

# CY8CKIT-045S PSoC 4500S Pioneer Kit Guide

## About this document

### Scope and purpose

The CY8CKIT-045S PSoC® 4500S Pioneer Kit is a scalable and reconfigurable platform structure of programmable embedded system controllers with an Arm® Cortex®-M0+ CPU.

## Table of contents

## Table of contents

<b>About this document.....</b>	<b>1</b>
<b>Table of contents.....</b>	<b>2</b>
<b>Safety Information .....</b>	<b>4</b>
Regulatory Compliance .....	4
General Safety Instructions .....	5
ESD Protection 5 .....	
Handling Boards .....	5
<b>1 Introduction .....</b>	<b>6</b>
1.1 Kit Contents .....	6
1.2 PSoC Creator .....	7
1.2.1 PSoC Creator Code Examples .....	8
1.2.2 Kit Code Examples .....	9
1.2.3 PSoC Creator Help.....	9
1.2.4 Component Datasheets .....	10
1.3 Getting Started .....	10
1.4 Additional Learning Resources .....	11
1.5 Technical Support.....	11
1.6 Document Conventions.....	12
1.7 Acronyms .....	12
<b>2 Kit Operation .....</b>	<b>13</b>
2.1 Theory of Operation .....	13
2.2 Programming and Debugging the PSoC 4500S Target Device.....	15
2.2.1 Programming Using PSoC Creator .....	15
2.2.2 Debugging Using PSoC Creator .....	16
2.2.3 Programming Using PSoC Programmer.....	16
2.3 USB-UART Bridge.....	17
2.4 USB-I2C Bridge .....	17
2.5 Updating the KitProg3 Firmware .....	18
<b>3 Code Examples .....</b>	<b>19</b>
3.1 Using the Kit Code Examples from the kit website .....	19
3.2 Using Built-in PSoC Creator Code Examples with the Kit .....	22
<b>4 Appendix.....</b>	<b>24</b>
4.1 Board Details .....	24
4.2 Hardware Details .....	25
4.2.1 PSoC 4500S Pioneer Board .....	25
4.2.2 KitProg3 .....	27
4.2.3 Serial Interconnection between PSoC 5LP and PSoC 4500S.....	28
4.2.4 Power Supply System .....	28
4.2.5 PSoC 4500S Power Selection/Current Measurement Jumper .....	30
4.2.6 Expansion Headers .....	30
4.2.6.1 Arduino-compatible Headers (J1, J2, J3, J4) & PSoC 4500S Extended I/O Headers (J10, J11).....	30
4.2.6.2 Pmod Header (J9) .....	31
4.2.7 User and Passive Inputs.....	32
4.2.7.1 CapSense Circuit .....	32
4.2.7.2 User Button .....	33
4.2.7.3 Reset Switch .....	33
4.2.7.4 Mode Switch .....	34

---

**Table of contents**

4.2.7.5	LEDs .....	34
4.2.7.6	Thermistor.....	36
4.2.7.7	Ambient Light Sensor.....	37
4.2.7.8	10-pin and 5-pin SWD Program/Debug Headers .....	37
4.2.8	Crystal Oscillator .....	38
4.3	PSoC 4500S Pioneer Board Rework.....	38
4.3.1	Bypassing Reverse Voltage Protection Circuits .....	38
4.3.2	Rework on CapSense and Additional Multiplexed Pins.....	39
4.3.3	Rework for Thermistor Block.....	40
4.3.4	Rework on J14 and J15 for Motor Control Application.....	40
4.4	PSoC 4500S Pioneer Kit Schematics .....	41
4.5	Bill of Materials .....	41
<b>Revision History .....</b>		<b>42</b>

## Safety Information

## Safety Information

### Regulatory Compliance

The CY8CKIT-045S PSoC 4500S Pioneer Kit is intended for use as a development platform for hardware or software in a laboratory environment. The board is an open system design, which does not include a shielded enclosure. 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.

This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required authorizations are first obtained. Contact [support@cypress.com](mailto:support@cypress.com) for details.

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 4500S Pioneer Board 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 PSoC 4500S Pioneer Boards in the protective shipping package.



#### End-of-Life/Product Recycling

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

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## Safety Information

### 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 antistatic wrist strap attached to the chassis ground (any unpainted metal surface) on your board when handling parts.

#### Handling Boards

PSoC 4500S Pioneer boards are sensitive to ESD. Hold the board only by its edges. After removing the board from its box, place it on a grounded, static-free surface. Use a conductive foam pad if available. Do not slide board over any surface.

## Introduction

# 1 Introduction

Thank you for your interest in the CY8CKIT-045S PSoC 4500S Pioneer Kit. The PSoC 4500S Pioneer Kit is a scalable and reconfigurable platform structure with a programmable embedded system controller containing an Arm Cortex-M0+ CPU. The PSoC 4 is a combination of a microcontroller with standard communication and timing peripherals, two motor control accelerator blocks specifically designed for motor control algorithm acceleration, a capacitive touch-sensing system (CapSense®) with best-in-class performance, programmable general-purpose continuous-time and switched-capacitor analog blocks, and programmable connectivity.

The PSoC 4500S pioneer kit integrates the Cypress KitProg3 that enables on-board programming, debugging, and bridging functionality, such as USB-UART and USB-I2C. KitProg3 is used to program and debug the target PSoC 4500S device.

## 1.1 Kit Contents

The CY8CKIT-045S PSoC 4500S Pioneer Kit contains the following, as shown in [Figure 1](#).

- PSoC 4500S Pioneer board
- USB Type-A to Micro-B cable
- Six jumper wires (five inches each)
- Quick Start Guide



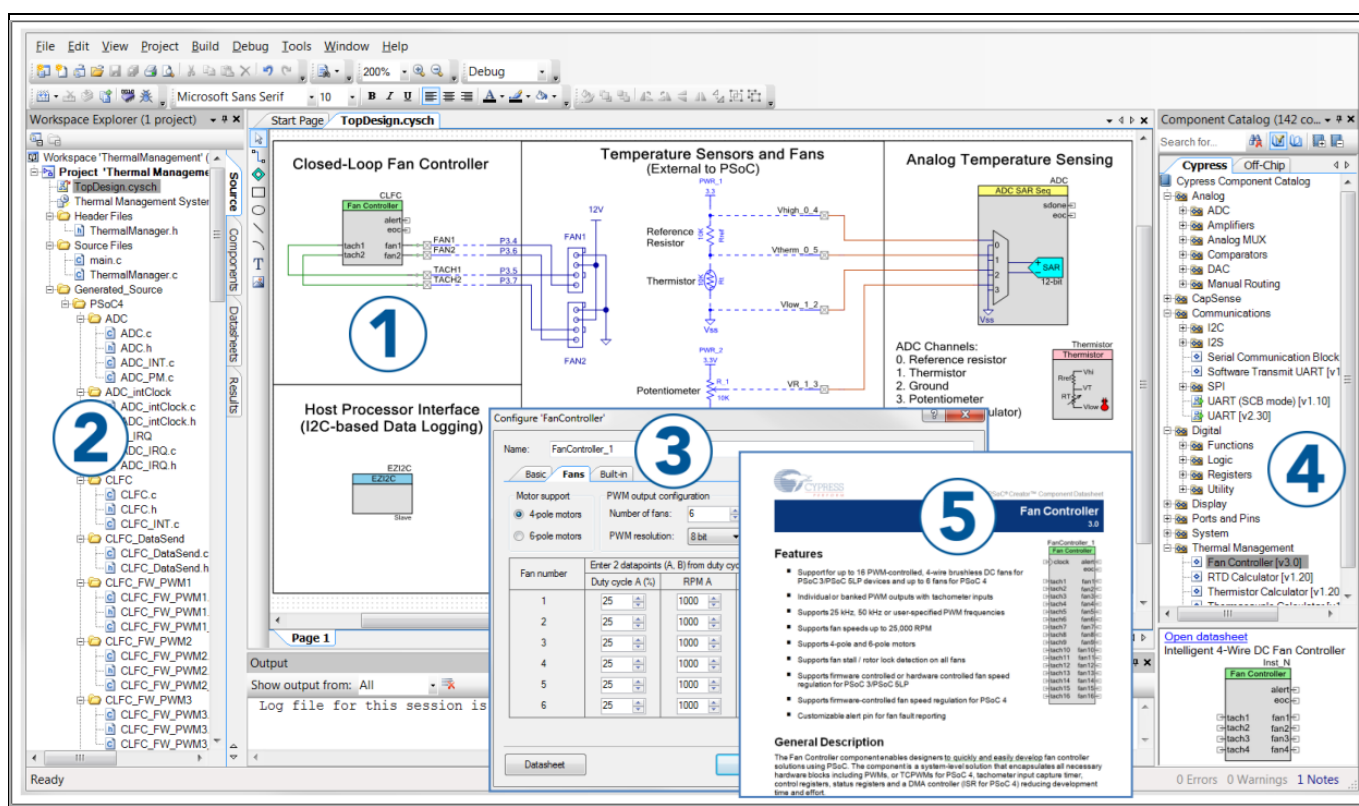
**Figure 1** CY8CKIT-045S PSoC 4500S Pioneer Kit Contents

## Introduction

### 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 2 PSoC Creator Features**

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

For more information, visit [www.cypress.com/psoccreator](http://www.cypress.com/psoccreator). Visit the [PSoC Creator Video Training Page](#) for video tutorials on learning and using PSoC Creator.

## Introduction

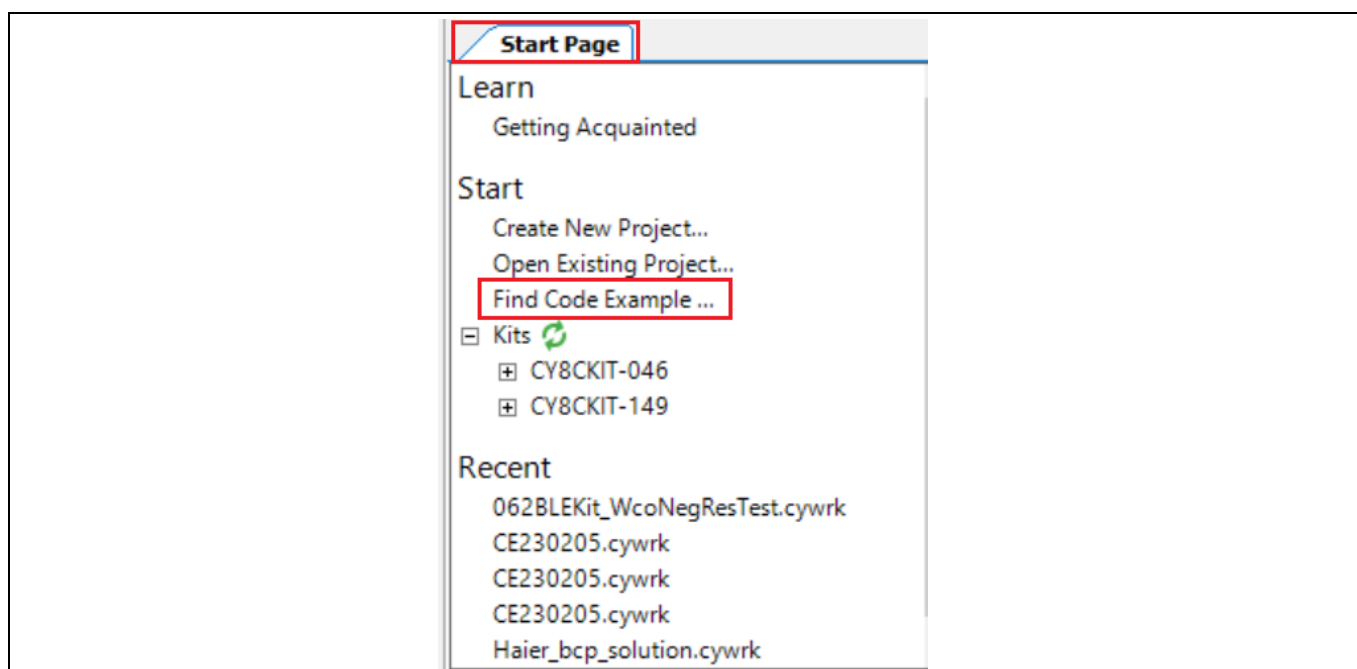
### 1.2.1 PSoC Creator Code Examples

PSoC Creator includes a large number of code examples. These examples are available from the PSoC Creator Start Page, as [Figure 3](#) shows or from the menu under “**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 4](#).

In the **Find Code Example** dialog shown in [Figure 4](#), you have several options:

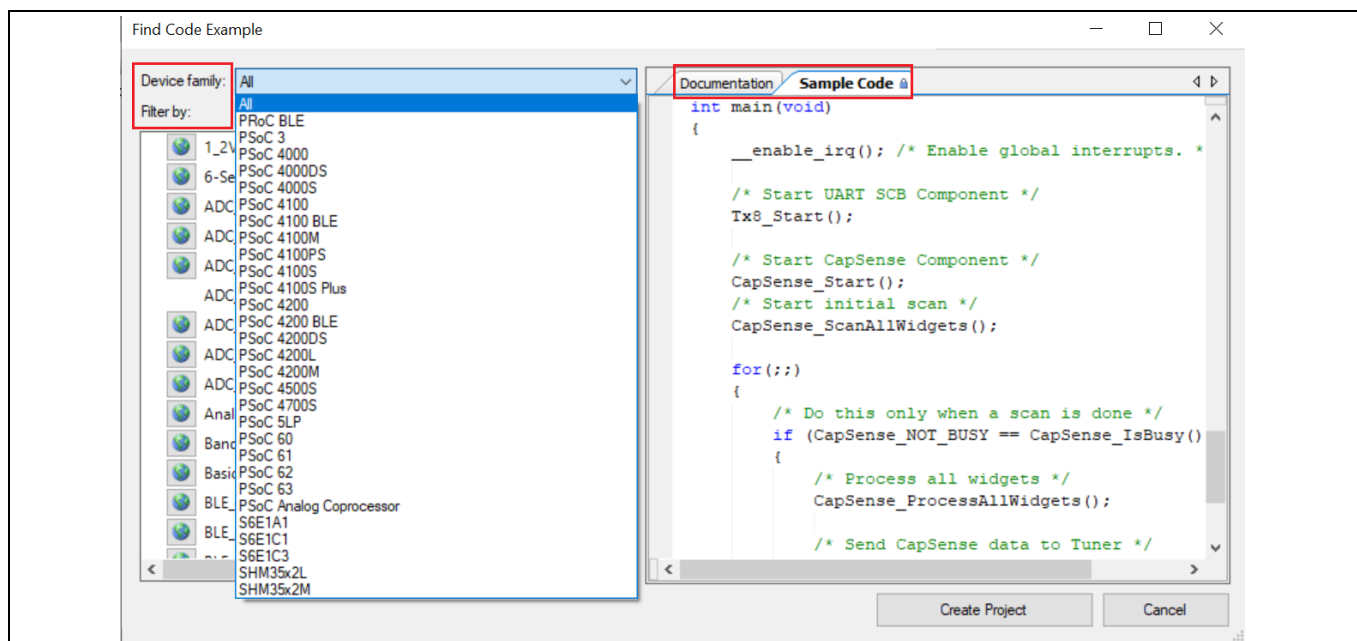
- Filter for examples based on architecture or device family, that is, PSoC 3, PSoC 4, or PSoC 5LP; project name; or keyword.
- Select from the list of examples offered based on the **Filter Options**.
- Review the code example’s description on the **Documentation** tab
- Review the code from the **Sample 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 3** Code Examples in PSoC Creator



## Introduction



**Figure 4** Code Example Projects with Sample Code

### 1.2.2 Kit Code Examples

You can download the kit code examples package from the kit webpage. Refer to the [Code Examples](#) chapter for a list of code examples that are provided with this kit.

### 1.2.3 PSoC Creator Help

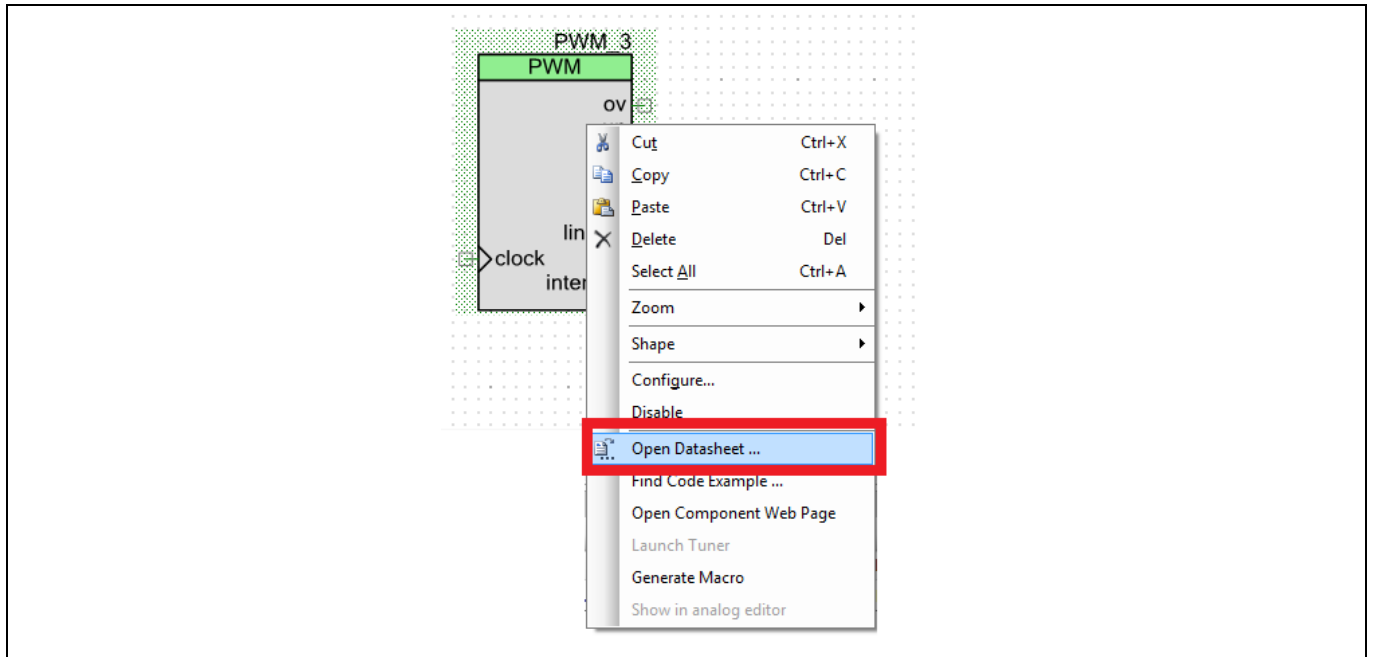
Launch PSoC Creator and navigate to the following items:

- **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 on the Component in the schematic or in the Component Catalog. Select the **Find Code Example** option 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.

## Introduction

### 1.2.4 Component Datasheets

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



**Figure 5** Opening Component Datasheet

## 1.3 Getting Started

This guide will help you get acquainted with the CY8CKIT-045S PSoC 4500S Pioneer Kit:

- The [Kit Operation](#) chapter describes the major features of the PSoC 4500S Pioneer Kit and functionalities such as programming, debugging, the USB-UART and USB-I2C bridges and the method to update the KitProg3 firmware.
- The [Code Examples](#) chapter describes multiple code examples that will help you understand how to create your own PSoC 4500S projects.
- The [Appendix](#) chapter describes the hardware content of the kit and the hardware operation and also provides kit schematics, and the bill of materials (BOM).

## Introduction

### 1.4 Additional Learning Resources

Cypress provides a wealth of data at [www.cypress.com](http://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](#), [PSoC 4000S](#), [PSoC 4100S](#), [PSoC 4100S Plus](#), [PSoC 4100S Plus 256K](#) and [PSoC 4500S](#) device families.
- [CapSense Design Guide](#): Learn how to design capacitive touch-sensing applications with the PSoC 4 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](#).
- [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](#), [CY8CKIT-040](#) and [CY8CKIT-045S](#) 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-147](#) and [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 [MiniProg4](#) 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](http://www.cypress.com/go/creatorstart/creatortraining) for a comprehensive list of video training on PSoC Creator.
- Learning from Peers: Visit [www.cypress.com/forums](http://www.cypress.com/forums) 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](#)

## Introduction

### 1.6 Document Conventions

**Table 1 Document Conventions for Guides**

Convention	Usage
Courier New	Displays file locations, user entered text, and source code: C:\...cd\icc\
<i>Italics</i>	Displays file names and reference documentation: Read about the <i>sourcefile.hex</i> file in the <i>PSoC Creator User Guide</i> .
[Bracketed, Bold]	Displays keyboard commands in procedures: [Enter] or [Ctrl] [C]
<b>File &gt; Open</b>	Represents menu paths: File > Open > New Project
<b>Bold</b>	Displays commands, menu paths, and icon names in procedures: Click the <b>File</b> icon and then click <b>Open</b> .
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 2 Acronyms Used in this Document**

Acronym	Description
ADC	Analog-to-Digital Converter
BOM	Bill of Materials
CE	Code Example
CMOD	Modulator Capacitor
DAC	Digital to Analog Converter
ESD	Electrostatic Discharge
GPIO	General Purpose Input/Output
I2C	Inter-Integrated Circuit
IDE	Integrated Design Environment
KBA	Knowledge Based Article
NTC	Negative Thermal Coefficient
LDO	Low Drop Out
LED	Light-Emitting Diode
PSoC	Programmable System-on-Chip
SAR	Successive Approximation Register
SWD	Serial Wire Debug
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus

## Kit Operation

## 2 Kit Operation

This chapter introduces you to the features of the CY8CKIT-045S PSoC 4500S Pioneer Kit. This primarily includes the programming/debugging functionality, KitProg3 USB-UART and USB-I2C bridges, and the method to update the KitProg3 firmware.

### 2.1 Theory of Operation

Figure 6 shows the block diagram for the CY8CKIT-045S PSoC 4500S Pioneer Kit.

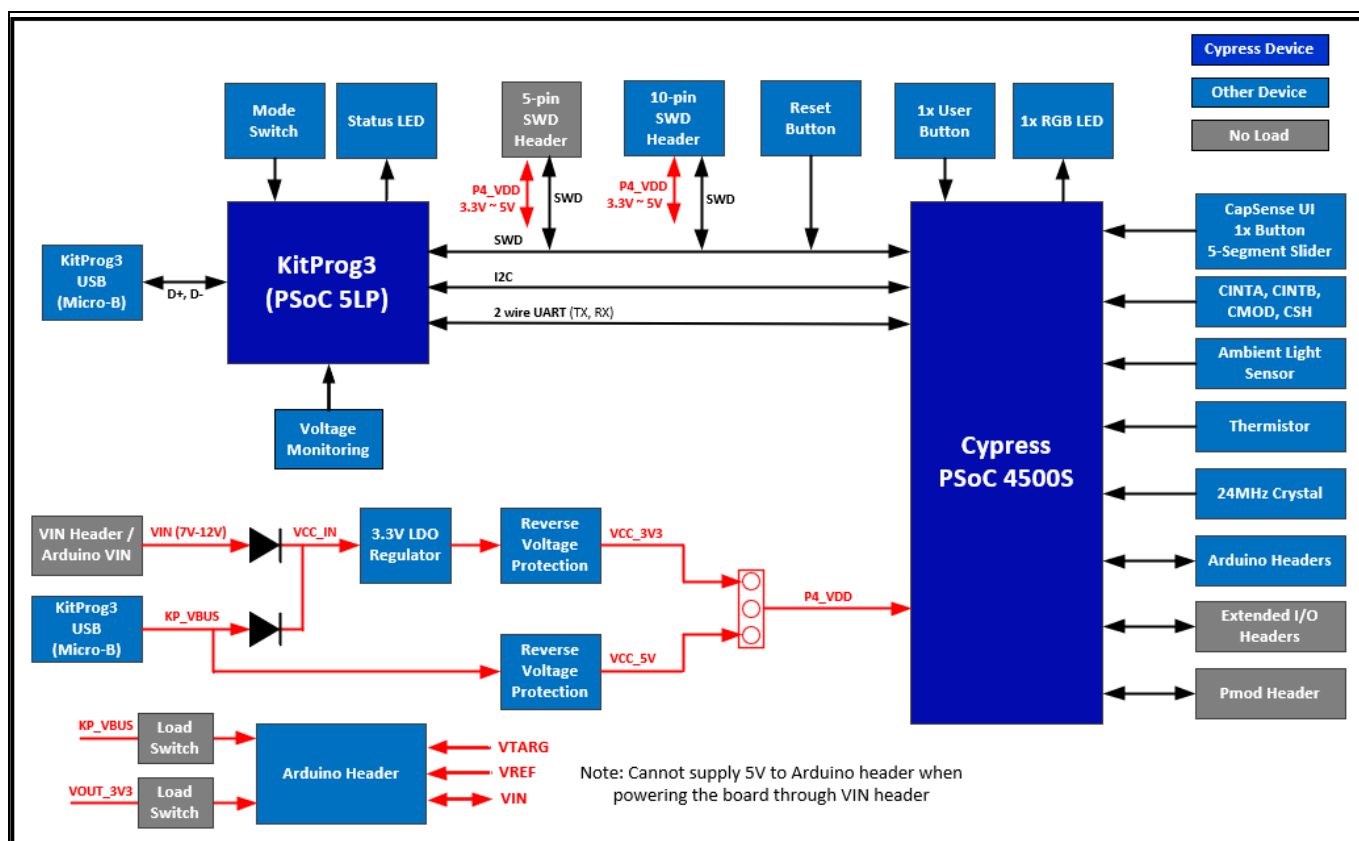


Figure 6 Block Diagram of CY8CKIT-045S PSoC 4500S Pioneer Kit

The PSoC 4500S Pioneer Kit is simplistic in design and focuses on providing you with complete access to develop applications using the PSoC 4500S device. This kit supports the following features:

- **PSoC 4500S Extended I/O Headers (J10, J11):** The PSoC 4500S Pioneer board brings most GPIOs of the target PSoC 4500S device to the two expansion headers enabling you to have maximum access to the capabilities of the PSoC 4500S device.
- **Arduino UNO R3-compatible Headers (J1, J2, J3, J4):** J1 header powers third-party Arduino Shields. This header also has a provision to power the PSoC 4500S Pioneer Kit through the VIN input on the header. J2, J3 and J4 headers are compatible with PSoC 4500S Pioneer Kit and operates flawlessly with third-party Arduino Shields.
- **User RGB LED (D8):** This on-board RGB LED can be used to display outputs from the PSoC 4500S device. This includes modulating the brightness of the LED to notify different states of the device.
- **User Button (SW2):** Provides an input to PSoC 4500S device.

## Kit Operation

**Note:** The button connects the PSoC 4500S pin (P1[2]) to ground when pressed. Therefore, you need to configure the PSoC 4500S pin as ‘resistive pull-up’ for detecting the switch press. Also note that when configuring the pin as ‘resistive pull-up’, the pin cannot be connected to any other internal peripheral through a hardware connection.

- **Reset Button (SW1):** Resets the PSoC 4500S device when pressed.
- **Power LED (D1):** Indicates power is being supplied to the board.
- **Five Segment CapSense Slider (CSS1):** This slider can be used to measure finger position to be used as a sliding scale control input.
- **CapSense Button (CSB1):** This button can be used as a general purpose on/off input as an alternative to a mechanical button.
- **ECO Crystal (Y1):** A 24-MHz crystal is loaded onboard for precision clock applications.
- **VIN Header (J8):** Connects an external DC power supply input to the onboard regulators. The voltage input from the external supply should be between 7 V and 12 V.
- **Thermistor (TH1):** The thermistor is used to measure ambient temperature.
- **Ambient Light Sensor (Q1):** A general purpose ambient light sensor.
- **Pmod (J9):** This header can be used to connect Digilent Pmod 1 × 6 pin SPI modules.
- **PSoC 4500S Device (U1):** Target device (CY8C4548AZI-S485) on the board.
- **5-pin and 10-pin SWD Program/Debug Headers (J7 and J12):** External programming headers that can be used to program/debug PSoC 4500S using MiniProg4. Typically, this connection is not required because the kit contains an integrated KitProg3.
- **Power Selection Jumper (J6):** Selects the PSoC 4500S supply voltage (P4\_VDD) between 5 V and 3.3 V.
- **KitProg3 USB Connector (J5):** Use the USB cable provided along with the PSoC 4500S Pioneer Board to connect the board to the PC to use the KitProg3 onboard programmer and debugger and to provide power to the board.
- **KitProg3 (U2):** An on-board programmer/debugger that uses a PSoC 5LP (CY8C5868LTI-LP039), which enables you to program and debug the target PSoC 4500S device. It can also act as a USB-UART and UART-I2C bridge.

When used as a standalone module, it can be used to program devices of the PSoC 3, PSoC 4, or PSoC 5LP families through the SWD interface. For more details on the KitProg3 functionality, see the [KitProg3 User Guide](#).

- **KitProg3 Mode Selection Button (SW3):** This button function is reserved for future use. Note that the button connects the PSoC 5LP pin to ground when pressed.
- **KitProg3 Status LED (D5):** Shows the programming/mode status of KitProg3.

**Table 3 KitProg3 Mode Switching**

KitProg3 Programming Modes *	Status LED (D5)
CMSIS-DAP/Bulk mode (default)	ON
CMSIS-DAP/HID mode	RAMPING at 1Hz

\***Note:** Switching between the programming modes can be done through [Firmware-loader](#) tool. Refer to the chapter 2.2.3 Mode Switching section of the [KitProg3 User Guide](#) for details.

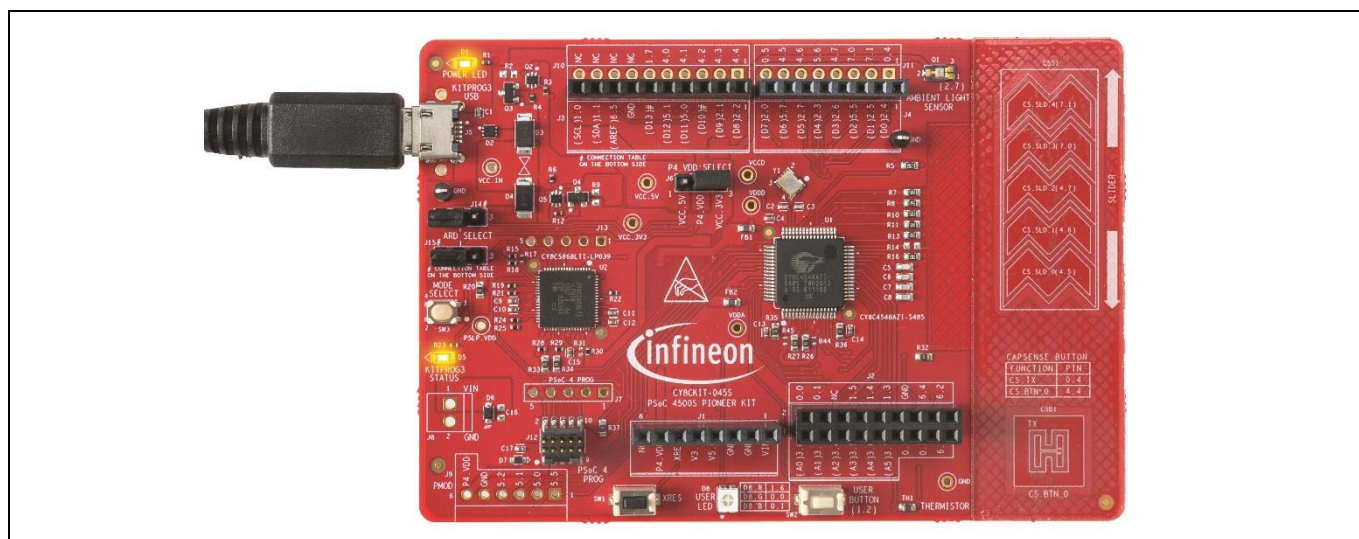
## Kit Operation

### 2.2 Programming and Debugging the PSoC 4500S Target Device

The target PSoC 4500S device can be programmed and debugged using KitProg3. Before programming the device, ensure that PSoC Creator and PSoC Programmer software are installed on the PC.

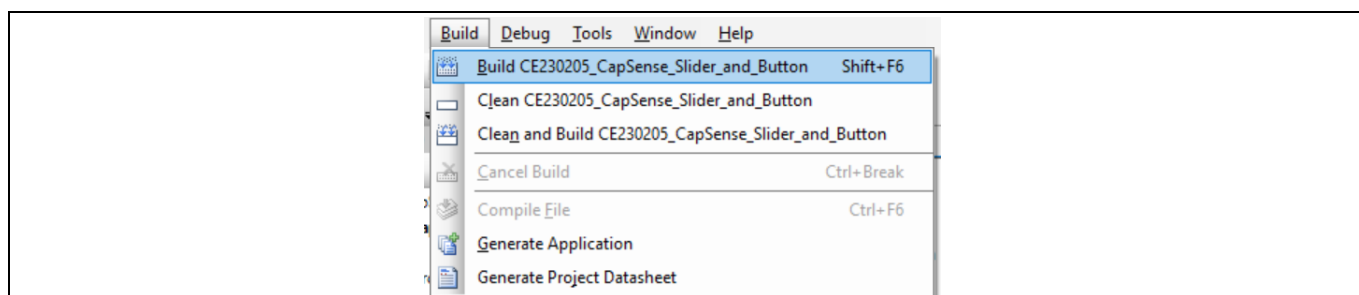
#### 2.2.1 Programming Using PSoC Creator

1. Connect the PSoC 4500S pioneer board to the computer through the connector (J5), as shown in [Figure 7](#). If you are plugging in the PSoC 4500S Pioneer Kit to your PC for the first time, the kit drivers will get installed automatically. KitProg3 can operate either in CMSIS-DAP HID mode or CMSIS-DAP Bulk mode (default). Programming is faster with the CMSIS-DAP Bulk mode. The status LED (Yellow) is always ON in CMSIS-DAP Bulk mode and is ramping (increasing and decreasing brightness) at 1 Hz rate in CMSIS-DAP HID mode. see the [KitProg3 User Guide](#) for details on the KitProg3 status and troubleshooting instructions.



**Figure 7** Connecting the CY8CKIT-045S PSoC 4500S Pioneer Kit to a Computer

2. Open the desired project in PSoC Creator. From inside PSoC Creator, go to **File > Open > Project/Workspace**. This provides the option to 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.
3. Select the option **Build > Build <Project\_Name>** or press **[Shift] [F6]** to build the project as shown in [Figure 8](#).

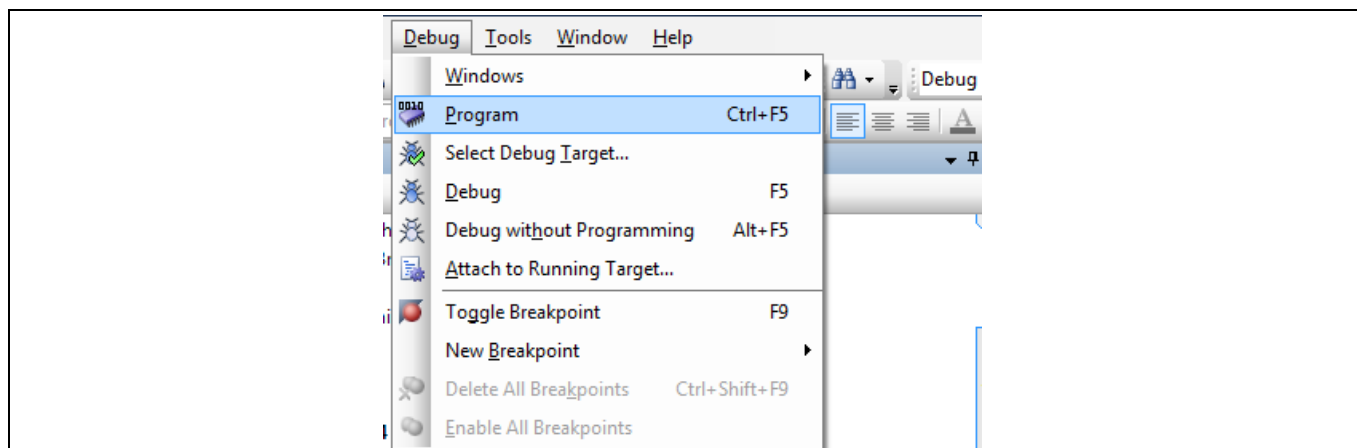


**Figure 8** Build a Code Example



## Kit Operation


- If there are no errors during build, program the firmware into the kit by choosing **Debug > Program** or press **[Ctrl] [F5]**, as shown in **Figure 9**. This programs the target PSoC 4500S device on the PSoC 4500S Pioneer Kit, and the kit is ready to use.



**Figure 9** Programming Device from PSoC Creator

### 2.2.2 Debugging Using PSoC Creator

For debugging the project using PSoC Creator, follow steps 1–3 from Programming Using PSoC Creator and then do the following:

- Click on the **Debug** button , press **F5** or select **Debug > Debug**.
- 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, refer to the PSoC Creator Help. Select **Help > PSoC Creator Help Topics** in the PSoC Creator menu. In the PSoC Creator Help window, locate **Using the Debugger** section in the **Contents** tab.

### 2.2.3 Programming Using PSoC Programmer

PSoC Programmer (3.29.0 or later) can be used to program existing *.hex* files into the PSoC 4500S Pioneer Kit. To do this, follow these steps.

- Connect the kit to your PC and open PSoC Programmer from **Start > All Programs > Cypress > PSoC Programmer <version> > PSoC Programmer<version>**.
- Click the **File Load** button at the top left corner of the window. Browse to the desired *.hex* file and click **Open**. For PSoC 4500S devices, the *.hex* file is located at: `< Project Directory>\< Project Name.cydsn>\CortexM0p\< Compiler Name and Version>\< Debug> or <Release>\< Project Name.hex>`.
- Click on the **KitProg3/<serial number>** in the **Port Selection** list to connect the kit to your computer.
- Click on the **Program** button to start programming the kit with the selected file.

**Note:** If the *.hex* file does not match the selected device, PSoC Programmer will display a device mismatch error and terminate programming. Ensure that you have selected the correct *.hex* file.

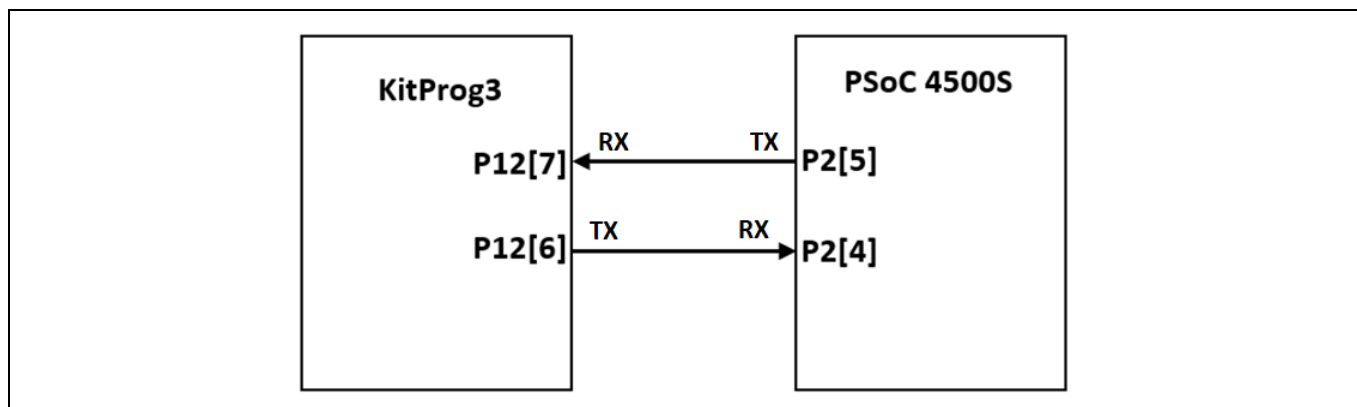
- When programming is completed successfully, indicated by a PASS message on the status bar, the kit is ready for use. Close PSoC Programmer.



## Kit Operation

### 2.3 USB-UART Bridge

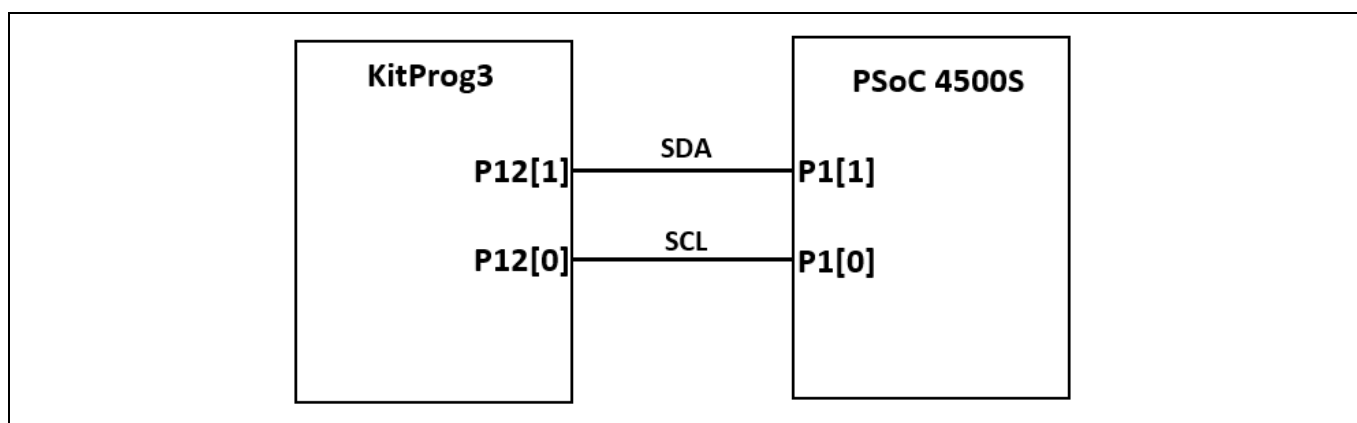
The KitProg3 on the PSoC 4500S Pioneer Kit can act as a USB-UART bridge. The UART lines between the KitProg3 and the PSoC 4500S are hard-wired on the board, with KitProg3 **UART\_RX (P12[7])** and **UART\_TX (P12[6])** connected to **P2[5] (TX)** and **P2[4] (RX)** of PSoC 4500S (target) respectively. For more details on the KitProg3 USB-UART functionality, see the [KitProg3 User Guide](#).



**Figure 10** UART Connection between KitProg3 and PSoC 4500S

### 2.4 USB-I2C Bridge

The KitProg3 can function as a USB-I2C bridge and communicate with the software utility, for example, to communicate with CapSense Tuner. The I2C lines on the PSoC 4500S (target) device are **P1[1] (SDA)** and **P1[0] (SCL)**, which are hard-wired 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 [KitProg3 User Guide](#).

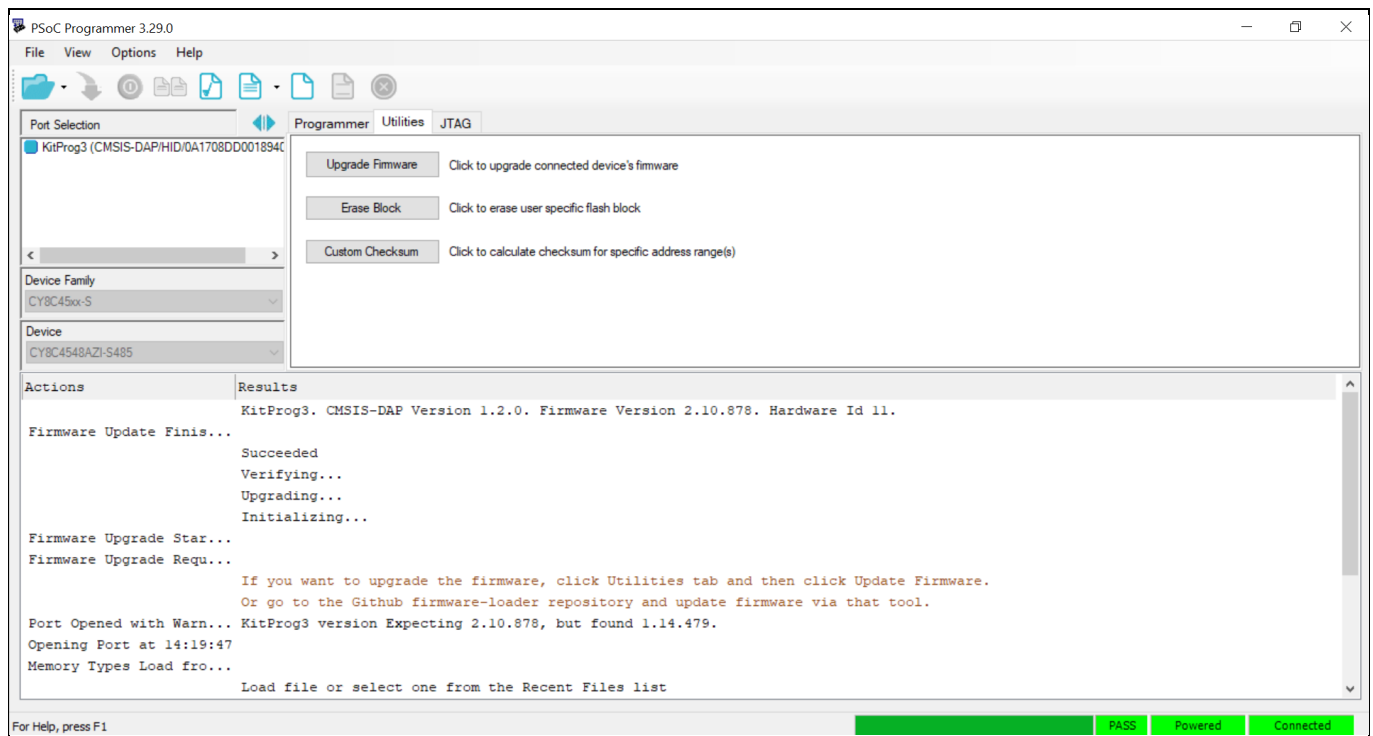


**Figure 11** I2C Connection between KitProg3 and PSoC 4500S

## Kit Operation

### 2.5 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. Open the PSoC Programmer, then click **Utilities > Upgrade Firmware** to update KitProg3 firmware.



**Figure 12** Upgrade KitProg3 Firmware

## Code Examples

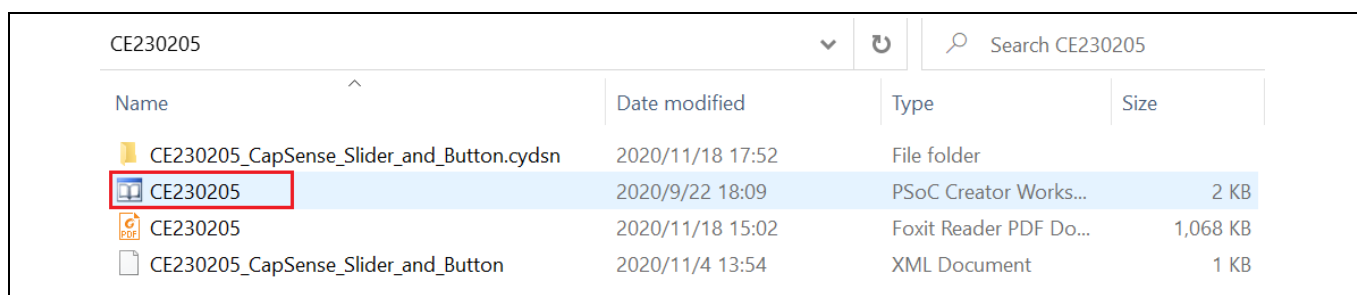
### 3 Code Examples

This chapter explains the code examples provided along with the PSoC 4500S Pioneer Kit. You can access the code examples either from the code examples ZIP file available on the kit [webpage](#) or from the Find Code Example wizard in the PSoC Creator. Each method is described separately below.

#### 3.1 Using the Kit Code Examples from the kit website

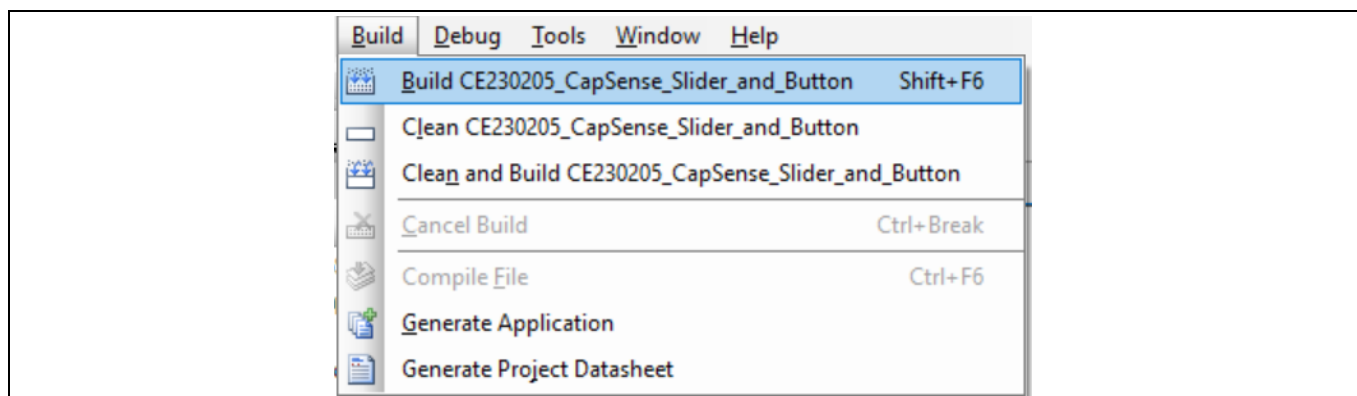
To access these code examples, download the CY8CKIT-045 PSoC 4500S Pioneer kit package from the kit [webpage](#). After extracting the downloaded zip file, select **File > Open > Project/Workspace** in PSoC Creator and then select the code example path to open it. See [Figure 13](#).

1. Launch PSoC Creator from the Windows Start menu (**Start > All Programs > Cypress > PSoC Creator <version> > PSoC Creator <version>**).
2. Click **File > Open > Project/Workspace**, and then select the code example path. See [Figure 13](#).
3. Click on the desired code example and open it. For the remaining steps, *CE230205.cywrk* is shown as reference.



**Figure 13 Open Code Example from PSoC Creator**

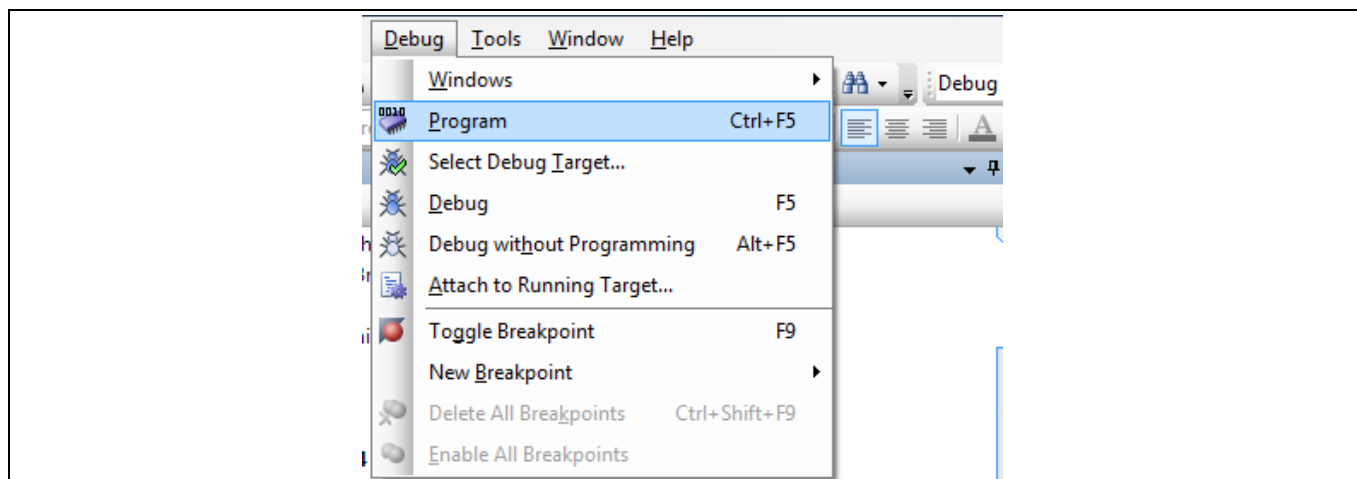
4. Build the code example by choosing **Build > Build <Project Name>**, as shown in [Figure 14](#). A .hex file is generated after a successful build process.



**Figure 14 Build Code Example from PSoC Creator**

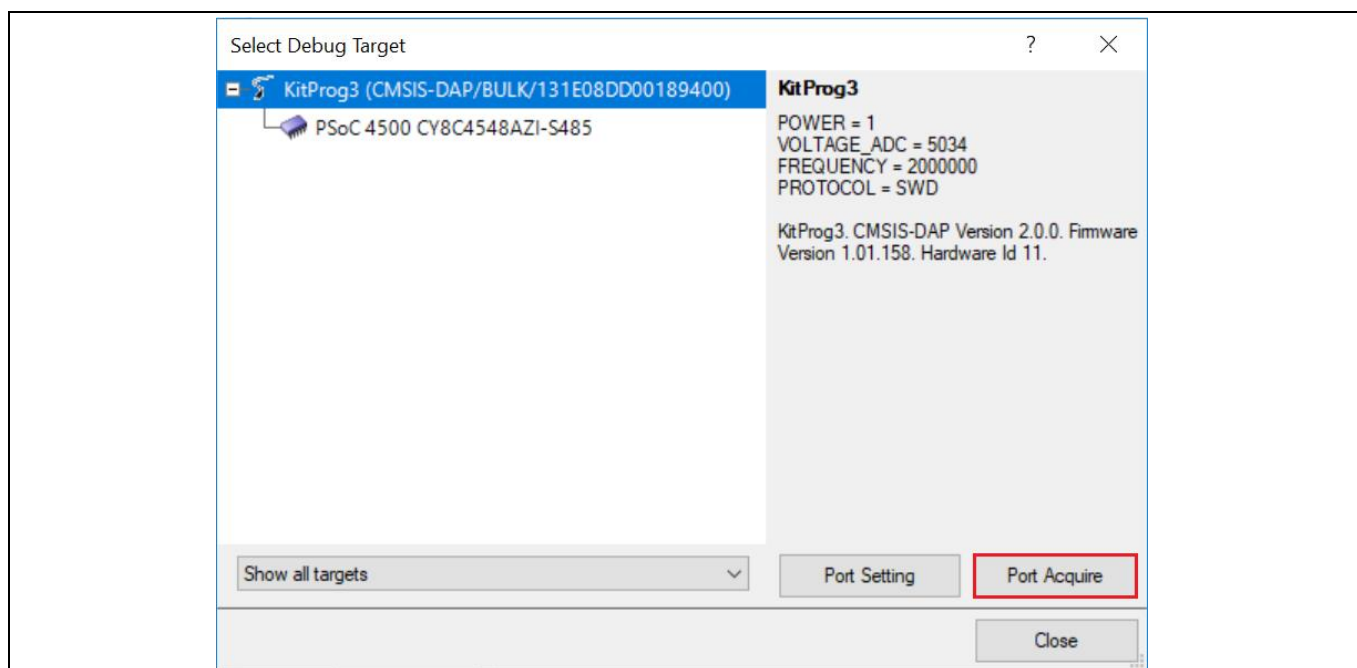
## Code Examples

5. Connect the PSoC 4500S Pioneer kit to the PC using the USB cable connected to KitProg3 USB connector, J5 as described in [Programming Using PSoC Creator](#) to program the kit with this code example. If this is the first time the kit is connected to the PC, you should wait for driver installation to complete before proceeding with the next step.
6. Choose **Debug > Program** in PSoC Creator as shown in [Figure 15](#).



**Figure 15** Programming using PSoC Creator

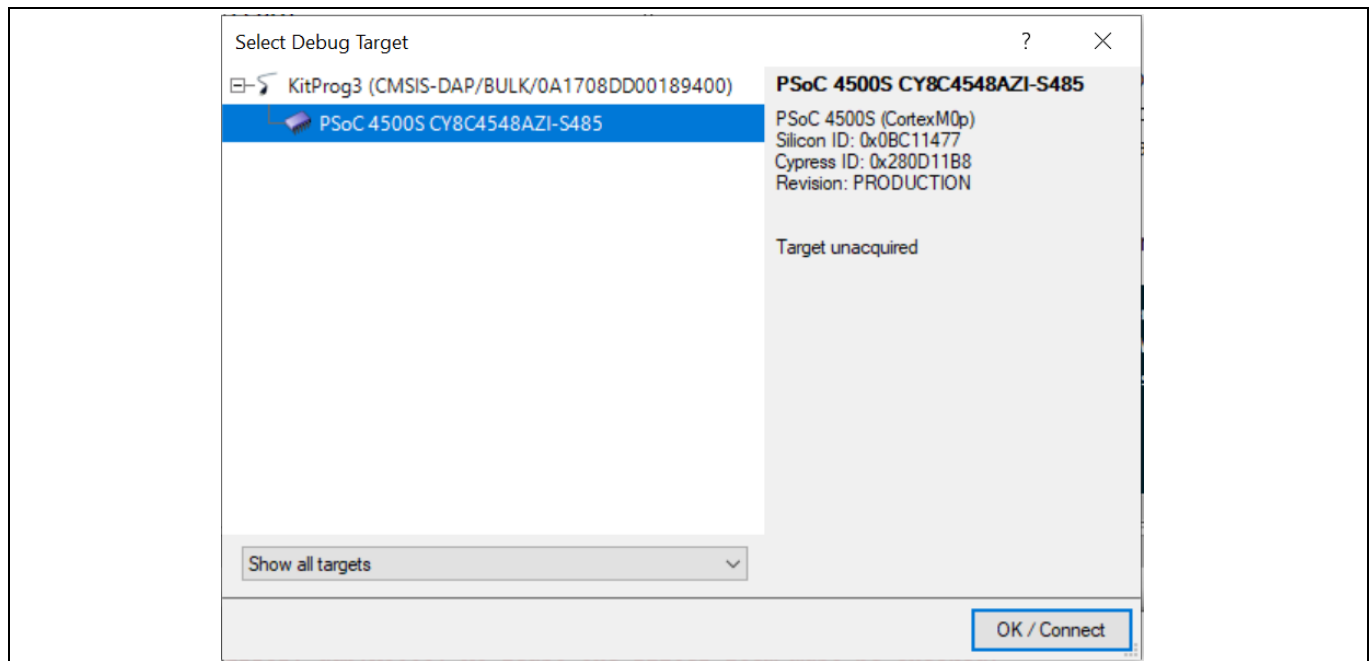
7. If the device is already acquired, programming will complete automatically and the result will appear in the PSoC Creator status bar at the bottom left side of the screen. If the device is yet to be acquired, the **Select Debug Target** window will appear. Select **KitProg3/<serial number>** and click the **Port Acquire** button, as shown in [Figure 16](#).



**Figure 16** Port Acquire

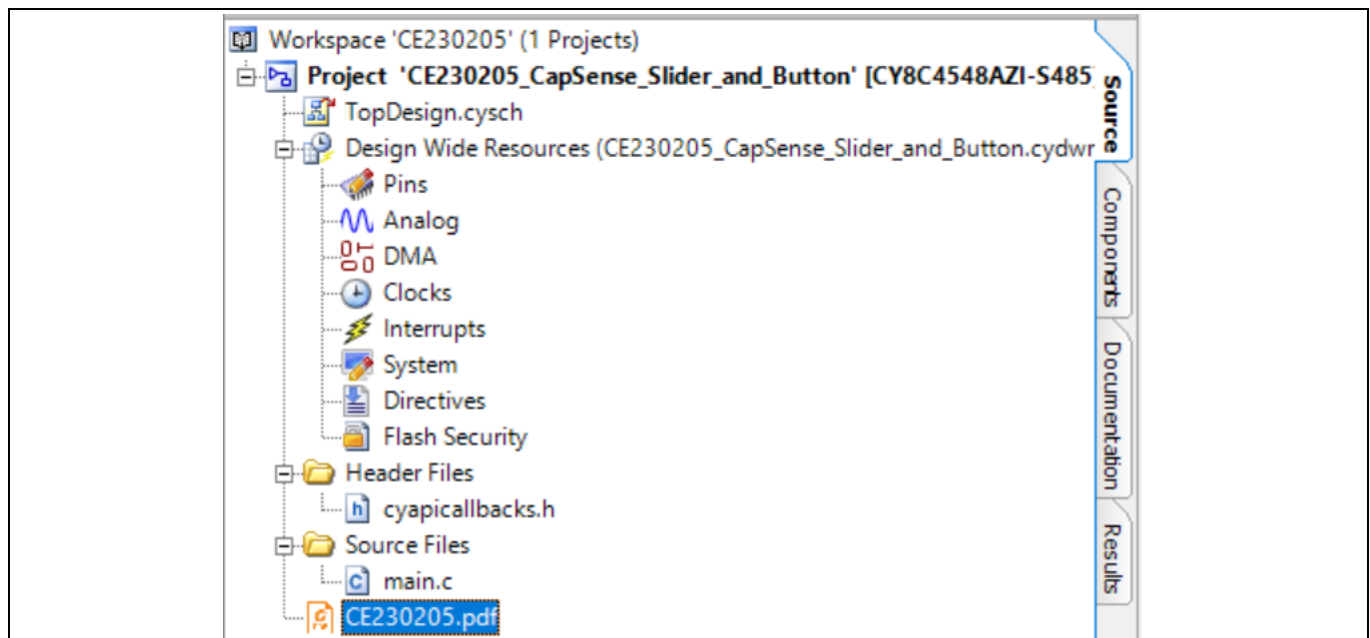
## Code Examples

- After the device is acquired, it is shown in a tree structure below the **KitProg3/<serial number>**. Click the **OK / Connect** button to exit the window and start programming, as shown in [Figure 17](#).



**Figure 17** Connect Device from PSoC Creator and Program

- From the workspace explorer in PSoC Creator, open *CE230205.pdf* as shown in [Figure 18](#) to learn more about how to verify the functionality of the code example.



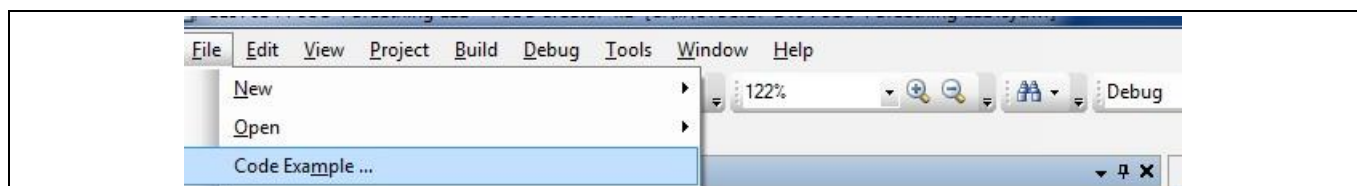
**Figure 18** CE230205.pdf

## Code Examples

### 3.2 Using Built-in PSoC Creator Code Examples with the Kit

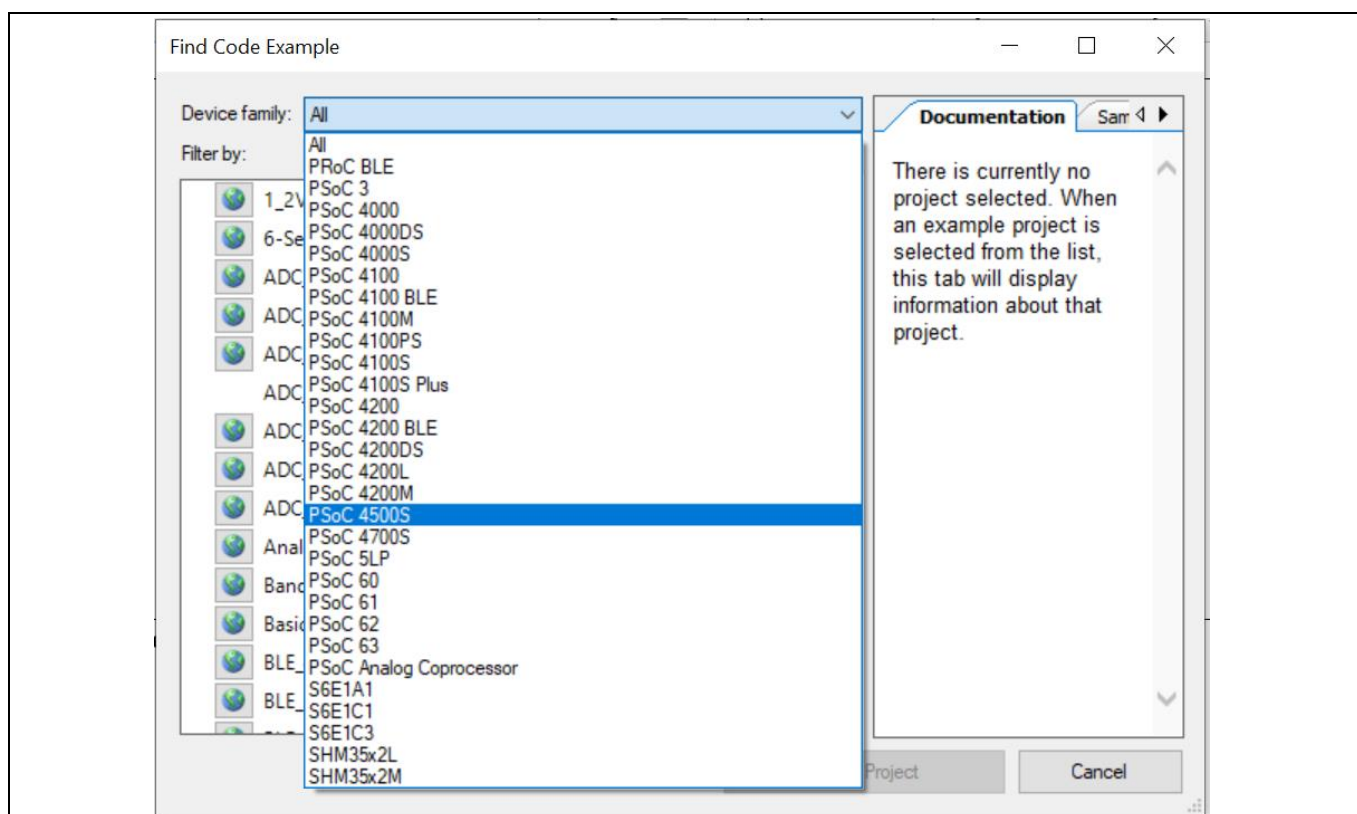
The built-in PSoC Creator code examples can be used by following the steps below.

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 use the menu item "**File > Code Example...**" as shown in [Figure 19](#).



**Figure 19** PSoC Creator Find Code Example

3. In the Find Code Example window, set the **Device family** to **PSoC 4500S** as shown in [Figure 20](#).

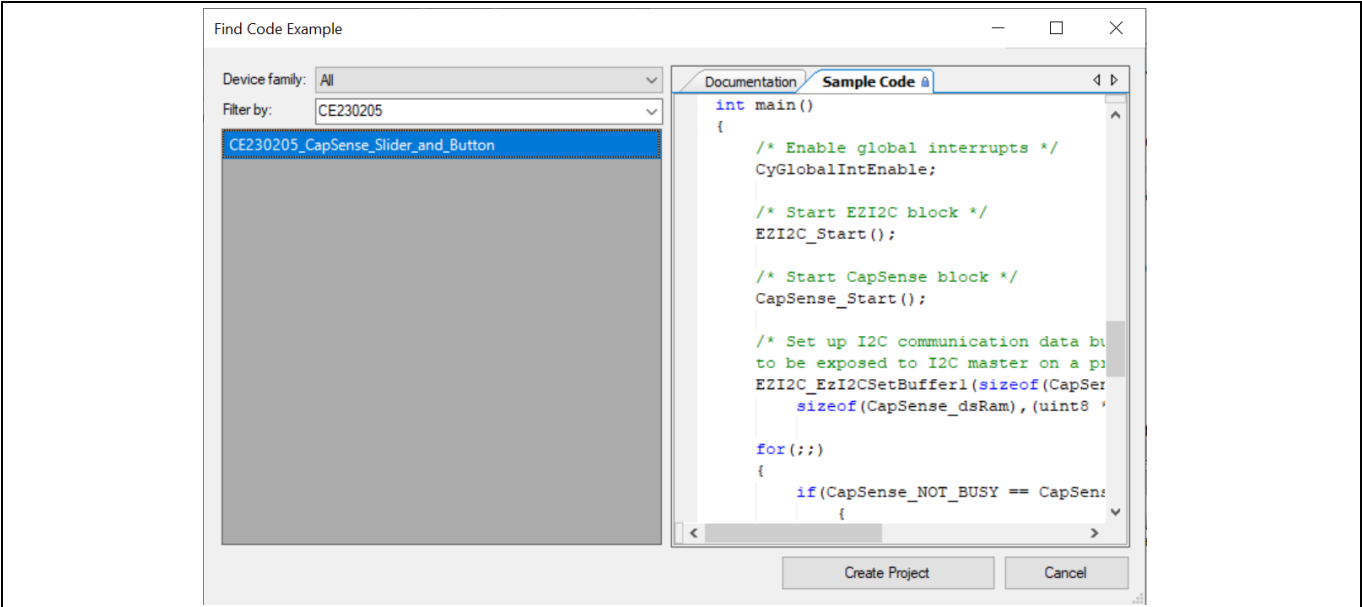


**Figure 20** Selecting PSoC 4500S Device Family in Find Code Example Window

You can use any project that appears in the list with the kit. As an example, we will select the **CE230205\_CapSense\_Slider\_and\_Button** project and see how to use it with the CY8CKIT-045S kit board.

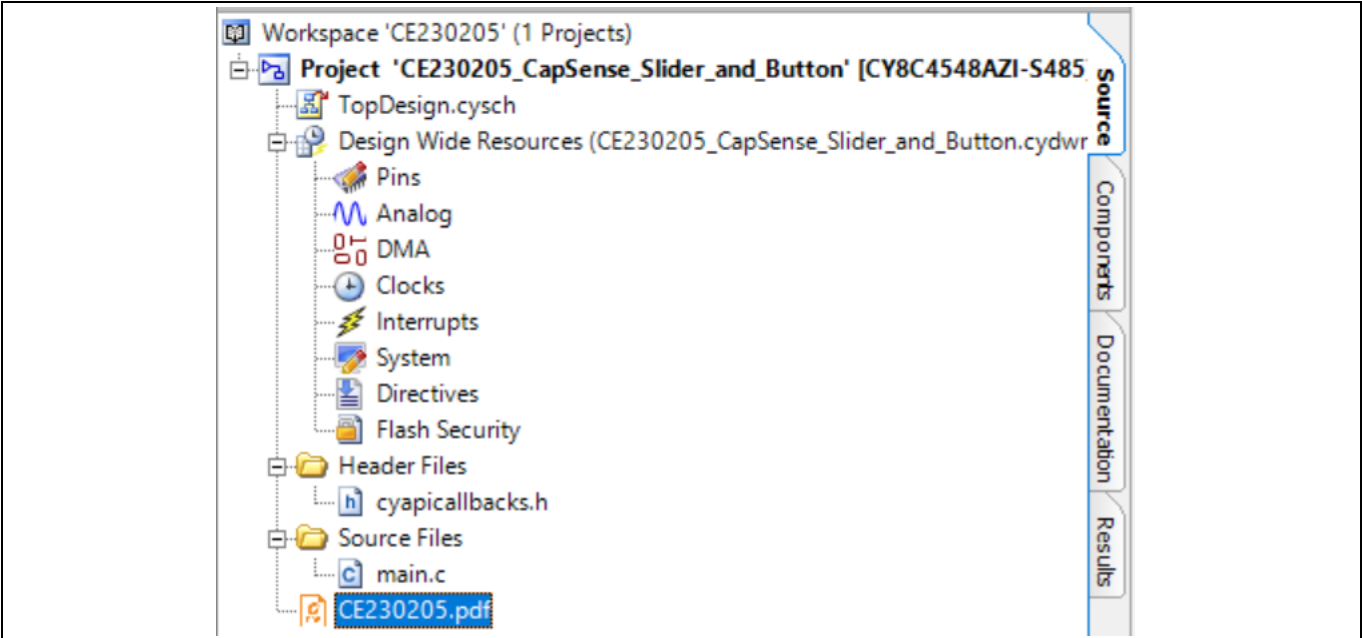
Code Examples

4. Select the **CE230205\_CapSense\_Slider\_and\_Button** project and click the **Create Project** button as shown in **Figure 21**. Save the workspace to a desired location.



**Figure 21** CE230205\_CapSense\_Slider\_and\_Button Code Example

5. Open **CE230205.pdf** from the Workspace Explorer to learn more about the code example and its configuration. See **Figure 22**.



**Figure 22** Project Datasheet: CE230205\_CapSense\_Slider\_and\_Button



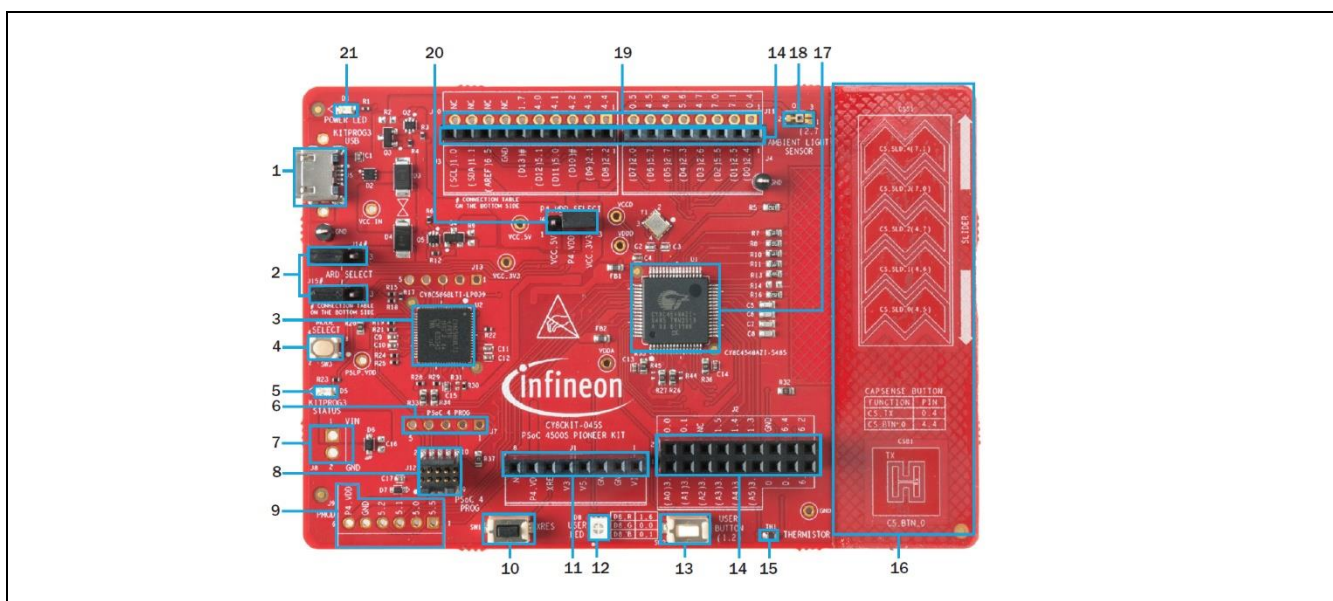
## Appendix

### 4 Appendix

#### 4.1 Board Details

The PSoC 4500S Pioneer kit consists of the following blocks:

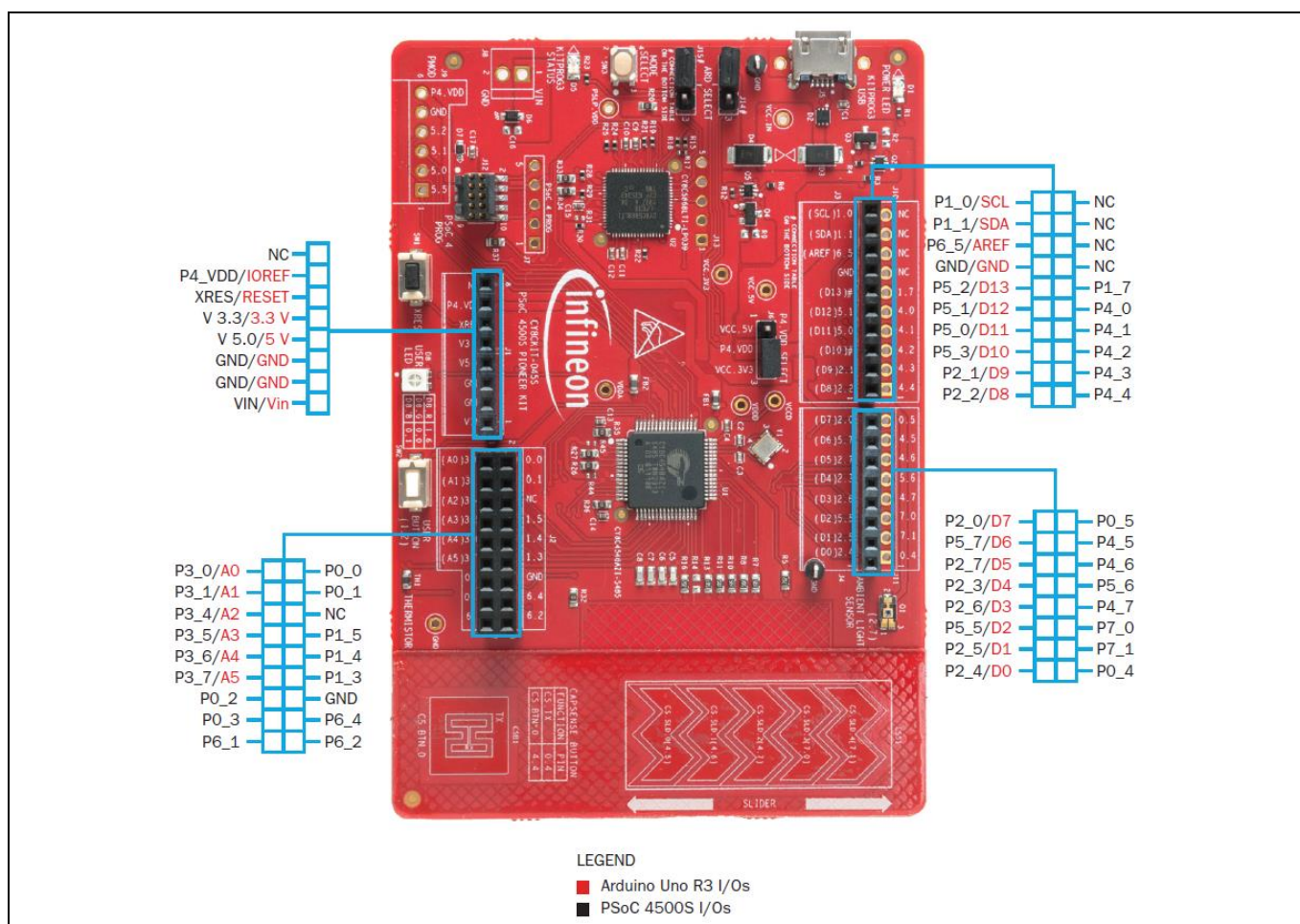
1. KitProg3 USB connector (**J5**)
2. Arduino select jumpers (**J14**, **J15**)
3. KitProg3 (PSoC 5LP) device (CY8C5868LTI-LP039) (**U2**)
4. One push button, **SW3** (KitProg3 Mode)
5. One yellow LED, **D5** (KitProg3 Status)
6. 5-pin PSoC 4500S SWD Program/Debug header (**J7**) (footprint only)
7. One external power supply connector (**J8**) (footprint only)
8. 10-pin PSoC 4500S SWD Program/Debug header (**J12**)
9. Pmod header (**J9**) (footprint only)
10. One push button, **SW1** (Reset)
11. Arduino UNO R3-compatible power header (**J1**)
12. One RGB LED, **D8** (User)
13. One push button, **SW2** (User)
14. Arduino UNO R3-compatible I/O headers (**J2**, **J3**, **J4**)
15. One thermistor (**TH1**)
16. CapSense button and slider (**CSB1** and **CSS1**)
17. PSoC 4500S device (CY8C4548AZI-S485) (**U1**)
18. One ambient light sensor (**Q1**)
19. PSoC 4500S Extended I/O headers (**J10**, **J11**) (footprint only)
20. PSoC 4500S power selection/current measurement jumper (**J6**)
21. One yellow LED, **D1** (Power)



**Figure 23** Cypress Normal Style PSoC 4500S Pioneer Board Details



## Appendix



**Figure 24** Cypress Normal Style PSoC 4500S Pioneer Board Pinout Details

## 4.2 Hardware Details

### 4.2.1 PSoC 4500S Pioneer Board

The target board uses the PSoC 4500S device. PSoC 4500S is a scalable and reconfigurable platform architecture for a family of programmable embedded system controllers with an Arm Cortex-M0+ CPU. It combines programmable and reconfigurable digital blocks with flexible automatic routing. The PSoC 4500S device family, based on this platform architecture, is a combination of a microcontroller with digital programmable logic, programmable interconnect, and standard communication and timing peripherals. PSoC 4500S is the first PSoC 4 device with two SAR blocks. PSoC 4500S products are fully compatible with members of the PSoC 4 platform for new applications and design needs. The digital subsystems allow flexibility and in-field tuning of the design. For more information, see the [PSoC 4500S Pioneer Kit web page](#) and the [PSoC 4500S family datasheet](#).

Appendix

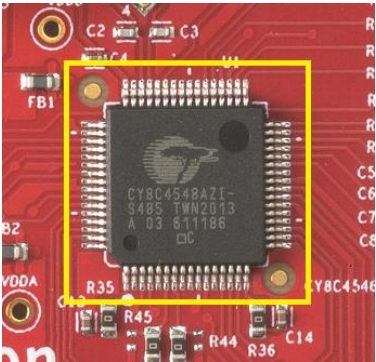
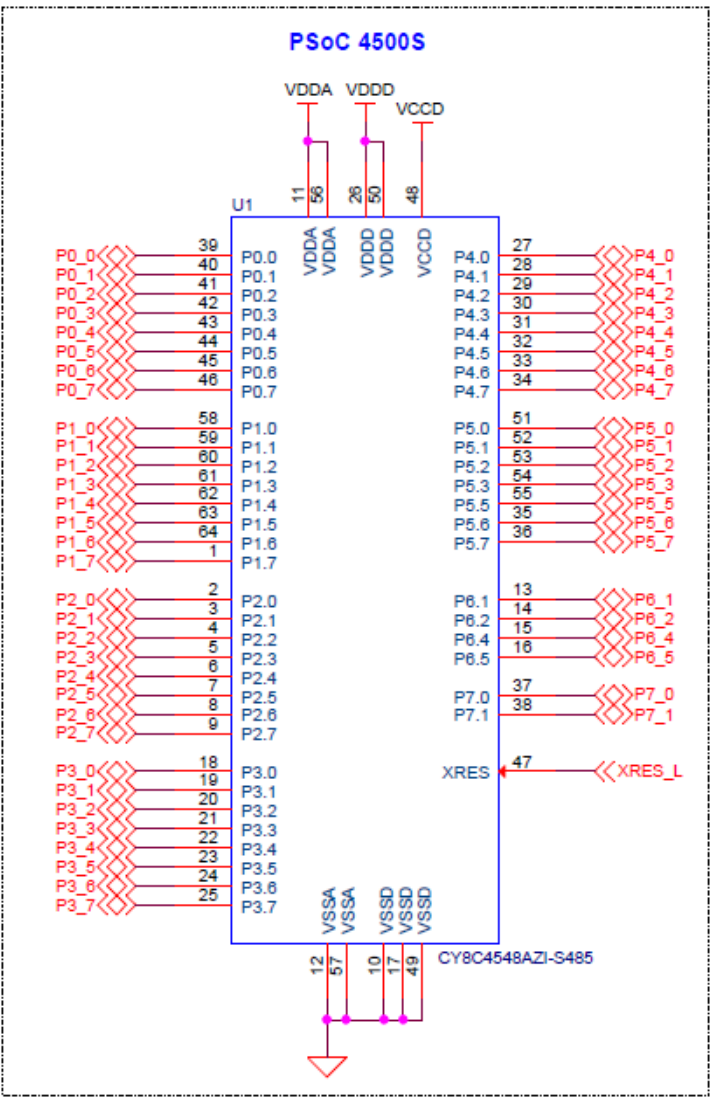
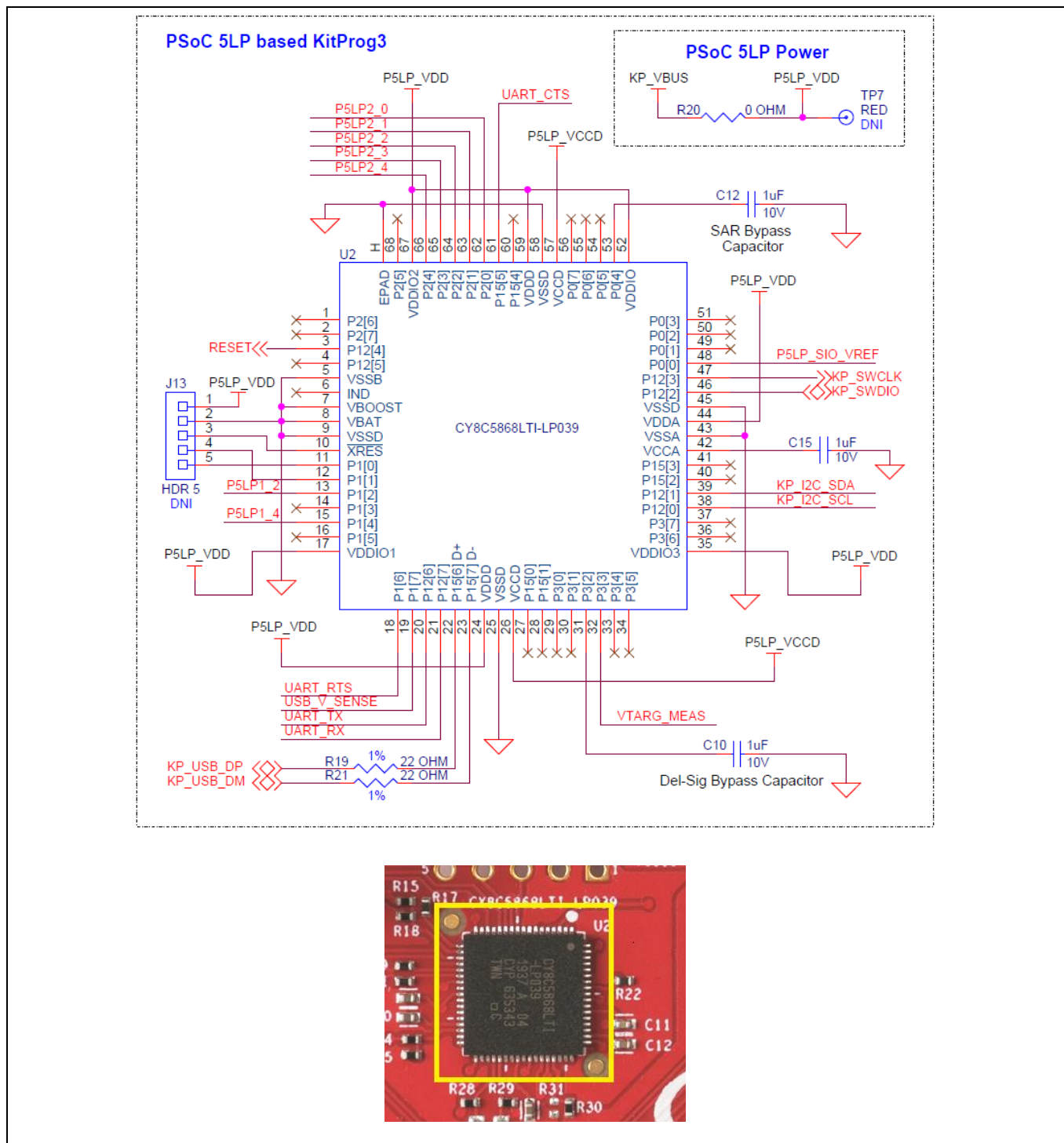


Figure 25 Schematic of PSoC 4500S (Target)

## Appendix

## 4.2.2 KitProg3

A PSoC 5LP-based KitProg3 is used to program and debug the target PSoC 4500S device. The PSoC 5LP device connects to the USB port of the PC through the KitProg3 USB connector and to the SWD interface of the target PSoC 4500S device.

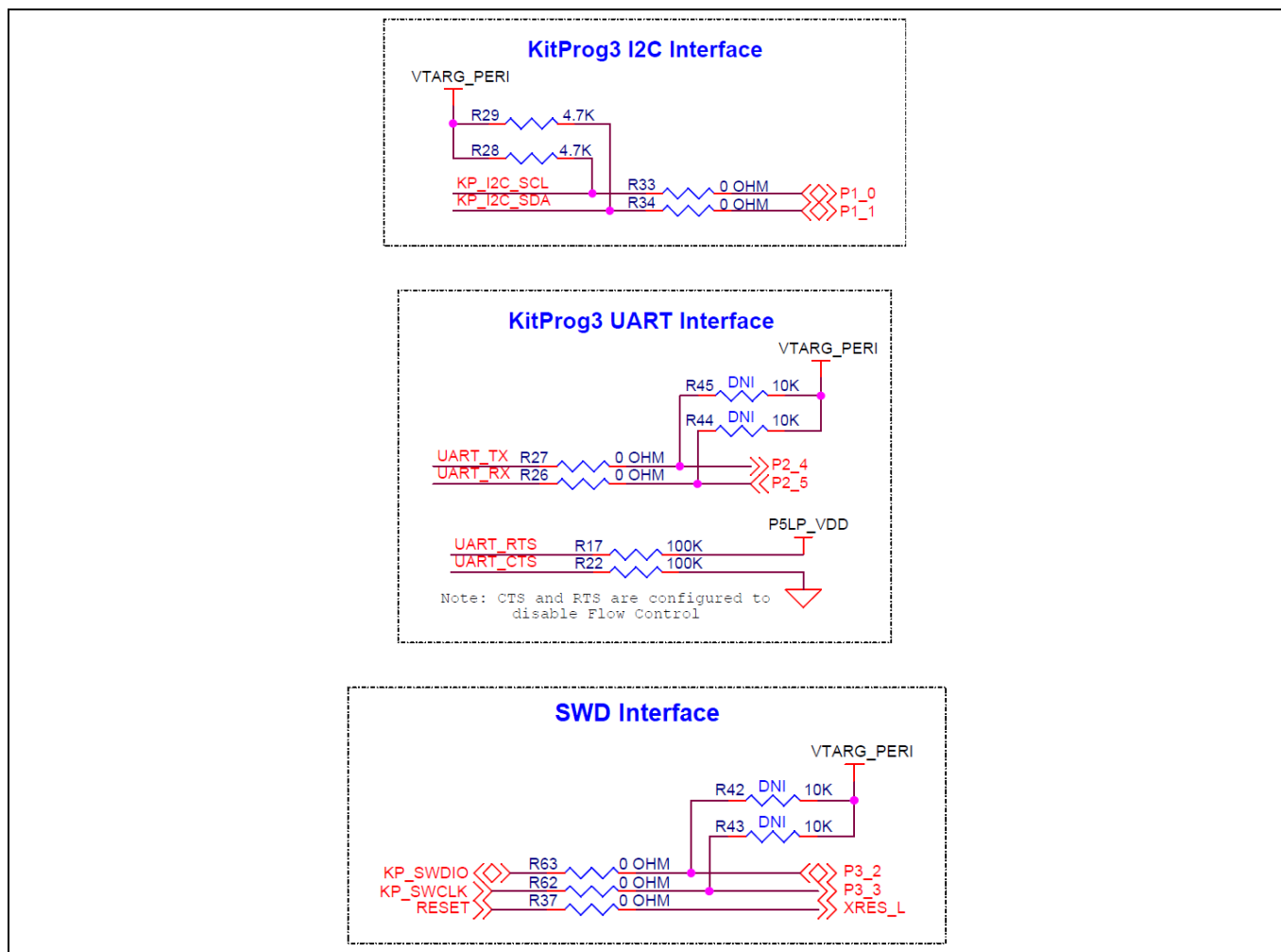


**Figure 26** Schematic of PSoC 5LP (KitProg3)

## Appendix

### 4.2.3 Serial Interconnection between PSoC 5LP and PSoC 4500S

In addition of use as an onboard programmer, the PSoC 5LP device functions as an interface for the USB-UART and USB-I2C bridges, as shown in **Figure 27**. The USB-Serial pins of the PSoC 5LP device are hard-wired to the I2C/UART pins of the PSoC 4500S. These pins are also available on the Arduino-compatible I/O headers; therefore, the PSoC 5LP device can be used to control Arduino shields with an I2C/UART interface.



**Figure 27 Schematics of Programming and Serial Interface Connections**

### 4.2.4 Power Supply System

The power supply system on this board is versatile, allowing the input supply to come from the following sources:

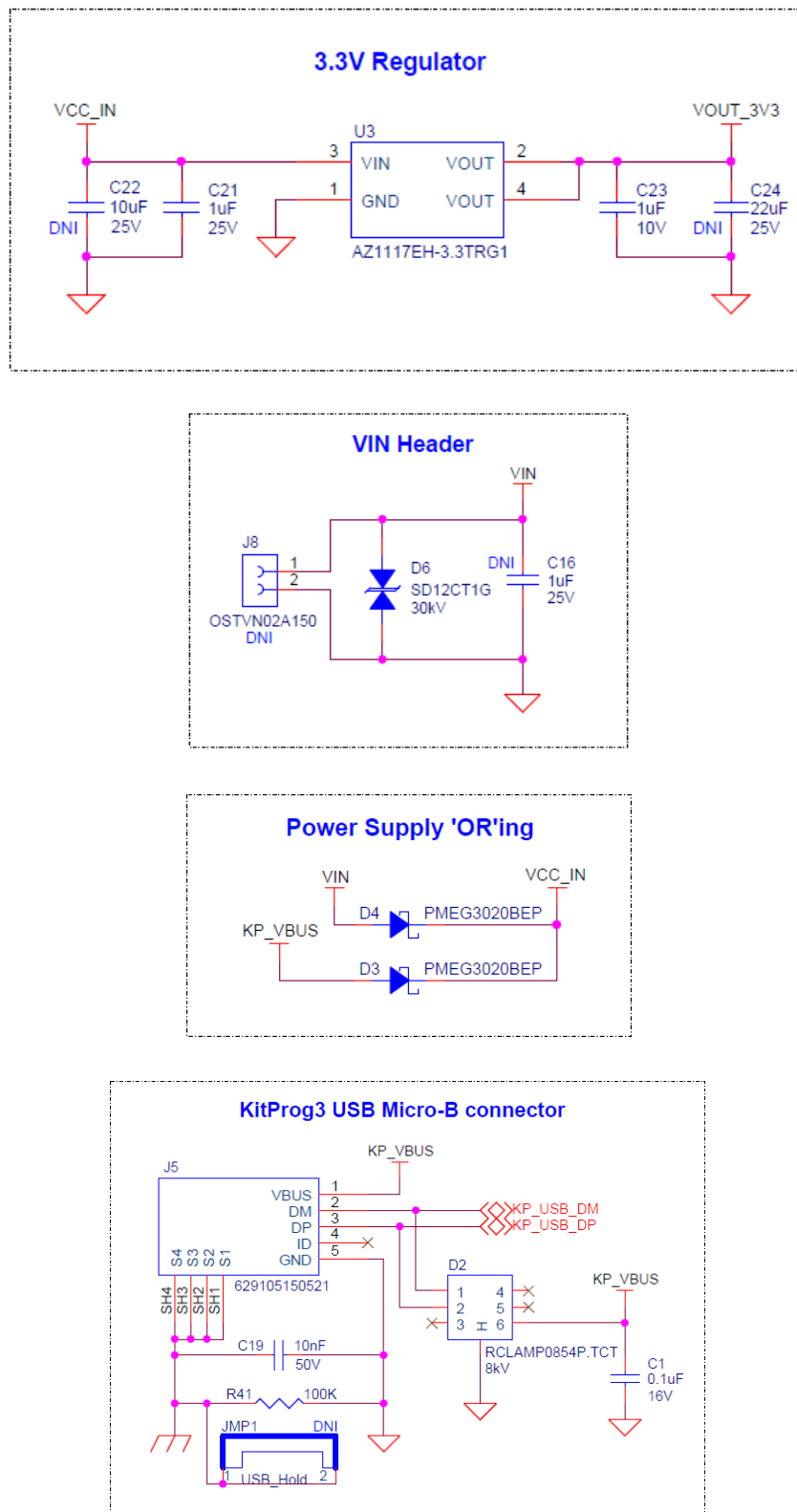
- 5 V from the onboard KitProg3 USB connector (**J5**)
- 7 V to 12 V power from an Arduino shield or from external power supply through VIN header **J1.1** or **J8**

The power supply system is designed to support 3.3 V or 5 V operation of PSoC 4500S. On the other hand, 5 V is provided for the KitProg3 operation.

The supply rails VIN (7V to 12 V from header **J8** or **J1.1**) and KP\_VBUS (5V KitProg USB connector **J5**) are combined into VCC\_IN through ORing diodes as **Figure 28** shows. An LDO regulator generates the 3.3 V output from VCC\_IN for PSoC 4500S. The VIN Header (**J8**) is not populated on the board by default.

## Appendix

It is important to understand that the 5 V will not be generated when the kit is powered from the VIN header because there is no separate 5 V regulator. 5 V will be present only when the kit is powered through the KitProg3 USB connector (**J5**).

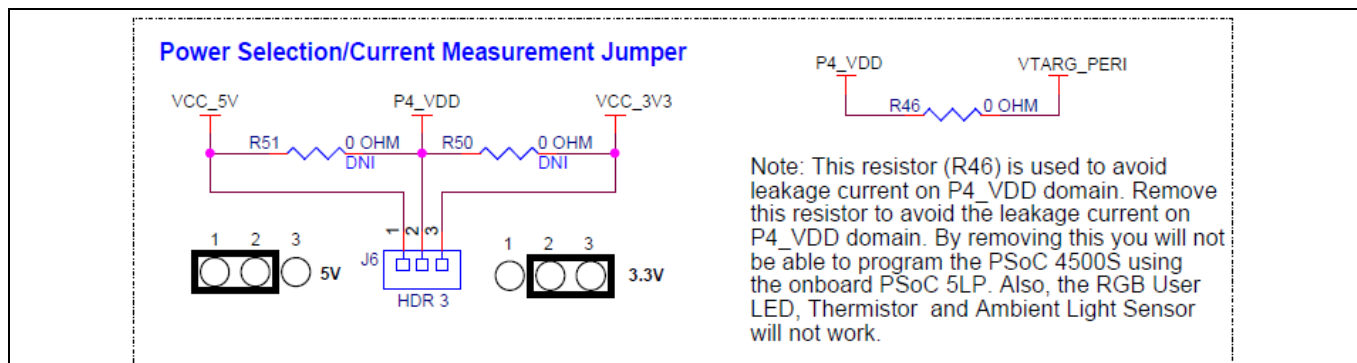


**Figure 28** Power Supply System

## Appendix

### 4.2.5 PSoC 4500S Power Selection/Current Measurement Jumper

The operating voltage P4\_VDD (3.3V or 5V) for PSoC 4500S can be selected using the jumper **J6**. It can also be used to measure the current consumption of PSoC 4500S using an ammeter without any additional rework done. The default position of **J6** is 3.3V.



**Figure 29 Power Selection/Current Measurement Jumper**

The following method is supported for measuring the current consumption of the PSoC 4500S device.

- Remove the jumper **J6** and connect an ammeter between the terminals 2 and 3, for 3.3V operation or connect between the terminals 1 and 2, for 5V operation.

### 4.2.6 Expansion Headers

#### 4.2.6.1 Arduino-compatible Headers (J1, J2, J3, J4) & PSoC 4500S Extended I/O Headers (J10, J11)

The board has four Arduino-compatible headers: **J1**, **J2**, **J3** and **J4**. You can connect 3.3 V or 5 V Arduino-compatible shields to develop applications based on the shield's hardware. The kit can also be used for motor control applications using CY8CKIT-037 by interfacing with these headers. See [Board Details](#) for details on PSoC 4500S pin mapping to these headers.

There are two headers **J10** and **J11** which provide connectivity to PSoC 4500S GPIOs that are not connected to the Arduino-compatible headers. The majority of these pins are multiplexed with onboard peripherals and are not connected to PSoC 4500S by default. For detailed information on how to rework the kit to access these pins, see [PSoC 4500S Pioneer Board Rework](#).



Appendix

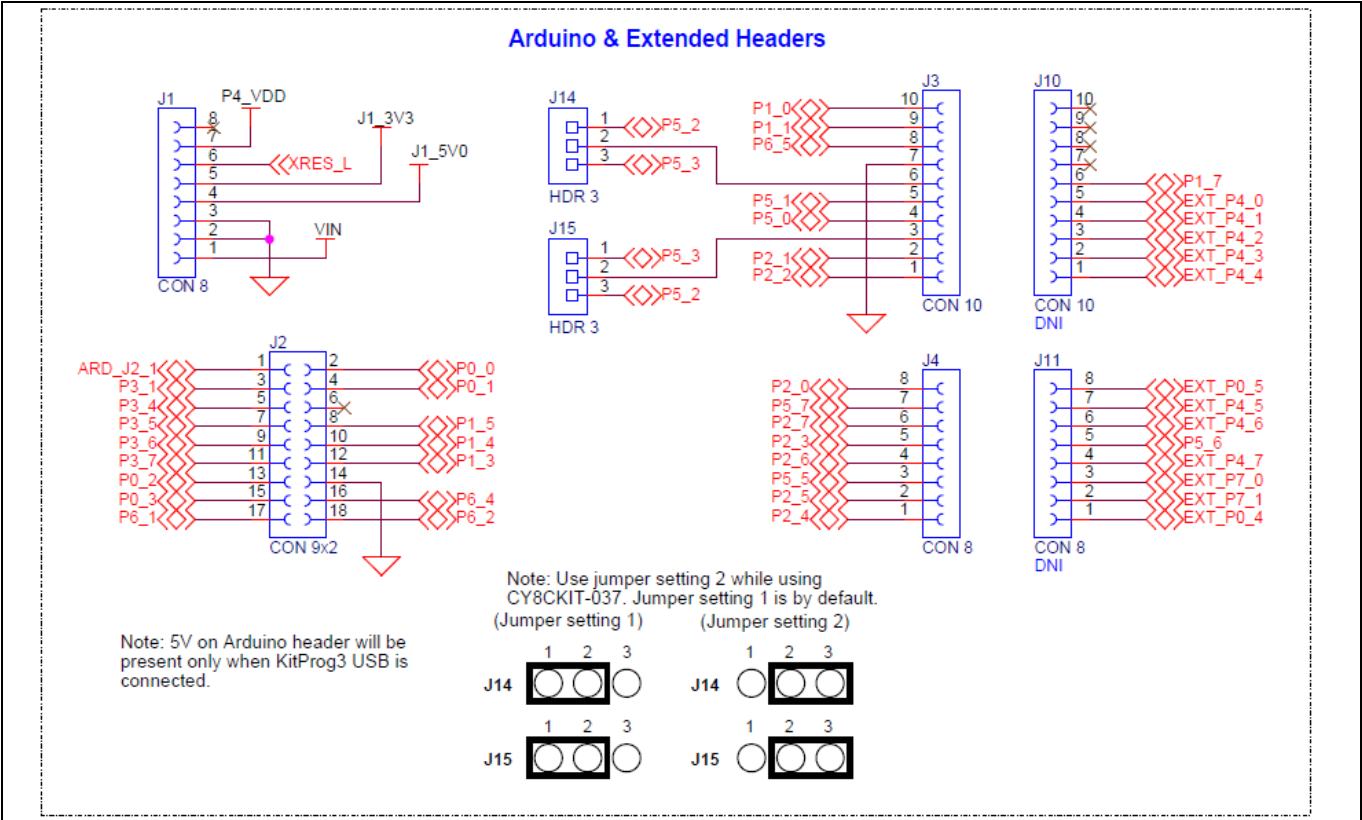


Figure 30 Arduino & Extended Headers

4.2.6.2 Pmod Header (J9)

The PSoC 4500S Pioneer board supports one Pmod header (J9). The header pins are hard-wired to PSoC 4500S GPIOs as shown in the **Figure 31**. Note that the Pmod header is not populated by default on the board.

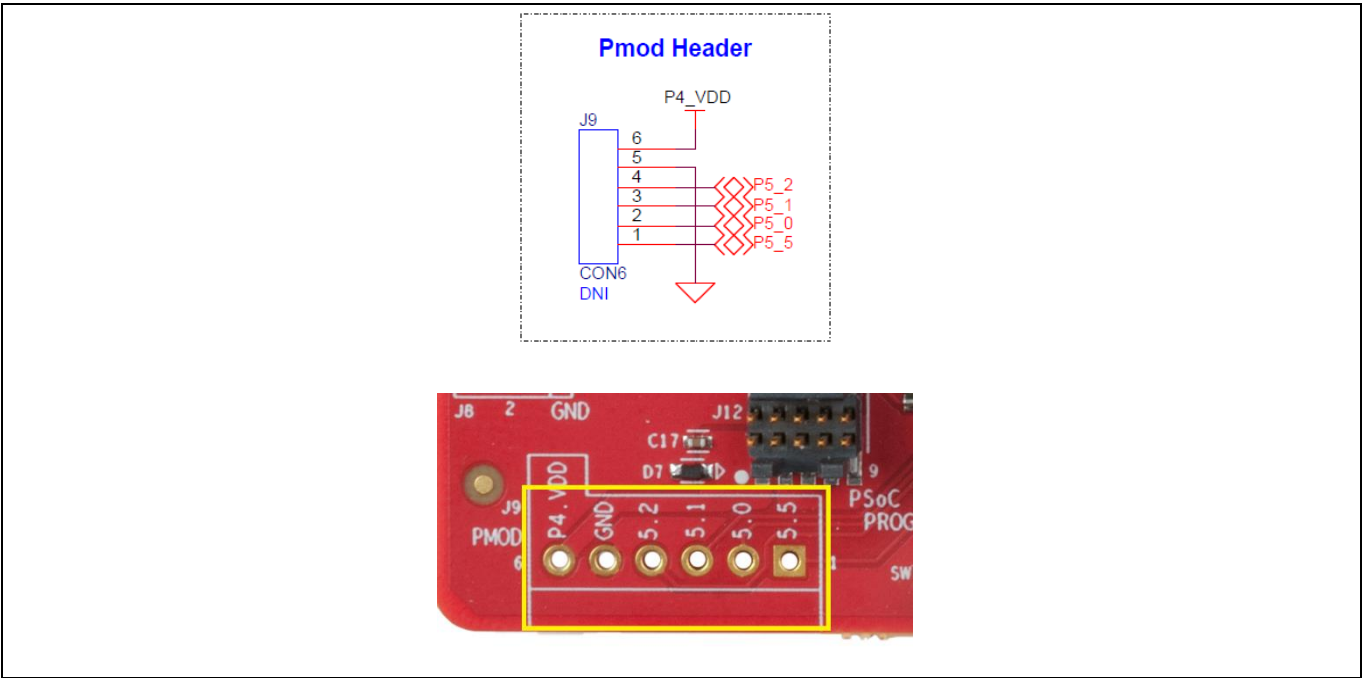


Figure 31 Pmod Header

Appendix

4.2.7 User and Passive Inputs

4.2.7.1 CapSense Circuit

One CapSense 5-segment slider and one CapSense button are connected to PSoC 4500S as **Figure 32** shows. The CapSense slider supports only self-cap (CSD) sensing, while the button supports both self-cap (CSD) and mutual cap (CSX) sensing. Four external capacitors - CMOD and CSH for CSD, CINTA and CINTB for CSX are present on the PSoC 4500S Pioneer board. Note that the CapSense shield is not connected to PSoC 4500S by default. Moreover, the CapSense GPIOs can also be used as external GPIOs which are routed to extended headers. For more detailed information on how to rework the kit to access these pins, see **PSoC 4500S Pioneer Board Rework**. For details on using CapSense including design guidelines, see the **Getting Started with CapSense Design Guide**.

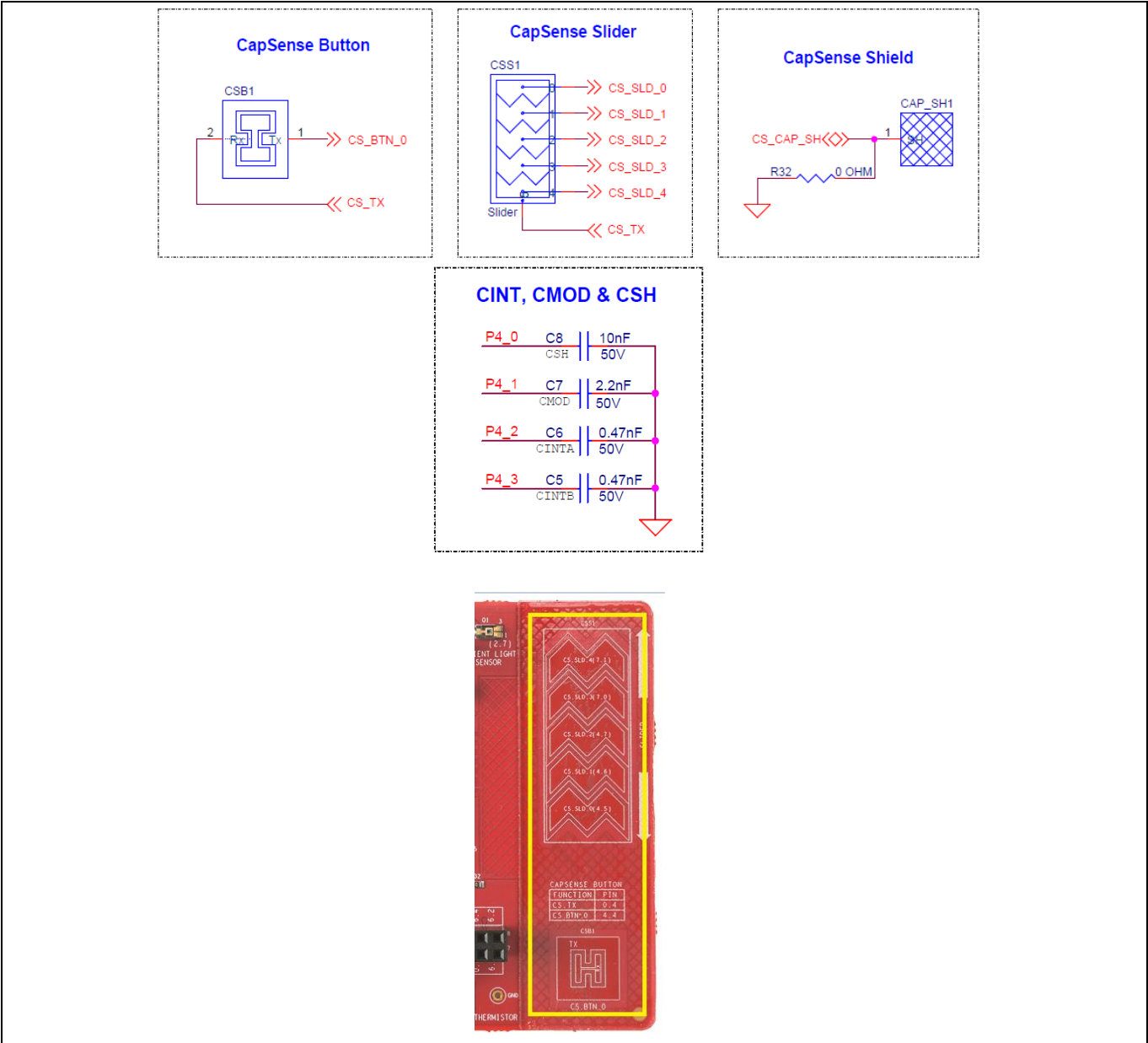


Figure 32 CapSense Circuit



## Appendix

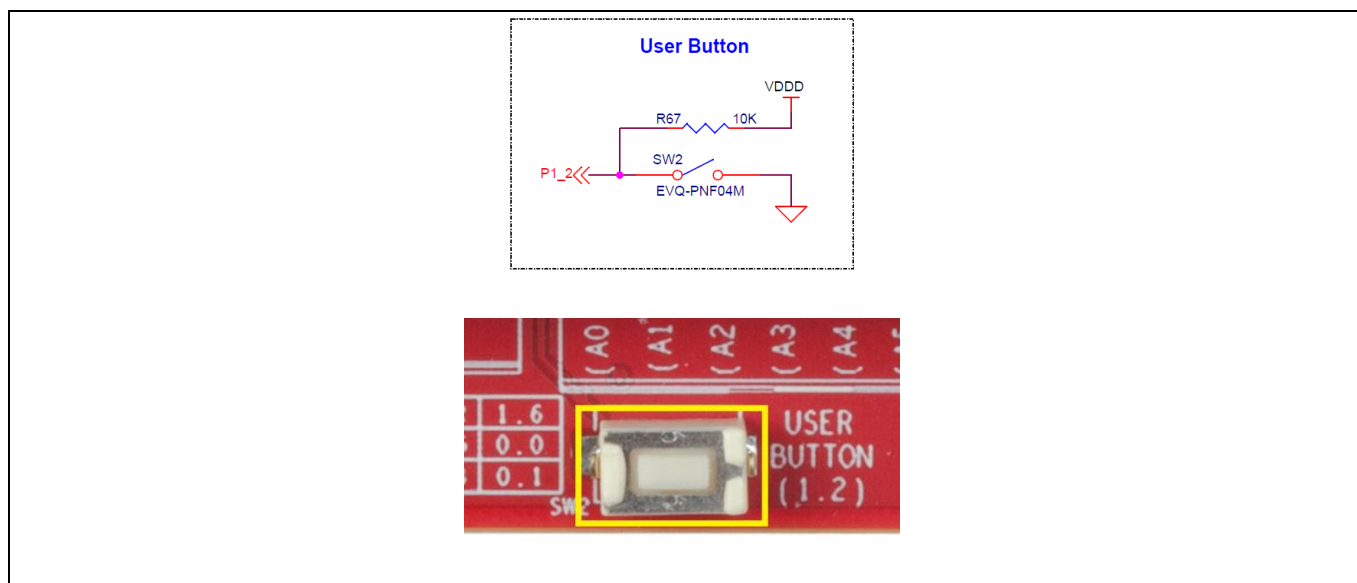
**Table 4** CapSense pin assignment

CapSense element	PSoC 4500S GPIO	CapSense element	PSoC 4500S GPIO
CS_TX	P0[4]	CS_SLD_4	P7[1]
CS_BTN_0	P4[4]	CS_CAP_SH*	P0[5]
CS_SLD_0	P4[5]	CMOD	P4[1]
CS_SLD_1	P4[6]	CINTA	P4[2]
CS_SLD_2	P4[7]	CINTB	P4[3]
CS_SLD_3	P7[0]	CSH	P4[0]

\* **Note:** Not connected by default.

### 4.2.7.2 User Button

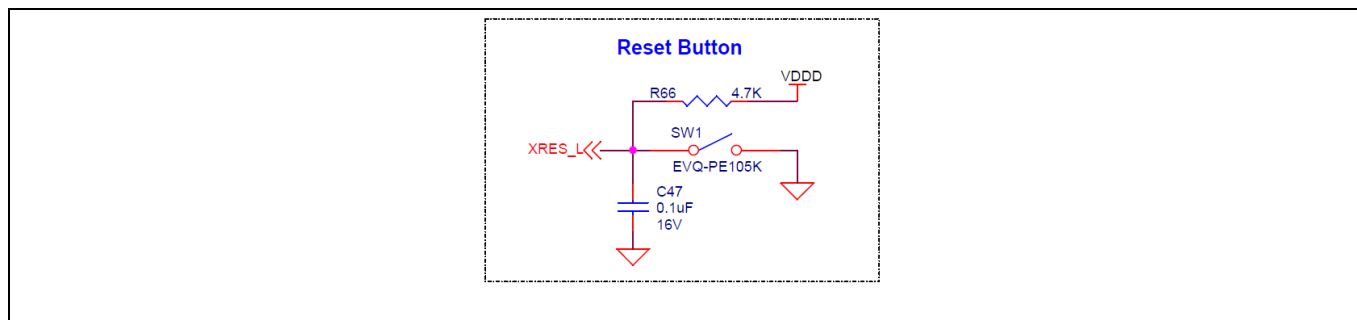
The target PSoC 4500S Pioneer board contains one user button connected to the **P1[2]** pin on the PSoC 4500S device. This button can be used for general user inputs or to control different states in an application.



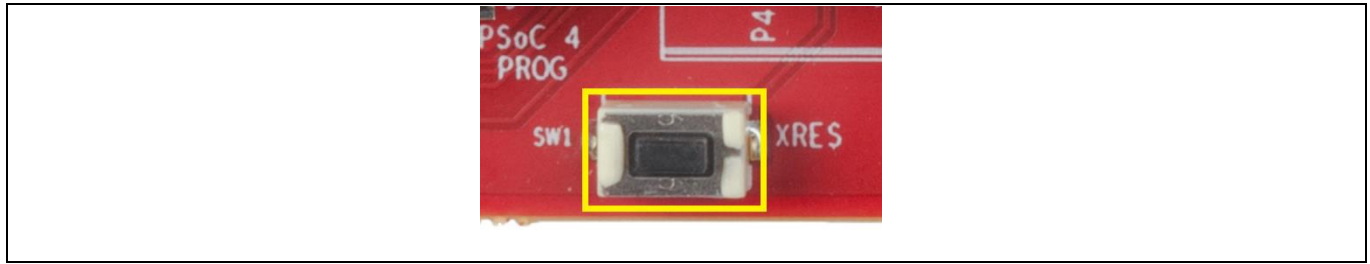
**Figure 33** User Button on the Board

### 4.2.7.3 Reset Switch

When this button is pressed, the **XRES\_L** line of the PSoC 4500S is pulled to ground, which, in turn, resets the target device.



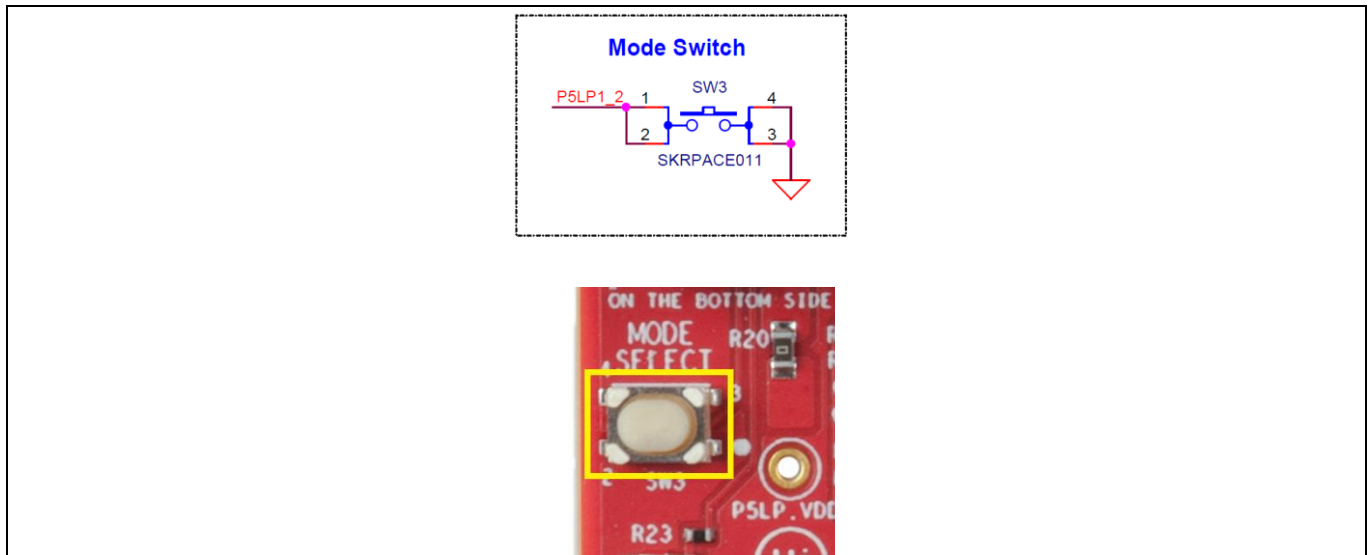
## Appendix



**Figure 34** Reset switch

### 4.2.7.4 Mode Switch

The PSoC 4500S Pioneer board contains a push button (**SW3**) connected to **P1[2]** of PSoC 5LP. This button function is reserved for future. Refer to the [KitProg3 User Guide](#) for more details.



**Figure 35** Mode switch

### 4.2.7.5 LEDs

The PSoC 4500S Pioneer kit contains three LEDs:

The yellow Power LED (**D1**): Indicates that the board is powered from the onboard KitProg3 USB Micro-B connector or VIN header.

The yellow Status LED (**D5**): Indicates the KitProg3 status (the LED is connected to **P1[4]** of the KitProg3 PSoC 5LP device). See [Table 3](#) for a summary of the status LED states. For more details on the KitProg3 status LED, see the [KitProg3 User Guide](#).

The RGB LED (**D8**): This is the user LED, connected to **P1[6]**, **P0[0]** and **P0[1]** of the target PSoC 4500S device. The LEDs are active low so the pins must be driven low to turn on the LEDs.

Appendix

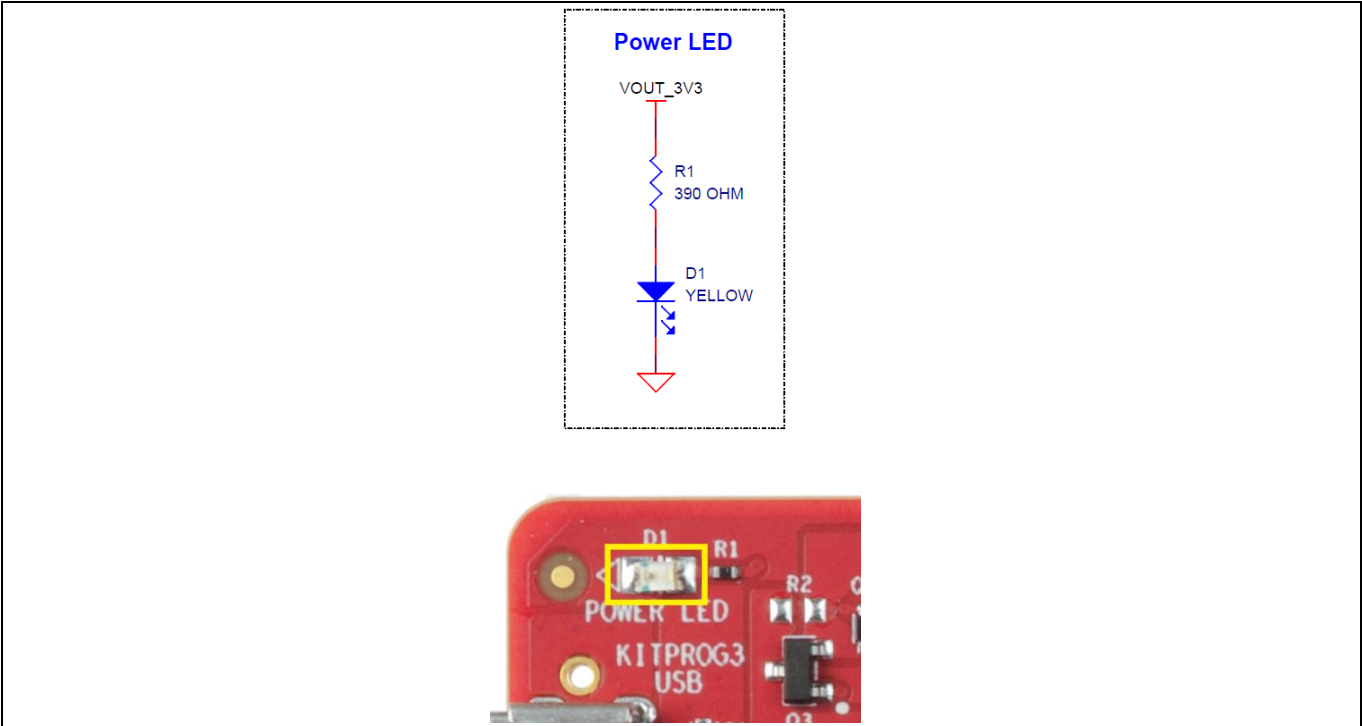


Figure 36 Power LED

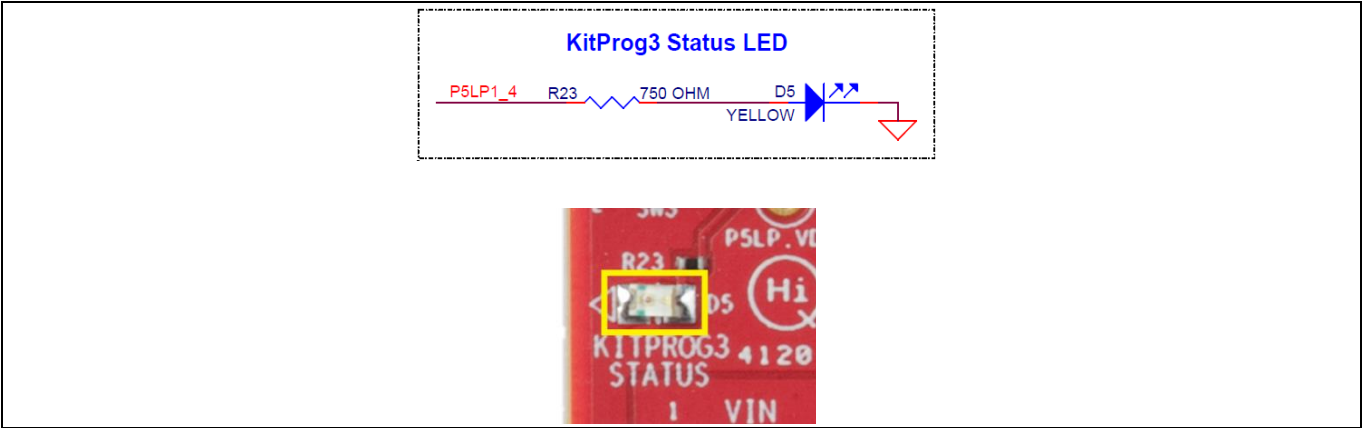
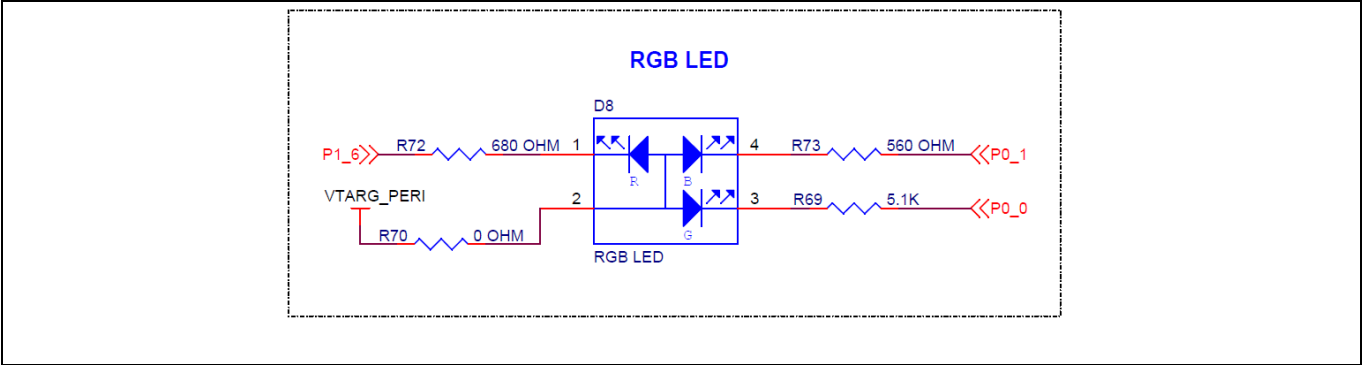
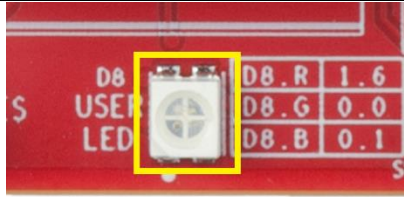


Figure 37 KitProg3 Status LED



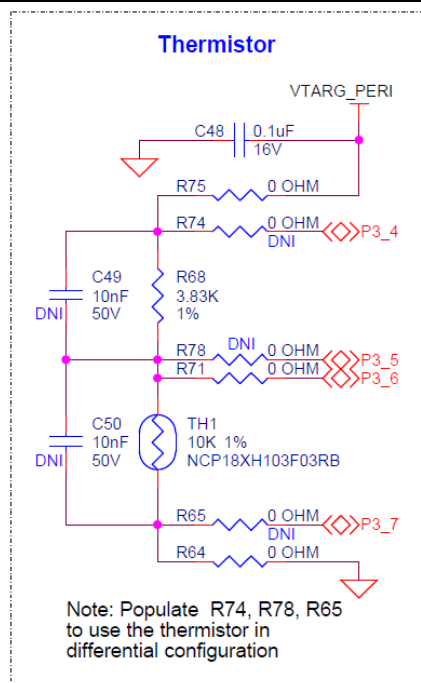
## Appendix



**Figure 38** User LED

### 4.2.7.6 Thermistor

The kit contains one NTC thermistor for temperature sensing. It is capable of sensing in both single-ended and differential mode. The single-ended mode is supported by default. **P3[4]**, **P3[5]**, **P3[6]** and **P3[7]** are the GPIOs which are used for the temperature sensing but only **P3[6]** is connected by default for single ended sensing. For differential sensing, see the [PSoC 4500S Pioneer Board Rework](#).

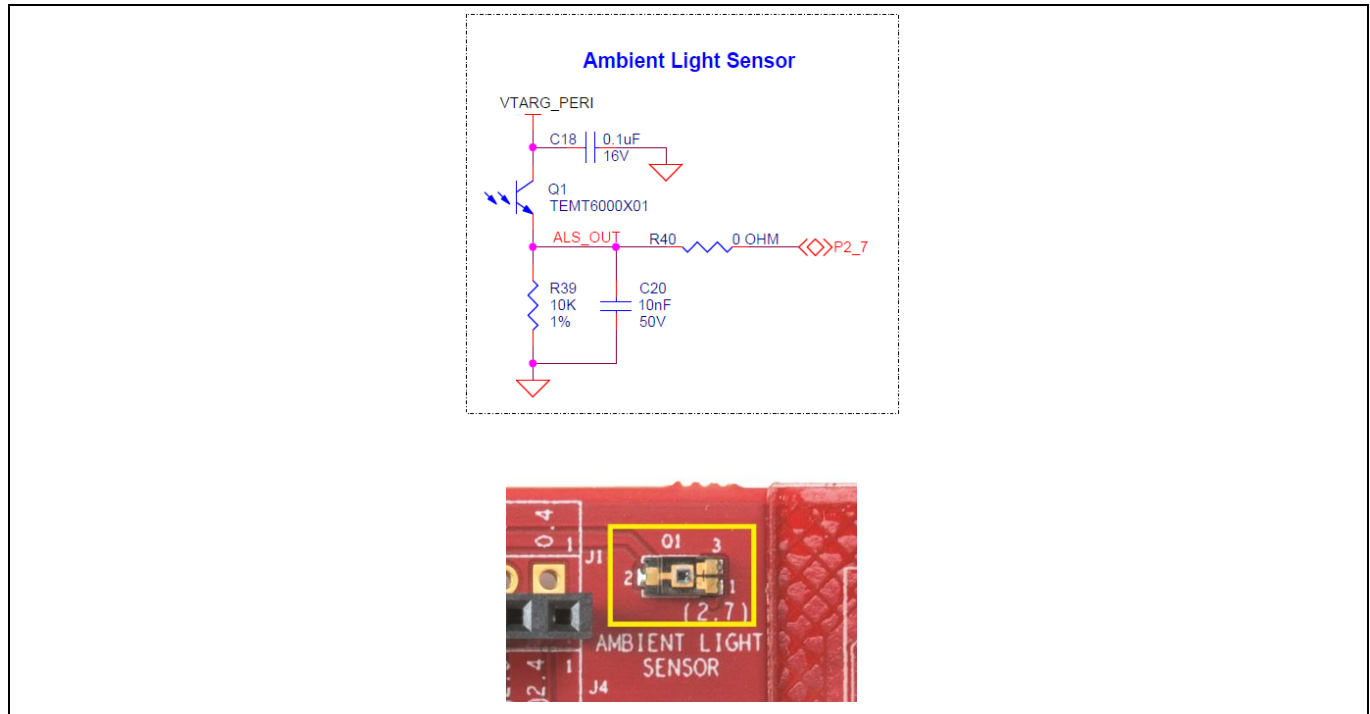


**Figure 39** Thermistor

## Appendix

### 4.2.7.7 Ambient Light Sensor

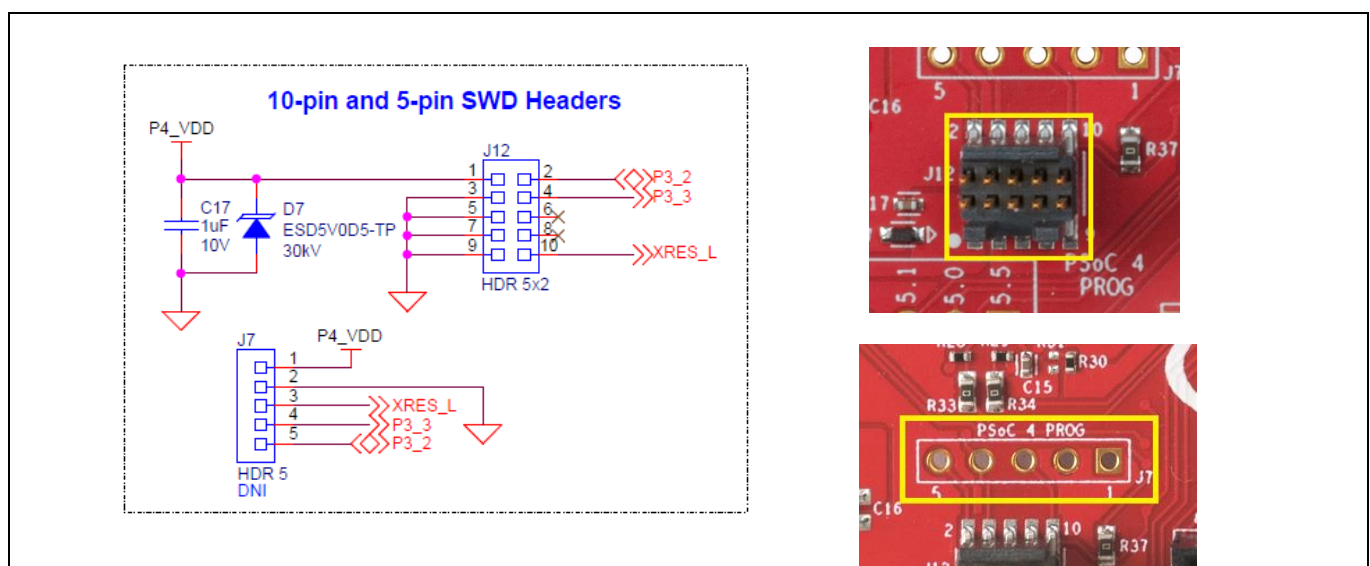
The kit contains one ambient light sensor (ALS) which uses the GPIO: **P2[7]** of PSoC 4500S for ambient light sensing.



**Figure 40** Ambient Light Sensor

### 4.2.7.8 10-pin and 5-pin SWD Program/Debug Headers

PSoC 4500S can be programmed alternatively through the 10-pin and 5-pin SWD headers (**J12** and **J7**) using a MiniProg4 programmer or any third-party programmer. Note that the 5-pin SWD header (**J7**) is not loaded by default.

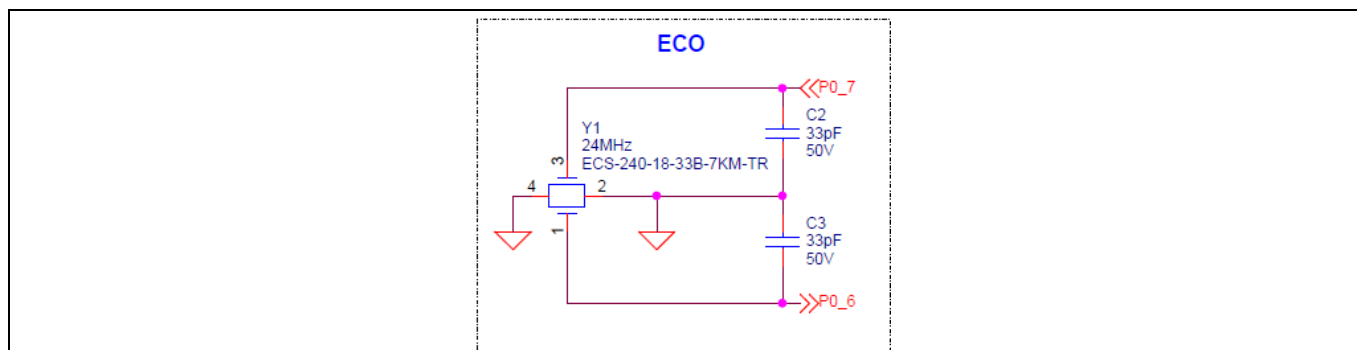


**Figure 41** 10-pin and 5-pin SWD Program/Debug Headers

## Appendix

### 4.2.8 Crystal Oscillator

The Pioneer board includes a 24-MHz ECO for PSoC 4500S device.

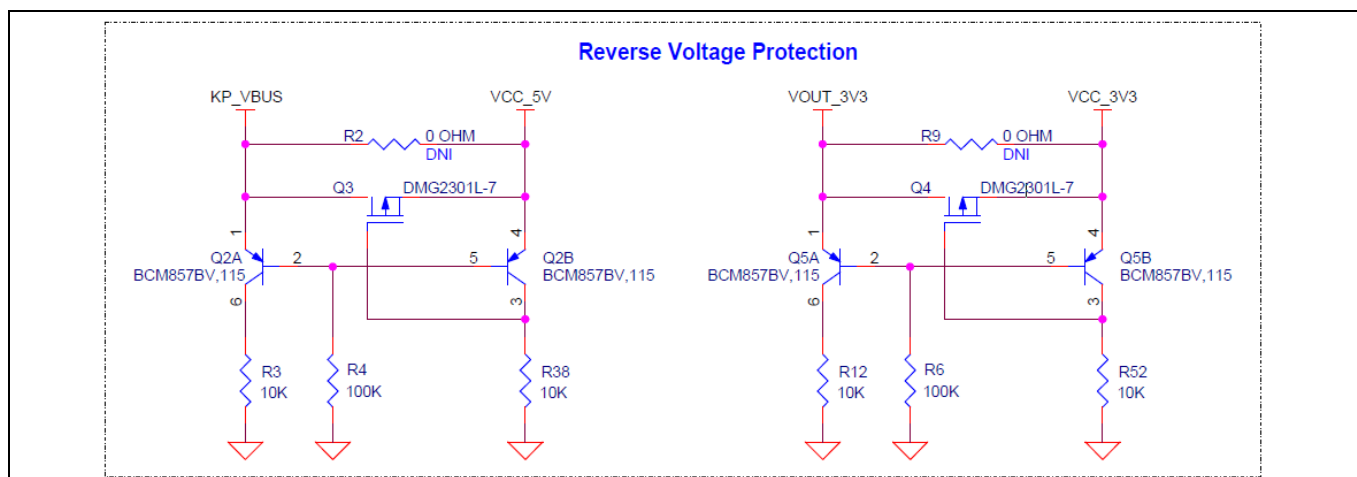


**Figure 42** Schematic of onboard ECO

## 4.3 PSoC 4500S Pioneer Board Rework

### 4.3.1 Bypassing Reverse Voltage Protection Circuits

The Reverse Voltage Protection circuit protects the 3.3V LDO (**U3**) and the onboard PSoC 4500S from getting damaged due to overvoltage. This protection circuit cuts-off any voltage greater than the rated max voltages by ~35mV.



**Figure 43** Schematic of Reverse Voltage Protection circuit

Note that the protection circuits have a voltage drop of maximum ~140 mV. To avoid the voltage drop, bypass the protection circuits by populating the bypass zero-ohm resistors **R2** and **R9**.

Note that this change will compromise the protection circuits when an overvoltage occurs at the respective supply connectors and may permanently damage the devices if the voltage exceeds the absolute maximum limit of devices.

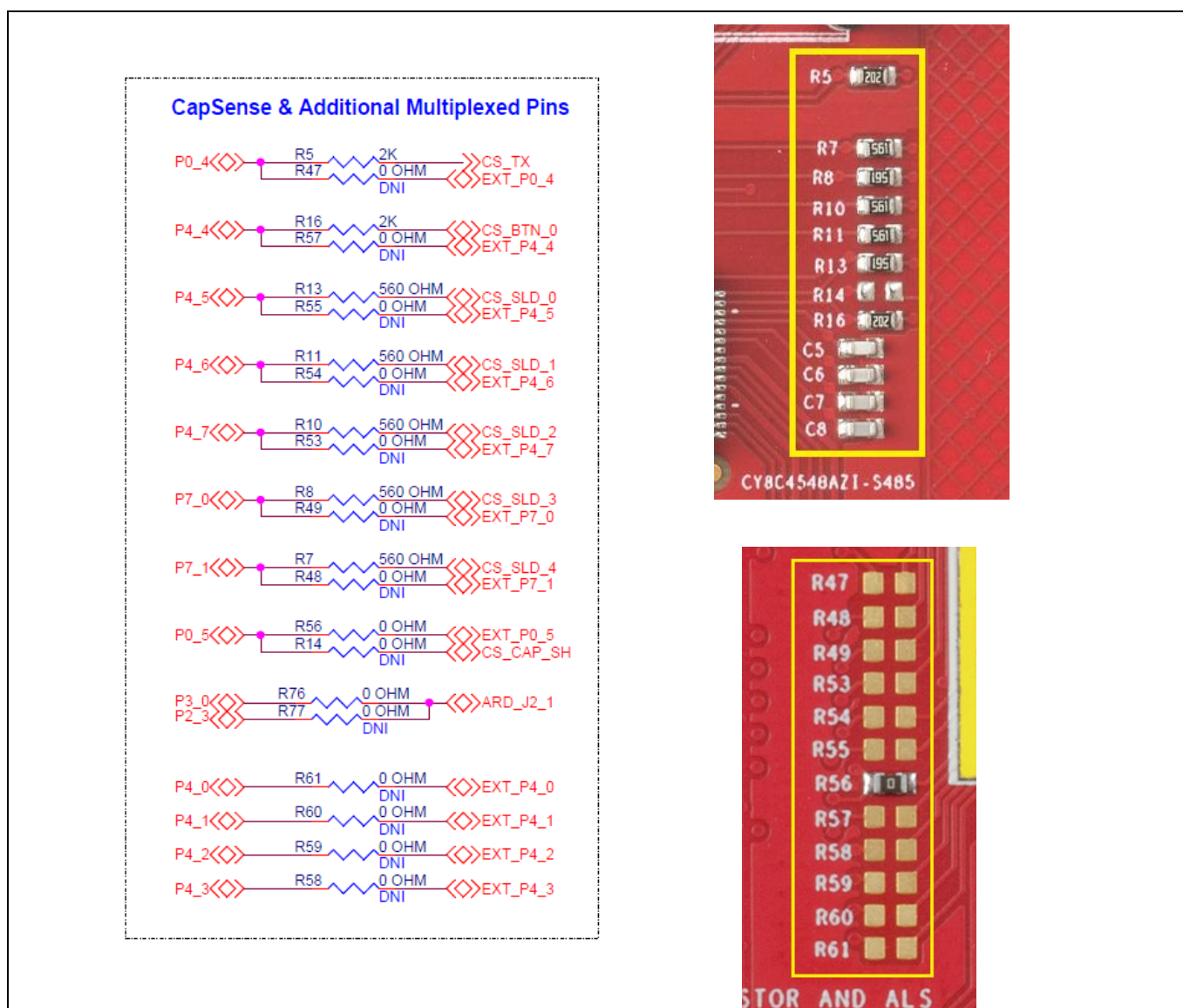
## Appendix

## 4.3.2 Rework on CapSense and Additional Multiplexed Pins

CapSense I/Os and the Expansions header GPIOs are multiplexed using the resistor Y-networks as shown in **Figure 44**. These give the provision to use the CapSense I/Os as external GPIOs by connecting to the expansion headers **J10** and **J11**.

The resistor pairs used for multiplexing are: **R5, R47; R16, R57; R13, R55; R11, R54; R10, R53; R8, R49; R7, R48; R56, R14; R76, R77**. To use the alternative GPIOs, you need to remove the mounted resistor and populate the other resistor of the mentioned pairs. For example, remove **R5** and populate **R47** to use the **P0.4** as extended GPIO at the header **J11.1**.

There is also provision of using the pins as extended GPIOs used for the CapSense capacitors CMOD, CINTA and CINTB. By populating the resistors: **R58, R59, R60** and **R61**, the respective pins **P4.3, P4.2, P4.1** and **P4.0** can be connected to the extended header **J10**.



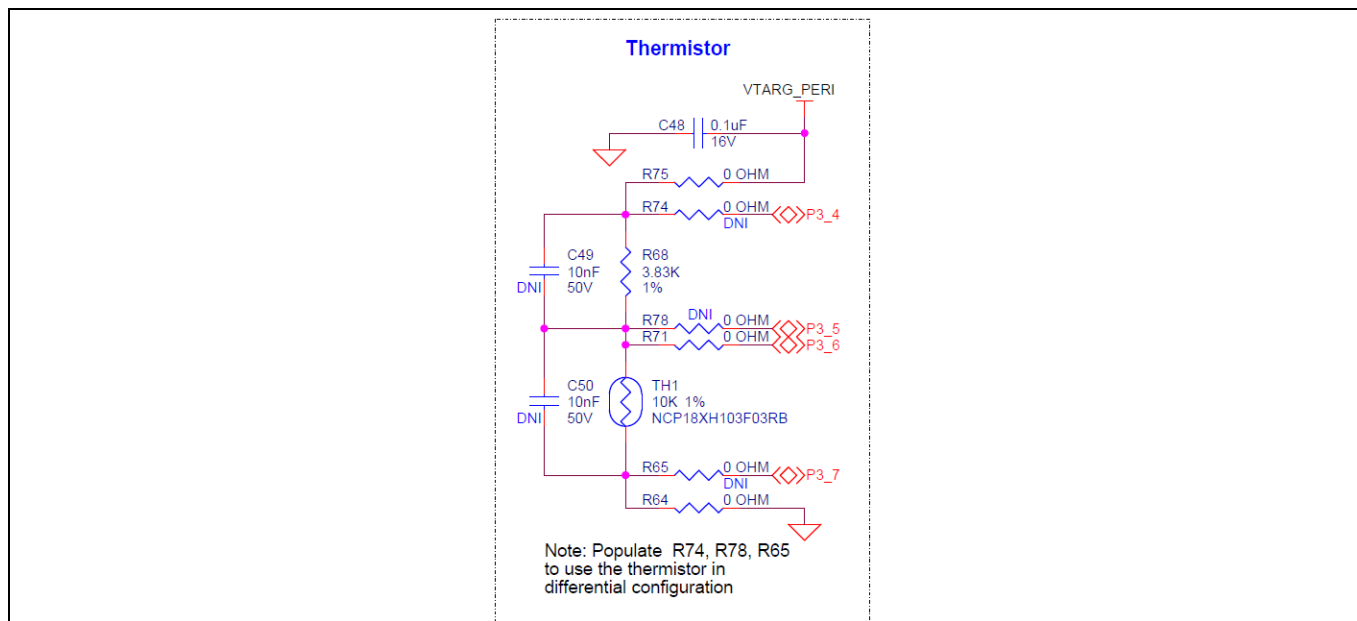
**Figure 44** Multiplexed Pins



## Appendix

### 4.3.3 Rework for Thermistor Block

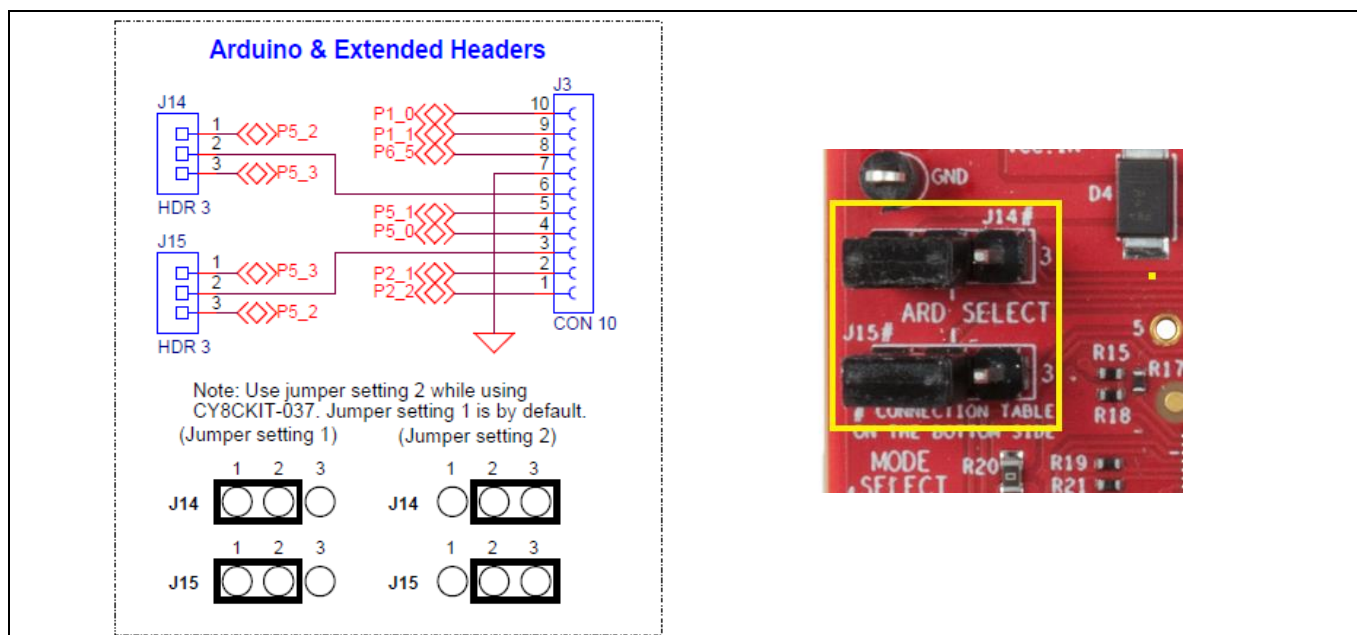
The onboard thermistor is capable of sensing the temperature both in single-ended and differential mode. The single-ended mode is supported by default. To change the sensing mode to differential, populate **R74**, **R78**, and **R65**.



**Figure 45 Thermistor**

### 4.3.4 Rework on J14 and J15 for Motor Control Application

The kit does not support SPI communication for Arduino UNO R3 shields and motor control support using CY8CKIT-037 at the same time. The kit does support SPI communication by default. To use the kit for motor control application using CY8CKIT-037, change the jumper positions of **J14** and **J15** to 2-3 position (Jumper setting 2). Default position of **J14** and **J15** is 1-2 (Jumper setting 1).



**Figure 46 Arduino Select Headers**



## Appendix

When using with CY8CKIT-037, by default, both the motor phase current signals gets connected to port 3 (**P3\_0** and **P3\_7**) which is the SARMUX port of SAR ADC 1. To make use of both the SAR ADCs of PSoC 4500S, with each SAR ADC measuring one of the phase currents, mount **R77** and remove **R76**. This connects one of the phase current signal to **P2\_3** and other to **P3\_7**.

### 4.4 PSoC 4500S Pioneer Kit Schematics

See the schematic file on the kit web page:

[www.cypress.com/CY8CKIT-045S](http://www.cypress.com/CY8CKIT-045S)

### 4.5 Bill of Materials

See the BOM file on the kit web page:

[www.cypress.com/CY8CKIT-045S](http://www.cypress.com/CY8CKIT-045S)

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**Revision History**
**Revision History**

Revision	Issue Date	Description of Change
**	11/25/2020	Initial release.
*A	12/17/2020	Updated Introduction: Updated Kit Contents: Updated Figure 1. Updated Kit Operation: Updated Programming and Debugging the PSoC 4500S Target Device: Updated Programming Using PSoC Creator: Updated Figure 7. Updated Appendix: Updated Board Details: Updated Figure 23. Updated Figure 24. Updated Hardware Details: Updated PSoC 4500S Pioneer Board: Updated Figure 25. Updated KitProg3: Updated Figure 26. Updated User and Passive Inputs: Updated CapSense Circuit: Updated Figure 32. Updated User and Passive Inputs: Updated Ambient Light Sensor: Updated Figure 40. Updated 10-pin and 5-pin SWD Program/Debug Headers: Updated Figure 41. Updated PSoC 4500S Pioneer Board Rework: Updated Rework on CapSense and Additional Multiplexed Pins: Updated Figure 44.

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