

Keysight Technologies

A Cost-effective Way to Test
Sub 1-GHz Wireless Modules

Application Note



Unlocking Measurement Insights

Introduction

Sub 1-GHz wireless modules are used in a wide variety of internet of things (IoT) systems, such as the automatic meter reading (AMR), traffic signs and signals, security and social alarms, barcode readers, and motion detection solutions.

Take an AMR system for example, this technology primarily saves utility providers the expense of periodic trips to each physical location to read a meter. Another advantage is that billing can be based on near real-time consumption rather than on estimates based on past or predicted consumption. This timely information, coupled with analysis, can help both utility providers and customers better control the use and production of electric energy, gas usage, or water consumption.

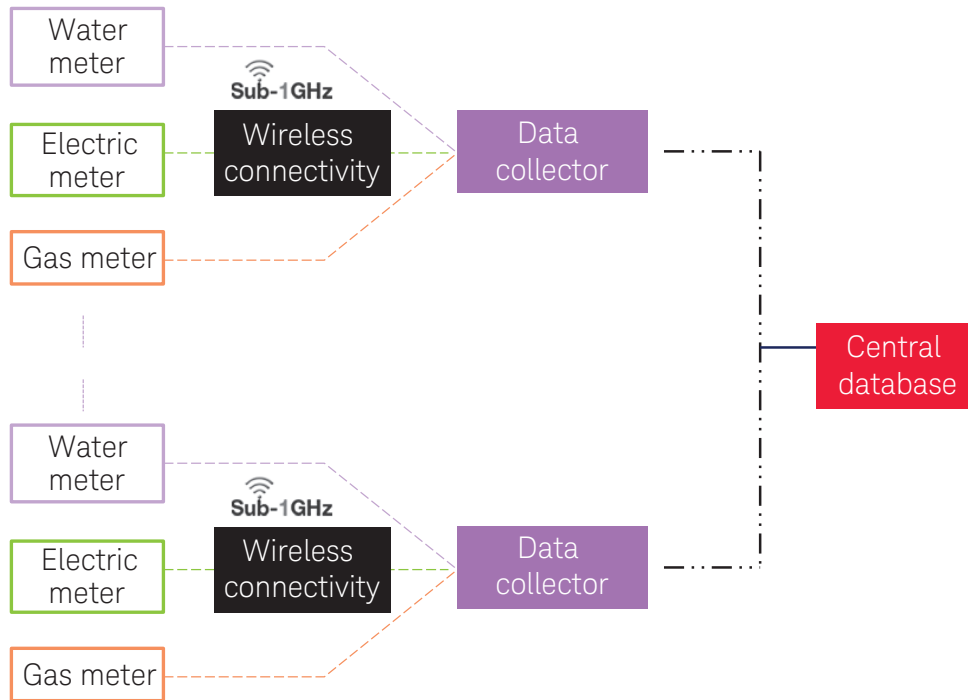


Figure 1. Block diagram of automatic metering system

In an AMR system, sub 1-GHz wireless modules play an essential role in collecting data from terminal locations. They transmit the meter data to the data collector using the ISM band and it is critical that they comply with regional and international performance standards such as is FCC Part 15. 247/249, ETSI EN300 220, ARIB T-96/108.

Testing Sub 1-GHz Devices

Testing sub 1-GHz modules or boards during product design and on the manufacturing line is essential for ensuring they will perform in the field as desired, and while while some test solutions can be costly, this section explains the capabilities of a budget-friendly solution, which includes:

- The Keysight Technologies, Inc. BSA Series spectrum analyzers to address transmitter test
- The Keysight IQ bundle, which uses the N9310A RF signal generator and 33522B/33600A Series waveform generator to address receiver test

Note that this type of wireless module works in burst mode, but the testing during manufacturing is usually performed with the module in continuous mode.

Transmitter characterization

The following testing items are typically covered in a transmitter test session for a sub 1-GHz device:

- Center frequency calibration and test
- Transmission power
- Adjacent channel power (ACP)
- FM/FSK/GFSK deviation

When testing a sub-1 GHz module with the Keysight BSA spectrum analyzer, either the spectrum analysis mode or the consolidated FSK demodulation analysis mode can be used, which gives users the flexibility to select the method best-suited for their application.

Example 1. Measuring an FSK signal at 433 MHz, -20 dB, symbol rate at 16 kbps, and FSK deviation at 40 kHz

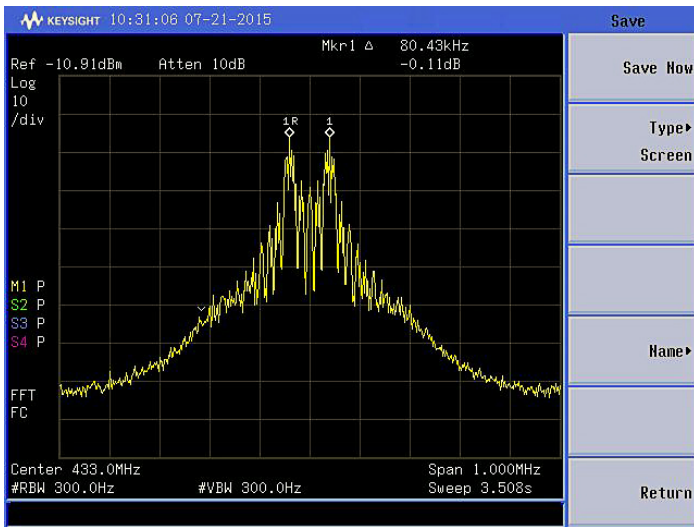


Figure 2. Measuring the FSK signal in spectrum analysis mode, with trace maximum hold

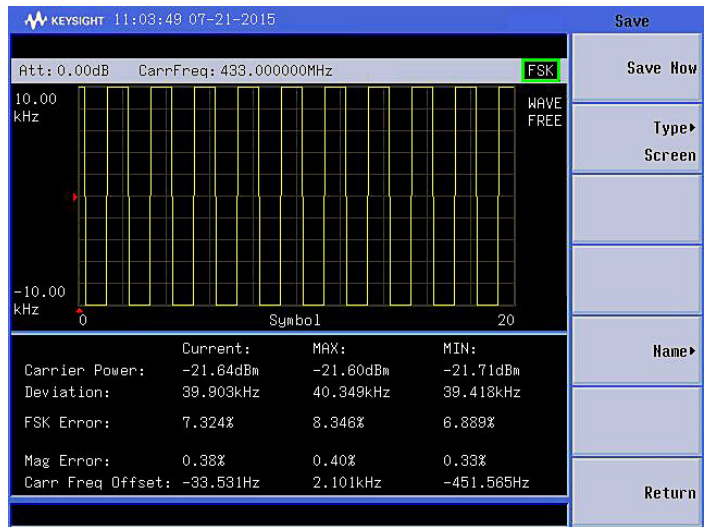


Figure 3. Using the FSK demodulation analysis mode of the N9320B to view the metrics and waveform

Example 2. Measuring a GFSK signal at 433 MHz, -20 dB, symbol rate at 50 kbps, and FSK deviation at 25 kHz

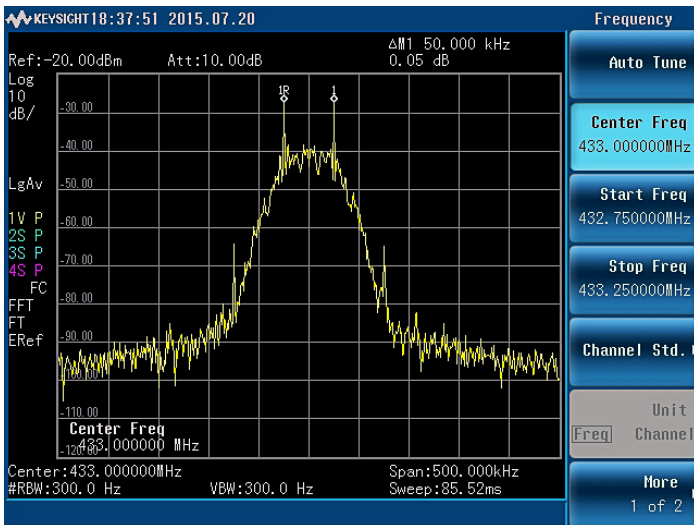


Figure 4. Measuring the GFSK signal in spectrum analysis mode, with trace maximum hold

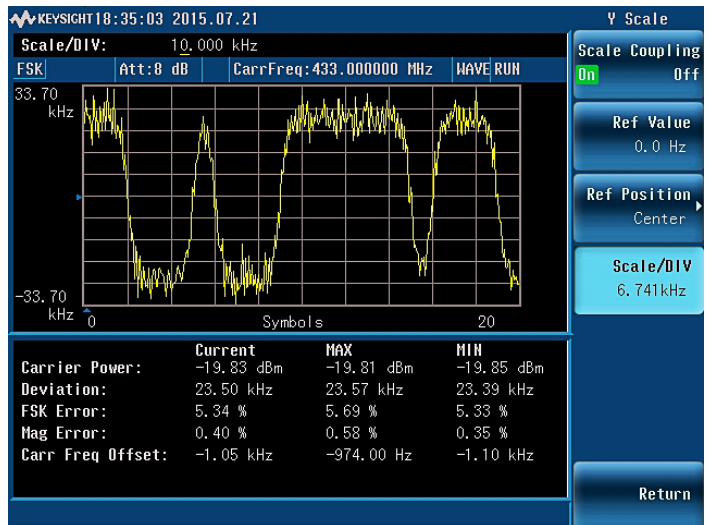


Figure 5. Using the FSK demodulation analysis mode of the N9322C to view the metrics and waveform

Receiver characterization

Usually, an RF signal source is needed to verify the sensitivity of the device under test (DUT). In instances when using an integrated vector signal generator is not feasible, the Keysight IQ bundle solution is a cost-effective alternative for digital signal generation. The 33522B or 33600A Series waveform generator used with the N9310A RF signal generator can be used to build the digital modulation formats that are widely used in sub 1-GHz modules, such as ASK, FSK, GFSK, or even OQPSK.

When using the IQ bundle solution, Figure 6 illustrates the typical procedure for building signals.

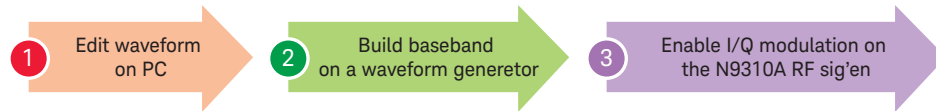


Figure 6. Overview of low-cost solution for building test signals

Table 1 summarizes what product is used to generate a ASK/FSK and GFSK signals and how the signals produced are used with the N9310A RF signal generator.

Table 1. IQ bundle solution tools and functions

	Waveform editor	System set up	For additional details
When building ASK/FSK signals	33503A BenchLink Waveform Builder Pro	Input the baseband signal from the waveform generator to the N9310A's modulation source input port	Application note 5990-8818EN
When building GFSK signals	GFSK IQ Baseband Builder (requires MATLAB)	Input the I/Q baseband signals to the N9310A I and Q baseband input ports	Application note 5991-2264EN

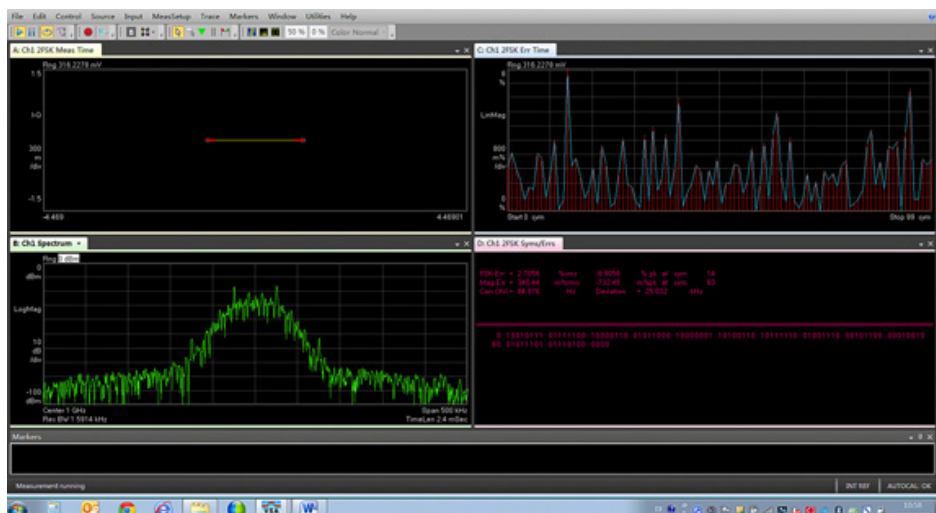


Figure 7. The GFSK signal as viewed on the 89600 VSA

More Information About the BSA Spectrum Analyzers

These N9320B and N9322C BSA spectrum analyzers focus on general-purpose spectrum analysis to address primary frequency domain measurement needs. They are ideal for consumer electronics, R&D, manufacturing, bench repair, universities and polytechnic education, and general purpose spectrum monitoring.

They cover frequencies up to 7 GHz, offer the one-button power measurement, and provide analog/digital demodulation and SCPI command compatibility with the Keysight ESA Series spectrum analyzers. They both offer an optional tracking generator for low cost stimulus response measurements.

Built to perform on the test bench and priced to compete in the market place, the BSAs provide reliable RF performance and a robust feature set at an affordable price.

Table 2. BSA spectrum analyzers selection and comparison

Key specification/function	N9320B	N9322C
Frequency	9 kHz to 3 GHz	9 kHz to 7 GHz
DANL at 1 GHz w/min. RBW and Preamp	-145 dBm	-152 dBm
Phase Noise at 1 GHz, 10 kHz offset	-90 dBc/Hz	-90 dBc/Hz
3rd Order Intercept (TOI) at 1 GHz	+13 dBm	+15 dBm
AM/FM modulation analysis	Yes	Yes
ASK/FSK modulation analysis	Yes	Yes
Spectrogram	No	Yes
Stimulus/Response	2-port transmission test	2-port transmission test; 1-port reflection measurement
Channel scanner	No	Yes

Conclusion

The sub 1-GHz test solution offers an efficient way for small to medium size companies to easily address the essential RF test needs, and improve productivity. For more information about the solutions mentioned in this application note, please visit:

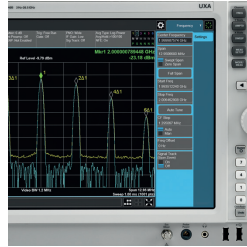
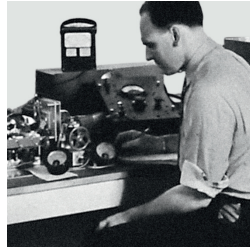
www.keysight.com/find/RFIOT

Reference

- A Flexible Test Solution for Internet of Things (IoT) devices with ASK/FSK Modulation (Publish number 5990-8818EN)
- Flexible Digital Modulation Solution (Publish number 5991-2264EN)

From Hewlett-Packard through Agilent to Keysight

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