CY8CKIT-145-40XX PSOC™ 4000S Prototyping Kit user guide

About this document

Scope and purpose

This guide helps you become acquainted with the CY8CKIT-145-40XX PSOC™ 4000S Prototyping Kit. The document explains the kit's operation, describes the out-of-the-box (OOB) example and its operation, and provides hardware details of the board.

Intended audience

This kit is intended for all technical specialists familiar with the PSOC™ 4 MCU and CAPSENSE™.

Reference board/kit

Product(s) embedded on a PCB with a focus on specific applications and defined use cases that may include software. PCB and auxiliary circuits are optimized for the requirements of the target application.

***Note**: Boards do not necessarily meet safety, EMI, quality standards (for example UL, CE) requirements.*

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

Table 1 Safety precautions

	**Caution:** *The evaluation or reference board contains parts and assemblies sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.*

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1 Introduction

The PSOC™ 4000S Prototyping Kit enables customers to evaluate and develop projects using the PSOC™ 4000S device family.

The PSOC™ 4000S device family is an expansion of the PSOC™ 4000 device family, offering more flash, GPIOs, and programmable analog and digital blocks. The PSOC™ 4000S device is a programmable embedded system-on-chip, integrating custom analog and digital peripheral functions, memory, and an Arm® Cortex®-M0+ microcontroller on a single chip. The programmable analog and digital peripheral functions allow higher flexibility, in-field design tuning, and faster time-to-market.

The PSOC™ 4000S Prototyping Kit offers an open-footprint breakout board to maximize the utility of the PSOC™ 4000S device. This kit offers a low-cost alternative to device samples and provides a platform to easily develop and integrate the PSOC™ 4000S device into your end system.

The board includes the following features:

- A PSOC™ 4000S device
- An onboard programmer/debugger (KitProg3)
- Three CAPSENSE™ buttons
- 5-segment CAPSENSE™ slider
- LEDs to provide feedback
- Onboard CMOD, CTANK, CintA, and CintB capacitors to enable CAPSENSE™ development
- Bypass capacitor to ensure high-quality analog-to-digital conversions (No load by default)
- A push button to provide simple user input
- Load capacitors to connect the 32-kHz external crystal oscillator
- AIROC™ Bluetooth® LE module
- 5 V operation

See AN85951 - PSOC™ 4 and PSOC™ 6 MCU CAPSENSE™ design guide for details and features of the CAPSENSE™ MCU.

You can use ModusToolbox™ software to develop and debug your PSOC™ 4 projects. ModusToolbox™ software is a set of tools that enables you to integrate Infineon devices into your existing development methodology.

If you are new to PSOC™ 4 and ModusToolbox™ software IDE, see AN79953 - Getting started with PSOC™ 4 to help familiarize yourself with PSOC™ 4 and help you create your own design.

1.1 Kit contents

The CY8CKIT-145-40XX PSOC™ 4000S Prototyping Kit comprises the following contents:

- PSOC™ 4000S Prototyping board
- Quick start guide (part of the packaging)

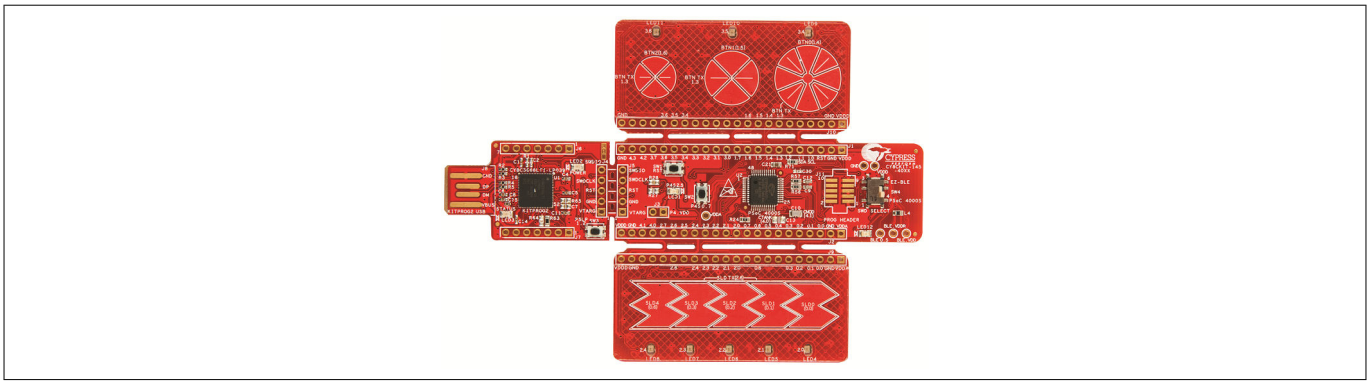

Figure 1 CY8CKIT-145-40XX PSOC™ 4000S Prototyping board

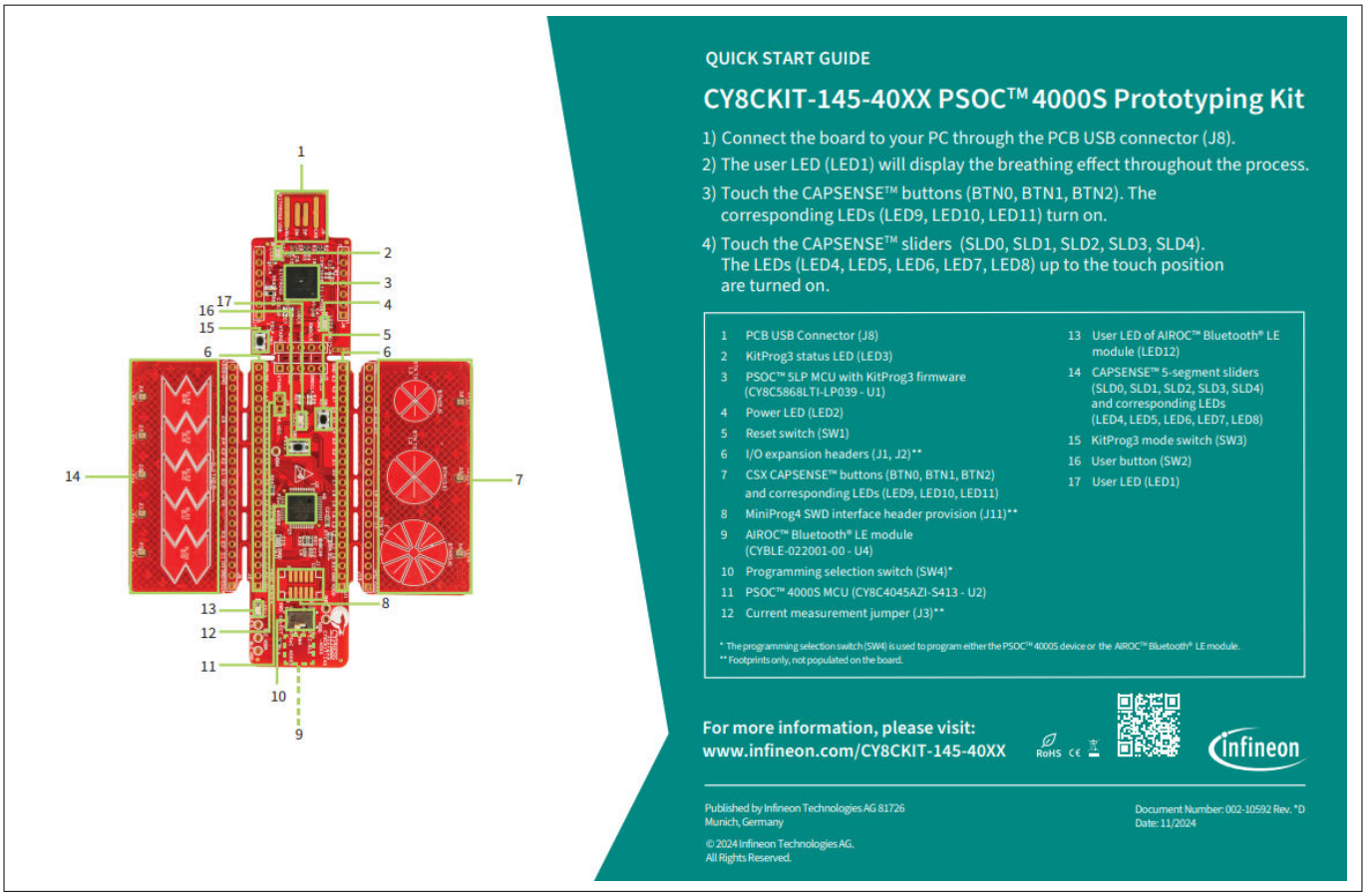

Figure 2 CY8CKIT-145-40XX PSOC™ 4000S Prototyping Kit quick start guide

Inspect the contents of the kit; if you find any part missing, contact your nearest Infineon sales office for help. For more information, see Technical Support.

1.2 Getting started

This guide helps you get acquainted with the PSOC™ 4000S Prototyping Kit.

- See the Kit operation section for an overview of the PSOC™ 4000S device features. Follow the Using the OOB example - CE237532 section to have a quick review of the OOB project preprogrammed in this kit. It also outlines the steps to create a project and program/debug using ModusToolbox™ software
- For a detailed hardware description, kit schematics, rework instructions, and the bill of materials (BOM), see the Hardware section

- Use ModusToolbox™ software for application development with the PSOC™ 4000S Prototyping Kit. For the latest software support for this development kit, see the kit webpage
  - ModusToolbox™ software is a free development ecosystem that includes the Eclipse IDE. With ModusToolbox™ software, you can enable and configure device resources, middleware libraries, and program and debug the device. You can download the software from the ModusToolbox™ software home page. For additional information, see the ModusToolbox™ software user guide
- Explore the wide range of code examples to evaluate the PSOC™ 4000S Prototyping Kit. These examples help you familiarize yourself with the PSOC™ 4000S device and create your own designs. You can also find code examples on the ModusToolbox™ software-based examples GitHub page
  - To access code examples through ModusToolbox™, see the 'Software development for PSOC™ 4' section in AN79953 - Getting started with PSOC™ 4 under 'PSOC™ 4 software resources'

1.3 Board details

The PSOC™ 4000S Prototyping board has the following features:

- PSOC™ 4000S device (U2, CY8C4045AZI-S413)
- PSOC™ 4000S I/O headers (J1, J2)
- 10-pin program/debug header (J11, footprint only)
- KitProg3 (PSOC™ 5LP) device (U1, CY8C5868LTI-LP039)
- KitProg3 I/O headers (J6, J7)
- 5-pin SWD connection headers (J4, J5)
- PCB USB finger connector (J8)
- AIROC™ Bluetooth® LE Module (U4)
- One DPDT switch to select the SWD target device (SW4)
- One blue user LED (LED1)
- One power LED (LED2)
- One KitProg3 status LED (LED3)
- User push button connected to GPIO of PSOC™ 4000S and AIROC™ Bluetooth® LE devices (SW2)
- Reset button connected to XRES pin of PSOC™ 4000S and AIROC™ Bluetooth® LE devices (SW1)
- User push button connected to GPIO of KitProg3 (SW3)
- Current measurement jumper (J3, footprint only)
- External reference capacitor - SAR ADC bypass (C3, No load by default)
- CAPSENSE™ capacitors (CMOD C10, CTANK C13, CintA C36, CintB C35)
- CAPSENSE™ sensors (three buttons: BTN0, BTN1, and BTN2; one linear slider with five segments: SLD0, SLD1, SLD2, SLD3, and SLD4)
- LEDs corresponding to CAPSENSE™ buttons (LED9, LED10, and LED11) and slider (LED4, LED5, LED6, LED7, and LED8)
- User LED for AIROC™ Bluetooth® LE module (LED12)
- Perforated snappable board design
- Overlay on CAPSENSE™ buttons and slider

Figure 3 shows the pinout of the evaluation board.

1 Introduction

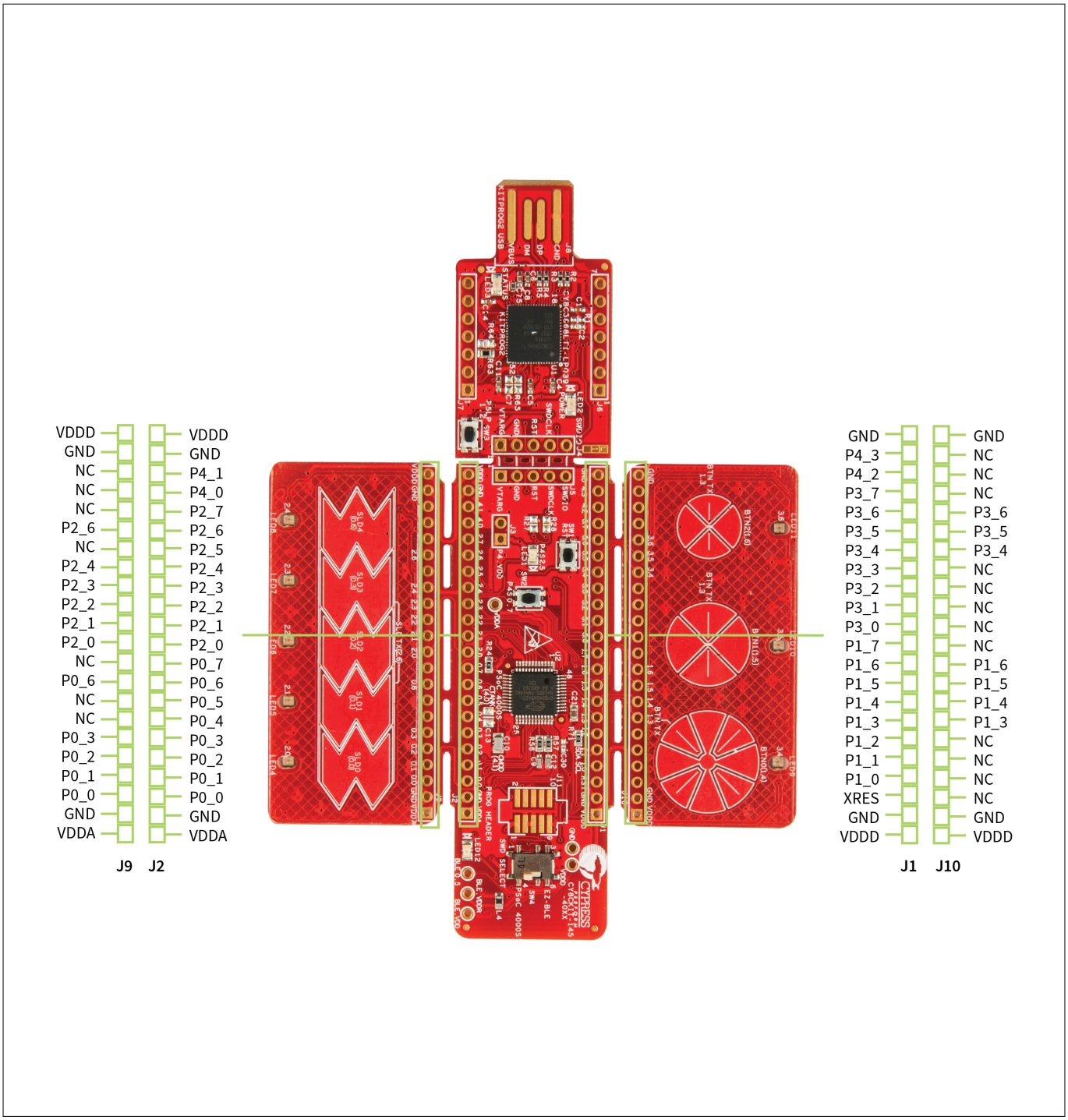

Figure 3 Board pinout

Table 2 Board pinout details

PSOC™ 4 pin	Primary onboard function	Secondary onboard function	Connection details
VDDD	Power	-	-
GND	Ground	-	-
XRES	Hardware reset	-	-

(table continues...)

Table 2 (continued) Board pinout details

PSOC™ 4 pin	Primary onboard function	Secondary onboard function	Connection details
P0.0	SLD0	-	CAPSENSE™ slider 0
P0.1	SLD1	-	CAPSENSE™ slider 1
P0.2	SLD2	-	CAPSENSE™ slider 2
P0.3	SLD3	-	CAPSENSE™ slider 3
P0.4	UART_RX	-	AIROC™ Bluetooth® LE UART interface RX
P0.5	UART_TX	-	AIROC™ Bluetooth® LE UART interface TX
P0.6	SLD4	-	CAPSENSE™ slider 4
P0.7	User button	-	-
P1.0	I^2C Clock	-	KitProg3 I^2C interface clock
P1.1	I^2C Data	-	KitProg3 I^2C interface data
P1.2	GPIO	-	-
P1.3	BTN TX	-	CAPSENSE™ CSX button TX
P1.4	BTN0	-	CAPSENSE™ button 0 RX
P1.5	BTN1	-	CAPSENSE™ button 1 RX
P1.6	BTN2	-	CAPSENSE™ button 2 RX
P1.7	GPIO	SAR ADC bypass capacitor	-
P2.0	LED4	-	CAPSENSE™ slider 0 LED
P2.1	LED5	-	CAPSENSE™ slider 1 LED
P2.2	LED6	-	CAPSENSE™ slider 2 LED
P2.3	LED7	-	CAPSENSE™ slider 3 LED
P2.4	LED8	-	CAPSENSE™ slider 4 LED
P2.5	LED1	-	User LED
P2.6	SLD TX	-	CAPSENSE™ slider TX
P2.7	GPIO	-	-
P3.0	UART RX	-	KitProg3 UART interface RX
P3.1	UART TX	-	KitProg3 UART interface TX
P3.2	SWDIO	-	SWD interface data I/O
P3.3	SWDCLK	-	SWD interface clock
P3.4	LED9	-	CAPSENSE™ button 0 LED
P3.5	LED10	-	CAPSENSE™ button 1 LED
P3.6	LED11	-	CAPSENSE™ button 2 LED

(table continues...)

Table 2 (continued) Board pinout details

PSOC™ 4 pin	Primary onboard function	Secondary onboard function	Connection details
P3.7	GPIO	-	-
P4.0	CTANK	-	Shield tank capacitor
P4.1	CMOD	-	Modulation capacitor
P4.2	CintA	-	Integration capacitor
P4.3	CintB	-	Integration capacitor

1.4 Additional learning resources

Infineon provides a wealth of resources on the PSOC™ 4 product webpage to help you select the suitable PSOC™ device for your design and to quickly and effectively integrate the device into your project.

Refer to the CAPSENSE™ design guide to design capacitive touch-sensing applications with the PSOC™ 4 family of devices.

1.5 Technical support

For assistance or product-related queries, contact Infineon Support or post your queries on the Infineon Developer Community platform.

You can also use the Self-help (technical documents) support resources for quick assistance.

2 Kit operation

This chapter provides an overview of the features of the PSOC™ 4000S device and a quick review of the out-of-box (OOB) project preprogrammed in this kit. It also outlines the steps to create a project and program/debug using ModusToolbox™ software.

2.1 Theory of operation

The PSOC™ 4000S Prototyping Kit is built around the PSOC™ 4000S device. Figure 4 shows the block diagram of the PSOC™ 4000S device used on the board. For detailed information about the device's features, see the device datasheet.

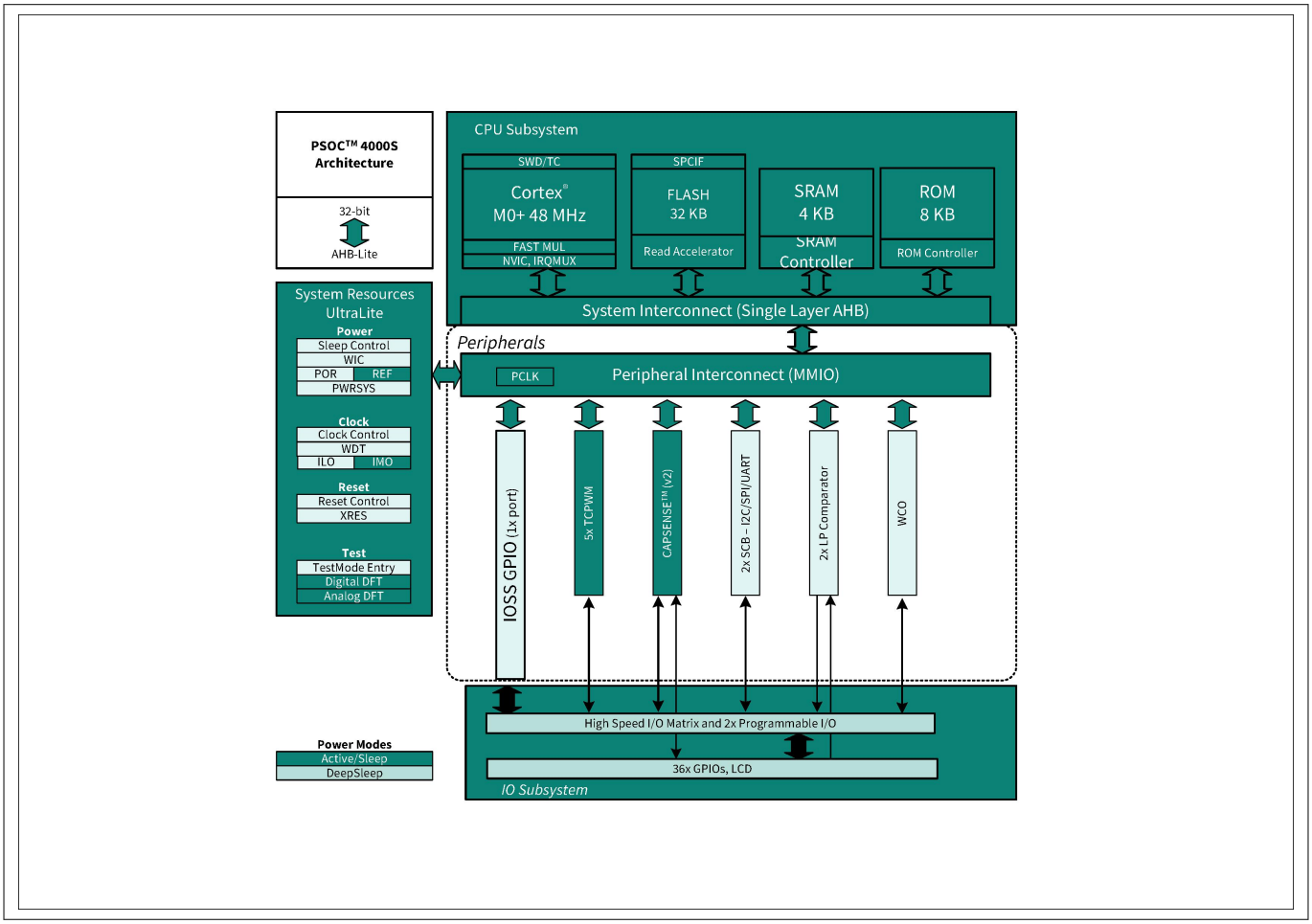

Figure 4 PSOC™ 4000S device block diagram

Figure 5 shows the functional block diagram of the PSOC™ 4000S Prototyping board.

2 Kit operation

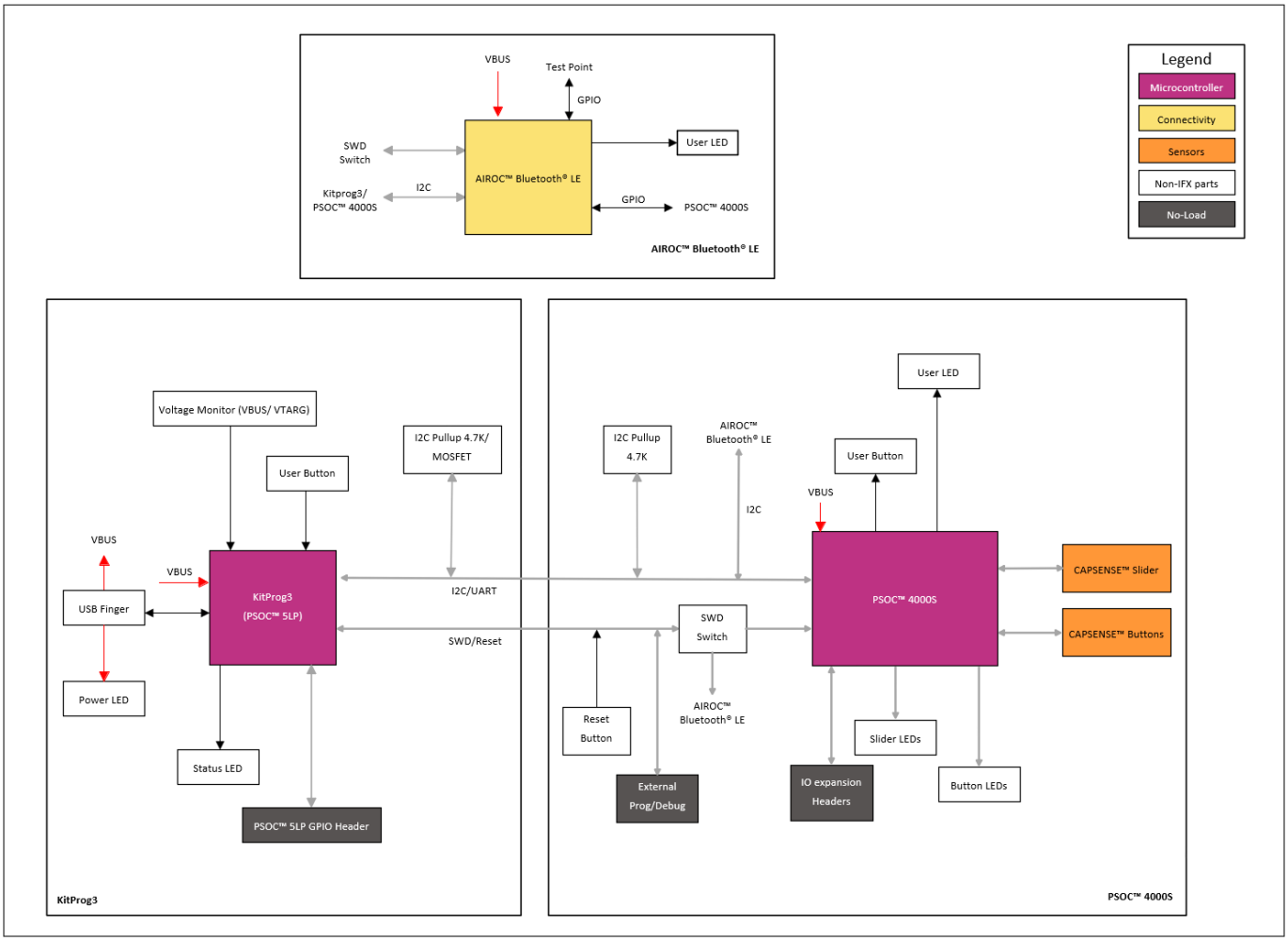

Figure 5 Functional block diagram of the PSOC™ 4000S Prototyping board

2 Kit operation

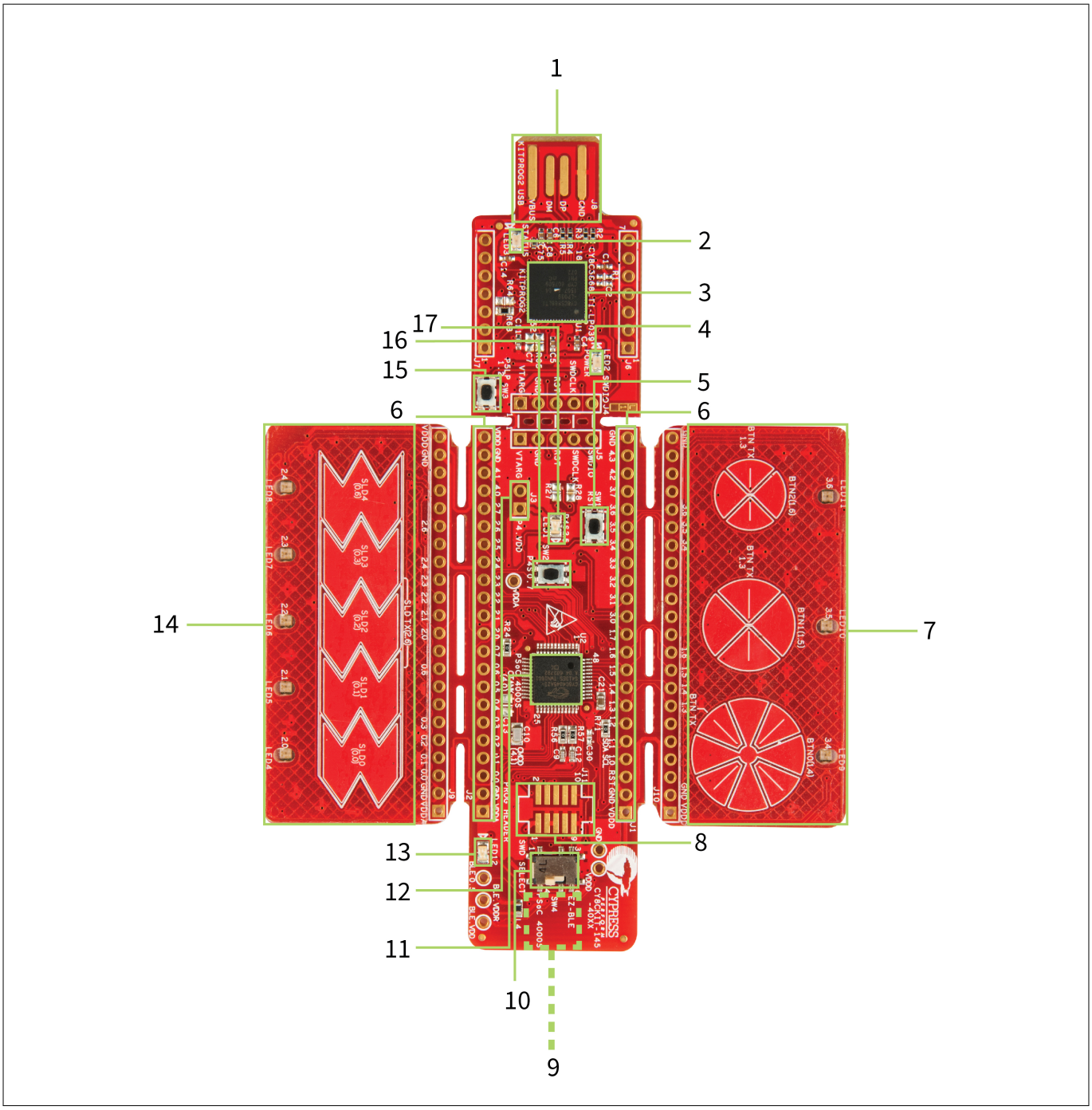

Figure 6 PSOC™ 4000S Prototyping board top view

The PSOC™ 4000S Prototyping Kit is simple in design and provides complete access to develop applications using the PSOC™ 4000S device family. This kit includes the following peripherals:

1. **PCB USB connector (J8)**: An onboard USB connector is provided to connect the kit to a computer
2. **KitProg3 status LED (LED3)**: The amber LED3 indicates the status of KitProg3. For details on the KitProg3 status, see the KitProg3 user guide
3. **KitProg3 (PSOC™ 5LP) programmer and debugger (CY8C5868LTI-LP039, U1)**: The PSOC™ 5LP device (CY8C5868LTI-LP039) serves as KitProg3, a multifunctional system that includes an SWD programmer, debugger, USB-I2C bridge, and USB-UART bridge. For more details, see the KitProg3 user guide
4. **Power LED (LED2)**: The amber power LED turns on when the kit is connected and powered through the onboard USB connector (J8)

5. **Reset switch (SW1)**: This button is used to reset PSOC™ 4000S and AIROC™ Bluetooth® LE devices
6. **I/O expansion headers (J1, J2)**: The PSOC™ 4000S Prototyping board brings all GPIOs of the target PSOC™ 4000S device to the two expansion headers, enabling maximum access to the capabilities of the PSOC™ 4000S device
7. **CSX CAPSENSE™ buttons and corresponding LEDs**: Three CAPSENSE™ buttons (BTN0, BTN1, and BTN2) are provided with their corresponding LEDs (LED9, LED10, and LED11)
8. **MiniProg4 SWD interface header provision (J11)**: This 10-pin header allows you to program and debug the PSOC™ 4 MCU using an external programmer such as MiniProg4
9. **AIROC™ Bluetooth® LE module(U4)**: The kit includes an AIROC™ Bluetooth® LE module for BLE connectivity
10. **SWD selection switch (SW4)**: A DPDT switch is provided on the prototyping board to select the SWD lines of either the PSOC™ 4000S or the AIROC™ Bluetooth® LE module for programming
11. **PSOC™ 4000S MCU (U2)**: This kit is designed to highlight the features of the PSOC™ 4000S (CY8C4045AZI-S413)
12. **Current measurement jumper (J3)**: Provision to mount a 2-pin jumper (J3) for measuring the current to the PSOC™ 4000S device. For measuring the current consumption of the PSOC™ 4000S device, see Measuring the current consumption of PSOC™ 4000S
13. **User LED of AIROC™ Bluetooth® LE module (LED12)**: A blue user LED (LED12) of the AIROC™ Bluetooth® LE module connected to P1.6 of its GPIO
14. **CAPSENSE™ 5-segment slider and corresponding LEDs**: A 5-segment linear slider (SLD0, SLD1, SLD2, SLD3, and SLD4) is provided with their corresponding LEDs (LED4, LED5, LED6, LED7, and LED8)
15. **KitProg3 programming mode selection button (SW3)**: Use this button to switch between various modes of operation of KitProg3. Note that this board supports only CMSIS-DAP BULK mode. For more details, see the KitProg3 user guide. This button function is reserved for future use
16. **User button (SW2)**: This push button can be used to provide an input to the PSOC™ 4000S/AIROC™ Bluetooth® LE devices. The switch connects the PSOC™ 4000S/AIROC™ Bluetooth® LE device's pin to ground when pressed, so configure the pin as resistive pull-up for detecting the switch press
17. **User LED (LED1)**: An onboard LED that can be controlled by the P2.5 pin of the PSOC™ 4000S MCU. The LED is Active low, so the pin must be driven low to turn on the LED

See the Functional description section for details on the various hardware blocks.

2.2 Using the OOB example - CE237532

The PSOC™ 4000S Prototyping Kit is pre-programmed with the CE237532 – PSOC™ 4: CAPSENSE™ SmartSense buttons slider code example (CE). This CE demonstrates how to tune self-capacitance (CSD)-based buttons and slider widgets in PSOC™ 4 devices using the CAPSENSE™ tuner. It also demonstrates a breathing effect on the onboard user LED using the SmartIO and TCPWM (configured as PWM) blocks.

To use the example, follow these steps:

- For a detailed description of the project, see the example's README file in the GitHub repository or from the application's top-level directory when the example is created using ModusToolbox™ software
- At any point in time, if you overwrite the OOB example, you can restore it by programming the PSOC™ 4: CAPSENSE™ SmartSense buttons slider code example. See Creating a project and program/debug using ModusToolbox™ software for programming the board

1. Connect the prototyping board to your PC using the PCB USB connector (J8), as shown in Figure 7

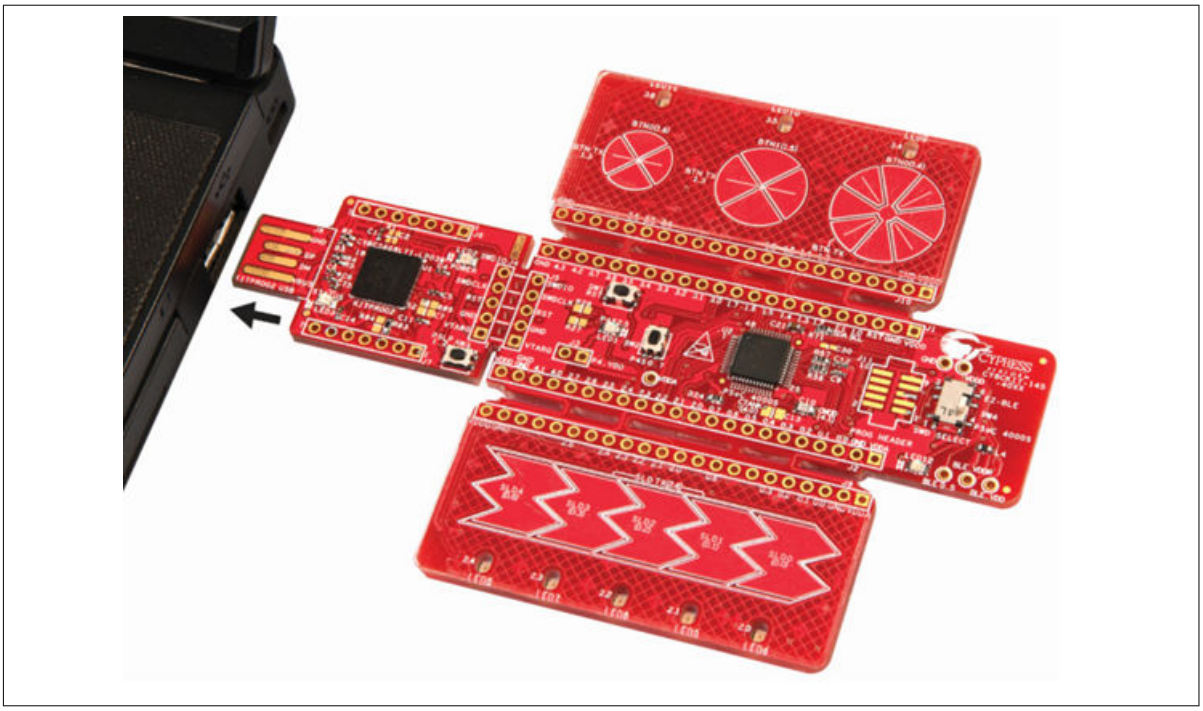

Figure 7 Connecting the PSOC™ 4000S Prototyping Kit to the PC

2. Touch the CAPSENSE™ buttons BTN0, BTN1, or BTN2 with your finger and observe the corresponding LEDs (LED9, LED10, and LED11) turn on, as shown in Figure 8

2 Kit operation

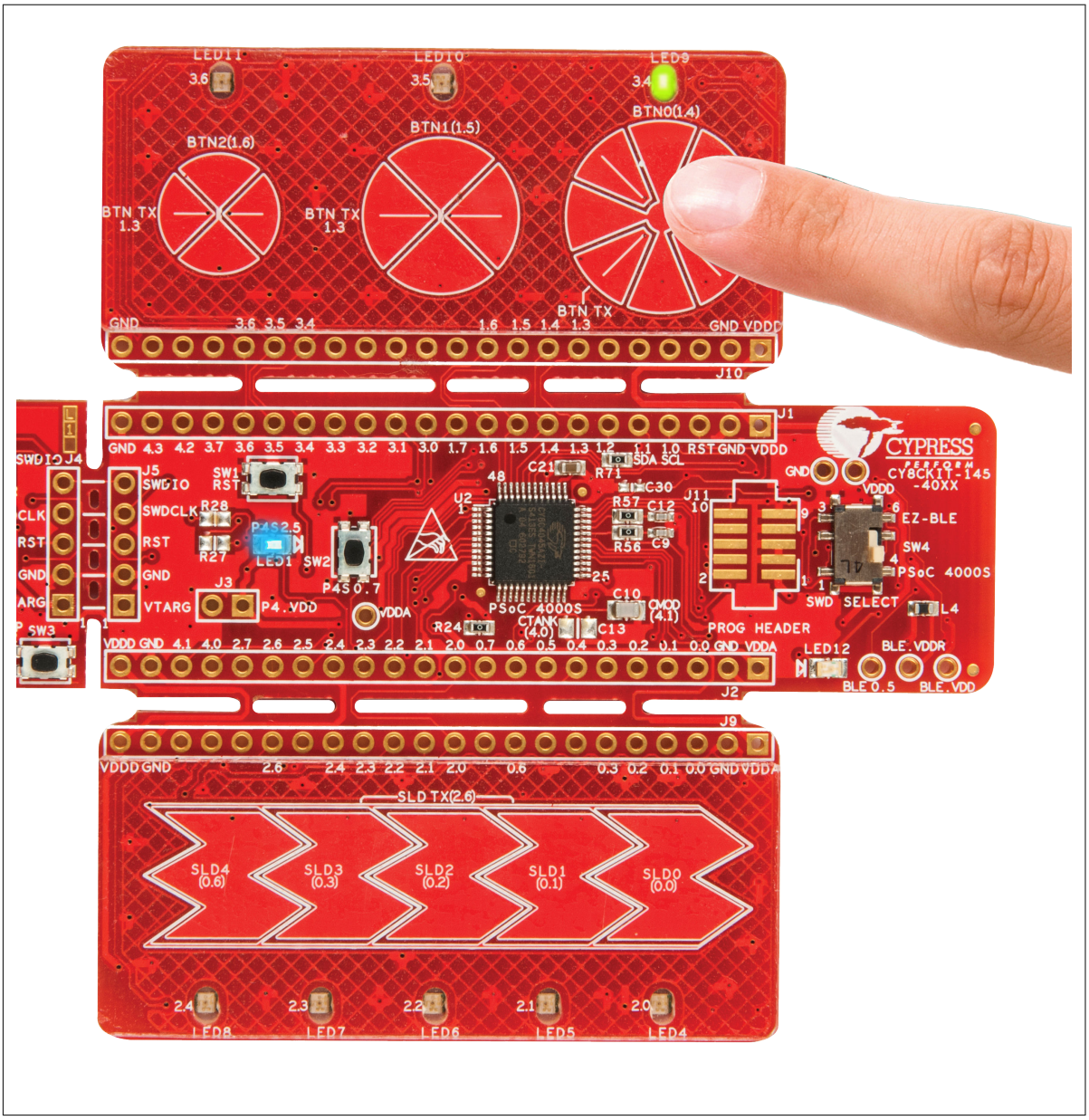

Figure 8 CAPSENSE™ button operation with LED indication

3. Touch the slider with your finger and observe the corresponding LEDs (LED4, LED5, LED6, LED7, and LED8) turn on up to the relative position of touch, as shown in Figure 9

Figure 9 CAPSENSE™ slider operation with LED indication

4. Observe the breathing effect on the onboard user LED (LED1)

2.3 Creating a project and program/debug using ModusToolbox™ software

This section briefly introduces project creation, programming, and debugging using the ModusToolbox™ software. For detailed instructions, see **Help > ModusToolbox™ general documentation > ModusToolbox™ user guide**.

1. Connect the prototyping board to your PC through the PCB USB connector (J8), as shown in Figure 7. The kit enumerates as a USB composite device if you connect it to the PC for the first time. KitProg3 operates in CMSIS-DAP Bulk mode; the status LED3 (amber) is always ON in CMSIS-DAP Bulk mode. If you do not see the correct LED status, see the KitProg3 user guide for details on KitProg3 status and troubleshooting instructions

To update the KitProg3 firmware, see the "Updating KitProg3" section in the KitProg3 user guide. For commands, see the Firmware Loader user guide

2. Import the required code example (application) into a new workspace in the Eclipse IDE for ModusToolbox™

a. Click **New Application** on the **Quick Panel**

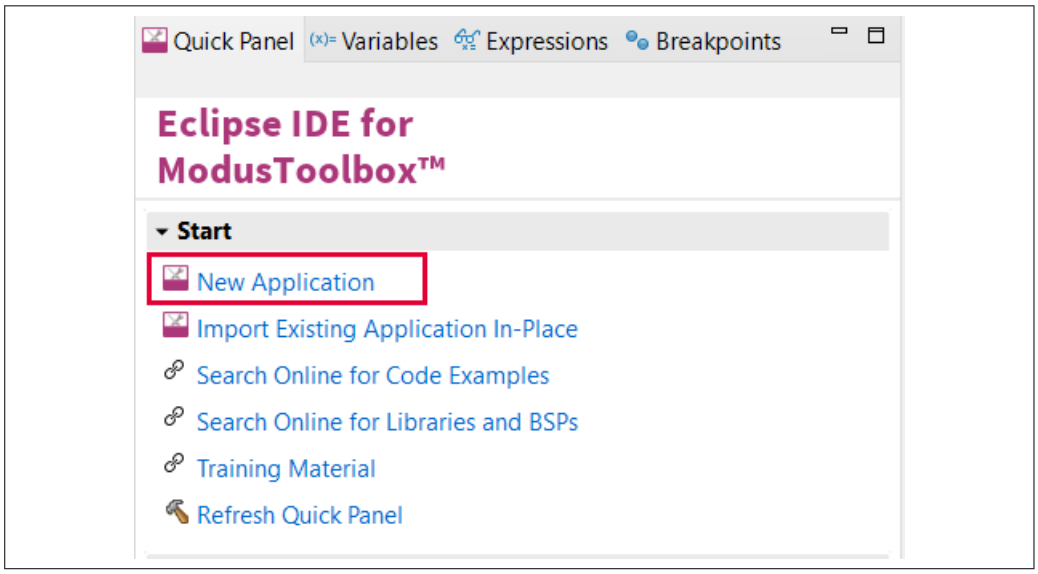

Figure 10 New Application in Quick Panel

b. In the **Choose Board Support Package (BSP) - Project Creator 2.21** window, expand PSOC™ 4 BSPs, select CY8CKIT-145-40XX, and click **Next**, as shown in Figure 11

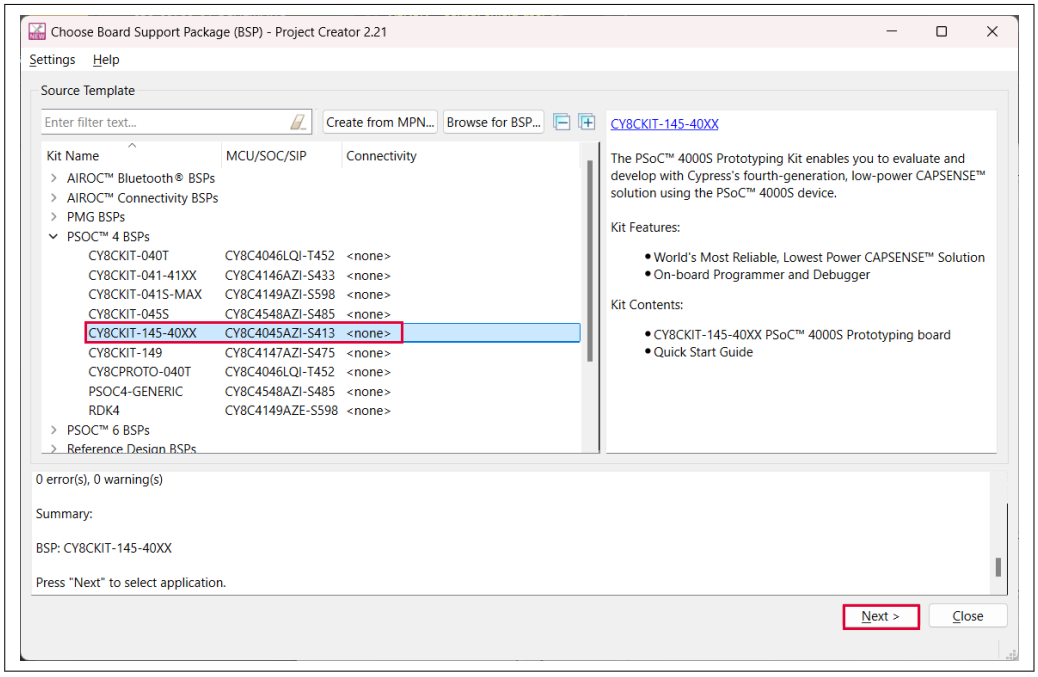

Figure 11 Creating a new application: Choose Board Support Package

c. Select the required application and click **Create**, as shown in Figure 12. The right pane shows the code example description and the link to view the README file on GitHub

2 Kit operation

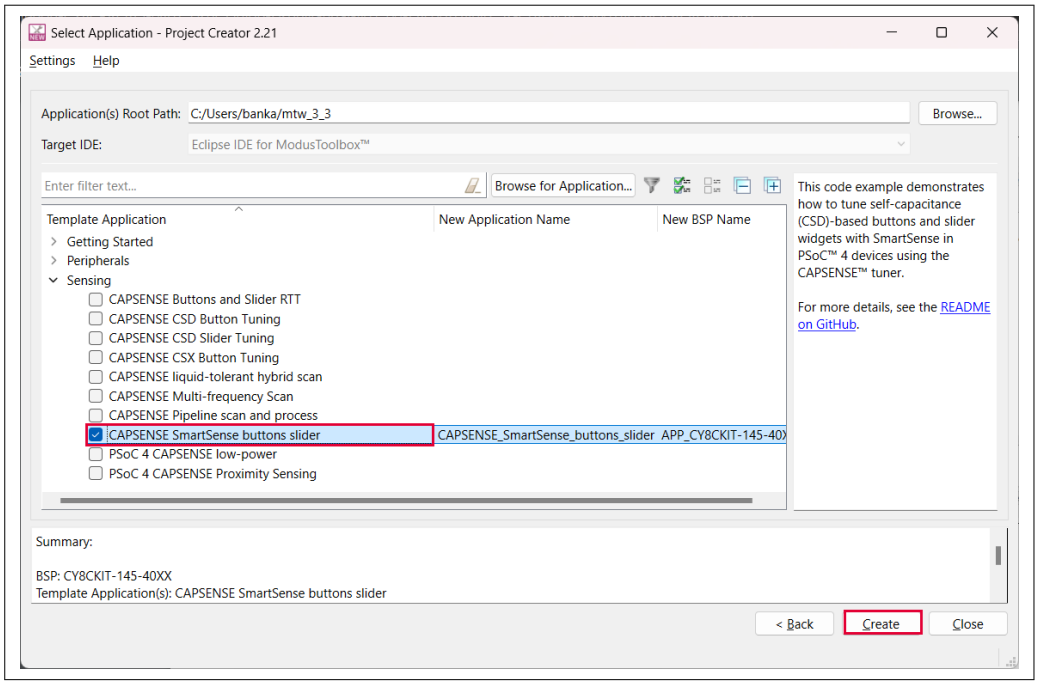

Figure 12 Creating a new application: Select Application

3. Select the project in the **Project Explorer** tab to build and program the PSOC™ 4000S device application. In the **Quick Panel** tab, scroll to the **Launches** section, and click the **Program (KitProg3_MiniProg4)** configuration, as shown in Figure 13

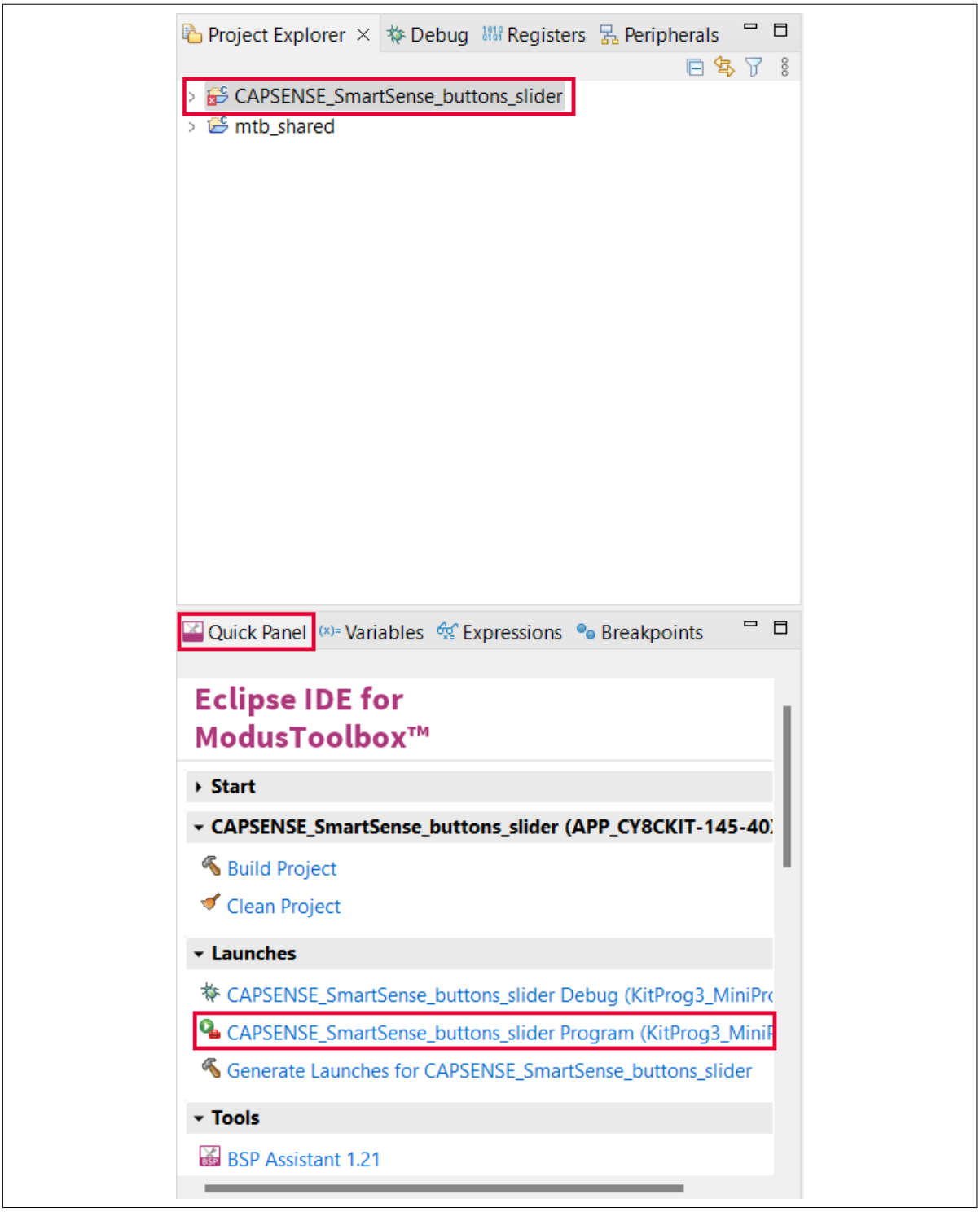

Figure 13 Building and programming the code example

4. ModusToolbox™ software has an integrated debugger. To debug the PSOC™ 4000S device application, in the Project Explorer tab, select the project. In the **Quick Panel** tab, scroll to the **Launches** section, and click the **<App_Name> Debug (KitProg3_MiniProg4)** configuration, as shown in Figure 14

   For a detailed explanation on how to debug using ModusToolbox™ software, see the “Program and Debug” section in the Eclipse IDE for ModusToolbox™ user guide

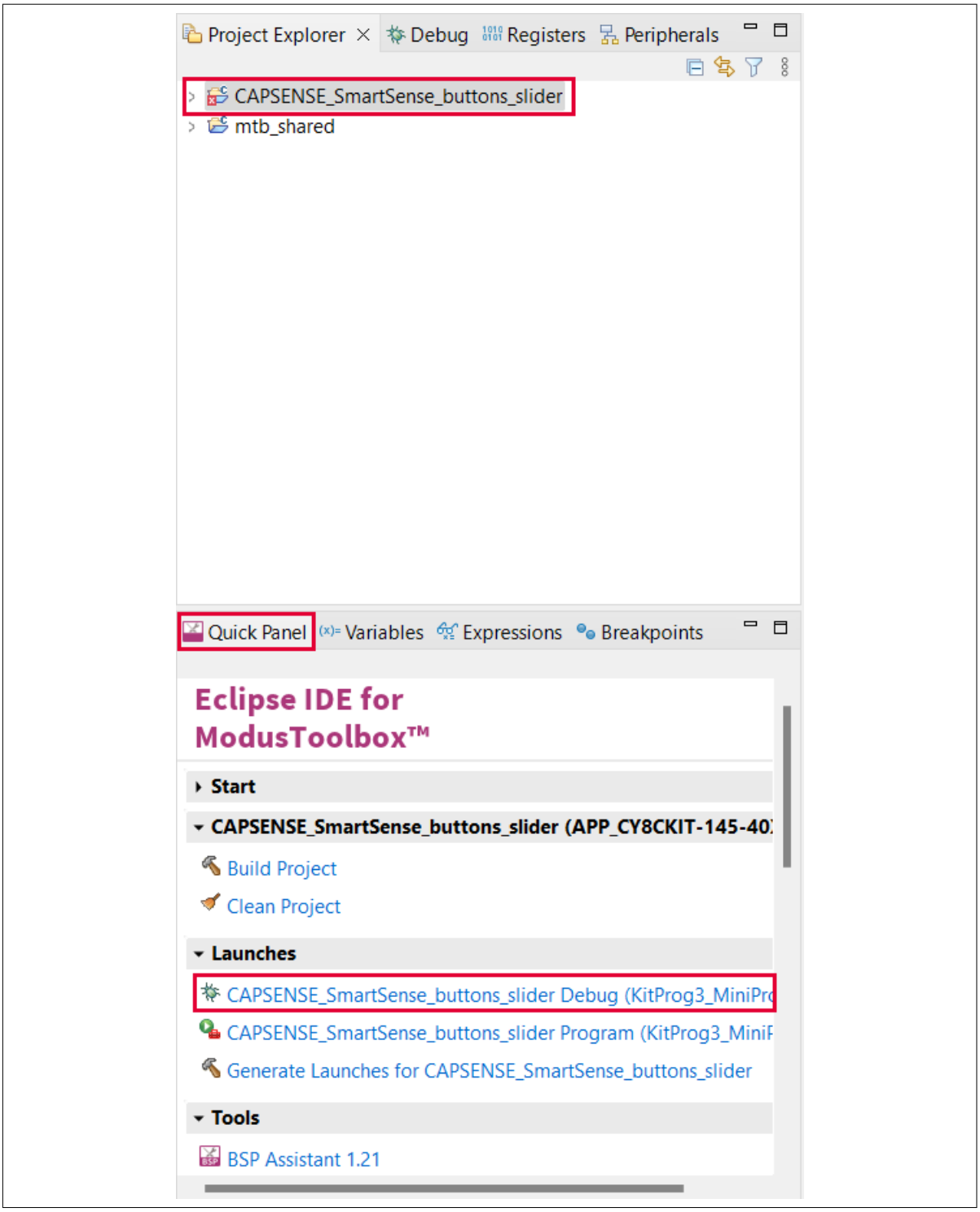

Figure 14 Debugging the code example

3 Hardware

3.1 Schematics

See the schematic files available on the kit webpage.

3.2 Functional description

This section describes the individual hardware blocks. The kit includes a PSOC™ 4000S Prototyping board, which consists of the following components:

1. PSOC™ 4000S device
2. KitProg3 programmer/debugger and bridge
3. CAPSENSE™ buttons supporting both CSD and CSX modes
4. CAPSENSE™ 5-segment slider supporting both CSX and CSD modes
5. LEDs corresponding to CAPSENSE™ buttons and slider
6. User LED
7. User button
8. DPDT slide switch for interface selection
9. Other passive components required for the essential operation of the kit

3.2.1 PSOC™ 4000S MCU features

The target board uses the PSOC™ 4000S device. PSOC™ 4000S is a scalable and reconfigurable platform architecture designed for a family of programmable embedded system controllers featuring an Arm® Cortex®-M0+ CPU. It combines programmable and reconfigurable analog and digital blocks with flexible automatic routing.

The PSOC™ 4000S device family, based on this platform architecture, integrates the following features:

1. Microcontroller with digital programmable logic
2. Programmable analog components
3. Programmable interconnects
4. High-performance analog-to-digital conversion
5. Operational amplifiers with comparator mode
6. Standard communication and timing peripherals

PSOC™ 4000S products are fully compatible with other members of the PSOC™ 4 platform, catering to new applications and design needs. The programmable analog and digital subsystems offer flexibility and enable in-field tuning of the design.

For more information, refer to the PSOC™ 4 web page and the PSOC™ 4000S family datasheet.

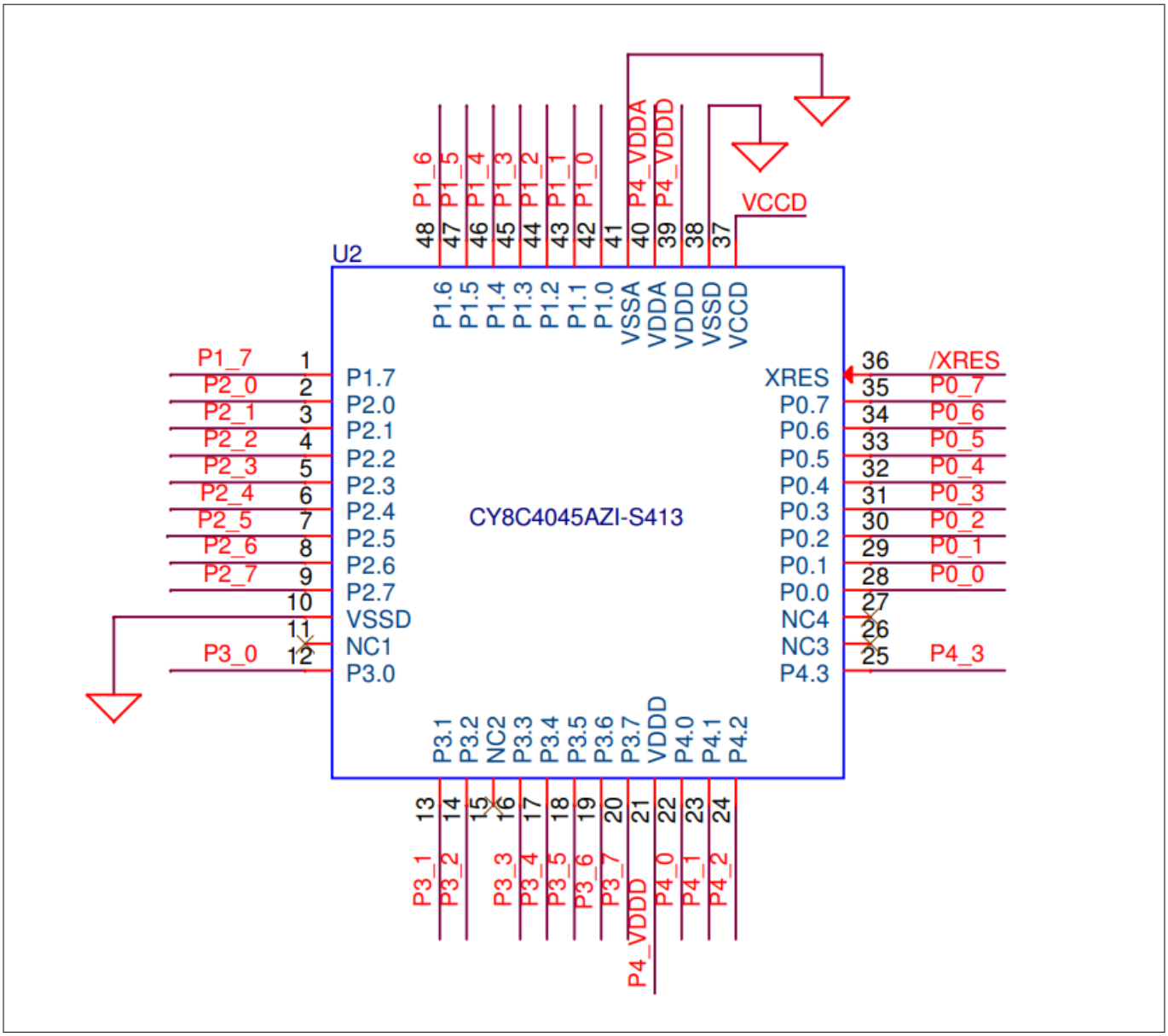

Figure 15 Schematic of the PSOC™ 4000S MCU

For more information related to pin assignment, see the Board details section.

3.2.1.1 PSOC™ 4000S device power supply system

The power supply system on this board depends on the power source. For most applications, you can use the 5 V supply from the USB connection to power the system. Alternatively, you can connect an external power supply to the board for low-voltage applications. The kit supports the following connections:

1. 5 V from the KitProg3 USB (J8)
2. 3.3 V to 5.5 V from a regulated supply connected to VTARG (this will not power the KitProg3 section of the board)

***Note**: To use an external power supply while KitProg3 is connected to the PCB USB, remove the D1 diode from the board. This ensures that the VTARG supply from KitProg3 is not supplied to the target device. KitProg3 measures the target voltage and adjusts the logic levels on the programming pins accordingly.*

Note that this prototyping kit does not include any onboard ESD protection circuitry. Therefore, the power source for the PSOC™ 4000S Prototyping Board must be of high quality to ensure that the board is protected from overcurrent conditions and swapped-power connections.

3.2.1.2 Measuring the current consumption of PSOC™ 4000S

You can measure the current consumption of the PSOC™ 4000S device by following these steps:

1. Remove the resistors R22 and R23, and install a 2-pin jumper in the supplied holes of J3
2. Connect an ammeter across the 2-pin jumper to measure the current to the PSOC™ 4000S device

This method can be used either with USB power or with power supplied to one of the VTARG pins, but not when supplying power to one of the VDD pins. After measuring the current consumption, re-populate the resistors R22 and R23 for normal kit operation.

3.2.1.3 Board separation (Snapping)

The PSOC™ 4000S Prototyping board consists of a PSOC™ 4000S board, a KitProg3 board, and two sensor boards.

Warning: ***Do not apply excess pressure on the board while snapping as it may damage the onboard components.***

To separate the PSOC™ 4000S and KitProg3 boards for evaluation or development, break the two boards apart at the built-in perforated edge between J4 and J5. To do this, follow these steps:

1. Place the kit on the edge of a table, ensuring the edge of the table is directly below the perforated edge and the smaller KitProg3 board is off the table edge
2. Press gently on the KitProg3 board and snap the two boards apart
3. If any material is removed from the edge of the boards, use shears to clean up the edge of the kit

Note that once the boards are separated, direct UART and I^2C connections between the PSOC™ 4000S device and KitProg3 are lost. This is because the traces connecting the UART and I^2C lines are cut off during the separation. However, you can access KitProg3's UART and I^2C lines through header J6.

Follow a similar approach to snap the sensor boards from the PSOC™ 4000S board.

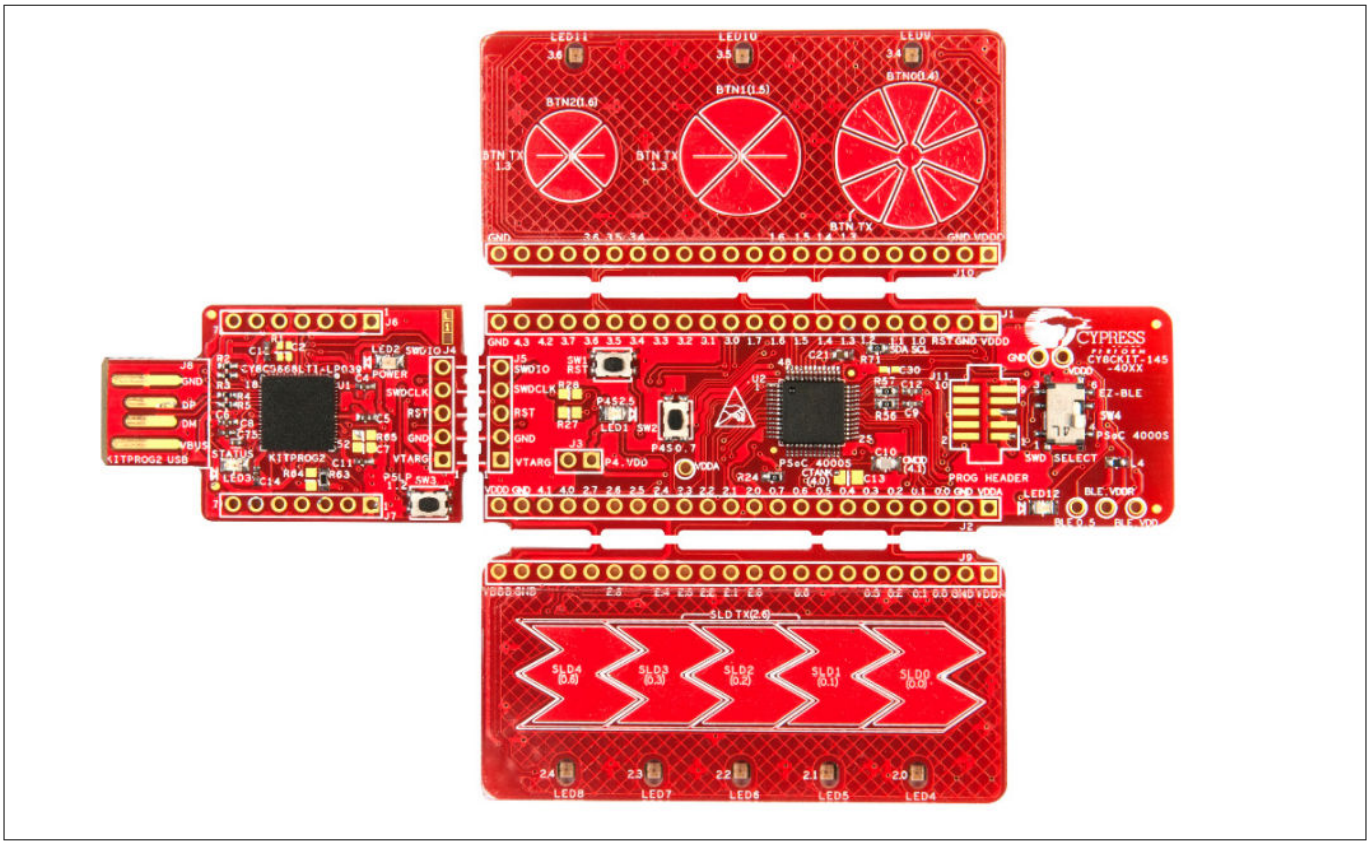

Figure 16 PSOC™ 4000S Prototyping board separated into four parts

3.2.1.4 Header connections

The PSOC™ 4000S Prototyping board supports a number of unpopulated headers on both the KitProg3 and the target PSOC™ 4 boards.

1. **Functionality of J1 and J2 headers (target board)**: The target board contains two single in-line headers (J1 and J2). Both are 1×22-pin headers and include all of the I/Os available on the PSOC™ 4000S device. These headers support all of the available ports, GND, VDD, and connections to passive elements and user-input devices
   - The J1 and J2 headers support 100-mil spacing, allowing you to solder connectors to connect the target board to any development breadboard
   - The CAPSENSE™ slider signals and the slider LED signals from header J1 are routed to header J10 on the sensor board
   - The CAPSENSE™ buttons signals and the button LED signals from header J2 are routed to header J9 on the sensor board

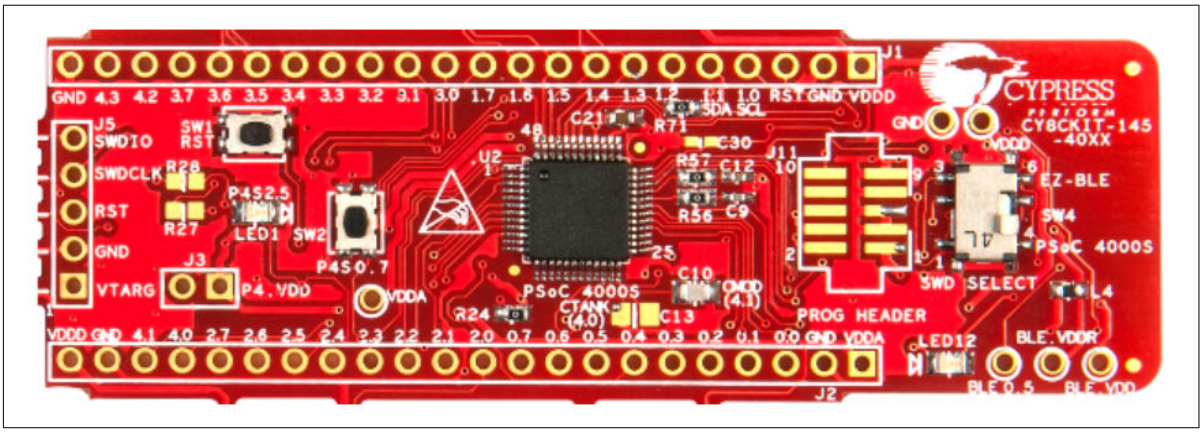

Figure 17 J1 and J2 headers

See Table 2 for the pin details of J1 and J2 headers.

2. **Functionality of J4 and J5 headers (PSOC™ 4000S to KitProg3)**: The KitProg3 and target boards each contain a 1 × 5-pin header. These headers provide a physical connection between the two devices. Specifically, the connection includes:
   - SWD interface, required to program/debug the target PSOC™ 4000S device/AIROC™ Bluetooth® LE module
   - Power
   - Ground
   - Reset

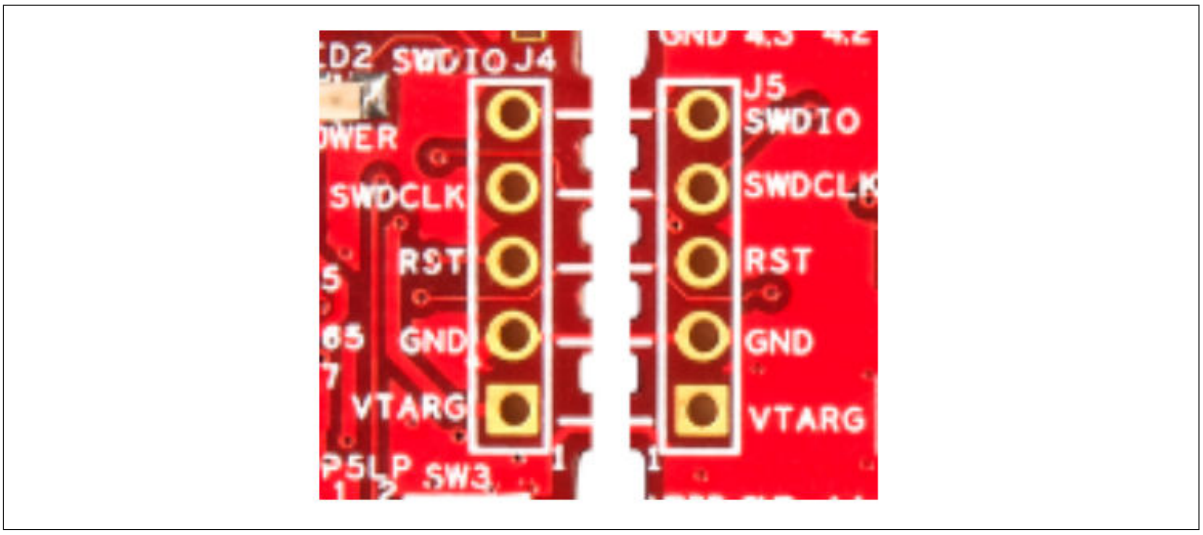

Figure 18 J4 and J5 headers

Table 3 Pin details of J4 header

Pin	Function	Connection details
J4_01	VTARG	Power
J4_02	GND	Ground
J4_03	KP_P12_4/RESET	KitProg3 GPIO/Target XRES
J4_04	KP_P12_3/SWDCLK	KitProg3 GPIO/Target SWD Clock
J4_05	KP_P12_2/SWDIO	KitProg3 GPIO/Target SWD Data

Table 4 Pin details of J5 header

Pin	Function	Connection details
J5_01	VTARG	Power
J5_02	GND	Ground
J5_03	XRES	Target device RESET
J5_04	SWDCLK	Target SWD Clock
J5_05	SWDIO	Target SWD Data

3. **Functionality of J6 and J7 headers (KitProg3)**: The KitProg3 board contains two single in-line headers (J6 and J7). Both are 1×7-pin headers, used to provide access to several pins of the PSOC™ 5LP device to support advanced features such as a low-speed oscilloscope and a low-speed digital logic analyzer. These headers also contain the KitProg3 bridge pins (UART and I^2C pins of KitProg3 (PSOC™ 5LP)) that can be used when the two boards are separated. The J6 and J7 headers support 100-mil spacing, allowing you to solder connectors to connect the KitProg3 board to any development breadboard.

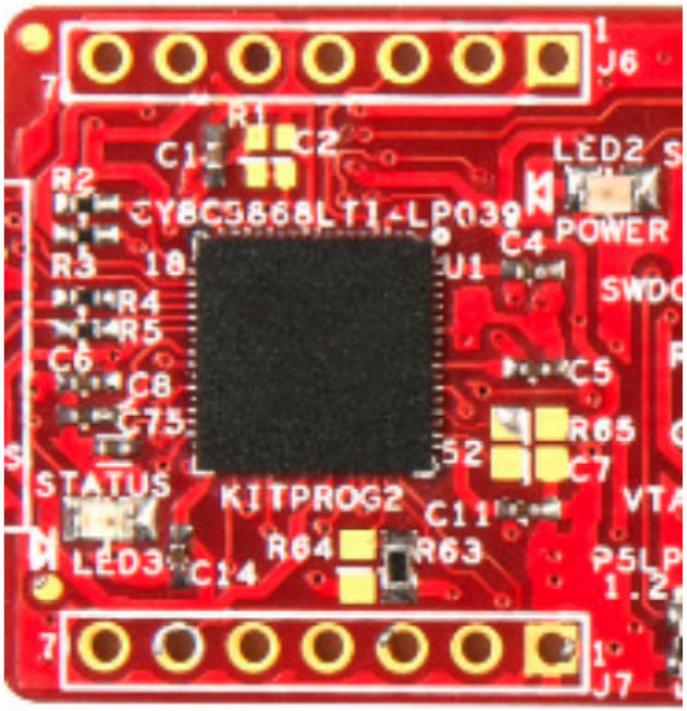

Figure 19 J6 and J7 headers

Table 5 Pin details of J6 header

Pin	Function	Connection details
J6_01	VBUS	Power
J6_02	GND	Ground
J6_03	KP_P12_5	GPIO
J6_04	KP_P12_0	I2C_SCL
J6_05	KP_P12_1	I2C_SDA

(table continues...)

Table 5 (continued) Pin details of J6 header

Pin	Function	Connection details
J6_06	KP_P12_7	UART_RX
J6_07	KP_P12_6	UART_TX

Table 6 Pin details of J7 header

Pin	Function	Connection details
J7_01	GND	Ground
J7_02	KP_P3_0	GPIO
J7_03	KP_P3_4	GPIO
J7_04	KP_P3_5	GPIO
J7_05	KP_P3_6	GPIO
J7_06	KP_P0_2	GPIO
J7_07	KP_P0_1	GPIO

3.2.1.5 10-pin program and debug header (J11)

This 10-pin header allows you to program and debug the PSOC™ 4000S and AIROC™ Bluetooth® LE module using an external programmer such as MiniProg4. Note that this header is not populated by default.

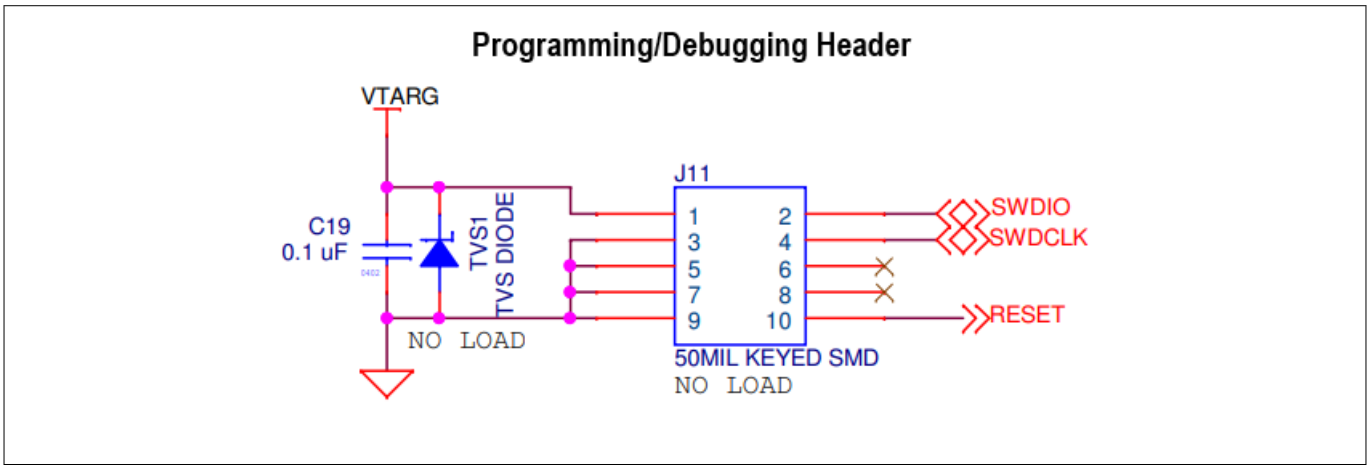

Figure 20 10-pin program and debug header

3.2.1.6 Reset button

The kit contains a push button (SW1) connected to the XRES pins on the target PSOC™ 4000S and AIROC™ Bluetooth® LE devices. When this button is pressed, the XRES lines of the PSOC™ 4000S and AIROC™ Bluetooth® LE are connected to the ground, thereby resetting the devices.

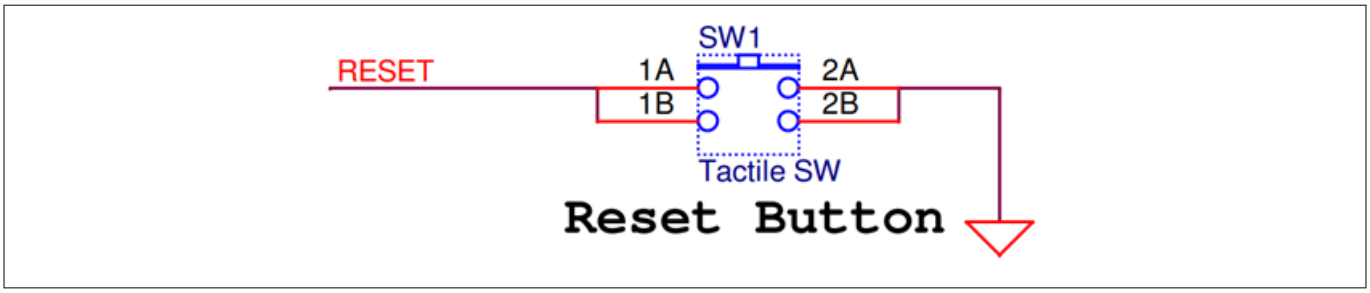

Figure 21 Reset button

3.2.2 PSOC™ 5LP-based KitProg3 programmer and debugger

PSOC™ 5LP on the KitProg3 board is used to program and debug the target PSOC™ 4000S device and the AIROC™ Bluetooth® LE module. The KitProg3 PSOC™ 5LP connects to the USB port of the computer through the PCB USB connector and to the SWD interface of the target PSOC™ 4000S device and the AIROC™ Bluetooth® LE module.

For more information, see the following:

- PSOC™ 5LP webpage
- CY8C58LPxx family datasheet

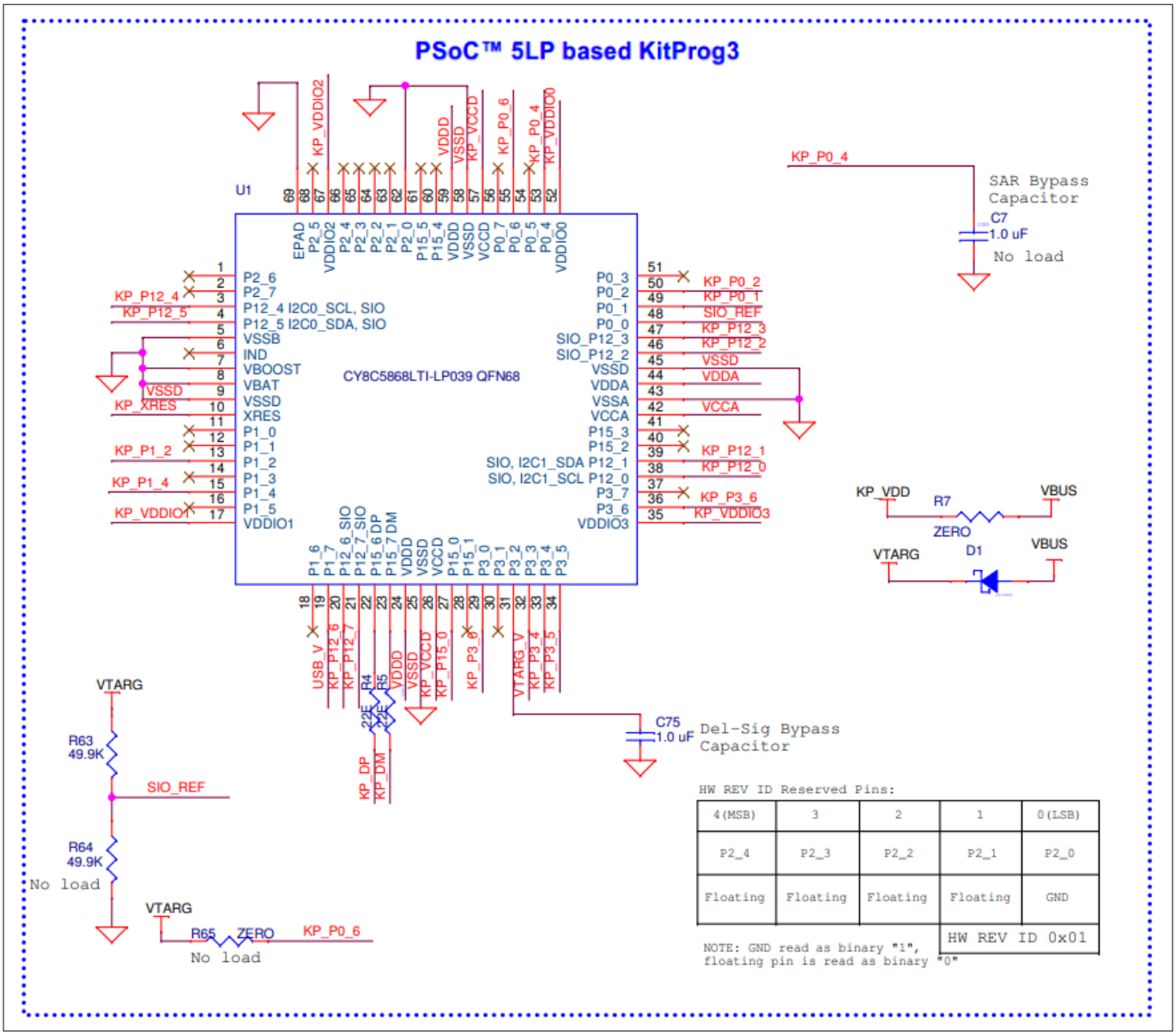

Figure 22 Schematic of PSOC™ 5LP-based KitProg3

3.2.2.1 KitProg3 onboard target voltage measurement

The PSOC™ 5LP on the KitProg3 board uses an ADC to measure the onboard target voltage. A voltage divider is placed before the ADC input to bring the target voltage within the dynamic range of the ADC.

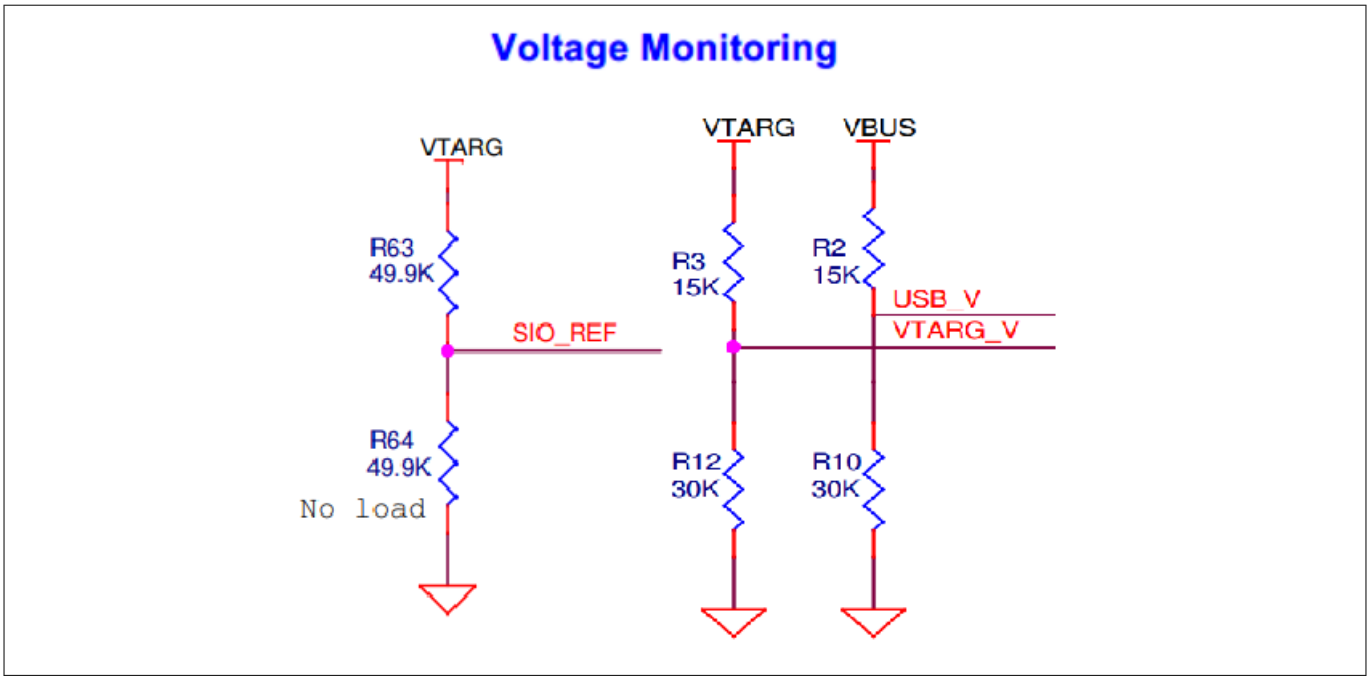

Figure 23 Schematic of KitProg3 onboard target voltage monitoring circuit

3.2.2.2 KitProg3 programming mode selection button and status LED

Use the SW3 button to switch between various modes of KitProg3 operation, such as from CMSIS-DAP HID mode to BULK mode, and to enable the bootloader mode. Note that KitProg3 on this board supports CMSIS-DAP BULK mode by default. This button function is also reserved for future use. The status LED (LED3) indicates the current mode of KitProg3.

For more details, see the KitProg3 user guide.

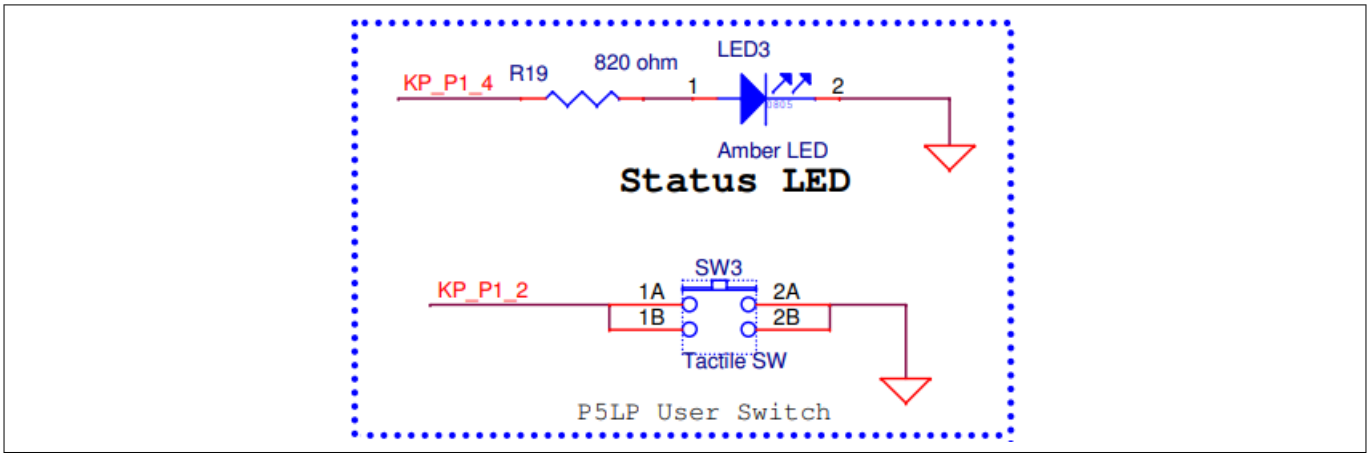

Figure 24 Schematic of KitProg3 mode selection button (SW3) and status LED (LED4)

3.2.2.3 USB-UART bridge

The KitProg3 on the PSOC™ 4000S Prototyping board can act as a USB-UART bridge. The UART lines between the KitProg3 and the target are hard-wired on the board through the snappable area, with UART_RX assigned to P3[1] and UART_TX assigned to P3[0] on the target PSOC™ 4000S.

For more details on the KitProg3 USB-UART functionality, see the KitProg3 user guide.

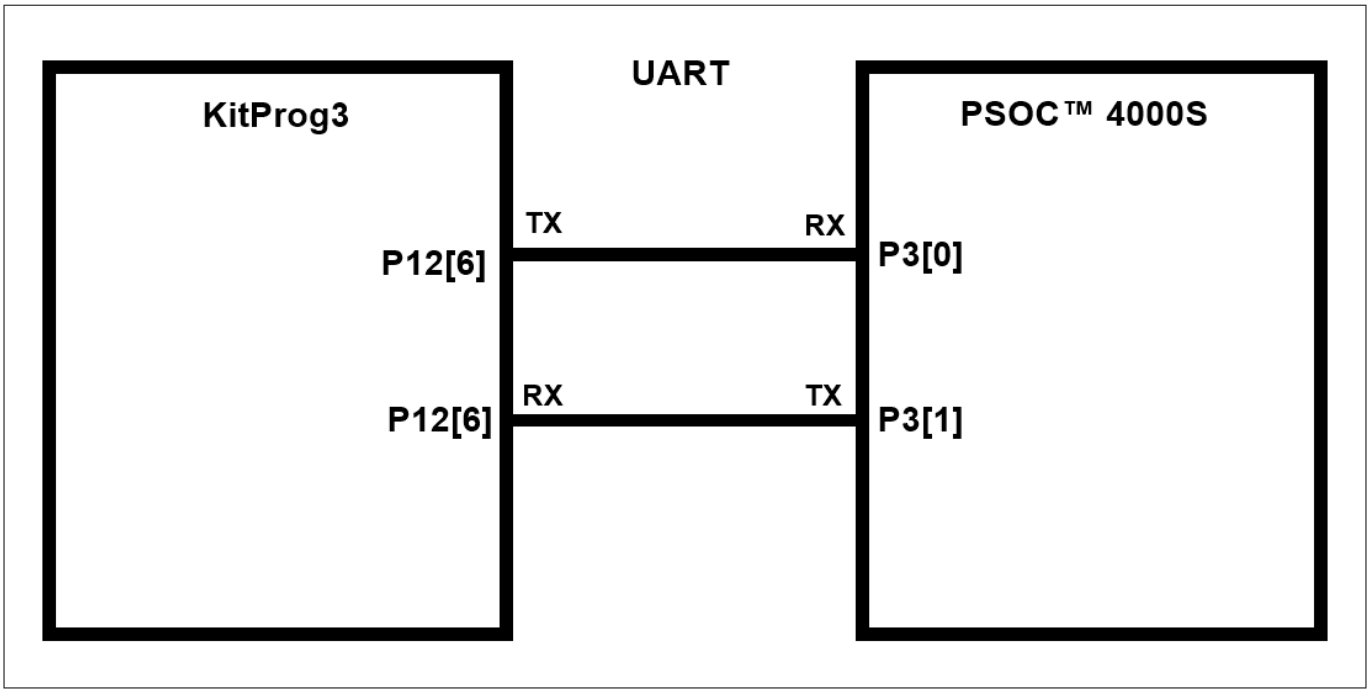

Figure 25 UART connection between KitProg3 and PSOC™ 4000S

3.2.2.4 USB-I²C bridge

The KitProg3 can function as a USB-I²C bridge and communicate with the Bridge Control Panel (BCP) software utility. The I²C lines between the KitProg3 and the target are hard-wired on the board through the snappable area, with SCL assigned to P1[0] and SDA assigned to P1[1] on the PSOC™ 4000S. The USB-I²C 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.

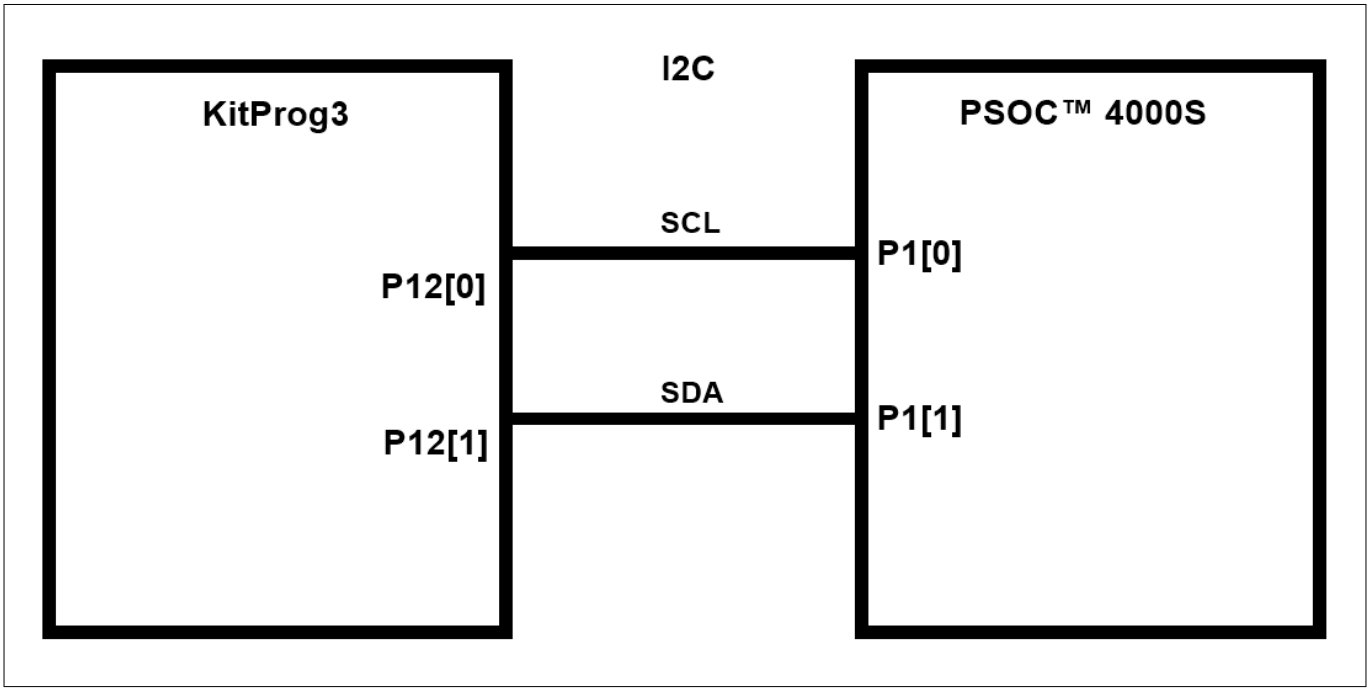

Figure 26 I²C connection between KitProg3 and PSOC™ 4000S

3.2.3 CAPSENSE™

3.2.3.1 Capacitive sensing

The PSOC™ 4000S Prototyping board consists of the following:

1. **CAPSENSE™ buttons and their corresponding LEDs**: The board includes three CAPSENSE™ buttons (BTN0, BTN1, and BTN2) and corresponding LEDs (LED9, LED10, and LED11) provided on a breakout board to demonstrate the CAPSENSE™ button functionality of the PSOC™ 4000S device. All the I/Os used for implementing the CAPSENSE™ buttons are exposed through headers J1 and J10

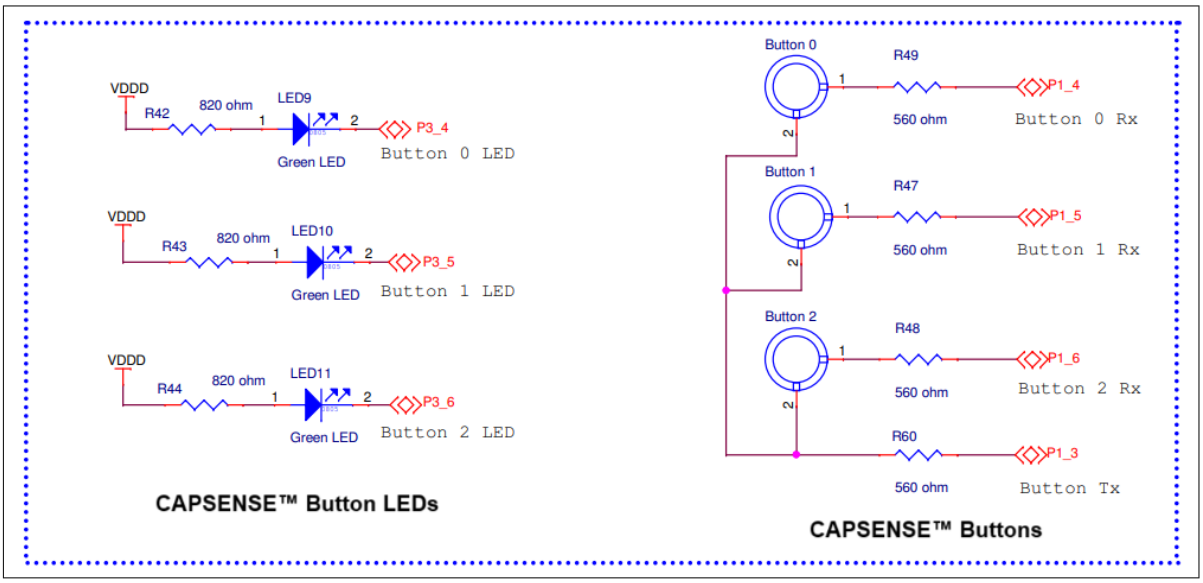

Figure 27 Schematic of CAPSENSE™ buttons and their corresponding LEDs

2. **CAPSENSE™ slider and their corresponding LEDs**: The board includes a 5-segment linear slider (SLD0, SLD1, SLD2, SLD3, and SLD4) and corresponding LEDs (LED4, LED5, LED6, LED7, and LED8) provided on a breakout board to demonstrate the CAPSENSE™ slider functionality of the PSOC™ 4000S device. All the I/Os used for implementing the CAPSENSE™ slider are exposed through headers J2 and J9

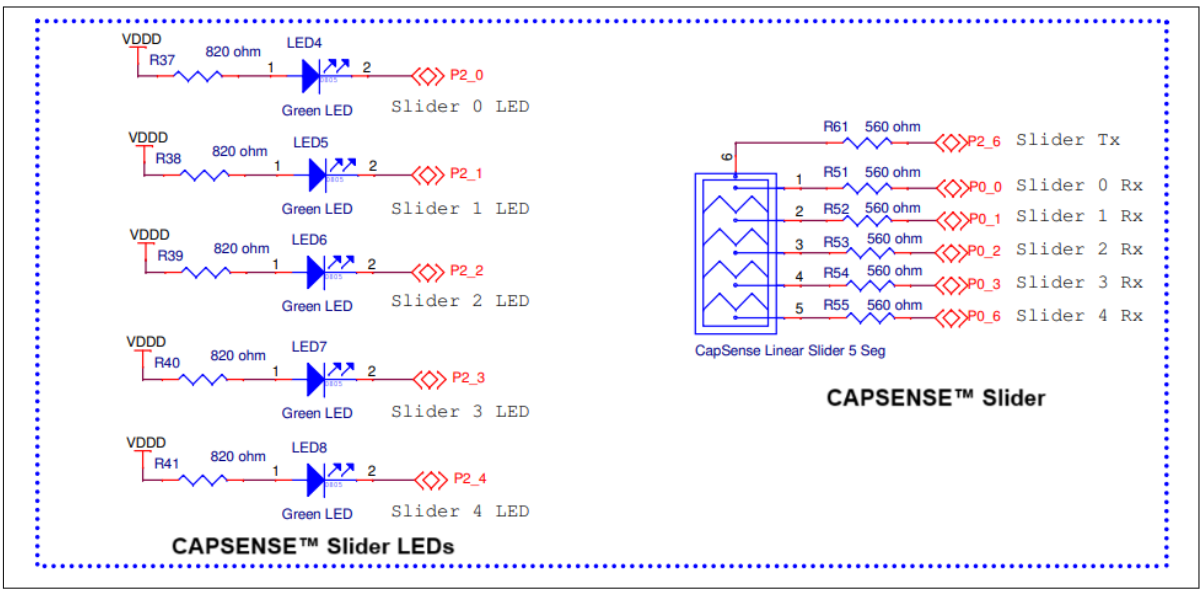

Figure 28 Schematic of CAPSENSE™ slider and their corresponding LEDs

3.2.4 System capacitors

The PSOC™ 4000S Prototyping board has eight capacitors in addition to power supply decoupling capacitors:

1. Four CAPSENSE™ capacitors (CMOD, CTANK, CintA, CintB): These are required for the CAPSENSE™ functionality of the PSOC™ 4000S device
2. SAR bypass capacitors: One for the PSOC™ 4000S (C3 - No Load by default) and one for the PSOC™ 5LP (C7)
3. Two biasing capacitors (C9 and C12): These are required to interface with an external 32-kHz crystal oscillator (WCO)

***Note**: The crystal oscillator is not placed on the board; it can be soldered onto pins P0[5] and P0[4] of the PSOC™ 4000S.*

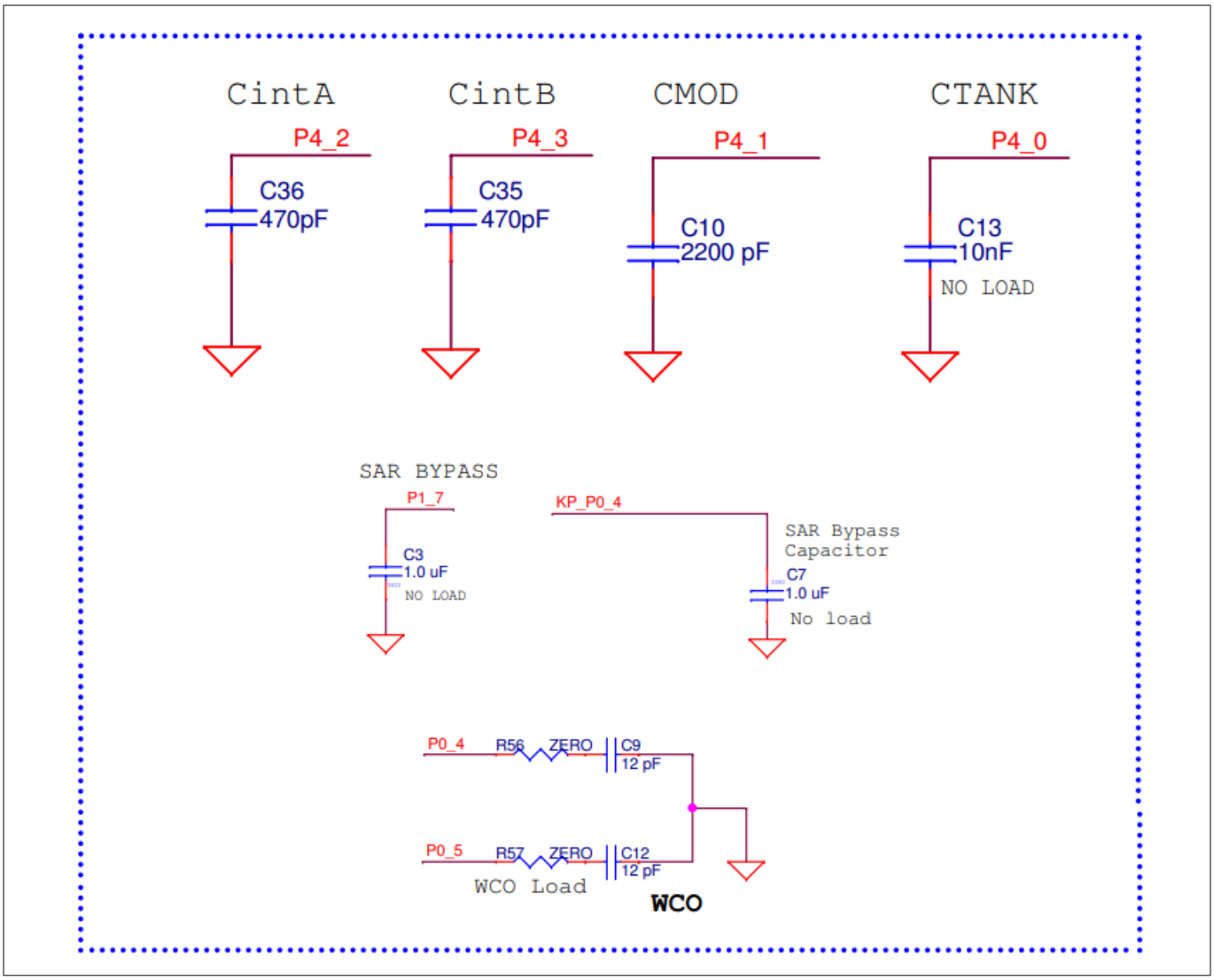

Figure 29 Circuit diagram of the system capacitor

3.2.5 User LEDs

The PSOC™ 4000S Prototyping board has a blue user LED (LED1) connected to P2[5] of the PSOC™ 4000S device.

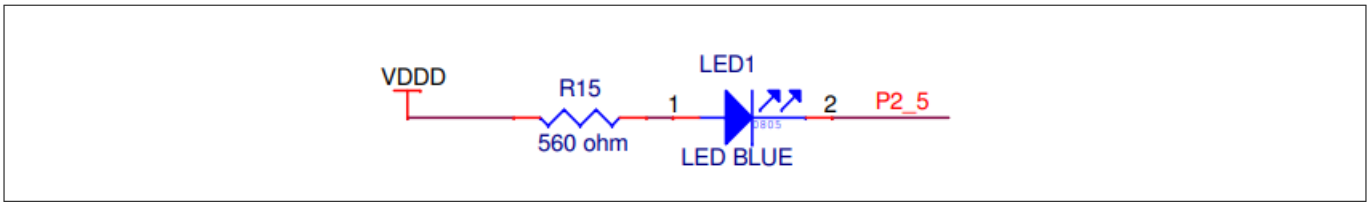

Figure 30 Schematic of the user LED

3.2.6 User button

The target PSOC™ 4000S Prototyping Board contains a single push button (SW2) connected to the P0[7] pin on the PSOC™ 4000S device. It is also connected to the P4[1] pin on the AIROC™ Bluetooth® LE module. This button can be used for general user inputs or to control different states in an application, including waking up the device from Sleep or Deep Sleep.

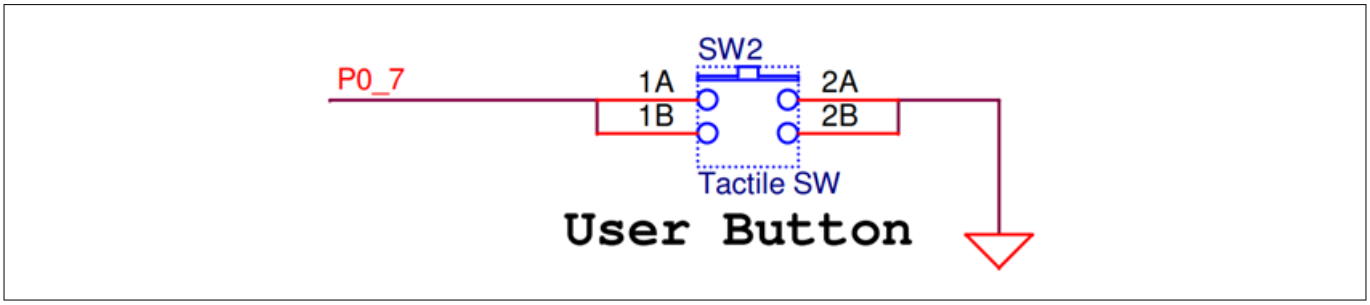

Figure 31 Schematic of the user button

3.2.7 AIROC™ Bluetooth® LE module

The board includes an AIROC™ Bluetooth® LE module, which is preloaded by default. The AIROC™ Bluetooth® LE Module is a fully integrated, 10 × 10 × 1.8 mm, fully certified, programmable module designed for ease of use and reduced time-to-market. It contains an Infineon AIROC™ Bluetooth® LE chip, two crystals, a chip antenna, a shield, and passive components.

For more details, see AN96841 - Getting Started With EZ-BLE PRoC module and AIROC™ Bluetooth® LE.

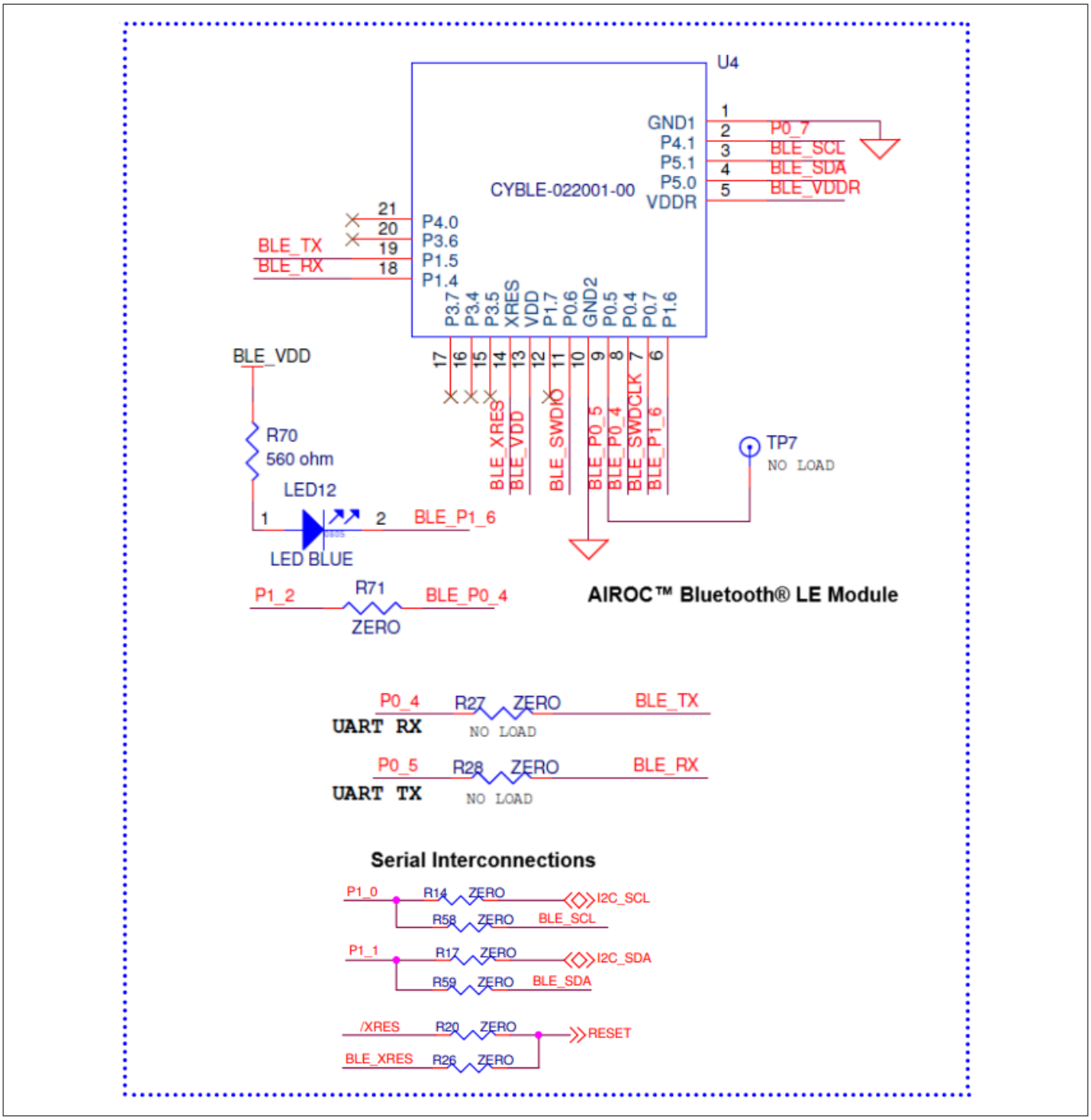

Figure 32 AIROC™ Bluetooth® LE connections

The AIROC™ Bluetooth® LE module includes the following connections to PSOC™ 4000S and KitProg3:

1. UART connections: Connected to PSOC™ 4000S through zero-ohm resistors R28 and R27 (see Figure 32 and Table 7). Note that R28 and R27 are not loaded by default
2. I^2C connections: Connected to KitProg3 and PSOC™ 4000S (see Table 7)
3. SWD connections: Connected to KitProg3 through the DPDT switch SW4. The SWD connections are shared between the PSOC™ 4000S and AIROC™ Bluetooth® LE devices

Table 7 AIROC™ Bluetooth® LE connections

AIROC™ Bluetooth® LE	PSOC™ 4000S	KitProg3	Description
BLE_TX, P1_5	P0_4	-	UART_RX
BLE_RX, P1_4	P0_5	-	UART_TX
BLE_SDA, P5_0	P1_1	P12_1	I2C_SDA
BLE_SCL, P5_1	P1_0	P12_0	I2C_SCL
BLE_SWDIO, P0_6	-	P12_2	SWDIO
BLE_SWDCLK, P0_7	-	P12_3	SWDCLK
P0_4	P1_2	-	GPIO
BLE_XRES	/XRES	P12_4	RESET
BLE_P1_6, P1_6	-	-	BLE LED
P4_1	P0_7	-	User button

Use the DPDT switch (SW4) to switch the SWD connections between the PSOC™ 4000S and the AIROC™ Bluetooth® LE module, as shown in Figure 33 for DPDT switch SW4 selection between PSOC™ 4000S and AIROC™ Bluetooth® LE module.

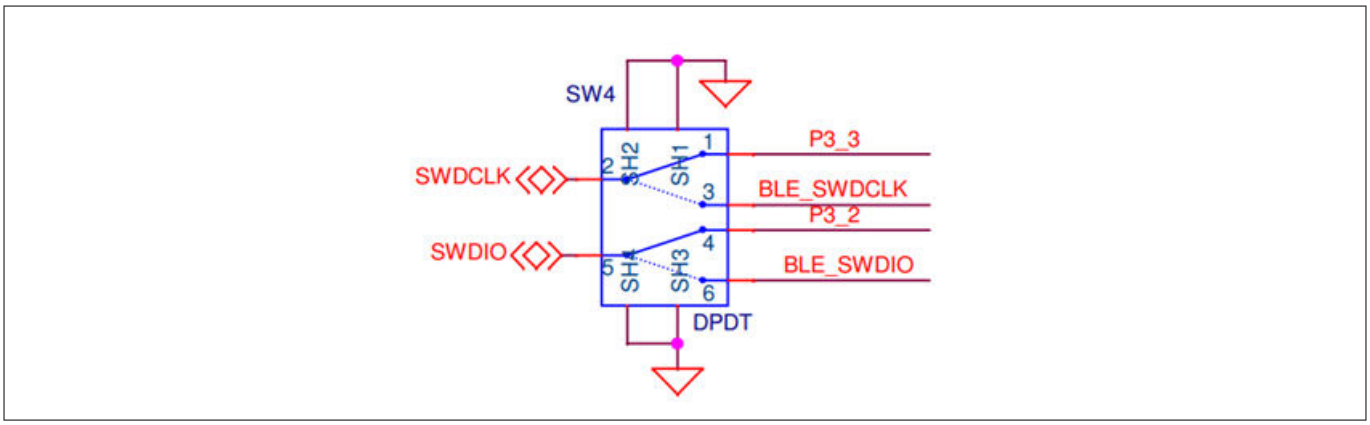

Figure 33 DPDT switch SW4 to select between PSOC™ 4000S and AIROC™ Bluetooth® LE module

3.3 Bill of materials

Refer to the bill of materials (BOM) files available on the kit webpage.

Glossary

BOM
Bill of materials

BSP
Board Support Package

Cint
Integration capacitor

CLI
Command-line interface

CMOD
Modulator capacitor

CMSIS-DAP
Cortex® Microcontroller System Interface Standard – Debug Access Port

CPU
Central processing unit

CSD
Self-capacitance

CSX
Mutual-capacitance

CTANK
Shield tank capacitor

EMC
Electromagnetic compatibility

ESD
Electrostatic discharge

GND
Ground

GPIO
General-purpose input/output

HMI
Human-machine interface

I2C
Inter-integrated circuit

IDE
Integrated development environment

Glossary

LED
Light-emitting diode

MCU
Microcontroller unit

OOB
Out-of-the-box

PC
Personal computer

PCB
Printed circuit board

PSOC™
Programmable system-on-chip

SCL
Serial clock (I2C)

SDA
Serial data (I2C)

SWD
Serial Wire Debug

UART
Universal Asynchronous Receiver-Transmitter

USB
Universal Serial Bus XRES external reset

Revision history

Document version	Date of release	Description of changes
**	2016-01-09	• New Kit guide
*A	2017-04-26	• Updated logo and copyright
*B	2017-12-14	Replaced “example projects” with “code examples” in all instances across the document. • Updated Introduction chapter • Updated “PSoC™ Creator” • Updated “PSoC™ Creator Code Examples” • Updated Figure 1-5 Code Examples in PSoC™ Creator • Updated “Additional Learning Resources” • Updated description • Updated “Technical Support” • Replaced “Ext. 2” with “Ext. 3” • Updated Software Installation chapter • Updated “Install Software” • Updated description • Updated Figure 2-2 Product Installation Overview • Updated Kit Operation chapter • Updated “KitProg2” • Updated “Programming Using PSoC™ Programmer” • Updated description • Updated Code Examples chapter • Updated description • Updated “Using the Kit Code Examples” • Updated description • Updated Figure 4-1 Open Code Example from PSoC™ Creator • Updated “CE210709 CapSense Linear Slider and Buttons” • Updated description • Completing Sunset Review
*C	2018-02-22	• Updated Figure 4-1 Open Code Example from PSoC™ Creator and Figure 4-3 Connect Device from PSoC™ Creator and Program

Revision history

Document version	Date of release	Description of changes
*D	2024-12-23	• Migrated to IFX template • Renamed PSoC™ to PSOC™ • Renamed EZ-BLE to AIROC™ Bluetooth® LE • Removed PSoC™ Creator sections • Removed KitProg2 sections • Updated Introduction • Updated Kit contents • Updated Getting started • Updated Board details • Updated Additional Learning Resources • Updated Technical support • Updated Theory of operation • Added Using the OOB example - CE237532 • Added Creating a project and program/debug using ModusToolbox™ software • Updated Schematics • Updated Functional description • Added PSOC™ 4000S MCU features • Added PSOC™ 4000S device power supply system • Added Measure PSOC™ 4000S current consumption • Updated Board separation (Snapping) • Updated Header connections • Updated 10-pin program and debug header (J11) • Added Reset button • Added PSOC™ 5LP-based KitProg3 programmer and debugger • Added KitProg3 onboard target voltage measurement • Added KitProg3 programming mode selection button and status LED • Added Capacitive sensing • Updated System capacitors • Added User LEDs • Added User button • Added AIROC™ Bluetooth® LE module

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