Application Note

BCM2073X

Manufacturing Bluetooth Test Tool

MMPMBT-AN100-R

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Revision History

Revision	*Date*	*Change Description*
MBT-AN100-R	07/30/14	Initial release

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About This Document

Purpose and Audience

This document provides information and test examples on using the manufacturing Bluetooth test tool (MBT) to test and verify the RF performance of the BCM2073x family of SoC Bluetooth Low Energy (BLE) devices. It is intended for development and test engineers who are working with those devices.

Acronyms and Abbreviations

In most cases, acronyms and abbreviations are defined on first use.

For a comprehensive list of acronyms and other terms used in Broadcom documents, go to: http://www.broadcom.com/press/glossary.php.

Document Conventions

The following conventions may be used in this document:

Convention	Description
Bold	User input and actions: for example, type exit, click **OK**, press **Alt + C**
`Monospace`	Code: `#include <iostream>` HTML: `<td rowspan = 3>` Command line commands and parameters: `wl [-l] <command>`
< >	Placeholders for *required* elements: enter your <username> or `wl <command>`
[ ]	Indicates optional command-line parameters: `wl [-l]` Indicates bit and byte ranges (inclusive): [0:3] or [7:0]

References

The references in this section may be used in conjunction with this document.

Note: Broadcom provides customer access to technical documentation and software through its Broadcom Support Community website (community.broadcom.com). Additional restricted material may be provided through the Customer Support Portal (CSP) and Downloads (support.broadcom.com).

For Broadcom documents, replace the "xx" in the document number with the largest number available in the repository to ensure that you have the most current version of the document.

Document (or Item) Name	Number	Source
Broadcom Items		
1] WICED Smart Quick Start Guide	WICED-Smart-QSG2xx-R	WICED Website
Other Items		
2] Bluetooth Specification, v4.1 [Vol 2]	—	Bluetooth SIG

Technical Support

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Overview

The manufacturing Bluetooth test tool (MBT) is used to test and verify the RF performance of the BCM2073x family of SoC Bluetooth Low Energy (BLE) devices. Each test sends an HCI command to the device and then waits for an HCI Command Complete event from the device.

Tests

Setup

To run the tests:

1. Configure the BCM2073x to run in the HCI mode. When a BCM2073x device starts up it looks for the HCI UART: if detected, the device stays in the HCI mode.
   Configuration example: to use a WICED Smart Tag board in the HCI mode, verify that all of the SW4 DIP switches are in the ON position.
2. Plug the BCM2073X into the computer and note the COM port assigned to the HCI UART. The COM port is used to send HCI commands and receive HCI events from the device.

Note: All examples in this document use COM4 as the port assigned to the BCM2073x by the PC. Replace “COM4” in each test example with the actual port assigned to the BCM2073x under test (see [1], for details on how to determine the assigned port).

Reset Test

This test verifies that the device is correctly configured and connected to the PC.

Usage: `mbt reset COMx`

The example below sends HCI_Reset command to the device and processes the HCI Command Complete event (see [2], Section 7.3.2 for details).

```
WICED-Smart-SDK\Tools\mbt\win32>mbt reset COM4
Sending HCI Command:
0000 < 01 03 0C 00 >
Received HCI Event:
0000 < 04 0E 04 01 03 0C 00 >
Success
```

The last byte of the HCI Command Complete event is the operation status, where 0 signifies success.

LE Receiver Test

This test configures the BCM2073x to receive reference packets at a fixed interval. External test equipment should be used to generate the reference packets.

The channel on which the device listens for the packets is passed as a parameter. BLE devices use 40 channels, each of which is 2 MHz wide. Channel 0 maps to 2402 MHz and Channel 39 maps to 2480 MHz (see [2], Section 7.8.28 for details).

Usage: `mbt le_receiver_test COMx <rx_channel>`

where:

- rx_channel = receive frequency minus 2402 divided by 2. For example, if the desired receive frequency is 2406 MHz then the rx_channel = (2406 – 2402) / 2 = 2.
  The channel range is 0–39 (2402–2480 MHz).

The example below starts the LE receiver test on Channel 2 (2406 MHz).

```
WICED-Smart-SDK\Tools\mbt\win32>mbt le_receiver_test COM4 2
Sending HCI Command:
0000 < 01 1D 20 01 02 >
Received HCI Event:
0000 < 04 0E 04 01 1D 20 00 >
Success
LE Receiver Test running, to stop execute mbt le_test_end COMx
```

The last byte of the HCI Command Complete event is the operation status, where 0 signifies success. Use `mbt le_test_end COMx` to complete the test and print the number of received packets.

Note: This test will fail if the device is running another test: use `le_test_end` or `reset` to put the BCM2073x in idle state before running this test.

LE Transmitter Test

The LE Transmitter Test configures the BCM2073x to send test packets at a fixed interval. External test equipment may be used to receive and analyze the reference packets.

The channel on which the BCM2073x transmits the packets is passed as a parameter. BLE devices use 40 channels, each of which is 2 MHz wide. Channel 0 maps to 2402 MHz and Channel 39 maps to 2480 MHz.

The other two parameters specify the length of the test data and the data pattern to be used (see [2], Section 7.8.29 for details).

Usage: `mbt le_transmitter_test COMx <tx_channel> <data_length> <packet_payload>`

where:

- tx_channel = transmit frequency minus 2402 divided by 2. For example, if the transmit frequency is 2404 MHz then the tx_channel = (2404 – 2402) / 2 =1.
  The channel range is 0–39 (2402–2480 MHz).
- data_length = 0–37
- data_pattern = 0–7
  - 0 = Pseudo-random bit sequence 9
  - 1 = Pattern of alternating bits: 11110000
  - 2 = Pattern of alternating bits: 10101010
  - 3 = Pseudo-random bit sequence 15
  - 4 = Pattern of all 1s
  - 5 = Pattern of all 0s
  - 6 = Pattern of alternating bits: 00001111
  - 7 = Pattern of alternating bits: 0101

The example below starts the test and instructs the device to transmit packets on Channel 2 (2406 MHz), with a 10-byte payload of all ones (1s).

```
WICED-Smart-SDK\Tools\mbt\win32>mbt le_transmitter_test COM4 2 10 4
Sending HCI Command:
0000 < 01 1E 20 03 02 0A 04 >
Received HCI Event:
0000 < 04 0E 04 01 1E 20 00 >
Success
LE Transmitter Test running, to stop execute mbt le_test_end COMx
```

The last byte of the HCI Command Complete event is the status of the operation, where 0 signifies the success.

Use `mbt le_test_end COMx` to complete the test.

Note: This test will fail if the device is running another test: use `le_test_end` or `reset` to put the BCM2073x in idle state before running this test.

LE Test End

This command stops the LE Transmitter or LE Receiver Test that is in progress on the BCM2073x.

The number of packets received during the test is reported by the device and printed out. The value will always be zero (0) if the LE Transmitter Test was active (see [2], Section 7.8.30 for details).

Usage: `mbt le_test_end COMx`

The example below stops the active test.

```
WICED-Smart-SDK\Tools\mbt\win32>mbt le_test_end COM4
Sending HCI Command:
0000 < 01 1F 20 00 >
Received HCI Event:
0000 < 04 0E 06 01 1F 20 00 00 00 >
Success num_packets_received 0
```

Continuous Transmit Test

Note: Unlike the LE tests, this test uses 79 frequencies, each 1 MHz wide.

This test configures the BCM2073x to turn the carrier ON or OFF. When the carrier is ON the device transmits an unmodulated pattern on the specified frequency at a specified power level.

The frequency to be used by the BCM2073x is passed as a parameter.

The PA table for the BLE BCM2073x family of devices is hard-coded to +3, –1, –5, –9, –13, –17, –21, and –25 dB. This table conforms to a power control type compliance format (4 dB steps). If a different value is specified in the test, the device will round the transmit power to the nearest value in the PA table.

Usage: `mbt set_tx_frequency_arm COMx <carrier on/off> <tx_frequency> <tx_power>`

where:

- carrier on/off:
  - 1 = carrier ON
  - 0 = carrier OFF
- tx_frequency = (2402 – 2480) transmit frequency, in MHz
- tx_power = (–25 to +3) transmit power, in dBm

The example below turns the carrier ON and instructs the BCM2073x to transmit an unmodulated pattern on 2402 MHz at 3 dBm.

```
WICED-Smart-SDK\Tools\mbt\win32> mbt set_tx_frequency_arm COM4 1 2402 3
Sending HCI Command:
0000 < 01 14 FC 07 00 02 00 03 08 03 00 >
Received HCI Event:
0000 < 04 0E 04 01 14 FC 00 >
Success
```

To stop the test, send the command a second time to the same COM port with the carrier on/off parameter set to zero (0). No other parameters are used.

```
WICED-Smart-SDK\Tools\mbt\win32>mbt set_tx_frequency_arm COM4 0 0 0
Sending HCI Command:
0000 < 01 14 FC 07 00 02 00 03 08 03 00 >
Received HCI Event:
0000 < 04 0E 04 01 14 FC 00 >
Success
```

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