M8920A PXIe Radio Test Set

100 kHz to 3.8 GHz or 6 GHz

Introduction

- Generate and analyze AM, FM, PM, and SSB signals
- Analyze Land Mobile Radio (LMR) formats (APCO25 P1/P2, DMR, TETRA I, and dPMR signals), generate APCO25 and DMR pre-loaded signals.
- Generate and analyze LMR and custom waveforms (FSK, MSK, PSK, QPSK, QAM, etc.)
- Simplex or full duplex radio testing
- Simpler measurement setup and customizable views with new multi-touch user interface
- Simultaneously view signal analysis while controlling signal generation in a quad display
- Create baseband audio waveforms: single tone, dual tone, etc.
- Most complete set of post-demod filters
- Smooth migration from HP 8920A/B and HP 8901A/B modulation analyzers.
- Test analog avionics radios using optional avionics databus interface hardware modules and associated software.

N9093EM0E Basic Analog Test Software

Available on the M8920A PXIe Radio Test Set, the Basic Analog Radio Test application transforms the PXIe hardware into an easy-to-use radio tester for analog modulated signals, including AM, FM, SSB and PM. By adding fast, one-button measurements, the analog demodulation measurement and signal generation application helps you design, evaluate, and manufacture your analog radios 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.

The Basic Analog Test application is just one in a common library of several applications used on the M8920A, an evolutionary approach to signal analysis and generation that spans instrumentation, measurements, and software.

Figure 1. N9093EM0E Basic Analog Test

TX 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.

TX demod waveform and AF spectrum

This measurement retrieves the baseband signal from the modulated signal via the demodulation process and then 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.

TX 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.

TX 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, SINAD, SNR, and distortions will be displayed.

TX 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 low-pass filter (300 Hz or 3, 15, 30, 80, 100, 300 kHz) or a user defined (Manual) for either HPF or LPF from the available post-demod filter bank to achieve the best demodulation results.

Other filters include:

- CCITT (ITU-T Rec. 041, ITU-T Rec. P.53)
- A-weighted (ANSI-IEC "A" weighted, per IEC Rec 179)
- C-weighted (IEEE Std 743-1995)
- C-message (C-Message per IEEE743)
- CCIR-1k weighted (CCIR Rec 468)
- CCIR-2k weighted (Dolby 2 K)
- CCIR unweighted (CCIR Rec 468)

RX audio metrics

While having full control of the RF and audio generators, the Audio Analysis Metrics gives you all the necessary audio measurements from the radio. These include audio frequency, signal-to- noise ratio (SNR), distortion, total harmonic distortion, SINAD, audio level (PK+, PK-, (PK-PK)/2, RMS, and watts), AM depth, FM deviation, and an analog SINAD meter.

RX audio filters

The RX audio filters help you to optimize the measurement results by filtering out undesired signals and only measuring the audio tone under test. You may choose a high-pass filter (HPF): 20, 50, 300, or 400 Hz and/or a low-pass filter (LPF): 3, 15, 30 or 80 kHz or a user defined (Manual) for LPF selection from the available filter bank to achieve the best received audio measurement results.

Other RX audio filters include:

- CCITT (ITU-T Rec. 041, ITU-T Rec. P.53)
- A-weighted (ANSI-IEC "A" weighted, per IEC Rec 179)
- C-message (C-Message per IEEE743)
- CCIR-1k weighted (CCIR Rec 468)
- CCIR-2k weighted (Dolby 2 K)

Figure 2. N9093EM0E Example Receiver Test Mode

N9093EM1E Basic Digital Test Software

The Basic Digital Radio Test application transforms the PXIe hardware into a vector signal analyzer by providing a wide range of measurements, demodulation types, and filters to perform comprehensive digital LMR signal analysis, helping you thoroughly test your designs, ensure product quality, and optimize without compromise.

The basic digital radio test application's analysis presets and pre-generated standard test signals adds the capability to test LMR radio performance rapidly and intuitively. Fully customizable view screens for LMR digital signal analysis and signal generation.

N9093EM1E Key features

Teamed with a Keysight X-Series signal analyzer, you can increase the speed of your measurement tasks with the flexibility this option offers:

Pre-defined modulation analysis formats cover APCO P25 P1/P2, DMR, dPMR, TETRA I for quick setups. Pre-generated waveforms for DMR and APCO-25 P1 also included.

- Fully customizable view screens for signal analysis and signal generation
- A complete set of FSK modulation quality measurements, including FSK error, magnitude error, carrier frequency offset, deviation, accuracy, clock error, rise/fall time, RF spectrum, and constellation diagram

Complex I/Q measurements include EVM, peak EVM, magnitude error, peak magnitude error, phase error, peak phase error, frequency error, clock error, I/Q offset, quadrature error, gain imbalance, amplitude droop, and I/Q, rise/fall time, RF spectrum, and constellation diagram.
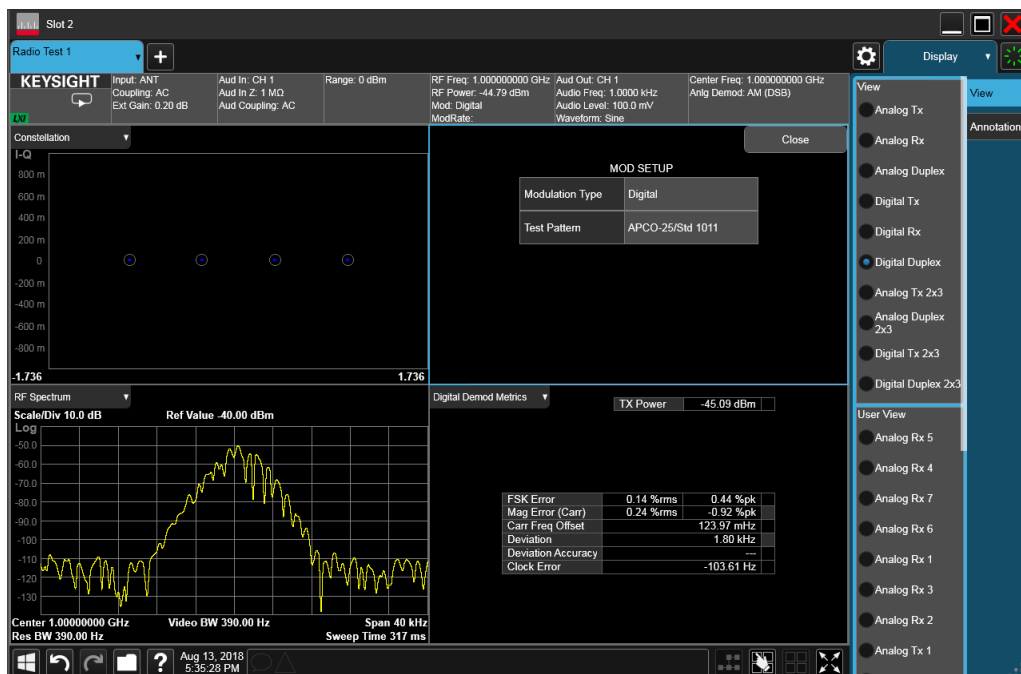
Figure 3. N9093EM1E Basic Digital Test

Y9054EM0E General Purpose Digital Test Software

This General Purpose Digital Radio Test Software package bundle addresses the R&D requirements while designing LMR radios and the MilCom radio needs for custom modulation/analysis requirements. Testing proprietary and custom signals is a challenge. Turnkey test software for those signals is seldom available off-the-shelf, so you must 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.

Y9054EM0E Key features

Flexible modulation analysis and flexible modulation generation with user payload generation.

- Y9054EM0E license enables flexible digital modulation and analysis. With this license you get the capabilities of the following 2 licenses:
  - N7608APPC Signal Studio for generating LMR and Custom Modulation (waveform playback)
  - N9054EM0E Vector Modulation Analyzer's Digital Demod capabilities
- Perform standard-based and flexible digital demodulation analysis and generation
- FSK, ASK, MSK, PSK, QPSK, QAM, etc. plus includes demod presets for LMR formats
- Measurements include monitor spectrum, RF envelope, I/Q waveform, raw main time, search time, spectrum measurements (channel power, occupied bandwidth, ACP, SEM), I/Q measurement time, I/Q ref time, I/Q measurement spectrum, I/Q ref spectrum, error vector time, error vector spectrum, magnitude error, phase error, demod results (EVM, SNR, frequency error, clock error, SNR, quad error, gain imbalance, RHo), demod bits, channel frequency response, EQ impulse response.
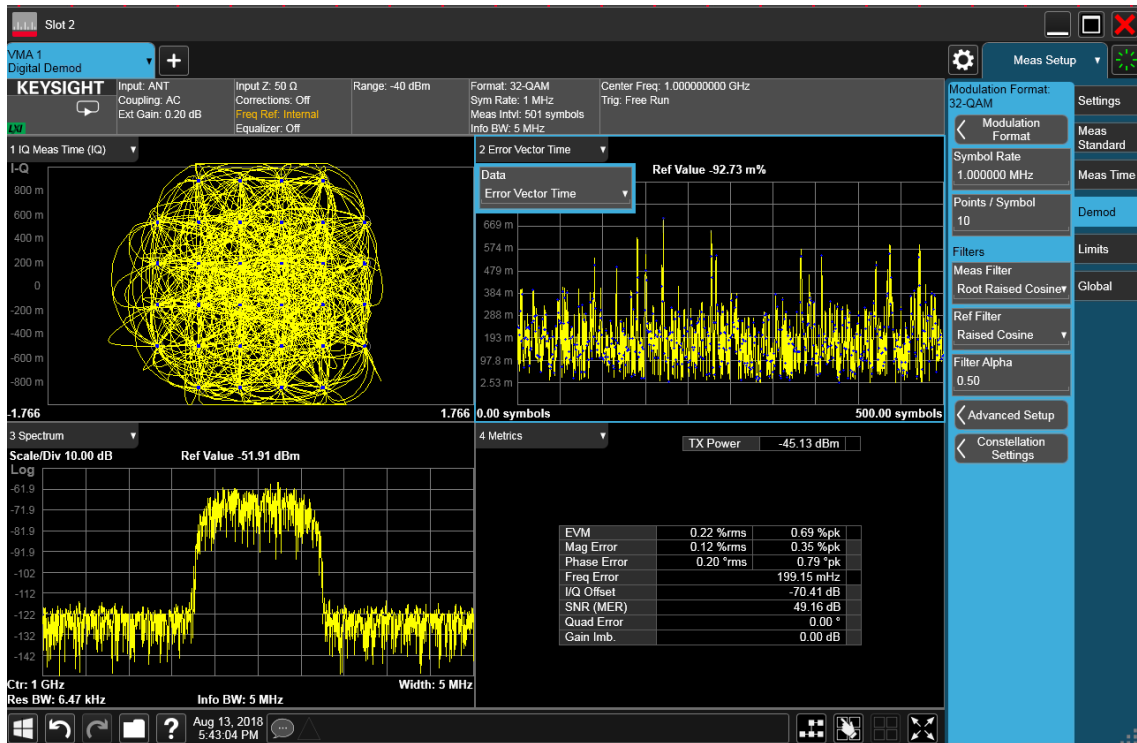
![KEYSIGHT]

Figure 4. Y9054EM0E General Purpose Digital Radio Application

Measurement Summary

One-button measurements

Technology	N9093EM0E	N9093EM1E	Y9054EM0E
AM	•		
FM	•		
SSB (USB/LSB)	•		
PM	•		
APCO25 P1		•	•
APCO25 P2[1]		o	•
DMR		•	•
dPMR[1]		o	•
TETRA 1[1]		o	•
Custom Modulation			•
ASK			•
FSK			•
MSK			•
PSK			•
QPSK			•

Technology	N9093EM0E	N9093EM1E	Y9054EM0E
QAM			•
ACPR	•	•	•
OBW	•	•	•
Channel Power	•	•	•
TX BER (APCO25)		•	•
Generic TX BER			•

1 These waveforms are not pre-loaded for ARB generation in the N9093EM1E software package. The N9093EM1E currently will
   only perform demodulation analysis on these three waveforms.

Automated Testing Capabilities

The Keysight Test Automation on PathWave (TAP) software provides powerful, flexible and extensible test sequence and test plan creation with additional capabilities that optimize your test software development and overall performance. Included with Keysight TAP is the core sequencing engine, tools and plugins to minimize your test system development time and test execution speed. The Radio Test Plugins allow users to add the M8920A Radio Test Set as an instrument and select test steps from the TAP plugin.

KS83120B Analog Radio Test Plugin Overview

The Analog Land Mobile Radio Plugin makes it possible for TAP users with no programming knowledge to automate M8920A Radio Test Sets. Test automation is done seamlessly without worrying about which specific SCPI commands need to be used. TAP users will simply focus on manipulating test parameters and test flow control for intended tests. The test results are automatically stored in any Result Listener configured in TAP for further analysis.

KS83122B Digital Radio Test Plugin Overview

The Digital Land Mobile Radio Plugin makes it possible to generate (APCO P1, DMR) and analyze Land Mobile Radio (LMR) formats: APCO25 P1/P2, DMR, TETRA I, and dPMR signals with N9093EM1E Software application on the M8920A.

KS83123B Tracking Generator Plugin Overview

Use Keysight Tracking Generator Test Automation on PathWave Test (TAP) software plugins to build test sequences to characterize and evaluate the performance and integrity of your DUT RF cables and characterize RF paths through your test fixture. Sweep frequencies from 100 kHz to 3.8/6 GHz with a generator output level of up to + 3 dBm, +13 dBm with M8920A-1EA option.

Radio Test Automated Test Plugin Key Features

The M8920A Radio Test Set is supported by the Radio Test plugins. Using the M8920A with the Radio Test Plug-ins and the predefined test setups enables easy test selection, flexible configuration, Generic radio DUT control, connection prompts, execution, and modern test results reporting.

- Perform many required tests of analog and digital radios per EIA/TIA Standards requirements
- Predefined test setup enables easy test selection, flexible configuration, Generic radio DUT control, connection prompts, execution, and modern test results reporting
- Report test results which documents test configuration, bench setup, measurements made, pass/fail status
- No programming needed, yet with the capability to create fully automated tests.

M8920A Key Specifications

These values indicate expected performance or describe product performance that is useful in the application of the product. Data subject to change. For a complete list of specifications, refer to the M8920A specification guide: www.keysight.com/find/radiotest

Analyzer and ARB Generator RF Performance

Option 504	100 kHz to 3.8 GHz
Option 506	100 kHz to 6 GHz

Analysis bandwidth (see M8920A Data Sheet for detailed bandwidth/frequency bands of ARB Gen)

Maximum bandwidth	Option B40 (Standard)	40 MHz
	Option B85	100 MHz
	Option B1X	160 MHz

Analyzer Frequency Resolution

RF Analyzer	0.01 Hz

Analyzer amplitude accuracy at 1 GHz

RF T/R port	± 1 dB
RF antenna port	± 1 dB

Analyzer Maximum safe RMS power input

RF T/R port high power attenuator ON	+47 dBm (50 W)
RF T/R port high power attenuator OFF	+33 dBm (2 W)
RF antenna port	+30 dBm (1 W)

Analyzer phase noise RF T/R port and antenna port (CF = 500 MHz)

1 kHz offset	-107 dBc/Hz typical
10 kHz offset	-111 dBc/Hz typical
100 kHz offset	-108 dBc/Hz typical

Display Average Noise Level (DANL) @ 900 MHz

RF T/R port high power attenuator OFF	-144 dBm
Antenna port	-157 dBm

Generator phase noise, CF = 500 MHz; (RF Gen port +10 dBm output); (T/R port 0 dBm output)

1 kHz offset	-115 dBc/Hz typical
10 kHz offset	-112 dBc/Hz typical
100 kHz offset	-118 dBc/Hz typical

Generator output level range

RF T/R port 100 kHz to 6 GHz	
RF T/R port high power attenuator OFF	-130 to + 3 dBm
RF T/R port high power attenuator ON	-130 to -20 dBm, settable to -15 dBm
RF Gen port 100 kHz to 6 GHz	
Standard	-130 to +3 dBm
Option M8920A-1EA High Power Output	-130 to +13 dBm, settable to +15 dBm

Generator amplitude accuracy[1] (1 GHz at -100 dBm)

RF generator port	± 1.25 dB, ± 0.95 dB typical
RF T/R port	± 1.4 dB, ± 1.0 dB typical

Generator Resolution

Power	0.02 dB (nominal)
Frequency	0.10 z (nominal)

1 Specifications apply when input port is set to Antenna In

Related Literature

For more detailed product and specification information refer to the following literature and web pages:

Publication title	Publication number
M8920A PXIe Radio Test Set Data Sheet	5992-2802EN
M8920A PXIe Radio Test Set Configuration Guide	5992-2800EN
M8920A PXIe Radio Test Set Getting Started Guide	M8920-90001
M9470A PXIe 50W Interface Module Data Sheet	5992-3140EN
M9421A VXT PXIe Vector Transceiver Data Sheet	5992-1646EN
M9260A PXIe Audio Analyzer Data Sheet	5992-1918EN
KS8312xA Technical Overview for Automated Radio Testing	5992-3511EN
PXIe Chassis Spec Guide	M9019-90015
PC Tested Configurations with PXIe Chassis Technical Overview	5990-7632EN
M9037A PXIe Embedded Controller Spec Guide	M9037-90015
Interface Modules and Adapters for PXIe Systems	5992-0377EN
M924XA InfiniiVision PXIe Modular Oscilloscopes Data Sheet	5992-2003EN
6.5 Digit PXI Digital Multimeter Data Sheet	5992-2757EN
PXIe Vector Network Analyzer Configuration Guide	5991-4885EN
PXI Avionics Bus Interface Cards Configuration Guide	5992-2448EN
89600 VSA Software Configuration Guide	5990-6386EN

Additional Information

Product webpages:

www.keysight.com/find/M8920A

www.keysight.com/find/N9093

www.keysight.com/find/PXI

X-Series measurement applications:

www.keysight.com/find/X-Series_Apps

Signal Studio Software:

www.keysight.com/find/signalstudio

89600 VSA Software:

www.keysight.com/find/89600

For more information on Keysight Technologies' products, applications, or services,
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