

## NetSeminar Q&A for Signal Integrity Series - Achieving Higher Bandwidth Connectivity with High-Speed Active Probes (November 7, 2002)

**Q: Does transmitted response equal gain?**

**A:** Yes, transmitted response equals gain versus frequency. As long as you define gain as being  $V_{out}$  of the probe relative to  $V_{in}$  of the probe.

**Q: Explaining slide 20, you said that your 10 cm connection does not sacrifice bandwidth, yet the data sheet for your new probe specs have bandwidth much lower than 7 GHz. Which is correct?**

**A:** The data sheet specifies the 10 cm solder-in differential probe head connection as 7 GHz. You may be looking at the single-ended solder-in connection, which is 5.2 GHz.

**Q: Why do your new probes have lower bandwidth in their single-ended configuration?**

**A:** It has to do with the symmetry of the connection. To a differential signal you get a virtual ground plane halfway between the plus and minus sides of the input. So to a differential signal, the loop area of the input connection looks like it's less for a differential probe than it is for a single-ended probe. That's the short answer that I can give.

**Q: Can you say some words about the BNC connector in the 6 GHz oscilloscope?**

**A:** First of all, I don't know that I would call it a BNC connector. It is a connector that is backward compatible with BNC connectors, but it is what we call a precision BNC connector. There are a few differences between this connector that we use and a typical BNC connector. One is that we removed the solid PTFE core, which ups the moding frequency to about 17.9 GHz. We also added a threaded collar that gives a very positive locking connection. There is absolutely no play in that connector when it's correctly attached. For those who are used to using more standard type connectors, like a precision 3.5 mm connector, we offer an adapter that adapts from our precision BNC connector to a more standard 3.5 mm connector. The reason we went with this kind of connector is to allow backward compatibility with all of our customers' existing accessories and cables.

**Q: Agilent logic analyzers have a specification called parasitic capacitance, which is used instead of the actual total capacitance. What is the corresponding specification for the oscilloscope probes?**

**A:** I'm not exactly sure what you are talking about. The only thing that we specify in both scopes and logic is the total capacitance of the probe. Now, we do give some probe load models in which we separate the capacitance that is actually used from the capacitance that is parasitic to the input, but that is not really a spec. The only thing that is specified is the sum of all of those things, and that is what we call the input impedance of the probe. So we don't offer a load model right now for this probe that separates the capacitance that is parasitic from the capacitance that is used by the probe. So the short answer is, what we specify is the total capacitance on this probe.

**Q: What is the probe loading across multiple frequencies, i.e., from 500 MHz up to 5 GHz?**

**A:** It varies depending upon the frequency as well as upon the type of probe head connection that you have on there. About the worst case is somewhere around 200 ohms. That's the absolute minimum that the input impedance of the probe ever gets to. The charts of impedance versus frequency, which are on page 21 of the presentation, show the measured input impedance versus frequency, if you would like a more detailed answer.

**Q: What voltage range can the InfiniiMax accommodate in both single-ended and differential?**

**A:** The dynamic range of the single ended probes is  $-2.5$  volts to  $+2.5$  volts. The dynamic range of the differential probe, which is the voltage between the plus and minus inputs, is  $-2.5$  volts to  $+2.5$  volts. Said differently, it is 5 volts peak-to-peak for both the single ended probe and the differential probe.

**Q: Are the damping resistors for the single-ended probes sacrificial? Do I order replacements or something like that?**

**A:** They can stand several cycles of soldering plus the kit comes with additional solder-in replacement tips as well. That's for the solder-in and socketed in type connections. The browsers have embedded damping resistors in the tips and it comes with several of those. So those are not sacrificial at all. But all of the resistors are replaceable.

**Q: How many insertions of the SMP connectors between the head and the amp rated for?**

**A:** The RF connector used in InfiniiMax is expected to last through at least 1,000 insertion cycles and maintain reasonable insertion forces. In the event that the insertion force gets too low, a retention ring on the connectors may be replaced. InfiniiMax will retain its electrical characteristics even when the connector has been cycled more than 1,000 times.

**Q: Is there a converter box to power these probes and let you use them with a logic analyzer or a DCA?**

**A:** For those of you who aren't familiar with what a DCA is, digital communication analyzer, it's our very high bandwidth sampling oscilloscopes, goes up to I think electrically 50 GHz, and optically 800 GHz, really high in the sky. But the answer as far as the DCA, I'm pretty sure that's something being worked on and available in the January/February time frame, so you can use the new InfiniiMax probes on the DCA. When the adapter for the DCA comes out it will have a power tail that plugs into either the DCA plug-ins or it will plug into an external power supply that's already available. I don't know about a converter box for the logic analyzers.

**Q: Do these probes work with other brands of instruments?**

**A:** If you own a Tektronix or LeCroy scope, the answer is no. It's only mechanically compatible with the Agilent scopes. For these you would have to get the converter box that goes to the DCA and the external power supply. So it's somewhat of a clunky solution, and you also don't get offset control from the user interface, but for those who want it badly, you could do it after we come out with our adapter, but it's not available right now.

**Q: Do these probes work with older Agilent oscilloscopes?**

**A:** Yes, they do.

**Q: I've heard that 50 ohm passive resistor divider probes are superior to active probes for high bandwidth oscilloscope measurements. Is that true?**

**A:** Prior to the introduction of these probes I would have said the answer is yes. The only way to make a roughly 7 GHz bandwidth measurement was to use a 50 ohm divider probe which is also known as a 500 ohm probe. There are problems with 500 ohm probes that these new active probes do not have, such as DC loading, which is the most obvious problem. There are also a couple more subtle problems.

The 500 ohm probes do not have any cable compensation, so the loss of the cable, which is typically about a meter long, is part of the response of the probe. With these active probes we compensate for the cable loss getting from the probe tip back to the scope.

Another problem with 500 ohm probes, and I think that this is the most significant issue is that they have very poor common mode rejection. If you attempt to measure a signal that is relative to a ground that is moving, a 500 ohm probe cannot reject that moving ground very well. In contrast, these new active probes that we just introduced, especially the differential probe, has excellent common mode rejection, so you can measure a signal relative to its ground even if its ground is moving significantly.

**Q: Do you supply fixtures for deskewing and calibrating all configurations of probes?**

**A:** Yes, we do provide a fixture that can be used for deskewing, calibrating, or measuring the response of probes. You saw during this presentation that I was using that particular fixture. We call it a 50 ohm through. It's a precision microstrip board and there is a method of doing automatic deskew of the probes.

**Q: Can the probes be AC coupled at the tip?**

**A:** Not internal to the probe. The only way to do that is to solder down a little AC coupling cap to the board you are measuring.

**Q: How much does the E2681A jitter analysis package cost?**

**A:** The E2681A jitter analysis software costs \$3,995 U.S.

**Q: Has Agilent addressed the time-based problem that limited jitter measurements in the past?**

**A:** Yes, this oscilloscope has a significantly improved time base performance. We specify 1 ps RMS jitter, which is better than any of the other 6 GHz scopes that are available right now.

**Q: Can the jitter package separate random and deterministic components?**

**A:** The E2681A Jitter Analysis Software does not automatically separate random and deterministic jitter components. However, deterministic jitter can be viewed and manually measured. Another solution is to use the Amherst Systems M1 jitter package, which is compatible with the new 54850 Infiniium oscilloscopes.

**Q: Can I get a copy of the presentation?**

**A:** Yes, go to slide 50 of the eSeminar archive. From there you can get a copy of the presentation plus find many valuable links for more information on the subject. There is also a Digital discussion forum (<http://www.agilent.com/find/forums>) if you would like to pose/review other questions.