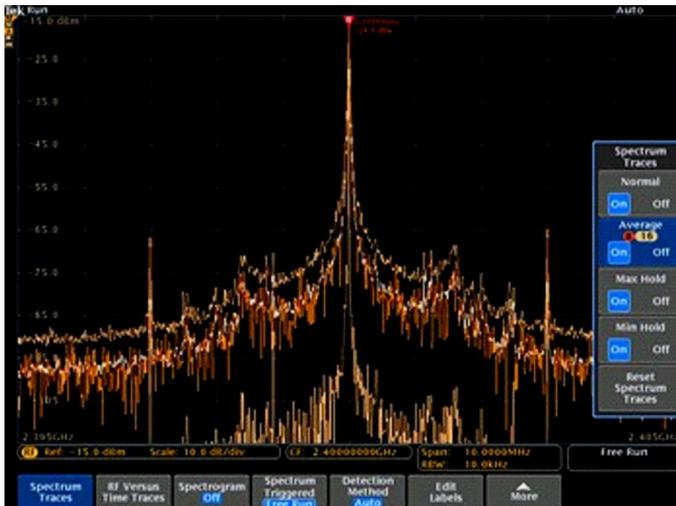


Spectral display of a bursted communication both into a device through Zigbee at 900 MHz and out of the device through Bluetooth at 2.4 GHz, captured with a single acquisition.

Spectrum traces – The MDO4000C Series spectrum analyzer offers four different traces or views including Normal, Average, Max Hold, and Min Hold. You can set the detection method used for each trace type independently or you can leave the oscilloscope in the default Auto mode that sets the detection type optimally for the current configuration. Detection types include +Peak, - Peak, Average, and Sample.



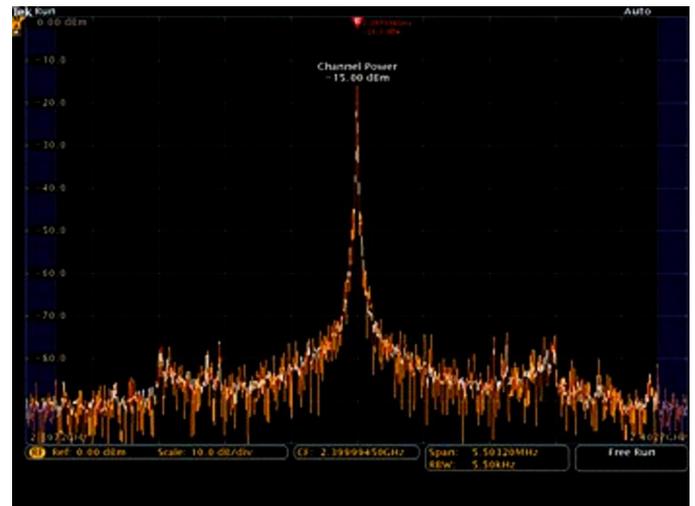
Normal, Average, Max Hold, and Min Hold spectrum traces

Triggered versus Free Run operation – When both the time and frequency domains are displayed, the spectrum shown is always triggered by the system trigger event and is time-synchronized with the active time-domain traces. However, when only the frequency domain is displayed, the spectrum analyzer can be set to Free Run. This is useful when the frequency domain data is continuous and unrelated to events occurring in the time domain.

Advanced triggering with analog, digital and spectrum analyzer channels – In order to deal with the time-varying nature of modern RF applications, the MDO4000C Series provides a triggered acquisition system that is fully integrated with the analog, digital and spectrum analyzer channels. This means that a single trigger event coordinates acquisition across all channels, allowing you to capture a spectrum at the precise point in time where an interesting time domain event is occurring. A comprehensive set of time domain triggers are available, including Edge, Sequence, Pulse Width, Timeout, Runt, Logic, Setup/Hold Violation, Rise/Fall Time, Video, and a variety of parallel and serial bus packet triggers. In addition, you can trigger on the power level of the spectrum analyzer input. For example, you can trigger on your RF transmitter turning on or off.

The optional MDO4TRIG application module provides advanced RF triggering. This module enables the RF power level on the spectrum analyzer to be used as a source for Sequence, Pulse Width, Timeout, Runt, and Logic trigger types. For example, you can trigger on a RF pulse of a specific length or use the spectrum analyzer channel as an input to a logic trigger, enabling the oscilloscope to trigger only when the RF is on while other signals are active.

RF measurements – The MDO4000C Series includes three automated RF measurements - Channel Power, Adjacent Channel Power Ratio, and Occupied Bandwidth. When one of these RF measurements is activated, the oscilloscope automatically turns on the Average spectrum trace and sets the detection method to Average for optimal measurement results.



Automated Channel Power measurement

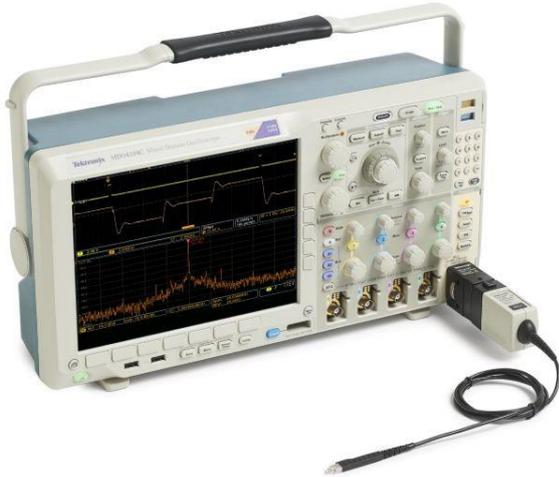
EMI troubleshooting – EMC testing is expensive regardless of whether you purchase the equipment to perform in-house testing or you pay an external test facility to certify your product. And that assumes that your product passes the first time. Multiple visits to a test house can add significant cost and delay to your project. The key to minimizing this expense is early identification and debug of EMI issues. Traditionally, spectrum analyzers with near field probe sets have been used to identify the location and amplitude of offending frequencies, but their ability to determine the cause of the issue is very limited. Designers are increasingly using oscilloscopes and logic analyzers as EMI issues become more transient due to the complex interactions of numerous digital circuits in modern designs.

Datasheet

The MDO4000C, with its integrated oscilloscope, logic analyzer, and spectrum analyzer is the ultimate tool for debugging modern EMI issues. Many EMI problems are caused from events rooted in the time domain, such as clocks, power supplies, and serial data links. With its ability to provide time correlated views of analog, digital, and RF signals, the MDO4000C is the only instrument available that can discover the connection between time-domain events and offending spectral emissions.

RF probing – Signal input methods on spectrum analyzers are typically limited to cabled connections or antennas. But with the optional TPA-N-VPI adapter, any active, 50 Ω TekVPI probe can be used with the spectrum analyzer on the MDO4000C Series. This enables additional flexibility when hunting for noise sources and enables easier spectral analysis by using true signal browsing on an RF input.

In addition, an optional preamplifier accessory assists in the investigation of lower-amplitude signals. The TPA-N-PRE preamplifier provides 12 dB nominal gain across the 9 kHz - 6 GHz frequency range.



The optional TPA-N-VPI adapter enables any active, 50 Ω TekVPI probe to be connected to the RF input.

Visualizing changes in your RF signal – The time domain graticule on the MDO4000C Series display provides support for three RF time domain traces that are derived from the underlying I and Q data of the spectrum analyzer input including:

- Amplitude - The instantaneous amplitude of the spectrum analyzer input vs. time
- Frequency - The instantaneous frequency of the spectrum analyzer input, relative to the center frequency vs. time
- Phase - The instantaneous phase of the spectrum analyzer input, relative to the center frequency vs. time

Each of these traces may be turned on and off independently, and all three may be displayed simultaneously. RF time domain traces make it easy to understand what's happening with a time-varying RF signal.



The orange waveform in the Time Domain view is the frequency vs. time trace derived from the spectrum analyzer input signal. Notice that Spectrum Time is positioned during a transition from the highest frequency to the lowest frequency, so the energy is spread across a number of frequencies. With the frequency vs. time trace, you can easily see the different frequency hops, simplifying characterization of how the device switches between frequencies.

Advanced RF analysis – When paired with SignalVu-PC and its Live Link option, the MDO4000C Series becomes the industry's widest bandwidth Vector Signal Analyzer with up to 1 GHz capture bandwidth. Whether your design validation needs include Wireless LAN, wideband radar, high data rate satellite links, or frequency-hopping communications, SignalVu-PC vector signal analysis software can speed your time-to-insight by showing you the time-variant behavior of these wideband signals. Available analysis options include Wi-Fi (IEEE 802.11 a/b/g/j/n/p/ac) signal quality analysis, Bluetooth Tx compliance, pulse analysis, audio measurements, AM/FM/PM modulation analysis, general purpose digital modulation and more.



MDO4000C paired with SignalVu-PC to analyze 802.11ac modulation.

Time synchronized insights into Analog, Digital, and RF – The MDO4000C Series is the world's first oscilloscope with a built in spectrum analyzer. This integration enables you to continue to use your debug tool of choice, the oscilloscope, to investigate frequency domain issues rather than having to find and re-learn a spectrum analyzer.

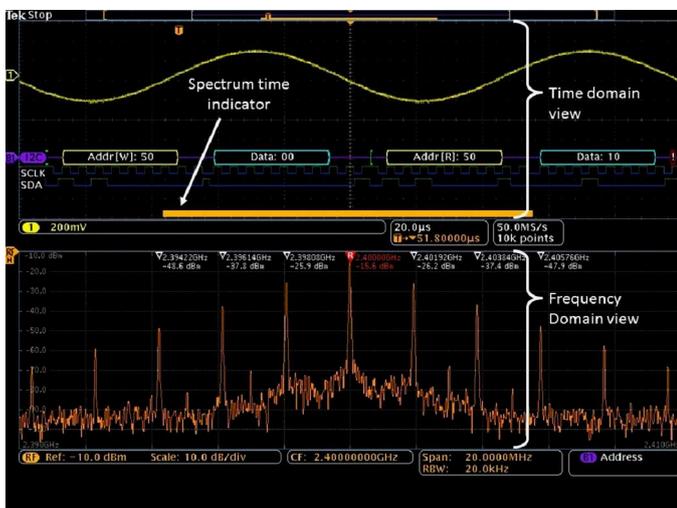
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However, the power of the MDO4000C Series goes well beyond simply observing the frequency domain as you would on a spectrum analyzer. The real power is in its ability to correlate events in the frequency domain with the time domain phenomena that caused them.

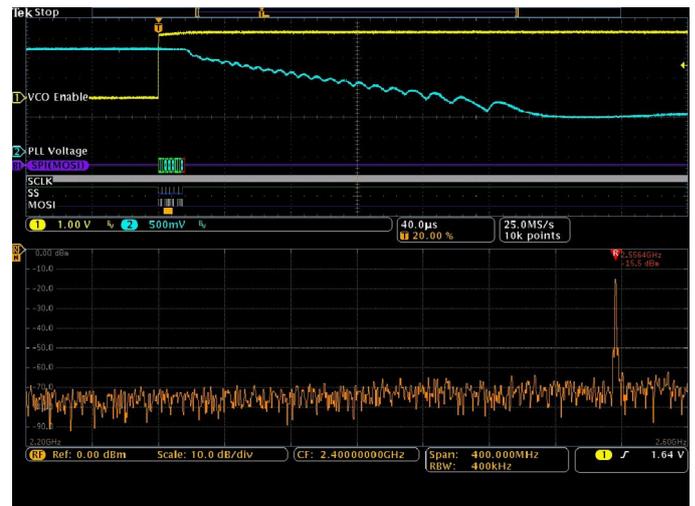
When both the spectrum analyzer and any analog or digital channels are on, the oscilloscope display is split into two views. The upper half of the display is a traditional oscilloscope view of the Time Domain. The lower half of the display is a Frequency Domain view of the spectrum analyzer input. Note that the Frequency Domain view is not simply an FFT of the analog or digital channels in the instrument, but is the spectrum acquired from the spectrum analyzer input.

Another key difference is that with traditional oscilloscope FFTs, you can typically either get the desired view of the FFT display, or the desired view of your other time domain signals of interest, but never both at the same time. This is because traditional oscilloscopes only have a single acquisition system with a single set of user settings such as record length, sample rate, and time per division that drive all data views. But with the MDO4000C Series, the spectrum analyzer has its own acquisition system that is independent, but time correlated, to the analog and digital channel acquisition systems. This allows each domain to be configured optimally, providing a complete time correlated system view of all analog, digital, and RF signals of interest.

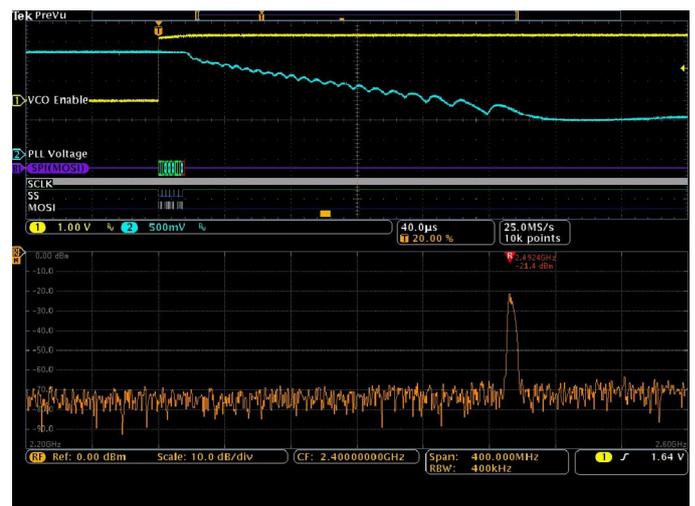
The spectrum shown in the Frequency Domain view is taken from the period of time indicated by the short orange bar in the time domain view - known as the Spectrum Time. With the MDO4000C Series, Spectrum Time can be moved through the acquisition to investigate how the RF spectrum changes over time. And this can be done while the oscilloscope is live and running or on a stopped acquisition.



The upper half of the MDO4000C Series display shows the Time Domain view of the analog and digital channels, while the lower half shows the Frequency Domain view of the spectrum analyzer channel. The orange bar - Spectrum Time - shows the period of time used to calculate the RF spectrum



1. Time and Frequency Domain view showing the turn-on of a PLL. Channel 1 (yellow) is probing a control signal that enables the VCO. Channel 2 (cyan) is probing the VCO tune voltage. The SPI bus which is programming the PLL with the desired frequency is probed with three digital channels and automatically decoded. Notice Spectrum Time is placed after the VCO was enabled and coincident with the command on the SPI bus telling the PLL the desired frequency of 2.400 GHz. Note that the RF is at 2.5564 GHz when the circuit turns on.



2. Spectrum Time is moved about 90 μ s to the right. At this point, the spectrum shows that the PLL is in the process of tuning to the correct frequency (2.400 GHz). It has made it down to 2.4924 GHz.

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