Service Manual

Tektronix

TOP Series
Fiber-Optic Instruments
TOP200, TOP220 Optical Power Meters
Volume 1

070-9379-03

Warning
The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

www.tektronix.com

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

WARRANTY

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor or will provide a replacement in exchange for the defective product.

In order to obtain service under warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THIS PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Replace Batteries Properly. Replace batteries only with the proper type and rating specified.

Recharge Batteries Properly. Recharge batteries for the recommended charge cycle only.

Use Proper AC Adapter. Use only the AC adapter specified for this product.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Wear Eye Protection. Wear eye protection if exposure to high-intensity rays or laser radiation exists.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Provide Proper Ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

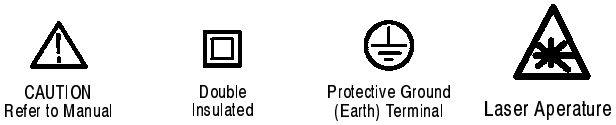
Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product. The following symbols may appear on the product:



Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power. To avoid electric shock, switch off the instrument power, then disconnect the power cord from the mains power.

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Preface

This manual is used for servicing the TOP200 and TOP220 optical power meters to *instrument level only.* It does not contain component-level service information, schematics, or parts lists.

If You Need Help

Information about servicing the TOP200 and TOP220 optical power meters is available by calling the Tektronix number listed in Contacting Tektronix on page xvi and selecting the desired option.

Assumptions

The procedures in this manual assume that you are a qualified electronic technician, and have a working knowledge of service procedures for fiber-optic test equipment.

Before Servicing

To prevent injury to yourself or damage to equipment:

- You must be a qualified service person
- Read the *Safety Summary* at the beginning of this manual.
- Heed to all warnings, cautions and notes in this manual.

What You Will Find in this Manual

- *General Information.* General product and operator information. Battery replacement. Specifications. Accessories and options.
- *Theory of Operation.* Basic information on how the TOP200 and TOP220 optical power meters operate.
- *Performance Verification.* Procedures for verifying that the TOP200 and TOP220 optical power meters function properly and meet warranted operating specifications.

- *Adjustment Process.* **Adjustment for the TOP200 and TOP220 optical power meters.**
- *Maintenance.* Cleaning procedures. General troubleshooting and fault isolation.
- *Replaceable Parts.* Part numbers and ordering information.

Related Documents

- The *TOP Series Fiber Optic Instruments User Manual*

Tektronix Service

Tektronix provides service to cover repair under warranty and post-warranty problems.

The TOP200 and TOP220 optical power meters are warranted for one year. The warranty statement appears at the beginning of this manual.

Contacting Tektronix

Phone	1-800-833-9200*
Address	Tektronix, Inc. Department or name (if known) 14200 SW Karl Braun Drive P.O. Box 500 Beaverton, OR 97077 USA
Web site	www.tektronix.com
Sales support	1-800-833-9200, select option 1*
Service support	1-800-833-9200, select option 2*
Technical support	Email: techsupport@tektronix.com 1-800-833-9200, select option 3* 1-503-627-2400 6:00 a.m. - 5:00 p.m. Pacific time

* **This phone number is toll free in North America. After office hours, please leave a voice mail message. Outside North America, contact a Tektronix sales office or distributor; see the Tektronix web site for a list of offices.**

General Information

Instrument Level Service

Overview

This service manual is used for servicing the TOP200 and TOP220 optical power meters to *instrument level only.* The usual corrective procedure is to replace, not repair, the instrument.

Static-Sensitive Components

CAUTION

The TOP200 and TOP220 optical power meters contain components that are sensitive to electrostatic discharge (ESD).

When servicing the TOP200 and TOP220 optical power meters, work only at a static-free workstation, and practice anti-static handling procedures.

WARNING

Laser Warning

While there is no potential for eye damage due to unaided direct exposure, never look directly into the output port. Do not use optical viewing instruments (such as microscopes, magnifiers, etc.). The use of these devices on active fibers can focus a highly intense beam onto the retina which can result in permanent eye damage.

Service Procedure

The direct service-related sections in this manual are:

- *Theory of Operation.* Reference information about the instruments.
- *Performance Verification.* Use to verify the TOP200 and TOP220 optical power meters to see that the instruments meet specification.
- ***Adjustment Process.*** **Use to adjust the TOP200 and TOP220 optical power meters if specifications are out of tolerance.**
- *Maintenance.* Use for:
  - Cleaning
  - Resolving error messages displayed on the screen
  - Troubleshooting problems
- *Replaceable Parts.* Part numbers and ordering information

The first section in this manual, *General Information,* contains product information, user information, battery/power information, specifications, accessories and options.

If you have no need for this information, go directly to the other sections.

Product Information

This section briefly describes the TOP200 and TOP220 optical power meters.

A quick review of this section will familiarizes you with the TOP200 and TOP220 optical power meters, which will help when servicing the instrument.

For complete product information, refer to the *TOP Series Fiber Optic Instruments User Manual.*

Product Package

The TOP200 and TOP220 optical power meters are supplied with the following equipment and standard accessories:

- One snap-on connector (SOC) adapter specified at time of order. Refer to *Accessories and Options* for a list of SOC adapter options.
- One rubber bumper with bail
- Two AA alkaline 1.5V batteries (>100 hours life)
- One user manual (070-9372-01)

Product Description

The Tektronix TOP200 and TOP220, true palm-sized optical power meters, cover the full range of optical fiber applications. These instruments were engineered for field and lab personnel requiring a high performance, cost effective, compact and rugged OPM.

The TOP200 and TOP220 optical power meters utilize the snap-on connector (SOC) interface. All industry-standard fiber-optic connectors can be accommodated via a complete line of snap-on connector adapters.

The TOP200 and TOP220 design combines a state-of-the-art signal processor and microcomputer electronics to provide superb performance as well as simple and elegant operation with just three controls: ON/OFF, dBm/dB and λ. Photonic energy is directly analyzed through digital signal processing. The result is a very fast readout settling time. The instrument settles within less than two seconds upon applying a 0dBm power level. Quick readout stabilization becomes very important when performing repetitive measurements or splice alignment.

The TOP220 has an optical filter in front of the photodetector to attenuate high power levels. This filter extends the range of the optical input power to +27dBm.

Operating Modes

The TOP200 and TOP220 optical power meters feature two operating modes: Normal Operation (OP) and Calibration (CAL). At power on, the optical power meter defaults to the operating mode and wavelength last selected as the default at power off.

To change to the calibration mode, set the switch found inside the battery compartment to CAL mode. A "C" in the lower left-hand corner of the LCD display indicates that the power meter is in calibration mode. See the *Calibration Process* section for calibration procedures.

Optical Interface

The optical interface, located above the power meter, detects the specified wavelength from the light source. Using an InGaAs detector, repeatability is achieved due to the exact center alignment of the SOC adapter. The wavelength options are 850nm, 1300nm, 1310nm and 1550nm for the TOP200; and 980nm, 1310nm and 1550nm for the TOP220.

The dust cap protects the optical interface when not in use.

Refer to the *Accessories and Options* section for a list of the most common connectors and SOC adapter options.

CAUTION

The optical interface must always be covered with the dust cap to protect the detector window from dirt or scratches.

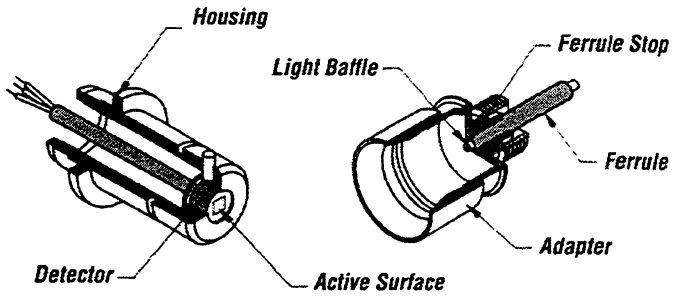


Figure 1-1: Optical Interface and SOC Adapter

Other Features

LCD Display

- The extended temperature range display offers 0.01dB resolution.
- dB, dBm and wavelength annunciators indicate current operating mode.
- All features rival functions otherwise only found in top-of-the-line laboratory instruments.

Optical Interface Features

- Easily cleanable detector window and connector adapter. Refer to *Cleaning and Troubleshooting* section for cleaning procedures.
- SOC adapters are field changeable and must match the type of fiber connector being used. Refer to *Accessories and Options* section for connector adapter options.

Rubber Bumper

- Every instrument includes a removable rubber bumper. This molded silicone shell acts to protect against shock in the field.
- The rubber bumper includes a pivoting bail to hold the instrument upright when required.

Structural Integrity

- The TOP200 and TOP220 instruments can take falls and are highly crush resistant.
- The unit provides reliable and accurate measurements from -15°C to +50°C.

Dust Cap

- The permanently attached dust cap simply snaps into place.
- There is no need to remove the adapter; the dust cap fits over all adapters.

Operator Information

This section summarizes the TOP200 and TOP220 optical power meter button functions as well as changing the Snap-on Connector (SOC) adapters.

A quick review of this section familiarizes you with the basic operation of the TOP200 and TOP220 optical power meters, which will help when servicing the instrument.

For complete operator information, refer to the *TOP Series Fiber Optic Instruments User Manual(s).*

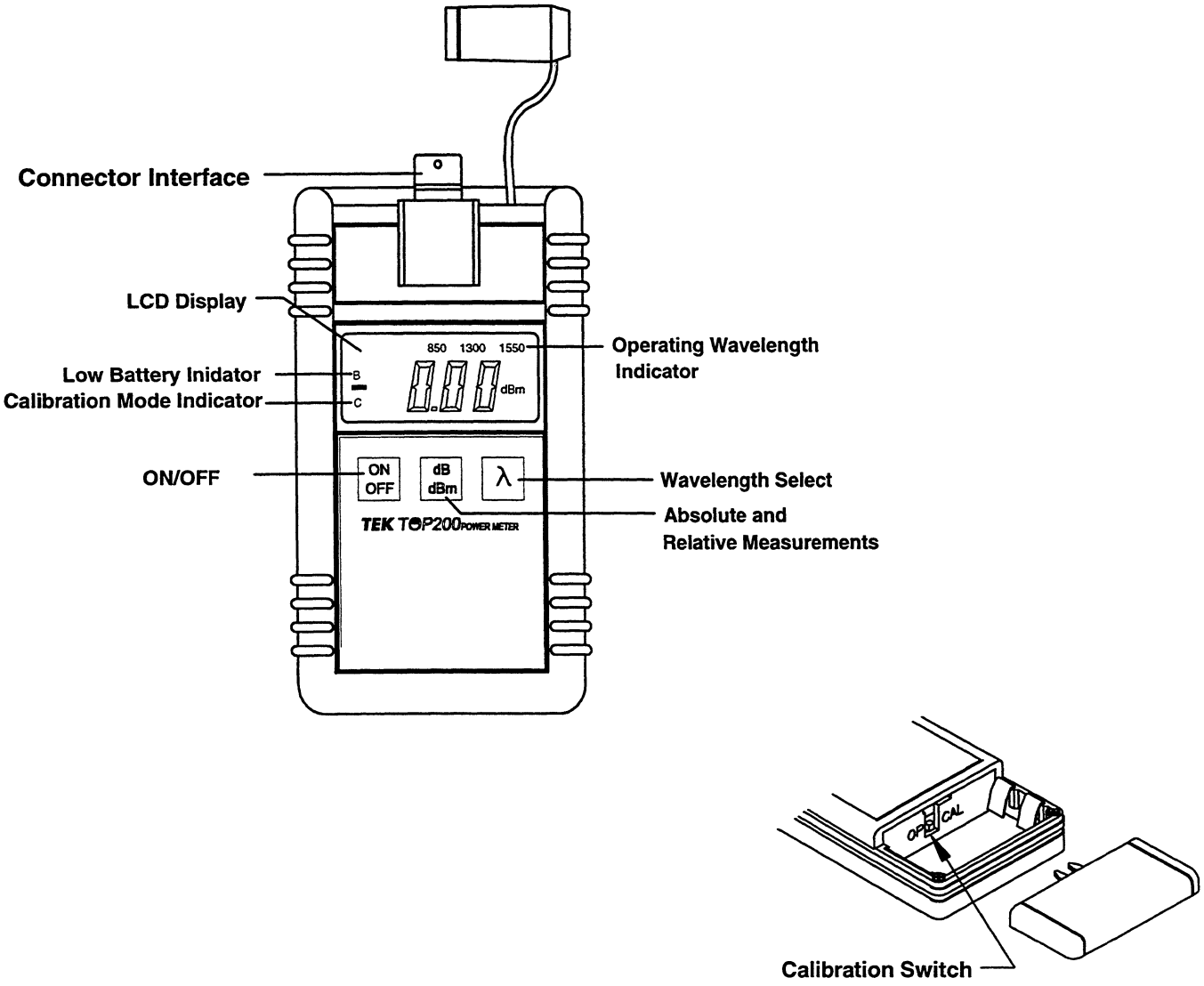


Figure 1-2: Instrument Button and Switch Locations

Labeled Buttons

The **ON/OFF** slide switch, the **dB/dBm** button and the λ button are the basic operator controls to operate the TOP200 and TOP220 optical power meters. This simple design allows ease of operation.

The **ON/OFF** button controls the power of the TOP200 optical power meter.

The **dB/dBm** button toggles between dBm and dB mode. It also sets the new dB reference by holding the button for 3 seconds until the "r" annunciator appears.

To disable the **Auto-Shutoff** feature: with the unit off, hold down the **dB/dBm** button, then press the **ON/OFF** button.

When dBm is displayed, the reading reflects the absolute measurement of the power of a fiber optic source.

$$dBm = 10 \cdot \mathrm{Log}_{10} \frac{P_{[mW]}}{1mW}$$

When dB is displayed, all subsequent readings are displayed relative to the reference power level.

$$dB = 10 \cdot \mathrm{Log}_{10} \frac{P_{[mW]}}{P_{Ref}\ [mW]}$$

To establish a new reference power level (P_{Ref}), depress the **dB/dBm** button for about 2-3 seconds until the "**r**" annunciator appears below the **dB** annunciator. The instrument displays 0.00 dB referenced to the current dBm input level. Note that the optical power meter reading may move several counts up and down around zero if the instrument detects minor fluctuations in the input signal.

The λ button selects the wavelength calibration factor being used by the optical power meter. The calibration wavelengths that are available for the TOP200 optical power meter are 850nm, 1300nm, 1310nm and 1550nm. The TOP220 calibration wavelengths are 980nm, 1310nm and 1550nm.

To select a start-up default wavelength, you simply select the desired wavelength by pressing and holding the λ button then pressing the **dB/dBm** button. When the power is turned off and on again, the optical power meter defaults to this wavelength.

This switch inside the battery compartment determines the current operating mode of the TOP200 and TOP220 optical power meters. Setting the switch to **OP** sets the power meter to normal operation mode, while setting the switch to **CAL** sets the power meter to calibration mode. A "C" is displayed on lower left-hand corner of the LCD display when the power meter is in calibration mode.

Connector Interface

The connector interface supports many SOC adapters to accommodate all popular industry standard fiber optic connectors.

To interchange SOC adapters:

- ☐ **Step 1:** Locate the anti-rotation key on the TOP200 optical power meter connector interface.
- ☐ **Step 2:** With the keyway properly aligned, slip the SOC adapter over the connector interface until fully locked into place indicated by a snap.
- ☐ **Step 3:** To remove SOC adapter, pull adapter off the connector interface. The adapter is firmly sealed and it requires considerable force to pull it off.

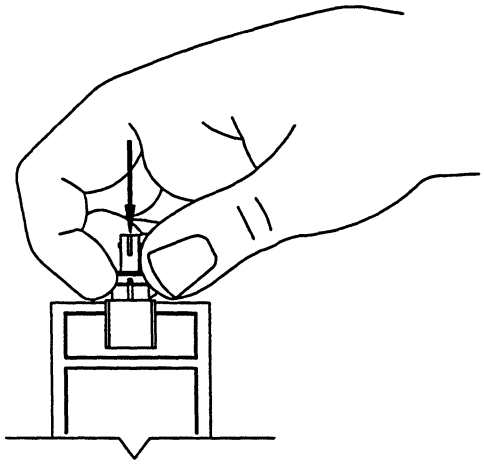


Figure 1-3: Changing the SOC Adapter

Battery Information

The TOP200 and TOP220 optical power meters are designed to operate on two standard 1.5V AA batteries. Low battery status is indicated when the letter "B" is displayed in the top left-hand corner of the LCD display. After LowBat indicator appears, the operator has at least five hours before the battery must be replaced.

Power Supply Circuitry

A power supply circuitry efficiently uses the precious battery power. The power supply circuitry uses two inductors to boost the 3V battery voltage to 5V. The battery voltage can drop all the way to 1V and the power meter will still operate.

Battery Replacement

To replace the batteries:

- ☐ **Step 1:** Remove rubber bumper
- ☐ **Step 2:** Remove battery cover by pressing on the center of the cover while pulling on its sides.
- ☐ **Step 3:** Remove used batteries and discard. Replace with new batteries.
- ☐ **Step 4:** Replace battery cover.
- ☐ **Step 5:** Replace rubber bumper.

NOTE

Observe the correct polarization as indicated in the bottom of the battery compartment. Failure to install the batteries in the correct orientation may damage the instrument.

Please discard batteries according to local environmental regulations.

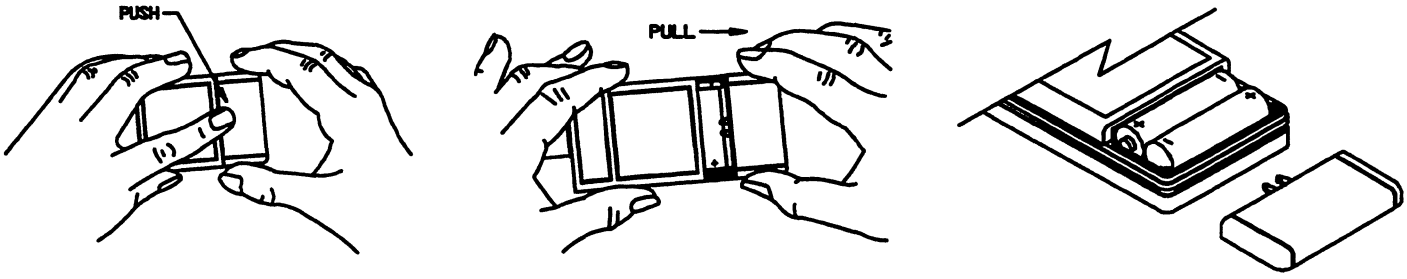


Figure 1-4: Battery Replacement

General Specifications

Performance Characteristics

Table 1-1: Performance Characteristics

Feature	TOP200	TOP220
Detector Material	InGaAs (1mm)	InGaAs (2mm)
Power Range	+3 to -60dBm	+27dBm to -30dBm (1310 and 1550nm) +30dBm to -27dBm (980nm only)
CAL Wavelengths	850nm, 1300nm, 1310nm, 1550nm	980nm, 1310nm, 1550nm
Absolute Accuracy	±0.25dB at Calibration Conditions[1]	
Stability Longterm (24 hours) Temp. (-15°C to +50°C)	 ±0.01dB ±0.05dB	
Drop With Rubber Bumper In Carrying Case 900A	 4 feet (all 6 faces plus 4 corners) 10 feet (all 6 faces plus 4 corners)	
Function	dBm (Absolute power) dB (Relative Power) λ (Select CAL wavelength, also used to set default/CAL wavelength) CAL (Calibrate unit)	
Calibration Data	Data stored in non-volatile memory	
Auto-Shutoff Shut-Off Disable	Unit powers down 70 minute after last key has been depressed. Disables the 70 minute power shut-off.	
Recalibration	Unit can be recalibrated by user, following procedures in *Calibration Process* section. CAL switch located inside battery compartment.	
Connector Interface	snap-on connector (SOC) Interface. See *Accessories and Options.*	

[1] Tektronix Calibration Conditions:
Power: -30 dBm (TOP200);-10 dBm (TOP220)
Wavelengths: 850 +/- 1 nm (TOP200); 980 +/- 1 nm (TOP220);
1310 +/- 20 nm and 1550 +/- 20 nm (TOP200/220)
Test Fibers: See the Equipment Required list in the performance Verification section

Power Requirements/Characteristics

Table 1-2: Power Requirements/Characteristics

Power Source	TOP200	TOP220
Battery	2 AA Alkaline Batteries 1.5V	
Typical Battery Life	>100 hours	
Power Supply Circuitry Increases 3V battery voltage to 5V		

EMC Compliance

Table 1-6 : Certifications and compliances

Category	Standards or description
EC Declaration of Conformity - EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities: EN 61326 — EMC requirements for Class A electrical equipment for measurement, control and laboratory use.[1] IEC 61000-4-2 — Electrostatic discharge immunity (Performance criterion B) IEC 61000-4-3 — RF electromagnetic field immunity (Performance criterion A)
Australia / New Zealand Declaration of Conformity - EMC	Complies with EMC provision of Radiocommunications Act per the following standard(s): AS/NZS 2064.1/2 — Industrial, Scientific, and Medical Equipment: 1992
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.

1 **Emissions which exceed the levels required by this standard may occur when this equipment is connected to a test object.**

Accessories and Options

Standard Accessories

Standard accessories are included with the instrument, or may be ordered by part number.

Table 1-7: Standard Accessories

Accessory	TEKTRONIX Part Number
User Manual	070-9372-01
Rubber Bumper w/ Bail	348-1480-00
Two (2) AA Alkaline 1.5 batteries (>100 hours life)	N/A
SOC Adapter specified at time of order	N/A

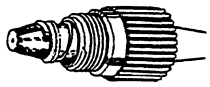
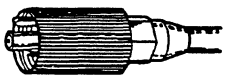
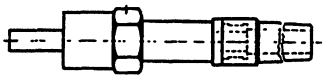
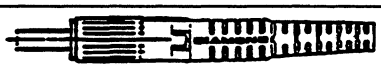
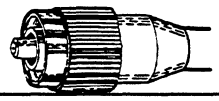
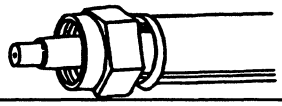
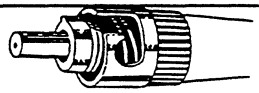
Optional Accessories

This service manual is an optional accessory and can be ordered by **Tektronix part number 070-9379-03.**

SOC adapters are interchangeable to accommodate a number of connector adapters. A SOC adapter is used to align the connector ferrule with the detector window.

Additional SOC adapters may be ordered by Tektronix part number.

Table 1-8: SOC Adapter Selection Chart

Connector Types		TOP200 SOC Adapters Tektronix Part Number
Biconic		119-5168-00
D4-PC		119-5167-00
HMS-10/HP (DIAMOND-2.5)		119-5171-00
DIAMOND-3.5		119-5172-00
DIN-PC DIN-APC/HRL-10		119-5166-00 119-5166-00
E2000-PC E2000-APC		119-5165-00 119-5165-00
FC-PC FC-APC		119-5146-00 119-5146-00
SC-PC SC-APC		119-5145-00 119-5145-00
SMA 905/906		119-5169-00
SMA-2.5		119-5170-00
ST-PC		119-5144-00

Theory of Operation

This section describes the theory of operation for the TOP200 and TOP220 optical power meters to provide a basic overview of how the instrument operate.

Power meters in general consist of five components:

- Optical Detector
- A/D Converter
- Micro Processor Unit
- Display and Display Driver
- Power Supply

See Figure 2-3 for system overview.

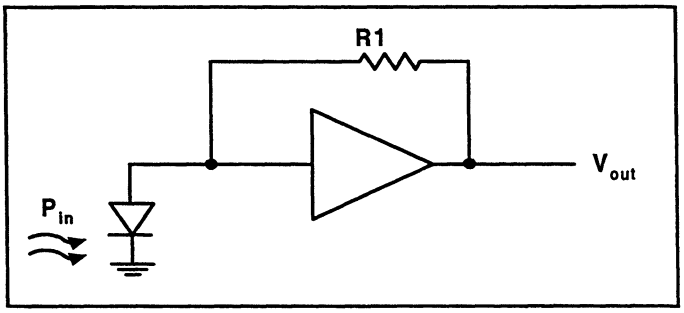
Optical Detector

The optical detector converts incident light power to electrical current. The optical detector is also called a photodiode, because it is a semiconductor PIN junction, and its electrical behavior is just like a diode. The energy of the photons absorbed on the detector surface frees up trapped electrons within the PIN junction. The relationship of photonic energy versus electrical current is highly linear.

The optical response of the detector is:

$$R_{[A/W]} = \frac{\text{Current [A]}}{\text{Optical Power [W]}}$$

The Optical Power versus current relationship is most linear when the photodetector is operated in the zero bias mode. For this purpose a trans-impedance amplifier is used.



The output voltage is:

$$V_{out[V]} = P_{in} * R_{[A/W]} * R1_{[\Omega]}$$

There are three different semiconductor materials used for optical detectors. Their performance varies in terms of sensitivity and wavelength coverage.

Table 2-1: Photodiode Characteristics

Material	Useful Wavelength Range	Sensitivity	MODEL
Si (Silicon)	400nm to 1000nm	1pW to 2mW	N/A
Ge (Germanium)	600nm to 1550nm	50pW to 5mW	N/A
InGaAs (Indium Gallium Arsenide)	750nm to 1600nm	1pW to 4mW	TOP200

Unfortunately, detectors do not respond equally well at different wavelengths. Generally at shorter wavelengths, the response R is lower than at longer wavelengths. Figure 2-1 below shows the response curves of the three materials.

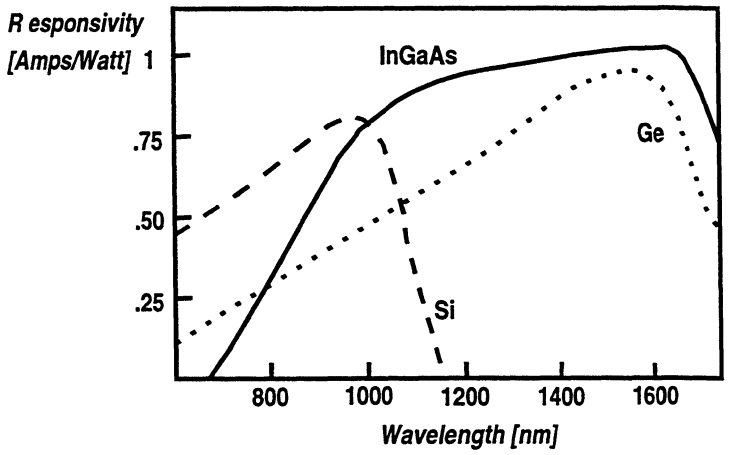


Figure 2-1: Wavelength Dependency

Based on Figure 2-1 above, if an InGaAs detector is illuminated with 1mW of optical power, then it produces 0.8mA of current. The optical detector does not know which wavelength is incident on the surface. Consequently, the user must "tell" the meter what wavelength is measured. During calibration, the power meter is told what the response factor is at the various calibration wavelengths. On the TOP200 and TOP220 optical power meters, this calibration data is stored in an EEPROM (electrically erasable programmable read only memory). See *Calibration Process* section for further information.

Detector saturation occurs when too much power falls onto one area of the detector surface. Every detector has a power density limit. Generally, this limit is around 2mW/mm^2 to 10mW/mm^2.

The TOP200 optical power meter utilizes a 1mm diameter InGaAs detector with a power limit of +3dBm. **Figure 2-1 shows the wavelength dependency of the TOP200.**
The TOP220 optical power meter utilizes a 2mm inGaAs detector with an attenuating filter. This filter compensates for the wavelength dependency of the detector. **The User Manual has more information about the TOP 220 wavelength dependency.**

The SOC adapter system assures that the fiber is correctly positioned at the right distance from the detector. Singlemode fibers have a much narrower NA (numerical aperture) and therefore do not fill the detector window, whereas large-core-area fibers often have a wider NA and cover the detector surface up to 90% with light.

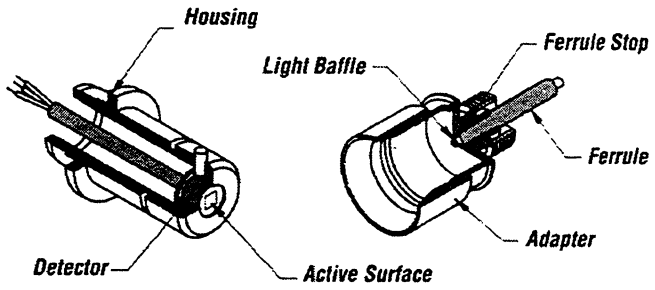


Figure 2-2: Detector and SOC Adapter Alignment

The SOC adapter is designed to position the connector ferrule at the exact center position for best repeatability. Unlike threaded adapters, the SOC adapter aligns on the cylindrical surface and, thus, greater repeatability is achieved.

The SOC adapter may be removed for cleaning the detector window, or it may be interchanged to accommodate a number of connector adapters.

NOTE: It is important to always keep the detector window clean.

A/D Converter

The analog voltage signal of the transimpedance amplifier must be converted to a digital number. Optical power meters employ a unique current-to-frequency converter. The microprocessor measures the period of the frequency signal and thus can accurately measure the current of the optical detector. Of course, the time period is inversely proportional to the analog current. The microprocessor program easily and accurately converts the signal to its real value.

Micro Processor

The micro processor's job is to perform the calculation from linear units to logarithmic dB units. The formulas for this conversion are:

$$dBm = 10 \log (P_{in} / 1mW)$$

{dBm is an absolute power unit based on 1mW}

$$dB = 10 \log (P_{in} / P_{ref})$$

{P_{ref} is normally the last stored reading}

The micro processor also retrieves the calibration data from the EEPROM memory based on the wavelength selection.

Another function of the micro processor is to scan the two key-board buttons and the CAL switch. Whenever a user event occurs, the function is executed. For example, the dB/dBm function toggles the reference power unit from 1mW to the relative unit of the last reading.

Power Supply

Although the power meter is powered by two AA batteries, a power supply circuit efficiently utilizes this precious battery power. This power supply circuitry uses two inductors to boost the 3V battery voltage to 5V. The battery voltage can drop all the way down to 1V and the power meter will still work. While the power meter is switched ON, a higher start up current is required. Therefore, it is important to keep the battery terminals clean.

TOP200, TOP220 Operation

The TOP200 and TOP220 optical power meters design follows the basic concept for power meters. To improve the readout settling time the transimpedance amplifier is improved by integrating components which are controlled by the microcontroller.

System Block Diagram

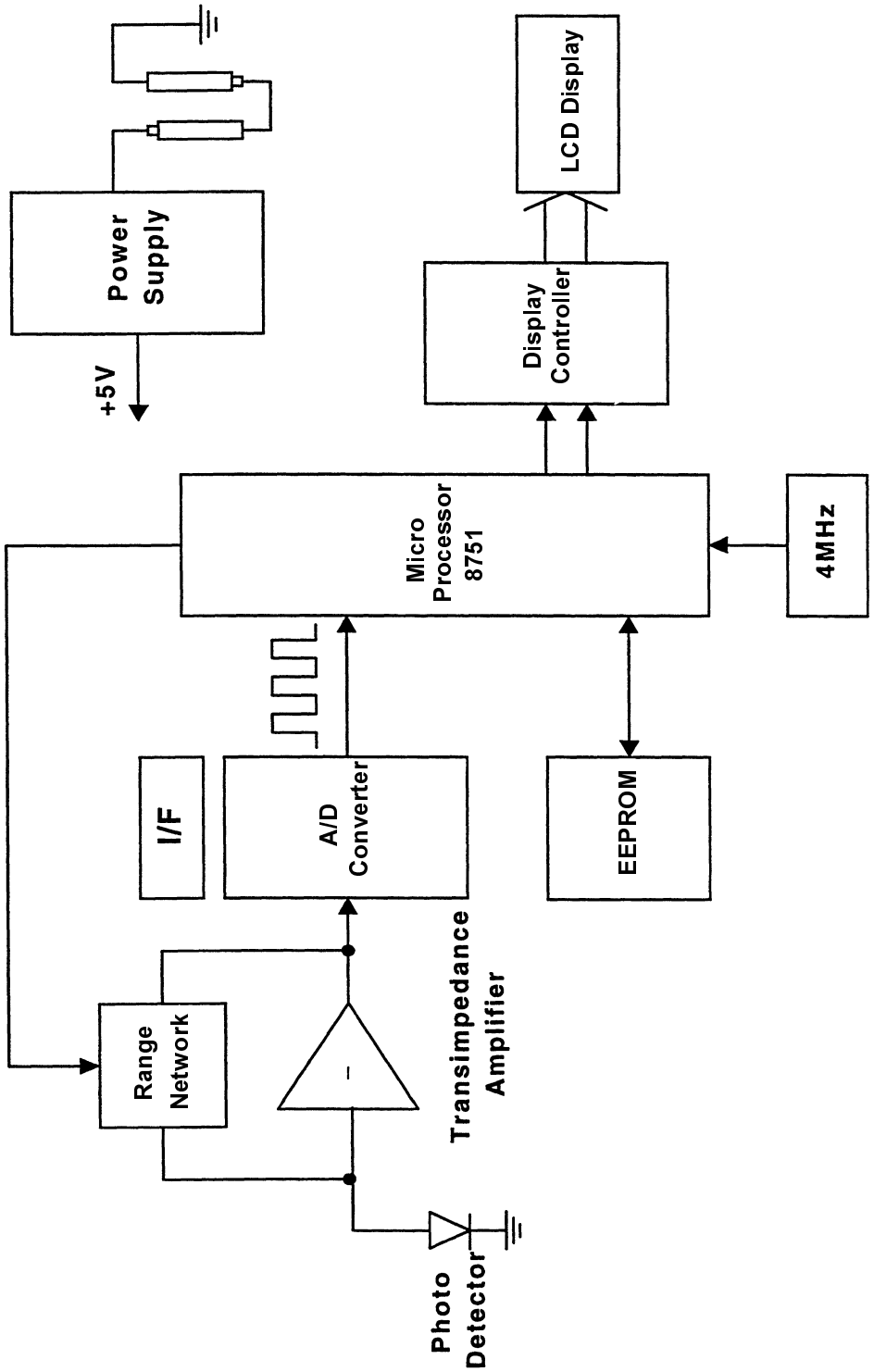


Figure 2-3: System Overview

Performance Verification

Performance verification verifies that the optical power meter is operating properly and within specification. If the specifications are out of tolerance, go to the Calibration Process section for proper calibration procedures.

Performance verification is done with the optical power meter covers in place.

Table 3-1: Equipment Required

DESCRIPTION	SPECIFICATION[1]	RECOMMENDED MODEL
Power Meter	Compatible with power sensors; see sensor specifications	HP 8153A or Advantest Q8221
Power Sensor, short wavelength[2]	±0.10 dB at -30 dBm, 850 nm	HP 81530A or Advantest Q82214 with special absolute power calibration
Power Sensor, long wavelength	±0.10 dB at -10 dBm and -30 dBm for 980, 1310, and 1550 nm wavelengths; linearity ±0.025 dB (-5 to -50 dBm)	HP 81532A or Advantest Q82208 with special absolute power calibration
Laser, 850 nm[2]	>50 μW CW into 62.5/125 μm fiber. Center wavelength: 849 to 851 nm Stability: ±0.05 dB	Rifocs 267A-106/APC10 or Rifocs 667R-106/APC10 selected for 850 +/- 1 nm)
Laser, 980 nm[3]	>500 μW CW into 62.5/125 μm fiber. Center wavelength: 979 to 981 nm Stability: ±0.05 dB	Special order
Laser, 1310 nm	>800 μW CW into 9/125 μm fiber. Center wavelength: 1290 to 1330 nm Stability: ±0.01 dB	Advantest Q8221/Q81211
Laser, 1550 nm	>500 μW CW into 9/125 μm fiber. Center wavelength: 1290 to 1330 nm Stability: ±0.01 dB	Advantest Q8221/Q81212
FC/PC Adapter	"SOC" adapter for TOP200/220	Tektronix part number: 119-5146-00
Attenuator, multimode	0.01 dB resolution; 50/125 or 62.5/125 μm	Tektronix part number: OA5012 or OA5022
Attenuator, single-mode	0.01 dB resolution; 0.05 dB repeatability	Tektronix part number: OA5002
Fiber, multimode 62.5/125 μm, 2 each	5 m, FC/PC connectors with metallic end faces on connector ferrules	Rifocs 2626-106-05
Fiber, single-mode 9/125 μm SMF-28, 2 each	5 m, FC/PC connectors with metallic end faces on connector ferrules	Rifocs 2626-101-05

NOTES:

[1] All meters, sensors, and lasers must have FC adapters

[2] Used only for TOP200

[3] Used only for TOP220

CAUTION

To prevent measurement errors, clean detector interface on the optical power meter, and all other fiber connectors and adapters before use.

WARNING

Do not look directly into the output port of the laser source. Do not use optical viewing instruments (such as microscopes, magnifiers, etc.) to view active fibers. The use of these devices on active fibers can focus a highly intense beam on to the retina, which can result in permanent eye damage.

Setup

Figure 3-1 illustrates how the stable light source (SLS), attenuator, reference power meter and power meter under calibration are connected for performance verification.

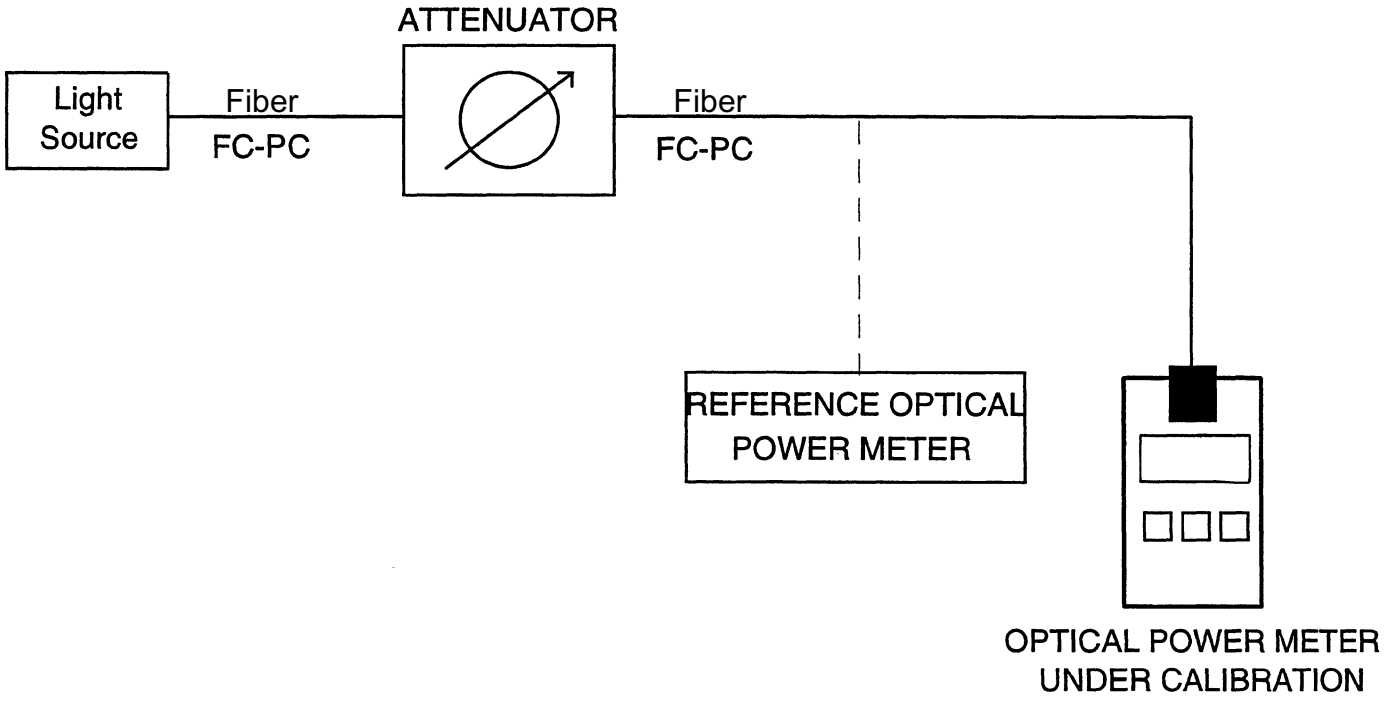


Figure 3-1: Performance Verification Setup

Display Check

☐ **Step 1:** Press and hold the λ button and press the **ON/OFF** button to power on the power meter. The display should show all the display segments as shown in Figure 3-20.

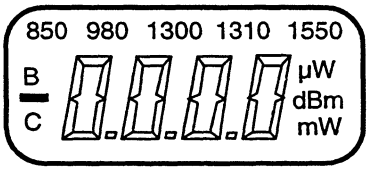


Figure 3-2: Display Segments

☐ **Step 2:** If some display segments are missing, turn power off and repeat Step 1. If failure repeats, see *Troubleshooting* section for possible solutions.

Software Revision Check

☐ **Step 1:** Press and hold on the **ON/OFF** button. The display should show the revision number of the software.

☐ **Step 2:** If revision number does not display, turn power off and repeat Step 1. If failure repeats, see *Troubleshooting* section for possible solutions.

Accuracy Verification

1. Attach FC adapters to the reference power sensors, attenuators, lasers, and device under test (DUT).

2. Use the 850 nm laser and short wavelength power sensor for the TOP200, Use the 980 nm laser and long wavelength power sensor for the TOP220.

NOTE. *Due to DUT wavelength dependence at 850 and 980 nm, laser source wavelength must be within ±1 nm of nominal.*

---

3. Use the multimode attenuator and multimode fibers for steps 4 to 11.

4. Turn on all equipment and allow a 15 minute warm-up.

5. With the reference power sensor covered, zero the reference power meter.

6. Use the fibers to connect the laser to the attenuator input, and the attenuator output to the reference power sensor.

7. Set the reference power meter wavelength to the nominal laser wavelength.

8. Adjust the attenuator for a reading on the reference power meter of -30.00 dBm (TOP200) or -10.00 dBm (TOP220).

9. Disconnect the fiber from the reference power meter and connect it to the DUT.

10. Set the DUT wavelength to the nominal laser wavelength (850 or 980 nm) by pressing the λ button.

11. Press the DUT **dB/dBm** button to indicate in dBm, and check for a reading between -30.25 and -29.75 dBm (TOP200) or -10.25 to -9.75 dBm (TOP220).

NOTE. *Fiber optic power measurements are sensitive to connector quality and cleanliness, and other factors that can increase uncertainty. It is recommended that the power accuracy verification tests be done at least twice to check repeatability. If the measure results don't repeat within about 0.10dB, then cleaning of connectors or replacement of cables or adapters may be needed.*

---

12. For the remaining steps, use the single-mode attenuator, single-mode fibers, and long wavelength power sensor.

13. Zero the reference power meter with the power sensor covered.

14. Use the fibers to connect the 1310 nm laser to the attenuator input, and the attenuator output to the reference power sensor.

15. Set the reference power meter wavelength to the actual (not nominal) laser wavelength.

16. Adjust the attenuator for a reading on the reference power meter of -30.00 dBm, (TOP200) or -10.00 dBm (TOP220).

17. Disconnect the fiber from the reference power meter and connect it to the DUT.

18. Set the DUT wavelength to 1310 nm by pressing the λ button.

19. Press the DUT **dB/dBm** button to indicate in dBm, and check for a reading between -30.25 and -29.75 dBm (TOP200) or -10.25 to -9.75 dBm (TOP220).

20. For TOP200 products with serial numbers B02xxxx and up, set the DUT wavelength to 1300 nm by pressing the λ button, and repeat step 19.

21. Repeat steps 14 to 19, using the 1550 nm laser, with the reference power meter wavelength set to the actual laser wavelength, and the DUT wavelength set to 1550 nm.

Linearity Verification

***NOTE**. There is no published specification for linearity. However, the DUT should pass the following procedure. If the DUT fails the procedure, it should be returned to Tektronix for evaluation and repair or replacement if needed, since there are no linearity adjustments.*

---

1. At the reference power meter, select the long wavelength sensor. Set the wavelength to 1310 nm. With the sensor covered, set the zero.

2. Attach the 1310 nm laser to the single-mode attenuator input, and the attenuator output to the long wavelength reference power sensor, using single-mode fibers.

3. Adjust the laser for maximum output (but not more than +5 dBm).

4. Adjust the attenuator for -10.00 dBm on the reference power meter. Make a copy of the Linearity Worksheet (Table 3-1), and record the attenuator setting with 0.01 dB resolution.

5. Adjust the attenuator for each of the reference meter levels listed in the worksheet, and record the attenuator settings. For the TOP220, leave out the -30 to -50 dBm tests.

***NOTE**. This procedure doesn't verify linearity over the full TOP220 operating range. If it is desired to test over the full range, it is necessary to obtain a laser, attenuator, and reference power sensor that can operate at >100mW average power level.*

---

6. Move the fiber from the reference sensor to the DUT. Set the DUT wavelength to 1310 nm.

7. Set the attenuator to the setting on the worksheet corresponding to -10.00 dBm. At the DUT, press and hold the **dB/dBm** button until the DUT reads 0.00 $\pm$0.01 dB.

8. Set the attenuator to the other values in the worksheet, and check that the DUT displays within the listed limits.

***NOTE**. If the results are out of tolerance, repeat the procedure. Attenuator repeatability, laser output level drift, and bad fiber connections can cause errors.*

Table 3-2: Linearity Worksheet

Ref. Power Meter Reading (dBm)	Attenuator Setting (dB)	DUT Reading (dB)	Low Limit (dB)	High Limit (dB)
-10.00		0.00 (set reference)	---	---
-5.00			+4.88	+5.12
-20.00			-10.12	-9.88
-30.00			-20.12	-19.88
-40.00			-30.12	-29.88
-50.00			-40.12	-39.88

***NOTE**. For TOP220, leave out the -30 to -50 dBm tests.*

Adjustment Process

This section describes the optical adjustment process for the TOP200 optical power meter.

Equipment Required

See Table 3-1 for equipment required.

CAUTION

To prevent measurement errors, clean detector interface on the TOP200/TOP220 optical power meters, and all other fiber connectors and adapters before use.

WARNING

Do not look directly into the output port of the laser source. Do not use optical viewing instruments (such as microscopes, magnifiers, etc.) to view active fibers. The use of these devices on active fibers can focus a highly intense beam on to the retina, which can result in permanent eye damage.

Laser Aperature

Setup

Figure 4-1 illustrates how the light source, attenuator, reference optical power meter and power meter under calibration are connected for adjustment.

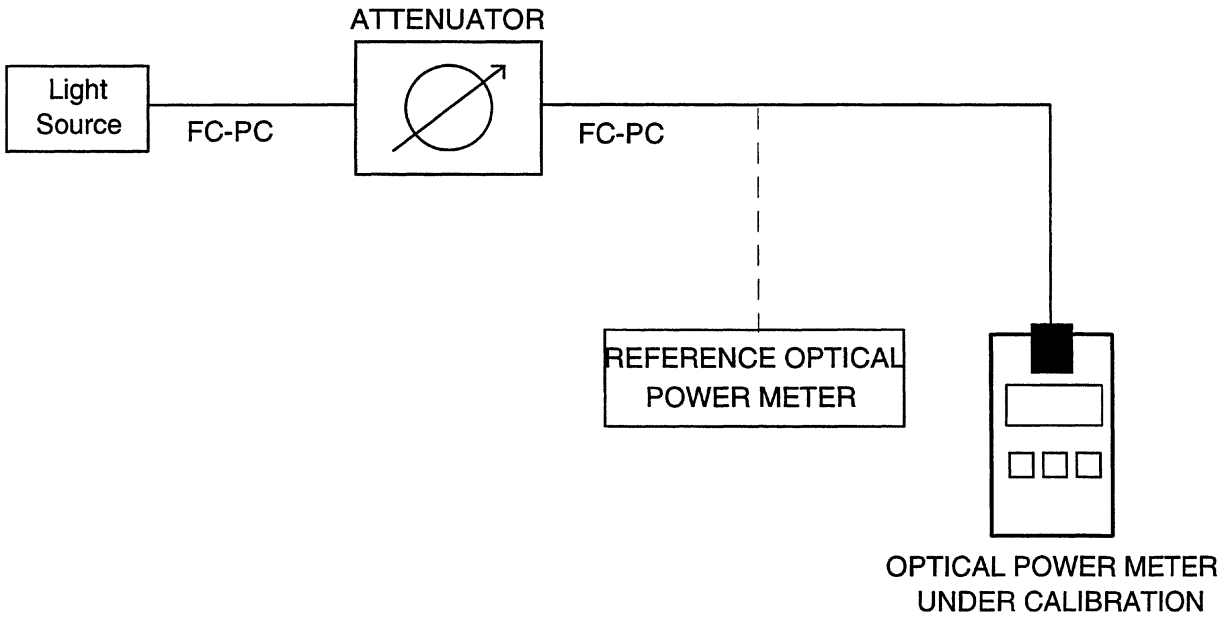


Figure 4-1: Adjustment Setup

Adjustment

1. To set the device under test (DUT) to the CAL (adjustment) mode:

   a. Turn power off.

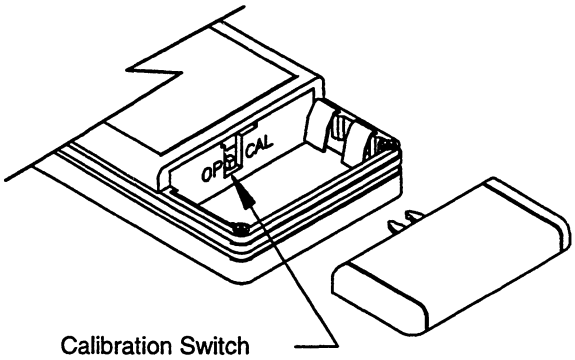
   b. Open battery compartment and remove batteries.

   c. Remove calibration tamper seal.

   d. Set CAL switch to CAL position.

   e. Reinstall batteries and battery compartment cover.

   f. Turn power on. "C" should appear on the bottom left-hand corner of the display.



2. Attach FC adapters to the reference power sensors, attenuators, lasers, and device under test (DUT).

NOTE. *You may adjust the absolute power accuracy at one or more wavelengths. Use steps 3 to 11 for 850 or 980 nm, and steps 12 to 21 for the other wavelengths. After adjustment, exit the CAL mode as directed in step 22.*

---

3. Use the 850 nm laser and short wavelength power sensor for the TOP 200. Use the 980 nm laser and long wavelength power sensor for the TOP 220.

***NOTE**. Due to DUT wavelength dependence at 850 and 980 nm, laser source wavelength must be within ± 1 nm of nominal.*

4. Use the multimode attenuator and multimode fibers for steps 5 to 11. Turn on all equipment and allow a 15 minute warm-up.

5. With the reference power sensor covered, zero the reference power meter.

6. Use the fibers to connect the laser to the attenuator input, and the attenuator output to the reference power sensor.

7. Set the reference power meter wavelength to the nominal laser wavelength.

8. Adjust the attenuator for a reading on the reference power meter of -30.00 dBm (TOP200) or -10.00 dBm (TOP220).

9. Disconnect the fiber from the reference power meter and connect it to the DUT.

10. Set the DUT wavelength to the nominal laser wavelength (850 or 980 nm) by pressing the λ button.

11. Press the DUT **dB/dBm** button to make the adjustment. Check for a reading between -30.02 and -29.98 dBm (TOP200) or -10.02 and -9.98 dBm (TOP220).

12. For the remaining steps, use the single-mode attenuator, single-mode fibers, and long wavelength power sensor.

13. Zero the reference power meter with the power sensor covered.

14. Use the fibers to connect the 1310 nm laser to the attenuator input, and the attenuator output to the reference power sensor.

15. Set the reference power meter wavelength to the actual (not nominal) laser wavelength.

16. Adjust the attenuator for a reading on the reference power meter of -30.00 dBm (TOP200) or -10.00 dBm (TOP220).

17. Disconnect the fiber from the reference power meter and connect it to the DUT.

18. Set the DUT wavelength to 1310 nm by pressing the λ button.

19. Press the DUT dB/dBm button to make the adjustment. Check for a reading between -30.02 and -29.98 dBm (TOP200) or -10.02 and -9.98 dBm (TOP220).

20. For TOP 200 products with serial numbers B02xxxx and up, set the DUT wavelength to 1300 nm by pressing the λ button, and repeat step 19.

21. Repeat steps 14 through 19, using the 1550 nm laser, with the reference power meter wavelength set to the actual laser wavelength and the DUT wavelength set to 1550 nm.

22. To exit CAL mode when adjustment is complete:

a. Turn power off.

b. Set the CAL switch to the OP position.

c. Place a tamper evident seal over the switch.

d. Install batteries and battery cover.

NOTE. *Fiber optic power measurements are sensitive to connector quality and cleanliness, and other factors that can increase uncertainty. Be sure to repeat the Accuracy Verification procedure after completing the Adjustment Procedure.*

Maintenance

Cleaning Procedures

This section discusses cleaning procedures for the connector interface, SOC adapters, fiber-optic connectors, battery contacts and instrument case.

It is absolutely critical to maintain the cleanliness off all connector interfaces, adapters, and fiber-optic connectors each and every time they are used to guarantee maximum performance by the TOP200 and TOP220 optical power meters.

Improper maintenance practices cause the following performance degradation:

- Measurement errors
- Dirty connectors may cause damage to their mated counterparts

Do not touch the detector window of the connector interface with anything but a dry lint-free cloth. In severe cases, you will need to use a reagent-grade isopropyl alcohol.

When not in use, keep the connector interface covered with the protective dust cap to prevent dust from accumulating and to avoid scratching the detector window.

Cleaning the Connector Interface

To clean the connector interface:

- ☐ **Step 1:** Remove the dust cap to expose the connector interface.
- ☐ **Step 2:** If there is a SOC adapter present, remove it as shown in Figure 1-3, page 1-9 in the section marked Operator Information.
- ☐ **Step 3:** Clean the exposed detector window with a dry lint free cloth as shown in Figure 5-1. In severe cases, you will need to use reagent-grade isopropyl alcohol (IPA).
- ☐ **Step 4:** Wipe the detector window again with a fresh dry lint free cloth to remove residual alcohol.
- ☐ **Step 5:** Clean exterior of SOC housing with clean lint free cloth.

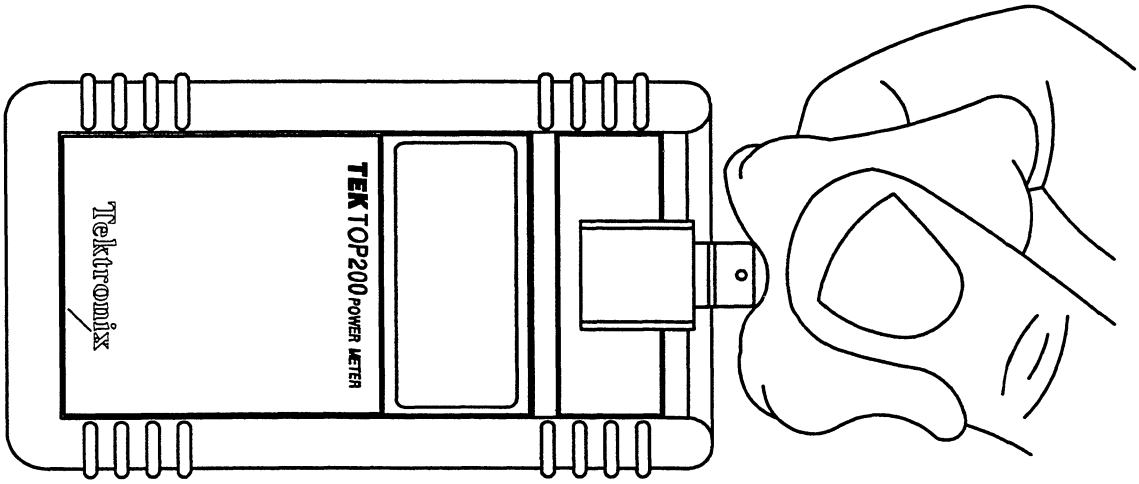


Figure 5-1: Cleaning the Connector Interface

CAUTION

To prevent it from being damaged, do not exceed pressure onto the detector window!

Cleaning the SOC Adapter

SOC adapters are interchangeable to accommodate all popular industry-standard fiber-optic connectors and must always be cleaned before each and every use.

To clean SOC adapters:

- ☐ **Step 1:** Using a clean lintless swab, insert the swab into the thru-hole of the adapter.
- ☐ **Step 2:** Clean exterior and interior surfaces using a lint free cloth wetted with reagent-grade isopropyl alcohol.
- ☐ **Step 3:** Wipe exterior and interior surfaces again with a fresh dry lint free cloth to remove any residual alcohol.

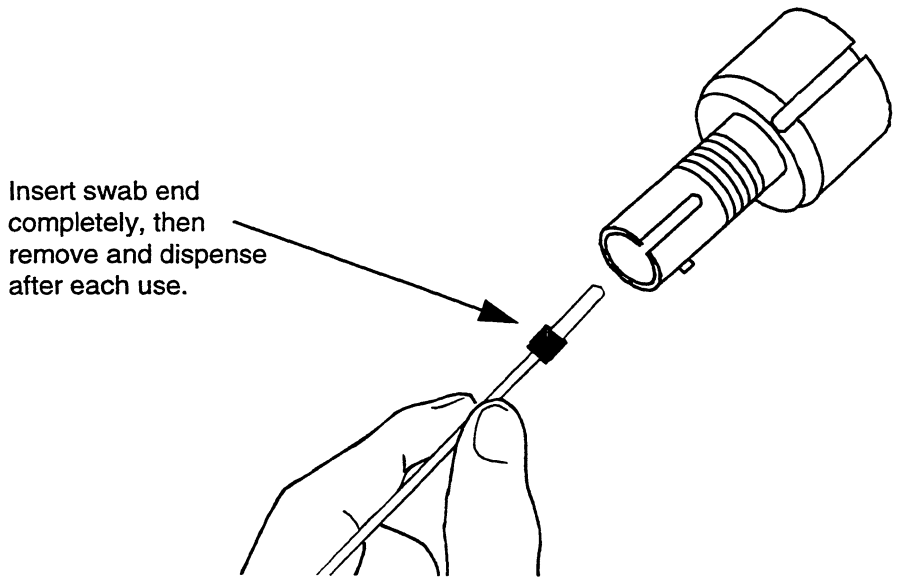


Figure 5-2: Cleaning the SOC adapter

Cleaning the Fiber Optic Connector

- ☐ **Step 1:** Dampen a lint-free swab or paper wipe with electronics-grade alcohol, and gently wipe across and around the connector a couple of times.
- ☐ **Step 2:** Dry with a dry swab or dry portion of the paper wipe.
- ☐ **Step 3:** If the connector is extremely dirty repeat the procedure with a second lint-free swab or paper wipe.

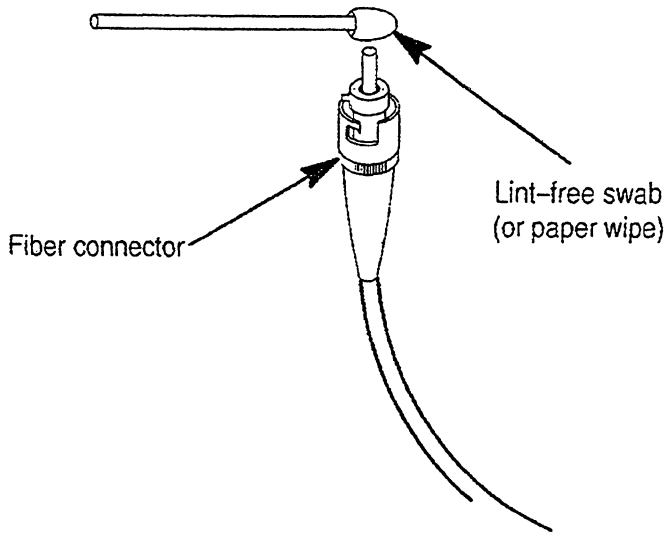


Figure 5-3: Cleaning the Fiber Connector

Cleaning Battery Contacts

Occasionally it is necessary to clean battery contacts due to leaky batteries or water contamination. If battery contacts can no longer be cleaned, replace them.

WARNING

Batteries that are leaking electrolyte are hazardous. Avoid contact with electrolyte, which may damage eyes, skin and clothing.

Discard batteries in accordance with local environmental regulations.

To clean battery contacts:

- ☐ **Step 1:** Remove battery compartment cover and the two AA batteries. Avoid contact with leaking electrolyte.
- ☐ **Step 2:** Remove each battery contact from its respective slot using needle-nose pliers (or equivalent).
- ☐ **Step 3:** In case of corrosion build-up on contacts, scrape it off using an abrasive paper or the flat edge of a tool (i.e. flat screwdriver).
- ☐ **Step 4:** Apply reagent-grade isopropyl alcohol on the contacts and brush off excess build-up with cleaning brush into towel.
- ☐ **Step 5:** Wipe exterior surface of battery contacts with dry paper towel to remove residual isopropyl alcohol.
- ☐ **Step 6:** Apply a thin film of WD-40 on the battery contacts for protection.
- ☐ **Step 7:** Place two new AA batteries and replace cover of the battery compartment. Make sure that the batteries are positioned with the correct polarization.

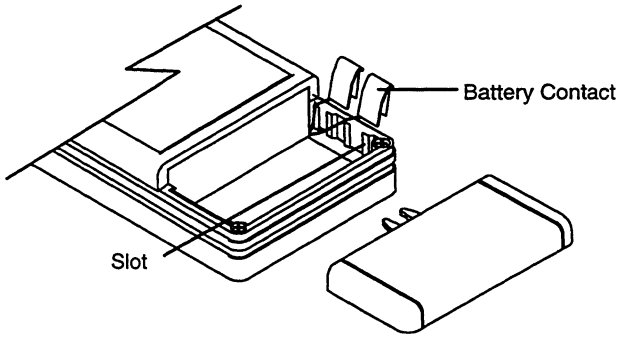


Figure 5-4: Cleaning Battery Contacts

Cleaning the Instrument Case

To clean instrument case:

- ☐ **Step 1:** Remove protective rubber bumper.
- ☐ **Step 2:** Wipe exterior surface of instrument case with clean paper towel dampened with a small amount of isopropyl alcohol.

CAUTION

NOTE: Avoid using an excessive amount of alcohol for it may damage the labels at the rear of the instrument.

Do not use alcohol on the LCD display. Alcohol leaves a film on the display. Use clean dry paper towel instead.

- ☐ **Step 3:** Wipe exterior surface of instrument case again with dry paper towel.
- ☐ **Step 4:** Replace rubber bumper.

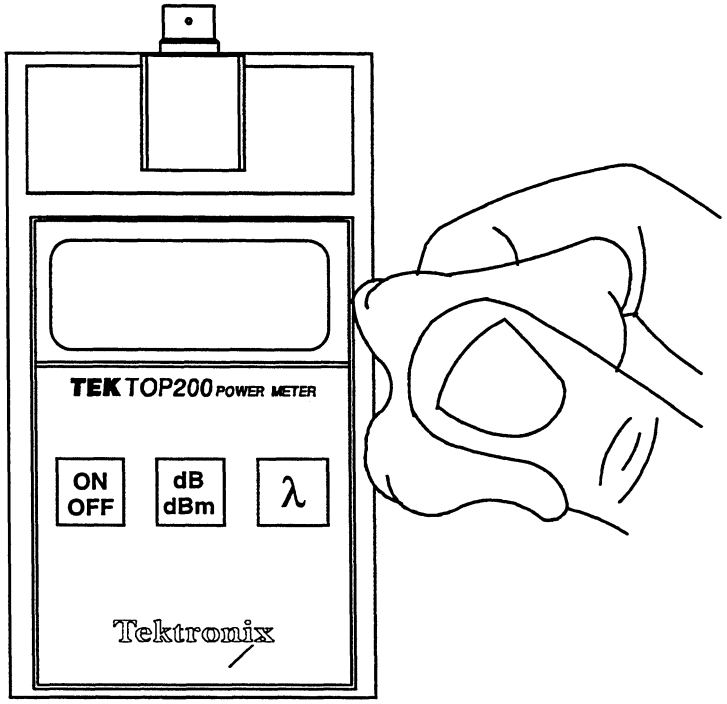


Figure 5-5: Cleaning the Instrument Case

Troubleshooting

No Power On

If the TOP200 or TOP220 optical power meter does not power on properly, the most likely cause is a discharged battery, battery installed improperly or a defect on the meter.

Typical indications of a discharged battery are:

- No power when turned ON
- "B" annunciator on top left-hand corner of LCD
- Faint LCD display

When the "B" annunciator first appears on the LCD, the power meter has five hours left before the batteries must be replaced. Replace the discharged batteries with new ones. If the power meter still does not power on properly, replace the instrument.

Error Messages

Error Message	Description	Possible Solutions
E1	Partial loss of calibration data	Turn power OFF and ON again. If error message repeats, replace instrument
E3	Total loss of memory	Replace instrument
E5	Stack overflow	Turn power OFF and ON again. If OK, check calibration. If error message repeats, replace instrument

Performance Problems

Problem	Possible Solutions
LCD has missing pixels	Replace instrument
Power meter does not respond to button presses or switching power ON/OFF	Replace instrument
-60dBm measurement is out of spec	Replace instrument
Out of calibration	Clean detector and recalibrate unit

Replaceable Parts

This section contains a list of replaceable parts in the TOP200 and TOP220 optical power meters. Use this list to identify and order replacement parts.

Ordering Information

Replacement parts are available from your local Tektronix service center.

When ordering a replacement part, include the following information:

- **Part number**
- Instrument model number
- Instrument serial number
- Instrument modification number, if applicable

If a part you order has been replaced with a new or improved part, your local Tektronix service center or representative will contact you regarding any change in the part number.

Instrument Replacement

The TOP200 and TOP220 optical power meters are serviced by replacing the instrument. These are two options you should consider:

Instrument Exchange - The TOP-series instruments are repaired by exchange of the entire instrument for a reconditioned instrument. The part number for reconditioned TOP200 and TOP220 optical power meters are listed below:

Description	Part No.	Serial No.	Part No.	Serial No.
TOP200 optical power meter	118-9281-00	B010100-B019999	118-9682-00	B02XXXX
TOP220 optical power meter	118-9640-00			

New Instruments - New instruments can be purchased like other replacement parts.

Replaceable Parts

Tektronix Part Number	Qty	Name and Description
		STANDARD ACCESSORIES
348-1480-00	1	Rubber Bumper with Pivoting Bail
119-4513-00	1	Adapter, ST:snap-on connector (SOC)
070-9372-01	1	Manual, Tech:User, TOP 130, 140, 150, 160, 200, 300 Fiber Optic Instruments

Tektronix Part Number	Qty	Name and Description
		OPTIONAL ACCESSORIES
119-5168-00	1	Adapter, Biconic:snap-on connector (SOC)
119-5167-00	1	Adapter, D4-PC:snap-on connector (SOC)
119-5171-00	1	Adapter, HMS-10/HP(DIAMOND-2.5):snap-on connector (SOC)
119-5172-00	1	Adapter, DIAMOND-3.5:snap-on connector (SOC)
119-5166-00	1	Adapter, DIN:snap-on connector (SOC)
119-5165-00	1	Adapter, E2000:snap-on connector (SOC)
119-5146-00	1	Adapter, FC:snap-on connector (SOC)
119-5145-00	1	Adapter, SC:snap-on connector (SOC)
119-5169-00	1	Adapter, SMA 905/906:snap-on connector (SOC)
119-5170-00	1	Adapter, SMA-2.5:snap-on connector (SOC)
070-9379-02	1	Manual, Tech:Service, TOP200 and TOP220

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Service Manual

Tektronix

TOP Series
TOP130, TOP140, TOP150, TOP160, TOP300
Fiber-Optic Instruments
Volume 2

070-9379-03

Warning
The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

www.tektronix.com

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

WARRANTY

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor or will provide a replacement in exchange for the defective product.

In order to obtain service under warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THIS PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Replace Batteries Properly. Replace batteries only with the proper type and rating specified.

Use Proper AC Adapter. Use only the AC adapter specified for this product.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Wear Eye Protection. Wear eye protection if exposure to high-intensity rays or laser radiation exists.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Provide Proper Ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product. The following symbols may appear on the product:

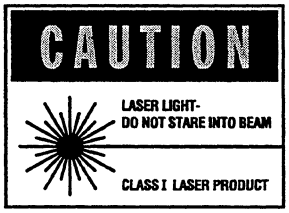
CAUTION
Refer to Manual

Double
Insulated

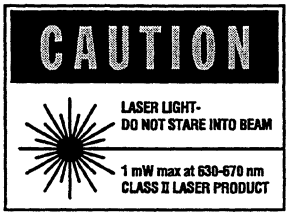
Protective Ground
(Earth) Terminal

Laser Aperature

TOP140, 150 and 160



TOP300



Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power. To avoid electric shock, switch off the instrument power, then disconnect the power cord from the mains power.

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Preface

This manual is used for servicing the TOP 130, 140, 150, 160 and 300 Fiber Optic Instruments to *instrument level only.* It does not contain component-level service information, schematics, or parts lists.

If You Need Help

Information about servicing the TOP130, 140, 150, 160, and 300 Fiber Optic instruments is available by calling the Tektronix number listed in Contacting Tektronix on page xvi and selecting the desired option.

Assumptions

The procedures in this manual assume that you are a qualified electronic technician, and have a working knowledge of service procedures for fiber-optic test equipment.

Before Servicing

To prevent injury to yourself or damage to equipment:

- You must be a qualified service technician.
- Read the *Safety Summary* at the beginning of this manual.
- Heed to all warnings, cautions and notes in this manual.

What You Will Find in this Manual

- *General Information.* General product and operator information. Battery replacement. Specifications. Accessories and options.
- *Performance Verification and Adjustment.* **Procedures for verifying that the TOP 130, 140, 150, 160, and 300 Fiber Optic Instruments function properly and meet warranted operating specifications and for adjustment.**

- *Maintenance.* Cleaning procedures. General troubleshooting and fault isolation.
- *Replaceable Parts.* Part numbers and ordering information.

Related Documents

- *The TOP 130, 140, 150, 160, 200, 300 Fiber Optic Instruments User Manual*

Tektronix Service

Tektronix provides service to cover repair under warranty and post-warranty problems.

The TOP 130, 140, 150, 160 and 300 Fiber Optic Instruments are warranted for one year. The warranty statement appears at the beginning of this manual.

Contacting Tektronix

Phone	1-800-833-9200*
Address	Tektronix, Inc. Department or name (if known) 14200 SW Karl Braun Drive P.O. Box 500 Beaverton, OR 97077 USA
Web site	www.tektronix.com
Sales support	1-800-833-9200, select option 1*
Service support	1-800-833-9200, select option 2*
Technical support	Email: techsupport@tektronix.com 1-800-833-9200, select option 3* 1-503-627-2400 6:00 a.m. - 5:00 p.m. Pacific time

* **This phone number is toll free in North America. After office hours, please leave a voice mail message. Outside North America, contact a Tektronix sales office or distributor; see the Tektronix web site for a list of offices.**

General Information

Instrument Level Service

Overview

This service manual is used for servicing the TOP 130, 140, 150, 160 and 300 Fiber Optic Instruments to *instrument level only.* The usual corrective procedure is to replace, not repair, the instrument.

Static-Sensitive Components

CAUTION

The TOP 130, 140, 150, 160 and 300 Fiber Optic Instruments contain components that are sensitive to electrostatic discharge (ESD).

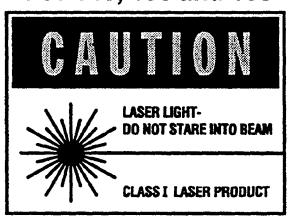
When servicing the TOP 130, 140, 150, 160 and 300 Fiber Optic Instruments, work only at a static-free workstation, and practice anti-static handling procedures.

WARNING

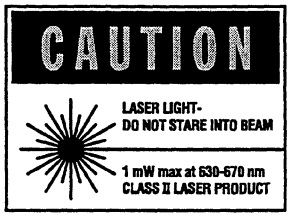
While there is no potential for eye damage due to unaided direct exposure, never look directly into the output port. Do not use optical viewing instruments (such as microscopes, magnifiers, etc.). The use of these devices on active fibers can focus a highly intense beam onto the retina which can result in permanent eye damage.

Laser Aperature

TOP140, 150 and 160



TOP300



Service Procedure

The direct service-related sections in this manual are:

- *Performance Verification and Adjustment.*
  Use to verify the TOP130, 140, 150, 160, and 300 Fiber Optic Instruments to see that they meet specification before and after repairs and adjustments have been made and to make adjustments.

- *Maintenance.* Use for:
  - Cleaning
  - Resolving error messages displayed on the screen
  - Troubleshooting problems
- *Replaceable Parts.* Part numbers and ordering information

The first section in this manual, *General Information,* contains product information, user information, battery/power information, specifications, accessories and options.

If you have no need for this information, go directly to the other sections.

Product Information

This section briefly describes the TOP 130, 140, 150, 160, 300 Fiber Optic Instruments.

A quick review of this section will familiarize you with the TOP 130, 140, 150, 160, 300 Fiber Optic Instruments, which may help when servicing the instrument.

For complete product information, refer to the *TOP 130, 140, 150, 160, 200, 300 Fiber Optic Instruments User Manual.*

Product Package

The TOP 130, 140, 150, 160, 300 Fiber Optic Instruments are supplied with the following equipment and standard accessories:

- One Rubber Bumper with bail
- Two AA alkaline 1.5V batteries
- One User Manual (070-9372-01)
- One Calibration Certificate

Product Description

The Tektronix TOP 130, 140, 150, 160, 300 Fiber Optic Instruments are true palm-sized, rugged and versatile instruments designed for use in the installation, maintenance and testing of fiber optic systems.

TOP130 Optical Dual LED Source

The Tektronix TOP130 Dual-Wavelength (850/1300nm) Optical LED Source is used for installing and testing attenuation of both singlemode and multimode fiber optic links, including telephony, datacom, CATV, FDDI and LAN applications.

The palm-sized TOP130 provides the flexibility in a single unit to interface to all industry standard fiber-optic connectors with high throughput, repeatability and stability. This optical interface of this instrument features the precision Snap-On connector (SOC) interface. A wide range of push-pull SOC adapters are available covering all popular industry-standard fiber-optic connectors (including FC, ST, SC, SMA, E2000, DIAMOND, etc.).

TOP140, TOP150, TOP160 Optical Laser Sources

The TOP140, TOP150 and TOP160 Optical Laser Sources were developed in response to requests from the fiber optic industry for small, rugged light sources for use in installing, maintaining and researching singlemode telephony, datacom, CATV, FDDI and other types of fiber optic links. The instrument provides a convenient calibrated output to speed up transmission-loss measurements. The instrument provides the flexibility in a single unit to interface to all industry standard fiber optic connectors with high throughput, repeatability and stability.

These palm-sized optical laser sources incorporate high-efficiency laser diodes with models offered to service each or both of the two singlemode windows - 1310nm and 1550nm. Internally, the optical power is coupled via a fiber to the unique universal connector interface (UCI). This connector is of the highest quality and precision using a proprietary fiber alignment process and convex polish, allowing physical contact of the fibers for optimum throughput. This Super PC interface accepts both singlemode and multimode fibers, minimizes insertion loss and maximizes repeatability (0.2dB, typical). The UCI is complemented by a broad line of simple, screw-on/screw-off adapters.

TOP300 Visual Fault Finder

The Tektronix TOP300 is specifically designed for field personnel who need an efficient and economical tool to visually inspect continuity and integrity of fiber installations, during and after installation. The highly efficient laser diode operates at short wavelengths which makes the emitted light even more visible to the human eye.

The TOP300 employs a military grade hermetically sealed laser diode with a proprietary and extremely stable fiber coupling scheme. Hermetically sealed laser diodes are important for reliability and longevity.

Operating Modes

The TOP 130, 140, 150, 160, and 300 Fiber Optic Instruments feature two front-panel selectable operating modes: CW (continuous) mode and MOD (modulated) mode.

CW Mode

In the CW mode, the LED is continuously powered with no frequency modulation. It features stabilized and calibrated output power to speed up transmission loss measurements.

MOD Mode

Many Fiber Identifiers, Optical Power Meters (Lock-in Meters) or other special equipment require that the optical level is modulated.

There are three established frequencies: 270Hz, 1kHz and 2kHz which are used worldwide. A switch within the battery compartment allows you to select the appropriate modulation frequency.

The modulating mode is best used with the TOP300 Visual Fault Finder for viewing or finding faults within the fiber. The modulating laser light can be detected far more easily, even in a bright lit environment.

Other Features

Optical Interface Features

- Easily cleanable connector adapter. Refer to *Cleaning and Troubleshooting* section for cleaning procedures.
- SOC and UCI adapters are field changeable and must match the type of fiber connector being used. Refer to *Accessories and Options* section for connector adapter options.

Rubber Bumper

- Every instrument includes a removable rubber bumper. This molded silicone shell acts to protect against shock in the field.
- The rubber bumper includes a pivoting bail to hold the instrument upright when required.

Structural Integrity

- The TOP series instrument can take falls and is highly crush resistant.
- The unit provides reliable and accurate measurements from -15°C to +55°C.

Dust Cap

- The permanently attached dust cap simply snaps into place.
- There is no need to remove the adapter; the dust cap fits over all adapters.

Operator Information

This section summarizes the TOP 130, 140, 150, 160, 300 Fiber Optic Instruments switch and LED functions as well as changing the modulation frequency and interchanging the Snap-on Connector (SOC) and Universal Connector Interface (UCI) adapters.

A quick review of this section will familiarize you with the basic operation of the TOP 130, 140, 150, 160, 300 Fiber Optic Instruments, which may help when servicing the instrument.

For complete operator information, refer to the *TOP 130, 140, 150, 160, 200, 300 Fiber Optic Instruments User Manual.*

TOP130 Dual LED Source

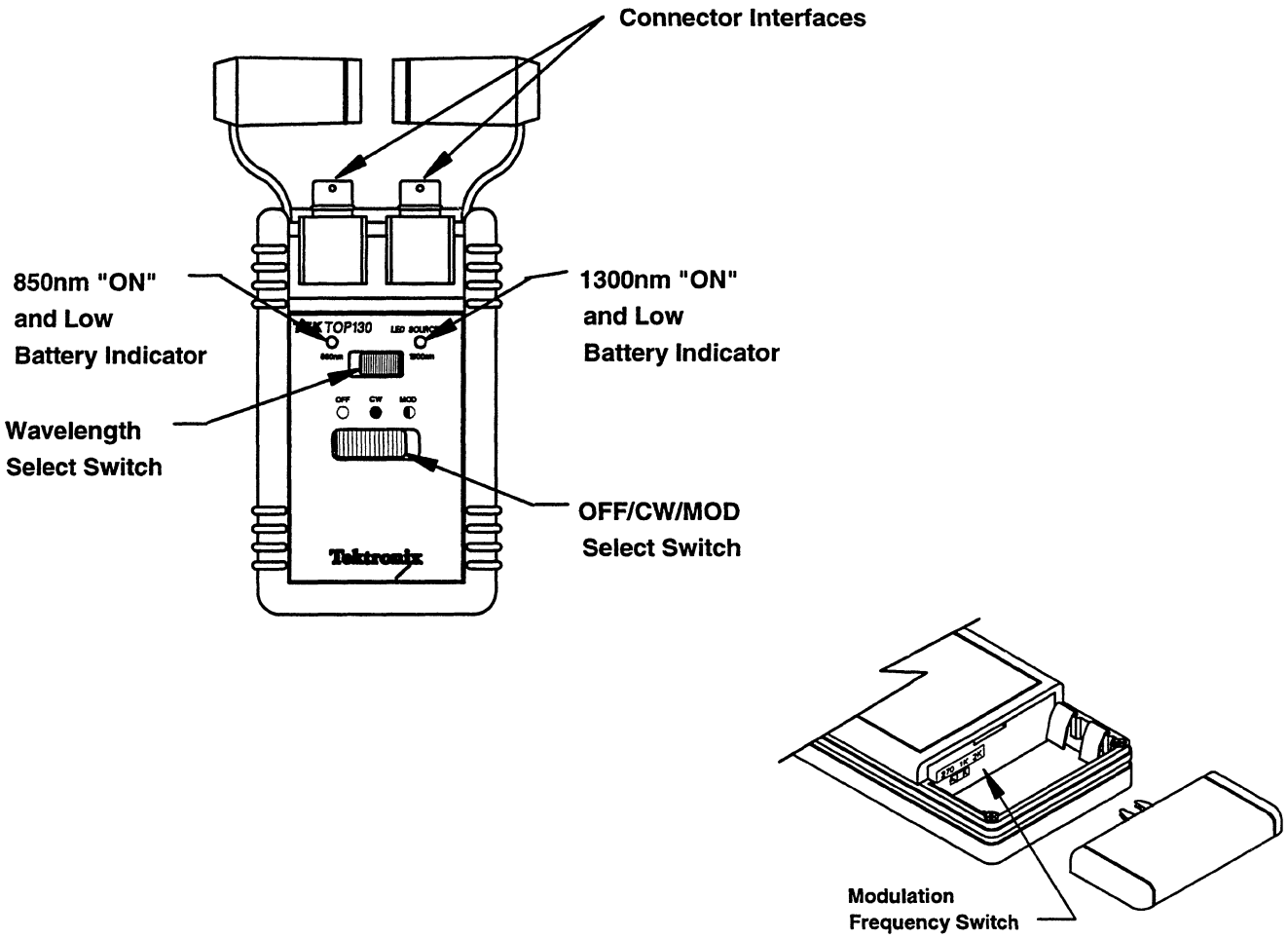


Figure 1-1: TOP130 Dual LED Source Switch and LED Locations

NOTE:

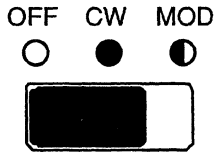
These pictures and descriptions are for products with serial numbers at B019999 and below. The latest TOP products user manual has pictures and descriptions for products with serial numbers of B020000 and up.

Labeled Switches and LEDs

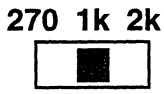
The **Wavelength Select** switch determines which LED is active: 850nm or 1300nm.

The **850nm Indicator/Low Battery Indicator** is on when the 850nm LED is active. It is also used as an indicator for low battery power.

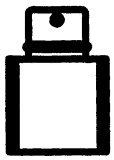
The **1300nm Indicator/Low Battery Indicator** is on when the 1300nm LED is active. It is also used as an indicator for low battery power.



The **OFF/CW/MOD** slide switch controls the power and the two operating modes: CW (continuous) mode and MOD (modulating) mode. The CW mode provides continuous and stable output used for loss measurements. The MOD is useful for special equipment that require modulated optical output.



The **Frequency Select** switch inside the battery compartment determines the current frequency modulation under MOD (modulating) mode. The output power is a square wave signal of either 270Hz, 1kHz or 2kHz.



The **Connector Interface** utilizes a Snap-on Connector (SOC) adapter. It allows you to quickly adapt to all popular industry standard fiber optic connectors.

NOTE:

These pictures and descriptions are for products with serial numbers at B019999 and below. The latest TOP products user manual has pictures and descriptions for products with serial numbers of B020000 and up.

TOP140 and TOP150 Laser Sources

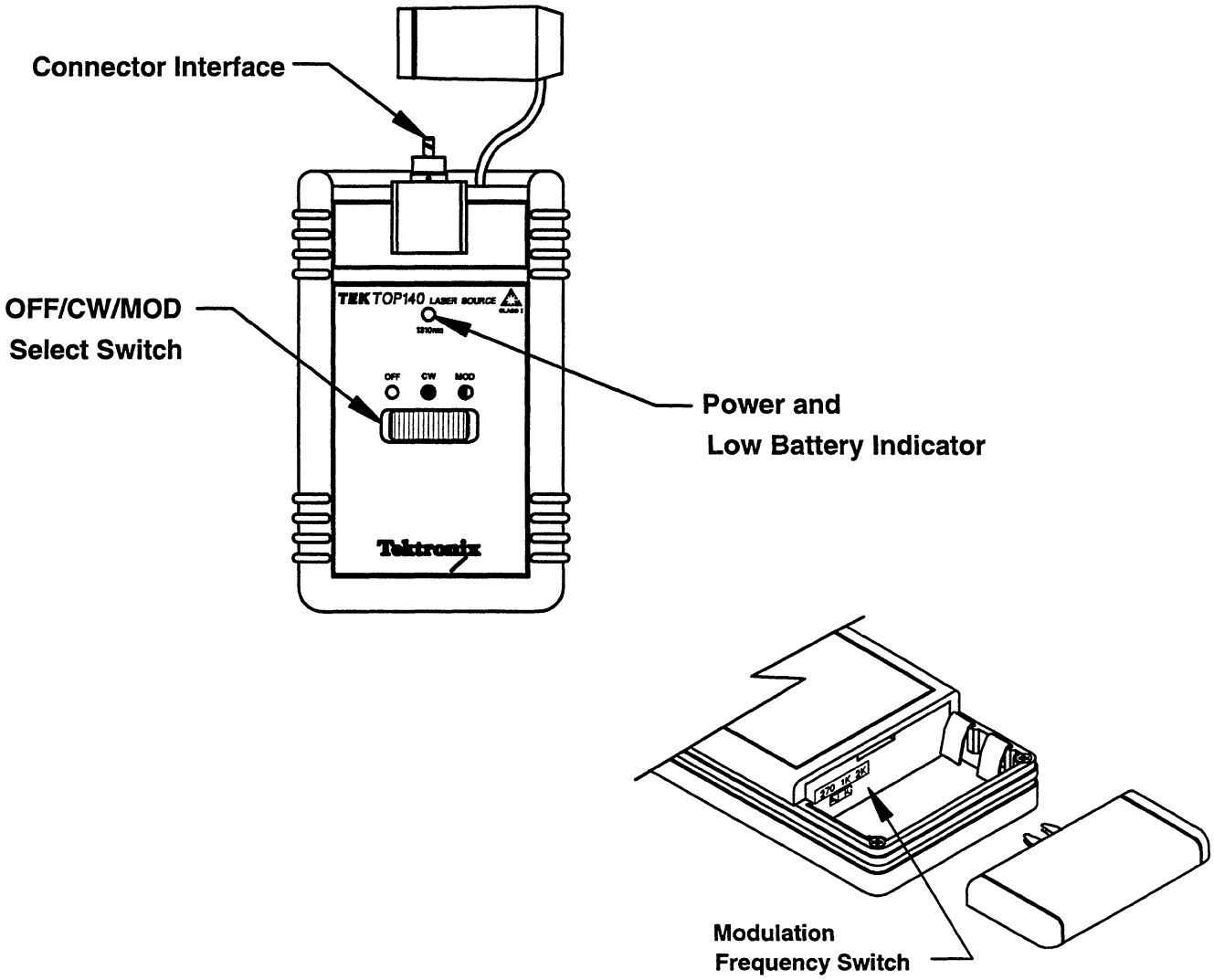
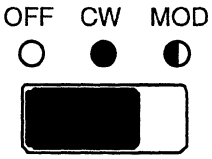


Figure 1-2: TOP140 and TOP150 Laser Sources Switch and LED locations

NOTE:

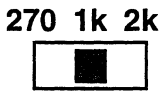
These pictures and descriptions are for products with serial numbers at B019999 and below. The latest TOP products user manual has pictures and descriptions for products with serial numbers of B020000 and up.

Labeled Switches and LEDs



The **OFF/CW/MOD** slide switch controls the power and the two operating modes: CW (continuous) mode and MOD (modulating) mode. The CW mode provides continuous and stable output used for loss measurements. The MOD is useful for special equipment that require modulated optical output.

The **Power and Low Battery Indicator** lights when the power is ON and blinks when the battery is low.



The **Frequency Select** switch inside the battery compartment determines the current frequency modulation under MOD (modulating) mode. The output power is a square wave signal of either 270Hz, 1kHz or 2kHz.

The **Connector Interface** utilizes a Universal Connector Interface (UCI) adapter. It allows you to quickly adapt to all popular industry standard fiber optic connectors.

NOTE:

These pictures and descriptions are for products with serial numbers at B019999 and below. The latest TOP products user manual has pictures and descriptions for products with serial numbers of B020000 and up.

TOP160 Laser Source

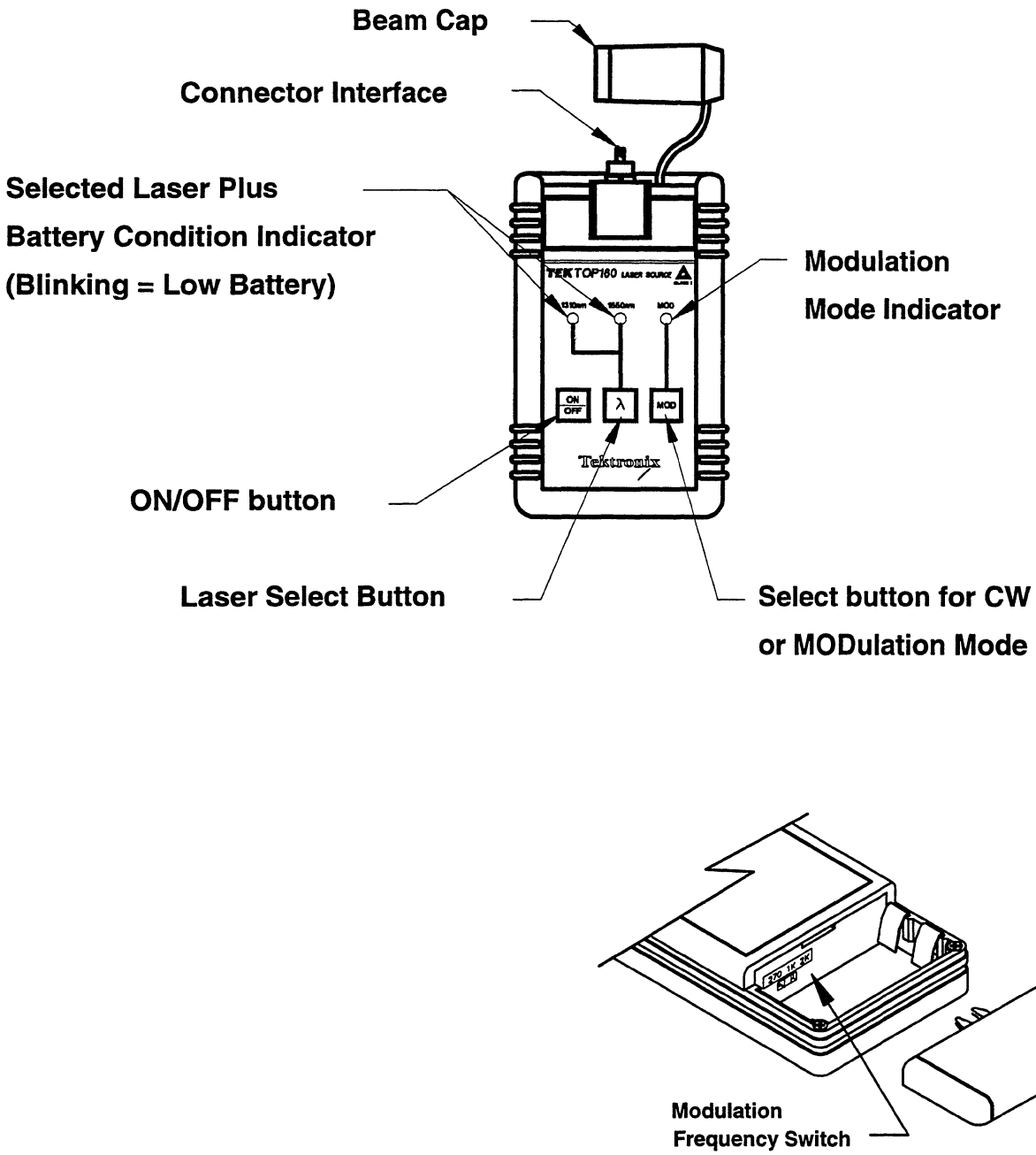
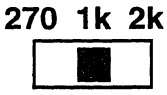


Figure 1-3: TOP160 Dual Laser Source Button, Switch and LED locations

Labeled Switches and LEDs

The **ON/OFF** button turns the TOP160 ON or OFF. The λ button controls which laser is on. The **MOD** button selects CW (continuous) mode and MOD (modulation) mode. The CW mode provides continuous and stable output used for loss measurements. The MOD is useful for special equipment that require modulated optical output.

The **1310nm indicator** lights when the 1310nm laser is selected. If the 1310nm laser is selected and a **Low Battery** condition exists, the 1310nm indicator blinks. The 1550nm indicator lights when the 1550nm laser is selected. If the 1550nm laser is selected and a **Low Battery** condition exists, the 1550nm indicator blinks. The **MOD** indicator lights when the modulating mode is selected.



The **Frequency Select** switch inside the battery compartment determines the current frequency modulation under MOD (modulating) mode. The output power is a square wave signal of either 270Hz, 1kHz or 2kHz.

The **Connector Interface** utilizes a Universal Connector Interface (UCI) adapter. It allows you to quickly adapt to all popular industry standard fiber optic connectors.

TOP300 Visual Fault Finder

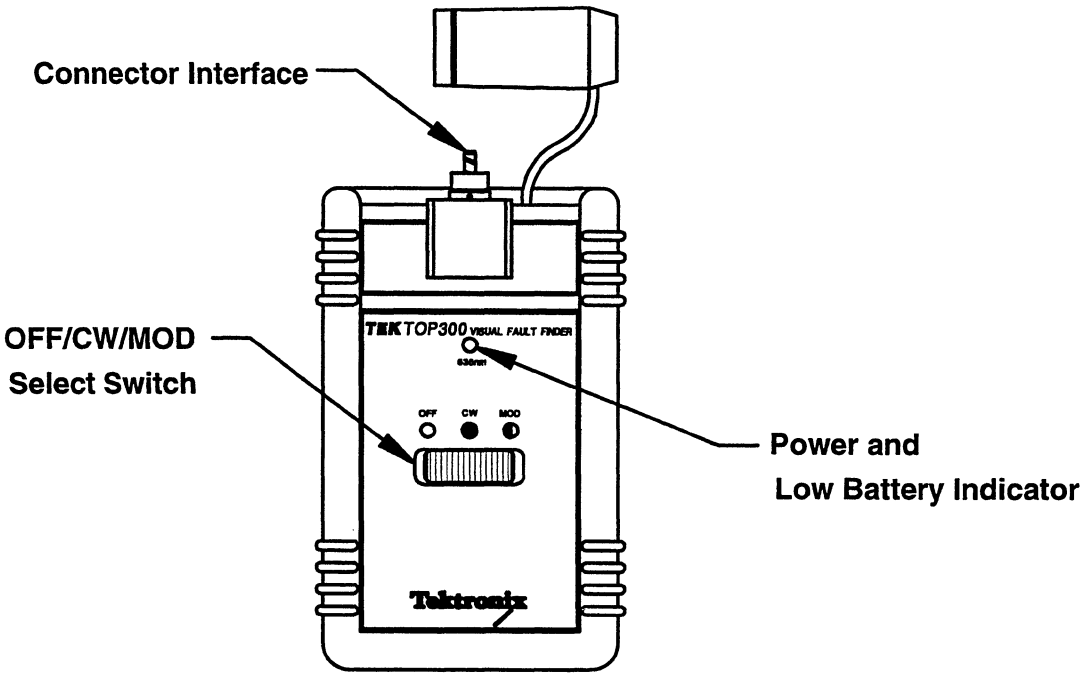
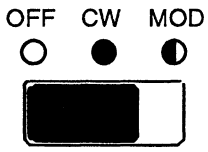


Figure 1-4: TOP300 Visual Fault Finder Switch and LED Locations

Labeled Switches and LEDs



The **OFF/CW/MOD** slide switch controls the power and the two operating modes: CW (continuous) mode and MOD (modulating) mode. The CW mode provides continuous and stable output used for loss measurements. The MOD is useful for special equipment that require modulated optical output.

●

The **Power and Low Battery Indicator** lights when the power is ON and blinks when the battery is low.

The **Connector Interface** utilizes a Universal Connector Interface (UCI) adapter. It allows you to quickly adapt to all popular industry standard fiber optic connectors.

NOTE:

These pictures and descriptions are for products with serial numbers at B019999 and below. The latest TOP products user manual has pictures and descriptions for products with serial numbers of B020000 and up.

Changing the Modulation Frequency

Many Fiber Identifiers, Optical Power Meters (Lock-in Meters) or other special equipment require that the optical level is modulated. There are three established frequencies which are used worldwide: 270Hz, 1kHz and 2kHz. A switch located inside the battery compartment allows you to select the appropriate modulation frequency for the TOP130 Dual LED Source and the TOP140, TOP150 and TOP160 Laser Sources. The instruments are shipped with the switch set to 1kHz.

To change the modulation frequency setting:

- ☐ **Step 1:** Turn power off.
- ☐ **Step 2:** Remove the battery cover and the two AA batteries.
- ☐ **Step 3:** Set the switch to the desired position. (see Figure 1-4).
- ☐ **Step 4:** Replace the batteries and the battery cover.
- ☐ **Step 5:** Turn power on and set the **OFF/CW/MOD** switch to **MOD** position. The output will now be square wave modulated.

NOTE: The average power output will be 3dB less than the average power in CW mode.

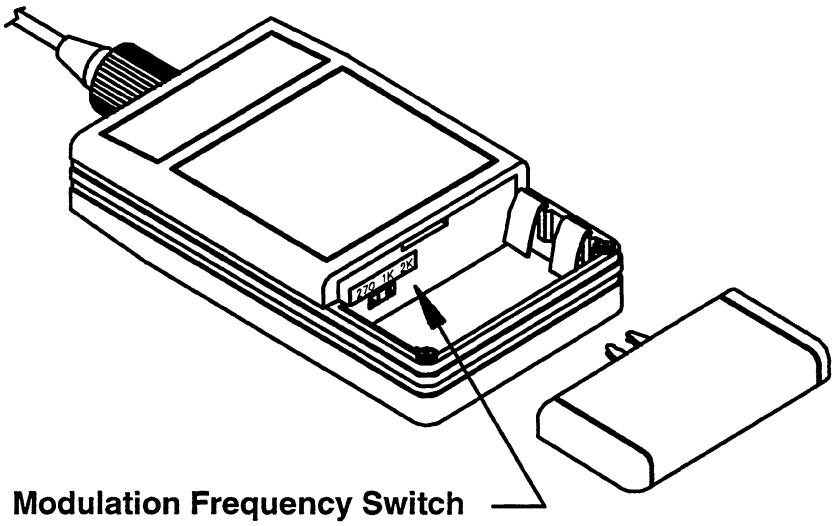


Figure 1-5: Frequency Modulation Switch

NOTE:

These pictures and descriptions are for products with serial numbers at B019999 and below. The latest TOP products user manual has pictures and descriptions for products with serial numbers of B020000 and up.

Connector Interface

Your TOP instruments are equipped with either a SOC or UCI adapter to accommodate all popular industry standard fiber optic connectors.

To interchange UCI adapters for the TOP 140, 150, 160 and 300 instruments:

- ☐ **Step 1:** Firmly press the adapter over the interface ferrule until it reaches the stop.
- ☐ **Step 2:** Rotate the adapter body until the anti-rotation pin engages.
- ☐ **Step 3:** Firmly tighten the knurled adapter shell.
- ☐ **Step 4:** To remove, simply unscrew the adapter.

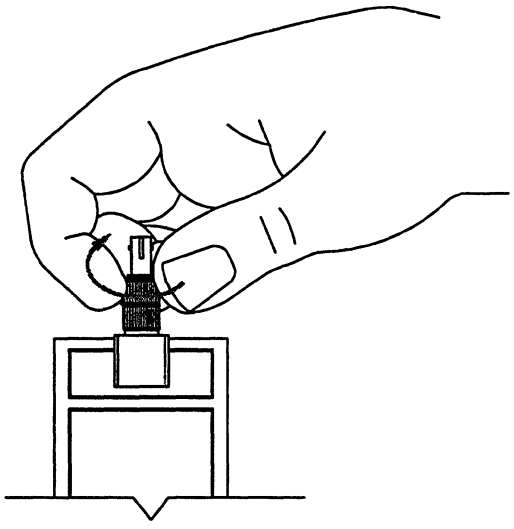


Figure 1-6: Interchanging the UCI Adapter

To interchange SOC adapters for the TOP130 Dual LED Source:

- ☐ **Step 1:** Locate the anti-rotation key on the TOP 130 Fiber Optic Instruments connector interface.
- ☐ **Step 2:** With the keyway properly aligned, slip the SOC adapter over the connector interface until fully locked into place indicated by a snap.
- ☐ **Step 3:** To remove SOC adapter, pull adapter off the connector interface. The adapter is firmly sealed and it requires considerable force to pull it off.

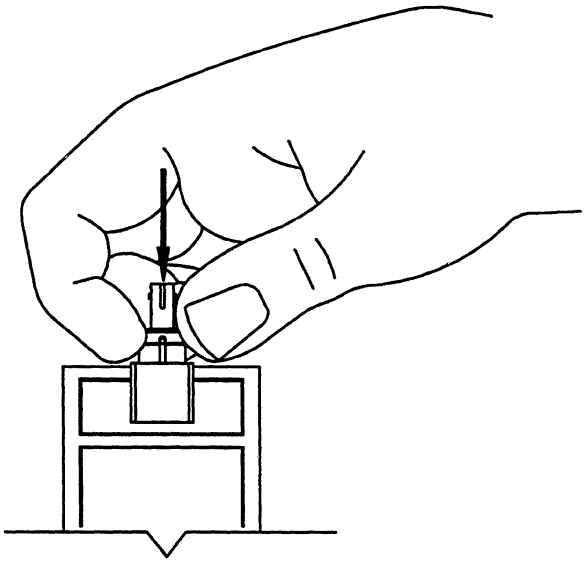


Figure 1-7: Interchanging the SOC Adapter

Battery Information

The TOP 130, 140, 150, 160, 300 Fiber Optic Instruments are designed to operate on two standard 1.5V AA batteries. Low battery status is indicated when the front panel LED indicator is blinking. You may continue to operate the instrument until the front panel LED shuts off. However, the optical output may not be stable while the battery discharges past this LOW BATTERY point.

Power Supply Circuitry

A power supply circuitry is used to utilize efficiently the precious battery power. The power supply circuitry uses two inductors to boost the 3V battery voltage to 5V. The battery voltage can drop all the way to 1V and the power meter will still operate.

Battery Replacement

To replace the batteries:

- ☐ **Step 1:** Remove rubber bumper.
- ☐ **Step 2:** Remove battery cover by pressing on the center of the cover while pulling on its sides.
- ☐ **Step 3:** Remove used batteries and discard. Replace with new batteries.
- ☐ **Step 4:** Replace battery cover.
- ☐ **Step 5:** Replace rubber bumper.

NOTE

Observe the correct polarization as indicated in the bottom of the battery compartment. Failure to properly install the batteries in the correct orientation may damage the instrument.

Please discard batteries according to local environmental regulations.

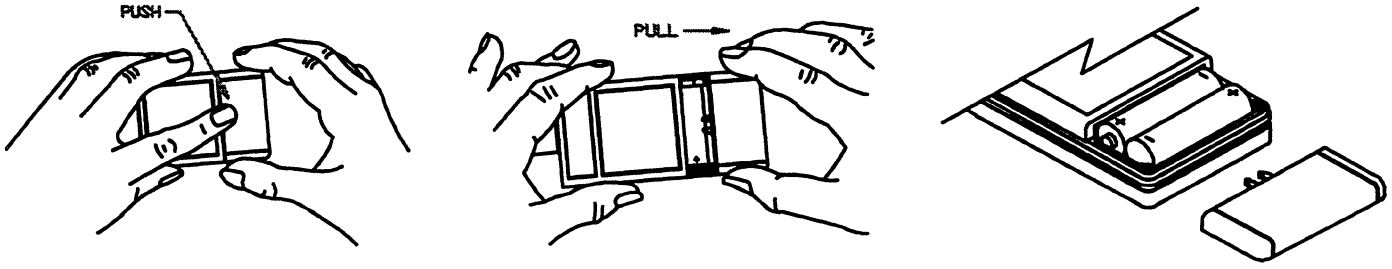


Figure 1-8: Battery Replacement

General Specifications

Performance Characteristics

Table 1-1: Performance Characteristics TOP130, TOP140, TOP150, TOP300

Characteristic	TOP130		TOP140	TOP150	TOP300
Source Type	LED	LED	Fabry-Perot	Fabry-Perot	Fabry-Perot
Center Wavelength	850nm	1300nm	1310nm	1550nm	635nm
Wavelength Range	840-880nm	1270-1345nm	1280-1340nm	1520-1580nm	630-640nm
Spectral Width	≤55nm (RMS)	<150nm (RMS)	<5nm (RMS)	<5nm (RMS)	<2 nm (RMS)
Stability[1]					
1 hour max deviation	±0.05dB	±0.05dB	±0.03dB	±0.03dB	±0.15dB
10 hour max deviation	N/A	N/A	±0.15dB	±0.15dB	±0.25dB
Power Output[2]					
into SMF-28/9µm core fiber	N/A	-38 dBm nominal	-7 dBm +/-0.5 dB	-7 dBm +/-0.5 dB	-4.5 dBm nominal
into 62.5/125 GI MM fiber	-13 dBm nominal	-20 dBm nominal	N/A	N/A	N/A
CDRH	N/A		Class I	Class I	Class II
Functions	MOD (Modulated) output mode CW (Continuous) DC output mode FREQ (Frequency) selection switch				
Connector Interface	Snap-On Connector (SOC) adapter. See *Accessories and Options* section		Universal Connector Interface (UCI) adapters. See *Accessories and Options* section		

Specifications subject to change without notice

[1] Within specified ambient environment of +20°C to +25C°
[2] In modulated mode power is 3dB lower.

Table 1-2: Performance Characteristics TOP160

Characteristic	TOP160	
Source Type	Fabry-Perot	Fabry-Perot
Center Wavelength	1310nm	1550nm
Wavelength Range	1280-1340nm	1520-1580nm
Spectral Width	<5nm (RMS)	<5nm (RMS)
Stability[1,3]		
1 hour max deviation	±0.05dB	±0.05dB
10 hour max deviation	±0.2 dB	±0.2 dB
Power Output[2]		
into SMF-28/9µm core fiber	-7 dBm +/-0.75 dB	-7 dBm +/-0.75 dB
CDRH	Class I	
Functions	MOD (Modulated) output mode CW (Continuous) DC output mode FREQ (Frequency) selection switch	
Connector Interface	Universal Connector Interface (UCI) adapters. See *Accessories and Options* section	

Specifications subject to change without notice

[1] Within specified ambient environment of +20°C to +25C°
[2] In modulated mode power is 3dB lower.
[3] Return loss to be > 30dB.

Power Requirements/Characteristics

Table 1-3: Power Requirements/Characteristics

Power Source	TOP130	TOP140	TOP150	TOP160	TOP300
Battery	2 AA Alkaline Batteries, 1.5V				
Typical Battery Life	>20 Hours	>80 Hours	>80 Hours	>50 Hours	>20 Hours
Power Supply Circuitry	Increases 3V battery voltage to 5V				

Size and Weight

Table 1-4: Size and Weight

Feature	TOP130	TOP140	TOP150	TOP160	TOP300
Weight					
Instrument	203g (7.2oz)	180g (6.4oz)	180g (6.4oz)	227g (8.0oz)	180g (6.4oz)
Shipping	480g (17oz)	430g (15.3oz)	430g (15.3oz)	539g (19.0oz)	430g (15.3oz)
Dimension					
Instrument	72 x 142 x 36mm (2.8 x 5.6 x 1.4 in.) (with rubber bumper)				
Shipping	185 x 240 x 35mm (7.3 x 9.3 x 1.8 in.)				

Environmental Specifications

Table 1-5: Environmental Specifications

Specification	TOP130	TOP140	TOP150	TOP160	TOP300
Temperature					
Operating	-15°C to +55°C	-15°C to +55°C	-15°C to +55°C	-15°C to +55°C	-15°C to +45°C
Non-Operating (storage)	-35°C to +70°C	-35°C to +70°C	-35°C to +70°C	-30°C to +60°C	-35°C to +70°C
Humidity					
Operating	0-95% RH (Non-condensing)				
Non-Operating (storage)	0-95% RH (Non-condensing)				

EMC Compliance

Table1-6:Certifications and compliances

Category	Standards or description	
EC Declaration of Conformity - EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:	
	EN 61326	EMC requirements for Class A electrical equipment for measurement, control and laboratory use.[1]
	IEC 61000-4-2	Electrostatic discharge immunity (Performance criterion B)
	IEC 61000-4-3	RF electromagnetic field immunity (Performance criterion A)
Australia / New Zealand Declaration of Conformity - EMC	Complies with EMC provision of Radiocommunications Act per the following standard(s):	
	AS/NZS 2064.1/2	Industrial, Scientific, and Medical Equipment: 1992
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.	

1 **Emissions which exceed the levels required by this standard may occur when this equipment is connected to a test object.**

Accessories and Options

Standard Accessories

Standard accessories are included with the instrument, or may be ordered by TEKTRONIX part number.

Table 1-7: Standard Accessories

Accessory	TEKTRONIX Part Number
User Manual	070-9372-01
Service Manual	070-9379-02
Rubber Bumper w/ Bail	348-1480-00
Two (2) AA Alkaline 1.5 batteries	N/A

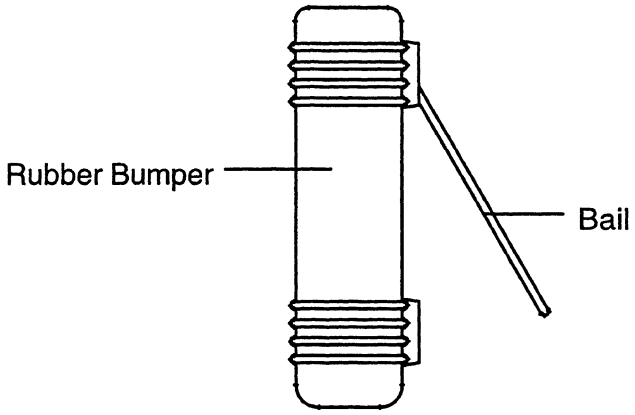


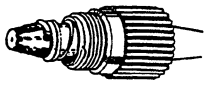
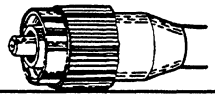
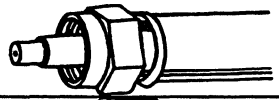
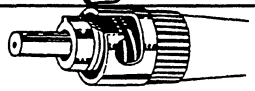
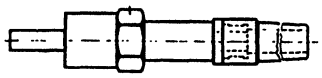
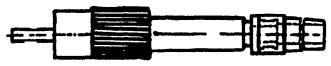
Figure 1-9: Rubber Bumper with Pivoting Bail

Optional Accessories

This service manual is an optional accessory and can be ordered by Tektronix part number 070-9379-03.

SOC and UCI adapters are interchangeable to accommodate a number of connector adapters. A SOC or UCI adapter is used to align the connector ferrule with the connector interface. Additional SOC and UCI adapters may be ordered by Tektronix part number.

Table 1-8: SOC/UCI Adapter Selection Chart

Option No.	Connector Types		TOP130 SOC Adapters Tektronix Part Number	TOP140, 150, 160, 300 UCI Tektronix Part Number
30	Biconic		119-5168-00	119-4515-00
31	FC-PC FC-APC		119-5146-00 119-5146-00	**119-5115-00** ----
32	D4-PC		119-5167-00	119-4514-00
33	SMA 905/906		119-5169-00	119-4557-00
34	ST-PC		119-5144-00	119-4513-00
35	DIN-PC DIN-APC /HRL-10		119-5166-00 119-5166-00	119-4546-00 ----
36	DIAMOND-3.5		119-5172-00	119-4558-00
37	DIAMOND-2.5/ HMS-10/HP		119-5171-00	119-4556-00
38	SC-PC SC-APC		119-5145-00 119-5145-00	**119-5116-00** ----
39	SMA-2.5		119-5170-00	119-4517-00

Performance Verification

Performance verification verifies that the TOP130, 140, 150, 160, and 300 Fiber Optic Instruments are operating properly and within specification.

Performance verification is done with the TOP130, 140, 150, 160, and 300 Fiber Optic Instrument covers in place.

Performance verification should be done before and after any repairs, or disassembly/reassembly of the TOP130, 140, 150, 160, and 300 Fiber Optic Instruments.

Table 2-1: Required Equipment

DESCRIPTION	SPECIFICATION	RECOMMENDED MODEL
Power Meter	Compatible with power sensors; see sensor specifications	Advantest Q8221 or HP 8153A
Power Sensor, short wavelength	±0.25 dB from -13 to -4 dBm, 615 to 880 nm, FC/PC	Advantest Q82214 or HP 81530A
Power Sensor, long wavelength	±0.25 dB from -20 dBm to -6 dBm, 1270 to 1580 nm, FC/PC	Advantest Q82208 or HP 81532A
Optical Spectrum Analyzer	600 to 1600 nm range Uncertainties for measurement of: laser source: λ_c ±0.5 nm, width ±0.2 nm LED with 55 nm spectral width: λ_c ±1.0 nm, width ±1.2 nm[1] LED with 150 nm spectral width: λ_c ±3.0 nm, width ±3.5 nm[1]	Advantest Q8381A or Advantest Q8384
DC Power Supply	3 V, 500 mA	Tektronix CPS250
FC/PC Adapter	SOC adapter for TOP130	Tektronix 119-5146-00
FC/PC Adapter	UCI adapter for TOP140/150/160/300	Tektronix 119-5115-00
Fiber, multimode 62.5/125 μm	5 m, FC/PC connectors with metallic end faces on connector ferrules	Rifocs 2626-106-05
Fiber, single-mode SMF-28 9/125 μm	5 m, FC/PC connectors with metallic end faces on connector ferrules	Rifocs 2626-101-05

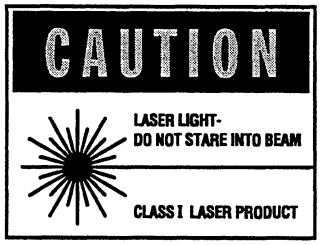
[1] OSA center wavelength (l_c) and spectral width uncertainties for LED sources include both the OSA wavelength and amplitude uncertainties for the rated LED spectral width.

CAUTION. *To prevent measurement errors, clean connector interface on the TOP series instruments and all other fiber connectors and adapters before use.*

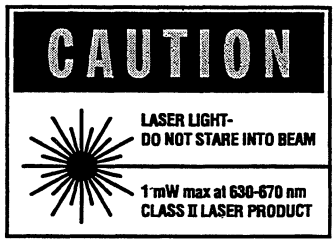
WARNING

Avoid looking directly into the output port of the laser source. Avoid using optical viewing instruments (such as microscopes, magnifiers, etc.) to view active fibers. The use of these devices on active fibers can focus a highly intense beam on to the retina which can result in permanent eye damage.

TOP140, TOP150, and TOP160



TOP300



Source Level Verification/Adjustment

Setup

Figure 2-1 illustrates how the TOP instrument, the reference cable and the power meter are properly connected to perform the source level verification and adjustment.

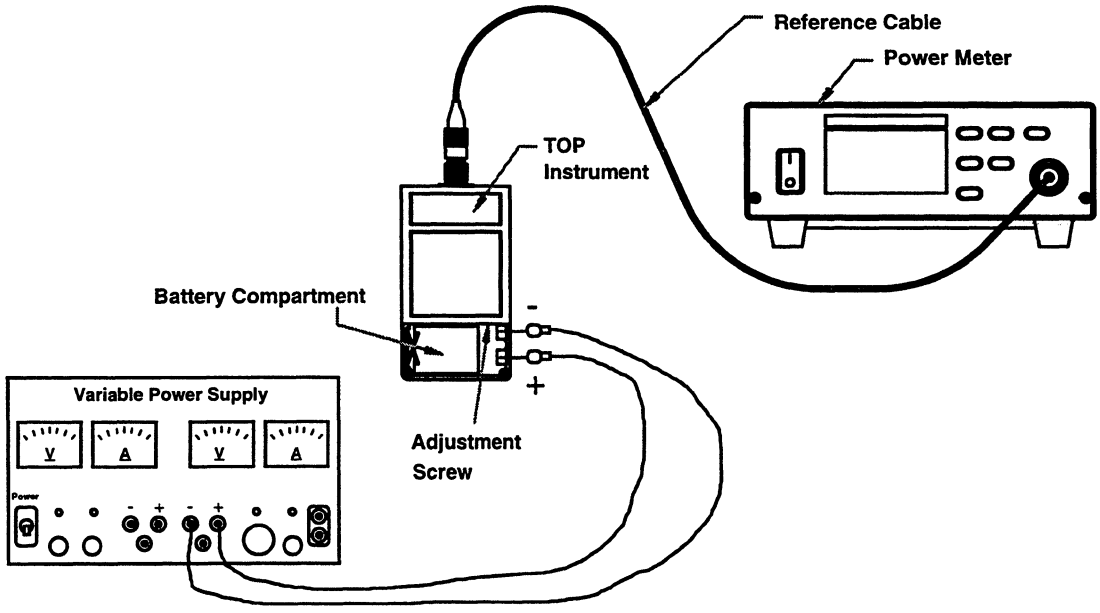


Figure 2-1: Setup for Source Level Verification/Adjustment

TOP 140, 150, 160, and 300 Laser Source Instruments

***NOTE**. Perform steps 1 and 2 only if adjustment is needed. Otherwise, battery power may be used. A 5 minute warm-up is adequate for all tests.*

1. Remove the battery cover and batteries to gain access to the adjustment(s).

2. Set the variable power supply to 3 V, and connect to the battery terminals.

3. Connect the TOP instrument output to the optical power sensor, using single mode fiber. See Table 2 to select the optical sensor and power meter wavelength setting.

4. Switch the TOP instrument to ON and CW, and verify that the output power is within the limits in Table 2. For the TOP160, check both wavelength lasers. The adjustment(s) are in the battery compartment.

5. Laser safety checks: Check that the LED indicator lights for the selected wavelength when power is on. Check that the dust cap is attached, and that it fits snugly.

***CAUTION.** After calibration (verification or adjustment), the output level must be below the specified upper limit (upper adjustment limit for the TOP300) to maintain the Laser Safety Class rating.*

For TOP140 products below S/N B010260 and TOP150 below S/N B010189, the original power setting at time of manufacture was -10 dBm. Products in these serial number ranges should not be considered out of tolerance if output power as received is -10 dBm ±0.5 dB. However, all TOP140 and TOP150 products regardless of serial number, should be adjusted to -7 dBm, ±0.5 dB, and the customer must be informed of the adjustment.

Table 2-2: Power Output Specifications for TOP140, 150, 160, and 300

Model	Power Output	Power Sensor	Meter Wavelength
TOP140	-7 dBm ±0.5 dB	long wavelength	1310 nm
TOP150	-7 dBm ±0.5 dB	long wavelength	1550 nm
TOP160, 1310 nm	-7 dBm ±0.75 dB	long wavelength	1310 nm
TOP160, 1550 nm	-7 dBm ±0.75 dB	long wavelength	1550 nm
TOP300	-4.5 dBm nominal adjust: -4.5 ±0.4 dB	short wavelength	635 nm

---

***NOTE**. The CW power level tolerances are typical, not warranted. This section is a functional check. Perform steps 1 and 2 only if adjustment is needed. Otherwise, battery power may be used. A 5 minute warm-up is adequate for all tests.*

---

1. Remove the battery cover and batteries to gain access to the adjustment(s).

2. Set the variable power supply to 3 V, and connect to the battery terminals.

3. Connect the output of the TOP130 to the short wavelength power sensor using the 62.5/125µm fiber cable.

4. Set the TOP130 to ON, 850, and CW mode. Set the power meter to 850 nm.

5. Check that the output power is -13 dBm, typically -15 to -11 dBm. The adjustment is in the battery compartment.

6. Connect the output of the TOP130 to the long wavelength power sensor using the 62.5/125 µm fiber cable.

7. Set the TOP130 to 1300. Set the power meter to 1300 nm.

8. Check that output power is -20 dBm, typically -22 to -18 dBm. The adjustment is in the battery compartment.

Verifying Modulation of the TOP130, 140, 150, and 160

***NOTE**. The MOD mode has only nominal (not warranted) specifications. This section is a functional check. MOD frequency can be set using a switch in the battery compartment. Normally, test MOD mode only at one frequency (don't change the switch setting).*

---

1. Connect the output of the TOP product (see the Source Level Verification section).

2. Set the TOP product to ON and CW mode. Set the power meter wavelength to the nominal TOP output wavelength.

3. Set the power meter to relative dB mode, and set the dB reference to 0 dB.

4. Set the TOP to MOD. Check for about -3 dB, typically -3.5 to -2.5 dB.

5. For multiple wavelength units, repeat steps 1 to 4 for each wavelength.

***NOTE**. Optionally, the MOD waveform can be viewed using an O/E converter such as a Tektronix P6701B or P6703B with an oscilloscope. A square wave should be displayed with frequency of 270 Hz, 1 kHz, or 2 kHz, depending on TOP switch setting (±5% typical). The duty cycle should be about 50%.*

Verifying Wavelength of the TOP130, 140, 150, 160, and 300

***NOTE**. A significant change in wavelength due to aging is unlikely. Facilities not having wavelength measurement equipment can leave out this section with minimal risk. However, since there are no amplitude accuracy specifications for the TOP130 and TOP300, these products can only be given traceable calibrations if wavelength specifications are tested.*

---

1. Connect the output of the TOP product using a single-mode fiber (multimode for TOP130) to the input of the Optical Spectrum Analyzer (OSA).

2. Set the TOP to ON, CW.

3. Turn on the OSA. Allow a 5 minute warm-up.

***NOTE**. The OSA instructions are written for an Advantest Q8381A. Consult the OSA operating manual for use of other OSA products.*

---

4. Set the OSA as follows:

CENTER:	(set to the nominal TOP wavelength)
SPAN:	300 nm (except 500 nm for TOP130 at 1300 setting)
REF LEVEL:	AUTO
LEVEL SCALE:	LIN
AVG:	1 (OFF)
SWEEP MODE:	ADAPTIVE
RESOLUTION:	5.0 nm (or maximum available setting if <5.0)
MEASURE:	REPEAT

5. After at least one complete sweep, set the OSA: CENTER to PEAK.

6. Change the OSA settings as in Table 2-3, then repeat CENTER to PEAK.

***NOTE**. Steps 7 and 8 set the OSA to measure in "RMS" mode:*
Center wavelength = weighted average wavelength of spectrum.
Spectral width = standard deviation of spectrum multiplied by Kr = 2.3548.

7. Press SPECTRAL WIDTH, then RMS soft key.

8. A small box should appear in the OSA display, showing spectral width parameters. Check that the bottom parameter shows "Kr(RMS): 2.3548". If not, set Kr(RMS) to 2.3548 by pressing "parameter" and making the appropriate entries.

9. In the box, check λ0 (center wavelength) for the tolerances in Table 2-3.

10. Check Δλ (spectral width) for the tolerances in Table 2-3.

11. Repeat steps 4 to 10 for each wavelength of the TOP product.

Table 2-3: Wavelength Specifications for TOP130, 140, 150, 160, and 300

Model	Specification (nm)	OSA SPAN (nm)	OSA RESOL. (nm)
TOP130, 850 nm	λ0: 840 to 880 Δλ: <55	300	5.0[1]
TOP130, 1300 nm	λ0: 1270 to 1345 Δλ: <150	500	5.0[1]
TOP140	λ0: 1280 to 1340 Δλ: <5	20	0.2
TOP150	λ0: 1520 to 1580 Δλ: <5	20	0.2
TOP160, 1310 nm	λ0: 1280 to 1340 Δλ: <5	20	0.2
TOP160, 1550 nm	λ0: 1520 to 1580 Δλ: <5	20	0.2
TOP300	λ0: 630 to 640 Δλ: <2.0	10	0.2

[1] If OSA maximum resolution is less than 5.0 nm, set OSA to maximum setting.

Verifying the Low Battery Indicator

NOTE. *Perform this procedure only if a low battery indicator malfunction is suspected.*

---

1. Remove the battery cover and batteries.

2. Connect the variable power supply to the battery clips.

3. Turn unit ON and set voltage to 3V on the power supply.

4. Slowly lower the voltage while observing the front panel LED indicator.

5. The LED indicator must start blinking at 2.5V $\pm$0.1V. The laser power must remain stable at 2.5V. For the TOP130, the LED indicator starts blinking at 2.2 $\pm$0.1V.

Maintenance

Cleaning Procedures

This section discusses cleaning procedures for the connector interface, SOC/UCI adapters, fiber optic connectors, battery contacts and instrument case.

It is absolutely critical to maintain the cleanliness off all connector interfaces, adapters, fiber optic connectors each and every time they are used to guarantee maximum performance by the TOP 130, 140, 150, 160 and 300 Fiber Optic Instruments..

Improper maintenance practices causes the following performance degradation:

- Measurement errors
- Poor analog transmission quality, critical to CATV and microwave-on-fiber applications
- Digital bit error rates increase
- Coupled light power is reduced
- Receiver input power outside optimum operating range
- Dirty connectors may cause damage to their mated counterparts

Do not touch the exposed ferrule tip of the connector interface with anything but a dry lint-free cloth. In severe cases, you will need to use a reagent-grade isopropyl alcohol.

When not in use, keep the connector interface covered with the protective dust cap.

Cleaning the Connector Interface

To clean the connector interface:

- ☐ **Step 1:** Remove the dust cap to expose the connector interface.
- ☐ **Step 2:** If there is a SOC or UCI adapter present, remove it as shown in Figure 1-5 and 1-6 in the *Operator Information* section.
- ☐ **Step 3:** Clean the connector interface with a dry lintfree cloth as shown in Figure 3-1. In severe cases, you will need to use reagent-grade isopropyl alcohol (IPA).
- ☐ **Step 4:** Wipe the connector interface again with a fresh dry lintfree cloth to remove residual alcohol.
- ☐ **Step 5:** Clean exterior of connector interface housing with clean lintfree cloth.

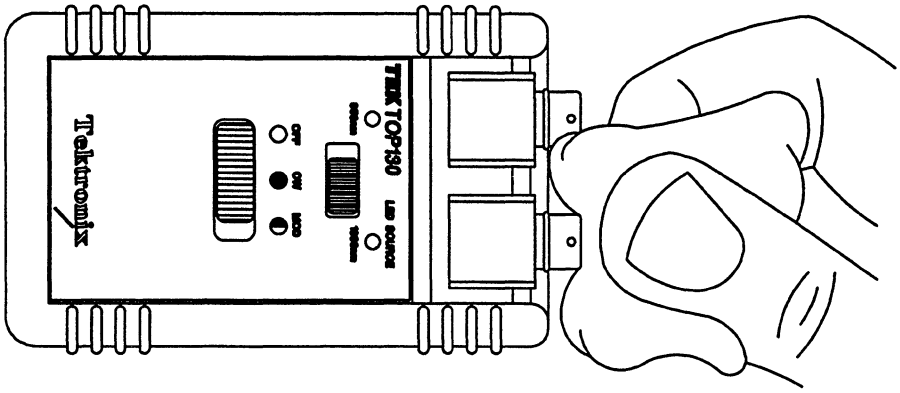


Figure 3-1: Cleaning the Connector Interface

Cleaning the SOC or UCI Adapter

SOC or UCI adapters are interchangeable to accommodate all popular industry standard fiber optic connectors and must always be cleaned before each and every use.

To clean SOC or UCI adapters:

- ☐ **Step 1:** Using a clean lintless swab (RIFOCS P/N 946), insert the swab into the thru-hole of the adapter.
- ☐ **Step 2:** Clean exterior and interior surfaces using a lintfree cloth wetted with reagent-grade isopropyl alcohol.
- ☐ **Step 3:** Wipe exterior and interior surfaces again with a fresh dry lintfree cloth to remove any residual alcohol.

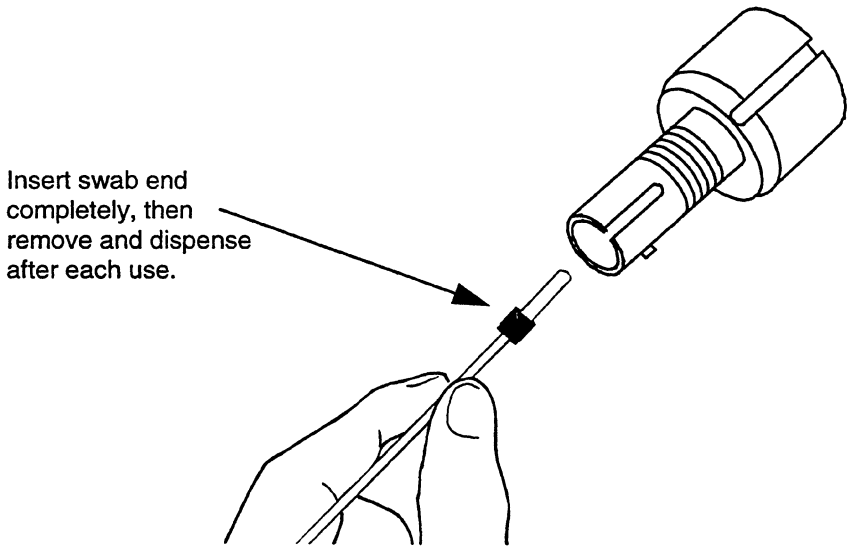


Figure 3-2: Cleaning the SOC or UCI adapter

Cleaning the Fiber Optic Connector

- ☐ **Step 1:** Dampen a lint-free swab or paper wipe with electronics-grade alcohol, and gently wipe across and around the connector a couple of times.
- ☐ **Step 2:** Dry with a dry swab or dry portion of the paper wipe.
- ☐ **Step 3:** If the connector is extremely dirty repeat the procedure with a second lint-free swab or paper wipe.

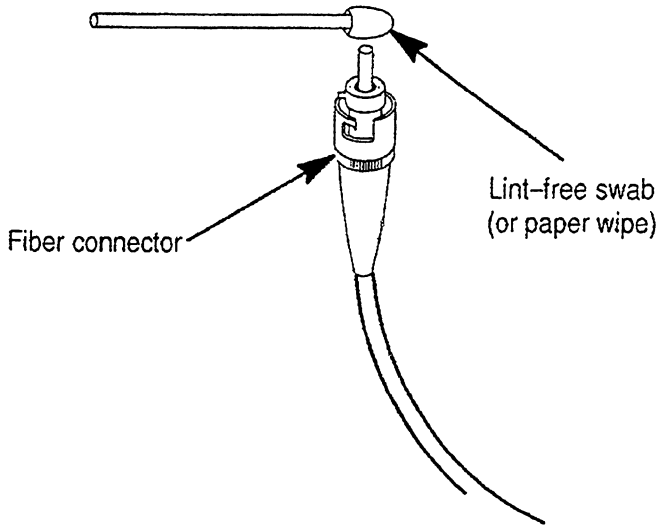


Figure 3-3: Cleaning the Fiber Connector

Cleaning Battery Contacts

In some occasions, it becomes necessary to clean battery contacts due to leaky batteries or water contamination. If battery contacts are no longer susceptible to cleaning, the corrective procedure is to replace them.

WARNING

Batteries that are leaking electrolyte are hazardous. Avoid contact with electrolyte which may damage eyes, skin and clothing.

Please discard batteries in accordance with local environmental regulations.

To clean battery contacts:

- ☐ **Step 1:** Remove battery compartment cover and the 2 AA batteries. Avoid contact with leaking electrolyte.
- ☐ **Step 2:** Remove each battery contact from its respective slot using needle-nose pliers (or equivalent).
- ☐ **Step 3:** In case of corrosion build-up on contacts, scrape it off using an abrasive paper or the flat edge of a tool (i.e. flat screwdriver).
- ☐ **Step 4:** Apply reagent-grade isopropyl alcohol on the contacts and brush off excess build-up with cleaning brush into towel.
- ☐ **Step 5:** Wipe exterior surface of battery contacts with dry paper towel to remove residual isopropyl alcohol.
- ☐ **Step 6:** Apply a thin film of WD-40 (lubricant) on the battery contacts for protection.
- ☐ **Step 7:** Place 2 new AA batteries and replace cover of the battery compartment. Make sure that the batteries are positioned with the correct polarization.

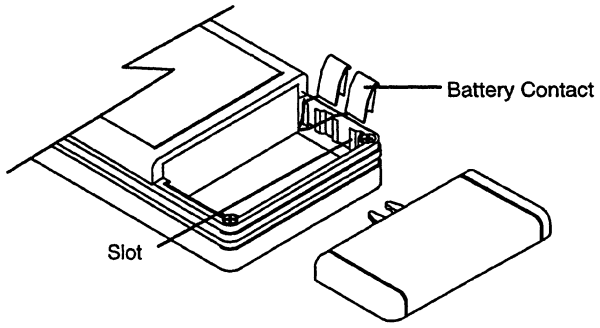


Figure 3-4: Cleaning Battery Contacts

Cleaning the Instrument Case

To clean instrument case:

- ☐ **Step 1:** Remove protective rubber bumper.
- ☐ **Step 2:** Wipe exterior surface of instrument case with clean paper towel wetted with a small amount of isopropyl alcohol.

CAUTION

NOTE: Avoid using an excessive amount of alcohol for it may damage the labels at the rear of the instrument.

- ☐ **Step 3:** Wipe exterior surface of instrument case again with dry paper towel.
- ☐ **Step 4:** Replace rubber bumper.

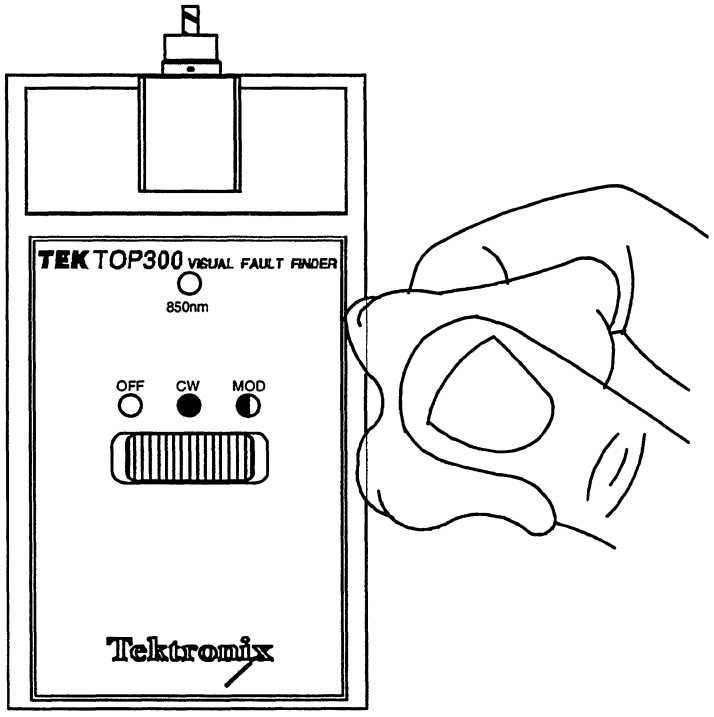


Figure 3-5: Cleaning the Instrument Case

Troubleshooting

No Power On

If the TOP 130, 140, 150, 160 and 300 Fiber Optic Instruments will not power on properly, the most likely cause is a discharged battery, battery installed improperly or a defect on the meter.

Typical indications of a discharged battery are:

- No power when turned ON
- Blinking LED indicator on front panel

You may continue to operate the unit until the front panel LED shuts off. However, the optical output may not be stable while the battery discharges past this LOW BATTERY point.

Performance Problems

Problem	Possible Solutions
Front panel LED(s) not working	Check for discharged battery. If failure repeats, replace instrument.
Modulation frequency out of spec	Replace instrument.
Mean Wavelength or Spectral Width out of spec	Replace instrument.
Loss of output power	Clean connector interface. If power continues to drop, check for discharged battery. If failure repeats, laser is dying. Replace instrument.
Switch/Button functions not responding	Replace instrument.
Dust Cap disconnected or loose on lasers	Replace Instrument.

Replaceable Parts

This section contains a list of replaceable parts for the TOP 130, 140, 150, 160, 300 Fiber Optic Instruments. Use this list to identify and order replacement parts.

Ordering Information

Replacement parts are available from your local Tektronix service center.

When ordering a replacement part, include the following information:

- Part Number
- Instrument model number
- Instrument serial number
- Instrument modification number, if applicable

If a part you order has been replaced with a new or improved part, your local Tektronix service center or representative will contact you regarding any change in the part number.

Instrument Replacement

The TOP 130, 140, 150, 160 and 300 Fiber Optic Instruments are serviced by replacing the instrument. These are two options you should consider:

Instrument Exchange - The TOP Series instruments are repaired by exchange of the entire instrument for a reconditioned instrument. The part numbers for these reconditioned instruments are listed below:

Description	Part No.	Serial No.	Part No.	Serial No.
TOP130 Dual LED Source	118-9276-00	B010100-B019999	118-9678-00	B02XXXX
TOP140 Laser Source	118-9277-00	B010100-B019999	118-9679-00	B02XXXX
TOP150 Laser Source	118-9278-00	B010100-B019999	118-9680-00	B02XXXX
TOP160 Dual Laser Source	118-9394-00	B010100-B019999	118-9681-00	B02XXXX
TOP300 Visual Fault Finder	118-9279-00	**B010100-B019999**	**118-9486-00**	**B02XXXX**

New Instruments - New instruments can be purchased like other replacement parts.

Replaceable Parts

Tektronix Part Number	Qty	Name and Description
		STANDARD ACCESSORIES
348-1480-00	1	Rubber Bumper with Pivoting Bail
119-4513-00	2	Adapter, ST:Snap-On Connector (SOC) for TOP130
119-5115-00	1	Adapter, FC-PC:Universal Connector Interface (UCI) for TOP 140, 150, 160 and 300
070-9372-01	1	Manual, Tech:User, TOP 130, 140, 150, 160, 200, 300 User Manual
006-8134-00	1	Alcohol Packet with Application Note

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Service Manual

Tektronix

TOP Series
Fiber-Optic Instruments
TOP400 Hand-Held Attenuator
Volume 3

070-9379-03

Warning
The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

www.tektronix.com

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

WARRANTY

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor or will provide a replacement in exchange for the defective product.

In order to obtain service under warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THIS PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

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Safety Summary

These terms appear in the manual:

- CAUTION statements identify conditions or practices that could result in damage to the instruments or other property.
- WARNING statements identify conditions or practices that could result in personal injury.

This symbol appears in the manual:

Laser Warning

Power Sources

The TOP400 hand-held attenuator does not require any batteries to operate.

Laser Radiation

There is no active source inside the TOP400, but be aware that light sources may be connected to it.

When making measurements on optical systems, avoid eye exposure to any open-ended fibers, optical connectors, optical interfaces or other sources, because they may be connected to laser transmitters.

- Do not look into the optical port when a source is turned on.
- Keep the dust cap on the optical port when not in use.
- Avoid looking at the free end of a test fiber (the end not connected to the instrument). If possible, direct the free end toward a non-reflective surface.

Do Not Remove Covers or Panels

Do not remove the instrument covers or panels, nor operate without covers and panels in place.

Qualified Personnel Only

This service manual is designed for use by qualified personnel only. To avoid damage to the instruments, do not perform any servicing unless you are a qualified technician.

Preface

This manual is used for servicing the TOP400 hand-held attenuator to *instrument level only.* It does not contain component-level service information, schematics, or parts lists.

If You Need Help

Information about servicing the TOP 400 hand-held attenuator is available by calling the Tektronix number listed in Contacting Tektronix on page viii and selecting the desired option.

Assumptions

The procedures in this manual assume that you are a qualified electronic technician, and have a working knowledge of service procedures for fiber-optic test equipment.

Before Servicing

To prevent injury to yourself or damage to equipment:

- You must be a qualified service technician.
- Read the *Safety Summary* at the beginning of this manual.
- Heed all warnings, cautions and notes in this manual.

What You Will Find in this Manual

- *General Information.* General product and operator information. Specifications. Accessories and options.
- *Performance Verification.* Procedures for verifying that the TOP400 hand-held attenuator functions properly and meet warranted operating specifications.
- *Calibration Procedures.* Procedures to calibrate the TOP400 hand-held attenuator.
- *Maintenance.* Cleaning procedures. General troubleshooting and fault isolation.
- *Replaceable Parts.* Part numbers and ordering information.

Related Documents

The TOP400 Hand-Held Attenuator User Manual (PN 071-0041-00)

Tektronix Service

Tektronix provides service to cover repair under warranty and post warranty problems. The TOP400 hand-held attenuator is warranted for one year. The warranty statement appears at the beginning of this manual.

Contacting Tektronix

Phone	1-800-833-9200*
Address	Tektronix, Inc. Department or name (if known) 14200 SW Karl Braun Drive P.O. Box 500 Beaverton, OR 97077 USA
Web site	www.tektronix.com
Sales support	1-800-833-9200, select option 1*
Service support	1-800-833-9200, select option 2*
Technical support	Email: techsupport@tektronix.com 1-800-833-9200, select option 3* 1-503-627-2400 6:00 a.m. - 5:00 p.m. Pacific time

* **This phone number is toll free in North America. After office hours, please leave a voice mail message. Outside North America, contact a Tektronix sales office or distributor; see the Tektronix web site for a list of offices.**

General Information

Instrument-Level Service

Overview

This service manual is used for servicing the TOP400 hand-held attenuator *instrument level only.* The usual corrective procedure is to replace, not repair, the instrument.

WARNING

While there is no potential for eye damage due to unaided direct exposure, always avoid looking directly into the output port. Do not use optical viewing instruments (such as microscopes, magnifiers, etc.). The use of these devices on active fibers can focus a highly intense beam onto the retina which can result in permanent eye damage.

Service Procedure

The direct service-related sections in this manual are:

- *Performance Verification.* Use to verify the TOP400 hand-held attenuator to see that the instrument meets specification.
- ***Adjustment Procedure.* Use to adjust the TOP400 hand-held attenuator.**
- *Maintenance.* Use for:
  - Cleaning
  - Troubleshooting problems
- *Replaceable Parts.* Part numbers and ordering information

The first section in this manual, *General Information,* contains product information, user information, specifications, accessories and options.

If you have no need for this information, go directly to the other sections.

Product Information

This section briefly describes the TOP400 hand-held attenuator.

A quick review of this section will familiarize you with the TOP400 hand-held attenuator, which may help when servicing the instrument.

For complete product information, refer to the *TOP400 Hand-Held Attenuator User Manual.*

Product Package

The TOP400 hand-held attenuator is supplied with the following equipment and standard accessories:

- One rubber bumper with bail
- Two universal connector interface (UCI) adapters per customer order
- One user manual (071-0041-00)
- One calibration certificate

Product Description

The TOP400 hand-held attenuator is the first truly palm-sized, low-back-reflection singlemode optical attenuator designed for actual field use. This attenuator utilizes a proprietary scheme for the attenuating mechanism. Small size and large dial indicator make this instrument an indispensable tool for fiber-optic line commissioning, bit-error-rate (BER) measurements, system margin analysis and receiver sensitivity testing. It is also versatile enough to be used as an "optical potentiometer" in the laboratory where the optical power has to be adjusted quickly and efficiently.

The TOP400 features the precision universal connector interface (UCI) for PC-style connectors which offers low insertion loss and excellent stability. The universal interface allows for quick adoption of most industry standard connectors. Furthermore, cleaning of the interface is accomplished by simply removing the adapter, which exposes the ferrule.

The attenuator is completely mechanical and does not require any batteries.

Features

Optical Interface Features

- Easily cleanable connector adapter. Refer to the *Cleaning and Troubleshooting* section for cleaning procedures.
- UCI adapters are field changeable and must match the type of fiber connector being used. Refer to the *Accessories and Options* section for connector adapter options.

  NOTE: Do not match APC with non-APC adapters or connectors or you will acquire erratic readings.

Rubber Bumper

- The TOP400 includes a removable rubber bumper. This molded silicone shell acts to protect against shock in the field.
- The rubber bumper includes a pivoting bail to hold the instrument upright when required.

Structural Integrity

- The TOP400 can take falls and is highly crush resistant.
- The unit provides reliable and accurate measurements from -15°C to +60°C.

Dust Cap

- The attached dust cap simply snaps into place.
- There is no need to remove the adapter; the dust cap fits over all adapters.

Operator Information

This section summarizes the basic operating procedures of the TOP400 hand-held attenuator as well as changing the universal connector interface (UCI) adapters.

A quick review of this section will familiarize you with the basic operation of the TOP400 hand-held attenuator, which may help when servicing the instrument.

For complete operator information, refer to the *TOP400 Hand-Held Attenuator User Manual.*

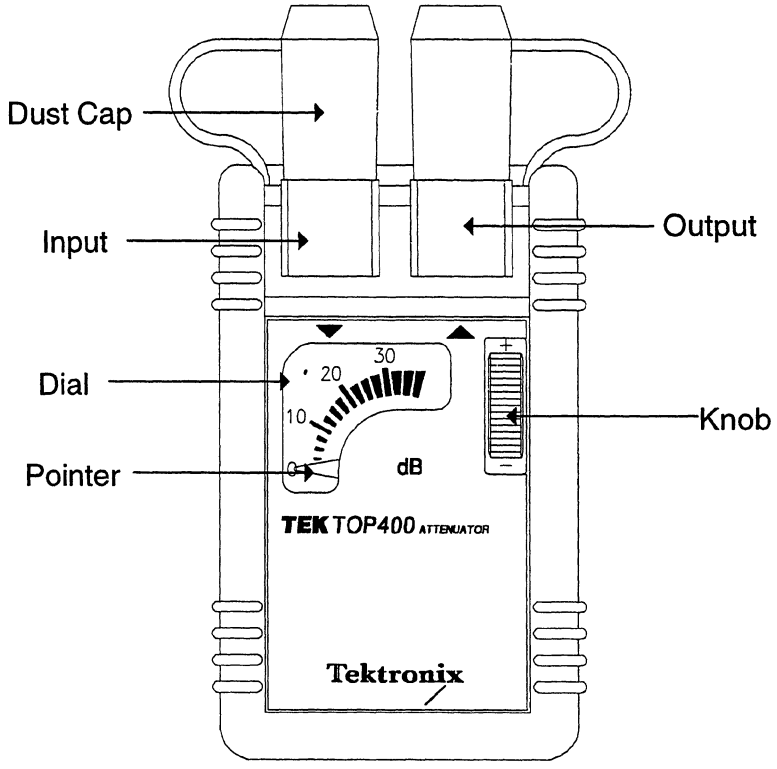


Figure 1-1: TOP400 Controls

Connector Interface

Your TOP400 attenuator is equipped with a UCI adapter to accommodate all popular industry standard fiber-optic connectors.

To change UCI adapters for the TOP400 hand-held attenuator:

- ☐ **Step 1:** Firmly press the adapter over the interface ferrule until it reaches the stop.
- ☐ **Step 2:** Rotate the adapter body until the anti-rotation pin engages.
- ☐ **Step 3:** Firmly tighten the knurled adapter shell.
- ☐ **Step 4:** To remove, simply unscrew the adapter.

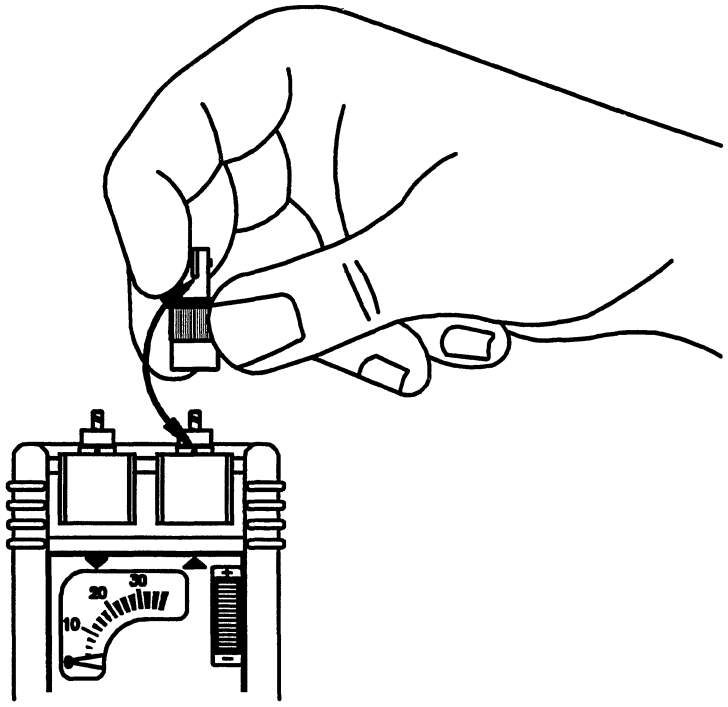


Figure 1-2: Changing the UCI Adapter

General Specifications

Performance Characteristics

Table 1-1: Performance Characteristics of the TOP400 Hand-Held Attenuator

Characteristic	Specification
Insertion Loss *	< 2dB (1.25dB typical)
Return Loss	> 40dB
Attenuation Range	0 - 35dB
Maximum Input Power	+23dBm
Fiber Compatibility	Singlemode SMF-28
Optical Interface	Universal Connector Interface (UCI) Adapters See Table 1.3 for available UCI adapters
Operating Environment Storage Environment	-15°C to +60°C, 0-95% RH (non-condensing) -35°C to +70°C, 0-95% RH (non-condensing)
Weight	310g (8.1 oz)
Size (W x H x D)	72 x 142 x 35mm (2.8 x 5.6 x 1.4 in.)

Specifications subject to change without notice

The insertion loss is the intrinsic loss of the instrument with the dial set to 0 dB.

Accessories and Options

Standard Accessories

Standard accessories are included with the instrument, or may be ordered by TEKTRONIX part number.

Table 1-2: Standard Accessories

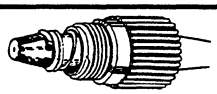
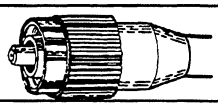
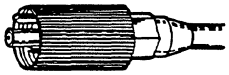
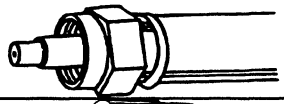
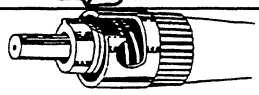
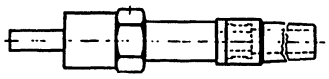
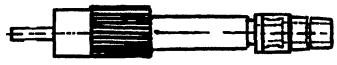
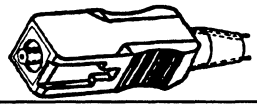
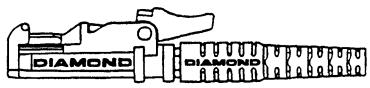
Accessory	TEKTRONIX Part Number
User Manual	071-0041-00
Rubber Bumper w/ Bail	348-1480-00

Optional Accessories

This service manual is an optional accessory and can be ordered by Tektronix part number 070-9379-03.

UCI adapters are interchangeable to accommodate a number of connector adapters. A UCI adapter is used to align the connector ferrule with the connector interface. Additional UCI adapters may be ordered by Tektronix part number.

Table 1-3: UCI Adapter Selection Chart

Option No.	Connector Types	TOP400 UCI Tektronix Part Number
30	Biconic 	119-4515-00
31	FC-PC FC-APC 	**119-5115-00** ----
32	D4-PC 	119-4514-00
33	SMA 905/906 	119-4557-00
34	ST-PC 	119-4513-00
35	DIN-PC DIN-APC/HRL-10 	119-4546-00 ----
36	DIAMOND-3.5 	119-4558-00
37	DIAMOND-2.5/ HMS-10/HP 	119-4556-00
38	SC-PC SC-APC 	**119-5116-00** ----
39	SMA-2.5 	119-4517-00
N/A	E2000-PC 	119-5164-00

Theory of Operation

This section describes the theory of operation for the TOP400 hand-held attenuator to provide a basic overview of how the instrument operates.

Principle of Operation

The attenuation principle relies on the fact that singlemode fibers may be separated to create a defined loss. In the TOP400 attenuator the distance of two precision-ground ferrules is accurately controlled. Typically, the attenuation versus ferrule separation is highly non-linear. A precision cam is used internally to linearize this curve.

The ferrules are ground at an angle to deflect the light from being guided back to the input.

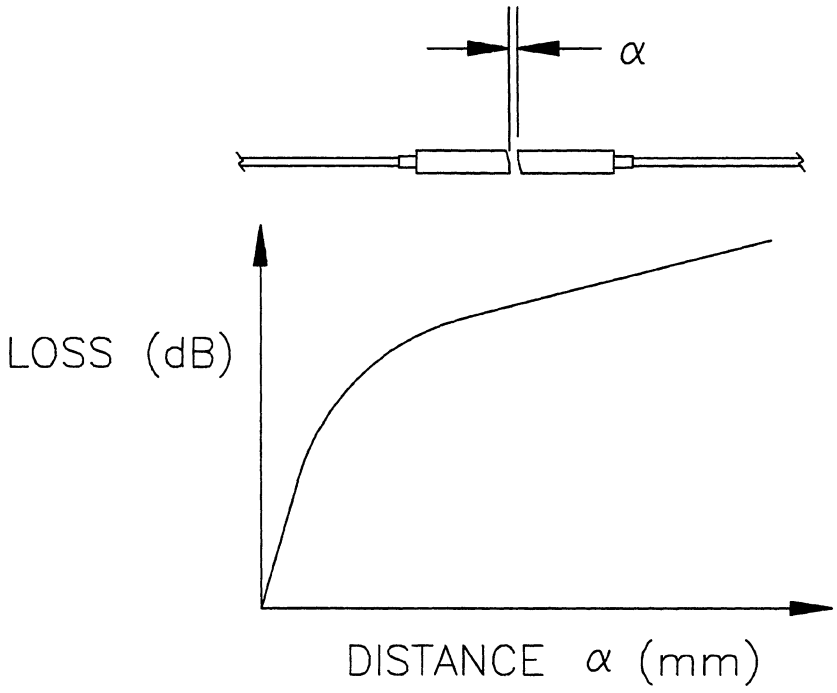


Figure 2-1: Loss versus Fiber Distance

Wavelength Dependency

Although the attenuation of the TOP400 is virtually independent of the wavelength, it varies slightly at operating wavelengths other than 1300nm. The curve below indicates the amount of deviation you can expect when operating at wavelengths from 1000nm to 1600nm.

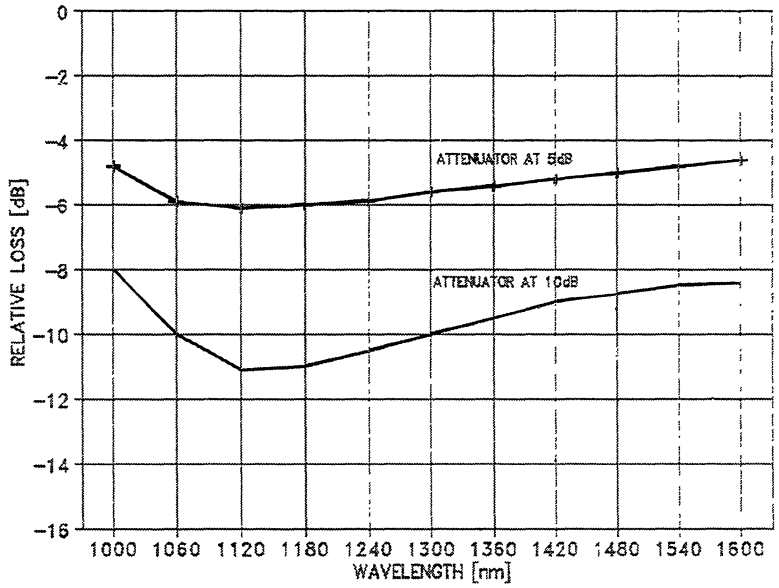


Figure 2-2: Wavelength Dependency

Performance Verification

Performance verification verifies that the TOP400 hand-held attenuator is operating properly and within specification.

Performance verification is done with the TOP400 hand-held attenuator covers in place.

Tektronix recommends the performance of the TOP400 hand-held attenuator be verified on annual basis.

Required Equipment

Equipment	Specification	Example	Comments
Optical Power Meter	0.25dB accuracy -75dBm to +3dBm range	RIFOCS 575L	Equivalent optical power meter may be used.
Return Loss Test Set	0dBm to -65dBm 1300nm	RIFOCS 585RL	Equivalent return loss test set may be used.
Reference Cable	FC-PC	RIFOCS 5920	Used on Return Loss Test Set
SOC Adapter	FC-PC	119-5146-00	Used on Optical Power Meter.
UCI Adapter (3)	FC-PC	119-4516-00	Used on the laser source and TOP400
Reference Cable	SMF-28	RIFOCS 2626-101-05	
Bulkhead Adapter	N/A	RIFOCS MPC-10	

CAUTION

To prevent measurement errors, clean connector interface on the TOP400 attenuator and all other fiber connectors and adapters before use.

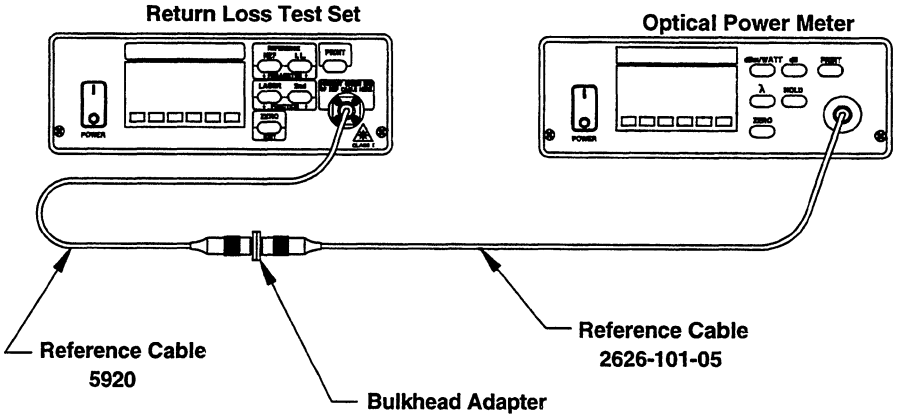
WARNING

Laser Warning

Do not look directly into the output port of the return loss test set. Do not use optical viewing instruments (such as microscopes, magnifiers, etc.) to view active fibers. The use of these devices on active fibers can focus a highly intense beam on to the retina, which can result in permanent eye damage.

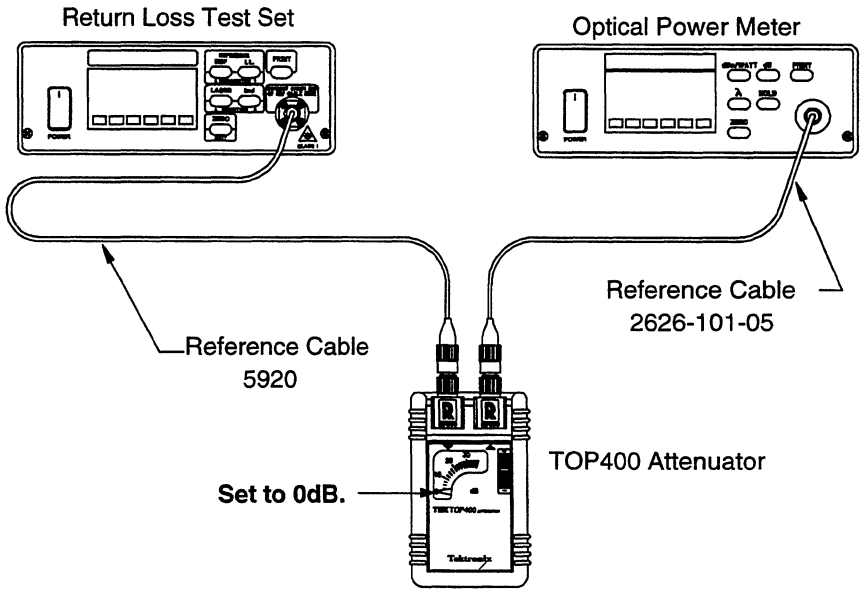
Insertion Loss Verification

☐ **Step 1:** Connect the return-loss test set to the optical power meter as shown below. **A 1310 nm single-mode laser source may be used in place of the Return Loss Test Set.**



☐ **Step 2:** Establish the zero reference by pressing the **dB** button on the optical power meter.

☐ **Step 3:** Connect the TOP400 in place of the bulkhead adapter and set it to 0dB.



☐ **Step 4:** Read the relative dB loss on the optical power meter display and **check that it is 2.0 dB or less.**

Table 3-1: Sample Test Specification

Test Specification	Min	Max	Actual
Insertion Loss	--	**2.0dB**	
Indicator at 10dB	**8dB**	**12dB**	
Indicator at Maximum	**35dB**	--	
Return Loss, Indicator at Maximum	**40dB**	--	

10dB Dial Setting Verification

- ☐ **Step 1:** Retain the setup as described in Step 3 of the Insertion Loss Verification.
- ☐ **Step 2:**. With the TOP400 set to 0dB press the **dB** button on the optical power meter. This establishes the baseline reading.
- ☐ **Step 3:** Set the dial indicator to exactly 10dB on the attenuator.
- ☐ **Step 4:** Read the loss increase in dB on the optical power meter. **Check for 10dB +/- 2dB.**

Maximum Loss Verification

- ☐ **Step 1:** Retain the setup as described Step 3 in the Insertion Loss Verification section.
- ☐ **Step 2:** Adjust the TOP400 knob to the maximum.
- ☐ **Step 3:** Read the relative dB loss on the optical power meter display and **check for 35dB or greater.**

Return Loss Verification

This test is optional. It should be performed if one of the other checks is out of tolerance or excessively noisy.

- ☐ **Step 1:** Reference the return loss test set as described in its user manual.
- ☐ **Step 2:** Connect the TOP400 using the 5920 reference cable.
- ☐ **Step 3:** Set the TOP400 to maximum loss. The return loss must be higher than 40dB.

Adjustment Process

This section describes the **adjustment process for the TOP400 hand-held** attenuator. All calibration procedures are in accordance with MIL-STD-45662A.

The following procedures should be performed by qualified personnel only.

Before service and repair is attempted, you must perform a performance verification test as described in the *Performance Verification* section. Doing so will help indicate the nature of the problem.

Required Equipment

Equipment	Specification	Example	Comments
Light Source	1300nm ±30nm >-10dBm power ±0.03dB stability	TOP160	Stable, narrow band laser source
Optical Power Meter	0.25dB accuracy -60dBm to +3dBm InGaAs	TOP200	NIST traceable. Equivalent optical power meter may be used.
Fiber Cable (2)	SMF-28 Singlemode FC-PC Connector		Clean connectors before use.
SOC adapter (1)	FC-PC	119-5146-00	Used on the TOP200.
UCI adapter (3)	FC-PC	119-4516-00	Used on light source and TOP400.
Bulkhead Adapter	N/A	RIFOCS MPC-10	Used for referencing setup.
Phillips Screw Driver			
Needle Nose Pliers			
Tweezers			

CAUTION

To prevent measurement errors, clean the connector interface on the TOP400 hand-held attenuator, and all other fiber connectors and adapters before use.

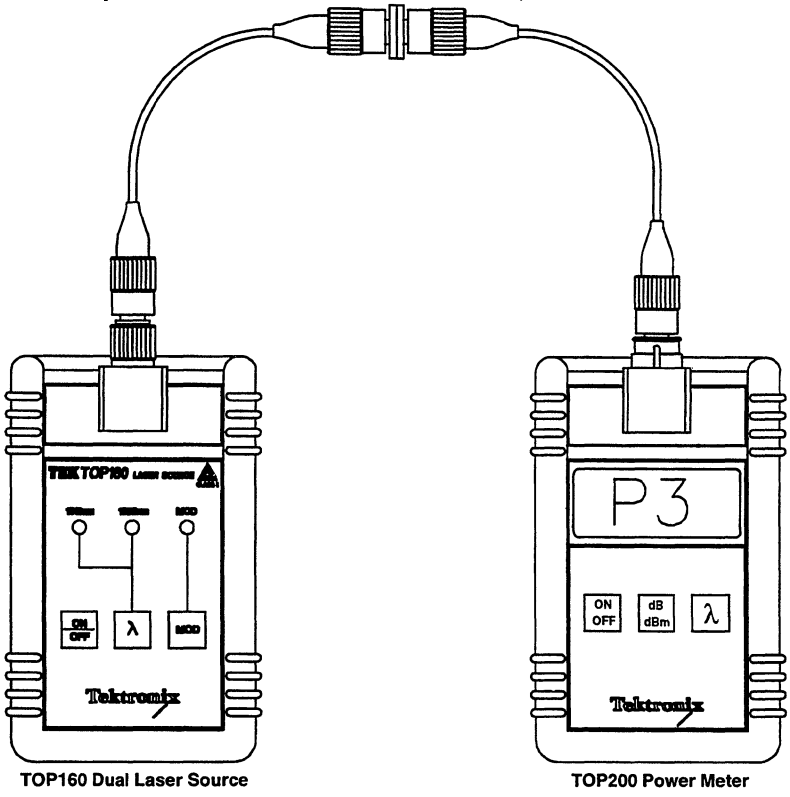
WARNING

Laser Warning

Do not look directly into the output port of the laser source. Do not use optical viewing instruments (such as microscopes, magnifiers, etc.) to view active fibers. The use of these devices on active fibers can focus a highly intense beam on to the retina, which can result in permanent eye damage.

Insertion Loss Alignment

☐ **Step 1:** Reference the optical power meter as shown in Figure 4-1. **Set the power meter to dB relative mode, and set the 0dB reference.**



TOP160 Dual Laser Source

TOP200 Power Meter

Figure 4-1: Initial Power Meter Referencing

☐ **Step 2:** Turn the knob of the TOP400 until the pointer is set at "0".

☐ **Step 3:** Remove the rubber bumper and the case cover located at the lower rear part of the instrument.

☐ **Step 4:** Connect the attenuator to the light source and optical power meter as shown in Figure 4-2.

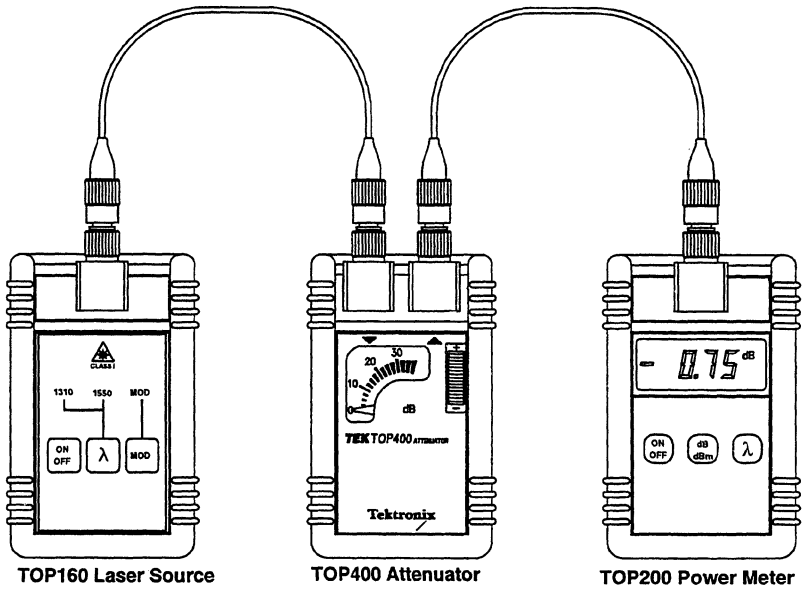


Figure 4-2: Setup for Insertion Loss Alignment

- ☐ **Step 5:** Gently rotate the ferrule-nut to achieve the lowest dB losses (max ≤1.75dB). **After the adjustment, set the power meter to 0dB reference.**
- ☐ **Step 6:** Turn the knob to align the pointer with "10".

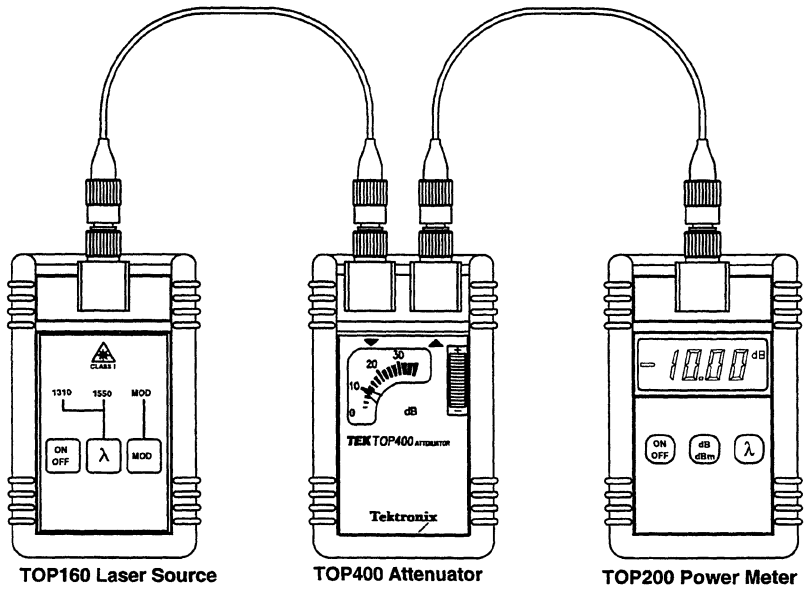


Figure 4-3: 10dB Point Verification

☐ **Step 7:** Adjust the set screw until the reading on the optical power meter reads -10.00dB ±0.2dB.

CAUTION

Do not tighten the set screw near the ferrule. Doing so may cause the TOP400 to operate erratically.

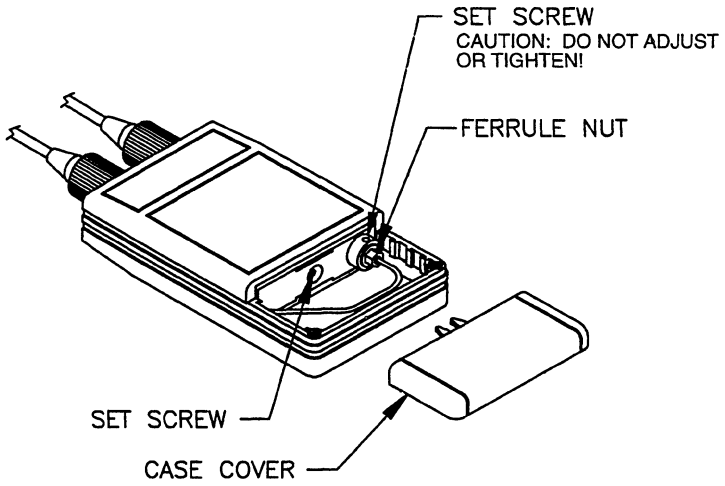


Figure 4-4: Location of Set Screw

☐ **Step 8:** Turn the knob of the TOP400 until the pointer is at "0" again. Readjust the set screw, only if necessary, to obtain the **0 dB loss obtained in Step 5, within +/- 0.1dB.**

NOTE: Turning the set screw as little as possible maintains a close relationship of "10" on the pointer with "10.00dB" on the optical power meter. You may have to repeat Steps 5, 6 and 7 until the insertion loss and the 10dB value match.

☐ **Step 9:** Turn the knob until the pointer reaches the maximum (max should be ≥35dB). Slowly bring down the pointer until it stops at 0. The dB loss must be the same as Step 5 with a tolerance of ±0.2dB.

☐ **Step 10:** Turn the knob to align pointer to 0. Adjust set screw if necessary.

☐ **Step 11:** Repeat Steps 9 and 10 **to check for repeatability.**

☐ **Step 12:** Disconnect the TOP400 from the light source and optical power meter. Replace the case cover and rubber cover.

Maintenance

Cleaning Procedures

This section discusses cleaning procedures for the connector interface, UCI adapters, fiber-optic connectors and instrument case.

It is absolutely critical to maintain the cleanliness of all connector interfaces, adapters, fiber-optic connectors each and every time they are used to guarantee maximum performance by the TOP400 hand-held attenuator.

Improper maintenance practices causes the following performance degradation:

- Measurement errors
- Poor analog transmission quality, critical to CATV and microwave-on-fiber applications
- Digital bit error rates increase
- Coupled light power is reduced
- Receiver input power outside optimum operating range
- Dirty connectors may cause damage to their mated counterparts

Do not touch the exposed ferrule tip of the connector interface with anything but a dry lint-free cloth. In severe cases, you will need to use a reagent-grade isopropyl alcohol.

When not in use, keep the connector interface covered with the protective dust cap.

Cleaning the Connector Interface

To clean the connector interface:

- ☐ **Step 1:** Remove the dust cap to expose the connector interface.
- ☐ **Step 2:** If there is a UCI adapter present, remove it as shown in Figure 1-2 in the *Operator Information* section.
- ☐ **Step 3**: Clean the connector interface with a dry lint free cloth as shown in Figure 5-1. In severe cases, you will need to use reagent-grade isopropyl alcohol (IPA).
- ☐ **Step 4:** Wipe the connector interface again with a fresh dry lint free cloth to remove residual alcohol.
- ☐ **Step 5:** Clean exterior of connector interface housing with clean lint free cloth.

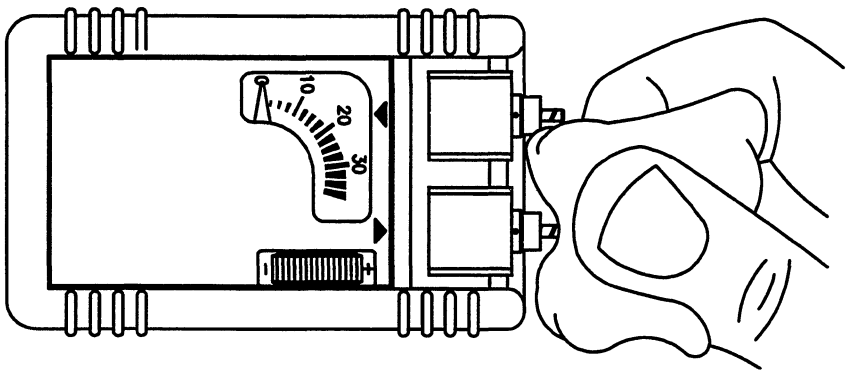


Figure 5-1: Cleaning the Connector Interface

Cleaning the UCI Adapter

UCI adapters are interchangeable to accommodate all popular industry-standard fiber-optic connectors and must always be cleaned before each and every use.

To clean UCI adapters:

- ☐ **Step 1:** Using a clean lintless swab, insert the swab into the thru-hole of the adapter.
- ☐ **Step 2:** Clean exterior and interior surfaces using a lint free cloth wetted with reagent-grade isopropyl alcohol.
- ☐ **Step 3:** Wipe exterior and interior surfaces again with a fresh dry lint free cloth to remove any residual alcohol.

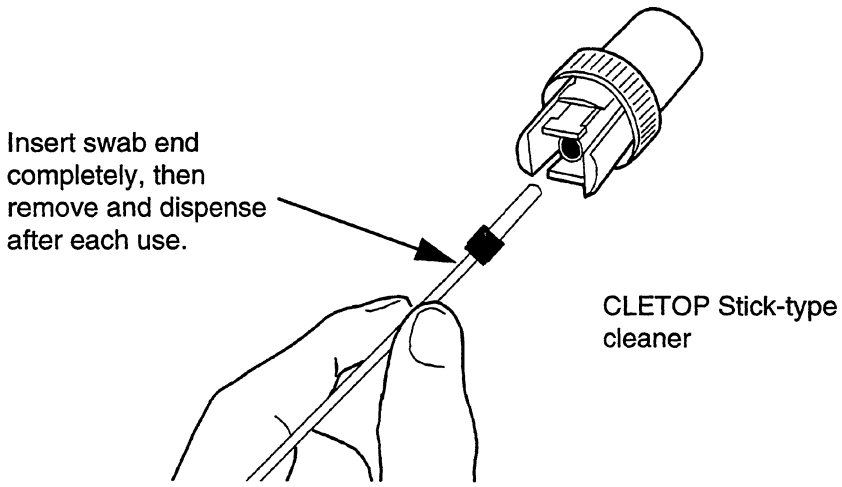


Figure 5-2: Cleaning the UCI adapter

Cleaning the Fiber Optic Connector

- ☐ **Step 1:** Dampen a lint-free swab or paper wipe with electronics-grade alcohol, and gently wipe across and around the connector a couple of times.
- ☐ **Step 2:** Dry with a dry swab or dry portion of the paper wipe.
- ☐ **Step 3:** If the connector is extremely dirty repeat the procedure with a second lint-free swab or paper wipe.

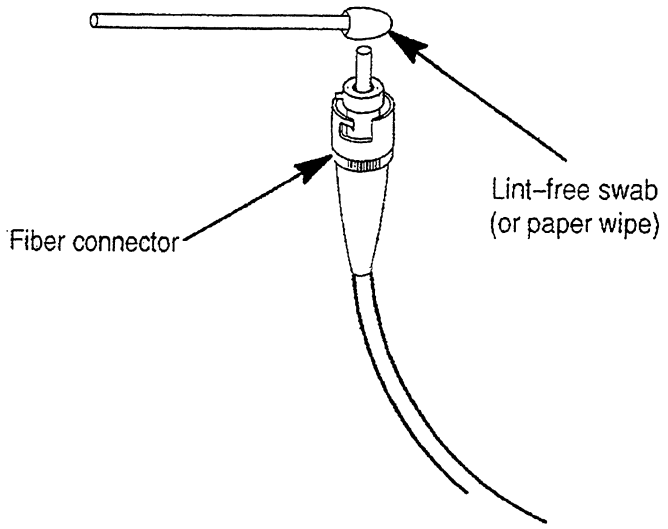


Figure 5-3: Cleaning the Fiber Connector

Cleaning the Instrument Case

To clean instrument case:

- ☐ **Step 1:** Remove protective rubber bumper.
- ☐ **Step 2:** Wipe exterior surface of instrument case with clean paper towel wetted with a small amount of isopropyl alcohol.

CAUTION

NOTE: Avoid using an excessive amount of alcohol. It can damage the labels at the rear of the instrument.

- ☐ **Step 3:** Wipe exterior surface of instrument case again with dry paper towel.
- ☐ **Step 4:** Replace rubber bumper.

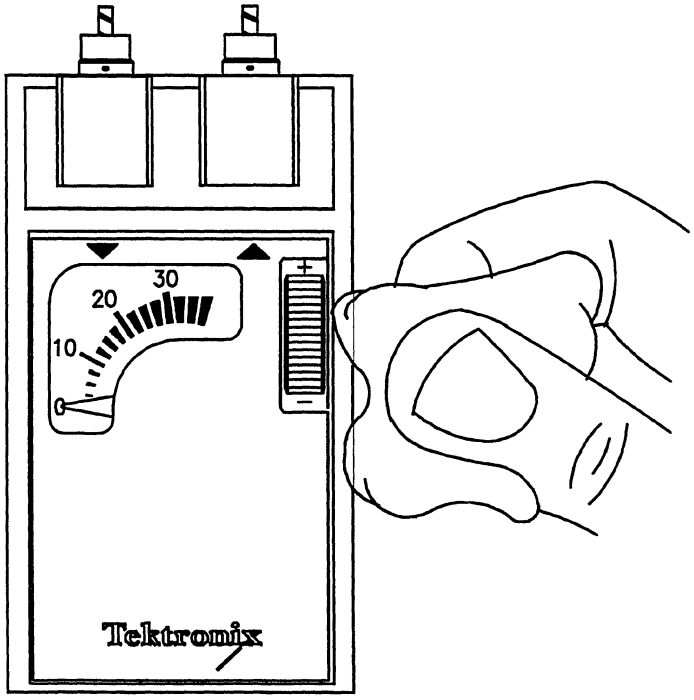


Figure 5-4: Cleaning the Instrument Case

Performance Problems

Problem	Possible Solutions
High insertion loss	Clean connectors (see pages 5-1 to 5-4).
High insertion loss	Operating wavelength is not 1310nm or 1550nm.
Can not adjust power	Bad optical connection/defective instrument.
Knob/pointer functions not responding	Replace instrument.
Dust cap disconnected or loose	Replace.

Replaceable Parts

This section contains a list of replaceable parts for the TOP400 hand-held attenuator. Use this list to identify and order replacement parts.

Ordering Information

Replacement parts are available from your local Tektronix service center.

When ordering a replacement part, include the following information:

- Part number
- Instrument model number
- Instrument serial number
- Instrument modification number, if applicable

If a part you order has been replaced with a new or improved part, your local Tektronix service center or representative will contact you regarding any change in the part number.

Instrument Replacement

The TOP400 hand-held attenuator is serviced by replacing the instrument. These are two options you should consider:

Instrument Exchange - The TOP400 hand-held attenuator is repaired by exchange of the entire instrument for a reconditioned instrument. The part number for a reconditioned instrument is listed below:

Description	Tektronix Part Number
TOP400 hand-held attenuator	118-9641-00

New Instruments - New instruments can be purchased like other replacement parts.

Replaceable Parts

Tektronix Part Number	Qty	Name and Description
		STANDARD ACCESSORIES
348-1480-00	1	Rubber Bumper with Pivoting Bail
119-4513-00	2	Adapter, ST:Universal Connector Interface (UCI)

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