Agilent 93000 SOC Series Bluetooth Radio Modem IC Test

Product Note

Minimize Test Times and Increase Throughput

- Real-Time RF Data Processing
- Real-Time BER Measurements
- Quad-Site Test

Agilent Technologies

The Bluetooth Evolution

In today's wireless market, the only constant is change. Bluetooth is no exception.

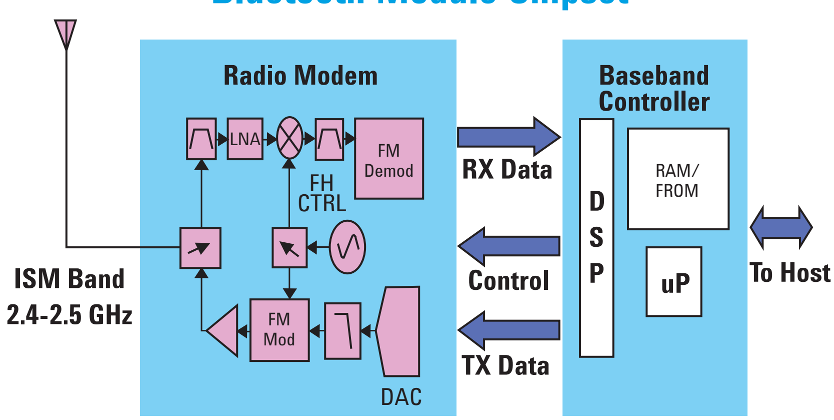
For Bluetooth™ applications, existing standards continue to evolve and new standards are still emerging, adding the functionality and interoperability demanded by the consumer market. In addition, faster data rates and higher frequencies are likely changes for future Bluetooth standards.

For Bluetooth to be widely accepted by the consumer market, it must be low cost. Industry analysts estimate that a $5 bill of material for Bluetooth modules will be needed. In order to achieve this goal, a fast test time for the radio modem integrated circuit (IC) will be necessary.

Today, there are two-chip implementations of the Bluetooth module: a radio modem IC and a baseband controller IC. In some cases, the Bluetooth module baseband controller is built into the host appliance's control logic. Single-chip or single-package implementations that include the radio modem and the baseband controller functions are also available.

With all of this variety, a test solution that can evolve with the changing standards, dropping prices, and higher integration levels is demanded. One that is flexible and scalable enough to meet your specific test needs yet provide high performance – ensuring quality products.

Bluetooth Module Chipset



Bluetooth Radio Modem IC Test

As the RF test technology leader, Agilent brings high frequency expertise to the proven Agilent 93000 SOC Series platform, providing the test capabilities needed to meet your test requirements for the Bluetooth radio modem IC.

With higher levels of integration, a solution that provides robust test capability – including analog, digital, RF, scan, and embedded memory – is required. Not only does the Agilent 93000 provide this on a single platform, but it can be scaled down to create a low cost focused solution – allowing you to purchase just enough test while maintaining the ability to upgrade tomorrow.

By creating a solution based on time proven technology that has all the necessary test functionality on a single platform, with the ability to create focused solutions and still upgrade in the future, Agilent provides the lowest risk Bluetooth solution.

Bluetooth Test Hardware Configuration:

- Model C200e with 200 Mbps digital data rates
- 128 digital pins
- RF Measurement Suite
  - Quad-site test
  - Three-tone stimulus

Test Requirements for a Bluetooth Radio Modem IC

Transmitter Tests for the Bluetooth Radio Modem IC

- Maximum Output Power Over Frequency
  Measure the maximum output power from the device under test (DUT) at several different frequencies.

- Output Power Control
  Adjust the output power of the DUT and measure output power control.

- Spurious Emissions
  - *In-band* – Measure the signal leakage from the desired channel into adjacent channels.
  - *Out-of-Band* – Measure signal leakage into frequency bands above and below the ISM band (2.400 to 2.4835 GHz). For example, from 30 MHz to 1 GHz, the emissions must be < -36 dBm in operation mode and < -57 dBm in idle mode; from 5.15 to 5.3 GHz, the emissions must be < -47dBm in operation and idle mode.

- Modulation Characteristics
  - *Initial Frequency Tolerance* – Verify the accuracy of the transmitter's carrier frequency.
  - *Drift over DH1, DH3, DH5 packets* – Measure drift of the carrier frequency over several different packet lengths.
  - *Maximum/Minimum Deviation* – Measure frequency deviation across different bits in a packet.

- Synthesizer Lock Time
  Measure how long it takes the synthesizer to lock to a new frequency.

- 20 dB Bandwidth
  Verify the 20 dB bandwidth of a modulated signal is less than 1 MHz (see Figure 1).

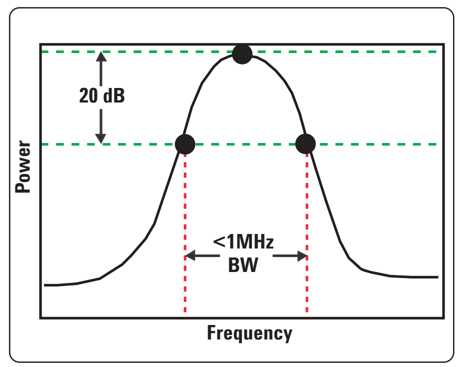


Figure 1. 20 dB Bandwidth Transmitter Test

Essentially, transmitter tests are power measurements over frequency and frequency measurements over time.

Receiver Tests for the Bluetooth Radio Modem IC

- Receiver Dynamic Range
  - *Minimum Sensitivity* – Stimulate the DUT with a low-level signal and measure bit error rate (BER).
  - *Maximum Input Power* – Stimulate the DUT with a strong signal and measure BER.
- Interference Performance
  - *Co-channel* – A weak interference signal is placed in the same channel as the desired signal to check the ability of the DUT to recover data in the presence of a co-channel interferer.
  - *Adjacent Channel 1,2,3 MHz* – Measure BER with interference signals in channels adjacent to the desired channel (see Figure 2).

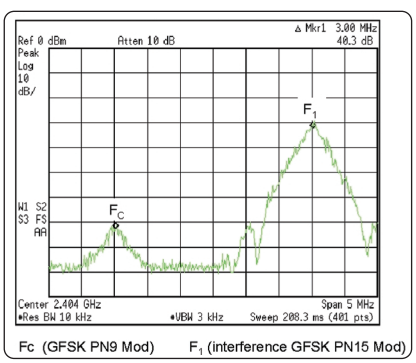


Figure 2. Adjacent Channel Interference Stimulus

- Out-of-Band Blocking
  Measure BER with an interferer signal outside of the ISM band in addition to the desired signal (see Figure 3).

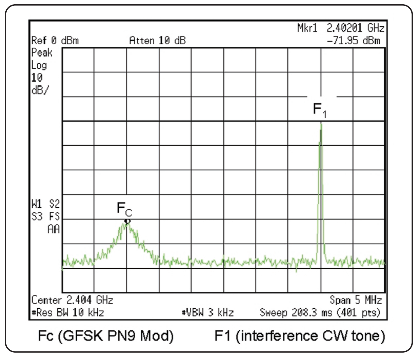


Figure 3. Out-of-Band Blocking Interference Stimulus

- Intermodulation Characteristics
  The DUT is stimulated with a three-tone signal: the desired modulated signal, a CW interferer signal, and a modulated interferer signal (see Figure 4). The interferer signals are spaced so the intermodulation product of the CW signal and modulated signal will fall in the desired channel. The BER of the DUT will depend on how high the product is of the two interfering signals. Intermodulation should be tested for n = 3 and 5.
- Frequency Hopping
  A number of the receiver tests are performed under frequency hopping conditions.

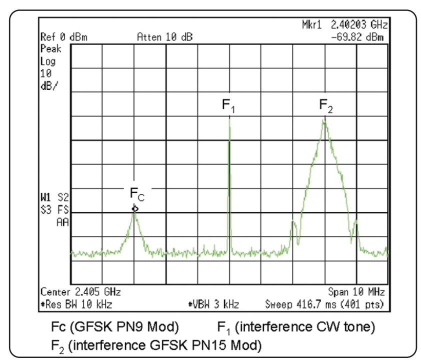


Figure 4. Third Order Intermodulation Stimulus

Receiver tests are basically several BER measurements performed under different stimulus conditions. Thus, reducing BER measurement times is critical in reducing cost of test.

Software Capability for Bluetooth Test

As you can see, there are a number of tests required for the Bluetooth radio modem IC. A solution with robust test capabilities that will allow you to provide quality product is required.

For example, a flat frequency response across the test system's IF bandwidth is required to accurately measure the 20 dB bandwidth of the DUT. The intermodulation characteristic measurements require three-tone stimulus capability. With the RF Measurement Suite, you can be assured of meeting all your test requirements with accurate and repeatable results.

In addition, the RF Measurement Suite provides capabilities critical to reducing test times and cost of test:

- Real-Time RF Data Processing
  Allows data manipulation and comparison in the DSP of the RF receiver, avoiding time consuming downloads of data to the host computer.
- Real-Time BER Measurements
  Four digital channels designed specifically for BER measurements provide real-time, parallel test on up to four DUTs, minimizing BER test times and ultimately device test time.
- Quad-Site Test
  Up to quad-site test is supported, ensuring the highest throughput and thus minimizing cost of test.
- Simple DUT Board Designs
  All RF components – such as splitters, combiners, switches, amplifiers, and attenuators – are built into the system, not on the DUT board, reducing cost and development time of new boards.
- Fast Switching Sources
  The primary RF source and system LO source have fast power level and frequency switching, providing significant test time reductions in power, gain, harmonic, and intermodulation measurements. This source also enables the frequency hopping capability.

SmarTest provides a programmatic interface to write custom test suites for test programs with RF requirements. The flexibility of SmarTest allows for reuse of test suites in other test programs, speeding up time to volume production on new devices.

SmarTest also provides debug tools (Figure 5). The mixed signal tool used for analyzing waveforms can be used to debug the device transmitter tests. With this tool, the output spectrum of the DUT can be viewed in real-time. A second tool is available for debugging BER measurements. This allows the data signal from the DUT to be viewed and analyzed. These debug tools, combined with the flexibility of the programmatic interface, ensure fast test plan development, and ultimately fast time to market.

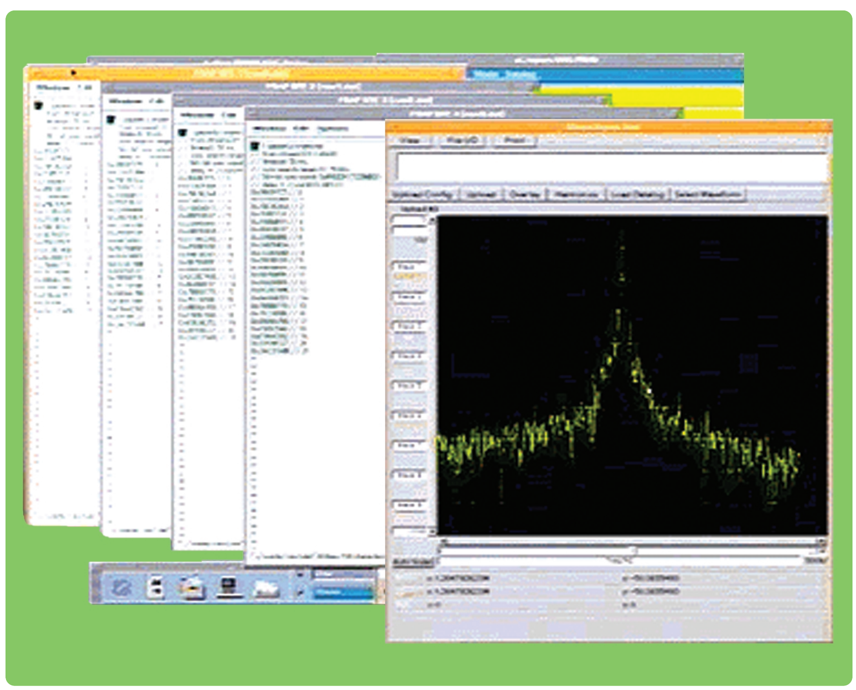


Figure 5: Software Debug Tools – BER and Waveform Tool

The Solution of Choice for Bluetooth Radio Modem IC Testing

The RF Measurement Suite is available on all models of the Agilent 93000 SOC Series. This single platform offers the widest application coverage in the industry. The scalability allows you to configure the Agilent 93000 as a low cost focused solution to meet your specific device needs while maintaining the ability to upgrade in the future.

Agilent is the leading provider of wireless test solutions with over 10,000 employees focused on technology for the wireless communications market. When Agilent's wireless test expertise is combined with the Agilent 93000 SOC Series, you get the ultimate test solution for Bluetooth radio modem ICs. A test solution with all the benefits of the lowest cost, single scalable platform. Plus, the assurance of meeting your challenging test requirements today – and in the future.

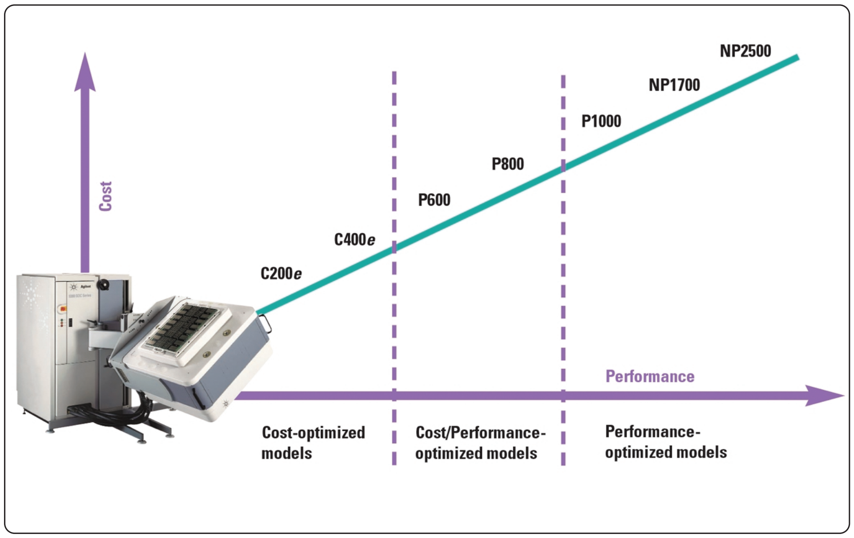


Figure 6. Agilent 93000 SOC Series Family Diagram

System Characteristics

Digital Characteristics

	C*e* Models	
	C200*e*	**C400*e***
Data Rate (Mbits/s)	250 @ 1V	500 @ 1V
Clock Rate (MHz)	200 @ 3V	200 @ 3V
EPA/OTA (ps)	175/350	175/350
Max Memory Per-Pin (MV)	28	28
Max Scan Per-Pin (MV)	336	336
Max # Digital Pins	1024	1024
Max # Analog Modules	24	24
Max # DPS Channels	32	32
Scan	*	*
Multi-Site	*	*
Memory Test	*	*
Analog	*	*
Speed Upgrade	To C400e	X
Memory Upgrade	*	*
100% Test Program Compatible	*	*
Common Docking	*	*

* = Available   X = Not Available

RF Characteristics

RF Source Frequency	10 MHz to 8 GHz (Modulated and CW)
RF Measurement Frequency	10 MHz to 8 GHz (Scalar)
Multiple Tone Stimulus	2 or 3 Tones; 500 MHz to 3 GHz (2 Mod or 2 Mod + 1 CW)
Frequency Hopping Source	100 µsec Hopping Time 20 MHz to 3 GHz
Modulation Formats	CW, GFSK, CDMA, NADC, GSM, TETRA, PHS, PDC, DECT, WCDMA, cdma2000, EDGE
IF Bandwidth	10 MHz
RF Ports	3 to 12

For more information about Agilent Technologies semiconductor test products, applications, and services, visit our website:
www.agilent.com/go/semiconductor
or you can call one of the centers listed and ask to speak with a semiconductor test sales representative.

For more information about other Agilent test and measurement products, go to
www.agilent.com

United States:
1 800 452 4844

Canada:
1 877 894 4414
Fax: (905) 282 6495

Europe:
(31 20) 547 2323
Fax: (31 20) 547 2390

Japan:
(81) 426 56 7832
Fax: (81) 426 56 7840

Latin America:
(305) 269 7500
Fax: (305) 269 7599

Australia/New Zealand:
1 800 629 485 (Australia)
Fax: (61 3) 9272 0749
0 800 738 378 (New Zealand)
Fax: (64 4) 495 8950

Asia Pacific:
(852) 3197 7777
Fax: (852) 2506 9284

Taiwan:
(886 2) 717 9524
Fax: (886) 2 718 9860

Korea:
(822) 769 0800
Fax: (822) 786 1083

Singapore:
(65) 1 800 292 8100
Fax: (65) 275 0387

Printed in U.S.A. January 10, 2001

5988-4261EN

Agilent Technologies