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Contact us

CY8CKIT-149

PSoC® 4100S Plus Prototyping Kit Guide

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Contents

Safety Information

Regulatory Compliance

The CY8CKIT-149 PSoC 4100S Plus Prototyping 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. This may cause interference to other electrical or electronic devices in close proximity. In a domestic environment, this product may cause radio interference. In such cases, you may be required to take adequate preventive measures. In addition, this board should not be used near any medical equipment or RF devices.

Attaching additional wiring to this product or modifying the product operation from the factory default settings 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 PSoC 4100S Plus Prototyping Kit, as shipped from the factory, has been verified to meet with requirements of CE as a Class A product.

The CY8CKIT-149 PSoC 4100S Plus Prototyping Kit contains electrostatic discharge (ESD) sensitive devices. Electrostatic charges readily accumulate on the human body and any equipment, and can 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-149 PSoC 4100S Plus Prototyping Kit boards in the protective shipping package.

End-of-Life/Product Recycling

This kit has an end-of life five years from the date of manufacture mentioned on the back of the box. Contact your nearest recycler for discarding the kit.

General Safety Instructions

ESD Protection

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

Handling Boards

The CY8CKIT-149 PSoC 4100S Plus Prototyping Kit board is 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 board over any surface.

1. Introduction

Thank you for your interest in the CY8CKIT-149 PSoC 4100S Plus Prototyping Kit. The PSoC 4100S Plus Prototyping Kit is designed as an easy-to-use and inexpensive prototyping platform. The PSoC 4100S Plus Prototyping Kit supports the PSoC 4100S Plus device, delivering a complete system solution for a wide range of embedded applications at a very low cost. The PSoC 4100S Plus device is a true programmable embedded system-on chip, integrating custom digital peripheral functions, memory, and an ARM® Cortex®-M0+ MCU on a single chip with flexible automatic routing. The 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 PSoC 4100S Plus Prototyping Kit offers an open footprint breakout board to maximize the end-utility of the PSoC 4100S Plus device. This kit provides a low-cost alternative to device samples while providing a platform to easily develop and integrate the PSoC 4100S Plus device into your end-system. In addition, the board includes the following features:

■ Two LEDs to provide feedback (One each for 4100S Plus device and EZ-BLE device)

■ A push button to provide a simple user input

■ Three CapSense buttons of different sizes with feedback LEDs

■ Six segment slider with feedback LEDs

■ EZ-BLE Module with feedback LED

■ External ECO crystal (4 MHz)

■ External WCO crystal (32.768 kHz)

■ 1.8 V to 5 V operation

The CY8CKIT-149 PSoC 4100S Plus prototyping kit also integrates Cypress 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 4100S Plus device and EZ-BLE Module (see Figure 1-1). The prototyping kit allows you to separate the KitProg2 board from the target PSoC 4100S Plus board.

1.1   Kit Contents

The PSoC 4100S Plus Prototyping Kit contains a PSoC 4100S Plus Prototyping board and Quick Start Guide.

Figure 1-1. CY8CKIT-149 PSoC 4100S Plus Prototyping Kit
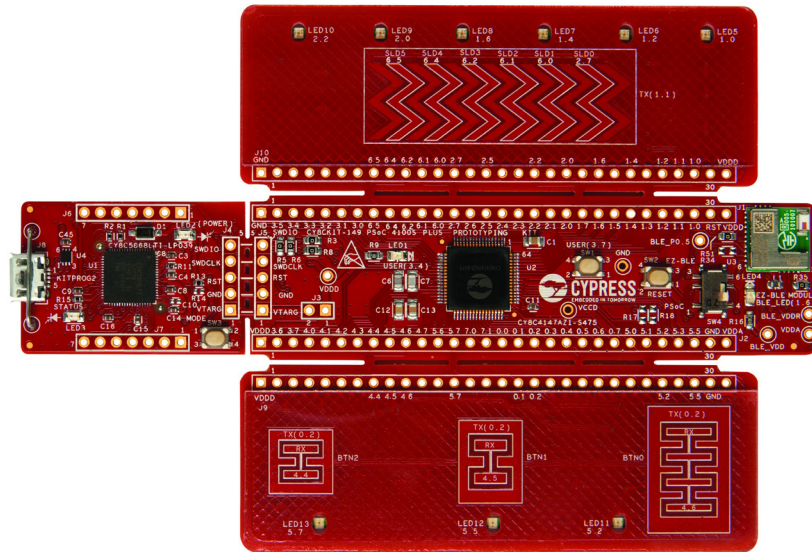
1.2   PSoC Creator

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:

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

Figure 1-2. PSoC Creator Features
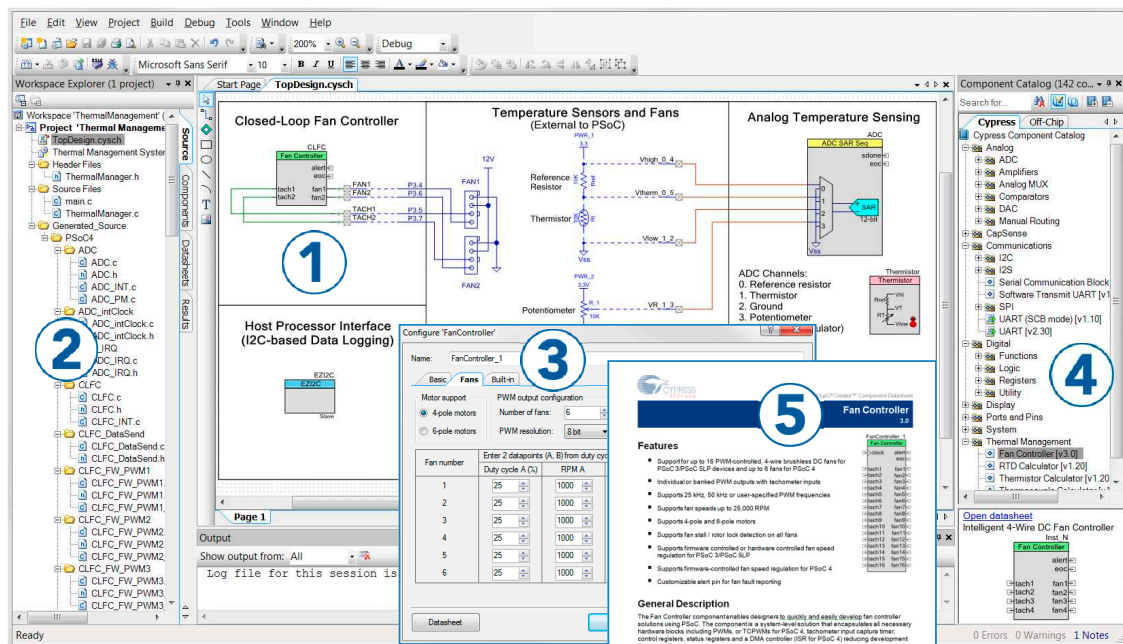
PSoC Creator also enables you to tap into an entire tool ecosystem with integrated compiler chains and programmers for PSoC devices.

For more information, visit www.cypress.com/psoccreator. Visit the PSoC Creator Video Training Page for video tutorials on learning and using 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 1-3 or from the menu **File** > **Code Example**....

Code examples can speed up your design process by starting you off with a complete design, instead of a blank page. The code examples also show how PSoC Creator Components can be used for various applications. Code examples and documentation are included, as shown in Figure 1-4 on page 11.

From the **Find Code Example** dialog shown in Figure 1-4 on page 11, you can

- Filter for examples based on architecture or device family, that is, PSoC 3, PSoC 4, or PSoC 5LP, project name, 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 needed) 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.

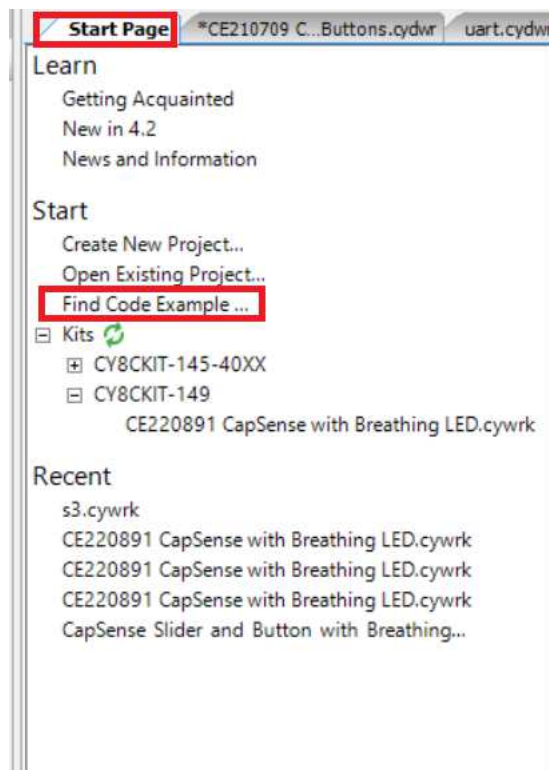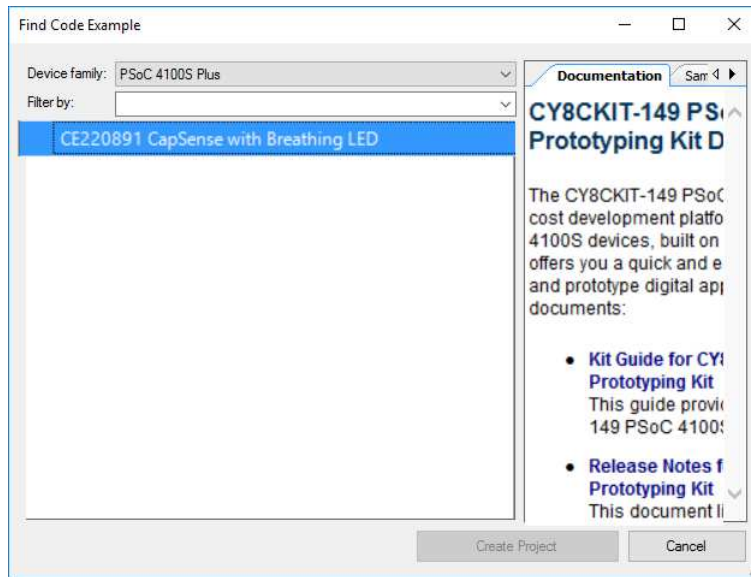Figure 1-3. Code Examples in PSoC Creator

Figure 1-4. Code Example Projects with Sample Code

1.2.2 Kit Code Examples

You can access the installed kit code examples from the PSoC Creator Start Page. To access these examples, expand **Kits** under **Start**; then, expand the specific kit to see the code examples. For a list of code examples that you can use on this kit, see the Code Examples chapter on page 26.

1.2.3 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.

1.2.4 Component Datasheets

Right-click a Component and select **Open Datasheet** (see Figure 1-5).

Figure 1-5. Opening Component Datasheet
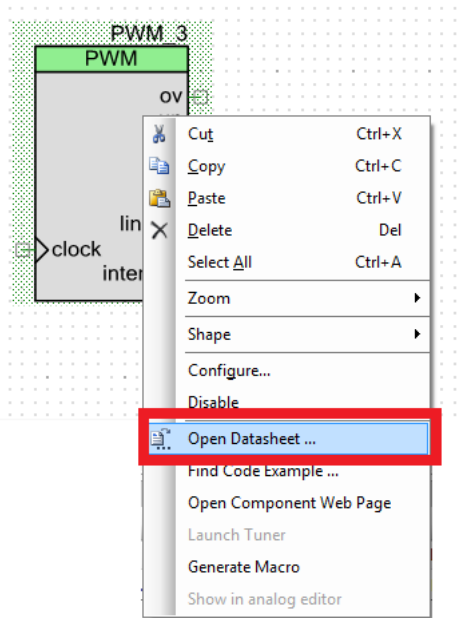
1.3 Getting Started

This guide will help you get acquainted with the PSoC 4100S Plus Prototyping Kit:

■ The Software Installation chapter on page 16 describes the installation of the kit software. This includes installation of the PSoC Creator IDE for development and debugging the applications, and PSoC Programmer for programming hex files.

■ The Kit Operation chapter on page 20 describes the major features of the PSoC 4100S Plus Prototyping Kit and functionalities such as programming, debugging, and the USB-UART and USB-I2C bridges.

■ The Code Examples chapter on page 26 describes multiple code examples that will help you understand how to create your own PSoC 4100S Plus projects.

■ The Appendix chapter on page 32 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

Cypress provides a wealth of data at www.cypress.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. For a comprehensive list of resources, see KBA86521, How to Design with PSoC 3, PSoC 4, and PSoC 5LP. The following is an abbreviated list for PSoC 4:

- Overview: PSoC Portfolio and PSoC Roadmap.
- Product Selectors: PSoC 4 Product Selector. In addition, PSoC Creator includes a device selection tool.
- Datasheets: Describe and provide electrical specifications for the PSoC 4000, PSoC 4100, PSoC 4200, PSoC 4100M, PSoC 4200M, PSoC 4200L, and PSoC 4100S Plus devices.
- CapSense Design Guide: Learn how to design capacitive touch-sensing applications with the PSoC 4 and PSoC Analog Coprocessor family of devices.
- Application Notes and Code Examples: Cover a broad range of topics, from basic to advanced. Many of the application notes include code examples. Visit the PSoC 3/4/5 Code Examples web page for a list of all available PSoC Creator code examples. To access code examples from within PSoC Creator, see PSoC Creator Code Examples on page 10.
- Technical Reference Manuals (TRM): Provide detailed descriptions of the architecture and registers in each PSoC 4 device family.
- Development Kits:
  - CY8CKIT-041, CY8CKIT-046, CY8CKIT-044, CY8CKIT-042, and CY8CKIT-040 are easy-to-use and inexpensive development platforms. These kits include connectors for Arduino™ compatible shields and Digilent Pmod Peripheral Modules.
  - CY8CKIT-043, CY8CKIT-049, CY8CKIT-145, CY8CKIT-146, CY8CKIT-149, are very low-cost prototyping platforms for sampling PSoC 4 devices.
  - CY8CKIT-001 is a common development platform for all PSoC family devices.
  - The MiniProg3 device provides an interface for flash programming and debug.
- Knowledge Base Articles (KBA): Provide design and application tips from experts on using the device.
- PSoC Creator Training: Visit www.cypress.com/go/creatorstart/creatortraining for a comprehensive list of video training on PSoC Creator.
- Learning from Peers: Visit community.cypress.com/welcome to meet enthusiastic PSoC developers discussing the next-generation embedded systems on Cypress Developer Community Forums.

1.5 Technical Support

For assistance, visit Cypress Support or contact customer support at +1 (800) 541-4736 Ext. 3 (in the USA) or +1 (408) 943-2600 Ext. 3 (International).

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

- Self-help (Technical Documents)
- Local Sales Office Locations

1.6　Document Conventions

Table 1-1. Document Conventions for Guides

Convention	Usage
Courier New	Displays file locations, user entered text, and source code: `C:\...cd\icc\`
Italics	Displays file names and reference documentation: Read about the *sourcefile.hex* file in the *PSoC Creator User Guide*.
[**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.

1.7 Acronyms

Table 1-2. Acronyms Used in this Document

Acronym	Description
ADC	Analog-to-Digital Converter
BCP	Bridge Control Panel
BLE	Bluetooth Low Energy
BOM	Bill of Materials
CE	Code Example
CMOD	Modulator Capacitor
CMP	Comparator
CTANK	Shield tank capacitor
DAC	Digital to Analog Converter
DPDT	Double-Pole, Double-Throw
ECO	External Crystal Oscillator
ESD	Electrostatic Discharge
GPIO	General Purpose Input/Output
I2C	Inter-Integrated Circuit
IDAC	Current DAC
IDE	Integrated Design Environment
KBA	Knowledge Based Article
LED	Light-Emitting Diode
PSoC	Programmable Systems-on-Chip
SAR	Successive Approximation Register
SCB	Serial Communication Block
SRAM	Static 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 PSoC 4100S Plus Prototyping Kit. This includes the IDE on which the projects will be built and used for programming.

2.1   Before You Begin

To install Cypress 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 Cypress software that is currently running.

2.2   Install Software

Follow these steps to install the PSoC 4100S Plus Prototyping kit software:

1. Download the PSoC 4100S Plus Prototyping kit software from www.cypress.com/CY8CKIT-149. The kit software is available in three formats for download.

    a. **CY8CKIT-149 Kit Only:** This executable file installs only the kit contents, which include kit 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.

    b. **CY8CKIT-149 Kit Setup:** This installation package contains the files related to the kit including PSoC Creator and PSoC Programmer. However, it does not include the Windows Installer or Microsoft .NET framework packages. If these packages are not on your PC the installer will direct you to download and install them from the Internet.

    c. **CY8CKIT-149 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 like a virtual CD/DVD using virtual drive programs such as Virtual CloneDrive and MagicISO. This package includes all the required software, utilities, drivers, hardware files, and user documents.

2. If you have downloaded the ISO file, mount it in a virtual drive. Extract the ISO contents if you do not have a virtual drive to mount. 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 Setup or Kit Only file, then go to step 4 for installation.

3. Click **Install CY8CKIT-149 Kit** to start the kit installation as shown in Figure 2-1.

Figure 2-1. Kit Installer Screen

4. Select the directory in which you want to install the PSoC 4100S Plus Prototyping Kit-related files. Choose the directory and click **Next**.

5. When you click **Next**, the PSoC 4100S Plus Prototyping kit installer automatically installs the required software, if it is not present on your PC. Following are the required software:

   a. PSoC Creator 4.2 or later: This software is available for download separately at www.cypress.com/psoccreator.

   b. PSoC Programmer 3.27 or later: This is installed as part of PSoC Creator installation (www.cypress.com/programmer).

6. Choose the **Typical**, **Custom**, or **Complete** installation type in the Product Installation Overview window, as shown in Figure 2-2. Click **Next** after selecting the installation type.

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

Figure 2-2. Product Installation Overview
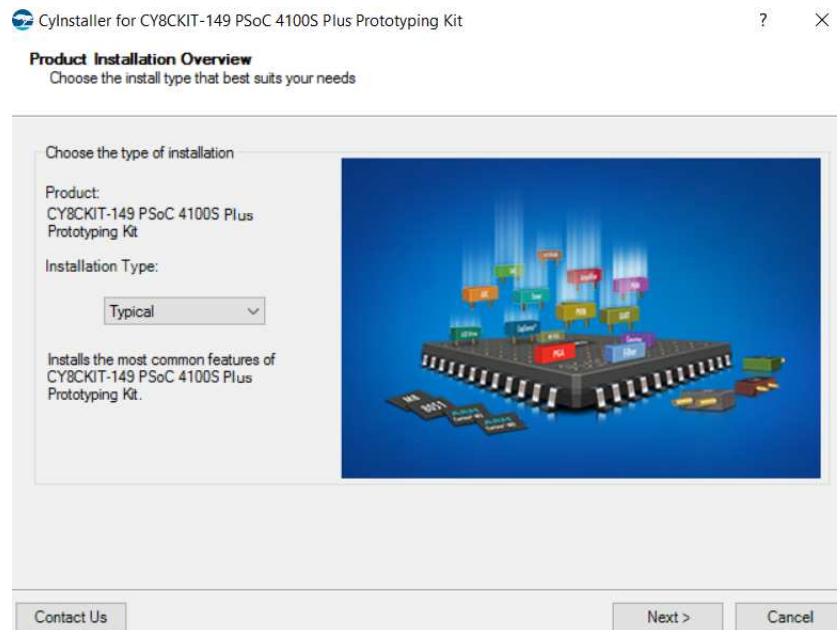
7. Read the License agreement and select **I accept the terms in the license agreement** to continue with the installation. Click **Next**. When the installation begins, a list of packages appears on the installation page. A green check mark appears next to each package after successful installation.

8. Enter your contact information or select the check box **Continue Without Contact Information**. Click **Finish** to complete the PSoC 4100S Plus Prototyping kit installation.

After the installation is complete, the kit contents are available at the following location:
`<Install_Directory>\CY8CKIT-149 PSoC 4100S Plus Prototyping Kit`

Default location:

Windows OS (64-bit):

`C:\Program Files (x86)\Cypress\CY8CKIT-149 PSoC 4100S Plus Prototyping Kit`

Windows OS (32-bit):

`C:\Program Files\Cypress\CY8CKIT-149 PSoC 4100S Plus Prototyping Kit`

Note: For Windows 7/8/8.1 and later users, the installed files and the folder are read-only. To use the installer code examples, follow the steps outlined in the Code Examples chapter on page 26.

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 PSoC 4100S Plus 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   Theory of Operation

shows the block diagram for the PSoC 4100S Plus Prototyping Kit.

Figure 3-1. Block Diagram of PSoC 4100S Plus Prototyping Kit
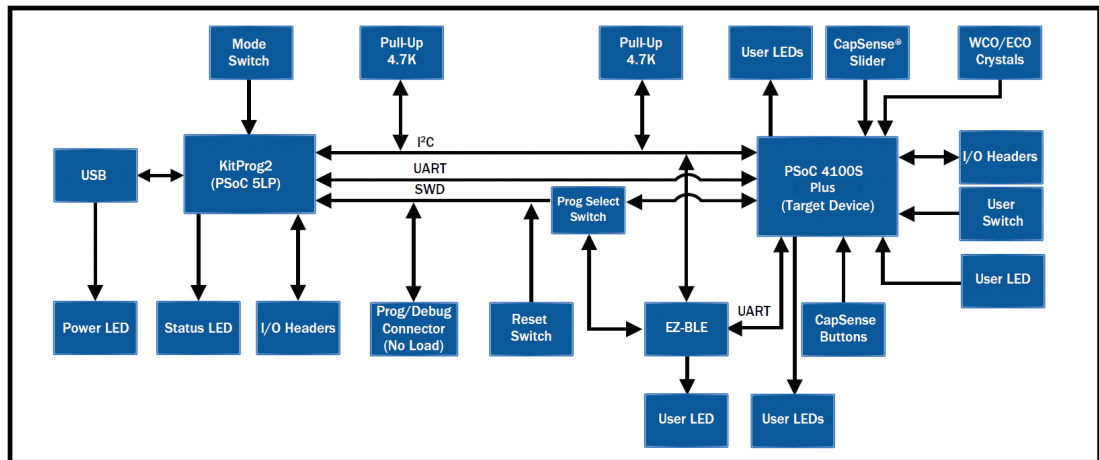
The PSoC 4100S Plus Prototyping Kit is simplistic in design and focuses on providing you with complete access to develop applications using the PSoC 4100S Plus device. This kit supports the following features:

■ **PSoC 4100S Plus I/O Headers:** The PSoC 4100S Plus Prototyping board brings all GPIOs of the target PSoC 4100S Plus device to the two expansion headers. This provides maximum access to the capabilities of the PSoC 4100S Plus device.

■ **User LEDs:** The onboard LEDs, LED1 and LED4 can be used to display outputs from the PSoC 4100S Plus device and EZ-BLE Module respectively. This includes modulating the brightness of the LED to notify different states of the device.

■ **User Button:** This kit has a push button, which can be used to provide an input to the PSoC 4100S Plus device.
Note: The switch connects the PSoC 4100S Plus device pin (P3.7) to ground when pressed. Therefore, you need to configure the PSoC 4100S Plus device pin as 'resistive pull-up' for detecting the switch press.

■ **Six Segment CapSense Slider with Feedback LEDs:** A six-segment CapSense Slider is provided in the snappable area of the kit. To evaluate the slider, six green LEDs are provided for feedback in the snappable area of the kit. The slider can perform in both Mutual Capacitance and Self Capacitance modes.

- **Three CapSense Buttons with User LEDs:** Three CapSense buttons of different sizes are provided with this kit in the snappable area. To evaluate the buttons, three green LEDs are provided for feedback in the snappable area of the kit. These buttons can perform in both Self Capacitance and Mutual Capacitance modes.

- **EZ-BLE Module with User LED:** EZ-BLE Module from Cypress is loaded on this kit with blue User LED connected to one of its GPIO. Using this module, you can work on various Bluetooth Low Energy (BLE) applications.

- **ECO Crystal:** A 4-MHz crystal is loaded onboard for precision clock applications.

- **WCO Crystal:** A 32.768-kHz crystal footprint is provided which can be loaded for precision clock applications.

- **Reset Button:** This button is used to reset the PSoC 4100S Plus device when pressed.

- **Power LED:** This LED indicates power is being supplied to the board.

- **PSoC 4100S Plus Device:** This is the target device (CY8C4147AZI-S475) on the board.

- **5-pin Programming Headers:** These are external programming headers that can be used to program the PSoC 4100S Plus device using a MiniProg3. Typically this connection is not required since the kit contains an integrated KitProg2.

- **PSoC 5LP IO Headers:** Using these headers, you can evaluate the PSoC 5LP (CY8C5868LTI-LP039) device. The PSoC 5LP is used to implement the KitProg2 functionality by default.

- **Current Measurement Jumper:** Using this jumper, you can measure the current consumed by the PSoC 4100S Plus device. This jumper is not populated by default. To use this jumper, you must remove the zero ohm resistor R53.

- **USB 2.0 Micro-B Connector:** Using this USB Micro-B connector (J8), you can connect the kit to a PC using USB 2.0 Type-A to Micro-B Cable.

- **KitProg2:** This is an onboard programmer/debugger utilizing a PSoC 5LP (CY8C5868LTI-LP039), which enables you to program and debug the target PSoC 4100S Plus device. It can also act as a USB-UART and UART-I2C bridge.
  When used as a standalone module, KitProg2 can be used to program devices of PSoC 3, PSoC 4, or PSoC 5LP families through the SWD interface. For more details on the KitProg2 functionality, see the *KitProg2 User Guide*.

- **KitProg2 Mode Selection Button:** This button is used to switch between the KitProg2 modes as shown in Table 3-1. You can also use this button to provide an input to the PSoC 5LP in custom applications. Note that the switch connects the PSoC 5LP pin to ground when pressed. For more details, see the *KitProg2 User Guide*.

- **KitProg2 Status LED:** This LED gives the programming/mode status of KitProg2.

Table 3-1. KitProg2 Mode Switching

KitProg2 Programming Modes *	Status LED (LED3)
KitProg2 Program/Debug Mode (PPCOM mode) (default)	ON
CMSIS-DAP & Mass Storage Programming Mode	OFF

***Note:** Toggling between programming modes can be done by pressing mode switch SW3.

3.2 Programming and Debugging the Target PSoC 4100S Plus Device

The target PSoC 4100S Plus device can be programmed and debugged using the KitProg2. Before programming the device, make sure that PSoC Creator and PSoC Programmer software are installed on the PC. See Install Software on page 16 for more information.

3.2.1 Programming Using PSoC Creator

1. Make sure SW4 is switched to PSoC side. Connect the prototyping board to the PC through the USB Micro-B Connector (**J8**) as shown in Figure 3-2. The kit enumerates as a composite device. If you are plugging in the PSoC 4100S Plus Prototyping Kit to your PC for the first time, the kit drivers will get installed automatically. The amber status LED (LED3) will turn ON to indicate successful enumeration. If the amber status LED (LED3) is OFF, see the *KitProg2 User Guide* for details on the KitProg2 status and troubleshooting instructions.
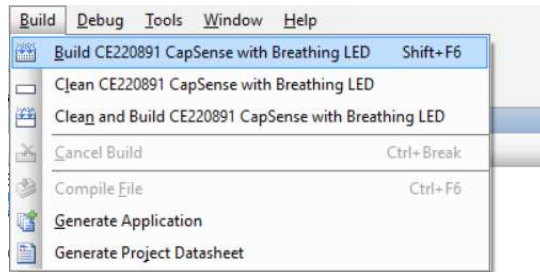
Figure 3-2. Connecting the PSoC 4100S Plus Prototyping Kit to a Computer
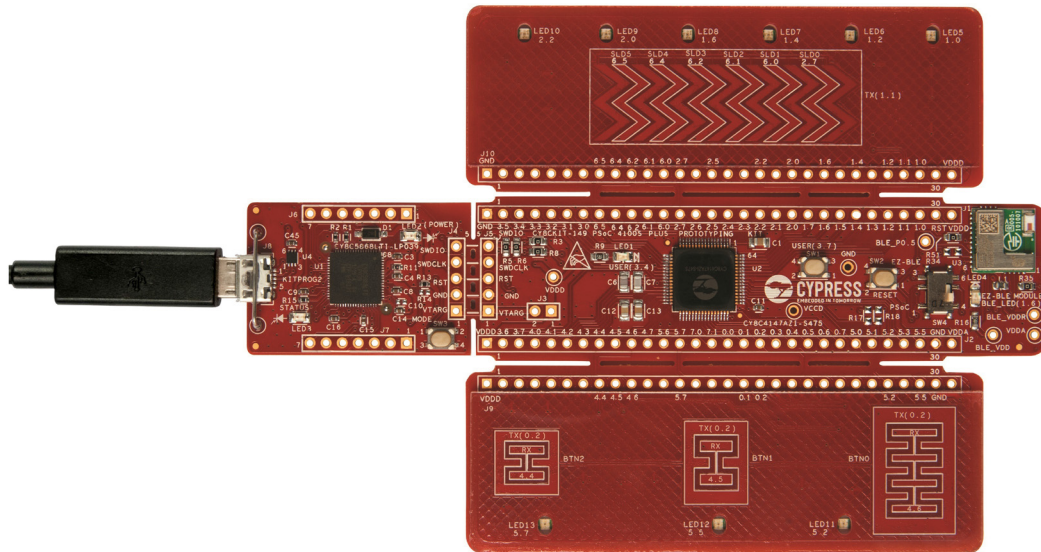
2. Open the desired project in PSoC Creator. From the PSoC Creator, go to **File** > **Open** > **Project/ Workspace**. You can browse and open a previously saved project. If you want to open one of the code examples provided with the kit, follow the instructions in the Code Examples chapter on page 26.

3. Select the option **Build** > **Build <Project_Name>** or press [**Shift**] [**F6**] to build the project as shown in Figure 3-3.

Figure 3-3. 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 3-4. This programs the target PSoC 4100S Plus device on the PSoC 4100S Plus Prototyping Kit, and the kit is ready to use.

Figure 3-4. Program Device in PSoC Creator
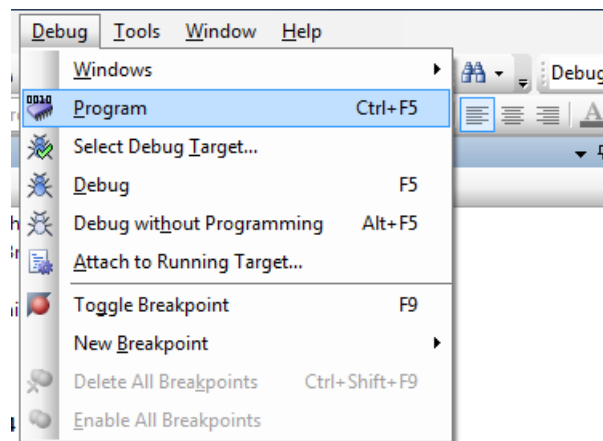
3.2.2 Debugging Using PSoC Creator

For debugging the project using PSoC Creator, follow steps 1–3 from Programming Using PSoC Creator on page 22 followed by:

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

For more details on using the debug features, see section 3.3 of the *KitProg2 User Guide*.

3.2.3 Programming Using PSoC Programmer

PSoC Programmer (3.27.0 or later) can be used to program existing `.hex` files into the PSoC 4100S Plus Prototyping Kit. For a detailed explanation on how to program using PSoC Programmer, see the **Programming Using PSoC Programmer** section in the *KitProg2 User Guide*.

3.2.4 Mass Storage Programming

The KitProg2 in the CY8CKIT-149 PSoC 4100S Plus Prototyping Kit supports programming through a USB Mass Storage interface. This interface allows you to program the PSoC 4100S Plus device by copying *.hex* files into an emulated USB Mass Storage device. For more details on using KitProg2 as a Mass Storage Programmer, see the *KitProg2 User Guide*.

Note: Mass Storage Programming is only supported in KitProg2 v1.05 and later for PSoC 4100S Plus devices.

3.3 USB-UART Bridge

The KitProg2 on the PSoC 4100S Plus Prototyping Kit can act as a USB-UART bridge. The UART lines between the KitProg2 and the target are hard-wired on the board, through the snappable area, with UART_RX assigned to **P7[0]** and UART_TX assigned to **P7[1]** on target PSoC 4100S Plus device. For more details on the KitProg2 USB-UART functionality, see the **USB-UART Bridge** section in the *KitProg2 User Guide*.

Figure 3-5. UART Connection between KitProg2, PSoC 4100S Plus Device, and EZ-BLE Module
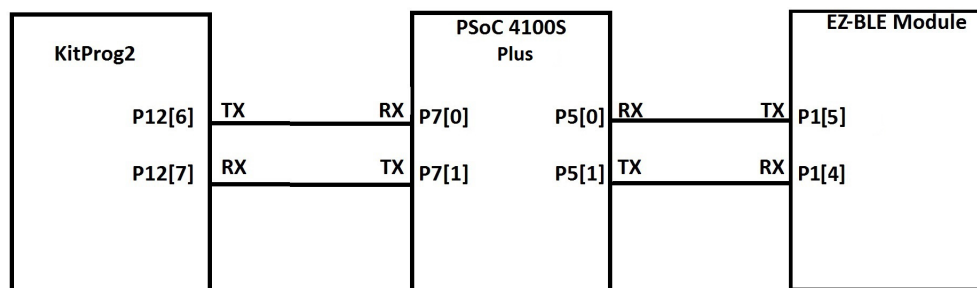
3.4   USB-I2C Bridge

The KitProg2 can function as a USB-I2C bridge and communicate with the software utility Bridge Control Panel (BCP). The I^{2}C lines on target PSoC 4100S Plus device are **P3[1] (SDA)** and **P3[0] (SCL)**, which are hardwired on the board to the I^{2}C lines of the KitProg2. The USB-I2C supports I^{2}C speeds of 50 kHz, 100 kHz, 400 kHz, and 1 MHz. For more details on the KitProg2 USB-I2C functionality, see the **USB-I2C Bridge** section in the *KitProg2 User Guide*.

Figure 3-6. I2C Connection between KitProg2, PSoC 4100S Plus Device, and EZ-BLE Module
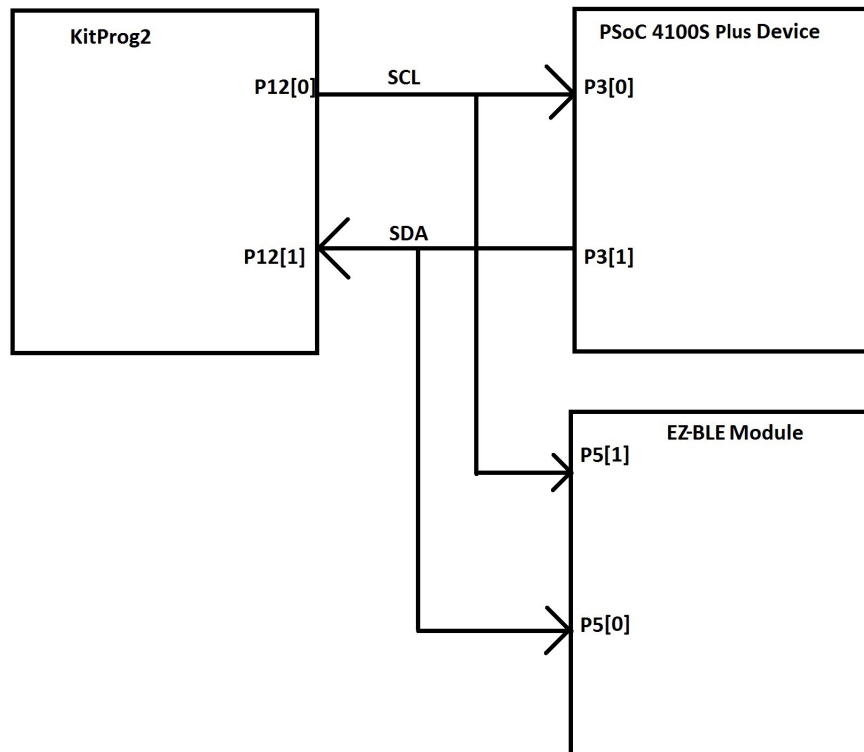
3.5   Updating the KitProg2 Firmware

The KitProg2 firmware normally does not require any update. You can use the PSoC Programmer software to update the KitProg2 firmware if necessary. For a detailed explanation on how to update the KitProg2 firmware, see **Updating the KitProg2 Firmware** in the *KitProg2 User Guide*.