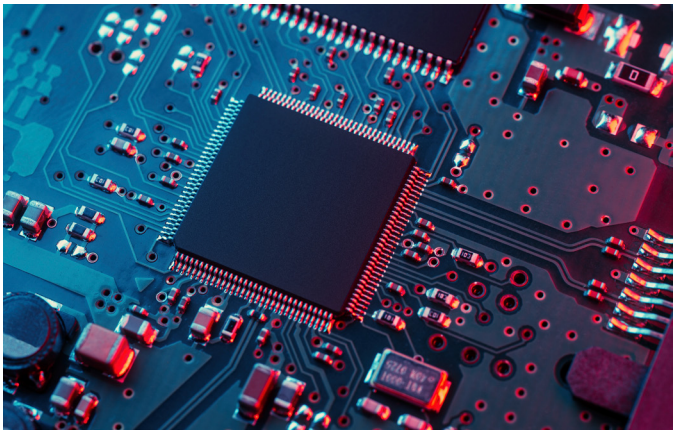
EASY POWER SEQUENCING AND RIPPLE NOISE ANALYSIS WITH MXO OSCILLOSCOPES

Today's complex circuits must integrate several components that feed on different power levels. A robust circuit that ensures interoperability of these components needs carefully designed, clean and stable power distribution networks for power timing. At lower voltage levels, tolerance is defined in percentages and can make precise measurements challenging.



Your task

The powering up or down of a circuit design is crucial to proper device behavior and helps make sure parts and components operate properly under expected voltage conditions. An oscilloscope is ideal for inspecting the timing behavior in power rail sequences. However, a typical 4-channel oscilloscope can only provide limited analysis of complex circuits. Smaller rail voltages and tighter tolerances from 1 % to 2 % often make it difficult for instruments to provide accurate measurements due to instrument and probing noise. Fast switching loads and high frequency noise coupling can cause problems, especially with EMI issues.

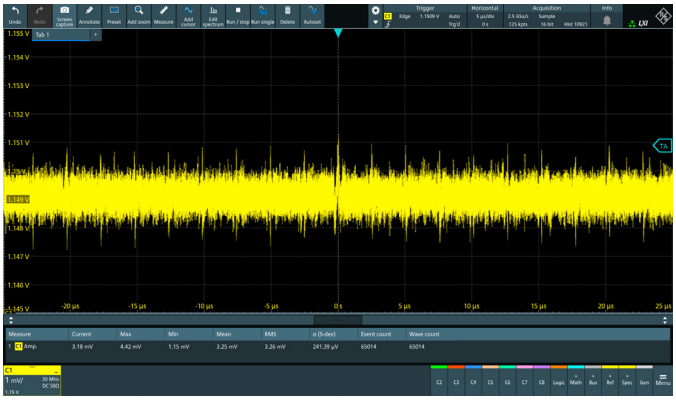
Rohde & Schwarz solution

The MXO 3 and MXO 5 series oscilloscope simplify power sequence analysis with easy probing of different power rails. The eight analog channels and 16 logic channels mean the oscilloscope can accommodate diverse acquisition needs for comprehensive insight into multiple rails. With the industry's deepest standard memory of up to 500 Mpoints per channel, the oscilloscope is great at capturing millisecond-range power up/down sequences while maintaining sampling resolution for signal details.

By reducing bandwidth in ripple noise analysis, the 12-bit ADC samples can be enhanced to 18-bit high definition (HD) resolution for accurate measurements. The instrument's high input sensitivity of 500 µV/div and extensive offset range of ±5 V lets users examine a 50 V DC rail (10:1 probe) at the highest vertical sensitivity settings. By leveraging the enhanced frontend performance, the MXO architecture uses a sample based trigger with remarkable sensitivity of < 0.0001 vertical divisions.

Benefits of MXO oscilloscopes

- Up to eight analog channels and 16 digital logic channels
- Up to 500 Mpoints standard memory per channel
- 12-bit ADC with 18-bit HD mode
- 500 µV/div sensitivity with ±5 V offset range
- Digital trigger implemented

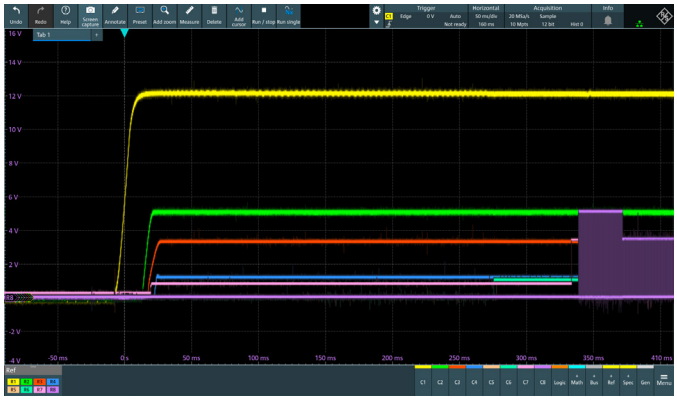


Frontend performance of the MXO with high sensitivity and larger offset

Power sequence measurement considerations

Precise voltage levels with specific timing are critical to circuit functionality. Power sequencing as a fundamental test for circuits can be a tedious process when probing and comparing multiple power rails. While logic channels can be used here, their detail is limited, they only indicate 1 or 0 against a threshold. Increasing the number of analog channels is better for capturing transition details.

Substantial record lengths are important, especially when observing for several hundred milliseconds or even several seconds (for high power circuits). The longer record length is essential for sufficient discharge times and the thorough assessment of power sequence dynamics. In power distribution networks, lower DC rails are derived from higher supplies and need time to stabilize before being regulated to smaller rails.



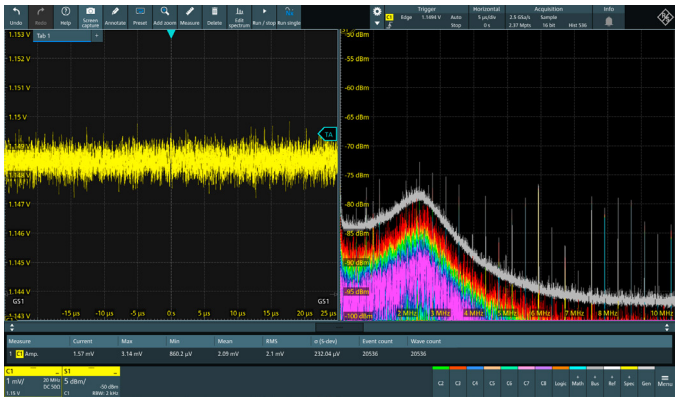
Timing delay between power rails are necessary to ensure stable supply available prior to activating different circuit parts.

Ripple noise measurement considerations

Bandwidth is important when determining power integrity. Measurement systems with higher bandwidths always capture higher noise levels. Identifying the frequency range of interest and selecting the appropriate measurement bandwidths and filter settings on measurement equipment is vital for capturing relevant frequency components while filtering out unwanted noise and harmonics. Power conversion circuits usually have a switching frequency of 1 MHz. So, 20 MHz of bandwidth is enough for a stability analysis of the feedback control loop. There is also a growing trend to characterizing power ripple noise with even higher bandwidth in the gigahertz range. The trend emphasizes the analysis of high frequency load changes. R&S®RT-ZPR power rail probes can provide up to 4 GHz of analysis bandwidth.

When measuring ripple noise, take care to prevent injecting additional noise into the setup. Short and direct connections help minimize interference. Coaxial cables can provide a low inductance setup for any measurements.

Spectral analysis can provide additional insight and help identify the frequency components of power ripples, pinpoint specific noise sources and effectively address them. MXO oscilloscopes have powerful spectral analysis that updates at a rate of 45 000 FFT/s. The fast update rate creates a responsive view of spectral noise for EMI analysis of elusive and sporadic events. Together with near field probes, emission sources can be located and necessary filter designs applied to mitigate power noise issues.



Spectral analysis on ripple noise shows the noise frequency components

Summary

Power sequence and power rail analysis are fundamental measurements to ensure proper circuit behavior. With eight channels, the MXO 3 and MXO 5 series are ideal for multiple rail analysis. With up to 500 Mpoints per channel retain high sampling resolution and the 12-bit ADC provides highest available precision for accurate measurements. Filtering and box car averaging allow the HD mode to provide up to 18-bit precision. The MXO series oscilloscopes also have a high input sensitivity of 500 µV/div with ±5 V offset range for an easy passive probe setups in power rail measurements. The channel input can also apply selective filters or use HD mode filtering to generate the required measurement bandwidth. Functions such as spectrum analysis and frequency response analysis can also be useful when characterizing power ripple behavior.

See also

www.rohde-schwarz.com/oscilloscopes

Rohde & Schwarz GmbH & Co. KG
www.rohde-schwarz.com

Rohde & Schwarz training
www.training.rohde-schwarz.com
Rohde & Schwarz customer support
www.rohde-schwarz.com/support

PD 3672.9338.92 | Version 02.00 | August 2025 (sk)
Easy power sequencing and ripple noise analysis with MXO oscilloscopes
Data without tolerance limits is not binding | Subject to change