USER MANUAL

CYPRESS

Enabled

Evaluation kit for ***PSoC 1 Low Power Kit***

Exclusively from

element14

Contents

1. Introduction

Thank you for your interest in the PSoC 1 Low Power kit. This development kit supports the PSoC 1 device family CY8C24x93. The following document will provide users guidance on using the PSoC 1 Low Power development kit, detailing the kit contents and kits example projects to get users started designing with PSoC.

1.1 Kit Contents

PSoC 1 Low Power kit contains:

- PSoC 1 Low Power kit board
- Quick Start Guide

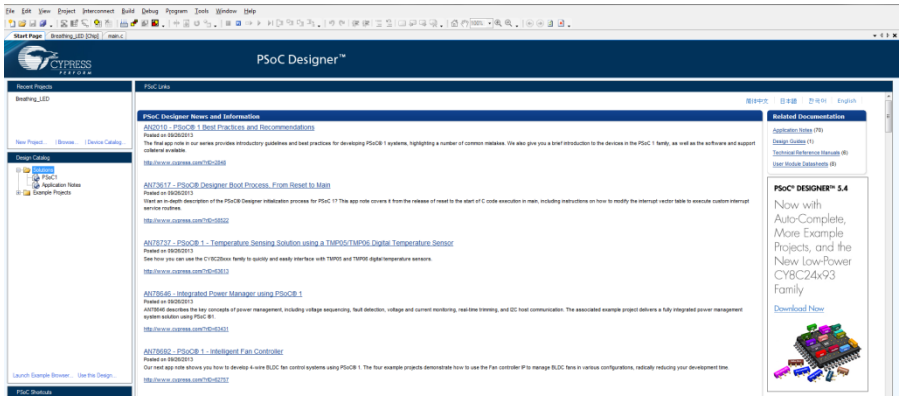
Kit Contents

2. Software Installation

2.1 Install Kit Software

To develop with the PSoC 1 Low Power development kit, users will need to download and install the latest release of PSoC Designer. The PSoC 1 Low Power development kit requires the following minimum software configuration:

- PSoC Designer 5.4 and later versions support the CY8C24x93 PSoC 1 device. Download the latest software from www.cypress.com/go/psocdesigner.
- Code Examples: located on the element14 kit page at, www.element14.com/psoc1



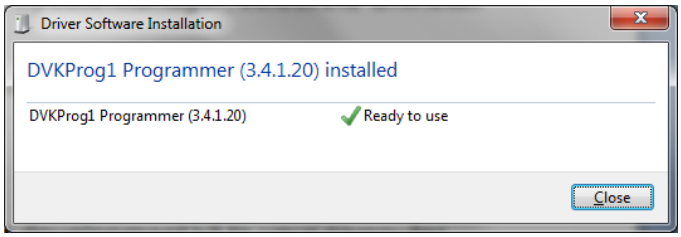
2.2 Install Software

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

- Go to Start > All Programs > Cypress > Cypress Update Manager > Cypress Update Manager; select the Uninstall button.
- Go to Start > Control Panel > Programs and Features; select the Uninstall/Change button.

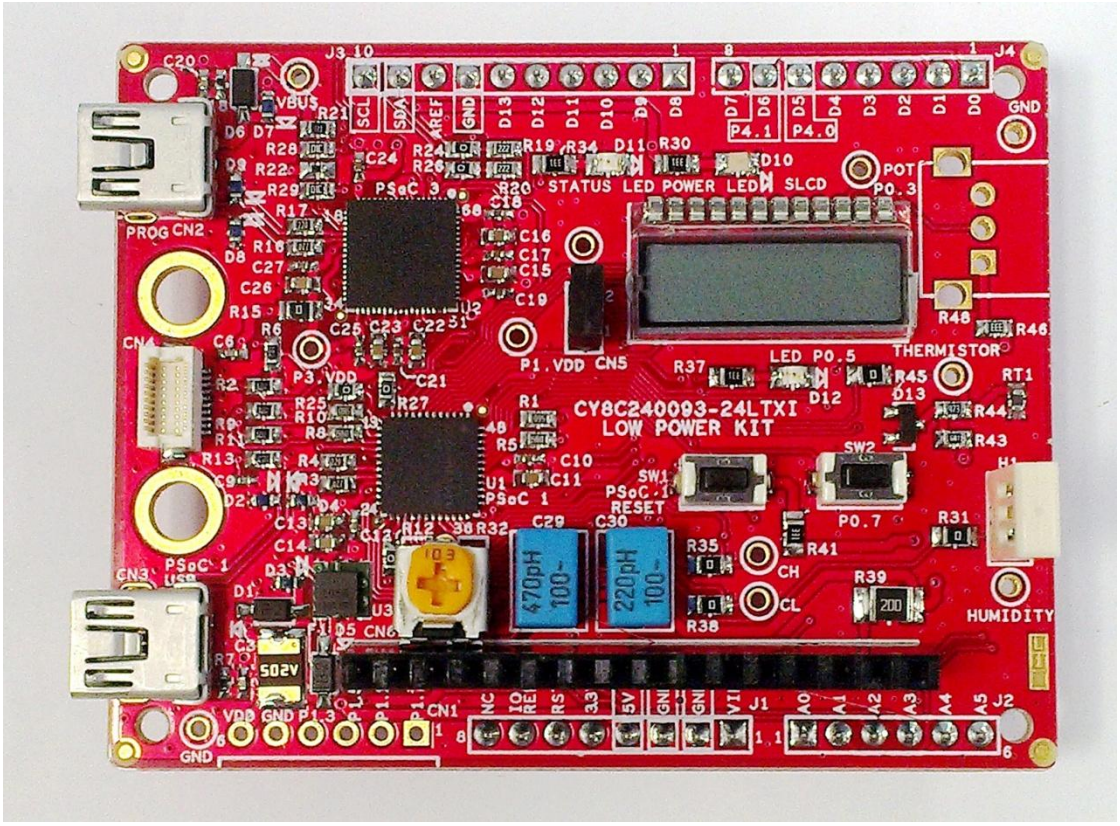
2.3 Install Hardware

After installing the PSoC Designer software you may connect your PSoC 1 Low Power development kit to your computer. When connecting your PSoC 1 Low Power kit to the computer for the first time it may take a moment to enumerate as the computer is completing an online check for the latest drivers. Please wait until this is complete or select the **Skip obtaining driver software from Windows Update.**



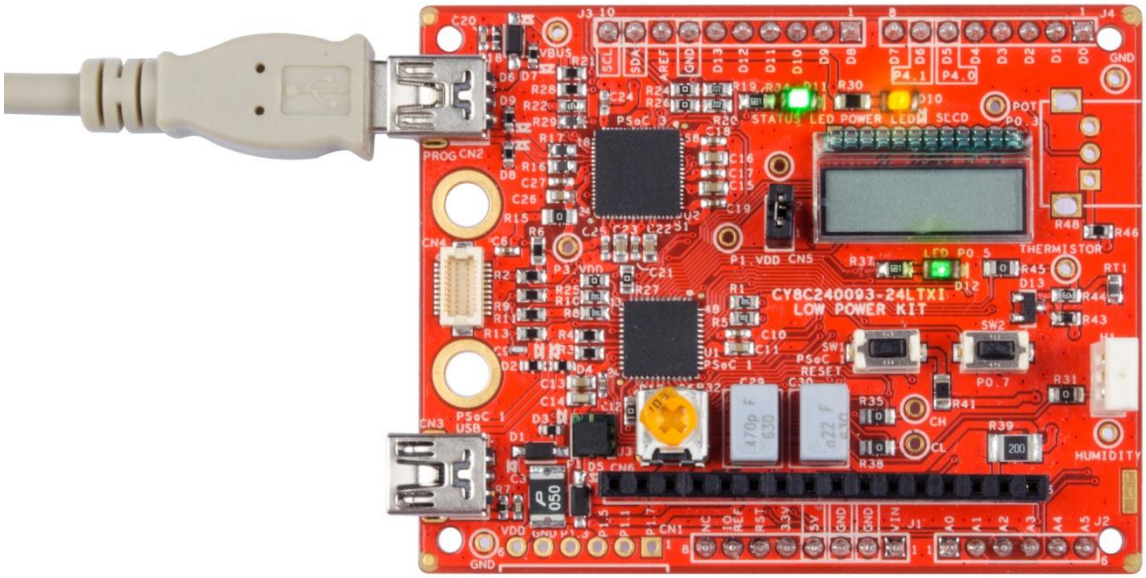
3. Kit Operation

The PSoC 1 Low Power Kit enables the user to develop applications using the CY8C24x93 PSoC 1 devices. This kit can also be used as an Arduino shield with other Arduino baseboard such as the Arduino Uno, or with Cypress's Arduino hardware compatible kits such as the CY8CKIT-042.



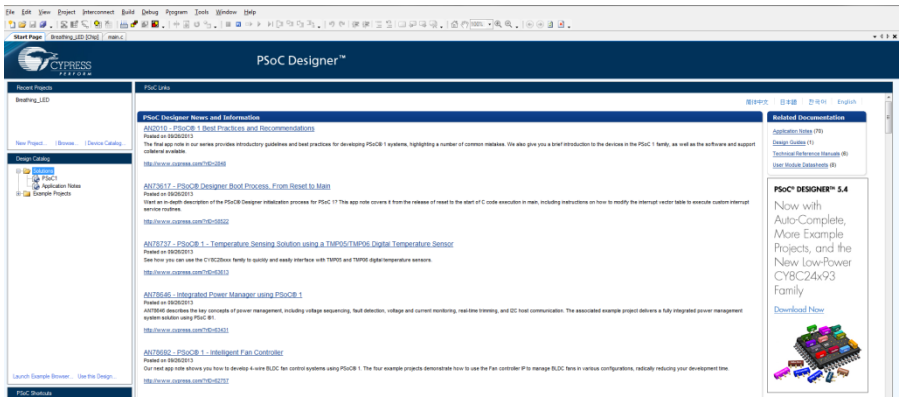
3.1 Connecting the PSoC 1 Prototyping Kit to the Computer

To use the PSoC 1 Low Power kit you need to connect the kit to a target PC. The Kit is designed to be connected to the PC through USB. The USB connector will provide power to the target boards and enables communication with the onboard programmer.

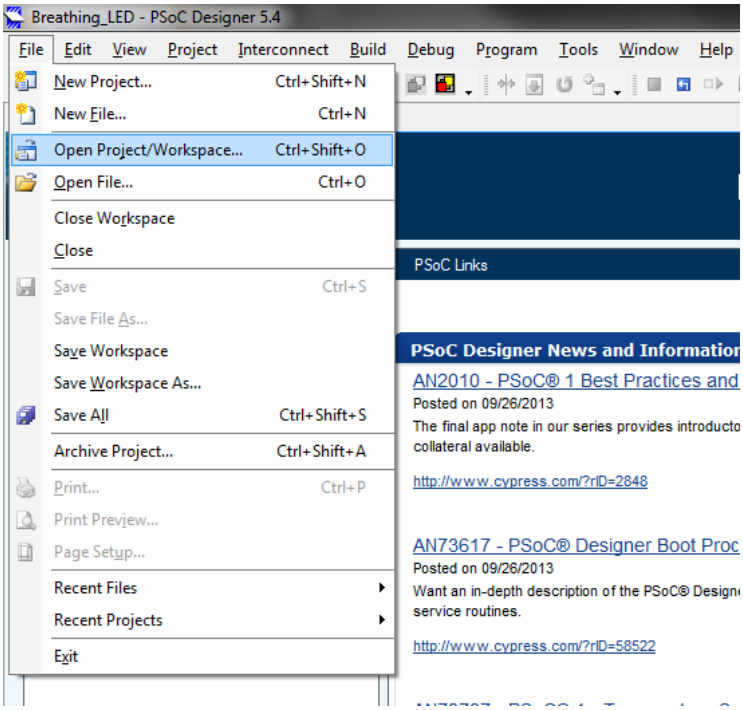


3.2 Open the PSoC 1 Low Power Example Project in PSoC Designer

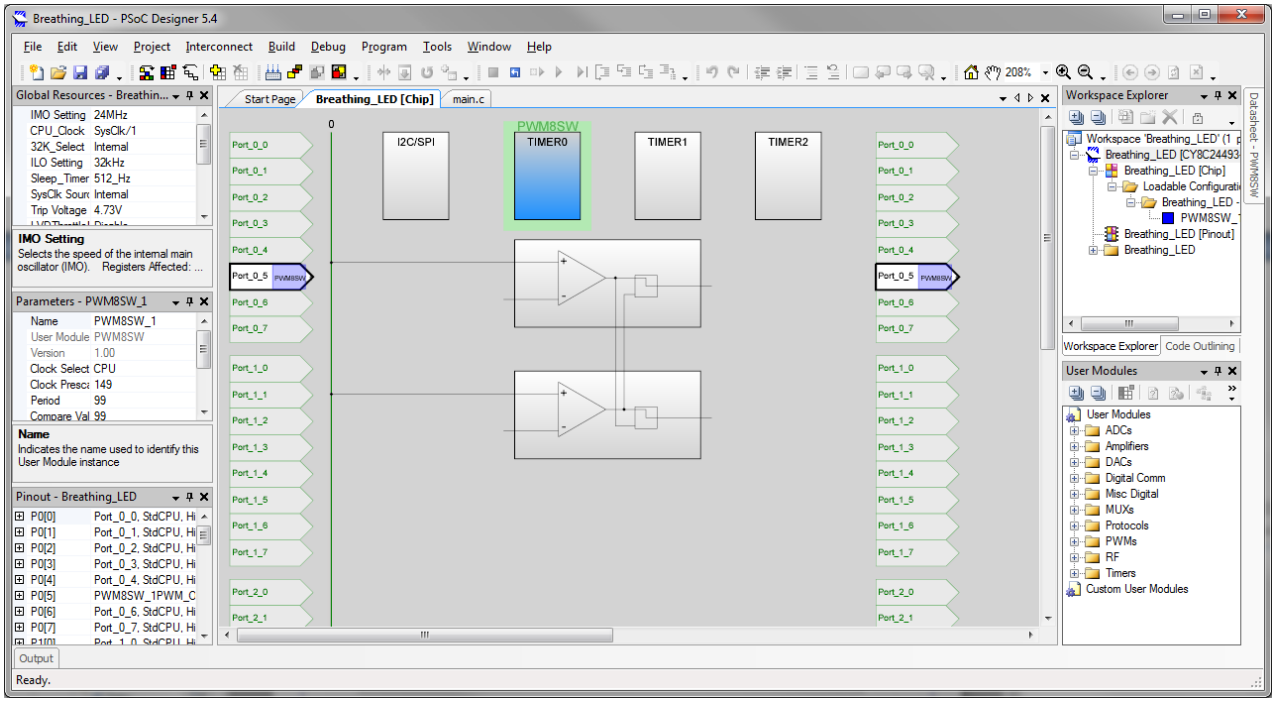
1. Launch the PSoC Designer software from the Start menu.



2. Open the example project by clicking the **Open Project/Workspace** option under the **File** menu**.** Open the project by navigating to the example project downloaded from the kit page.



3. The example project opens and displays the project files in the **Workspace Explorer**. Subsequent sections of this user guide show how to build, program, and understand the example projects supplied with this kit.

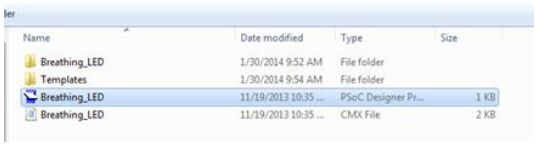


3.3 My First PSoC 1 (CY8C24x93) Project

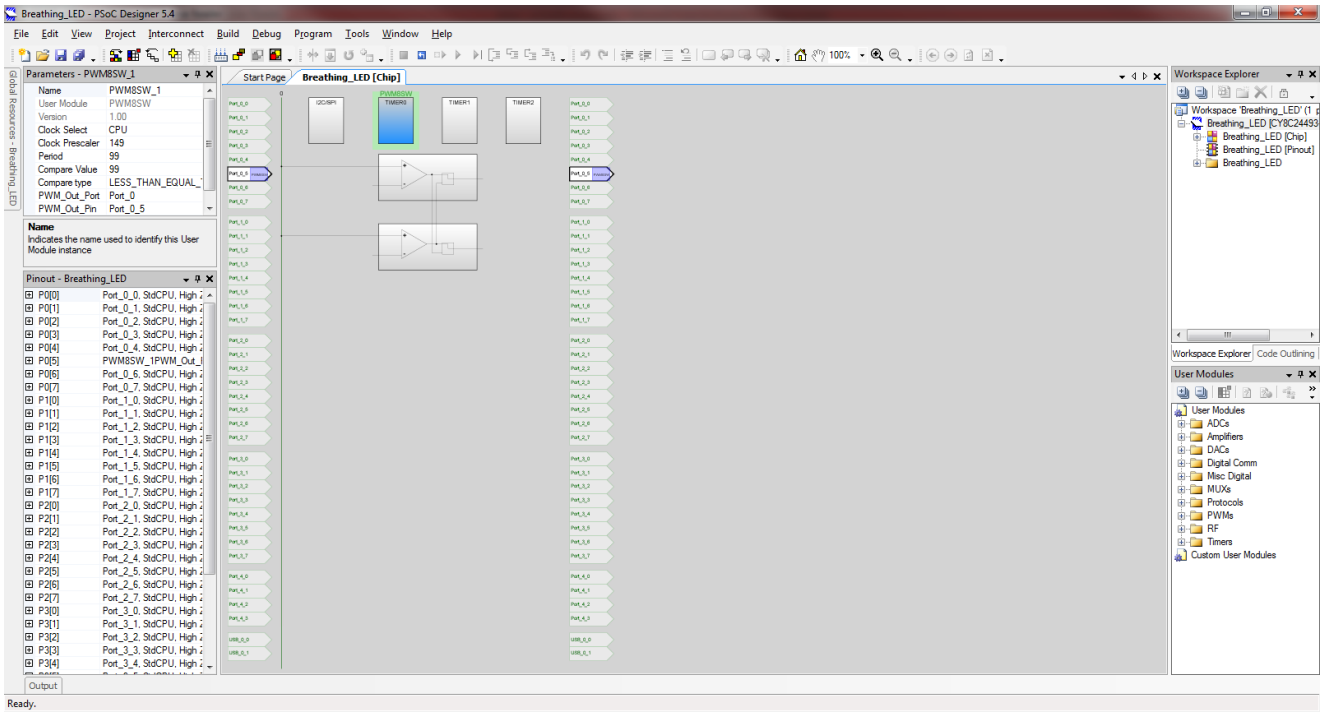
This is a simple PSoC 1 project which uses a PWM8SW User Module to continuously change the brightness of an LED. This section describes how to open, build and program a project.

3.3.1 Loading My First PSoC 1 Project

1. Open PSoC Designer.
2. In the Start Page, navigate to **File > Open Project/Workspace**.
3. Navigate to the project directory: <Install_Directory>:\ PSoC 1 Low Power Kit\<version>\Firmware\.
4. Open the **Breathing_LED** folder.
5. Double-click **Breathing_LED.app** file.

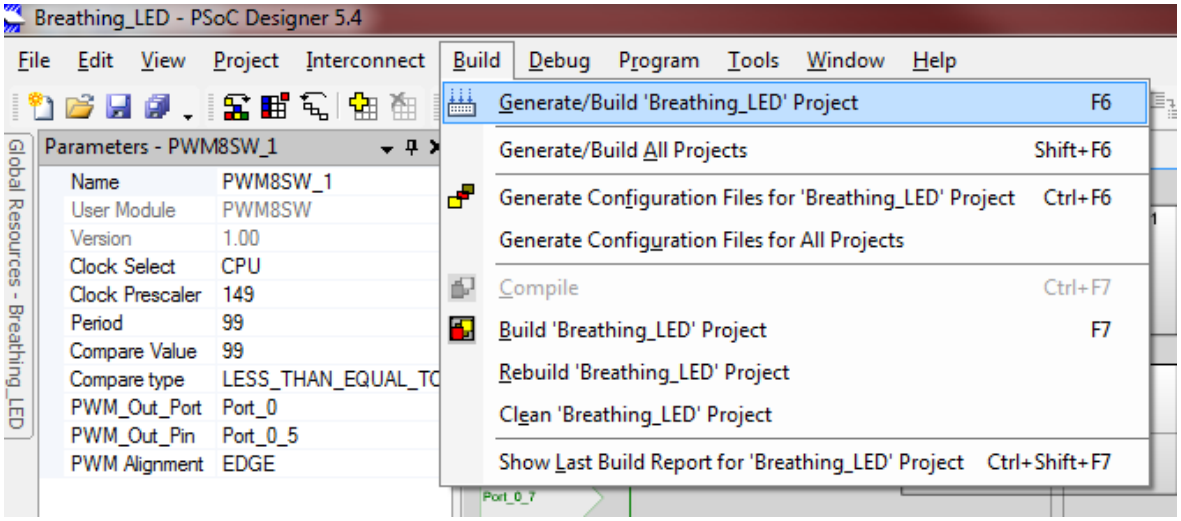


6. The project opens in the Chip Editor view.

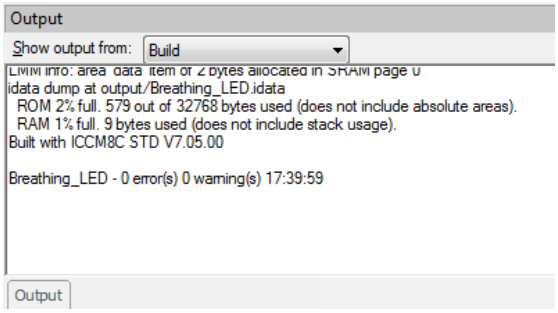


3.3.2 Building My First PSoC 1 Project

1. Select **Build > Generate/Build ' Breathing_LED ' Project**.



2. PSoC Designer builds the project and displays comments in the Output window. When you see the message that the project is built with 0 errors and 0 warnings, you are ready to program the device.



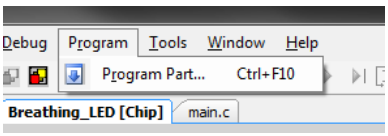
3.3.3 Programming the PSoC 1 Low Power Kit

The kit allows programming of the PSoC 1 device using the onboard PSoC 3 programmer.

1. To program the device, plug the USB cable into the Programming USB connector ‘USB_Prog’. The kit will enumerate as a **DVKProg1**.

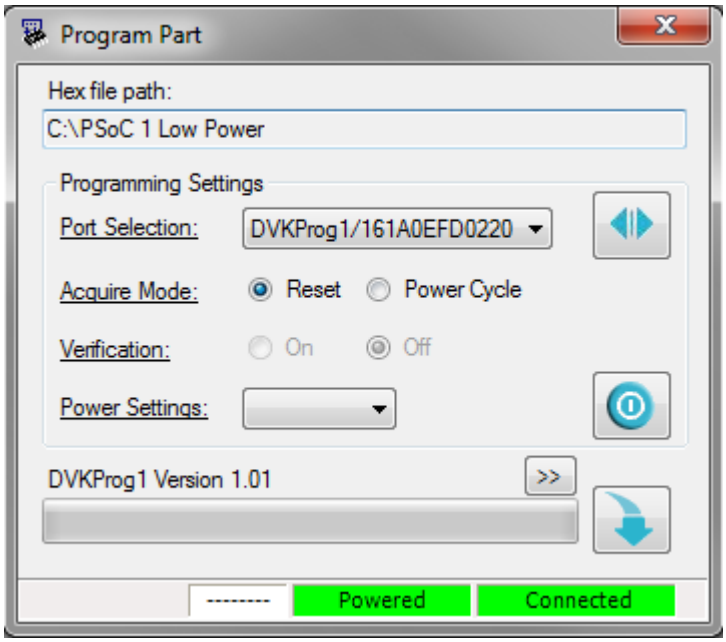
Note: PSoC Programmer 3.18 or higher must be installed for proper installation of the kit driver.

2. The onboard PSoC 3 uses ISSP to program the PSoC 1 device.
3. Open the Program Part window in PSoC Designer by selecting **Program > Program Part**.

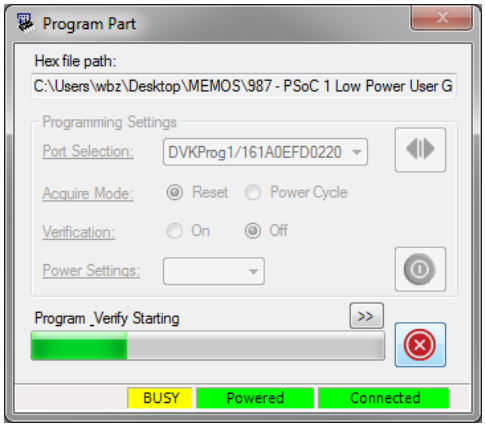


4. In the Program Part window make the following selections:
   a. Select **DVKProg1** in the **Port Selection** drop-down menu.
   b. Set **Acquire Mode** to **Reset**.

c. Set **Verification** to **On**. This ensures that the downloaded checksum matches the actual checksum.



5. In the Program Part window, click the **Program** button to program the device.
6. Wait until programming is complete.

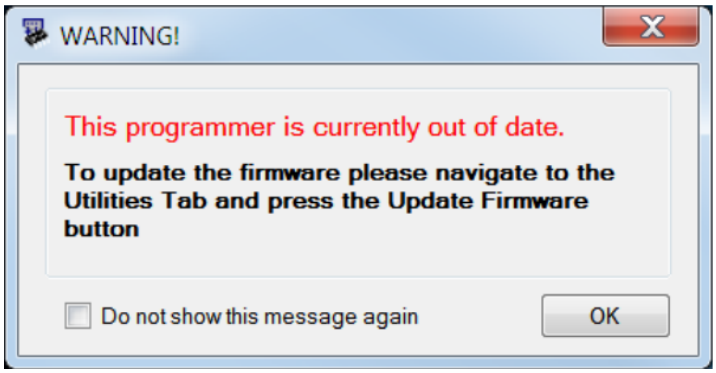


7. See that the **LED** on the kit is now breathing.

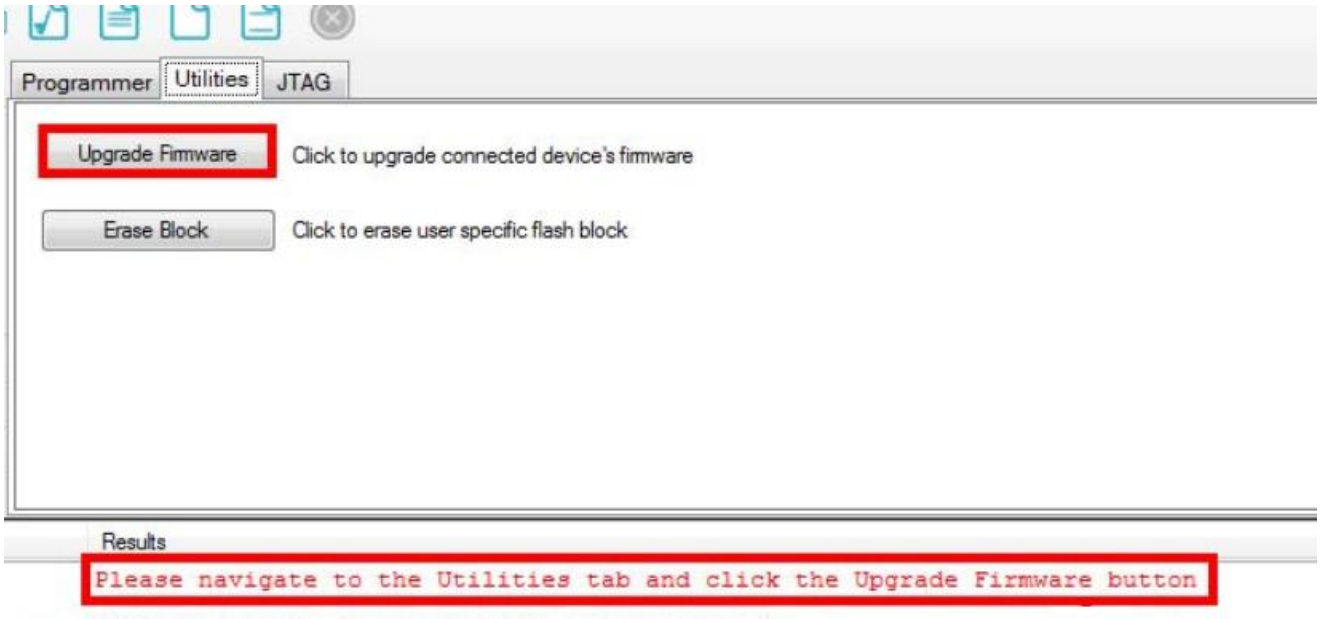
3.4 Updating the Onboard Programmer Firmware

The firmware of the onboard programmer, PSoC 3, can be updated from PSoC Programmer. When a new firmware releases is available PSoC Programmer will display a warning message indicating that the new firmware is available.

Open PSoC Programmer from the **Start > All Programs > Cypress > PSoC Programmer <version>**. When Program opens a warning window pops up saying that the programmer is currently out of date.



Click **OK** to close the window. On closing the warning window, the **Action and Results** window displays "Please navigate to the Utilities tab and click Upgrade Firmware Button."



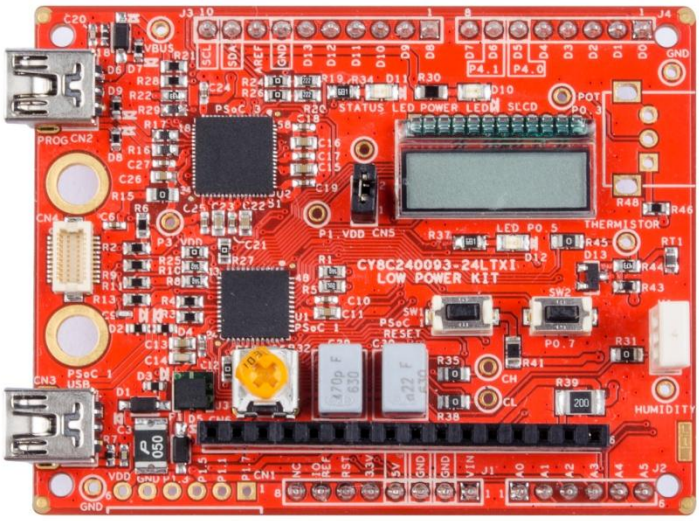
Click the **Utilities** tab and click the **Upgrade Firmware** button. On successful upgrade, the **Action and Results** window displays the firmware update message and the new kit firmware version.

4. Hardware

4.1 Board Details

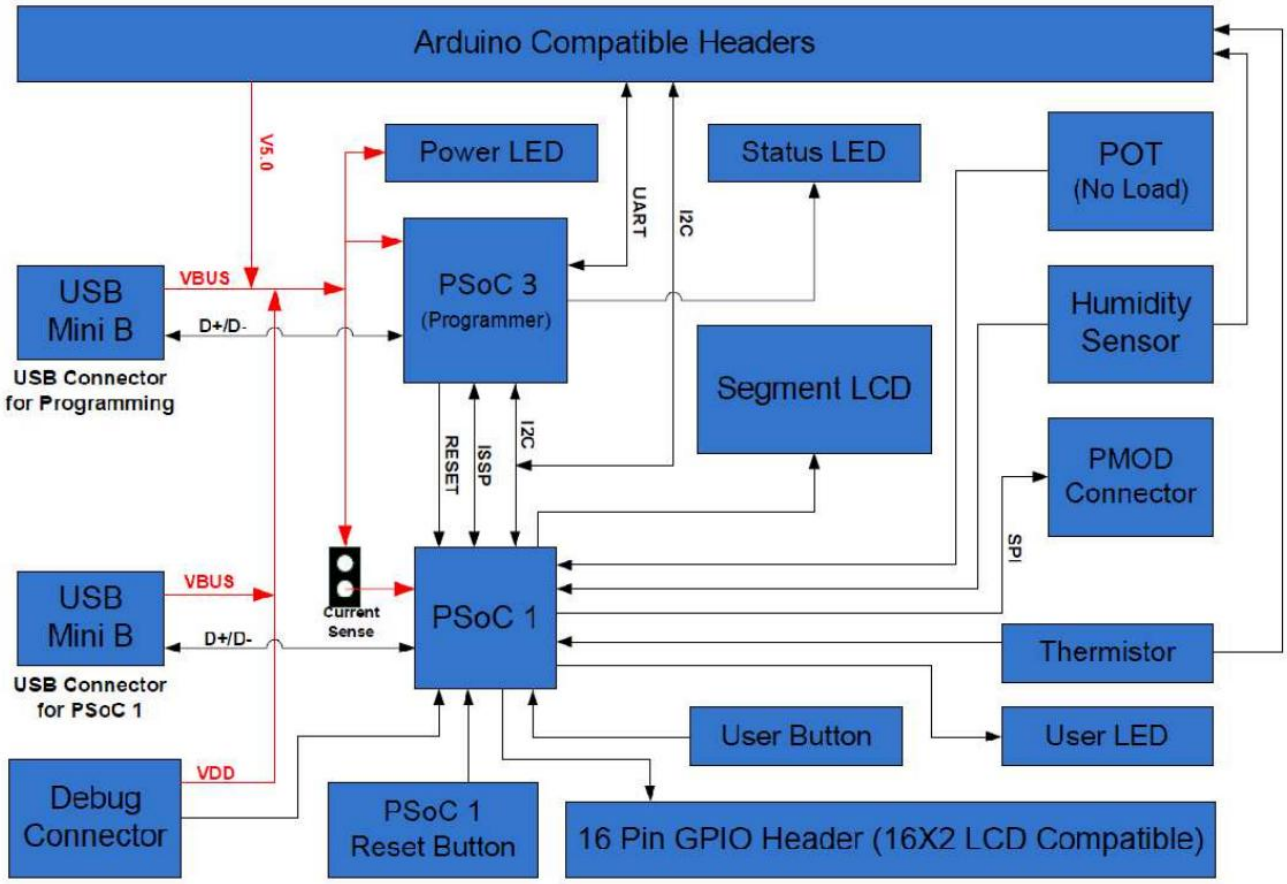
The PSoC 1 Low Power kit consists of the following sections:

- PSoC 1
- PSoC 3 Programmer
- Power supply system
- Programming interface
- USB interface
- CY3215 ICE-Cube Debugging interface headers
- Arduino compatible headers
- Power board LEDs
- Push buttons (Reset Button and User Button)
- Thermistor
- Humidity sensor
- SLCD
- Potentiometer



4.2 Theory of Operation

This section provides a block level description of the PSoC 1 low power kit.



The CY8C24x93 PSoC 1 device is a low power and low pin count PSoC 1 device. The CY8C24x93 family allows customers to quickly add USB support to their designs with minimal effort with PSoC Designer. It supports a wide operating range from 1.7V to 5.5V.

The PSoC 1 low power board features an on-board PSoC 3 which communicates interfaces with a PC through USB to program the PSoC 1 device using ISSP protocol.

The PSoC 1 kit has a user LED, a status LED and a power LED. The user LED is connected to the PSoC 1 device and the status LED is connected to the PSoC 3 device.

The PSoC 1 kit also includes a PSoC 1 reset button which connects to the PSoC 1 XRES pin, a user button and a segment LCD display. The PSoC 1 pins are brought out to the headers J1 – J4 so that it can be connected to Arduino base boards such as the PSoC 4 Pioneer kit. The Port 2 pins of the PSoC 1 device are also brought out to the header CN6 so that a standard 16x2 character LCD can be connected to the board.

The PSoC 1 low power board can be powered from the two USB connectors as well as the Arduino connectors. The power source can be selected using the jumper J1. The input voltage is 5V.

4.3 Functional Description

4.3.1 PSoC 1

The kit uses the PSoC 1 CY8C24x93 family of devices. The PSoC 1 CY8C24x93 devices are a combination of a microcontroller with programmable digital, 10-bit ADC and comparators. For more information refer to the PSoC 1 CY8C24x93 webpage and the PSoC 1 CY8C24x93 family datasheet.

Features

- Powerful Harvard-architecture processor
  - M8C CPU with a max speed of 24 MHz
- Operating Range: 1.71V to 5.5V
  - Standby Mode 1.1 µA (Typ)
  - Deep Sleep 0.1 µA (Typ)
- Operating Temperature range: –40 °C to +85 °C
- Flexible on-chip memory
  - 8 KB flash, 1 KB SRAM
  - 16 KB flash, 2 KB SRAM
  - 32 KB flash, 2 KB SRAM
  - Read while Write with EEPROM emulation
  - 50,000 flash erase/write cycles
  - In-system programming simplifies manufacturing process
- Four Clock Sources
  - Internal main oscillator (IMO): 6/12/24 MHz
  - Internal low-speed oscillator (ILO) at 32 kHz for watchdog and sleep timers
  - External 32 KHz Crystal Oscillator
  - External Clock Input
- Programmable pin configurations
  - Up to 36 general purpose dual mode GPIO (Analog inputs and Digital I/O supported)
  - High sink current of 25 mA per GPIO
    - Max sink current 120 mA for all GPIOs
  - Source Current
    - 5 mA on ports 0 and 1
    - 1 mA on ports 2, 3 and 4
  - Configurable internal pull-up, high-Z and open drain modes
  - Selectable, regulated digital I/O on port 1

- ❒ Configurable input threshold on port 1

■ Versatile Analog functions

- ❒ Internal Low-Dropout voltage regulator for high power supply rejection ratio (PSRR)

■ Full-Speed USB

- ❒ 12 Mbps USB 2.0 compliant
- ❒ Eight unidirectional endpoints
- ❒ One bidirectional endpoint
- ❒ Dedicated 512 byte SRAM
- ❒ No external crystal required

■ Additional system resources

- ❒ I2C Slave:
  - Selectable to 50 kHz, 100 kHz, or 400 kHz
- ❒ Configurable up to 12 MHz SPI master and slave
- ❒ Three 16-bit timers
- ❒ Watchdog and sleep timers
- ❒ Integrated supervisory circuit
- ❒ 10-bit incremental analog-to-digital converter (ADC) with internal voltage reference
- ❒ Two general-purpose Comparators
  - 3 Voltage References (0.8 V, 1 V, 1.2 V)
  - Any pin to either comparator inputs
  - Low-power operation at 10 µA
- ❒ One 8-bit IDAC with full scale range of 512 µA
- ❒ One 8-bit Software PWM

■ Development Platform

- ❒ PSoC Designer™ IDE

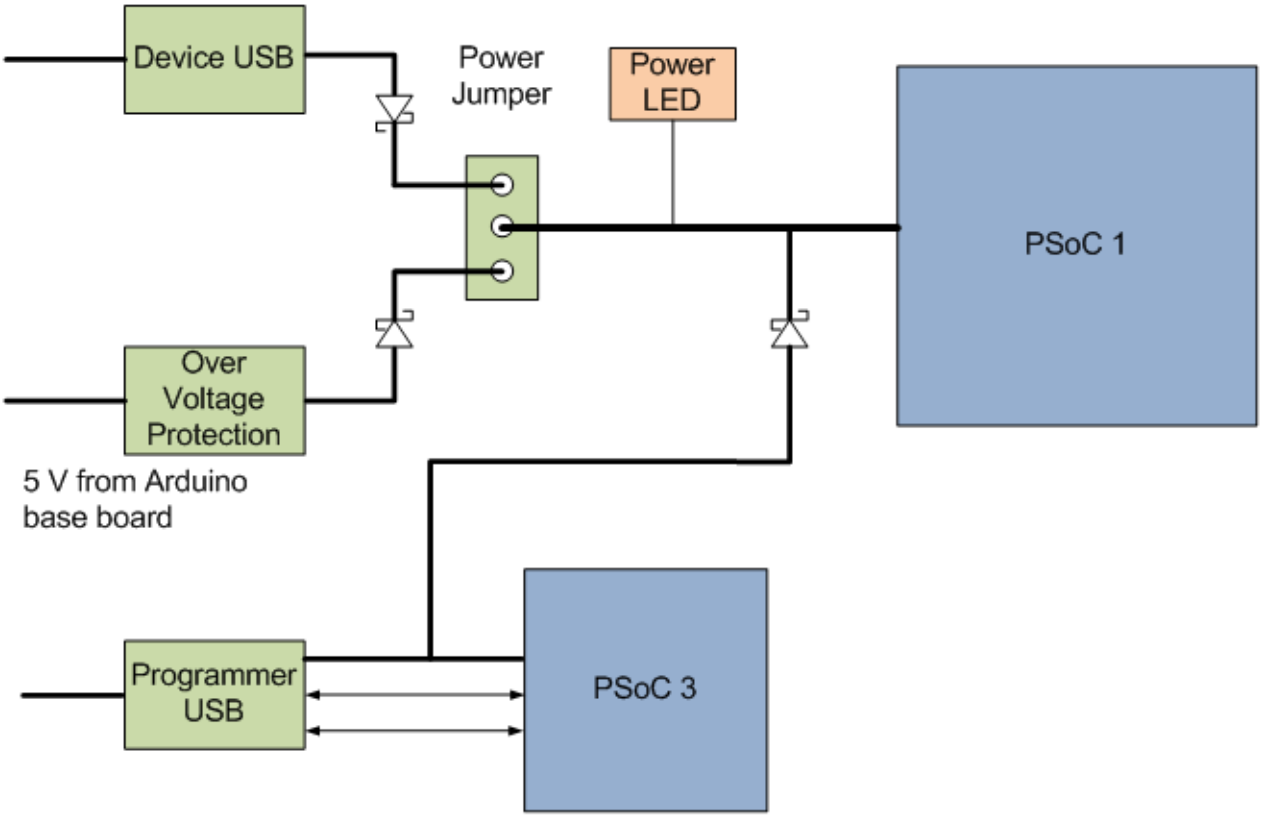
■ GPIOs and Package options

- ❒ 13 GPIOs - QFN 16
- ❒ 28 GPIOs - QFN 32
- ❒ 34 GPIOs - QFN 48
- ❒ 36 GPIOs - QFN 48

4.3.2 Power Supply System

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

- 5V from the on-board USB programming header (PROG)
- VREG from the Arduino base board

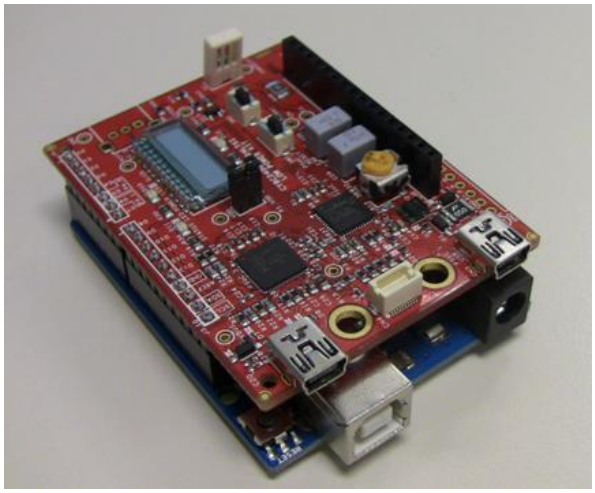


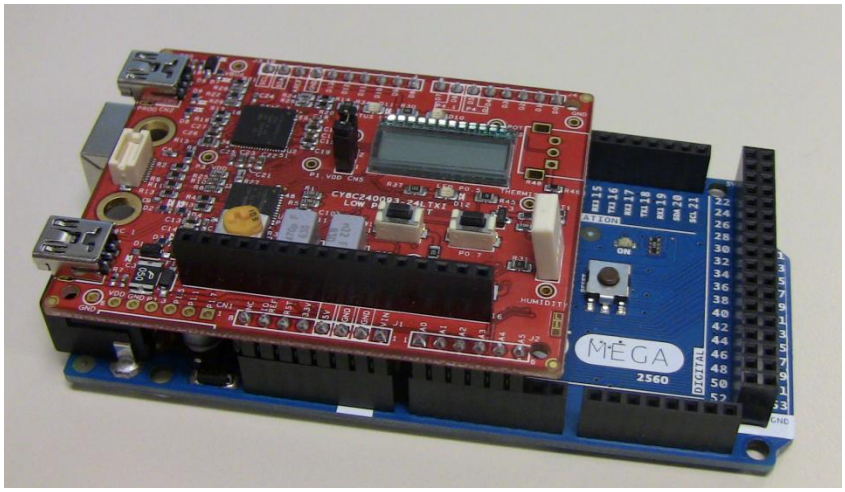
4.3.3 Power Measurement (CN5)

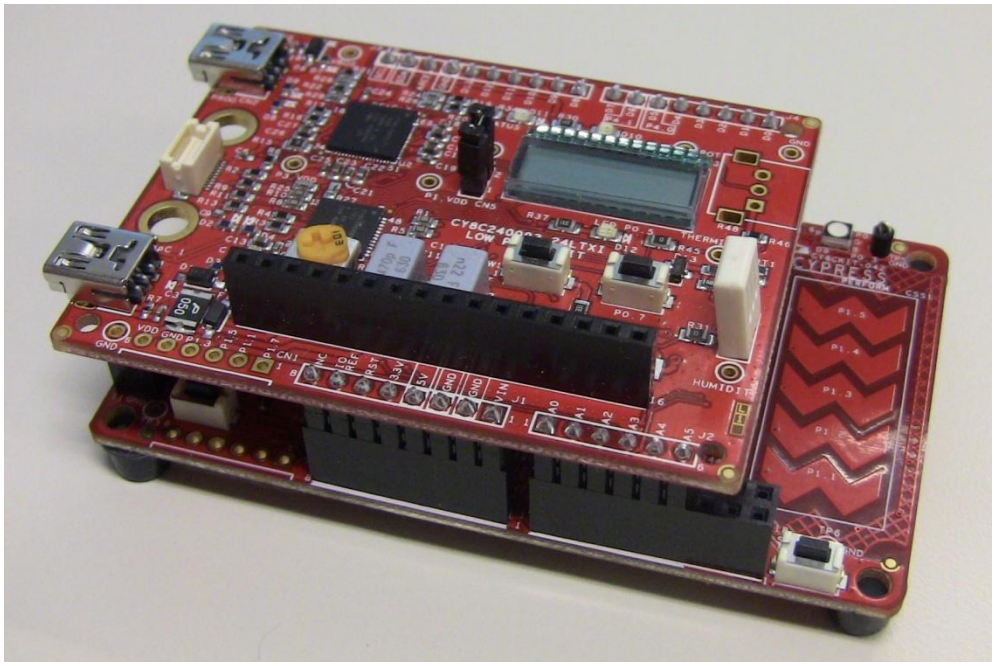
The PSoC 1 Low Power kit provides users with the ability to connect an ammeter to the board and measure current consumption on the PSoC. On the board there is a header with a jumper. This jumper can be removed and the user can connect the ammeter in series to calculate the current consumption.

4.3.4 Arduino Compatible Headers (J1, J2, J3, and J4)

The kit has four Arduino compatible headers; J1, J2, J3, and J4. The user can develop applications to interface with an Arduino base board. The PSoC 1 board will serve as a shield interface to the base Arduino board. In the following images we show the PSoC 1 Low Power board interfacing with the Arduino Uno, Arduino Mega, and PSoC 4 Pioneer Board. Users can develop applications that interface with these various base boards.

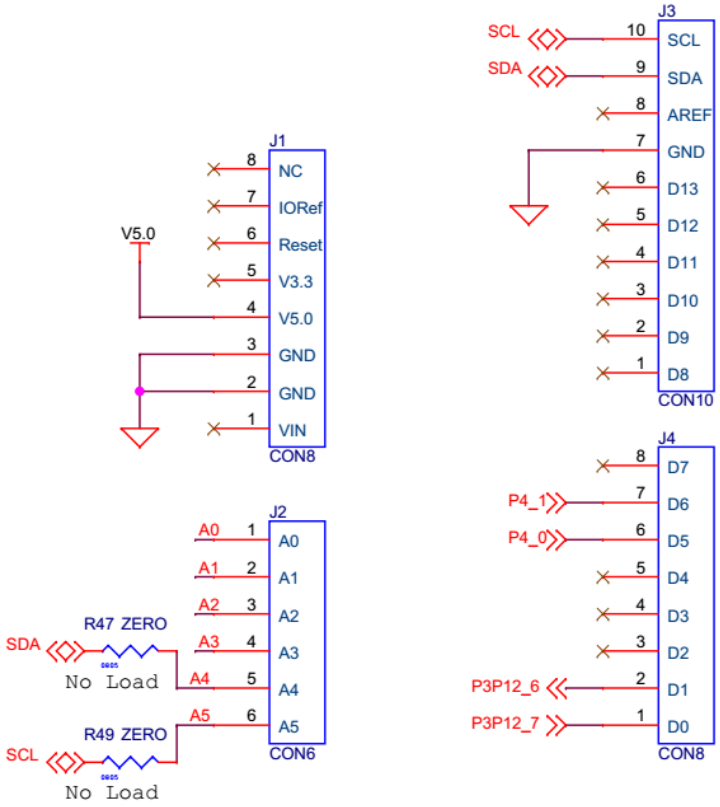






The majority of the I/O on the PSoC 1 kit is tied to onboard features such as the Thermistor or the LCD. However, there are a number of I/O that are connected to the PSoC 1 device and are exposed for usage by the base board.

The header J1 contains all of the power and ground connections to the base board. Header J2 contains connections to the SCL and SDA pins which can be used to communicate with an Arduino base board. The SCL and SDA lines are also connected to the PSoC 3 which provided USB-I2C bridging capabilities. Header J3 contains all of the analog pin connections to the onboard features. There is an option to enable the SCL and SDA lines on the A4 and A5 pins. The header J4 provides to pin connections to a target base board through the D5 and D6 pin connections. Here the base board will be able to provide I/O inputs to the PSoC 1 board.

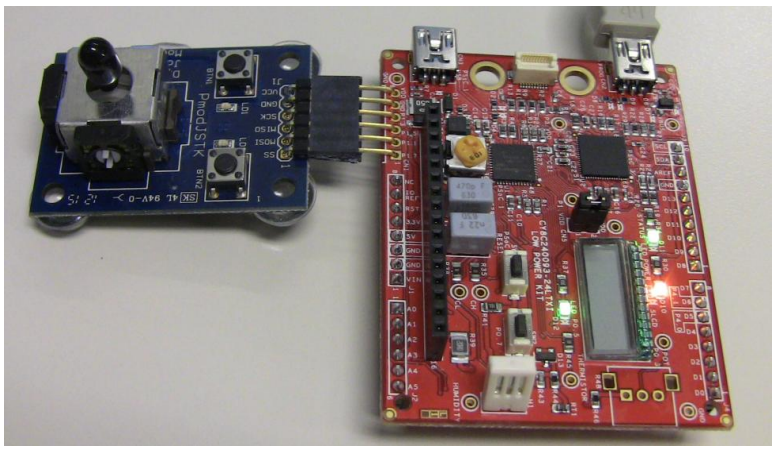


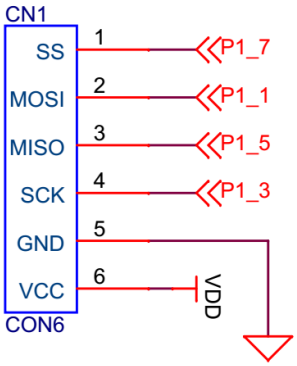
(J1- J4) Arduino Connectors

4.3.5 Digilent Pmod Compatible Header (CN1)

This port supports Digilent Pmod peripheral modules. Pmods are small I/O interfaces, which connect with the embedded control boards through either 6- or 12-pin connectors. The PSoC 1 Low Power kit supports the 6-pin Pmod type 2 (SPI) interface. For Digilent Pmod cards, go to www.digilentinc.com.

The header is not populated on the PSoC 1 kit. You must populate this header before connecting the Pmod daughter cards.

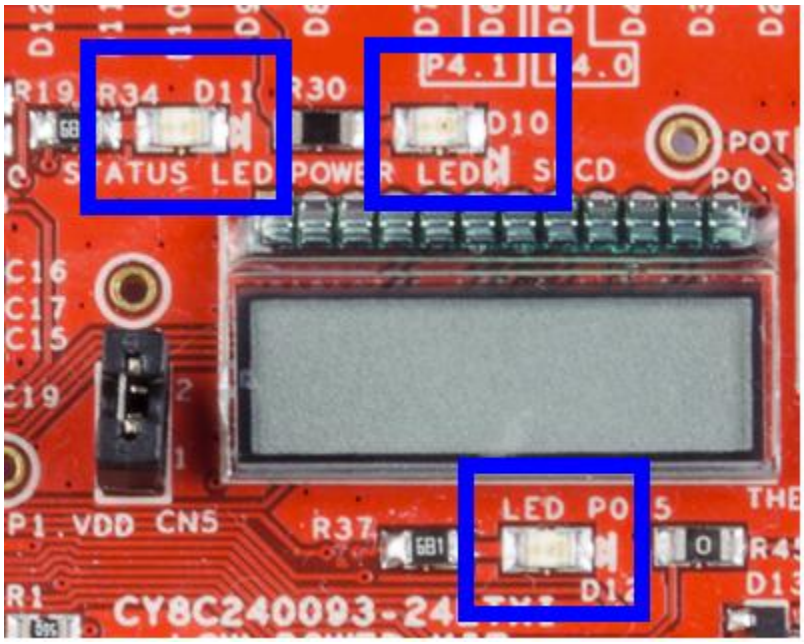


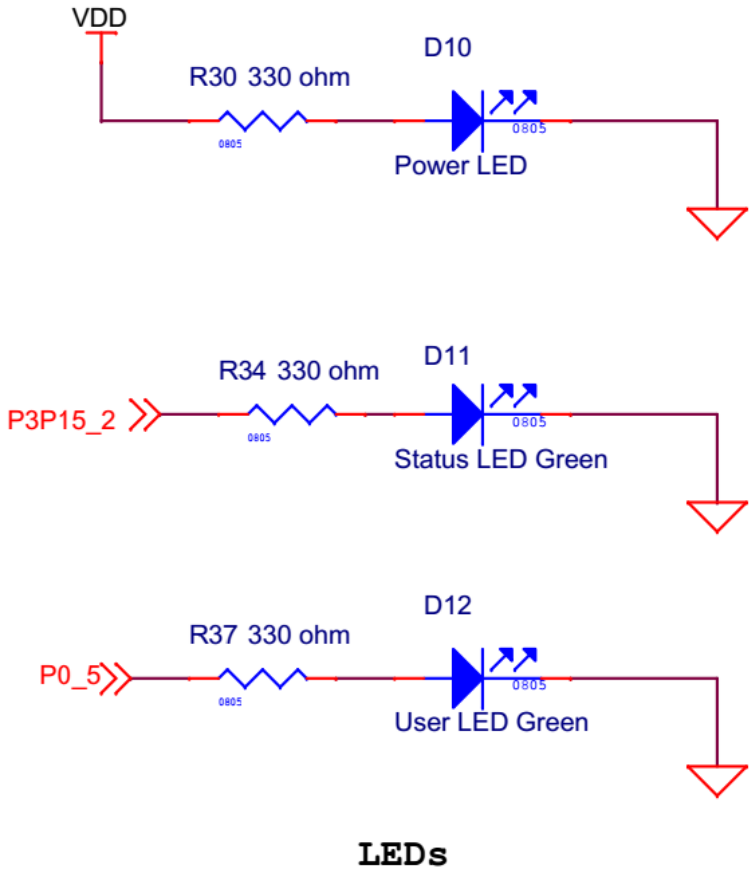


PMOD Connector

4.3.6 PSoC 1 board LEDs

The PSoC 1 Low Power Board supports three LEDs. A green LED (D11) that indicates the status of the programmer. A red colored LED (D10) is used to indicate the power status of the board. The board also has a user LED (D12) which is a general purpose LED connected to pin P0_5.

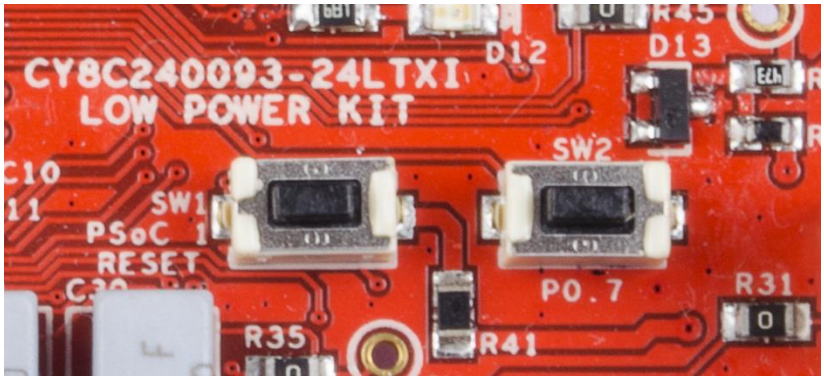


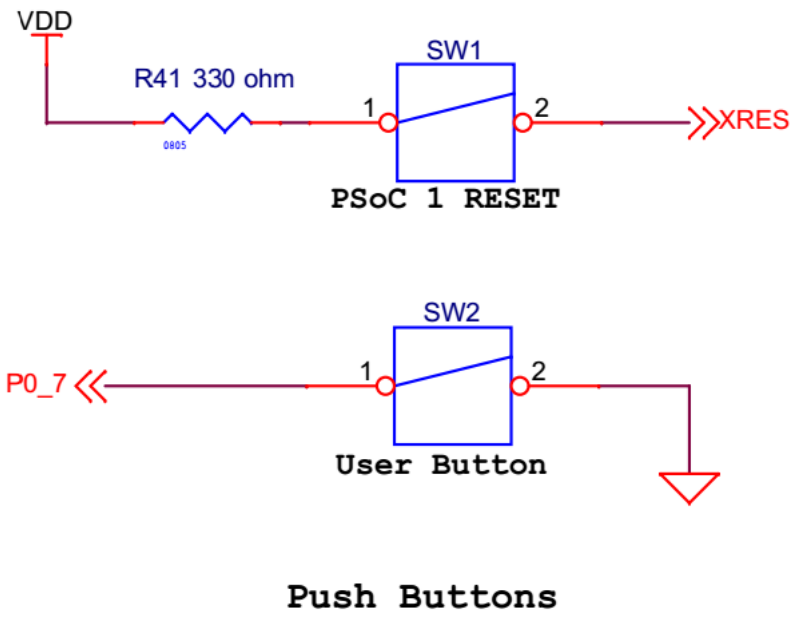


LEDs

4.3.7 Push Buttons

The PSoC 1 kit contains a Reset and User push buttons. The reset push button is connected to the XRES pin of the PSoC 1 device and is used to reset the PSoC 1 device on- board. The user push button is connected to P0[7] of the PSoC 1 device.

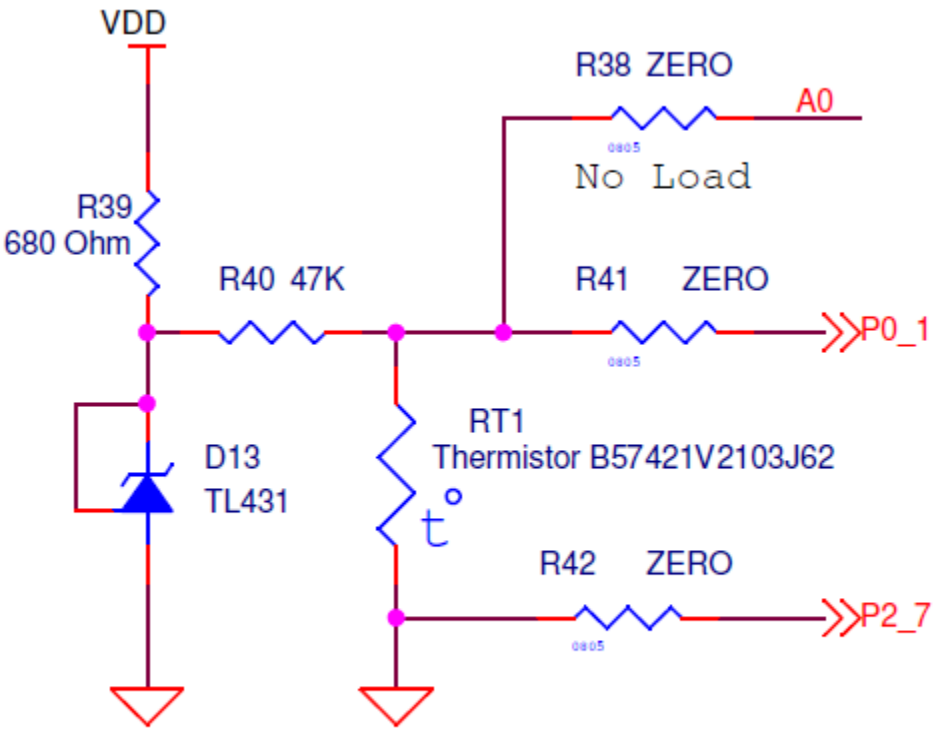




4.3.8 Thermistor

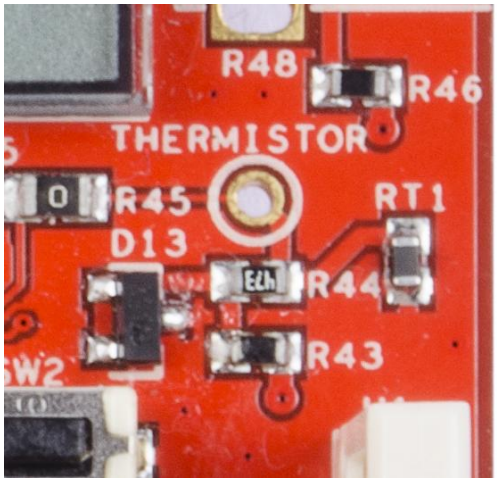
Application note AN2017 - PSoC® 1 Temperature Measurement with Thermistor explains the thermistor theory and temperature measurement with thermistor. The thermistor resistance changes with temperature in a nonlinear fashion. Many Thermistor manufacturers provide the thermistor temperature versus resistance table. The Steinhart-Hart equation characterizes thermistor resistance change with temperature to a good accuracy and can be used to find temperature from thermistor resistance.

Following figure shows the implementation of thermistor on the PSoC 1 Low Power Kit. The thermistor circuit is implemented in such a way that the input voltage range to the PSoC 1 ADC is 0 – 1.2V.



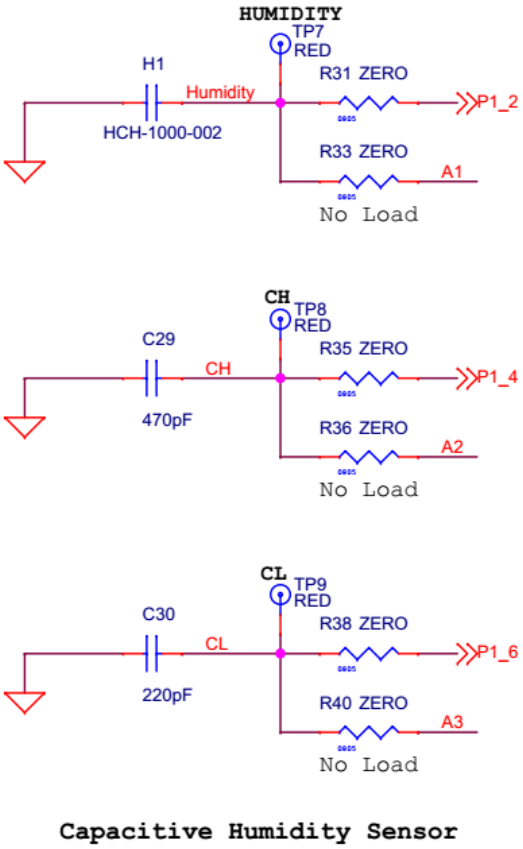
Thermistor

The Thermistor RT1 is located next to the LCD screen, above the white humidity sensor.



4.3.9 Humidity Sensor

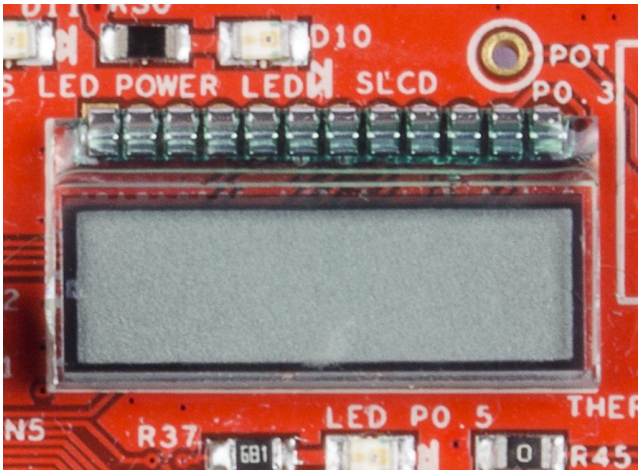
The onboard capacitive humidity sensor (HCH-1000-002) along with reference capacitors can be used to measure the humidity. The humidity sensor is implemented on the kit. The humidity sensor is read using the P1(2) pin on the PSoC 1 device. The PSoC 1 kit also includes two reference capacitors circuits to calculate the upper and lower reference bounds for the Humidity sensor. These two capacitor circuits can be charged and that charging time measured to give you 0% and 100% range for the humidity sensor.



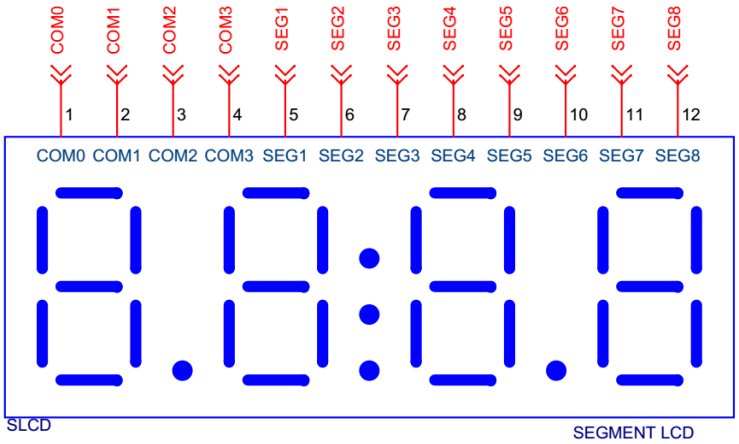
Capacitive Humidity Sensor

4.3.10 Segment LCD

The onboard segment LCD can be used to show various output. The SLCD user Module can be used to drive this SLCD. The following table gives the pin connections of the SLCD. The LCD can display 4 numeric characters and 3 decimal points.



SLCD Pin	PSoC 1 Pin
COM0	P0_6
COM1	P0_4
COM2	P0_2
COM3	P0_0
SEG1	P3_0
SEG2	P3_1
SEG3	P3_2
SEG4	P3_3
SEG5	P3_4
SEG6	P3_5
SEG7	P3_6
SEG8	P3_7



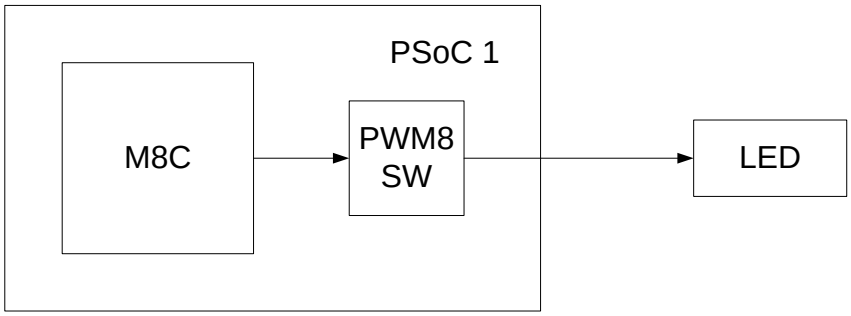
5. Example Projects

The example projects described in the following sections introduce the functionality of the CY8C24x93 PSoC 1 device and the on-board components to the user. To download these examples navigate to the kit web page: www.element14.com/psoc1.

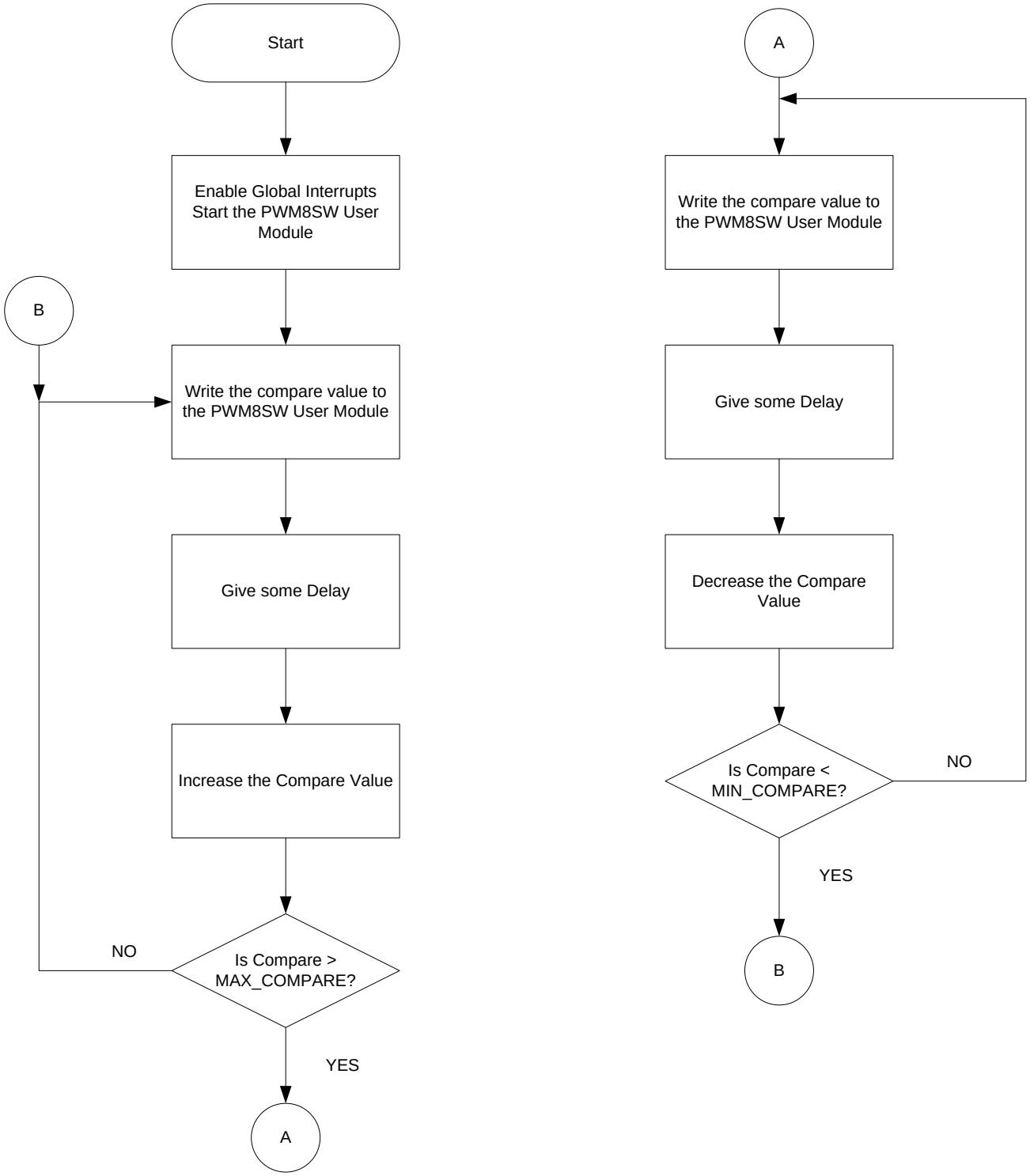
5.1 Project: Breathing LED

5.1.1 Project Description

This example project uses a PWM8SW user module to illuminate the user LED. The brightness of the LED is controlled using the PWM duty cycle. This duty cycle is continuously varied to change the brightness of the LED and thus producing a breathing effect.



5.1.2 Flowchart

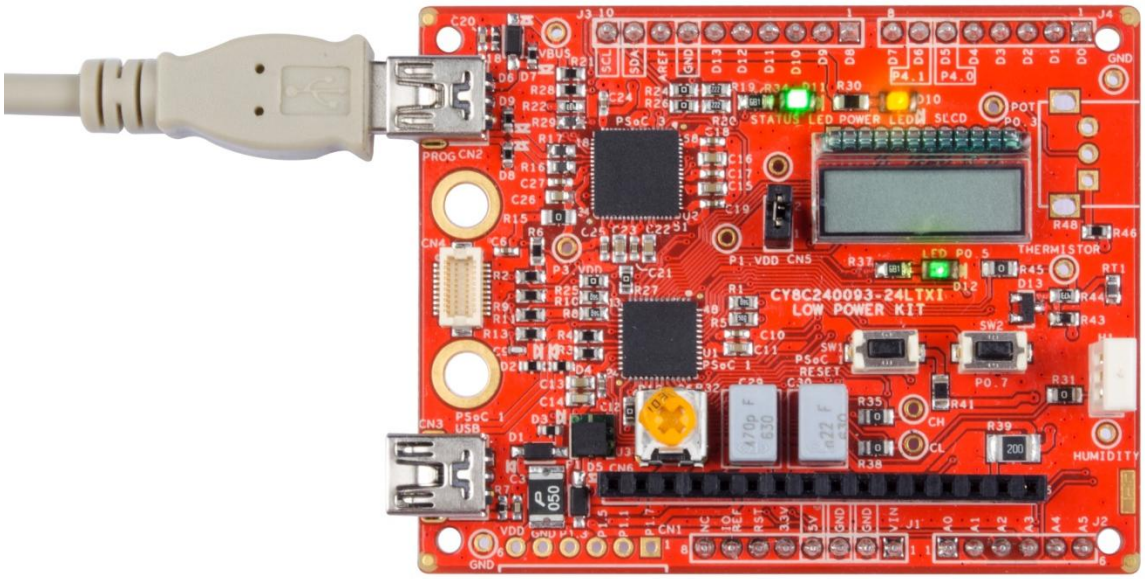


5.1.3 Hardware Connections

There are no specific hardware connections for this project because all the connections are hardwired on the board (P0_5 to LED D12).

5.1.4 Verify Output

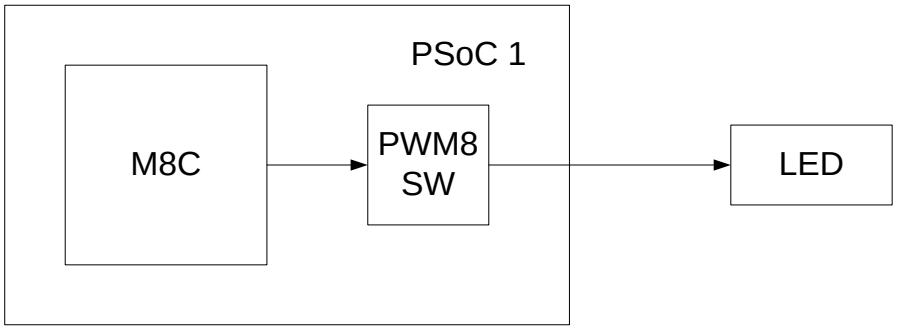
Build and program the code example on to the device. The brightness of the LED should smoothly vary over time.



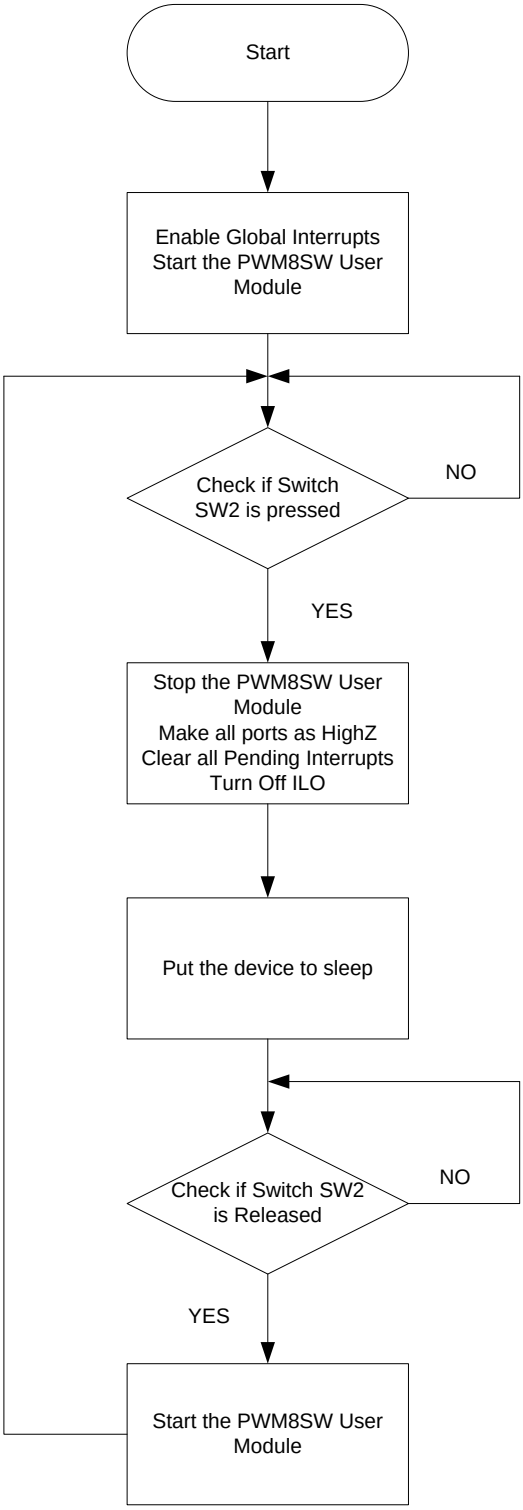
5.2 Project: Sleep_Wakeup

5.2.1 Project Description

This project demonstrates how to use the sleep functionality in the CY8C24x93 PSoC 1 device. On startup, the PSoC 1 device continuously blinks the LED using a PWM8SW User Module. When the switch SW2 is pressed, the PSoC 1 device goes into sleep mode by shutting down various peripherals. When the switch SW2 is pressed again, the PSoC 1 device wakes up and start blinking the LED again.



5.2.2 Flow Chart



5.2.3 Hardware Connections

There are no specific hardware connections for this project because all the connections are hardwired on to the board (P0_5 to LED D12, P0_7 to Switch SW2).

5.2.4 Verify Output

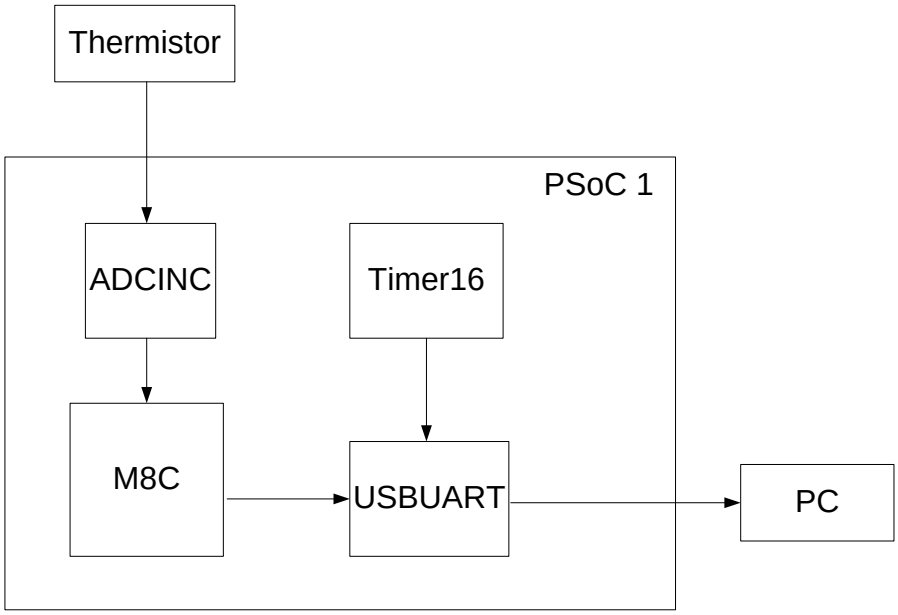
Build and program the code example on to the device. When the board is powered, the LED starts blinking. Press switch SW2 to put the device to sleep. The LED will stop blinking. You can measure the current consumed by the PSoC 1 device using the CN5 header.

5.3 Project: Data_Logger

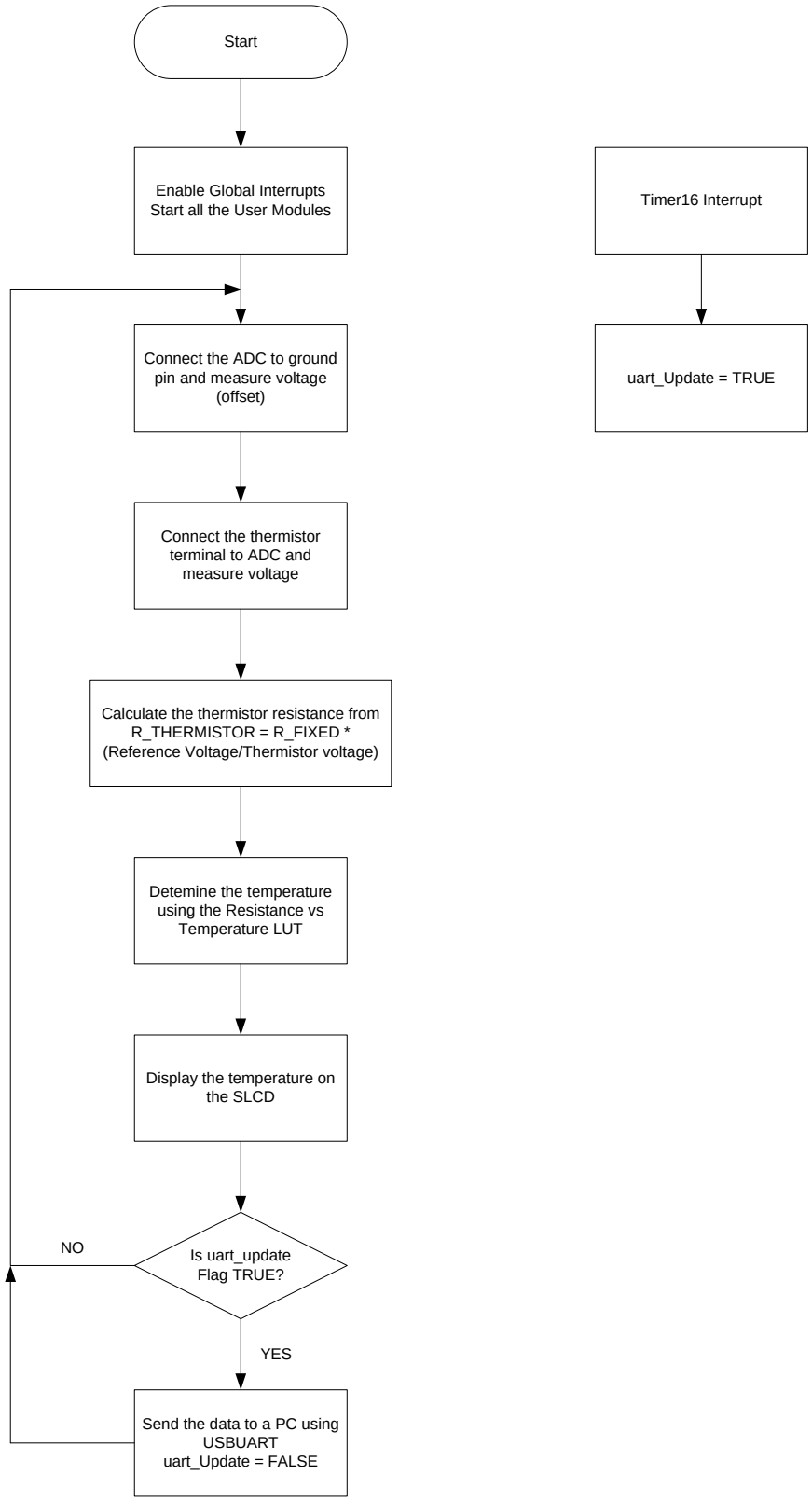
5.3.1 Project Description

This project demonstrates how measure temperature using a thermistor and transferring the data to a PC every second. The project uses the ADCINC User Module to measure the thermistor voltage, SLCD User Module to display the current temperature on a segment LCD and the Timer16 and USBUART User Modules to send the data to a PC every one second.

Note: The USBART User Module used here does not act as an USBUART bridge. It is used here so that it will be enumerated as a COM port in the PC.

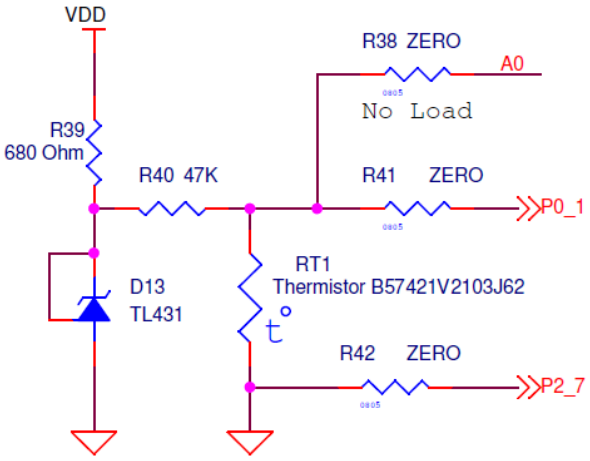


5.3.2 Flow Chart



5.3.3 Hardware Connections

Connect the kit board to a PC using a USB A to mini B cable. Use the Dev_Prog connector to connect the USB cable. Other than this, there are no specific hardware connections for this project because all the connections are hardwired on to the board as shown in the following schematic.



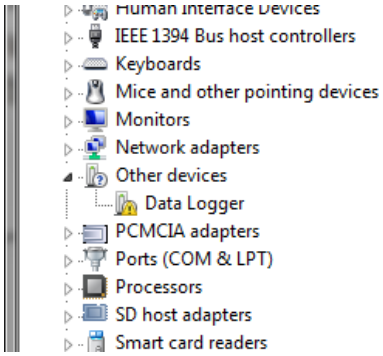
Thermistor

5.3.4 Verify Output

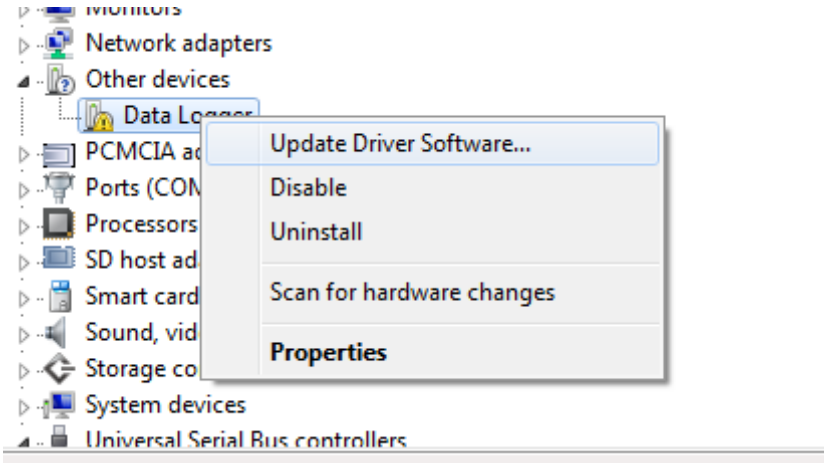
Build and program the code example on to the device. Open a terminal console such as TeraTerm on your PC. When the kit is powered, the terminal console will start displaying temperatures every second. The SLCD on-board will also display the same temperature.

Note: After programming the PSoC 1 device and connecting the board to the PC for the first time, the device will get enumerated but the driver will not be enumerated properly as it is not an HID device. The driver needs to be installed manually and is located at <*Project Workspace*>/Data_Logger/Data_Logger/lib/USBUART_1.inf. To complete that installation please use the following steps.

1. Connect the USB cable to the **PSoC 1 USB** connector.
2. The device will enumerate but not correctly install the driver. Navigate to the **Device Manager** by clicking **Start** and right clicking on **Computer** and selecting **Properties.** Then select **Device Manager**. You will see that under **Other Devices** there is a listing for a *Data Logger*

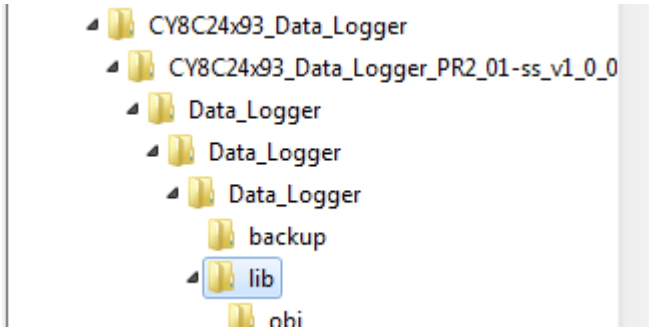


3. Right click on the *Data Logger* and select **Update Driver Software**

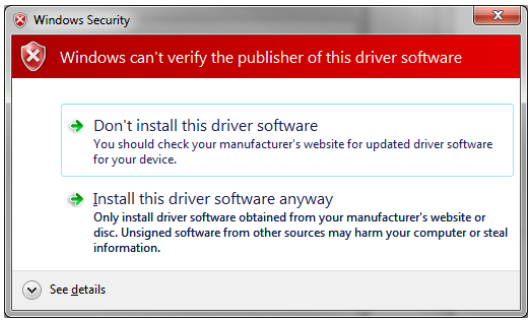


4. Navigate to the driver stored in the example project directory.

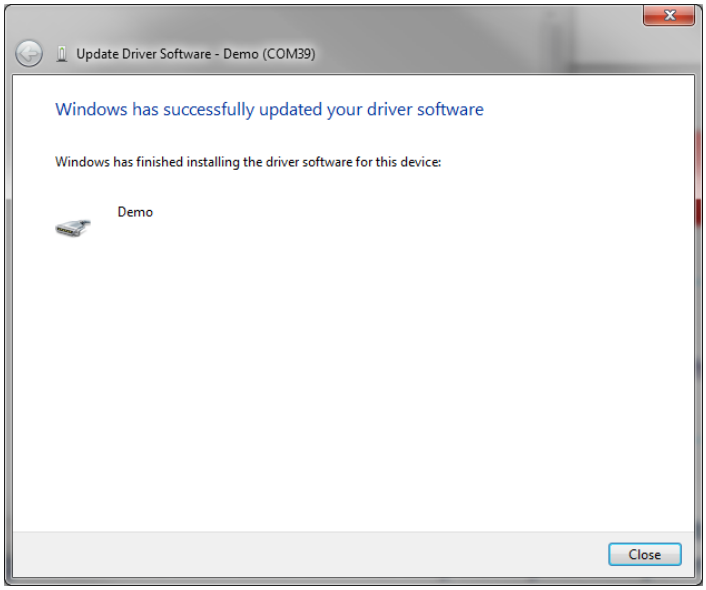
   <Project Workspace>/Data_Logger/Data_Logger/lib/USBUART_1.inf.



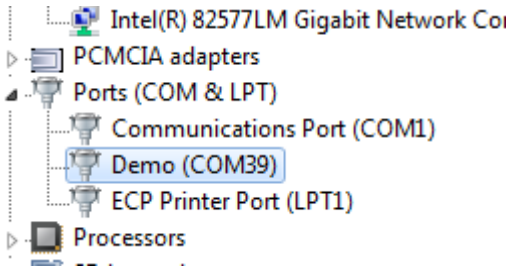
5. The driver will install. You will likely get a message that the driver is not signed and asking if you would like to continue. Select **Install This Driver Anyways**.



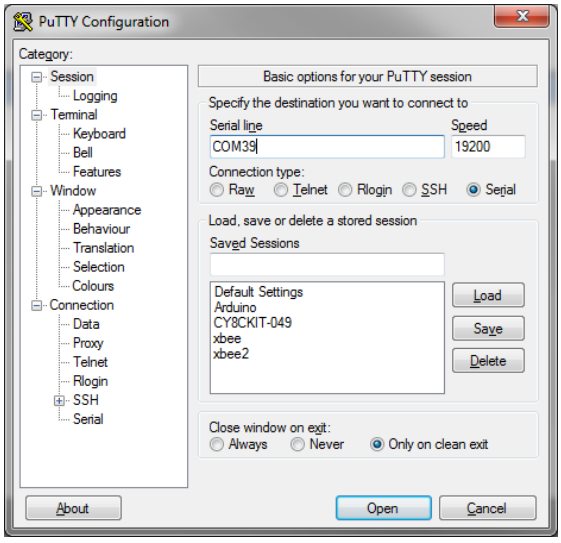
6. Once the driver is complete you will get a message that the driver has been installed. It will be named **Demo.**



7. The user will see the COM port under **Ports (COM & LPT)**



8. Launch a Hyperterminal client like PuTTY. You will not need to configure the baud rate as the driver uses a custom driver and not the HID driver. Set the serial port to the correct port, in this example the port is **COM39.** Click **Open.**



9. The PuTTY terminal then will display the streaming data.