Keysight Technologies
Simplifying the Characterization of Wideband Pulsed Signals

Application Brief

In the design of radar and electronic-warfare (EW) systems, increasingly complex pulse compression techniques are being deployed to maximize resolution and range, or to reduce the likelihood of detection. Measuring these wideband pulsed signals and characterizing various pulse signatures is often challenging. To help developers appropriately identify and measure performance, a test solution with high resolution, excellent dynamic range and wide analysis bandwidth is required.

To push the envelope in these areas, engineers have been forced to take on much of the test burden themselves, compromising on ease-of-use, maintenance and supportability, and calibration. While some recent approaches have used a spectrum analyzer as a downconverter and an oscilloscope as a wideband digitizer, this method lacks the usability and dynamic range of a signal analyzer that includes a fully integrated wideband digitizer. With the N9040B UXA X-Series signal analyzer, Keysight has broken the gigahertz barrier, offering the industry's first signal analyzer with integrated 1 GHz analysis bandwidth.

KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

Gaining simplicity through integration

The UXA offers a big step forward in usability by providing factory calibration and operational alignments across the full 1 GHz bandwidth. Integration into the signal analyzer delivers several other benefits: 1 GHz coverage across the full frequency range (3 Hz to 50 GHz); seamless switching between swept, vector and real-time measurements; and easy operation through the streamlined multi-touch user interface (UI). This combination of capabilities enables informative measurements of pulsed signals in less time (Figure 1).

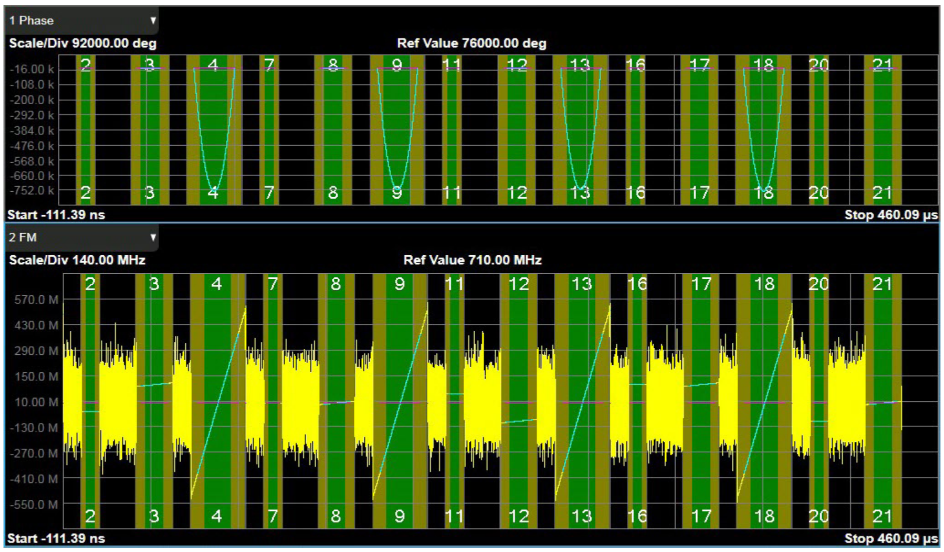


Figure 1: The wide integrated bandwidth simplifies measurements of linear FM-modulated pulses.

In contrast, the two-instrument approach (i.e., downconverter and digitizer) requires the user to run separate calibration with an external source or reconfigure connections to get a flat, usable band, or uses a generic correction that provides less accuracy. Additionally, the wideband capability cannot be accessed in low-band with the two-instrument approach, limiting the minimum frequency to at least several gigahertz.

Frequently Used Settings Available on Touchscreen

The Keysight Technologies, Inc. X-Series signal analyzers with multi-touch provide a touchscreen UI that includes features such as drop down menus and customizable user menus. Rather than navigating through hardkeys, softkeys and long menus, most of the capabilities can be accessed with the tap of a finger. In addition, many frequently used display settings can be modified in the menu bar, measurement bar and annotation hotspot areas. It's as easy as tapping the settings tables and diagrams, or you can interact with the selected trace by stretching, pinching, dragging or tapping.

Using the broader applicability of wide bandwidth

While it is clear that another measurement receiver is needed when a signal occupies more bandwidth than the analyzer, it may be less obvious that a wideband analyzer offers benefits in measuring narrower pulsed signals. For example, when measuring pulse rise-times or viewing parameters such as overshoot or droop, the wider analyzer bandwidth offers a faster sample rate, providing more resolution for the measurement. As shown in Figure 2, this can be an important aid to understanding the signature of the waveforms.

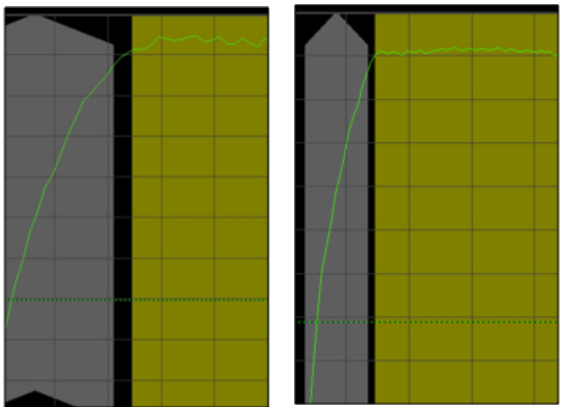


Figure 2: The image on the left uses half the sample rate of that on the right. The larger sample rate (or wider bandwidth) shows a clearer envelope of the signal and hence a better representation of the signature of the pulse.

Marker resolution is also improved with wider bandwidth. Other techniques such as zero-padding can also be used: this will help you see the signal; however, it will still mask the true signature of any fast-moving transient activity such as overshoot.

Finally, it's important to see multiple emitters in any radar or EW signal environment. These emitters likely will also have some intra-pulse modulation and can occur over a wide bandwidth. The UXA can capture multiple emitters across 1 GHz of bandwidth and calculate statistics over a long time period. The N9067C embedded pulse application automatically detects and analyzes pulses, providing comprehensive results that enable full characterization of captured pulses (Figures 3 and 4).

Droop	Overshoot	Ripple	Time	Freq	Phase	Best-Fit FM
☐ Droop (%)	☐ Overshoot (%)	☐ Ripple (%)	✓ Rise Time (sec)	✓ Freq Mean (Hz)	✓ Phase Mean (deg)	☐ Best-Fit FM Mean (Hz)
✓ Droop (dB)	✓ Overshoot (dB)	✓ Ripple (dB)	✓ Rise Edge (sec)	☐ Freq Pulse-Pulse Diff (Hz)	☐ Phase Pulse-Pulse Diff (deg)	☐ Best-Fit FM Start (Hz)
☐ Droop Rate (dB/µs)			✓ Fall Time (sec)	☐ Freq Pk-Pk Dev (Hz)	☐ Phase Pk-Pk Dev (deg)	☐ Best-Fit FM Stop (Hz)
☐ Droop Start (dBm)			✓ Fall Edge (sec)	✓ Freq Error RMS (Hz)	✓ Phase Error RMS (deg)	☐ Best-Fit FM Pk-Pk Dev (Hz)
☐ Droop Stop (dBm)			✓ Width (sec)	☐ Freq Error Peak (Hz)	☐ Phase Error Peak (deg)	✓ Best-Fit FM Slope (Hz/µs)
			☐ Off Time (sec)	☐ Freq Error Peak Loc (sec)	☐ Phase Error Peak Loc (sec)	✓ Best-Fit FM INL (%)
			✓ PRI (sec)			
			☐ PRF (Hz)			
			✓ Duty Cycle (%)			

Figure 3: The table of available results lets you select from an extensive set of pulse parameters to be displayed.

Figure 4: The N9067C embedded pulse application can display numerous pulse statistics, simplifying characterization of dense pulse environments.

Applying the flexibility of a complete solution

In many cases, making a proper high-quality pulse measurement is the second or third step in analyzing a signal or system. Initially, it is vital to check the overall RF environment to understand what's going right and then identify which unexpected issues might be present. To accomplish this, many RF engineers traditionally turn to the swept mode of a spectrum analyzer—but they can also use the more modern approach of real-time spectrum analysis (RTSA).

In addition to 1 GHz instantaneous bandwidth, the UXA offers superior dynamic range in its swept and real-time modes. Combining these functions into a single instrument enables engineers to scan gigahertz of spectrum with swept analysis, see dynamic multi-emitter signal activity in real-time, and make detailed wideband pulse measurements—all in less than two touches, saving time whether measuring or troubleshooting (Figure 5).

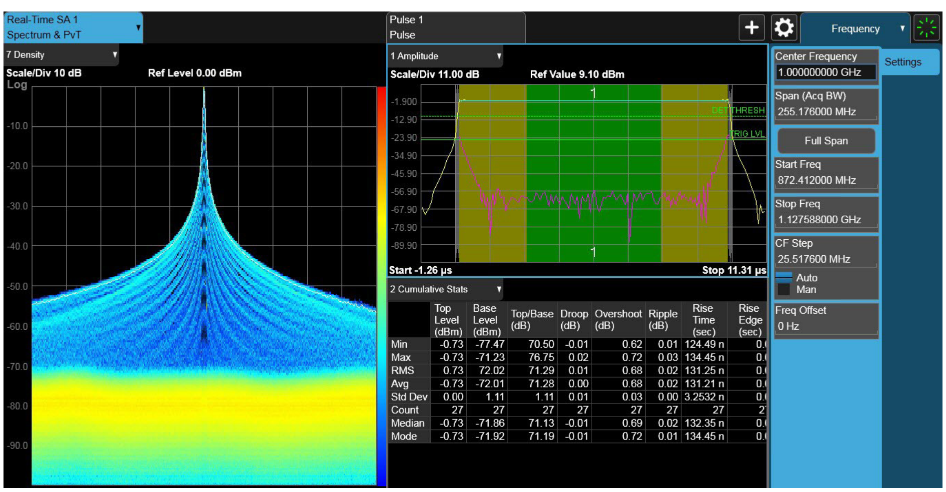


Figure 5: The large multi-touch display provides side-by-side views of real-time measurements and tabular pulse metrics, which can be easily exported for post analysis.

In the UXA, an enhanced 255 MHz bandwidth path co-exists with the 1 GHz wideband path, offering approximately 80 dBc of dynamic range and gap-free RSTA capability. In addition to ensuring that no signal is missed, real-time also provides frequency-mask and time-qualified triggers (Figure 6). Users can prune and select specific signals in a dense environment using time, frequency and amplitude triggering, or any combination of the three.

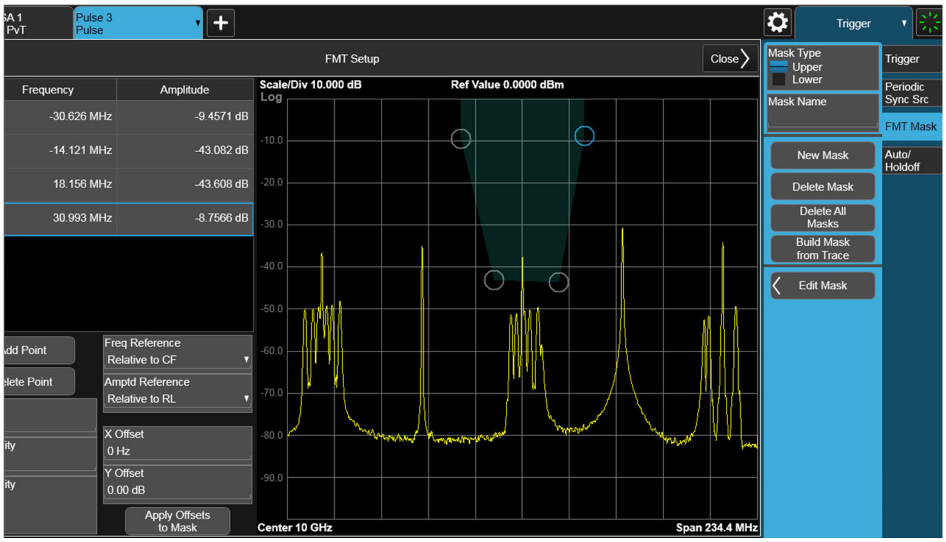


Figure 6: Frequency-mask trigger enables frequency-selective analysis with RTSA up to 255 MHz of bandwidth.

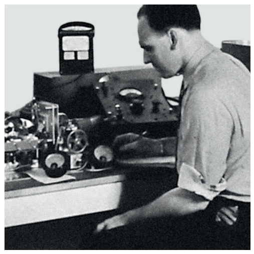
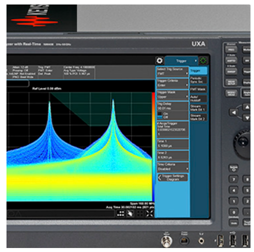
Conclusion

The X-Series signal analyzers are the benchmark for accessible performance that puts you closer to the answer by easily linking cause and effect. Across the full spectrum — from CXA to UXA — you'll find the tools you need to design, test and deliver your next breakthrough.

With 1 GHz analysis bandwidth, the flagship UXA delivers wide-open performance and deeper views of elusive and wideband signals. In-depth analysis is made easy with the pulse application software and the 14.1-inch screen with multi-touch UI. With its familiar spectrum-analyzer user experience and capabilities never before offered in an integrated instrument, the UXA enables you to see more and take your designs farther.

From Hewlett-Packard through Agilent to Keysight

For more than 75 years, we‘ve been helping you unlock measurement insights. Our unique combination of hardware, software and people can help you reach your next breakthrough. Unlocking measurement insights since 1939.

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