

THE SIDELIGHTER: A NEW DEAD-ZONE FREE DISTANCE TO FAULT FIBER OPTIC CABLE MEASUREMENT SYSTEM

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Introduction

As the use of fiber grows in short haul systems such as fiber to the premise and military platforms there is a need to locate failures in fiber optic cables with accuracies to a few centimeters at distances of less than a few hundred feet. Additionally, the elimination of the dead-zone is paramount for close in measurements. Artisan Laboratories Corporation has developed a new “dead-zone free” high resolution and high dynamic range fiber optic measurement system called the *Sidelighter* [1] that has these capabilities. In this paper we show results of this new measurement system that has the capability of 10 cm resolution; an optical dynamic range of > 40 dB and dead-zone free operation.

Sidelighter Operation

The *Sidelighter* is designed to accurately locate and identify faults and failures in fiber optic cables, connectors and many optical components eliminating the “dead-zone” associated with optical time domain reflectometers (OTDRs). The *Sidelighter* connects directly with popular RF cable measurement equipment such as Anritsu’s Site Master™ and Scorpion™ Vector Network Analyzers and Bird®’s Site Analyzer® family of Cable and Antenna Tester products allowing any experience level user to perform optical “distance-to-fault” measurements. The *Sidelighter* is easily used in installations for troubleshooting and maintaining optical systems without the need to buy expensive OTDRs.

Figure 1 shows the *Sidelighter* module. To perform a distance to fault measurement, the microwave analyzer is calibrated in a normal fashion as directed by the manufacturer. The *Sidelighter* is then connected to the analyzer and the propagation velocity factor is set to match the velocity of the optical signal in the fiber. This value is typical 68% to 70 % of free space propagation. The *Sidelighter* is powered on and the optical cable or network is connected to the output. The microwave analyzer is set to return loss mode as directed by the manufacturer and a measurement is taken. The distance to fault is read directly on the display.

Test Results

In this section we will present a series of test results highlighting the performance *Sidelighter* module. In these tests various lengths of fiber and fiber terminations are selected and connected directly the *Sidelighter* module. The results are downloaded from the microwave analyzer memory and the results are shown in the figures.



Figure 1. The *Sidelighter* is connected to popular microwave analyzers to measure distance to fault in fiber optic cables. Dead-zone free failures in fiber optic cables can be obtain with <10 cm resolution.

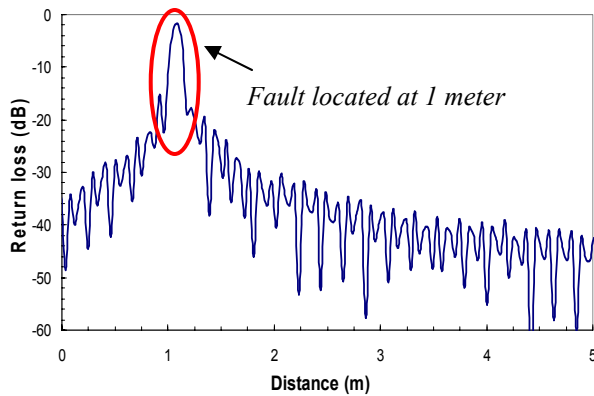


Figure 2. Measurement results demonstrating a reflection at one meter away from the *Sidelighter* interface.

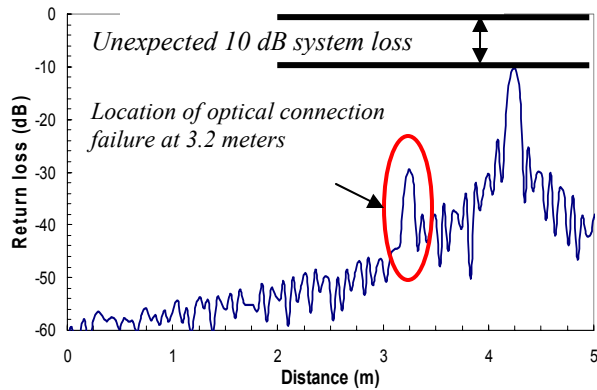


Figure 3. Measurement results demonstrating a reflection due to a poor optical connector interface at 3.2 meters away from the *Sidelighter*

In this version of the *Sidelighter* the optical wavelength is 1550 nm and the input frequency is set from 1.0 GHz to 2.0 GHz for a resolution of 10 cm. In the first test, a one meter gold-tipped fiber is connected to the optical connector of the *Sidelighter*. Figure 2 shows a distance to fault measurement result with the x-axis showing the distance (meters) and the y-axis showing the return loss (dB). The reflection in the fiber that is located at one meter away. In Fig.2, a poor connector interface is observed due to a reflection at 3.2 meters and a high insertion loss of about 10 dB from a reference location at 4.2 meters. The 10 dB loss is due to the improper mating of a UPC and APC optical connector. Figure 3 shows the results of an open fiber optic cable with a UPC optical connector. The reflection is observed at 4.2 meters with a return loss of -40 dB. Fig. 5 shows a measurement of a fiber in excess of 100 feet indicated by a return loss reflection peak.

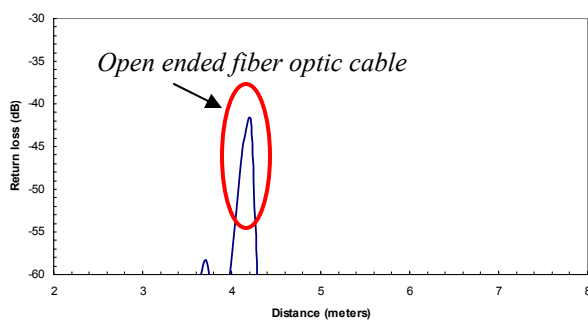


Figure 4. Measurement results demonstrating 40 dB of dynamic range from an open ended fiber.

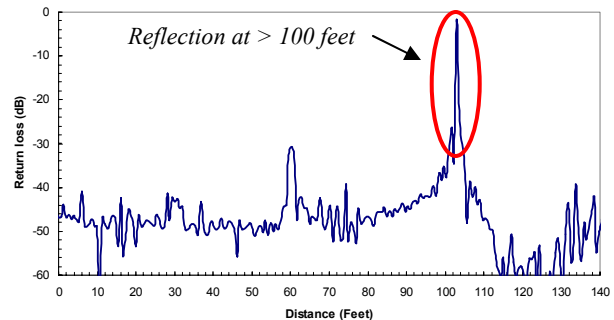


Figure 5. Measurement results demonstrating a reflection at >100 feet

Conclusion

We have shown a method of locating faults in fiber using a new *Sidelighter* module that easily connects to popular microwave analyzers. The *Sidelighter* can be used in the field as it is compact and battery operated. Using the *Sidelighter* allow users to test RF and optical cables in one system. We have achieved 10 cm measurement resolution and can located failures in fibers at distances of up to 1 Km.

References

1 US Patent pending, May 9, 2005