7 Reasons You're Paying Too Much for Your Spectrum Analyzer

With the proliferation of wireless technologies into all aspects of our lives, more engineers are finding the need for RF measurements. In the past, RF technology support required the use of expensive test equipment and were used by engineers with deep RF knowledge. Today, however, a wide range of engineers and technicians require the ability to measure RF. Spectrum analyzers are the most common lab instrument as they allow for the measurement of RF signals. Historically an expensive spectrum analyzer might sit in the lab and be protected by the resident RF guru. This was easy to understand due to the large investment required to bring the capability in-house.

Ongoing advances in RF integrated circuits have enabled Signal Hound to push the envelope with our unique spectrum analyzer architecture. This allows us to affordably offer the performance you need. Manufacturers developing new products, and the technicians supporting them, utilize the most popular standards we know today – Bluetooth, Wi-Fi, LTE, 5G, etc. Many companies are surprised to learn that modern RF instrumentation no longer needs to be so expensive. Today they can buy one Keysight or Rohde & Schwarz spectrum analyzer to make the few unique measurements that have the most challenging requirements and then use the remaining budget to buy enough Signal Hound spectrum analyzers to stock everyone's bench and/or service truck to take care of the remaining 95% of the workload.

Signal Hound spectrum analyzers offer the performance you need at the best price available on the market (**Figure 1**). In this paper we discuss 7 reasons that you may be paying too much for your spectrum analyzers. If any of these reasons apply to your test needs, maybe it's time to consider why you should add USB-based RF test capability to your lab – or even your own desk!

USB-SA44B
1 Hz to 4.4 GHz spectrum analyzer

BB60C
9 kHz to 6 GHz spectrum analyzer

SM200A
100 kHz to 20 GHz spectrum analyzer

Figure 1— Expand your test capabilities with the level of performance you need

Reason 1—How Much Dynamic Range Do You Need?

Dynamic range is an important specification for a spectrum analyzer. When looking for low level signals, it determines one's ability to distinguish a signal from the measurement noise floor. An important consideration will be determining how low a level is needed for your test situation. **Figure 2** highlights the importance of dynamic range when looking for low level signals. For many measurements the main objective may be to accurately characterize the main signal. In these cases, having a 60 dB signal-to-noise floor may be more than enough. In some labs a few test stations may require a more expensive spectrum analyzer that offers 85 dB or more.

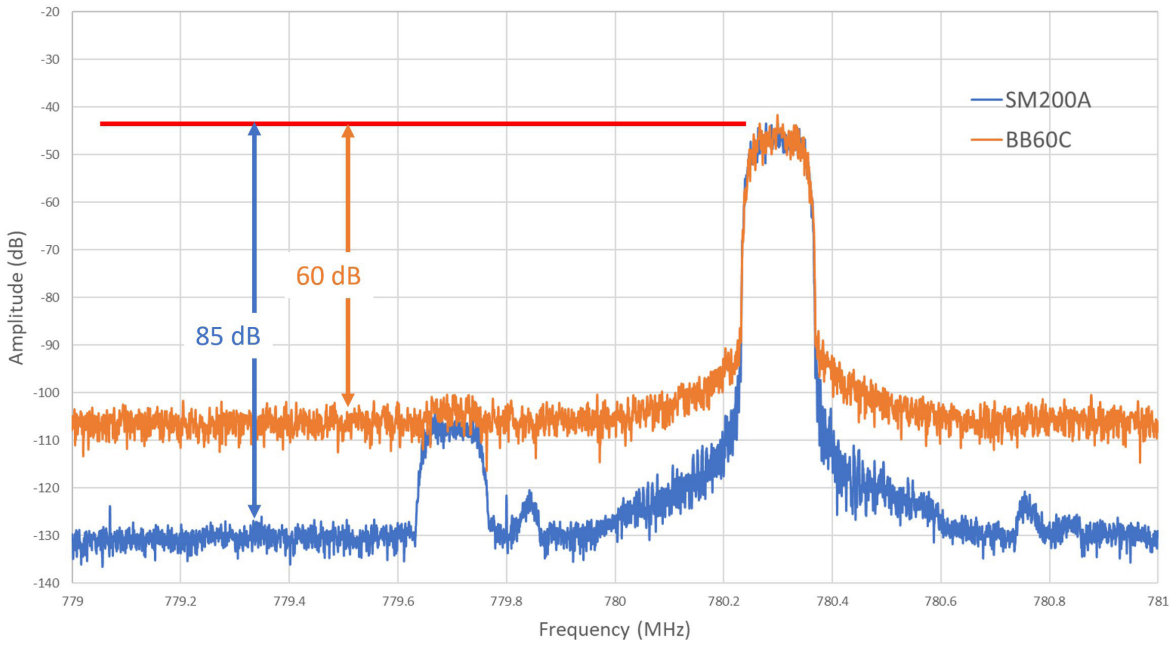

Figure 2—Outside of your main signal, what is your noise requirement? Do you need to accurately locate signals more than 60 dB down? More than 85 dB?

It can be confusing when looking at a spectrum analyzer's dynamic range specification. Often a very low number for DANL or Displayed Average Noise Level is displayed (e.g. less than -150 dBm/Hz). The DANL numbers can sometimes be misunderstood, as they depend on many factors such as: frequency, attenuation, detectors, preamps, etc.

To make a simple comparison between spectrum analyzers one can look at the maximum dynamic range specified as two thirds of the difference between the 3rd order intercept point and DANL at 1 GHz. **Table 1** provides a comparison of the performance of the Signal Hound families along with Keysight's MXA.

Table 1—Dynamic Range

Analyzer	Maximum Dynamic Range @1 GHz	Price
Signal Hound SA44B 4.4 GHz, 250 kHz IBW	104 dB	$919 USD
Signal Hound BB60C 6 GHz, 27 MHz IBW	95 dB	$2879 USD
Signal Hound SM200A 20 GHz, 160 MHz IBW	118 dB	$11,900 USD
Keysight N9020B-526-B1X (MXA) 26.5 GHz, 160 MHz IBW	116 dB	$72,329 USD

Reason 2—Speed No Longer Means Expensive

For many applications sweep speed is of critical importance. For example, spectrum monitoring situations often require broad frequency sweeps in search of a variety of signal situations. Signal Hound's SM200A offers an industry leading 1 THz/sec sweep speed at any of its resolution bandwidth settings ≥30 kHz. Covering 1 GHz to 20 GHz in just 19 milliseconds allows for a constant sweep of the airwaves. Best of all, this can be done automatically, with no operator present, over long periods of time. Simply define a baseline and any signals that violate it will be logged to a CSV file in real-time. This maximizes both efficiency and security, as data is preserved even if the computer shuts down.

In production environments throughput can mean everything. The cost of test equipment can become insignificant as volumes increase. However, with the need to constantly drive down costs, saving money on test equipment may also allow for more production lines. **Table 2** highlights the sweep speed of each of the Signal Hound spectrum analyzers.

Table 2—Sweep Speeds

	Signal Hound USB-SA4B	Signal Hound BB60C	Signal Hound SM200A
Sweep speeds	140 MHz/s ≥ 10 kHz RBW	24 GHz/s ≥ 30 kHz RBW	1 THz/s ≥ 30 kHz RBW

The Signal Hound spectrum analyzer architecture also allows for an additional technique to further increase speed performance. In many cases the instrument software can consume computer processor overhead. The added use of the Spike (GUI) program may have a small impact on overall test times. In cases where fractions of a second are critical, Signal Hound allows its users to bypass the Spike software application (**Figure 3**). This allows for direct device API programming for even faster measurements. The Signal Hound spectrum analyzers can be programmed in C++, LabVIEW, MATLAB, Python, C# or any language that has C bindings.

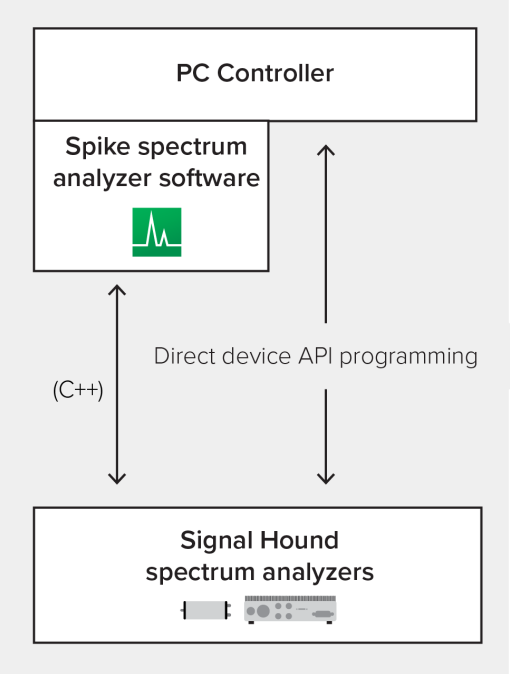

Figure 3—Increase your measurement speed further with direct device API programming of the Signal Hound spectrum analyzer.

Reason 3—Accurate Phase Noise Measurements

Many devices, subsystems, and systems require accurate phase noise measurements. Spectrum analyzers are commonly used for this measurement. However, the spectrum analyzer itself must have low enough phase noise so as not to contribute to the device measurement. While many test equipment vendors charge for phase noise measurement personalities, Signal Hound's spectrum analysis software, Spike, includes phase noise measurement capability (**Figure 4**).

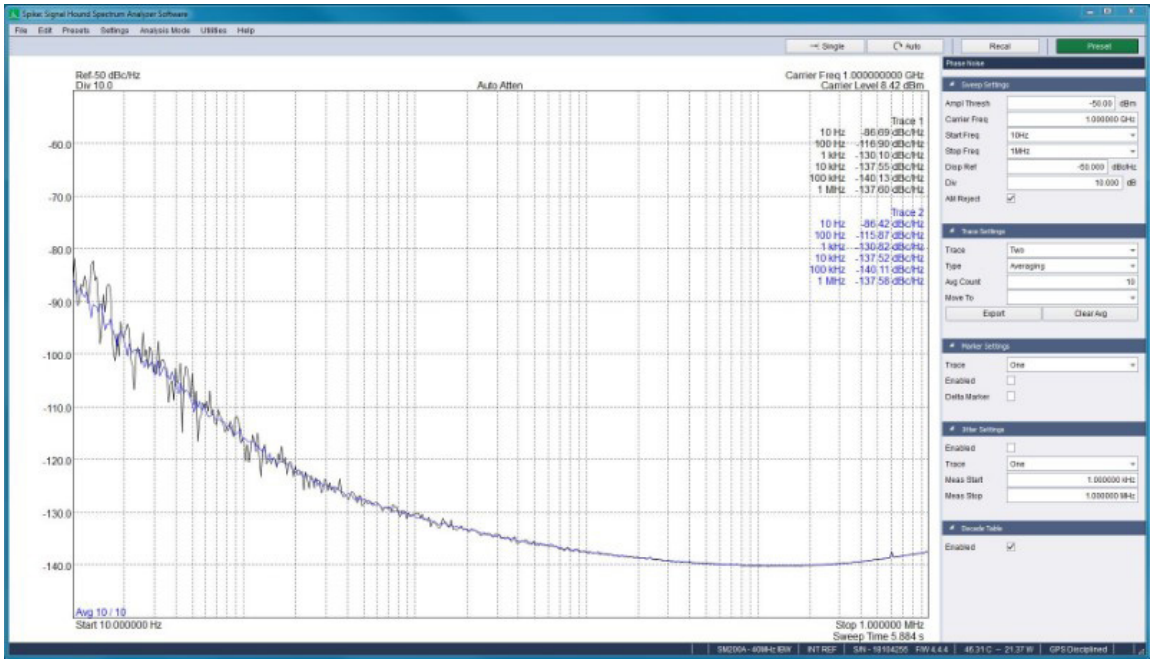

Figure 4—Accurate phase noise measurements can be made affordably!

The Signal Hound SM200A uses a low IF architecture design that enables exceptional phase noise performance, comparable to the performance of a more expensive spectrum analyzer (**Table 3**). The Signal Hound SA44 and BB60 use a more traditional superheterodyne architecture to achieve a more modest phase noise performance, but at an even more affordable price. Note that for the SA44, the results listed are typical as it does not have a hard spec for phase noise.

Table 3—SSB Phase Noise for a 1 GHz Carrier

	Signal Hound			Keysight N9020B 26.5 GHz MXA	
Offset	USB-SA44B (Typ.)	BB60C (Spec.)	SM200A (Spec.)	Spec.	Typical
10 Hz			-76		-80
100 Hz	-80	-70	-108	-91	-100
1 kHz	-88	-76	-123		-112
10 kHz	-91	-83	-132	-113	-114
100 kHz	-100	-93	-136	-116	-117
1 MHz			-133	-135	-136

The low IF architecture of the SM200A enables phase noise performance with a lower cost design, but it does come with a tradeoff of higher image response spurs. While the residual response spurs are comparable to the MXA, the image response spurs are not as good as the MXA (<-74 dBc). The SM200A Spike software provides a Signal ID feature to be activated and deactivated to allow low level mixer spurs to be differentiated from RF Input signals (**Table 4)**. In many cases the spurs can be identified as coming from the spectrum analyzer and not the device-under-test (DUT), allowing them to be ignored during the actual measurement. The more traditional superheterodyne architecture of the BB60C typically has -70 dBc image rejection. The BB60C spurs are generally not from the image response.

Table 4—SM200A Image Response Signal ID Feature

	Signal Hound SM200A	
Frequency	Image Reject Off	Image Reject On
100 kHz to 6 GHz	-58 dBc	-75 (typ)
6 GHz to 10 GHz	-55 dBc	-75 (typ)
10 GHz to 20 GHz	-44 dBc	-75 (typ)

Reason 4—Real-Time Spectrum Analyzer Capabilities

For many real-world signals—from complex modulated communications signals, to interference events, to pulsed tactical signals—the signal energy can be sporadic, non-recurring, or even random. With traditional spectrum analysis, these signals could be nearly impossible to “catch” in an analysis window and to trigger on. Present and future communication modulations are increasing the challenge further with techniques, such as frequency hopping, spread spectrum, pulsed, and cognitive radio low probability of intercept techniques.

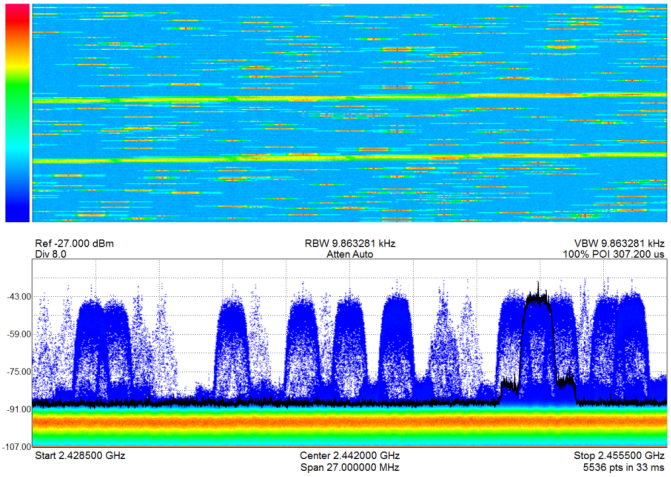

Figure 5— The persistence and waterfall display in real-time analysis show the occupancy of the 2.4 GHz ISM band. Shown are the transmissions of a Bluetooth headset and a cell phone searching for a wireless network.

Real-time SA (RTSA) is a digital signal processing method that leverages overlapping FFTs and high-speed memory to have a 100% probability of intercept (POI) in even extremely dense environments. Real-time bandwidth, which is the maximum frequency span offering gap-free overlapping FFT processing, is an important parameter of an RTSA that can enable a more detailed analysis of a spectrum.

Real-time no longer means real expensive. Signal Hound offers real-time spectrum analysis capabilities up to 160 MHz with a 100 percent probability of intercepting signals as fast as 12-microseconds. However, in many cases you don’t even need 160 MHz of analysis bandwidth (**Figure 5**). For example, what if you are testing a device that has a 25 kHz maximum bandwidth signal, such as a key fob? You may just need to push the key and make sure that the center

frequency is right, and the bandwidth is right, and the modulation is right. **Table 5** highlights the real-time analysis capabilities of the Signal Hound spectrum analyzers.

Table 5—Real-time Spectrum Analysis Capabilities

Analyzer	Real-Time Bandwidth	100% Prob of Intercept (POI)
Signal Hound SA44B 4.4 GHz	250 kHz	592 µs @ 10 kHz RBW 4.7 ms @ 1 kHz RBW
Signal Hound BB60C 6 GHz	27 MHz	19.2 µs @ 300 kHz RBW 38.4 µs @ 100 kHz RBW
Signal Hound SM200A 20 GHz	160 MHz	12 µs @ 300 kHz RBW 49 µs @ 100 kHz RBW
Keysight N9020B-526-B1X (MXA) 26.5 GHz	85 / 125 / 160 MHz	17.3 µs (RBW not specified)

Reason 5— Analyzing Complex Signals

Don't pay extra to analyze your complex signals! Signal Hound's Spike software includes a full suite of signal analysis capabilities (**Figure 6**). Our digital modulation analysis capability includes constellation diagrams and symbol tables for modulation formats such as QPSK, BPSK, 8PSK, π/4DQPSK, DQPSK, and QAM16/32/64/256. Measurements include: error vector magnitude (EVM), Signal-to-Noise Ratio (SNR), Modulation Error Ratio (MER), Modulation quality metrics, Linear compensations such as carrier offset, I/Q offset, am-

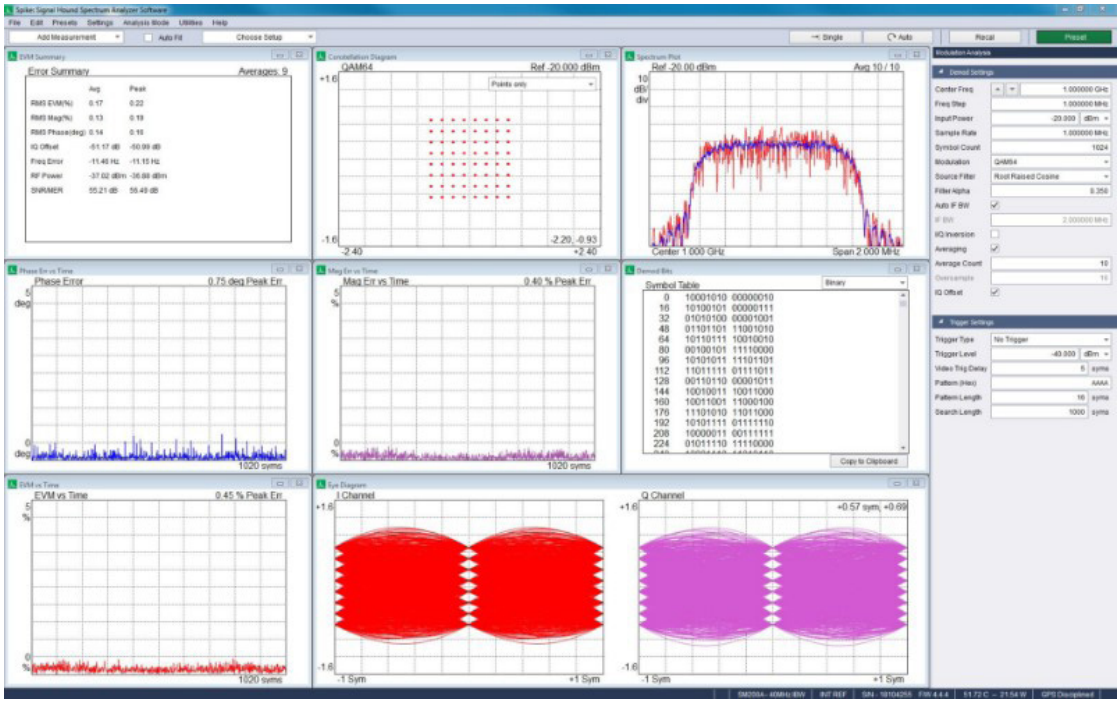

Figure 6— Signal Hound's Spike software includes a full suite of digital modulation analysis capabilities.

plitude droop (linear amplitude corrections), sync pattern triggering, and eye diagrams.

Additional signal analysis capabilities include adjacent channel power ratio (ACPR) or adjacent channel leakage ratio (ACLR), occupied bandwidth (OBW) and channel power measurements. 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. For applications where you need more instantaneous bandwidth, the SM200A offers 160 MHz. **Figure 7** highlights examples of ACPR measurements.

Figure 7—Adjacent Channel Power Ratio (ACPR) measurements. *(**Note**—Figure 7 shows the same signal being measured by both the BB60C and the SM200A. Note the 22dB lower noise floor achieved by the SM200A as compared to the BB60C. If you need the extra dynamic range for some of the more demanding ACPR measurements, then the SM200A will provide that needed performance.)*

While Signal Hound supports typical physical layer measurements, we do not currently support protocol specific measurement personalities (LTE, W-CDMA, etc.). Information regarding protocol headers, payloads, error correction are not currently supported due to the large number of programming hours that would be required. This may not be too surprising since these software options alone often cost more than our spectrum analyzers.

Reason 6—Do You Need an Old PC?

Traditionally, test instrumentation utilizes a built-in PC controller. These special internal controller boards are produced at a much lower volume than commercial PCs and are typically manufactured by a third-party vendor. It is not unusual for these internal controllers to be two to five generations behind their commercial peers because they are embedded. This invariably means that by the time the spectrum analyzer reaches the market, the internal controller is dated. Additionally, these built-in controllers are usually only updated when the instrument is replaced – meaning that by the end of an instrument's life cycle, the user is dealing with a processor that is several generations slower than current PCs. Using the latest generation of PC will keep the overall performance of your test equipment much closer to current standards.

Now factor in the cost of the traditional internal controller and mark it up by at least 4 times the vendor's cost to arrive at the customer's cost. Signal Hound's USB-based test instruments eliminate this issue with the use of an external PC as the measurement controller (**Figure 8**). This cost-effective approach removes unnecessary expenses and allows you to focus your investment on buying a spectrum analyzer with premium performance.

An additional benefit of using your own PC to control your measurement is that all the data you collect is on your PC. You no longer need to download data from your test instrument or worry about someone accidently deleting your data. With the Signal Hound API or Spike software running on your PC you can always look at your data where ever you go.

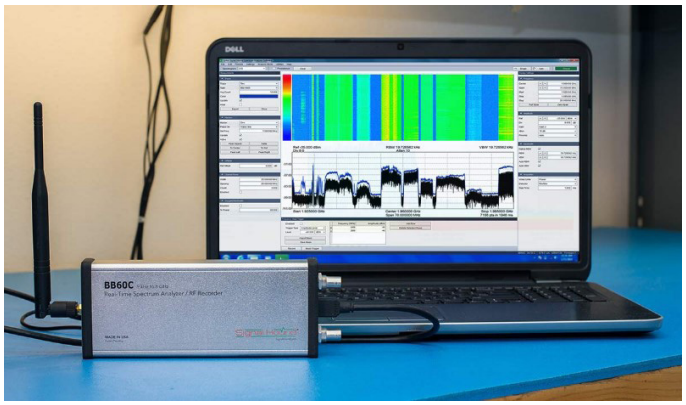

Figure 8—Using an external PC ensures optimum performance, plus allows you to leverage your investment for more spectrum analyzer performance.

Reason 7—SWaP+C - Look No Further

Next generation defense systems are pushing the boundaries of performance even as they continue to reduce size, weight, power, and cost (SWaP+C). Even in the commercial world, providing test engineers with critical test equipment in their drawer or on-the-go provides a competitive advantage. Signal Hound products are a natural fit for customers looking for SWaP+C solutions (**Table 6**).

Table 6—Signal Hound's SWaP+C Parameters

Signal Hound		
USB-SA44B	BB60C	SM200A
Size		
16.7 x 8.2 x 3.1 cm 6.6 x 3.2 x 1.2 in	19.3 x 8.2 x 3.1 cm 7.6 x 3.2 x 1.2 in	25.9 x 18.3 x 5.5 cm 10.2 x 7.2 x 2.2 in
Weight		
0.367 kg 0.809 lbs	0.56 kg 1.234 lbs	3.59 kg 7.914 lbs
Power		
2 W (USB 2.0)	6 W (USB 3.0 Y-cable)	28 W typ (Ext. Pwr)
Cost		
$919 USD	$2879 USD	$11,900 USD

Summary

Implementing wireless technologies is becoming part of many of our jobs. Having a spectrum analyzer available to test and implement RF designs into your projects is key. Signal Hound spectrum analyzers offer unrivaled value by providing the best price/performance ratio on the market. With PC-based spectrum analyzers becoming mainstream, maintaining the status quo begs the question: why let big, expensive spectrum analyzers of the past limit your test capabilities and capacity?

Signal Hound offers the spectrum analyzer you need to keep your product supported. Don't wait for your turn in the lab – now you can have what you need in your own desk drawer!

For full details and purchase information, check out the Signal Hound website at signalhound.com.

Further Reading

Learn more about Signal Hound's robust, real-time USB-powered spectrum analyzers at signalhound.com/learn.

About Signal Hound

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 SM200A spectrum analyzer, introduced June February 2018, which is a 20 GHz high-performance spectrum analyzer with applications from spectrum monitoring to benchtop RF analysis.

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