PSoC 4 BLE - Game Controller

Objective

This example demonstrates the use of the PSoC4 BLE to design a Low Power Wireless HID Joystick that can be used for gaming purpose.

Overview

This example uses the BLE Pioneer Kit & Joystick Arduino shield to design a simple 2 Axis, 2 Button Wireless HID Joystick application using the standard services defined by the Bluetooth SIG. In this example, the BLE component is configured as HID over GATT profile in the HID Device role. The HID device has one instance of the HID Service, Battery Service and Device Information Service.

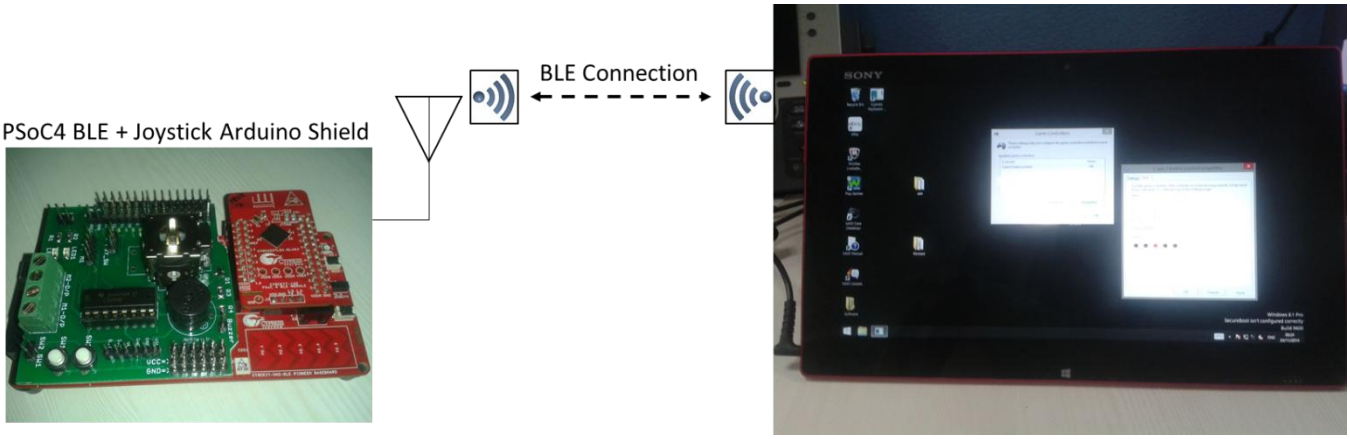

Figure 1: Game Controller Setup

Requirements

Design Tool: PSoC Creator 3.1 SP1.

Programming Language: C (GCC 4.8.4 – included with PSoC Creator)

Associated Parts: All PSoC 4 BLE devices

Related Hardware: CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit & Arduino IO Shield

Testing Tool: Joy.cpl (Game Controller Configuration Tool available in Windows)

PSoC Creator Schematic

The example project schematics (Figure 2: PSoC Creator Schematics) consists of the following components: BLE, UART, digital Input Pins, digital Output Pins, Watch Dog Timer, and SAR ADC. The UART is used for transmitting debug information. The output pins are used to reflect the BLE connections status. The Input pin is configured as resistive pull up and used to take the Push Button input from the Joystick Arduino shield. The SAR ADC is used to convert the X axis and Y axis potentiometer inputs to digital value. The BLE component is configured as HID over GATT profile in the HID Device role (GATT Server) and is used to transmit the Joystick data. In addition to the HID service the BLE also has Battery Service, Device Information Service, and Scan parameter Service.

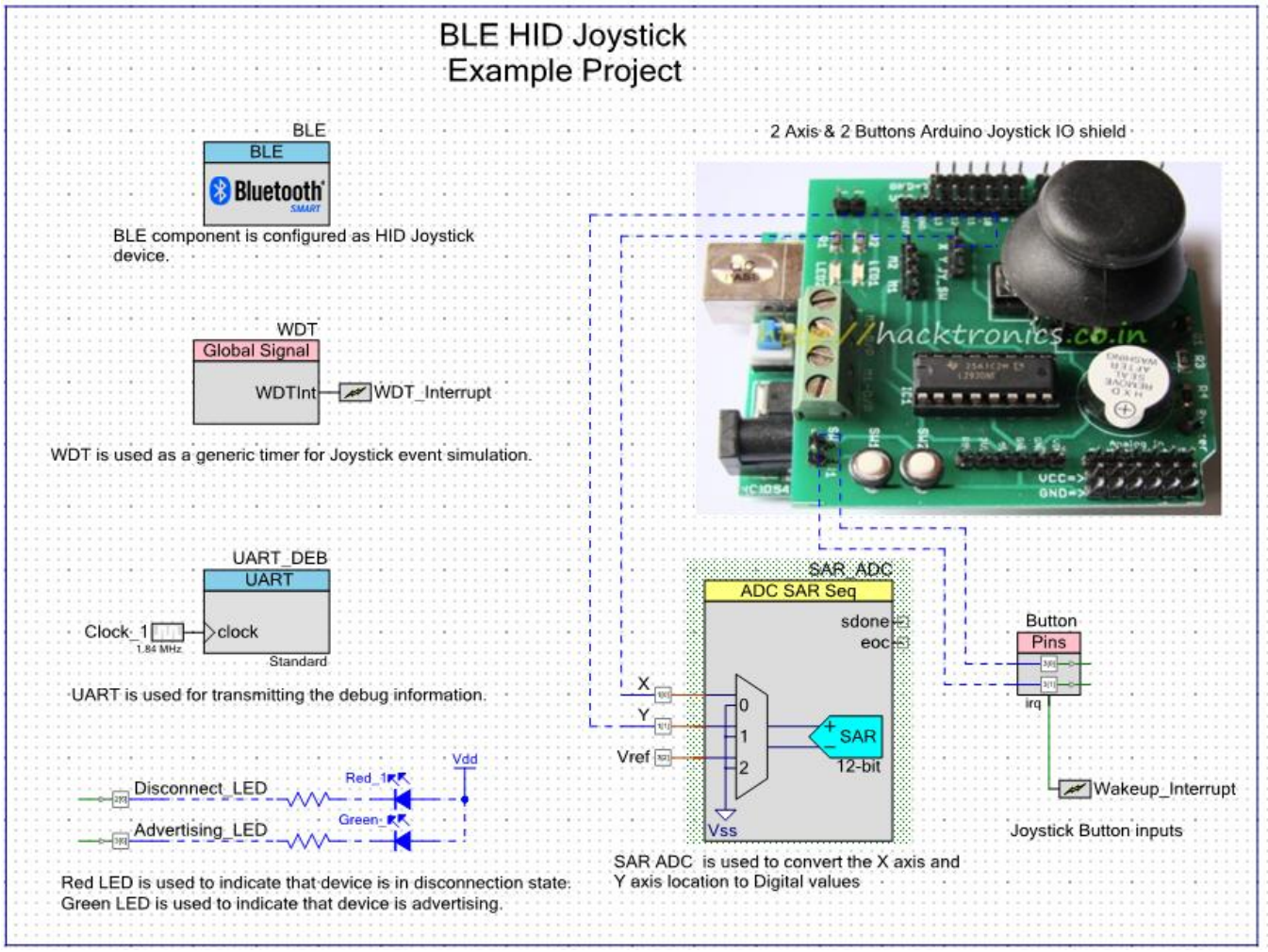

Figure 2: PSoC Creator Schematics

Hardware Setup

The device has following hardware Setup

- X axis Pin (Port 0, Pin 0) gives the X co-ordinate of the Joystick. Connect this to X axis output of the Arduino shield.
- Y axis Pin (Port 0, Pin 1) gives the Y co-ordinate of the Joystick. Connect this to Y axis output of the Arduino shield.
- Buttons (Port 3, Pin 0 & Pin 1) is used to implement the Joystick button as well as to wake up the device, start re-advertising. Connect this to buttons of the Arduino shield.
- The Red LED (Port 2 , Pin 6) is used to indicate a BLE Disconnection State
- The Green LED (Port 3, Pin6) is used indicate an advertising State
- Vref Pin (Port 3, Pin 2) Measures the Battery level of the Coin cell battery. Connect J3 VREF to J2 P3.2

Operation

The project demonstrates the functionality of the BLE Component configured as a HID Device. After the device is turned on, it initializes the BLE component, SAR ADC and the UART component. In this project there are four callback functions.

1. AppCallBack() : This is required to receive the generic events from the BLE Stack
2. HidsCallBack() : This is HID event callback function that receives the HID Service specific events
3. BasCallBack(): This is required to receive the Battery Service specific events

The component has also buried a call to CyBle_GappStartAdvertisement() inside the AppCallBack() and on execution of this function the device will start advertising with the advertisement packet shown below in Figure 3

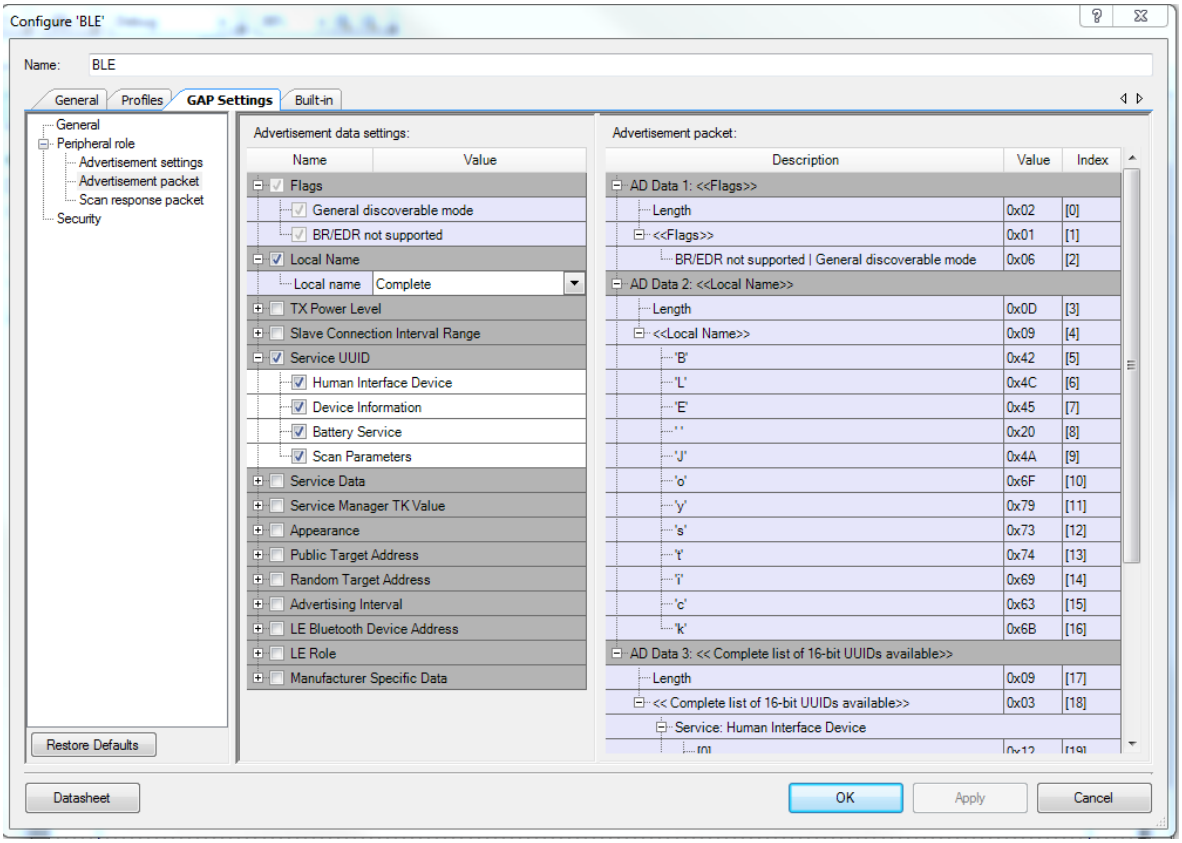

Figure 3: GAP settings

As the BLE component is configured in the General Discovery mode (Figure 3), it will stop advertising after an advertisement period expires. On advertisement timeout, the system enters into the hibernate mode. The Joystick Buttons on the Arduino shield is used to wake up the system and start re-advertising. BLE subsystem and CPU enters into low power Deep-Sleep mode between connection and advertising intervals. BLE subsystem automatically wakes up to maintain connection and sending data transfer

To indicate that the device advertises, the green LED is blinking. The red LED will be lighted on after disconnection to indicate that no Client is connected to the device. When client is connected successfully both red and blue LEDs will turn off.

Build and Program

1. Open the project **BLE_HID_Joystick.cywrk** in PSoC Creator 3.1 Service Pack 1.
2. In PSoC Creator, select **Build > Clean and Build BLE_HID_Joystick**, as shown in Figure 4Figure 4: Build Menu in PSoC Creator.

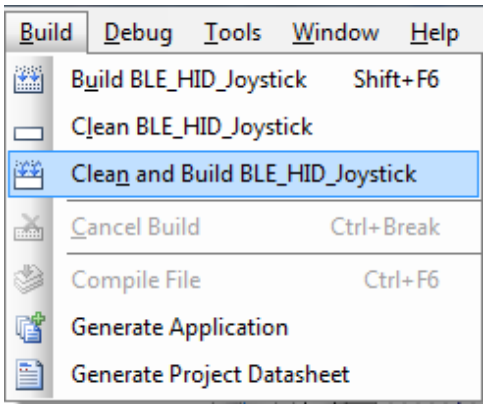

Figure 4: Build Menu in PSoC Creator

3. On a successful build, the total flash and SRMA usage is reported as shown in Figure 5.

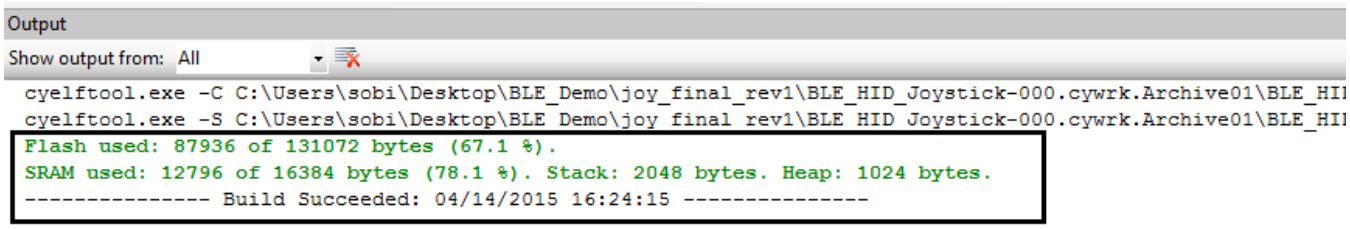

Figure 5: Build output

4. Select **Debug > Select Debug Target**.
5. In the **Select Debug Target** dialog box, click **Port Acquire**, and then click **Connect** as shown in Figure 6. Click **OK** to close the dialog box.

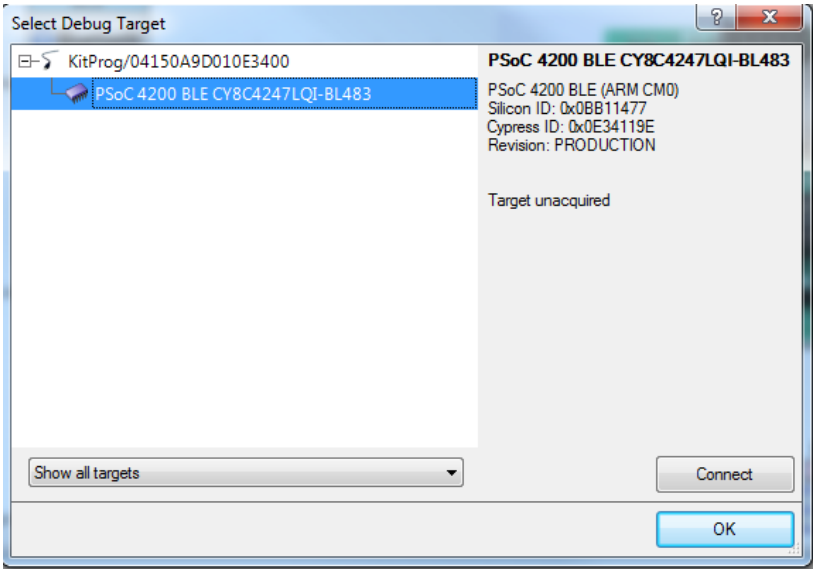

Figure 6: Select Debug Target Window

6. Select **Debug> Program** to program the device with the project.

7. You can view the programming status on the PSoC Creator status bar (lower-left corner of the window).

Testing in PC with Bluetooth 4.0

You can test the HID Joystick Project directly with Windows 8 PC. Windows 7 and older OS don't have HOGP drivers. Please ensure that a PC with Windows 8 has Bluetooth 4.0 installed. Follow the below steps to install the BLE Joystick Device and test.

1. Search for **Device Settings** in the Windows 8 Start Menu and select it. It opens the PC and Devices
2. Under PC **and Devices** select Bluetooth as shown in Figure 7, it will list all the Bluetooth Device discovered.

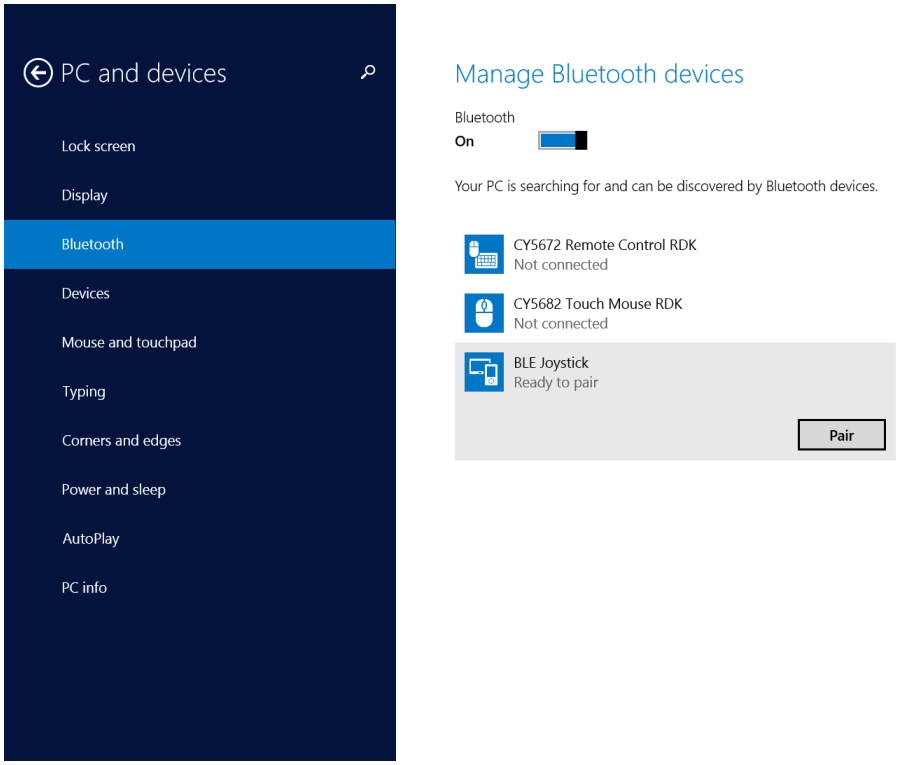

Figure 7: PC and Devices Setting in Windows 8

3. You can see our **BLE Joystick** device listed. Click on the **Pair** Button. Once the device is paired, it appears as connected as shown inFigure 8: PSoC BLE Joystick listed under Bluetooth devices Figure 8.

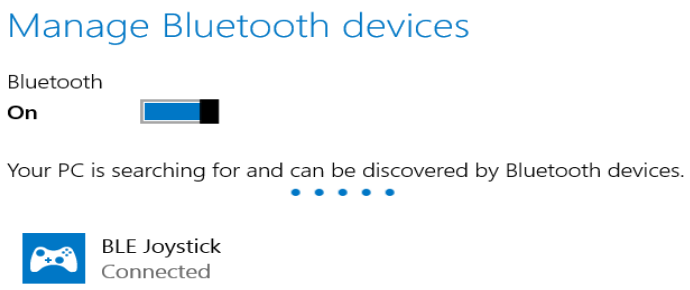

Figure 8: PSoC BLE Joystick listed under Bluetooth devices

4. Search for application **joy.cpl** in the Windows 8 search menu. Select the application as shown in Figure 9: Game Controller application shown in Start Menu

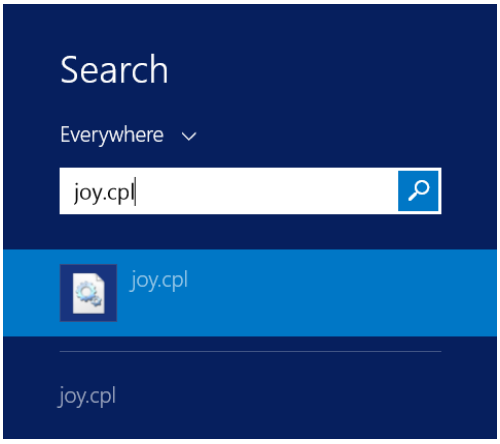

Figure 9: Game Controller application shown in Start Menu

5. The **Game Controller** application opens. Click on the **Properties** button in the application. Select the **Test** tab as shown in Figure 10. Move the Joystick around and press buttons. The result of the movement and button press is also shown in Figure 10.

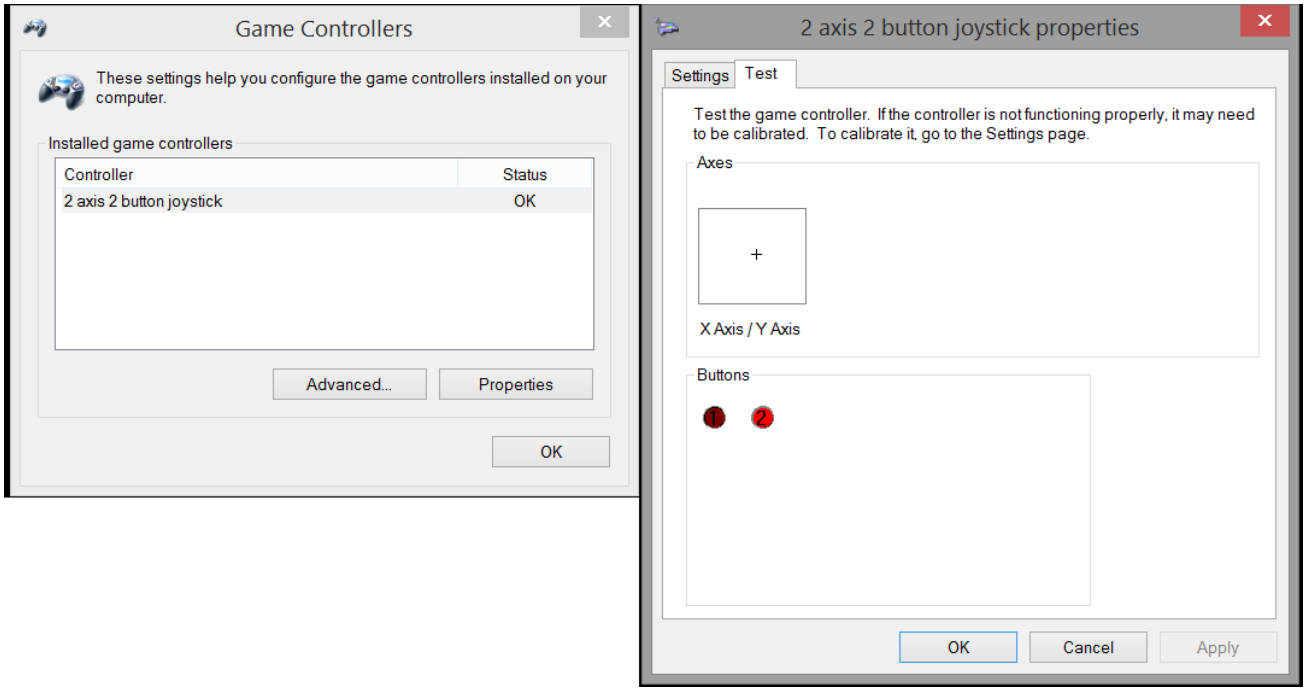

Figure 10: Game Controller Application & Properties Windows

Testing in PC without Bluetooth 4.0

The Laptops and PC older than or equal to Windows 7 do not have Bluetooth 4.0. To make it easy for users who do not have Windows 8 laptops with Bluetooth 4.0, we have created a BLE to USB Bridge project. The PSoC4 BLE and PSoC5LP devices in the CY5670- Smart USB Dongle has to re-program to act as a BLE to USB Bridge. The PSoC4 BLE in the dongle will act as BLE Host to UART Bridge. The PSoC5LP will take the data over UART and sends it to PC over USB. The USB in PSoC5LP is configured as HID Class USB with the descriptor same as that of BLE's HID Descriptor.

Programming the PRoC BLE in the CySmart Dongle

1. Connect the CY5670 Smart USB dongle to the PC. Run the PSoC Programmer 3.22 by choosing **Start > All Programs > Cypress > PSoC Programmer.**
2. Select the **KitProg/BLE** listed under the **Port Selection** by clicking on it as. Once the device is successfully connected, the status is shown in the lower right corner of the PSoC Programmer as shown in Figure 11.The Status turns green when connected.

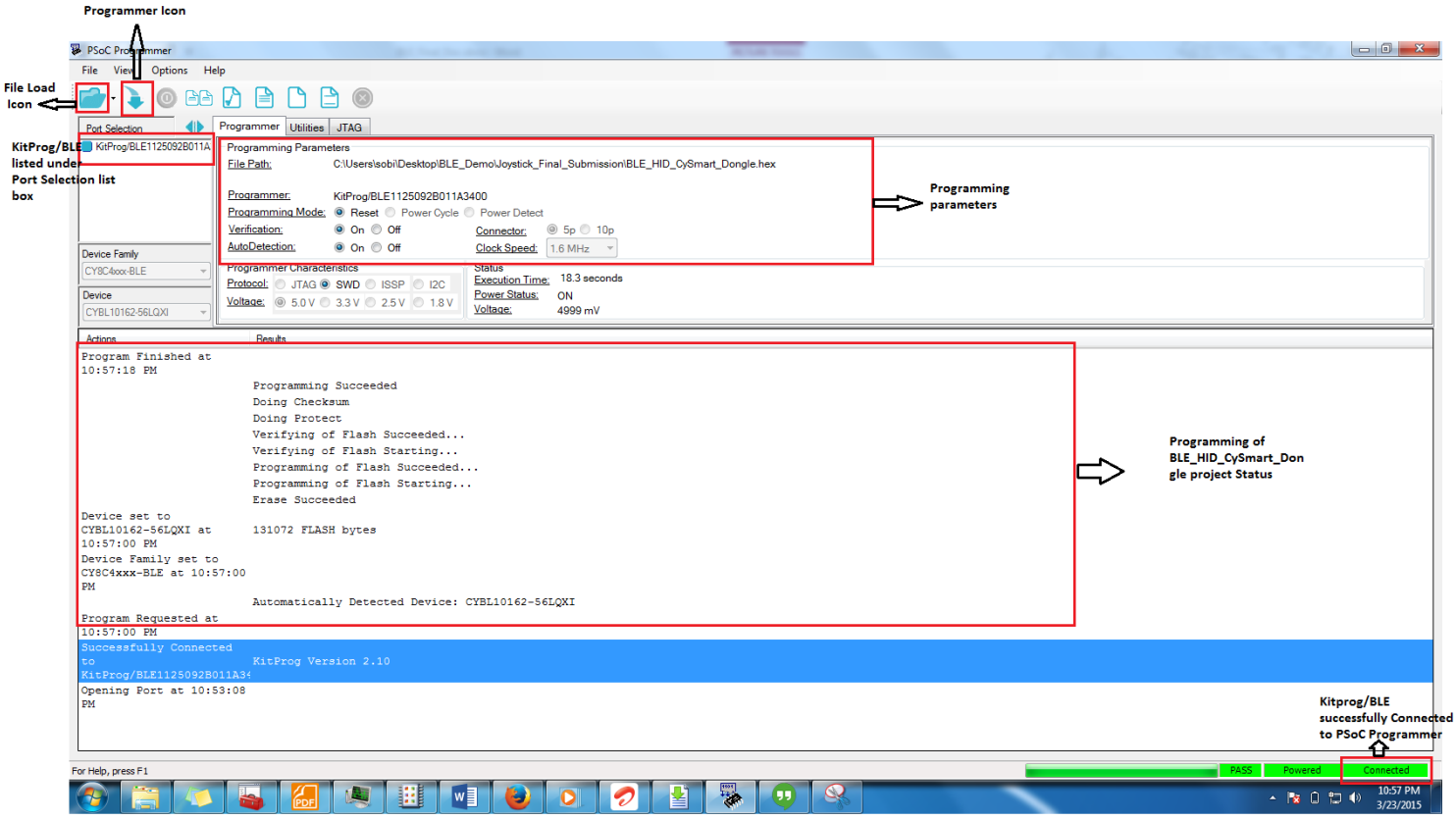

Figure 11: PSoC Programmer

➔ Select the File Load button in the PSoC Programmer. Browse to the location where the hex files of these projects is stored.. Slect the BLE_HID_CySmart_Dongle.hex .

➔ Click the Program icon to program the PRoC BLE device on the CySmart USB dongle with the selected hex file. After successful programming, a **Programming Succeeded** message is displayed in the log area, as shown in Figure 11. Also, the status in the lower right corner of the PSoC Programmer window turns green and shows **PASS**.

Programming the PSoC5LP in the CySmart Dongle

The PSoC 5LP controller on the CySmart USB dongle acts as an UART-to-USB bridge, which transfers the data received from PRoC BLE over UART to the USB interfaces. The PSoC 5LP controller provides USB bootloader support to enable users to change the firmware. Follow these steps to download the BLE to Joystick USB bootloadable firmware onto the PSoC 5LP device.

1. Keep the reset switch (SW1) pressed and insert the CySmart USB dongle into a USB port on the PC. If the switch is pressed for more than 100 ms, the PSoC 5LP on the dongle enters into bootloader mode. This is indicated by a blinking green LED on the dongle.
2. Open the Bootloader Host tool from PSoC Creator by choosing **Tools** > **Bootloader Host**.
3. In the Bootloader Host tool, click **Filters** and add a filter to identify the USB device. Set **VID** as “0x04B4” and **PID** as “0xF13B,” and then click **OK,** as shown in Figure 12.

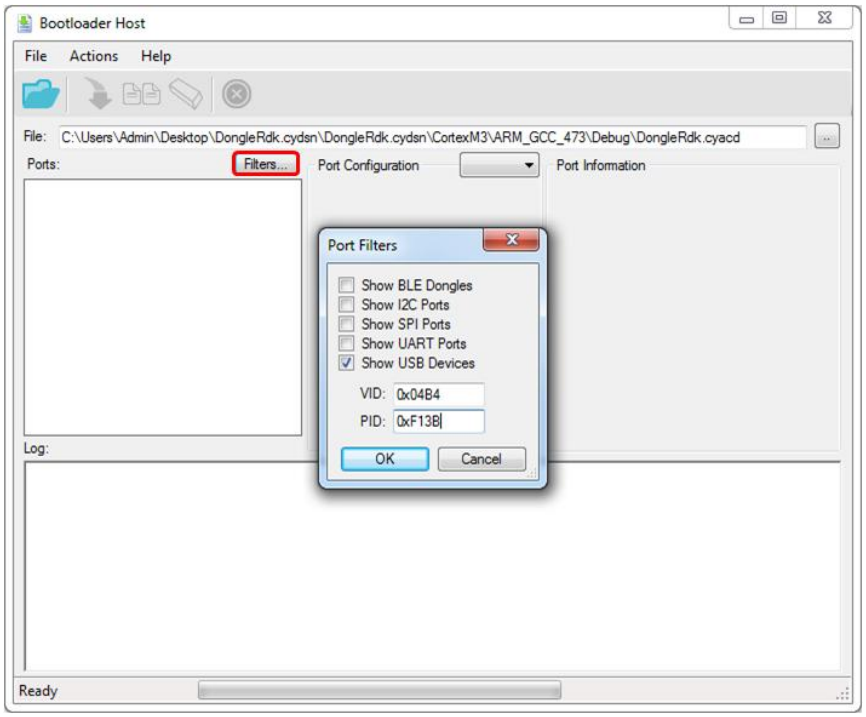

Figure 12: Filters Tab in Bootloader Host Tool

4. In the Bootloader Host tool, click the **Open File** button (as shown in Figure 13**Error! Reference source not found.**) to browse to the location of the Joystick Bridge bootloadable file *(Dongle_Bridge.cyacd*), as shown in Figure 14.

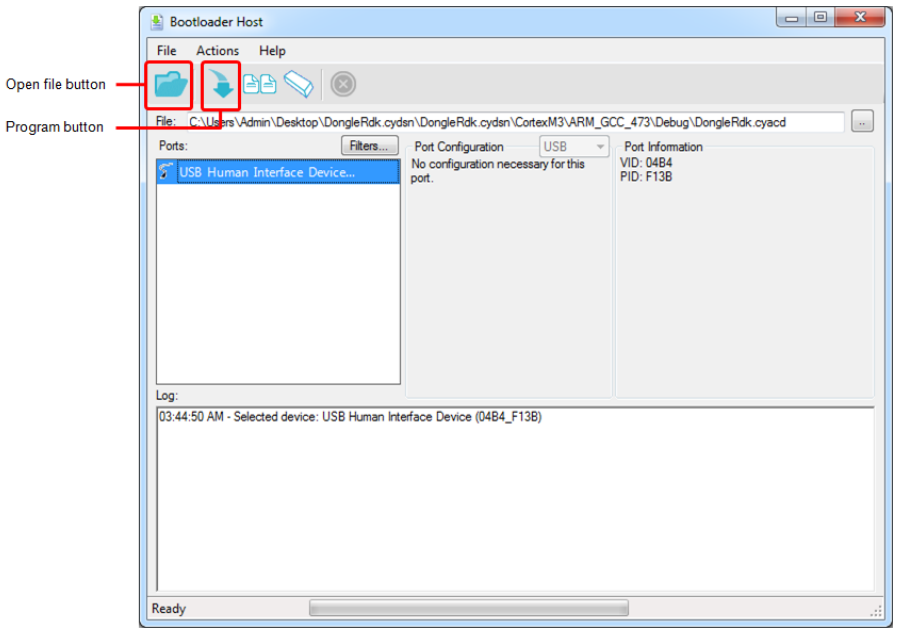

Figure 13: Open/Program Bootloadable File from Bootloader Host Tool

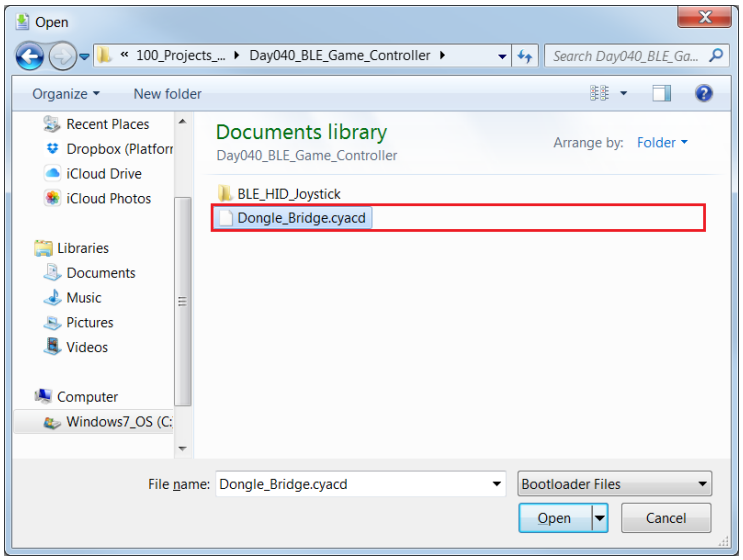

Figure 14. Select Bootloadable File from Bootloader Host

5. Click the **Program** button in the Bootloader Host tool to program the device, as shown in Figure 13.
6. If the bootload is successful, the log of the tool displays “Successful”; otherwise, it displays “Failed” with a statement describing the failure.
7. Once the bootloading is successful, the device appears as HID Device in device manager

For additional information on bootloaders, refer to Cypress application note AN73503 – *USB HID Bootloader for PSoC 3 and PSoC 5LP.*

Note: **To revert back to the default PSoC5LP firmware you need to use the **.cyacd* file provided as part of the CY8CKIT-042 BLE Kit installer. The bootloadable file is available in *<Install_Directory>* *CY8CKIT-042-BLE Kit\1.0\Firmware\Programmer\KitProg\KitProg.cyacd.***

Running Game Controller Application

1. Press the SW2 switch in the CySmart Dongle to pair the Joystick BLE with the Dongle
2. In the Start Menu type **Joy.cpl** and press Enter.
3. The Game Controllers application opens and it will list our Dongle as Joystick as shown in the Figure 15

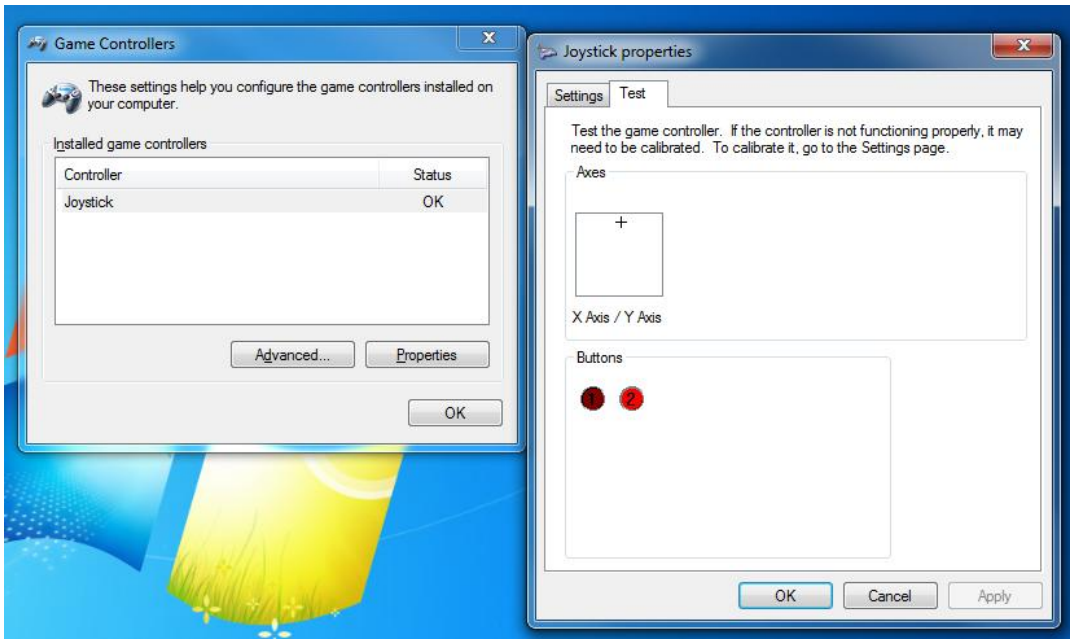

Figure 15: Game Controller windows application

4. Click on the **Properties** button in the application. Select the **Test** tab as shown in Figure 10. Move the Joystick around and press buttons. The result of the movement and button press will be shown in application.

Related Documents

Table 1**Error! Reference source not found.** lists all relevant application notes, code examples, knowledge base articles, device datasheets, and Component / user module datasheets.

Table 1. Related Documents

Document	Title	Comment
AN73503	*USB HID Bootloader for PSoC 3 and PSoC 5LP.*	For additional information on bootloaders, refer to this AN
AN57473	USB HID Basics with PSoC3 and PSoC5LP	For additional information on Joystick USB refer to this AN