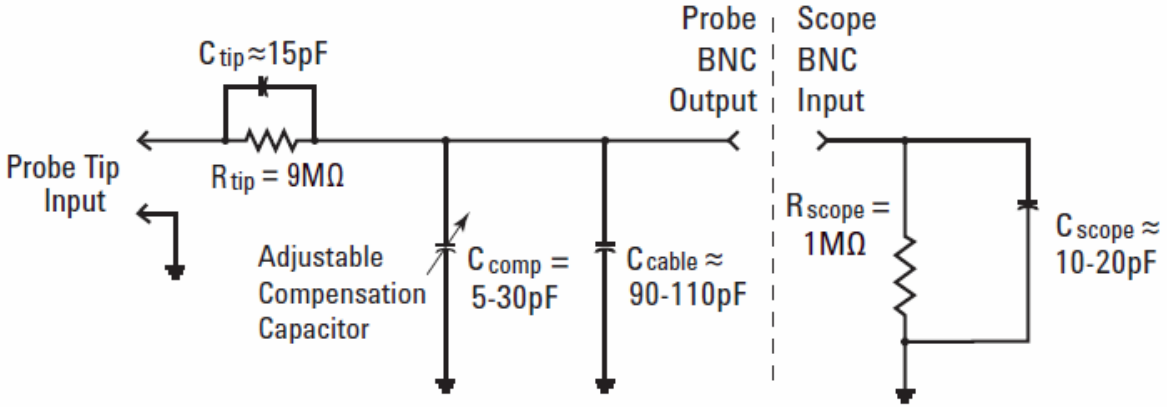
# Probing Basics

- **Probes are used to transfer the signal from the device-under-test to the oscilloscope's BNC inputs.**

- **There are many different kinds of probes used for different and special purposes (high frequency applications, high voltage applications, current, etc.).**

- **The most common type of probe used is called a "Passive 10:1 Voltage Divider Probe".**

# Passive 10:1 Voltage Divider Probe



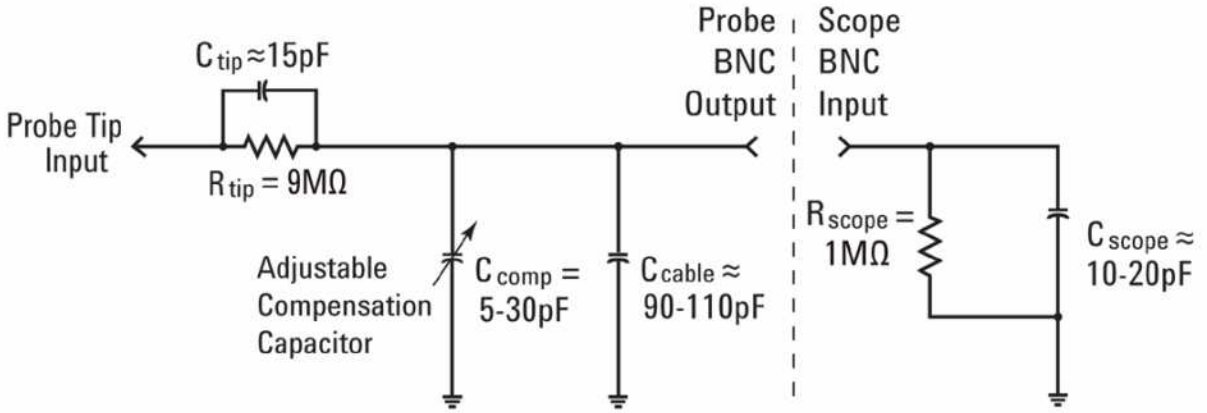

**Passive 10:1 Probe Model**

Passive: Includes no active elements such as transistors or amplifiers.

10-to-1: Reduces the amplitude of the signal delivered to the scope's BNC input by a factor of 10. Also increases input impedance by 10X.

***Note: All measurements must be performed relative to ground!***

# Probing Revisited - Dynamic/AC Probe Model



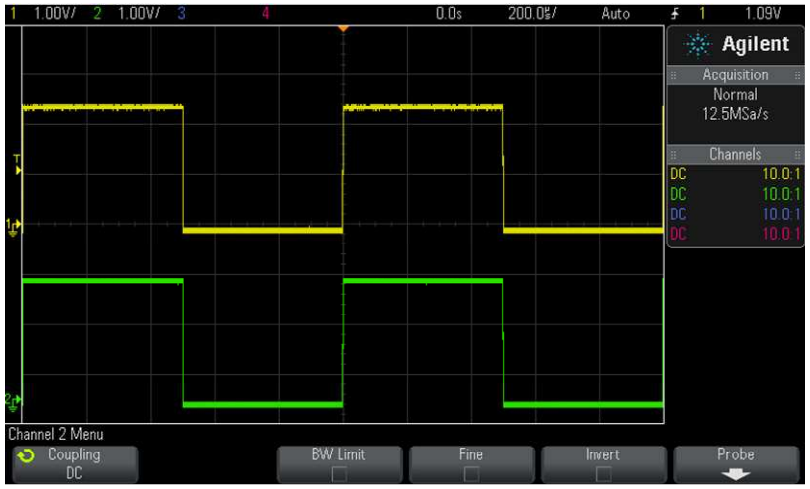

**Passive 10:1 Probe Model**

- $C_{scope}$ and $C_{cable}$ are inherent/parasitic capacitances (not intentionally designed-in)
- $C_{tip}$ and $C_{comp}$ are intentionally designed-in to compensate for $C_{scope}$ and $C_{cable}$.
- With properly adjusted probe compensation, the dynamic/AC attenuation due to frequency-dependant capacitive reactances should match the designed-in resistive voltage-divider attenuation (10:1).

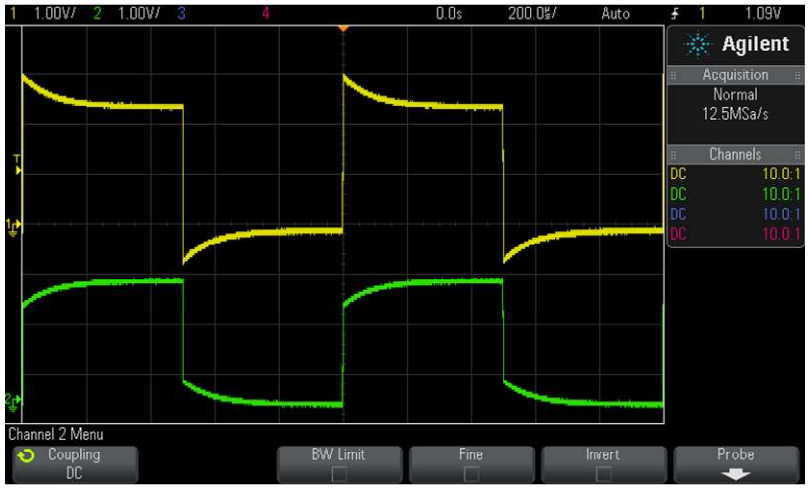
$$\frac{1}{2\pi f C_{tip}} = \frac{9}{2\pi f C_{parallel}}$$

***Where $C_{parallel}$ is the parallel combination of $C_{comp}$ + $C_{cable}$ + $C_{scope}$***

# Compensating the Probes




**Proper Compensation**

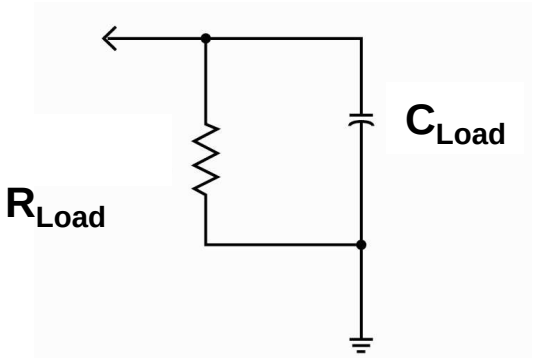



**Channel-1 (yellow) = Over compensated**
**Channel-2 (green) = Under compensated**

- Connect Channel-1 and Channel-2 probes to the “Probe Comp” terminal (same as Demo2).
- Adjust V/div and s/div knobs to display both waveforms on-screen.
- Using a small flat-blade screw driver, adjust the variable probe compensation capacitor ($C_{comp}$) on both probes for a flat (square) response.

# Probe Loading

- The probe and scope input model can be simplified down to a single resistor and capacitor.




**Probe + Scope Loading Model**

- Any instrument (not just scopes) connected to a circuit becomes a part of the circuit under test and will affect measured results… especially at higher frequencies.
- “Loading” implies the negative affects that the scope/probe may have on the circuit’s performance.