Review: Signal Hound BB60C real time 6 GHz spectrum analyzer

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The Signal Hound series of spectrum analyzers are about as small as three large-size Hershey chocolate bars stacked on top of each other. The unit offered for review is the recently released model BB60C real time analyzer, which can tune from 9 kHz to 6 GHz with a dynamic range of +10 to approximately -158 dBm (DANL, which is dependent on resolution BW). It can easily fit within a standard briefcase with room left over for a medium sized laptop.

Figure 1 - The Signal Hound real time spectrum analyzer fits easily into a standard briefcase.

So what does "real time" mean for a spectrum analyzer? In a nutshell, it can display near instant frequency information in up to a 27 MHz instantaneous bandwidth (IBW). The response is so quick, it can trap and display intermittent signals with pulse width as narrow as 4 µs, with 1 µs pulses only attenuated by 2-3 dB. The I/Q data stream is sent through the USB 3.0 port and data streams between 250 kHz to 27 MHz of amplitude-corrected bandwidth may be viewed. The sweep speed is 24 GHz/sec with 1.2 million FFTs per second Because much of the signal processing is performed within the PC, you'll need a pretty powerful computer. In fact the recommended setup would be a PC running Windows 7 or 8, with an Intel i7 (3rd generation (Ivy Bridge) or later with a quad core processor, 8 GB RAM, one USB 3.0 port and one adjacent USB 2.0 or 3.0 port, and OpenGL 3.0

capable graphics processor. While my Mac is a pretty fast machine and can display the GUI interface and waveform OK, some of the display text is jumbled, making it tough to determine the frequency and bandwidth parameters. So, I'll borrow a Dell inspiron 17-inch laptop to continue the review.

So, what's in the box? The well-packed BB60C, of course, a CD-ROM with the drivers and operating software and a special dual USB 3.0 cable that connects and fully powers the unit. Be sure you have at least two USB 3.0 ports on the same side of your laptop, as this special cable has a Y-adapter that won't reach from one side to the other of most laptops. I had to purchase a USB extension to try it out on my Macbook Pro. The user manual is automatically downloaded to C:\Program Files\Signal Hound\BB60\manuals or it may be [downloaded from the Signal Hound web site](#).

Figure 2 - The analyzer, supplied CD-ROM and connecting cable are included.

Architecture

The BB60C analyzer is based upon a two-stage superheterodyne receiver. Two independent IF frequencies (1.26 and 2.42. GHz) are used based on the tuned RF frequency. Distributed element notch filters are used to suppress spurious responses. To reduce second-order intermodulation, push-pull amplifiers are used to cancel even-order mixing. Direct conversion is used below 10 MHz to avoid mixing products. The front end uses and preamp-attenuator combination that has a spurious-free dynamic range better than 50 dB. The 14-bit ADC uses built-in dithering, which adds improved linearity as well as decreased spurious IF responses. ADC spurs are typically less than 70 dB below the carrier. From the ADC, the digitized IF data goes to an FPGA, where it's packetized and sent over a USB 3.0 port to the PC, where 80 million 14-bit ADC samples per second are processes into a spectrum sweep or I/Q data stream.
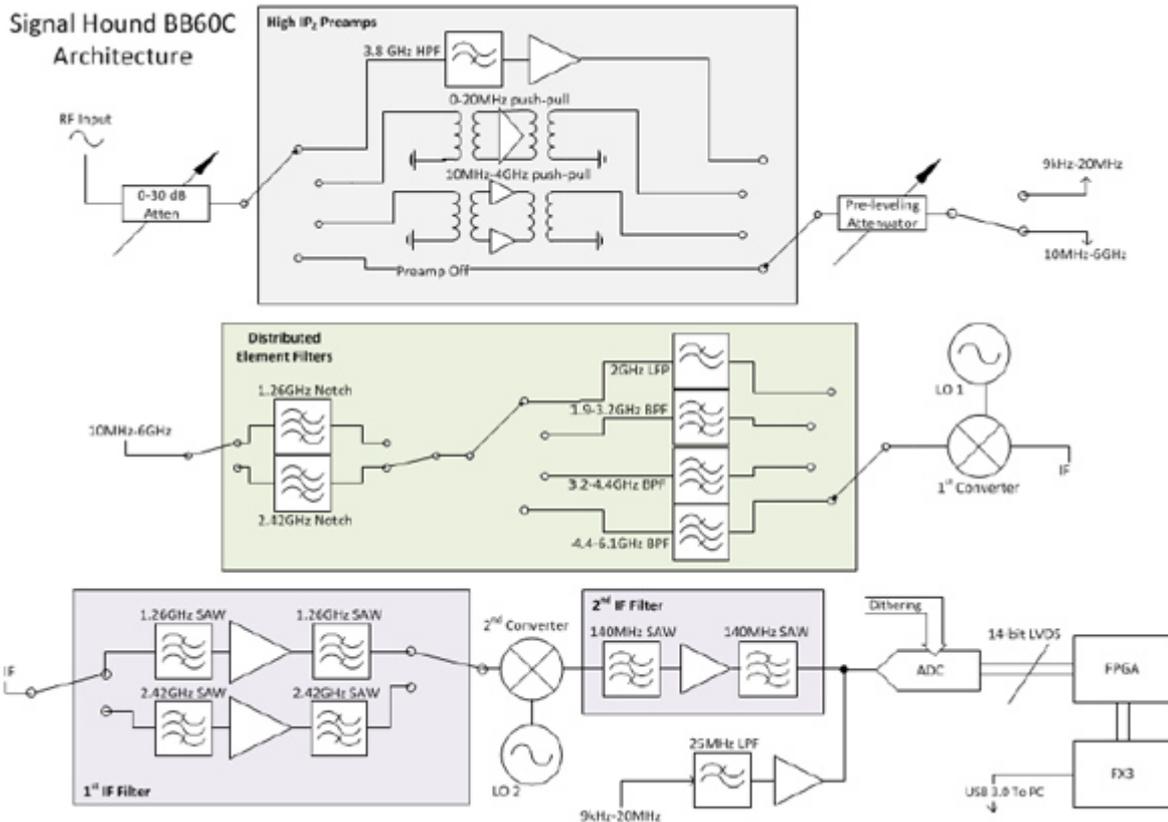
Figure 3 - The system block diagram of the real time analyzer. Courtesy Signal Hound.

Here are some primary specifications:

- Frequency range: 9 kHz to 6 GHz
- Streaming IF data: 250 kHz to 27 MHz real time analysis BW (amplitude corrected)
- Resolution bandwidth (RBW): 10 Hz to 10 MHz
- Internal timebase accuracy: +/- 1 ppm/year
- Sweep speed (RBW>10 kHz): 24 GHz/sec
- Amplitude range: +10 dBm to DANL
- Absolute amplitude accuracy: +/- 2.0 dB
- Displayed average noise level (DANL), (dBm/Hz, ref level -60 dBm, atten=0 dB):

  - 9 kHz to 500 kHz: -140
  - 500 kHz to 10 MHz: -155
  - 10 MHz to 6 GHz: -159 + 1 dB/GHz

- LO leakage at RF input: -80 dBm
- Size: 8.63 x 3.19 x 1.19 inches
- Power: one USB 3.0 port and an adjacent USB 2.0 or 3.0 port.

 Controls
Controls

The front panel includes a 50-Ω SMA RF input. The maximum power tolerance is +20 dBm. A
READY/BUSY light flashes each time a command from the PC is processed. The rear panel includes

the USB 3.0 interface port, along with a 10 MHz reference input/output and a 1 pps trigger/sync input.

The software and drivers installed just fine on my Macbook Pro running Parallels 9.0 and windows 8.1. Because my Mac uses a virtualization of Windows 8.1, some of the the text above and below the displayed waveform was mashed together, but the general GUI controls and displayed waveform were fine. Once I switched to a faster PC, the user interface displayed just fine.

Launching the software brings up the spectral display with GUI controls on either side. The left-hand panel controls up to six traces with user selectable colors. Trace Type includes settings for Clear & Write, Max Hold, Min Hold, Min/Max Hold, Average (10 samples) and Average (100 samples). I'd love to see a Freeze Display choice, as well. This would be valuable in saving and comparing a particular trace, while measuring using a second trace. This would be extremely useful for "A" versus"B" measurements. You can also Export the current display to memory. Marker controls include Peak Search, To Center, Peak Left, Peak Right, To Ref and Delta. Manual positioning of the marker may be done by clicking on the displayed spectrum and then using the left/right arrows to fine tune the position. Depending on the Span setting, the marker step size may be a little too small. This panel also includes a Ref Offset control and Channel Power measurement setup.

The right-hand panel includes the frequency settings: Span, Center, Start, Stop and Step. The Step control is nice if you want to step the frequency over fixed harmonically-related frequencies, for example. There are also push buttons for going to Full Span (9 kHz to 6 GHz) or Zero Span (soon to be implemented) that will allow you to demodulate specific frequencies. This is also where you'd control the amplitude features, like Ref Level, units (dBm, dBmV, dBμV, mV), dB/Div, Gain and Atten. Attenuation may be set to Auto, 0, 10, 20 or 30 dB. By leaving this control set to Auto, the device can best optimize for dynamic range and compression. Gain is used to control the RF input level. It may be set to Auto, Gain 0, Gain 1, Gain 2, or Gain 3. Again, the recommendation is to leave this set to Auto where the best gain setting is based on the reference level. I only wish they'd replace the "Gain N" labels with actual dB levels, as I have no idea what the various gain settings really are.

The right-hand panel also includes means to set the resolution bandwidth (RBW). The RBW controls the FFT size and signal processing similar to selecting IF bandpass filters on an analog spectrum analyzer. The unit uses "native BWs" that are "digital" in nature and speak the language of the FFT algorithms. They are available from 1 Hz to 10.1 MHz in powers of two. The unit also uses the more common "non-native" RBWs and can be set from 10 Hz to 10 MHz in steps of a 1-3-10 sequence (for example, 1 kHz, 3 kHz, 10 kHz,…). I do find I can specify arbitrary RBWs, such as the EMI bandwidths of 9 kHz, 120 kHz and 1 MHz. The Video Bandwidth (VBW) is also controllable similarly, but can not be set higher than the RBW setting. The VBW can also be set to auto track with the RBW. In Real Time mode, VBW is not selectable. Finally, there is an Acquisition section, where Video Units of Power, Log, Voltage, or Sample may be selected. A Detector setting allows a choice of Min/Max or Average detection. The company is also working on a Quasi-Peak detector function, which will be included in a software update. Sweep time in ms may also be set here.

These two panels may be positioned differently around the display or even placed one over the other using a tabbed feature.

Along the top of the display, you'll find controls for selecting 2D or 3D spectrogram displays along with the frequency display. For the 3D display, you can drag it back and forth with the mouse for best viewability. You can enable or clear Persistence and can control Single Trig sweep or Continuous sweep. There is also a Preset control that restores the unit to its initial power-on state. In the main menu drop downs, in File, you'll find ways to Print, Save as Image or Import Path Loss

or Limit Lines. In Edit, you'll find the means to add a title to the display area, as well as changing color schemes and preferences. There is a Preset drop down that allows you to save or recall up to six instrument configurations. One nitpick I have would be to make the number of presets unlimited, rather than limited to just six. Under Settings, you may switch between the internal and external 10 MHz reference clock and sync trigger. Analysis Mode switches the instrument between Idle, Sweep or Real Time. The Utilities drop down includes what they call the Audio Player. This is actually the means to demodulate AM or FM signals, which would be useful in helping identify whether a measured signal is an ambient commercial broadcast or two-way radio transmitter. Bringing this up displays a separate pop-up window with controls for center frequency (plus frequency step controls) and Audio Type (AM, FM, USB, LSB or CW). The Bandwidth setting only goes down to 60 kHz for all modes and I've mentioned to the designer this ought to be designed to be adjustable down way lower. There are also low pass and high pass audio limits as well as a Deemphasis setting in us. I was able to demodulate both AM and FM broadcast signals without a problem.

There is a recording and playback feature along the bottom of the frequency display, that allows you to save a real-time record of the display to memory and play it back later. This might be very useful for spectrum management applications.

Figure 4 - The FM broadcast band displayed using persistence mode. Note the pulsed series of harmonics left of center. These would be unclear on a regular spectrum analyzer.

If portability is an issue and you have a powerful enough laptop, this may be just the ticket to affordable EMI pre-compliance testing or troubleshooting. With the exception of the Gain setting, the controls worked just as you would expect of most bench top analyzers. I'm often on the road visiting clients and toting around a 6 GHz analyzer in my briefcase sounds pretty good. With more engineers using Apple products lately, I'd sure like to see software developed for the Macbook Pro laptops!

The top of the line Signal Hound BB60C real time spectrum analyzer may be ordered directly from the company's web site: https://www.signalhound.com/shop/bb60c/ and costs just $2,879 with immediate availability. Highly recommended, assuming you have the PC horsepower required.

Part 2 of this article will include more hands-on measurements and sample screen captures.

For more:

Signal Hound BB60C review - Part 2
Signal Hound web site
Signal Hound BB60C User Manual
YouTube demo