PWB Controlled Impedance Testing

Comparison of TDR Hand Probes
Introbotics ACCU-Prober™ Probes
and Other TDR Hand Probes

- **Robustness**
- **Visibility**
- **Fixed Pitch vs. Variable Pitch Probes**
- **Fast Risetime (and Falltime)**
- **Importance of TDR Risetime**
  - Measurement Resolution (and Accuracy)
  - Measuring Short Traces
  - Measuring Short Segments on Long Traces
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Robustness

A very important requirement for TDR probes being used in a manufacturing environment is the robustness. These probes are subject to sustained usage (24hours/day and 7 days/weeks) while being handled by a number of different users. The probes must be rugged, durable and be able to maintain their accuracy over long periods of time. Introbotics ACCU-Prober line of probes are designed and built to meet these requirements. The body of the probes is constructed with a high quality brass to meet the electrical requirements and for the durability. (Other probe assemblies utilize plastic.) Also unlike other TDR probes there are no moving parts (spring-loaded pins) which can mechanically fail overtime. These "pogo" pins also significantly degrade the bandwidth of the probe and their electrical characteristics change over time as the pins wear out.

ACCU-Prober probes do NOT incorporate a PWB (printed wiring board) into its design. PWB and their interconnects are subject to impedance variations with temperature and humidity changes which make the probe less able to work in various environmental conditions. PWB edge mount SMA connectors (that are used with other probe designs) are less robust and have been known to fail after repeated use. Failures in these components can produce measurement errors that can go undetected and adds the requirement of frequent calibration checking.

Visibility

ACCU-Prober probes are designed with a gentle taper so that the user has maximum visibility of the board's test points during the probing operations.

Fixed Pitch vs. Variable Pitch Probes

ACCU-Prober probes are made with a fixed pitch, the distance between the signal pin and the ground pin. The fixed pitch design allows the best possible bandwidth response because it minimizes the differences in length between the signal pin and ground pin. It is

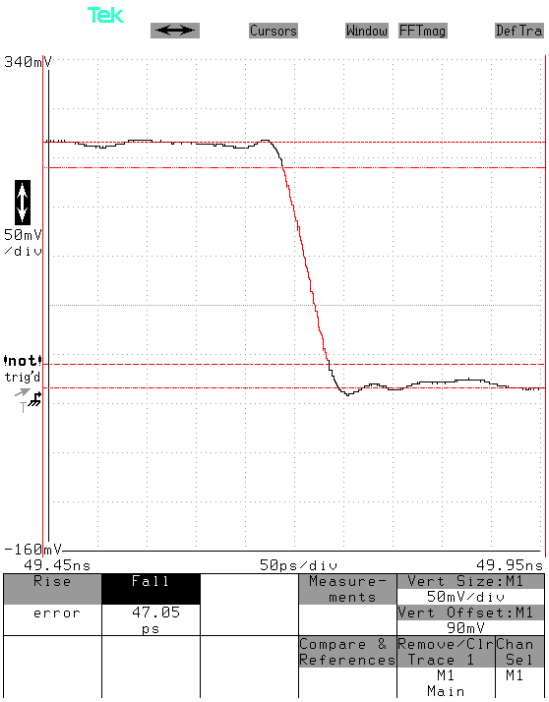
the differences in these lengths that produce inductance and capacitance discontinuities that lower the probe's performance. A variable pitch probe, while providing flexibility, also has the disadvantage of having moving parts that degrade the performance both with time (as they wear) and with pitch distance (as the pitch is changed).

Fast Risetime (and Falltime)

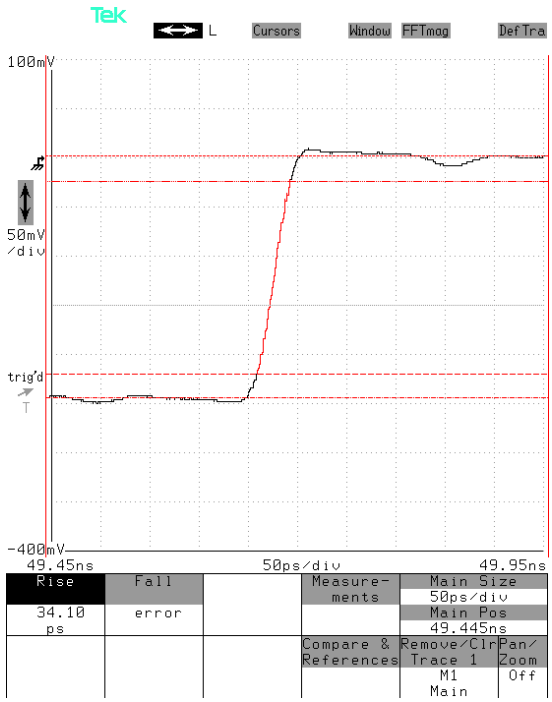
To obtain accurate, repeatable and high-resolution TDR measurements it is critical to have a fast risetime system. (See description below entitled "Importance of TDR Risetime"). TDR probes can be the biggest contributors of the loss of risetime. The use of pogo pins, PWB interconnects, and high loss connectors are being used today in some TDR probes assemblies and all contribute to significant loss in risetime. Introbotics ACCU-Prober probes are designed with extremely fast risetimes. The signal path is impedance matched (50 ohms) throughout the probe assembly and inductive and capacitive discontinuities are minimized and that eliminates most ringing at the end of the probe tip.

Falltime (probing a short circuit-i.e. a piece of copper) is an important characteristic of the probe in that it defines the quality of both the signal pin and the ground pin of the TDR probe. Inductance discontinuities associated with poor ground pin design and construction will be identified with this measurement. Fall time characteristics are very important if you are making measurements at impedance below 50 ohms (i.e., 28 ohms).

Listed below are typical TDR response waveforms for the ACCU-Prober probes. Note the sharp falling and rising curves on the waveform. Also note the significant lack of ringing after the probe tip. :



ACCU-Prober Probe Falltime



ACCU-Prober Probe Risetime

Importance of TDR Risetime

TDR Risetime is critical to the measurement resolution and accuracy of a Controlled Impedance test system. Here are the three reasons:

Measurement Resolution (and Accuracy)

The TDR Risetime specification defines the measurement resolution of your tester. The smaller the value of risetime the better the resolution. In practice it is important to have a low value for risetime (high resolution) in order to accurately record the impedance (and prop delay) of the coupon or board under test. Trace elements like vias or neckdowns that cause changes in the impedance of the trace will be hidden from a tester that does NOT have the necessary risetime value. This Tester will inaccurately report a lower or higher value of impedance because of the lack of good resolution. The ACCU-Prober system (including the Tektronix TDR unit) has a reflected risetime of 34 psec (without cables and probes) as compared to other systems that report a risetime of 200 psec or greater. Introbotics supplies high performance probe and cable assemblies that produce a total Tester risetime of 50 psec. Other tester probes and cables produce a total Tester risetime of 235 psec.

ACCU-Prober Tester Risetime at Probe tip: 50 psec
Other Tester Risetime at Probe tip: 235 psec

Measuring Short Traces

The TDR Risetime directly affects the length of trace that may be accurately tested. For reference only, a common rule of thumb is that signals will travel through a stripline trace in FR4 at 180 psec/in. This means that your Tester must, at a minimum, have a risetime value of 180 psec at most in order to measure a trace that is one (1) inch long. In practice the resolution must be higher to accurately report the impedance of the trace. The ACCU-Prober has measured traces repeatably and accurately as short as 0.5". (Please refer to the Introbotics technical applications note entitled "Measuring Short PWB Traces – Rambus TDR Benchmark".)

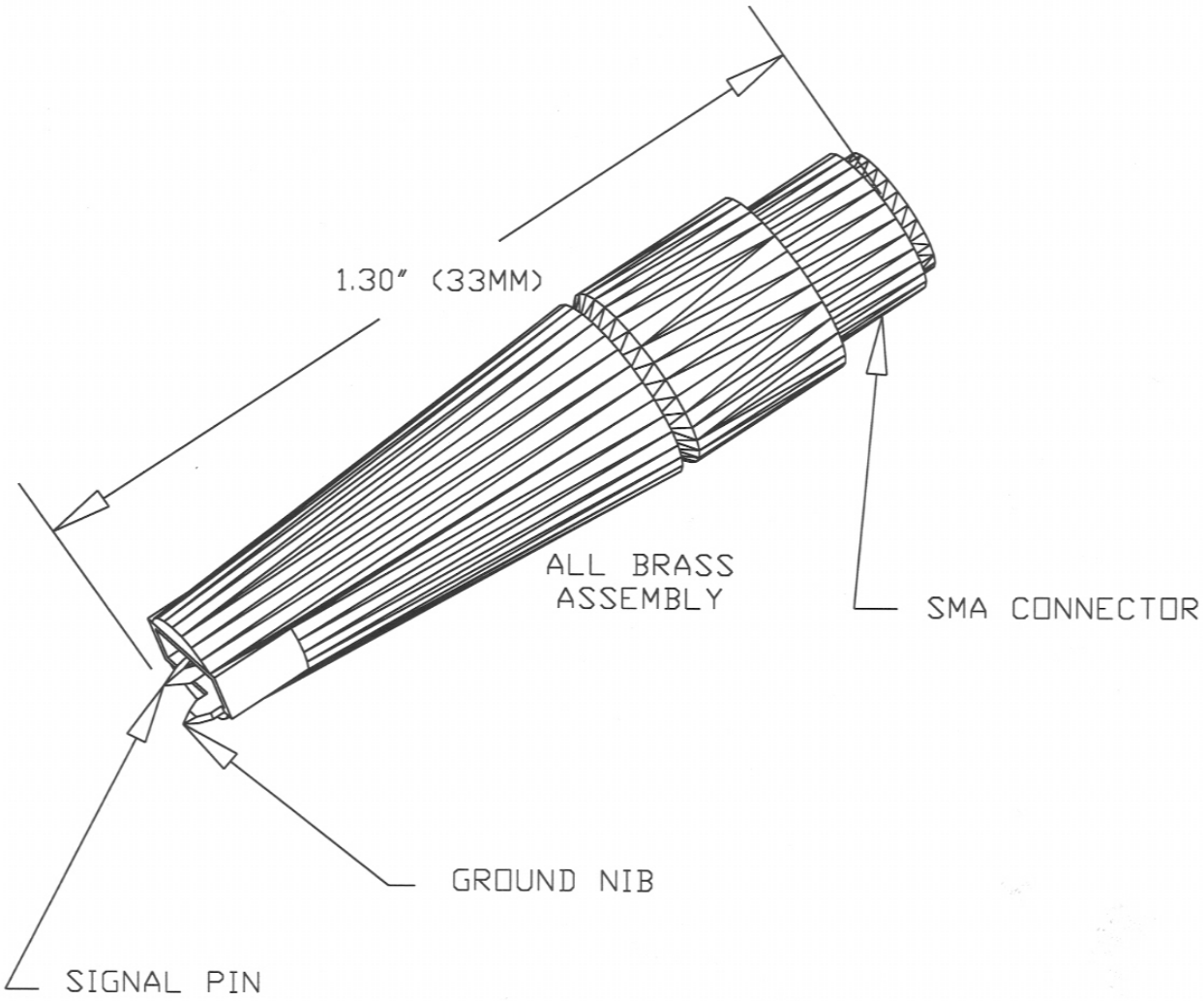
Intel in their paper entitled " PCB Test Methodology Revision 1.6" in section 2.1.1 Impedance Test Coupons General Procedures states the following:
"Required coupon line length….
is a minimum of 1 inch long for a Tektronix tester with microprobes
is a minimum of 6 inches long for a Polar tester with their IP50 probe."

Measuring Short Segments on Long Traces

The ability to take measurements on short segments of long traces is directly related to the resolution of the Tester. A practical example is the need to test on-board traces of a backplane. These traces are laid out in a daisy chain, looping from one via to the next. In this arrangement the impedance of a straight section of the trace would be impossible to measure, due to the impedance discontinuities of the vias, if your Tester resolution is low.

With a Tester Risetime of 50 psec or less you can accurately measure these backplane trace sections under one (1) inch.

AVAILABLE PITCHES:
0.040" (1MM)-0.250" (6.35MM)



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