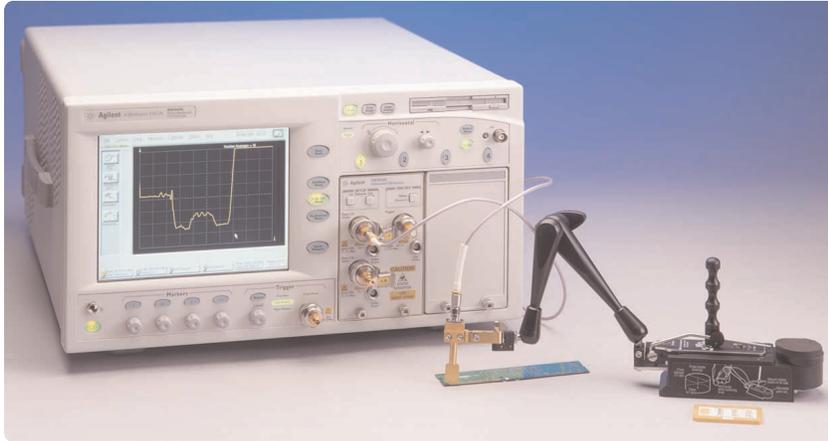


## Agilent RAMBUS® Product Overview

### RAMBUS Impedance Measurements? No Problem—Agilent has TDR with Normalization.



Direct Rambus™ is a high-speed digital bus that requires circuit board traces that are designed to function in a controlled impedance environment of 28 ohms. This two byte wide bus double pumps a 400 MHz clock to

*Because of its intuitive nature, Time Domain Reflectometry (TDR) is the tool of choice for digital design engineers today.*

enable data transfer on both the rising and falling clock edges. Assuming 100% utilization of the data bus, the peak bandwidth is a blazing 1.6 Gbytes per second. For high bandwidth applications like Rambus, the traditional logic analysis measurement technique now needs to be complemented with a signal integrity measurement tool. Because of its intuitive nature, Time Domain Reflecto-

metry (TDR) is the tool of choice for digital design engineers today.

The TDR oscilloscope measures impedance verses distance (or time). Highly accurate impedance measurements require a TDR calibration that sets the reference plane at the device under test's (DUT) input. To address the most demanding impedance profile measurements, the Agilent 86100A Infiniium DCA allows the user to set this reference plane at the probe tip. By using the Agilent N1020A TDR probe kit, a special calibration adapter enables a precision 50-ohm air dielectric termination and SMA short to be connected to the probe tip.

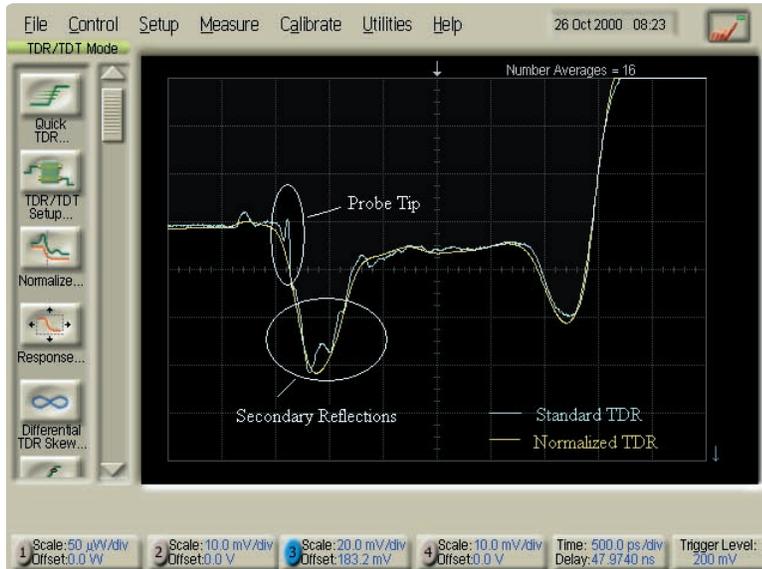
#### Enhanced Accuracy

When attaching any test instrumentation to a DUT, the test fixturing utilized always affects the measurement in some

fashion. TDR test fixturing is no exception. Whether probing or launching from an SMA connector, there are anomalies and impedance discontinuities located within the test fixture which inherently contribute to measurement error. With a TDR measurement, this is directly translated into error in the impedance value.

The Direct Rambus microstrip trace needs to be maintained to 28 ohms  $\pm 2.8$  ohms. Enhancement of standard TDR waveforms is needed to ensure compliance to this standard along the complete length of the RAMBUS channel.





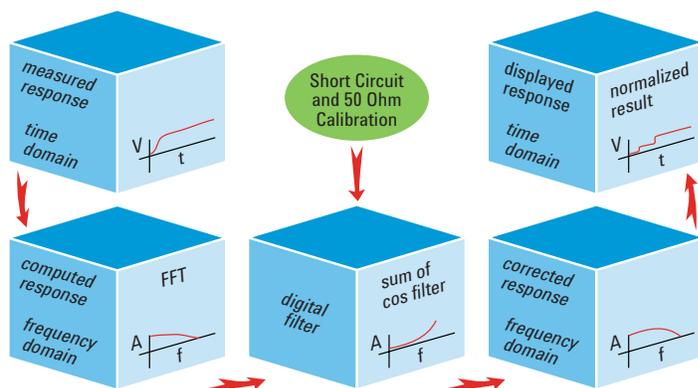
As seen in the oscilloscope display above, the standard TDR wave-form depicts reflections from the Rambus CRIMM (Continuity Rambus In-line Memory Module) using the internal 40 picosecond TDR step generator.

The superimposed waveform is the normalized waveform that corrects for test fixture anomalies. The very beginning of the 28-ohm microstrip section has artifacts at the “knee” which are not characteristic of the DUT. When viewing the normalized waveform, these artifacts have

been corrected, thus yielding an enhanced accuracy impedance measurement.

#### Normalization Process

The method of TDR calibration used for setting the reference plane at the probe tip is a two-point calibration using a precision 50-ohm load and a short. The powerful processor of the 86100A then performs a normalization routine which corrects for test fixture errors in the frequency domain. A graphical representation of this internal process is shown below.



#### Equipment

The Rambus TDR set up includes the following equipment:

- Agilent 86100A Infiniium DCA
- Agilent 54754A Differential TDR Plug-in Module
- Agilent N1020A TDR Probe Kit
- Agilent 909D Precision 50 Ohm Termination, APC 3.5 male
- Agilent 1250-2128 Precision Short, APC 3.5 male
- 28 Ohm Airline–Maury Microwave PN 2603Q2

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5988-0572EN



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