Oscilloscope Selection Tip 11: Probing

Part 11 of a 12-part series

Tip 11 *Select an oscilloscope from a vendor that can also provide the variety of specialty probes that you may require.*

Agilent offers a broad range of oscilloscope probes to fit your specific voltage and current measurement applications.

Your oscilloscope measurements can only be as good as what your oscilloscope probe delivers to the oscilloscope's BNC inputs. When you connect any kind of measurement system to your circuit, the instrument (and probe) becomes a part of your device-under-test. This means it can "load" or change the behavior of your signals to some degree. Good probes should not disturb the input signal and should ideally deliver an exact duplicate of the signal that was present at the probe point before the probe was attached.

When you purchase a new oscilloscope, it typically comes standard with a set of high-impedance passive probes — one probe for each input channel of the oscilloscope. These types of general-purpose passive probes are the most commonly used and enable you to measure a broad range of signals relative to ground. But these probes do have limitations. Figure 1 shows an electrical model of a typical 10:1 passive probe connected to the high-impedance input (1-MΩ input of an oscilloscope).

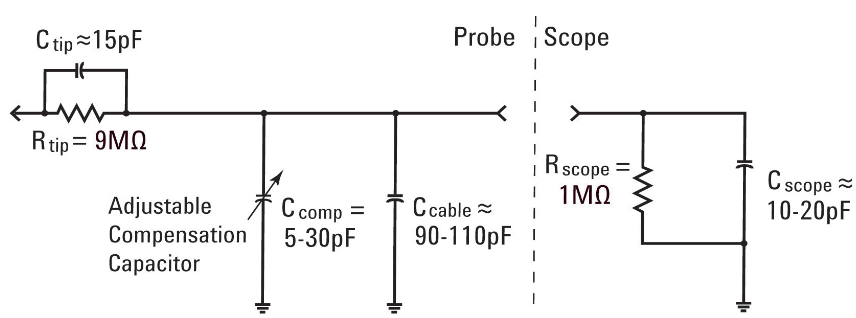

Figure 1: Typical model of a 10:1 passive probe

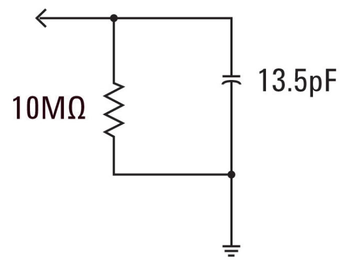

Figure 2: Simplified probe/oscilloscope electrical model.

Figure 3: Agilent's InfiniiMode Series differential active probe

Inherent in all oscilloscope probe and oscilloscope inputs are parasitic capacitances. These include the probe cable capacitance (C_{cable}), as well as the oscilloscope's input capacitance (C_{scope}). "Inherent/parasitic" simply means that these elements of the electrical model are not intentionally designed-in; but are just an unfortunate fact of life in the real world of electronics. The amount of inherent/parasitic capacitance will vary from oscilloscope-to-oscilloscope and probe-to-probe. Also included in this electrical model are designed-in capacitive elements that are used to compensate for low-frequency pulse response.

The electrical model of any probe (passive or active) and oscilloscope can be simplified down to parallel combination of a single resistor and single capacitor. Figure 2 shows a typical oscilloscope/probe loading model for a 10:1 passive probe. This is what gets connected in parallel with your DUT when making oscilloscope measurements with a probe. For low frequency or DC applications, loading is dominated by the 10 MΩ resistance, which in most cases should not be a problem. Although 13.5 pF may not sound like much capacitance, at higher frequencies the amount of loading contributed by this capacitance can be significant. For instance, at 500 MHz the reactance of 13.5 pF in this model is just 23.6 Ω, which could contribute to significant "loading" and signal distortion.

For higher frequency measurement applications, active probes should be used, such as Agilent's InfiniiMode Series differential active probe shown in Figure 3. "Active" means that the probe consists of an amplifier near the probe's tip. This can significantly reduce the amount of capacitive loading and increase probing bandwidth. But the tradeoff with high-frequency active probes is often reduced dynamic range.

Besides high-frequency active probes, there are many other specialty probing applications that should be considered including high voltage measurements and current measurements.

Broad range of probing solutions for Agilent's InfiniiVision X-Series Oscilloscopes

If you are in the market today to purchase your next oscilloscope, Agilent Technologies' InfiniiVision X-Series oscilloscopes come in various bandwidth models ranging from 70 MHz up to 1.5 GHz. Agilent also offers a broad range of probing solutions to fit your specific measurement needs.

To learn more about Agilent's InfiniiVision X-Series oscilloscopes and mixed signal oscilloscopes, go to www.agilent.com/find/InfiniiVision.

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