Keysight Technologies

VMA Vector Modulation Analysis
X-Series Measurement Application, Multi-Touch

N9054C

Technical Overview

- Perform standard-based and flexible digital demodulation analysis
- Multiple result traces and modulation quality results
- Spectrum measurements (monitor spectrum, channel power, OBW, CCDF, ACP, SEM and spurious)
- Multi-touch interface and SCPI remote interface
- Built-in, context-sensitive help
- Extend test assets with a transportable license between X-Series signal analyzers with multi-touch UI

KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

VMA Vector Modulation Analysis Measurement Application

The VMA vector modulation analysis measurement application transforms the X-Series signal analyzers with multi-touch into vector signal analyzers by providing a wide range of measurements, digital 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

X-Series measurement applications increase the capability and functionality of Keysight Technologies, Inc. signal analyzers to speed time to insight. They provide essential measurements for specific tasks in general-purpose, cellular communications, wireless connectivity applications, covering established standards or modulation types. Applications are supported on both benchtop and modular, with the only difference being the level of performance achieved by the hardware you select.

Flexible digital modulation analysis

The flexible digital modulation analysis 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:

- Support time domain measurement as I/Q waveform, spectrum measurement as monitor spectrum and modulation quality measurement as digital demod
- Customize modulation analysis formats including: 2-16 FSK, BPSk, QPSK, 8PSK, 16-1024QAM, MSK, ASK, APSK, VSB etc.
- A complete set of measurement traces and modulation quality results, including raw main time, I/Q measurement time, I/Q measurement spectrum, EVM vs. symbol time, EVM spectrum, constellation, channel frequency response, EQ impulse response, EVM average/peak, magnitude error, phase error, frequency error, clock error, I/Q offset, SNR, quadrature error, gain imbalance, Rho and demod bits
- Convenient measurement preset to cover popular formats, including NADC, EDGE, PDC, PHS, DVB (16/32/64/256QAM), TETRA, APCO-25, DMR, dPMR, WiSUN (MR-FSK PHY), DECT, VDL Mode 2, MIL-STD CPM and SOQPSK-TG

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.

Top Features

Visualize custom QPSK modulation analysis

Figure 1 shows QPSK modulation analysis with 1 MSa/s symbol rate, raised cosine filter alpha as 0.5. Modulation quality results are shown in quad view layout:

- Upper left: IQ constellation
- Lower left: spectrum
- Upper right: error vector magnitude versus time (symbol) trace
- Lower right: demod results table

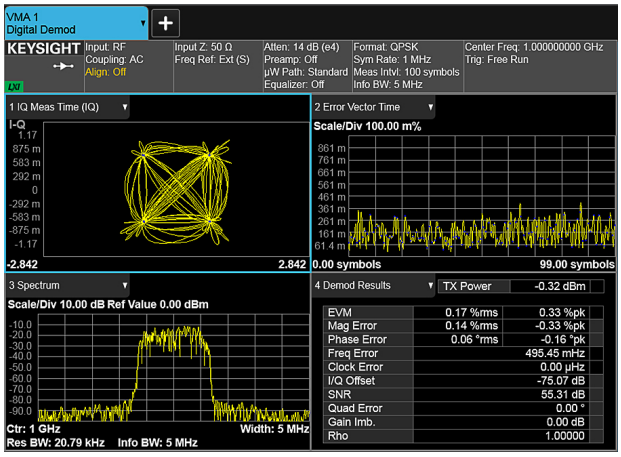

Figure 1.

I/Q waveform RF envelope analysis

Figure 2 shows the I/Q waveform RF envelope measurement. Meas time, sample rate etc. parameters are settable and the measurement results like Mean power, Pk-To-Mean ratio, Max power and Min power are shown at the bottom of the screen.

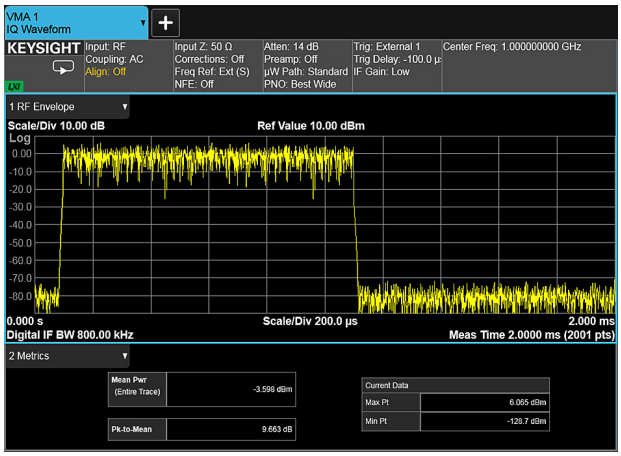

Figure 2.

Monitor spectrum

Figure 3 shows the spectrum measurement with monitor spectrum, which uses signal analyzer sweep mode with marker function band power turning on. Other spectrum measurements are also available like channel power, OBW, CCDF, ACP, SEM and spurious measurements.

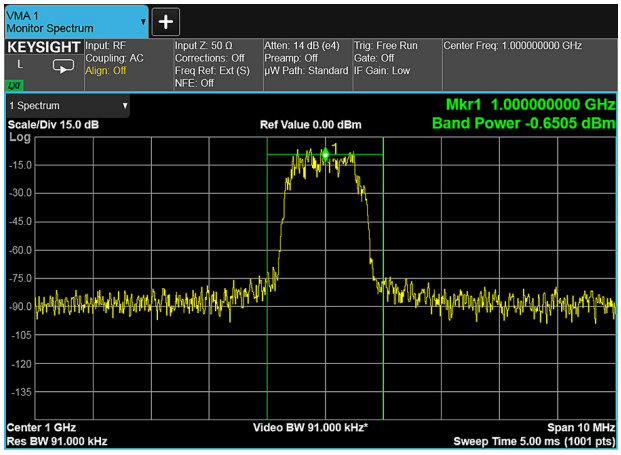

Figure 3.

APCO-25 modulation analysis

Figure 4 shows the modulation quality measurement for APCO-25 standard which is one of the more than 20 preset standards included in N9054C. It shows a 2X2 layout with trace results:

- Constellation (upper left),
- Raw main time (upper right)
- Spectrum (lower left)
- Demod results (lower right)

Other trace results available can be chosen from the pop-up menu in each trace window.

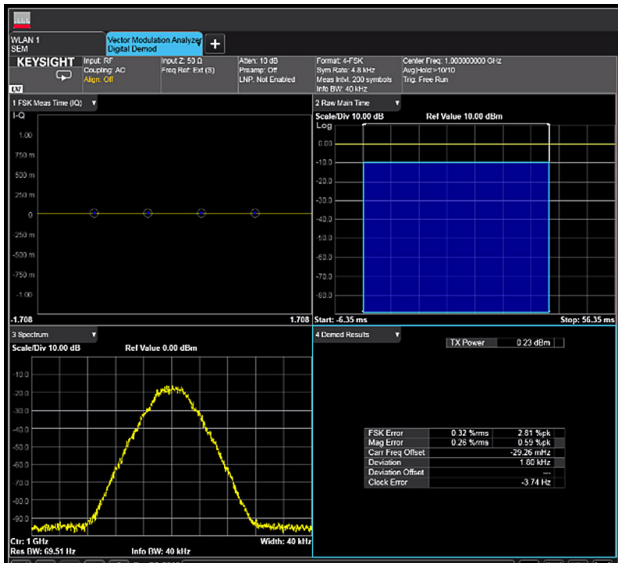

Figure 4.

Adjacent Channel Power (ACP)

Figure 5 shows the ACP measurement for a digital modulated signal.

- ACP measurement metrics (upper window)
- ACP measurement graph (lower window with Total carrier power, Lower and Upper ACP results vs. Reference carrier in both dBm and dBc formats)

Limit test is supported with Pass/Fail tag shown on the left top of the column.

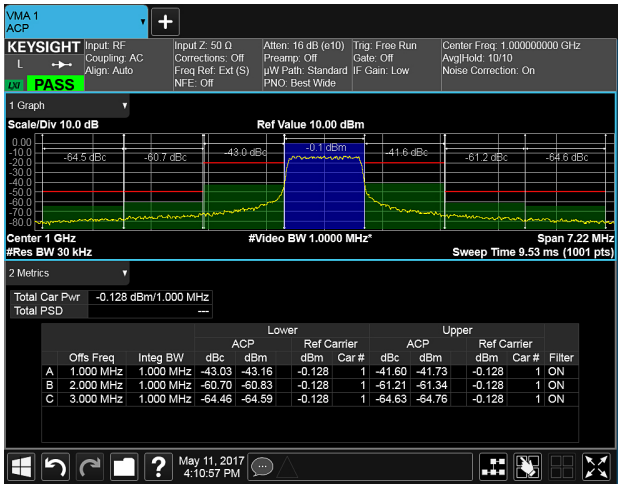

Figure 5.

Power stat CCDF

Figure 6 shows the Power Stat CCDF measurement for a digital modulated signal.

- CCDF measurement metrics (left window with average power, power level from 10% to 0.0001% probability, peak power ratio to average power and Peak power in dBm)
- CCDF measurement graph (right window, result trace in yellow color with Gaussian as reference trace in blue color)

Info BW, Counts, Measure Cycles and Meas Interval should be correctly configured to get the correct results.

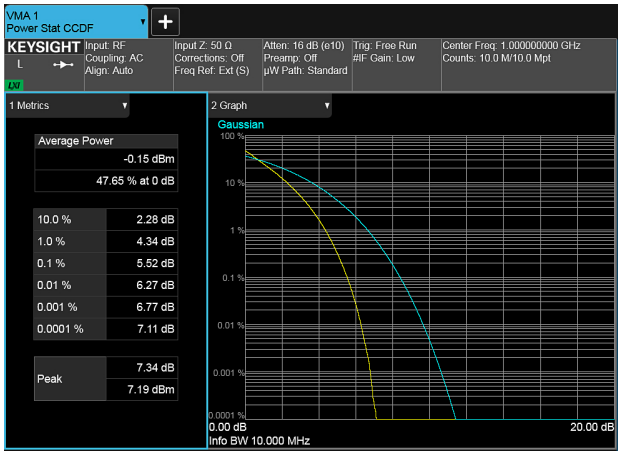

Figure 6.

Key Features of Digital Modulation Analysis

Standard Presets (for single carrier)	
Cellular	NADC, EDGE, PDC, PHS (PHP)
Wireless networking	Wi-SUN (802.15.4g MR-FSK)
Digital video	ATSC 8/16VSB, DVB (16, 32, 64, 128, 256QAM)
Radio	APCO-25 (C4FM/CQPSK, HCPM, HDQPSK), TETRA, DMR, dPMR
Other	DECT, VDL Mode 2, MIL-STD CPM (188-181C), SOQPSK-TG
Modulation Formats	
FSK	2, 4, 8, 16 level
	MSK (Type1, Type2)
PSK	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
APSK	16, 32
VSB	8, 16
ASK	2-ASK
Filter types	Raised cosine, square-root raised cosine, Gaussian, EDGE, 1REC, 3RC, 4RC, APCO-25 P2 RC, SOQPSK-TG, low pass, rectangular, half-sine, user-defined, none
Alpha/BT	Continuously adjustable alpha from 0.05 to 1, and BT from 0.05 to 100
Symbol rate	Rate = Frequency span / (1+α); maximum symbol rate limited only by the measurement span
Equalizer	Equalizer On/Off, filter length, convergence, hold On/Off
FFT window	Flattop, gaussian, hanning, uniform
Optimization	Phase noise optimization (Best close-in noise, Best-wide offset Phase noise, Fast tuning), Gain imbalance/quad skew, Coupling on/off, Clock adjust, I/Q normalize on/off, Low SNR enhancement on/off
Constellation state setting	User-friendly graph definition for constellation state
Limit test	Tx power, RMS EVM, frequency error, clock error settings for limit
Measurement symbols	Up to 500,000 symbols
Advanced analysis setup	Burst search Sync search (with user-selected synchronization word) Adjustable search length and offset timing
Measurements/displays	Monitor spectrum RF envelope I/Q waveform Raw main time Search time Spectrum measurements (channel power, occupied BW, ACP, SEM, CCDF and spurious) I/Q meas time I/Q ref time I/Q meas spectrum I/Q ref spectrum Error vector time Error vector spectrum Mag error Phase error Demod results (EVM, SNR, freq error, clock error, SNR, quad error, gain imbalance, RHo) Demod bits Channel frequency response EQ impulse response

Key Specifications

Definitions

– All of the values shown below are nominal. These values indicate expected performance, or describe product performance that is useful in the application of the product.

Note: Data subject to change.

This section contains specifications for the N9054C Vector Modulation Analysis Measurement Application, which support PSK formats: BPSK, QPSK, Offset QPSK, Shaped OQPSK, DQPSK, π/4 DQPSK, 8-PSK, π/8 D8PSK, D8PSK; QAM formats: 16/32/64/128/256/512/1024-QAM; FSK formats: 2/4/8/16-FSK; MSK formats: MSK Type 1, MSK Type 2; ASK formats: 2-ASK; APSK formats: 16/32 APSK; VSB formats: 8/16-VSB; others: CPM (FM), EDGE.

Accuracy, nominal		**UXA**	**PXA**	**MXA**	**EXA**	**CXA**
Condition		Modulation formats include BPSK, QPSK, DQPSK, π/4 DQPSK, 8-PSK, π/8 D8PSK, D8PSK, 16/32/64/128/256/512/1024-QAM; Center Frequency = 1 GHz; Transmit filter is RRC with α = 0.35; Result length set to at least 150 symbols, or 3 × Number of ideal constellation states; Average number = 10.				
Residual errors	Symbol rate[1]					
Residual EVM	1 MSa/s	0.50%	0.50%	0.70%	0.70%	0.70%
	10 MSa/s	0.50%	0.50%	0.70%	0.70%	0.70%
	25 MSa/s	0.50%	0.50%	1.10%	1.10%	N/A
	100 MSa/s	0.50%	0.50%	1.30%	N/A	N/A
Condition		Modulation formats include MSK Type 1 and MSK Type 2; Center Frequency = 1 GHz; Transmit filter is Gaussian with BT = 0.3; Result length set to 150 symbols; Average number = 10.				
Residual errors	Symbol rate[1]					
Residual EVM	10 MSa/s	0.50%	0.50%	0.90%	0.90%	1.00%
	80 MSa/s	1.40%	1.40%	1.80%	N/A	N/A
Condition		Modulation formats include 8-VSB and 16-VSB; Transmit filter is RRC with α = 0.115; Center Frequency < 3.6 GHz; Result length = 800; Average number = 10.				
Residual errors	Symbol rate[1]					
	10.762 MHz	1.50% (SNR 36 dB)	1.50% (SNR 36 dB)	1.50% (SNR 36 dB)	1.50% (SNR 36 dB)	1.50% (SNR 36 dB)

1. Supportable symbol rate is dependent on the analyzer hardware bandwidth option.

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

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

Software Licensing and Configuration

Choose from two license types:

- Fixed, perpetual license:
  This allows you to run the application in the X-Series analyzer in which it is initially installed.
- Transportable, perpetual license:
  This allows you to run the application in the X-Series analyzer in which it is initially installed, plus it may be transferred from one X-Series analyzer to another.

You Can Upgrade!

Options can be added after your initial purchase.

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

UP GRADE

The table below contains information on our fixed, perpetual licenses. For more information, please visit the product web pages.

N9054C Vector modulation analysis measurement application

Model-Option	Description
N9054C-1FP	Vector modulation analysis measurement application, fixed perpetual
N9054C-1TP	Vector modulation analysis measurement application, transportable perpetual

Hardware Configuration

For vector modulation analysis measurements, Keysight recommends a minimum level of X-Series multi-touch instrument hardware functionality at each instrument performance point.

Supported instruments include:

- UXA N9040B
- PXA N9030B
- MXA N9020B
- EXA N9010B
- CXA N9000B

Capability	Instrument Option	Benefit
Analysis bandwidth	25 MHz minimum (-B25) or wider.	**Required:** based on bandwidth of signal under test
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 up to instrument maximum RF frequency as available	**Recommended:** For maximizing the measurement sensitivity
Microwave preselector bypass option	-MPB	**Required:** For measurements > 3.6 GHz
Real-time spectrum analysis	-RT1 or -RT2	**Required:** For real-time spectrum analysis. Maximum bandwidth varies by instrument.

Additional Information

Web

Product page:
www.keysight.com/find/N9054C

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

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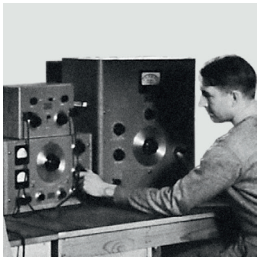

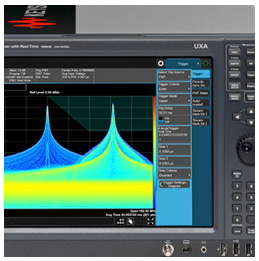

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Published in USA, December 1, 2017
5992-2250EN
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