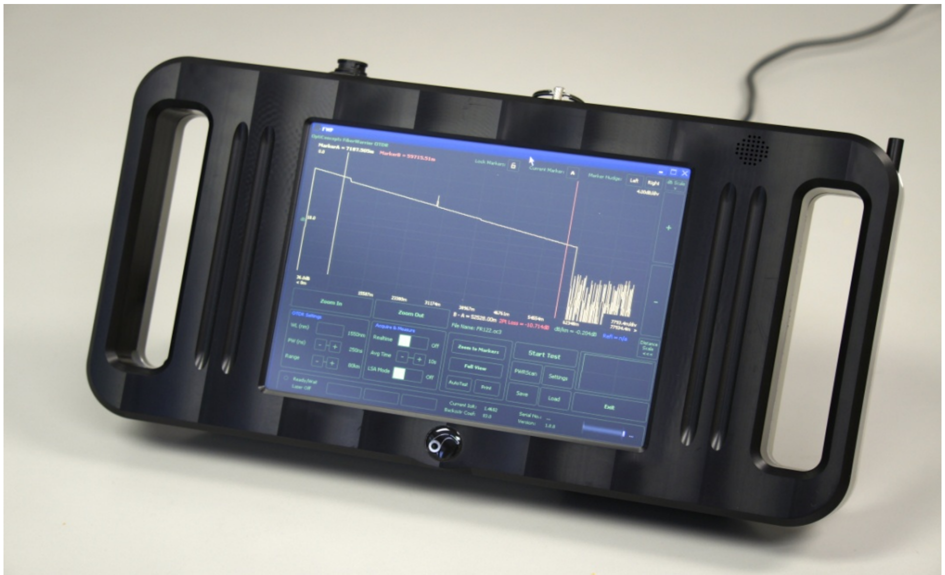
OptiConcepts

FiberWarrior Pro™ OTDR Users Guide



FWP OTDR Series • Version 1.9 • October 2014

Copyright Information

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Cautionary Statements and Warnings

The operator **MUST** read and observe all Warnings and Cautionary statements listed below.

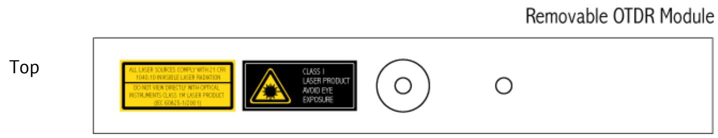
WARNING: Never replace or substitute the external power supply with any device other than provided by OptiConcepts. Failure to use appropriate power supply can lead to personal injury and/or product damage and/or cause a fire.

WARNING: Never expose the test instrument to direct sunlight or excessive moisture or water. Exposure can lead to personal injury and/or product damage and/or cause a fire.

WARNING: High Voltage Present. Never remove the module from the unit while the unit is powered on. Exposure could lead to personal injury and/or product damage and/or cause a fire.

CE These products conform to the relevant requirements of the European Union.

WARNING: Invisible Laser Radiation Present. Never look or stare into any of the optical ports or ends of optical cables connected to the equipment as permanent damage to the eye is possible.



CAUTION: Never plug any device into the optical or electrical (USB, Ethernet) ports without reading and abiding by the Operational Instructions. Failure to do so can lead to product damage.

CAUTION: Never touch the screen with any device except a finger or approved styli. Never touch the screen with any sharp object. Permanent instrument damage may occur.

Introduction

The OptiConcepts FiberWarrior Pro series of OTDRs provides contractors, technicians, engineers, quality personnel, and other fiber specialists with a comprehensive, yet easy to use tool to measure critical fiber parameters. Through the use of quality components, a ruggedized design, and an expandable platform, the FiberWarrior Pro will provide years of accurate optical fiber measurements and analysis.

The FiberWarrior Pro Optical Time Domain Reflectometer (OTDR) is one of the most versatile pieces of equipment for testing optical fibers within network cables. The OTDR measures distance and loss of optical fiber and components. It can measure these characteristics with access to only one end of the fiber, which makes the OTDR a very unique tool since fibers can be many miles long. The OTDR works like a radar where short pulses of light are transmitted down the fiber under test and measures the small fraction of light that is reflected back into the unit. This reflected light can be used to show the user fiber attenuation and point discontinuities. The graph displayed on the screen of an OTDR is called a trace. The traces show signal strength as a function of the distance along the fiber. The slope along the trace indicates fiber loss. Discontinuities in the trace indicate the location of events, such as connectors, splices, damage, etc. The drop in power of the discontinuity indicates its loss. The following OTDR trace shows some typical characteristics of an optical fiber and is referred to as a signature trace. Note the overall appearance of the trace, the vertical height, and the horizontal slope. Each characteristic has a specific meaning.

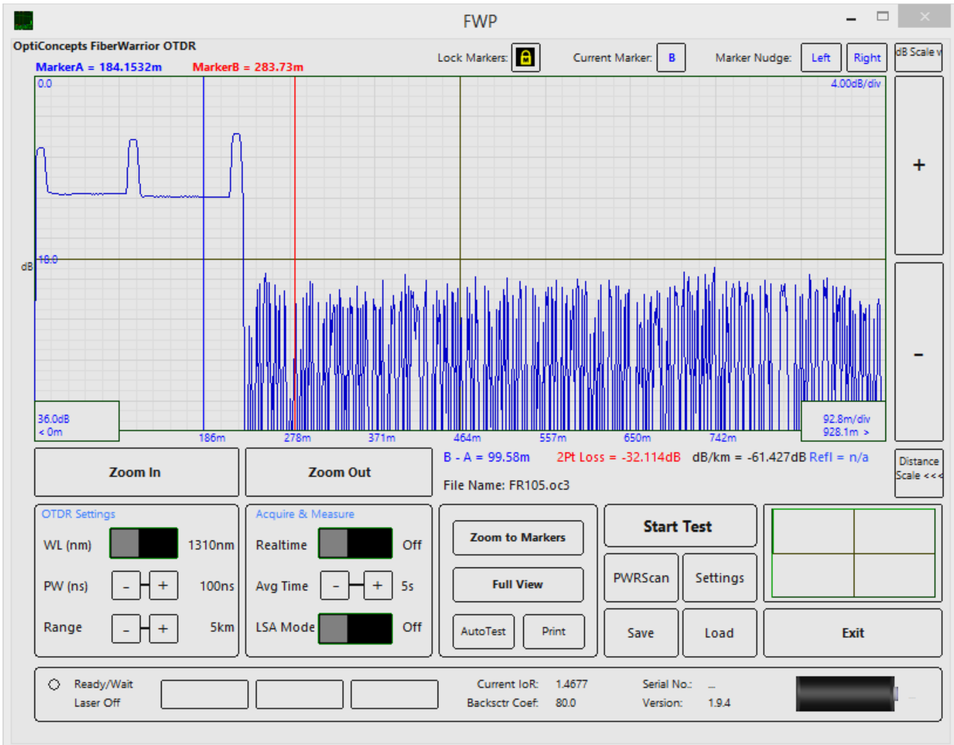


Figure 1 Typical Fiber Trace

Relative power is represented by the vertical axis and is measured in dB (decibels). The slope of the trace (easily seen by looking at the backscatter) relative to the vertical axis indicates the attenuation loss of the fiber, often measured in dB/km. The length and distance is represented on the horizontal axis and typically measured in feet or meters. Linear portions of the trace represent continuous sections of the fiber. Pulses or spikes located along the linear sections of the fiber indicate reflective discontinuity of the fiber. On the typical fiber trace shown previously, there are three reflective events: 1) the initial reflection at the far left showing the fiber connection at the OTDR, 2) a reflection in the middle showing a connector pair, and 3) the end reflection, representing a connector at the fiber far end.

General OTDR Theory of Operation

The OTDR characterizes an optical fiber span, which typically consists of sections of fiber joined with either connectors or splices. The OTDR operates by launching relatively short pulses of light into a fiber, and then measures the returned signal at the same end of the fiber as a function of time. After a pulse is injected into the fiber, light immediately begins to reflect back into the OTDR based on time. Natural uniform impurities in the glass absorb and refract the light, thus weakening the pulse of light as it continues (fiber attenuation). A very small amount of light reflects off of the impurities and back to the photodiode within the OTDR. The returned signal is digitized, converted to logarithmic units (dB), and then displayed with the time base translated to fiber distance. To improve the signal-to-noise ratio of the received signal, pulses are consecutively transmitted, received, and averaged together. The returned signal consists of backscattered light (Rayleigh backscattering) from the fiber and reflected light (Fresnel reflections) from refractive index discontinuities at fiber joints, breaks, and system ends.

The further the pulse of light travels down the fiber medium, the longer it takes for the reflection to return, thus an analogous stream of light returns to the photodiode within the OTDR and the fiber trace is created. Optical loss between two points on the fiber can be indirectly determined by measuring the difference in the returned backscatter power between the two points in question.

The basic building blocks of an OTDR include an optical laser source, a beam splitter, a photodiode detector, process controller, A/D converter, and a display as shown below.

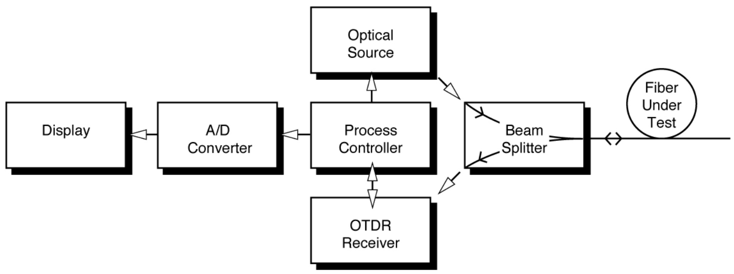


Figure 2 Basic OTDR Block Diagram

The optical laser source is capable of producing high power pulses in the tens of thousands of hertz and in the range of 10 to 20000ns (nanoseconds). The optical beam splitter is a coupler and/or a wave division multiplexer (WDM) which acts as a gate, allowing laser pulses to exit the OTDR while channeling returning signals to the photodetector. The OTDR receiver is typically an avalanche photodiode (APD) that converts photons into electrical signals that allow the OTDR electronics to amplify, filter, and process the signal into useful information for the user. The process controller and the A/D converter perform signal processing, such as converting signals from their analogous state to a digital form so that the OTDR can perform operations on the signal, including: averaging, analysis, storage, control, and display operations. Many commercially available OTDR's have software capabilities that can automatically analyze the trace and report results directly to the user without having to manually measure each fiber characteristic.

Getting Started with the FiberWarrior Pro OTDR

The basic FiberWarrior Pro OTDR comes with all of the required items to get the platform up and running. Additionally, there are numerous optional items available to help the user accessorize the OTDR for specific testing needs. Many of the popular accessories are available in kits to make ordering easy. Please refer to the FiberWarrior Pro OTDR Specification Sheet for all available kits and accessories.

Basic Equipment

Mainframe

The Mainframe is an Intel Atom class based computer capable of running WindowsXPe and Linux operating systems. This system is encased in a high-quality aluminum / acetal enclosure with an adjustable kickstand and a bay for replaceable optical test modules. The mainframe frontal surface is made up of a high quality 8.4" (21.3cm) active matrix color LCD screen with touch support and contains two USB ports and one Ethernet port for external communications. A basic mainframe configuration contains 1Gb of RAM, a high-performance 16Gb internal flash drive, Li-Ion batteries, and a built-in battery charger.

FiberWarrior Pro OTDR Module

The removable FiberWarrior Pro OTDR module encases all of the OTDR hardware and the optical connector port(s). The module can contain one to four lasers: single-mode, multimode, or both, as required by the user.

Power Supply and Cord

A universal (100-250VAC, 50-60Hz) power supply and an appropriate power cord for the country in which the FiberWarrior Pro is shipped shall be provided.

Stylus

A hardened stylus is provided to assist in user interaction with the mainframe via the Touchscreen. Though human fingers can be used, the stylus provides more accurate on-screen selections and can increase the speed of user input.

Calibration Certificate and Other Documentation

A calibration certificate is provided as well as other documentation as required.

Optional Equipment

Launch Cords

Optical Launch Cords provide a specific length of optical fiber (typically 100-500 meters) for the purpose of 'pushing' the fiber or system under test out on the OTDR so an accurate measurement can be made on the near-end connector. The Launch Cords also serve as a method of matching the OTDR port connector with that of the fiber under test connector. OptiConcepts Launch Cords are packaged in extremely compact enclosures.

Figure 3 OptiConcepts OTDR Launch Cords

Hardened Transit Case

The Hardened Transit Case (Figure 4) provides a hard plastic, rugged solution to transport the FiberWarrior Pro OTDR and a number of accessories. It provides a good level of protection against moisture, shock, and damage, and is designed for moderate and harsh field transportation. A typical Hardened Transit Case will support the FiberWarrior Pro OTDR, a power supply/cord, two OptiConcepts soft launch cords, and other accessories. The Hardened Transit Case has sturdy wheels and a telescoping handle to make transporting easy.

Figure 4 Hardened Transit Case

Cleaning Tools

OptiConcepts Cleaning tools provide basic to robust solutions to cleaning test equipment, test/launch cords, and system connectors and components. Dirty and contaminated connectors and components are a leading reason for loss of optical signal and inaccurate test results.

Flexible Keyboard

The Flexible Keyboard option provides users with a method of inputting data via an external USB keyboard instead of using the on-screen keyboard. The Flexible Keyboard is rubberized to prevent damage when getting dirty or damp in the field and can be folded for compact storage.

Basic Hardware Features

The following three sections describe the basic features and functionality of the FiberWarrior Pro OTDR hardware.

Ports, Controls, and Features

There are various ports, controls, and features located on the front, top, and sides of the FiberWarrior Pro OTDR.

On the front, the main interface simply consists of the color LCD touchscreen that allows both a visual interface and a touch surface to communicate with the OTDR.

On the front (Figure 5), there are five notable items:

1. Ergonomic Handles
2. Touchscreen
3. External Speaker
4. Stylus
5. Power Port (side of unit through handle)

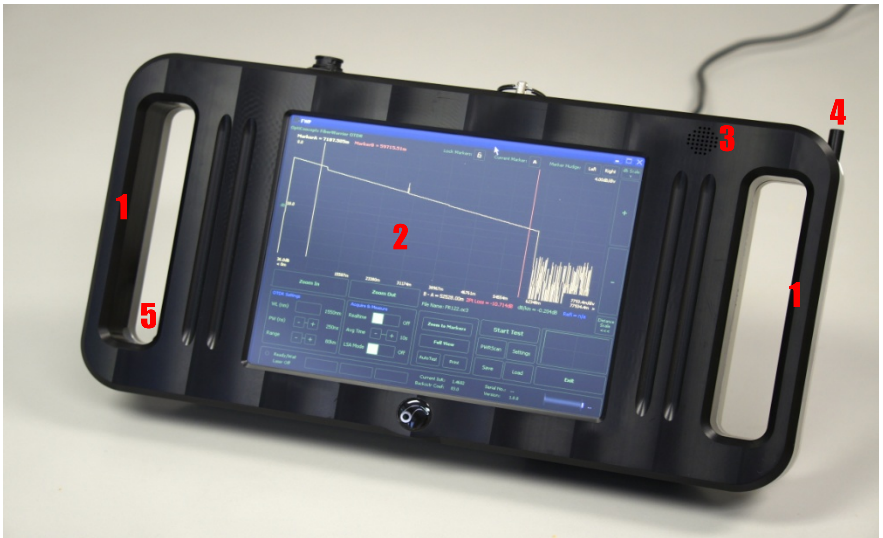


Figure 5 FiberWarrior Pro Front View

On the top (Figure 6), there are five notable items:

1. Power Button
2. USB Ports (2)
3. Ethernet Port
4. OTDR Optical Input / Output Port
5. Optical Loss Testing Port (optional)

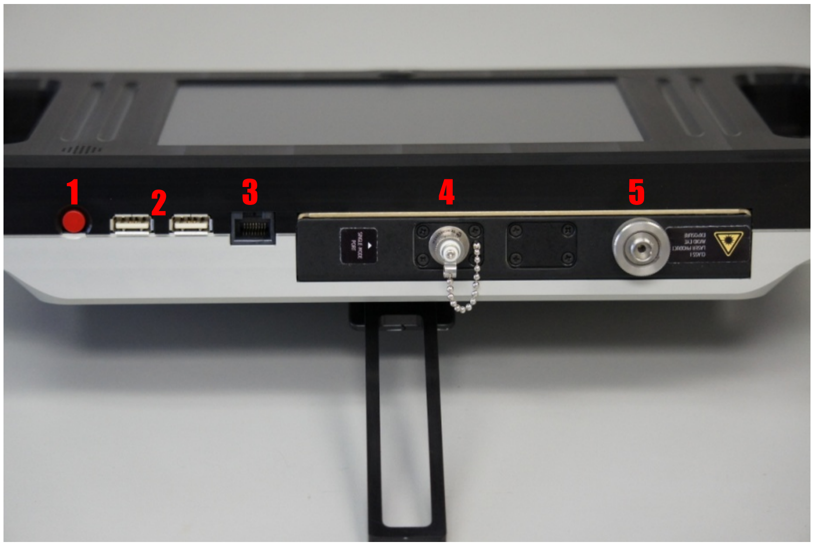


Figure 6 FiberWarrior Pro Top View

On the back (Figure 7), there are two notable items:

1. Kickstand
2. Fan

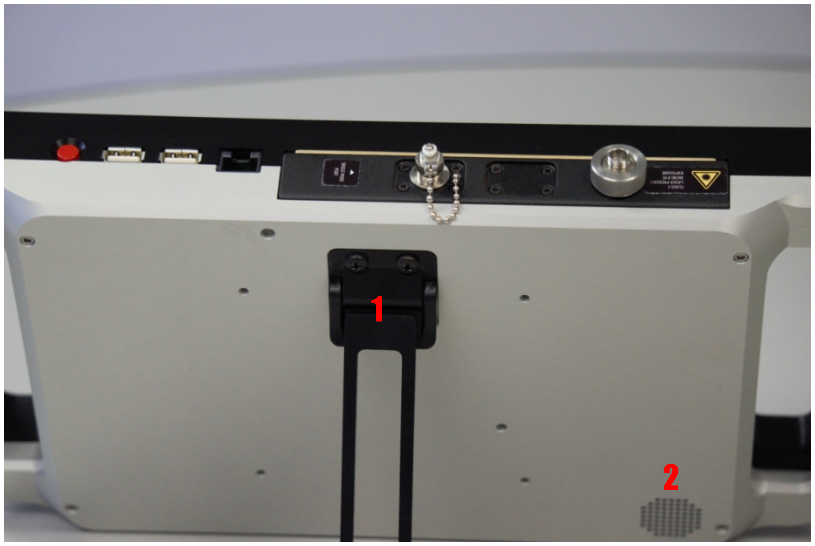


Figure 7 FiberWarrior Pro Back View

Installing and Removing Modules

The FiberWarrior Pro OTDR module can be easily installed and removed from the Mainframe. This allows for easy upgrading and the installation of other optical test modules.

Figure 8 FiberWarrior Pro OTDR Module

To install the OTDR module:

1. Ensure the mainframe power is turned off.
2. Align the back of the module with the module bay opening. The 20-pin connector on the back of the module should be on the same side as the mainframe power switch.
3. Slowly slide the module into the mainframe until it stops. The module should now be flush with the mainframe top surface.

To remove the OTDR module:

1. Ensure the mainframe power is turned off.
2. Grasp the pull ring on the module and slowly pull the module out.

WARNING:
High Voltage Warning. NEVER place your fingers or other unintended objects in the module bay. Serious personal injury or damage to the FiberWarrior Pro may occur.

CAUTION:
Do not touch the 20-pin connector on the back of the module. Damage to these pins can cause further damage within the mainframe or cause the OTDR to malfunction.

WARNING:
Do not remove or install an optical module while the mainframe if powered on. Damage to the FiberWarrior Pro may occur.

Rechargeable Batteries

The FiberWarrior Pro contains internal Li-Ion batteries to provide power when AC power is unavailable. The batteries provide operational power for several hours, though the actual time can greatly vary depending on usage.

The batteries are automatically charged, as needed, when the mainframe is plugged into AC power. The batteries will generally charge faster when the mainframe is turned off as more power can be dedicated to the charging circuitry. An on-screen battery indicator is displayed to provide the user with the approximate remaining battery capacity.

A full charge is generally obtained within 2.5 hours when the mainframe is off and plugged into an AC power source.

A redundant number of safety features are employed to protect the user and system. These features include: overvoltage and undervoltage protection, overcurrent protection, and system overcurrent protection.

> **WARNING:**
> Never open the FiberWarrior Pro or the battery pack and attempt to replace or service the batteries (or any other component). Serious injury or death may occur. The batteries MUST be serviced or replaced by OptiConcepts.

Wi-Fi Communications (option)

OptiConcepts FiberWarrior Pro OTDRs have the capability of communicating via Wi-Fi. This is an option that can be installed upon request.

Operational Environment

The FiberWarrior Pro OTDR is designed to provide years of accurate service in both lab and field environments. However, the FiberWarrior Pro is also a highly sensitive technological instrument that must be used in a reasonable operational environment, which includes the following parameters:

1. An operational temperature of 0°-50°C
2. An operational relative humidity of 0-95%
3. Out of direct sunlight

4. Away from damp or wet environments
5. Out of the presence of extreme dust or debris
6. Away from flammable or explosive gases or chemicals
7. An environment where humidity and/or temperature does not rapidly change

Basic Operation

The FiberWarrior Pro OTDR is designed to be an extremely easy to use OTDR with powerful features that provide an extensive list of capabilities that provide highly accurate results. The sections that follow provide information on general mainframe usage, FiberWarrior Pro OTDR features and functionality, and using the FiberWarrior Pro to test optical fibers.

General Operation

Getting Started

To begin, securely connect the detachable AC cord into the AC power supply. Connect the AC cord into an AC wall outlet and last, securely connect the power supply connector into the FiberWarrior Pro power jack located through the handle on the side of the unit.

Adjust the kickstand on the back of the FiberWarrior Pro to the desired viewing angle.

Make sure there are no devices connected to the USB ports and turn the power on with the switch located on the top of the FiberWarrior Pro. How USB devices can be connected and used is described in the sections that follow.

After the power is turned on, an OptiConcepts logo will display for several seconds and the operating system should load and a WindowsXPe or Linux desktop will appear. Please follow the appropriate section below that reflects the installed operating system.

WindowsXP Embedded OS (XPe)

Once the operating system has loaded, a Windows desktop will appear much like that of a standard WindowsXP desktop PC. Much of the same functionally of WindowsXP can be found in the FiberWarrior Pro WindowsXP embedded operating system. Actions such as creating files, folders, networking, transferring files, etc. are similar to that of Windows XP and the use and operation of the FiberWarrior with the Windows operating system assumes the user has a good working knowledge of WindowsXP. For detailed information about using WindowsXP, please visit www.microsoft.com.

As a general rule, the FiberWarrior Pro OTDR should be used as an OTDR, not a one-to-one replacement for a personal computer. Though many features of WindowsXP can be used as well as external peripherals and third party software, OptiConcepts cannot support any of the aforementioned items other than those listed in this document. Damage or loss of information that occurs is the responsibility of the user. Since WindowsXP Embedded is an 'embedded' operating system, the restoration of a damaged or corrupt disk must be performed at OptiConcepts.

Information regarding supported software and external devices is described below.

Using the Touchscreen

Once the operating system has loaded and a desktop is visible, the basic means of communicating with the FiberWarrior Pro is through the use of the touchscreen. The touchscreen replaces the basic concept of using a mouse to point, click, select, and drag objects within a graphical user interface. OptiConcepts has integrated the touchscreen within the FiberWarrior Pro so an external mouse is not needed in the field.

To use the touchscreen simply touch the screen with the provided stylus or finger.

CAUTION:
Never use any device other than the provided OptiConcepts stylus or finger to touch the screen. Permanent damage to the screen can occur.

To select an object or icon, single tap the object. To instantiate a button, checkbox, etc., tap the object. To open a file, application, or folder, double tap the object. To select multiple files or objects, click and drag a 'box' around the icons to make the selection. To perform an equivalent mouse right click, tap and hold the icon or object for about 1.5 seconds.

Calibrating the Touchscreen

Occasionally, the touchscreen may need to be calibrated to properly align the on-screen pointer with finger/stylus presses. If the on-screen pointer does not accurately move to the pressed point on the screen, a simple calibration may be needed.

To calibrate the touchscreen:

1. Open the Start Menu in the lower left corner of the screen and select 'All Programs'.
2. Open the 'Microchip Control Panel' application.
3. Select the 'Calibration' tab and press the target in the center of the screen.
4. Press and hold each of the targets as the software instructs.
5. Once the calibration is complete, press on different areas of the screen to ensure the pointer moves as expected. Repeat the procedure if necessary. Press Accept to finish.

Using the On-Screen Keyboard

Through the use of the touchscreen, a virtual on-screen keyboard can be used to eliminate the need for an external keyboard to enter alphanumeric information. To open and use the virtual keyboard, open the Start Menu and select All Programs > Accessories > Accessibility > Onscreen Keyboard. Select the area on the screen in which to type and type using the virtual keyboard. Press the red 'X' to close the keyboard. When in the FiberWarrior Pro OTDR software, press the 'Keyboard' button to open the virtual keyboard.

Connecting to a Network

To connect to a network, plug a CAT5/6 Ethernet cable into the FiberWarrior Pro on the top of the unit and power the unit on. If the connected network is TCP/IP using DHCP with automatic address selection, then the FiberWarrior Pro will connect automatically. If special settings are required, then Open the Start Menu in the lower left corner of the screen and select 'Control Panel'. Then, select 'Network Connections' and adjust the settings as directed by the network administrator.

Connecting Peripherals

External peripherals can be connected to the FiberWarrior Pro via the two available USB ports on the top of the unit. A keyboard, mouse, and USB flash drive are generally intended devices to be connected to the FiberWarrior Pro. A mouse and keyboard are generally used when the user prefers not to use the touchscreen and a USB flash drive to transfer files (usually OTDR traces) off the FiberWarrior Pro.

The best devices are those that do not require the installation of additional software or drivers to operate. If WindowsXPe can use a connected device without additional software, a message should appear on the screen within a short amount of time informing the user the device is ready to be used. A message should only be displayed the first time a device is connected.

OptiConcepts only supports external peripherals sold by OptiConcepts. Any and all other devices are the responsibility of the user and are not supported by OptiConcepts.

Though a USB hub can be connected to the unit, it is not recommended and if the total current supplied to either port exceeds 5.0v/0.5A, then damage to the FiberWarrior Pro may occur.

Using the FiberWarrior Pro OTDR

All information to this point has been related to the hardware and use of the operating system. The information provided in this section specifically discusses the operation of the FiberWarrior Pro OTDR. The OTDR software is called FiberWarior Pro (FWP) and is located on the desktop for easy access. To open FiberWarrior Pro, double tap the FWP icon.

Once FWP is opened, a self-test will run in the background and connection will be made to the OTDR module. Through the communication process, the FiberWarrior Pro will know what options are available to the user and these options will be reflected within the interface. If there are any issues with the connection or hardware failures, a dialog with the appropriate information will be displayed.

On-Screen Elements and Controls

The main FWP graphical user interface is divided into two major sections:

1. The OTDR Graphing Area at the top of the screen showing the actual fiber trace along with certain scales and measurements,
2. The Control Panel at the bottom of the screen to allow quick user access to the OTDR controls and functions.

In Figure 9, the on-screen elements and controls are called-out and are described in detail in the following section. The controls can be used by tapping or dragging as necessary.

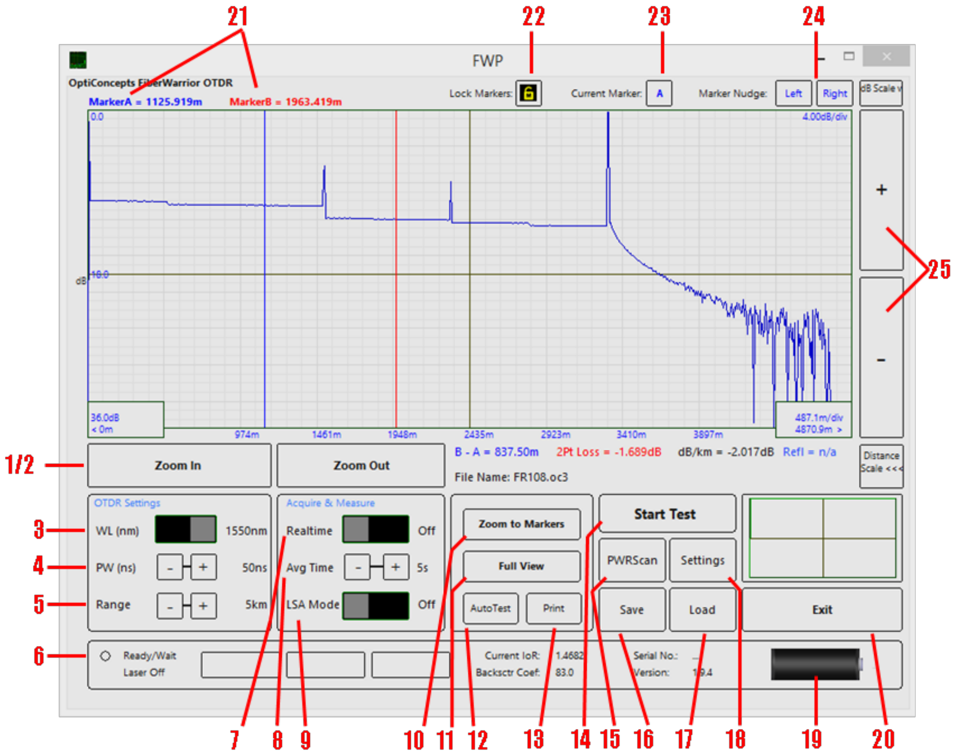


Figure 9 FWP Interface Screen

List of Controls and On-Screen Elements

1. ***Zoom In/Zoom Out:*** Expands or contracts the distance (horizontal) scale. The distance scale is displayed along the bottom of the graph
2. ***Pan Left/Pan Right:*** Slides (pans) the fiber trace to the left or right using the currently selected distance scale
3. ***Wavelength:*** Selects one the available lasers for testing a connected optical fiber. The typical values are 850 and 1300nm for multimode and 1310 and 1550nm for single-mode
4. ***Pulsewidth:*** Selects one of the available laser pulsewidths for testing a connected optical fiber. The typical range is 10-20000ns. Shorter pulsewidths are used to test shorter fibers with events closely spaced together. Longer pulsewidths are used for longer fibers with events more widely spaced apart
5. ***Range:*** Caps the maximum measurement range. The typical range values are from 5km (16kft) to 120km (394kft). A range value should be selected that is as close to, but over the total fiber under test length multiplied by 10%
6. ***Laser Power Indicator**:* Indicates when the laser is powered up
7. ***Realtime/Averaged Modes:*** Selects between realtime mode and average mode. Realtime mode quickly displays (> 3 times per second) a fiber trace on-screen and allows the user to recognize changes to the system as they occur in realtime. Averaged mode averages many thousands of datapoint sets to allow for the accurate measurement of an optical fiber
8. ***Average Time:*** Selects the amount of time an Averaged Mode fiber test will run. The longer the time, the more accurate the test will be. In general, shorter fibers and/or longer

pulsewidths require less time whereas longer fibers and/or shorter pulsewidths require more time. The typical average time values are from 10 to 180 seconds

9. ***LSA Mode:*** Least Squares Approximation, a measurement method to reduce the effect of noise
10. ***Zoom to Markers:*** Expands the distance scale so the fiber between the markers fills the screen
11. ***Full View:*** Contracts the distance scale so the entire range is visible
12. ***Auto Test:*** Method that allows the OTDR to select settings based on an initial reading of the network being tested
13. ***Print:*** Prints the current trace or a batch print process may be executed
14. ***Start Test:*** Fires the lasers and performs a fiber test
15. ***PWRScan™*: **Invokes a comprehensive software algorithm for auto-searching a fiber trace for events and anomalies while providing length, location, loss, and reflectance measurements for a given fiber. The results are quickly returned in tabular format
16. ***Save:*** Saves the currently displayed fiber trace to disk
17. ***Load:*** Recalls and displays a saved fiber trace
18. ***Settings:*** Opens a settings screen to change specific fiber parameters and general FWP settings (see Controls and Settings within the Settings Window below)
19. ***Battery Indicator:*** Shows battery charge level
20. ***Exit:*** Closes the FWP Application

21. ***Markers:*** Two markers (A and B) are provided to make two-point loss and reflectance measurements. Tapping at the desired location moves the markers on the graph. Marker positions are displayed above each marker and their measurements are listed below the graph
22. ***Marker Lock:*** Locks the markers together synchronizing their movement
23. ***Marker Select:*** Allows the selection of the A or B markers
24. ***Marker Increment:*** Allows precision left/right movement of each marker
25. ***dB Zoom In/Zoom Out:*** Expands or contracts the dB (vertical) scale. The dB scale is displayed along the left side of the graph

Controls and Settings within the Settings Window

Once the 'Settings' button is tapped, more options and parameter settings will be displayed.

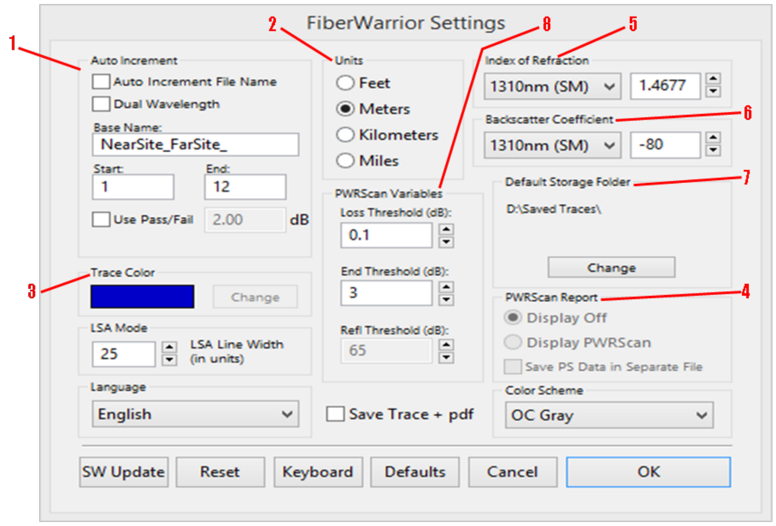


Figure 9a FWP Settings Screen

1. ***Auto Increment File Name:*** Used to set parameters and start Auto Increment. Auto Increment will begin automatically when the Auto Increment File Name block is checked and the OK button is pressed. Dual Wavelength sets Auto Increment to run/save tests at both wavelengths (else the currently selected wavelength will be used). Base Name will be used as a common prefix for all files saved. Start and End sets the first fiber to save as well as the last fiber

2. ***Units:*** Used to set the unit of measure
3. ***Trace Color:*** Changes the on-screen trace color
4. ***PWRScan:*** Automatically runs and displays PWRScan analysis information after each test
5. ***Index of Refraction:*** Sets the Index of Refraction for each available wavelength
6. ***Backscatter Coefficient:*** Sets the Backscatter Coefficient for each available wavelength
7. ***Default Storage Folder:*** Sets the default folder in which to save traces
8. ***PWRScan Variables:*** Variables to control the PWRScan analysis software. Loss Threshold sets the minimum detectable non-reflective event, in dB (default value is 0.5dB). With a value of 0.5dB, all non-reflective events equal to or greater than 0.5dB will be listed in the PWRScan table. End Threshold sets the loss value in which to terminate fiber evaluation (default value is 3.0dB). With a value of 3.0 dB, the software will report an end of system condition when a sudden loss of 3dB is encountered

General FiberWarrior Pro Operation

Now that the basic FWP interface controls and elements have been described, an explanation of making fiber measurements will be provided.

Connecting a Fiber to the FiberWarrior Pro

Plug a launch cord into the OTDR connector port and then to the fiber to be tested. A multimode launch cord should be approximately 100m in length, and a single mode access jumper should be approximately 305m in length for most LAN measurements (use a longer cord as necessary).

NOTE:
Always make sure launch cord connectors and the connectors under test are in good working order and have been thoroughly cleaned. Failure to inspect and clean optical connectors can quickly degrade good connectors and can cause poor or inaccurate test results.

Starting a Test

Once all of the settings have properly been entered from the previous sections and the fiber connected to the OTDR, tap the 'Start Test' button to fire the laser and begin the test. If using Averaged Mode (Realtime = Off), then a timer will begin counting down. Once the time reaches '0', the laser will turn off and the test will conclude.

If using Realtime, the laser will fire and a realtime trace will be continuously displayed and updated on the screen until the 'Stop Test' button is tapped.

Navigating the Screen

To zoom in and out and pan the trace within the graph, a number of controls are provided to assist in the navigation.

First, the Zoom In and Zoom Out buttons allow the trace to be zoomed in and out along the distance (horizontal) scale. Pressing the Zoom-In button will decrease the distance scale with '0' meters or feet constrained to the left side of the screen. Pressing the Zoom-Out button will increase the distance scale with the maximum range ultimately being displayed on the right side of the screen. (Figure 10 and 11.)

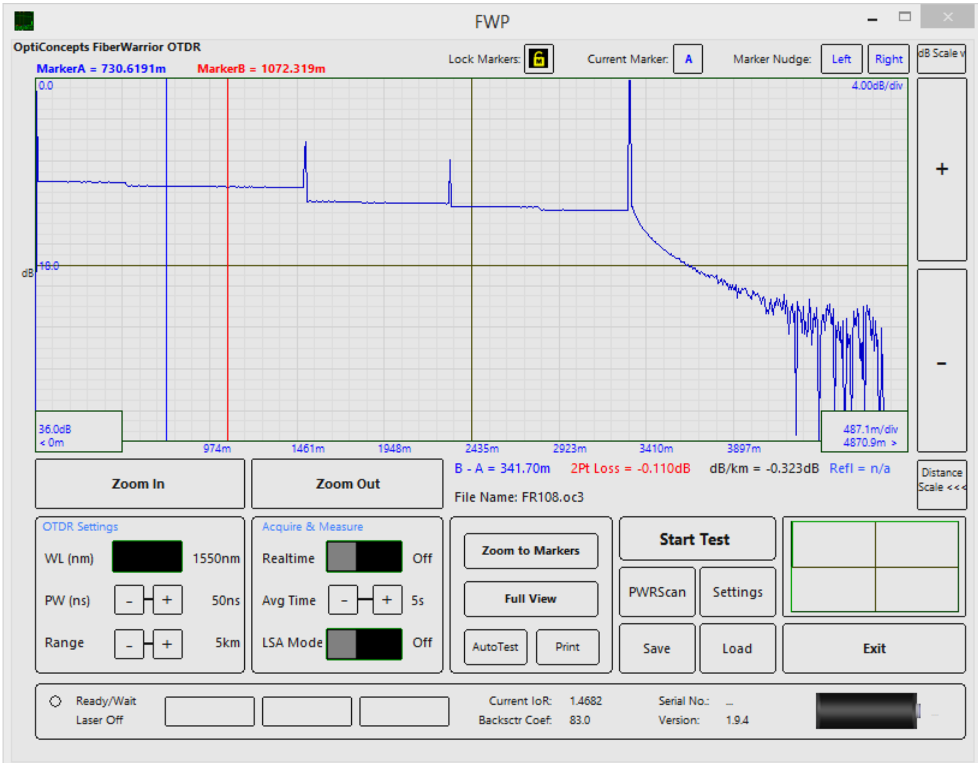


Figure 10 Zoomed Out Example

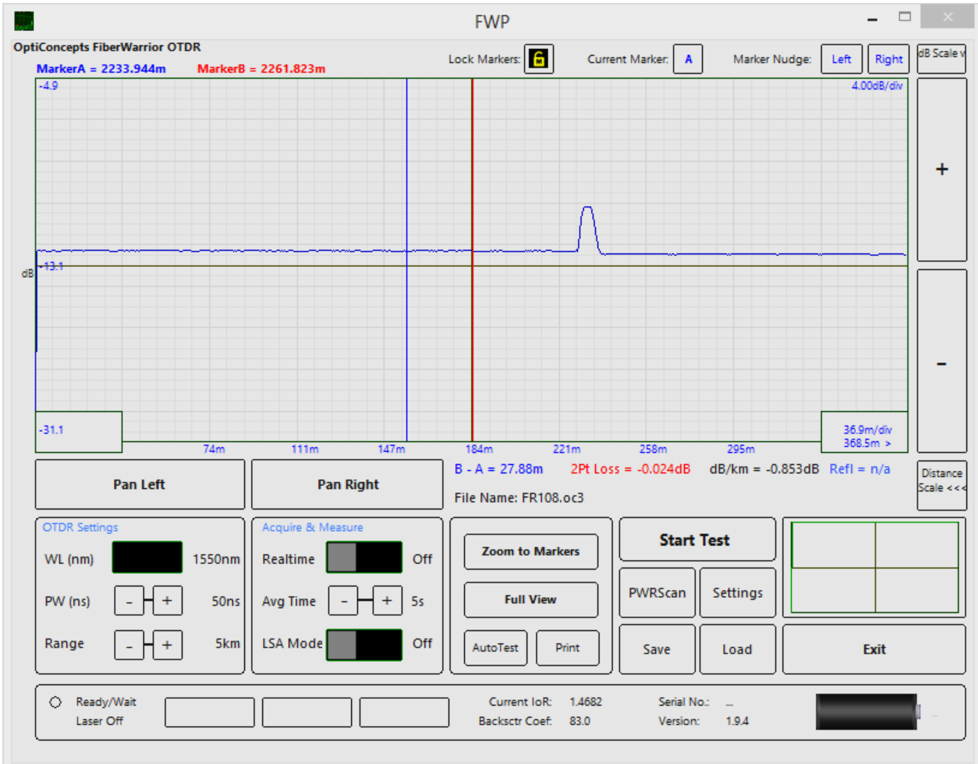


Figure 11 Zoomed In Example

Next, the + and - buttons allow the trace to be zoomed in and out along the dB (vertical) scale. Pressing the - button will widen (zoom out) the dB scale with '0' dB constrained to the top of the screen. Pressing the + button will reduce (zoom in) the dB scale. (See Figure 12.)

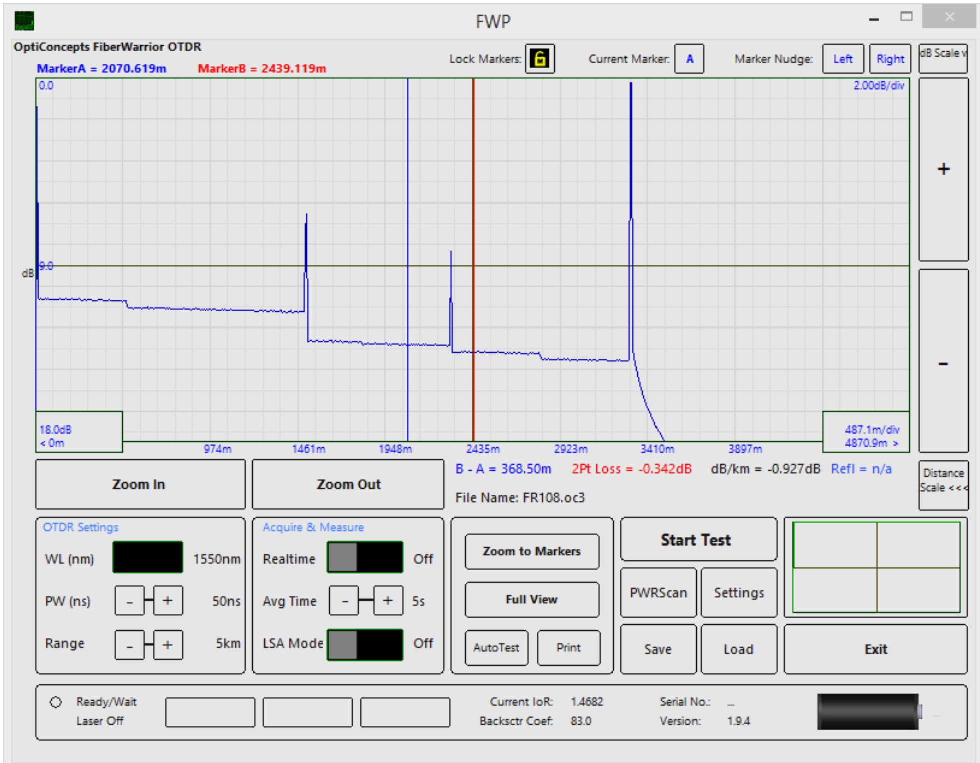


Figure 12 Zoom-In to 2dB/div

The Zoom to Markers button will zoom the distance scale such that the left marker distance position becomes the left side of the screen and the right marker distance position becomes the right side of the screen. Once the Zoom to Markers button has been pressed, the dB scale now revolves around the dB value of where Marker A is positioned. This is very useful for zooming and examining specific areas of the fiber trace. Furthermore, the distance Zoom In and Out button are now Pan Left and Pan Right allowing the user to slide the trace left or right. Press the Full View button to return to the previous full screen state. (See Figure 13.)

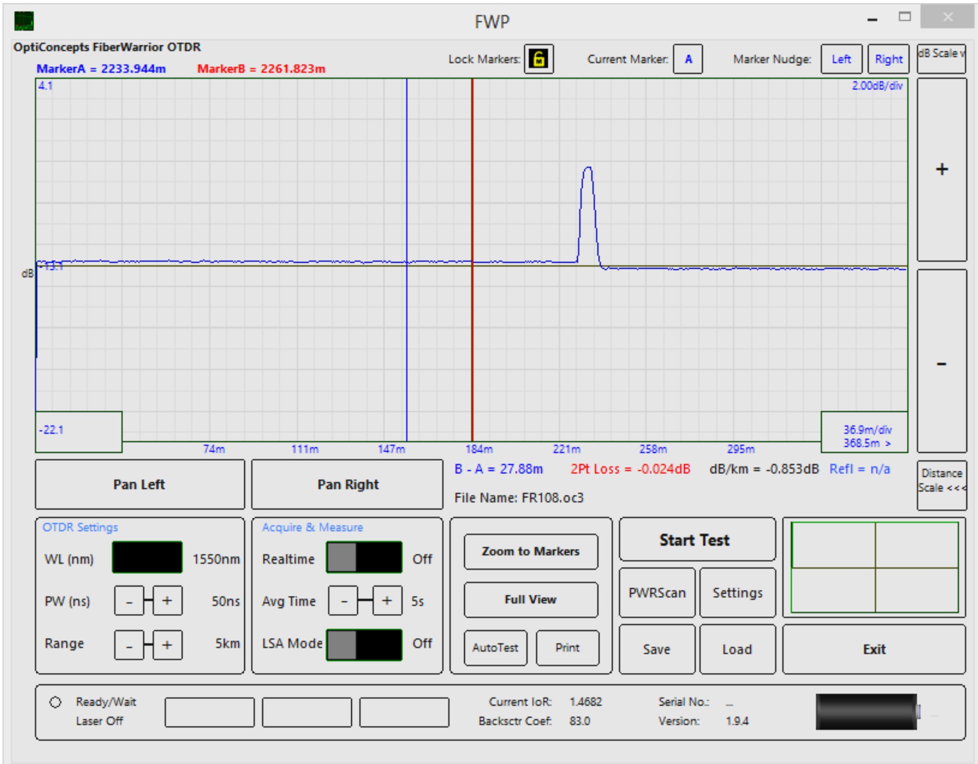


Figure 13 Zoom to Markers

Making Manual Measurements

In order to make manual distance, loss, dB/km, and reflectance measurements, Markers A and B are moved around a specific area to be measured. (See Figure 14).

Distance Measurements: To measure the distance between two points, appropriately place Markers A and B on the graph and read the delta measurement (displayed in yellow) below the graph screen. The distance between the markers is the Marker B location less the Marker A location.

Loss (dB) Measurements: To measure loss in dB between two points, appropriately place Markers A and B on the graph and read the two-point loss (displayed in red) below the graph screen. The loss between the markers is the Marker B dB value less the Marker A dB value.

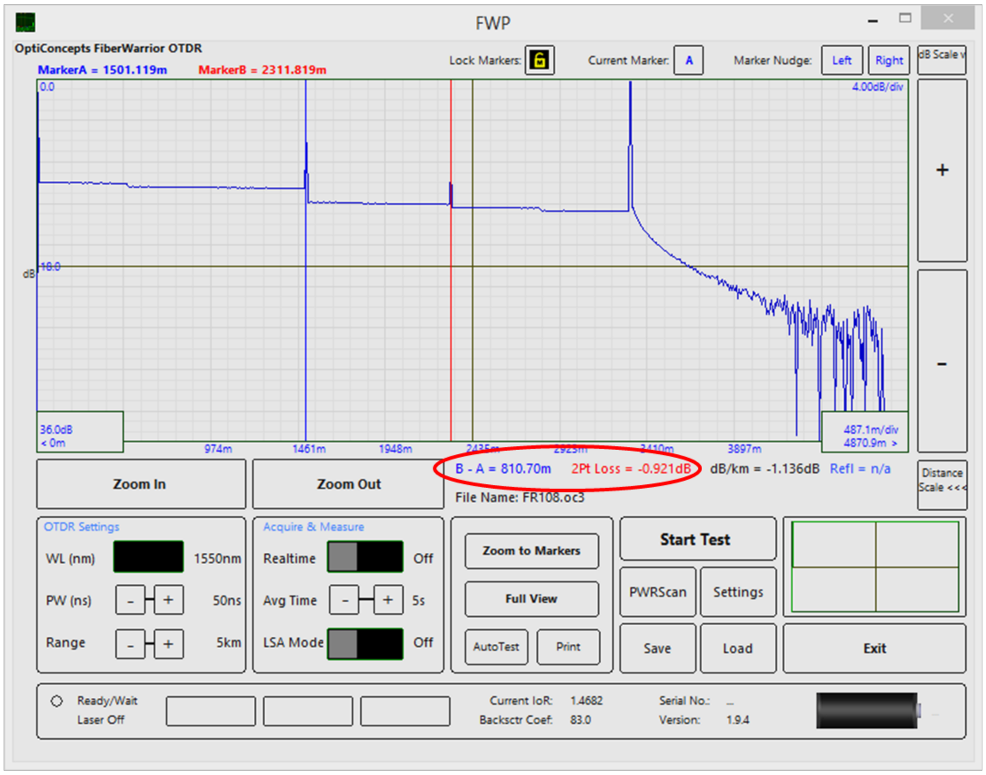


Figure 14 Measurement and 2-Point Loss Measurement

dB per km (dB/km) Measurements: To measure dB/km loss between two points, appropriately place Markers A and B on the graph and read the dB/km loss(displayed in black) below the graph screen. Make sure there are no reflective or non-reflective events between the markers. The dB/km loss is calculated as Marker B dB value – Marker A dB value times (1000/Distance in meters between the Markers). (Refer to Figure 15.)

Figure 15 dB/km Measurement

Reflectance (dB): To measure event reflectance in dB between two points, place Markers A on the backscatter just to the left of an event and Marker B on the reflective peak of an event and read the reflectance value (displayed in blue) below the graph screen. (See Figure 16.)

Figure 16 Reflectance Measurement

Saving a Trace to Disk and Loading Saved Files

Once a test has completed in Averaged Mode, press the Save button to store the trace to disk. The trace can be stored on the internal flash drive or an optional external drive. Once the Save button is pressed, the on-screen keyboard will automatically launch, allowing the user to name the trace file.

To recall a saved trace, press the Load button and navigate through the file system until the trace of interest is found. Press open to load.

Saving Multiple Traces to Disk Using Auto Increment

The Auto Increment mode allows the user to setup a basic set of parameters and then quickly test a large array of fibers by simply connecting to each fiber to test and pressing a button.

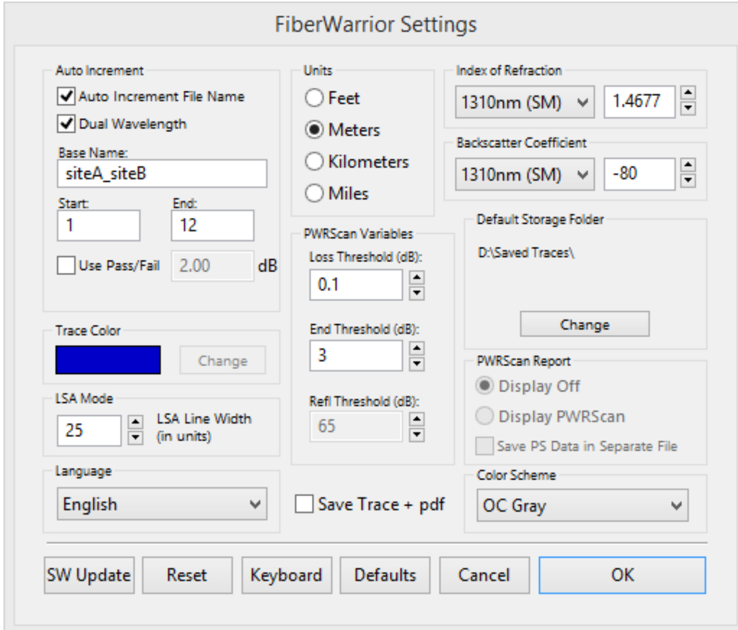


Figure 17 Auto Increment Setup

To use Auto Increment Mode, set all of the on-screen parameters up first, including: Range, Pulsewidth, Averaging Time, and setup the Distance and dB scales as appropriate. (See Figure 17.)

Next, press the Settings buttons and fill out the information in the Auto Increment section. The Auto Increment File Name check block enables Auto Increment. If this box is checked, Auto Increment will start once the OK button is pressed. The Dual Wavelength check box will shoot each fiber with two wavelengths and save two individual trace files if selected. Otherwise, the currently selected wavelength will be used. The Base Name is the prefix for each file saved. A common prefix is to name the near site and far site. Last, the Start and End numbers are the fiber numbers to test. If the numbers are 1 and 12 respectively, then the user will be prompted to test 12 fibers.

With settings used in the figure above, the file names will appear as follows…

siteA_siteB_1310_1
siteA_siteB_1550_1
siteA_siteB_1310_2
siteA_siteB_1550_2
…
siteA_siteB_1310_12
siteA_siteB_1550_12

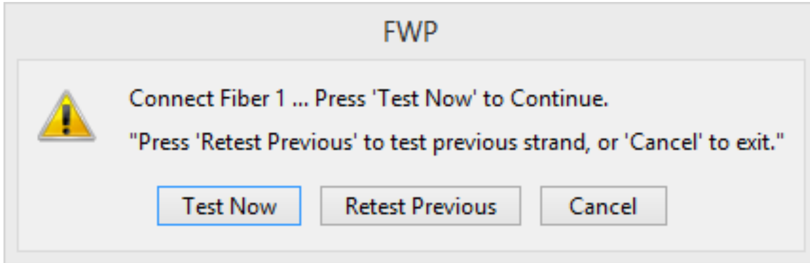


Figure 18 Auto Increment Dialog

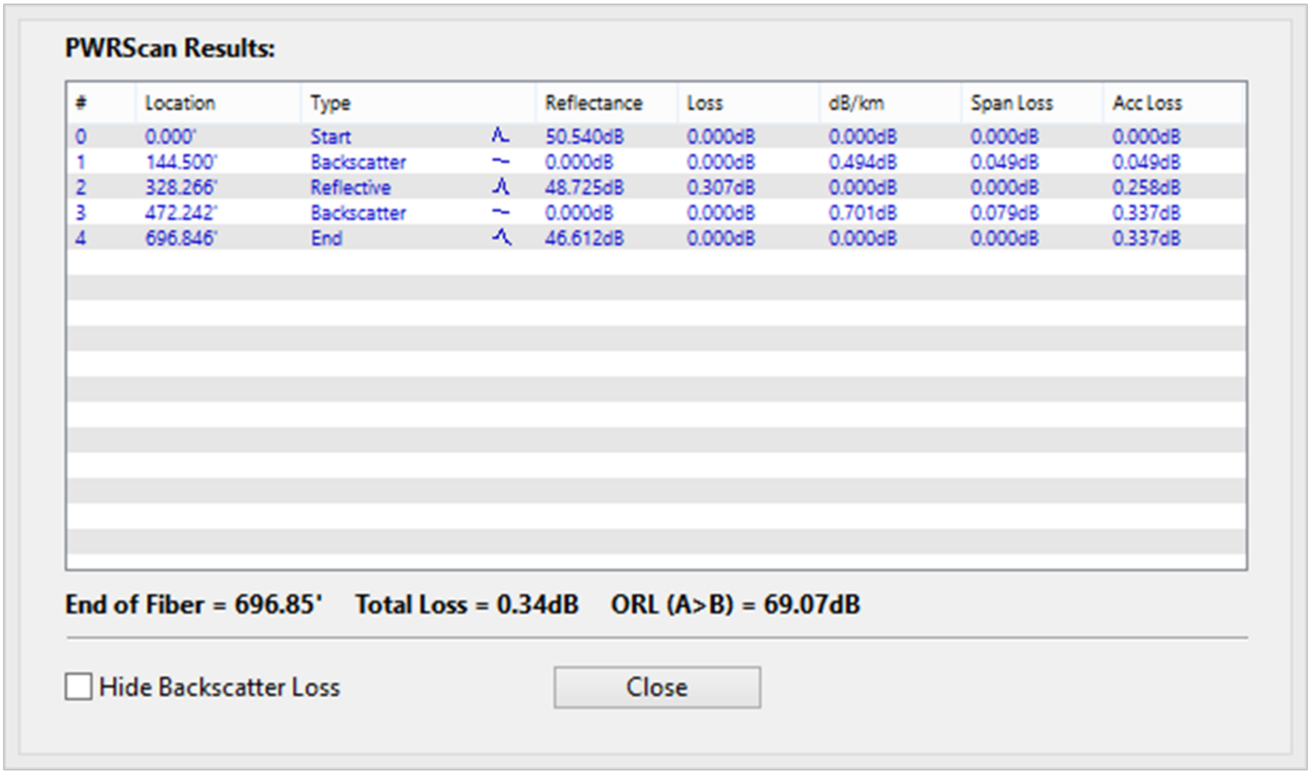
After a fiber test is complete, a dialog box will display and provide an option to 'Test Now', 'Retest Previous', or to cancel. (See Figure 18.)

Analyzing Traces Using PWRScan

PWRScan is OptiConcepts trace event table generator. It is accessible anytime there is a valid, completed trace displayed on the FWP graph screen. The trace may be one that has just been acquired, or one that has been loaded from a trace file. (Refer to Figure 19.)

PWRScan applies a variety of stable mathematical, statistical, spectral and transform algorithms to establish accurate and precise standard event characteristics. As with all event table generators, the most precise and accurate tables are produced using low noise trace data; the longer a trace is signal averaged, the easier it is for PWRScan to perform reliable trace analysis. Of course, even at short data accumulation times, very short laser pulse widths, and very large ranges, wherein the data set is generally noisy, good event tables may still be generated. For higher precision and accuracy, however, less noisy data sets are always a must.

If PWRScan returns an "empty" blank event table and message, try changing the experimental parameters, run a new trace, and run PWRScan again. Some likely causes of a "blank" event table are having chosen too short a range, or a poor bulkhead connection to the fiber cable, giving very large reflective singularities near the bulkhead. Check and clean, if necessary, the bulkhead and/or the lead-in cable. Choose a longer range, and adjust other parameters as required.



PWRScan Results:

#	Location	Type	Reflectance	Loss	dB/km	Span Loss	Acc Loss
0	0.000'	Start	50.540dB	0.000dB	0.000dB	0.000dB	0.000dB
1	144.500'	Backscatter	0.000dB	0.000dB	0.494dB	0.049dB	0.049dB
2	328.266'	Reflective	48.725dB	0.307dB	0.000dB	0.000dB	0.258dB
3	472.242'	Backscatter	0.000dB	0.000dB	0.701dB	0.079dB	0.337dB
4	696.846'	End	46.612dB	0.000dB	0.000dB	0.000dB	0.337dB

Figure 19 PWRScan Result Table

Printing

Printing OTDR traces can be done using 2 methods.

Method one is to print one trace at a time. This method is executed by having the desired trace loaded on the screen, then selecting the print function, then selecting the Print function in the Print Option window.

Method two is to batch print multiple traces. This process is detailed below.

Best Practice Recommendations

- Use the “Default Storage Folder” and “Auto Increment” features in the OTDR Settings area to help organize files when originally collecting traces.
- Make a new folder for each cable tested putting all trace files in the single folder for the cable being tested. Multiple fibers are likely to be tested and filed in this folder.
- Traces with different lengths should not be batch printed together.
- Length changes, most likely from testing a different cable, trigger the need to make a new folder.

See figure 20 for examples of folders for traces.

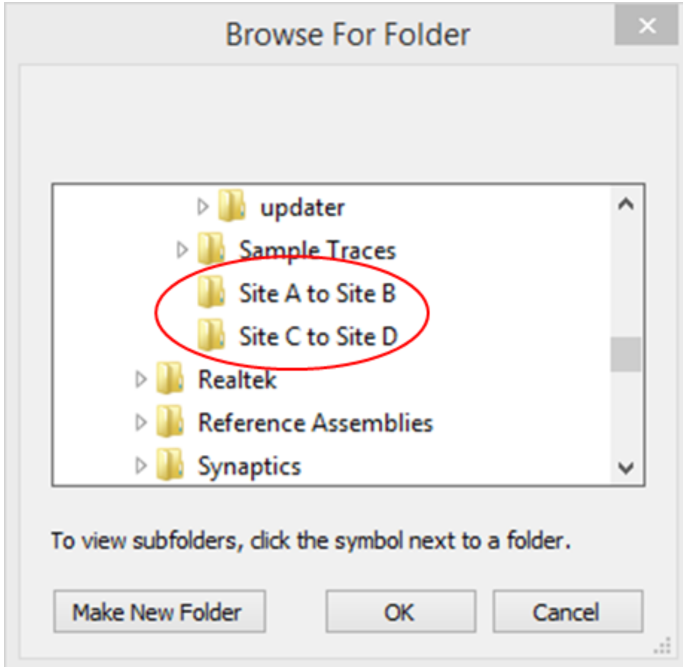


Figure 20 Examples of Folders for Traces

Initiating the Batch Print Process

- The FWP OTDR software should be up and running.
- Load the first trace from the group of traces to be printed.
- Adjust the trace on the screen to the way you want the printout to look.
- This requires using the Zoom In / Zoom Out features of the FiberWarrior Pro OTDR.
- Do not use the Zoom to Markers feature at this time.

After getting the trace to look as desired, position the markers where you want them on the trace.

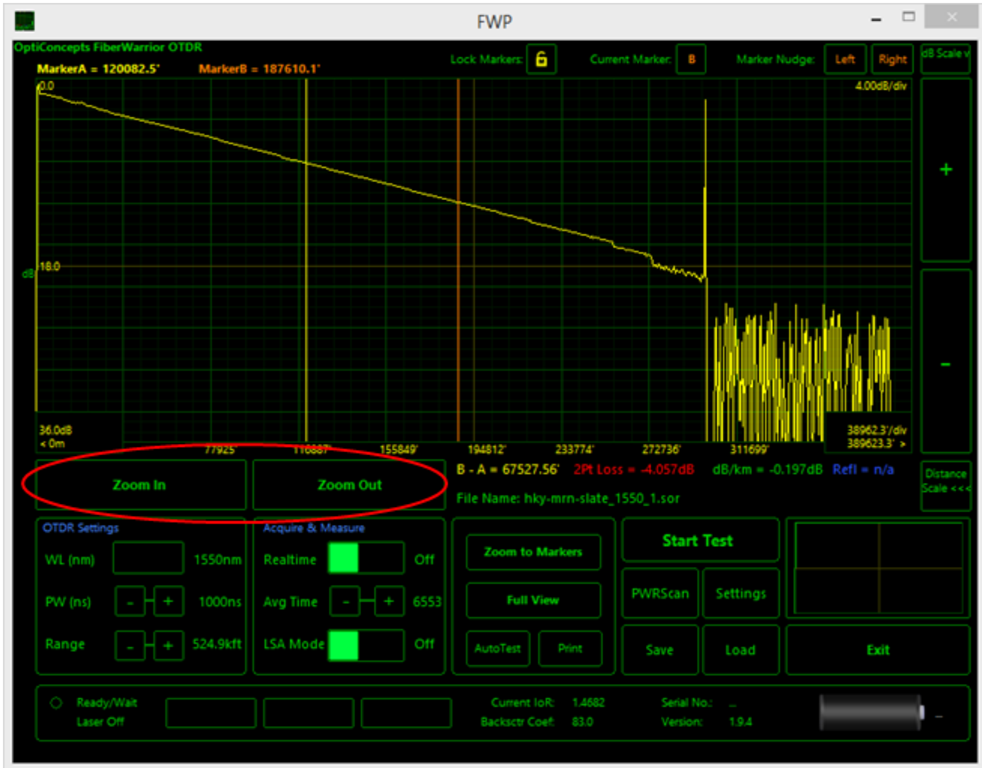


Figure 21 Zoom In / Zoom Out Features

- Select the Print function.

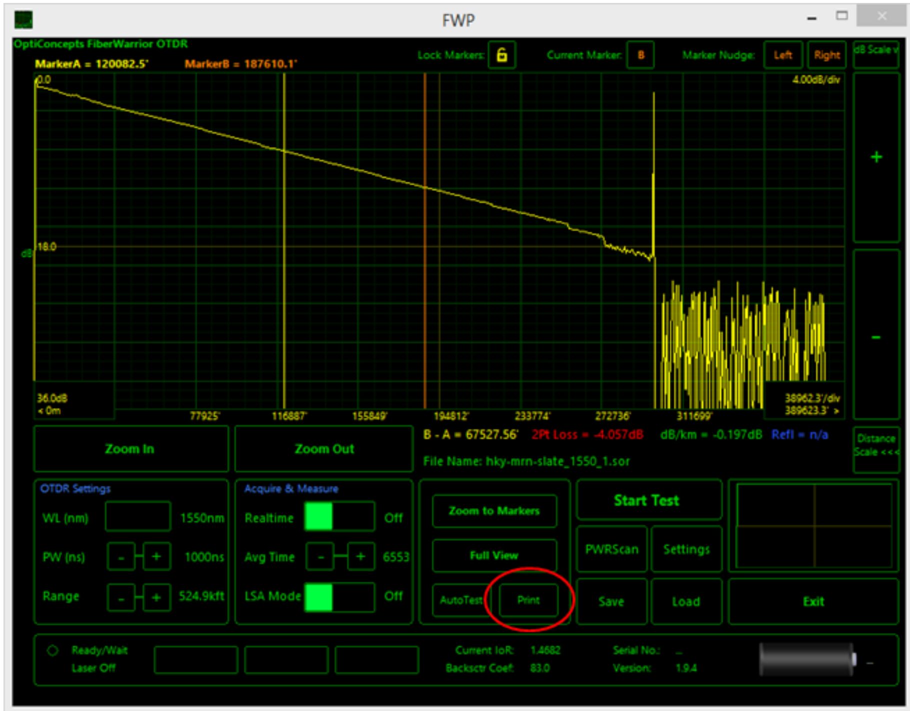


Figure 22 Print Function

- The Print Options window will appear.

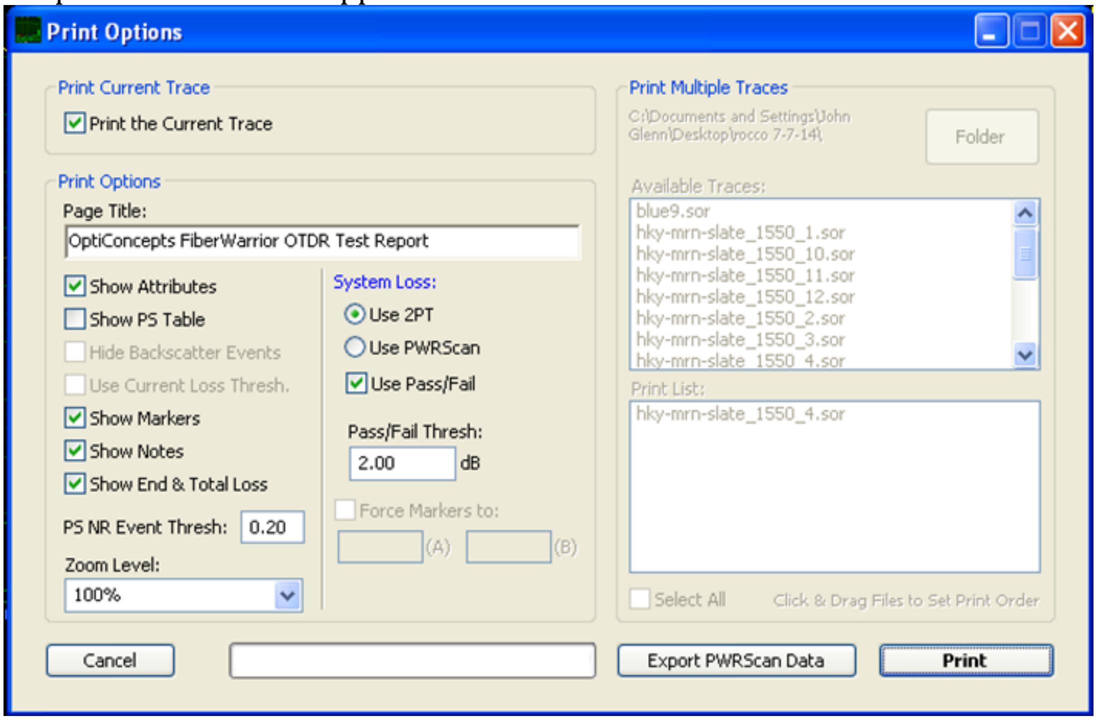


Figure 23 Print Options

- Uncheck the "Print Current Trace" box. Once you do this, the "Print Multiple Traces" function will activate allowing you to access the traces to print.
- Select the "Folder" button in the Print Multiple Trace area.
- Go to the folder of the traces you want to print and select it. This will load all the trace files (files with .sor or .OC3 extensions) in the box labeled "Available Traces" of the Print Multiple Traces area. See the example below.

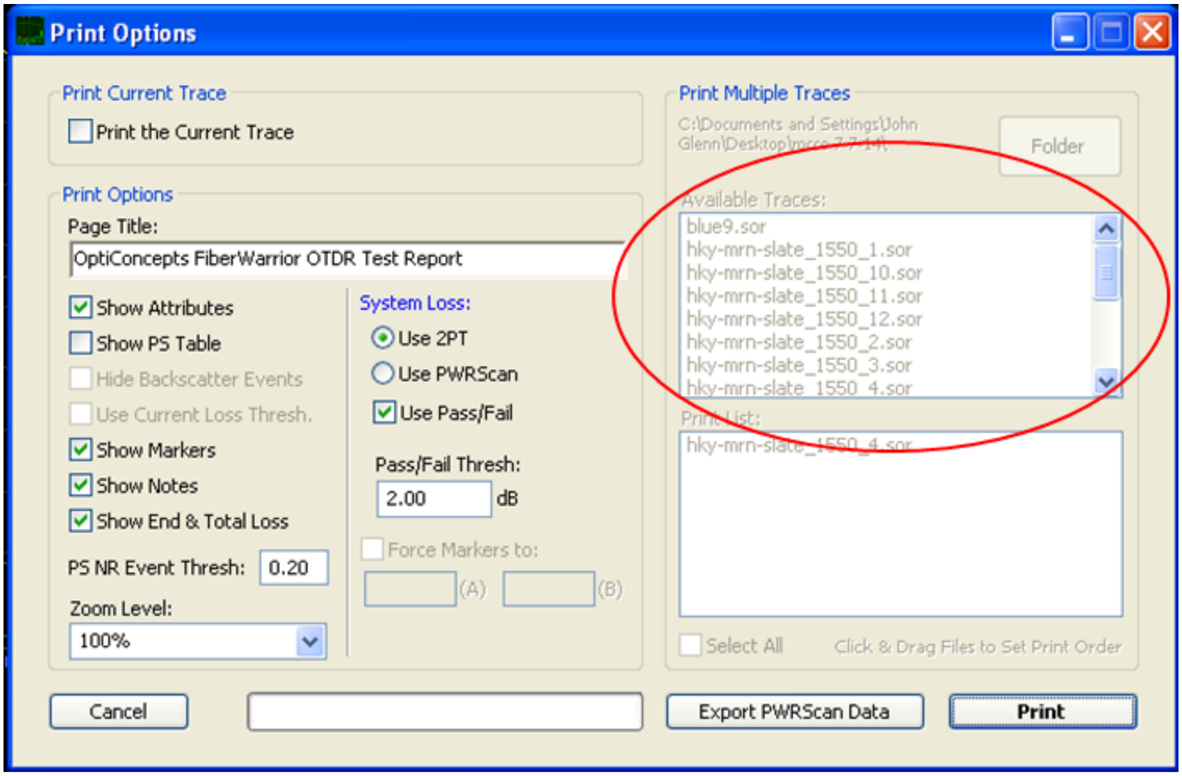


Figure 24 Available Traces

- You may use either the “Select All” check box to select all the traces to be printed or you double click the traces to be printed into the “Print List” area one at a time. A trace is in the Print List area in the example below.

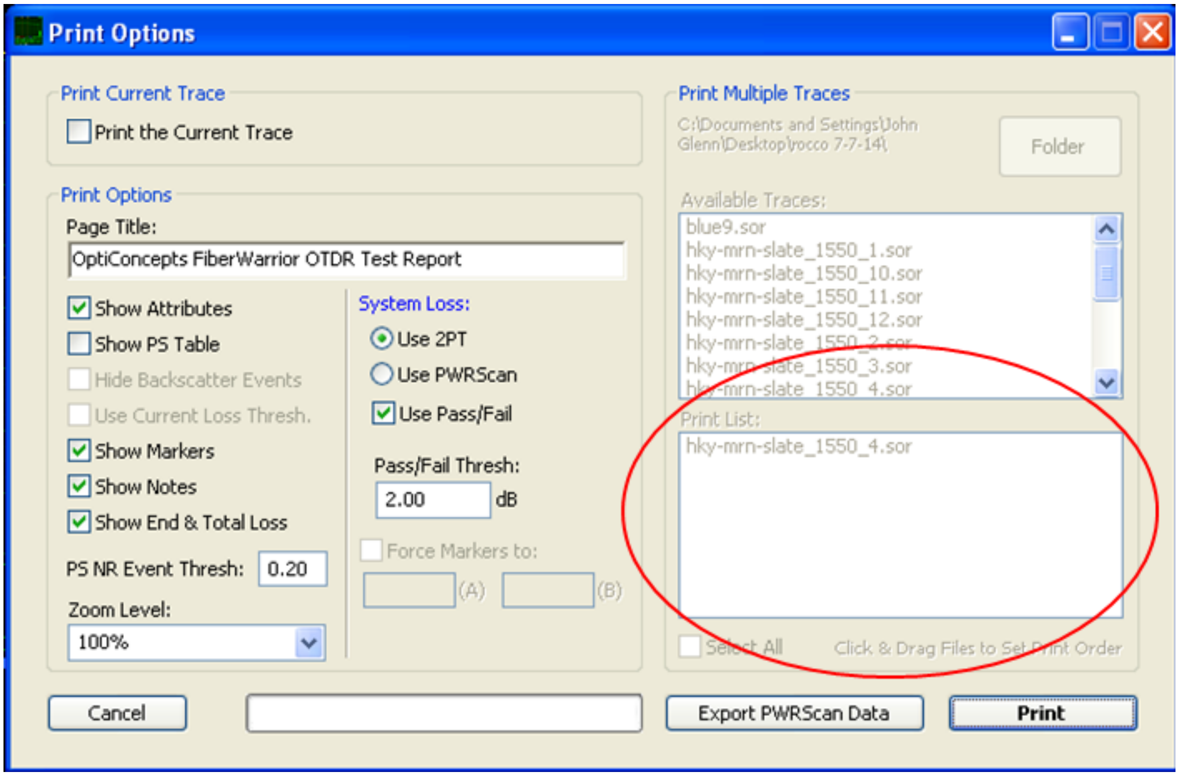


Figure 25 Trace in Print List Area

- The order in which the traces are printed can be changed by clicking on a trace to be moved and dragging it to the new position. Do this to get all the traces in the order in which you want them to print.
- Select the characteristics to be printed in the Print Options area. The characteristics that can be selected are described below.
  - Page Title – this is the title that will be shown just above the print trace. It can be edited as needed by the user.
  - Show Attributes – creates a table of Trace Parameters and Attributes printed below the trace. The contents of the table include filename, save date, print date, OTDR settings, marker positions, and loss data.
  - Show PS Table – this is the PWRScan table which lists all loss events and backscatter information. It is printed below the attribute table. Contents include locations of events, loss and reflectance values, and accumulated loss.
  - Show Markers – displays the markers as placed on the trace screen by the user.
  - Show Notes – prints an empty dialog box at the bottom of the printout to allow the user to put hand written notes on the trace printout.
  - Show End & Total Loss – three attributes print after the PWRScan table indicating the end of the path being tested, the total system loss, and whether the path being tested meets the loss performance entered by the user.
  - System Loss – area where the user defines the area of interest for losses and the performance criteria. Methods that can be used are described below.

        - Use 2PT – uses the 2 points where the markers are set as the area of interest relative to concern of losses.
        - Use PWRScan – uses the PWRScan area as the area of interest relative to concern of losses.
        - Use Pass/Fail – allows the user to define overall system used for acceptance. The *Show End & Total Loss* feature must be selected for this feature to be active.
        - Pass/Fail Tresh (Threshold): when the "Use Pass/Fail" option is selected, the user enters the overall system loss or loss budget in this area.
        - Force Markers to: - feature that allows the user to enter specific locations for each of the markers.
        - PS NR Event Thres (Threshold): - this allows the user to set the threshold for non-reflective events which can reduce PWRScan table entries for events that are not critical.
    - Zoom Level - a feature allows the user to set the trace zoom. It is recommended that the Zoom In / Zoom Out functions on the main OTDR trace screen be used rather than this feature but the user can set zoom this way if desired.
    - Splice Level Threshold – enables user adjust of splice joint loss levels to minimize impact to PWRScan results.
- Select Print.
    - You can print to a printer or print to a file using a .pdf print program or the .xps function in Windows.

Exporting Trace Data to a File

- The button titled "Export PWRScan Data" is used to send the trace data to a format to allow use in spreadsheet programs.

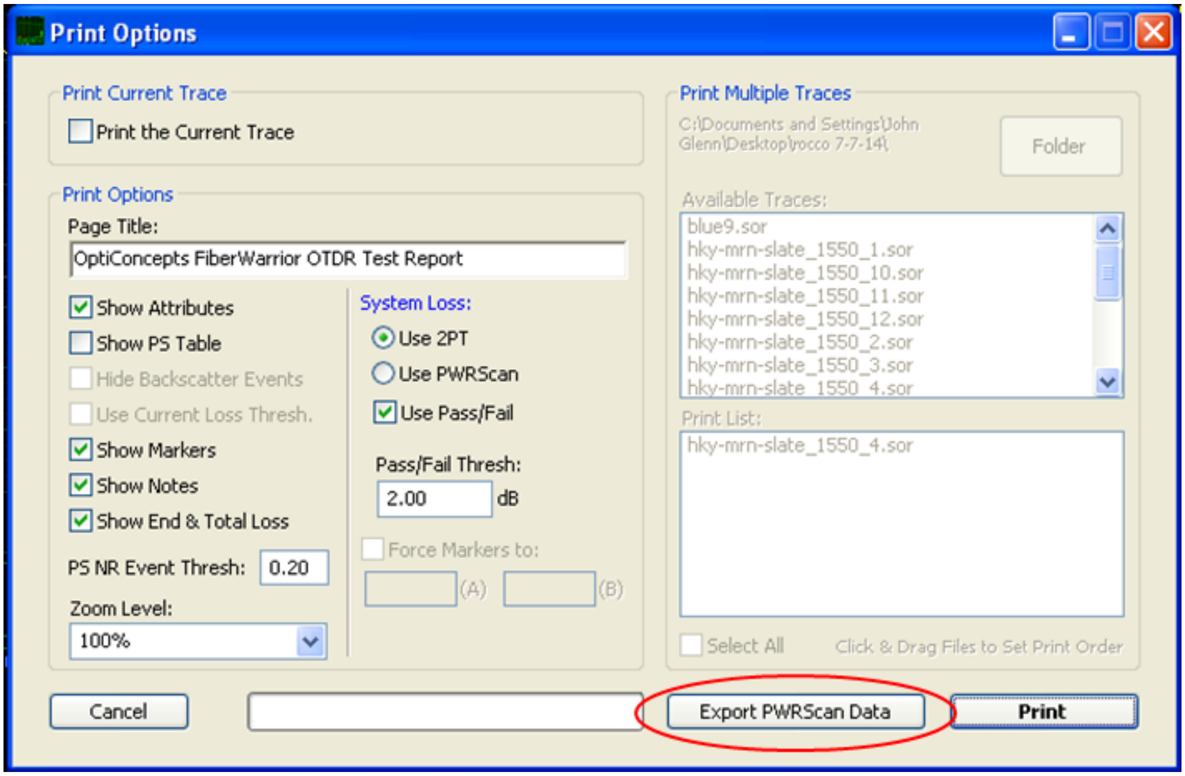


Figure 26 Export PWRScan Data

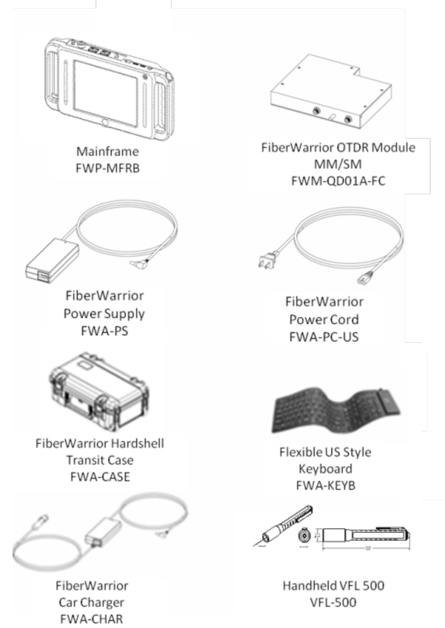
- Once the function is selected, the system creates a text document of the selected traces in the folder where the traces are stored.
- To tabulate the data in a spreadsheet program such as Excel:
  - Open the spreadsheet program.
  - Open the text file.
  - Select "Delimited" file type.
  - Identify "Commas" as the delimiter. This will create a table similar to the one that follows. Note that headers have been inserted in the appropriate columns and two columns between "Event" and "Location" have been deleted. A legend for the "Type" event is at the bottom of the table.

Event	Location	Type	Reflectance	Event Loss	dB/km	Backscatter End Location	Span Loss	Accumulated Loss
0	0	S	-50.41385	0	0	0	0	0
1	111.066395	F	0	0	-0.319972	1498.758025	-0.47956	-0.47956
2	1499.077182	R	-55.37901	-2.078472	0	0	0	-2.558032
3	1609.824421	F	0	0	-0.387704	803.635585	-0.311573	-2.869605
4	2302.712767	R	-54.670837	-0.320596	0	0	0	-3.190202
5	2413.460006	F	0	0	-0.391931	506.820218	-0.165365	-3.355567
6	2809.213828	L	0	-0.231174	0	0	0	-3.586741
7	2835.384646	F	0	0	-0.240614	494.692278	-0.139457	-3.726198
8	3304.225263	R	-52.712133	-0.053437	0	0	0	-3.779635
9	3414.972502	F	0	0	-0.623687	309.581619	-0.194675	-3.974309
10	3613.806883	E	-26.855508	0	0	0	0	-3.974309
	S - Start Point		F - Backscatter		R - Reflective Event		L - Non-reflective Event	

Figure 27 Example of Data Exported to Excel

FiberWarrior Pro Care and Maintenance

Typical FiberWarrior Kit Components



All kits include the Mainframe, Module, Power Supply/Cord, Launch Cord, Rechargeable Battery, Hard Transit Case, and FiberWarrior Pro Trace software.

Other items, such as the Keyboard, VFL, and Car Charger are optional.

Other options are available, including Patch Cords, Adapters, Cleaning Supplies, Soft Memory Expansion, and other items.

Cleaning the Unit

Make sure the unit is unplugged and off before cleaning it. Wiping the unit with a nonabrasive, dry cloth is the recommended method of cleaning. Do not use any liquids or chemicals to clean the unit. This applies to the FiberWarrior Pro Mainframe housing as well as the touchscreen.

Keep the cooling fan vent clean by making sure the ventilation holes are not blocked. If ventilation is obstructed, the unit could overheat and impede normal operation.

Connector port cleaning is critical to proper OTDR operation. To properly clean the OTDR port, use a dry adapter port swab or an automatic port cleaner such as the OptiConcepts one-click tip style cleaner for 2.5mm ferrule connectors (FWA-SCR1). Make sure the unit is turned off before cleaning the OTDR ports. If using the dry adapter port swabs, insert a new, clean tip into the OTDR port and gently twist the swab to clean the connector endface. Twist the swab around the adapter port tube as the swab is removed to clean the inner wall of the port. If using the automatic port cleaner, simply press the cleaner into the port until it clicks.

OptiConcepts 2.5mm One-Click Cleaner

Storing the Unit

Before storing, wipe the unit down with a soft, dry cloth. Store unit and accessories in the transit or carrying case supplied with unit. Avoid storing in the following conditions: exposure to direct sunlight or large amounts of dust; high humidity where condensation could occur; area that may be exposed to volatile gases. Recommended storage temperature range is from -20°C to 60°C with a humidity level no greater than 95%.

Battery Replacement

This unit uses rechargeable lithium-ion batteries. The batteries are factory replaceable when they have lost their useful life of about 300 charge cycles. Annual calibration service ensures batteries are inspected and replaced as needed.

Best Practices

The following best practices are recommended to keep your OptiConcepts FiberWarrior Pro OTDR in top working condition.

- Keep away from heat
- Charge when cool to the touch
- Use only OptiConcepts provided power adapters
- To keep your OTDR running as efficiently as possible do not load additional software on it such as word processors or spreadsheet programs

Calibration and Self-Test

Factory calibration is highly recommended for the FiberWarrior Pro on an annual basis. No usable, adjustable controls are available for self-calibration in the field.

Several key parameters are monitored via software and a dialog box informing the user of possible trouble will appear on the screen if an issue is realized. These automated checks include: zero distance calibration, signal level, pulsewidth abnormalities, and communications handshaking.

Preventative Maintenance

In order to reduce downtime, several key preventative maintenance items should be performed. As a preventative maintenance routine, repeat all items below once every six months.

1. As described in the cleaning section above, clean the external FiberWarrior Pro Mainframe surface and touchscreen after use and before storage. It is recommended the OTDR ports be cleaned after each testing session to prevent dirt or debris from building up and hardening on the internal connector.
2. Calibrate the touchscreen as directed in the User's Manual. This is performed via software.
3. Connect the FiberWarrior Pro to a network via the Ethernet port and ensure the unit properly connects.
4. Connect a USB device (memory stick, keyboard, or mouse) to each of the two USB ports and ensure the ports are working correctly.
5. Inspect the power cord and power supply wires for frays or other damage. Make sure all connections (wall plug, power supply plug, and unit power plug) securely connect in their respective receptacles.

Troubleshooting

In case the FiberWarrior is not operating as expected or to the OptiConcepts published specifications, a list of possible issues along with solutions is provided below.

Basic FiberWarrior Troubleshooting

1. *The FiberWarrior will not power on.*

   The most common issue is the batteries are dead or the unit does not have a proper connection to A/C power. Make sure the cord is properly plugged into a working A/C outlet, the cord is securely attached to the power supply, and the adapter is securely plugged into the FiberWarrior Pro power jack. If this doesn't work, try a new OptiConcepts power supply.

2. *The batteries will not charge.*

   This is usually caused by the power supply not connected to the unit properly.

3. *The mouse pointer jumps around erratically or not to the point on the screen in which it was touched.*

Several things can be done to resolve touchscreen issues. First, it is important to keep the screen clean and dry. Dirty screens and/or high humidity can provide sources of feedback to the screen and cause issues. Additionally, make sure the screen is calibrated as described in the user's manual. Rebooting the machine can resolve software conflicts.

4. *The operating system seems to be slow or is not responding.*

   If the system memory is full or there has been a software failure or conflict, reboot the FiberWarrior Pro.

5. *OTDR tests and traces do not appear as expected.*

   See the OTDR Specific Troubleshooting section below.

6. *The fan makes excessive noise.*

   If too much debris has been trapped in the fan, turn the unit off, disconnect the power supply, and remove the OTDR module. Gently blow dry compressed air through the fan opening holes until they are clear.

OTDR Specific Troubleshooting

One of the most frustrating things for an OTDR user is to run into issues and spend an excessive amount of time troubleshooting. In order to become an efficient and credible OTDR user, the quick identification and resolution of problems must be mastered. Below is an ideal fiber trace followed by a group of the most common problems found in the field.

Ideal System

An ideal fiber system is shown below. A test fiber, or launch cord, has been added between the OTDR and the fiber under test so that the connector pair at the patch panel can be accurately measured. The markers have been positioned to measure both the connector pair and the link loss of the fiber. In this example, the far end connector has not been evaluated. Either a trailing-end cord should be added or the system should be shot from the opposite direction for the most thorough OTDR test.

Ideal Fiber Trace

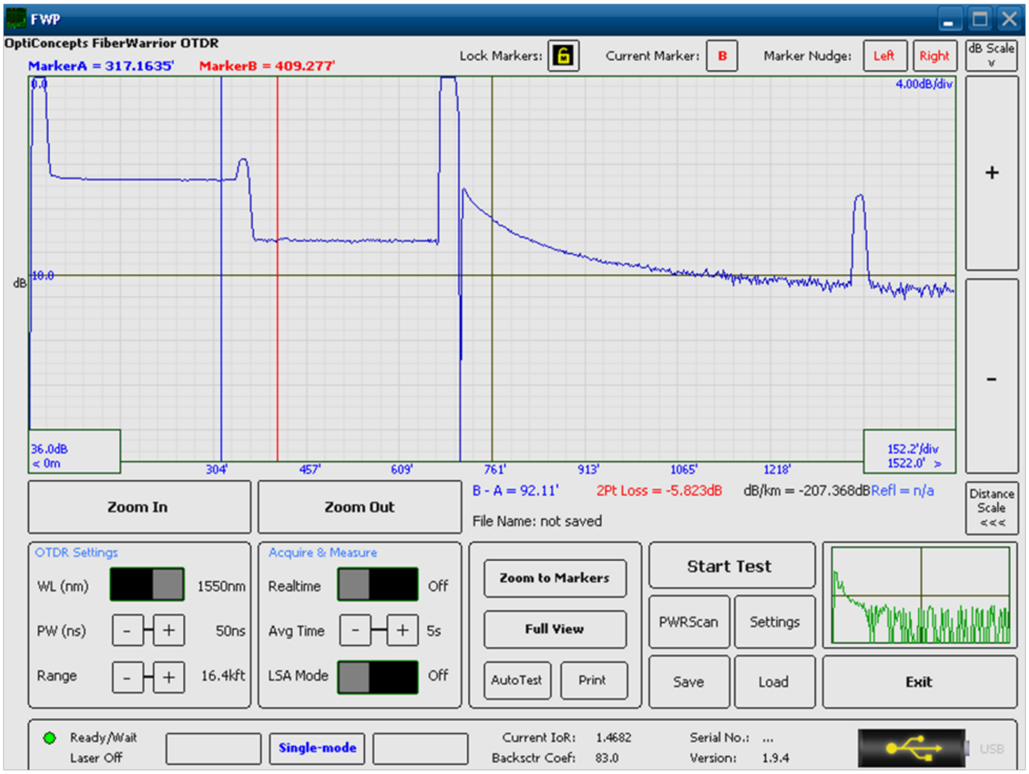
Ideal Fiber Trace Showing the Patch Panel Connecter Mating

Now that the ideal system has been described, several problems will be evaluated.

Significant Signal Loss at the Patch Panel

The following example shows a seemingly good launch fiber, but nearly a 6dB loss at the patch panel. Several things could be wrong:

1. The far end of the launch fiber could be bad. Troubleshoot by cleaning the connectors, and then switch the ends of the launch fiber.
2. The first connector of the system under test could be bad. Troubleshoot by inspecting the connector and replace if necessary.
3. There could be a significant bending issue within the patch panel. Troubleshoot by switching the OTDR wavelength to 1310nm and see if the 6dB loss improves. If it does, use a Visual Fault Locator (visible laser) to pinpoint the bending issue.
4. Inspect and replace the adapter sleeve.



Major Loss near the Patch Panel

The problem with this particular shot was actually a pinched fiber in the patch panel. It was quickly identified and repaired after observing an improvement in loss when testing at 1310nm. Wavelength switching is usually most effective when troubleshooting single-mode fiber.

Reflections in the Right Places, but Rolling Trace from the Start

The following screenshot seems to have reflective events where we would expect (as compared to the ideal trace), but appears to roll-off and the two-point loss values seem to be unacceptable. Since the trace begins to roll-off from the start, troubleshooting should be focused at the OTDR bulkhead connection.

1. Clean both the OTDR bulkhead connector and the near-end launch fiber connector. Make sure they are properly mated to one another. Repair or replace any defective connectors in fiber system under test.
2. Replace the launch fiber with a known good unit. The launch fiber could be damaged.
3. Return the OTDR for repair. Bulkhead connector problems are the #1 issue with OTDRs since the connector wears out with repeated connections.

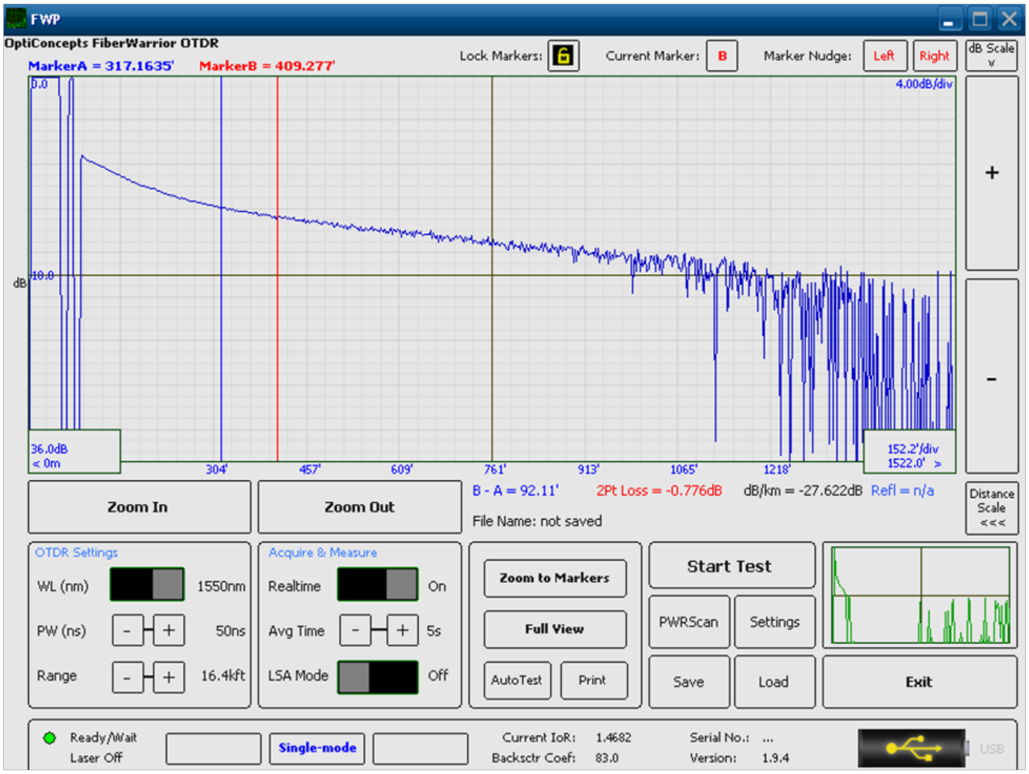
The Classic Problem of a Rolling Trace (with Reflections)

The issue with this particular problem was the launch fiber connector not being properly tightened down to the OTDR bulkhead. A clue to this was the reflections in place, telling us that at least some light was getting through.

Rolling Trace from the Start, but no Reflections

Another popular occurrence is the rolling trace with no reflections issue. This is likely another issue at the OTDR bulkhead, but this time, there doesn't seem to be any light being coupled into the fiber at all. Possible problems include…

1. No fiber is connected to the OTDR.
2. There is a broken fiber near the bulkhead. This could be within the launch fiber near-end connector, in the launch fiber box, or a broken fiber in the OTDR itself.



Classic Problem of a Rolling Trace (with no Reflections)

With this issue, the user forgot to connect a fiber to the OTDR.

Rolling Trace at the Patch Panel

A poor connection caused by dirt, oil, debris, scratches, air gap, etc. will cause the trailing side to roll off slowly, but eventually recover to a somewhat expected backscatter level. In this example, the roll off starts to level out around 500'. To troubleshoot:

1. Inspect and clean both the far-end launch fiber connector and the near end fiber connector under test. Replace the connector as necessary.
2. Inspect and replace the adapter sleeve.
3. Make sure the connectors are properly connected together.

Rolling Trace after the Patch Panel

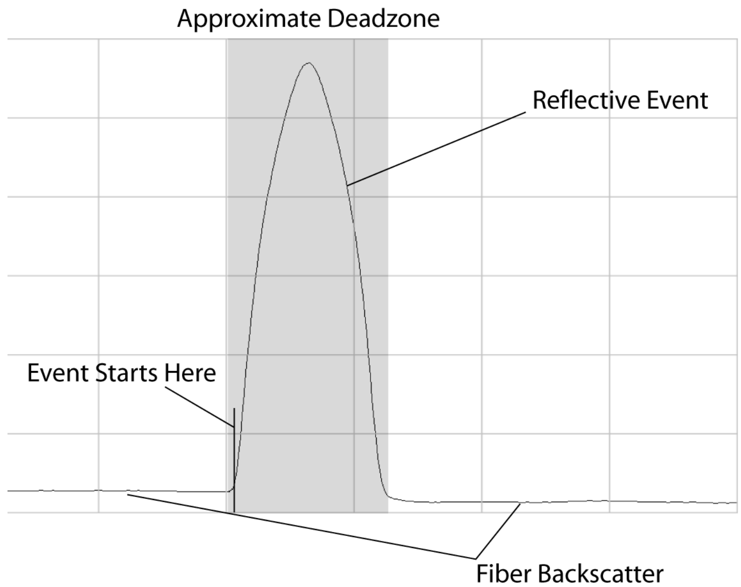
The problem was simply a dirty connector pair.

OTDR Limitations and Performance Verification

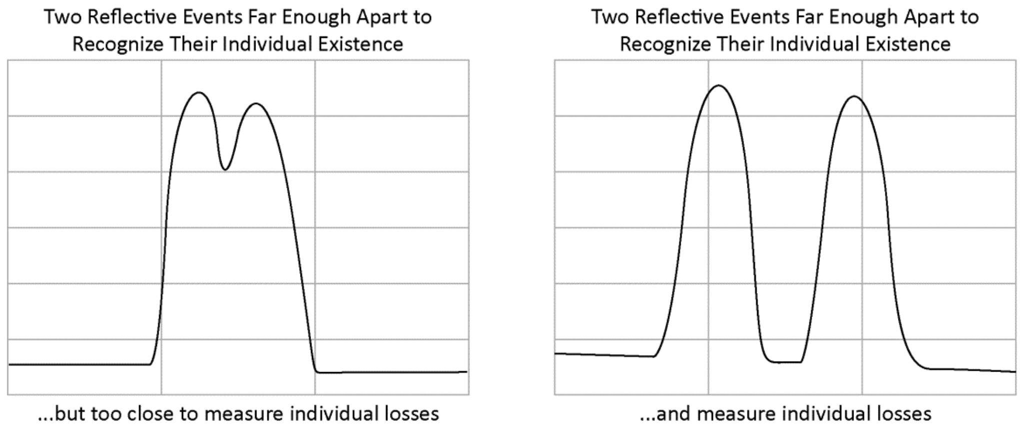
An OTDR has two distinct characteristics that directly limit (or allow) measurement capabilities. These two characteristics are called deadzones and dynamic range. Short deadzones allow the measurement of events that are relatively close together. Increased dynamic ranges allow the OTDR to 'see' further, thus measure longer systems. The characteristics of deadzones and dynamic range tend to work against one another, as improvement of one often requires the degradation of the other.

Deadzones

Deadzones are best described as an area, or zone, on the fiber trace that cannot provide useful measurement information. These zones most often occur immediately after a reflective event. Once a pulse of laser light encounters a sudden change in index of refraction, such as the mating of two connectors, a relatively strong pulse reflects back to the OTDR. The returning pulsewidth is proportionally the same width as the initial laser pulse since the returning pulse is essentially an echo that has bounced off of the connector pair. This can be compared to shining a flashlight through a window, where most of the light passes through, but some will reflect back and be seen by the person holding the light. The reflecting light shows up on the OTDR screen as a pulse. The width of the pulse is the area (distance) after the event and has 'blinded' the photodetector for an amount of time proportional to the width of the original transmitted laser pulse. The area occupied by the pulse is the unusable deadzone.



Approximate Deadzone of a Reflective Event

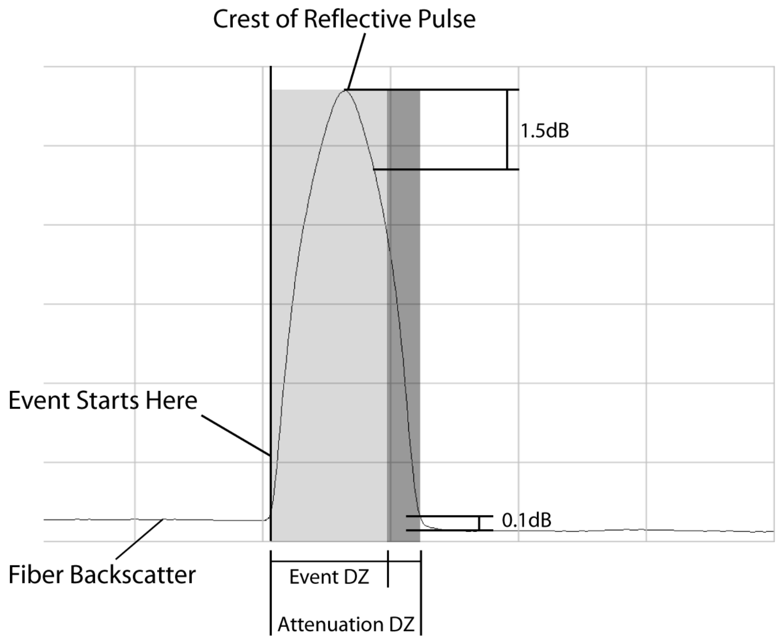


Pulses Close Together can be Difficult to Measure

Deadzones are typically measured in meters. Shorter pulsewidths reduce the recovery time of the photodetector and allows the user to measure events closer together. However, shorter deadzones means shorter pulses of laser light, which further means less optical energy traveling down the fiber- resulting in reduced dynamic range (the ability to 'see' longer spans of fiber).

There are two definitions of deadzones. The first type, attenuation deadzones, are defined as the width of the area between the beginning (left side) of the reflective pulse to beyond the falling edge of the pulse where the signal level has returned to within 0.1dB of the following backscatter. Attenuation deadzones tell the user how much distance is required after a reflective event to accurately measure fiber attenuation. The second type, event deadzones (sometimes called reflective deadzones) are defined as the width of the area between the beginning (left side) of the reflective pulse and ending 1.5dB down the falling edge of the pulse measured from the crest of the given pulse. Event deadzones tell the user how close two events can be spaced apart and still be visually identified on an OTDR. However, the individual losses of each event cannot be determined at the event deadzone spacing- the attenuation deadzone value must be used. Therefore, event deadzones are always shorter than attenuation deadzones and the latter is generally more useful.

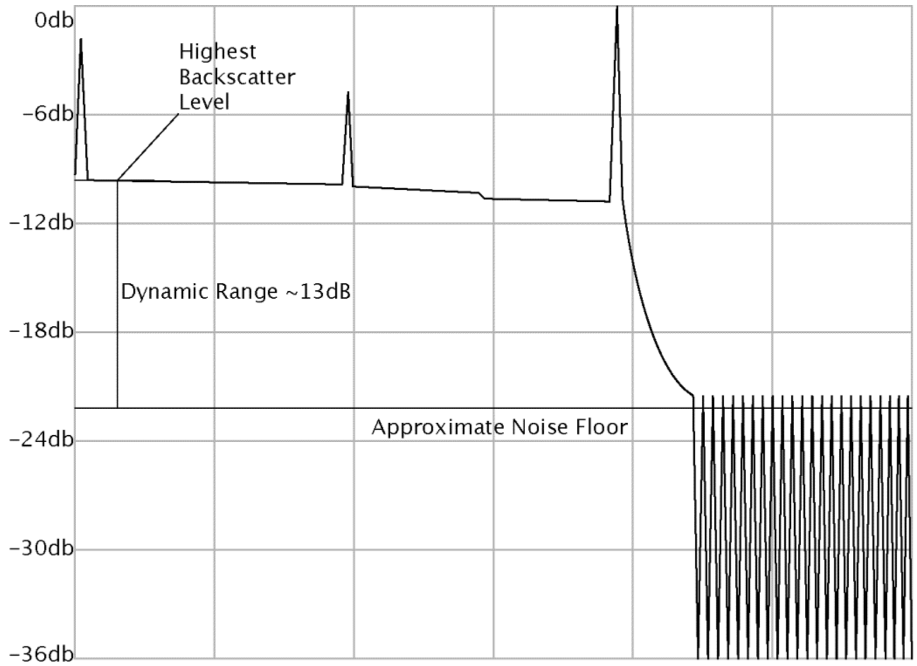
OTDRs typically have a variety of pulsewidths, from as low as 5ns to as high as 30000ns. Theoretically, deadzones can be calculated by dividing the pulsewidth (in ns) by 10 to obtain the deadzone in meters. Published deadzone specifications of an OTDR usually reflect the value of the shortest possible pulsewidth of the machine. Again, the shorter the pulsewidth, the closer two events can be identified and measured, but at the cost of overall range.



Determining Deadzones

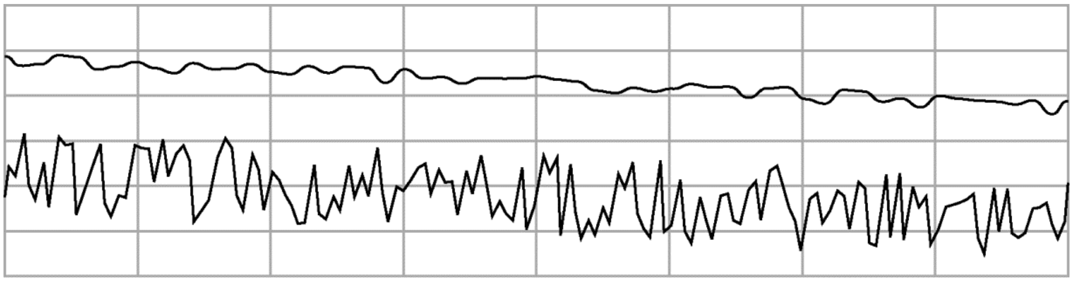
Dynamic Range

Dynamic range is effectively the signal to noise ratio between the strength of the received laser signal and the noise produced by the OTDR electronics. The larger the ratio between signal to noise, the better the trace information. Dynamic range generally improves as pulsewidth increases due to more energy traveling along the fiber. Dynamic range can be compared with a radio signal reaching your car. The closer you are to a radio tower, the greater the signal and the better the station sounds. As you drive away from the tower, the signal reaching the car decreases and eventually, the static noise overrides the signal all together. If the radio operator increases the signal at the tower, the further the signal can be received. Similarly, when the OTDR user increases the pulsewidth, the further the signal will travel due to the increased optical energy. Dynamic range is measured in dB from the highest possible level of fiber backscatter to what is referred to as the noise floor. Of course, the highest level of backscatter is that closest to the OTDR bulkhead connector.



Approximating Dynamic Range

With a decreased signal to noise ratio, a noisy (bumpy) trace can be expected due to the inclusion of undesirable noise. Averaging many traces together and displaying the result can reduce some noise seen by the user.



Two Traces of the Same Fiber: Top Trace with 30s Averaging, the Bottom with 5s

Published dynamic range specifications of an OTDR usually reflect the value of the longest possible pulsewidth of the machine. Again, the longer the pulsewidth, the greater the measurable range, but at the cost of the deadzones.

Warranty

OptiConcepts warrants that one year from date of shipment, equipment is free from defects in material and workmanship under normal use and service. OptiConcepts retains the option to repair or replace the equipment or to refund the current value of the item.

No warranty shall apply to the following:
Any goods that have been modified, altered, or disassembled by persons other than OptiConcepts; any goods subjected to misuse, neglect, improper installation, improper maintenance, or accidental damage; damage due to natural disasters, including fire, earthquake, and flood; damage due to use of non-specified peripheral equipment, power supply, accessories, or consumables.

This warranty is made on the condition that Buyer gives OptiConcepts immediate notice of defect and that inspection by OptiConcepts reveals that the warranty claim is valid under the terms of this warranty. No return will be accepted unless accompanied by a Return Material Authorization issued by OptiConcepts. Warranty is non-transferrable beyond original Buyer/End-user.

Technical Support and Service

Do not attempt to open the unit or to disassemble any parts; there are no user serviceable parts available. Only OptiConcepts trained personnel or staff should service this equipment. There are high voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. There is also risk of damage to precision parts.

If you are in need of equipment service, please call 828.320.0138 or email support@opticoncepts.com for a Return Material Authorization (RMA) number. The RMA should be written on the outside of the returning container. OptiConcepts will advise as to the proper return packaging required at the time the RMA is issued. Please do not ship equipment back to OptiConcepts without an RMA number.

FiberWarrior Pro Platform Specifications

Processor	Atom N455 Class Processor
Operating System	OptiLin™ Linux or WindowsXPe®
On-Board Flash Memory	16Gb (larger options available by request)
RAM	1Gb
Ports	2-USB, 1-Ethernet
Display	8.4” Color TFT LCD
User Input Device	Resistive Touchscreen
Power Supply	AC, 100-250VAC, 50-60Hz
Battery	14.4V 5.6WH Rechargeable Li-Ion
Size	13.5” x 7.0” x 2.05” (34.29 x 17.78 x 5.2cm)
Weight	5.65lbs. (2.57kg) without Battery / 7.35lbs. (3.34kg) with Battery
Operational Temperature	0° to 50°C
Storage Temperature	-20° to 60°C
Humidity	0 to 95%, non-condensing

FiberWarrior Pro OTDR Specifications

Wavelengths:	MM: 850nm/1300nm; SM: 1310nm/1550nm/1625nm (±20nm)
Dynamic Range:	MM: 25/25dB, typical, SNR=1 SM: 30-44dB, typical, SNR=1
Pulsewidth Range:	MM: 10ns to 1µs SM: 10ns to 20µs
Loss Resolution:	0.001dB
Linearity:	±0.05dB/dB
Maximum Reach:	MM: 80km SM: 40dB+ - 520km, 30-38dB – 320km
Event Deadzone:	<3m
Attenuation Deadzone:	<12m
Sample Points:	16,000 standard (up to 64,000, depending on configuration)