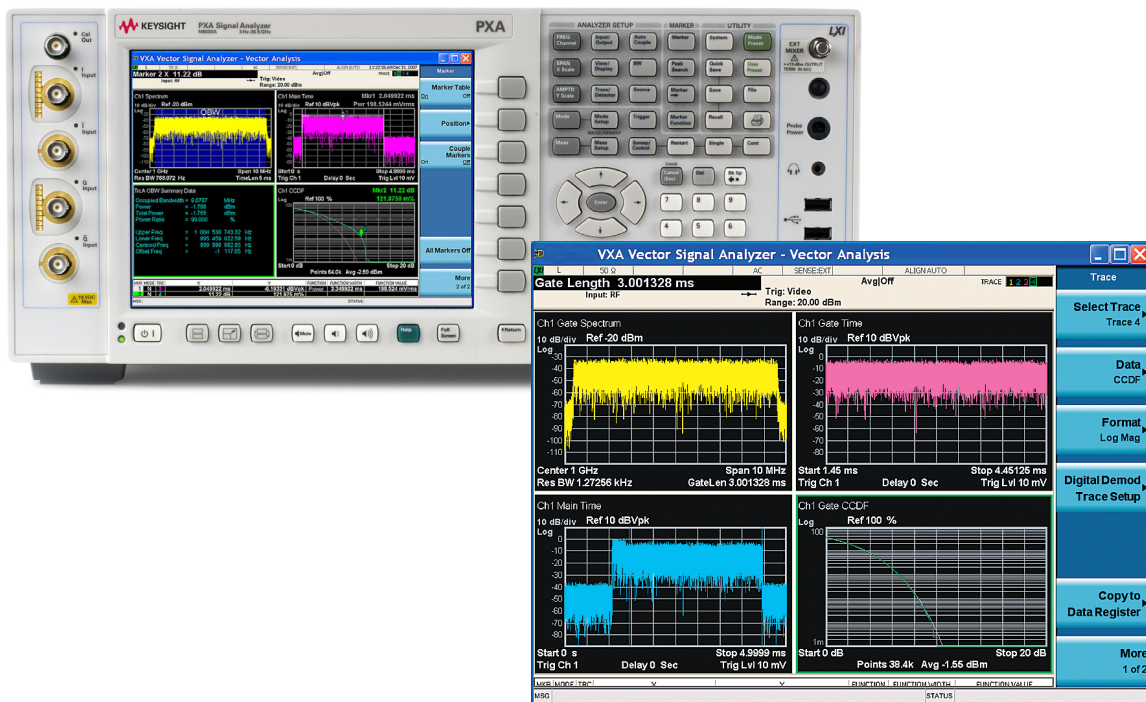# Keysight

VXA Vector Signal Analysis
X-Series Measurement App, Traditional UI
N9064EM0D

Technical Overview

- FFT-based spectrum analysis
- Time-domain analysis tools for burst analysis
- Flexible modulation analysis
- Hardkey/softkey manual user interface or SCPI remote user interface
- Built-in, context-sensitive help
- Flexible licensing provides the option of using perpetual or time based licenses with one or multiple signal analyzers

KEYSIGHT
TECHNOLOGIES

VXA Vector Signal Analysis Measurement Application

The VXA vector signal analysis measurement application transforms the X-Series signal analyzers into vector signal analyzers by providing a wide range of measurements, demodulation types, and filters to perform comprehensive signal analysis, helping you thoroughly test your designs, ensure product quality, and optimize without compromise.

X-Series measurement applications can help you:
- Gain more insight into device performance with intuitive display and graphs for your application. Select from our library of over 25 different measurement applications.
- Ensure that your design meets the latest standard. Updates are made to the X-Series measurement applications as standards evolve.
- Apply the same measurement science across multiple hardware platforms for consistent measurement results over your design cycle from R&D to production.
- Choose the license structure that meets your business needs. We provide a range of license types (node-locked, transportable, floating or USB portable) and license terms (perpetual or time-based).

More about signal analysis

The VXA measurement application is a general-purpose FFT-based spectrum analysis application, with a wide selection of demodulation types and filters to perform flexible digital modulation analysis.

- Bring comprehensive vector signal analysis to the test rack
- Troubleshoot signals with powerful time domain capability
- Use analog demodulation to identify unintentional modulations
- Test when no commercial test standard is available
- Utilize flexible digital modulation analysis capability

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Vector Signal Analysis Measurement Details

Bringing comprehensive vector signal analysis to the test rack

The vector signal analysis (Option 1FP) is the foundation of all measurement options in the VXA measurement application and is a required option. Each measurement is available simultaneously, in either one, two, three or four user-selected separate trace displays. You have full control of trace data format and scaling.

- – Spectrum, instantaneous spectrum
- – Time, instantaneous time, raw time
- – Time gating
- – Time averaging, including continuous repeat max hold, exponential max hold, RMS (video), RMS (video) exponential, time, time exponential
- – Band power
- – Power spectral density (PSD)
- – Power statistics (including gated):
  - – Complementary cumulative distribution function (CCDF)
  - – Cumulative distribution function (CDF)
  - – Probability distribution function (PDF)
- – Auto correlation
- – Occupied bandwidth (OBW)
- – Adjacent channel power (ACP)
- – Analog demodulation: AM/FM/PM (includes spectrum, time, gated time, PSD, power statistics)
- – Frequency counter
- – Signal tracking
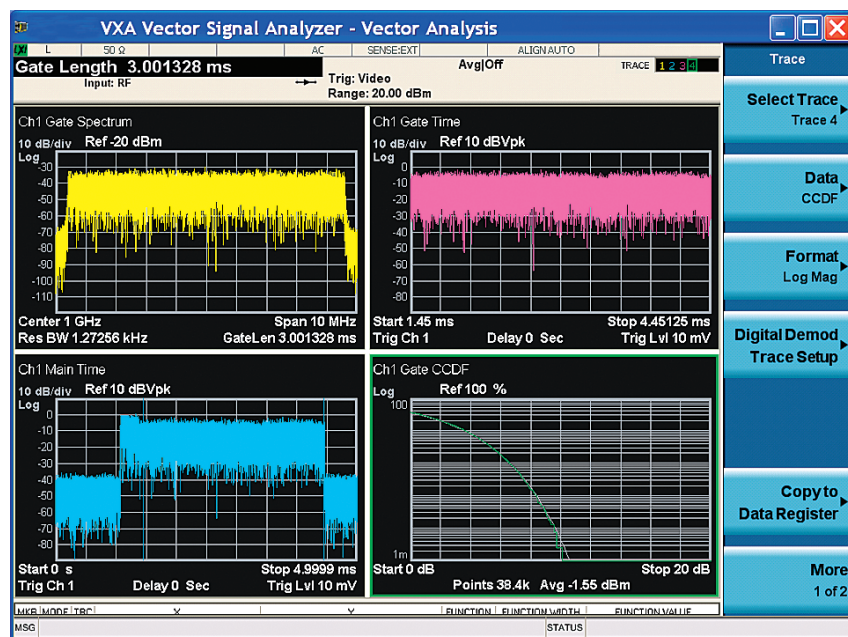- – Marker coupling
- – Ability to save traces

Figure 1. Basic vector signal analysis: The spectrum, time, and CCDF of the gated signal are shown, as well as the full time domain signal (Trace 2, lower left).

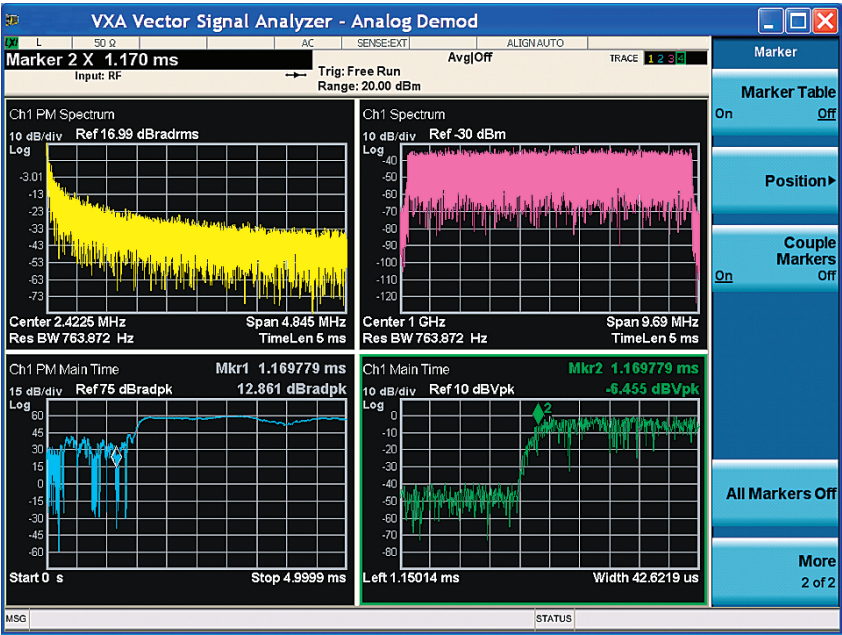# Vector Signal Analysis Measurement Details (continued)

Figure 2. Analog demodulation: PM demodulation showing phase stability of the burst at turn-on; by coupling markers to an expanded time domain trace, we can see that data is sent prior to the phase settling out to a stable value after the burst turn-on occurs.
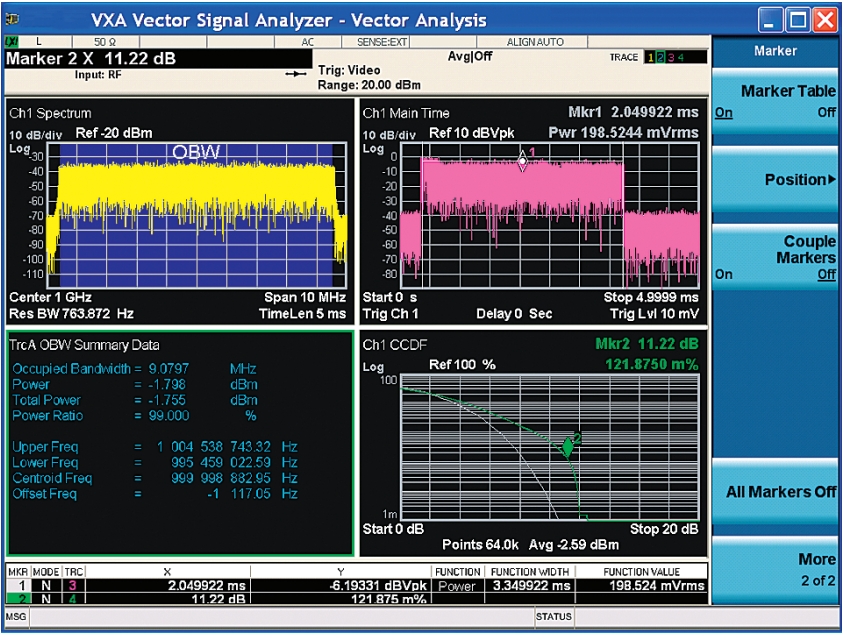

Figure 3. 2x2 grid display showing multiple measurements, markers, and marker table for at-a-glance signal analysis.

Top Features

View detailed frequency behavior

The VXA measurement application gives you a complete set of tools to maximize the resolution of your spectrum display and the accuracy of the data displayed:

– Up to 409601 frequency points across whatever frequency span you select provides unprecedented frequency resolution to locate the most difficult problem; RBWs of less than 1 millihertz are available
– Automatic selection of highest frequency resolution for a given measurement
– Four different FFT window functions to choose from to meet specific measurement needs—Gaussian filter for high dynamic range measurements, or flat top filter for highest amplitude accuracy measurements amplitude accuracy measurements
– Use the X-axis scaling feature for a better view of the area of interest on the signal; save this display or paste the measurement result into a report to the design team

Figure 4. The FFT window filter is applied to each frequency bin, similar to the filter that a spectrum analyzer uses as it sweeps across the frequency span of the measurement; however, with VXA, the filters are applied simultaneously to all frequencies and can be changed.
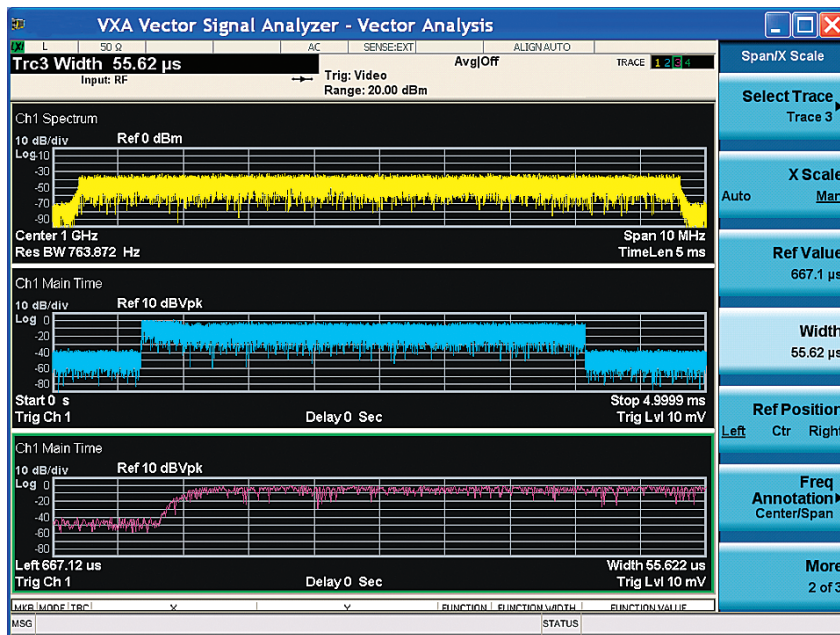

Figure 5. High-resolution frequency and time domain traces; Trace 3 shows the same time with the x-axis expanded to improve resolution of burst turn-on.

Enhance your time to insight for baseband signal quality

PXA or MXA signal analyzers with Option BBA installed expands the baseband analysis capability for troubleshooting and design verification of RF devices.

Flexible Digital Modulation Analysis

Add powerful analysis options

The flexible digital modulation analysis option, Option 2FP, adds the capability to visualize system performance rapidly and intuitively. Teamed with an Keysight X-Series signal analyzer, you can increase the speed of your measurement tasks with the flexibility this option offers:

– Customize modulation analysis formats including PSK, QAM (16 to 1024QAM), MSK, EDGE, FSK, VSB, DVBQAM, APSK, SOQPSK
– A complete set of more than 30 modulation quality measurements, including overall EVM, peak EVM, EVM vs. symbol time, EVM spectrum, time, spectrum, constellation diagram, vector diagram, IQ parameters, requency and clock error, channel/impulse response with EQ filter, zero crossing error, and symbol clock error
– Convenient measurement presets to cover popular communication formats, such as CDMA, GSM/EDGE, *Bluetooth*®, Zigbee, TETRA, APCO25, and Wi-SUN (MR-FSK PHY)

Testing when no commercial test standard is available

Testing proprietary and custom signals is a challenge. Turnkey test software for those signals is seldom available off-the-shelf, so you have to design and implement the tests yourself. The flexible digital modulation analysis option will help you with that task. It covers the various demands of "do it yourself" testing for single carrier, single modulation signals with a deep set of flexible modulation analysis tools that you can tweak to meet your needs. In addition, these flexible tools are SCPI programmable.
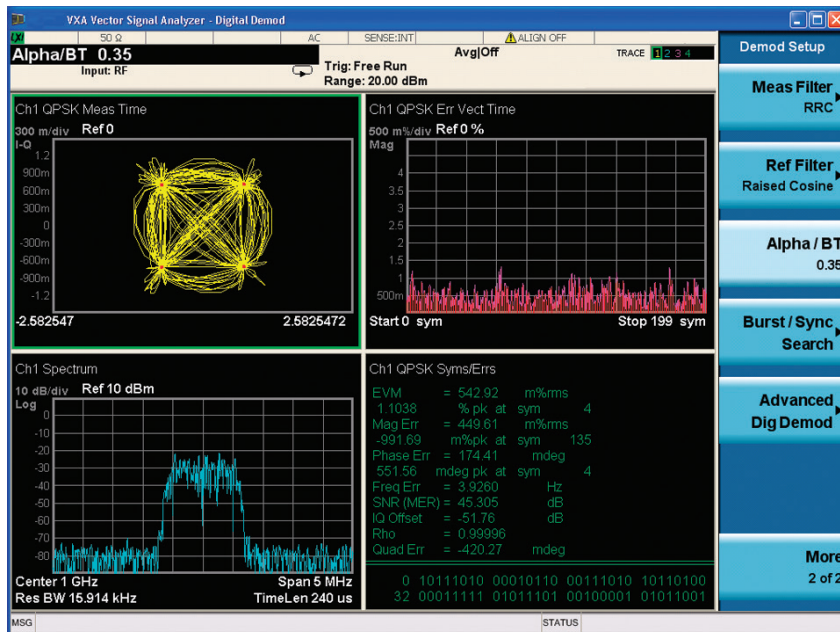

Figure 6. QPSK modulation analysis in default quad view: Trace 1 (upper left), IQ constellation; Trace 2 (lower left), spectrum; Trace 3 (upper right), error vector magnitude versus time (symbol) trace; Trace 4 (lower right), Symbols/Error table.

Key Features of Digital Modulation Analysis

Standard presets (for single carrier)	
Cellular	CDMA (base, mobile), CDPD, EDGE, GSM, NADC, PDC, PHS (PHP), W-CDMA
Wireless networking	*Bluetooth* (Basic Rate), HIPERLAN/1 (HBR, LBR), WLAN (802.11b), ZigBee (802.15.4, 868/915/2450 MHz), Wi-SUN (802.15.4g, MR-FSK PHY)
Digital video	DTV (8, 16), DVB (16, 32, 64, 128, 256), DVB (16APSK, 32APSK)
Other	APCO 25, APCO 25 P2 (HCPM), APCO 25 P2 (HDQPSK), DECT, TETRA, VDL Mode 3, MIL-STD 188-181C, SOQPSK-TG
Modulation formats	
FSK	2, 4, 8, 16 level (including GFSK)
	MSK (including GMSK)
	BPSK, QPSK, OQPSK, DQPSK, D8PSK, π/4DQPSK, 8PSK, 3π/8 8PSK (EDGE), π/8 D8PSK, SOQPSK
QAM (absolute encoding)	16, 32, 64, 128, 256, 512, 1024
QAM (differential encoding per DVB standard)	16, 32, 64, 128, 256
APSK	16, 16 w/DVB, 32, 32 w/DVB
VSB	8, 16
Filter types	Raised cosine, square-root raised cosine, IS-95 compatible, Gaussian, EDGE, 1REC, 3RC, SOQPSK-TG, low pass, rectangular, half-sine, none
Alpha/BT	Continuously adjustable from 0.05 to 10 user-defined filters
Adaptive equalizer	Decision directed, LMS, feed-forward, equalization with adjustable convergence rate; removes the effects of linear distortion (i.e. non-flat frequency response, multipath, etc.) from modulation quality measurements
Symbol rate	Rate = Frequency span / $(1+\alpha)$; maximum symbol rate limited only by the measurement span
Advanced analysis setup	Burst search
	Pulse search
	Sync search (with user-selected synchronization word)
	Adjustable search length and offset timing
Measurements/displays	Eye diagram
	Trellis diagram
	Polar diagram
	Constellation and vector (shows trajectory between symbol times) diagram
	I and Q versus time
	Error vector magnitude
	EVM versus symbol time
	EVM versus frequency
	Magnitude and phase error
	Frequency error (carrier offset frequency)
	IQ origin offset
	Quadrature error
	Gain imbalance
	Amplitude droop (PSK and MSK formats)
	SNR (8/16VSB and QAM formats)
	Symbols table (demodulated bits)
	Error table with tabular EVM and IQ errors
	Equalizer channel frequency response
	Equalizer imipulse response
	Symbol clock error
	Zero crossing error

Key Specifications

Definitions

– Specifications describe the performance of parameters covered by the product warranty.

– 95th percentile values indicate the breadth of the population (≈2σ) of performance tolerances expected to be met in 95% of cases with a 95% confidence. These values are not covered by the product warranty.

– Typical values are designated with the abbreviation "typ." These are performance beyond specification that 80% of the units exhibit with a 95% confidence. These values are not covered by the product warranty.

– Nominal values are designated with the abbreviation "nom." These values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.

– PXA specifications apply to analyzers with frequency options of 526 and lower. For analyzers with higher frequency options, specifications are not warranted but performance will nominally be close to that shown in this section.

Note: Data subject to change

N9064EM0D VXA vector signal analysis

Description	PXA	MXA	EXA	CXA
Maximum frequency	50 GHz	26.5 GHz	44 GHz	26.5 GHz
External mixing support with Option EXM	Yes	Yes	Yes	N/A
Center frequency tunning resolution	10 µHz	1 mHz	1 mHz	1 mHz
Frequency span	10 MHz (standard); 25 MHz (Option B25) 40 MHz (Option B40) 85 MHz (Option B85) 160 MHz (Option B1X)	25 MHz (standard) 40 MHz (Option B40) 85 MHz (Option B85) 125 MHz (Option B1A) 160 MHz (Option B1X)	25 MHz (standard) 40 MHz (Option B40)	10 MHz (standard) 25 MHz (Option B25)
Frequency point per span	Calibrated points: 51 ~ 409, 601; Displayed points: 51 ~ 524, 288			
Absolute amplitude accuracy (Freq < 3.6 GHz)	± 0.19 dB, 95% confidence accuracy	± 0.23 dB, 95% confidence accuracy	± 0.27 dB, 95% confidence accuracy	± 0.50 dB, (Freq < 3 GHz) 95% confidence accuracy
Third-order intermodulation distortion, two –20 dBfs tones, 400 MHz to 13.6 GHz, (7.5 GHz for CXA) tone separation > 15 kHz	–90 dBc (nom)	–90 dBc (nom)	–84 dBc (nom)	–66 dBc (nom)
Resolution bandwidth	RBWs range from less than 1 Hz to greater than 2.8 MHz (standard); Greater than 7 MHz (with Option B25)			
RBW filter shapes	Flat top, Gaussian top, Hanning, Uniform			
Analog demodulation types	AM, FM, PM			

Key Specifications (continued)

X-Series signal analyzers

Accuracy		PXA	MXA	EXA	CXA	BBIQ [1]
Conditions		Modulation formats include BPSK, D8PSK, DQPSK, QPSK, (16/32/64/128/256/512/1024) QAM, (16/32/64/128/256)DVBQAM, π/4-DQPSK, 8-PSK. EVM normalization reference set to constellation maximum. Transmit filter is root raised cosine with alpha=0.35. Center frequency 1 GHz. Signal amplitude of −16 dBm, analyzer range set to −10 dBm. Result length set to at least 150 symbols, or 3 × {Number of ideal state locations}. RMS style averaging with a count of 10. Phase noise optimization adjusted based on symbol rate of measurement. Available span dependent on analyzer hardware bandwidth options.				
Residual errors	Symbol rate/Span					
Residual EVM	1 Msps/5 MHz	≤ 0.5% rms	≤ 0.7% rms	≤ 0.7% rms	≤ 0.7% rms	≤ 0.5% rms
	10 Msps/25 MHz	≤ 0.5% rms	≤ 0.7% rms	≤ 0.7% rms	≤ 0.9% rms	≤ 0.5% rms
	25 Msps/40 MHz	≤ 0.7% rms	≤ 1.1% rms	≤ 1.1% rms	–	≤ 0.6% rms
	100 Msps/160 MHz	≤ 1.0% rms	≤ 1.3% rms	–	–	–
Magnitude error	1 Msps/5 MHz	≤ 0.4% rms	≤ 0.5% rms	≤ 0.5% rms	≤ 0.5% rms	≤ 0.5% rms
	10 Msps/25 MHz	≤ 0.5% rms	≤ 0.5% rms	≤ 0.5% rms	≤ 0.6% rms	≤ 0.5% rms
	25 Msps/40 MHz	≤ 0.6% rms	≤ 0.8% rms	≤ 0.8% rms	–	≤ 0.6% rms
	100 Msps/160 MHz	≤ 0.9% rms	≤ 1.0% rms	–	–	–
Phase error	1 Msps/5 MHz	≤ 0.5° rms	≤ 0.6° rms	≤ 0.6° rms	≤ 0.7° rms	≤ 0.6° rms
	10 Msps/25 MHz	≤ 0.6° rms	≤ 0.6° rms	≤ 0.6° rms	≤ 0.8° rms	≤ 0.6° rms
	25 Msps/40 MHz	≤ 0.6° rms	≤ 1.1° rms	≤ 1.1° rms	–	≤ 0.6° rms
	100 Msps/160 MHz	≤ 1.0° rms	≤ 1.3° rms	–	–	–
Frequency error	Added to frequency accuracy if applicable	≤ Symbol rate / 500,000				
I/Q origin offset [1]		≤ −60 dB				
Accuracy		**PXA**	**MXA**	**EXA**	**CXA**	**BBIQ** [1]
Conditions		Modulation formats include MSK and MSK2. Transmit filter is gaussian with BT=0.3. Center frequency 1 GHz. Signal amplitude of -16 dBm. Analyzer range set to −10 dBm. Result length set to 150 symbols. RMS style averaging with a count of 10. Available span dependent on analyzer hardware bandwidth options.				
Residual errors	Symbol rate/Span					
Residual EVM	10 Msps/25 MHz	≤ 0.5% rms	≤ 0.9% rms	≤ 0.9% rms	≤ 1.0% rms	≤ 0.8% rms
	80 Msps/160 MHz	≤ 1.4% rms	≤ 1.8% rms	–	–	–
Phase error	10 Msps/25 MHz	≤ 0.4° rms	≤ 0.5° rms	≤ 0.5° rms	≤ 0.5° rms	≤ 0.5° rms
	80 Msps/160 MHz	≤ 1.3° rms	≤ 1.3° rms	–	–	–

1. I+jQ measurements performed using signal amplitude and analyzer range near 0 dBm, with a 0 Hz center frequency. I/Q origin offset metric does not include impact of analyzer DC offsets.

For a complete list of specifications refer to the appropriate specifications guide.

PXA: www.keysight.com/find/pxa_specifications
MXA: www.keysight.com/find/mxa_specifications
EXA: www.keysight.com/find/exa_specifications
CXA: www.keysight.com/find/cxa_specifications

PXIe:
VSA up to 6 GHz: www.keysight.com/find/m9391a
VSA up to 50GHz: www.keysight.com/find/m9393a
VXT: www.keysight.com/find/m9421a
CXA-m: www.keysight.com/find/m9290a

Ordering Information

Flexible licensing and configuration

– **Perpetual:** License can be used in perpetuity.
– **Time-based:** License is time limited to a defined period, such as 12-months.
– **Node-locked:** Allows you to use the license on one specified instrument/computer.
– **Transportable:** Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
– **Floating:** Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.
– **USB portable:** Allows you to move the license from one instrument/computer to another by end-user only with certified USB dongle, purchased separately.
– **Software support subscription:** Allows the license holder access to Keysight technical support and all software upgrades

You Can Upgrade!

All of our X-Series application options are license-key upgradeable.

UP GRADE

VXAX Vector Signal Analysis measurement application (N9064EM0D)

Model	Software License Type	Support Contract	Support Subscription (12-month) [2]
N9064EM0D-1FP	Node-locked perpetual	R-Y5C-001-A[2]	R-Y6C-001-L[2]
N9064EM0D-1FL	Node-locked 12-month	R-Y4C-001-L[1]	Included
N9064EM0D-1TP	Transportable perpetual	R-Y5C-004-D[2]	R-Y6C-004-L[2]
N9064EM0D-1TL	Transportable 12-month	R-Y4C-004-L[1]	Included
N9064EM0D-1NP	Floating perpetual	R-Y5C-002-B[2]	R-Y6C-002-L[2]
N9064EM0D-1NL	Floating 12-month	R-Y4C-002-L[1]	Included
N9064EM0D-1UP	USB portable perpetual	R-Y5C-005-E[2]	R-Y6C-005-L[2]
N9064EM0D-1UL	USB portable 12-month	R-Y4C-005-L[1]	Included

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Software Models & Options

To learn more about X-Series measurement application licensing, model numbers and options, please visit:
www.keysight.com/find/X-Series_apps_model

One month software support subscription extensions [3]

Model	Description
R-Y6C-501[3]	1-month of software support subscription for node-locked license
R-Y6C-502[3]	1-month of software support subscription for floating license
R-Y6C-504[3]	1-month of software support subscription for transportable license
R-Y6C-505[3]	1-month of software support subscription for USB portable license

1. All time-based X-Series measurement application licenses includes a 12-month support contract which also includes the 12-month software support subscription as same duration.
2. Support contract must bundle software support subscription for all perpetual licenses in the first year. All software upgrades and Keysight support are provided for software licenses with valid support subscription.
3. After the first year, software support subscription may be extended with annual or monthly software support subscription extensions for perpetual licenses.

Hardware Configuration

For optimizing the LTE and LTE-Advanced FDD/TDD measurement application, Keysight recommends a minimum level of instrument hardware functionality at each instrument performance point. Supported instruments include:

Benchtop:
– PXA   N9030A
– MXA N9020A

– EXA N9010A
– CXA N9000A

PXIe:
– VSA (6 GHz) M9391A
– VSA (50 GHz) M9393A

– VXT   M9420/21A
– CXA-m M9290A

N90x0A X-Series signal analyzer

Capability	Instrument Option	Benefit
Analysis bandwidth	10 or 25 MHz as default or higher	**Required**: Wider analysis bandwidth options such as 25/40/85/160 MHz can be selected depending on the specified signal analyzer model
Precision frequency reference	-PFR	**Recommended**: For enhanced frequency accuracy and repeatability for lower measurement uncertainty
Electronic attenuator	-EA3	**Recommended**: Fast and reliable attenuation changes ideal for manufacturing without the wear associated with mechanical attenuators up to 3.6 GHz in 1 dB steps
Pre-amplifier	3.6 GHz (-P03) or higher	**Recommended**: For maximizing the measurement sensitivity
Fine resolution step attenuator	-FSA	**Recommended**: Useful for maximizing useable dynamic range to see signals
Analog baseband I/Q inputs	-BBA on PXA and MXA only	**Optional**: To extend measurements at baseband if required by device under test

M9391/93A PXIe VSA vector signal analyzer

Description	Model-Option	Additional information
Frequency range 3 or 6 GHz	M9391A-F03, or F06	One required for M9391A
Frequency range 8.4, 14, 18, or 27 GHz	M9393A-F08, F14, F18, or F27	One required for M9393A
Frequency extension to 43.5 or 50 GHz	M9393A-FRZ or FRX	Optional (requires M9393A-F27)
Analysis bandwidth 40, 100 or 160 MHz	M9391A/M9393A-B04, B10 or B16	One required
Memory 128, 512 or 1024 MSa	M9391A/M9393A-M01, M05 or M10	One required
Frequency reference 10 MHz and 100 MHz	M9391A/M9393A-300	One required

M9420/21A PXIe VXT vector transceiver

Description	Model-Option	Additional information
Frequency range 3.8 or 6 GHz	M9420A/M9421A-504, or 506	One required
Analysis bandwidth 40, 80 or 160 MHz	M9420A/M9421A-B40/B80/B1X	One required
Memory 256 or 512 MSa	M9420A/M9421A-M02/M05	One required
Half duplex port	M9420A/M9421A-HDX	Optional
High output power	M9420A/M9421A-1EA	Optional

M9290A CXA-m PXIe signal analyzer

Description	Model-Option	Additional information
Frequency range 3, 7.5, 13.6 or 26.5 GHz	M9290A-F03, F07, F13, or F26	One required
Analysis bandwidth 25 MHz	M9290A-B25	Optional
Preamplifier, 3, 7.5, 13.6 or 26.5 GHz	M9290A-P03, P07, P13 or P26	One required
Fine resolution step attenuator	M9290A-FSA	Optional
Precision frequency reference	-PFR	Optional

Related Literature

Description	Publication number
N9064A & W9064A Vector Signal Analysis, Self-Guided Demonstration	5990-6159EN
N9064A & W9064A Vector Signal Analysis, Measurement Guide	N9064-90004
User's and Programmer's Reference guide is available in the library section of the N9064A and W9064A product pages.	

Web

Product page:
www.keysight.com/find/N9064D

X-Series measurement applications:
www.keysight.com/find/X-Series_Apps

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

PXIe VXT vector transceiver:
www.keysight.com/find/VXT

PXIe VSA vector signal analyzer:
www.keysight.com/find/M9391A
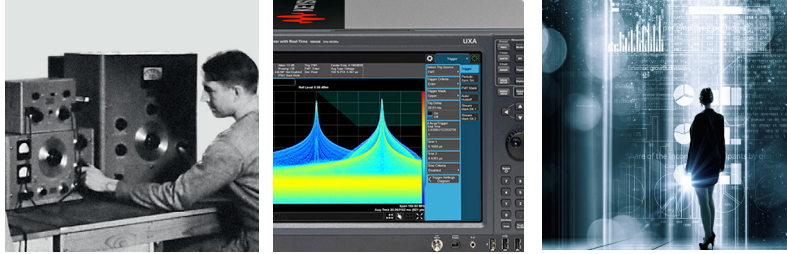www.keysight.com/find/M9393A

PXIe CXA-m signal analyzer:
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