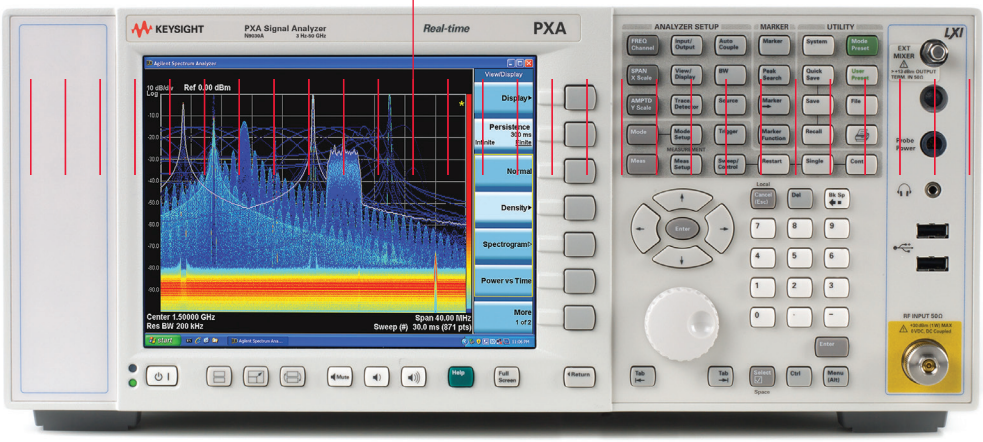
Keysight Technologies

Real-Time Spectrum Analyzer (RTSA)
X-Series Signal Analyzers
N9030A/N9020A-RT1 & -RT2

Technical Overview



KEYSIGHT TECHNOLOGIES

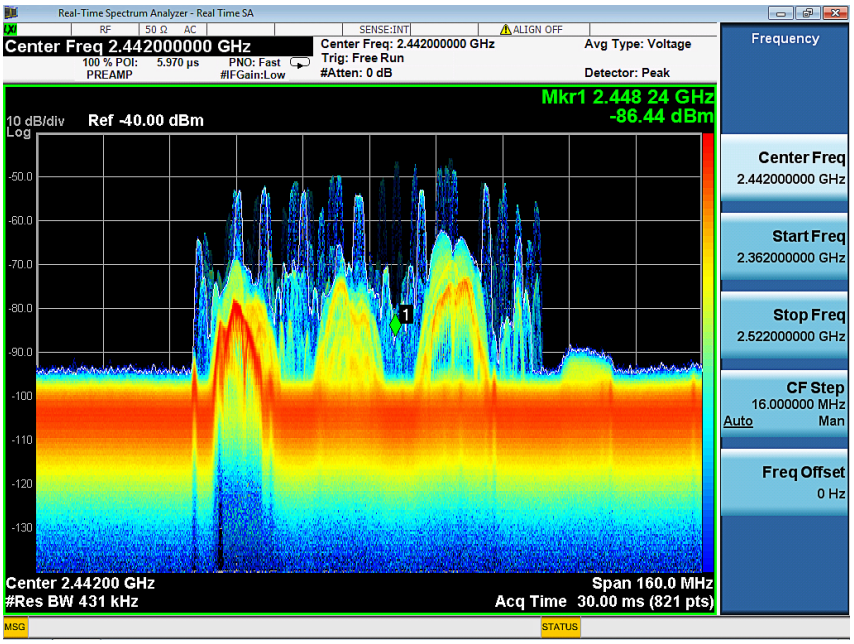
Features

- Detect signals as short as 5 ns with 100% POI
- Scan with 160-MHz real-time bandwidth up to 50-GHz
- See small signals in the presence of large ones with up to 75 dB spurious-free dynamic range
- Eliminate the need for a dedicated instrument: RTSA is an upgrade option for new and existing PXAs/MXAs
- Go deeper and thoroughly analyze complex signals with 89600 VSA software
- Real-time spectrum recorder and analyzer application (Option RTR)

Experience Real-Time Spectrum Analysis – the Keysight Way

The PXA and MXA are the first mainstream signal analyzers to be upgradable to real-time capabilities. You can readily convert an existing analyzer in-place without re-calibration. With PXA or MXA as the foundation, you get new levels of performance, flexibility and usability in real-time spectrum analysis.

With our real-time spectrum analyzer (RTSA) option, the PXA and MXA deliver excellent sensitivity, analysis bandwidth, frequency range and, most important, probability of intercept (POI). In addition, a real-time PXA or MXA provides continuous acquisition of RF signals, including low-level signals occurring close to larger ones. Its conditional triggering capabilities can watch for transient or intermittent events and initiate signal capture, measurement and display. The ultimate result: you can see more, capture more and understand more.



Summary of Key Specifications

	PXA	MXA
Frequency ranges	Minimum: 3 Hz Maximum: 3.6, 8.4, 13.6, 26.5, 43, 44 and 50 GHz	Minimum: 10 Hz Maximum: 3.6, 8.4, 13.6, 26.5 GHz
Maximum real-time analysis bandwidth (determined by analysis BW option)	85 or 160 MHz	85, 125, or 160 MHz
Minimum detectable signals with Option RT2 (in all display types)	5 ns (Opt B1X), 11.42 ns (Opt B85)	5 ns (Opt B1X), 8 ns (Opt B1A), 11.42 ns (Opt B85)
Displayed average noise level	–157 dBm/Hz at 10 GHz, preamp off	–153 dBm/Hz at 5.8 GHz, preamp off
Spurious-free dynamic range across 160-MHz BW	Up to 75 dB	Up to 72 dB

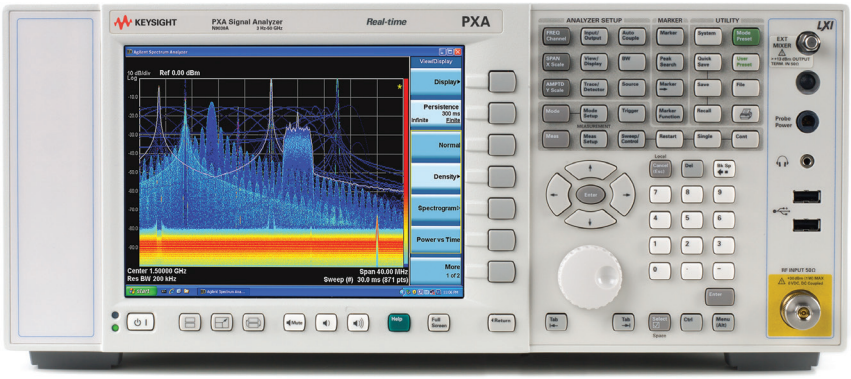
See side-by-side comparison and other videos on YouTube at http://qrs.ly/3o2ykl1

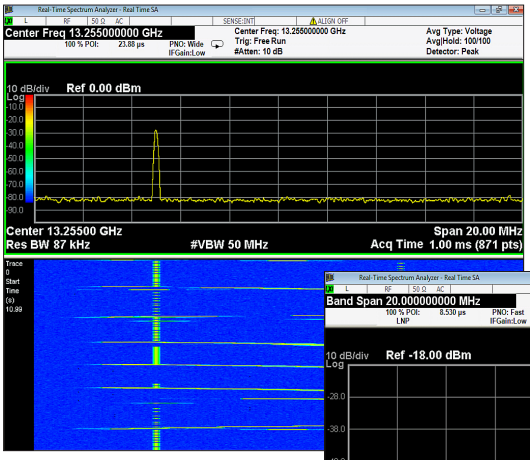
Know You've Got It

Even at the extremes of signal analysis, your analyzer should be ready for anything. That's why we're offering real-time spectrum analysis (RTSA) as an upgrade option for new and existing PXA and MXA signal analyzers.

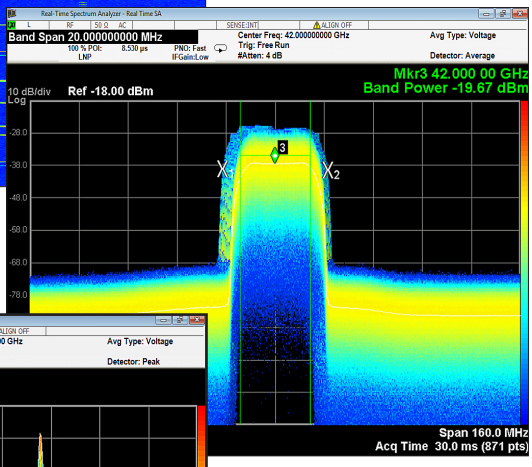
Adding RTSA lets you see, capture and understand the most elusive signals—known or unknown. To go deeper, you can combine a real-time PXA or MXA with the 89600 VSA software to create a solution that lets you thoroughly characterize complex signals.

Inside signal-rich systems and environments, go real-time with Keysight Technologies, Inc. and know you've got it.

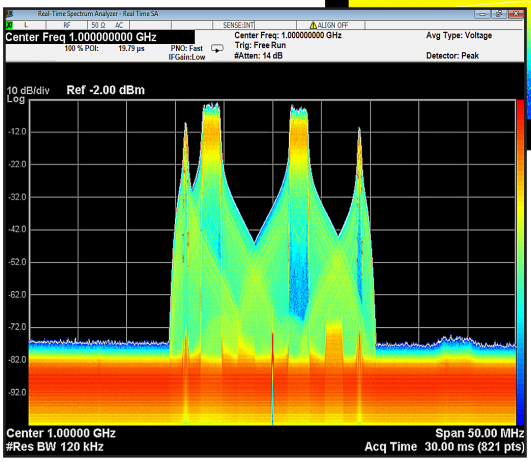




Frequency hopping



Ka-Band satellite signal with amplitude and frequency variations



Frequency-hopping LTE-Advanced uplink signal

Defining real-time analysis

In a spectrum or signal analyzer with a digital intermediate frequency (IF) section, real-time operation is a state in which all signal samples are processed for some sort of measurement result or triggering operation. In most cases the measurement results are scalar—power or magnitude—corresponding to traditional spectrum measurements.

In addition to gap-free analysis, a real-time RF analyzer may be defined as having four more key attributes: high-speed measurements, consistent measurement speed, frequency-mask triggering and advanced composite displays.

In general, the stream of spectra from real-time processing can be used in one of two ways: The spectra can be combined into a composite spectrum display or successively compared to a limit mask to implement frequency-mask triggering. Both of these capabilities are present in the RTSA option.

See, Capture and Understand the Most Elusive Signals

The real-time PXA and MXA include four key innovations: wider bandwidth, better dynamic range, higher POI and integrated analysis capabilities. Individually and collectively, these capabilities bring you a host of important benefits.

See more with wider bandwidth and better dynamic range

The PXA and MXA have the required combination of IF bandwidth, signal sampling and signal processing to handle 160 MHz continuously. This gap-free bandwidth applies not only to real-time spectrum analysis but also to frequency-mask trigger (FMT), gap-free time capture and real-time magnitude calculations for IF magnitude triggering.

To help you detect small signals in the presence of large ones, the PXA and MXA provide 75 or 72 dB of SFDR, respectively, across the full 160-MHz analysis bandwidth. Dynamic range is enhanced by the low noise floor and excellent distortion performance of the analyzers. When dealing with very small signals above 3.6 GHz, the PXA can be further enhanced by adding the low noise path (LNP) option, which improves sensitivity while still handling high-level signals.

Capture more with higher POI

The X-Series analyzers' advanced processing architecture combines with its 160-MHz analysis bandwidth and wide dynamic range to provide 100 percent POI for signals with durations as short as 3.57 µs with full amplitude accuracy. Gap-free analysis is just one element of POI. Within the instrument, other contributing factors are processor and analyzer dynamic range (including sensitivity), sampling bandwidth, processing continuity and FFT processing overlap (which compensates for windowing functions).

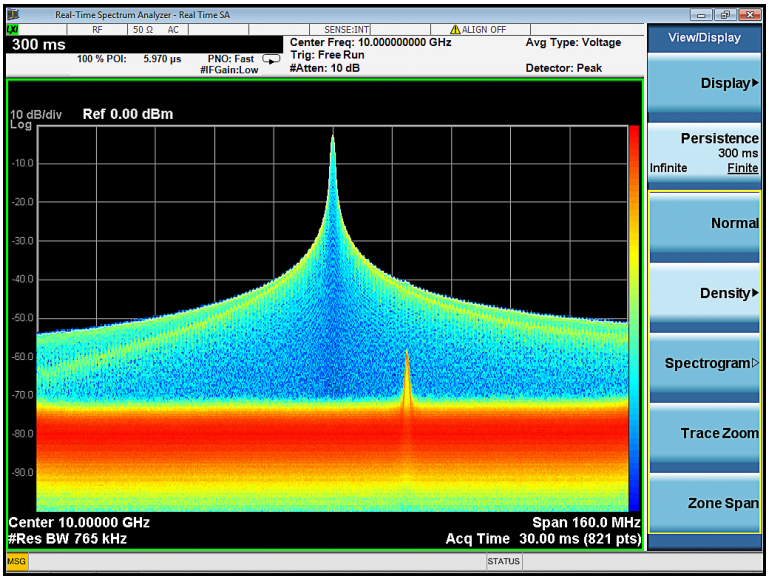


Figure 1. See small signals in the presence of large ones

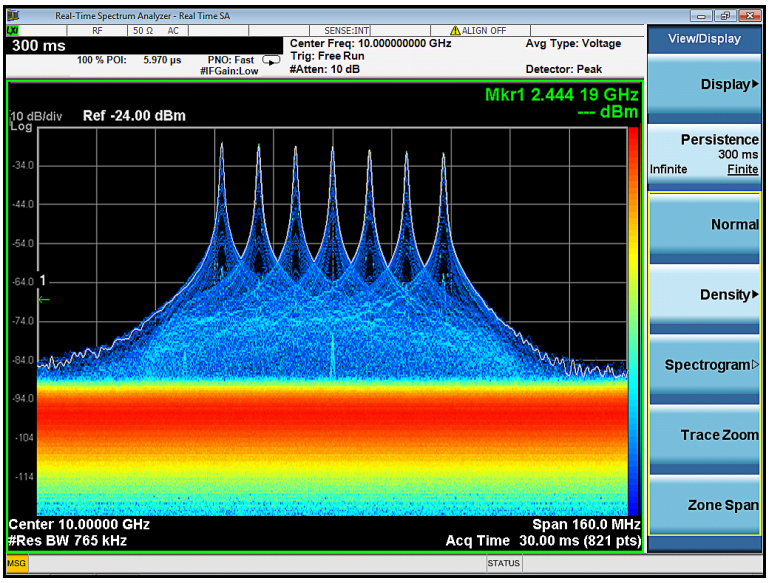


Figure 2. View a fast-hopping radar signal

Understand more with integrated analysis capabilities

In some cases, simply finding an elusive signal is enough. In other situations, finding the signal is just the first step toward a thorough understanding of what's happening. This is when the combination of a real-time PXA or MXA, real-time FMT and the 89600 VSA software is especially useful.

The real-time trigger can start any VSA measurement—one or many—in any measurement mode, including demodulation. The trigger can be initiated when a specific spectrum mask is entered or exited, or with more complex sequences such as exit followed by re-entering. Pre- and post-trigger delays are also available, letting you make measurements of signals prior to the trigger event.

These capabilities make the real-time PXA or MXA plus VSA a great combination for measuring modulated transients, frequency-hopping signals, frequency settling, and undesired transients in signal sources such as VCOs or YIG oscillators.

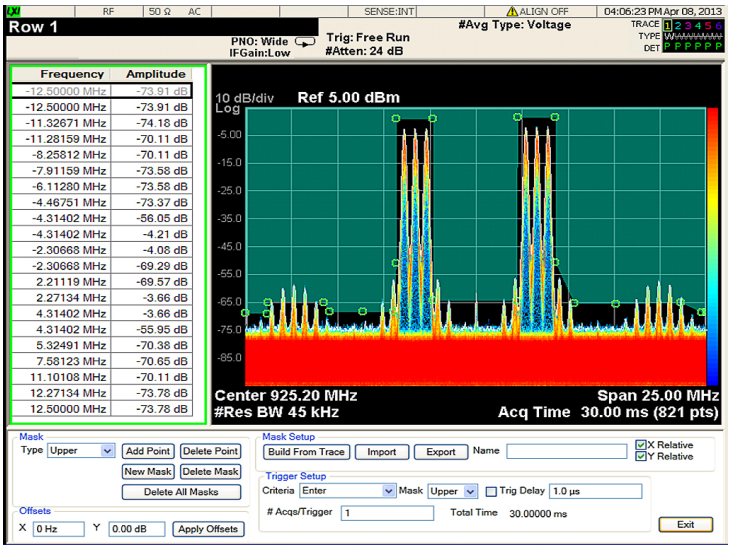


Figure 3. GSM base station signal with an FMT configured to identify and measure unintended emissions, such as intermod products

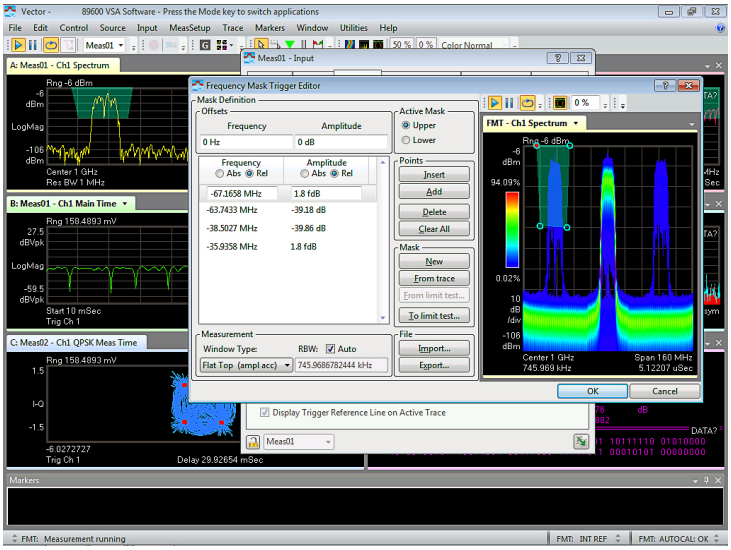


Figure 4. Real-time FMT trigger in the VSA software to demodulate a frequency hopping signal

Go deeper with the 89600 VSA

The 89600 VSA software is a comprehensive set of tools for demodulation and vector signal analysis. These tools enable you to explore virtually every facet of a signal and optimize your most advanced designs.

You can use the 89600 VSA to measure more than 75 modulation types, from custom OFDM or APSK to standard-based signals such as MIL-STD, GSM and LTE. With frequency-mask triggering, you can capture intermittent signals for detailed characterization, and then use them as stimulus signals by playing them back with an Keysight signal generator or in simulation software such as Keysight SystemVue.

Characterize Highly Elusive Radar and EW Signals

From simple to complex, all radar, EW and ELINT systems pose a variety of challenges whether you're testing components, subsystems or systems. When deployed, these systems operate in cluttered spectral environments filled with intentional and unintentional interferers. In the lab or in the field, a real-time PXA or MXA lets you see more, capture more and understand more.

Maximize the performance of radar and EW systems during development

Adding RTSA to the PXA creates a cost-effective solution that combines real-time analysis with traditional spectrum measurements such as noise figure, phase noise and power. For example, you can use a real-time PXA to identify spurious signals using traditional swept analysis then switch modes to see pulsed spurs using real-time analysis and displays.

The PXA will detect all signals with durations greater than 3.57 µs—the best POI currently available—with full amplitude accuracy. For signals with a large signal-to-noise ratio (> 60 dB), the PXA will detect signals with durations as short as 5 ns.

With the optional pulse measurement application (N9051A), you can quickly characterize pulse width, pulse repetition interval (PRI), and more. When creating or analyzing jamming techniques, you can use FMT with the 89600 VSA software and its record/playback capabilities.

Capture, catalog and understand highly elusive signals in the field

Being able to identify intentional and unintentional interferers requires a variety of powerful signal-analysis tools. To help you view faint return signals in transient or dynamic antenna scans, the real-time PXA enhances POI with a noise floor of –157 dBm (10 GHz, no preamp).

Capabilities such as simultaneous display of real-time spectrogram and power-versus-time enable you to capture radar and communication jamming and interference. By combining FMT with the 89600 VSA software, you can easily identify, capture and play back portions of EW techniques.

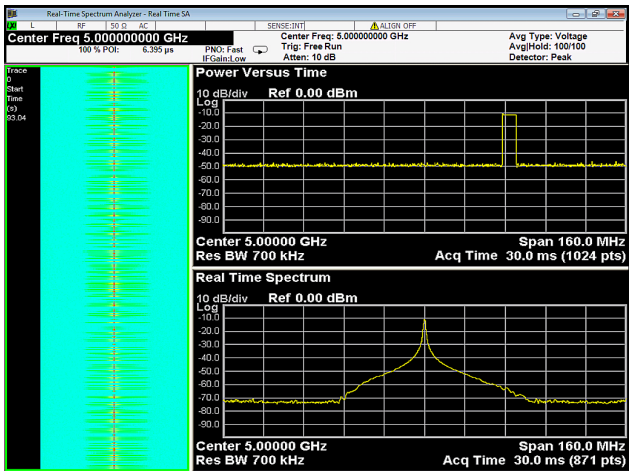


Figure 5. Pulse analysis using power vs. time, RT spectrum and spectrogram

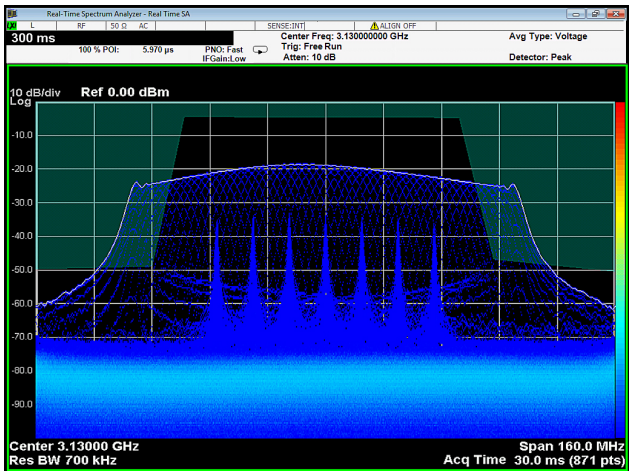


Figure 6. Radar mode switching

Accelerate Development of Communication Systems

Whether you're focused on transmitters, transceivers or whole radios, today's systems rely on signals that are agile, wide and complex. Adding RTSA to a PXA or MXA creates a cost-effective solution that combines traditional spectrum measurements with real-time capabilities, including the highest performance in transient real-time analysis.

Enhance performance in wireless communication and connectivity

With a real-time MXA, you can capture and analyze complete transmitter-channel characteristics at gap-free bandwidths of up to 160-MHz within a 26.5-GHz frequency range. In highly integrated multimode multiband devices (MMMDs), you can identify intermittent interoperability issues with the ability to capture signals as short as 7 ns, the best real-time analyzer performance available. You can also observe base station function using wideband persistence displays, which help pinpoint problems such as intermittent pre-distortion issues.

FMT capabilities enable you to characterize frequency switching, verify overall system operation and find system violations or interfering signals. For deeper analysis, add the 89600 VSA software: with support for dozens of standards-based signals and custom waveforms, chances are good it can demodulate the signals you're working with. To reveal greater detail, you can check PLL settling and identify LO issues by combining FMT, VSA software and real-time spectrogram displays.

Push performance higher in MILCOM and SATCOM systems

In today's crowded signal environment, multi-format, high-rate communication systems are more likely to experience interoperability issues. To verify system performance, you can use a real-time PXA to perform fast pre-scans up to 50 GHz with swept-tuned capabilities, then zoom in using real-time mode with up to 75 dB of dynamic range.

RTSA provides the performance you need to observe radio function using wideband persistence and pinpoint possible issues caused by errors in baseband algorithms. You can also review cognitive radio algorithms and dynamic spectrum management scenarios with wideband real-time persistence across 160-MHz spans.

In the field, easily measure small signals in the presence of powerful transmitters with industry-leading performance in noise floor and distortion. These capabilities let you sift through a dense environment and easily find previously undetected intermittent interferers or "signals within signals."

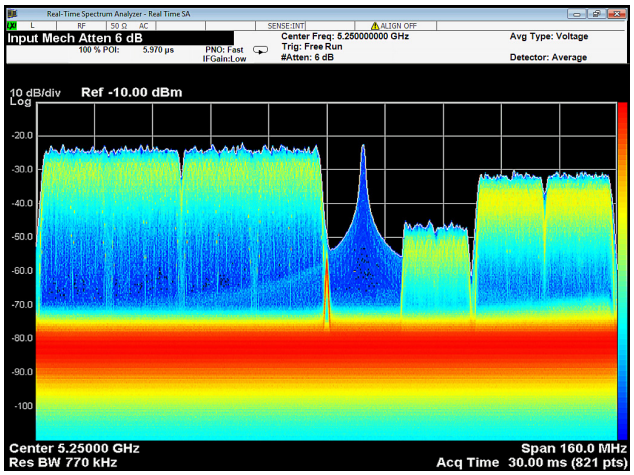


Figure 7. A transition analysis for various WLAN signals showing the frequency-switching performance when in the presence of a pulsed signal (DFS).

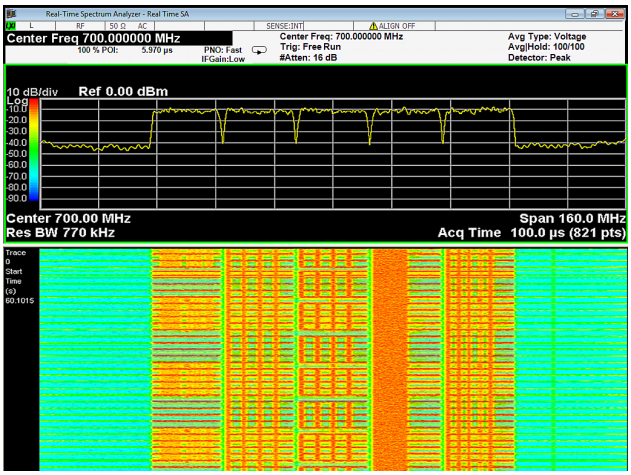


Figure 8. Spectral analysis of an LTE signal where, without demodulation, you can see the signal, control and synch structures are present.

Eliminate the need for a Dedicated Real-Time Analyzer

With the availability of RTSA as an upgrade option, you can eliminate the need for a specialized or dedicated instrument. A real-time PXA/MXA retains all the functionality of a traditional signal analyzer. Utilize integrated applications for power measurements and communications standards and, when needed, shift to real-time capabilities in the same unit.

Drive your evolution with the PXA signal analyzer

The future-ready PXA is the evolutionary replacement for your current high-performance signal analyzer. It helps you sustain your past achievements, enhance current designs and accelerate future innovation with industry-leading performance:

- Reduce measurement uncertainty with ± 0.19 dB absolute amplitude accuracy
- See more with excellent sensitivity: DANL is –157 dBm/Hz at 10 GHz (no preamp)
- Characterize high-precision signals with phase noise of –132 dBc/Hz at 1 GHz (10 kHz offset)

Figure 9. Noise figure measurement

Accelerate in wireless with the MXA signal analyzer

The MXA is the accelerator as you develop new wireless devices. It has the versatility to easily adapt to your evolving test requirements, today and tomorrow:

- Accurately measure your designs across 160 MHz bandwidth with 0.3% (-50 dB) EVM for 802.11ac WLAN
- Characterize signals with phase noise of –106 dBc/Hz at 1 GHz (10 kHz offset)
- Address multiple formats, generations and devices with a broad library of one-button standard-specific measurement applications for WLAN, LTE, MSR, and more.

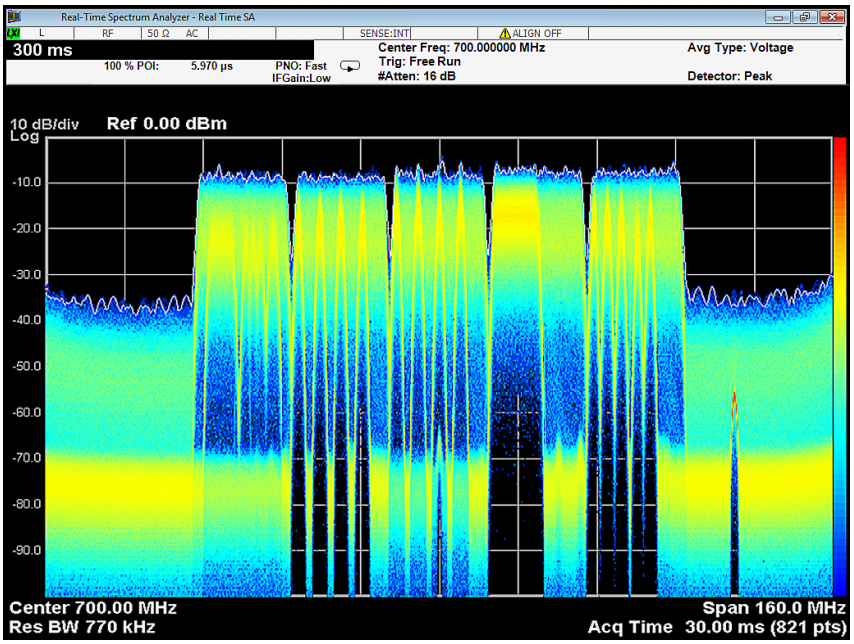


Figure 10. 5-carrier LTE-Advanced signal with in-band and out-of-band interference

Key Specifications

Values in this table describe the key performance of RTSA parameters. Refer to the PXA or MXA specifications guide for more details.

Note: Data subject to change

Description	Option RT2			Option RT1			Notes
Global characteristics for frequency domain views							
Maximum real-time analysis bandwidth	Up to 160 MHz			Up to 160 MHz			Determined by analysis BW option
Minimum signal duration with 100% probability of intercept (POI) at full amplitude accuracy	3.57 µs			17.3 µs			Maximum span (> 85 MHz); default window is Kaiser; viewable on screen
Supported detectors	Peak, Negative peak, Sample, Average						
Number of traces	6			6			Clear write, Max hold, Min hold, View
Resolution bandwidths (Kaiser window)	**Span**	**Min BW**	**Max BW**				Six RBWs available for each window type, except rectangular. Span:RBW ratio availability is nominally 6.7 to 212 for Flattop, 13 to 417 for Gaussian and Blackman-Harris, 13 to 418 for Kaiser and 17 to 551 for Hanning
	160 MHz	383 kHz	12.2 MHz*				
	100 MHz	239 kHz	7.63 MHz				
	50 MHz	120 kHz	3.82 MHz				
	10 MHz	23.9 kHz	763 kHz				
	1 MHz	2.39 kHz	76.3 kHz				
	100 kHz	239 Hz	7.63 kHz				
Window types	Hanning, Blackman-Harris, Rectangular, Flattop, Rectangular, Kaiser, Gaussian						
Maximum sample rate With Option B1X With Option B1A (for N9020A MXA only) With Option B85	 200 MSa 157 MSa 106 MSa			 200 MSa 157 MSa 106 MSa			 For N9020A MXA only
FFT rate	292,969/s			292,969/s			Value for maximum sample rate; nominal for all spans greater than 300 kHz
Number of markers	12			12			
Supported markers	Normal, Delta, Noise, Band power						
Amplitude resolution	0.01 dB			0.01 dB			
Frequency points	821			821			
Minimum acquisition time	104 µs			104 µs			Value for maximum sample rate.
Density view							
Probability range	0 to 100%			0 to 100%			Variable in 0.001% steps
Minimum span	100 Hz			100 Hz			
Persistence duration	30 ms to 10 s			30 ms to 10 s			
Color palettes	Cool, warm, grey scale, radar, fire, frost						
Spectrogram view							
Maximum amount of acquisitions stored	10,000			10,000			5,000 with power vs. time combination view
Dynamic range covered by colors	200 dB			200 dB			
Power vs. time							
Supported detectors	Peak, Negative Peak, Sample, Average						
Number of markers	12			12			
Maximum time viewable	40 s			40 s			
Minimum time viewable	250 µs			250 µs			
Minimum detectable signal With Option B1X With Option B1A (for N9020A MXA only) With Option B85	 5 ns 8 ns 11.42 ns						Signal must have > 60 dB Signal-to-Mask (StM) to maintain 100% probability of intercept (POI). Does not include analog front-end effects. Available with "Multi-view".

**: This maximum RBW is for Option RT2 only. Option RT1 has a maximum RBW of 10 MHz.*

Description	Option RT2	Option RT1	Notes
Frequency mask trigger (FMT)			
Trigger views	Density, Spectrogram, Normal		
Trigger resolution	0.5 dB	0.5 dB	
Trigger conditions	Enter, Leave, Inside, Outside, Enter->Leave, Leave->Enter		
Minimum detectable signal duration with > 60 dB Signal-to Mask (StM)			Does not include analog front-end effects.
With Option B1X	5 ns		
With Option B1A (for N9020A MXA only)	8 ns		
With Option B85	11.42 ns		
POI vs. StM			
Minimum duration for 100% trigger with various RBWs	For Option RT2 only		

	Duration (µs)						
Span (MHz)	RBW 1	RBW 2	RBW 3	RBW 4	RBW 5	RBW 6	
160	8.53	5.97	4.69	4.05	3.73	3.57	RBW 1~6 can be selected under [BW] manual
120	10.23	6.82	5.11	4.26	3.83	3.62	
80	13.65	8.53	5.97	4.69	4.05	3.73	
40	23.88	13.6	8.52	5.96	4.68	4.04	
20	44.40	23.9	13.6	8.52	5.96	4.68	

For Option RT1 only

	Duration (µs)						
Span (MHz)	RBW 1	RBW 2	RBW 3	RBW 4	RBW 5	RBW 6	
160	22.19	19.63	18.35	17.71	17.39	17.23	RBW 1~6 can be selected under [BW] manual
120	23.89	20.47	18.77	17.91	17.49	17.27	
80	27.33	22.21	19.65	18.37	17.73	17.41	
40	37.56	27.32	22.20	19.64	18.36	17.72	
20	58.12	37.64	27.40	22.28	19.72	18.44	

Minimum signal duration for 100% probability of FMT triggering with various StM offset — For Option RT2 only

	Duration (µs)						
Span (MHz)	0-dB offset	6-dB offset	12-dB offset	20-dB offset	40-dB offset	60-dB offset	
160	8.53	3.42	2.44	1.58	0.325	0.035	Indicates 100% POI with 1024-point Blackman-Harris Window (RBW 1)
120	10.23	3.42	2.12	1.04	0.120	0.013	
80	13.65	3.48	1.76	0.71	0.080	0.010	
40	23.88	4.66	2.22	0.88	0.100	0.020	
20	44.36	8.36	4.00	1.64	0.240	0.040	

For Option RT1 only

	Duration (µs)						
Span (MHz)	0-dB offset	6-dB offset	12-dB offset	20-dB offset	40-dB offset	60-dB offset	
160	22.19	17.08	16.10	15.23	13.87	13.03	Indicates 100% POI with 1024-point Blackman-Harris Window (RBW 1)
120	23.89	17.07	15.77	14.61	12.79	11.67	
80	13.65	3.48	1.76	0.71	0.08	0.01	
40	22.88	4.66	2.22	0.88	0.10	0.02	
20	44.36	8.36	4.00	1.64	0.24	0.04	

Ordering Information

The real-time spectrum analyzer is available as an option for the N9030A PXA signal analyzer and the N9020A MXA. For complete ordering and configuration information, please refer to the *PXA or MXA configuration guide found on the "Options and Accessories" tab on the product web page*.

PXA signal analyzer

Model-Option	Description	Notes
N9030A-RT1	Real-time analysis up to 160 MHz BW, basic detection	For frequency mask trigger: minimum 17.3 µs signal duration for 100% POI; requires Option B85 or B1X, the analysis BW option determines maximum real-time BW
N9030A-RT2	Real-time analysis up to 160 MHz BW, optimum detection	For frequency mask trigger: minimum 3.57 µs signal duration for 100% POI; requires Option B1X or B85, the analysis BW option determines maximum real-time BW
N9030A-RTR	Real-time spectrum recorder and analyzer application (Option RTR)	Enables recording, analyzing and playback of signal and spectrum density data for detecting and analyzing signal anomalies, and for viewing the evolution of signals and spectrum density over time.

MXA signal analyzer

Model-Option	Description	Notes
N9020A-RT1	Real-time analysis up to 160 MHz BW, basic detection	For frequency mask trigger: minimum 17.3 µs signal duration for 100% POI; requires Option B85, B1A or B1X, the analysis BW option determines maximum real-time BW
N9020A-RT2	Real-time analysis up to 160 MHz BW, optimum detection	For frequency mask trigger: minimum 3.57 µs signal duration for 100% POI; requires Option B1X, B1A, or B85, the analysis BW option determines maximum real-time BW
N9020A-RTR	Real-time spectrum recorder and analyzer application (Option RTR)	Enables recording, analyzing and playback of signal and spectrum density data for detecting and analyzing signal anomalies, and for viewing the evolution of signals and spectrum density over time.

You can upgrade!

Options can be added after your initial purchase.

UP GRADE

Most X-Series options are license-key upgradeable.

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www.lxistandard.org
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Additional Resources

Application notes and videos

Measuring Agile Signals and Dynamic Signal Environments:
www.keysight.com/find/AgileSignals_AN
YouTube playlist for real-time spectrum analyzer:
http://qrs.ly/3o2ykl1

Products

Real-time spectrum analyzer: www.keysight.com/find/RTSA
PXA signal analyzer: www.keysight.com/find/PXA
MXA signal analyzer: www.keysight.com/find/MXA
89600 VSA software: www.keysight.com/find/89600VSA

Applications

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Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100

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Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
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