Cheat Sheet

8 BEST PRACTICES FOR OSCILLOSCOPE PROBING

1 Compensate passive probes

- Passive probes contain a **fixed parallel RC network** (in the probe tip) and a **variable compensation capacitance** (usually at the scope attachment point)
- **Probe compensation** involves adjusting the variable compensation capacitance in order to cancel out or "compensate" for the inherent input capacitance of a scope.
- How do I do it?
  - Locate the 1000 Hz square wave generator (available on the front of most scopes for probe compensation)
  - The probe tip is connected to the source and probe ground is connected to ground.
  - A non-conductive tool is inserted into a small hole in the compensation box and rotated to adjust capacitance.
  - Adjust until square wave on the display is as rectangular as possible.

2 Use the shortest ground lead possible

- Passive probes are single-ended - they measure voltage relative to ground.
- They need a ground connection, usually via a ground lead with an alligator clip.
- Longer leads add inductance to the measured signal
- This affects higher frequency components, create ringing as well as over- or under-shoot in square wave type signals.
- The lead should be kept as short as possible.

3 Select the correct input impedance

- Some oscilloscopes allow users to select an input impedance or "termination" between 50Ω and 1MΩ.
- An incorrect input impedance can affect the measured signal amplitude and lowers the max safe input voltage
- A feedthrough adapter can be used for scopes that don't natively support 50Ω.

4 Zero and degauss current probes

- **Zeroing**
  - Current probes produce an output voltage proportional to the amount of measured current
  - Ideally, a current probe should read zero when no current is present
  - The "zero" value can drift over time due to temperature or environment conditions
  - Correct this by zeroing or zero adjusting the current probe either on the probe itself or through menus on the scope
  - Always zero current probes before making measurements for best accuracy
- **Degaussing**
  - Current probe core may retain magnetism (flux) even without current
  - Residual magnetism can create offset and impact measurements
  - Most probes have a degauss function accessible from the probe itself or the scope UI
  - It's best to demagnetize or "degauss" current probes before zeroing and measuring

5 Multiple loops for current sensitivity

- Looping the conductor through the current probe multiple times increases measurement sensitivity
- Sensitivity increases linearly with the number of loops
- Since the scope doesn't know the number of loops, so the appropriate scaling value must be manually entered
- Note: looping also increases the insertion impedance, but this is usually small and does not significantly affect low current measurements

6 Deskew probes for power measurements

- Power measurements require simultaneous measurement of current and voltage, so current probes and voltage probes are used together to make power measurements
- A time offset or "skew" exists because of different propagation times in the probe leads
- This skew between current and voltage waveforms can lead to incorrect power results
- Special deskew fixtures generate time-aligned voltage and current pulses to detect and compensate for skew
- Determine and enter the appropriate deskew offset to the scope to align the two waveforms back into phase and improve the accuracy of power measurements

7 Differential probes for floating measurements

- Oscilloscope probes normally measure voltage relative to ground (single-ended measurements)
- Sometimes we want to measure voltage between two points which are not connected to the ground ("floating" or "differential" measurements)
- Differential probes use an internal differential amplifier to produce a voltage that corresponds to the voltage difference at the two connection points
- Differential probes reject common mode noise and protect both devices and human operators from the high currents created by accidental ground connection

8 Active probes for demanding applications

- Active probes have powered components like FET (field effect transistor) in the tip
- With much lower input capacitance than passive probes, they provides two main advantages:
  - Reduced circuit loading for more accurate signal reproduction and less impact on the circuit
  - Higher bandwidth for more accurate measurement of high speed and high frequency signals like square waves and pulses

FIND OUT MORE:

'Understanding Oscilloscope Probing – Best Practices' video

'Oscilloscope and probing fundamentals' webpage