good information,
right here, right now

It's a never-ending cycle: Every new generation of processors, buses and peripherals creates a renewed need for speed—in users and in you. As edge rates go sub-nanosecond and schedules get shorter, signal integrity problems get tougher and you want to solve them as early as possible in the design process. Perhaps we can help.

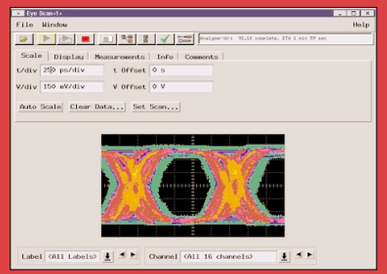
You see, while you've been working hard to balance the compromises between the schedule and your design, we've been busy working with chip vendors and real engineers like you to improve circuit probing, device modeling and more. We thought we'd share some of what we've learned along the way.

Lighten the Load

As you probe around, searching for the causes of signal integrity problems, you might start wondering if your oscilloscope is showing you what's really happening in the circuit. The problem could be right there in your hand: scope probes can load the circuit, disrupting signals and changing circuit behavior.

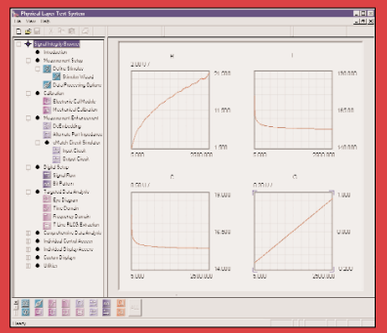
The higher the probe's input impedance, the less it will affect the circuit being measured. However, the input impedance varies with frequency across the probe's bandwidth. From low to high frequency, the dominant elements are internal resistance, then internal capacitance, and finally a combination of inductance and capacitance at the physical junction of probe tip and measurement point.

As frequency increases, these effects are more likely to degrade the accuracy of your measurements. Low input resistance can cause bias changes, amplitude reduction and offset shift. High input capacitance can change rise time and propagation delay—and may even cause a circuit to stop or start operating whenever you connect the probe.



Eye displays in a logic analyzer can show voltage and time data from multiple channels simultaneously, helping you spot sub-nanosecond problems in much less time than conventional methods.

You can reduce or even eliminate these errors with an active probe, which provides higher resistance, lower capacitive loading and greater precision across a broad frequency range. What's more, flat response across its full bandwidth will help you see the actual behavior of the signal at the probe tip.



By providing capabilities such as the analysis and assessment of R, L, C and G characteristics, a physical-layer test system can add a virtual signal integrity expert to your design team.

Build a Better Model

New techniques can help prevent signal integrity problems before you commit the design to hardware. One approach called *measurement-based design* uses iterative cycles of simulation, design, measurement and validation to help you achieve better device models, fewer design iterations and fewer compromises.

The process uses measurements to create device models that improve the predictive power of simulations. At higher frequencies, measuring a device's true response means removing the effects of probes, cables, test fixtures and so on, which can introduce errors such as attenuation, coupling, radiation and dispersion (or group delay). With a time-domain reflectometer (TDR), *normalization* can automatically remove the oscilloscope response, step aberrations, and cable losses and reflections. With a vector network analyzer (VNA), *de-embedding* uses a model of the hardware errors and mathematically removes them from the overall measurement.

The next step is to apply software tools that can extract a device model from the normalized or de-embedded measurement. At gigahertz speeds, the most accurate models include the effects of the IC package, PC board pads, solder and so on. Typically, second-order models with optimized (not just ideal) parameter values provide an excellent balance between accuracy and simulation time.

Make Fewer Compromises

Sharing techniques like these is just one of the ways Agilent can help you tip the balance of schedule compromises in favor of your design. From probes to instruments to electronic design automation software to engineering services, we can help you find the causes of signal integrity problems now and design them out next time.

There's more where this came from at www.agilent.com/find/moresi, where you can download application notes about probing, normalization, de-embedding and more, order a CD-ROM, and attend a series of FREE signal integrity eSeminars.

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