

Keysight Technologies

Two-Way Radio Testing with the U8903A Audio Analyzer

Application Note



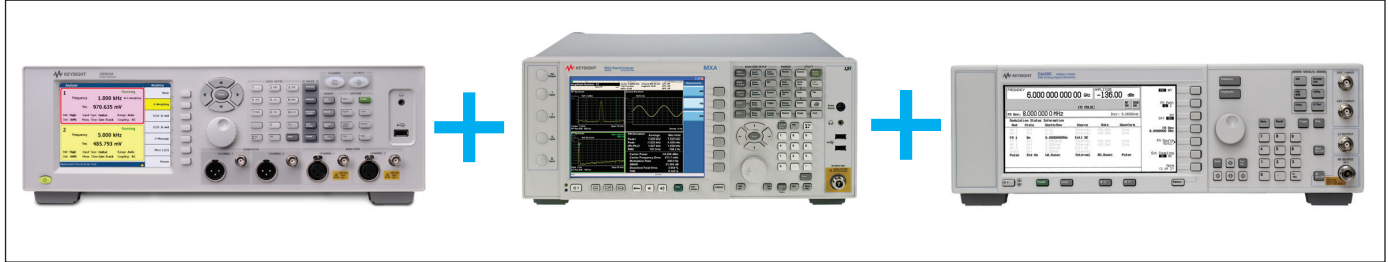


Introduction

As the two-way radio band gets deregulated, there is a noticeable increase in product offerings in this area. What was a specialized field with a product premium many years ago has turned competitive. In some instance, some product offerings in this area has become a commodity.

This application note highlights how you can use the Keysight Technologies, Inc. U8903A audio analyzer to guarantee the audio quality of your design for you to use audio as a competitive advantage.

Combining the U8903A Audio Analyzer with the Keysight N9063A MXA Spectrum Analyzer and E4428C Signal Generator Provides a Good Solution for Two-Way Radio Testing



A two-way radio transfers a signal (audio source) to another two-way radio by using frequency modulation (FM) radio frequency (RF) wave. During this process, the two-way radio converts the audio source to frequency modulated RF waves and sends it to a receiver. Then, the receiver demodulates the FM RF wave back to the original audio signal generated by the source.

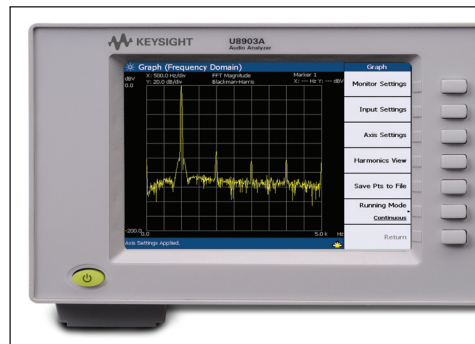
There are two major tests for a two-way radio: Transmitter and receiver tests.

In a two-way radio transmitter test, the audio analyzer provides a 1 kHz audio tone signal to the two-way radio transmitter (DUT). The transmitter (DUT) converts the signal to FM RF waves, which will be measured using the N9063A MXA spectrum analyzer.

During the two-way radio receiver test, the audio analyzer provides a 1 kHz audio tone signal to the signal generator. The signal generator converts the 1 kHz audio tone signal to frequency modulated RF waves and transmits the FM RF waves to the two-way radio receiver (DUT) for demodulating back to an audio sound signal, which will be measured by the audio analyzer with related audio signal parameters.

The Keysights Solution

Keysight offers a total solution for two-way radio testing by combining U8903A audio analyzer, E4428C ESG signal generator, and N9020A MXA spectrum analyzer. The U8903A audio analyzer provides a clean and low-distortion signal (audio source) and combines the functionality of level, frequency response, SINAD, and THD+N measurements. The E4428C ESG signal generator performs FM and convert the audio signal to FM modulated RF wave. The N9020A MXA spectrum analyzer with N9063A analog demodulation measurement application is able to demodulate on FM signals, display modulation metrics such as FM Deviation with Peak+, Peak-, (Pk-Pk)/2 and RMS, carrier power, carrier power error, modulation rate, SINAD, Distortion/Total Vrms, THD, and display demodulated signals in both time and frequency domains.



Two-Way Radio Transmitting Test

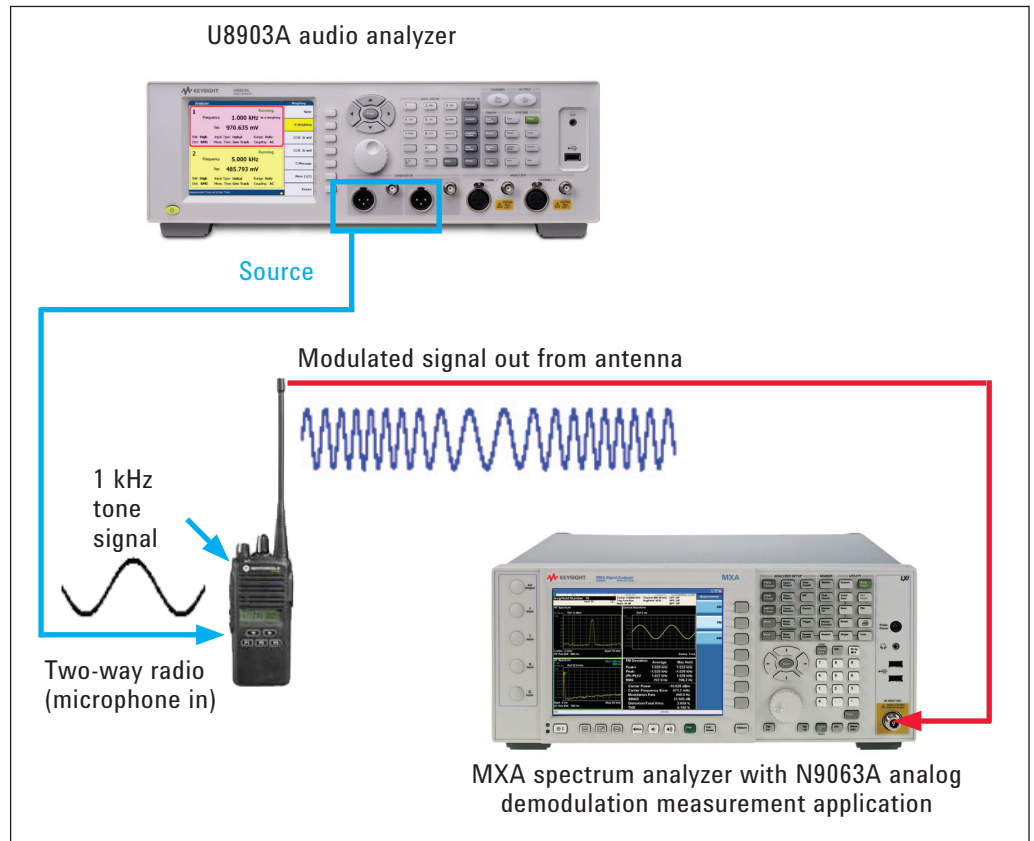


Figure 1. Two-way radio transmitting test diagram

In a two-way radio transmitting test, we are testing the quality of the FM RF wave signals that a two-way radio transmits to another two-way radio. The U8903A audio analyzer provides a clean and low-distortion audio signal source, and the N9020A MXA spectrum analyzer with the N9063A analog demodulation measurement application measures level, frequency response, THD+N, SINAD, carrier power, and modulation rate. Below are the steps for setting up the transmitting test:

STEPS FOR Setting up the transmitting test:

1. U8903A audio analyzer provides a signal (audio source) 1 kHz tone signal (sine wave) to the two-way radio's microphone in.
2. On two-way radio, select CH1 (Channel 1) and press the "push to talk" button. The signal (audio source) will be converted to frequency modulated(FM) RF wave signal.
3. On the N9020A MXA spectrum analyzer, set frequency to 462.5625MHz (same frequency with two-way radio's channel 1), enable the analog demodulation and do measurements on level, frequency response, THD+N, SINAD, carrier power, and modulation rate.

Two-Way Radio Transmitting Test (continued)

Refer to Figure 2 for the measurements result of two-way radio transmitter test on N9020A MXA spectrum analyzer.

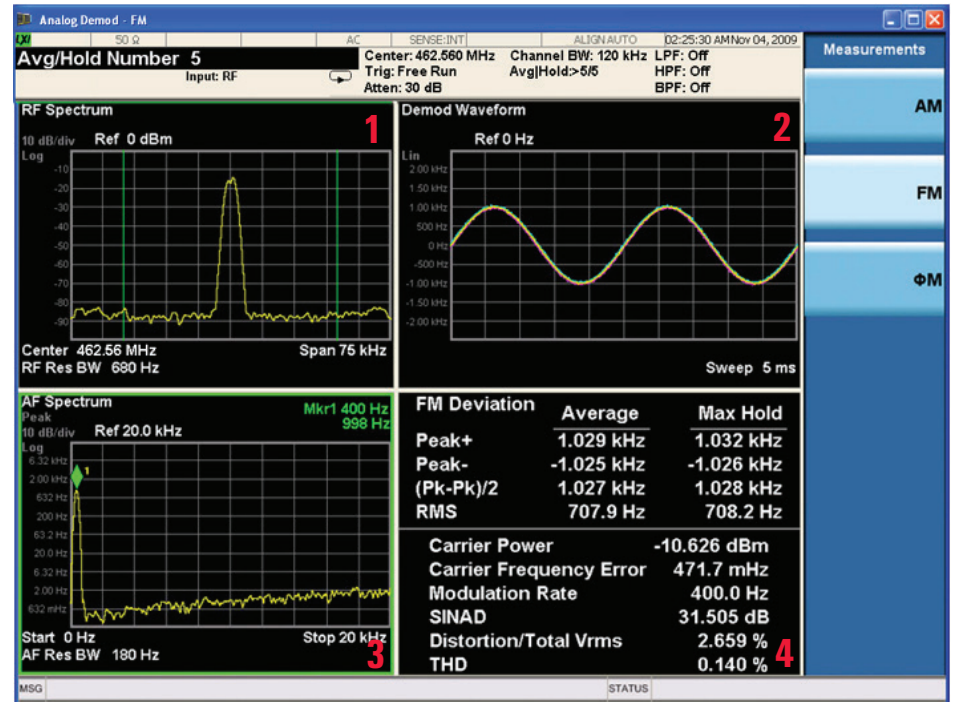


Figure 2. Two-way radio transmitting test result on N9020A MXA Spectrum Analyzer with N9063A analog demodulation measurement application

Table Number	Description
1. Upper-left table	Original RF waveform from two-way radio (Spectrum Analyzer mode)
2. Upper-right table	Signal after demodulated @ time-based domain
3. Bottom-left table	Signal after demodulated @ frequency-based domain
4. Bottom-right table	Measurement results for frequency response, carrier power, modulation rate, SINAD, Distortion/Total Vrms, and THD

Two-Way Radio Receiver Test (continued)

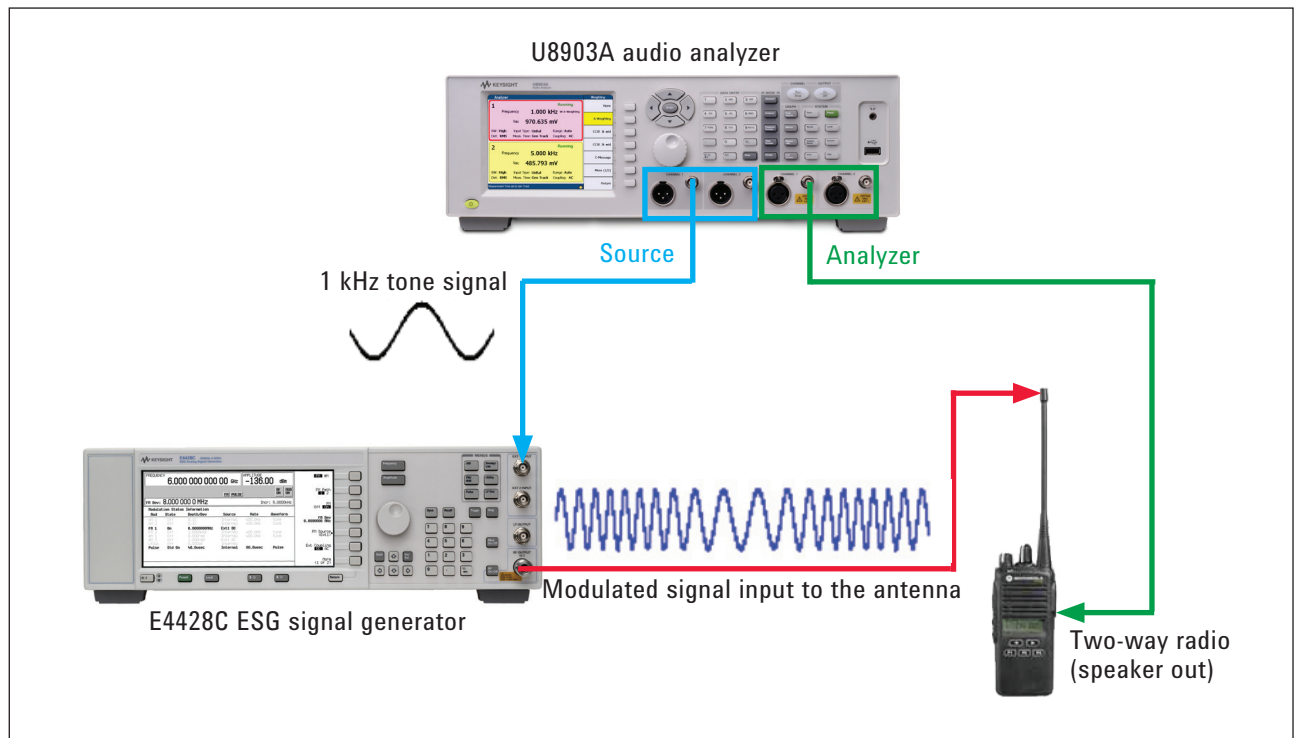


Figure 3. Two-way radio receiving test diagram

In the two-way radio receiving test, we are testing the quality of the audio signal that is reproduced by the two-way radio after transmission. The U8903A audio analyzer provides a clean and low-distortion audio source and measurement of the signal that is reproduced by the two-way radio receiver. The Keysight E4428C signal generator is used to modulate the audio signal source to FM RF waves.

STEPS FOR SETTING UP THE RECEIVING TEST:

1. The U8903A audio analyzer provides a signal (audio source) 1 kHz tone signal to E4428C ESG signal generator's external input (Ext In).
2. At E4428C ESG signal generator, set frequency to 462.5625 MHz (same frequency with two-way radio's channel 1), then convert the input signal to frequency modulation (FM) RF wave, and send it to the two-way radio's antenna.
3. Use the analyzer part of U8903A audio analyzer to do measurements such as level, frequency response, THD+D, and SINAD.
4. In order to check the receiver sensitivity, adjust the E4428C ESG signal generator carrier power to achieve the SINAD at 12 dB at the U8903A audio analyzer.

Two-Way Radio Receiving Test (continued)

Refer to Figure 4 for the measurements of the two-way radio receiver test on U8903A audio analyzer.

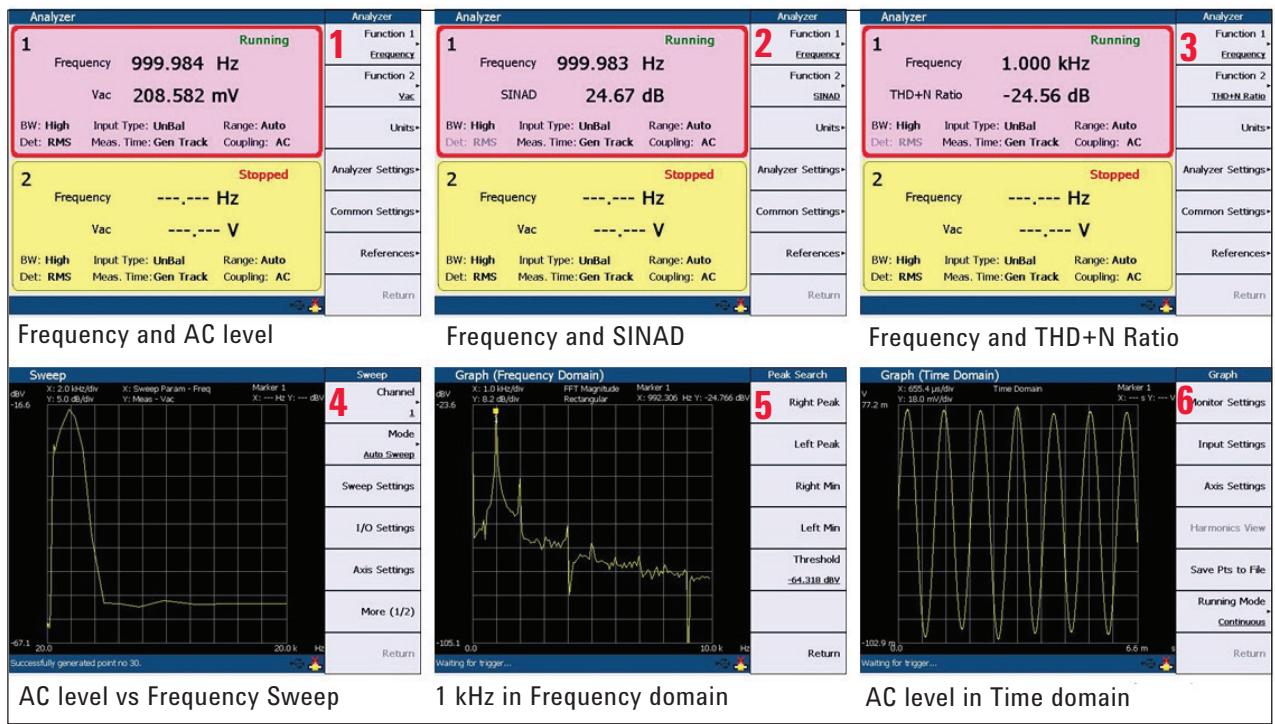


Figure 4. Two-way radio receiver test results on U8903A audio analyzer

Table Number	Description
1. Top row (left)	Frequency and AC level
2. Top row (center)	Frequency and SINAD
3. Top row (right)	Frequency and THD+N Ratio
4. Bottom row (left)	Frequency Sweep
5. Bottom row (center)	1 kHz in Frequency domain
6. Bottom row (right)	AC level in Time domain

CONCLUSION

The Keysight U8903A audio analyzer combines the functionality of a distortion meter, SINAD meter, frequency counter, AC voltmeter, DC voltmeter, and FFT analyzer with a low-distortion audio source. With its accuracy and versatility, U8903A will help you to make an audible difference in your end product. The combination of N9020A MXA spectrum analyzer with N9063A analog demodulation measurement application option and Keysight E4428C ESG signal generator is a total solution for industrial two-way radio testing.

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