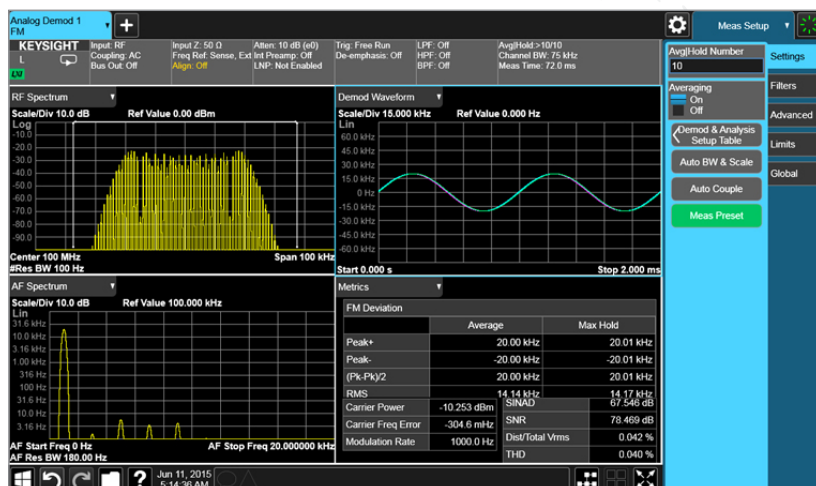


Analog Demodulation X-Series Measurement App, Multi-Touch UI

N9063EM0E

- Accelerate measurements with one-button AM, FM, PM and FM stereo signals
- Visualize multiple, simultaneous displays of RF spectrum, demodulated waveforms, AF spectrum, demodulation metrics, and transient events such as attack/release time
- Analyze FM stereo signals for MPX, mono, stereo, channel characterization, and RDS/RBDS decoding
- Use multi-touch interface and SCPI remote interface
- Flexible licensing provides the option of using perpetual or time based licenses with one or multiple signal analyzers
- Smooth migration from 8901A/B modulation analyzers



Analog Demodulation Measurement Application

The analog demodulation measurement application transforms the X-Series signal analyzer into an easy-to-use transmitter tester for analog modulated signals, including AM, FM, PM, and FM stereo. By adding fast, one-button measurements, the analog demodulation measurement application helps you design, evaluate, and manufacture your analog devices quickly and accurately. Even in the modern digital world, the analog demodulation measurement application helps you to troubleshoot distortions due to unintentional, analog modulation from digitally-modulated transmitters -- allowing you to stay on the leading edge of your design and manufacturing challenges.

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.

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).



Top Features

Visualize multiple displays simultaneously

Easily customize a multiple window display. One example is shown on the right. The FM measurement provides the capability of demodulating the frequency modulated signal and displaying the metrics results in graph and table simultaneously.

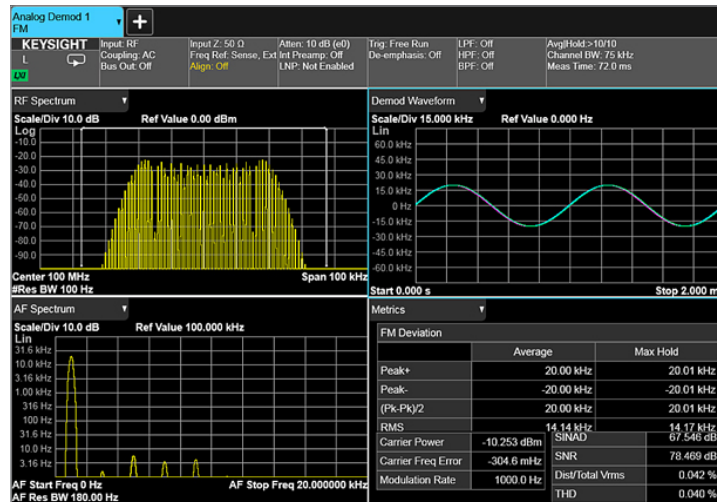


Figure 1. The quad view presents the demodulation metrics results in graph and table simultaneously.

Monitor RF spectrum

This is the most traditional spectrum analyzer measurement viewing the modulated carrier signal power in frequency domain. Prior to being modulated, the signal power of a sinusoidal carrier concentrates at the carrier frequency. By contrast, modulation causes sidebands indicating the power redistribution over frequencies. The pattern of the sidebands depends upon the modulation format. (Refer to Figure 2.)

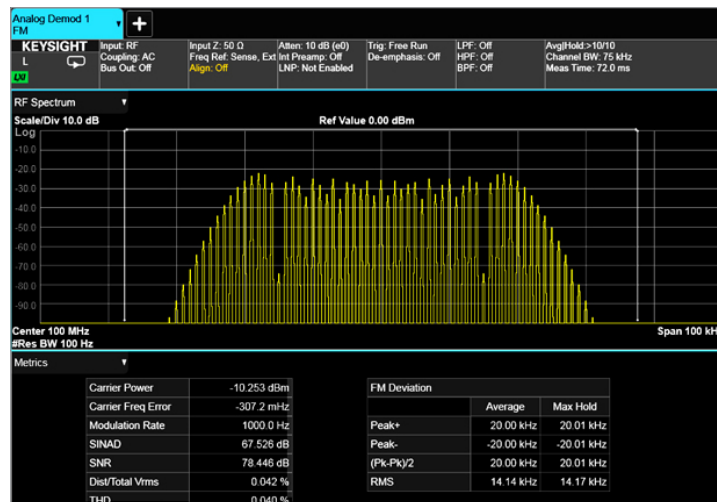


Figure 2. The RF spectrum view presents the modulated signal along with the results of demodulation.

Demod waveform and AF spectrum

This measurement retrieves the baseband signal from the modulated signal via the demodulation process, and displays the baseband signal in a pattern of modulation depth/deviation versus time. Because the modulation depth/deviation is directly proportional to the instantaneous amplitude of the baseband signal, the measurement result helps to intuitively evaluate the quality of the baseband signal. (Refer to Figure 3.)

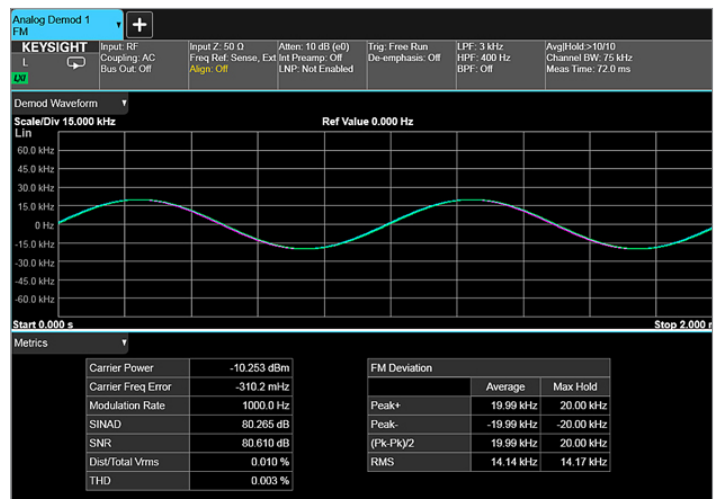


Figure 3. The demod waveform view displays the baseband signal in time domain.

AF spectrum view

By applying the fast Fourier transform (FFT) to the baseband waveform, AF spectrum demonstrates the baseband signal behaviors in frequency domain graphically. This measurement reveals the distortion of the baseband signal clearly just as the RF spectrum does for the RF signal. (Refer to Figure 4.)

Modulation metrics

Besides the frequency domain and time domain view of analog modulation signals, one of the most important features of this application is numeric result that demonstrates the modulation parameters and error information. For AM signal, the AM depth, modulation rate and distortions like SINAD will be displayed in metrics view; for FM/PM signal, the FM deviation/PM deviation, carrier frequency error and distortions will be displayed. (Refer to Figure 4.)

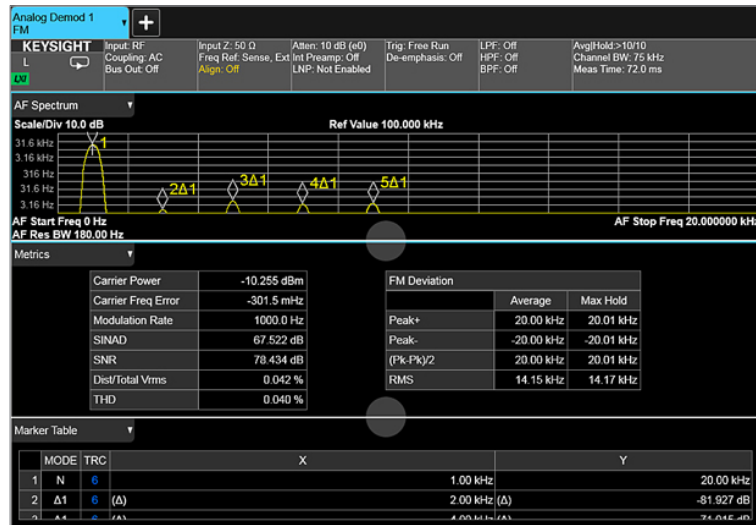


Figure 4. AF spectrum view with table facilities.

Post-demod filters

The post-demod filters help you to optimize the measurement results by filtering out undesired signals such as harmonics, noise, and spurs from the demodulated signal. You may choose a high-pass filter (20, 50, 300, or 400 Hz), and/or a lowpass filter (300 Hz or 3, 15, 30, 80, 100, 300 kHz, or any other user defined) from the available post-demod filter bank to achieve the best demodulation results. (Refer to Figure 5.) For example, applying an appropriate low-pass filter helps minimize overshoot from square-wave modulation, such as frequency shift keying (FSK).

Additionally, a CCITT filter, which simulates the frequency response behavior of the human auditory system, is also available to help you evaluate the consequences of distortion of the demodulated signal from the human hearing perspectives. The filter bank also allows you to select from various other filters to optimize your measurements and comply with certain regulatory standards. These filters include:

- A-weighte
- C-weighted
- C-message
- CCIR-1k weighted
- CCIR-2k weighted
- CCIR unweighted
- SIAND notch
- Signaling notch filters

To accommodate your pre-emphasized FM signals, the N9063EM0E is also equipped with four separate de-emphasis filters (25, 50, 75, and 750 μ s) for you to select from.

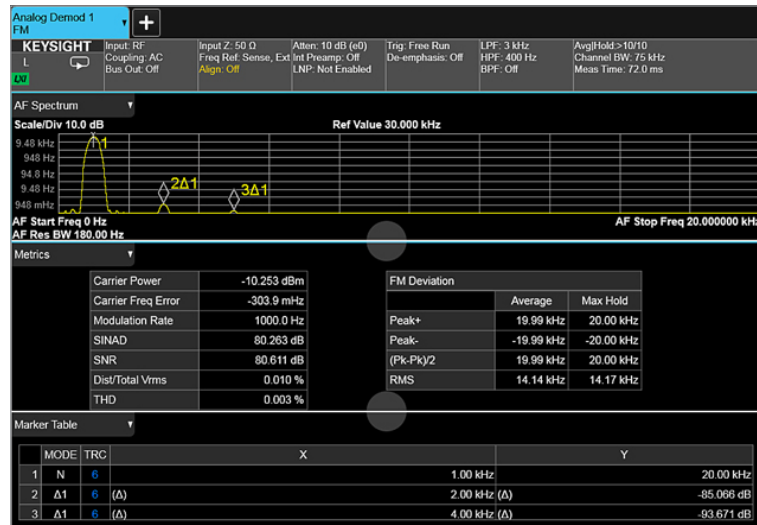


Figure 5. Apply the “post-demod” filters to optimize analysis results for the baseband (AF) spectrum.

Quantify the transient events with "Transient Analysis" view

Transient Analysis view is a new view type for measuring transient events, such as "attack" (transmitter turn-on), "release" (transmitter turn-off), and VCO settling characteristics. The upper display is RF Envelope (magnitude) versus time; the lower display is FM Demod Waveform (frequency) versus time. Transient measurements are single-shot, and require an External trigger edge to establish time t=0 (e.g. from the PTT button).

Certain measurements from TIA-603 - such as Carrier Attack Time, Transient Frequency Behavior, and Encoder Response Time - are much easier to make with this new view. The view can be used for general amplitude and frequency transient or settling measurements. And transmitters that use FM or FSK in a burst can also be captured and measured, with RF Burst trigger.

The view supports long post-demod waveforms, storing a post-demod FM Waveform up to 3.6 M samples (previously limited to 1001 pts.); this data is available for query via SCPI. Additionally, limit lines for FM Waveform can be imported from customer-defined CSV files and displayed.

The InfoBW control allows the user to trade off the bandwidth of the measurement (frequency range of demod) with the noise in the frequency measurement. Figure 6, the "Attack/Release view", captures the transient events in time domain when the modulation starts and the carrier power switches to different levels.



Figure 6. "Transient Analysis" view helps quantify the transient events in time domain.

Analyze FM stereo/RDS signals

FM stereo is an enhancement to FM that uses stereo multiplexing. An FM stereo signal carries stereophonic programs in which signals are transmitted for L (left) and R (right) audio channels. Radio data system (RDS) consists of the text information such as traffic, weather, and radio station information carried in the FM signals. This information can be displayed on the screen of the end-user's device. RBDS is the United States version of RDS.

The N9063EM0E analog demodulation application supports FM stereo/RDS signal analysis with multiple views including MPX view, mono/stereo/left/right view, RDS/RBDS decoding results view and numeric result summary view.

Tune and listen

Listening to the demodulated signal through a speaker may give you more insights. Many experts and technicians can figure out the cause of a problem by hearing buzzing, humming, and/or clicking noises.



Figure 7. FM stereo MPX view/display with RF spectrum, AF spectrum, demod waveform and demodulation metrics results.

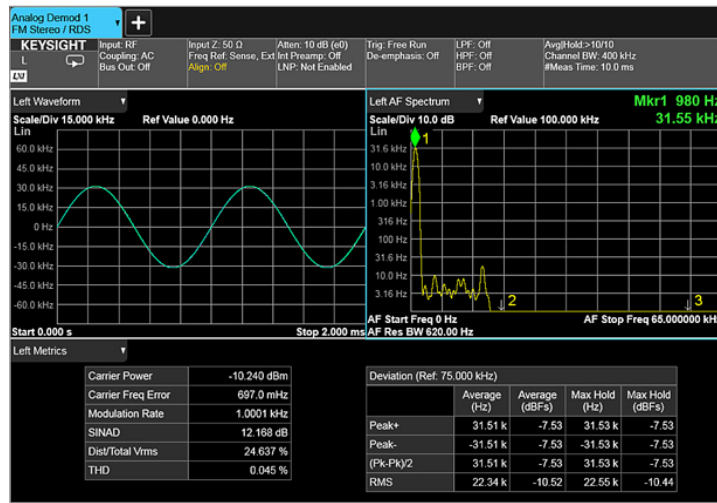


Figure 8. FM stereo mono/stereo/left/right view/display with demod waveform, AF spectrum and demodulation metrics results.

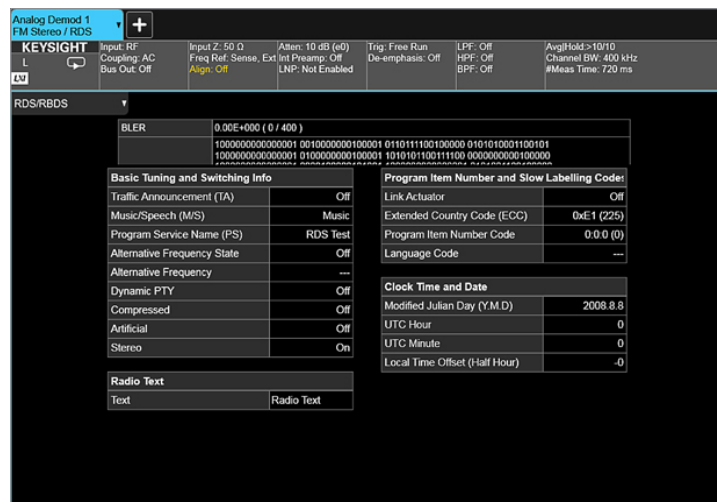


Figure 9. FM stereo RDS/RBDS decoding results view/display with BLER and decoded RDS information.

Measurement Summary

One-button measurements

All of these measurements are available on the X-Series signal analyzer with the press of a button. The measurements are fully remote controllable via the IEC/IEEE bus or LAN, using SCPI commands.

Measurement details

Technology	AM	PM	FM	FM stereo/RDS
Measurement				
RF spectrum	•	•	•	•
RF carrier power (dBm)	•	•	•	•
RF carrier freq error (Hz)		•	•	•
AF spectrum	•	•	•	MPX, mono, stereo, left, right
Demodulated waveform	•	•	•	MPX, mono, stereo, left, right
Demodulation	AM depth (%)	PM deviation (rad, deg)	FM deviation (Hz)	FM deviation (Hz)
– Peak+	•	•	•	•
– Peak-	•	•	•	•
– (Pk-Pk)/2	•	•	•	•
– RMS	•	•	•	•
Modulation rate (Hz)	•	•	•	•
SINAD (dB)/SNR (dB)	•	•	•	•
THD (dB or %)	•	•	•	•
Distortion/total power (dB or %)	•	•	•	•
Total power	•			
Left to right ratio (dB)				•
Mono to stereo ratio (dB)				•
38 kHz carrier power (dB)				•
38 kHz freq error (Hz)				•
RDS/RBDS decoding				•
BLER				•
Radio text				•
Attack/release time			•	
Long capture (3.6 MSa)	•	•	•	•

Key Specifications

- Specifications describe the performance of parameters covered by the product warranty. Warranted specifications apply over an operating temperature range of 20 to 30 °C; and mixer level –24 to –18 dBm (mixer level = Input power level – Attenuation). Additional conditions are listed in specification tables, or in footnotes.
- 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.

Note: Data subject to change.

The following table provides analog demodulation specifications apply to the UXA N9040B Band 0 (up to 3.6 GHz) unless otherwise noted. For other X-Series signal analyzer specifications please refer to the links at the end of this section.

Description	N9040B UXA signal analyzer
FM demodulation	
FM deviation accuracy ^{1,2,3} 0.2 ≤ Modulation Index ≤ 1000 Modulation Index ≥ 1000	$\pm(0.3\% \times \text{Reading} + 0.1\% \times \text{Rate})$ $\pm(0.35\% \times \text{Reading})$
FM rate accuracy ⁴ 0.2 ≤ Modulation Index < 10 Modulation Index ≥ 10	$\pm(0.006\% \times \text{Reading}) + rfa$ $\pm(0.002\% \times \text{Reading}) + rfa$
Carrier frequency error ^{5,6} (Modulation index ≤ 100)	$\pm(2 \text{ ppm} \times \text{Deviation} + 50 \text{ ppm} \times \text{Rate}) + tfa$
Post-demod distortion residual ⁷	
Distortion (SINAD) ⁸	$0.4\% / \sqrt{\text{ModIndex}} + 0.04\%$
THD	$0.32\% / \sqrt{\text{ModIndex}}$
Post-demod distortion accuracy (Rate: 1 to 10 kHz, Modulation index: 0.2 to 100)	
Distortion	$\pm(2\% \text{ of reading} + \text{DistResidual})$
THD	$\pm(2\% \text{ of reading} + \text{DistResidual})$ (2nd and 3rd harmonics)
AM rejection ⁹	2.8 Hz
Residual FM ¹⁰	1.2 Hz (rms)

1. This specification applies to the result labeled “(Pk-Pk)/2”.
2. For optimum measurement, ensure that the channel bandwidth is set wide enough to capture the significant RF energy. Setting the channel bandwidth too wide will result in measurement errors.
3. Reading is a measured frequency peak deviation in Hz, and Rate is a Modulation Rate in Hz.
4. Reading is a measured modulation rate in Hz.
5. tfa = transmitter frequency x frequency reference accuracy
6. Deviation is a frequency peak deviation in Hz, and Rate is a modulation rate in Hz.
7. For optimum measurement, ensure that the channel bandwidth is set wide enough to capture the significant RF energy. Setting the channel bandwidth too wide will result in measurement errors.
8. SINAD [dB] can be derived by $20 \times \log_{10}(1/\text{Distortion})$.
9. AM rejection describes instruments FM reading for an input that is strongly AMed (with no FM); this spec includes contribution from residual FM. AM signal (Rate = 1 kHz, Depth = 50%), HPF = 50 Hz, LPF = 3 kHz, Channel BW = 15 kHz
10. Residual FM describes instruments FM reading for an input that has no FM and no AM; this spec includes contribution from FM deviation accuracy. HPF = 50 Hz, LPF = 3 kHz, Channel BW = 15 kHz

Description	N9040B UXA signal analyzer
AM demodulation	
AM depth accuracy ^{1,2}	$\pm(0.1\% \text{ of reading} + 0.07\%)$
AM rate accuracy ^{3,5} (Rate: 1 kHz to 100 kHz)	$\pm\left((2.5 \text{ ppm of reading}) \times \left(\frac{100\%}{\text{Depth}}\right)\right) + rfa$
Post-demod distortion residual	
Distortion (SINAD) ⁴	$0.1\% \times \left(\frac{100\%}{\text{Depth}}\right) + 0.02\%$
THD	$0.015\% \times \left(\frac{100\%}{\text{Depth}}\right) + 0.05\%$
Post-demod distortion accuracy (Rate: 1 to 10 kHz, Depth: 5 to 90%)	
Distortion	$\pm(1\% \text{ of reading} + \text{DistResidual})$
THD	$\pm(1\% \text{ of reading} + \text{DistResidual})$ (2nd and 3rd harmonics)
FM rejection ⁶	0.04%
Residual AM ⁷	0.02% (rms)

1. This specification applies to the result labeled "(Pk-Pk)/2".
2. Reading is a measured AM depth in %, and Rate is a Modulation Rate in Hz.
3. Reading is a modulation rate in Hz and Depth is in %.
4. SINAD [dB] can be derived by $20 \times \log_{10}(1/\text{Distortion})$.
5. rfa = Modulation Rate \times Frequency reference accuracy.
6. FM rejection describes instruments AM reading for an input that is strongly FMed (with no AM); this spec includes contribution from residual AM. FM signal (Rate = 1 kHz, Deviation = 50 kHz), HPF = 300 Hz, LPF = 3 kHz, channel BW = 420 kHz
7. Residual AM describes instruments AM reading for an input that has no AM and no FM; this spec includes contribution from AM depth accuracy. HPF = 300 Hz, LPF = 3 kHz, channel BW = 15 kHz

Description	N9040B UXA signal analyzer
PM demodulation	
PM deviation accuracy ^{1,2,3} (Rate : 100 Hz to 50 kHz)	$\pm(0.1\% \times \text{Reading} + 1 \text{ mrad})$
PM rate accuracy ^{2,4,12}	
Rate : $\leq 500 \text{ Hz}$	$\pm(0.004 \text{ Hz} / \text{Deviation}) + rfa$
Rate : $500 \text{ Hz} < \text{Rate} \leq 50 \text{ kHz}$	$\pm(0.03 \text{ Hz} / \text{Deviation}) + rfa$
Carrier frequency error ^{2,5,6}	$\pm(8 \text{ ppm} \times \text{Deviation} + 2 \text{ ppm}) \times \text{Rate} + tfa$
Post-demod distortion residual ⁷	
Distortion (SINAD) ^{8,9}	$0.2\% / \text{Deviation} + 0.01\%$
THD ⁹	$0.06\% / \text{Deviation} + 0.008\%$
Post-demod distortion accuracy (Rate: 1 to 10 kHz)	
Distortion	$\pm(2\% \text{ of reading} + \text{DistResidual})$
THD	$\pm(2\% \text{ of reading} + \text{DistResidual})$ (2nd and 3rd harmonics)
AM rejection ¹⁰	1.2 mrad (PM peak)
Residual FM ¹¹	0.6 mrad (rms)
FM stereo/RDS	FM stereo with 67.5 kHz reference deviation and 1 kHz modulation rate plus 6.75 kHz pilot deviation
SINAD (with A-Weighted filter)	69 dB nominal
SINAD (with CCITT filter)	71 dB nominal
Left to right ratio (with A-Weighted filter)	72 dB nominal
Left to right ration (with CCITT filter)	76 dB nominal

1. This specification applies to the result labeled "(Pk-Pk)/2".
2. For optimum measurement, ensure that the channel bandwidth is set wide enough to capture the significant RF energy. Setting the channel bandwidth too wide will result in measurement errors.
3. Reading is a measured peak deviation in radian.
4. Deviation is a peak deviation in radian.
5. Rate is a Modulation Rate in Hz.
6. tfa = transmitter frequency x frequency reference accuracy
7. For optimum measurement, ensure that the channel bandwidth is set wide enough to capture the significant RF energy. Setting the channel bandwidth too wide will result in measurement errors.
8. Deviation is a peak deviation in radian.
9. SINAD [dB] can be derived by $20 \times \log_{10}(1/\text{Distortion})$.
10. AM rejection describes instruments PM reading for an input that is strongly AMed (with no PM); this spec includes contribution from residual PM. AM signal (Rate = 1 kHz, Depth = 50%), HPF = 50 Hz, LPF = 3 kHz, Channel BW = 15 kHz
11. Residual PM describes instruments PM reading for an input that has no PM and no AM; this spec includes contribution from PM deviation accuracy. HPF = 50 Hz, LPF = 3 kHz, Channel BW = 15 kHz
12. rfa = Modulation Rate x Frequency reference accuracy.

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

UXA N9041B: <https://literature.cdn.keysight.com/litweb/pdf/N9041-90004.pdf>

UXA N9040B: 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

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.



Analog demodulation measurement application (N9063EM0E)

Software license type	Software license	Support subscription
Node-locked perpetual	R-Y5C-001-A	R-Y6C-001- Z ²
Node-locked time-based	R-Y4C-001-Z ¹	Included
Transportable perpetual	R-Y5C-004-D	R-Y6C-004- Z ²
Transportable time-based	R-Y4C-004- Z ¹	Included
Floating perpetual	R-Y5C-002-B	R-Y6C-002- Z ²
Floating time-based	R-Y4C-002- Z ¹	Included
USB portable perpetual	R-Y5C-005-E	R-Y6C-005- Z ²
USB portable time-based	R-Y4C-005- Z ¹	Included

Try Before You Buy!

Evaluate a full-featured version of our X-Series measurement application with our **FREE** trial. Redeem one 30-day trial license of each measurement application online at: www.keysight.com/find/X-Series_apps_trial

One-month software support subscription extension³

Support subscription	Description
R-Y6C-501	1-month of support subscription for node-locked perpetual license
R-Y6C-502	1-month of support subscription for floating perpetual license
R-Y6C-504	1-month of support subscription for transportable perpetual license
R-Y6C-505	1-month of support subscription for USB portable perpetual license

Hardware Configurations

To learn more about compatible platforms and required configurations, please visit: www.keysight.com/find/X-Series_apps_platform

Software Models and Options

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

1. z means different time-based license duration. F for six months, L for 12 months, X for 24 months, and Y for 36 months. All time-based licenses have included the support subscription same as the time-base duration.
2. z means different support subscription duration. L for 12 months (as default), X for 24 months, Y for 36 months, and Z for 60-months. Support subscription must be purchased for all perpetual licenses with 12-months as the default. All software upgrades and KeysightCare support are provided for software licenses with valid support subscription.
3. Support subscription for all perpetual licenses can be extended with monthly extensions.

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:

Benchtop:		PXI:	
- UXA	N9041B ¹	- PXIe VSA up to 6 GHz	M9391A
- UXA	N9040B	- PXIe VSA up to 50 GHz	M9393A
- PXA	N9030B		
- MXA	N9020B		
- EXA	N9010B		
- CXA	N9000B		

Capability	Instrument Option	Benefit
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	Recommended: For real-time spectrum analysis. Maximum bandwidth varies by instrument.
External Mixer	-EXM	Recommended: For mmWave measurement up to 110 GHz

1. Currently analog demodulation measurement application has only been qualified for UXA N9041B Input 1 Port.

Additional Information

Analog demodulation X-Series measurement app, multi-touch UI product webpage:

www.keysight.com/find/N9063E

Use *N/W9063A Analog Demodulation Measurement Application to Replace HP 8901 Modulation Analyzers*, application note, literature number 5991-4913EN.

X-Series measurement applications:

www.keysight.com/find/X-Series_Apps

X-Series signal analyzers:

www.keysight.com/find/X-Series

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:

www.keysight.com/find/contactus

