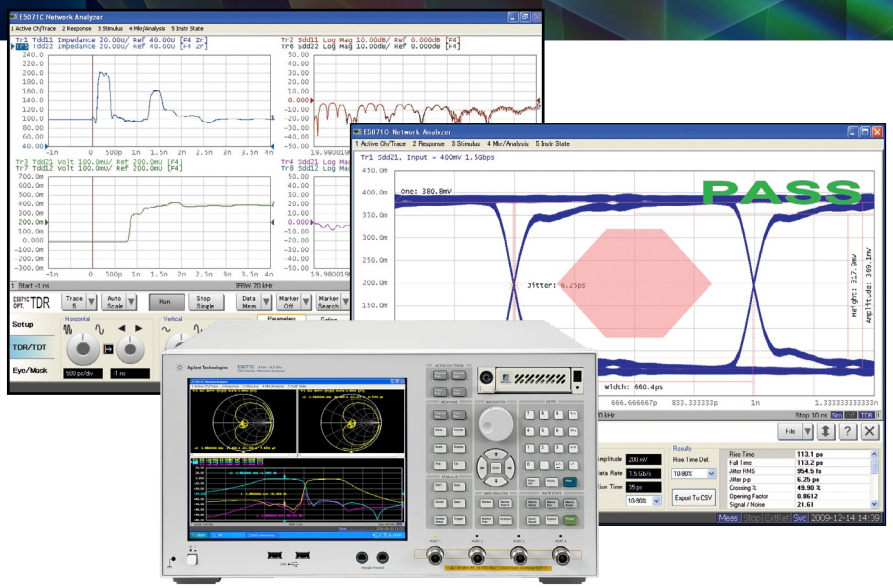
# Network Analyzer Time Domain Reflectometry Measurements

## Agilent Technologies and Granite River Labs




## Ensure your high-speed interconnect designs conform to the relevant standards

Time domain reflectometry (TDR) is the standard technique used to verify the performance of high-speed interconnects. Standards such as Thunderbolt, PCI Express, SATA, HDMI, DisplayPort, and USB 3.0 and others increasingly call for the use of S-parameters and impedance measurements to ensure system performance and interoperability. A vector network analyzer equipped with time domain reflectometry provides the rapid, accurate and robust measurements you need to efficiently characterize your high-speed interconnect designs.

The latest high-speed interconnect standards implement much higher, multi-Gbps, transmission rates. Thunderbolt specifies a bit rate of 10 Gbps and greater, SATA up to 6 Gbps and USB 3.0, 5 Gbps. These signals place a greater burden on the physical channel. With this increase in bit rate, issues such as reflection and losses cause distortion in digital signals leading to bit errors. Timing skew of signal paths becomes critical as the acceptable time margin for proper device operation decreases. The ability to make accurate return loss and eye mask measurements is critical to ensure your high-speed interconnect devices operate correctly and conform to the relevant standards.

Granite River Labs (GRL) has exceptional experience in all aspects of signal integrity testing and provides a comprehensive range of test and characterization services for all of the high-speed interconnect standards. GRL provides signal and power integrity analysis, signal integrity model creation and validation, independent compliance testing, IC characterization and stress testing, debugging, and field failure support. GRL uses a range of Agilent Technologies test equipment but when making time domain reflectometry measurements with a vector network analyzer it uses the Agilent E5071C ENA Option TDR.

The E5071C Option TDR combines both frequency and time domain analysis allowing a range of tests to be undertaken, including TDR/TDT and S-parameter measurements. Single connection forward and return transmission and reflection measurements allow the sources of losses, reflections and crosstalk to be rapidly located. The network analyzer also

- ***Network analyzer time domain reflectometry measurements***
- ***For characterizing all high-speed interconnects***
- ***Ensure your devices conform to standards***
- ***GRL testing services based on Agilent E5071C Option TDR***
- ***E5071C Option TDR allows fast, accurate measurements***
- ***Simple and intuitive interface, high resistance to ESD***

**Agilent Technologies**

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provides simulated eye diagram analysis eliminating the requirement for a separate pulse pattern generator. The instrument comes with a suite of predefined eye diagram masks that conform to the industry standards to allow easy comparison of actual to expected results.

The Agilent vector network analyzer provides the performance and accuracy required by GRL to meet the needs of its customers. By using the services of GRL based on the Agilent E5071C Option TDR you can ensure your high-speed interconnect devices are characterized comprehensively and meet all of the necessary standards.

## System Components

### Agilent Technologies

| | |
|---|---|
| **E5071C** | ENA network analyzer |
| **E5071C-TDR** | Enhanced time domain analysis |

### Granite River Labs

Granite River Labs provides a comprehensive range of signal integrity, stress test, compliance and characterization services for all high-speed interconnect standards.

**To learn how this solution can address your specific needs please contact Agilent's solutions partner, Granite River Labs.**

**www.agilent.com/find/grl**

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## Time Domain Reflectometry

Traditionally, time domain reflectometry measurements are made using a digital sampling oscilloscope. However, the relatively high noise of the oscilloscope means that achieving high-dynamic range and fast measurements simultaneously is difficult. Averaging is typically used to lower the noise, but this sacrifices measurement speed, resulting in measurement times of minutes. In addition, implementing electrostatic discharge (ESD) protection circuits on the oscilloscope are difficult with the result that TDR oscilloscopes are prone to failure due to ESD.

These issues can be resolved by making time domain reflectometry measurements with a vector network analyzer. Vector network analyzers measure the frequency response of the device-under-test (DUT) by sweeping a sine wave signal at its input and measuring the resulting transmitted or reflected signals. A bandpass filter at the input of the receiver means that a network analyzer is inherently a lower noise instrument than an oscilloscope. The bandpass filter removes the noise and unwanted signals from the measurement, which improves accuracy and increases the speed of measurements.

The E5071C Option TDR provides fast, accurate measurements with a simple and intuitive interface and high resistance to electrostatic discharge. TDR measurements that take minutes on a sampling oscilloscope can be completed in seconds with the E5071C Option TDR and protection circuits built into the instrument mean that the danger of ESD is kept to a minimum.

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**Granite River Labs** (GRL) helps customers implement high-speed connectivity technologies as the technologies become faster, complex, and more difficult to test. GRL combines recognized industry experts, high performance test equipment, and convenient lab locations to provide the utmost in customer service. GRL's test facilities are conveniently located in Silicon Valley, Taipei & Hsinchu Taiwan, and near Stuttgart, Germany.
**www.graniteriverlabs.com**

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Product specifications and descriptions in this document subject to change without notice.


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