Fiber Optic Test Set

Operator's Manual

Model Number:
IF-FOM

INDUSTRIAL FIBER OPTICS

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INTRODUCTION

This manual provides information about Industrial Fiber Optics' Fiber Optic Test Set. It contains all the information you need to operate this device safely and knowledgeably, even if you are a novice to this technology. Please read the manual carefully before operating.

As soon as you receive the Fiber Optic Test Set, inspect it and the shipping container for damage. If any damage is found, immediately refer to the section of this manual entitled "Shipment Damage Claims".

Industrial Fiber Optics makes every effort to incorporate state-of-the-art technology, highest quality, and dependability in its products. We constantly explore new ideas and products to best serve the rapidly expanding needs of industry and education. We encourage comments that you may have about our products, and we welcome the opportunity to discuss new ideas that may better serve your needs. For more information about our company and products refer to **www.i-fiberoptics.com** *on the Worldwide Web.*

Thank you for selecting this Industrial Fiber Optics product. We hope it meets your expectations and provides many hours of productive activity.

Sincerely,

The Industrial Fiber Optics Team

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BACKGROUND

As human society, the role of information in our daily lives grows in importance. It has been said that we are entering the “information age”. In the past century, electronic means of communications such as radio, telephone and television have become dominant because of their ability to send information quickly over large distances. The next step of this revolution is communications using fiber optic technology.

Using fiber optic technology, information is passed between two points with light energy instead of electrical currents on wire or radio waves. Electronic circuits are used to impart information on a light beam, and fiber optic cables are the medium used to carry the light energy to its destination. Compared to traditional technology, fiber optic communications can carry more information with less loss over larger distances.

As more fiber optic communications systems are put into use, the need for tools to evaluate and maintain them also grows. Test equipment is important for any practical application of technology, and fiber optic communications is no exception. While the principles used to test communication systems are similar, the actual equipment varies with the technology.

The Fiber Optic Test Set described in this manual is a practical piece of test equipment designed to be used by instructors, students, and technicians. It contains a light source for launching energy into a fiber optic cable, and an instrument for measuring the energy of visible or infrared light coming out of a cable. Applications of this test set include:

- Measuring optical power and attenuation in fiber optic cables
- Testing detectors and light sources used in fiber optic links
- Experiments demonstrating fiber optic technology
- Troubleshooting fiber optic links

For more details about the specifications and use of this test set, continue to the next section.

Table 1. Common abbreviations used in this manual

Abbreviation	Long Version	Scientific Notation
mW	milliwatts	1 x 10^{-3} watts
µW	microwatts	1 x 10^{-6} watts
nW	nanowatts	1 x 10^{-9} watts
mm	millimeters	1 x 10^{-3} meters
µm	micrometers	1 x 10^{-6} meters
nm	nanometers	1 x 10^{-9} meters

GENERAL INFORMATION

The Fiber Optic Test Set is a measurement system containing an optical source and a digital radiometer in one self-contained unit. The optical source is a solid state Light Emitting Diode (LED) that operates in the visible red region of the electromagnetic spectrum. The radiometer uses a silicon photodetector sensitive to visible and near-infrared light. The two components can be operated together or independently, permitting great measurement flexibility.

The LED and the photodetector are contained inside industry-standard "ST®" style fiber optic connectors which are accessed through the front panel. The test set is battery-operated, allowing portable use in the field and lab.

Front Panel Controls

On/Off Switch

The "ON/OFF SWITCH" is a "push on - push off" switch that applies power to the test set. Pressing the switch will activate the LCD Display, and energize the LED source for approximately one second. Pushing the switch again will remove battery power from the internal test set circuitry.

Display Selector Switch

The "DISPLAY SELECTOR SWITCH" is used to select the full scale sensitivity of the test set's radiometer which is indicated on the LCD Display. Four power ranges are provided: 20 microwatts (µW), 200 µW, 2 milliwatts (mW), and 20 mW.

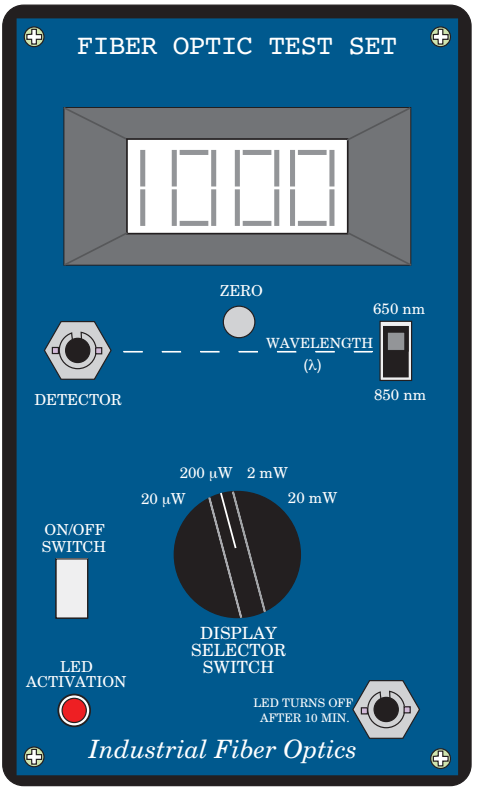

Figure 1. Fiber Optic Test Set front panel

LED Activation

The “LED ACTIVATION” push-button is a momentary switch which turns on the built-in LED source for approximately 10 minutes, after which the LED turns off to conserve battery life.

Wavelength

The “WAVELENGTH” slide switch adjusts the sensitivity of the radiometer at two factory calibrated wavelengths, 650 nm (visible red) and 850 nm (near-infrared).

Zero

The “ZERO” hole provides screwdriver access for an adjustment that sets the LCD display indication to zero when there is no incoming light on the radiometer detector.

Display

The indicator for the digital radiometer is a Liquid Crystal Display (LCD) with 3-1/2 digit resolution. The maximum valid numerical reading is 1999 and the minimum is 0. When the display has a non-zero or negative reading with no light on the radiometer, the “Zeroing” procedure in the section titled SERVICE AND MAINTENANCE should be performed.

Receptacles

Detector

The receptacle labeled “DETECTOR” contains the optical sensor for the radiometer to measure power from fiber optic cables. Optical power absorbed by the detector is converted to an electrical signal which is amplified and shown on the LCD display. The detector is a silicon photodiode approximately 6.6 mm2 (0.01 inches2) which has a peak response at 850 nm. The receptacle is a female “ST®” bayonet style fiber optic connector, which accepts the popular ST® male plug used with plastic jacketed fiber optic cables. Un-connectorized cables may also be inserted into this receptacle for measurements. The plastic cap over the ST® receptacle protects the internal detector from damage and dust. The cap must be removed prior to measurement and should be replaced when the test set is not in use.

LED

The receptacle in the lower right corner of the front panel contains the LED optical light source used to launch energy into fiber optic cables. The LED operates at a wavelength of 660 nm with a nominal optical power of 0.25 mW. The receptacle is a female "ST®" bayonet style fiber optic connector, which also accepts the ST® male plug used with plastic jacketed fiber optic cables. Un-connectorized cables may also be inserted into this receptacle for measurements. As with the Detector, the plastic cap over the ST receptacle protects the internal LED from damage and dust. The cap must be removed prior to measurement and replaced when the test set is not in use.

Batteries

The Fiber Optic Test Set requires two 9-volt batteries (included) for operation. For shipping and storage purposes they have not been installed at the factory. To install or replace the batteries, follow the procedure in the section titled SERVICE AND MAINTENANCE.

Battery types suggested for use with this test set include standard, heavy duty, and alkaline 9-volt batteries. Part numbers from major manufacturers are shown in Table 2. *Note: The use of nickel-cadmium (NiCd) batteries is not recommended because their lower cell voltages may produce inaccurate readings.*

Table 2. Part numbers for popular batteries suitable for the Fiber Optic Test Set

Manufac-turer	Standard	Heavy Duty	Alkaline
Duracell©	Not available	M9V	MN1604
Eveready©	216	1222	522VP
Ray-o-Vac©	1604	D1604	A1604

Test Cable

A connectorized fiber optic cable approximately one meter long is provided with the test set. Using the cable, a "self-test" procedure can be performed to verify proper instrument operation before making measurements. The cable is tested at the factory prior to shipment and a calibration value is supplied with the test set documentation. An adjustment procedure using this value compensates for aging of the built-in LED source. *The cable is not intended for use as a patch cord and must be protected from damage to preserve its calibration value.*

SPECIFICATIONS

Table 3. Fiber Optic Test Set specifications

Parameter	Value
Power requirements	Two 9-volt batteries (1 display, 1 main circuit)
Power consumption (nominal)	Display 2 mA; 10 mA (LED on)
PHOTODETECTOR	
Detector active area	6.6 mm^2 (0.01 in^2)
Maximum optical input	100 milliwatts (mW)
Wavelength of detector peak response	850 nanometers (nm) ± 50 nm
Wavelength range (S response =50% of Smax)*	450 to 950 nanometers (nm)
Measurement ranges (full scale)	19.99 µW, 199.9 µW, 1.999 mW, 19.99 mW ± 10%
Accuracy**	± 10%
LED LIGHT SOURCE	
Nominal wavelength	660 nm
Output power	0.25 mW nominal; 0.85 mW max.
Emitting area	0.078 mm2 (0.00012 in^2)
STORAGE	
Control/Display Unit	16 x 9.5 x 6.5 centimeters (6.3 x 9.5 x 2.6 inches)
Weight	750 grams (26 oz)
Temperature	-10 to 50 ° C (14 to 122 ° F)

* Covers the visible (450 to 750 nm) through the near-infrared (750 to 950 nm) electromagnetic spectrum; detector sensitivity is not constant across entire band.

** Calibrated at 650 nm and 850 nm. Consult factory for calibration at other wavelengths.

SAFETY

Electrical

The Fiber Optic Test Set is particularly safe because it operates from low voltage batteries. However, as when using any electrical device, certain safety precautions are advised:

- Do not operate this instrument while in contact with water.
- Use only recommended batteries.
- Do not modify any of the electrical circuitry in the Fiber Optic Test Set. (Modifying circuitry will also void your product warranty.)

Optical

The Fiber Optic Test Set contains an incoherent LED optical source that is completely eye-safe. However, since this instrument can be used in conjunction with lasers and other high intensity light sources, it is recommended that safe operating procedures be followed. ***Never stare directly at a laser or other potential source of high intensity light.***

The same precaution applies to fiber optic cables carrying visible or invisible optical energy. Become familiar with the operating and safety procedures for any light sources used in setups with the Fiber Optic Test Set. If protective eyeware is required for operation of a light source, be certain it meets the safety specifications outlined and is worn at all times during operation. If you are uncertain or unfamiliar with the operating procedures of equipment in a setup, review the manuals or contact your instructor or safety officer.

INITIAL CHECK OUT

1. Unwrap all components from in the protective packaging. Do not throw away the 12 x 6 x 4 tuck-top box, as it can be used to store the Fiber Optic Test Set.

2. Check that the Fiber Optic Test Set is complete and in good, undamaged condition. The shipping box should contain the test set, two 9-volt batteries, and a connectorized test cable with a calibration value.

3. Install the batteries following the procedure found in the section titled SERVICE AND MAINTENANCE.

4. Remove the protective caps from the Detector and LED receptacles. Turn the "Display Selector Switch" to "20 µW".

5. Turn the test set on by pressing the "ON/OFF" switch and observe that the LED light source illuminates for approximately one second. Numbers on the LCD display should now be visible.

6. Remove the protective caps from the ends of the supplied test cable. Insert the test cable onto the "DETECTOR" and "LED" front panel receptacles. Note that the receptacles have a key slot to accept a raised notch on the test cable connector. Line up the notch with the slot, then push the cable connector down into the receptacle and twist until it is locked into position.

7. Observe the digital LCD display and note if the reading is zero (± 0.02 µW). *Note: Do not press the "LED ACTIVATION" button during this zero check. If this is done inadvertently, turn the test set off, then back on to reset the LED circuit.* If the reading is not zero, refer to the section titled SERVICE AND MAINTENANCE and follow the "Zeroing" procedure.

8. Press the "LED ACTIVATION" button, then wait approximately one minute for the LED source to stabilize. Observe the digital LCD display and note if the reading is within ± 10% of the calibration value supplied with the test cable. If the reading is outside the limits, refer to the section titled SERVICE AND MAINTENANCE and follow the LED Power Adjustment procedure.

9. Turn off the Fiber Optic Test Set by pressing the "ON/OFF" switch. Remove the test cable connectors from the front panel receptacles, then replace the protective caps on the receptacles and test cable.

You have now verified that the Fiber Optic Test Set has arrived in good physical condition and checked for proper electrical/optical operation. The following section describes sample procedures to measure total transmitted output power and transmission loss (attenuation) in fiber optic cable.

OPERATING PROCEDURES

Reading the display

The Fiber Optic Test Set contains a digital radiometer which converts optical power to an electrical signal shown numerically on the digital LCD display. The unit of measure is watts expressed as a decimal. For example, 1 milliwatt (mW) = 1/1000th of a watt which is expressed as .001 watts in decimal form. The "Display Selector Switch" moves the decimal point automatically so that readings are always related to a significant increment of Watts. So a reading of 1.000 on the 2 mW range would represent 1.000 mW.

The display on the Fiber Optic Test Set is designed to respond in a *linear scale*, meaning that doubling the optical power will produce a numerical reading twice as large. This type of scaling has an advantage when trying to observe small differences in power while maintaining maximum display sensitivity.

Connecting cables to the "ST®" receptacles

The Fiber Optic Test Set receptacles can accept an industry-standard "ST®" fiber optic connector, an un-connectorized plastic fiber cable, or a bare fiber. ST® connectors are available for a variety of fiber cable core/cladding sizes. When attaching a connector to a fiber optic cable, follow the manufacturer's instructions carefully. *Make certain the fiber end does not protrude beyond the end of the connector ferrule, or damage to internal components of the test set may occur.*

If you are not using a connectorized cable, note that the receptacle has an internal diameter of 2.5 mm. This provides a good fit for a 1000 µm (1 mm) core, plastic jacketed fiber optic cable, which has an overall outside diameter of 2.2 mm. For best results, the cable end should be prepared by cutting with an appropriate tool such as those available from Industrial Fiber Optics.

When measuring an un-connectorized fiber or cable with a diameter smaller than 2.2 mm, some type of sleeve should be used to make up the difference. In all cases the fiber end should be properly prepared by cleaving, cutting, or polishing as recommended by the fiber or connector manufacturer. An unprepared or damaged fiber end will spray light in unintended directions, resulting in power loss and inaccurate readings.

Measuring Power from a Fiber Optic Cable

Overview

One of many important measurements in the fiber optic industry is that of optical power. Transmitting information using fiber optic links depends on sufficient optical power traveling through the optical fiber, connectors, and other elements in which light could be lost. Enough power must reach the receiver so that the data can be distinguished from random noise. By measuring the optical power at various points in a fiber optic link, proper operation can be confirmed or faulty components pinpointed.

Procedure for measuring output power

The procedure for measuring optical power in a fiber optic cable end is similar to the initial checkout of the test set. During the checkout, you actually measured optical power, using the built-in LED as an optical source, and the test cable as a delivery system. The following procedure is more general since the source can be a transmitter from a fiber optic link, or another piece of test equipment.

1. Put the protective cap on the "DETECTOR" receptacle and set the "DISPLAY SELECTOR SWITCH" to 20 µW. Turn on the test set by pressing the "ON/OFF" switch.

2. If the meter does not read zero (± 0.02 µW), refer to the section titled "SERVICE AND MAINTENANCE" and follow the "Zeroing" procedure. Remove the protective cap.

3. Set the "DISPLAY SELECTOR SWITCH" to 20 mW or the highest expected power to be measured. Set the "WAVELENGTH" switch to the closest value of wavelength for the transmitter or optical source. For visible sources choose 650 nm; for infrared sources select 850 nm. If you are using the built in LED optical source in the Fiber Optic Test Set, select 650 nm.

4. Attach one end of a connectorized cable to the external optical source or transmitter. If you are using the built-in LED, remove the protective cap from the receptacle and insert the connector. See Figure 2. Insert the remaining connector into the "DETECTOR" receptacle. *When making measurements with un-connectorized cable ends or fiber, gently insert them into the appropriate receptacles on the test set. Do not apply pressure beyond what is required to seat the ends or internal components may be damaged.*

5. If the cable has connectors, make sure the source end of the cable is inserted into the remote optical transmitter or fiber optic light source. Insert the connector for the receiver or delivery end into the "DETECTOR" receptacle on the test set. *When measuring power from an un-connectorized cable end or fiber, gently insert it into the detector receptacle. Do not apply pressure beyond what is required to seat the fiber or the detector may be damaged.* It is assumed the transmitter side of the cable has a connector or other low-loss launch interface.

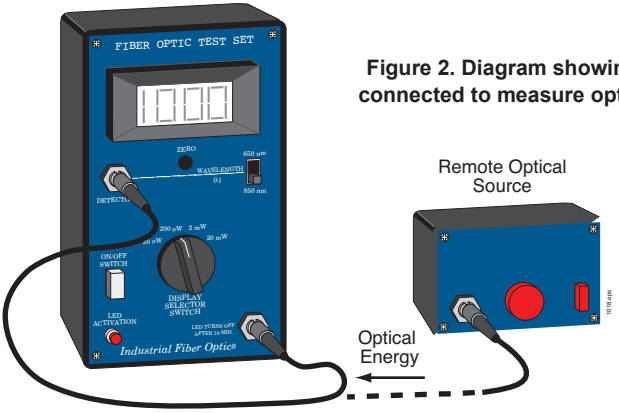

Figure 2. Diagram showing test set connected to measure optical power

6. Turn the optical transmitter or source on and make any adjustments necessary to set the data rate or power level. *Observe proper safety precautions as outlined in the SAFETY section of this manual.* If you are using the built-in LED optical source in the Fiber Optic Test Set, push the "LED ACTIVATION" button. Allow one minute for the source to stabilize.

7. Observe the LCD display for an indication or non-zero reading. If the reading is zero or very low, rotate the '"DISPLAY SELECTOR SWITCH" counter-clockwise (more sensitive scale) until the display gives a maximum reading without over-ranging. Note the reading in µW or mW and compare it to the expected power level. Optical power is often specified in units of dBm which uses a more compressed scale to indicate wide variations in power. Table 4 shows some common units of dBm and the equivalent power in watts. For an explanation of the dBm scale, see the section titled Logarithms/dB measurement units.

8. If the reading is much less than expected, possible causes are:

- Lossy or bad connection at transmitter or optical source-check connector ends for cleanliness and scratches or other damage.
- Bad splices or connector-to-connector interfaces.
- Fiber broken inside cable jacket

9. Turn off the Fiber Optic Test Set by pressing the "ON/OFF" switch. Remove all cable ends from the test set receptacles and replace the protective caps.

Measuring Attenuation in Optical Fiber

Overview

Fiber optic cables offer many advantages over copper cables, including lighter weight, higher information carrying capacity, and lower signal loss. Eventually as light travels through a fiber some optical signal loss or attenuation does occur. The two main causes of optical attenuation are scattering and absorption. Scattering is the redistribution of a light beam from a single direction into many or all directions. In an optical fiber scattering is the result of imperfections in density and composition that are natural by-products of manufacturing. Light rays hitting these imperfections are scattered, reducing the power in the intended direction. Absorption is a process where impurities in the fiber absorb optical energy and dissipate it as heat. (Impurities occur during the manufacturing process when unwanted chemical ions and other substances are introduced into the fiber.)

Measuring attenuation in optical fibers is important because it allows fiber optic system designers to predict the power which will be lost through a fiber optic cable link. For long-distance transmission, multiple optical links are used with repeaters to replace the power lost to attenuation. Repeaters amplify weak signals and restore the power to a level high enough to send the signal down the next link. By knowing the attenuation and other losses in fiber optic cable links, a designer can budget the correct quantity of expensive repeater systems.

Procedure for measuring attenuation — Cutback method

Two ways to measure attenuation in fiber cables are the cutback method and comparison to a known reference cable. With the cutback method, optical power is launched into a cable and the power coming out the end is measured. The cable is cut back by a known length and the increase in output power is measured. The two readings are used with the cutback length to calculate the loss per unit length of the cable.

The other approach is to launch power into a known reference cable and measure the output. It is then replaced by the cable under test and the readings are compared.

The cutback method sacrifices some cable length but doesn't require a reference cable because the measurement is relative. It is also less prone to error caused by changes in launch conditions because the optical source is never disconnected. You can measure attenuation with the Fiber Optic Test Set using the built in LED or an external optical source to launch energy into the fiber.

It is important that the cable being tested is long enough to get a good change in reading when it is cut back. For plastic cable, a starting length of 10 meters is recommended.

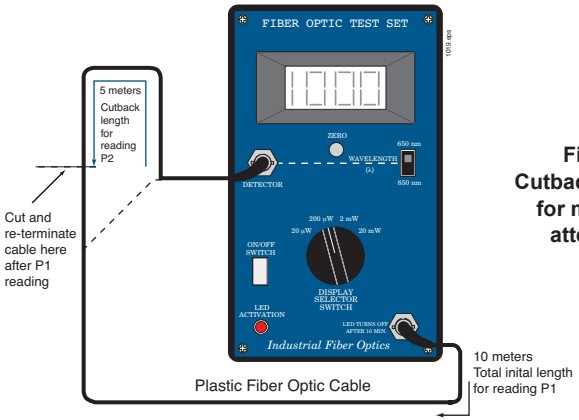

Figure 3.
Cutback approach for measuring attenuation

1. Put the protective cap on the "DETECTOR" receptacle and set the "DISPLAY SELECTOR SWITCH" to 20 µW. Turn on the test set by pressing the "ON/OFF" switch.

2. If the meter does not read zero (± 0.02 µW), refer to the section titled "SERVICE AND MAINTENANCE" and follow the "Zeroing" procedure. Remove the protective cap.

3. Set the "DISPLAY SELECTOR SWITCH" to 20 mW or the highest expected power to be measured. Set the "WAVELENGTH " switch to the closest value for the optical source being used. For visible sources choose 650 nm; for infrared sources select 850 nm. If you are using the LED in the Fiber Optic Test Set, select 650 nm.

4. If you are using the built-in LED, remove the protective cap from the receptacle, then insert one end of the connectorized cable. Otherwise install one end of the cable into the external optical source. Insert the remaining connector into the "DETECTOR" receptacle on the test set. *When making measurements with un-connectorized cable ends or fiber, gently insert them into the appropriate receptacles on the test set. Do not apply pressure beyond what is required to seat the ends or internal components may be damaged.*

5. Push the "LED ACTIVATION" button and allow one minute for the source to stabilize. If you are using an external optical source, turn it on and make any adjustments necessary to set the power level. *Observe proper safety precautions as outlined in the SAFETY section of this manual.*

6. Observe the LCD display for an indication or non-zero reading. If the reading is zero or very low, rotate the '"DISPLAY SELECTOR SWITCH" counter-clockwise (more sensitive scale) until the display gives a maximum reading without over-ranging. Note the reading in µW or mW and record the result as P_1

7. Turn the test set off by pressing the "ON/OFF" switch and remove *only the cable attached to the "DETECTOR" receptacle. If you are using an external source, turn it off to ensure eye safety during the next steps.*

8. For the plastic fiber, measure a distance of five meters (5 m) from the unconnected end of the cable, then cut it squarely with a single edge razor or a tool such as the IF-FC1. If the original cable end had an ST® connector, complete the termination process by following the installation instructions for a new connector. Regardless of the cable type it is important to restore the same condition as the original cable end to reduce the effect of the cut on the measurement.

9. Insert the newly terminated cable end into the "DETECTOR" receptacle. Turn the test set on by pressing the "ON/OFF" switch. Push the "LED ACTIVATION" button and allow one minute for the source to stabilize. If you are using an external optical source, turn it on and make any adjustments necessary to set the power level.

10. Observe the LCD display. You should note an increase in reading from the one recorded in Step 6 above. If the display is over-ranging, rotate the '"DISPLAY SELECTOR SWITCH" clockwise to get a maximum in-range reading, then record the result as P_2.

11. Turn off the Fiber Optic Test Set by pressing the "ON/OFF" switch. Remove all cable ends from the test set receptacles and replace the protective caps.

12. To calculate the attenuation in dB/km (decibels per kilometer), use the following formula:

$$attenuation = 10 \bullet \frac{\log(P_1 / P_2)}{l_c}$$

P_2 – *power measured at orginal length*

P_1 – *power measured at cutback length*

l_c – *cutback length*

For example…

$P_2 = 1.6\ \mu W$

$P_1 = 1.0\ \mu W$

l_c – *5 meter (.005 km)*

$$Then\ \ attenuation = 10 \bullet \frac{\log(1.6 / 1)}{5\ m}$$

$attenuation = .408\ dB/m\ \ or\ \ 408\ dB/km$

This is typical attenuation for 1000 µm core plastic fiber at 650 nm wavelength. Note that low-loss fibers may require more cutback length to give a sufficient difference between P_1 and P_2 readings for accurate attenuation measurements. In those instances, simply convert the cutback length to its equivalent in meters or kilometers and use the previous formula.

LOGARITHMS/DB MEASUREMENT UNITS

Some instruments have a display that responds in a logarithmic scale, where the measurement is related numerically to the base 10 logarithm (Log) of the change in optical power. For example, a radiometer has an input power of 1 mW (a reference level in the fiber optic industry), and the display is adjusted to indicate zero. If the input power is now increased by a factor of 10 to 10 mW, the Log of 10 mW divided by 1 mW is equal to 1. This ratiometric change of 10 is referred to as 1 Bel (abbreviated B). In practice, a smaller fraction of a Bel is most used: 1/10 of a Bel or decibel (abbreviated dB), where one Bel is equal to 10 decibels. Therefore, in the example above, the display would indicate a 10 dB change. If the input power was raised to 100 mW, the display would indicate a 20 dB change. Note that all these readings are relative, since one power level is ratioed to another with no indication of the absolute power in the reading.

You can see that the dB scale shows large power variations with small changes in the displayed reading. An example where the decibel scale is used is in the measurement of fiber attenuation, where the standard unit is dB/km (decibels of loss-per-kilometer length of fiber).

An important variation on the dB scale was hinted at earlier. 1 mW is a standard power level reference in fiber optic and other industries, and is displayed as a reading of 0 dBm (recall that the Log of 1 is zero). Note that the small "m" following the dB unit refers to the 1 mW power reference. Optical power measurements can be compared as before, but now the result shows the absolute power. For example, 10 dBm equals an absolute power of 10 mW, or 10 dB more than the 1 mW reference.

Table 4. Conversion from dBm to radiometric power

dBm	Optical Power
+20 dBm	100 mW
+13 dBm	20 mW
+10 dBm	10 mW
+7 dBm	5 mW
+3 dBm	2 mW
0 dBm	1 mW
-3 dBm	500 µW
-10 dBm	100 µW
-13 dBm	50 µW
-20 dBm	10 MW
-23 dBm	5 µW
-30 dbm	1 µW

TROUBLESHOOTING

LCD Remains Blank When Switch is Depressed

- No batteries installed.
- Batteries may be weak. The display circuit is powered by the battery closest to the “ON/OFF” switch. See the section titled SERVICE AND MAINTENANCE for battery installation.

LCD Display Does Not Read “ZERO”

- Install protective cap on “DETECTOR” receptacle.
- Zero adjustment is needed. Follow the “Zeroing” Procedure in the section titled SERVICE AND MAINTENANCE.
- Batteries may be weak. The display circuit is powered by the battery closest to the “ON/OFF” switch. See the section titled SERVICE AND MAINTENANCE for battery installation.

No Change in Display Reading

- Detector sensitive area blocked. Check for foreign matter in “DETECTOR” receptacle.
- Fiber optic connector end not properly seated in receptacle. Make certain ST® connector is properly inserted and locked in place. Check source side of fiber optic cable.
- “DISPLAY SELECTOR SWITCH” is set at too high a range. Turn switch counter-clockwise until reading is obtained.
- Batteries may be weak. The display circuit is powered by the battery closest to the “ON/OFF” switch. See the section titled SERVICE AND MAINTENANCE for battery installation.

Built-in LED is Dim or Does Not Light

- Batteries may be weak. The LED circuit is powered by the battery closest to the LED receptacle. See the section titled SERVICE AND MAINTENANCE for battery installation.
- LED drive current needs adjustment. Follow the LED Power Adjustment Procedure in the section titled SERVICE AND MAINTENANCE.

Do not attempt to troubleshoot the Fiber Optic Test Set beyond the steps listed above. If you believe that a problem exists within the Fiber Optic Test Set, please either contact the factory or return it for appropriate servicing to Industrial Fiber Optics, as described in the section titled SERVICE AND MAINTENANCE.

SERVICE AND MAINTENANCE

The only service and maintenance that the Fiber Optic Test Set should require is battery replacement, “zeroing”, and LED power adjustment. Instructions for these procedures follow. All other adjustments have been made by Industrial Fiber Optics.

Battery Installation Procedure

The recommended batteries for the Fiber Optic Test Set are standard, heavy-duty or alkaline 9-volt batteries. See Table 2 for the part numbers of major battery manufacturers. ***Do not use nickel-cadmium batteries in this meter because their lower cell voltages will produce inaccurate readings. Contact the factory if in doubt regarding proper battery selection.***

1. Remove the four screws at the corners of the Fiber Optic Test Set front panel.
2. Carefully lift the front panel from the test set chassis and place it on a table or bench face down.
3. To remove a battery from its holder, lift the rear portion (end without the terminals) upward until the battery unsnaps from the holder terminal connections.
4. Remove any protective packaging from the replacement battery.
5. Line up the replacement battery terminals to ensure proper polarity in the holder, then securely push the battery into place. Check that the battery holder and 9-volt battery terminals are fully engaged. When the battery is properly positioned it will be level with and reside just below the sides of the battery holder.
6. Install the other 9-volt battery.
7. Place the front panel back onto the test set chassis. Replace the four screws in the corners of the front panel and tighten them securely.
8. Press the “ON/OFF” switch and check for proper operation. If necessary, perform the INITIAL CHECK OUT procedure contained in this manual.

“Zeroing” Procedure

Periodically it may become necessary to adjust the LCD Display indication so that it reads “zero” in the absence of light on the radiometer. “Zeroing” the radiometer can be done using the following procedure.

1. Install the protective cap on the “DETECTOR” receptacle.
2. Turn the “DISPLAY SELECTOR SWITCH” to the range you’ll be using, then turn the test set on by pressing the “ON/OFF” switch. Allow one minute for the meter to stabilize.

3. Insert a small NON-METALLIC screwdriver (standard blade type) into the hole marked "ZERO" on the test set front panel and engage the slot on the internal potentiometer. Adjust the potentiometer until the display reads as close to zero as possible. *Note: This potentiometer turns only 3/4 of a revolution; do not adjust beyond this amount or permanent damage to the test set will result.*

4. In certain conditions of ambient light, there may be sufficient leakage past the protective cap to cause difficulty in the "Zeroing" procedure. If this occurs, remove the protective cap and attach the test cable supplied with the test set to the LED and "DETECTOR" receptacles. Repeat steps 1 through 3 above. *Note: Do not press the "LED ACTIVATION" button during this zero check. If this is done inadvertently, turn the test set off, then back on to reset the LED circuit.*

5. Turn off the Fiber Optic Test Set by pressing the "ON/OFF" switch. Remove all cable ends from the test set receptacles and replace the protective caps.

LED Power Adjustment Procedure

The LED optical source in the Fiber Optic Test Set is factory-adjusted to deliver reasonable power with good battery life. After this adjustment the transmission of the fiber optic test cable is measured using the test set LED and radiometer. This reading is supplied as a calibration value with the test cable.

As the test set is used, the LED power may drift from the factory setting, or the user may desire a different power level for a specific application. The following procedure will restore the LED power to the factory setting, or allow a different power level to be established.

1. Remove the four screws at the corners of the Fiber Optic Test Set front panel.

2. Carefully lift the front panel from the test set chassis and place it on a table or bench with the display side facing up.

3. Attach the fiber optic test cable supplied with the test set to the "LED" and "DETECTOR" receptacles. Turn the "DISPLAY SELECTOR SWITCH" to the 2 mW range.

4. Push the "LED ACTIVATION" button and

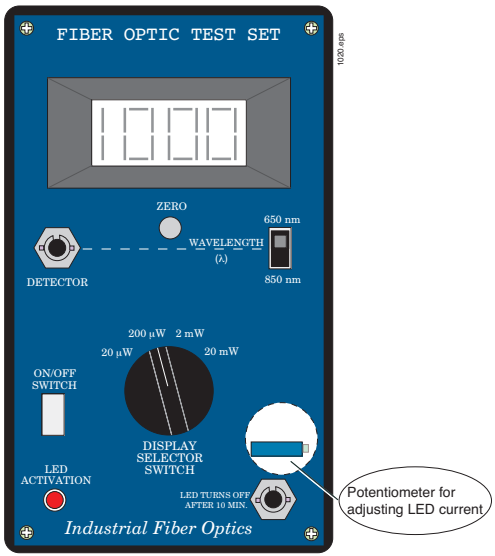

Figure 4. Test Set front panel showing the location of the potentiometer for adjusting the LED current

allow one minute for the source to stabilize. Note if the reading on the display is within ± 10% of the test cable calibration value. A reading outside this range can be caused by drift of the LED from aging or large changes in room temperature. To restore the factory setting or establish a different power level proceed with the following steps.

5. Locate the rectangular potentiometer (it has a small screwdriver slot) on the circuit board area closest to the LED receptacle as shown in Figure 4. With the LED source on and stable, adjust the LED drive current (controls the power) by turning the potentiometer slot with a small blade screw-driver. Clockwise rotation will increase the current, and vice-versa. Adjust the potentiometer until the display reads within ± 10% of the calibration value supplied with the test cable. **Note: DO NOT ADJUST ANY OTHER POTENTIOMETER ON THE CIRCUIT BOARD SET EXCEPT THE ONE DESCRIBED. Doing so will destroy factory calibration of the radiometer portion of the test set, requiring the unit to be returned for service.**

6. If a different power level is desired, adjust the potentiometer until the display reads an appropriate fraction of the calibration value. For example, if you want to double the LED power from the factory setting, adjust the potentiometer until the display reads double the calibration value. To restore LED power to the factory setting, simply adjust the drive current until the display reads the test cable calibration value.

7. After the adjustment is made, turn off the test set power by pressing the "ON/OFF" switch. Remove the test cable and place the front panel back onto the chassis. Replace the four screws in the corners of the front panel and tighten them securely.

Malfunctions

In the unlikely event that the meter malfunctions, you may have it repaired by doing the following:

- In writing, describe the problem, name of the person whom we should contact, phone number, and an appropriate return address.
- Zero adjustment is needed. Follow the "Zeroing" Procedure in the section titled SERVICE AND MAINTENANCE.
- Pack the Fiber Optic Test Set, test cable, manual and your letter carefully in a strong box with adequate packing material to prevent damage in shipment.
- Ship the package to:

INDUSTRIAL FIBER OPTICS
1725 WEST 1ST STREET
TEMPE, AZ 85281-76222
USA

WARRANTY

Industrial Fiber Optics products are warranted against defects in materials and workmanship for 90 days. The warranty will be voided if internal or external components have been damaged, mishandled, or altered by the buyer.

Warranty liability is limited to repair or replacement of any defective unit at the company's facilities, and does not include attendant or consequential damages. Repair or replacement can be made only after failure analysis at the factory. Authorized warranty repairs are made at no charge, and are guaranteed for the balance of the original warranty.

Industrial Fiber Optics will pay the return freight and insurance charges for warranty repair within the continental United States, by United Parcel Service or Parcel Post. Any other delivery means must be paid for by the customer.

The costs of return shipments for a Fiber Optic Test Set no longer under warranty must be paid by the customer. If an item is not under warranty, repairs will not be undertaken until the cost of such repairs has been prepaid by the customer. Typical repair costs range from $15 - $75, and completion times from two to three weeks.

When returning items for analysis and possible repair, please do the following:

- In a letter, describe the problem, person to contact, phone number, and return address.
- Pack the Fiber Optic Test Set, test cable, manual and letter carefully in a strong box with adequate packing material to prevent damage in shipment.
- Ship the package to:

INDUSTRIAL FIBER OPTICS
1725 WEST 1ST STREET
TEMPE, AZ 85281-76222
USA

SHIPMENT DAMAGE CLAIMS

If damage to an Industrial Fiber Optics product should occur during shipping, it is imperative that it be reported immediately, both to the carrier and the distributor or salesperson from whom the item was purchased. DO NOT CONTACT INDUSTRIAL FIBER OPTICS.

Time is of the essence because damage claims submitted more than five days after delivery may not be honored. If damage has occurred during shipment, please do the following:

- Make a note of the carrier company; the name of the carrier employee who delivered the damaged product; the date; and the time of the delivery.
- Keep all packing material.
- In writing, describe the specific nature of damage to the product.
- In cases of severe damage, do not attempt to use the product or install batteries.
- Notify the carrier immediately of any damaged product.
- Notify the distributor from whom the purchase was made.

NOTES

Rules for Laser Safety

- Lasers produce a very intense beam of light. Treat them with respect. Most educational lasers have an output of less than 3 milliwatts, and will not harm the skin.
- Never look into the laser aperture while the laser is turned on! **PERMANENT EYE DAMAGE COULD RESULT.**
- Never stare into the oncoming beam. Never use magnifiers (such as binoculars or telescopes) to look at the beam as it travels – or when it strikes a surface.
- Never point a laser at anyone's eyes or face, no matter how far away they are.
- When using a laser in the classroom or laboratory, always use a beam stop, or project the beam to areas, which people won't enter or pass through.
- Never leave a laser unattended while it is turned on – and always unplug it when it's not actually being used.
- Remove all shiny objects from the area in which you will be working. This includes rings, watches, metal bands, tools, and glass. Reflections from the beam can be nearly as intense as the beam itself.
- Never disassemble or try to adjust the laser's internal components. Electric shock could result.