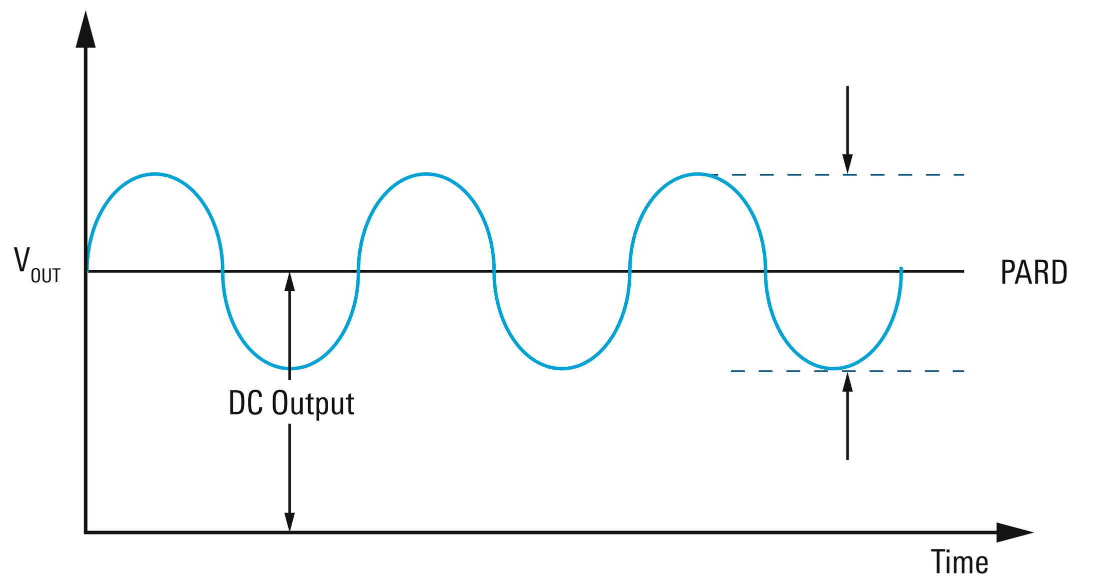
Power Integrity Fundamentals
A guide to verifying power rail tolerances

Common PI measurements

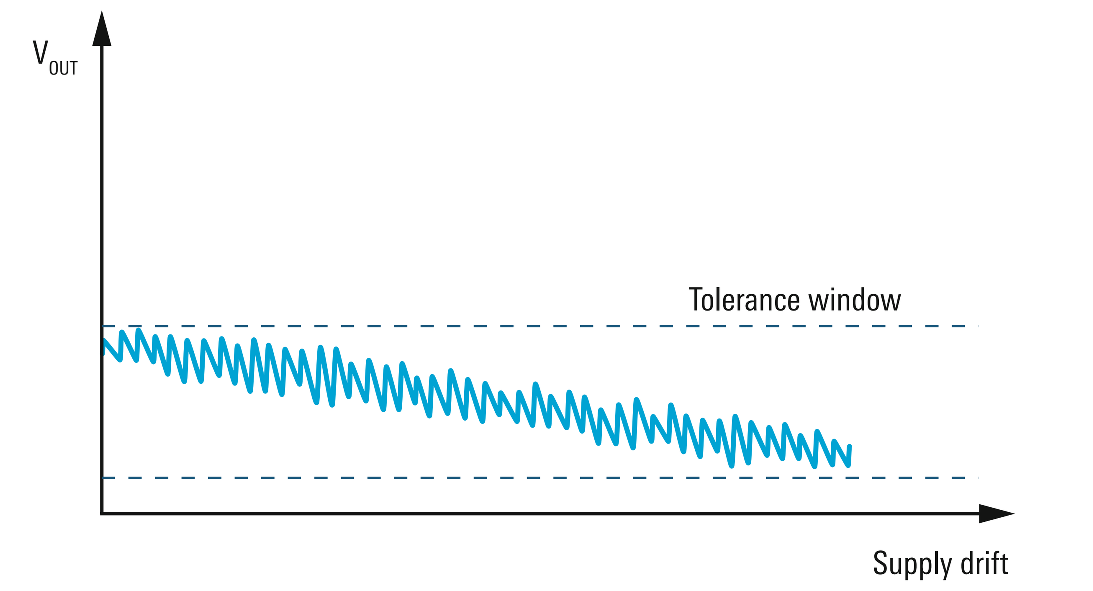
Lower rail values and tighter tolerances combine to require ripple and noise measurements of just a few mV in amplitude. These dynamics challenge the traditional oscilloscope measurement accuracy.

1. PARD



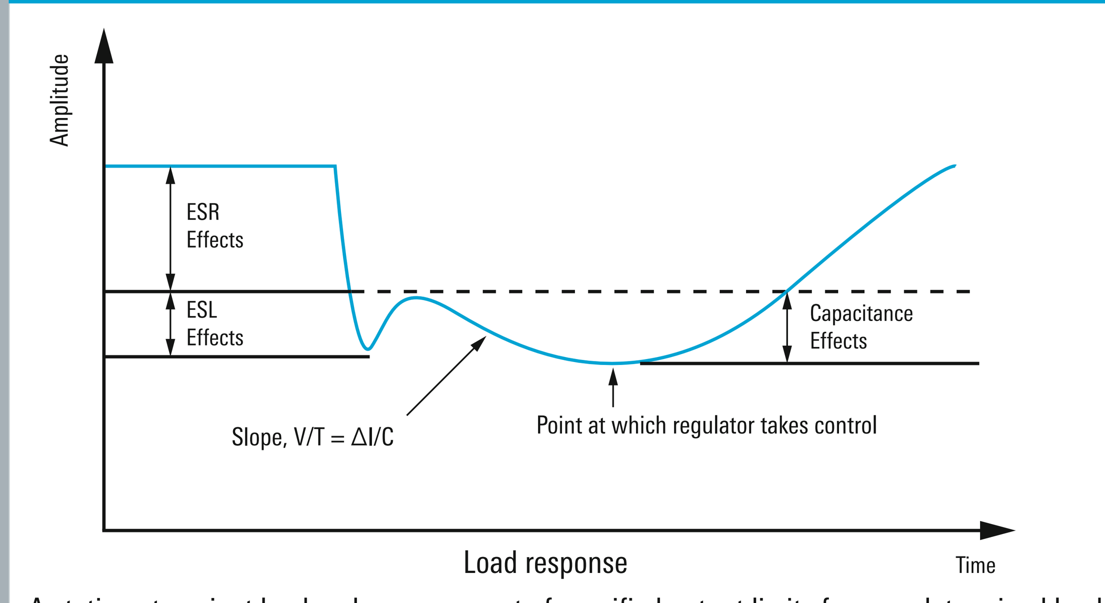
PARD (periodic and random deviation) is the deviation of the DC output from its desired value. It is typically measured in peak-to-peak.

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 V/div settings. This limits the ability to zoom in on the signal for the most accurate measurement.

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

V/div full bandwidth + low noise

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

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

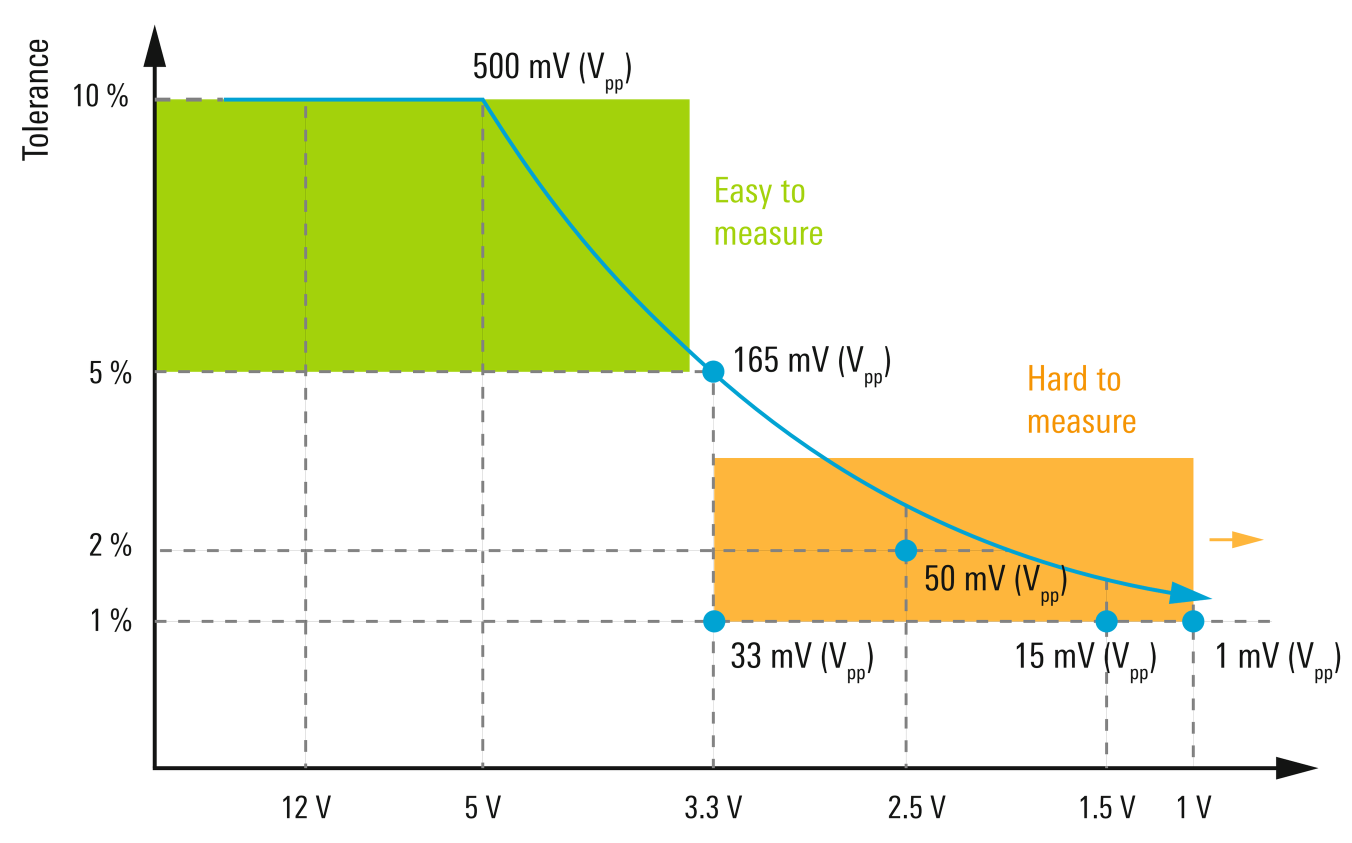
Hint: If you ever have had to leave a oscilloscope running overnight with infinite persistence turned on, it is likely due to a slow update rate.

What to look for in an oscilloscope?

Important oscilloscope features

- **Low noise**
  Important to start with, so as to not eat more margin
- **Bandwidth of 2 GHz to 4 GHz**
  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 an oscilloscope with powerful FFT for fast analysis
- **Deep memory**
  Allows capturing of more time at higher sample rates
- **Power rail probe**
  A probe focused on PI allows the oscilloscope to make the best measurements

Do you know?

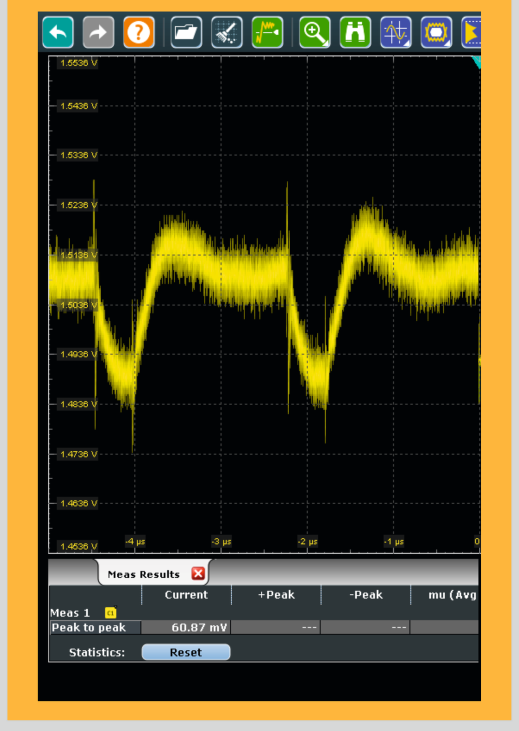


Today's highly integrated electronic devices use smaller voltage levels requiring smaller ripple levels on the power rails for reliable operation. The challenge lies in accurately measuring very small mV level signals riding on power rails.

Power Integrity probing methods

10:1 Passive probe	1:1 Passive probe	DC Block and 50 Ω Pig tail	Power rail probe
10:1 attenuation adds noise	1:1 attenuation is low noise	Direct connect is low noise	1:1 is low noise
< 500 MHz bandwidth	< 50 MHz bandwidth limits capability	Bandwidth to limit of scope	Bandwidth > 2 GHz allows you to capture high frequency coupling
Good offset due to 10:1 attenuation	Offset is limited to scope offset	DC block removes offset	Built-in offset supports up to 60 V
Good input impedance at very low frequencies	Good input impedance at very low frequencies	DC block misses drift	Excellent input impedance minimizes loading
Heavier loading at > 100 MHz		Poor input impedance	

Passive probe



Power rail probe

What to look for in a probe?

I 1:1 Attenuation and Low Noise
II High bandwidth (> 2 GHz)
III High offset
IV High input impedance

PD 5215.8929.82 V01.00

www.rohde-schwarz.com/oscilloscopes

For more information:

ROHDE&SCHWARZ