Příloha č. 1: Technický popis

Signálový analyzátor s frekvenčním rozsahem alespoň 9 kHz až 3 GHz, předzesilovač alespoň 100 kHz až 3 GHz, analyzační šířka pásma alespoň 10 MHz, tracking generátor alespoň 9 kHz až 3 GHz:

Keysight N9000B spektrální analyzátor v konfiguraci:

Opt. 503 … frekvenční rozsah 9 kHz – 3 GHz

Opt. P03 … předzesilovač 3 GHz

Opt. T03 … tracking generátor 9 kHz – 3 GHz

Osciloskop s maximální frekvencí alespoň 1 GHz, alespoň dva vstupní analogové kanály, vstupní impedance 1 MOhm a 50 Ohm, vzorkovací frekvence alespoň 5 GSa/s pro polovinu vstupních kanálů a 2.5 GSa/s pro všechny vstupní kanály, hloubka paměti vzorků alespoň 4 Mpts pro polovinu vstupních kanálů a 2 Mpts pro všechny kanály:

Keysight DSOX3102G osciloskop 2 kanály 1 GHz

LCR můstek s frekvenčním rozsahem alespoň 1 MHz až 300 MHz, úroveň testovacích signálů alespoň od 4.5 mV do 0.5 V a proud od 0.1 mA do 10 mA, základní přesnost alespoň +/- 0.8 %, rozsah měřených impedancí alespoň 0.15 Ohm do 4.8 kOhm:

Keysight E4982A LCR metr v konfiguraci:

Opt. 030 … frekvenční rozsah 1 MHz – 300 MHz

N9000B CXA X-Series Signal Analyzer, Multi-touch

9 kHz to 3.0, 7.5, 13.6, or 26.5 GHz

Leading Low-Cost Tool

The CXA is today's leading low-cost tool for essential signal characterization. Its capabilities provide a solid foundation for cost-effective testing in general-purpose and educational applications.

This data sheet is a summary of the specifications and conditions for CXA signal analyzers. For the complete specifications guide, visit www.keysight.com/find/cxa_specifications

KEYSIGHT

Table of Contents

Definitions and Conditions

Specifications describe the performance of parameters covered by the product warranty and apply to temperature ranges 0 to 55 °C, unless otherwise noted.

95th percentile values indicate the breadth of the population (approx. 2s) of performance tolerances expected to be met in 95 percent of the cases with a 95 percent confidence, for any ambient temperature in the range of 20 to 30 °C. In addition to the statistical observations of a sample of instruments, these values include the effects of the uncertainties of external calibration references. These values are not warranted. These values are updated occasionally if a significant change in the statistically observed behavior of production instruments is observed.

Typical describes additional product performance information that is not covered by the product warranty. It is performance beyond specifications that 80 percent of the units exhibit with a 95 percent confidence level over the temperature range 20 to 30 °C. Typical performance does not include measurement uncertainty.

Nominal values indicate expected performance, or describe product performance that is useful in the application of the product, but are not covered by the product warranty.

The analyzer will meet its specifications when:

- It is within its calibration cycle
- Under auto couple control, except when Auto Sweep Time Rules = Accy
- The analyzer has been stored at an ambient temperature within the allowed operating range for at least two hours before being turned on; if it had previously been stored at a temperature range inside the allowed storage range, but outside the allowed operating range
- The analyzer has been turned on at least 30 minutes with Auto Align set to Normal, or, if Auto Align is set to Off or Partial, alignments must have been run recently enough to prevent an Alert message. If the Alert condition is changed from “Time and Temperature” to one of the disabled duration choices, the analyzer may fail to meet specifications without informing the user. If Auto Align is set to Light, performance is not warranted, and nominal performance will degrade to become a factor of 1.4 wider for any specification subject to alignment, such as amplitude tolerances.

For ordering information, refer to the CXA Signal Analyzer Configuration Guide (5992-1275EN).

Get more information

This CXA signal analyzer data sheet is a summary of the complete specifications and conditions for N9000B CXA signal analyzers, which are available in the CXA Signal Analyzer Specification Guide. The CXA Signal Analyzer Specification Guide can be obtained on the web at: www.keysight.com/find/cxa_specifications

Frequency and Time Specifications

Frequency range	DC coupled		AC coupled
Option 503	NA		9 kHz to 3.0 GHz
Option 507	NA		9 kHz to 7.5 GHz
Option 513	9 kHz to 13.6 GHz		10 MHz to 13.6 GHz
Option 526	9 kHz to 26.5 GHz		10 MHz to 26.5 GHz
	Band	LO multiple (N)	
0RF (Option 503, 507)	0	1	9 kHz to 3.0 GHz
	1	1	2.95 to 3.80 GHz
	2	1	3.70 to 4.55 GHz
	3	1	4.45 to 5.30 GHz
	4	1	5.20 to 6.05 GHz
	5	1	5.95 to 6.80 GHz
	6	1	6.70 to 7.50 GHz
MW (Option 513, 526)	0	1	9 kHz to 3.08 GHz
	1	2	2.95 to 7.58 GHz
	2	2	7.45 to 9.55 GHz
	3	2	9.45 to 12.60 GHz
	4	2	12.50 to 13.05 GHz
	4	4	12.95 to 13.80 GHz
	5	4	13.40 to 15.55 GHz
	6	4	15.45 to 19.35 GHz
	7	4	19.25 to 21.05 GHz
	8	4	20.95 to 22.85 GHz
	9	4	22.75 to 24.25 GHz
	10	4	24.15 to 26.55 GHz
Frequency reference			
Accuracy	± [(time since last adjustment x aging rate) + temperature stability + calibration accuracy]		
Aging rate	Option PFR $\pm 1 \times 10^{-7}$ / year		Standard $\pm 1 \times 10^{-6}$ / year
	$\pm 1.5 \times 10^{-7}$ / 2 years		
Temperature stability	Option PFR		Standard
20 to 30 °C	$\pm 1.5 \times 10^{-8}$		$\pm 2 \times 10^{-6}$
Full temperature range	$\pm 5 \times 10^{-8}$		$\pm 2 \times 10^{-6}$
Achievable initial calibration accuracy	Option PFR		Standard
	$\pm 4 \times 10^{-8}$		$\pm 1.4 \times 10^{-6}$
Example frequency reference accuracy (with Option PFR)	$= \pm (1 \times 10^{-7} + 5 \times 10^{-8} + 4 \times 10^{-8})$		
1 year after last adjustment	$= \pm 1.9 \times 10^{-7}$		
Residual FM			
Option PFR	≤ (0.25 Hz x N) p-p in 20 ms nominal		
Standard	≤ (10 Hz x N) p-p in 20 ms nominal		
	See band table above for N (LO multiple)		

Frequency readout accuracy (start, stop, center, marker)			
		± (marker frequency x frequency reference accuracy + 0.25 % x span + 5 % x RBW + 2 Hz + 0.5 x horizontal resolution [1])	
Marker frequency counter			
Accuracy		± (marker frequency x frequency reference accuracy + 0.100 Hz)	
Delta counter accuracy		± (delta frequency x frequency reference accuracy + 0.141 Hz)	
Counter resolution		0.001 Hz	
Frequency span (FFT and swept mode)			
Range		0 Hz (zero span), 10 Hz to maximum frequency of instrument	
Resolution		2 Hz	
Accuracy	Swept	± (0.25 % x span + horizontal resolution)	
	FFT	± (0.10 % x span + horizontal resolution)	
Sweep time and triggering			
Range		Span = 0 Hz	1 µs to 6000 s
		Span ≥ 10 Hz	1 ms to 4000 s
Accuracy		Span ≥ 10 Hz, swept	±0.01 % nominal
		Span ≥ 10 Hz, FFT	±40 % nominal
		Span = 0 Hz	±1 % nominal
Trigger		Free run, line, video, external 1, RF burst, periodic timer	
Trigger delay		Span = 0 Hz or FFT	–150 to +500 ms
		Span ≥ 10 Hz, swept	1 µs to 500 ms
		Resolution	0.1 µs
Time gating			
Gate methods		Gated LO; gated video; gated FFT	
Gate length range (except method = FFT)		100.0 ns to 5.0 s	
Gate delay range		0 to 100.0 s	
Gate delay jitter		33.3 ns p-p nominal	
Sweep (trace) point range			
All spans		1 to 40001	
Resolution bandwidth (RBW)			
Range (–3.01 dB bandwidth)		1 Hz to 3 MHz (10 % steps), 4, 5, 6, 8 MHz	
Bandwidth accuracy (power)		1 Hz to 750 kHz	±1.0 % (±0.044 dB) nominal
		820 kHz to 1.2 MHz (< 3 GHz CF)	±2.0 % (±0.088 dB) nominal
		1.3 to 2.0 MHz (< 3 GHz CF)	±0.07 dB nominal
		2.2 to 3 MHz (< 3 GHz CF)	±0.15 dB nominal
		4 to 8 MHz (< 3 GHz CF)	±0.25 dB nominal
Bandwidth accuracy (–3.01 dB)	RBW range	1 Hz to 1.3 MHz	±2 % nominal
Selectivity (–60 dB/–3 dB)		4.1:1 nominal	
EMI bandwidth (CISPR compliant)		200 Hz, 9 kHz, 120 kHz, 1 MHz	(Option EMC required)
EMI bandwidth (MIL STD 461E compliant)		10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz	(Option EMC required)

1. Horizontal resolution is span/(sweep points – 1)

Analysis bandwidth [1]		
Maximum bandwidth	Option B25	25 MHz
	Standard	10 MHz
Video bandwidth (VBW)		
Range	1 Hz to 3 MHz (10 % steps), 4, 5, 6, 8 MHz, and wide open (labeled 50 MHz)	
Accuracy	±6 % nominal	
Measurement speed [2]		
Local measurement and display update rate	11 ms (90/s) nominal	
Remote measurement and LAN transfer rate	6 ms (167/s) nominal	
Marker peak search	5 ms nominal	
Center frequency tune and transfer	22 ms nominal	
Measurement/mode switching	75 ms nominal	

1. Analysis bandwidth is the instantaneous bandwidth available around a center frequency over which the input signal can be digitized for further analysis or processing in the time, frequency, or modulation domain.
2. Sweep points = 101

Amplitude Accuracy and Range Specifications

Amplitude range

Measurement range			
RF (Option 503, 507)	Preamp off	100 kHz to 1 MHz	Displayed average noise level (DANL) to +20 dBm
		1 MHz to 7.5 GHz	Displayed average noise level (DANL) to +23 dBm
	Preamp on	100 kHz to 7.5 GHz	Displayed average noise level (DANL) to +15 dBm
MW (Option 513/526)	Preamp off	100 kHz to 26.5 GHz	Displayed average noise level (DANL) to +23 dBm
	Preamp on	100 kHz to 26.5 GHz	Displayed average noise level (DANL) to +23 dBm
Input attenuator range			
RF (Option 503, 507)	Standard	0 to 50 dB in 10 dB steps	
	Option FSA	0 to 50 dB in 2 dB steps	
MW (Option 513, 526)	Standard	0 to 70 dB in 10 dB steps	
	Option FSA	0 to 70 dB in 2 dB steps	
Maximum safe input level			
Average total power	RF (Option 503, 507)	+30 dBm (1 W)	Input attenuation ≥ 20 dB, preamp off
		10 dBm (10 mW)	Input attenuation ≥ 20 dB, preamp on
	MW (Option 513, 526)	+30 dBm (1 W)	Input attenuation ≥ 10 dB, preamp off
		+30 dBm (1 W)	Input attenuation ≥ 20 dB, preamp on
Peak pulse power			
		+50 dBm (100 W)	< 10 µs pulse width, < 1 % duty cycle, input attenuation ≥ 30 dB
DC volts			
RF (Option 503, 507)		AC coupled	±50 Vdc
		AC coupled	±50 Vdc
		DC coupled	±0.2 Vdc
Display range			
Log scale		0.1 to 1 dB/division in 0.1 dB steps	
		1 to 20 dB/division in 1 dB steps (10 display divisions)	
Linear scale		10 divisions	
Scale units		dBm, dBmV, dBµV, dBmA, dBµA, V, W, A	

Frequency range		Specification	95th percentile (≈ 2σ)
(10 dB input attenuation, 20 to 30 °C, s = nominal standard deviation)			
RF (Option 503, 507)	9 kHz to 10 MHz	±0.60 dB	±0.45 dB
	10 MHz to 3 GHz	±0.75 dB	±0.55 dB
	3 to 5.25 GHz	±1.45 dB	±1.00 dB
	5.25 to 7.5 GHz	±1.65 dB	±1.20 dB
MW (Option 513, 526)	9 kHz to 10 MHz	±0.8 dB	±0.5 dB
	10 MHz to 3 GHz	±0.65 dB	±0.4 dB
	3 to 7.5 GHz	±1.5 dB	±0.5 dB
	7.5 to 13.6 GHz	±2.0 dB	±0.8 dB
	13.6 to 19 GHz	±2.0 dB	±1.0 dB
	19 to 26.5 GHz	±2.5 dB	±1.3 dB
Preamp on (P03, P07)			
RF (Option 503, 507)	100 kHz to 3 GHz		±0.70 dB
	3 to 5.25 GHz		±0.85 dB
	5.25 to 7.5 GHz		±1.35 dB
Preamp on (P03, P07, P13, P26)			
MW (Option 513, 526)	100 kHz to 3.6 GHz		±0.28 dB nominal
	3.5 to 8.4 GHz		±0.67 dB nominal
	8.4 to 26.5 GHz		±0.80 dB nominal
	26.4 to 44 GHz		±0.80 dB nominal
Input attenuation switching uncertainty		Specifications	Additional information
Attenuation > 2 dB, preamp off	50 MHz (reference frequency)	±0.32 dB	±0.15 dB typical
Relative to 10 dB (reference setting)	100 kHz to 3.0 GHz		±0.30 dB nominal
	3.0 to 7.5 GHz		±0.50 dB nominal
	7.5 to 26.5 GHz		±0.70 dB nominal
Total absolute amplitude accuracy			
(10 dB attenuation, 20 to 30 °C, 1 Hz ≤ RBW ≤ 1 MHz, input signal –10 to –50 dBm, all settings auto-coupled except Auto Swp Time = Accy, any reference level, any scale, s = nominal standard deviation)			
	At 50 MHz	±0.40 dB	
	At all frequencies	± (0.40 dB + frequency response)	
	9 kHz to 3.6 GHz	±0.27 dB (95th percentile ≈ 2 σ)	
Preamp on (Option P03, P07, P13, P26)			± (0.39 dB + frequency response) nominal
Input Voltage Standing Wave R**atio (VSWR) (≥ 10 dB attenuation)**			
1 Hz to 3 MHz RBW	±0.15 dB		
4, 5, 6, 8 MHz RBW	±1.0 dB		
Reference level			
Range	Log scale	–170 to +23 dBm in 0.01 dB steps	
	Linear scale	Same as log (707 pV to 3.16 V)	
Accuracy	0 dB		
Display scale switching uncertainty			
Switching between linear and log	0 dB		
Log scale/div switching	0 dB		

Display scale fidelity			
–80 dBm ≤ input mixer level < –15 dBm	±0.15 dB total		
–15 dBm ≤ input mixer level < –10 dBm	±0.30 dB	±0.15 dB typical	
Trace detectors			
Normal, peak, sample, negative peak, log power average, RMS average, and voltage average			
Preamplifier (Option P03, P07, P13, P26)			
Frequency range	Option P03	100 kHz to 3.0 GHz	
	Option P07	100 kHz to 7.5 GHz	
	Option P13	100 kHz to 13.6 GHz	
	Option P26	100 kHz to 26.5 GHz	
Gain	100 kHz to 26.5 GHz	+20 dB nominal	
Noise figure	100 kHz to 26.5 GHz	DANL + 176.24 dB nominal	

Dynamic Range Specifications

	1 dB gain compression (two-tone)		Total power at mixer input	
RF (Option 503, 507)	Preamp off	50 MHz to 7.5 GHz	+2 dBm nominal	
	Preamp on	50 MHz to 7.5 GHz	–19 dBm nominal	
MW (Option 513, 526)	Preamp off	50 MHz to 7.5 GHz	+7 dBm noiminal	
		7.5 to 13.6 GHz	+3 dBm noiminal	
		13.6 to 26.5 GHz	+0 dBm noiminal	
	Preamp on	50 MHz to 26.5 GHz	–19 dBm nominal	
Displayed average noise level (DANL)				
(Input terminated, sample or average detector, averaging type = Log, 0 dB input attenuation, IF Gain = High, 20 to 30 °C)				
		Parentheses indicate typical performance		
		Preamplifier OFF	Preamplifier ON	
RF (Option 503, 507)	9 kHz to 1 MHz	(–120) dBm	(–139) dBm, 100 kHz to 1 MHz	
	1 to 10 MHz	–130 (–137) dBm	–149 (–157) dBm	
	10 MHz to 1.5 GHz	–148 (–150) dBm	–161 (–163) dBm	
	1.5 to 2.2 GHz	–144 (–147) dBm	–160 (–163) dBm	
	2.2 to 2.5 GHz	–144 (–147) dBm	–158 (–161) dBm	
	2.5 to 2.7GHz	–142 (–145) dBm	–158 (–161) dBm	
	2.7 to 3.0 GHz	–139 (–143) dBm	–158 (–161) dBm	
	3 to 4.5 GHz	–137 (–140) dBm	–155 (–159) dBm	
	4.5 to 6 GHz	–133 (–136) dBm	–152 (–156) dBm	
	6 to 7.5 GHz	–128 (–131) dBm	–148 (–152) dBm	
MW (Option 513, 526)	1 to 10 MHz	–143 (–148) dBm	–153 (–158) dBm	
	10 MHz to 1.5 GHz	–147 (–150) dBm	–160 (–163) dBm	
	1.5 to 6 GHz	–143 (–147) dBm	–158 (–161) dBm	
	6 to 7.5 GHz	–141 (–145) dBm	–155 (–160) dBm	
	7.5 to 13.6 GHz	–139 (–142) dBm	–155 (–160) dBm	
	13.6 to 20 GHz	–134 (–140) dBm	–153 (–157) dBm	
	20 to 24 GHz	–132 (–138) dBm	–151 (–155) dBm	
	24 to 26.5 GHz	–124 (–129) dBm	–142 (–147) dBm	
Spurious responses				
RF (Option 503, 507)	Residual responses (Input terminated and 0 dB attenuation, 20 to 30 °C)	200 kHz to 7.5 GHz (sweptz)	–90 dBm	
		Zero span or FFT or other frequencies	–100 dBm nominal	
	Input related spurious	10 MHz to 7.5 GHz	–60 dBc typical	
MW (Option 513, 526)		Tuned frequency (f)	Mixer level	Response
	Image responses	10 MHz to 26.5 GHz	−10 dBm	−60 dBc typical
	LO-related spurious	10 MHz to 3 GHz	−10 dBm	−64 dBc typical
	Other spurious responses			
	First RF orderm(f ≥ 10 MHz from carrier)		−10 dBm	−65 dBc
	High RF order (f ≥ 10 MHz from carrier)		−10 dBm	−65 dBc
Second Harmonic Distortion (SHI)				
	Source frequency	SHI (nominal)		
RF/MW (Option 503, 507, 513, 526)	10 MHz to 3.75 GHz	+42 dBm		
MW (Option 513, 526)	3.75 to 13.25 GHz	+54 dBm		

Third-order intermodulation distortion (TOI)			
Parentheses indicate typical performance			
RF (Option 503, 507)	Preamp off (Two –20 dBm tones at input mixer spaced by 100 kHz, 0 dB attenuation, 20 to 30 °C)	10 to 400 MHz	+10 (+14) dBm
		400 MHz to 3 GHz	+13 (+17) dBm
		3 to 7.5 GHz	+13 (+15) dBm
MW (Option 513, 526)	Preamp off (Two –20 dBm tones at input mixer spaced by 100 kHz, 0 dB attenuation, 20 to 30 °C)	10 to 500 MHz	+11 dBm, (+15) dBm
		500 MHz to 2 GHz	+12 dBm, (+15) dBm
		2 to 3 GHz	+11 dBm, (+15) dBm
		3 to 7.5 GHz	+12 dBm, (+17) dBm
		7.5 to 13.6 GHz	+11 dBm, (+15) dBm
		13.6 to 26.5 GHz	+10 dBm, (+14) dBm
Option P03, P07, P13, P26	Preamp on (Two –45 dBm tones at the preamp input, spaced by 100 kHz, 0 dB attenuation, 20 to 30 °C)	10 MHz to 26.5 GHz	–8 dBm nominal
Phase noise	Offset	Specification	Typical
Noise sidebands (20 to 30 °C, CF = 1 GHz)			
	1 kHz	–98 dBc/Hz	–103 dBc/Hz
	10 kHz	–106 dBc/Hz	–110 dBc/Hz
	100 kHz	–108 dBc/Hz	–110 dBc/Hz
	1 MHz	–130 dBc/Hz	–130 dBc/Hz
	10 MHz		–145 dBc/Hz nominal

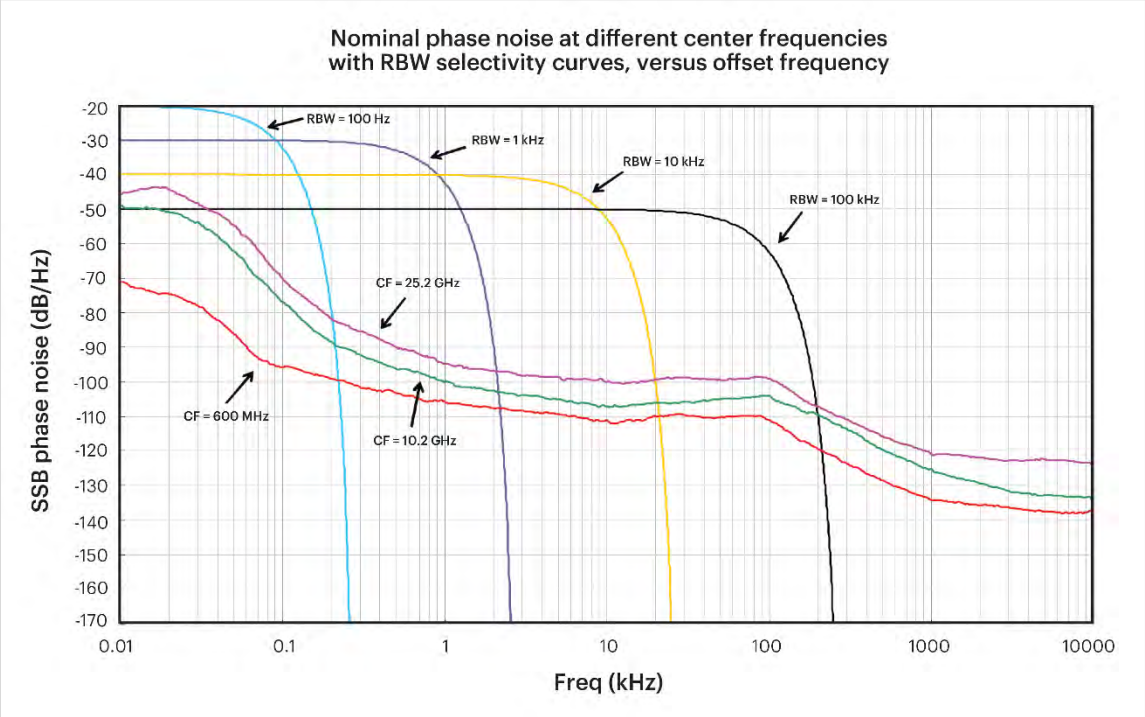


Figure 1. Nominal phase noise at different center frequencies for CXA

PowerSuite Measurement Specifications

Channel power			
Amplitude accuracy, W-CDMA or IS95 (20 to 30 °C, attenuation = 10 dB)		±1.33 dB (±0.61 dB 95th percentile)	
Occupied bandwidth			
Frequency accuracy		± [span/1000] nominal	
Adjacent channel power			
Accuracy, W-CDMA (ACLR) (at specific mixer levels and ACLR ranges)		Adjacent	Alternate
MS		±0.76 dB	±0.73 dB
BTS		±1.72 dB	±1.96 dB
Dynamic range (typical)			
RF (Option 503, 507)	Without noise correction	–63 dB	–67 dB
	With noise correction	–73 dB	–78 dB
MW (Option 513, 526)	Without noise correction	–66 dB	–69 dB
	With noise correction	–73 dB	–78 dB
Offset channel pairs measured		1 to 6	
Power statistics CCDF			
Histogram resolution		0.01 dB	
Harmonic distortion			
Maximum harmonic number		10th	
Result		Fundamental power (dBm), relative harmonics power (dBc), total harmonic distortion in %	
Burst power			
Methods		Power above threshold, power within burst width	
Results		Single burst output power, average output power, maximum power, minimum power within burst,	
Spurious emission			
W-CDMA (1 to 3.6 GHz) table-driven spurious signals; search across regions			
Dynamic range (RBW=1 MHz)		70.7 dB	(75.9 dB typical)
Absolute sensitivity (RBW=1 MHz)		−76.5 dBm	(−82.5 dBm typical)
Spectrum emission mask (SEM)			
cdma2000® (750 kHz offset)			
Relative dynamic range (30 kHz RBW)		67.4 dB	(72.7 dB typical)
Absolute sensitivity		−93.7 dBm	(−99.7 dBm typical)
Relative accuracy		±0.11 dB	
3GPP W-CDMA (2.515 MHz offset)			
Relative dynamic range (30 kHz RBW)		73.4 dB	(80.2 dB typical)
Absolute sensitivity		−91.7 dBm	(−97.7 dBm typical)
Relative accuracy		±0.11 dB	

Tracking Generator Specifications

Output frequency			
Frequency range	Option T03[1]	9 kHz to 3 GHz	
	Option T06[1]	9 kHz to 6 GHz	
Resolution		1 Hz	
Output power level			
Range		−50 to 0 dBm	
Resolution		0.1 dB	
Absolute accuracy (at 50 MHz, −10 dBm, 20 to 30 °C)		±0.55 dB	
Output flatness (referenced to 50 MHz, −10 dBm, 20 to 30 °C)		Specification	95th percentile (≈ 2s)
9 kHz to 100 kHz		±1.5 dB	±1.2 dB
100 kHz to 3.0 GHz		±1.2 dB	±0.8 dB
3.0 GHz to 6.0 GHz		±1.5 dB	±1.2 dB
Level accuracy	9 kHz to 100 kHz		±1.0 dB nominal
	100 kHz to 3.0 GHz		±0.5 dB nominal
	3.0 GHz to 6.0 GHz		±0.8 dB nominal
Output power sweep			
Range		−50 to 0 dBm	
Resolution		0.1 dB	
Maximum safe reverse level			
Average total power		+30 dBm (1 W)	
AC coupled		±50 Vdc	
Phase noise			
Noise sidebands (CF = 1 GHz)		Offset	
		10 kHz	−102 dBc/Hz nominal
		100 kHz	−104 dBc/Hz nominal
		1 MHz	−117 dBc/Hz nominal
Spurious outputs (0 dBm output)			
Harmonic spurs	100 kHz to 3 GHz	< −35 dBc	
	3 GHz to 6 GHz	< −30 dBc	
Non-harmonic spurs	9 kHz to 10 MHz		< −35 dBc nominal
	10 MHz to 6 GHz	< −35 dBc	
Dynamic range			
Maximum output power – displayed average noise level			110 dBc nominal
Output VSWR			
9 kHz to 6 GHz		< 1.5:1 nominal	

1. Not available on microwave CXA (Option 513 or 526)

General Specifications

Temperature range			
Operating		0 to 55 °C	
Storage		–40 to 70 °C	
EMC			
Complies with the essential requirements of the European EMC Directive and the UK Electromagnetic Compatibility Regulations 2016 as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity): • IEC/EN 61326-1 or IEC/EN 61326-2-1 • CISPR 11 Group 1, Class A • AS/NZS CISPR 11:2002 • ICES/NMB-001 This ISM device complies with Canadian ICES-001 Cet appareil ISM est conforme à la norme NMB-001 du Canada			
Safety			
Complies with the essential requirements of the European Low Voltage Directive a well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity) • IEC/EN 61010-1 • Canada: CSA C22.2 No. 61010-1 • U.S.A.: UL 61010-1			
Audio noise			
Acoustic noise emission		Geraeuschemission	
LpA < 70 dB		LpA < 70 dB	
Operator position		Am Arbeitsplatz	
Normal position		Normaler Betrieb	
Per ISO 7779		Nach DIN 45635 t.19	
Environmental stress			
Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of storage, transportation, and end-use; those stresses include, but are not limited to, temperature, humidity, shock, vibration, altitude, and power line conditions; test methods are aligned with IEC 60068-2 and levels are similar to MILPRF-28800F Class 3.			
Power requirements			
Voltage and frequency		100/120 V, 50/60/400 Hz 220/240 V, 50/60 Hz	The instruments can operate with mains supply voltage fluctuations up to ±10% of the nominal voltage
Power consumption	On	270 W maximum	
	Standby	20 W	
Display			
Resolution		1280 x 768, WXGA	
Size		269 mm (10.6 in.) diagonal (nominal)	
Data storage			
Internal		160 GB nominal (removable solid state drive)	
External		Supports USB 2.0 compatible memory devices	
Weight (without options)			
Net		15.4 kg (34.0 lbs)	
Shipping		27.4 kg (60.4 lbs)	
Dimensions			
Height		177 mm (7.0 in)	
Width		426 mm (16.8 in)	
Length		368 mm (14.5 in)	
Warranty			
The CXA signal analyzer is supplied with a 3-year warranty			
Calibration cycle			
The recommended calibration cycle is one year; calibration services are available through Keysight service centers.			

Inputs and Outputs

Front panel		
RF input connector		Type-N female, 50 Ω nominal
RF output (Option T03 or T06) Connector		Type-N female, 50 Ω nominal
Probe power		
Voltage/current		+15 Vdc, ±7 % at 150 mA max nominal
		–12.6 Vdc, ±10 % at 150 mA max nominal
USB ports		
Host (3 ports)	Standard	Compatible with USB 2.0
	Connector	USB Type-A female
Output current	Port marked with lightning bolt	1.2 A nominal
	Ports not marked with lightning bolt	0.5 A nominal
Rear panel		
10 MHz out	Connector	BNC female, 50 Ω nominal
	Output amplitude	≥ 0 dBm nominal
	Frequency	10 MHz ± (10 MHz x frequency reference accuracy)
Ext Ref In	Connector	BNC female, 50 Ω nominal
	Input amplitude range	10 MHz ± nominal
	Input frequency	10 MHz nominal
	Frequency lock range	±5 x 10^{-6} of specified external reference input frequency
Trigger 1 inputs	Connector	BNC female
	Impedance	> 10 kΩ nominal
	Trigger level range	–5 to 5 V
Trigger 1 outputs	Connector	BNC female
	Impedance	50 Ω nominal
	Level	5 V TTL nominal
Monitor output	Connector	VGA compatible, 15-pin mini D-SUB
	Format	XGA (60 Hz vertical sync rates, non-interlaced) analog RGB
	Resolution	1024 x 768
Noise source drive +28 V (pulsed)	Connector	BNC female
SNS Series noise source		
Analog out	Connector	BNC female
USB ports		
Host, super speed 2 ports (stacked with each other)	Standard	Compatible with USB 3.0
	Connector	USB Type-A female
	Output current	0.9 A
Host 1 port (stacked with LAN)	Standard	USB 2.0
	Connector	USB Type-A female
	Output current	0.5 A
Device	Standard	Compatible with USB 3.0 USB
	Connector	USB Type-B female

Rear panel		
GPIB interface	Connector	IEEE-488 bus connector
	GPIB mode	SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3, C28, DT1, L4, C0
	GPIB codes	Controller or device
LAN TCP/IP interface	Standard	1000Base-T
	Connector	RJ45 Ethertwist
Sync (reserved for future use)	Connector	BNC female
IF output	Connector	SMA female
	Impedance	50 Ω nominal
Wideband IF output, Option CR3[1]		
Center frequency		
SA mode or I/Q analyzer		322.5 MHz
Conversion gain		–4 to +7 dB (nominal) plus RF frequency response
Bandwidth	Low band	Up to 120 MHz (nominal)
	High band	Up to 40 MHz (nominal)

1. Not available on microwave CXA (Option 513 or 526)

I/Q Analyzer

Frequency				
Frequency span	Standard	10 Hz to 10 MHz		
	Option B25	10 Hz to 25 MHz		
Resolution bandwidth (spectrum measurement)				
Range	Overall	100 MHz to 3 MHz		
	Span = 1 MHz	50 Hz to 1 MHz		
	Span = 10 kHz	1 Hz to 10 kHz		
	Span = 100 Hz	100 MHz to 100 Hz		
Window shapes				
Flat top, Uniform, Hanning, Gaussian, Blackman, Blackman-Harris, Kaiser Bessel (K-B 70 dB, K-B 90 dB and K-B 110 dB)				
Analysis bandwidth				
Standard		10 Hz to 10 MHz		
Option B25		10 Hz to 25 MHz		
IF frequency response (standard 10 MHz IF path)				
IF frequency response (demodulation and FFT response relative to the center frequency, 20 to 30 °C)				
Center frequency (GHz)		Span (MHz)	Max. error	RMS (nominal)
≤ 3.0		≤ 10	±0.40 dB	0.03 dB
3.0 < f ≤ 26.5		≤ 10	±0.40 dB	0.25 dB
IF phase linearity (deviation from mean phase linearity, nominal)				
Center frequency (GHz)		Span (MHz)	Peak-to-peak	RMS
≤ 3.0		≤ 10	0.5°	0.2°
3.0 < f ≤ 7.5		≤ 10	2.7°	2.4°
7.5 < f ≤ 26.5		≤ 10	1.5°	0.4°
Data acquisition (standard 10 MHz IF path)				
Time record length		5,000,000 IQ sample pairs		
Sample rate		30 MSa/s		
ADC resolution		14 Bits		
Option B25 25 MHz analysis bandwidth				
IF frequency response (demodulation and FFT response relative to the center frequency, 20 to 30 °C)				
Center frequency (GHz)		Span (MHz)	Max. error	RMS
≤ 3.0		10 to ≤ 25	±0.45 dB	0.03 dB
3.0 < f ≤ 26.5		10 to ≤ 25	±0.45 dB	0.65 dB
IF phase linearity (deviation from mean phase linearity, nominal)				
Center frequency (GHz)		Span (MHz)	Peak-to-peak	RMS
0.02 ≤ f ≤ 3.0		10 to ≤ 25	2.7°	0.9°
3.0 < f ≤ 7.5		10 to ≤ 25	4.7°	2.2°
7.5 < f ≤ 26.5		10 to ≤ 25	3.5°	1.0°
Data acquisition (B25 IF path)				
Time record length	IQ analyzer	5,000,000 IQ sample pairs		
	Sample rate	90 MSa/s		
	ADC resolution	14 Bits		

Related Literature

Publication title	Publication number
CXA Signal Analyzer N9000B - Configuration Guide	5992-1275EN
X-Series Signal Analyzers - Brochure	5992-1316EN

For more information or literature resources please visit the web: www.keysight.com/find/cxa

Web

- Product page: www.keysight.com/find/N9000B
- X-Series measurement applications: www.keysight.com/find/X-Series_Apps
- X-Series signal analyzers: www.keysight.com/find/X-Series

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at www.keysight.com.

TECHNICAL OVERVIEW

N9000B CXA Signal Analyzer

9 kHz to 26.5 GHz

Master the Essentials of Signal Characterization for Industrial Communications and IoT

As the low cost, entry-level member of Keysight X-series signal analyzers, N9000B CXA signal analyzer is crafted for essential signal characterization for industrial communications and IoT. Harness the power of the X-series, and the proven measurement science, N9000B CXA is a reliable spectrum and signal analysis platform to address your versatile needs: from RF design verification, engineering, manufacturing, and repair service.

A flexible, scalable test platform for you

When you need deeper insight into your design beyond spectrum analysis – CXA protects your investment with scalable capabilities, such as analog/digital demodulation, noise figure, EMI emission, LoRa, NB-IoT signal analysis, etc. All these extended capabilities can be easily enabled by X-series applications.

KEYSIGHT TECHNOLOGIES

Three great reasons of having a CXA signal analyzer on your bench

Superior performance adds confidence in each measurement you make

- Frequency range: 9 kHz to 3/7.5/13.6/26.5 GHz
- Internal fully calibrated preamplifier up to 26.5 GHz
- Resolution bandwidth: 1 Hz to 8 MHz
- Displayed average noise level (at 1 GHz): -163 dBm/Hz
- Third order interception (at 1 GHz): +17 dBm
- Total absolute amplitude accuracy (at 1 GHz): ± 0.5 dB
- Phase noise (1 GHz, 10 kHz offset): -110 dBc/Hz
- Maximum analysis bandwidth: 25 MHz

Figure 1. Detecting low-level and close-in signals made easy

Scalable applications help you gain deeper insight into your designs

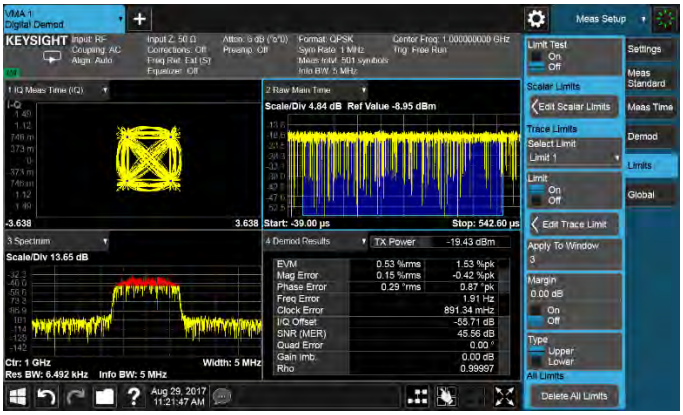


Figure 2. Signal demodulation analysis via the VMA application

Equip CXA with application software to cover your evolving testing needs:

- EMI precompliance test features: CISPR16-1-1 bandwidth, quasi-peak detector, limit lines, and amplitude correction factor, as well as easy-to-use instrument presets
- Popular applications such as noise figure, phase noise, EMI emissions, vector signal demodulation (VMA) and analog demodulation
- A wealth of wireless connectivity signal analysis applications such as LoRa CSS, 802.15.4 Zigbee, Bluetooth 4.0/4.2 and Bluetooth 5, WLAN 802.11a/b/g/j/p/n/af/ah; as well as legacy cellular communications formats from 2G to 4G

Easy to use in either manual or remote operation environment

- Multi-touch graphic user interface, 10.6-inch display
- Powersuite (requires N90EMPSMB software) covers frequently-used power measurements such as Channel power, PSD, OBW, ACP, CCDF, SEM, Harmonics, Spurious emission, Burst power, and TOI
- LXI-C certified with LAN Triggering and Time Synchronization
- I/O interface choices: USB, 100 Base-T LAN, GPIB
- Programming code compatible with Agilent ESA and X-series, IVI-COM supported
- Support BenchVue software (BV90001B)

Take a Closer Look

We incorporated all the proven architecture, measurement science, expertise and software into this industry-leading low-cost platform - N9000B CXA.

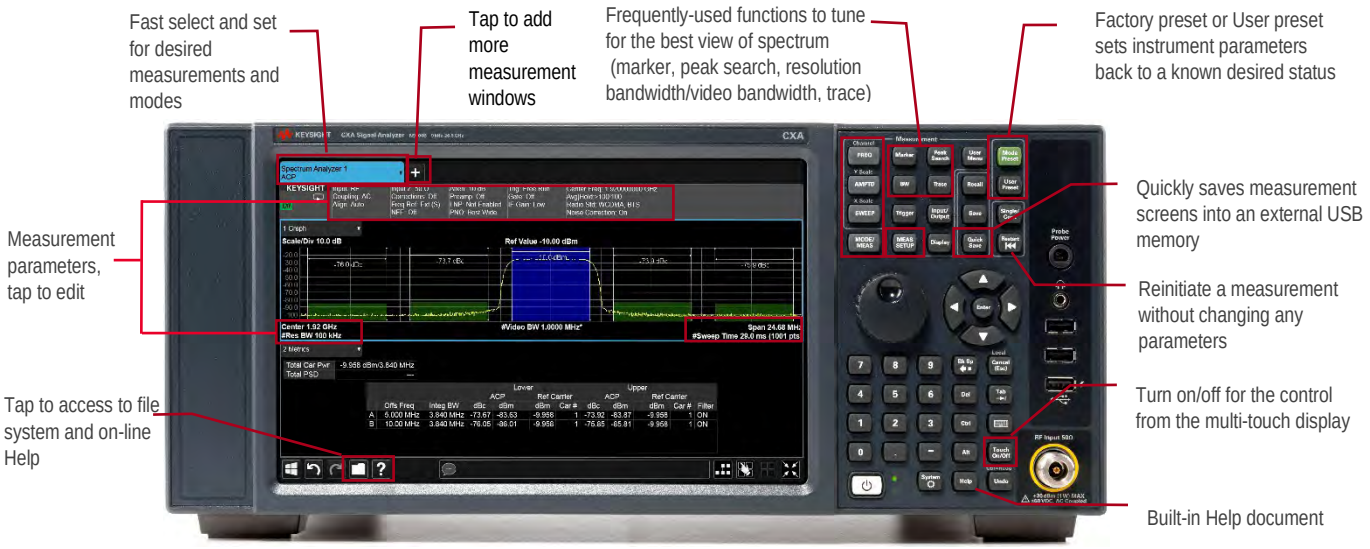


Figure 3. N9000B CXA signal analyzer front view

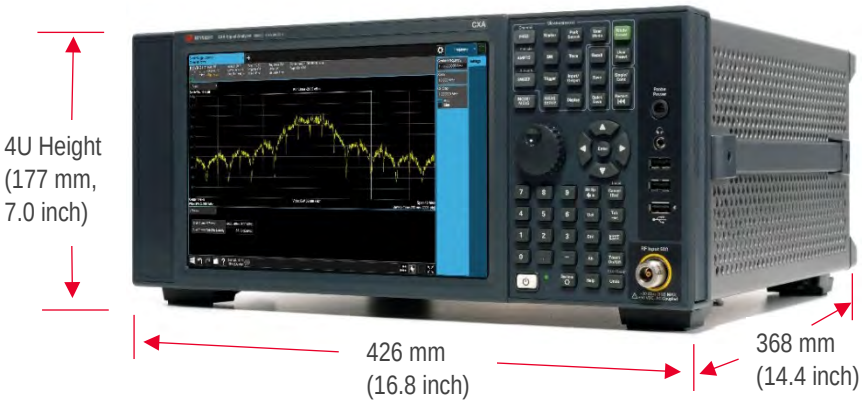


Figure 4. The dimension of N9000B CXA signal analyzer

Proven Architecture Inside

- High performance dual core 64-bit CPU
- 8 GB RAM, 160 GB removable solid-state drive
- Windows 10 operating system

Figure 5. The rear panel of N9000B CXA signal analyzer

Common Measurements Available From a CXA

RF design engineers' ultimate goal is to ensure their radio transmitters to transmit at the right frequency with enough power, but not excessive power that may bring bad interference to other electronic devices in the neighborhood. For example, in radio transmitter test case, you primarily care about the transmission power and frequency, and how accurate they are. You also care about those harmonics, spurious and distortions that might generate internal or external interference to the whole system. If you design wireless devices, IoT devices, or medical devices, you need test your products against certain wireless standard to make sure your device follow and meet all the required specifications

Keysight N9000B CXA is primarily a general purpose spectrum analyzer, which helps you to characterize the most fundamental parameters of an wireless transmitter, such as if its center frequency, drift; output power, or occupied bandwidth; or its in-band or out-band spurious.

When you add the X-series applications onto the CXA, it becomes a flexible signal analyzer, capable to characterize today's narrow band wireless connectivity formats, such as LoRa, Bluetooth, Zigbee, NB-IoT signals, WLAN 802.11 a/b/g/j/p/n/af/ah, and more custom digital modulation signals. The N9000B CXA signal analyzer is with 10 MHz analysis bandwidth as standard, and up to 25 MHz analysis bandwidth optional (option B25)

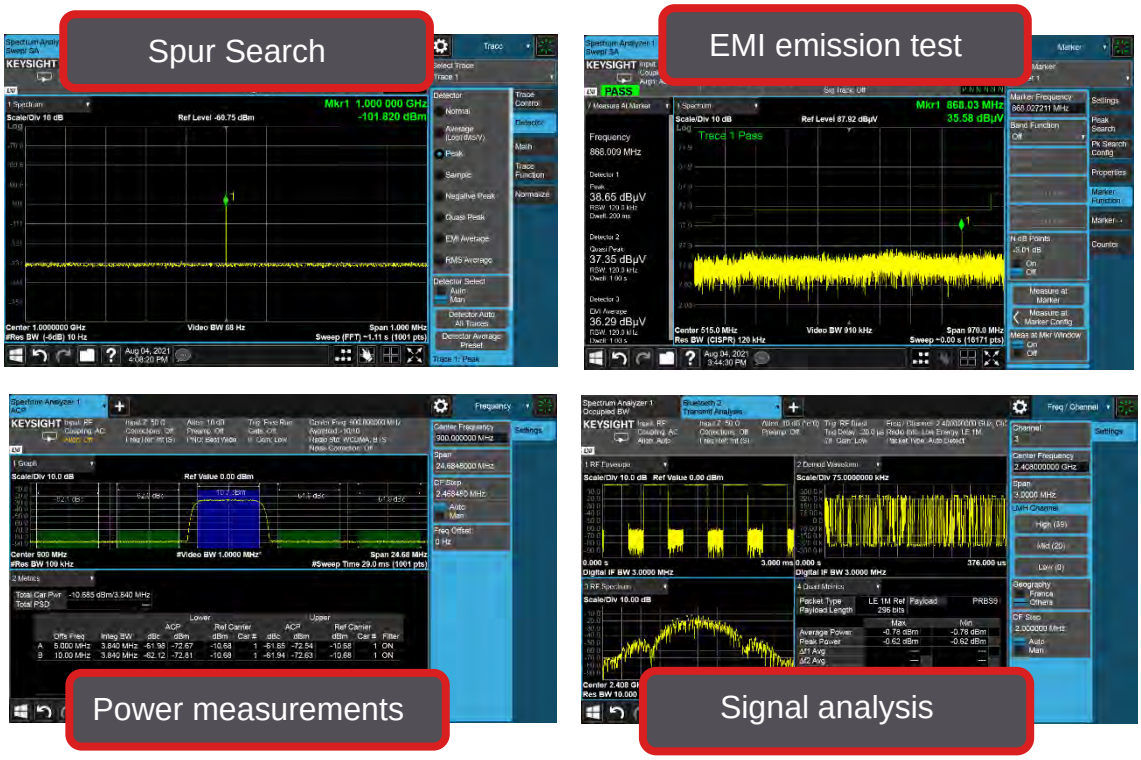


Figure 6. The 4 types of common measurements available from a CXA

Power measurements

There are many transmitter related power measurements that you can reply on CXA to accomplish them easily. And we put them into one-button Powersuite (N90EMPSMB), covering:

- Channel power (CHP)
- Occupied bandwidth (OBW)
- Adjacent channel power (ACP)
- CCDF
- Burst power
- Spurious emission
- SEM
- TOI
- Harmonics

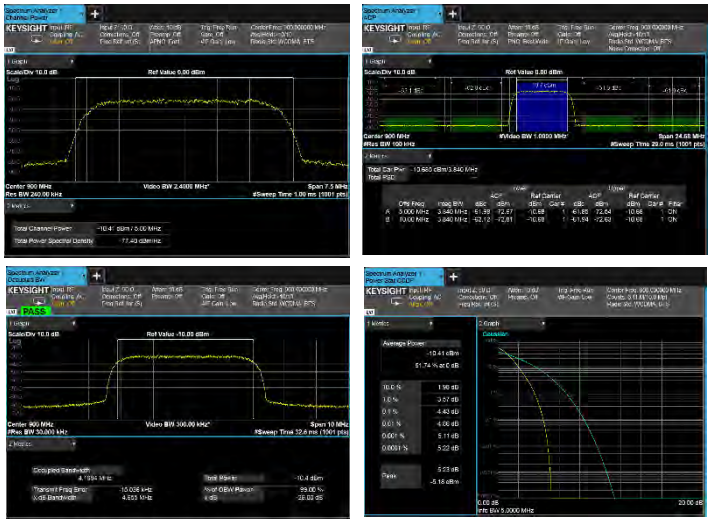


Figure 7. N90EMPSMB Powersuite measurements running on CXA

EMI emission measurements

The concept of getting a product to market on time and within budget is nothing new. Companies know well that EMI compliance testing can be a bottleneck in the product development cycle. To ensure a successful final EMI compliance testing, precompliance test has been added into the product development cycle, and it is the earlier, the better.

Early stage of EMI precompliance test does not mean you always need to set up an expensive EMI compliance test lab of your own. Instead, you can highly rely on a signal analyzer or a spectrum analyzer to detect unwanted power emissions:

- Does my product generate excessive power or unexpected spurious?
- Does my product cause radiated emissions from a USB port, a LAN port, a faulty shielding case or a cable, even the power cord?

Figure 8. Detecting EMI emissions with a near-field probe (N9311X-100)

The close field testing is the only way to locate the exact source of the emission, however, it is a relative test, meaning a comparison of the measurement results from time to time is more meaningful for EMI improvement of your design.

Note that it is meaningless to compare the close field test result against the EMI standard test limit lines, because several factors can affect the test readout.

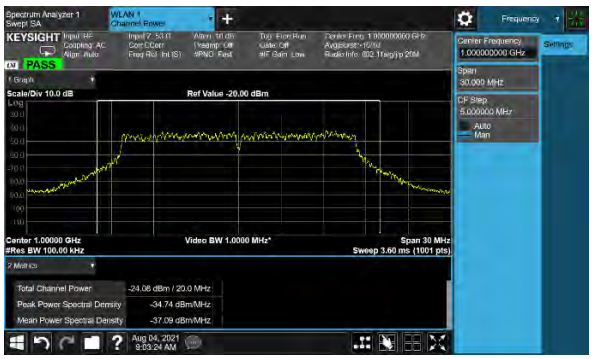
Expect More

N9000B CXA signal analyzer supports more than 25 measurement applications, to address your evolving demands of technology:

General purpose	Wireless connectivity	Cellular communication	Others
Analog demodulation Vector demodulation EMI precompliance Noise figure Phase noise Pulse	WLAN (802.11a/b/g/j/p/n/af/ah) Short-range and IoT (802.15.4 Zigbee, Z-wave; LoRa CSS) Bluetooth NB-IoT	LTE/LTE-Advanced FDD LTE/LTE-Advanced TDD LTE V2X NB-IoT and eMTC FDD W-CDMA/HSPA+ GSM/EDGE/Evo	Enhanced display package Basic EMI precompliance External source control SCPI command compatibility

These applications offer 4 license types and 2 license terms, flexibly addressing different budget spending needs. It also helps you to manage the licenses for multiple projects and multiple users in multiple locations.

Type	Perpetual	Time-based
Node-locked	■	■
Transportable	■	■
USB portable	■	■
Network floating	■	■
Business expense	Capex $$'s	Opex $$'s



Ordering Information

Ordering number	Description
Base Instrument	
N9000B-503	N9000B CXA signal analyzer, 9 kHz to 3 GHz
N9000B-507	N9000B CXA signal analyzer, 9 kHz to 7.5 GHz
N9000B-513	N9000B CXA signal analyzer, 9 kHz to 13.6 GHz
N9000B-526	N9000B CXA signal analyzer, 9 kHz to 26.5 GHz
Performance option	
N9000B-PFR	Precision frequency reference (enables ±0.1ppm annual aging rate)
N9000B-FSA	Fine resolution attenuator (enables 2-dB steps of the input attenuator)
N9000B-B25	25 MHz analysis bandwidth
N9000B-P03	Preamplifier, 3 GHz
N9000B-P07	Preamplifier, 7.5 GHz
N9000B-P13	Preamplifier, 13.6 GHz
N9000B-P26	Preamplifier, 26.5 GHz
Additional capability	
N9000B-TG3	Tracking generator, 9 kHz to 3 GHz
N9000B-TG6	Tracking generator, 9 kHz to 6 GHz

Download N9000B configuration guide (5992-1275EN) for a complete view of options and software for N9000B CXA signal analyzer

Visit N9000B website www.keysight.com/find/CXA for more information

Visit our website www.keysight.com/find/xseriesapps for more information about X-series applications

Related documents

Literature	What's included	Pub number
N9000B Data Sheet	Summary of instrument specifications	5992-1274EN
N9000B Specification Guide	Instrument specifications in details	N9000-90035
N9000B Configuration Guide	Instrument options, software, upgrade kits	5992-1275EN
User's and Programmer's Guide	About the GUI, measurement modes, functions, key reference, and SCPI commands	N9060-90041
EMI troubleshooting: The need for close field probes	Locating, evaluating, and troubleshooting potential emission sources with close field probes	5991-0144EN
Making conducted and radiated emission measurements	An overview of conducted and radiated EMI emission measurements and a methodology for EMI precompliance testing	5990-6152EN
Technical overview of N6141EM0E EMI measurement application	A summary of the N6141EM0E measurement application for EMI emission test: features, and license types and terms	5992-2842EN
Spectrum analysis Basics (AN150)	The classic AN150 introduces the fundamentals of classic swept-tuned spectrum analyzers and the latest advances in modern signal analyzers	5952-0292EN
IoT design and development solutions	Learn about the rising challenges for IoT devices, test considerations, and solutions	5992-1478EN
Noise figure measurement guide	About how to carry out noise figure measurements with X-series signal analyzers and relevant application N9069EM0E	N9060-90001
10 hints for noise figure measurements	About how to minimize the uncertainties in your noise figure measurements	5980-0288EN
N9054EMxE Technical Overview VMA vector modulation analysis	A summary of the N9054EMxE VMA application for a wide range of comprehensive signal analysis: time domain I/Q waveform, monitoring spectrum and digital demodulation analysis	5992-2852EN

Learn more at: www.keysight.com

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KEYSIGHT TECHNOLOGIES

DATA SHEET

InfiniiVision 3000G X-Series Oscilloscopes

Product Overview

The InfiniiVision 3000G X-Series oscilloscopes with bandwidth models ranging from 100 MHz up to 1 GHz offer high-end technology in a small form factor. With an intuitive touch user-interface, industry-leading waveform update rate, zone trigger, and 8 new standard features, you can capture and isolate elusive glitches and anomalies not possible on other oscilloscopes.

KEYSIGHT TECHNOLOGIES

Table of Contents

InfiniiVision 3000G X-Series: The Best in Usability Deserves the Best Features

Meet the new generation of Keysight's industry leading InfiniiVision X-Series oscilloscopes. With the best in usability, a comprehensive front panel with quick access buttons, easy-to-use touch operation or mouse-based control through direct connection or web-based UI, the InfiniiVision 3000G X-Series oscilloscope enables you to work in whatever way is best for you.

Keysight's InfiniiVision 3000G X-Series oscilloscope come in 2-channel models, 4-channel models, and mixed signal oscilloscope (MSO) models with bandwidths ranging from 100 MHz up to 1 GHz.

All models are enhanced with **standard features** that you would typically expect to pay extra for including:

- Powerful triggering and decoding serial buses including I^2C, SPI, UART/RS232/RS485, I^2S, and USB-PD
- High performance mask and measurement limit testing enabled in hardware
- Frequency response analysis (Bode plots)
- Waveform & measurement histograms
- Built-in function/arbitrary waveform generator
- HDTV video analysis
- LAN/VGA I/O communication
- PathWave BenchVue Oscilloscope software for control, automation, and offline analysis

Figure 1. InfiniiVision 3000G X-Series with MegaZoom IV smart memory technology

Touch, Discover, Solve

The InfiniiVision 3000G X-Series oscilloscopes have a capacitive touch screen user-interface that was designed for touch operation. Also included is hardware-based zone triggering combined with an industry-leading uncompromised update rate of 1 million waveform/sec to give you the confidence that you're seeing all of your signal detail and the ability to discover any issues.

The InfiniiVision 3000G X-Series redefines what you can expect in a general-purpose oscilloscope by providing all the performance and capability you need to get to measurement insights faster:

Touch:

- 8.5-inch capacitive touch screen
- Designed-for-touch interface

Discover:

- Industry's fastest uncompromised waveform update rate
- Zone trigger

Solve:

- Wide range of serial decodes
- 7-in-1 instrument integration
- Time/frequency domain correlation

Touch: Designed-for-touch operation to simplify use

From the start of product development, we designed every aspect of this oscilloscope to be seamlessly driven by a touch interface. Large, easy-to-touch targets, a graphical user interface that adapts to show you more and be easier to touch, and a large, sensitive, capacitive touch screen all combine to make operation quick and natural, just like your favorite tablet devices.

Figure 2. An 8.5" capacitive touch display with large, touchable targets.

Capacitive touch screen technology enables productivity

The user interface allows you to use the alphanumeric pad for quick annotation, place waveforms or cursors in exact positions and drag docking panels across the screen to see more measurement information.

The InfiniiVision 3000G X-Series offers three ways to access key menus and features: touch GUI for those that prefer tablet or smart phone touch interfaces, front panel buttons and knobs for the traditional oscilloscope users, and Keysight Insight pull down menu for users who prefer Windows-like operations. The 3000G X-Series also offers a “touch off” button as well as USB mouse and keyboard support.

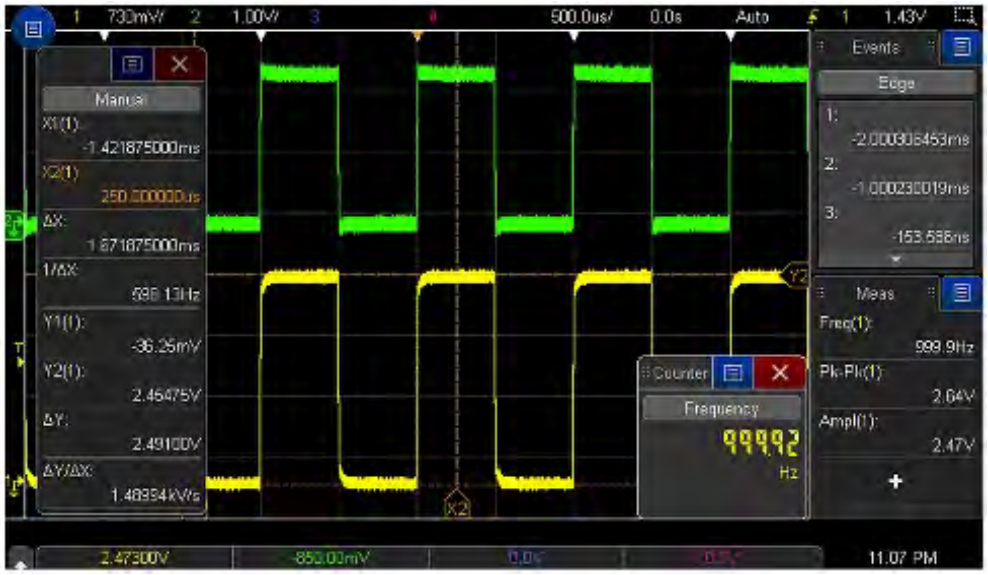


Figure 3. Side bar with movable docks allows information to be placed on the screen precisely where you want it for documentation.

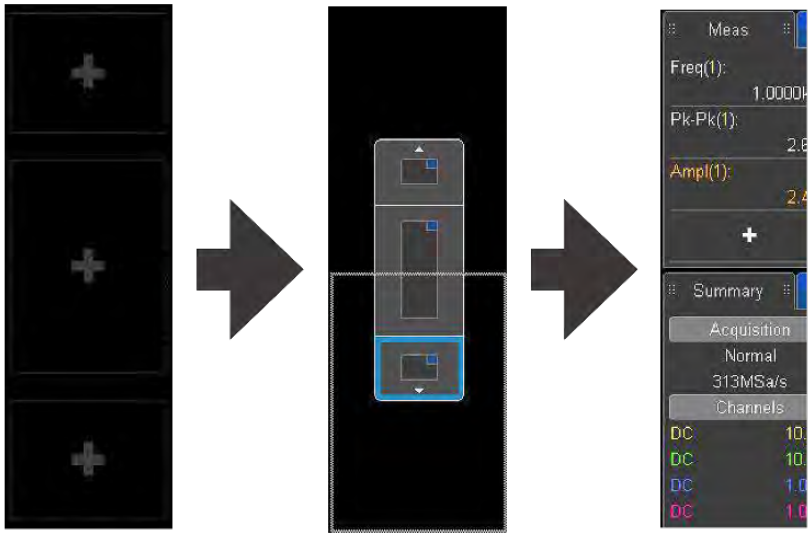


Figure 4. A dock-able sidebar allows you to customize how you view your measurements.

Touch interface simplifies documentation

The availability of up to 10 annotations on screen makes it easy to highlight key items on screen shots. Streamline documentation with the ability to input information via a pop-up soft keyboard on the touch screen or a USB keyboard. A sidebar displays additional information without covering the waveform graticule and allows you to dock and scroll through multiple measurement values. Touch gestures (like flicking) make navigating lists or moving between segment waveforms easy.

Figure 5. See up to ten annotations on screen at once for documentation. The standard touch screen makes inputting notes simple.

In addition to the benefits of touch, built-in USB host and USB device ports, as well as a LAN port, make PC connectivity easy. The BV0004B oscilloscope control and PC-based software (standard with the purchase of each InfiniiVision X-Series oscilloscope) lets you control and visualize the InfiniiVision 3000G X-Series and multiple measurements simultaneously. It lets you build automated test sequences just as easily as you can with the front panel. Save time with the ability to export measurement data to Excel, Word and MATLAB in three clicks. Monitor and control your 3000G X-Series oscilloscope with a mobile device from anywhere. Simplify your testing with BenchVue software.

Learn more at www.keysight.com/find/BenchVue

Figure 5. Use BenchVue for remotely logging and plotting measurement data.

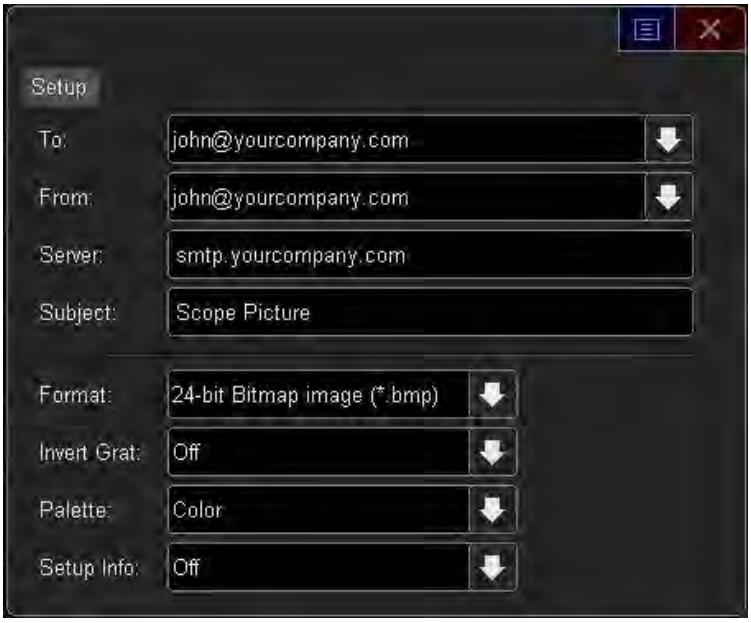


Figure 6. With the standard LAN/VGA module you can email yourself setups, data, and screenshots.

Redefine your remote web control oscilloscope experience

The InfiniiVision 3000G X-Series oscilloscope offers traditional control via a PC Web browser, but also supports remote control through popular tablet devices when using the standard LAN/VGA interface.

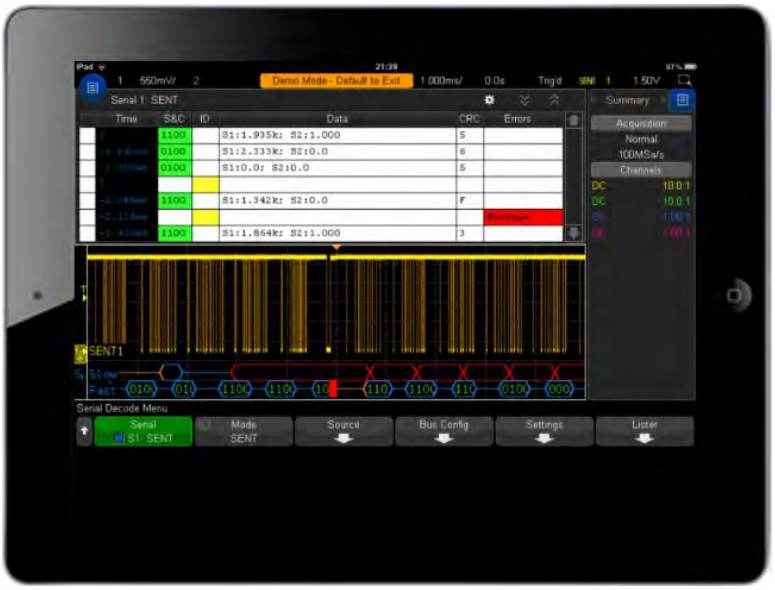


Figure 7. Remotely control the InfiniiVision 3000G X-Series oscilloscope via tablet device.

Discover: Fast Update Rate and Zone Triggering Uncover Hidden Signal Problems

Industry-leading uncompromised update rate

If you can't see the problem, you can't fix the problem. With an industry-leading update rate of over one million waveforms per second, the InfiniiVision 3000G X-Series oscilloscope gives you the highest probability of capturing random and infrequent events that you would miss on an oscilloscope with a lower waveform update rate.

Powered by MegaZoom IV smart memory technology, the InfiniiVision 3000G X-Series not only lets you see more waveforms, but it has the uncompromised ability to find the most difficult problems in your design under any conditions. Unlike other oscilloscopes, uncompromised ability means:

- Always-fast, responsive operation
- No slowdown with logic channels on
- No slowdown with protocol decoding on
- No slowdown with math functions on
- No slowdown with measurements on
- No slowdown with vectors on
- No slowdown with sinx/x interpolation on

What is waveform update rate?

As oscilloscopes acquire data, process it, and plot it to the screen, there is inevitable “dead time,” or the time oscilloscopes miss signals completely while processing waveform data from the previous acquisition. In general, the faster the waveform update rate, the shorter the dead time. The shorter the dead time, the more likely an oscilloscope is to capture anomalies and infrequent events. This is why it is important to select an oscilloscope with a fast waveform update rate. Figures 9 and 10 demonstrate the difference between a slower update rate and a faster update rate.

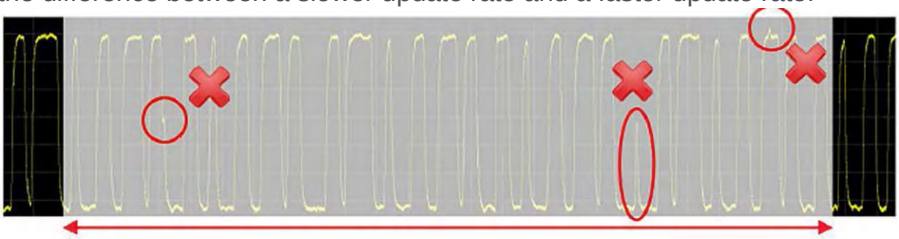


Figure 9. Another vendor’s oscilloscope with 50,000 waveforms/second. A long dead time decreases your chances of capturing infrequent events.

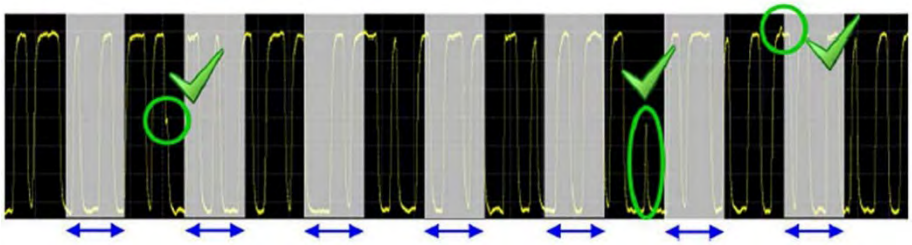


Figure 10. InfiniiVision 30000G X-Series with 1,000,000 waveforms/second. A short dead time increases the probability of capturing infrequent events.

But all specs aren’t equal. Many vendors may claim a fast update rate specification, but that is only in a special mode, or without any features turned on. Table 1 shows the 3000G X-Series’ update rate versus a competing oscilloscope.

While all scopes update rate will vary to some degree by the timebase setting, it is critical that the update rate remain constant regardless of the functionality you are using within the oscilloscope.

Table 1. Measured update rate between the 3000G X-Series and the Danaher Tektronix MDO3000. Note how the update rate fluctuates wildly on the MDO3000 based on different settings/features.

	10 ns/div			
	Keysight 3000G X-Series		Tektronix MDO3000 Series	
Max with no features on	Update rate	Probability	Update rate	Probability
Max with digital ch on	1,114,000	94%	281,000	50%
Max with measurements on	1,101,000	94%	132	0.03%
Max with FFT on	1,114,000	94%	2,200	0.55%
Max with serial on	1,114,000	94%	2,200	0.55%
Max with search on	1,100,000	94%	1,800	0.45%
Max with ref wfms on	1,113,000	94%	2,200	0.55%

Why is an uncompromised update rate important?

When debugging or troubleshooting a project, it is important that you see as much signal detail as possible. A fast update rate is just part of the overall equation to determine the likelihood of seeing an anomaly. The frequency of the anomaly, the timebase setting of the oscilloscope and the amount of time you allow the oscilloscope to see the anomaly all come in to play:

$P_t = 100 \times (1-[1-RW]^{(U \times t)})$

Where:

Pt = Probability of capturing anomaly in “t” seconds

t = Observation time

U = Scope’s measured waveform update rate

R = Anomalous event occurrence rate

W = Display acquisition window = Timebase setting x 10

Therefore, it is important to select an oscilloscope with the fastest uncompromised update rate to allow enough time to increase your chances of seeing the glitch. In Table 1, in addition to the measured update rate, we show the probability of seeing a glitch that happens 5 times a second while allowing the oscilloscope to acquire for 5 seconds. With the 3000G X-Series you maximize your chances of seeing the infrequent glitch. With the competing scope, if you are using any of the other features like measurements, or search or digital channels, the update rate slows considerably. The only option you have in this case is to allow the oscilloscope to run longer. For example, if you are using digital channels, you’ll have to let the scope run over 8,000 times longer to get a similar probability to the uncompromised update rate of the 3000G X-Series. That’s almost 12 hours of time versus 5 seconds!

MegaZoom IV smart memory technology enables uncompromised update rate

Traditionally, CPU processing was the major bottleneck for oscilloscope waveform update rate and responsiveness. Typically, the CPU handles interpolations, logic channel plotting, serial bus decoding, measurements and more, and the waveform update rate drops dramatically as these features are turned on.

The InfiniiVision 3000G X-Series requires minimum support from a CPU, as most core operations are handled by Keysight proprietary technology, the MegaZoom IV smart memory ASIC. MegaZoom includes hardware serial decoders and hardware mask limit testing capability, plots analog and digital data directly to the display, supports GUI operation, and integrates additional instruments like the WaveGen function/arbitrary waveform generator.

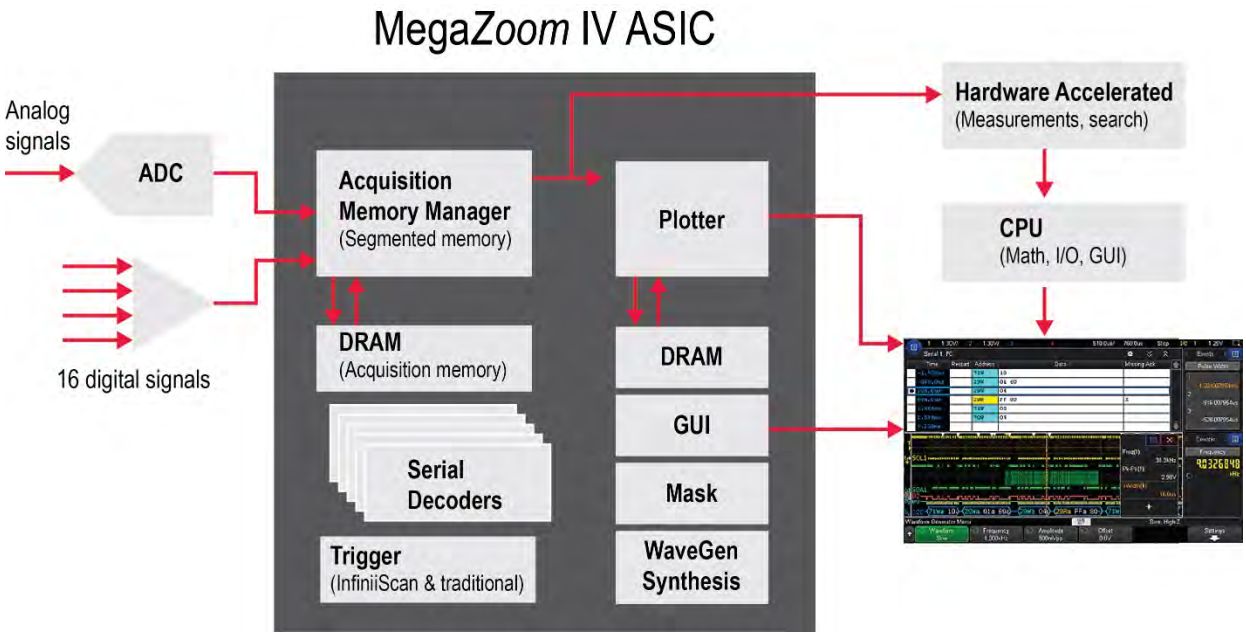


Figure 11. The 3000G X-Series oscilloscopes' uncompromised responsiveness, speed and waveform update rate are enabled by the MegaZoom IV, smart memory ASIC. The CPU is not used for core waveform operations.

Excellent signal integrity allows you to see more signal detail

The 3000G X-Series has excellent signal integrity, including full bandwidth to 1 mV/div and the ability to obtain up to 12-bits of resolution using the high-resolution acquisition mode.

Some oscilloscopes in this class limit their bandwidth at lower volt-per-division settings without on-display user notifications. This is likely to keep the noise acceptable at lower volt-per-division settings.

Table 2 shows a comparison of the typical noise floor at 20 µs/div between the normal and high-resolution mode. You will notice that the noise floor performance improves as much as five times.

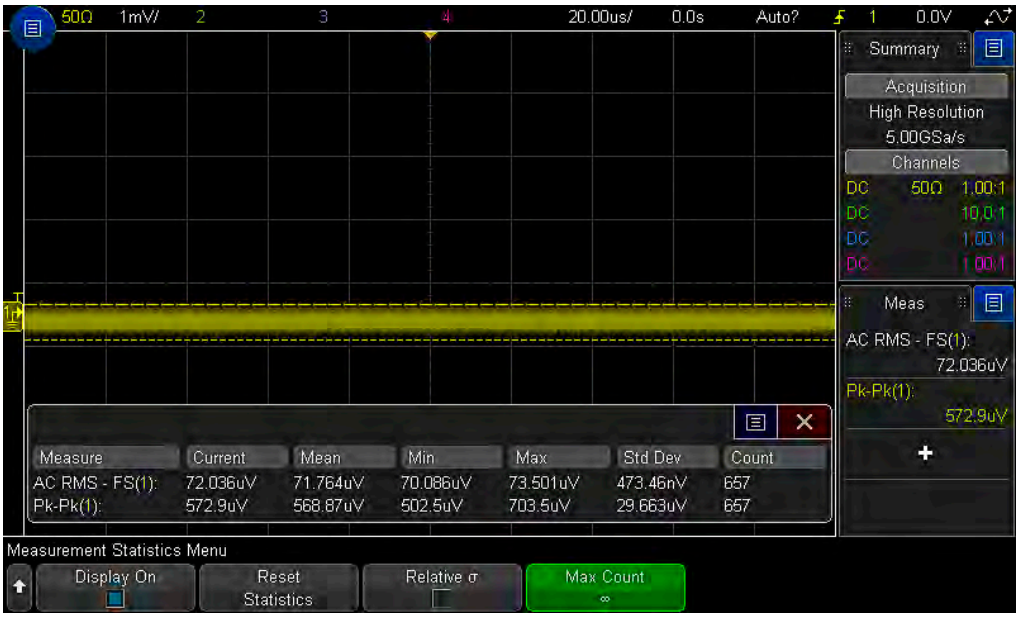


Figure 12. High resolution mode allows you to lower your noise and increase your resolution up to 12-bits.

Table 2. Noise comparison between the normal and high-resolution mode at 20 µs/div.

50 Ω 1 GHz bandwidth Vrms measurement (units = mV)			
Vertical setting	Normal mode	**High resolution mode**	Notes
1 mV	0.277	0.072	Some other manufacturers will limit their bandwidth significantly at these vertical settings, but the Keysight 3000G X-Series provides full bandwidth at all settings.
2 mV	0.277	0.072	
5 mV	0.297	0.081	
10 mV	0.352	0.081	
20 mV	0.597	0.102	
50 mV	1.500	0.340	
100 mV	2.560	0.480	
200 mV	5.500	1.050	
500 mV	15.200	3.630	
1 V	26.000	4.830	

Zone trigger makes triggering on complex signals simple

An uncompromised update rate allows you to see an anomaly, but to continue the debug process you must isolate it. Setting up advanced trigger conditions has been a challenge since oscilloscopes introduced triggered waveforms. While oscilloscopes have added more and more triggering capability over the years, setting up specialized trigger conditions has remained complex at best and impossible at worst.

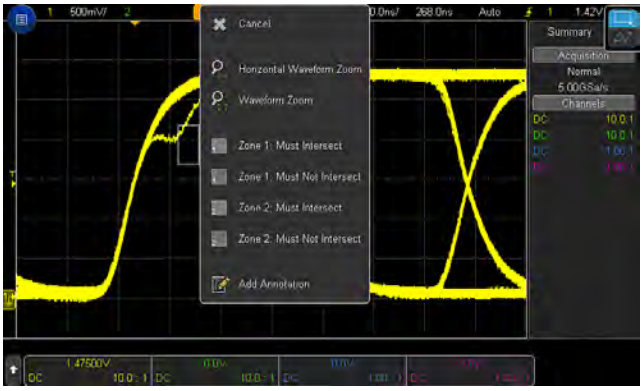
Zone trigger eliminates the complexity of setting up advanced triggers. Now, if you can see an infrequent event on the display of the oscilloscope, you can trigger on it by simply drawing a box that intersects a portion waveform you want to isolate.

See how easy Zone touch triggering can be with these examples:

Steps to isolate a non-monotonic edge: 3000G X-Series:

- Draw box on the infrequent non-monotonic edge
- Select “must intersect”

In some cases, you may have to select the appropriate source/channel if it wasn’t already selected.



Traditional scopes with advanced triggers

(assuming the update rate is fast enough to see what you want to trigger on):

1. Determine what trigger makes the most sense for the signal you are trying to isolate. In this case, we’ll try a rise-time trigger first.
2. Select cursors
3. Move cursor a to 10% level
4. Move cursor b to 90% level on the non-monotonic edge
5. Obtain the delta time (rise time) between the cursors
6. Select trigger menu
7. Press trigger type
8. Select Rise/Fall time Trigger
9. Select your source
10. Select your slope
11. Select when you want it to trigger – is it less than, greater than, equal to, not equal to. We’ll select greater than.
12. Dial in the “greater than” setting to the measured rise time
13. Adjust your low threshold to the 10% level
14. Adjust your high threshold to the 90% level

Steps to trigger on a runt signal: 3000G X-Series

1. Draw box on the infrequent runt pulse
2. Select “must intersect”
3. Draw a second box if needed to further isolate the runt from other runts
4. Select “must intersect” or “must not intersect”

In some cases, you may have to select the appropriate source/channel if it wasn’t already selected.

Traditional scopes with advanced triggers

(Assuming the update rate is fast enough to see what you want to trigger on).

Determine what trigger makes the most sense for the signal you are trying to isolate. In this case, we’ll use a runt trigger first.

1. Select trigger menu
2. Press trigger type
3. Select runt Trigger
4. Select your source
5. Select the runt’s polarity
6. Adjust your low threshold to below the runt
7. Adjust your high threshold to above the runt
8. Select when you’ll trigger – in this case, we want to trigger on the exact pulse width of the runt
9. Select cursors
10. Move cursor a to the rising edge of the pulse at the 50% mark
11. Move cursor b to the falling edge of the pulse at the 50% mark
12. Obtain the delta time (pulse width) between the cursors
13. Adjust the runt width to be equal to the pulse width that was measure

Standard segmented smart memory allows you to capture longer periods of time at higher sample rates

Acquisition memory size is an essential oscilloscope specification because it determines sustainable sample rate and the amount of time you can capture in a single acquisition. In general, longer memory is better. However, no memory will always be long enough to capture all the signals you need, especially when capturing infrequent anomalies, data bursts, or multiple serial bus packets. Segmented memory acquisition lets you selectively capture and store important signal activity without capturing unimportant signal idle time. In addition, it provides a time stamp of each segment relative to the first trigger event to enable analysis of the frequency of the event. Segmented memory comes standard on the InfiniiVision 3000G X-Series oscilloscope.

Figure 13 shows segmented memory successfully capturing 100 small and large glitch events at 5 GSa/s in 47 seconds. Traditional memory architecture would require almost 203G points of memory to accomplish the same result! This memory is not available on any scope in the market.

Furthermore, segmented memory discovered that the worst offender glitch happened 40 seconds from the first trigger event, or at the 95th glitch. It also found out a unique glitch took place 13 seconds after the first glitch. As shown in figure 14, you can overlay all segments to have a comprehensive view as well.

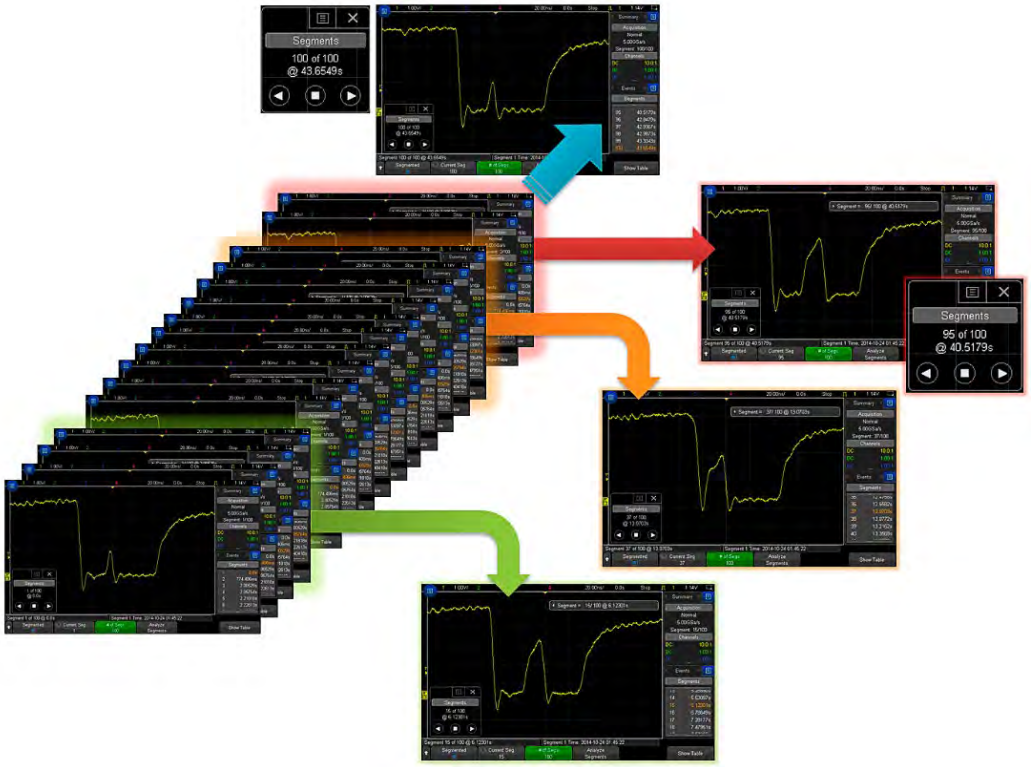


Figure 13. Segmented memory reveals different types of glitches are taking place.

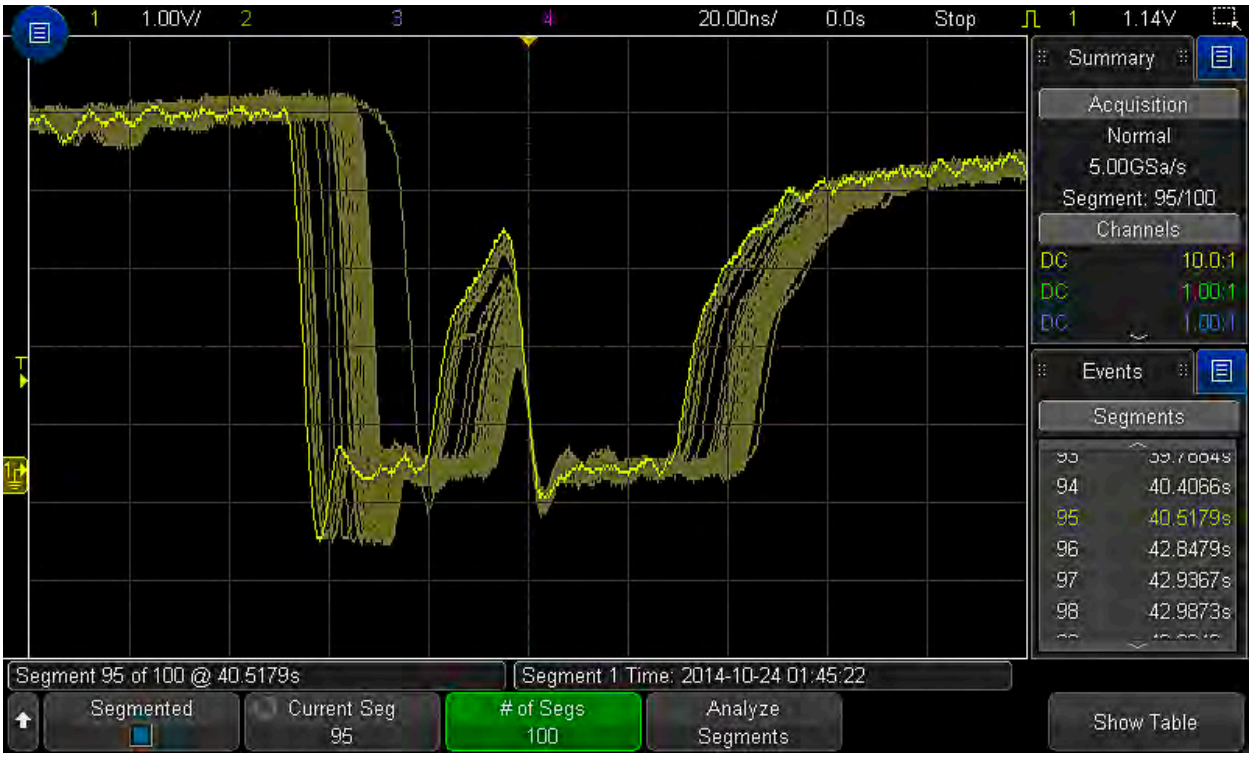


Figure 14. Screen showing an overlay of all 100 segments for worst case waveform analysis.

Dedicated search & navigation helps you navigate deep memory

Parametric and serial bus search and navigation comes standard on the InfiniiVision 3000G X-Series oscilloscopes. When you are capturing long, complex waveforms using an oscilloscope's acquisition memory, manually scrolling through stored waveform data to find specific events of interest can be slow and cumbersome. With automatic search and navigation capability, you can easily set up specific search criteria and then quickly navigate to "found and marked" events. Available search criteria include edges, pulse width (time-qualified), rise/fall times (time-qualified), runt pulses (time-and level-qualified), frequency peaks (FFT function, threshold and excursion qualified), and serial bus frames, packets, and errors.

Close-up on buttons on the front panel of the scope. Alternatively, you also can use the touch navigation control.

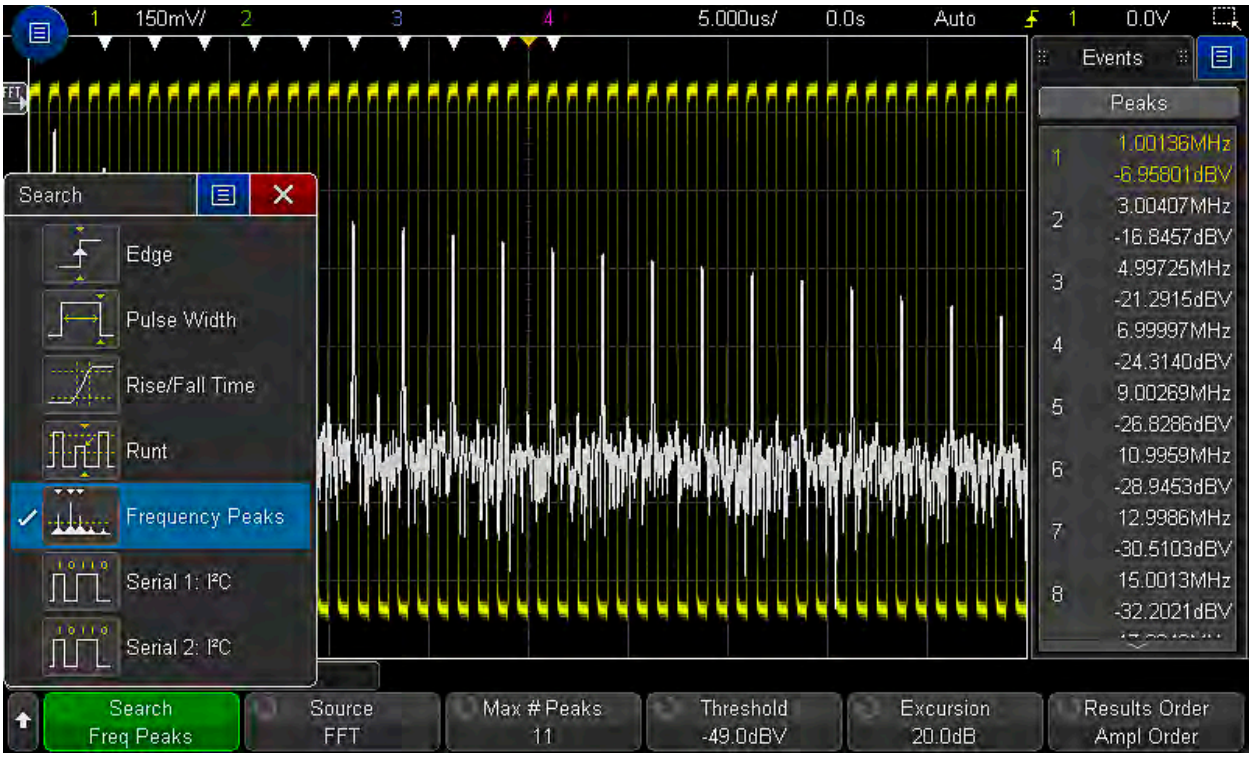


Figure 15. The InfiniiVision 3000G X-Series was set up to capture clock signals for FFT analysis. Using the search and navigation capability, the scope was able to find, mark (white triangles) and quickly navigate to the first 11 frequency peak occurrences. You can select to sort the search results in the order of frequency or amplitude.

Solve: Analyze waveform data quickly with advanced features

Hardware-based serial decode & triggering makes easy work of low-speed serial buses

Keysight InfiniiVision oscilloscopes, including the new 3000G X-Series, use hardware-based serial protocol decoding. Most other vendors use software post-processing techniques to decode serial packets⁄frames, and therefore have slow waveform and decode capture rates and could miss critical events and errors due to a long dead-time. Faster decoding with hardware-based technology enhances the probability of capturing infrequent serial communication errors.

After capturing serial bus communication, you can easily perform a search operation based on specific criteria and then quickly navigate to bytes/frames of serial data that satisfy that search criteria. The 3000G X-Series can decode two serial buses simultaneously using hardware-based decoding and display the captured data in a time-interleaved “lister” display.

Serial protocol decoding can be used simultaneously with segmented memory and Zone triggering. The 3000G X-Series has the most decode/trigger capabilities in this class of instrument including I²C, SPI, RS232/422/485/UART, I²S, CAN, CAN FD, LIN, SENT, CXPI, FlexRay, MIL-STD 1553, ARINC 429, USB PD, and USB 2.0 low- & full-speed.

Optional and standard supported serial bus protocols

The InfiniiVision 3000G X-Series supports a range of different serial decode and trigger options including:

- I^2C (standard)
- SPI (2/3/4 wire, standard)
- RS232/422/485/UART (standard)
- USB 2.0 low- and full-speed
- CAN (symbolic with .dbc file)
- CAN FD (symbolic with .dbc file)
- LIN (symbolic with .ldf file)
- SENT
- CXPI
- FlexRay
- MIL-STD 1553
- ARINC 429
- USB PD (standard)
- I^2S (standard)
- User-definable Manchester
- User-definable NRZ

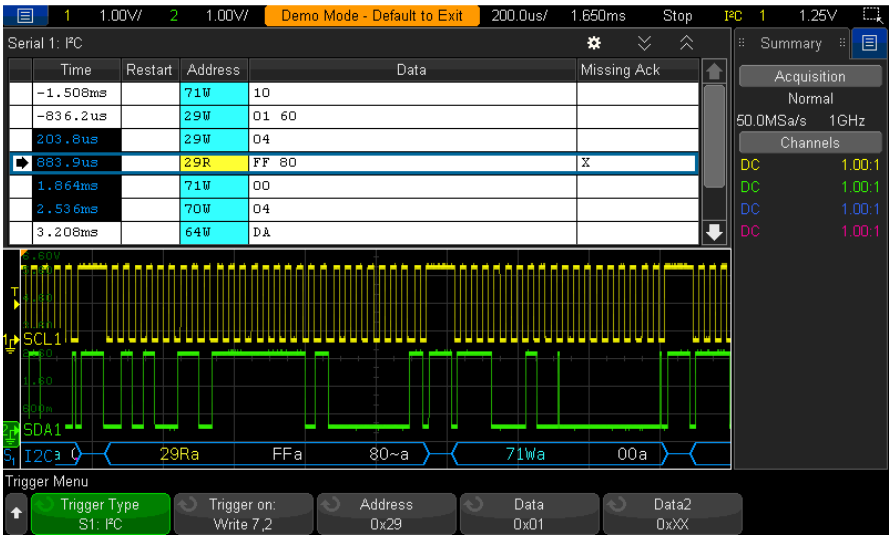


Figure 16. I^2C decode and trigger.

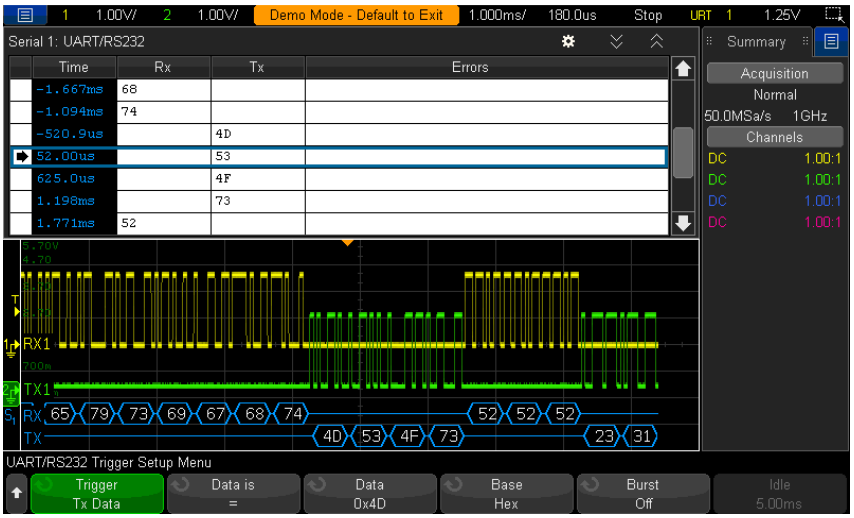


Figure 17: UART/RS232/RS485 trigger and decode.

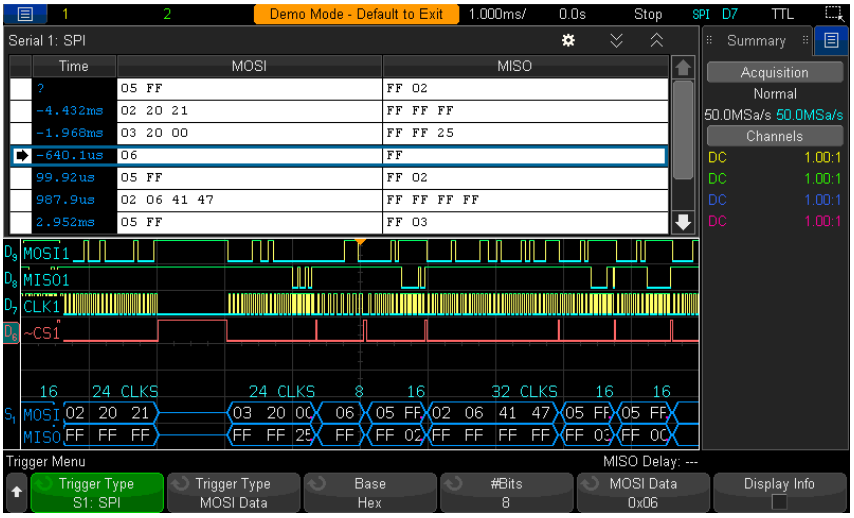


Figure 18: SPI trigger and decode.

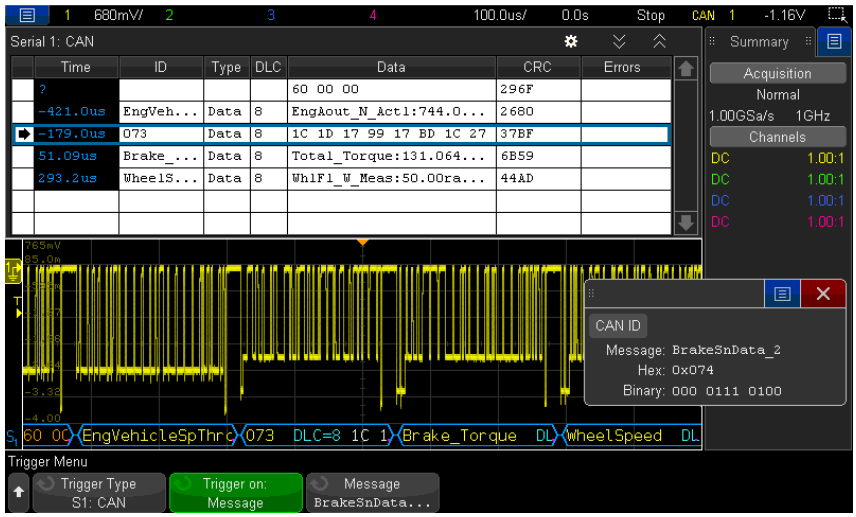


Figure 19: CAN trigger and decode with symbolic .dbc file.

Segmented memory combined with protocol analysis enables insights over long periods of time

Segmented memory works in conjunction with any of the optional serial protocol decodes. For example, by setting the trigger condition to “SENT serial bus error,” segmented memory captures and stores only SENT pulse period error packets and stitches together each segment for easy viewing of the decoded data in the lister. You can quickly compare time tags to discover time intervals between errors.

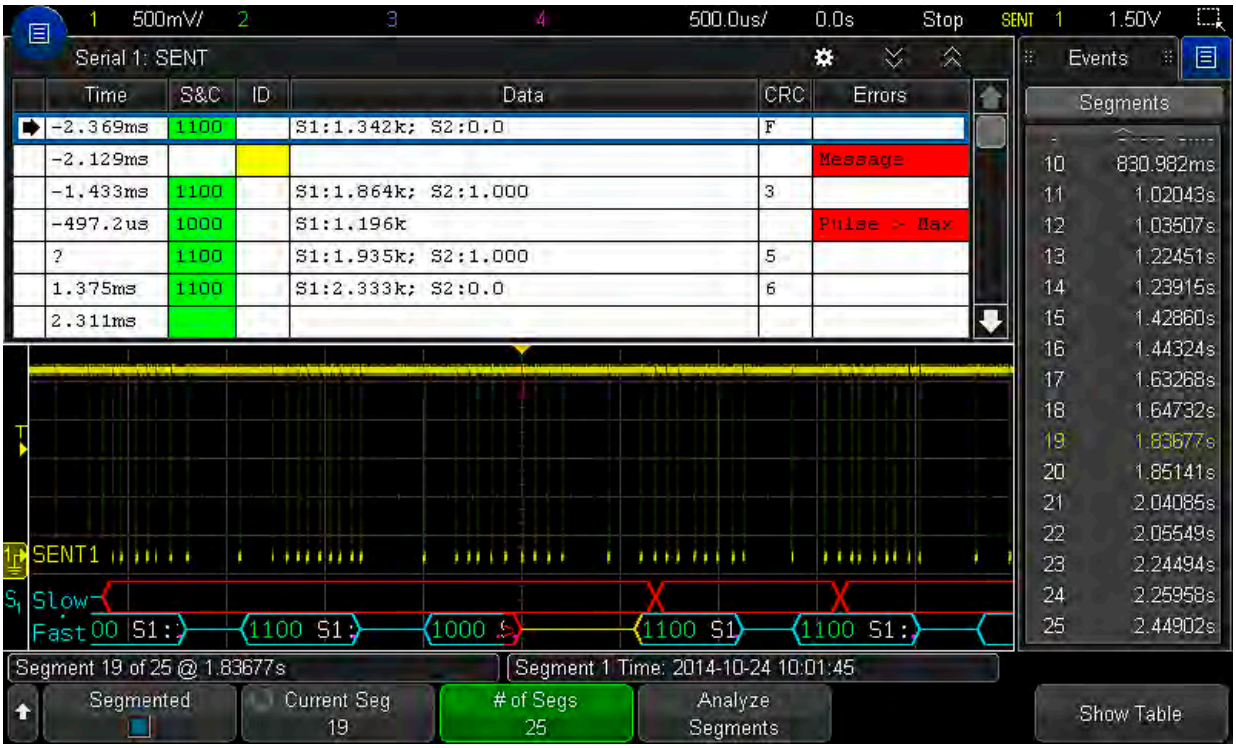


Figure 20. Segmented memory being used in conjunction with SENT bus serial decode resulting in maximum insight to the serial bus.

Dedicated frequency/spectrum analysis allows you to time-correlate analog, digital, and frequency-domain waveforms in a single instrument

Viewing the frequency content of waveforms is greatly simplified by a dedicated FFT button and level adjustment knobs. Pop up keypads make inputting start, stop, span and center frequency easy. And the new problem-solving feature called “gated FFT”, unique in this class of instrument, lets you time correlate the analog, digital, and frequency domain to aid in analysis and debug. In addition, there are new capabilities for peak searching, max and min hold and averaging of FFTs to increase dynamic range.

When gated FFT is on, the oscilloscope goes into zoom mode. The FFT analysis shown in the zoomed (bottom) window is taken from the period of time indicated by the zoom box in the main (top) window. In the gated FFT mode, touch and flick the zoom box through the acquisition to investigate how the FFT analysis changes over time, correlating the RF phenomenon with the analog and digital phenomenon.

Figure 21 through 25 show a simple gated FFT example observing a RF signal frequency transition from 400 MHz to 200 MHz, time correlated to both the SPI controlling signal (digital) and a VCO enable signal (analog). Note, you can also visualize the RF signal itself in the time-domain to gain additional insight such as a gap in the RF time domain waveform.

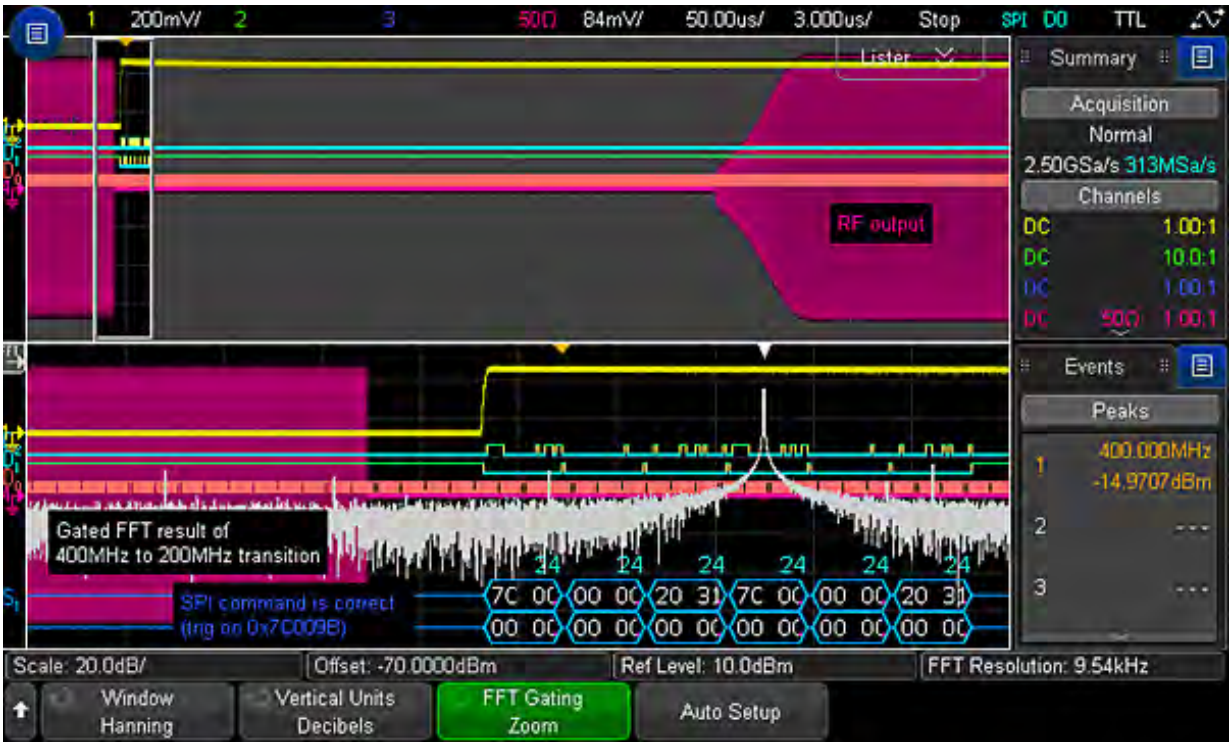


Figure 21. Triggered on a SPI command, the RF signal is still at 400 MHz as indicated in the frequency peak search result lister.

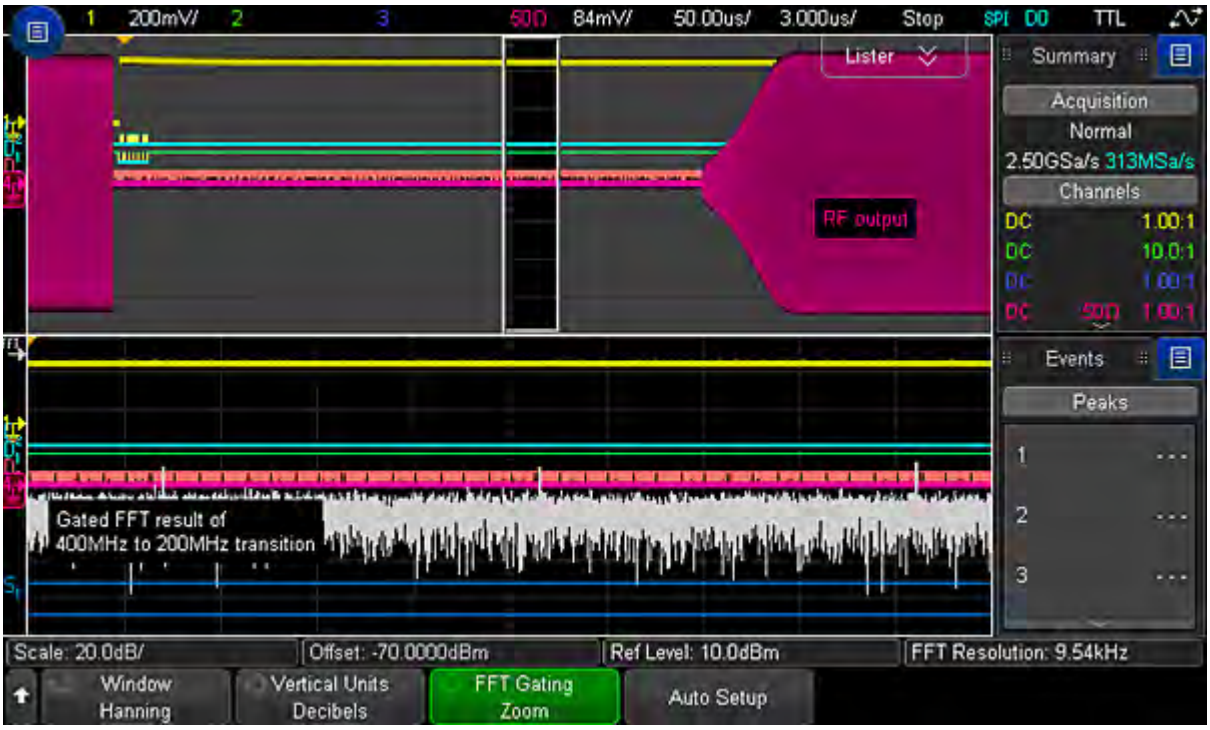


Figure 22. No RF activities in this zoomed time.

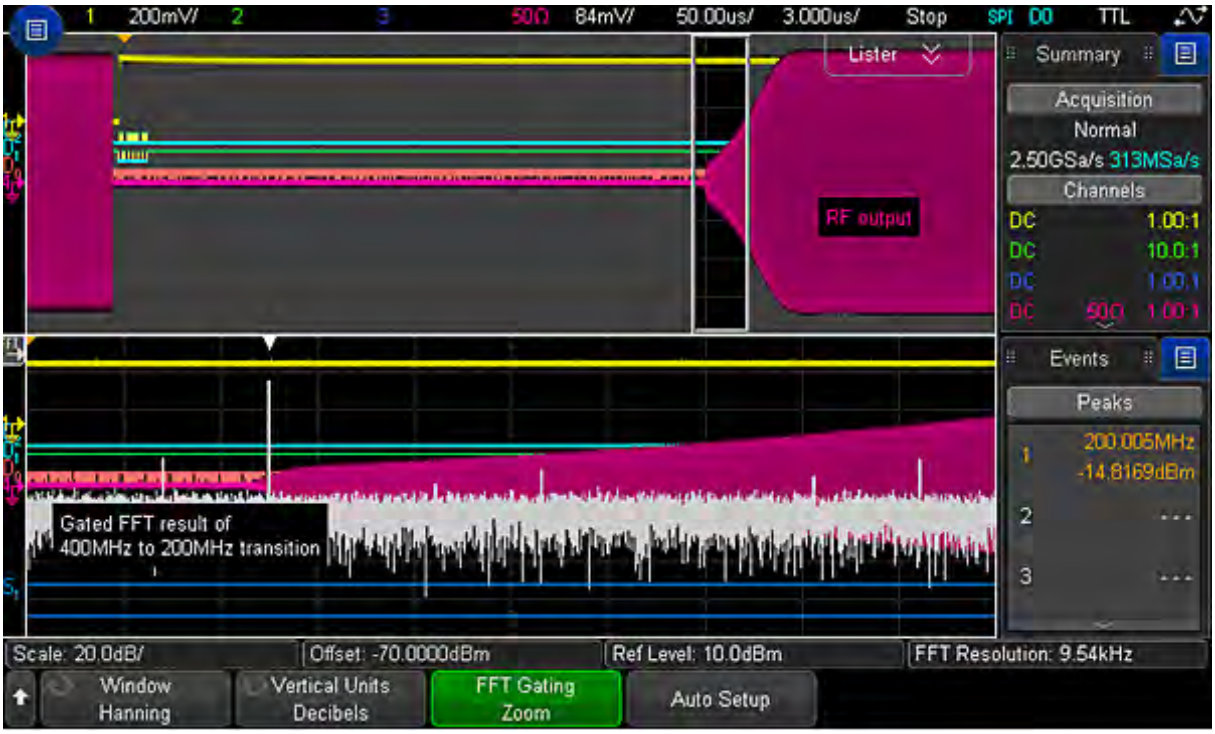


Figure 23. Start observing the RF signal at 200 MHz. You can validate this from the RF analog waveform as well.

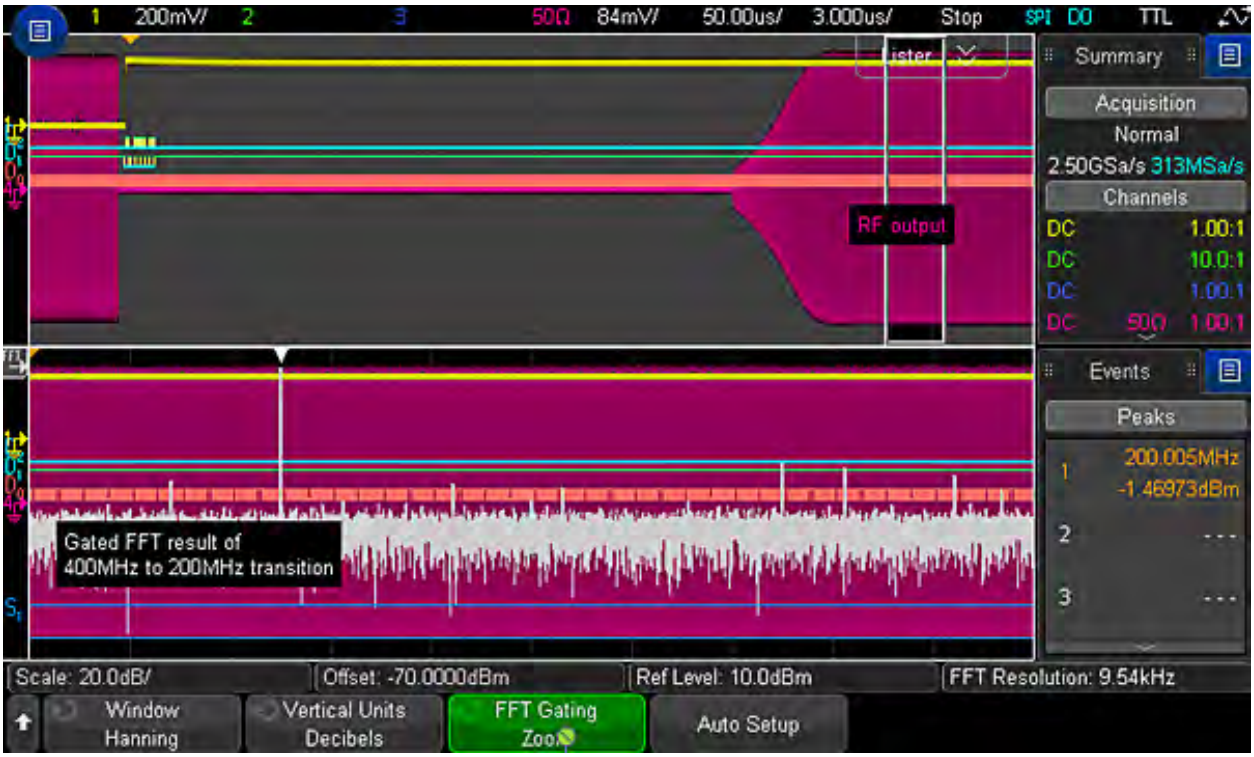


Figure 24. RF signal settled down at 200 MHz as indicated in the search lister.

Analyze statistical distribution of jitter and noise with waveform and measurement histograms

Using the oscilloscope's touch screen, you can draw a rectangular "slice" across a horizontal or vertical segment of a repetitively captured and updated waveform to view a statical histogram of timing jitter or vertical noise along with statistical results as shown in Figures 25 and 26.

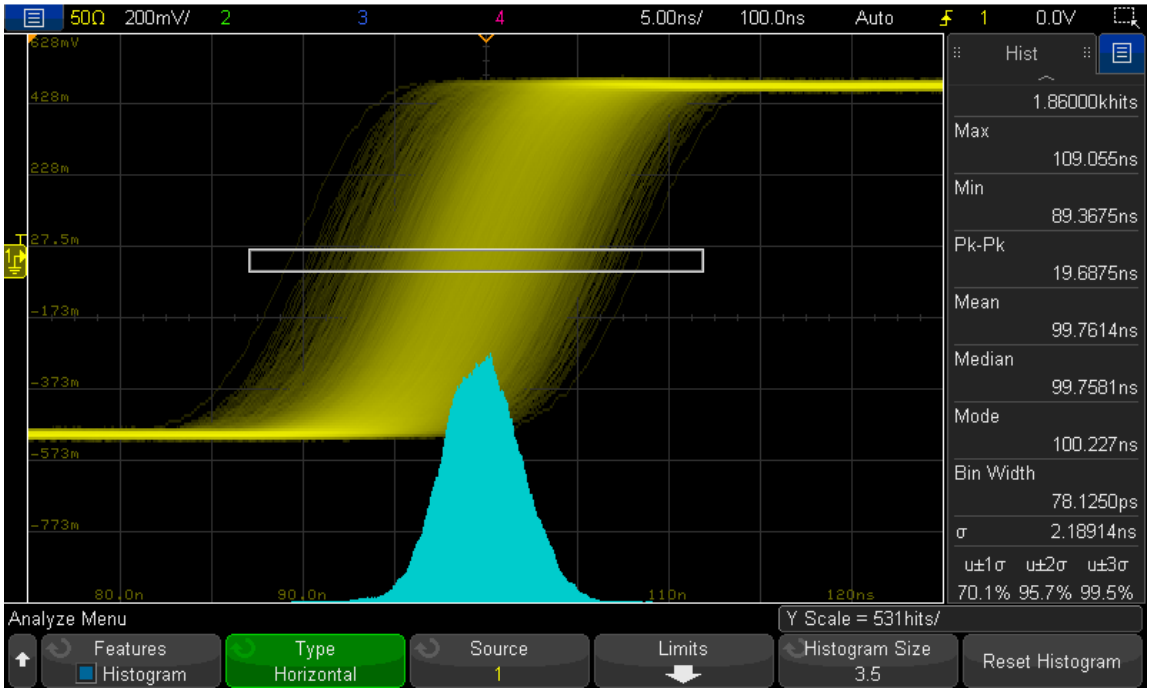


Figure 25. Horizontal waveform histogram reveals Gaussian jitter with standard deviation of 2.2 ns.

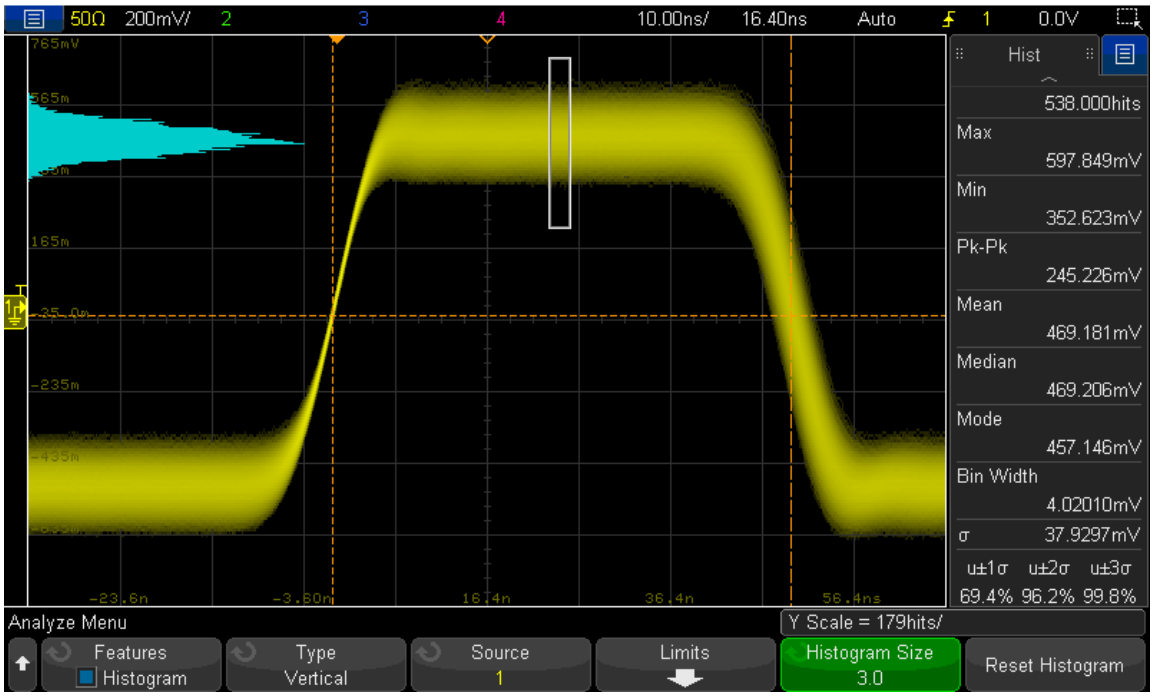


Figure 26. Vertical waveform histogram reveals Gaussian noise with standard deviation of 38 ns.

Advanced waveform math functions

Advanced math analysis provides a variety of additional math functions and comes standard on the 3000G X-Series. Additionally, math functions can be nested to provide additional insight into your designs. You can create up to two math functions, with one math function and FFT displayed at a time.

The InfiniiVision 3000G X-Series supports up to two cascaded math functions with an assortment of operators, transforms, filters, and visualization functions:

Operators

- Add, subtract, multiply, divide

Transforms

- Differentiate, integrate
- FFT (magnitude and phase)
- Ax + B
- Squared, square root
- Absolute value
- Common logarithm, natural logarithm
- Exponential, base 10 exponential

Filters

- Low-pass filter, high-pass filter, band-pass filter
- Averaged value
- Smoothing
- Envelope

Visualizations

- Magnify
- Max and min hold
- Measurement trend
- Chart logic bus timing, chart logic bus state
- Chart serial signal (CAN, CAN FD, LIN, and SENT)
- Maximum and minimum
- Peak-Peak

Automatic parametric measurements provide quick answers

Automatic measurements are the essential tool of an oscilloscope. To make quick and efficient measurements, the InfiniiVision 3000G X-Series provides 44 powerful automatic measurements and can display up to 8 at a time. Measurements can be gated by auto select, main window, zoom window, or cursors, and include full statistics.

Vertical

- Peak-to-peak, maximum, minimum, Y at X, amplitude, top, base, overshoot, pre-shoot, average N-cycles, average full-screen, DC RMS-N cycles, DC RMS-full screen, AC RMS-N cycles, AC RMS full-screen (standard deviation), ratio N-cycles, ratio full-screen

Time

- Period, frequency, counter, + width, - width, burst width, + duty cycle, - duty cycle, bit rate, rise time, fall time, time at edge, delay, phase, X at min Y, X at max Y

Count

- Positive pulse count, negative pulse count, rising edge count, falling edge count

Mixed

- Area N-cycles, area full-screen, slew rate

Power

- Channel power, occupied power, adjacent power ratio, total harmonic distortion

7-in-1 instrument integration provides synergistic measurements

In addition to the class leading oscilloscope and powerful serial protocol analysis capabilities, the InfiniiVision 3000G X-Series offers five additional integrated instrument capabilities not always found in this class of oscilloscope.

Integrated mixed signal oscilloscope (MSO – optional)

The InfiniiVision 3000G X-Series offers 16 optional, integrated, and upgradable digital channels. Digital content is everywhere in today's designs and traditional 2 and 4 channel oscilloscopes do not always provide enough channels for the job at hand.

With an additional 16 integrated digital channels, you now have up to 20 channels of time-correlated acquisition and viewing on the same instrument. In addition to offering powerful triggering across the analog and digital channels, this also gives you additional channels to use for serial decode and triggering. You can either purchase an MSO model that comes standard with the 16 additional digital/logic channel and a logic probe or purchase a DSO model and then upgrade it at any time to an MSO with a software license (DSOXG3MSO) that ships with the 16-channel logic probe.

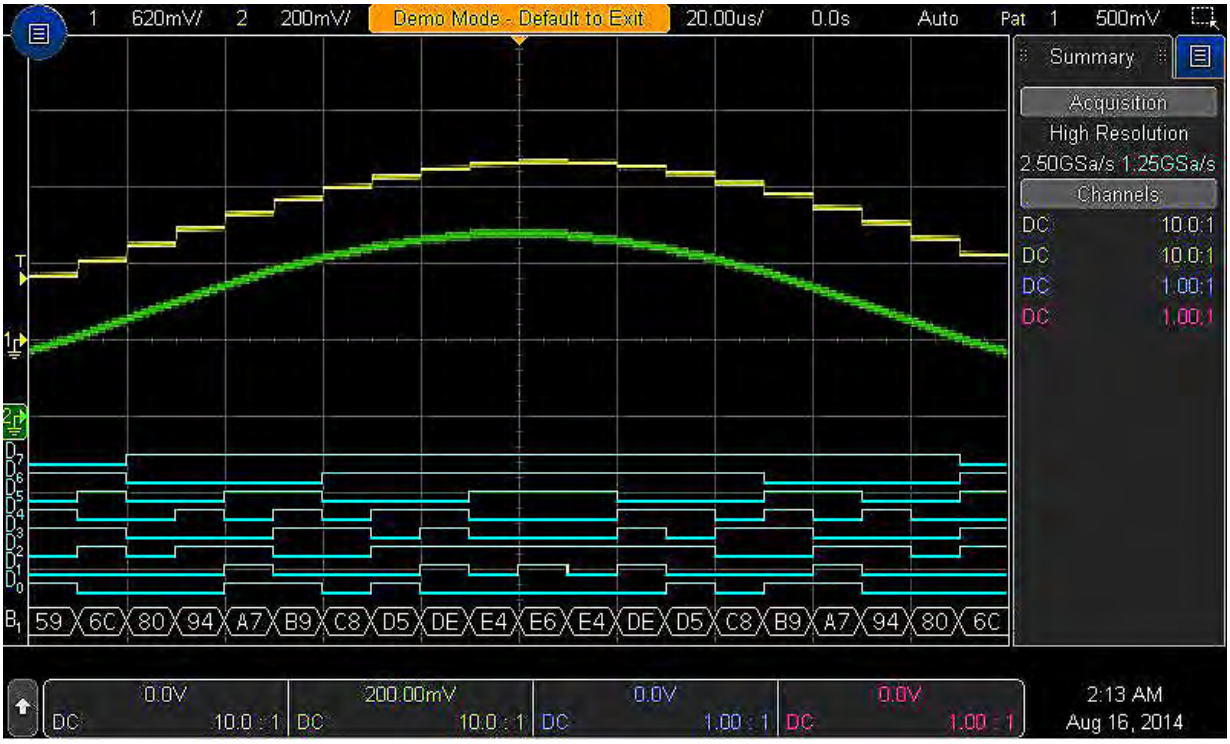


Figure 27. Optional digital channels allow a timing view of up to 16 channels. Tightly integrated, they work with the analog triggers and serial triggers/decoding.

Frequency response analysis (Bode plots, standard)

Frequency Response Analysis (FRA) is an often-critical measurement used to characterize the frequency response (gain and phase versus frequency) of a variety of today's electronic designs, including passive filters, amplifier circuits, and negative feedback networks of switch mode power supplies (loop response). InfiniiVision 3000G X-Series oscilloscopes use the oscilloscope's built-in waveform generator (WaveGen) to stimulate the circuit under test at various frequency settings and capture the input and output signals using two oscilloscope channels. At each test frequency, the oscilloscope measures, computes, and plots gain (20LogVout/Vin) and phase logarithmically.

Figure 28. Frequency response analysis plot (Bode gain & phase) of a bandpass filter.

DSOXBODE Bode plot training kit (optional)

The DSOXBODE Bode plot training kit consists of a series R-L-C circuit board with a BNC input that attaches directly to the output of the oscilloscope's WaveGen function generator. There are clearly labeled test points for probing VIN and BPFOUT (bandpass filter output) or LPFOUT (low-pass filter output). Also included with this training kit is a comprehensive tutorial and lab guide that engineering students and professors can download. The DSOXBODE Bode plot training kit is compatible with all InfiniiVision 3000G X-Series oscilloscopes.

Integrated WaveGen: Built-in 20 MHz function/arbitrary waveform generator

The InfiniiVision 3000G X-Series comes standard with an integrated 20 MHz function/arbitrary waveform generator (WaveGen) that also support modulation. The function generator provides stimulus output of sine, square, ramp, pulse, DC, Sinc (x), exponential rise/fall, cardiac, Gaussian Pulse and noise waveforms to your device under test. The modulation feature supports AM, FM, and FSK modulations with modulation shapes of sine, square, and ramp. The generator can output a continuous or a single-shot waveform. With AWG functionality, you can store waveforms from analog channels or reference memory to the arbitrary memory and output from WaveGen. Then easily create or edit the waveform using the built-in editor via touch and the large screen or by using Keysight's BenchLink Waveform Builder software: www.keysight.com/find/33503

Figure 29. Standard arbitrary waveform generator provides easy access to stimulus. The integrated arbitrary waveform generator makes capturing, modifying, and replaying signals simple.

Integrated DVM: Standard 3-digit digital voltmeter

An integrated 3-digit voltmeter is included standard on your InfiniiVision 3000G X-Series oscilloscope. The voltmeter operates through the same probes as the oscilloscope channels. However, the DVM measurements are made independently from the oscilloscope acquisition and triggering system so you can make both the DVM and triggered oscilloscope waveform captures with the same connection. The voltmeter results are always displayed, keeping these quick characterization measurements at your fingertips.

Figure 30. DVM and counter takes advantage of separate signal paths to provide measurements without a trigger, while still using the scope probes.

Integrated frequency measurements: Standard 8-digit counter and totalizer

Traditional oscilloscope counter measurements offer only five or six digits of resolution, which may not be enough for the most critical frequency measurements are being made.

With the InfiniiVision 3000G X-Series' standard 8-digit counter, you can see your measurements with the precision you would normally expect only from a standalone counter. Because the integrated counter measures frequencies up to a wide bandwidth of 1.0 GHz, you can use it for many high-frequency applications as well.

The counter's totalizer feature adds another valuable capability to the oscilloscope. It can count the number of events (totalize), and it also can monitor the number of trigger-condition-qualified events. The trigger-qualified events totalizer does not require an actual trigger to occur. It only requires a trigger-satisfying event to take place. In other words, the totalizer can monitor events faster than the trigger rate of a scope, as fast as 25 million events per second (a function of the oscilloscope's holdoff time, which has the minimum of 40 ns). Figures 31 shows example of a totalizer counting the number of CAN FD CRC delimiter bit error packets that took place in a design.

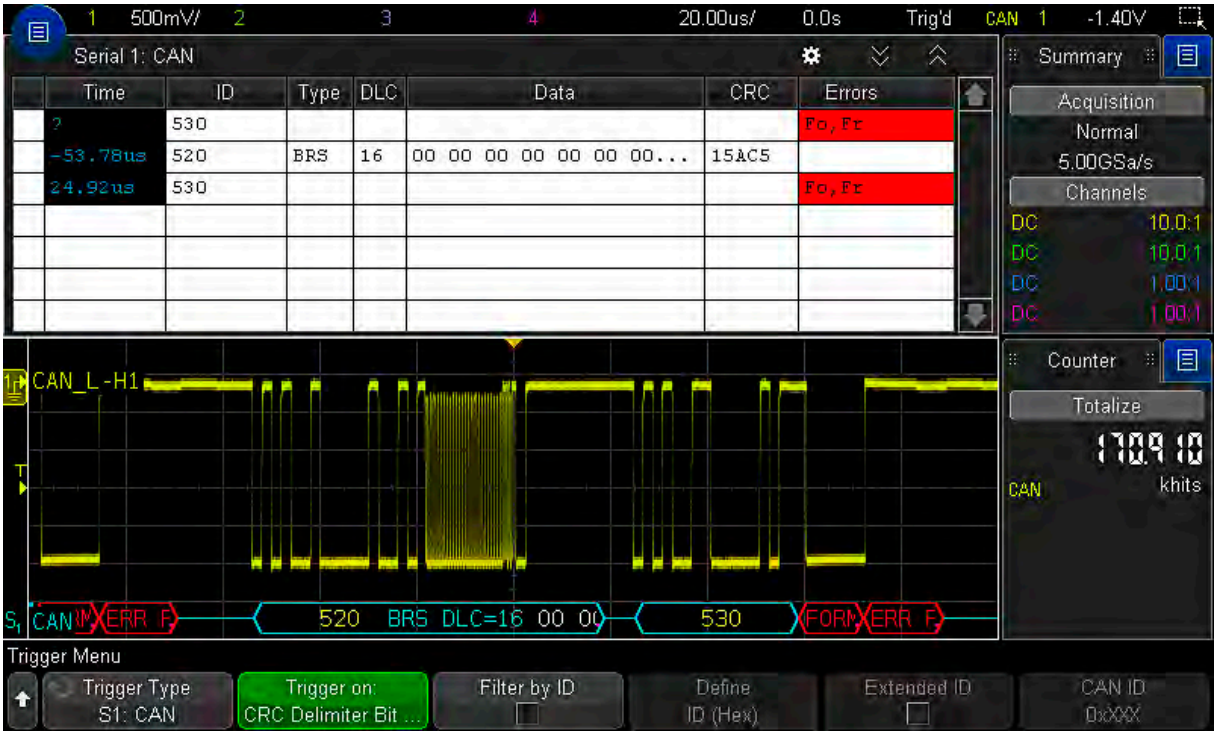


Figure 31. Totalizer counts the number of events. In addition, it can count the number of trigger-condition-qualified events as fast as 25 million events a second.

Other Advanced Measurements and Features

Hardware-based mask limit & measurement limit testing (standard) for quick pass/fail testing

Whether you are performing pass/fail tests to specified standards in manufacturing or testing for infrequent signal anomalies, mask limit and measurement limit testing can be a valuable productivity tool. The InfiniiVision 3000G X-Series features powerful hardware-based mask testing that can perform up to 270,000 tests per second. You can select multiple test criteria, including the ability to run tests for a specific number of acquisitions, a specified time, or until detection of a failure.

With the standard measurement limit testing capability, you can perform pass/fail testing based on user-defined maximum and minimum limits on any parametric measurement that has been selected and turned on. Stop-on-failure is also available.

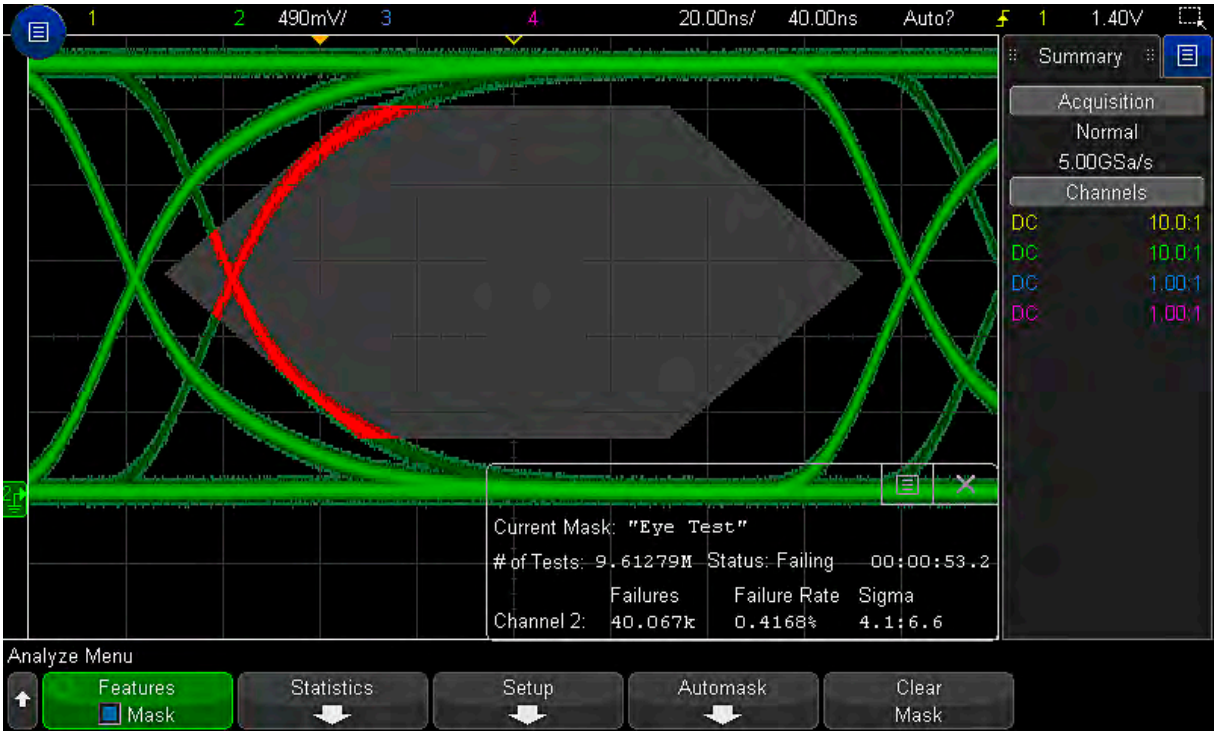


Figure 32. Hardware accelerated mask testing allows testing against a golden waveform or user created mask to find violations. In this example we captured over 9M tests in only 53 seconds.

Integrated advanced power supply measurements and analysis (optional)

When you are working with switching power supplies and power devices, the power measurements software package (D3000PWRB) provides a full suite of power measurements and analysis in the oscilloscope.

Click here to learn more about the D3000PWRB optional software package.

In addition, there are several power specific probes that make analysis of your power supplies (e.g., switch mode power supplies) and power consuming devices (e.g., batteries) easy.

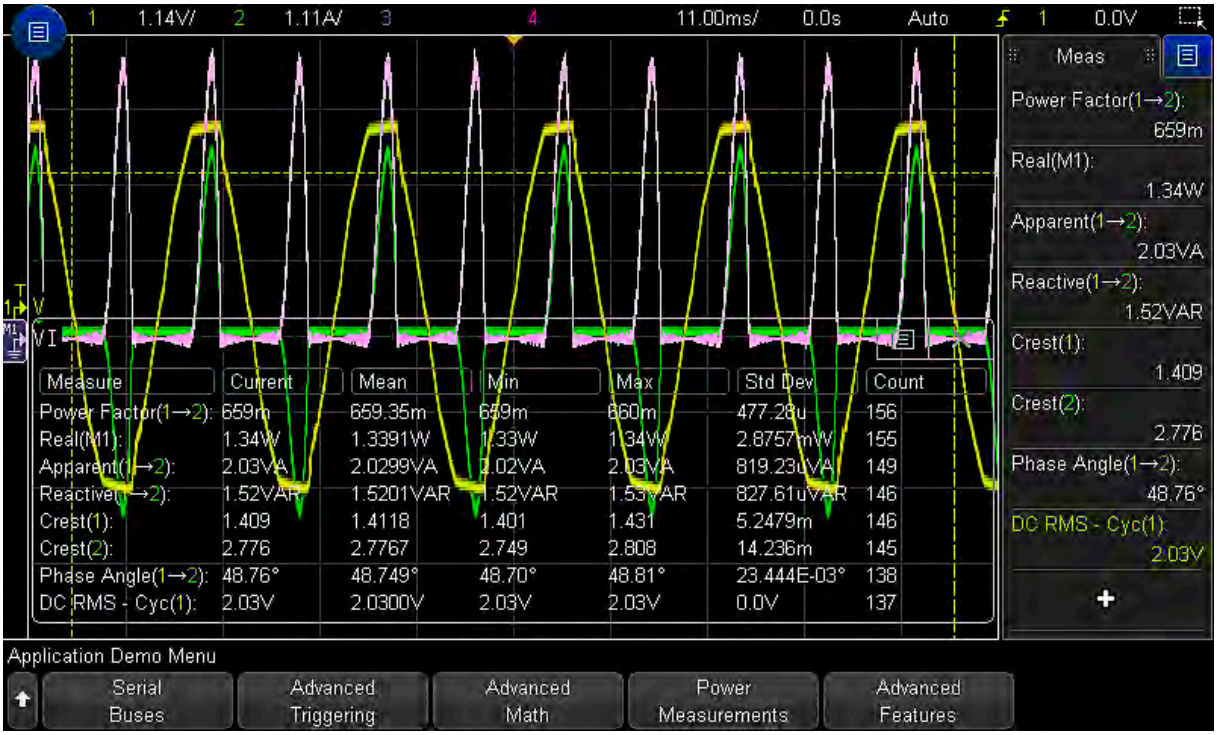


Figure 33. Integrated power measurements make quick work of analyzing power producing and power consuming devices.

Figure 34. Control loop response analysis (bode plot) shows the gain/phase plot over frequency sweep range up to 20 MHz with automatic determination of phase margin (PM) and gain margin (GM).

Innovative power rail probe (option) provides insights for DC output integrity

The power rail noise, ripple, and transient measurements can be challenging due to required offset range and mV sensitivity. With its ± 24 V offset range, ultra-low noise 1:1 attenuation ratio, and 2-GHz bandwidth, the N7020A power rail probe is for users making critical power integrity measurements that need mV sensitivity on their DC power rails.

Figure 35. N7020A Power Rail Probe.

Figure 36. 3000G X-Series and N7020A acquire not only the power rail ripples but the high frequency transients as well.

Enhanced HDTV video analysis (standard)

Whether you are debugging consumer electronics with HDTV or characterizing a design, Enhanced Video Analysis (optional) provides support for a variety of HDTV standards for triggering and analysis.

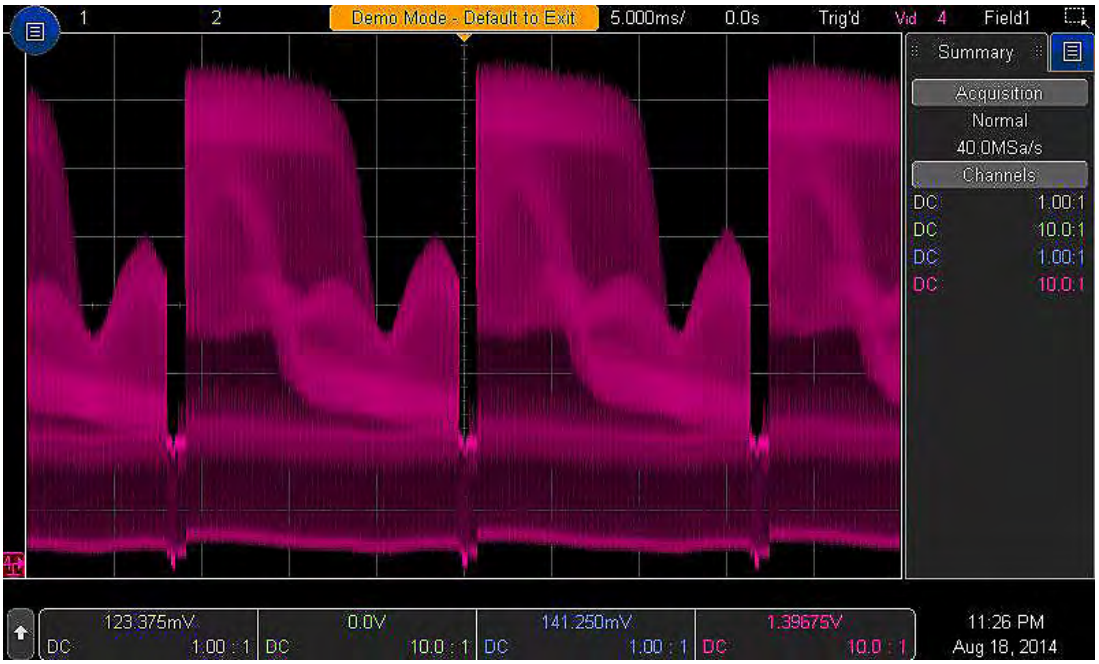


Figure 37. Trigger on and display HDTV signals with enhanced HDTV video analysis (standard).

While the “Touch, Discover, & Solve” elements of the scope highlight the key features that will make it easy to and troubleshoot your device, there are other features that you may also want to consider when choosing your next oscilloscope.

Total Cost of Ownership

The InfiniiVision 3000G X-Series offers an extremely low cost of ownership. Between an industry leading mean time between failure (MTBF) of over 250,000 hours and a market-leading calibration period of 3 years, you can rest assured that your investment in a 3000G X-Series will be protected for years to come. In addition, because needs change over time, you can purchase just what you need today and then upgrade the scope’s bandwidth or application-specific software packages easily over time as your projects evolve.

Educator’s Training Kit

Have new hires that need to quickly become familiar with the scope? Or are you a professor that wants to teach your students what an oscilloscope is and how to perform basic measurements? The Educator’s Oscilloscope Training Kit (standard) makes that easy. It includes training tools created specifically for electrical engineering and physics undergraduate students and professors. It contains an array of built-in training signals (built into the scope), a comprehensive oscilloscope lab guide and tutorial written specifically for the undergraduate student and an oscilloscope fundamentals PowerPoint slide set for professors and lab assistants. The built-in training signals are included standard in the oscilloscope, while the lab guide, slide set, as well as other valuable technical resources for students and professors are available to download at www.keysight.com/find/edk.

Built-in Features to Help the Infrequent User

In addition to the educator’s training kit, the oscilloscope includes a localized front panel and GUI available in 15 languages, along with an integrated (and localized) help system. Just press & hold down any front panel key or soft panel button and a brief overview will appear that explains how to use that feature.

30-day Trial License

The InfiniiVision 3000G X-Series comes with a one-time 30-day, all optional-features trial license. You can choose to start the 30-day trial at any time. In addition, you can redeem individual optional feature 30-day trial licenses at any time by visiting www.keysight.com/find/30daytrial. This enables you to receive in effect 60 days of trial license of each optional feature.

Localized GUI and Front Panel Overlays

The InfiniiVision 3000G X-Series oscilloscope supports 15 different languages:

- English
- Japanese
- Simplified Chinese
- Traditional Chinese
- Thai
- Korean
- German
- French
- Spanish
- Russian
- Portuguese
- Italian
- Polish
- Czech
- Turkish

"Designed for Touch". **8.5-inch capacitive touch screen with gesture support.**

7-in-1 instruments helps you solve your problems: oscilloscope channels digital channels, frequency response analysis, serial protocol analysis, WaveGen, DVM, and 8-digit counter-totalizer. **Fully upgradeable** including bandwidth.

Reconfigurable Docking panels with the capacitive touch screen adds a new dimension to the usability.

Zone touch trigger, if you can see it, you can trigger on it by drawing a box.

Standard **Gated FFT** for your time correlated analog, digital, and frequency domain signal

Uncompromised 1,000,000 waveform per second update rate minimize the dead-time for maximum probability of capturing infrequent events and anomalies.

Built-in features to help the infrequent user - ***GUI available in 15 languages.***

Display up to ***8 measurements*** simultaneously, without compromising other key info. 44 automatic measurements. ***Gated by cursors*** supported.

Integrated DVM and ***8-digit counter with totalizer.*** Wide coverage of application and serial protocol solutions including ***CAN-FD and SENT trigger and decode.***

Both ***USB keyboard and mouse*** are supported in 3000G X-Series for additional ease of use.

Standard segment memory with event lister powered by ***MegaZoom IV*** smart memory technology intelligent capture of just the signals of interest.

Configuring Your Oscilloscope

Step 1
Choose your bandwidth and number of channels

3000 X-Series Specification Overview											
		3012G	3014G	3022G	3024G	3032G	3034G	3052G	3054G	3102G	3104G
Bandwidth (–3 dB)		100 MHz		200 MHz		350 MHz		500 MHz		1 GHz	
Calculated rise time (10 to 90%)		≤ 3.5 ns		≤ 1.75 ns		≤ 1 ns		≤ 700 ps		≤ 450 ps	
Input channels	DSOX	2	4	2	4	2	4	2	4	2	4
	MSOX	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16

For example, if you chose 1 GHz, 4+16 channels, the model number will be MSOX3104G

Step 2
Select hardware upgrades

Hardware Upgrade	Description	Model Number to Order
Enhanced Security Option	Disable non-volatile memory, USB, LAN, and firmware upgrades	DSOXG3SECA
GP-IB module	Plug-in module to support GP-IB connectivity	DSOXGPIB

Step 3
Select software upgrades

License **Upgrade**	Description	Model Number to Order
Embedded software package	I^2C, SPI, UART (RS232/422/485), I^2S, and USB PD serial trigger and decode, plus Measurement Limit Testing, Mask Limit Testing, Frequency Response Analysis (Bode plots), and Enhanced HDTV Video Analysis	Standard
Automotive software package	CAN (symbolic with .dbc file), CAN FD (symbolic with .dbc file), LIN (symbolic with .ldf file), FlexRay, SENT, CXPI, PSI5 (user-definable Manchester), and User-definable	D3000AUTB

License **Upgrade**	Description	Model Number to Order
	NRZ serial trigger & decode (CAN/CAN FD mask files available to download)	
Aero software package	MIL-STD 1553 and ARINC 429 serial trigger & decode (standard mask files available to download)	D3000AERB
USB software package	USB 2.0 Low- & Full-speed	D3000USBB
Power software package	Power quality, current harmonics, switching loss, transient response, turn-on/off time, output ripple, efficiency, control loop response, PSRR, etc.	D3000PWRB
Ultimate bundle software package	CAN, CAN FD, LIN, FlexRay, CXPI, PSI5 (User-definable Manchester), User-definable NRZ, MIL-STD 1553, and ARINC 429 serial trigger & decode, and Power Analysis	D3000BDLB

Step 4

Choose your probes

For a complete list of compatible probes, visit http://www.keysight.com/find/scope_probes. In general, the InfiniiVision 3000G X-Series supports up to two active probes simultaneously with some exceptions. Contact Keysight for more detail.

Probes		
N2843A	Passive probe 500 MHz, 10:1, 1 MΩ, 11 pF	Standard (1 per channel)
N2756A	16 digital channel MSO cable	Standard on MSOX models and with DSOXG3MSO MSO upgrade
N2870A	Passive probe 35 MHz, 1:1, 1 MΩ	Optional
10076C	Passive probe 500 MHz 100:1 attenuation (4 kV)	Optional
N2795A	1.0 GHz 10:1 single-ended active probe, 1 MΩ / 1 pF, ± 8 V	Optional
N2797A	1.5 GHz 10:1 single-ended active probe, 1 MΩ / 1 pF, ± 8 V, extreme temperature	Optional
N2791A	25 MHz 10:1/100:1 HV differential active probe, 8 MΩ / 8 pF, ± 700 V	Optional
N2790A	100 MHz 50:1/500:1 HV differential probe, 8 MΩ /3.5 pF, ± 1,400 V	Optional
N2805A	200 MHz 50:1 HV differential active probe, 4 MΩ / 4 pF, ± 100 V	Optional

Probes		
N2804A	300 MHz 100:1 HV differential active probe, 8 MΩ / 10 pF, ± 300 V	Optional
N2750A	1.5 GHz 2:1/10:1 differential active probe, 200 kΩ / 0.7 pF, ± 5 V	Optional
N7020A	2 GHz 1:1 power rail probe, ± 24 V offset range, 50 kΩ, ± 850 mV ripple range	Optional
1147B	50 MHz, 15 Amp AC/DC current probe	Optional
N2893A	100 MHz, 15 Amp AC/DC current probe	Optional
N7026A	150 MHz, 40 Amp AC/DC high-sensitivity current probe	Optional
N2820A	2-channel high-sensitivity current probe 50 µA to 5 A	Optional
N2821A	1-channel high-sensitivity current probe 50 µA to 5 A	Optional
N7040A	23 MHz, 3 kA, Rogowski coil AC current probe	Optional
N7041A	30 MHz, 600 A, Rogowski coil AC current probe	Optional
N7042A	30 MHz, 300 A, Rogowski coil AC current probe	Optional

Step 5

Choose your accessories and additional productivity software

Recommended Accessories and PC Software		
DSOXBODE	Bode plot training kit	Optional
N2167A	Front panel cover	Optional
N2168A	Front panel cover and soft carrying case	Optional
N2169A	Rack mount kit	Optional
Hard transit case	CaseCruzer 3F1112-1510J (available from http://www.casecruzer.com/)	Optional
BV0004B	BenchVue Oscilloscope Application PC software	Standard
33503B	BenchLink Waveform Builder Pro and Basic PC Software	Optional
D9010BSEO	Infiniium Offline Oscilloscope Analysis PC Software	Optional
D9010UDAA	User-definable Application (UDA) software	Optional
89601B (version 2020 and higher)	Vector Signal Analyzer (VSA) software	Optional

Step 6

Calibration plans[1]

Calibration		
DSOX3000G-1A7	Calibration + uncertainties + guardbanding certificate (not accredited)	Optional
DSOX3000G-AMG	Calibration + uncertainties + guardbanding certificate (accredited)	Optional

1. The InfiniiVision 3000G X-Series oscilloscope come from the factory calibrated with a standard calibration certificate. Additional calibration testing with uncertainties and guardbanding can be purchased as an option.

Performance Characteristics

3000G X-Series Specification Overview											
		3012G	3014G	3022G	3024G	3032G	3034G	3052G	3054G	3102G	3104G
Bandwidth 1 (–3 dB)		100 MHz		200 MHz		350 MHz		500 MHz		1 GHz	
Calculated rise time (10 to 90%)		≤ 3.5 ns		≤ 1.75 ns		≤ 1 ns		≤ 700 ps		≤ 450 ps	
Input channels	DSOX	2	4	2	4	2	4	2	4	2	4
	MSOX	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16	2 + 16	4 + 16
Maximum sample rate		5 GSa/s half channels, 2.5 GSa/s all channels									
Maximum memory depth		4 Mpts half channels, 2 Mpts all channels									
Display size and type		8.5-inch capacitive touch gesture-enabled display									
Waveform update rate		> 1,000,000 waveforms per second									
Vertical System Analog Channels											
Hardware bandwidth limits		Approximately 20 MHz (selectable)									
Input coupling		AC, DC									
Input impedance		Selectable: 1 MΩ ± 1% (14 pF), 50 Ω ± 1.5%									
Input sensitivity range		100 MHz ~ 500 MHz models: 1 mV/div to 5 V/div 2 (1 MΩ and 50 Ω)									

3000G X-Series Specification Overview	
	1 GHz models: 1 mV/div to 5 V/div 2 (1 MΩ), 1 mV/div to 1 V/div (50 Ω)
Vertical resolution	8 bits (measurement resolution is 12 bits with averaging)
Maximum input voltage	125 Vrms; 190 Vpk
	Probing technology allows testing of higher voltages. For example, the included N2843A 10:1 probe supports testing up to 300 Vrms
	Use this instrument only for measurements within its specified measurement category (not rated for CAT II, III, IV). No transient overvoltage allowed
DC vertical accuracy	± [DC vertical gain accuracy + DC vertical offset accuracy + 0.25% full scale] [2]
DC vertical gain accuracy [1]	± 2.0% full scale [2]
DC vertical offset accuracy	± 0.1 div ± 2 mV ± 1% of offset setting
Channel-to-channel isolation	> 100:1 from DC to maximum specified bandwidth of each model (measured with same V/div and coupling on channels)
Offset range	± 2 V (1 mV/div to 200 mV/div)
	± 50 V (> 200 mV/div to 5 V/div)
Vertical System Digital Channels	
Digital input channels	16 digital (D0 to D15. pod 1: D7 ~ D0, Pod 2: D15 ~ D8)
Thresholds	Threshold per pod
Threshold selections	TTL (+1.4 V), 5 V CMOS (+2.5 V), ECL (–1.3 V), user-defined (selectable by pod)
User-defined threshold range	± 8.0 V in 10 mV steps
Maximum input voltage	± 40 V peak
Threshold accuracy [1]	± (100 mV + 3% of threshold setting)
Maximum input dynamic range	± 10 V about threshold
Minimum voltage swing	500 mVpp
Input impedance	100 kΩ ± 2% at probe tip
Input capacitance	~8 pF
Vertical resolution	1 bit

1. Denotes warranted specifications, all others are typical.
2. Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature. 1 mV/div and 2 mV/div are a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 1 mV div and 2 mV/div sensitivity setting.

Horizontal System Analog Channels										
		3012G	3014G	3022G	3024G	3032G	3034G	3052G	3054G	3102G	3104G
Time base range		5 ns/div to 50 s/div		2 ns/div to 50 s/div				1 ns/div to 50 s/div		500 ps/div to 50 s/div	
Time base accuracy [1]		± 1.6 ppm + aging factor (1st year: ± 0.5 ppm, 2nd year: ± 0.7 ppm, 5 years: ± 1.5 ppm, 10 years: ± 2.0 ppm)									
Time base delay time range	Pre-trigger	Greater of 1 screen width or 250 µs									
	Post-trigger	1 s to 500 s									
Channel-to-channel deskew range		± 100 ns									
Δ Time accuracy (using cursors)		± (time base acc. x reading) ± (0.0016 x screen width) ± 100 ps									
Modes		Main, zoom, roll, XY									
XY		On channels 1 and 2 only. Z Blanking on Ext Trigger Input, 1.4 V threshold									
		Bandwidth: Maximum bandwidth. Phase error at 1 MHz: < 0.5 degree									
Horizontal System Digital Channels											
Minimum detectable pulse width		5 ns									
Channel-to-channel skew		2 ns (typical); 3 ns (maximum)									
Maximum analog channels sample rate		5 GSa/s half channel interleaved, 2.5 GSa/s all channel									
Maximum analog channels record length		4 Mpts half channel interleaved, 2 Mpts all channel									
Maximum digital channels sample rate		1.25 GSa/s all pods									
Maximum digital channels record length		2 Mpts (with digital channels only)									
Acquisition mode	Normal	Default mode									
	Peak detect	Capture glitches as narrow as 250 ps at all time base settings									
	Averaging	Selectable from 2, 4, 8, 16, 64, ... to 65,536									

Horizontal System Analog Channels		
	High resolution	Real time boxcar averaging reduces random noise and effectively increases vertical resolution 12 bits of resolution when ≥ 10 µs/div at 5 GSa/s or ≥ 20-µs/div at 2.5 GSa/s
	Segmented	Segmented memory optimizes available memory for data streams that have long dead times between activity. Maximum segments = 1000. Re-arm time = 1 µs (minimum time between trigger events)
	Digitizer	Allows independent selection of sample rate and memory depth
Time mode	Normal	Default mode
	Roll	Displays the waveform moving across the screen from right to left. Available at the time base 50 ms/div or slower
	XY	Displays the volts-versus-volts display. Time base can be set from 200 ns/div to 50 ms/div

Trigger System	
Trigger sources	Analog channel (1 ~ 4), digital channel (D0 ~ D15), line, external, WaveGen (1 or mod) (FM/FSK)
Trigger modes	Normal (triggered): Requires trigger event for scope to trigger
	Auto: Triggers automatically in absence of trigger event
	Single: Triggers only once on a trigger event, press [Single] again for scope to find another trigger event, or press [Run] to trigger continuously in either Auto or Normal mode
	Force: front panel button that forces a trigger
Trigger coupling	DC: DC coupled trigger
	AC: AC coupled trigger, cutoff frequency: < 10 Hz (internal); <50 Hz (external)
	HF reject: High frequency reject, cutoff frequency ~ 50 kHz
	LF reject: Low frequency reject, cutoff frequency ~ 50 kHz
	Noise reject: Selectable OFF or ON, decreases sensitivity 2x
Trigger holdoff range	40 ns to 10.00 s
Trigger Sensitivity	
Internal [1]	< 10 mV/div: Greater of 1 div or 5 mV; ≥ 10 mV/div: 0.6 div
External [1]	200 mVpp from DC to 100 MHz
	350 mVpp 100 MHz to 200 MHz
Trigger Level Range	
Any channel	± 6 div from center screen
External[2]	± 8 V
Trigger Type Selections	
Zone (HW zone qualifier)	Trigger on user-defined zones drawn on the display. Applies to one analog channel at a time. Specify zones as either “must intersect” or “must not intersect.” Up to two zones. > 200,000 scans/sec update rate
	Supported modes: normal, peak detect, high resolution
	Also works simultaneously with the serial trigger and mask limit test
Edge	Trigger on a rising, falling, alternating or either edge of any source
Edge then edge (B trigger)	Arm on a selected edge, wait a specified time, then trigger on a specified count of another selected edge
Pulse width	Trigger on a pulse on a selected channel, whose time duration is less than a value, greater than a value, or inside a time range
	Minimum duration setting: 2 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz), 10 ns (100 MHz)
	Maximum duration setting: 10 s
	Range minimum: 10 ns
Runt	Trigger on a position runt pulse that fails to exceed a high-level threshold. Trigger on a negative runt pulse that fails to exceed a low-level threshold. Trigger on either polarity runt pulse based on two threshold settings. Runt triggering can also be time-qualified (< or >) with a minimum time setting of 2 ~ 10 ns and maximum time setting of 10 s

Trigger System	
	Minimum time setting: 2 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz)
	10 ns (100 MHz)
Setup and hold	Trigger and clock/data setup and/or hold time violation. Setup time can be set from –7 to 10 s. Hold time can be set from 0 s to 10 ns
Rise/fall time	Trigger on rise-time or fall-time edge speed violations (< or >) based on user-selectable threshold
	Select from (< or >) and time settings range between
	Minimum: 1 ns (500 MHz, 1 GHz), 2 ns (350 MHz), 3 ns (200 MHz), 5 ns (100 MHz)

1. Denotes warranted specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature.
2. 1 mV/div and 2 mV/div is a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 1 mV/div and 2 mV/div sensitivity setting.

Trigger Type Selections	
N^{th} edge burst	Trigger on the Nth (1 to 65535) edge of a pulse burst. Specify idle time (10 ns to 10 s) for framing
Pattern	Trigger when a specified pattern of high, low, and don't care levels on any combination of analog, digital, or trigger channels is [entered | exited]. Pattern must have stabilized for a minimum of 2 ns to qualify as a valid trigger condition
	Minimum duration setting: 2 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz), 10 ns (100 MHz)
	Maximum duration setting: 10 s
	Range minimum: 10 ns
Or	Trigger on any selected edge across multiple analog or digital channels
Video	Trigger on all lines or individual lines, odd/even or all fields from composite video, or broadcast standards (NTSC, PAL, SECAM, PAM-M)
Enhanced Video (standard)	Trigger on lines and fields of enhanced and HDTV standards (480p/60, 567p/50, 720p/50, 720p/60, 1080p/24, 1080p/25, 1080p/30, 1080p/50, 1080p/60, 1080i/50, 1080i/60)
USB	Trigger on start of packet, end of packet, reset complete, enter suspend, or exit suspend. Support USB low-speed and full-speed
I^2C (standard)	Trigger at a start/stop condition or user defined frame with address and/or data values. Also trigger on missing acknowledge, address with no ack, restart, EEPROM read, and 10-bit write
SPI (standard)	Trigger on SPI (Serial Peripheral Interface) data pattern during a specific framing period. Supports positive and negative Chip Select framing as well as clock Idle framing and user-specified number of bits per frame. Supports MOSI and MISO data
RS-232/422/ 485/UART (standard)	Trigger on Rx or Tx start bit, stop bit or data content or parity error
I^2S (standard)	Trigger on 2's complement data of audio left channel or right channel (=, ≠, <, >, > <, < >, increasing value, or decreasing value)
CAN (optional)	Trigger on CAN (controller area network) version 2.0A,2.0B, and CAN-FD (Flexible Data-rate) signals. Trigger on the start of frame (SOF), the end of frame (EOF), data frame ID, data frame ID and data (non-FD), data frame ID and data (FD), remote frame ID, remote or data frame ID, error frame, acknowledge error, from error, stuff error, CRC error, spec error (ack or form or stuff or CRC), all errors, BRS Bit (FD), CRC delimiter bit (FD), ESI bit active (FD), ESI bit passive (FD), overload frame., message, message and signal (non-FD), message and signal (FD, first 8 bytes only)

Trigger Type Selections	
LIN (optional)	Trigger on LIN (Local Interconnect Network) sync break, sync frame ID, or frame ID and data, parity error, checksum error, frame (symbolic), frame and signal (symbolic)
CXPI (optional)	Trigger on the start of frame (SOF), the end of frame (EOF), PTYPE, frame ID, data and info frame ID, data and info frame ID (long frame), CRC field error, parity error, inter-byte space error, inter-frame space error, framing error, data length error, sample error, all errors, sleep frame, wakeup pulse
FlexRay (optional)	Trigger on frame ID, frame type (sync, start-up, null, normal), cycle-repetitive, cycle-base, and errors.
MIL-STD 1553 (optional)	Trigger on MIL-STD 1553 signals based on word type (Data or Command/Status), Remote Terminal Address, data, and errors (parity, sync, Manchester encoding)
ARINC 429 (optional)	Trigger on ARINC429 data. Trigger on word start/stop, label, label + bits, label range, error conditions (parity, word, gap, word or gap, all), all bits (eye), all 0 bits, all 1 bits
SENT (optional)	Trigger on SENT bus. start of fast channel message, start of slow channel message, fast channel SC and data, slow channel message ID, slow channel message ID and data, tolerance violation, fast channel CRC error, slow channel CRC error, all CRC errors, pulse period error, successive sync pulses error (1/64)
User-definable Manchester/NRZ (optional)	Trigger on start-of-frame (SOF), bus value, and Manchester errors
USB PD (standard)	Trigger on preamble, EDP, ordered sets, preamble errors, CRC errors, header content (control messages, data messages, extended messages, and value in HEX)
NFC (standard)	NFC-A: SENS_REQ, ALL_REQ, or Either NFC-B: SENSB_REQ, ALLB_REQ, or Either NFC-F (212 kbps): SENSF_REQ or ATR_REQ NFC-F (242 kbps): SENSF_REQ or ATR_REQ

Waveform Measurements		
Cursors [2]		Single cursor accuracy: ± [DC vertical gain accuracy + DC vertical offset accuracy + 0.25% full scale]
		Dual cursor accuracy: ± [DC vertical gain accuracy + 0.5% full scale] [1]
		Units: Seconds(s), Hz (1/s), phase (degrees), ratio (%)
Automatic measurements		Measurements continuously updated with statistics. Cursors track last selected measurement. Select up to eight measurements from the list below: Snapshot All: Measure all single waveform measurements (31) **Vertical:** Peak-to-peak, maximum, minimum, amplitude, top, base, overshoot, pre-shoot, average- N cycles, average- full screen, DC RMS- N cycles, DC RMS- full screen, AC RMS- N cycles, AC RMS- full screen (std deviation), ratio- N cycle, ratio- full screen, Y at X **Time:** Period, frequency, counter, T at edge, + width, - width, burst width, +duty cycle, -duty cycle, bit rate, rise time, fall time, delay, phase, X at min Y, X at max Y, **Count:** Positive pulse count, negative pulse count, rising edge count, falling edge count **Mixed:** Area- N cycles, area- full screen, slew rate **Power:** Channel power, occupied bandwidth, adjacent power ratio, total harmonic distortion
Automatic measurement logging		Available via BenchVue
Counter		Built-in frequency counter
		Source: On any analog or digital channel
		Resolution: 5 digits
		Maximum frequency: Bandwidth of scope
Waveform Math		
Number of math functions		Two, displays FFT and one math simultaneously. Can be cascaded
Arithmetic		Add, subtract, multiply, divide, differentiate, integrate, FFT, Ax + B, squared, square root, absolute value, common logarithm, natural logarithm, exponential, base 10 exponential, low pass filter, high pass filter, averaged value, smoothing, envelope, magnify, max hold, min hold, measurement trend, chart logic bus (Timing or State), chart serial signal (CAN, CAN FD, LIN, and SENT)
Enhanced FFT	Record size	Up to 64 kpts resolution
	Window types	Hanning, Flat Top, Rectangular, Blackman-Harris, Bartlett
	Time gated FFT	Gate the time range of data for FFT analysis in the zoom view. For time and frequency domain correlated analysis.

Waveform Measurements		
	Waveforms	FFT, max hold, min hold, average
	Peak search	Max 11 peaks, threshold and excursion control
Search, Navigate, and Lister		
Type		Edge, pulse width, rise/fall, runt, frequency peak, serial bus 1, serial bus 2
Copy		Copy to trigger, copy from trigger
Frequency peak	Source	Math functions
	Max # of peaks	11
	Control	Results order in frequency or amplitude
Result display		Event lister or navigation. Manual or auto scroll via navigation or touch event lister entry to jump to a specific event
Display Characteristics		
Display		8.5-inch capacitive touch/gesture enabled TFT LCD
Resolution		800 (H) x 480 (V) pixel format (screen area)
Graticules		8 vertical divisions by 10 horizontal divisions with intensity controls
Format		YT, XY, and Roll
Maximum waveform update rate		> 1,000,000 waveforms/sec
Persistence		Off, infinite, variable persistence (100 ms to 60 s)
Intensity gradation		64 intensity levels

1. Denotes warranted specifications, all others are typical.
   Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature.
2. 1 mV/div and 2 mV/div is a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 1 mV/div and 2 mV/div sensitivity setting.

WaveGen – Built-in Function/Arbitrary Waveform Generator (specifications are typical)		
WaveGen out	Front-panel BNC connector	
Waveforms	Sine, Square, Ramp, Pulse, DC, Noise, Sine Cardinal (Sinc), Exponential Rise, Exponential Fall, Cardiac, Gaussian Pulse, and Arbitrary	
Modulation	Modulation types: AM, FM, FSK Carrier waveforms: sine, ramp, sine cardinal, exponential rise, exponential fall, and cardiac Modulation source: internal (no external modulation capability)	
	AM:	Modulation: sine, square, ramp Modulation frequency: 1 Hz to 20 kHz Depth: 0% to 100%
	FM:	Modulation: sine, square, ramp Modulation frequency: 1 Hz to 20 kHz Minimum carrier frequency: 10 Hz Deviation: 1 Hz to carrier frequency or (2e12 / carrier frequency), whichever is smaller
	FSK:	Modulation: 50% duty cycle square wave FSK rate: 1 Hz to 20 kHz Hop frequency: 2 x FSK rate to 10 MHz
Sine	Frequency range: 0.1 Hz to 20 MHz	
	Amplitude flatness: ± 0.5 dB (relative to 1 kHz)	
	Harmonic distortion: –40 dBc	
	Spurious (non-harmonics): –40 dBc	
	Total harmonic distortion: 1%	
	SNR (50 Ω load, 500 MHz BW): 40 dB (Vpp > = 0.1 V); 30 dB (Vpp < 0.1V)	
Square wave /pulse	Frequency range: 0.1 Hz to 10 MHz	
	Duty cycle: 20 to 80%	
	Duty cycle resolution: Larger of 1% or 10 ns	
	Pulse width: 20 ns minimum	
	Rise/fall time: 18 ns (10 to 90%)	
	Pulse width resolution: 10 ns or 5 digits, whichever is larger	
	Overshoot: < 2%	
	Asymmetry (at 50% DC): ± 1% ± 5 ns	
	Jitter (TIE RMS): 500 ps	
Ramp/triangle wave	Frequency range: 0.1 Hz to 200 kHz	
	Linearity: 1%	

WaveGen – Built-in Function/Arbitrary Waveform Generator (specifications are typical)	
	Variable symmetry: 0 to 100%
	Symmetry resolution: 1%
Noise	Bandwidth: 20 MHz typical
Sine Cardinal (Sinc)	Frequency range: 0.1 Hz to 1.0 MHz
Exponential Rise/Fall	Frequency range: 0.1 Hz to 5.0 MHz
Cardiac	Frequency range: 0.1 Hz to 200.0 kHz
Gaussian Pulse	Frequency range: 0.1 Hz to 5.0 MHz
Arbitrary	Waveform length: 1 to 8k points
	Amplitude resolution: 10 bits (including sign bit) [1]
	Repetition rate: 0.1 Hz to 12 MHz
	Sample rate: 100 MSa/s
	Filter bandwidth: 20 MHz

1. Full resolution is not available at output due to internal attenuator stepping.

WaveGen – Built-in Function/Arbitrary Waveform Generator (specifications are typical) (continued)	
Frequency	Sine wave and ramp accuracy:
	130 ppm (frequency < 10 kHz)
	50 ppm (frequency > 10 kHz)
	Square wave and pulse accuracy:
	[50+frequency/200] ppm (frequency < 25 kHz)
	50 ppm (frequency ≥ 25 kHz)
	Resolution: 0.1 Hz or 4 digits, whichever is larger
Amplitude	Range:
	20 mVpp to 5 Vpp into Hi-Z [1]
	10 mVpp to 2.5 Vpp into 50 Ω [1]
	Resolution: 100 µV or 3 digits, whichever is higher
	Accuracy: 2% (frequency = 1 kHz)
DC offset	Range:
	± 2.5 V into Hi-Z [1]
	± 1.25 V into 50 Ω [1]
	Resolution: 100 µV or 3 digits, whichever is higher
	Accuracy (waveform modes): ± 1.5% of offset setting ± 1% of amplitude ± 1 mV
	Accuracy (DC mode): ± 1.5% of offset setting ± 3 mV
Trigger output	Trigger output available on Trig out BNC
Main output	Impedance: 50 Ω typical
	Isolation: Not available, main output BNC is grounded
	Protection: Overload automatically disables output
Output mode	Normal
	Single-shot (arbitrary, sine, ramp, sine cardinal, exp rise/fall, cardiac, Gaussian pulse)
Digital Voltmeter (specifications are typical)	
Functions	ACrms, DC, DCrms
Resolution	ACV/DCV: 3 digits
Measuring rate	100 times/second
Autoranging	Automatic adjustment of vertical amplification to maximize the dynamic range of measurements

WaveGen – Built-in Function/Arbitrary Waveform Generator (specifications are typical) (continued)		
Range meter		Graphical display of most recent measurement, plus extrema over the previous 3 seconds
Precision Counter/Totalizer (specification are typical)		
Counter	Source	Any analog channel or trigger qualified event
	Resolution	8 digits (8 digits for trigger qualified event)
	Max frequency	1 GHz
	Trig qual events	1/(trigger hold off time) for trigger qualified events (max 25 MHz, minimum dead time of 40 ns)
Measurement		Frequency, period, totalize
Totalizer	Counter size	64-bit totalizing counter
	Edge	Rise or fall
	Gating	Positive or negative level. Select from analog channels except the source

1. Gaussian Pulse: 4 Vpp maximum into Hi-Z; 2 Vpp maximum into 50 Ω.

Connectivity	
Standard ports	One USB 2.0 hi-speed device port on rear panel. Supports USBTMC protocol
	Two USB 2.0 hi-speed host ports, front and rear panel. Support memory devices, printers, and keyboards
	LAN (10/100Base-T)
	WVGA video out
Optional ports	GPIB
Trigger out	BNC connector on the rear panel. Supported modes: triggers, mask, and waveform generator sync pulse
General and Environmental Characteristics	
Power line consumption	Max 100 W
Power voltage range	100 to 120 V, 50/60/400 Hz; 100 to 240 V, 50/60 Hz
Environmental rating	5 to 50 °C with 4000m max Maximum Relative Humidity: 95%RH up to 40 °C From 40°C to 50°C, the maximum % Relative Humidity follows the line of constant dew point
Electromagnetic compatibility	Meets EMC directive (2004/108/EC), meets or exceeds IEC 61326-1:2005/EN 61326-1:2006 Group 1 Class A requirement CISPR 11/EN 55011 IEC 61000-4-2/EN 61000-4-2 IEC 61000-4-3/EN 61000-4-3 IEC 61000-4-4/EN 61000-4-4 IEC 61000-4-5/EN 61000-4-5 IEC 61000-4-6/EN 61000-4-6 IEC 61000-4-11/EN 61000-4-11 Canada: ICES-001:2004 Australia/New Zealand: AS/NZS
Safety	ANSI/UL Std. No. 61010-1:2012; CAN/CSA-C22.2 No. 61010-1-12
	ANSI/UL Std. No. 61010-2-030:2012; CAN/CSA-C22.2 No. 61010-2-030-12
Vibration	Meets IEC60068-2-6 and MIL-PRF-28800; class 3 random
Shock	Meets IEC 60068-2-27 and MIL-PRF-28800; class 3 random; (Operating 30 g, ½ sine. 11 ms duration, 3 shocks/axis along major axis, total of 18 shocks
Dimensions (W x H x D)	381 mm (15 in) x 204 mm (8 in) x 142 mm (5.6 in)
Weight	Net: 4.2 kg (9.3 lbs.), shipping: 4.4 kg (9.5 lbs.)

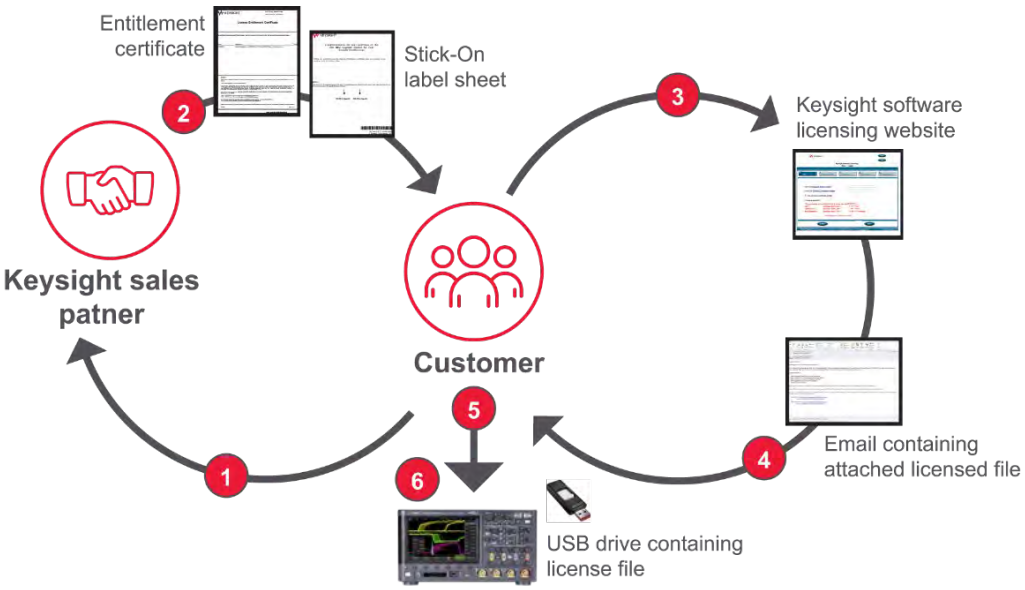
Nonvolatile Storage		
Reference waveform display		Two internal waveforms or USB thumb drive. Displays 1 reference waveform at a time
Data/file save	Setup/image	Setup (*.scp), 8 or 24-bit Bitmap image (*.bmp), PNG 24-bit image (*.png)
	Waveform data	CSV data (*.csv), ASCII XY data (*.csv), Binary data (*.bin), Lister data (*.csv), Reference waveform data (*.h5), multi-channel waveform data (*.h5), Arbitrary Waveform data (*.csv)
	Application data	Mask (*.msk), Power harmonics data (*.csv), USB signal quality (*.html & *.bmp)
	Analysis results (*.csv)	Cursor data, measurement results, mask test statistics, search, segmented timestamps
Max USB flash drive size		Supports industry standard flash drives
Set ups without USB flash drive		10 internal setups
Set ups with USB flash drive		Limited by size of USB drive
Included Standard with Oscilloscope		
Calibration		Soft copy of Certificate of Calibration (CoC) with measurement results downloadable from https://service.keysight.com/infoline/public/details.aspx?i=DOC, 3-year calibration interval
Mean time before failure (MTBF)		> 250,000 hours
Standard secure erase		
Probes		
N2843A Passive probe 500 MHz 10:1 attenuation		1 per channel
N2756A 16 digital channel MSO cable		1 per scope included on all MSO models and DSOXT3MSO
Interface and built-in help language support		English, Chinese (simplified), Chinese (traditional), Czech, French, German, Italian, Japanese, Korean, Portuguese, Russian, Spanish, Polish, Thai, Turkish
Localized power cord and overlay		

For MET/CAL procedures, click on the Cal Labs solutions link https://www.callabsolutions.com/procedures/. These procedures are FREE to customers

Related Literature

Publication Title	Publication Number
Triggering on Infrequent Anomalies and Complex Signals using Zone Trigger - Application Note	5991-1107EN
InfiniiVision 3000G X-Series Oscilloscopes - Product Fact Sheet	3122-1256EN
Time Gated Fast Fourier Transforms for Time Correlated Mixed Domain Analysis - Application Note	5992-0244EN
Embedded Software Package - Data Sheet	5992-3924EN
Automotive Software Package - Data Sheet	5992-3912EN
Aero Software Package - Data Sheet	5992-3910EN
Power Software Package - Data Sheet	5992-3925EN
USB Software Package - Data Sheet	5992-3920EN
Ultimate Bundle Software Package - Data Sheet	5992-3918EN

After-Purchase License-Only Upgrades



1. Place order for a license-only upgrade to a Keysight sales partner.
2. You will receive a paper or electronic .pdf Entitlement Certificate.
3. Use Entitlement Certificate containing instructions and certificate number needed to generate a license file for a particular 3000G X-Series oscilloscope model number and serial number unit.
4. Receive the licensed file and installation instructions via email.
5. Copy license file (.lic extension) from email to a USB drive and follow instructions in email to install the purchased bandwidth upgrade or measurement application on the oscilloscope.

Software Upgrades

Model Number	Description
D3000AUTB	Automotive Software Package: CAN, CAN FD, LIN, FlexRay, SENT, CXPI, PSI5 (User-definable Manchester), and User-definable NRZ serial trigger & decode
D3000AERB	Aero Software Package: MIL-STD 1553 and ARINC 429 serial trigger and decode
D3000PWRB	Power Software Package: Power quality, current harmonics, switching loss, turn-on/off time, transient response, loop response, PSRR, & more
D3000BDLB	Ultimate Bundle Software Package: CAN, CAN FD LIN, FlexRay, CXPI, PSI5 (User-definable Manchester), User-definable NRZ, MIL-STD 1553, and ARINC 429

Hardware Upgrades

Model Number	Description
DSOXG3MSO	MSO upgrade: Add 16 digital timing channels (N2756A MSO cable delivered separately)
DSOXG3SECA	Enhanced security option
DSOXT3B1T22	Bandwidth upgrade from 100 to 200 MHz, 2-ch models (license only)
DSOXT3B1T24	Bandwidth upgrade from 100 to 200 MHz, 4-ch models (license only)
DSOXT3B3T52	Bandwidth upgrade from 350 to 500 MHz, 2-ch models (license only)
DSOXT3B3T54	Bandwidth upgrade from 350 to 500 MHz, 4-ch models (license only)

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- Programming environments
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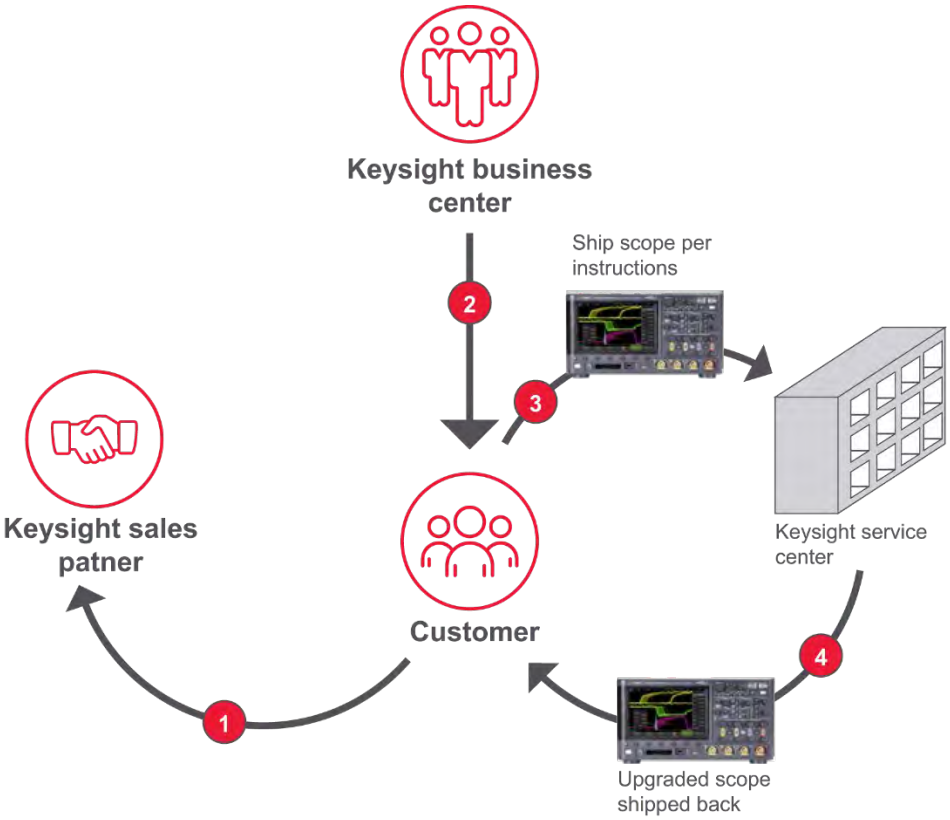
Return-to-Keysight Service Center Bandwidth Upgrades



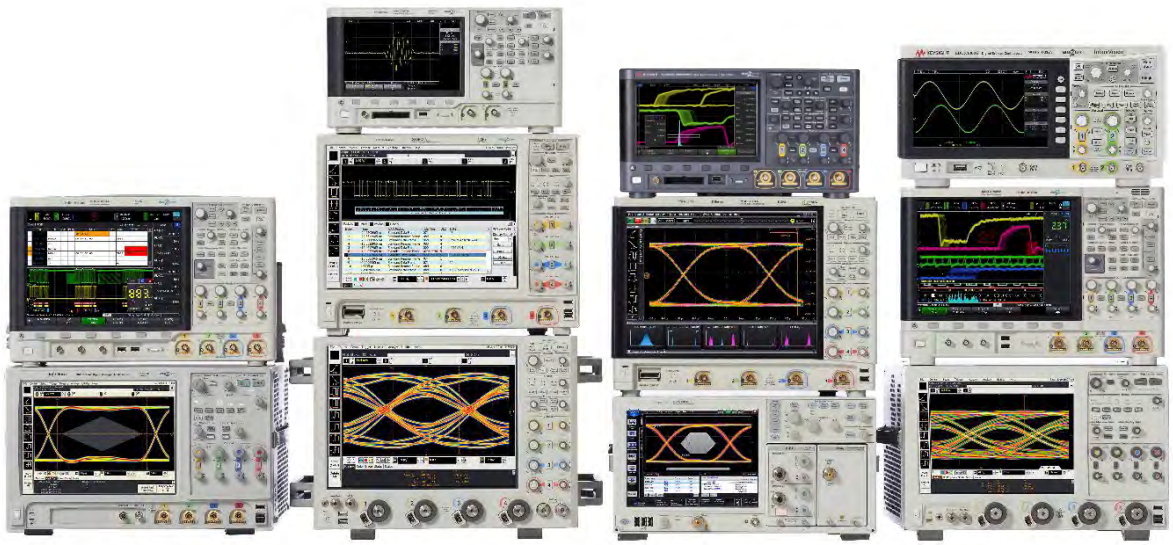
- Place order for a return-to-Keysight Service Center bandwidth upgrade product to a Keysight sales partner. Shipment costs are in addition to bandwidth upgrade product price.
- Keysight Business Center will contact you regarding process and timing of the Service Center installation. Continue to use oscilloscope until contacted again later when parts are available at Service Center.
- Ship the oscilloscope per provided instructions to Service Center.
- Service Center ships back upgraded oscilloscope with stick-on labels applied to front and rear panels indicating upgraded bandwidth specification. Model number and serial number of the oscilloscope do not change.

Return-to-Keysight Bandwidth Upgrades

Model Number	Description
DSOXT3B1T32U	Service center bandwidth upgrade 100 to 350 MHz upgrade, 2 ch
DSOXT3B1T52U	Service center bandwidth upgrade 100 to 500 MHz upgrade, 2 ch
DSOXT3B1T102U	Service center bandwidth upgrade 100 MHz to 1 GHz upgrade, 2 ch
DSOXT3B1T34U	Service center bandwidth upgrade 100 to 350 MHz upgrade, 4 ch
DSOXT3B1T54U	Service center bandwidth upgrade 100 to 500 MHz upgrade, 4 ch
DSOXT3B1T104U	Service center bandwidth upgrade 100 MHz to 1 GHz upgrade, 4 ch
DSOXT3B2T32U	Service center bandwidth upgrade 200 to 350 MHz upgrade, 2 ch
DSOXT3B2T52U	Service center bandwidth upgrade 200 to 500 MHz upgrade, 2 ch
DSOXT3B2T102U	Service center bandwidth upgrade 200 MHz to 1 GHz upgrade, 2 ch
DSOXT3B2T34U	Service center bandwidth upgrade 200 to 350 MHz upgrade, 4 ch
DSOXT3B2T54U	Service center bandwidth upgrade 200 to 500 MHz upgrade, 4 ch
DSOXT3B2T104U	Service center bandwidth upgrade 200 MHz to 1 GHz upgrade, 4 ch
DSOXT3B3T102U	Service center bandwidth upgrade 350 MHz to 1 GHz upgrade, 2 ch
DSOXT3B3T104U	Service center bandwidth upgrade 350 MHz to 1 GHz upgrade, 4 ch
DSOXT3B5T102U	Service center bandwidth upgrade 500 MHz to 1 GHz upgrade, 2 ch
DSOXT3B5T104U	Service center bandwidth upgrade 500 MHz to 1 GHz upgrade, 4 ch

Keysight Oscilloscopes

Multiple form factors from 50 MHz to 110 GHz | Industry leading specs | Powerful applications



Learn more at: www.keysight.com

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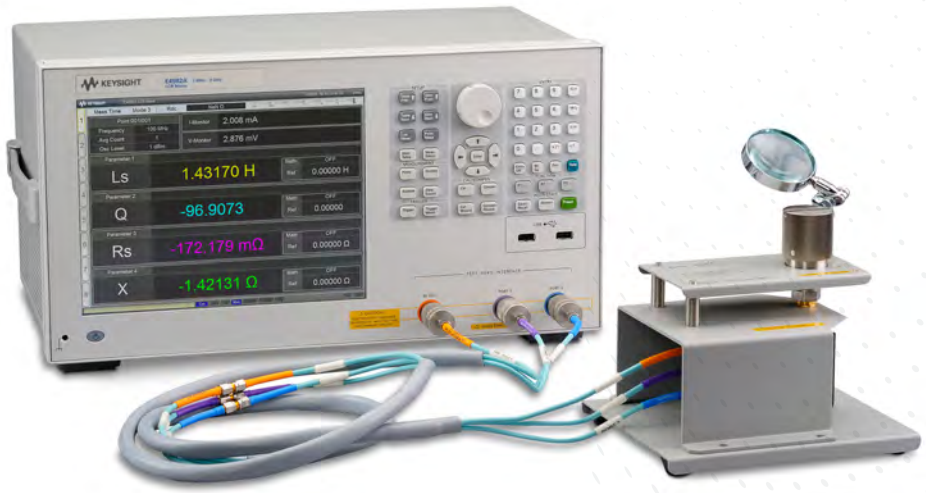
KEYSIGHT TECHNOLOGIES

DATA SHEET

E4982A LCR Meter

1 MHz to 300 MHz/500 MHz/1 GHz/3 GHz



KEYSIGHT TECHNOLOGIES

Specification (spec.)

Warranted performance. All specifications apply at 23 °C ± 5 °C unless otherwise stated, and 30 minutes after the instrument has been turned on. Specifications include guard bands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions.

Following supplemental information is intended to provide information that is helpful for using the instrument.

Typical (typ.)

Expected performance of an average unit which does not include guardbands. It is not covered by the product warranty.

Supplemental performance data (SPD)

Represents the value of a parameter that is most likely to occur; the expected mean or average. It is not covered by the product warranty.

General characteristics or nominal (nom.)

A general, descriptive term that does not imply a level of performance. It is not covered by the product warranty.

Basic Measurement Characteristic

Measurement parameters	
Impedance parameters	|Z|, |Y|, Ls, Lp, Cs, Cp, Rs, Rp, X, G, B, D, Q, θz [°], θz [rad], θy [°], θy [rad], User defined parameter (A maximum of four parameters can be displayed at one time.)
Measurement range	
Impedance parameters	140 mΩ to 4.8 kΩ (Frequency = 1 MHz, Averaging factor = 8, Measurement time mode = 3, Oscillator level = 1 dBm, Measurement uncertainty ≤ ± 10%, Calibration is performed within 23 °C ± 5 °C, Measurement is performed within ± 5 °C from the calibration temperature)

Source Characteristics

Frequency	
Range	1 MHz to 300 MHz (Option 030)
	1 MHz to 500 MHz (Option 050)
	1 MHz to 1 GHz (Option 100)
	1 MHz to 3 GHz (Option 300)
Resolution	1 kHz [1]
Uncertainty	± 10 ppm (23 °C ± 5 °C)
	± 20 ppm (5 °C to 40 °C)
Oscillator level	
Cable length = 1 m	
Power range (When 50 Ω LOAD is connected to test port)	−40 dBm to 1 dBm
Current range (When SHORT is connected to test port)	0.0894 mArms to 10 mArms
Voltage range (When OPEN is connected to test port)	4.47 mVrms to 502 mVrms
Uncertainty (When 50 Ω LOAD is connected to test port)	(23 °C ± 5 °C) ± 2 dB (frequency ≤ 1 GHz) ± 3 dB (frequency > 1 GHz)
	(5 °C to 40 °C) ± 4 dB (frequency ≤ 1 GHz) ± 5 dB (frequency > 1 GHz)
Resolution	0.1 dB (When the unit is set at mV or mA, the entered value is rounded to 0.1 dB resolution.)
Cable length = 2 m (When option 002 is used)	
Power range	Subtract the following attenuation from the power (setting value) at 1 m cable length: Attenuation [dB] = 0.42 √f (f: Frequency [GHz])
Uncertainty (When 50 Ω LOAD is connected to test port)	(23 °C ± 5 °C) ± 3 dB (frequency ≤ 1 GHz) ± 4 dB (frequency > 1 GHz)
	(5 °C to 40 °C) ± 5 dB (frequency ≤ 1 GHz) ± 6 dB (frequency > 1 GHz)
Resolution	0.1 dB (When the unit is set at mV or mA, the entered value is rounded to 0.1 dB resolution.)

Output impedance

Output impedance	50 Ω (nominal)

1. Applies to the units with firmware revision B.02.20 or later. (For the units with firmware revision below B.02.20, the resolution is 100 kHz.)

Measurement Accuracy

Condition for definition of accuracy:

- 23 °C ± 5 °C
- 7-mm connector of 3.5-mm-7-mm adapter connected to 3.5-mm terminal of test heads

Basic measurement uncertainty (Typical)

0.45 %

Measurement uncertainty

When OPEN/SHORT/LOAD calibration is performed:

$\lvert Z\rvert, \lvert Y\rvert$	$\pm (E_a + E_b)$ [%]
$\Delta\theta$	$\pm \frac{(E_a + E_b)}{100}$ [rad]
L, C, X, B	$\pm (E_a + E_b) \times \sqrt{(1 + D^2_x)}$ [%]
R, G	$\pm (E_a + E_b) \times \sqrt{(1 + Q^2_x)}$ [%]
ΔD	
at $\left\lvert D_x \tan\left(\frac{E_a + E_b}{100}\right)\right\rvert < 1$	$\pm \frac{(1+D_x^2)\tan\left(\frac{E_a + E_b}{100}\right)}{1 \mp D_x \tan\left(\frac{E_a + E_b}{100}\right)}$
Especially, at $D_x \leq 0.1$	$\pm \frac{E_a + E_b}{100}$
ΔQ	
at $\left\lvert Q_x \tan\left(\frac{E_a + E_b}{100}\right)\right\rvert < 1$	$\pm \frac{(1+Q_x^2)\tan\left(\frac{E_a + E_b}{100}\right)}{1 \mp Q_x \tan\left(\frac{E_a + E_b}{100}\right)}$
Especially, at $\frac{10}{E_a + E_b} \geq Q_x \geq 10$	$\pm Q_x^2 \frac{E_a + E_b}{100}$

Measurement uncertainty

When OPEN/SHORT/LOAD/Low Loss capacitance calibration is performed (SPD):

$\lvert Z\rvert, \lvert Y\rvert$	$\pm\left(E_a + E_b\right)$ [%]
$\Delta\theta$	$\pm \frac{E_c}{100}$ [rad]
L, C, X, B	$\pm\sqrt{\left(E_a + E_b\right)^2 + \left(E_c D_x\right)^2}$ [%]
R, G	$\pm\sqrt{\left(E_a + E_b\right)^2 + \left(E_c Q_x\right)^2}$ [%]
ΔD	
at $\left\lvert D_x \tan\left(\frac{E_c}{100}\right)\right\rvert < 1$	$\pm \frac{\left(1+D_x^2\right)\tan\left(\frac{E_c}{100}\right)}{1 \mp D_x \tan\left(\frac{E_c}{100}\right)}$
Especially, at $D_x \leq 0.1$	$\pm \frac{E_c}{100}$
ΔQ	
at $\left\lvert Q_x \tan\left(\frac{E_c}{100}\right)\right\rvert < 1$	$\pm \frac{\left(1+Q_x^2\right)\tan\left(\frac{E_c}{100}\right)}{1 \mp Q_x \tan\left(\frac{E_c}{100}\right)}$
Especially, at $\frac{10}{E_c} \geq Q_x \geq 10$	$\pm Q_x^2 \frac{E_c}{100}$

Definition of each parameter

Dx =	Measurement value of D		
Qx =	Measurement value of Q		
Ea =	Within 23 ± 5 °C from the calibration temperature. Measurement accuracy applies when the calibration is performed at 23 ± 5 °C. When the calibration is performed beyond 23 ± 5 °C, the measurement accuracy decreases to half that described.		
	Measurement Time: Mode 1	Oscillator level = 1 dBm	± 0.54 % at 1 MHz ≤ frequency ≤ 100 MHz
			± 0.62 % at 100 MHz < frequency ≤ 500 MHz
			± 0.92 % at 500 MHz < frequency ≤ 1 GHz
			± 2.05 % at 1 GHz < frequency ≤ 1.8 GHz
			± 4.42 % at 1.8 GHz < frequency ≤ 3 GHz
		–20 dBm ≤ Oscillator level < 1 dBm	± 0.66 % at 1 MHz ≤ frequency ≤ 100 MHz
			± 0.74 % at 100 MHz < frequency ≤ 500 MHz
			± 1.11 % at 500 MHz < frequency ≤ 1 GHz
			± 2.36 % at 1 GHz < frequency ≤ 1.8 GHz
			± 4.81 % at 1.8 GHz < frequency ≤ 3 GHz
		-33 dBm ≤ Oscillator level < –20 dBm	± 1.13 % at 1 MHz ≤ frequency ≤ 100 MHz
			± 1.22 % at 100 MHz < frequency ≤ 500 MHz
			± 1.84 % at 500 MHz < frequency ≤ 1 GHz
			± 3.54 % at1 GHz < frequency ≤ 1.8 GHz
			± 6.35 % at 1.8 GHz < frequency ≤ 3 GHz
		Oscillator level < –33 dBm	± 2.08 % at 1 MHz ≤ frequency ≤ 100 MHz
			± 2.26 % at 100 MHz < frequency ≤ 500 MHz
			± 2.27 % at 500 MHz < frequency ≤ 1 GHz
			± 4.34 % at 1 GHz < frequency ≤ 1.8 GHz
			± 7.60 % at 1.8 GHz < frequency ≤ 3 GHz
	Mode 2	Oscillator level = 1 dBm	± 0.52 % at 1 MHz ≤ frequency ≤ 100 MHz
			± 0.59 % at 100 MHz < frequency ≤ 500 MHz
			± 0.89 % at 500 MHz < frequency ≤ 1 GHz
			± 1.99 % at 1 GHz < frequency ≤ 1.8 GHz
			± 4.34 % at 1.8 GHz < frequency ≤ 3 GHz
		–20 dBm ≤ Oscillator level < 1 dBm	± 0.58 % at 1 MHz ≤ frequency ≤ 100 MHz
			± 0.66 % at 100 MHz < frequency ≤ 500 MHz
			± 0.98 % at 500 MHz < frequency ≤ 1 GHz
			± 2.14 % at 1 GHz < frequency ≤ 1.8 GHz
			± 4.54 % at 1.8 GHz < frequency ≤ 3 GHz
		–33 dBm ≤ Oscillator level < –20 dBm	± 0.81 % at 1 MHz ≤ frequency ≤ 100 MHz
			± 0.90 % at 100 MHz < frequency ≤ 500 MHz
			± 1.35 % at 500 MHz < frequency ≤ 1 GHz
			± 2.74 % at 1 GHz < frequency ≤ 1.8 GHz
			± 5.31 % at 1.8 GHz < frequency ≤ 3 GHz
		Oscillator level < –33 dBm	± 1.30 % at 1 MHz ≤ frequency ≤ 100 MHz
			± 1.44 % at 100 MHz < frequency ≤ 500 MHz
			± 1.44 % at 500 MHz < frequency ≤ 1 GHz
			± 2.92 % at 1 GHz < frequency ≤ 1.8 GHz
			± 5.59 % at 1.8 GHz < frequency ≤ 3 GHz

Definition of each parameter (Continued)

Ea =	Mode 3	Oscillator level = 1 dBm	± 0.51 % at 1 MHz ≤ frequency ≤ 100 MHz
			± 0.59 % at 100 MHz < frequency ≤ 500 MHz
			± 0.87 % at 500 MHz < frequency ≤ 1 GHz
			± 1.97 % at 1 GHz < frequency ≤ 1.8 GHz
			± 4.32 % at 1.8 GHz < frequency ≤ 3 GHz
		–20 dBm ≤ Oscillator level < 1 dBm	± 0.55 % at 1 MHz ≤ frequency ≤ 100 MHz
			± 0.63 % at 100 MHz < frequency ≤ 500 MHz
			± 0.94 % at 500 MHz < frequency ≤ 1 GHz
			± 2.08 % at 1 GHz < frequency ≤ 1.8 GHz
			± 4.46 % at 1.8 GHz < frequency ≤ 3 GHz
		–33 dBm ≤ Oscillator level < –20 dBm	± 0.65 % at 1 MHz ≤ frequency ≤ 100 MHz
			± 0.80 % at 100 MHz < frequency ≤ 500 MHz
			± 1.20 % at 500 MHz < frequency ≤ 1 GHz
			± 2.50 % at 1 GHz < frequency ≤ 1.8 GHz
			± 5.00 % at 1.8GHz < frequency ≤ 3 GHz
		Oscillator level < –33 dBm	± 1.00 % at 1 MHz ≤ frequency ≤ 100 MHz
			± 1.20 % at 100 MHz < frequency ≤ 500 MHz
			± 1.20 % at 500 MHz < frequency ≤ 1 GHz
			± 2.50 % at 1 GHz < frequency ≤ 1.8 GHz
			± 5.00 % at 1.8 GHz < frequency ≤ 3 GHz
Eb =	$\pm \left(\frac{Zs}{\lvert Zx \rvert} + Yo \times \lvert Zx \rvert \right) \times 100\ [\%]$		(|Zx| : Measurement value of |Z|)
Ec =	$\pm \left(0.06 + \frac{0.08 \times F}{1000} \right)\ [\%]$		(F : Frequency [MHz])
Zs =	Within 23 ± 5 °C from the calibration temperature. Measurement accuracy applies when the calibration is performed at 23 ± 5 °C. When the calibration is performed beyond 23 ± 5 °C, the measurement accuracy decreases to half that described. (F: Frequency [MHz])		
	Measurement Time: Mode 1	Oscillator level = 1 dBm, Average factor ≥ 8	± (14 + 0.5 × F) [mΩ]
		Oscillator level = 1 dBm, Average factor < 8	± (19 + 0.5 × F) [mΩ]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor ≥ 8	± (20 + 0.5 × F) [mΩ]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor < 8	± (37 + 0.5 × F) [mΩ]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor ≥ 8	± (36 + 0.5 × F) [mΩ]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor < 8	± (110 + 0.5 × F) [mΩ]
		Oscillator level < –33 dBm	± (248 + 0.5 × F) [mΩ]

Definition of each parameter (Continued)

Zs =	Mode 2	Oscillator level= 1 dBm, Average factor ≥ 8	± (13 + 0.5 × F) [mΩ]
		Oscillator level= 1 dBm, Average factor < 8	± (15 + 0.5 × F) [mΩ]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor ≥ 8	± (16 + 0.5 × F) [mΩ]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor < 8	± (24 + 0.5 × F) [mΩ]
		–33 dBm ≤ Oscillator level< -20 dBm, Average factor ≥ 8	±(24+0.5×F) [mΩ]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor < 8	± (64 + 0.5 × F) [mΩ]
		Oscillator level < –33 dBm	± (133 + 0.5 × F) [mΩ]
	Mode 3	Oscillator level = 1 dBm, Average factor ≥ 8	± (12 + 0.5 × F) [mΩ]
		Oscillator level = 1 dBm, Average factor < 8	± (14 + 0.5 × F) [mΩ]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor ≥ 8	± (15 + 0.5 × F) [mΩ]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor < 8	± (20 + 0.5 × F) [mΩ]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor ≥ 8	± (20 + 0.5 × F) [mΩ]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor < 8	± (50 + 0.5 × F) [mΩ]
		Oscillator level < –33 dBm	± (100 + 0.5 × F) [mΩ]
Yo =	Within 23 ± 5 °C from the calibration temperature. Measurement accuracy applies when the calibration is performed at 23 ± 5 °C. When the calibration is performed beyond 23 ± 5 °C, the measurement accuracy decreases to half that described. (F: Frequency [MHz])		
	Measurement Time: Mode 1	Oscillator level = 1 dBm, Average factor ≥ 8	± (22 + 0.15 × F) [µS]
		Oscillator level = 1 dBm, Average factor < 8	± (28 + 0.15 × F) [µS]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor ≥ 8	± (30 + 0.15 × F) [µS]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor < 8	± (53 + 0.15 × F) [µS]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor ≥ 8	± (52 + 0.15 × F) [µS]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor < 8	± (110 + 0.15 × F) [µS]
		Oscillator level < –33 dBm	± (247 + 0.15 × F) [µS]
	Mode 2	Oscillator level = 1 dBm, Average factor ≥ 8	± (20 + 0.15 × F) [µS]
		Oscillator level = 1 dBm, Average factor < 8	± (23 + 0.15 × F) [µS]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor ≥ 8	± (24 + 0.15 × F) [µS]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor < 8	± (35 + 0.15 × F) [µS]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor ≥ 8	± (35 + 0.15 × F) [µS]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor < 8	± (63 + 0.15 × F) [µS]
		Oscillator level < –33 dBm	± (133 + 0.15 × F) [µS]

Definition of each parameter (Continued)

Yo =	Mode 3	Oscillator level = 1 dBm, Average factor ≥ 8	± (19 + 0.15 × F) [µS]
		Oscillator level = 1 dBm, Average factor < 8	± (22 + 0.15 × F) [µS]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor ≥ 8	± (22 + 0.15 × F) [µS]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor < 8	± (30 + 0.15 × F) [µS]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor ≥ 8	± (30 + 0.15 × F) [µS]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor < 8	± (50 + 0.15 × F) [µS]
		Oscillator level < –33 dBm	± (100 + 0.15 × F) [µS]

Measurement error may exceed the specifications described above at 90 MHz due to the E4982A's spurious characteristics.

Examples of Calculated Impedance Measurement Accuracy

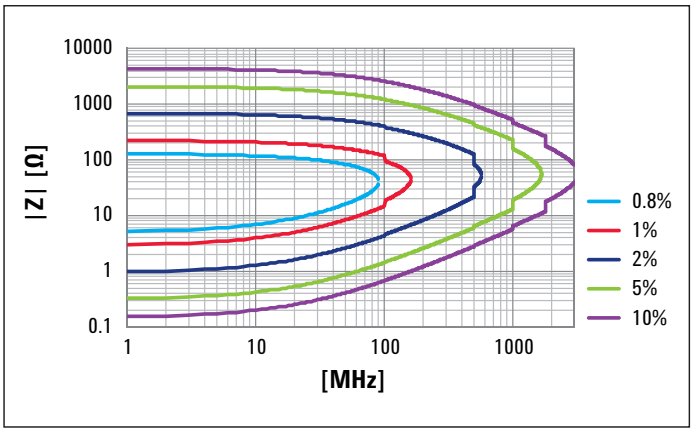


Figure 1. Measurement Time: Mode 3, Oscillator Level = 1 dBm, Averaging Factor < 8, Temperature Deviation ≤ 5 °C

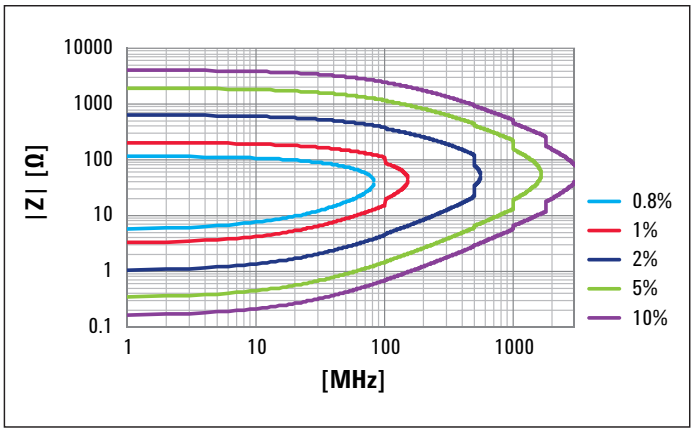


Figure 2. Measurement Time: Mode 2, Oscillator Level = 1 dBm, Averaging Factor < 8, Temperature Deviation ≤ 5 °C

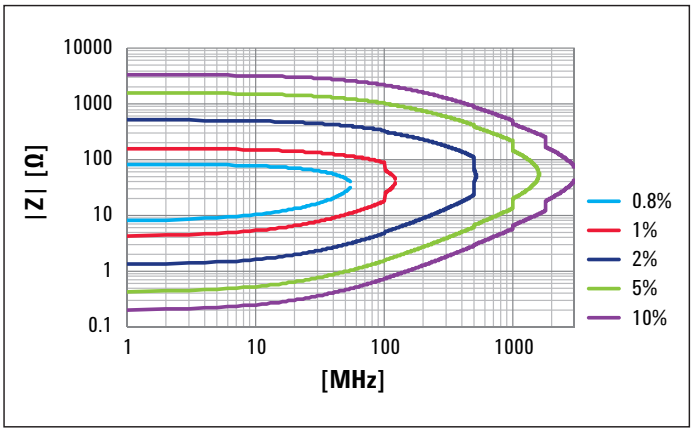


Figure 3. Measurement Time: Mode 1, Oscillator Level = 1 dBm, Averaging Factor < 8, Temperature Deviation ≤ 5 °C

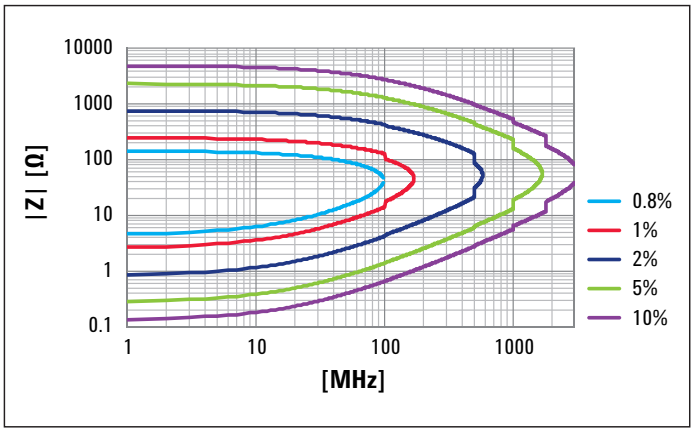


Figure 4. Measurement Time: Mode 3, Oscillator Level = 1 dBm, Averaging Factor ≥ 8, Temperature Deviation ≤ 5 °C

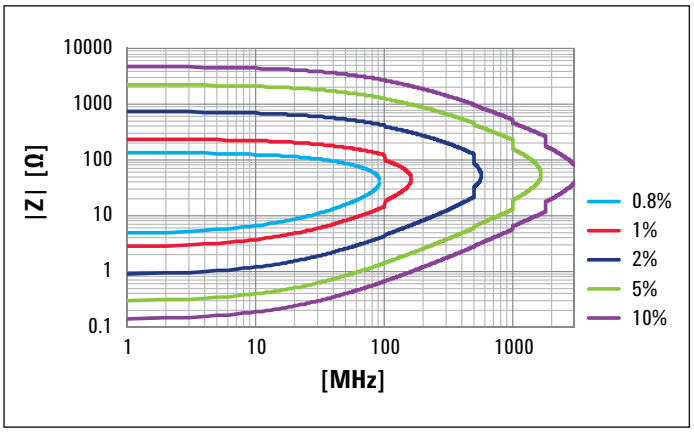


Figure 5. Measurement Time: Mode 2, Oscillator Level = 1 dBm, Averaging Factor ≥ 8, Temperature Deviation ≤ 5 °C

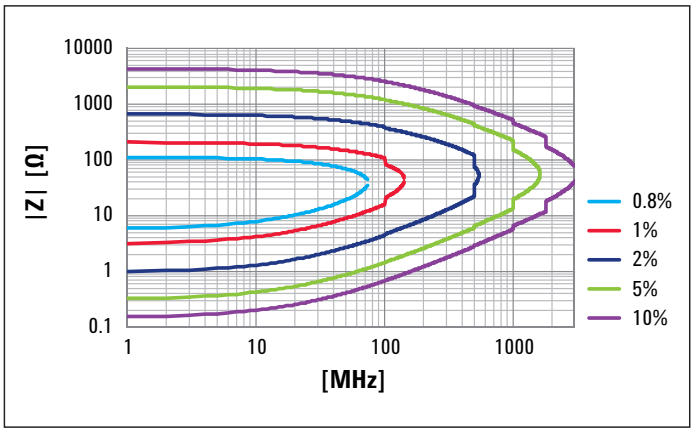


Figure 6. Measurement Time: Mode 1, Oscillator Level = 1 dBm, Averaging Factor ≥ 8, Temperature Deviation ≤ 5 °C

Timing Chart and Measurement Time (SPD)

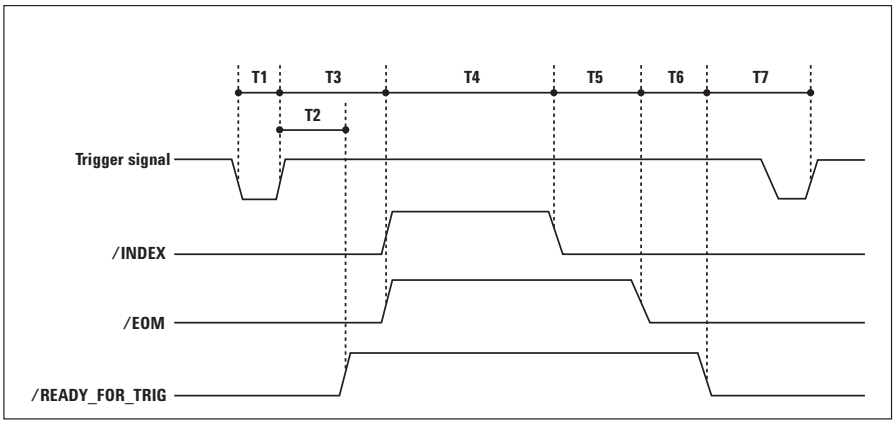


Figure 7. Timing chart of handler interface signal.

Cycle Time

		Test condition			Timing											
					Mode 1 (1 MHz)			Mode 1 (100 MHz)			Mode 2			Mode 3		
		Screen setting	Rdc meas.	Comparator	Min.	Median	Max.	Min.	Median	Max.	Min.	Median	Max.	Min.	Median	Max.
T1	Trigger pulse width	–	Off	Off	2 µs	–	–	2 µs	–	–	2 µs	–	–	2 µs	–	–
T2	Trigger response time of Ready_for_Trig	–	Off	Off		–	< 50 µs		–	< 50 µs		–	< 50 µs		–	< 50 µs
T3	Trigger response time (INDEX, EOM)	–	Off	Off		–	< 50 µs		–	< 50 µs		–	< 50 µs		–	< 50 µs
T4	Measurement time (INDEX)	1 point meas (Preset)	Off	Off	–	1.6 ms	1.6 ms		0.9 ms	0.9 ms		2.1 ms	2.1 ms		3.7 ms	3.7 ms
			On	Off	–	4.5 ms	4.5 ms		3.8 ms	3.8 ms		5.0 ms	5.0 ms		6.6 ms	6.6 ms
T4 + T5	Measurement data calculation time (EOM)	1 point meas (Preset)	Off	Off	–	1.6 ms	1.8 ms		0.9 ms	1.1 ms		2.1 ms	2.3 ms		3.7 ms	4.0 ms
			Off	On	–	1.7 ms	1.9 ms	–	1.0 ms	1.2 ms	–	2.2 ms	2.7 ms	–	3.8 ms	4.1 ms
T4 + T5 + T6	Ready_for_Trig setting time	1 point meas. Ls-Q meas.	Off	Off	–	1.8 ms	2.2 ms	–	1.1 ms	1.4 ms	–	2.3 ms	2.8 ms	–	3.9 ms	4.4 ms
			Off	On	–	1.9 ms	2.3 ms	–	1.2 ms	1.9 ms	–	2.4 ms	3.3 ms	–	4.0 ms	4.5 ms
			On	Off	–	5.1 ms	5.6 ms	–	4.4 ms	4.9 ms	–	5.6 ms	6.1 ms	–	7.2 ms	7.7 ms
			On	On	–	5.2 ms	5.7 ms	–	4.5 ms	4.9 ms	–	5.7 ms	6.3 ms	–	7.2 ms	7.8 ms
T7	Trigger wait time	–	–	–	0	–	–	0	–	–	0	–	–	0	–	–

Condition: Display Off or : DISP : UPD OFF, Trigger delay=0, Point delay=0
E4982A OS: Windows 7 (Serial Prefix: MY523)

Test Condition for Measurement Time

The measurement time of E4982A is scattered to some extent by an overhead of the internal operation system and other conditions, so it is difficult to define the specification of handler interface timing. Thus, for your reference, we provide “SPD” data on it in table by defining the following test condition.

Median: Median value of running one minute of measurement data
Max.: Maximum value of running one minute of measurement data

NOTE

1. The instrument’s operating system sometimes suffers interruptions during measurement, and we sometimes observe an extremely large overhead in handler interface timings. The table excludes such special cases, thus you can sometimes see timing over the maximum value data shown in the table. If you make a handshake using the READY_FOR_TRIGGER signal of the handler interface, your test system can continue to work correctly regardless of such an irregular measurement time drift.
2. If your system communicates with external devices, you will see longer timing results than those on the table.
3. In the case of using a bus trigger in the GPIB/LAN/USB system instead of the handler interface, you should measure the test cycle time for yourself, because the system performance depends heavily on the system parameters. Of course, you will see much longer test cycle times from your system software overhead.

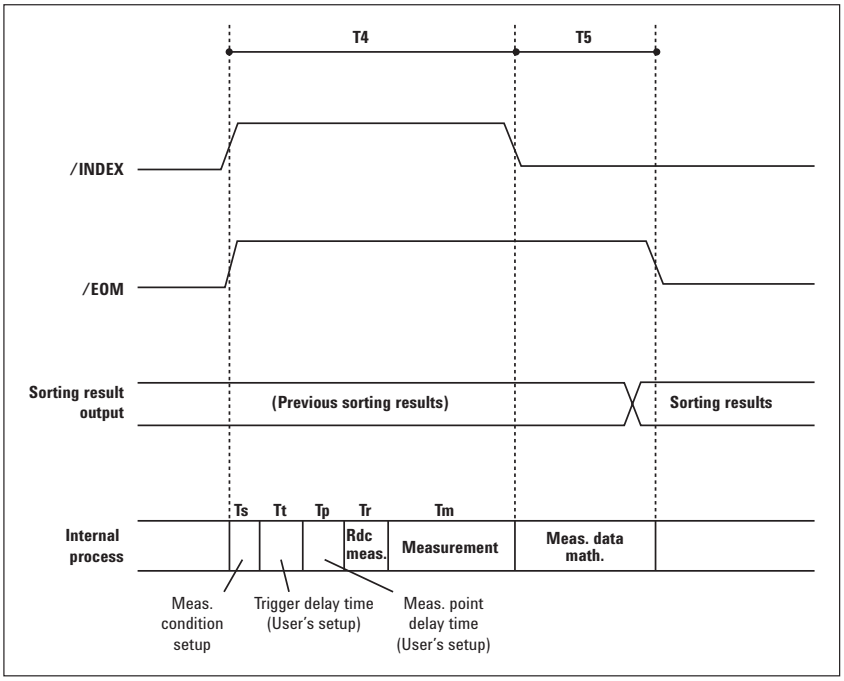


Figure 8. Measurement time T4 for single point measurement.

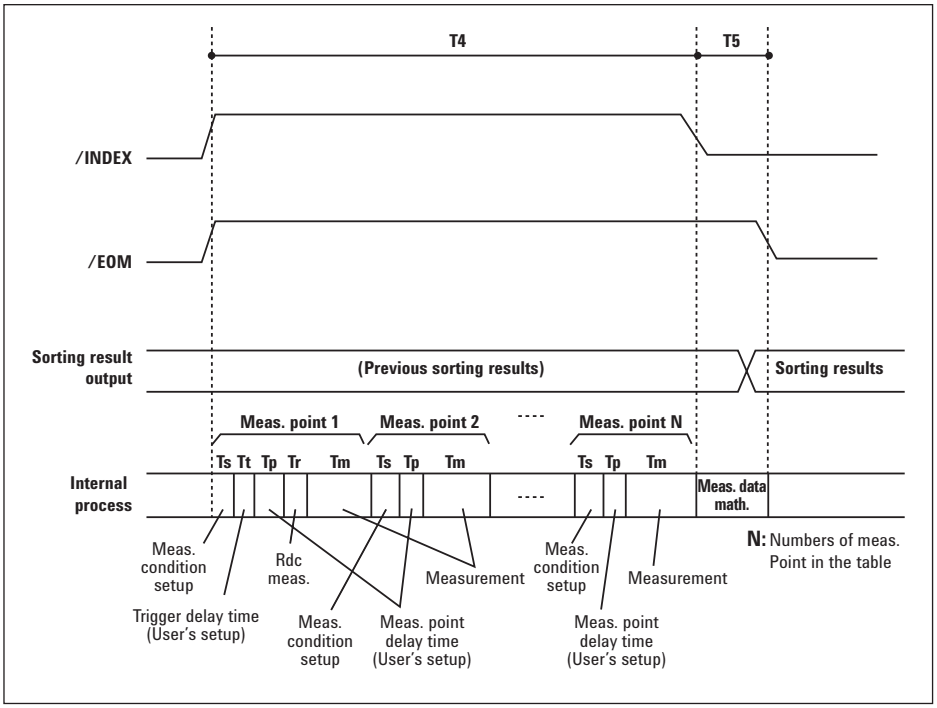


Figure 9. Measurement time T4 for list measurement.

Data Transfer Time (Typical)

Mode 3

Data transfer format	Number of measurement points	Required time for FETCh? command (ms)		
		GPIB	USB	LAN (Socket)
ASCII	1	0.4	0.4	0.6
	2	0.7	0.4	0.6
	3	1.0	0.4	0.7
Binary	1	0.5	1.1	0.6
	2	0.5	1.1	0.5
	3	0.6	1.1	0.6

Host computer	DELL PRECISION 390 Intel Core2Duo 6300 1.86 GHz/RAM: 2 GB
GPIB I/F	Keysight Technologies, Inc. PCI GPIB E2078A/82350A
IO Lib	Keysight IO Libraries Suite 16.1.14931.0
E4982A setting	
Frequency	100 MHz
OSC level	0 dBm
Average	1
Display	Off
List measurement	
Measurement parameter	Ls-Q (Parameters No.3 and 4: Off)
Measurement signal level monitor	Off
Comparator	Off
Rdc measurement	Off

Measurement Support Functions

Error correction function

Available calibration and compensation	
OPEN/SHORT/LOAD calibration	Connect OPEN, SHORT, and LOAD standards to the desired reference plane and measure each kind of calibration data. The reference plane is called calibration reference plane.
Low-Loss capacitor calibration	Connect the dedicated standard (Low-Loss capacitor) to the calibration reference plane and measure the calibration data.
Port extension compensation (Fixture selection)	When a device is connected to the terminal that is extended from the calibration reference plane, set the electrical length between the calibration plane and the device contact. Select a model number of the registered test fixtures in the E4982A's softkey menu or enter the electrical length for user's test fixture.
OPEN/SHORT compensation	When a device is connected to the terminal that is extended from the calibration reference plane, make OPEN and/or SHORT states at the device contact and measure each kind of compensation data.
Calibration/compensation data measurement point	
Data measurement points	Same as measurement points which are set in the measurement point setup display. (Changing the frequency, oscillator level, or measurement time settings after the calibration or compensation makes the calibration and compensation data invalid.)

DC resistance (Rdc) measurement

Measurement range	0.1 Ω to 100 Ω
Measurement resolution	1 mΩ
Test signal level	1 mA (maximum)
Error correction	OPEN/SHORT/LOAD Calibration, OPEN/SHORT Compensation. (Changing the frequency or oscillator level settings after the calibration or compensation makes the calibration and compensation data invalid.)
Measurement uncertainty (SPD)	$\pm\left[1+\left(\frac{0.05}{Rdut}+\frac{Rdut}{10000}\right)\times 100\right]$ [%] Rdut : DC resistance measurement value [Ω] (At averaging factor=128, within ± 5 °C from the calibration temperature. Measurement accuracy applies when the calibration is performed at 23 °C ± 5 °C. When the calibration is performed beyond 23 °C ± 5 °C, the measurement accuracy decreases to half that described.)

Trigger function

Trigger mode	Internal, External (external trigger input connector or handler interface), Bus (GPIB, USB or LAN), Manual (front key)

Measurement time

Time	Mode 1 (Short), Mode 2 (Mid), Mode 3 (Long)

Averaging function

Setting range	1 to 100 (integer)

List measurement function

Number of measurement points	201 points for each table (maximum)
Number of tables	8 tables

Test signal level monitor function

Uncertainty of monitor value (SPD)	$\pm\left[30+\left(10^{\frac{A}{20}}-1\right)\times 100+B\right]$ [%] A: Uncertainty of oscillator level [dB], B: Uncertainty of impedance measurement [%]

Front panel

Ports	Type N (3 ea.) connected to test head	
Display	Type/size	10.4 inch TFT color LCD
	Resolution	XGA (1024 × 768) [1]
USB	Universal serial bus jack, Type A configuration; female; provides connection to mouse, key board, printer or USB stick memory.	

Measurement terminal (at test head)

Connector type	3.5-mm (female) connector (Can be converted to 7-mm connector using the 3.5 mm to 7 mm adapter)

Rear panel

External reference signal input connector	
Frequency	10 MHz ± 10 ppm (Typ.)
Level	0 dBm ± 3 dB (Typ.)
Input impedance	50 Ω (nominal)
Connector type	BNC (female)
Internal reference signal output connector	
Frequency	10 MHz ± 10 ppm (Typ.)
Uncertainty of frequency	Same as frequency uncertainty described in “Source Characteristics”.
Level	0 dBm ± 3 dB into 50 Ω (Typ.)
Output impedance	50 Ω (nominal)
Connector type	BNC (female)
External trigger signal input connector	
Level	LOW threshold voltage: 0.5 V
	HIGH threshold voltage: 2.1 V
	Input level range: 0 to +5 V
Pulse width (Tp)	≥ 2 µsec (SPD). See the following figure for definition of Tp
Polarity	Positive or negative (Selective)
Connector type	BNC (female)

1. Valid pixels are 99.99% and more. Below 0.01% of fixed points of black, blue, green or red are not regarded as failure.

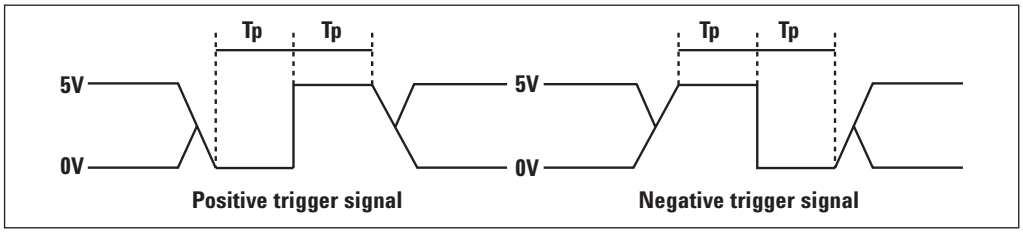


Figure 10. Definition of pulse width (Tp).

Interface

GPIB	24-pin D-Sub (Type D-24), female; compatible with IEEE-488.
	IEEE-488 interface specification is designed to be used in environment where electrical noise is relatively low.
	LAN or USBTMC interface is recommended to use at the higher electrical noise environment.
USB host port	Universal serial bus jack, Type A configuration; female; provides connection to mouse, key board, printer or USB stick memory.
USB (USBTMC) interface port	Universal serial bus jack, Type B configuration (4 contacts inline); female; provides connection to an external PC; compatible with USBTMC-USB488 and USB 2.0.LA
	USB Test and Measurement Class (TMC) interface that communicates over USB, complying with the IEEE 488.1 and IEEE 488.2 standards.
LAN	10/100/1000 Base T Ethernet, 8-pin configuration; auto selects between the two data rates
Video output	15-pin mini D-Sub; female; drives VGA compatible monitors

Handler interface

Connector type	36-pin centronics, female
Signal type	Negative logic, opto-isolated, open collector output
Output signal	BIN sort result (BIN 1 to BIN 13, OUT_OF_GOOD_BINS)
	DC resistance pass/fail (DCR_OUT_OF_RANGE)
	Overload (OVLD)
	Alarm (ALARM)
	End of analog measurement (INDEX)
	End of measurement (EOM)
	Ready for trigger (READY_FOR_TRIG)
Input signal	Eternal trigger (EXT_TRIG)
	Key lock (KEY_LOCK)
Pin location	See the following figure. Refer to Help for the definition of each pin.

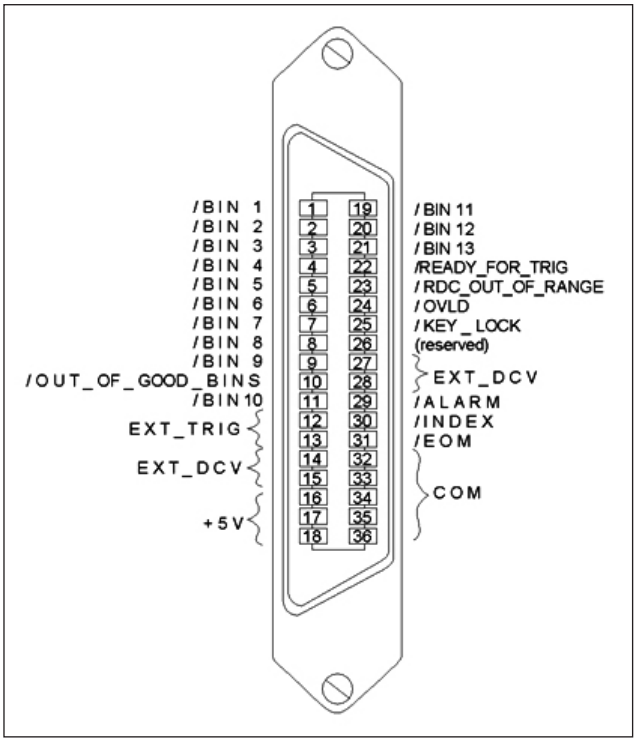


Figure 11. Pin assignment.

Line power

Frequency	47 to 63 Hz
Voltage	90 to 264 VAC (Vpeak > 120 V)
VA max	300 VA max.

EMC, safety, environment and compliance

EMC	
CE ISM 1-A	European Council Directive 2004/108/EC IEC 61326-1:2012 EN 61326-1:2013 CISPR 11:2009 +A1:2010 EN 55011: 2009 +A1:2010 Group 1, Class A IEC 61000-4-2:2008 EN 61000-4-2:2009 4 kV CD / 8 kV AD IEC 61000-4-3:2006 +A1:2007 +A2:2010 EN 61000-4-3:2006 +A1:2008 +A2:2010 3 V/m, 80-1000 MHz, 1.4 - 2.0 GHz / 1V/m, 2.0 to 2.7 GHz, 80% AM IEC 61000-4-4:2004 +A1:2010 EN 61000-4-4:2004 +A1:2010 1 kV power lines / 0.5 kV signal lines IEC 61000-4-5:2005 EN 61000-4-5:2006 0.5 kV line-line / 1 kV line-ground IEC 61000-4-6:2008 EN 61000-4-6:2009 3 V, 0.15-80 MHz, 80% AM IEC 61000-4-8:2009 EN 61000-4-8:2010 30A/m, 50/60Hz IEC 61000-4-11:2004 EN 61000-4-11:2004 0.5-300 cycle, 0% / 70% **NOTE-1:** When tested at 3 V/m according to EN61000-4-3, the measurement accuracy will be within specifications over the full immunity test frequency range except when the analyzer frequency is identical to the transmitted interference signal test frequency. **NOTE-2:** When tested at 3 V according to EN61000-4-6, the measurement accuracy will be within specifications over the full immunity test frequency range except when the analyzer frequency is identical to the transmitted interference signal test frequency.
ICES/NMB-001	ICES-001:2006 Group 1, Class A
	AS/NZS CISPR11:2004 Group 1, Class A
MSIP-REM-Kst-WNMODSF36	KN11, KN61000-6-1 and KN61000-6-2 Group 1, Class A

EMC, safety, environment and compliance (Continued)

Safety

CE
ISM 1-A

European Council Directive 2006/95/EC
IEC 61010-1:2001 / EN 61010-1:2001
Measurement Category I
Pollution Degree 2
Indoor Use

NOTE-1:
When tested at 3 V/m according to EN61000-4-3, the measurement accuracy will be within specifications over the full immunity test frequency range except when the analyzer frequency is identical to the transmitted interference signal test frequency.

NOTE-2:
When tested at 3 V according to EN61000-4-6, the measurement accuracy will be within specifications over the full immunity test frequency range except when the analyzer frequency is identical to the transmitted interference signal test frequency.

LR95111C

CAN/CSA C22.2 No. 61010-1-04
Measurement Category I
Pollution Degree 2
Indoor Use

Environment

This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a “Monitoring and Control instrumentation” product. Do not dispose in domestic household waste.

To return unwanted products, contact your local Keysight Office.

Compliance

LXI

Class C

Environmental Specifications and Dimensions

Operating environment	
Temperature	+5 °C to +40 °C
Error-corrected temperature range	23 °C (± 5 °C) with < 5 °C deviation from calibration temperature
Humidity	20% to 80% at wet bulb temperature < +29 °C (non-condensation)
Altitude	0 to 2,000 m (0 to 6,561 feet)
Vibration	0.21 Grms maximum, 5 Hz to 500 Hz
Non-operating environment	
Temperature	–10 °C to +60 °C
Humidity	20% to 90% at wet bulb temperature < 40 °C (non-condensation)
Altitude	0 to 4,572 m (0 to 15,000 feet)
Vibration	2.1 Grms maximum, 5 Hz to 500 Hz
Dimensions, weight	
Weight	Main unit: 13 kg, test head: 250 g with plate

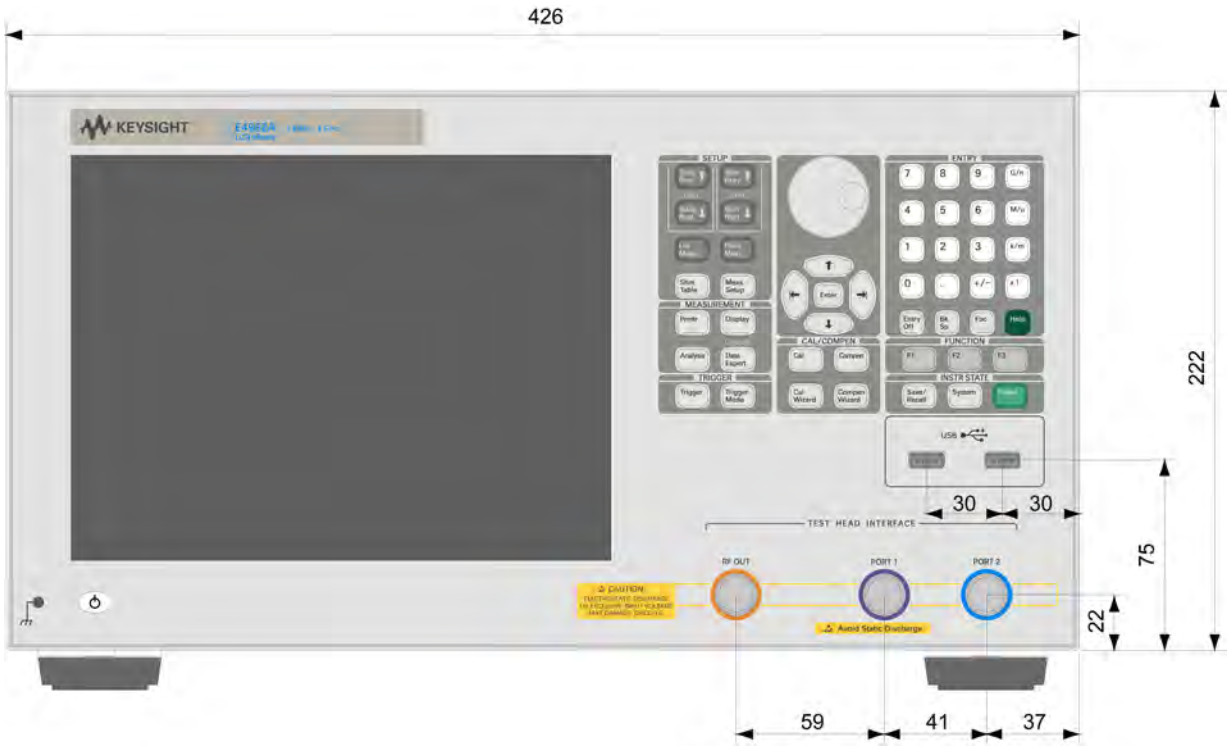


Figure 12. Front view.

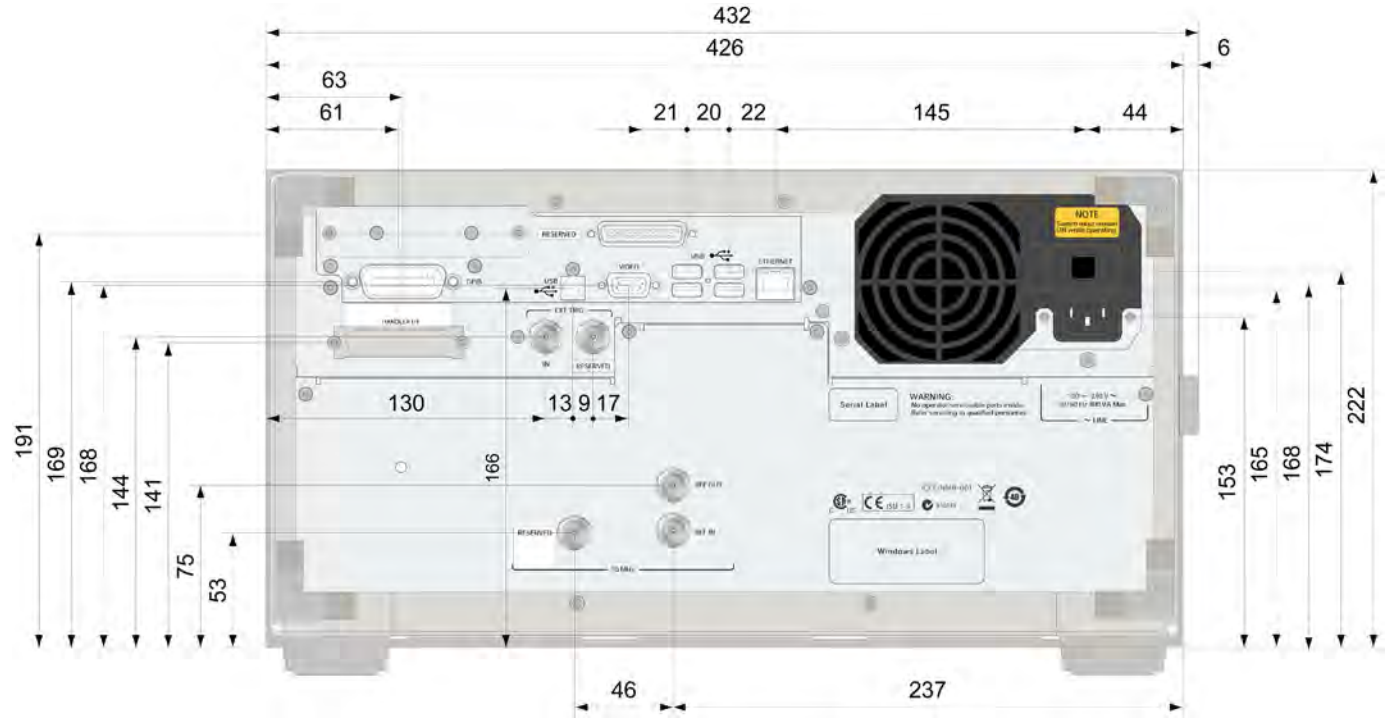


Figure 13. Rear view.

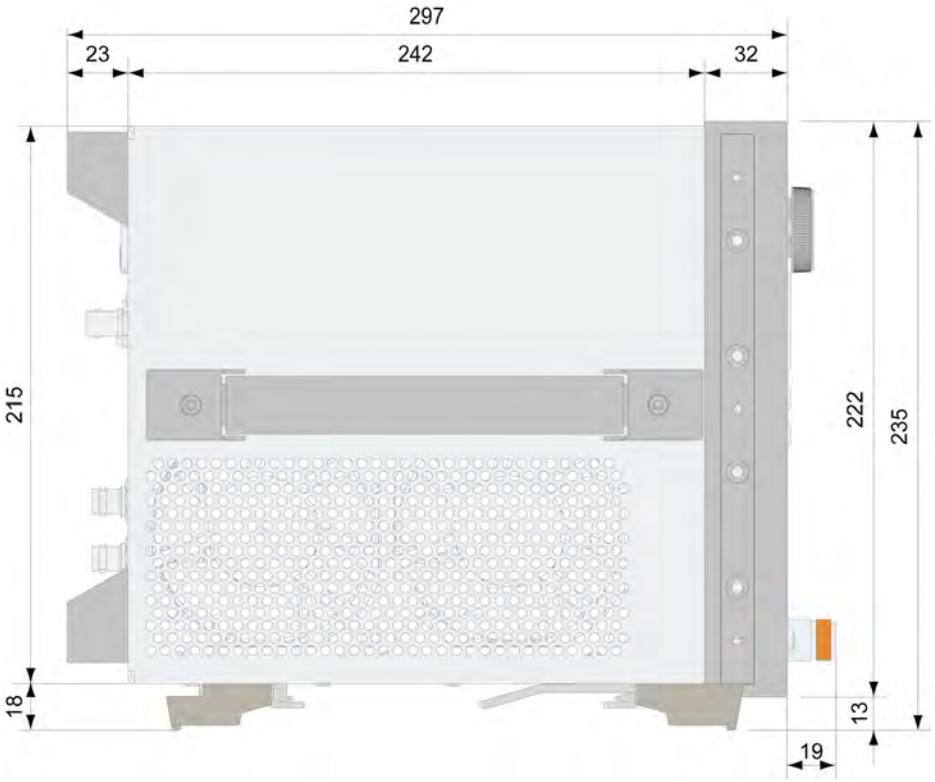


Figure 14. Side view.

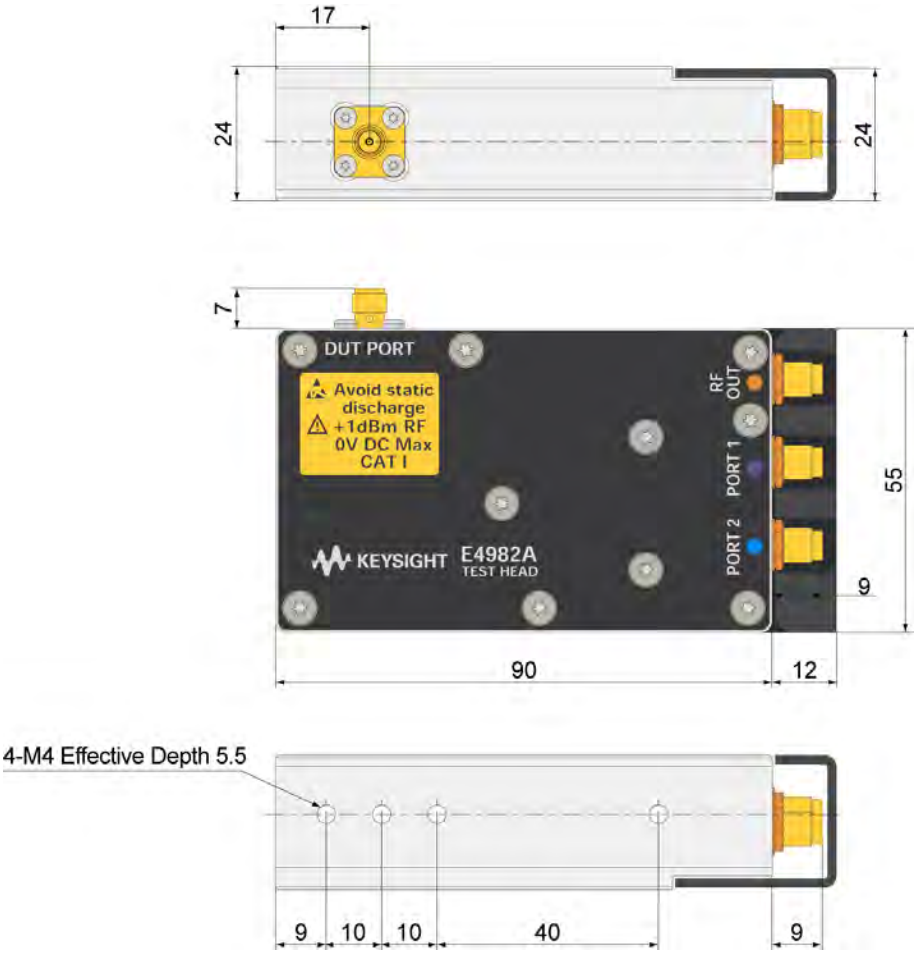


Figure 15. Test head.

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KEYSIGHT TECHNOLOGIES

Příloha č. 2 Kupní smlouvy

SEZNAM PODDODAVATELŮ / ČESTNÉ PROHLÁŠENÍ

1. Název veřejné zakázky	
„Měřící elektronika - LUMI-BNL-CZ"	
2. Identifikační údaje účastníka zadávacího řízení	
Obchodní firma:	**H TEST a.s.**
Sídlo:	Praha 5, Na Hřebenkách 1206/25, PSČ 15000
IČO:	25784480
Právní forma:	Akciová společnost - akcie v zaknihované podobě

Účastník zadávacího řízení čestně prohlašuje, že nemá v úmyslu zadat určitou část výše uvedené veřejné zakázky jiné osobě, tj. poddodavateli.