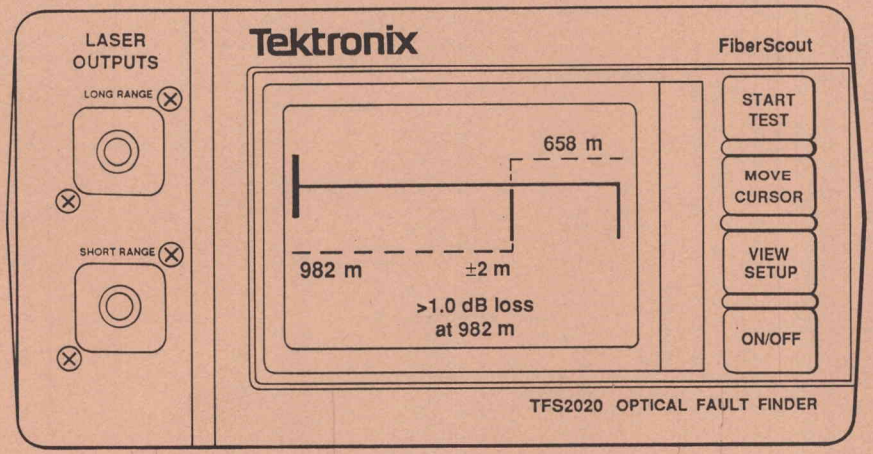

TFS2020 FiberScout

Optical Fault Finder

Operator Manual

Tektronix®
Committed to Excellence

First Printing January 1992
Revised 15 Oct 92

NOTE

The FiberScout Operator Manual consists of two documents: (1) this manual, which is the instrument operator manual, and (2) the Operator Manual Supplement entitled "How to Change Setups."

The instrument operator manual describes FiberScout and how to test a fiber.

The Operator Manual Supplement describes how to change FiberScout setups only, and is restricted to users who are authorized to access and change instrument operating parameters.

This edition of the manual applies only to instruments that have software release 7.xx. Page 2-2 shows the display that has the software release number for your instrument.

Certificate of the Manufacturer/Importer

We hereby certify that Optical Fault Finder Model TFS2020 complies with the RF Interference Suppression requirements of Amtsbl.-Vfg 1046/1984. The German Postal Service was notified that the equipment is being marketed. The German Postal Service has the right to re-test the series and to verify that is complies.

TEKTRONIX

Bescheinigung des Herstellers/Importeurs

Hiermit wird bescheinigt, daβ das Optical Fault Finder Model TFS2020 in Übereinstimmung mit den Bertimmungen der Amtsblatt-Verfügung 1046/1984 funkentstört ist. Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die Bereschtigung zur Überprufüng der Serie auf Einhalten der Bestimmungen eingeraümt.

TEKTRONIX

NOTICE to the user/operator:

The German Postal Service requires that this equipment, when used in a test setup, may only be operated if the requirements of Postal Regulation, Vfg. 1046/1984, Par. 2, Sect. 1.7.1 are complied with.

HINWEIS für den Benutzer/Betreiber:

Dieses Gerät darf in Meβaufbauten nur betrieben werden, wenn die Voraussetzungen des Par. 2, Ziff. 1.7.1 der Vfg. 1046/1984 eingehalten werden.

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SAFETY INFORMATION

CAUTION notes identify potentials for property damage.

WARNING notes identify hazards to personal safety or potentials for property damage that are not immediately accessible.

DANGER notes identify immediate hazards to personal safety and property.

Protective ground (earth) terminal.

POWER SOURCES. FiberScout is designed to operate from an internal, rechargeable 16.8 volt nickel-cadmium (NiCad) battery pack, or an external AC/DC power adapter rated at between 15 and 30 VDC, 900 mA.

BATTERY POWER. Do not expose battery pack to fire or intense heat. Do not open or mutilate the batteries. Avoid contact with released electrolyte which is corrosive and may damage eyes, skin and clothing. Check with local codes for special disposal instructions.

EXTERNAL POWER. Use only the AC/DC Power/Charger Adapter that is specified for FiberScout (see "Accessories and Options" in Section 1).

LASER RADIATION. FiberScout tests optical fibers by emitting short pulses of laser light. The interval between pulses is large compared to the pulsewidth. Although the pulsed power is in the milliwatt range, the average power is only in the microwatt range. The light is emitted by either the Long Range port or Short Range port on the front panel and is invisible to the human eye.

FiberScout is classified as a Class I Laser Product under the Radiation Control and Health Safety Act of 1968, and complies with 21 CFR 1040.10 and 1040.11.

Even though FiberScout is categorized as a Class I laser product (the lowest classification) you should avoid exposing your eyes to its light by doing the following:

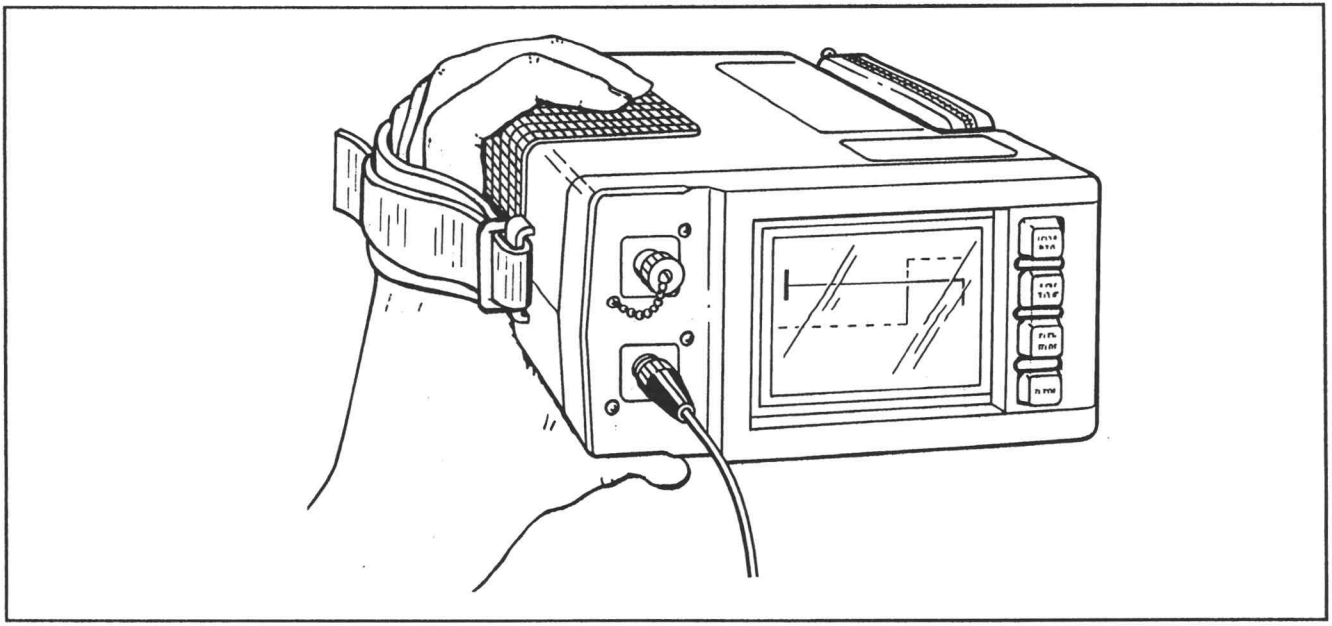
- *Do not look into either the Long Range or Short Range port when FiberScout is on.*
- *Keep the dust cap on the Laser Output port unless the port is being used to test a fiber.*

- *Avoid looking at the free end of a fiber (the end not connected to FiberScout) when a fiber is being tested. If possible, direct the free end toward a non-reflective surface.*

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES. Do not operate FiberScout in an explosive atmosphere unless it has been specifically certified for such operation.

DO NOT REMOVE COVERS OR PANELS. Do not remove FiberScout's covers or panels (except to recharge or replace the battery pack), nor operate FiberScout without covers and panels in place. Refer all repair problems to qualified service personnel.

ELECTROMAGNETIC EMISSIONS. The FiberScout product has been verified for compliance to FCC Class A and VDE Limit Class B.



TFS2020 FiberScout Optical Fault Finder

Section 1. PRODUCT OVERVIEW

Thank You for Choosing FiberScout

We are pleased that you have decided to use the TFS2020 FiberScout for your optical fault-finding requirements.

FiberScout is compact, lightweight and battery operated. This makes it easy to take the unit practically anywhere.

But, the best part is that it's so easy to use. Even if you have never tested a fiber before!

To determine a fiber's condition, simply connect FiberScout to the fiber, turn FiberScout on and press the START TEST button. FiberScout tests the fiber automatically, and displays the results in straightforward words and symbols. No mathematics to remember. No complex equations to use. No backscatter signals to interpret.

FiberScout lets you locate faults quickly so the network can be restored with minimum downtime.

ATTENTION!

Read "Safety Information" section before operating FiberScout.

If you have questions about using FiberScout or have application problems, call our toll-free help line 1-800-833-9200 (USA only).

Contents of this Manual

Section 1 - Product Overview

Section 1 contains a general overview and description of FiberScout including: inspection and shipping instructions, product description, summary of front panel display text and graphic symbols, front panel pushbutton descriptions, and accessories and options.

Use this section to get a general understanding of FiberScout. Then, refer to Section 2 for a quick tutorial on how to use FiberScout, and the following appendices for specific application information:

- Appendix B - Long Range Port
- Appendix C - Universal Short Range Port
- Appendix D - Multimode Short Range Port
- Appendix E - Extended Long Range Port

Section 2 - Generic Test Example

Section 2 contains general operating information. Use this section to gain quick understanding on how to use FiberScout, then refer to appendices B, C, D and E for specific application information.

Section 3 - Recharging the Battery Pack

Section 3 contains battery pack recharging instructions and information.

Section 4 - Troubleshooting

Section 4 contains Laser Output Port and fiber connector cleaning instructions, plus discrepancy messages and error messages.

Section 5 - Generic Specifications

Section 5 contains general specifications that are valid for all units. Refer to appendices B, C, D and E for specifications that apply to specific Laser Output ports.

Appendix A - Glossary

Appendix A is a glossary of terms and definitions that apply to FiberScout.

Appendix B - Long Range Port

Appendix B contains application information and specifications specific to instruments equipped with the Long Range Laser Output Port.

Appendix C - Universal Short Range Port

Appendix C contains application information and specifications specific to instruments equipped with the Universal Short Range Laser Output Port.

Appendix D - Multimode Short Range Port

Appendix D contains application information and specifications specific to instruments equipped with the Multimode Short Range Laser Output Port.

Appendix E - Extended Long Range Port

Appendix D contains application information and specifications specific to instruments equipped with the Extended Long Range Laser Output Port.

Appendix F - Storing/Viewing/Printing Test Results

Appendix F describes how to store test results in FiberScout's non-volatile memory, how to upload results to a PC and how to use a Seiko printer to create a hard copy of test results.

Appendix X - FiberScout/OTDR Comparisons

Appendix X contains comparisons between typical messages displayed by FiberScout when using the Long Range port, and traces displayed by an OTDR (Optical Time Domain Reflectometer). This information

is furnished as reference for users interested in such comparisons.

Operator Manual Supplement: "How to Change Setups"

The *Operator Manual Supplement* entitled *How to Change Setups* is a separate document that describes how to configure FiberScout for a particular test environment, plus establish the fault threshold level.

It is intended only for users who are authorized to change FiberScout's setups.

Other Reference Material

The *Reference Label* sticker on the inside of the Accessory Pouch summarizes FiberScout's display information and pushbutton descriptions.

The label on top of FiberScout defines the symbols used in displaying fiber test results.

Conventions Used in this Manual

In the text of this manual, front panel pushbutton use is printed in boldface capital letters; e.g., "Press **START TEST** to begin testing..."

FiberScout readouts (text and graphic symbols) are illustrated as they appear on the display.

Boldface, *italic* and <u>underlined</u> typefaces are used for emphasis and explanatory notes.

NOTE

All examples in this manual use distance, distance accuracy and loss values that are illustrative only. They should not be used to infer any FiberScout performance specifications or capabilities.

<u>Actual performance specifications for each Laser Output Port are contained in the appropriate appendix</u>.

Inspection and Shipping

Inspection

FiberScout is shipped to you with the following equipment and standard accessories:

- Instrument with port options as ordered.
- Travel case with attachable pouches.
- Operator Manual and Supplement.
- Reference Label (inside Accessory Pouch).
- NiCad battery pack. The battery pack must be charged before initial use. See Section 3 for charging information.
- AC/DC Power/Charger Adapter.

If the contents of the shipping container are incomplete, contact your Tektronix representative. If shipping resulted in damage to FiberScout, notify the carrier and your Tektronix representative.

Shipping

FiberScout was inspected mechanically and electrically before shipment. If it fails to perform satisfactorily, contact your Tektronix representative immediately or telephone toll-free 1-800-833-9200 (USA only). If FiberScout must be returned to Tektronix for service:

1) Use the original shipping container, or equivalent with dimensions at least 6 inches greater than FiberScout to allow for cushioning.

2) Cover FiberScout with polyethylene sheeting to protect its finish, or put it in its Travel Case.

3) Cushion FiberScout equally on all sides with packing material. Seal the carton with shipping tape or an industrial stapler.

4) Ship insured to Tektronix Redmond Division. Include name of your company, person to contact and description of problem.

Product Description

FiberScout is designed to locate significant events in fiber optic cables (see glossary in Appendix A for definition of terminology).

FiberScout automatically evaluates a fiber and locates events using the principles of time domain reflectometry. It measures the distance to, and approximate loss, of each event detected.

Measurement results are displayed on a front panel LCD (Liquid Crystal Display) using graphic symbols that represent events, and messages that describe events.

Types of data displayed include:

- Distance from start of fiber to user-selected event. (Start of fiber is at the Laser Output Port on FiberScout's front panel).
- Distance from user-selected event to last event displayed. (Last event displayed is as far as FiberScout can test under a given set of operating parameters, which may or may not be the entire length of the fiber).
- Distance accuracy to the events expressed in plus/minus (±) terms.
- Reflective events (see Appendix A for definition).
- Non-reflective faults (see Appendix A for definition).
- Low-battery warning indication.

FiberScout can be equipped with the following Laser Output ports depending on options ordered:

- Long Range Port (see Appendix B)
- Universal Short Range Port (Appendix C)
- Multimode Short Range Port (Appendix D)
- Extended Long Range Port (Appendix E)

Break Finder and Fault Finder Modes

The Long Range Port and Extended Long Range Port give you the option to test in either Break Finder Mode or Fault Finder Mode. You may test in either Break Finder Mode or Fault Finder Mode exclusively. Or set FiberScout to prompt you to select either Break Finder Mode or Fault Finder Mode for each test.

See the *Operator Manual Supplement* for setup information about Break Finder and Fault Finder modes.

Break Finder Mode

Break Finder Mode locates significant reflective events and catastrophic faults (i.e., breaks) quickly and easily. Three kinds of events are searched for:

1) A reflective or non-reflective fault with loss equal to or greater than 4 dB;
2) a reflection equal to or greater than 3 dB above backscatter;
3) the maximum range reachable by FiberScout.

Fault Finder Mode

Fault Finder Mode enables you to choose a fault detection level (threshold) that is significant for the particular system under test; i.e., either 1, 2, 3 or 4 dB. FiberScout will then search for either reflective or non-reflective faults with loss equal to or greater than your selected threshold value.

Also, if the Reflections setup is turned on, all reflective features with reflective heights above backscatter that are greater than a predetermined threshold value will be reported.

See the *Operator Manual Supplement* for detailed information about the Reflections setup.

Notes About How FiberScout Works

Measurement Time

When you press the **START TEST** button, FiberScout makes an automatic evaluation of the fiber to locate significant events.

The time required to make an evaluation depends upon the operating mode (i.e., Break Finder or Fault Finder mode), the types of events detected and which port is being used.

Assume typical fibers: 2 km (6560 ft.) for the Universal Short Range and Multimode Short Range ports; 45 km (~28 miles) for the Long Range Port; 64 km (~40 miles) for the Extended Long Range Port. The approximate measurement time is as follows:

- Three minutes if using the Universal Short Range or Multimode Short Range Port. Add about 30 seconds for each event detected.
- Four minutes if using the Long Range Port in Fault Finder Mode. Add about 1 minute for each event detected.
- Less than 2 minutes if using the Long Range Port in Break Finder Mode.
- Four minutes if using the Extended Long Range Port in Fault Finder Mode. Add about 2 minutes for each event detected.
- Less than 3 minutes if using the Extended Long Range Port in Break Finder Mode.

After evaluation, the condition of the fiber will be displayed in text and graphic symbols on FiberScout's display.

Universal Short Range and Multimode Short Range distance accuracies are about ±2 m (6.6 ft.).

Long Range and Extended Long Range distance accuracies to reflective events are about ±5 m (16.4 ft.).

Initial distance accuracy to a non-reflective fault is generally less than ±200 m (760 ft.) for the Long Range and Extended Long Range ports.

Non-Reflective Fault Distance Accuracy

The distance accuracy to a non-reflective fault may be improved with longer processing time. If distance accuracy can be improved, the fault's distance accuracy readout showing on the display will be flagged with a pair of asterisks (example: * ±33 m *).

When you move the cursor to a non-reflective fault symbol on the display, and leave it there, FiberScout will continue to acquire data on the fault for up to 10 minutes, or until FiberScout can no longer improve the accuracy level. As distance accuracy increases, the readout will update accordingly.

You may choose to quit acquiring more accurate distance measurements on a non-reflective fault by moving the cursor to another event.

See the appropriate appendix for details on instrument performance specifications.

Power Requirements

FiberScout is powered by either a rechargeable NiCad battery pack or an AC/DC Power/Charger Adapter. Both are standard accessories.

See Section 3 for information about how to recharge the battery pack.

The AC/DC Power/Charger Adapter plugs into the pin connector located inside the Accessory Pouch, and connects to an appropriate AC power source (see Fig. 1-1).

When the Power/Charger Adapter is being used as the power source, battery power will be over-ridden. And, FiberScout can be operated via the Power/Charger Adapter even when the NiCad battery pack is dead or removed.

There are no user-replaceable fuses in FiberScout.

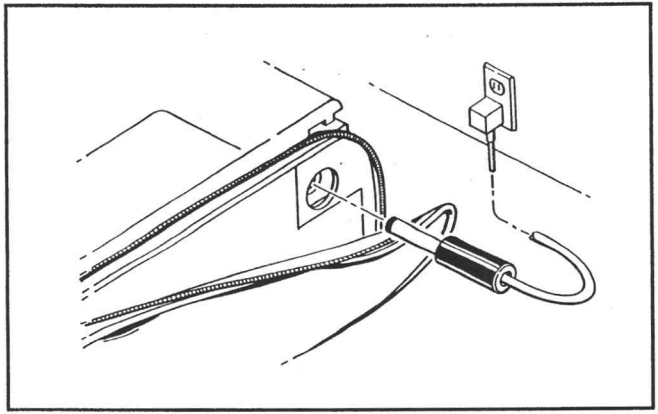


Fig. 1-1. AC/DC Power/Charger Adapter Connector.

Laser Output

FiberScout usually emits laser light only when testing a fiber. This is a safety feature that reduces the chance of accidental exposure.

FiberScout can tell when a fiber is connected to one of its Laser Output ports and will not continue to pulse its lasers indefinitely if a fiber is not connected.

However, in the following situations, pulsed laser light may be emitted briefly although there may be no fiber connected:

- After pressing the START TEST button.
- If FiberScout is testing near its front panel (testing near the front panel is a user option).
- If a fiber is disconnected while FiberScout is in the process of testing.
- If you press the MOVE CURSOR button during a "...poor connection..." message.

- During a fiber display, if the cursor is positioned on a non-reflective fault while the distance accuracy indicators are displayed.

WARNING

FiberScout tests optical fibers by emitting short pulses of invisible laser light. The time interval between pulses is large compared to the pulsewidth. Although the pulsed power is in the milliwatt range, the average power is only in the microwatt range.

FiberScout is classified as a Class I Laser Product under the Radiation Control and Health Safety Act of 1968, and complies with 21 CFR 1040.10 and 1040.11.

Although FiberScout is categorized as a Class I laser product (the lowest classification) you should avoid exposing your eyes to its light:

- *Do not look into either Laser Output Port when FiberScout is turned on.*
- *Keep the dust cap on the Laser Output Port that is not is being used.*
- *Avoid looking at the free end of a fiber (the end not connected to FiberScout) when a fiber is being tested. If possible, direct the free end toward a non-reflective surface.*

Selecting a Laser Output Port

When FiberScout is equipped with both a Long Range and Short Range port, the choice of which port to use is made by connecting a fiber to that specific port. There are no port selector switches.

If fibers are connected to both ports at the same time, and both ports have good connections, FiberScout will test the port that was used previously.

Or, on initial power-up, FiberScout will test the Universal or Multimode Short Range port first (if so equipped).

CAUTION

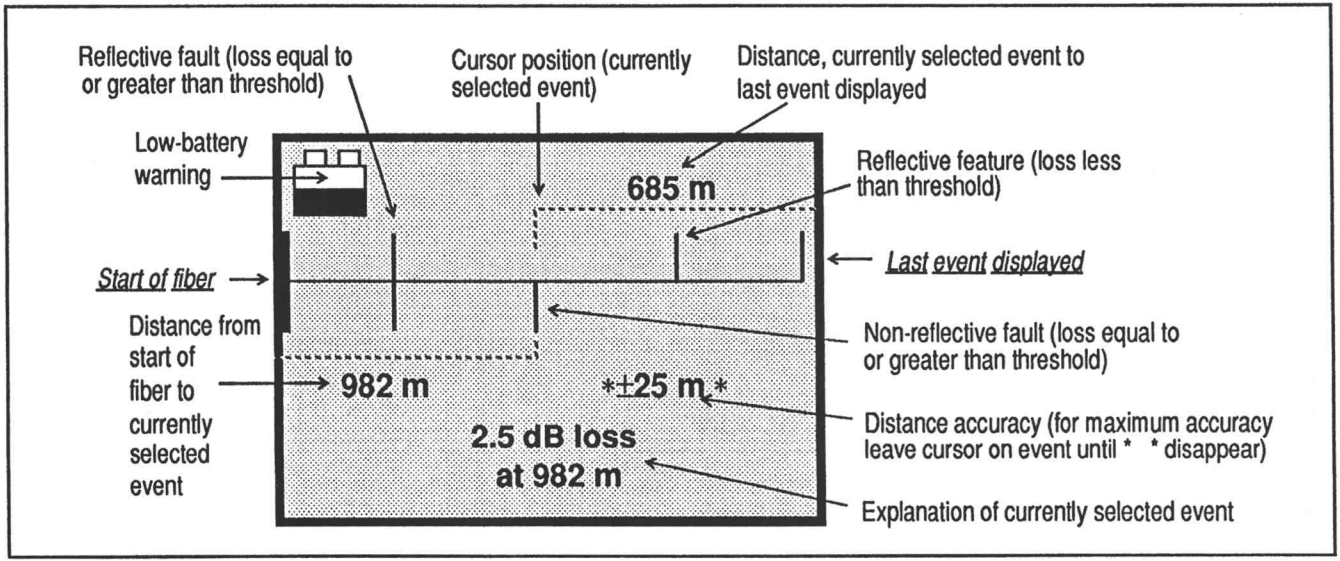
Keep the Laser Output ports clean at all times. Dust and dirt can affect laser output. Ports should be capped when not in use.

If a port becomes contaminated with dust or dirt, see Section 4 for cleaning instructions.

Do not use index matching fluid or gel on a port or connector. It may cause contamination and a fatal error message.

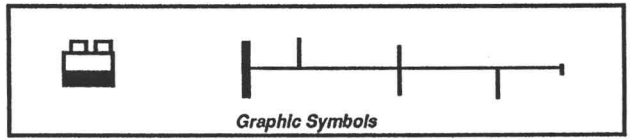
Front Panel Display and Pushbutton Descriptions (Generic)

Front Panel Display Summary (Fault Finder Mode)



Display Descriptions (Fault Finder Mode)

This table summarizes typical messages and graphic symbols displayed by FiberScout. Refer to appendices B, C, D and E for specific application information.



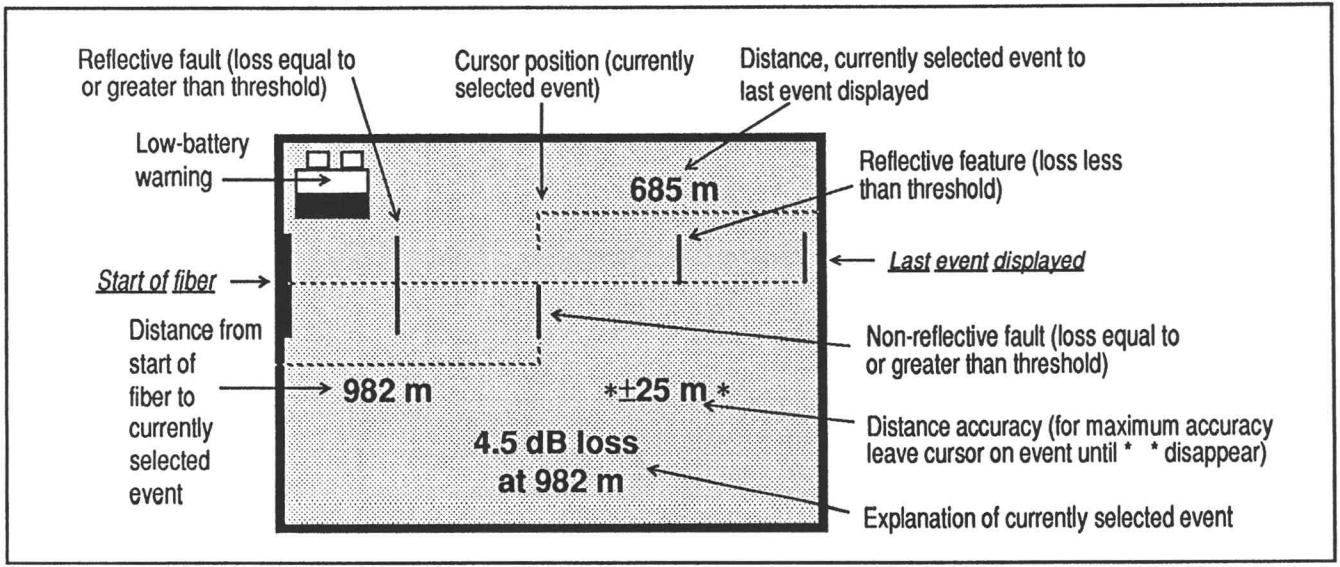
Graphic Symbols

Graphic	Typical Message	Description
	No Message	Low battery warning. Recharge batteries as soon as possible.
	No Fault Found Max Range of TFS2020 Reached	No events found. FiberScout does not have adequate dynamic range to test farther.
	Reflection with <x.0 dB Loss at xxxx m	Reflective feature (loss less than threshold).
	Reflection with x.y dB Loss at xxxx m	Reflective fault (loss equal to or greater than threshold).
	x.y dB Loss at xxxx m	Non-reflective fault (loss equal to or greater than threshold).

Display Descriptions - Fault Finder Mode (cont.)

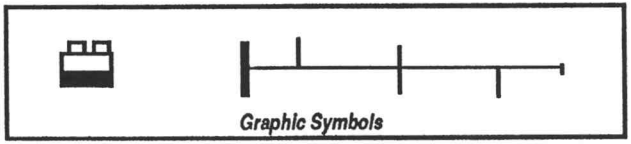
Graphic	Typical Message	Description
	**Reflection with Max Range of TFS2020 Reached**	Reflective event. FiberScout does not have adequate dynamic range to test farther.
	**Loss with No Cable Found after xxxx m**	Non-reflective fault. FiberScout has adequate dynamic range to determine that loss is catastrophic.
	**Reflection with No Cable Found after xxxx m**	Reflective fault. FiberScout has adequate dynamic range to determine that loss is catastrophic.

Front Panel Display Summary (Break Finder Mode)

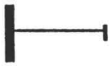


Display Descriptions (Break Finder Mode)

This table summarizes typical messages and graphic symbols displayed by FiberScout. Refer to appendices B, C, D and E for specific application information.



Graphic Symbols

Graphic	Typical Message	Description
	*No Message*	Low battery warning. Recharge batteries as soon as possible.
	**No Fault Found Max Range of TFS2020 Reached**	No events found. FiberScout does not have adequate dynamic range to test farther.

Graphic	Typical Message	Description
	**Reflection with <4.0 dB Loss at xxxx m**	Reflective feature (loss less than break threshold).
	**Reflection with 4.x dB Loss at xxxx m**	Reflective fault (loss equal to or greater than break threshold).
	**4.x dB Loss at xxxx m**	Non-reflective fault (loss equal to or greater than break threshold).

Display Descriptions - Break Finder Mode (cont.)

Graphic	Typical Message	Description
	**Reflection with Max Range of TFS2020 Reached**	Reflective event. FiberScout does not have adequate dynamic range to test farther.
	**Loss with No Cable Found after xxxx m**	Non-reflective fault. FiberScout has adequate dynamic range to determine that loss is catastrophic.
	**Reflection with No Cable Found after xxxx m**	Reflective fault. FiberScout has adequate dynamic range to determine that loss is catastrophic.

Pushbutton Descriptions

ON/OFF

Press **ON/OFF** to turn FiberScout on and off.

START TEST

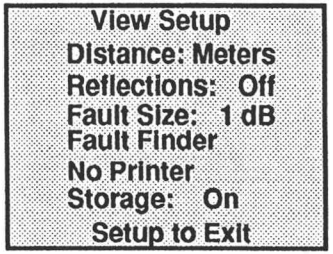
Press **START TEST** to begin testing a fiber.

MOVE CURSOR

Press **MOVE CURSOR** to move the cursor to the next event displayed. The cursor will blink steadily on the symbol displayed for the event. A description of the event will also be displayed.

VIEW SETUP

Press **VIEW SETUP** to examine instrument setups. This is a sample setup display:



NOTE: *For setup definitions and instructions on how to change setups, see the "Operator Manual Supplement."*

Access to changing setups is intended only for users who are authorized to change FiberScout's operating parameters.

Accessories and Options

STANDARD ACCESSORIES

Accessory	Part Number
Operator Manual and Supplement	070-7167-04
Reference Label (Installed in Accessory Pouch)	062-9360-01
NiCad Battery Pack	146-1000-01
110 V AC/DC Power/Charger Adapter (USA/Canada)	119-2731-00
Accessory Pouch	016-0993-01
Travel Case	016-1024-01

OPTIONAL ACCESSORIES

Accessory	Part Number
AC/DC Power/Charger Adapters	
220 V (Europe)	119-2712-00
240 V (UK)	119-2713-00
External Battery Chargers	
USA/Canada	118-8497-00
Europe	118-8498-00
UK	118-8501-00
Cables (2-Meter Long, RS232C) for:	
Seiko DPU201G Printer (DB9-DB9)	174-2560-00
Seiko DPU411 Printer (DB9-DB25)	174-2562-00
IBM-Compatible PC	
25-Pin Serial Port (DB25-DB9)	174-2563-00
9-Pin Serial Port (DB9-DB9)	174-2561-00
FiberScout Test Interface Package (Includes DB9-DB9 Interface Cable and software for IBM-compatible PC)	FSTIP

AC/DC POWER/CHARGER ADAPTER OPTIONS

Option Number	FiberScout Equipped With:
1C	220 V AC/DC Power/Charger Adapter (Europe)
2C	240 V AC/DC Power/Charger Adapter (UK)

LASER OPTIONS

Option Number	FiberScout Equipped With:
01	Both Long Range and Universal Short Range ports
02	Long Range Port only
03	Universal Short Range Port only
05	Both Extended Long Range and Universal Short Range ports
06	Extended Long Range Port only
09	Multimode Short Range Port only

CONNECTOR OPTIONS

Connector	Long Range and Extended Long Range Ports	Universal Short Range Port	Multimode Short Range Port
Biconic	20	30	40
FCPC	21	31	41
D4PC	22	32	42
STPC®	24	34	44
DINPC 47256	25	35	45
SCPC	28	38	48
SMA	N/A	N/A	46

Section 2. GENERIC TEST EXAMPLE

Introduction

This test example contains general instructions about how to test a typical fiber.

Use this section to familiarize yourself with the operation of FiberScout. Then refer to the appropriate appendix for application information for the Laser Output Port to be used.

NOTE

Clean the fiber connector before using FiberScout. Do not clean FiberScout's Laser Output Port unless you get a "...poor connection..." message upon power-up (see Section 4).

FiberScout's battery pack should be fully charged, or use the AC/DC Power/Charger Adapter as the power source (see Section 3).

The distance tolerances and loss values used in this test example are illustrative only. They should not be used to infer any performance specifications for FiberScout.

Test Procedure

1) Press **ON/OFF** to power-up FiberScout. Do not attach the fiber to be tested yet.

   This copyright message is displayed when FiberScout is first powered-up. FiberScout will then perform a brief initialization sequence.

   NOTE

   See "Troubleshooting" in Section 4 if a discrepancy message or error message occurs anytime during power-up or testing.

   LOW-BATTERY WARNING

   If this low-battery warning symbol appears in the upper-left corner of the display, recharge the battery pack before continuing. Weak batteries may degrade the performance of FiberScout.

See Section 3 for battery pack recharging information.

2) When this display appears, initialization has been successfully completed.

   Connect the test fiber (either directly or use a jumper cable) to the appropriate Laser Output Port on FiberScout's front panel.

   NOTE

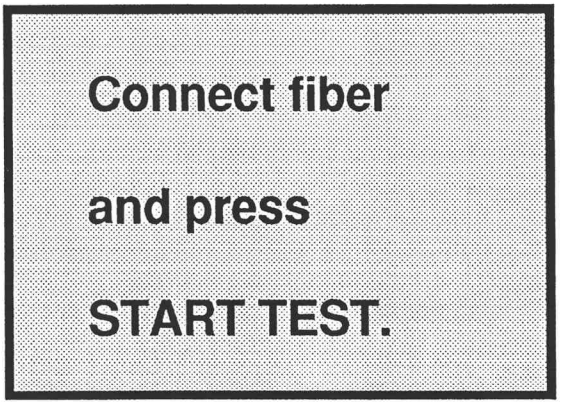
   Always clean the fiber connector before connecting it to FiberScout.

   The fiber connector should be finger tight.

   WARNING

   Although FiberScout is categorized as a Class I laser product, avoid exposing your eyes to its light.

   Follow the safety procedures described under "Laser Radiation" in the Safety Information section of this manual.



3) Press **START TEST** to begin testing the fiber.

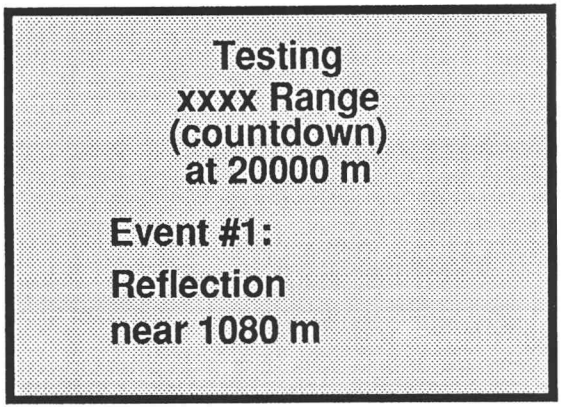
This display indicates that testing is in progress. The "xxxx" refers to the Laser Output Port in use (either Long Range or Short Range).

The "countdown" will start at number "8" and end at "0." The distance readout (at 20,000 meters in this example) and location of last event detected will appear following the countdown. This provides a general idea of the distance at which testing is occurring.

As the optical pulse is launched, any reflective feature/fault (if the Reflections setup is turned on), or non-reflective fault, will be reported.

The last event detected will continue to be reported until another event is found, or the test is completed (see Step 4). This provides an immediate overview of the condition of the fiber.

A reflective feature/fault will be reported as "Reflection near...."



A non-reflective fault will be reported as "Loss near..."

NOTE

If the fiber is improperly connected at the front panel, or there is a large loss close to the front panel, a discrepancy message will appear. Refer to Section 4 for message descriptions.

4) Sample display of a completed test. The graphic symbols represent events detected.

   The blinking cursor is positioned on the last event displayed (20,000 meters in this example).

   Reported distance accuracy is ±5 meters.

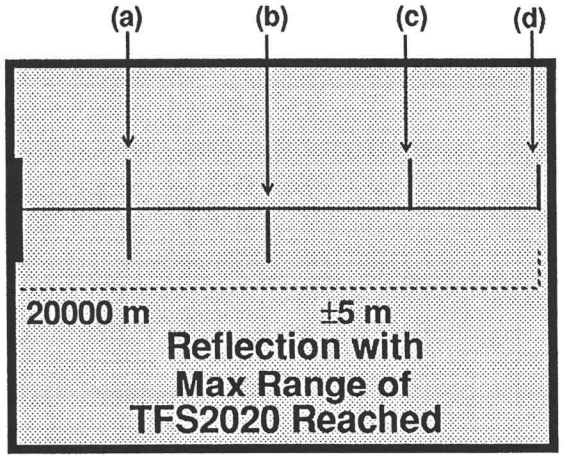
   The events detected are:

   (a) A reflective fault with loss equal to or greater than threshold.

   (b) A non-reflective fault with loss equal to or greater than threshold. (A fault with no reflective component above backscatter level at that location).

   (c) A reflective feature with loss less than threshold. This feature is displayed only when the Reflections setup in the Test Setup Menu is turned on.

   (d) A reflective event at the end of FiberScout's dynamic range. FiberScout does not have adequate dynamic range to test past this distance reliably.



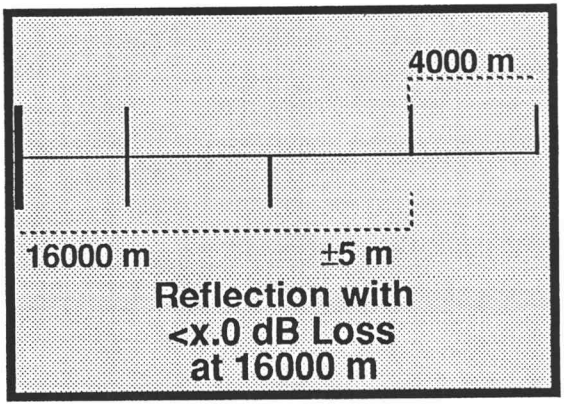
5) Press **MOVE CURSOR** once. The cursor moves to the next previous event which is a reflective feature with loss less than threshold.

   Its distance from both near end of fiber (16,000 meters) and far end of fiber (4000 meters) are displayed. Reported distance accuracy is ±5 meters.

   The message "Reflection with <x.0 dB Loss at 16000 m" is typical of the kind of message displayed when this type of event is detected. "x" represents the current fault threshold setting (i.e., either 1, 2, 3 or 4 dB)

   Typically, this feature is used to identify a mechanical connector or other reflection that will be used as a test reference point.

   ***NOTE**: Display of this type of event can be turned on or off by accessing the Reflections setup in the Test Setup Menu (see "Operator Manual Supplement").*

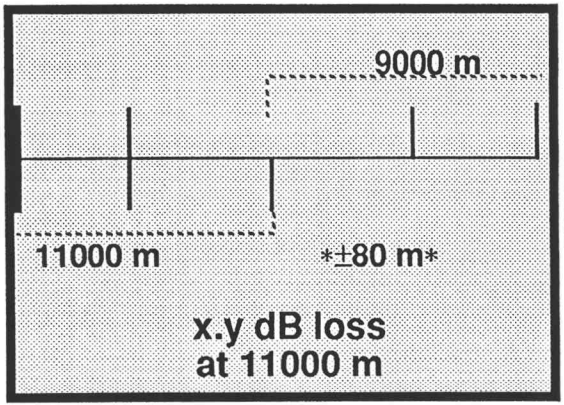


6) Press **MOVE CURSOR** once again. The cursor moves to the next previous event which is a non-reflective fault with loss equal to or greater than threshold (i.e., a fault with no reflective component above the backscatter level at this location).

   Again, distances and distance accuracy are displayed. Note that because the distance accuracy is flagged by asterisks, as long as the cursor is left on this event, the distance accuracy will be updated continuously for up to approximately 10 minutes, or until the event's distance accuracy can no longer be improved.

   The message "x.y dB loss at 11000 m" is typical of the kind of message displayed when this type of event is detected.

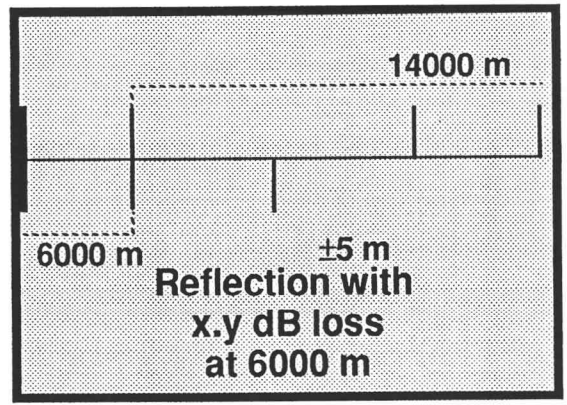
   Examples: fusion splices, non-reflective breaks, microbends, macrobends.



7) Press **MOVE CURSOR** once again. The cursor moves to the event closest to the front panel which is a reflective fault with loss equal to or greater than threshold.

   The message "Reflection with x.y dB loss at 6000 m" is typical of the kind of message displayed when this type of event is detected.

   Examples: connector with high loss, reflective fault.

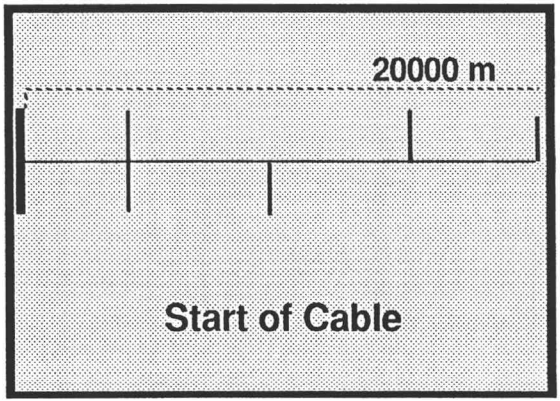


8) Press **MOVE CURSOR** once again. The cursor moves to the start of the fiber at the front panel. The length of fiber display (20,000 meters) is shown without a distance accuracy display.

THE TEST IS OVER

You may now either:

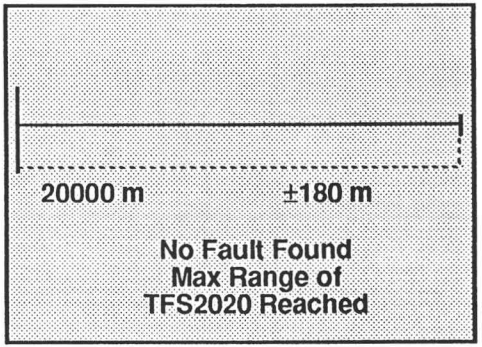
- Review the test results by continuing to press **MOVE CURSOR** (the cursor will wrap-around to the last event displayed);
- re-test the fiber by pressing **START TEST**;
- power-down by pressing **ON/OFF**.



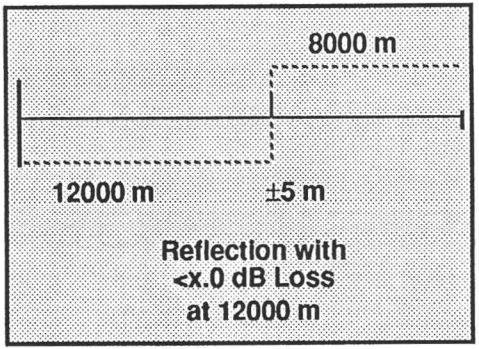
NOTE

A front panel button must be pressed within 15 minutes or FiberScout will power-down automatically to conserve battery power. This will happen whether or not the battery pack is used as the power source.

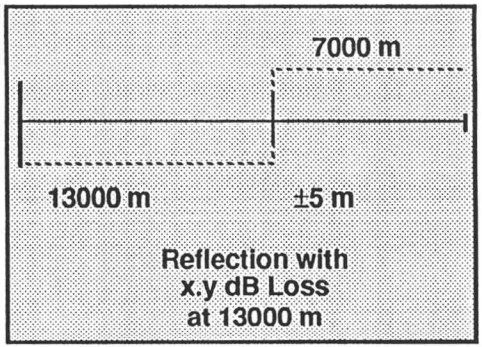
Example Messages



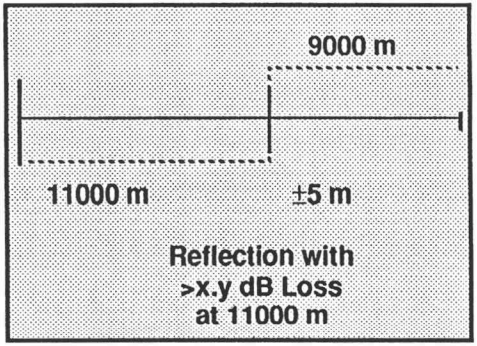
Explanation: No events found. FiberScout does not have adequate dynamic range to reliably test past 20,000 meters.



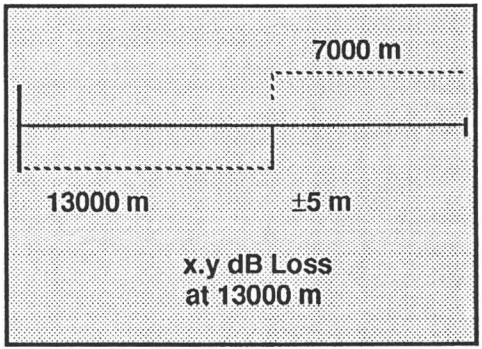
Explanation: The cursor is on a reflective feature with loss less than threshold. The Reflections setup must be turned on to allow this type of event to be reported.



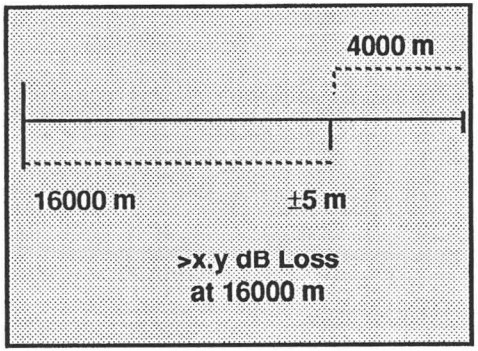
Explanation: The cursor is on a reflective fault with loss equal to or greater than threshold.



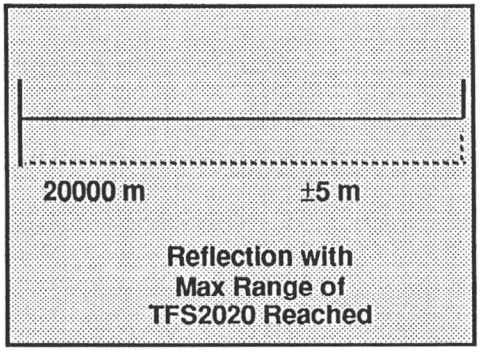
Explanation: The cursor is on a reflective fault with loss equal to or greater than threshold. However, a loss measurement with sufficient repeatability cannot be made, so the greater-than sign (>) is displayed which indicates that the loss is at least x.y dB.



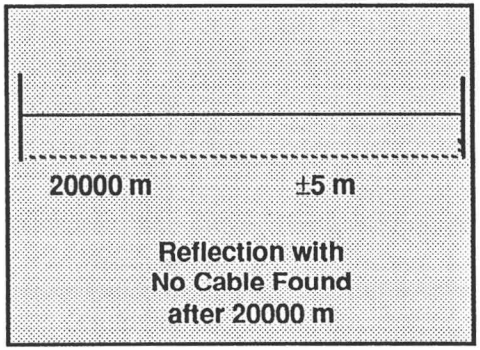
Explanation: The cursor is on a non-reflective fault with loss equal to or greater than threshold.



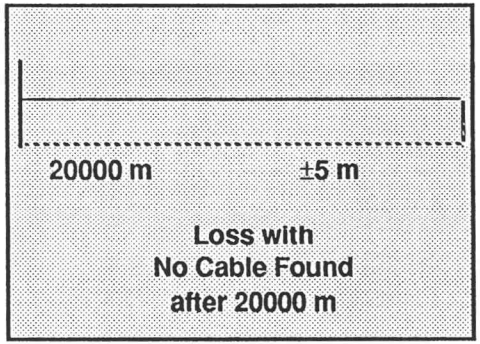
Explanation: The cursor is on a non-reflective fault with loss equal to or greater than threshold. However, a loss measurement with sufficient repeatability cannot be made, so the greater-than sign (>) is displayed which indicates that the loss is at least x.y dB.



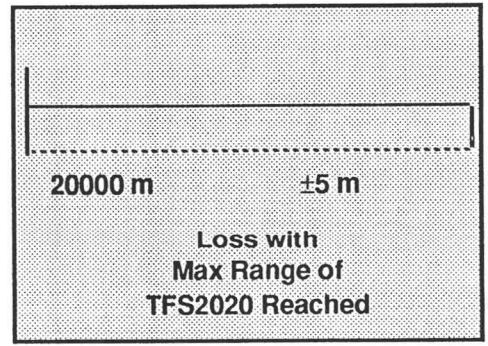
Explanation: The cursor is on a reflective event. However, FiberScout cannot accurately determine whether or not there is fiber beyond the reflection due to insufficient dynamic range.



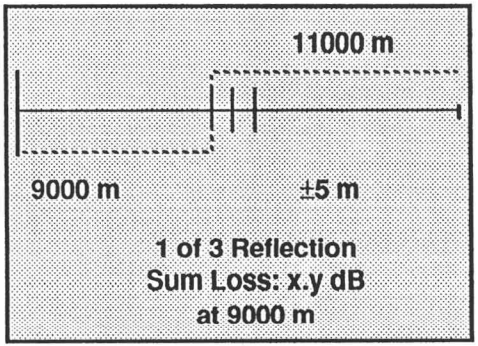
Explanation: The cursor is on a reflective fault. FiberScout has adequate dynamic range to determine that the loss is catastrophic.



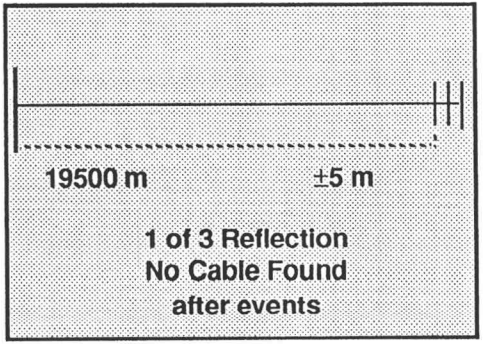
Explanation: The cursor is on a non-reflective fault. FiberScout has adequate dynamic range to determine that the loss is catastrophic.



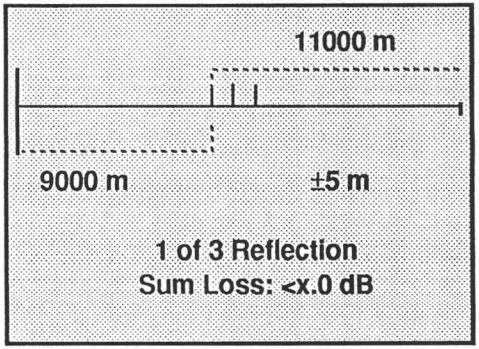
Explanation: The cursor is on a non-reflective fault. FiberScout cannot accurately determine whether or not there is fiber beyond the fault, nor loss associated with the fault because of insufficient dynamic range.



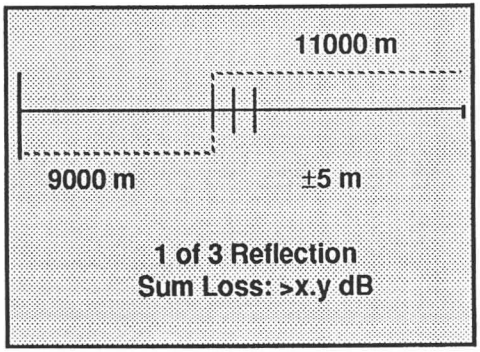
Explanation: The cursor is on the first of three reflective events. The combined loss is x.y dB. However, the reflections are so close together that FiberScout cannot measure the separate loss at each event. *If the number of reflections exceeds nine, the first line of the message will read ">9 Reflection."*



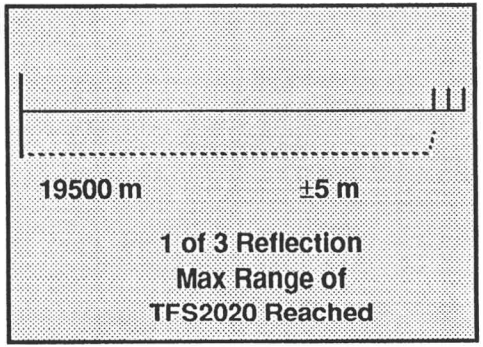
Explanation: The cursor is on the first of three reflective events. The combined loss is catastrophic. However, the reflections are so close together that FiberScout cannot measure the separate loss at each event. *If the number of reflections exceeds nine, the first line of the message will read ">9 Reflection."*



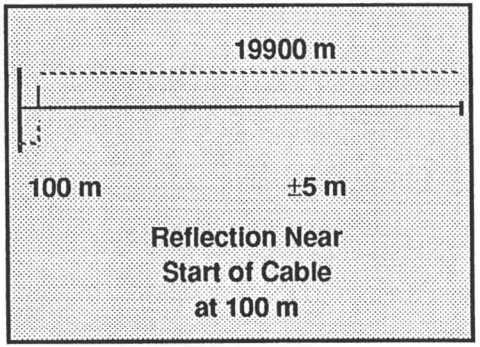
Explanation: The cursor is on the first of three reflective events having a combined loss less than threshold. However, the reflections are so close together that FiberScout cannot measure the loss at each event. *If the number of reflections exceeds nine, the first line of the message will read "*>9 Reflection.*"*



Explanation: The cursor is on the first of three reflective events having a combined loss greater than threshold. However, a loss measurement with sufficient repeatability cannot be made, so the greater-than sign (>) is displayed. The reflections are so close together that FiberScout cannot measure the loss at each event. *If the number of reflections exceeds nine, the first line of the message will read "*>9 Reflection.*"*

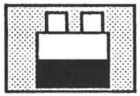


Explanation: The cursor is on the first of three reflective events. FiberScout does not have adequate dynamic range to accurately determine whether or not there is fiber beyond the reflections. *If the number of reflections exceeds nine, the first line of the message will read ">9 Reflection."*



Explanation: The cursor is on a reflective event close to the front panel connector. FiberScout can locate the event but cannot measure its loss separately from that of the front panel connector.

Section 3. RECHARGING THE BATTERY PACK



Recharge the battery pack before using FiberScout on battery power, and when this low-battery warning indicator appears in the upper left corner of the display. Operating FiberScout with low batteries may result in degraded performance. FiberScout may be operated via the Power/ Charger Adapter with or without the battery pack.

Recharging Procedure - Internal Charger

These instructions are for instruments with a built-in internal battery charger (instruments with serial numbers greater than B025000). Use the AC/DC Power/Charger Adapter (standard accessory) to recharge the battery pack (see Fig 3-1).

1) Turn off FiberScout. Open zipper on Accessory Pouch to expose the Power/Charger Adapter receptacle.

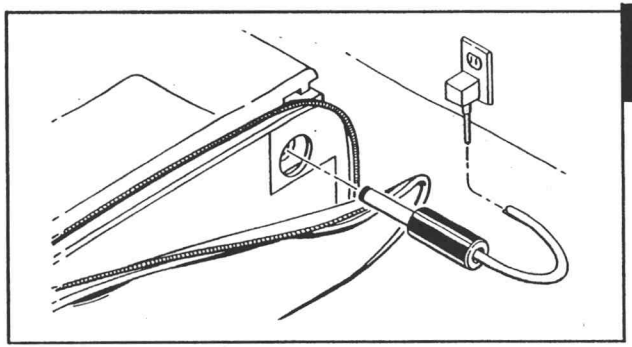


Fig. 3-1. Recharging Setup.

2) Plug the Power/Charger Adapter into the receptacle and a suitable AC power source.

3) Recharging time for a dead battery pack at room temperature is about 6 hours.

NOTE

The battery pack will not overcharge if left connected to the Power/Charger Adapter.

There is no indicator that shows whether or not the battery pack is charging, or is fully charged.

4) Disconnect the Power/Charger Adapter.

Power-up FiberScout and make sure that the low-battery warning indicator is no longer displayed.

Recharging Procedure - External Charger

These instructions are for the external battery charger, an optional accessory.

To connect the external battery charger, first access the battery pack. The battery pack is located behind the sliding removable panel attached to the Accessory Pouch mounted on the side of FiberScout (Fig. 3-2). It is not necessary to remove the battery pack for recharging, but it can be removed if desired (see Fig. 3-5).

1) Turn off FiberScout. Close zipper on Accessory Pouch.
2) Grasp Accessory Pouch. Press down firmly and pull removable panel gently toward back of FiberScout (approximately 3/16") until tabs on removable panel disengage from slots in case (see Fig. 3-2).
3) Lift panel away from case to expose battery pack.

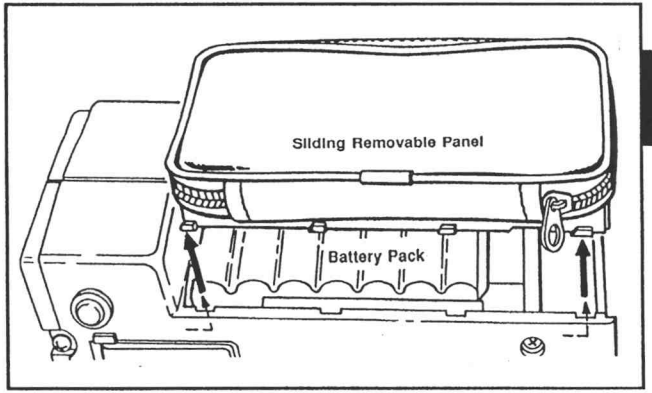


Fig. 3-2. Battery Pack Access

4) Disconnect battery pack cable from connector on Filter Board (Fig. 3-3).

5) Connect battery pack cable to external charger per Fig. 3-4.

   Plug external charger into an AC power source.

   The red indicator on the charger will light while the battery pack is recharging. From a full discharge, recharging time at room temperature takes about 8 hours.

6) When batteries are fully recharged, the red indicator will turn off and the green indicator will light to indicate trickle charge.

   Disconnect external charger, reconnect battery pack cable, replace removable panel and power up FiberScout to make sure low-battery warning indicator is no longer displayed.

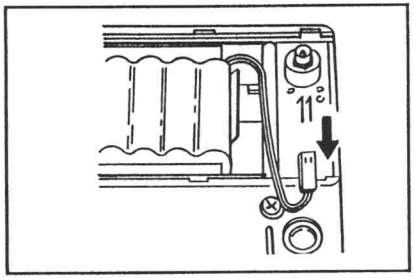


Fig. 3-3. Battery Disconnection.

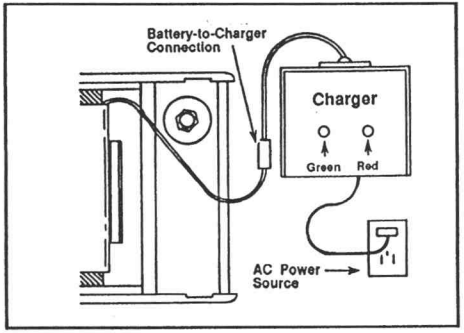


Fig. 3-4. External Charger Setup.

Battery Pack Information

Operational problems may result from insufficient battery power. Before attempting any repairs, first recharge the battery pack fully to see if that corrects the problem.

You may also check for proper operation by using the AC/DC Power/Charger Adapter as the power source.

Use of Internal Charger

Instruments with the built-in internal charger must be turned OFF and the AC/DC Power/Charger Adapter plugged in properly in order for the battery pack to recharge.

If FiberScout is turned on during recharging, the recharging circuits will switch off, the battery pack will not recharge, and power will be suppled by the AC/DC Power/Charger Adapter.

The battery pack will not overcharge if left connected to the Power/Charger Adapter.

Use of External Charger

The battery pack will not overcharge if left connected to the Tektronix-supplied external charger beyond the 8-hour maximum.

While the battery pack is being recharged, FiberScout may be turned on and operated by using the AC/DC Power/Charger Adapter.

Fully Recharge the Battery Pack

For optimum performance and battery life, we recommend that you use only the Tektronix-supplied

Power/Charger Adapter, or external charger, as the battery charger.

Battery Characteristics

The nickel-cadmium (NiCad) battery pack is rated 16.8 V, 1.2 amp/hr.

When using the Short Range Port, typical battery life is 3 hours when making continuous measurements, and 5 hours at 50% idle time.

When using the Long Range Port, typical battery life is 4.25 hours when making continuous measurements, and 6.5 hours at 50% idle time.

Environmental Concerns

Extremes in heat and cold will shorten the life of the battery pack. The battery pack should be stored at temperatures between -30°C and +50°C (-26°F and +122°F), and should be fully recharged before use after prolonged storage.

Shelf life is 80% capacity after one month at 20°C (68°F); 50% capacity after one month at 50°C (122°F).

When stored in FiberScout at 20°C (68°F), typical shelf life is 50% capacity after 6 months.

Automatic Shutdown

To conserve battery power, FiberScout will display a flashing warning at 9 minutes and begin sending an audible alert at approximately every 30 seconds. Then it will power itself down automatically after 15 minutes unless a front panel button is pressed to

continue activity. Power-down is automatic whether or not the battery pack is being used as the power source.

Battery Pack Removal

If it becomes necessary to remove the battery pack from the instrument case, disconnect the power cable from its connector and simply lift the battery pack out of its snap-in holder (see Fig. 3-5).

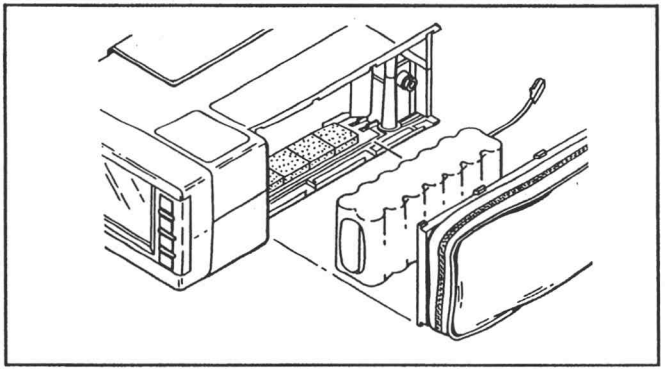


Fig. 3-5. Battery Pack Removal.

WARNINGS

Refer all battery problems to qualified service personnel.

Do not open or mutilate the battery pack nor expose it to fire or intense heat. It may explode.

Avoid contact with electrolyte. It may damage eyes, skin and clothing.

External Charger. *The external charger supplied by Tektronix has protection circuits that prevent overcharging.*

If using an external charger other than that supplied by Tektronix, do not recharge the battery pack beyond the 8-hour maximum recommended for a full recharge.

Unless there are protection circuits on the charger, the battery pack may overheat and explode.

Section 4. TROUBLESHOOTING

Introduction

This section describes what to do about displayed discrepancy messages and error messages, and other problems that may affect FiberScout.

No Power-Up

If FiberScout will not power-up, the most likely cause is a discharged battery pack. Recharge the battery pack, or try powering FiberScout with the AC/DC Power/ Charger Adapter.

If using the Power/Charger Adapter or recharging the battery pack does not solve the problem, consult service personnel.

NOTE

To conserve battery power, FiberScout will beep and display a flashing warning 9 minutes after the last button was pressed. The warning will continue to beep every 30 seconds. Then FiberScout will power itself down automatically after 15 minutes unless a front panel button is pressed.

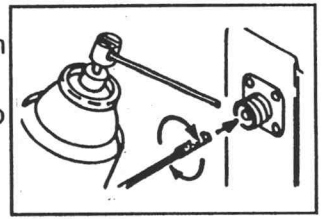
Power-down is automatic whether or not the battery pack is being used as the power source.

Cleaning Ports and Connectors

Laser Output Ports

When a Laser Output Port becomes contaminated with dust or dirt, try to remove the contaminant by blowing with clean, canned air.

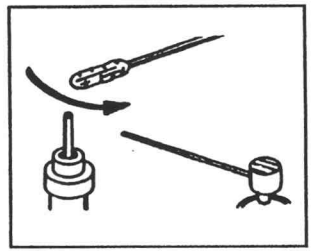
If air alone doesn't work, dampen a lint-free swab with electronics-grade isopropyl alcohol. Insert the swab into the port and rotate gently. Then blow completely dry with clean, canned air. Or, consult service personnel.



Fiber Connectors

Clean the end of a fiber connector by first blowing it with clean, canned air.

Otherwise, dampen a lint-free swab with electronics-grade isopropyl alcohol. Gently wipe across the end of the connector and around the tip. Then blow completely dry with clean, canned air. Or, consult service personnel.



CAUTION

Do not use cotton swabs, abrasives or unclean compressed air to clean Laser Output ports and fiber connectors because damage may occur.

Do not use index matching fluid or gel on the port or connector because it may cause contamination or a fatal error message.

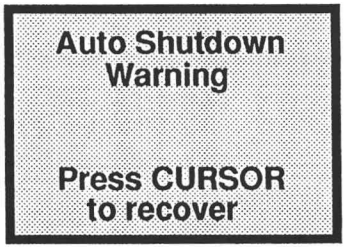
If a fatal error message occurs, first clean the port or connector thoroughly and retry before sending the instrument in for repairs.

WARNING

Do not remove FiberScout's covers except to recharge or replace the battery pack. Refer repair problems to qualified service personnel.

Discrepancy Messages

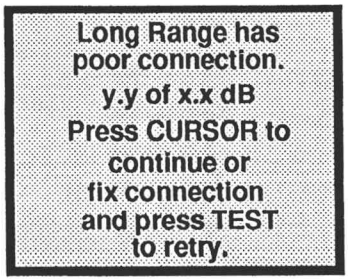
Any of the following discrepancy messages may occur during power-up or testing:



AUTOMATIC SHUTDOWN IS IMMINENT

More than 9 minutes have passed since a front panel button was pressed. Press **MOVE CURSOR** to recover the last display and continue using FiberScout. This display will flash about every 30 seconds and an annunciator will beep.

FiberScout will power-down automatically after 15 minutes unless a front panel button is pressed.



POOR FIBER CONNECTION (may be either 'Short Range' or 'Long Range')

1) Check tightness of connector at front panel (should be finger tight).
2) Disconnect fiber and check Laser Output Port and fiber connector for damage or dirt. Clean port and connector.

   Reattach fiber and press **START TEST**. FiberScout will recalculate the signal-to-noise factor. If it is greater than the specified dynamic range for the Laser Output Port being used, FiberScout will automatically start testing the fiber. If

the factor is less than the specified dynamic range, the message will reappear with a new "y.y" factor.

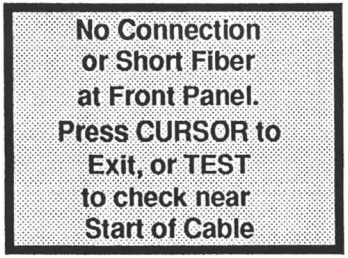
3) Make sure that the test fiber conforms to the Laser Output Port being used. Fiber/Port mismatch may cause this message even though connections are clean.

   Specifically, if the 62.5/125 Multimode Short Range Port is used to test a 50/125 multimode fiber, the available dynamic range will be reduced by about 2 dB, which may be enough to trigger this message.

4) This condition may be caused by a high-loss event close to the front panel. Try testing a different fiber. If this message is consistently displayed using different fibers, contact the Tektronix Redmond Division (1-800-833-9200) for further instructions.

NOTE

If **MOVE CURSOR** *is pressed without correcting the problem, testing will continue but the dynamic range will be limited and performance may degrade.*



VERY POOR (OR NONEXISTENT) FRONT PANEL CONNECTION

This message is displayed when the signal-to-noise factor is so low that insufficient dynamic range exists to test the fiber.

1) If a fiber is not connected to either Laser Output Port, press **MOVE CURSOR**. Then connect a fiber and press **START TEST**.

2) If too short a fiber is connected to the Long Range Port, press **MOVE CURSOR.** Then disconnect, clean and reconnect the fiber to the Short Range Port (if available) and press **START TEST**.

   Or, you may press **START TEST** to test the short fiber using the Long Range Port. If a reflective event is found, the test results will be displayed. If no reflections are found, the "No Connection..." message will be reappear with a "Press CURSOR to Continue" instruction.

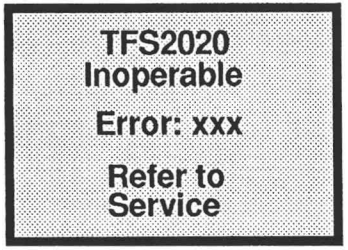
   If the fiber is connected to the Short Range Port, press **START TEST** to test the fiber. If a reflective event is found, the test results will be displayed. If no reflections are found, the "No Connection..." message will be reappear with a "Press CURSOR to Continue" instruction.

3) The port or fiber connector may be dirty or damaged. Clean the connector and retest the fiber. If this message is still displayed, clean the connector again, and the port, and retest the fiber.

4) Try testing a different fiber. If this message is consistently displayed using different fibers, contact the Tektronix Redmond Division (1-800-833-9200) for further instructions.

Error Messages

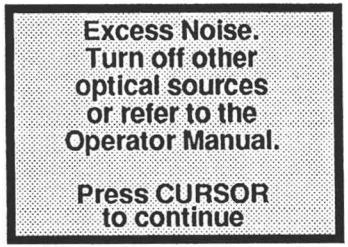
Any of the following error messages may occur during power-up or testing:



FATAL ERROR

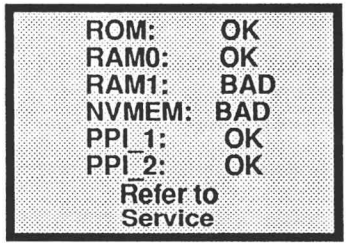
Internal hardware problem. Try powering FiberScout off and on again. If the error reappears, do not continue using FiberScout. Refer problem to qualified service personnel.

NOTE: *If either the "Error: 002" or "Error: 003" message appears, try cleaning the Laser Output Port and fiber connector. If either error message reappears, refer problem to qualified service personnel.*



EXCESSIVE OPTICAL SIGNAL NOISE ON FIBER

Turn off all optical sources connected to the fiber and press **MOVE CURSOR** to resume the test. If the message reappears, and no other optical sources are connected to the fiber or emitting a signal, refer problem to qualified service personnel.



SELF TEST ERRORS

Errors found in the power-up self test procedure. Try turning FiberScout off and on again. If the error reappears, do not continue using FiberScout. Turn FiberScout off and refer problem to qualified service personnel.

Section 5. GENERIC SPECIFICATIONS

The specifications in this section apply to all FiberScout options. For specifications that apply to a specific option, refer to the appropriate appendix.

Power Characteristics

Power	
Internal Battery Pack	16.8 V, 1.2 amp/hr NiCad battery pack
AC/DC Power/Charger Adapter	15 to 30 VDC (10 VA minimum output)
Consumption	Maximum 10 watts; typical 6 watts
Battery Life	
Continuous Measurements	3 hours (Short Range Port); 4.25 hours (Long Range Port)
Normal Use (50% Idle)	5 hours (Short Range Port); 6.5 hours (Long Range Port)
Shelf Life	80% capacity after 1 month @ 20°C
	50% capacity after 1 month @ 50°C
Battery Recharge Time	6 hours @ 250 mA charge current

Test Setup Menu Options

READOUT	OPTIONS	FACTORY DEFAULTS[1]
Distance	Meters, Feet	Meters
Reflections Report	On, Off	Off
Fault Size[2]	1, 2, 3, 4 dB	3 dB
Test Mode[2]	Break Finder, Fault Finder, Finder Select	Fault Finder
Printer	No Printer, Seiko 201G On, Seiko 201G Auto, Seiko 411 On, Seiko 411 Auto	No Printer
Storage	On, Auto, Off	Off

NOTES:
1. These are first time power-up default setups. On subsequent power-ups, FiberScout will default to setups in effect at last power-down.
2. If available for the specific options installed. Refer to the appropriate appendix for further information.

Port Setup Menu Options [1]

READOUT	OPTIONS	FACTORY DEFAULTS[2]
IR (Index of Refraction)	1.4000 to 1.5999[3]	1.4690 for Long Range 1.4697 for Extended Long Range 1.5020 for Multimode Short Range 1.4738 for Universal Short Range
Loss/km	0.10 to 0.99 for Long Range and Extended Long Range	0.35 for Long Range 0.25 for Extended Long Range
	1.00 to 9.99 for Universal Short Range and Multimode Short Range	2.50 for Universal Short Range 3.00 for Multimode Short Range
Default	On, Off	On

NOTES:

1. Refer to the "Operator Manual Supplement" for information about these parameters.

2. These are first time power-up default setups. On subsequent power-ups, FiberScout will default to setups in effect at last power-down.

3. Index of refraction at either 1300 or 1550 nm selected by user. Instrument corrects for internal use at other wavelengths by equation: IR(1300) = IR(850) X 0.99677 or IR(1550)=IR(850) X 0.99723 .

Display Characteristics

Readout Resolution	
Distance	1 m (3.28 ft.)
Loss	0.1 dB
Measurement Readout Range	
Distance	1 m (3.28 ft.) to 300 km (~186.5 miles)
Loss	0.8 dB to 9.9 dB

Physical Characteristics

Weight (Including Battery Pack and Both Ports)	2.3 kg (5 lbs.) including standard accessories
Dimensions	15.9 cm wide x 8.25 cm high x 26 cm long (6.25 in. wide x 3.25 in. high x 10.25 in. long)

Environmental Characteristics

Temperature	
Operating	0°C to 40°C (32°F to 104°F)
Storage[1]	-20°C to 70°C (-4°F to 158°F)
Humidity	0 to 95% relative humidity, noncondensing
Altitude	
Operating	4600 m (15,088 ft.)
Storage	12,000 m (39,360 ft.)

1. NiCad battery pack storage temperature range: -20°C to 50°C (-4°F to 122°F).

Appendix A. GLOSSARY

Most of the following definitions consist of common optical fiber terminology. However, some terminology associated with FiberScout is unique.

Backscatter

Also called Rayleigh backscatter. Caused by diffraction at microscopic non-uniformities in the optical fiber. A portion of the scattered light is captured by the fiber and propagates back to the light energy launch point. Backscatter is the dominant loss mechanism in high-quality optical fibers.

The initial backscatter power level is proportional to the length of the input optical pulse and its power. And, inversely proportional to the input optical pulse wavelength raised to the 4th power.

Backscatter power level decreases logarithmically with distance from the light energy launch point. This attenuation (power loss) is usually stated in decibels per kilometer (dB/km).

Rayleigh backscatter is the principle upon which optical time domain reflectometery is based.

Break Finder Mode

Break Finder Mode is an option available with either the Long Range or Extended Long Range Port. This mode lets FiberScout locate catastrophic faults quickly.

In Break Finder Mode, FiberScout searches for three kinds of events: 1) a reflective or non-reflective fault with loss equal to or greater than 4 dB; 2) a reflection equal to or greater than 3 dB above backscatter; and 3) the maximum range reachable by FiberScout.

See either Appendix B or Appendix E for information about Break Finder Mode.

Dynamic Range (One-Way)

Dynamic range is the maximum one-way Rayleigh scattering loss (in dB) that can be detected. Dynamic range increases with increased optical energy injected into the fiber, and is one of many considerations for OTDR-based optical fiber test equipment.

Other considerations include: distance and loss measurement repeatability; two-event distance resolution; total setup and measurement elapsed time; accuracy specification relative to a known light source and a powermeter calibrated for the light source.

Echoes

FiberScout operates by sending short pulses of light down a fiber. When a pulse hits a reflective event, part of the pulse is reflected back to FiberScout.

If the reflection travels straight back, the time between launch of the pulse and detection of its reflection is a measure of the distance to the event.

In highly reflective systems, the reflected pulse might take an indirect path back to FiberScout, bouncing off other reflective events along the fiber. When this happens, the reflection is called an echo.

Echoes, when viewed on an OTDR (Optical Time Domain Reflectometer) trace, appear to be reflections, but are not physically real.

Under highly reflective conditions, FiberScout, which operates on the same basic principal as an OTDR, may also report echoes as reflective features.

Fig. A -1 shows the similarity between echoes and reflective features.

Part A shows a typical OTDR test setup. There are two lengths of fiber under test, each 1 km long, joined by reflective connectors. The fiber is connected to the OTDR via a 20 meter jumper cable with a reflective connector.

The launch pulse is reflected off the first connector. Part of the reflection is detected by the OTDR and displayed

at 20 meters, the true location of the first connector (see Fig. A-1, Part B).

But, part of the reflection bounces off the OTDR's front panel and travels back to the first connector where it is again reflected back to the OTDR.

This second reflection (called an echo) is displayed by

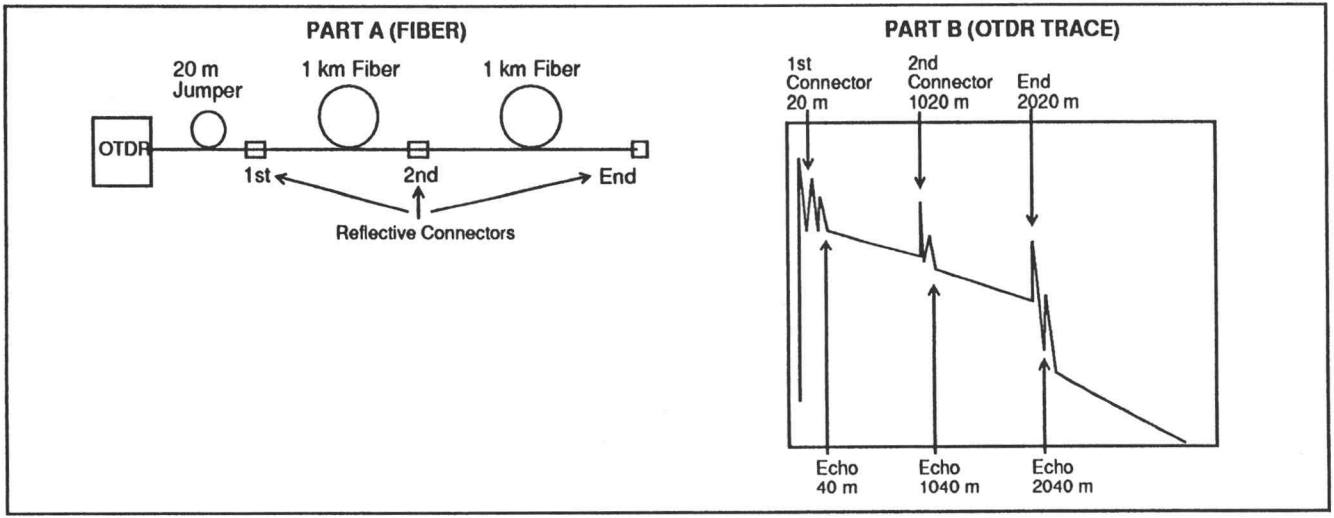


Fig. A-1. Echo Example.

the OTDR at 40 meters (20 meters after the first connector).

Similar echoes occur at the second connector and end of the fiber. The result is that three echoes appear as real events in the OTDR trace.

In systems with highly reflective connectors or splices, fiber backscatter can be reflected more than once before being detected. This is called "echoed backscatter." Also, two or three echoes may be associated with each reflection along the fiber.

Fig. A-1 shows a moderately reflective system with only one echo associated with each reflective event.

FiberScout's unique design greatly reduces the likelihood of reporting echoes. It does this two ways:

First, FiberScout terminates the search algorithm when a catastrophic loss is detected. This reduces the chance of reporting an echo after the end of the fiber.

Second, If you suspect that echoes are present and may affect the measurement, turn reflections OFF.

FiberScout will not report reflections unless they are associated with faults that are greater than the currently defined threshold.

Only by chance will an echo line up with a loss in the fiber. And, unless it does, the echo will not have loss associated with it. This further reduces the likelihood of reporting echoes.

Event

Any discontinuity in a fiber. An event can be a reflective feature, a reflective fault or a non-reflective fault.

Fault (Long Range and Extended Long Range Ports)

An event with loss equal to or greater than the user-defined threshold.

Fault (Universal Short Range Port)

Events reported that are primarily catastrophic; i.e., a break or bend resulting in excessive loss.

***NOTE**: Certain events may not be reported by the Universal Short Range Port, as compared to an OTDR because of wavelength and/or launch condition differences (see Appendix C).*

Fault (Multimode Short Range Port)

An event with loss equal to or greater than the user-defined threshold.

Fault Finder Mode

Fault Finder Mode is an option available with either the Long Range Port or Extended Long Range Port. In Fault Finder Mode, FiberScout lets you choose a fault threshold level of either 1, 2, 3 or 4 dB. FiberScout will then search for either reflective or non-reflective faults with loss equal to or greater than your selected threshold.

Also, if the Reflections setup is turned on, all reflective features with reflective heights above backscatter that are greater than a predetermined threshold value will be reported.

See the *Operator Manual Supplement* for additional information about the Reflections setup.

See either Appendix B or Appendix E for information about Fault Finder Mode.

Fault Threshold (Long Range and Extended Long Range Ports)

This is the lowest decibel (dB) loss limit used in detecting faults using the Long Range or Extended Long Range Port.

A higher threshold allows you to test a longer length of fiber (see appendices B and E for specifications).

The user-selectable threshold values are 1, 2, 3 or 4 dB. Selectable values allow you to determine what fault level is significant in a particular system.

See *the Operator Manual Supplement* for information about the setup procedure for fault threshold.

Fault Threshold (Multimode Short Range Port)

Lowest decibel (dB) loss limit used in detecting faults using the Multimode Short Range Port.

The user-defined threshold values are 1, 2, 3 or 4 dB. Selectable values allow you to determine what fault level is significant in a particular system.

See *Operator Manual Supplement* for setup procedure for fault threshold.

Fresnel Reflection

A Fresnel reflection occurs because of a discontinuity in the index of refraction within the medium that the light energy is traveling. The amount of reflected energy depends on the size of the discontinuity of the index.

Discontinuities occur because of many reasons. Most commonly, the mating of optical fibers causes the waveguide to be discontinuous. Mechanical connectors and splices fall into this category. Most types of fiber breaks also generate Fresnel reflections.

Ghost

A ghost (sometimes confused with an echo) results from a laser pulse repetition rate that is too fast for the fiber distance currently being evaluated.

It is the phenomenon of sensing a reflection (off the end of a fiber or a connector) from the previous pulse while the system is looking for data from the current pulse.

Example: a fiber 30 km long, IR = 1.500 @ 1300 nm. The round-trip time for a pulse to travel this fiber is:

$t = 2x30x10^3$ m / ($3x10^8$ meters per sec / 1.500)

$t = 300\ \mu s$

If the repetition rate was 200 µs, a ghost would appear 100 µs or 10 km down the fiber due to the end reflection from the previous pulse being acquired on the current pulse.

FiberScout automatically checks for ghosts whenever it finds a reflection. When FiberScout finds a ghost, it adjusts the pulse repetition rate to eliminate the ghost.

Index of Refraction (IR)

Index of refraction of glass is the ratio of the speed of light in glass to the speed of light in a vacuum. The index of refraction for glass is approximately 1.5.

The greater the index of refraction, the slower the speed of light in the material. The index of refraction is light energy wavelength dependent.

'Max Range Reached" Message

FiberScout has reached the point where sufficient dynamic range is not available to make measurements within guaranteed specifications.

"No Cable Found After...." Message

FiberScout found an event with loss that is catastrophic.

"No Fault Found" Message

FiberScout reached maximum range without finding any reflective events or non-reflective faults.

Non-Reflective Fault

A discontinuity that doesn't produce a reflection, but has a loss that exceeds the currently-defined threshold. Examples: fusion splices, non-reflective breaks, microbends, macrobends.

Optical Energy Launch Conditions

Launch conditions can have a profound impact on dynamic range and loss measurements.

Singlemode launch is suitable for making accurate loss measurements in singlemode optical fiber. More coarse loss measurements can be made on multimode fiber.

Singlemode launch excites only the lowest order modes in multimode fiber. These low-order modes are less sensitive to losses caused by bending or connector/ splice misalignment.

Generally, multimode launch is suitable only for making measurements on multimode fibers because the coupling efficiency into singlemode fiber is very low. Thus, the initial backscatter signal begins much lower than on multimode fiber. This reduces dynamic range dramatically.

Optical Link Loss

The optical link loss is the reduced amount of light energy that reaches the optical receiver end of the transmission link. There are four principle causes of optical fiber loss: attenuation, connector loss, bending loss and splice loss.

Attenuation. Light energy lost due to optical fiber characteristics (specified as dB/km). It is caused mainly by scattering, absorption and radiation.

Connector Loss. The mechanical means of connecting two lengths of optical fiber together so that they can be disconnected and reconnected easily. Connector loss is specified in dB.

Each type of connector has its own loss and mated reflectivity characteristics which can be affected by: dirt on the fiber mating surface, scratches on the fiber mating surface, misalignment of the fiber connector.

Bending Loss. A macrobend loss results when a fiber is bent in a circle and the radius of the curvature is larger

than the core diameter of the fiber.

A microbend loss is caused by distortion of fiber geometry where curvature of the distortion is comparable to the core diameter of the fiber (i.e., local distortion such as a pinch or stress point).

Both macrobends and microbends cause losses (specified in dB) that are both curvature and wavelength dependent.

Splice Loss. The light energy lost (specified in dB) by splicing two lengths of fiber together. Splices can be mechanical, chemical or thermal.

The splice characteristics can be affected by: poorly prepared fiber end surfaces, core misalignment (offset or tilt), distortions of the core/cladding, splicing different fiber types together, a discontinuous waveguide.

Optical Time Domain Reflectometers (OTDR)

OTDR's are fundamentally optical radar instruments that launch narrow optical pulses into one end of an optical fiber.

The return signal is then fed into an optical receiver. The electrical signal output by the receiver is amplified, sampled and displayed as a waveform that can be analyzed for amplitude and time characteristics.

If the index of refraction for the fiber is known, the distance to any point on the waveform can be determined from the time domain.

Reflective Fault

A fault that has a reflective component that is detectable above the backscatter level at that location.

Reflective Feature

An event that has a reflective component that is 3 dB or more above the backscatter level at that location, but does not have a loss greater than the currently-defined threshold.

U.S./Metric Equivalents

1 mile	= 1609.3 meters; 1.6093 km
1 km	= 0.62137 mile
1 meter	= 3.28 feet
1 foot	= 0.3048 meter

Appendix B. LONG RANGE PORT

Introduction

Appendix B contains application information that pertains to instruments equipped with the Long Range Laser Output Port. The Long Range Port is used for testing singlemode fibers with lengths up to 45 km (~28 miles) typically.

Break Finder and Fault Finder Modes

If you use the Long Range Port you have three test options: 1) test in Break Finder Mode only; 2) test in Fault Finder Mode only, or 3) configure FiberScout so that it will prompt you to select either Break Finder Mode or Fault Finder Mode for each test (called Finder Select Mode).

How to select one of these options is explained in the *Operator Manual Supplement.*

Break Finder Mode

Break Finder Mode locates significant reflective events and catastrophic faults (i.e., breaks) quickly and easily. Three kinds of events are searched for:

1) A reflective or non-reflective fault with loss equal to or greater than 4 dB;
2) a reflection equal to or greater than 3 dB above backscatter;
3) the maximum range reachable by FiberScout.

Fault Finder Mode

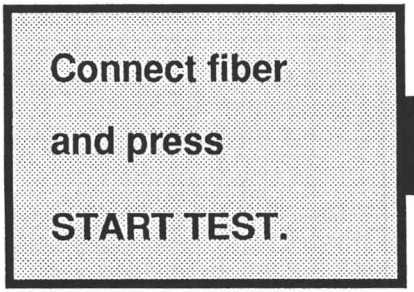
Fault Finder Mode provides the option to choose a fault detection level that is significant for the particular system under test; i.e., either 1, 2, 3 or 4 dB. FiberScout will then search for either reflective or non-reflective faults with loss equal to or greater than your selected threshold.

Also, if the Reflections setup is turned on, all reflective features with reflective heights above backscatter that are greater than a predetermined threshold value will be reported.

See the *Operator Manual Supplement* for detailed information about the Reflections setup.

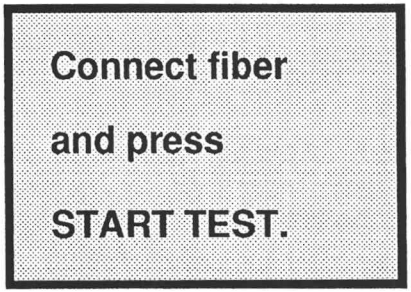
Break Finder Mode Only

If you configure FiberScout to test in Break Finder Mode only, FiberScout will test in Break Finder Mode when you respond to this start-up prompt, and each time thereafter when you press the **START TEST** button:



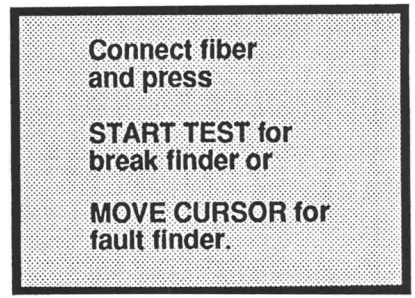
Fault Finder Mode Only

If you configure FiberScout to test in Fault Finder Mode only, FiberScout will test in Fault Finder Mode when you respond to this start-up prompt, and each time thereafter when you press the **START TEST** button:



Finder Select Mode

If you configure FiberScout so that you can choose to test in either Fault Finder Mode or Break Finder Mode for each test, FiberScout will ask you to select one mode when this prompt is displayed:

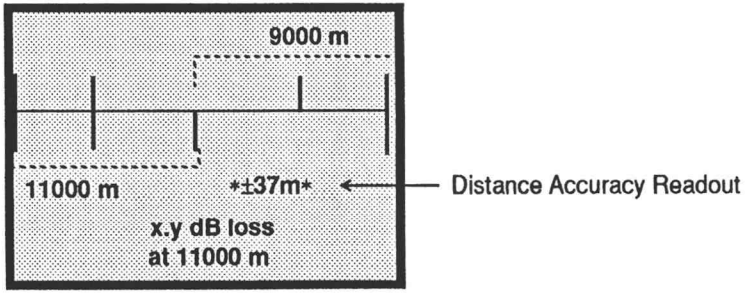


You must press **START TEST** to begin testing in Break Finder Mode, or **MOVE CURSOR** to begin testing in Fault Finder Mode.

If you want to test in the other mode after testing in one mode, press **START TEST**. This prompt will redisplay and wait for your response.

Distance Accuracy

When a non-reflective fault is detected using the Long Range Port, its distance accuracy may increase with longer processing time. If distance accuracy can be improved, the fault's distance accuracy readout figure will be flagged with a pair of asterisks. Example:



As long as the cursor remains on the fault, distance accuracy will improve for up to approximately 10 minutes, or until FiberScout can no longer improve the accuracy level. When the asterisks disappear from the readout, maximum distance accuracy has been obtained.

To quit acquiring more accurate distance data and move to the next event, press **MOVE CURSOR**.

Other Information

The Long Range port also reports specific information concerning the loss of each fault detected. Refer to the specifications for both Break Finder Mode and Fault Finder Mode on the following pages for details.

Specifications - Long Range Port (Break Finder Mode) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Fault Measurement Range	≥16 dB	≥40 km (~25 miles)
Distance Accuracy[4]		
To Reflective Event	±5 m (16.4 ft.)	
To Non-Reflective Fault	±200 m (656 ft.)	First pass accuracy; Second pass accuracy will typically be ≤±30 m (98.4 ft.)[5]
Loss Measurement Repeatability	±0.5 dB	
Reflective Event Detection		
Loss Less than 4 dB	Reflections >3 dB above backscatter (@ 1 km pulsewidth)	Typical minimum reflectivity of -35 dB
Loss greater than 4 dB	Reflections >3 dB above backscatter (@ 100 m pulsewidth)	Typical minimum reflectivity of -45 dB up to ~30 km. After that the minimum reflectivity increases proportionally to backscatter slope.

See Page B-10 for notes.

Specifications - Long Range Port (Break Finder Mode cont.) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Two-Event Resolution		
Reflective Event to Reflective Event		
Distance to Detect a Secondary Reflection	≤150 m (492 ft.)	At faults ≥4 dB
Reflective Event to Reflective Event, or Reflective Event to Non-Reflective Fault		
Distance to Separate Loss Between Events	≤2700 m (8856 ft.)	Up to40 km (~25 miles)

See Page B-10 for notes.

Specifications - Long Range Port (Break Finder Mode cont.) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Non-Reflective Fault to Non-Reflective Fault		
Distance to Separate Loss Between Events	≤2500 m (8200 ft.)	Up to 40 km (~25 miles)
Optical Output		
Wavelength	1300 nm ±25 nm	
Peak Optical Power Output	≥8.75 mW	
Pulsewidths	1 µs, 10 µs ±1%	
Laser Safety	Class I, 21 CFR 1040	
Output Core Size	8 to 10 microns	

See Page B-10 for notes.

Notes:

1. *Actual measurements obtained will depend upon: number of faults, reflectivity of each fault, loss value of each fault, quality of fiber connection to FiberScout and the fiber attenuation factor.*
2. *Use of highly reflective jumpers or highly reflective fiber terminations can degrade the specifications.*
3. *All distance values are based on an assumed fiber attenuation of 0.4 dB/km, no events.*
4. *±quantization error in the index of refraction setting and timebase accuracy: approximately 0.01% of distance measured.*
5. *Until distance accuracy is less than 30 m (98.4 ft.) or up to approximately 10 minutes.*

Specifications - Long Range Port (Fault Finder Mode) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Fault Measurement Range	≥16 dB	≥40 km (~25 miles)
Distance Accuracy[4]		
To Reflective Event	±5 m (16.4 ft.)	Entire dynamic range
To Non-Reflective Fault[5]	±5 m (16.4 ft.) ±20 m (65.6 ft.) ±200 m (656 ft.)	First pass accuracy: Up to 10 km (~6 miles) Up to 22 km (~14 miles) Up to 40 km (~25 miles)
		Second pass accuracy will typically be ≤ ±30 m (98.4 ft.) [6]
Loss Measurement Repeatability	±0.3 dB	

See Page B-15 for notes.

Specifications - Long Range Port (Fault Finder Mode cont.) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Reflective Event Detection at 1 dB Fault Threshold		
Loss Less than 1.0 dB	Reflections >1.0 dB above backscatter (@ 1 km pulsewidth)	Typical minimum reflectivity of -42 dB
Loss Greater than 1.0 dB	Reflections >1.0 dB above backscatter (@ 100 m pulsewidth)	Typical minimum reflectivity of -52 dB up to ~30 km. After that the minimum reflectivity increases proportional to backscatter slope.
	Reflections >1.5 dB above backscatter (@ 20 m pulsewidth)	Typical minimum reflectivity of -57 dB up to ~10 km. After that, minimum reflectivity increases proportional to backscatter slope.

See Page B-15 for notes.

Specifications - Long Range Port (Fault Finder Mode cont.) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Two-Event Resolution		
Reflective Event to Reflective Event		
Distance to Detect a Secondary Reflection	≤40 m (131.2 ft.)	Entire dynamic range
Reflective Event to Reflective Event, or Reflective Event to Non-Reflective Fault		
Distance to Separate Loss Between Events	≤150 m (492 ft.) ≤400 m (1312 ft.) ≤2700 m (8856 ft.)	Up to 10 km (~6 miles) Up to 22 km (~14 miles) Up to 40 km (~25 miles)

See Page B-15 for notes.

Specifications - Long Range Port (Fault Finder Mode cont.) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Non-Reflective Fault to Non-Reflective Fault		
Distance to Separate Loss Between Events	≤50 m (164 ft.) ≤250 m (820 ft.) ≤2500 m (8200 ft.)	Up to 10 km (~6 miles) Up to 22 km (~14 miles) Up to 40 km (~25 miles)
Optical Output		
Wavelength	1300 nm ±25 nm	
Peak Optical Power Output	≥8.75 mW	
Pulsewidths	200 ns, 1 µs, 10 µs ±1%	
Laser Safety	Class I, 21 CFR 1040	
Output Core Size	8 to 10 microns	

See Page B-15 for notes.

Notes:

1. *Actual measurements obtained will depend upon: threshold setting, number of faults, reflectivity of each fault, loss value of each fault, quality of fiber connection to FiberScout and the fiber attenuation factor.*
2. *Use of highly reflective jumpers or highly reflective fiber terminations can degrade the specifications.*
3. *All distance values are based on a factory default assumed fiber attenuation of 0.40 dB/km, no events.*
4. *±quantitative error in the index of refraction setting and timebase accuracy: approximately 0.01% of distance measured.*
5. *Event must be completely non-reflective. A reflective component of less than 1 dB above the backscatter level at the fault location may cause worst-case distance errors up to ±500 m (1640 ft.).*
6. *Until distance accuracy is less than 30 m (98.4 ft.) or up to approximately 10 minutes.*

Appendix C. UNIVERSAL SHORT RANGE PORT

Introduction

Appendix C contains application information that pertains to instruments equipped with the Universal Short Range Laser Output Port.

Description

The Universal Short Range Port is used for high-resolution testing at short distances. It is basically a catastrophic fault finder that detects and reports breaks in both singlemode and multimode fibers. Use the Universal Short Range Port to test singlemode fibers with total lengths of approximately 4 km (13,120 ft.), and multimode fibers with total lengths of 1 to 3 km (3280 to 9840 ft.).

The Universal Short Range Port is designed for use in three basic applications:

1) To supplement a Long Range Port by providing better two-event resolution. This lets you narrow-down where a singlemode fiber's problem exists near the front panel (i.e., inside the central office).

2) To be a stand-alone port for locating significant faults in short-distance singlemode applications where events are often closely spaced (i.e., subscriber feeders, fibers to the home).

3) To be a stand-alone port for locating breaks and most major faults in multimode fibers.

Because of its 8-micron launch condition, and because of wavelength differences from that of the Long Range Port, the loss threshold is preset at the factory and cannot be changed by the user. This means that all faults reported will have losses equal to or greater than 1 dB. However, this does not mean that all faults with 1 dB of loss will be reported (refer to "Optical Fiber Discussion" below).

The Universal Short Range Port does not report specific information concerning the loss of each fault detected. Refer to the specifications on the following pages for details.

Optical Fiber Discussion

Before describing the operation and limitations of the Universal Short Range Port, let's review some basic properties of optical fibers.

Optical fibers are generally classified in two groups: multimode and singlemode. These groups are distinguished by the number of optical modes they carry. The number of modes, in turn, is determined by the physical characteristics of the fiber, such as core diameter and numerical aperture.

Multimode fibers generally have a core diameter between 50 and 100 microns, and a numerical aperture of about 0.25. Common multimode fibers carry hundreds of modes at all visible and near infrared wavelengths.

Singlemode fibers have a lower limit called the cutoff wavelength below which they stop carrying only one mode. Typical singlemode fibers have a core diameter of 9 microns, a numerical aperture of 0.12 and a cutoff wavelength of about 1280 nm.

Most events on singlemode fibers are sensitive to wavelength. A good example of this is a simple bend where losses are more severe at 1550 nm than 1300 nm.

Because of this wavelength sensitivity, loss measurements with the Universal Short Range Port (which operates at 850 nm) will not correlate directly to system losses where normal operation is at 1300 or 1550 nm.

Furthermore, 850 nm is below the cutoff wavelength of most singlemode fibers, so events that exhibit mode dependencies may contribute to any loss measurement discrepancy.

This is the reason for not allowing user-set thresholds and not reporting specific loss measurements with the Universal Short Range Port.

From a standpoint of fault location, these wavelength effects do not result in an insurmountable problem. This is because the effects are small or the losses are greater at 850 nm than at 1300 nm. In the majority of cases, the Universal Short Range Port, with its factory preset threshold, can find events on a singlemode fiber that are over 1 dB.

However, loss measurements on multimode fibers are usually more sensitive to mode distribution than to wavelength. This is because most events in multimode fibers attenuate some modes more than others. The higher order modes are generally attenuated more than the lower order modes. Still, in most cases, the Universal Short Range Port will be able to locate breaks or large-loss faults in multimode fibers.

Note that reflective events are usually mode-independent, so only the measurement of events with loss are affected by launch conditions.

Summary

The Universal Short Range Port has a 9-micron fiber that allows it to test either singlemode or multimode fibers. However, on multimode fibers, the launch condition is underfilled. This means that the Universal Short Range Port excites only low-order modes.

Most multimode systems excite a much larger number of modes. Consequently, events that are mode-selective will probably exhibit greater system loss than the Universal Short Range Port will be able to detect. This underfilled launch condition may mean that, in certain cases on multimode fibers, only breaks or catastrophic losses will be detected.

On singlemode fibers, any loss greater than 1 dB will generally be reported.

Specifications - Universal Short Range Port

Category	Performance Requirement[1,2]	Supplemental Information
Fault Measurement Range	≥7.5 dB	Up to 3 km @ 2.5 dB/km (singlemode fiber) Up to 1.3 km @ 3.5 dB/km (62.5 nm multimode fiber)
Distance Accuracy[3]		
To Reflective Event	±2 m (6.56 ft.)	
To Non-Reflective Fault	±2 m (6.56 ft.)	
Two-Event Resolution Reflective Event to Reflective Event		
1. Distance to Detect a Secondary Reflection	≤10 m (32.8 ft.)	≤5 m (16.4 ft.) typical
2. Distance to Determine Which Event is Responsible for Major Fault	≤60 m (196.8 ft.)	≤40 m (131.2 ft.) typical

See Page C-7 for notes.

Specifications - Universal Short Range Port (cont.)

Category	Performance Requirement[1,2]	Supplemental Information[3]
Reflective Event to Non-Reflective Fault		
Distance to Determine Which Event is Responsible for Major Fault	≤60 m (196.8 ft.)	≤40 m (131.2 ft.) typical
Non-Reflective Fault to Non-Reflective Fault		
Distance to Determine Which Event is Responsible for Major Fault	≤15 m (49.2 ft.)	
Optical Output		
Wavelength	850 nm +20 nm, -50 nm	
Peak Optical Power Output	≥30 mW	
Pulsewidths	10 ns ±20%, 50 ns ±10%	
Laser Safety	Class I, 21 CFR 1040	
Output Core Size	8 to 10 microns	

See Page C-7 for notes.

Notes:

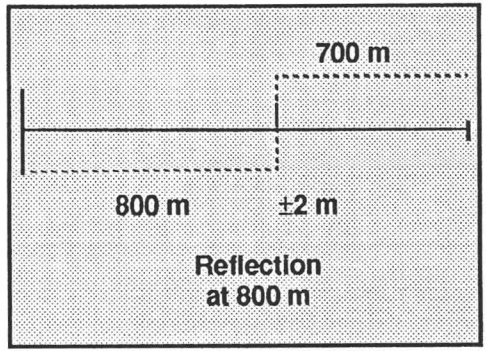
1. Actual measurements obtained will depend upon: number of faults, reflectivity of each fault, loss value of each fault, quality of fiber connection to FiberScout and the fiber attenuation factor.

2. Use of highly reflective jumpers or highly reflective fiber terminations can degrade the specifications.

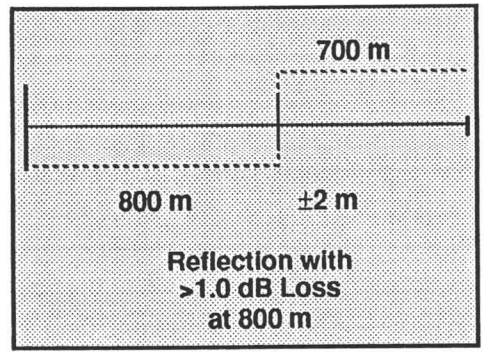
3. ± quantitative error in index of refraction setting and timebase accuracy: approximately 0.01% of distance measured.

Reporting Specific Events

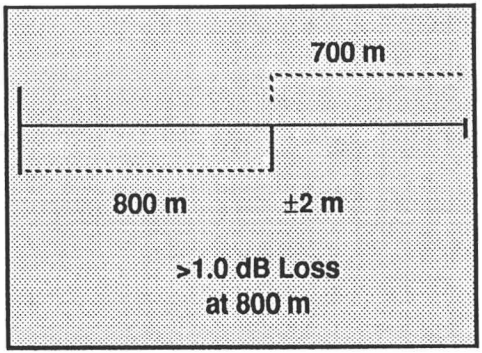
A user-selectable threshold is not available with the Universal Short Range Port. All faults reported will have a loss equal to or greater than 1 dB. The specific displays affected are as follows:



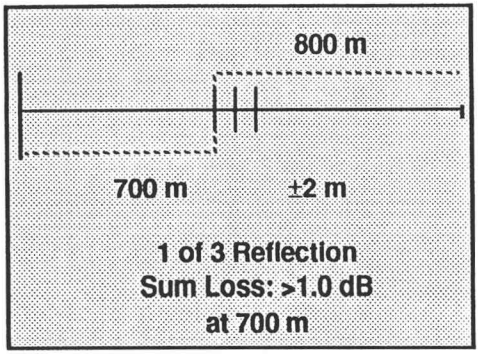
Explanation: The cursor is on a reflective feature with loss less than FiberScout can detect. The Reflections setup must be turned on to allow this type of fault to be reported.



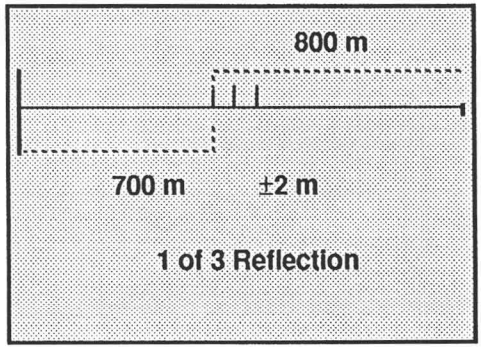
Explanation: The cursor is on a reflective fault with loss equal to or greater than 1.0 dB.



Explanation: The cursor is on a non-reflective fault with loss equal to or greater than 1.0 dB.



Explanation: The cursor is on the first of three reflective events. The combined loss is greater than 1.0 dB. However, the reflections are so close together that FiberScout cannot measure the loss at each fault. *If the number of reflections exceeds nine, the first line of the message will read ">9 Reflection."*



Explanation: The cursor is on the first of three reflective features having a combined loss less than FiberScout can detect. The Reflections setup must be turned on to allow this type of fault to be reported. *If the number of reflections exceeds nine, the first line of the message will read ">9 Reflection."*

Appendix D. MULTIMODE SHORT RANGE PORT

Introduction

Appendix D contains application information that pertains to instruments equipped with the Multimode Short Range Laser Output Port.

Description

The Multimode Short Range Port is used for testing multimode fibers with total lengths to approximately 3 km (9840 ft.).

The launch condition from the Multimode Short Range Port is a Gaussian mode distribution in a 62.5 micron fiber; i.e., the accuracy specifications are in respect to the testing of a 62.5 micron fiber. However, any core size multimode fiber can be tested, but FiberScout may not meet the detailed specifications listed on the following pages.

For information about multimode fibers with core sizes other than 62.5 microns, contact the Tektronix Redmond Division at 1-800-833-9200 (USA), or your local Tektronix representative.

User-Selectable Threshold

The Multimode Short Range Port features a user-selectable loss threshold that allows you select a fault threshold level of either 1, 2, 3 or 4 dB. This enables users to choose a fault detection level that is significant for the particular system under test. For information about choosing a threshold level, refer to the *Operator Manual Supplement*. (Note that the initial threshold is factory-set at 3 dB).

Other Information

The Multimode Short Range Port also reports specific information concerning the loss of each fault detected. Refer to the specifications on the following pages for details.

Specifications - Multimode Short Range Port

Category	Performance Requirement[1,2]	Supplemental Information[3]
Fault Measurement Range	≥10.5 dB	Up to 3 km (9840 ft.)
Distance Accuracy[4]		
To Reflective Event	±2 m (6.56 ft.)	
To Non-Reflective Fault	±2 m (6.56 ft.)	
Loss Measurement Repeatability	±0.2 dB	
Reflective Event Detection	Reflections >3 dB above backscatter @ 5 m pulsewidth	Typical minimum reflectivity of -44 dB up to ~3 km
Two-Event Resolution		
Reflective Event to Reflective Event		
Distance to Detect a Secondary Reflection	≤10 m (32.8 ft.)	≤5 m (16.4 ft.) typical

See Page D-5 for notes.

Specifications - Multimode Short Range Port (cont.)

Category	Performance Requirement[1,2]	Supplemental Information[3]
Reflective Event to Reflective Event, or Reflective Event to Non-Reflective Fault		
Distance to Separate Loss Between Events	≤40 m (131.2 ft.) ≤60 m (196.8 ft.)	Up to 1.5 km (4920 ft.) Up to 3 km (9840 ft.)
Non-Reflective Fault to Non-Reflective Fault		
Distance to Separate Loss Between two Non-Reflective Faults	≤15 m (49.2 ft.)	≤13 m (42.6 ft.) typical
Optical Output		
Wavelength	850 nm +20 nm, -50 nm	
Peak Optical Power Output	≥500 mW	
Pulsewidths	10 ns ±20%, 50 ns ±10%	
Laser Safety	Class I, 21 CFR 1040	
Output Core Size	62.5 microns	

See Page D-5 for notes.

Notes:

1. Actual distances obtained depend upon threshold setting, number of events, reflective component size, loss value of each fault, fiber attenuation and the quality of the fiber's connection to FiberScout.

2. Use of highly reflective jumpers or highly reflective fiber terminations can degrade these specifications.

3. All distance values are based on an assumed fiber attenuation of 3.5 dB/km and an assumed core size of 62.5 nm.

4. ± quantitative error in the index of refraction setting and timebase accuracy: approximately 0.01% of distance measured.

Appendix E. EXTENDED LONG RANGE PORT

Introduction

Appendix E contains application information that pertains to instruments equipped with the Extended Long Range Laser Output Port. The Extended Long Range Port is used for testing singlemode fibers with lengths up to 64 km (~40 miles) typically.

Break Finder and Fault Finder Modes

If you use the Extended Long Range Port you have three test options: 1) test in Break Finder Mode only; 2) test in Fault Finder Mode only, or 3) configure FiberScout so that it will prompt you to select either Break Finder Mode or Fault Finder Mode for each test (called Finder Select Mode).

How to select one of these options is explained in the *Operator Manual Supplement.*

Break Finder Mode

Break Finder Mode locates significant reflective events and catastrophic faults (i.e., breaks) quickly and easily. Three kinds of events are searched for:

1) A reflective or non-reflective fault with loss equal to or greater than 4 dB;
2) a reflection equal to or greater than 3 dB above backscatter;
3) the maximum range reachable by FiberScout.

Fault Finder Mode

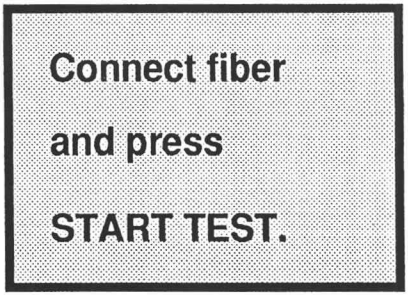
Fault Finder Mode provides the option to choose a fault detection level that is significant for the particular system under test; i.e., either 1, 2, 3 or 4 dB. FiberScout will then search for either reflective or non-reflective faults with loss equal to or greater than your selected threshold.

Also, if the Reflections setup is turned on, all reflective features with reflective heights above backscatter that are greater than a predetermined threshold value will be reported.

See the *Operator Manual Supplement* for detailed information about the Reflections setup.

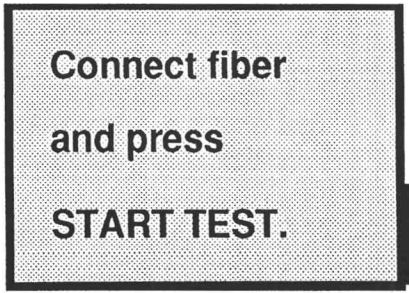
Break Finder Mode Only

If you configure FiberScout to test in Break Finder Mode only, FiberScout will test in Break Finder Mode when you respond to this start-up prompt, and each time thereafter when you press the **START TEST** button:



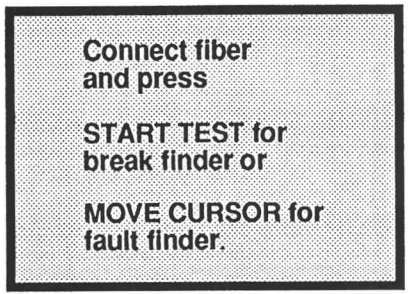
Fault Finder Mode Only

If you configure FiberScout to test in Fault Finder Mode only, FiberScout will test in Fault Finder Mode when you respond to this start-up prompt, and each time thereafter when you press the **START TEST** button:



Finder Select Mode

If you configure FiberScout so that you can choose to test in either Fault Finder Mode or Break Finder Mode for each test, FiberScout will ask you to select one mode when this prompt is displayed:

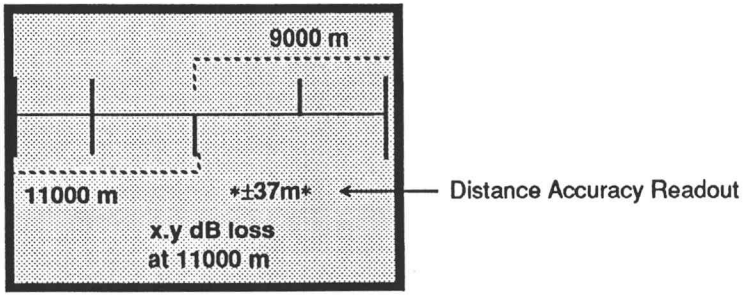


You must press **START TEST** to begin testing in Break Finder Mode, or **MOVE CURSOR** to begin testing in Fault Finder Mode.

If you want to test in the other mode after testing in one mode, press **START TEST**. This prompt will redisplay and wait for your response.

Distance Accuracy

When a non-reflective fault is detected using the Extended Long Range Port, its distance accuracy may increase with longer processing time. If distance accuracy can be improved, the fault's distance accuracy readout figure will be flagged with a pair of asterisks. Example:



As long as the cursor remains on the fault, distance accuracy will improve for up to approximately 10 minutes, or until FiberScout can no longer improve the accuracy level. When the asterisks disappear from the readout, maximum distance accuracy has been obtained.

To quit acquiring more accurate distance data and move to the next event, press **MOVE CURSOR**.

Other Information

The Extended Long Range port also reports specific information concerning the loss of each fault detected. Refer to the specifications for both Break Finder Mode and Fault Finder Mode on the following pages for details.

Specifications - Extended Long Range Port (Break Finder Mode) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Fault Measurement Range	≥16 dB	≥64 km (~40 miles)
Distance Accuracy[4]		
To Reflective Event	±5 m (16.4 ft.)	
To Non-Reflective Fault	±200 m (656 ft.)	First pass accuracy; Second pass accuracy will typically be ≤ ±30 m[5]
Loss Measurement Repeatability	±0.5 dB	
Reflective Event Detection		
Loss Less than 4 dB	Reflections >3 dB above backscatter (@ 1 km pulsewidth)	Typical minimum reflectivity of -37 dB
Loss greater than 4 dB	Reflections >3 dB above backscatter (@ 100 m pulsewidth)	Typical minimum reflectivity of -47 dB up to ~40 km. After that the minimum reflectivity increases proportionally to backscatter slope.

See Page E-10 for notes.

Specifications - Extended Long Range Port (Break Finder Mode cont.) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Two-Event Resolution		
Reflective Event to Reflective Event		
Distance to Detect a Secondary Reflection	≤150 m (492 ft.)	At faults ≥4 dB
Reflective Event to Reflective Event, or Reflective Event to Non-Reflective Fault		
Distance to Separate Loss Between Events	≤2700 m (8856 ft.)	Up to 64 km (~40 miles)

See Page E-10 for notes.

Specifications - Extended Long Range Port (Break Finder Mode cont.) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Non-Reflective Fault to Non-Reflective Fault		
Distance to Separate Loss Between Events	≤2500 m (8200 ft.)	Up to 64 km (~40 miles)
Optical Output		
Wavelength	1550 nm ±25 nm	
Peak Optical Power Output	≥6.5 mW	
Pulsewidths	1 µs, 10 µs ±1%	
Laser Safety	Class I, 21 CFR 1040	
Output Core Size	8 to 10 microns	

See Page E-10 for notes.

Notes:

1. *Actual measurements obtained will depend upon: number of faults, reflectivity of each fault, loss value of each fault, quality of fiber connection to FiberScout and the fiber attenuation factor.*
2. *Use of highly reflective jumpers or highly reflective fiber terminations can degrade the specifications.*
3. *All distance values are based on an assumed fiber attenuation of 0.25 dB/km, no events.*
4. *±quantization error in the index of refraction setting and timebase accuracy: approximately 0.01% of distance measured.*
5. *Until distance accuracy is less than 30 m (98.4 ft.) or up to approximately 10 minutes.*

Specifications - Extended Long Range Port (Fault Finder Mode) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Fault Measurement Range	≥16 dB	≥64 km (~40 miles)
Distance Accuracy[4]		
To Reflective Event	±5 m (16.4 ft.)	Entire dynamic range
To Non-Reflective Fault[5]		First pass accuracy:
	±5 m (16.4 ft.)	Up to 16 km (~10 miles)
	±20 m (65.6 ft.)	Up to 40 km (~25 miles)
	±200 m (656 ft.)	Up to 64 km (~40 miles)
		Second pass accuracy will typically be ≤ 30 m (98.4 ft.)[6]
Loss Measurement Repeatability	±0.3 dB	

See Page E-15 for notes.

Specifications - Extended Long Range Port (Fault Finder Mode cont.) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Reflective Event Detection at 1 dB Fault Threshold		
Loss Less than 1.0 dB	Reflections >1.0 dB above backscatter (@ 1 km pulsewidth)	Typical minimum reflectivity of -45 dB
Loss Greater than 1.0 dB	Reflections >1.0 dB above backscatter (@ 100 m pulsewidth)	Typical minimum reflectivity of -54 dB up to ~40 km. After that the minimum reflectivity increases proportional to backscatter slope.
	Reflections >1.5 dB above backscatter (@ 20 m pulsewidth)	Typical minimum reflectivity of -59 dB up to ~16 km. After that, minimum reflectivity increases proportional to backscatter slope.

See Page E-15 for notes.

Specifications - Extended Long Range Port (Fault Finder Mode cont.) [1]

Category	Performance Requirement[2]	Supplemental Information[3]
Two-Event Resolution		
Reflective Event to Reflective Event		
Distance to Detect a Secondary Reflection	≤40 m (131.2 ft.)	Entire dynamic range
Reflective Event to Reflective Event, or Reflective Event to Non-Reflective Fault		
Distance to Separate Loss Between Events	≤150 m (492 ft.) ≤400 m (1312 ft.) ≤2700 m (8858 ft.)	Up to 16 km (~10 miles) Up to 40 km (~25 miles) Up to 64 km (~40 miles)

See Page E-15 for notes.

Specifications - Extended Long Range Port (Fault Finder Mode cont.)

Category	Performance Requirement[1,2]	Supplemental Information[3]
Non-Reflective Fault to Non-Reflective Fault		
Distance to Separate Loss Between Events	≤50 m (164 ft.) ≤250 m (820 ft.) ≤2500 m (8200 ft.)	Up to 16 km (~10 miles) Up to 40 km (~25 miles) Up to 64 km (~40 miles))
Optical Output		
Wavelength	1550 nm ±25 nm	
Peak Optical Power Output	≥6.5 mW	
Pulsewidths	200 ns, 1 µs, 10 µs ±1%	
Laser Safety	Class I, 21 CFR 1040	
Output Core Size	8 to 10 microns	

See Page E-15 for notes.

Notes:

1. *Actual measurements obtained will depend upon: threshold setting, number of faults, reflectivity of each fault, loss value of each fault, quality of fiber connection to FiberScout and the fiber attenuation factor.*
2. *Use of highly reflective jumpers or highly reflective fiber terminations can degrade the specifications.*
3. *All distance values are based on an assumed fiber attenuation of 0.25 dB/km, no events.*
4. *±quantization error in the index of refraction setting and timebase accuracy: approximately 0.01% of distance measured.*
5. *Event must be completely non-reflective. A reflective component of less than 1 dB above backscatter level at the fault location may cause worst-case distance errors up to ± 500 m (1640 ft.).*
6. *Until distance accuracy is less than 30 m (98.4 ft.) or up to approximately 10 minutes.*

Appendix F. STORING/VIEWING/PRINTING TEST RESULTS

Introduction

Appendix F contains information about how to store test results in FiberScout's memory, and how to upload the results to an IBM-compatible PC for analysis, modification, archiving, etc. Any IBM-compatible PC may be used. (The PC application software and interface cable that enables downloading are available from Tektronix as optional accessories).

Appendix F also explains how to use a Seiko printer to generate an immediate hard copy of test results. Only the Seiko DPU411 and DPU201G printers are supported, and must be purchased separately from Seiko (phone 310-517-7783, fax 310-517-7792 for information). Printer interface cables are available from Tektronix as optional accessories.

Information stored in FiberScout's memory is non-volatile; i.e., it is preserved at power-down and if the battery is discharged or removed.

Appendix F is divided into three sections: (1) How to Store Test Results in Memory, (2) How to Upload to an IBM-Compatible PC, and (3) How to Use a Seiko Printer.

How to Store Test Results in Memory

Storage Capacity

The number of complete tests that can be stored depends on the number of events detected for each fiber. A table of typical values follows:

- 1 event per fiber - 119 tests stored
- 2 events per fiber - 74 tests stored
- 3 events per fiber - 54 tests stored
- 4 events per fiber - 43 tests stored
- 5 events per fiber - 35 tests stored
- 6 events per fiber - 30 tests stored
- 7 events per fiber - 26 tests stored

How to Activate Storage

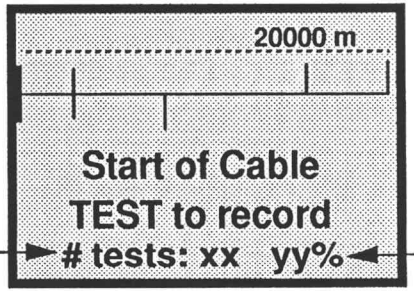
The storage of test results is enabled and disabled via the Test Setup Menu. The controlling menu item is Storage: <On/Auto/Off> (see the *Operator Manual Supplement* for instructions on how to access the Test Setup Menu and toggle through the selections).

Factory default is Storage: Off (storage turned off). Subsequent defaults are those in effect at last power-down.

Storage: On (Storage Turned On)

Storage turned on (Storage: On) enables manual storage of current test results.

To store test results currently displayed by FiberScout, move the cursor to the Start of Cable. This message will be displayed:



Shows number of tests currently in storage. Updated as each succeeding test is stored.

Indicates percentage of test storage memory used.

Press **START TEST** to copy current test results into storage. The "Test to record" message will disappear.

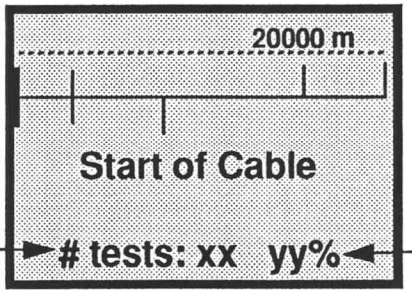
Long Range Non-Reflective Events. If you want to further process long range non-reflective events (events flagged with asterisks in the display) and store the results, move the cursor back through the other events in the test–pausing on the non-reflective events of interest–and back to the Start of Cable. Then press the START TEST button to store the updated results.

This method of storing multiple versions of the same test allows FiberScout to further resolve the accuracy of any long range non-reflective events that weren't completely resolved during the first pass.

Storage: Auto (Automatic Storage)

The automatic storage option (Storage: Auto) automatically stores each test result after it has been completed and displayed by FiberScout. User interaction is not necessary.

However, if you move the cursor to the Start of Cable, the following summary message will be displayed:



Shows number of tests currently in storage. Updated as each succeeding test is stored.

Indicates percentage of test storage memory used.

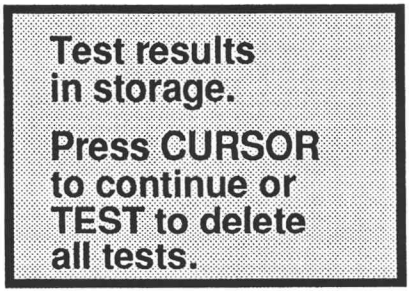
Long Range Non-Reflective Events. If you want to further process long range non-reflective events (events flagged with asterisks in the display) and store the results, move the cursor back through the other events in the test– pausing on the non-reflective events of interest–*and back to the Start of Cable.*

The updated results will automatically be stored when the cursor is moved to the Start of Cable *only if there were changes in the test result data.* If there were no changes in the test, storage will not occur.

Storage: Off (Storage Turned Off)

Storage turned off (Storage: Off) disables the storage of test results. Test results currently in storage may either be deleted or saved.

When you turn Storage off, you will be prompted with the following message when you exit the Test Setup Menu:

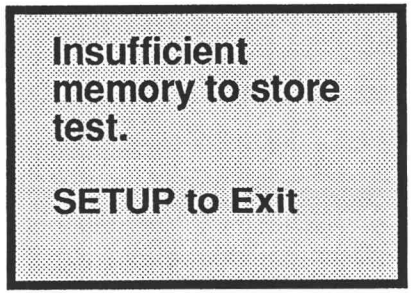


Press **MOVE CURSOR** to preserve the test results. Press **START TEST** to delete the test results.

Remember that this message will appear only when Storage was toggled from On (or Auto) to Off while there were test results in memory.

Insufficient Memory Available

If storage has been enabled, and there is insufficient memory to store additional test results, you will be prompted with this message when you try and store a test:



Press **VIEW SETUP** to return to normal testing.

Freeing Additional Storage and Saving Contents. If you want to free additional storage and preserve data currently in storage, upload the existing data to a PC. When data is uploaded, it will be deleted from storage (see "How to Upload to an IBM-Compatible PC" on the next page).

Freeing Additional Storage and Deleting Contents. If you want to free additional storage and delete data currently in storage, toggle the Storage item in the Test Setup Menu from On (or Auto) to Off (see Page F-5).

How to Upload to an IBM-Compatible PC

When the FiberScout/PC interface is properly set up, all test results currently in storage will be uploaded automatically when FiberScout is turned on.

Any IBM-compatible PC may be used for uploading. The software and interface cable that enables uploading are available from Tektronix as an optional accessory called FSTIP (FiberScout Test Interface Package). The software is housed on a 5.25 or 3.5 floppy disc; the interface cable is two-meters long with DB9 connectors at each end.

Uploading procedure:

(1) FiberScout must be turned *off*. Test results must be currently stored in FiberScout's memory.

(2) Connect the interface cable between FiberScout's RS232C connector and the COM1 or COM2 port on the PC (COM1 is the default).

RS232C DB9 Connector

(3) Power-up the PC. Access the directory in which you want to store the test results.

(4) Install the FSTIP software on the PC by copying the software to your current directory. Example: If the floppy is in your a drive, type **copy a:fstip.exe** .<cr> (<cr>means press the carriage return key).

(5) On the PC, type **fstip**<cr> to begin the program.

A message describing how the program works will appear on the PC screen together with the following prompts:

(a) Do you wish to continue, yes or no? Press **y**<cr> (or just <cr>) to continue program.

(b) Enter output file name prefix (5 chars max): Example: type **tests**<cr> for your prefix.

A complete filename consists of your prefix and <testnumber>.tfs as the suffix. In this example, tests012.tfs will be the filename for test number 12 after uploading to the PC. Test results will be uploaded sequentially; e.g., tests001.tfs, tests002.tfs, tests003.tfs, tests004.tfs, etc.

(c) Enter Operator Name: Name of test operator (optional). Example: type **Joe Smith**<cr> (or just press <cr> to skip this entry).

(d) Enter Fiber ID: Fiber identifier (optional). Example: type **12345**<cr> (or just press <cr> to skip this entry).

(e) Enter 1 if using COM1, 2 for COM2: Press **1**<cr> (or just <cr>) if using the PC's COM1 port; **2**<cr> if using COM2.

After answering these prompts, reminder messages to check cable connections, turn FiberScout on, etc., will appear on the PC screen.

(6) Turn FiberScout on (press **ON**).

FiberScout will attempt to communicate with the PC briefly (for about 15 seconds) during power-up.

Sending Test results to PC.
Test #: xx
CURSOR to Abort

If FiberScout and the PC are communicating, FiberScout will automatically begin uploading all stored test results to the PC, and display this message:

As each test result is being uploaded to the PC, its number will be displayed by FiberScout and the PC. All stored test results will be deleted from FiberScout's memory after they have been uploaded successfully.

If there is no communication[1] between FiberScout and the PC, FiberScout will power-up normally without any interaction with the PC.

NOTE: *Press the Esc (escape key) on the PC or MOVE CURSOR key on FiberScout to abort the program anytime during its operation.*

All test results will be deleted from FiberScout's memory only after all results have been successfully uploaded to the PC. If the uploading program is aborted before completion, all test results will be left intact in FiberScout's memory and nothing will be uploaded to the PC.

(7) After the test results have been uploaded to the PC, they may be viewed, printed or modified like any other file.

1. If proper communication is not achieved, check cable connections and software installation procedure. FiberScout must not be powered-up until all other PC operations are completed, and the message "Waiting for Tektronix TFS2020 to establish link" appears on the PC screen. Also, there will be no link unless there are tests stored in FiberScout.

How to Use a Seiko Printer

By connecting a Seiko printer directly to FiberScout, a hard copy of test results can be made in the field.

Only the Seiko DPU411and DPU201G printers are supported, and must be purchased separately from Seiko (phone 310-517-7783, fax 310-517-7792 for information). Interface cables for each printer are available as optional accessories. The cables connect the printers to FiberScout's RS232C DB9 connector.

Printer Selection

The print option is accessed via the Test Setup Menu. The controlling menu item is Printer: No Printer/<type> On/ <type> Auto (see the *Operator Manual Supplement* for instructions on how to access the Test Setup Menu and toggle through the selections).

The No Printer selection negates printing, and is the factory-set power-up default. Subsequent defaults are those in effect at last power-down.

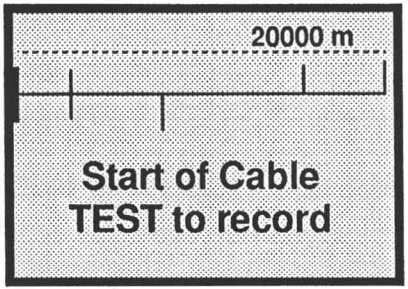
The <type> On and <type> Auto selections access the printer connected to FiberScout in either manual or automatic mode. In the menu, <type>is replaced by the type of printer being used. The menu will show either: "Seiko 201G On" or "Seiko 201G Auto;" "Seiko 411 On" or "Seiko 411 Auto."

NOTE: *When using a Seiko printer, power-up FiberScout before powering-up the printer. See Page F-13 for printer switch setups before using the printer.*

Printer <type>On (Printer Turned On)

Printing turned on (Printer: <type> On) enables the printing of test results currently displayed by FiberScout.

To print test results, move the cursor to the Start of Cable. This message will be displayed:



Press **START TEST** to print the current test results. The "Test to record" message[1] will disappear.

To abort the print in progress, press any front panel button on FiberScout or turn off the printer.

Long Range Non-Reflective Events. If you want to further process long range non-reflective events (events flagged with asterisks in the display) and print the results, move the cursor back through the other events in the test–pausing on the non-reflective events of interest–and back to the Start of Cable. Then press the START TEST button to print the updated results.

1. If the Storage option is turned on, test results will also be stored in FiberScout's memory as well as printed.

Printer <type>Auto (Automatic Print)

The automatic print option (Printer: <type> Auto) prints each test result after a test has been completed and displayed by FiberScout. User interaction is not necessary. It is not necessary to move the cursor to the Start of Cable or press the START TEST button to activate automatic printing.

Long Range Non-Reflective Events. If you want to further process long range non-reflective events (events flagged with asterisks in the display) and print the results, move the cursor back through the other events in the test–pausing on the non-reflective events of interest–*and back to the Start of Cable.*

The updated results will automatically be printed when the cursor is moved to the Start of Cable *only if there were changes in the test result data.* If there were no changes in the test, reprint will not occur.

Seiko Printer Switch Setups

Seiko DPU411 Switch Setup

Switch Number	Function	Required Selection	Switch Setting
DIP101			
Sw1	Input data format	Serial Input	Off
Sw2	Auto line feed	-	Off
Sw3	No. of columns/line	80	Off
Sw4	Character selection	Regular	On
Sw5	Zero form selection	-	Off
Sw6-8	International characters	USA	Sw6-Off, Sw7-On, Sw8-On
DIP102			
Sw1	Data bit length	7 bits	Off
Sw2	Parity permission	With	Off
Sw3	Parity setting	Even	Off
Sw4-6	Baud rate setting	4800	Sw4-Off, Sw5-Off, Sw6-On

Seiko DPU201G Switch Setup

Switch Number	Function	Required Selection	Switch Setting
Sw1	Data bit length	7 bits	Off
Sw2	Parity permission	With	Off
Sw3	Parity setting	Even	Off
Sw4-6	Baud rate setting	4800	Sw4-Off, Sw5-On, Sw6-Off

Appendix X. FIBERSCOUT/OTDR COMPARISONS

Introduction

Appendix X shows comparisons between typical FiberScout displays and how the fiber would look on an OTDR (Optical Time Domain Reflectometer).

FiberScout operates by sending a series of short pulses down an optical fiber. Because of microscopic discontinuities in the fiber, part of each pulse is scattered back to FiberScout. Also, some components such as connectors reflect part of each pulse.

FiberScout measures the intensity and time of arrival of this radiation, and uses the information to determine distance to and size of events along the fiber.

FiberScout's method of operation is similar to that of an OTDR. One difference is the way information about the fiber is displayed.

An OTDR displays a trace of the fiber, and requires you to interpret the display and make measurements on the events.

FiberScout interprets the data for you, and provides a symbolic display that automatically identifies events and displays information about loss and distance for each event.

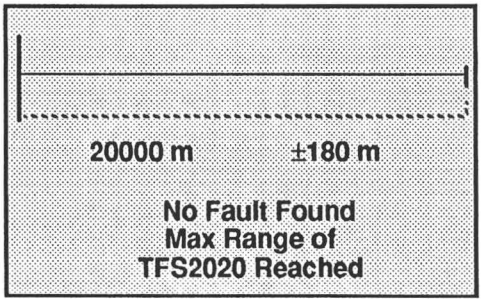
In the FiberScout/OTDR examples on the following pages, the terms "ALL" (Accurate Loss Level) and "ESL" (End of Search Level) are used:

- ALL is the minimum signal-to-noise level required for FiberScout to make repeatable loss measurements.
- ESL refers to the minimum signal-to-noise level required for FiberScout to consistently detect faults.

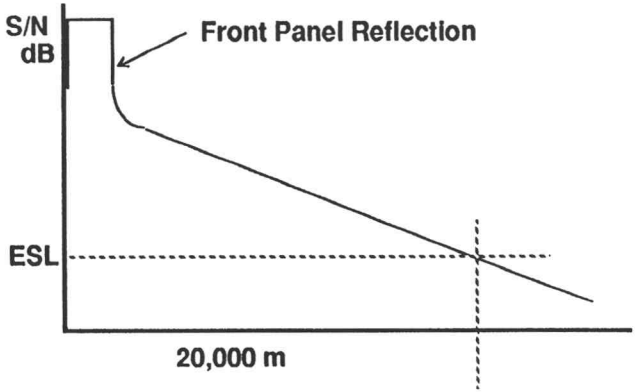
NOTE

The distance tolerances and loss values used in the following examples are illustrative only. They should not be used to infer any performance specifications for FiberScout.

FiberScout Display

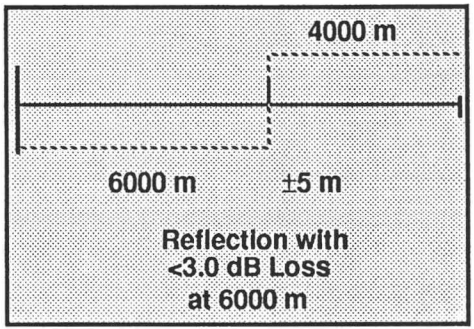


Equivalent OTDR Display

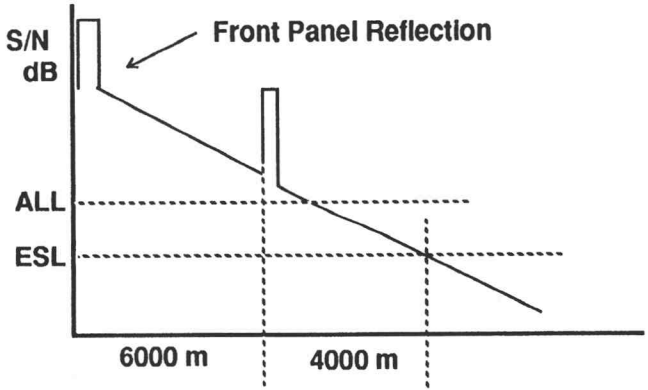


Explanation: No events have been found. FiberScout does not have adequate dynamic range to reliably test beyond 20,000 meters.

FiberScout Display

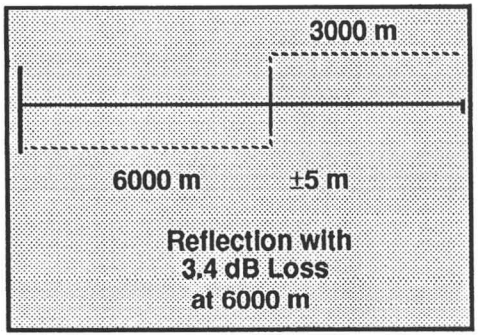


Equivalent OTDR Display

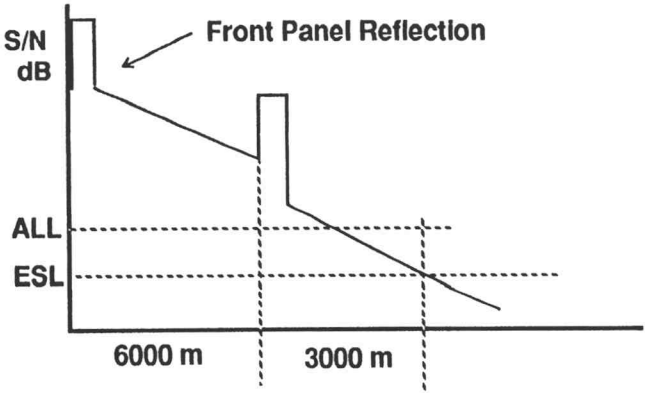


Explanation: The cursor is on a reflective feature with loss less than threshold. In this example the threshold is set at 3.0 dB.

FiberScout Display

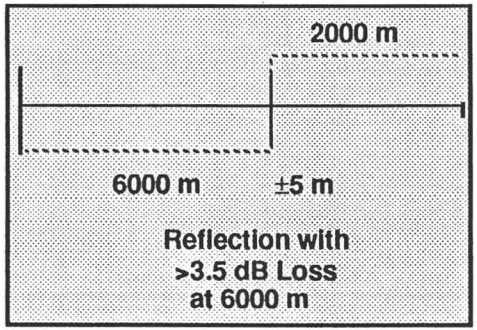


Equivalent OTDR Display

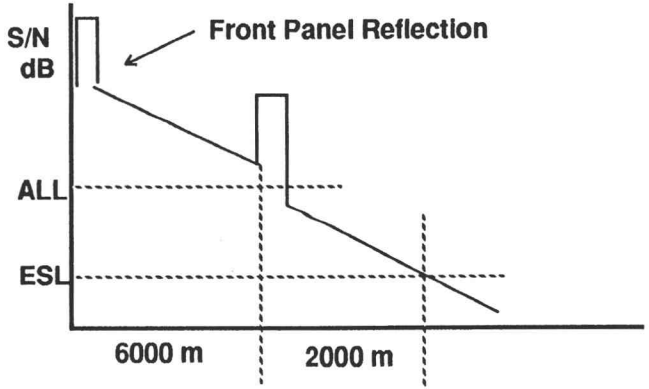


Explanation: The cursor is on a reflective fault with loss greater than threshold. In this example the threshold is set at 3.0 dB or less.

FiberScout Display

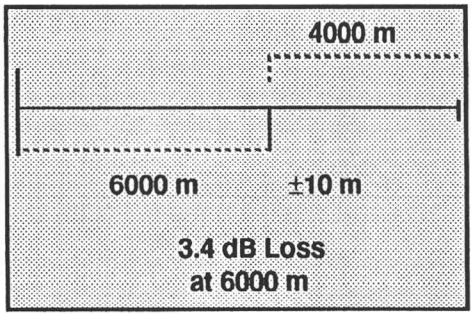


Equivalent OTDR Display

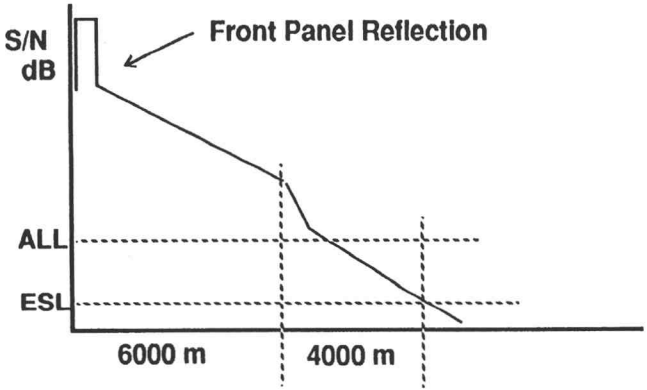


Explanation: The cursor is on a reflective fault with loss greater than threshold (3.0 dB or more in this example). Because the signal-to-noise ratio near the fault is low, FiberScout cannot make a loss measurement within the specified tolerance for the Laser Output port being used.

FiberScout Display

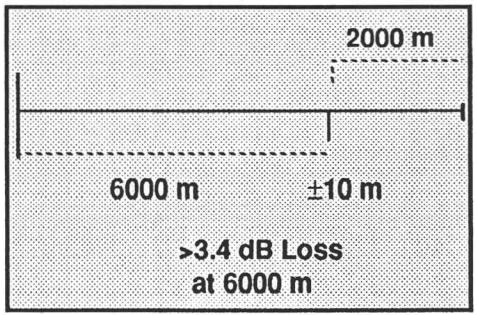


Equivalent OTDR Display

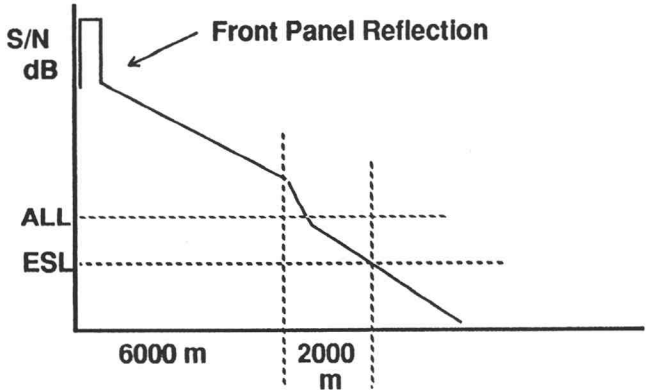


Explanation: The cursor is on a non-reflective fault with loss greater than threshold (3.0 dB or more in this example).

FiberScout Display

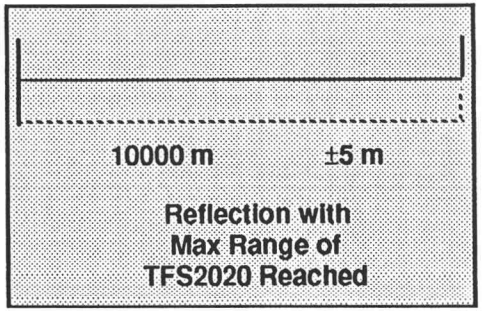


Equivalent OTDR Display

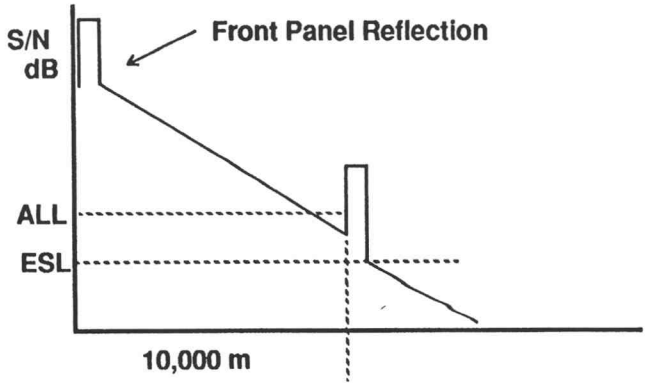


Explanation: The cursor is on a non-reflective fault with loss greater than threshold (3.0 dB or more in this example). Because the signal-to-noise ratio near the fault is low, FiberScout cannot make a loss measurement within the specified tolerance for the Laser Output port being used.

FiberScout Display

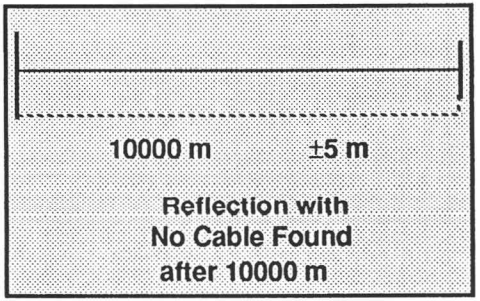


Equivalent OTDR Display

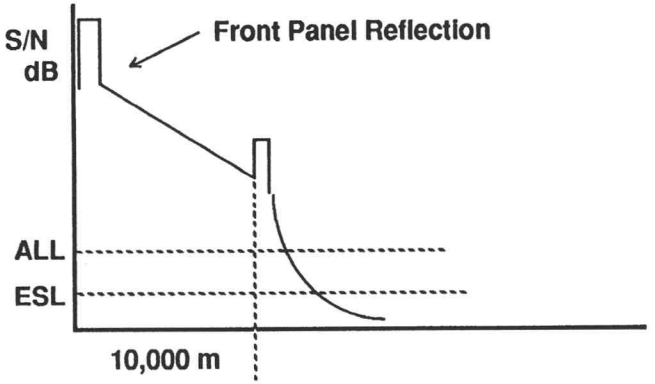


Explanation: The cursor is on a reflective event. FiberScout does not have adequate dynamic range to test the fiber beyond the reflection.

FiberScout Display

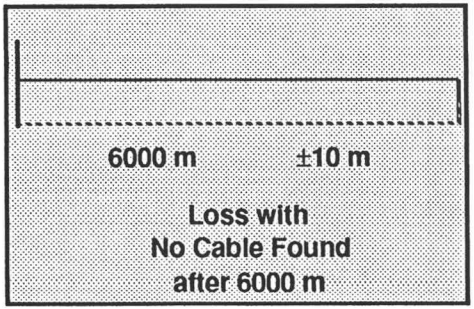


Equivalent OTDR Display

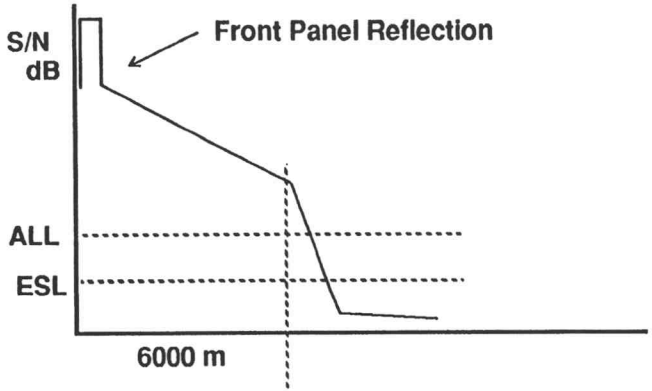


Explanation: The cursor is on a reflective fault. FiberScout has adequate dynamic range to determine that the loss is catastrophic. The search algorithm is stopped and the message "Reflection with No Cable Found after xxxx m" is displayed.

FiberScout Display

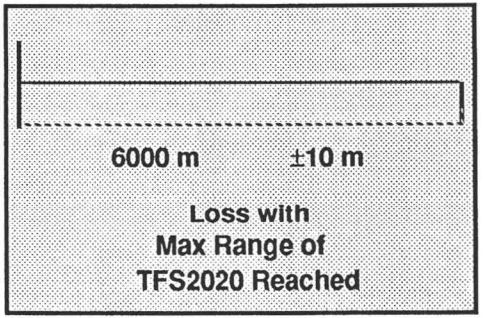


Equivalent OTDR Display

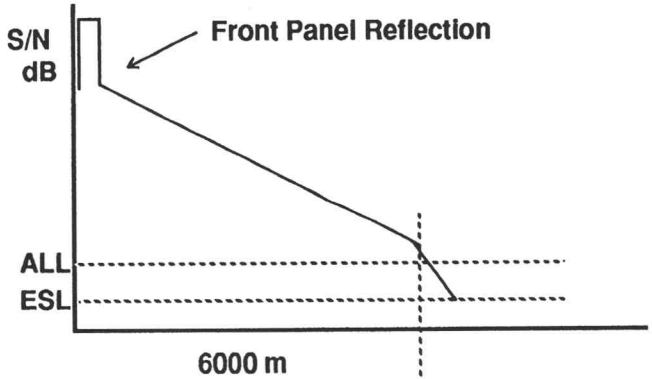


Explanation: The cursor is on a non-reflective fault. FiberScout has adequate dynamic range to determine that the loss is catastrophic. The search algorithm is stopped and the message "Loss with No Cable Found after xxxx m" is displayed.

FiberScout Display

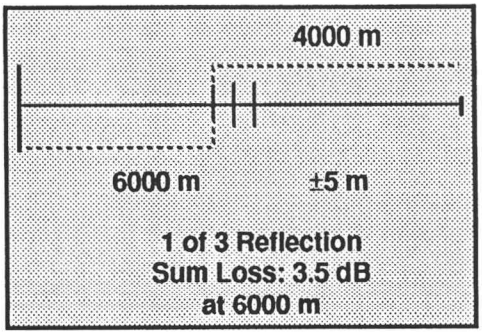


Equivalent OTDR Display

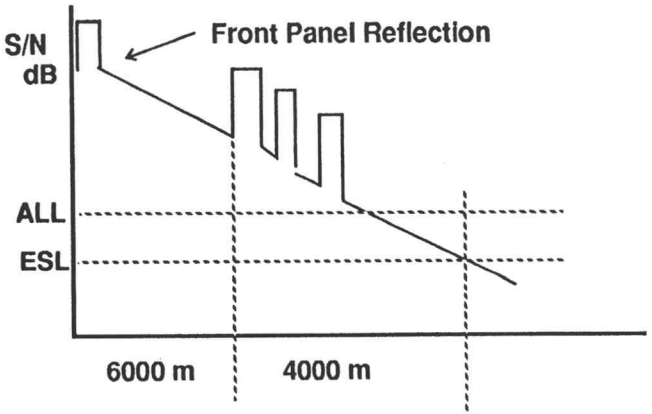


Explanation: The cursor is on a non-reflective fault. FiberScout does not have adequate dynamic range to measure the loss or test the fiber beyond the event.

FiberScout Display

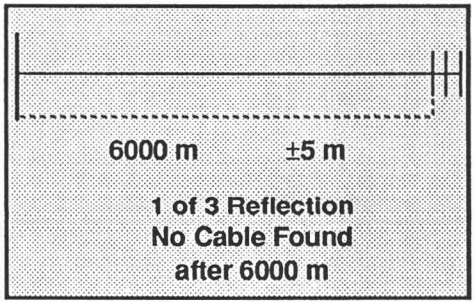


Equivalent OTDR Display

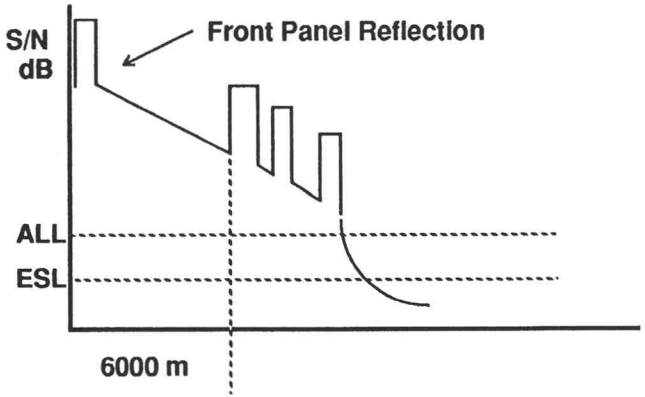


Explanation: The cursor is on the first of three closely spaced reflective events. The combined loss is 3.5 dB. However, the reflections are so close together that FiberScout cannot measure individual loss at each reflection.

FiberScout Display

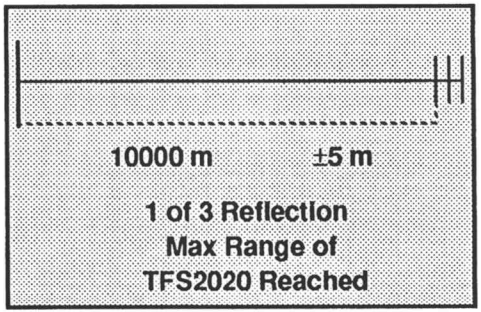


Equivalent OTDR Display

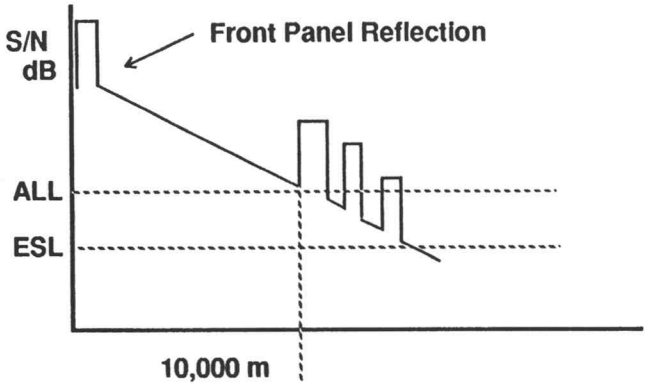


Explanation: The cursor is on the first of three closely spaced reflective events. The combined loss is determined to be catastrophic. However, the reflections are so close together that FiberScout cannot measure the individual loss at each event.

FiberScout Display

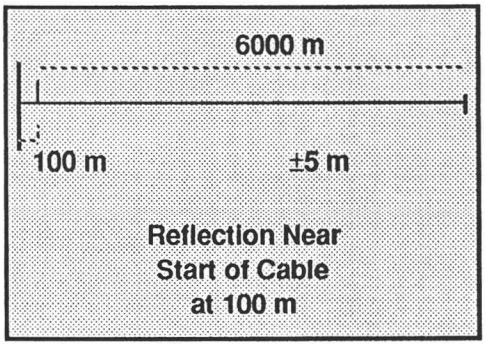


Equivalent OTDR Display

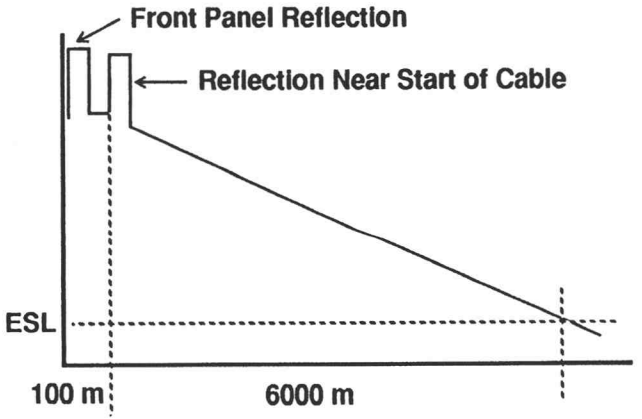


Explanation: The cursor is on the first of three closely spaced reflective events. FiberScout does not have adequate dynamic range to accurately determine whether or not there is cable beyond the reflections, or measure their combined loss.

FiberScout Display



Equivalent OTDR Display



Explanation: The cursor is on a reflective event close to the front panel connector. FiberScout can locate the event but cannot measure its loss separately from the loss at the front panel.

Tektronix, Inc.
Redmond Division
P.O. Box 1197
625 S.E. Salmon Street
Redmond, Oregon 97756-0227 U.S.A.
Phone 1-800-833-9200

Part No. 070-7167-04
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