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CYALKIT-E04

S6AE102A and S6AE103A Evaluation Kit Guide

Document Number: 002-12768 Rev. *F

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Contents

1. Safety Information

1.1 Regulatory Compliance

CYALKIT-E04 S6AE102A and S6AE103A EVK is is intended for use as a development platform for hardware or software in a laboratory environment. The board has an open system design, which does not include a shielded enclosure. This may cause interference with other electrical or electronic devices in close proximity. In a domestic environment, this product may cause radio interference. In this case, the user may be required to take adequate preventive measures. Also, the board should not be used near any medical equipment or RF devices.

Attaching additional wiring to this product or modifying the product operation from the factory default 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.

CYALKIT-E04 S6AE102A and S6AE103A EVK 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 to devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Store unused CYALKIT-E04 boards in the protective shipping package.

End of Life/Product Recycling

The end of life of this kit is five years after the date of manufacture mentioned on the back of the box. Contact your nearest recycler to discard the kit.

1.2 General Safety Instructions

1.2.1 ESD Protection

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

1.2.2 Handling Boards

CYALKIT-E04 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 the board over any surface.

2. Introduction

Thank you for your interest in the CYALKIT-E04 S6AE102A and S6AE103A EVK. It provides an easy-to-use platform to develop battery-free applications with an energy-harvesting device. This kit consists of an S6AE102A board, an S6AE103A board, and a sensor board along with a solar module, wires, and a battery for testing different configurations. Table 2-1 shows the features of S6AE102A and S6AE103A. This kit can be used stand-alone or it can be used in conjunction with the CY8CKIT-042-BLE Bluetooth Low Energy Pioneer kit to demonstrate and develop applications that power a BLE device using harvested energy.

This kit guide explains how to set up and use the Evaluation Kit (EVK). Be sure to read it before using the product. Consult with sales or support representatives for more information.

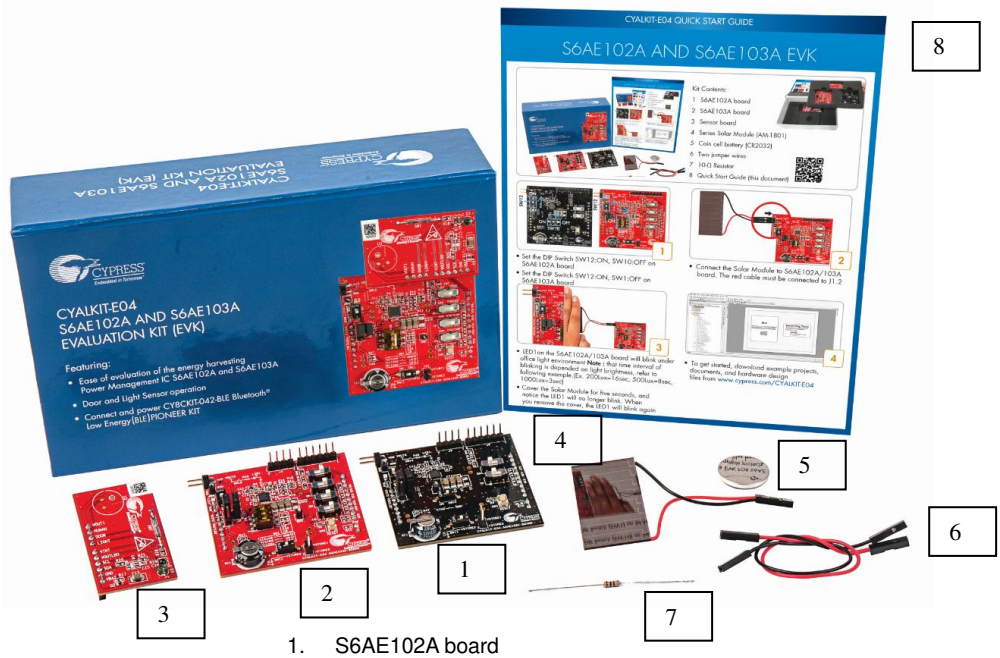
Note: All information included in this document is current as of the date it was issued. Such information is subject to change without any prior notice. Please confirm the latest relevant information with the sales representatives.

Table 2-1. Features of S6AE102A and S6AE103A

Feature	S6AE102A	S6AE103A
LDO	Yes	Yes
CR Timer	-	Yes
Comparator	-	Yes
Package	20-pin QFN (4 x 4 mm)	24-pin QFN (4 x 4 mm)

2.1 Kit Introduction

Figure 2-1. Kit Contents



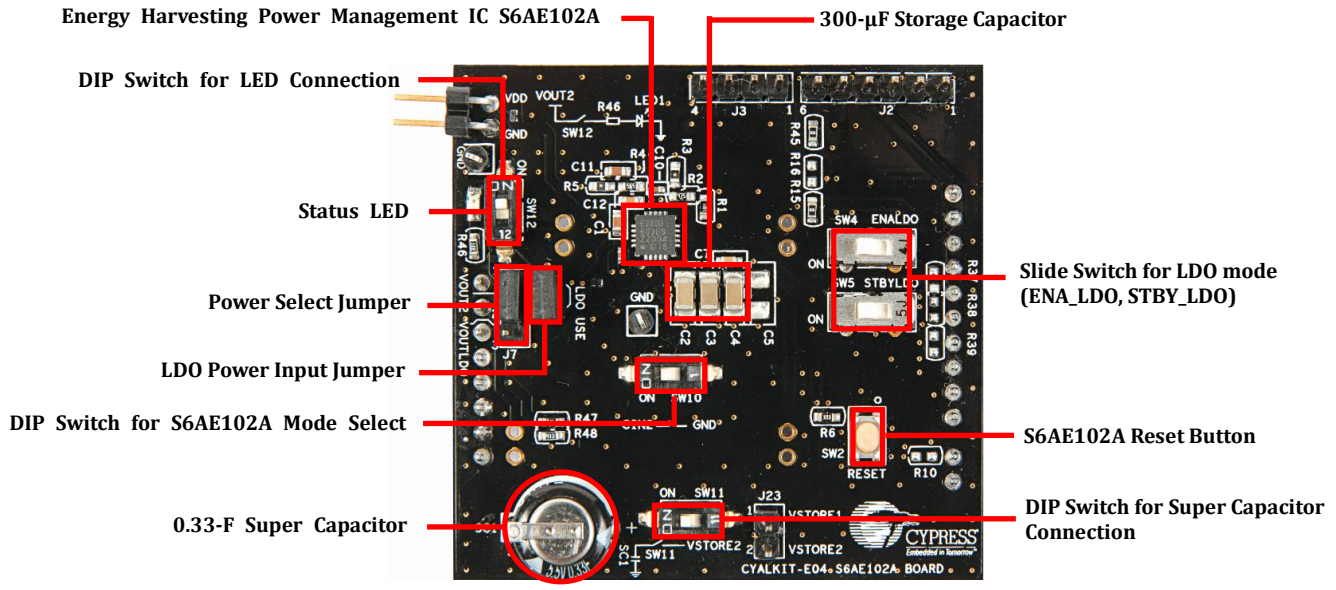
1. S6AE102A board
2. S6AE103A board
3. Sensor board (door, light)
4. Series Solar Module (Panasonic AM-1801)
5. Coin cell battery (CR2032)
6. Two jumper wires
7. 10-Ω Resistor
8. Quick Start Guide

2.2 Board Details

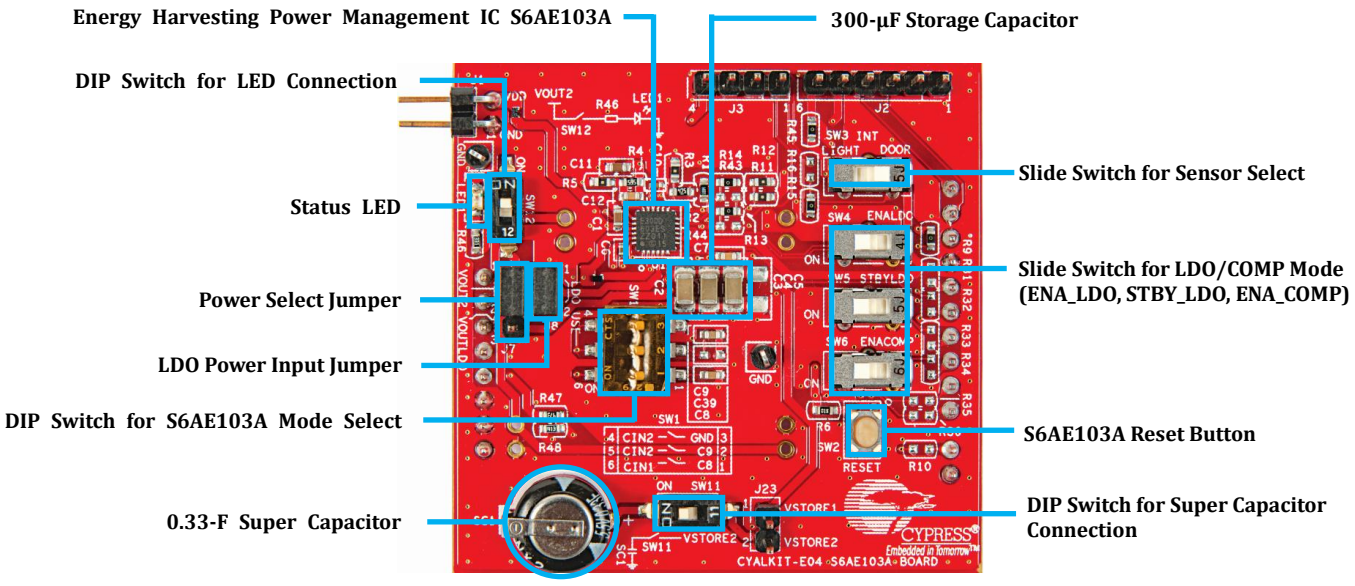
CYALKIT-E04 S6AE102A and S6AE103A EVK consists of the blocks shown below.

Figure 2-2. Board Details

S6AE102A Board Details



S6AE103A Board Details



The following figure shows a markup of the onboard connectors and switches of the S6AE102A board (in black) and the S6AE103A board (in red).

Figure 2-3. Onboard Connectors and Switches

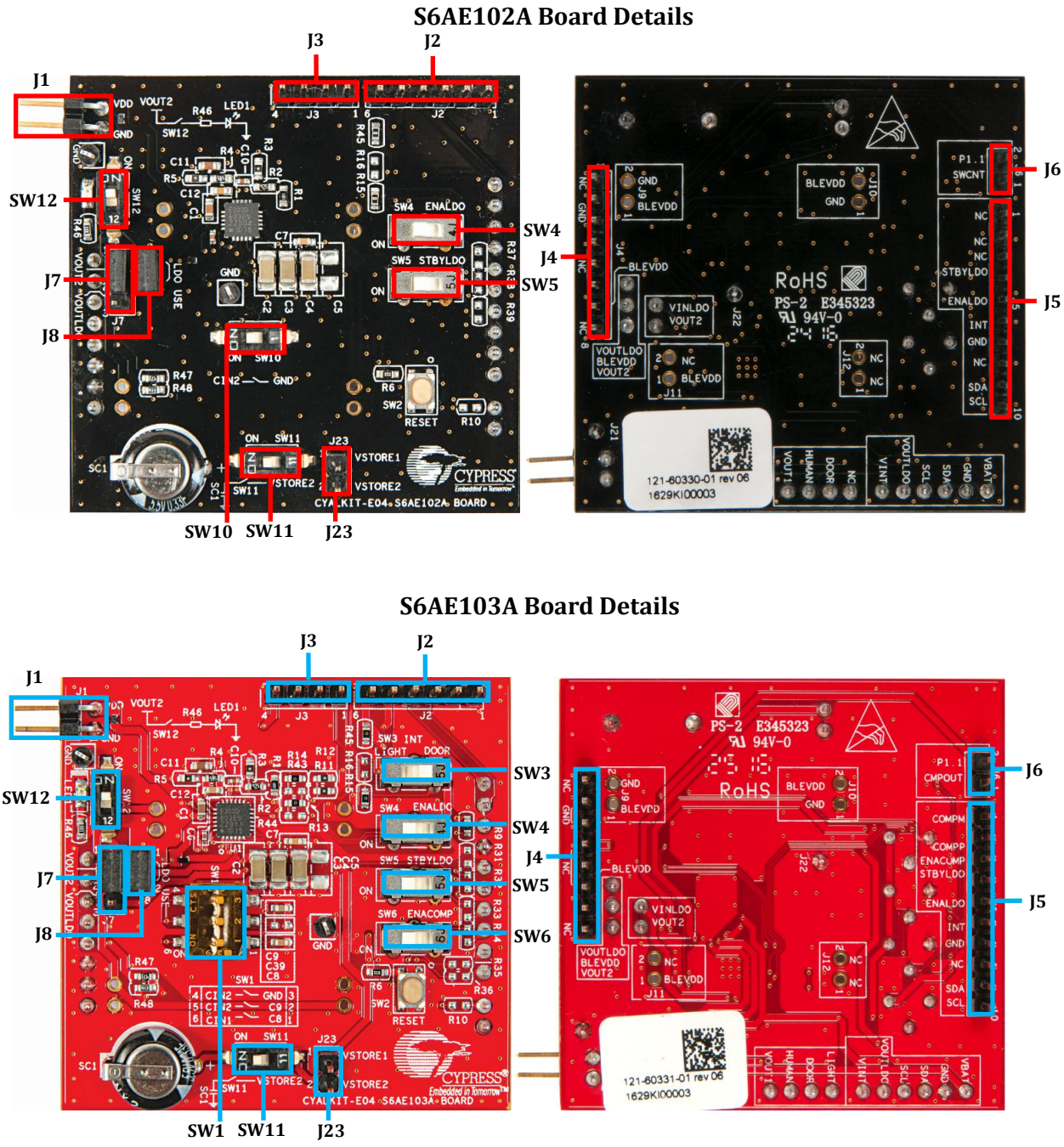


Table 2-2. S6AE102A and S6AE103A Board Pinout

Header	Pin#	S6AE102A board	S6AE103A board
J1	1	GND	GND
J1	2	VDD	VDD
J2	1	VBAT	VBAT
J2	2	GND	GND
J2	3	SDA	SDA
J2	4	SCL	SCL
J2	5	VOUT_LDO	VOUT_LDO
J2	6	VINT	VINT
J3	1	NC	LIGHT
J3	2	DOOR	DOOR
J3	3	PIR	PIR
J3	4	VOUT1	VOUT1
J4	1	NC	NC
J4	2	GND	GND
J4	3	GND	GND
J4	4	V5.0	V5.0
J4	5	NC	NC
J4	6	NC	NC
J4	7	BLE_VDD *	BLE_VDD *
J4	8	NC	NC
J5	1	NC	COMPM
J5	2	NC	COMPP
J5	3	NC	ENA_COMP
J5	4	STBY_LDO	STBY_LDO
J5	5	ENA_LDO	ENA_LDO
J5	6	INT	INT
J5	7	GND	GND
J5	8	NC	NC
J5	9	SDA	SDA
J5	10	SCL	SCL
J6	1	SW_CNT	COMPOUT
J6	2	P1.1	P1.1
J23	1	VSTORE1	VSTORE1
J23	2	VSTORE2	VSTORE2

* The BLE_VDD terminal is mainly intended to supply power to Cypress Pioneer series kits when CYALKIT-E04 is connected via Arduino-compatible headers. Jumper J7 sets the connection to BLE_VDD from VOUT2 or VOUT_LDO. See Using CYALKIT-E04 with the CY8CKIT-042-BLE Bluetooth Low Energy Kit for an example of using CYALKIT-E04 with a CY8CKIT-042-BLE Pioneer kit.

Table 2-3. Switch/Jumper Default Position of S6AE102A Board

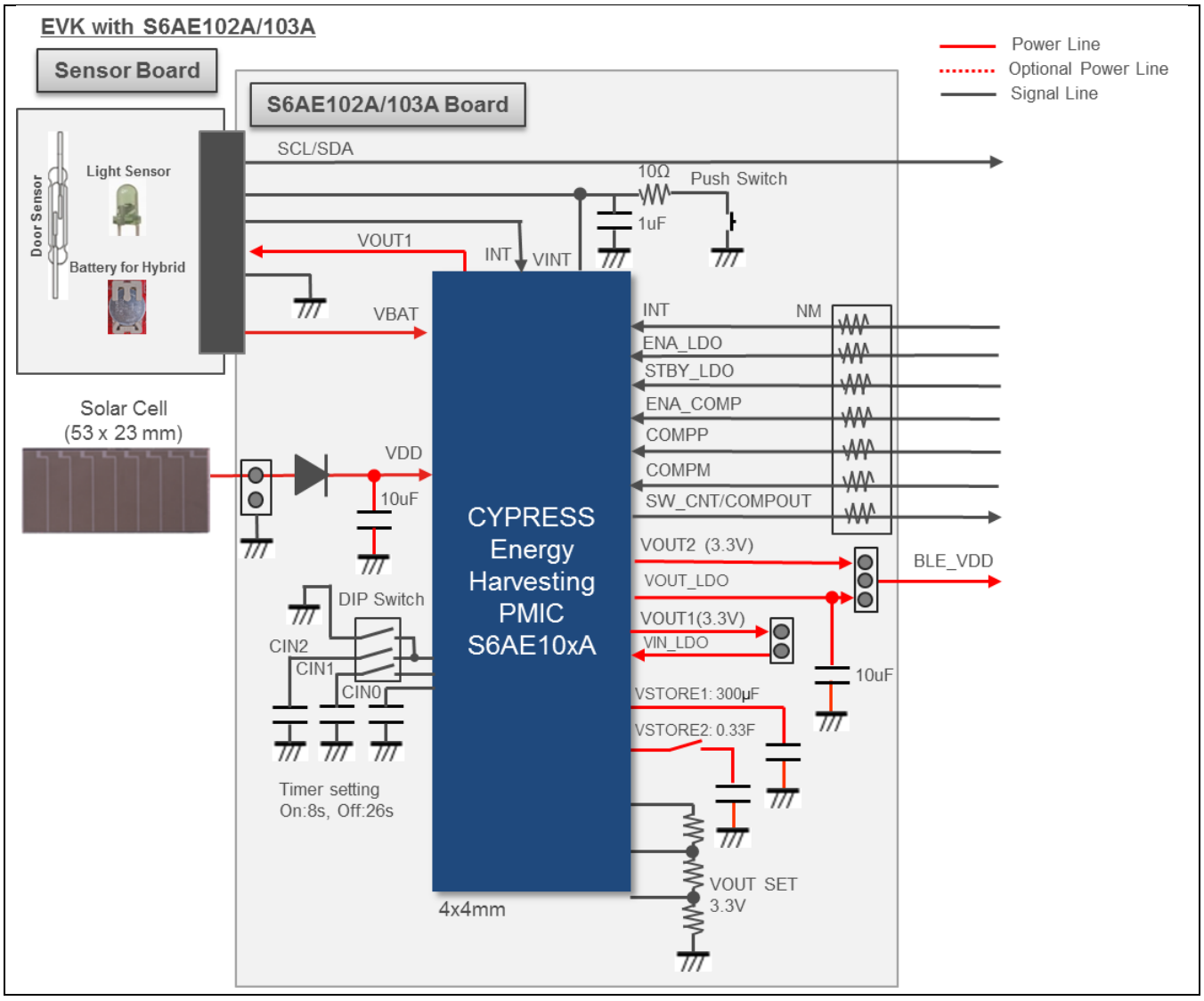
Switch/Jumper	Purpose	Default Position
SW10	Operation mode	OFF: Energy driven mode
SW4	ENA_LDO	ON: LDO enabled
SW5	STBY_LDO	ON: LDO normal mode
SW11	Switch for super capacitor connection	ON: super capacitor connected
SW12	Switch for LED connection	ON: LED connected
J7	Power select jumper	Short 1-2: VOUT2-BLE_VDD connected
J8	LDO Power input jumper	Short 1-2: VIN_LDO-VOUT1 connected

Table 2-4. Switch/Jumper Default Position of S6AE103A Board

Switch/Jumper	Purpose	Default Position
SW1	Operation mode	1: OFF; 2: OFF; 3: OFF: Energy driven mode
SW3	INT	DOOR: INT is connected door sensor output
SW4	ENA_LDO	ON: LDO enabled
SW5	STBY_LDO	ON: LDO normal mode
SW6	ENA_COMP	ON: Comparator connected
SW11	Switch for super capacitor connection	ON: super capacitor connected
SW12	Switch for LED connection	ON: LED connected
J7	Power select jumper	Short 1-2: VOUT2-BLE_VDD connected
J8	LDO Power input jumper	Short 1-2: VIN_LDO-VOUT1 connected

2.3 Block Diagram

Figure 2-4. Block Diagram of S6AE102A and S6AE103A EVK



2.4 Features

CYALKIT-E04 S6AE102A and S6AE103A EVK makes it easy to evaluate the ultra-low-power, energy harvesting S6AE102A and S6AE103A PMICs. This evaluation kit consists of three independent boards: the S6AE102A board, S6AE103A board, and sensor board. This kit is capable of supporting the life extension of a primary battery or becoming a battery-less solution, and can be used for evaluation of diverse power management functions used for wireless sensor networks. Magnetic door sensor operation and ambient light sensor operation can be evaluated by connecting the sensor board to the S6AE102A/S6AE103A board.

- The S6AE102A/103A boards support the following:
  - Selecting the mode (Energy-driven mode / Event-driven mode 1 / Event-driven mode 2, Timer-driven mode) using a switch
  - Charging the surplus solar energy to a 0.33-F super capacitor
  - Reset button for S6AE102A/S6AE103A
  - LEDs for status
  - Test pin header for ground
- The sensor board supports the following:
  - Expansion board for sensor/battery input
  - Magnetic door sensor (reed switch)
  - Ambient light sensor
- Reference schematic, BOM list, and layout for easy design.
- Sample firmware for CY8CKIT-042-BLE to work with EVK

The kit uses the S6AE102A/S6AE103A ultra-low-power Energy Harvesting Power Management IC (PMIC) and is Arduino pin header-compatible.

3. Software Installation

This section describes how to install the software.

3.1 Install Software

Follow these steps to install the CYALKIT-E04 S6AE102A and S6AE103A EVK software:

1. Download the CYALKIT-E04 S6AE102A and S6AE103A EVK software from www.cypress.com/CYALKIT-E04.

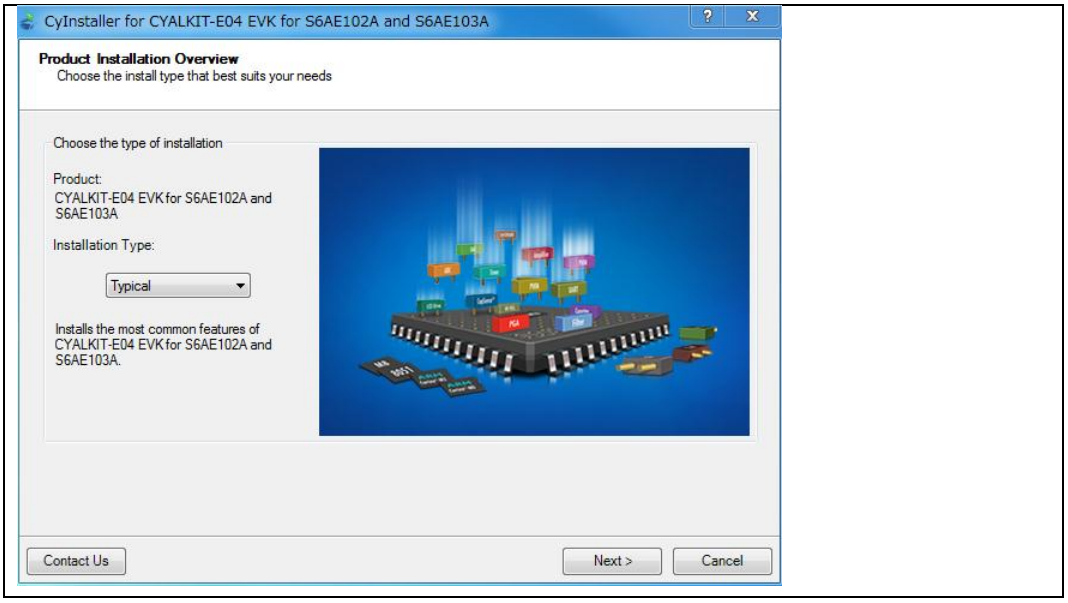
   It is available in three formats for download:

   - **CYALKIT-E04 Complete Setup:** This installation package contains the files related to the kit. However, it does not include the Windows Installer or Microsoft .NET framework packages. If these packages are not already installed on your computer, the installer directs you to download and install them from the Internet.
   - **CYALKIT-E04 Only Package:** This executable file installs only the kit contents, which include code examples, hardware files, and user documents. This package can be used if all the software prerequisites are installed on your computer.
   - **CYALKIT-E04 CD ISO:** This file is a complete package, stored in a CD-ROM image format that can be used to create a CD, or extract using ISO extraction programs such as WinZip or WinRAR. This file includes all the required software, utilities, drivers, hardware files, and user documents.

2. Run **Install S6AE102A and S6AE103A EVK** to start the installation.
3. Select the folder to install the files related to CYALKIT-E04 S6AE102A and S6AE103A EVK. Choose the directory and click **Next.**

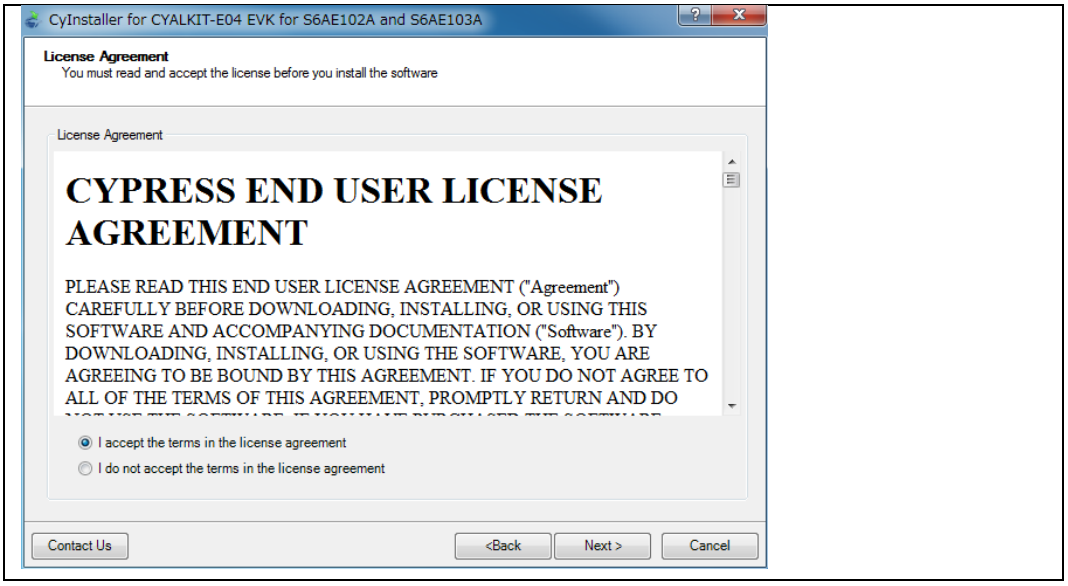
   The CYALKIT-E04 CD ISO installer automatically installs the required software if it is not present on your computer. The CYALKIT-E04 Complete Setup installer directs you to download the required software from the Internet.
4. Choose the **Typical**/**Custom**/**Complete** installation type in the **Product Installation Overview** window. Click **Next** after you select the installation type.

Figure 3-1. Select Installation Type



5. Read the **Cypress End User License Agreement** and make a selection based on the terms of the license agreement. Click **Next** to continue the installation.

Figure 3-2. Accept End User License Agreement



6. When the installation begins, a list of packages appears on the installation page. A green check mark appears next to each package after successful installation.
7. Click **Finish** to complete the installation.
8. Enter your contact information or select the **Continue Without Contact Information** check box. Click **Finish** to complete the installation.
9. After the installation is complete, the kit contents are available at the following location:

<Install directory>\S6AE102A and S6AE103A Kit

Default location (Example: Windows 7):

64-bit: *C:\Program Files (x86)\Cypress\ CYALKIT-E04 S6AE102A and S6AE103A Kit*

32-bit: *C:\Program Files\Cypress\ CYALKIT-E04 S6AE102A and S6AE103A Kit*

3.2 Uninstall Software

You can uninstall the CYALKIT-E04 S6AE102A and S6AE103A EVK software using one of the following methods:

Example: Windows 7

- Go to **Start** > **All Programs** > **Cypress** > **Cypress Update Manager**; click the **Uninstall** button.
- Go to **Start** > **Control Panel** > **Programs and Features**. Select the **S6AE102A and S6AE103A EVK** program from the list and click the **Uninstall**/**Change** button.

3.3 PSoC Creator

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

- Drag and drop PSoC Components to build a schematic of your custom design
- Automatically place and route Components and configure GPIOs
- Develop and debug firmware using the included Component APIs

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

To develop firmware for the BLE pioneer kit which can be used in conjunction with this kit in order to demonstrate powering wireless BLE solutions from an energy harvesting device, PSoC Creator 3.3 CP3 or newer is required. Download the latest version from www.cypress.com/psoccreator.

4. Getting Started

You can become familiar with the CYALKIT-E04 by checking each sensor operation. This activity will also confirm that the S6AE102A board, S6AE103A board, and sensor board are operating properly.

In this section, you will confirm the basic operation of the Energy Harvesting PMIC and the sensor by using the provided kit to detect light and door open/close conditions.

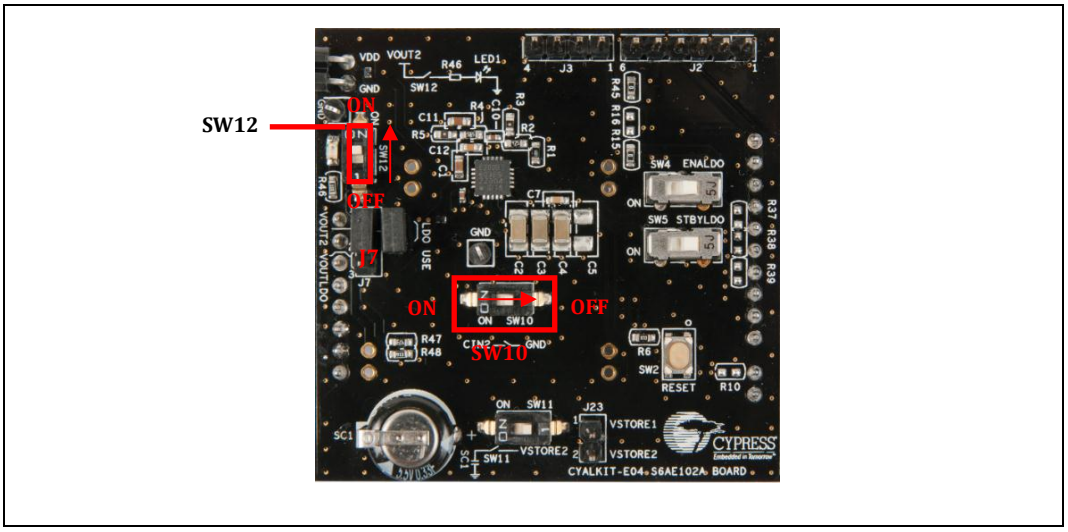
The door sensor operation uses Event-Driven mode 1 of S6AE102A/103A. Refer to the datasheet for details on the mode's function.

4.1 Solar and Battery Power Options

4.1.1 Operation with the Solar Module

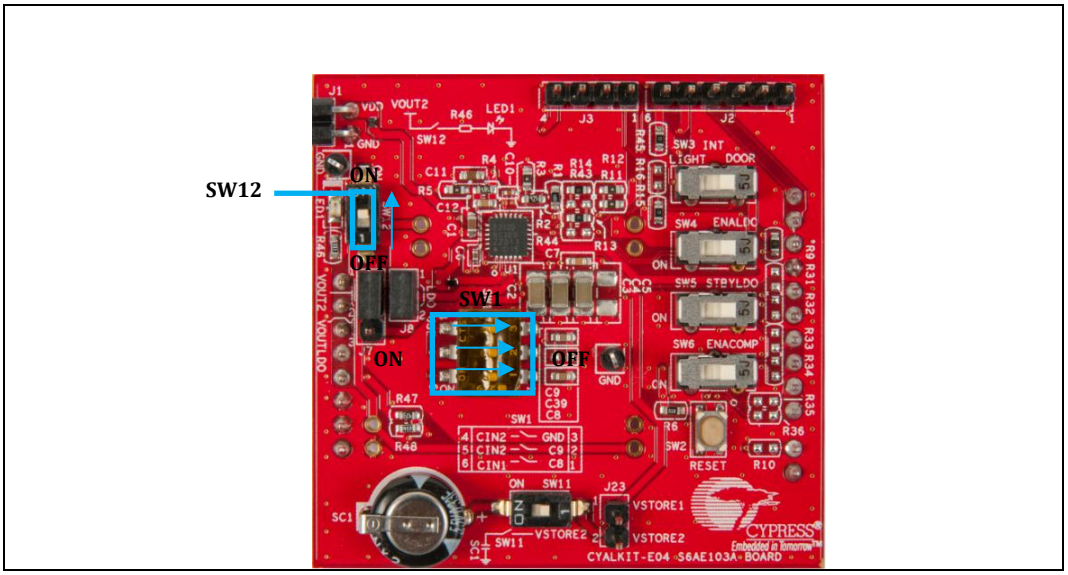
1. Set switch SW12 to ON to enable the LED.
2. For the S6AE102A board: set switch SW10 to OFF for Energy-driven mode.

Figure 4-1. S6AE102A Board Settings for Operation with Solar Module



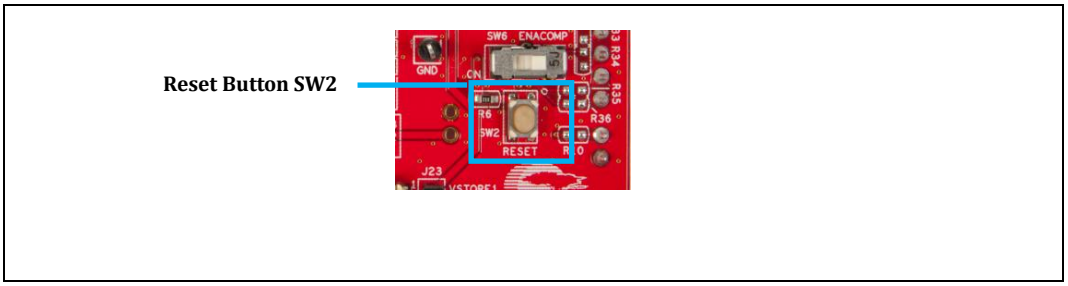
2. For the S6AE103A board: set switch SW1 as follows for Energy driven mode: 1: OFF, 2: OFF, 3: OFF.

Figure 4-2. S6AE103A Board Settings for Operation with the Solar Module



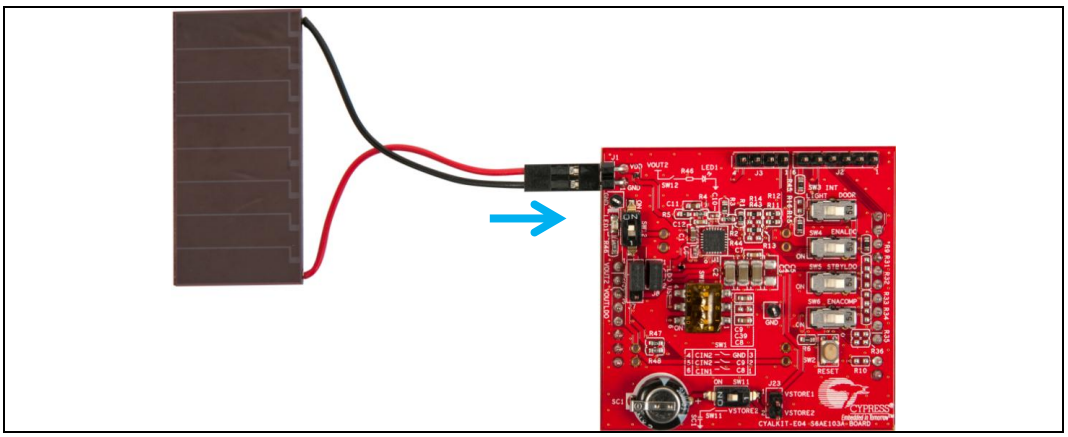
2. Push the reset button SW2.

Figure 4-3. S6AE102A/103A Reset Button



3. Connect the solar module to the S6AE102A/103A board. The red cable is connected to J1 pin 2.

Figure 4-4. Connecting the Solar Module



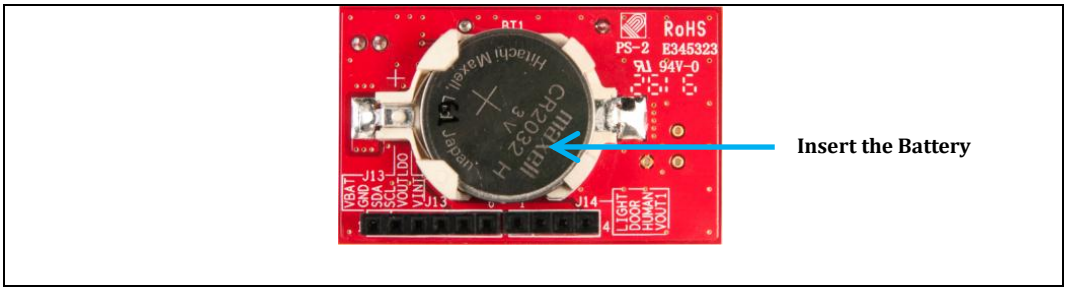
4. LED1 on the S6AE102A/103A board will blink under an office light environment.

   Note: The interval of blinking will depend on light brightness. For example, at 200 Lux, the interval is 16 seconds; at 500 Lux, 8 seconds; and at 1000 Lux, 3 seconds.

4.1.2 Solar and Battery Operation with the Solar Module and Sensor Board

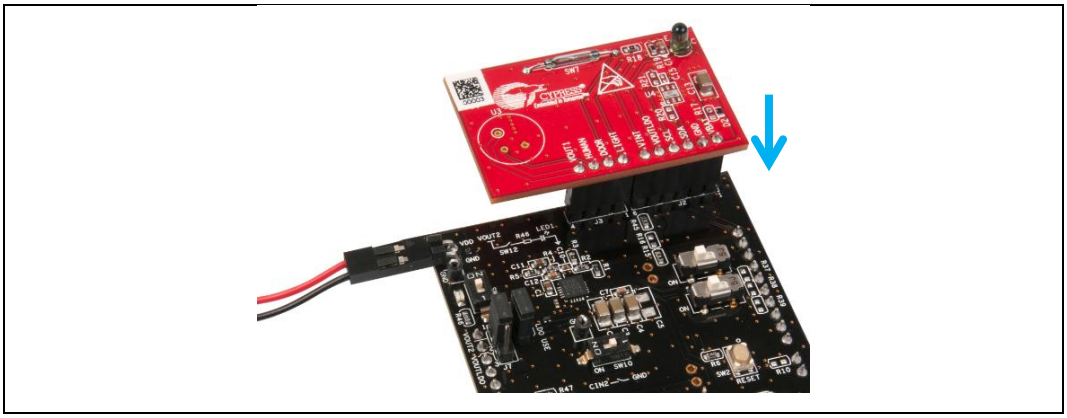
1. Leave all jumpers and switches set as in the previous example.
2. Insert the coin cell battery (CR2032) into the battery holder on the sensor board.

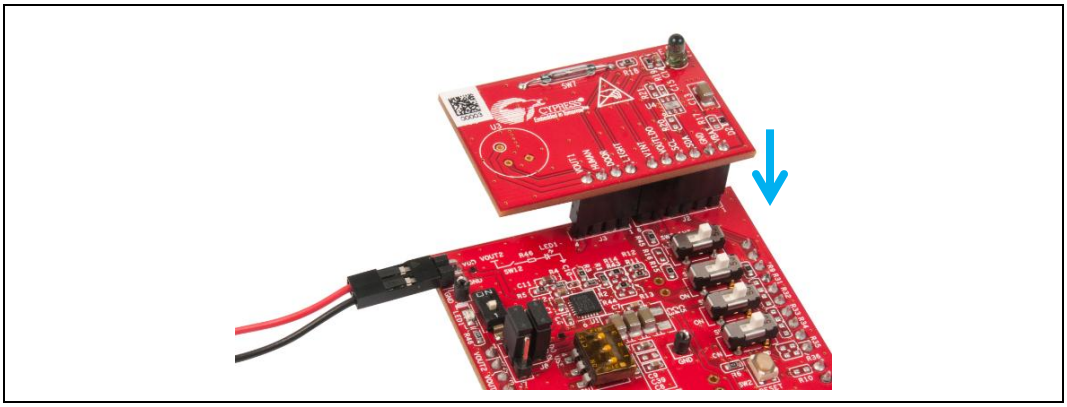
Figure 4-5. Inserting the Coin Cell Battery



3. Connect the sensor board to the S6AE102A/103A board.

Figure 4-6. Connecting the Sensor Board to S6AE102A/103A Board





5. LED1 on the S6AE102A/103A board will stay ON irrespective of whether the solar module is connected.

Note: Remove the coin cell battery (CR2032) from the battery holder of the sensor board to prevent battery leakage when not using this kit.

4.1.3 Super Capacitor Charging Operation with Solar Module

1. Set SW12 to OFF. This disables the LED.

2. Set switch SW11 to ON. This connects the super capacitor.
3. Connect the solar module to the S6AE102A/103A board. The red cable is connected to J1 pin 2.
4. Monitor the voltage of VSTORE2 (J23 2). The voltage of the super capacitor will increase gradually. See Waveforms of Charging and Discharging Operation for more information on the charging operation of the super capacitor.

Figure 4-7. S6AE102A Board Settings for Checking Super Capacitor Charging with Solar Module

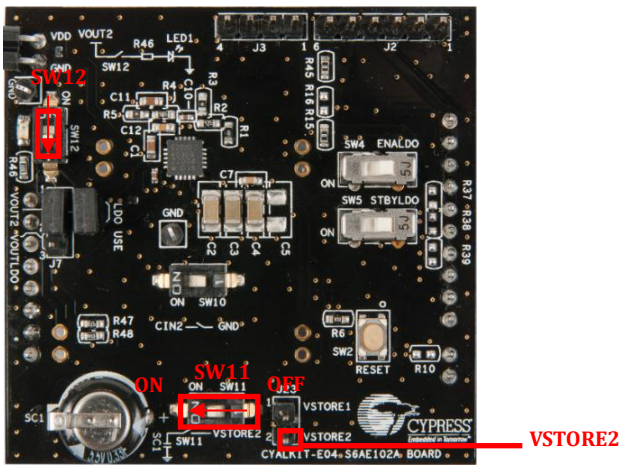
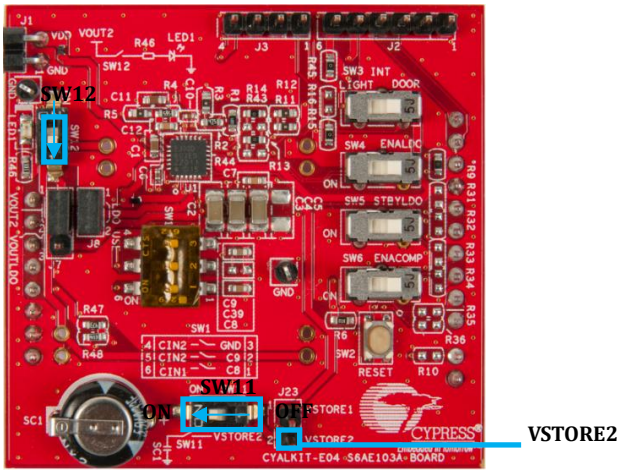


Figure 4-8. S6AE103A Board Settings for Checking Super Capacitor Charging with Solar Module



4.1.4 LDO Operation with the Solar Module and Battery

1. Connect VOUT1 and VIN_LDO (J8 1-2). This provides power to the LDO.
2. Connect BLE_VDD and VOUT_LDO (J7 2-3). This connects the LDO output to BLE_VDD.
3. Set switch SW12 to OFF. This disables the LED.
4. Set switch SW4 to ON and SW5 to ON. This enables LDO with normal mode.
5. Set switch SW11 to ON. This enables the super capacitor.
6. Connect the solar module to the S6AE102A/103A board. The red cable is connected to J1 pin 2.

7. Connect the sensor board with battery to the S6AE102A/103A board.
8. Monitor that BLE_VDD becomes 1.8 V.

Figure 4-9. S6AE102A Board Settings for Checking LDO Operation

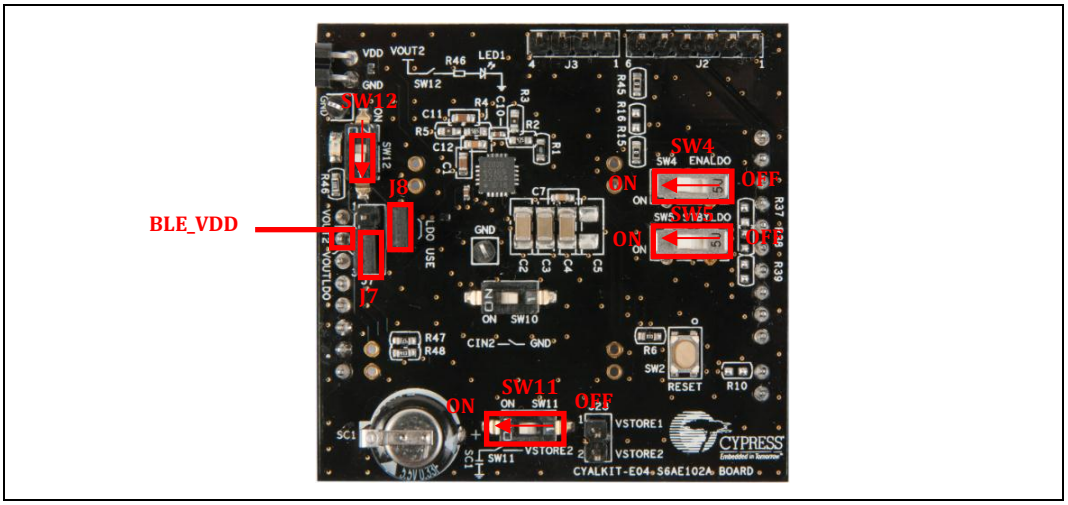
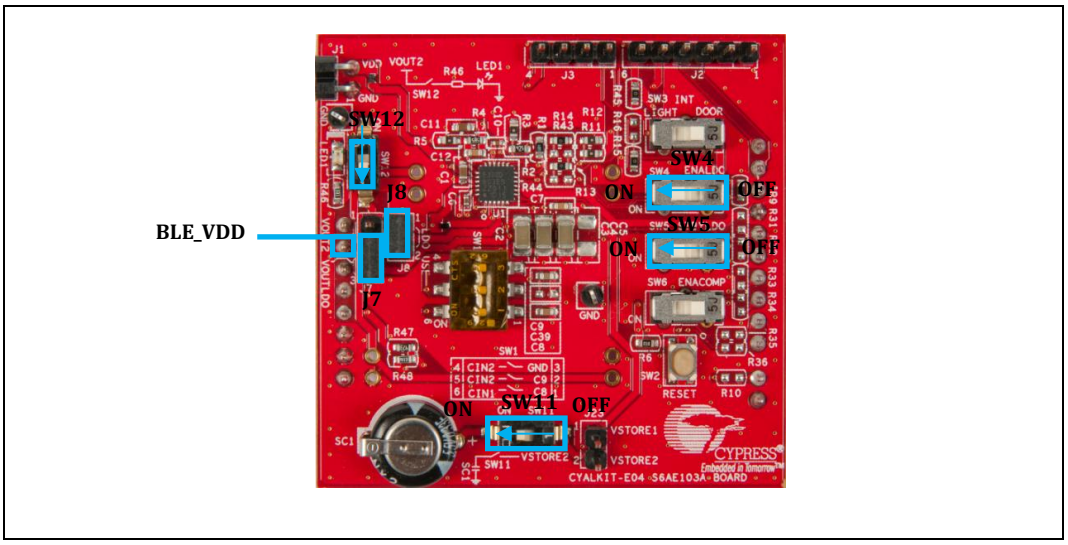
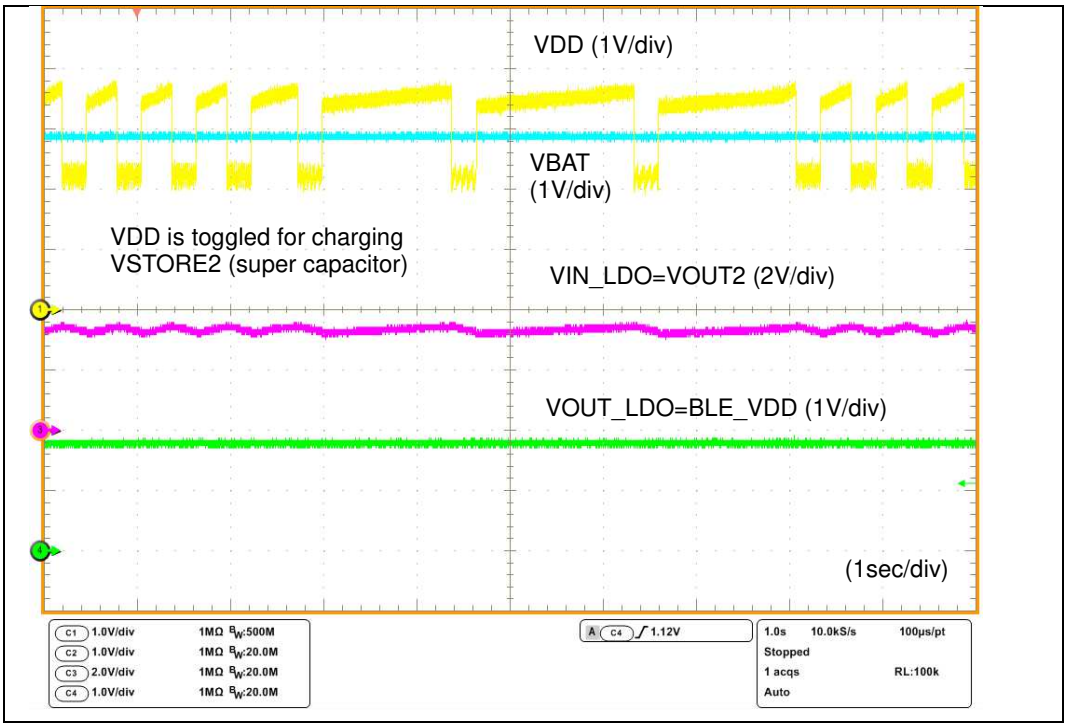


Figure 4-10. S6AE103A Board Settings for Checking LDO Operation



Note that VOUT_LDO can output a stable voltage even if VOUT2 has ripple or if a dual input (solar and battery) is connected as the power source.

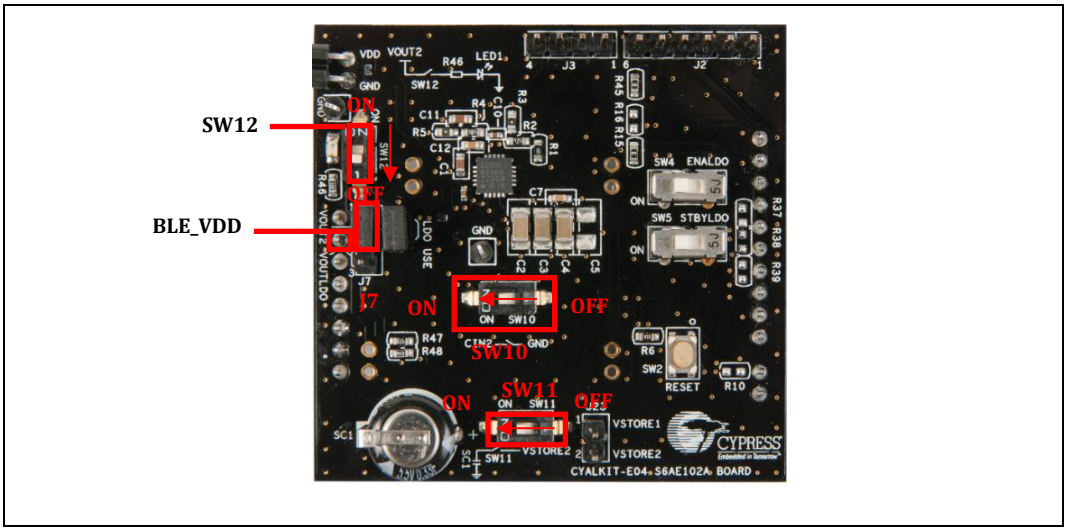
Figure 4-11. LDO with Solar + Battery Input



4.2 Door Sensor Operation with S6AE102A/S6AE103A/Sensor Board and Solar Module

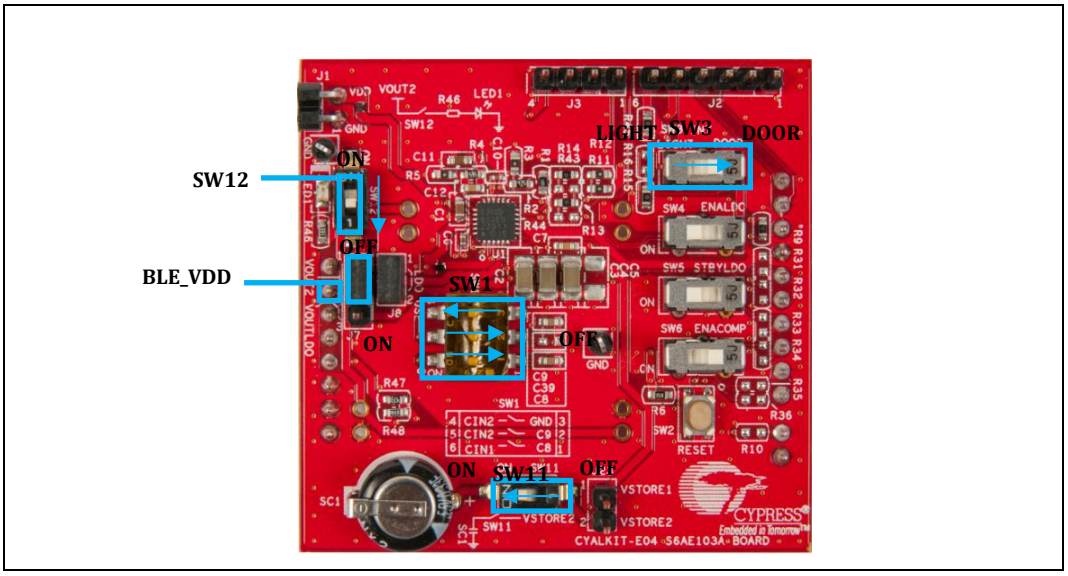
1. Set switch SW11 to ON. This enables the super capacitor.
2. Set switch SW12 to OFF. This disables the LED.
3. Connect BLE_VDD and VOUT2 (J7 1-2).
4. For the S6AE102A board: set switch SW10 to ON for setting Event-driven mode 1.

Figure 4-12. S6AE102A Board Settings for Checking Door Sensor Operation



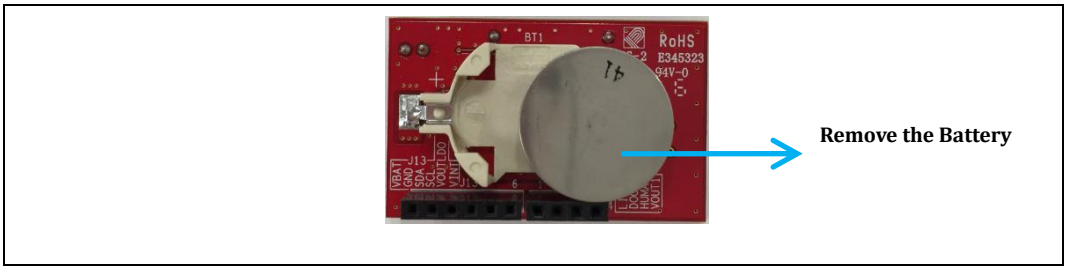
3. For the S6AE103A board: set switch SW1 as follows for setting Event-driven mode 1. 1: OFF, 2: OFF, 3: ON.
4. For the S6AE103A board: set switch SW3 to DOOR for inputting the door sensor signal to INT.

Figure 4-13. S6AE103A Board Settings for Checking Door Sensor Operation



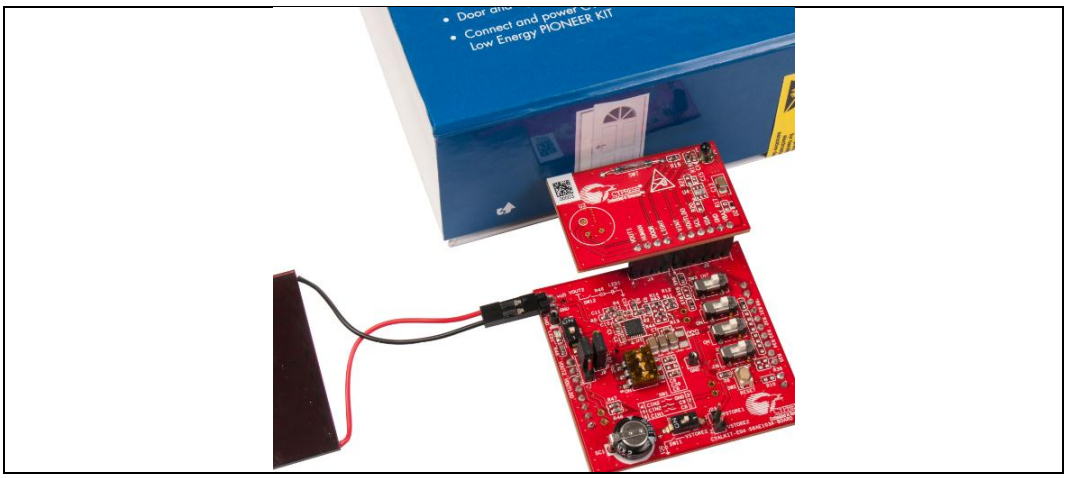
5. Push the reset button SW2.
6. Connect the sensor board to the S6AE102A/103A board without the CR2032 battery.

Figure 4-14. Removing the Coin Cell Battery



7. Connect the solar module to the S6AE102A/103A board. The red cable is connected to J1 pin 2.
8. Monitor that BLE_VDD is low when the magnetic sensor SW7 is placed against the doorknob picture on the kit box. There are magnets at those two positions in the kit box. BLE_VDD goes above 3 V when the magnetic sensor SW7 is separated by more than 10 mm from the doorknob picture. This functionality allows a subsystem (for example a BLE signaling device) to be powered whenever the door is open. When the door is closed, the subsystem is powered down and energy is stored in the super capacitor.

Figure 4-15. Checking the Door Sensor Operation



9. The following waveforms illustrate the electrical signals on the kit during the operation as a door sensor.

Figure 4-16. Door Sensor with Solar Input

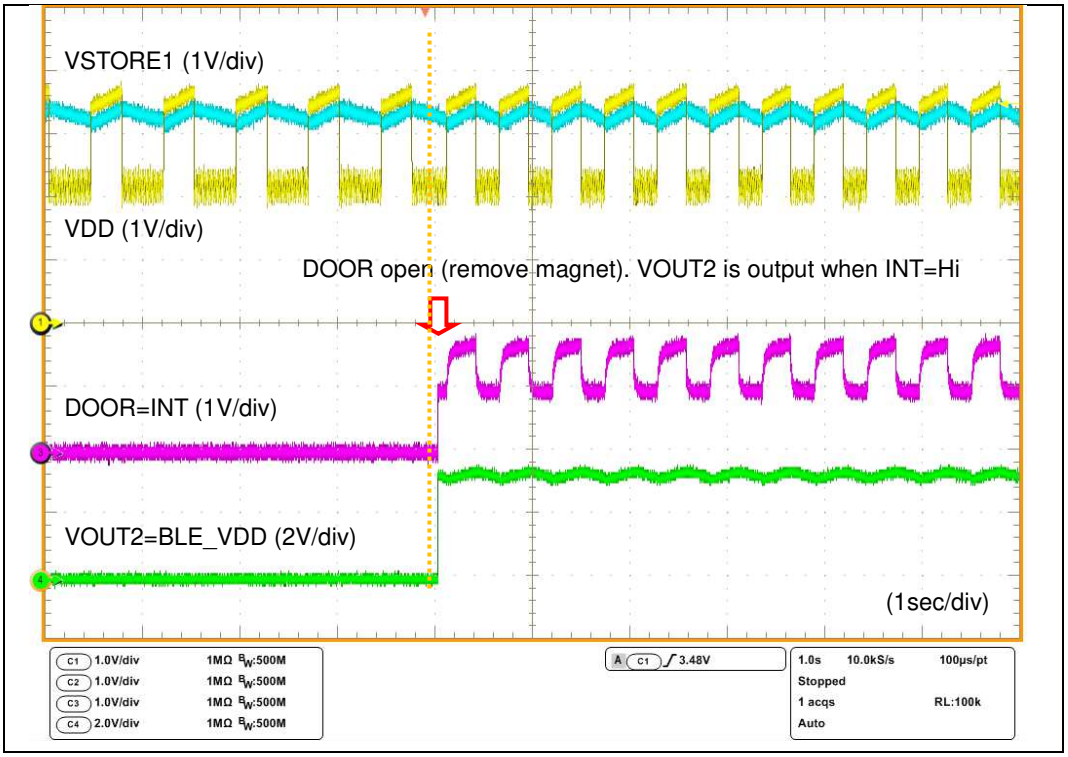


Figure 4-17. S6AE103A Board Measurement Points