PSoC 4 BLE – Proximity Gestures

Objective

This example project PSoC 4 BLE – Proximity Gestures demonstrates proximity gestures simulating keyboard left and right arrow keys.

Overview

This example uses the CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit and CY8CKIT-024 CapSense Proximity Shield to design a simple keyboard with left and right arrow keys. CY8CKIT-024 supports both X-Axis and Y-Axis CapSense gestures, only X-Axis gestures are used in this project. The example also demonstrates handling suspend event from the central device and enters low power mode when suspended. CapSense data is sent out using TX8 for debugging.

Requirements

Design Tool: PSoC Creator 3.1

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

Associated Devices: All PSoC 4 BLE devices supporting CapSense (Refer PSoC 4 BLE Datasheet)

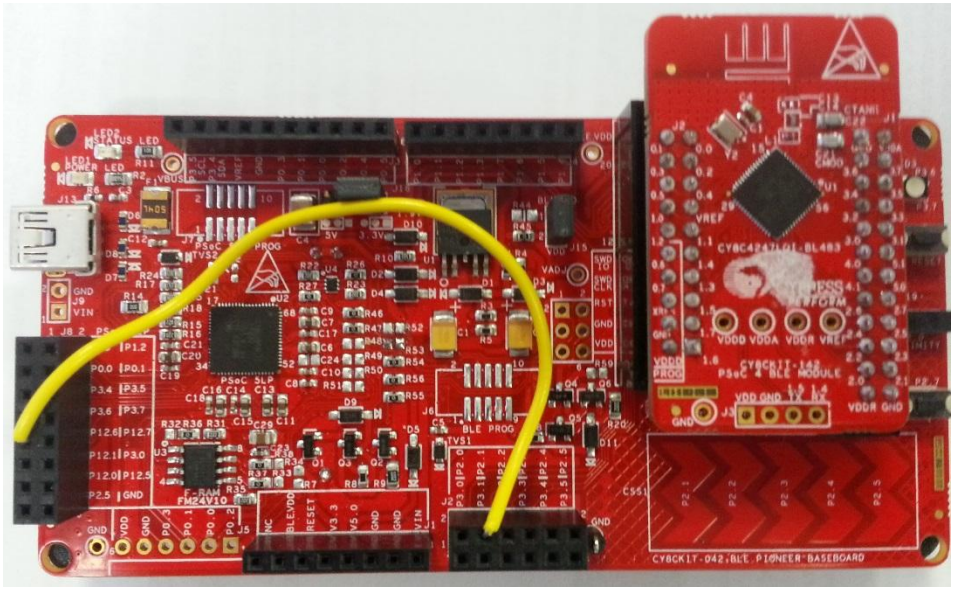
Required Hardware: CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit, CY8CKIT-024 CapSense Proximity Shield, PC with Windows 8 and with built-in BLE support

Hardware Setup

The BLE Pioneer Kit and CapSense Proximity shield has all of the necessary hardware required for this lab. Follow the steps below to complete hardware setup.

1. To read the proximity sensor data via software TX8, connect a jumper wire between pin P2[1] on the J2 header and P12[6] on the J8 header using a wire, as Figure 1 shows.

Figure 1. TX8 connection in BLE Pioneer Kit



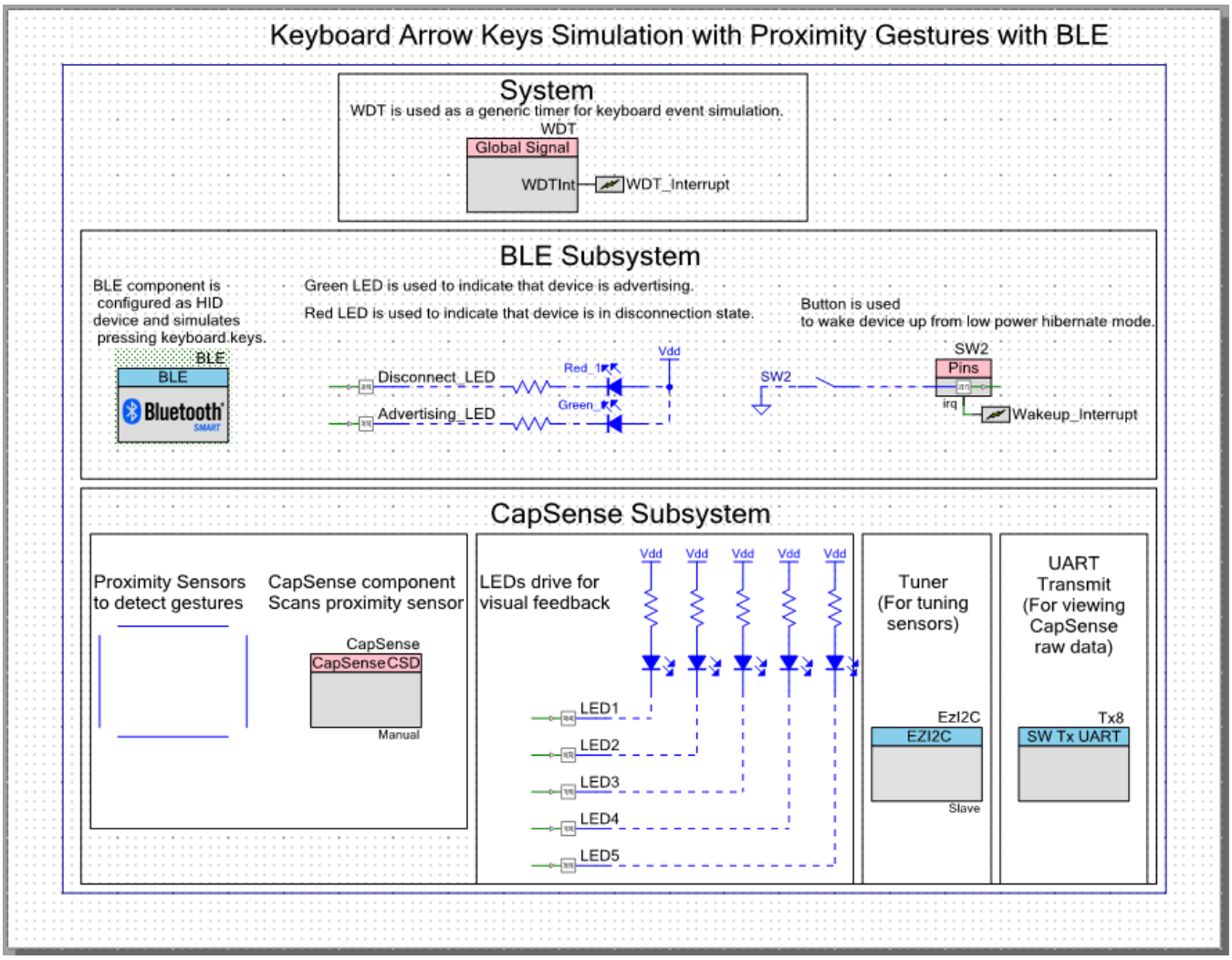
2. Connect the J1, J2, J3, and J4 headers on CY8CKIT-042 -BLE to the J1, J2, J3, and J4 headers on CY8CKIT-024 respectively as shown in Figure 2. Remove resistors R52 and R53 on CY8CKIT-042 –BLE. These resistors connect a proximity sensor pin and Shield pin to two PSoC5LP pins. Removal is not mandatory but removal of these resistors ensures that there are no extra sources of noise for CapSense.

Figure 2. CY8CKIT-024 Proximity Shield and CY8CKIT-042 Connection

3. Connect the BLE Pioneer baseboard along with CapSense Proximity Shield to your computer using the USB Standard-A to Mini-B cable for power.

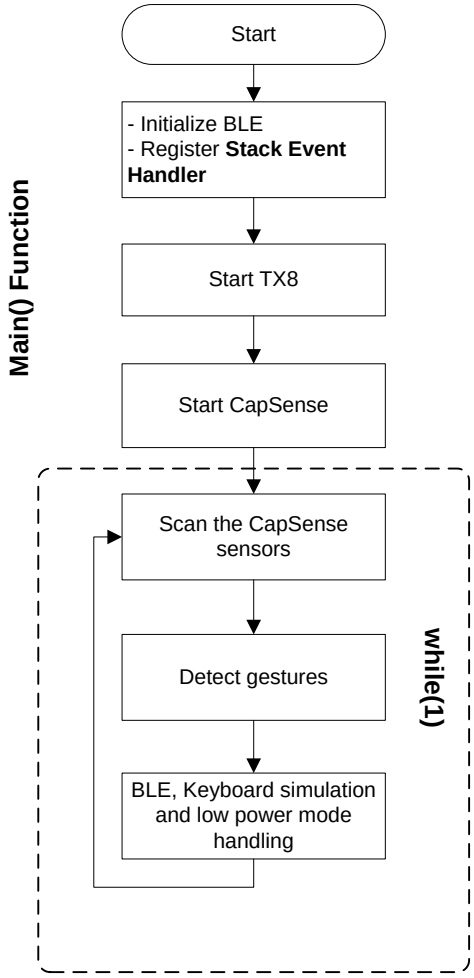
PSoC Creator Schematic

Figure 3. PSoC Creator Schematic



Firmware Flow

Figure 4. Firmware Flow



Right after the device is started, it performs the BLE component initialization as well as initialization of the CapSense and TX8 components. Three callback functions are required in this project for BLE operation. One callback function (AppCallBack()) is required to receive generic events from BLE Stack and the others (HidsCallBack(), BasCallBack()) are required for receiving events from the services. The component has also buried a call to CyBle_GappStartAdvertisement() on an execution of which the device will start advertising, RGB LED will start blinking in GREEN color to indicate advertising. As the BLE component is configured in the General Discovery mode, it will stop advertising after an advertisement period expires, RGB LED will glow in RED color to indicate device is not advertising. On advertisement timeout, the system enters into the hibernate mode. Press the mechanical button on CY8CKIT-042 BLE (SW2) 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 advertising data transfer. On a successful connection with another device, RGB LED does not glow. Refer to creator example project BLE_HID_Keyboard for complete details on how to use BLE as HID keyboard.

CapSense sensors are scanned continuously in while (1) loop. Once the sensors are scanned the F/W checks for any gestures and sends the gestures information to PC as keyboard presses via BLE. For details on how gestures are detected refer to AN92239 - Proximity Sensing with CapSense®. Current F/W is configured to detect left to right gesture and right to left gesture. Left to right gesture information is sent as right arrow key pressed and right to left gesture is sent as left arrow key pressed information to PC. To save further power, CapSense sensors can be scanned only when BLE connection is established.

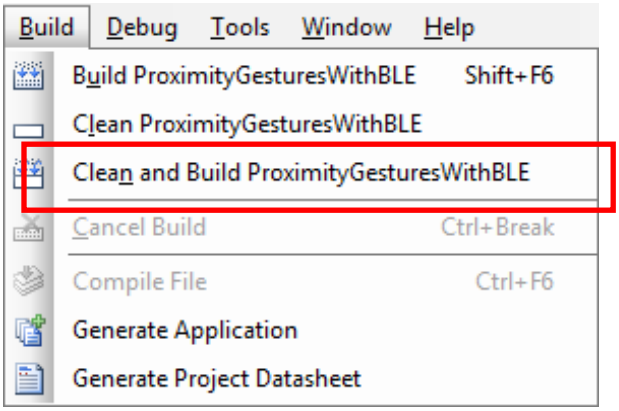
Build and Program

This section shows how to build the project and program the PSoC 4 BLE device. If you are using a development kit with a built-in programmer (BLE Pioneer Kit, for example), connect the BLE Pioneer Baseboard to your computer using the USB Standard-A to Mini-B cable. For other kits, refer to the kit user guide.

If you are developing on your own hardware, you need a hardware debugger, for example, a Cypress CY8CKIT-002 MiniProg3.

1. Open the project ***"ProximityGesturesWithBLE"*** using PSoC Creator.
2. On PSoC Creator, select **Build** > **Clean and Build PSoC 4BLE *ProximityGesturesWithBLE***, as shown in Figure 5.

Figure 5. Build Project



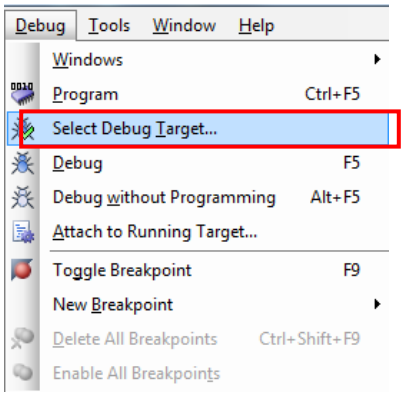
3. On a successful build, the total flash and SRAM usage is reported as shown in Figure 6.

Figure 6. Build Succeeded

```
Flash used: 87169 of 131072 bytes (66.5 %).
SRAM used: 12820 of 16384 bytes (78.2 %). Stack: 2048 bytes. Heap: 1024 bytes.
```

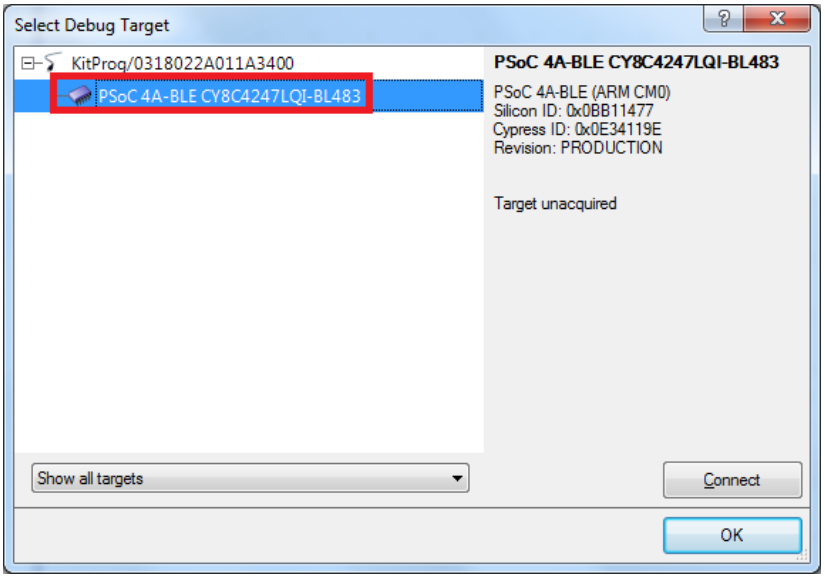
4. Select **Debug** > **Select Debug Target**, as shown in Figure 7.

Figure 7. Selecting Debug Target



5. In the **Select Debug Target** dialog box, click **Port Acquire**, and then click **Connect** as shown in Figure 8. Click **OK** to close the dialog box.

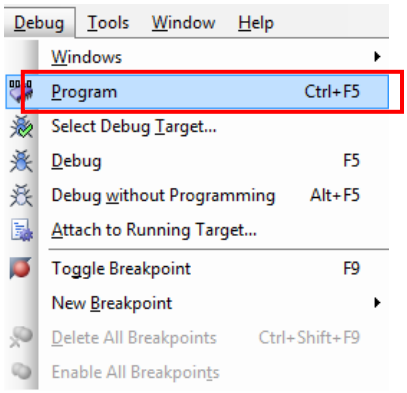
Figure 8. Connecting to a Device



If you are using your own hardware, make sure the *Port Setting* configuration under *Select Debug Target* window for your programming hardware is configured as per your setup.

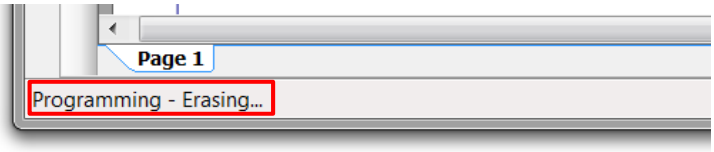
6. Select **Debug** > **Program** to program the device with the project, as shown in Figure 9.

Figure 9. Programming the Device



You can view the programming status on the PSoC Creator status bar (lower-left corner of the window), as shown in Figure 10.

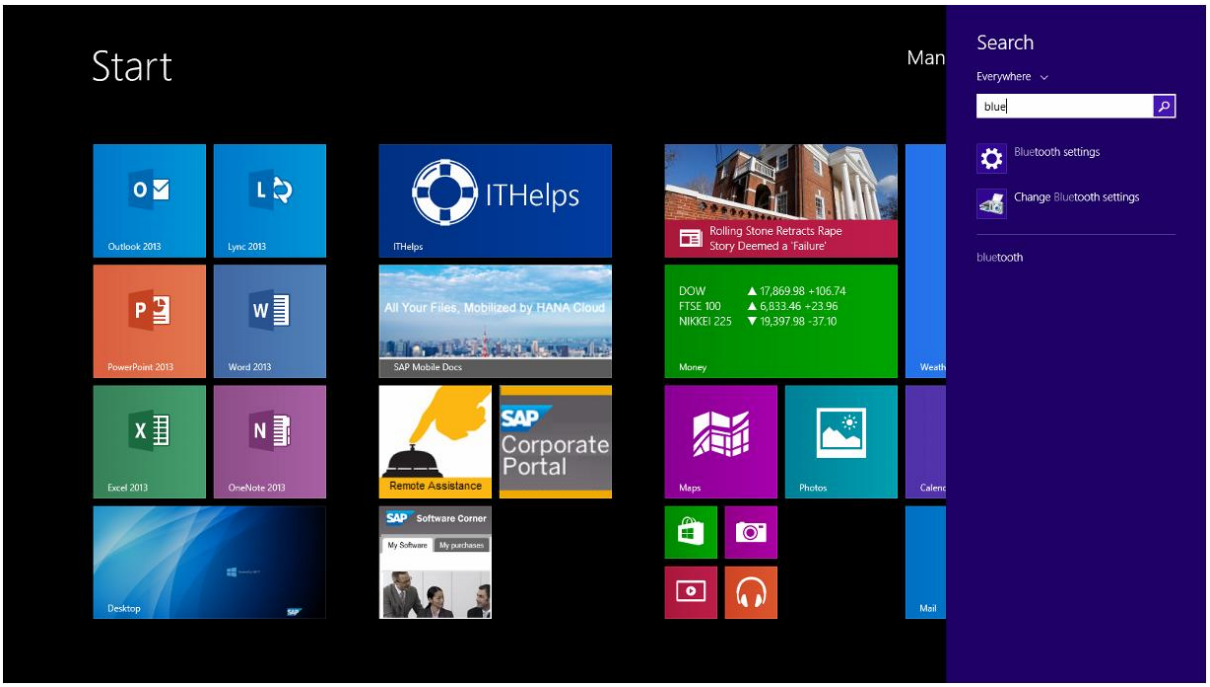
Figure 10. Programming Status



Testing

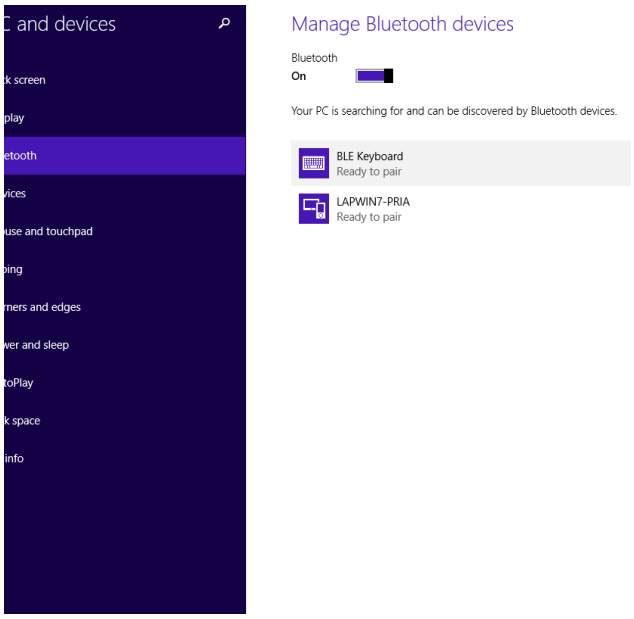
1. After programming, plug the BLE Pioneer Kit to your Windows 8 computer's USB port. As soon as the device gets powered, the RGB LED should start blinking in GREEN color, indicating BLE ADVERTISING.
2. Press "windows" button, and start typing Bluetooth, and then click Bluetooth settings as shown below

Figure 11. Search window in Windows 8 operating system



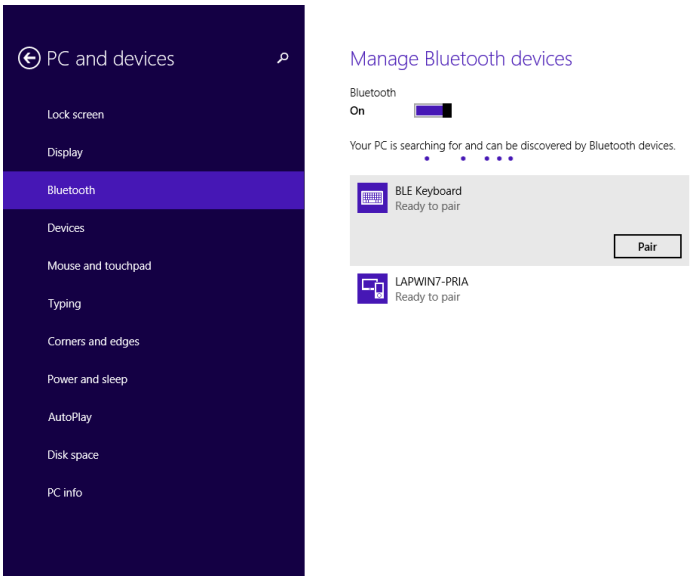
3. In Bluetooth settings, you will see "BLE Keyboard" showing "Ready to Pair". Click on this BLE Keyboard as shown below.

Figure 12. Bluetooth settings in Windows 8 operating system



4. Click on “BLE Keyboard” and then click on “Pair” as shown below.

Figure 13. Bluetooth pairing settings



5. After “Pair” is clicked, BLE keyboard connection will be established as shown in figures below. Once the connection is established the RGB LED should stop blinking.

Figure 14. BLE Keyboard connection in progress

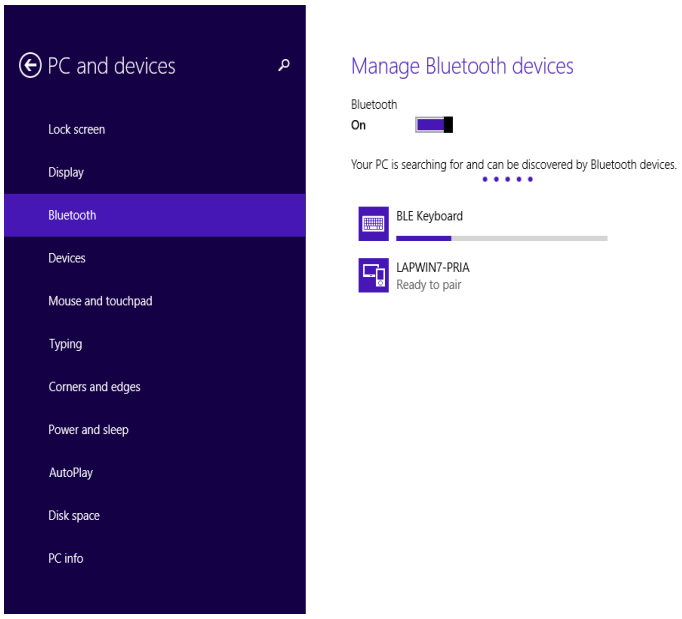
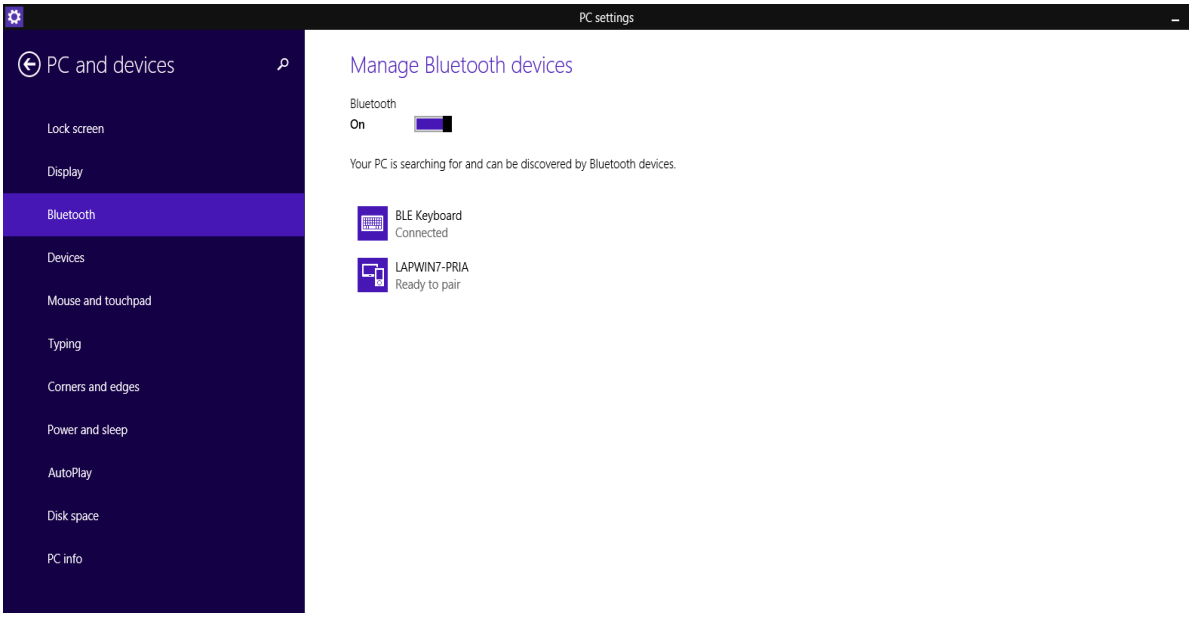


Figure 15. BLE Keyboard connected



6. Open “Microsoft Office PowerPoint” and open any presentation in slideshow mode.
7. At a distance of about 2 cm from the proximity shield, move the hand from left to right, as Figure 16 shows, or from right to left.

Figure 16. Left-to-Right Swipe Gesture

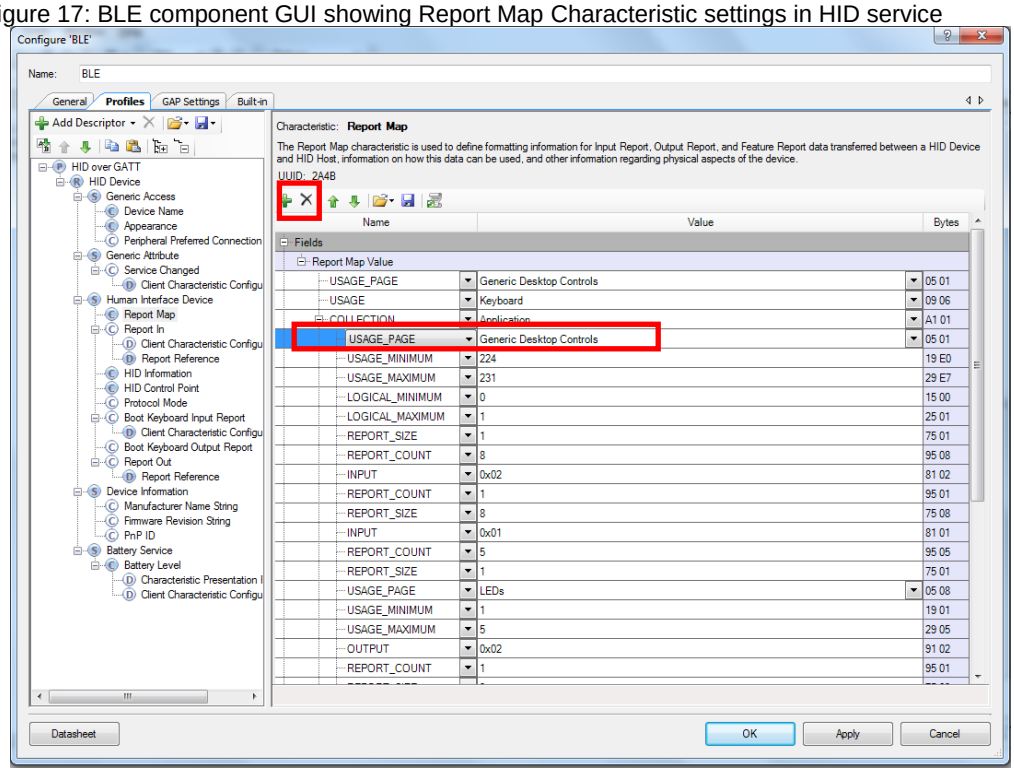
8. LEDs on the CapSense Proximity Shield will be turned ON, after the gesture is completed, in the same direction as gesture.
9. If “left to right” gesture is performed, the next slide appears in the PowerPoint, simulating “right arrow key” of keyboard, and if “right to left” gesture is performed, the previous slide appears in the PowerPoint, simulating “left arrow key” of keyboard.

Testing with Windows7

Below is the procedure for testing the project with a system with Windows7:

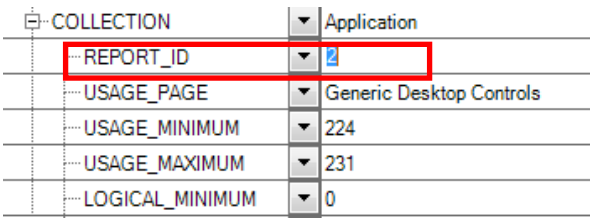
1. In the PSoC Creator project, go to TopDesign.cysch and double click “BLE” component.
2. Go to ‘Profile’ tab and select ‘Report Map’ characteristic in ‘Human Interface Device’ profile. Click on ‘USAGE_PAGE’ under ‘COLLECTION’ and click on ‘+’ as shown in figure below.

Figure 17: BLE component GUI showing Report Map Characteristic settings in HID service



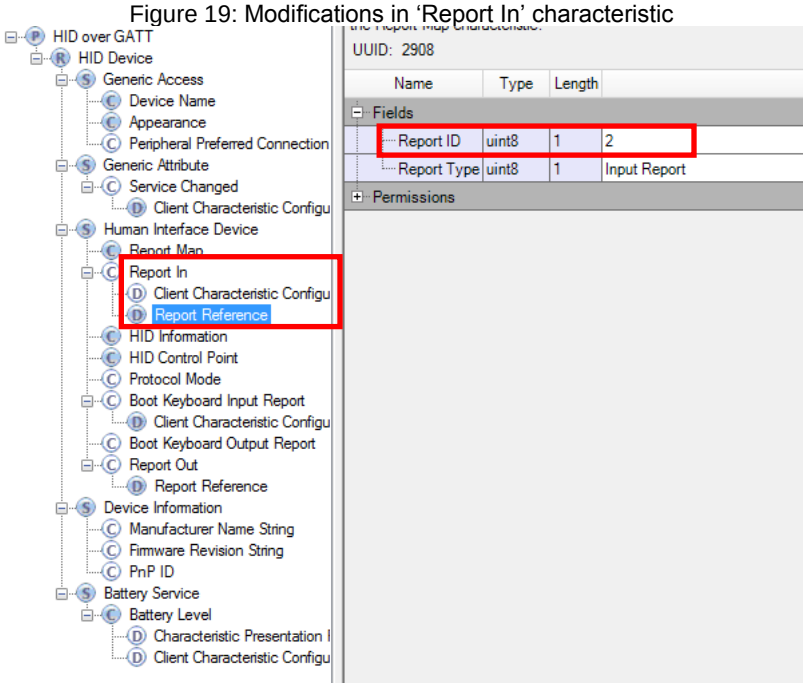
3. In the new collection added, select ‘REPORT_ID’ and change the value to 2.

Figure 18: Addition of REPORT_ID



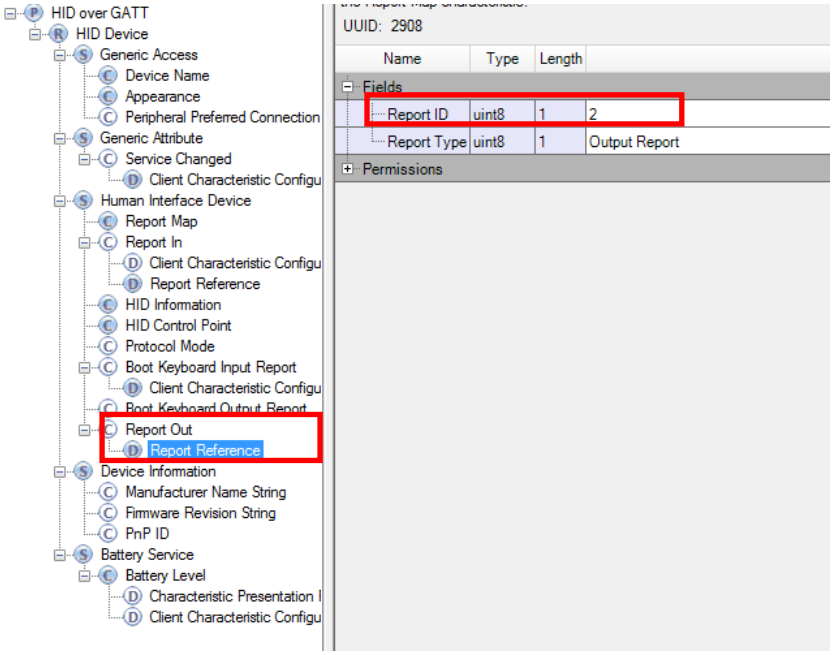
4. Go to ‘Report Reference’ in ‘Report In’ as shown in the figure below and change the ‘Report ID’ value to 2.

Figure 19: Modifications in ‘Report In’ characteristic



5. Go to Report Reference’ in ‘Report Out’ as shown in the figure below and change the ‘Report ID’ value to 2.

Figure 20: Modifications in ‘Report Out’ characteristic



6. Build the project and program the device.

7. Program the PRoC BLE dongle which comes with CY8CKIT-042 with the hex file attached with this project “CY5672_Dongle_Bridge.hex”. The instructions to program are in Appendix A of this document.

8. Bootload the attached .cyacd file on PSoC5 LP on dongle. Instructions to bootload the cyacd file are in Appendix A of this document.
9. Power CY8CKIT-042. Connect the dongle to the USB of the windows 7 system. The PSoC-BLE starts advertising. Press ‘User button’ on dongle as shown in Figure 4-3 in the attached user guide.
10. The device should get connected to the dongle. Now test the project as described in the test procedure for Windows8 in the previous section.

Related Documents

Table 1 lists all relevant application notes, code examples, knowledge base articles, device datasheets, and Component / user module datasheets.

Table 1. Related Documents

Document	Title	Comment
AN91267	Getting Started with PSoC 4 BLE	Provides an introduction to PSoC 4 BLE device that integrates a Bluetooth Low Energy radio system along with programmable analog and digital resources.
AN91445	Antenna Design Guide	Provides guidelines on how to design an antenna for BLE applications.
AN92239	Proximity Sensing with CapSense®	Provides guidelines to how to design capacitive proximity sensors and how to implement gestures using capacitive proximity sensors

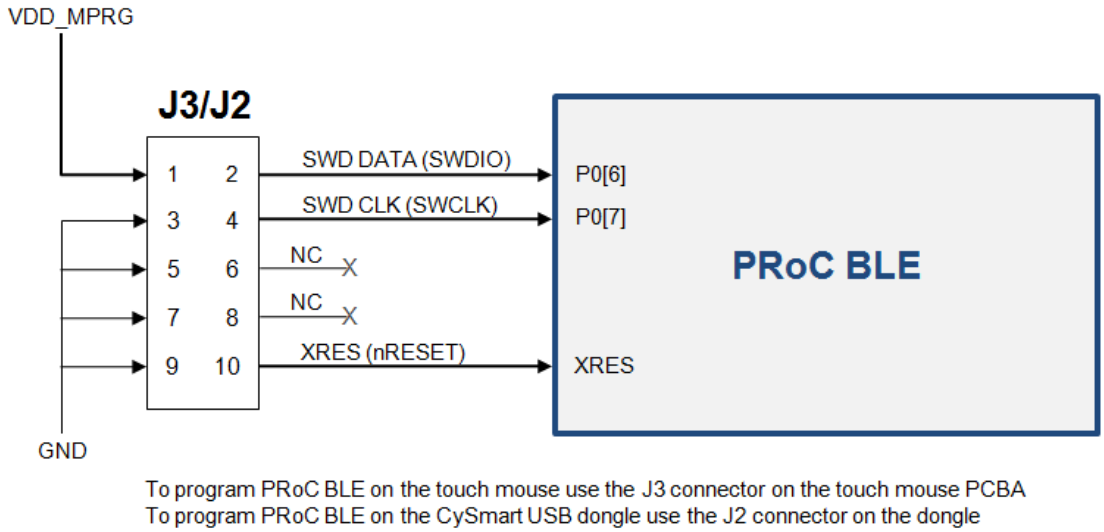
Appendix A

Programming and Debugging

Programming and Debugging PRoC BLE onDongle

The PRoC BLE CySmart USB dongle supports programming and debugging using the MiniProg3 programmer/debugger provided with the kit. Both expose a 10-pin connector. The below figure is a block diagram showing the header and associated connections.

Figure 21: Programming/Debugging PRoC BLE



Notes:

- Remove the warning sticker before using MiniProg3.
- Before trying to program or debug the device, make sure that PSoC Creator and PSoC Programmer are installed on the PC.

You can program the dongle either with PSoC Programmer or directly from PSoC Creator.

Programming PRoC BLE on Dongle Using PSoC Programmer

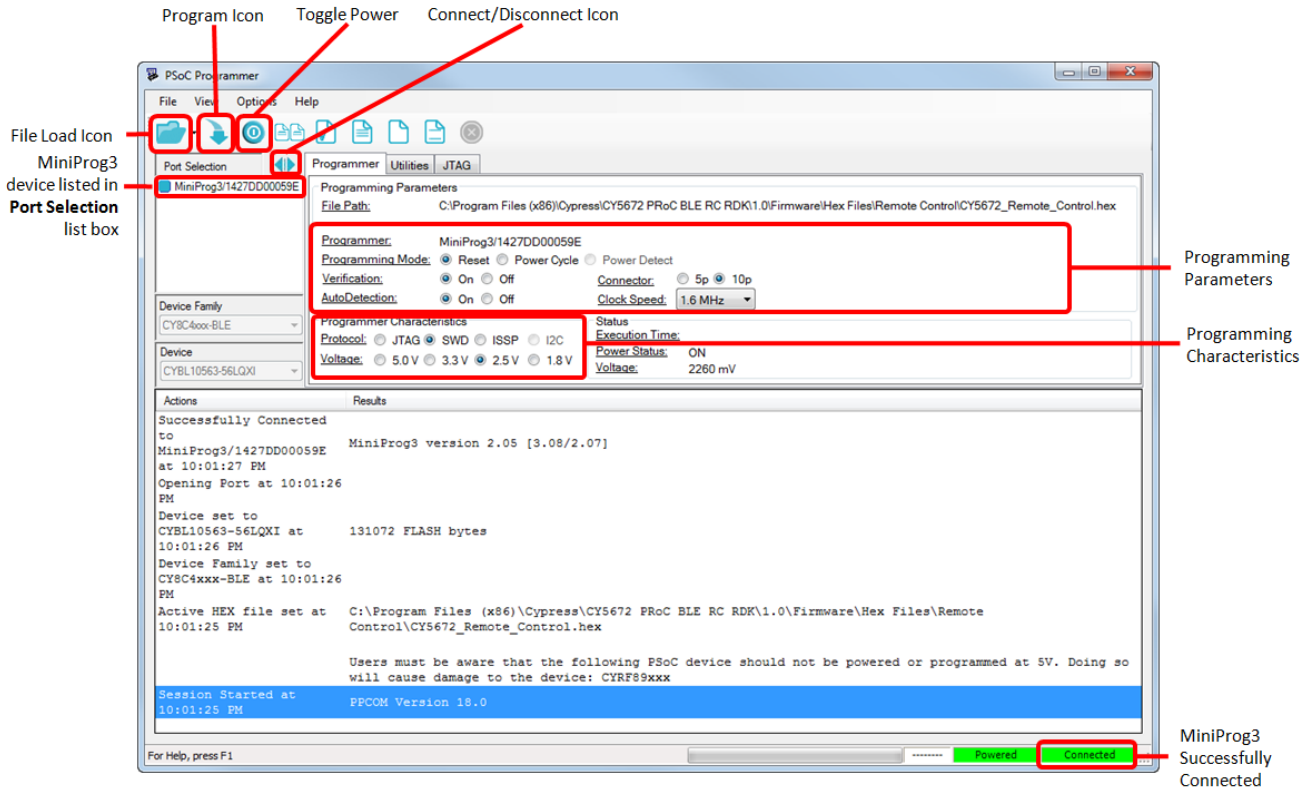
To program the PROC BLE using PSoC Programmer, follow these steps.

1. Connect MiniProg3 to the PC using the USB A to mini-B cable provided with the kit. When it is properly connected, the four LEDs on the MiniProg3 turn on for a few seconds.
2. Connect one end of the 10-pin ribbon cable, provided with the kit, to the 10-pin header on the MiniProg3.
3. Connect the other end of the 10-pin ribbon cable to the 10-pin connector (J2 on the CySmart USB dongle). Programming headers on the CySmart USB dongle (J2) are polarized. Do not apply excessive force; instead, ensure that the connectors are plugged in the correct orientation.
4. Run PSoC Programmer by choosing **Start** > **All Programs** > **Cypress** > **PSoC Programmer**.

   Note: Ensure that only one instance of PSoC Programmer is running on the PC.

5. To establish the connection with a programmer, select either the “MiniProg3” device from the **Port Selection** list box or the **Connect/Disconnect** icon, as shown in the figure below.

Figure 22: PSoC Programmer



6. If the connection is successful, the green status LED on MiniProg3 lights up. A blue square with rounded corners appears next to “MiniProg3” in the **Port Selection** list box. Also, the status in the lower right corner of the PSoC Programmer window turns green and displays **Connected**.

7. Ensure that the settings under **Programming Parameters** in the **Programmer** tab are set to the values specified in the table below.

Table 2: Programming Parameters

Programming Parameter	Setting
Programming Mode	Dongle: Reset (if plugged into and powered via USB port) or Power Cycle (when unplugged from USB port)
Verification	On
AutoDetection	On
Connector	10p
Clock Speed	1.6 MHz

Note: Reset mode can be used even when batteries are not inserted if the **Toggle Power** button shown in figure above is pressed before step 9.

8. Ensure that the parameters under **Programmer Characteristics** are set to the values specified in the table below:

Table 3: Programmer Characteristics

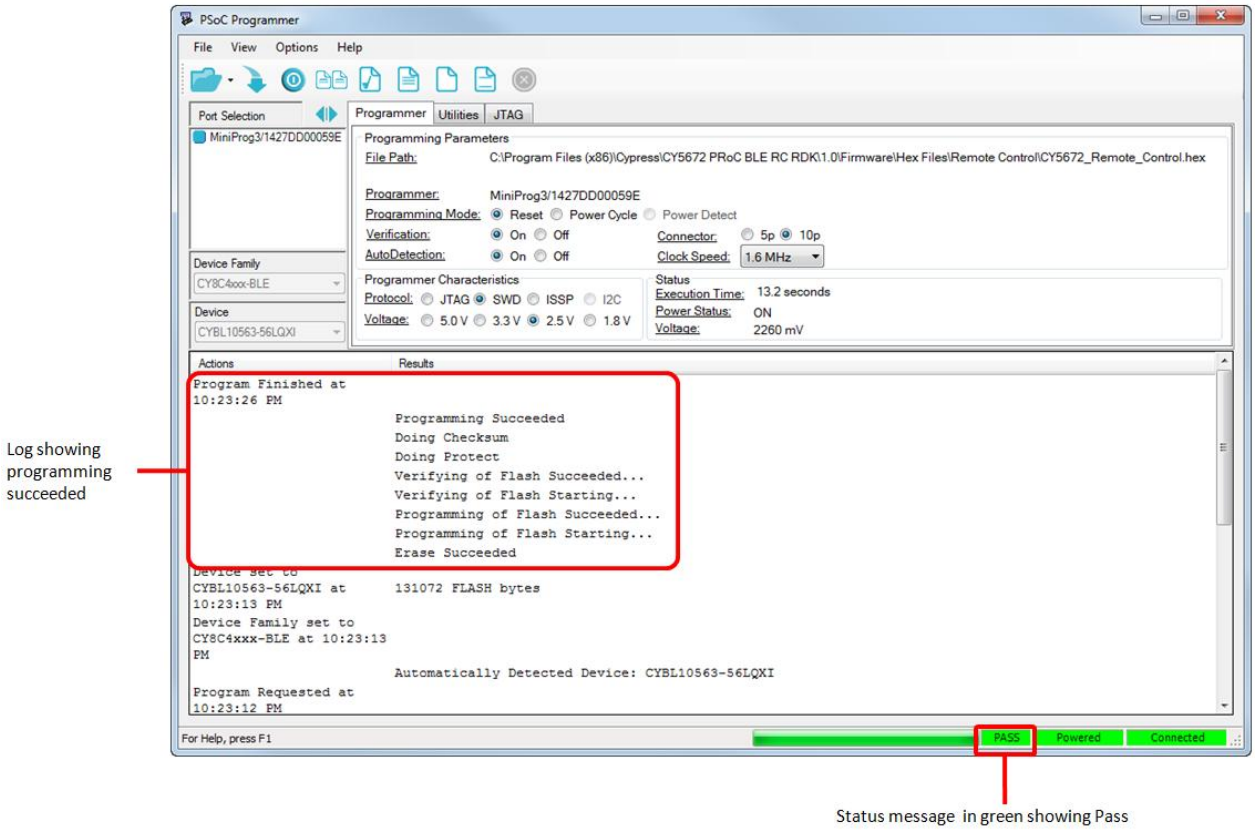
Programmer Characteristics	Setting
Protocol	SWD (Serial Wire Debug)
Voltage	2.5 V

Note: The value of 5 V for **Voltage** in the **Programmer Characteristics** section is not supported, as it is beyond the operating voltage of the dongle. The dongle contains an overvoltage protection circuit to prevent damage to the kit if 5 V is selected.

9. Click on the **File Load** icon. A dialog box appears. Browse to the location of the hex file to be programmed and select the hex file. The selected file appears as the "File Path" in the **Programmer** tab. Load the attached hex file "*CY5672_Dongle_Bridge.hex*".

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

Figure 23: Programmer Window after Successful Programming



Programming PSoC 5LP on the CySmart USB Dongle

The PSoC 5LP controller on the CySmart USB dongle acts as a UART-to-USB bridge, which transfers the data received from PRoC BLE over UART to the USB interfaces listed in the table below. The PSoC 5LP controller provides USB bootloader support to enable users to change the firmware.

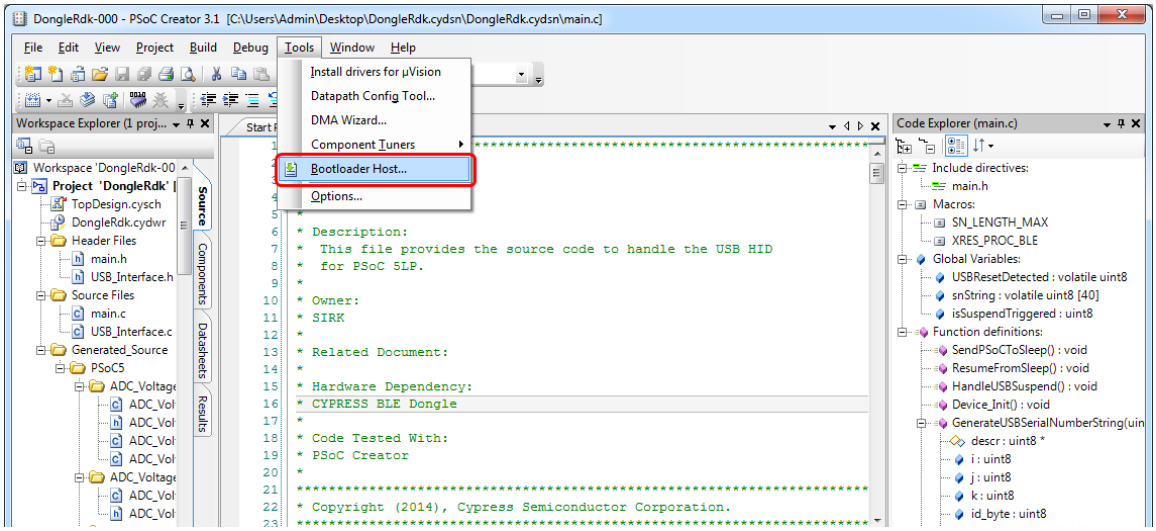
Table 4: Exposed CySmart USB Dongle Interfaces

Interface	Description
USB Composite Device	Generic USB device that supports multiple interfaces
USBUART (COM Port)	USB-UART bridge to work with CySmart tool
Mouse	Standard mouse device for generic mouse functionality
Keyboard	Keyboard device for Windows based shortcuts
Cypress Digital Audio Microphone	Microphone to stream voice data

Follow these steps to download the bootloadable project onto the PSoC 5LP device.

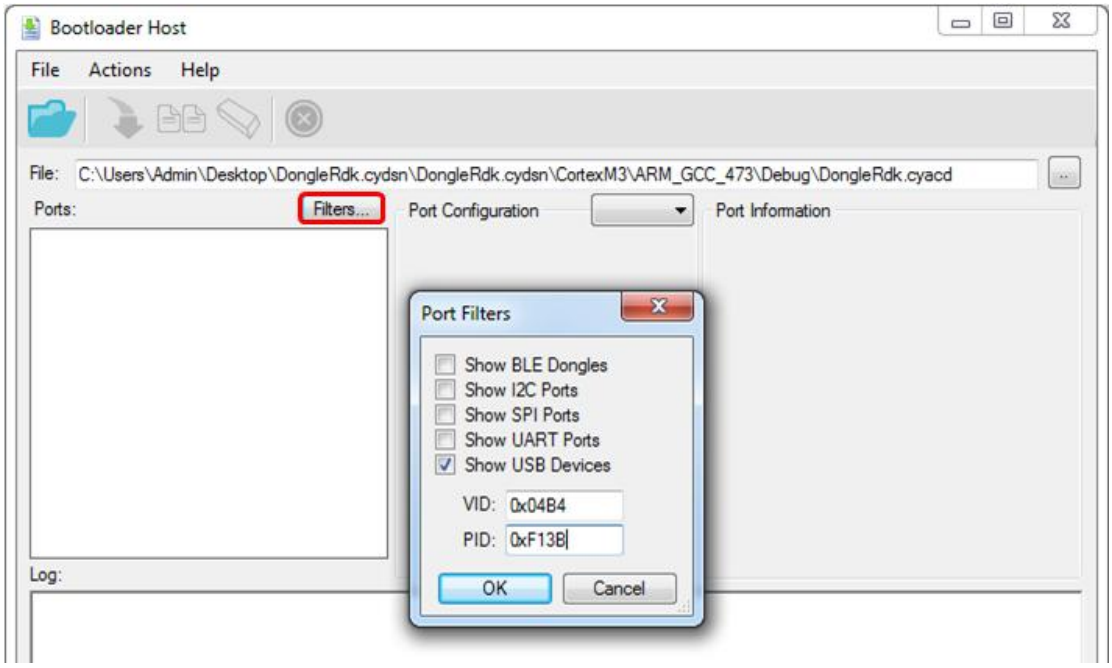
1. Keep the reset switch (SW1) pressed and insert the CySmart USB dongle into a USB port on the PC. If the switch is pressed for more than 100 ms, the PSoC 5LP on the dongle enters bootloader mode. This is indicated by a blinking green LED on the dongle.
2. Open the Bootloader Host tool from PSoC Creator by choosing **Tools** > **Bootloader Host,** as shown in the figure below.

Figure 24: Open Bootloader Host Tool from PSoC Creator



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 the figure below.

Figure 25: Port Filters Tab in Bootloader Host Tool



4. In the Bootloader Host tool, click the **Open File** button (shown in the figure below) and load the bootloadable file attached(**.cyacd*), as shown in the Figure 27.

Figure 26: Open/Program Bootloadable File from Bootloader Host Tool

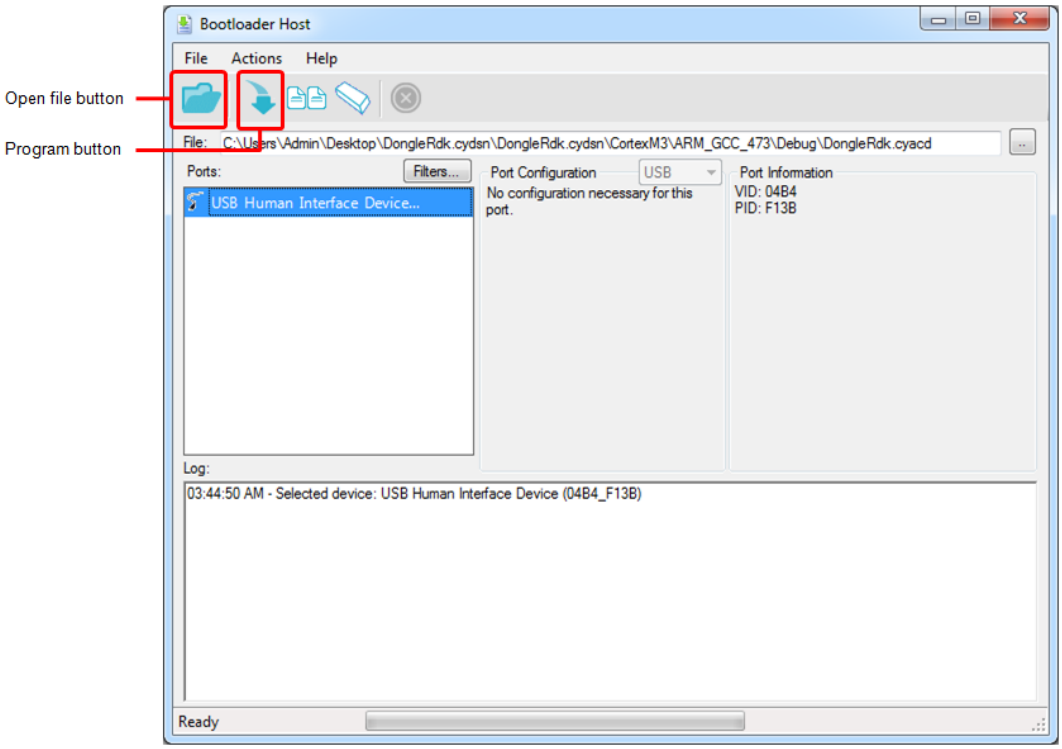
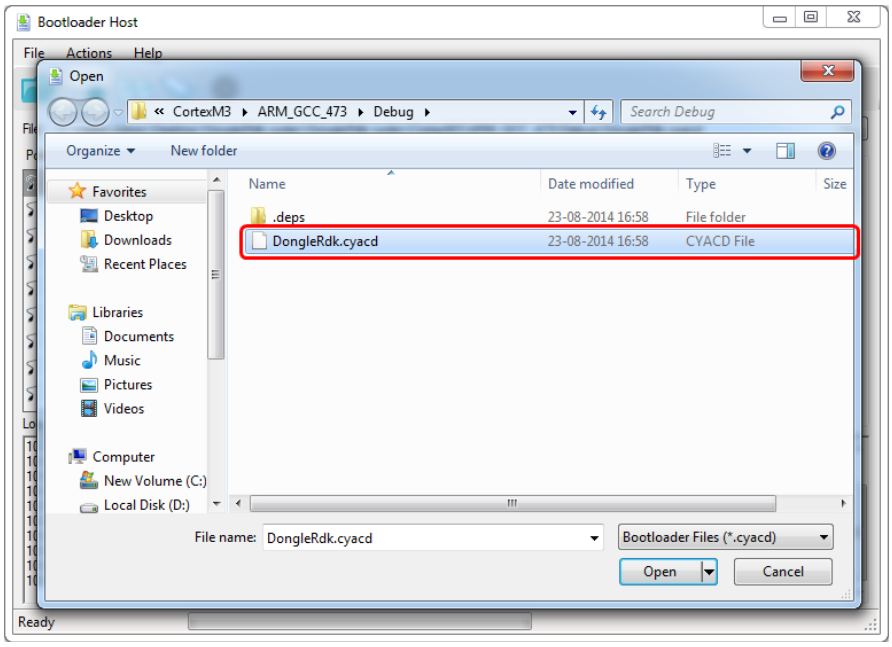


Figure 27: Select Bootloadable File from Bootloader Host



5. Click the **Program** button in the Bootloader Host tool to program the device.
6. If the bootload is successful, the log of the tool displays “Successful”; otherwise, it displays “Failed” with a statement describing the failure.

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