89601X VXA Vector Signal Analyzer Measurement Application

Technical Overview with Self-Guided Demonstration

Option B7R WLAN (802.11a/b/g) Modulation Analysis

Agilent Technologies

Product Overview

Optimize without compromise

Every new product introduction creates tension between schedule and quality — but you refuse to compromise either one. The ability to quickly define the tests you need and minimize their execution time can help ease the tension. The Agilent VXA measurement application helps you verify product designs and ensure product quality through a deep, flexible set of tools that puts comprehensive vector signal analysis in the test rack. Operating within an Agilent X-Series signal analyzer, the VXA measurement application lets you tweak and tune its standard measurements for today's complex signals. Verify designs, ensure product quality, and optimize without compromise — with the VXA measurement application in the X-Series signal analyzer.

The VXA measurement application combines advanced measurement algorithms from Agilent's industry-leading 89600 Series VSA software with SCPI programming and the familiar X-Series signal analyzer front-panel user interface. The result: measurements you can trust to thoroughly test your design and familiar tools to quickly automate the tests you choose.

- Multiple domain analysis — spectrum, time, and modulation quality measurements in a single data acquisition
- WLAN standard-based modulation analysis: IEEE 802.11a OFDM, 802.11b DSSS/CCK/PBCC, 802.11g OFDM, 802.11p DSRC, and 802.11j 10 MHz

Advanced tools for WLAN modulation analysis

IEEE 802.11a/b/g WLAN standards are successfully in service around the world. Because of the high demand for lower prices and ever better quality, R&D, design verification, and production engineers are under pressure to improve their designs while reducing manufacturing time. The VXA measurement application Option B7R takes on the challenge by providing a comprehensive set of measurement tools that test WLAN signals from the frame to the raw bits. In addition, the tools are SCPI programmable.

A powerful measurement combination

The depth and flexibility of the VXA measurement application together with Agilent's X-Series signal analyzer puts unmatched measurement power at your fingertips. Agilent's N9020A MXA signal analyzer offers the best mid-range spectrum analyzer performance with 26.5 GHz frequency range, powerful swept-tuned spectrum analysis, one-button RF power measurements, a great feature set, and the fastest measurement speed on the market. Or, choose the economy-class N9010A EXA signal analyzer to enhance your yield and throughput, and eliminate the compromise between speed and price.

Add the tremendous insight that the VXA application provides, and you get comprehensive vector signal analysis — allowing you to optimize without compromise.

Figure 1. MXA signal analyzer with VXA vector signal analyzer measurement application.

Key Features

OFDM modulation analysis

Signal acquisition

Supported standards:	IEEE 802.11a/b/g, HiperLAN2, IEEE 8 02.11p DSRC, IEEE 802.11j 10 MHz
Standard presets:	IEEE 802.11a/g/OFDM, HiperLAN2, IEEE 802.11g DSSS-OFDM, IEEE 802.11a/g turbo mode, IEEE 802.11p DSRC, IEEE 802.11j 10 MHz
Modulation format:	BPSK, QPSK, 16QAM, 64QAM (auto detect or manual)
Triggering:	Single/continuous, free-run/channel/ external

Adjustable parameters

Data format:	IEEE 802.11a, HiperLAN2
Sub-carrier spacing:	Continuously adjustable
Symbol timing adjust:	Adjustable between 0 and guard interval
Guard interval:	¼, ⅛ (HiperLAN2 only), adjustable between 0 and 1 in 1/64 increments
Pilot tracking:	Phase, amplitude, timing
Carriers to analyze:	All, single, or pilots

Demodulation measurement results

I-Q measured:	All carriers over all symbol times
Error vector spectrum:	Error values for each symbol time plotted for each carrier
Error vector time:	Error values for each carrier plotted for each symbol time
RMS error vector:	Time, spectrum
Common pilot error:	Phase, magnitude

Symbol table and error summary:

EVM, pilot EVM, CPE (common pilot error), IQ (origin) offset, frequency error, symbol clock error, sync correlation, number of symbols, modulation format, code rate, bit rate, IQ gain imbalance, IQ quadrature skew

Display formats

Error vector spectrum:	Error values for each symbol time plotted for each carrier
Error vector time:	Error values for each carrier plotted for each symbol time

DSSS modulation analysis

Signal acquisition

Modulation format:	Barker1, Barker2, CCK5.5, CCK11, PBCC5.5, PBCC11, PBCC22, PBCC33 (Auto detect or manual)
Preamble:	Auto detect (short, long)
Triggering:	Single/continuous, free-run, channel, external

Supported formats

Formats:	IEEE 802.11b including optional short preamble and optional PBCC modes; IEEE 802.11g including PBCC22 and PBCC33 modes

Adjustable parameters

Chip rate:	Continuously adjustable
Clock adjust:	Continuously adjustable between ±0.5 chips
Equalizer:	On/Off
Equalizer filter length:	3 to 99 chips
Descrambler mode:	On/off, preamble only, preamble, header only
Reference filter:	Rectangular, Gaussian, root raised cosine
Filter BT:	.05 to 100

Demodulation measurement results

IQ data:	Measured, reference
Other IQ error traces:	IQ magnitude error, IQ phase error
Despread symbols:	Preamble, header, data
Error vector spectrum:	Error values for each symbol time plotted for each carrier
Error vector time:	Error values for each carrier plotted for each symbol time

Symbol and error table summary:

IEEE 802.11b 1,000-chip peak EVM, EVM, magnitude error, phase error, IQ offset, frequency error, sync correlation, burst type, bit rate, number of data octets, data length

Demonstration Preparation

Getting started

This product overview will guide you through a typical usage scenario for an Agilent X-Series signal analyzer (MXA/EXA) analyzer with the WLAN modulation analysis Option B7R to the VXA measurement application. Follow the keystrokes described in "Instructions." All demonstrations utilize the X-Series analyzer with the 25 MHz analysis bandwidth Option B25 and the VXA measurement application configured with Options 205 (Basic VSA-Lite), 333 (X-Series analyzer connectivity), and B7R (WLAN modulation analysis). Keystrokes surrounded by [ ] indicate front-panel keys, while softkeys, located on the right edge of the display, are indicated in **bold** type.

Configuration of the VXA and MXA analyzer is simple. Connect the RF output of the signal generator to the RF input of the MXA analyzer. Recommended settings for the signal generator are:

Center frequency = 2.412 GHz

Level = -10 dBm

IEEE 802.11g OFDM using 54 Mbps data rate

Event output at the frame boundary to connect to analyzer's external trigger input

Set the analyzer center frequency (CF) of 2.412 GHz after entering the keystrokes **[Mode] > Vector Signal Analyzer (VXA)**, and then **Mode Preset**. If you set your signal source output frequency to a different value, set the analyzer accordingly.

It is always a good idea to make a spectrum measurement first to make sure your analyzer is set to the right frequency. If you encounter any issues during setup, use **[Mode Preset]** or **[Meas Setup] > More 1 of 2 > Meas Preset**.

Figure 2. 802.11g signal in VXA vector analysis measurement (with external trigger, 20 kHz RBW and auto-scale on Trace 1).

Figure 3. EXA signal analyzer with VXA vector signal analyzer measurement application.

Demonstration

Quick demonstration: *802.11g WLAN OFDM modulation analysis measurements*

While Option B7R supports both DSSS and OFDM WLAN measurements, we will use an OFDM signal for our example. You can adjust the following parameters when making WLAN modulation measurements with the B7R option to the VXA measurement application:

- Averaging setup (average counts, average mode)
- Demodulation setup (modulation format auto-detection, modulation format, guard interval)
- Preset to standard (IEEE 802.11a/g OFDM, HIPERLAN/2, IEEE 802.11g DSSS-OFDM, IEEE 802.11a/g Turbo Mode, IEEE 802.11p DSRC, IEEE 802.11j 10 MHz)
- Measurement time (search length, result length, meas offset, meas interval)
- Subcarriers to analyze (all, pilots, single)
- Advanced parameters setup (subcarrier spacing adjust, symbol timing adjust, pilot tracking parameters, EQ training mode, IQ normalize)

The following steps are useful when analyzing WLAN signals:

- Check the center frequency and spectrum of the signal first. Make sure it is on frequency and has the right bandwidth. This is also a good time to evaluate the time domain behavior of the overall signal (burst length, Power, CCDF, and more).
- Set up your demodulator and demodulate the signal. Start your analysis with the basic quality numbers: overall EVM, I/Q gain, I/Q imbalance, clock error, and more.
- Move on to the more advanced modulation analysis measurements such as using the Error Vector Time measurement to evaluate EVM behavior symbol by symbol.

Instructions	Keystrokes
Go to VXA mode on the X-Series analyzer.	**[Mode] > Vector Signal Analyzer (VXA)**
Select WLAN OFDM modulation analysis.	**[Meas] > WLAN OFDM**
Adjust ranging to input power level.	**[AMPTD] Range [0] dBm**
Set the demodulation parameters to match the signal (Figure 4).	**[Meas Setup] > Preset to Standard > 802.11a/g OFDM**
Select a display, then auto scale it.	**[Trace/Detector] > Select Trace > Trace 1 to 4** **[AMPTD Y Scale] > Auto Scale**

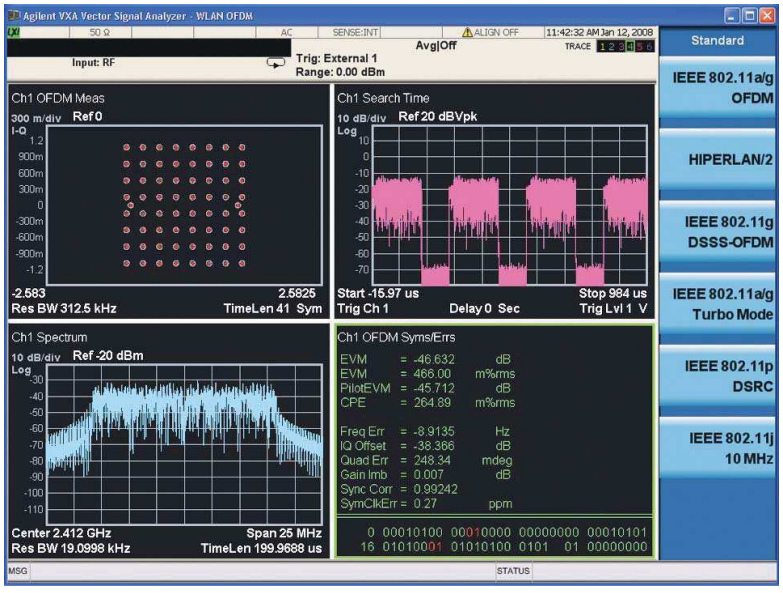

Figure 4. 802.11g WLAN OFDM modulation analysis in default quad view: Trace 1 (upper left), IQ constellation; Trace 2 (lower left), spectrum; Trace 3 (upper right), search time, Trace 4 (lower right), Symbol/error table with demod bits

Specifications

WLAN modulation analysis (Option B7R)

These specifications summarize the performance for the N9020A MXA signal analyzer with 89601X-205, 333, and B7R installed. Unless otherwise stated, these specifications are typical values, and are not warranted. Please refer to the MXA signal analyzer data sheet and specification guide for spectrum analysis performance. (Note: Please refer to the VXA technical overview, 5989-7463EN, for more information on Option 205, Basic VSA-Lite.)

Note that the EXA with Option B25 is supported but not specified for use with VXA Option B7R.

IEEE 802.11a/g OFDM	**N9020A MXA[1]**
Accuracy	20 averages, input range ≥ -30 dBm, within 2 dB of full scale, input range ≥ -20 dBm for frequency > 3.6 GHz
Center frequency	2.4 GHz, 5.8 GHz
Residual EVM	
Equalizer training = chan. Est. seq. and data	≤ -45 dB
Equalizer training = chan. Est. seq.	≤ -43 dB
Frequency error	
Carrier spacing	312 kHz 1.4 MHz max. user settable
Lock range	±624 kHz ±2 x sub-carrier spacing
Frequency accuracy	±8 Hz

IEEE 802.11b/g DSSS	**N9020A MXA**
Accuracy	Total power within 2 dB of full scale
Center frequency	2.4 GHz
Residual EVM	≤1.5% ≤0.5% with equalizer enabled; reference filter = transmitter filter = Gaussian with BT 0.5
Frequency error	Relative to frequency standard
Lock range	±2.5 MHz
Frequency accuracy	±8 Hz

1. Option BBA BBIQ inputs are not specified for use.

Ordering Information

VXA measurement application

Your Agilent VXA measurement application must include Option 205 Basic VSA-Lite and Option 333 X-Series connectivity at your initial order. You may order it to be installed when you order an X-Series analyzer, or you may order it separately to install yourself.

- First, order the 89601X vector signal analyzer measurement application for the X-Series analyzer. Note, this is a $0 item and is **required for all orders**.
- Second, choose the license terms you would like:

  89601XFP - Fixed, perpetual license: This allows you to run the application in the X-Series analyzer in which it is initially installed.

  89601XTP - Transportable, perpetual license: This allows you to run the application in the X-Series analyzer in which it is initially installed, and it may be transferred from one X-Series analyzer to another (MXA/EXA).

- Finally, choose your options:

Try before you buy!

FREE 14 day trials of X-Series measurement applications, including the VXA application with Option B7R, are available and provide unrestricted use of each application's features and functionality.

Redeem a trial license today for your existing X-Series analyzer on-line at **www.agilent.com/find/xseries_trial**

X-Series signal analyzer

For further information, refer to MXA Configuration Guide, 5989-4943EN and to the EXA Configuration Guide, 5989-6513EN.

Note: The EXA signal analyzer with Option B25 is supported but not specified for use with Option B7R.

Option number	Details	Notes
-205	Basic VSA-lite	**Required at initial order**. Once installed, it is not required to order this option when adding options to your VXA signal analyzer in the future.
-333	X-Series analyzer connectivity	**Required at initial order.** Once installed, it is not required to order this option when adding options to your VXA signal analyzer in the future.
-AYA	Vector modulation analysis	Optional. May be ordered at initial purchase or added later. See the *Option AYA Vector Modulation Analysis Option Technical Overview and Demo Guide*, literature number 5989-7464EN.
-B7R	WLAN modulation analysis	Optional. May be ordered at initial purchase or added later. See the *Option B7R WLAN Modulation Analysis Option Technical Overview and Demo Guide*, literature number 5989-7465EN. Note, Option B25 is recommended for the X-Series analyzers.

Example 1. Initial order for a VXA with vector modulation analysis, fixed perpetual license.
89601X vector signal analyzer measurement application for the X-Series analyzer ***(required)***
89601X**F**P-205 Basic VXA-lite **(required)**
89601X**F**P-333 X-Series analyzer connectivity **(required)**
89601X**F**P-AYA Vector modulation analysis

Example 2. Upgrade order, to add WLAN modulation analysis to the above unit in example 1.
89601X vector signal analyzer measurement application for the X-Series analyzer ***(required)***
89601X**F**P-B7R WLAN modulation analysis

Example 3. Initial order for a basic VXA, with a transportable, perpetual license.
89601X vector signal analyzer measurement application for the X-Series analyzer ***(required)***
89601X**T**P-205 Basic VXA-lite **(required)**
89601X**T**P-333 X-Series analyzer connectivity **(required)**

Example 4. Upgrade order, to add vector modulation analysis and WLAN modulation analysis to the unit in example 3.
89601X vector signal analyzer measurement application for the X-Series analyzer ***(required)***
89601X**T**P-AYA Vector modulation analysis
89601T**T**P-B7R WLAN modulation analysis

For the latest information, go to **www.agilent.com/find/VXA**

Related Literature

Publication title	Pub number
Agilent MXA Signal Analyzers	
Agilent MXA Signal Analyzer Brochure	5989-5047EN
Agilent MXA Signal Analyzer N9020A Data Sheet	5989-4942EN
Agilent MXA Signal Analyzer N9020A Configuration Guide	5989-4943EN
MXA Signal Analyzer Option BBA: Analog Baseband IQ Inputs Technical Overview	5989-6538EN
Agilent EXA Signal Analyzers	
Agilent EXA Signal Analyzer Brochure	5989-6527EN
Agilent EXA Signal Analyzer N9010A Data Sheet	5989-6529EN
Agilent EXA Signal Analyzer N9010A Configuration Guide	5989-6531EN
Agilent X-Series Signal Analyzers (MXA/EXA)	
Agilent X-Series Signal Analyzers (MXA/EXA) Demonstration Guide	5989-6126EN
X-Series Signal Analyzer Measurement Applications Overview	5989-8019EN
EMI Precompliance Measurements Using the X-Series Signal Analyzers (MXA/EXA)	5990-3690EN
N9063A Analog Demodulation Measurement Application Technical Overview	5989-6535EN
N9069A Noise Figure Measurement Application Technical Overview	5989-6536EN
N9068A Phase Noise Measurement Application Technical Overview	5989-5354EN
N9051A Pulse Measurement Software Technical Overview	5990-3801EN
N9073A-2FP HSDPA/HSUPA Measurement Application *N9073A-XFP Single Acquisition Combined W-CDMA Measurement Application* *Agilent X-Series Signal Analyzers (MXA/EXA) Technical Overview*	5989-5352EN
N9075A 802.16 OFDMA Measurement Application *Agilent X-Series Signal Analyzers (MXA/EXA) Technical Overview*	5989-5353EN
Agilent X-Series Signal Analyzers (MXA/EXA) GSM with EDGE Measurement Application (N9071A) Technical Overview	5989-6532EN
Agilent X-Series Signal Analyzers (MXA/EXA) N9071A-3FP EDGE Evolution Measurement Application Flyer	5989-9837EN
N9072A cdma2000 and N9076A 1xEV-DO Measurement Applications Technical Overview	5989-6533EN
N9079A TD-SCDMA Measurement Application Technical Overview	5989-6534EN
N9080A LTE Measurement Application Technical Overview	5989-6537EN
Single Acquisition Combined WLAN Measurement Application Technical Overview	5990-3519EN
Single Acquisition Combined Fixed WiMAX Measurement Application Technical Overview	5990-3520EN
Breakthrough High-Speed Manufacturing Solutions for X-Series Signal Analyzers	5990-3521EN
DVB-T/H Measurement Application Technical Overview	TBD
DTMB Measurement Application Technical Overview	TBD
N9061A Remote Language Compatibility (RLC) Application Technical Overview	5989-6539EN
Speed Enhancement and Removable Hard Drive for the X-Series Signal Analyzers (MXA/EXA)	5989-6541EN
Using the Agilent MXA Signal Analyzer for Measuring and Troubleshooting Digitally Modulated Signals Application Note 1585	5989-4944EN
X-Series Signal Analyzer (MXA/EXA) Preselector Tuning for Amplitude Accuracy in Microwave Spectrum Analysis Application Note 1586	5989-4946EN
Maximizing Measurement Speed with Agilent's X-Series Signal Analyzers Application Note 1583	5989-4947EN
Making Precompliance Conducted and Radiated Emissions Measurements with Option EMC for the X-Series Signal Analyzers (EXA/MXA) Application Note	5990-3133EN
Agilent VXA Vector Signal Analyzer Measurement Application	
89601X VXA Vector Signal Analyzer Measurement Application Options 205 Basic VXA-Lite Option 333 X-Series Analyzer Connectivity Technical Overview	5989-7463EN
89601X VXA Vector Signal Analyzer Measurement Application Option AYA Vector Modulation Analysis Technical Overview	5989-7464EN
89601X VXA Vector Signal Analyzer Measurement Application Option B7R WLAN (802.11a/b/g) Modulation Analysis Technical Overview	5989-7465EN

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LXI

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Revised: October 6, 2008

Product specifications and descriptions in this document subject to change without notice.

Printed in USA, March 25, 2009
5989-7465EN

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