PSoC™ 6 CY8CPROTO-063-BLE with AIROC™ Bluetooth® LE Prototyping Board user guide

About this document

Scope and purpose

Thank you for your interest in the CY8CPROTO-063-BLE PSoC™ 6 Bluetooth® LE Prototyping Board.

The CY8CPROTO-063-BLE PSoC™ 6 Bluetooth® LE Prototyping Board is designed as an easy-to-use and inexpensive prototyping platform. The CY8CPROTO-063-BLE Prototyping Board includes the AIROC™ CYBLE-416045-02 Bluetooth® LE module, delivering a complete system solution for a wide range of embedded applications at a very low cost.

In addition, the board includes the following features:

- Two LEDs to provide feedback
- A push button to provide a simple user input
- Footprint for external ECO (2.0 mm × 1.6 mm, 24 MHz)
- External WCO (32.768 kHz)
- 1.8 V to 3.3 V operation

Intended audience

This document is intended for users interested in the PSoC™ 6 Bluetooth® LE Prototyping Board.

Evaluation board

This board is to be used during the design-in process for evaluating and measuring characteristic curves, and for checking datasheet specifications.

***Note**: PCB and auxiliary circuits are NOT optimized for final customer design.*

Important notice

“Evaluation Boards and Reference Boards” shall mean products embedded on a printed circuit board (PCB) for demonstration and/or evaluation purposes, which include, without limitation, demonstration, reference and evaluation boards, kits and design (collectively referred to as “Reference Board”).

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Safety precautions

***Note**: Please note the following warnings regarding the hazards associated with development systems.*

Table 1 Safety precautions

	**Caution:** *The evaluation or reference board contains parts and assemblies sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.*
	**Caution:** *A drive that is incorrectly applied or installed can lead to component damage or reduction in product lifetime. Wiring or application errors such as undersizing the motor, supplying an incorrect or inadequate AC supply, or excessive ambient temperatures may result in system malfunction.*
	**Caution:** *The evaluation or reference board is shipped with packing materials that need to be removed prior to installation. Failure to remove all packing materials that are unnecessary for system installation may result in overheating or abnormal operating conditions.*

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1 Introduction

PSoC™ 6 MCU is a programmable embedded system-on chip, integrating custom digital peripheral functions, memory, and both an Arm® Cortex®-M0+ CPU and Cortex®-M4 CPU on a single chip with flexible automatic routing. Programmable digital peripheral functions allow higher flexibility, in-field tuning of the design, and faster time-to-market. It is a combination of MCU with standard communication and timing peripherals, and a capacitive touch sensing system with best-in-class performance.

The CY8CPROTO-063-BLE PSoC™ Bluetooth® LE Prototyping Board offers an open footprint breakout board to maximize the end utility of the PSoC™ 6 MCU with Bluetooth® Low Energy Connectivity (PSoC™ 63 Line) device. This kit provides a low-cost alternative to device samples while providing a platform to easily develop and integrate the PSoC™ 6 MCU into your end-system.

The CY8CPROTO-063-BLE PSoC™ 6 Bluetooth® LE Prototyping Board also integrates Infineon KitProg3 that enables onboard programming, debugging, and bridging functionalities, such as USB-UART and USB-I2C. KitProg3 is used to program and debug the target PSoC™ 6 MCU which is part of the Bluetooth® LE Module (see Figure 1). The Prototyping board allows you to separate the KitProg3 board from the target PSoC™ 6 Bluetooth® LE board.

1.1 Kit contents

The CY8CPROTO-063-BLE PSoC™ 6 Bluetooth® LE Prototyping Kit contains PSoC™ 6 Bluetooth® LE Prototyping Board (which contains AIROC™ CYBLE-416045-02 Bluetooth® LE module), USB 2.0 Type-A to Micro-B Cable and Quick Start Guide.

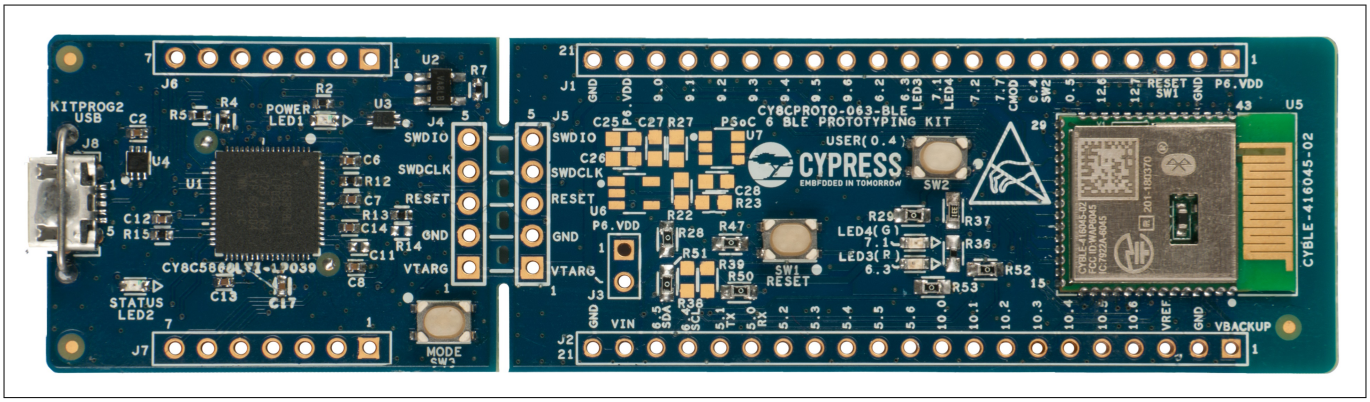

Figure 1 CY8CPROTO-063-BLE PSoC™ 6 Prototyping Board - Top view

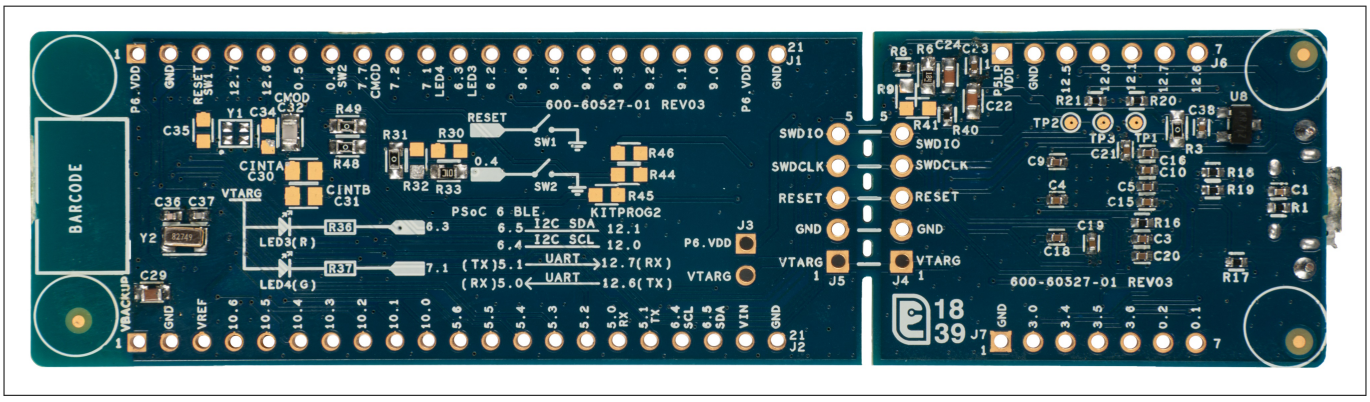

Figure 2 CY8CPROTO-063-BLE PSoC™ 6 Prototyping Board - Bottom view

2 ModusToolbox™

ModusToolbox™ is a free software development ecosystem that includes the Eclipse IDE for ModusToolbox™, AIROC™ BTSTACK, Bluetooth® SDK, and the PSoC™ 6 SDK to develop applications for Infineon IoT products. Eclipse IDE for ModusToolbox™ is a multi-platform, integrated development environment (IDE) used to create new applications, update application code, change middleware settings, and program or debug applications.

Using ModusToolbox™, you can enable and configure device resources and middleware libraries, write C source code, and program and debug the device. The build system infrastructure includes the new project creation wizard that can run independently of the Eclipse IDE, the make infrastructure, and other tools. This means you can choose your compiler, RTOS, and ecosystem without compromising usability or access to our industry-leading CAPSENSE™ (Human-Machine Interface), AIROC™ Wi-Fi and Bluetooth®, security, and various other features.

The Infineon's AIROC™ BTSTACK is a software implementation of the Bluetooth® core 5.4 host protocol stack. The stack is hosted as a library on Infineon's GitHub. The stack library includes both Bluetooth® BR/EDR and Bluetooth® Low Energy hosts and provides APIs for them. The application can choose to use Bluetooth® Low Energy or both BR/EDR + LE. The stack is available for different Arm® cores, such as CM4 and CM33, and can be used with three toolchains Arm®, GCC, and IAR.

For more details on ModusToolbox™ installation and usage, see the ModusToolbox™ user guide

2.1 ModusToolbox™ code examples

ModusToolbox™ includes many code examples. Many of these code examples are compatible with this kit. Browse the collection of starter applications during application setup through **File** > **New** > **ModusToolbox™ Application** or browse the collection of code examples on Infineon's GitHub repository.

2.1.1 Create a new application

This part takes you step-by-step through creating a new ModusToolbox™ application. Before performing the steps in this section, decide whether you want to create and run the code example as-is or you would instead learn how to create an application from scratch. Depending on your choice, the steps you need to follow are as shown below:

Path	"Using CE directly" path (Evaluate existing code example (CE) directly)	"Working from Scratch" path (Use existing code example (CE) as reference only)
Actions	Follow the sections Select a new workspace, Create a new ModusToolbox™ application, Select PSoC™ 63 MCU-based target hardware, and Create the Bluetooth® LE Find Me code example (applicable only for the "Using CE directly" flow). Ignore section Select a starter application and create the application (Applicable only for "Working from Scratch" flow).	Follow the sections Select a new workspace, Create a new ModusToolbox™ application, Select PSoC™ 63 MCU-based target hardware, and Select a starter application and create the application (Applicable only for "Working from Scratch" flow). Ignore section Create the Bluetooth® LE Find Me code example (applicable only for the "Using CE directly" flow).

Launch ModusToolbox™ and get started.

2.1.1.1 Select a new workspace

At launch, ModusToolbox™ presents a dialog to choose a directory for use as the workspace directory. The workspace directory is used to store workspace preferences and development artifacts such as device configuration and application source code.

You can choose an existing empty directory by clicking the **Browse** button, as Figure 3 shows. Alternatively, you can type in a directory name to be used as the workspace directory along with the complete path, and ModusToolbox™ will create the directory for you.

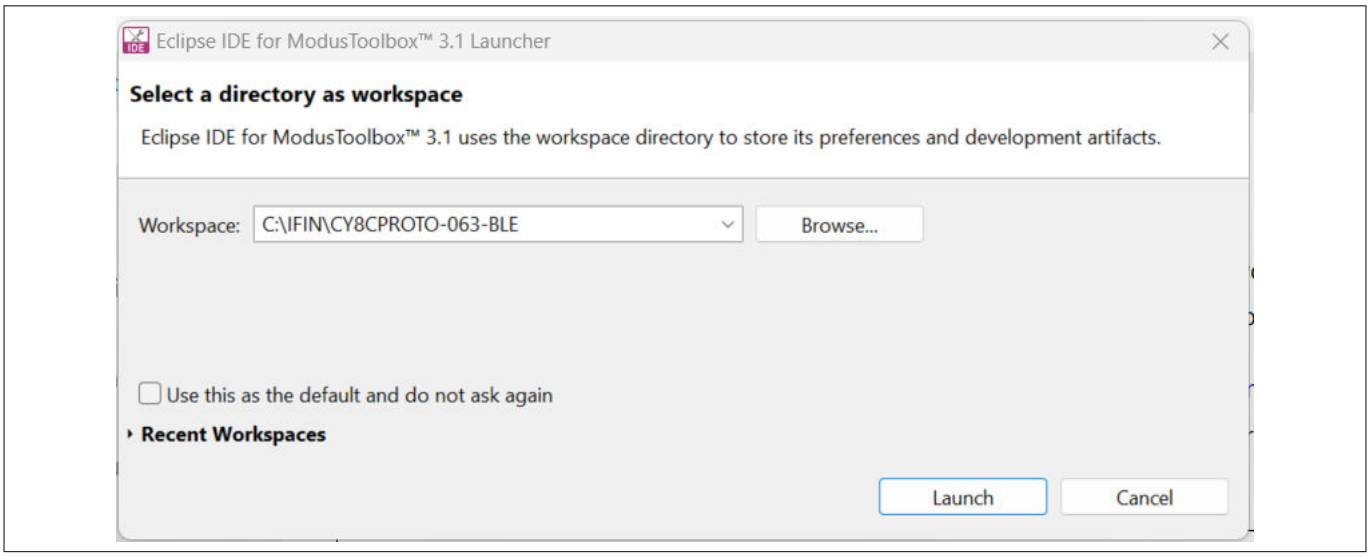

Figure 3 Select a directory as workspace

2.1.1.2 Create a new ModusToolbox™ application

Click **New Application** in the Start group of the Quick Panel. Alternatively, you can choose **File > New > ModusToolbox™ Application** (Figure 4).

The Eclipse IDE for ModusToolbox™ Application window appears.

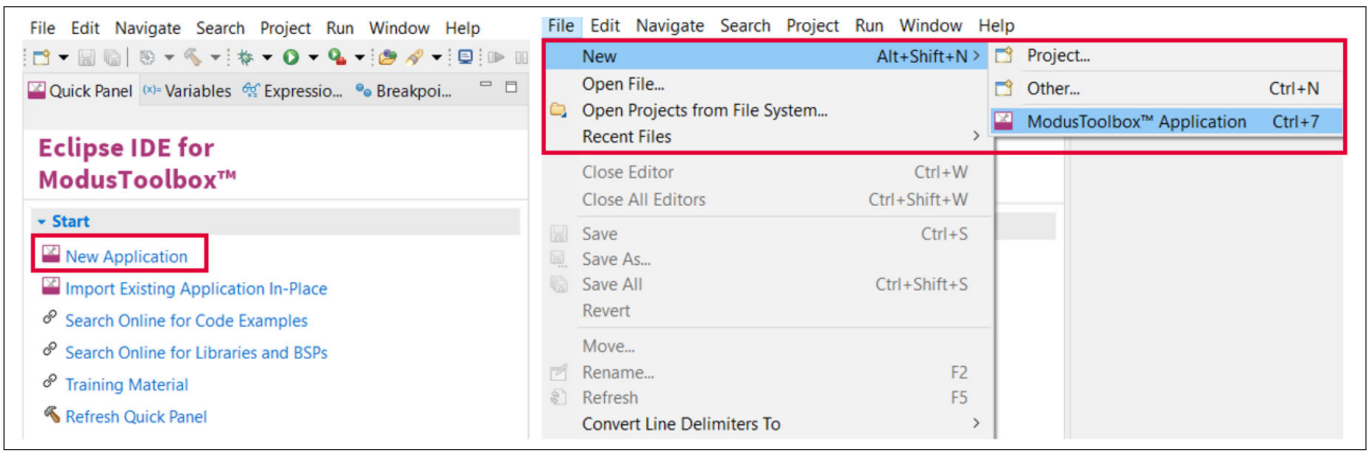

Figure 4 Create a new ModusToolbox™ application

2.1.1.3 Select PSoC™ 63 MCU-based target hardware

ModusToolbox™ presents the list of Infineon kits to start your application development. In this case, we want to develop an application on the CY8CPROTO-063-BLE evaluation board that uses the PSoC™ 63-line device. Select **CY8CPROTO-063-BLE** and click **Next** (Figure 5).

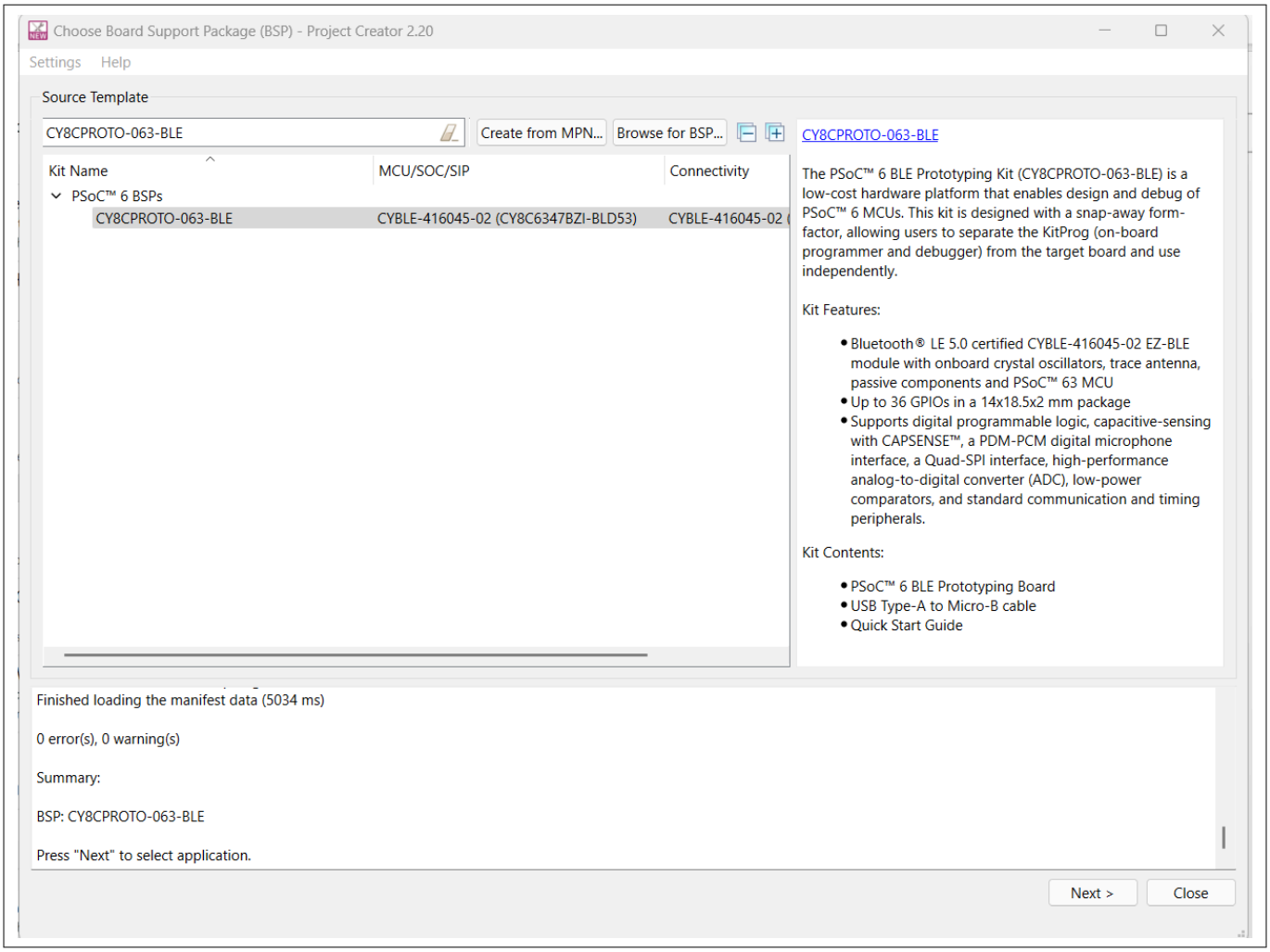

Figure 5 Choose target hardware

2.1.1.4 Create the Bluetooth® LE Find Me code example (applicable only for the “Using CE directly” flow)

Here, you **Create** an existing code example into Eclipse IDE for ModusToolbox™. Use this feature to create the Bluetooth® LE Find Me code example for the *Using CE directly* flow. Figure 6 shows the **Select Application** dialog of the project creator tool. Select the Bluetooth® LE Find Me application, and optionally, in the ‘New application Name’ field, change the name of the application. Click on **Create** and wait for the application to get downloaded and created in the workspace. Click on **Close** to complete the application creation process.

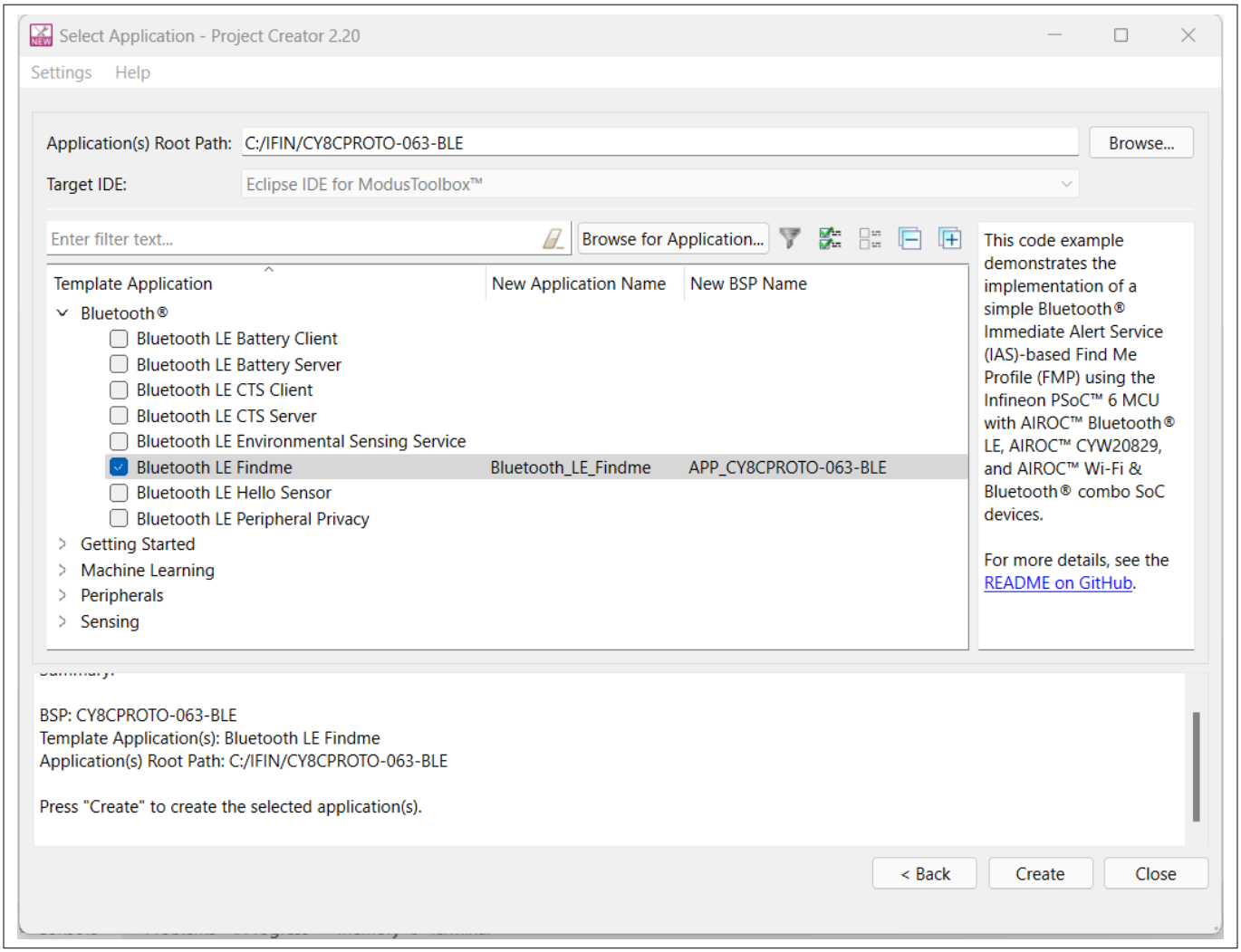

Figure 6 Create Bluetooth® LE Find Me code example

You have successfully created a new ModusToolbox™ application for CY8CPROTO-063-BLE.

2.1.1.5 Select a starter application and create the application (Applicable only for “Working from Scratch” flow)

Here, you use an existing template application as the starting point for the *Working from Scratch* development flow. In the **Select Application** dialog shown in Figure 7, select **Empty_ App**. In the **Name** field, type in a name for the application and click **Next**; the application summary dialog appears. Click on **Create** and wait for the application to get downloaded and created in the workspace. Click on **Close** to complete the application creation process.

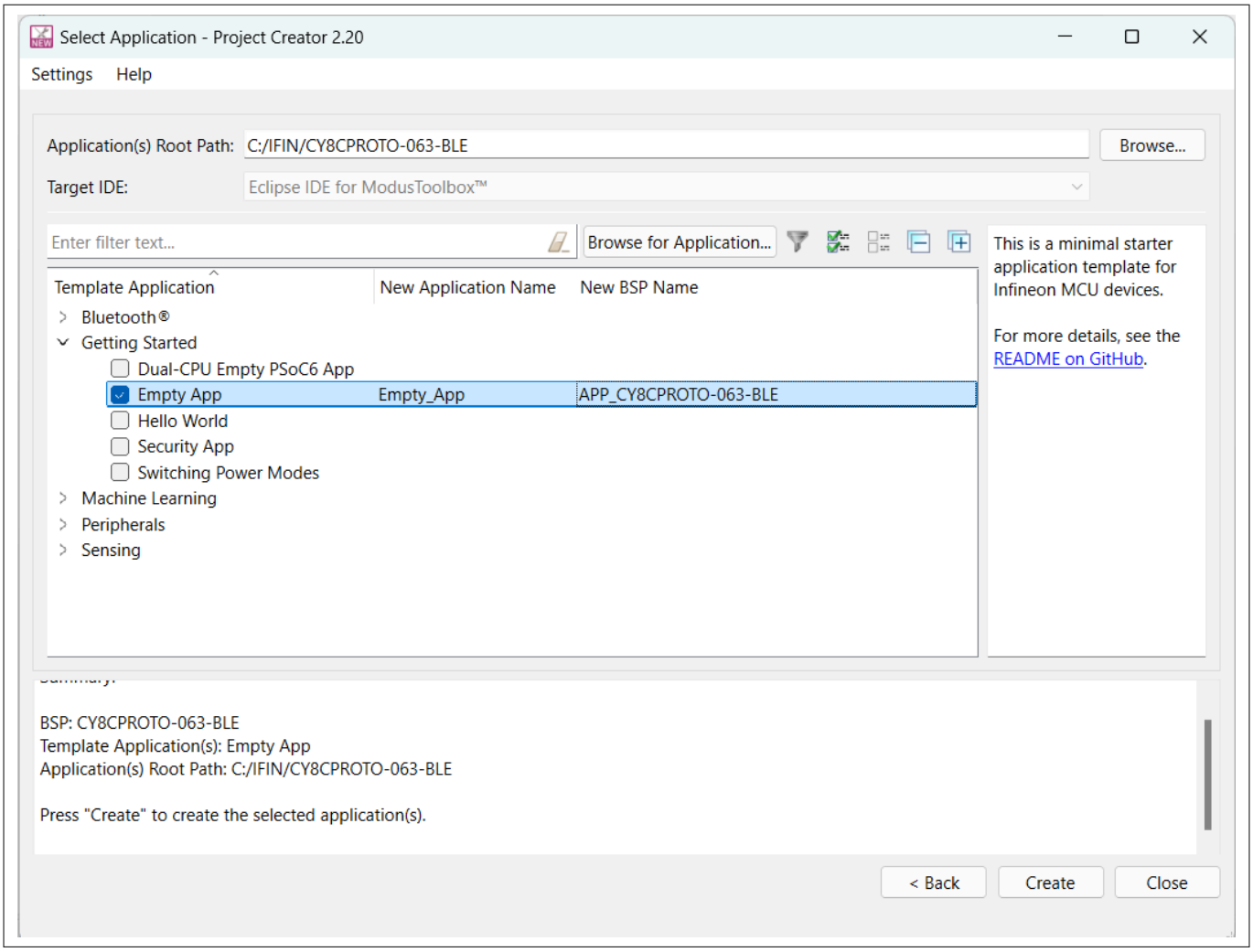

Figure 7 Starter application window

You have successfully created a new ModusToolbox™ application for CY8CPROTO-063-BLE.

2.1.1.6 Programming and debugging using ModusToolbox™

You can build and program the application in ModusToolbox™. In the project explorer, select the **<App Name>** project. In the Quick Panel, scroll to the **Launches** section, and click the **<App Name> Program (KitProg3_MiniProg4)** configuration as shown in Figure 8.

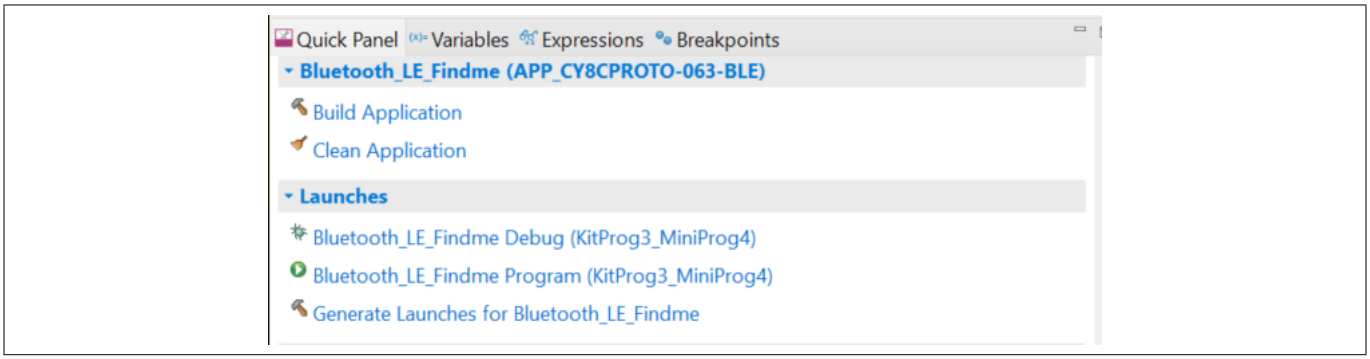

Figure 8 Programming the CY8CPROTO-063-BLE device using ModusToolbox™

2.2 Related code examples

The kit code examples are accesses from the GitHub repository. This code example is available in ModusToolbox™. For the most recent version of the code example, check the GitHub repository. You can find the CE230297 code example in mtb-example-btstack-freertos-findme. For more details on the functionality, design, and implementation of the code example, see the `Readme` file present in the same folder as that of the code example. To import the most recent version of the GitHub code examples into ModusToolbox™, see the ModusToolbox™ user guide document (**Help** > **ModusToolbox™** > **Documentation** > **User guide**).

2.3 ModusToolbox™ help

Launch ModusToolbox™ and navigate to the following items:

- **Quick start guide**: Choose **Help** > **Eclipse IDE for ModusToolbox™ Documentation** > **Quick start guide**. This guide gives you the basics of using ModusToolbox™
- **ModusToolbox™ General Documentation**: Choose **Help** > **ModusToolbox™ General Documentation** > **ModusToolbox™ Documentation Index**. This page provides links to various ModusToolbox™ documents
- **ModusToolbox™ User guide**: Choose **Help** > **Eclipse IDE for ModusToolbox™ Documentation** > **User guide**. This is a comprehensive guide for creating, building, and programming ModusToolbox™ applications

2.4 Getting started

This guide will help you get acquainted with the CY8CPROTO-063-BLE PSoC™ 6 Bluetooth® LE Prototyping Board:

- The Kit operation chapter describes the major features of the CY8CPROTO-063-BLE PSoC™ 6 Bluetooth® LE Prototyping Board and functionalities such as programming, debugging, and the USB-UART and USB-I2C bridges
- The Code examples chapter describes how to easily adapt a code example that was originally developed for PSoC™ 6 Bluetooth® LE Pioneer Kit (CY8CKIT-062-BLE)
- The Appendix describes the hardware content of the kit and the hardware operation, details about programming the kit using MiniProg4, Kit Schematics, and the bill of materials (BOM)

2.5 Additional learning resources

Infineon provides a wealth of data at www.infineon.com to help you to select the right PSoC™ device for your design, and to help you to quickly and effectively integrate the device into your design. The following is an abbreviated list for PSoC™ 6 MCU:

- Overview: PSoC™ Portfolio
- Product Selectors: PSoC™ 6 MCU Product Selector
- Datasheets: Describe and provide electrical specifications for the PSoC™ 61, PSoC™ 62, PSoC™ 63 devices and AIROC™ CYBLE-416045-02 Bluetooth® LE module datasheet
- PSoC™ 4 and PSoC™ 6 MCU CAPSENSE™ design guide: Learn how to design capacitive touch-sensing applications with the PSoC™ 6 MCU and PSoC™ 4 family of devices
- Reference manual: Provide detailed descriptions of the architecture and registers in each PSoC™ 6 MCU family
- Development Kits:
  - PSoC™ 6 Bluetooth® LE Pioneer Kit (CY8CKIT-062-BLE) and PSoC™ 6 WiFi -BT Pioneer Kit (CY8CKIT-062-WiFi-BT) are easy-to use and inexpensive development platforms. These kits include connectors for Arduino compatible shields and Digilent Pmod Peripheral Modules

- PSoC™ 6 Bluetooth® LE Prototyping Kit (CY8CPROTO-063-BLE) are very low-cost prototyping platform for sampling PSoC™ 6 MCU
- CY8CKIT-005-A is a common development platform for all PSoC™ family devices
- The MiniProg4 device provides an interface for flash programming and debug

  ***Note**: MiniProg4 is not required to use kits such as CY8CPROTO-063-BLE that have KitProg3 provided on-board*

- Knowledge Base Articles (KBA): Provide design and application tips from experts on using the device
- ModusToolbox™ Training: Visit ModusToolbox™ for a comprehensive list of video training on ModusToolbox™
- Learning from Peers: Visit community.infineon.com/welcome to meet enthusiastic PSoC™ developers discussing the next-generation embedded systems on Infineon Developer Community Forums

2.6 Technical support

For assistance, visit Infineon Support.

You can also use the following support resources if you need quick assistance:

- Self-help (Technical documents)
- Local sales office locations

3 Kit operation

This chapter introduces you to different features of the CY8CPROTO-063-BLE PSoC™ 6 Bluetooth® LE Prototyping Kit. This primarily includes the programming and debugging functionalities, KitProg3 USB-UART and USB-I2C bridges, and the procedure to update the KitProg3 firmware.

3.1 Theory of operation

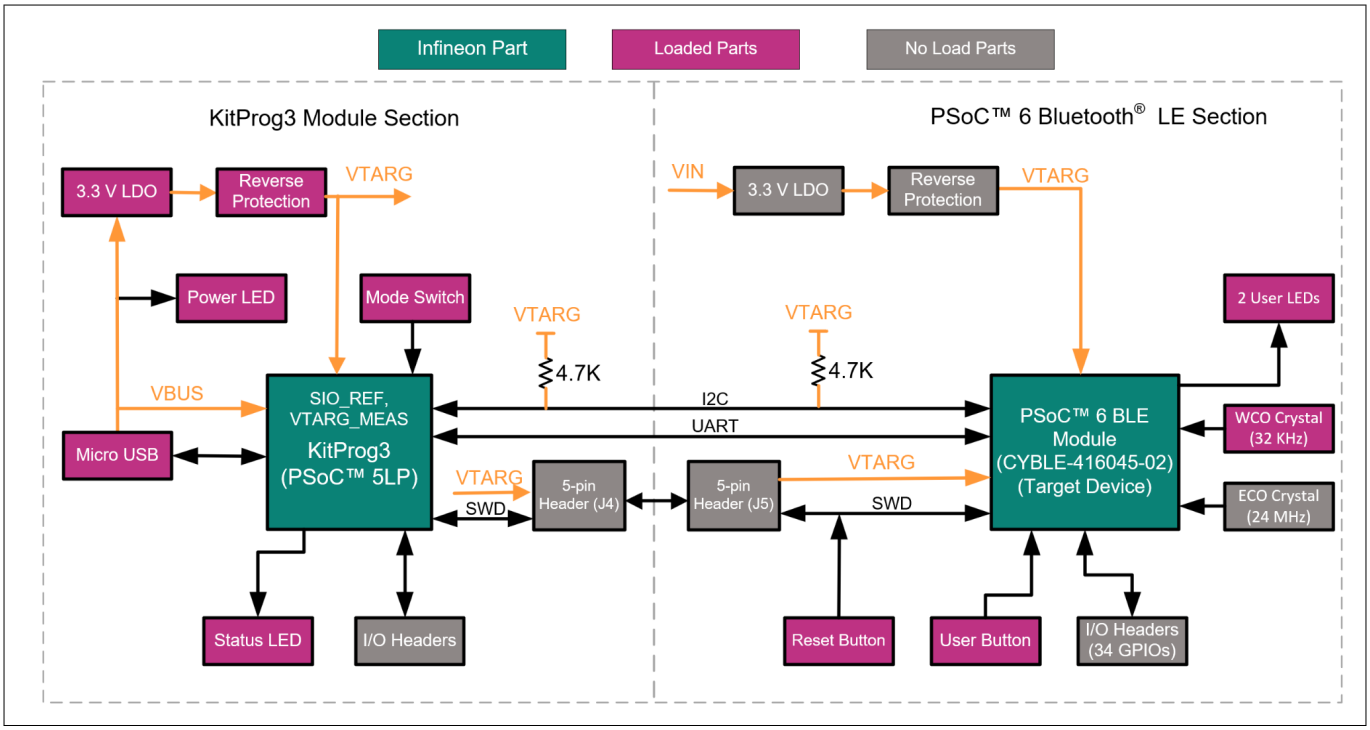

Figure 9 Block Diagram of CY8CPROTO-063-BLE PSoC™ 6 Bluetooth® LE Prototyping Board

The CY8CPROTO-063-BLE PSoC™ 6 Bluetooth® LE Prototyping Kit is simplistic in design and focuses on providing you with complete access to develop applications using the PSoC™ 6 MCU. This kit supports the following features:

- **PSoC™ 6 Bluetooth® LE I/O Headers**: The Prototyping Board brings all GPIOs of the target CYBLE-416045-02 module to the two expansion headers, except the pins used for the WCO crystal. Although this is a subset of the actual PSoC™ 6 MCU, it is sufficient to evaluate most of the features
- **User LEDs**: The onboard LEDs, (LED3 and LED4) can be used to display outputs from the PSoC™ 6 Bluetooth® LE device. This includes modulating the brightness of the LED to notify different states of the device. You may interface other LEDs as well by connecting to the expansion headers directly or by connecting them to a breadboard
- **User Button**: This kit has a push button, which can be used to provide an input to the PSoC™ 6 MCU.

  Note: *The button connects the PSoC™ 6 MCU pin (P0[4]) to ground when pressed. Therefore, you need to configure the PSoC™ 6 MCU pin as 'resistive pull-up' for detecting the button press*

- **Bluetooth® LE Module**: The Bluetooth® LE module (CYBLE-416045-02) from Infineon is used to demonstrate how easily an end product can be created with Bluetooth® LE. The Bluetooth® LE module contains the CY8C6347BZI-BLD53 PSoC™ 6 MCU, crystal used for the Bluetooth® LE radio, and an onboard antenna. Most code examples that work for the PSoC™ 6 MCU will work with the Bluetooth® LE module, depending only on the GPIO requirements

- **ECO Crystal footprint**: A footprint for an external crystal is provided so that you may attach a crystal with your choice of frequency.

  The recommended crystal is ECS-240-8-37CKM from ECS Inc., which provides 24 MHz at ±50 ppm accuracy. Any crystal with compatible footprint (2.0 mm × 1.6 mm) can be used
- **WCO Crystal**: A 32.768-kHz crystal is provided and is used for Bluetooth® LE applications to provide accurate timing including when the device is in low power mode
- **Reset Button**: This button is used to reset the PSoC™ 6 MCU when pressed
- **Power LED**: This LED indicates power is being supplied to the board
- **5-pin Programming Headers**: These are programming headers that can be used to program the Bluetooth® LE module using a MiniProg4 programmer/debugger. Typically, this connection is not required because the kit contains an integrated KitProg3 for programming and debugging
- **PSoC™ 5LP I/O Headers**: Using these headers, you can evaluate the PSoC™ 5LP (CY8C5868LTI-LP039) device. The PSoC™ 5LP device is used to implement the KitProg3 functionality by default
- **Current Measurement Jumper**: Using this jumper, you can measure the current consumed by the Bluetooth® LE module. This jumper is not populated by default. To use this jumper, you must remove the zero-Ω resistor R28
- **USB 2.0 Micro-B Connector**: This connector is used to connect the board to the PC with the provided USB cable, enable to program and/or debug the device. It is used to provide power to the device
- **KitProg3**: This is an onboard programmer/debugger utilizing a PSoC™ 5LP device (CY8C5868LTI-LP039), which enables you to program and debug the target PSoC™ 6 MCU. It can also act as a USB-UART and USB-I2C bridge.

  When used as a standalone module, KitProg3 can be used to program devices of PSoC™ 3, PSoC™ 4, PSoC™ 5LP, or PSoC™ 6 families through the SWD interface. This version of the KitProg3 supplies 3.3 volts to the PSoC™ 6 MCU section of the board. For more details on the KitProg3 functionality, see the KitProg3 user guide
- **KitProg3 Mode Selection Button**: This button is used to switch between KitProg3 modes as shown in Table 2. You can also use this button to provide an input to the PSoC™ 5LP device in custom applications. Note that the button connects the PSoC™ 5LP pin to ground when pressed. For more details, see the KitProg3 user guide
- **KitProg3 Status LED**: This LED gives the programming/mode status of KitProg3

Table 2 KitProg3 Mode Switching

KitProg3 Programming Modes[1)]	Status LED (LED2)
KitProg3 Program/Debug mode (default)	ON
CMSIS-DAP Programming mode	OFF

3.2 USB-UART Bridge

KitProg3 on the PSoC™ 6 Bluetooth® LE Prototyping Board can act as a USB-UART bridge. The UART lines between KitProg3 and the target are hard-wired on the board, through the snappable area, with UART_RX assigned to **P5[0]** and UART_TX assigned to **P5[1]** on target PSoC™ 6 MCU. For more details on the KitProg3 USB-UART functionality, see the **USB-UART Bridge Feature** section in the KitProg3 user guide.

1 Toggling between programming modes can be done by pressing mode switch SW3.

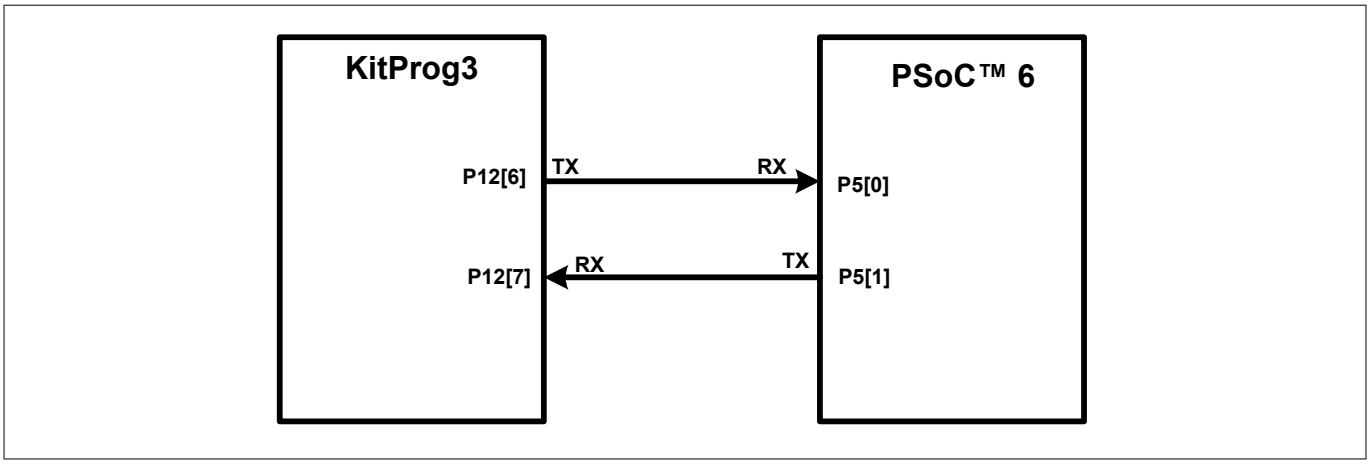

Figure 10 UART Connection between KitProg3 and Bluetooth® LE module

3.3 USB-I2C Bridge

KitProg3 can function as a USB-I2C bridge and communicate with the software utility Bridge Control Panel (BCP). The I2C lines on target Bluetooth® LE module are **P6[5] (SDA)** and **P6[4] (SCL)**, which are hardwired on the board to the I2C lines of KitProg3. The USB-I2C bridge supports I2C speeds of 50 kHz, 100 kHz, 400 kHz, and 1 MHz. For more details on the KitProg3 USB-I2C functionality, see the **USB-I2C/USB-SPI Bridge Feature** section in the KitProg3 user guide.

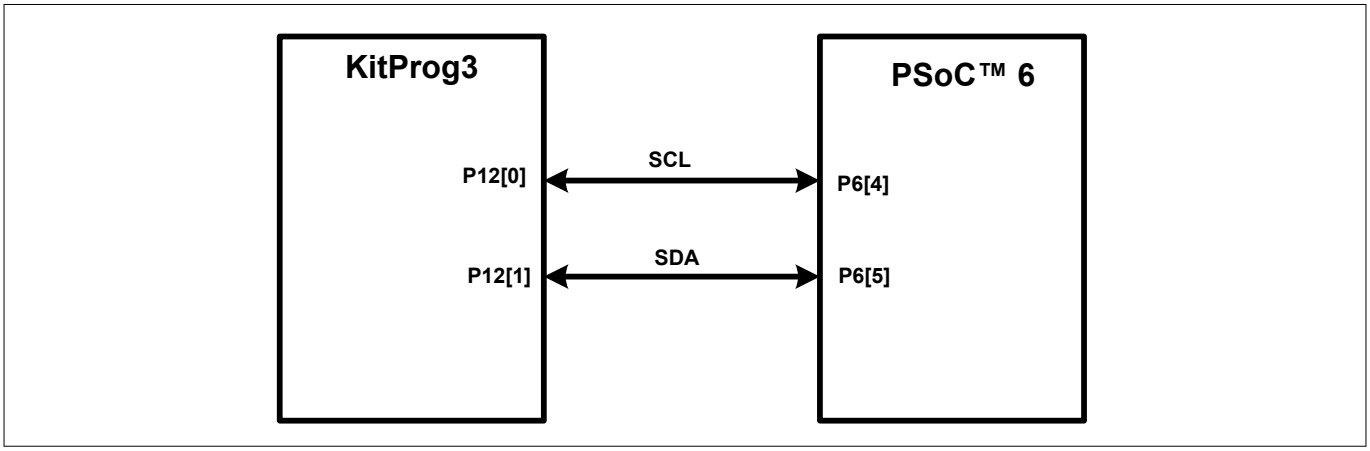

Figure 11 I2C Connection between KitProg3 and Bluetooth® LE module

3.4 Updating the KitProg3 firmware

The KitProg3 firmware normally does not require any update. You can use the PSoC™ Programmer software to update the KitProg3 firmware if necessary. For a detailed explanation on how to update the KitProg3 firmware, see **Updating KitProg3** in the KitProg3 user guide.

4 Code examples

This chapter explains the code example to be adapted to the PSoC™ 6 Prototyping Board. Most existing PSoC™ 6 MCU code examples only require the device to be changed and GPIOs to be reassigned to match the board.

All the code examples are available in ModusToolbox™, make sure that you install the Bluetooth® LE module device support by following the instructions provided in the ModusToolbox™ installation guide.

A Appendix

A.1 Board details

The PSoC™ 6 Bluetooth® LE Prototyping Board consists of the following blocks:

- Bluetooth® LE module (CYBLE-416045-02)
- PSoC™ 6 MCU I/O headers J1 and J2
- KitProg3 (PSoC™ 5LP) device (CY8C5868LTI-LP039)
- KitProg3 I/O headers J6 and J7
- SWD connection headers J4 and J5
- USB 2.0 Micro-B connector J8
- Power LED, LED1 (amber)
- KitProg3 Status LED, LED2 (amber)
- User LED, LED3 (red)
- User LED, LED4 (green)
- ECO Crystal (footprint)
- WCO Crystal (32.768 kHz)
- One Push Button SW2 (User)
- One Push Button SW1 (Reset)
- One Push Button SW3 (KitProg3 Mode)
- Current Measurement Jumper J3 (foot-print only, shorted by the zero-Ω resistor R28)
- Perforated ‘snappable’ board design

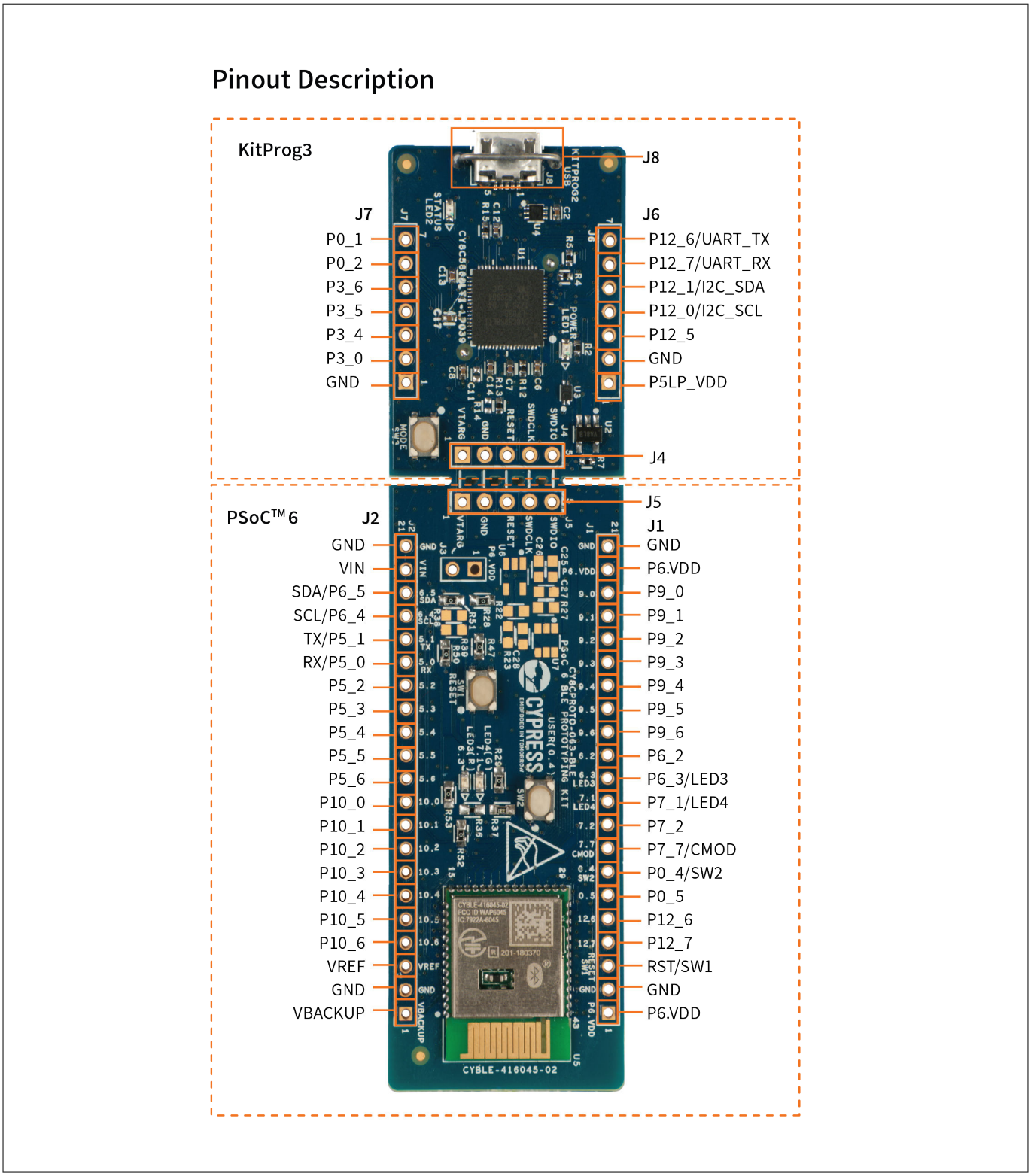

Figure 12 PSoC™ 6 Bluetooth® LE Prototyping Board pin details

A.2 Hardware details

A.2.1 Target board

The target board uses the AIROC™ CYBLE-416045-02 Bluetooth® LE module, which contains a PSoC™ 6 MCU, CY8C6347BZI-BLD53. PSoC™ 6 MCU is a scalable and reconfigurable platform architecture for a family of programmable embedded system controllers with both Arm® Cortex®-M0+ CPU and Cortex®-M4 CPU on a single chip. It combines programmable and reconfigurable digital blocks with flexible automatic routing. The PSoC™ 6 MCU, based on this platform architecture, is a combination of an MCU with digital programmable logic, programmable interconnect, and standard communication and timing peripherals. The digital subsystems allow flexibility and in-field tuning of the design. For more information, see the PSoC™ 6 MCU datasheet and the AIROC™ CYBLE-416045-02 Bluetooth® LE module datasheet.

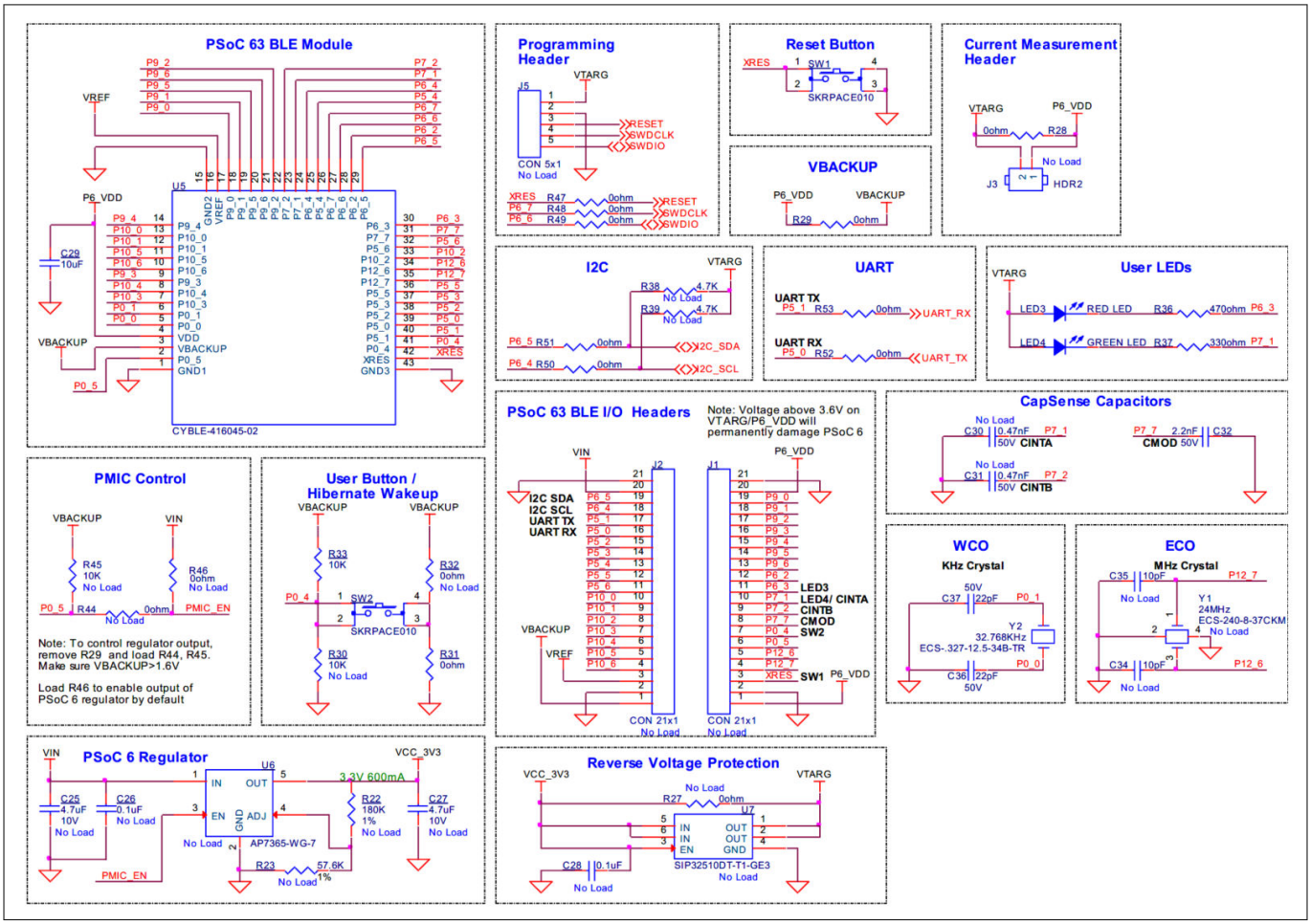

Figure 13 Schematic of PSoC™ 6 MCU (target)

A.2.2 KitProg3 board

A PSoC™ 5LP device on the KitProg3 board is used to program and debug the target PSoC™ 6 MCU. The PSoC™ 5LP-based KitProg3 connects to the USB port of the PC through the USB 2.0 Micro-B connector and to the SWD interface of the target Bluetooth® LE module.

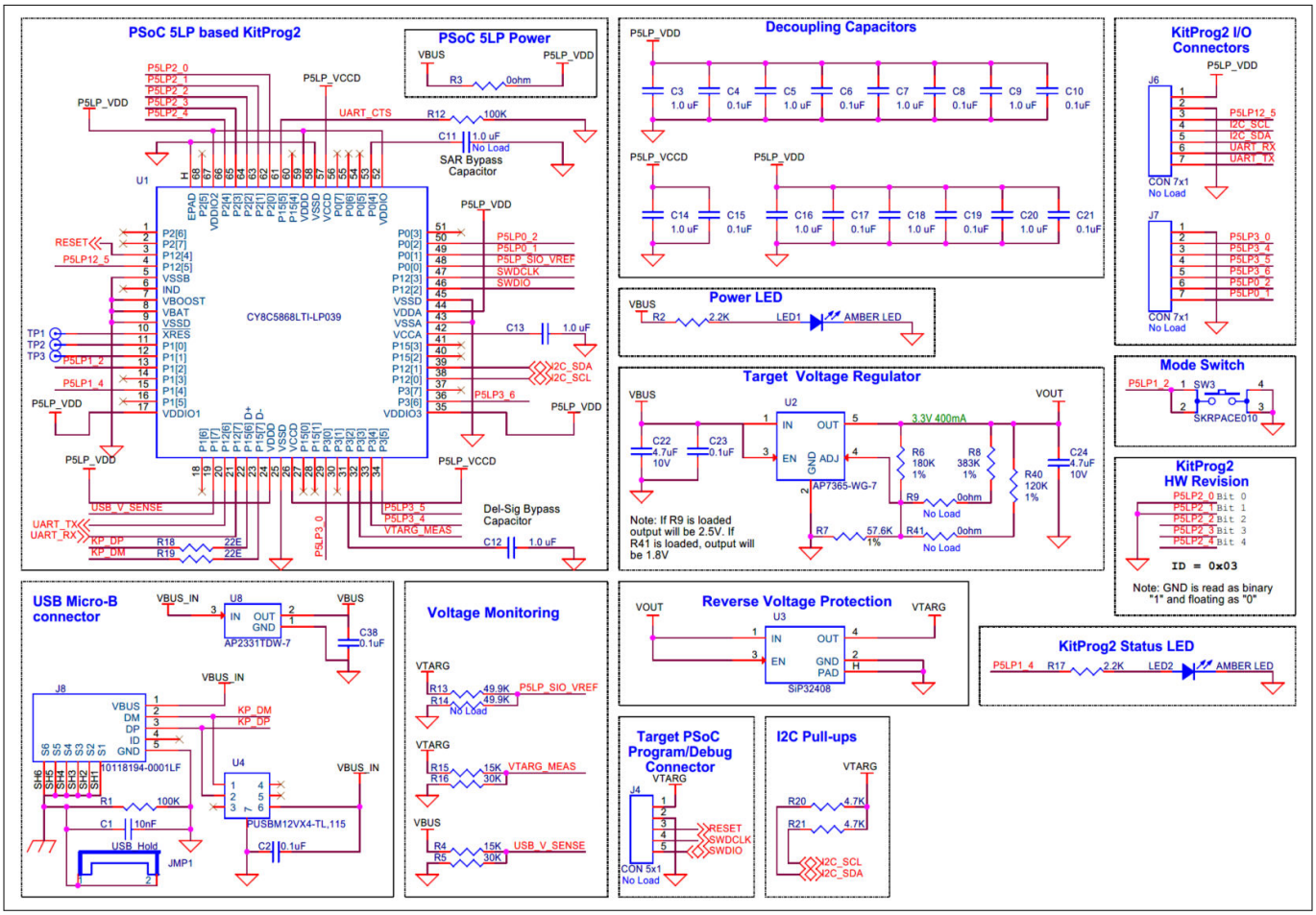

Figure 14 Schematic of PSoC™ 5LP (KitProg3)

A.2.3 Power supply system

The power supply system uses 5 V from the USB connector as the input to a voltage regulator on the KitProg3 section of the board. This regulator provides 3.3 V to the PSoC™ 6 MCU by default. Provisions have been added so that the output can be easily changed to 2.5 V or 1.8 V by adding either R9 or R41 zero-Ω resistors respectively. You can also connect an external power supply to the board at P6.VDD that is present on pin 20 of J1 for low-voltage applications.

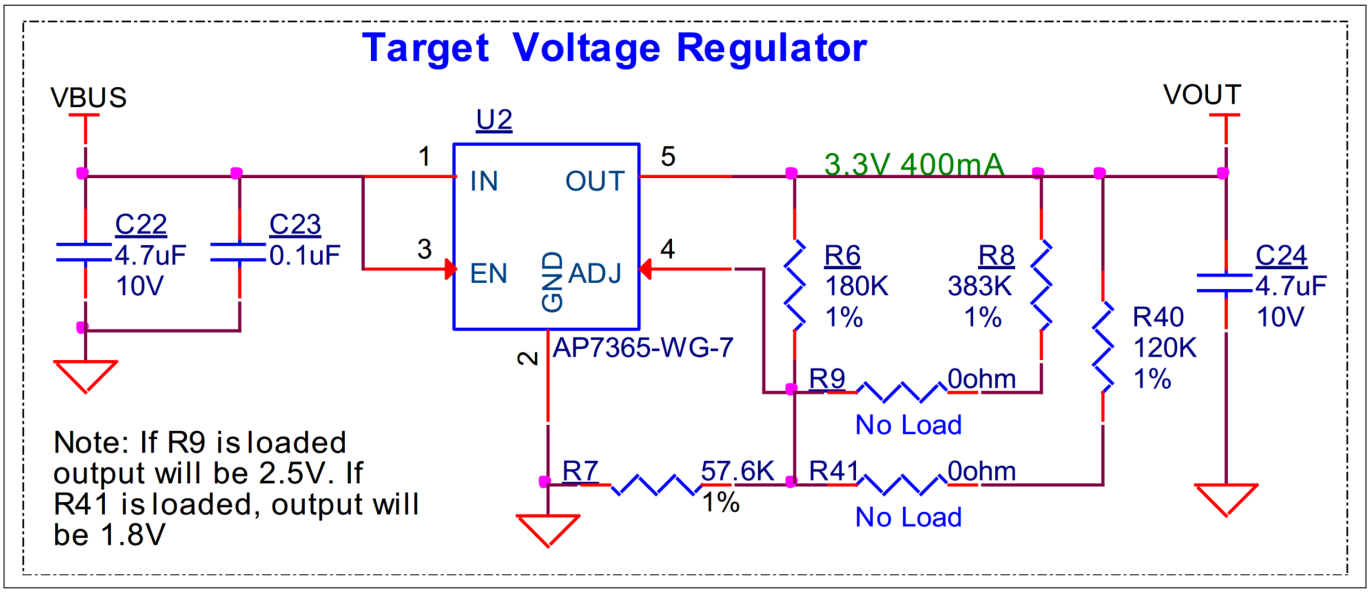

Figure 15 Target power supply

A.2.3.1 Optional PSoC™ 6 MCU voltage regulator

If the PSoC™ 6 MCU section of the board is disconnected from the KitProg3 side by breaking the board between J4 and J5, there are two power options. The first option is to power the board directly with the required voltage at the target voltage (P6.VDD) on connector J1, pin 20. The other alternative is to load the optional components for the PSoC™ 6 MCU regulator and apply a voltage at the VIN connector (J2, pin 20). See schematic below for the PSoC™ 6 MCU regulator.

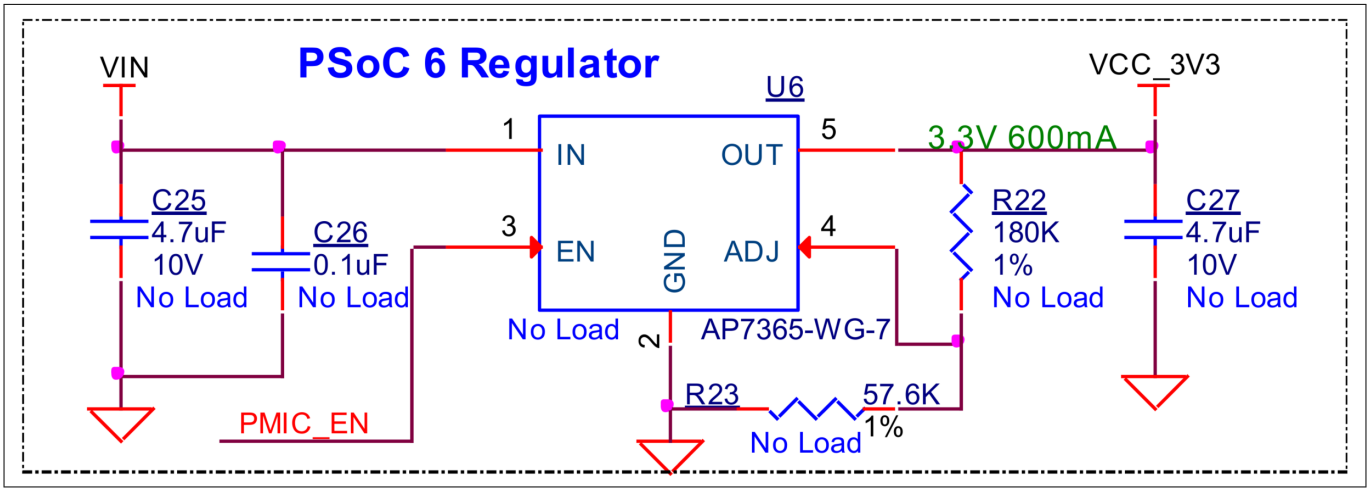

Figure 16 Optional PSoC™ 6 MCU regulator

	**Caution:** Note that the PSoC™ 6 Bluetooth® LE Prototyping Board does not have any onboard ESD protection circuitry. Therefore, the power source for the PSoC™ 6 Bluetooth® LE Prototyping Board must be of high quality to make sure that the board is protected from any over-current conditions and swapped-power connections.

A.2.3.2 Measure Bluetooth® LE module current consumption

To measure the Bluetooth® LE module current, follow these steps:

1. Remove the zero-Ω resistor R28 and install a 2-pin jumper in the supplied holes of J3
2. Connect an ammeter across the 2-pin jumper to measure the current to the Bluetooth® LE module

This method can be used either with USB power or with the power supplied to one of the VTARG pins (J5.1 or J4.1), but NOT when supplying power to one of the P6.VDD pins (J1.1 or J1.20).

After measuring the current consumption, populate resistor R28 or place a shorting jumper across the two jumper pins for normal operation of the kit.

***Notes**:*
After removing R28, system may have some leakage power such as the following:

1. *Communication circuitry between KitProg3 and Target (I2C, UART, SWDIO)*
2. *Reset switch between KitProg3 and target device along with PSoC™ 6 MCU*

A.2.4 Board separation (snapping)

The PSoC™ 6 Bluetooth® LE Prototyping Board consists of a PSoC™ 6 MCU and a KitProg3 board. To separate the two boards for evaluation or development, break the two boards apart at the built-in perforated edge between J4 and J5.

The easiest method of separating the two boards is to place the kit on the edge of a table, where the edge of the table is directly below the perforated edge and the smaller KitProg3 board is off the table edge. Press gently on the KitProg3 board and snap the two boards apart. If any material is removed from the edge of the boards, use sheers to clean up the edge of the kit.

After the PSoC™ 6 Bluetooth® LE Prototyping Board is broken into two, the two halves can be reconnected for programming and debugging by adding connectors at J5 and J6. Also, a Infineon MiniProg4 device can be connected to a connector at J5 to perform programming and debug.

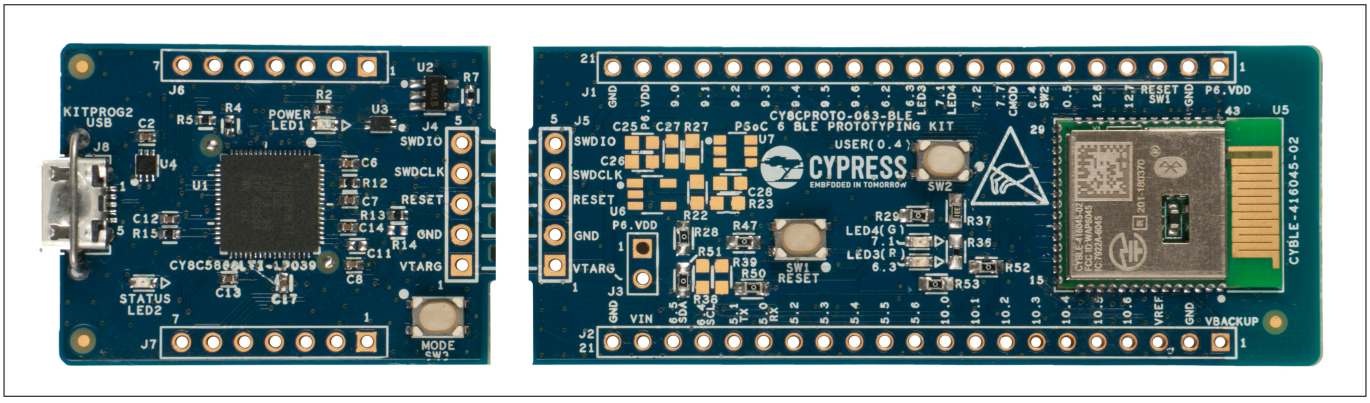

Figure 17 PSoC™ 6 Bluetooth® LE Prototyping Board broken into two parts

After the PSoC™ 6 Bluetooth® LE Prototyping Board is broken into two, the two halves can be reconnected for programming and debugging by adding connectors at J5 and J6. Also, a Infineon MiniProg4 device can be connected to a connector at J5 to perform programming and debug.

	**Caution:** Once the boards are separated, direct UART and I2C connections between the Bluetooth® LE module and KitProg3 are lost. This is because the traces connecting the UART and I2C lines are cut off during the separation. However, you can access KitProg3's UART and I2C lines through header J6 and make the following connections to J2. UART Reconnect: • J6.7 to J2.16 (PSoC™ 5LP P12.6 to PSoC™ 6 P5.0) • J6.6 to J2.17 (PSoC™ 5LP P12.7 to PSoC™ 6 P5.1) I2C Reconnect: • J6.5 to J2.19 (PSoC™ 5LP P12.1 to PSoC™ 6 P6.5) • J6.4 to J2.18 (PSoC™ 5LP P12.0 to PSoC™ 6 P6.4)

A.2.5 Header connections

The PSoC™ 6 Bluetooth® LE Prototyping Board supports a number of unpopulated headers on both the KitProg3 and the target PSoC™ 6 MCU sections.

A.2.5.1 Functionality of the J1 and J2 headers (target board)

The target PSoC™ 6 MCU section contains two single inline headers (J1 and J2). These 1×21-pin headers have 0.1-inch spacing and include all of the GPIOs available on the Bluetooth® LE module. Power pins, reference input and reset signal are also available on these connectors. See Figure 18 for details.

The target headers J1 and J2 are partially compatible with mikroBUS. It supports only 3.3 V operation with Click Boards, and does not have the reset pin functionality.

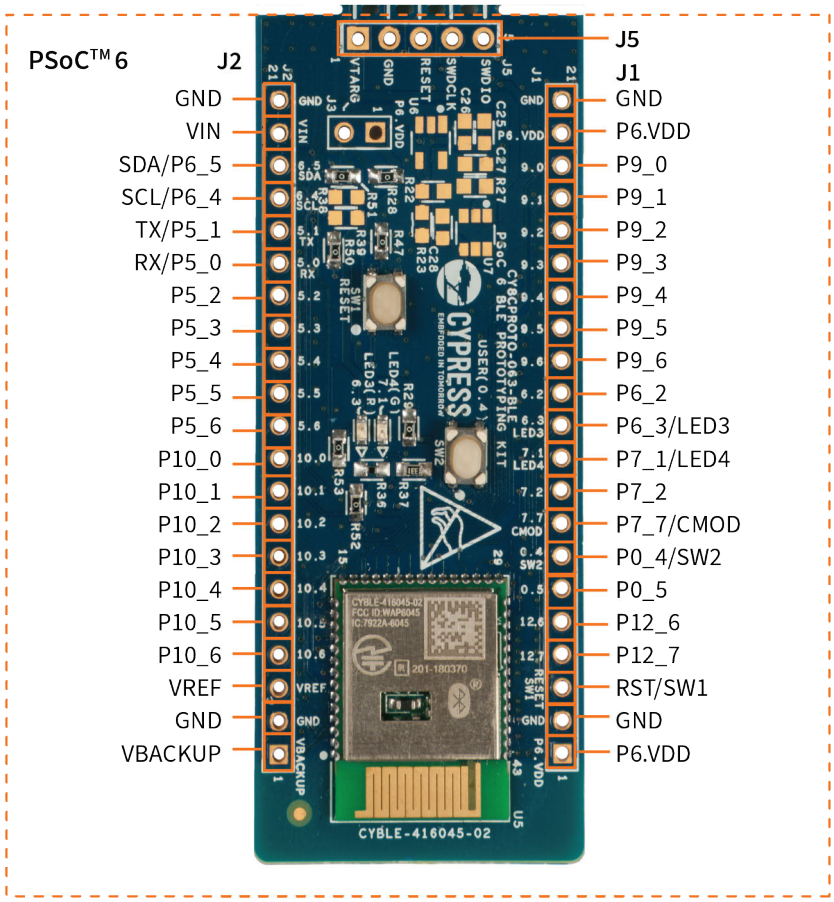

Figure 18 J1 and J2 headers

Table 3 Pin Details of J1 and J2 headers

PSoC™ 6 Bluetooth® LE Prototyping Board GPIO header (J2)			PSoC™ 6 Bluetooth® LE Prototyping Board GPIO header (J1)		
Pin	**Signal**	**Description**	**Pin**	**Signal**	**Description**
J2_01	VBKUP[2)]	Backup Power	J1_01	P6_VDD[2)]	Power
J2_02	GND	Ground	J1_02	GND	Ground
J2_03	V_{REF}	SAR ADC Vref	J1_03	RST	PSoC™ 6 MCU Reset
J2_04	P10.6	GPIO	J1_04	P12.7	GPIO
J2_05	P10.5	GPIO	J1_05	P12.6	GPIO
J2_06	P10.4	GPIO	J1_06	P0.5	GPIO
J2_07	P10.3	GPIO	J1_07	P0.4	GPIO/User SW2
J2_08	P10.2	GPIO	J1_08	P7.7	GPIO/CMOD

(table continues...)

2 P6_VDD and VBKUP should never exceed 3.6 V.

Table 3 (continued) Pin Details of J1 and J2 headers

PSoC™ 6 Bluetooth® LE Prototyping Board GPIO header (J2)			PSoC™ 6 Bluetooth® LE Prototyping Board GPIO header (J1)		
Pin	**Signal**	**Description**	**Pin**	**Signal**	**Description**
J2_09	P10.1	GPIO	J1_09	P7.2	GPIO
J2_10	P10.0	GPIO	J1_10	P7.1	GPIO/LED4
J2_11	P5.6	GPIO	J1_11	P6.3	GPIO/LED3
J2_12	P5.5	GPIO	J1_12	P6.2	GPIO
J2_13	P5.4	GPIO	J1_13	P9.6	GPIO
J2_14	P5.3	GPIO	J1_14	P9.5	GPIO
J2_15	P5.2	GPIO	J1_15	P9.4	GPIO
J2_16	P5.0	GPIO/UART_RX	J1_16	P9.3	GPIO/SPI-CS
J2_17	P5.1	GPIO/UART_TX	J1_17	P9.2	GPIO/SPI-SCK
J2_18	P6.4	GPIO/I2C-SCL	J1_18	P9.1	GPIO/SPI-MISO
J2_19	P6.5	GPIO/I2C-SDA	J1_19	P9.0	GPIO/SPI-MOSI
J2_20	VIN	Input Voltage	J1_20	P6_VDD[2)]	Target Voltage Input
J2_21	GND	Ground	J1_21	GND	Ground

A.2.5.2 Functionality of J4 and J5 headers (KitProg3 to PSoC™ 6 MCU)

The KitProg3 and target boards each contain a 1×5-pin header. These headers provide a physical connection between the two devices. Specifically, the connection includes the SWD interface, required to program/debug the target PSoC™ 6 MCU in the Bluetooth® LE module, power, ground, and reset.

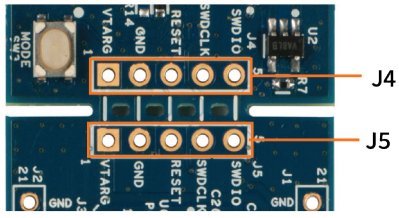

Figure 19 J4 and J5 headers

2 P6_VDD and VBKUP should never exceed 3.6 V.

Table 4 Pin Details of J4 and J5 headers

KitProg3 header (J4)			PSoC™ 6 MCU header (J5)		
Pin	**Signal**	**Description**	**Pin**	**Signal**	**Description**
J4_1	VTARG	Power	J5_1	VTARG	Power
J4_2	GND	Ground	J5_2	GND	Ground
J4_3	P12.4	Reset	J5_3	XRES	Reset
J4_4	P12.3	SWD_CLK	J5_4	P6.7	SWD_CLK
J4_5	P12.2	SWD_IO	J5_5	P6.6	SWD_IO

When the boards are separated, the KitProg3 board can be used to program any other PSoC™ 3, PSoC™ 4, PSoC™ 5LP and PSoC™ 6 family of devices via J4.

A.2.5.3 Functionality of J6 and J7 headers (KitProg3)

The KitProg3 board contains two single in-line headers (J6 and J7). Both are 1×7-pin-headers, used to pull out several pins of the PSoC™ 5LP device to support advanced features such as low-speed oscilloscope and a low-speed digital logic analyzer. This header also contains KitProg3 UART and I2C bridge pins that can be used when the two boards are separated.

The J6 and J7 headers support 100-mil spacing, so you can solder connectors to connect the KitProg3 board to a development breadboard.

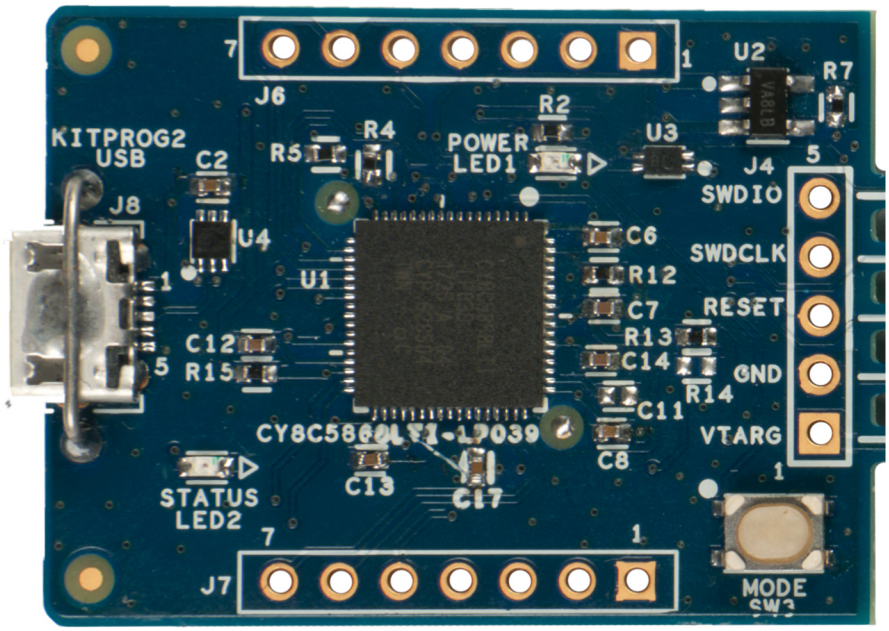

Figure 20 J6 and J7 Headers

Table 5 Pin Details of J6 and J7 Headers

PSoC™ 5LP KitProg3 Header (J6)			PSoC™ 5LP KitProg3 Header (J7)		
Pin	**Signal**	**Description**	**Pin**	**Signal**	**Description**
J6_01	P5LP_VDD	Power	J7_01	GND	Ground
J6_02	GND	Ground	J7_02	P3.0	GPIO
J6_03	P12.5	GPIO	J7_03	P3.4	GPIO
J6_04	P12.0	GPIO/I2C_SCL	J7_04	P3.5	GPIO
J6_05	P12.1	GPIO/I2C_SDA	J7_05	P3.6	GPIO
J6_06	P12.7	GPIO/UART_RX	J7_06	P0.2	GPIO
J6_07	P12.6	GPIO/UART_TX	J7_07	P0.1	GPIO

A.2.6 PSoC™ 6 Bluetooth® LE Prototyping Board features

Use the following features of the Prototyping Board to perform a quick evaluation right out of the box.

- Two user LEDs connected to GPIO pins for feedback
- User switch for user input
- Jumper for current measurement (when R28 is removed)
- Onboard Bluetooth® LE Antenna
- Onboard reset switch

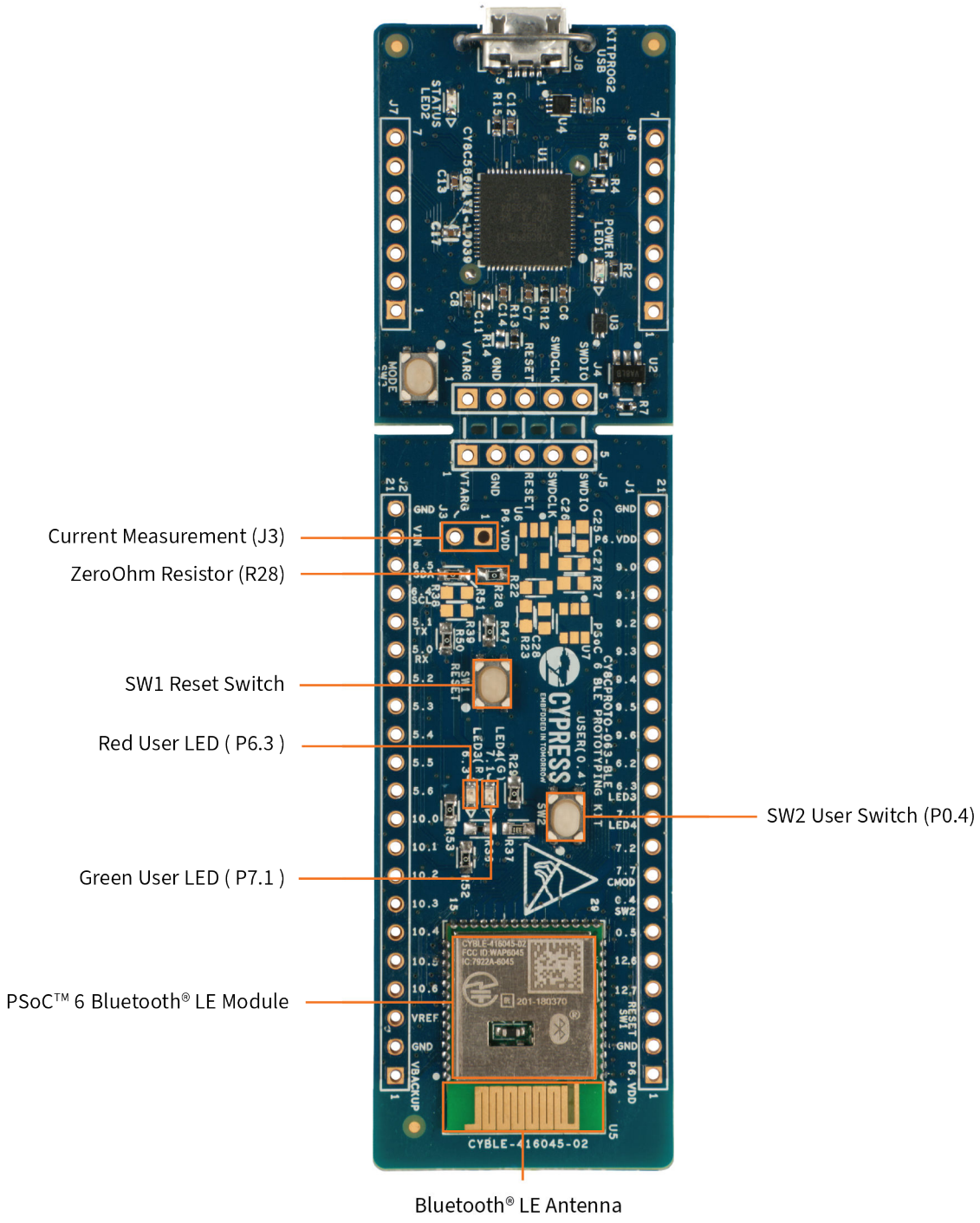

Figure 21 PSoC™ 6 Bluetooth® LE Prototyping Board features

A.2.6.1 User button

The target PSoC™ 6 MCU board contains a button connected to the P0.4 pin on the PSoC™ 6 MCU. This button can be used for general user inputs or for wakeup during Hibernate mode. The buttons connect to ground on activation (active low) by default. User button (SW2) can be changed to active high mode by changing the zero resistors shown below.

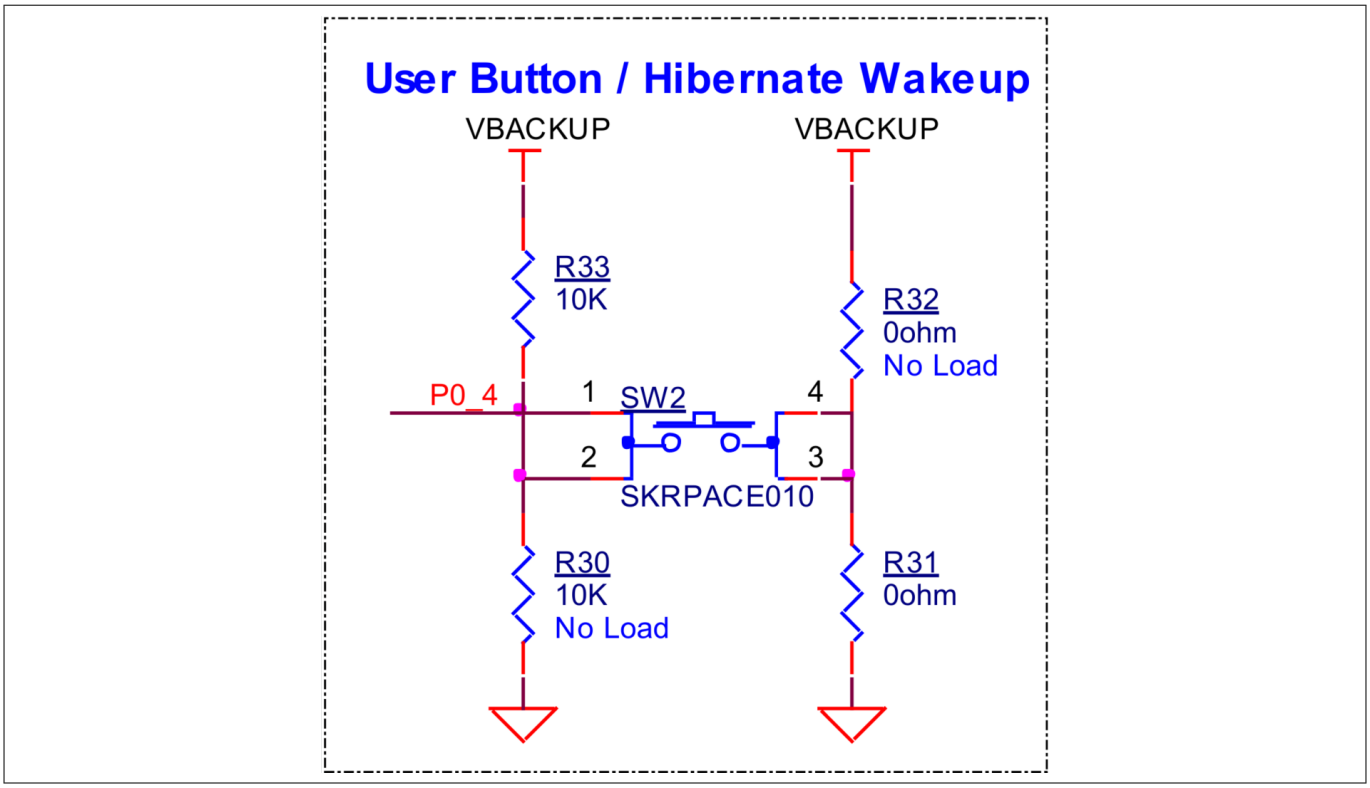

Figure 22 User button on the board

A.2.6.2 User LEDs

There are two user LEDs on the board connected to pins P6.3 (red) and P7.1 (green) to allow the user to indicate an event or mode. The drive is active LOW so the LED will be ON when the GPIO is driven to a '0' and OFF when driven to a '1'.

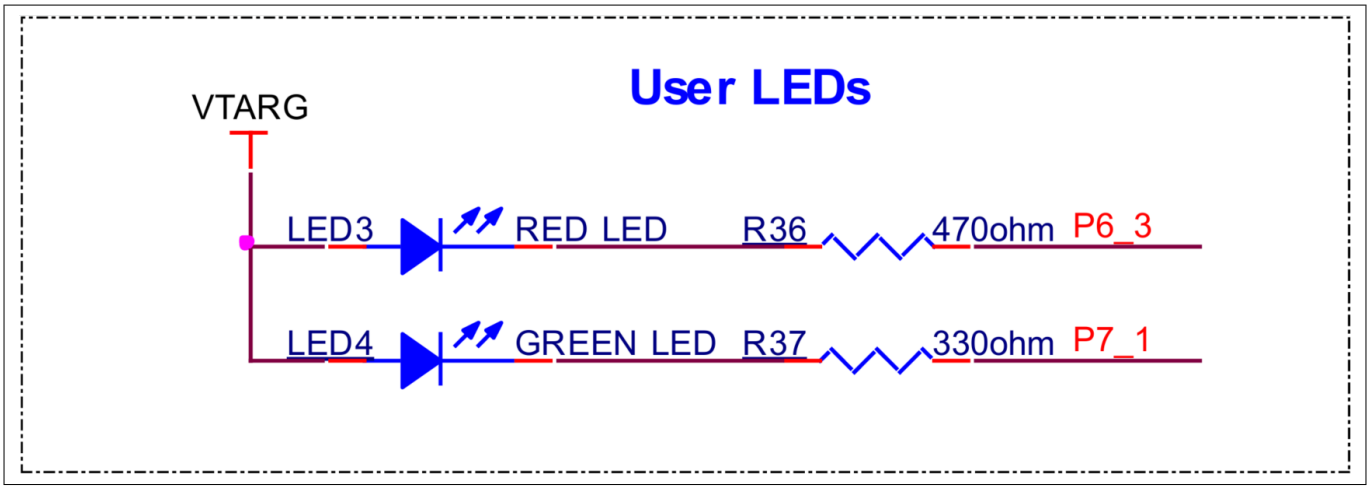

Figure 23 User LEDs

A.2.6.3 Reset button

When the Reset button (SW1) is pressed, the XRES line of the PSoC™ 6 MCU is pulled to ground, which resets the target device.

A.2.6.4 CAPSENSE™ capacitors

There are footprints for three CAPSENSE™ capacitors - one for self-capacitance and one for mutual Capacitance sensing modes, but only the CMOD capacitor used for self-capacitance mode is loaded. If CAPSENSE™ is not used but P7.7 is used for a digital or analog function, C32 may need to be removed. See the datasheet on the CAPSENSE™ component for more information on how to select and use theses capacitors (C30-CINTA, C31-CINTB, and C32-CMOD).

***Note**: P7[1] is used for LED4 (green LED) by default. This must be disconnected by removing R37 before loading C30 for mutual capacitive sensing (CSX).*

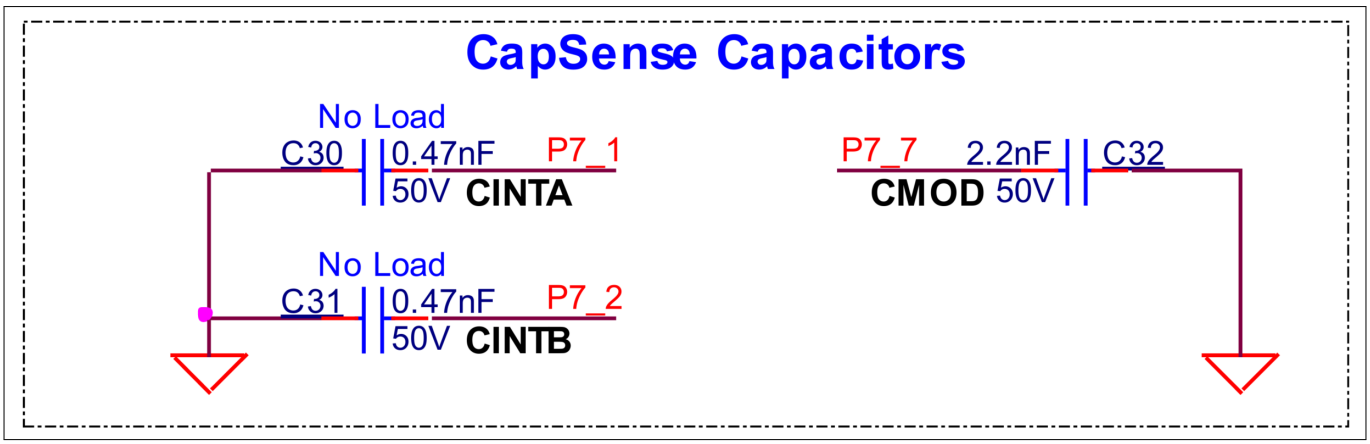

Figure 24 CAPSENSE™ capacitors

A.2.6.5 System crystals

Two different crystal oscillators inputs are available on the board. The WCO kHz crystal (32.768 kHz) is populated and is used for Bluetooth® LE timing. Pads for the ECO MHz crystal and load crystals are on the board so that you can easily select the crystal of your choice. The ECO is optional and only required when the internal clock must be more accurate than the IMO (Internal Main Oscillator). The internal FLL and PLL help to provide a wide range of options with either the ECO or IMO. The crystal used for the Bluetooth® LE radio is pre-installed in the Bluetooth® LE module.

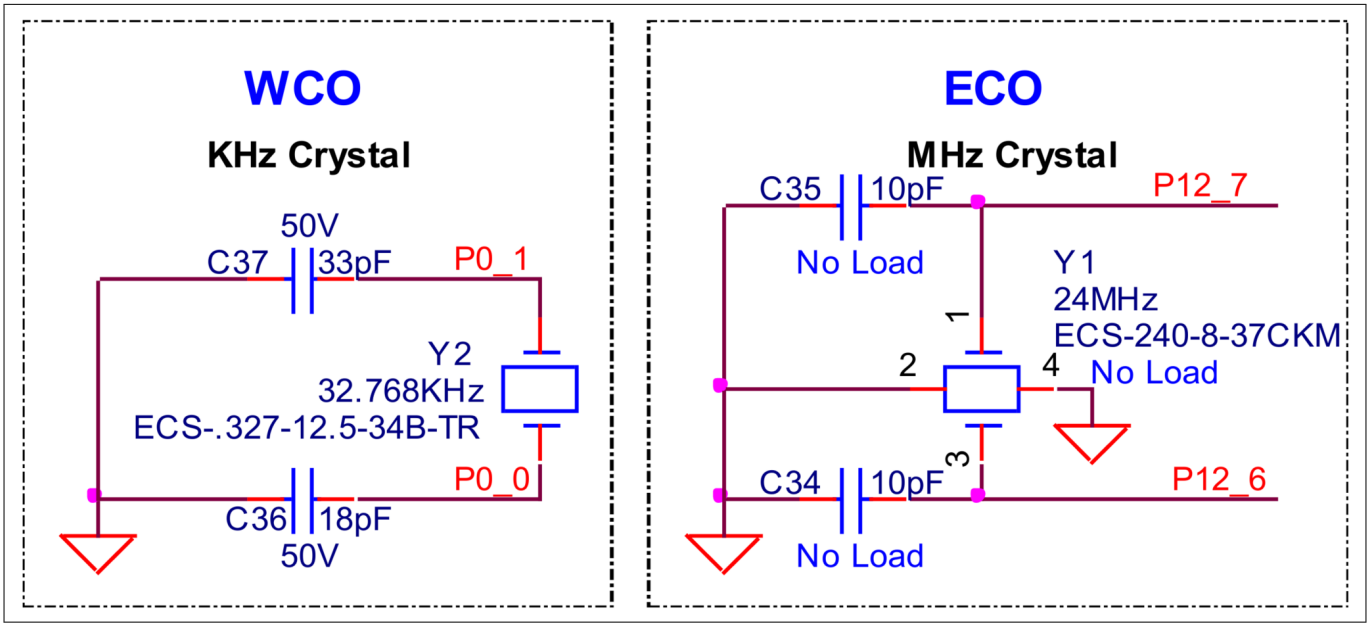

Figure 25 System crystals

A.2.6.6 Bluetooth® LE module

CYBLE-416045-02 is a fully certified and qualified module supporting Bluetooth® Low Energy wireless communication. CYBLE-416045-02 is a turnkey solution and includes onboard crystal oscillators, trace antenna, passive components, and the Infineon PSoC™ 6 MCU.

The Bluetooth® LE module is a scalable and reconfigurable platform architecture. It combines programmable and reconfigurable analog and digital blocks with flexible automatic routing. CYBLE-416045-02 also includes digital programmable logic, high-performance analog-to-digital conversion (ADC), low-power comparators, and standard communication and timing peripherals.

CYBLE-416045-02 includes a royalty-free Bluetooth® LE stack compatible with Bluetooth® 5.0 and provides up to 36 GPIOs in a 14 × 18.5 × 2.00 mm package. CYBLE-416045-02 is a complete solution and an ideal fit for applications seeking a high-performance Bluetooth® LE wireless solution. See the AIROC™ CYBLE-416045-02 Bluetooth® LE module datasheet.

The module is based on CY8C6347BZI-BLD53 but gives access only to a sub-set of the I/O pins and functionality. Most PSoC™ 63 code examples can be adapted to run on this module.

A.2.6.7 KitProg3 switch and LEDs

The KitProg3 board contains a push button connected to P1.2 of PSoC™ 5LP. When this button is pressed, it toggles between KitProg3 mode and CMSIS-DAP mode. For more details, see the KitProg3 user guide.

A power indicator LED (LED1) will turn ON when the board is plugged into an active USB port to indicate that power is being supplied.

A second LED (LED2) is used to indicate the status of KitProg3. The Amber Status LED (LED2) indicates the KitProg3 status connected to P1[4] of the KitProg3 PSoC™ 5LP device. See Table 6 for a summary of the status LED states. For more details on the KitProg3 status LED, see the KitProg3 user guide.

Table 6 LED status for KitProg3 modes

KitProg3 programming modes[3)]	Status LED (LED2)
KitProg3 Program/Debug mode (default)	ON
CMSIS-DAP mode	OFF

A.3 Programming PSoC™ 6 Bluetooth® LE Prototyping Board using MiniProg4/KitProg3

The target board provides a provision to program the PSoC™ 6 MCU using MiniProg4 or an external KitProg3 via the 5-pin SWD header. To do this, connect wires or a 5-pin 100-mil spaced header to **J5**. The PSoC™ 6 Bluetooth® LE Prototyping Board supports both power cycle and reset programming modes.

Caution: MiniProg4 can provide up to 5 V at VTARG which will result in permanent damage of the device. Please make sure that VTARG is in the range 1.8 V to 3.3 V. Ideally, this configuration is only used when the KitProg3 section is separated.

3 Toggling between programming modes can be done by pressing mode switch SW3.

Figure 26 Connecting the CY8CPROTO-063-BLE to a MiniProg4

Note: *CY8CKIT-005-A MiniProg4 is not part of the PSoC™ 6 Bluetooth® LE Prototyping Board contents and can be purchased from the Infineon Online Store.*

Acronyms

Table 7 Acronyms Used in this Document

Acronym	Definition
ADC	Analog-to-Digital Converter
BCP	Bridge Control Panel
BLE	Bluetooth® Low Energy
BOM	Bill of Materials
CE	Code Example
C_{MOD}	Modulator Capacitor
DAC	Digital to Analog Converter
ECO	External Crystal Oscillator
ESD	Electrostatic Discharge
FLL	Frequency Locked Loop
GPIO	General-Purpose Input/Output
I2C	Inter-Integrated Circuit
IDAC	Current DAC
IDE	Integrated Design Environment
IMO	Internal Main Oscillator
KBA	Knowledge Based Article
LED	Light-Emitting Diode
PLL	Phase Locked Loop
PSoC™	Programmable System-on-Chip
SAR	Successive Approximation Register
SCB	Serial Communication Block
SRAM	Serial Random Access Memory
SWD	Serial Wire Debug
TCPWM	Timer, Counter, Pulse Width Modulator
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
WCO	Watch Crystal Oscillator

Revision history

Document revision	Date	Description of changes
**	2018.11.02	New kit guide.
*A	2020.01.17	Updated Appendix section Updated “Hardware Details” section Updated “Target Board” section Updated Figure 13. Updated “PSoC™ 6 Bluetooth® LE Prototyping Board features” section Updated “System Crystals” section Updated Figure 25. Updated to new template.
*B	2024-09-27	Template update Updated Safety precautions Replaced PSoC™ creator software with ModusToolbox™ based procedure Updated PSoC to PSoC™ Updated BLE to Bluetooth® LE Removed the document conventions section Updated CYBLE-416045-02 EZ-BLE Creator Module to AIROC™ CYBLE-416045-02 Bluetooth® LE module Updated EZ-BLE Module to Bluetooth® LE module Updated all diagrams to Infineon branding Updated CapSense to CAPSENSE™ Updated KitProg2 to KitProg3 Updated MiniProg3 to MiniProg4 Added About this document section Updated the term Cypress to Infineon

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