Transmission Line Probes Enable Higher Bandwidth, Lower Noise Measurements For PDNs

Picotest.com, a provider of high-resolution test and measurement equipment, has released two new 50-Ω transmission line test probes. Coined “PDN” Probes, for their effective use in measuring the ultra-low impedances found in power distribution networks (PDNs), these precision 1x probes support a variety of measurements including impedance (one-port reflection, two-port series and shunt thru, non-invasive stability, and PCB resonances), transient (step-load, ripple, TDT/TDR, and clock jitter), and spectrum (noise, etc.) (see Fig 1.) By controlling the impedance very precisely, thereby eliminating nearly all parasitic capacitances and inductances, and incorporating an infinitely variable lead pitch design (see Fig. 2), these compact probes achieve much higher bandwidth than most 1X probes, lower noise than active probes, and greatly improved SNR.

Although transmission line test probes currently exist for making higher-frequency time-domain reflectometry (TDR) and time-domain transmissometry (TDT) measurements, according to Charles Hymowitz, VP of sales and marketing at Picotest, these new probes are the first of their kind for making impedance and step-load measurements.

The one-port probe, being a unity-gain wide-bandwidth probe, allows the measurement of ripple and noise with optimum signal-to-noise ratio (SNR). The two-port probe is bi-directional and can be used to transmit a load current step through one port, while measuring the response from the other port, simultaneously. Both probes can be used to inject noise for the assessment of sensitivity to the power supply for sensitive circuits such as clocks and LNAs. The probes are supported by a wide range of signal injectors and accessories, such as dc blockers, preamplifiers, and high-speed current injectors, which are offered by Picotest.

The high-bandwidth (dc- to 1.3-GHz), variable-pitch design enables accurate impedance measurements for high-speed PCB development and manufacturing. It eliminates the need for soldering SMA cables to your board and the risk of damaging fine copper pads or pulling up small components. You can get connectivity to circuit boards and devices without connectors. The probes come with an accessory kit that includes a variety of interchangeable probe tips and lead extenders that enable the user to reach tight places. A dc blocking device is also included.

Milliohm Impedances And Gigahertz Frequencies Drive Probe Creation

High-speed applications put pressure on the measurement of power supply busses up to unprecedented frequencies. As an example, the measurement of power distribution network (PDN) impedance for FPGAs generally requires the measurement of impedance levels in the milliohm range at frequencies exceeding 1 GHz. Measuring the high-speed step-load response in power systems is difficult because of the need to connect two 50-Ω transmission lines to the output capacitor. Compounding this difficult task is that these measurements often need to be made in very small circuits such as cell phones, solid-state disk drives, and computer tablets; to name just a few applications.

These unique one-port and two-port PDN probes alleviate many of these challenges while maintaining the precision 50-Ω impedance characteristics required for the wide-bandwidth measurements.

The probes are designed to work with the Picotest J2180A low-noise preamplifier to improve signal-to-noise performance, the J2102A common-mode transformer to eliminate dc ground loops, and the J2130A dc bias injector to provide dc blocking to protect VNA inputs.

Transmission line probes are a special type of passive probe that replaces the high-impedance probe cable found in a traditional passive probe with a precision transmission line, which has a characteristic impedance that matches the oscilloscope’s input (50 Ω). This greatly reduces the input capacitance to a fraction of a picofarad, minimizing the loading on high-frequency signals.

The very fast pulse response of the one-port probe is illustrated by the measurement in Fig 3, which is obtained using a 100-ps/div time scale. The inductance of the pivoting ground pin limits the probe’s bandwidth to 1.3 GHz.
The input impedance of the Picotest probes remains nearly constant over their entire frequency range. A traditional 10x passive probe has a high input impedance at dc, however, this impedance drops rapidly with frequency, passing below the input impedance of a transmission line probe at <100 MHz.

The probes are useful in applications that produce fast rising, narrow pulses with amplitudes which exceed the dynamic range of active probes. They also tend to have less parasitic effects on frequency response and so they are ideal for measuring impedance.

By providing a simple yet elegant solution to probing high-frequency signals, Picotest’s one- and two-port transmission line probes preserve signal fidelity and allow high-bandwidth test equipment to properly measure circuit characteristics.

Available now, the one-port PDN probe is priced at $1,495. The two-port PDN probe, which is expected to be available in mid-December, will be priced at $2,495. The PDN probe bundle including both probes will be priced at $3,495. The probes are compatible with all VNAs, oscilloscopes, and spectrum analyzers. For more information, contact the company at 1-877-914-PICO or visit www.Picotest.com.

Fig. 1. The Picotest PDN 50-Ω 1x transmission line probes support one-port and two-port measurements such as impedance, PCB resonances, step load, clock jitter, TDR/TDT, non-invasive phase margin, and ripple and noise. By controlling the impedance very precisely, thereby eliminating nearly all parasitic capacitances and inductances, and incorporating an infinitely variable lead pitch design, these compact probes have much higher bandwidth than most 1X probes, lower noise than active probes, and greatly improved SNR, according to the vendor. (The one-port probe is shown here.)
Fig. 2. The variable-pitch pin tip eliminates the need for multiple probes. It allows easy probing of various sized components. The small form factor enables the probe to get into tight places. (Again, the one-port probe is shown here.)

Fig. 3. This measurement taken at 100-ps/div. shows the very fast pulse response of the one-port probe. The inductance of the pivoting ground pin limits the probe’s bandwidth to 1.3 GHz.