DATA SHEET

Keysight Technologies
Infiniium UXR-Series Oscilloscopes
N2163A mmWave Wideband Analysis Acceleration and Frequency Extension

The world's insatiable demand for next generation mobile devices and wireless communications, with better performance, Multiple Input Multiple Output (MIMO) support, shorter design cycles, and ever more bandwidth, has driven the need for analysis tools that bridge the boundaries between signal / spectrum analysis and digital design. Keysight Technologies' Infiniium UXR-Series oscilloscopes and optional mmWave Wideband Analysis functionality provide the signal integrity, versatility, affordability, and performance necessary to bring signal, spectrum, and digital capabilities together, within a single instrument. Infiniium UXR-Series 1 mm input models provide up to four phase coherent channels, each with up to 110 GHz of usable bandwidth and come standard with hardware accelerated digital down conversion (DDC) capabilities, so even the most demanding MIMO, mixed signal, radar, satcom or high-frequency high-bandwidth designs are no challenge for the Infiniium UXR-Series.

Key Features

mmWave ready UXR models available starting with 25 GHz native bandwidth

- 2 channel and 4 channel models
- Phase coherent channels
- Easy to setup from configuration to capture
- Wide offset phase noise support

Dynamically configurable frequency extension bandwidth windows

- 5 GHz and 10 GHz wide bandwidth options
- Independently configurable per channel
- mmWave spectrum support up to 110 GHz

Real-Time Digital Down Conversion

- Up to 2.16 GHz of analysis bandwidth
- 50x faster measurement performance

KEYSIGHT TECHNOLOGIES

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Infiniium UXR-Series Oscilloscopes for Millimeter Wave Applications

The Infiniium UXR is the first real-time oscilloscope to provide flexible bandwidth options, hardware accelerated acquisition and the signal integrity necessary to enable affordable wideband multi-channel mmWave signal analysis. Available mmWave Wideband Analysis Acceleration and Frequency Extension options, coupled with 1 mm input UXR-Series models, enable users to dynamically allocate 5 GHz or 10 GHz wide bandwidth windows for analysis of frequency ranges up to 110 GHz, regardless of the oscilloscopes maximum licensed native bandwidth. Additionally, all Infiniium UXR models come standard with 40 MHz of hardware accelerated real-time Digital Down Conversion[1] (DDC) – with the option to expand to 160 MHz and 2.16 GHz of analysis bandwidth. With the Infiniium UXR you get world-leading digital and mmWave performance in a single instrument with up to four phase coherent channels – enabling you to more quickly deliver next generation mmWave technologies, pulsed radar, integrated mixed signal designs, spread spectrum clocking (SSC), and advanced wideband research & development.

Keysight Infiniium UXR-Series
1 mm input models are available
with 2 or 4 coherent channels

Featuring

- DC to 110 GHz of dynamically configurable frequency ranges
- High-definition 10-bit analog-to-digital converter (ADC)
- 256 GSa/s real-time or 3,200 MSa/s complex sample rates
- Industry best -158 dBm/Hz DANL from 50 GHz to 85 GHz
- Optional 2.16 GHz hardware accelerated DDC I/Q demodulation bandwidth
- Dynamically configurable 5 GHz and 10 GHz bandwidth extension options
- Easy MIMO support with independently configurable coherent channels
- Largest phase noise offset frequency range from 1 kHz to 100% carrier frequency

mmWave Wideband Analyzer 110 GHz Capable Model Overview

The maximum achievable frequency of a UXR-Series oscilloscope is limited by the physical capabilities of its input connector. For maximum versatility, Keysight recommends using models with 1 mm inputs, which can achieve bandwidths over 110 GHz, to get the greatest utility, upgradability and flexibility for your mmWave analysis.

Model Number		Oscilloscope Bandwidth	Configurable Frequency Extension Range[2]	Hardware Accelerated DDC I/Q Demodulation Analysis Bandwidth	Memory Depth per Channel
4 Channel	2 Channel				
UXR0254AP	UXR0252AP	25 GHz	Min: 1 GHz Max: 110 GHz	Standard: 40 MHz Optional: 160 MHz & 2.16 GHz	Standard: 200 Mpts Optional: 1 Gpt & 2 Gpts
UXR0404AP	UXR0402AP	40 GHz			
UXR0594AP	UXR0592AP	59 GHz			
UXR0704AP	UXR0702AP	70 GHz			
UXR0804A	UXR0802A	80 GHz			
UXR1004A	UXR1002A	100 GHz			
UXR1104A[3]	UXR1102A[3]	110 GHz			

1 DDC mode cannot be used concurrently with time-based mode
2 Requires 5 GHz or 10 GHz mmWave Frequency Extension option license
3 Comes standard with 110 GHz of bandwidth and is not applicable for use with mmWave Frequency Extension options

Superior Signal and Spectrum Fidelity from a High-Performance Real-Time Oscilloscope

Undeniably the Industry's Best Signal Integrity

- Up to four phase coherent channels
- 110 GHz frequency range and analysis bandwidth
- World's first high-performance oscilloscope with a high-definition 10-bit Analog-to-Digital Converter (ADC)
- Low-noise analog front ends enable precision signal acquisition
  - 860 µV (rms) noise @ 110 GHz analysis bandwidth
  - Less than 58 µV (rms) noise @ 2 GHz analysis bandwidth, for center frequencies from 1 GHz to 110 GHz
- The industry's highest ENOB and EVM
  - 5.0 bits for 110 GHz analysis bandwidth
  - 9.0 bits for 1 GHz analysis bandwidth (67 GHz CF)
- Down to 7.5 mV/div vertical scaling supported in hardware
- Hardware bandwidth limit filters enable accurate scalability
- Correction filters ensure flat frequency magnitude and phase response
- 20 fs (typical) of intrinsic jitter produce excellent jitter characterizations

Bringing Together Signal, Spectrum, Phase Noise and Digital Analysis

Developing tomorrow's next generation technologies requires breaking the barriers inhibiting faster data throughput and better performance. These demands are driving current digital and mmWave technologies to their limits. At the same time, new technologies are emerging every 2 to 3 years as opposed to every 4 to 5 years. Engineers and scientists can't afford to replace their research and development infrastructure to keep pace with every new technology wave. Keysight recognized this shift and designed the UXR-Series to be a multi-purpose and fully upgradable platform – offering upgradable bandwidths ranging from 25 GHz to 110 GHz, with 2 and 4 channel bandwidth extendable configurations. Now, you can purchase a single instrument that meets your signal, spectrum, phase noise and digital analysis needs. Additionally, you can rest easy knowing it has the power, features, signal integrity and upgradability to satisfy your most demanding future requirements, while preserving your investment.

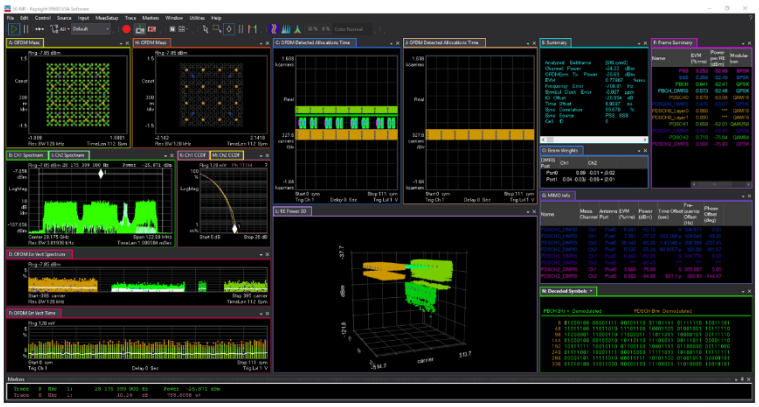
- Largest range of supported bandwidths – all with industry best signal integrity and performance
- Fully upgradable between supported bandwidths (AP models require only a license key to upgrade)
  - Starting from 25 GHz to 110 GHz
- Grow from 2 to 4 channel full bandwidth configurations
- Upgrade to 1 Gpt and 2 Gpts of memory via license keys
- Full Infiniium analysis software, decode and compliance application support
- Widest range of probing and connectivity options
- Measure spread spectrum clock (SSC) phase noise
- Phase noise measurement support across a wide variety of signal types
  - Square waves, differential signals, probed signals, with SSC, and after PLLs
  - 2 channel x-correlation to remove impacts of corelated scope and probe noise
- Fast Fourier Transform (FFT) for frequency domain (spectrum) analysis
  - Multiple FFT windows including Hanning, rectangular, Blackman-Harris, flattop, and Hamming
  - FFT mask and frequency select triggering
- Wideband DDC with > 2 GHz of hardware accelerated analysis bandwidth
- I/Q data and time domain captures can be saved for more detailed analysis later
- Full integration with Keysight 89600 VSA Software for advanced spectral and vector analysis

Optional Advanced Analysis Tools: 89600 VSA Software

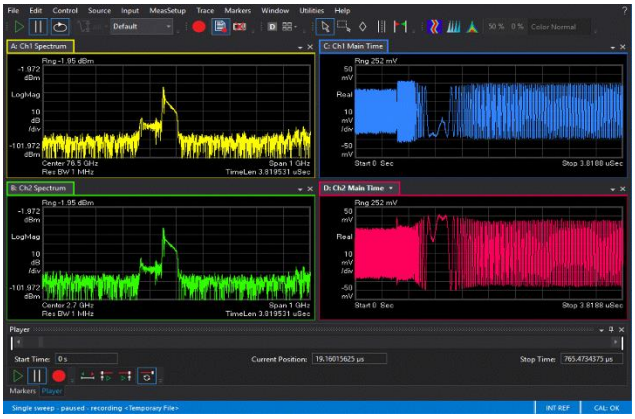
See through the complexity of your designs

Development becomes more complex when faster data rates intersect with today's crowded spectral environment. Finding a signal problem is essential – but achieving the clarity to pinpoint the answer is the crucial challenge. The 89600 VSA software is a comprehensive set of tools for demodulation and vector signal analysis. These tools enable you to explore virtually every facet of a signal and optimize even your most advanced designs.

The 89600 VSA software is fully integrated with the UXR-Series and takes full advantage of the optional >2 GHz of DDC hardware accelerated analysis bandwidth for fast and responsive mmWave wideband analysis up to 110 GHz.



Characterize the complex modulation of evolving cellular communications standards like 5G NR (New Radio) for both FR1 and FR2 frequency bands



Directly capture high frequency wideband signals on the UXR-Series – without the need for signal degrading downconversion

VSA software empowers ultimate mmWave analysis

- Gain greater insight with high-resolution FFT-based spectrum, time, and modulation domain analysis
- Analyze and troubleshoot signals in cellular, wireless-connectivity, aerospace, defense and general-purpose activities
- Apply vector signal analysis at virtually any point in your design, from simulation to production, baseband to RF
- Supports up to 8 channels for MIMO and advanced multi-channel analysis
- Directly capture wideband signals >2 GHz bandwidth such as 802.11ay with the UXR-Series without the need for signal degrading downconversion

Support for over 75 signal and modulation types

- **Cellular communications:** 5G New Radio (NR), Verizon® 5GTF, LTE-Advanced, LTE, W-CDMA HSPA+, GSM/EDGE Evolution, cdma2000®, TD-SCDMA
- **Wireless connectivity:** WLAN 802.11ax, 802.11n/ac, 802.11a/b/g/ j/p, WiMAX™, Bluetooth®, Zigbee, RFID
- **Aerospace, defense and satellite:** AM, FM, PM, BPSK, QPSK, QAM, APSK, FSK, VSB, SOQPSK, APCO 25
- **Cable TV:** Legacy RF, DOCSIS 3.0 and 3.1
- **Custom modulations:** Evaluate your non-standard or proprietary OFDM and APSK signals

Analyze modulation types ranging from AM/FM/PM to QPSK (shown), 4096QAM and 18APSK.

Configure your ultra-high-performance mmWave solution today

With an Infiniium UXR you get the best of both worlds

Get the most out of your oscilloscope investment by choosing options and software to speed your most common tasks. Use option numbers when ordering at time of purchase.

1. Choose your 1 mm Input Infiniium UXR Real-Time Oscilloscope

1 mm Input UXR-Series Oscilloscope Models		Maximum Bandwidth	Configurable Frequency Extension Range[1]	Minimum Input Power Required		Maximum Sample Rate
4 Channel	2 Channel			4 Channel	2 Channel	
UXR1104A	UXR1102A	110 GHz	Min: 1 GHz Max: 110 GHz	200 V_{ac}	110 V_{ac}	Real: 256 GSa/s
UXR1004A	UXR1002A	100 GHz				
UXR0804A	UXR0802A	80 GHz				
UXR0704AP	UXR0702AP	70 GHz				
UXR0594AP	UXR0592AP	59 GHz				
UXR0404AP	UXR0402AP	40 GHz				
UXR0254AP	UXR0252AP	25 GHz				

All 1 mm input UXR models come standard with:

- 200 Mpts deep memory
- A removable 960GB Enterprise grade SSD 2.5” hard drive
- Country-specific power cord, front cover, mini USB keyboard, USB optical mouse, input-specific connector savers (one per channel - 1 mm F Ruggedized to 1 mm F & 1 mm F Ruggedized to 1.85 mm F connector savers, and one 1 mm F Ruggedized to 2.92 mm F connector saver & one 3.5 mm F to 3.5 mm F connector saver), open ended torque wrenches (5/16 inch 8-in-lb, 6 mm 4-in-lb, and 14 mm dual-ended 4-in-lb & 10-in-lb), open ended standard wrenches (8mm and dual-ended 6 mm & 7 mm), and an ESD mat with wrist and heel straps.

2. Optionally upgrade your oscilloscope memory to enable more capture depth

Model number	Description
Memory Options:	
UXR0000-01G	1 Gpt per channel High Performance Memory
UXR0000-02G	2 Gpts per channel High Performance Memory

3. Choose your mmWave Wideband Analysis Acceleration and Frequency Extension Options

DDC model numbers	Description
N2163A-601	Hardware Accelerated DDC for UXR-Series, 160 MHz BW
N2163A-602	Upgrade Hardware Accelerated DDC for UXR-Series BW from 160 MHz to 2 GHz

Frequency Extension model numbers	Description
N2163A-005	5 GHz Configurable mmWave Extension Bandwidth Window
N2163A-010	Upgrade 5 GHz to 10 GHz Configurable mmWave Extension Bandwidth Window

4. Choose your optional Infiniium UXR-Series Software and Accessories

Keysight offers a wide variety advanced measurement, analysis, compliance and decode software applications for the Infiniium UXR-Series. Software is available with a wide variety of flexible licensing options to fit your needs and budget. Choose your license term, license type, and KeysightCare software support subscription.

All Infiniium UXR models come standard with:

- Serial data analysis (SDA) software to provide flexible clock recovery including 1st and 2nd-order PLL and constant algorithms. With a stable clock, you can look at real-time eyes of transition and non-transition bits. UXR-Series oscilloscopes with SDA software also provide a new unique view of bits preceding an eye.
- User defined function
- Fast Fourier Transform (FFT) for frequency domain (spectrum) analysis. Use the FFT to compute both magnitude and phase and take advantage of several useful features to assist in spectral analysis. The FFT can control span and resolution bandwidth

For more information about Infiniium UXR-Series oscilloscope software and accessories –

View the data sheet with Keysight publication number 5992-3132EN

5. Choose your optional Infiniium Probes and Probe Accessories

For more information about Infiniium Oscilloscope probes and accessories –

View the data sheet with Keysight publication number 5968-7141EN

For more information about InfiniiMax III/III+ Probing System –

View the data sheet with Keysight publication number 5990-5653EN

Legacy Infiniium software support

Infiniium UXR-Series oscilloscopes maintain backward compatibility with legacy Infiniium software applications and decode packages. A valid support contract will be required to receive and use software updates or receive product support for legacy Infiniium software.

For more information about all available Infiniium software and options please visit:

https://www.keysight.com/en/pc-1152185/oscilloscope-software

6. Choose your Infiniium UXR Hardware Support, Services and Training Options

Gain business value and a clear advantage in product performance and reliability with Keysight Services.

Model numbers	Description
R-51B-001-3C	Warranty Assurance Plan - Return to Keysight - 3 years
R-51B-001-5C	Warranty Assurance Plan - Return to Keysight - 5 years
R-50C-001-3	Calibration Assurance Plan - Return to Keysight - 3 years
R-50C-001-5	Calibration Assurance Plan - Return to Keysight - 5 years
PS-S10	Remote scheduled productivity assistance. Select 1 to 999 hours.
PS-S20	On site startup assistance, daily
PS-T10-SCOPES	On site 0.5 day - H7240B-100 - Digitizing Oscilloscope Fundamentals class. Max 8 students.
PS-X10	Custom services

7. *Choose your 89600 Vector Signal Analysis (VSA) Software Options*

The 89600 VSA software is a comprehensive set of tools for demodulation and vector signal analysis. These tools enable you to explore virtually every facet of a signal and optimize your most advanced designs. As you assess the tradeoffs, the 89600 VSA helps you see through the complexity.

89600 VSA software will run on any UXR-Series oscilloscope or laptop, desktop or Windows-based instrument, as long as it meets or exceeds the minimum PC requirements.

For a list of PC requirements, see http://www.keysight.com/find/89600-pc.

For more detailed information on the 89600 VSA software please visit: http://www.keysight.com/find/89600vsa.

Selecting your license:

Step 1. Choose your 89601B license type: Transportable, USB portable, or floating.
Step 2. Choose your software product options.
Step 3. Choose your license term: perpetual or time-based.
Step 4. Depending on the license term, choose your support subscription duration.

89601B Option 200 is required. It provides:

- Basic time and spectrum measurements
- Analog demodulation of AM, FM, PM signals
- Analysis of imported data files
- Links to Keysight EDA SystemVue and ADS
- Connectivity to hardware platforms
- Power spectrum with PXIe VSA M9393A/M9391A

Model numbers	License Type
89601B-200	Transportable
89601BN-200	USB portable
89601BK-200	Floating (single site)

Select your VSA software model options:

Description	89601B-xxx Options	Notes
General Purpose:		
Vector modulation analysis	AYA	Analysis of >40 modulation formats, including custom APSK and presets for communication formats like GSM/EDGE, ZigBee FSK, Bluetooth® BR, APCO25 and SOQPSK.
Custom OFDM modulation analysis	BHF	Proprietary and pre-standard OFDM formats.
Custom IQ modulation analysis	BHK	Proprietary and pre-standard, customized IQ constellation signals. Requires option AYA.
Channel quality measurements	BHL	Channel response measurements such as multi-tone group delay and phase/magnitude response.
Cellular Communications:		
5G NR/Pre-5G modulation analysis	BHN	
LTE FDD modulation analysis	BHD	
LTE TDD modulation analysis	BHE	
LTE-Advanced FDD modulation analysis	BHG	Requires option BHD
LTE-Advanced TDD modulation analysis	BHH	Requires option BHE
NB-IoT modulation analysis	BHT	
3G modulation analysis bundle	B7N	Includes cdma2000, W-CDMA/HSPA+, 1xEV-DO, and TD-SCDMA/HSPA
Wireless Connectivity:		
WLAN 802.11n/ac modulation analysis	BHJ	
WLAN 802.11ax modulation analysis	BHX	Requires option BHJ
WLAN 802.11a/b/g modulation analysis	B7R	Includes WLAN 802.11j/p
WiMAX™ 802.16 modulation analysis	B7Y	Mobile and Fixed
Radar Analysis:		
FMCW radar analysis	BHP	For multi-chirp linear FM modulated signals or automotive radar
Pulse analysis	BHQ	
Other Standard Formats:		
DOCSIS 3.1 modulation analysis	BHM	Downstream and upstream
TEDS modulation analysis	BHA	Includes TETRA2
RFID modulation analysis	BHC	Includes NFC formats

Select your license terms

Perpetual – Perpetual licenses can be used indefinitely, license does not expire.

Time-based – Time-based licenses can be only be used through the term of the license (6, 12, 24, or 36 months license options available).

Note: 89601BK USB portable license is only available with perpetual license term, no time-based license offering.

Protect your 89600 VSA software investment

A 12-month subscription to 89600 VSA software is included with each 89601B/BK/BN option 200 initial purchase. You may also purchase an additional 12-month subscription at the time of initial purchase or after the initial purchase, to gain immediate access to the latest features and enhancements for the 89600 VSA software (v13.0 or higher), after the initial 12-month subscription period expires.

Vertical System – Performance Characteristics (All 1 mm models)

Vertical System Specifications	25 GHz to 110 GHz 1 mm models
Analog input connector	Ruggedized 1.0 mm Male - with AutoProbe III jack
Input impedance[1]	50 Ω, ± 3%
Input coupling	DC
Sample rate per channel	256 GSa/s (Configurable in powers of two)
Input range	± 4 divisions from center screen
Displayed input sensitivity[2]	1 mV/div to 500 mV/div
Hardware sensitivity[2]	60 mV full scale to 4.0 V full scale
Vertical resolution[2,3]	10 bits, ≥ 14 bits with averaging
Maximum input power	+16 dBm at maximum range Range +6 dB at all ranges
DC gain accuracy*[,1,2,3]	± 2% of full scale (Typical: ±1% of full scale)
DC voltage accuracy Dual Cursor: Single Cursor:	 ± [(DC gain accuracy) + (resolution)] ± [(DC gain accuracy) + (offset accuracy) + (resolution/2)]
Maximum input voltage	± 8 divisions from center screen
Channel to channel isolation	60 dB
Offset range	**Vertical sensitivity** / **Available offset** 1 mV/div to 59 mV/div / ± 0.40 V 60 mV/div to 127 mV/div / ± 0.86 V 128 mV/div to 279 mV/div / ± 1.85 V 280 mV/div to 500 mV/div / ± 4.00 V
Offset accuracy*[,1,2,3]	± 2% of channel offset + 1% of full scale
Offset accuracy (typical)	± 1% of channel offset + 1% of full scale
Amplitude Flatness[4]	Any frequency ≤ 50 GHz: < 0.3 dB within any 500MHz span < 0.5 dB within any 10GHz span Frequencies between 50 GHz and 90 GHz < 1 dB within any 10GHz span Frequencies between 90 GHz and 110 GHz < 2 dB within any 10GHz span
Phase Flatness[5]	Any frequency ≤ 50 GHz: < 1 degree within any 500MHz span < 2 degrees within any 10GHz span Frequencies between 50 GHz and 90 GHz < 3 degrees within any 10GHz span Frequencies between 90 GHz and 110 GHz < 7 degrees within any 10GHz span

* Denotes warranted specifications, all others are typical. Valid after 30-minute warm up period and ± 5°C from oscilloscope firmware calibration temperature

1 Input impedance is valid when V/div scaling is adjusted to show all waveform vertical values within scope display

2 Full scale is defined as 8 vertical divisions. Magnification is used below 10 mV/div. Below 10 mV/div, full scale is defined as 80 mV. The major scale settings are 1 mV/div, 2 mV/div, 5 mV/div, 10 mV/div, 20 mV/div, 50 mV/div, 100 mV/div, 200 mV/div and 500 mV/div Magnification scales of 1mV/div, 2mV/div & 5mV/div are not warranted for Offset Accuracy & DC Gain Accuracy

3 Vertical resolution for 10 bits = 0.1% of full scale, for 14 bits = 0.006% of full scale

4 Measured result using N2125A as reference. Maximum deviation from average in a span

5 Measured result using N2125A as reference. Maximum deviation from best fit line (degrees) in a span

Vertical System – Performance Characteristics (1 mm AP models)

Vertical System Specifications (25 GHz to 70 GHz AP models)	UXR0254AP / UXR0252AP	UXR0404AP / UXR0402AP	UXR0594AP / UXR0592AP	UXR0704AP / UXR0702AP
Full bandwidth analog input channels	4 / 2	4 / 2	4 / 2	4 / 2
Analog bandwidth (3 dB)				
Typical bandwidth	26.2 GHz	42.0 GHz	61.9 GHz	70.0 GHz
Warranted bandwidth*	25.0 GHz	40.0 GHz	59.0 GHz	67.0 GHz
Rise time/fall time				
10 to 90%[1]	11.0 ps	11.0 ps	7.5 ps	6.3 ps
20 to 80%[2]	7.8 ps	7.8 ps	5.3 ps	4.4 ps
ENOB typical[3]				
at ≥ 400 mV_{fs}	6.2	5.8	5.5	5.4
at 60 mV_{fs}	5.6	5.4	5.1	5.0

Vertical System – Performance Characteristics (1 mm A models)

Vertical System Specifications (80 GHz to 110 GHz A models)	UXR0804A / UXR0802A	UXR1004A / UXR1002A	UXR1104A / UXR1102A
Full bandwidth analog input channels	4 / 2	4 / 2	4 / 2
Analog bandwidth (3 dB)			
Typical bandwidth	84.0 GHz	105.0 GHz	113.0 GHz
Warranted bandwidth*	80.0 GHz	100.0 GHz	110.0 GHz
Rise time/fall time			
10 to 90%[1]	5.5 ps	4.4 ps	4.0 ps
20 to 80%[2]	3.9 ps	3.1 ps	2.8 ps
ENOB typical[3]			
at ≥ 400 mV_{fs}	5.3	5.1	5.0
at 60 mV_{fs}	4.8	4.4	4.2

Vertical System – Performance Measurements (All 1 mm models)

Vertical System Measurements	25 GHz to 110 GHz 1 mm models					
	20 ns measurement by frequency span bandwidth @ center frequency (CF)					
	CF	113 GHz	10 GHz	5 GHz	2 GHz	1 GHz
Banded ENOB	67 GHz	5.0	7.6	8.1	8.7	9.0
	90 GHz	4.8	7.5	8.0	8.4	8.7
	110 GHz	4.9	6.9	7.4	7.9	8.2

* Denotes warranted specifications, all others are typical. Valid after 30-minute warm up period and ± 5°C from oscilloscope firmware calibration temperature

1 Calculation based on Tr = 0.44/BW
2 Calculation based on Tr = 0.31/BW
3 The average value from DC to full bandwidth of model

Vertical System – Performance Measurements (All 1 mm models – Continued)

Vertical System Measurements	25 GHz to 110 GHz 1 mm models		
Displayed Average Noise Level (DANL)	1 GHz wide span measured at Center Frequency (CF), 1 Hz reference:		
		80 mV_{FS} (-18 dBm range)	1.26 V_{FS} (6 dBm range)
	1 GHz	-161 dBm/Hz	-138 dBm/Hz
	10 GHz	-161 dBm/Hz	-138 dBm/Hz
	25 GHz	-159 dBm/Hz	-137 dBm/Hz
	50 GHz	-158 dBm/Hz	-137 dBm/Hz
	75 GHz	-158 dBm/Hz	-138 dBm/Hz
	100 GHz	-156 dBm/Hz	-136 dBm/Hz
Dynamic Range [2/3 * (TOI - DANL)]	6 dBm range, 200 mV/div @ 110 GHz BW 25 GHz CF, 100 MHz span, 1 Hz RBW		103 dB
Signal to Noise Dynamic Range	Measured with FFT: 0 dBm range, -1 dBm signal, 100 MHz span, 1 KHz RBW, at +20 MHz from the center frequency (CF)		1 GHz CF: 115 dB 67 GHz CF: 113 dB
Phase noise	1 GHz carrier, input signal 90% full scale		
	@ Offset	Single channel phase noise	2 channel x-corelated
	10 KHz	-120 dBc/Hz	-121 dBc/Hz
	20 KHz	-124 dBc/Hz	-127 dBc/Hz
	100 KHz	-137 dBc/Hz	-147 dBc/Hz
	1 MHz	-143 dBc/Hz	-151 dBc/Hz
	10 MHz	-143 dBc/Hz	-156 dBc/Hz
	100 MHz	-142 dBc/Hz	-158 dBc/Hz
	400 MHz	-141 dBc/Hz	-165 dBc/Hz
Two Tone Third-Order Intermodulation (TOI)	1.2 V_{fs} (6 dBm range), -12 dBm input/tone, 3 KHz RBW, 400 KHz span: +22.9 dBm @ 3.65 GHz and 3.6501 GHz +18.2 dBm @ 26.5 GHz and 26.5001 GHz		
2nd and 3rd harmonic distortion	60 mV_{FS} (7.5 mV/div), -26 dBm input signal (~50% FS), 100 KHz RBW		
	Fundamental	2nd harmonic	3rd harmonic
	1 GHz	≤ -68 dBc	≤ -61 dBc
	16.5 GHz	≤ -64 dBc	≤ -62 dBc
	25 GHz	≤ -62 dBc	≤ -61 dBc
	50 GHz	≤ -56 dBc	---
	700 mV_{FS} (87.5 mV/div), -1 dBm input signal (~90% FS), 100 KHz RBW		
	Fundamental	2nd harmonic	3rd harmonic
	1 GHz	≤ -55 dBc	≤ -50 dBc
	16.5 GHz	≤ -55 dBc	≤ -50 dBc
	25 GHz	≤ -51 dBc	≤ -46 dBc
	50 GHz	≤ -44 dBc	---

Vertical System – Performance Measurements (All 1 mm models – Continued)

Vertical System Measurements	25 GHz to 110 GHz 1 mm models	
Spurious-free dynamic range (SFDR) (excl. harmonics)[1]	Measured via FFT: 5 GHz center frequency, 10 GHz span, 100 kHz RBW, 0 dBm range, -1 dBm signal @ 700 mV FS (87.5 mV/div) with a 5 GHz input carrier	≤ -65 dBc
	Measured via FFT: 50 GHz center frequency, 20 GHz span, 100 kHz RBW, 0 dBm range, -1 dBm signal @ 700 mV FS (87.5 mV/div) with a 50 GHz input carrier	≤ -61 dBc
Residuals, images, and spurious responses[1]	Signal related (non-harmonic, multiple per 16 GHz interval): -52 dBc @ 0 dBm range Residual responses (major per 16 GHz interval): -65 dB_{FS} @ 0 dBm range -65 dBm clock spur @ 64 GHz	
Error Vector Magnitude (EVM)	Two-channel bonded 802.11ay (61.56 GHz CF, 3.8 GHz span): 5G NR, 1 CC (100 MHz), measured at 28 GHz: 5G NR, 1 CC (100 MHz), measured at 39 GHz:	1.23% 0.60% 0.90%
Channel to channel phase / Phase coherency	Inter-channel jitter @ 39GHz, 1GHz BW: ± 2.5 deg (0.5 deg rms)	
Conducted emissions[1]	Clock emissions conducted out front panel connector @64GHz:	-65 dBm
S11	< 50GHz, -15dB ≥ 50GHz, -7dB	

RMS Noise Floor – Performance Characteristics (Measured at Maximum Bandwidth)

Full BW RMS Noise Floor	UXR0254AP / UXR0252AP	UXR0404AP / UXR0402AP	UXR0594AP / UXR0592AP	UXR0704AP / UXR0702AP
Vertical setting, Full scale				
60 $mV_{full\ scale\ (fs)}$	340 µV (rms)	340 µV (rms)	460 µV (rms)	500 µV (rms)
100 $mV_{full\ scale\ (fs)}$	490 µV (rms)	490 µV (rms)	640 µV (rms)	680 µV (rms)
160 $mV_{full\ scale\ (fs)}$	720 µV (rms)	720 µV (rms)	950 µV (rms)	970 µV (rms)
400 $mV_{full\ scale\ (fs)}$	1.6 mV (rms)	1.6 mV (rms)	2.1 mV (rms)	2.2 mV (rms)
800 $mV_{full\ scale\ (fs)}$	3.4 mV (rms)	3.4 mV (rms)	4.3 mV (rms)	4.5 mV (rms)
1.6 $V_{full\ scale\ (fs)}$	6.7 mV (rms)	6.7 mV (rms)	8.4 mV (rms)	9.0 mV (rms)
4.0 $V_{full\ scale\ (fs)}$	16 mV (rms)	16 mV (rms)	20 mV (rms)	21 mV (rms)

Full BW RMS Noise Floor	UXR0804A / UXR0802A	UXR1004A / UXR1002A	UXR1104A / UXR1102A
Vertical setting, Full scale			
60 $mV_{full\ scale\ (fs)}$	580 µV (rms)	770 µV (rms)	860 µV (rms)
100 $mV_{full\ scale\ (fs)}$	780 µV (rms)	990 µV (rms)	1.1 mV (rms)
160 $mV_{full\ scale\ (fs)}$	1.1 mV (rms)	1.4 mV (rms)	1.5 mV (rms)
400 $mV_{full\ scale\ (fs)}$	2.4 mV (rms)	2.8 mV (rms)	2.9 mV (rms)
800 $mV_{full\ scale\ (fs)}$	4.8 mV (rms)	5.8 mV (rms)	6.1 mV (rms)
1.6 $V_{full\ scale\ (fs)}$	9.7 mV (rms)	12 mV (rms)	13 mV (rms)
4.0 $V_{full\ scale\ (fs)}$	23 mV (rms)	27 mV (rms)	29 mV (rms)

[1] Measured with inputs terminated

DDC and Frequency Extension Option – Performance Characteristics

DDC & Frequency Extension Specifications			
DDC center frequency resolution	Center frequency rounded to nearest 6.25 MHz interval		
DDC frequency range	With Frequency Extension option:		DC to 113 GHz (1 mm models) DC to 70 GHz (1.85 mm models) DC to 33 GHz (3.5 mm models)
	Without Frequency Extension option:		DC to max scope bandwidth
DDC sampling rate	50 MSa/s to 3,200 MSa/s (Configurable in powers of two)		
Max DDC sampling rate	Standard: 50 MSa/s	Opt 601: 200 MSa/s	Opt 602: 3,200 MSa/s
Max DDC signal analysis bandwidth (±1 dB)	Standard: 40 MHz	Opt 601: 160 MHz	Opt 602: 2.00 GHz 2.16 GHz ±3 dB (typical)
DDC output	40 bits complex per sample (16 bits I/Q + flags and markers)		
10 GHz BW Frequency Extension range	Min CF: Max CF:	6 GHz 103 GHz (1 mm models) 64 GHz (1.85 mm models) 27 GHz (3.5 mm models)	
5 GHz BW Frequency Extension range	Min CF: Max CF:	3.5 GHz 109.5 GHz (1 mm models) 66.5 GHz (1.85 mm models) 29.5 GHz (3.5 mm models)	
Frequency Extension channel support	Center frequency configurable per channel, up to 4 channels		

DDC and Frequency Extension Option – Performance Characteristics (continued)

DDC Option / Configuration	Bandwidth Range	Capture Time @ Max Sample Rate		
		Std Mem *200 Mpts real* *50 MSa complex*	**UXR0000-01G option** *1 Gpt real* *250 MSa complex*	**UXR0000-02G option** *2 Gpts real* *400 MSa complex*
No DDC	Up to 110 GHz	780 µs	3.9 ms	7.8 ms
STD DDC *50 MSa/s complex*	40 MHz	1 s	5 s	8 s
N2163A-601 *50 to 200 MSa/s complex*	40 MHz to 160 MHz	250 ms	1.25 s	2 s
N2163A-602 *50 to 3200 MSa/s complex*	40 MHz to 2.16 GHz	15.6 ms	78 ms	125 ms

Horizontal System – Performance Characteristics

Horizontal System: Oscilloscope channels	25 GHz to 110 GHz 1 mm models	
Main timebase range	1 ps/div to 20 s/div real-time	
Sample rate per channel	256 GSa/s (Configurable in powers of two)	
Main timebase delay range	200 s to -200 s real-time	
Reference position	Continuously adjustable across horizontal display range	
Zoom timebase range	1 ps/div to current main timescale setting	
Channel de-skew range	± 1 ms range, 10 fs resolution	
Time scale accuracy*,[1]	± (25 ppb initial + 100 ppb/year aging) first year of manufacture ± (25 ppb initial + 30 ppb/year aging) after first year of manufacture	
Intrinsic jitter[3] Acquired time range / delta-time interval	**Internal Reference**	**External Reference**
<1 µs (100 ns/div)	25 fs rms	25 fs rms
10 µs (100 µs/div)	25 fs rms	25 fs rms
100 µs (1 µs/div)	40 fs rms	40 fs rms
1 ms (10 µs/div)	50 fs rms	50 fs rms
Inter-channel intrinsic jitter[2,3]	< 10 fs rms	
Inter-channel skew drift[2,5,6]	± 1 ps	
Inter-channel intrinsic skew[2,5,6]	± 5 ps	
Measured Time Interval Error (TIE)	400 mVfs, 70 GHz bandwidth, 90% input signal, 2.2 mVrms noise: 37 fs (rms) @ 70 GHz	

* Denotes warranted specification, all others are typical. Specifications are valid after a 30-minute warm-up period and ± 5 °C from calibration temperature.

1 initial = immediately after factory or user calibration.
2 intra-chan = both edges on the same channel, inter-chan = two edges on different channels of the same scope frame.
3 External timebase reference values measured using a Wenzel 501-04608A 10 MHz reference. Intrinsic jitter value depends on acquisition time range for TIE formula and depends on delta-time between edges for all two-edge formulas.
5 Scope channels and signal interconnect de-skewed prior to measurement.
6 Skew between channels caused by ± 5 deg C temperature change.

Horizontal System – Performance Characteristics (continued)

Horizontal System: Oscilloscope channels	
Jitter measurement floor[1,2] (sec rms)	
Time interval error (sec rms)	$\sqrt{\left(\frac{\text{Noise Floor}}{\text{Slew Rate}}\right)^2 + (\text{Intrinsic Jitter})^2}$
Period jitter (sec rms)	$\sqrt{2}\cdot\sqrt{\left(\frac{\text{Noise Floor}}{\text{Slew Rate}}\right)^2 + (\text{Intrinsic Jitter})^2}$
Cycle-cycle / N-cycle jitter (sec rms)	$\sqrt{3}\cdot\sqrt{\left(\frac{\text{Noise Floor}}{\text{Slew Rate}}\right)^2 + (\text{Intrinsic Jitter})^2}$
Inter-channel jitter[2] (sec rms) Inter-scope jitter[2] (sec rms)	$\sqrt{\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge1)}\end{matrix}\right)^2 + \left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge2)}\end{matrix}\right)^2 + \left(\begin{matrix}\text{Inter channel}\\ \text{Intrinsic Jitter}\end{matrix}\right)^2}$
Delta-time measurement accuracy[2,3,4,5]	
Intra-channel no averaging	$\pm\left[5\cdot\sqrt{\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge1)}\end{matrix}\right)^2 + \left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge2)}\end{matrix}\right)^2} + \left(\left(\begin{matrix}\text{Time Scale}\\ \text{Accuracy}\end{matrix}\right)\cdot\left(\begin{matrix}\text{Delta}\\ \text{Time}\end{matrix}\right)\right)\right]$
Intra-channel 256 averages	$\pm\left[\frac{5}{16}\cdot\sqrt{\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge1)}\end{matrix}\right)^2 + \left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge2)}\end{matrix}\right)^2} + \left(\left(\begin{matrix}\text{Time Scale}\\ \text{Accuracy}\end{matrix}\right)\cdot\left(\begin{matrix}\text{Delta}\\ \text{Time}\end{matrix}\right)\right)\right]$
Inter-channel no averaging	$\pm\left[\begin{matrix}5\cdot\sqrt{\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge1)}\end{matrix}\right)^2 + \left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge2)}\end{matrix}\right)^2 + \left(\begin{matrix}\text{Inter channel}\\ \text{Intrinsic Jitter}\end{matrix}\right)^2}\\ +\left(\left(\begin{matrix}\text{Time Scale}\\ \text{Accuracy}\end{matrix}\right)\cdot\left(\begin{matrix}\text{Delta}\\ \text{Time}\end{matrix}\right)\right)+\left(\begin{matrix}\text{Inter channel}\\ \text{Skew Drift}\end{matrix}\right)\end{matrix}\right]$
Inter-channel 256 averages	$\pm\left[\begin{matrix}\frac{5}{16}\cdot\sqrt{\left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge1)}\end{matrix}\right)^2 + \left(\begin{matrix}\text{Time Interval}\\ \text{Error (Edge2)}\end{matrix}\right)^2 + \left(\begin{matrix}\text{Inter channel}\\ \text{Intrinsic Jitter}\end{matrix}\right)^2}\\ +\left(\left(\begin{matrix}\text{Time Scale}\\ \text{Accuracy}\end{matrix}\right)\cdot\left(\begin{matrix}\text{Delta}\\ \text{Time}\end{matrix}\right)\right)+\left(\begin{matrix}\text{Inter channel}\\ \text{Skew Drift}\end{matrix}\right)\end{matrix}\right]$

1 Specifications are typical and valid after a 30-minute warm-up period and ± 5 °C from calibration temperature.
2 Scope channels and signal interconnect de-skewed prior to measurement.
3 Sample rate at maximum. Noise and slew rate determined at fixed-voltage measurement threshold, near middle of signal. Displayed signal not vertically clipped. Slew rate of sine wave = (peak signal amplitude) · 2 · π · f, slew rate of fast step ~= (10-90% rise time).
4 intra-chan = both edges on the same channel, inter-chan = two edges on different channels of the same scope frame, inter-scope = two edges on different scope frames. TIE(Edge1) = time-interval error measurement floor of first edge, TIE(Edge2) = time-interval error measurement floor of second edge.
5 Reading is the displayed DTMA measurement value. Do not double the listed TSA value in DTMA formula.

Acquisition System – Performance Characteristics

Acquisition System Specifications	25 GHz to 110 GHz 1 mm models
Maximum real-time sample rate	256 GSa/s
Sampling resolution	3.90625 ps/Sample
Memory depth per channel 200 Mpts 1 Gpt 2 Gpts	 Standard Option UXR0000-01G / N2130A-01G Option UXR0000-02G / N2130A-01G
Memory depth (with RT Averaging) standard option 01G or 02G	 200 Mpts 335.556 Mpts
Acquisition time at max sampling rate 200 Mpts 1 Gpt 2 Gpts	 780 µs 3.9 ms 7.8 ms
Sampling Modes	
Real-time	Successive single shot acquisitions
Real-time with averaging	Selectable from 2 to 1,048,575
Real-time with peak detect, Segmented with peak detect	256 GSa/s
	Extends acquisition time range by compressing un-aliased full-sample rate waveform samples into voltage range values collected over and reported at larger time intervals
Real-time with high resolution, Segmented with high resolution	Real-time boxcar averaging reduces random noise and increases resolution
Segmented Memory	Captures bursting signals at max sample rate without consuming memory during periods of inactivity
Max # of Segments:	Independent of memory option
High-bandwidth trigger enabled	20,825
High-bandwidth trigger disabled	134,885
Min time between triggers	
High-bandwidth trigger enabled	5.0 µs
High-bandwidth trigger disabled	3.5 µs
Max time between triggers	> 100,000 years
Filters	
Bandwidth limit	Brick wall or 4th order Bessel, selectable bandwidth value
Frequency response	Flat mag and linear phase, Gaussian mag and linear phase: Slower filter roll off while maintaining linear phase
Sin(x)/x interpolation	On/off selectable FIR digital filter with selectable 2x to 32x ratio: Digital signal processing adds points between acquired data points to enhance measurement accuracy and waveform display

Trigger System – Performance Characteristics

Hardware Trigger Specifications	
Trigger sources	All channel inputs, 1 auxiliary trigger input
Sensitivity	1 div p-p
Edge trigger bandwidth	Equal to acquisition analog bandwidth
Edge trigger bandwidth (AUX)	DC to 2 GHz @ 150 mV_{pp} 4 GHz @ 175 mV_{pp} 5 GHz @ ≥ 400 mV_{pp}
Minimum pulse width trigger	
Hardware	50 ps
Software (InfiniiScan)	40 ps
Level range	
Internal	± 4 div from center screen or ± 4 V, whichever is smaller
Auxiliary	± 5 V (into 50 Ω), 5 Vpp maximum input signal swing
Sweep Modes	Auto, triggered, single
Display jitter (Trigger Jitter)	71 fs (rms)[1]
Trigger holdoff range	Fixed 40 ns to 10 s, Random 100 ns to 10 s
Trigger qualification (AND qualifier)	Qualifies a trigger setup by logically ANDing or ORing it with signal levels on analog channels
Trigger actions	Specifies an action to occur (and the frequency of the action) when a trigger condition occurs. Actions include email on trigger and execute "multipurpose" user setting.
Trigger Sequences	Sequence triggers let you trigger on an event that follows another event. Three stage trigger sequences including two-stage hardware (find event (A) and trigger event (B)) and one-stage InfiniiScan software trigger. Supports all hardware trigger modes except “edge then edge” and “video” and "Gbit serial." Supports “delay (by time)” and “reset (by time or event)” between two hardware sequences.

Trigger modes - Hardware	
Burst	Triggers on the Nth edge of a burst that occurs after an idle time from 1.5 ns to 20 s.
Edge	Triggers on a specified slope (rising, falling or alternating between rising and falling) and voltage level on any channel or auxiliary trigger.
Edge transition	Triggers on rising or falling edges that cross two voltage levels in > or < the amount of time specified. Edge transition setting from 75 ps
Edge then edge (Time)	The trigger is qualified by an edge. After a specified time delay between 1.5 ns to 20 s, a rising or falling edge on any one selected input will generate the trigger
Edge then edge (Event)	The trigger is qualified by an edge. After a specified delay between 1 to 65,000,000,000 rising or falling edges, another rising or falling edge on any one selected input will generate the trigger
Glitch	Triggers on glitches narrower than the other pulses in your waveform by specifying a width less than your narrowest pulse and a polarity. Triggers on glitches as narrow as 50 ps. Glitch range settings: < 75 ps to < 10 s

[1] Value shown represents typical Display jitter for UXR1104A at 100 mV/div triggering on 500 mVpp 55 GHz sin wave signal.

Trigger modes – Hardware (Continued)	
High-Bandwidth Trigger	Edge trigger up to scopes maximum bandwidth (works with edge positive slope and edge negative slope only)
OR'd Edges	Identifies a trigger condition by looking for selected edges on up to four channels
Pattern / State	Identifies a trigger condition by looking for a specified pattern or a pattern and an edge (state) across the input channels
Pulse width	Triggers on a pulse that is wider or narrower than the other pulses in your waveform by specifying a pulse width and a polarity. Triggers on pulse widths as narrow as 75 ps. Pulse width range settings 75 ps to 20 s. Trigger point can be configured for "end of pulse" or "time out"
Window	Specifies a voltage range and then trigger when the waveform either exits this range, enters this range, stays outside the range for too long or too short, or stays inside the range for too long or too short. Range setting from 75 ps to 20 s.
Runt	Triggers on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again. Can be time qualified with minimum setting of 75 ps
Timeout	Triggers the oscilloscope when the waveform has been at a higher voltage than the voltage specified by the Level control for too long (High Too Long), when the waveform has been at a lower voltage than the Level voltage for too long (Low Too Long), or when the waveform has taken too long to pass through the Level voltage (Unchanged Too Long). Timeout settings from 75 ps to 20 s.
Setup and hold	Triggers on violations of Setup time, Hold time, or both Setup and Hold time. Setup times from 75 ps to 20 s and hold times from 75 ps to 100 ns.
Protocol	Trigger on certain packets or patterns in protocol-based data.
Trigger modes – Software (Requires N5414B InfiniiScan event identification software)	
Zone qualify	Software triggers on the user-defined zones on screen. Zones can be specified as either "must intersect" or "must not intersect." Up to eight zones can be defined across multiple channels
Generic serial	Software triggers on NRZ-encoded data up to 8.0 Gbps, up to 80-bit pattern. Support multiple clock data recovery methods including constant frequency, 1st-order PLL, 2nd-order PLL, explicit clock, explicit 1st-order PLL, explicit 2nd-order PLL, Fibre Channel, FlexRay receiver, FlexRay transmitter
Measurement limit	Software triggers on the results of the measurement values. For example, when the "pulse width" measurement is turned on, InfiniiScan measurement software trigger triggers on a glitch as narrow as 40 ps. When the "time interval error (TIE)" is measured, InfiniiScan can trigger on a specific TIE value
Non-monotonic edge	Software triggers on the non-monotonic edge. The non-monotonic edge is specified by setting a hysteresis value
Runt	Software triggers on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again. Unlike hardware runt trigger, InfiniiScan runt trigger can be further qualified via a hysteresis value

Measurements and Math

Oscilloscope Measurements	
Measurement update rate	> 50,000 measurement/sec (one measurement turned on)
	> 250,000 measurement/sec/measurement (ten measurements turned on)
Measurement modes	Standard, Measure all edges mode
Jitter analysis measurements[1]	
Clock	Time interval error, N-period, period to period, positive width to positive width, neg width to neg width, and duty cycle to duty cycle
Data	Time interval error, unit interval, N Unit Interval, unit interval to unit interval, data rate, CDR, de-emphasis
Waveform Measurements	
Vertical	Peak to peak, minimum, maximum, average, RMS, amplitude, base, top, overshoot, preshoot, upper, middle, lower, Vovershoot, Vtime, Vpreshoot, crossing, pulse base, pulse amplitude, pulse top, PAM level mean[2], PAM level RMS[2], PAM level skew[2], PAM level thickness[2]
Time	Delta time, rise time, fall time, positive width, negative width, burst width, burst period, burst interval, Tmin, Tmax, Tvolt, + pulse count, - pulse count
Clock	Period, frequency, duty cycle, phase, N-period
Data	Setup time, hold time
Mixed	Area, slew rate
Frequency domain	FFT frequency, FFT magnitude, FFT delta frequency, FFT delta magnitude, FFT Channel Power, FFT Power Spectral Density, FFT Occupied Bandwidth, and peak detect mode
Level qualification	Any channels that are not involved in a measurement can be used to level-qualify all timing measurements
Eye-diagram measurements	Eye height, eye width, eye jitter, crossing percentage, Q factor, and duty-cycle distortion
PAM4 measurements[2]	Level mean, level RMS, level skew, level thickness, eye height, eye width, eye skew, eye level, BER (Cumulative), BER (Per Acq), SER (Cumulative), SER (Per Acq), PRBS13Q J4u, PRBS13Q Jrms, PRBS13Q EOJ, clock recovery rate, pattern length, rise time, fall time, and time interval error
Statistics	Displays the current, mean, minimum, maximum, range (max-min), standard deviation, number of measurements value for the displayed automatic measurements. Also shows Fail Min and Fail Max when measurement Limit Test is enabled
Histograms	
Source	Waveform or measurement
Orientation	Vertical (for timing and jitter measurements) or horizontal (noise and amplitude change) modes, regions are defined using waveform markers
Measurements (available as a function)	Mean, standard deviation, mean ± 1, 2, and 3 sigma, median, mode, peak-to-peak, min, max, total hits, peak (area of most hits), X scale hits, and X offset hits
Mask testing	Allows pass/fail testing to user-defined or Keysight-supplied waveform templates. Automask lets you create a mask template from a captured waveform and define a tolerance range in time/voltage or screen divisions. Test modes (run until) include test forever, test to specified time or event limit, and stop on failure. Executes “multipurpose” user setting on failure
	“Unfold real-time eye” feature allows individual bit errors to be observed by unfolding a real-time eye when clock recovery is on
	Communications mask test kit option provides a set of ITU-T G.703, ANSI T1.102, and IEEE 802.3 industry-standard masks for compliance testing

1 Requires EZJIT Complete analysis application (D9010JITA)
2 Requires PAM4 analysis application (D9010PAMA)

Oscilloscope Measurements (continued)	
Waveform math	
Number of functions	16
Hardware accelerated math operations	Differential and Common Mode
Math functions	Absolute value, add, amplitude demodulation (radar envelope), average, Butterworth[1], common mode, delay, differentiate, divide, FFT magnitude, FFT, phase, FIR[1], high pass filter, histogram, horizontal gating, integrate, invert, LFE[1], low pass filter (4th-order Bessel Thompson filter), magnify, max, measurement trend, min, multiply, RT Eye[1], smoothing, SqrtSumOfSquare[1], square, square root, subtract, versus, and optional user defined function
FFT	
Frequency range	DC to scope's maximum bandwidth
Frequency resolution	Sample rate/memory depth = resolution
Window modes	Hanning, flattop, rectangular, Blackman-Harris, Hamming
Measurement modes	
Automatic measurements	Measure menu access to all measurements, up to 20 measurements can be displayed simultaneously
Multipurpose	Front-panel button activates up to ten pre-selected or up to ten user-defined automatic measurements
Drag-and-drop measurement toolbar	Measurement toolbar with common measurement icons that can be dragged and dropped onto the displayed waveforms
Marker modes	Manual markers, track waveform data, track measurements, track RF (on FFT math function waveforms)
Bookmarks and callouts	Supports callouts for measurements and FFT peaks. Supports bookmarks for team collaboration

Keysight Infiniium UXR-Series – Platform Characteristics

Computer system and peripherals	
Operating system	Windows 10 64-bit
CPU	Intel i5-3550S quad-core CPU at 3.00 GHz
PC system memory	16 GB DDR3 RAM
PC ports	USB 2.0 hi-speed (host), USB 2.0 hi-speed (device), VGA, DisplayPort, USB 3.0 (host), USB 3.0 (device), dual-monitor video output, audio, 10/100/1000 LAN, LXI LAN
Drives (SSD)	960GB Enterprise grade internal SSD removable hard drive
Peripherals	Optical USB mouse, compact USB keyboard supplied. All UXR models support any Windows-compatible input device with a USB interface
File types	
Waveforms	Compressed internal format (*.wfm (200 Mpts)), comma-separated values (*.csv (2 Gpts)), tab-separated values (*.tsv (2 Gpts)), public binary format (.bin (500 Mpts)), Y value files (*.txt (2 Gpts)), hierarchal data file (*.hf5 (2 Gpts))
Images	BMP, PNG, TIFF, GIF, JPG or OSC file format

Keysight Infiniium UXR-Series – Platform Characteristics (continued)

I/O Ports	
Aux in	5 Vpp max signal between -5 V and +5 V, 50 Ω impedance
Aux out	0 V to 5 V, 50 Ω impedance
Cal out	-2.4 V to +2.4 V, 50 Ω impedance
Probe compensation terminal	0 V to 5 V, 50 Ω impedance
Reference clock input	400 MHz, 0.25 Vpp to 0.50 Vpp, 50 Ω impedance
Reference clock output	400 MHz, 0.25 Vpp to 0.50 Vpp, 50 Ω impedance
Sample clock input	8 GHz, -5 dBm to +15 dBm, 50 Ω impedance
Sample clock output	8 GHz, +10 dBm to +15 dBm, 50 Ω impedance
Timebase reference input	Input frequency lock range: 10 MHz ±20 ppm, 50 Ω impedance
	Amplitude, sine wave input: 630 mVpp (0 dBm) min to 3.54 Vpp (+15 dBm) max, 50 Ω impedance
	Amplitude, square wave input: 500 mVpp min to 3.54 Vpp max, 50 Ω impedance
Timebase reference output	Amplitude into 50 Ω (internal or external timebase reference selected): 1.1 to 2.0 Vpp (+ 5 to + 10 dBm) sine wave
	Frequency (internal timebase reference selected): ± (25 ppb initial + 100 ppb/year aging) first year of manufacture ± (25 ppb initial + 30 ppb/year aging) after first year of manufacture
	Frequency, external timebase reference selected: external reference frequency
Trig out	0 V to 5 V, 50 Ω impedance

Display	
Display	15.4-inch color XGA TFT-LCD with capacitive touch screen
Intensity grayscale	256-level intensity-graded display
Resolution XGA	1024 pixels horizontally x 768 pixels vertically
Annotation	Up to 100 bookmarks can be inserted into the waveform window. Each can float or be tied to a specific waveform
Grids	Choose between 1-16 grids per waveform area, 10-bit vertical resolution
Waveform areas	Supports eight waveform areas plus chart mode for EZJIT, InfiniiSim, protocol, and PrecisionProbe
Waveform styles	Connected dots, dots, infinite persistence, color graded infinite persistence. Includes up to 256 levels of intensity-graded waveforms., variable persistence
Maximum update rate	> 400,000 waveforms per second (when in the segment memory mode)

Keysight Infiniium UXR-Series 1 mm Model – General Characteristics

General Characteristics		
Temperature	Operating: 5 to + 40 °C up to 2,000 meters, de-rated between 2,000 and 3,000 meters by 1 °C for every 100 meters	
	Non-operating: –20 to +70 °C	
Humidity	Operating: Up to 95% relative humidity (non-condensing) at +40 °C	
	Non-operating: Up to 90% relative humidity at +65 °C	
Altitude	Operating: Up to 3,000 meters (9,842 feet); de-rate maximum temperature by 1 °C for every 100 meters above 2,000 meters	
	Non-operating: Up to 4,600 meters (15,090 feet)	
Vibration	Operating random: 0.21 g (rms)	
	Non-operating random: 2.0 g (rms)	
	Swept sines: 0.50 g (rms)	
Power	UXR1102A, UXR1002A, UXR0802A, UXR0702AP, UXR0592AP, UXR0402AP, UXR0252AP	110 to 240 VAC at 50/60 Hz
		Maximum input power 1370 VA
	Well-regulated power is required for 110-120 V operation: Connect only to a 20-amp outlet or a dedicated 15-amp outlet.	
	UXR1104A, UXR1004A, UXR0804A, UXR0704AP, UXR0594AP, UXR0404AP, UXR0254AP	200 VAC to 240 VAC at 50/60 Hz
		Maximum input power 2615 VA
	Connect only to outlets rated for 15 amps or higher.	
Weight	UXR1102A, UXR1002A, UXR0802A, UXR0702AP, UXR0592AP, UXR0402AP, UXR0252AP	36.15 kg (79.7 lbs.)
	UXR1104A, UXR1004A, UXR0804A, UXR0704AP, UXR0594AP, UXR0404AP, UXR0254AP	42.05 kg (92.7 lbs.)
Dimensions	Width: 435 mm with handles removed (17.126”) 530 mm with handles (20.866”)	
	Depth: 513 mm main body (20.197”) 560 mm including knobs and rear feet (22.047”)	
	Height: 311 mm (7U) with feet removed (12.244”) The rackmount kit will take up 8U to allow for airflow and cabling 333 mm with feet (13.11”)	
	Inputs: Connectors are 75 mm apart horizontally on the 4-channel frame and 150 mm apart on the 2-channel frame. Centers are 49 mm above the surface when resting flat (no tilt levers) and 90 mm above the surface when using the front tilt levers.	
	Clearances: Fans draw cool air in from the sides and bottom, and blow it out the back of the oscilloscope. Allow at least 8 inches (203 mm) of clearance from the rear. Side handles provide sufficient airflow clearance side to side. Feet provide sufficient airflow clearance from the bottom.	
Safety	CAN/CSA-C22.2 No. 61010-1-12 ANSI/UL Std. No. 61010-1:2012	

Definitions

Measured (meas)
An attribute measured during development for purposes of communicating the expected performance. This data is not warranted, does not include measurement uncertainty, and is measured at room temperature (approximately 23°C).

Nominal (nom)
The mean or average characteristic performance, or the value of an attribute that is determined by design such as a connector type, physical dimension, or operating speed. This data is not warranted and is measured at room temperature (approximately 23°C).

Specification (spec)
The warranted performance of a calibrated instrument that has been stored for a minimum of 2 hours within the operating temperature range of 5 – 40°C and after a 30-minute warm up period.

Typical (typ)
The characteristic performance, which 80% or more of manufactured instruments will meet. This data is not warranted, does not include measurement uncertainty, and is valid only at room temperature (approximately 23°C).

Operating frequency range
The operating frequency range is the frequency range of corrected signal spectral components by deembeding for frequency and phase characteristics of the individual hardware.

Analog bandwidth
The analog bandwidth describes the 3 dB bandwidth of the full opto-electronic input path without any frequency or phase corrections.

Sensitivity
The sensitivity limit corresponds to the received signal power at the input interface for which a 32 GBaud DP-QPSK exhibits an EVM of 32.5% or less. An EVM of 32.5% corresponds to a BER of 1E-3 for assumed added Gaussian white noise (AWGN) according to =0.5*ERFC(1/(SQRT(2)*(EVM²+1))).

Effective Number of Bits (ENOB)
Definition in accordance with IEEE 1057: “For an input sinewave of specified frequency and amplitude, ENOB is the number of bits of an ideal waveform recorder for which the rms quantization error is equal to the rms NAD of the waveform recorder under test.”

ENOB is determined by equation.

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