TFS-301™
Optical Power Meter

Operation Manual

think ahead.

TRILITHIC

Trilithic Company Profile

Trilithic is a privately held manufacturer founded in 1986 as an engineering and assembly company that built and designed customer-directed products for telecommunications, military, and industrial customers. From its modest beginnings as a two-man engineering team, Trilithic grew over the years and broadened its offerings of RF and microwave components by adding broadband solutions to its product line. This was accomplished with the acquisition of components manufacturer Cir-Q-Tel and instruments manufacturer Texscan.

Today, Trilithic is an industry leader providing telecommunications solutions for major broadband, RF, and microwave markets around the world. As an ISO 9000:2001 certified company with over 40 years of collective expertise in engineering and custom assembly, Trilithic is dedicated to providing quality products, services, and communications solutions that exceed customer expectations.

Trilithic is comprised of five major divisions:

- **Broadband Instruments and Systems**
  Offers test, analysis, and quality management solutions for the major cable television systems worldwide.
- **Telecom Solutions**
  Offers affordable, easy-to-use instruments for testing and measurement of Telecom networks.
- **RF Microwave Components**
  Provides components and custom subsystems for companies specializing in cellular, military, and other wireless applications.
- **Emergency Alert Systems**
  Leading supplier of government-mandated emergency alert systems used by broadcast TV, cable TV, IPTV, DBS, and radio stations.
- **XFTP**
  Offers a specialty line of field technical products for cable operators and technicians, as well as a line of products for installing electronics in the home of the future.

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Chapter 1
General Information

Helpful Website

The following website contains general information which may be of interest to you:

http://www.trilithic.com

Trilithic's website contains product specifications and information, tips, release information, marketing information, Frequently Asked Questions (FAQs), bulletins and other technical information. You can also check this website for product updates.

Where to Get Technical Support

Trilithic technical support is available Monday through Friday from 8:00 AM to 5:00 PM EST. Callers in North America can dial 317-895-3600 or 800-344-2412 (toll free). International callers should dial 317-895-3600 or fax questions to 317-895-3613. You can also e-mail technical support at techsupport@trilithic.com.

For quicker support response when calling or sending e-mail, please provide the following information:

- Your name and your company name.
- The technical point of contact (name, phone number, e-mail).
- Product name, model number, and serial number.
- A detailed description of the problem you are having, including any error or information messages.

How this Manual is Organized

This manual is divided into the following chapters:

- Chapter 1, “General Information” provides Trilithic contact information and describes how this operation manual is structured.
- Chapter 2, “Introduction” describes the purpose and lists the features of the TFS-301™ Optical Power Meter.
- Chapter 3, “Operation” describes how to setup, test, and operate the TFS-301™ Optical Power Meter.
- Chapter 4, “Appendix” describes the troubleshooting procedures and technical specifications of the TFS-301™ Optical Power Meter.

Conventions Used in this Manual

This manual has several standard conventions for presenting information.

- Connections, menus, menu options, and user-entered text and commands appear in **bold**.
- Section names, web and e-mail addresses appear in *italics*.

WARNING

A WARNING alerts you to any condition that could cause personal injury.

CAUTION

A CAUTION alerts you to any condition that could cause a mechanical failure or potential loss of data.

NOTE

A NOTE is information that will be of assistance to you related to the current step or procedure.

Precautions

WARNING

When working with any fiber optic test equipment or in an area with active fiber optic links, be aware there can be infrared optic energy present.

WARNING

Use only NiMH rechargeable batteries ONLY with the same mAh rating otherwise damage to the product may occur.

CAUTION

When cleaning the output ports or using the bare fiber adapters, be careful not to scratch or otherwise contaminate the port optics. They are highly polished glass and can be damaged.

CAUTION

Do not remove the top bumper or otherwise remove the source circuitry from its enclosure. Doing so will not only alter unit calibration and void the warranty, but may permanently damage the unit.

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Chapter 2
Introduction

This chapter:

- Describes the TFS-301™ Optical Power Meter's purpose
- Lists the TFS-301™ Optical Power Meter's features

Purpose

The fiber optic power meter can best be described as the workhorse of the fiber industry. It is to fiber what the voltmeter is to electronics. If a technician with a limited budget could have only one piece of optical test equipment, it should be the fiber optic power meter.

The TFS-301™ Optical Power Meter from Trilithic redefines quality and durability. This full-featured instrument incorporates impact absorbing end bumpers, weather resistant membrane switches, a durable powder coat finish, and four (4) NIST traceable calibrated wavelengths. Equipped with a universal receptacle to accept a variety of connector styles, the unit features 0.01 dB resolution over the full dynamic range, four nonvolatile independent zero references, an easy to read supertwist graphic display, and an emergency quick charge mode to charge batteries in less than an hour!

Features

- 1310 nm / 1490 nm / 1550 nm / 1625 nm Operation
- Absolute & Relative Measurements with Reference Storage
- Autoranging +3 dBm to -60 dBm
- Resolution of 0.01 dB over entire range
- Modulated light averaging to < 30 Hz
- Emergency quick charge mode
- Universal detector receptacle
- Extra rugged packaging

Advanced Features

The TFS-301™ Optical Power Meter incorporates the following advanced features:

- **Autosense Backlight** - The included backlight is always enabled yet will turn itself off to conserve battery life after 30 seconds if no keys are pressed or if the unit is not moved. As soon as a key is pressed or the unit is moved, the light will turn on.
- **Auto Power Off (APO)** - The meter checks the WVL and REL buttons for activity. If not pressed for 20 minutes, the unit will automatically store the last mode of operation and any references taken and then shut down.
- **Enhanced Relative Mode** - The Relative (dB) Mode includes an unaveraged +/-1 dB tuning bar and mini-display to allow for splice and connector optimization.
- **Watts Mode** - Allows the user to read power levels in watts. This mode is selected with the REL button. By depressing the REL button, the meter will cycle between dBm, dB, and watts mode.

Equipment Supplied with Your Optical Power Meter

- **TFS-301™ Optical Power Meter** - Portable meter used to measure fiber optic system source energy.
- **Rechargeable Batteries** - Four (4) "AA" NiMH.
- **AC to DC Power Adapater/Charger** - Power adapter and battery charger for the TFS-301™ Optical Power Meter.
- **Operation Manual** - Full Operation Manual on CD.

Related Products

TFS-201 Optical Light Source

When performing attenuation tests on fiber links, it is necessary to have a stable source of light on which to base measurements. The TFS-201™ Optical Light Source provides the stability needed to allow accurate testing.

Trilithic's new TFS-201™ Optical Light Source allows simultaneous operation of both outputs or individual operation with either CW, 30 Hz, 500 Hz, or 2 kHz modulation for use with leak detectors or fiber identifiers. The optical light source operates at 1310 nm or 1550 nm with ST, SC & FC adapters.

When the optical light source is used in conjunction with the TFS-301™ Optical Power Meter relative measurements can be made to accurately determine fiber loss.

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Chapter 3
Operation

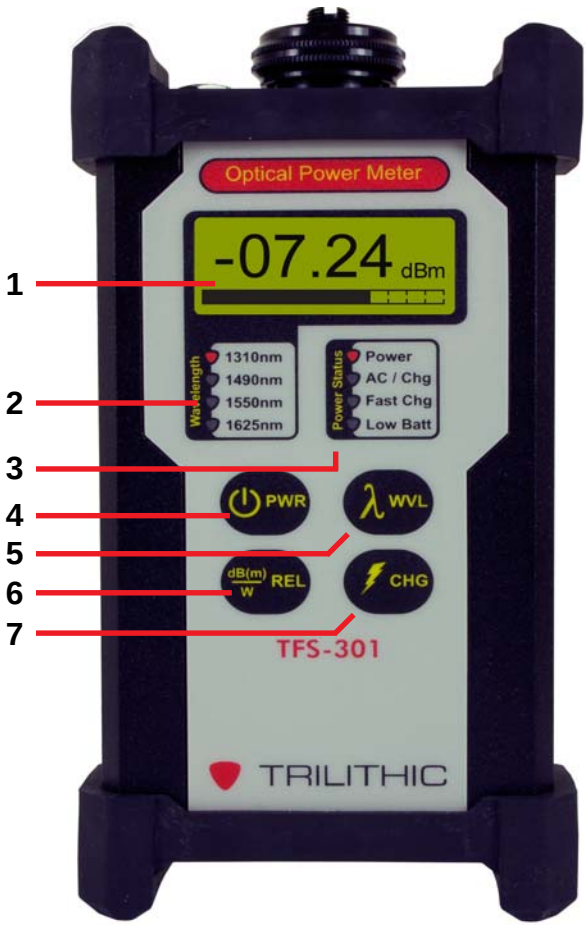
This chapter:

- Provides information on the TFS-301™ Optical Power Meter's general use, testing, and operation

General Use

Front Panel

1. **Graphic Display** - Shows the current absolute or relative power level along with an analog representation of the input power.
2. **Wavelength Indicator** - Shows the current calibrated wavelength setting for absolute measurements.
3. **Power Status** - Indicates the meter power status, battery charge mode, and battery condition.
4. **PWR (Power Button)** - Turns the unit on and off. This will not affect the zero reference stored in memory.
5. **WVL (Wavelength Select Button)** - Selects one of four calibration wavelengths for absolute readings.
6. **REL (Relative/Absolute Button)** - Cycles between absolute (dBm) mode, relative (dB) mode, and absolute (watts) mode.
7. **CHG (Quick Charge)** - Cycles the charging mode of the NiMH (Nickel-metal Hydride) batteries.



Getting Started

The TFS-301™ Optical Power Meter is shipped with four AA type rechargeable NiMH batteries. Although charged partially during lab inspection and calibration, the batteries should be charged fully before field use. This is accomplished by connecting the included AC power adapter to the charging socket at the top of the unit. The unit will automatically power off without front panel button activity after 20 minutes.

Next, the appropriate connector adapter cap must be screwed onto the optical head. The Trilithic optical head will accept adapter caps which allow connection to most types of connectors.

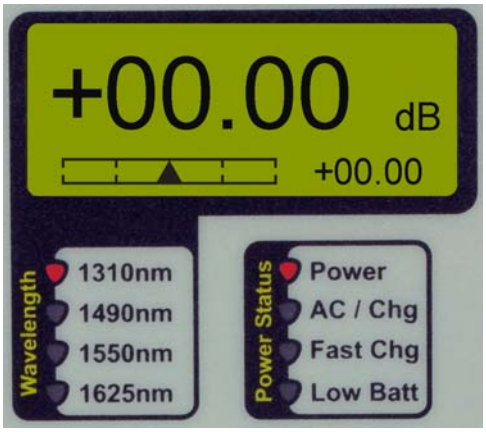
Absolute Mode

Depressing the PWR button will turn on the meter. Although the ON LED will light instantly, the display will take a few seconds to respond while the meter automatically calibrates and recalls internal status information. Upon power-up, the display will appear similar to the illustration below.

Note that the meter display shown is reading -7.24 dBm at 1310 nm. In our example, the meter is in absolute mode. This means that the display is currently telling the user that if 1310 nm light is being measured, the current power level is 7.24 decibels less than 1 milliwatt of light. In other words, the power level being read is -7.24 dBm.

Absolute measurements tell the user exactly how much optical power is hitting the detector at the top of the unit. This information is useful when checking to see if a system is injecting enough power into the fiber to be seen by its receiver. It is important to remember to select the proper wavelength for your system by depressing the WVL button until the proper value is selected; otherwise, readings will be inaccurate.

Relative Mode



In the absolute mode, the meter was reading -7.24 dBm. By depressing the REL button, the meter display will change from absolute mode to relative mode. The meter is still reading the same power but is now displaying the deviations in power from the -7.24 dBm level. Since the power has not yet changed in our example, the reading is 00.00 dB.

The units of measurement are now displayed as dB or decibels as opposed to dBm which means decibels as referenced to a milliwatt.

If the power were to drop to -10.24 dBm, the display would read -3.00 dB. This is because the relative mode shows only the change in power. In the relative mode, a negative number means the signal level has dropped while positive numbers indicate the signal level has increased.

Note the small numeric display and “analog meter” at the bottom of the screen. The small display is not averaged and is therefore fast responding for splice/connector tuning. The “analog meter” section shows up to 1 dB variations (zero center) in real-time with a sliding pointer. Due to the Trilithic averaging technique, the large display takes more time to stabilize at low power levels. The small display essentially sacrifices some stability for speed.

Again, when the REL button is pressed, a zero reference is stored in the memory, subsequent readings are compared to that number, and the deviations are displayed. The relative mode is used for loss testing of the cables and splice/connector tuning. The *Operation Modes* section describes the cable loss tests using the relative mode in more detail.

Pressing the REL button a second time will place the meter in the absolute (watts) mode. Operation in the watts mode is similar to the absolute (dBm) mode except the unit of measurement will be shown as milliwatts (mw), microwatts (µw), or nanowatts (nw) depending upon the power level.

Finally, pressing the REL button a third time will return the meter to the absolute (dBm) mode. To summarize, the REL button simply cycles between the absolute (dBm), relative (dB), and absolute (watts) modes.

The Trilithic TFS-301™ Optical Power Meters are capable of storing up to four separate references. This time saving feature allows references for different wavelengths to be taken at one time when testing. Also, the TFS-301™ meter remembers references indefinitely even with the power off and no batteries thereby allowing the unit to be turned off when moving from the reference site to the test site. Because of these advanced features, the user should always make note of the operating mode whenever switching wavelengths or turning on the unit.

Operation Modes

WARNING

When working with any fiber optic test equipment or in an area with active fiber optic links, be aware there can be infrared optic energy present.

As mentioned earlier, there are two types of testing which can be performed with the TFS-301™ Optical Power Meter, absolute and relative. Since the absolute measurements were discussed earlier, emphasis will now be placed on the relative loss testing.

As always, clean all the optical surfaces with alcohol wipes or the equivalent before testing. Also, screw the appropriate adapter cap on the meter before testing.

Loss testing specifically determines the amount of light which will be absorbed or scattered in a fiber link at a particular wavelength. Since these losses are wavelength dependent, it is necessary to have both a source and meter which can test the same wavelengths used in the final system.

Launch Cable and Source

Loss testing requires a power meter, a source, a connector bushing, and two patch cables.

To properly test for loss in a fiber system, it is necessary to launch not only the correct wavelength of light into a system, but that light must also be conditioned to check the core glass only.

First, when light sources are powered up, they should be allowed to stabilize for a minimum of five minutes to allow accurate reference points to be taken. Next, a launch cable of similar fiber size and performance to the cable under test must be connected to the source. The launch cable will not only connect the source to the system under test but will also provide a fiber core source. The fiber optic emitters generally fill both the core and cladding of a fiber. In loss tests, the cladding light is not desired since it is not carried well by fiber. Also, in multimode fibers, an equilibrium mode distribution (EMD) must be established. The EMD is the illumination of the entire fiber core in the same way it would be lit in a long run of fiber. Both the cladding mode strip and mode scrambling function can be realized through the use of a simple mandrel wrap in the launch cable.

A mandrel wrap is five wraps of fiber around a 1/2" rod under zero tension and is generally wound by hand in the field.

NOTE

Some military tests do not permit the use of a mandrel wrap for mode conditioning.

Loss Measurement

1. Attach the launch cable with a 1/2", 5 turn mandrel wrap to the TFS-201 Optical Light Source.
2. Turn the source on and allow it to stabilize for a minimum of five minutes. If testing two wavelengths, turn on both the emitters and use two separate launch cables.
3. Attach a patch cable to the meter without a mandrel wrap. This will be called the receive cable. Make sure that the free ends of the receive and launch cables have the same connector style or can otherwise be directly mated. Also, make sure to select the proper wavelength on your meter.
4. Connect the free cable ends together with a connector bushing and press the REL control on the meter. The meter should read 00.00 dB. For dual wavelength testing, connect to the second launch cable, select the second wavelength on the meter, and zero the second wavelength also.
5. Disconnect the cable ends that were connected in Step 4, then take the source and meter to the opposite ends of the cable to be tested. Do not remove the launch and receive cables from the instruments.
6. Connect the free ends of the launch and receive cables to the cable under test. The meter will display the loss of the cable under test. For dual wavelength tests, test all the fibers in the link at one wavelength.
7. Switch the launch cables at the source end, change to the second wavelength at the meter end, and repeat Step 6.

Power Supply and Battery Charging

The TFS-301™ Optical Power Meter is powered by an AC to DC Power Adapter/Charger or NiMH batteries.

The unit uses four AA size NiMH batteries (cells should be 600 mAh type or better) which are mounted in the lower half of the meter enclosure. Although the included rechargeable cells rarely need changing under normal usage, they are easily replaced.

To change the batteries, perform the following steps:

1. Use a small flat blade screwdriver to loosen the two mounting screws which hold the bottom bumper in place and then gently pull the bumper off.
2. Pull the exposed tab to remove the battery holder, taking note of which slot the holder is in.
3. When installing new cells, make sure that they are seated well.

WARNING

Use only NiMH rechargeable batteries ONLY with the same mAh rating otherwise damage to the product may occur.

AC to DC Power Adapter/Charger

The TFS-301™ Optical Power Meter is shipped with four AA rechargeable NiMH batteries. Although charged partially during lab inspection and calibration, the batteries should be charged fully before field use. This is accomplished by connecting the included AC to DC Power Adapter/Charger to the AC power connector on top of the unit.

Slow and Fast Charge Modes

The TFS-301™ Optical Power Meter operates two different ways.

Slow Charge

When first connected in NiMH mode, power from the AC to DC Power Adapter/Charger is sent not only to the source circuitry, but to the batteries as well. This is referred to as slow charge or trickle charging and is indicated by the SLOW CHG LED on the front panel. Slow charging the batteries will generally take between 12 and 15 hours and provides a full, deep charge. Slow charging is by far the most popular method for recharging batteries due to its simplicity and depth of charge. It is also recommended for general use. Sometimes, however, situations arise which require immediate use. In these cases, TFS-201™ Optical Light Source owners can utilize the fast charge feature.

Fast Charge

Fast charging will not take place unless the AC to DC Power Adapter/Charger is plugged in, the installed batteries are not completely dead, and the CHG button is pressed. Once fast charging is initiated, the batteries will charge until a “peak” charge has been reached or approximately one hour has passed. While charging, the SLOW CHG and FAST CHG LEDs will light and the enclosure may warm by a few degrees. Special circumstances will impact fast charging. First, as mentioned, very dead batteries will need to be slow charged for a few minutes before the fast charger will turn on. This is to prevent damage to the cells. Second, after fast charging is finished, it cannot be re-initiated unless the AC power is removed and connected again. This reduces the likelihood of overcharging. Next, if the unit is very hot or very cold, bring the unit to within the recommended operating temperature before fast charging. The fast charger utilizes battery temperature fluctuations to determine peak charge and temperature extremes defeat the sensing circuitry. A 1 A fuse protects the internal circuitry against short circuits. If the fuse is blown, the unit will not charge.

Fast charging will only charge batteries to about an 80% level before switching to slow charge to top the charge off. Overcharging or excessive fast charging may reduce battery life.

Chapter 4
Appendix

Troubleshooting

Before You Begin Troubleshooting

- A low battery may cause the detector to not turn on or operate incorrectly. Make sure you have properly charged NiMH batteries installed before troubleshooting the unit.

Optical Power Meter Does Not Turn On

- Batteries are installed incorrectly. Check the batteries orientation and make sure they are properly seated.
- Batteries are drained. Slow charge the batteries for a minimum of five minutes and try again.

Poor Optical Power Meter Run Time

- Old or aging batteries. Replace the batteries with AA 600 mAh NiMH type batteries.
- Batteries are not of the AA 600 mAh NiMH type in the TFS-301™ Optical Power Meter. Exchange the batteries with the appropriate type.
- Batteries are too hot or cold or exposed to damaging conditions.

Optical Power Meter Does Not Fast Charge

- Fuse blown. Change the fuse.
- Batteries are extremely drained. Slow charge for five minutes and try again.
- Batteries are fully charged (if FAST CHG LED lights momentarily then turns off).
- Batteries are installed incorrectly or dislocated from holder. Reinstall the batteries correctly.

Incorrect or Unstable Readings

- The adapter cap is loose. Tighten the cap and try again.
- The source is unstable or modulating at less than 20 Hz.
- The detector endface is dirty or scratched.
- The fiber core size is greater than 100 µm.
- The connector is not secured in the adapter cap.
- The fiber optic cable is moving or bending.

Unreadable Display

- The temperature of the meter is out of the specified range of operation. Remove the meter from the out of range environment and retest.

Specifications

Optical

Detector	Ge
Port Style	Universal Detector Receptacle
Fiber Size (MAX)	100/140
Wavelength	1310 nm, 1490 nm, 1550 nm, 1625 nm
Range	+3 dBm to -60 dBm
Display Resolution	0.01 dB
Accuracy	+/- 0.25 dB

General

Operating Temperature	0°C to +50°C
Storage Temperature	-10°C to +60°C
Humidity	10% to 90%, non-condensing
Power	4 x AA NiMH Batteries, 120 VAC / 60 Hz
Battery Life	8 - 10 hours typical
Charge Time	Trickle Charge - 16 hours typical Quick-Charge - 1 hour typical
Physical Specification	Size - 7” x 3.5” x 1.3” Weight - < 1 lb.

Warranty Information

Trilithic, Inc. warrants that each part of this product will be free from defects in materials and workmanship, under normal use, operating conditions and service for a period of one (1) year from date of delivery. Trilithic, Inc.'s obligation under this Warranty shall be limited, at Trilithic, Inc.'s sole option, to replacing the product, or to replacing or repairing any defective part, F.O.B. Indianapolis, Indiana; provided that the Buyer shall give Trilithic, Inc. written notice.

Batteries are not included or covered by this Warranty.

The remedy set forth herein shall be the only remedy available to the Buyer under this Warranty and in no event shall Trilithic, Inc. be liable for incidental or consequential damages for any alleged breach of this Warranty. This Warranty shall not apply to any part of the product which, without fault of Trilithic, Inc., has been subject to alteration, failure caused by a part not supplied by Trilithic, Inc., accident, fire or other casualty, negligence or misuse, or to any cause whatsoever other than as a result of a defect.

Except for the warranty and exclusions set forth above, and the warranties, if any, available to the Buyer from those who supply Trilithic, Inc., there are no warranties, expressed or implied (including without limitation, any implied warranties of merchantability of fitness), with respect to the condition of the product or its suitability for any use intended for it by the Buyer or by the purchaser from the Buyer.

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