FIBERMASTER

OPTICAL TIME DOMAIN REFLECTOMETER, POWER METER AND LIGHT SOURCE MANUAL

TREND NETWORKS

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Contents

Chapter 1 Using This Manual

This manual contains operation information for the TREND Networks, FiberMASTER Optical Time Domain Reflectometer. This includes the standard Dual and Quad wave OTDRs. For most situations the difference between these OTDRs are the available wavelengths.

The touchscreen is a resistive style screen and only proper stylus devices should be used while operating this product.

Precautions

Optical time domain reflectometers are optical instruments that emit laser radiation and though this level of radiation is not considered a danger, there are safety considerations and certain practices that should be followed.

Please read and follow all warning and caution information noted in this manual.

There are warnings, cautions and notes posted throughout this manual.

Warning
A warning alerts to situations that could cause personal injury.

Caution
A caution alerts to situations that may cause damage to the equipment or produce poor testing
conditions resulting in inaccurate test results.

Note
A special annotation that will assist the user with operational features.

The information in this chapter pertains to safety consideration of OTDRs in general.

This product has been designed and tested in accordance with the manufacturer's safety standards, and has been supplied in a safe condition.

This document contains information that must be followed by the user to ensure safe operation and to maintain the product in a safe condition. Failure to follow these safety warnings and cautions can result in harm to the user or damage to the instrument.

Warning

Personnel should always be aware when working with fiber optic test equipment that active fibers may be present, therefore infrared optical energy may be present.

Warning

Never look directly into the end of a connected fiber optic cable or fiber optic interface of optical test equipment- to do so could expose the user to laser radiation and could result in personal injury.

Warning

To Prevent Fire or Shock Hazard:

✱Do not install battery types other than those supplied by the manufacturer.

✱Do not use the charger without the proper batteries installed.

✱Do not expose the battery charger to rain or excessive moisture.

✱Do not use the AC adapter when there are signs of damage to the adapter or USB cable

✱Ensure that you are using the correct charger for the local line voltage.

✱Do not puncture batteries.

✱Do not incinerate batteries.

✱All batteries should be disposed of in a proper manner.

Failure to follow these caution statements could cause unsafe conditions for the operator and equipment and may void the warranty.

Failure to follow these cautions statements may void the warranty of, or cause damage to this equipment.

Caution

Fiber-optic connectors are easily contaminated or damaged. The connection to the OTDR is physical contact type of connections and dirty or damaged connectors may impair the instruments capabilities at minimum and at worst result in the need to return the OTDR to the factory for expensive repairs. Prior to making any connection to the unit, ensure that all proper cleaning procedures have been followed. Use appropriate Connectors Only. DO NOT insert APC connectors into the optical ports, unless the product is designed for and marked accordingly for use with APC style connectors.

Caution

The OTDR is equipped with a protection circuit to avoid damage from live fiber connections, the instrument will not operate properly with active fibers. Even with this protection, high power output from EDFA's or other equipment can damage detectors and should never be connected to the OTDR.

If a live fiber is connected to the OTDR and a scan is attempted, a warning dialog will be displayed as in fig. 2.1. Immediately remove the live fiber from the OTDR and press select to clear the message.

>>> WARNING <<<

Live traffic detected.
Please disconnect the fiber.

Press SELECT to Continue.
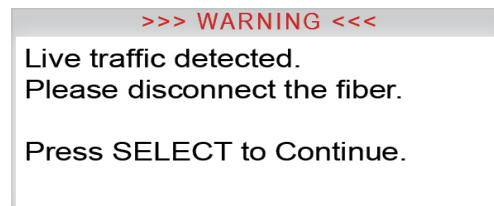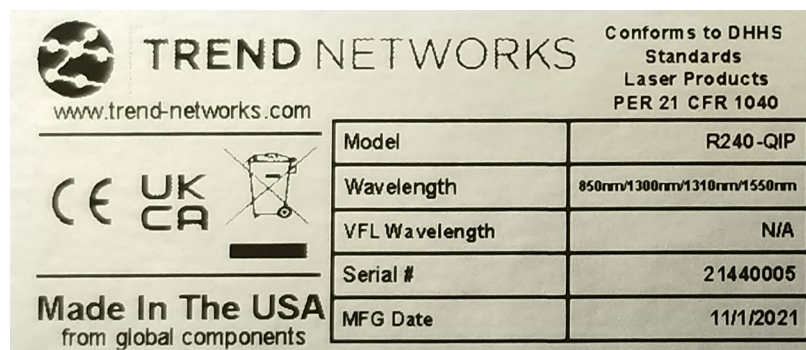
Chapter 2 Inspection

Before shipment, this instrument was inspected and found to be in perfect working order and free of defects.

The shipping carton contains the following:

1. OTDR with Protective boot
2. Hard carry case with shoulder strap
3. USB 5 Volt charger and cable
4. 2 x Stylus
5. Quick Reference Guide
6. SC OTDR adapter
7. LC, SC ST, FC, 1.25 universal and 2.5 universal Power Meter adapters

The instrument's Model/Part Number, Serial Number and Date of Manufacture are indicated on a label located on the back of the unit. The instrument's history is filed at the factory by model/part number and serial number. The unit's serial number is also located on the top plate just above the USB Port.

Chapter 3 Physical Description

3.1 OTDR Handset and Ports

Instrument Enclosure

The TREND FiberMASTER OTDR is packaged in a rugged housing which is further protected with a rubberized boot. Although the front panel is weather resistant, care must be taken to avoid liquids and contaminants around the fragile optical and electrical connectors, and the glass display. Use a mild cleaning agent and soft damp cloth to clean up the panels and the outside case. See the maintenance section to clean the optical connector. NEVER open the instrument for cleaning. Return to the factory for servicing if necessary.

Front View

Protective Rubber Boot

Color Touch Screen

Power Button

NOTE
This is an example of a possible port configuration, ports may vary, based on OTDR style and options installed

Top View

Video Probe Port

Serial Number Label

Power Meter

OTDR Port 1

USB Port

Battery Charge Indicator

OTDR Port 2 / Visible Fault Locator
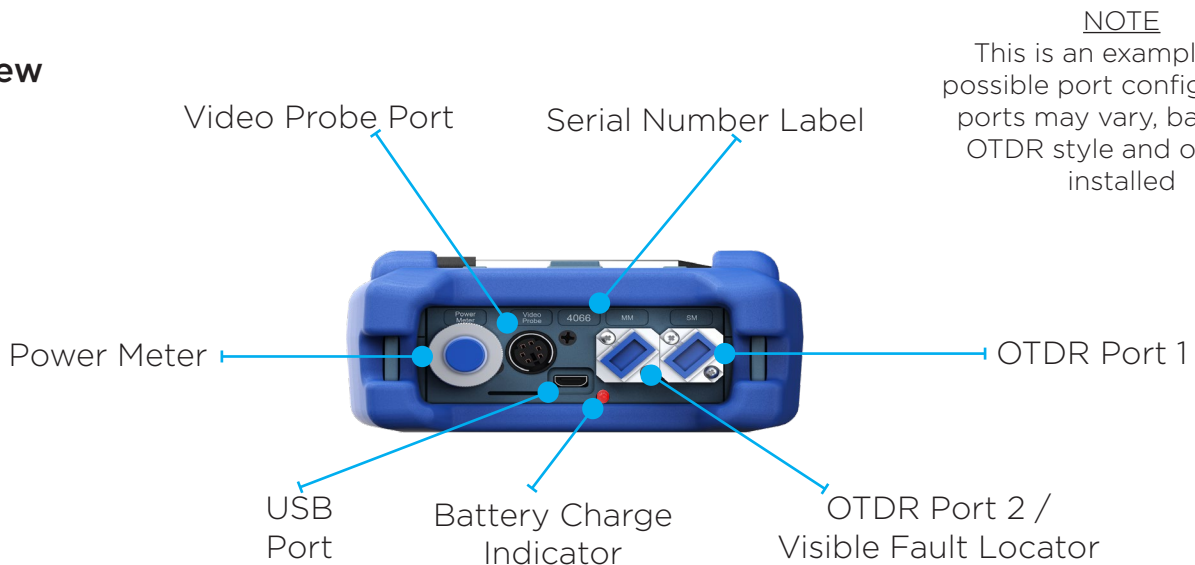
Chapter 4 Main Screen

This unit is equipped with a 3.5 in (8.9 cm) color TFT resistive touch display.

Settings
Set language, date and time

OTDR
Configure the OTDR settings and run a test

View Last Trace
Opens the last run trace for viewing and analysis

Scope
Open the video scope interface

Power Meter/Light Source
Opens the power meter and light source controls

VFL (VisualFault Locator)
(not shown on Quad OTDR, PON OTDR, and Quad light source models)

Version and Model Information
Touch this icon to display the installed options, port configuration, model number and version number for the unit

Chapter 5 Power Requirements

5.1 Battery

The FiberMASTER OTDR is equipped with a 3.7 V, 8000 mAh Li-polyer battery.

The FiberMASTER OTDR is supplied with a 100-240V USB power adapter with 5VDC, 2.1A output. A fully charged Li-poly battery will typically enable approximately 10 hrs. of use and require approximately 4 hours of recharging.

Warning

To Prevent Fire or Shock Hazard:

✱Do not install battery types other than those supplied by the manufacturer.

✱Do not use the charger without the proper batteries installed.

✱Do not expose the battery charger to rain or excessive moisture.

✱Do not use the AC adapter when there are signs of damage to the enclosure or cord.

✱Ensure that you are using the correct charger for the local line voltage.

✱Do not puncture batteries.

✱Do not incinerate batteries.

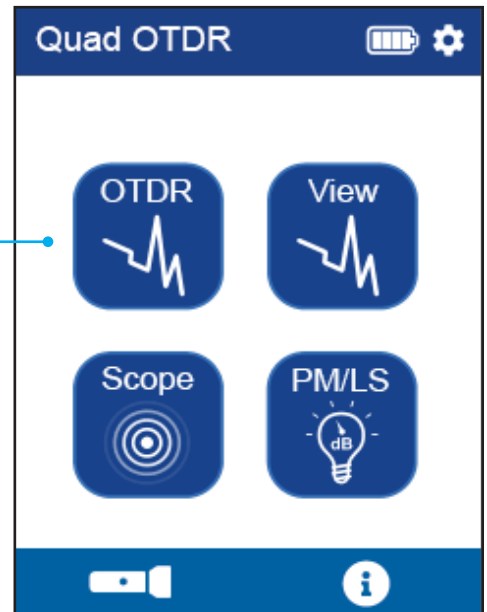✱All batteries should be disposed of in a proper manner.

Failure to follow these caution statements could cause unsafe conditions for the operator and equipment and may void the warranty.

Chapter 6 OTDR Operation

6.1 Entering OTDR Function

Press the power button the to turn on the FiberMASTER OTDR.

Touch the OTDR icon to enter the OTDR function.

6.2 OTDR Setup

The OTDR menu is divided into three sections.

Setup OTDR
Configures the parameters used to acquire a trace. Affects what the trace will look like and what events are detected.

Limits
Sets the pass/fail criteria for the test. Settings include cabling standards, application standards and manually configured limits.
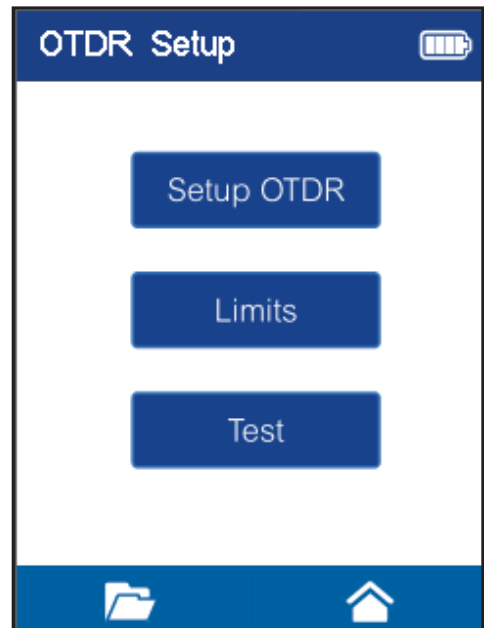
Test
Starts the test after confirming the acquisition and limit settings.

Project Manager (Folder icon)
Manage stored project folders and stored tests. Open/delete/edit projects and tests.

Home
Return to the main OTDR home screen.

Press Setup OTDR to configure the OTDR acquisition parameters.

Several pages are available. Press the < or > button to change pages and press ☑ to accept the configuration and return to the previous screen.

6.3 Launch / Tail Cable Selection

The first setup screen is the Launch/Tail cable selection. A launch and tail cable is necessary to measure the quality of the end connectors in the cabling system under test.

By pressing ☑ next to Launch Cable or Tail Cable, the OTDR will exclude the length of the Launch and/or Tail cables while including the connectors on either end.
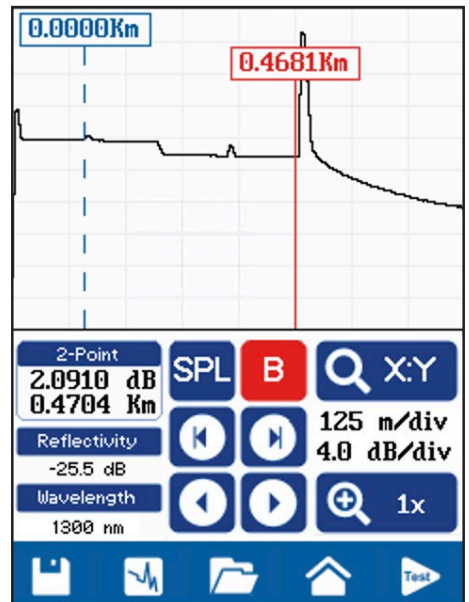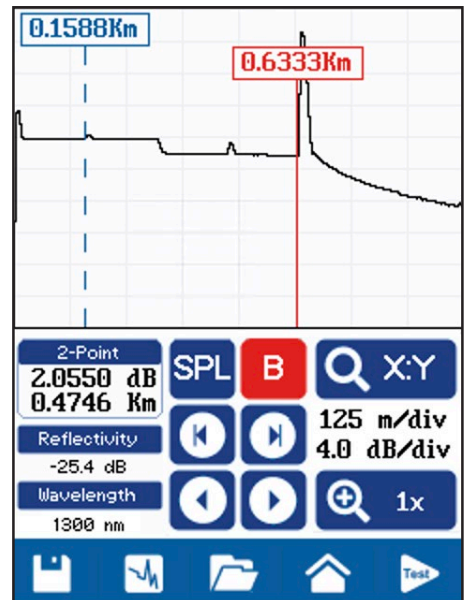
Enter the length of the Launch/Tail cables using the edit buttons.

The software will use the entered length and search within +/-10% of the entered value for a connector.

The first trace shown is with the launch cable setting disabled. Cursor A (blue) is at the first connector, and the distance of 158.8 meters is the distance from the front of the OTDR to the end of the launch cable.

The second trace is with the launch cable setting enabled. Cursor A is in the same position, on the first connector at the end of the launch cable. Now the distance reads 0.0 meters because the OTDR is ignoring the length and loss of the launch cable.

With the launch cable setting enabled, the distance to events is measured from the end of the launch cable and not from the OTDR port. This eliminates the need to subtract the launch cable length when locating faults on the physical cable using distance measurements from the OTDR.
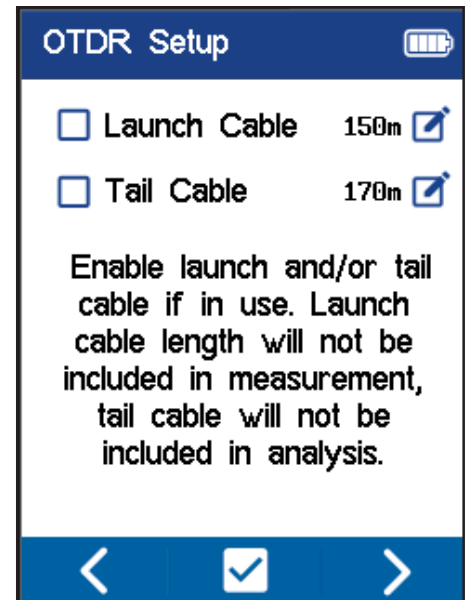
Measurement Without vs. With Launch and Tail Cables

Without Launch/Tail cables

First connector is <u>not</u> measured

Measured

Last connector is <u>not</u> measured

Connectors

Splice

Connectors

Patch cord
(2 meter typical)

With Launch/Tail cables

First connector <u>is</u> measured

Measured

Last connector <u>is</u> measured

Connectors

Splice

Connectors

Launch cable
(150 meter typical)
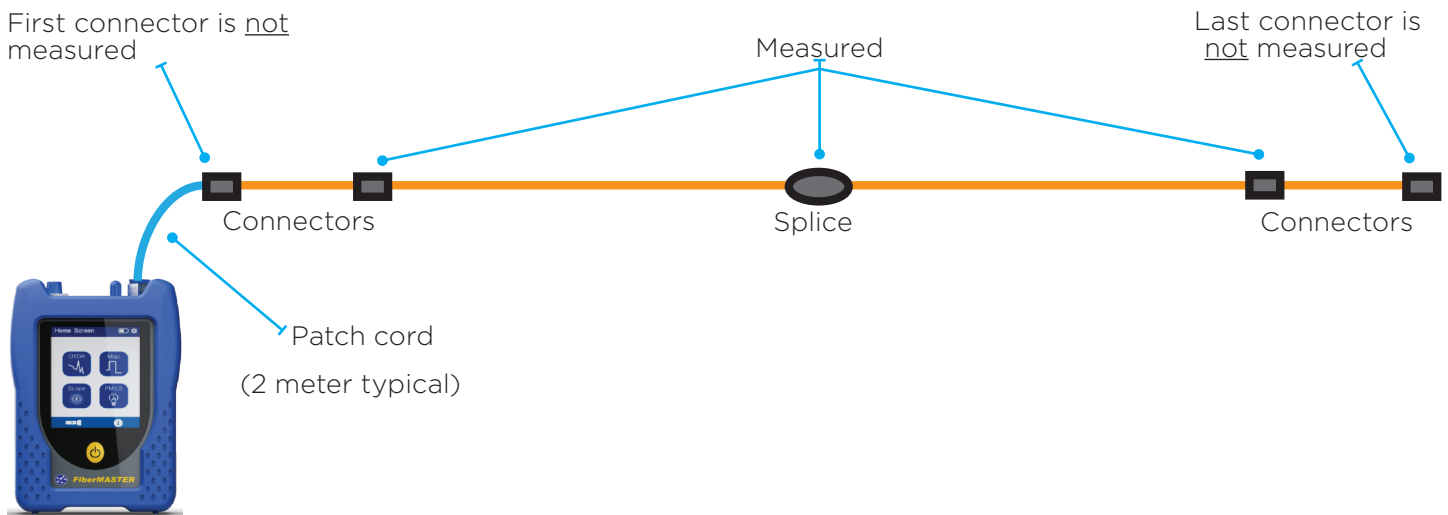
Tail cable
(150 meter typical)
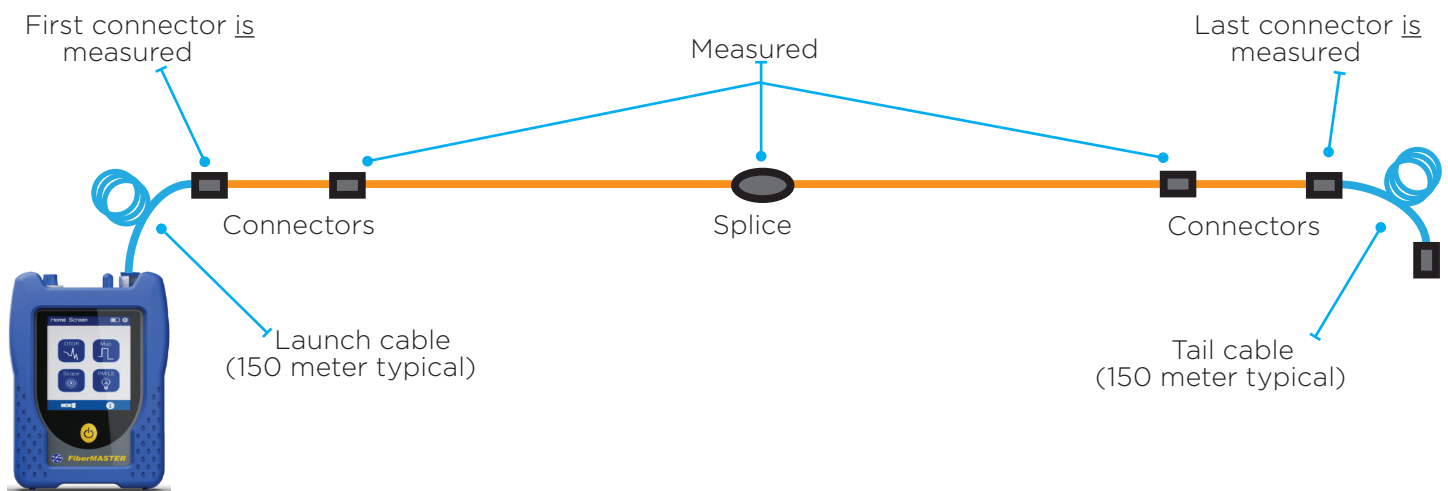
The length of a launch cable should be 5-10x the pulse width setting of the OTDR. The table below shows the suggested launch cable lengths for a range of pulse widths.

Pulse Width	Suggested Length	Pulse Width	Suggested Length
5 ns/0.5 m	2.5-5 m	1 µs/100 m	500 - 1000 m
10 ns/1.0 m	5 - 10 m	3 µs/300 m	1500 - 3000 m
30 ns/3.0 m	15 - 30 m	10 µs/1 km	5000 - 10,000 m
100 ns/10 m	50 - 100 m	20 µs/2 km	10,000 m - 20,000 m
300 ns/30 m	150 - 300 m		

6.4 Wavelength Selection

Touch the desired wavelength to test. Both wavelengths can be selected to perform a dual-wavelength test which can be helpful in locating macro bends in single mode cabling.

When using a quad wavelength OTDR only one mode (multi-mode or singlemode) can be selected at a time.

Multi-mode tests are conducted using the left side OTDR port.
Single mode tests are conducted using the right side OTDR port when looking at the tester from the front.
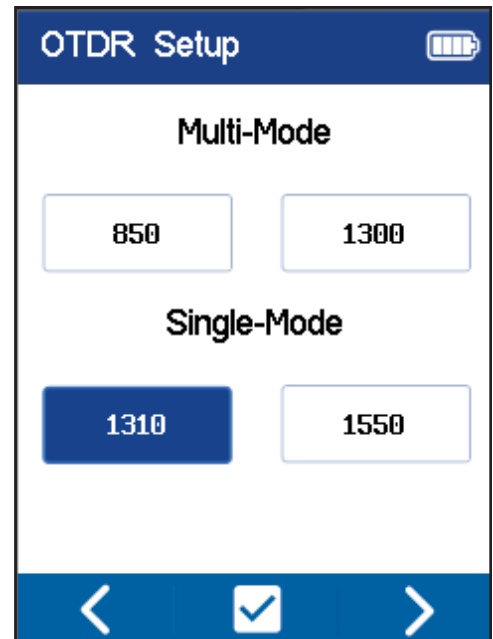
Both wavelengths selected for a dual-wavelength test.

Note:
If both 1310 and 1550 wavelengths are selected one of them must be de-selected before a multi-mode wavelength can be selected. The same applies if both 850 and 1300 are selected before the system can be changed to singlemode.

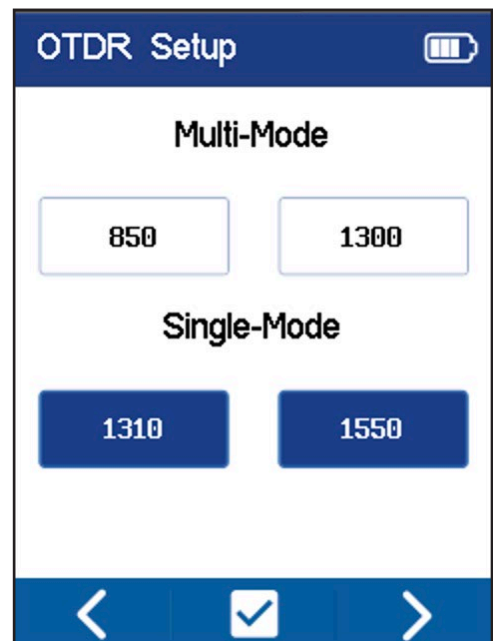## 6.5 Refractive Index and End of Fiber (EOF) Threshold

The Refractive Index (RI) setting calibrates the OTDR so it measures the correct length of the fiber under test. The RI setting is a ratio of the speed of light in the fiber to the speed of light in a vacuum.

The correct RI can be found on the data sheet from the fiber cable manufacturer. If it is unknown, press the Load Default button to use a setting that is approximation of most typical fiber types.

EOF (End of Fiber) Detection Threshold

The End of Fiber detection is a setting that tells the OTDR at what loss should be considered the end of the cable. Any loss equal or greater than this setting will signal the end of cable. Typical values are 3-6 dB.

Setting the value too low may cause the OTDR to falsely trigger EOF on high loss splices or connectors, and not scan the fiber beyond those events.

Setting the value too high may cause the OTDR to not detect the EOF if the attenuation roll-off is too gradual and it does not detect a sharp end event.
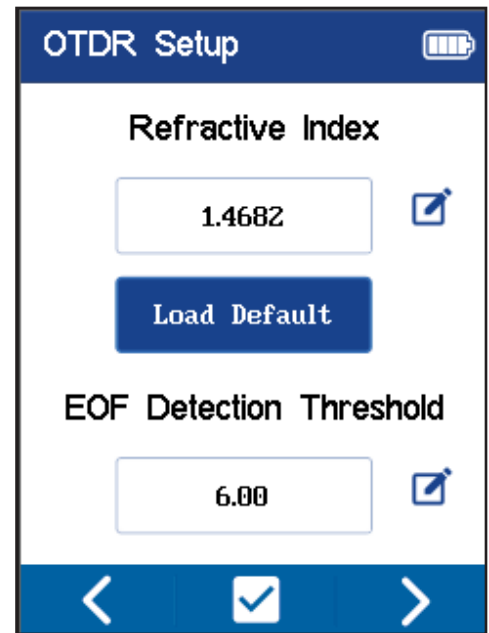
6.6 Auto / Manual Mode Selection

Choose whether the OTDR should automatically choose the remaining acquisition parameters, or allow the user to configure the parameters manually.

Auto Mode
The OTDR will set the acquisition parameters using values that balance dynamic range and dead zone performance to provide a balanced trace image.

When Auto is selected the > button is locked out to block access to the manual settings.

Manual Mode
All of the acquisition parameters are available for adjustment. The following pages in the Setup screen are: Averaging Time, Event Sensitivity, Range, and Pulse Width.
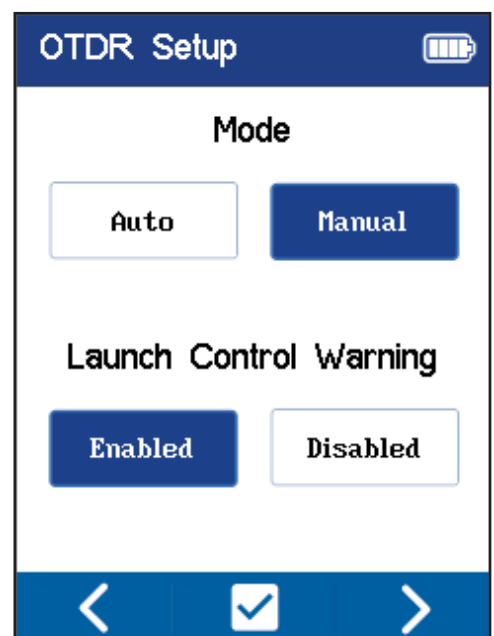
6.7 Launch Control Warning

Launch Control Warning evaluates the reflection of the front end connector to determine whether any parameters exceed thresholds that may cause an erroneous OTDR acquisition.

Enabled: Provides a warning whenever any of these criteria are met,

- Saturated initial reflection detected - there is significant reflection from the connector attached to the OTDR. Most likely causes are a dirty connector, damaged connector, misaligned connector, APC-to-UPC (Angled Physical Contact to Ultra Physical Contact) connection.
- Low backscatter level detected - the level of reflected energy after the initial pulse is lower than expected. Most likely cause is the connector plugged into the OTDR is not fully inserted/secured, or the fiber is broken immediately in front of the OTDR connector.
- No launch detected - there is no reflected energy coming into the OTDR detector. This is likely caused by damage to the OTDR's internal optics which requires factory service.

Launch control should be set to Enabled unless there are specific conditions which are causing a warning that do not otherwise impede testing.

The first example trace is with the launch cable fully seated in the OTDR port. The trace is clean and all of the events are easily recognizable.

The second example trace has a saturated initial reflection. Note the height of the spike at the start of the trace followed by the slow fall-off compared to the first example. This is typical of a damaged connector or when an APC connector has been connected to a UPC port.

APC connectors can be identified by a green colored sleeve/shell and should never be mated to a non-green colored connector. The ferrule (tip) of an APC connector is angled at 8 degrees to reduce back-reflection. Mating APC to UPC connectors creates an air gap that causes a large reflection and loss between the connectors.

Beside a poor optical connection, the OTDR port can be permanently damaged if the incorrect type of connector is inserted into the port.
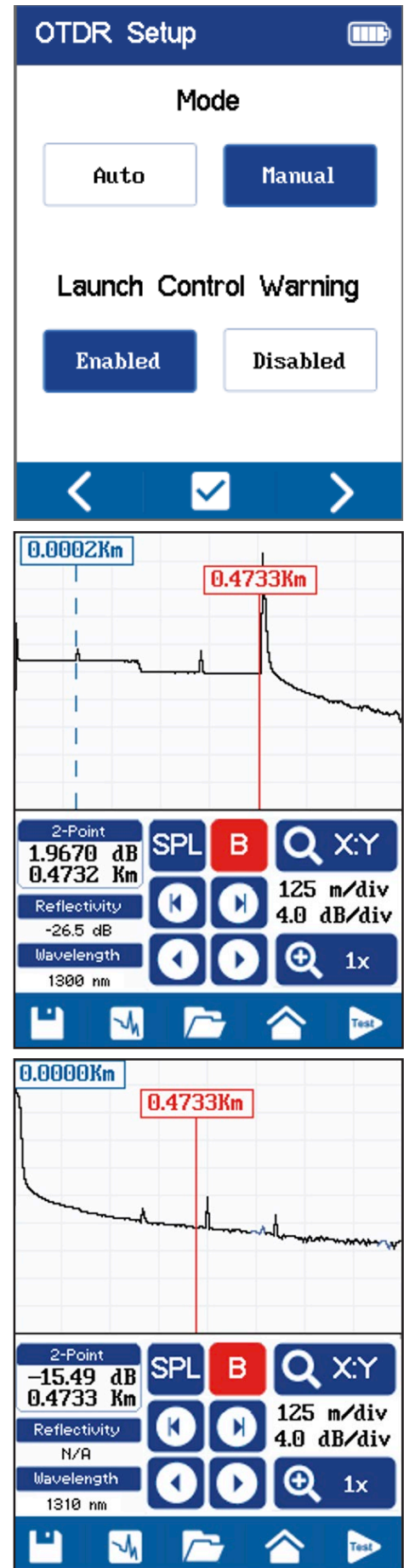
6.8 Averaging Time

Averaging time is the amount of time that the OTDR runs and captures data during the test. During the test, thousands of samples are taken and averaged together to reduce noise in the traces.

Reduced noise will make it easier for the OTDR to detect low loss events such as fusion splices that may be obscured by noise when the averaging time is too short.

Longer averaging times increase the dynamic range of the test by averaging the noise floor at the end of the fiber.

Short Averaging vs. Long Averaging Times

A comparison of averaging times reveals the how it affects the trace result.

15 Second Average
The first trace was captured using a 15 second averaging time on a multi-mode cable that is 620 m/2000 ft in length.

Because of the high loss at 850 nm, the power returned to the OTDR quickly diminishes and the signal trace becomes noisy as the signal gets closer to the noise floor.

2 minute Average
The additional averaging time reduces noise in the trace and increases the dynamic range (difference between launch power and noise floor).

The fusion splice and connector are clearly visible and can be accurately measured. In the 15 second test the instrument will not be able to detect each event and measure the losses.

Real-time Testing
Real-time tersting can be selected for troubleshooting operations. In real-time mode the screen updates three times per second which allows the operator to detect intermittent problems or terminate mechanical splices. Real-time testing does not perform any averaging of the pulse samples and
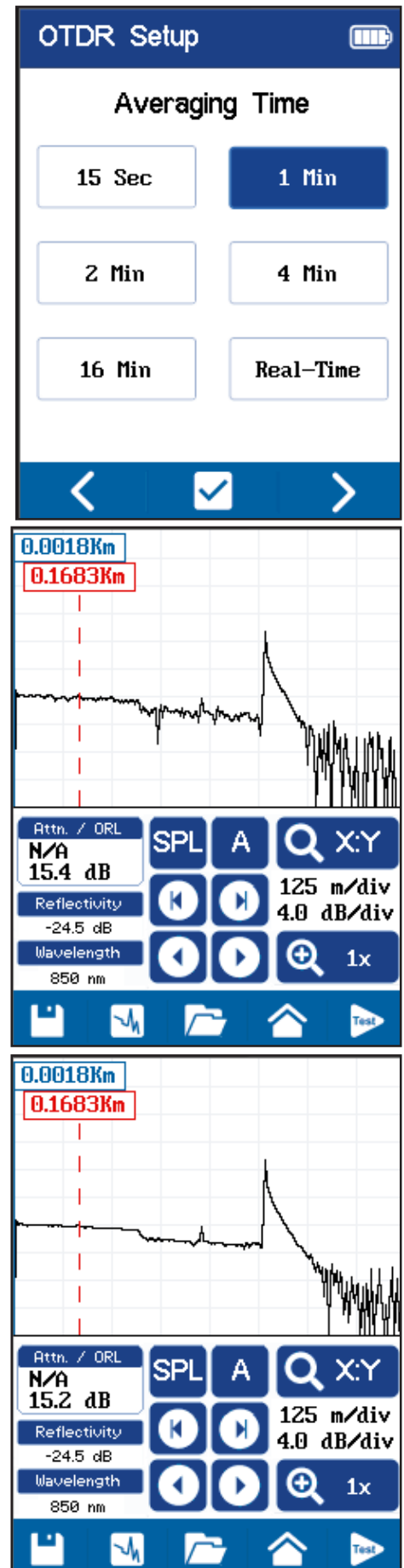
as a a result the noise floor will be very high. It is recommended that high pulse widths be used to compensate for the lack of overaging and the increased noise floor.

Low loss events such as high-quiality fusion splices are likely to not be visible in real-time mode, it it best used for detecting reflective events or high-loss fusion splices or splitters.

The first trace to the right shows a cable tested in real-time mode while the lower trace shows the same cable tested with a 2 minute average. Both are taken with 100 ns pulse widths.

The bottom trace is a real-time test of the same cable with a 30 ns pulse width. Here, there is not enough power to see anything but the distance to the most reflective events in the cable which may be fine for some troubleshooting applications but not for qualification of the instalation.
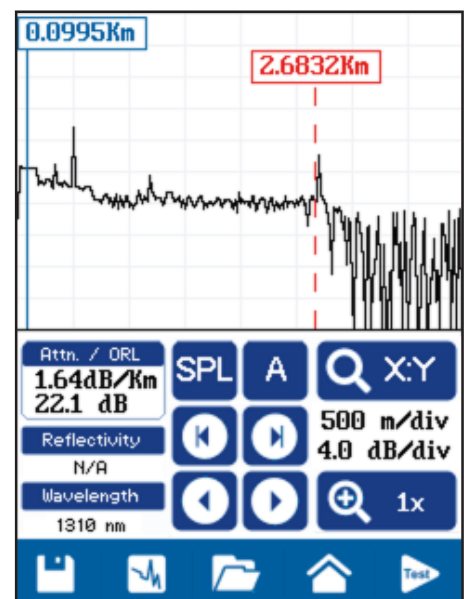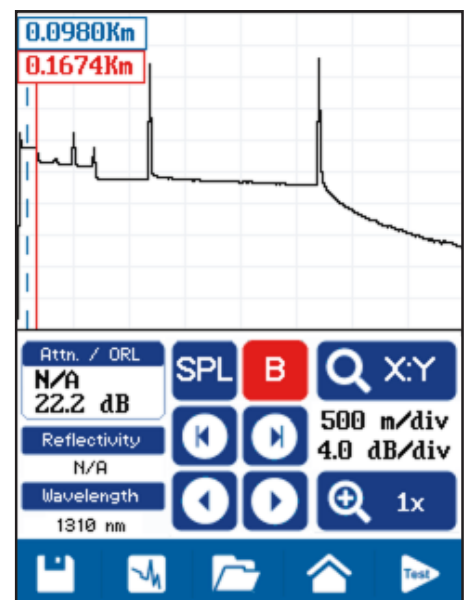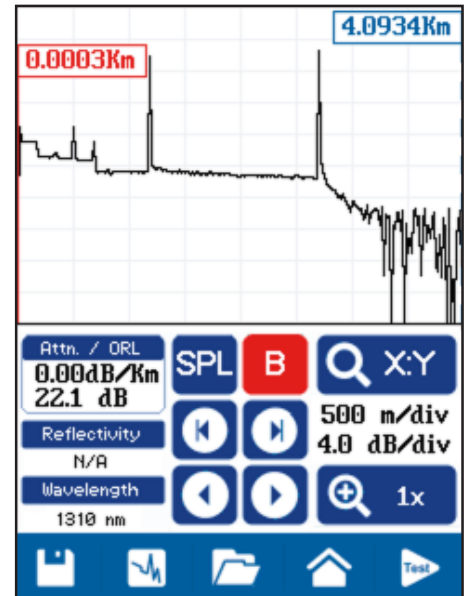
6.9 Event Sensitivity

Controls the noise filter in the OTDR firmware that minimizes false events from being detected.

Low = events must be very discernible from noise to be detected.

Medium = some amount of noise can be in the trace and the firmware will still identify them. This is the recommended setting.

High = The firmware will use minimal filtering and on a noisy trace there is a possibility that false events will be identified.

6.10 Range

Sets the distance of the X-axis scale and controls the distance the OTDR will stop evaluating returned reflections.

The range setting should generally be set to 2x the actual fiber length. If the length is unknown, test at a long range setting, then reduce the range to approximately 2x the fiber length.

The 2x length range setting is recommended to provide the best sampling resolution possible.

The OTDR has a maximum of 128,000 sample points, meaning the distance of the X-axis is divided into 128,000 points. By using a range scale that is 2x the fiber length, the cursor step size will be as small as possible and the OTDR will provide the best resolution of small events such as fusion splices.

In these examples the same 470 m long fiber was tested with the range set to 64 km and 1 km.

The first trace is the 64 km setting. The A & B cursors are as close to together as possible and the step distance is about 61 m.

The second trace is the 1 km setting. Here the A & B cursor step distance is less than 1 m.

Also notice the improved sharpness of the 1 km trace with the finer resolution.
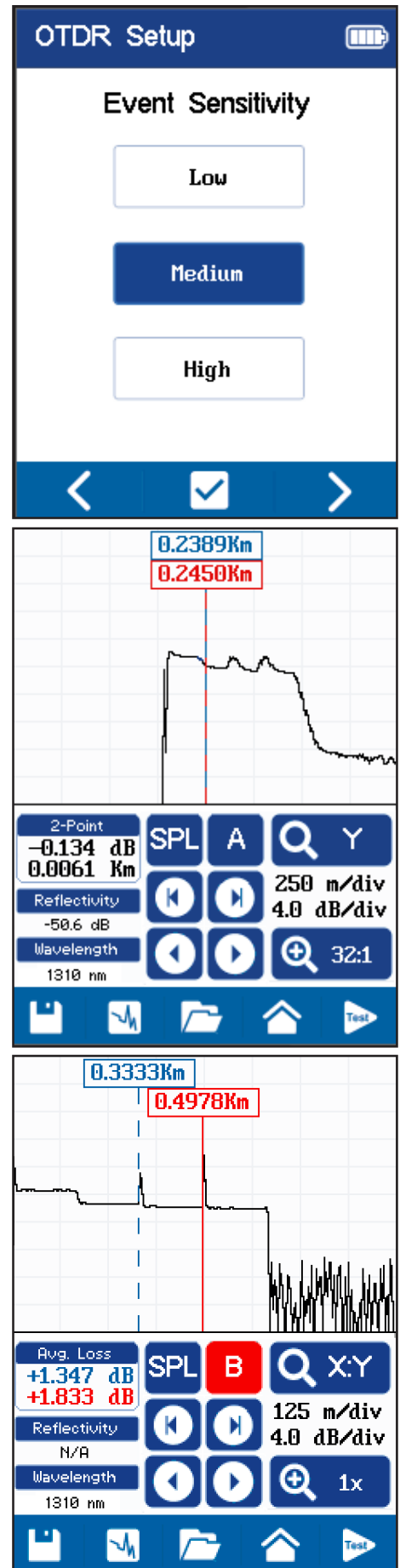
6.11 Pulse Width

Pulse Width (PW) setting adjusts the amount of power the OTDR sends into the fiber with each pulse. Rather than adjusting the brightness of the laser, power is controlled by the amount of time the laser fires for each pulse.

The higher the PW, the more energy is input into the fiber and the farther the OTDR can measure. The PW needs to be set high enough that the end of the fiber can be reached before the signal runs into the noise floor. Visually, the effect of increasing the PW raises the trace vertically, increasing the dynamic range of the system.

The downside to high PW settings is that the dead zone after a reflective event is increased. Meaning the OTDR is blind to connectors or other events for a greater distance than with a smaller PW setting.

Generally the PW needs to be set high enough to reach the end of the fiber and provide a clean trace view.

There is a strong relationship between PW and averaging time. A short PW can result in a noisy trace, though the noise can be reduced with a longer test time and more averaging. The downside is that each test takes longer to run.

A long PW will provide clean traces with short test times, however dead zones will be increased which can be a problem with networks where connectors are in close proximity, an example being MPO breakout cassettes.

Pulse Width Examples

The two traces are taken with a 15 second averaging time. The first trace is a 5 ns pulse width, the second trace is a 30 ns pulse width. The 30 ns pulse inputs a high power level into the fiber (higher on the Y-axis) and is well above the noise floor. The result is a cleaner trace in the same amount of time.
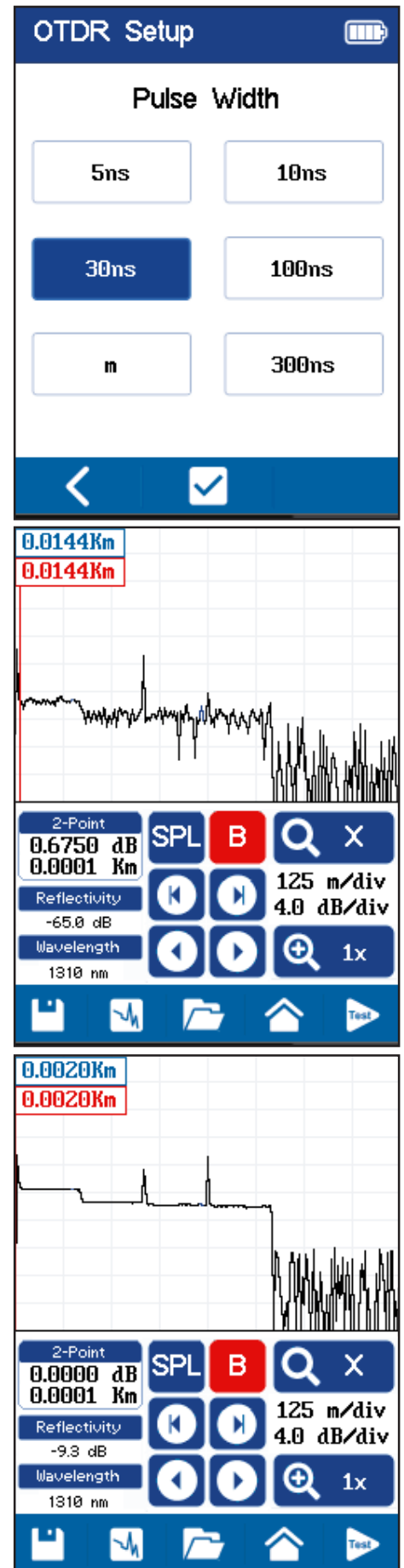
Range vs. Pulse Width

Not all pulse widths can be selected on all ranges because a short pulse cannot reach the end of very long fibers, and long pulses can be too long for short fibers. The table below shows the allowable pulse widths depending on the selected range.

Pulse Width

Range	5 ns	10 ns	30 ns	100 ns	300 ns	1 μs	3 μs	10 μs	20 μs
250 m	✓	✓	✓	✓	✓				
500 m	✓	✓	✓	✓	✓				
1 km	✓	✓	✓	✓	✓				
2 km		✓	✓	✓	✓	✓			
4 km		✓	✓	✓	✓	✓			
8 km			✓	✓	✓	✓	✓		
16 km			✓	✓	✓	✓	✓		
32 km					✓	✓	✓	✓	✓
64 km					✓	✓	✓	✓	✓
128 km					✓	✓	✓	✓	✓

The pulse width (PW) selection can be toggled between time by pressing the lower-left button. Initially, the PW is set to time and the toggle button displays 'm' to change the PM mode to meters. When the PW mode is in meters, the mode button will display ns for nanoseconds which will revert the setting to time mode.

The conversion is 10 ns = 1 m, i.e., a 100 ns pulse is 10 m long.

The pulse witdth should be shorter than the distance between any events on the fiber under test. For example, if there are patch panels that are 5 meters apart, the pulse width should not exceed 50 ns. Since the FiberMASTER offers 30 and 100 ns pulse width options, the maximum selection should be 30 ns. Shorter options are fine as long as the trace has acceptable clarity.

Pulse width mode toggle →
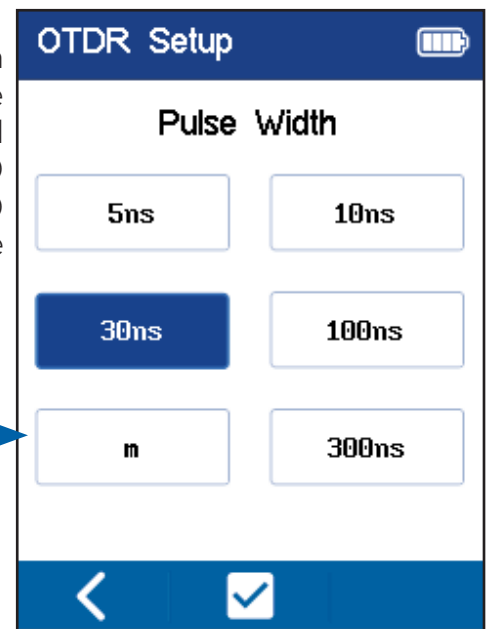
Chapter 7 Test Limit Selection

7.1 Limits Setup

The Limits setup section determines the pass/fail parameters of each test. These limits are divided into two primary groups.

There are four parameters that can be checked:
- Connector - loss of connectors (reflective events)
- Splices - loss of fusion splices (non-reflective events)
- Segment attenuation slope - loss of a section of cable vs. length
- Link - total loss of a link including all cable, connectors and splices.

7.2 Cabling Limits

Cabling limits are created by international standards organizations that determine the allowable loss for components of fiber cabling systems.
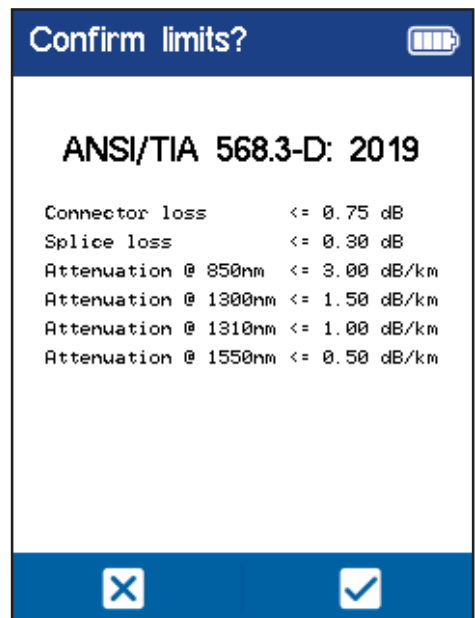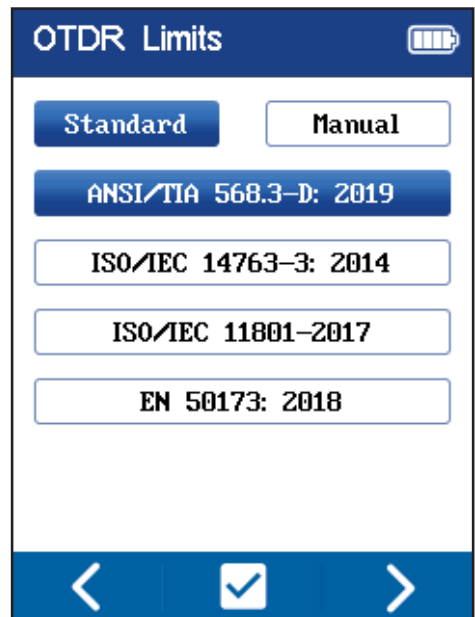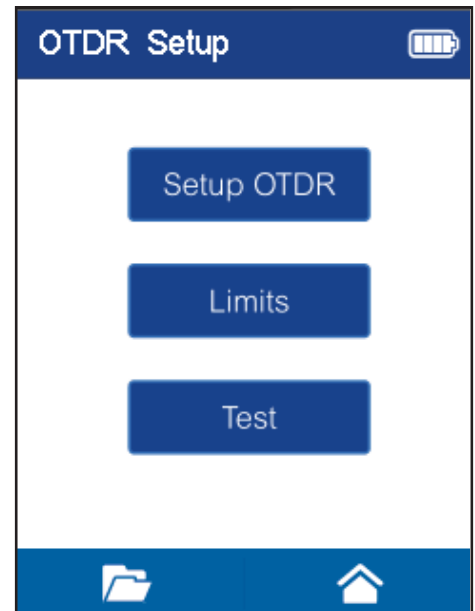
Select one off the standards and press ☑ to proceed.

The confirmation screen appears and displays the limits for connector, splice, and cable loss for each wavelength.

Press ☑ to confirm or ☒ to cancel.

From the OTDR Limits screen,
Press the > button to view the first page of application limits.

Press Manual to enter custom pass/fail limits for each parameter.

7.3 Application Limits

After the Cabling Limits page, there are several pages of application limits. Application limits are defined by the IEEE and provide the maximum loss and length for each Ethernet speed for a given fiber type and wavelength.

The application names can be decoded to determine the speed, wavelength, and fiber type.
- The first number is the Ethernet speed. Example, 1G = 1 Gbps, 10G = 10 Gbps and so on.
- The first set of letters defines the wavelength.
  - S or SX = 850 nm
  - LX = 1300/1310 nm
  - ZX= 1550 nm
- The last set of letters defines the fiber type.
  - OM1 = 62.5Qm MM fiber
  - OM2, OM3, OM4 = Grade 2, 3, or 4 of 50Qm MM fiber
  - OMx = any grade of MM fiber
 - OS1 and OS2 = SM fiber
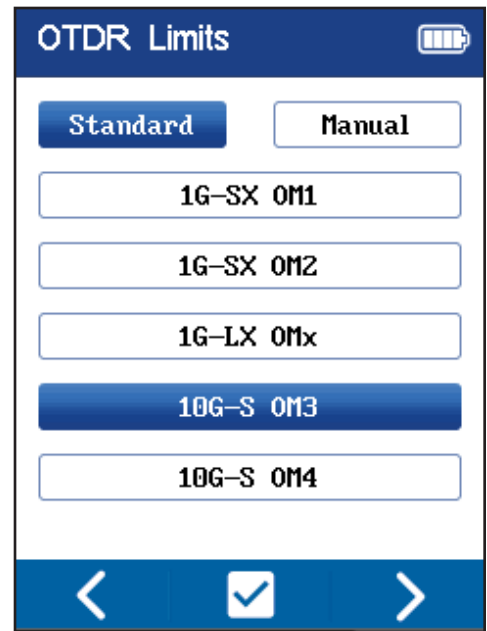
Confirm Application Limit

After pressing ☑ with an application selected, the confirmation screen appears.

The confirmation screen displays the loss and length limits for the selected application. In this example, 10 Gbps, 850nm, OM3 MM Ethernet is selected.

The maximum loss allowed is 2.6 dB.
The maximum length allowed is 300m.

Press ☑ to confirm or the X box to cancel.
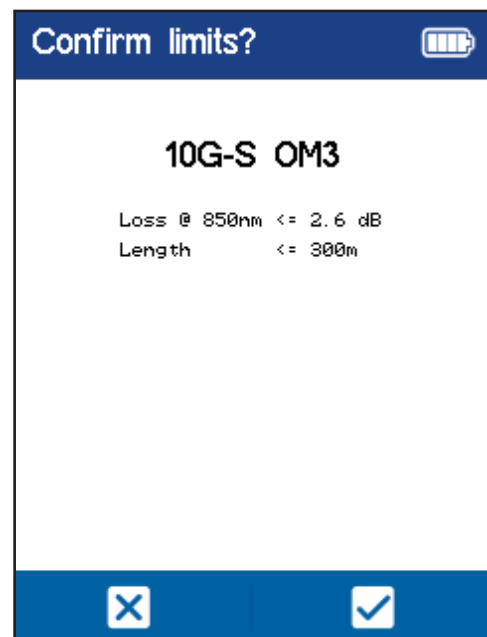
7.4 Manual Limit Selection

Press the Manual button to enter custom pass/fail limits.

Page 1 contains settings for the following limits:
- Connector - loss of connectors (reflective events)
- Splices - loss of fusion splices (non-reflective events)
- Segment attenuation slope - loss of a section of cable vs. length for 850, 1300, 1310, and 1550 nm wavelengths

Press > to continue to page 2.

Page 2 contains settings for the following limits:
- Segment attenuation slope - loss of a section of cable vs. length for the 1625 nm wavelength
- Link budget (maximum total loss) for 850, 1300, 1310, 1550, and 1625 nm wavelengths.

Press the ☑ to the left of each parameter that should be evaluated during the test. Unchecked parameters will not be tested.

Press the edit icon to the right of each value to change the limit for each parameter.

Press Load Defaults on page 2 to restore the factory default settings for each parameter.

Press ☑ to confirm the selections and return to the OTDR Setup page.
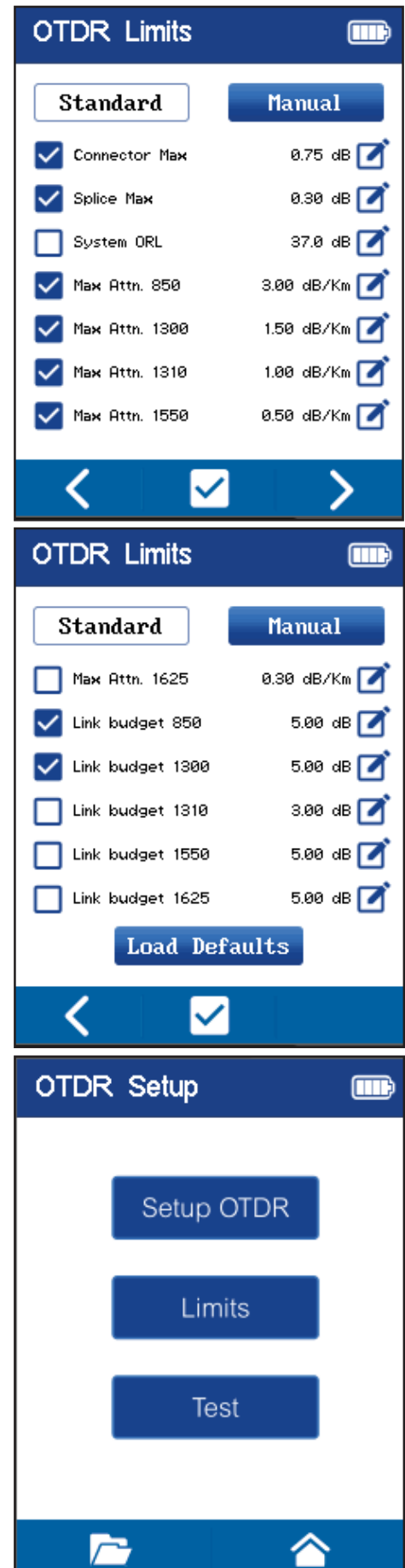
Chapter 8 Project Management

8.1 Project Manager

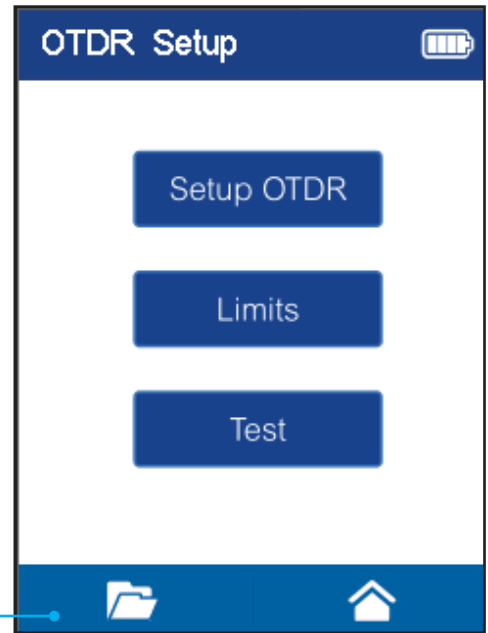Press the folder icon in the OTDR Setup screen to open Projects. The Project folder is also available in other screens throughout the user interface. It operates the same regardless where the function is initiated.

Projects contains a list of user created folders that can each store measurement results for OTDR tests, power meter tests and video inspection scope images.

Up to 40,000 total files can be stored, though the maximum depends on the mix of types and the number of data points in OTDR trace files.

Projects

Project List

Press the folder icon in the OTDR Setup screen to open Projects.
Projects contains a list of user created folders that can each store measurement results for OTDR tests, power meter tests and video inspection scope images.

Tap to scroll the selected project up

Exit to previous screen

Enter selected project to view stored tests

Tap to scroll the selected project down

Delete selected project

Edit the name of the selected project

Create a new project

Return to Home screen
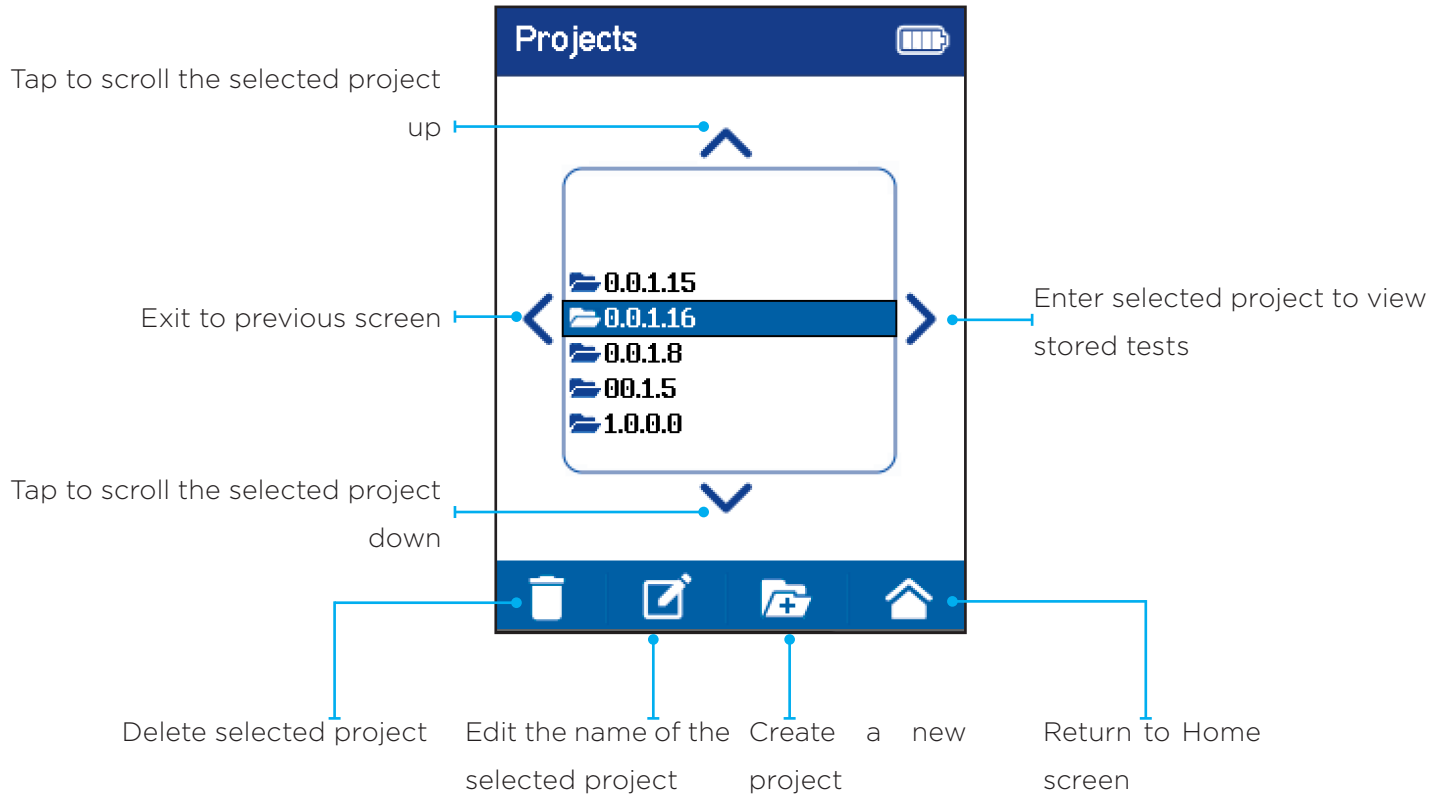
8.2 Files List

Displays a list of test files in the selected project. Preceding each file name is an icon that identifies the type of file. Test selection can be performed by scrolling within the list or using the arrow buttons above and below the list.

Tap to scroll the selected test up

Return to project list

Open selected test

Tap to scroll the selected test down

Delete selected test file

Edit name of selected test

Return to Home screen

Power meter file

Inspection scope file

OTDR file
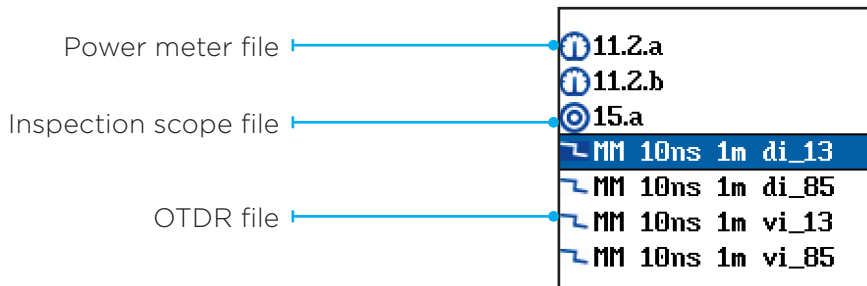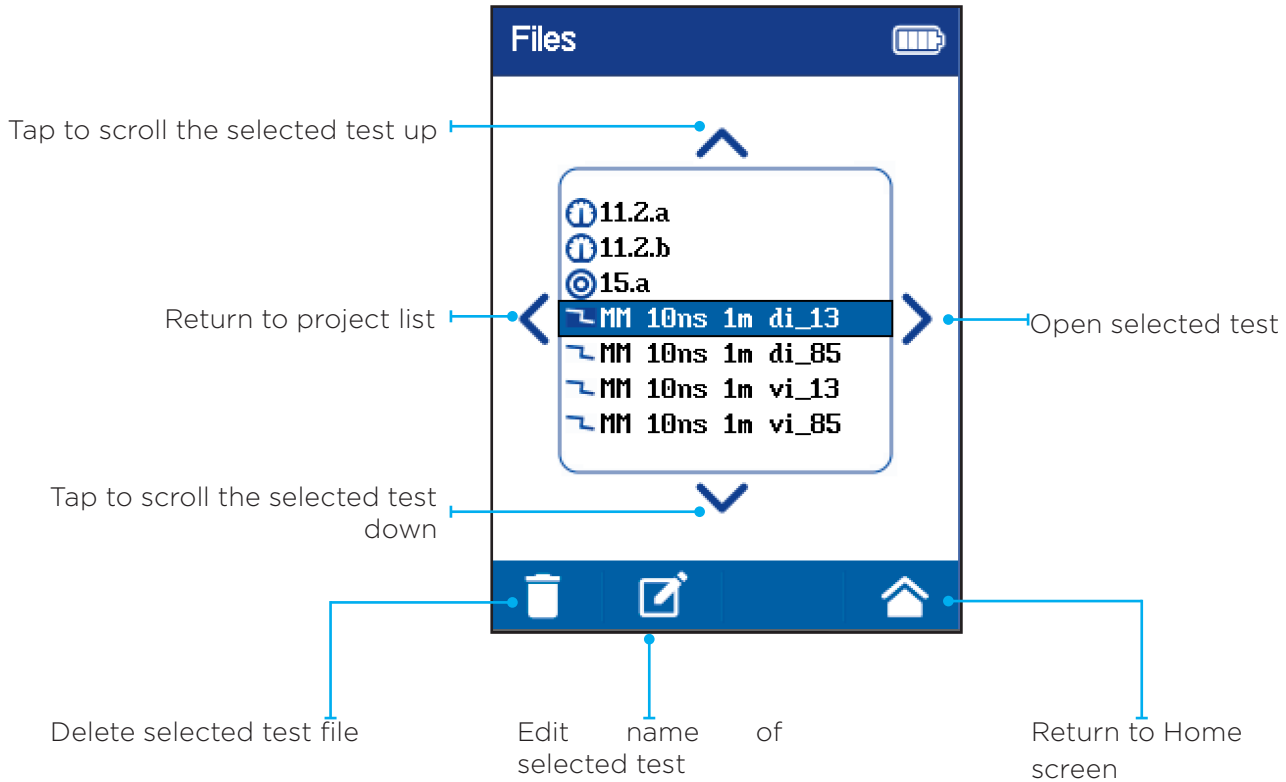
Create a new Project
Press the '+' folder button to create a new project.
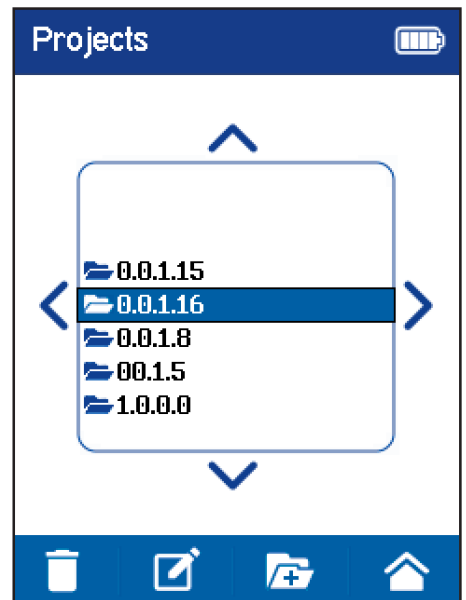
Enter a name for the new project using the keyboard. Letters, numbers and punctuation are allowed.

Press Save to create the new project.

The new project will appear in the project list and any future tests can be saved to this or any existing project.
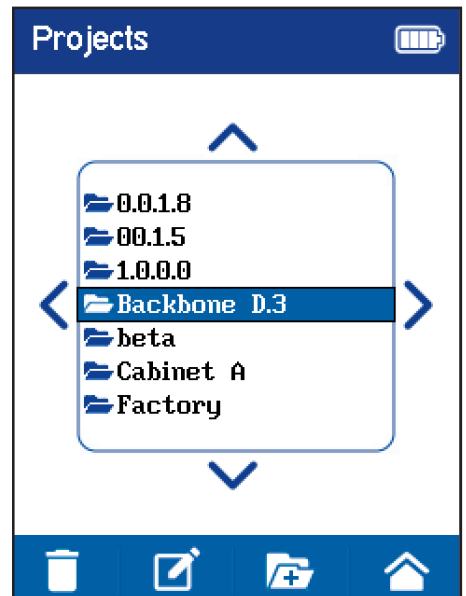
Continue with testing

Once a project has been selected, press Test to begin the testing process.

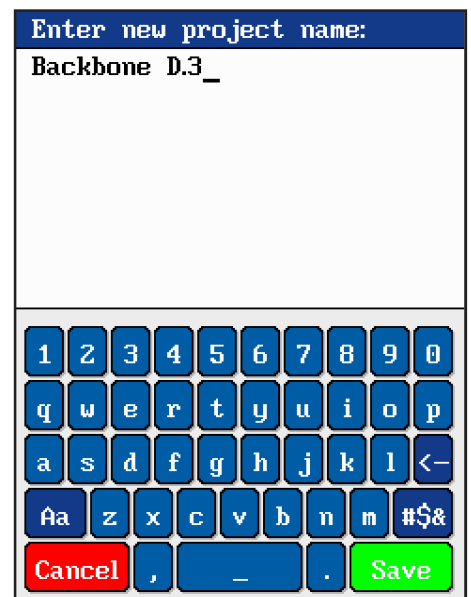After pressing Test, the Test Parameters confirmation screen displays the selected settings for the limits and the OTDR configuration.

Press ☒ to return to the OTDR Setup screen.

Press ☑ to start the test.

The progress bar appears as the OTDR runs and acquires data for the selected test time.

Press Cancel to stop scanning. The test will not abort, instead the results will be displayed using the data that had been acquired at the time Cancel was pressed.
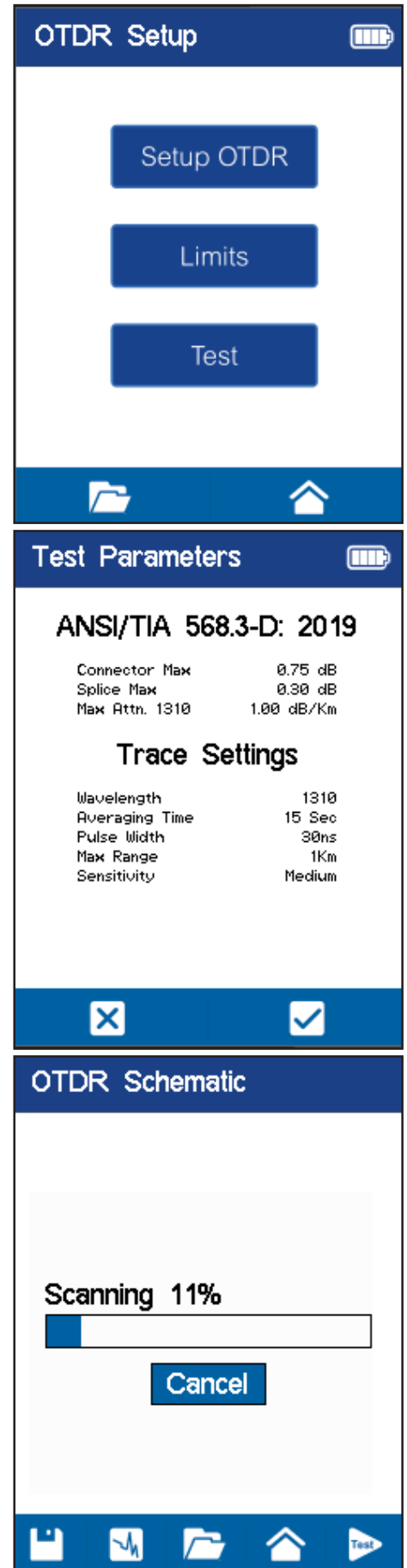
Chapter 9 OTDR Operation

9.1 OTDR Result Screens

There are three views for the OTDR results, they are; Schematic, Trace, and Event Table

The first view displayed after the test is run is the OTDR Schematic. The Schematic view is a linear map of the events detected by the FiberMASTER software which are classified as Launch, Splice, Connector, End, and Link.
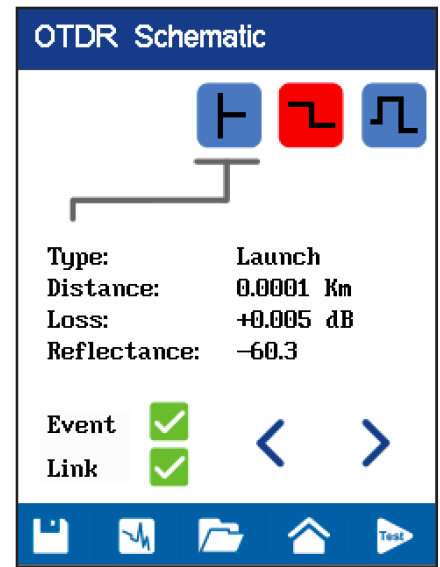
Pressing the View button on the menu bar cycles between the three OTDR views.

The second view is the trace screen which displays a detailed OTDR trace, loss information, zoom and cursor controls.

Detailed use of the controls are described later in the manual.

The third view is the event table, event diagram, detailed view of the active event and the trace parameters.

Pressing the Cycle view button again will return to the Schematic view.

OTDR Schematic

Type:	Launch
Distance:	0.0001 Km
Loss:	+0.005 dB
Reflectance:	−60.3

Event ✓
Link ✓

Cycle View

0.1625Km
0.4959Km

Avg. Loss	
+1.831 dB	
+0.151 dB	

SPL B

125 m/div
4.0 dB/div

Reflectivity
-47.3 dB

Wavelength
1310 nm

1x
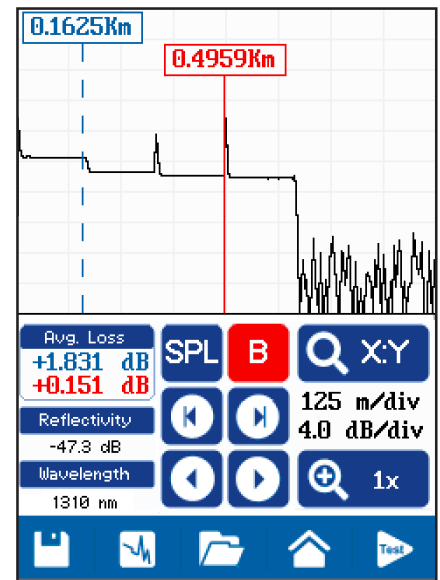
Cycle View

#	P	KM	SPLICE	2POINT	DB/KM	TYPE
1	F	0.1683	+1.905	0.178	+1.260	Splice
2	P	0.3319	+0.255	-0.279	-1.801	Conn.
3	P	0.4963	+0.203	-0.510	-3.277	Conn.
E		0.6621	N/A	-0.417	-2.645	End
L	P	0.6621	N/A	2.198	+3.371	-39.0

1   2   3
0.1683Km   0.3319Km   0.4963Km

WL 1310
Avg 60sec
PW 10ns
Rng 1Km

Default | Pt. 1 | << | >>

9.2 OTDR Schematic Screen

The schematic screen appears when the OTDR test is finished running.

The schematic is a series of icons that represents events that the OTDR has analyzed from the raw trace data which are presented in an easy to understand format.

An event can be activated by either tapping on it directly, or by tapping the left/right arrows to cycle through the list of events on the link.

The first event is the launch. This is the first reflective event detected at the front of the OTDR. The quality of the rest of the link is dependant on the reflectance of the launch. It should be better than -50 dB for a UPC connector. In this example a reflectance of -60.3 dB is a good, low reflectance level.

Non-Reflective Events (splices)

In this example a failing non-reflective event symbol is shown. A non-reflective event is one where there is no air gap to create loss as there is with a connector. Instead there is a bend in the fiber, or there is a fusion splice.

The OTDR will identify a non-reflective event as a Splice regardless of the true nature of the event. In this example the loss is 1.525 dB which exceeds the limit setting of 0.3 dB as shown on the Trace Parameters page.
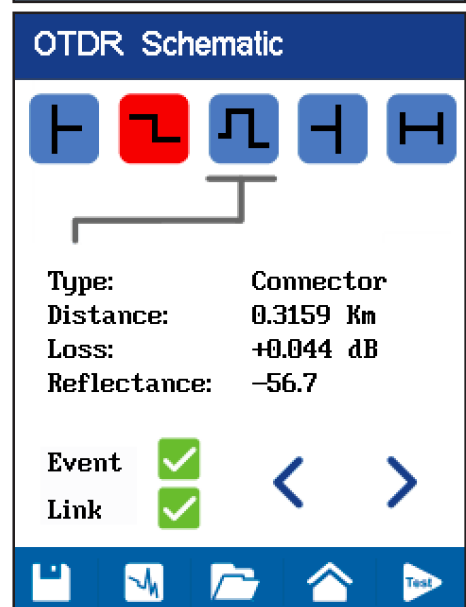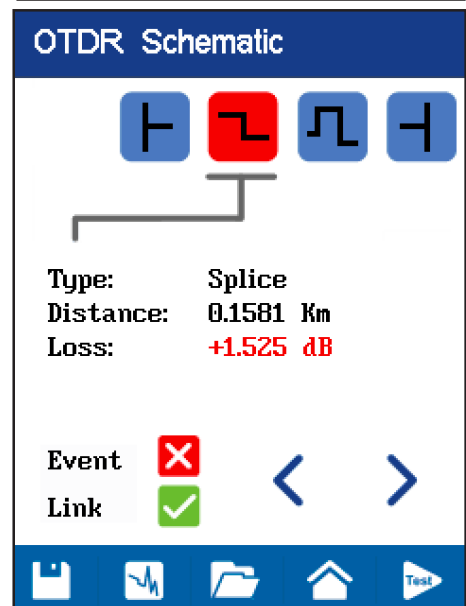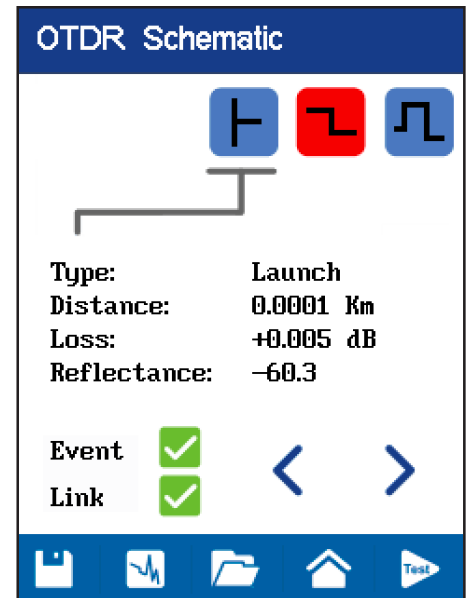
The Event status shows Fail for this event while the link shows Pass. This can happen because the total link loss is a function of the length of the fiber, and in this case the loss of the link is under the maximum allowed for it's length despite the failing splice.

Reflective Events (connectors)

In this example a passing connector symbol is shown. Reflective events occur when there is an optical discontinuity in the fiber and a reflection is sent back to the OTDR.

One of the side-effects of reflective events is that there is a dead zone after the event in which the OTDR cannot "see" anything. The size of the dead zone depends on the pulse width setting used to acquire the trace.

This connector is 315.9 meters from the start, has a loss of 0.044 dB, and a reflectance of -56.7 dB. The connector passes the test specifications as shown by the green Event ✔ mark.

OTDR Schematic

Type: Launch
Distance: 0.0001 Km
Loss: +0.005 dB
Reflectance: −60.3

Event ✅
Link   ✅

OTDR Schematic

Type: Splice
Distance: 0.1581 Km
Loss: +1.525 dB

Event ❌
Link   ✅

OTDR Schematic

Type: Connector
Distance: 0.3159 Km
Loss: +0.044 dB
Reflectance: −56.7

Event ✅
Link   ✅

OTDR Schematic End Event

The End event is where the OTDR detects the end of the fiber as set of the EOF setting the OTDR Setup configuration (described below).

The End event displays the total distance of the link which in this example is 474.4 meters, and the reflectance of the last connector which is -26.5 dB. Note that the high reflectance is the result of an open connector going into air, versus a mated pair of UPC connectors.

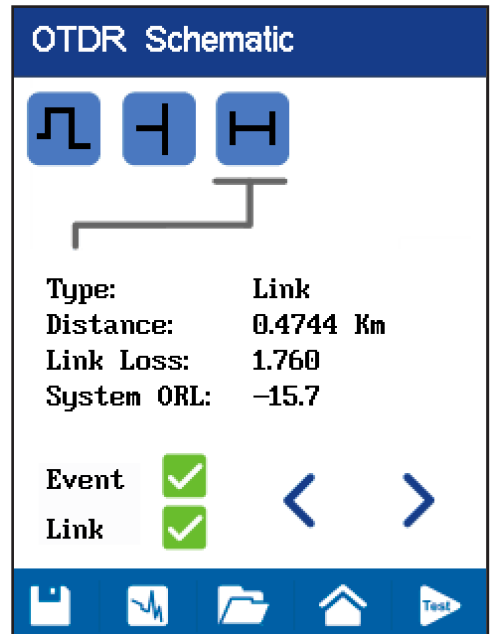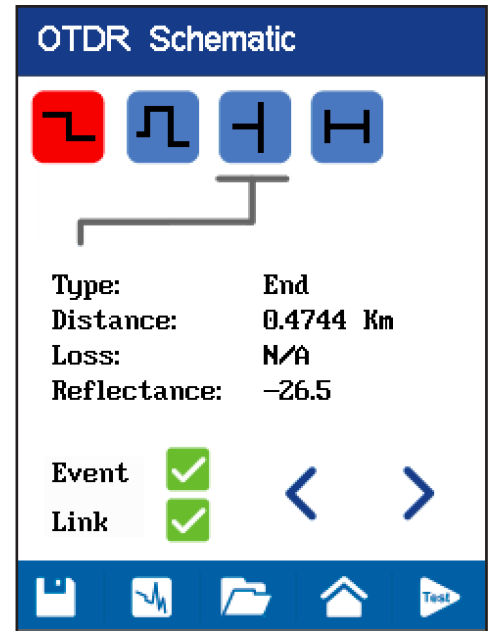The Event and Link indicators also show pass for the End event.

Link Summary

The Link summary gives the total length, loss and ORL (Optical Return Loss) of the link. In this example the length is 474.4 meters with a loss of 1.768 dB which includes all connectors, splices and fiber, and an ORL of -15.7 dB.

ORL is a measure of the total amount of light reflected back towards the launch. High ORL (low negative number) can create interference with network transmitters and ORL performance is important in high bandwidth networks. For example, 40 Gb/s networks require better than 30 dB ORL.

APC (Angled Physical Contact) connectors are used to achieve low reflectance connections/high ORL performance when required.

Press Cycle View to change to the OTDR Trace mode.

OTDR Schematic

Type: End
Distance: 0.4744 Km
Loss: N/A
Reflectance: -26.5

Event ✓
Link ✓

OTDR Schematic

Type: Link
Distance: 0.4744 Km
Link Loss: 1.760
System ORL: -15.7

Event ✓
Link ✓

Cycle View

9.3 OTDR Trace Screen

Trace mode provides a classical OTDR trace that the user must interpret to find events, section losses, faults and other conditions.

The appearance of the trace highly depends on the pulse width and averaging time of the test. If the trace is noisy, or there no events shown on the schematic when events are expected, try increasing the pulse width by one level.

Some events may not be visible on zoom level 1x due to the resolution sampling size. Zooming into 2x and scanning across the screen may be necessary to see certain types of reflective events.

The active cursor can be moved by tapping the desired position on the screen, by pressing the next/previous event buttons or by pressing the fine step buttons.

Cursor A is blue, cursor B is red. The active cursor is toggled by pressing the A/B button near the center of the screen.

"A" Cursor with Position Data (Inactive)

Loss Window
Tap to cycle between average loss of events at the A and B cursors, LSA loss at the A and B cursors, 2-point loss between the A and B cursors, or the slope loss and ORL between the A and B cursors.

Reflectivity
Displays the reflectivity of the active cursor if placed at the *beginning* of a reflective event.

Wavelength
Displays the wavelength of the trace. Toggles between wavelengths on dual wavelength tests.

Save Trace
Save the active trace. A prompt will first appear to select a project.

"B" Cursor with Position Data (Active)

Zoom Control
Toggles between zooming the X + Y, X only, or Y only axis when the Zoom level button is pressed.

Units per Division
Displays the number of meters per horizontal grid division, and dB per vertical grid division of the OTDR trace.

Zoom Level
Increases zoom level in steps from 1x to 2x, 4x, 8x, 16, 32. Displays X:Y levels individually when they differ.

Next View
Cycle to the Event Table view

Projects
Open the project manager to view saved tests

Home
Return to the OTDR Setup menu

Run Test
Press to begin another test using the same settings.

Central control buttons

Splice Zone Setting

When pressed (red when active), sets the position of the four cursors that control the splice/connector measurement zones. Press to cycle from cursors 1 through 4. Position cursors 1 and 2 on the flat area to the left of the splice/connector, and cursors 3 and 4 on the flat area to the right of the splice/connector.

Press the SPL button again to turn the splice zone setting off.

See section 11.3 for additional details on setting splice zones.

Toggle Active Cursor

Press to change which cursor is active. Cursor A is blue, cursor B is red. Touching the screen positions the active cursor to that position

Previous/Next Event

Jumps the active cursor to the previous event when |< is pressed or the next event when >| is pressed.

Fine Cursor Step

Moves the active cursor in single steps each time < or > is pressed. The step size is determined by the range setting.

9.4 Event Table

The Event Table is a view which displays the test results in event table with the schematic and a magnified view of the active event.

#	P	KM	SPLICE	2POINT	DB/KM	TYPE
1	F	0.1683	+1.905	0.178	+1.260	Splice
2	P	0.3319	+0.255	-0.279	-1.801	Conn.
3	P	0.4963	+0.203	-0.510	-3.277	Conn.
E		0.6621	N/A	-0.417	-2.645	End
L	P	0.6621	N/A	2.198	+3.371	-39.0

Event Table — Active event highlighted in blue

Fiber Map — 1 · 0.1683Km · 2 · 0.3319Km · 3 · 0.4963Km

WL 1310
Avg 60sec
PW 10ns
Rng 1Km

Default | Pt. 1 | << | >>

Wavelength of active test. Press to toggle wavelength for dual-wavelength tests

Average time, pulse width and range of the test

Adjust splice points 1 - 4

Reset splice points to defaults

Event view

Menu bar

Event Location

Event Loss in dB Red text = fail

Loss Between Previous and Current Events

dB Per/Km Between Events

#	P	KM	SPLICE	2POINT	DB/KM	TYPE
1	F	0.1683	+1.905	0.178	+1.260	Splice
2	P	0.3319	+0.255	-0.279	-1.801	Conn.
3	P	0.4963	+0.203	-0.510	-3.277	Conn.
E		0.6621	N/A	-0.417	-2.645	End
L	P	0.6621	N/A	2.198	+3.371	-39.0

Pass/Fail

Event Number

EOF Event Information

Link Information

Link Loss

Link dB Per/Km

System ORL

Event Type or Reflectance Value

Fiber Map

Range of the trace

Fiber link length

Event number

Failing event is red

0.1834Km   0.3647Km   0.5455Km

1   2   3

Red area is currently being displayed

Passing event is green

Event location

Reflective events   **Non-reflective event**
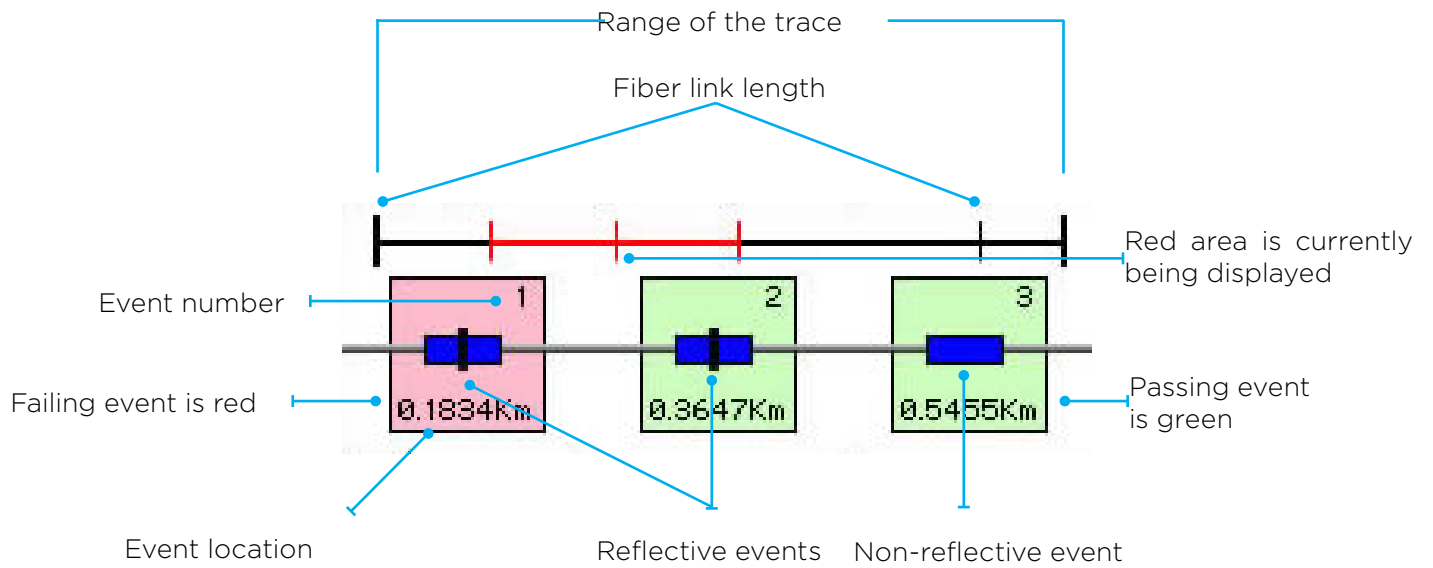
Note
The End of Fiber is the last item in the Fiber Map view. It is labeled E in the event number position and displays a vertical bar instead of horizontal.

9.5 Event Table Description

Event Table Field Description

Event Number:
Indicates the event in sequence, where the higher the number the further distance from the OTDR the event occurs. "E" (End) which is the event determined to be the end of the fiber under test. The last column is labeled "L" the row included data that is relevant to the link (full fiber under test).

P/F:
Pass/Fail, if any one of the thresholds are not met for and event, the P/F column will display an F. The parameter that failed will be displayed in red. If all the parameters are met, this column will display a P. There is no Pass/Fail threshold for the last event labeled "E" (End) and the Pass/Fail for the "L" (Link) row includes the 2POINT column, which for the link is the total link loss and the TYPE column which for the link row is the system ORL.

KM:
Event Location (Distance from OTDR), labeled Km for Kilometer. This is the distance/location that the event occurs along the fiber link. This data should be the same for the End of Fiber and Link.

Splice:
SPLICE is the dB loss at the event at this location on the fiber. Loss is represented as a positive number. (A positive number is the amount of loss and a negative number indicates a gain normally due to mismatched index of refraction.) This is a stable threshold for the Pass/Fail purposes. The "E" event will display LINK as this is not an event that would have meaning. The event that is deemed the EOF will normally display a large loss as this loss will be greater than the threshold set to determine the end of the fiber.

2POINT:
2 Point Loss is the loss measured from the end of the dead zone of the previous event to the beginning of current event. The value in the "L" line of the table for this column is the link loss. The loss from the beginning of the trace to the event determined to be the EOF. This is the value used to determine if the fiber link passes or fails it's loss threshold.

DB/KM:
dB per Kilometer. This is the calculated loss per Km from the end of the dead zone of the previous event to the beginning of the current event. The value in the "L" line of the table for this column is the dB Per/KM for the total link.

TYPE:
Event Type is the type of event or the return loss of and event. If the event has no reflection, "Splice" will be displayed and if the event is reflective, the reflectance value will be displayed. For the last event which is labeled "E", there is not value displayed, it simply shows "End" and in the "L" row, the Optical Return Loss for the link is displayed (System ORL).

Chapter 10 Advanced OTDR Operation

10.1 Average Splice Loss

The Average Splice Loss method is meant to be used on noisy traces when it is difficult to attain an LSA area that lays flat on the back scatter before and after the cursor. This method takes an average of the selected points before and after the active cursor and uses this average to make a good estimation of the event loss. This is an estimation but this method may be more accurate than LSA Splice Loss method when there is a lot of noise in the trace.

When using the splice loss It is necessary to set the splice loss areas in clear backscatter (areas that do not consist of other events). For accurate splice loss measurements, set a cursor at the beginning of an event and set splice loss measurement areas as shown in Fig. 8.6. Splice loss measurement areas will follow the undulations of the back scatter line unlike LSA areas.

10.2 Least Squares Approximation (LSA)

Least Squares Approximation (LSA) Splice loss method gives the user a visual aid in setting splice loss areas. This method can be more accurate by affording the ability to see the slope of the splice loss areas, however: it can also supply a reading with greater error if not used properly. The splice loss lines must be set to overlay the backscatter of a trace without over lapping any other events. Unlike basic splice lose, LSA measurement areas are drawn as straight lines without regard to the undulations of the back scatter. The idea of LSA loss is that the OTDR calculates a linear slope of the backscatter based on the selected splice markers. The slopes before and after the splice/connector are extended into the area of the connector and the difference in height is measured.
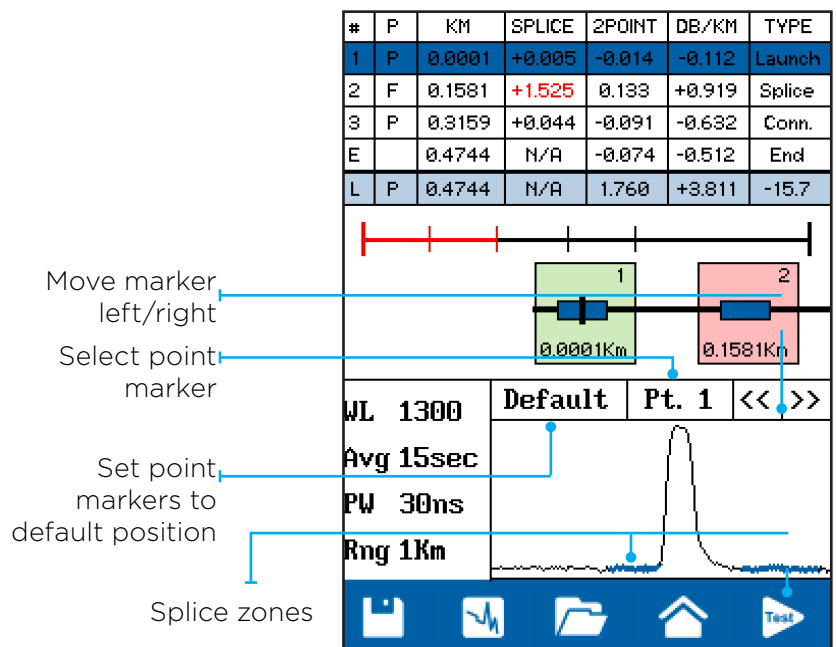
Excess error can be induced if the splice markers are incorrectly positioned in such a way that noise or undulations in on the trace affect the slope of the calculated line affecting the measured splice loss.

10.3 Loss Measurement Settings

Setting the Default Splice Loss Measurement zones

After a test the default splice zones should be set automatically. Should they need to be reset, or if they were not set properly for the trace they can be set to default from the Event Table screen.

Press the Change View button until the Event Table is shown. The splice loss zones are the blue lines before and after the selected event. Press Default to reset the splice zones to the default positions.

#	P	KM	SPLICE	2POINT	DB/KM	TYPE
1	P	0.0001	+0.005	-0.014	-0.112	Launch
2	F	0.1581	+1.525	0.133	+0.919	Splice
3	P	0.3159	+0.044	-0.091	-0.632	Conn.
E		0.4744	N/A	-0.074	-0.512	End
L	P	0.4744	N/A	1.760	+3.811	-15.7

Move marker left/right

Select point marker

Set point markers to default position

Splice zones

WL 1300
Avg 15sec
PW 30ns
Rng 1Km

Default   Pt. 1   << >>

Splice loss measurement zones

The splice zones for Average and LSA measurements can be manually set in the Trace and Event Table modes. The process of setting the splice measurement zones involves positioning four cursors that define two zones. Cursor 1 and 2 define the zone to the left of the splice/connector. Cursor 3 and 4 define the zone to the right of the splice/connector.

The zones should be set on the flat backscatter area immediately before and after the splice/connector, paying careful attention to not allow either zone to enter the sloped area of the event to be measured.
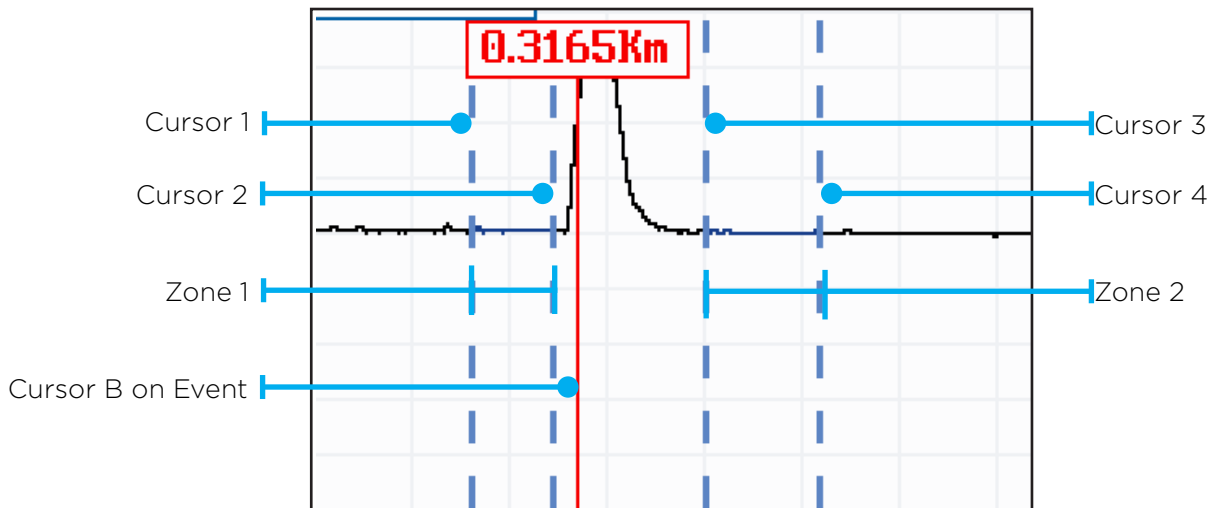
Splice loss measurement zone controls (Trace Mode)

Set the loss measurement mode to Avg. Loss or LSA Loss. In LSA mode the LSA slope lines will be visible between the splice zone cursors as shown below.

Zoom into an event and press the SPL button to change it from blue to red.
In adjustment mode the A/B cursor button will change to 'S1', representing Splice zone 1. With each press it will cycle from 1 to 4, then back to 1.
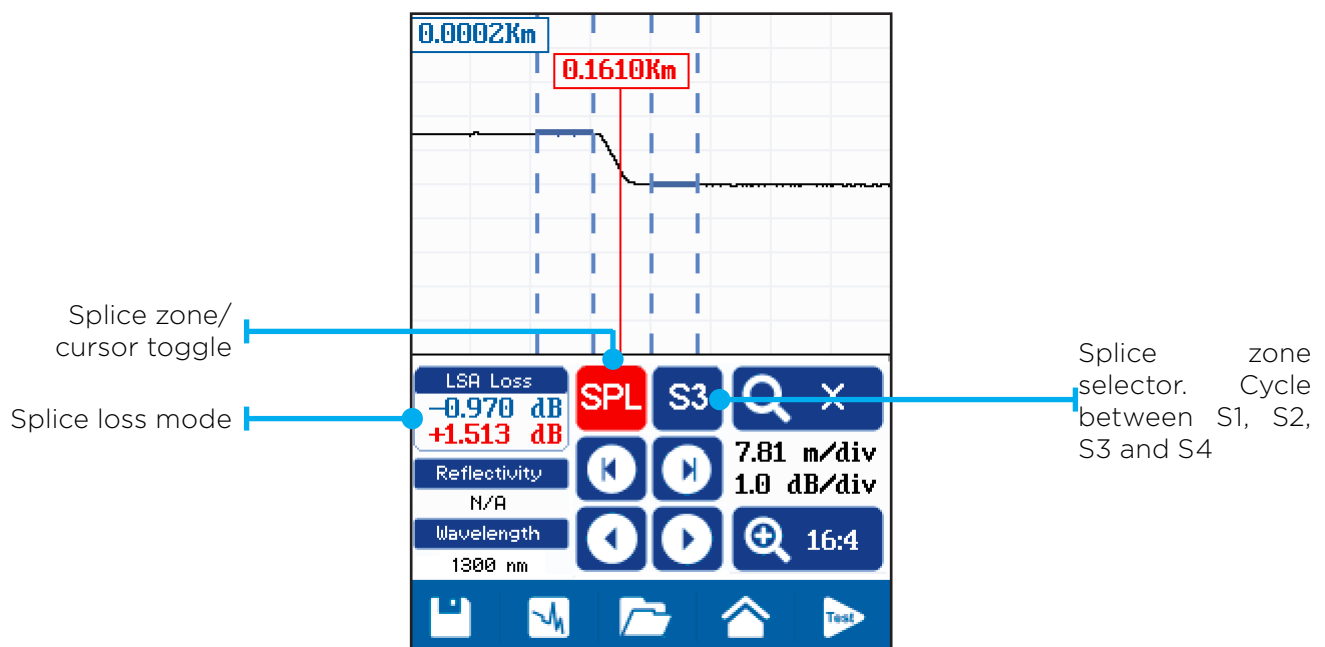
# Correct vs. Incorrect Splice Zone Setup
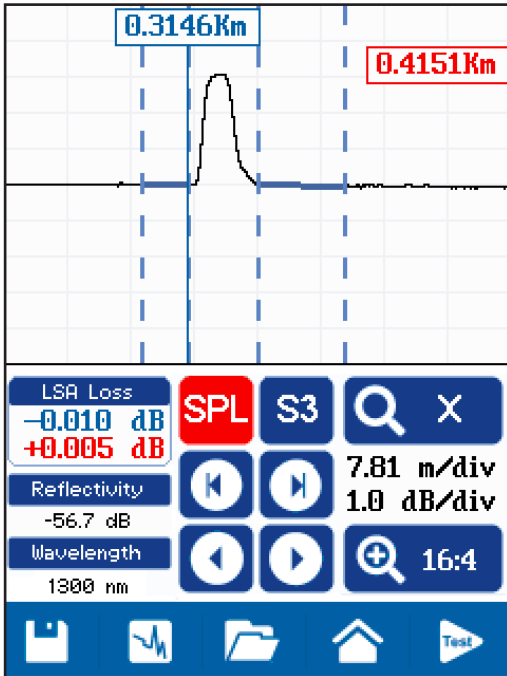
Splice zones properly setup on each side of the event. The LSA lines are flat on the back scatter before and after the reflection of the connector. Connector loss = 0.010 dB.
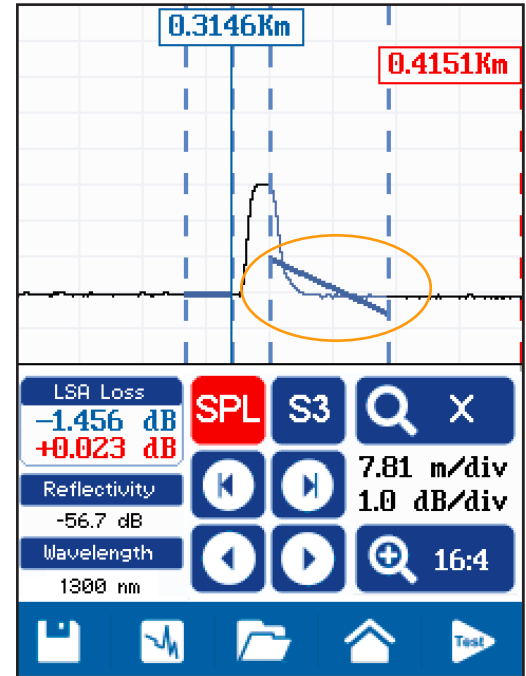
Splice cursor 3 is set on the reflection of the connector causing the LSA line on the right of the connector to not be flat. Calculated loss is 1.456 dB.
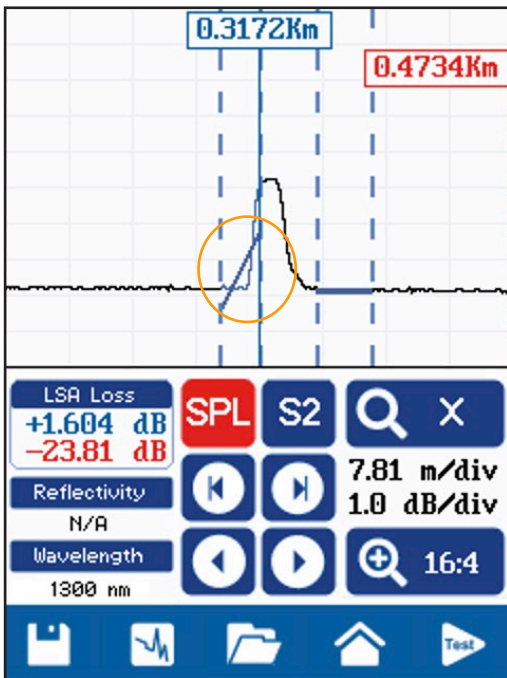
Splice cursor 2 is set on the reflection of the connector causing the LSA line on the left of the connector to not be flat. Calculated loss is 1.604 dB.
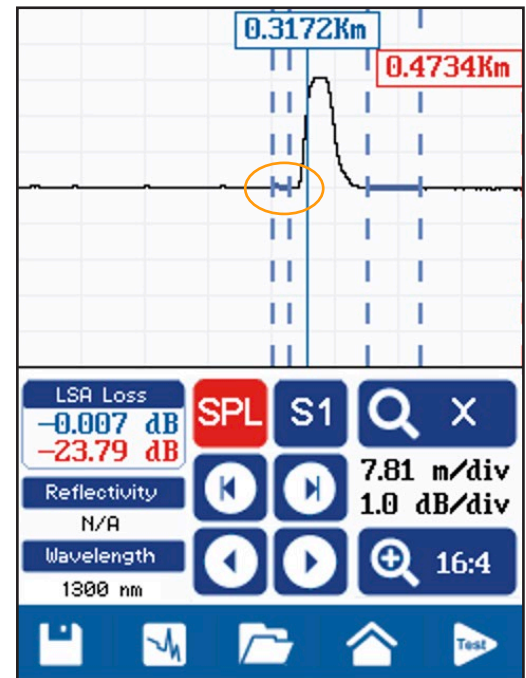
Splice cursor 1 is set on a slightly high noise spike that is causing the LSA line to dip from left down to the right. The result is an artificially low loss measurement of 0.007 dB.

10.4 2-Point Connector Measurements

The 2-point measurement mode measures the total loss between cursors A and B, including the loss of all fiber, splices and connectors. This is a quick method of measuring the link loss using the OTDR trace mode.

Care must be taken when using the 2-point mode to ensure the cursors are not placed on the slope of a reflective event or a noise dip/spike. The 2-point loss is a measure of a direct line drawn between the intersection of cursor A and B into the trace.

The 2-point mode can also be use to measure the dead zone of an event by placing the cursors at either side of a reflective event.

Short pulse width example

In this example the trace was taken with a 5 ns pulse width. The dynamic range is low, resulting in noise in the trace. Positioning of the cursors for a 2-point measurement has an impact on the measurement. Depending on whether the cursor is on a peak or a null, the resulting loss can be higher or lower than the LSA or Average loss measurement of the same event.

The 2-point loss of the connector in this example is 0.034 dB.

A benefit of the short pulse width is the is that the dead zone are also short. The 2-Point measurement box reads 0.0080 Km or 0.8 meters.
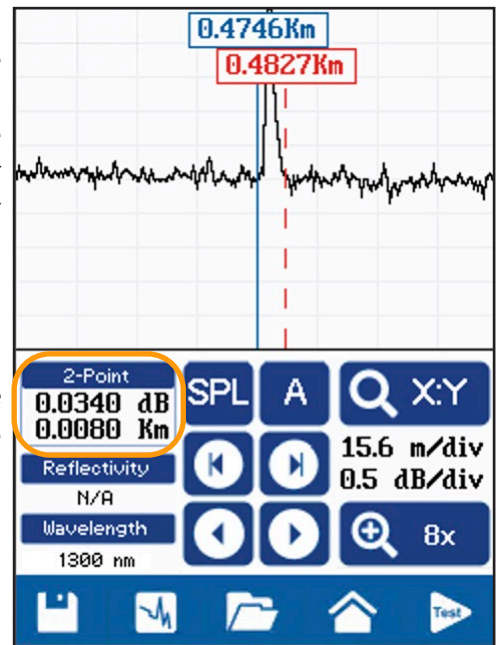
Long pulse width example

In this example the trace was taken with a 100 ns pulse width. The dynamic range is high, resulting in a clean trace. The high dynamic range is a result of the launch power being much higher than the back scatter reflection level.

Positioning the cursors is not critically important because the lack of noise will not affect the resulting loss measurement.

The 2-point loss of the connector in this example is 0.0640 dB.

A drawback of the long pulse width is that dead zones are long and can hide connectors or splices that are in close proximity.

The 2-point measurement box shows the distance between the A and B cursors (dead zone) is 0.0163 Km or 16.3 meters.
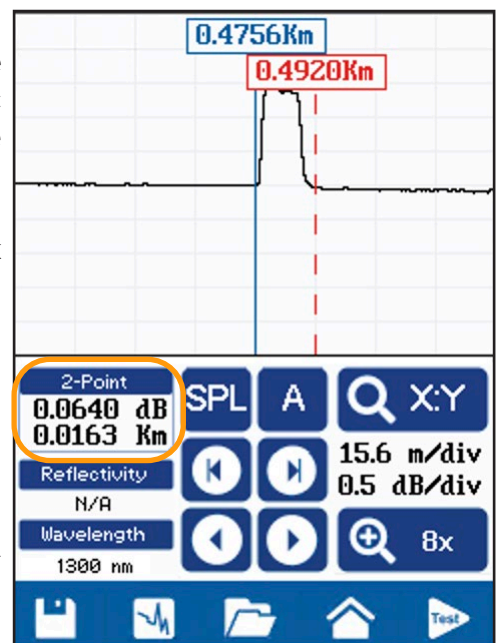
10.5 2-Point Link Measurements

A quick way to check the link loss is to change to 2-point mode and set cursor A at the beginning of the link, just after the dead zone, and cursor B just before the end-of-fiber event.

The 2-Point box will provide the loss of the total link (not including the first connector), including the two connectors and the splice in this example.

Short pulse width example

Because we are not trying to position the two cursors around a reflective event to measure it's loss the noise in the 5 ns trace is not as much of a factor in this example.

The main difference is the dead zone of the front-end event. Cursor A is able to be positioned at just 0.0102 km or 10.2 m from the front connector ensuring there are no "hidden" connectors or splices behind the first connector.

The 2-point link loss is 1.8761 dB and the distance between cursors A and B is 623.1 meters. The reflection of the end of fiber is -29.4 dB.
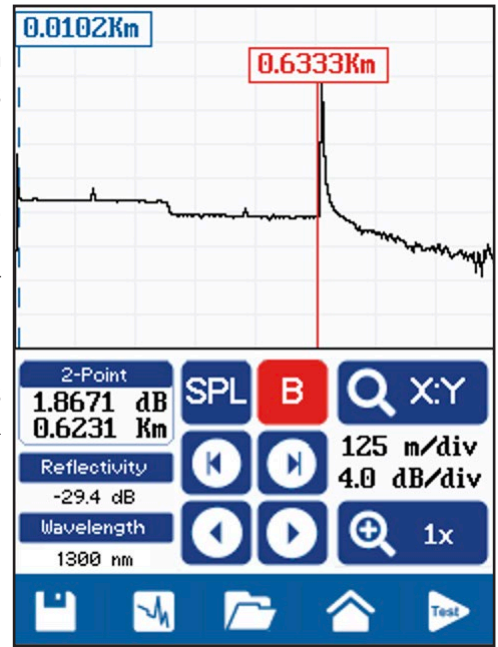
Long pulse width example

With the 100 ns pulse, cursor A must be positioned further into the fiber to get past the front-end dead zone. The distance of the dead zone here is 0.0333 km or 33.3 meters.

The 2-point loss is 2.1130 dB. The difference from the 5 ns example is due to the noise at the beginning of the 5 ns trace. The cursor is sitting in a dip that is causing the loss to be slightly lower.

The distance between the cursors is 0.6000 km or 600.0 meters vs 632.1 meters on the 5 ns trace. The difference is due to the position of cursor A being placed further into the fiber to account for the increased dead zone.

The reflection is slightly higher at -25.4 dB because the 100 ns pulse is launching more energy into the fiber and the OTDR is receiving a larger reflection from the end connector.
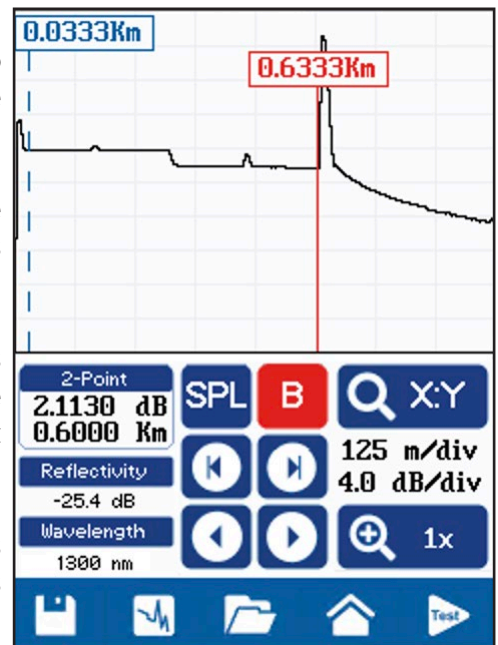
10.6 Slope / ORL Measurements

The 2-point cursor mode can be used to measure the attenuation slope of a section of fiber. Slope is defined as the attenuation per kilometer (dB/km) of fiber. This measurement can be directly compared to the specifications of the installed cabling to check for installation stress or damage that may be causing high loss along the entire length of the cable, not just in one spot.

To measure the slope, position the cursors on a section of fiber without any connectors or splices in between and touch the measurement box until it changes to Attn. / ORL.

The OTDR will measure the loss between the cursors and divide it by the distance between them, providing the calculated value in the measurement box.

The slope (attenuation) of this section of fiber measures 3.58 dB/km at 850 nm and 0.94 dB/km at 1300 nm which are typical attenuation values for multi-mode fiber.
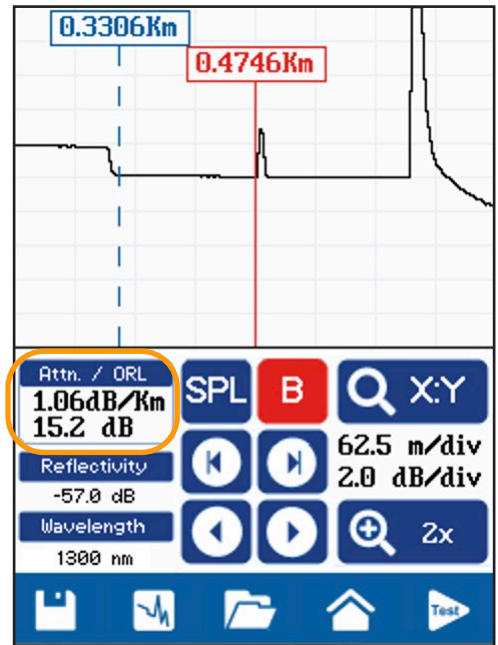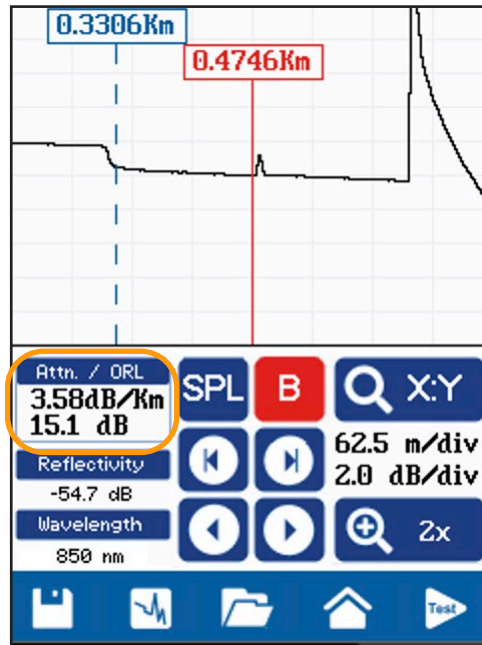
Running a dual wavelength test make is easy to visualize the difference in attenuation between 850 nm and 1300 nm of multi-mode fiber. At 850 nm, multi-mode fiber has more than 3x the attenuation compared to 1300 nm

The ORL (Optical Return Loss) value is a measure of the total power reflected from the link back to the OTDR port. The system ORL at 1300 nm is 15.1 dB which is typical of a link where the end connector is left in open air.
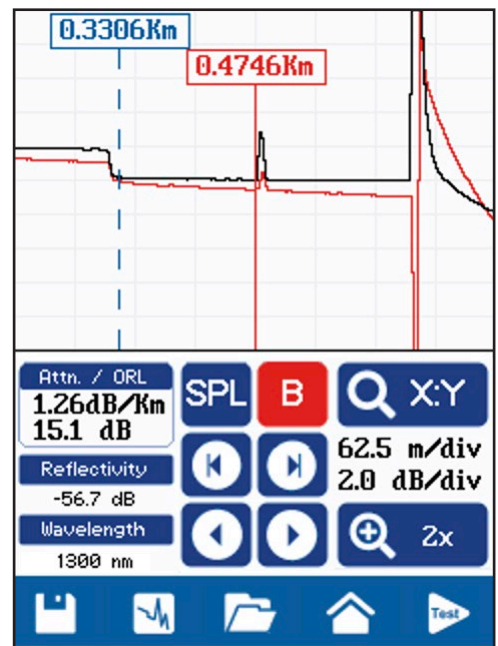
Chapter 11 Video Inspection Probe

11.1 Video Inspection Probe Operation

The video inspection probe allows magnified end-face inspection of fiber optic connectors check for contaminates or damage. Proper cleaning and end-face inspection is a critical practice each time a connector is plugged into a mating connection or piece of fiber optic equipment.

Fiber optic connectors are physical contact, meaning the faces touch each other when mated. Contamination from one connector will be transferred to the other connector. The same is true for the OTDR port. Plugging a dirty connector into the OTDR will contaminate the OTDR port leading to high reflection/dead zones for every test until the OTDR port is properly cleaned.

Video Probe Tips

There are a number of video probe tips available. To remove a tip from the Probe, grasp the probe tip and unscrew the tip retention nut from the tip. Pull the tip straight up from the probe. To place a tip on the probe, ensure the lens is clean, slide the tip on to the end of the probe and tighten the tip retention nut. Do not overtighten the retention nut.
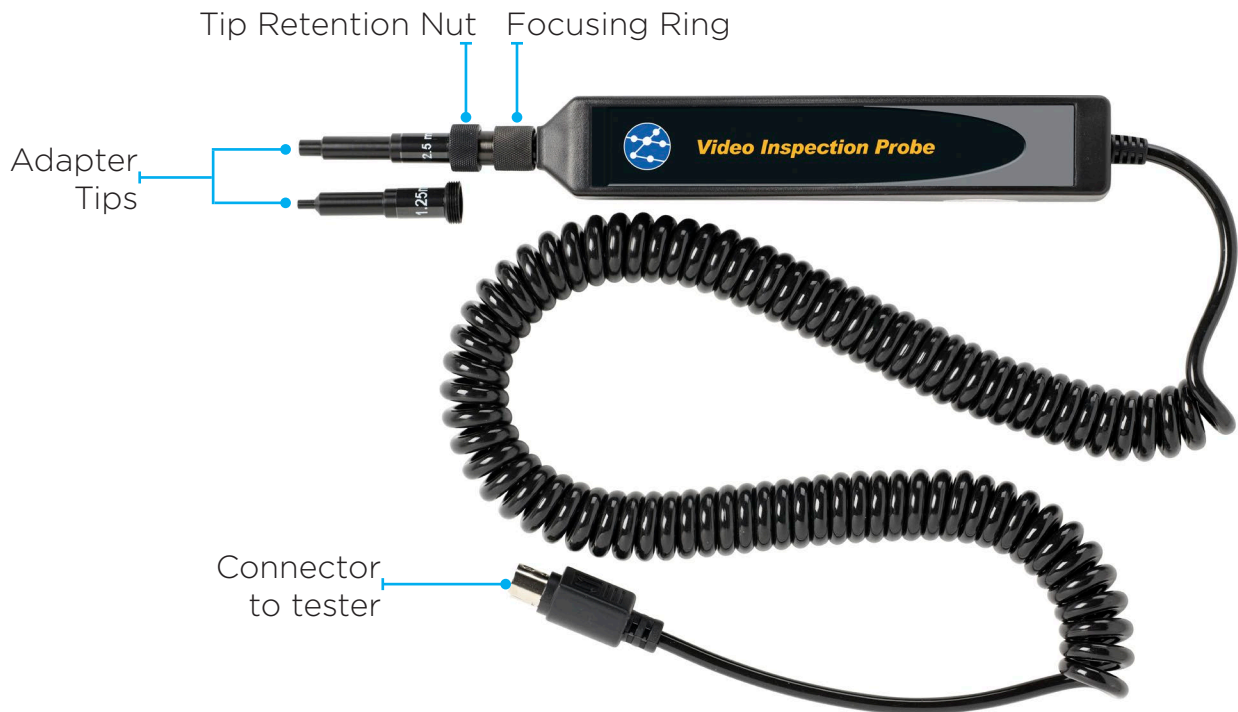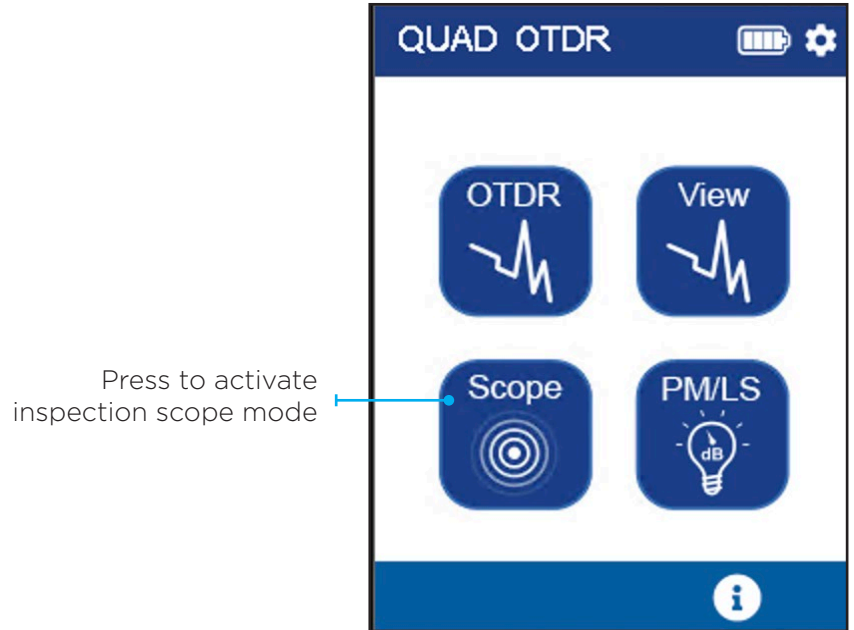

Viewing/Focusing a Connector

With the video scope turned on and the video probe plugged into the OTDR, insert a connector in to universal tip or insert the panel adapter tip into the appropriate port. The scope must be in the live scanning mode to make focus adjustments. Use the focus ring to get the connector image as sharp as possible. When using panel adapters it is possible to turn the body of the probe to while the adapter is inserted into the panel to make focus adjustments.
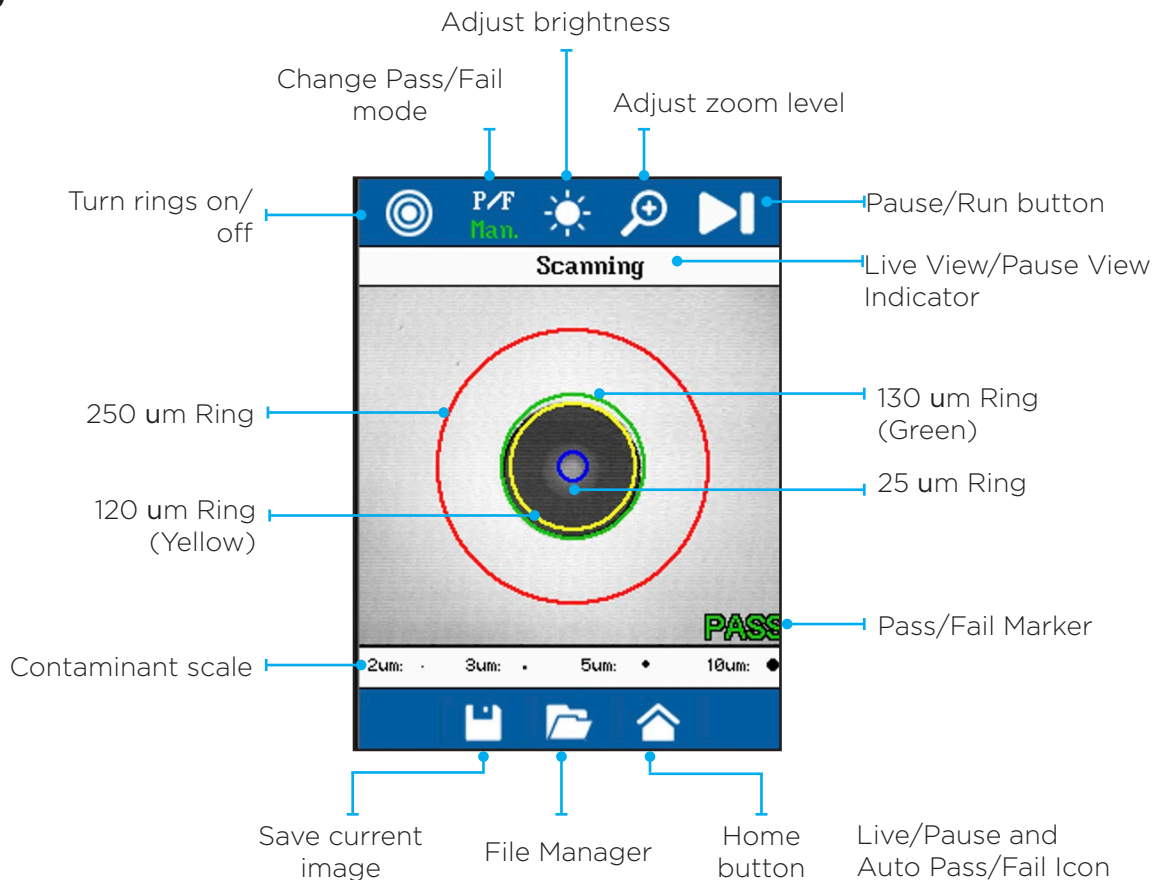
NOTE:

> To autocenter the image, touch the center of the connector image and the connector will move as close as possible to the center of the display.

11.2 Video Inspection Probe Display

To operate the video scope, from the home screen, touch the Scope icon. If a probe is not connected already, connect the R-240-VIP video inspection probe to the video probe port on the top of the OTDR.

Press to activate inspection scope mode

VIP Display

- Adjust brightness
- Change Pass/Fail mode
- Adjust zoom level
- Turn rings on/off
- Pause/Run button
- Live View/Pause View Indicator
- 250 um Ring
- 130 um Ring (Green)
- 120 um Ring (Yellow)
- 25 um Ring
- Contaminant scale
- Pass/Fail Marker
- Save current image
- File Manager
- Home button
- Live/Pause and Auto Pass/Fail Icon

11.3 Video Inspection Probe Functions

Rings
Used to turn on and off the rings that indicate the IEC 61300-3-35 grading zones.
The rings do not need to be turned on for the automatic image grading test, they are for reference only.

Pass/Fail Modes
Off - No Pass/Fail indication will be marked on the image.
Man. PASS - All images will be marked PASS.
Man. FAIL - All images will be marked FAIL.
Auto - When scanning is paused, the image will be evaluated against the IEC 61300-3-35 standard and marked PASS or FAIL accordingly.

Adjust Brightness
Press to cycle through the brightness levels. Note that if the image is too dark, the automatic PASS/FAIL testing will tend to fail clean connectors.

Adjust Zoom
Toggles between low and high magnification.

Pause/Run Button
Pauses the image for automatic evaluation and PASS/FAIL testing. Press again to resume live scanning.

Home Button
Returns to OTDR Home main home screen

File Manager
Opens the file manager to create/delete projects and open saved files.

Save current image
Saves the current image to a selected project.

Containment scale
Reference for the size of contamination particles on the connector end-face.

11.4 Using the Video Inspection Probe

Centering a Connector Image
Once the image is stable and focused, use the stylus to touch the approximate center of the connector to snap the image as close as possible to the center of the display and the center of the grading rings. It may be necessary to adjust the adapter tip if centering is not possible.

Pausing Image Scan
After centering the image, freeze it's position and focus level for inspection by touching the Pause/Run Icon. If the PASS/FAIL mode is set to Auto, pausing the image will start an automatic analysis of the connector and the result will be displayed in the bottom-right corner of the screen.

Grading Rings
Touch the Grading Ring Icon to turn off and on the grading rings. The unit must be in live scan mode to turn the rings off or on.

Pass/Fail
Use the pass/fail criteria tables on the next page to determine if the connector passes the IEC 61300-3-35 standard. There is a guide to contamination size located at the bottom of the image. To manually mark a connector as Pass or Fail, touch the Pass fail icon and cycle to the desired state. Once the pass fail status has be entered, the scan may be paused with the Live/Pause-Auto Pass/Fail icon to allow for marking the contamination points.

Marking Points of Contamination
To mark the points of contamination the unit must be in paused mode. Pick up the contamination marker by using the stylus and touching the contamination sample size that is required. Touch the image to place the marker. The marker may be fine-tuned with the stylus to cover the contamination point on the image to be marked. Once the marker is positioned properly, touch the contamination sample size again to set the marker. Repeat as many times as desired.

Note:
Marking the points of contamination should be done last, just before saving the image. Once the unit is returned to live mode the markers are removed.

Auto Pass/Fail
Once the image has been centered as close as possible in the grading rings, set the P/F icon to Auto and touch Live/Pause-Auto Pass/Fail icon. The video scope will evaluate the image and grade it with Pass or Fail. Contamination will be displayed on the image.

11.5 Connector Pass/Fail Criteria

Fiber End Face Criteria Table for Angled PC Polished Connectors

Zone	Description	Diameter	Allowable Scratches (Width)	Allowable Defects (Diameter)
A	Critical Zone	0 um to 25 um	≤ 4 um	None
B	Cladding Zone	25 um to 120 um	No limit	No Limit < 2 um 5 from 2 um to 5 um None > 5 um
C	Adhesive Zone	120 um to 130 um	No limit	No limit
D	Contact Zone	130 um to 250 um	No limit	None ≥ 10 um

Fiber End Face Criteria Table for Ultra PC Polished Connectors

Zone	Description	Diameter	Allowable Scratches (Width)	Allowable Defects (Diameter)
A	Critical Zone	0 um to 25 um	None	None
B	Cladding Zone	25 um to 120 um	No limit ≤ 3 um None > 3 um	No Limit < 2 um 5 from 2 um to 5 um None > 5 um
C	Adhesive Zone	120 um to 130 um	No limit	No limit
D	Contact Zone	130 um to 250 um	No limit	None ≥ 10 um

Fiber End Face Criteria Table for SM PC Polished Conn. (Single Mode Fiber, RL≥ 26 dB)

Zone	Description	Diameter	Allowable Scratches (Width)	Allowable Defects (Diameter)
A	Critical Zone	0 um to 25 um	2 ≤ 3 um None > 3 um	2 ≤ 3 um None > 3 um
B	Cladding Zone	25 um to 120 um	No limit ≤ 3 um None > 3 um	No Limit < 2 um 5 from 2 um to 5 um None > 5 um
C	Adhesive Zone	120 um to 130 um	No limit	No limit
D	Contact Zone	130 um to 250 um	No limit	None ≥ 10 um

Chapter 12 Loss Test Set

12.1 Loss Test Set Operation

The loss test set includes two components; an optical source and an optical power meter. On FiberMASTER, the OTDR port is also the optical source used for taking power loss measurements. It can be operated in continuous wave (CW) mode, or modulated at various frequencies for use with industry standard fiber identification devices and power meters that support modulation detection.

The power meter port uses a broadband detector on all OTDR models that can measure from 850 nm to 1625 nm. When used with the FiberMASTER source, the power meter automatically detects the wavelength being transmitted and sets itself to the same wavelength. The power meter can be used with any optical source, though the wavelength must be set manually.

The power meter includes LC, SC, ST, FC, 2.5 mm universal, and 1.25 mm universal adapters.

Power meter port

Single mode source port

Multi-mode source port

Press to activate Power meter/Light source Mode
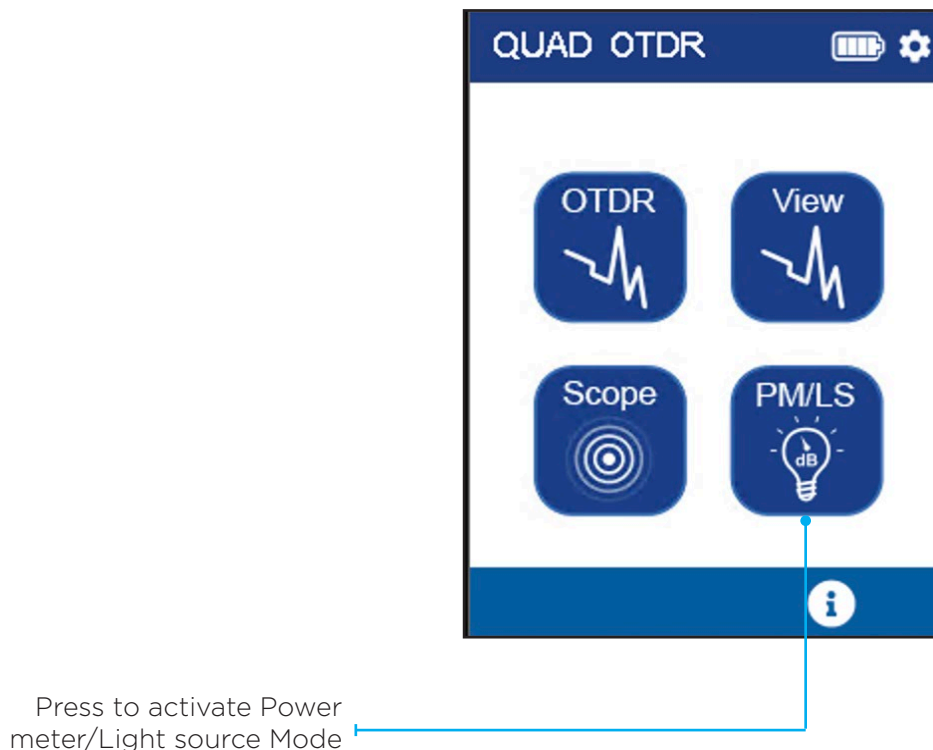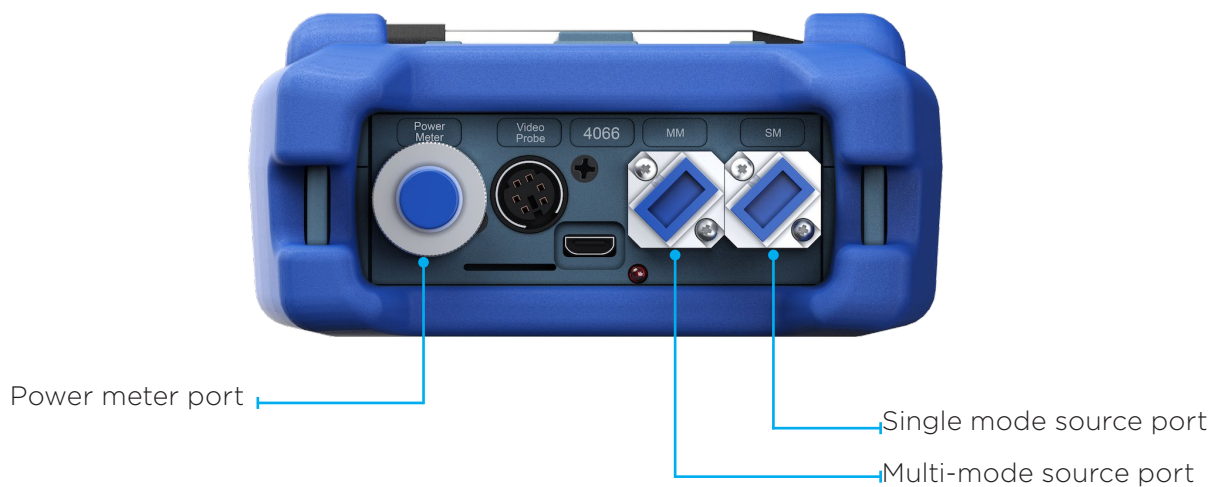
12.2 Loss Test Set Display

Press to activate open light source wavelength selection

Press to open the source modulation options

Current measurement reading

Unit of measure

Press to open power meter wavelength selection

Press to open the power meter set reference options

Save current measurement

Open Project Manager

Return to the OTDR Home screen

Select the wavelength to be transmitted by the light source. Ensure the launch cable is connected to the correct connector for the selected wavelength.

Select the modulation of the light source. CW (continuous wave) is normally used when taking power measurements. 270, 1000, and 2000 Hz modulations are used to identify cables with fiber identifiers.

Select the wavelength to be measured by the power meter when not using the FiberMASTER light source. When the FiberMASTER source is used, the power meter will automatically detect the wavelength of the source.

Select whether the display is the absolute power value (dBm) or relative power (dB) after setting a reference value.

12.3 Power Meter Operation

The FiberMASTER power meter can be used with any light source to measure the amount of power entering the port. When used with the OTDR light source, the power meter's wavelength is automatically set to match the output of the OTDR source. When used with other light sources, the wavelength must be set manually.

Note: The wavelength information ID is transmitted during the initial 1-2 seconds of OTDR source activation. If the power meter is not connected to the OTDR source during this initial time, automatic wavelength detection cannot occur and the power meter wavelength will need to be set manually.

Power Meter Display Modes - View Absolute (dBm)
Displays power in dBm (decibel-miliwatt), meaning 0 dBm = 1 mW of power. This is an absolute reading of the amount of power arriving at the detector. Absolute power readings are useful when troubleshooting optical equipment to compare power arriving at the receive port to the specifications of the equipment.
Example, if the specification of an optical receiver states that the input power range is from -40 to 0 dBm. Use the power meter to measure the incoming power from the source fiber. If the incoming power is -50 dBm, it is below the minimum sensitivity of the receiver and it will not operate.

Power Meter Display Modes - View Relative (dB)
Displays changes in power from a reference point in dB (decibel). Measuring relative power is useful when testing the loss of a cable from one end to the other. To obtain an accurate measurement, a reference must first be made. The reference value is the absolute power (dBm 1) directly between the light source and the power meter, which is stored in the tester's memory. Then when making the relative measurement, a second absolute power measurement (dBm 2) and the difference between the two absolute measurements dBm 2 - dBm 1.

The power meter is set to absolute mode (dBm) with the source and meter both at 1310 nm.

When the meter is in absolute mode the Reference value can be ignored. It is only applicable when the meter is in relative (dB) mode.

Below the power reading is the modulation detection. It will display 270Hz, 1000Hz, or 2000Hz when an the incoming signal is modulated. This function is used to ensure the intended fiber is being measured while in the presence of other live fibers.
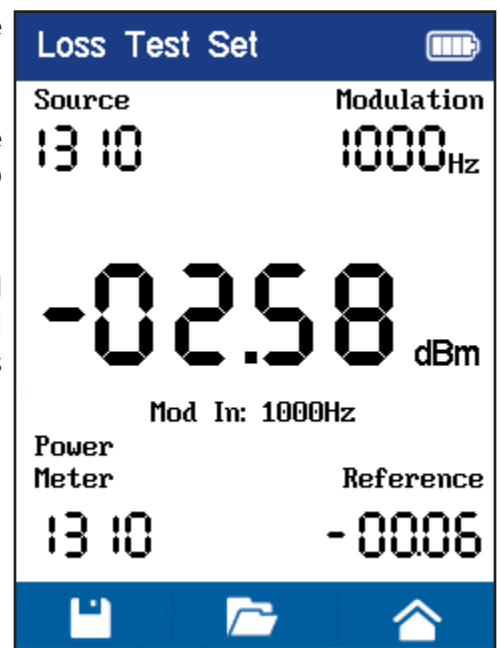
12.4 Light Source Operation

The light source is located in the top left portion of the display. The current status is displayed, example, 1310 is displayed when the 1310 nm SM source is active, OFF is displayed when no source is active.

Press the desired wavelength to activate the source. The power meter will auto-detect the FiberMASTER source wavelength only when connected during the initial turn-on sequence.

In the top right portion of the display, select the modulation of the light source. CW (continuous wave) is the normal operating mode for use with any power meter. 270, 1000, or 2000 Hz modulations can be enabled for use with power meters or fiber identifiers that detect any of these three frequencies.

Menu Bar

Save

Saves the current reading to internal memory. Files can be opened by themselves or attached to an OTDR trace for reporting.

Note: For safety, the source will turn off when a file is saved and must be enabled to test again.

Project Manager

Open the project manager to view stored test files.

Home

Returns to the main OTDR home screen.

12.5 Setting a Reference Value and Testing a Cable

When testing a cabling link for dB loss, the starting power level going into the cable under test must be known, excluding the loss of any test jumpers. This process is known as setting a reference. Failure to set the reference will result in inaccurate loss readings.

1. Connect test jumper 1 between the light source and power meter with the meter set in Absolute mode. Any light source can be used.
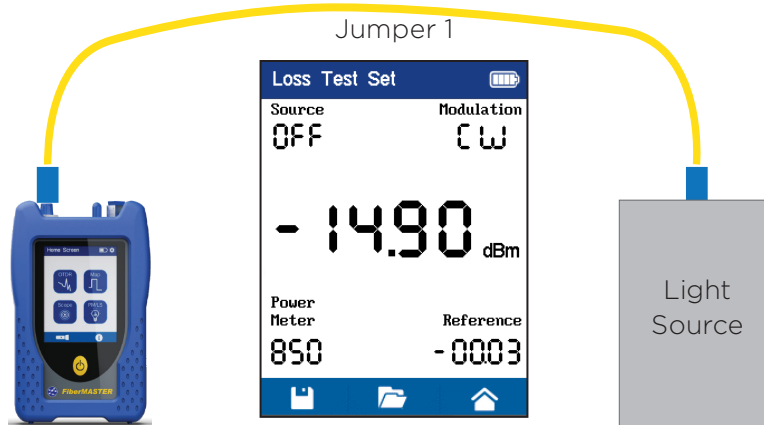
2. Press Set Reference on the bottom right menu to store the reference value in the meter. The display will change to 0.00 dB which is now in the relative mode.
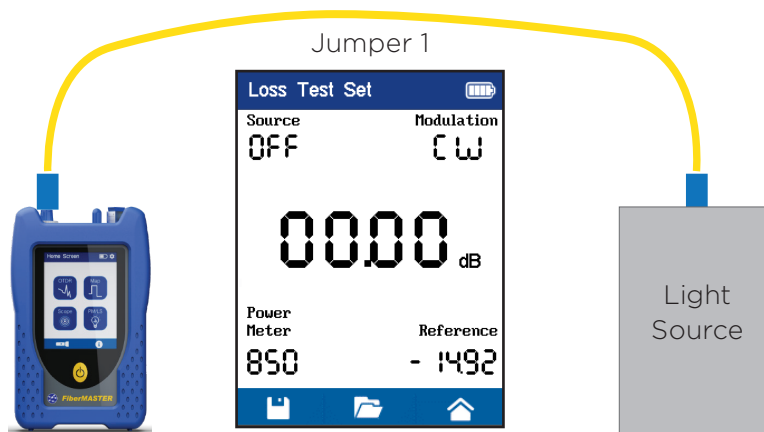
3. Disconnect jumper 1 from the power meter.
   Do not disconnect the jumper from the light source once the reference has been set.
4. Connect jumper 2 between the power meter and jumper 1 using a coupler. The loss value shown here is the loss of jumper 2 and coupler. Ensure that the value is less than 0.75 dB. If the value exceeds 0.75 dB clean the connections or use a new set of jumpers and return to step 1.
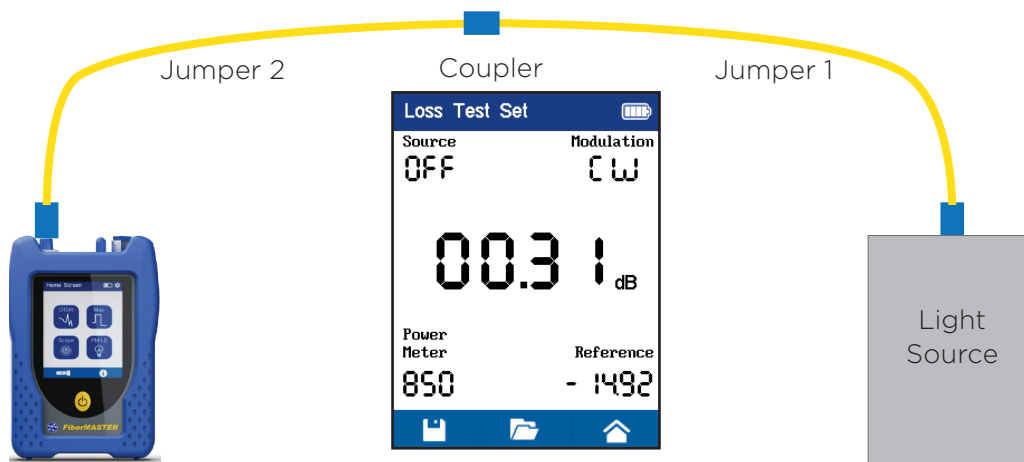
5. Connect the cable to be tested between the two jumpers. Read the loss of the cable and store the reading if desired.
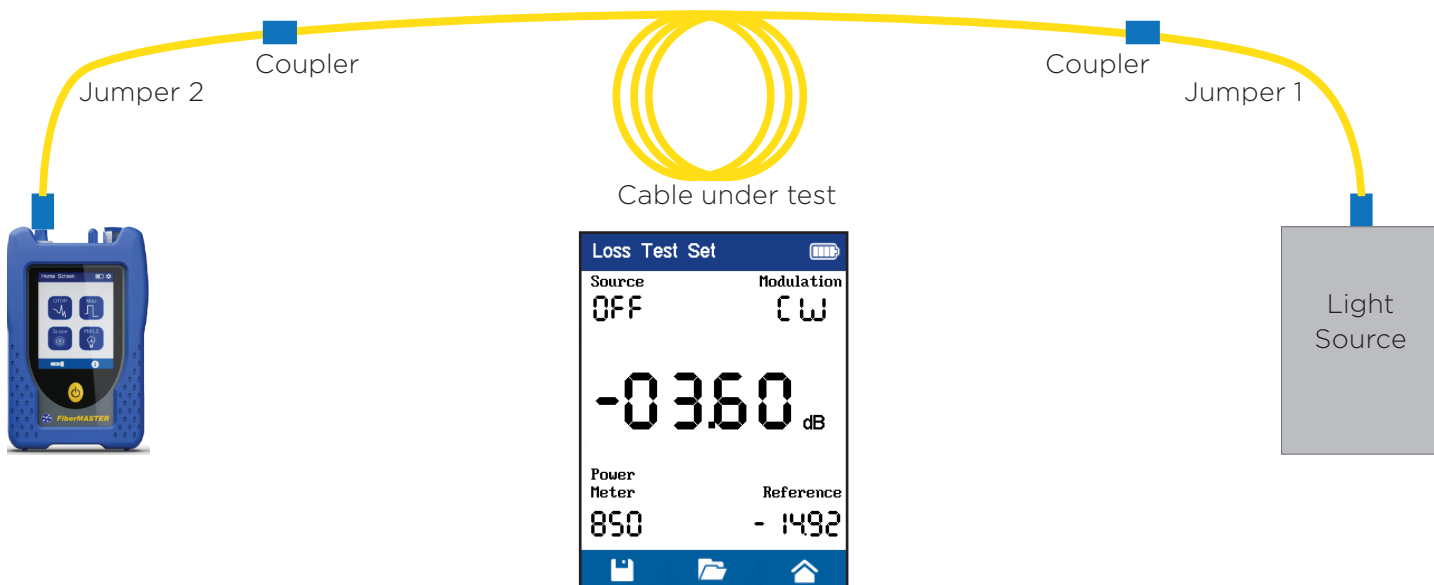
Chapter 13 Visual Fault Locator

13.1 VFL Safety

Caution

This Visual Fault Locator is classified as a Class II laser system and must be used with all commensurate safety precautions. Never view the light emanating from the fiber directly. Place a white piece of paper at the end of the fiber and look for the presence of a red spot on the paper.

13.2 VFL Description

The Visual Fault Locator emits visible (red) light at the 650 nm wavelength. Its intended function is to allow an operator to identify the exact location of a break, micro bend, or other discontinuity in a fiber optic cable. As the radiation is visible, light emanating from a break or micro bend enables the user to locate the exact position of a fault even at very short distances that would not be detectable by conventional means such as an Optical Time-Domain Reflectometer, (OTDR). It is also useful for identifying a particular fiber in a cable by exciting the fiber to be located with visible radiation.

13.3 VFL Operation

The Visual Fault Locator is access from the Home screen.

The fiber to be tested is connected to the VFL port of the OTDR by means of a standard 2.5 mm fiber optic connector. The source may be used in one of its two modes, Modulated or Continuous. In the modulated mode the laser is turned on and off at a 6 Hz rate. The laser is on for approximately one third of the cycle. This mode is helpful in permitting the user to identify the source radiation in the presence of high levels of ambient light. It also aids in conserving battery life.

The usable range for fault location depends on many factors, the type of fiber, the type of cable, the overall loss.

To activate the VFL, tap the VFL icon to cycle through the available states of off, Continuous and Modulated.

Chapter 14 Specifications

14.1 OTDR Specifications

Wavelength	850, 1300, 1310,1550 and 1625 ±20 nm
Dynamic Range	Multi-mode: 29 dB @ 850 nm, 30, dB @ 1300 nm SInglemode: 37 dB @ 1310 nm, 38 dB @ 1550 nm PON: 36 dB @ 1625 nm
Pulse Width	5 - 20,000 ns
Units of Measurement	km
Event Dead zone	1 meter
Attenuation Dead Zone	5 meter
Resolution	.125 - 32m
Distance Uncertainty	±(0.75m + 0.005% x distance + sampling resolution)
Full Scale Distance Range	0.25-128 km
Typical Real-time Refresh Rate	2 Hz
Group Index of Refraction (GIR)	1.024 - 2.048
Linearity	± .05 dB/dB
Memory Capacity	~40,000
Memory Type	Internal
Power Supply / Charger	5V, 2.1A USB Charger
Battery	Li-Poly, 3.7V, 8,000 mAh, 10 hour operation typical
Storage Temperature	-20 to 60 C
Operating Temperature Range	0 to 40 C
Dimensions (w/out rubber boot)	6.25" L x 4.125" W x 1.875" H (159mm L x 105mm W x 48mm H)
Weight	1.5 lbs (0.7 kg)
Communications ports	USB and Bluetooth
Connector Styles	SC UPC MM/SM, SC APC PON

TREND reserves the right to change specifications without notice.

14.2 Power Meter Specifications

Detector Type	InGaAs
Connector Type	2.5mm Interchangeable
Dynamic Range	+5 to -77dB (CATV - +25 to -57dB)
Calibrated Wavelengths	850, 1300, 1310, 1490, 1550, 1625 nm (standard wavelengths)
Power Measurement Uncertainty	± 0.18 dB under reference conditions, ± 0.25 dB from 0 to -65 dBm, ± 0.35 dB from 0 to +5 dBm and from -65 to -77 dBm
Units of Measurement	dBm, dB
Resolution	.01 dB

14.3 Light Source Specifications

Fiber Type	Single mode, Multimode
Wavelengths	850, 1300, 1310, 1550, 1625 nm ±20 nm *
Output Power	0 dBm ±0.5 dB (-3 dBm ± 0.5 dB @ 1625 nm)
Laser safety classification	Class I Safety Per FDA/CDRH and IEC-825-1 Regulation
Modulation Modes	CW, 270 Hz, 1000 Hz, 2000 Hz

* Light source wavelengths present are determined by the OTDR configuration

14.4 Visible Fault Locator Specifications

Emitter Type	Laser Photo Diode
Wavelength	650 nm ±5nm
Output Power	1 mW Max.
Connector Type	2.5 mm Universal
Laser safety classification	Class 2 Per FDA/CDRH and IEC-825-1 Regulation
Modulation Modes	CW, 1 Hz

TREND reserves the right to change specifications without notice.

Chapter 15 CertSoft 2 PC Software

15.1 Description

CertSoft2 is a Windows PC software application used to transfer test files from the FiberMASTER OTDR to the PC for archival and generation of test reports. Download and install the software from www.trend-networks.com/support

Requirements:
- Windows 7 or newer running on an Intel or AMD x86 PC.
- 8 GB RAM, 500 MB disk space
- USB Type A port

User Interface

Current file path

OTDR/LTS Tab

Trace area

Zoom X, Y, X|Y toggle

OTDR connection status

Test file list

Test type tabs

Test details area

16.2 Transferring Files

Connect the OTDR to the PC using a USB cable. Verify that the OTDR connection status icon turns green. If the icon does not turn green check the following:

- Cable plugged securely into OTDR, the LED light should be on.
- Ensure the cable is plugged directly into the PC, not into a USB hub.
- Reinstall the CertSoft2 software and ensure the USB drivers are installed.

The first column identifies the type of file. Click Features on the menu, then select File Transfer.
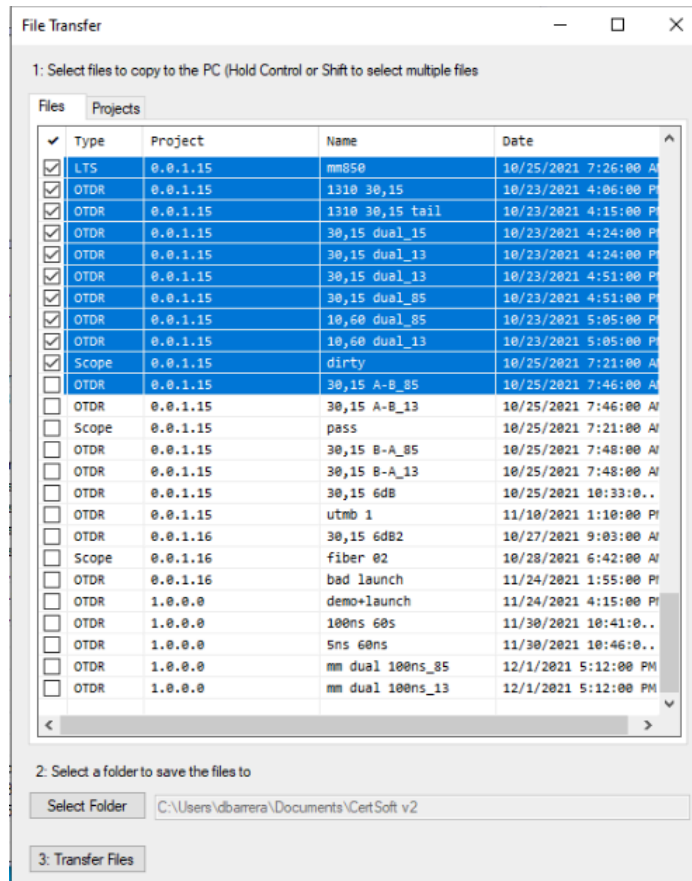
- Select the files to import by either choosing the box beside the file or select multiple file by selecting the first file name, holding Shift, then selecting the last file name to choose all of the files in between.
- Select the Projects tab to import all files within a selected project.
- Click Select Folder to choose the target folder to copy the files to.

Click Transfer Files to start copying files from the OTDR to the PC.

15.3 Opening a Trace

Double-click a file in the list to open a trace.
- Double-click the same file to close the trace.
- A second trace can be opened to compare two traces in the window.
- The trace color matches the color of the file name in the test list.
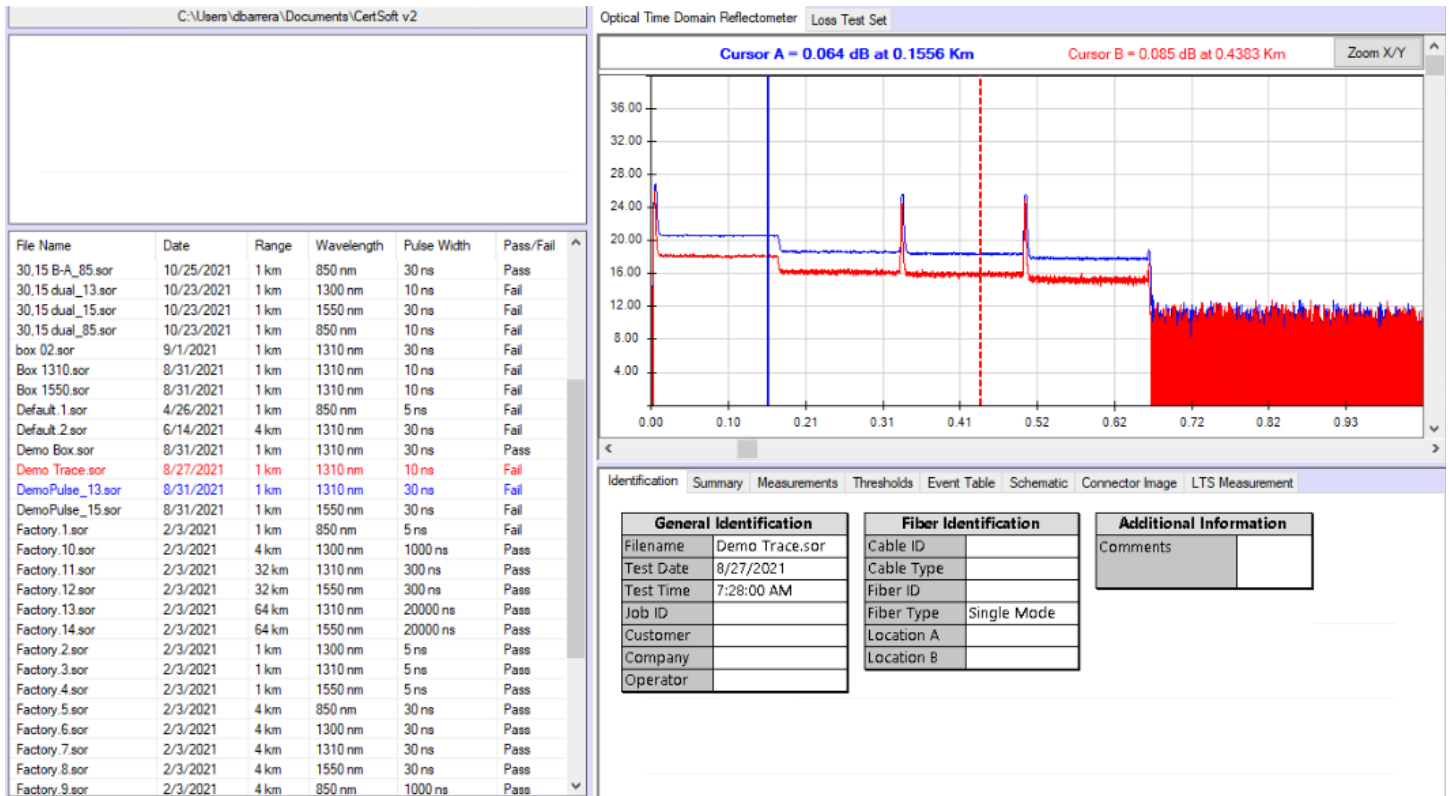
- Left-click on the trace to position the selected cursor.
- Right-click to toggle between cursor A (blue) and cursor B (red).

Click Transfer Files to start copying files from the OTDR to the PC.

15.4 Editing Trace Information

Information can be applied to the header for fiber(s) in the active folder. This information will appear on the printed/PDF reports.

- Click the General Information box to edit the Header Information.
- Update the desired information.
- Press Apply to Folder to save this information to all tests in the active folder. Press Apply to Selection to save this information to the current test.

15.5 Adding Connector Images

A connector image from the video inspection probe can be attached to each trace file. The image will appear on the printed/PDF reports.

- Click on the Connector Image tab.
- Click in the box to add an image.
- Select an image from the active directory. The image files are transferred the in the same manner as the OTDR trace files.
- The selected image will appear in the Connector Image tab. Right-click the image to remove it and left-click in the box to add another.
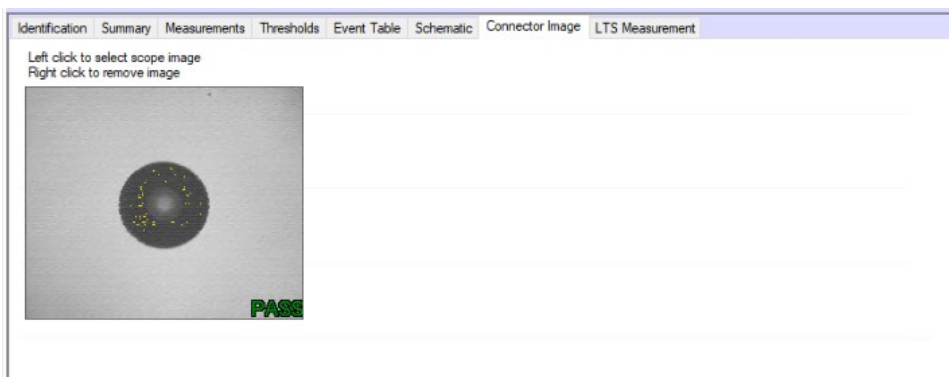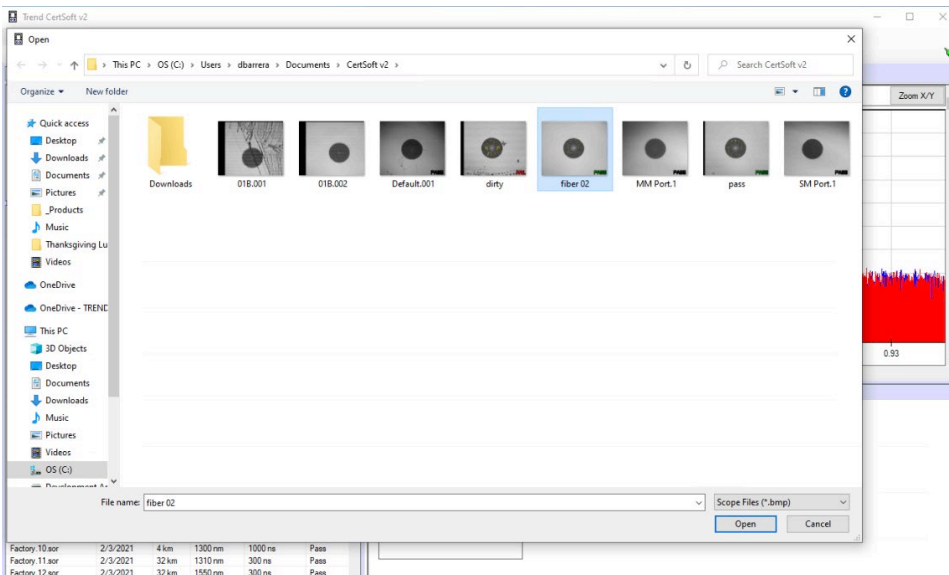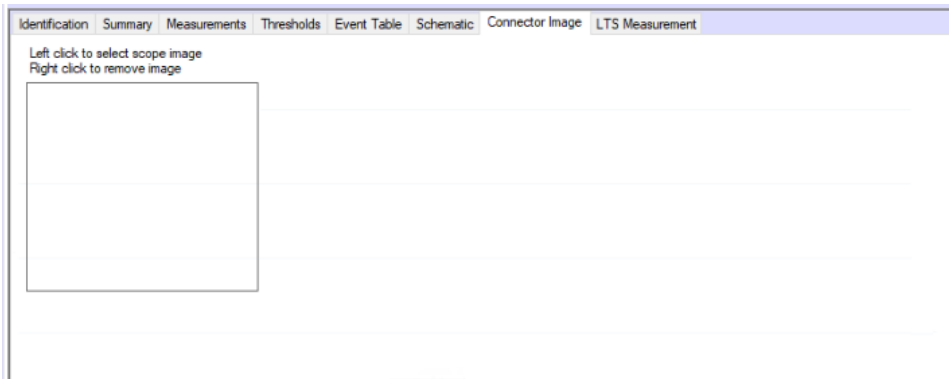
15.6 Adding Loss Test Set Measurements

Loss test sets measurements are light source/power meter measurements made with the OTDR that can be attached to a trace.

- Click on the LTS Measurement tab.
- Click the Link LTS File button.
- Select an LTS file from the active directory. The LTS files are transferred the in the same manner as the OTDR trace files.
- The selected result will appear in the the window with the wavelength, absolute power level, relative loss, and reference level displayed.
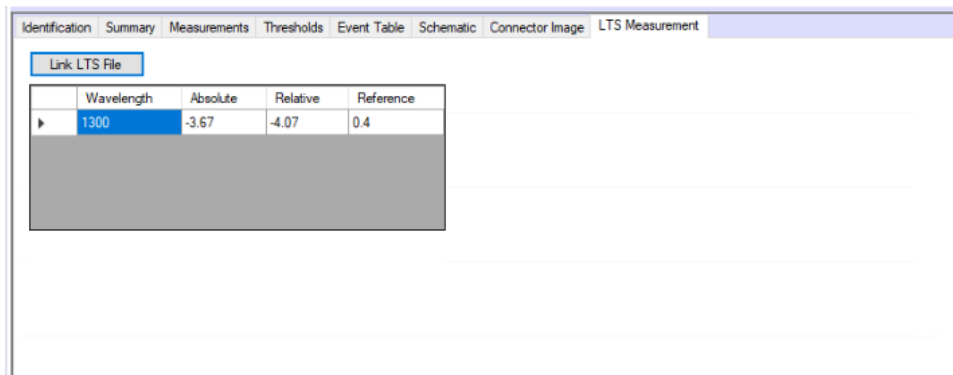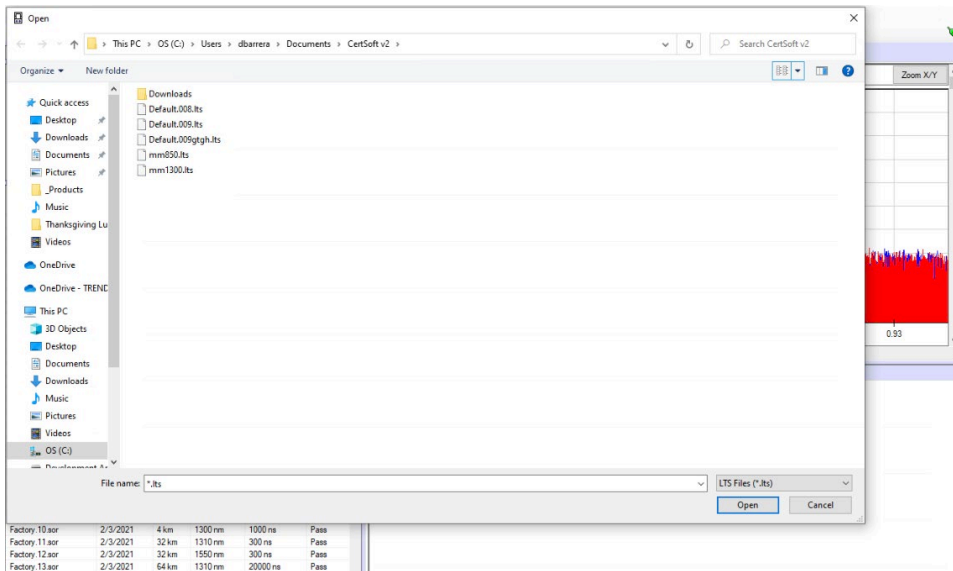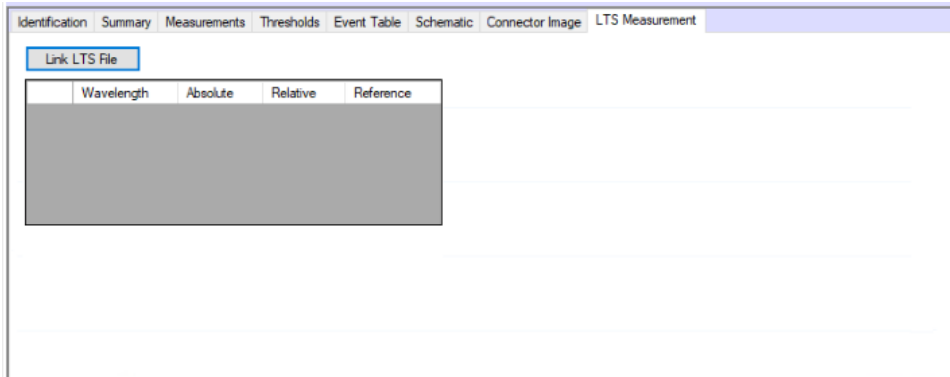
15.7 Loss Test Set Mode

The Loss Test Set tab is used to open LTS files that are <u>not</u> associated with an OTDR trace. This mode is compatible with the FiberMASTER OTDR and the FiberMASTER Power Meter/Light Source test kit.

- Click on the Loss Test Set tab.
- Select an LTS file from the active directory. The LTS files are transferred the in the same manner as the OTDR trace files.
- The selected result will appear in the the window with the wavelength, absolute power level, relative loss, and reference level displayed.
- Select up to two connector images that will be displayed on the report.
- Enter information for the Header Info that summarizes the test identification. Apply the information to only the active test or to all tests in the current folder.

15.8 Generating Test Reports

The Loss Test Set tab is used to open LTS files that are <u>not</u> associated with an OTDR trace. This mode is compatible with the FiberMASTER OTDR and the FiberMASTER Power Meter/Light Source test kit.

- Click on the Loss Test Set tab.
- Select an LTS file from the active directory. The LTS files are transferred the in the same manner as the OTDR trace files.
- The selected result will appear in the the window with the wavelength, absolute power level, relative loss, and reference level displayed.
- Select up to two connector images that will be displayed on the report.
- Enter information for the Header Info that summarizes the test identification. Apply the information to only the active test or to all tests in the current folder.

15.9 Updating Instrument Firmware

The FiberMASTER firmware is routinely updated to add or improve functionality. Updating the firmware requires a Windows PC with an available USB port and the CertSoft2 PC software.

Updating the firmware does not delete any files or settings from the OTDR. However, in the event a problem occors during the update it is recommended that all test files be uploaded to CertSoft2 before updating the firmware.

ENSURE THE BATTERY IS FULLY CHARGED BEFORE PROCEEDING.

Download the latest firmware from www.trend-networks.com/support
Take note of the directory to which the firmware zip file is downloaded. Do not unzip the firmware file.

Open CertSoft2 and connect the FiberMASTER to the PC with the USB cable. Confirm the connection status by checking that the icon in the upper-right corner of the screen is green. If the OTDR does not connect, try disconnecting/reconnecting the USB cable, cycling the OTDR power and restarting the software to reset the USB connection.

1. Click on Help
2. Click Firmware Upgrade
3. Click Select Upgrade File
4. Navigate to the firmware zip image file. Note, do not unzip the file. Simply select the zip file as shown.
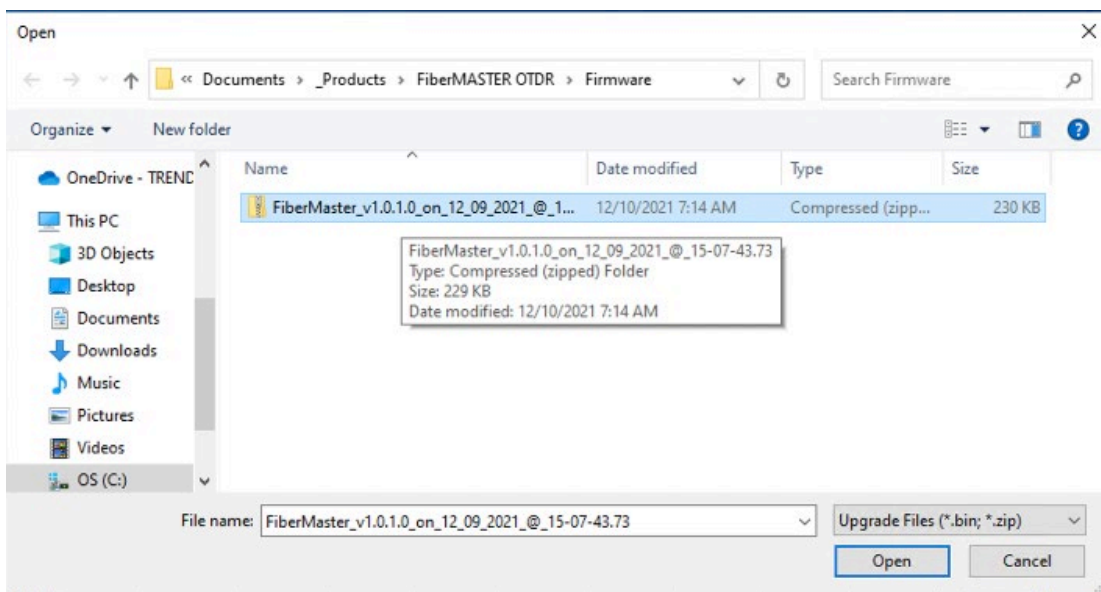
5. Click Open to choose the update image.
6. The update will begin. Follow the prompts to complete the update process.

DO NOT DISCONNECT THE USB CABLE OR POWER OFF THE OTDR DURING THE UPDATE PROCESS.

If the update process stops responding during the update:
1. Wait 5 minutes
2. Power OFF the OTDR
3. Disconnect the USB cable
4. Clear any warnings on CertSoft2
5. Close CertSoft2
6. Open CertSoft2
7. Power ON the OTDR
8. Connect the USB cable
9. Confirm the connection status is green
10. Restart the firmware update process

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