USER MANUAL

OPX-BOX/OPX-BOX+/ OPX-BOXe

Compact OTDR

Please direct all questions to your local VeEX Sales Office, Representative, or Distributor. Or, contact VeEX technical support at www.veexinc.com.

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1.0 About This User Manual

Every effort was made to ensure that the information contained in this user manual is accurate. Information is subject to change without notice and we accept no responsibility for any errors or omissions. In case of discrepancy, the web version takes precedence over any printed literature. The content in this manual may vary from the software version installed in the unit.

This user manual is suitable for novice, intermediate, and experienced users and is intended to help you successfully use the features and capabilities of the OPX-BOX. It is assumed that the user has basic computer skills and is experienced with basic fiber optic concepts, technology and terminology.

For more technical resources, visit the VeEX, Inc. web site at www.veexinc.com.

If you need assistance or have questions related to the use of this product, call or e-mail our customer care department for customer support. Before contacting our customer care department, you must have your product serial number and software version ready. Please provide this number when contacting VeEX customer service.

Customer Care:

Phone: + 1 510 651 0500
E-mail: customercare@veexinc.com
Website: www.veexinc.com

2.0 Safety Information

Safety precautions should be observed during all phases of operation of this instrument. The instrument has been designed to ensure safe operation however please observe all safety markings and instructions. Do not operate the instrument in the presence of flammable gases or fumes or any other combustible environment. VeEX Inc. assumes no liability for the customer's failure to comply with safety precautions and requirements.

Laser Safety

Never look directly into the beam of an active optical source as this may result in harmful eye damage from radiation exposure. Make sure that optical sources are inactive before connecting fiber to the test set to avoid skin or eye damage, or damage to the unit.

3.0 Introduction

The OPX-BOX+ is an ultra-compact OTDR designed to operate remotely using Fiberizer™ software from Windows, Linux, or Android devices. The unit can be controlled via USB and, optionally, via Bluetooth or WiFi depending upon the configuration.

OPX-BOX options:

- USB
- USB and Bluetooth

OPX-BOX+ options:

- USB
- USB and Bluetooth or WiFi

OPX-BOXe options:

- USB
- USB and Bluetooth and/or WiFi

The OTDR can be equipped with up to three wavelengths for OTDR testing including a live 1625 or 1650 nm filtered or Multimode using the AUX test port. The OTDR can be configured with dynamic range up to 42 dB with best in class Event (1m) and Attenuation Loss (4m) dead zones. In addition, the OTDR can be configured with the OLS (CW) mode and VFL options. Both OLS and VFL options can be activated using the Power buttons on the OPX-BOX panel; thereby not requiring any remote control.

Fiberizer Mobile or Desktop software is required to control the device—various versions are available for mobile phones and tablets (Android/Linux/iOS) including Windows PC platforms. The OPX-BOX can also be used with Fiberizer Cloud, a powerful online software tool for batch analysis, reporting and archiving of OTDR traces and related fiber measurements.

Platform Highlights

- Battery: Li-Ion Polymer, 3400 mAh (6-8 hours activity)
- Interface options: USB standard, optional Bluetooth and/or WiFi
- Dimensions: 125 x 31 x 85 mm
- Weight: 0.3 kg, shock-resistant construction and packaging
- Power consumption: 2 W (1 W for OTDR)
- Up to 3 wavelengths for OTDR testing including Live port (1625 nm, 1650 nm)
- Up to 41 dB Dynamic Range and testing 1/4m Dead Zones
- Optional Light Source (via OTDR port)
- Optional Visual Fault Locator (VFL)
- Multimode and Singlemode wavelength test options - 850, 1300, 1310, 1490, 1550, 1625 and 1650 nm

- Software available for Windows, Linux and Android operating systems and devices
- Can be controlled remotely via Fiberizer Desktop Windows software

Key Features

- Simple operation - VFL and OLS can be activated locally using a single button
- Fixed and inter-changeable optical adaptors (SC/FC/ST/LC)
- Ruggedized case and gap-free design protect the device from harsh and hazardous environments
- Ultra-compact design
- Suitable for harsh field conditions/environments
- Automatic measurement with a single button
- V-Scout Intelligent Link Mapping support (optional)

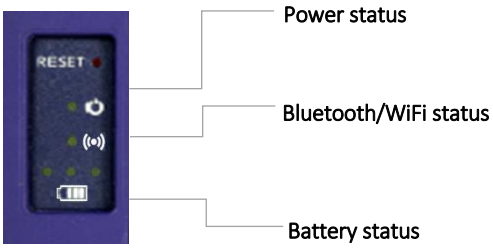
3.1 OPX-BOX Overview

OPX-BOX can be used for optical fiber and optical component measurement.

- **OTDR**: measures attenuation, length, distance, and loss of events in singlemode or multimode fiber systems (model dependent).
- **Optical Light Source** (OLS): operates in CW mode to measure level, loss and reflectance in optical components; optional, depends on the OTDR laser fitted.
- **Visual Fault Locator** (VFL): (Optional) fault finding in ODFs and patchcords; used for short-haul fiber identification.

OPX-BOX+ Platform

3.1.1 LEDs



- **Laser:** When LED is solid, this indicates the OTDR laser or light source is on and active.
- **Power status**:

When Power status LED is…	
Solid	• Indicates OTDR is initialized and connected to software (Fiberizer Mobile via Bluetooth or Fiberizer via USB). • Indicates USB cable from PC is connected to OTDR.
Blinking slowly	• Indicates the slow battery charge mode (4+ hours) when connected to an AC power supply. • Indicates OTDR is powered ON, but nothing is connected to it yet. • Indicates no USB cable from PC is connected to OTDR.
Blinking quickly	• Indicates the quick battery charge mode (2-3 hours) when connected to an AC power supply. • Indicates device is in LS mode. Double-click the power button to change laser modes.

- **Bluetooth/WiFi status:**

When Bluetooth or WiFi status LED is…	
Blinking	• Indicates Bluetooth or WiFi embedded in the OTDR is searching for compatible devices.
Solid	• Indicates the OTDR is connected to a compatible device.

***Note**: When no connection is detected within a certain number of minutes, the OPX-BOX powers down to preserve battery power.*

Use the information below to connect to the OTDR:

Bluetooth password: *1234*

WiFi password: *12345678*

- **Battery status:**

Battery capacity is indicated via the LED on the rear panel. It is also indicated in the Fiberizer Mobile app when operating the OTDR.

The OPX-BOX+ battery status is indicated by three single color LEDs.

- Green: Indicates >80% battery charge.
- Yellow: Indicates <60% battery charge.
- Red: Indicates <30% battery charge.

***Note**: If you own an older OTDR unit, it may display three Battery status LEDs (one LED indicates <33% battery charge, two LEDs indicates <67% battery charge, and three LEDs indicates 100% battery charge.)*

When Battery status LED is…	
Flashing slowly	• Indicates slow charge mode. OTDR detects LOW current/power USB source (e.g. a PC USB port with 500mA).
Flashing quickly	• Indicates fast charge mode. OTDR detects a connection to a good power source (max current 1.5A or higher).

3.2 Battery

Under normal conditions, the Li-Ion battery can operate continuously for up to 10 hours.

3.2.1 Charging the Battery

To charge the device, connect the AC/DC adaptor supplied with the unit. The battery is charged irrespective of whether the unit is switched on or off. The battery charging time is approximately 4 hours, but it depends on the battery condition and ambient temperature.

Charge the battery once every 3 months, if the unit is left unused for an extended period. Only use the charger provided with the unit to charge the battery.

3.2.2 Battery Safety

The Li-Polymer battery is designed for maximum safety. However, the battery may explode, leak or catch fire when:

- It is exposed to high temperature or fire;
- It is opened or dismantled.

To operate the battery reliably and safely, use the main adaptor supplied with the unit.

3.2.3 Battery Replacement

- OPX-BOX: Battery replacement in the field is not authorized or permitted. The unit must be returned to an authorized VeEX service center or partner for repair.
- OPX-BOX+/OPX-BOXe: Battery replacement in the field is allowed. The unit is fitted with a battery cover that can be removed easily by loosening one screw, allowing access to the Li-Ion Polymer battery. Only approved VeEX batteries should be used.

OPX-BOX+ Battery Location

4.0 Theory of Operation

4.1 OTDR

The principle of OTDR operation is based on measuring the Rayleigh back scattering signal when a single powerful optical pulse passes through an optical fiber. The weak back scattering signal is registered by an optical receiver, converted into digital form, and averaged many times.

The OTDR calculate distance with next formula:

```
Distance = c * t / (2 * n)

where
c – light speed in vacuum
n – optical fiber index of refraction
t – time delay between transmitted pulse and the reception by the receiver
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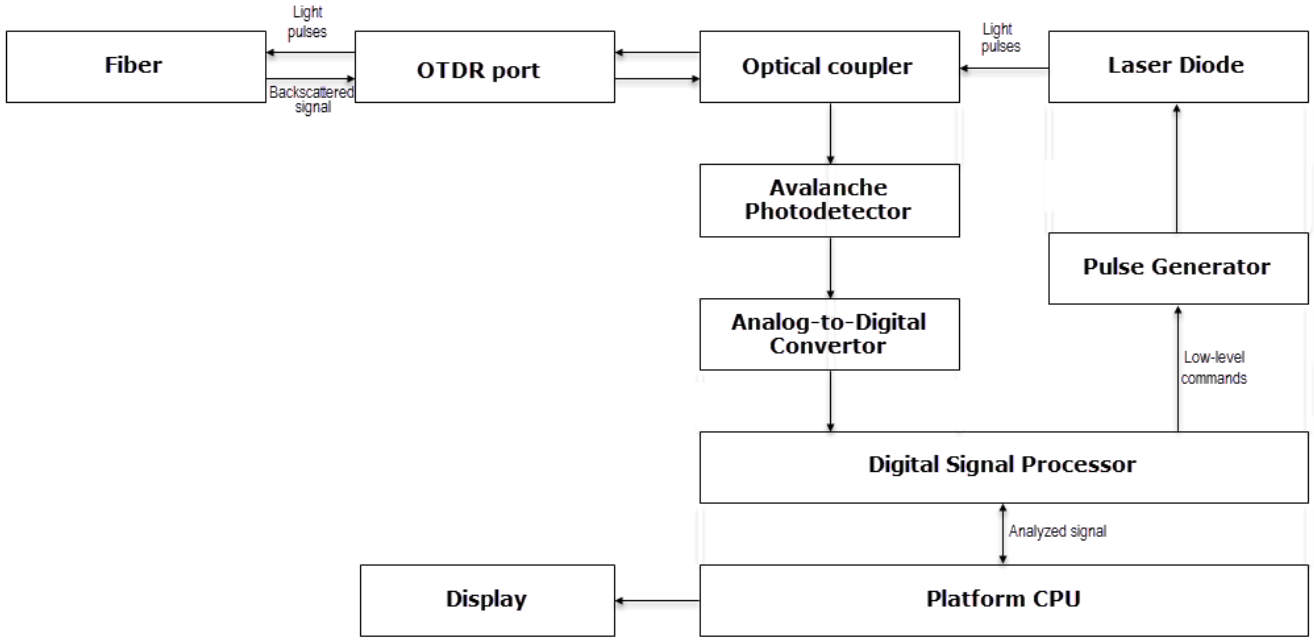
Each measurement sample processed and converted by the ADC into digital form is registered in memory (RAM). In order to measure the backscatter signal more precisely, optical pulses are repeated and measured again. The processor averages all measurement samples to improve the signal-to-noise (SNR) ratio. After several cycles, the measured values are transferred from memory and displayed.

OTDR – Principle of Operation

OTDR Operation



4.2 Light Source

The optional light source shares the same test port as the OTDR when it uses the same laser diode/s and optical splitter as the OTDR. The light source generates constant wave (CW) output. The output of the light source is same as the OTDR port.

The VFL output is stabilized using a photodiode and stabilization circuit. It has two operation modes: Continuous and Modulated (2 Hz modulation). The output power in modulation mode is 3dB lower than when compared to continuous (CW) mode.

For more information on how to switch on the OTDR and activate the OLS and VFL, see section ***5.2 Switch on the OPX-BOX***.

5.0 Working with the OPX-BOX

Attention!

The OPX-BOX conforms to IEC 61010-1, equipment class III standards. The AC/DC adaptor corresponds to IEC 61010-1 norms, equipment class II.

The OTDR laser corresponds to class 1M of IEC 60825-1, while the visual fault locator corresponds to class 2 of IEC 60825-1.

While operating the unit, avoid direct exposure of optical radiation to the eyes. Do not plug or unplug the device while measuring (when the LASER LED is on).

5.1 Get Started

- Quick-charge the battery by connecting the power supply to the micro-USB port. The 'CHARGE' LED blinks while charging and turns a continuous green when the battery is fully charged. The battery also charges when connected to a PC (slow charge mode).
- Make sure you use the optical connector corresponding to the OTDR test port. To ensure optimal performance, always inspect and clean the optical connector and test jumper before connecting to the fiber under test.

5.2 Switch on the OPX-BOX

To switch on the OPX-BOX:

- Press and hold the ⏻ (**Power**) button for several seconds. When the unit is turned on, the POWER LED lights illuminates and a beep sound is audible.

  Note: *The unit is turned on automatically when connected to a PC via a USB cable.*

To switch off the OPX-BOX:

- Press and hold the ⏻ (**Power**) button for several seconds. When the unit is off, the POWER LED no longer illuminates.

5.2.1 Activating the VFL and OLS

To activate the Visual Fault Locator (VFL):

- After the unit is turned on, press the ⏻ (**Power**) button. Subsequent presses switch the VFL to the 2Hz modulation mode or de-activate it.

To activate the Optical Light Source (OLS) in the CW mode:

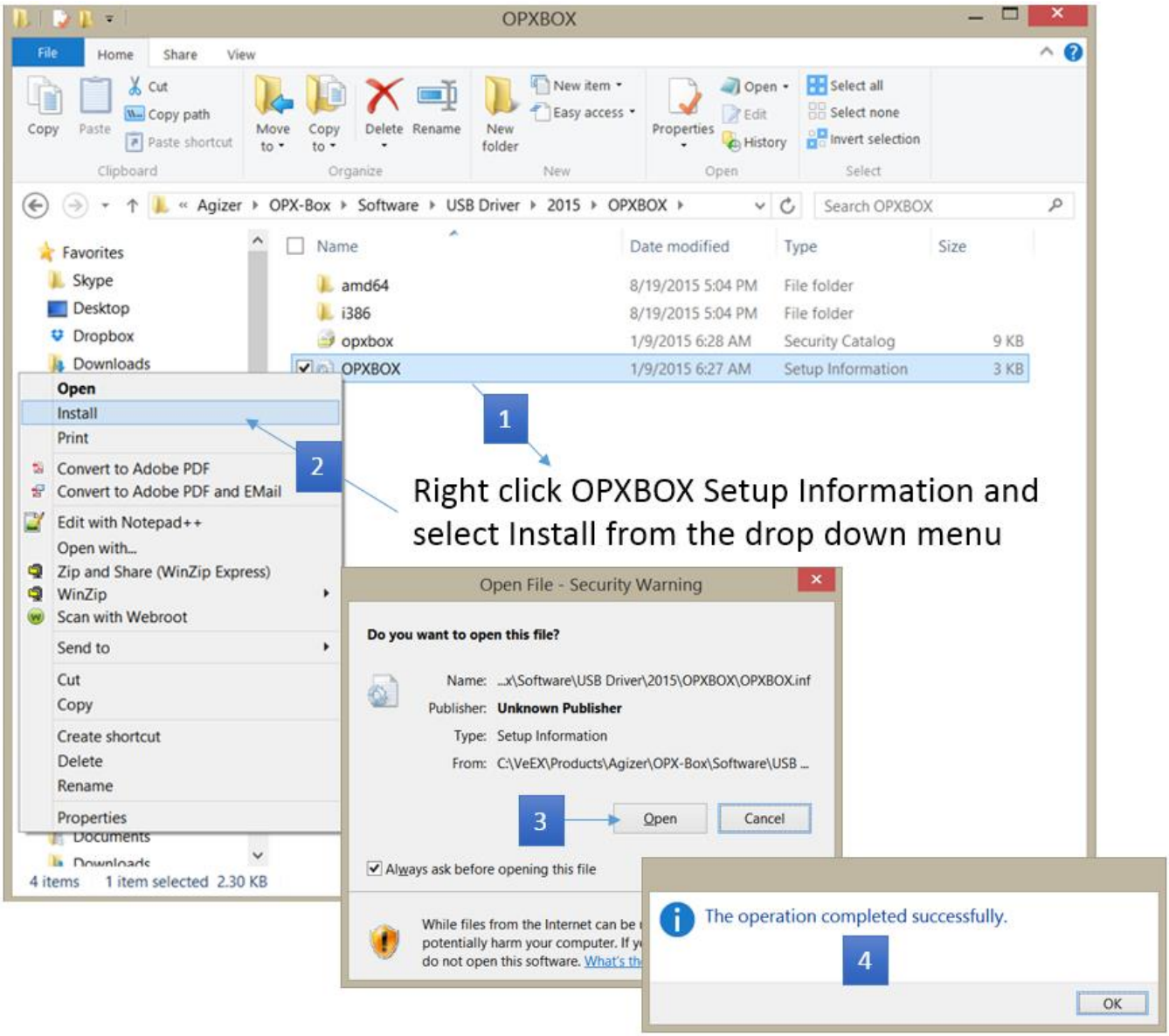
- After the unit is turned on, double-click the ⏻ (**Power**) button. The LED starts blinking quickly (unlike OTDR mode).

  When in OLS mode, the first laser is activated automatically. To toggle to the next wavelength, single-click the ⏻ (**Power**) button. To escape OLS mode, double-click the ⏻ (**Power**) button again.

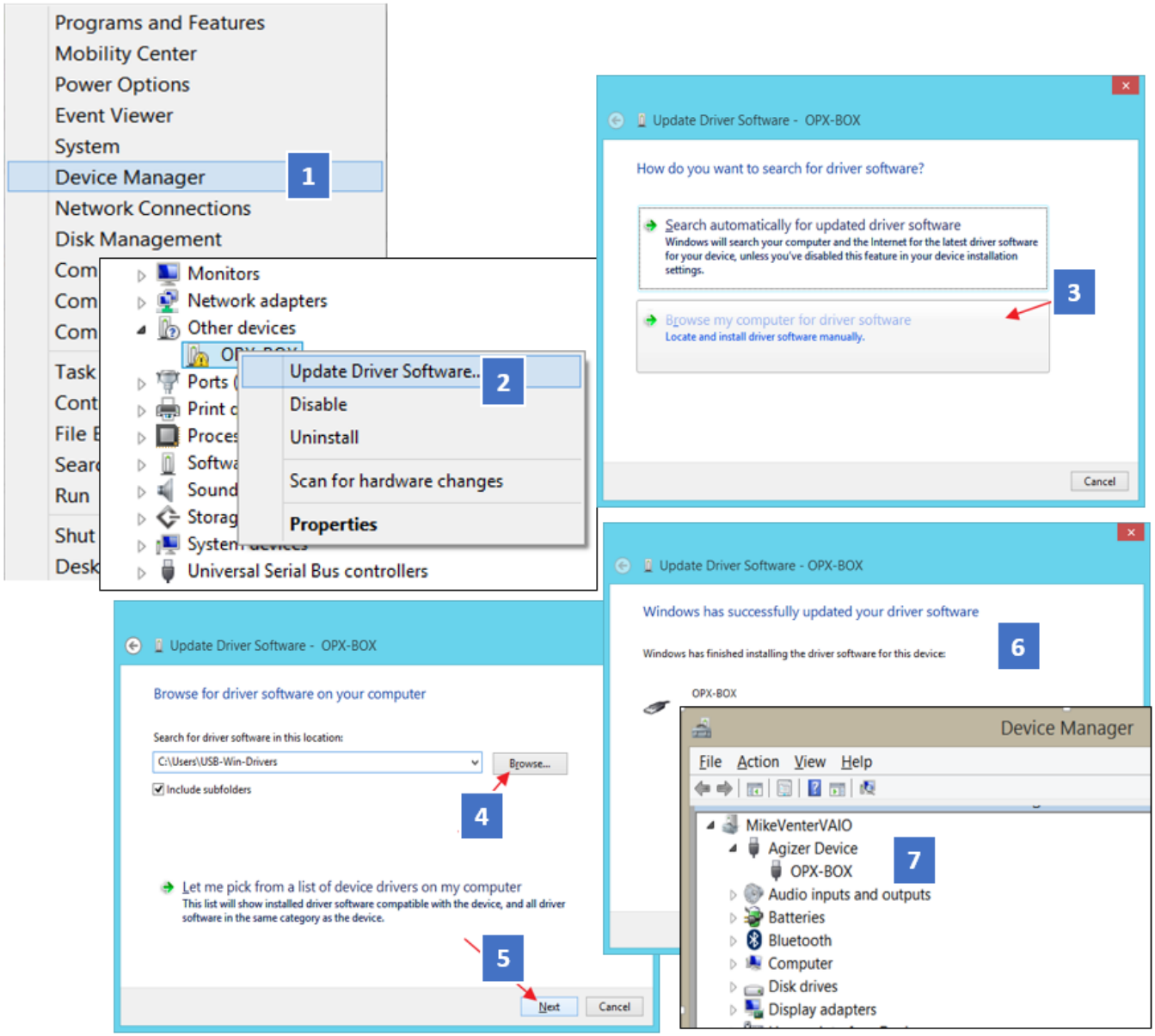
5.3 Install the OPX-BOX USB driver

Connect your device to a Windows PC using the micro USB-B to USB-A cable provided. The PC requires the OPX-BOX driver be installed initially, which is available on the CD shipped with the unit.

5.3.1 Method # 1 – Installing USB driver from file directory



5.3.2 Method # 2 – Installing USB driver using Windows Device Manager

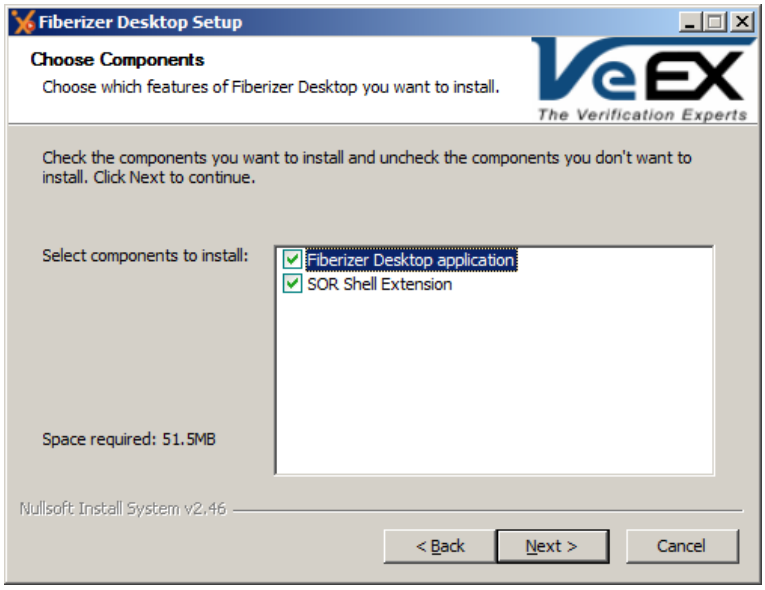


5.4 Install Fiberizer Desktop software (USB or Bluetooth operation)

To control and operate your device using a Windows PC, you must use Fiberizer Desktop software, which can be downloaded from http://fiberizer.com/ or www.veexinc.com.

Start Fiberizer Setup and follow the on-screen setup instructions.

Fiberizer Desktop Setup screen



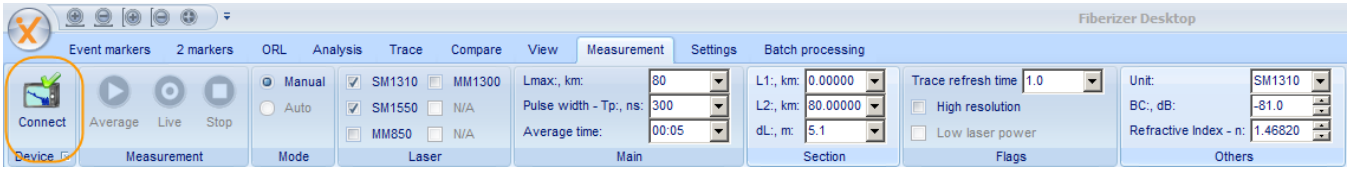
5.5 Initialize the OPX-BOX

After installing Fiberizer Desktop, you must perform an initialization of the OPX-BOX.

To initialize the OPX-BOX:

1. Launch Fiberizer Desktop by double-clicking the shortcut on your desktop or by using the **Start** menu.
2. Select the **Measurement** tab to operate the unit and to set/view OTDR test parameters.

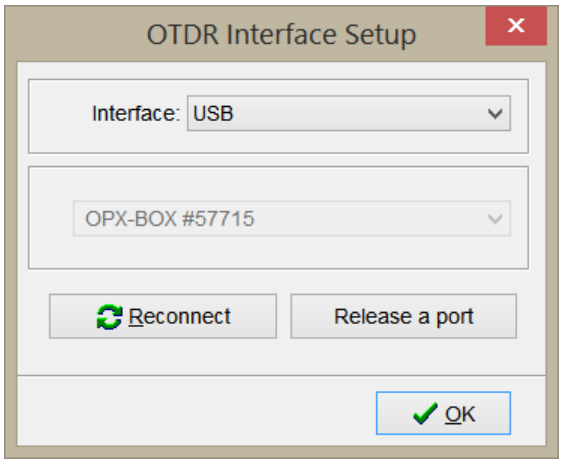
Fiberizer Desktop: Connect button



3. Select the **Device** arrow at the bottom of the **Connect** button to detect and connect to the device.
4. On the **OTDR Interface Setup** window, select **USB**, **Bluetooth,** or **WiFi** from the **Interface** drop-down list box, and click **Reconnect**. The software checks connectivity with the device, and displays the connection status.

The software also detects the OTDR configuration and performance criteria.

OTDR Interface Setup window

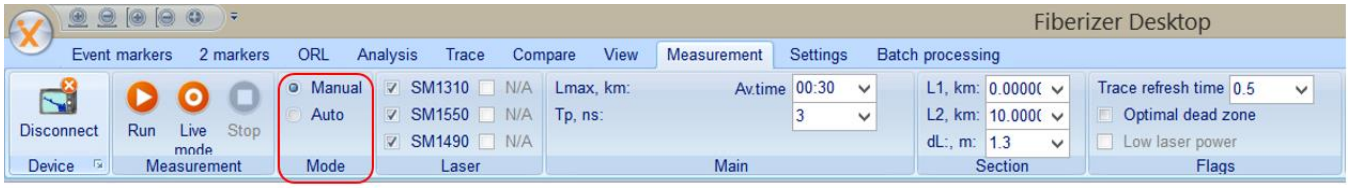


5.5.1 Setting measurement parameters

When you are connected to the device, both **Run** and **Live** mode buttons appear. Prior to measurement, you still need to enter the test parameters.

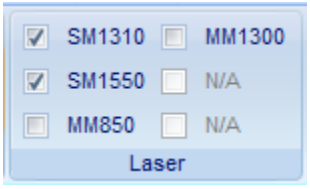
Click the **Measurement** tab and select the measurement mode desired.

Fiberizer Desktop: Measurement modes



Manual: User determines test parameters such as distance range, length, pulse width and averaging (measurement) time.

Fiberizer Desktop: Test wavelengths



Auto: *Option not available at this time.*

***Note**: User must select at least one test wavelength.*

If two or more wavelengths are selected, measurements are performed in succession. After all measurements are completed, they are displayed together on the same screen.

The test parameters are defined as follows:

- **Distance range (Lmax)** – Set by User: 5, 10, 20, 40, 80, 120, 160, 240 km. The range value should be at least 50% longer than the estimated length of the fiber under test because it determines the pulse repetition rate (the period should be at least twice the time the pulse travels along the fiber).
- **L1** - distance from the beginning of the fiber to the beginning of the section to be measured, can be between 0 and Lmax, selected from the drop-down menu or entered manually.
- **L2** - distance from the beginning of the fiber to the end of the section to be measured, can be between L1 and Lmax, selected from the drop-down menu or entered manually.

  Note: The distance between L1 and L2 must exceed 100 m.
- **dL** – Resolution or distance between OTDR sampling points. Depends on Lmax setting and is limited automatically by the software.
- **Tp** – Pulsewidth settable in the range 3, 10, 25, 100, 300, 500, 1000, 3000, 10000, 20000 ns. The pulse width range depends on the Lmax value and is limited automatically by the software. Pulse width affects the measurement distance since the power in the pulse creates more or less backscatter, which also impacts resolution between events.
- **Optimal dead zone** – when selected, the receiver bandwidth is increased to improve Dead Zone to help identify closely spaced events. However, the noise level in this mode is also increased.
- **Measurement with averaging**
  - **Average time (min:ss) –** test duration of measurement with averages. The unit will take multiple samples of the trace and average the results. If you need to measure longer distances with high resolution, using more averages with a short test pulse is recommended. However, more averages take more time.
- **Live mode**
  - **Trace refresh time** – defines how often the measurement is updated in Live mode (can be 0.2; 0.5; 1.0; 2.0 s).

5.5.2 Setting Fiber parameters

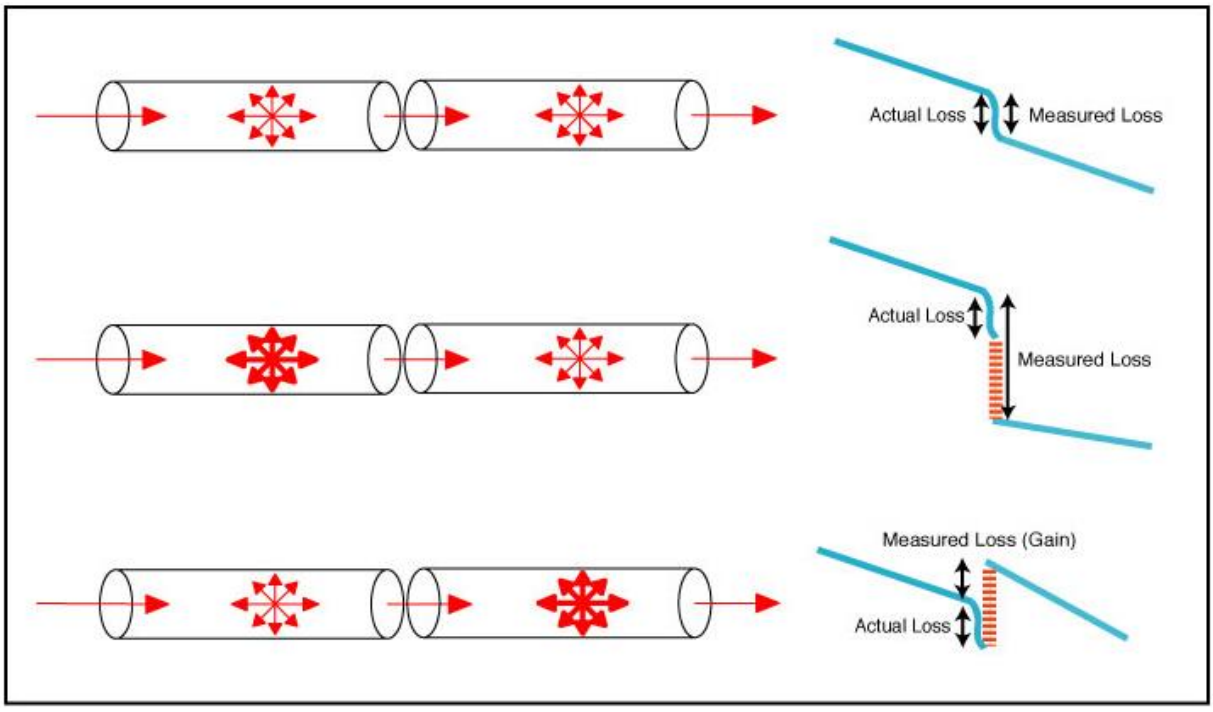
- **Backscattering coefficient -** adjustable with 0.1 dB resolution.

In simple terms, backscatter is the amount of light from the outgoing test pulse that is scattered back toward the OTDR. Typical backscatter coefficients are:

- - 80 dB for singlemode 1310 nm wavelength
- - 81 dB for singlemode, 1490 nm wavelength
- - 81 dB for singlemode, 1550 nm wavelength
- - 81 dB for singlemode 1625 nm wavelength
- - 75 dB for multi-mode 1300 nm wavelength
- - 72 dB multi-mode 850 nm wavelength

Note: The backscatter level is a function of the attenuation and the diameter of the core or mode field diameter (MFD). If different fibers are spliced together, the backscatter coefficients may cause a different amount of light to be reflected back to the OTDR resulting in loss errors. For example, when both fibers are identical (such as re-splicing a broken fiber), the backscattering will be the same on both sides of the joint and the OTDR will measure the actual splice loss. However, when fibers are different, the backscatter coefficients will cause a different amount of light to be sent back to the OTDR.

OTDR Backscatter: Actual Loss vs Measured Loss



If the fiber before the connection has more attenuation than the fiber after, the amount of light from the OTDR test pulse decreases, so the measured loss includes the actual loss plus a loss error caused by the lower backscatter level, making the displayed loss greater than it actually is.

In contrast, going from a low attenuation fiber to a high attenuation fiber, the backscatter increases, resulting in a measured loss lower than it actually is. If the change in backscatter is greater than the splice loss, it shows as a “gainer” which may be confusing to new OTDR users.

Tip: You can overcome the variations in backscatter by measuring the fiber in both directions with the OTDR and averaging the losses using Fiberizer software.

- **Refractive index (n)** – adjustable from 1.30000 to 1.70000 in 0.00001 increments.

  ***Note**: In simple terms, the Index of Refraction (IoR) or refractive index is the speed of light in the fiber, which the OTDR uses to calculate distance. It is a dimensionless number that describes how light propagates through the medium compared to a vacuum. It is defined as:*

$$n = \frac{c}{v},$$

  Where c is the speed of light in vacuum and v is the phase velocity of light in the medium. For example, the refractive index of water is 1.333, meaning that light travels 1.333 times faster in a vacuum than it does in water.

5.5.3 Fiber Cleaning (Before Making Measurements)

Many measurement variations and test repeatability conditions in fibers can be traced back to the cleanliness of optical connections. Contamination of fiber end faces not only affects optical power levels, but also impacts back reflectance performance and levels which is harmful to sensitive optical components.

Optical connectors are susceptible to contamination from airborne particles and human body oils when exposed. Leftover liquid residue from improper cleaning can also leave the fiber end face contaminated.

Whenever possible, inspect the fiber-optic connection (connectors, bulkheads, and test interfaces) with a fiber microscope. It is recommended to wear laser safety glasses when you work with fiber-optic connections, and always check that you disconnect the laser or transmitter before you begin cleaning the connector end faces.

To ensure proper and effective cleaning of optical fiber connectors and interfaces, equip yourself with the following cleaning materials:

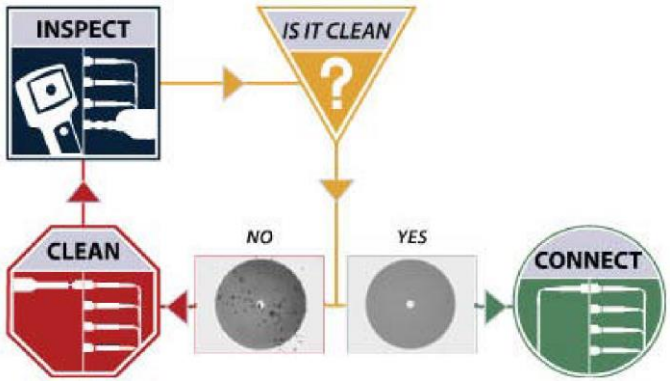
- Lint free soft tissues
- Ferrule cleaners (1.25mm and 2.5mm versions)
- Dry clean ‘Click’ sticks
- Connector reel cleaners (Cletop or similar)
- Optical grade cleaning fluid
- Optical grade foam swab

Best Practices

When handling optical fiber, adopt best practices to ensure optimum test results.

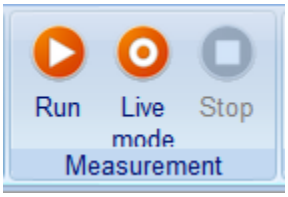
- Never touch the end face of an optical fiber connector with your fingers.
- Always install protective caps on unplugged fiber connectors.
- Store unused protective caps in a re-sealable plastic bag to prevent dust accumulating on the caps.
- Never reuse optic cleaning swabs or lint free wipes. Always discard materials that have been used.
- Ensure all alcohol or solvent residues are removed after using wet cleaning techniques.
- It is recommended to re-inspect the bulkhead receptacles and connector end face using a fiber microscope following the cleaning and prior to use.

Fiber Cleaning Work Flow



5.5.4 Making Measurements

Fiberizer Desktop: Start/Stop Measurements



- To start measurement with averaging, click the **Run** button.
- To start measurement in live mode, click the **Live mode** button.
- To stop measurement in progress, click the **Stop** button.

5.6 Fiberizer Desktop/Fiberizer Mobile Operation

For more information on using Fiberizer Desktop/Fiberizer Desktop+, see the *Fiberizer Desktop User Manual* on www.veexinc.com.

For more information on using Fiberizer Mobile (Android/iOS), see the *Fiberizer Mobile User Manual* on www.veexinc.com.

6.0 Maintenance and Calibration

6.1 Overview

VeEX Inc. certifies that the equipment was checked and tested prior to shipment using calibrated measuring instruments and was found to meet the published specifications.

To ensure accurate results and smooth operation, follow these guidelines to prolong the life of your OTDR:

- Clean the optical fiber connectors each time before use;
- Clean the chassis and keypad panel using cotton cloths moistened slightly with warm water and mild solvent. Never use any product containing acetone, trichloro-ethylene, benzine or alcohol;
- Store the equipment in a clean and dry place away from excess humidity, extreme temperatures, and direct sunlight.

6.2 Maintenance Procedure

The technical complexity of the OPX-BOX dictates the unit be returned to the factory for repair. Work on this device should only be performed by qualified personnel using suitable equipment. In most cases, you should contact the nearest VeEX service facility who will troubleshoot and perform repair work as necessary.

By doing so, the high performance and quality of the unit will be preserved and it will continue to operate within specifications after repairs are completed. This procedure also has the advantage of reducing repair costs and downtime.

Repairs and/or calibration are completed typically in 5 to 15 working days. The factory pays shipping costs only when returning equipment to a customer following warranty repair. It is the responsibility of the customer to notify the factory technical support persons prior to shipping products for servicing, since many times problems may be solved over the telephone, saving the user more precious time and shipping costs.

In the unlikely event of failure, it is essential to indicate the following information when returning the unit:

- Model and Serial number of the unit
- A description of the fault found on the unit.

6.3 OTDR Recalibration

ISO/IEC 17025 is the main standard used by testing and calibration laboratories. The Standard states that calibration documents should not contain a recommended calibration interval, unless this has been previously agreed upon with the customer/s. To this extent, validity of specifications depends on operating conditions and the calibration period can vary depending on customer usage patterns, environmental conditions and ongoing maintenance. It is the responsibility of the user or company's quality department to determine the calibration cycle of the OTDR based on accuracy requirements. Under normal circumstances and regular usage, VeEX Inc. recommends calibrating the unit annually.

7.0 Warranty and Software

Warranty Period: The warranty period for hardware, software and firmware is one (1) year from the date of shipment to the customer. The warranty period for battery pack, LCD, LCD touch panel, LCD protective cover, and accessories (including, but not limited to patch cords, AC adaptor, SFP, USB adaptors, carrying case, carrying pouch) is limited to one (1) year.

Hardware Coverage: VeEX Inc. warrants hardware products against defects in materials and workmanship. During the warranty period, VeEX Inc. will, at its sole discretion, either

- Repair the products
- Replace hardware which prove to be defective

provided that the products that the customer elects to replace are returned to VeEX Inc. by the customer, along with Proof of Purchase, within thirty (30) days of the request by the customer, freight prepaid.

Software Coverage: VeEX Inc. warrants software and firmware materials against defects in materials and workmanship. During the warranty period, VeEX Inc. will, at its sole discretion, either

- Repair the products
- Replace software and/or firmware which prove to be defective

provided that the products that the customer elects to replace are returned to VeEX Inc. by the customer, along with proof of purchase, within thirty (30) days of the request by the customer, freight prepaid.

Additionally, during the warranty period, VeEX Inc. will provide, without charge to the customer, all fixes, patches and enhancements to the purchased software, firmware and software options. VeEX Inc. does not warrant that all software or firmware defects will be corrected. New enhancements attached to a software option require the option to be purchased (at the time of order or the time of upgrade) in order to benefit from such enhancements.

Limitations: The warranty is only for the benefit of the customer and not for the benefit of any subsequent purchaser or licensee of any merchandise (hardware, software, firmware and/or accessories).

Revoking the warranty: VeEX Inc. does not guarantee or warrant that the operation of the hardware, software or firmware will be uninterrupted or error-free. The warranty will not apply in any of the following cases:

- Improper or inadequate maintenance by the customer

- Damage due to software installed by the customer on the unit without prior authorization (written) from VeEX Inc.
- Unauthorized alteration or misuse
- Damage occurred from operating the unit outside of the environmental specifications for the product
- Improper installation by the customer

8.0 Product Specifications

The most recent product specifications can be found on the VeEX web site at www.veexinc.com.

9.0 Certifications and Declarations

Declaration of Conformity

What is CE?

The CE marking is a mandatory European marking for certain product groups to indicate conformity with the essential health and safety requirements set out in European Directives. To permit the use of a CE mark on a product, proof that the item meets the relevant requirements must be documented.

Use of this logo implies that the unit conforms to requirements of European Union and European Free Trade Association (EFTA). EN61010-1

For a copy of the CE Declaration of Conformity relating to VeEX products, please contact VeEX customer service.

ROHS Statement

What is RoHS?

RoHS is the acronym for Restriction of Hazardous Substances. Also known as Directive 2002/95/EC, it originated in the European Union and restricts the use of specific hazardous materials found in electrical and electronic products. All applicable products imported into the EU market after July 1, 2006 must pass RoHS compliance.

For more information about RoHS as it relates to VeEX Inc, go to the VeEX web site at www.veexinc.com.

10.0 About VeEX

VeEX Inc., the Verification EXperts, is an innovative designer and manufacturer of test and measurement solutions addressing numerous technologies. Global presence through a worldwide distribution channel provides uncompromised product support.

Visit us online at www.veexinc.com for the latest updates and additional documentation.

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