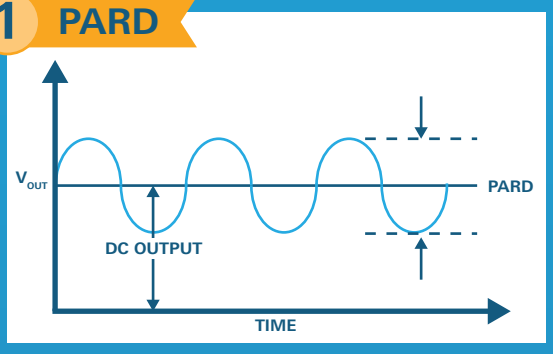
POWER INTEGRITY FUNDAMENTALS

A GUIDE TO VERIFYING POWER RAIL TOLERANCES

Common PI Measurements

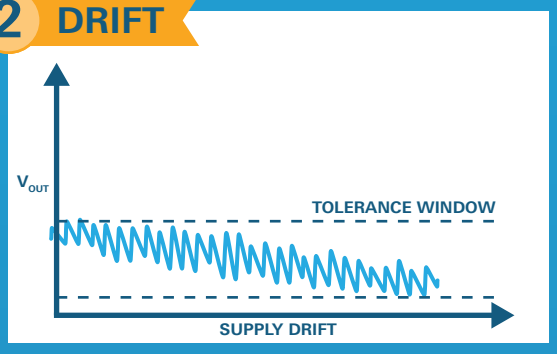
Lower rail values and tighter tolerances combine to require ripple and noise measurements of just a few mV in amplitude. These dynamics challenge traditional oscilloscope measurement accuracy.

1 PARD



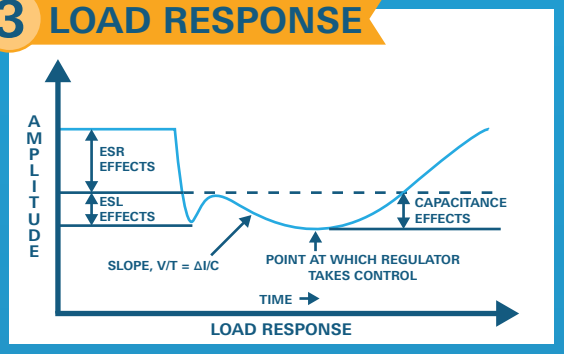
PARD (periodic and random deviation) is the deviation of the DC output from its desired value. It is typically measured in peak-to-peak.

2 DRIFT



Variations and drift over time

3 LOAD RESPONSE



A static or transient load and measurement of specified output limits for a predetermined load.

Test Equipment Measurement Challenges

OFFSET

Most oscilloscopes have limited offset capability at small volt/div settings. This limits the ability to zoom in on the signal for the most accurate measurement.

Hint: If you've ever turned the volt/div knob and the signal jumped off the screen, you are probably offset limited.

VOLT/DIV FULL BANDWIDTH + LOW NOISE

Many scopes limit bandwidth at small volt/div settings due to poor noise performance. Others expand a larger volt/div setting (adding noise).

Hint: Noisy scopes will often display a division or more noise at 1mV/div. For scopes that limit bandwidth the noise specification is sometimes hidden so you have to look at the scope's spec sheet.

UPDATE RATE

Update rate is important to quickly find outliers in your system and to increase confidence that you're within the power rail's required tolerances.

Hint: If you ever have had to leave a scope running overnight with infinite persistence turned on, it is likely due to a slow update rate.

What to Look For in a Scope?

Low noise: Important to start with so as to not eat more margin.

2-4GHz of bandwidth: Allows viewing of high-frequency signals that may couple to the rail.

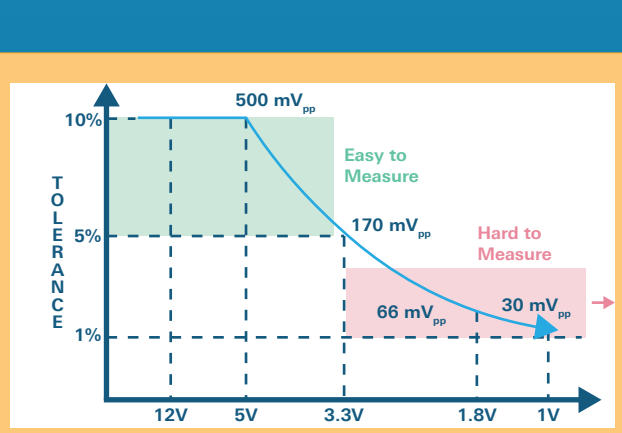
Fast update rate: Quickly capture outliers that impact margin.

Excellent frequency domain capability: It's easier to see a coupling signal in the frequency domain. Look for a scope with a fast FFT.

Deep memory: Allows capturing of more time at higher sample rates.

Power rail probe: A probe focused on PI allows the scope to make the best measurements.

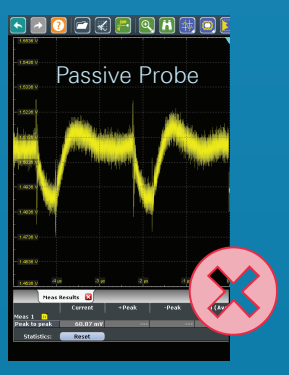
Power Integrity Probing Methods

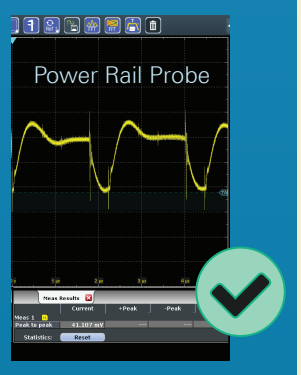


Today's highly integrated electronic devices use smaller voltage levels requiring smaller ripple levels on the power rails for reliable operation. The challenge lies in accurately measuring very small mV level signals riding on power rails.

WHAT TO LOOK FOR IN A PROBE:

- A 1:1 Attenuation and Low Noise
- B High Offset
- C High Bandwidth (>2GHz)
- D High Input Impedance





10:1 Passive Probe

- 10:1 attenuation adds noise
- <500MHz bandwidth
- Good offset due to 10:1 attenuation
- Good input impedance at very low frequencies.
- Heavier loading at >100MHz.

1:1 Passive Probe

- 1:1 attenuation is low noise
- <50MHz bandwidth limits capability
- Offset is limited to scope offset
- Good input impedance at very low frequencies.

DC Block and 50Ω Pig Tail

- Direct connect is low noise
- Bandwidth to limit of scope
- DC block removes offset
- DC block misses drift
- Poor input impedance

Power Rail Probe

- 1:1 is low noise
- Bandwidth >2GHz allows you to capture high frequency coupling
- Built-in offset supports up to 60V
- Excellent input impedance minimizes loading

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