these coatings.

Lens assemblies consisting of several lenses are not normally sealed. Therefore, use as little liquid as possible, as it can get between the lenses and in doing so can change the properties of projection.

Preferred Procedure

Use the following procedure on most occasions.

1   Blow away any dust or dirt with compressed air.

Procedure for Stubborn Dirt

Use this procedure particularly when there is greasy dirt on the lens:

CAUTION   **Only use water if you are sure that your device does not corrode. Do not use hot water as this can lead to mechanical stress, which can damage your device.**

Make sure that your liquid soap has no abrasive properties or perfume in it, because they can scratch and damage your device. Do not use normal washing-up liquid as sometimes an iridescent film remains.

1   Moisten the lens or the mirror with water.

2   Put a little liquid soap on the surface and gently spread the liquid over the whole area.

3   Wash off the emulsion with water, being careful to remove it all, as any remaining streaks can impair measurement accuracy.

4   Take a new, dry soft-tissue and remove the water, by rubbing gently over the surface using a small circular movement.

5   Blow away remaining lint with compressed air.

Alternative Procedure A

To clean lenses that are extremely sensitive to mechanical stress or pressure you can also use an optical clean polymer film. This procedure is time-consuming, but you avoid scratching or destroying the surface.

1   Put the film on the surface and wait at least 30 minutes to make sure that the film has had enough time to dry.

2   Remove the film and any dirt with special adhesive tapes.

Alternative Procedure B

If your lens is sensitive to water then:

1 Moisten the lens or the mirror with isopropyl alcohol.

2 Take a new, dry soft-tissue and remove the alcohol, dissolved sediment and dust, by rubbing gently over the surface using a small circular movement.

3 Blow away remaining lint with compressed air.

E.19 Other Cleaning Hints

Selecting the correct cleaning method is an important element in maintaining your equipment and saving you time and money. This Appendix highlights the main cleaning methods, but cannot address every individual circumstance.

This section contain some additional hints which we hope will help you further. For further information, please contact your local Agilent Technologies representative.

Making the connection

Before you make any connection you must ensure that all lightwave cables and connectors are clean. If not, then use appropriate the cleaning methods.

When you insert the ferrule of a patchcord into a connector or an adapter, ensure that the fiber end does not touch the outside of the mating connector or adapter. Otherwise, the fiber end will rub up against something which could scratch it and leave deposits.

Lens cleaning papers

Note that some special lens cleaning papers are not suitable for cleaning optical devices like connectors, interfaces, lenses, mirrors

and so on. To be absolutely certain that a cleaning paper is applicable, please ask the salesperson or the manufacturer.

Immersion oil and other index matching compounds

Do not use immersion oil or other index matching compounds with optical sensors equipped with recessed lenses. They are liable to dirty the detector and impair its performance. They may also alter the property of depiction of your optical device, thus rendering your measurements inaccurate.

Cleaning the housing and the mainframe

When cleaning either the mainframe or the housing of your instrument, only use a dry and very soft cotton tissue on the surfaces and the numeric pad.

Never open the instruments as they can be damaged. Opening the instruments puts you in danger of receiving an electrical shock from your device, and renders your warranty void.

F

Environmental Profile

Environmental Profile

F.1 Product Summary

This information is valid for all Rack OTDRs

Transport restrictions:	none
Hazardous or restricted materials:	no hazardous materials no CFCs or brominated fire retardants
Parts requiring special disposal:	Li-Ion Backup-battery

F.2 Materials of Construction

Material	actual weight	% weight	% recyclable/ reusable
Metals			
Aluminium	1250g	54	100
Plastic parts:			
TPU	40g	2	100
Others:			
Printed Circuit Boards	510g	22	0

F.3 Energy Use/Efficiency

Normal Operation:	< 10 Watt
Standby:	< 5 Watt

F.4 Operation Emissions

Ozone:	No ozone emissions
Radio Frequency Noise:	Meets CISPR 11 (CISPR22)

F.5 Batteries

The Lithium backup battery requires special disposal. Dispose in accordance with local laws and regulations.

F.6 Materials of Packaging

Material	% weight		% recyclable/reusable
PU	250g	18	100
Corrugated Paper	1150g	82	100

F.7 Learning Products

Manuals are 100% recyclable.

F.8 Agilent Technologies Manufacturing Process

Agilent Technologies has eliminated ozone depleting substances such as chlorofluorocarbons (CFCs), trichlorethane (TCA), and carbon tetrachloride from its manufacturing process worldwide.

Appendix F. Environmental Profile
Agilent Technologies Manufacturing Process

Agilent Technologies is surveying and working with suppliers to identify and eliminate any ozone depleting substances from their manufacturing.

G

The DC/DC Adapter

The DC/DC Adapter

G.1 Introduction

If you have Option 004 of the Rack OTDR, an external DC/DC switcher is mounted on the rear of your instrument.

The switcher is attached to your Rack OTDR (Figure G-1), with the equipment displayed in Figure G-2

M3 x 16mm

M3 x 30 mm

protective earth connection between
Rack OTDR and external DC/DC switcher
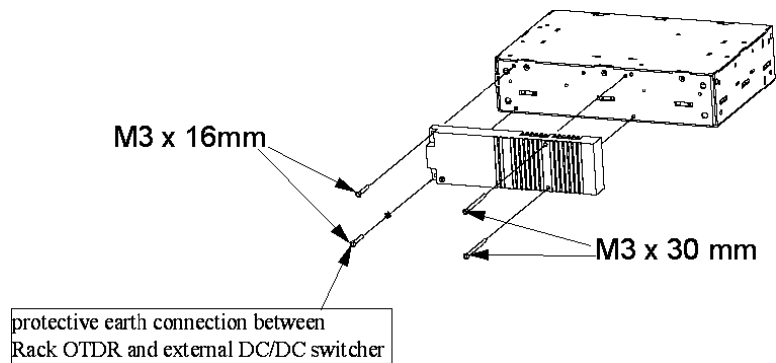
Figure G-1   **DC/DC Adapter attachment**

NOTE   **The bottom left screw acts as a protective earth for the DC/DC switcher.**

The other 3 screws just act to hold the switcher in position

Appendix G. The DC/DC Adapter

Introduction

.
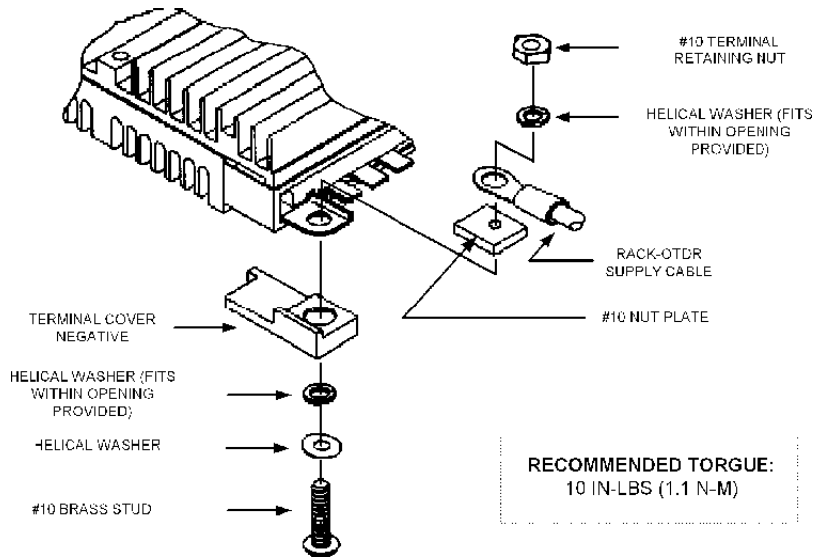
Figure G-2   **Attaching a DC/DC Adapter**

A power cord is attached to the switcher (Figure G-3).
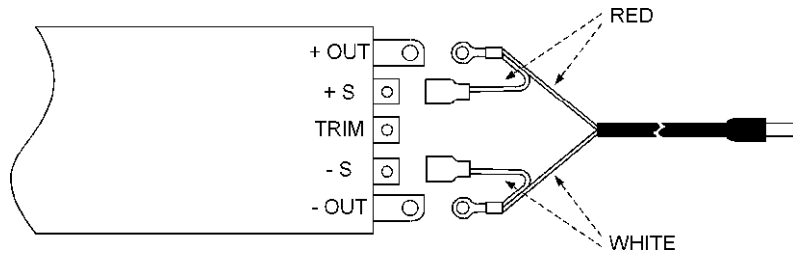
Figure G-3   **Attaching a power cord to the DC/DC switcher**

Appendix G. The DC/DC Adapter
Introduction

When you receive your Rack OTDR, the power cord is screwed to the side of the Rack OTDR (Figure G-4 on page 187). However, you can unscrew the power cord and pass it through your Rack OTDR flaps (Figure G-5).

M4 x 6mm
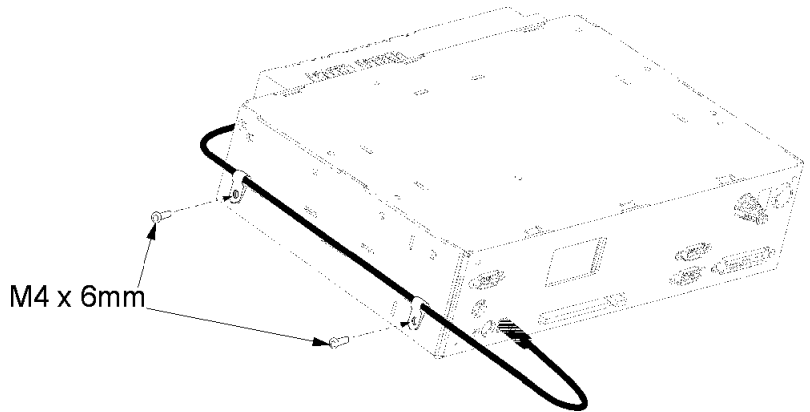
Figure G-4   **Rack OTDR power cord: without rackmount kit**
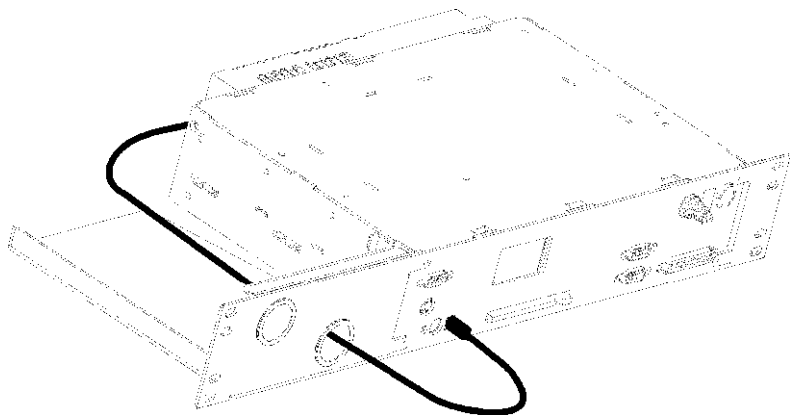
Figure G-5   **Rack OTDR power cord: with rackmount kit**

G.2 Safety Considerations

NOTE **When the Rack OTDR has option 004 (externally mounted DC/DC converter), and the Rack and DC/DC switcher are in use, the system complies to Safety Class 1 (for instruments provided with a terminal for protective grounding).**

NOTE **The following label is fixed onto the DC/DC switcher.**

Vicor Model No.:
VI-LCN3-CY

Input:
Voltage: 48VDC
Current: 1.7A

G.3 Power Supply Requirements

Input Line Fusing

NOTE

⚠

The DC/DC switcher, which is mounted on the rear side of the Rack OTDR, must be fused externally. The fuse must have 7 A, a rating of at least 60 V and must be of type "fast acting" (for example, fuse type 3AB-7).

The fuse must be inserted into the 48 VDC supply circuit using the DC/DC switcher.

Grounding

For safe operating, the externally mounted DC/DC switcher **must** be grounded (see "Safety Considerations" on page 188).

Connect a protective ground lead to the terminal marked on the DC/DC switcher:
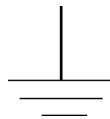
Figure G-6   **Protective ground marking**

Use a wire of at least 16 AWG wire with color code yellow-green for this connection.

Input Voltage Connection

Connect the +48 V line to the Vin+ (positive) and the ground to the Vin- (negative) points of the external DC/DC switcher mounted on the rear side of your Rack OTDR (Figure G-7).

189

Alternatively, connect the -48 V line to the Vin- (negative) and the ground to the Vin+ (positive) points.

Use wires of 16 AWG to connect the line to the points.

If you use the Rack OTDR option 004 in a battery system, you can connect the protective ground terminal (marked with the symbol shown in Figure G-6) to the corresponding ground potential of the +48 VDC and -48 VDC input.

Be sure to tighten the lead securely. We recommend a connector screw torque of 3.5 in-lbs (0.4 Nm).

NOTE   **If you attach the 48 VDC line to the input of the connected external DC/DC switcher the Rack OTDR automatically boots when the switcher is not disabled.**

The Rack OTDR also boots if you remotely switch on the DC/DC converter by interrupting the disabling circuit (see "Master Disable" on page 190).

WARNING   **The DC/DC power supply is for indoor use only.**

Master Disable

The Master Disable input is optically isolated and incorporates a reverse polarity protection diode (Figure G-7).
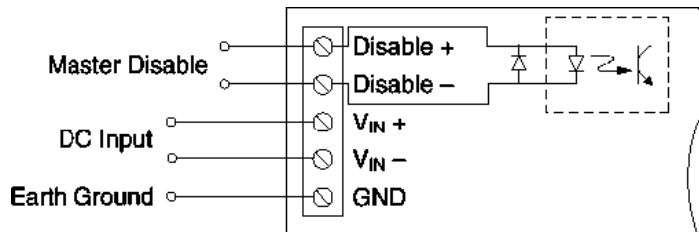
Figure G-7   **Master Disable**

Apply a current of at most 20 mA to disable output.

WARNING	**20 mA is the absolute maximum current that you should apply. Never apply a higher current.**

Figure G-8 gives a diagram showing a disabled circuit.
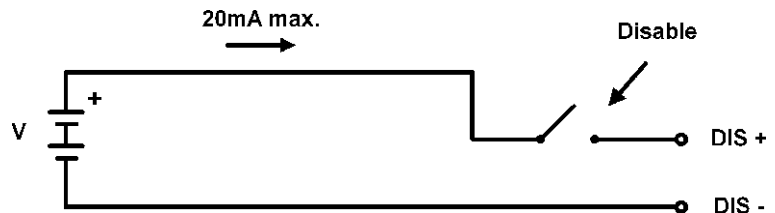
Figure G-8   **Interrupting the disabling circuit**

The typical current level is below 4 mA

G.4 Specifications

- **Dimensions**: ca. 71 mm H, 290 mm W, 230 mm D (3.0" x 11.6" x 9.1").

- **Weight**: < 2.6 kg (5.8 lb)

- **Input voltage of externality mounted DC/DC switcher**:
  +48 VDC nom. (42 .. 60 VDC)
  -48 VDC nom. (-60 .. -42 VDC): see "Input Voltage Connection" on page 189.

- **Maximum power consumption**: 25 W

- **Typical power consumption**: 10 W

- **Standby power consumption**: < 5 W

Appendix G. The DC/DC Adapter
Specifications

Index

Index