



CY8CKIT-042-BLE

Bluetooth[®] Low Energy (BLE)
Pioneer Kit Guide

Doc. # 001-93731 Rev. *B

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Safety Information



The CY8CKIT-042-BLE Bluetooth Low Energy (BLE) Pioneer Kit is intended for use as a development platform for hardware or software in a laboratory environment. The board is an open system design, which does not include a shielded enclosure. Due to this reason, the board may cause interference with other electrical or electronic devices in close proximity. In a domestic environment, this product may cause radio interference. In such cases, the user may be required to take adequate preventive measures. Also, this board should not be used near any medical equipment or critical RF devices.

The CY8CKIT-042-BLE Bluetooth Low Energy (BLE) Pioneer Kit is intended for use as a development, demonstration and evaluation platform for hardware or software in a laboratory environment. The kit is not intended for general consumer use. Cypress recommends that the kit only be used in a shielded room.

Attaching additional wiring to this product or modifying the product operation from the factory default may affect its performance and cause interference with other apparatus in the immediate vicinity. If such interference is detected, suitable mitigating measures should be taken.

The CY8CKIT-042-BLE as shipped from the factory has been verified to meet with requirements of CE as a Class A product.



The CY8CKIT-042-BLE boards contain electrostatic discharge (ESD) sensitive devices. Electrostatic charges readily accumulate on the human body and any equipment, which can cause a discharge without detection. Permanent damage may occur on devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Store unused CY8CKIT-042-BLE boards in the protective shipping package.



End-of-Life/Product Recycling

The end-of-life cycle for this kit is five years from the date of manufacture mentioned on the back of the box. Contact your nearest recycler to discard the kit.

General Safety Instructions

ESD Protection

ESD can damage boards and associated components. Cypress recommends that the user perform procedures only at an ESD workstation. If an ESD workstation is not available, use appropriate ESD protection by wearing an antistatic wrist strap attached to the chassis ground (any unpainted metal surface) on the board when handling parts.

Handling Boards

CY8CKIT-042-BLE boards are sensitive to ESD. Hold the board only by its edges. After removing the board from its box, place it on a grounded, static-free surface. Use a conductive foam pad if available. Do not slide the board over any surface.

Battery Care and Use

- Use the correct size and type of battery specified in this guide.
- Keep battery contact surfaces and battery compartment contacts clean by rubbing them with a clean pencil eraser or a rough cloth each time you replace batteries.
- Remove the battery from a device when it is not expected to be in use for several months.
- Make sure that you insert the battery into your device properly, with the + (plus) and – (minus) terminals aligned correctly.
- Do not place the battery next to metallic objects such as keys and coins.
- Never throw the battery into fire.
- Do not open up the battery.
- Do not short the battery.
- Do not subject the battery to high temperatures or high humidity.
- Store the battery in a dry place.
- Do not recharge a battery unless it is marked “rechargeable.”

Battery Disposal

Batteries can be safely disposed of with normal household waste. Never dispose of batteries in fire because they can explode. It is important not to dispose of large amounts of batteries in a group. Used batteries are often not completely “dead.” Grouping used batteries together can bring these “live” batteries into contact with one another, creating safety risks.

Regulatory Compliance Information

The kit contains devices that transmit and receive radio signals in accordance with the spectrum regulations for the 2.4-GHz unlicensed frequency range.

Cypress Semiconductor Corporation has obtained regulatory approvals for this kit to be used in specific countries. These countries include United States (FCC Part 15), Canada (IC RSS210) and Japan (JRF/TELEC). Additional regional regulatory agency approval may be required to operate these throughout the world.

This kit as shipped from the factory has been tested and found to comply with the limits/requirements for following compliances:

- FCC as a class B digital device, pursuant to part 15 of the FCC Rules.
- This Class B digital apparatus complies with Canadian ICES-003



CAUTION: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Only the PCB antenna(s) that were certified with the module may be used. Other antennas may be used only if they are of the same type and have the same or lower gain.

The module must be recertified as a Class II permissive change if the module is built into a different device than the EVB (evaluation board) it was certified with.

THE MANUFACTURER IS NOT RESPONSIBLE FOR ANY RADIO OR TV INTERFERENCE CAUSED BY UNAUTHORIZED MODIFICATIONS TO THIS EQUIPMENT. SUCH MODIFICATIONS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

Regulatory statements and Product Labeling

United States (FCC)

This equipment complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The CY8CKIT-142 PSoC 4 BLE and CY5671 PRoC BLE modular transmitter must be labeled with its own FCC ID number, and, if the FCC ID is not visible when the module is installed in to another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following:

Contains FCC ID: **WAP-CY8CKIT-142** and **WAP-CY5671**, The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation. Any similar wording that expresses the same meaning may be used.

CAUTION: The changes or modifications not expressly approved by the party responsible for Compliance could void the user's authority to operate the equipment and the antennas for this transmitter must be installed to provide a separation distance of 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Canada (IC)

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

This equipment complies with radio frequency exposure limits set forth by Industry Canada for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the device and the user or bystanders.

CAUTION: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This Module is labelled with its own IC ID. If the IC ID Certification Number is not visible while installed inside another device, then the device should display the label on it referring the enclosed module. In that case, the final end product must be labelled in a visible area with the following:

“Contains Transmitter Module IC **7922A-CY8CKIT142** and **7922A-CY5671**”

OR

“Contains IC: **7922A-CY8CKIT142** and **7922A-CY5671**”

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Cet équipement est conforme aux limites d'exposition aux radiofréquences définies par Industrie Canada pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20cm de distance entre le dispositif et l'utilisateur ou des tiers.

Ce module est étiqueté avec son propre ID IC. Si le numéro de certification IC ID n'est pas visible lorsqu'il est installé à l'intérieur d'un autre appareil, l'appareil doit afficher l'étiquette sur le module de référence ci-joint. Dans ce cas, le produit final doit être étiqueté dans un endroit visible par le texte suivant:

“Contains Transmitter Module IC **7922A-CY8CKIT142** and **7922A-CY5671**”

OR

“Contains IC: **7922A-CY8CKIT142** and **7922A-CY5671**”

Japan (TELEC)

CY8CKIT-142

Manufactured by Cypress Semiconductor.



® 005-100919

CY5671

Manufactured by Cypress Semiconductor.



® 005-100920

1. Introduction



Thank you for your interest in the CY8CKIT-042-BLE Bluetooth Low Energy (BLE) Pioneer Kit. The BLE Pioneer Kit enables customers to evaluate and develop BLE projects using the PSoC[®] 4 BLE and PRoC[®] BLE devices.

Bluetooth SMART™ or Bluetooth[®] Low Energy (BLE) is a fully featured, layered, communication protocol that includes a 2.4 GHz Radio, a link layer and an application layer. However, in order to implement your projects using PSoC 4 BLE or PRoC BLE, you do not need to understand the complex protocol. The Cypress BLE solution which includes the device, BLE Component and the BLE Firmware Stack will take care of it for you. The Cypress BLE Firmware Stack is royalty free.

You will use two software tools, PSoC Creator and CySmart Central Emulation Tool to develop and debug your BLE project. PSoC Creator is Cypress' standard Integrated Development Environment (IDE). The BLE protocol has been abstracted into an easy drag-and-drop BLE Component in PSoC Creator. CySmart Central Emulation Tool is a Central emulation tool for Windows PCs. CySmart Central Emulation Tool provides an easy-to-use Graphical User Interface (GUI) to enable customers to test and debug their BLE projects.

The BLE Pioneer Kit offers footprint-compatibility with Arduino™ shields as well as 6-pin Digilent Pmod daughter cards. In addition, the kit features a CapSense[®] slider, an RGB LED, a push button switch, an onboard programmer/debugger and USB-UART/I2C bridge functionality block (KitProg), a coin cell battery holder and a Cypress F-RAM. The BLE Pioneer Kit supports 1.9 V, 3.3 V or 5 V as operating voltages.

The BLE Pioneer Kit supports two devices: PSoC 4 BLE and PRoC BLE.

PSoC 4 BLE is a 32-bit, 48-MHz ARM[®] Cortex™-M0 BLE solution with CapSense, 12-bit Analog Front End (1x SAR ADC, 4x Low-Power Opamps, 2x Low-Power Comparators, 2x Current DACs), 4x TCPWM¹, 2x SCBs², 4x UDBs³, LCD⁴, I²S⁵ and 36 GPIOs.

PSoC 4 BLE provides a complete solution for sports and fitness monitors, wearable electronics, medical devices, home automation systems and sensor-based low-power systems for the Internet of Things (IoT).

PRoC BLE is a 32-bit, 48-MHz ARM[®] Cortex™-M0 BLE solution with CapSense, 12-bit ADC, 4x TCPWM¹, 2x SCBs², LCD⁴, I²S⁵ and 36 GPIOs.

PRoC BLE provides a complete solution for BLE connectivity, HID, remote controls and toys.

Both devices are supported by a royalty-free Stack compatible with Bluetooth 4.1.

Notes:

1. Configurable timer, counter, pulse-width modulator.
2. Serial communication blocks (configurable to I²C, SPI or UART).
3. Universal Digital Blocks.
4. Configurable liquid crystal display driver.
5. Configurable integrated interchip sound serial bus interface.

1.1 Kit Contents

The BLE Pioneer Kit contains the following items, as shown in [Figure 1-1](#).

- BLE Pioneer Baseboard preloaded with the CY8CKIT-142 PSoC 4 BLE Module
- CY5671 PSoC BLE Module
- CY5670 CySmart USB Dongle (BLE Dongle)
- Quick start guide
- USB Standard-A to Mini-B cable
- Four jumper wires (4 inch) and two proximity sensor wires (5 inch)
- Coin cell (3V CR2032)

Figure 1-1. Kit Contents



If any part of the BLE Pioneer Kit is missing, contact your nearest Cypress sales office for help:
www.cypress.com/go/support.

1.2 BLE Pioneer Baseboard Details

The BLE Pioneer Baseboard consists of the blocks shown in [Figure 1-2](#).

1. RGB LED
2. Module reset button
3. CapSense proximity header
4. User button
5. CapSense slider
6. Arduino compatible I/O headers (J2/J3/J4)
7. Arduino compatible power header (J1)
8. Digilent Pmod compatible I/O header (J5)
9. Cypress F-RAM 1-Mb (FM24V10-G)
10. PSoc 5LP - programmer and debugger (CY8C5868LTI-LP039)
11. PSoc 5LP I/O header (J8)
12. Coin cell holder (bottom side)
13. USB connector (J13)
14. Power LED and Status LED
15. System power supply jumper (J16) - LDO 1.9 V~5 V
16. BLE power supply jumper (J15) - for current measurement
17. Module headers (J10/J11)

Figure 1-2. BLE Pioneer Baseboard

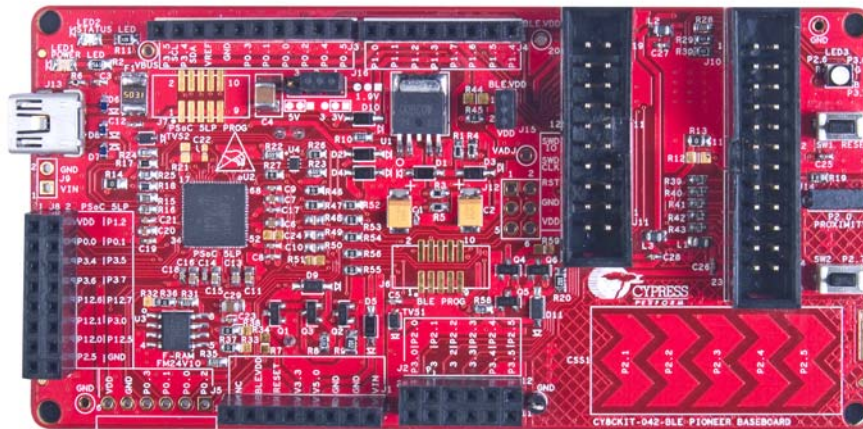
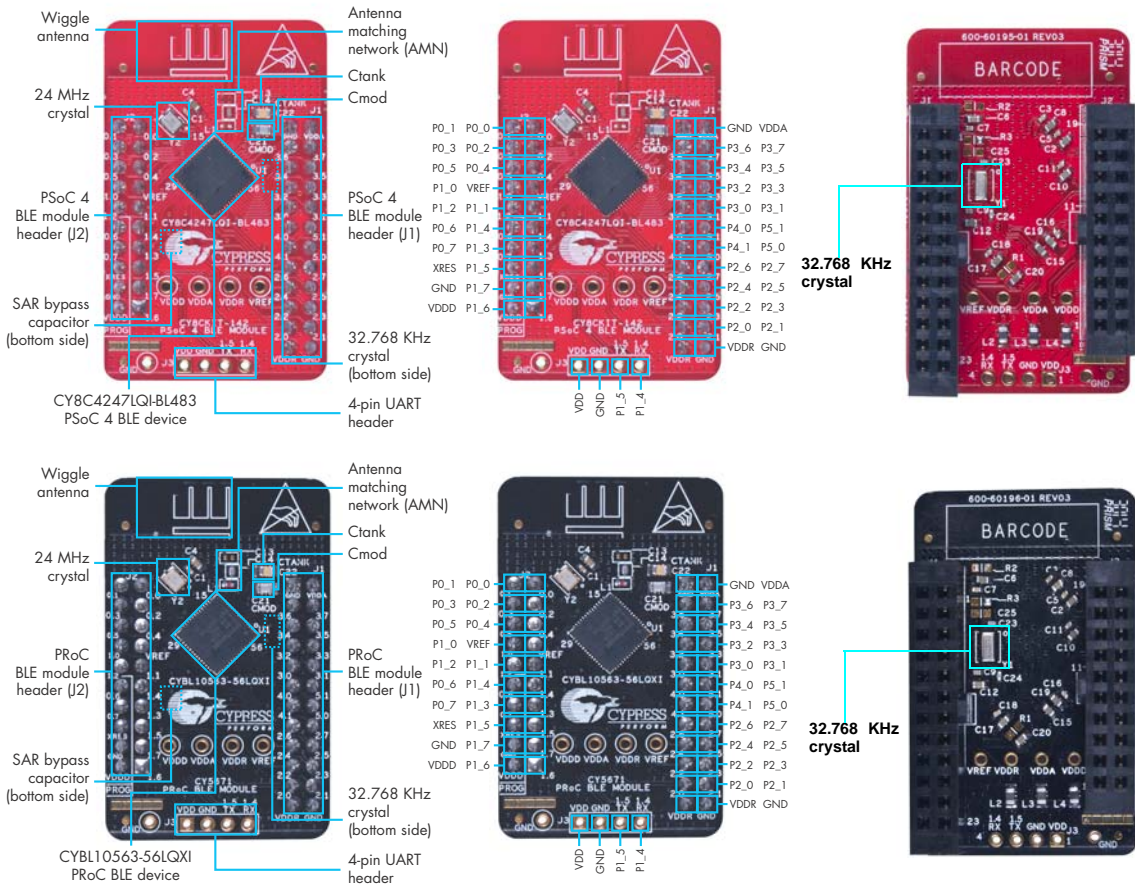


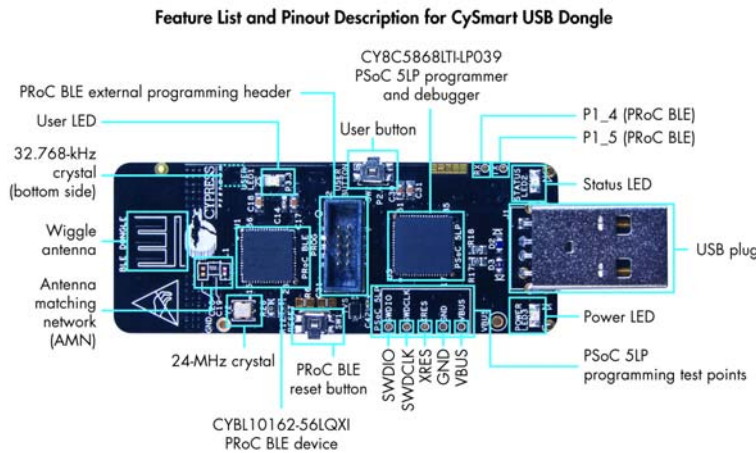
Figure 1-3 shows a markup of the onboard components, where red module denotes the PSoC 4 BLE module and black module denotes the PProC BLE module.

Figure 1-3. BLE Module Markup



The BLE Dongle board consists of the blocks shown in [Figure 1-4](#).

Figure 1-4. BLE Dongle Markup



1.3 PSoC Creator™

PSoC Creator is a state-of-the-art, easy-to-use integrated design environment (IDE). It is a revolutionary hardware and software co-design environment, powered by a library of preverified and precharacterized PSoC Components™.

With PSoC Creator, you can:

- Drag and drop PSoC Components to build a schematic of your custom design
- Automatically place and route components and configure GPIOs
- Develop and debug firmware using the included component APIs

PSoC Creator also enables you to tap into an entire tool ecosystem with integrated compiler chains and production programmers for PSoC devices.

For more information, visit www.cypress.com/psoccreator.

1.4 Getting Started

This guide will help you get acquainted with the BLE Pioneer Kit:

- The [Software Installation chapter on page 23](#) describes the installation of the kit software. This includes the PSoC Creator IDE for development and debugging applications, PSoC Programmer for programming hex files, and the CySmart Central Emulation Tool for BLE Central emulation.
- The [Kit Operation chapter on page 27](#) describes the major features of the BLE Pioneer Kit such as USB-UART and USB-I²C bridges and functionalities such as programming and debugging.
- The [Example Projects chapter on page 41](#) describes multiple PSoC 4 BLE and PProC BLE code examples that will help you understand how to create your own BLE application using the BLE Component and device.
- The [Hardware chapter on page 85](#) details the hardware content of the BLE Pioneer Kit and BLE Dongle, and the hardware operation.
- The [Advanced Topics chapter on page 111](#) explains the functionality of the kit features, such as the USB-UART bridge, USB-I²C bridge, F-RAM, iOS app, and the CySmart Central Emulation Tool.
- The [Appendix on page 117](#) provides schematics, board layouts, KitProg LED status, and the bill of materials (BOM).

1.5 Additional Learning Resources

Visit www.cypress.com/go/psoc4ble and www.cypress.com/procble for additional learning resources including datasheets, technical reference manuals, and application notes.

Visit www.cypress.com/go/cysmart for information on the CySmart Central Emulation Tool.

1.5.1 Beginner Resources

PSoC Creator Training: www.cypress.com/go/creatorstart/creatortraining

1.5.2 Application Notes

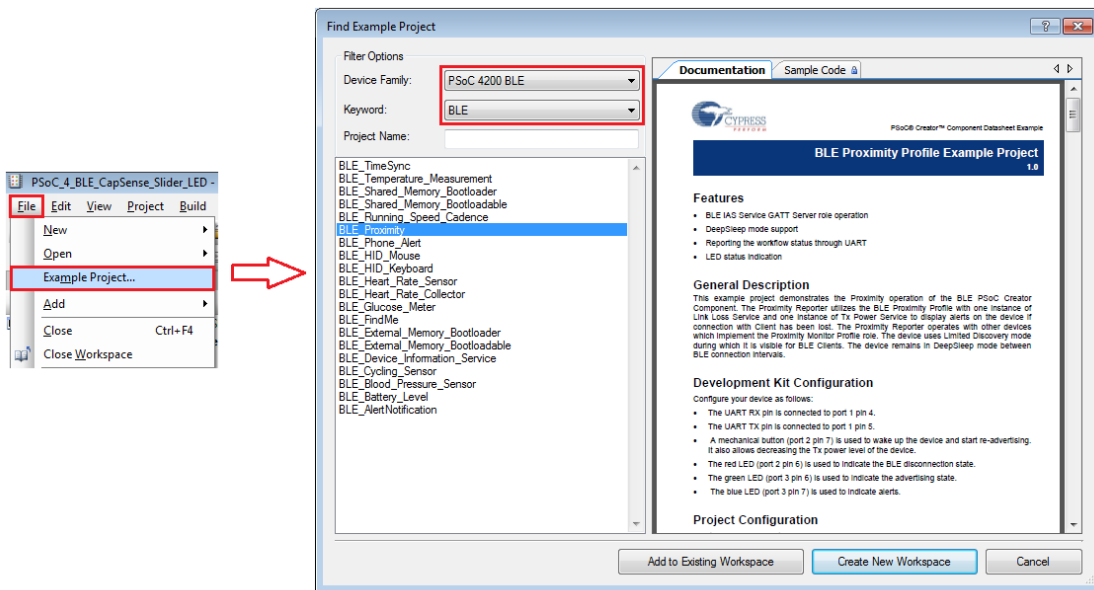
Visit www.cypress.com/appnotes to view a growing list of application notes for PSoC 3, PSoC 4, PSoC 4 BLE, PSoC BLE, and PSoC 5LP.

Visit [this site](#) for PSoC 4BLE and PSoC BLE application notes.

1.5.3 PSoC Creator Example Projects

These simple example projects demonstrate how to configure and use PSoC Creator components. To open an example project in PSoC Creator, go to **File > Example Project** (see [Figure 1-5](#)) and choose the required example project.

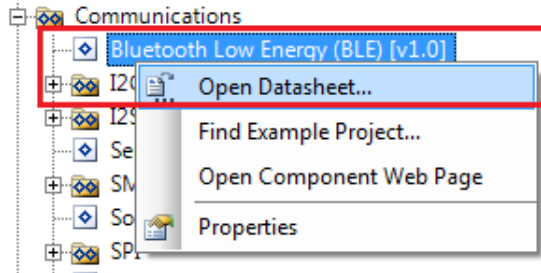
Figure 1-5. PSoC Creator Example Projects



1.5.4 Component Datasheets

To open the datasheet for any component, right-click on the component and select **Open Datasheet** (see [Figure 1-6](#)).

Figure 1-6. Opening Component Datasheet



1.5.5 Bluetooth Learning Resources

The [Bluetooth Developer Portal](#) provides material by the Special Interest Group (SIG) for learning various aspects of the Bluetooth Low Energy protocol and systems. Some of them are:

- [Training videos](#)
- [GATT profiles](#)
- [Bluetooth community forum](#)

1.5.6 Learning From Peers

Cypress Developer Community Forums: Visit www.cypress.com/forums

1.5.7 Other Related Resources

- Diligent PMod: www.diligentinc.com/pmods/
- Arduino: <http://arduino.cc/en/Main/ArduinoBoardUno>

1.6 Technical Support

For assistance, go to our support web page, www.cypress.com/support, or contact our customer support at +1 (800) 541-4736 Ext. 2 (in the USA) or +1 (408) 943-2600 Ext. 2 (International).

1.7 Documentation Conventions

Table 1-1. Document Conventions for Guides

Convention	Usage
Courier New	Displays file locations, user entered text, and source code: C:\...\cd\icc\
<i>Italics</i>	Displays file names and reference documentation: Read about the <i>sourcefile.hex</i> file in the <i>PSoC Creator User Guide</i> .
[Bracketed, Bold]	Displays keyboard commands in procedures: [Enter] or [Ctrl] [C]
File > Open	Represents menu paths: File > Open > New Project
Bold	Displays commands, menu paths, and icon names in procedures: Click the File icon and then click Open .
Times New Roman	Displays an equation: $2 + 2 = 4$
Text in gray boxes	Describes cautions or unique functionality of the product.

1.8 Acronyms

Table 1-2. Acronyms Used in this Document

Acronym	Definition
ADC	Analog-to-Digital Converter
API	Application Programming Interface
BD address	Bluetooth Device address
BLE	Bluetooth Low Energy
CDC	Communications Device Class
COM	Communication Port
DVD	Digital Video Disc
ESD	Electrostatic Discharge
F-RAM	Ferroelectric Random Access Memory
GUI	Graphical User Interface
GPIO	General Purpose Input/Output
I2C	Inter-Integrated Circuit
IAS	Immediate Alert Service
IDAC	Interconnecting Digital-Analog Converter
IDE	Integrated Development Environment
LDO	Low Drop Out (voltage regulator)
LED	Light-Emitting Diode
LP	Low Power
LPT	Line Print Terminal
PHY	Physical Layer
PrISM	Precise Illumination Signal Modulation
PRoC	Programmable Radio-on-Chip
PRM	Protocol Service Multiplexer
PSoC	Programmable Systems-on-Chip
PWM	Pulse-Width Modulation
QFN	Quad Flat No-lead (package)
RGB	Red Green Blue
SAR	Successive Approximation Register
SMA	SubMiniature version A
SPI	Serial Peripheral Interface
SWD	Serial Wire Debug
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus

2. Software Installation



This chapter describes the steps to install the software tools and packages on a PC for using the BLE Pioneer Kit. This includes the IDE in which the projects will be built and used for programming.

2.1 Before You Begin

All Cypress software installations require administrator privileges. Ensure you have the required privileges on the system for successful installation. Before you install the kit software, close any other Cypress software that is currently running.

2.2 Install Software

Follow these steps to install the BLE Pioneer Kit software:

1. Download the BLE Pioneer Kit software from www.cypress.com/CY8CKIT-042-BLE. The software is available in the following formats:
 - a. CY8CKIT-042-BLE Kit Complete Setup: This installation package contains the files related to the BLE Pioneer Kit. However, it does not include the Windows Installer or Microsoft .NET framework packages. If these packages are not on your computer, the installer directs you to download and install them from the Internet.
 - b. CY8CKIT-042-BLE Kit Only Package: This executable file installs only the BLE Pioneer Kit contents, which include code examples, hardware files, and user documents. This package can be used if all the software prerequisites (listed in step 5) are installed on your PC.
 - c. CY8CKIT-042-BLE DVD ISO: This file is a complete package, stored in a DVD-ROM image format, that you can use to create a DVD or extract using an ISO extraction program such as WinZip or WinRAR. The file can also be mounted similar to a virtual CD/DVD using virtual drive programs such as 'Virtual CloneDrive' and 'MagicISO'. This file includes all the required software, utilities, drivers, hardware files, and user documents.
2. If you have downloaded the ISO file, mount it on a virtual drive; if you do not have a virtual drive to mount, extract the ISO contents using the appropriate ISO extractor (such as MagicISO or PowerISO). Double-click *cyautorun.exe* in the root directory of the extracted content or mounted ISO if "Autorun from CD/DVD" is not enabled on the PC. The installation window will appear automatically.

Note: If you are using the "Kit Complete Setup" or "Kit Only Package" file, then go to step 4 for installation.

3. Click **Install CY8CKIT-042-BLE Kit** to start the installation, as shown in [Figure 2-1](#).

Figure 2-1. Installer Screen



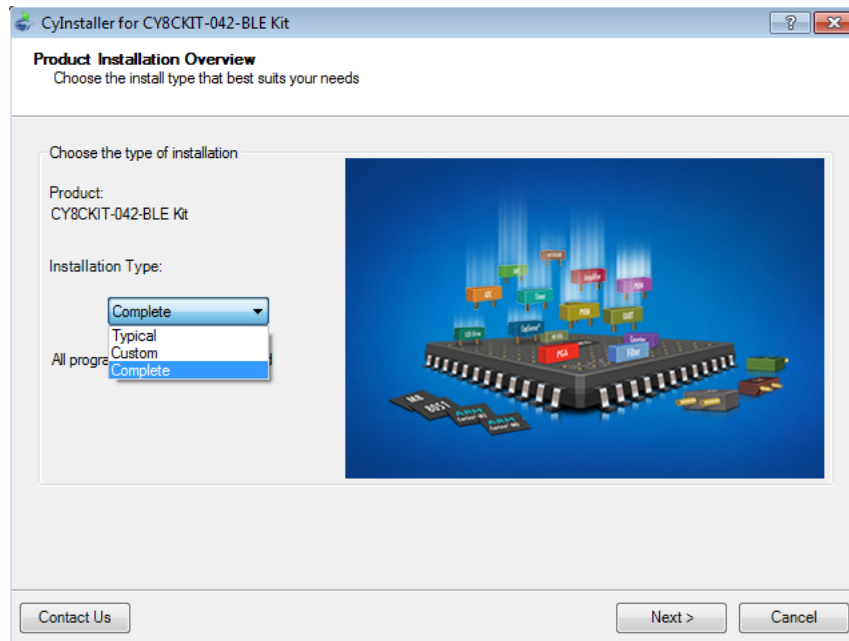
4. Select the folder in which you want to install the CY8CKIT-042-BLE kit-related files. Choose the directory and click **Next**.
5. When you click **Next**, the CY8CKIT-042-BLE Kit installer automatically installs the required software, if it is not present on your computer. The following software packages are required:

Note: For the Kit Only Package, download and install the following prerequisites.

 - a. PSoC Creator 3.1 or later: Download the latest version from www.cypress.com/psoccreator.
 - b. PSoC Programmer 3.22 or later: This is installed as part of PSoC Creator installation (www.cypress.com/programmer).
 - c. CySmart 1.0 or later: Download the latest version from www.cypress.com/cysmart.

- Choose the Typical/Custom/Complete installation type in the **Product Installation Overview** window, as shown in [Figure 2-2](#). Click **Next** after you select the installation type.

Figure 2-2. Product Installation Overview



- Read the license agreement and select **I accept the terms in the license agreement** to continue with installation. Click **Next**.
- When the installation begins, a list of packages appears on the installation page. A green check mark appears next to each package after successful installation.
- Click **Finish** to complete the CY8CKIT-042-BLE kit installation.
- Enter your contact information or select the **Continue Without Contact Information** check box. Click **Finish** to complete the CY8CKIT-042-BLE kit installation.
- After the installation is complete, the kit contents are available at the following location:

<Install_Directory>\CY8CKIT-042-BLE Kit

Default location:

Windows 7 (64-bit): C:\Program Files (x86)\Cypress\CY8CKIT-042-BLE Kit

Windows 7 (32-bit): C:\Program Files\Cypress\CY8CKIT-042-BLE Kit

Note: For Windows 7/8/8.1 users, the installed files and the folder are read only. To use the installer example project, follow the steps outlined in the [Example Projects chapter on page 41](#).

The BLE Pioneer Kit installer also installs the CySmart Central Emulation Tool on your PC. This software, along with the BLE Dongle, allows the PC to emulate as a BLE Central device. Refer to [CySmart Mobile Application on page 112](#) for more details on how to use the CySmart Central Emulation Tool.

2.3 Windows 8.1 USB selective suspend setting

Windows 8.1 operating system issues a suspend command to connected USB device if there is no activity on its USB bus. This may happen to BLE Pioneer Kit/BLE Dongle if the driver installation is not complete or driver not found. In this situation, as a response to the suspend command from the

operating system, the KitProg will shut down the on-board LDO to remain within the USB suspend current requirement. Due to this, the BLE Pioneer Kit will not be powered and will not be functional.

To prevent this, take either of the two actions below:

1. Allow complete driver installation to take place on Windows 8.1 operating system before using the BLE Pioneer Kit.
2. Disable the USB selective suspend setting for BLE Pioneer Kit from Power Options on Windows 8.1:
 - a. From Control Panel, go to Power Options.
 - b. Under Advanced settings, expand USB settings > USB selective suspend setting.
 - c. Select option to Disabled for Plugged in and On battery operation.
 - d. Select OK.

3. Kit Operation

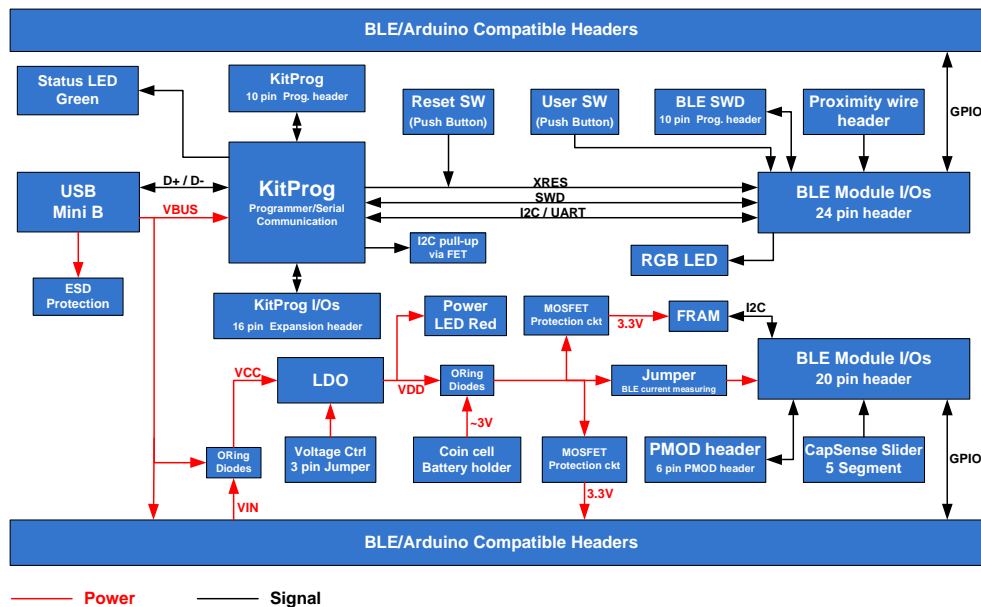


This chapter introduces you to the BLE Pioneer Kit and the features that will be used as part of its operation. We will discuss features such as USB connection, programming/debugging, and programmer firmware update. The chapter also describes the USB-UART and USB-I²C bridges along with the PC tools that can be used to communicate with the BLE device on the BLE Pioneer Kit.

3.1 Theory of Operation

Figure 3-1, Figure 3-2, and Figure 3-3 show the block diagrams for the BLE Pioneer Baseboard, PSoC 4 BLE/PRoC BLE Module, and BLE Dongle.

Figure 3-1. BLE Pioneer Baseboard Block Diagram

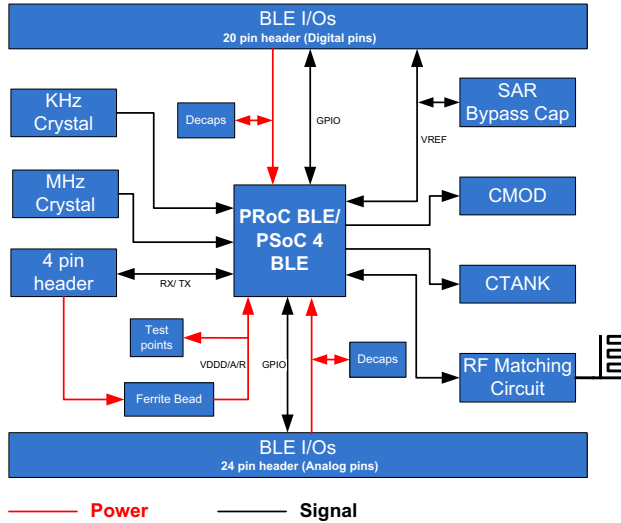


The BLE Pioneer Baseboard acts as the baseboard for the PSoC 4 BLE (red module) and PRoC BLE (black module). The BLE Pioneer Baseboard contains a PSoC 5LP device, that has KitProg firmware, used as an onboard programmer or debugger, and for the USB-Serial interface.

The baseboard is Arduino form-factor compatible, enabling Arduino shields to be connected on top of the board to extend the functionality of BLE modules. The board also features a 1-Mb F-RAM, an RGB LED, a five-segment CapSense slider, a proximity header, a user switch, and a reset switch for the PSoC 4 BLE and PRoC BLE devices on the module. The Pioneer board supports three voltage levels: 1.9 V, 3.3 V, and 5 V.

The BLE Pioneer Baseboard can also be used as a standalone programmer to program and debug other BLE devices using serial wire debug (SWD), and as a USB-Serial interface. The KitProg firmware on PSoC 5LP device enables bootloading PSoC 5LP over USB to upgrade the firmware.

Figure 3-2. PSoC 4 BLE/PRoC BLE Module Block Diagram

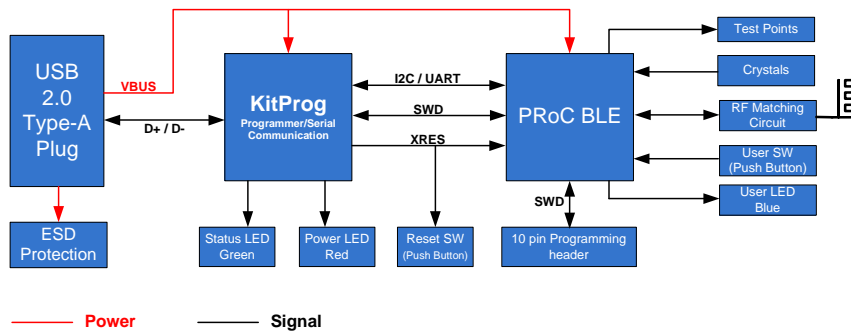


This BLE Pioneer Kit includes two modules. These modules act as a basic breakout board for the CY8C4247LQI-BL483 (PSoC 4 BLE) and CYBL10563-56LQXI (PRoC BLE) device. The PSoC 4 BLE and PRoC BLE Modules are identical except for the BLE device.

The BLE Dongle is the wireless interface for the CySmart Central Emulation Tool. The BLE Dongle has a PRoC BLE device for BLE communication and KitProg for onboard programming, debugging and for the USB-Serial interface, as shown in Figure 3-3.

The BLE Dongle has a USB Type-A plug to connect the KitProg to the USB port of the host PC. The KitProg then communicates with the PRoC BLE device over UART or multiplexed I²C or an SPI bus. The BLE Dongle also features a user LED, a user switch, and a reset switch for the PRoC BLE device. The BLE Dongle is powered directly through the USB port (VBUS) at 5.0 V.

Figure 3-3. BLE Dongle Block Diagram



3.2 KitProg

KitProg is the hardware/firmware block for on-board programming, debugging and bridge functionality. It is a common reusable hardware/firmware block used across many Cypress Kit platforms. It consists of a PSoC 5LP which connects to the PC over an USB interface and connects to the PSoC 4 BLE or PSoC BLE device over SWD, I2C and UART pins.

The KitProg communicates with PSoC Programmer and PSoC Creator software to program/debug the target PSoC 4 BLE or PSoC BLE over the SWD interface. The main advantage of an onboard programmer/debugger is that users don't have to buy an extra programmer/debugger hardware.

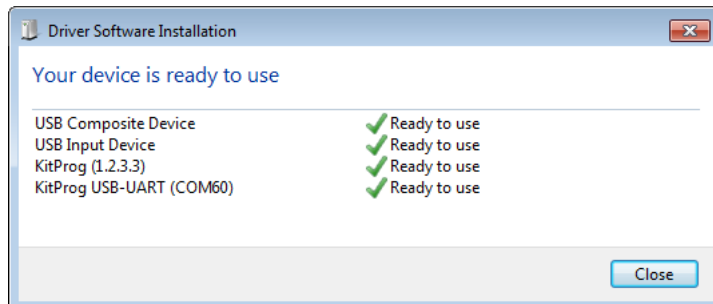
3.3 BLE Pioneer Kit USB Connection

The BLE Pioneer Kit powers from a PC over the USB interface (J13). It enumerates as a composite device, as shown in Table 3-1. USB drivers required for this enumeration are part of the kit installer. The kit should be installed properly for its correct operation. Visit www.cypress.com/CY8CKIT-042-BLE for latest kit installer.

Table 3-1. BLE Pioneer Kit Enumerated Interfaces

Port	Description
USB Composite Device	Composite device
USB Input Device	USB-I ² C bridge, Kitprog Command Interface
KitProg	USB-I ² C bridge, Programmer and Debugger
KitProg USB-UART	USB-UART bridge, which appears as a COM# port

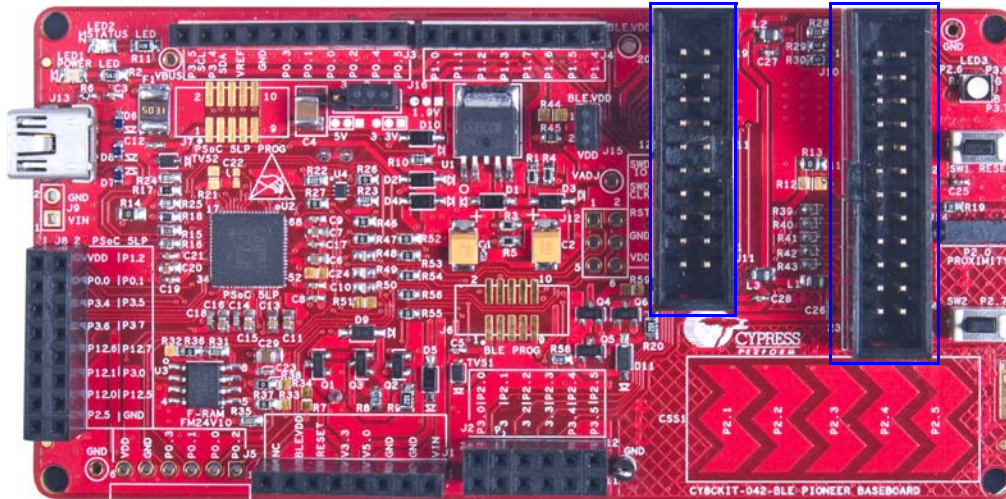
Figure 3-4. KitProg Driver Installation (appearance may differ depending on Windows version)



3.4 Placing Modules on Baseboard

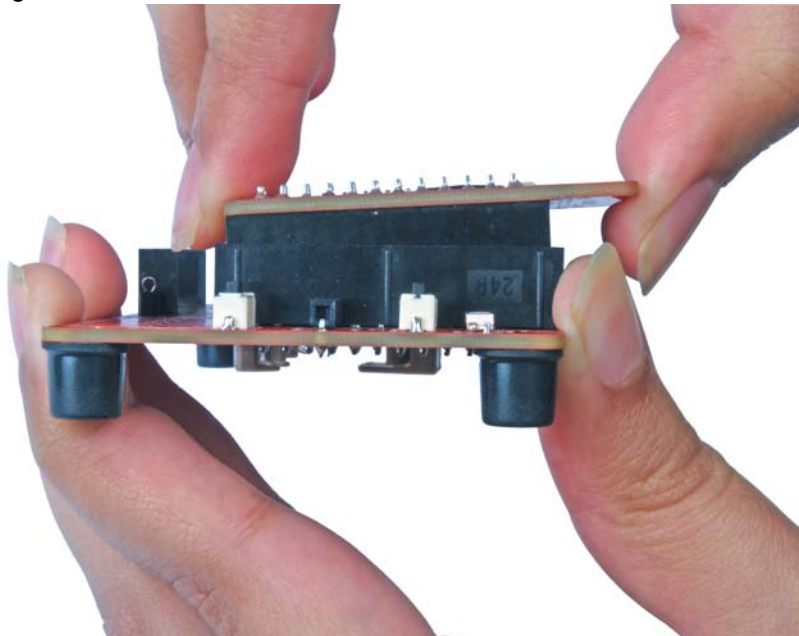
Plug the module into the BLE Pioneer Baseboard on headers J10 and J11, while keeping the antenna directed outside. Note that the two parallel headers J10 and J11 are not equal (24-pin and 20-pin, respectively) and will not allow the module to be inserted in the opposite direction.

Figure 3-5. Baseboard with J10 and J11 Headers to connect modules



To remove the modules from the BLE Pioneer Kit, hold the BLE Pioneer Kit in one hand and the module in the other, as shown in Figure 3-6, and pull it out using a rocking motion.

Figure 3-6. Remove module connected on BLE Pioneer Kit



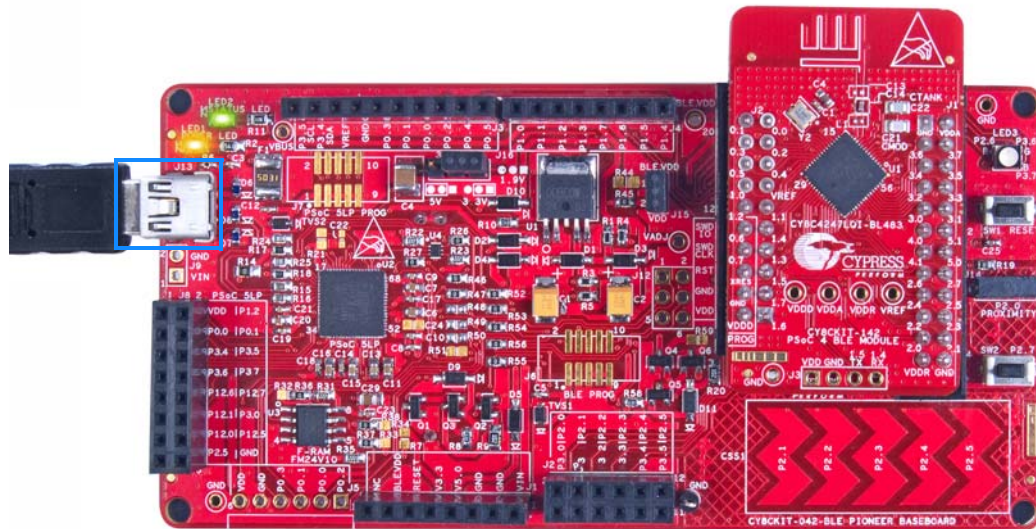
3.5 Programming and Debugging BLE Device

The BLE Pioneer Kit and BLE Dongle can be programmed and debugged using the KitProg. Before programming the device, ensure that PSoC Creator and PSoC Programmer are installed on the PC. See the section [Install Software on page 23](#) for more information.

3.5.1 Programming using PSoC Creator

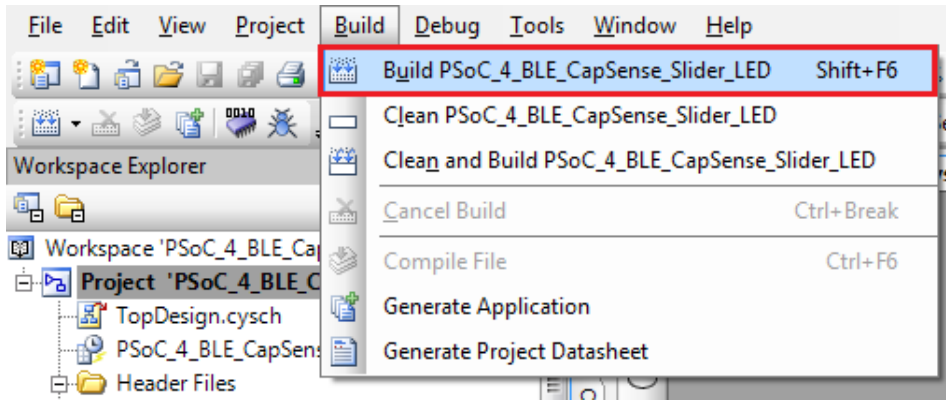
1. Connect the BLE Pioneer Kit/BLE Dongle to the PC USB port, as shown in [Figure 3-7](#).

Figure 3-7. Connect USB Cable to J13



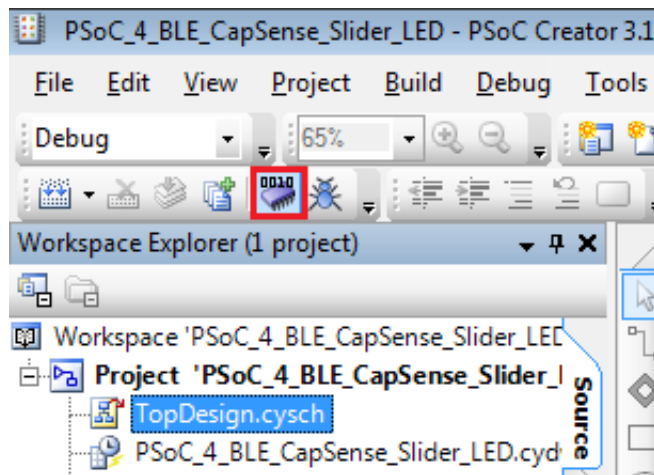
2. Load the desired example project in PSoC Creator from **File > Open > Project/Workspace**.
3. Build the project by choosing **Build > Build <Project Name>** or **[Shift] [F6]**, as shown in Figure 3-8.

Figure 3-8. Build an Example Project



4. If there are no errors during build, program the firmware by clicking **Program** button on toolbar or pressing **[Ctrl] [F5]**, as shown in Figure 3-9. This will program the device on the BLE Pioneer Kit/ BLE Dongle and it will be ready for use.

Figure 3-9. Programming Device From PSoC Creator

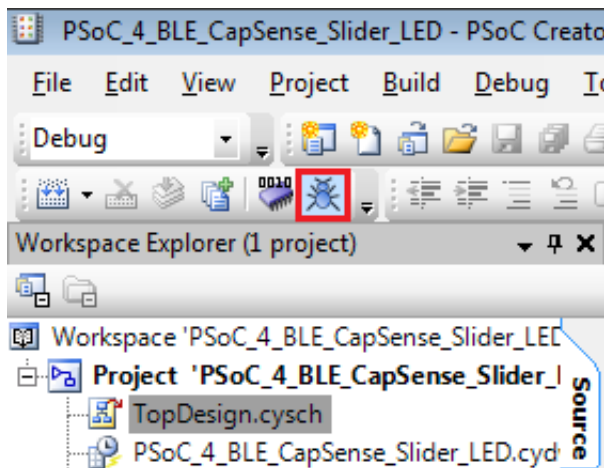


3.5.2 Debugging using PSoC Creator

For debugging the project using PSoC Creator, follow steps 1-5 from [Programming using PSoC Creator on page 30](#) followed by:

1. Click on **Debug** icon or press **[F5]**, as shown in [Figure 3-10](#).

Figure 3-10. Start debug on PSoC Creator



2. Once Creator opens in debug mode, use the buttons on toolbar for debugging.

For more details on using the debug features, see the Cypress application note [Getting Started with PSoC 4 BLE](#).

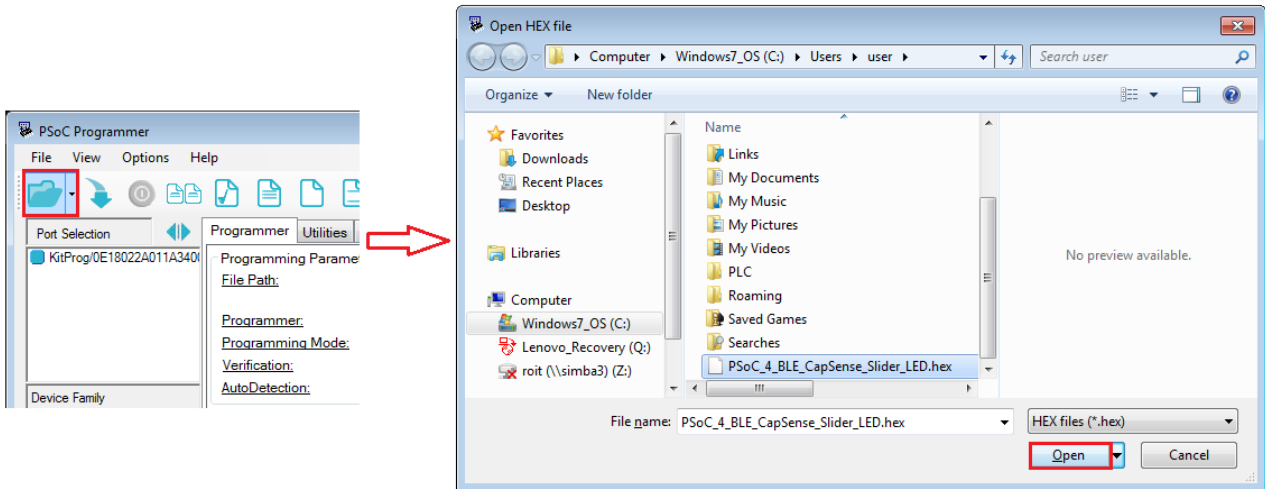
3.5.3 Programming using PSoC Programmer

PSoC Programmer (3.22 or later) can be used to program existing hex files into both the BLE Pioneer Kit or BLE Dongle. To do this, follow these steps.

1. Connect the BLE Pioneer Kit or BLE Dongle to PC and open PSoC Programmer from **Start > All Programs > Cypress > PSoC Programmer <version> > PSoC Programmer <version>**.

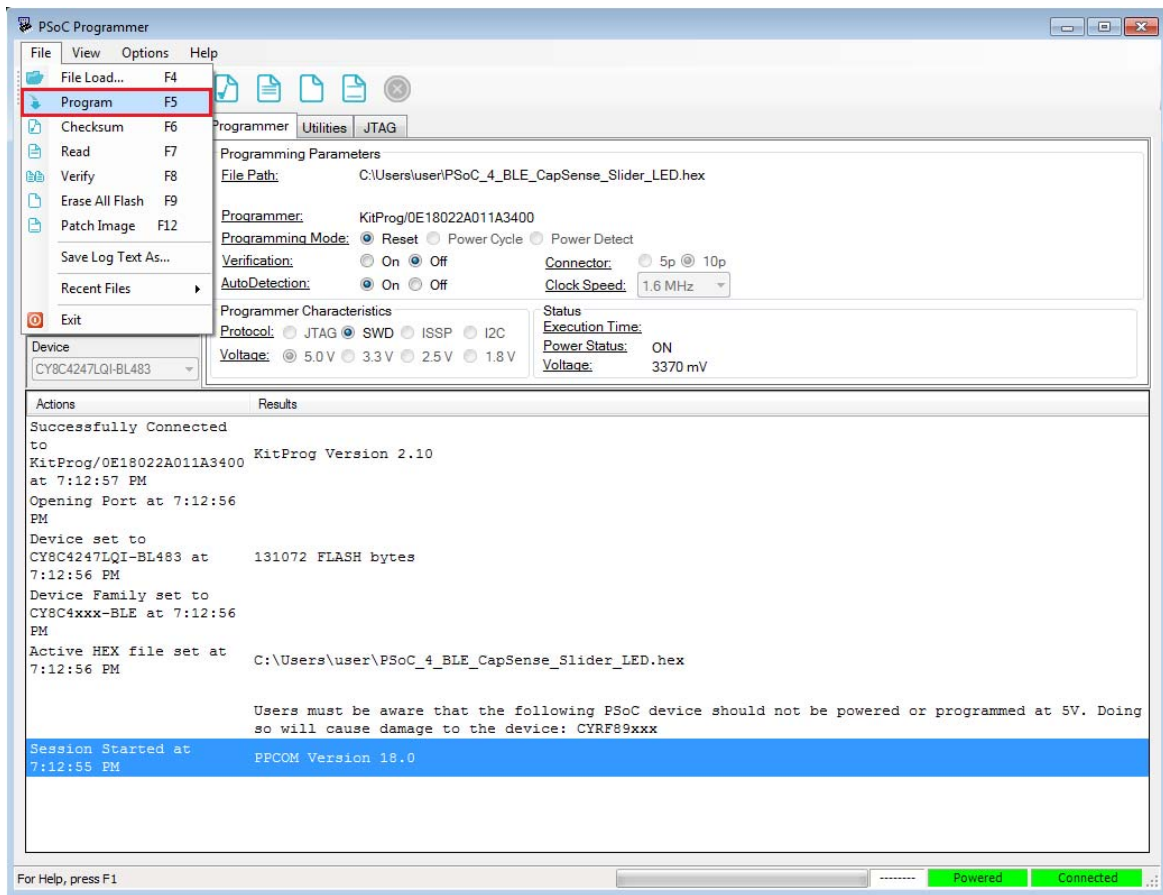
- Click the **File Load** button at the top left corner of the window. Browse for the desired hex file and click **Open**.

Figure 3-11. Select Hex File



- Go to **File > Program** to start programming the kit with the selected file.
Note: If the hex file does not match the device selected, then PSoC Programmer will throw an error of device mismatch and terminate programming.

Figure 3-12. Program Hex File to Kit



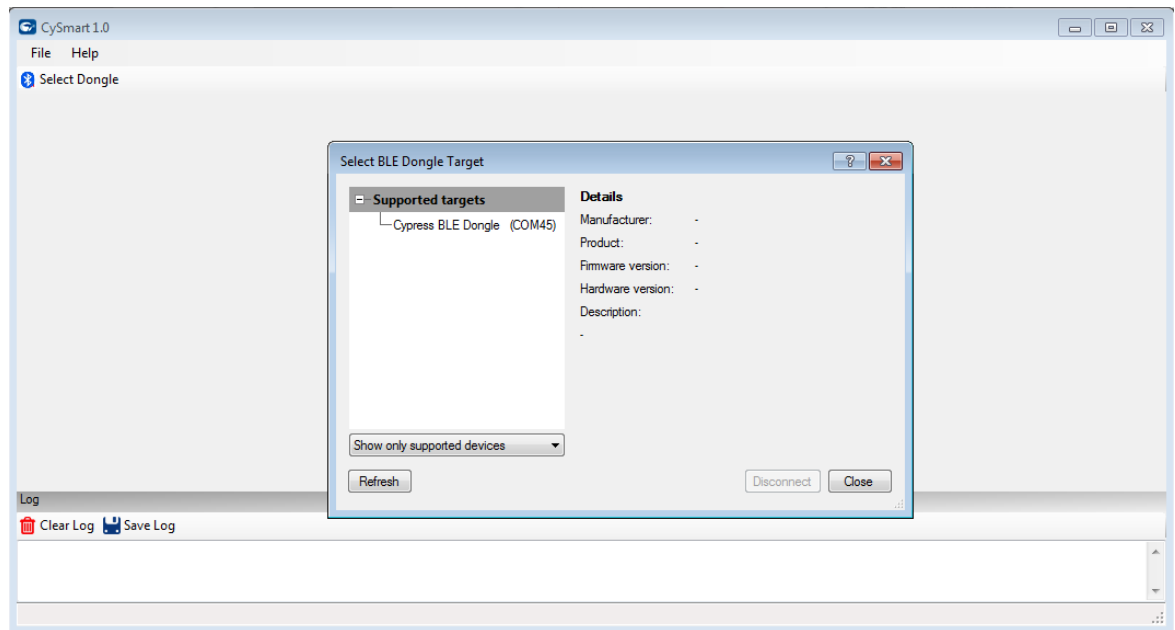
- When the programming is finished successfully, indicated by a PASS message on the status bar, the BLE Pioneer Kit/BLE Dongle is ready for use. Close PSoC Programmer.

3.6 Updating BLE Dongle for CySmart Central Emulation Tool

The BLE Dongle, provides a BLE Central mode capability using the CySmart Central Emulation Tool (see [CySmart Mobile Application on page 112](#)) on the PC. The CySmart Central Emulation Tool on the PC is the interface with which to configure the BLE Dongle and analyze the data transferred after connecting with a BLE peripheral.

The BLE Dongle works along with the CySmart Central Emulation Tool, as shown in [Figure 3-13](#). The CySmart Central Emulation Tool is installed as part of the BLE Pioneer Kit installation and can be opened from **Start > All Programs > Cypress > CySmart <version> > CySmart <version>**. The tool operation is explained in user guide of the tool, which can be accessed from **Help > Help Topics**.

Figure 3-13. BLE Dongle Interface on CySmart Central Emulation Tool



If the BLE Dongle contains custom firmware on PSoC BLE, the original CySmart firmware can be programmed back to restore the CySmart functionality. It must be connected through the USB and enumerated as KitProg. To do this, follow these steps:

1. Connect the BLE Dongle to the USB port on the PC.
2. Open PSoC Programmer by going to **Start > All Programs > Cypress > PSoC Programmer <version> > PSoC Programmer <version>**.
3. Click the **File Load** button and browse to the location of the *BLE_Dongle_CySmart.hex* file. The hex file is located at:
`<Install_Directory>\CY8CKIT-042-BLE Kit\<version>\Firmware\ BLE Dongle\Hex Files\`

Note: If Cypress releases new versions of the CySmart Central Emulation Tool and the BLE Dongle firmware, then the CySmart Central Emulation Tool will display a message requesting to update the firmware, as shown in the following figures.

Figure 3-14. Update BLE Dongle Firmware with Hex from Latest Kit Installer

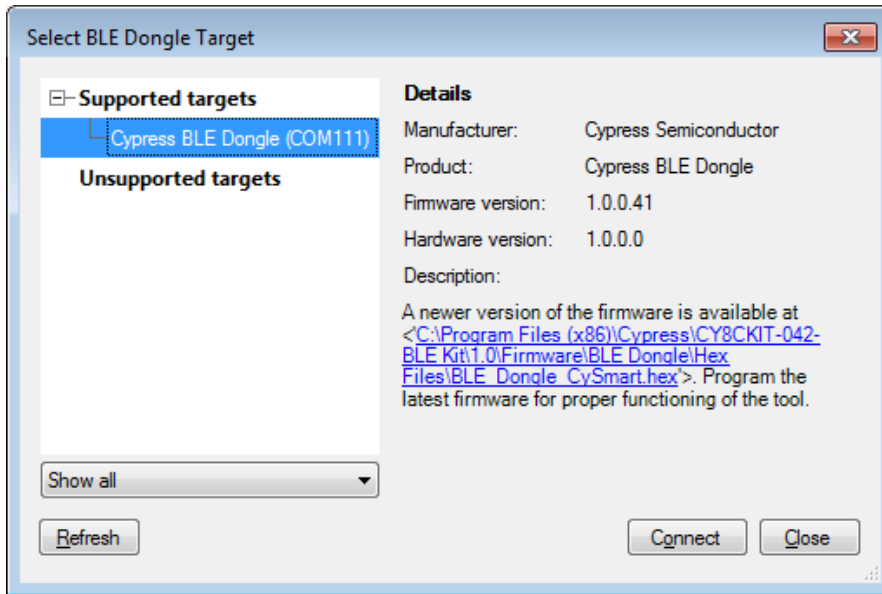
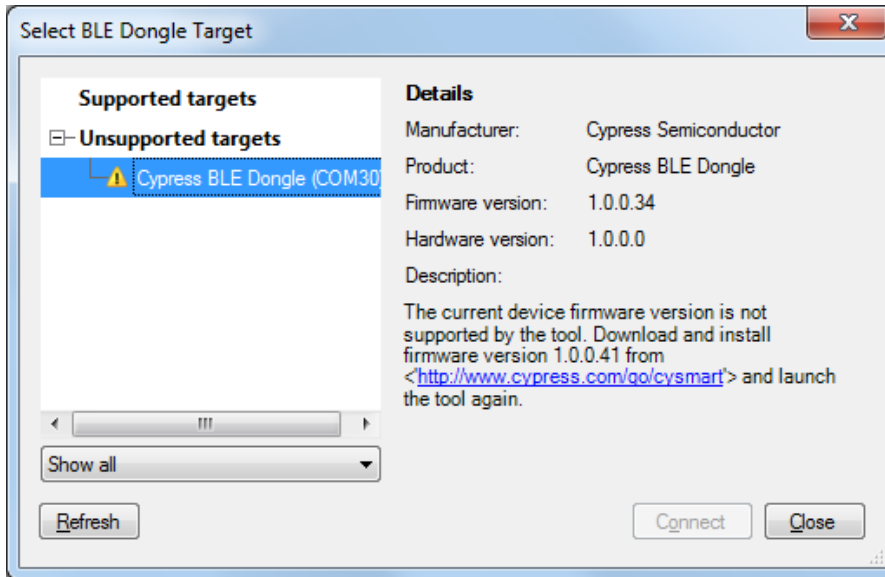
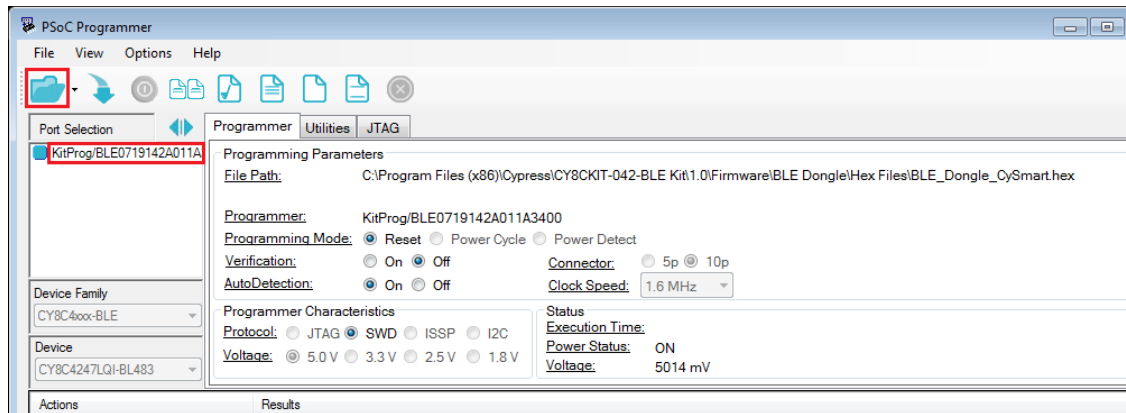


Figure 3-15. Update BLE Dongle Firmware with Hex from Web



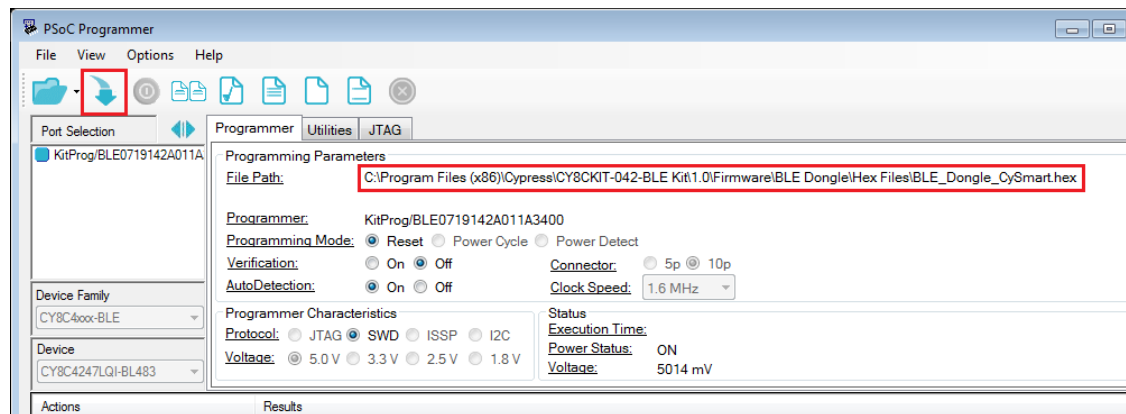
In this scenario, choose the hex file from the respective location and update the BLE Dongle firmware with the following steps.

Figure 3-16. Open Hex File



4. Ensure the other settings match as shown in [Figure 3-16](#). Click the **Program** button to start programming. The status bar at the bottom of the PSoC Programmer window will show the programming status and the result (Pass/Fail).

Figure 3-17. Programming Hex File to Dongle



5. After programming is completed successfully, the BLE Dongle firmware is updated and can be used to connect to the CySmart Central Emulation Tool.

3.7 USB-UART Bridge

The KitProg on both the BLE Pioneer Baseboard and BLE Dongle acts as a USB-UART bridge. When connected to PC, a device named **KitProg USB-UART** is available under **Ports (COM & LPT)** in the Device Manager. The UART lines between modules and KitProg are hard-wired on board, with UART_RX assigned to **P1_4** and UART_TX assigned to **P1_5** on PSoC 4 BLE/PRoC BLE device.

COM terminal software, such as Hyperterminal or TeraTerm, can be used to send and receive data. UART data sent from PSoC 4 BLE/PRoC BLE device on UART_TX line will be received by the software. Data entered in the software will be received by PSoC 4 BLE/PRoC BLE on UART_RX line. Refer to Advanced section in [CY8CKIT-042 PSoC® 4 Pioneer Kit User Guide](#) for more details.

Table 3-2 lists the specifications supported by the USB-UART bridge.

Table 3-2. Specifications Supported by USB-UART Bridge

Parameter	Supported Values
Baud Rate	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200
Data Bits	8
Parity	None
Stop Bits	1
Flow Control	None
File Transfer Protocols supported	Xmodem, 1K Xmodem, Ymodem, Kermit, and Zmodem (only speeds greater than 2400 baud)

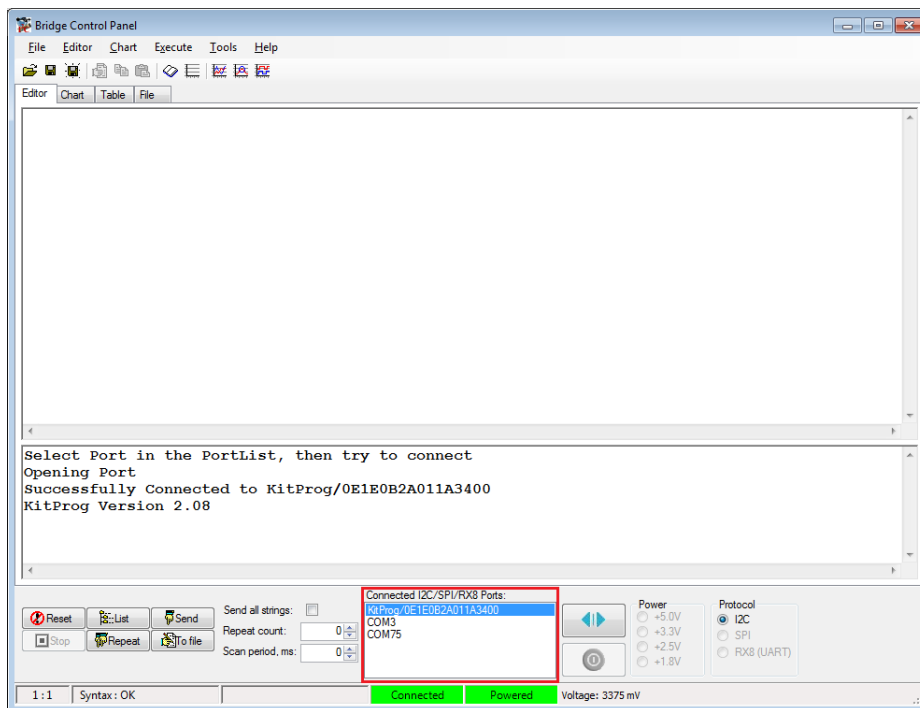
3.8 USB-I²C Bridge

The KitProg can function as USB-I²C bridge and communicate with software utility Bridge Control Panel (BCP). When connected to BCP, the KitProg USB-I²C is available under **KitProg\<serial number>** in the BCP. The I²C connection between PSoC 4 BLE/PRoC BLE device and KitProg is used to transfer data with BCP. The I²C lines on PSoC 4 BLE/PRoC BLE device are **P3_4 (SDA)** and **P3_5 (SCL)**, which are hardwired on board to I²C lines of KitProg. The USB-I²C supports I²C speed of 50 kHz, 100 kHz, 400 kHz and 1 MHz.

BCP is installed as part of PSoC Programmer installation and can be accessed from **Start > All Programs > Cypress > Bridge Control Panel**. Refer to Advanced section in [CY8CKIT-042 PSoC[®] 4 Pioneer Kit User Guide](#) for more details.

To use the USB-I²C functionality, select the **KitProg\<serial number>** in the BCP. On successful connection, the **Connected** and **Powered** status box turn green, as shown in [Figure 3-18](#).

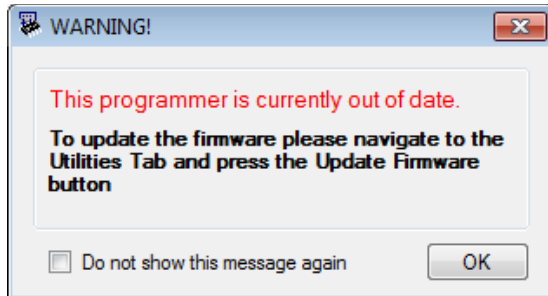
Figure 3-18. KitProg USB-I²C Connected in Bridge Control Panel



3.9 Updating the KitProg Firmware

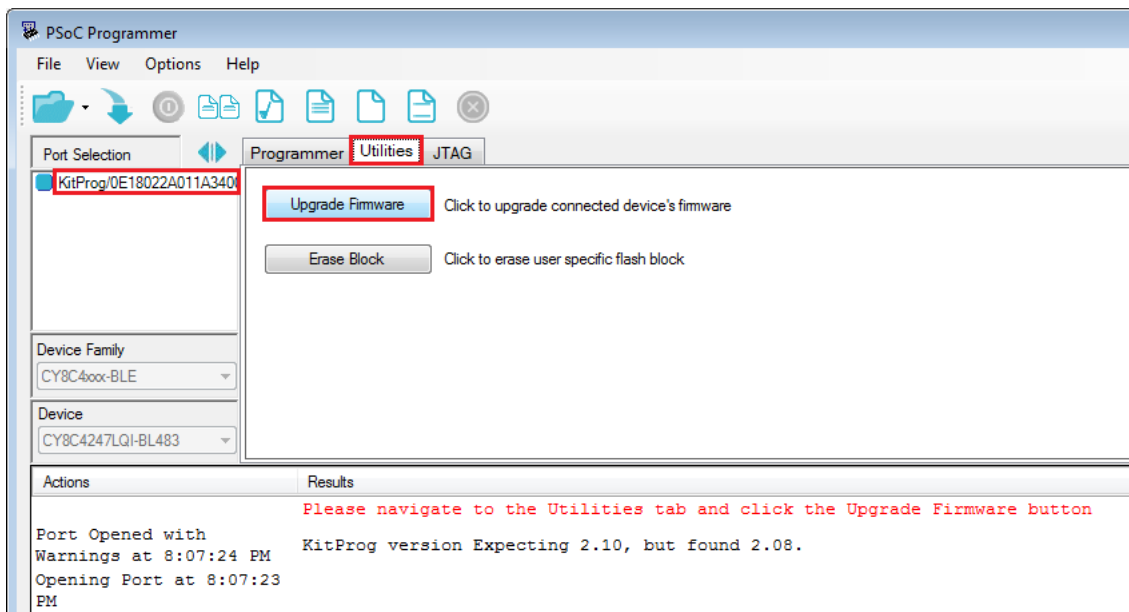
The KitProg firmware normally does not require any update. If an update is required, then PSoC Programmer will display a warning message when the kit is connected to it, as shown in [Figure 3-19](#).

Figure 3-19. Update KitProg



To update the KitProg, go to the **Utilities** tab on PSoC Programmer and click **Upgrade Firmware**, as shown in [Figure 3-20](#).

Figure 3-20. Update KitProg from PSoC Programmer



4. Example Projects



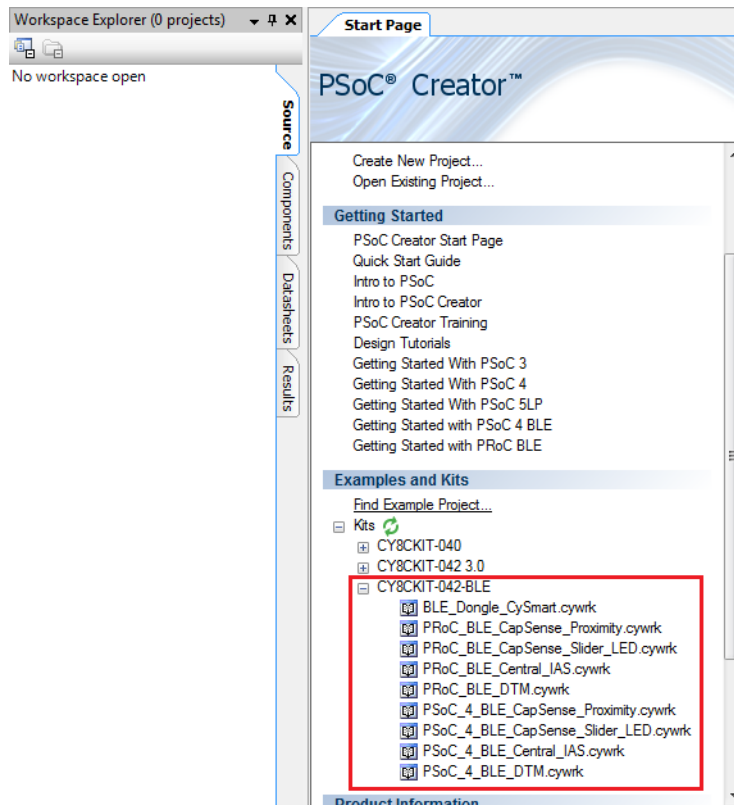
This chapter demonstrates the functionality of the PSoC 4 BLE and PProC BLE devices using the BLE Pioneer Kit-based example projects. Download and install the kit setup file from the [kit web page](#). The example projects can be accessed under the **Examples and Kits** on Start Page of PSoC Creator.

4.1 Using Example Projects

Follow these steps to open and use the example projects:

1. Launch PSoC Creator from **Start > All Programs > Cypress > PSoC Creator 3.1 > PSoC Creator 3.1**.
2. On the Start Page, under **Examples and Kits** section, choose **Kits > CY8CKIT-042-BLE**. A list of example projects appears, as shown in [Figure 4-1](#). Projects named with the prefix 'PSoC_4_BLE_' work on the BLE Pioneer Kit with the PSoC 4 BLE Module; projects named with the prefix 'PProC_BLE_' work on the BLE Pioneer Kit with the PProC BLE Module.
3. Click on the desired example project.

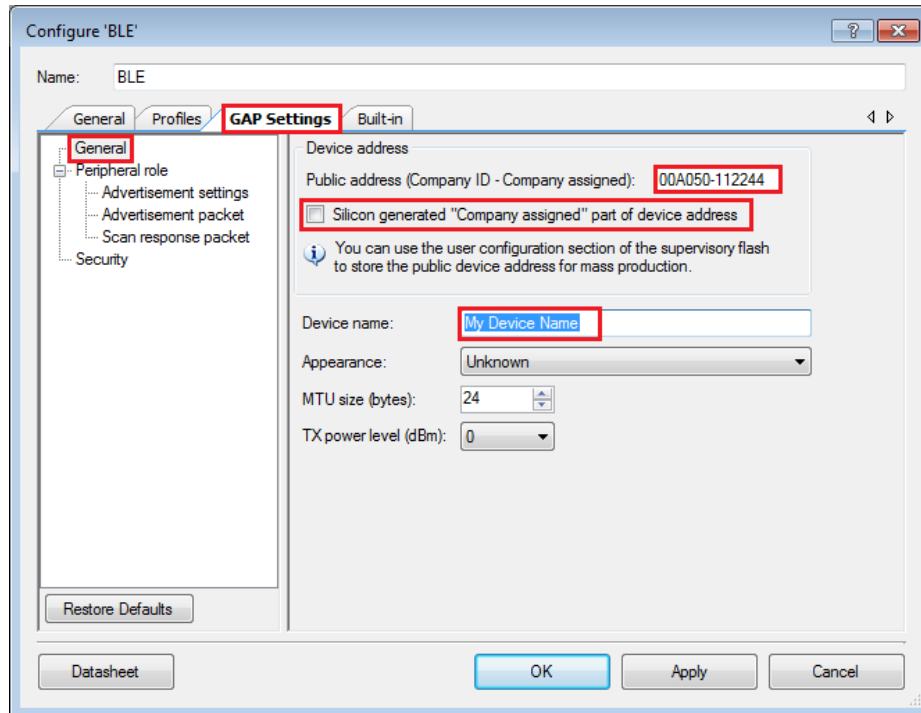
Figure 4-1. Open Example Project from PSoC Creator



4. Select the folder where you want to save the project and click **OK**.
5. Every BLE project use a public address set in the BLE component GUI to advertise and scan, depending on the role: peripheral or central mode. If multiple kits in close proximity have the same public address, then wrong devices may be connected or connections may fail. To prevent this, change the **Public address** (and preferably **Device name**) in the BLE component **GAP Settings** tab as shown in [Figure 4-2](#). Click **OK**.

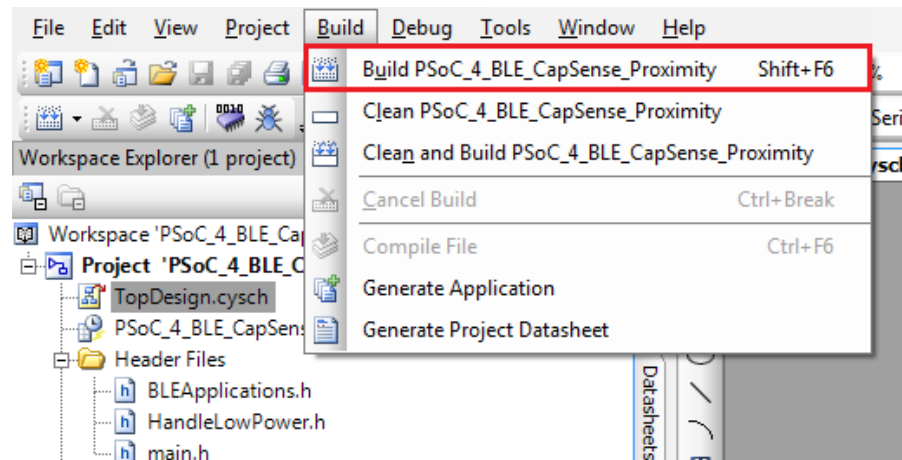
Alternatively, you can select the 'Silicon generated' device address by selecting the check box. This way, the Bluetooth Device (BD) address is generated using the silicon ID, unique to each device. Click **OK**.

Figure 4-2. Change BLE Public Address and Name



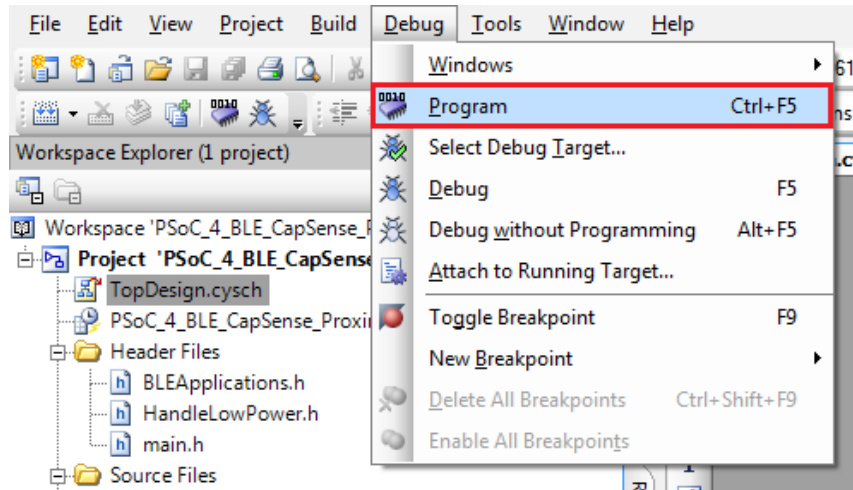
6. Build the example project by choosing **Build > Build <Project Name>**, as shown in [Figure 4-3](#). A `.hex` file will be generated.

Figure 4-3. Build Project from PSoC Creator



7. Connect the BLE Pioneer Baseboard to the PC through USB Mini-B connector J13. Ensure that the correct module (PSoC 4 BLE or PProC BLE) is placed on the baseboard, depending on the project opened.
8. Choose **Debug > Program** in PSoC Creator, as shown in [Figure 4-4](#).

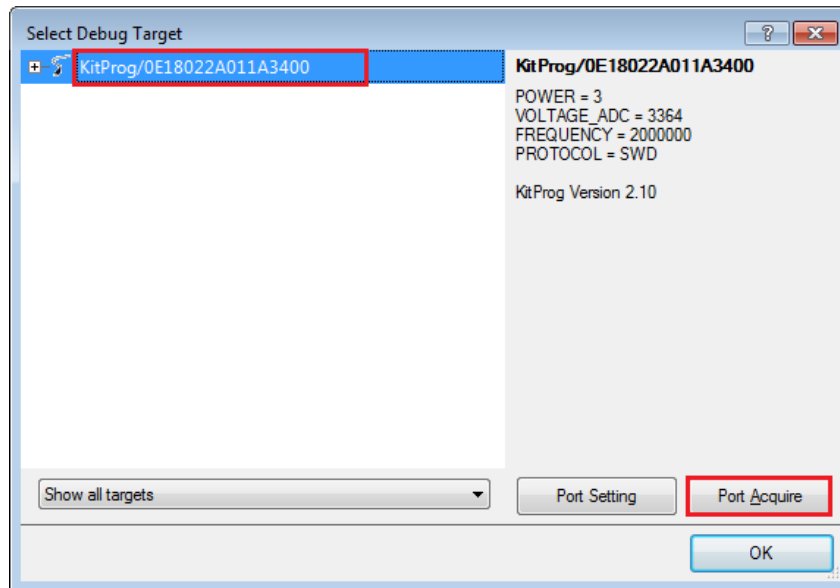
Figure 4-4. Program Device in PSoC Creator



9. If the device is not yet acquired, PSoC Creator will open the programming window. Select **KitProg** and click the **Port Acquire** button, as shown in [Figure 4-5](#).

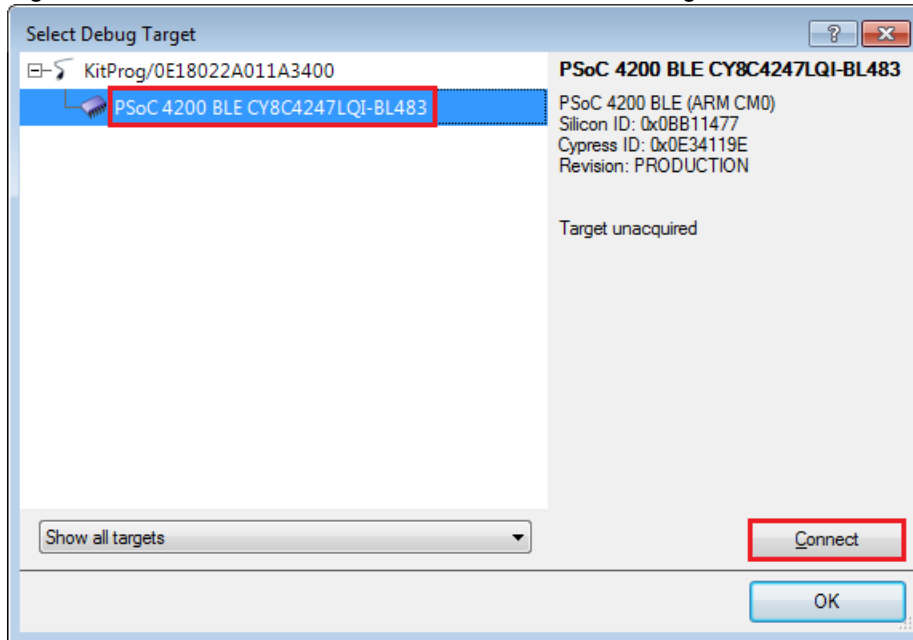
Note: The serial ID starting with 'BLE' belongs to the BLE Dongle (see [Updating BLE Dongle for CySmart Central Emulation Tool on page 35](#)).

Figure 4-5. Port Acquire



10. After the device is acquired, it is shown in a structure below the KitProg. Click the **Connect** button and then **OK** to exit the window and start programming, as shown in [Figure 4-6](#).

Figure 4-6. Connect Device From PSoC Creator and Program



Note: As stated previously, the BLE Pioneer Kit supports both Cypress BLE devices: PSoC 4 BLE and PSoC BLE. The description, hardware configurations, and verification method of the Example projects explained in the following sections are valid for both PSoC 4 BLE and PSoC BLE devices. Unless explicitly mentioned, the theory and usability for these Example projects should be considered the same for both the modules.

This document refers to the BLE Pioneer Kits, BLE Dongle, and PC/mobile as Central or Peripheral devices. A Central device is normally the master and requests/commands data from the Peripheral device. BLE-enabled phones and PCs are one such example. Peripheral device, on the other hand, store the actual data and send it to Central device when requested. Examples include BLE-enabled sensors, proximity beacons, and so on.

4.2 CapSense Slider and LED

4.2.1 Project Description

This project demonstrates connectivity between the BLE Pioneer Kit (acting as a Peripheral and GATT server device) and CySmart Central Emulation tool or mobile device running the CySmart mobile application (acting as a Central and GATT client device). This project demonstrates following:

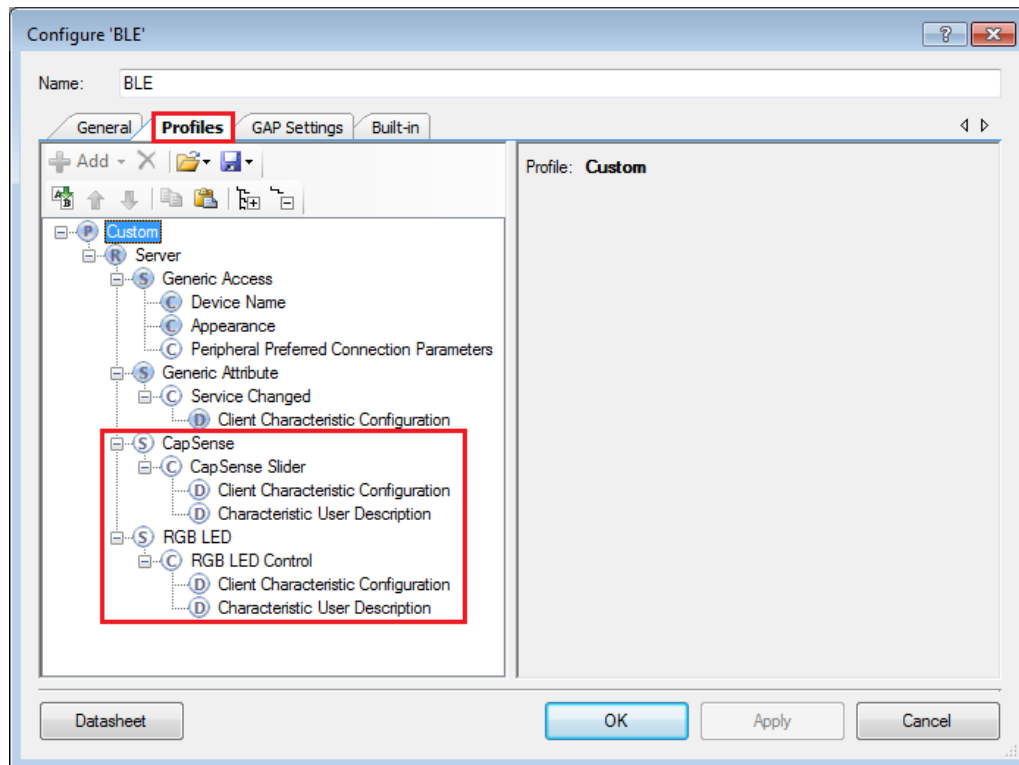
- Advertisement with timeout
- Connection with any Central device
- Two custom services in single profile
- Data transfer over BLE custom service using notifications, read, and write
- Low-power mode implementation for coin-cell operation

The BLE profile in this project consists of two BLE custom services: CapSense and RGB LED. The **CapSense service** consists of one custom characteristic, termed as CapSense Slider. The CapSense slider characteristic is used to send one byte data, ranging from 0 to 100, as notification to the GATT client device. This data is the finger location read by the CapSense component on the five-segment slider (CSS1) present on the kit. This characteristics supports notification, which allows the GATT server to send data to the connected client device whenever new data is available.

The **RGB LED service** also consists of one custom characteristic, termed as RGB LED Control. This characteristic supports two operations, read and write, through which the connected GATT client device can read data as well as write a new value to the characteristic. This data has four byte values indicating red, green, blue, and intensity values to control the onboard RGB LED.

These properties for the custom service/characteristics are configured in the BLE component under the Profiles tab, as shown in [Figure 4-7](#).

Figure 4-7. Attributes Configuration in BLE Component for custom services



The project consists of the following files:

■ **main.c/h**

These files contain the main function, which is the entry point and execution of the firmware application. It also contains function definition for initialization of the system and reading the CapSense slider data from the CapSense component.

■ **BLEApplications.c/h**

These files contain all the macros and function definitions related to BLE communication and operation. It contains the event callback function definition that is registered with the BLE component startup and used by the component to send BLE-related events from the BLE stack to the application layer for processing. It contains a method to send CapSense notifications to the GATT client device and process the Read and Write commands on the RGB LED characteristic by the GATT client device. It updates the BLE Connection parameter, which is important for low-power mode usage.

■ **HandleLowPower.c/h**

These files contain the function to handle low-power mode. This function is continuously called in the main loop and is responsible for pushing the BLE hardware block (BLESS) as well as the CPU to Deep Sleep mode as much as possible. The wakeup source is either the BLE hardware block Link Layer internal timer or the interrupt from the user button press (**SW2**). This allows for very low power mode implementation and operation using a coin cell.

Additionally, the PSoC BLE version of this project consists of the RGB_PRSm.c/h file, which contains the function to drive the software-based PRiSM method and drive the color and intensity on the RGB LED.

This is the default firmware that comes in the modules shipped with the kit.

Two projects demonstrate this functionality on two different devices:

■ **PSoC_4_BLE_CapSense_Slider_LED** works with the PSoC 4 BLE Module.

■ **PSoC_BLE_CapSense_Slider_LED** works with the PSoC BLE Module.

The PSoC 4 BLE project implements RGB color and intensity control using the PRiSM component whereas the PSoC BLE uses the software implementation of the PRiSM mode.

Figure 4-8. TopDesign for PSoC_4_BLE_CapSense_Slider_LED Project

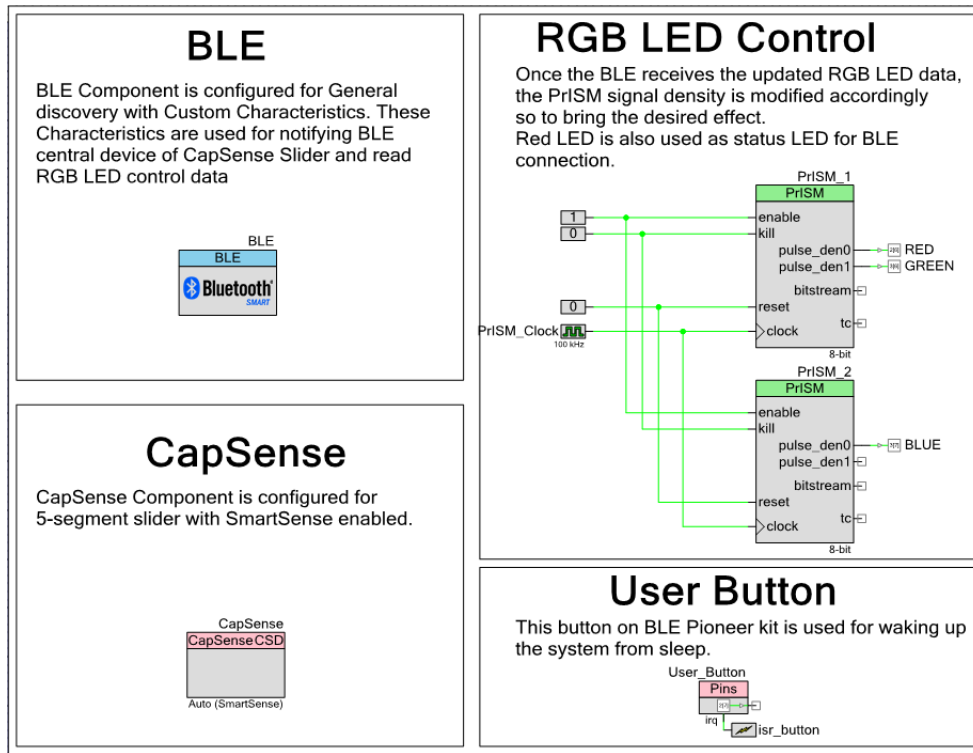
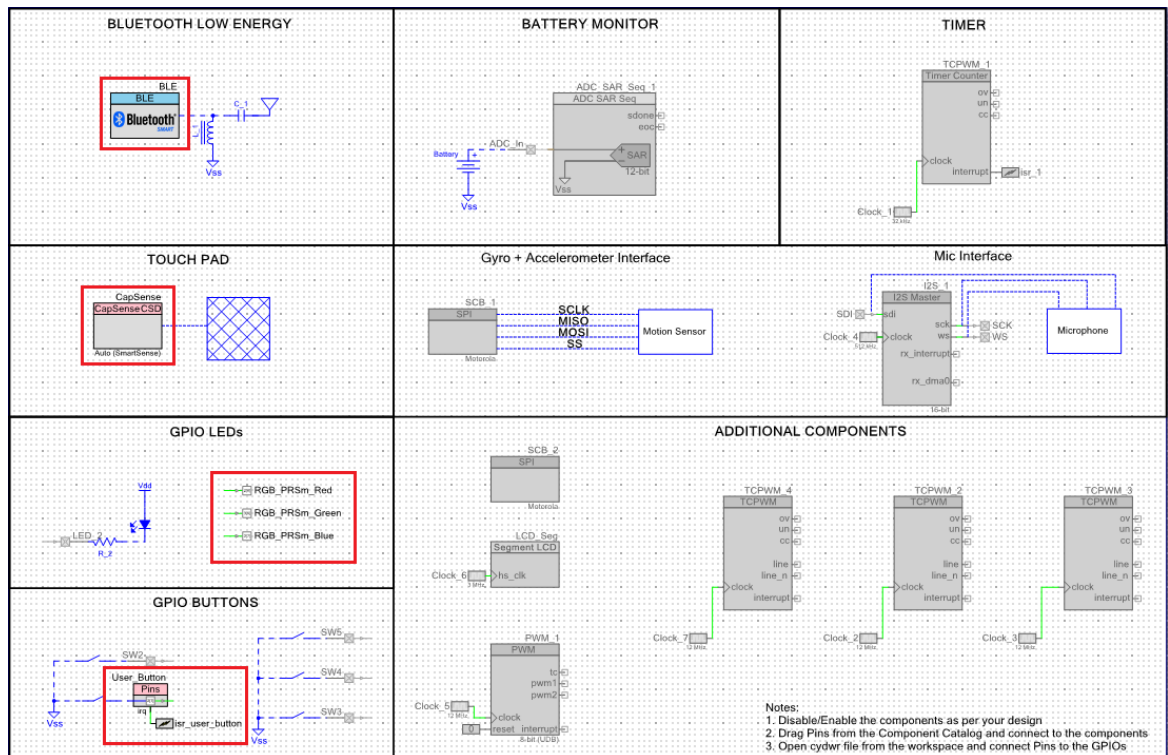


Figure 4-9. TopDesign for PSoC_4_BLE_CapSense_Slider_LED Project



4.2.2 Hardware Connections

No specific hardware connections are required for this project because all connections are hardwired on the BLE Pioneer Baseboard. Ensure that the correct module is placed on the baseboard corresponding to the project being used. PSoC_4_BLE_CapSense_Slider_LED works with the PSoC 4 BLE Module. PRoC_BLE_CapSense_Slider_LED works with the PRoC BLE Module.

The pin assignment for this project is in **PSoC_4_BLE_CapSense_Slider_LED.cydwr/PRoC_BLE_CapSense_Slider_LED.cydwr** in the Workspace Explorer, as shown in [Figure 4-10](#).

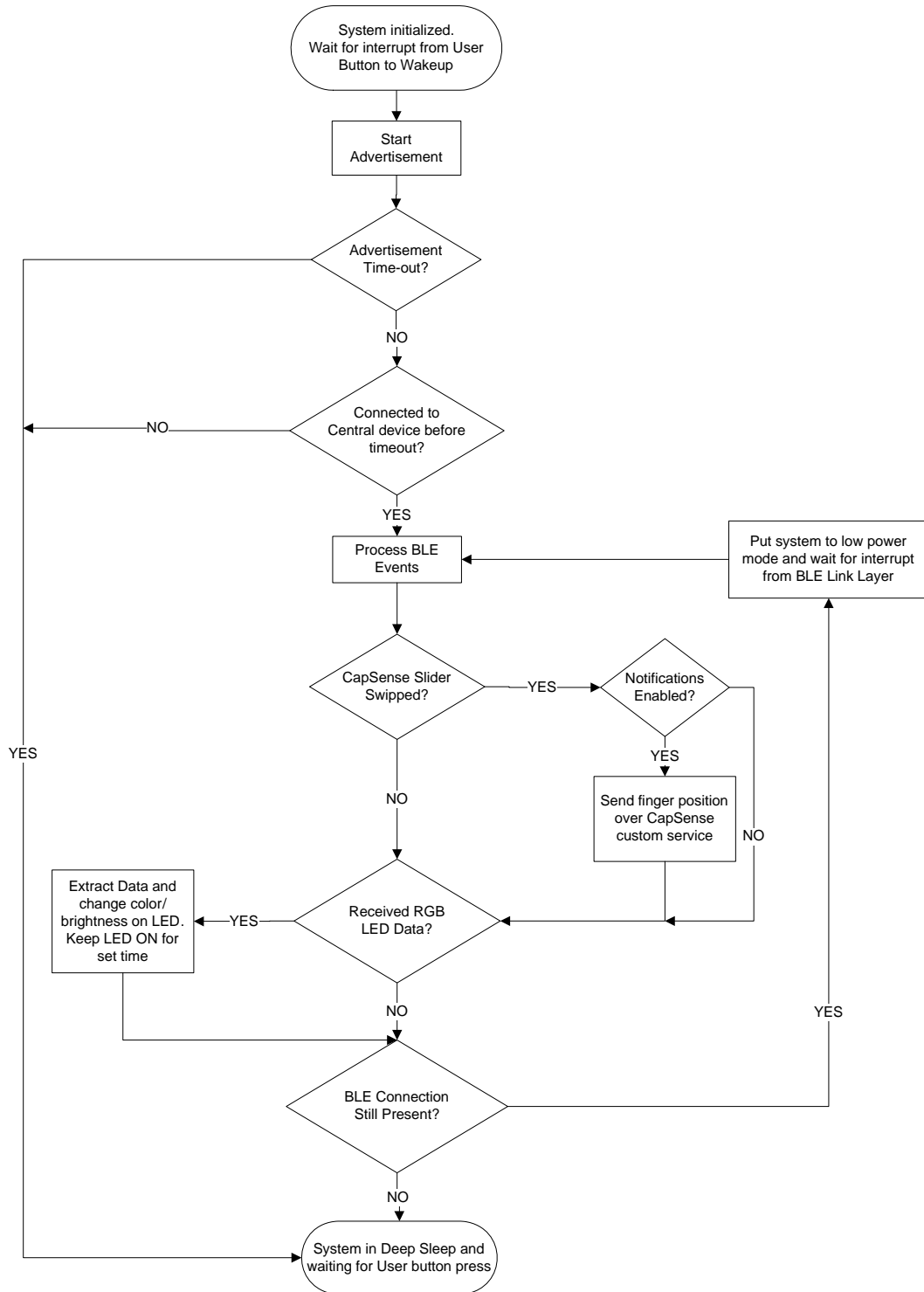
Figure 4-10. Pin Selection for CapSense Slider and LED Project

Alias	Name	Port	Pin	Lock
Cmod	\CapSense:Cmod\	P4[0] CSD:c_mod, TCPWM0:line_out, SCB1:uart_rts, SCB1:spi_mosi	5	<input checked="" type="checkbox"/>
LinearSlider0_e0_LS	\CapSense:Sns[0]\	P2[1] OA0:vminus, SCB0:spi_select[2]	38	<input checked="" type="checkbox"/>
LinearSlider0_e1_LS	\CapSense:Sns[1]\	P2[2] OA0:vout_10x, SRSS:wakeup, SCB0:spi_select[3]	39	<input checked="" type="checkbox"/>
LinearSlider0_e2_LS	\CapSense:Sns[2]\	P2[3] OA1:vout_10x, SRSS:ext_clk_lf	40	<input checked="" type="checkbox"/>
LinearSlider0_e3_LS	\CapSense:Sns[3]\	P2[4] OA1:vminus	41	<input checked="" type="checkbox"/>
LinearSlider0_e4_LS	\CapSense:Sns[4]\	P2[5] OA1:vplus	42	<input checked="" type="checkbox"/>
	BLUE	P3[7] SARMUX:pads[7], TCPWM3:line_out_compl, SCB1:uart_cts, SRSS:ext_clk_lf	54	<input checked="" type="checkbox"/>
	GREEN	P3[6] SARMUX:pads[6], TCPWM3:line_out, SCB1:uart_rts	53	<input checked="" type="checkbox"/>
	RED	P2[6] OA0:vplus_alt	43	<input checked="" type="checkbox"/>
	User_Button	P2[7] OA1:vplus_alt, SRSS:ext_clk	44	<input checked="" type="checkbox"/>

4.2.3 Flow Chart

Figure 4-11 shows the flow chart of the code implemented.

Figure 4-11. CapSense Slider and LED Project Flow Chart



4.2.4 Verify Output

The project can be verified by two methods: using the CySmart Central Emulation Tool and BLE Dongle or using the CySmart mobile application.

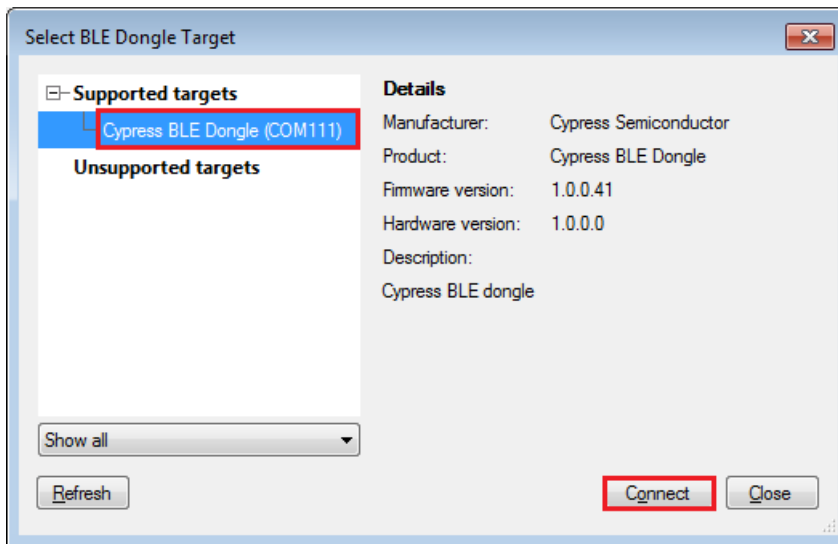
4.2.4.1 CySmart Central Emulation Tool

To verify the CapSense and LED project using the CySmart Central Emulation Tool, follow these steps:

Note: Refer [CySmart BLE Host Emulation tool](#) to learn how to use the tool.

1. Connect the BLE Dongle to one of the USB ports on the PC.
2. Start the CySmart Central Emulation Tool on the PC by going to **Start > All Programs > Cypress > CySmart <version> > CySmart <version>**. You will see a list of BLE Dongles connected to it. If no BLE Dongle is found, click **Refresh**. Select the BLE Dongle and click **Connect**.

Figure 4-12. Connect to BLE Dongle

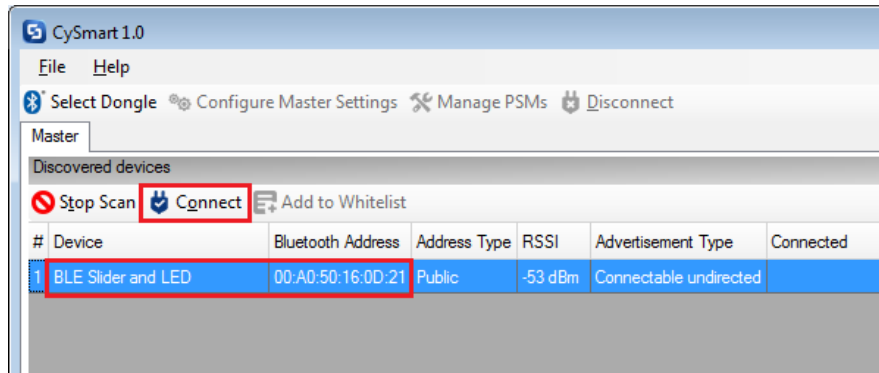


3. Place module on the BLE Pioneer Kit, depending on the project chosen.
4. Power the BLE Pioneer Kit through the USB connector **J13**.
5. Program the BLE Pioneer Kit with the CapSense and LED example project. Follow steps in [Using Example Projects on page 41](#) to program the device.
6. After programming successfully, press the user button (**SW2**) on the BLE Pioneer kit to start the advertisement. Advertisement is indicated by a blinking red LED on the baseboard.

Note: The project has an advertisement timeout of 30 seconds after which it returns to Deep Sleep. Press **SW2** again to restart the advertisement.
7. On the CySmart Central Emulation Tool, click **Start Scan** to see the list of available BLE peripheral devices.

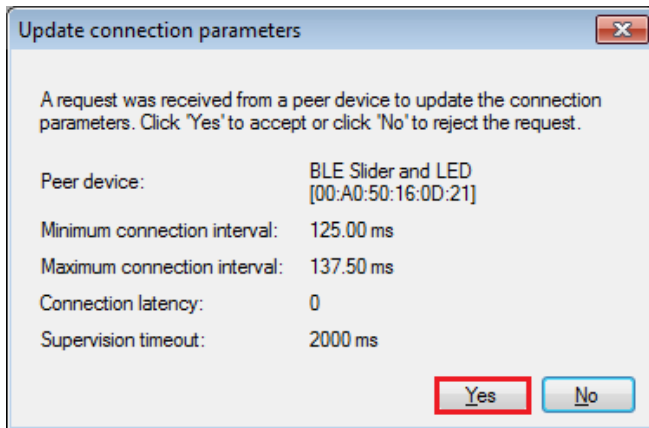
- Double-click the **BLE Slider and LED** device to connect, or click **BLE Slider and LED** and then click **Connect**.

Figure 4-13. Connect to BLE Slider and LED Peripheral



- When connected, the CySmart Central Emulation Tool will display a message for the **Update connection parameters**. Select **Yes**, as shown in Figure 4-14.

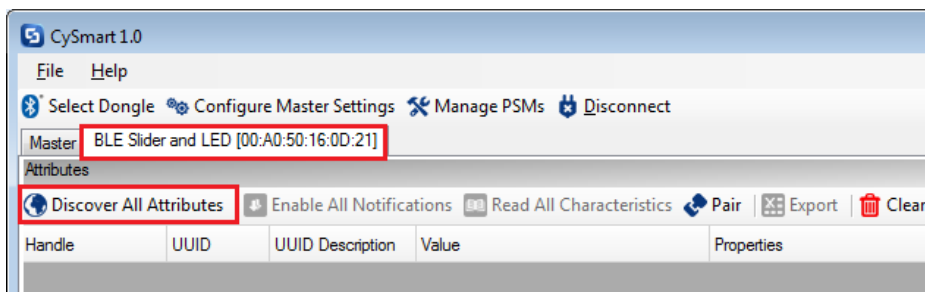
Figure 4-14. Update Connection Parameter Option



Note: If you select **No**, the project will still work. However, the current consumption will be higher due to faster connection interval.

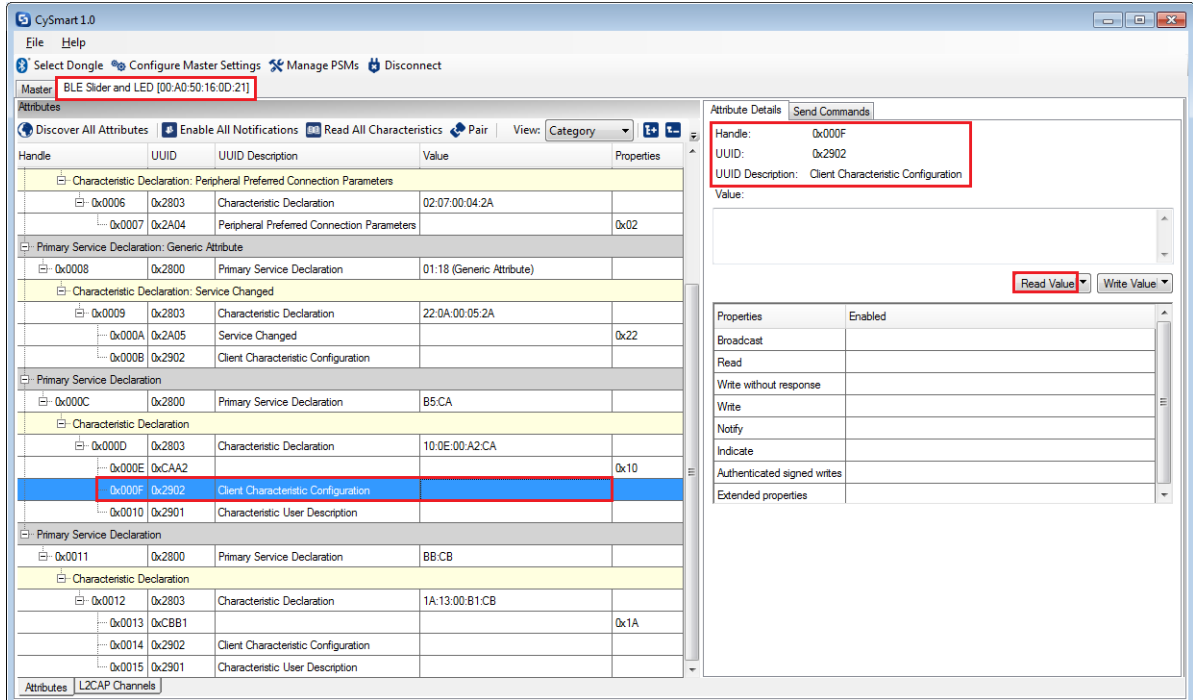
- Click **Discover All Attributes** to find all attributes supported.

Figure 4-15. Discover All Attributes



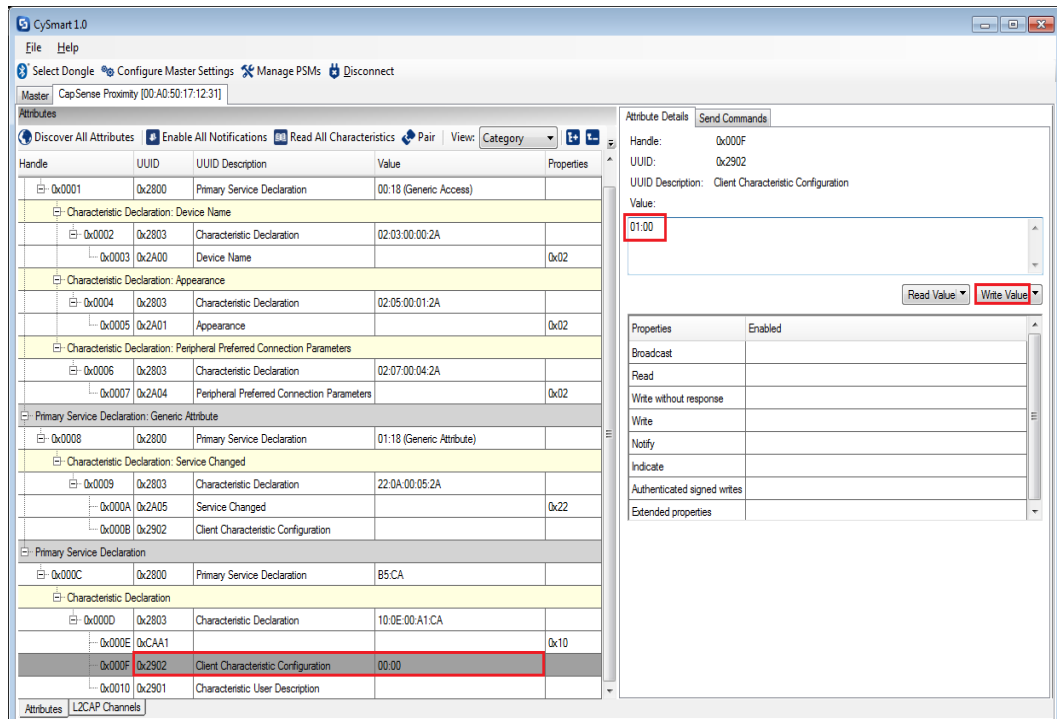
11. Locate the attribute **Client Characteristic Configuration** descriptor (UUID 0x2902) under CapSense Slider characteristic (UUID 0xCA A2). Click **Read Value** to read the existing Client Characteristic Configuration Descriptor (CCCD) value as shown in Figure 4-16.

Figure 4-16. Read CCCD for CapSense Slider Characteristic



12. Modify the **Value** field of CCCD to '01:00' and click **Write Value**. This enables the notifications on the **CapSense Slider** characteristic.

Figure 4-17. Write CCCD to Enable Notifications



13. Swipe your finger on the CapSense slider on the BLE Pioneer kit, as shown in Figure 4-18 and see the notification values in the CapSense Slider value field, as shown in Figure 4-19.

Figure 4-18. CapSense Slider

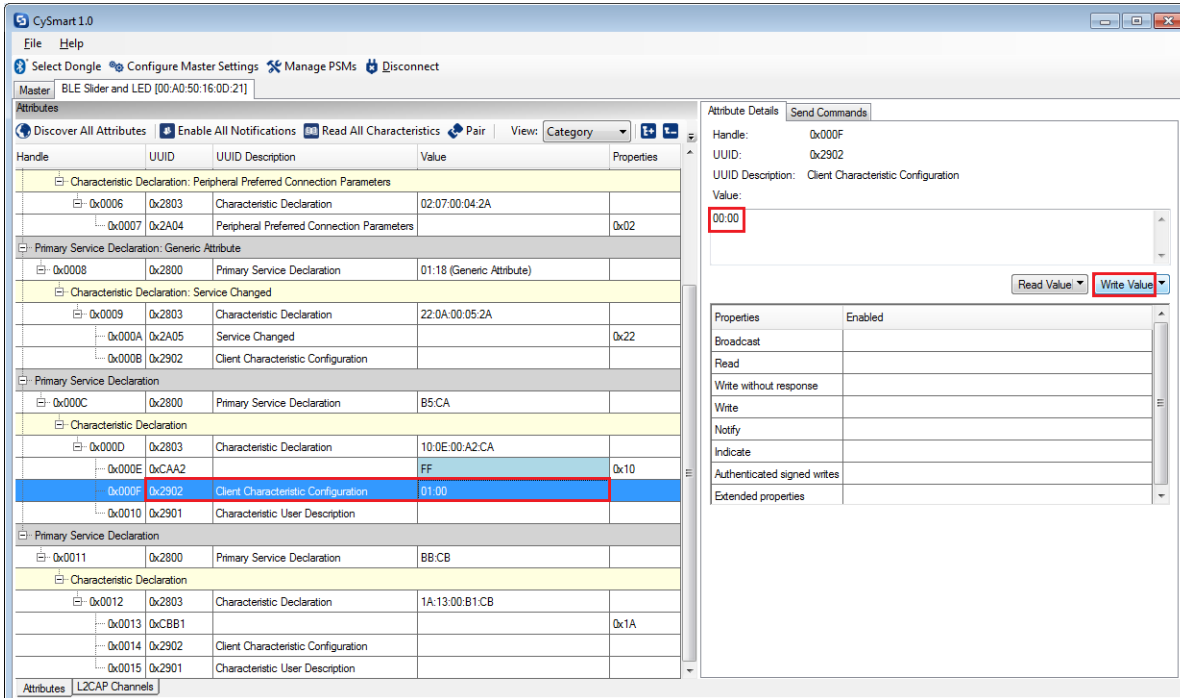


Figure 4-19. CapSense Slider Notification Received

Primary Service Declaration				
0x000C	0x2800	Primary Service Declaration	B5:CA	
Characteristic Declaration				
0x000D	0x2803	Characteristic Declaration	10:0E:00:A2:CA	
0x000E	0xCAA2		44	0x10
0x000F	0x2902	Client Characteristic Configuration	01:00	
0x0010	0x2901	Characteristic User Description		

14. To disable notifications, modify the **Value** field of the **Client Characteristic Configuration** descriptor to '00:00' and click **Write Value**.

Figure 4-20. Disable Notifications



15. Locate the **RGB LED Control** characteristic (**UUID 0xCBB1**). Click **Read Value** to read the existing 4-byte onboard RGB LED color information, as shown in [Figure 4-21](#).

Figure 4-21. Read RGB LED Control Characteristic Value

Primary Service Declaration				
0x0011	0x2800	Primary Service Declaration	BB:CB	
Characteristic Declaration				
0x0012	0x2803	Characteristic Declaration	1A:13:00:B1:CB	
0x0013	0xCBB1		00:00:00:00	0x1A
0x0014	0x2902	Client Characteristic Configuration		
0x0015	0x2901	Characteristic User Description		

16. Modify the four bytes of data in the **Value** field and click **Write Value**. You will see the corresponding change in the color and intensity of the RGB LED on the BLE Pioneer kit, as shown in Figure 4-22. The RGB LED will be on for 3 seconds before switching off to conserve power.

Note: If the BLE Pioneer kit is powered from a coin cell and not the USB Vbus, then the color mixing and intensity will vary. This is because the coin cell provides a lower driving voltage for RGB LEDs.

Figure 4-22. Write RGB LED Control Characteristic Value

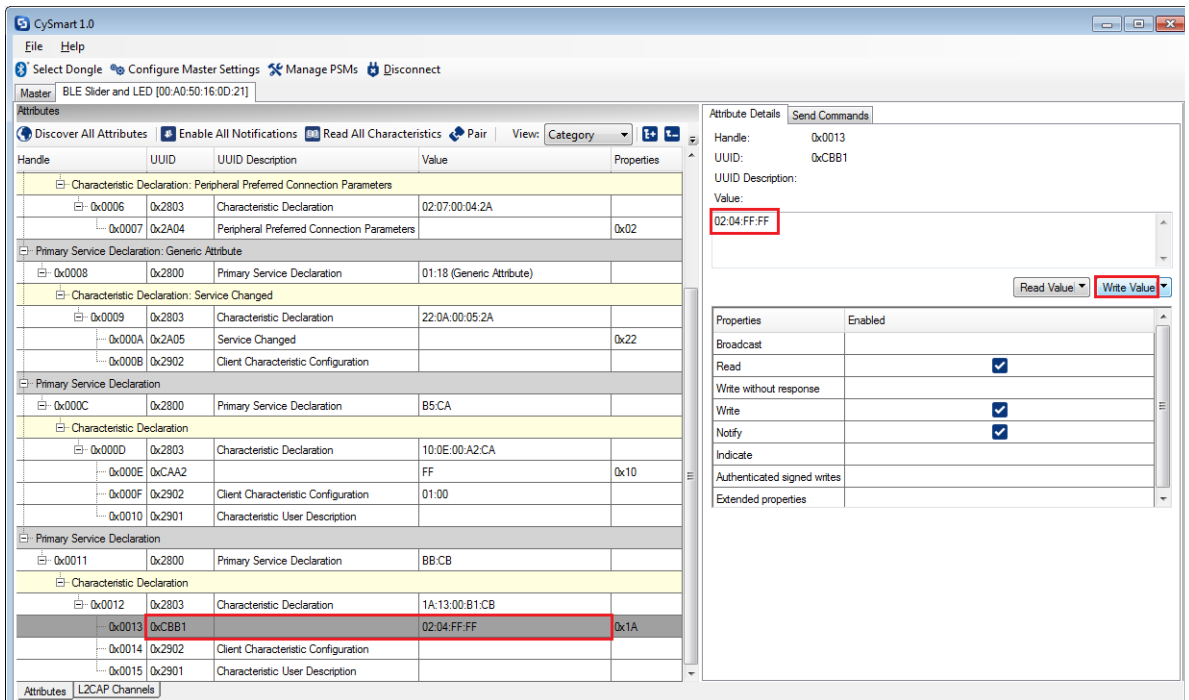
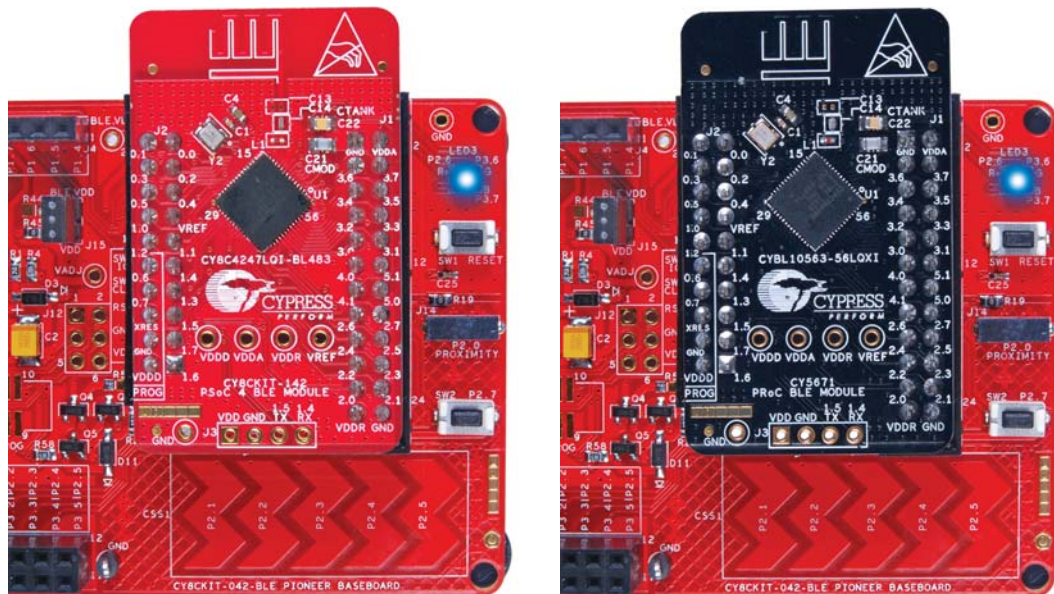
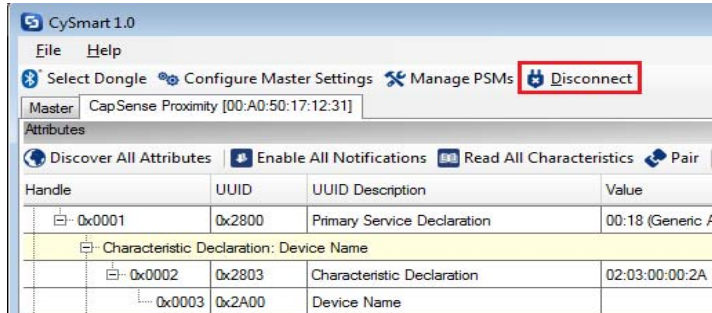


Figure 4-23. RGB LED Control with PSoC 4 BLE Module and PSoC BLE Module



17. To disconnect from the device, click **Disconnect**, as shown in [Figure 4-24](#).

Figure 4-24. Disconnect from the Device



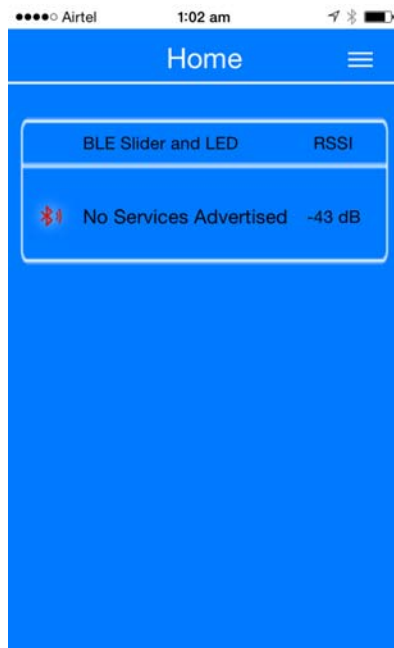
18. To connect to this Peripheral again, restart advertising by pressing the user button (**SW2**) on the BLE Pioneer Kit. Advertising is indicated by the blinking red LED.

4.2.4.2 CySmart Mobile Application

To verify the CapSense and LED project using the CySmart mobile application (see [CySmart Mobile Application on page 112](#)), follow these steps:

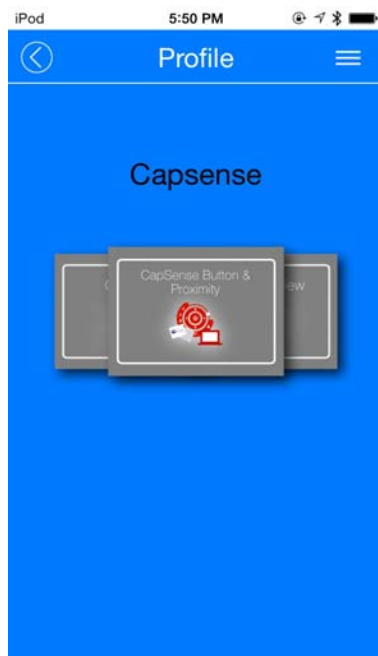
1. Plug the desired module on the BLE Pioneer Baseboard.
2. Connect the BLE Pioneer Kit into the PC using the J13 USB connector.
3. Program the kit with the CapSense and LED example projects. See [Using Example Projects on page 41](#) for programming instructions.
4. Press the user button (**SW2**) on the BLE Pioneer Kit to start the advertisement. This is indicated by the blinking red LED on the BLE Pioneer Kit.
5. Open the application on the mobile device. If Bluetooth is not enabled on the device, the application will ask to enable it.
6. After Bluetooth is enabled, the CySmart mobile application will automatically search for available Peripherals and list them. Select the **BLE Slider and LED** Peripheral as shown in [Figure 4-25](#).

Figure 4-25. BLE Slider and LED Peripheral



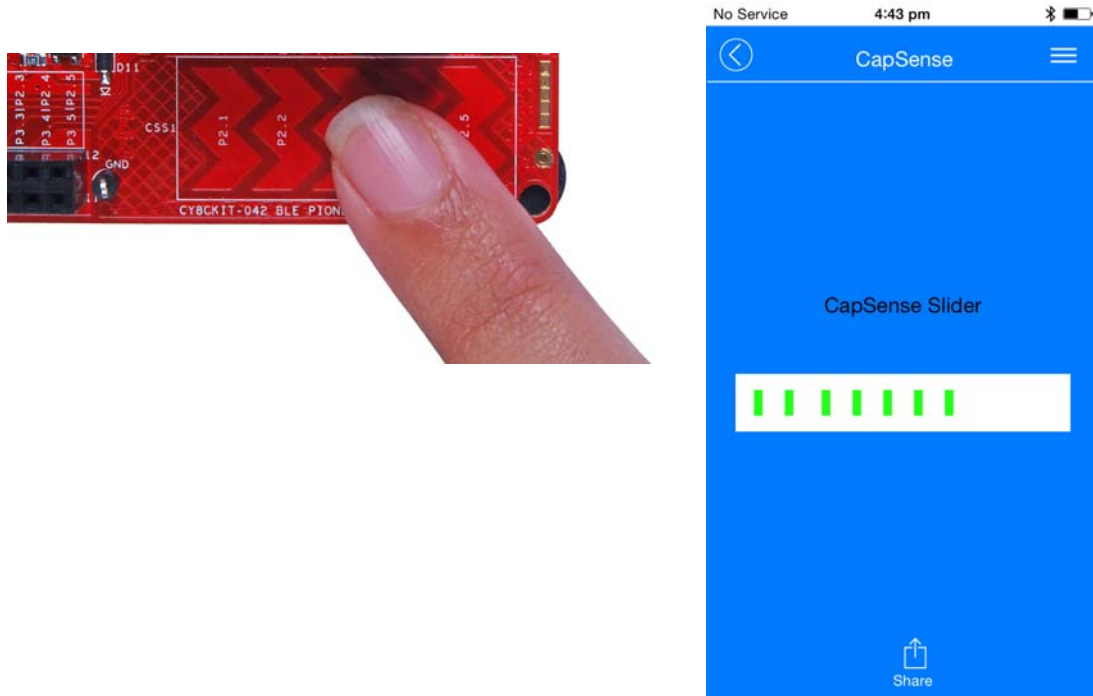
- When connected, the CySmart mobile application will list the supported profiles by the Peripherals. Scroll and select the CapSense icon, as shown in [Figure 4-26](#).

Figure 4-26. CapSense Service Page



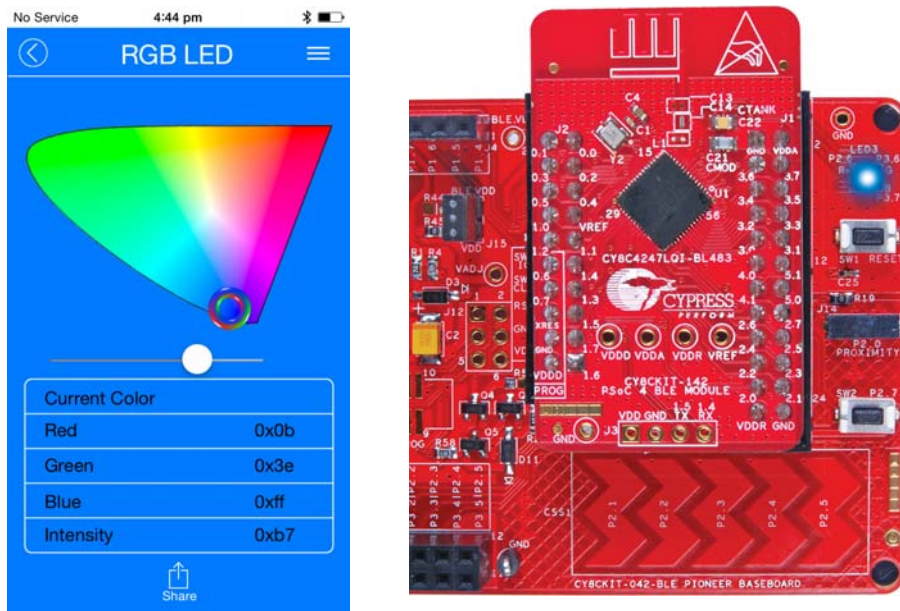
- Swipe your finger on the CapSense slider on the BLE Pioneer Kit and see a similar response on the **CapSense** page in the CySmart application ([Figure 4-27](#)).

Figure 4-27. CapSense Slider



9. Press the back button to return to the service selection page. Scroll and tap on the RGB LED service.
10. On the RGB LED service page, swipe over the color gamut to see a similar color response on the BLE Pioneer Kit RGB LED. The slider below the color gamut controls the intensity of the RGB LED color. The RGB LED will be on for 3 seconds before switching off. This is done to conserve power.

Figure 4-28. RGB LED Control with CySmart mobile application



11. To disconnect from the BLE Pioneer Kit, return to the CySmart mobile application home screen by pressing the back button.
12. To reconnect to the peripheral, press the user button (**SW2**) on the BLE Pioneer Kit again and then scan for devices using CySmart mobile application.

4.3 CapSense Proximity

4.3.1 Project Description

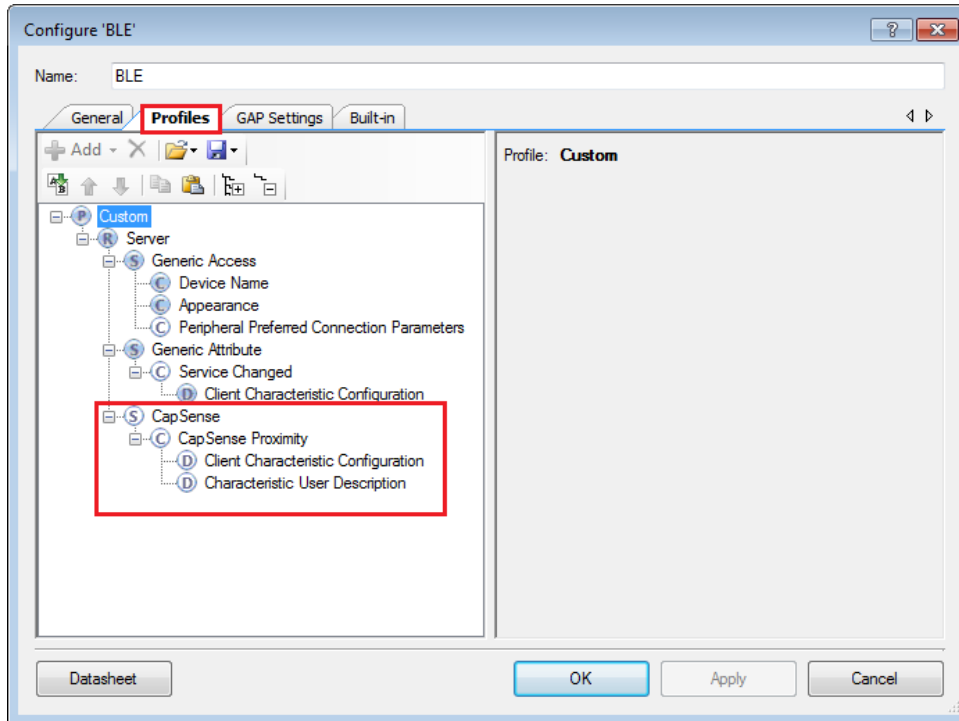
This project demonstrates connectivity between the BLE Pioneer Kit (acting as a Peripheral and GATT server device) and the CySmart Central Emulation Tool or mobile device running the CySmart mobile application (acting as a Central and GATT client device). This project demonstrates the following:

- Advertisement with timeout
- Connection with any Central device
- One custom service
- Data transfer over BLE custom service using notifications
- Low-power mode implementation for coin cell operation

The BLE profile in this project consists of a single BLE custom service, called CapSense. The **CapSense service** consists of a custom characteristic, termed as **CapSense Proximity**. The CapSense proximity characteristic is used to send one byte data, ranging from 0 to 255, as notification to the GATT client device. This data is the difference count read by the CapSense component on the one-wire proximity sensor (J14) connected on the kit. This characteristic supports notification, which allows the GATT server to send data to the connected GATT client device whenever new data is available.

The properties for the custom attributes are configured in the BLE component under the Profiles tab, as shown in [Figure 4-29](#).

Figure 4-29. Attributes Configuration in BLE Component for CapSense Proximity



The project consists the following files:

- **main.c/h**

These files contain the main function, which is the entry point and execution of the firmware application. It contains function definition for initialization of the system and reading the CapSense proximity data from the CapSense component.

- **BLEApplications.c/h**

These files contain all the macros and function definitions related to BLE communication and operation. It contains the event callback function definition that is registered with the BLE component startup and used by the component to send BLE-related event from the BLE stack to the application layer for processing. It contains a method to send CapSense notifications to the GATT client device. It updates the BLE Connection parameter, which is important for low-power mode usage.

- **HandleLowPower.c/h**

These files contain the function to handle low-power mode. This function is continuously called in the main loop and is responsible for pushing the BLE hardware block (BLESS) as well as the CPU to Deep Sleep mode as much as possible. The wakeup source is either the BLE hardware block Link Layer internal timer or the interrupt from the user button press (**SW2**). This allows for very low-power mode implementation and operation using a coin cell.

The red LED is used as the status LED and provides visual confirmation on advertising or connection states. A blinking red LED indicates advertising state.

Two projects demonstrate this functionality on two different devices:

- **PSoC_4_BLE_CapSense_Proximity** works with the PSoC 4 BLE Module.
- **PRoC_BLE_CapSense_Proximity** works with the PRoC BLE Module.

Figure 4-30. Top Design for PSoC_4_BLE_CapSense_Proximity Project

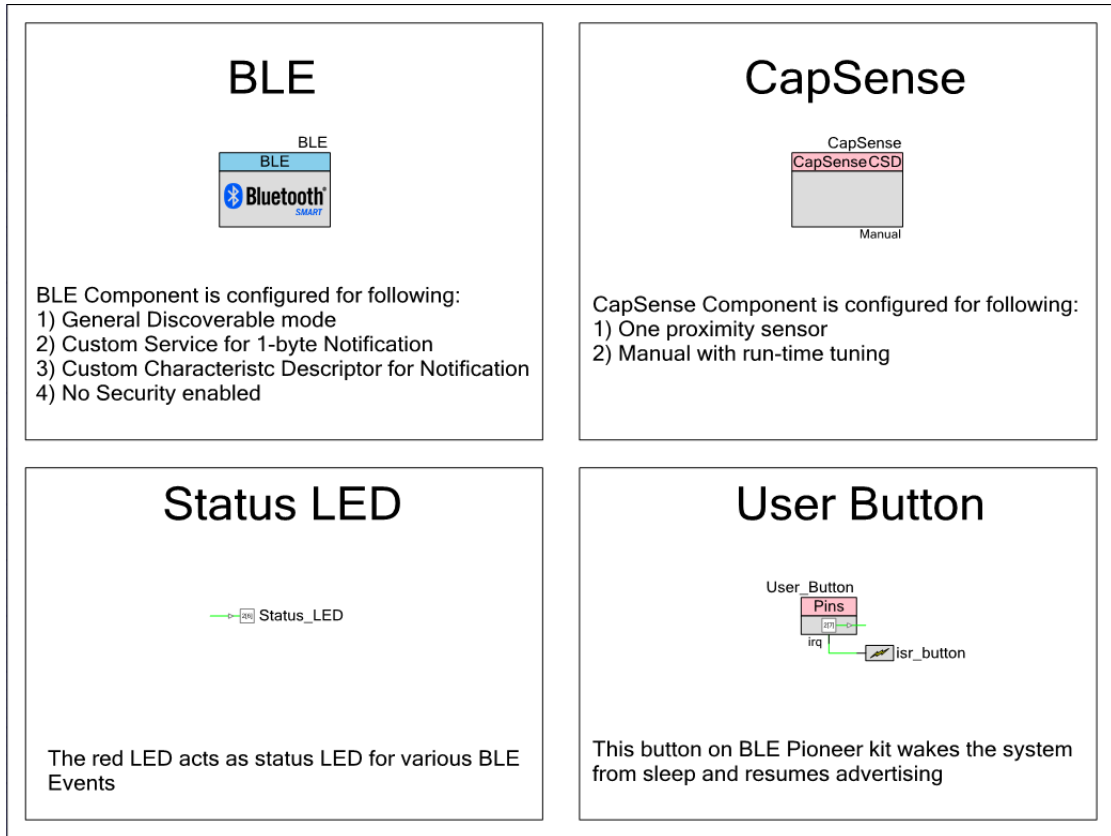
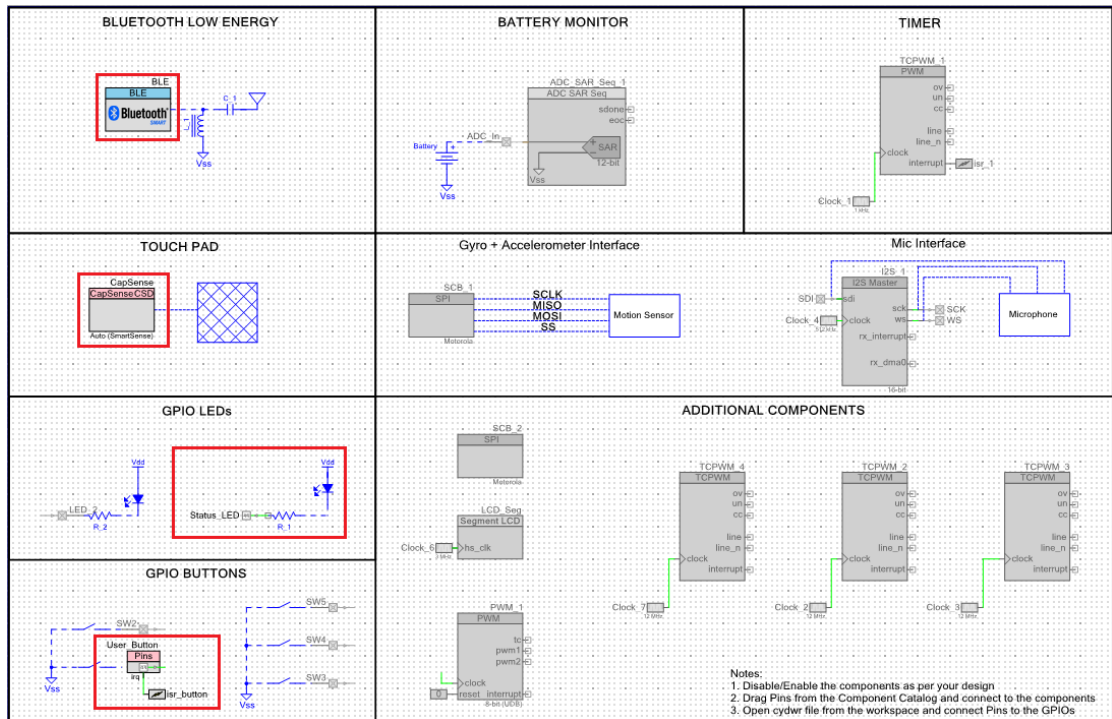


Figure 4-31. Top Design for PSoC_4_BLE_CapSense_Proximity Project



4.3.2 Hardware Connections

- Ensure that the correct module is placed on the baseboard corresponding to the project being used. PSoC_4_BLE_CapSense_Proximity works with the PSoC 4 BLE Module. PProC_BLE_CapSense_Proximity works with the PProC BLE Module.
 - Connect a five-inch wire (provided as part of this kit) to the proximity connector J14 on the baseboard. Loop the wire as shown in Figure 4-32.
- Note:** Ensure that the proximity sensor loop wire is kept away as much as possible from the BLE antenna on the modules.

Figure 4-32. Proximity Sensor Connection on BLE Pioneer Kit with PSoC 4 BLE Module

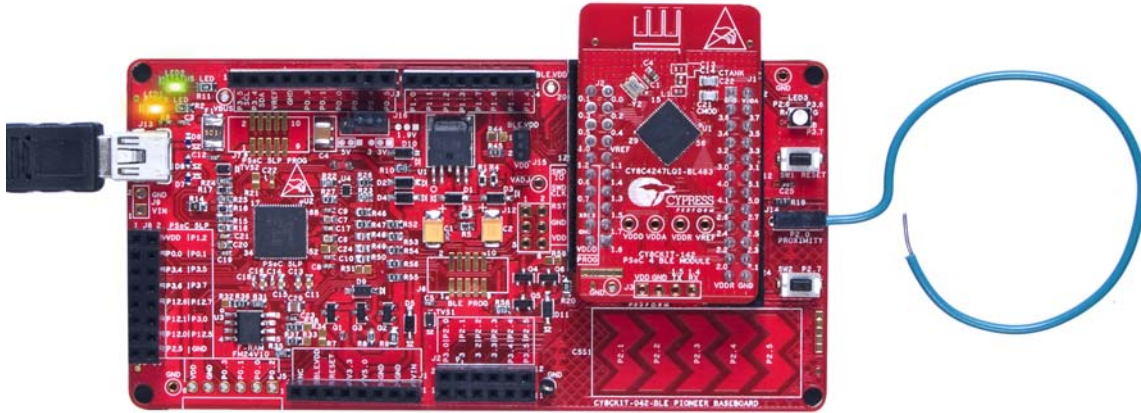
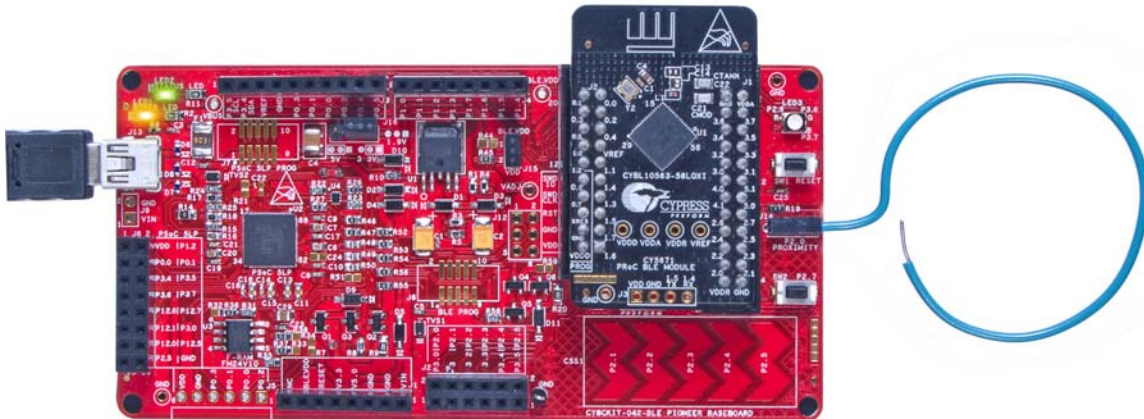


Figure 4-33. Proximity Sensor Connection on BLE Pioneer Kit with PProC BLE Module



The pin assignment for this project is in **PSoC_4_BLE_CapSense_Proximity.cydwr/ PProC_BLE_CapSense_Proximity.cydwr** in the Workspace Explorer, as shown in Figure 4-34.

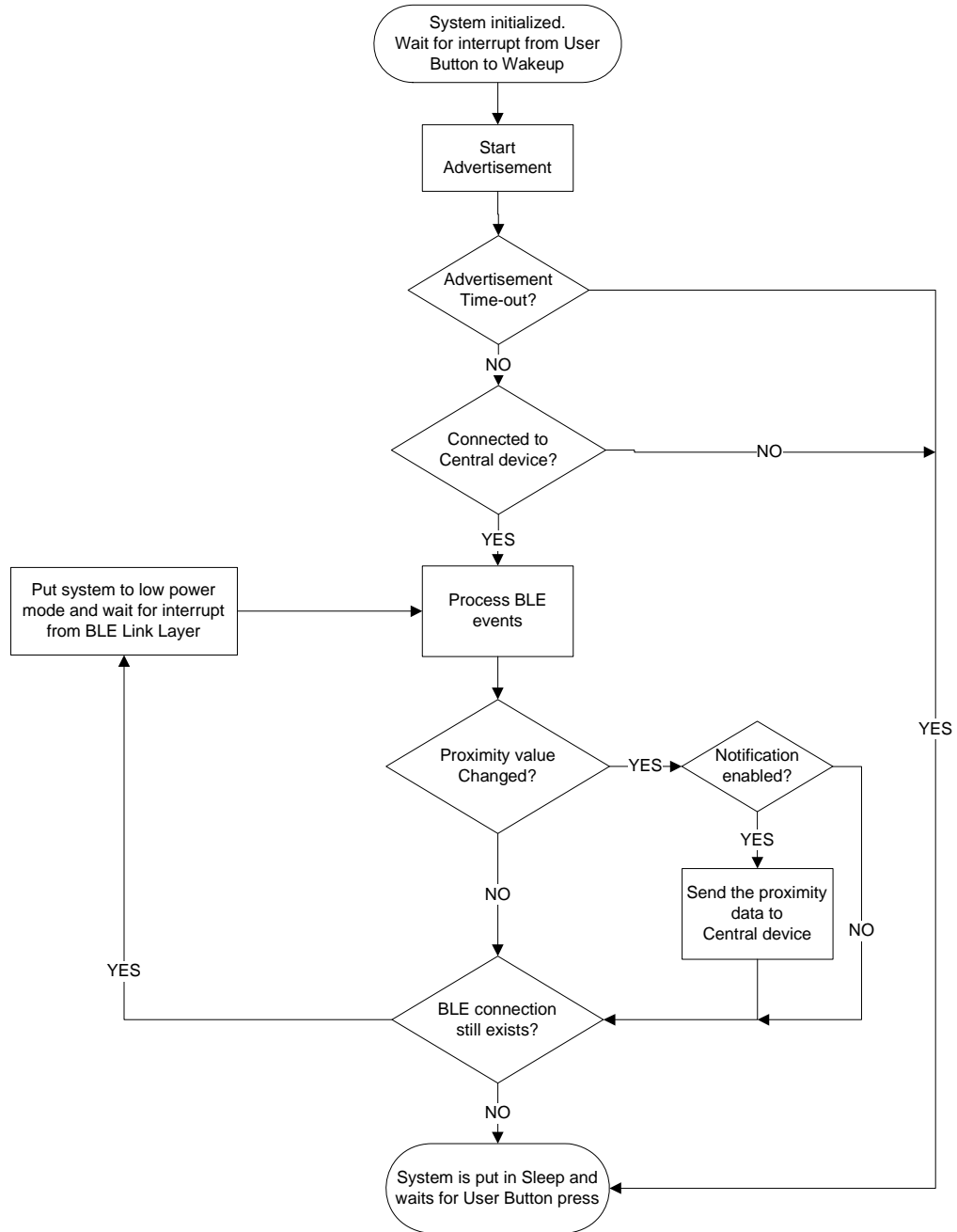
Figure 4-34. Pin Selection for CapSense Proximity Project

Alias	Name	Port	Pin	Lock
Cmod	\CapSense:Cmod\	P4[0] CSD:c_mod, TCPWM0:line_out, SCB1:uart_rts, SCB1:spi_mosi	5	<input checked="" type="checkbox"/>
ProximitySensor0_0_PROX	\CapSense:Sns\	P2[0] OA0:vplus, SCB0:spi_select[1]	37	<input checked="" type="checkbox"/>
	Status_LED	P2[6] OA0:vplus_alt	43	<input checked="" type="checkbox"/>
	User_Button	P2[7] OA1:vplus_alt, SRSS:ext_clk	44	<input checked="" type="checkbox"/>

4.3.3 Flow Chart

Figure 4-35 shows the flow chart of code implemented.

Figure 4-35. CapSense Proximity Project Flow Chart



4.3.4 Verify Output

The project can be verified by two methods: using the CySmart Central Emulation Tool and BLE Dongle or using the CySmart iOS/Android app.

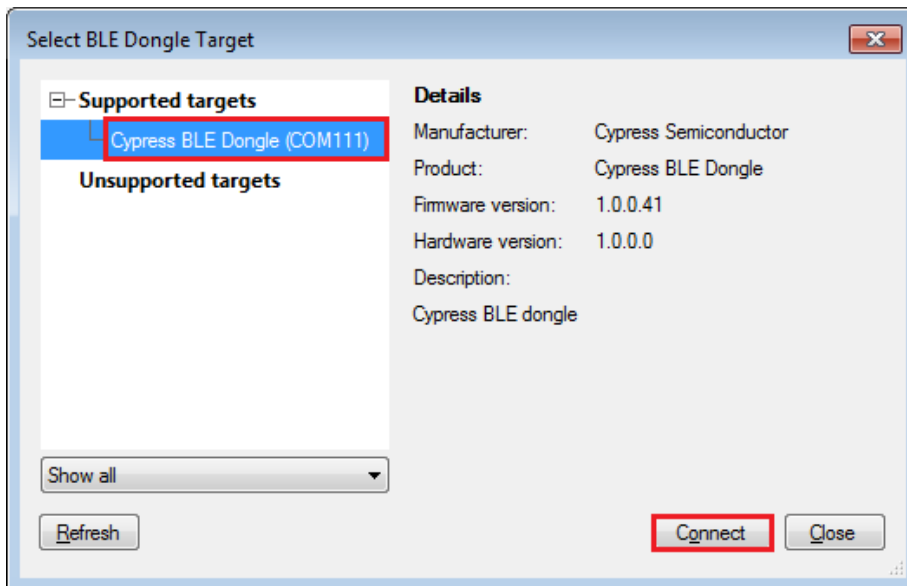
4.3.4.1 CySmart Central Emulation Tool

To verify the CapSense proximity project using the CySmart Central Emulation Tool, follow these steps:

Note: Refer [CySmart BLE Host Emulation tool](#) to learn how to use the tool.

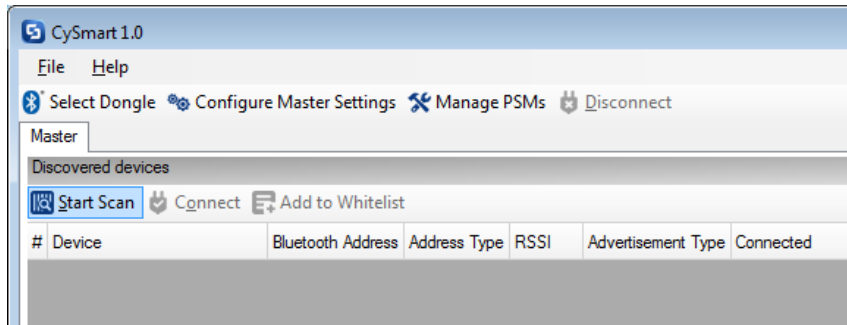
1. Connect the BLE Dongle to one of the USB ports on the PC.
2. Start the CySmart Central Emulation Tool on the PC by going to **Start > All Programs > Cypress > CySmart <version> > CySmart <version>**. You will see a list of dongles connected to it. If no BLE Dongle is found, click **Refresh**. Select the BLE Dongle and click **Connect**.

Figure 4-36. Connect to BLE Dongle



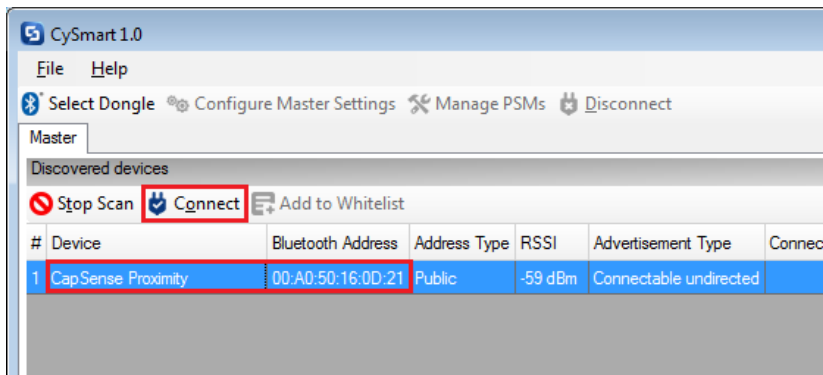
3. Connect a five-inch wire (included in the kit) to the proximity sensor connector J14 and make a loop of it.
4. Power the BLE Pioneer Kit through the USB connector **J13**.
5. Program the BLE Pioneer Kit with the CapSense proximity example project. Follow the steps in [Using Example Projects on page 41](#) to program the device.
6. After programming successfully, press the user button (**SW2**) on the BLE Pioneer kit to start the advertisement. This is indicated by a blinking red LED on the baseboard.
Note: The project has an advertisement timeout of 30 seconds after which it returns to Deep Sleep. Press **SW2** again to restart the advertisement.
7. On the CySmart Central Emulation Tool, click **Start Scan** to see the list of available Peripheral devices.

Figure 4-37. Start Scanning



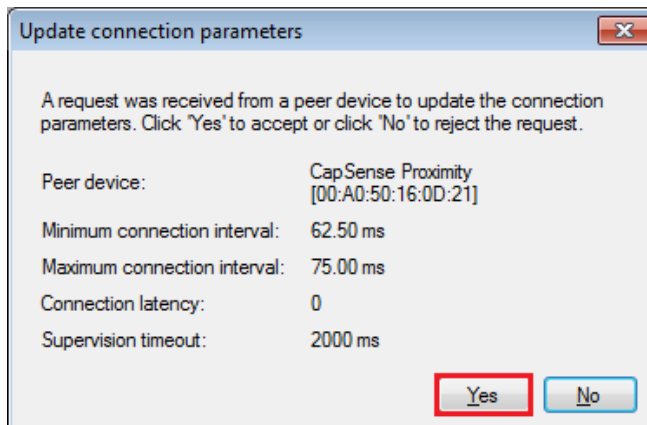
8. Double-click **CapSense Proximity** to connect or click **Connect** to connect to the BLE Pioneer Kit.

Figure 4-38. Connect to CapSense Proximity Peripheral



9. When connected, the CySmart Central Emulation Tool will display a message for the **Update connection parameters**. Select **Yes**, as shown in Figure 4-39.

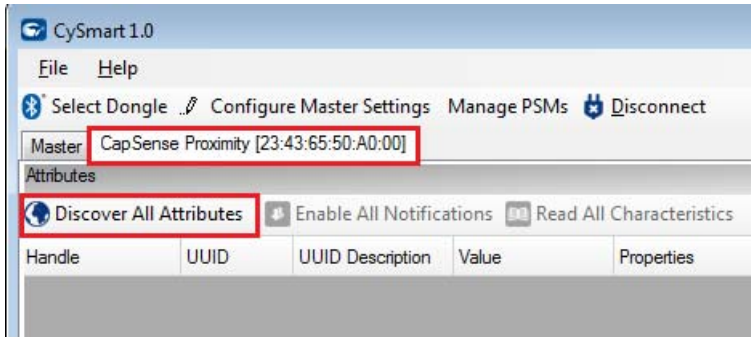
Figure 4-39. Update Connection Parameter Option



Note: If you select **No**, the project will still work. However, the current consumption will be higher due to faster connection interval.

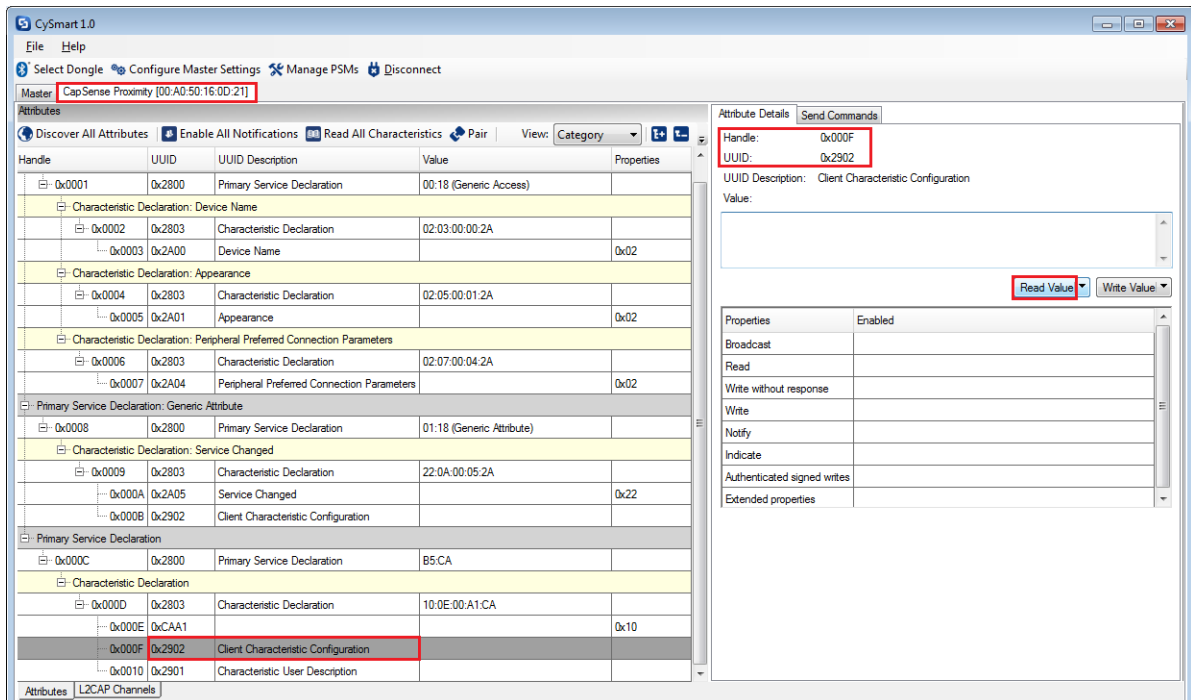
10. Click **Discover All Attributes** to find all attributes supported by the Peripheral.

Figure 4-40. Discover All Attributes



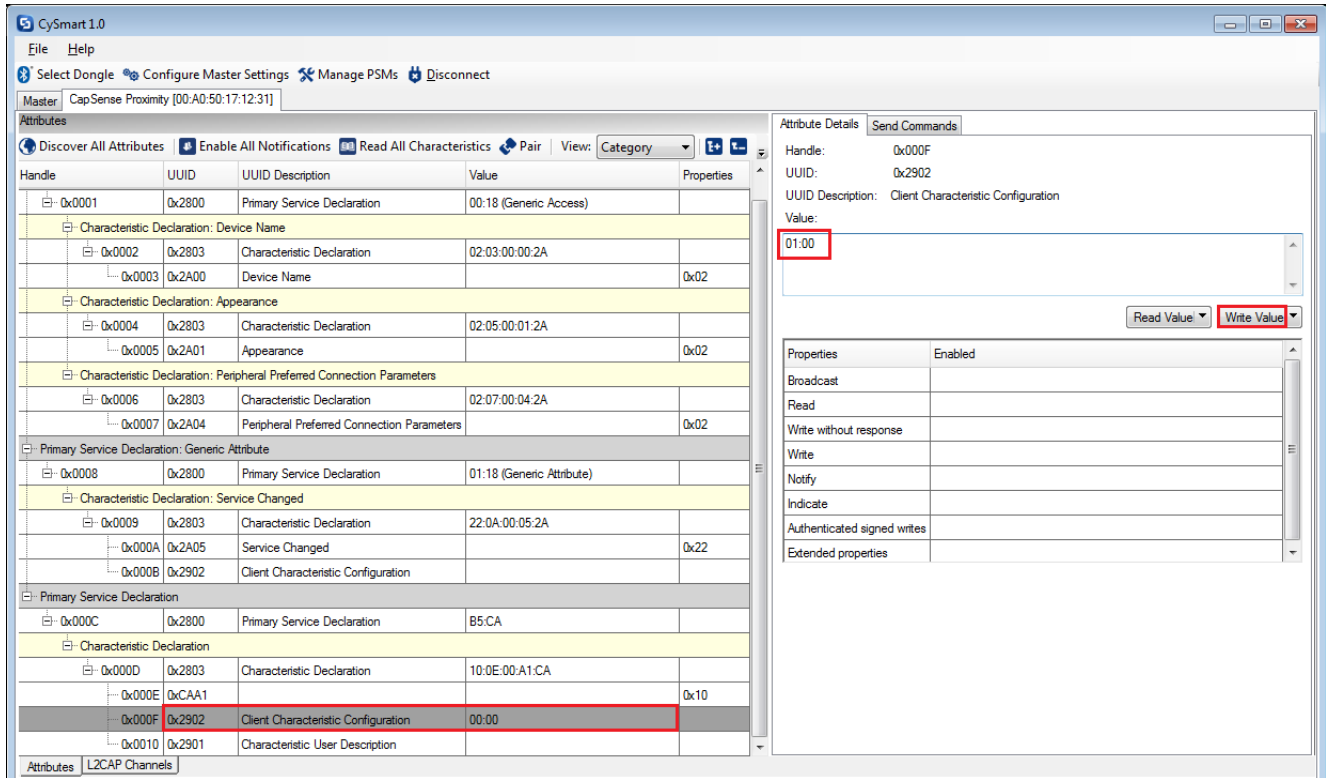
11. When all the attributes are listed, locate the **Client Characteristic Configuration** descriptor (UUID 0x2902) under CapSense Proximity characteristic (UUID 0xCAA1). Click **Read Value** to read the existing CCCD value as shown in Figure 4-41.

Figure 4-41. Read CapSense Proximity CCCD



12. Modify the **Value** field to '01:00' and click **Write Value**. This enables the notifications on the CapSense Proximity characteristic.

Figure 4-42. Write CCCD to Enable Notifications



13. Bring your hand closer to the proximity sensor on the BLE Pioneer Kit, as shown in Figure 4-43 and observe the value changing in the characteristic value field, as shown in Figure 4-44.

Figure 4-43. CapSense Proximity Sensing with PSoC 4 BLE Module

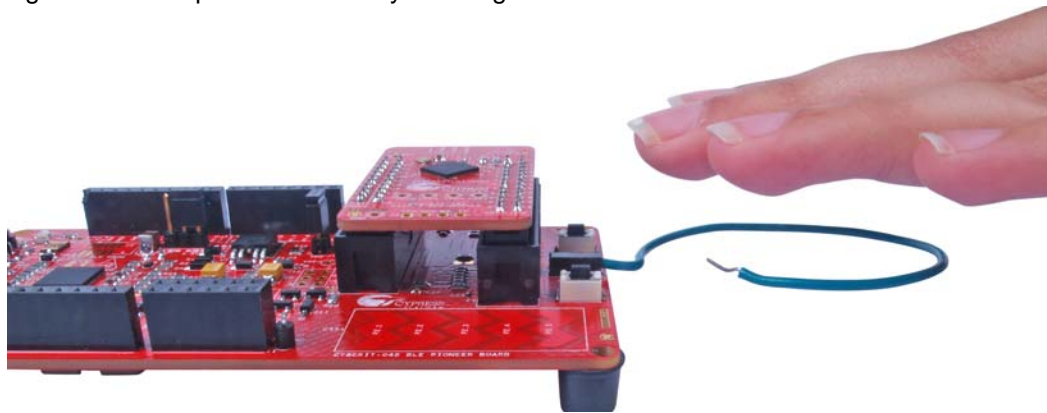


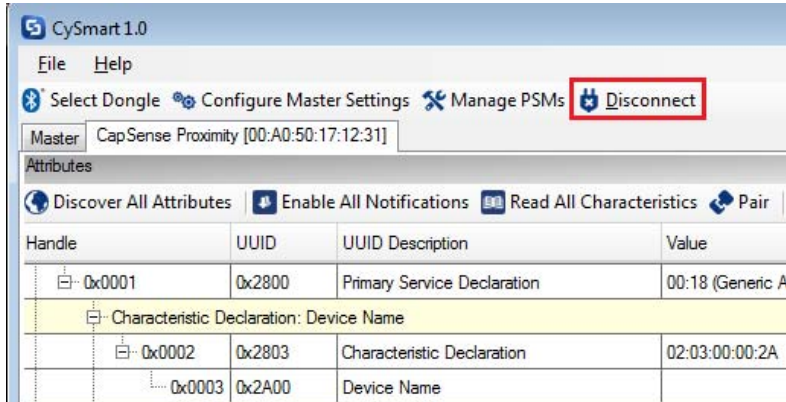
Figure 4-44. CapSense Proximity Notification Received

Primary Service Declaration				
0x000C	0x2800	Primary Service Declaration	B5:CA	
Characteristic Declaration				
0x000D	0x2803	Characteristic Declaration	10:0E:00:A1:CA	
0x000E	0xCAA1		71	0x10
0x000F	0x2902	Client Characteristic Configuration	01:00	
0x0010	0x2901	Characteristic User Description		

14. Modify the Value field of the Client Characteristic Configuration descriptor to '00:00' to disable notifications.

15. To disconnect from the device, click **Disconnect**, as shown in [Figure 4-45](#).

Figure 4-45. Disconnect from the Device



16. Press user button (**SW2**) to wake up from sleep and restart the advertisement for the next connection.

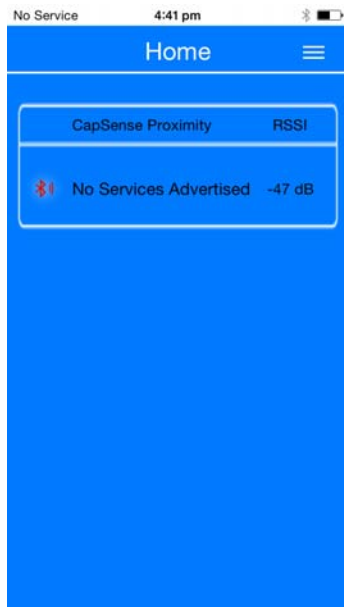
4.3.4.2 CySmart Mobile Application

To learn how to use the CySmart mobile application, see [CySmart Mobile Application on page 112](#) or the [app user guide](#).

To verify the CapSense proximity project using the CySmart mobile application, follow these steps:

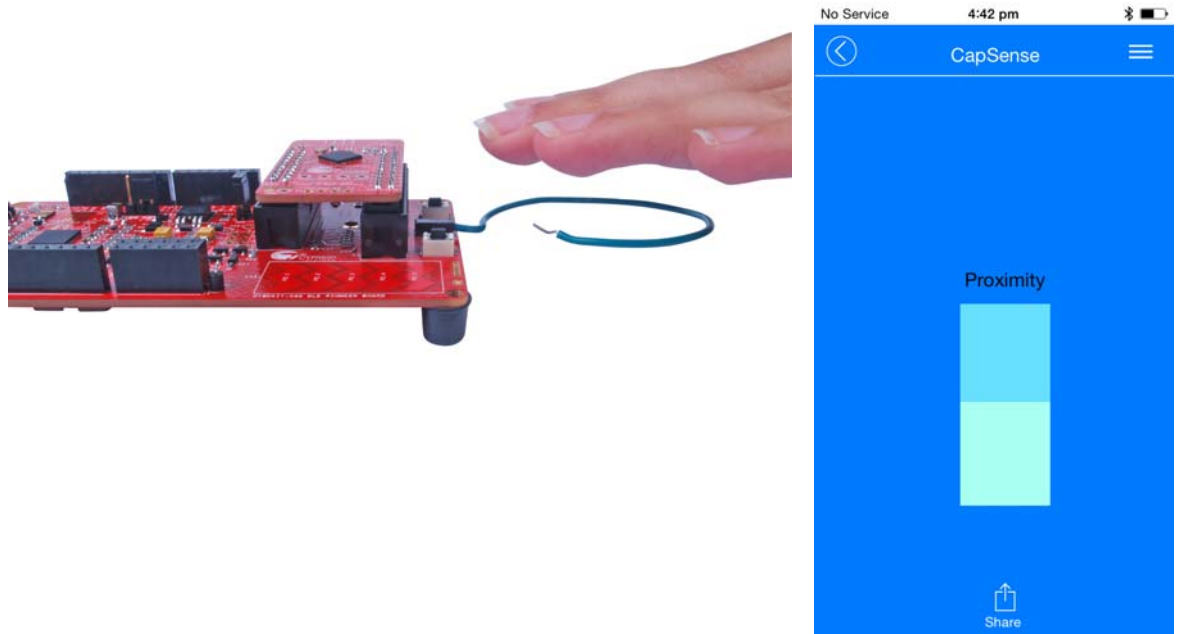
1. Place the desired module on BLE Pioneer Baseboard.
2. Connect the five-inch wire as a loop to the proximity connector J14 on the baseboard.
3. Plug the BLE Pioneer Kit into the PC, using the J13 USB connector.
4. Program the kit with the CapSense proximity example project. Follow steps in [Using Example Projects on page 41](#) to program the device.
5. Press the user button (**SW2**) on the BLE Pioneer Kit to start the advertisement.
6. Open the CySmart mobile application on the mobile device. If Bluetooth is not enabled on the device, the app will ask to enable it.
7. The app will automatically search for available Peripherals and list them. Select the **CapSense Proximity** Peripheral, as shown in [Figure 4-46](#).

Figure 4-46. Connect to CapSense Proximity Peripheral



8. When connected, the app will list the services supported by the Peripherals. Scroll and select the **CapSense** service.
9. When the CapSense service page opens, bring your hand near the sensor wire on the BLE Pioneer Kit and see a similar response in the app as a bar graph, as shown in [Figure 4-47](#).

Figure 4-47. CapSense Proximity Sensing with PSoC 4 BLE Module



10. To disconnect from the BLE Pioneer Kit, return to the device selection screen on the CySmart mobile application.
11. To reconnect to the Peripheral, press the user button (**SW2**) on the BLE Pioneer Kit to restart the advertisement and scan for the device in the CySmart mobile application.

4.4 BLE Central Mode

4.4.1 Project Description

The BLE projects described above have been functioning as Peripheral devices. This means that the firmware role was set to be a Peripheral and GATT server; another device such as the CySmart Central Emulation Tool or CySmart mobile application will connect to it and collect the data.

This example project demonstrates the Central and GATT client mode where it will scan for a Peripheral device, connect to it, and send commands. In this project, the BLE Pioneer Kit scans and auto-connects to a particular Peripheral device supporting **Immediate Alert Service (IAS)**. Whenever the Peripheral with a predetermined public address is found, a connection request is sent followed by discovering the attributes. When the discovery is over, you can send one of the three alert levels to the Peripheral device over the IAS. This is done by pressing the **SW2** button on the BLE Pioneer Kit and cycling through the alert levels.

The BLE Central project supports low-power mode operation, where the firmware supports BLE Hardware Block and CPU Deep Sleep mode whenever possible. The system remains in Deep Sleep when disconnected. Press **SW2** to wake up the system and start scanning (blinking blue LED). The scanning timeout interval is set to 30 seconds. If the particular Peripheral device is found advertising before timeout, a connection is made (blue LED always ON). If no such device is found, then the system stops scanning and returns to Deep Sleep mode (LED OFF). Press **SW2** again to wake the system and restart scanning.

To aid in evaluation, the Peripheral project with the particular public address is provided in the same workspace. This Peripheral project supports IAS and has fixed public address that the Central device will recognize and auto-connect to. This Peripheral project should be programmed on the BLE Dongle and powered through the USB port of PC. The received alert levels (No, Mid, and High alert) on the BLE Dongle are represented by different LED status. No Alert is represented by LED OFF, Mid Alert by blinking LED, and High Alert with LED always ON. Upon each successive button press on the BLE Pioneer Kit, the LED state on the BLE Dongle changes in a circular fashion.

Two projects demonstrate the BLE Central functionality on the two devices:

- **PSoC_4_BLE_Central_IAS** works with the PSoC 4 BLE Module.
- **PRoC_BLE_Central_IAS** works with the PRoC BLE Module.

Additionally, the **BLE_Dongle_Peripheral_IAS** project is to be programmed on the BLE Dongle. This project is present in both the **PSoC_4_BLE_Central_IAS** and the **PRoC_BLE_Central_IAS** workspace and can be used to program the BLE Dongle separately.

Note: If the BLE Dongle is programmed with the **BLE_Dongle_Peripheral_IAS** example, it will not work with the CySmart PC utility. Reprogram the BLE Dongle with the CySmart firmware according to [Updating BLE Dongle for CySmart Central Emulation Tool on page 35](#) to use the CySmart Central Emulation Tool.

Figure 4-48. PSoC_4_BLE_Central_IAS TopDesign

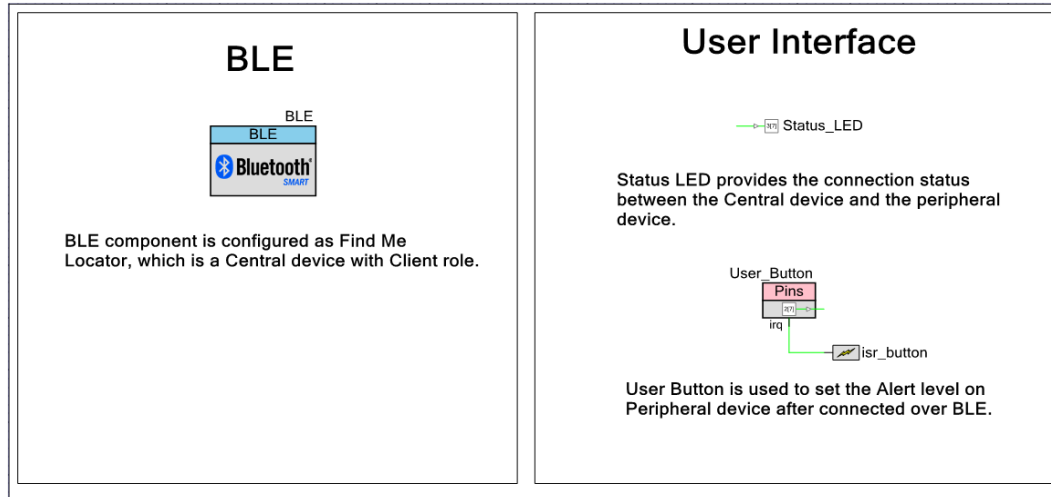


Figure 4-49. PSoC_BLE_Central_IAS TopDesign

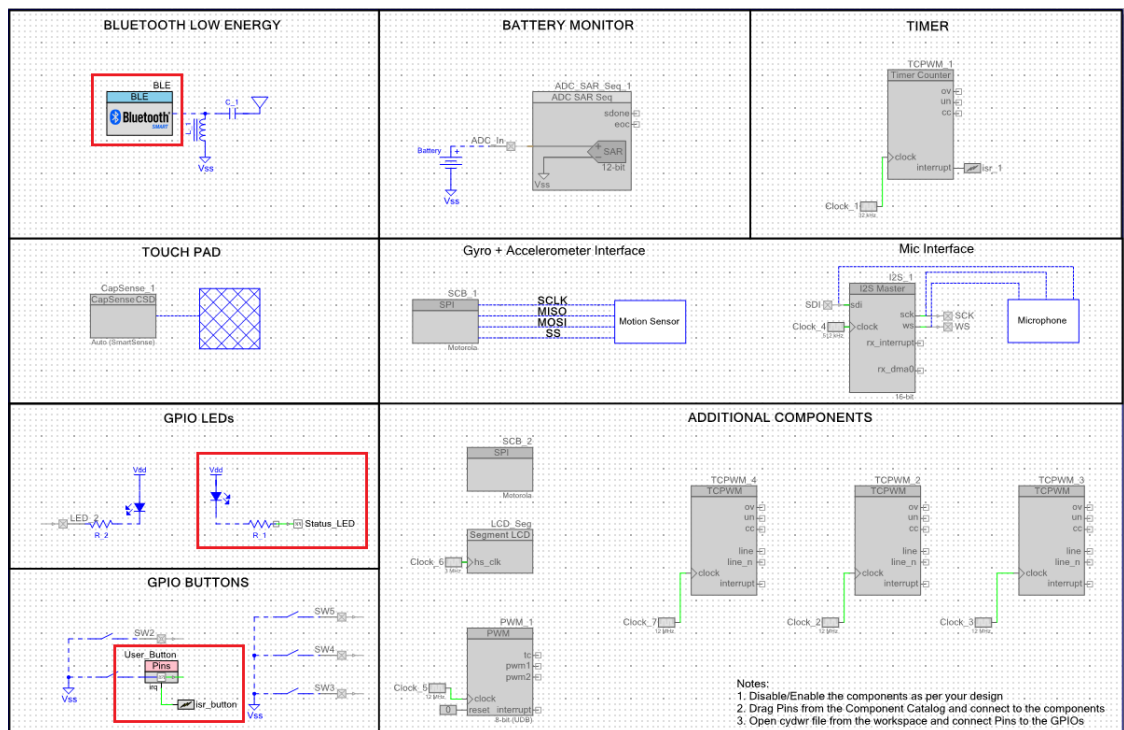
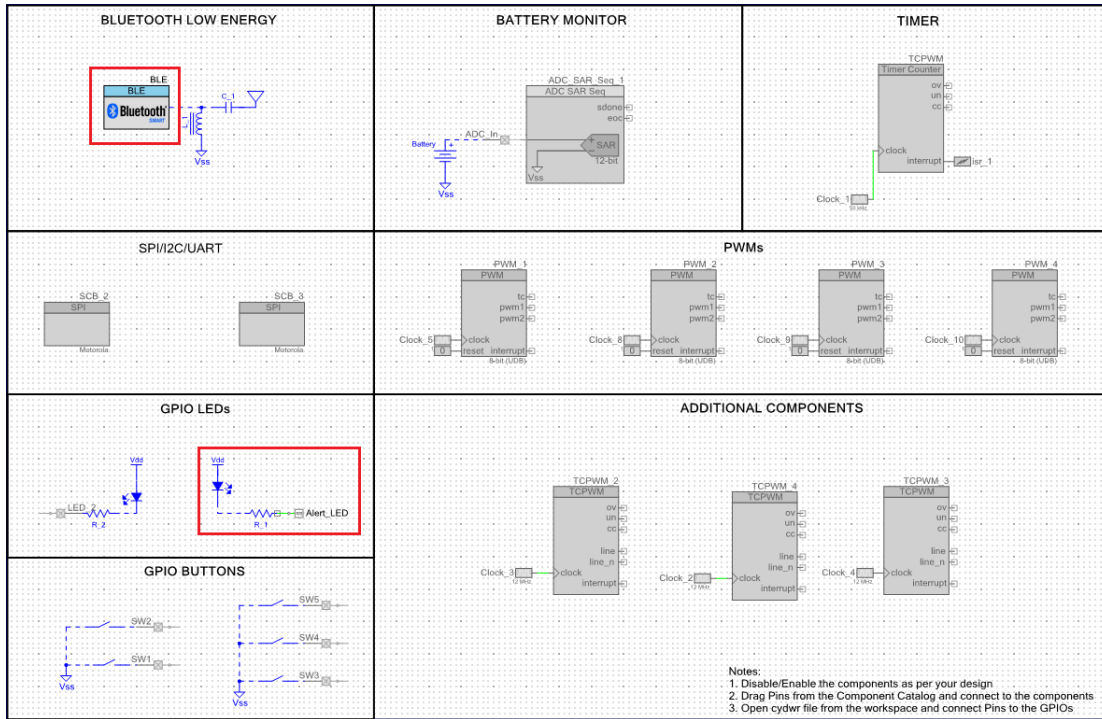


Figure 4-50. BLE_Dongle_Peripheral_IAS TopDesign



4.4.2 Hardware Connections

No specific hardware connections are required for this project because all connections are hardwired on the BLE Pioneer Baseboard.

Ensure that the correct module is placed on the BLE Pioneer Baseboard corresponding to the project being used. PSoC_4_BLE_Central_IAS works with the PSoC 4 BLE Module. PProC_BLE_Central_IAS works with the PProC BLE Module. BLE_Dongle_Peripheral_IAS is the common project for both workspaces and programs the BLE Dongle with Peripheral mode firmware.

The pin assignment for this project is in **PSoC_4_BLE_Central_IAS.cydwr/ PProC_BLE_Central_IAS.cydwr** in the Workspace Explorer, as shown in [Figure 4-51](#).

Figure 4-51. Pin Selection for BLE IAS Central Example Project

Alias	Name /	Port	Pin	Lock
Status_LED	P3[7] SARMUX:pads[7], TCPWM3:line_out_compl, SCB1:uart cts, SRSS:ext clk lf		54	<input checked="" type="checkbox"/>
User_Button	P2[7] OAl:vplus_alt, SRSS:ext_clk		44	<input checked="" type="checkbox"/>

Similarly, the pin assignment for the BLE Dongle Peripheral project is in **BLE_Dongle_Peripheral_IAS.cydwr** in the Workspace Explorer as shown in [Figure 4-52](#).

Figure 4-52. Pin Selection for BLE IAS Peripheral Example Project

Alias	Name /	Port	Pin	Lock
Alert_LED	P3[3] SARMUX:pads[3], TCPWM1:line_out_compl, SCB0:uart cts		50	<input checked="" type="checkbox"/>

4.4.3 Flow Chart

Figure 4-53 shows the flow chart for the IAS GATT client mode example project.

Figure 4-53. IAS GATT client mode Flow Chart

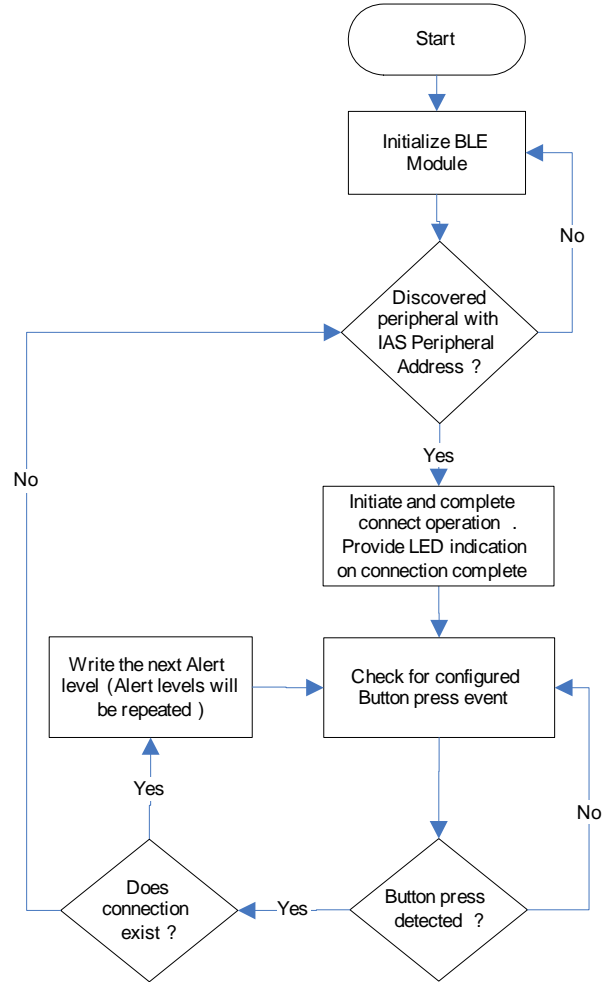
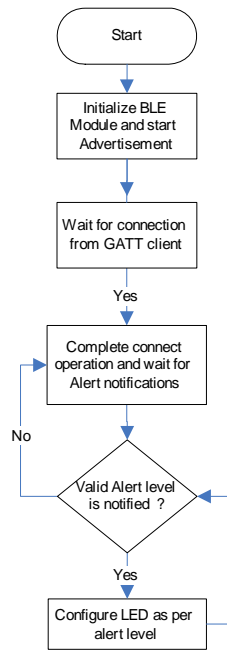


Figure 4-54 shows the flow chart for the IAS GATT server mode example project.

Figure 4-54. IAS GATT server mode Flow Chart



4.4.4 Verify Output

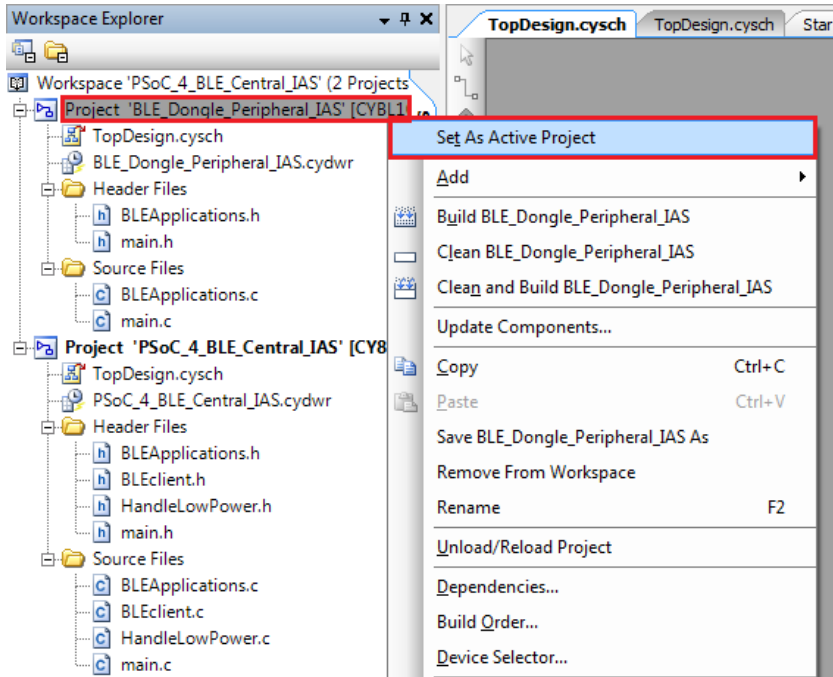
1. Connect the BLE Dongle to one of the USB ports on the PC.

Figure 4-55. Connect BLE Dongle to USB Port



- In the PSoC Creator Workspace Explorer, right-click on the **BLE_Dongle_Peripheral_IAS** project and select **Set As Active Project**, as shown in [Figure 4-56](#).

Figure 4-56. Set Dongle Peripheral Project as Active

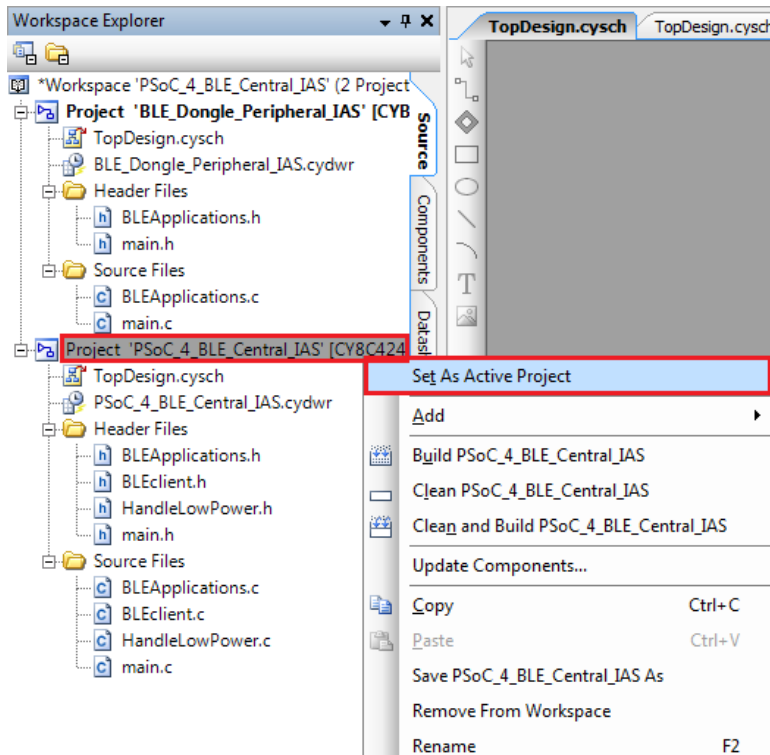


- Program the BLE Dongle with the BLE_Dongle_Peripheral_IAS project described in [Using Example Projects on page 41](#).

Note: Do not update the public device address (inside the BLE component) for the **BLE_Dongle_Peripheral_IAS** example project. Changing the **BLE_Dongle_Peripheral_IAS** example project public address will lead to no connection with the BLE Central device on the BLE Pioneer kit.

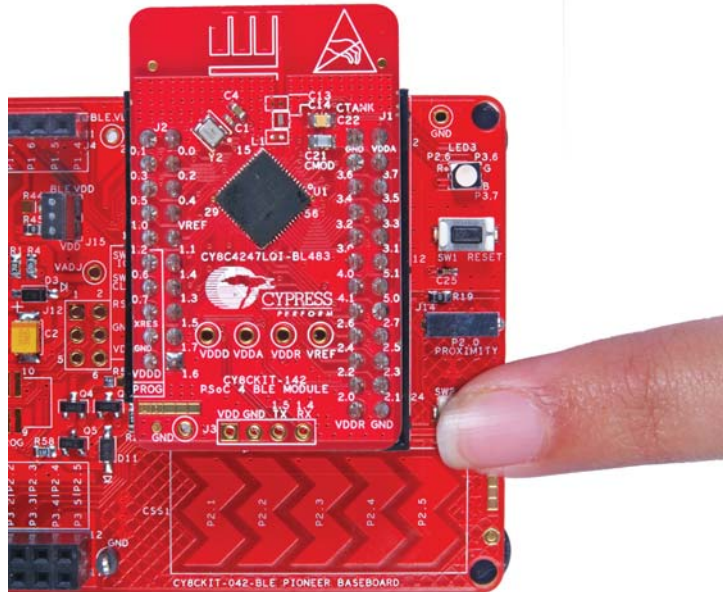
- Power the BLE Pioneer Kit through USB connector **J13**.
- In the Workspace Explorer, right-click on the **PSoC_4_BLE_Central_IAS** project and select **Set As Active Project**, as shown in [Figure 4-57](#).

Figure 4-57. Set Central IAS Project as Active



6. Program the BLE Pioneer Kit with either the **PSoC_4_BLE_Central_IAS** or the **PRoC_BLE_Central_IAS** project, depending on the module placed on the BLE Pioneer Kit.
7. Press button **SW2** on the BLE Pioneer Kit to wake the system and start scanning. Scanning is indicated by a blinking LED.
8. Wait for the BLE connection between the BLE Dongle and the BLE Pioneer Kit. The connection success status is indicated on the baseboard in the following three stages:
 - a. Fast blinking blue LED represents scanning mode. During this mode, the BLE Pioneer Kit is scanning for peripheral devices.
 - b. Slow blinking blue LED represents discovery mode. During this mode, the BLE Pioneer Kit has found the BLE Dongle Peripheral device and has started the connection procedure.
 - c. The blue LED remains on, representing the connected mode. This mode indicates that the Peripheral device has been connected and the application can now send alert levels.
9. Press button **SW2** on the BLE Pioneer Kit to send the next alert level to the BLE Dongle. The alert level will rotate from No Alert to Mid Alert to High Alert.

Figure 4-58. User Button on BLE Pioneer Kit with PSoC 4 BLE Module



10. Check if the LED behavior changes for each alert notification on the BLE Dongle according to the following table:

Alert Level	LED State
No Alert	LED Off
Mild Alert	LED Blinking
High Alert	LED On

Note: To revert the CySmart functionality to the dongle, program the dongle hex file, as described in [Updating BLE Dongle for CySmart Central Emulation Tool on page 35](#).

4.5 BLE Dongle and LED Control

4.5.1 Project Description

This firmware supports the CySmart debug tool (see [CySmart Mobile Application on page 112](#)) by acting as the BLE host emulator. This is the default firmware that comes in the BLE Dongle shipped with the kit.

This project additionally demonstrates LED brightness control via a custom BLE profile, which works with the CapSense slider example explained in [CapSense Slider and LED on page 45](#).

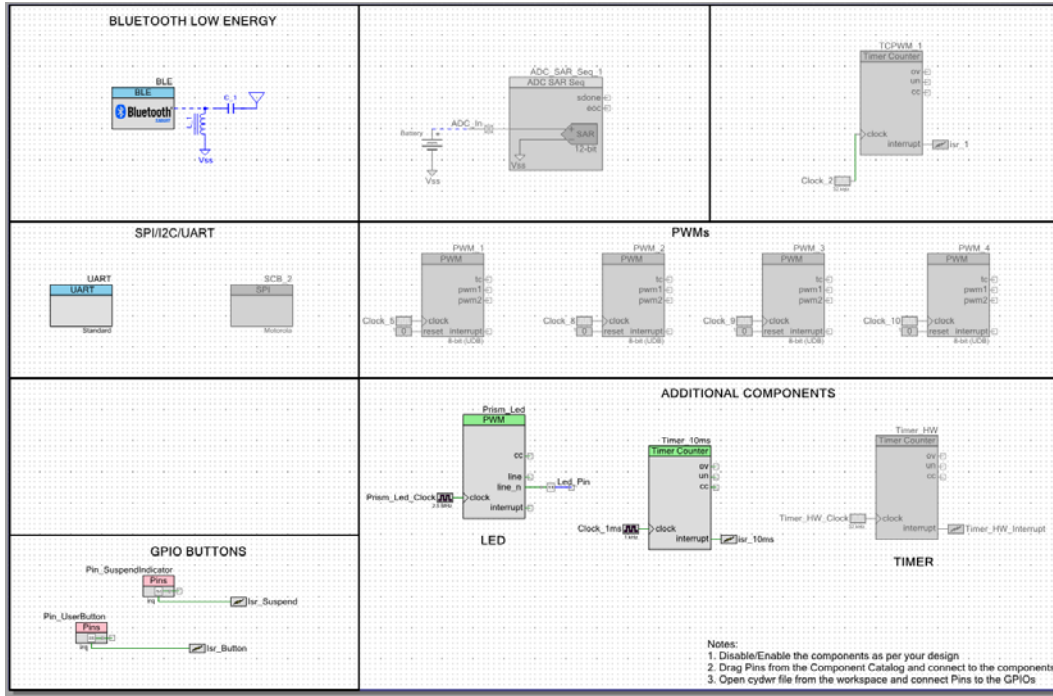
The device will scan for the Peripheral acting as a CapSense Slider and LED device, and connect to it automatically. This is achieved by filtering the advertisement packets for the CapSense Slider service data. Then, it will enable slider notifications and process the received notifications. Whenever CapSense detects activity, it will notify the finger location to the BLE Dongle; it will update the LED brightness using PWM.

The custom GATT client LED control will be stopped if the CySmart Central Emulation Tool acquires the dongle. The dongle will enter the CySmart emulator mode, in which it will process all BLE commands as triggered by the user via the tool. The project uses custom command/event protocol to exchange data between the CySmart Central Emulation Tool and the BLE device via a USB-CDC

interface. It uses the Cypress USB-UART bridge functionality from the PSoC 5LP-based KitProg module.

Note: This project is meant only for the PSoC BLE device and works on the dongle hardware.

Figure 4-59. Top Design for BLE_Dongle_CySmart Project



4.5.2 Hardware Connections

No specific hardware connections are required for this project because all connections are hardwired on the BLE Dongle.

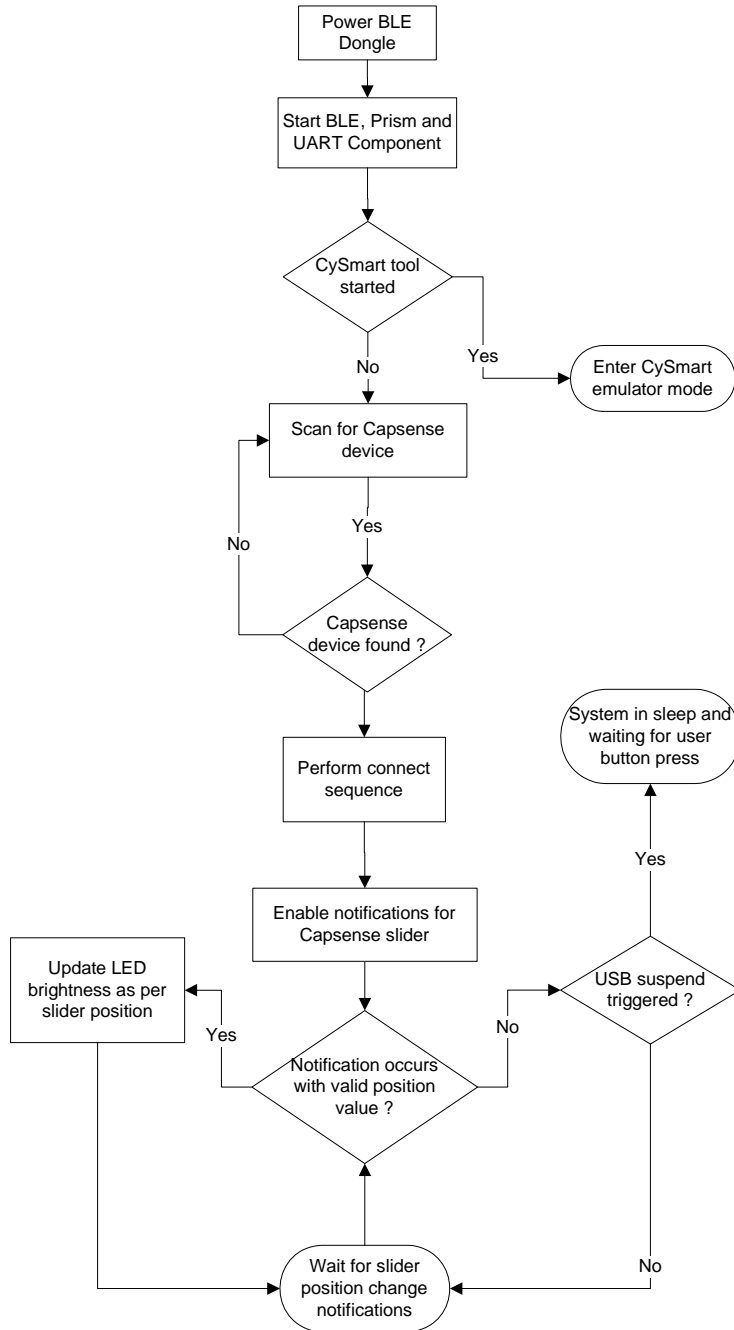
The pin assignment for this project is in **BLE_Dongle_CySmart.cydwr** in the Workspace Explorer, as shown in [Figure 4-60](#).

Figure 4-60. Pin Selection for BLE Dongle Project

Alias	Name	Port	Pin	Lock
\UART:rx_wake\		P1[4] OA3:vminus, TCPWM2:line_out, SCB0:uart_rx, SCB0:i2c_sda, SCB0:spi_mosi	32	<input checked="" type="checkbox"/>
\UART:tx\		P1[5] OA3:vplus, TCPWM2:line_out_compl, SCB0:uart_tx, SCB0:i2c_scl, SCB0:spi_miso	33	<input checked="" type="checkbox"/>
Led_Pin		P3[3] SARMUX:pads[3], TCPWM1:line_out_compl, SCB0:uart_cts	50	<input checked="" type="checkbox"/>
Pin_SuspendIndicator		P3[2] SARMUX:pads[2], TCPWM1:line_out, SCB0:uart_rts	49	<input checked="" type="checkbox"/>
Pin_UserButton		P2[6] OA0:vplus_alt	43	<input checked="" type="checkbox"/>

4.5.3 Flow Chart

Figure 4-61. Flow Chart for BLE_Dongle_CySmart Project



4.5.4 Verify Output

This project will be used whenever the CySmart Central Emulation Tool (see [CySmart Mobile Application on page 112](#)) is invoked for testing other example projects. In addition, the LED control operation can be verified as follows.

1. Power the BLE Pioneer kit through the USB connector J13.
2. Program the BLE Pioneer kit with the CapSense and LED example project described in [CapSense Slider and LED on page 45](#).
3. Connect the BLE Dongle to one of the USB ports on the PC.
4. Program the BLE Dongle with the **BLE_Dongle_CySmart** project. See [Using Example Projects on page 41](#) for programming instructions.
5. Press the user button **SW2** on both the BLE Dongle and the BLE Pioneer Kit. The BLE Dongle will start scanning and the BLE Pioneer Kit will start advertising.
6. Wait for the BLE connection between the BLE Dongle and the BLE Pioneer Baseboard. The connection success status will be indicated by a 3-second ON state of the red LED followed by the OFF state on the BLE Pioneer Baseboard.
7. Swipe your finger on the CapSense slider and check the LED brightness variation on the BLE Dongle.

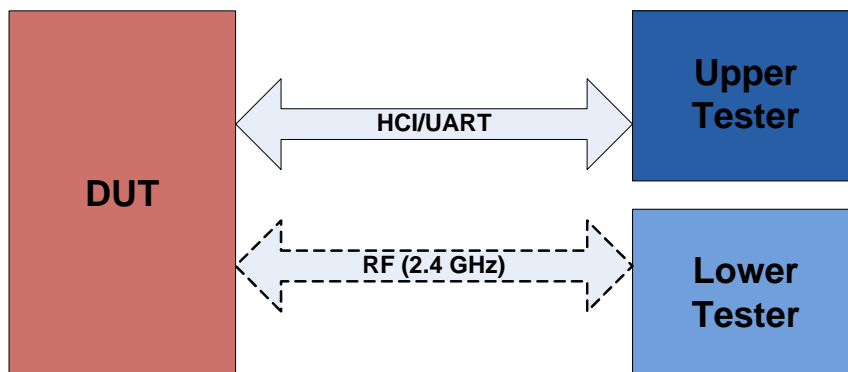
4.6 Direct Test Mode (DTM)

4.6.1 Project Description

[Bluetooth Core specification](#) (v4.0 and later), Volume 6, Part F defines Direct Test Mode (DTM) as a method to test the BLE PHY layer and provide a report back to the tester. It uses one of the two methods, over **Host Controller Interface (HCI)** or through a **two-wire UART interface**.

Device under test (DUT) is the BLE system that is to be tested (for example, BLE Pioneer Kit). With DTM, the RF performance of the BLE system can be verified during development or in production line. The environment consists of the DUT and a tester. The tester has two parts; the **upper tester** sends commands through one of the two methods (HCI or two-wire UART) and the **lower tester** performs the corresponding action over the RF link. The tester compares the command sent over HCI and the response received over RF, and provides a result of the performance.

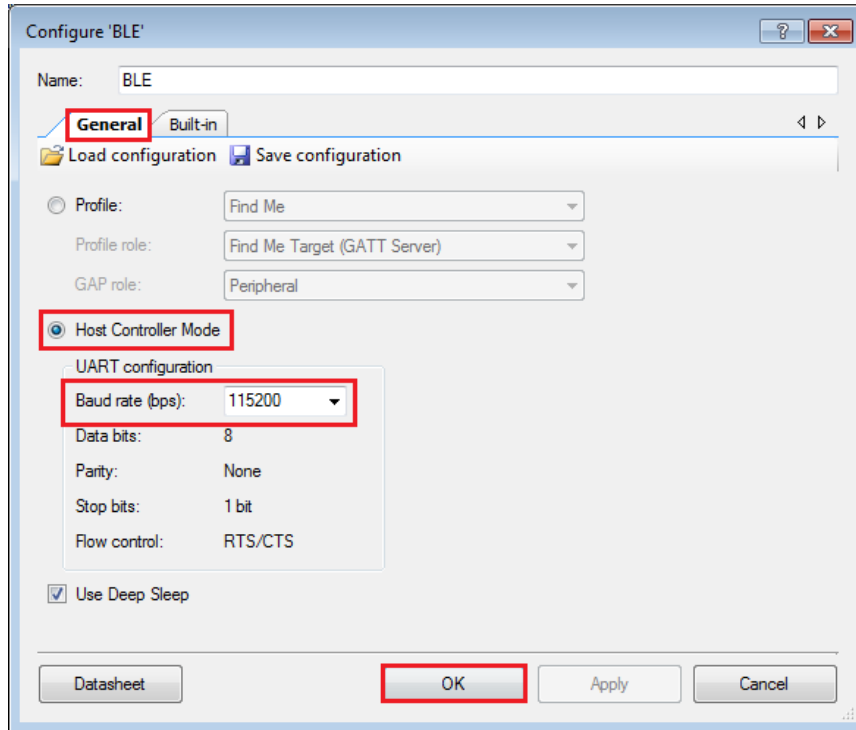
Figure 4-62. Direct Test Mode (DTM) Setup



The BLE Component allows configuring the device in DTM by enabling the HCI. The appropriate response to commands from the tester are performed by the BLE protocol stack and does not involve separate application handling. The only task is to start the BLE Component and call the API to process the events.

The HCI is enabled in the BLE Component under the General Settings. Note that when the HCI mode is selected, all other tabs are hidden and cannot be configured. This is because in HCI mode, there are no upper layer processes. On enabling HCI mode in the components, the components automatically reserves a UART block to allow communication between the tester and BLE stack. The UART exposes the pins that can be assigned in `<project.cydwr>` file under Pins tab. The only option to be configured for HCI mode is the baud rate and the pins for communication with the tester.

Figure 4-63. HCI Mode in BLE Component

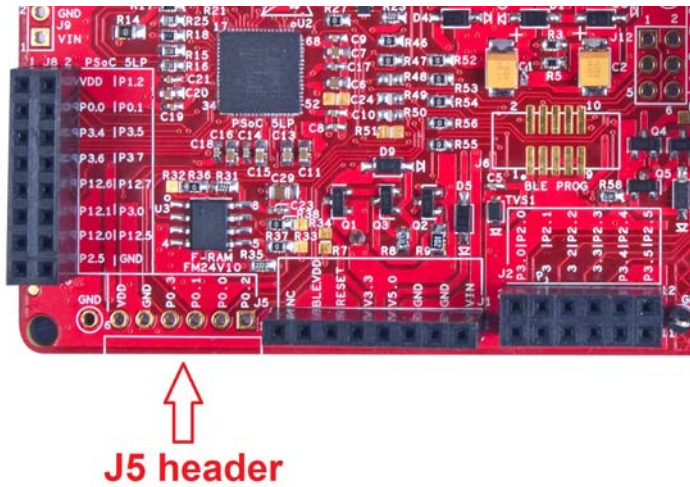


Many companies develop BLE testers for Direct Test Mode. It is also possible to create PC-based software tools that will send HCI commands over serial communication links.

For PC-based software, the serial communication link is the COM port, which is enumerated by Kit-Prog on PSoC 5LP of the BLE Pioneer kit. In such a case, the UART pins in PSoC 4 BLE/PRoC BLE should be assigned to P1_4 and P1_5. These pins are hardwired to pins on PSoC 5LP and allows USB-UART data communication between the PC-based software and the BLE device.

For external BLE testers, the serial communication is mostly over the RS232. To test with this system, an external RS232 voltage translator is required, such as [Digilent's Pmod RS232](#). This translator will modify the signal level of the serial communication between the BLE device and the RS232 port on the tester. The UART pins of the BLE device can be assigned to P0_0 and P0_1 and the header J5 can be used to connect to the RS232 translator.

Figure 4-64. J5 Header to Interface RS232 Translator



4.6.2 Hardware Connection

For DTM test mode, it is recommended to use SMA connectors and connect the tester and DUT using a SMA to SMA connector cable. This ensures that there is minimum interference to RF communication between the DUT and tester, and the performance measured is the true RF performance of the device. The BLE Pioneer Kit module with SMA connector (CY8CKIT-141 PSoC 4 BLE) is available separately and can be ordered from the [Cypress web page](#).

Four UART pins are exposed when HCI mode is selected in the BLE Component. These pins should be assigned to allow communication with the external tester. The connection depends on the tester being used.

If the tester is a PC-based software and communicated with HCI over serial link, then the onboard PSoC 5LP on the BLE Pioneer Kit can act as the USB-UART bridge. The KitProg on the PSoC 5LP enumerates as a USB-UART interface and opens a COM port in the PC. This COM port is then used by the software tool to communicate commands to the BLE device. In this case, the UART pins should be assigned as follows.

Table 4-1. UART Pin Assignment for PC Software Tester

UART Pins	Pin Assigned
RX	P1_4
TX	P1_5
RTS	P1_6
CTS	P1_7

The UART for HCI communication exposes hardware flow control lines CTS and RTS. They can either be connected to the hardware control lines of the tester or CTS connected to ground for operation without hardware flow control.

If the tester is an external hardware tester (CBT), then connect any of the [RS232 voltage translators](#) to header J5 on the BLE Pioneer Kit. The UART pins should be assigned as follows.

Table 4-2. UART Pin Assignment for RS232 Voltage Translator

UART Pins	Pin Assigned
RX	P0_0
TX	P0_1
RTS	P0_2
CTS	P0_3

4.6.3 Verify Output

1. Connect the BLE Pioneer Kit through the USB connector J13.
2. Program the BLE Pioneer Kit with the PSoC_4_BLE_DTM or PSoC_BLE_DTM project, depending on the module used (PSoC 4 BLE or PSoC BLE), as described in [Using Example Projects on page 41](#). Programming should complete successfully.
3. Connect the Serial link, UART or RS232 to the tester.
4. On the software tool for tester, configure the UART communication with the correct COM port and baud rate, as set in the BLE Component.
5. Start the test. The tool will generate the report after the end of the test. This depends on the tester/tool being used.

5. Hardware



This chapter describes the contents of the BLE Pioneer Kit hardware and its different blocks, such as the power block, USB connection, Arduino-compatible headers, module connectors, and CapSense slider.

5.1 BLE Pioneer Baseboard

5.1.1 PSoC 5LP

An onboard PSoC 5LP contains KitProg which is used to program and debug the BLE device. The PSoC 5LP connects to the USB port of the PC through a USB Mini-B connector and to the SWD interface of the BLE device. PSoC 5LP is a true system-level solution providing MCU, memory, analog, and digital peripheral functions in a single chip. The CY8C58LPxx family offers a modern method of signal acquisition, signal processing, and control with high accuracy, high bandwidth, and high flexibility. The analog capability spans the range from thermocouples (near DC voltages) to ultrasonic signals.

For more information, visit the [PSoC 5LP web page](#).

See [Serial Interconnection between KitProg and Module on page 101](#) for more details.

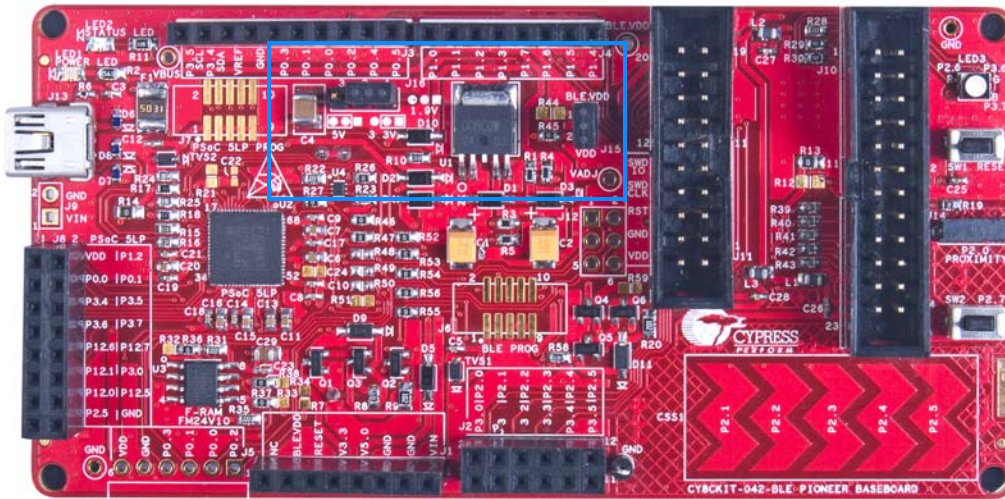
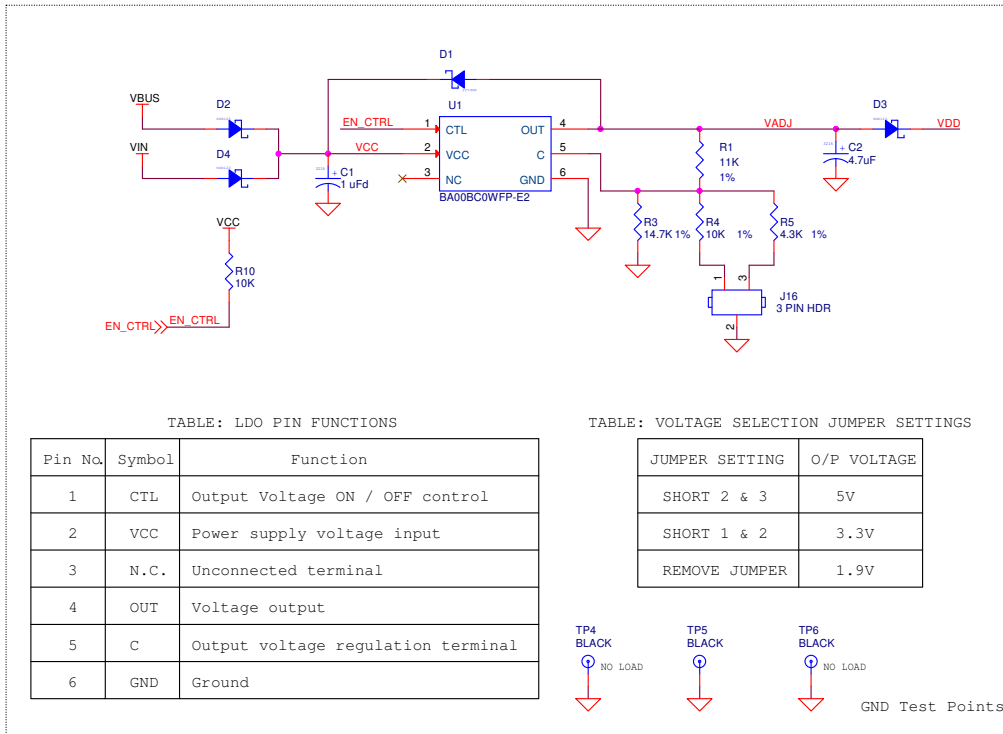
5.1.2 Power System

The power supply system on BLE Pioneer Baseboard is versatile, allowing the input supply to come from the following sources:

- 5-V power from onboard USB connector
- 5-V to 12-V VIN power from Arduino power header (J1)
- 3-V from CR2032 coin cell

An adjustable LDO is used to output three different voltage levels (1.9 V, 3.3 V, and 5 V) to power the module. These voltages are selected with the J16 jumper, as shown in Figure 5-1.

Figure 5-1. Schematics and Board Highlight of LDO and Power Selection Jumper

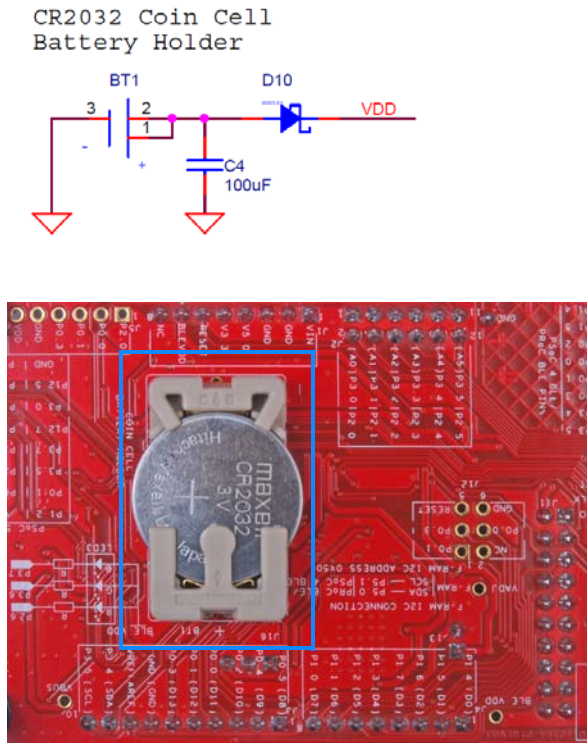


The input to the LDO can come from either the USB, the VIN pin in the Arduino header J1 or header J9.

Note: The typical dropout voltage of the selected LDO is 0.3 V at 500-mA output current. This gives a minimum output of 4.6 V from the input voltage of 5 V from the VBUS. This drop also takes into account the voltage drop across the Schottky diode connected at the output of the LDO to protect against voltage applied at the output terminal of the regulator.

The BLE Pioneer Baseboard also contains a CR2032 coin cell holder to power it using a coin cell, as shown in [Figure 5-2](#).

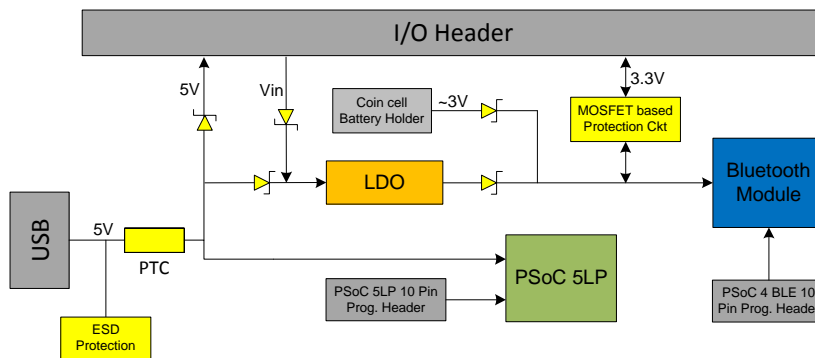
Figure 5-2. Schematics and Board Highlight of Coin Cell Holder



5.1.2.1 Protection Circuits

The power supply rail has reverse-voltage, overvoltage, short circuits, and excess current protection features, as shown in [Figure 5-3](#).

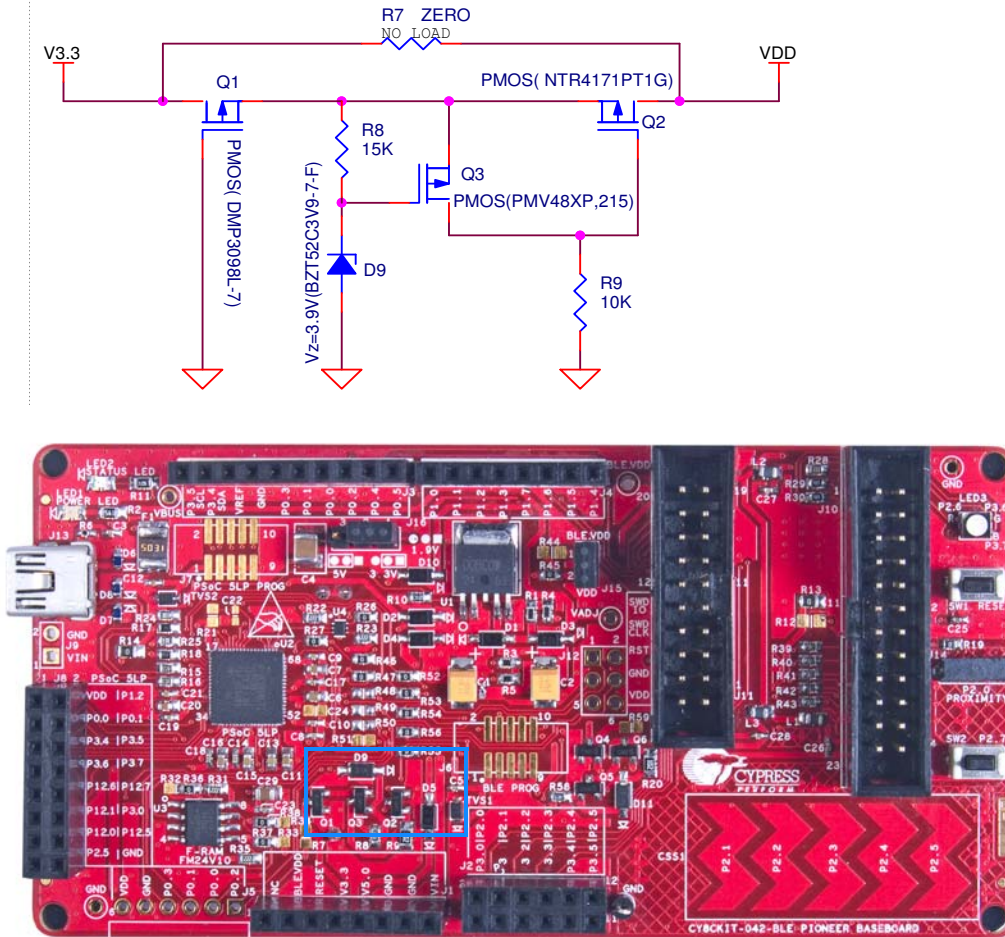
Figure 5-3. Power Supply Block Diagram With Protection Circuits



- A PTC resettable fuse is connected to protect the computer's USB ports from shorts and overcurrent.
- ORing diodes prevent damage to components when the BLE Pioneer Baseboard is powered from different voltage sources at the same time.
- ESD protection is provided for the USB Mini-B connector.

- A MOSFET-based protection circuit is provided for overvoltage and reverse-voltage protection for the 3.3-V rail from J1.5, as shown in [Figure 5-4](#).

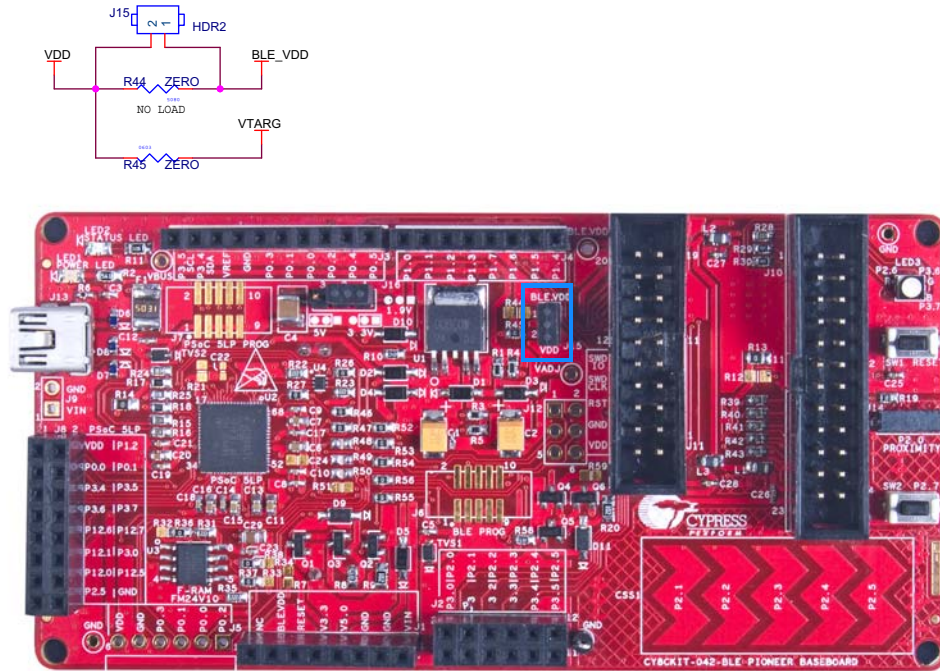
Figure 5-4. Schematics and Board Highlight of MOSFET Protection Circuit for 3.3-V rail from J1.5



5.1.2.2 Current Measurement Jumper

To demonstrate the low power consumption of PSoC 4 BLE/PRoC BLE Module, a two-pin header (J15) is populated in series with the power supply to the module. This can be used to measure current using an ammeter without the need to desolder any components from the BLE Pioneer Baseboard, as shown in Figure 5-5.

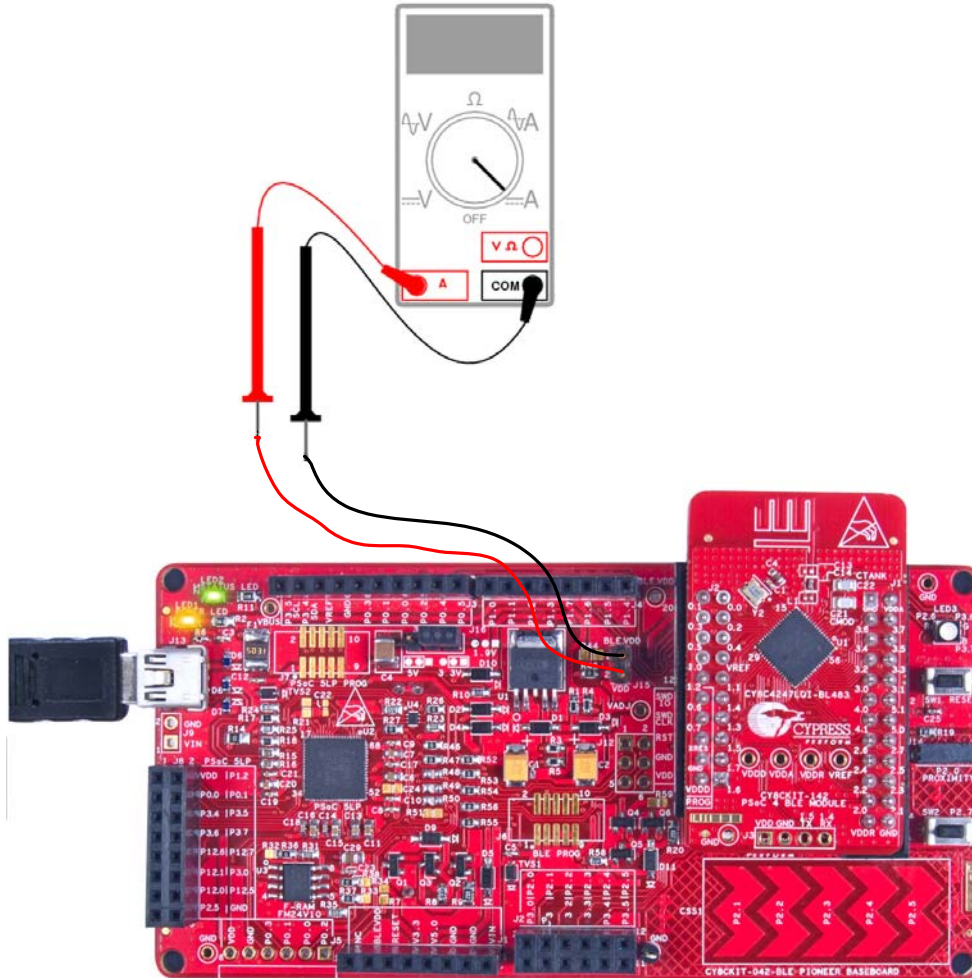
Figure 5-5. Schematics and Board Highlight of Current Measurement Jumper



The following methods are supported for measuring the current consumption of the module.

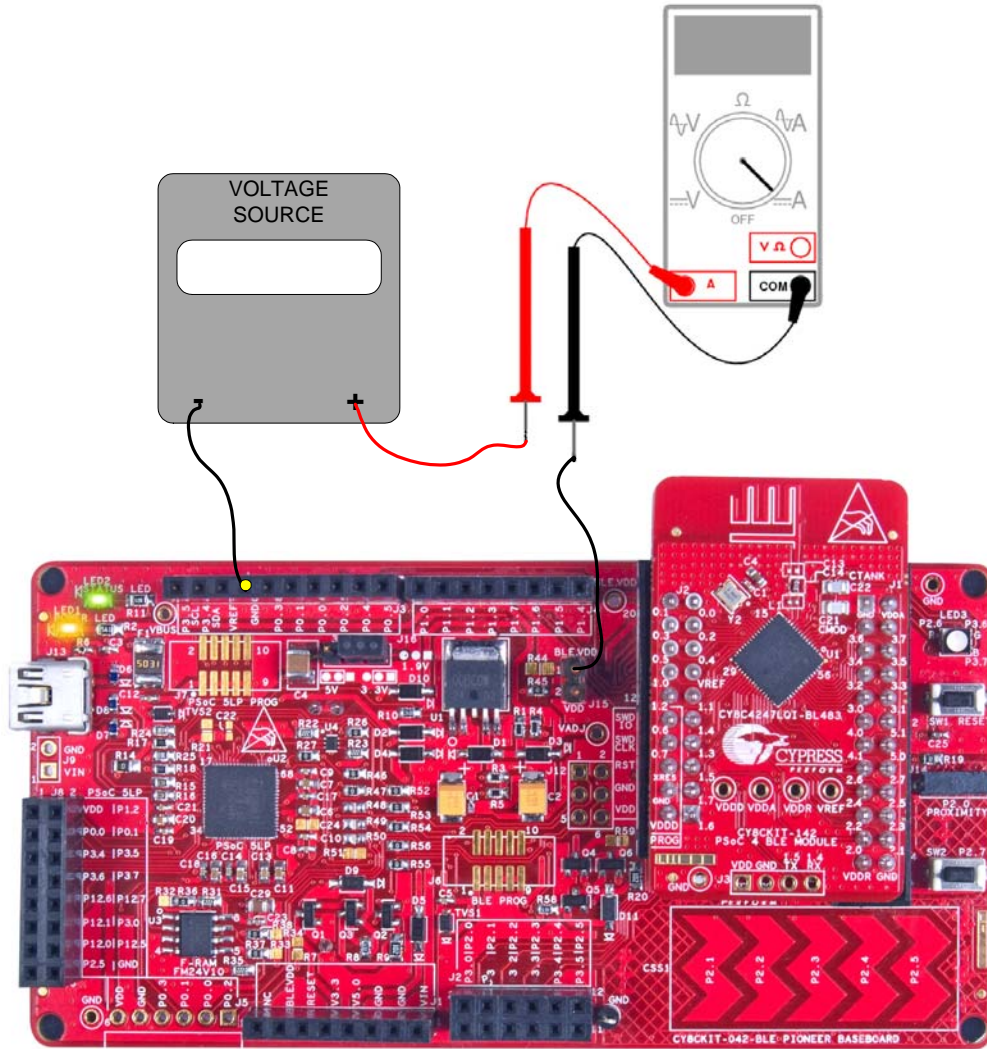
- When the BLE Pioneer Baseboard is powered through the USB port (J13), remove jumper J15 and connect an ammeter, as shown in [Figure 5-6](#).

Figure 5-6. Current Measurement when Powered from USB Port



- When the BLE Pioneer Baseboard is powered from an external voltage supply, remove the USB cable from J13. Connect the positive terminal of the external voltage supply to the positive terminal of the ammeter and the negative terminal of the ammeter to the upper pin of J15. Connect the negative terminal of the external voltage supply to and GND pin on board. [Figure 5-7](#) shows the required connections.

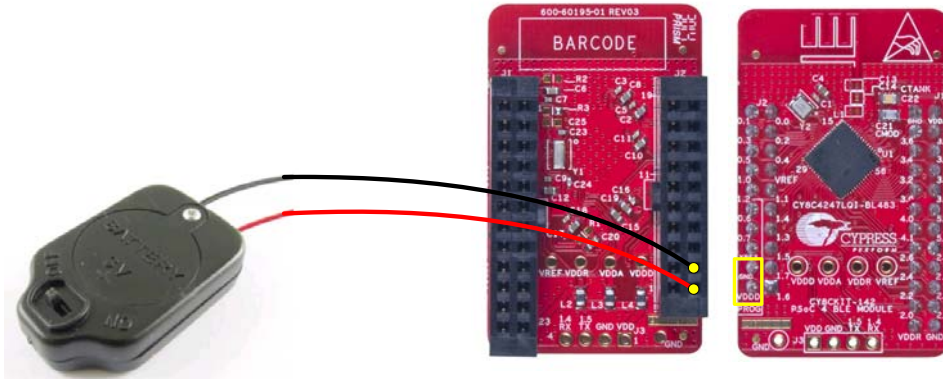
Figure 5-7. Current Measurement when Powered Separately



To measure the power consumption of only module with coin cell, connect the coin cell directly to the modules, as shown in [Figure 5-8](#). The BLE Pioneer Baseboard is designed with additional circuits to protect the BLE device and the F-RAM in Arduino environment. Note that power consumption measurements on the BLE Pioneer Baseboard will also include the power consumed by these additional circuits.

Connect the positive terminal of the coin cell to pin J2.2 and negative terminal to pin J2.4 using wires.

Figure 5-8. Powering the module using a Coin Cell



5.1.3 Programming Interface

The BLE Pioneer Kit allows you to program and debug the PSoC 4 BLE/PROc BLE in two ways:

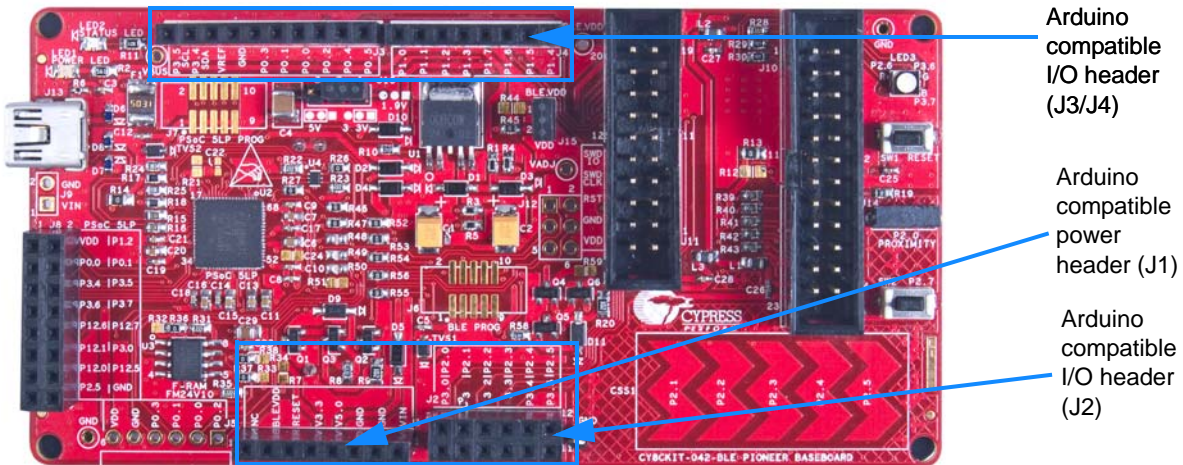
- Using the onboard KitProg
- Using a CY8CKIT-002 MiniProg3 Programmer and Debugger

5.1.4 Expansion Connectors

5.1.4.1 Arduino Compatible Headers (J1, J2, J3, J4, and J12-unpopulated)

The BLE Pioneer Kit has five Arduino compatible headers: J1, J2, J3, J4, and J12, as shown in [Figure 5-9](#). You can develop applications based on the Arduino shield's hardware.

Figure 5-9. Arduino Headers



The J1 header contains I/O pins for reset, I/O reference voltage (IOREF), and power supply line. The J2 header is an analog port that contains I/O pins for SAR ADC, comparator, and Op-amp. The J3 header is primarily a digital port that contains I/O pins for PWM, I²C, SPI, and analog reference. The J4 header is also a digital port that contains I/O pins for UART and PWM. The J12 header is an Arduino ICSP compatible header for the SPI interface and is not populated. Refer to the “No Load Components” section of [Bill of Materials \(BOM\) on page 133](#) for the header part number.

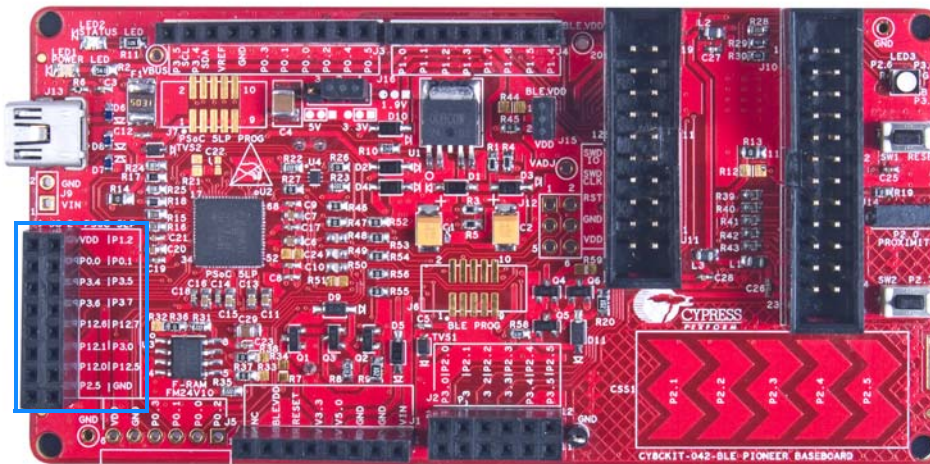
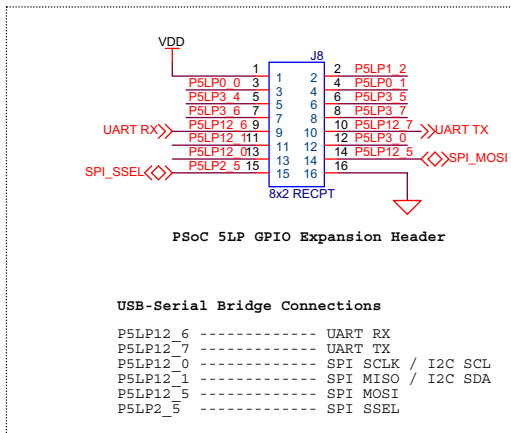
Note: Take care when powering the Arduino shields via Arduino-compatible power header (J1). The V3.3 pin will output 5 V when the board is powered from USB/VIN and the system power supply jumper (J16) is set to 5 V operation.

5.1.4.3 PSoC 5LP GPIO Header (J8)

An 8x2 header is provided on the BLE Pioneer Baseboard to pull out several pins of PSoC 5LP to support advanced features such as a low-speed oscilloscope and a low-speed digital logic analyzer (see Figure 5-11). This header also contains the USB-Serial interface pins that can be used when these pins are not accessible on the Arduino headers because a shield is connected.

Note: You can use PSoC 5LP for your own custom firmware.

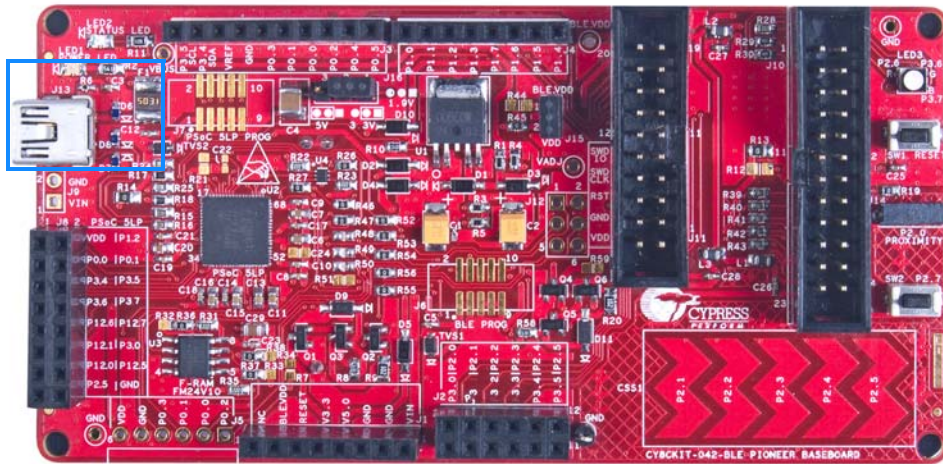
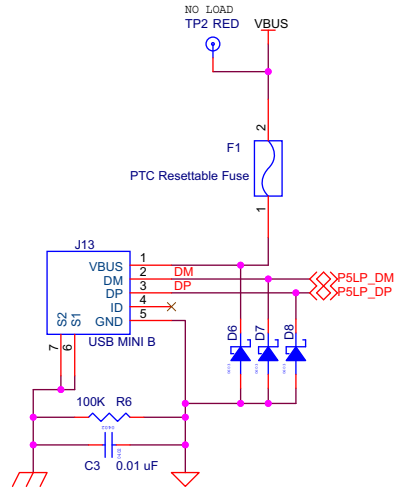
Figure 5-11. Schematics and Board Highlight of PSoC 5LP GPIO Expansion Header



5.1.5 USB Mini-B Connector

The PSoC 5LP connects to the USB port of a PC through a Mini-B connector (see [Figure 5-12](#)), which can also be used to power the BLE Pioneer Baseboard. A resettable polyfuse is used to protect the computer's USB ports from shorts and overcurrent. If more than 500 mA is drawn from the USB port, the fuse will automatically break the connection until the short or overload is removed.

Figure 5-12. Schematics and Board Highlight of USB Mini-B Connector

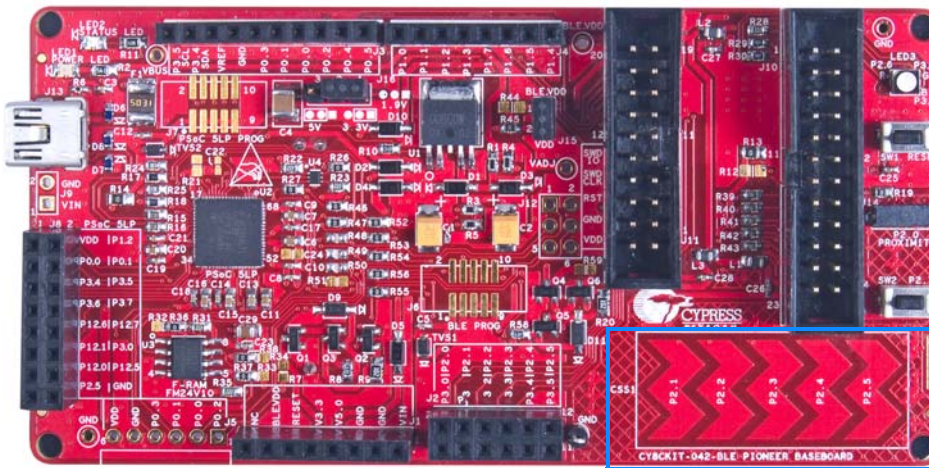


5.1.6 CapSense Circuit

5.1.6.1 CapSense Slider

The BLE Pioneer Kit has a five-segment linear capacitive touch slider, which is connected to the PSoC 4 BLE/PROC BLE Module pins (see [Figure 5-13](#)). The CMOD and CTANK capacitors are required for CapSense functionality and are provided on the modules (see [Module Board on page 103](#)). A 2.2-nF capacitor is present on the CMOD pin, P4[0], for CapSense operation. BLE Pioneer Kit also supports CapSense designs that enable waterproofing. The connection of the shield to the pin or to ground is made by resistors R12 and R13, respectively. By default, R13 is mounted on the BLE Pioneer Baseboard, which connects the shield to ground. Populate R12 and remove R13 when evaluating waterproofing designs, which will connect the shield to the designated pin, P1[6].

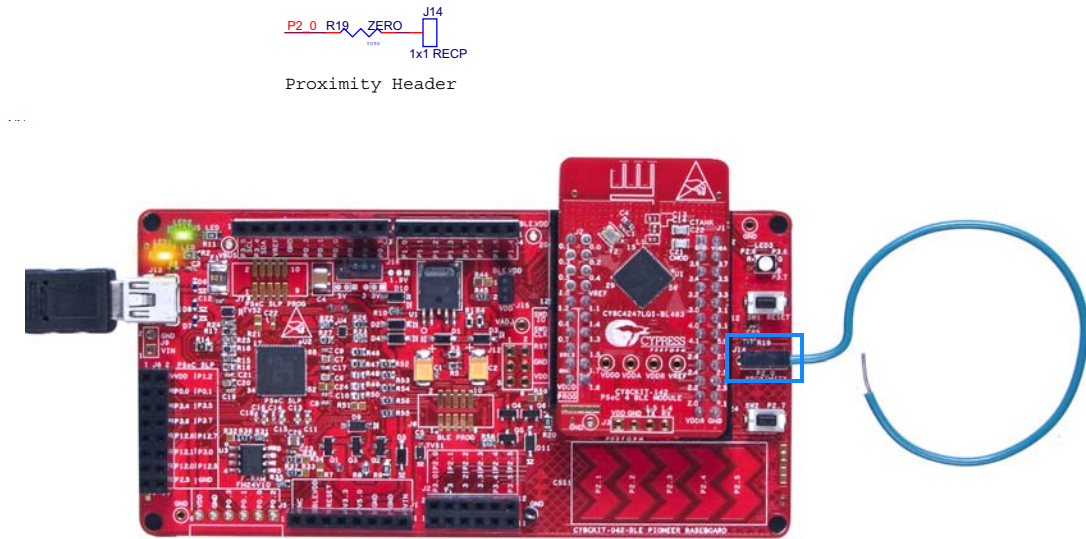
Figure 5-13. Schematics and Board Highlight of CapSense Slider and Shield Setting



5.1.6.2 Proximity Header

The BLE Pioneer Baseboard contains a header (J14) for CapSense proximity wire connection (see [Figure 5-14](#)).

Figure 5-14. Schematics and Board Highlight of Proximity Header



5.1.7 BLE Pioneer Baseboard LEDs

The BLE Pioneer Baseboard has three LEDs. A green LED (LED2) indicates the status of the programmer. An amber LED (LED1) indicates the status of power supplied to the board. The BLE Pioneer Kit also has a general-purpose tricolor LED (LED3) for user applications. These are connected to P2_6 (Red LED), P3_6 (Green LED) and P3_7 (Blue LED). [Figure 5-15](#) and [Figure 5-16](#) show the schematics of these LEDs.

Figure 5-15. Schematics of Status and Power LED

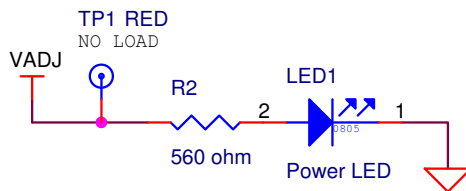
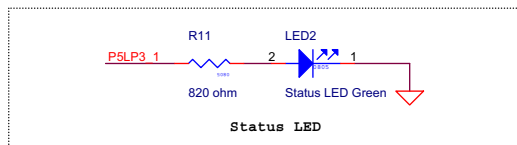
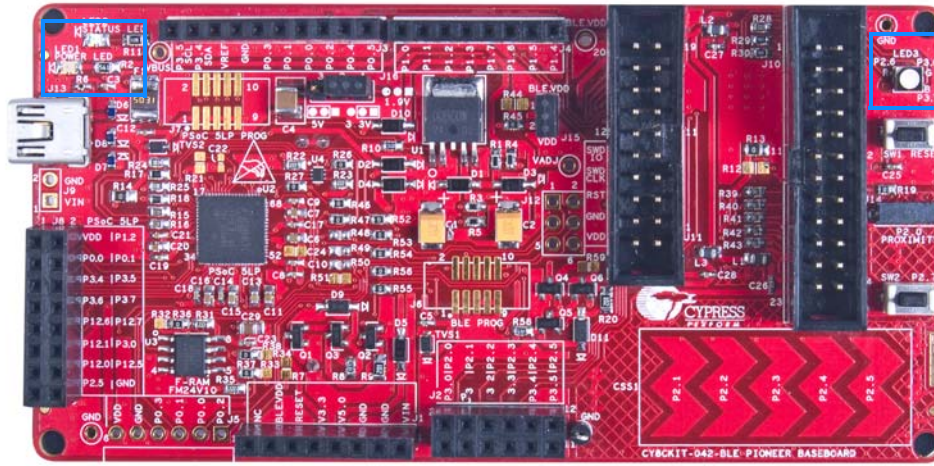
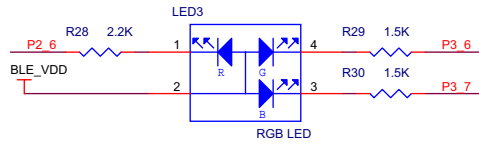


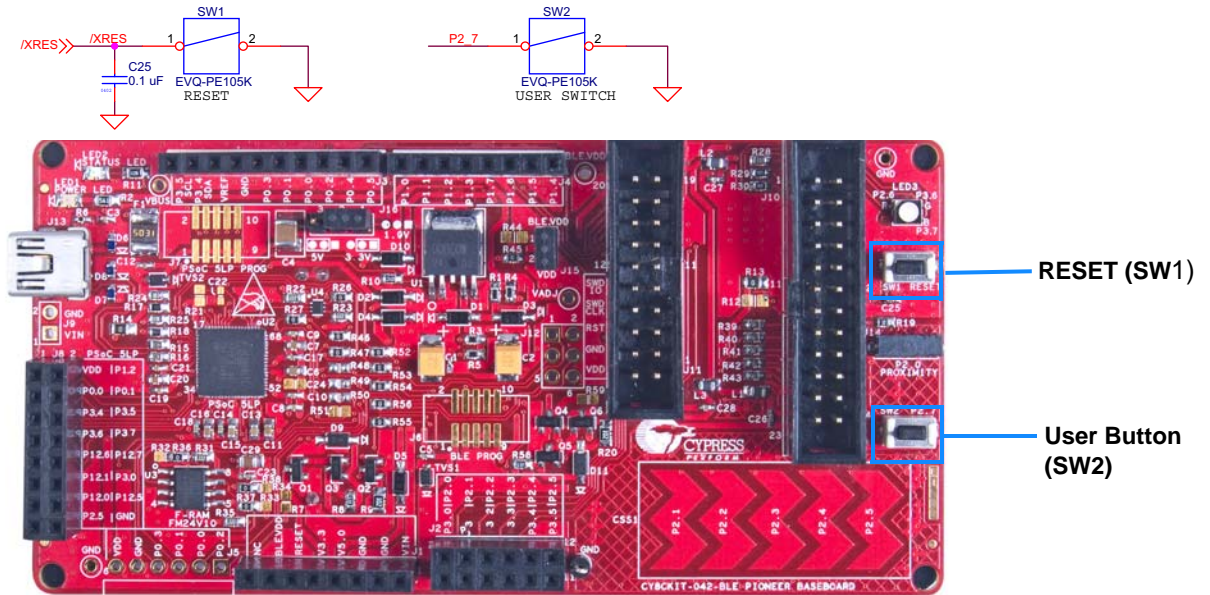
Figure 5-16. Schematics and Board Highlight of RGB LED



5.1.8 Push Buttons

The BLE Pioneer Baseboard contains a reset push button and a user push button, as shown in [Figure 5-17](#). The reset button is connected to the XRES pin of BLE device and is used to reset it. The user button is connected to P2[7] of the BLE device. Both the push buttons connect to ground on activation (active low).

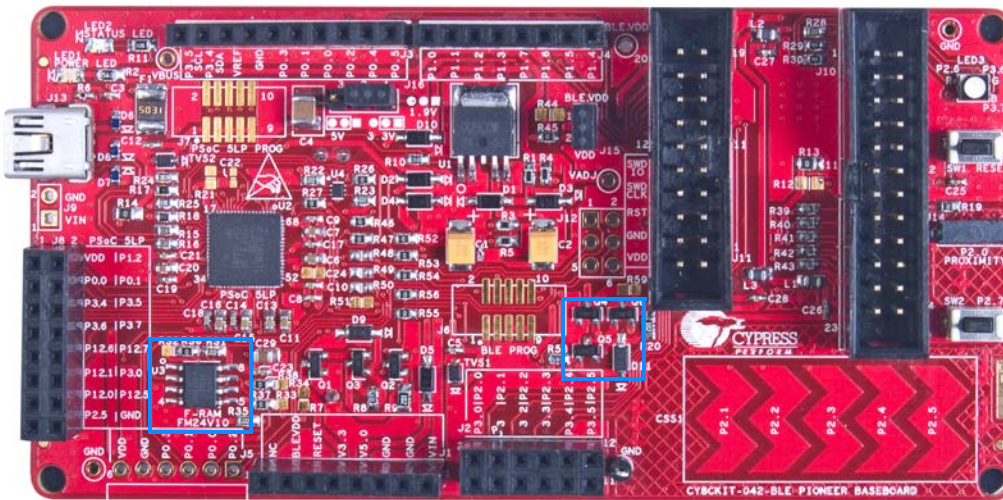
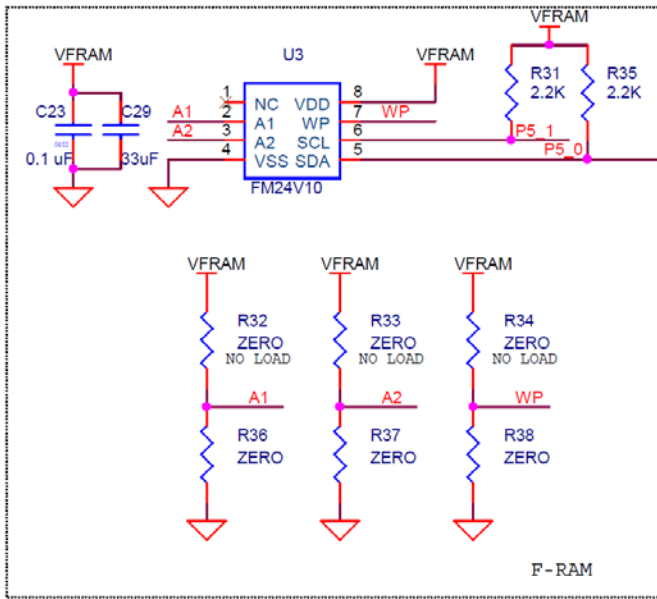
Figure 5-17. Schematics and Board Highlight of Reset Button and User Push Button



5.1.9 Cypress Ferroelectric RAM (F-RAM)

The BLE Pioneer Baseboard contains an F-RAM device (FM24V10-G) (see [Figure 5-18](#)) that can be accessed through I²C lines P5[0] and P5[1] of the PSoC 4 BLE/PROC BLE Module. The F-RAM is 1-Mbit (128 KB) with an I²C speed up to 1 Mbps. The I²C slave address of the F-RAM device is seven bits wide, and the LSB two bits are configurable through physical pins and are hardwired to 00 on the board. By default, the address of the F-RAM device used on the BLE Pioneer Baseboard is 0x50. This address can be modified by changing the R32/R36 and R33/R37 pairs. The operating voltage range of the F-RAM is between 2 V and 3.6 V. To prevent the application of 5 V from the adjustable LDO regulator on the BLE Pioneer Baseboard, a MOSFET based protection circuit similar to the one used for the 3.3-V rail is connected between the output of the regulator and the VDD pin of the F-RAM. The protection circuit cuts off the power to the F-RAM when the output of the regulator is greater than 3.6 V.

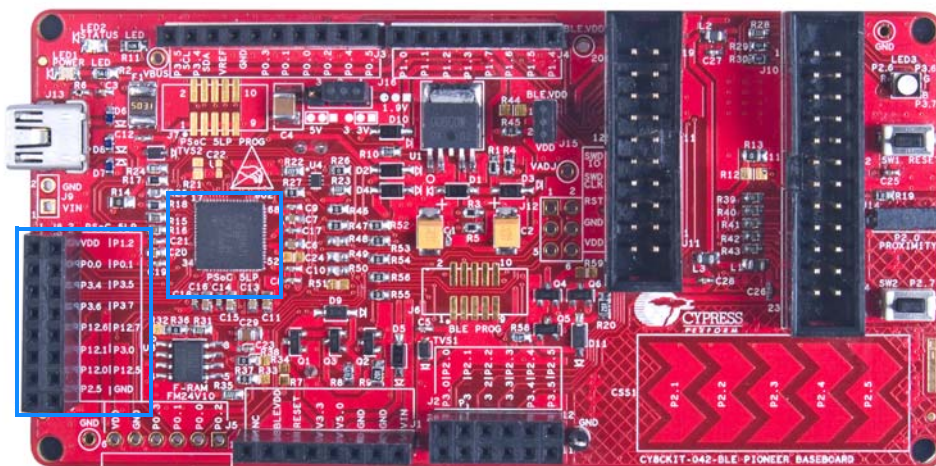
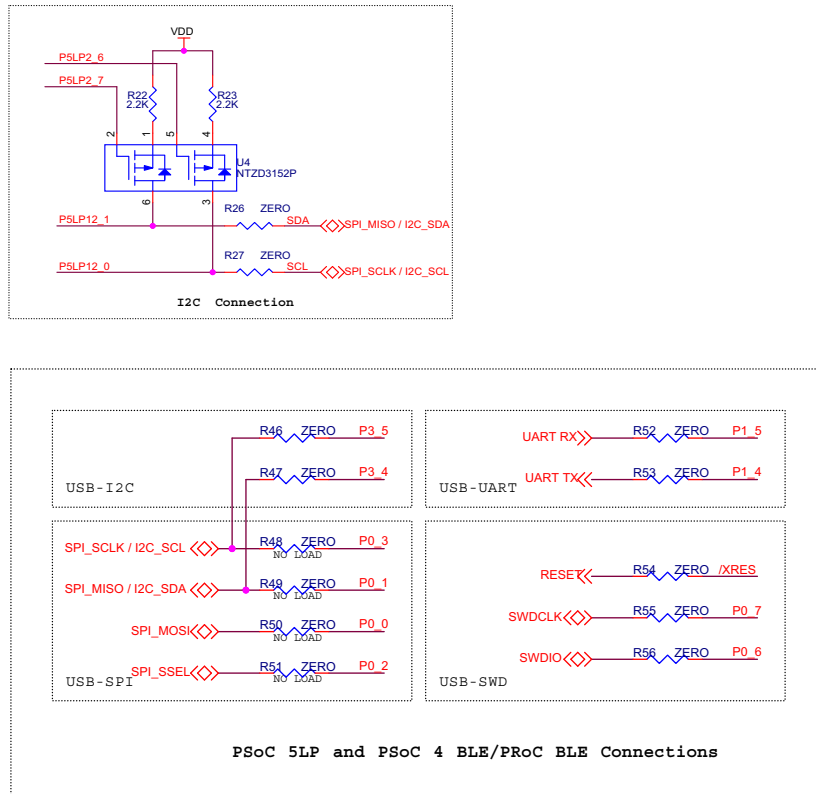
Figure 5-18. Schematics and Board Highlight of F-RAM



5.1.10 Serial Interconnection between KitProg and Module

The KitProg is also a USB-Serial interface. It supports USB-UART and USB-I²C bridges (see [Figure 5-19](#)). The pull-ups resistors on I²C bus are enabled when the protocol is selected from user interface (like Bridge Control Panel). The USB-Serial pins of the KitProg are also available on the Arduino header; therefore, it can be used to control Arduino shields with the SPI/I²C/UART interface. Refer [USB-UART Bridge on page 37](#) and [USB-I2C Bridge on page 38](#) for more information on how to use these serial interconnections.

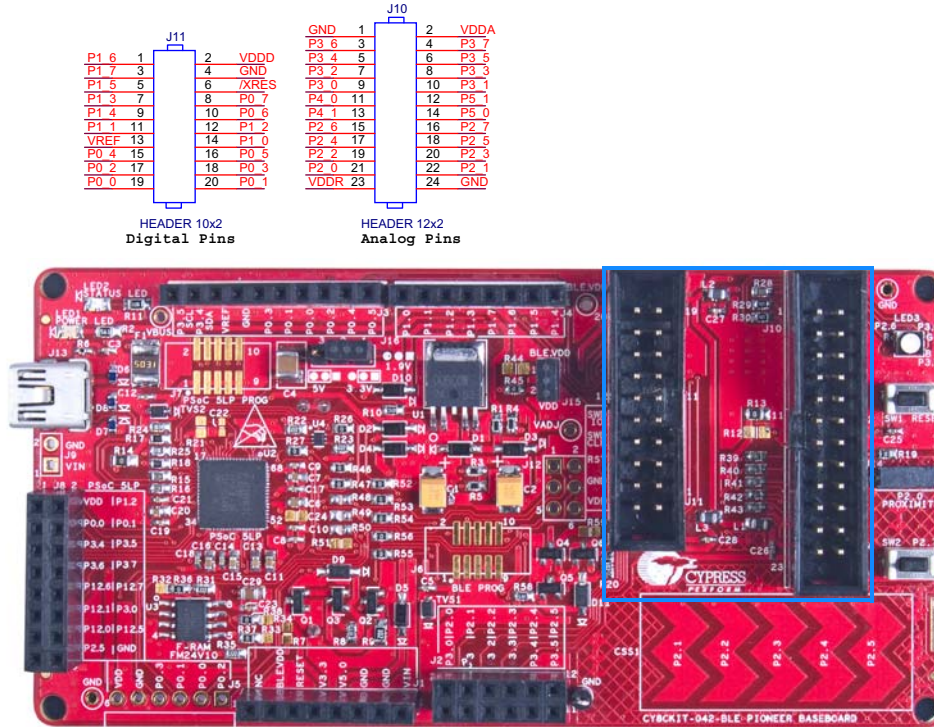
Figure 5-19. Schematics and Board Highlight of Serial Interface and I²C Pull-Up via FET



5.1.11 Module Headers

The PSoC 4 BLE and PRoC BLE Modules are connected to the BLE Pioneer Baseboard using the two (24-pin and 20-pin) module headers, as shown in [Figure 5-20](#).

Figure 5-20. Schematics and Board Highlight of Module Headers



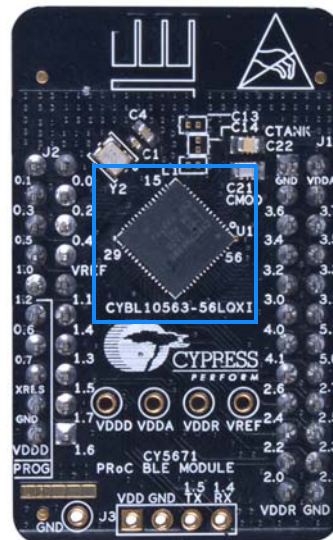
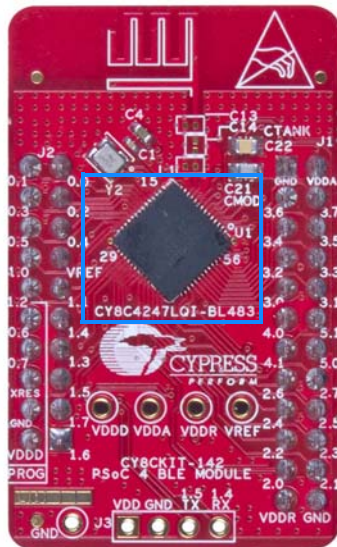
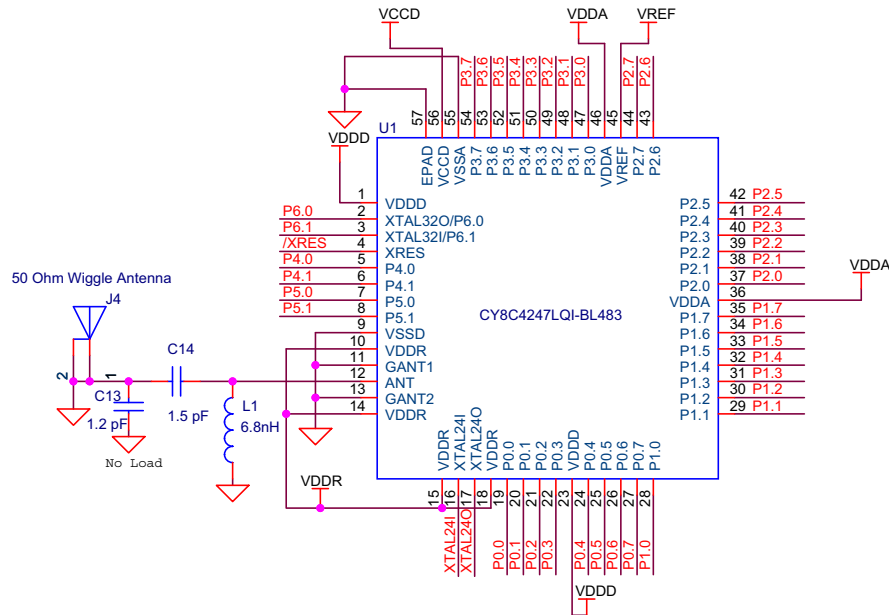
For information on how to add these on your own board refer to [Adding BLE module compatible headers on your own baseboard on page 144](#).

5.2 Module Board

5.2.1 PSoC 4 BLE or PRoC BLE Device

The PRoC BLE or PSoC 4 BLE device is the main component on the module. It provides the RF interface and analog and digital capability. The PRoC BLE or PSoC 4 BLE pins are mapped to the module headers (see Figure 5-21). For more information, refer to the [BLE web page](#).

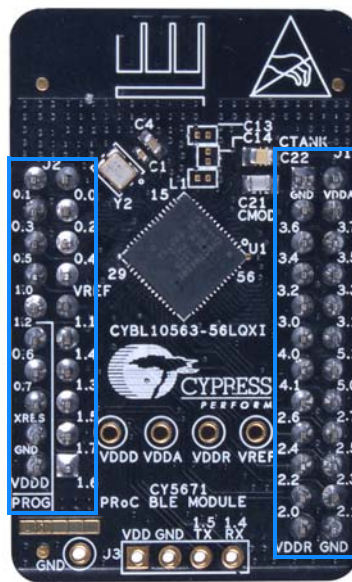
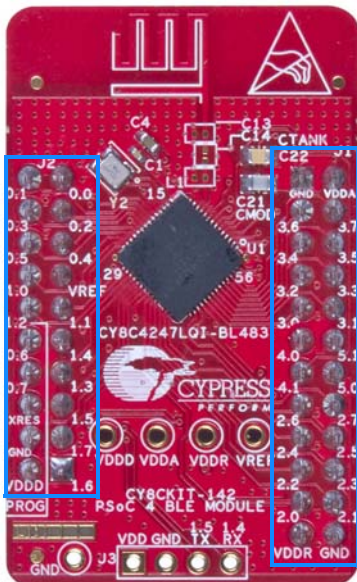
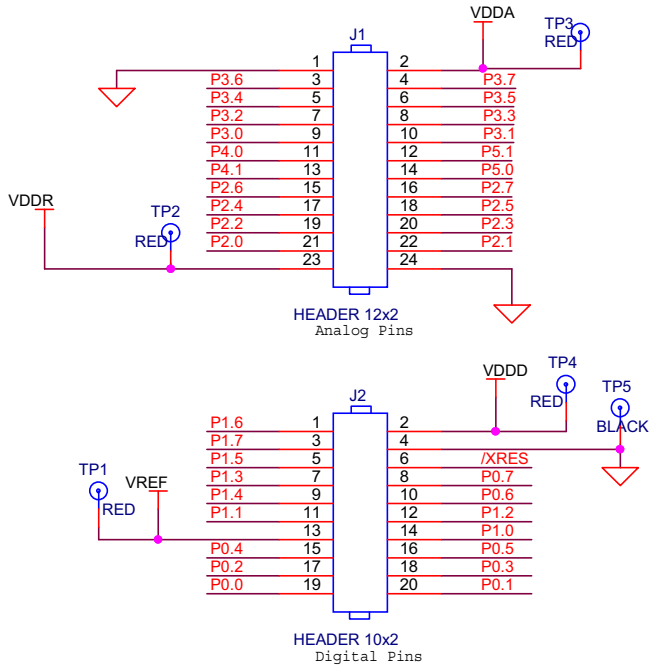
Figure 5-21. Schematics and Board Highlight of Module Headers for BLE Pins



5.2.2 Module Headers (20-Pin and 24-Pin Headers)

The PSoC 4 BLE and PSoC 4 ProC BLE Modules connect to the BLE Pioneer Baseboard using the two (20-pin and 24-pin) module headers (Figure 5-22). All GPIOs and power domains are brought out to these headers. These headers are the counterparts of the connectors in [Expansion Connectors on page 92](#).

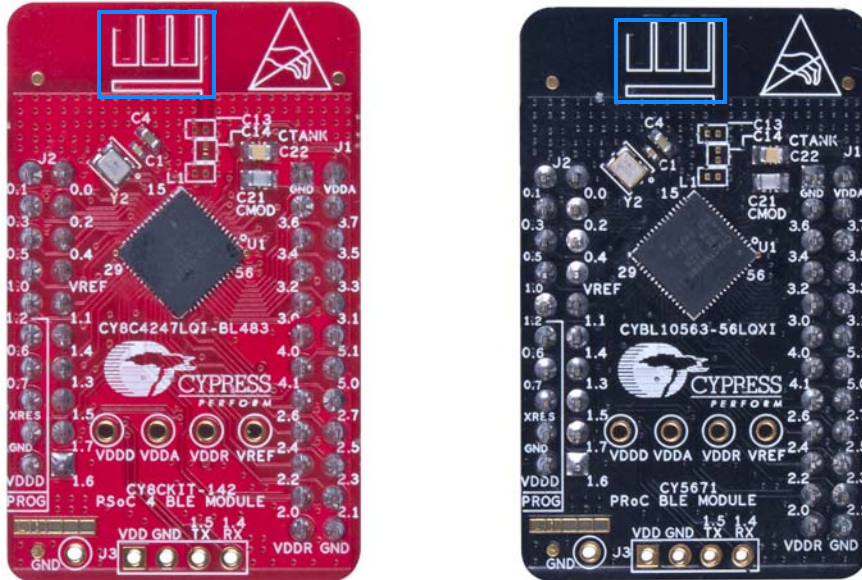
Figure 5-22. Schematics and Board Highlight of Headers



5.2.3 Wiggle Antenna

Both the modules use the wiggle antenna. Refer to the Antenna Design Guide ([AN91445](#)) for details.

Figure 5-23. Board Highlight of Wiggle Antenna

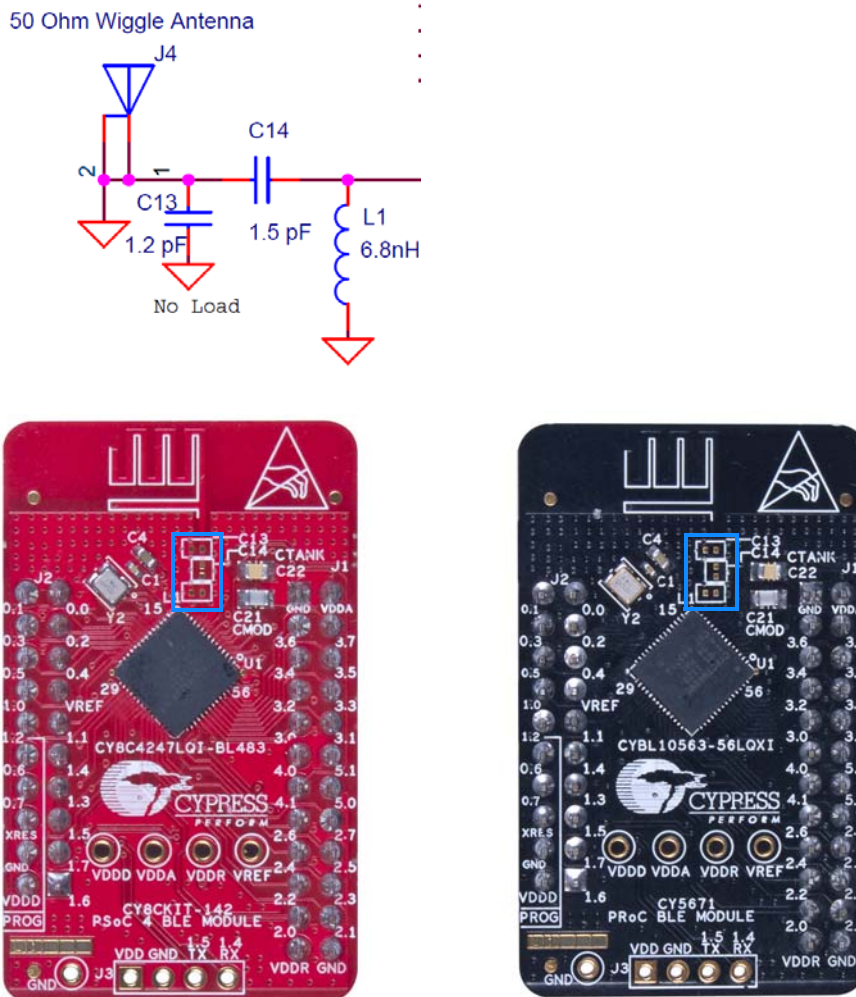


5.2.4 Antenna Matching Network

An Antenna Matching Network is required between the BLE device and the antenna to achieve optimum performance (Figure 5-24). The matching network has four main tasks:

- Transform the balanced output of the radio to an unbalanced connection to the antenna (balun).
- Transform the output impedance of the radio to a 50-ohm antenna.
- Suppress harmonics to a level below the regulations level in TX mode.
- Suppress the local oscillator (LO) leakage in RX mode.

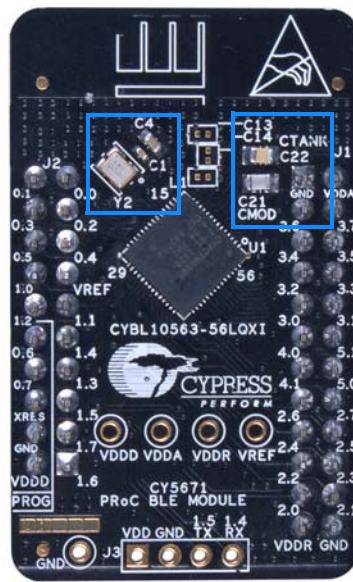
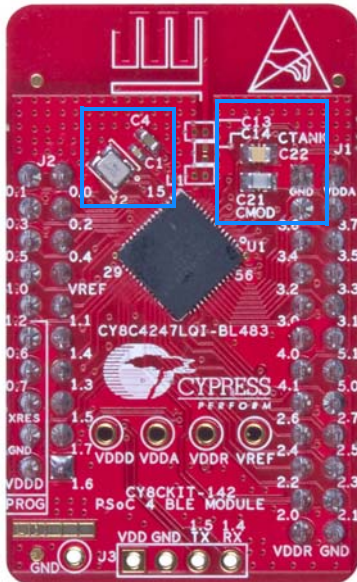
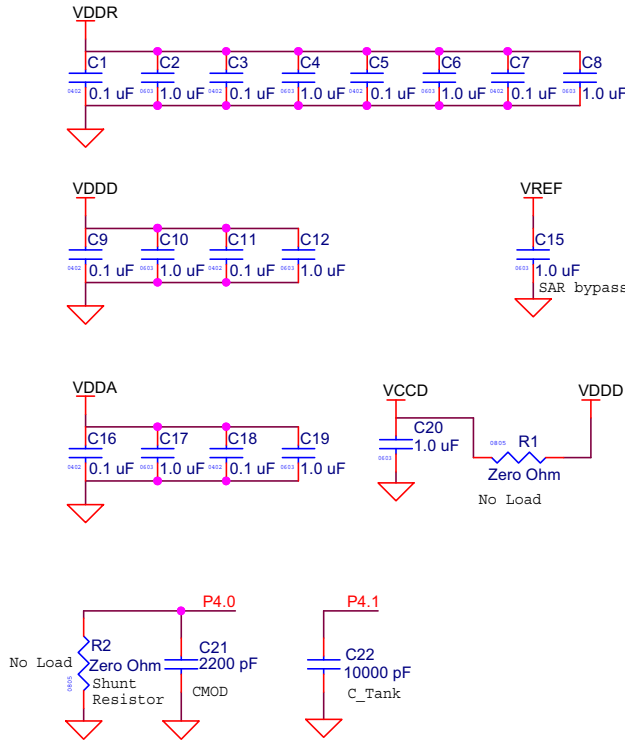
Figure 5-24. Schematics and Board Highlight of Antenna Matching Network and Antenna



5.2.5 BLE Passives

Module boards include a 24-MHz crystal and a 32-kHz crystal, the CMOD and shield (CTANK) circuit for CapSense, a SAR bypass capacitor, and adequate decoupling capacitors for all the power domains, as shown in Figure 5-25.

Figure 5-25. Schematics and Board Highlight of External Crystal, CMOD, CTANK, Decaps, Jumpers





5.2.6 Test Points

All power domains are brought out as test points for easy probing.

5.3 BLE Dongle Board

See [PSoC 4 BLE or PRoC BLE Device](#) on page 103 for Schematics of PRoC BLE pins.

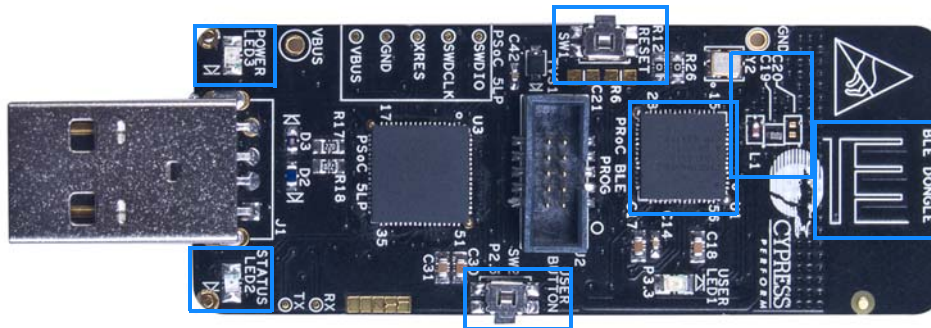
See [Wiggle Antenna](#) on page 105 for Schematics of Wiggle Antenna.

See [Antenna Matching Network](#) on page 106 for Schematics of Antenna Matching Network.

See [BLE Pioneer Baseboard LEDs](#) on page 97 for Schematics of Power and Status LED.

See [Push Buttons](#) on page 99 for Schematics of Push Buttons.

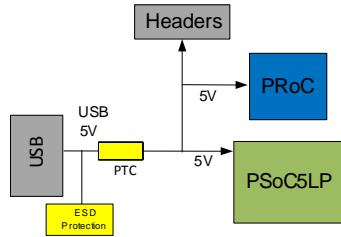
Figure 5-26. Board Highlight



5.3.1 Power System

The BLE Dongle is powered directly using 5 V from the USB port, as shown in [Figure 5-27](#).

Figure 5-27. Power Supply Block Diagram With Protection Circuits



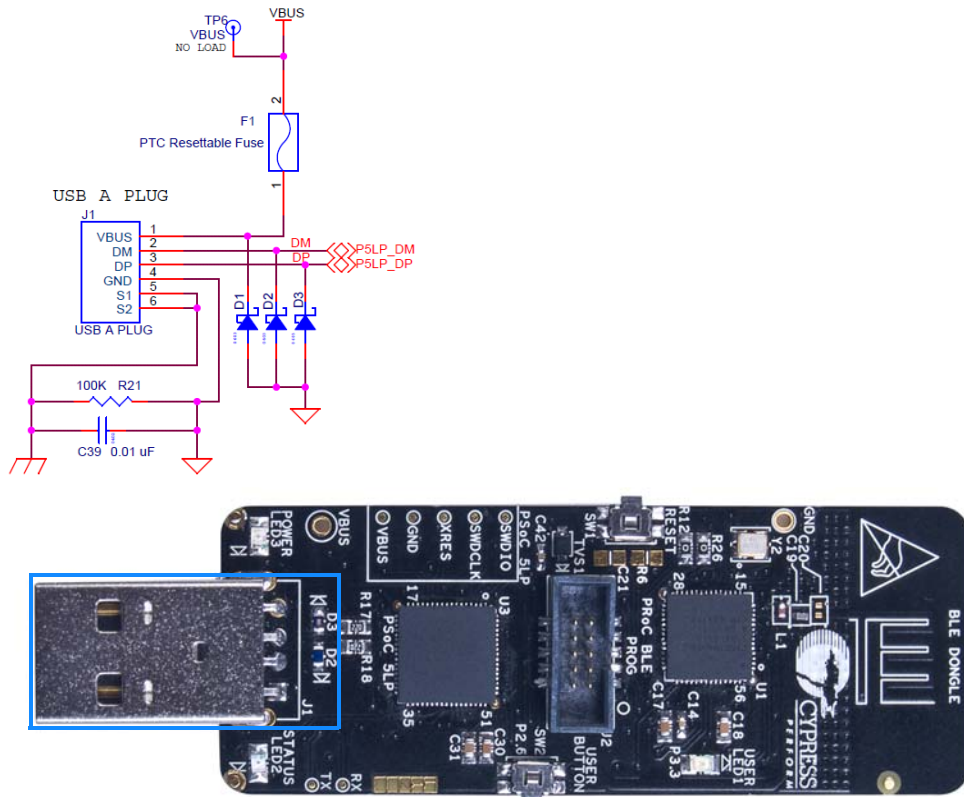
5.3.1.1 Protection Circuits

The PTC resettable fuse is connected to protect the computer's USB ports from shorts and overcurrent.

5.3.2 USB Type-A Plug

The KitProg on BLE Dongle connects to the USB port of a PC through a USB Type-A plug ([Figure 5-28](#)). The BLE Dongle is powered using the same plug. A resettable polyfuse is used to protect the computer's USB ports from shorts and overcurrent. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed. The VBUS, D+, and D– lines from the USB connector are also protected against ESD events using TVS diodes.

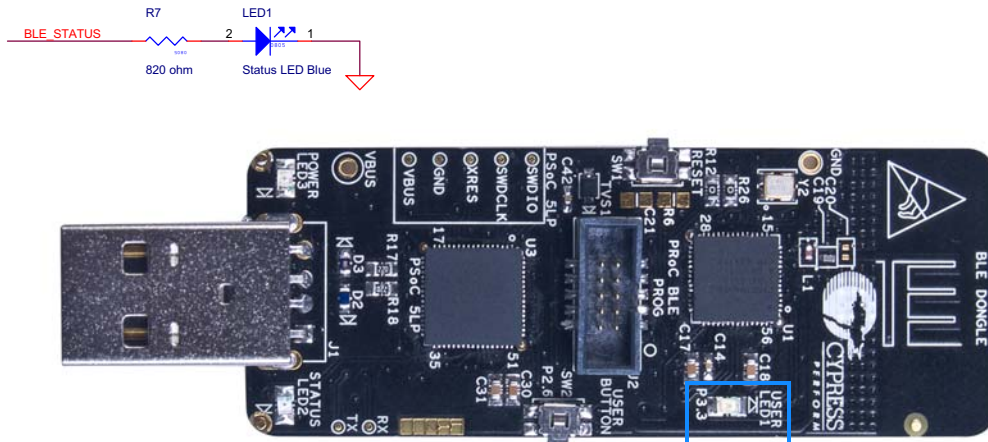
Figure 5-28. Schematics and Board Highlight of USB Type-A Plug



5.3.3 User LED

A user LED is provided to indicate status from the PSoC BLE device (Figure 5-29). It is also used to show the bind status.

Figure 5-29. Schematics and Board Highlight of User LED



6. Advanced Topics



This chapter describes advanced features of the BLE Pioneer Kit as well as the corresponding projects. It can be used as reference to exploit these features for other applications, according to project requirements.

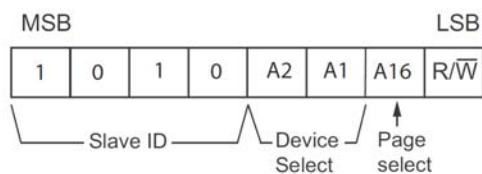
6.1 Using FM24V10 F-RAM

The BLE Pioneer Baseboard has an onboard ferroelectric RAM chip that can hold up to 1 Mb of data. The chip provides an I²C communication interface for data access. It is hardwired to the I²C lines (P3_4 and P3_5). Because the F-RAM device is an I²C slave, it can be accessed or shared among various I²C masters on the same line. For more details on the F-RAM device, refer to the [device datasheet](#).

6.1.1 Address Selection

The slave address of the F-RAM device consists of three parts, as shown in [Figure 6-1](#): slave ID, device select, and page select. Slave ID is an F-RAM family-specific ID located in the datasheet of the particular F-RAM device. For the device used in BLE Pioneer Baseboard (FM24V10), the slave ID is 1010b. Device select bits are set using the two physical pins A2 and A1 in the device. The setting of these two pins on the BLE Pioneer Baseboard is controlled by resistors R32/R36 (A1) and R33/R37 (A2). Because the memory location in F-RAM is divided into two pages of 64 KB each, the page select bit is used to refer to one of the two pages in which the read or write operations will take place.

Figure 6-1. F-RAM I²C Address Byte Structure



6.1.2 Write/Read Operation

The device's datasheet includes details on how to perform a write/read operation with the F-RAM. [Figure 6-2](#) and [Figure 6-3](#) provide a snapshot of the write/read packet structure as a quick reference.

Figure 6-2. F-RAM Single-Byte and Multiple-Byte Write Packet Structure

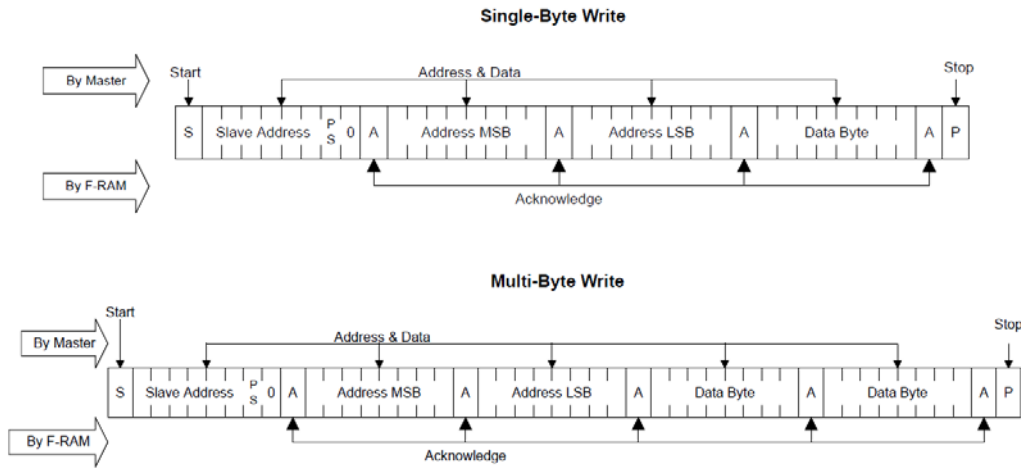
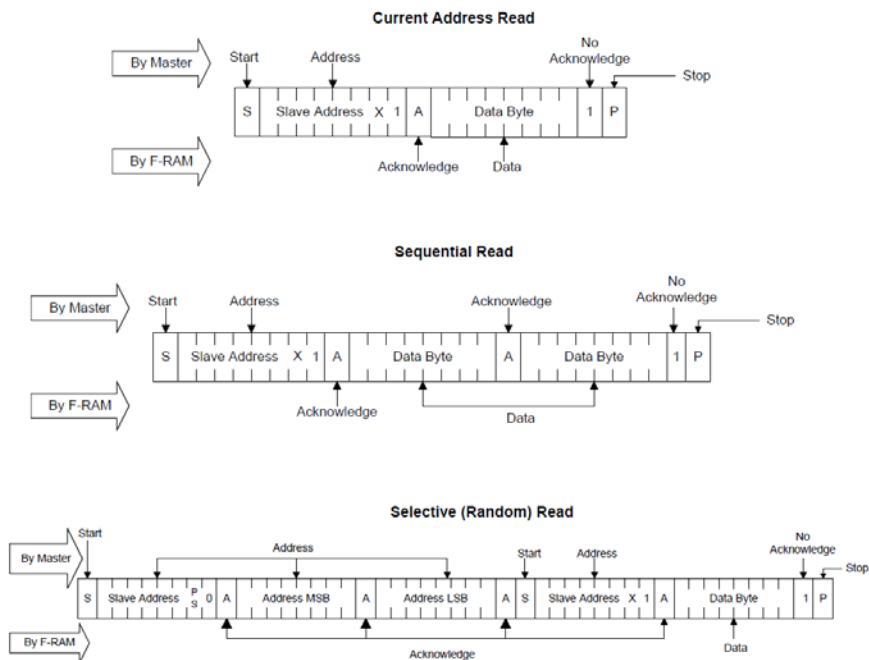


Figure 6-3. F-RAM Single-Byte and Multiple-Byte Read Packet Structure



As shown in the figures, all operations start with the slave address followed by the memory address. For write operations, the bus master sends each byte of data to the memory, and the memory generates an acknowledgement condition. For read operations, after receiving the complete slave address and memory address, the memory begins shifting data from the current address on the next clock.

6.2 CySmart Mobile Application

The CySmart mobile application is a powerful tool that allows the mobile device (iOS and Android) with BLE capability to connect to a Peripheral device and communicate with it. It supports various standard BLE services along with two custom services for CapSense and LED control. It also provides a common support for all profiles, standard or custom.

This app is free. You can download and install it for Apple iOS devices from the [App Store](#) and for Android Devices from [Play Store](#). Make sure that the mobile device being used supports BLE.

To verify the example project using the CySmart mobile app, follow these steps.

1. Plug the BLE Pioneer Kit into the PC for power, using the J13 USB connector.
2. Program the BLE Pioneer Kit with the desired BLE example project.
3. Open the CySmart mobile application on the mobile device.
4. If Bluetooth is not enabled on the device, the app will ask to enable it, as shown in [Figure 6-4](#).

Figure 6-4. Turn on Bluetooth on Device



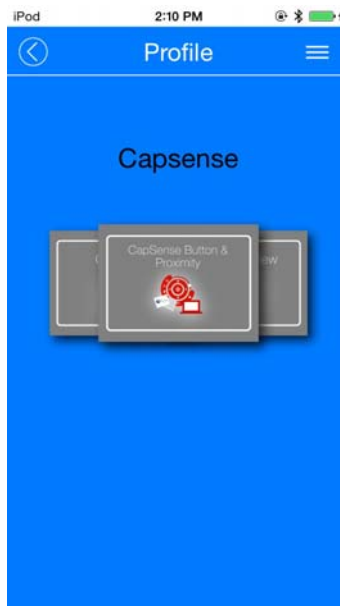
5. After Bluetooth is enabled, the app will automatically search for available Peripherals and list them, as shown in [Figure 6-5](#). Select the BLE Pioneer Kit in the list. The name displayed in the list will be the same as that set in the BLE Component.

Figure 6-5. Peripheral Connections Page



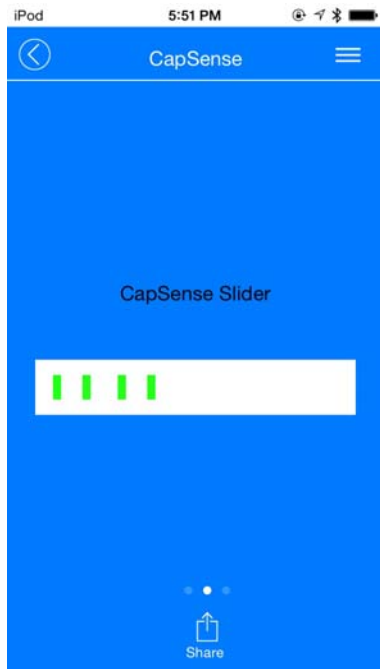
- When connected, the CySmart mobile application will list the supported profiles by the Peripherals, as shown in [Figure 6-6](#). Tap on the desired profile.

Figure 6-6. Profiles Page



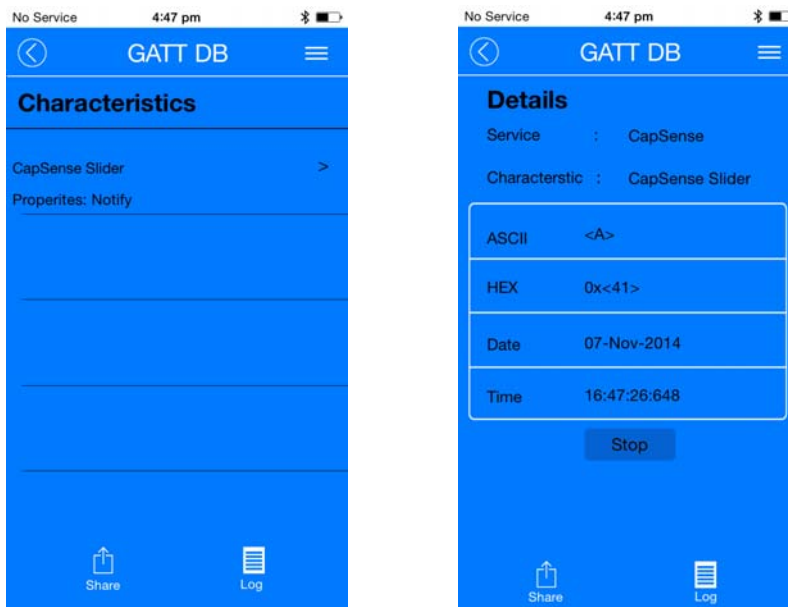
- Depending on the type of profile chosen, the CySmart mobile application will display options for the profile. [Figure 6-7](#) shows an example for the CapSense slider custom profile, where swiping a finger on the CapSense slider of the BLE Pioneer Kit is reflected in the CySmart mobile application. See [BLE Pioneer Baseboard on page 85](#).

Figure 6-7. CapSense Slider GUI



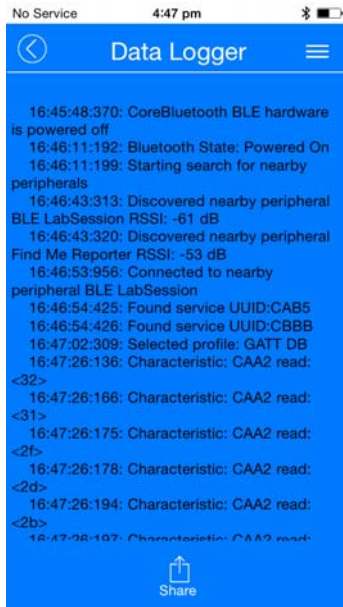
8. To go to a different service, go back to the service page in the GUI.
9. To connect to a new Peripheral, go back to home page and swipe the screen below to scan for devices.
10. To transfer data/notifications through any other profile that is not listed on the Profiles page after connecting to the peripheral, go to the **GATT DB** option on the Profiles page. The GATT DB allows you to access the services and characteristics of a profile directly, as shown in Figure 6-8, and to modify or receive values through BLE.

Figure 6-8. GATT DB GUI for Characteristics



The **Data Logger** option provides a textual form of all the events that has happened with a particular Peripheral device, including scanning and connection.

Figure 6-9. Data Logger

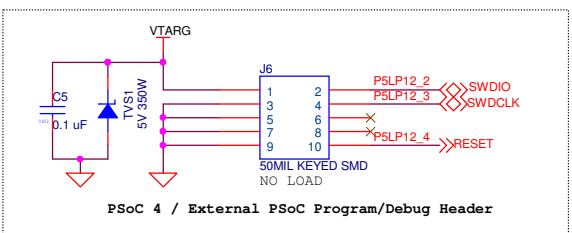
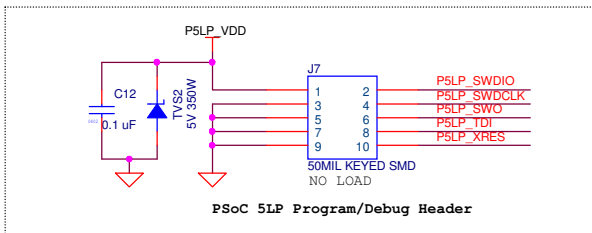
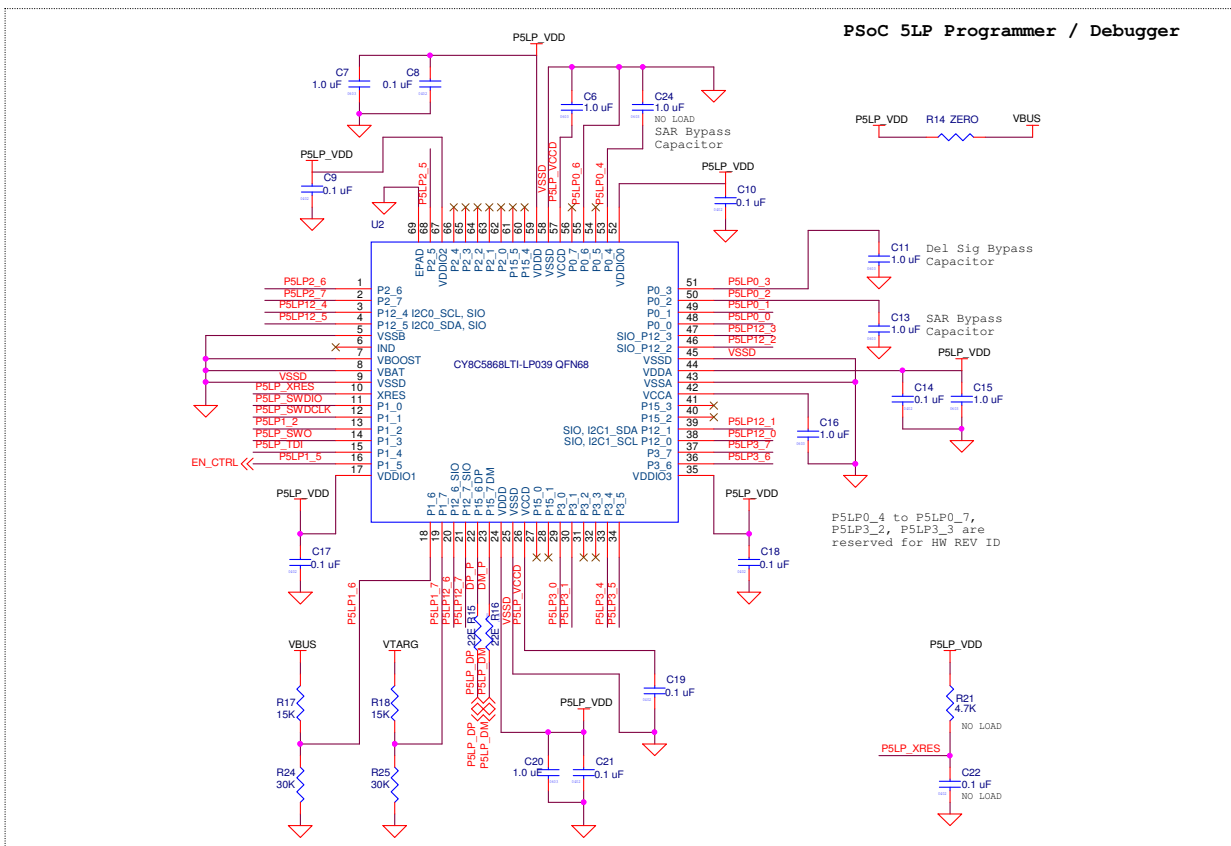


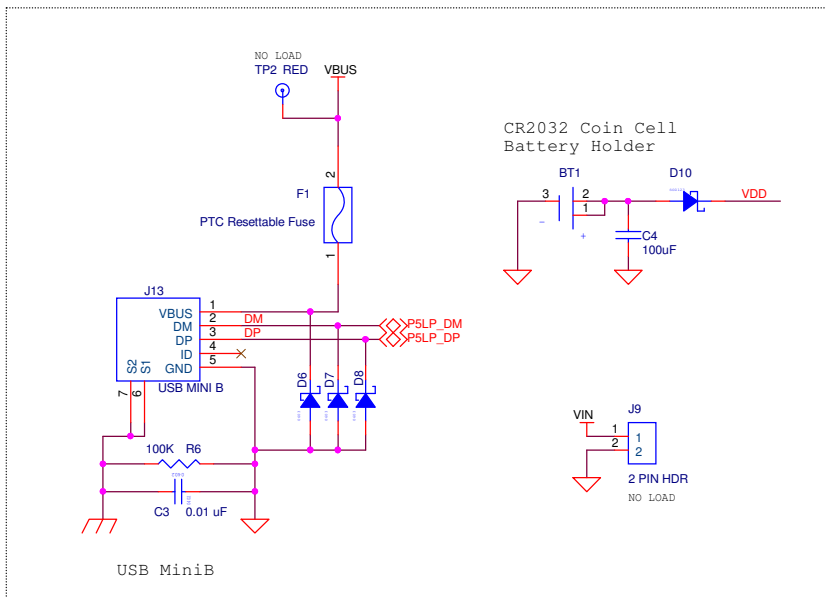
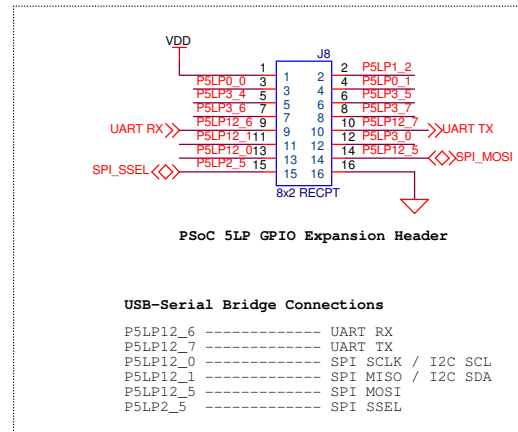
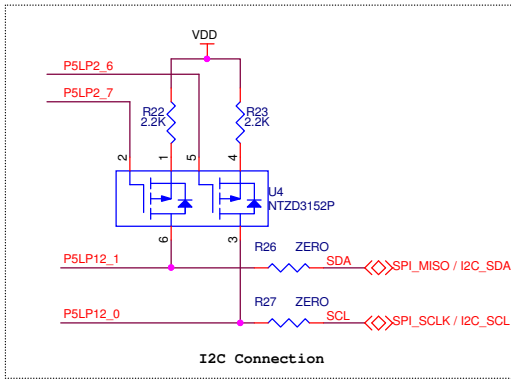
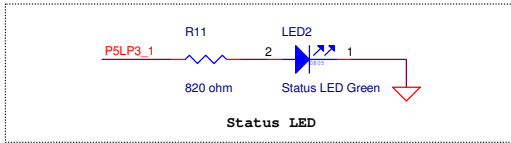
A. Appendix

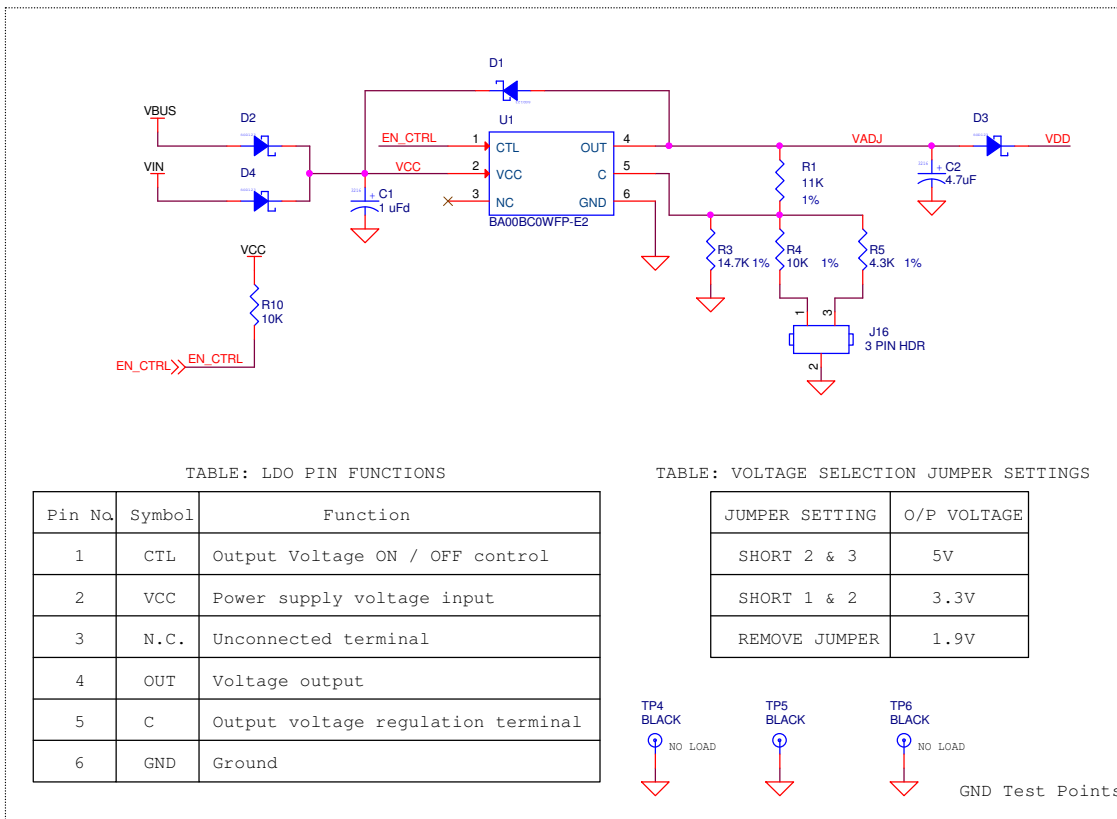
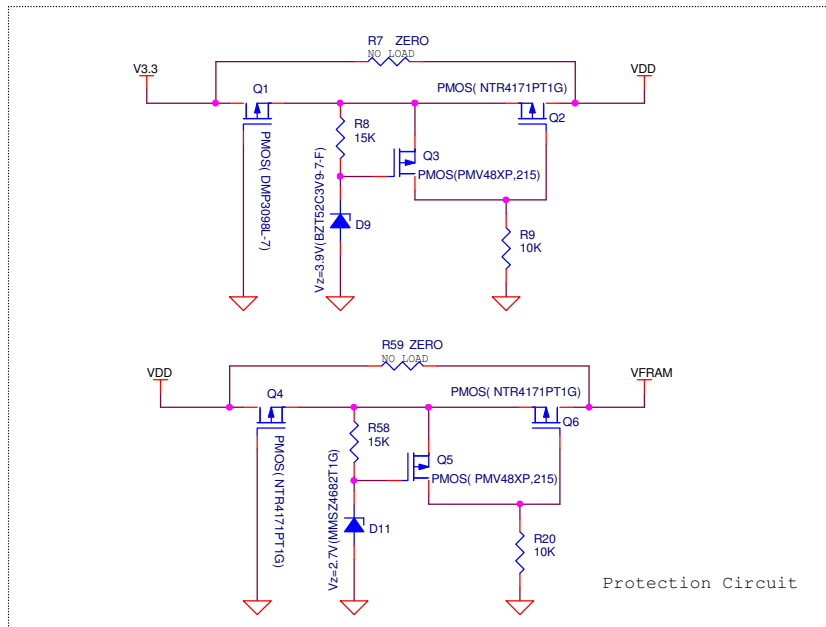


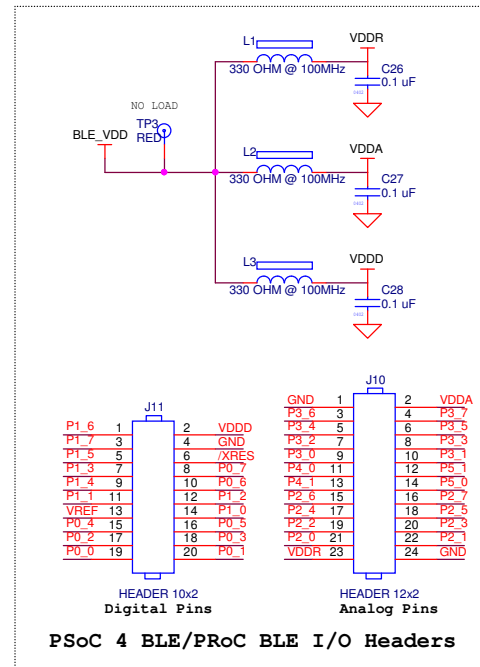
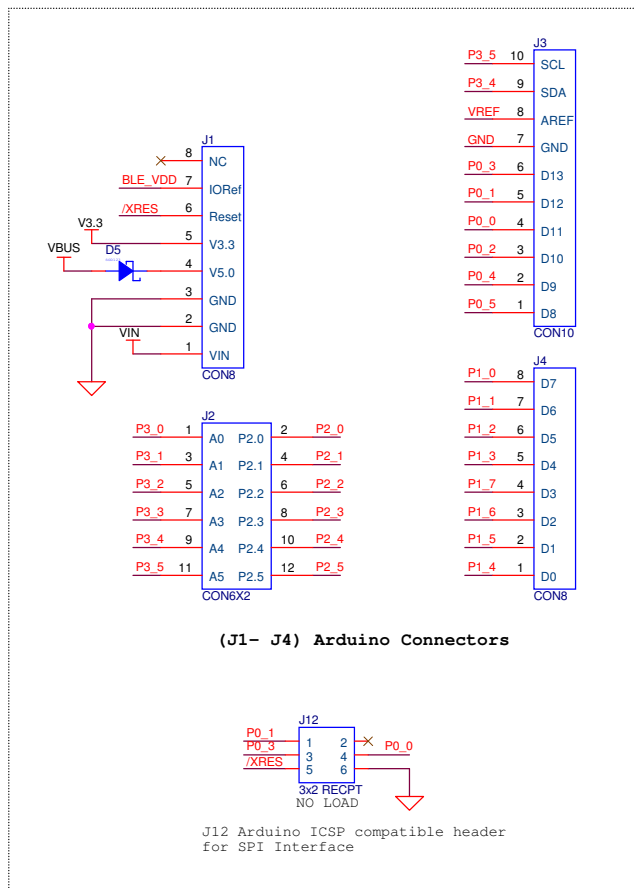
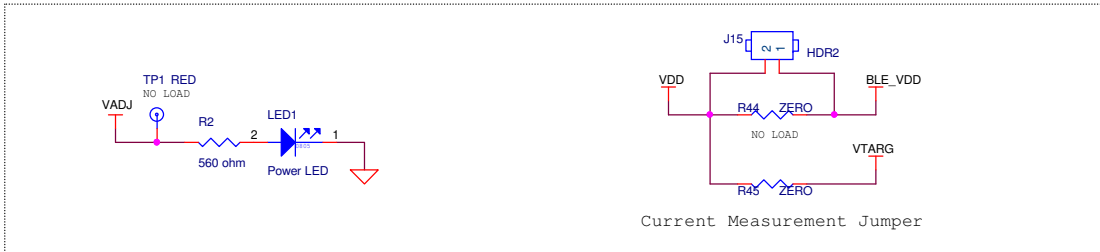
A.1 Schematics

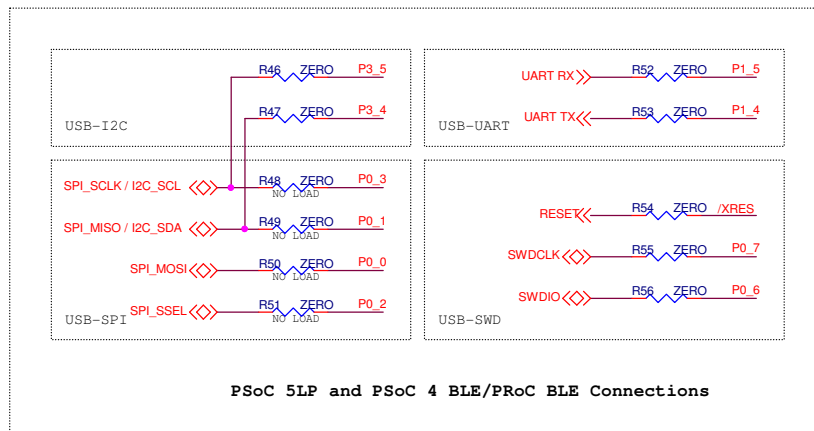
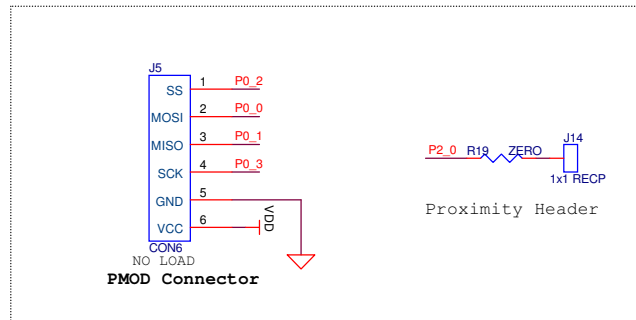
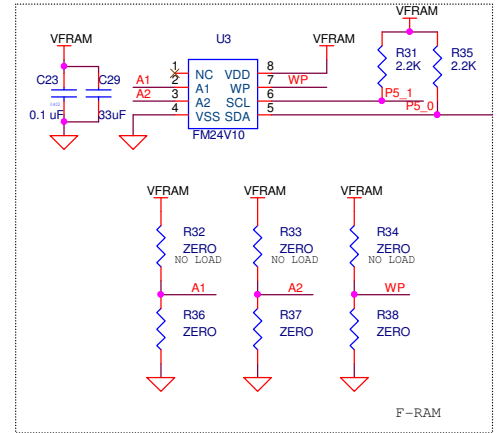
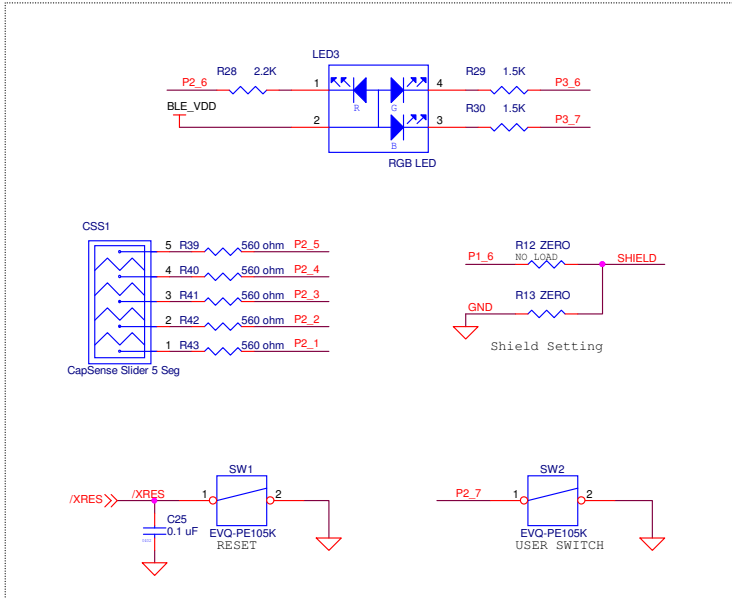
A.1.1 BLE Pioneer Baseboard



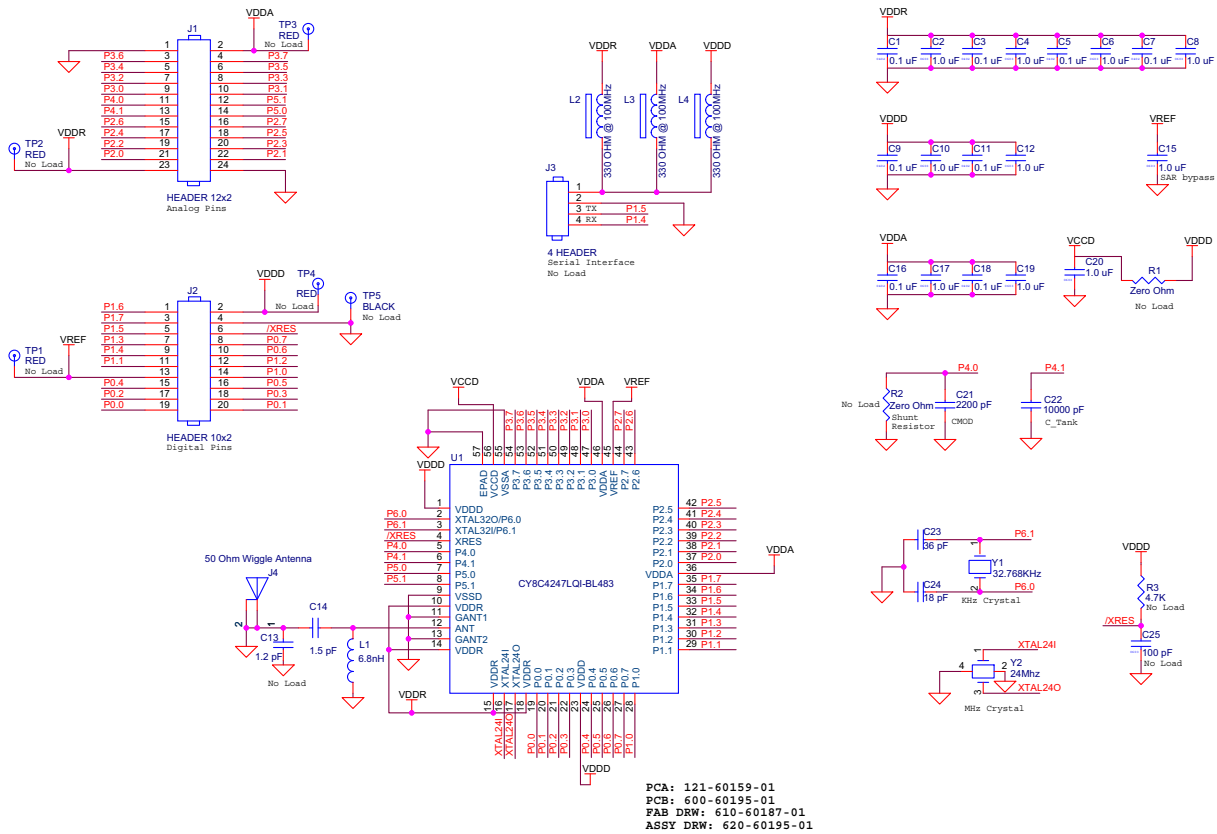




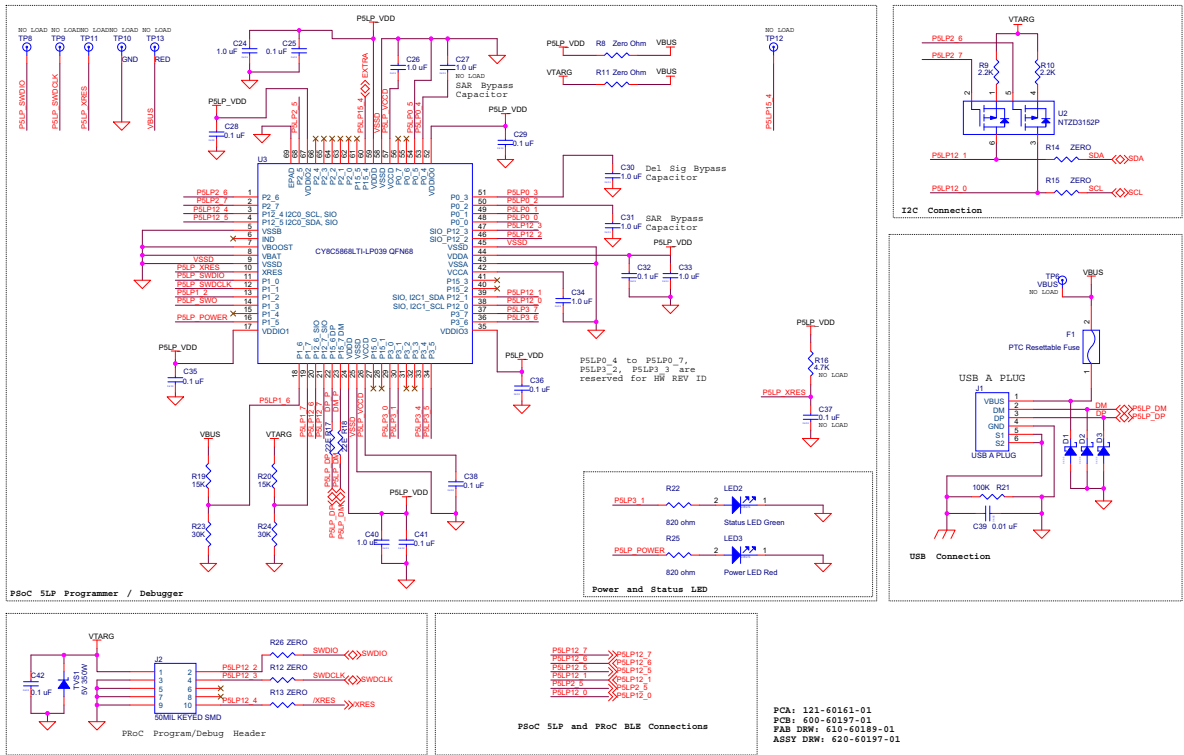


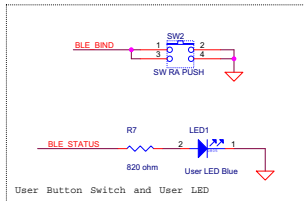
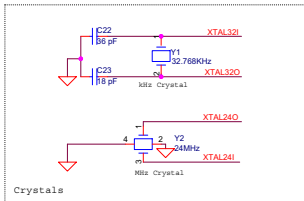
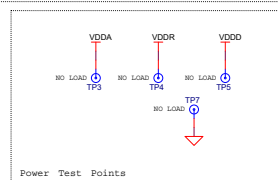
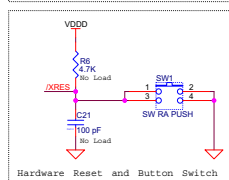
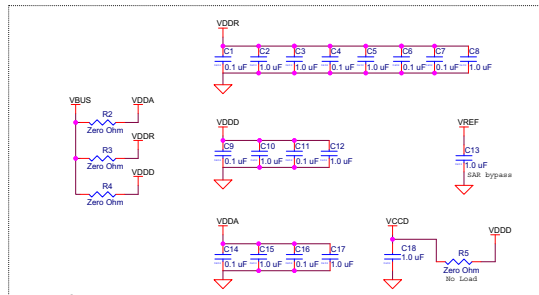
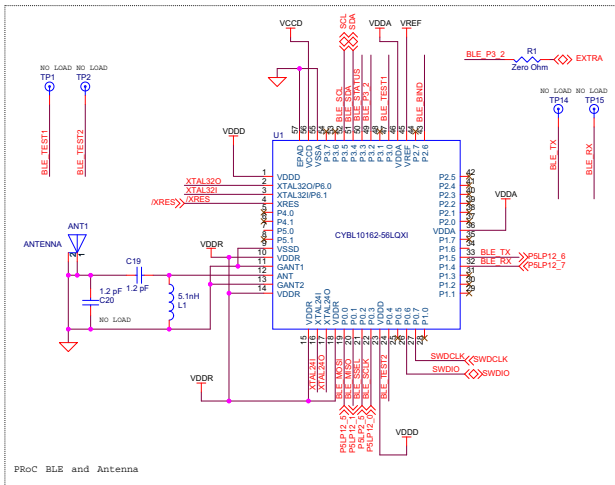


A.1.2 Module



A.1.3 BLE Dongle





PCA: 121-60161-01
 PCB: 600-60197-01
 FAB DRW: 610-60189-01
 ASSY DRW: 620-60197-01

A.2 Board Layout

A.2.1 BLE Pioneer Baseboard

Figure A-1. Primary Side of BLE Pioneer Baseboard

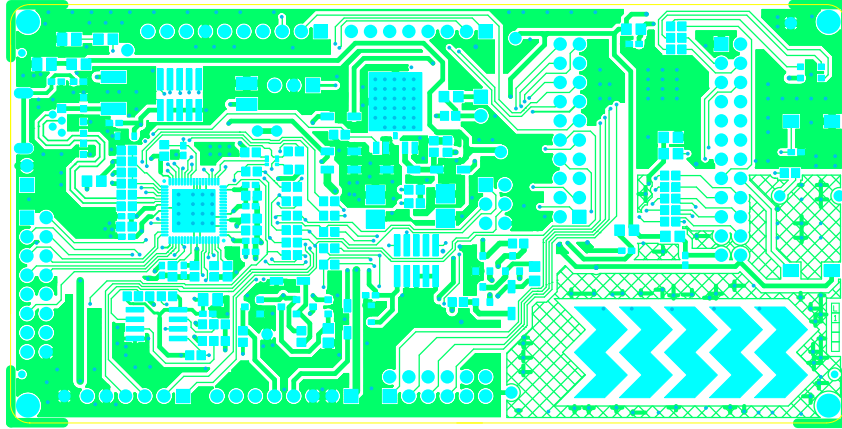


Figure A-2. Ground Layer of BLE Pioneer Baseboard

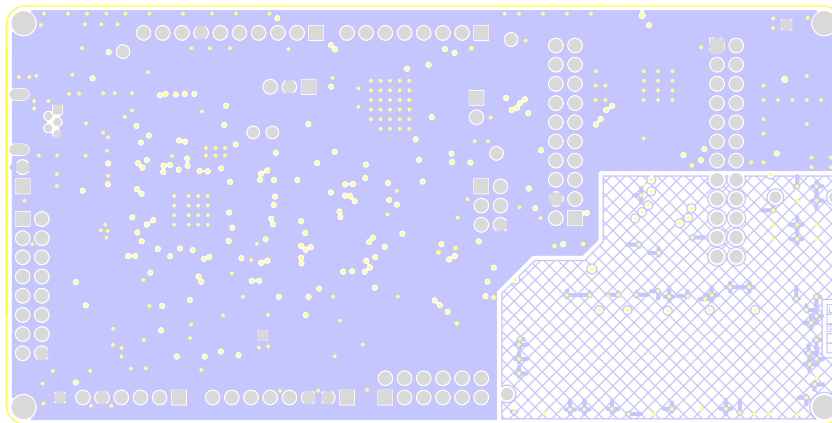


Figure A-3. Power Layer of BLE Pioneer Baseboard

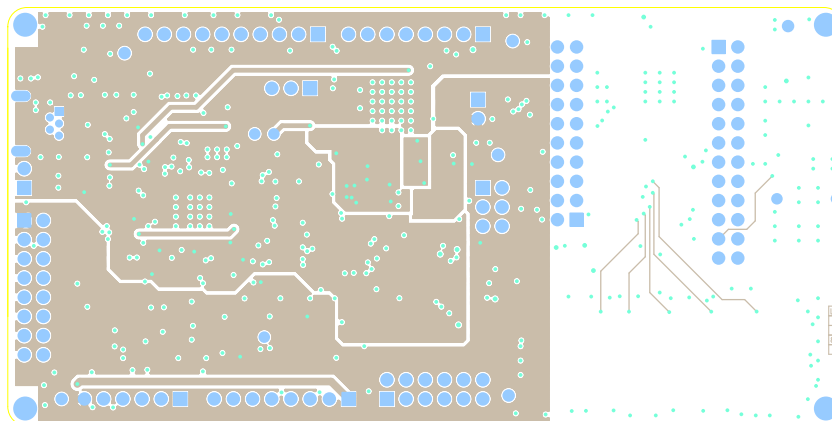


Figure A-4. Secondary Side of BLE Pioneer Baseboard

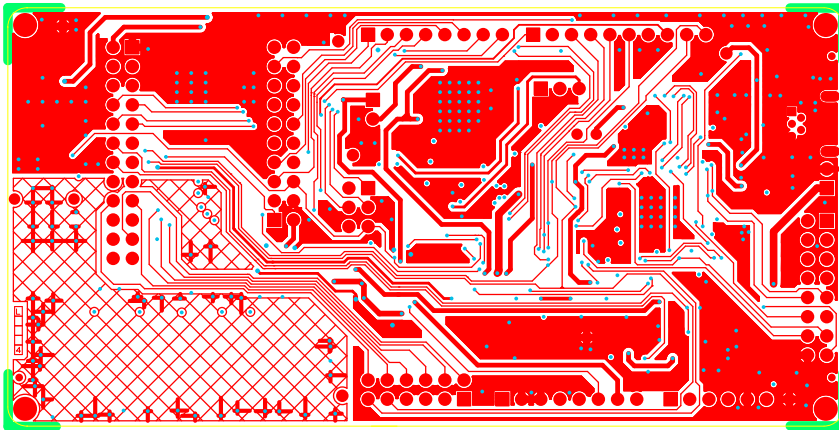


Figure A-5. Primary Silkscreen of BLE Pioneer Baseboard

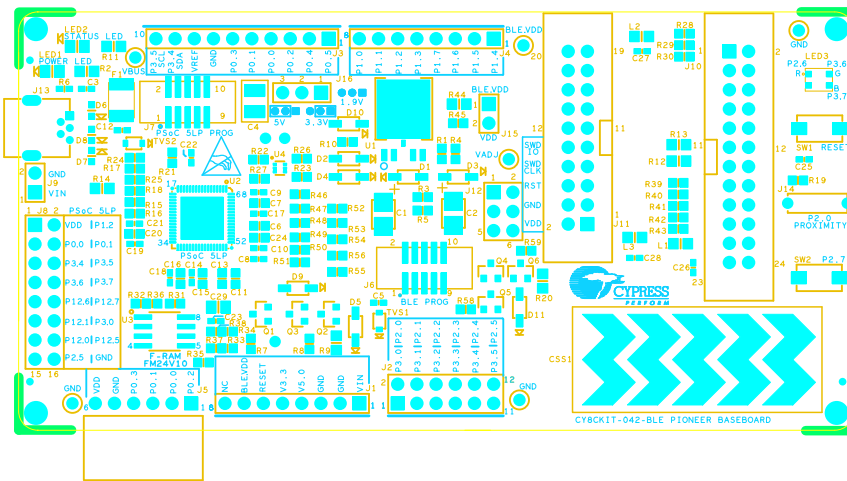
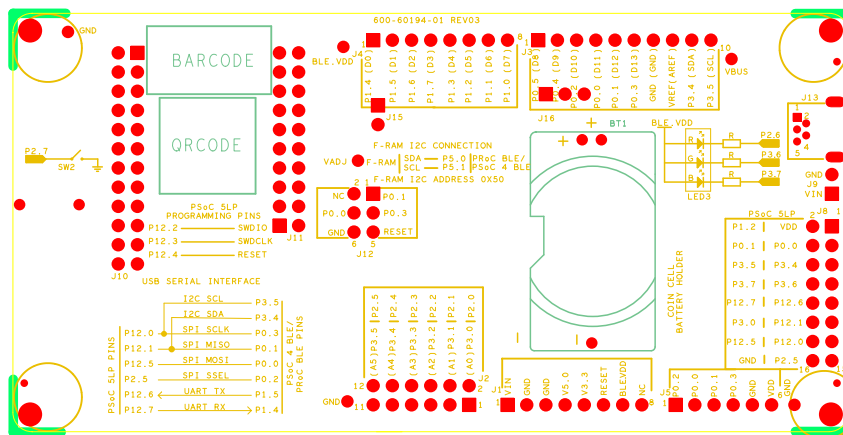


Figure A-6. Secondary Silkscreen of BLE Pioneer Baseboard



A.2.2 PRoC BLE Module

Figure A-7. Primary Side of PRoC BLE Module

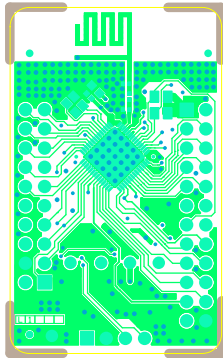


Figure A-8. Ground Layer of PRoC BLE Module

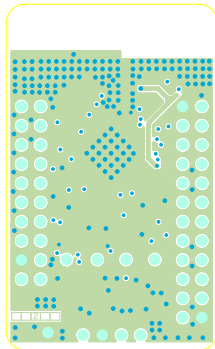


Figure A-9. VCC Layer of PRoC BLE Module

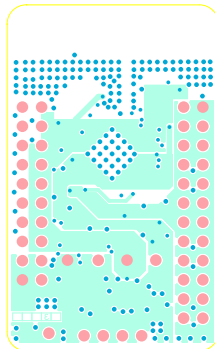


Figure A-10. Secondary Side of PProC BLE Module

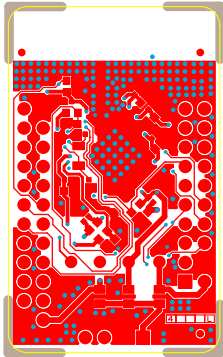


Figure A-11. Primary Silkscreen of PProC BLE Module

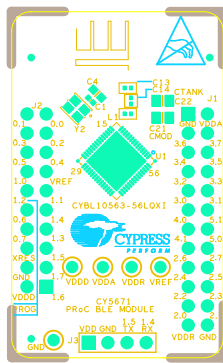
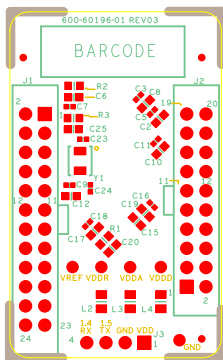


Figure A-12. Secondary Silkscreen of PProC BLE Module



A.2.3 PSoC 4 BLE Module

Figure A-13. Primary Side of PSoC 4 BLE Module

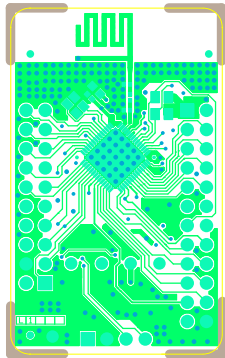


Figure A-14. Ground Layer of PSoC 4 BLE Module

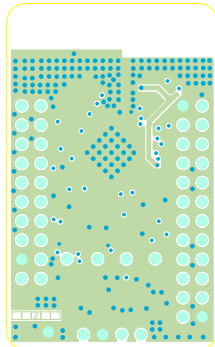


Figure A-15. VCC Layer of PSoC 4 BLE Module

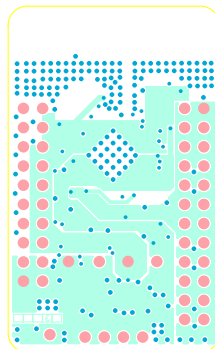


Figure A-16. Secondary Side of PSoC 4 BLE Module

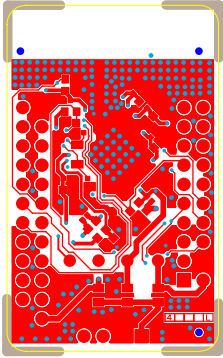


Figure A-17. Primary Silkscreen of PSoC 4 BLE Module

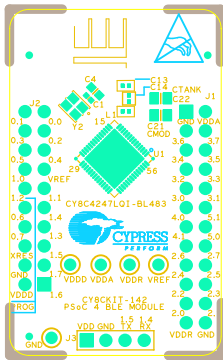
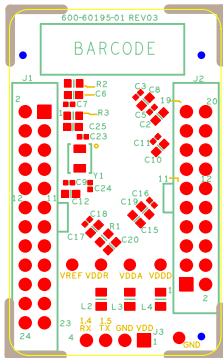


Figure A-18. Secondary Silkscreen of PSoC 4 BLE Module



A.2.4 BLE Dongle

Figure A-19. Primary Side of BLE Dongle

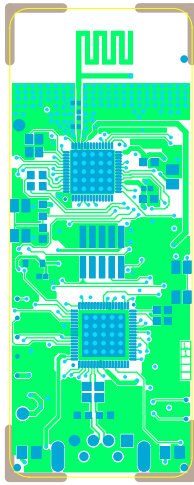


Figure A-20. Ground Layer of BLE Dongle

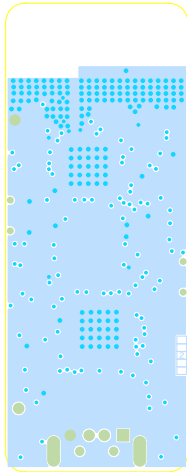


Figure A-21. Power Layer of BLE Dongle

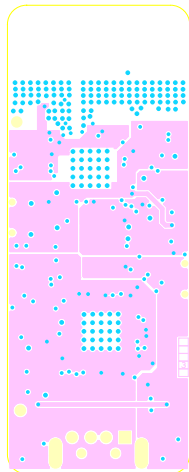


Figure A-22. Secondary Side of BLE Dongle

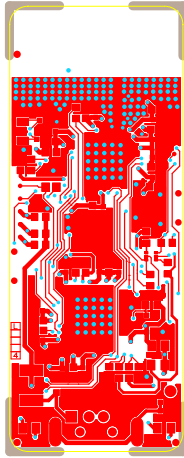


Figure A-23. Primary Silkscreen of BLE Dongle

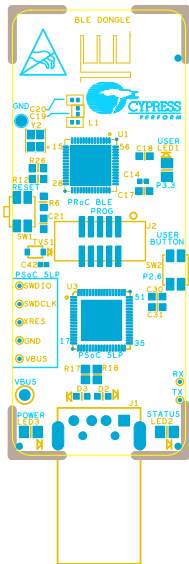
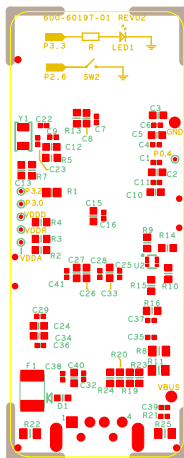


Figure A-24. Secondary Silkscreen of BLE Dongle



A.3 Bill of Materials (BOM)

A.3.1 BLE Pioneer Baseboard

Item	Qty	Reference	Value	Description	Manufacturer	Mfr Part Number
1			-	PCB, 106.22 mm x 53.34 mm, High Tg, ENIG finish, 4 layer, Color = RED, Silk = WHITE.	Cypress	
2	1	BT1	CR2032 Battery Holder	HOLDER COIN CELL CR2032 EJECT	MPD	BA2032
3	1	C1	1.0 uF	CAP TANT 1UF 35V 10% 1210	AVX Corporation	TAJB105K035RNJ
4	1	C2	4.7 uF	CAP TANT 4.7UF 20V 10% 1210	AVX Corporation	TAJB475K020RNJ
5	1	C3	0.01 uFd	CAP 10000PF 16V CERAMIC 0402 SMD	TDK Corporation	C1005X7R1C103K050BA
6	1	C4	100 uFd	CAP CER 100UF 6.3V 20% X5R 1210	TDK Corporation	C3225X5R0J107M250AC
7	15	C5,C8,C9,C10,C12,C14,C17,C18,C19,C21,C23,C25,C26,C27,C28	0.1 uFd	CAP .1UF 16V CERAMIC X5R 0402	TDK Corporation	C1005X5R1A104K050BA
8	7	C6,C7,C11,C13,C15,C16,C20	1.0 uFd	CAP CERAMIC 1.0UF 25V X5R 0603 10%	Taiyo Yuden	TMK107BJ105KA-T
9	1	C29	33 uF	CAP CER 33UF 6.3V 20% X5R 0805	TDK Corporation	C2012X5R0J336M125AC
10	6	D1,D2,D3,D4,D5,D10	MBR0520L	DIODE SCHOTTKY 0.5A 20V SOD-123	Fairchild Semiconductor	MBR0520L
11	3	D6,D7,D8	ESD diode	SUPPRESSOR ESD 5VDC 0603 SMD	Bourns Inc.	CG0603MLC-05LE
12	1	D9	3.9V Zener	DIODE ZENER 3.9V 500MW SOD12	Diodes Inc	BZT52C3V9-7-F
13	1	D11	2.7V Zener	DIODE ZENER 2.7V 500MW SOD123	ON Semiconductor	MMSZ4682T1G
14	1	F1	FUSE	PTC RESETTABLE .50A 15V 1812	Bourns	MF-MSMF050-2
15	2	J1, J4	8x1 RECP	CONN HEADER FEMALE 8POS .1" GOLD	Protectron Electromech	P9401-08-21
16	1	J2	6x2 RECP	CONN HEADER FMAL 12PS.1" DL GOLD	Protectron Electromech	P9403-12-21
17	1	J3	10x1 RECP	CONN HEADER FMALE 10POS .1" GOLD	Protectron Electromech	P9401-10-21
18	1	J8	8X2 RECP	CONN HEADER FMAL 16PS.1" DL GOLD	Protectron Electromech	P9403-16-21
19	1	J10	12X2 RECP	CONN HEADER 2.54MM 24POS GOLD	Sullins Connector Solutions	SBH11-PBPC-D12-ST-BK
20	1	J11	10X2 RECP	CONN HEADER 2.54MM 20POS GOLD	Sullins Connector Solutions	SBH11-PBPC-D10-ST-BK
21	1	J13	USB MINI B	MINI USB RCPT R/A DIP	TE Connectivity	1734510-1

Item	Qty	Reference	Value	Description	Manufacturer	Mfr Part Number
22	1	J14	1X1 RECP	CONN RCPT 1POS .100" SNGL HORZ	Samtec Inc	BCS-101-L-S-HE
23	1	J15	2p_jumper	CONN HEADR BRKWAY .100 2POS STR	Protectron Electro-mech	P9101-02-12-1
24	1	J16	3p_jumper	CONN HEADR BRKWAY .100 3POS STR	Protectron Electro-mech	P9101-03-12-1
25	1	LED1	Power LED Amber	LED 595NM AMB DIFF 0805 SMD	Avago Technologies	HSMA-C170
26	1	LED2	Status LED Green	LED GREEN CLEAR 0805 SMD	Chicago Miniature	CMD17-21VGC/TR8
27	1	LED3	RGB LED	LED RED/GREEN/BLUE PLCC4 SMD	Cree, Inc.	CLV1A-FKB-CJ1M1F1BB7R4S3
28	3	L1,L2,L3	330 OHM @ 100MHz	FERRITE CHIP 330 OHM 0805	Murata	BLM21PG331SN1D
29	3	Q2,Q4,Q6	PMOS	MOSFET P-CH 30V 2.2A SOT23	ON Semiconductor	NTR4171PT1G
30	1	Q1,	PMOS	MOSFET P-CH 30V 3.8A SOT23-3	Diodes Inc	DMP3098L-7
31	2	Q3,Q5	PMOS	MOSFET P-CH 20V 3.5A SOT23	NXP Semiconductors	PMV48XP,215
32	1	R1	11K 1%	RES 11K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF1102V
33	1	R2	560 ohm	RES 560 OHM 1/8W 5% 0805 SMD	Panasonic - ECG	ERJ-6GEYJ561V
34	1	R3	14.7K 1%	RES 14.7K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF1472V
35	1	R4	10K 1%	RES 10K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF1002V
36	1	R5	4.3K 1%	RES 4.3K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF4301V
37	1	R6	100K	RES 100K OHM 1/10W 5% 0402 SMD	Panasonic - ECG	ERJ-2GEJ104X
38	14	R19,R26,R27,R36,R37,R38,R45,R46,R47,R52,R53,R54,R55,R56	ZERO	RES 0.0 OHM 1/10W 0603 SMD	Panasonic - ECG	ERJ-3GEY0R00V
39	2	R8,R58	15K	RES 15K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF1502V
40	2	R9,R20	10K 1%	RES 10K OHM 1/8W 1% 0805 SMD	Stackpole Electronics Inc	RMCF0805FT10K0
41	1	R10	10K	RES 10K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ103V
42	1	R11	820 ohm	RES 820 OHM 1/8W 5% 0805 SMD	Panasonic - ECG	ERJ-6GEYJ821V
43	2	R13,R14	ZERO	RES 0.0 OHM 1/8W 0805 SMD	Panasonic-ECG	ERJ-6GEY0R00V
44	2	R15,R16	22E	RES 22 OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF22R0V
45	2	R17,R18	15K	RES 15K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ153V

Item	Qty	Reference	Value	Description	Manufacturer	Mfr Part Number
46	5	R22,R23,R28,R31,R35	2.2K	RES 2.2K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ222V
47	2	R24,R25	30K	RES 30K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ303V
48	2	R29,R30	1.5K	RES 1.5K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ152V
49	5	R39,R40,R41,R42,R43	560 ohm	RES 560 OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ561V
50	2	SW1,SW2	SW PUSH-BUTTON	SWITCH TACTILE SPST-NO 0.05A 12V	Panasonic - ECG	EVQ-PE105K
51	1	TP5	BLACK	TEST POINT PC MINI .040"D Black	Keystone Electronics	5001
52	2	TVS1,TVS2	5V 350W	TVS UNIDIR 350W 5V SOD-323	Diodec Inc.	SD05-7
53	1	U1	LDO	IC REG LDO ADJ 1A TO252-5	Rohm Semiconductor	BA00BC0WFP-E2
54	1	U2	PSoC 5LP	68QFN PSoC 5LP chip for USB debug channel and USB-Serial interface	Cypress Semiconductor	CY8C5868LTI-LP039
55	1	U3	F-RAM	F-RAM 1-Mbit (128K X 8) I2C interface	Cypress Semiconductor	FM24V10-G
56	1	U4	DUAL PMOS	MOSFET 2P-CH 20V 430MA SOT-563	ON Semiconductor	NTZD3152PT1G
Install on Bottom of PCB As per the Silk Screen in the Corners						
57	4	N/A	N/A	BUMPER CYLIN 0.375" DIA BLK	3M	SJ61A4
Special Jumper Installation Instructions						
58	2	J15,J16	Install jumper across pins 1 and 2	Rectangular Connectors MINI JUMPER GF 6.0MM CLOSE TYPE BLACK	Kobiconn	151-8010-E
Label						
59	1	N/A	N/A	LBL, PCA Label, Vendor Code, Datecode, Serial Number 121-60158-01 Rev 04 (YYWWVVXXXXX)	Cypress Semiconductor	
60	1	N/A	N/A	LBL, QR code, 12mm X 12mm	Cypress Semiconductor	
No load components						
61	1	C22	0.1 uFd	CAP .1UF 16V CERAMIC Y5V 0402	TDK Corporation	C1005X5R1A104K050BA
62	1	C24	1.0 uFd	CAP CERAMIC 1.0UF 25V X5R 0603 10%	Taiyo Yuden	TMK107BJ105KA-T
63	9	R7,R59,R32,R33,R34,R48,R49,R50,R51	Zero Ohm	RES 0.0 OHM 1/10W JUMP 0603	TE Connectivity	1623094-1
64	1	R21	4.7K	RES 4.7K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ472V
65	2	J7,J6	50MIL KEYED SMD	CONN HEADER 10 PIN 50MIL KEYED SMD	Samtec	FTSH-105-01-L-DV-K

Item	Qty	Reference	Value	Description	Manufacturer	Mfr Part Number
66	1	J9	2 PIN HDR	CONN HEADER FEMALE 2POS .1" GOLD	Sullins Connector Solutions	PPPC021LFBN-RC
67	2	TP4,TP5	BLACK	TEST POINT 43 HOLE 65 PLATED BLACK	Keystone Electron- ics	5001
68	3	TP1,TP2,TP3	RED	TEST POINT 43 HOLE 65 PLATED RED	Keystone Electron- ics	5000
69	2	R44,R12	ZERO	RES 0.0 OHM 1/8W 0805 SMD	Panasonic-ECG	ERJ-6GEY0R00V
70	1	J12	3x2 RECPT	CONN HEADER FMAL 6PS .1" DL GOLD	Sullins Connector Solutions	PPPC032LFBN-RC
71	1	J5	6X1 RECP RA	CONN FEMALE 6POS .100" R/A GOLD	Sullins Connector Solutions	PPPC061LGBN-RC

A.3.2 Module

A.3.2.1 CY5671 PProC BLE Module

Item	Qty	Reference	Value	Description	Manufacturer	Mfr Part Number
1	1	600-60196-01	-	PProC BLE Module printed circuit board	Cypress qualified vendor	600-60196-01 Rev03
2	8	C1,C3,C5,C7,C9,C11,C16,C18	0.1 uF	CAP .1UF 16V CERAMIC Y5V 0402	Samsung Electro-Mechanics America, Inc	CL05F104ZO5NNNC
3	10	C2,C4,C6,C8,C10,C12,C15,C17,C19,C20	1.0 uF	CAP CERAMIC 1.0UF 25V X5R 0603 10%	TDK Corporation	C1608X5R1E105K080AC
4	1	C21	2200 pF	CAP CER 2200PF 50V 5% NP0 0805	Murata Electronics	GRM2165C1H222JA01D
5	1	C22	10000 pF	CAP CER 10000PF 50V 5% NP0 0805	Murata Electronics	GRM2195C1H103JA01D
6	1	C23	36 pF	CAP CER 36PF 50V 5% NP0 0402	Murata Electronics	GRM1555C1H360JA01D
7	1	C24	18 pF	CAP CER 18PF 50V 1% NP0 0402	Murata Electronics	GRM1555C1H180FA01D
8	1	C14	1.5 pF	CAP CER 1.5PF 50V NP0 0402	Johanson Technology Inc	500R07S1R5BV4T
9	1	J1	HEADE R 24	CONN HEADR FEMALE 24POS .1" DL AU	Sullins Connector	SFH11-PBPC-D12-ST-BK
10	1	J2	HEADE R 20	CONN HEADR FEMALE 20POS .1" DL AU	Sullins Connector	SFH11-PBPC-D10-ST-BK
11	1	L1	6.8nH	CER INDUCTOR 6.8NH 0402	Johanson Technology Inc	L-07C6N8JV6T
12	3	L2,L3,L4	330 Ohm @100 MHz	FERRITE CHIP 330 OHM 0805	Murata Electronics	BLM21PG331SN1D
13	1	U1	PProC BLE	56 QFN PProC BLE	Cypress Semiconductor	CYBL10563-56LQXI
14	1	Y1	32.768K Hz	CRYSTAL 32.768KHZ 12.5PF SMD	ECS Inc	ECS-.327-12.5-34B
15	1	Y2	24MHz	CRYSTAL 24.000 MHZ 8PF SMD	ECS Inc	ECS-240-8-36CKM
16	1	LBL	-	LBL, PCA Label, Vendor Code, Datecode, Serial Number 121-60160-01 Rev 04 (YYWWV-VXXXXX)	Cypress qualified vendor	-
No Load components						
17	1	C13	1.2 pF	CAP CER 1.2PF 50V NP0 0402	Johanson Technology Inc	500R07S1R2BV4T
18	1	C25	100pF	CAP CER 100PF 50V 10% X7R 0603	Kemet	C0603C101K5RACTU

Item	Qty	Reference	Value	Description	Manufacturer	Mfr Part Number
19	1	R1	Zero Ohm	RES 0.0 OHM 1/8W 0605 SMD	TE Connectivity	1623094-1
20	1	R2	Rbleed	No Load	-	-
21	1	R3	4.7K	RES 4.7K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ472V
22	1	J3	4 HEADER	CONN HEADER 4POS .100 R/A 15AU	FCI	68016-204HLF
23	4	TP1,TP2,TP3,TP4	RED	TEST POINT 43 HOLE 65 PLATED RED	Keystone Electronics	5000
24	1	TP5	BLACK	TEST POINT 43 HOLE 65 PLATED BLACK	Keystone Electronics	5001

A.3.2.2 CY8CKIT-142 PSoC 4 BLE Module

Item	Qty	Reference	Value	Description	Manufacturer	Mfr Part Number
1	1	600-60195-01	-	PSoC 4 BLE Module printed circuit board	Cypress qualified vendor	600-60195-01 Rev03
2	8	C1,C3,C5,C7,C9,C11,C16,C18	0.1 uF	CAP .1UF 16V CERAMIC Y5V 0402	Samsung Electro-Mechanics America, Inc	CL05F104ZO5NNNC
3	10	C2,C4,C6,C8,C10,C12,C15,C17,C19,C20	1.0 uF	CAP CERAMIC 1.0UF 25V X5R 0603 10%	TDK Corporation	C1608X5R1E105K080AC
4	1	C21	2200 pF	CAP CER 2200PF 50V 5% NP0 0805	Murata Electronics	GRM2165C1H222JA01D
5	1	C22	10000 pF	CAP CER 10000PF 50V 5% NP0 0805	Murata Electronics	GRM2195C1H103JA01D
6	1	C23	36 pF	CAP CER 36PF 50V 5% NP0 0402	Murata Electronics	GRM1555C1H360JA01D
7	1	C24	18 pF	CAP CER 18PF 50V 1% NP0 0402	Murata Electronics	GRM1555C1H180FA01D
8	1	C14	1.5 pF	CAP CER 1.5PF 50V NP0 0402	Johanson Technology Inc	500R07S1R5BV4T
9	1	J1	HEADER 24	CONN HEADR FEMALE 24POS .1" DL AU	Sullins Connector	SFH11-PBPC-D12-ST-BK
10	1	J2	HEADER 20	CONN HEADR FEMALE 20POS .1" DL AU	Sullins Connector	SFH11-PBPC-D10-ST-BK
11	1	L1	6.8nH	CER INDUCTOR 6.8NH 0402	Johanson Technology Inc	L-07C6N8JV6T
12	3	L2,L3,L4	330 Ohm @100 MHz	FERRITE CHIP 330 OHM 0805	Murata Electronics	BLM21PG331SN1D
13	1	U1	PSoC 4BLE	56 QFN PSoC 4 BLE	Cypress Semiconductor	CY8C4247LQI-BL483
14	1	Y1	32.768K Hz	CRYSTAL 32.768KHZ 12.5PF SMD	ECS Inc	ECS-.327-12.5-34B
15	1	Y2	24MHz	CRYSTAL 24.000 MHZ 8PF SMD	ECS Inc	ECS-240-8-36CKM
16	1	LBL	-	LBL, PCA Label, Vendor Code, Datecode, Serial Number 121-60159-01 Rev 04 (YYWWVVXXXXX)	Cypress qualified vendor	-
No Load components						
17	1	C13	1.2 pF	CAP CER 1.2PF 50V NP0 0402	Johanson Technology Inc	500R07S1R2BV4T
18	1	C25	100pF	CAP CER 100PF 50V 10% X7R 0603	Kemet	C0603C101K5RACTU
19	1	R1	Zero Ohm	RES 0.0 OHM 1/10W JUMP 0603	TE Connectivity	1623094-1
20	1	R2	Rbleed	No Load	-	-

Item	Qty	Reference	Value	Description	Manufacturer	Mfr Part Number
21	1	R3	4.7K	RES 4.7K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ472V
22	1	J3	4 HEADER	CONN HEADER 4POS .100 R/A 15AU	FCI	68016-204HLF
23	4	TP1,TP2,TP3,TP4	RED	TEST POINT 43 HOLE 65 PLATED RED	Keystone Electron- ics	5000
24	1	TP5	BLACK	TEST POINT 43 HOLE 65 PLATED BLACK	Keystone Electron- ics	5001

A.3.3 BLE Dongle

Item	Qty	Reference	Value	Description	Manufacturer	Mfr Part Number
1	1	600-60197-01	-	PCB, 60 mm x 30 mm, High Tg, ENIG finish, 2 layer, Color = BLACK, Silk = WHITE.	Cypress qualified vendor	600-60197-01 Rev02
2	17	C1,C4,C6,C7,C9,C11,C14,C16,C25,C28,C29,C32,C35,C36,C38,C41,C42	0.1 uFd	CAP .1UF 16V CERAMIC Y5V 0402	TDK Corporation	C1005X5R1A104K050BA
3	17	C2,C3,C5,C8,C10,C12,C13,C15,C17,C18,C24,C26,C30,C31,C33,C34,C40	1.0 uFd	CAP CERAMIC 1.0UF 25V X5R 0603 10%	Taiyo Yuden	TMK107BJ105KA-T
4	1	C19	1.2 pFd	CAP CER 1.2PF 50V NP0 0402	Johanson Technology Inc	500R07S1R2BV4T
5	1	C22	36 pF	CAP CER 36PF 50V 5% NP0 0402	Murata Electronics	GRM1555C1H360JA01D
6	1	C23	18 pF	CAP CER 18PF 50V 1% NP0 0402	Murata Electronics	GRM1555C1H180FA01D
7	1	C39	0.01 uFd	CAP 10000PF 16V CERAMIC 0402 SMD	TDK Corporation	C1005X7R1C103K050BA
8	3	D1,D2,D3	ESD diode	SUPPRESSOR ESD 5VDC 0603 SMD	Bourns Inc.	CG0603MLC-05LE
9	1	F1	FUSE	PTC RESETTABLE .50A 15V 1812	Bourns	MF-MSMF050-2
10	1	J1	USB Type-A PLUG	CONN PLUG USB 4POS RT ANG PCB	Molex Inc	480370001
11	1	J2	50MIL KEYED SMD	CONN HEADER 10POS DUAL SHRD SMD	FCI	20021521-00010T1LF
12	1	LED1	Status LED Blue	LED BLUE CLEAR THIN 0805 SMD	LiteOn Inc	LTST-C171TBKT
13	1	LED2	Status LED Green	LED GREEN CLEAR 0805 SMD	Chicago Miniature	CMD17-21VGC/TR8
14	1	LED3	Power LED Red	LED SUPER RED CLEAR 0805 SMD	LiteOn Inc	LTST-C170KRKT
15	1	L1	5.1 nH	CER INDUCTOR 5.1NH 0402	Johanson Technology Inc	L-07C5N1SV6T
16	2	R8,R11	Zero Ohm	RES 0.0 OHM 1/8W 0805 SMD	Panasonic-ECG	ERJ-6GEY0R00V
17	1	R7	820 ohm	RES 820 OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ821V
18	2	R22,R25	820 ohm	RES 820 OHM 1/8W 5% 0805 SMD	Panasonic - ECG	ERJ-6GEYJ821V
19	2	R9,R10	2.2K	RES 2.2K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ222V

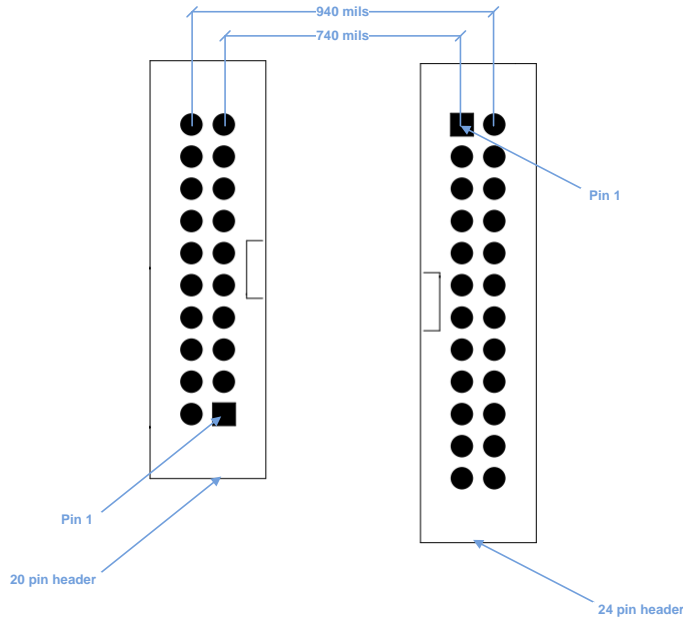
Item	Qty	Reference	Value	Description	Manufacturer	Mfr Part Number
20	9	R1,R2,R3,R4,R12,R13,R14,R15,R26	ZERO	RES 0.0 OHM 1/10W 0603 SMD	Panasonic - ECG	ERJ-3GEY0R00V
21	2	R17,R18	22E	RES 22 OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF22R0V
22	1	R21	100K	RES 100K OHM 1/10W 5% 0402 SMD	Panasonic - ECG	ERJ-2GEJ104X
23	2	R19,R20	15K	RES 15K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ153V
24	2	R23,R24	30K	RES 30K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ303V
25	2	SW1,SW2	SW RA PUSH	SWITCH TACTILE SPST-NO 0.05A 12V	Panasonic - ECG	EVQ-P3401P
26	1	TVS1	5V 350W	TVS UNIDIR 350W 5V SOD-323	Diodes Inc.	SD05-7
27	1	U1	PRoC BLE	PRoC BLE, Programmable Radio on Chip, 56QFN	Cypress Semiconductor	CYBL10162-56LQXI
28	1	U2	DUAL PMOS	MOSFET 2P-CH 20V 430MA SOT-563	ON Semiconductor	NTZD3152PT1G
29	1	U3	PSoC 5LP	PSoC 5LP Programmable System on Chip, 68QFN	Cypress Semiconductor	CY8C5868LTI-LP039
30	1	Y1	32.768K Hz	CRYSTAL 32.768KHZ 12.5PF SMD	ECS Inc	ECS-.327-12.5-34B
31	1	Y2	24MHz	CRYSTAL 24.000 MHZ 8PF SMD	ECS Inc	ECS-240-8-36CKM
32	1	N/A	N/A	LBL, PCA Label, Vendor Code, Datecode, Serial Number 121-60161-01 Rev 03 (YYW-WVVXXXXX); Only barcode	Cypress qualified vendor	-
No load components						
33	1	C20	1.2 pF	CAP CER 1.2PF 50V NP0 0402	Johanson Technology Inc	500R07S1R2BV4T
34	1	C21	100pF	CAP CER 100PF 50V 10% X7R 0603	Kemet	C0603C101K5RACTU
35	1	C37	0.1 uFd	CAP .1UF 16V CERAMIC Y5V 0402	TDK Corporation	C1005X5R1A104K050BA
36	1	C27	1.0 uFd	CAP CERAMIC 1.0UF 25V X5R 0603 10%	Taiyo Yuden	TMK107BJ105KA-T
37	1	R5	Zero Ohm	RES 0.0 OHM 1/10W JUMP 0603	TE Connectivity	1623094-1
38	2	R6,R16	4.7K	RES 4.7K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ472V
39	15	TP1,TP2,TP3,TP4,TP5,TP6,TP7,TP8,TP9,TP10,TP11,TP12,TP13,TP14,TP15	No load	No load	-	-

A.4 KitProg Status LED States

	User Indication	Scenario	Action Required by user
1	LED blinks fast: Frequency = 4.00 Hz	LED starts blinking at power up, if bootloadable file is corrupt.	Bootload the <i>KitProg.cyacd</i> file: in PSoC Programmer, connect to the kit, open the Utilities tab and press Upgrade Firmware button.
2	LED blinks slow: Frequency = 0.67 Hz	Entered Bootloader mode by holding the BLE Pioneer Kit/BLE Dongle Reset button during kit power-up.	Release the Reset button and re-plug power if you entered this mode by mistake. If the mode entry was intentional, bootload the new.cyacd file using the Bootloader Host tool shipped with PSoC Creator.
3	LED blinks very fast: Frequency = 15.0 Hz	SWD operation is in progress. Any I2C traffic. Kit's COM port connect/disconnect event (one blink).	In PSoC Programmer, watch the log window for status messages for SWD operations. In the Bridge Control Panel, the LED blinks on I2C command requests. In BCP or any other serial port terminal program, distinguish the kit's COM port number by the blinking LED when the port is connected or disconnected.
4	LED is ON.	USB enumeration successful. Kit is in the idle state waiting for commands.	The kit functions can be used by PSoC Creator, PSoC Programmer, Bridge Control Panel, and any serial port terminal program.
5	LED is OFF.	Power LED is ON.	This means that the USB enumeration was unsuccessful. This can happen if the kit is not powered from the USB host or the kit is not connected to the USB host through the USB cable. Verify the USB cable and check if PSoC Programmer is installed on the PC.

A.5 Adding BLE module compatible headers on your own baseboard

The baseboard should have two headers, one 20-pin and another 24-pin. Dimension of these connects are detailed below.



You can get these at Digikey.

#	Description	Manufacturer	Mfr Part Number	Digikey part #
1	CONN HEADER 2.54MM 24POS GOLD	Sullins Connector Solutions	SBH11-PBPC-D12-ST-BK	SBH11-PBPC-D12-ST-BK-ND
2	CONN HEADER 2.54MM 20POS GOLD	Sullins Connector Solutions	SBH11-PBPC-D10-ST-BK	S9172-ND

Revision History



CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit Guide Revision History

Document Title: CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit Guide			
Document Number: 001-93731			
Revision	Issue Date	Origin of Change	Description of Change
**	11/10/2014	ROIT	New kit guide.
*A	12/25/2014	ROIT	Updated Safety Information chapter on page 7: Updated entire section.
			Updated Introduction chapter on page 13: Updated description before “Kit Contents” on page 14. Updated “Kit Contents” on page 14: Updated description. Updated “BLE Pioneer Baseboard Details” on page 15: Updated Figure 1-3 . Updated Figure 1-4 .
			Updated “Additional Learning Resources” on page 18: Updated “PSoC Creator Example Projects” on page 18: Updated Figure 1-5 . Updated Software Installation chapter on page 23: Updated “Before You Begin” on page 23: Updated description. Updated “Install Software” on page 23: Updated description. Removed “Uninstall Software”. Added “Windows 8.1 USB selective suspend setting” on page 25.

CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit Guide Revision History (continued)

Document Title: CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit Guide			
Document Number: 001-93731			
Revision	Issue Date	Origin of Change	Description of Change
*A (cont.)	12/25/2014	ROIT	<p>Updated Kit Operation chapter on page 27:</p> <p>Updated “Theory of Operation” on page 27:</p> <p>Updated description.</p> <p>Updated Figure 3-1.</p> <p>Updated Figure 3-2.</p> <p>Updated Figure 3-3.</p> <p>Added “KitProg” on page 29.</p> <p>Updated “BLE Pioneer Kit USB Connection” on page 29:</p> <p>Updated description.</p> <p>Updated “Programming and Debugging BLE Device” on page 30:</p> <p>Added “Programming using PSoC Creator” on page 30.</p> <p>Added “Programming using PSoC Creator” on page 30.</p> <p>Added “Programming using PSoC Programmer” on page 32.</p> <p>Removed “Measure Coin-cell Power Consumption”.</p> <hr/> <p>Updated Example Projects chapter on page 41:</p> <p>Updated “CapSense Slider and LED” on page 45:</p> <p>Updated “Flow Chart” on page 49:</p> <p>Updated Figure 4-11.</p> <p>Updated “Verify Output” on page 50:</p> <p>Updated “CySmart Central Emulation Tool” on page 50:</p> <p>Updated Figure 4-17.</p> <p>Updated Figure 4-24.</p> <p>Updated “CapSense Proximity” on page 59:</p> <p>Updated “Project Description” on page 59:</p> <p>Updated Figure 4-30.</p> <p>Updated “Flow Chart” on page 63:</p> <p>Updated Figure 4-35.</p> <p>Updated “Verify Output” on page 64:</p> <p>Updated “CySmart Central Emulation Tool” on page 64:</p> <p>Updated Figure 4-42, Figure 4-45.</p> <p>Updated “CySmart Mobile Application” on page 68:</p> <p>Replaced “iOS” with “iOS/Android” in all instances in the section.</p> <p>Updated “Direct Test Mode (DTM)” on page 80:</p> <p>Updated “Hardware Connection” on page 82:</p> <p>Updated description.</p> <p>Updated “Verify Output” on page 83:</p> <p>Updated description.</p>

CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit Guide Revision History (continued)

Document Title: CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit Guide			
Document Number: 001-93731			
Revision	Issue Date	Origin of Change	Description of Change
*A (cont.)	12/25/2014	ROIT	<p>Updated Hardware chapter on page 85:</p> <p>Updated “BLE Pioneer Baseboard” on page 85:</p> <p>Updated “PSoC 5LP” on page 85:</p> <p>Updated description.</p> <p>Updated “Power System” on page 85:</p> <p>Updated description.</p> <p>Updated Figure 5-1.</p> <p>Updated “Protection Circuits” on page 87:</p> <p>Updated description.</p> <p>Updated Figure 5-4.</p> <p>Updated “Current Measurement Jumper” on page 89:</p> <p>Updated description.</p> <p>Added Figure 5-8.</p> <p>Updated “Expansion Connectors” on page 92:</p> <p>Updated “Arduino Compatible Headers (J1, J2, J3, J4, and J12-unpopulated)” on page 92:</p> <p>Updated description.</p> <p>Updated Figure 5-9.</p> <p>Removed figure “Schematics of Arduino Connectors”.</p> <p>Updated “PMod Connector - Digilent Pmod Compatible (J5-unpopulated)” on page 93:</p> <p>Updated description.</p> <p>Updated Figure 5-10.</p> <p>Updated “PSoC 5LP GPIO Header (J8)” on page 94:</p> <p>Updated description.</p> <p>Updated “USB Mini-B Connector” on page 95:</p> <p>Updated description.</p> <p>Updated “CapSense Circuit” on page 96:</p> <p>Updated “CapSense Slider” on page 96:</p> <p>Updated description.</p> <p>Updated “BLE Pioneer Baseboard LEDs” on page 97:</p> <p>Updated description.</p> <p>Updated Figure 5-16.</p> <p>Updated “Push Buttons” on page 99:</p> <p>Updated description.</p> <p>Updated “Cypress Ferroelectric RAM (F-RAM)” on page 100:</p> <p>Updated description.</p> <p>Updated “Serial Interconnection between KitProg and Module” on page 101:</p> <p>Updated description.</p> <p>Updated “Module Headers” on page 102:</p> <p>Updated description.</p>

CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit Guide Revision History (continued)

Document Title: CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit Guide			
Document Number: 001-93731			
Revision	Issue Date	Origin of Change	Description of Change
*A (cont.)	12/25/2014	ROIT	Updated Hardware chapter on page 85 : Updated “ Module Board ” on page 103: Updated “ Wiggle Antenna ” on page 105: Updated description. Updated “ BLE Passives ” on page 107: Updated description. Updated “ BLE Dongle Board ” on page 108: Updated description. Added Figure 5-26 . Removed section “ PRoC BLE ”. Removed section “ Wiggle Antenna ”. Removed section “ Antenna Matching Network ”. Removed section “ System Status LED and Power LED ”. Removed section “ Push Buttons ”.

CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit Guide Revision History (continued)

Document Title: CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit Guide			
Document Number: 001-93731			
Revision	Issue Date	Origin of Change	Description of Change
*A (cont.)	12/25/2014	ROIT	<p>Updated Advanced Topics chapter on page 111: Removed “Using PSoC 5LP as USB-UART Bridge”. Removed “Using PSoC 5LP as USB-I²C Bridge”. Removed “Developing Applications for PSoC 5LP”. Removed “PSoC 5LP Factory Program Restore Instructions”. Updated “Using FM24V10 F-RAM” on page 111: Updated description. Updated “Address Selection” on page 111: Updated description. Updated “Write/Read Operation” on page 111: Updated description. Updated “CySmart Mobile Application” on page 112: Updated description. Removed figure “CapSense Buttons GUI Page”. Removed figure “CapSense Slider GUI Page”. Removed figure “CapSense Proximity GUI Page”. Removed figure “RGB LED Profile”. Removed “CySmart PC Tool”.</p>
			<p>Updated Appendix chapter on page 117: Updated “Schematics” on page 117: Updated entire section. Updated “Bill of Materials (BOM)” on page 133: Updated “BLE Pioneer Baseboard” on page 133: Updated entire section. Updated “Module” on page 137: Updated “CY5671 PSoC BLE Module” on page 137: Updated entire section. Updated “CY8CKIT-142 PSoC 4 BLE Module” on page 139: Updated entire section. Updated “BLE Dongle” on page 141: Updated entire section. Updated “KitProg Status LED States” on page 143: Updated details in “User Indication” column for LED 1, LED 2 and LED 3. Added “Adding BLE module compatible headers on your own baseboard” on page 144.</p>
*B	01/13/2015	RRAM / RKPM	<p>Updated Introduction chapter on page 13: Updated description before “Kit Contents” on page 14. Updated Kit Operation chapter on page 27: Updated “KitProg” on page 29: Updated description.</p>

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