CYBLE-416045-EVAL Kit guide

About this document

Scope and purpose

The Infineon CYBLE-46045-EVAL Kit enables evaluation, prototyping, and development of a wide array of Internet of Things (IoT) applications using the AIROC™ PSoC™ 6, a low-power and high-performance Bluetooth® Low Energy (LE) MCU. The system features a 150-MHz Arm® Cortex®-M4 as the primary application processor, a 100-MHz Arm® Cortex®-M0+ that supports low-power operations, up to 1 MB Flash and 288 KB SRAM, an integrated Bluetooth® LE 4.2 radio, CAPSENSE™ touch-sensing, and programmable analog and digital peripherals that allow higher flexibility, in-field tuning of the design, and faster time-to-market.

This document will introduce boards structure and guide how to download demo application into the board.

Intended audience

This document is intended for users interested in the CYBLE-46045-EVAL kit.

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.*

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Safety precautions

Note: Please note the following warnings regarding the hazards associated with development system

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

Thank you for your interest in the CYBLE-416045-EVAL board.

The CYBLE-416045-EVAL board is designed as an easy-to-use and inexpensive prototyping platform. It includes the CYBLE-416045-02 AIROC™ Bluetooth® LE module, delivering a complete system solution for a wide range of embedded applications at a very low cost. 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 CYBLE-416045-EVAL 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. In addition, the board includes the following features:

- One RGB LED to provide feedback
- A push button to provide a simple user input
- External WCO (32.768 kHz)
- 1.8 V or 3.3 V operation

The CYBLE-416045-EVAL board also integrates KitProg2 that enables onboard programming, debugging, and bridging functionalities, such as USB-UART and USB-I2C. KitProg2 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 KitProg2 board from the target PSoC™ 6 Bluetooth® LE board.

1.1 Kit contents

The CYBLE-416045-EVAL Kit contains CYBLE-416045-EVAL board, USB 2.0 Type-A to Micro-B cable and quick start guide (QSG).

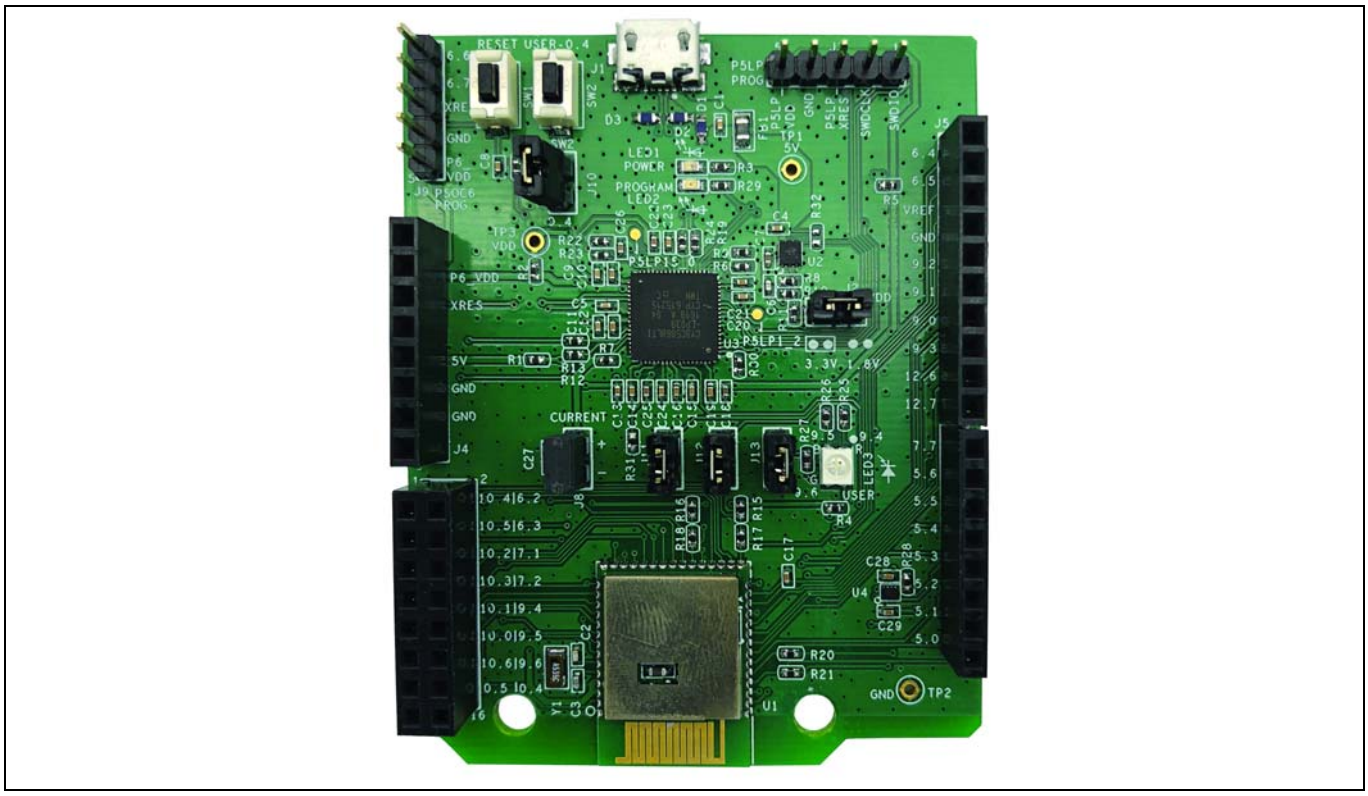


Figure 1 CYBLE-416045-EVAL - top view

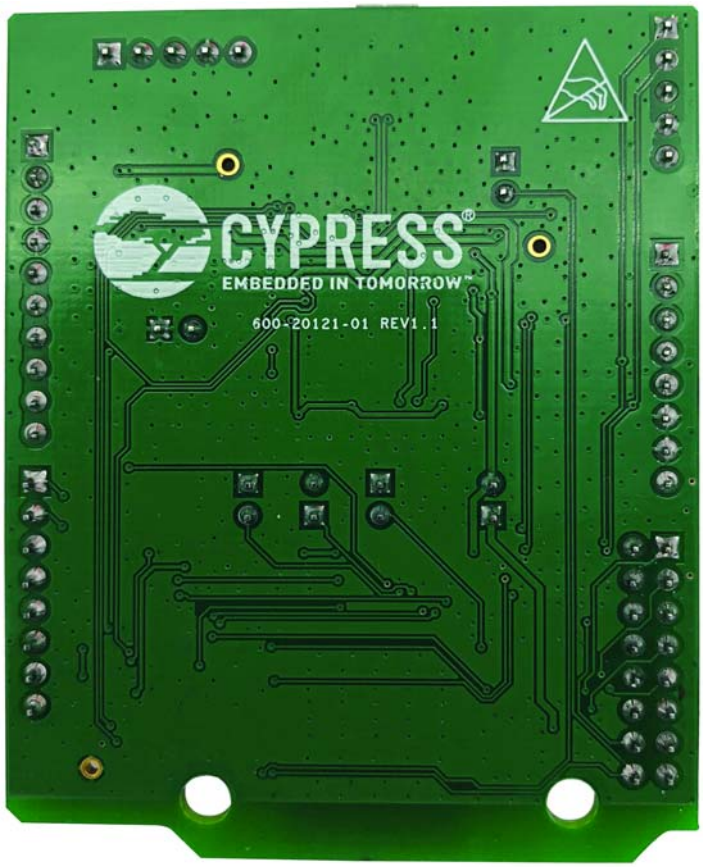


Figure 2 CYBLE-416045-EVAL - bottom view

1.2 PSoC™ Creator

PSoC™ Creator is a state-of-the-art, easy-to-use integrated design environment (IDE). It introduces revolutionary hardware and software co-design, powered by a library of pre-verified and pre-characterized PSoC™ Components. With PSoC™ Creator, you can:

- Drag and drop Components to build your hardware system design in the main design workspace.
- Co-design your application firmware with the PSoC™ hardware.
- Configure Components using configuration tools.
- Explore the library of 100+ Components.
- Review Component datasheets.

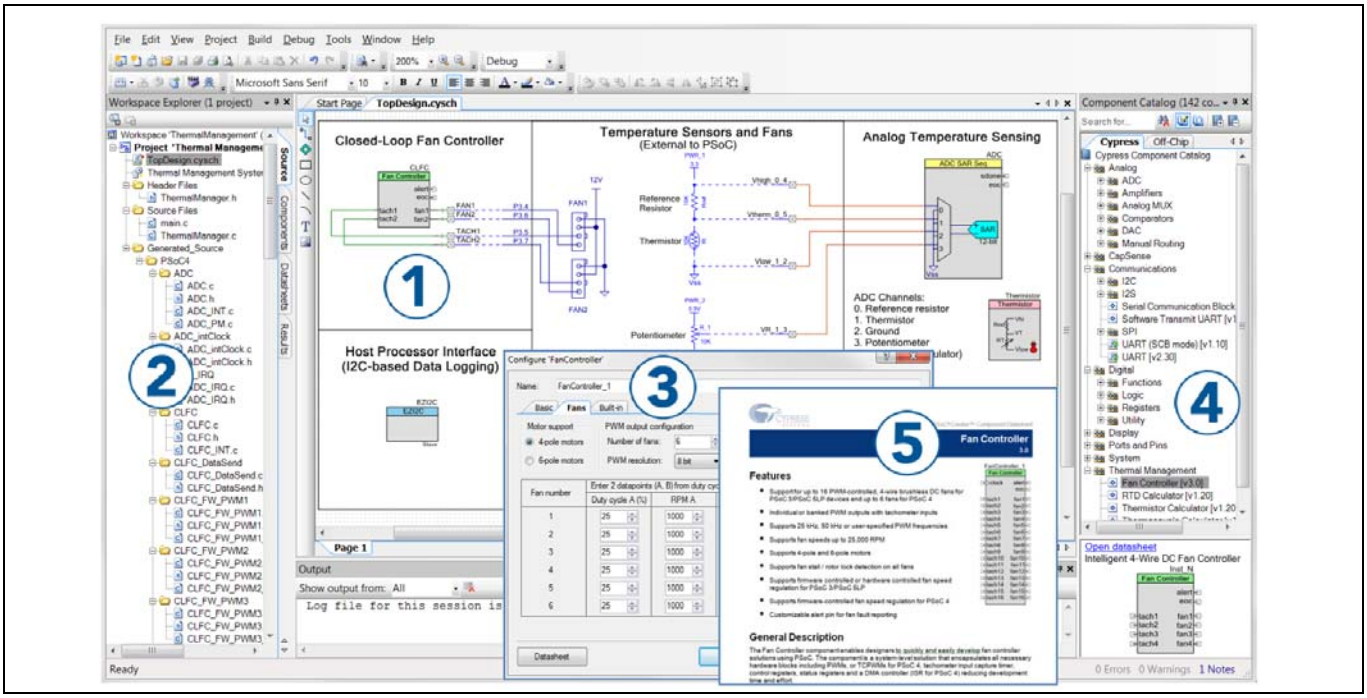


Figure 3 PSoC™ Creator features

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

For more information, go to PSoC™ Creator.

1.2.1 PSoC™ Creator code examples

PSoC™ Creator includes a large number of code examples. These examples are available from the PSoC™ Creator Start Page, as shown in Figure 4 or from the menu **File** > **Code Example**.

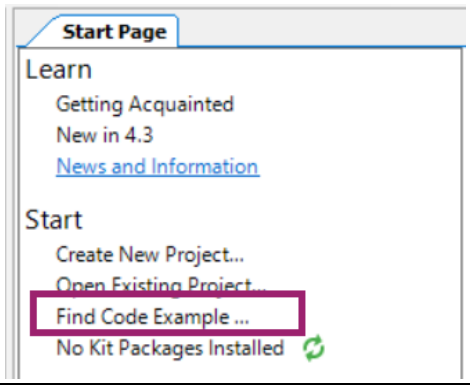


Figure 4 Code examples in PSoC™ Creator

The code examples can speed up your design process by starting you off with a complete design, instead of a blank page. The code examples demonstrate the PSoC™ Creator Components utility for various applications.

From the **Find Code Example** dialog shown in Figure 5, you can

- Filter for examples based on architecture or device family, that is, PSoC™ 3, PSoC™ 4, PSoC™ 5LP, PSoC™ 63, or keyword
- Select from the list of examples offered based on the **Filter Options**
- Review the code example's description (on the **Documentation** tab)

- Review the code from the **Sample Code** tab. You can copy the code from this window and paste to your project, which can help speed up code development.
- Create a new project (and a new workspace if desired) based on the selection. This can speed up your design process by starting you off with a complete, basic design. You can then adapt that design to your application.

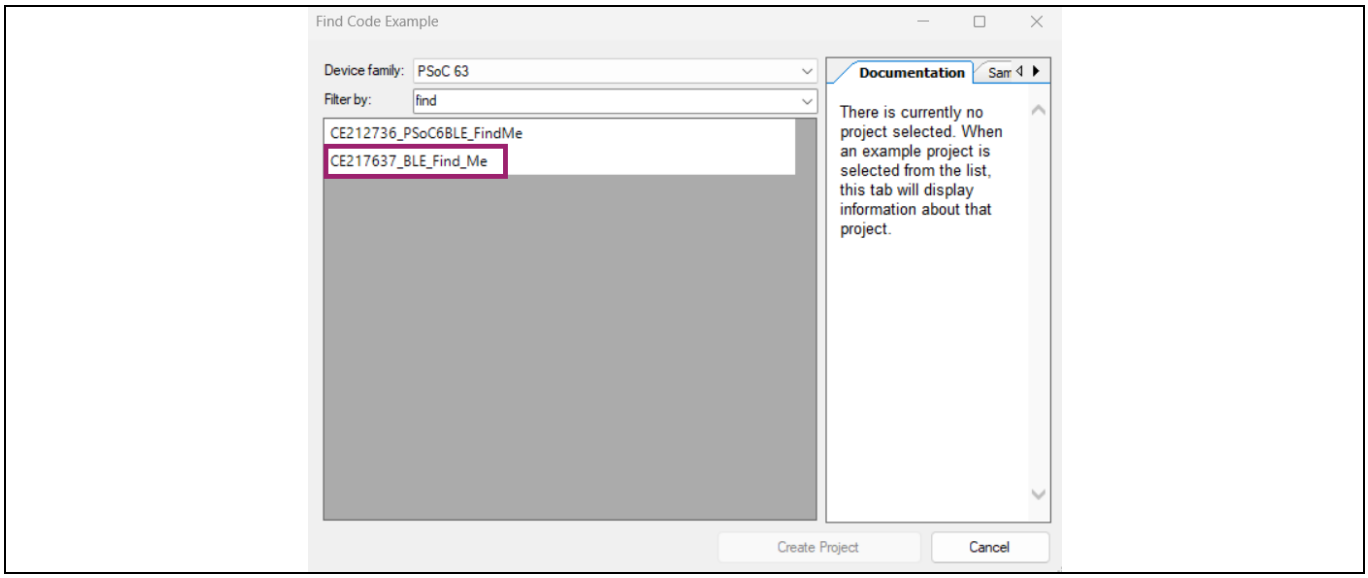


Figure 5 Code example projects with sample code

1.2.2 PSoC™ Creator help

Launch PSoC™ Creator and navigate to the following items:

- **Quick Start Guide:** Choose **Help** > **Documentation** > **Quick Start Guide**. This guide gives you the basics for developing PSoC™ Creator projects.
- **Simple Component Code Examples:** Choose **File** > **Code Example**. These examples demonstrate how to configure and use PSoC™ Creator Components. To access examples related to a specific Component, right-click the Component in the schematic or in the Component Catalog. Select **Find Code Example** in the context menu that appears.
- **System Reference Guide:** Choose **Help** > **System Reference Guides**. This guide lists and describes the system functions provided by PSoC™ Creator.

1.2.3 Component datasheets

Right-click a component and select **Open Datasheet** (see Figure 6).

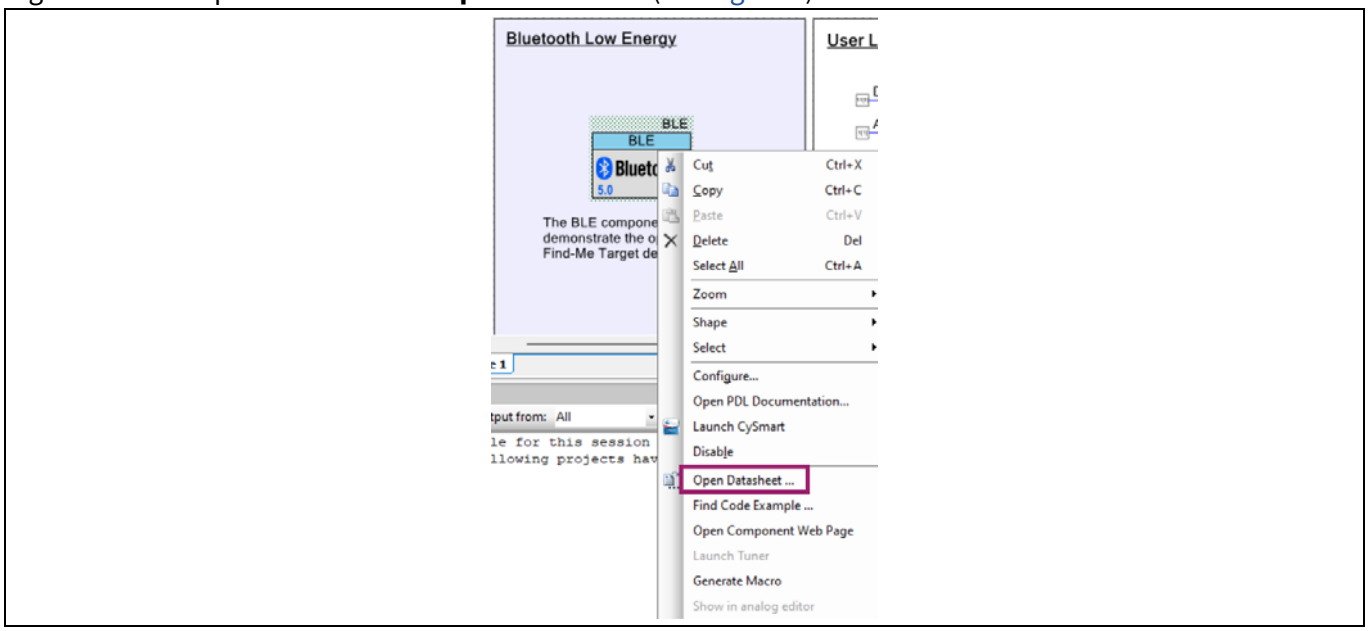


Figure 6 Opening component datasheet

1.3 Getting started

This guide will help you get acquainted with the CYBLE-416045-EVAL board:

- The Software installation section describes the installation of the required software to operate this kit. This includes the installation of the PSoC™ Creator IDE, peripheral driver library (PDL) and CySmart for development and debugging the applications, and PSoC™ Programmer for programming the *.hex* files.
- The Kit operation section describes the major features of the CYBLE-416045-EVAL board and functionalities such as programming, debugging, and the USB-UART and USB-I2C bridges.
- The Code examples section 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 MiniProg3, kit schematics, and the bill of materials (BOM).

1.4 Additional learning resources

A wealth of data at Infineon webpage enables to select the right PSoC™ device for your design, and to quickly and effectively integrate the device into your design. For a comprehensive list of resources, see AN210781 - Getting started with PSoC™ 6 MCU with Bluetooth® low energy connectivity on PSOC™ Creator.

1.5 Technical support

To select the right IoT device for the design, Infineon provides a wide range of product documentation at AIROC™ Bluetooth® LE & Bluetooth® / PSoC™ 63 - Bluetooth® Low Energy MCU. Also, a professional community at community.infineon.com supplies developers with the latest software and tools to solve common evaluation and integration problems while interacting directly with both Infineon engineers and experienced peers.

1.6 Acronyms

Table 2 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
I^2C	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

2 Software installation

This chapter describes the steps to install the software tools and packages on a PC for using the CYBLE-416045-EVAL board. This includes the IDE on which the projects will be built and used for programming.

2.1 Before you begin

To install software, you will require administrator privileges. However, they are not required to run the software that is already installed. Before you install the kit software, close any other software that is currently running.

2.2 Install software

Follow these steps to install the required software to operate this kit:

1. Download and install the following if it is not present on your PC.
   a) PSoC™ Creator 4.2 or later: This software is available for download at PSoC™ Creator.
   b) Peripheral Driver Library (PDL) 3.0.4 or later: Peripheral Driver Library is available for download at PSoC™ 6 Peripheral Driver Library (PDL) for PSoC™ Creator.
2. Choose the **Typical**, **Custom**, or **Complete** installation type in the Product Installation Overview window. Click **Next** after selecting the installation type.

Note: Typical installation is recommended, however you can choose according to your requirement.

3. Read the License agreement and select **I accept the terms in the license agreement** to continue with the 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.
4. Enter your contact information or select the check box **Continue Without Contact Information**.
5. Click **Finish** to complete the installation.

2.3 Uninstall software

The software can be uninstalled using one of the following methods:

1. Go to **Start** > **All Programs** > **Cypress** > **Cypress Update Manager** and select **Uninstall**.
2. Go to **Start** > **Control Panel** > **Programs and Features for Windows 7** or **Add/Remove Programs for Windows XP** and select **Uninstall/Change**.

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, KitProg2 USB-UART and USB-I2C bridges, and the procedure to update the KitProg2 firmware.

3.1 Board details

The CYBLE-416045-EVAL board consists of the following blocks:

- AIROC™ Bluetooth® LE module (CYBLE-416045-02)
- PSoC™ 6 MCU I/O headers (J4, J5, J6, and J7)
- KitProg2 (PSoC™ 5LP) device (CY8C5868LTI-LP039)
- PSoC™ 5LP SWD header (J3)
- Modle SWD header (J9)
- USB 2.0 Micro-B connector (J1)
- Power LED - amber (LED1)
- KitProg2 Status LED - amber (LED2)
- User LED - red, green, blue (LED3)
- WCO crystal (32.768 kHz)
- One user push button SW2
- One reset push button SW1
- Current measurement jumper (J8)

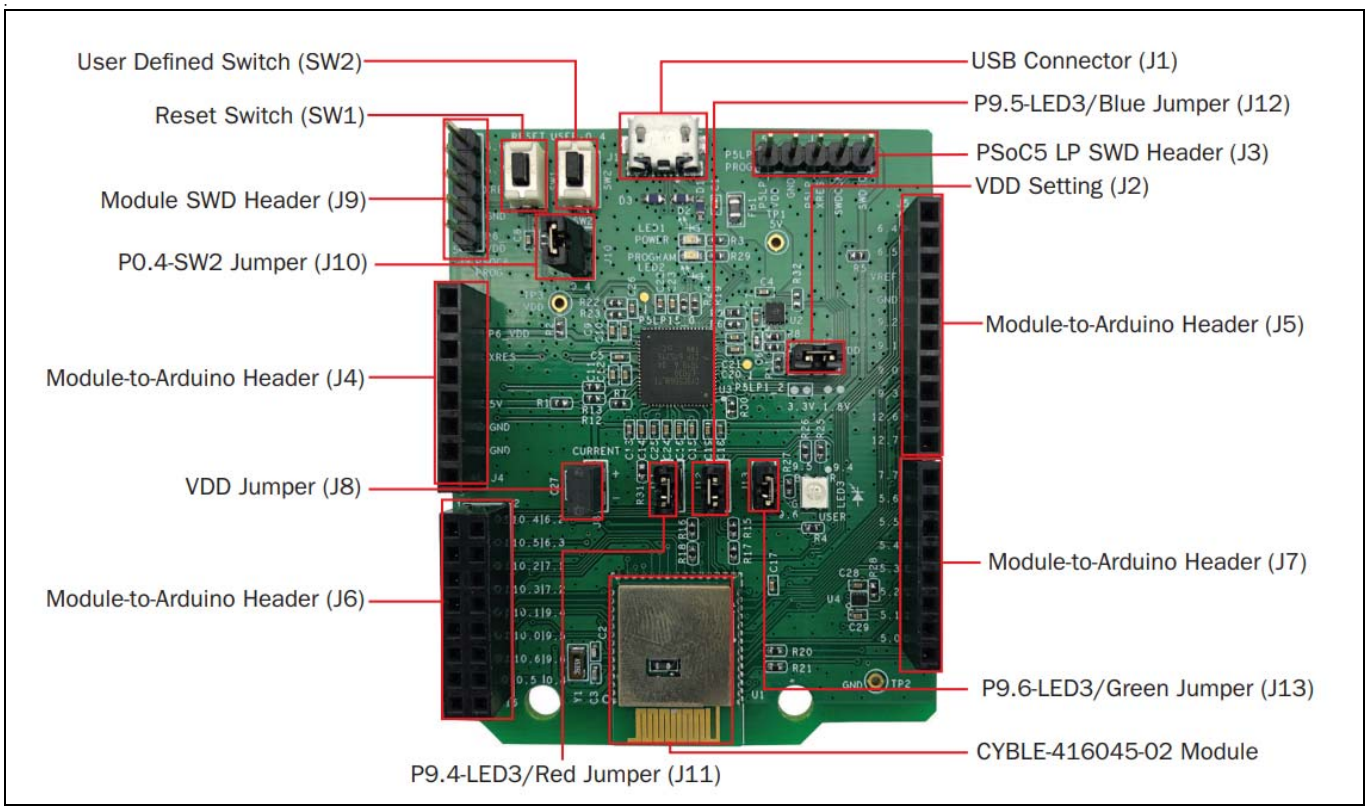


Figure 19 PSoC™ 6 Bluetooth® LE prototyping board pin details

3.2 Theory of operation

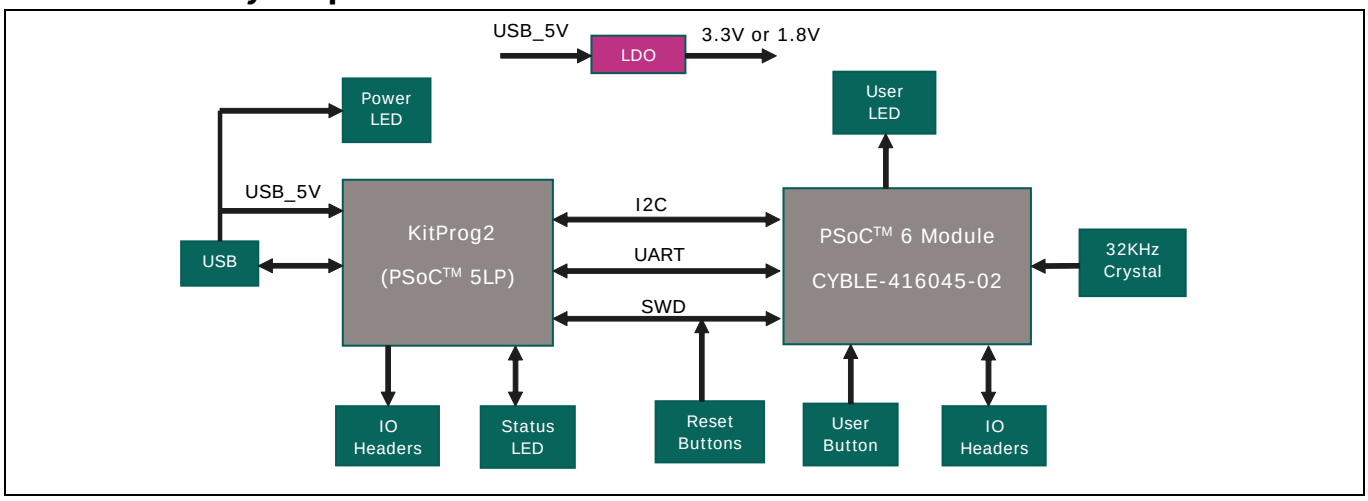


Figure 7 Block diagram of CYBLE-416045-EVAL board

The CYBLE-416045-EVAL 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 LED:** One RGB LED (LED3) 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 user button (SW2), 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.

- **AIROC™ Bluetooth® LE module:** The AIROC™ Bluetooth® LE module (CYBLE-416045-02) is used to demonstrate how easily an end product can be created with Bluetooth® LE. The AIROC™ 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 AIROC™ Bluetooth® LE module, depending only on the GPIO requirements.
- **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 (SW1) is used to reset the PSoC™ 6 MCU when pressed.
- **Power LED:** This LED indicates power is being supplied to the board.
- **Current measurement jumper:** Using jumper (J8), you can measure the current consumed by the AIROC™ Bluetooth® LE module.
- **USB 2.0 Micro-B connector:** Connector (J1) 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.
- **KitProg2:** 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, KitProg2 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 KitProg2 supplies 3.3 V to the PSoC™ 6 MCU section of the board.
- **KitProg2 status LED:** LED (LED2) gives the programming/mode status of KitProg2.

3.3 Programming and debugging the target PSoC™ 6 MCU

The target PSoC™ 6 MCU can be programmed and debugged using KitProg2. Before programming the device, make sure that PSoC™ Creator and PSoC™ Programmer software are installed on the PC. See Install software for more information.

3.3.1 Programming using PSoC™ Creator

1. Connect the Prototyping board to the PC through the USB Micro-B connector (J1). The kit enumerates as a composite device. If you are plugging in the CYBLE-416045-EVAL to your PC for the first time, the kit drivers will get installed automatically. The amber status LED (LED2) will turn ON to indicate successful enumeration. If the amber status LED (LED2) is OFF.
2. Open the desired project in PSoC™ Creator. From the PSoC™ Creator, go to **File** > **Open** > **Project/Workspace**. You can browse and open a previously saved project. If you want to open one of the code examples compatible with this kit, follow the instructions in the Code examples.
3. Select the option **Build** > **Build <Project_Name>** or press **Shift** + **F6** to build the project as shown in Figure 8.

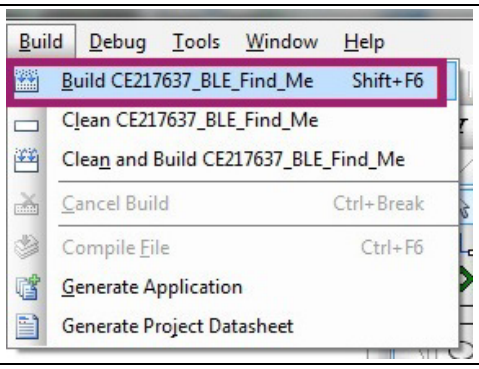


Figure 8 Build a code example

4. If there are no errors during build, program the firmware onto the kit by choosing **Debug** > **Program** or press **Ctrl** + **F5**, as shown in Figure 9. This programs the target PSoC™ 6 MCU on the Prototyping Board.

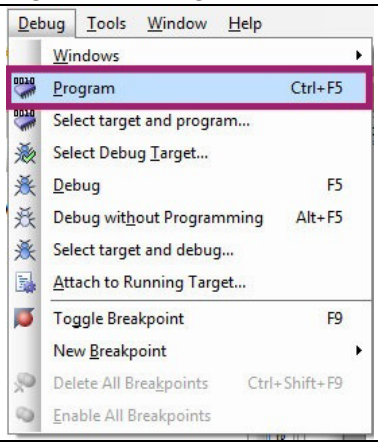


Figure 9 Program device in PSoC™ Creator

3.3.2 Debugging using PSoC™ Creator

For debugging the project using PSoC™ Creator, follow steps 1–3 from Programming using PSoC™ Creator followed by:

1. Click the **Debug** icon or press **F5**. Alternatively, you can use the option **Debug** > **Debug**.
2. Once PSoC™ Creator opens in Debug mode, use the buttons on the toolbar to debug your application.

3.3.3 Programming using PSoC™ Programmer

PSoC™ Programmer (3.27.3 or later) can be used to program existing *.hex* files into the PSoC™ 6 Bluetooth® LE Prototyping Board.

3.4 USB-UART Bridge

KitProg2 on the PSoC™ 6 Bluetooth® LE Prototyping Board can act as a USB-UART bridge. The UART lines between KitProg2 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.

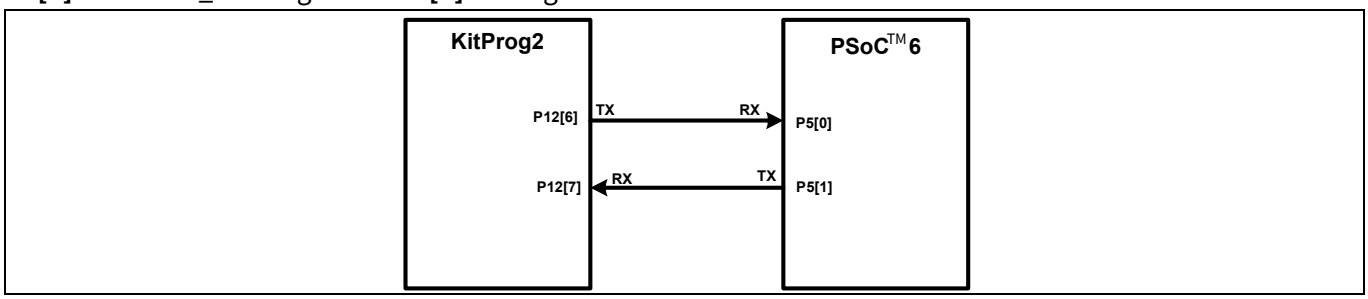


Figure 10 UART connection between KitProg2 and AIROC™ Bluetooth® LE module

3.5 USB-I2C Bridge

KitProg2 can function as a USB-I2C bridge and communicate with the software utility Bridge Control Panel (BCP). The I2C lines on target AIROC™ Bluetooth® LE module are **P6[5] (SDA)** and **P6[4] (SCL)**, which are hardwired on the board to the I2C lines of KitProg2. The USB-I2C bridge supports I2C speeds of 50 kHz, 100 kHz, 400 kHz, and 1 MHz.

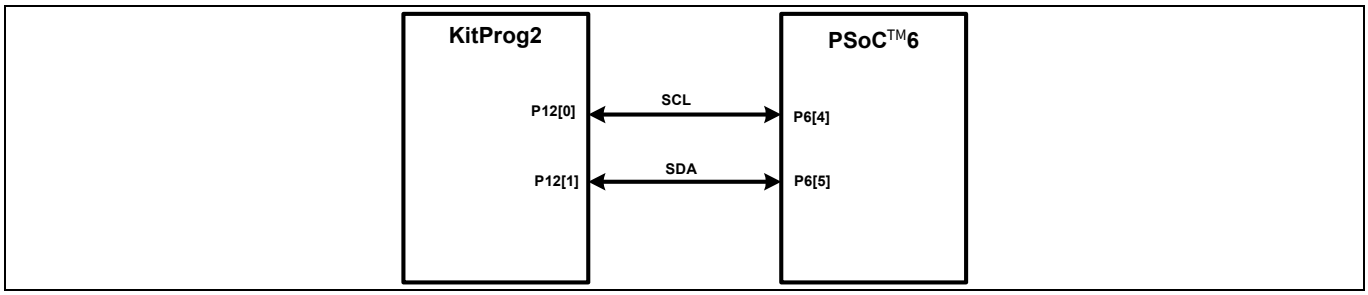


Figure 11 I2C connection between KitProg2 and AIROC™ Bluetooth® LE module

3.6 Updating the KitProg2 firmware

The KitProg2 firmware normally does not require any update. You can use the PSoC™ Programmer software to update the KitProg2 firmware if necessary.

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.

4.1 Using built-in PSoC™ Creator code examples with the kit

Follow these steps to open and use the built-in PSoC™ Creator examples.

1. Launch PSoC™ Creator from **Start** > **All Programs** > **Cypress** > **PSoC™ Creator <version>** > **PSoC™ Creator <version>**.
2. On the Start page, click **Find Code Example...** under **Start** or follow the menu **File** > **Code Example...** as shown in Figure 12.

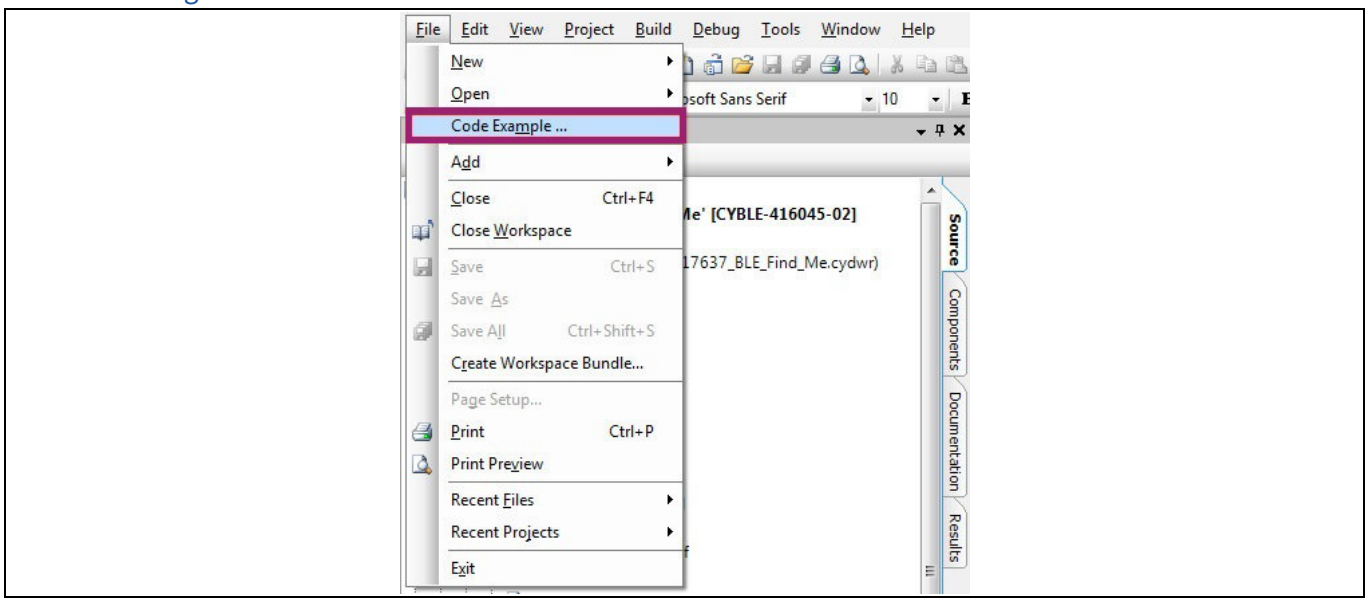


Figure 12 PSoC™ Creator find code example

3. In the Find Code Example window, set the **Device family** to **PSoC™ 63** as shown in Figure 13.

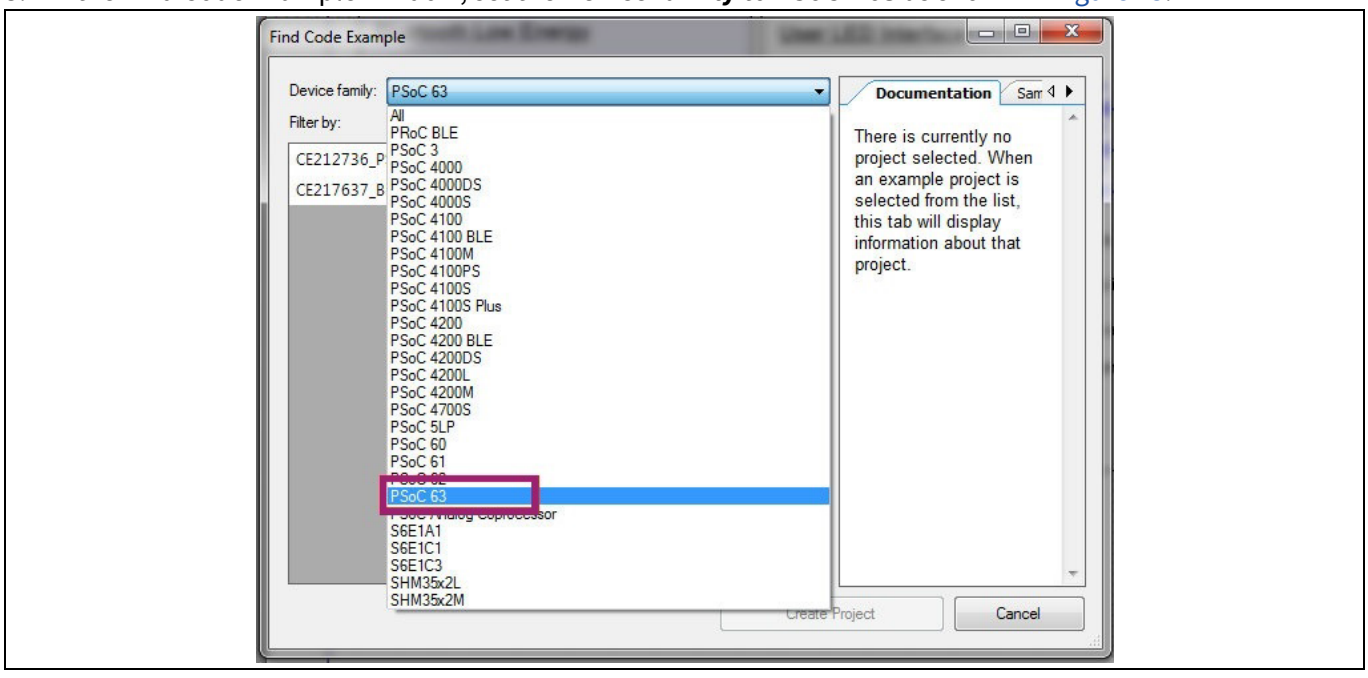


Figure 13 Selecting PSoC™ 63 device in find code example window

Code examples

4. You can select the *CE217637_BLE_Find_Me* project and see how to use it with the CYBLE-416045-EVAL board.
5. Select the *CE217637_BLE_Find_Me* project and click **Create Project** as shown in Figure 14. Save the workspace to a desired location.

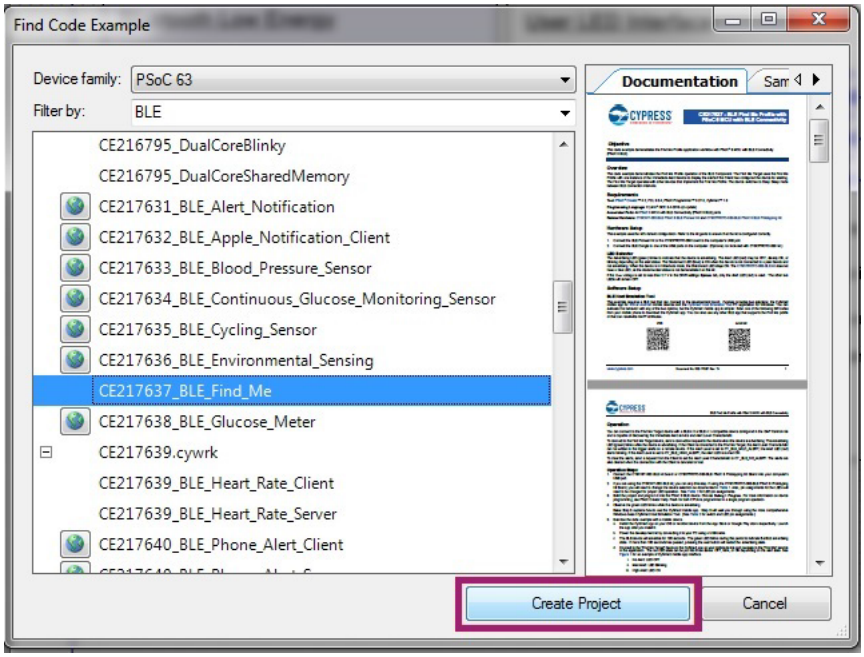


Figure 14 CE217637_BLE_Find_Me code example

6. Open *CE217637.pdf* from the Workspace Explorer to learn more about the code example and its configuration. See Figure 15.

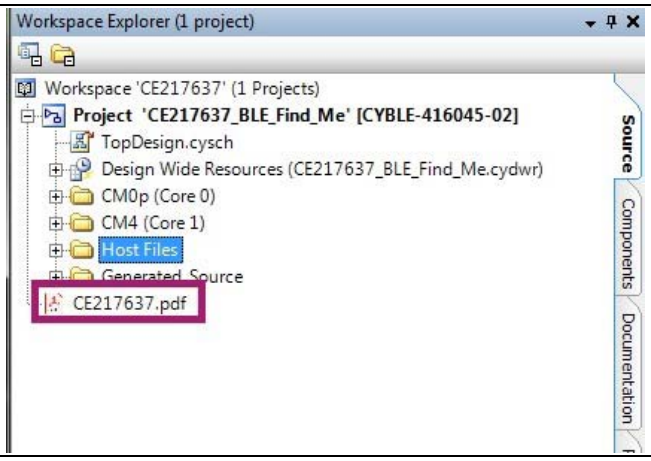


Figure 15 Project datasheet: *CE217637*

7. Right-click the project name, and select **Device Selector**.

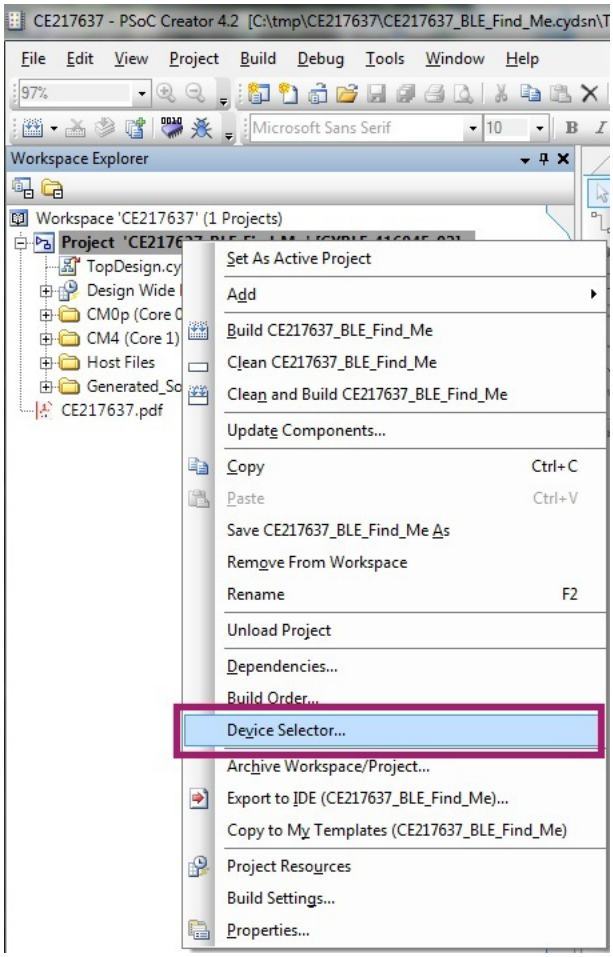


Figure 16 Project configuration

Code examples

Next from the list of devices, select the **CYBLE-416054-02** device from the list.

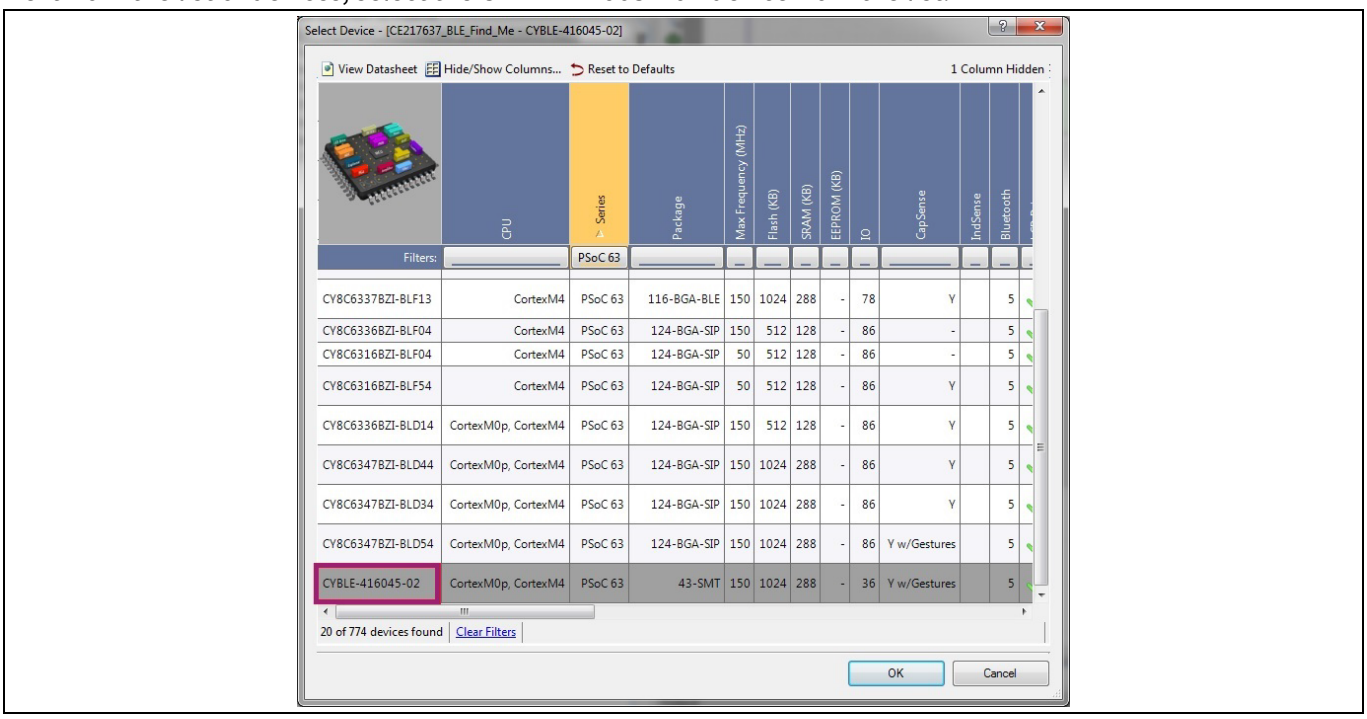


Figure 17 Device selector wizard

8. On the left-hand side in the Workspace Menu, select the “Pins” option under the “Design Wide Resources” tab. The Pins tab will appear on the right as shown, see Figure 18. Because this code example was originally created for a different board, you will need to reassign the LED pins to be compatible with the CY8CPROTO-063-BLE Prototyping Board. Make the following assignments.
   a) Advertising_LED => P9[5]
   b) Alert_LED => P9[6]
   c) Disconnect_LED => P9[4]

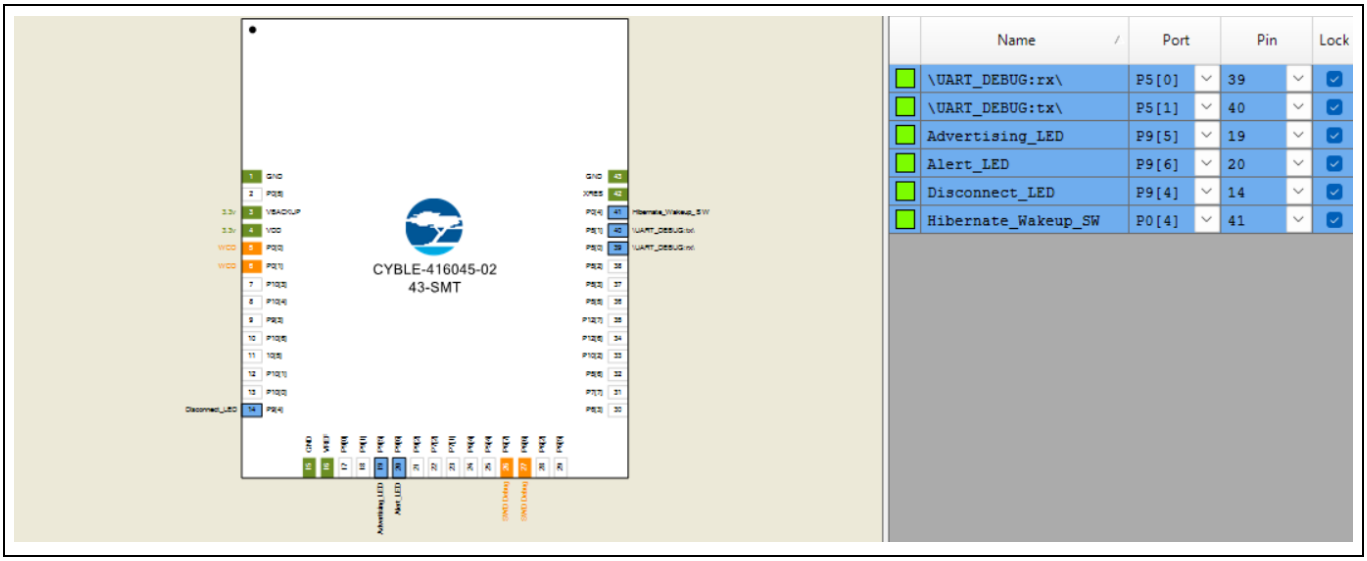


Figure 18 Pin selection / Reassignmen

9. Build and program the project as described in the Programming and debugging the target PSoC™ 6 MCU.

5 Appendix

5.1 Hardware details

5.1.1 Target board

The target board uses the CYBLE-416045-02 AIROC™ 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 CYBLE-416045-02 EZ-BLE Creator Module.

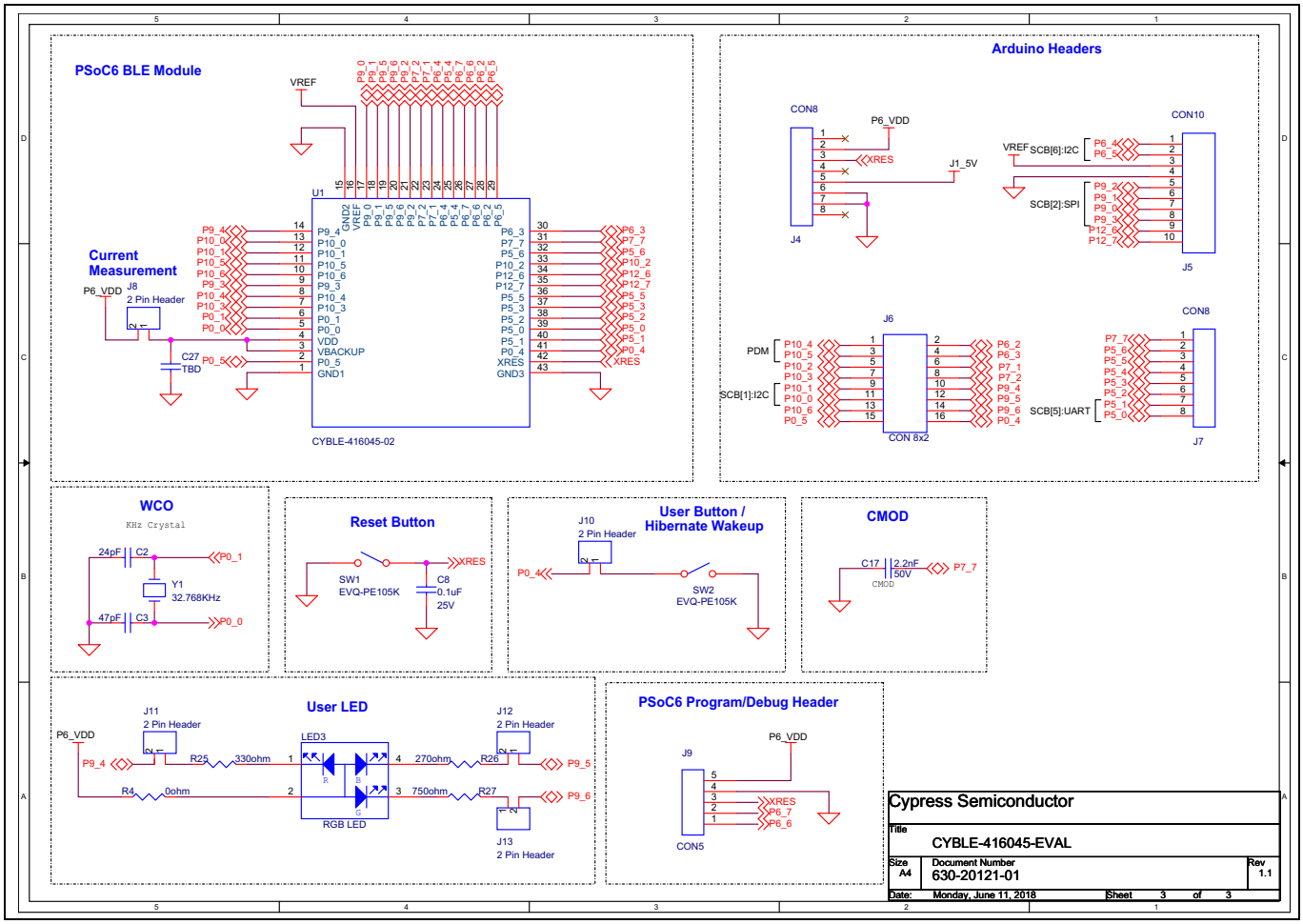


Figure 1 Schematic of PSoC™ 6 MCU (target)

5.1.2 KitProg2 board

A PSoC™ 5LP device on the KitProg2 board is used to program and debug the target PSoC™ 6 MCU. The PSoC™ 5LP-based KitProg2 connects to the USB port of the PC through the USB 2.0 Micro-B connector and to the SWD interface of the target AIROC™ Bluetooth® LE module.

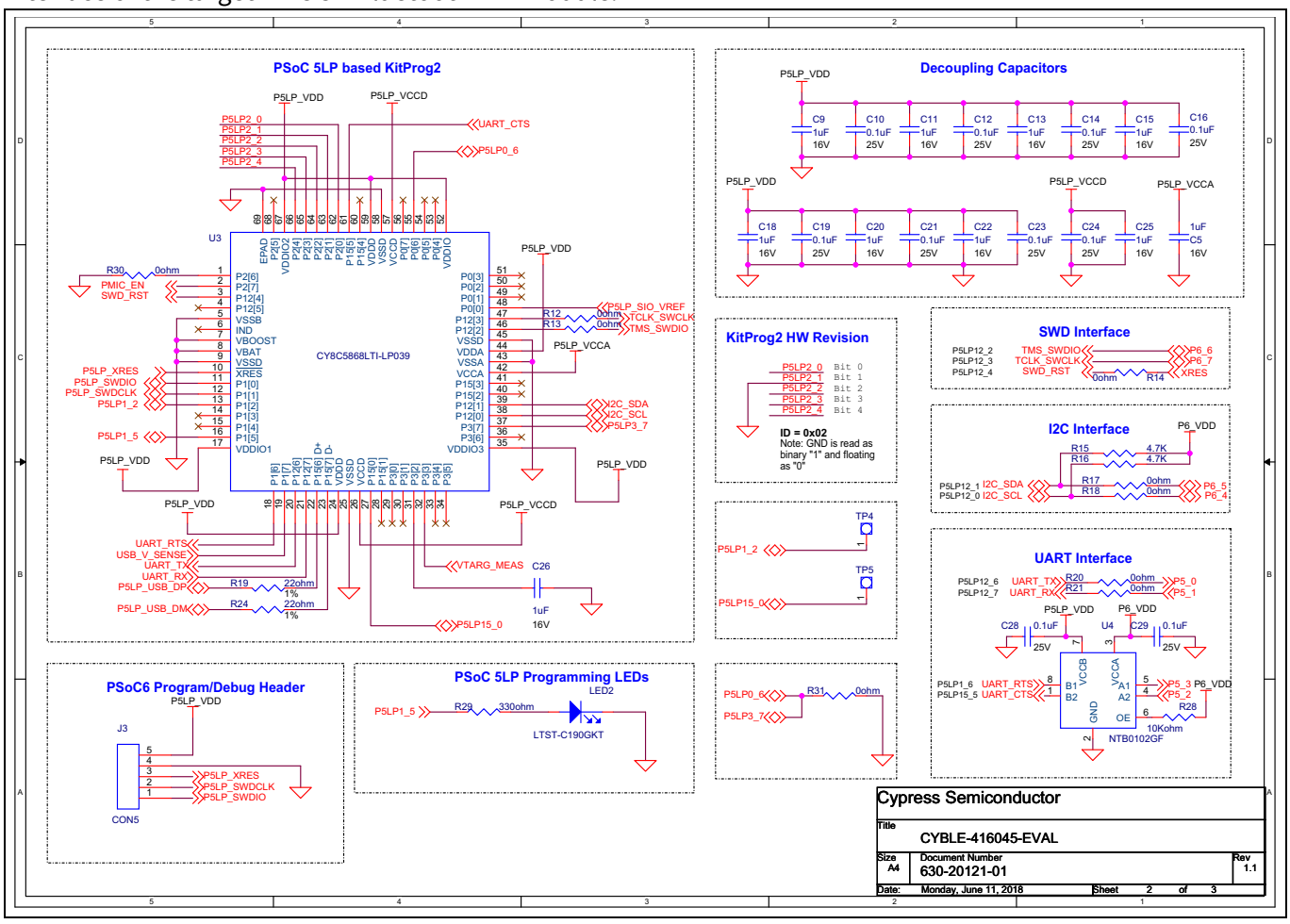


Figure 2 Schematic of PSoC™ 5LP (KitProg2)

5.1.3 Power supply system

The power supply system uses 5 V from the USB connector as the input to a voltage regulator on the KitProg2 section of the board. This regulator provides 3.3 V or 1.8 V to the PSoC™ 6 MCU.

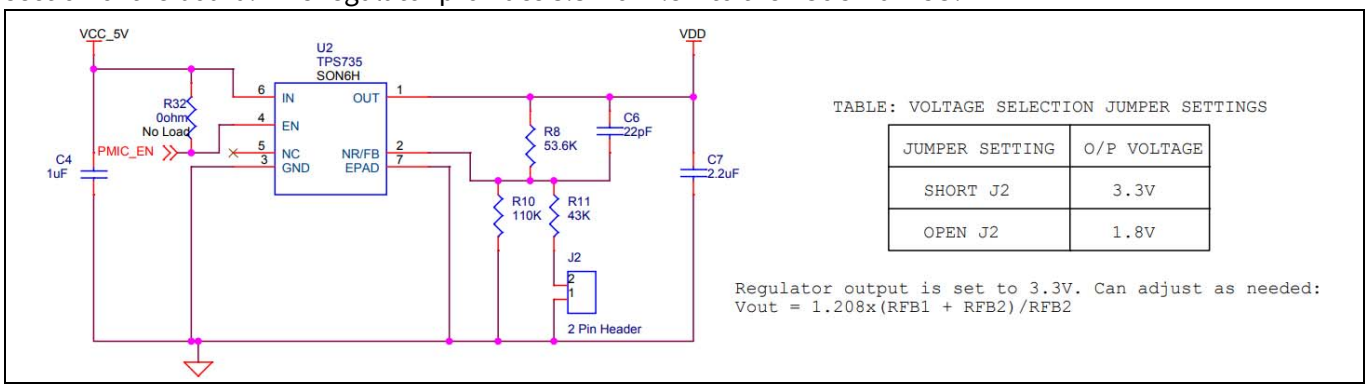


Figure 3 Target power supply

5.1.3.1 Measure AIROC™ Bluetooth® LE module current consumption

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

- Connect an ammeter across the 2-pin jumper J8 to measure the current to the AIROC™ Bluetooth® LE module.

This method can be used either with USB power or with the power supplied.

5.1.4 CYBLE-416045-EVAL board features

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

- LED connected to GPIO pins for feedback
- User switch for user input
- Jumper for current measurement (J8)
- Onboard Bluetooth® LE Antenna
- Onboard reset switch

5.1.4.1 User button (SW2)

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. By default, the buttons connect to ground on activation (active LOW). The user button (SW2) can be changed to active high mode by changing the zero resistors shown in Figure 4.

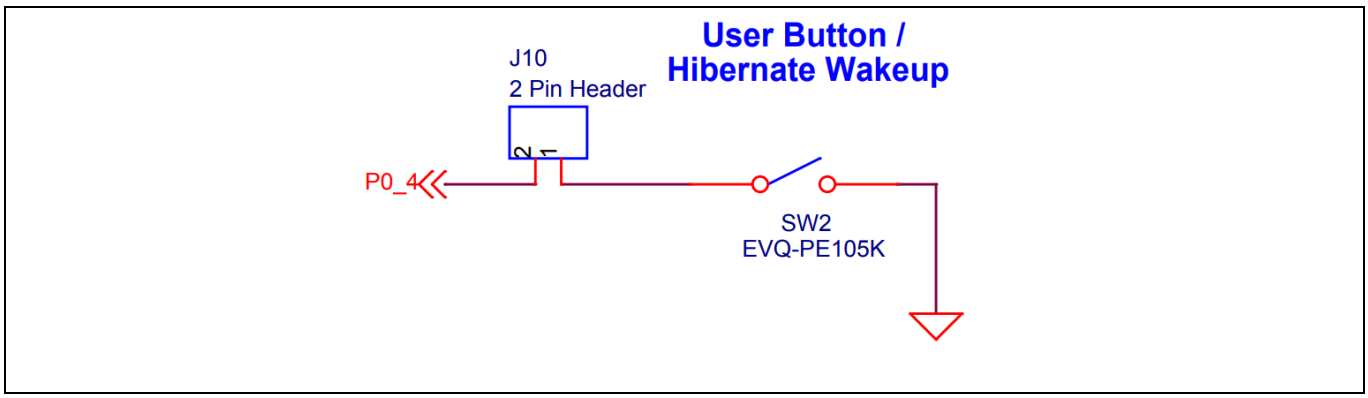


Figure 4 User button on the board

5.1.4.2 User LED (LED3)

There is RGB LED on the board connected to pins P9.4 (red) P9.5 (blue), P9.6 (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 '0' and OFF when driven to '1'.

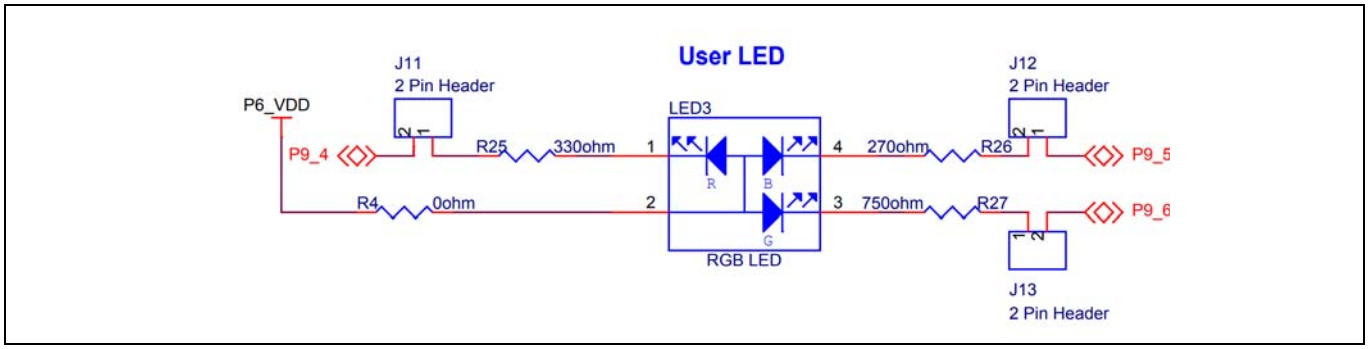


Figure 5 User LEDs

5.1.4.3 Reset button (SW1)

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

5.1.4.4 CAPSENSE™ capacitors

There is CMOD capacitor used for self-capacitance mode. If CAPSENSE™ is not used but P7.7 is used for a digital or analog function, C17 may need to be removed. See the datasheet on the CAPSENSE™ component for more information on how to select and use this capacitor.

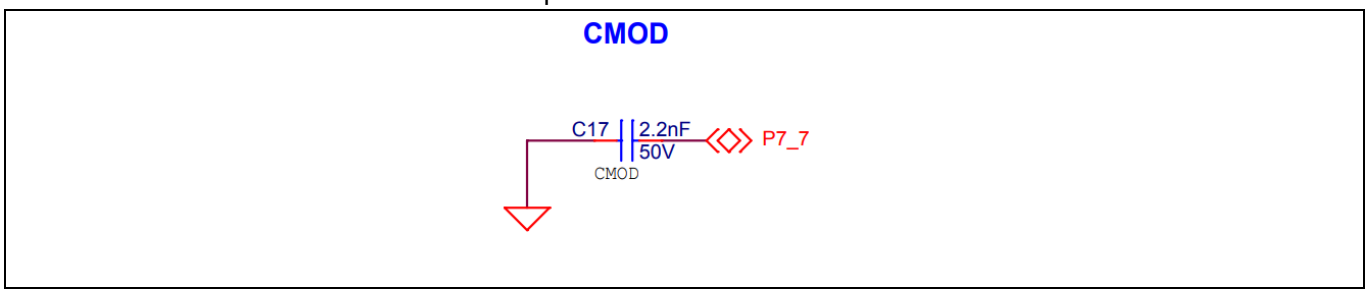


Figure 6 CAPSENSE™ capacitors

5.1.4.5 32 kHz crystal

The WCO kHz crystal (32.768 kHz) is populated and is used for Bluetooth® LE timing. The crystal used for the Bluetooth® LE radio is pre-installed in the AIROC™ Bluetooth® LE module.

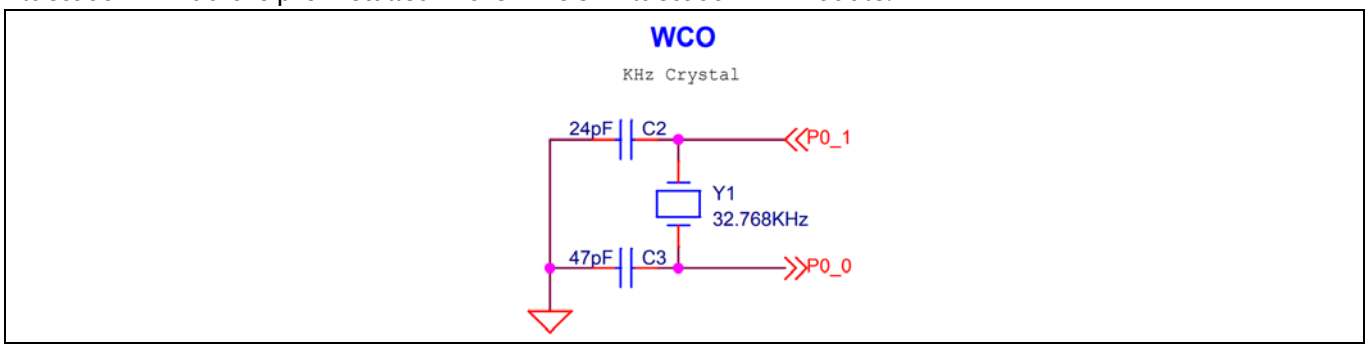


Figure 7 23K Crystal

5.1.4.6 AIROC™ Bluetooth® LE module

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

The AIROC™ 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.

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.

5.1.4.7 KitProg2 LEDs (LED1, LED2)

A power indicator LED (LED1) turns 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 KitProg2. The amber status LED (LED2) indicates the KitProg2 status connected to **P1[5]** of the KitProg2 PSoC™ 5LP device.

Revision history

Document revision	Date	Description of changes
**	2024-09-20	Initial release.

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