

An Update on Features and Performance in Today's Spectrum Analyzers

By Gary Breed
Editorial Director

New spectrum analyzers have many more features than those produced just five or ten years ago

Spectrum analyzers are among the most common RF and microwave test instruments. Viewing, measuring and analyzing signals

in the frequency domain is their fundamental job, but the ability to perform those tasks has improved markedly in a relatively short time. This month's tutorial is a review of the significant improvements in features and performance that instrument manufacturers have made to this important engineering tool over the past several years.

Handheld Portability

It's easy to appreciate the challenge of packing the basic circuits of a spectrum analyzer into a handheld, battery-operated package. But it's harder to figure out how companies like Anritsu and Rohde & Schwarz have also included high performance that would match or beat laboratory analyzers of not very long ago, with a set of analysis and display features that match today's needs.

As an example, the Anritsu MS2721A pictured on this page includes frequency coverage from 100 kHz to 7.1 GHz with 10 Hz to 3 MHz resolution bandwidth (RBW) and a -153 dBm displayed average noise level (DANL at RBW of 10 Hz). This unit includes preset "smart measurement" setups for field strength, channel power, occupied bandwidth, adjacent channel power ratio (ACPR) and carrier-to-interference ratio (C/I).

Handheld instruments share technologies common to portable computers and other consumer products—color LCD display, Li-ion batteries, USB or LAN interface and compact



Handheld portable spectrum analyzers with high performance, like this Anritsu MS2721A, are among the recent developments by instrument manufacturers.

external memory devices.

The Rohde & Schwarz FSH3 handheld spectrum analyzer includes many of the features of the above unit, with specs that include 100 kHz to 3 GHz range to cover popular wireless bands, DANL of -135 dBm (RBW 100 Hz). Resolution bandwidths range from 100 Hz to 1 MHz. This unit offers sample, max/min peak, auto peak and RMS detectors, and has an optional tracking generator.

High Performance Portables

Although handhelds are extremely convenient for many field engineering and service tasks, traditional form factor portable spectrum analyzers remain popular. They can provide basic performance that nearly equals laboratory instruments. Models from various makers cover from 4 GHz to beyond 40 GHz. Features are often tailored for specific appli-



With today's complex wireless systems, portable instruments must have performance like their laboratory counterparts. This example is the Rohde & Schwarz model FSL.

cations such as CATV, SATCOM, WLAN or any of the wireless phone standards, including new 2.5G and 3G systems. All major manufacturers address the market niche with various models.

A representative example is the Rohde & Schwarz FSL, pictured above. The FSL features a large number of standard functions, including a choice of detectors: max, min, auto-peak, sample, RMS, average, quasi-peak; CP/ACP/fast ACP measurement functions with a host of predefined standards; time domain power measurement; carrier-to-noise ratio C/N or C/N0 referenced to 1 Hz or channel bandwidth; CCDF: measurement of crest factor and amplitude probability function.

All of today's full-feature portable and benchtop instruments include full programmability, typically with a stand-alone Windows-based operating system and LAN-based or Internet protocol communications to other computers or instruments. Digital IF filters and digital analysis features are either standard or optional, depending on the particular model. DANL performance may range from -115 dBm to -150 dBm depending on the intended application, frequency range and price.

These portable units are often used as the primary laboratory spectrum analyzer at many RF/microwave companies.

Benchtop Instruments

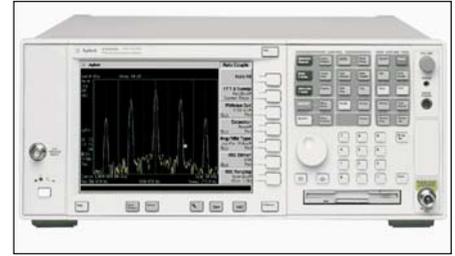
In the engineering laboratory, it is important to have test instruments that noise, dynamic range and bandwidth performance that allows full and precise characterization of any design, no matter how complex or high performance. Benchtop instruments fill that need.

In this segment of technology is the Agilent PSA series (right), a family of six models covering from 3 Hz up to 6.7, 13.2, 26.5, 42.98, 44 or 50 GHz. External mixers allow three models to operate up to 325 GHz. With -153 dBm DANL and $+19$ dBm third order intercept (TOI), these analyzers cover a wide dynamic range.

At this high performance level, highly accurate frequency and amplitude characteristics are required. The PSA series provides ± 0.17 dB typical amplitude accuracy and ± 0.05 dB RBW switching uncertainty.

Attention is also paid to ease of use (a relative term given the flexibility of today's instruments). One-button menu selection of the most common commands is included for general operation, while at the complex level, specific "personalities" are included for various standards. These are supported by options such as digital demodulation and wide bandwidth digitizers to capture and analyze signals.

Beyond basic spectrum analysis, instruments are also available for



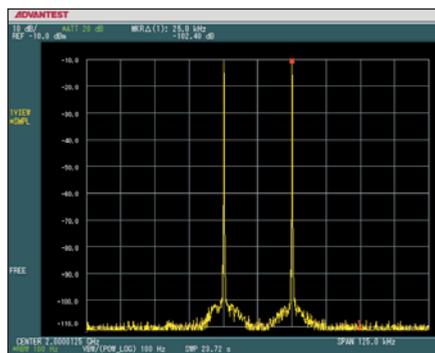
Benchtop instruments like the Agilent Technologies PSA series offer laboratory performance plus a wide range of options and analysis capabilities.

complete signal analysis, such as the Advantest R3671/3681 models, covering up to 13 GHz and 32 GHz respectively. These instruments are high-end spectrum analyzers combined with an optional built-in digital modulation signal generator. The basic performance of the spectrum analyzer is -158 dBm DANL, $+26$ dBm TOI and low local oscillator phase noise (see the screen photo below). These units are supported with various analysis options for WLAN, W-CDMA, cdma2000, Bluetooth and others.

Custom Measurement Setups

The availability of optional software and hardware features is an important recent trend in spectrum analyzers. These save user time and assure consistent measurement setups for standards-based systems. Signal generator and arbitrary waveform generators allow a single unit to provide the input to the device or system under test.

With very high "raw" performance and highly flexible operation, today's spectrum analyzers make it possible to perform complex tests with speed and accuracy that has not been available until now. Standard setups are valuable, but all the functions are still available to the user, who can make his or her own custom personalities for specific applications. The capabilities that can now be accessed for those measurements are higher than ever.



New instruments have low noise, as indicated by this phase noise display of the Advantest R3671