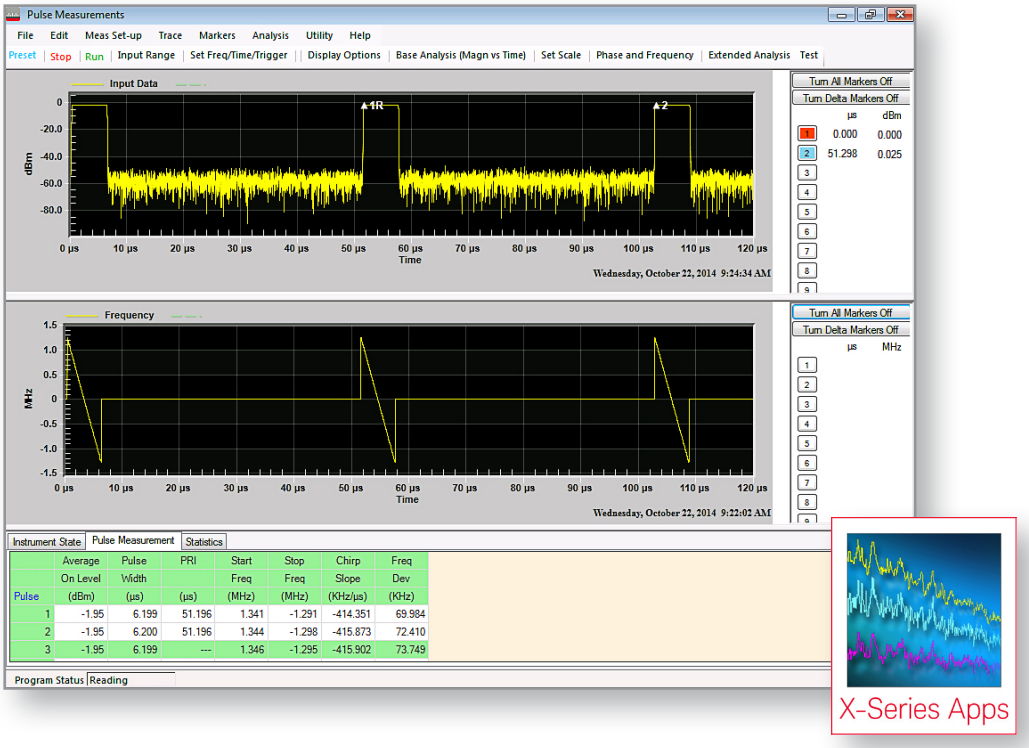
Keysight Technologies

N9051B Pulse Measurement Software

X-Series Signal Analyzers

Technical Overview



Pulse	Average On Level (dBm)	Pulse Width (µs)	PRI (µs)	Start Freq (MHz)	Stop Freq (MHz)	Chirp Slope (KHz/µs)	Freq Dev (KHz)
1	-1.95	6.199	51.196	1.341	-1.291	-414.351	69.984
2	-1.95	6.200	51.196	1.344	-1.298	-415.873	72.410
3	-1.95	6.199	---	1.345	-1.295	-415.902	73.749

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Features

- Display pulsed signals in a power-vs-time trace, providing more complete insight into radar, EW, and other pulsed signals – from your spectrum analyzer
- Measure pulsed carriers up to 50 GHz and bandwidth up to 160 MHz (depending on configuration)
- Intuitive “zoom” feature give you a closer examination of fine details within a long acquisition, by simply drawing a box with mouse
- Up to 10 markers, including delta-markers, allow easy measurements of power differences and time intervals
- Export images, traces, and pulse tables for your presentations, reports, archives, and deeper analysis in Excel
- Examine phase and frequency characteristics, such as chirp, hopping, pulse-to-pulse phase, etc. (with Option 3FP)
- Extended Analysis (Option 4FP) performs statistical analysis on large data sets (up to 200,000 pulses) accumulated from multiple acquisitions
- Capture up to 50 MSa with Option 5FP “Deep Capture” – over 100x greater depth than the N9051A

Pulse Measurement Software Overview

Radar and electronic-warfare (EW) engineers often work with pulsed RF signals, characterizing signals in both frequency-domain (spectrum) and time-domain (oscilloscope-like).

The N9051B pulse measurement software uses the X-Series signal analyzer, but processes the data in the time-domain using the same instrument hardware. The base application (Option 2FP, required) enables basic magnitude-vs-time analysis. You can easily view pulses and pulse-bursts in time and make calibrated measurements in both time (for example, pulse width, Pulse Repetition Interval or “PRI”, and rise-/fall-time), as well as amplitude (signal levels in dBm, Watts, or volts).

There are 10 markers available; these can be absolute, or “delta” markers relative to a reference marker. Markers can help highlight specific points of interest on the trace, and read out precise timing and amplitude information.

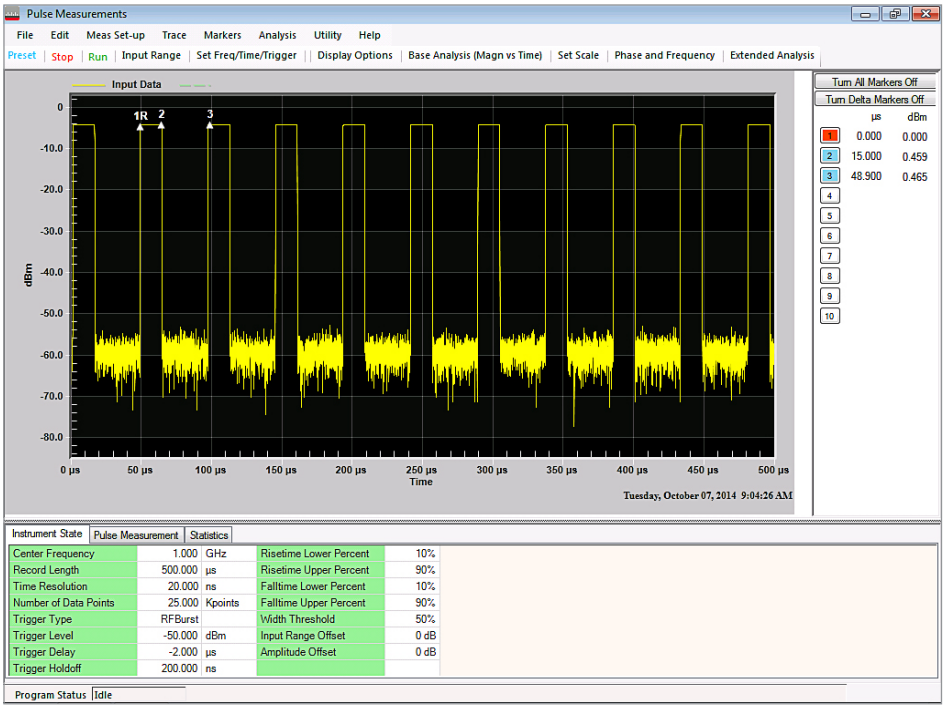


Figure 1. View pulsed RF signals in a magnitude-vs-time trace. Use markers and delta-markers to examine amplitude and timing details.

Radars and EW sub-systems might generate bursts or patterns with hundreds or thousands of pulses. Ordinary trace displays may not be able to show each pulse clearly. But the N9051B software has a rapid and intuitive “zoom” function: just draw a box with the mouse, and the zone of interest is re-scaled both horizontally and vertically.

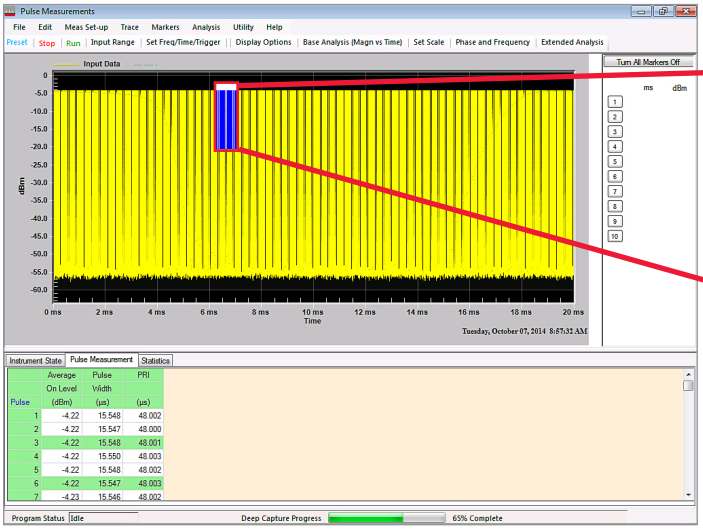


Figure 2a. Activate an intuitive “zoom” function by drawing a box with the mouse – to view a few pulses out of hundreds, or take a close look at amplitude variations.

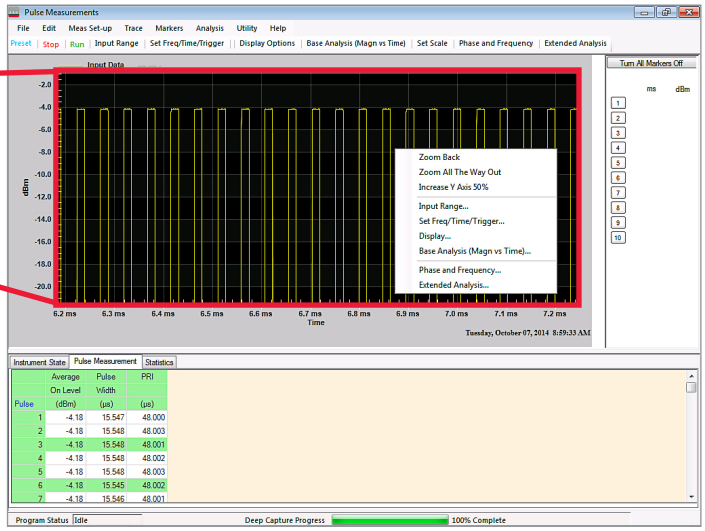
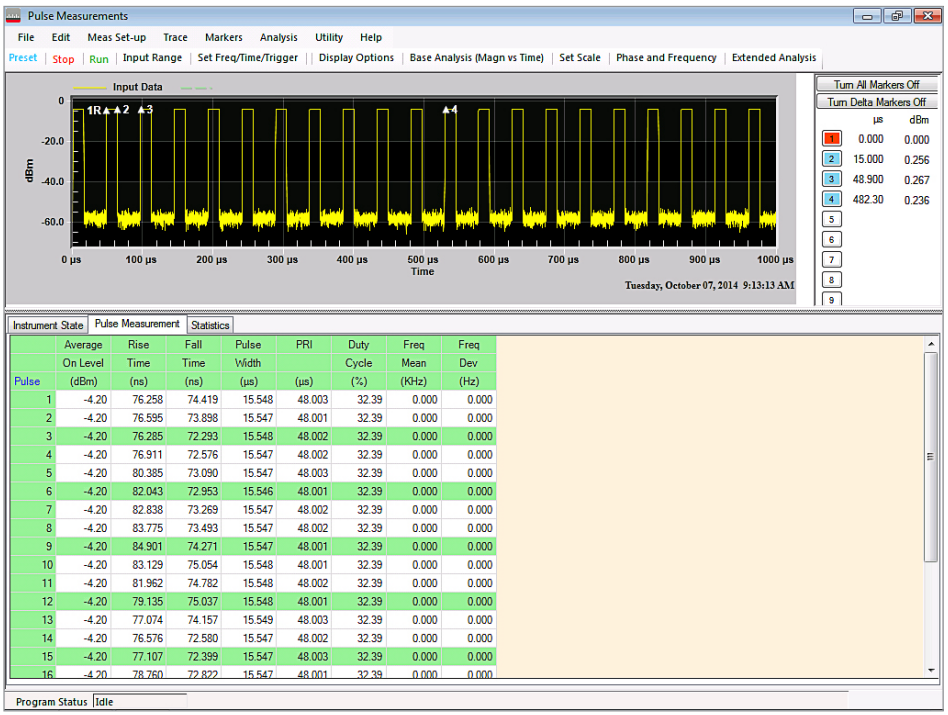


Figure 2b. Use right-mouse-click to see a context-sensitive list of commands, include Zoom Back and Zoom All the Way Out.

The application automatically finds pulses, and measures > 25 user-selectable parameters, for each pulse. The results are presented in a table, with a row for each pulse and a column for each parameter. Scroll through the table to examine over 1000 pulses. The user can modify the thresholds used for certain analysis algorithms.

Even more pulses – up to 200,000 – can be exported into an Excel table via a CSV file.

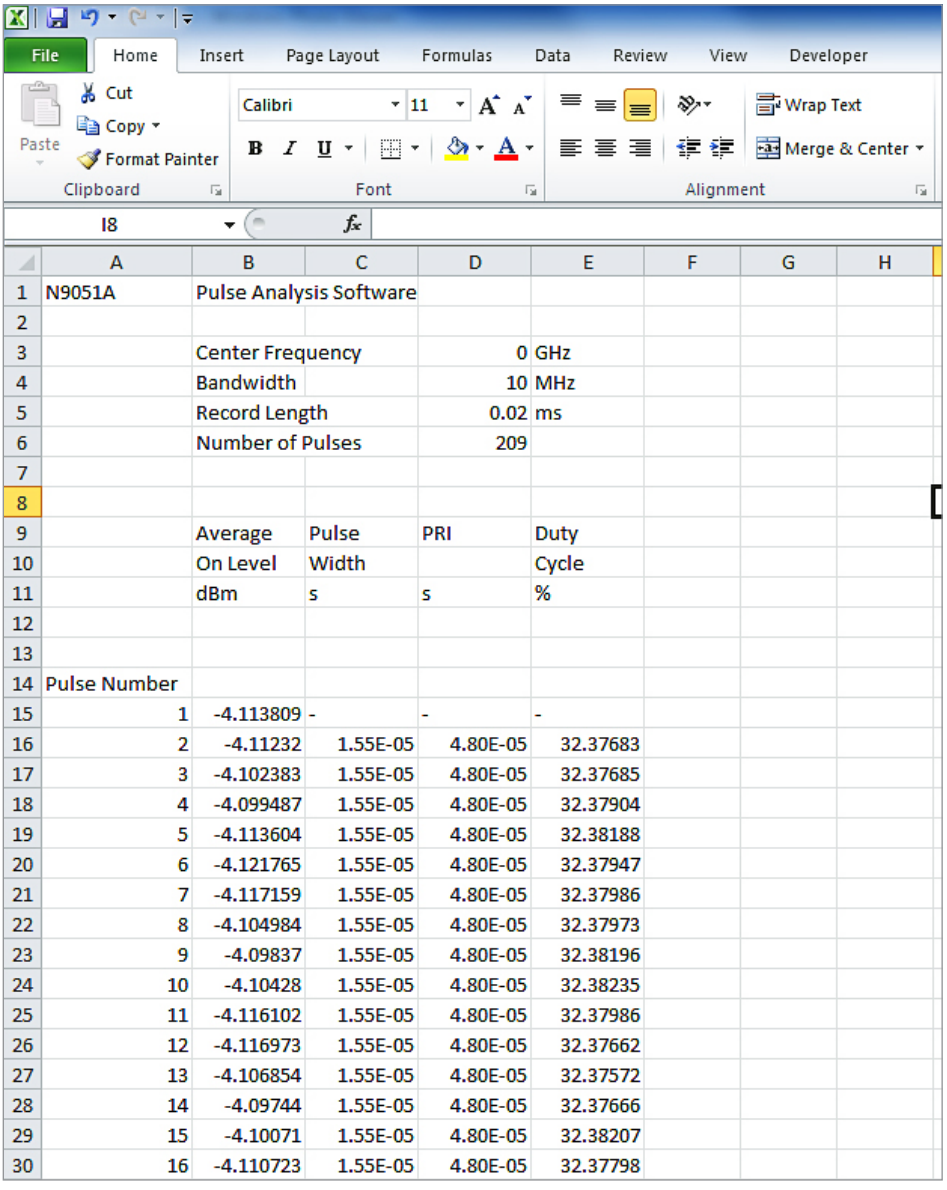


Pulse	Average On Level (dBm)	Rise Time (ns)	Fall Time (ns)	Pulse Width (µs)	PRI (µs)	Duty Cycle (%)	Freq Mean (KHz)	Freq Dev (Hz)
1	-4.20	76.258	74.419	15.548	48.003	32.39	0.000	0.000
2	-4.20	76.595	73.898	15.547	48.001	32.39	0.000	0.000
3	-4.20	76.285	72.293	15.548	48.002	32.39	0.000	0.000
4	-4.20	76.911	72.576	15.547	48.002	32.39	0.000	0.000
5	-4.20	80.385	73.090	15.547	48.003	32.39	0.000	0.000
6	-4.20	82.043	72.953	15.546	48.001	32.39	0.000	0.000
7	-4.20	82.838	73.269	15.547	48.002	32.39	0.000	0.000
8	-4.20	83.775	73.493	15.547	48.002	32.39	0.000	0.000
9	-4.20	84.901	74.271	15.547	48.001	32.39	0.000	0.000
10	-4.20	83.129	75.054	15.548	48.001	32.39	0.000	0.000
11	-4.20	81.962	74.782	15.548	48.002	32.39	0.000	0.000
12	-4.20	79.135	75.037	15.548	48.001	32.39	0.000	0.000
13	-4.20	77.074	74.157	15.549	48.003	32.39	0.000	0.000
14	-4.20	76.576	72.580	15.547	48.002	32.39	0.000	0.000
15	-4.20	77.107	72.399	15.547	48.003	32.39	0.000	0.000
16	-4.20	78.760	72.822	15.547	48.001	32.39	0.000	0.000

Figure 3. Automatically find pulses, characterize a wide range of pulse metrics for each pulse, and summarize in a table.

Although similar to 0-span (zero-span), the N9051B makes full use of the bandwidth (BW) available in the instrument. (It is not limited by the RBW filter of SA mode, typically 8 MHz maximum.) Wider BW means ability to resolve very narrow or closely-spaced pulses, see wide chirp modulation or hopping sequences, and examine fast rise-/fall-times without distortion.

File functions let you capture images (JPG, PNG, etc.) for use in presentations or reports. And you can capture trace data, or data from the pulse table (rows/columns), and export as a CSV (Comma-Separated Values) file, which can then be imported into Excel for further analysis.



	A	B	C	D	E	F	G	H
1	N9051A	Pulse Analysis Software						
2								
3		Center Frequency		0	GHz			
4		Bandwidth		10	MHz			
5		Record Length		0.02	ms			
6		Number of Pulses		209				
7								
8								
9		Average	Pulse	PRI	Duty			
10		On Level	Width		Cycle			
11		dBm	s	s	%			
12								
13								
14	Pulse Number							
15	1	-4.113809	-	-	-			
16	2	-4.11232	1.55E-05	4.80E-05	32.37683			
17	3	-4.102383	1.55E-05	4.80E-05	32.37685			
18	4	-4.099487	1.55E-05	4.80E-05	32.37904			
19	5	-4.113604	1.55E-05	4.80E-05	32.38188			
20	6	-4.121765	1.55E-05	4.80E-05	32.37947			
21	7	-4.117159	1.55E-05	4.80E-05	32.37986			
22	8	-4.104984	1.55E-05	4.80E-05	32.37973			
23	9	-4.09837	1.55E-05	4.80E-05	32.38196			
24	10	-4.10428	1.55E-05	4.80E-05	32.38235			
25	11	-4.116102	1.55E-05	4.80E-05	32.37986			
26	12	-4.116973	1.55E-05	4.80E-05	32.37662			
27	13	-4.106854	1.55E-05	4.80E-05	32.37572			
28	14	-4.09744	1.55E-05	4.80E-05	32.37666			
29	15	-4.10071	1.55E-05	4.80E-05	32.38207			
30	16	-4.110723	1.55E-05	4.80E-05	32.37798			

Figure 4. Export table or trace data into Excel for further analysis; or copy/paste screen images for reports or archives.

Phase and frequency measurements

The “core” software (2FP) enables analysis of RF amplitude only (i.e. magnitude or “envelope” versus time). To also see phase and frequency information, add Option 3FP. You can examine phase- or frequency- vs-time traces, and use markers or “zoom” features to take a closer look. Chirp (linear FM) modulation can be seen on the trace, and/or automatically analyzed for chirp-slope and deviation from best-fit ideal linear chirp. Similarly, you can visualize phase modulation (e.g., Barker codes), or measure pulse-to-pulse phase stability automatically.

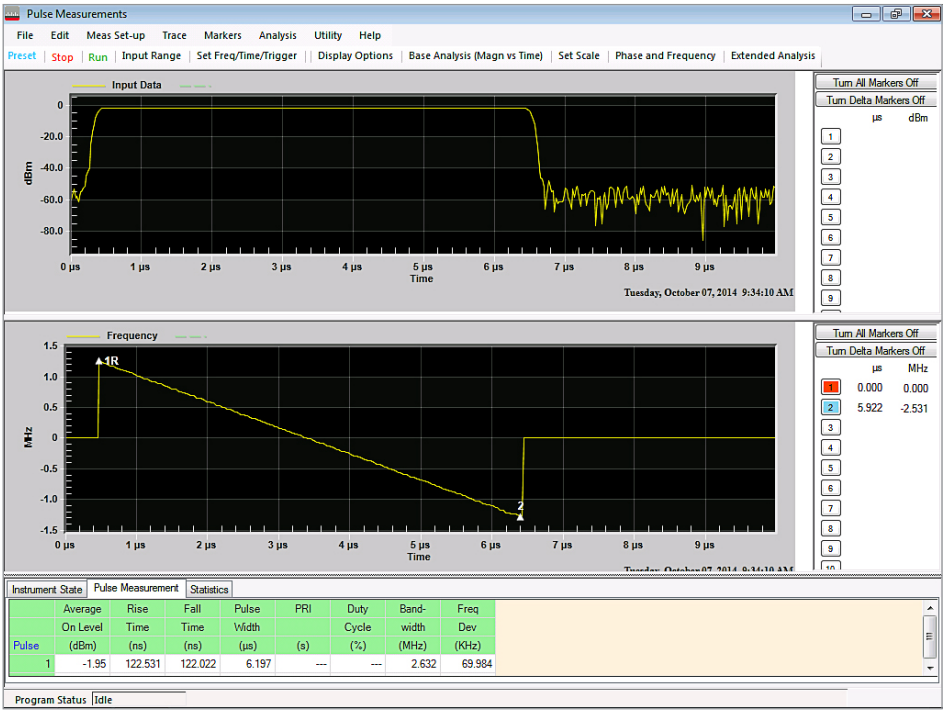


Figure 5. Open up a second display and view a phase or frequency trace that is time-aligned to the pulse magnitude trace. Here, a linear FM chirp is easily measured.

Extended analysis

Radar and EW engineers often need to verify large sets of pulses to study multi-mode radars or verify complex multi-emitter simulations. Option 4FP provides an “accumulator” to store results from 100s or 1000s of acquisitions into a data base. This large population of pulses (up to 200,000) can be continuously analyzed with histogram (probability distribution) or trend-vs-time tools. Any of the > 25 analysis parameters can be studied.

Option 4FP also includes a “halt on” feature, which examines each capture and stops the acquisition cycle when any pulse parameter exceeds a user-defined threshold. This “freezes” the trace containing a “needle-in-haystack” abnormality, for further analysis or archiving.

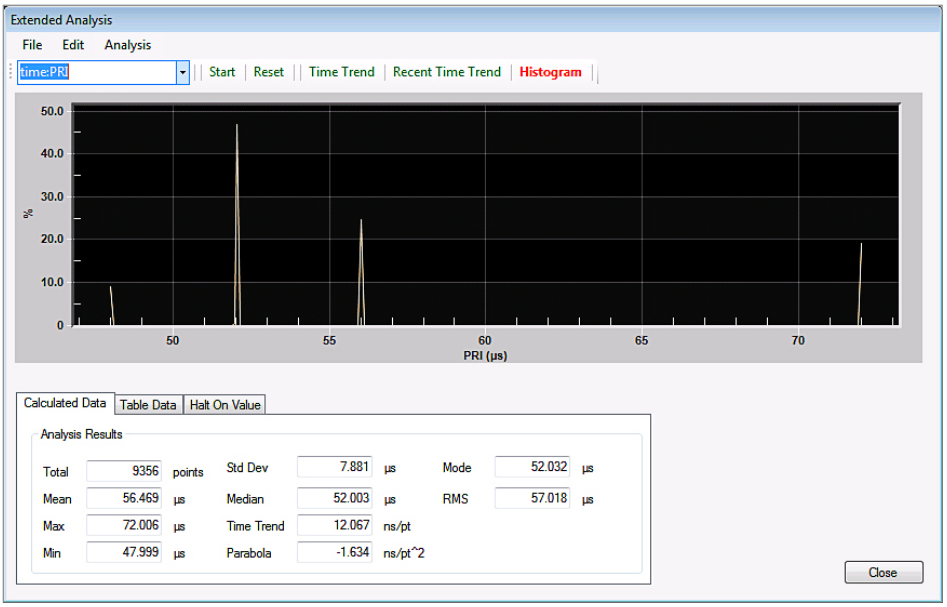


Figure 6. A distinct window contains the Extended Analysis features, including statistics, trend, and histogram views of large data-sets. Here is the probability distribution of PRI, showing four distinct modes.

Deep capture

High sample rates (wide BW) give excellent time resolution ... but also fill up limited memory quickly. Option 5FP increases the capture depth by over 100x; from 409 kSa to 50 MSa. This extends the maximum capture duration, increasing the number of pulses that can be seen, and increasing the probability-of-intercept for rare or intermittent pulses. Cases that were previously limited to only 10 ms can now be captured for over 1 sec or more.

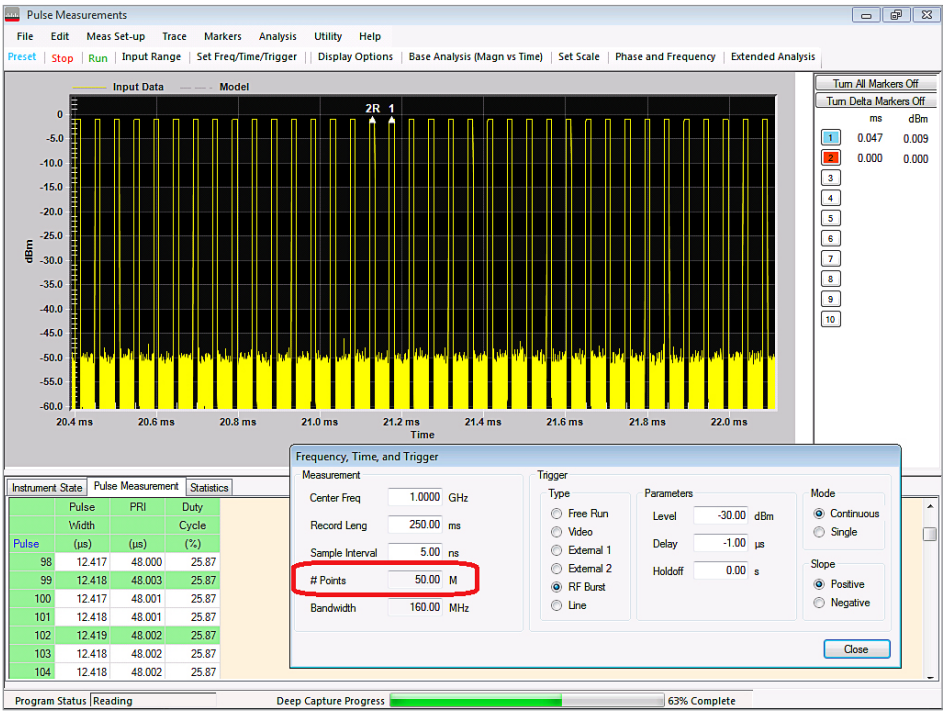


Figure 7. With Option 5FP “Deep Capture”, you can capture up to 50 MSa per acquisition.

Software Characteristics

Parameter	E8267D PSG
Frequency	Up to 50 GHz. Up to maximum of analyzer HW, less BW/2
Trigger types	Free Run, External, RF Burst, Video, or Line
Sample interval, time resolution	Depends on analysis bandwidth (BW) of hardware Min Sample Interval = 1/(1.25*BW) (e.g. 5 ns for 160 MHz BW) Max Sample Rate = 1/(SampleInterval) = 1.25*BW
Min pulse width	~6x SampleInterval
Min rise-/fall-time	~3x SampleInterval
Capture depth (samples), # of trace points	Maximum capture depth (in Samples) is: – 50 MSa with Opt 5FP and hardware configuration to support it – 4 MSa with Opt 5FP and other hardware configurations – 409 kSa without Opt 5FP Min 51 Sa and ≥ 10*SampleInterval Display pixel resolution will limit number of visually distinct points
Record length	SampleInterval * CaptureLengthSa (e.g., 250 mS for 160 MHz BW and 50 MSa)
Pulse detection	IEEE-181 method, Absolute Level, Level Relative to Max
Max # of pulses	1,050 viewable in Pulse Table 200,000 per acquisition, exportable 200,000 cumulative (multiple acquisitions) in Extended Analysis 4FP
Scale	Auto, Manual, plus “Zoom” (draw box with mouse), and “Zoom Back”
Displays	Three: – Upper Display: Magnitude (dBm, W, V), Model (best fit overlay) – Lower Display: Phase (deg, rad), Frequency – Tab/Table: Instrument State Summary, Pulse Table, Simple Statistics
Markers	10 (absolute or delta)
File save, recall, export	State (settings of entire application) Image: Upper Display or Entire Screen, as JPG, PNG, GIF, TIF, or BMP Trace (data): Binary (for save/recall), CSV (export to Excel) Pulse Table (data): CSV (export to Excel)
Help	Getting Started and User’s Reference available as PDF at run-time

Comparing N9051A to N9051B

The N9051B is the recommended replacement for the N9051A. The following table summarizes the key differences.

	N9051A	N9051B
HW control SW	Based on "invisible" copy of 89600 VSA software to control instrument	Based on IQ Analyzer mode, a thin/light X-app available on all X-SA free of charge
Analyzers supported	X-Series signal analyzer, PSA, oscilloscopes, more	X-Series signal analyzer
Host PC and OS	X-Series signal analyzer CPU (Windows XP or 7) or generic ext. PC (Windows XP or 7)	X-Series signal analyzer CPU (Windows 7 64-bit)
Capture depth	Up to 409 kSa	Up to 50 MSa (with Option 5FP "Deep Capture")
Trace registers	Mag, Phase, Freq, Model plus Six registers capable of: – Max Hold, Min Hold, Average – Addition, Subtraction – Spectrum	Mag, Phase, Freq, Model (registers eliminated to conserve memory)
Amplitude probability curves	PDF, CDF, CCDF	n/a
Low-phase-distortion filter low overshoot or "ringing")	Bessel Filter	n/a
Start-up time		~5x faster
Measurement cycle time		~2x faster
SCPI remote programming	n/a	n/a

Ordering Information

N9051B pulse measurement software configuration

Model-Option	Description	Notes
N9051B-2FP	Base magnitude-vs-time – Amplitude- or power-vs-time trace and markers – Automatic amplitude and time parameters	
N9051B-3FP	Phase and frequency – Phase-vs-time trace and markers – Frequency-vs-time trace and markers – Automatic phase and frequency parameters – Chirp, pulse-to-pulse phase, etc.	Requires 2FP
N9051B-4FP	Extended analysis – Trend analysis – Probability distribution (histogram) analysis – "Halt on" feature	Requires 2FP
N9051B-5FP	Deep capture (to 50 MSa) – Extended capture depth	Requires 2FP See also HW configuration below

The table above contains information on "Fixed, Perpetual" (nFP) licenses; these allow you to run the N9051B application in the single X-Series analyzer in which it si initially installed. N9051B licenses are also available in type "Transportable, Perpetual" (nTP); these licenses can be transferred from one X-Series analyzer to another.

Upgrade existing N9051A to N9051B

Model-Option	Description	Notes
N9051B-A2B	Upgrade N9051A to N9051B	Requires N9051A-2FP license

Provides –A2B license, which enables N9051B software to recognize 'A' licenses when redeemed/installed on the same instrument. N9051A-2FP license is required; -3FP or -4FP licenses will also enable comparable features in N9051B software when combined with –A2B.

Hardware configuration

Please see "Software characteristics" to understand how bandwidth is related to sample interval, time resolution, rise-/fall-time, and minimum pulse width.

N9030A PXA signal analyzer

Description	Model-Option	Additional information
3.6, 8.4, 13.6, 26.5, 43, 44, or 50 GHz frequency range	N9030A-503, -508, -513, -526, -543, -544, or -550	One required
25, 40, 85, or 160 MHz bandwidth	N9030A-B25, -B40, -B85, or –B1X	One required for analysis bandwidth over 10 MHz (standard)
Microwave pre-selector by-pass	N9030A-MPB	Required for B40 and above, when input is > 3.6 GHz
Windows 7 (embedded standard) operating system	N9030A-W7X	Required

All PXA configurations support N9051B-5FP "Deep Capture" to 50 MSa

N9020A MXA signal analyzer

Description	Model-Option	Additional information
3.6, 8.4, 13.6, or 26.5 GHz frequency range	N9020A-503, -508, -513, or -526	One required
25, 40, 85, 125, or 160 MHz bandwidth	N9020A-B25, -B40, -B85, -B1A, or –B1X	One required for analysis bandwidth over 10 MHz; on new orders, B25 included at no charge
Microwave pre-selector by-pass	N9020A-MPB	Required for B40 and above, when input is > 3.6 GHz
Digital processor with 2 GB capture memory	N9020A-DP2	Required for N9051B-5FP "Deep Capture" to 50 MSa if bandwidth option is less than 40 MHz
Windows 7 (embedded standard) operating system	N9020A-W7X	Required

N9010A EXA signal analyzer

Description	Model-Option	Additional information
3.6, 8.4, 13.6, 26.5, 43, 44, or 50 GHz frequency range	N9010A-503, -508, -513, -526, -543, -544, or -550	One required
25 or 40 MHz bandwidth	N9010A-B25, -B40	One required for analysis bandwidth over 10 MHz; on new orders, B25 included at no charge
Microwave pre-selector by-pass	N9010A-MPB	Required with B40, when input is > 3.6 GHz
Digital processor with 2 GB capture memory	N9010A-DP2	Required for N9051B-5FP "Deep Capture" to 50 MSa if bandwidth option is less than 40 MHz
Windows 7 (embedded standard) operating system	N9010A-W7X	Required

N9000A CXA signal analyzer

Description	Model-Option	Additional information
3.0, 7.5, 13.6, or 26.5 GHz frequency range	N9000A-503, -507, -513, or -526	One required
25 MHz bandwidth	N9000A-B25	Required for analysis bandwidth over 10 MHz (standard)
Windows 7 (embedded standard) operating system	N9000A-W7X	Required

All CXA configurations limit N9501B-5FP "Deep Capture" to only 4 MSa

Instrument must have 64-bit CPU and Windows 7 operating system. Currently shipping products (new orders) meet these criteria. Previously shipped instruments should be verified, and (if necessary) upgraded prior to installing N9051B. For details, visit www.keysight.com , then search for model number (e.g. N9030A), then click on "Post-Purchase Upgrades" link (under "Product Support Center" on right), then find PC4, PC5, or W7X

Additional Information

Websites

X-Series signal analyzers: **www.keysight.com/find/x-series**

X-Series measurement applications: **www.keysight.com/find/x-series_apps**

N9051B pulse measurement software: **www.keysight.com/find/n9051b**

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www.lxistandard.org
LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. Keysight is a founding member of the LXI consortium.

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