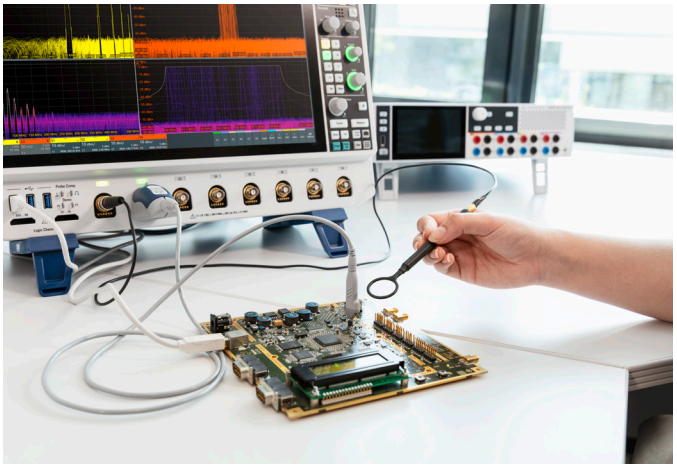
EMI DEBUGGING USING FAST FFT WITH MXO OSCILLOSCOPES

With advanced FFT capabilities and unparalleled sensitivity and dynamic range, the MXO oscilloscopes are the perfect choice for electromagnetic interference (EMI) debugging. Swiftly and accurately detect and analyze EMI emanating from electronic circuits and boards with time-correlated RF analysis. Elevate your debugging experience with the fast performance of the MXO oscilloscopes.



Your task

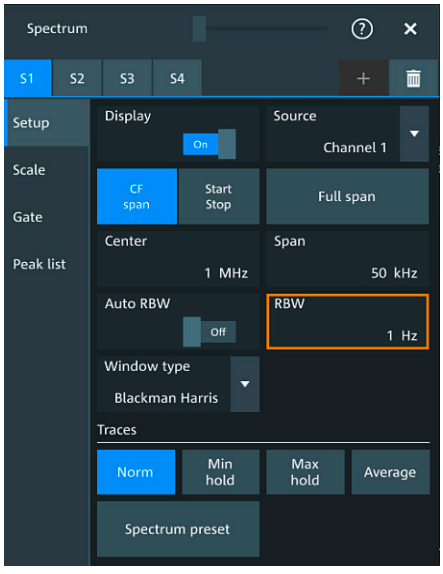
EMI/EMC regulations help ensure reliable operation and safety for users of electrical and electronic equipment, and designers need to invest significant time to keep their products within these limits.

During the design and prototyping phases, it is common practice to perform debugging measurements that identify and resolve potential EMI/EMC challenges before subjecting the product to compliance testing. This proactive approach significantly mitigates the risk of noncompliance. The goal is to efficiently locate emission sources that might impact conformity results using a range of testing tools and troubleshooting techniques. For an all-encompassing solution that streamlines the debugging process, consider an oscilloscope with time-correlated RF measurement capabilities, such as the MXO oscilloscopes.

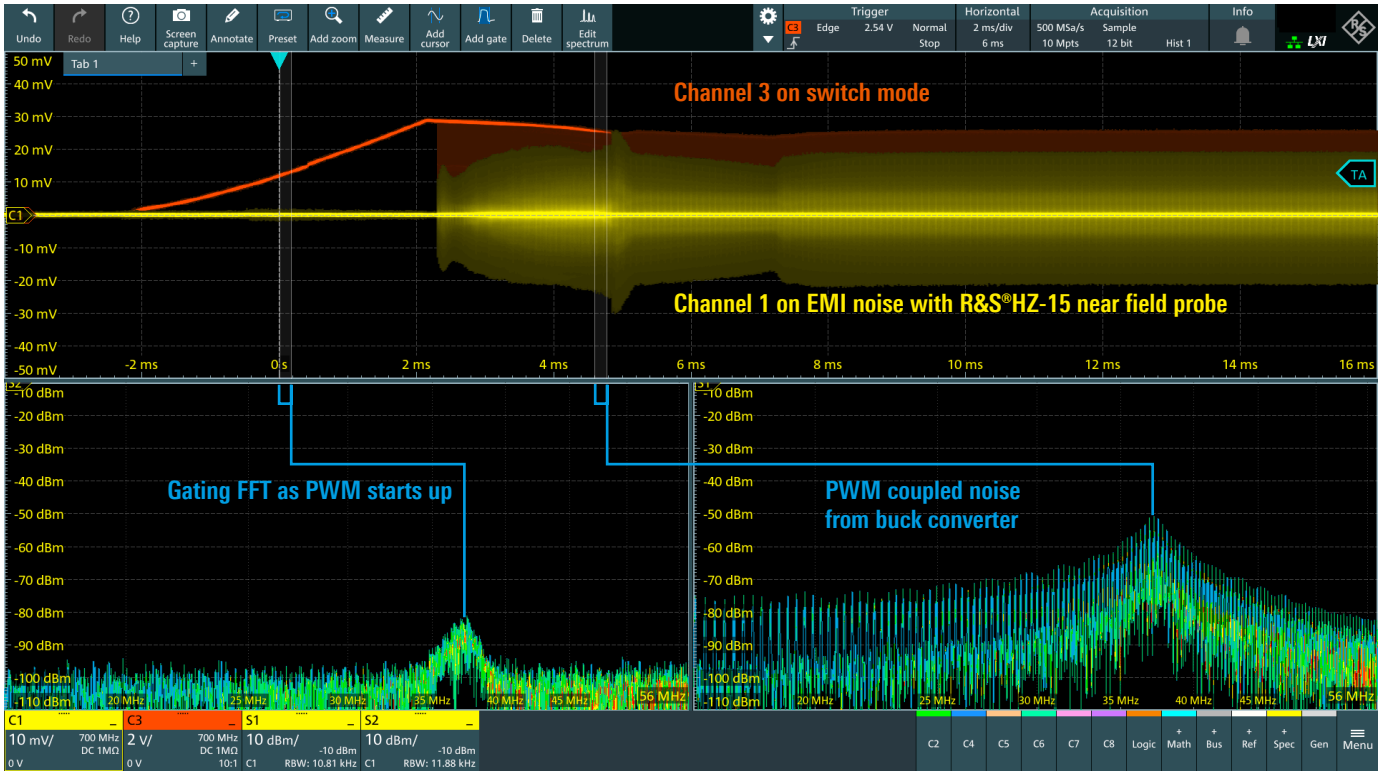
Rohde&Schwarz solution

The MXO oscilloscopes provides a synchronized display of analog signal characteristics, digital timing, bus transactions and the frequency spectrum. This is enabled by the new ASICs, which process RF measurements in the hardware and overcomes traditional limitations of slow FFT computation. This is further enhanced by the user interface with familiar spectrum analysis controls (center frequency, span and RBW).

- Independent optimization of displays in the time and frequency domains
- High spectrum display update rate
- Signals can be displayed in both a waveform and spectrum view, without splitting the signal path
- Easy and accurate correlation of time and frequency events with RF and time trigger functions
- Peak list and log-log scales for easy EMI comparison



ROHDE&SCHWARZ
Make ideas real



Outstanding RF performance: high dynamic range and sensitivity

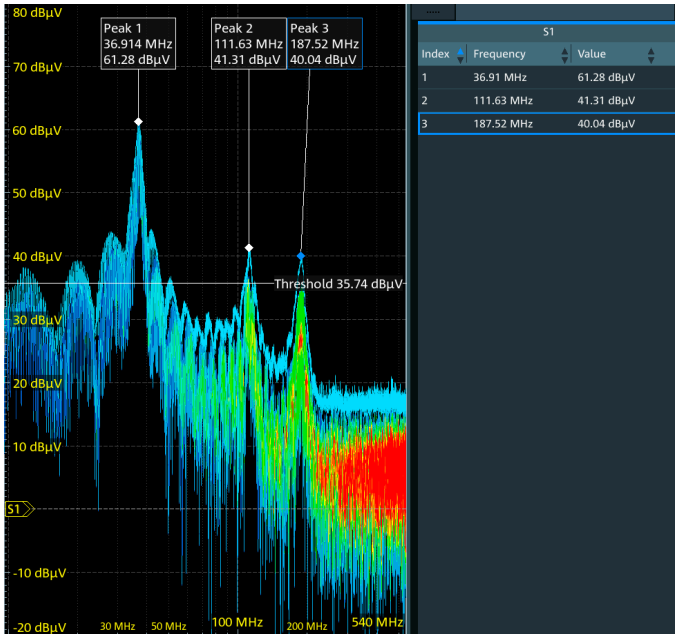
For EMI debugging, the MXO oscilloscopes have a high dynamic range and input sensitivity of 500 µV/div at full measurement bandwidth, allowing even weak emissions to be detected. The 12-bit ADC and 18-bit HD mode enhance the vertical precision. The hardware-accelerated FFT makes analysis in the frequency domain fast and responsive thanks to the high acquisition rate and functions such as color coding of the spectral display depending on the frequency of occurrence.

Additional feature for EMI debugging

- Ultrafast FFT analysis:
  > 45 000 FFT/s update rate helps capture spurious and elusive spectral events
- Logarithmic display and dBµV scales:
  Easy comparison with EMC test lab results and checking with limit lines based on CISPR standards
- Fast results with automatic peak list measurement:
  Automatically measure frequency peaks marked in the FFT and listed in a table
- Max./min. hold and average trace:
  Statistical traces record the maximum, minimum and average value of spectral energy

Gated FFT: correlation between frequency and time

The oscilloscope's gated FFT function enables FFT analysis on a user-defined region of the acquired time domain signal. Move this time window across the signal to determine which segments of the time domain signal correlate to which events in the spectrum. For example, correlate unwanted emissions from switched-mode power supplies with overshoots from the switching transistor.



Probe set for E and H near field measurements

For conducted emissions, line impedance stabilization networks (LISN) typically include noise output for measurements. However, this includes all the conductive noise in the device under test (DUT). To locate the emission sources within the DUT, near field probes are useful to detect magnetic and electric fields in closer proximity.

The R&S®HZ-15 near field probes offers a frequency range from 30 MHz to 3 GHz. The R&S®HZ-16 amplifier extend the lower frequency down to 9 kHz. The near field probe set include various electrically shielded probe tips with special shapes that are designed for different measurements.

Why are fast FFTs important?

While all modern oscilloscopes support FFTs as a means of providing spectral information about the waveform, the required computation often slows down the acquisition rate. Most oscilloscopes can be as slow as 1 FFT/s to 100 FFT/s. This slow performance means that the instrument will have a longer blind time, missing important spectral events between acquisitions. This can be frustrating when locating spectral emissions with near field probes, since the user needs to hold out the probes for several seconds to detect possible noise.

The MXO oscilloscopes have powerful ASICs that allow a hardware implementation of FFT processing. This enables ultrafast calculations that provide more than 45 000 FFT/s. The blind time is minimized and the responsiveness simplifies sniffing for emissions with near field probes. Users can scan the DUT with the probe to determine where and when the noise could be an issue.

Where to start?

To identify the source of an EMI issue, determine the source of energy and find out how this energy is being radiated. Common sources of EMI problems include:

- LCD emissions
- Ground impedance
- Component parasitics
- Poor cable shielding
- Power supply filters
- Switching power supplies (DC/DC converters)
- Internal coupling issues
- Inadequate signal returns
- ESD in metalized enclosures

Start by using an H near field probe to locate the source of the energy. Align the probe to determine the direction of the magnetic flux through the plane of the loop. If you move the H near field probe around the conductor, you can locate the energy source. Then use a finer probe to concentrate the search on a smaller area.

Examining the coincidence of EMI problems with electrical events is arguably the most time-consuming process in EMI diagnostics. The fast FFT of the MXO makes correlating the spectral and time events easy. MXO 5 series oscilloscopes provide multiple FFTs that can have their own RF settings, enabling further debugging by comparing spectral events at different DUT locations.

Summary

EMI can be elusive and a failure to comply with EMC standards can hinder product development. EMI debugging early on in development can help detect problems at an early stage and improve circuit performance.

The MXO oscilloscopes are valuable tools for developers to perform EMI debugging on electronic circuits, featuring powerful FFT signal processing, high input sensitivity and extensive acquisition and analysis capabilities. The oscilloscopes' hardware-accelerated FFTs and color-coded spectral display provide an overview of the frequency of occurrence of spectral components in the acquired signals, allowing fast identification of EMI sources. Since the FFT function is controlled in a similar way as it is in spectrum analyzers, users can easily navigate in the frequency domain without having to worry about the time domain settings.

See also

www.rohde-schwarz.com/oscilloscopes

Rohde & Schwarz GmbH & Co. KG
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Rohde & Schwarz training
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EMI debugging using fast FFT with MXO oscilloscopes
Data without tolerance limits is not binding | Subject to change

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