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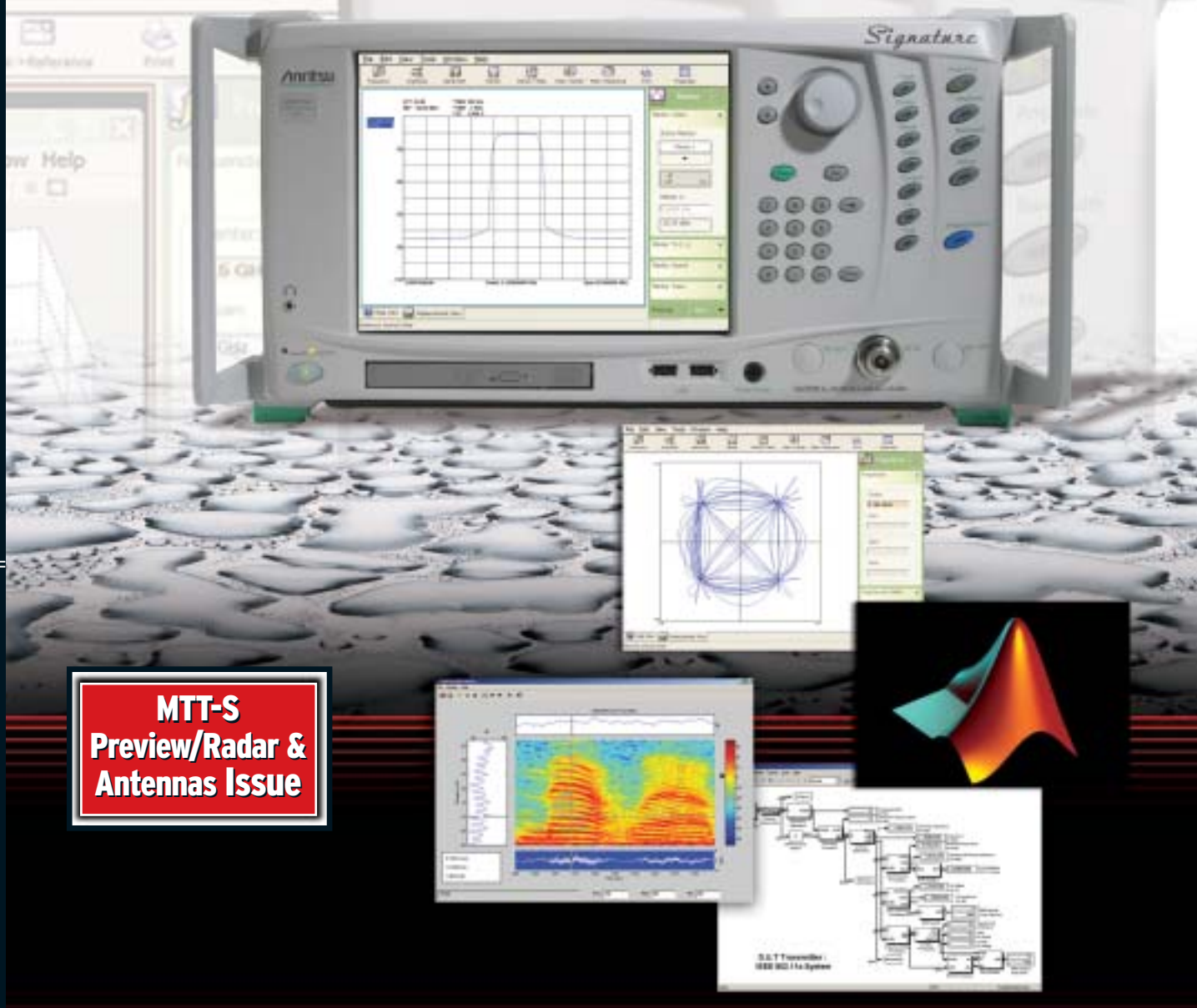

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cover story

Smart Signal Analyzer Decodes 100 Hz To 8 GHz

An innovative front-end architecture based on a 9.5-to-17.5-GHz LO arms the Signature analyzer to capture modulation bandwidths to 30 MHz with stunning frequency and amplitude accuracy.

Signal analysis in this "wireless age" requires a fair amount of processing power. In the new model MS2781A Signature™ High Performance Signal Analyzer from Anritsu Co. (Morgan Hill, CA), it is safe to say that the power is linked to both hardware and software. Not only does the instrument's advanced front-end architecture allow it to demodulate a 30-MHz signal across a total frequency of 100 Hz to 8 GHz, but also its built-in Windows XP Professional operating system and touch-screen display make it simple to program and provide the flexibility to link seamlessly with industry-standard analysis and simulation software tools.

JACK BROWNE
Publisher/Editor

In spite of the fact that this is a complex instrument with frequency-domain and time-domain measurement capabilities, Signature's clean front-panel display **(Fig. 1)** offers an immediate indication of its ease of use. The large (10.5-in.) touch-screen display frames the measurement window with the familiar Windows XP Professional operating system toolbars (with drop-down menu items). Large function keys on the right-hand side provide access to frequency, amplitude, bandwidth, and marker functions; these keys are backlit when activated to alert an operator. Additional function keys offer instant access to trace adjustments, display options, sweep controls, triggers, system commands, file management, and help files. Of course, all of these controls and adjustments can also be accessed by means of the Windows XP Professional drop-down menus.

All of this control would be meaningless without a powerful hardware engine, and Signature brings a platform that combines aspects of a microwave spectrum analyzer and a vector signal analyzer. The hardware is based on fundamental mixing of input signals using four stages of down-conversion **(Fig. 2)** . The first stage features a synthesized local-oscillator (LO) tuning from 9.5 to 17.5 GHz and yielding a fixed intermediate frequency (IF) of 9.5 GHz. This IF is then mixed with an 8.4-GHz second LO to produce a second IF of 1.1 GHz. This second IF is in turn mixed with a 1-GHz third LO to yield a third IF of 75 MHz, which is then mixed with

1. The Anritsu Signature™ High-Performance Signal Analyzer can capture and demodulate signals as wide as 30 MHz over a total range of 100 Hz to 8 GHz.

a fourth LO of 85.7 MHz to yield the 10.7-MHz IF signals familiar to most receiver designers.

The four-stage, fundamental mixing approach provides resolution bandwidths from 0.1 Hz to 8 MHz while also preserving a wide dynamic range. The displayed dynamic range of the MS2781A is typically better than 120 dB, thanks to a system noise figure of better than 29 dB at 1 GHz and displayed average noise level (DANL) of better than -147 dBm from 10 MHz to 2.5 GHz (in a 1.0-Hz resolution bandwidth) and better than -145 dBm from 2.5 to 7 GHz (in a 1.0-Hz resolution bandwidth). The analyzer boasts a third-order intercept point of better than +19 dBm below 100 MHz and better than +23 dBm at 100 MHz and above. The analyzer has a 1-dB compression point of +10 dBm and accepts input signals to +30 dBm with the aid of its front-end attenuator. The single-sideband (SSB) phase noise achieved by the four-LO receiver chain is better than -115 dBc/Hz offset 100 kHz from a 1-GHz carrier and better than -140 dBc/Hz offset 5 MHz from the same carrier. The analyzer features error-vector-magnitude (EVM) performance of better than 2 percent and wideband CDMA (WCDMA) adjacent-channel-power-ratio (ACPR) measurement capability of better than 82 dB, making it well suited as a signal-quality tester for the most-demanding wireless-communications standards.

As an option (Option 22), Signature can be equipped with a 30-MHz IF bandwidth. The option, which permits demodulation of signals as wide as 50 MHz, provides the analyzer with differential in-phase (I) and quadrature (Q) baseband inputs. Another option (Option 38) supports vector signal analysis of quadrature-amplitude-modulation (QAM) and phase-shift-keying (PSK) signals, allowing an operator to select bit rate, symbol rate, modulation type, and filter methods to demodulate captured signals. The option enables a group of automatic, "one-button" measurements, including EVM, carrier leakage, and I/Q imbalance measurements.

Signature's advanced hardware architecture allows operators to set frequency spans from 10 Hz to 8 GHz (full range) while achieving center-frequency resolution of 1 Hz. The analyzer also has a Fast Fourier Transform (FFT) mode with FFT (digital) resolution bandwidths of 0.1 Hz to 100 kHz. Video bandwidths can be selected from 1 Hz to 10 MHz, all with 10-percent accuracy. Signature has overall amplitude accuracy of ±0.82 dB over its full measurement range (amplitude and frequency), with the capability of setting amplitude reference levels from -150 to +30 dBm. Without use of preselection or image-reject filtering, the front-end architecture results in spurious levels that are better than -70 dBc at all offsets and image rejection that is typically better than -100 dB.

Signature provides both frequency-domain and time-domain sweep capabilities. Frequency-domain sweeps can

Working Signature With MATLAB And Simulink

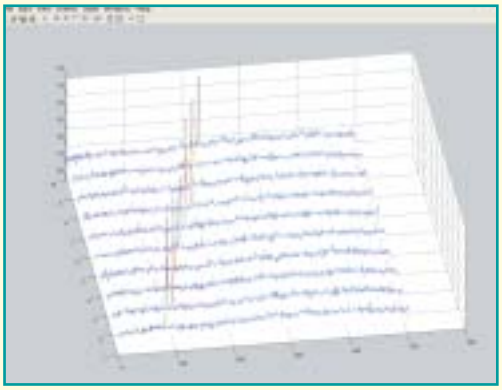
JACK BROWNE
Publisher/Editor

Signal analysis with the Signature analyzer takes on new meaning when linked to MATLAB® and Simulink® software tools from The MathWorks (Natick, MA). The combination forms a test/software design environment with seamless flow between measurements and simulation. Using the intuitive language and powerful graphical capabilities in MATLAB, engineers can create and plot complex measurements, such as waterfall displays, power spectral density plots, signal rise/fall time, frequency as a function of time, and even plots of modulation quality. Simulink enhances the capabilities of MATLAB by providing a block-diagram environment to simplify modeling, simulations, and analysis.

For example, this sample string of MATLAB code

```
for i=1:10
   Tracedata(i,:)=Trace1;
   pause(0.1);
end
waterfall (Tracedata);
```

works with the Signature analyzer to import 10 signal traces from the instrument, one every 100 ms, and create a waterfall display **(see figure)**. A simple loop or a timer object can make this display update every time the instrument makes a new measurement. Signature automatically creates the variable Trace1 in MATLAB, and updates it whenever a new measurement is made.



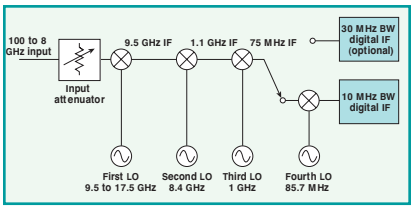
This waterfall plot was generated by MATLAB using 10 traces from the Anritsu Signature analyzer.

While Signature provide an environment for direct analysis of data using MATLAB and Simulink, the MathWorks Instrument Control Toolbox allows users to communicate with and control additional hardware in a test setup, such as a signal generator or a power meter. Support is provided for GPIB, VISA, TCP/IP, and UDP communication protocols. Using MATLAB with the Instrument Control Toolbox and the Anritsu Signature analyzer, users can easily create a test system for performing tasks such as monitoring power changes with temperature or measuring amplifier distortion as a function of signal level.

be set from 16 ms to 10,000 s for sweeps as narrow as 10 Hz or as wide as 8 GHz. Time-domain sweeps can be set from 1 µs to 10,000 s. The analyzer can show as many as four graphs on the screen at the same time, using horizontal and vertical limit lines as well as normal and delta marker functions to highlight frequency and amplitude values.

Because Signature is essentially a Windows XP Professional personal computer (PC) as well as an advanced signal analyzer, it can perform measurements and generate documentation quickly and easily. Captured signal information can be saved and imported into Windows XP programs, such as Microsoft Word, Excel, and PowerPoint. Visual Basic scripts can also be written into the analyzer. This built-in file portability and Windows XP environment also allows Signature to seamlessly work with industry-leading analysis tools, such as the MATLAB and Simulink programs (which can run from within the analyzer) from The MathWorks (Natick, MA), for comprehensive analysis of captured signals or signal model generation (see sidebar).

Signature's built-in PC/analyzer combination results in an intelligent instrument that can be programmed for single-button control of complex measurement functions (many of which are preset at the factory), including measurements of channel power, burst power, and adjacent-channel power (ACP). The unit provides many ways to transport software and data, with a built-in DVD-ROM/CD-R/W drive, two (front-panel-mounted) USB ports, and GPIB and Ethernet interfaces. A generous (20-GB) hard-disk drive provides ample storage for captured waveform files, the operating system, and a host of applications. The front panel also includes a connector to power a measurement probe, a headphone jack, while the rear panel includes connectors for access to the first and second IFs, the 10-MHz reference, an input connector for an external frequency reference, a VGA monitor output, a third USB port, a parallel printer port, a power connector for a +24-VDC noise source, and PS2 connections for a computer mouse and keyboard. **For more information call 1-800-ANRITSU, or visit www.us.anritsu.com/Signature**



2. This block diagram shows the fundamental-frequency, multiple-down-conversion architecture used in the Signature analyzer to control spurious and image signals while maintaining an extremely wide dynamic range.

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11410-00338 Rev. A

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