AN214785

Establishing Bluetooth Low Energy (BLE) Connections and Conducting Throughput Testing Using Bluetool™

Associated Part Family: CYW20704

This document provides procedures that describe how to establish BLE connections and conduct throughput measurements using the Broadcom® BlueTool™ software utility. The document shows software engineers how to use BlueTool™ software to prepare two CYW20704-equipped devices for Bluetooth throughput testing.

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1 About This Document

1.1 Cypress Part Numbering Scheme

Cypress is converting the acquired IoT part numbers from Broadcom to the Cypress part numbering scheme. Due to this conversion, there is no change in form, fit, or function as a result of offering the device with Cypress part number marking. The table provides Cypress ordering part number that matches an existing IoT part number.

Table 1. Mapping Table for Part Number between Broadcom and Cypress

Broadcom Part Number	Cypress Part Number
BCM20704	CYW20704

1.2 Acronyms and Abbreviations

In most cases, acronyms and abbreviations are defined on first use. For a more complete list of acronyms and other terms used in Cypress documents, go to: http://www.cypress.com/glossary.

2 IoT Resources

Cypress provides a wealth of data at http://www.cypress.com/internet-things-iot to help you to select the right IoT device for your design, and quickly and effectively integrate the device into your design. Cypress provides customer access to a wide range of information, including technical documentation, schematic diagrams, product bill of materials, PCB layout information, and software updates. Customers can acquire technical documentation and software from the Cypress Support Community website (http://community.cypress.com/).

3 System Requirements

3.1 Host System Requirements

A personal computer running the Microsoft® Windows® operating system is required to use BlueTool. Broadcom recommends running Windows XP. However, other versions of Windows are supported.

Note: BlueTool is frequently updated, resulting in operational and other changes to the graphical user interface. Consequently, this document only contains basic instructions on using BlueTool. These instructions should remain the same for all BlueTool releases. If discrepancies exist between this document and the version of BlueTool you are using, contact your Broadcom technical representative.

3.2 Hardware Requirements

The following hardware is required to use BlueTool:

- Two USB cables.
- Two Broadcom Bluetooth CYW20704-based devices.
- Two UART-to-USB adapter boards. If using the CYW20704's USB transport, adapter boards are not required.

Note: Contact your Cypress sales representative for the UART-to-USB adapter boards.

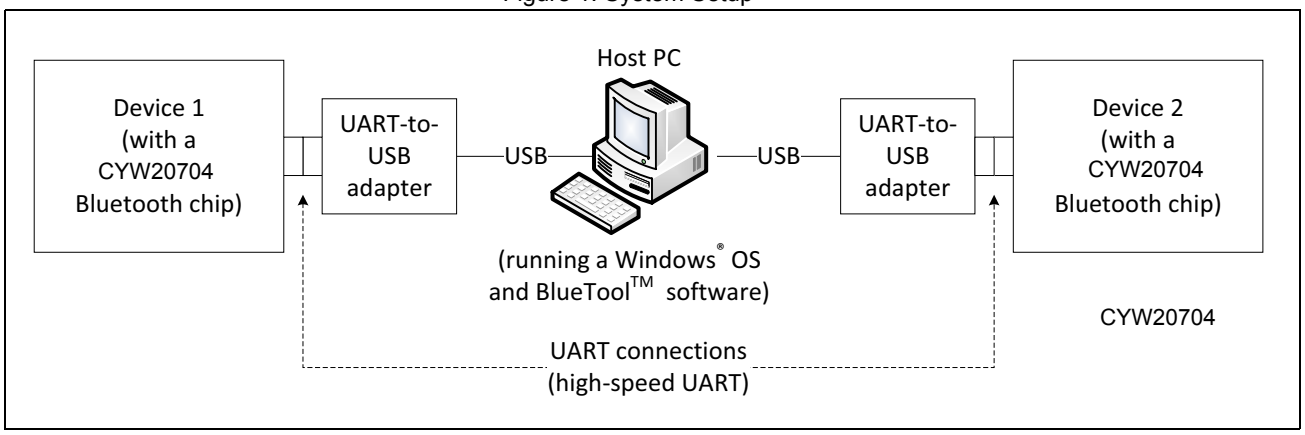
3.3 Software Requirements

BlueTool provides support for Perl® scripting. If this feature is being used to automate throughput testing, then a Win32® version of ActivePerl (5.8.4 or higher) must be installed on the host computer. Earlier versions of ActivePerl are not supported.

Note: ActivePerl is available from ActiveState at www.activestate.com.

4 System Connections

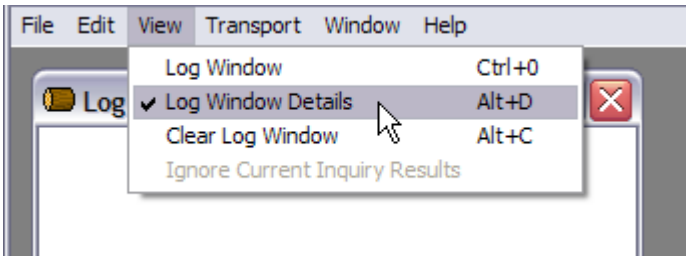
Figure 1. System Setup



5 Launching BlueTool

Complete these steps to launch BlueTool and display the log window:

1. Click **Start>All Programs>Broadcom BlueTool>BlueTool** to open the BlueTool application.
2. In BlueTool, click **View>Log Window** to display the log window.
3. Click **View>Log Window Details** to enable the log window to display detailed log information.



6 Configuring BlueTool for LE Connections and Throughput Testing

This section contains instructions on configuring BlueTool for over-the-air throughput testing.

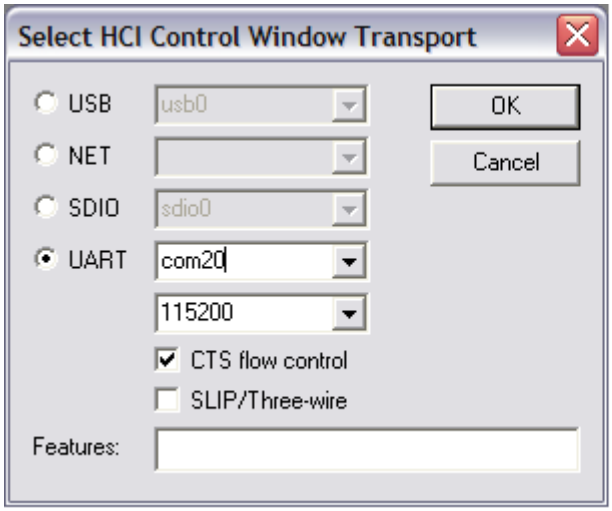
- Setting Up the HCI Control Transport on page 3
- Low Energy Control for Advertising on page 5
- Setting Up Devices for Throughput Testing on page 10

Note: As shown in Figure 1 on page 2, the host PC has two UART connections. The associated COM ports displayed in the screenshots of this section are com20 and com21. These COM ports can vary among different test setups.

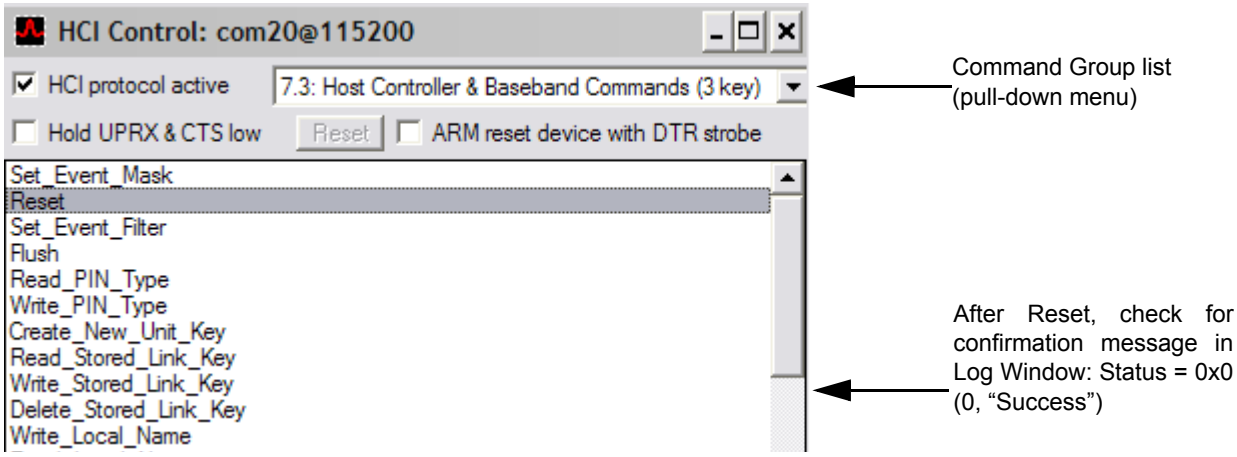
6.1 Setting Up the HCI Control Transport

6.1.1 Setting Up the HCI Control Transport for Device 1

1. Click **Transport>HCI Control** (keyboard shortcut **CTRL+1**) to display the Select HCI Control Window Transport window.

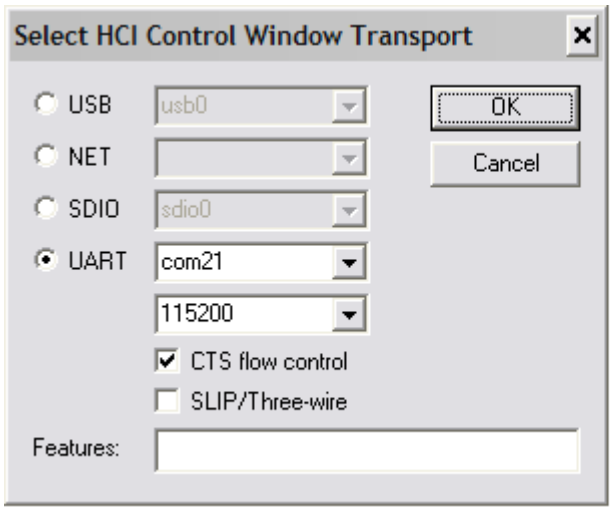


2. Select the **UART** option and select or type the Device 1 COM port, and then click **OK**.
   BlueTool displays an HCI Control window with the selected COM port and rate displayed in the window title. For the following screenshot, the port and data rate is shown as com20@115200. If using USB transport, select the USB option and select the correct USB port, and then click **OK**.

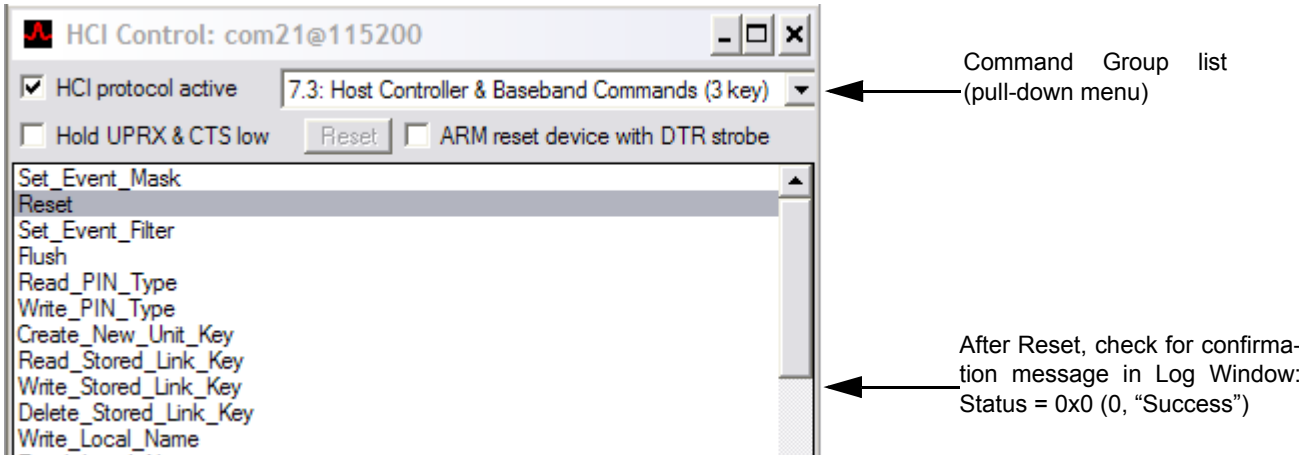


6.1.2 Setting Up the HCI Control Transport for Device 2

1. Click **Transport>HCI Control** (keyboard shortcut **CTRL+1**) to display the Select HCI Control Window Transport window.



2. Select the **UART** option and select or type the Device 2 COM port, and then click **OK**.
   BlueTool displays an HCI Control window with the selected COM port and rate displayed in the window title. For the following screenshot, the port and rate are shown as com21@115200. If using USB transport, select the USB option and select the correct USB port, and then click **OK**.



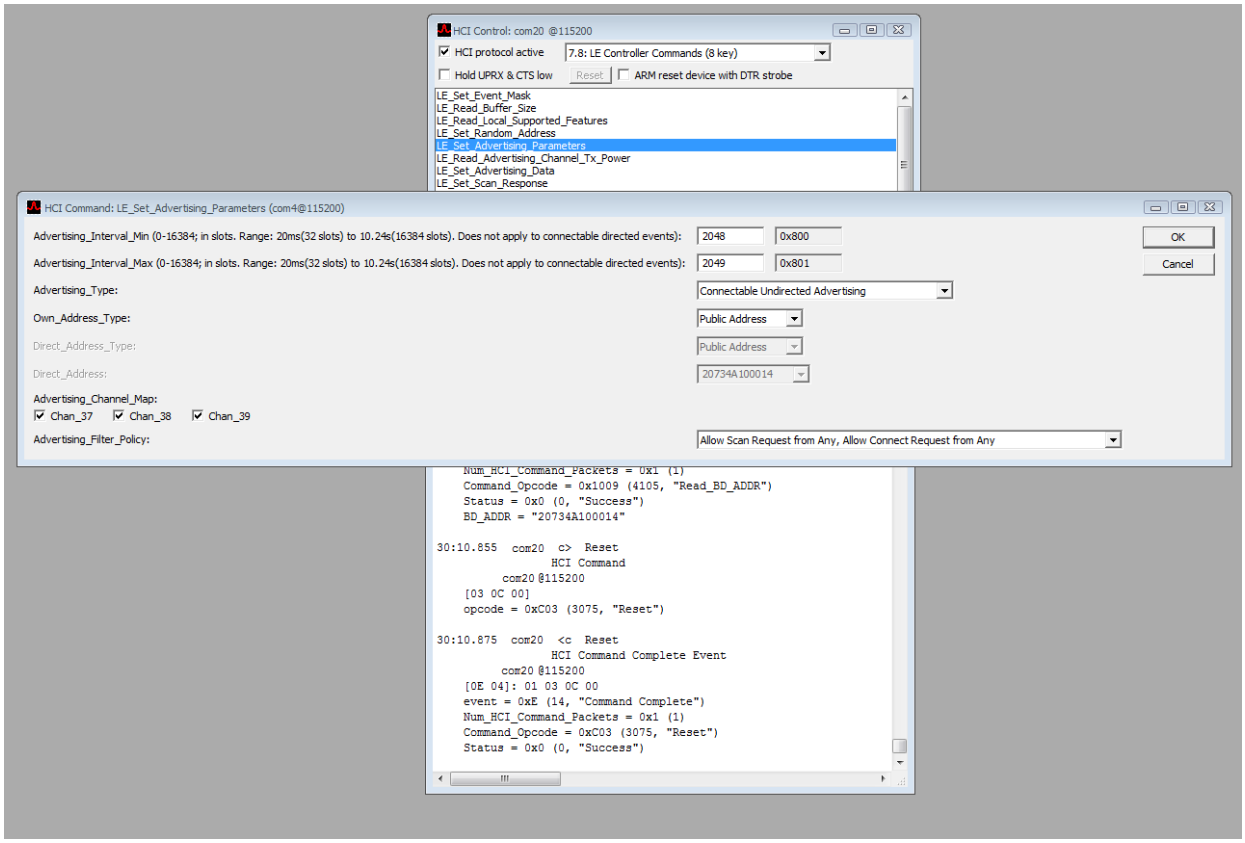
6.2 Low Energy Control for Advertising

Advertising is done between boards via ports. This procedure describes advertising between two CYW20704-equipped devices.

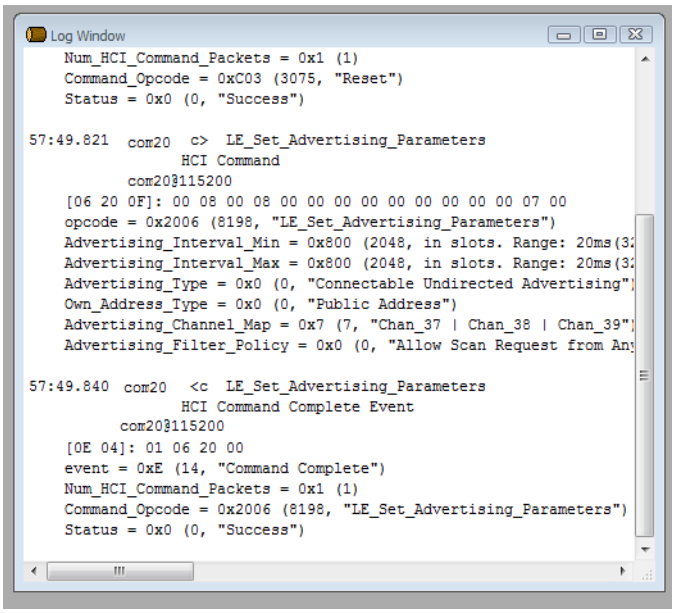
6.2.1 Setting LE Advertising Parameters

These steps apply to the first of two CYW20704-equipped boards.

1. In the HCI Control window, do the following to set advertising parameters:
   a. Select **7.8: LE Controller Commands (8 key)** from the Command Group list.
   b. From the list of available subcommands, select **LE_Set_Advertising_Parameters**.
2. Enter the settings according to the screenshot shown below:

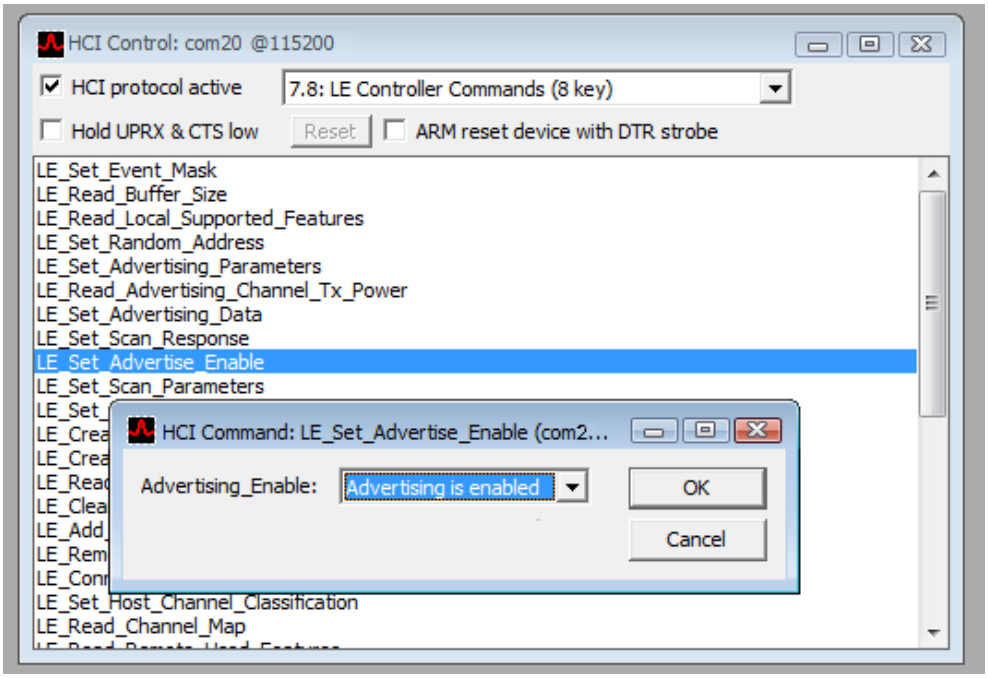


3. Click **OK** and check for success status in the log window as shown in the following screenshot.

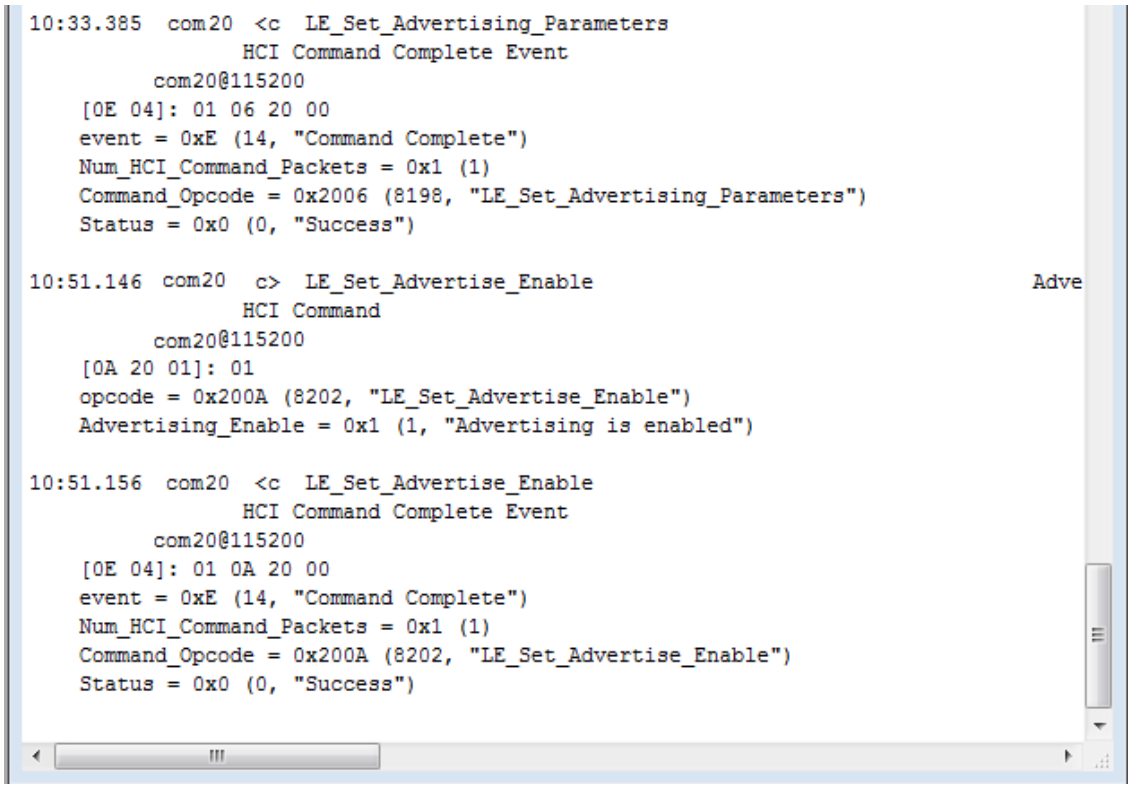


6.2.2 Enabling LE Advertising Parameters

1. In the HCI Control window, do the following to enable advertising parameters:
   a. Select **7.8: LE Controller Commands (8 key)** from the Command Group list.
   b. From the list of available subcommands, select **LE_Set_Advertise_Enable.**
2. Select **Advertising is enabled** according to the screenshot shown below:



3. Click **OK** and make sure LE advertise has been enabled. This is confirmed by the display of the Status=0x0 (0,"success") message as shown in the following screenshot.

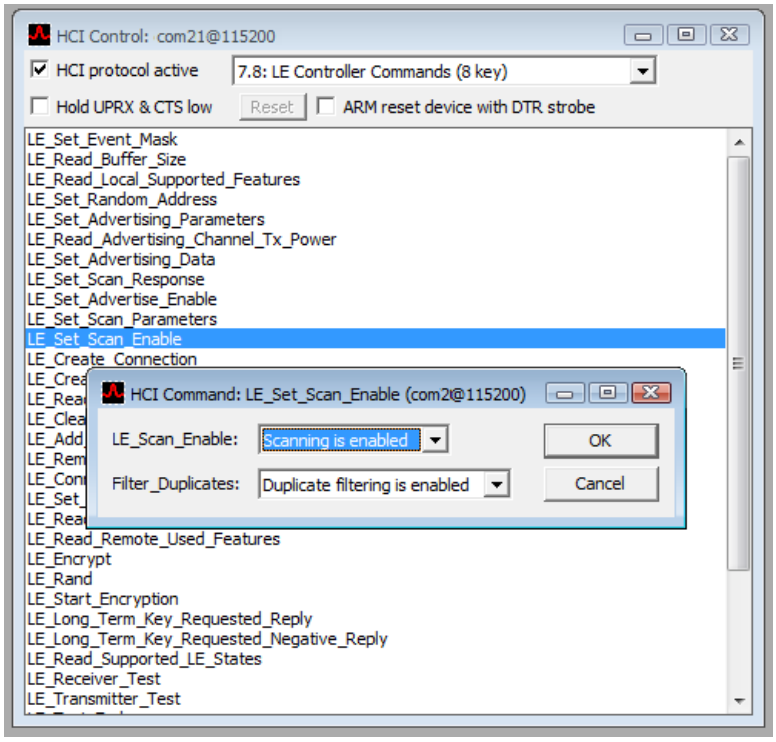


6.3 Starting an LE Connection

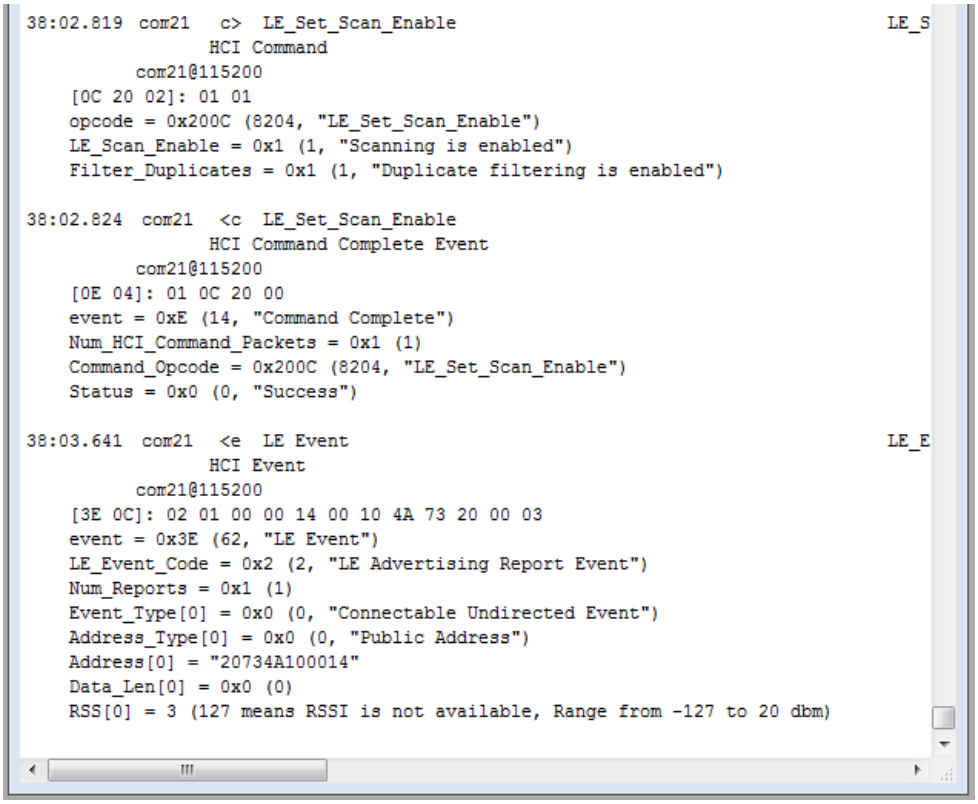
These steps apply to the second of two CYW20704-equipped boards.

6.3.1 Enabling LE Scanning

1. In the HCI Control window, do the following to enable LE scanning:
   a. Select **7.8: LE Controller Commands (8 key)** from the Command Group list.
   b. From the list of available subcommands, select **LE_Set_Scan_Enable.**
2. Select **Scanning is enabled** and **Duplicate filtering is enabled** according to the screenshot shown below:



3. Click **OK** and check to verify that LE scan is enabled as shown in the following screenshot.

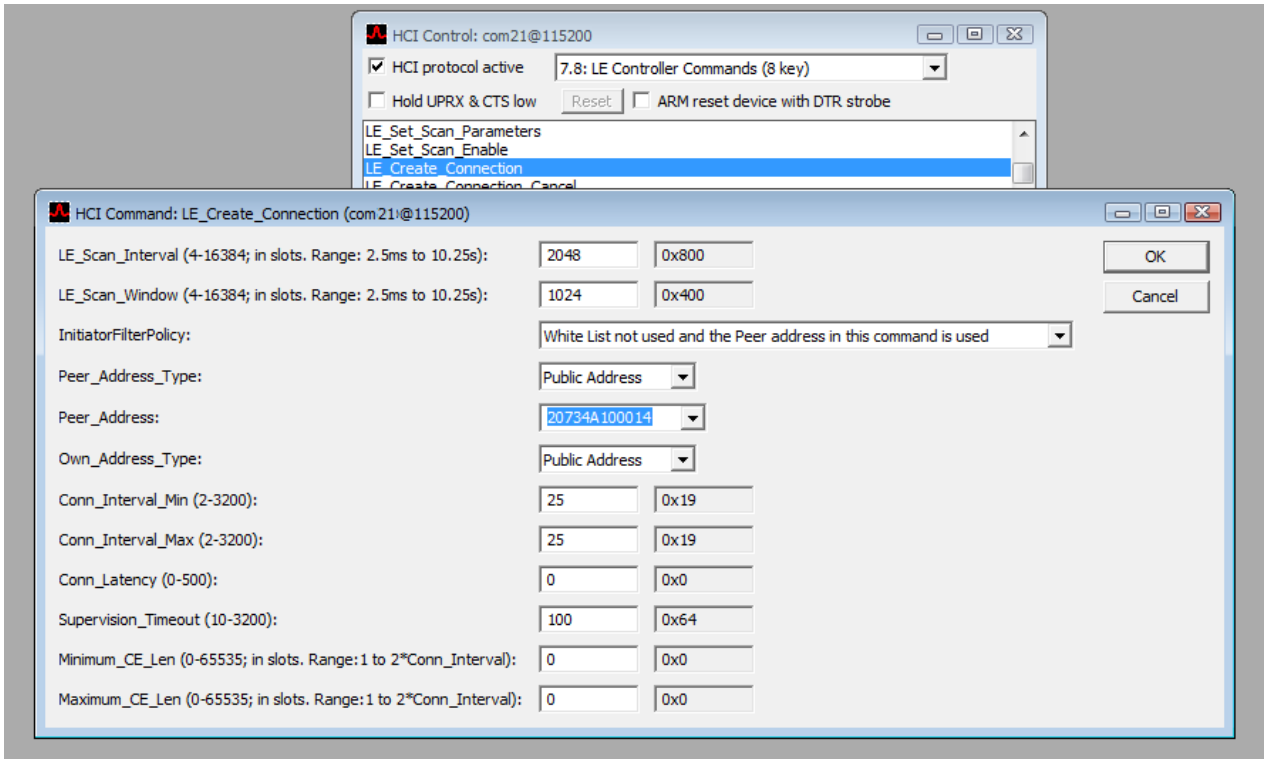


```
38:02.819  com21   c>  LE_Set_Scan_Enable                                    LE_S
                  HCI Command
           com21@115200
    [0C 20 02]: 01 01
    opcode = 0x200C (8204, "LE_Set_Scan_Enable")
    LE_Scan_Enable = 0x1 (1, "Scanning is enabled")
    Filter_Duplicates = 0x1 (1, "Duplicate filtering is enabled")

38:02.824  com21   <c  LE_Set_Scan_Enable
                  HCI Command Complete Event
           com21@115200
    [0E 04]: 01 0C 20 00
    event = 0xE (14, "Command Complete")
    Num_HCI_Command_Packets = 0x1 (1)
    Command_Opcode = 0x200C (8204, "LE_Set_Scan_Enable")
    Status = 0x0 (0, "Success")

38:03.641  com21   <e  LE Event                                            LE_E
                  HCI Event
           com21@115200
    [3E 0C]: 02 01 00 00 14 00 10 4A 73 20 00 03
    event = 0x3E (62, "LE Event")
    LE_Event_Code = 0x2 (2, "LE Advertising Report Event")
    Num_Reports = 0x1 (1)
    Event_Type[0] = 0x0 (0, "Connectable Undirected Event")
    Address_Type[0] = 0x0 (0, "Public Address")
    Address[0] = "20734A100014"
    Data_Len[0] = 0x0 (0)
    RSS[0] = 3 (127 means RSSI is not available, Range from -127 to 20 dbm)
```

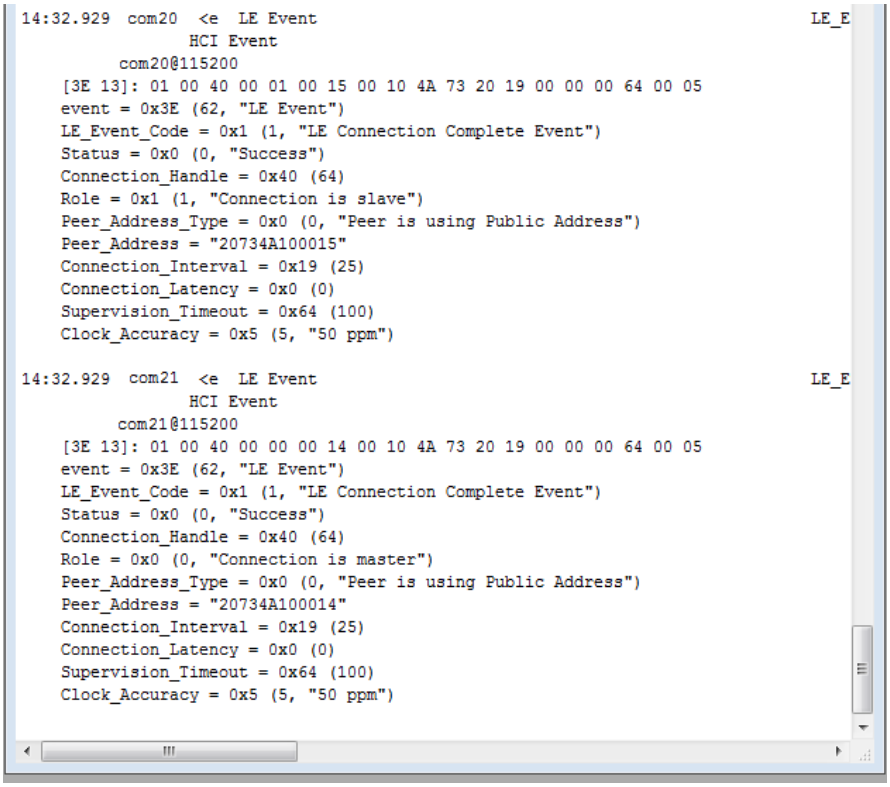
6.3.2 Creating an LE Connection

1. In the HCI Control window, do the following to enable LE scanning:
   a. Select **7.8: LE Controller Commands (8 key)** from the Command Group list.
   b. From the list of available subcommands, select **LE_Create_Connection**.
2. Select the settings according to the screenshot shown below.

Note: The Peer_Address is the BD_Address of the port for the device that was configured as *Advertise Enabled* (see Enabling LE Advertising Parameters on page 6).



3. Click **OK** once the settings illustrated above are set. To confirm that the creation of a connection is completed, see the display of the Status=0x0 (0,"success") message as shown in the following screenshot.

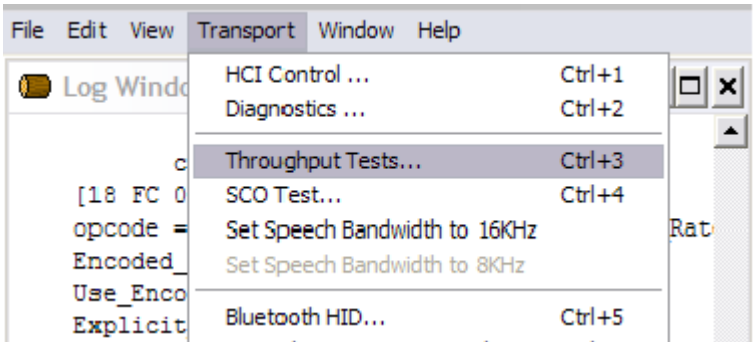


6.4 Setting Up Devices for Throughput Testing

The screenshot used in this section applies to configuration for both Device 1 and Device 2.

6.4.1 Preparing Device 1

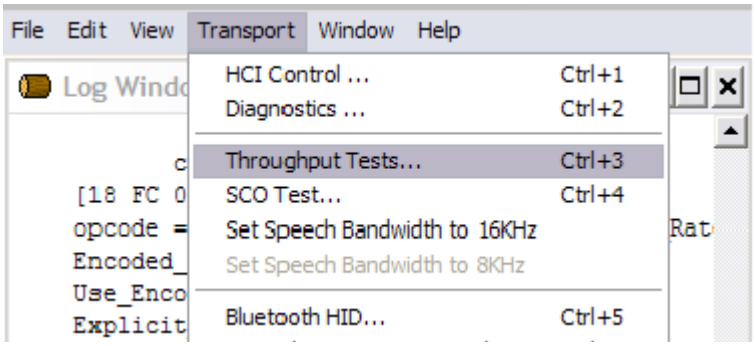
1. Click **Transport>Throughput Tests...** (keyboard shortcut **CTRL+3**).



2. In the Select Throughput Tests Transport window, choose **UART**, select or type the Device 1 COM port, and then click **OK**. If using USB transport, select the USB option and select the correct USB port, and then click **OK**.

6.4.2 Preparing Device 2

1. Click **Transport>Throughput Tests...** (keyboard shortcut **CTRL+3**).

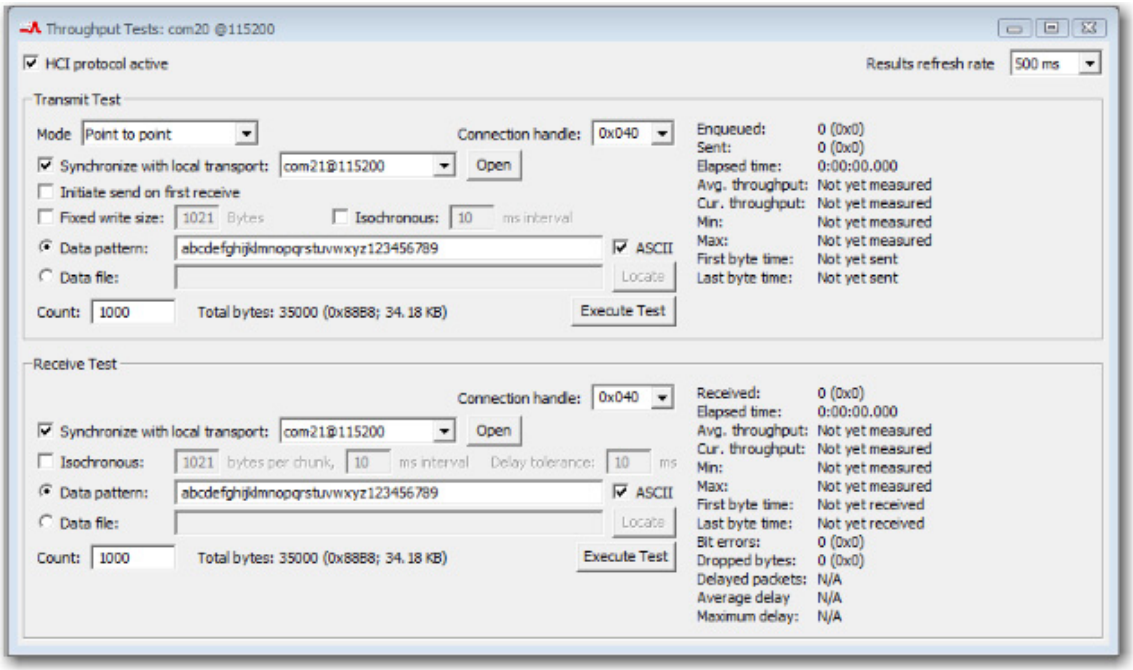


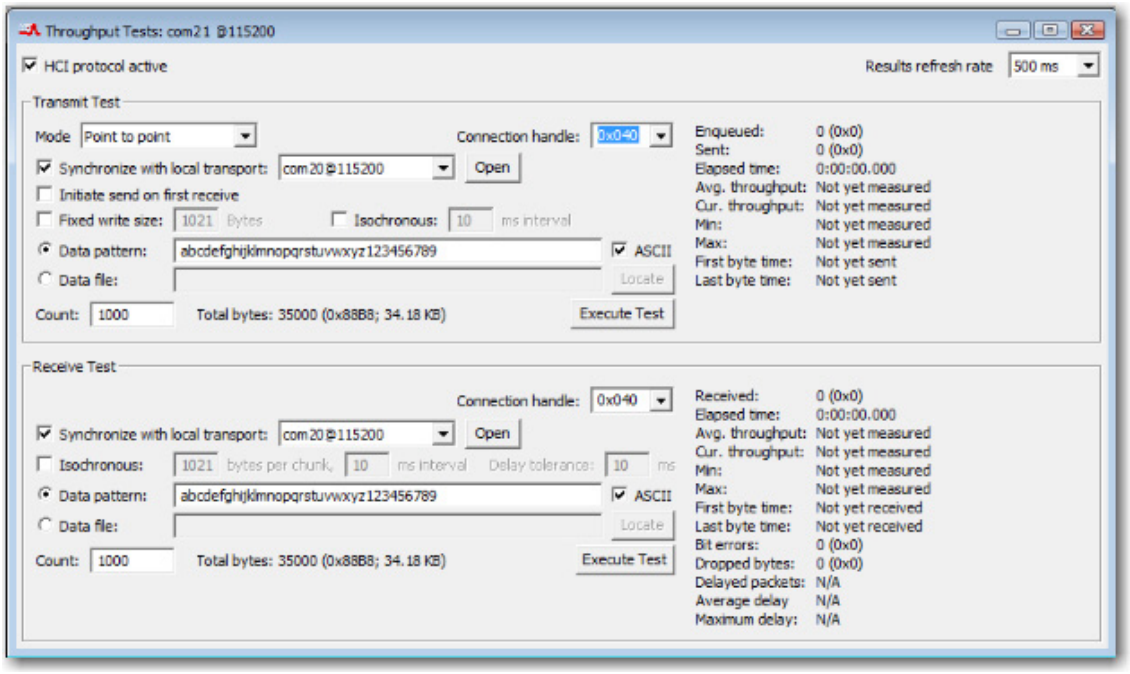
2. In the Select Throughput Tests Transport window, choose **UART**, select or type the Device 2 COM port, and then click **OK**. If using USB transport, select the USB option and select the correct USB port, and then click **OK**.

6.4.3 Setting up Throughput

1. In the Throughput Tests window, do the following in both the Transmit Test and Receive Test panes:
   a. Verify that a value is generated for the connection handle.
   b. Select the **Data pattern** option.
   c. If not already selected, select **ASCII**, and then enter the desired data pattern (a typical ASCII data pattern is a string of alphanumeric characters).
   d. In the Count field, enter the number of bytes to be sent, being sure not to exceed the total byte limitations of the host PC.
2. Select **Synchronize with local transport**, and then select the communications port for the other device.

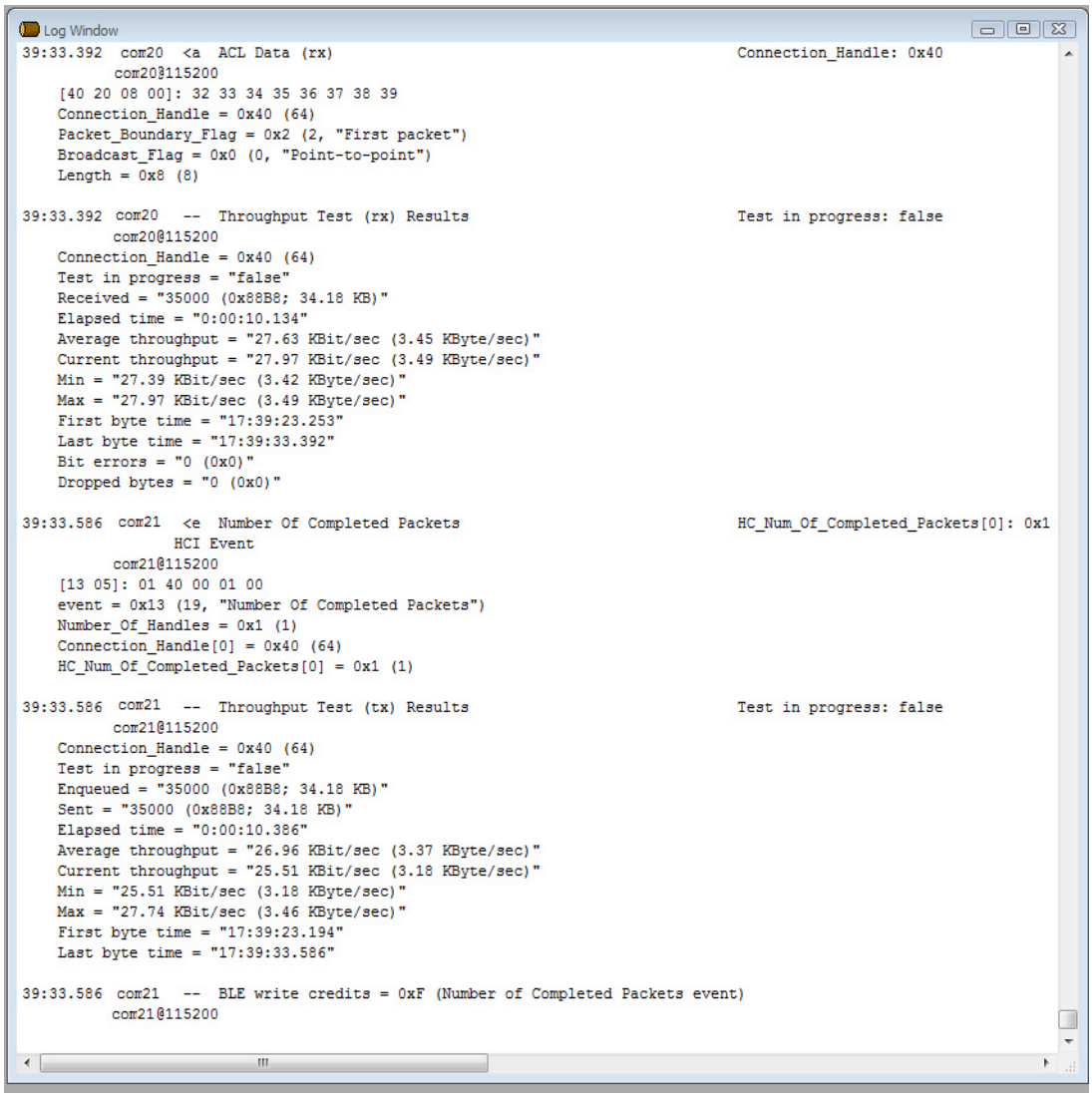
   The following two screenshots show representative configuration examples.




Throughput Tests: com21 @115200
HCI protocol active
Results refresh rate
500 ms
Transmit Test
Mode
Point to point
Connection handle:
0x040
Synchronize with local transport:
com20@115200
Open
Initiate send on first receive
Fixed write size:
1021
Bytes
Isochronous:
10
ms interval
Data pattern:
abcdefghijklmnopqrstuvwxyz123456789
ASCII
Data file:
Locate
Count:
1000
Total bytes: 35000 (0x88B8; 34.18 KB)
Execute Test
Enqueued: 0 (0x0)
Sent: 0 (0x0)
Elapsed time: 0:00:00.000
Avg. throughput: Not yet measured
Cur. throughput: Not yet measured
Min: Not yet measured
Max: Not yet measured
First byte time: Not yet sent
Last byte time: Not yet sent
Receive Test
Connection handle:
0x040
Synchronize with local transport:
com20@115200
Open
Isochronous:
1021
bytes per chunk,
10
ms interval
Delay tolerance:
10
ms
Data pattern:
abcdefghijklmnopqrstuvwxyz123456789
ASCII
Data file:
Locate
Count:
1000
Total bytes: 35000 (0x88B8; 34.18 KB)
Execute Test
Received: 0 (0x0)
Elapsed time: 0:00:00.000
Avg. throughput: Not yet measured
Cur. throughput: Not yet measured
Min: Not yet measured
Max: Not yet measured
First byte time: Not yet received
Last byte time: Not yet received
Bit errors: 0 (0x0)
Dropped bytes: 0 (0x0)
Delayed packets: N/A
Average delay N/A
Maximum delay: N/A

6.4.4 Executing Test

1. Click **Execute Test** in the Transmit Test pane to automatically select the Receive Test settings for the second device communications port.
2. The following screenshot shows the results in the Log Window.



Document History Page

Document Title: AN214785 - Establishing Bluetooth Low Energy (BLE) Connections and Conducting Throughput Testing Using Bluetool™ Document Number: 002-14785				
Rev.	**ECN No.**	**Orig. of Change**	**Submission Date**	**Description of Change**
**	–	–	05/08/2015	20704-AN400-R Initial release
*A	5461612	UTSV	10/04/2016	Updated to Cypress template Added Cypress part numbering scheme
*B	5883803	AESATMP8	09/14/2017	Updated logo and Copyright.

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