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CY8CKIT-038

PSoC® 4200 Family Processor Module Kit Guide

Doc. # 001-85916 Rev. *A

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Safety Information

Regulatory Compliance

The CY8CKIT-038 is intended for use as a development platform for hardware or software in a laboratory environment. The board is an open system design, which does not include a shielded enclosure. This may cause interference to other electrical or electronic devices in close proximity. In a domestic environment, this product may cause radio interference. In this case, take adequate prevention measures. Also, do not use the board 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.

The CY8CKIT-038, as shipped from the factory, has been verified to meet with requirements of CE as a Class A product.

The CY8CKIT-038 contains electrostatic discharge (ESD) sensitive devices. Electrostatic charges readily accumulate on the human body and any equipment, and can discharge without detection. Permanent damage may occur on devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Store unused CY8CKIT-038 boards in the protective shipping package.

End-of-Life / Product Recycling

The end-of life for this kit is after five years from the date of manufacturing mentioned on the back of the box. Contact your nearest recycler for dispositioning the kit.

General Safety Instructions

ESD Protection

ESD can damage boards and associated components. Cypress recommends that you perform procedures only at an ESD workstation. If 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.

Handling Boards

CY8CKIT-038 boards are sensitive to ESD. Hold the board only by its edges. After removing the board from its box, place it on a grounded, static free surface. Use a conductive foam pad if available. Do not slide board over any surface.

1. Introduction

Thank you for your interest in the CY8CKIT-038 PSoC® 4200 Family Processor Module Kit. This kit allows you to develop applications on various products such as the sensor-less e-bike, white goods, field oriented control (FOC) motor control, and home appliances. You can also design your own projects with PSoC Creator™, the integrated design environment (IDE) for PSoC devices.

The CY8CKIT-038 Processor Module is a PSoC 4200 family processor module designed for the CY8CKIT-001 DVK. PSoC 4200 is a family of programmable embedded system devices with an ARM Cortex-M0 CPU. It combines programmable analog, programmable interconnect, and user programmable digital logic with a high-performance ARM Cortex-M0 subsystem.

1.1 Kit Contents

This kit contains:

- CY8CKIT-038 processor module
- I2C character LCD
- Quick start guide
- Kit CD/DVD

You can purchase this kit and download the example projects at http:/www.cypress.com/go/CY8CKIT-038

Inspect the contents of the kit; if you find any part missing, contact your nearest Cypress sales office for help or visit www.cypress.com/support.

1.2 PSoC Creator

Cypress's PSoC Creator software is a state-of-the-art, easy-to-use software development IDE. It introduces a hardware and software co-design environment based on classical schematic entry and revolutionary embedded design methodology.

With PSoC Creator, you can:

- Create and share user-defined, custom peripherals using a hierarchical schematic design.
- Automatically place and route select components and integrate simple glue logic normally residing in discrete muxes.
- Trade-off hardware and software design considerations allowing you to focus on what matters and get to market faster.

PSoC Creator also enables you to tap into an entire tools ecosystem with integrated compiler tool chains, RTOS solutions, and production programmers to support PSoC devices.

For more information, visit the PSoC Creator web page.

1.3 Additional Learning Resources

Visit www.cypress.com/Products/Programmable System-on-Chip for additional learning resources in the form of datasheets, technical reference manual, and application notes.

- Beginner Resources: PSoC Creator Training
  - Getting Started With PSoC 4
- Learning from Peers: Cypress Developer Community Forums

1.4 Document Revision History

Table 1-1. Revision History

Revision	PDF Creation Date	Origin of Change	Description of Change
**	05/10/2013	SRYP	Initial version of kit guide
*A	09/26/2013	SASH	Updated images for PSoC Creator 3.0

1.5 Documentation Conventions

Table 1-2. Document Conventions for Guides

Convention	Usage
`Courier New`	Displays file locations, user entered text, and source code: `C:\ ...cd\icc\`
Italics	Displays file names and reference documentation: Read about the *sourcefile.hex* file in the *PSoC Designer User Guide*.
[**Bracketed, Bold**]	Displays keyboard commands in procedures: [**Enter**] or [**Ctrl**] [**C**]
File > Open	Represents menu paths: File > Open > New Project
Bold	Displays commands, menu paths, and icon names in procedures: Click the **File** icon and then click **Open**.
Times New Roman	Displays an equation: 2 + 2 = 4
Text in gray boxes	Describes Cautions or unique functionality of the product.

2. Getting Started

This chapter describes how to install and configure the CY8CKIT-038 PSoC 4200 Family Processor Module kit software. Chapter 3 shows you how to program the kit, Chapter 4 documents the hardware features of the kit, and Chapter 5 explains the operation of the code examples. The Appendix section provides the schematics, PCB layout, and bill of materials (BOM) associated with the kit.

2.1 CD/DVD Installation

Follow these steps to install the CY8CKIT-038 PSoC 4200 Family Processor Module Kit software:

1. Insert the kit CD/DVD into your PC's CD/DVD drive. The CD/DVD is designed to auto-run. If auto-run does not execute, double click **AutoRun** on the root of the CD/DVD.
2. After the installation is complete, the kit contents are available at the following location:
   `<InstallDirectory>\PSoC 4200 Processor Module Kit\<version>`

2.2 Install Hardware

No hardware installation is required for this kit. The processor module is designed to be used in conjunction with the CY8CKIT-001.

2.3 Install Software

When installing the CY8CKIT-038 PSoC 4200 Family Processor Module Kit, the installer checks if your system has the required software. These include PSoC Creator, PSoC Programmer, Windows Installer, .NET, Acrobat Reader, and Keil complier. If these applications are not installed, the installer prompts you to download and install them.

The following software needs to be installed that are specified in the CD/DVD:

- PSoC Creator 3.0 or later
- PSoC Programmer 3.19.1 or later
  Note Select the **Typical** installation type for all installations.

Code examples are provided in the Firmware folder of the kit installer.

2.4 Uninstall Software

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

- Go to **Start** > **Control Panel** > **Programs** > **Uninstall Programs;** select the **Uninstall** tab for Windows.
- Go to **Start** > **All Programs** > **Cypress** > **Cypress Update Manager** > **Cypress Update Manager**; select the **Uninstall** button next to the software that needs to be uninstalled.

2.5 Verify Kit Version

To know the kit revision, look for the white sticker on the bottom left, on the reverse of the kit box. If the revision reads CY8CKIT-038 Rev **, then, you own the latest version.

3. Kit Operation

The CY8CKIT-038 PSoC 4200 Family Processor Module Kit should be mounted on the CY8CKIT-001 DVK. The serial wire debugger (SWD) interface is available for programming/debugging on the processor module board, as shown in the Figure 3-1.

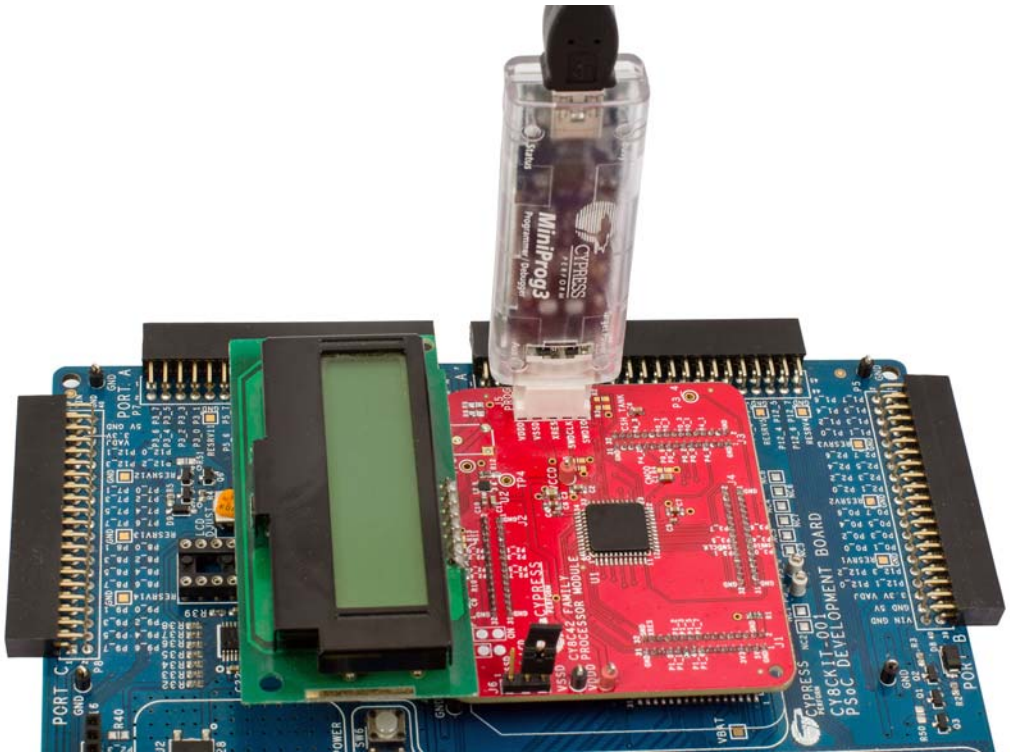
3.1 Programming CY8CKIT-038

This section provides details on how to program the PSoC 4200 family device by using the "VoltageDisplay_SAR_DAC" example project.

Follow this procedure to program a project onto the PSoC 4200 family device:

1. Connect the PSoC 4200 family processor module on the CY8CKIT-001 DVK.
2. Apply the power to the CY8CKIT-001 DVK using either the battery connections or a wall power unit using 12-V AC adapter.
3. Connect the MiniProg3 to the processor module on the 5-pin programming header J5, as shown in Figure 3-1; then, connect it to the host PC's USB high-speed port using a USB cable.

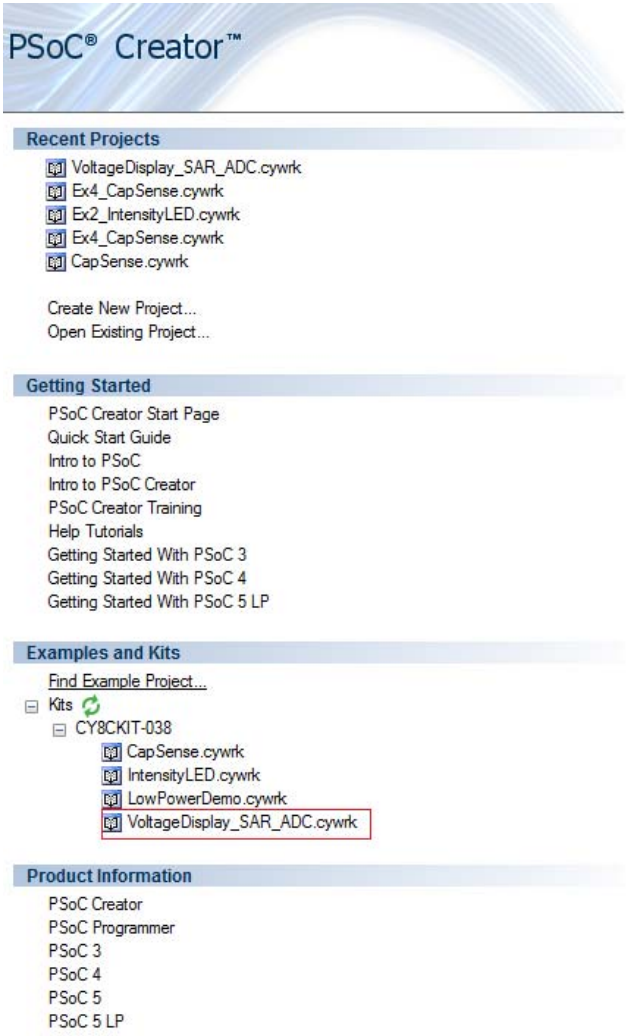
Figure 3-1. Connecting CY8CKIT-038 and MiniProg3 with CY8CKIT-001 DVK



Note Refer to CY8CKIT-001 PSoC Development Kit Board Guide for more details on connections.

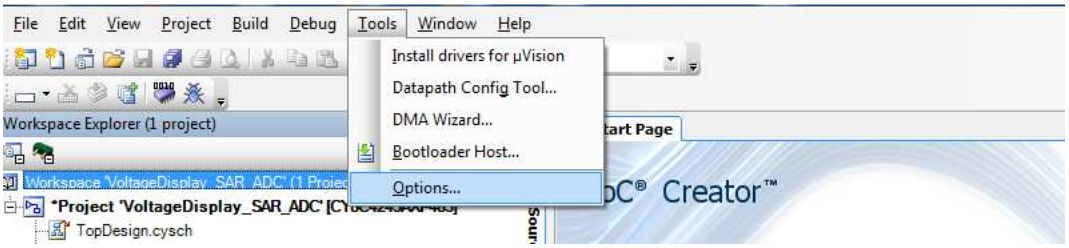
4. Open PSoC Creator. Click on the **VoltageDisplay_SAR_ADC** example project from the **Kits** folder present on the **Start Page**.

Figure 3-2. Kit Projects in the PSoC Creator Start Page



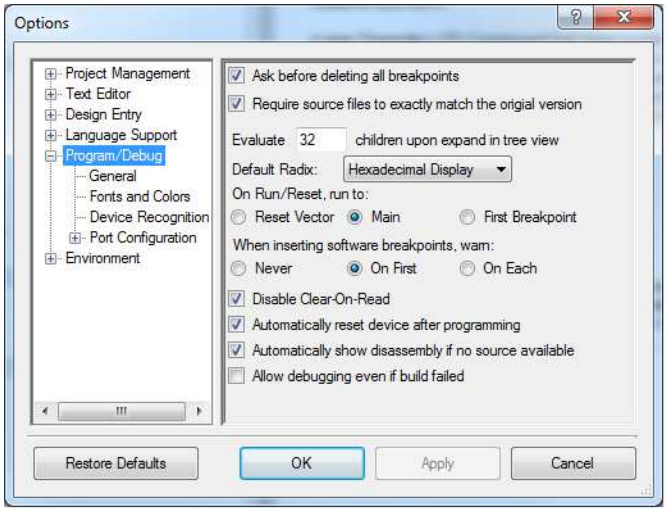
5. Create a folder in the desired location and click **OK.**
6. The project opens up in PSoC Creator and is saved in that folder.
7. Go to the **Tools** menu select **Options**.

Figure 3-3. Tools > Options



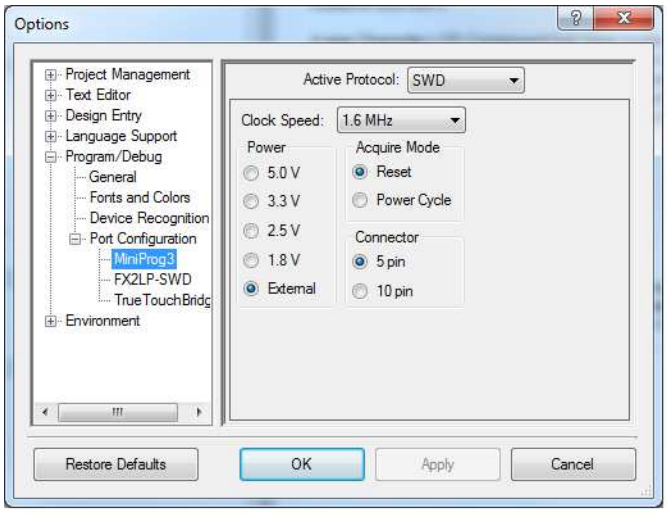
8. Go to **Program/Debug.**

Figure 3-4. Program/Debug Option



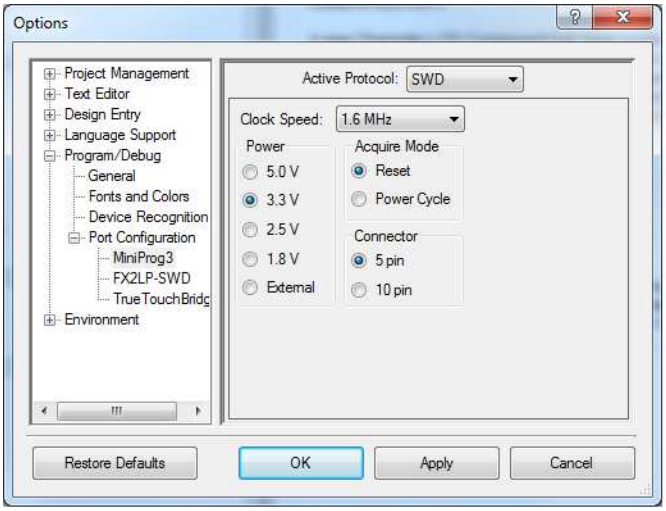
9. Select **Port Configuration** and click **MiniProg3**.

Figure 3-5. Select MiniProg3



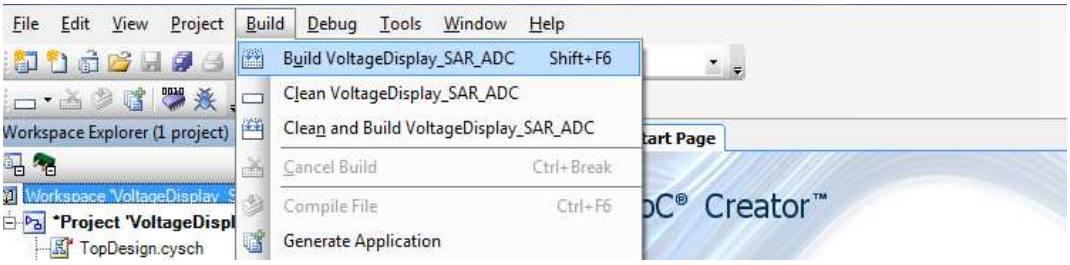
10. Configure **MiniProg3** using the following settings.

Figure 3-6. MiniProg3 Configurations



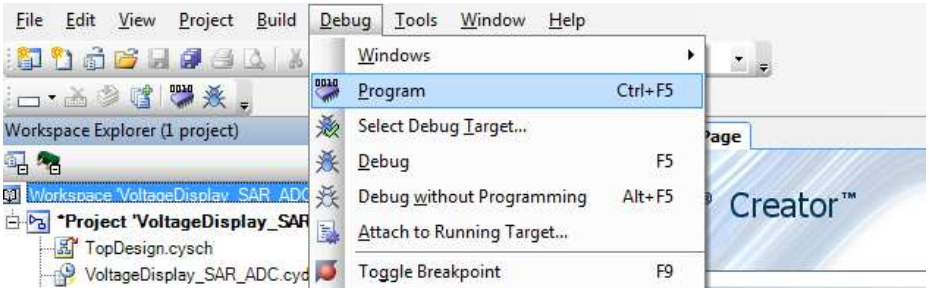
11. Build the project by selecting the **Build** option.

Figure 3-7. Build Option



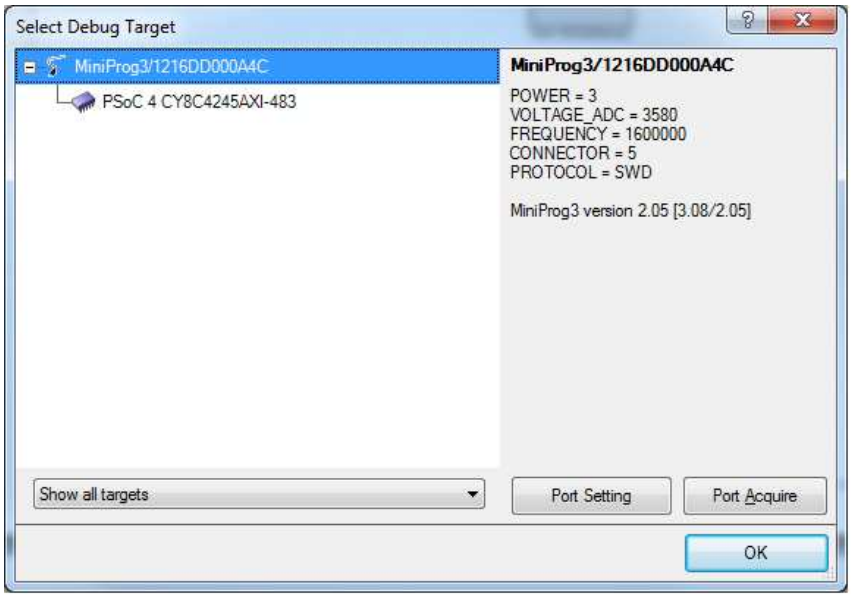
12. Click the **Program** icon.

Figure 3-8. Program Option



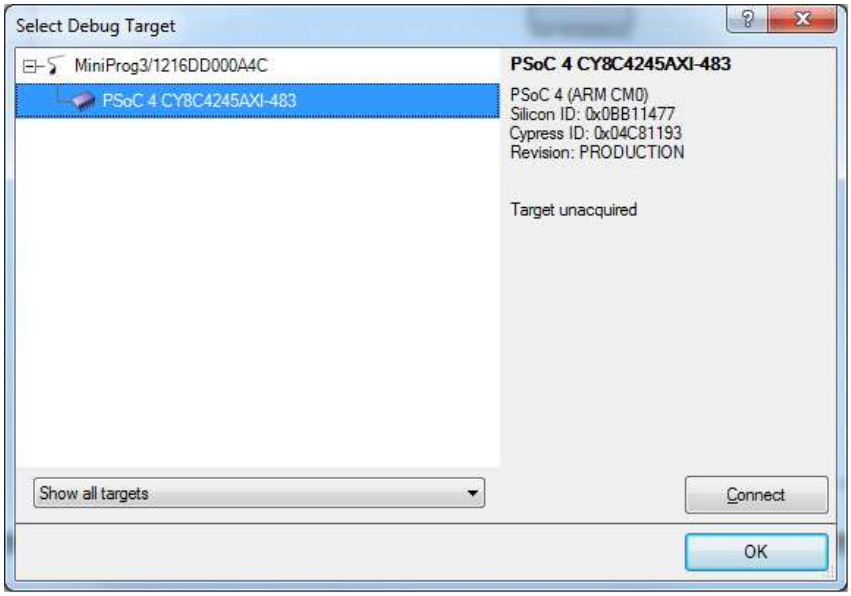
In some cases, when you click the **Program** tab, the following window pops up.

Figure 3-9. Select Debug Target Window



Click on **Port Acquire**. Click **Connect** and then select **OK** to program the device.

Figure 3-10. Program Device



13. After successful programming, a prompt message is displayed in the output window (see Figure 3-11).

Figure 3-11. Successful Programming Message in Output Window

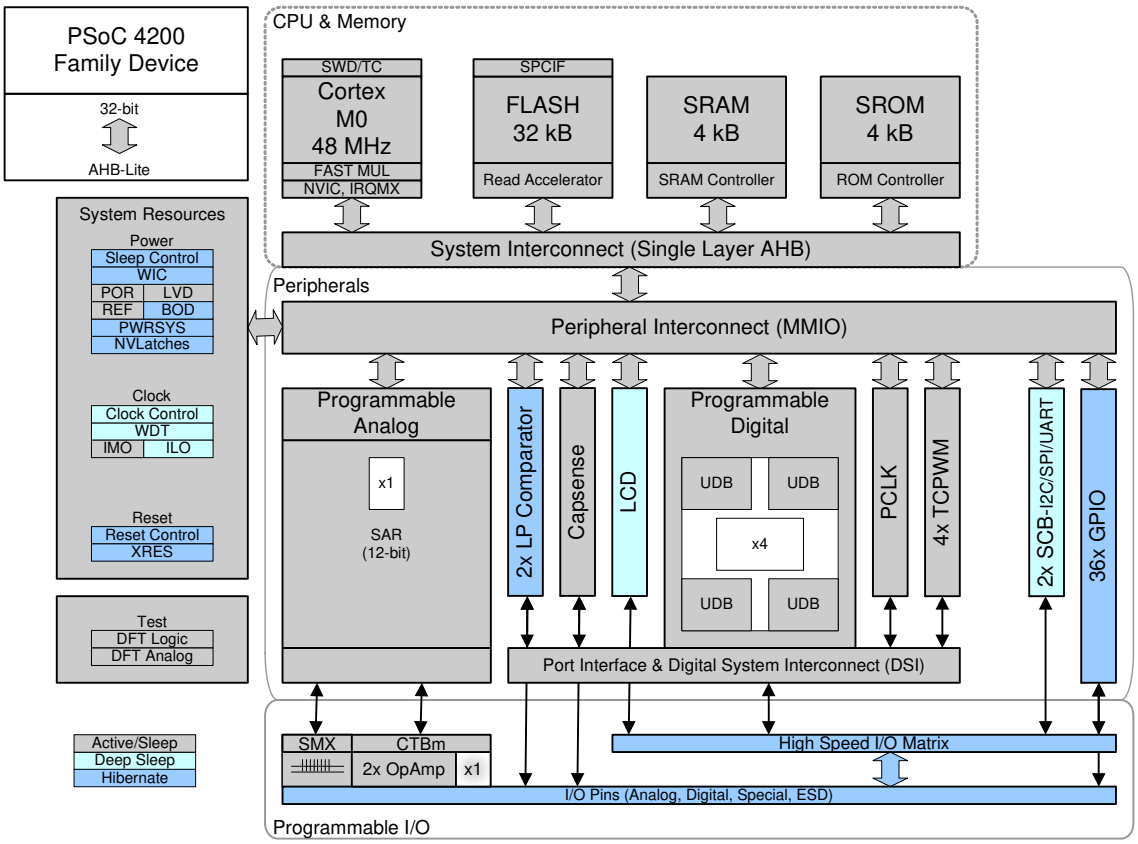
```
---------- Build Succeeded: 04/02/2013 11:43:36 ----------
Programming started for device: 'PSoC 4 CY8C4245AXI-483'.
Device ID Check
Erasing...
Programming of Flash Starting...
Protecting...
Verify Checksum...
Device 'PSoC 4 CY8C4245AXI-483' was successfully programmed at 04/02/2013 11:43:39.
```

Note Refer to Example Projects chapter on page 19 for more example projects.

4. Hardware

4.1 System Block Diagram

Figure 4-1. PSoC 4200 Family Block Diagram

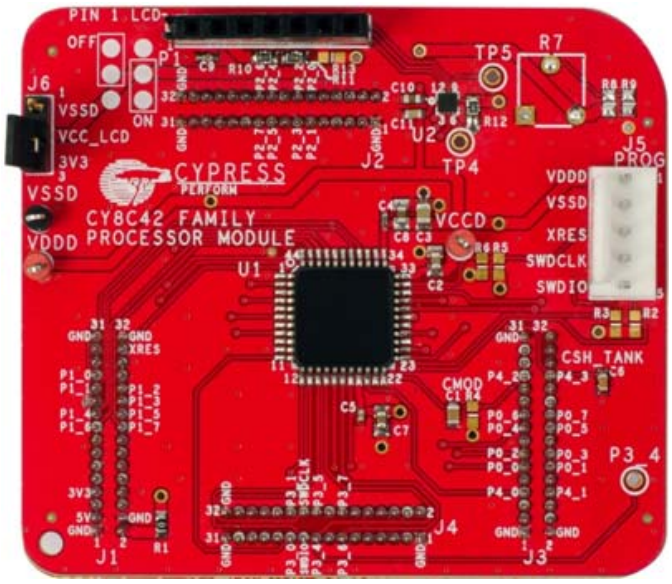


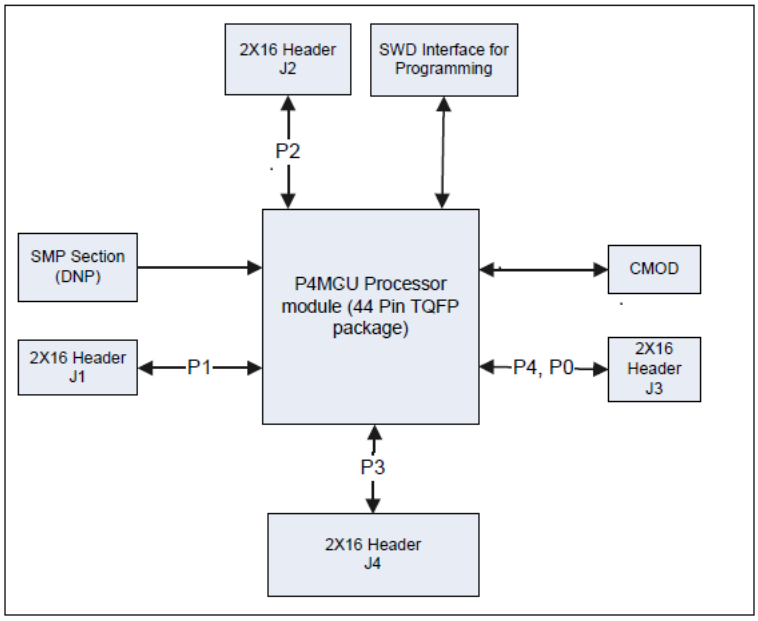
Features

- 48-MHz Cortex-M0 CPU (0.9 DMIPS/MHz)
- 32-KB flash and 4-KB SRAM
- Programmable logic: Four universal digital blocks
- Analog blocks: 12-bit 1-MSPS SAR ADC with sample and hold and a programmable sequencer, a continuous time block with two opamps with a comparator mode, a temperature sensor, and two low-power comparators
- Fixed-function digital blocks: Two combination UART/SPI/I2C (one function at a time) serial communication blocks (SCB). Four 16-bit counter/timer/PWMs with center-aligned capability

- Fixed-function special blocks: CSD CapSense block with shield driver for waterproofing and digital LCD drive on all pins
- Clocking: Trimmed IMO and ILO clock sources
- Deep Sleep, Hibernate, and Stop low-power modes

Figure 4-2. CY8CKIT-038 PSoC 4200 Family Processor Module Board





The CY8CKIT-038 PSoC 4200 family processor module board has the following four blocks:

- 44-Pin TQFP package PSoC 4200 family device
- Four 2 × 16 headers, which connect to the CY8CKIT-001 DVK main board
- CMOD circuitry for CapSense application
- Single-wire debug (SWD) connector

5. Example Projects

All code examples provided with this kit are for the PSoC 4 device, CY8C4245AXI-483. Make sure that you select this device when creating new projects using this processor module. Visit http://www.cypress.com/?id=4519 for more information about the PSoC 4200 device portfolio.

5.1 Project: VoltageDisplay_SAR_ADC

For all the projects, place jumper J12 on CY8CKIT-001 in the LCD power off position.

5.1.1 Project Description

This example project measures an analog voltage controlled by the potentiometer. The project uses the internal SAR ADC configured for a 12-bit operation; the ADC range is 0 to VDDA. The results are displayed on the I2C character LCD.

Figure 5-1. VoltageDisplay_SAR_ADC Schematic

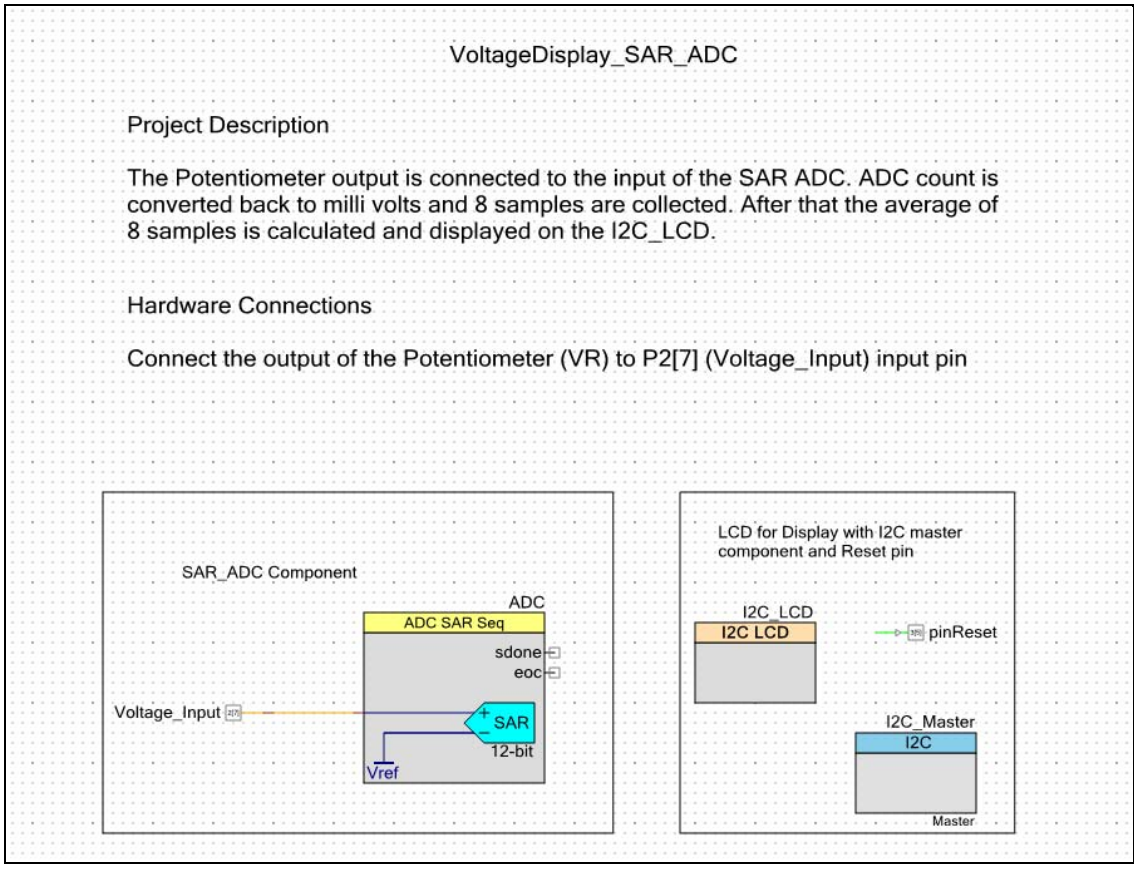
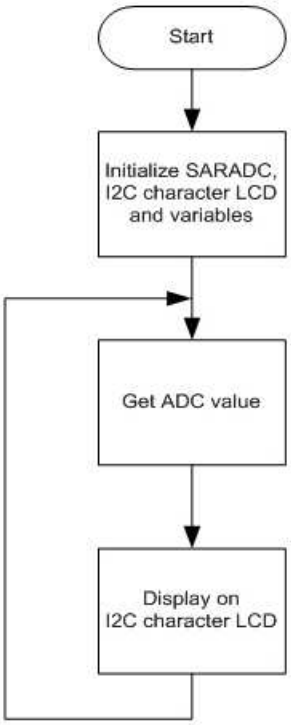


Figure 5-2. Project Flow Chart

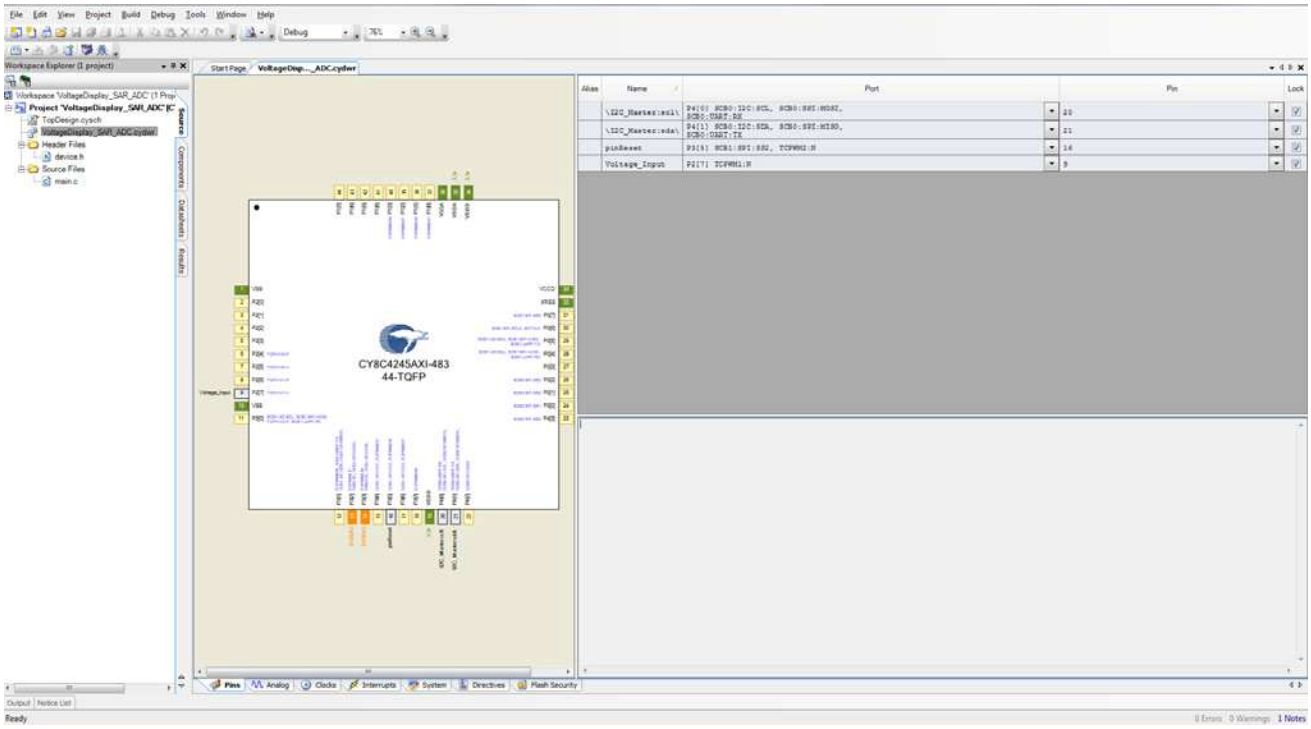


5.1.2 Hardware Connections

The I2C character LCD should be configured as shown in the following table.

Pin Name	Port Name
Reset	P3[5]
SCB_SCL	P4[0]
SCB_SDA	P4[1]

5.1.2.1 PSoC Creator Connections (VoltageDisplay_SAR_ADC.cydwr)



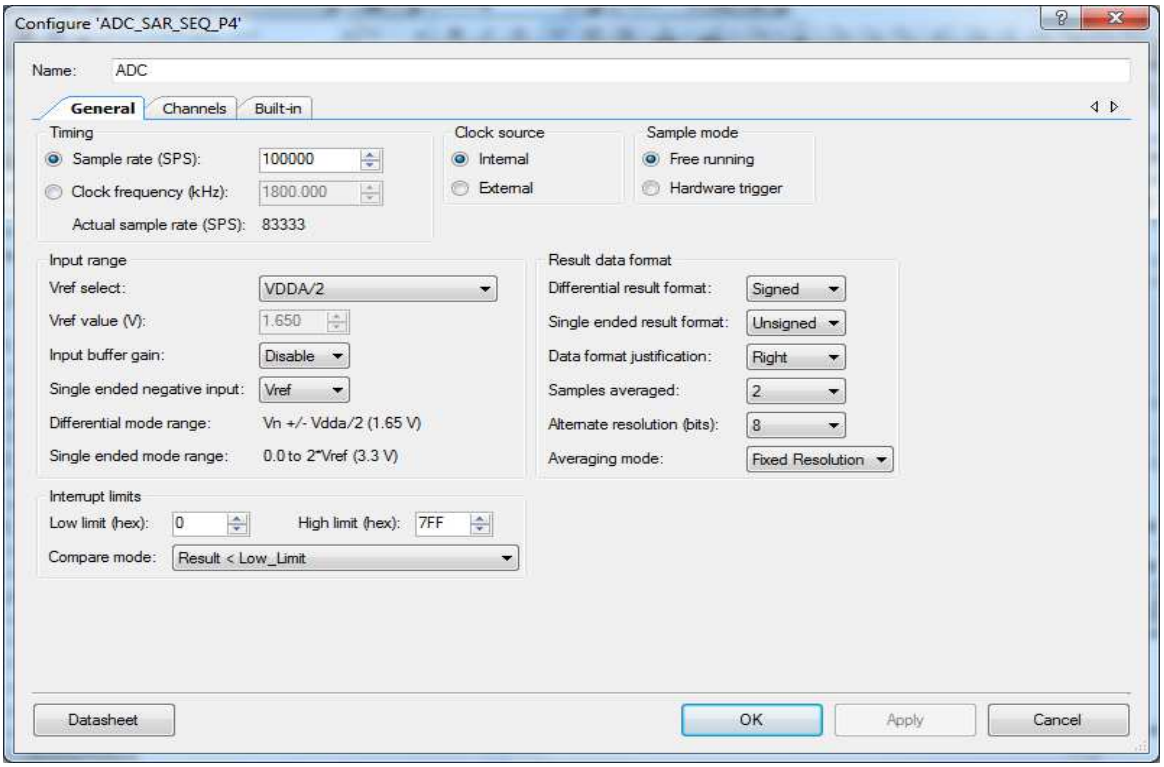
5.1.2.2 Physical Connections on CY8CKIT-001 DVK

Because it uses the potentiometer, the jumper VR_PWR (J11) should be in place. This connects the potentiometer to the VDDA. Connect the output of the VR pin to P2[7] (Voltage_Input) input pin, as shown in Figure 5-5 on page 23.

5.1.3 SAR ADC Configuration

To view or configure the SAR ADC component, double-click the component in the *TopDesign.cysch* file.

Figure 5-3. SAR ADC Configuration

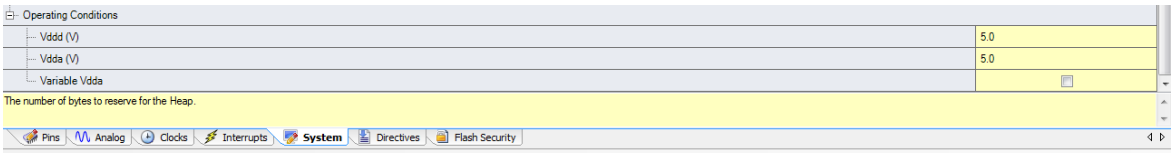


The SAR ADC is configured as follows:

- Free-running mode of operation is selected because the ADC scans only one channel continuously.
- Sample rate is set to 100,000 sps. The code waits for each sample, processes it, and displays the result on the LCD.
- Range is set to VSSA to 2*VREF (3.3 V) in single-ended mode because the potentiometer output is a single-ended signal that can go from 0 to VDDA.Therefore, at 12-bit resolution, the ADC resolves in steps of VDDA/2.
- Voltage reference should be set to VDDA/2 supply voltage when the input range is set to VSSA to VDDA. It is set to 1.65 V here, because by default the VDDA jumper setting on the board is set to 3.3 V.

When the VDDA jumper on the board is set to 5 V, set **Operating Conditions** in the **System** tab to 5 V as shown in Figure 5-4.

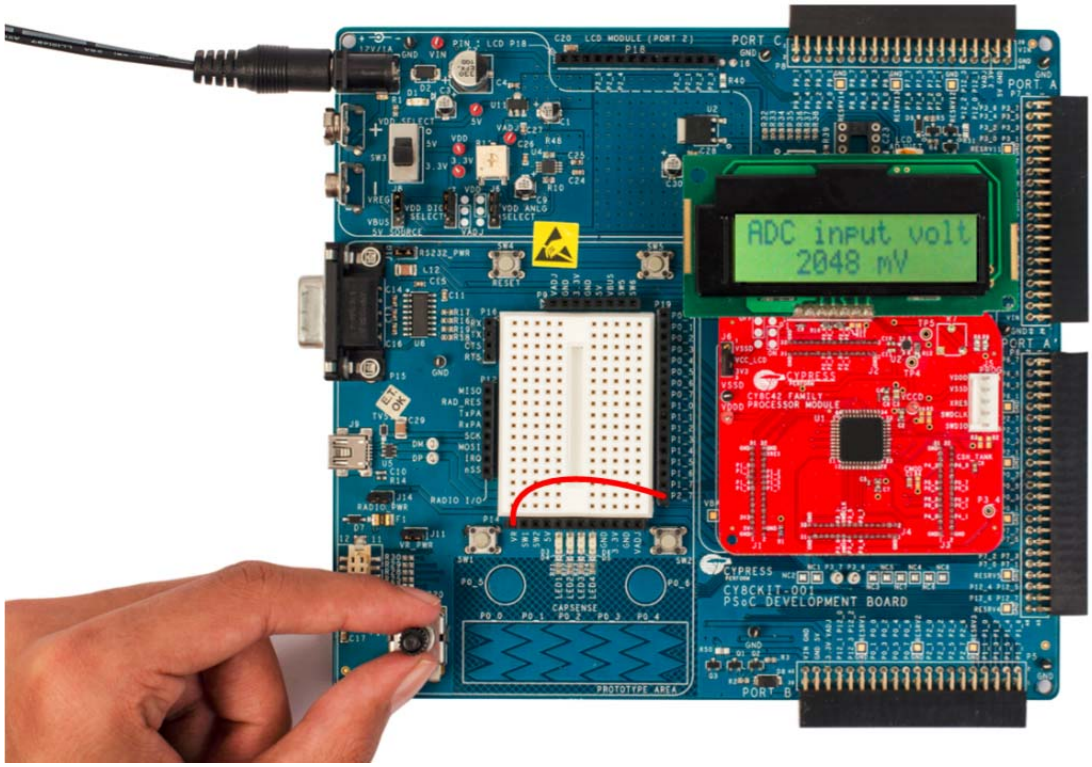
Figure 5-4. Operating Condition



5.1.4 Verify Output

Build and program the code example, and reset the device. The LCD shows the voltage reading corresponding to the voltage on the potentiometer. The following figure demonstrates the functionality. When you turn the potentiometer, the voltage value changes.

Figure 5-5. VoltageDisplay_SAR_ADC Project Demonstration



You can also verify the voltage on the potentiometer using a precision multimeter.

Note The potentiometer connects to a differential ADC, which works in the single-ended mode. This means the ADC input is measured against internal VSSA. Any offset in the measurement can be positive or negative. This can result in a small offset voltage even when the potentiometer is zero.

5.2 Project: IntensityLED

5.2.1 Project Description

This example code uses pulse-width modulators (PWM) to illuminate an LED. When the pulse width of the PWM varies, the LED brightness changes. By continuously varying the pulse width of the PWM, the example code makes an LED go from low brightness to a high brightness and back.

Figure 5-6. Intensity LED Schematic

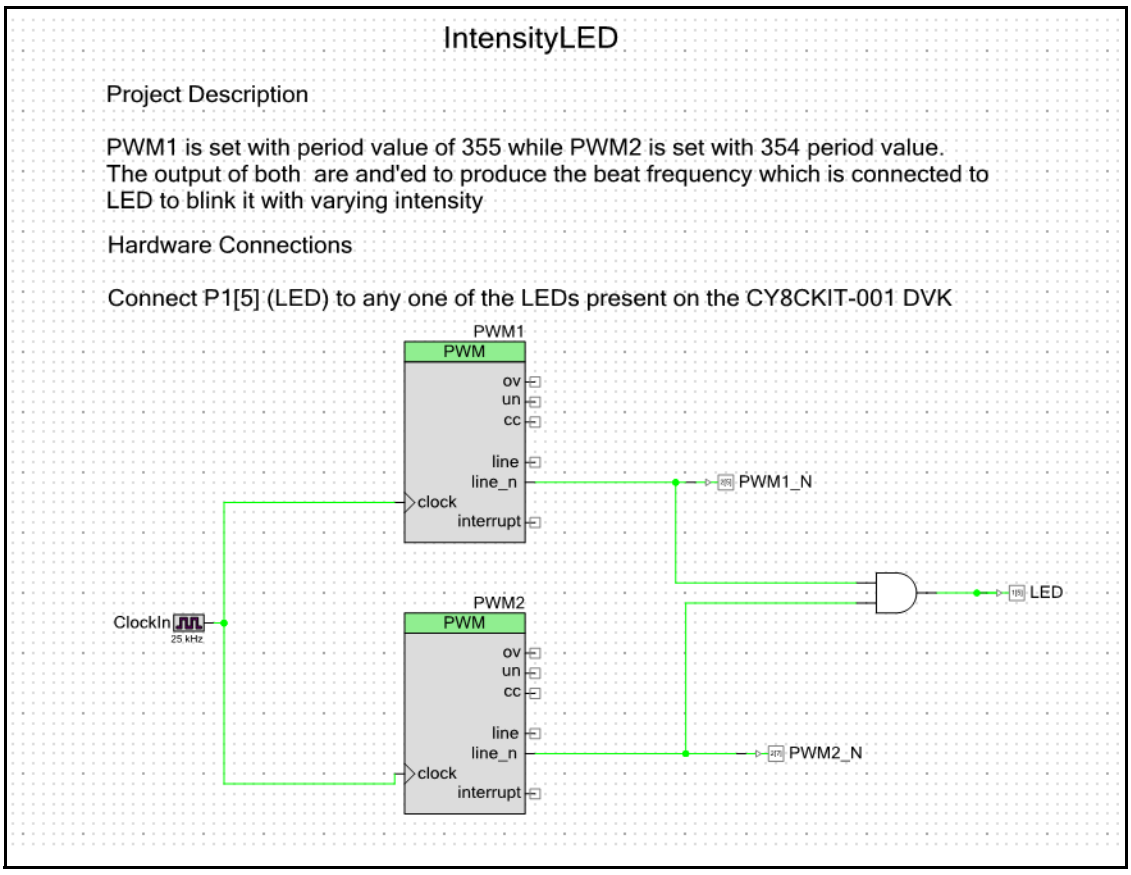
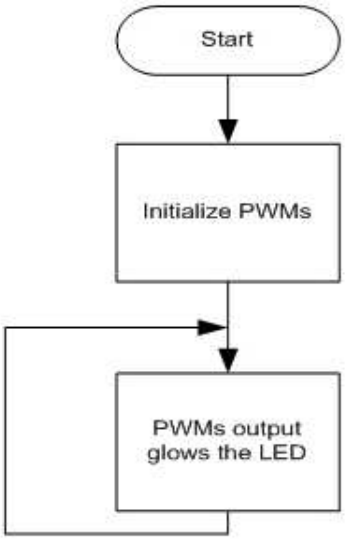
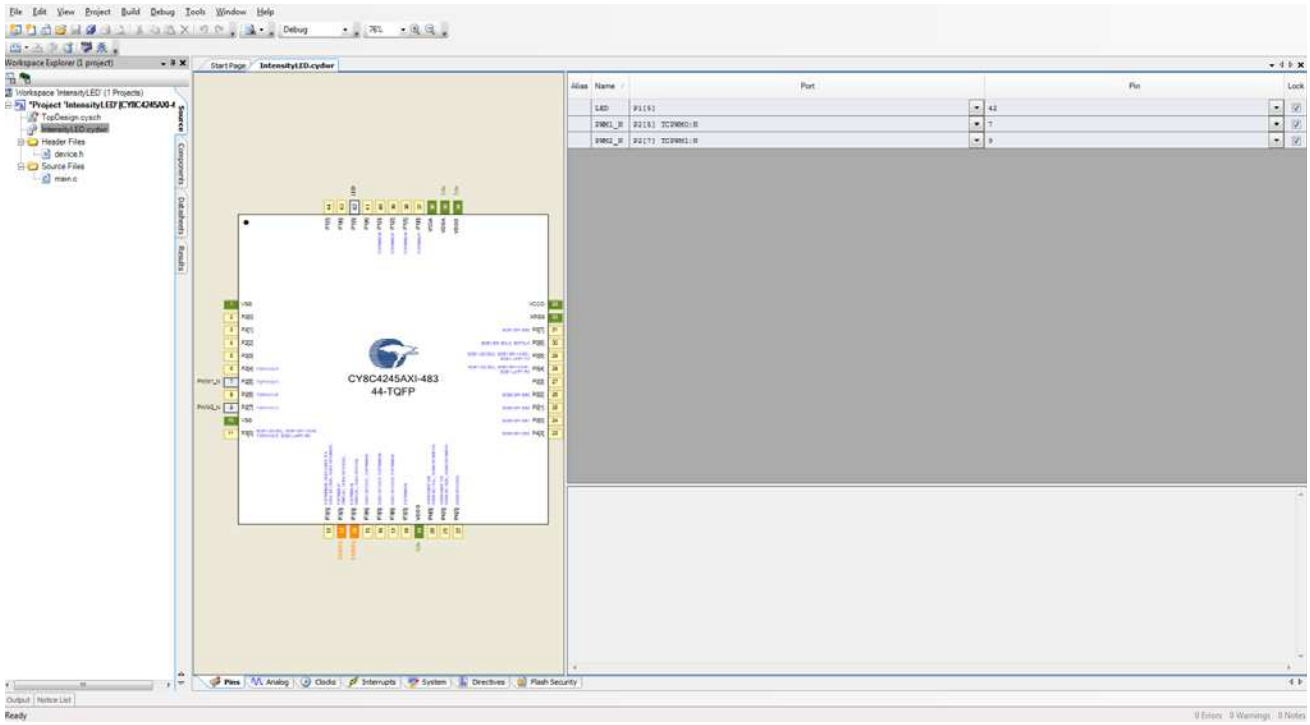


Figure 5-7. Project Flow Chart



5.2.2 Hardware Connections

5.2.2.1 PSoC Creator Connections (IntensityLED.cydwr)



5.2.2.2 Physical Connections on CY8CKIT-001 DVK

Connect the output pin P1[5] (LED) to any one of the LEDs present on the CY8CKIT-001 DVK, as shown in Figure 5-8.