Finding, Classifying and Analyzing Interfering Signals

H500/SA2500 Handheld Spectrum Analyzer

Tektronix®

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Signal Discovery and Capture

Mapping

Offline Signal Analysis

1. Automatically Scan Wide Frequency Range And Capture Only Events Of Interest Intelligently With DPX Spectrum Mask

Overview:

The sample script in H500 Command Macro Tool uses spectrum masks in DPX mode to scan the whole ISM band and capture wideband hopping/pulse/transients automatically. If a mask violation is detected for a given sub-range of the ISM band, both a screen shot and stored results are saved.

This sample Macro script helps you to

- Add more sub-span to scan the whole frequency band you need.

- Check for mask violations by loading the frequency mask.

- Adjust the sleep time for however long you want to dwell at the current sub-span looking for mask violations.

- Set to stop acquiring and export a screen shot and store the current results if a violation occurs.

With no programming knowledge needed, you could adjust the commands easily to meet any other scanning measurement requirements.

The following example shows how to scan the whole 80 MHz ISM band (made up by four 20 MHz real time sub-scan channels) and capture the violation signals with DPX spectrum mask. An antenna is required.

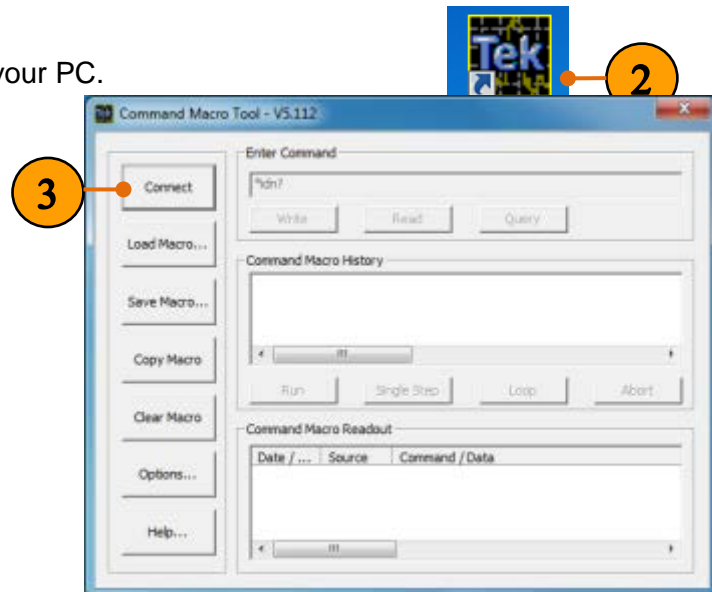**Settable With Up To 20MHz/CH DPX Spectrum Mask Test**
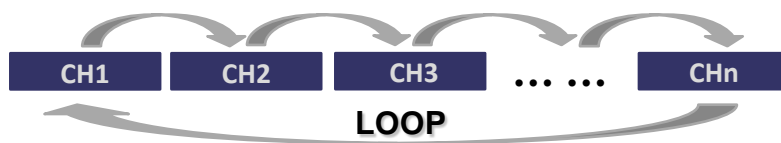
1. Establish a connection between the **Remote Client and Remote Server**.

   Please refer to Tektronix H500/SA2500 Handheld Spectrum Analyzer – How to Guide Series:

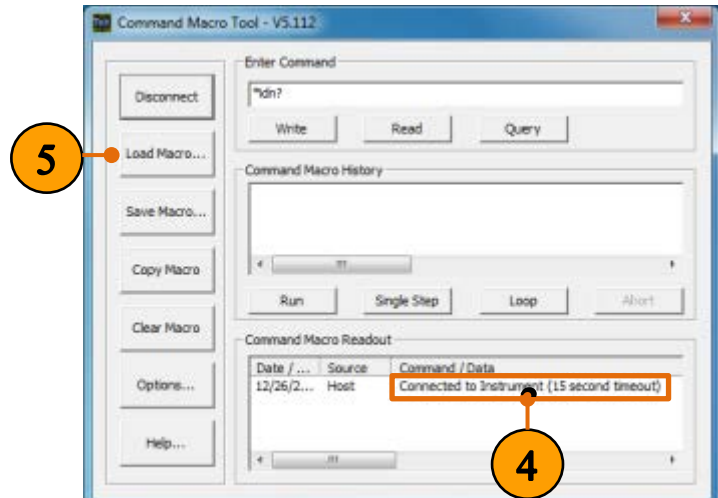   "**4. How to remote control H500 in the field with Remote Client/Server**".

2. Run **Command Macro Tool** on your PC.

3. Click Connect.

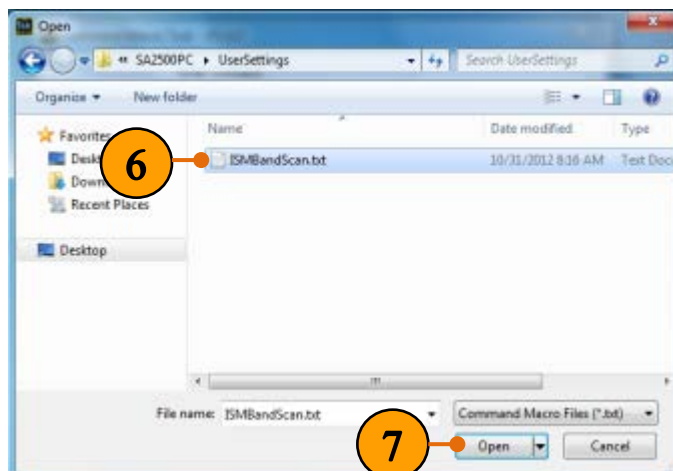4. Check **Command Macro Readout** to make sure the Marco is connected to instrument.

5. Click **Load Macro…**

6. Navigate to the path named C:\Program Files (x86)\Tektronix\SA2500PC\UserSettings, and click the file named **ISMBandScan.txt**.
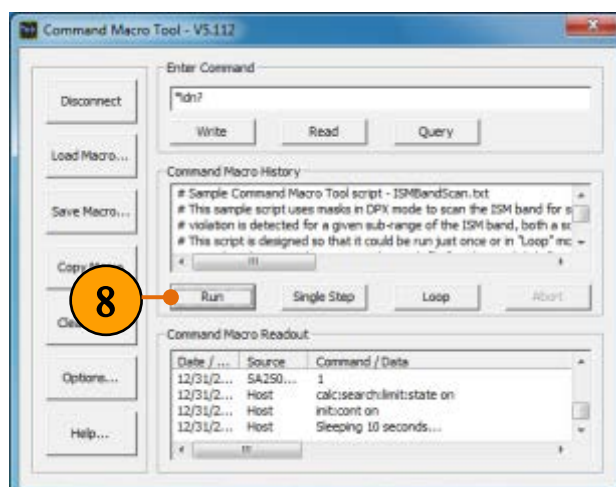
7. Click **Open**.

   The script file will be loaded into Command Macro History window.

8. Click **Run**.

   Cmmands will be sent to H500.

Quick Tips:

- The **ISMBandScan.txt** file is editable to help you create your own command file.

  You can add or change existing sub-span channel, adjust the dwelling time, select different exported file types when violation with no programming needed.

- You can execute the currently selected line from the Command Macro History window using "Single Step" or run the current macro continuously using "Loop".

- Note that this script does require the mask file "60dBmMask.hdm" to be present.

  You could define your own DPX mask using Auto mask with one touch.
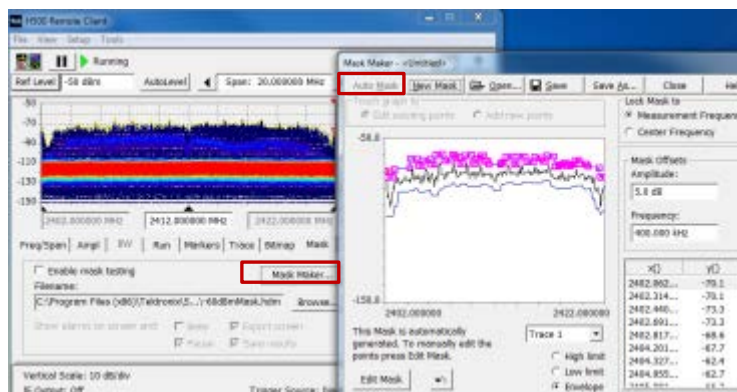
The sample script uses DPX frequency masks scan the whole ISM band (80 MHz) made up by four 20 MHz real time sub-span channels. Both PDX spectrum file (.spdx) and screen shot are exported when signals exceed the -60dBm limit (the Green mask).

Settable With Up To 20MHz/CH DPX Spectrum Mask Test

| 2392 MHz-2412 MHz | 2412 MHz-2432 MHz | 2432 MHz-2452 MHz | 2452 MHz-2472 MHz |

LOOP
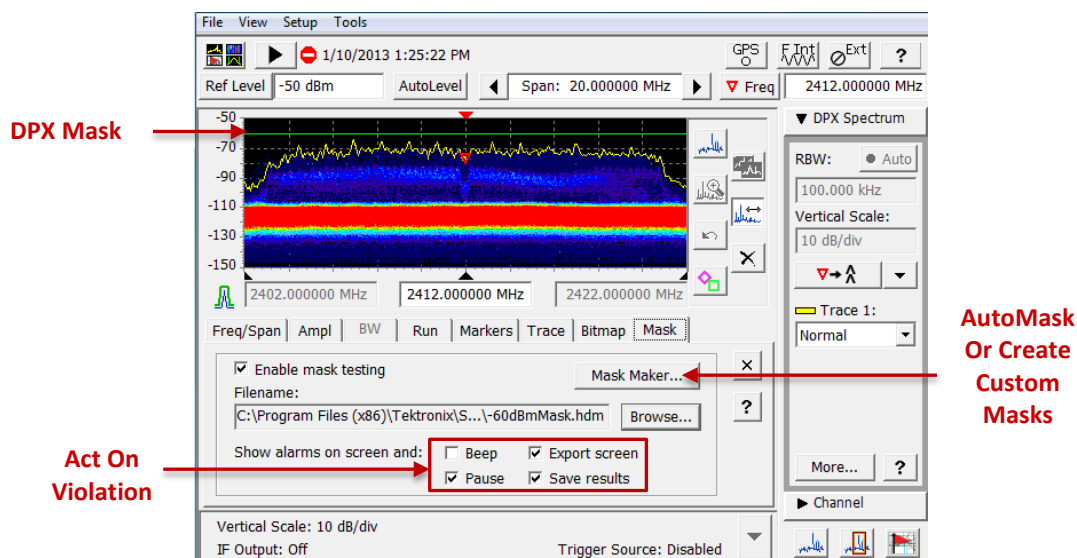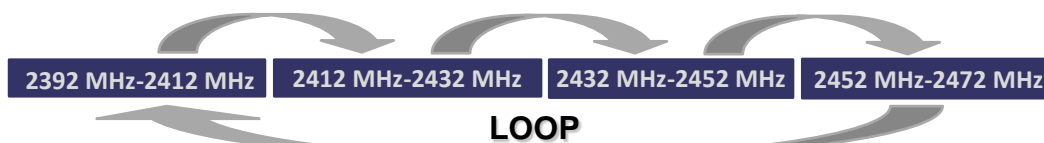
Mask Violation Screen Shots
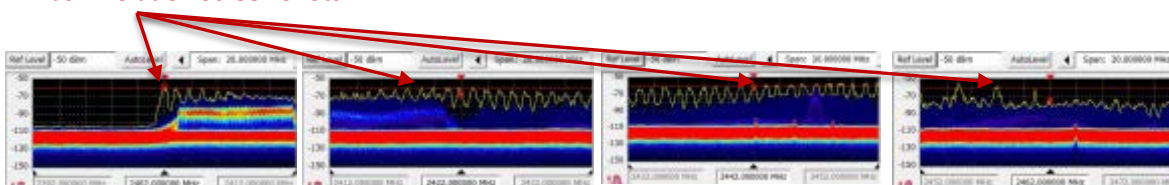
2. Discover Signals of Interest With Signal Classification Measurement

Overview:

Signal Classification feature in Tektronix H500/SA2500 Handheld Spectrum Analyzer helps you determine the various parameters of a part of the signal span.

Signal Classification lets you:

- Define areas of interest as regions (center frequency and frequency span) anywhere on the waveform
- Recognize the presence of new unwanted signals by comparing current results against previously saved spectrum surveys.
- Efficiently categorize signals by assigning classification labels and notes to regions

The Color-coded signal classification database can be saved, recalled, imported, exported, and shared to keep track of spectrum activities at different locations.

Continued from the last example, the following example shows how to recognize and classify the ISM band signals with Signal Classification Measurements.
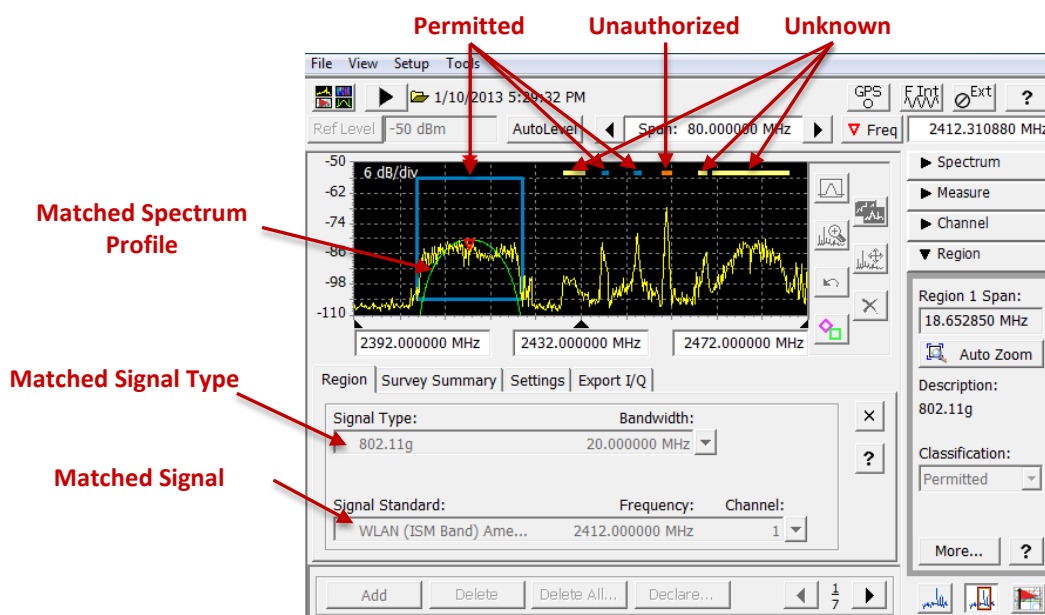
With the setting of the last example:

1. Unselect **Enable mask testing** under the Mask tab.
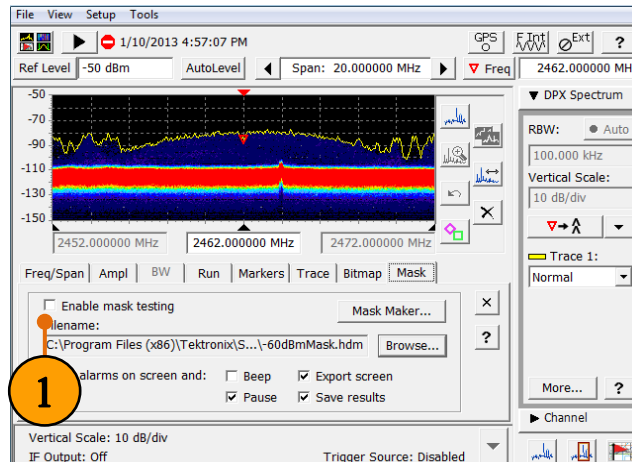
2. Select **continuous** mode under the Run tab.

3. Click **Spectrum measurement display**.

4. Set **Span** as 80 MHz.

5. Set **Center Freq** as 2432 MHz.

6. Set Trace 1 as **Max Hold**.

7. Click **Signal Classification display**.

8. Click **Pause** when you can see most signals in ISM band.
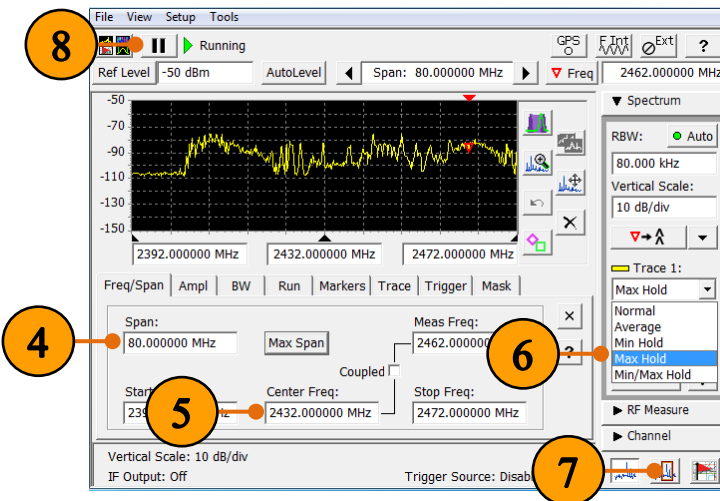
9. Tap the **Add** button.

10. Tap and drag on the screen to define the region width of the 1st signal you are interested.

11. Select the best matched **Signal Type**.

    The list is sorted with best matches at the top of the list, and uses a cell-phone-style strength icon to show relative signal type match relevance.

12. Select the best matched **Signal Standard**.

    The green trace displayed is the spectrum profile of the signal type we selected.

13. Click **Declare**.

14. Choose **Permitted** under Classification, since the signal is identified as WLAN signal at 2412 MHz.

15. Comment/notes could be edited.

16. Click **OK**.

    The color of the permitted region block will be changed to blue.
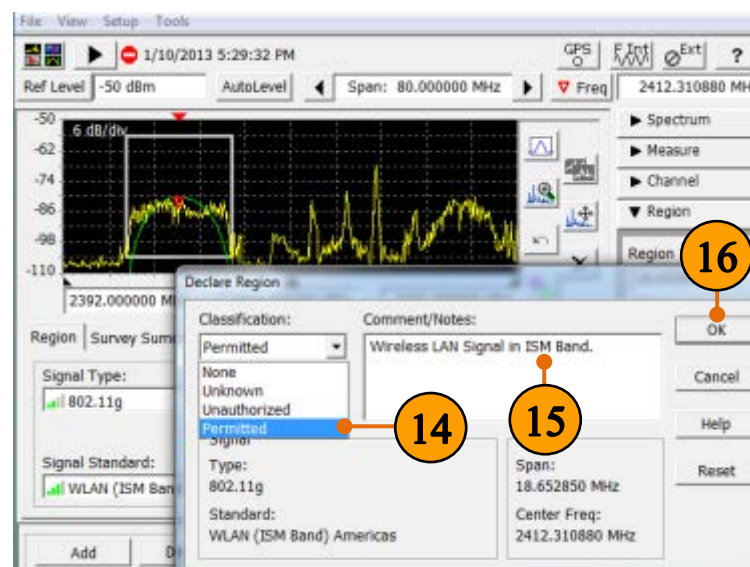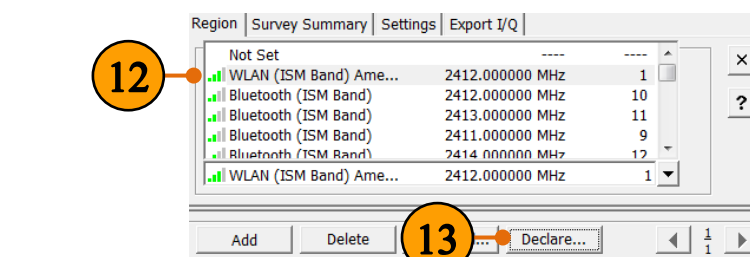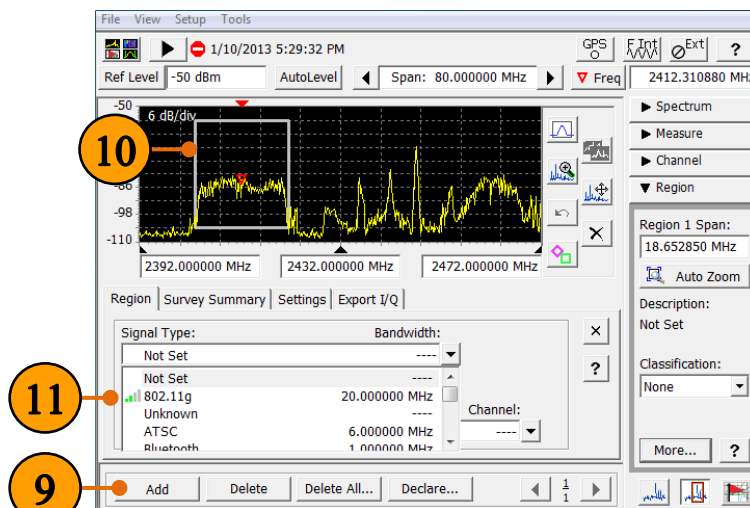
17. Tap the **Add** button to category more signals.

18. Repeat step 10-17 to declare the signal.

   In this example, a Bluetooth signal at 2447 MHz is declared as Unauthorized.

   The color of the unauthorized region block is changed to orange.
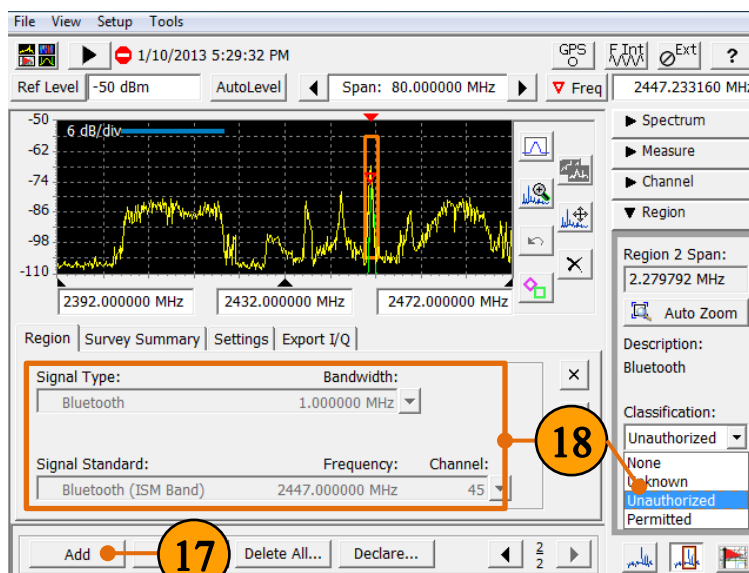
Quick Tips:

- You could choose back to Normal or Average mode from Max hold mode to know the signal character better.

- Click **More…** under Signal Type or Signal Standard to have more selection other than factory Reset database.

All the other signals in ISM band could be recognized and classified if you continue to repeat the declare steps from 10-17. The Color-coded regions can be saved as .txt or .csv file and recalled keeping track of spectrum activity at different location.
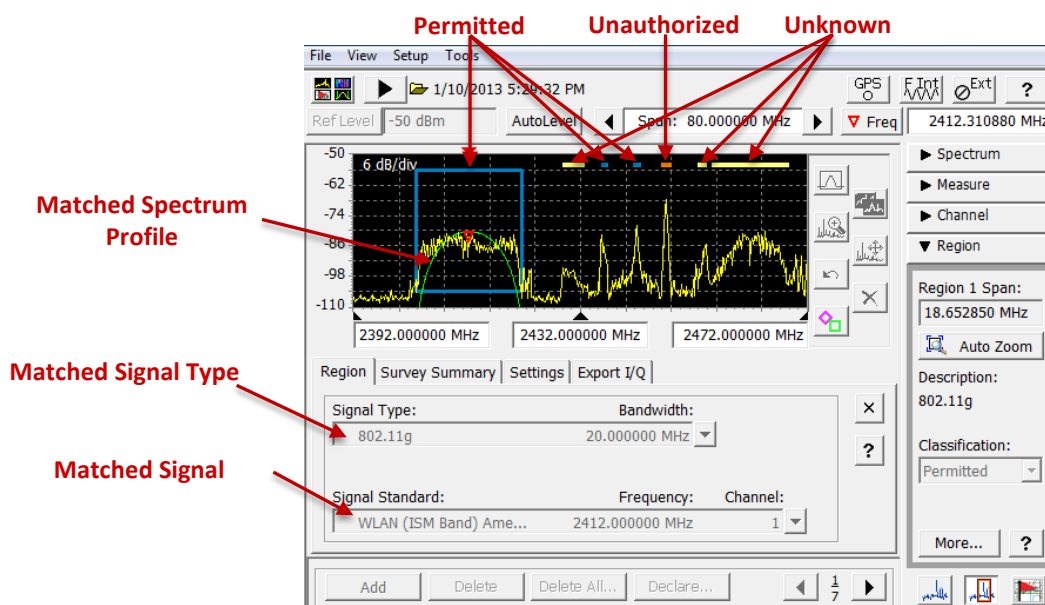
3. Capture Only Events of Interest Intelligently With I/Q Data Saving

Overview:

The Export I/Q tabs of Signal Classification display and Amplitude vs. Time display in Tektronix H500/SA2500 Handheld Spectrum Analyzer set the parameters for saving complex I/Q (In-phase & Quadrature) data. You can then load the saved I/Q data in an external program to perform further analysis.

Three file formats are supported:

- comma-separated value (.CSV);
- MATLAB (.MAT);
- I/Q Time data format (.IQT)

Continued from the last example, the following example shows how to save the complex I/Q file of the WLAN signal we discovered by Classification Measurement for further offline analysis.
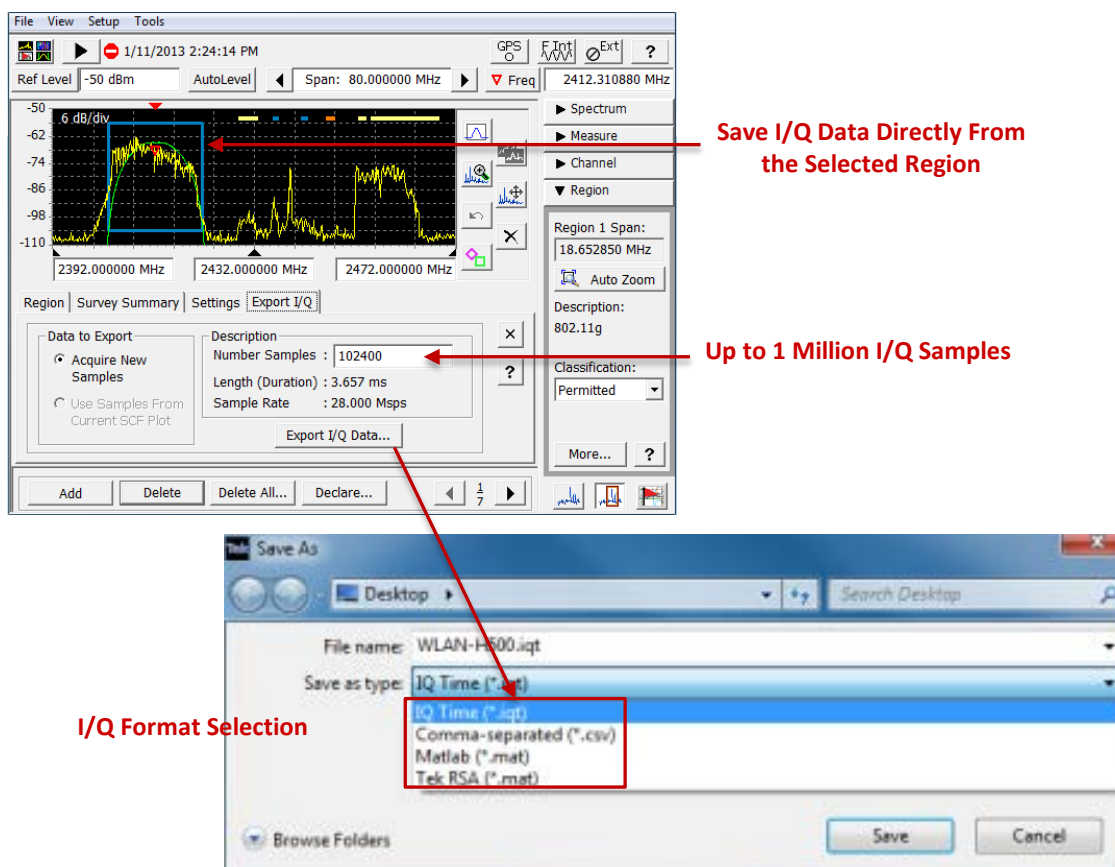
With the setting of the last example:

1. Click the BLUE permitted regions presenting WLAN signals.

2. Select the **Export I/Q** tab.

3. Changing the **Number Samples** from the default 65536 to 102400.

4. Click **Export I/Q data…** to open the Save As dialog box.

5. Navigate to the location where you want to save the I/Q data file.

    Select IQ Time (*.iqt) and enter the file name WLAN-H500.

6. Click **Save**.
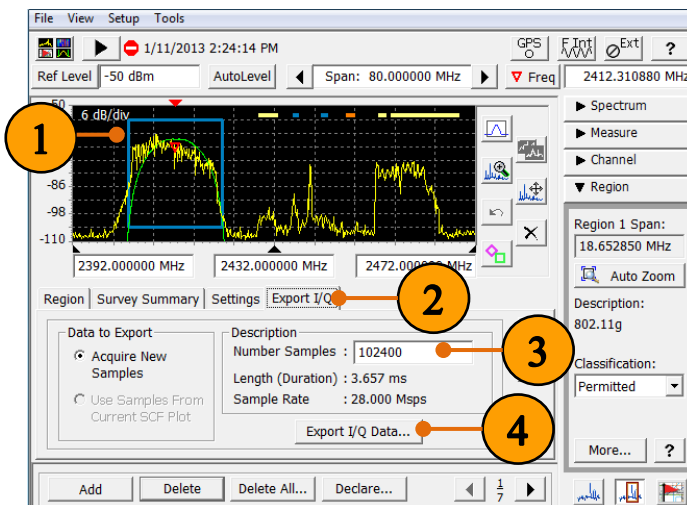
Quick Tips:

- When exporting the I/Q data, you can save from 1,024 to 65,536 samples. When exporting the I/Q data of the currently selected region, you can save from 1,024 to 1,024,000 samples.

- A smaller number of samples requires less time to write to the file, and generates a smaller file.

- The CSV file uses the first four rows to list the sampling frequency, number of samples, date/time of the export, and the center frequency of the region being exported. The following rows in the CSV file are the pairs of I/Q data.

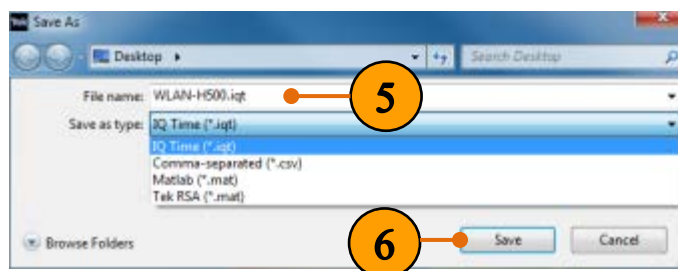- The MatLab file format is a binary file for use with the MatLab application. When loading the MatLab format file into MatLab, the sampling frequency, number of samples, date/time of the export, center frequency of the region, and I/Q data are loaded as MatLab variables.

- The I/Q Time file format is a binary file for use with the Tektronix RSAVu application. See the RSAVu documentation for more information. When exporting date in I/Q time format, the number of samples exported is, if necessary, rounded down to the next even 1024 sample count boundary.

- You could also use the Export I/Q tabs of Amplitude vs. Time display for I/Q data saving.

4. "Drive Test" For Field Interference Hunting With Built-In Mapping

Overview:

iMap measurement in Tektronix H500/SA2500 Handheld Spectrum Analyzer lets you use an on-screen map to record the location and value of measurements. The iMap tool integrates interference, coverage, in-building mapping, and outdoor signal mapping.
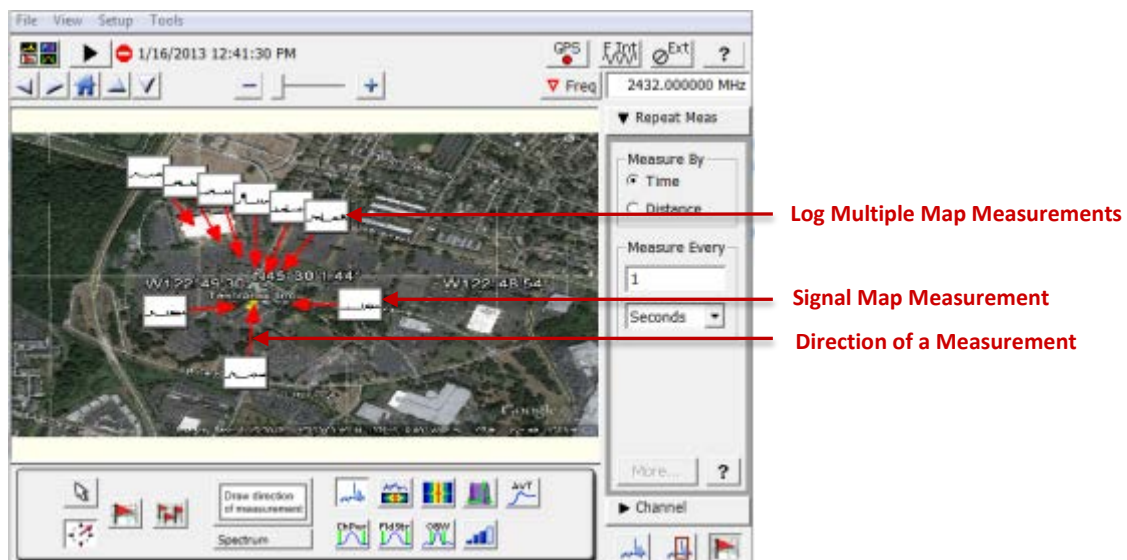
With iMap you can do the following:

- Map a Measurement
- Mark the Direction of a Measurement (Azimuth)
- Log Multiple Map Measurements
- Convert Map Files
- Use Grid Maps
- Save Mapped Measurements

Continued from the application the example, the following example shows how to use of Tektronix H500/SA2500 Handheld Spectrum Analyzer to take iMap measurement.

Convert Map Files:

Use a convenient map conversion utility to load image files from map or drawing programs, add latitude and longitude information to the bitmap file, and use that map for GPS position measurement mapping.

Please refer to Tektronix H500/SA2500 Handheld Spectrum Analyzer – How to Guide Series:
"**2. How to convert map to be loaded into H500 with iMap Converter**".

Use Grid Maps:

Use GSF and MIF file maps for GPS position measurement mapping. To load the GSF or MIF file maps into H500:

1. Select **iMap** measurement.

2. Select **Load Map…** under File, and load a grid map.

    Demo map.gsf created in "2. How to convert map to be loaded into H500 with iMap Converter" in How to Guide Series is used for this example.
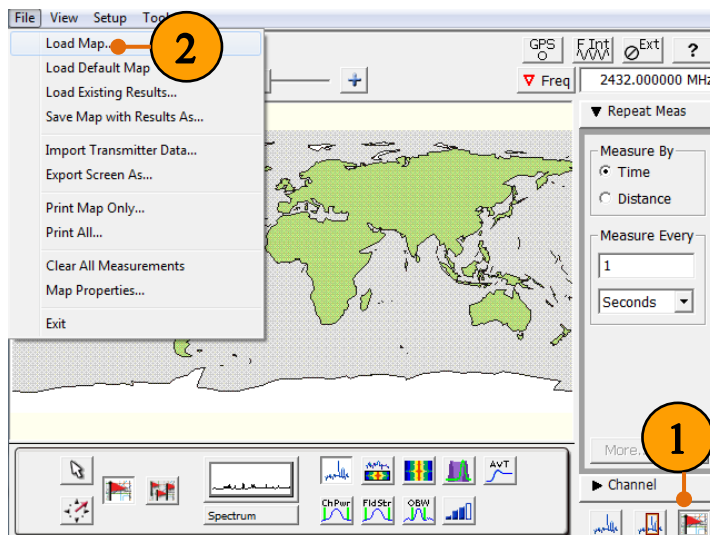
3. Use the panning buttons and zoom controls to position the displayed map to your area of interest.
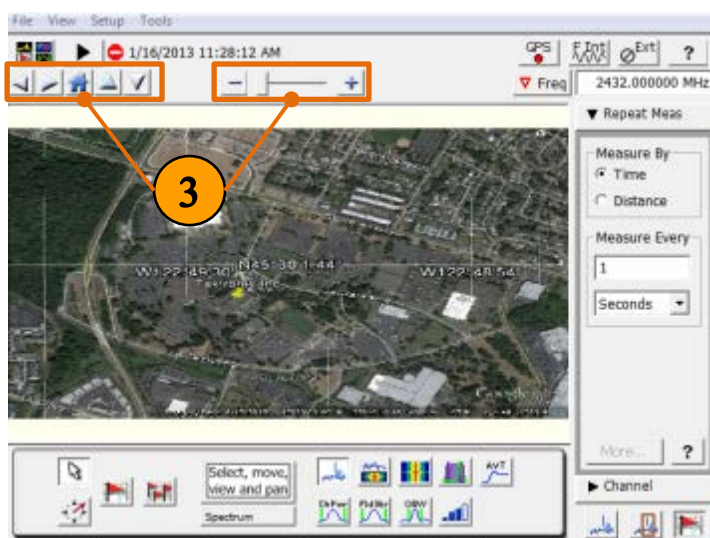
Quick Tips:

- Supported map formats are GSF, MIF, and BMP.

- Although the iMap tool supports a number of grid and image file formats, Tektronix recommends that you use the iMap Converter PC tool to convert all maps to GSF-format. See Convert Map Files.

Map a Measurement:

Select a measurement and touch the displayed map where you want the measurement to be placed.

1. Select one of the **iMap Measurement** Buttons to select the measurement to map.

   The example shows selecting the Spectrum measurement to observe the whole ISM band.

2. Tap the **Single Measurement** button.

3. Tap the **measurement thumbnail** in the iMap controls to open the measurement display for the selected iMap measurement. Set up the measurement parameters as necessary to take the selected measurement. Then return to the iMap display.

4. Tap the map.

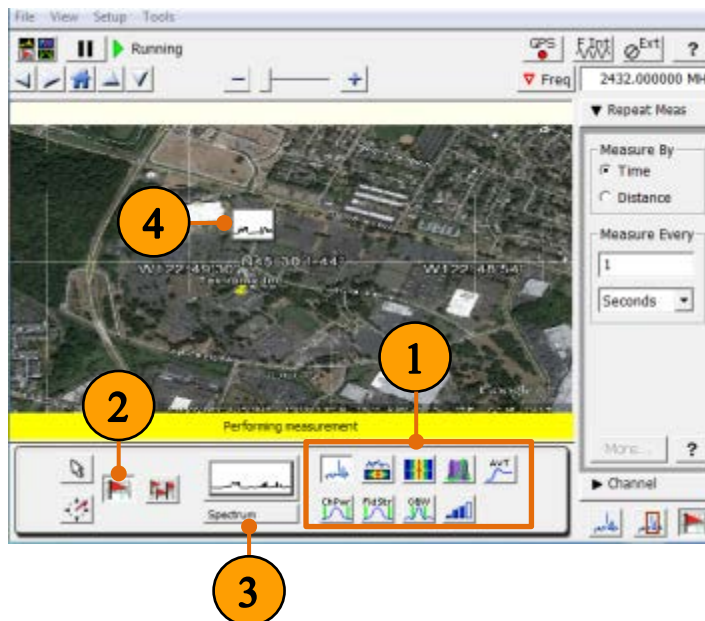   ▪ If the GPS receiver is active and locked and you have loaded a grid map in the instrument, then a single measurement is placed at the current latitude and longitude coordinates.

   ▪ If the GPS receiver is not active, cannot lock on the GPS satellite signals, or if you have loaded an image map (such as a building floor plan), then a single measurement is placed where you tapped the map.

5. Repeat steps 1 through 3 to select other measurements to place on the map.

Quick Tips:
▪ To add measurements at a new location on a grid map with an active GPS receiver, you must physically move to the new location.

▪ There is a limit of 200 measurements per map. When the instrument reaches the measurement limit, a message is displayed and no more measurements are placed on the map. Use File > Clear to clear the map, or File > Save Map With Results As to save the current measurements and map to a file.

Log Multiple Map Measurements:

The iMap Log Measurements function lets you automatically attach multiple measurements to a map based on a time interval or a geophysical location change (when used with GPS). Measurements are taken at the specified interval or distance change until you turn off the Log Measurement function.

1. Use the controls in the Repeat Meas drawer to set the **measurement interval** (distance or time).

2. Tap the **Log Measurements** button.

3. Tap the map at the measurement starting location to start logging measurements.

4. Tap the map at the position the last measurement was taken to stop logging measurements.

5. Selecting **Display Measurements** shows measurements using large icons.

   Notes: The flag icon takes up the least space on a map.
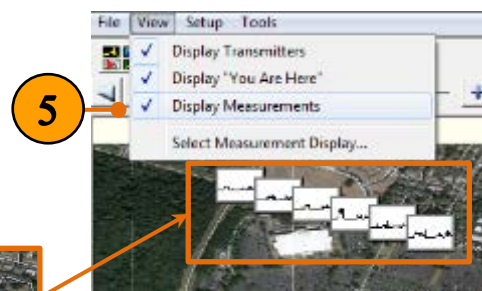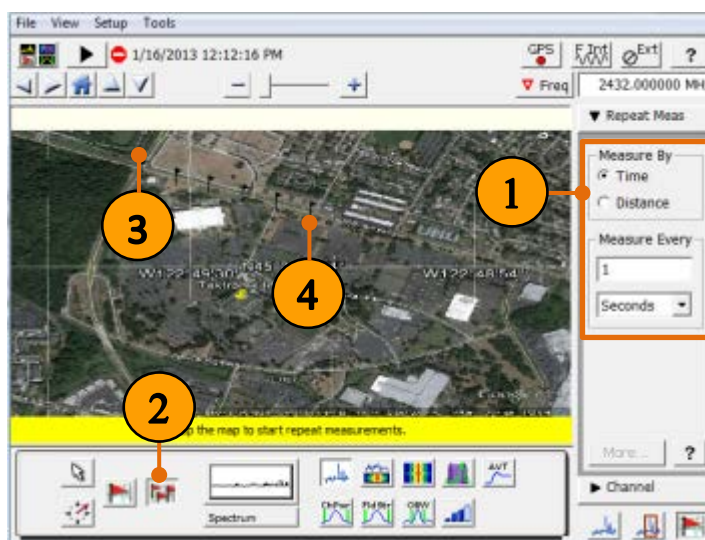
Quick Tips:

- To start logging measurements:
  - For grid maps with an active GPS receiver, tap the map at any point. The instrument begins adding measurement flags to the map at the current GPS position.
  - For image maps, or for grid maps without an active GPS receiver, tap the map at the measurement starting location. The instrument begins taking measurements, but does not display them on the map. Walk or move to the stop point at an even speed.

- To stop logging measurements:
  - For grid maps with an active GPS receiver, tap the map at any position. Measurements are then placed on the map at the measurement locations.
  - For image maps (or grid maps without an active GPS receiver), tap the map at the position the last measurement was taken. Measurements are then evenly spaced between the start and stop map points.
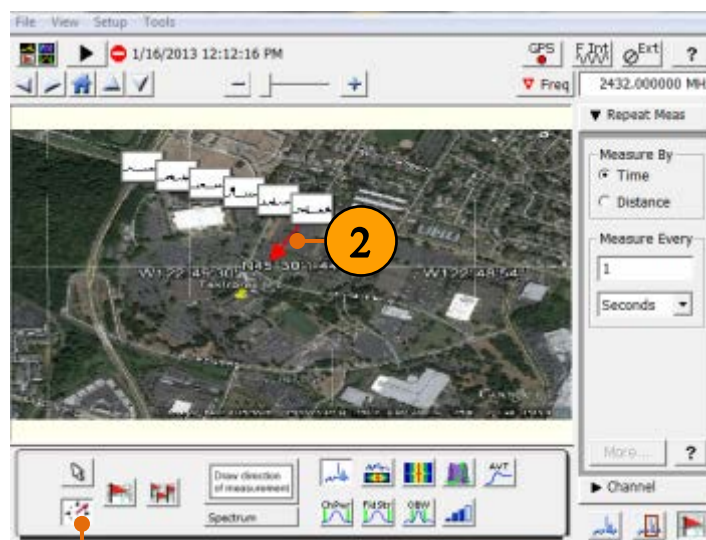
Mark the Direction of a Measurement (Azimuth):

An azimuth arrow shows the direction a measurement was taken. iMap uses the azimuth arrow to calculate the direction of the measurement and stores the azimuth data with the measurement.

1. Tap the **Measurement Direction** button.

2. Tap and press the measurement icon for which you want to indicate a measurement direction.

   Drag a line in the direction the antenna was pointed when the measurement was taken.

   Lift the stylus from the screen. The instrument draws a red line with an arrow.

Quick Tips:

▪ You can also manually enter a measurement azimuth using The Map Measurements Dialog Box, to one degree of adjustment.

Repeat Step 2 to add a direction arrow to other icons, or to redraw the direction of an azimuth arrow on an icon that already has an azimuth arrow.

Log Multiple Map Measurements

Signal Map Measurement

Direction of a Measurement
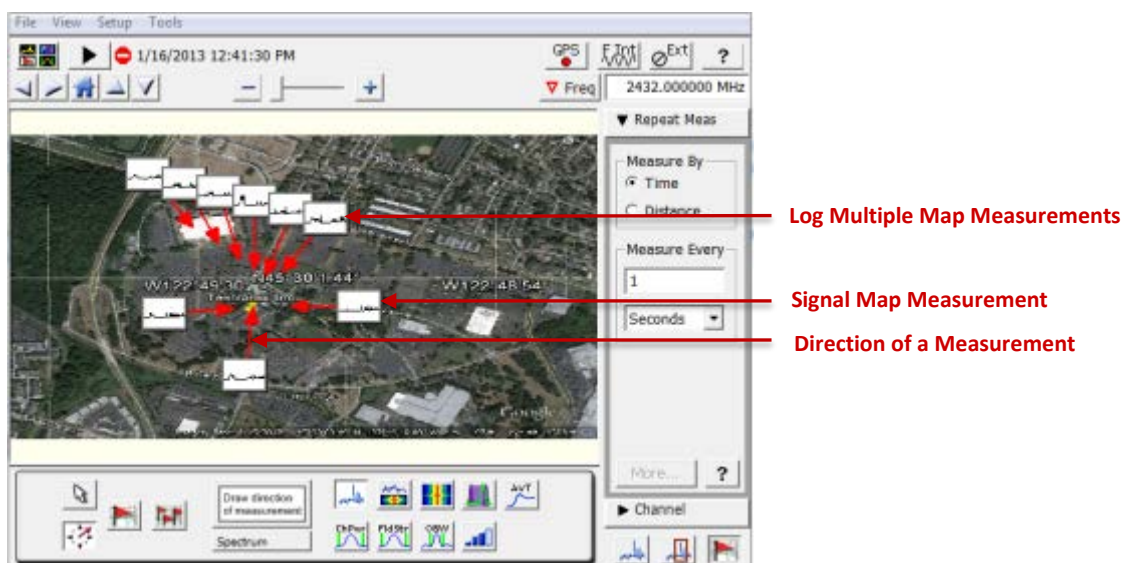
Save Mapped Measurements:

You can save the iMap map and measurements results (CSV or MapInfo) to a zip-format compressed file. You can then load the map and results back into the instrument or use a PC software application to create printable maps for further analysis of mapping measurement results.

1. Select **Save Map with Results As…** under File to create a ".zip" file of the iMap measurement results.

2. This saved .zip file could be loaded back to H500 or analyzed for other PC software application.
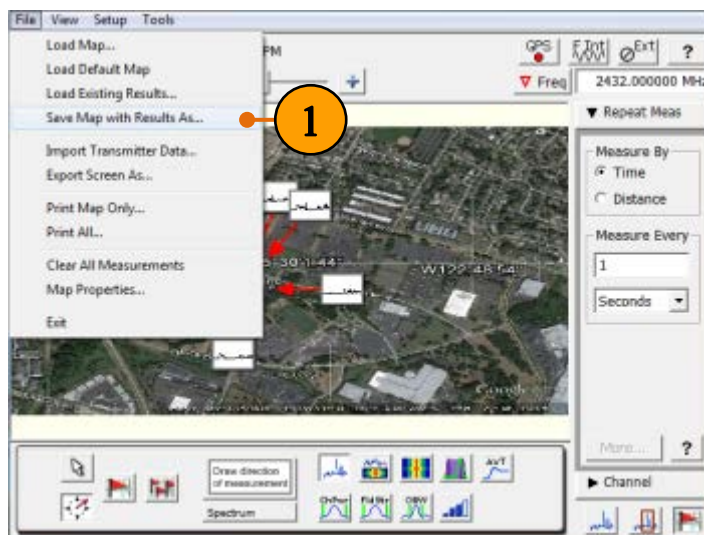
Quick Tips:

- Please refer to Tektronix H500/SA2500 Handheld Spectrum Analyzer – How to Guide Series:

  "**3. How To Export Measurement Results To Free Google Earth Map With Google Earth Mapping Tool**".

## 5. Analyze the Nature of the Signal with H500 PC Software

Overview:

The Spectrogram measurement displays the spectral content (power versus frequency) of a signal over time, where the signal amplitude is represented by a range of colors. This display is especially useful for recording intermittent signals, as you can set the Spectrogram to acquire measurements from seconds to days apart and automatically save the measurements to a file.

The save and record playback feature of Tektronix H500/SA2500 Handheld Spectrum Analyzer helps users to view spectrum waveforms playback for the selected records in dual display mode. Every saved file contains up to 80 spectrum waveforms.

A free PC application software of H500 is provided for offline analysis. You can download at:

http://www.tek.com/spectrum-analyzer/h500-sa2500/h500-0-software/h500-pc-applications-installation-file-english-v5112

Continued from the example 3, the following example shows how to save the Spectrogram result in ISM band, and open in the free H500 offline PC software for offline playback and analysis.

Data Record 80

⋮

Data Record 54

⋮

Data Record 1

Cursor of The Current Recorded Spectrum
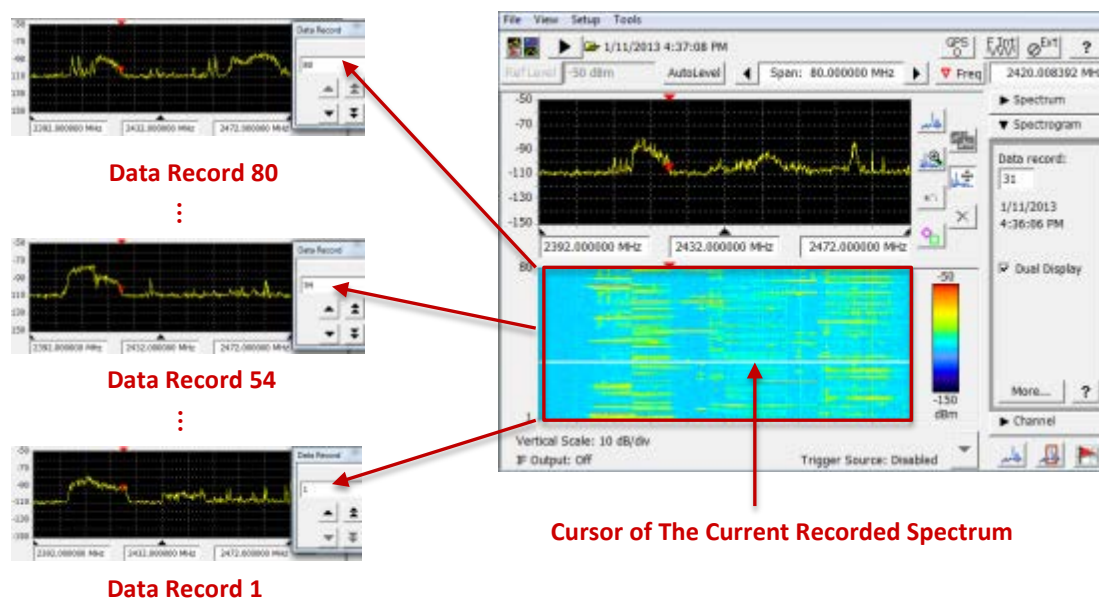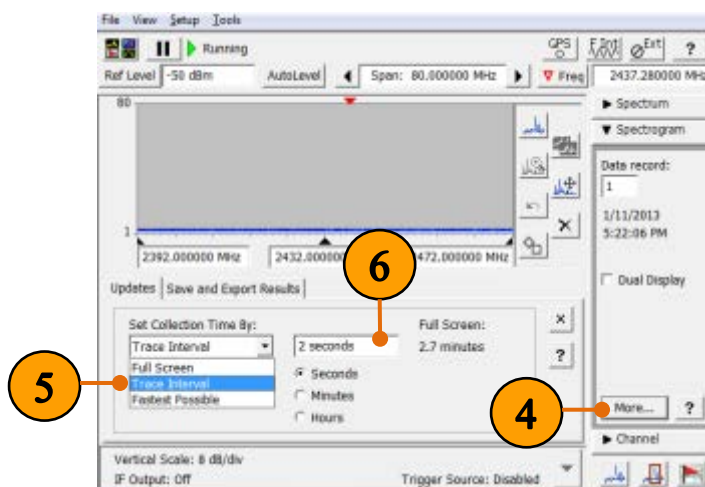
With the setting of the example 3:

1. Click the **Measurement display** selection.

2. Select **Spectrogram** Display.

3. Click **OK**.
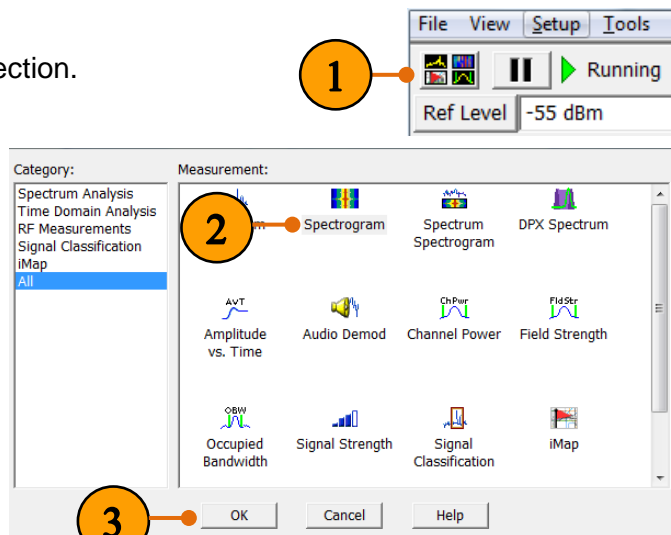
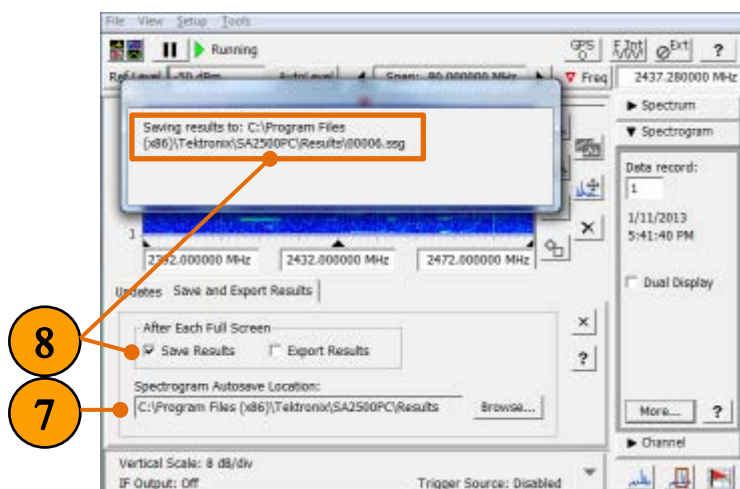4. Click **More…**.

5. Set Collection Time By: **Trace Interval.**

6. Set the **time interval** to be 2 seconds.

   The total time to scan the screen is displayed as Full Screen: 2.7 minutes.

7. Choose the **Spectrogram Autosave location**.

8. Select **Save Results**.

   The Spectrogram file will be saved as .ssg automatically when the full screen is scanned.

9. Run the free H500 application software on PC.

10. Click **Open Results…**.

   Select the .ssg file you saved in Step 8.
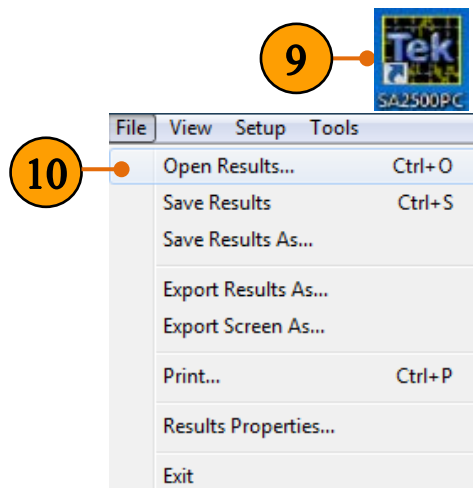
11. Select **Dual Display**.

12. Close the **setting** panel.

13. Tap the **Data Record** field in the Spectrogram drawer.

14. Use the Data Record increment tool to move the data record cursor to a particular record.

   The spectrum display shows the signal for the current record, and the Spectrogram drawer shows the record data and time.

Quick Tips:

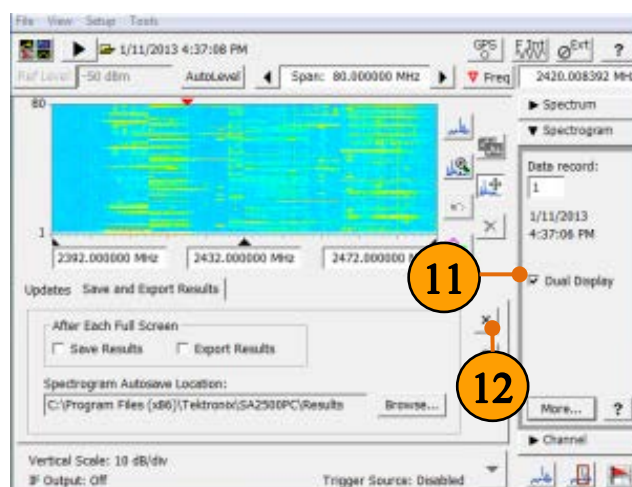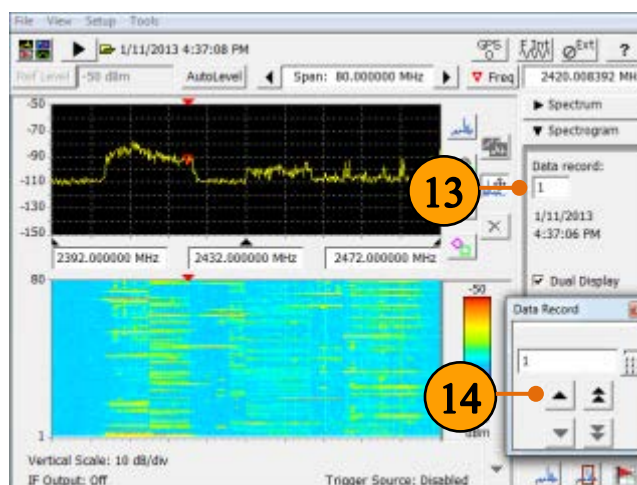- The colors used by the spectrogram depend on the signal vertical range on the spectrum display. You can use the Ref Level, Vertical Scale, and Vertical Position controls to zoom in on a signal area of interest so that it fills the entire vertical space on the screen. Doing this provides the greatest range of color changes for the spectrogram plot, to better differentiate signal level changes.

- The trace interval affects the trace type selection. When set to Fastest Possible, the trace type must always be Normal. Otherwise, you can select any trace type except Min/Max hold.

  When using a selection other than Fastest Possible, the instrument resets the spectrum waveform between each spectrogram data acquisition. For example, if you set a trace interval of one minute, you can select a max hold trace type. Spectrum measurements will be made for one minute with the max hold waveform building up over that time period. At the end of the minute, the spectrogram data is updated with the max hold waveform. The instrument then resets the waveform at the start of the next acquisition of spectrogram data.

Each of the 80 saved data records could be viewed by changing the number of the Data Record field. Transient, hopping signals and pulses signals in every moment could be captured and analyzed in this free offline H500 PC software.

Data Record 80

Data Record 54

Data Record 1

Cursor of the Current Recorded Spectrum
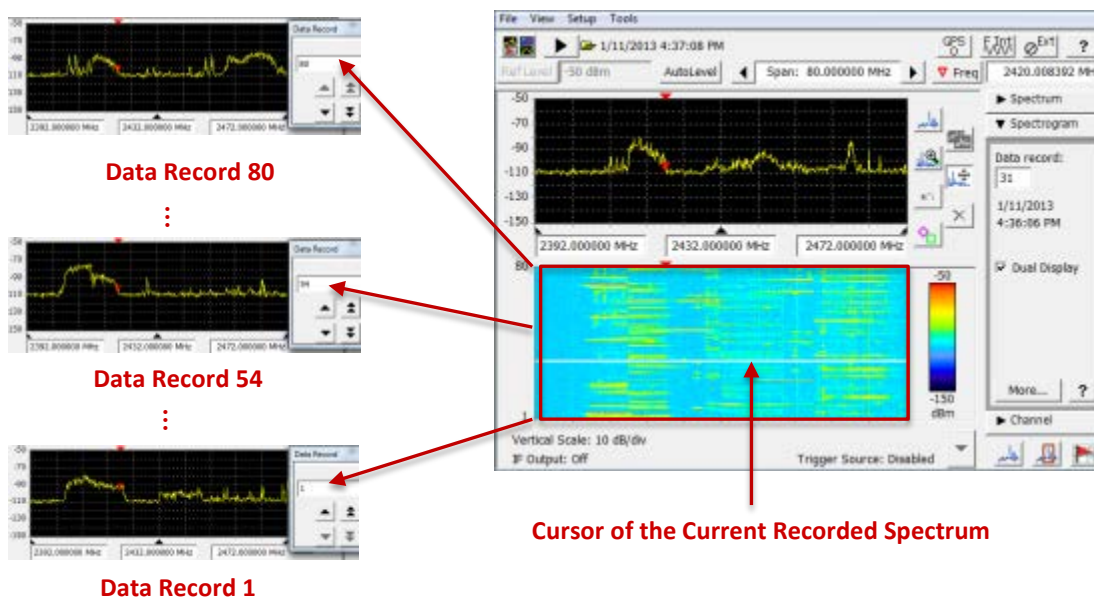
6. Perform Modulation Analysis According To Communication Standards With RSAVu

Overview:

RSAVu software enables offline analysis of data captured from Tektronix Real-Time Spectrum Analyzers (RTSAs) and oscilloscopes. Options allow customers to extend the analysis capabilities of RSAVu to include general purpose and applications specific modulation analysis.

With RSAVu, customers can acquire I/Q data using their Tektronix H500/SA2500 Handheld Spectrum Analyzer and then performs modulation analysis according to a communication standard offline on a PC.

Basic RSAVu with pulse analysis suite is free of charge and can be downloaded from:

http://www.tek.com/product-software/rsavu-software/rsavu-offline-analysis-software-v420008-v420008

Continued from the example 3, the following example shows how to use the modulation analysis feature in RSAVu to analyze the I/Q data of WLAN signal captured by Tektronix H500/SA2500 Handheld Spectrum Analyzer.
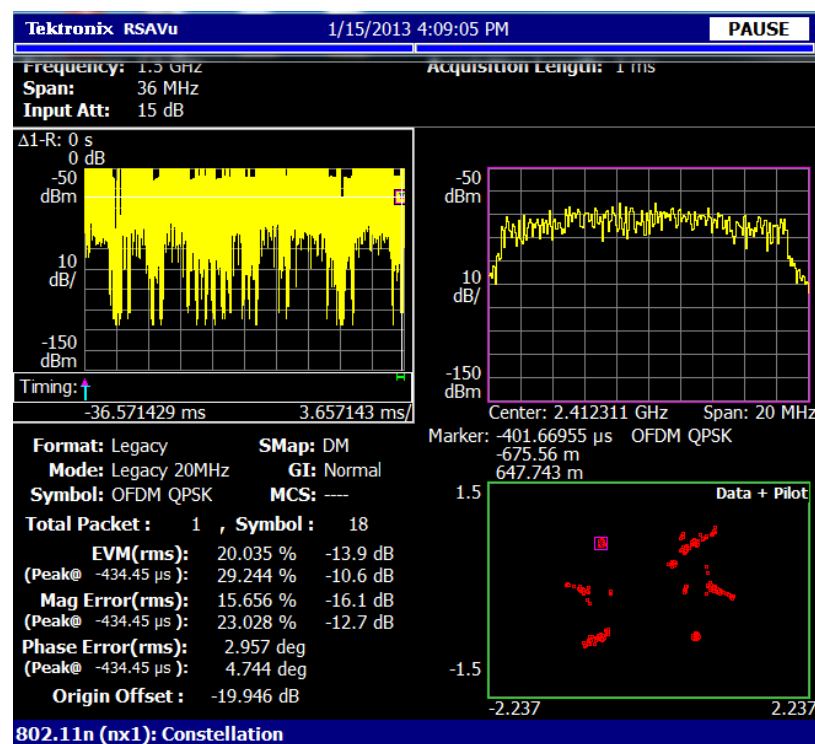
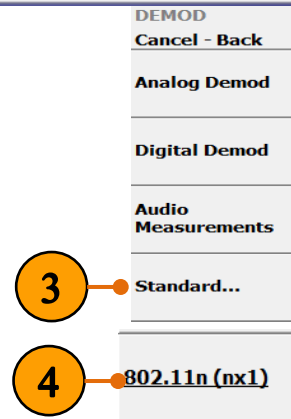**Modulation Analysis of 802.11n in RSAVu**

1. Run RSAVu.

2. Click the Tektronix logo, and select **Demod** on front panel.
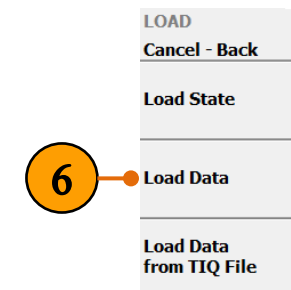
3. Select **Standard…**.

4. Click **802.11n (n×1)**.

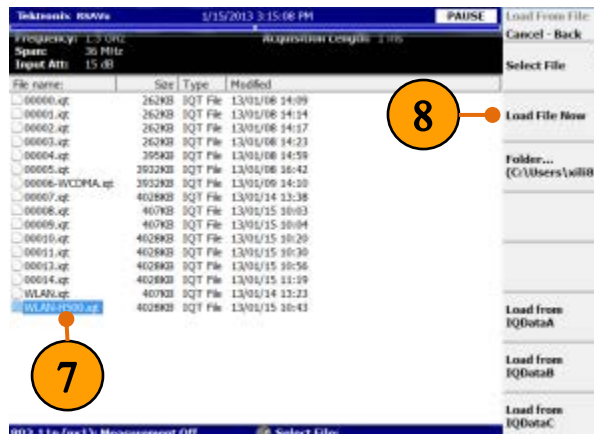5. Click **Load** on front panel.

6. Click **Load Data**.

7. Navigate to the location where the I/Q data file "WLAN-H500.iqt" saved in application example 3.
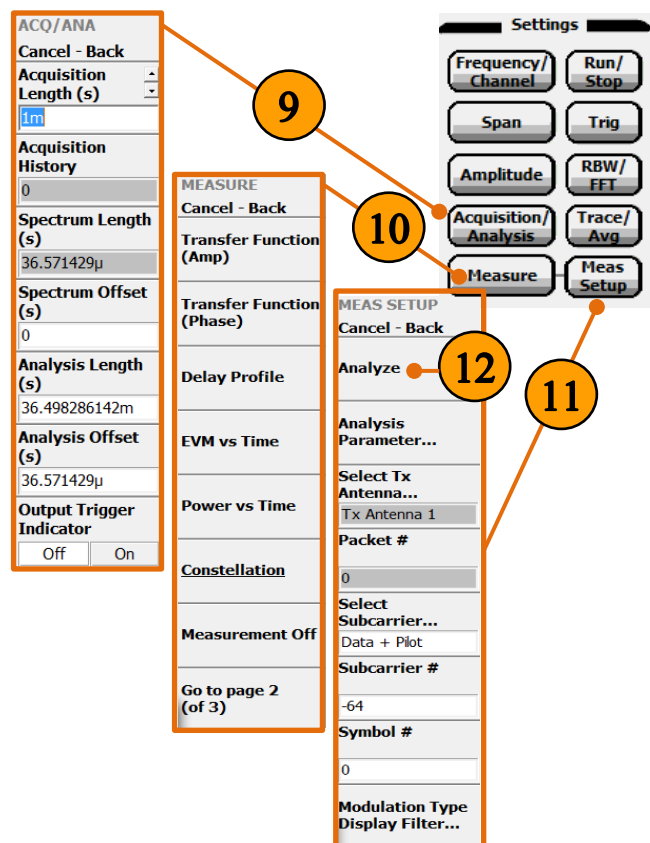
8. Click **Load File Now**.

   a. The I/Q data will be loaded into RSAVu for analysis.

9. Press the **Acquisition/Analysis** key and set the acquisition and analysis parameters.

10. Press the **Measure** key and select the measurement item.

11. Press **Meas Setup** to set the measurement parameters.

12. Press **Analyze** to start the analysis for the acquired data with the specified parameters.

Quick Tips:

- If you need more detail for signal analysis, please see online help of RSAVu.

ACQ/ANA
Cancel - Back
Acquisition Length (s)
1m
Acquisition History
0
Spectrum Length (s)
36.571429µ
Spectrum Offset (s)
0
Analysis Length (s)
36.498286142m
Analysis Offset (s)
36.571429µ
Output Trigger Indicator
Off   On

MEASURE
Cancel - Back
Transfer Function (Amp)
Transfer Function (Phase)
Delay Profile
EVM vs Time
Power vs Time
Constellation
Measurement Off
Go to page 2 (of 3)

Settings
Frequency/Channel   Run/Stop
Span   Trig
Amplitude   RBW/FFT
Acquisition/Analysis   Trace/Avg
Measure   Meas Setup

MEAS SETUP
Cancel - Back
Analyze
Analysis Parameter...
Select Tx Antenna...
Tx Antenna 1
Packet #
0
Select Subcarrier...
Data + Pilot
Subcarrier #
-64
Symbol #
0
Modulation Type Display Filter...

In this example, the WLAN signal captured in Tektronix H500/SA2500 Handheld Spectrum Analyzer is demodulated, the Amplitude vs Time, Spectrum, Constellation Diagram, and modulation information are showed below.
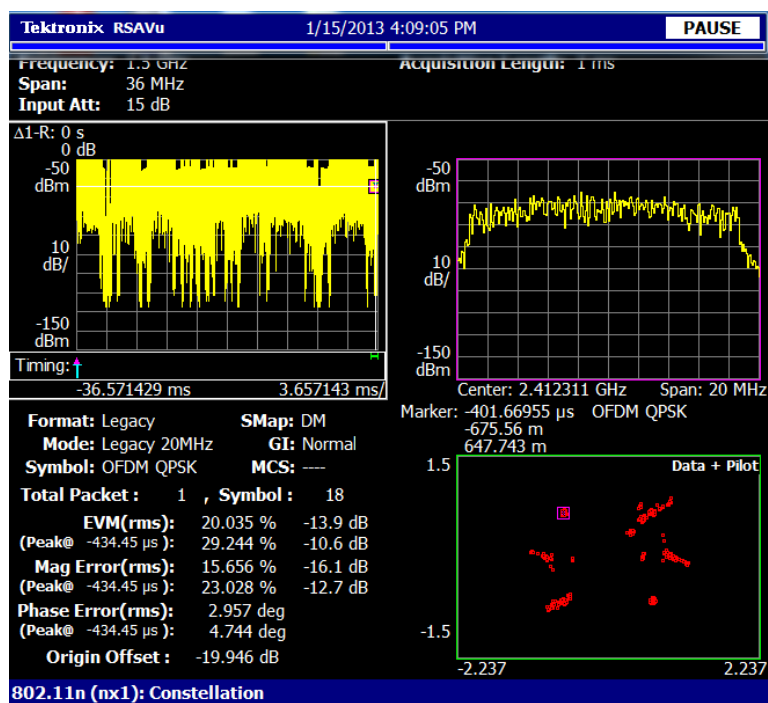
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Brazil +55 (11) 3759 7627
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Central Europe & Greece +41 52 675 3777
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Contact List Updated March 2013

For Further Information
Tektronix maintains a comprehensive, constantly expanding
collection of application notes, technical briefs and other
resources to help engineers working on the cutting edge of
technology. Please visit www.tektronix.com

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