The most important thing we build is trust

Bluetooth® (BR+EDR+LE) Measurement Suite

Data Sheet

- Bench-top R&D and production ready ATE solutions
- Transmitter and receiver RF performance characterization
- Optional multi device parallel testing for higher throughput
- Support for Basic Rate (BR), Enhanced Data Rate (EDR) and Low Energy (LE)

Whether testing devices on the bench in R&D or in high volume automated production lines, the Bluetooth™ measurement suite provides the ideal functionality, performance and user interface.

- PXI Studio 2 supports bench-top manual operation for use during design integration or trouble-shooting.
- PXI Maestro provides a turnkey production ATE solution optimized for test speed and includes integrated control of the device under test and external PSU equipment to enable fast ramp up times.
- Measurement and analysis component libraries provide low level remote programming interfaces for ATE system integrators with custom requirements.
- Pre-defined Bluetooth™ test waveforms are supplied for standard Receiver Sensitivity measurements. Alternatively, IQCreator waveform generation software can be used to generate custom waveforms.
The Bluetooth® measurement suite is a collection of software tools for generating and characterizing Bluetooth® signals during design validation or production test. The software is designed for use in conjunction with the PXI 3000 Series of RF modular instruments and performs measurements in accordance with the methods of Bluetooth® Specification 1.2 / 2.0 / 2.0+EDR / 2.1 / 2.1+EDR and Low Energy 4.0.

Figure 1: Measurement Suite Software Component Architecture
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<td>TRM/CA/07/C</td>
<td>11110000 10101010</td>
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<td>BR Receiver Sensitivity</td>
<td>RCV/CA/01/C RCV/CA/02/C</td>
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<td>TRM/CA/13/C</td>
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<td>√</td>
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<tr>
<td>EDR Receiver Sensitivity</td>
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<tr>
<td>Modulation Characteristics</td>
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<td>RCV-LE/CA/01/C RCV-LE/CA/02/C</td>
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</table>

Table 1. Test coverage support with the Bluetooth® Measurement Suite
Figure 2. Studio 2, IQCreator and PXI Maestro example screenshots
IQCreator, PXI Maestro and PXI Studio 2 application software is supplied free of charge. Operation of the Bluetooth measurement suite or IQCreator requires simple activation of the relevant license key options on the PXI 3000 hardware.

Further information for these applications is available through the following links:

IQCreator
PXI Studio
PXI Maestro

The Bluetooth® measurement suite is suitable for characterizing devices operating in a non-signalling test mode. Measurement results for burst length, position, rise and fall times and power are provided for the entire packet as well as the individual GFSK and PSK modulated elements within the packet. For PSK modulation, the DEVM is reported together with max frequency error and origin offset. Time domain trace displays are provided for burst power, GFSK frequency deviation and DEVM. Additionally PSK modulation can be viewed as a constellation diagram.

Receiver sensitivity (BER) test for signals adhering to Test Suite Structure (TSS) and Test Purposes (TP) System Specification 1.2 / 2.0 / 2.0+EDR / 2.1 / 2.1+EDR revision 2.1E1 (2008) / 4.0 can be performed either in single ended or loopback mode. In loopback mode the device is configured to re-transmit received packets and the measurement suite performs the measurement and displays the result. In this case receiver and transmitter measurements can be performed concurrently.

A typical PXI installation for testing of WLAN, Bluetooth and other connectivity standard e.g. Zigbee™ wireless connectivity devices is shown in Figure 2 below. Ask Cobham Sales to recommend a system configuration for your application.

Figure 3. Typical PXI configuration

Figure3 illustrates a multi UE wireless connectivity test configuration comprising a PXI chassis with a PXI-PCIe interface to an external PC and populated with a VSG (3050A/3320), a VSA (3070A) and optional RF combiner module providing up to 4 DUT connection ports.
SPECIFICATION

BLUETOOTH® BR, EDR AND LOW ENERGY

Performance is specified over the frequency range 2400 MHz to 2483.5 MHz when used in conjunction with any 3030 Series or 3070A RF Digitizer with option 106 and where applicable any 3020 Series or 3050A RF signal generator.

PXI Maestro operation further requires Connectivity Test Sequencing option 203 enabled in 3030 Series or 3070A RF Digitizers.

Specifications are defined with the input signal applied to the RF Digitizer at the tuned frequency and at the reference level unless otherwise specified.

Measurements are performed in accordance with the requirements of Bluetooth® Specification 1.2 / 2.0 / 2.0+EDR / 2.1 / 2.1+EDR revision 2.1E1(2008) / 4.0

CONFIGURATION

Channel Number/Frequency
- BR and EDR: 0 to 78 or Hz
- LE: 0-39 or Hz

Packet Types
- BR and EDR: DHx, 2-DHx, 2-EVx, 3-DHx (where x = 1, 3, or 5), 2-EV3, 2-EV5, LE

Payload Length
- BR and EDR: Up to 1021 bytes
- LE: Up to 39 bytes

ARB File Impairment
- Dirty transmitter, frequency drift and dirty transmitter+frequency drift

Payload Bit Pattern
- 10101010, 11110000, PN9

Synchronization (Demodulation)
- RF burst and P0

EDR Blocks (x 50 symbols)
- 1 to 99999

Path Loss
- In dB

Triggering
- See digitizer plug-in

BR MEASUREMENTS

Output Power
- Average power across a burst (dBm)
- Peak power within a burst (dBm)
- Accuracy: typically ±0.3 dB

Power Density
- Measurements: Peak power density (dBm) per 100 kHz

TX Output Spectrum –20 dB Bandwidth
- Measurements: -20 dB bandwidth (kHz)

TX Output Spectrum Adjacent Channel Power
- Measurements: Adjacent channel power(s) in ±N channels (Max N =5)

Modulation Characteristics
- Measurements: Δfavg (Hz), Δfmax (Hz), Δf2max Pass Rate (%), Δf2avg /Δf1avg (ratio)
Packet type: longest supported (DH1, DH3, DH5)
Payload: 10101010 and 11110000

Bits above threshold: In compliance with the Bluetooth® Basic Rate test specification, a minimum of 99.9% of all measured bits must have a frequency deviation of at least 115 kHz.

**Initial Carrier Frequency Tolerance**
Measurements: ICFT, carrier behaviour at burst turn on

**Carrier Frequency Drift**
Measurements: carrier drift (per packet), drift rate in payload (per 50 μs)
Packet Type: DH1, DH3, DH5
Payload: 10101010

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**EDR MEASUREMENTS**

**Packet Types**
2-DHx, 2-EVx, 3-DHx

**EDR Relative Transmit Power**
Measurements:
a) GFSK (header) Avg power (dBm)
b) PSK payload Avg power (dBm)
c) Relative power (dB) between a) and b)

**EDR Carrier Frequency Stability and Modulation Accuracy**
Measurements: (taken per packet and EDR Blocks)
Worst case carrier frequency error ($\omega_o$) for all packets (Carrier frequency stability)
Worst case carrier frequency error ($\omega_i$) for all blocks
($\omega_o + \omega_i$) for all blocks
DEVM (rms & peak)
99% DEVM
Measurement uncertainties: Frequency error, typically 2 Hz excluding frequency reference error

**EDR In-band Spurious Emissions**
Adjacent channel powers dBm / dBc in ±N channel (Max N =5)

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**LE MEASUREMENTS**

**Output Power**
Average power across a burst (dBm)
Peak power within a burst (dBm)
Accuracy: typically ±0.3 dB

**Modulation Characteristics**
Measurements: $\Delta f_{avg}$ (Hz), $\Delta f_{max}$ (Hz), $\Delta f_{2max}$ Pass Rate (%), $\Delta f_{2avg}$ / $\Delta f_{1avg}$ (ratio)
Packet type: longest supported (LE)
Payload: 10101010 and 11110000

Bits above threshold: In compliance with the Bluetooth® low energy RF test specification, a minimum of 99.9% of all measured bits must have a frequency deviation of at least 185 kHz.

**Initial Carrier Frequency Tolerance**
Measurements: ICFT, carrier behaviour at burst turn on

**Carrier Frequency Drift**
Measurements: carrier drift (per packet), drift rate in payload (per 50 μs)
Packet Type: LE
Payload: 10101010
LE In-band Emissions

Adjacent channel powers dBm / dBc in ±N channel (Max N =5)

GENERAL BURST ANALYSIS

Measurement Results

Burst position based on both
- (leading Pav –3 dB point relative to start of burst) μs
- position of bit 0

Burst length (between Pav -3 dB points) μs based on both
- (leading Pav –3 dB point relative to start of burst) μs
- position of bit 0

Burst power (Pav and PPk ) dBm based on both
- (leading Pav –3 dB point relative to start of burst) μs
- position of bit 0

Rise time (10% Pav to 90% Pav ) μs
Fall time (90% Pav to 10% Pav ) μs

Measurement Uncertainty

Burst length, Rise time, fall time <2 samples
Burst power. As per specified 303x level accuracy

OCCUPIED BANDWIDTH (OBW)

Bandwidth containing 99% of total transmitted burst power

Indication
In Hz

Measurement Range
1 MHz

TRACES

Captured I&Q power (dBm) vs. time
Burst power (dBm) vs. time
GFSK frequency offset vs. time
DPSK DEVM (%) vs. symbol
DPSK measured and ideal constellation diagrams
Burst spectrum

BER

Measurement Results

Number of bits analyzed
Block error rate (%)
Number of error bits
Number of packets analyzed
Number of invalid packets
Packet error rate (%)
Number of error packets
Number of missing packets
Number of CRC error packets

Setup

Number of bits to analyze: 1 to 2,000,000
GENERAL

Operating System

Windows® 7/32 bit or 7/64 bit

Required Memory

512 Mbytes minimum, 1024 Mbytes recommended

2 Gbytes minimum when using PXI Maestro

Display Resolution

Minimum 1024 x 768

Other

PXI3000 Series modules require NI VISA version 4.6 or later
PXI 3000 Series module drivers version 7.0.0 or later

ORDERING

Bluetooth®

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