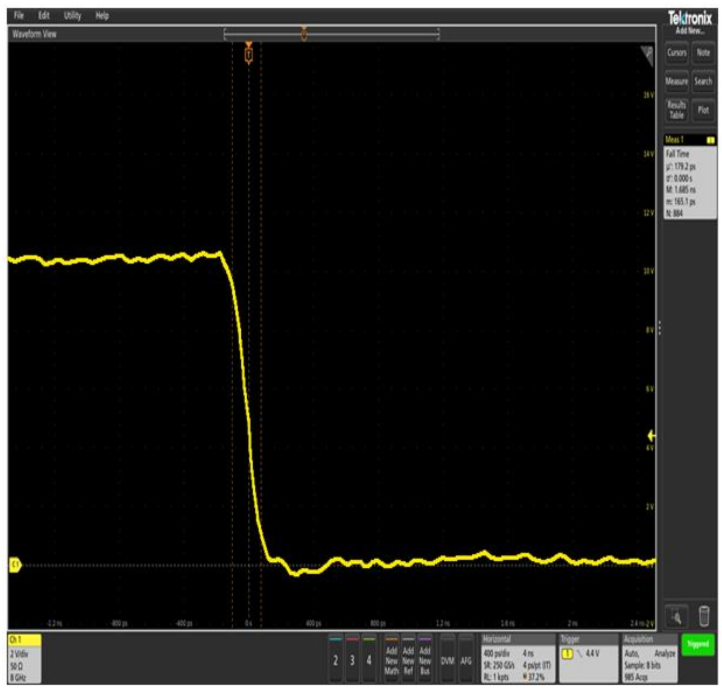
J2152A Data Sheet

High Speed Probe Calibrator

Ultra-High-Performance Pulse Generator



low impedance calibration source

de-embed probes and interconnects

identify bandwidth and resonances

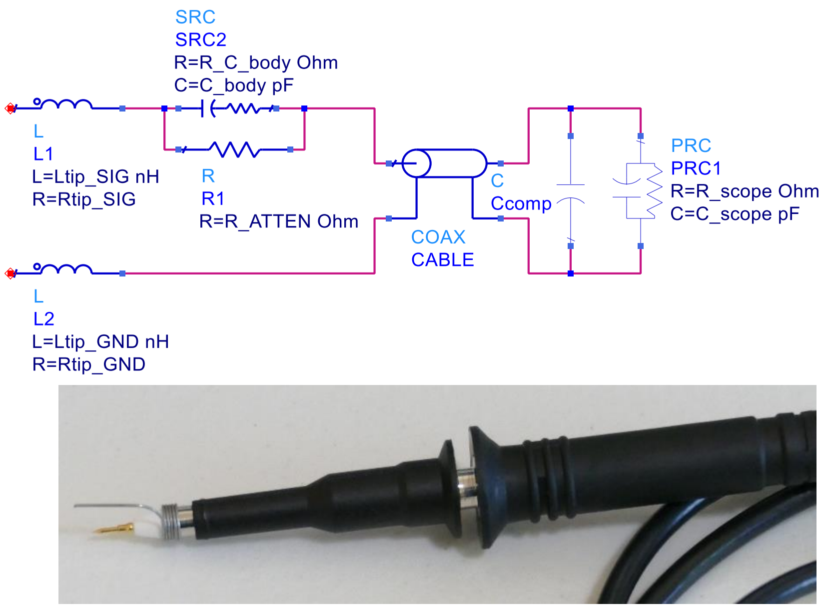
ultra-fast transient edge generation

PICOTEST

High Speed Probe Calibrator

The Picotest J2152A probe calibrator enables the engineer to detect and account for the limitations of probe transfer functions and support de-embedding for accurate measurements. The J2152A high-speed, low-impedance transient signal source permits testing far beyond the oscilloscope's built-in test signal capabilities. This allows the engineer to verify and improve on the limitations of the probes and interconnects.

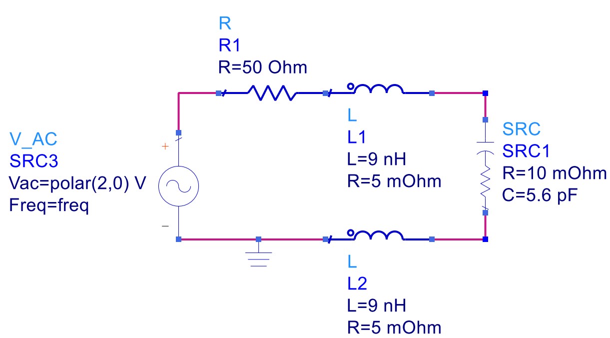
Figure 1 shows the component parts of a typical passive probe.



Typical Oscilloscope Probe Parasitic Elements
Figure 1

For an accurate measurement, the test source impedance must be much lower than the probe DUT (Device Under Test). If this condition is not met, a correction factor can be used to cancel out the probe's attenuation error.

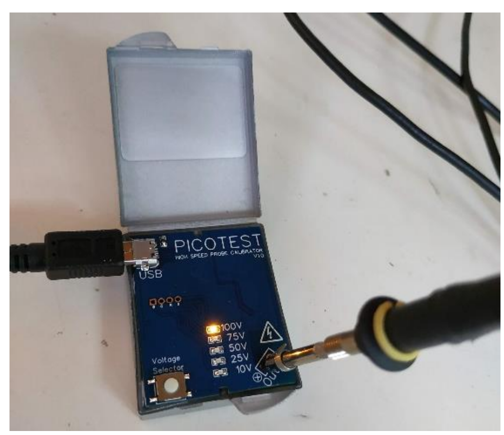
As shown in Figure 2, the probe tip and ground connections form an inductive loop. The inductance is proportional to the loop area and varies greatly from probe to probe.



Typical Oscilloscope Probe Parasitic Elements
Figure 2

FEATURES:

- Calibrates Probes up to 1.4GHz
- Evaluate probe response above the probe bandwidth and without the damping introduced by a 50Ω signal source
- Properly compensate the probe with a low impedance source
- Compensate the probe with the oscilloscope being used for the measurement
- Pocket size, Micro-USB powered
- Very simple to use
- 200ps Typical Fall Time
- < 1Ω Discharge Impedance
- Voltage Selection: 10V, 25V, 50V, 75V and 100V selectable to match probe or application
- Probe Modeling
- Works with all probes with at least (or greater than) a 10V dynamic range

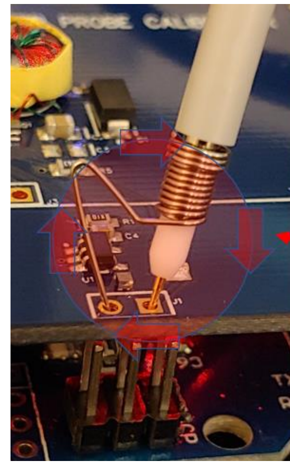


Slim Body Probe with Extended Tip

KEY PROBE CALIBRATOR CHARACTERISTICS

The ability to calibrate and de-embed cables, fixtures and interconnects is essential for high frequency measurements. Measuring edge speeds and pulse flatness is difficult. The probe might have up to three adjustment methods for optimal probe compensation. In the ideal case, compensation is performed to obtain a flat frequency response up to the probe's -3db bandwidth. Regardless of whether the probe can be adjusted or not, it is important to know what can be accurately measured.

The typical probe compensation method uses a source with an impedance too close to the probe impedance. As an example, consider a 500Mhz 10:1 probe with 5.6pF of tip capacitance.



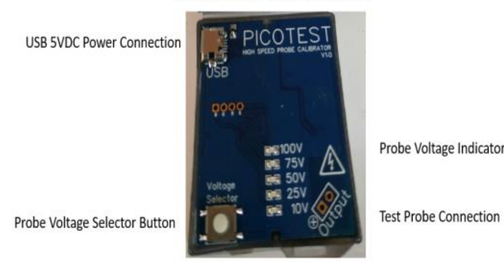
For an accurate measurement up to 500Mhz, this loop area should be less than 0.72"

$$Z_{TIP} = \frac{1}{2\pi f C} = \frac{1}{2\pi * 500Mhz * 5.6pF} = 56\Omega$$

In this case, we can directly measure the probe frequency response only if the signal generator impedance is much lower than 56Ω. This means using a signal generator with a 50Ω output impedance will give an inaccurate and misleading result.

Digging deeper into the probe's character, the probe tip wires add inductance. To support an accurate measurement, what is the maximum inductance we can tolerate?

J2152A High Speed Probe Calibrator



$$L_{MAX} = \frac{1}{(2\pi f)^2 * C} = \frac{1}{(2\pi * 500Mhz)^2 * 5.6pF} = 18nH$$

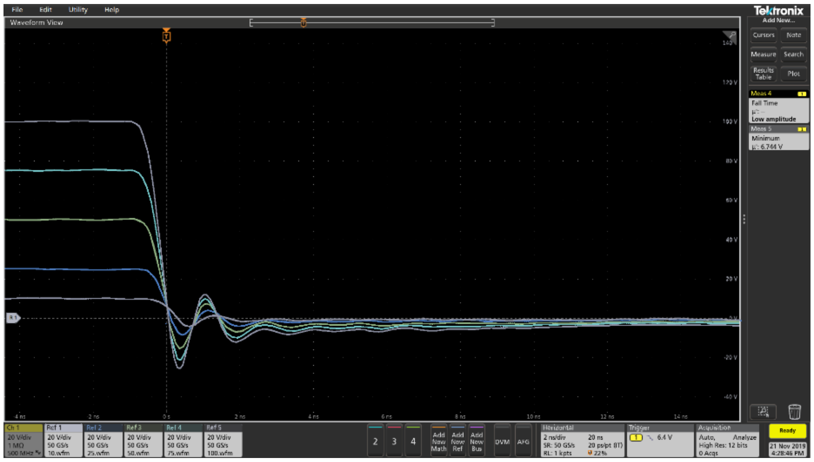
An approximation for wiring inductance is 25nH per loop-circumference-inch. To get a measurement inductance less than 18nH, we need a loop area of less than 0.72" or 0.36" for the tip and 0.36" for the ground return.

The probe inductance will resonate with the capacitance—the probe will oscillate at this frequency. In addition, the probe impedance will be at a minimum at this frequency, which makes a low source impedance even more important.

The bandwidth of most high-impedance probes is less than 1Ghz. This means the frequency response of the test method should have at least a 2x measurement margin, or 2Ghz. This sets the requirement for the test pulse fall time.

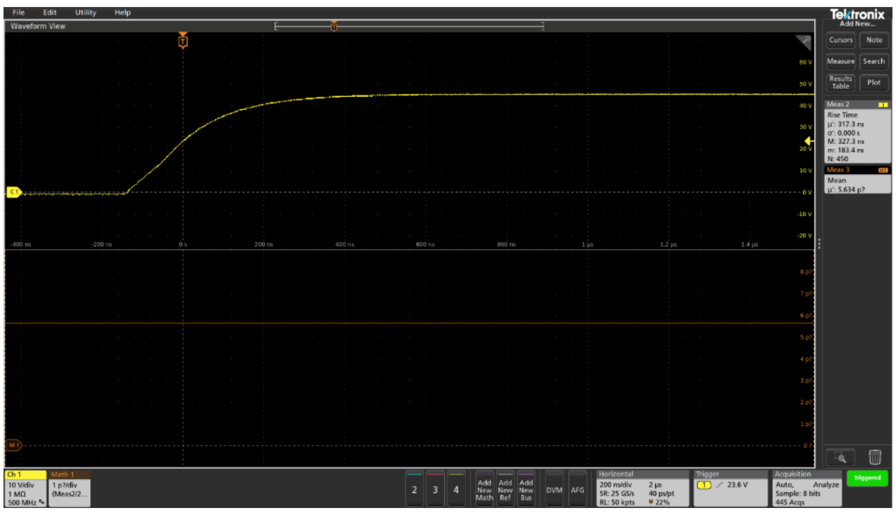
$$T_{FALL} = \frac{0.35}{2Ghz} = 175ps$$

With the included USB Type-A to Micro-USB cable, the J2152A takes 5VDC power from a standard, powered USB port. The 5V input is pumped up to a user-selected probe voltage with 10V, 25V, 50V, 75V and 100V options.



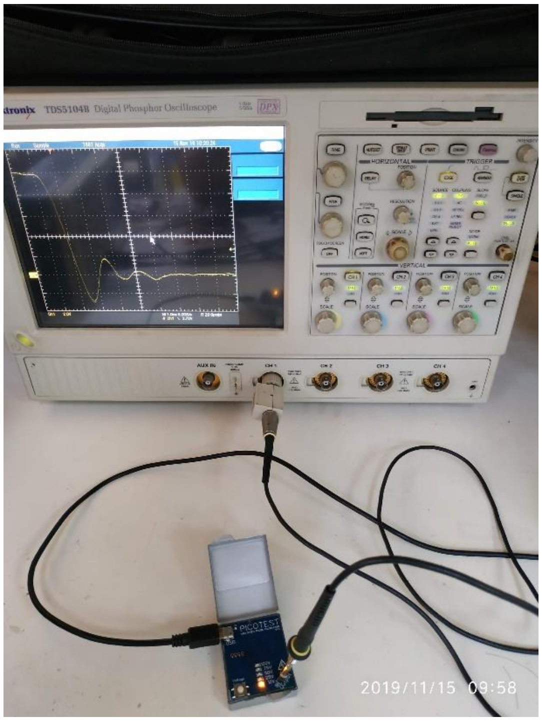
The probe tip is charged to a programmable voltage, up to 100V. The probe is then discharged using a GaN FET. The result is a time domain response as seen in the ringing waveform.

Figure 3

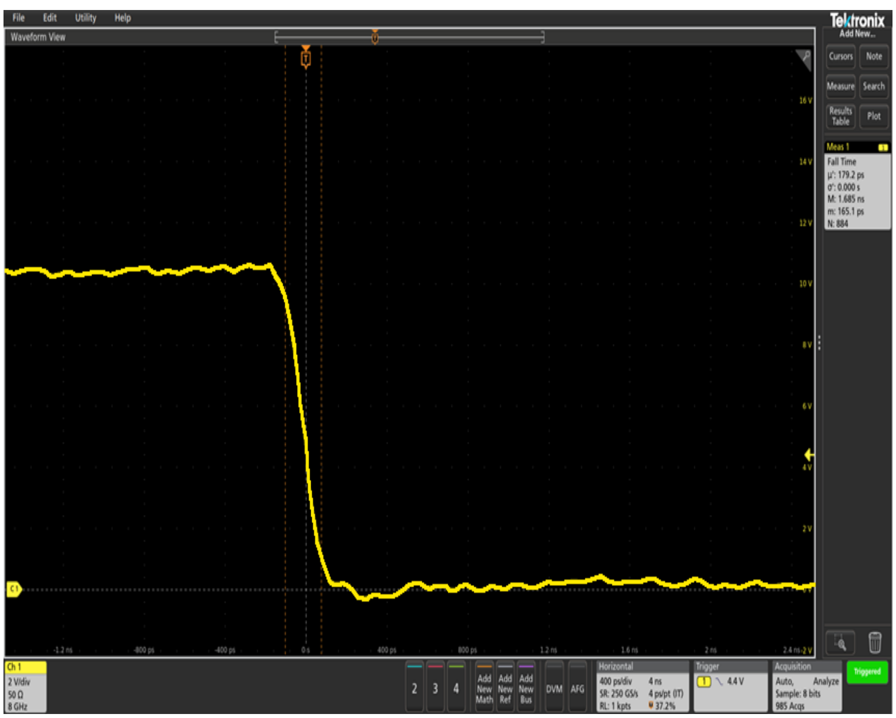


The probe tip capacitance is measured using the rise time of the probe tip charge voltage.

Figure 4



Typical Usage of the J2152A Probe Calibrator
Figure 5



The measurement of a Tektronix P6150 9 GHz probe indicates a 179ps fall time with no ringing, preshoot or overshoot. The 179ps includes the slew rates of the probe pulser, the probe under test and the oscilloscope. De-embedding the scope and probe bandwidth shows a 169ps fall time.
Figure 6

OPERATING PROCEDURE

1. Connect the USB cable from a USB source that has 5VDC power capability.
2. Press the Voltage Selector button until the desired peak voltage LED is illuminated.
3. Connect the probe to be tested to the OUTPUT pads. Note that the probe tip should connect to the square pad 1 and return connects to pad 2. The voltage selected should be the highest voltage that is safe for the oscilloscope.
4. Set the oscilloscope to negative trigger.
5. Evaluate the resultant waveform.
6. Figure 6 is an example of a well-behaved probe. If the probe being tested has a compensation adjustment, then the overshoot and oscillation (ringing) can be minimized. This will give you the highest possible accuracy and identify limitations in the probing system.

SPECIFICATIONS

Characteristic	**Minimum**	**Typical**	**Maximum**
USB Power Input	4.75	5.00	5.25
USB Cable Connectors		USB Type-A USB-Micro	
Input Current	100mA	150mA	200mA
Probe Voltage[1]	10 V_{PK}	25, 50, 75V_{PK}	100V_{PK}
Probe Voltage Accuracy[2]		2%	
Probe Pull-up Resistance		10K	
Probe Discharge Resistance	0.4Ω	0.6Ω	0.8Ω
Probe Discharge Fall Time[3]		200pSec	250pSec

[1] User-Selectable Probe Voltages
[2] Percentage of Selected Probe Voltage
[3] Measured with zero tip capacitance using e-field integration.