VIAVI Solutions

Fiber Optic Troubleshooting and Maintenance

Mike Dee
Senior Field Engineer
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Typical Avionics Fiber Testing Application

Typical Fiber Testing Requirement

Characterization and location of fiber optics components (mainly connectors)

Fault location: dirty, loose or bad connectors, bends and breaks

Fiber end-face inspection in **HARD TO REACH** locations

Typical Optical Components characteristics:

Multimode “harsh environment” fiber cable assemblies and harnesses (50, 62.5µm, or larger core)

Singlemode (9µm)

Length: 25 cm to 100 m

Highly reflective connectors ≤ - 20 dB

Test Equipment Requirement

- Multimode OTDR
  - High Resolution (short dead zones & high dynamic range at short pulsewidths)
  - Reliable OTDR trace analysis (immune to high reflectance)
  - Easy/Auto modes for measurement setting and result analysis
  - Lightweight and compact
- Inspection & Cleaning Tools
  - Fiber End Face Microscopes
  - MIL tips for avionic/tactical termini
  - Inspection Assistant Guides for avionic connectors
  - Cleaners (sticks, wipes, solvent…)
  - Skipping Education/Training on Inspection/Cleaning today. Focus is on the inspection application and test requirement

Common Avionic Tools – OTDR and Inspection

Installation/Maintenance

Hi-Res OTDR

OneAdvisor 800 Fiber

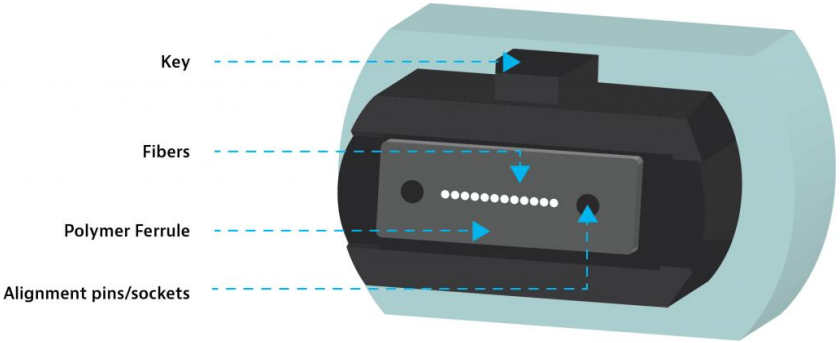
Inspection probe
with MIL/avionic tips

P5000i Fiber Inspection Microscope with HD4i Display

Inspection Devices Must be Able to Inspect Avionic and Tactical Fiber Optic Connectors

Specific Aircraft Tips and Guides

Commercial MTP/MPO



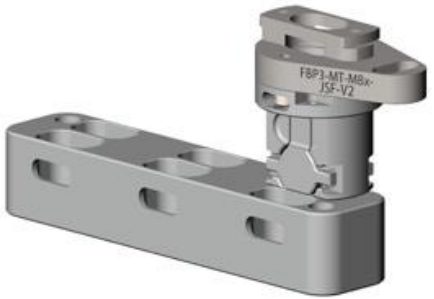
FBP3-MT-MB-JSF-V2-T	JSF		JSF MT Motherboard Tip for FBP3 (Tip Only)	FBPT-P3-xxx
FBPT-P3-1100	Barrel Assemblies		Long Barrel Extension with 1-row RibbonDrive™ 11 Inch*	
FBPT-P3-750	Barrel Assemblies		Long Barrel Extension with 1-row RibbonDrive™ 7.5 Inch*	

* For visual image assessments (automated image analysis not supported)

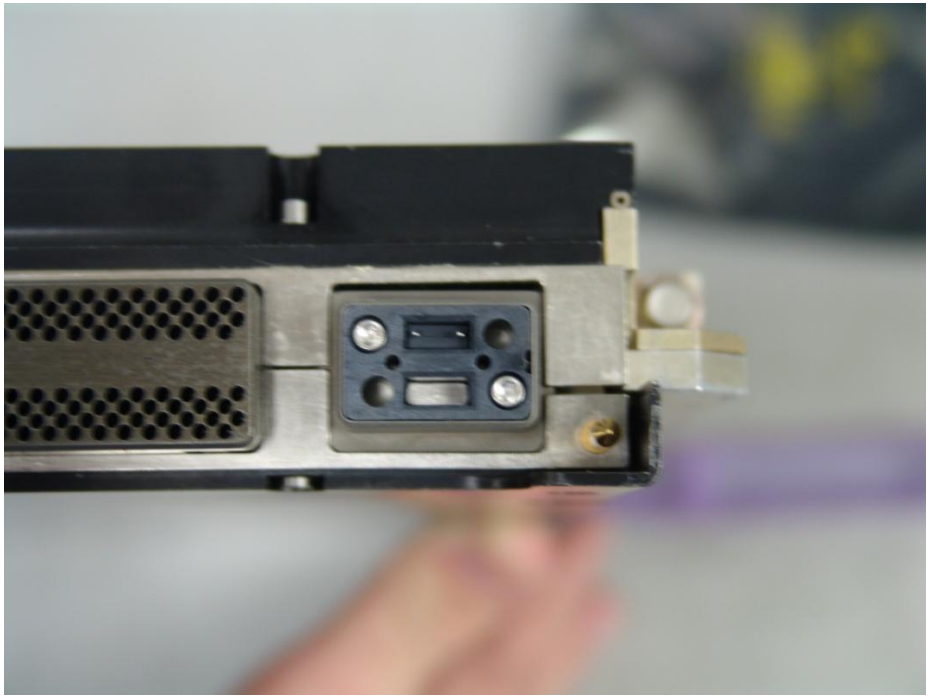
FBPT-MT-MB-JSF-V2-T	JSF		Tip 1-Axis Pan for JSF MT Motherboard	None
FBPT-MT-MB-JSF-V3-T	JSF		Tip 2-Axis Pan for JSF MT Motherboard	None
FBPT-MT-MB2-JSF-V2-G	JSF		Guide for 2-Position JSF MT Motherboard	FBPT-MT-MB-JSF-V2-T, FBPT-MT-MB-JSF-V3-T
FBPT-MT-MB6-JSF-V2-G	JSF		Guide for 6-Position JSF MT Motherboard	FBPT-MT-MB-JSF-V2-T, FBPT-MT-MB-JSF-V3-T

Specific Aircraft Tips and Guides

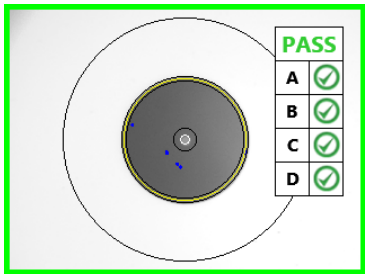
FBP3-MT-MB2-JSF-V2	JSF		JSF MT Motherboard 2-Position Tip and Guide Kit for FBP3 (FBP3-MT-MB-JSF-V2-T and FBPT-MT-MB2-JSF-V2-G)	FBPT-P3-xxx
FBP3-MT-MB6-JSF-V2	JSF		JSF MT Motherboard 6-Position Tip and Guide Kit for FBP3 (FBP3-MT-MB-JSF-V2-T and FBPT-MT-MB6-JSF-V2-G)	FBPT-P3-xxx
FBPT-MT-MB2-JSF-V2	JSF		Tip and Guide Kit for 2-Position JSF MT Motherboard (FBPT-MT-MB-JSF-V2-T and FBPT-MT-MB2-JSF-V2-G)	None
FBPT-MT-MB6-JSF-V2	JSF		Tip and Guide Kit for 6-Position JSF MT Motherboard (FBPT-MT-MB-JSF-V2-T and FBPT-MT-MB6-JSF-V2-G)	None



Example of 2-position MT Guide Inserted into Shell



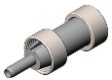
P5000i Fiber Inspection Microscope and HD4i Display TAA Compliant

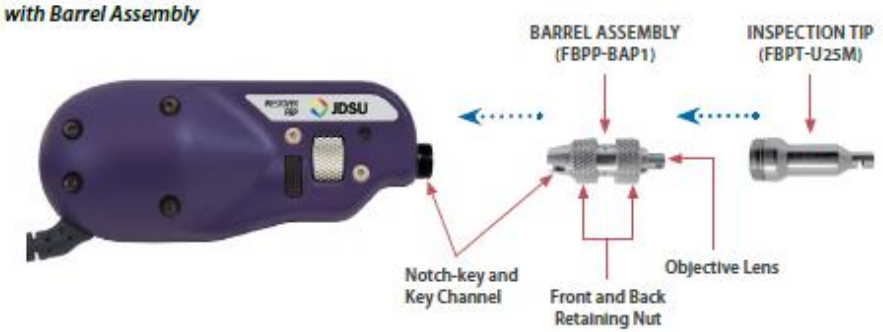


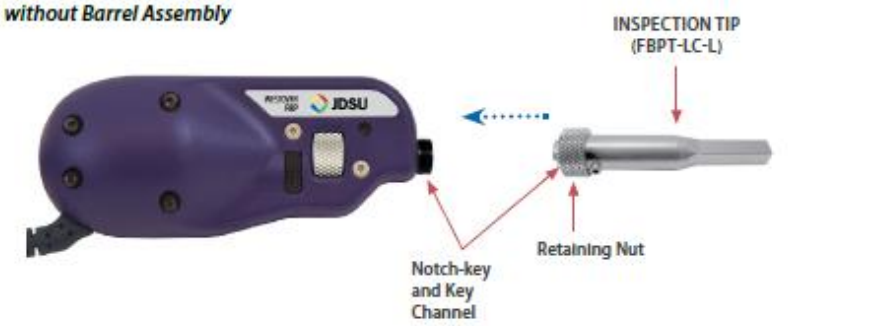
P5000i Controls

Removable Lens/Barrel Assembly

- Allows for lens/barrel to be replaced in the field instead of a Depot/Service Center Repair – no need to return microscope
- Allows for “specialty” tips to be used for avionic/tactical inspection
- The P5000i is so common in avionic applications that other companies make tips and guides for it
- Allows all connectors to be inspected
- The BAP3 and other MIL BAPs can inspect over 70+ different avionic connectors







Application Requirements

- Pass/Fail end face inspection images according to commercial industry standards AND include JSF and Navy inspection profiles. Internet/WF/BT/USB can’t be used to add profiles
- No WiFi/BT on fiber inspection microscope
- No use with phone/tablet/laptop/PC
- No built-in display. Scope can be used where the display is NOT visible so an external display is required
- Access in small places required
- Must be able to inspect nearly all and any avionic connectors with either generic or custom tips and guides
- “Extender” option needed if a person can’t reach or get access to the connector
- Removable lens is extremely useful so a broken lens is a field swap with no need to ship the scope for service
- Commonly needs to be “kitted” for protecting tools, easy storage, and inventory control
- Add your own or edit the above list

High Resolution OTDR

Fiber Optics Usage in Avionics and Aerospace Applications

Military Aircraft/ Unmanned Aerial Vehicles(UAV)

- Use with sensors, radar signals
- Weapon control and electronic warfare systems
- Flight navigation and guidance system control
- External and night vision cameras

Commercial Aircrafts:

- Transmission of sensors, radars signals
- Flight navigation and guidance system control
- IFE (In-Flight Entertainment system) and internet access

Why There is a Need for New Hi-Res OTDR

- Fiber Optic test equipment developed for the telecommunications field is inadequate
  - Resolution is not tight enough
- Fiber Optic test equipment currently available for avionic/aerospace industry is
  - Too expensive ($50,000 to $100,000+/unit) – such as an OBR
  - Not suitable for harsh/confined environment
  - Too complex (user interface)
  - Too big/heavy

VIAVI has developed the industry's most compact, lightweight and portable high resolution multimode OTDR solution

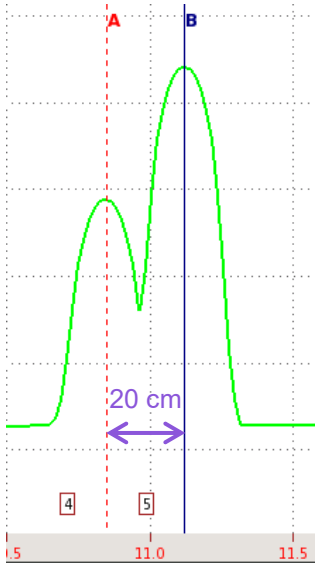
OTDR Critical Parameters: Resolution (called Dead Zones)

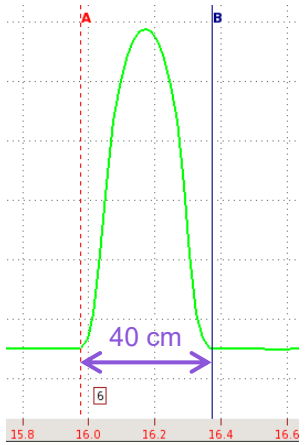
Event Dead Zone (EDZ)

- Minimum distance where two consecutive reflective events, such as connectors, can still be distinguished
- In this case, the loss of each event cannot be measured (see ADZ). The OTDR reports the cumulative loss on the last event

Attenuation Dead Zone (ADZ)

- Minimum distance after a reflective event where a non-reflective event, a splice for example, can be measured
- Minimum distance to be able to measure insertion loss after a reflective event





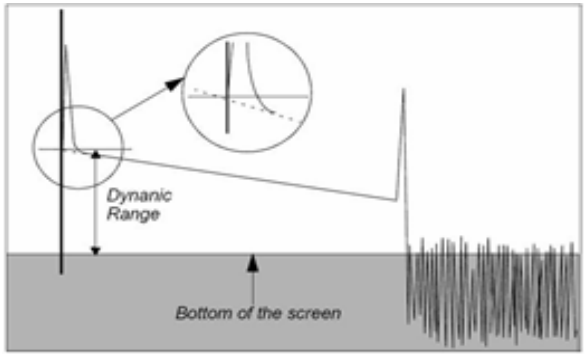
OTDR Critical Parameters: Dynamic Range

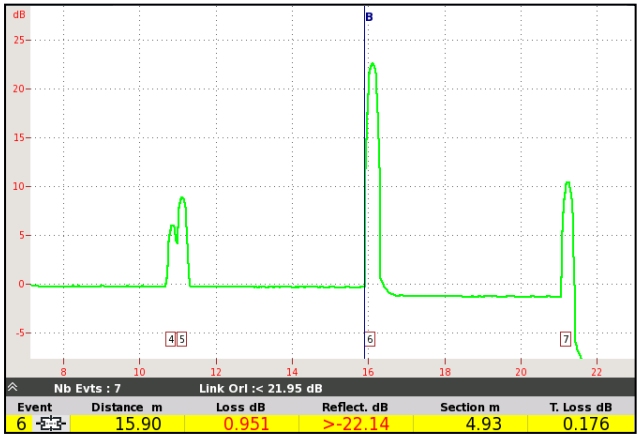
Total Budget Loss

- Difference between backscatter signal and noise floor
- Dynamic range is specified at shortest pulse-width for short fiber links (>10 dB IEC)

Maximum reflectance above noise floor

- Reflectance = ratio of reflected power to incident power at a discrete location
- MM connector reflectance is usually high, it shouldn't be a limited performance factor





VIAVI High Res. OTDR is not sensitive to high reflectance

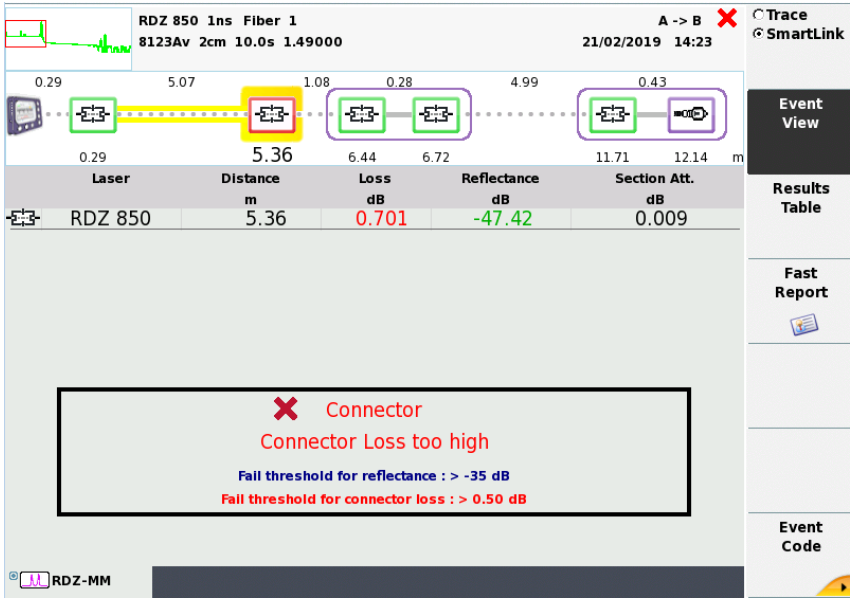
VIAVI High Resolution MM OTDR Solution… What is It?

- Industry's most compact, lightweight and portable high resolution multimode OTDR module
- Specific user interface designed to simplify OTDR testing, results interpretation
- One data set, 3x results views, to match user profile and preference without application switching
  - SmartLink Mapper
  - Trace
  - Table

Wavelengths	EDZ (m)	ADZ (m)	Dyn. Range (dB RMS) at 1ns
850 / 1300nm	MM: 0.2 / 0.2	MM: 0.4 / 1	16

SmartLink Mapper View

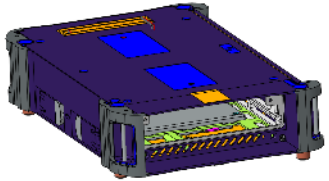
- Get detailed information of the highlighted optical event and section
- Analyze the cause of the failure (excessive loss and/or reflectance due to a loose and/or dirty connection)
- No analysis of an OTDR/OBR trace required



Supported on OneAdvisor 800 Fiber Platform

- Battery-operated, field-portable instrument
- Familiar touch gesture control user interface with assistant apps to guide techs through instrument usage
- Streamlined and error-free setup
- Automated pass/fail connector inspection software
- FastReport on-board PDF generation
- All-in-one fiber test tool: OTDR, a visual fault locator (red light), an optical powermeter and compatible with fiber end-face inspection microscope

Fiber Module Carrier



Fiber Module Carrier
p/n E81FMC2

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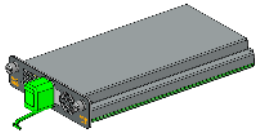

8100-Series Module

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OneAdvisor 800 mainframe
p/n ONA-800A-F

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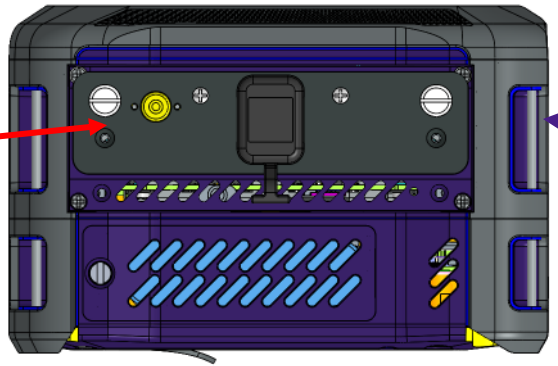
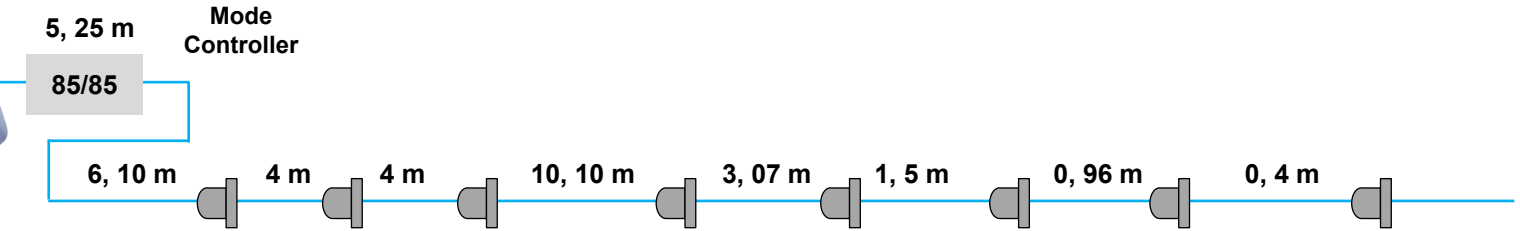
HR MM OTDR module



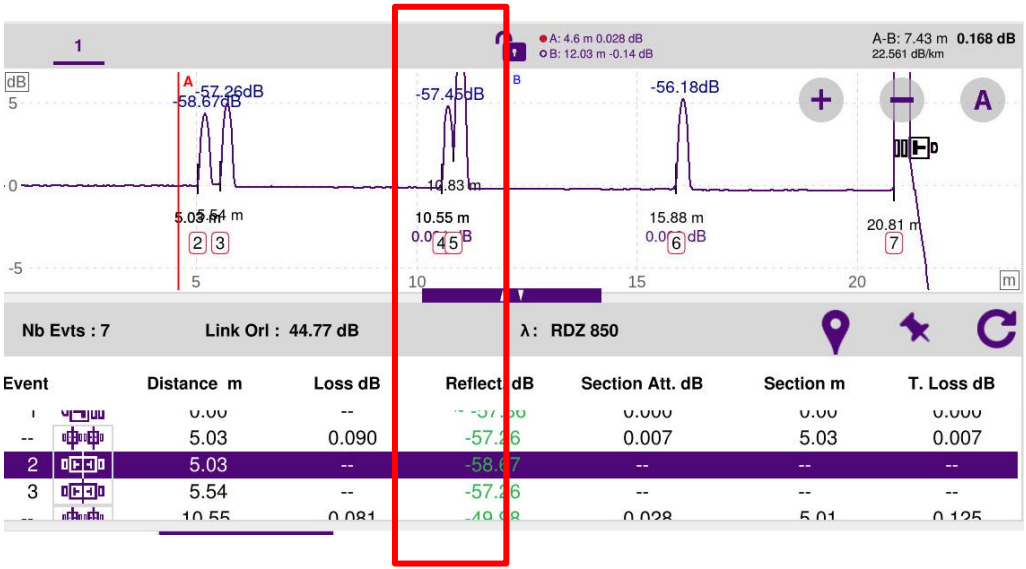
Fiber Module Carrier

Example of an Avionic Fiber Assembly Test with an OTDR



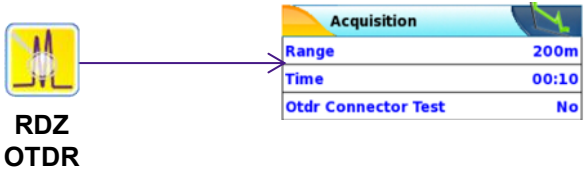
Mode Controller

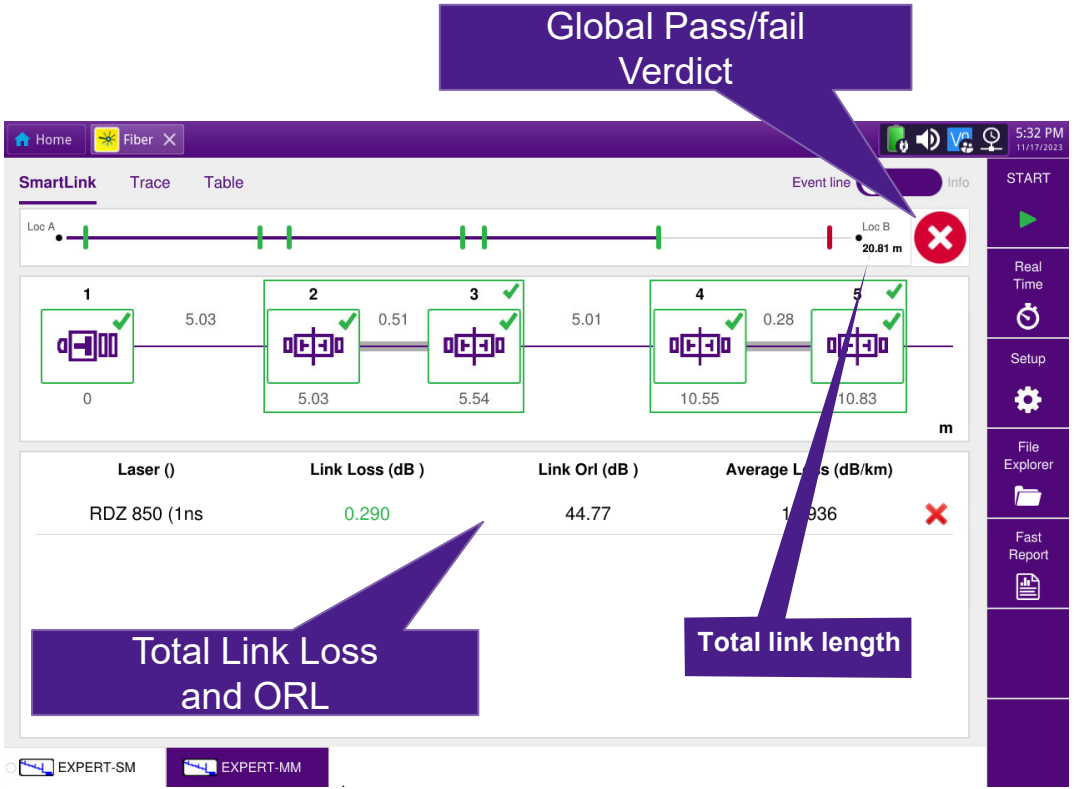
It is recommended to use a mode controller between the OTDR and the multimode fiber to improve the measurement accuracy and repeatability. Please refer to your Methods and Procedures



VIAVI Hi-Res OTDR Multimode OTDR Streamlined User Interface

- Specific OTDR Mode called RDZ (Reduced Dead Zone) leading to an extremely simplified Set-up menu
- Results are displayed with icon-based map-view (SLM)

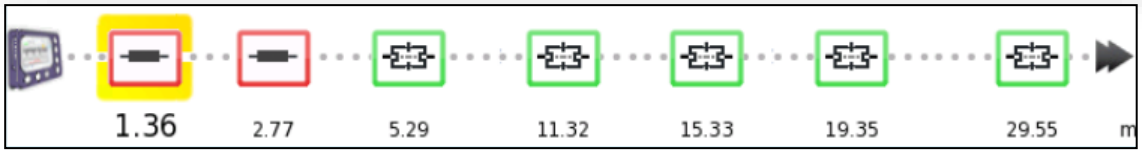




Example of Avionic Fiber Assembly (Table of Results)

Nb Evts : 11 Link Orl : 26.74 dB

Event	Distance m	Loss dB	Reflect. dB	Section m	T. Loss dB
1	1.36	2.424		1.36	0.001
2	2.77	0.626		1.41	2.424
3	5.29	0.018	-60.36	2.52	3.096
4	11.32	0.019	-25.52	6.03	3.132
5	15.33	0.341	-39.04	4.01	3.163
6	19.35	-0.056	-42.06	4.03	3.512
7	29.55	0.060	-57.38	10.20	3.479
8	32.66	0.051	-61.78	3.10	3.542
9	34.15	0.049	-55.05	1.49	3.606
10	35.07	0.000	-30.01	0.92	3.676
11	35.51		-23.97	0.43	3.676



Application Requirements

- Must be cost feasible
- Size must allow the unit to be functional
- Users must be able to set up unit, obtain results, and analyze results with minimal outside assistance
- Battery power is needed in case AC power is not available
- Determination if high-cost solution is required or if a lower cost solution will work – pro/con analysis of each tool
- Different views for results to allow both a novice and an expert to use the tool
- Must be designed to work on short spans(very short)
- Commonly needs to be “kitted” for protecting tools, easy storage, and inventory control
- Add your own or edit the above list

Summary

Solutions Availability and Support

- Commonly sold through System Integrators who focus on DoD/MIL/Avionic applications so “kits” can be created
- Viavi Field Engineering Team and TAC is available for support – US FE Team and TAC support DoD outside of the US(globally) but International TAC locations are available
- Viavi has Quick Cards and Short Training Videos for all products, but can create custom training tools if requested

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