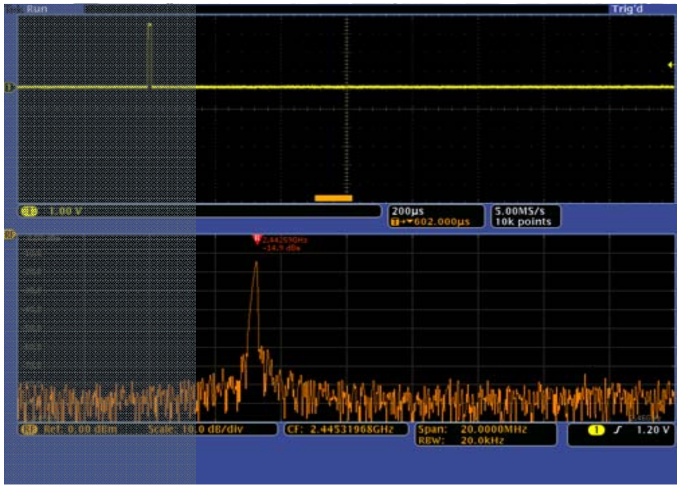
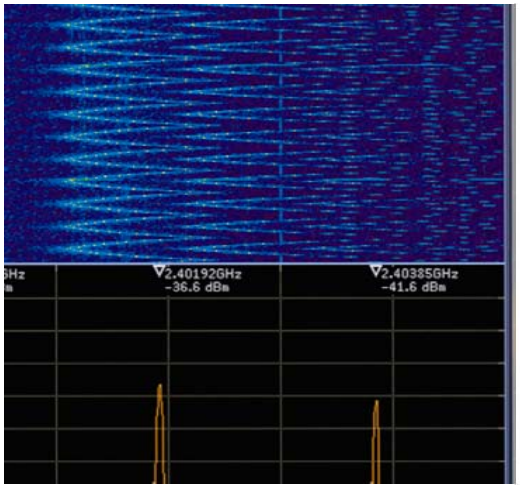
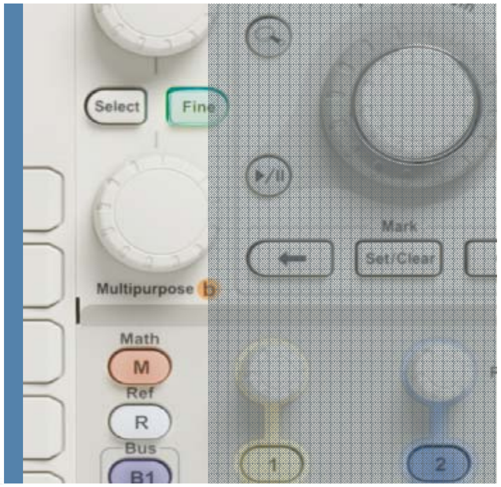
MDO4000 Series Self Guided Tour







Tektronix®

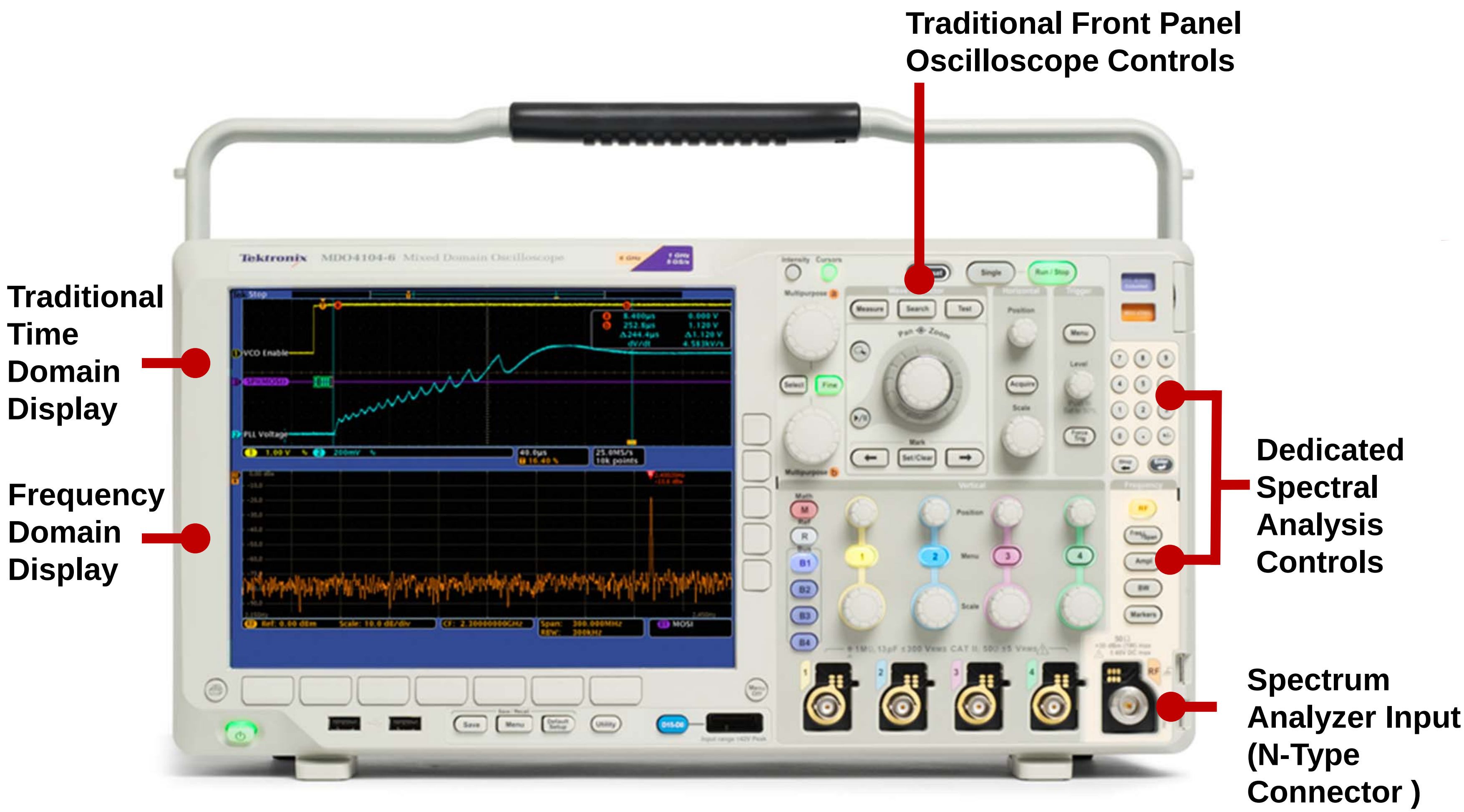
MDO4000 Mixed Domain Oscilloscope

Self Guided Tour

With this guide, you will explore what you can do with the world's first oscilloscope with an integrated spectrum analyzer. Applications range from simple frequency / amplitude measurements of RF signals to time-correlated acquisitions of analog, digital and RF signals that provide you with a complete system view of your device under test.

MDO4000 Mixed Domain Oscilloscope

Tour of the World's First Mixed Domain Oscilloscope

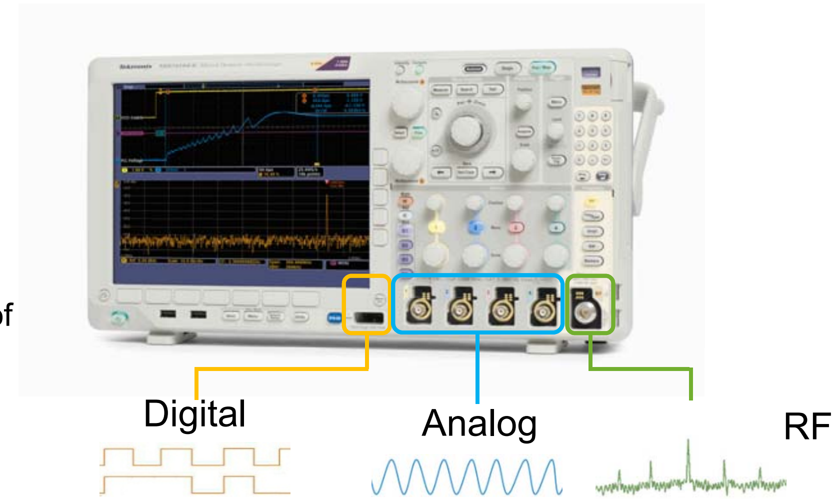


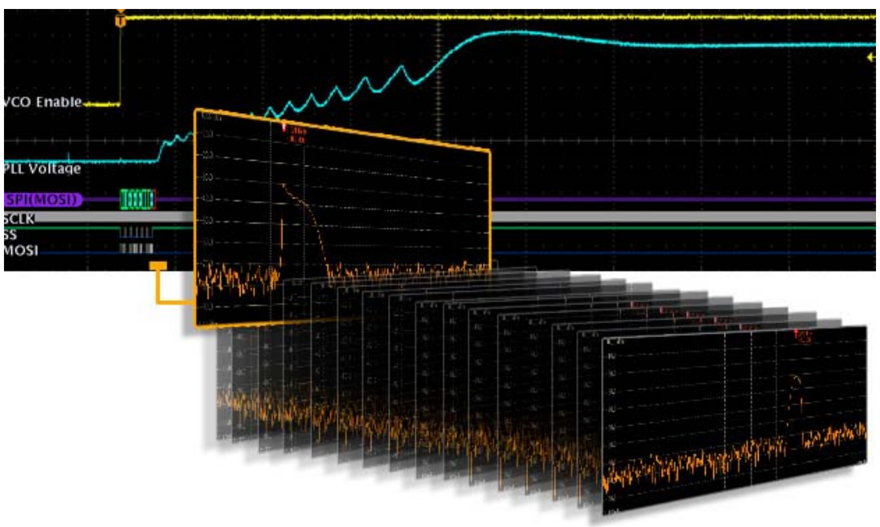
MDO4000 Mixed Domain Oscilloscope

How It Works

The Mixed Domain Oscilloscope

The MDO4000 is the world's first oscilloscope with an integrated spectrum analyzer. When the spectrum analyzer is off, the MDO works just like a traditional oscilloscope. When only the spectrum analyzer is on, the MDO works like a traditional spectrum analyzer. When both are on, you have the ultimate debug tool – the only instrument in the world capable of providing time correlated views of analog, digital and RF signals all in a single instrument.





Time and Frequency Domains

The real power of the MDO4000 comes from its universal trigger and acquisition system. All channels are fully integrated, so you can trigger on any of your signals and the oscilloscope will capture all channels simultaneously. As a result, all signals—analog, digital and RF—are time-correlated for accurate analysis.

Since the MDO4000 captures a long time period of your RF signal, you can choose the precise spectrum you want to see at any point in time. By simply moving Spectrum Time through your acquisition, you can see how your RF spectrum is changing over time or device state.

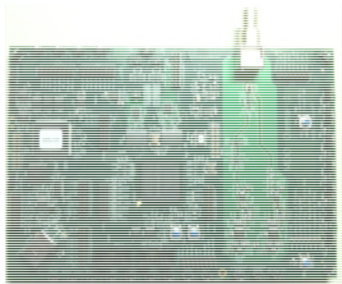
MDO4000 Mixed Domain Oscilloscope

Checklist for the Tour

Before beginning the tour, please be sure you have the following items:

- ❑ MDO4000 Mixed Domain Oscilloscope
- ❑ Power cord

- ❑ MDO Demo 1 board



- ❑ USB cable

- ❑ N-to-BNC adapter

- ❑ Two (2) TPP1000 or TPP0500 passive probes with hook tips attached

- ❑ P6616 digital probe with extension ground tips connected to D0, D1 and D2

Extension ground tips can be found in the Logic Probe Accessories Kit

- ❑ BNC cable

MDO4000 Mixed Domain Oscilloscope

Setting up for the Tour

As with any test, one of the first steps is to connect the instrument to the device under test. For the initial exploration, a test board has been provided to output signals needed for the tour. After you've completed the tour and have gained an understanding of how the MDO4000 operates, please feel free to connect to your own system and see how the MDO can help in your day-to-day work.

1 Setup the Oscilloscope and the Test Board

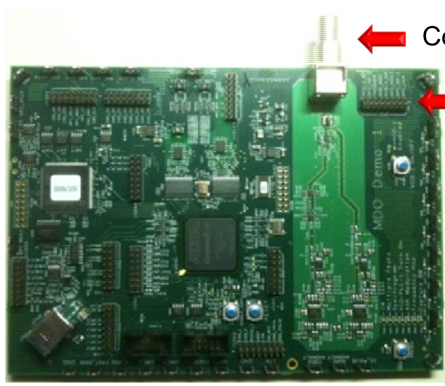
- Plug in and power on the oscilloscope.
- Insert the (2) male B connectors of the USB cable into the (2) USB host ports on the rear panel of the oscilloscope.
- Insert the (1) male A connector of the USB cable into the USB device port on the test board. The board is on when the LEDs are lit.

2 Attach Probes to the Scope

- Connect TPP1000 or TPP0500 passive probes to Channel 1 and Channel 2 inputs on the oscilloscope.
- Connect the P6616 digital probe to the D15-D0 input on the oscilloscope.

3 Connecting the Probes to Test Board

- Connect Channel 1 probe tip to **VCO-1 Enable** loop, connect Channel 2 probe tip to **PLL-1** loop and both probe grounds to **GND** on the test board.
- Connect Digital probe:
  D0 to **SPI_CLK**,
  D1 to **SPI_SS-1**,
  D2 to **SPI_MOSI**
  square pins on the test board.
- Connect the N-to-BNC adapter to the RF input on the oscilloscope.
- Connect the BNC cable to the N-to-BNC adapter. Connect the other end of the cable to the **RF Out** BNC connector on the test board.



MDO4000 Mixed Domain Oscilloscope

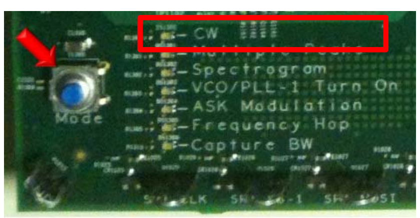
Basic Spectrum Analysis

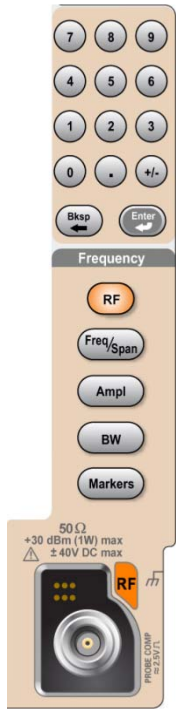
The MDO4000 is the world's first oscilloscope with an integrated spectrum analyzer. When the need arises to view RF signals, it is far simpler and faster to continue using the engineer's tool of choice – the oscilloscope – rather than finding and relearning a spectrum analyzer.

<u>Objective</u>: See how simple it is to perform basic spectrum analysis on an MDO4000

1 Setting Up

- Push the **Mode** button on the test board until the <u>CW</u> LED is lit.
- Press the **Default Setup** front-panel button.
- Press the **Ch1** front-panel button <u>twice</u> to turn off Ch1
- Press **RF** front-panel button to turn on the spectrum analyzer





2 Spectrum Analyzer Controls

- Notice an entire section of the front panel is dedicated to spectrum analyzer controls – no buried menus!
- Most commonly performed functions have front panel keys associated with them
  - Setting center frequency/span
  - Setting reference level
  - Setting resolution bandwidth
  - Using markers
- 10 digit keypad on front panel for precision entry of specific values

3 Basic Settings

- Press **Freq/Span** button
- Press **Center Frequency** (CF) bezel button
- Use keypad to set CF to 2.4 GHz
- Press **Span** bezel button
- Use **Multipurpose** (b) to set span to 10 MHz
- Press **Ampl** button
- Use **Multipurpose** (a) to set Reference Level to -10dBm
- Notice spectral peak is automatically marked

Summary

The addition of a true RF acquisition system, N-connector, dedicated spectrum analyzer controls and user interface make the MDO4000 Series the world's first oscilloscope with an integrated spectrum analyzer. Now you can continue to use your tool of choice – the oscilloscope – for all your debugging needs, regardless of time or frequency domain.

MDO4000 Mixed Domain Oscilloscope

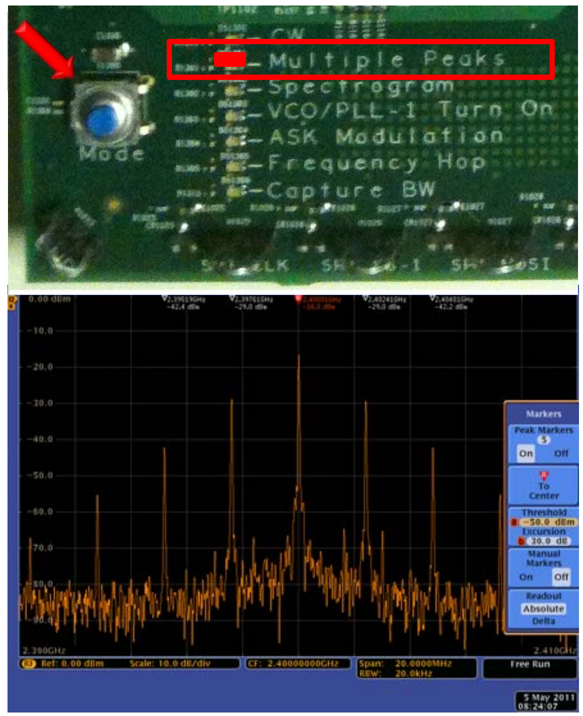
Spectral Peak Identification

Identifying peaks in your spectrum is one of the first steps to understanding the behavior of your design. Whether you are using the basic marker functions or analyzing noise density or phase noise, easy-to-use tools are critical for saving time.

Objective: Discover how the frequency and amplitude of peaks in the spectrum are quickly identified with automated peak markers. Learn how manual markers can be used to measure non-peak portions of the spectrum.

1 Setting Up

- Push the **Mode** button on the test board until the Multiple Peaks LED is lit.
- Press the **Default Setup** front-panel button.
- Press the **Utility** front panel-button.
- Press **Utility Page** and select **Demo** using Multipurpose **a** .
- Press **Multiple Peaks**.
- Press **Recall Demo Setup**.
- Press **Markers** front-panel button.



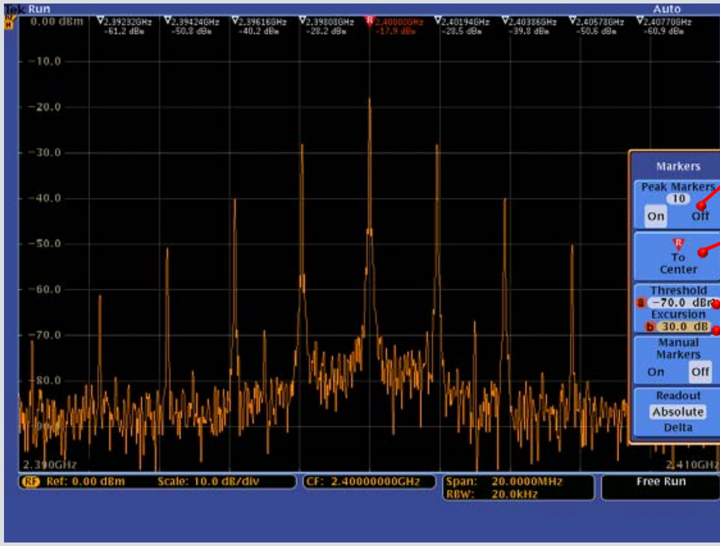
2 Exploring

- Use Multipurpose **a** to set number of Peak Markers to 11
- Press Threshold and use Multipurpose **b** to set threshold to -70.0 dBm
- Notice that peaks meeting the criteria are indicated with Absolute Frequency and Amplitude Readouts
- Press Readout to select Delta
- Notice peak readouts are now relative to the Reference Marker R
- Press Manual Markers
- Notice the Ref. Marker R can now be moved anywhere via manual markers

Summary

While performing spectrum analysis, markers are an invaluable tool for easily quantifying peaks in a spectrum. Simply define threshold and excursion values to automatically mark all peaks that meet your criteria. Or user manual markers to investigate any non-peak areas of the spectrum.

MDO4000 Series Automatic Markers



MDO4000 Series Manual Markers

Marker Options

Peak Markers	▪ Press to turn markers on or off. ▪ Use Multipurpose a to select maximum number of peak to be marked.
R To Center	▪ When Manual Markers are off, then the Reference marker R is placed on the highest amplitude peak. ▪ When Manual Markers are on, then the Reference Marker R is attached to Multipurpose a control. ▪ Press to quickly set the Center Frequency to the frequency of the Reference Marker R.
Thresholds	▪ If you are only interested in marking peaks above a certain level, then set the marker threshold to that level.
Excursion	▪ If spectrum is noisy and all markers are on non-essential peaks, then adjust the excursion value. The excursion value is how far a signal amplitude needs to fall between marked peaks to be considered another valid peak.
Manual Markers	▪ Press to turn on two manual markers to use for measuring non-peak areas of the spectrum.
Readouts	▪ Absolute: Readouts are absolute frequency and absolute amplitude. ▪ Delta: Readouts indicates each peak's delta frequency and delta amplitude relative to the Reference Marker R. ▪ Manual Markers have a third line of readout information – For multipurpose a marker, this indicates noise density – For multipurpose b marker, this indicates noise density when readout is set to absolute; when set to delta, it indicates phase noise relative to multipurpose a marker.

MDO4000 Mixed Domain Oscilloscope

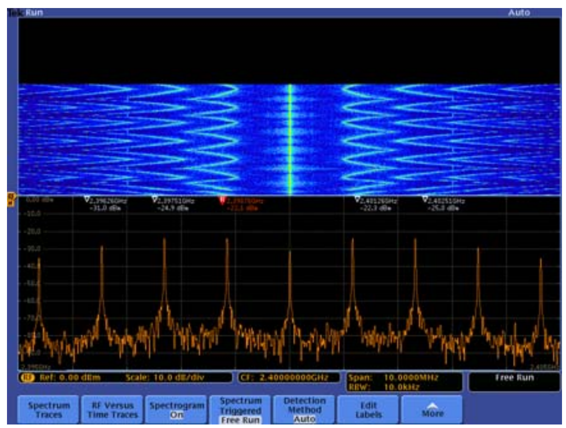
Viewing RF Signals Over Time

A spectrogram is a view of relative amplitudes in a spectrum as seen over time. The spectrogram display provides an intuitive color map showing how your signal varies over time. You can even go back and compare previously acquired data.

Objective: See how a spectrogram can be used to monitor a slowly changing RF signal and view different spectrums within the spectrogram.

1 Setting Up

- Push the **Mode** button on the test board until the Spectrogram LED is lit.
- Press the **Default Setup** front-panel button.
- Press the **Utility** front panel-button.
- Press **Utility Page** and select **Demo** using Multipurpose **a** .
- Press **Spectrogram**.
- Press **Recall Demo Setup**.
- Press **Menu Off** front-panel button.



2 Exploring

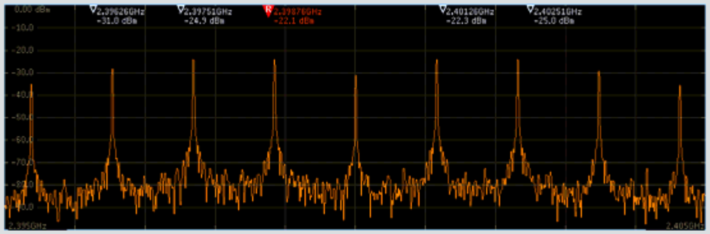
- Allow spectrogram to accumulate until half of the spectrogram display area is filled.
- Press **Run/Stop** to stop acquiring.
- Press **RF** button.
- Press Spectrogram.
- Turn Multipurpose **a** to scroll through Spectrum Slices.
- Or, enter desired Slice using keypad (such as slice -55).

Summary

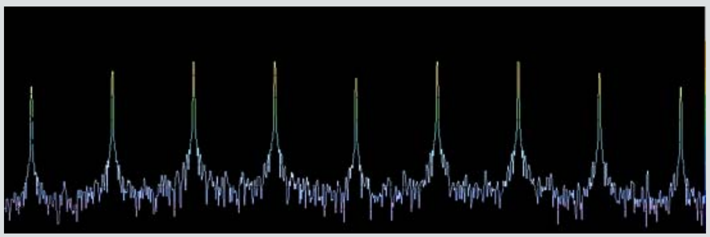
With the spectrogram view you can view how your RF signal is changing over time. You can monitor only portions of the signal (triggered) or look at a wider range of signals (free run). For many designs, spectrum analysis begins with signal visualization and spectrogram makes this task even easier.

How Spectrograms are Generated

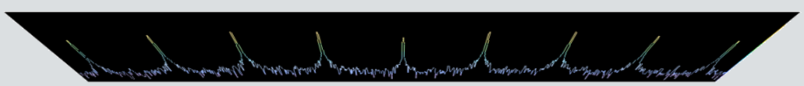
1. Spectrum Acquired



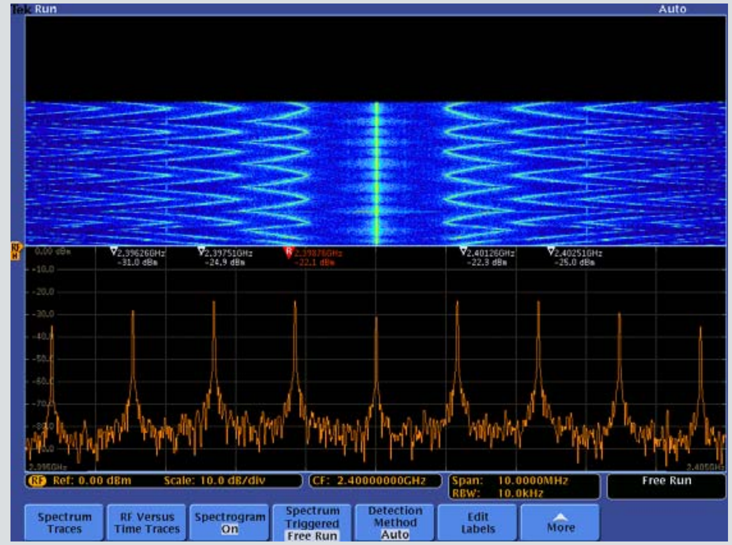
2. Color the spectrum trace to indicate amplitude at each point
   - Cold colors (blue, green) indicate lower amplitude
   - Hot colors (red, yellow) indicate higher amplitude



3. Spectrum is flipped with the peaks pointing towards the viewer with the newest acquired spectrum added to the bottom of the stack

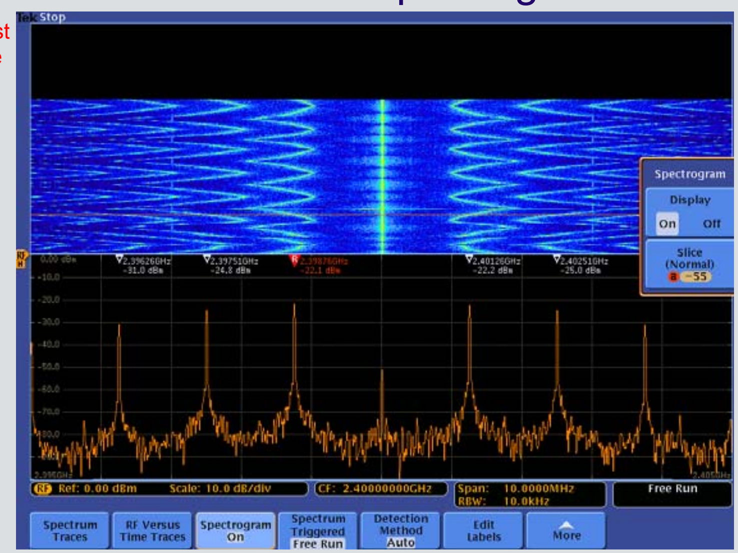


MDO4000 Series Spectrogram



MDO4000 Series Spectrogram Slice

Oldest Slice



MDO4000 Mixed Domain Oscilloscope

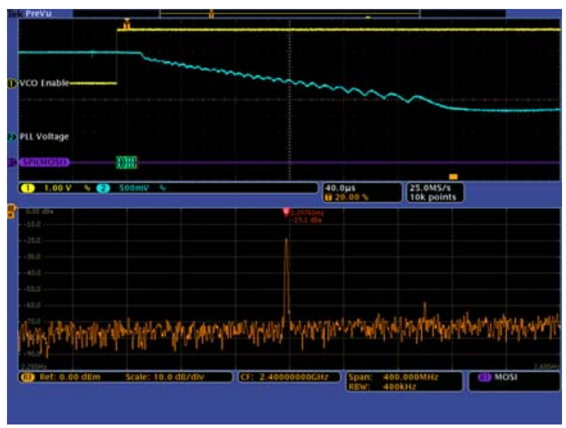
Viewing Complete System Activity

Debugging modern wireless-enabled designs often requires investigation of more than just the RF signal. Understanding timing relationships between the RF and other analog, digital, or bus signals in the device under test is critical but incredibly difficult with multiple stand alone pieces of test equipment that weren't designed for the task..

<u>Objective</u>: Experience the MDO4000's unique ability to acquire and display time correlated analog, digital and RF signals.

1 Setting Up

- Verify that the oscilloscope and test board are setup as previously directed.
- Push the **Mode** button on the test board until the <u>VCO/PLL-1 Turn On</u> LED is lit.
- Press the **Default Setup** front-panel button.
- Press the **Utility** front panel-button.
- Press **Utility Page** and select **Demo** using Multipurpose .
- Press **VCO/PLL Turn On** button.
- Press **Recall Demo Setup**.
- Press **Menu Off** front-panel button.



2 Exploring

- Press the **Single** front-panel button to arm the scope for an acquisition.
- Press the **VCO-1 Enabled** button on the demo board. The LED next to the button should turn off.
- Press the **VCO-1 Enabled** button again. The LED next to the button should light and the scope should acquire data.
- Use the front-panel Wave Inspector **Pan** knob (outer ring) to move the Spectrum Time indicator (orange bar) through the acquisition to see how the spectrum changes during the VCO/PLL turn on.

Summary

With a Mixed Domain Oscilloscope, you can easily track down system-level issues by viewing analog, digital and RF signals time-correlated on the same display. By moving Spectrum Time throughout the waveform record, you can quickly see how your RF signal changes relative to the time-domain signals.

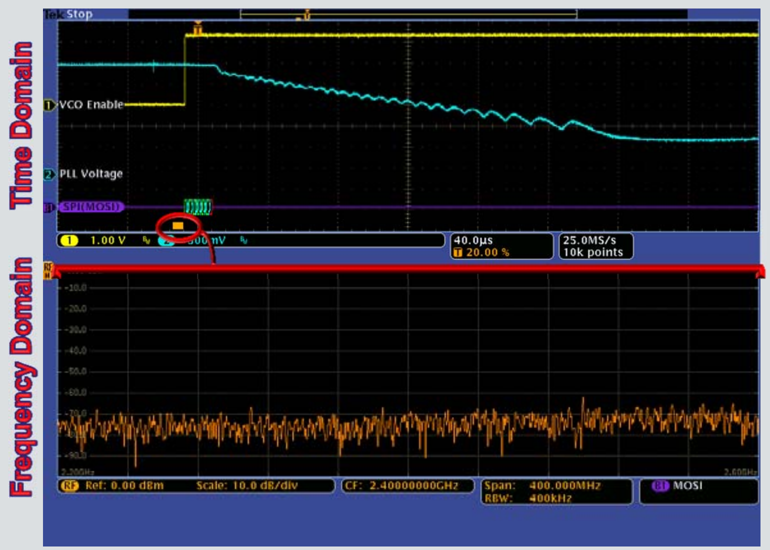
Explanation of Spectrum Time

- The spectrum shown in the frequency domain graticule corresponds to the period of time indicated by the orange bar in the time domain graticule
- This orange bar is known as Spectrum Time.
- Spectrum Time can be moved throughout the acquisition to see how the spectrum changes over time or relative to other analog, digital, or bus signals.

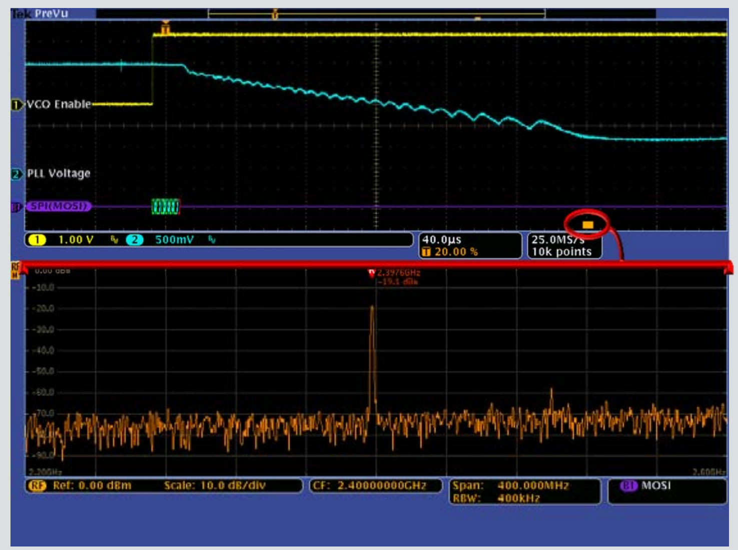
What's Happening?

- The VCO (voltage controlled oscillator) is enabled when channel 1 goes high.
- Next a command on the SPI bus tells the VCO/PLL (phase-locked loop) circuit the desired frequency, which in this case is 2.4 GHz.
- Once the SPI command has been transmitted, the VCO/PLL circuit begins tuning to the desired frequency.
- In the screenshots below, we've made a single acquisition of this turn-on event by triggering on the SPI command indicating the desired 2.4 GHz freq.
- In screenshot 1, the Spectrum Time (orange bar) is positioned prior to the VCO being enabled, thus there is no activity in the spectrum yet.
- In screenshot 2, the Spectrum Time (orange bar) has been moved (via the Wave Inspector Pan knob) to view the spectrum about midway through the VCO/PLL's process of tuning to the desired frequency.
- With the MDO4000 Series, you can easily correlate frequency domain events with relevant time domain control signals, enabling you to quickly and easily make critical timing measurements such as time to stability of a VCO/PLL circuit.

1 Spectrum Prior to Trigger Event



2 Spectrum After the Trigger Event



MDO4000 Mixed Domain Oscilloscope

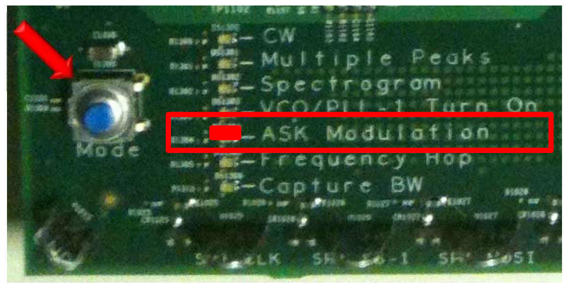
Debugging Amplitude Modulated Signals

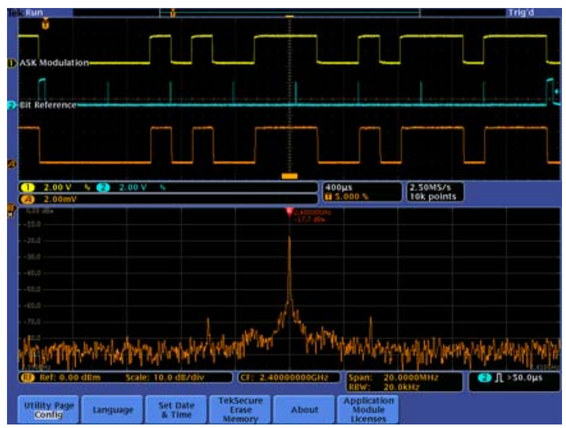
Observing RF signal amplitude changes over time and monitoring system-level interactions of analog and RF signals can be difficult and time-consuming. Time trend views of amplitude vs. time can make spectrum analysis an easier task.

<u>Objective</u>: Discover how to quickly see the amplitude changes over time of an Amplitude Shift Key (ASK) modulated signal using the MDO4000's RF Amplitude vs. Time trace.

1 Setting Up

- Move Channel 1 probe tip to the **ASK-MOD** loop, move Channel 2 probe tip to the **TRIGGER** loop on the test board.
- Push the **Mode** button on the test board until the <u>ASK Modulation</u> LED is lit.
- Press the **Default Setup** front-panel button.
- Press the **Utility** front panel-button.
- Press **Utility Page** and select **Demo** using Multipurpose .
- Press **ASK Modulation** button.
- Press **Recall Demo Setup**.
- Press **Menu Off** front-panel button.





2 Exploring

- Press the **Single** front-panel button to acquire a single acquisition.
- Use the front-panel Wave Inspector **Pan** knob (outer ring) to move the Spectrum Time indicator (orange bar) through the acquisition to see how the spectrum changes with the ASK modulation.
- Notice the RF Amplitude vs. Time trace in the time domain graticule (orange) allows you to quickly see how the RF signal amplitude changes over time and relative to other time domain signals

Summary

With a Mixed Domain Oscilloscope, you can quickly investigate amplitude modulated RF signals. The RF amplitude vs. time trace shows the instantaneous amplitude of the acquired spectrum and can provide insight into such problems as noise, interference issues, and transient behavior.

Explanation of Spectrum Time

- The spectrum shown in the frequency domain graticule corresponds to the period of time indicated by the orange bar in the time domain graticule
- This orange bar is known as Spectrum Time.
- Spectrum Time can be moved throughout the acquisition to see how the spectrum changes over time or relative to other analog, digital, or bus signals.

What's Happening?

- The ASK (Amplitude Shift Key) Modulation signal on Channel 1 is a digital modulation control signal that is turning the RF output on and off in order to transmit a 3 bit counter progressing through the numbers 0-7.
- The Bit Reference signal on Channel 2 is shown to aid in understanding the bit pattern on the modulation signal.
- In each of the screenshots, the position of Spectrum Time (orange bar) has been moved to view the spectrum at various points in time.
  - In (1) Spectrum Time is positioned where the RF output has been on and stable for a while, thus the view in the frequency domain is a stable signal at 2.4 GHz.
  - In (2) Spectrum Time is positioned at an off-to-on transition in the RF, thus we see 'smearing' in the frequency domain.
  - Similarly, in (3) Spectrum Time is positioned at an on-to-off transition in the RF, thus we again see 'smearing' in the frequency domain.
- Note how you can quickly see how the RF signal amplitude changes over time and relative to other analog or digital control signals.
- With the MDO4000 Series, you can easily correlate frequency domain events with changes in the time domain signals.

MDO4000 Mixed Domain Oscilloscope

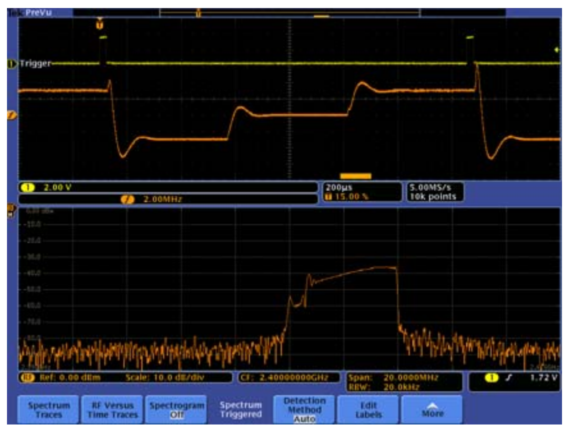
Debugging Frequency Modulated Signals

Characterizing and correlating time varying RF events with analog signals can be difficult and time-consuming. With the right oscilloscope, you can easily monitor system behavior with easy-to-use signal visualization tools.

Objective: Explore how the RF Frequency vs. Time trace allows you to quickly characterize time varying events of a frequency hopping signal (such as how long it takes to settle to a new frequency).

1 Setting Up

- Move Channel 1 probe tip to the **TRIGGER** loop on the test board.
- Push the **Mode** button on the test board until the Frequency Hop LED is lit.
- Press the **Default Setup** front-panel button.
- Press the **Utility** front panel-button.
- Press **Utility Page** and select **Demo** using Multipurpose .
- Press **Frequency Hop** button.
- Press **Recall Demo Setup**.
- Press **Menu Off** front-panel button.



2 Exploring

- Press the **Single** front-panel button to acquire a single acquisition.
- Use the front-panel Wave Inspector **Pan** knob (outer ring) to move the Spectrum Time indicator (orange bar) through the acquisition to see how the spectrum changes with the Frequency Modulation.
- Notice the RF Frequency vs. Time trace in the time domain graticule (orange) allows you to quickly see how the RF signal frequency changes over time and relative to other time domain signals.

Summary

Modern RF signals can vary significantly with time. With a Mixed Domain Oscilloscope, you can quickly characterize time varying RF events – without having to look through the spectrum in the frequency domain view.

Explanation of Spectrum Time

- The spectrum shown in the frequency domain graticule corresponds to the period of time indicated by the orange bar in the time domain graticule
- This orange bar is known as Spectrum Time.
- Spectrum Time can be moved throughout the acquisition to see how the spectrum changes over time or relative to other analog, digital, or bus signals.

What's Happening?

- The Trigger signal on Channel 1 is a digital control signal that initiates the frequency hopping cycle.
- In each of the screenshots, the position of the Spectrum Time (orange bar) has been moved to view the spectrum at various points in time after the trigger event.
  - In 1 Spectrum Time is positioned in the middle of the second hop frequency, thus the frequency domain view shows a single peak at 2.4 GHz
  - In 2 Spectrum Time is positioned in the transition from the 2nd hop frequency to the 3rd, thus we see RF energy smeared across the spectrum in the frequency domain view.
  - In 3 Spectrum Time is positioned in the transition from the 3rd hop frequency back to the 1st. This is a wider transition, thus we see RF energy smeared across more of the spectrum in the frequency domain view.

- Note that you can quickly characterize time varying RF events (such as how long it takes to settle to a new frequency or how much overshoot/undershoot there is during a transition) with RF vs. time traces.
- With the MDO4000 Series, you can easily correlate frequency domain events with changes in the time domain signals.

MDO4000 Mixed Domain Oscilloscope

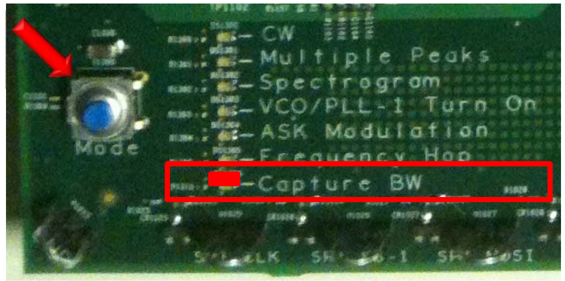
Capturing Wideband Signals

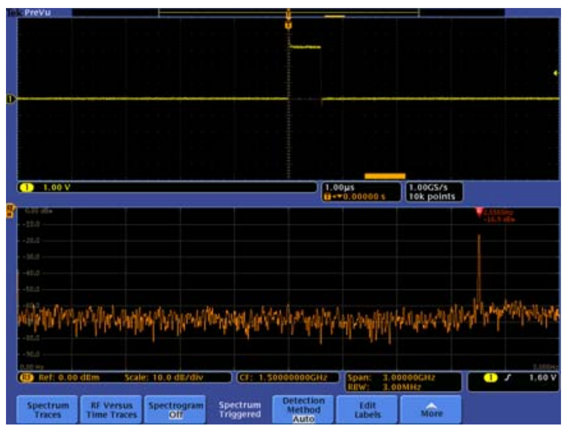
RF standards continue to evolve to wider bandwidths. In addition, many modern wireless devices transmit and receive over multiple bands. Traditional spectrum analyzers do not have the capture bandwidth necessary to debug these systems.

Objective: See the power of the MDO4000's exceptionally wide capture bandwidth (up to 3 GHz) by capturing an RF device's transition from 900 MHz to 2.4 GHz in a single acquisition.

1 Setting Up

- Ensure the Channel 1 probe tip is on the **TRIGGER** loop on the test board.
- Push the **Mode** button on the test board until the Capture BW LED is lit.
- Press the **Default Setup** front-panel button.
- Press the **Utility** front panel-button.
- Press **Utility Page** and select **Demo** using Multipurpose .
- Press **Capture Bandwidth** button.
- Press **Recall Demo Setup**.
- Press **Menu Off** front-panel button.





2 Exploring

- Press the **Single** front-panel button to acquire a single acquisition.
- Notice the Span is set to 3 GHz. This is 3 GHz capture bandwidth.
- Use the front-panel Wave Inspector **Pan** knob (outer ring) to move the Spectrum Time indicator (orange bar) before and after the pulse on Ch 1
- Notice that before the pulse, the RF output is at 900 MHz, it then transitions to 2.4 GHz after the pulse.

Summary

With the MDO4000 Series, you can see your whole spectrum of interest at any point in time with the up to 3 GHz ultra-wide capture bandwidth (approximately 100 times wider than the 10-40 MHz capture bandwidths of traditional spectrum analyzers). Whether you're looking at multiband systems or ultra-wide bandwidth designs, you won't miss any details with the MDO4000.

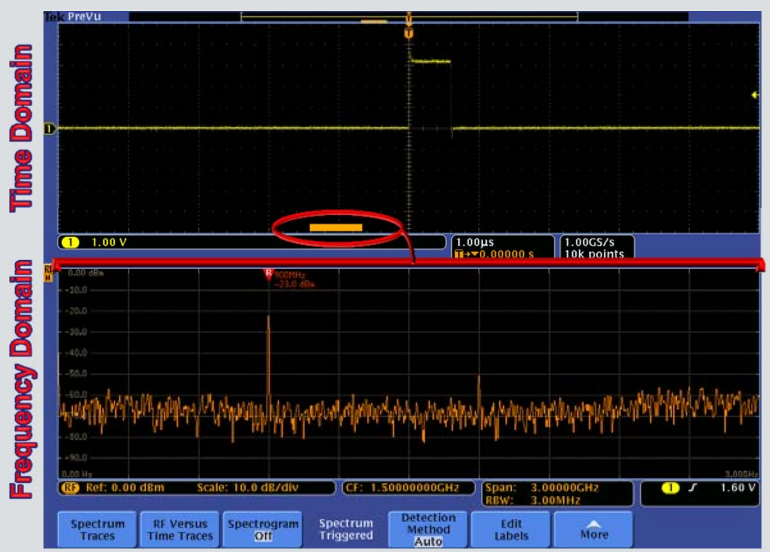
Explanation of Spectrum Time

- The spectrum shown in the frequency domain graticule corresponds to the period of time indicated by the orange bar in the time domain graticule
- This orange bar is known as Spectrum Time.
- Spectrum Time can be moved throughout the acquisition to see how the spectrum changes over time or relative to other analog, digital, or bus signals.

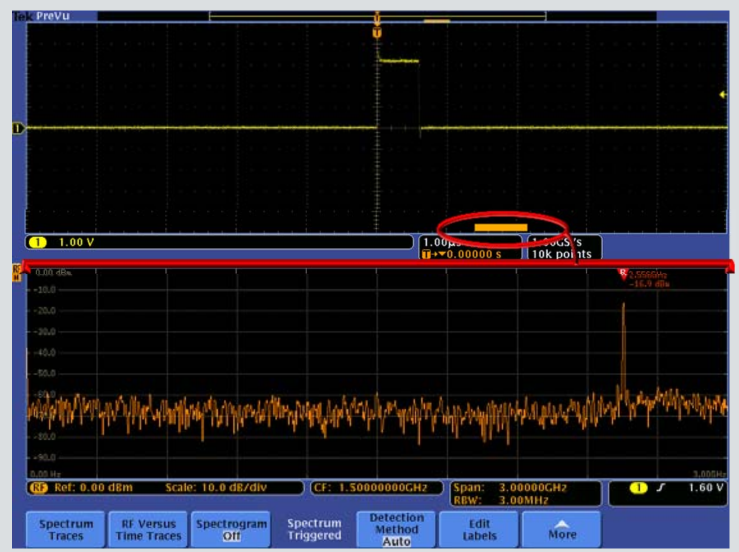
What's Happening?

- The pulse see on channel 1 is a control signal telling the device to switch the RF output from 900 MHz to 2.4 GHz.
- We are capturing this transition in a single acquisition! This ability to look across 3 GHz of spectrum and correlate the RF activity to other analog and digital signals is unique to the MDO4000.
- In screenshot 1, Spectrum Time is positioned prior to the trigger event (single pulse on channel 1). In the spectrum, the device under test is currently communicating to a device in the 900 MHz ISM (Industrial, Scientific, and Medical) radio band.
- In screenshot 2, Spectrum Time has been moved to view the spectrum after the trigger event. In the spectrum, the digital control signal (the trigger event) results in the RF output switching from communicating from one device in the 900 MHz ISM radio band to another device in the 2.4 GHz ISM radio band.
- Notice that both the 900 MHz and 2.4 GHz ISM radios bands are captured in a single acquisition. A typical spectrum analyzer with capture bandwidth of 10-40 MHz could not capture this wideband, transitory event.
- With the MDO4000 Series , you can easily correlate frequency domain events with changes in the time domain signals.

1 Spectrum Prior to Trigger Event



2 Spectrum After the Trigger Event



MDO4000 Mixed Domain Oscilloscope

Specifications and Ordering Information

Models	Analog Ch.	Analog Bandwidth	Analog Sample Rate	Digital Ch.	Spectrum Analyzer Input	Spectrum Analyzer Frequency Range
MDO4014-3	4	100 MHz	2.5 GS/s	16	1	50 kHz – 3 GHz
MDO4034-3	4	350 MHz	2.5 GS/s	16	1	50 kHz – 3 GHz
MDO4054-3	4	500 MHz	2.5 GS/s	16	1	50 kHz – 3 GHz
MDO4054-6	4	500 MHz	2.5 GS/s	16	1	50 kHz – 6 GHz
MDO4104-3	4	1 GHz	5 GS/s	16	1	50 kHz – 3 GHz
MDO4104-6	4	1 GHz	5 GS/s	16	1	50 kHz – 6 GHz

Standard Probes and Accessories

- Four TPP0500 (≤500 MHz models) or TPP1000 (1 GHz models) Passive Voltage Probes
- One P6616 16 Channel Logic Probe
- N-to-BNC Adapter (103-0045-00)
- OpenChoice® Desktop and NI LabVIEW SignalExpress™ TE (LE version) Software
- Calibration Certificate, Quick Reference Manual & Documentation on CD
- Front Panel Cover, Power Cord
- 3-year Warranty

Application Modules

Serial Bus Triggering and Protocol Analysis:

DPO4AERO	Aerospace (MIL-STD 1553)
DPO4AUDIO	Audio (I^2S, LJ, RJ and TDM)
DPO4AUTO	Automotive (CAN, LIN)
DPO4AUTOMAX	Automotive (CAN, LIN, FlexRay)
DPO4COMP	Computer (RS-232/422/485)
DPO4EMBD	Embedded (I^2C, SPI)
DPO4ENET	Ethernet (10BASE-T,100BASE-TX)
DPO4USB	USB 2.0 (LS, FS, HS)

Additional Analysis:

MDO4TRIG	Adv. RF Power Level Triggering
DPO4PWR	Power Analysis
DPO4LMT	Limit and Mask Testing
DPO4VID	HDTV & Custom Video Triggering

Recommended Probes and Accessories

RF Accessories:

TPA-N-PRE	Preamplifier, 12 dB gain, 9kHz – 6 GHz
TPA-N-VPI	N-to-TekVPI Adapter
119-4146-00	Near Field Probe Set, 100 kHz – 1 GHz
119-6609-00	Flexible Monopole Antenna

Passive Voltage Probes:

TPP0502	500 MHz, 2X, 300V TekVPI Low C (12.7 pF)
TPP0850	800 MHz, 50X, 2.5 kV TekVPI, Single-ended

Active Voltage Probes:

TAP1500	1.5 GHz, 10X, ±8V TekVPI, Single-ended
TAP2500	2.5 GHz, 10X, ±4V TekVPI, Single-ended
TAP3500	3.5 GHz, 10X, ± xxx TekVPI, Single-ended

Voltage Probes:

TDP0500	500 MHz, 50X/5X, ±42V TekVPI Differential
TDP1000	1 GHz, 50X/5X, ±42V TekVPI Differential
TDP1500	1.5 GHz, 10X/1X, ±8V TekVPI, Differential
TDP3500	3.5 GHz, 5X, ±2V TekVPI, Differential
THDP0100	100 MHz, 1000X/100X, ±6kV TekVPI, Differential
THDP0200	200 MHz, 500X/50X, ±1.5kV TekVPI, Differential
TMDP0200	200 MHz, 250X/25X, ±750V TekVPI, Differential

Current Probes:

TCP0020	50 MHz, 20A AC/DC TekVPI
TCP0030	120 MHz, 30A AC/DC TekVPI
TCP0150	20 MHz, 150A AC/DC TekVPI

Key Applications	Benefits
System-level Troubleshooting	• See your time-correlated analog, digital and RF signals on a single display • Analyze the time and frequency domains with one instrument.
Troubleshooting of Embedded RF Modules	• Time-correlate events (such as timing relationship between RF module and serial control signal) to understand the root cause of improper system behavior • Monitor multiple radio bands simultaneously to observe harmonic content and intra-radio interference with ≥1 GHz capture bandwidth
Troubleshooting of EMI Problems	• Quickly determine amplitude and how often a signal is present with Spectrogram display • Trigger on the known EMI suspects (such as power supplies, clocks, serial bus) to directly measure and correlate frequency and time domain events
Troubleshooting of Power Distribution in Embedded Systems	• Isolate and correlate unintended power supply events to RF emissions • Monitor variations in switching power supplies and RF emissions caused by changing load conditions

MDO4000 Mixed Domain Oscilloscope

Summary

This concludes the MDO tour. You have just experienced the world's first oscilloscope with an integrated spectrum analyzer. This enables you to continue to use your tool of choice – the oscilloscope – to debug your designs regardless of whether you're tracking down time or frequency domain issues. In addition, the MDO4000's unique capability of acquiring and displaying time correlated analog, digital, and RF in a single instrument makes it the ultimate debug tool for the modern design engineer. Complete system visibility like this hasn't existed before now.

Are you ready to try this on your own design?

To learn more, visit www.tektronix.com/mdo4000 for detailed application notes, videos and other materials. For further product demonstrations or to request a quote, please contact your local Tektronix authorized distributor.