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# OFL280 Application Note

# Tracing Live or Dark FTTx PONs through Splitter using OFL280

## Introduction

AFL's PON-optimized **OFL280-103 FlexTester** is ideally suited for both out-of-service installation testing, as well as in-service fault location on FTTx PON networks. The **OFL280-103**'s unique Service-Safe™ check prevents service-disrupting OTDR scans at 1310 or 1550 nm on live fibers, while allowing 1625 nm out-of-band testing to proceed. OTDR scans can be completed on in-service (live) and out-of-service (dark) PONs. Traces can be obtained from the ONT to the splitter, as well as from the ONT through the splitter to the OLT. This application note outlines procedures for completing such testing.

## FTTx PON OTDR Applications

AFL's **OFL280-103 FlexTester** is ideally suited for both installation and in-service testing of FTTx Passive Optical Networks (PONs). The **OFL280-103** is an all-in-one PON tester, including a PON-optimized OTDR, Optical Power Meter (OPM), dual-wavelength Optical Laser Source (OLS), and a Visible Fault Identifier (VFI).

The **OFL280-103** may be used to scan out-of-service PON networks from the OLT. In this mode, backscatter and reflections from all customer fiber legs after the splitter are summed together, providing a trace which is difficult to interpret beyond the splitter. However, when trying to locate faults in the feeder fiber between the OLT and the splitter, scanning from the OLT will provide the best distance resolution since a narrower pulsewidth can be used.

The **OFL280-103** is more typically used to scan PONs from ONT to OLT, as shown in Figure 1 and Figure 2.

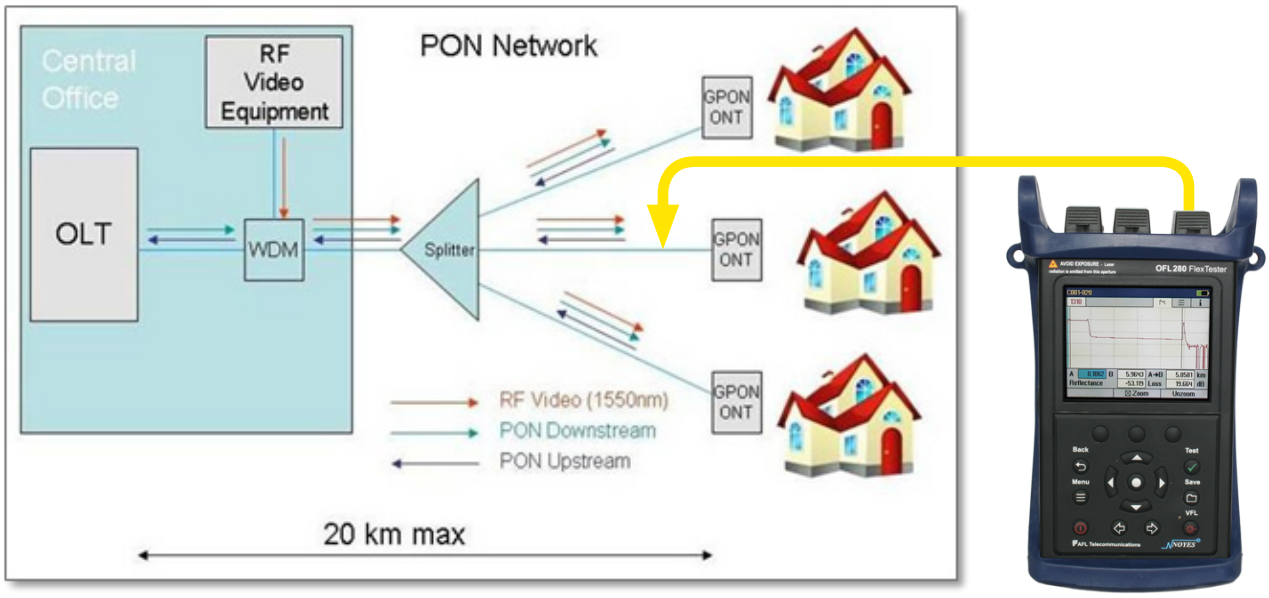


**Figure 1: Using OFL280 to scan an FTTx PON from ONT to OLT through 1xN splitter**

During installation testing (before OLT and ONT are attached to the deployed PON), the **OFL280-103** should be used in **FTTx – PON Construction** mode. In this mode, each customer leg can be scanned from the ONT end through the fiber at 1310, 1550, and possibly 1625 nm. In normal operation, the OLT will deliver downstream customer traffic to each customer's ONT at 1490 nm and possibly at 1550 nm. Each ONT communicates upstream to the OLT at 1310nm. Losses due to macrobends are higher at 1550 nm than at 1310 nm. For these reasons, it is recommended to scan out-of-service PON networks at both 1310 and 1550 nm.

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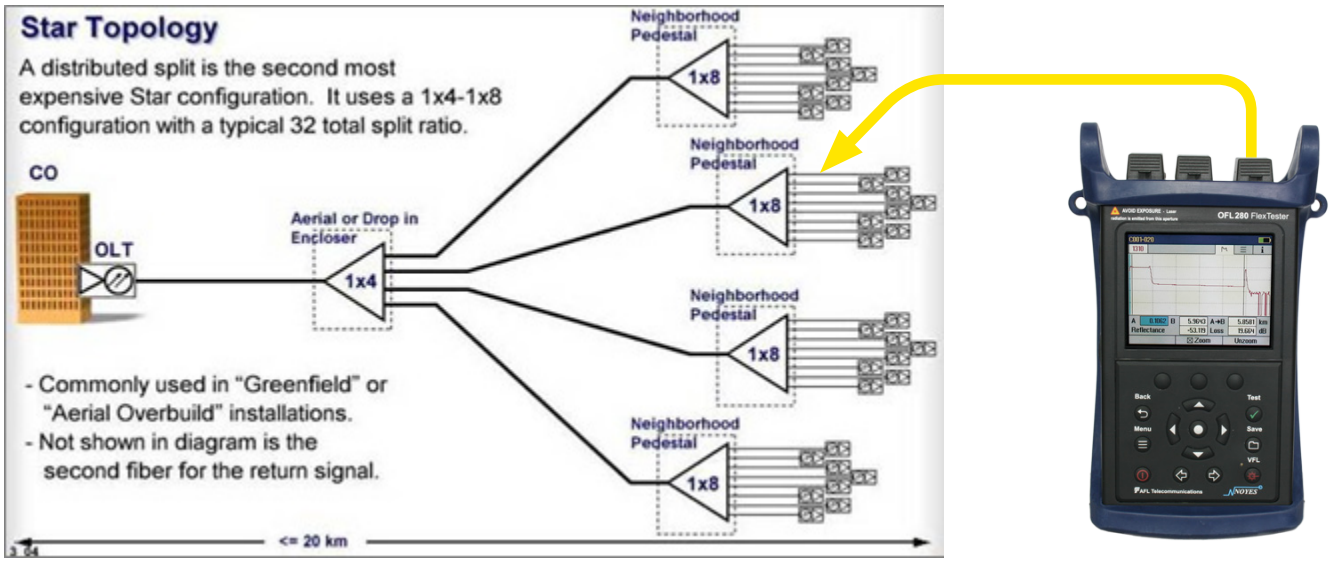


Figure 2: Using OFL280 to scan FTTx PON from ONT to OLT through cascaded 1x4 and 1x8 splitters

Once a PON is in-service, the **OFL280-103** can be used to scan the live PON network from an out-of-service ONT location without disrupting service to other ONTs on the PON. In-service testing may be required to troubleshoot a failure at one customer's location, while other customers continue to receive services over the PON. This situation may occur either due to a failure of the customer's ONT, or a break in the fiber between the splitter and the customer's ONT.

The **OFL280-103**'s FTTx **In-Service** mode is optimized to detect faults in a faulty customer leg of an in-service PON. When scanning only from the ONT to the splitter, a narrow pulsewidth is used to provide a high-resolution trace, allowing one to more precisely locate faults between the ONT and splitter. However, such a scan does not provide a useful trace of the feeder fiber between the splitter and the OLT, as shown in Figure 3.

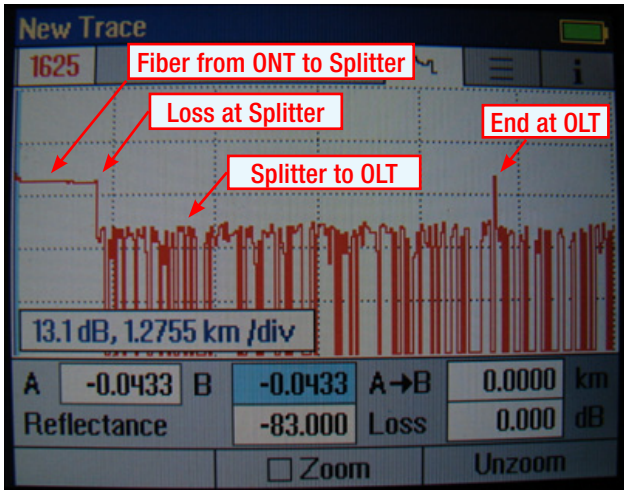


Figure 3: FTTx In-Service Mode provides OTDR trace only as far as the Splitter

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Scanning through the splitter, especially high split ratio splitters (e.g. 1x32, 1x64), requires higher dynamic range. This is obtained using a wider pulsewidth and longer averaging times, at the expense of distance resolution.

The **OFL280-103** can be used to scan live fibers in either **FTTx – In-Service** or **FTTx – PON Construction** modes. The **OFL280-103**'s exclusive Service-Safe™ feature automatically detects downstream signals from the OLT at either 1490 or 1550 nm. When an in-service signal is detected in either In-Service or PON Construction mode, Service-Safe™ only allows the **OFL280-103** to scan the fiber using the out-of-band, non-service-disrupting 1625 nm wavelength.

The following procedure provides the steps to complete an OTDR scan on a live FTTx PON from the ONT to the OLT through the splitter using the **OFL280-103** in **FTTx – PON Construction** mode.

Additional tips on improving the quality of your FTTx PON OTDR traces are also provided.

**Note:** While the **OFL280-101** also supports testing at 1625 nm, the **OFL280-101** cannot be used to test in-service FTTx PONs since the downstream 1490 or 1550 nm wavelengths interfere with the 1625 nm backscatter signal. Other models of the OFL280 (-100, -102) only support testing at 1310, 1490, and/or 1550 nm. These also cannot be used to test live FTTx PONs.

## OFL280-103 Procedure: Live PON Trace in FTTx – PON Construction Mode

Use the following procedure with the **OFL280-103 FlexTester** to trace in-service (live) fibers from the ONT through the splitter to the OLT without any danger of disrupting service:

1. From the main menu, select **FTTx -- PON** Construction mode. The **OFL280-103** will prompt the user to configure the test Wavelength(s), distance Range, and the PON split ratio, as shown in Figure 4.

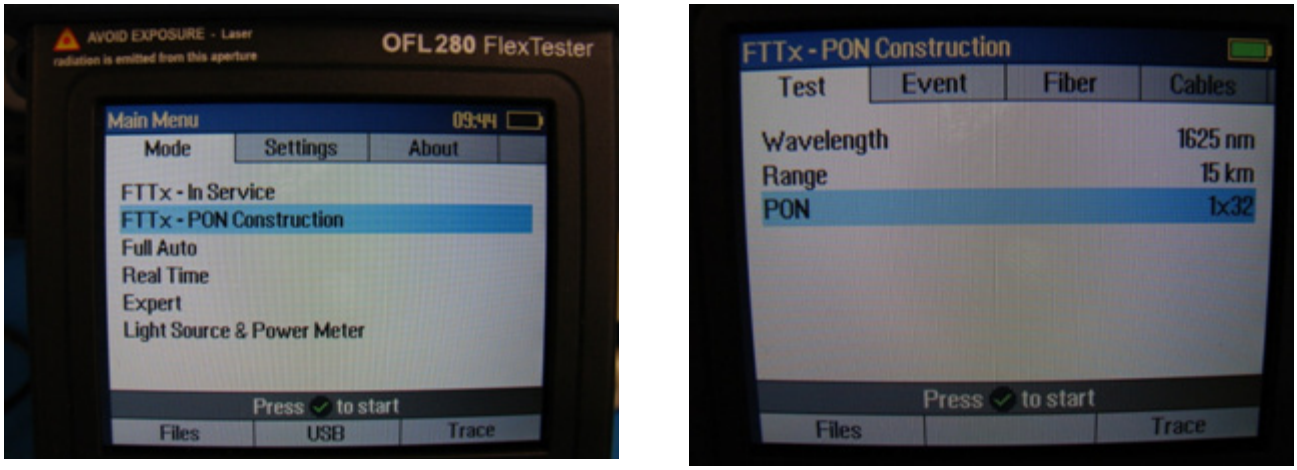


Figure 4: From Main Menu (Left) Select FTTx – PON Construction Setup (Right)

2. Set the Wavelength to any of the available selections. The **OFL280-103**'s Service-Safe™ check will prevent testing at 1310 or 1550 nm if a live fiber is detected.
3. Set the Range to approximately 1.5x your best estimate of the distance from the ONT to the OLT. If you do not know the distance, select a long range to ensure you scan the entire length through the splitter. If the selected range is too long, the trace will be compressed and distance resolution will be less than ideal. However, you can determine the distance from the ONT to OLT, then rescan with a shorter range setting.

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4. Set the PON setting to the PON split ratio. If you do not know the ratio, select a higher setting (e.g. 1x32) to ensure the scan will not report the loss through a high-ratio splitter as the end of the fiber. The high split ratio will force a wider pulsewidth to be used to see through the higher loss of the splitter. The splitter can be easily identified from the trace as a high loss event (> 3dB), as shown in Figure 5. You can estimate the actual split ratio from an initial scan using Table 1.


**Figure 5: Locate the splitter as the high loss event.**

5. Some PON systems are constructed by cascading two or more splitters separated by several km of fiber (as shown in Figure 2). This appears in a trace as several high-loss events, as shown in Figure 6. In this case, add the losses of the high-loss splitter events to determine the appropriate split ratio setting from Table 1.

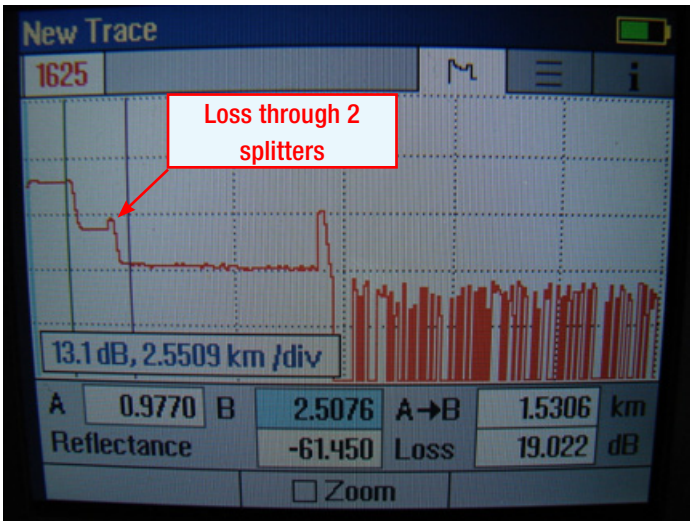


**Figure 6: Add the loss of cascaded splitters to determine correct PON setting.**

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Table 1: Determining Split Ratio from Loss at Splitter

| APPROXIMATE LOSS AT SPLITTER | SPLIT RATIO |
|---|---|
| 9-11 dB | 1 x 8 |
| 12-14 dB | 1 x 16 |
| 15-18 dB | 1 x 32 |
| 18-22 dB | 1 x 64 |

6. If you determine the PON is constructed with a lower split ratio, adjust the setting and rescan to obtain better distance resolution.
7. Press the Test √ button to start the OTDR scan. The **OFL280-103** will initiate its Service-Safe™ check for downstream wavelengths present in a live system.

   If downstream 1490 or 1550 nm light > -50 dBm is not detected, the **OFL280-103** will begin scanning the fiber at the user-selected wavelength.

   If either 1490 or 1550 nm light is detected at > -50 dBm power level, the **OFL280-103** will indicate the fiber is Live, report the measured power level at each wavelength and prompt the user to Press Test √ to start a live fiber OTDR test at 1625 nm, as shown in Figure 7.


**Figure 7: Live fiber detected; Press Test √ to initiate in-service OTDR trace at 1625 nm**

8. Once Test √ is pressed, the **OFL280-103** will indicate New Trace and begin to acquire and display trace results. Multiple scans are averaged to improve trace quality. Averaging time depends on the Range and PON split ratio settings. A red meter at the top of the screen indicates progress towards scan completion. Once the scan is complete, a trace from ONT through the splitter to OLT will be displayed, similar to those shown in Figure 5 and Figure 6.

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# Tips on Improving Trace Quality

Below is a list of commonly encountered trace quality issues and recommendations for improving your OTDR trace results.

1. **Trace compressed to less than half of the screen:** Range set too long. Select a shorter range and rescan. Use the Zoom function to expand the trace. To zoom, press the Zoom softkey. Notice the check in the box, indicating the left/right and up/down arrows are used to control zooming. Traces may be zoomed both horizontally and vertically about the currently selected cursor. Use the key inside the arrow keys to select between the two cursor locations. To reposition a cursor, if zoom is enabled, press the Zoom softkey to disable zooming. Notice the Zoom box no longer has a check in it. Use the left/right arrow keys to reposition the cursor.
2. **Too wide a pulsewidth used,** limiting ability to precisely locate the distance to a fault detected in the customer drop fiber. Select FTTx – In-Service mode or shorten the range to ~1.5x the distance to the fault and rescan.
3. **Too narrow a pulsewidth used,** resulting in a very noisy trace after the splitter. Select FTTx – PON Construction mode and set Range and PON split ratio settings appropriately. If the range is correct, increase the PON split ratio, resulting in a wider pulsewidth and less noisy trace.
4. **Dirty, damaged or incompatible connectors,** resulting in a large reflection and curved trace at the beginning of the trace. Inspect and clean connectors. Make sure both connectors are of the same type and endface finish (PC, UPC, or APC). Use connector colors to identify PC/UPC vs. APC.

## Conclusion

This application note outlines procedures for obtaining OTDR traces from both in-service (live) and out-of-service (dark) FTTx PONs using AFL's PON-optimized **OFL280-103 FlexTester**. The **OFL280-103**'s unique Service-Safe™ check prevents service-disrupting OTDR scans at 1310 or 1550 nm on live fibers, while allowing 1625 nm out-of-band testing to proceed. Tips are provided for optimizing OTDR settings when testing FTTx PONs.

Should you require additional information regarding the **OFL280-103 FlexTester** or solutions for your fiber optic test applications, please contact Tech Support at AFL's Noyes Test and Inspection at +1 (800) 321-5298.



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