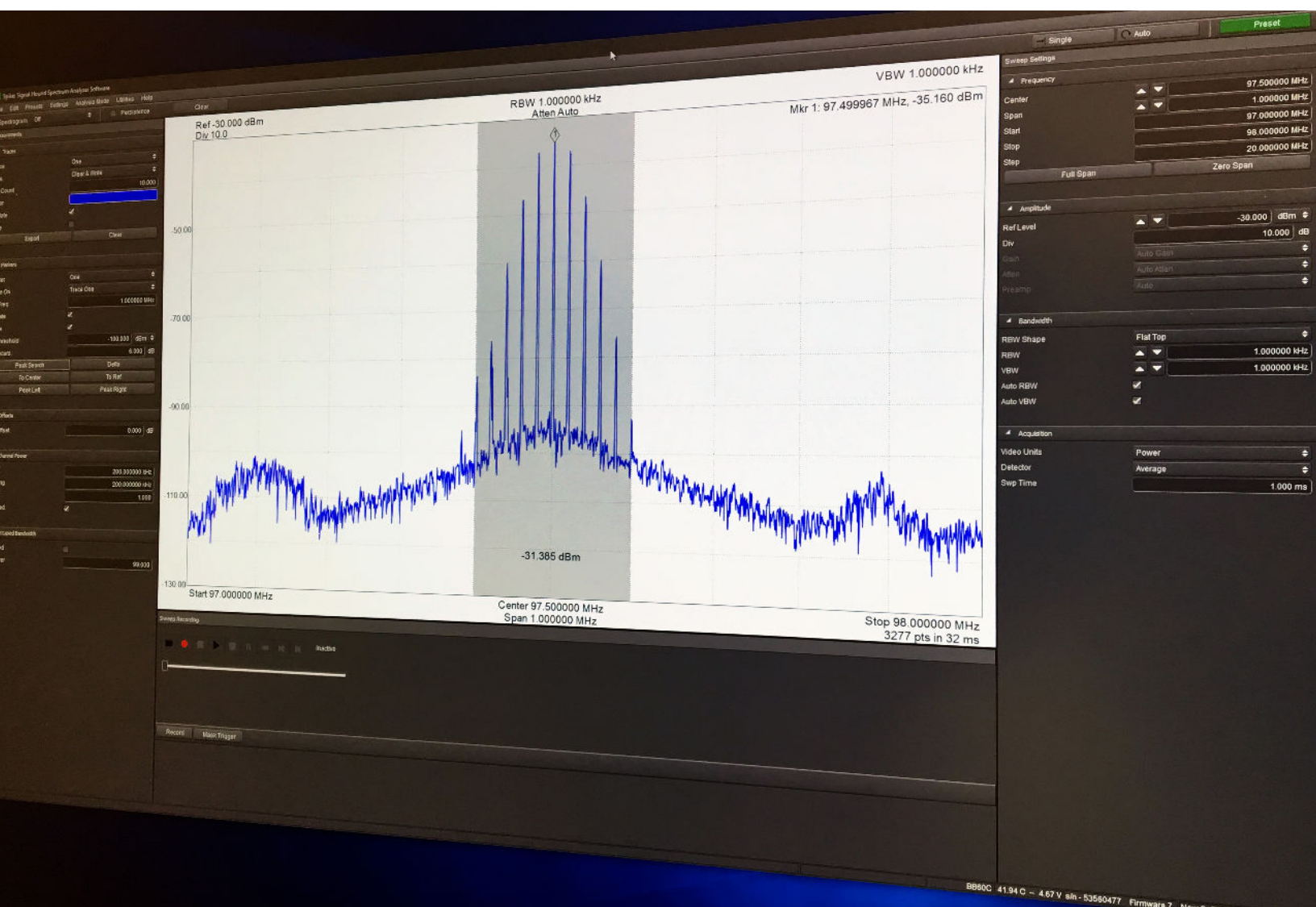




# Occupied Bandwidth and Channel Power Measurements with a Real-time Spectrum Analyzer

Signal Hound – October 6, 2017





## Introduction

As wireless telecommunication features continue to expand into virtually every control and sense technology in military, industrial, and domestic environments, a wide array of new wireless transmitters and transmitter components will need to be designed, prototyped, calibrated, and analyzed for quality assurance. There are many measurement methods and figures of merit that can be brought to bear in analyzing transmitter performance. Two such methods, occupied bandwidth (OBW) and channel power measurements, are relatively easy measurements to make that can reveal distortion, poor power amplifier (PA) design, filter effects, system noise, and other signal degradation factors.

Recently, with the advent of real-time spectrum analyzers (RTSAs), pulsed, frequency-hopping, and other transient/intermittent signals can now be characterized using OBW and channel power measurements. Signal Hound's Spike software and one of the Signal Hound RTSAs, such as a BB60C, can be used to analyze highly modulated signals and transient signals using built-in occupied bandwidth and channel power measurement features.

This document will walk through an example setup and testing procedure for both occupied bandwidth and channel power measurements. The goal of the walkthrough is to demonstrate and explain the critical aspects of occupied bandwidth and channel power measurements and how Signal Hound tools can be used to reliably produce low-cost and low-learning-curve measurements rapidly and with little setup.



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## Overview of Occupied Bandwidth Measurements

For any frequency or phase modulated signal, occupied bandwidth measurements are critical in ensuring that the transmission hardware and modulation parameters are properly designed to prevent interference and efficient transmission. For example, cellular technologies, Wi-Fi, and many more recent digital modulated technologies use a variety of modulation parameters, and some are even reprogrammable. Hence, ensuring that the occupied bandwidth of the modulated transmissions stay within a specified bandwidth under all modulation configurations can help a designer make the necessary tradeoffs between hardware costs and data rate and bit-error-rate (BER).

As pulsed radar signals and transient modulation signals are nearly impossible to catch with standard spectrum analyzers, RTSAs enable capture and record of real-time signals, and can be used to illuminate important signal characteristics necessary in identifying and analyzing pulsed hardware and modulation schemes. OBW is one such measurement, where wide-bandwidth real-time signal capture of an entire pulsed signal and its transient behavior is necessary to make an accurate analysis of the transmitter and modulations signal characteristics (see Figure 1).

There are several methods of measuring OBW. However, the general structure of the measurement concludes that OBW is the bandwidth of a signal in which 99% of the total integrated power of the transmitted spectrum is contained. Some standards also include specific settings for an analyzer to properly take an occupied bandwidth measurement. For example, the 3GPP dictates that the measurement of the distribution of the power spectrum is made using a Gaussian filter with a bandwidth greater than 10 MHz and a resolution bandwidth filter (RBW) set to 30 kHz or less for WCDMA modulation.

The order of operations for the measurement is that first the total spectral power in the frequency range is measured. Following this calculation and beginning at the lowest frequency range in the sweep, the power distribution at each frequency is summed until the summation reaches exactly 0.5% of the total spectral power within the sweep range. This measurement is repeated inversely starting at the highest frequency range and summing the power at each frequency until the sum reaches 0.5% of the total power. This method reveals the upper and lower frequency boundaries of the occupied bandwidth as the 0.5% points.

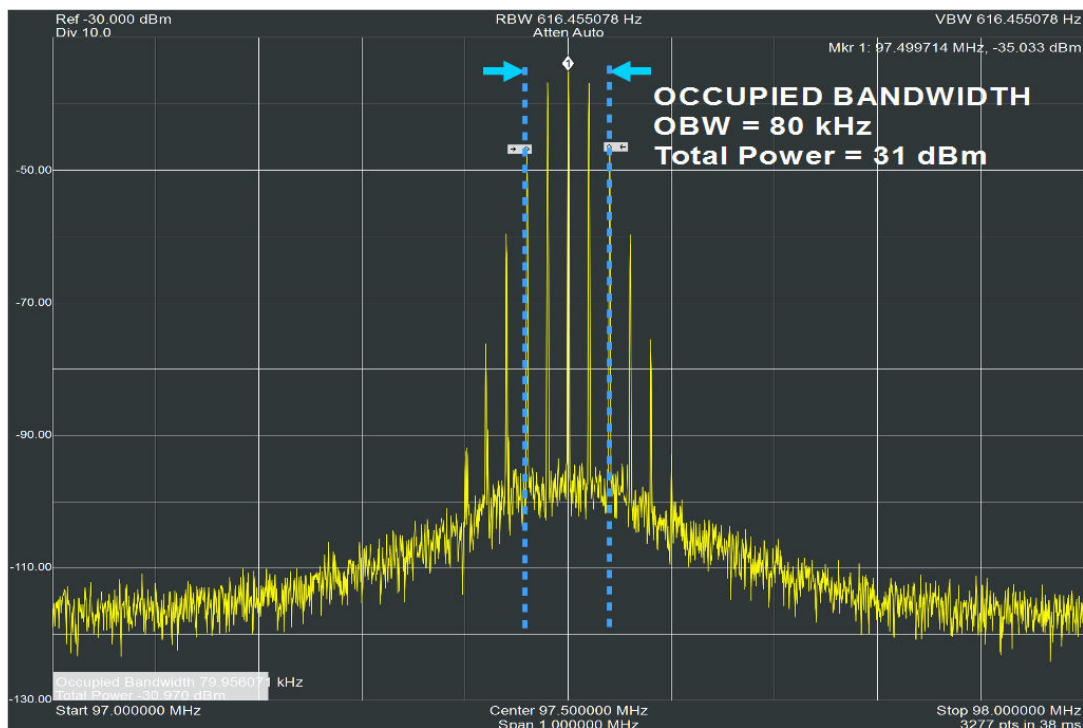


Figure 1—Some spectrum analyzer software packages are able to automatically measure occupied bandwidth, saving the effort of exporting trace data and analyzing it in 3rd party data analysis suites.

# Overview of Channel Power Measurements

From Wi-Fi, Bluetooth, and cellular to broadcast radio stations and satellite TV, much of the usable RF/microwave spectrum is segmented into designated channels. However, there is very limited spectrum and most countries limit certain applications to a small range of frequencies, Thus, many telecommunications protocols depend upon tightly packed channels that further subdivide the spectrum in hopes of preventing interference and optimizing use of the available spectrum.

As not all radio hardware is created equal, some modulation schemes may be more prone to nonlinear distortions and phase noise related spectral regrowth, and interference from adjacent channels can dramatically reduce communications capability. Measuring the power within a channel and how much power is also transmitted into adjacent channels can prevent transmitter designs and operation that leads to interference.

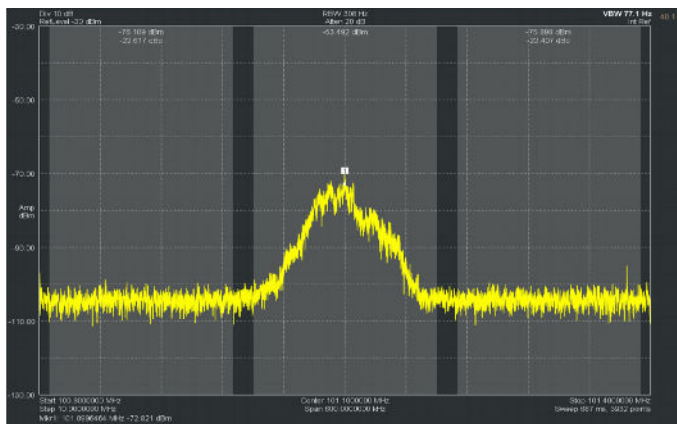
## Channel Power

Measuring the amount of power transmitted within the designed channel is necessary in the adjacent channel power ratio (ACPR) or adjacent channel leakage ratio (ACLR) measurements. Additionally, measuring the channel power can give insight into the efficiency of the transmission system and the modulation scheme chosen.

Channel power is calculated with a digital spectrum analyzer by integrating the FFT bins over the programmed channel bandwidth using the following equation:

$$P_{ch} = \frac{\sum_{f=Freq\ Start}^{Freq\ Stop} 10^{\frac{FFT\ Bin(f)}{10}}}{Window\ Bandwidth}$$

The window bandwidth is equivalent to the noise bandwidth of the RBW filter setting used, and the Pch result is in milliwatts if the FFT bin data is provided in dBm. Specifically, for the Spike software, the average detector and power video units must be selected with the spur reject algorithm checked as disabled. These settings are necessary to achieve an accurate measurement for channel power, as the calculation requires a sample detector or root-mean square (RMS) power averaging detector to be used.



## Adjacent Channel Power (ACP) or Adjacent Channel Leakage (ACL)

Another measurement of interest is the adjacent channel power (ACP), which is the measured power in the adjacent channels to the channel of interest. This measurement is performed as the channel power measurement is performed in the adjacent channels.

## Adjacent Channel Power Ratio (ACPR) or Adjacent Channel Leakage Ratio (ACLR)

The comparison of the amount of power in the primary channel to the amount of power in the adjacent channels is often used as a transmitter and modulation scheme figure of merit of the linearity and noise performance. ACPR is the logarithmic comparison of the channel power in the primary channel compared to the adjacent channel power.

$$ACPR_{dBc} = 10 * \log_{10}\left(\frac{P_{adj}}{P_{ch}}\right)$$

The ACPR measurement is best suited to revealing the significance of the nonlinear characteristics of the power amplifier, amplifier subassembly components/connections, and the mixer components. The impacts of phase noise and the systems noise behavior also contribute to the ACPR performance of the system.



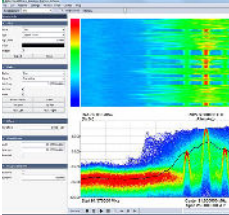


Fortunately, Spike Software paired with a Signal Hound RTSA enables easy measurement of channel power, adjacent channel power, and ACPR. Additionally, Spike Software is capable of measuring the channel power characteristics for more than just the immediately adjacent channel, and can be configured to measure secondary and tertiary adjacent channels.

## Equipment and Accessories for ACPR and OBW Measurements

Prior to more flexibly programmed spectrum analyzers and RTSAs, ACPR and OBW were performed by specialized or custom test sets. Typically, all that is necessary for this measurement is a spectrum analyzer and software with OBW and ACPR measurement modes, the device-under-test (DUT), and the accessory interconnect, cabling, PC, and power supplies. If the spectrum analyzer software isn't capable of OBW and ACPR measurements, the trace data can be exported and analyzed using a 3rd party software suit capable of mathematical analysis of array data.

Signal Hound has enabled ACPR and OBW measurements in a very cost effective, efficient, and small footprint implementation with their series of RTSAs and Spike Software. For convenience and easy demonstration, this guide uses the Signal Hound BB60C for the spectrum analyzer and the Signal Hound VSG25A to emulate a DUT.

### Test Equipment Suggested for ACPR and OBW Measurements:

	<p><b>Signal Hound BB60C</b></p> <p>The 27 MHz of instantaneous bandwidth provided by the BB60C enables real-time OBW and ACPR measurements of very wide-bandwidth signals, transient or continuous. However, if a frequency or phase modulated continuous wave signal is the desired measurement target, a swept-spectrum analyzer can be used to similar effect. This walkthrough will use the BB60C RTSA.</p>
	<p><b>Signal Hound BB60C Accessories</b></p> <ul style="list-style-type: none"> <li>• <b>USB 3.0 Double Power Cable</b>—Provided by Signal Hound with every BB60C. These cables need to be connected to a USB 3.0 compatible PC. Only a USB 3.0 compatible PC can adequately supply the necessary power through the USB cables and carry the digitized frequency data from the RTSA.</li> <li>• <b>SMA to BNC Adapter</b>—Used for convenient connection to BNC interconnect transmission lines.</li> </ul>
	<p><b>Spike Spectrum Analyzer Software (from Signal Hound)</b></p> <p>Spike Software requires a PC equipped with Windows 7, 8, or 10 operating system either 32 or 64-bit. For Signal Hounds BB series RTSAs, an Intel Desktop quad-core i5/i7 processor model number 3000 series or later is required. Additionally, a minimum of 4 GB of RAM are required, with 8 GB of RAM being the recommended hardware. Spike Software typically requires less than 1 GB of available hard disk space.</p> <p>Download for free at <a href="https://signalhound.com/spike">https://signalhound.com/spike</a>.</p>
	<p><b>Signal Hound VSG25A</b></p> <p>A 100 MHz to 2.5 GHz vector signal generator from Signal Hound.</p> <ul style="list-style-type: none"> <li>• <b>USB 2.0 Male A to Male B-type</b>—This cable is used to connect the Signal Hound VSG25A to the PC via a USB 2.0 port.</li> <li>• <b>SMA to BNC Adapter</b>—Used for convenient connection of the VSG25A to the BB60C</li> <li>• <b>Signal Hound VSG25A Control Software</b>—This software is used to program the VSG25A and is available for free on the Signal Hound website. <a href="http://www.signalhound.com/sigdownloads/VSG25/VSG25_104.zip">http://www.signalhound.com/sigdownloads/VSG25/VSG25_104.zip</a></li> </ul>
	<p><b>Equipment &amp; Accessories</b></p> <ul style="list-style-type: none"> <li>• <b>BNC-BNC Cable</b>—This coaxial cable is used to connect the VSG25A to the BB60C during the OBW and ACPR measurements.</li> <li>• <b>PC with 2x USB 3.0 and 1x USB 2.0 Ports and Necessary Specs</b>— This PC is used to control the VSG25A and to run the Spike Software and BB60C data.</li> </ul>



## Equipment Setup and Configuration for the OBW and ACPR Walkthroughs

These walkthroughs leverage the Signal Hound BB60C, VSG25A, Spike Software, and VSG25A Software to demonstrate an occupied bandwidth measurement. The VSG25A is used as the DUT in the measurement as it is a signal generator capable of complex vector modulation, including frequency modulation.

The connection diagram below describes the appropriate connection and connection types for each component of the OBW and ACPR measurements. Hand tightening of the SMA to BNC coaxial connectors should be adequate for the SMA ports on the VSG25A and the BB60C. Conversely, an SMA to SMA cable can be used to directly connect the VSG25A and BB60C.

**Note**—Test ports will degrade with performance over time and have a finite number of mating cycles before failure. Hence, an intermediate adapter is used to prevent early test port degradation and failure.

As the VSG25A and the BB60C are both powered by the USB ports of the PC, it is suggested to run the devices on the PC USB ports capable of supply adequate power to both devices. If two separate USB 3.0 connections are used for the BB60C's dual USB cable and a USB 2.0 connection is used for the VSG25A, this arrangement should be adequate.

**Note**—All appropriate protective gear, grounding mats/straps, and a clean environment should be used when operating any electrical measurements.

### Setting Up the BB60C with Spike Software

#### Test equipment setup of the BB60C

1. Ensure the test environment or operator is properly grounded and clean
2. Connect the SMA to BNC adapter to the RF SMA port on the BB60C
3. Connect the BNC cable to the SMA to BNC adapter.
4. Connect both USB male connectors to the PC USB 3.0 female connections
5. Insert the USB cable into the USB 3.0 port of the BB60C
6. Observe the green 'Ready' light before proceeding
7. Connect the BB60C with Spike software
  - a. Ensure that Spike software is properly installed
  - b. Ensure that the USB drivers are properly configured
  - c. Launch the Spike software
  - d. Connect the BB60C with Spike software by clicking **File > Connect > BB60C**

Once the BB60C is connected to the PC with the dual USB 3.0 cable (see Figure 3) and the appropriate drivers and the Spike software are installed, a green ready light should appear. This ready light should turn orange rapidly after booting up the Spike software and connecting the BB60C, as the default measurement parameters are engaged and measurement begins.

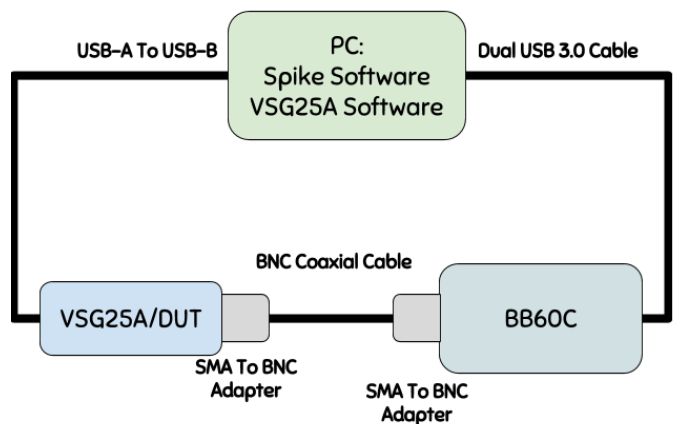


Figure 3—The VSG25A, BB60C, and PC connection order

## Setting Up The VSG25A

After proper installation of the VSG25A control software, the following steps connect the VSG25A to the computer.

### Test equipment setup of the VSG25A

1. Ensure the test environment or operator is properly grounded and clean
2. Connect the SMA to BNC adapter to the RF SMA port on the vsg25a
3. Connect the BNC cable to the SMA to BNC adapter (the other end should already be attached to the BB60C)
4. Connect the USB male connector to the PC USB 2.0 female connection
5. Insert the USB cable into the VSG25A's USB 2.0 port
6. Observe the green 'Ready' light before proceeding
7. Connect the VSG25A with the VSG25A software
  - a. Ensure that the VSG25A software is properly installed
  - b. Ensure that the USB drivers are properly installed
  - c. Launch the VSG25A software

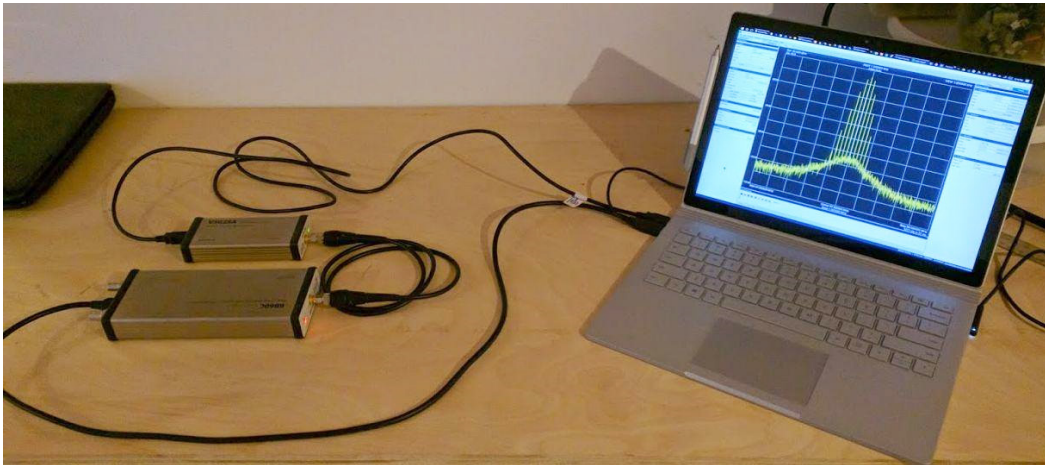


Figure 4—An Example setup for OBW and ACPR measurements using the Signal Hound BB60C, VSG25A, and Spike software with an intel i7 PC.

# Occupied Bandwidth Measurement Walkthrough

The following procedures work through the process of using Signal Hound equipment for occupied bandwidth measurements.

## Occupied Bandwidth Sinusoidal Frequency Modulated Signal Test Procedure

This section of the walkthrough will detail the programming parameters and steps of properly measuring the occupied bandwidth of a 97.9 MHz carrier frequency modulated with a 20 kHz sine wave with an FM deviation of 25 kHz at -30 dBm. The VSG25A is used as the DUT in the measurement performed by the BB60C RTSA and recorded and controlled by Spike Software.

### 1. Setup BB60C and Spike Software for OBW Measurement

The following steps detail the exact parameter definitions to be input in the Spike Software. These parameters can be manipulated as the BB60C is taking measurements. However, if the VSG25A and BB60C are appropriately connected, the only signal in the measurements before activating the VSG25A should be the noise floor, and possibly, low-level spurs.

#### Configuring sweep settings in Spike for OBW measurement

1. From the main menu, select **Analysis Mode > Sweep**
2. In the **Frequency** panel, set the following:
  - a. Center Frequency = 97.5 MHz
  - b. Span = 1 Mhz
3. In the **Amplitude** panel, set the following:
  - a. Ref Level = -30 dB
  - b. Div = 10 dB
4. In the **Bandwidth** panel, set the following:
  - a. RBW Shape = Flat Top, Nutall, or Gaussian
  - b. RBW = 616.455078 Hz
  - c. VBW = RBW
  - d. Select **Auto RBW**
  - e. Select **Auto VBW**

5. In the **Acquisition** panel, set the following:
  - a. Video Units = Power
  - b. Detector = Average
  - c. Swp Time = 1.000 ms
6. In the **Traces** panel, set the following:
  - a. Trace = One
  - b. Type = Clear & Write
  - c. Avg Count = 10
  - d. Color = yellow
  - e. Select **Update**
  - f. Deselect **Hide**
7. In the **Offsets** panel, in the **Ref Offset** field, type 0.000.
8. In the **Occupied Bandwidth** panel, set the following:
  - a. Select **Enabled**
  - b. % Power = 99.000

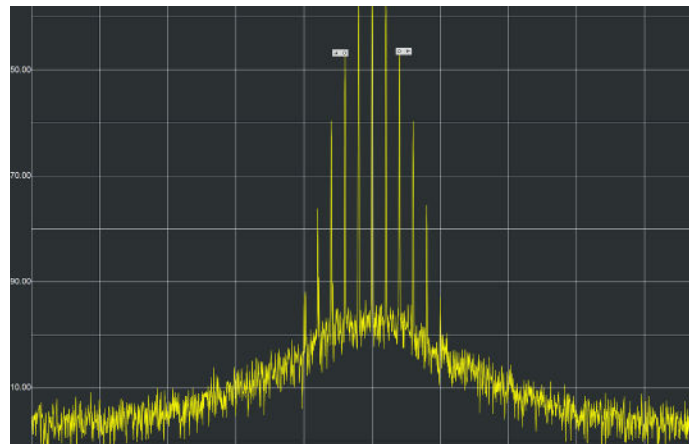


Figure 5—Signal Hound's Spike software can be configured to measure occupied bandwidth with the click of an enable option.

## 2. Setup VSG25A for the measurement

When launching the VSG25A software, a dialog with all of the programmable parameters of the VSG25A will open. The image and configuration parameter listing below provides the description of how to generate a sinusoidal frequency modulated signal at 97.5 MHz with a modulation rate of 20 kHz and FM deviation of 25 kHz at -30 dBm power level.

### Configuring The VSG25A for OBW Measurement

1. Select the **FM** button in the panel on the right-hand side of the window.
2. In the fields near the top of the window, set the following:
  - a. Frequency (MHz) = 97.5
  - b. Amplitude (dBm) = -30
3. In the **Frequency Modulation** panel, set the following:
  - a. Modulation Rate (kHz) = 20
  - b. FM Deviation (kHz) = 25
  - c. Modulation Shape = Sine Wave
4. Click **Apply Settings**

**Note**—This must be done before proceeding to the next steps.

5. In the **RF** pane, select On
6. In the **Mod** pane, select On

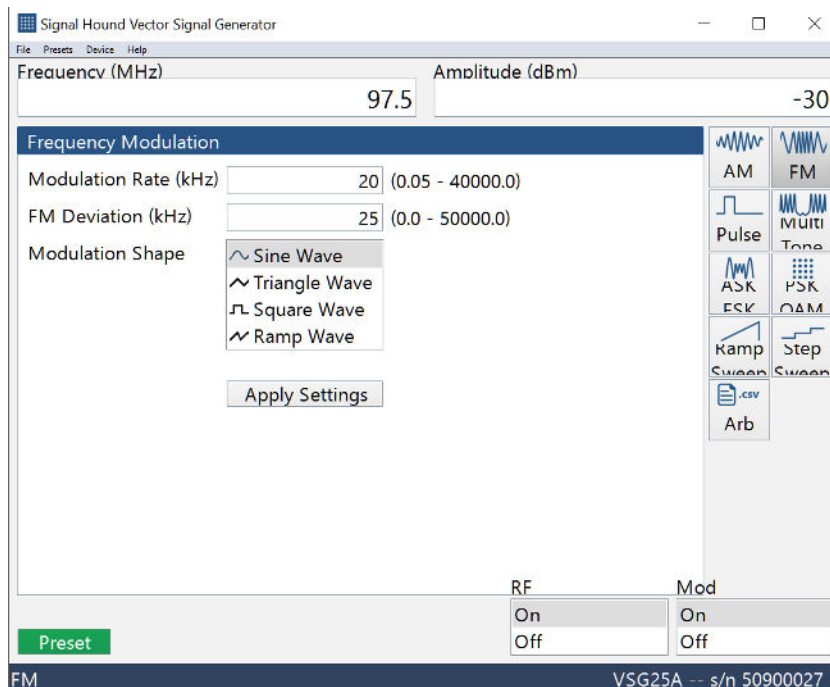
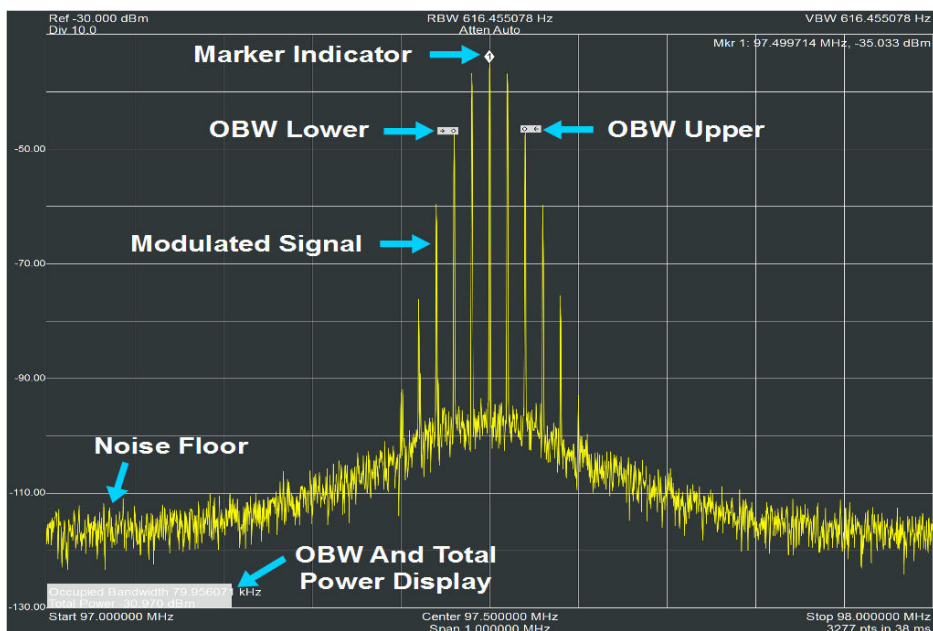


Figure 6—Configuring the VSG25A for FM modulation

### 3. Analyzing the Measurement

After applying the RF On setting, a single tone should appear at 97.5 MHz. Once the Mod settings is On, then the sinusoidal frequency modulation should become apparent as several tones appear symmetric around 97.5 MHz. The diagram below indicates observable areas of interest. A marker is used to show that the peak frequency of the signal is at the desired 97.5 MHz. The marker settings on the left-hand side of the Spike Software panel can be used to adjust the marker parameters and create new markers. To place a marker on the peak frequency, simply click "Peak Search" in the Markers selection field.



The modulated signal should be located at roughly 97.5 MHz with a power level within several dBm of -30 dBm. However, the signal should have less than -30 dBm of power at the peak frequency as some signal power is spread over the modulated signal range. The occupied bandwidth feature should create upper and lower frequency markers designating the boundaries within which 99% of the power is contained. There is an OBW display window on the bottom left of the measurement window, which indicates the OBW measurement and the total power of the signal. The total signal power should be within a few fractions of a dBm of -30 dBm.

It should be observed that the occupied bandwidth of the signal is much greater than the modulation depth and the FM deviation settings of the transmitter. This effect occurs as a result of the resultant tones of the pure sinusoidal modulation, as well as the imperfect linearity, noise, and phase noise characteristics of the transmitter.

## Occupied Bandwidth Measurement for Pulsed or Intermittent Signals

Unlike with continuous wave signals, pulsed signals and transient signals may not necessarily have consistent characteristics in time of frequency. In the case of some signals, such as pulsed radar, these signals may demonstrate consistently repeating pulsed square wave signals with set repetition rate, constant pulse width, constant shape, and amplitude. In this case, it is easy enough to trigger on this signal and accurately measure its characteristics, including occupied bandwidth.

However, for pulsed or transient signals that may be intermittent or have unknown characteristics, taking these measurements may be a greater challenge. Fortunately, a real-time spectrum analyzer is able to observe and measure this transient behavior down to the attack time limits of the analyzer. Several tools exist to help identify and measure intermittent time-varying signals, such as a waterfall spectrum display (spectrogram), persistent display, max-hold, zero span mode, and etc.

The following walkthrough will demonstrate using the max-hold and trace-data export features to provide detailed analysis, including occupied bandwidth, for pulsed and other transient signals. The export of trace data is necessary, as Spike Software's occupied bandwidth measurement feature will currently only measure the incoming data instantaneously.

### 1. Setup BB60C and Spike Software for the Pulsed OBW Measurement

As this measurement also uses the VSG25A and the same frequencies are used as in the continuous wave OBW measurement, the configuration of the BB60C and Spike Software is the same as the previous measurement. See [1. Setup BB60C and Spike Software for OBW Measurement](#) for details.

### 2. Setup VSG25A for the Pulsed OBW Measurement

This measurement will use the VSG25A to generate a square pulse wave with consistent frequency and timing characteristics at 97.5 MHz with a pulse width of 100ms and a pulse period of 1000ms at -30 dBm power level.

#### Configuring The VSG25A for Pulsed OBW Measurement

1. Select the **Pulse** button in the panel on the right-hand side of the window.
2. In the fields near the top of the window, set the following:
  - a. Frequency (MHz) = 97.5
  - b. Amplitude (dBm) = -30
3. In the **Pulse Modulation** panel, set the following:
  - a. Pulse Width (us) = 100
  - b. Pulse Period (ms) = 1000 (the equivalent of 1 second)
4. Click **Apply Settings**

**Note**—This must be done before proceeding to the next steps.

5. In the **RF** pane, select On
6. In the **Mod** pane, select On

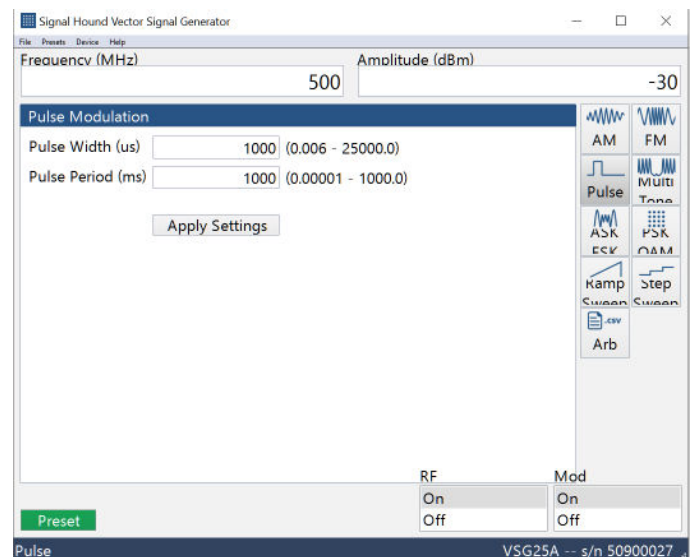


Figure 8—The VSG25A configured for a pulsed OBW measurement

Now you can use 2D spectrogram mode within the Spike software to monitor and confirm the appropriate signal characteristics over time, bandwidth, and amplitude.

7. In the upper left-hand corner of the Spike software interface, from the **Spectrogram** menu, select **2D Spectrogram**.

Spike now displays the RF activity in the spectrum waterfall plot (see Figure 9).

As the signal is apparently pulsed at an even pulsing ratio, a method of catching the highest power at each frequency of interest is to use the Max-hold trace mode instead of the clear and write trace mode.

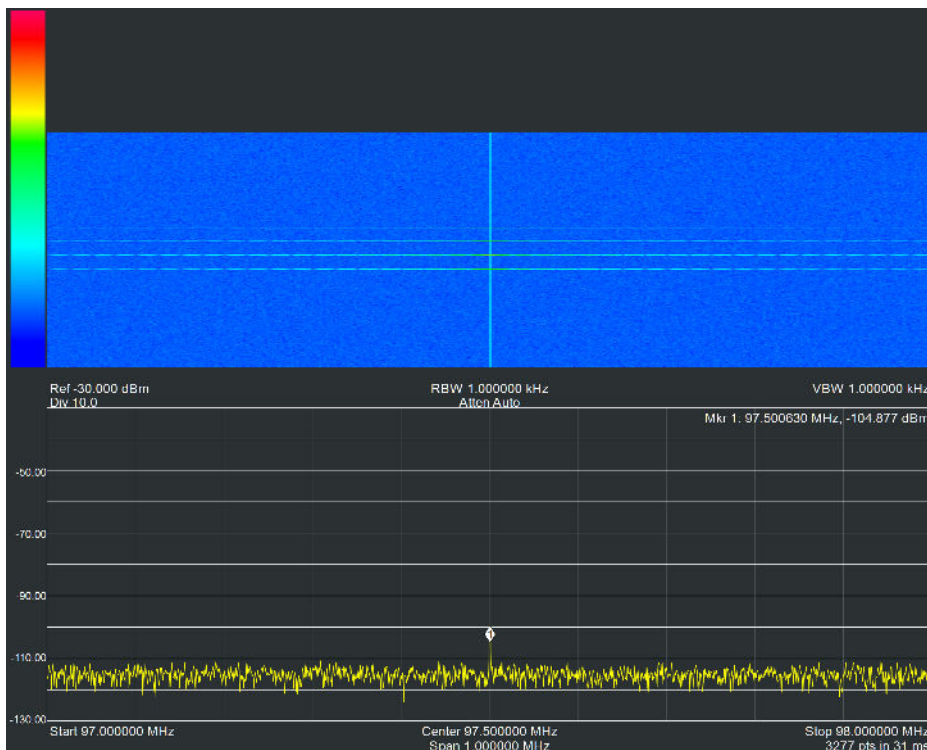


Figure 9—A 2D Spectrogram reveals the intensity of power levels within the sweep range. However, a real-time spectrum analyzer is capable of capturing even extremely short duration signals as long as they are contained within the instantaneous bandwidth of the analyzer.



## Using Max-Hold Trace Mode with Spike Software

The Max-Hold feature of Spike Software uses the highest power level yet measured in each frequency bin and displays that as a trace. This approach reveals the highest power at each frequency over the length of observation. Spike Software enables multiple traces to be viewable in the same display. If a second trace is configured to have the Max-Hold property, then both a clear and write and Max-Hold trace can be displayed for comparison.

### Creating A Second Trace with Max-Hold Mode

While Spike is displaying pulsed data from the VSG25A, do the following:

1. In the **Traces** panel, from the **Trace** drop-down menu, select **Two**.
2. From the **Type** drop-down menu select **Max Hold**
3. Click the color swatch in the **Color** field. The **Select Color** window appears.
4. In the **Select Color** window, either click on a color chip or use the available fields to configure your trace color, and click **Ok**.
5. Select **Update**

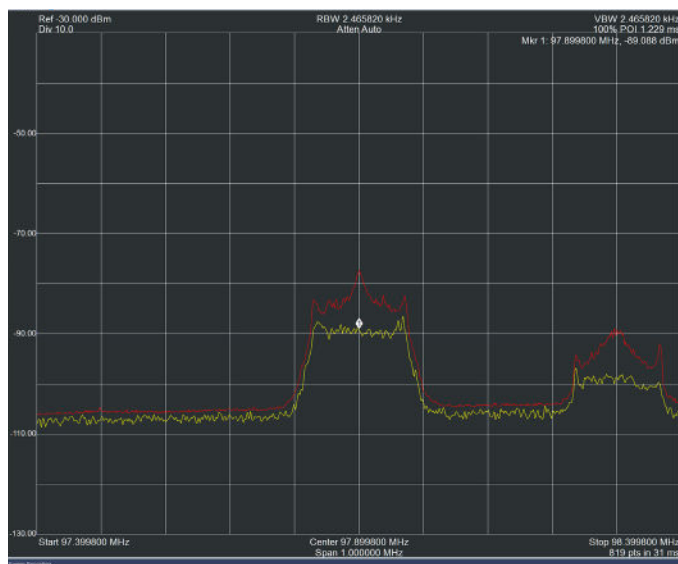


Figure 10—The Max-Hold trace in red and clear write trace in yellow demonstrate that the Max-Hold trace is able to reveal the highest power levels at each individual frequency and hold those values for comparison.

## Export and Analyze Trace Data

As Spike Software is unable to perform an occupied bandwidth measurement on anything but instantaneous data from the BB60C, external tools will be necessary to calculate the OBW. This can be done by exporting the trace data and further analyzing the data in 3rd party software. The export function will export a CSV file (.csv) that can be read by other software and can be further analyzed.

### Exporting the Max-Hold Trace Data from Spike Software

While Spike is displaying pulsed data from the VSG25A, do the following:

1. In the **Traces** panel, from the **Type** drop-down menu, select **Max Hold**
2. Near the bottom of the **Traces** panel, click **Export**
3. Save the CSV file in an appropriate location to be accessed by the 3rd party software

The CSV is now ready for analysis by any of the software tools available on the market for analyzing array data from CSV files. Examples include MATLAB™, LABVIEW™, Microsoft™ Excel, and many others.



# Channel Power and Adjacent Channel Power Ratio Walkthrough

This section of the walkthrough will demonstrate the use of Spike Software's built in channel power, adjacent channel power, and adjacent channel power ratio measurement features. The first two sections of this walkthrough use the VSG25A as the signal generating DUT.

## Channel Power Measurement Procedure

The following procedure works through the process of using Signal Hound equipment for channel power measurements.

### 1. Setup the BB60C, VSG25A, and Spike Software for a Channel Power Measurement

Using the same settings specified in the [Occupied Bandwidth Measurement Walkthrough](#) for the VSG25A, BB60C, and Spike prepares the equipment for the walkthrough. This time, however, the only difference is that the Channel Power Settings are configured instead of manipulating the Occupied Bandwidth parameters.

### 2. Configure the Channel Power Settings

As with the OBW measurement, Spike provides a convenient measurement field. In the same field as OBW, Channel Power measurement can also be configured and programmed to automatically perform channel power and adjacent channel power ratio measurements. It is important to note that the center frequency of the primary channel should be the center frequency of the frequency sweep programmed in the Frequency fields. The Channel Power measurements assume that the center frequency desired in the sweep center frequency.

Channel Power	
Width	200.000000 kHz
Spacing	200.000000 kHz
Count	5.000
Enabled	<input type="checkbox"/>
Occupied Bandwidth	
Enabled	<input type="checkbox"/>
% Power	99.000

The Width field sets the bandwidth of the channel to be measured. The Spacing field dictates the center-frequency to center-frequency spacing of the channels. For example, to measure a channelized modulation protocol with guard bands, the Width can be set to the maximum channel bandwidth minus the sum of the guard band bandwidths.

## Configuring Spike for channel power measurements

While Spike is displaying data from your test setup:

1. In Spike, in the **Channel Power** panel, set the following:

- Width = 200 kHz
- Spacing = 200 kHz
- Count = 1

2. Select **Enabled**

### 3. Observe The Channel Power Measurement

The results of the Channel Power measurement are a number in dBm below, and in the center, of the channel of interest. A grey shaded area is placed on the frequency display, which indicates the channel being measured (see Figure 11).

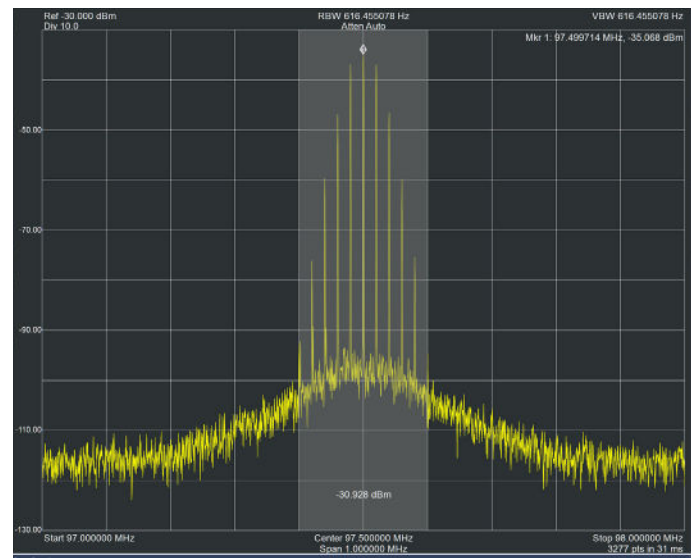


Figure 11—The Channel Power measurement reveals the total power within a programmed channel. If a signal has highly linear and low noise/phase noise characteristics, the majority of the transmitted signal power should be contained within the primary channel.

## Adjacent Channel Power Ratio Measurement

Where the channel power measures the total power within a channel, adding additional “counts” or channels in the Channel Power field in Spike Software, will automatically measure the power in the adjacent channels and provide a ratio of the adjacent channel power to the primary channel.

### 1. Configure the Channel Power Settings

The only configuration difference between ACPR and CP measurements are the use of the “count” field. Changing the count field will increase the number of channels that are including in the channel power measurements.

#### Configure Spike for channel power measurements

While Spike is displaying data from your test setup:

1. In Spike, in the **Channel Power** panel, set the following:

- a. Width = 200 kHz
- b. Spacing = 200 kHz
- c. Count = 3

2. Select **Enabled**

### 2. Observe the Channel Power and ACPR Measurements

Once the Enable field is selected, grey fields will appear designating each channel being measured. A count of 3 measures the primary channel and the two adjacent channels (see Figure 13). The Channel Power and the ACPR are displayed in the center of each measured channel. The ACPR measurement is displayed below the Channel Power and is in the units of “dBc”, which are scalar logarithmic units.

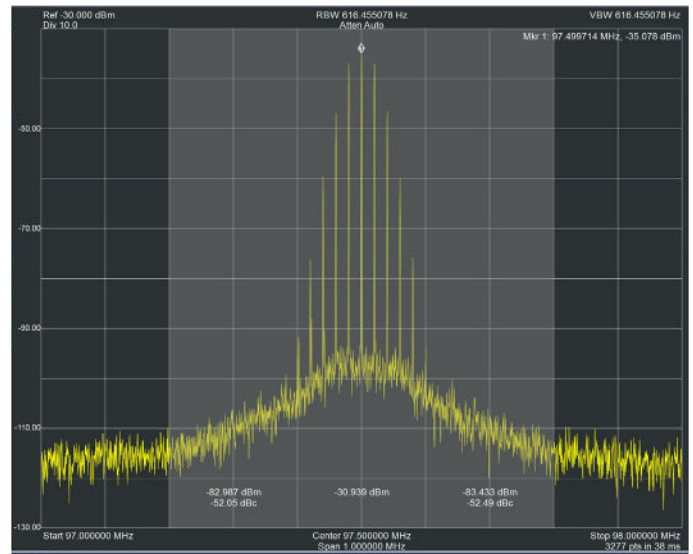


Figure 12—The ACPR measures the amount of signal energy that has bled into the adjacent channels, and can be used to predict interference. This measurement requires a closed system test, as outside interference could artificially inflate the power in the adjacent channels compared to the primary channel.

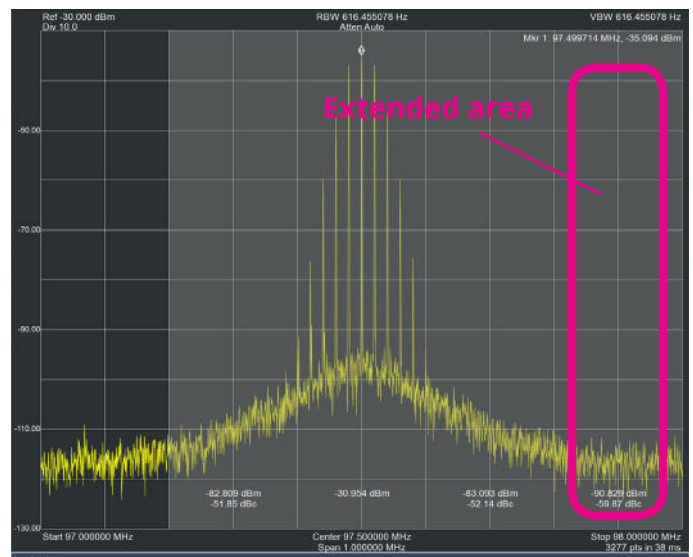


Figure 13—Changing the “Count” field in Spike Software to 4 or more extends the adjacent channel power ratio measurement beyond the immediately adjacent channels.



## Further Reading

Download the Spike software manual from [www.SignalHound.com/spike](http://www.SignalHound.com/spike) for more OBW and CPM information.

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The Signal Hound® company started as Test Equipment Plus (TEP) in 1996 with the belief that providing quality used test equipment, at affordable prices to every customer, would drive growth and foster loyal customers. It did. Then in 2006, TEP expanded their focus by designing and manufacturing a color LCD display retrofit kit to answer the need for CRTs that were no longer available for the aging HP® 8566A, 8566B, 8568A, and 8568B spectrum analyzers. TEP also began offering a repair service for HP/Agilent® step attenuators. In 2007 TEP designed and began manufacturing another color LCD display retrofit kit to support the HP/Agilent 8560 series spectrum analyzers. At the same time, TEP also decided to play to their strengths, and began offering test equipment repair services for Agilent spectrum analyzers, network analyzers, and signal generators. The repair segment of TEP is now recognized in the RF and microwave test equipment industry as a world class operation.

The LCD kits were so well received that in 2009, TEP decided to design a compact, lightweight, and inexpensive spectrum analyzer. The goal was to provide an economical spectrum analyzer with unparalleled value compared to anything else on the market. TEP achieved that goal with the USB-SA44 spectrum analyzer which was introduced in February 2010, marking the birth of the Signal Hound line of test equipment. In April of 2014, Test Equipment Plus began officially doing business as Signal Hound. Signal Hound's latest innovation is the Signal Hound BB60C spectrum analyzer, introduced June 2014, which is an enhanced version of its well-received predecessor, the BB60A.

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