Tektronix RSA306
USB Spectrum Analyzer

Self-Guided Demo

071-3330-00

Tektronix

Tektronix RSA306
USB Spectrum Analyzer

Self-Guided Demo

Revision A

www.tektronix.com
071-3330-00

Tektronix

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- Worldwide, visit *www.tektronix.com* to find contacts in your area.

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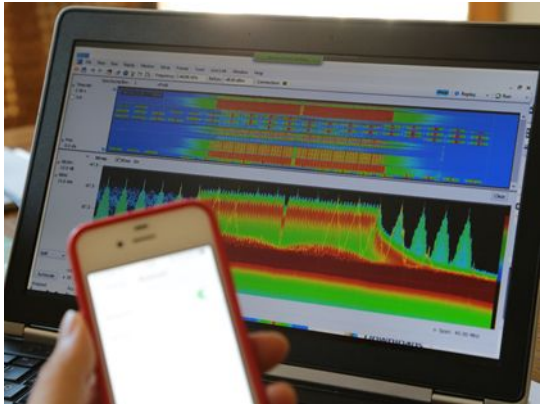
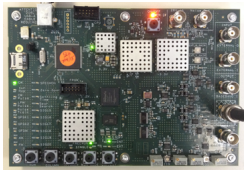
Introduction



With this guide, you will explore what you can do with the RSA306 USB spectrum analyzer. Applications range from simple frequency / amplitude measurements of RF signals to real-time and modulation analysis that provide you with a complete system view of your device under test.

Check list for the demo

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

Item	Illustration
RSA306 USB spectrum analyzer	
RTSA demo board	

Item	Illustration
USB Y-cable (to power the board)	
N-BNC adapter	
Whip antenna	

Item	Illustration
BNC cable	
USB 3.0 cable	

Demo guide overview

Fundamental operations of spectrum analyzers

The Tektronix RSA306 USB Signal Analyzers have the ability to perform basic spectrum measurements that most Spectrum Analyzer users are already accustomed to. The goal of this part is to demonstrate that the instrument has these basic spectrum analyzer capabilities.

- Demo 1: Basic spectrum measurements with markers
- Demo 2: Power measurements with markers
- Demo 3: Traces and detectors
- Demo 4: Save and recall

Real-time DPX

Two of the most challenging types of signals to identify and capture are low-level signals close to your signal frequency and rarely-occurring transients. Sometimes the interference is so infrequent that you can't detect it at all. You suspect it is there because of seemingly-random errors. DPX Spectrum instantly demystifies these situations by displaying a clear image of the offending signals. Its capture probability is 100% for transients as short as 100 µsec.

- Demo 5: DPX and transient capture
- Demo 6: Transient capture: Mask test and act on violation

Modulation

Digital modulation is used in virtually all modern communication systems. These systems have penetrated every aspect of our lives at a rapid pace. The growth has put increased stress on the ability to quickly and efficiently analyze a wide variety of digital modulation schemes. In some cases, general modulation schemes have been included in complex standards with rigorous specifications involving manual test procedures according to these standards that require lengthy test setups with skilled engineers. Analog modulation is the most fundamental modulation method, and is frequently used to demonstrate principles in education labs.

- Demo 7: Analog modulation analysis
- Demo 8: Digital modulation analysis

EMI spurious search

From the first wireless transmissions, electromagnetic interference (EMI) has been a concern for design engineers. General-purpose spectrum analyzers that contain appropriate filters and detectors are often employed in diagnostics and pre-compliance, as they are fast measurement tools that often are already used in the design process and do not require additional capital expense.

- Demo 9: EMI spurious

Over-the-air demo

This part shows how to use the RSA306 in off-air applications. Using the whip antenna provided with the RSA306 demonstration kit, you can demodulate and listen to the signals from the local FM broadcasting station, see the realtime spectrum of the signals in the ISM band created by your smart phone, and use the RSA306 in interference-hunting.

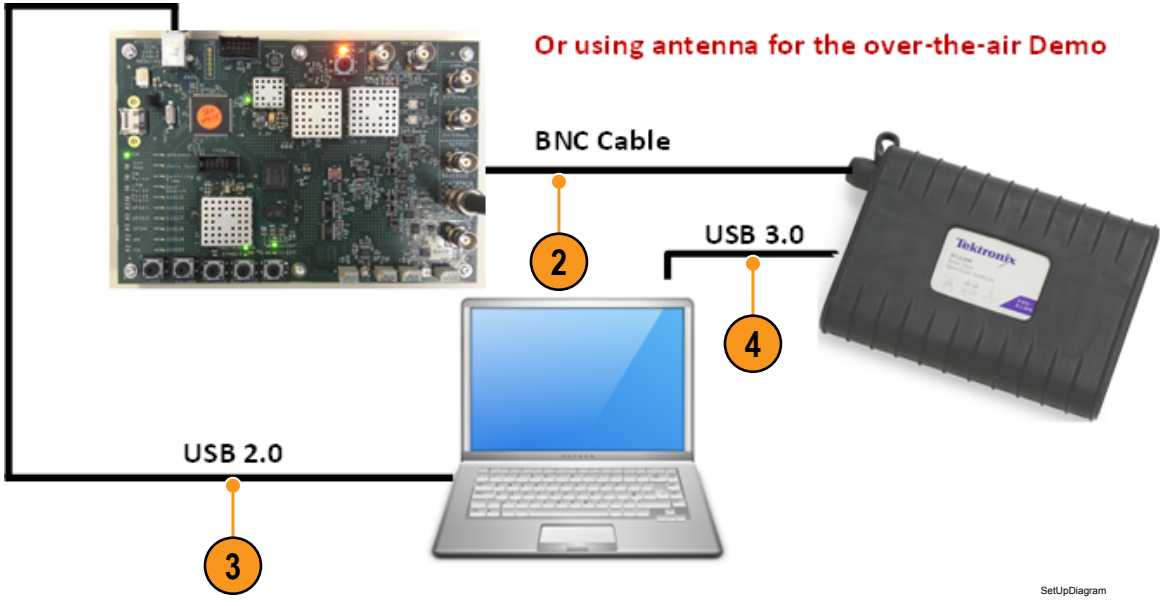
- Demo 10: FM listening
- Demo 11: ISM band DPX

Setup

As with any test, one of the first steps is to connect the instrument to the device under test. For the initial exploration, a demo board has been provided to output signals needed for the demo. After you've completed the demo and have gained an understanding of how the RSA306 operates, connect to your own system and see how the RSA306 can help in your day-to-day work.

1. **Install SignalVu-PC**
   - Install the SignalVu-PC software onto your PC. You can download the software from *www.tektronix.com/downloads*, or it is available on the flash drive that is provided with the RSA306.
2. **Set up the RSA306**
   - Power the RSA306 by connecting the USB 3.0 cable to the USB 3.0 port of your PC.
   - Install the N-BNC adaptor on RSA306.
3. **Setup the demo board**
   - Connect one end of the USB Y-Cable to the demo board.
   - Connect the other end of the USB Y-Cable to 2 USB ports either on your PC or a separate USB power supply.

4. **Connect the RSA306 to the demo board**
   - Connect one end of the BNC cable to the RF port of the RSA306.
   - Connect the other end of the BNC cable to the RF port of the board.


Or using antenna for the over-the-air Demo
BNC Cable
USB 3.0
USB 2.0
2
3
4
Tektronix
SetUpDiagram

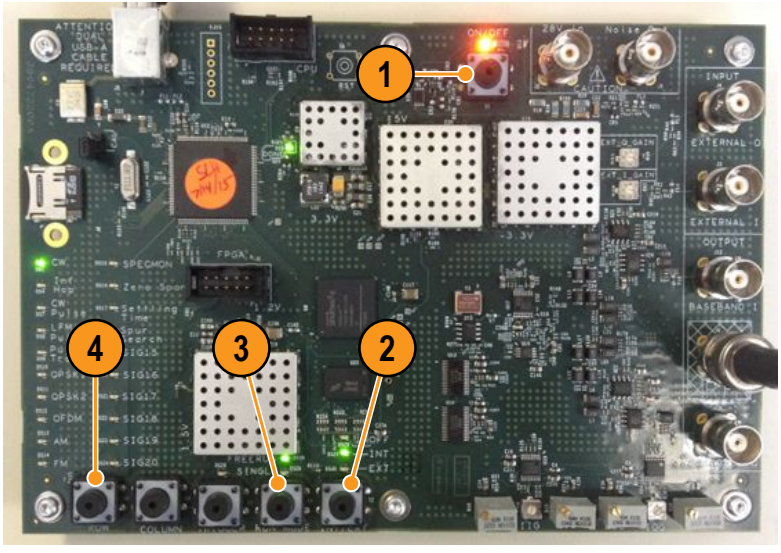
Demo instructions

Demo 1: Basic spectrum measurements with markers

When using a spectrum analyzer, one of the first settings is that of the frequency. In this demonstration, we will use markers to locate the CW signal generated from the demo board, and set the appropriate frequency for the measurement.

Instructions for the demo board

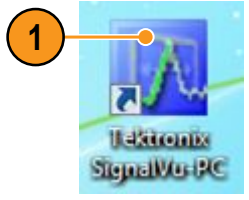
1. Press the On button to turn on the demo board.
2. Set the reference to INT (internal reference).
3. Set the run mode to FREE RUN.
4. Click the ROW and COLUMN buttons to select CW as the signal to generate.



demoboard1

Instructions for the RSA306

1. Double click the SignalVu-PC icon on the PC desktop to start the application.

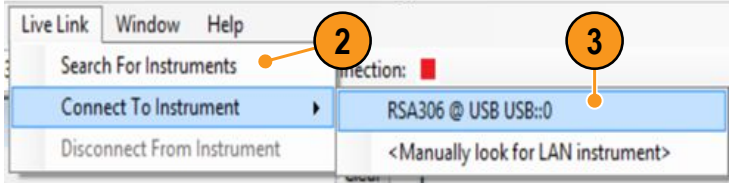


screenicon

2. Click Live Link on the menu bar to view the drop down menu. Click Search for Instrument.

   A notification will briefly appear stating that the instrument was found.

3. Click Connect To Instrument. Select RSA306@USB USB::0. First-time connection to the analyzer may take up to 10 seconds.

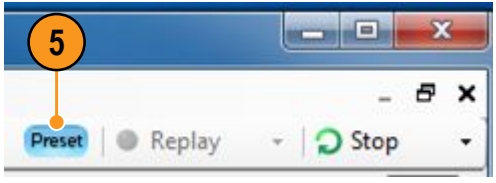


rsaconnect

4. A Connect Status dialog box will appear to confirm the instrument is connected. Click OK.

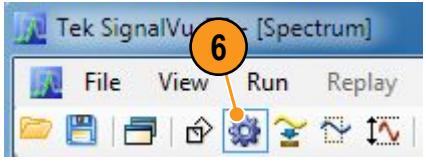
TIP. *You can quickly verify connection status by looking at the connection indicator square on the menu bar. It is green (■) when an instrument is connected. It is red (■) when it is not. You can also view the name of the instrument that is connected by hovering the mouse indicator over the ■.*

5. Click the Preset button.



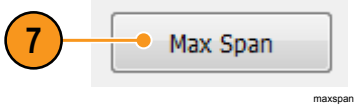
preset

6. Click the settings button to display the settings control panel.



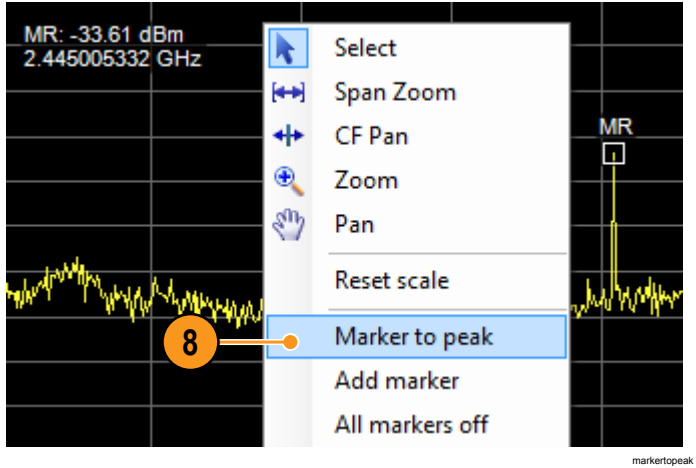
topleft

7. Click Max Span to set the Span to the maximum value.



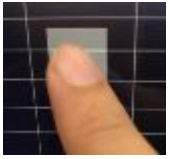
maxspan

8. Right click the screen, and select Marker to peak.



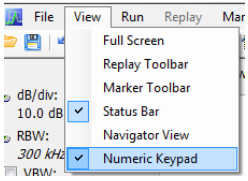
TIP. Right Click on Tablet

Touch the screen where you want to right-click, hold until a complete square appears, and then lift your finger. The shortcut menu appears after you lift your finger.



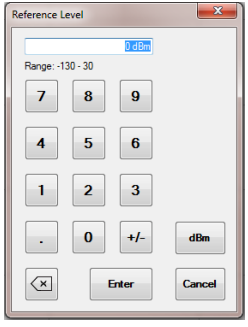
For Tablet users

Activate the on-screen numeric entry of values and Up/Down controls by selecting View: Numeric Keypad.

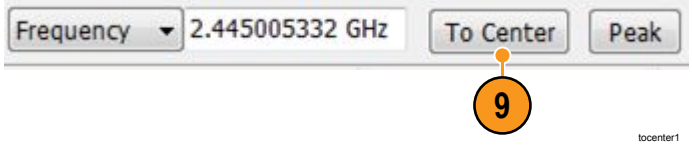


When the Numeric Keypad view is activated, up/down arrows and a numeric keypad icon will pop up whenever a field requiring input is selected.

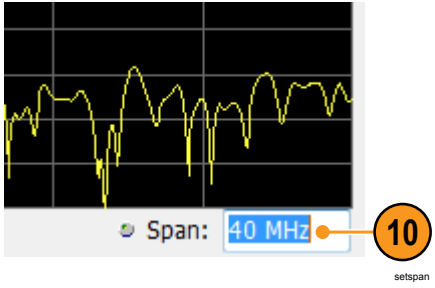
Selecting the 'calculator' numeric keypad icon will pop up a numeric entry box.



9. Click To Center in the bottom marker setting area. This sets the center frequency of the analyzer to the center of the signal.



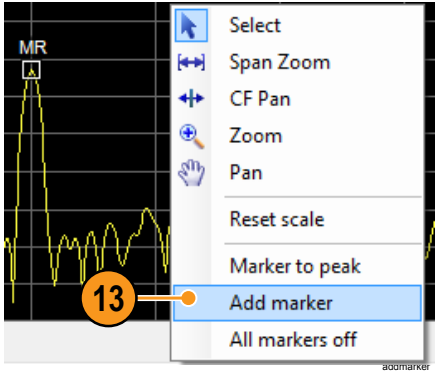
10. Set the Span to 40 MHz.



11. Click Peak.

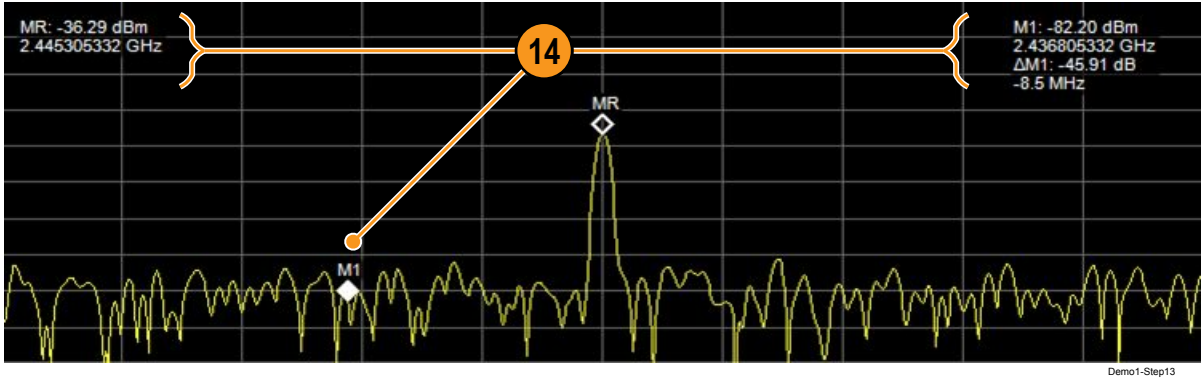
12. Click To Center again.

13. Right click the screen, and select Add marker.



14. Drag the new marker M1 to the noise level. Notice that readouts show:

- The amplitude and the frequency of the reference marker (MR).
- The amplitude and the frequency of the selected marker (M1).
- The difference (ΔM1) between the selected marker position and the position of the reference marker.

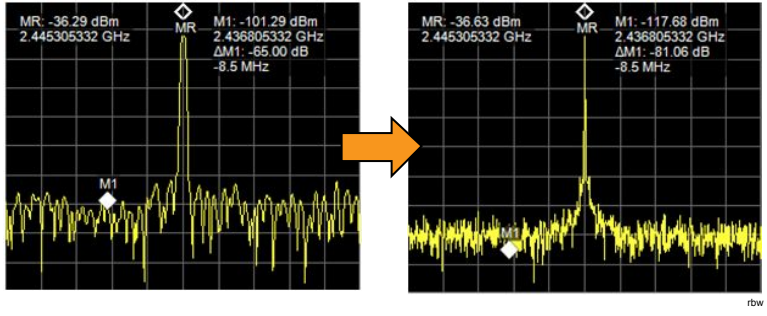

MR: -36.29 dBm
2.445305332 GHz
14
M1: -82.20 dBm
2.436805332 GHz
ΔM1: -45.91 dB
-8.5 MHz
MR
M1
Demo1-Step13

TIP. Undo, Redo, and Recall

You can undo anything you do with this *control.*

If you are having trouble with this step, recall the setting `Demo1_CW.tiq` *from the directory* `C:/SignalVu-PC Files/Example Files`*. This will give you the correct amplitude, frequency, span and marker settings automatically. This file also contains data collected from a previous test and creates a trace on screen of the result. Press Run to clear this data and take results from your instrument.*

15. Set the RBW to 30 kHz. The RBW setting is located at the left side of the spectrum display.

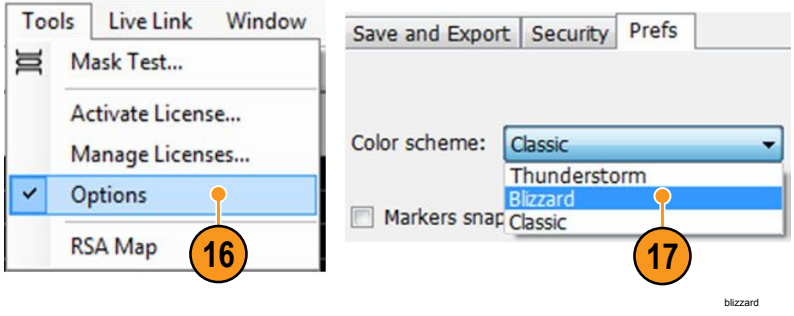


TIP. RBW

The resolution bandwidth (RBW) determines the fast Fourier transform (FFT) bin size, or the smallest frequency that can be resolved. Smaller RBW improves the selectivity, but degrades the sweep speed and the trace update rate.

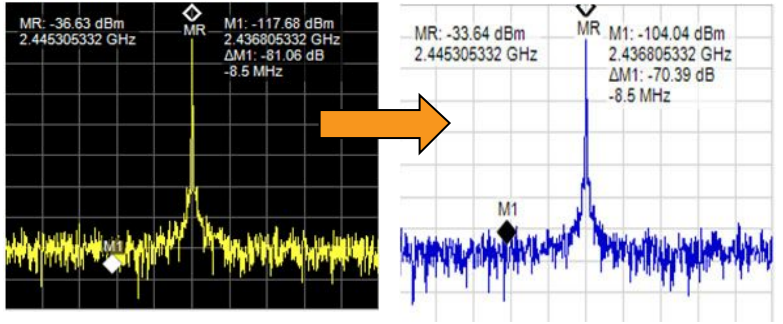
16. Select Options from the Tools menu.

17. Under the Prefs tab, set the Color Scheme to Blizzard.



TIP. Ink Saver Mode

You can print screen images with a white background. Selecting the scheme color to Blizzard makes the background color changes from black to white in the graphs.



Demo1Step16Note

Demo 2: Power measurements with markers

Integrated power between markers is an easy way to measure the power of a modulated signal without setting up a channel power measurement. SignalVu-PC performs integrated power and power density measurements using power markers. When measuring signal density, the signal is assumed to be noise like, and measurements are corrected to a 1 Hz bandwidth. Selecting power measurement markers automatically switches the trace detector to Ave (RMS) for accurate results. Integrated power between markers is an easy way to measure the power of a modulated signal without setting up a dedicated channel power measurement.

Instructions for the demo board

1. Keep the same setting as the last demo. Use the ROW and COLUMN buttons to change the signal type from CW to OFDM.

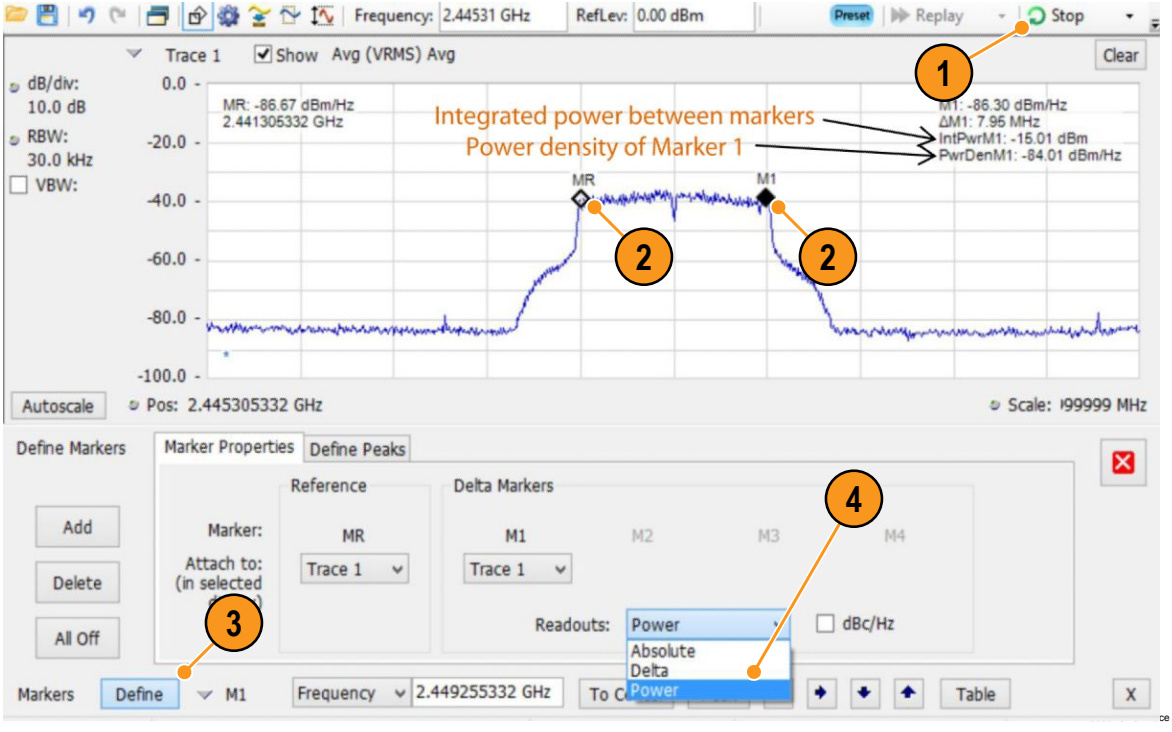
odfm

Instructions for the RSA306

1. Keep the same setting as the last demo, or recall the setting `Demo1_CW.tiq`. Click the Stop button to pause the measurement.
2. Drag the marker reference (MR) on left side, and marker 1 (M1) on right side of the OFDM spectrum.
3. Click the Define button in the Marker settings.
4. Within the Marker Properties tab, in the Readouts dropdown box, select Power.

TIP. *You can measure phase noise by setting the delta marker to dBc/Hz.*

Advanced channel power measurement and ACLR (adjacent channel leakage power ratio) measurement can be done in "Chan Pwr and ACPR" display.

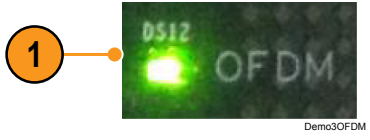

Frequency: 2.44531 GHz
RefLev: 0.00 dBm
Preset
Replay
Stop
Trace 1
Show
Avg (VRMS) Avg
Clear
dB/div:
10.0 dB
RBW:
30.0 kHz
VBW:
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
MR: -86.67 dBm/Hz
2.441305332 GHz
Integrated power between markers
Power density of Marker 1
M1: -86.30 dBm/Hz
ΔM1: 7.95 MHz
IntPwrM1: -15.01 dBm
PwrDenM1: -84.01 dBm/Hz
MR
M1
1
2
2
Autoscale
Pos: 2.445305332 GHz
Scale: 99999 MHz
Define Markers
Marker Properties
Define Peaks
Add
Delete
All Off
Marker:
Attach to:
(in selected
Reference
MR
Trace 1
Delta Markers
M1
M2
M3
M4
Trace 1
Readouts:
Power
Absolute
Delta
Power
dBc/Hz
3
4
Markers
Define
M1
Frequency
2.449255332 GHz
Table
X

Demo 3: Traces and detectors

This demo familiarizes you with the trace detection and function controls available in SignalVu-PC used with the RSA306.

Instructions for the demo board

1. Keep the same setting (OFDM signal) as the last demo.



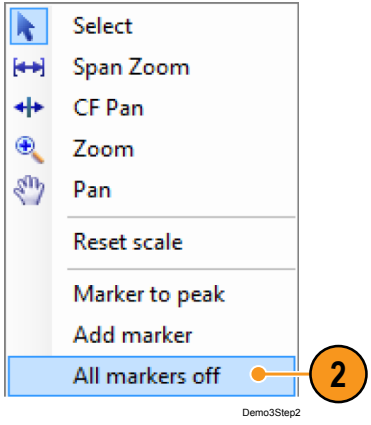
Demo3OFDM

Instructions for the RSA306

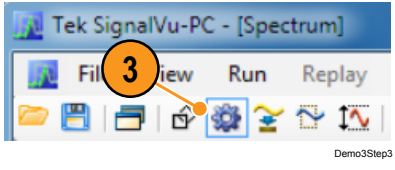
1. Keep the same setting, or recall the setting Demo2_OFDM_marker.tiq. Click Run.

Demo3Step1

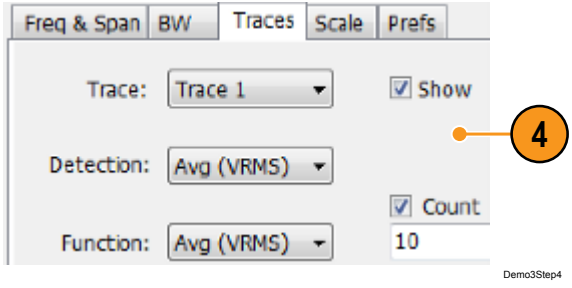
2. Right click the screen, and select All markers off.



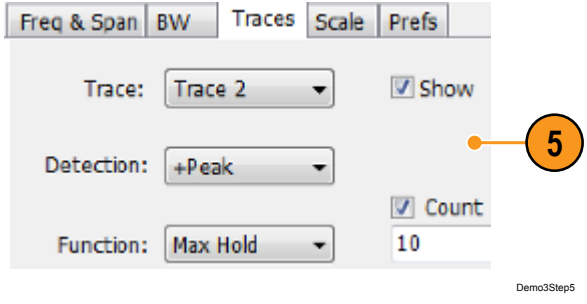
3. Click the settings button to display the Settings control panel.



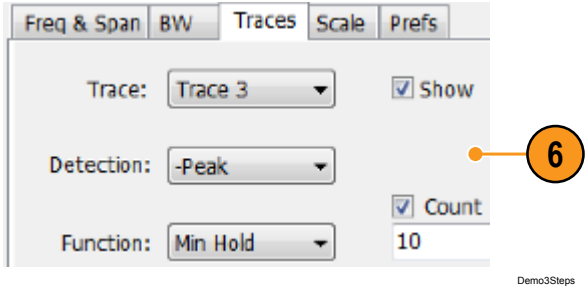
4. In the Traces tab, select Trace 1, and then set Detection to Avg (VRMS) and Function to Avg (VRMS).



5. Select Trace 2, and then set Detection to +Peak, Function to Max Hold, and enable Show.



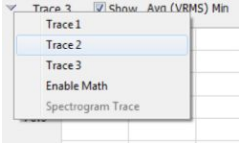
6. Select the trace to Trace 3, select Detection to -Peak, Function to Min Hold, and enable Show.



TIP. *Trace detectors process the data underlying the trace to provide the results you need depending upon your application. Available detection methods are +Peak, -Peak, Avg (VRMS), Sample, and CISPR Pk.*

Trace functions are applied to multiple traces as they are displayed. Available settings are Normal, Average, Max Hold, and Min Hold. The Number of Traces setting specifies how many traces are averaged.

The same selections are available in the upper left display selection and mouse-over dropdowns.



The results show the three difference traces displayed in the screen at the same time.

- The Average trace is generated by multiple traces averaged together. There is one vertical value for each underlying frequency data point. Once the specified number of traces have been acquired and averaged to generate the displayed trace, each new trace takes the place of the oldest trace in the calculation.
- Max Hold trace displays the maximum value in the trace record for each display point. Each new trace display point is compared to the previous maximum value and the greater value is retained for display and subsequent comparisons.
- Min Hold trace displays the minimum value in the trace record for each display point. Each new trace display point is compared to the previous minimum value and the lesser value is retained for display and subsequent comparisons.

Trace 3
Show -Peak Min 10
Clear
-2.0
-22.0
-42.0
-62.0
-82.0
-102.0
CF: 2.44531 GHz
Span: 40.00 MHz
Drop-down quick trace selection
Max Hold Trace
Average (RMS) Trace
Min Hold Trace
Restart multi-trace functions

TIP. Right-click action menu. *You can change marker settings and how waveforms are displayed by using the right-click Actions menu.*

Select	*Selects markers and adjusts their position.*
Span zoom	*Zooms the graph area about the selected point. Right-click in the graph display at a point of interest and drag to increase or decrease the span about the point of interest. Span zoom adjusts the span control.*
CF pan	*Adjusts the center frequency according to horizontal movement.*
Zoom	*Adjusts the horizontal and vertical scale of the graph. The first direction with enough movement becomes the primary scale of adjustment. Adjustment in the secondary direction does not occur until a threshold of 30 pixels of movement is crossed. Dragging to the left or down zooms out and displays a smaller waveform (increases the scale value). Dragging to the right or up zooms in and displays a larger waveform (decreases the scale value).*
Pan	*Adjusts the horizontal and vertical position of the waveform. The first direction with enough movement becomes the primary direction of movement. Movement in the secondary direction does not occur until a threshold of 30 pixels of movement is crossed.*
Marker to peak	*Moves the selected marker to the highest peak. If no marker is turned on, this control automatically adds a marker.*
Add marker	*Defines a new marker located at the horizontal center of the graph.*

Demo 4: Save and recall

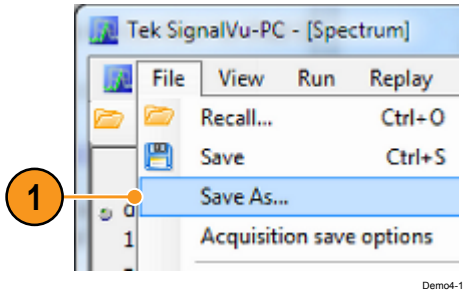
In SignalVu-PC, you can save different types of data for later recall and analysis.

Instructions for the demo board

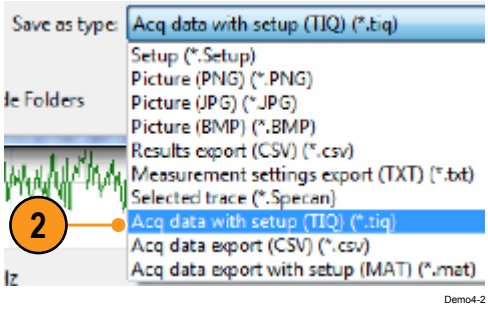
1. Keep the same setting (OFDM signal) as the last demo.

Instructions for the RSA306

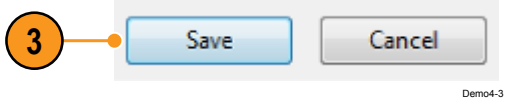
1. Keep the same setting, or recall the setting Demo3_OFDM_trace.tiq. Select Save As from the File menu to open the Save As dialog box.



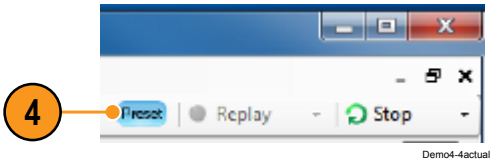
2. Navigate to the folder where you want to save the setups, or use the default location. Enter a file name. Select the type of file to Acq data with setup (TIQ)(*.tiq).



3. Click save.



4. Click the Preset button.



5. Select Recall from the File menu to open the Open dialog box. Navigate to the folder containing the file you want to recall. Select the .tiq file you just saved to recall, and click the Open icon .

TIP. File formats you can use to save files

Setup files (Setup)	*Saves all of the setup information for all displays.*
Screen shot (PNG/JPG/ BMP)	*Saves a capture of the screen in the specified format.*
Results Export files (CSV)	*Saves the trace and numeric data for the selected display. The trace and numeric data are saved as CSV files.*
Measurement Settings (TXT)	*Saves a list of settings relevant to the selected measurement to a text file. This option is useful for including the measurement settings in reports.*
Trace (Various)	*Saves a trace for later recall into the display from which it was saved.*
Data (TIQ/CSV/MAT)	*Saves data and measurement setup for analysis later (TIQ format) or as data to use with external software in either CSV (comma-separated value) or MAT (MATLAB) formats.*

Demo 5: DPX and transient capture

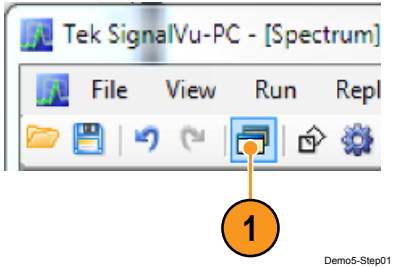
The DPX display helps you to see how traces change over time and displays signal events that cannot be seen on a swept spectrum analyzer. DPX Spectrum indicates how traces change in two ways. First, it uses color shading to show how consistent the shape of a trace is. Second, it uses persistence to hold signals on the screen so you can see them longer. The DPX display reveals transient signal behavior that helps you discover instability, glitches, and interference.

Instructions for the demo board

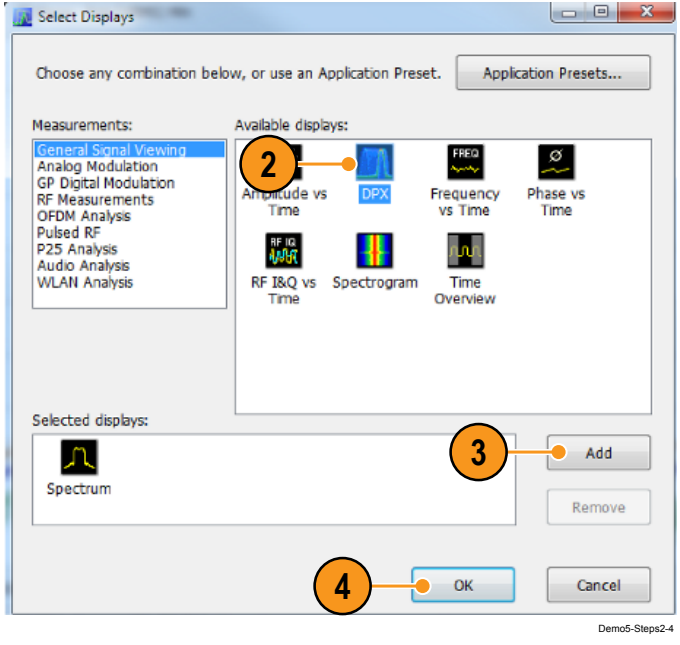
1. Keep the same setting as the last demo. Use the ROW and COLUMN buttons to change the signal from OFDM to Inf Hop (Infrequent hopping signals).

Instructions for the RSA306

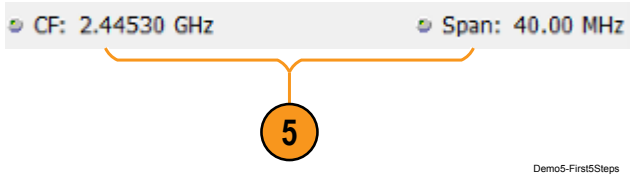
1. Keep the same setting, or recall the setting Demo3_OFDM_trace.tiq. Click the Display icon.



2. In General Signal Viewing, select DPX from the Available displays box.
3. Click the Add button (or double-click the DPX icon). This will add the DPX icon to the Selected Displays box.
4. Click the OK button.

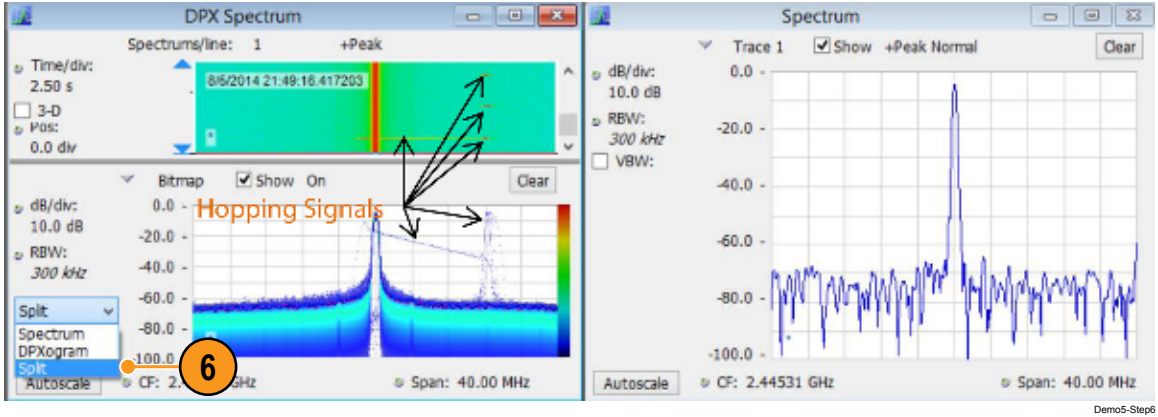


5. In the DPX display, set the CF to 2.4453 GHz and the Span to 40 MHz.

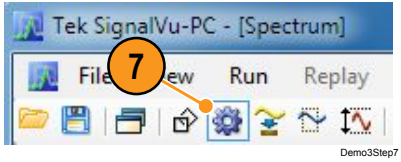


6. Select the Split view.

   You can see the hopping signals displayed in the DPX spectrum, and compare it in the standard spectrum display on the right side. Note that the standard spectrum display nearly or always misses the transient signal.


DPX Spectrum
Spectrums/line: 1
+Peak
Time/div:
2.50 s
3-D
Pos:
0.0 div
8/5/2014 21:49:16.417203
Bitmap
Show On
Clear
dB/div:
10.0 dB
RBW:
300 kHz
Hopping Signals
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
Split
Spectrum
DPXogram
Split
6
Autoscale
CF: 2.
Span: 40.00 MHz
Spectrum
Trace 1
Show
+Peak Normal
Clear
dB/div:
10.0 dB
RBW:
300 kHz
VBW:
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
Autoscale
CF: 2.44531 GHz
Span: 40.00 MHz
Demo5-Step6

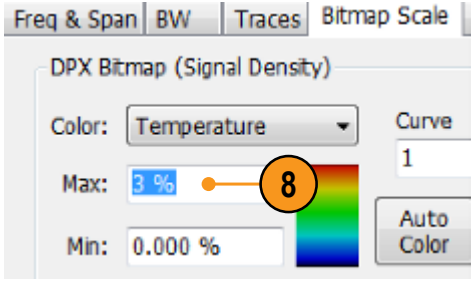
7. Select the DPX display by clicking anywhere on it with the mouse, and click the settings button.



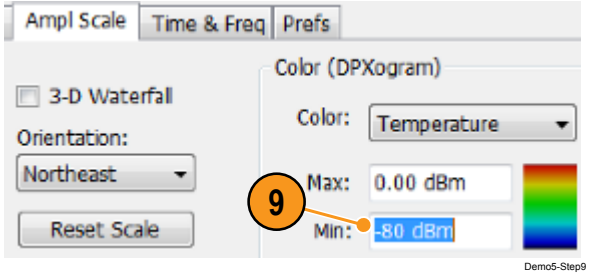
TIP. Changing the color scheme

In the "temperature" palette, the highest color (Maximum) is deep red and the lowest (Minimum) is dark blue. Values between Maximum and Minimum are represented by the other colors of the palette.

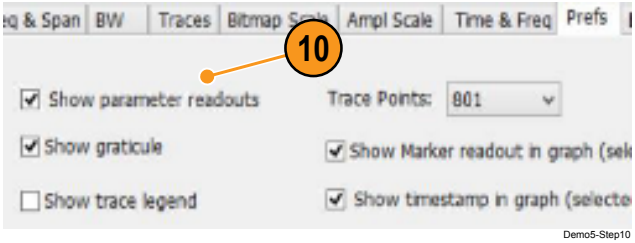
8. Under the Bitmap Scale tab, set the Max scale to 3% for the DPX Spectrum display.



9. Under the Ampl Scale tab, set the Min color scale to -80 dBm for the DPXogram display.

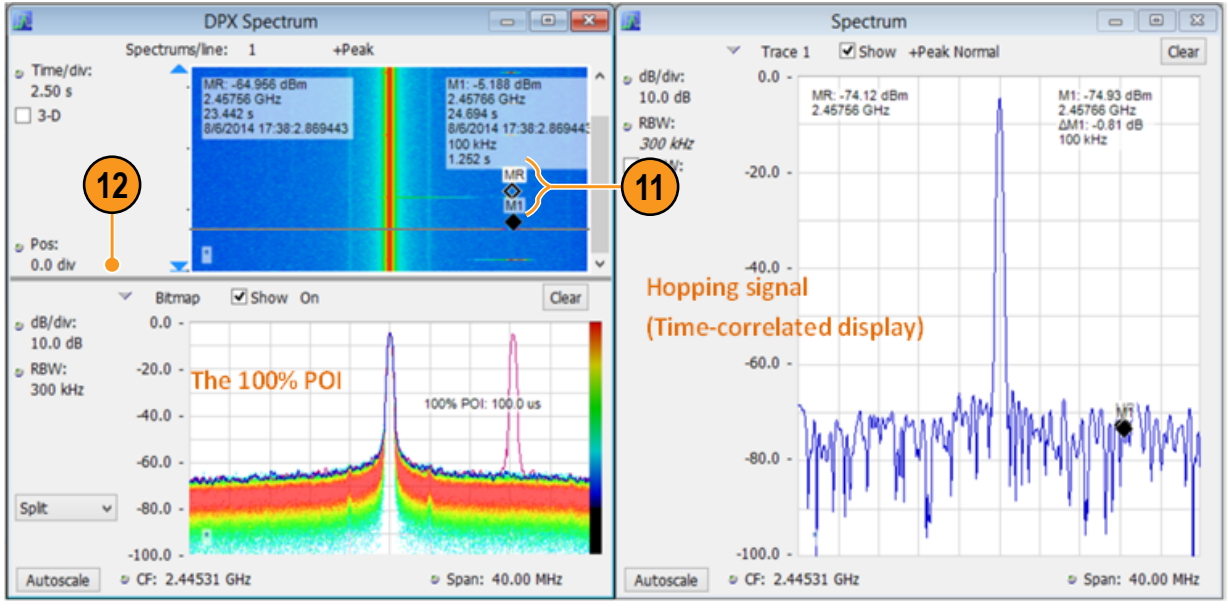


10. Under the Prefs tab, enable Show parameter readouts.



11. Click Stop to pause the measurement. Right click the DPXogram screen, select Add marker, and drag the marker to one hopping signal. Then add another marker and drag it to the closest hopping signal. The delta marker will show the time between two hopping signals is about 1.25 s, or the hop occurs every 1.25 second.

12. You can set the size of the DPX spectrogram by selecting the divider bar between the displays and moving it up or down to add area to the display of interest.


DPX Spectrum
Spectrums/line: 1 +Peak
Time/div: 2.50 s
3-D
MR: -64.956 dBm
2.45756 GHz
23.442 s
8/6/2014 17:38:2.869443
M1: -5.188 dBm
2.45766 GHz
24.694 s
100 kHz
1.252 s
MR
M1
12
11
Pos: 0.0 div
Bitmap
Show On
Clear
dB/div: 10.0 dB
RBW: 300 kHz
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
The 100% POI
100% POI: 100.0 us
Split
Autoscale
CF: 2.44531 GHz
Span: 40.00 MHz
Spectrum
Trace 1
Show +Peak Normal
Clear
dB/div: 10.0 dB
RBW: 300 kHz
MR: -74.12 dBm
2.45756 GHz
M1: -74.93 dBm
2.45766 GHz
ΔM1: -0.81 dB
100 kHz
Hopping signal
(Time-correlated display)
Autoscale
CF: 2.44531 GHz
Span: 40.00 MHz

TIP. 100% POI

The minimum event duration required to ensure 100% Probability of Intercept (POI) or event capture. It depends on interaction between span, RBW, and FFT length. You can use the POI time value to determine if you are at risk of either missing a narrow transient or of its captured amplitude being less than the actual signal. The minimum 100% POI for RSA306 is 100 µs.

Demo 6: Transient capture - Mask test and act on violation

The mask test feature in SignalVu-PC allows you to save events of interest automatically and allows you to save an acquisition file in an open data format and/or a screen capture when a signal in the frequency domain violates the mask.

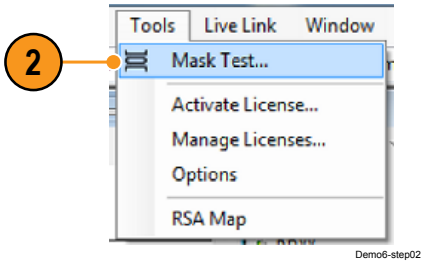
Instructions for the demo board

1. Keep the same setting (Infrequent hopping signals) as the last demo.

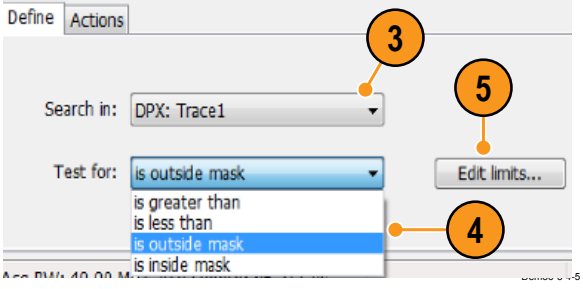
Instructions for the RSA306

1. Keep the same setting, or recall the setting Demo5_DPX.tiq. Click Run.

2. Under the Tools menu, click Mask Test….



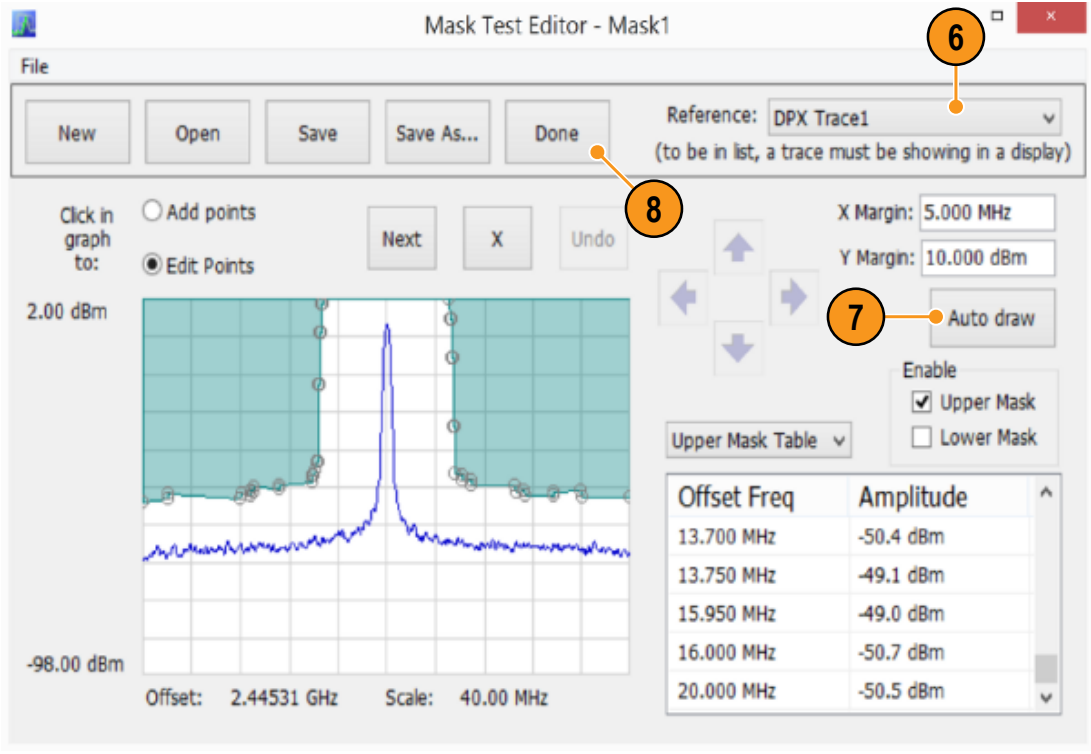
3. Select DPX: Trace1 from Search in:.
4. Select is outside mask from Test for:.
5. Click Edit limits… to open the Mask Test Editor.



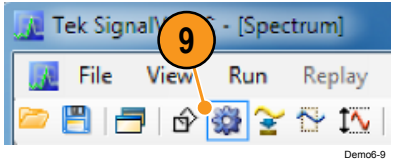
6. In the Mask Test Editor, select the DPX Trace1 as the Reference.
7. Click Auto Draw to generate a mask automatically adjusted to the Reference.
8. Click Done.

TIP. Mask Test Editor

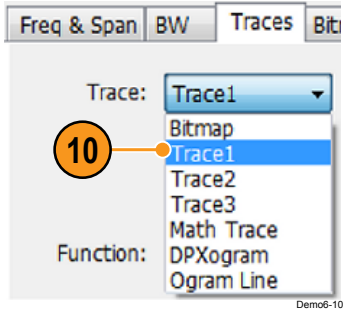
- *The margins between the mask and the reference trace can be specified by X Margin and Y Margin.*
- *The points can be added, edited, or deleted.*
- *You can also create a Frequency Mask by using the manual method.*


Mask Test Editor - Mask1
File
New
Open
Save
Save As...
Done
Reference:
DPX Trace1
(to be in list, a trace must be showing in a display)
6
8
Click in graph to:
Add points
Edit Points
Next
X
Undo
X Margin:
5.000 MHz
Y Margin:
10.000 dBm
7
Auto draw
Enable
Upper Mask
Lower Mask
2.00 dBm
-98.00 dBm
Offset: 2.44531 GHz
Scale: 40.00 MHz
Upper Mask Table
Offset Freq
Amplitude
13.700 MHz
-50.4 dBm
13.750 MHz
-49.1 dBm
15.950 MHz
-49.0 dBm
16.000 MHz
-50.7 dBm
20.000 MHz
-50.5 dBm

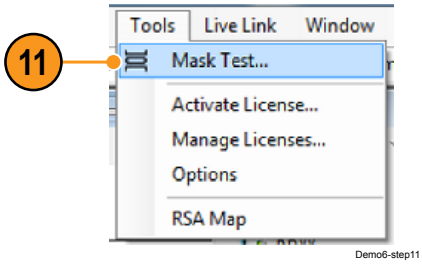
9. In the DPX display, and click the settings button.



10. Select Trace1 as the Trace under the Traces tab.



11. Under Tools, click Mask Test….



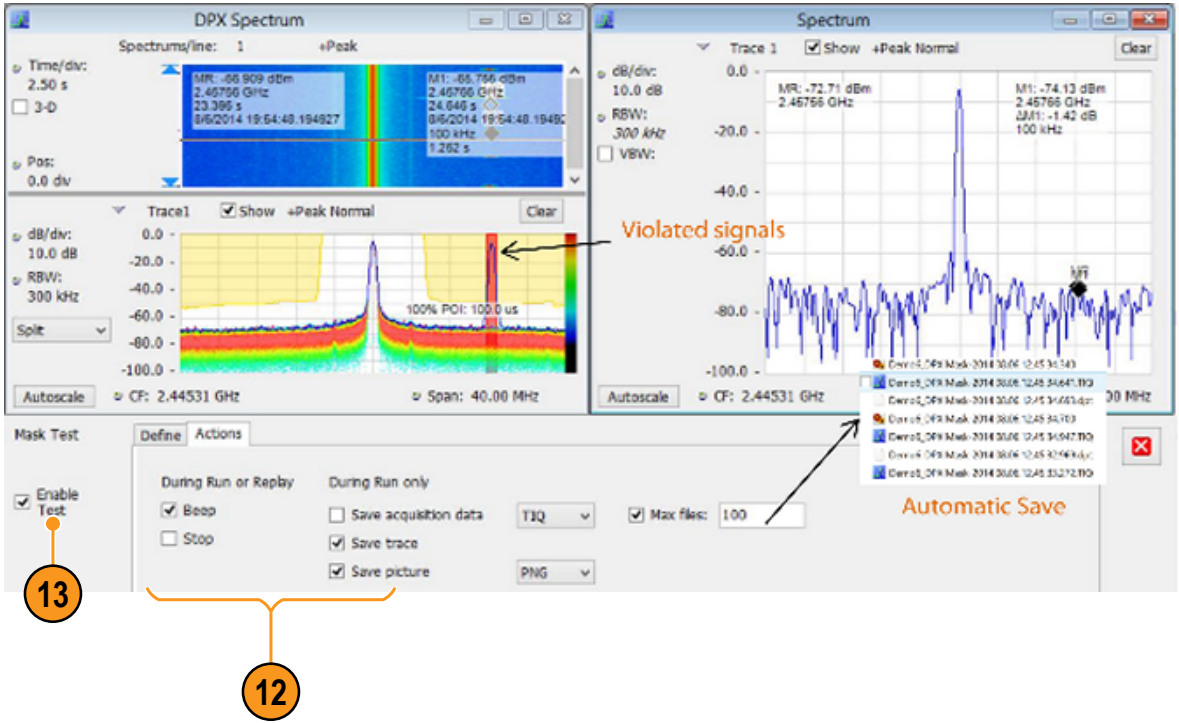
12. Under the Actions tab, select Beep, Save acquisition data, Save trace, and Save picture.

13. Click Enable Test.

When a mask violation is detected, the system will sound a beep, and save all your selected format of files into the selected folder automatically.

TIP. Actions for violations

- *The analyzer can take up to five actions when a match occurs. In Run mode, the analyzer can sound a beep, stop acquisitions, save acquisition data, save trace data, and save a picture of the display. In Replay mode, it can sound a beep and stop analyzing.*
- *Files can be saved in the native format of SignalVu-PC (.tiq), or in comma separated variable (.CSV) or Matlab level 5 (.MAT) formats.*
- *The folder for saving files can be selected from Save as….*


DPX Spectrum
Spectrums/line: 1
+Peak
Time/div:
2.50 s
3-D
Pos:
0.0 div
Trace1
Show
+Peak Normal
Clear
dB/div:
10.0 dB
RBW:
300 kHz
Split
100% POI: 100.0 us
Autoscale
CF: 2.44531 GHz
Span: 40.00 MHz
Spectrum
Trace 1
Show
+Peak Normal
Clear
dB/div:
10.0 dB
RBW:
300 kHz
VBW:
MR: -72.71 dBm
2.45766 GHz
M1: -74.13 dBm
2.45766 GHz
ΔM1: -1.42 dB
100 kHz
Violated signals
Autoscale
CF: 2.44531 GHz
Mask Test
Define
Actions
Enable Test
During Run or Replay
Beep
Stop
During Run only
Save acquisition data
IQ
Save trace
Save picture
PNG
Max files:
100
Automatic Save
13
12

Demo6-12-13

Demo 7: Analog modulation analysis

Analog modulation is the most fundamental modulation method. The analog modulation analysis feature in the RSA306 series provides measurements to demodulate and analyze amplitude modulation (AM), frequency modulation (FM), and phase modulation (PM). This example shows how to analyze an FM signal with the RSA306.

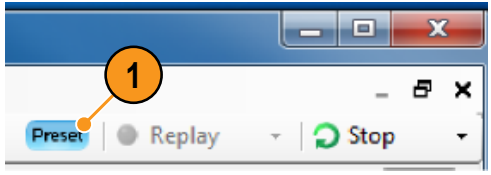
Instructions for the demo board

1. Keep the same setting as the last demo. Use the ROW and COLUMN buttons to change the signal type from Inf Hop to FM (frequency modulation signals).

Demo7-FM

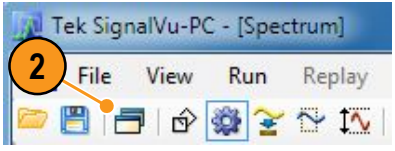
Instructions for the RSA306

1. Click the Preset button.

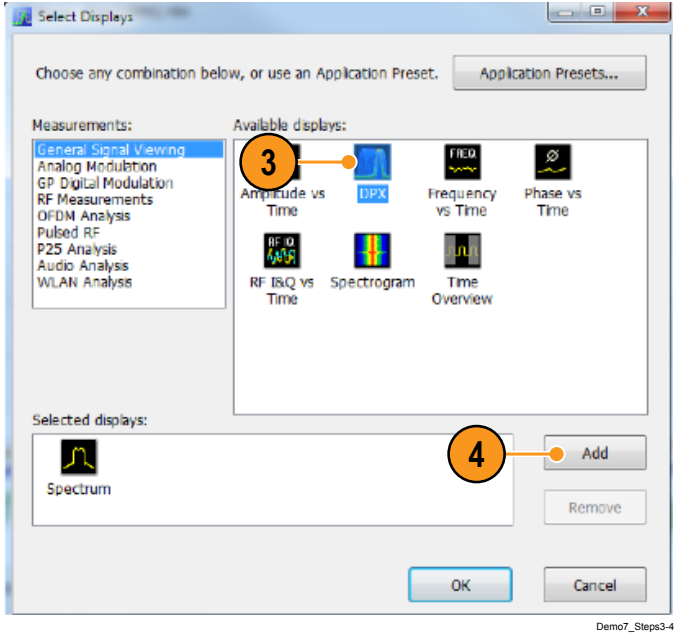


Demo7-1

2. Click the Display button.



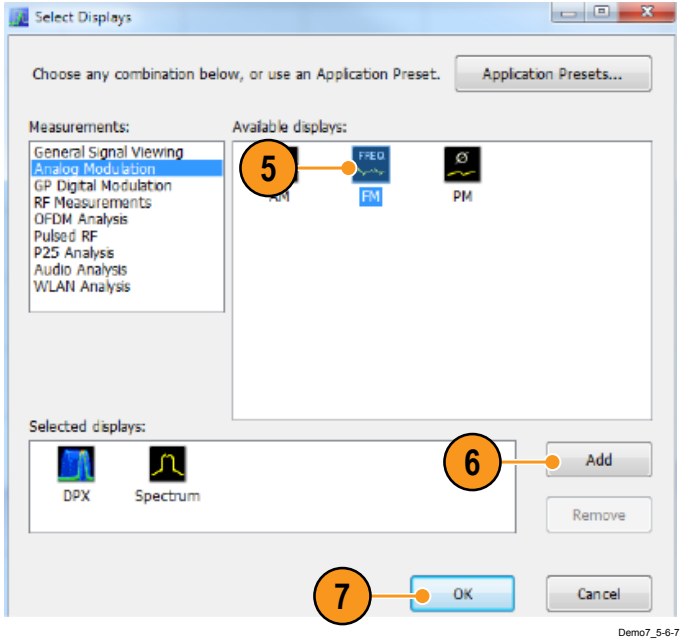
3. In General Signal Viewing, select DPX from the Available displays box.
4. Click the Add button. This will add the DPX icon to the Selected Displays box (and remove it from the Available displays box).



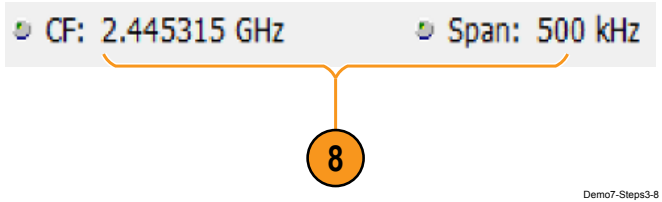
5. In Analog Modulation, select FM from the Available displays box.
6. Click the Add button.
7. Click the OK button.

TIP. Selecting displays

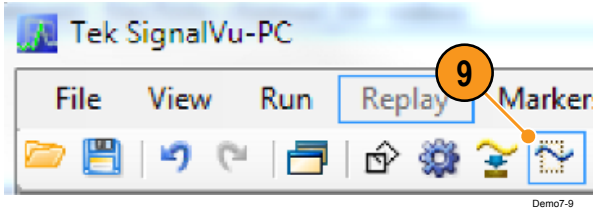
- *You can also double-click the desired display to add or remove it.*
- *Five application presets are available for the display selection.*



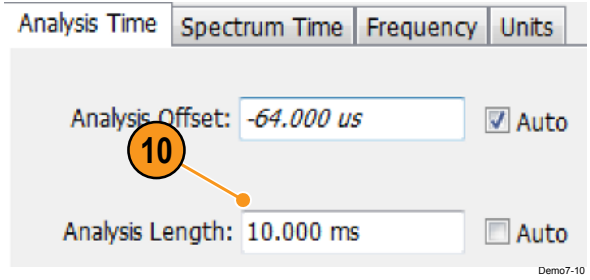
8. Select the DPX display by clicking anywhere on it with the mouse, and set the CF to 2.445315 GHz and the Span to 500 kHz.



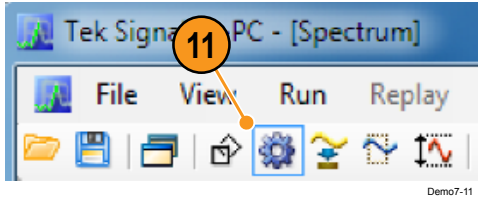
9. Click the Analysis control button.



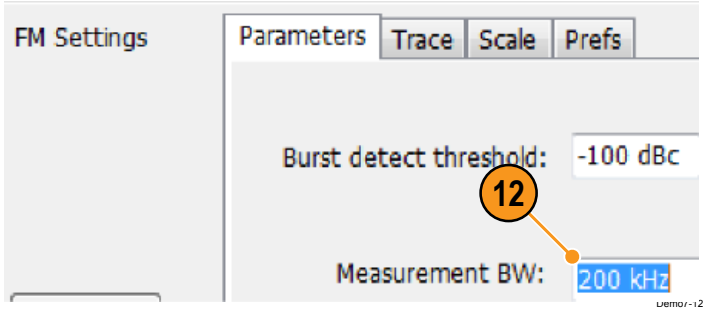
10. Under the Analysis Time tab, set the Analysis Length to 10 ms.



11. Click the FM display, and then click the settings button.

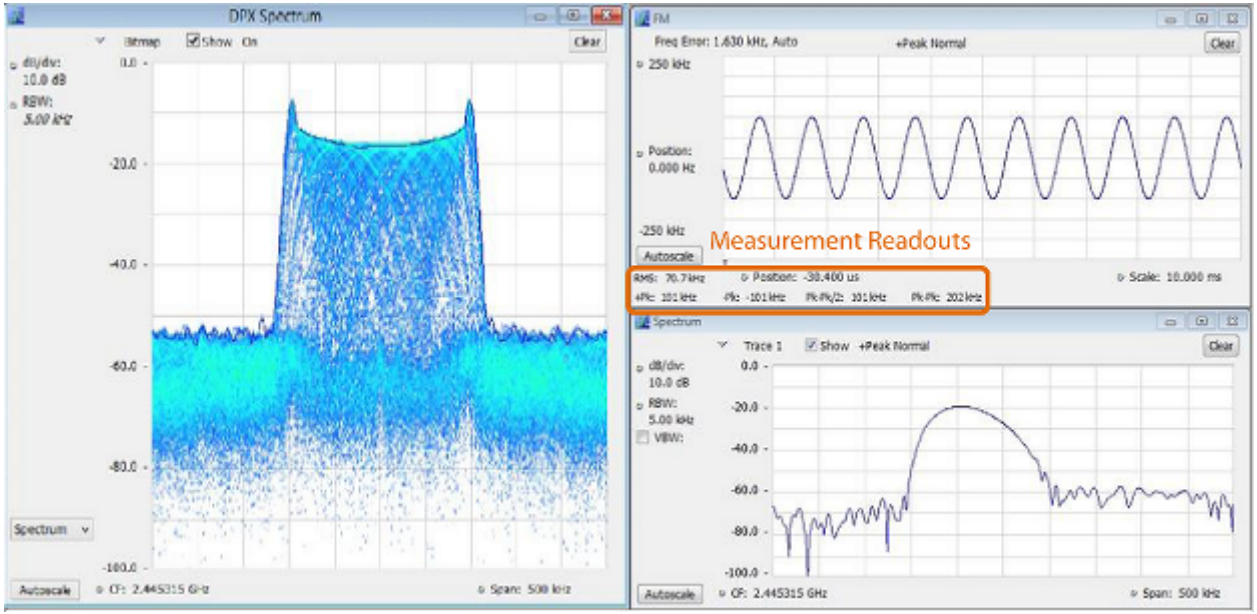


12. Under the Parameters tab, set the Measurement BW to 200 kHz.



NOTE. FM measurements readout

- *+Pk: positive frequency deviation*
- *–Pk: negative frequency deviation*
- *RMS: RMS value of the deviation*
- *Pk-Pk: peak-to-peak frequency deviation*
- *Pk-Pk/2: peak-to-peak frequency deviation divided by two*


DPX Spectrum
Bitmap
Show On
Clear
dB/div:
10.0 dB
RBW:
5.00 kHz
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
Spectrum
Autoscale
CF: 2.445315 GHz
Span: 500 kHz
FM
Freq Error: 1.630 kHz, Auto
+Peak Normal
Clear
250 kHz
Position:
0.000 Hz
-250 kHz
Autoscale
Measurement Readouts
RMS: 70.74Hz
Position: -38.400 us
Scale: 10.000 ms
+Pk: 101 kHz
-Pk: -101 kHz
Pk-Pk/2: 101 kHz
Pk-Pk: 202 kHz
Spectrum
Trace 1
Show +Peak Normal
Clear
dB/div:
10.0 dB
RBW:
5.00 kHz
VBW:
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
Autoscale
CF: 2.445315 GHz
Span: 500 kHz

Demo 8: Digital modulation analysis

The General Purpose Digital Modulation Analysis provides vector signal analyzer functionality. A wide variety of modulation types are supported, allowing you to view your signals in Constellation, Eye and Trellis diagrams, measure the quality of the modulation, display time-domain waveforms for demodulated I & Q signals, EVM, Phase Error, Magnitude Error, and more. This example shows how to demodulate a QPSK signal with RSA306. This demonstration also introduces the concept of application presets to quickly set up for complex analysis tasks. This demonstration relies on the optional modulation analysis capabilities of SignalVu-PC. If you are using a basic version of SignalVu-PC, a trial license for this analysis can be accessed through the Tools: Manage Licenses menu of the software.

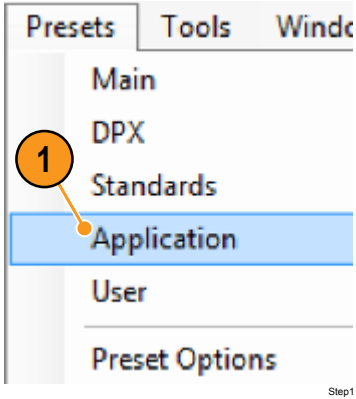
Instructions for the demo board

1. Use the ROW and COLUMN buttons to change the signal type from FM to QPSK1.

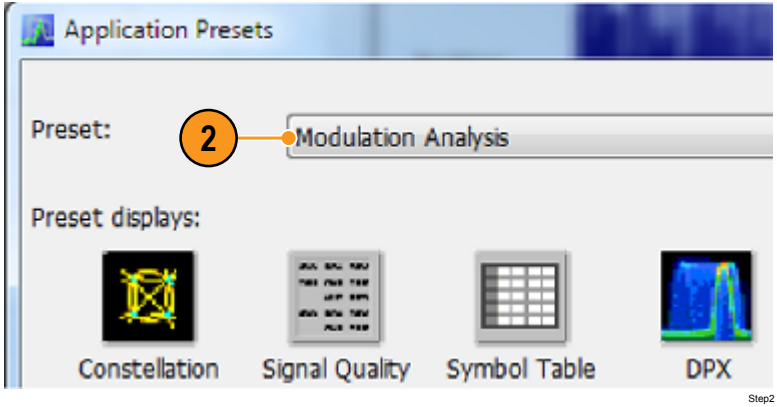
Demo8-QPSK

Instructions for the RSA306

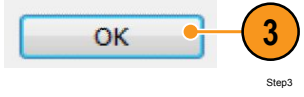
1. In the Presets menu, click application.



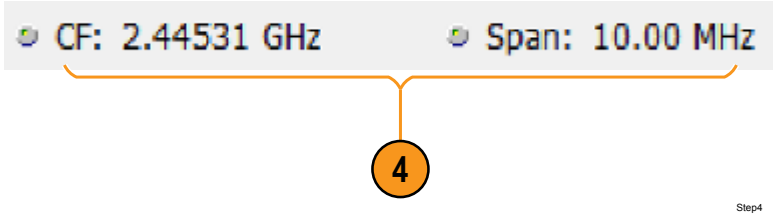
2. Select Modulation Analysis for the Preset.



3. Click OK.



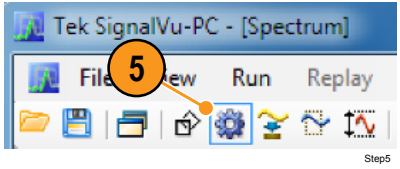
4. Click the DPX display, set the CF to 2.445315 GHz and the Span to 10 MHz.



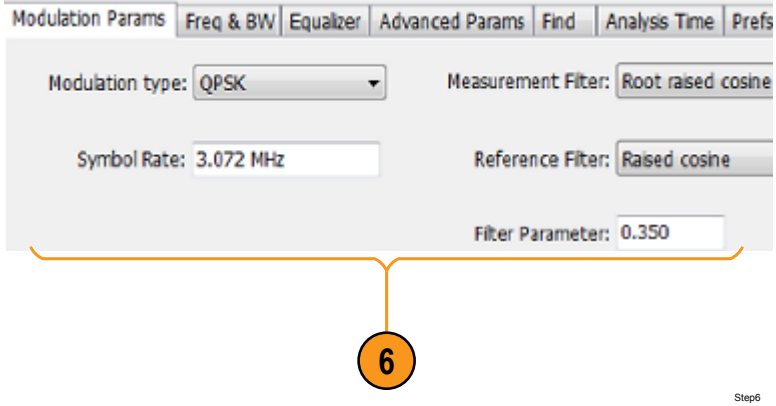
TIP. Save as application presets

To save setups so that they appear in the Application Presets window, save your setup in the folder C:\SignalVu-PC Files\User Presets. The saved setup will appear in the Application Presets window with the name you give the file.

5. Click the Constellation display, and then click the settings button.



6. Under the Modulation Params tab, Select QPSK from the Modulation Type list, set the Symbol Rate to 3.072 MHz, set Measurement Filter to Root raised cosine, Reference Filter to Raised cosine, and Filter parameter to 0.35.



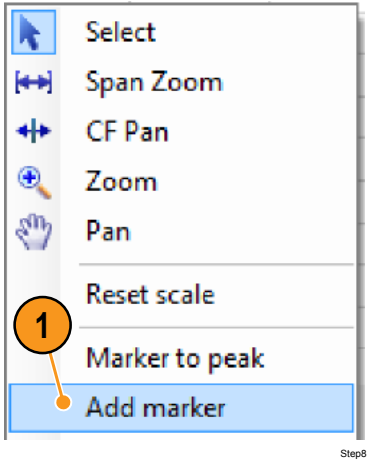
TIP. Modulation filters

In most modulation schemes, signals are filtered to reduce the bandwidth prior to transmission. When the signal under test has been passed through a modulation filter, a matching Measurement Filter should be selected in the instrument in order to interpret symbols properly. The Reference Filter, while not used for demodulation, is important for making the proper error vector measurement calculations. This filter will normally be defined by the modulation/demodulation standard.

7. Click the Stop button.

Step7

8. Select the Symbol Table, right click the screen, and select Add Marker.



9. Drag the marker to any cell in the Symbol Table. This sets the marker (MR) time value to the starting time for the cell containing the marker.

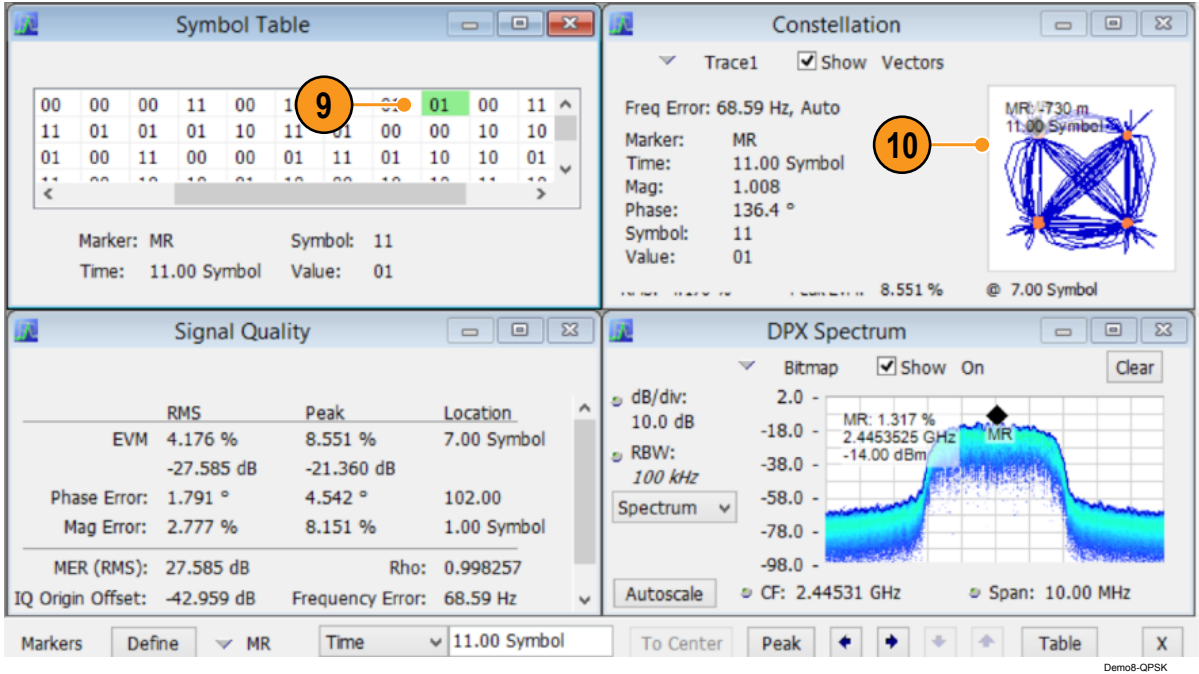
10. Look for MR in the Constellation graph. Move the marker to different cells in the Symbol Table.

TIP. Symbol table

Each symbol value is assigned a position in the Constellation diagram. The Symbol Table will be used to demonstrate the mapping between quadrants in the Constellation diagram and the symbol values.

TIP. Correlated display

Not only are all the displays correlated through the shared data set, but the markers, which are inherently correlated, make it very easy to see how a data point in one domain relates to a specific data point in any other. This can greatly reduce troubleshooting time.

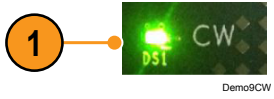

Symbol Table
9
Marker: MR
Symbol: 11
Time: 11.00 Symbol
Value: 01
Constellation
Trace1
Show Vectors
Freq Error: 68.59 Hz, Auto
10
Marker: MR
Time: 11.00 Symbol
Mag: 1.008
Phase: 136.4 °
Symbol: 11
Value: 01
8.551 %
@ 7.00 Symbol
Signal Quality
RMS Peak Location
EVM 4.176 % 8.551 % 7.00 Symbol
-27.585 dB -21.360 dB
Phase Error: 1.791 ° 4.542 ° 102.00
Mag Error: 2.777 % 8.151 % 1.00 Symbol
MER (RMS): 27.585 dB Rho: 0.998257
IQ Origin Offset: -42.959 dB Frequency Error: 68.59 Hz
DPX Spectrum
Bitmap
Show On
Clear
dB/div: 10.0 dB
RBW: 100 kHz
Spectrum
2.0
-18.0
-38.0
-58.0
-78.0
-98.0
MR: 1.317 %
2.4453525 GHz
-14.00 dBm
MR
Autoscale
CF: 2.44531 GHz
Span: 10.00 MHz
Markers
Define
MR
Time
11.00 Symbol
To Center
Peak
Table
X
Demo8-QPSK

Demo 9: EMI spurious

The spurious measurement in the RSA306 is set up to change limits vs. frequency, and antenna correction factors can be applied. Violations above the user-set limits are shown in red on the table. This example shows how to use the spurious display in SignalVu-PC and the RSA306 to perform EMI pre-compliance and diagnostics.

Instructions for the demo board

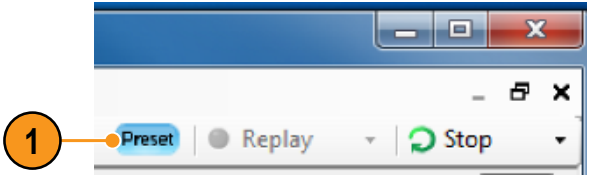
1. Keep the same setting as the last demo. Use the ROW and COLUMN buttons to change the signal type from QPSK1 back to CW.



Demo9CW

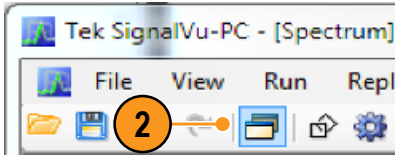
Instructions for the RSA306

1. Click Preset.

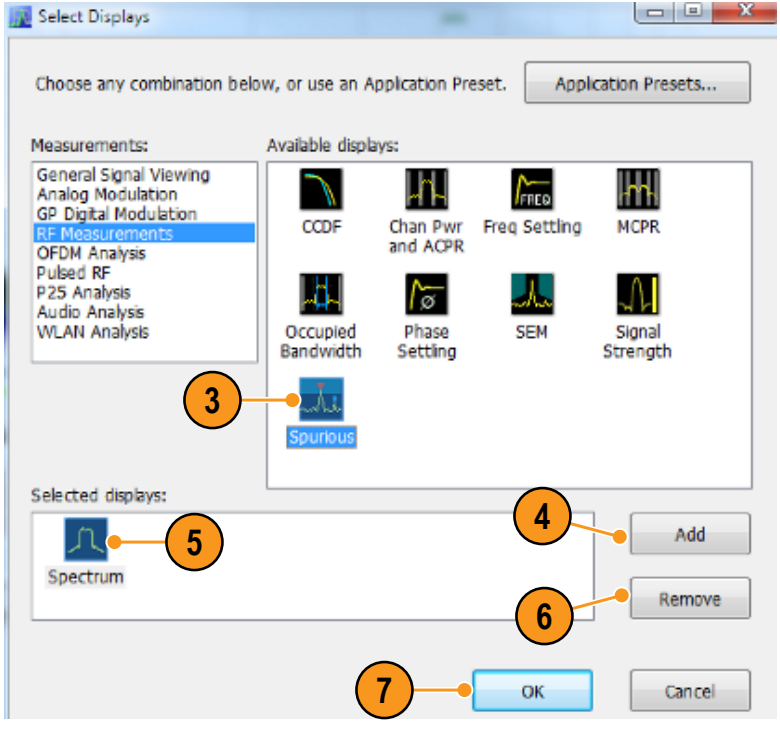


Demo9-Step1

2. Click the Display button.

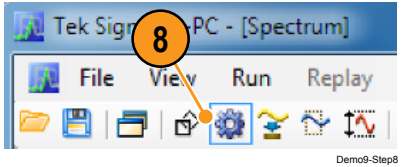


3. In RF Measurement, select Spurious from the Available displays box.
4. Click Add to add the application to the Selected Displays list.
5. Select the Spectrum icon in the Selected Displays list.
6. Click Remove to clear the icon from the list.
7. Click OK.

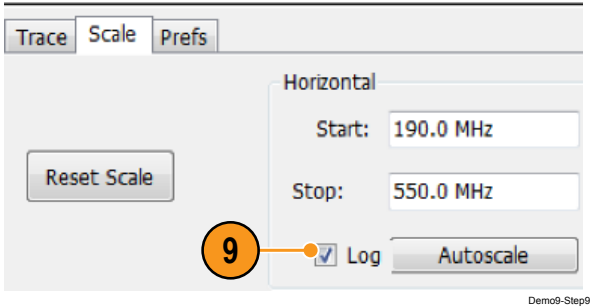


Demo9-Steps3-7

8. Click the settings button.

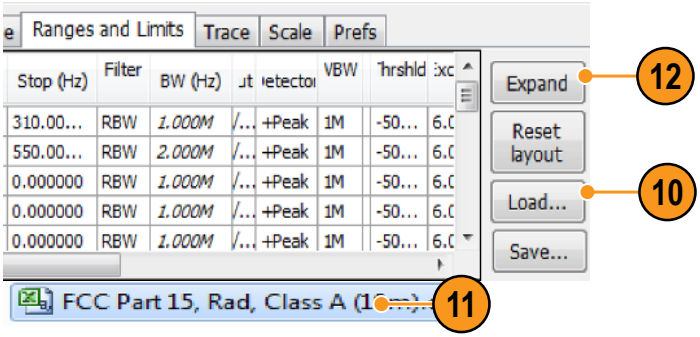


9. In the Scale tab, select the Log scale to reset the display to show the frequency axis in a logarithmic scale.



TIP. Loss correction

The External Gain/Loss Correction tab under the amplitude control panel ( ) allows you to apply a correction to a signal to compensate for the use of external equipment, such as an amplifier or attenuator. External loss tables can be used to apply a frequency dependent gain/loss correction to the signal.

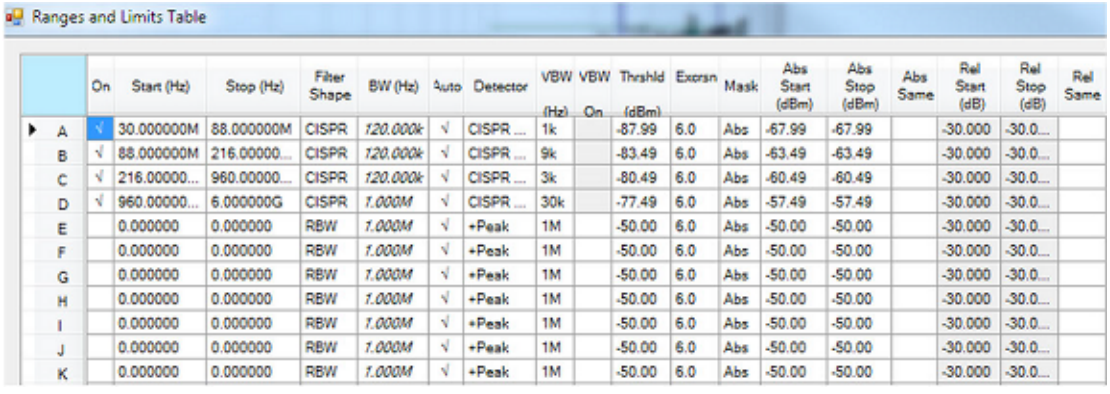


10. Under the Ranges and Limits tab, click Load to select the appropriate limit line and measurement condition.

11. Select FCC Part 15, Rad, Class A (10m).csv for this example.

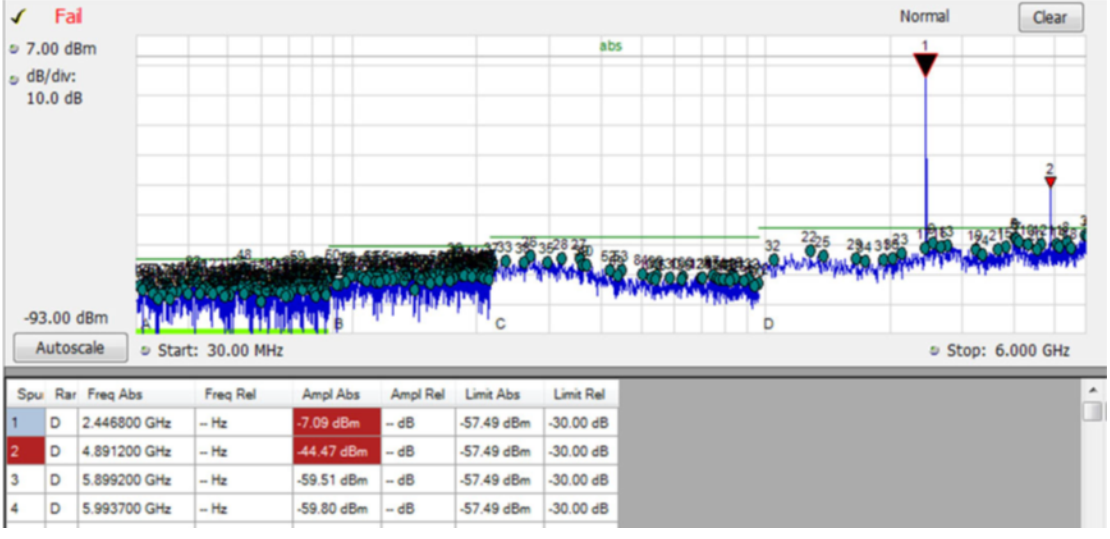
12. A larger new resized window of range and limit table can be displayed by clicking Expand.

You can edit the start and stop range, filter shape, RBW, VBW, detector, threshold and excursion, and limit line.



	On	Start (Hz)	Stop (Hz)	Filter Shape	BW (Hz)	Auto	Detector	VBW (Hz)	VBW On	Thrshld (dBm)	Excrsn	Mask	Abs Start (dBm)	Abs Stop (dBm)	Abs Same	Rel Start (dB)	Rel Stop (dB)	Rel Same
A	√	30.000000M	88.000000M	CISPR	120.000k	√	CISPR ...	1k		-87.99	6.0	Abs	-67.99	-67.99		-30.000	-30.0...	
B	√	88.000000M	216.00000...	CISPR	120.000k	√	CISPR ...	9k		-83.49	6.0	Abs	-63.49	-63.49		-30.000	-30.0...	
C	√	216.00000...	960.00000...	CISPR	120.000k	√	CISPR ...	3k		-80.49	6.0	Abs	-60.49	-60.49		-30.000	-30.0...	
D	√	960.00000...	6.000000G	CISPR	1.000M	√	CISPR ...	30k		-77.49	6.0	Abs	-57.49	-57.49		-30.000	-30.0...	
E		0.000000	0.000000	RBW	1.000M	√	+Peak	1M		-50.00	6.0	Abs	-50.00	-50.00		-30.000	-30.0...	
F		0.000000	0.000000	RBW	1.000M	√	+Peak	1M		-50.00	6.0	Abs	-50.00	-50.00		-30.000	-30.0...	
G		0.000000	0.000000	RBW	1.000M	√	+Peak	1M		-50.00	6.0	Abs	-50.00	-50.00		-30.000	-30.0...	
H		0.000000	0.000000	RBW	1.000M	√	+Peak	1M		-50.00	6.0	Abs	-50.00	-50.00		-30.000	-30.0...	
I		0.000000	0.000000	RBW	1.000M	√	+Peak	1M		-50.00	6.0	Abs	-50.00	-50.00		-30.000	-30.0...	
J		0.000000	0.000000	RBW	1.000M	√	+Peak	1M		-50.00	6.0	Abs	-50.00	-50.00		-30.000	-30.0...	
K		0.000000	0.000000	RBW	1.000M	√	+Peak	1M		-50.00	6.0	Abs	-50.00	-50.00		-30.000	-30.0...	

After loading the spurious table, your display should look similar to the picture below. The green bar is the loaded limit line as standards suggest.



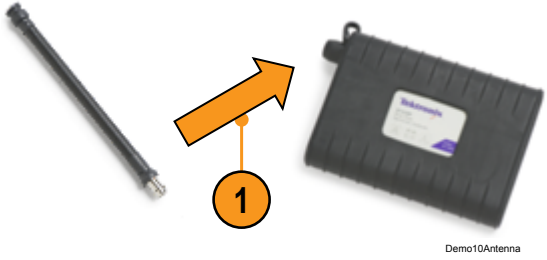
Spu	Rar	Freq Abs	Freq Rel	Ampl Abs	Ampl Rel	Limit Abs	Limit Rel
1	D	2.446800 GHz	-- Hz	-7.09 dBm	-- dB	-57.49 dBm	-30.00 dB
2	D	4.891200 GHz	-- Hz	-44.47 dBm	-- dB	-57.49 dBm	-30.00 dB
3	D	5.899200 GHz	-- Hz	-59.51 dBm	-- dB	-57.49 dBm	-30.00 dB
4	D	5.993700 GHz	-- Hz	-59.80 dBm	-- dB	-57.49 dBm	-30.00 dB

Demo 10: FM listening (Demo board not needed)

The RSA306 Series USB Spectrum Analyzers can demodulate audio signals, which can help you to identify unknown radio signals. You access the Audio Demod tab from the Settings control panel of the DPX Spectrum plot display. This Demo shows how to use the RSA306 to demodulate the local FM radio signals and listen to the programming.

Instructions for the antenna

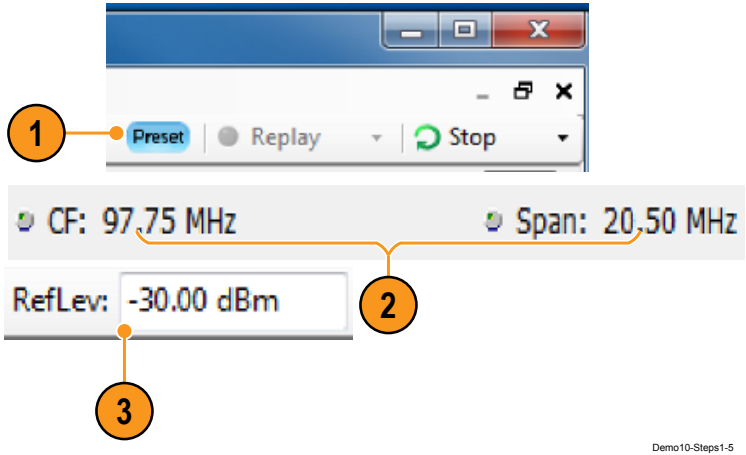
1. Unplug the BNC cable from the RSA306, and connect the provided whip antenna to the RSA306 input.



Demo10Antenna

Instructions for the RSA306

1. Click the Preset button.
2. In the Spectrum display, set the CF to 97.75 MHz and the Span to 20.5 MHz.

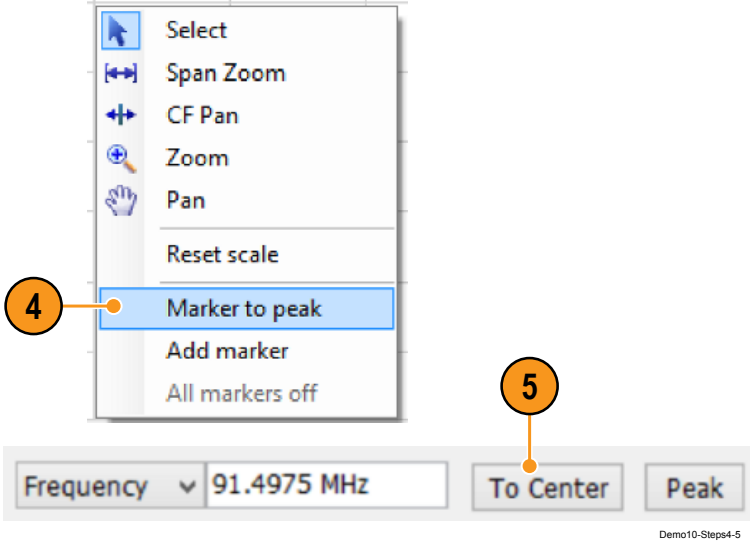


TIP. FM broadcasting

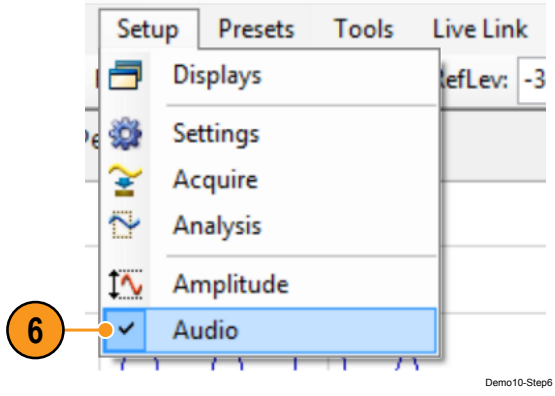
Throughout the world, the FM broadcast band falls within the VHF part of the radio spectrum. Usually the FM band starts from 87.5 MHz to 108.0 MHz. (The frequency modulation radio broadcast band in Japan is 76-90 MHz.)

3. Set the RefLev to -30 dBm.

4. Right click the screen, and click Marker to peak.
5. Click To Center in the bottom marker setting area. This sets the center frequency of the analyzer to the center of the signal.



6. In the Setup menu, click Audio.



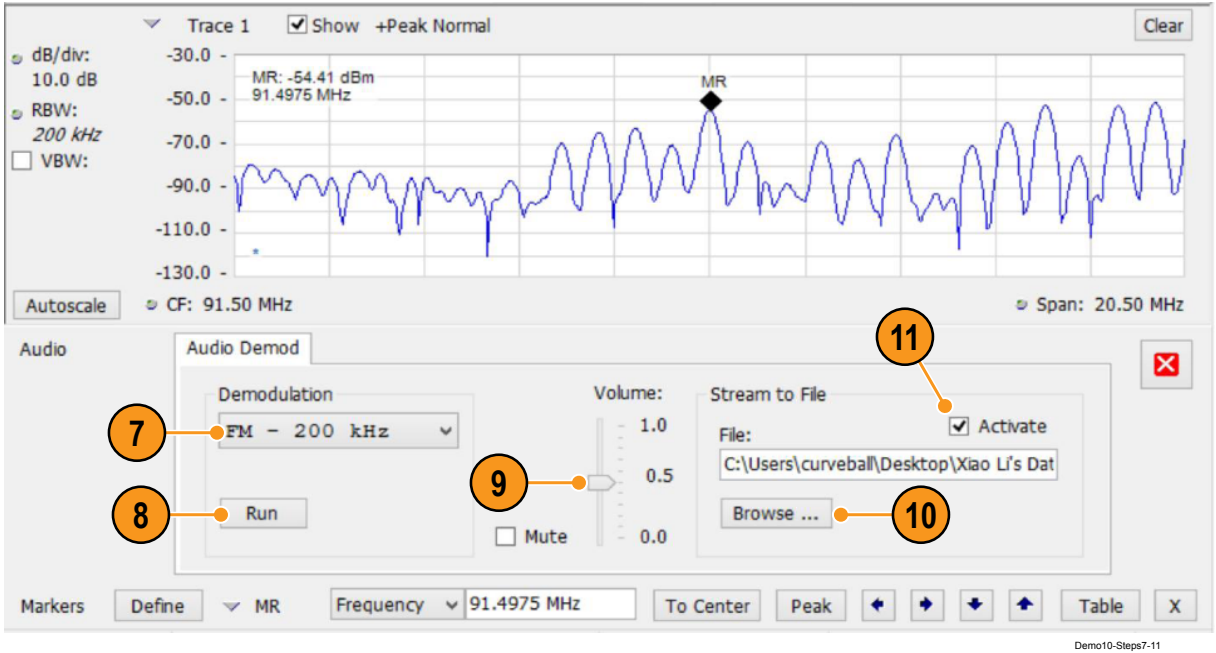
TIP. Audio on DPX

Audio Demodulation is also available when DPX display is running, but the sound quality may be degraded depending on the processer of the host PC.

7. Select FM – 200 kHz as the demodulation.
8. Click Run to start listening to the FM radio signal.
9. Adjust the Audio Gain setting so you can hear the demodulated signal. The sound level is also affected by the setting of the Windows volume control.
10. Click the Browse… button to select the location you want to save the steam file.

11. Enable the Activate button to start saving the audio, and disable the activate button when you want to stop saving. The saved audio format is .wav, which can be played by Windows media player in your PC.

The screenshot below shows the RSA306 is tuned to 91.5 MHz center frequency to listen the local FM broadcasting. Drag the marker to other spectrum peaks, center the peaks, and listen to the programming at other channels.

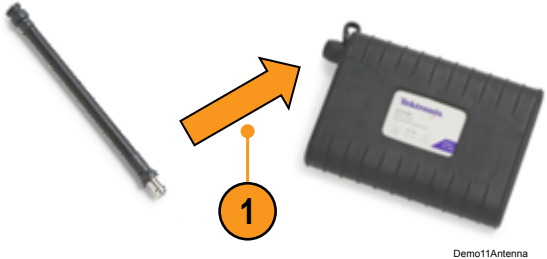

Trace 1
Show
+Peak Normal
Clear
dB/div:
10.0 dB
RBW:
200 kHz
VBW:
-30.0
-50.0
-70.0
-90.0
-110.0
-130.0
MR: -54.41 dBm
91.4975 MHz
MR
Autoscale
CF: 91.50 MHz
Span: 20.50 MHz
Audio
Audio Demod
Demodulation
FM - 200 kHz
Run
Mute
Volume:
1.0
0.5
0.0
Stream to File
Activate
File:
C:\Users\curveball\Desktop\Xiao Li's Dat
Browse ...
7
8
9
10
11
Markers
Define
MR
Frequency
91.4975 MHz
To Center
Peak
Table
X
Demo10-Steps7-11

Demo 11: ISM band DPX (Demo board not needed)

The real time streaming of the RSA306 combined with the DPX processing of the SignalVu-PC software is designed to address the measurement challenges associated with dynamic RF signals such as the bursted packet transmissions of WLAN and Bluetooth. Combo devices that use both Bluetooth and 802.11b/g/n WLAN networks have a unique set of RF interference problems because they share the same 2.4 GHz Industrial/Scientific/Medical (ISM) frequency band. In this example, we will explore this real-world problem using a whip antenna. The demonstration relies on WLAN and Bluetooth signals from a tablet, phone or PC that you can control On or Off.

Instructions for the antenna

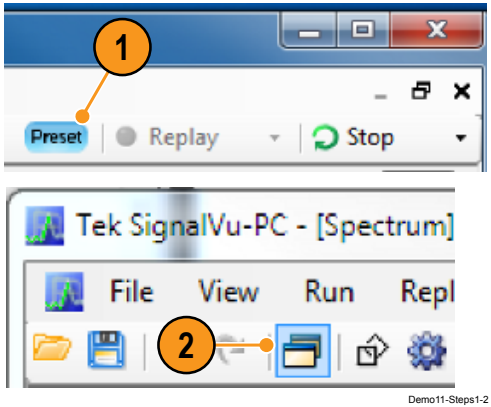
1. Keep the whip antenna attached to the RF input on the demo board as in the last example.



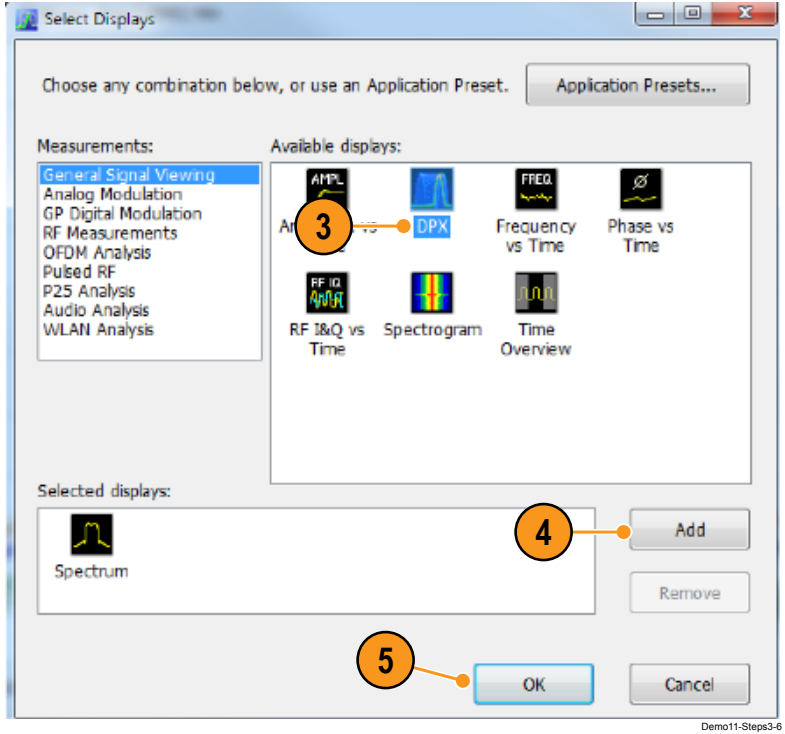
Demo11Antenna

Instructions for the RSA306

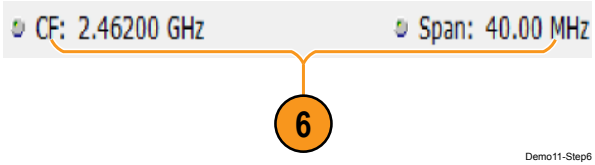
1. Click the Preset button.
2. Click the Display button.



3. In General Signal Viewing, select DPX from the Available displays box.
4. Click the Add button. This will add the DPX icon to the Selected Displays box (and remove it from the Available displays box).
5. Click the OK button.



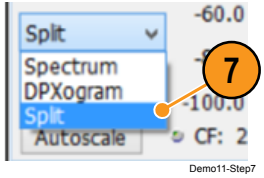
6. In the DPX display, set the CF to 2462 MHz or to the center frequency of one of the WLAN channels. Set the Span to 40 MHz. See the tip below.



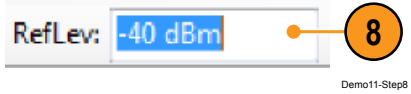
TIP. 2.4 GHz WLAN channels

There are 14 channels designated in the 2.4 GHz range (2400–2483.5 MHz) spaced 5 MHz apart. Channels 1 (2412 MHz), 6 (2437 MHz), and 11 (2462 MHz) are the most common channels to choose, and most routers will use one of them as the default channel.

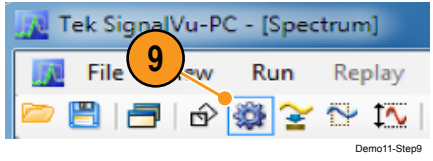
7. Select the Split view.



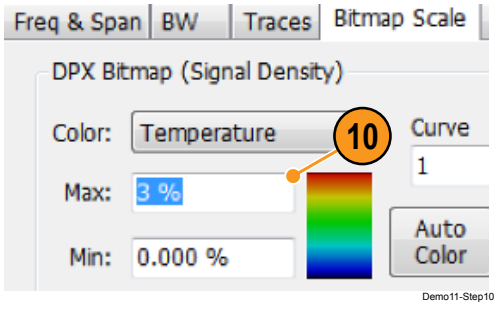
8. Set the RefLev to -40 dBm.



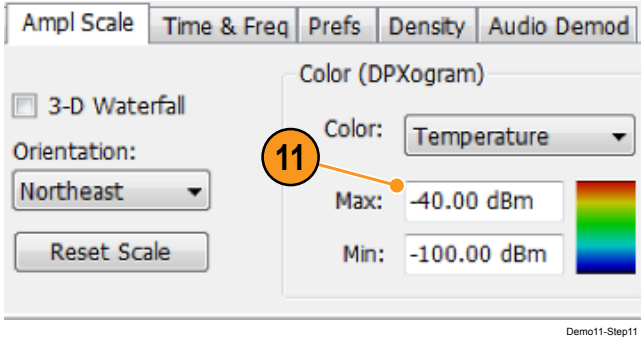
9. In the DPX display, and click the settings button.



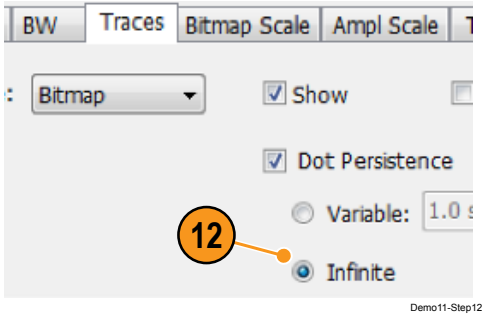
10. Under the Bitmap Scale tab, set the Max scale to 3% for the DPX Spectrum Display.



11. Under the Ampl Scale tab, set the Max color scale to -40 dBm for the DPXogram Display.

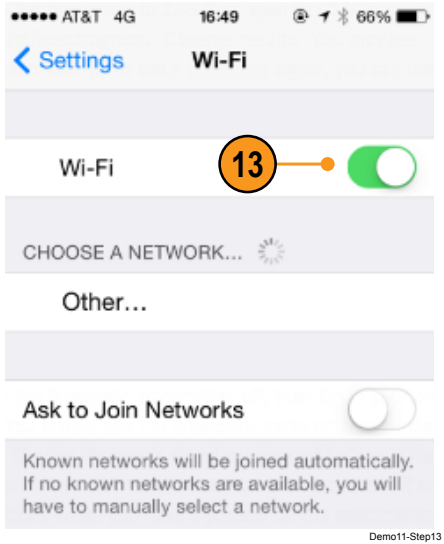


12. In the Traces tab, set the Dot Persistence to Infinite.



13. Turn the WLAN function Off, then On in your smart phone/tablet/PC while monitoring with the setup above.

Check the DPX display to see if you can see the spectrum of the WLAN signals. If no signal, you can change the center frequency of the RSA306 to other channels.



TIP. DPX persistence

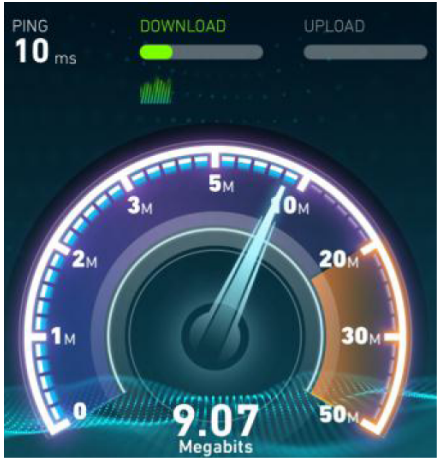
You can set the Dot Persistence to be Variable or Infinite.

- *In variable persistence mode, you specify a decay period that limits how long a point will be displayed.*
- *In infinite persistence mode, once a point in the display has been written to, it will remain visible indefinitely.*

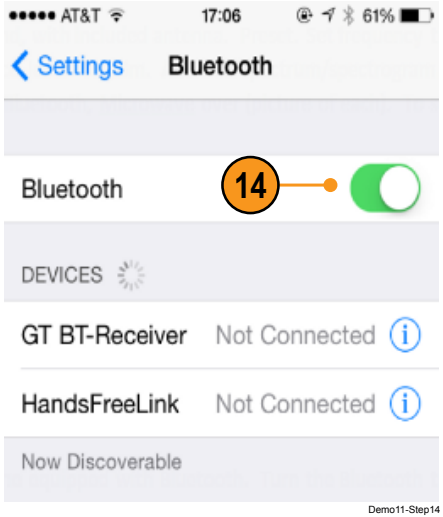
We start with infinite persistence because it ensures that all transients are kept on screen.

TIP. Wi-Fi test mode

To better observe the WLAN activities in the DPX display, you can cause both uplink and downlink activity on your device by navigating to an "internet speed testing" webpage to test both the uploading and downloading speed, and monitor the DPX display of the RSA306 at the same time.

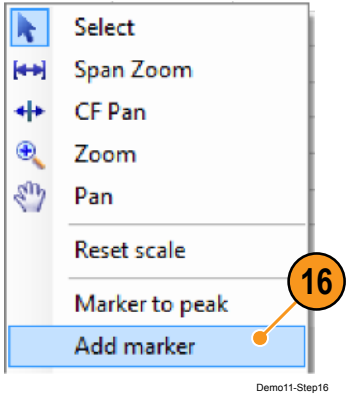


14. Turn the Bluetooth function Off, then On in your smart phone/tablet/PC while monitoring with the setup above.

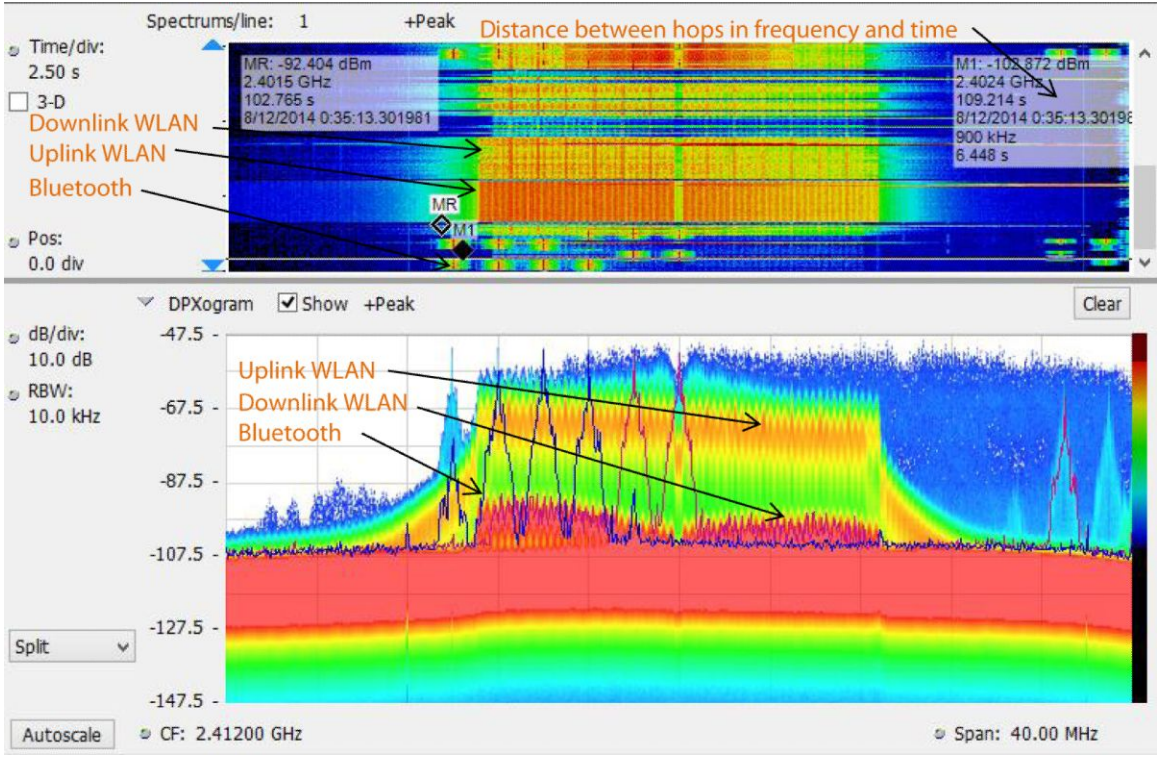


15. Click Stop to stop the acquisitions when you have a pattern on the spectrogram you would like to examine.

16. Right click the display, and click Add markers twice to add two markers. Then you can measure the distance between hops in frequency and time using the markers on the spectrogram.



The following screen shot shows the real time display in the RSA306. You can see a typical WLAN interchange between a nearby smart phone/tablet/PC and a more-distant network access point (AP). The smart phone/tablet/PC signal is nearly 30 dB stronger than the AP's signal because it is closer to the measurement antenna. At the same screen, you can also see the Bluetooth signals, and even the measurements of the time and frequency intervals between those hop signals.


Spectrums/line: 1
+Peak
Distance between hops in frequency and time
Time/div:
2.50 s
3-D
Downlink WLAN
Uplink WLAN
Bluetooth
Pos:
0.0 div
MR: -92.404 dBm
2.4015 GHz
102.765 s
8/12/2014 0:35:13.301981
M1: -103.872 dBm
2.4024 GHz
109.214 s
900 kHz
6.448 s
MR
M1
DPXogram
Show
+Peak
Clear
dB/div:
10.0 dB
RBW:
10.0 kHz
-47.5
-67.5
-87.5
-107.5
-127.5
-147.5
Uplink WLAN
Downlink WLAN
Bluetooth
Split
Autoscale
CF: 2.41200 GHz
Span: 40.00 MHz