

# 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.

## Contents

1	About This Document.....	1	5	Launching BlueTool.....	2
1.1	Cypress Part Numbering Scheme.....	1	6	Configuring BlueTool for LE Connections and Throughput Testing .....	3
1.2	Acronyms and Abbreviations.....	1	6.1	Setting Up the HCI Control Transport.....	3
2	IoT Resources.....	1	6.2	Low Energy Control for Advertising .....	5
3	System Requirements.....	2	6.3	Starting an LE Connection .....	7
3.1	Host System Requirements.....	2	6.4	Setting Up Devices for Throughput Testing .....	10
3.2	Hardware Requirements .....	2		Document History Page .....	14
3.3	Software Requirements.....	2		Worldwide Sales and Design Support .....	15
4	System Connections .....	2			

## 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.

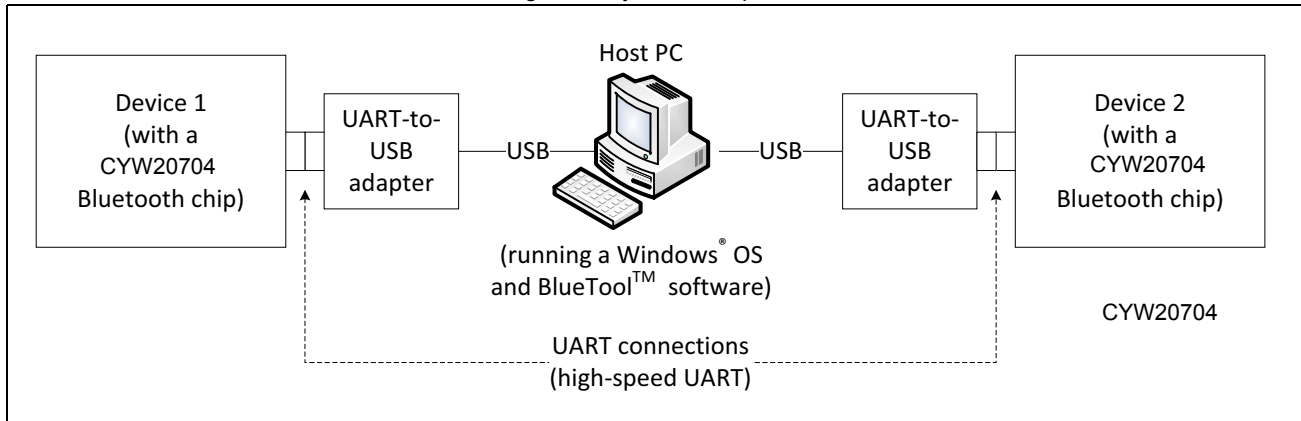
#### 3.3 Software Requirements

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](http://www.activestate.com).

### 4 System Connections

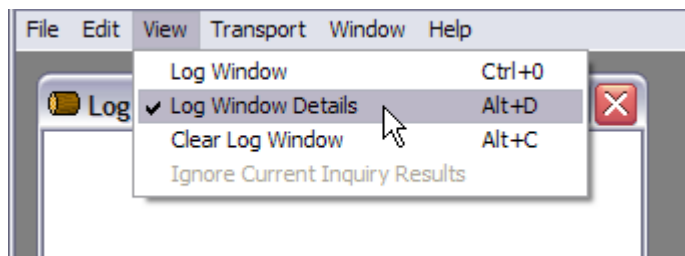
Figure 1. System Setup



### 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.

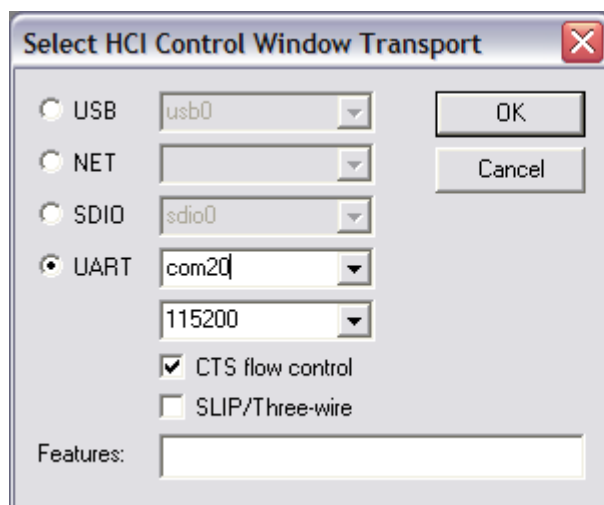
- [Setting Up the HCI Control Transport on page 3](#)
- [Low Energy Control for Advertising on page 5](#)
- [Setting Up Devices for Throughput Testing on page 10](#)

**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.

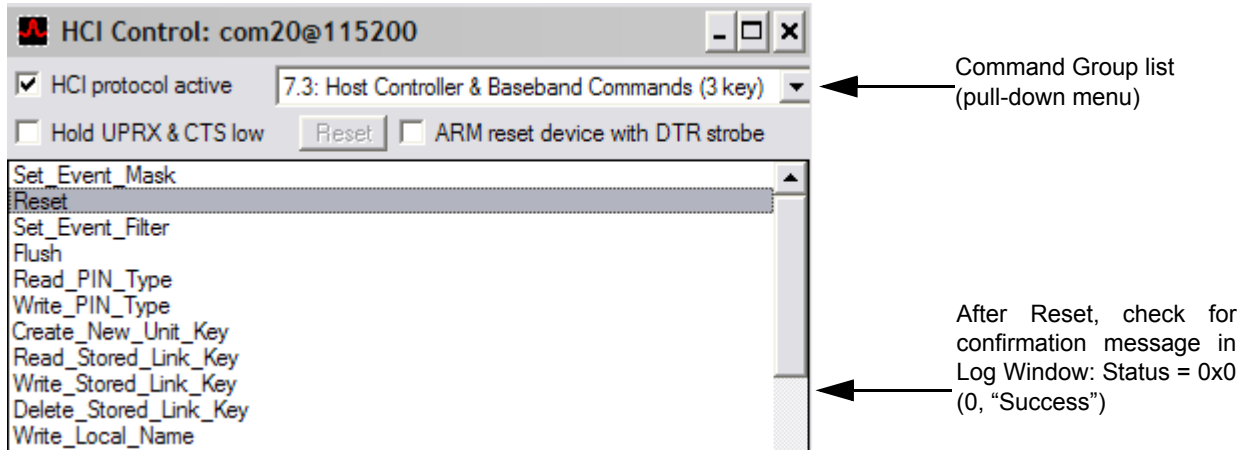
### 6.1 Setting Up the HCI Control Transport

#### 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.

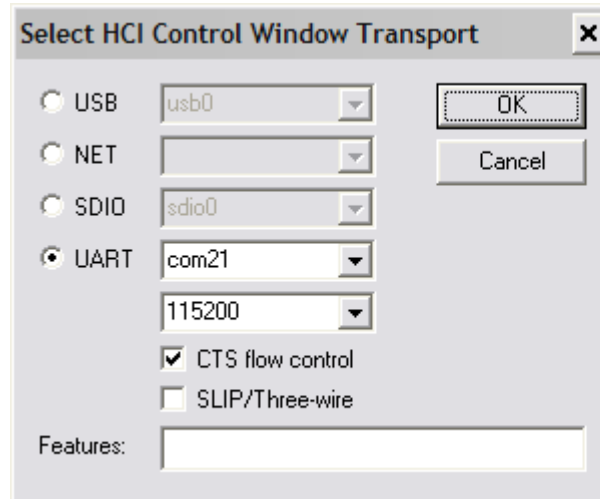


2. Select the **UART** option and select or type the Device 1 COM port, and then click **OK**.  
BlueTool displays an HCI Control window with the selected COM port and rate displayed in the window title. For the following screenshot, the port and data rate is shown as com20@115200. If using USB transport,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

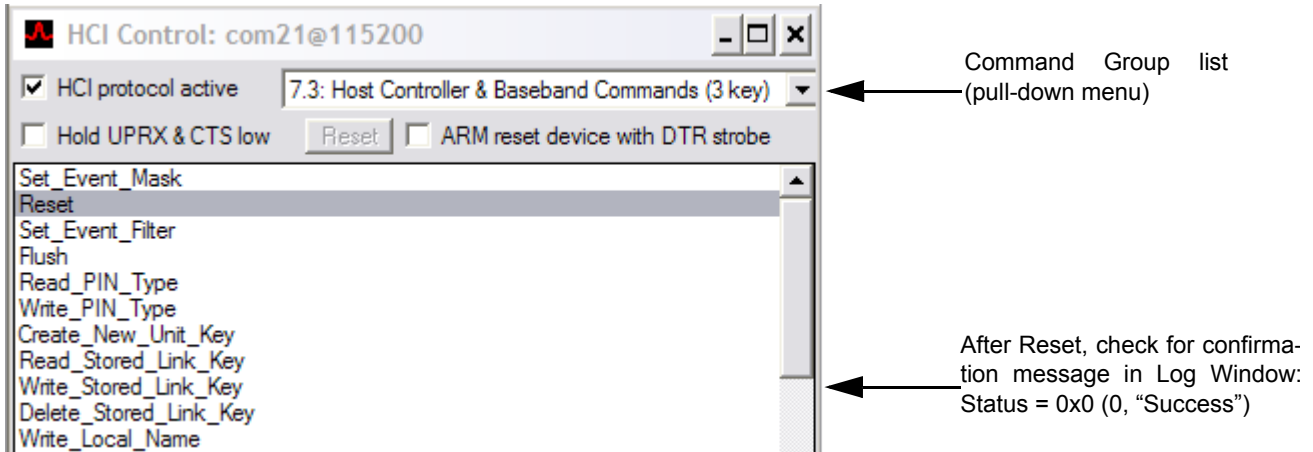


### 6.1.2 Setting Up the HCI Control Transport for Device 2

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**.



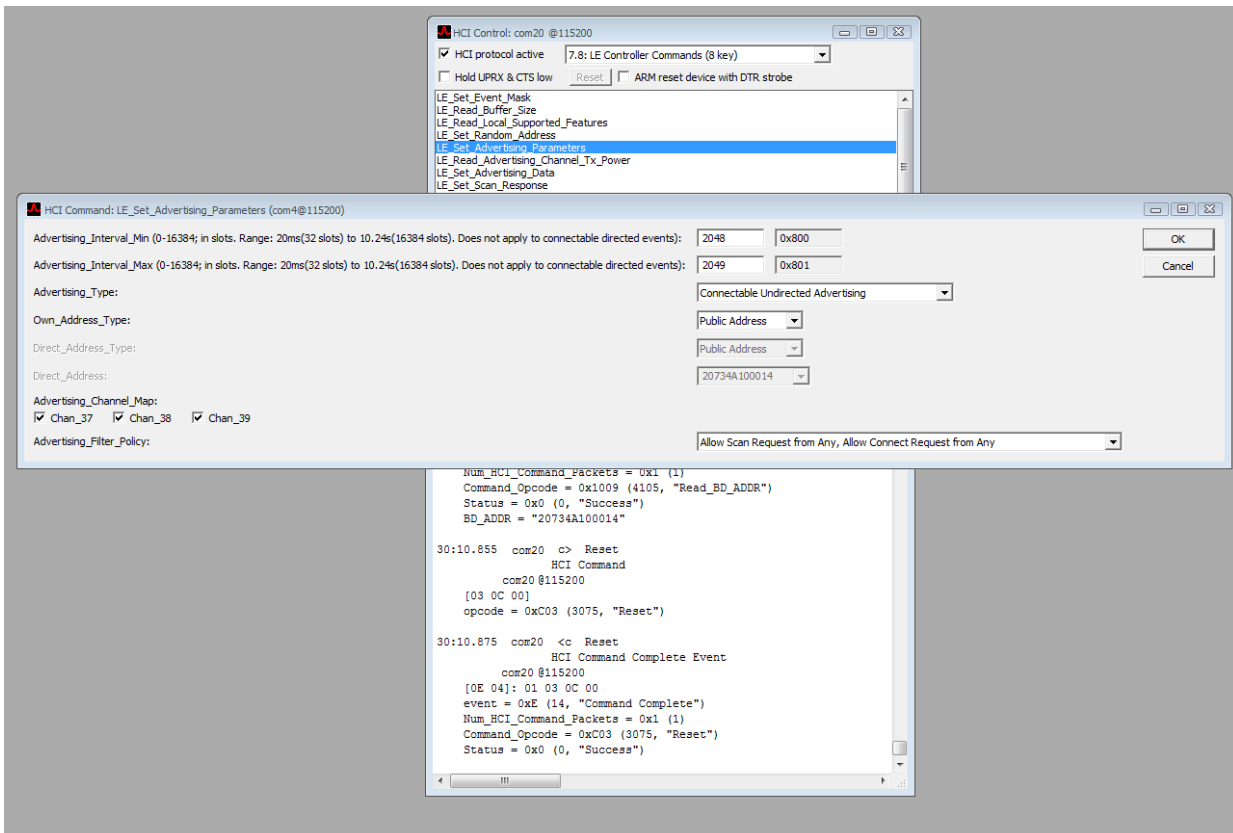
## 6.2 Low Energy Control for Advertising

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

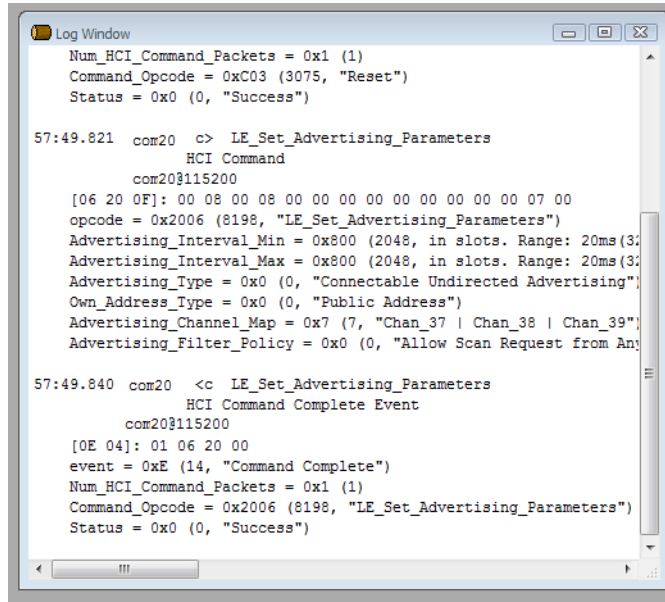
### 6.2.1 Setting LE Advertising Parameters

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:

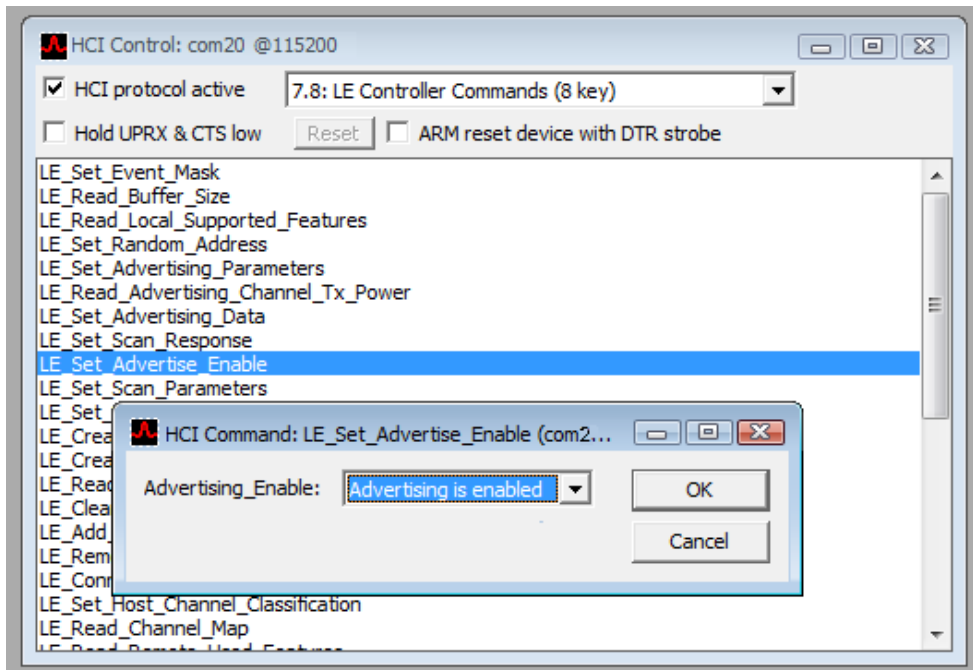


3. Click **OK** and check for success status in the log window as shown in the following screenshot.



### 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.

```

10:33.385 com20 <c LE_Set_Advertising_Parameters
                HCI Command Complete Event
                com20@115200
                [0E 04]: 01 06 20 00
                event = 0xE (14, "Command Complete")
                Num_HCI_Command_Packets = 0x1 (1)
                Command_Opcode = 0x2006 (8198, "LE_Set_Advertising_Parameters")
                Status = 0x0 (0, "Success")

10:51.146 com20 <c> LE_Set_Advertise_Enable
                HCI Command
                com20@115200
                [0A 20 01]: 01
                opcode = 0x200A (8202, "LE_Set_Advertise_Enable")
                Advertising_Enable = 0x1 (1, "Advertising is enabled")

10:51.156 com20 <c LE_Set_Advertise_Enable
                HCI Command Complete Event
                com20@115200
                [0E 04]: 01 0A 20 00
                event = 0xE (14, "Command Complete")
                Num_HCI_Command_Packets = 0x1 (1)
                Command_Opcode = 0x200A (8202, "LE_Set_Advertise_Enable")
                Status = 0x0 (0, "Success")

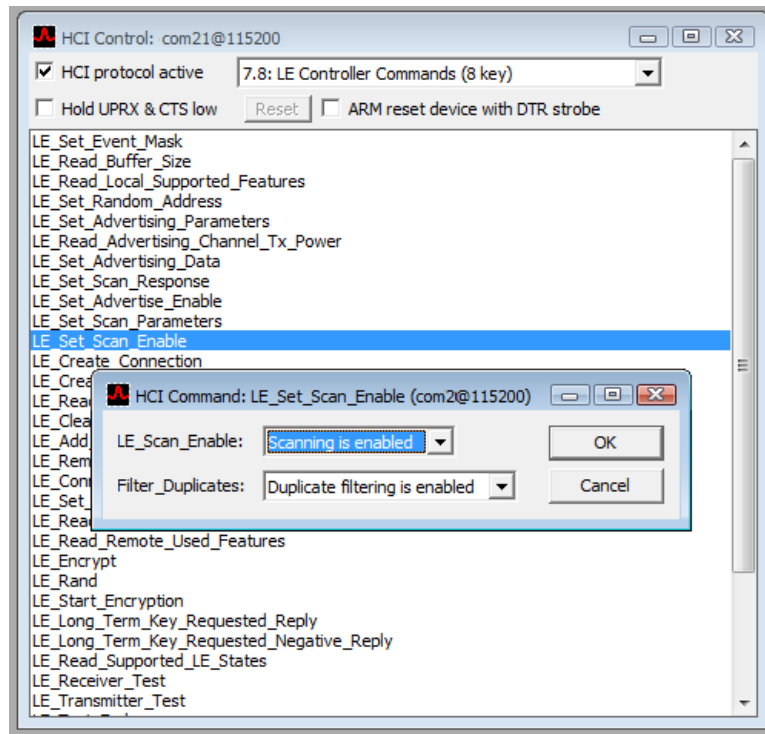
```

## 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                                     LE_S
        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")

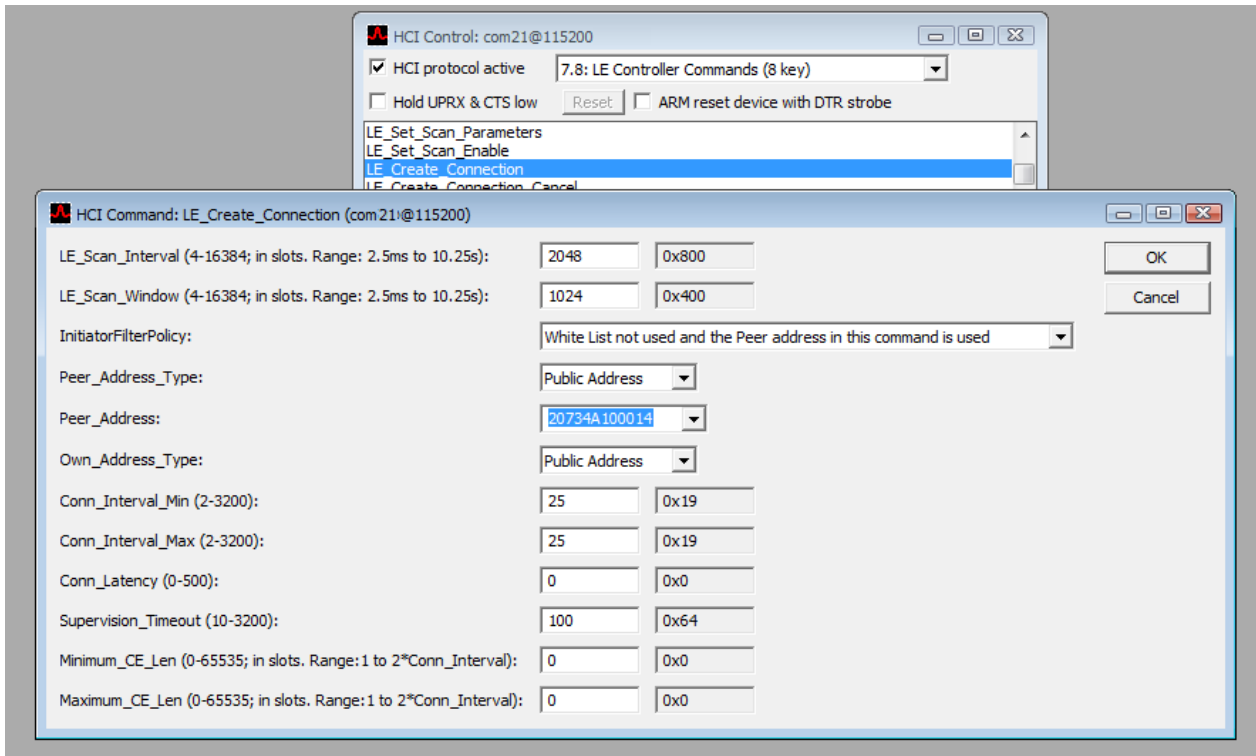
38:03.641 com21 <e> LE_Event                                             LE_E
        HCI Event
        com21@115200
        [3E 0C]: 02 01 00 00 14 00 10 4A 73 20 00 03
        event = 0x3E (62, "LE_Event")
        LE_Event_Code = 0x2 (2, "LE Advertising Report Event")
        Num_Reports = 0x1 (1)
        Event_Type[0] = 0x0 (0, "Connectable Undirected Event")
        Address_Type[0] = 0x0 (0, "Public Address")
        Address[0] = "20734A100014"
        Data_Len[0] = 0x0 (0)
        RSSI[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.

```

14:32.929 com20 <e LE Event                                     LE_E
          HCI Event
          com20@115200
          [3E 13]: 01 00 40 00 01 00 15 00 10 4A 73 20 19 00 00 00 64 00 05
          event = 0x3E (62, "LE Event")
          LE_Event_Code = 0x1 (1, "LE Connection Complete Event")
          Status = 0x0 (0, "Success")
          Connection_Handle = 0x40 (64)
          Role = 0x1 (1, "Connection is slave")
          Peer_Address_Type = 0x0 (0, "Peer is using Public Address")
          Peer_Address = "20734A100015"
          Connection_Interval = 0x19 (25)
          Connection_Latency = 0x0 (0)
          Supervision_Timeout = 0x64 (100)
          Clock_Accuracy = 0x5 (5, "50 ppm")

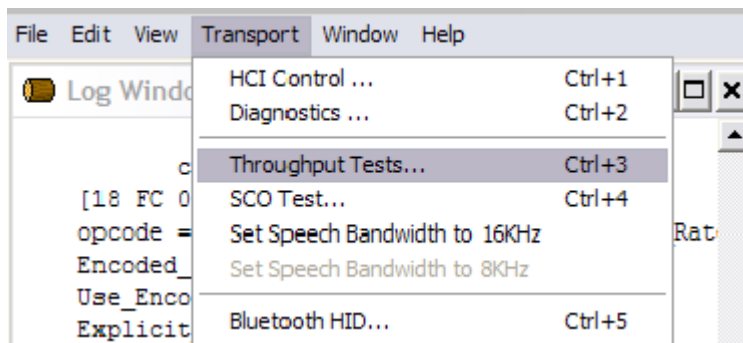
14:32.929 com21 <e LE Event                                     LE_E
          HCI Event
          com21@115200
          [3E 13]: 01 00 40 00 00 00 14 00 10 4A 73 20 19 00 00 00 64 00 05
          event = 0x3E (62, "LE Event")
          LE_Event_Code = 0x1 (1, "LE Connection Complete Event")
          Status = 0x0 (0, "Success")
          Connection_Handle = 0x40 (64)
          Role = 0x0 (0, "Connection is master")
          Peer_Address_Type = 0x0 (0, "Peer is using Public Address")
          Peer_Address = "20734A100014"
          Connection_Interval = 0x19 (25)
          Connection_Latency = 0x0 (0)
          Supervision_Timeout = 0x64 (100)
          Clock_Accuracy = 0x5 (5, "50 ppm")
    
```

## 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

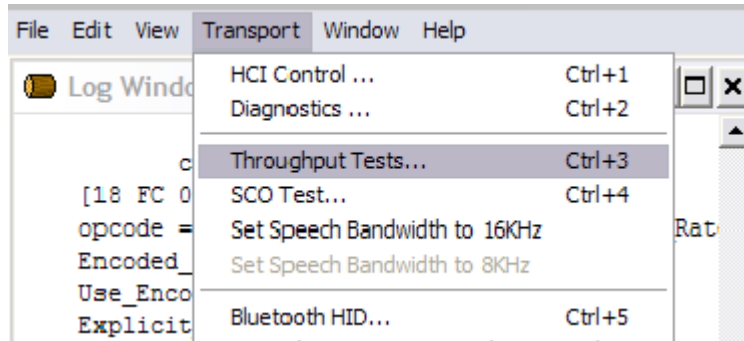
1. Click **Transport>Throughput Tests...** (keyboard shortcut **CTRL+3**).



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

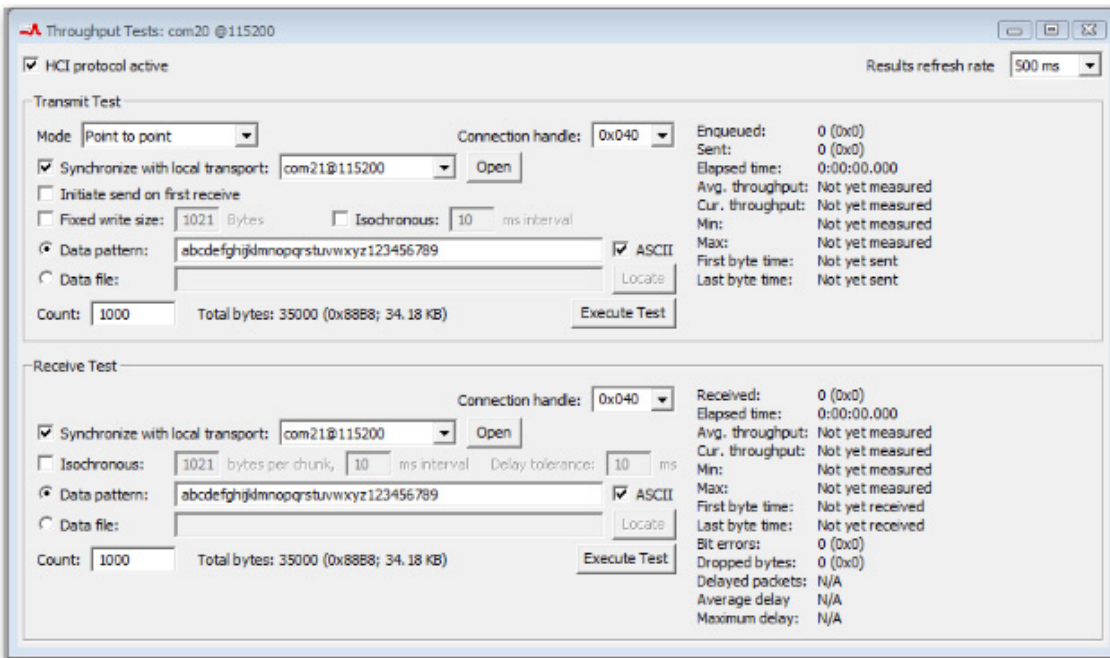
1. Click **Transport>Throughput Tests...** (keyboard shortcut **CTRL+3**).

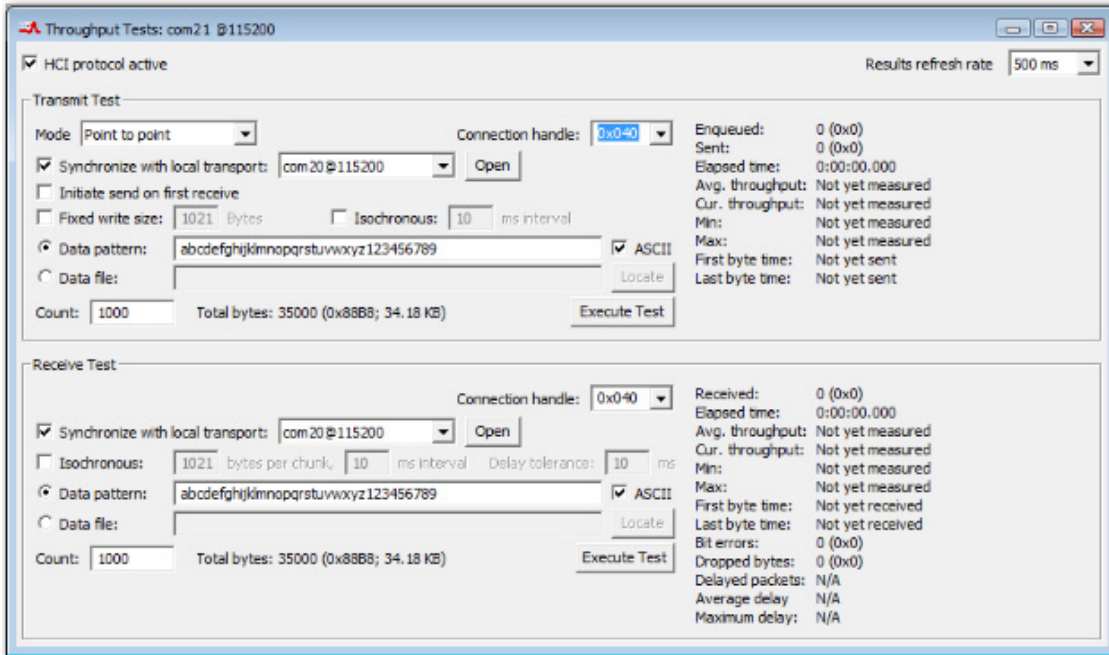


2. In the Select Throughput Tests Transport window, choose **UART**, select or type the Device 2 COM port, and then click **OK**. If using USB transport, select the USB option and select the correct USB port, and then click **OK**.

### 6.4.3 Setting up Throughput

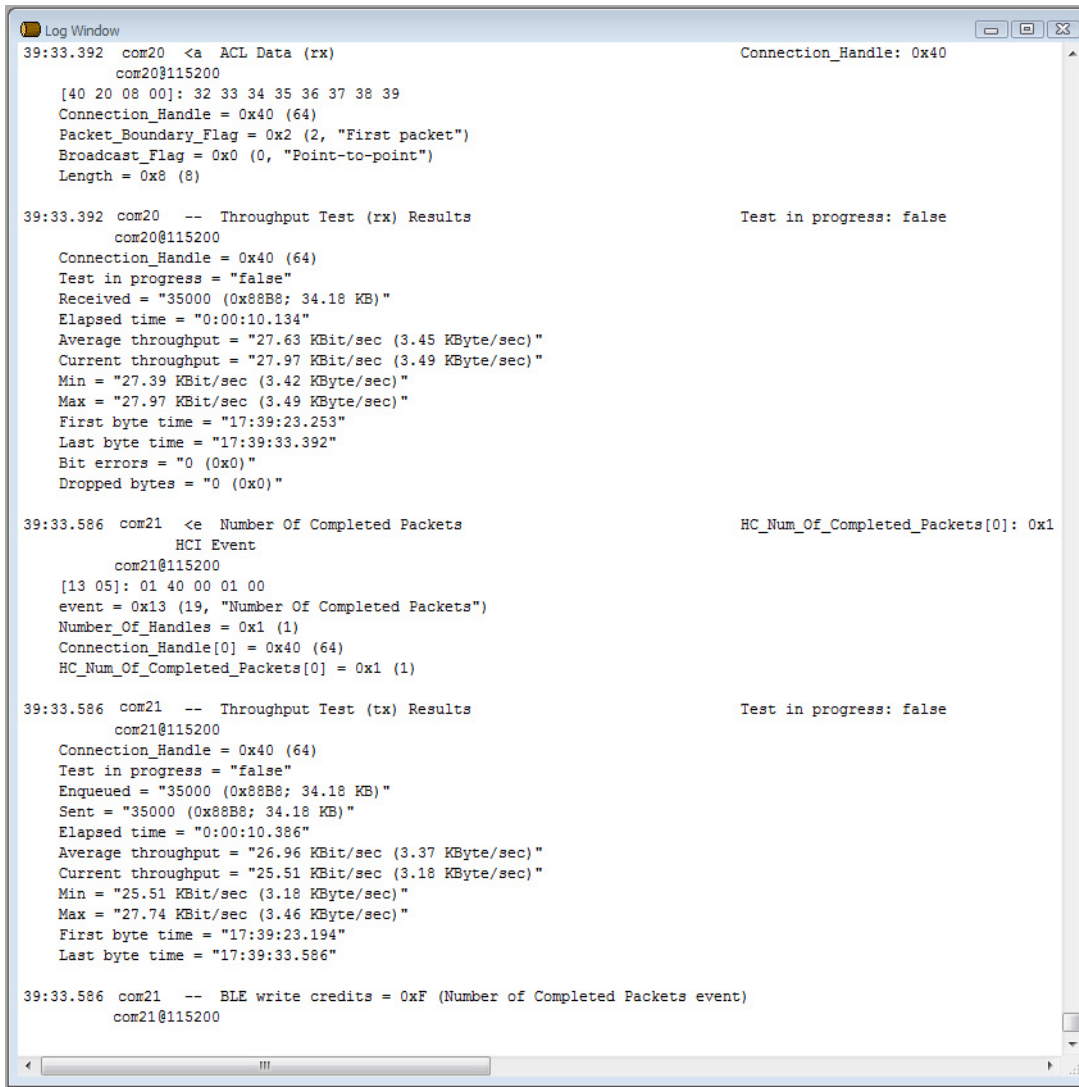
1. In the Throughput Tests window, do the following in both the Transmit Test and Receive Test panes:
  - a. Verify that a value is generated for the connection handle.
  - b. Select the **Data pattern** option.
  - c. If not already selected, select **ASCII**, and then enter the desired data pattern (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.





### 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.



```

Log Window
39:33.392 com20 <a ACL Data (rx)                               Connection_Handle: 0x40
com20@115200
[40 20 08 00]: 32 33 34 35 36 37 38 39
Connection_Handle = 0x40 (64)
Packet_Boundary_Flag = 0x2 (2, "First packet")
Broadcast_Flag = 0x0 (0, "Point-to-point")
Length = 0x8 (8)

39:33.392 com20 -- Throughput Test (rx) Results                Test in progress: false
com20@115200
Connection_Handle = 0x40 (64)
Test in progress = "false"
Received = "35000 (0x88B8; 34.18 KB)"
Elapsed time = "0:00:10.134"
Average throughput = "27.63 KBit/sec (3.45 KByte/sec)"
Current throughput = "27.97 KBit/sec (3.49 KByte/sec)"
Min = "27.39 KBit/sec (3.42 KByte/sec)"
Max = "27.97 KBit/sec (3.49 KByte/sec)"
First byte time = "17:39:23.253"
Last byte time = "17:39:33.392"
Bit errors = "0 (0x0)"
Dropped bytes = "0 (0x0)"

39:33.586 com21 <e Number Of Completed Packets                HC_Num_Of_Completed_Packets[0]: 0x1
HCI Event
com21@115200
[13 05]: 01 40 00 01 00
event = 0x13 (19, "Number Of Completed Packets")
Number_Of_Handles = 0x1 (1)
Connection_Handle[0] = 0x40 (64)
HC_Num_Of_Completed_Packets[0] = 0x1 (1)

39:33.586 com21 -- Throughput Test (tx) Results                Test in progress: false
com21@115200
Connection_Handle = 0x40 (64)
Test in progress = "false"
Enqueued = "35000 (0x88B8; 34.18 KB)"
Sent = "35000 (0x88B8; 34.18 KB)"
Elapsed time = "0:00:10.386"
Average throughput = "26.96 KBit/sec (3.37 KByte/sec)"
Current throughput = "25.51 KBit/sec (3.18 KByte/sec)"
Min = "25.51 KBit/sec (3.18 KByte/sec)"
Max = "27.74 KBit/sec (3.46 KByte/sec)"
First byte time = "17:39:23.194"
Last byte time = "17:39:33.586"

39:33.586 com21 -- BLE write credits = 0xF (Number of Completed Packets event)
com21@115200

```

## Document History Page

Document Title: AN214785 - Establishing Bluetooth Low Energy (BLE) Connections and Conducting Throughput Testing Using Bluetooth™				
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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