



CY8CKIT-001

PSoC[®] Development Kit Guide

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Cypress Semiconductor
198 Champion Court
San Jose, CA 95134-1709
Phone (USA): 800.858.1810
Phone (Intl): 408.943.2600
<http://www.cypress.com>

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Contents



1. Introduction	7
1.1 Kit Overview.....	7
1.2 Kit Contents	7
1.3 Installation.....	8
1.3.1 Before You Begin	8
1.3.2 Prerequisites	8
1.3.3 Installing PSoC 1 Development Software	8
1.3.4 Installing PSoC 3 Development Software	8
1.3.5 Installing PSoC 5 Development Software	9
1.4 PSoC Development Board.....	10
1.4.1 Default Switch and Jumper Settings	10
1.5 Conventions	12
1.6 Document Revision History	12
2. Loading My First PSoC Project	13
2.1 My First PSoC 1 (CY8C28) Project	14
2.1.1 Loading My First PSoC 1 Project	14
2.1.2 Building My First PSoC 1 Project	15
2.1.3 Programming My First PSoC 1 Project	15
2.1.4 Running My First PSoC 1 Project	16
2.2 My First PSoC 1 (CY8C29) Project	17
2.2.1 Loading My First PSoC 1 Project	17
2.2.2 Building My First PSoC 1 Project	18
2.2.3 Programming My First PSoC 1 Project	19
2.2.4 Running My First PSoC 1 Project	20
2.3 My First PSoC 3 (CY8C38) Project	21
2.3.1 Loading My First PSoC 3 Project	21
2.3.2 Building My First PSoC 3 Project	22
2.3.3 Programming My First PSoC 3 Project	23
2.3.4 Running My First PSoC 3 Project	24
2.4 My First PSoC 5 (CY8C55) Project	25
2.4.1 Loading my First PSoC 5 Project	25
2.4.2 Building My First PSoC 5 Project	26
2.4.3 Programming My First PSoC 5 Project	27
2.4.4 Running My First PSoC 5 Project	28
3. Sample Projects	29
3.1 CY8C28 Family Processor Module Example Projects.....	29
3.1.1 My First PSoC 1 (CY8C28) Project.....	29
3.1.1.1 Creating My First PSoC 1 (CY8C28) Project.....	29
3.1.1.2 main.c	38
3.1.2 ADC to LCD Project	39

3.1.2.1	Creating ADC to LCD Project.....	39
3.1.2.2	main.c.....	44
3.1.3	ADC to UART with DAC.....	46
3.1.3.1	Creating ADC to UART with DAC Project	46
3.1.3.2	main.c.....	55
3.1.4	CapSense®.....	58
3.1.4.1	Creating CapSense Project.....	58
3.1.4.2	main.c.....	64
3.2	CY8C29 Family Processor Module Example Projects	68
3.2.1	My First PSoC 1 (CY8C29) Project.....	68
3.2.1.1	Creating My First PSoC 1 (CY8C29) Project.....	68
3.2.1.2	main.c.....	76
3.2.2	ADC to LCD Project.....	77
3.2.2.1	Creating ADC to LCD Project.....	77
3.2.2.2	main.c.....	82
3.2.3	ADC to LCD with DAC and UART	84
3.2.3.1	Creating ADC to LCD with DAC and UART Project	84
3.2.3.2	main.c.....	95
3.2.3.3	Counter8_1INT.asm	99
3.3	CY8C38 / CY8C55 Family Processor Module Example Projects.....	101
3.3.1	My First PSoC 3 / PSoC 5 Project	101
3.3.1.1	Creating My First PSoC 3 / PSoC 5 Project	101
3.3.1.2	Placing and Configuring the PWM.....	102
3.3.1.3	Placing and Configuring Digital Output Pin Hardware	103
3.3.1.4	Placing and Configuring the Software Digital Output Pin	104
3.3.1.5	Connecting the Components Together.....	105
3.3.1.6	Configuring the Pins	106
3.3.1.7	Creating the main.c File.....	107
3.3.1.8	Configuring and Programming the PSoC Development Board	108
3.3.2	ADC to LCD Project.....	109
3.3.2.1	Creating ADC to LCD Project.....	109
3.3.2.2	Placing and Configuring Delta Sigma ADC	109
3.3.2.3	Placing and Configuring an Analog Pin	110
3.3.2.4	Placing and Configuring Character LCD	111
3.3.2.5	Connecting the Components Together.....	112
3.3.2.6	Configuring the Pins	112
3.3.2.7	Creating the main.c File.....	113
3.3.2.8	Configuring and Programming the PSoC Development Board	115
3.3.3	ADC to UART with DAC.....	116
3.3.3.1	Creating ADC to UART with DAC Project	116
3.3.3.2	Placing and Configuring Delta Sigma ADC	116
3.3.3.3	Placing and Configuring an Analog Pin	117
3.3.3.4	Placing and Configuring Character LCD	118
3.3.3.5	Placing and Configuring Voltage DAC.....	119
3.3.3.6	Placing and Configuring Opamp.....	120
3.3.3.7	Placing and Configuring Analog Pin	121
3.3.3.8	Placing and Configuring UART.....	122
3.3.3.9	Placing and Configuring Digital Output Pin	123
3.3.3.10	Placing and Configuring DMA	124
3.3.3.11	Connecting the Components Together.....	124
3.3.3.12	Configuring the Pins	125
3.3.3.13	Creating the main.c File.....	126
3.3.3.14	Configuring and Programming the PSoC Development Board	130

3.3.4	USB HID.....	132
3.3.4.1	Creating USB HID Project.....	132
3.3.4.2	Placing and Configuring USBFS.....	132
3.3.4.3	Placing and Configuring Software Digital Input Pin	135
3.3.4.4	Placing and Configuring LED.....	136
3.3.4.5	Configuring the Pins.....	138
3.3.4.6	Creating the main.c File.....	138
3.3.4.7	Configuring and Programming the PSoC Development Board.....	143
3.3.5	CapSense	144
3.3.5.1	Creating CapSense Project	144
3.3.5.2	Placing and Configuring CapSense	144
3.3.5.3	Placing and Configuring Character LCD.....	148
3.3.5.4	Placing and Configuring Digital Output Pin.....	149
3.3.5.5	Configuring the Pins.....	150
3.3.5.6	Creating the main.c File.....	151
3.3.5.7	Configuring and Programming the PSoC Development Board.....	154
3.3.6	SAR ADC (PSoC 5 Only).....	155
3.3.6.1	Creating ADC to UART with DAC Project.....	155
3.3.6.2	Placing and Configuring SAR ADC.....	155
3.3.6.3	Placing and Configuring an Analog Pin	156
3.3.6.4	Placing and Configuring Character LCD.....	157
3.3.6.5	Placing and Configuring Voltage DAC.....	158
3.3.6.6	Placing and Configuring Opamp.....	159
3.3.6.7	Placing and Configuring Analog Pin	160
3.3.6.8	Placing and Configuring UART	161
3.3.6.9	Placing and Configuring Digital Output Pin.....	162
3.3.6.10	Placing and Configuring DMA.....	163
3.3.6.11	Connecting the Components Together.....	163
3.3.6.12	Configuring the Pins.....	164
3.3.6.13	Creating the main.c File.....	165
3.3.6.14	Configuring and Programming the PSoC Development Board.....	169

Appendix A. Board Specifications and Layout 171

A.1	PSoC Development Board.....	171
A.1.1	Factory Default Configuration	171
A.1.1.1	Power Supply	171
A.1.2	Power Supply Configuration Examples.....	172
A.1.2.1	Setting a 5V Supply from VREG.....	172
A.1.2.2	Setting a 3.3V Supply from VREG.....	172
A.1.2.3	Setting VDD ANLG as VADJ and VDD DIG as VDD for VDD = 3.3V 173	
A.1.2.4	Setting VDD DIG as VADJ and VDD ANLG as VDD for VDD = 3.3V 173	
A.1.2.5	Setting a 5V Supply from VBUS.....	174
A.1.2.6	Setting a 3.3V Supply from VBUS	174
A.1.2.7	J1 - DC Power Jack.....	175
A.1.2.8	9V Battery Terminals.....	175
A.1.2.9	J8 - 5V Source.....	175
A.1.2.10	VDD Select Switch	175
A.1.2.11	J7 - VDD DIG Select.....	176
A.1.2.12	J6 - VDD ANLG Select	176
A.1.2.13	R11 - Adjustable Regulator Variable Resistor	176
A.1.3	Prototyping Components.....	177

A.1.3.1	Prototyping Area.....	177
A.1.3.2	P15 - DB9 Serial Communications Port.....	178
A.1.3.3	J10 - Serial Port Power.....	178
A.1.3.4	J9 - Full Speed USB Port.....	178
A.1.3.5	P17 - Artaflex WirelessUSB LP Radio Module Receptacle.....	178
A.1.3.6	J14 - Wireless Radio Module Power.....	179
A.1.3.7	R20 - Multipurpose Variable Resistor.....	179
A.1.3.8	J11 - Variable Resistor Power.....	179
A.1.3.9	SW1 and SW2 - Multipurpose Push Button Switches.....	179
A.1.4	LCD Module.....	179
A.1.4.1	R31 - LCD Contrast Adjustment.....	180
A.1.4.2	J12 - LCD Module Power.....	180
A.1.5	CapSense Elements.....	180
A.1.6	Processor Module.....	180
A.1.6.1	J2, J3, J4 and J5 - VDDIO Select.....	180
A.1.6.2	SW4 - Processor Reset Button.....	181
A.1.6.3	U8 - External MHz Oscillator.....	181
A.1.6.4	P1, P2, P3 and P4 - Processor Module Receptacles.....	181
A.1.7	Expansion Ports.....	184
A.1.7.1	Expansion Ports A and A'.....	186
A.1.7.2	Expansion Port B.....	186
A.1.7.3	Expansion Port C.....	186
A.2	Schematics.....	187
A.2.1	CY8CKIT-001 PSoC Development Board.....	187
A.2.2	CY8C28 Family Processor Module.....	188
A.2.3	CY8C29 Family Processor Module.....	189
A.2.4	CY8C38 Family Processor Module.....	190
A.2.5	CY8C55 Family Processor Module.....	191
A.3	Bill of Materials.....	192
A.3.1	CY8CKIT-001 PSoC Development Board.....	192
A.3.2	CY8C28 Family Processor Module.....	194
A.3.3	CY8C29 Family Processor Module.....	195
A.3.4	CY8C38 Family Processor Module.....	195
A.3.5	CY8C55 Family Processor Module.....	197

Appendix B. MiniProg3 199

B.1	MiniProg3 LEDs.....	199
B.2	Programming in Power Cycle Mode.....	199
B.3	Interface Pin Assignment Table.....	199
B.4	Protection Circuitry.....	200
B.5	Level Translation.....	200

Appendix C. MiniProg3 Technical Description 201

C.1	Interfaces.....	202
C.1.1	ISSP.....	202
C.1.2	JTAG.....	202
C.1.3	SWD/SWV.....	202
C.1.4	I2C™.....	202
C.2	Connectors.....	203
C.2.1	5-Pin Connector.....	203
C.2.2	10-Pin Connector.....	203
C.3	Power.....	205

1. Introduction



1.1 Kit Overview

The CY8CKIT-001 PSoC[®] Development Kit provides you a common development platform where you can prototype and evaluate different solutions using any one of the PSoC 1, PSoC 3, or PSoC 5 architectures. This guide and kit gives you a practical understanding of PSoC technology. In addition, the kit gives several example projects with step-by-step instructions to enable you to easily get started developing PSoC solutions. This kit includes PSoC CY8C28, CY8C38, and CY8C55 Family Processor Modules.

1.2 Kit Contents

The CY8CKIT-001 PSoC Development Kit includes:

- PSoC Development Board
- PSoC CY8C28 Family Processor Module
- PSoC CY8C38 Family Processor Module
- PSoC CY8C55 Family Processor Module
- MiniProg3 Programmer and Debug tool
- USB Cable
- 12V Power Supply Adapter
- Wire Pack
- Printed Documentation
 - Quick Start
 - Schematic PSoC Development Board Design
- Software CD for PSoC 1, which includes
 - PSoC[®] Designer[™] IDE
 - PSoC[®] Programmer[™] Software
 - CY8C28 Data Sheets
 - Kit Release Notes
 - Software Release Notes
 - Example Project Files, Firmware, And Documentation
- Software CD for PSoC 3 / PSoC 5, which includes
 - PSoC[®] Creator[™] IDE
 - PSoC Programmer Software
 - CY8C38 Data Sheet
 - CY8C55 Data Sheet
 - Kit Release Notes
 - Software Release Notes
 - Example Project Files, Firmware, And Documentation

1.3 Installation

Everything you need to use the PSoC Development Kit is included, but you only need to install the software for the processor module you plan to use.

Note PSoC CY8C29 Family Processor Module is not part of this Kit. However, you can purchase this module from www.cypress.com.

1.3.1 Before You Begin

All Cypress software installations require administrator privileges but is not required to run the installed software.

Shut down any currently running Cypress software.

Disconnect any ICE Cube or MiniProg devices from your computer.

1.3.2 Prerequisites

PSoC Creator and PSoC Designer both use the Microsoft .NET Framework, Adobe Acrobat Reader, and a Windows Installer. If .NET Framework and Windows Installer are not on your computer, the installation automatically installs it for you. If you do not have Adobe Acrobat Reader, you have to manually download from Adobe website and install it.

1.3.3 Installing PSoC 1 Development Software

To use the CY8C28 or CY8C29 Family Processor Module (PSoC 1) you need:

- PSoC Designer 5.0 SP6 or higher
- PSoC Programmer 3.11 or higher

If PSoC Designer 5.0 is currently installed, uninstall it. Click **Start**, click **Control Panel**, and then double click **Add or Remove Programs**.

PSoC Designer 5.0 SP4.5 is not presently compatible with Microsoft Internet Explorer 8 beta (any beta version). If you have Internet Explorer 8 beta, uninstall it and replace it with the released version of Microsoft Internet Explorer 8.

Insert the **PSoC 1 Software** CD and, using the menu, select **Install Software for PSoC 1**.

After installation, user guides and key documents are located in the `\Documentation` subdirectory of the PSoC Designer installation directory. The default location is:

```
C:\Program Files\Cypress\PSoC Designer 5\Documentation
```

1.3.4 Installing PSoC 3 Development Software

To use the CY8C38 Family Processor Module (PSoC 3) you need:

- PSoC Creator 1.0 Beta 4.1 or higher
- PSoC Programmer 3.11 Beta or higher
- PSoC Development Kit example files

Insert the **PSoC 3 / PSoC 5 Software** CD and, using the menu, select **Install Software for PSoC 3**. This option installs all three required software packages. The installers for PSoC Programmer and PSoC Creator automatically start before the Kit examples are installed.

For each installation, select **Typical** on the **Installation Type** page.

PSoC Creator uses the Keil CA51 compiler to build PSoC 3 applications. This compiler is included on the CD, and will prompt you to install if it is not detected.

Note The Keil compiler is distributed with a free license. You must activate this license within 30 days of installation. Once the Cypress software installation is complete, and you run PSoC Creator, activate the compiler license from the **Keil Registration** option under the **Tools** menu.

After installing PSoC Creator and PSoC Programmer, refer to the documentation as needed:

- **PSoC Creator** → **Help** → **Topics** → **Getting Started**
- **Programmer** → **Documentation** → **User Guide**

Other documents included with this release are located in the `\Documentation` subdirectory of the PSoC Creator installation directory. The default location is:

`C:\Program Files\Cypress\PSoC Creator\1.0\PSoC Creator\documentation`

You can access this directory from within PSoC Creator under **Help** → **Documentation** → **Reference Material**. Documents include (but not limited to):

- *PSoC Creator Component Author Guide (component_author_guide.pdf)*
- *Warp Verilog Reference Guide (warp_verilog_reference.pdf)*
- *Customization API Reference (customizer_api.chm)*

Note After the installation is complete, the kit contents are found at the following location:

`C:\Program Files\Cypress\PSoC Development Kit\`

1.3.5 Installing PSoC 5 Development Software

To use the CY8C55 Family Processor Module (PSoC 5) you need:

- PSoC Creator 1.0 Beta 4.1 or higher
- PSoC Programmer 3.11 Beta or higher
- PSoC Development Kit example files

Insert the **PSoC 3 / PSoC 5 Software** CD and, using the menu, select **Install Software for PSoC 5**. This option installs all three required software packages. The installers for PSoC Programmer and PSoC Creator automatically start before the Kit examples are installed.

For each installation, select **Typical** on the **Installation Type** page.

PSoC Creator uses the Keil CA51 compiler to build PSoC 5 applications. This compiler is included on the CD, and will prompt you to install if it is not detected.

Note The Keil compiler is distributed with a free license. You must activate this license within 30 days of installation. Once the Cypress software installation is complete, and you run PSoC Creator, activate the compiler license from the **Keil Registration** option under the **Tools** menu.

After installing PSoC Creator and PSoC Programmer, refer to the documentation as needed:

- **PSoC Creator** → **Help** → **Topics** → **Getting Started**
- **Programmer** → **Documentation** → **User Guide**

Other documents included with this release are located in the `\Documentation` subdirectory of the PSoC Creator installation directory. The default location is:

`C:\Program Files\Cypress\PSoC Creator\1.0\PSoC Creator\documentation`

You can access this directory from within PSoC Creator under **Help** → **Documentation** → **Reference Material**. Documents include (but not limited to):

- *PSoC Creator Component Author Guide (component_author_guide.pdf)*
- *Warp Verilog Reference Guide (warp_verilog_reference.pdf)*
- *Customization API Reference (customizer_api.chm)*

Note After the installation is complete, the kit contents are found at the following location:

`C:\Program Files\Cypress\PSoC Development Kit CY8C55\`

1.4 PSoC Development Board

The CY8CKIT-001 PSoC Development Board is designed to aid hardware, firmware, and software developers in building their own systems around Cypress's PSoC devices. The flexibility to configure the power domains is one of the foremost features of this board. Input power to the board is from one of two sources:

- 12V 1A power supply adapter
- 9V alkaline battery (not included)

This full featured board incorporates three onboard linear regulators that power peripherals and PSoC processor modules at voltages between 1.7V and 5.0V. These regulators include a fixed 5V 1A linear regulator, a fixed 3.3V 300 mA linear regulator, and a 1.5V to 5.5V 300 mA adjustable regulator. The board also provides the ability to separate the PSoC core VDD rail into two separate rails, analog and digital. In addition, the board is able to separate the I/O VDD rails, giving the flexibility to power the I/O ports at different voltages.

The board is equipped with a 2x16 alphanumeric LCD module capable of 1.8V to 5.0V I/O. In addition, there is a mini-B full speed USB interface and a female DB9 serial communications interface. Also included is a 12-pin wireless radio module interface which can be used to develop CyFi™ Low-Power RF or other embedded RF solutions with this kit. The board also has a prototyping area containing a small breadboard complete with I/O port sockets nearby, multipurpose LEDs, mechanical push buttons, and a multipurpose variable resistor. In addition, three capacitive sensing elements (two buttons and a five segment slider) are included on the board to allow the evaluation of CapSense® applications.

The board has four GPIO expansion slots, allowing the I/O to expand to external boards.

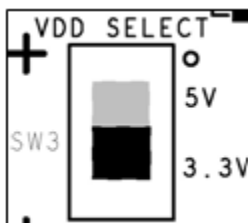
The board was designed with modularity in mind and, as a result, supports removable processor modules. This allows you to plug different PSoC processor modules into the board based upon the desired features of both 8-bit and 32-bit PSoC devices.

1.4.1 Default Switch and Jumper Settings

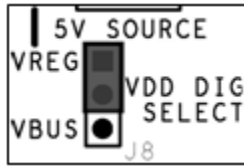
Jumpers on the CY8CKIT-001 PSoC Development Main Board have a default setting for 3.3V operation. For Default configuration, each of the jumpers must be set according to these instructions.

Note All CY8C28 and CY8C29 family processor module example projects are configured for 5V. Configure the board to 5V, before creating the example projects.

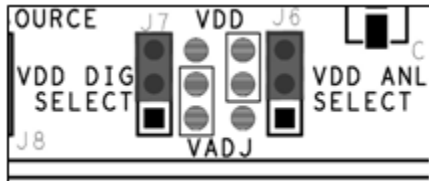
SW3 - VDD Select. Default Position: 3.3V (down position)



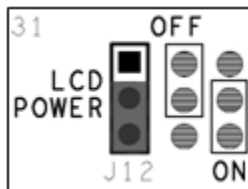
J8 - 5V Source. Default Position: VREG (upper two pins)



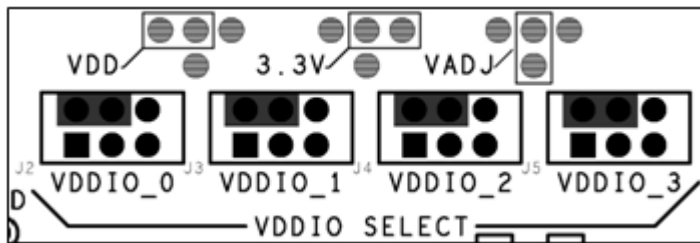
J7, J6 - VDD Digital, VDD Analog. Default Position: VDD (upper two pins, both headers)



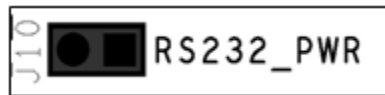
J12 - LCD Power. Default Position: ON (lower two pins)



J2-J5 - VDDIO Power Select. Default Position: VDD (upper left two pins)



J10 - RS232 Power (Serial Communications). Default Position: Installed



J14 - Radio Power. Default Position: Installed



J11 - Variable Resistor Power. Default Position: Installed



1.5 Conventions

These conventions are used throughout this guide.

Table 1-1. Documentation Conventions

Convention	Usage
Courier New Size 12	Displays file locations and source code: C:\ ...cd\iccc\.
<i>Italics</i>	Displays file names and reference documentation: <i>sourcefile.hex</i>
[bracketed, bold]	Displays keyboard commands in procedures: [Enter] or [Ctrl] [C]
Bold → With → Arrows	Represents menu paths, user entered text: File → New Project → Clone
Bold	Displays commands and selections, and icon names in procedures: Click the Debugger icon, and then click Next .
Note	Displays functionality unique to PSoC Designer, PSoC Creator, or the PSoC device.
WARNING:	Displays cautions that are important to the subject.

1.6 Document Revision History

Document Title: CY8CKIT-001 PSoC Development Kit Guide			
Document Number: 001-48651			
Revision	Issue Date	Origin of Change	Description of Change
**	6/23/09	AESA	New Guide
*A	7/22/09	AESA	CDT based updates
*B	11/19/09	AESA	CDT based updates
*C	5/21/10	AESA	Updated with PSoC 5.

2. Loading My First PSoC Project



The CY8CKIT-001 PSoC Development Kit supports projects across the PSoC 1, PSoC 3, and PSoC 5 architectures. This section walks you through the high level design process for opening, building, programming, and running your first PSoC projects using this kit.

Before beginning, follow each of these steps to make certain that your software and hardware environments are properly configured and ready for these projects:

1. Install PSoC Designer using the steps listed in [Installing PSoC 1 Development Software on page 8](#).
2. Install PSoC Creator using the steps listed in [Installing PSoC 3 Development Software on page 8](#).
3. Connect the MiniProg3 into your PC using the supplied USB cable. When you connect the MiniProg3, Microsoft Windows® may indicate that it has found new hardware. All required drivers were installed as part of the PSoC Programmer installation process; however, if Windows opens the driver installation dialog boxes, accept the defaults and allow Windows to automatically find the appropriate driver.
4. Close any open PSoC Creator or PSoC Designer applications and projects.
5. Configure the PSoC Development Board (jumper settings and switches) in its default configuration, as described in [Default Switch and Jumper Settings on page 10](#).
6. Use the PSoC CY8C28 Family Processor Module or PSoC CY8C29 Family Processor Module for the PSoC 1 version of your first PSoC project ([My First PSoC 1 \(CY8C28\) Project on page 14](#) or [My First PSoC 1 \(CY8C29\) Project on page 17](#)).
7. Use the PSoC CY8C38 Family Processor Module for the PSoC 3 version of your first PSoC project ([My First PSoC 3 \(CY8C38\) Project on page 21](#)).
8. Use the PSoC CY8C55 Family Processor Module for the PSoC 5 version of your first PSoC project ([My First PSoC 5 \(CY8C55\) Project on page 25](#)).
9. For a PSoC 1 project, use the ISSP header on the PSoC CY8C28 Family Processor Module or PSoC CY8C29 Family Processor Module and connect the MiniProg3 ISSP port.
10. For a PSoC 3 or PSoC 5 project, use the JTAG ribbon cable. Connect the ribbon cable to the MiniProg3 and the PSoC CY8C38 Family Processor Module, or PSoC CY8C55 Family Processor Module into the header labeled PROG on the processor module.
Note The MiniProg3 should not be "hot plugged" into processor modules that are attached to the PSoC Development Board. In other words, do not plug the ribbon cable of the MiniProg3 into the processor module while code is actively running on the module. Doing so may cause the PSoC device to unintentionally reset. Power down the PSoC Development Board and module by unplugging the power supply from the Development Board before attaching the MiniProg3 device to the module board. Once the ribbon cable is attached to the module board, power can then be applied to the system by plugging in the power supply to the PSoC Development Board. This will avoid any undesirable PSoC device resets.
11. Power the PSoC Development Board using the 12V AC power supply adapter

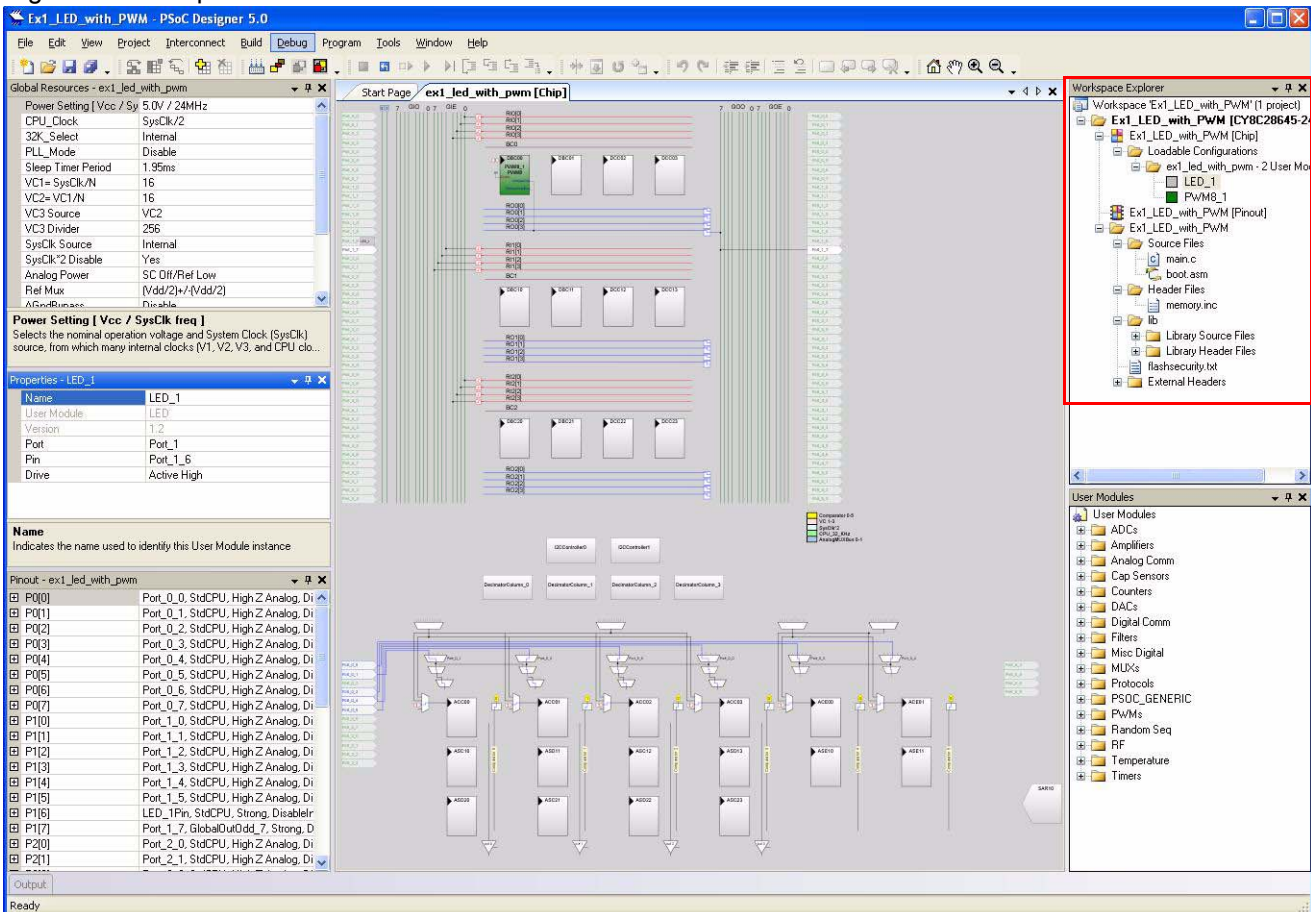
2.1 My First PSoC 1 (CY8C28) Project

This is a simple PSoC 1 project using a PWM peripheral inside PSoC, and software to control the blinking rates of two different LED outputs. For this project, be sure you have the PSoC CY8C28 Family Processor Module inserted into the PSoC Development Board and the appropriate software installed. This section walks you through the high level steps of opening, building, and programming a project.

2.1.1 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
`C:\Cypress\CY8CKIT-001\CY8C28 Projects\`
4. Open the folder `Ex1_LED_with_PWM`.
5. Double click **Ex1_LED_with_PWM.app**.
6. The project opens in the Chip Editor view. All the project files are in the **Workspace Explorer**.

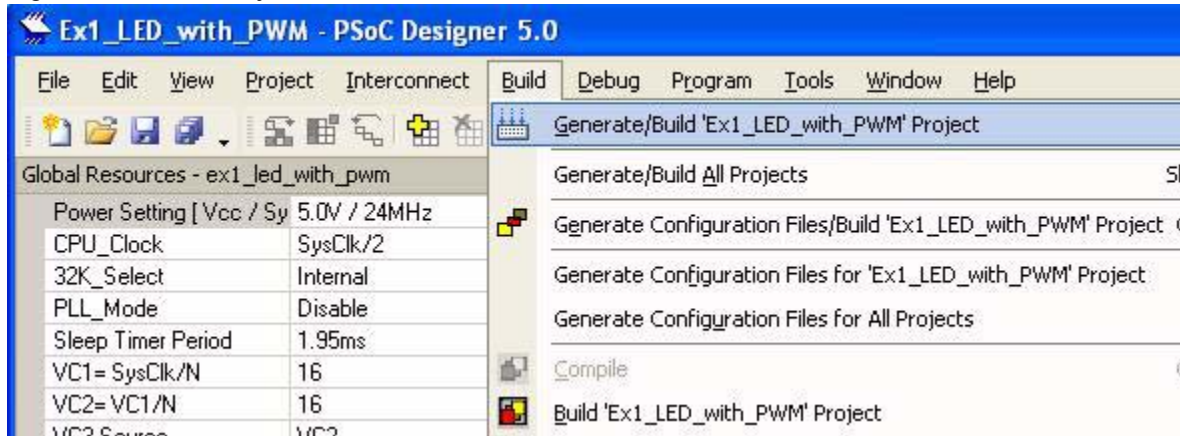
Figure 2-1. Chip Editor View



2.1.2 Building My First PSoC 1 Project

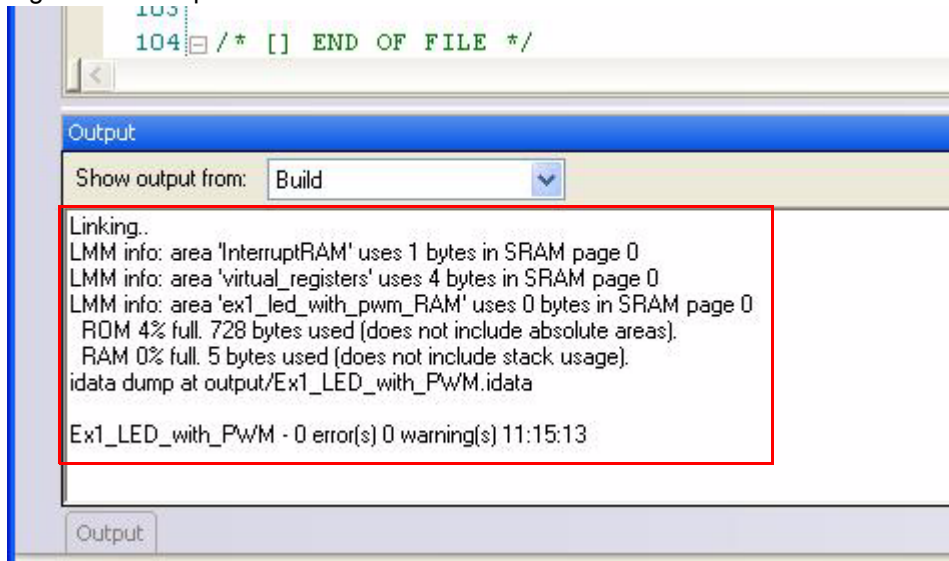
1. Select **Build** → **Generate/Build 'Ex1_LED_with_PWM' Project**.

Figure 2-2. Build Project



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

Figure 2-3. Output Window



2.1.3 Programming My First PSoC 1 Project

1. Open **Program Part** from within PSoC Designer by selecting **Program** → **Program Part**.
2. In the **Program Part** window, ensure that **MiniProg3** is selected in the **Port Selection** box.
3. In the **Program Part** window, set **Acquire Mode** to **Reset**.
4. In the **Program Part** window, set **Verification** to **On**. This ensures that downloaded checksum matches the actual checksum.
5. In PSoC Programmer, set **AutoDetection** to **On** to enable the software to automatically detect and configure for the target device family and device. **Note** If PSoC Programmer is properly configured, AutoDetection reports a device family of 28xxx.
Note Make sure ISSP protocol is selected.

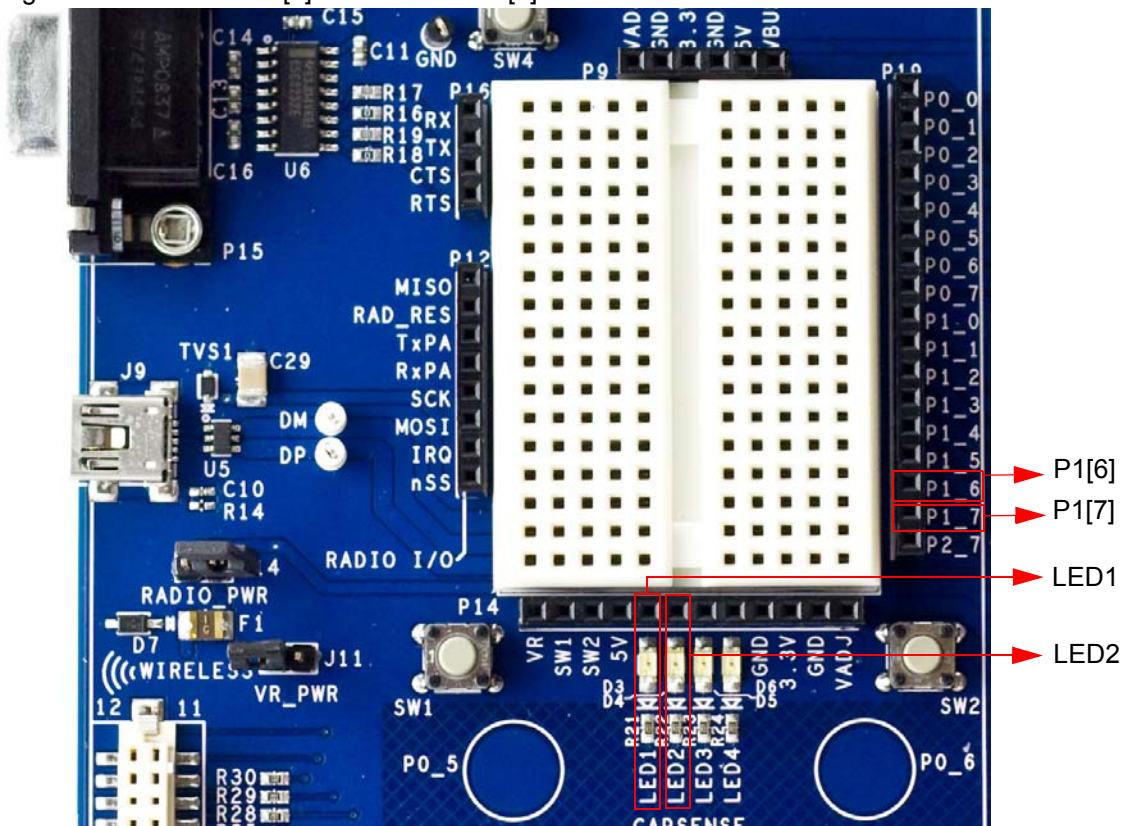
6. In the **Program Part** window, click the program arrow to program the device.
7. Wait until programming is completed to continue.

Note For debugging purposes, the CY8C28 Family Processor Module is designed to accommodate the use of the CY3215-DK In-Circuit Emulator (ICE Cube). When using the ICE Cube debugger, make certain that PSoC Designer is configured so that the ICE Cube DOES NOT provide power to the processor module. Within the **PSoC Designer** application, select **Project** → **Settings** and select **Debugger** from the tree list. Make sure **External only** is selected under the **Pod Power Source** section and select **Execute program** from **Debug** menu to start debugging.

2.1.4 Running My First PSoC 1 Project

1. Connect P1[6] to LED1 and P1[7] to LED2. Verify that LED1 and LED2 are blinking based on the project's use of the PWM and software. Now that the PSoC 1 device is programmed, reset the PSoC Development Board by pressing and releasing the reset switch (SW4).
2. LED1 blinks approximately once every second and LED2 blinks about three times a second.

Figure 2-4. Connect P1[6] to LED1 and P1[7] to LED2



3. For more details regarding this project, see the detailed step-by-step project instructions in [My First PSoC 1 \(CY8C28\) Project](#) on page 29.

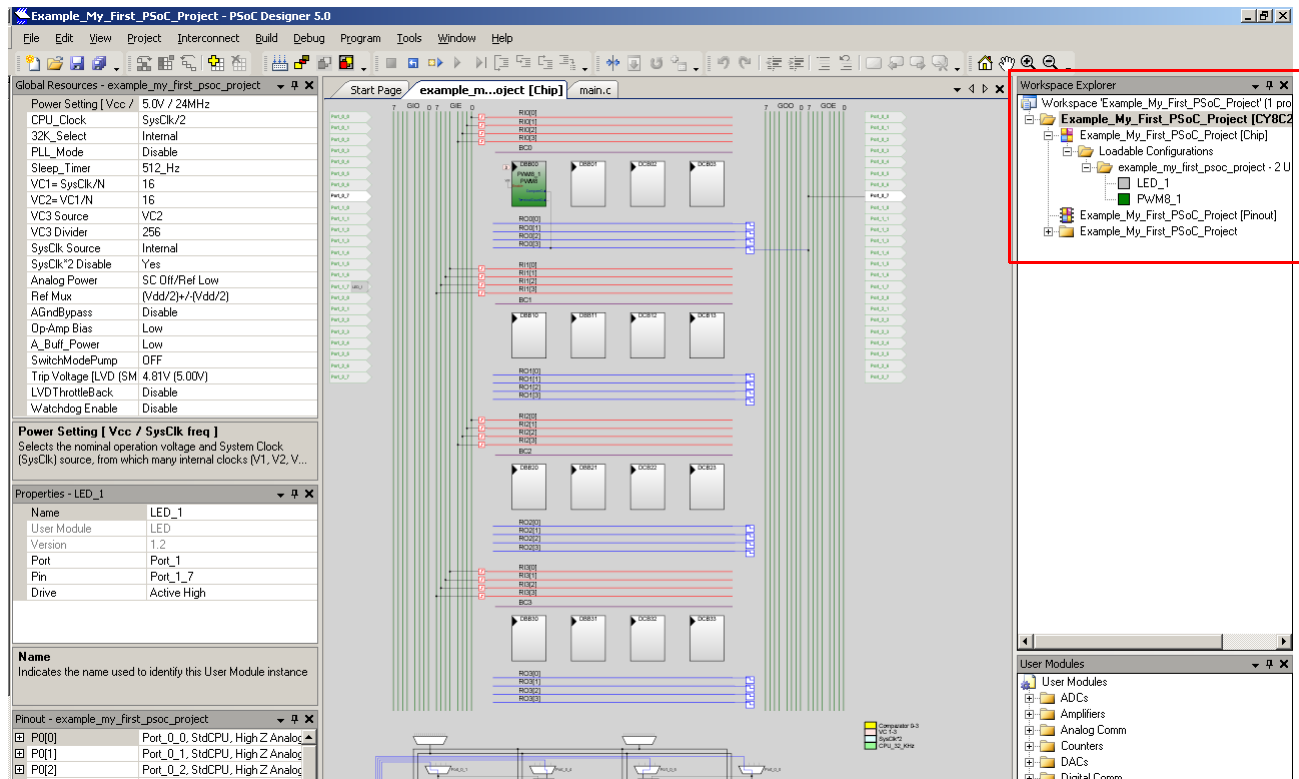
2.2 My First PSoC 1 (CY8C29) Project

This is a simple PSoC1 project using a PWM peripheral inside PSoC, and software to control the blinking rates two different LED outputs. For this project, be sure you have the PSoC CY8C29 Family Processor Module inserted into the PSoC Development Board and the appropriate software installed. This section walks you through the high level steps of opening, building, and programming a project.

2.2.1 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
`C:\Cypress\CY8CKIT-001\CY8C29 Projects\`
4. Open the folder `Example_My_First_PSoC_Project`.
5. Double click **Example_My_First_PSoC_Project.app**.
6. The project opens in the Chip Editor view. All the project files are in the **Workspace Explorer**.

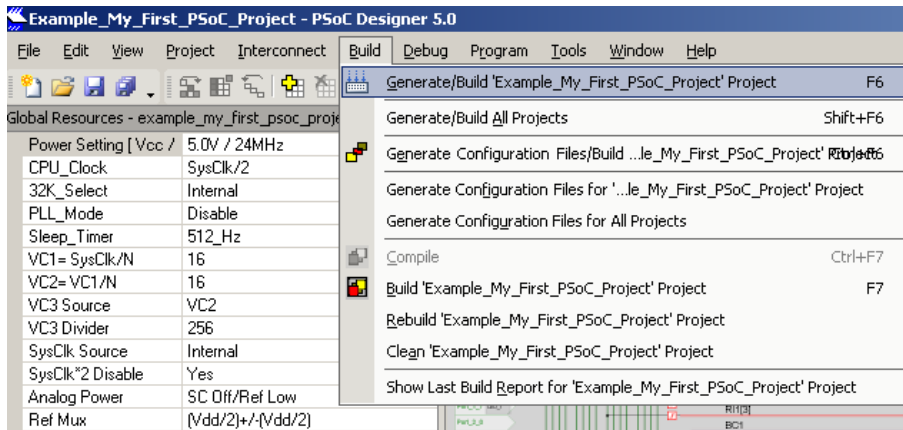
Figure 2-5. Chip Editor View



2.2.2 Building My First PSoC 1 Project

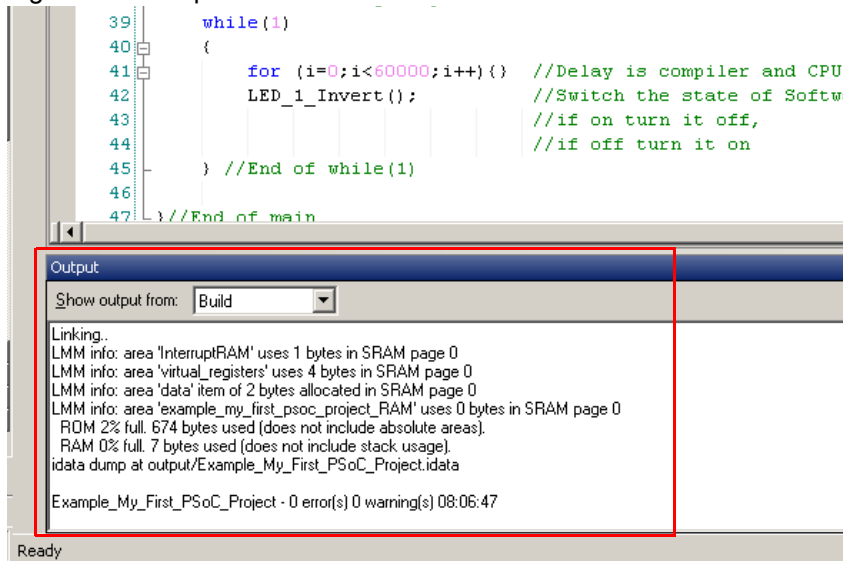
1. Select **Build** → **Generate/Build 'Example_My_First_PSoC_Project' Project**.

Figure 2-6. Build Project



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

Figure 2-7. Output Window



2.2.3 Programming My First PSoC 1 Project

Figure 2-8. Connect MiniProg3 to J5 on the CY8C29 Family Processor Module



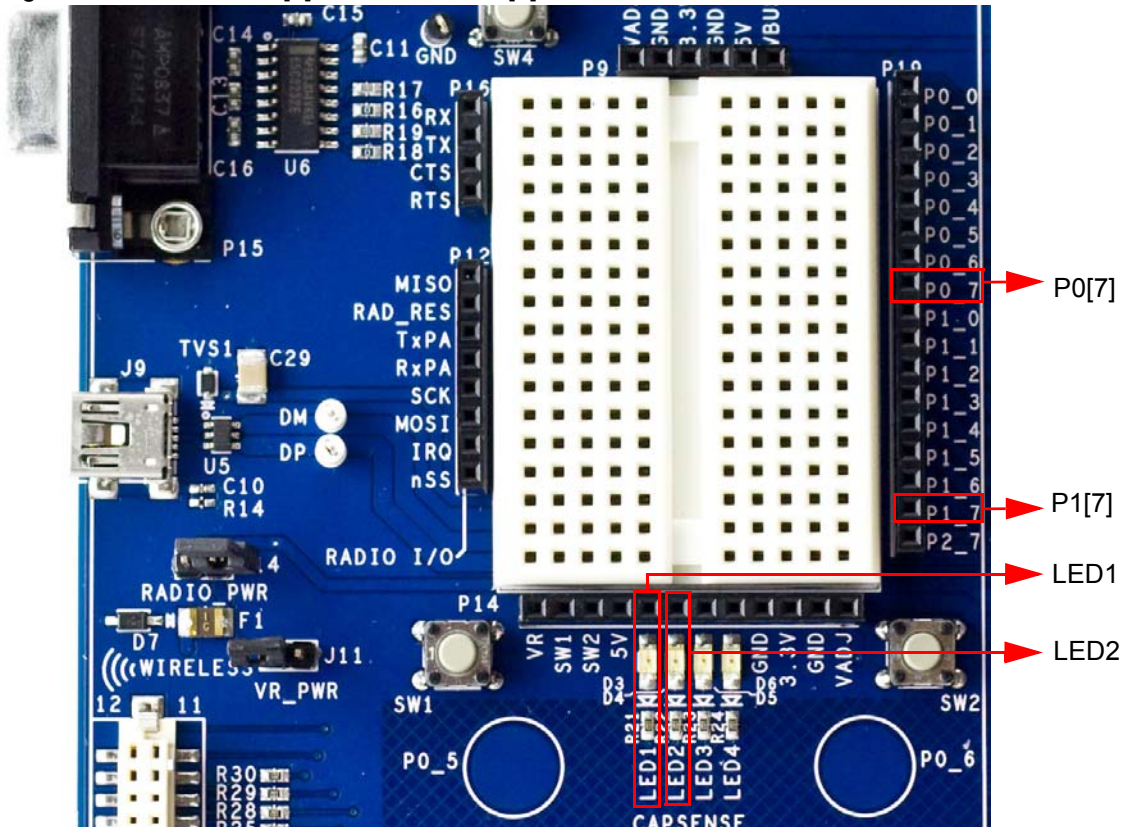
1. Open PSoC Programmer from within PSoC Designer by selecting **Program** → **PSoC Programmer**.
2. In PSoC Programmer, make sure that **MiniProg3** is selected in the **Port Selection** box.
3. In PSoC Programmer, set **Programming Mode** to **Reset**.
4. In PSoC Programmer, set **Verification** to **On** so that the software verifies that the downloaded program's checksum matches the actual checksum of the flash memory after programming. This is a precautionary check to verify that there is no data corruption during programming.
5. In PSoC Programmer, set **AutoDetection** to **On** to enable the software to automatically detect and configure for the target device family and device. **Note** If PSoC Programmer is properly configured, AutoDetection reports a device family of 29x66 and device of CY8C29466. **Note** Make sure ISSP protocol is selected.
6. With these settings configured, click **Program** to program your PSoC 1 device.
7. Wait until programming is complete before continuing.

Note For debugging purposes, the CY8C29 Family Processor Module is designed to accommodate the use of the CY3215-DK In-Circuit Emulator (ICE Cube). When using the ICE Cube debugger, make certain that PSoC Designer is configured so that the ICE Cube DOES NOT provide power to the processor module. Within the **PSoC Designer** application, select **Project** → **Settings** and select **Debugger** from the tree list. Make sure **External only** is selected under the **Pod Power Source** section and select **Execute program** from **Debug** menu to start debugging.

2.2.4 Running My First PSoC 1 Project

1. Connect P0[7] to LED1 and P1[7] to LED2. Verify that LED1 and LED2 are blinking based on the project's use of the PWM and Software. Now that the PSoC 1 device is programmed, reset the PSoC Development Board by pressing and releasing the reset switch (SW4).
2. LED1 blinks approximately once every second and LED2 blinks about three times a second.

Figure 2-9. Connect P0[7] to LED1 and P1[7] to LED2



3. For more details regarding this project, see the detailed step-by-step project instructions in [My First PSoC 1 \(CY8C29\) Project](#) on page 68.

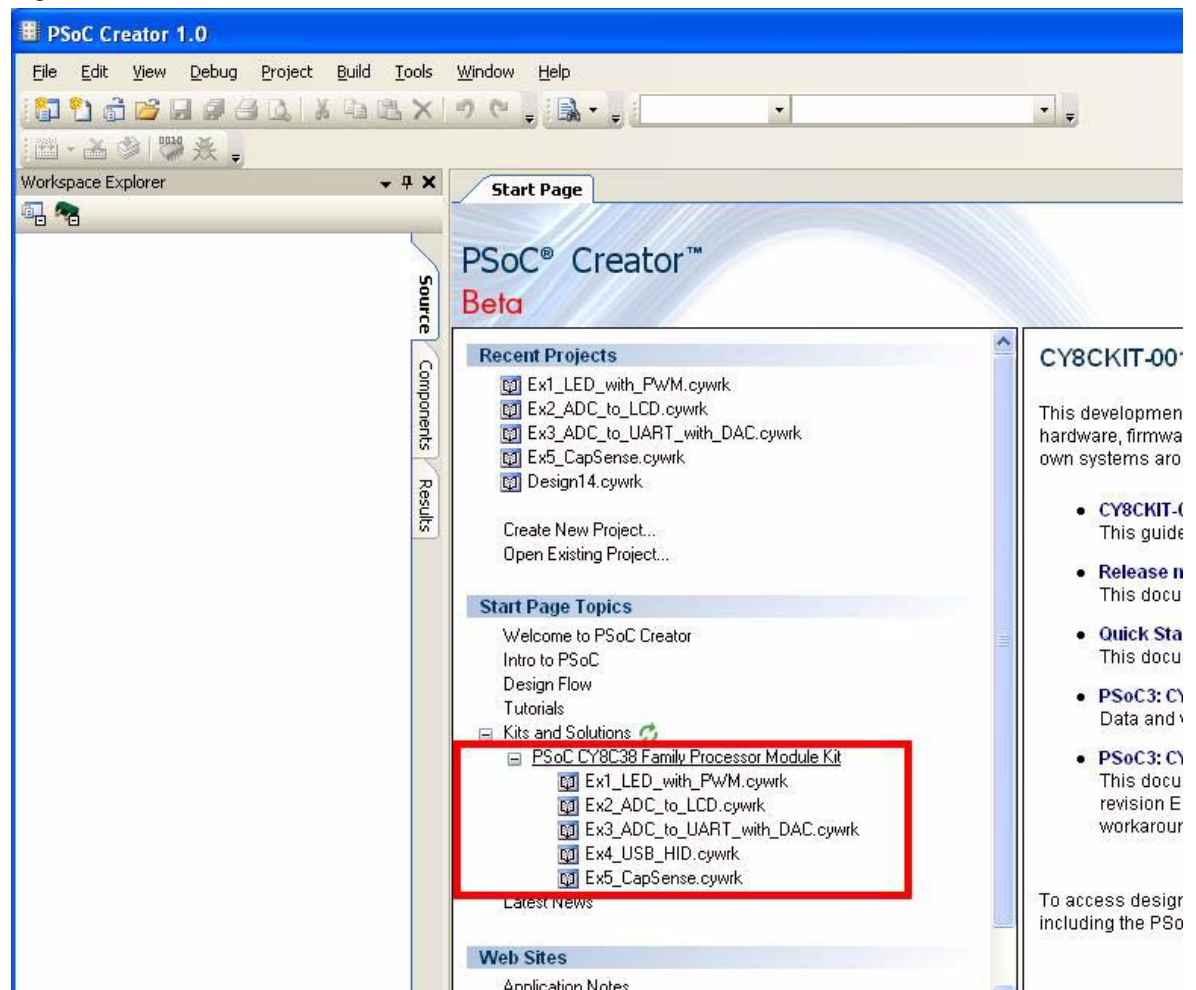
2.3 My First PSoC 3 (CY8C38) Project

This is a PSoC 3 project using a PWM peripheral programmed from inside the PSoC 3 device to control the blinking rates of two different LED outputs. For this project, insert the PSoC CY8C38 Family Processor Module in the PSoC Development Board and install the appropriate software. This section shows you the high level steps of opening, building, and programming a project.

2.3.1 Loading My First PSoC 3 Project

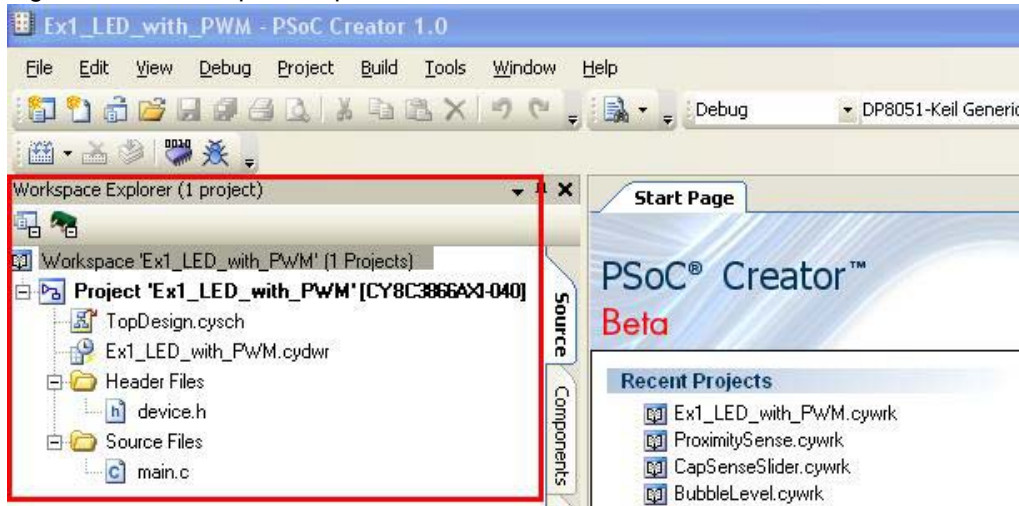
1. Open PSoC Creator.
2. In the **Start Page**, under **Start Page Topics** expand **Kits and Solutions**.
3. Under **Kits and Solutions**, expand **PSoC CY8C38 Family Processor Module Kit**.
4. Click **Ex1_LED_with_PWM.cywrk** to open the project.

Figure 2-10. Kits and Solutions



5. Select the directory in which to store the project.
6. After the project opens, you can see the project files in **Workspace Explorer** (see [Figure 2-11 on page 22](#)).

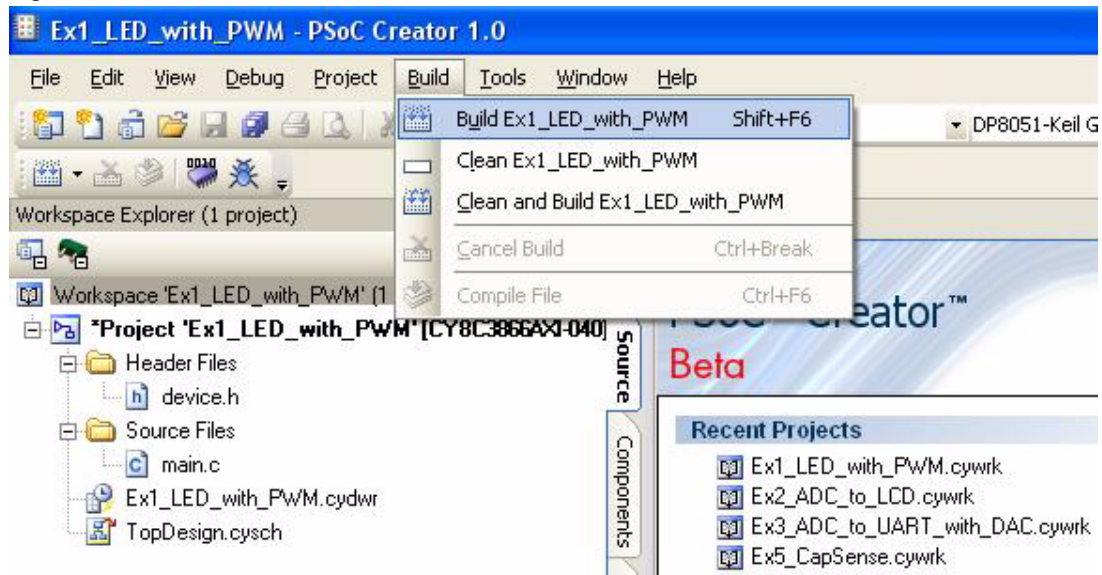
Figure 2-11. Workspace Explorer



2.3.2 Building My First PSoC 3 Project

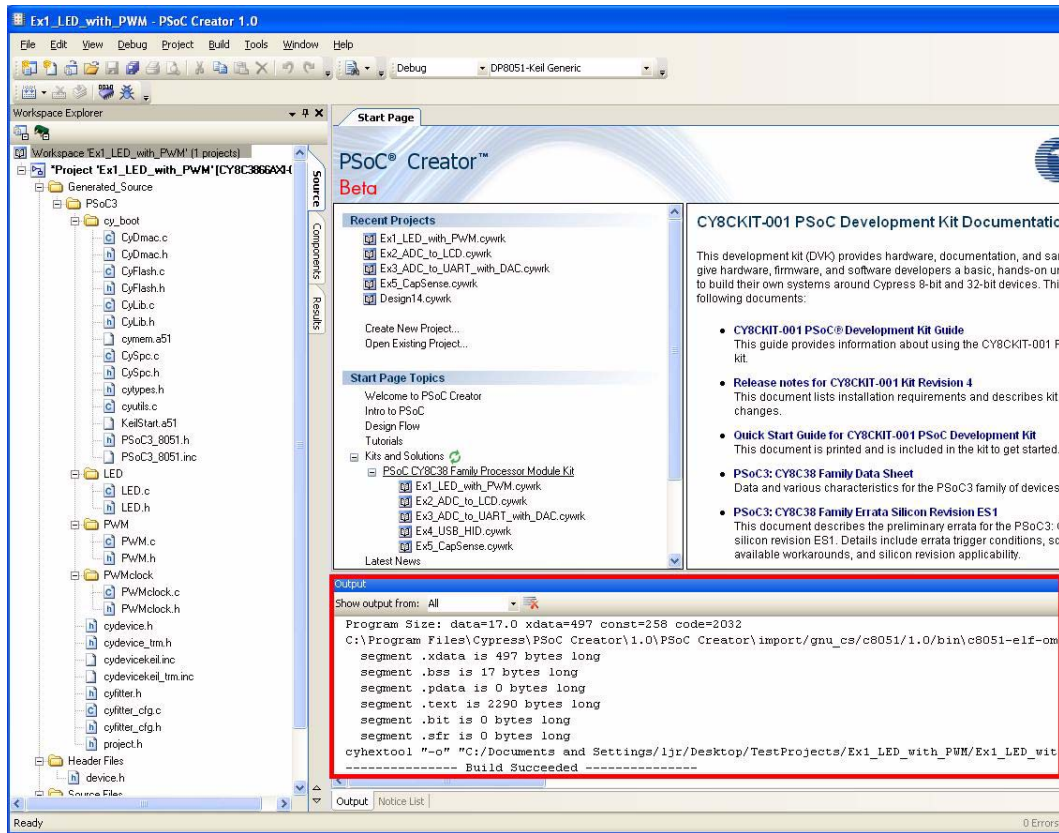
1. Select **Build** → **Build Ex1_LED_with_PWM**.

Figure 2-12. Build Window



2. PSoC Creator builds the project and displays the comments in the **Output** window. When you see the message "Build Succeeded" you are ready to program the device.

Figure 2-13. Output Window



2.3.3 Programming My First PSoC 3 Project

Figure 2-14. Connect MiniProg3 to J5 on the CY8C38 Family Processor Module



1. If this is your first time running PSoC Creator, follow these steps to configure the MiniProg3 device for these PSoC Development Kit projects. If these configurations are set, skip to the next step below and begin programming.

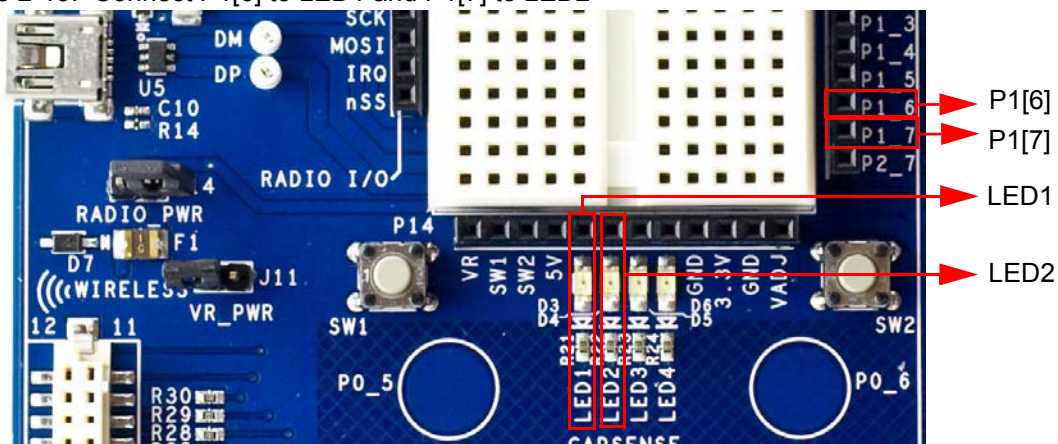
Note VTARG of the MiniProg3 is wired exclusively to VDDIO1 of the chip on the PSoC CY8C38 Family Processor Module. Because of this, you cannot perform power cycle mode programming.

- From the **Tools** menu in PSoC Creator, click **Options**. The **Options** window opens.
 - In the **Options** window, select **Programmer/Debugging** → **MiniProg3** from the tree list.
 - Set **Applied Voltage** to **3.3V**
 - Set **Transfer Mode** to **SWD**
 - Set **Active Port** to **10 Pin**
 - Set **Acquire Mode** to **Reset**
 - Set **Debug Clock Speed** to **3.2 MHz**
 - Click **OK**.
 - From the **Debug** menu, select **Select Debug Target**. The **Select Debug Target** dialog box opens.
 - Expand the tree under **MiniProg3** and click **Port Acquire**.
 - Select the appropriate device and click **Connect**.
 - Click **Close**.
2. In PSoC Creator, from the **Debug** menu, click **Program**.
 3. The PSoC Creator Status Bar indicates that the device is programming.
 4. Wait until programming is complete before continuing.

2.3.4 Running My First PSoC 3 Project

1. Unplug the DVK board, switch SW3 to 3.3V and then reapply power to the DVK board.
2. Connect P1[6] to LED1 and P1[7] to LED2. Verify that LED1 and LED2 are blinking based on the project's use of the PWMs.
3. LED1 blinks approximately once every second and LED2 blinks about three times a second.

Figure 2-15. Connect P1[6] to LED1 and P1[7] to LED2



4. For more details regarding this project, review the detailed step-by-step project instructions in [My First PSoC 3 / PSoC 5 Project on page 101](#).

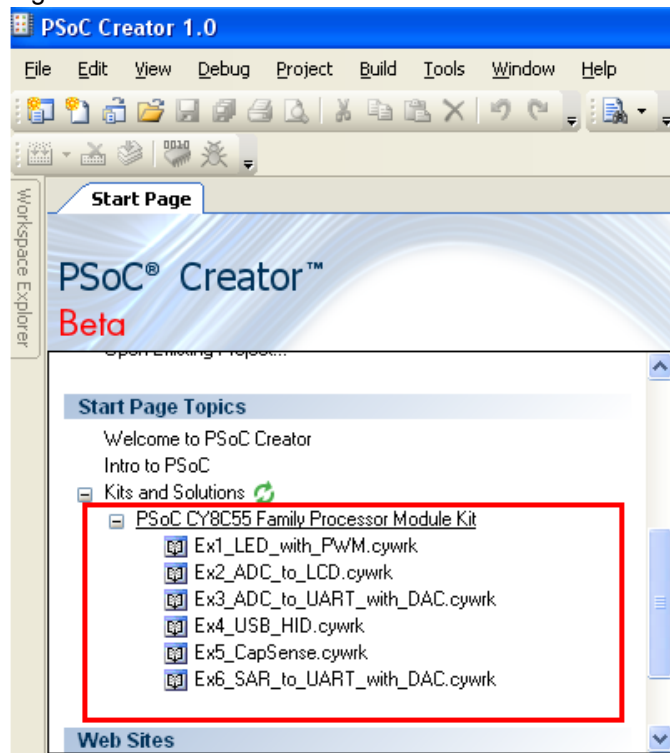
2.4 My First PSoC 5 (CY8C55) Project

This project uses a PWM peripheral programmed from inside the PSoC 5 to control the blinking rates of two different LED outputs. For this project, insert the PSoC CY8C55 Family Processor Module in the PSoC Development Board and install the appropriate software. This section shows the high level steps of opening, building, and programming a project.

2.4.1 Loading my First PSoC 5 Project

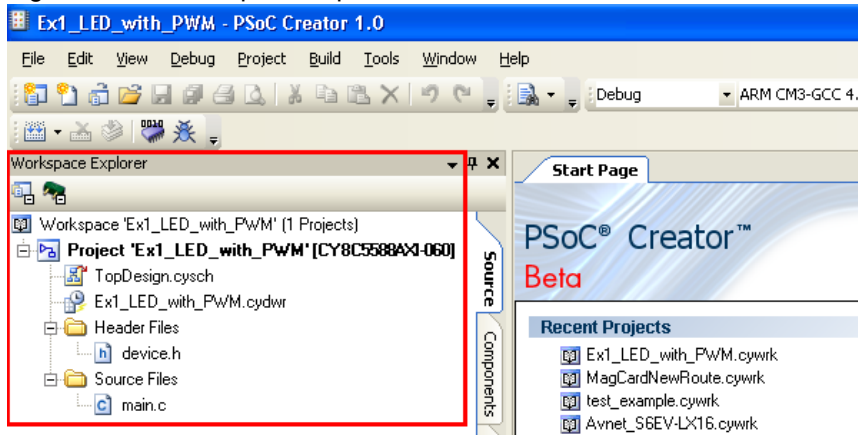
1. Open PSoC Creator.
2. In the **Start Page**, under **Start Page Topics** expand **Kits and Solutions**.
3. Under **Kits and Solutions**, expand **PSoC CY8C55 Family Processor Module Kit**.
4. Click **Ex1_LED_with_PWM.cywrk** to open the project.

Figure 2-16. Kits and Solutions



5. Select the directory in which to store the project.
6. After the project opens, you can see the project files in Workspace Explorer.

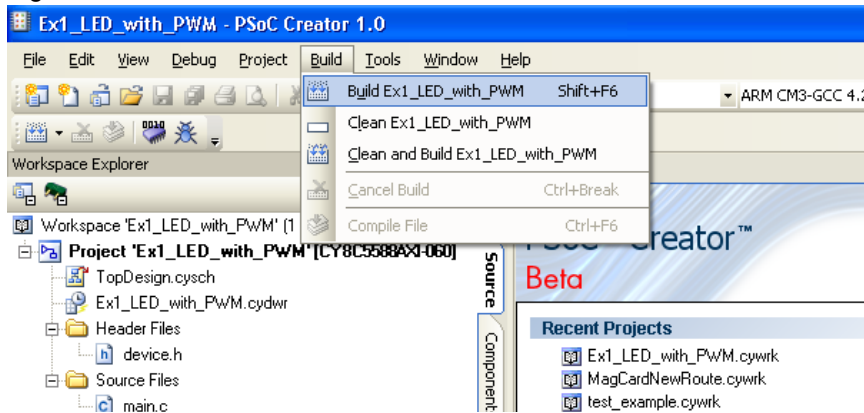
Figure 2-17. Workspace Explorer



2.4.2 Building My First PSoC 5 Project

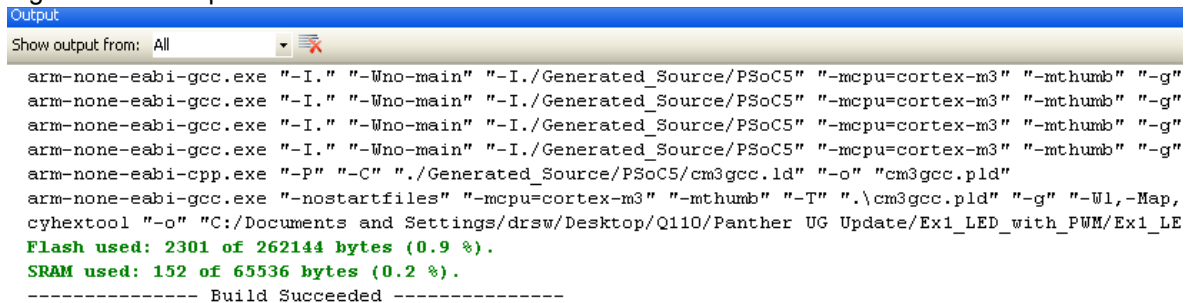
1. Select **Build** → **Build Ex1_LED_with_PWM**.

Figure 2-18. Build Window



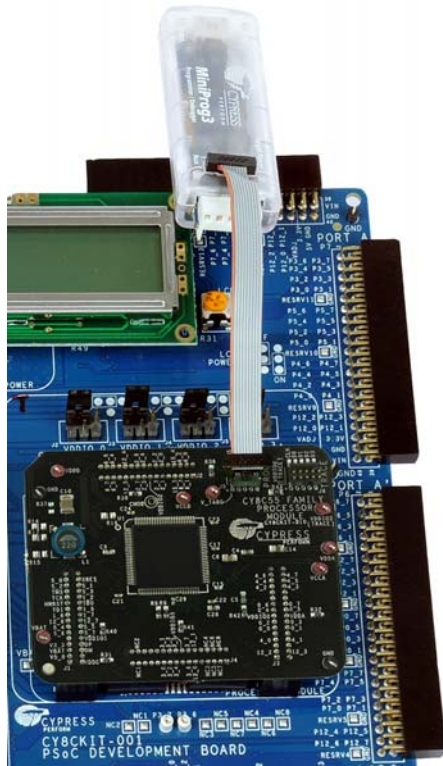
2. PSoC Creator builds the project and displays the comments in the Output window. When you see the message "Build Succeeded" you are ready to program the device.

Figure 2-19. Output Window



2.4.3 Programming My First PSoC 5 Project

Figure 2-20. Connect MiniProg3 to J5 on the CY8C55 Family Processor Module



1. If this is your first time running PSoC Creator, follow these steps to configure the MiniProg3 device for these PSoC Development Kit projects. If these configurations are set, skip to the next step below and begin programming.

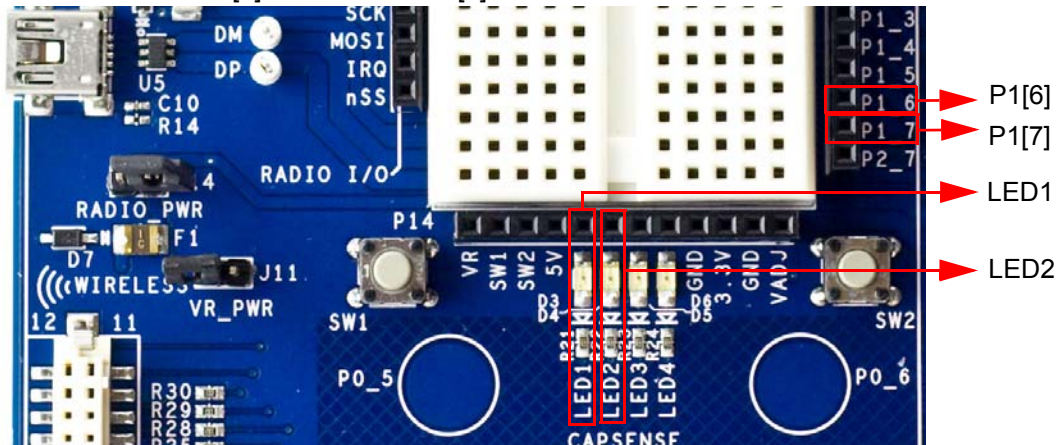
Note VTARG of the MiniProg3 is wired exclusively to VDDIO1 of the chip on the PSoC CY8C55 Family Processor Module. Because of this, you cannot perform power cycle mode programming.

 - From the **Tools** menu in PSoC Creator, click **Options**.
 - In the Options window, select **Programmer/Debugging** → **MiniProg3** from the list.
 - Set **Applied Voltage** to **3.3V**
 - Set **Transfer Mode** to **SWD**
 - Set **Active Port** to **10 Pin**
 - Set **Acquire Mode** to **Reset**
 - Set **Debug Clock Speed** to **3.2 MHz**
 - Click **OK**
 - From the **Debug** menu, select **Select Debug Target**.
 - Expand the tree under **MiniProg3** and click **Port Acquire**.
 - Select the appropriate device and click **Connect**.
 - Click **Close**.
2. In PSoC Creator, from the **Debug** menu, click **Program**.
3. The PSoC Creator Status Bar indicates that the device is programming.
4. Wait until programming is complete before continuing.

2.4.4 Running My First PSoC 5 Project

1. Unplug the DVK board, switch SW3 to 3.3V and then reapply power to the DVK board.
2. Connect P1[6] to LED1 and P1[7] to LED2. Verify that LED1 and LED2 are blinking based on the project's use of the PWMs.
3. LED1 blinks approximately once every second and LED 2 blinks about three times a second.

Figure 2-21. Connect P1[6] to LED1 and P1[7] to LED2



3. Sample Projects



This chapter shows you how to create the sample projects included with this kit.

Read these precautions before you create example projects:

- All CY8C28 / CY8C29 family processor module example projects are configured for 5V.
- All CY8C38 / CY8C55 family processor module example projects are configured for 3.3V.
- Close any open project in PSoC Creator before loading or creating an example project.
- When working with example projects, use 12V power supply adapter.
- Remove power before changing board jumpers for each example project. Reapply power after you place jumpers on the breadboard.
- When you complete each project make certain to save the project.

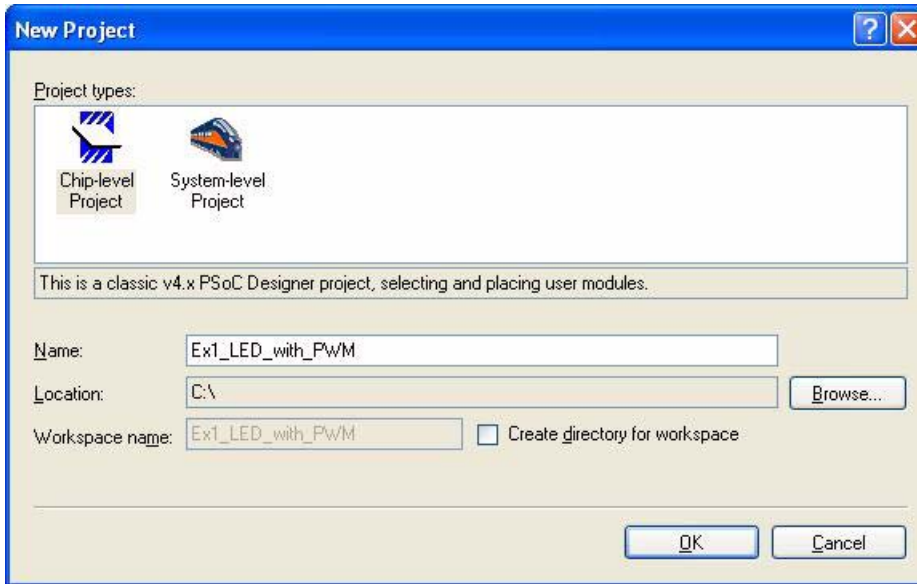
3.1 CY8C28 Family Processor Module Example Projects

3.1.1 My First PSoC 1 (CY8C28) Project

3.1.1.1 *Creating My First PSoC 1 (CY8C28) Project*

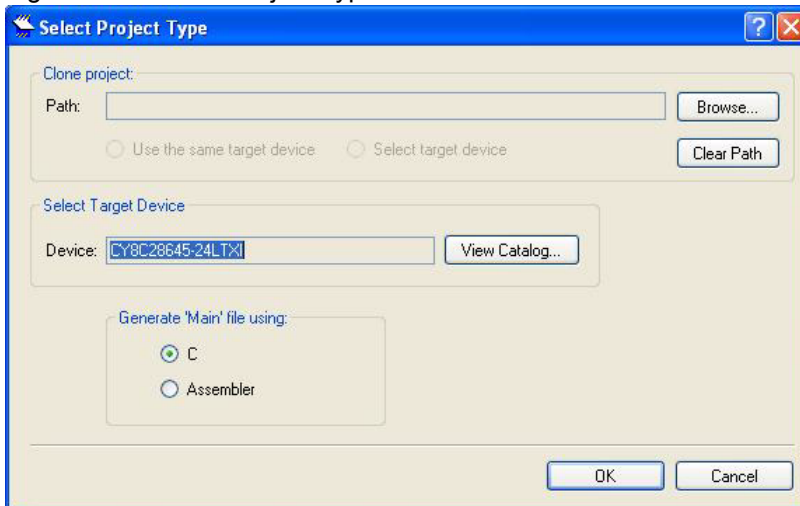
1. Open PSoC Designer 5.0
2. To create a new project, click **File** → **New Project**. The **New Project** window opens.
3. In the **New Project window**, select the **Chip-Level Project**. **Name** the project **Ex1_LED_with_PWM**.
4. In **Location**, click **Browse** and navigate to the appropriate directory.

Figure 3-1. New Project Window



5. Click **OK**. The **Select Project Type** window opens.

Figure 3-2. Select Project Type Window



6. In this window under **Select Target Device**, click **View Catalog**.

7. The **Device Catalog** window opens. Click on the **PSoC** tab, and scroll down to the **CY8C28XXX** section.

8. For this project click CY8C28645-24LTXI device in this section and then click **Select**.

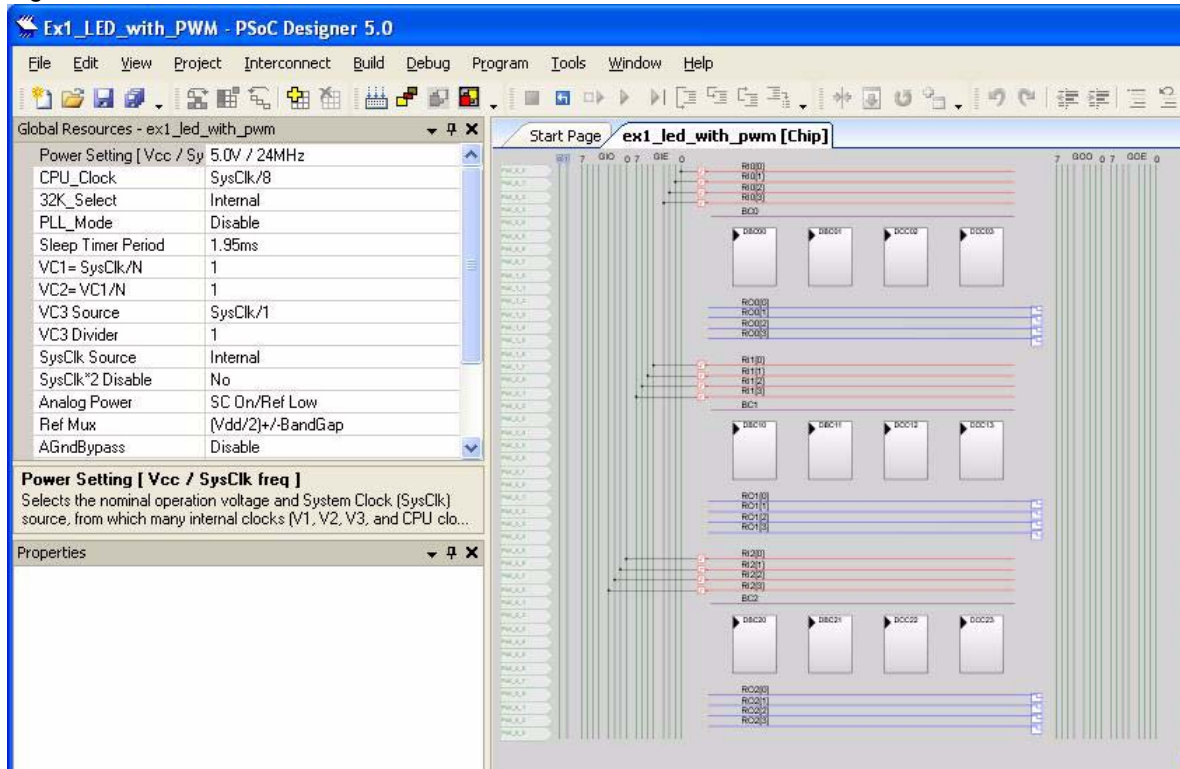
Figure 3-3. Device Catalog Window

Device Catalog									
Part Number	Analog Blocks	Digital Blocks	Flash	RAM	IO Count	Supply Voltage	SMP	Temp	
Click here to Remove All Filters									
	all	all	all	all	all	all	all	all	
wUSB									
CY8C27443-24SXI	12	8	16K	256	24	3.0 to 5.25	YES	Inc	
CY8C27543-24AXI	12	8	16K	256	40	3.0 to 5.25	YES	Inc	
CY8C27643-24PVXI	12	8	16K	256	44	3.0 to 5.25	YES	Inc	
CY8C27643-24LFXI	12	8	16K	256	44	3.0 to 5.25	YES	Inc	
USB									
CY8C28XXX (Datasheet) (Help Me Choose a Part)									
CY8C28403-24PVXI	0	12	16K	1024	24	3.0 to 5.25	Yes	Inc	
CY8C28413-24PVXI	0 + *4	12	16K	1024	24	3.0 to 5.25	Yes	Inc	
CY8C28513-24AXI	0 + *4	12	16K	1024	40	3.0 to 5.25	Yes	Inc	
CY8C28623-24LTXI	6	12	16K	1024	44	3.0 to 5.25	Yes	Inc	
CY8C28433-24PVXI	6 + *4	12	16K	1024	24	3.0 to 5.25	Yes	Inc	
CY8C28533-24AXI	6 + *4	12	16K	1024	40	3.0 to 5.25	Yes	Inc	
Lighting									
CY8C28243-24PVXI	12	12	16K	1024	16	3.0 to 5.25	Yes	Inc	
CY8C28643-24LTXI	12	12	16K	1024	44	3.0 to 5.25	Yes	Inc	
Automotive									
CY8C28445-24PVXI	12 + *4	12	16K	1024	24	3.0 to 5.25	Yes	Inc	
CY8C28545-24AXI	12 + *4	12	16K	1024	40	3.0 to 5.25	Yes	Inc	
PSoC									
CY8C28645-24LTXI	12 + *4	12	16K	1024	44	3.0 to 5.25	Yes	Inc	
CY8C28452-24PVXI	12 + *4	8	16K	1024	24	3.0 to 5.25	Yes	Inc	
II Devices									
Extended CY8C28XXX (Datasheet) (Help Me Choose a Part)									
CY8C28403-12PVXQ	0	12	16K	1024	24	4.75 to 5.25	Yes	Ext	
CY8C28413-12PVXQ	0 + *4	12	16K	1024	24	4.75 to 5.25	Yes	Ext	
CY8C28513-12AXQ	0 + *4	12	16K	1024	40	4.75 to 5.25	Yes	Ext	

9. Under **Generate 'Main' File Using:**, for this project select **C**, then click **OK**.

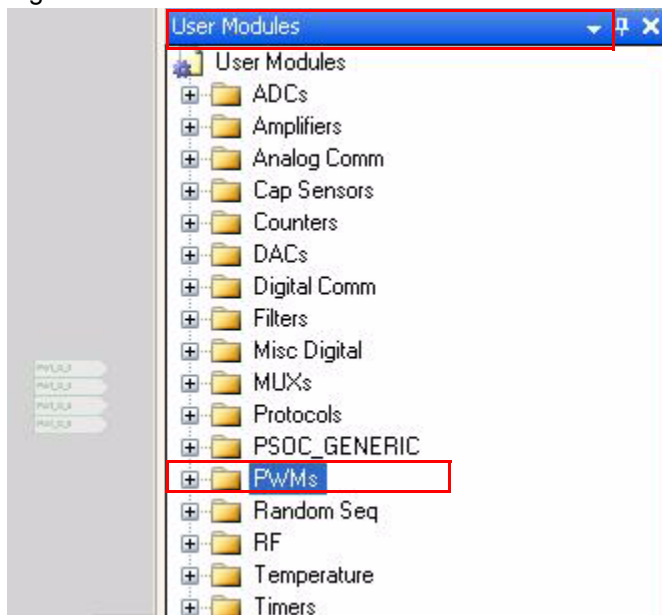
10. By default, the project opens to chip view

Figure 3-4. Default View.



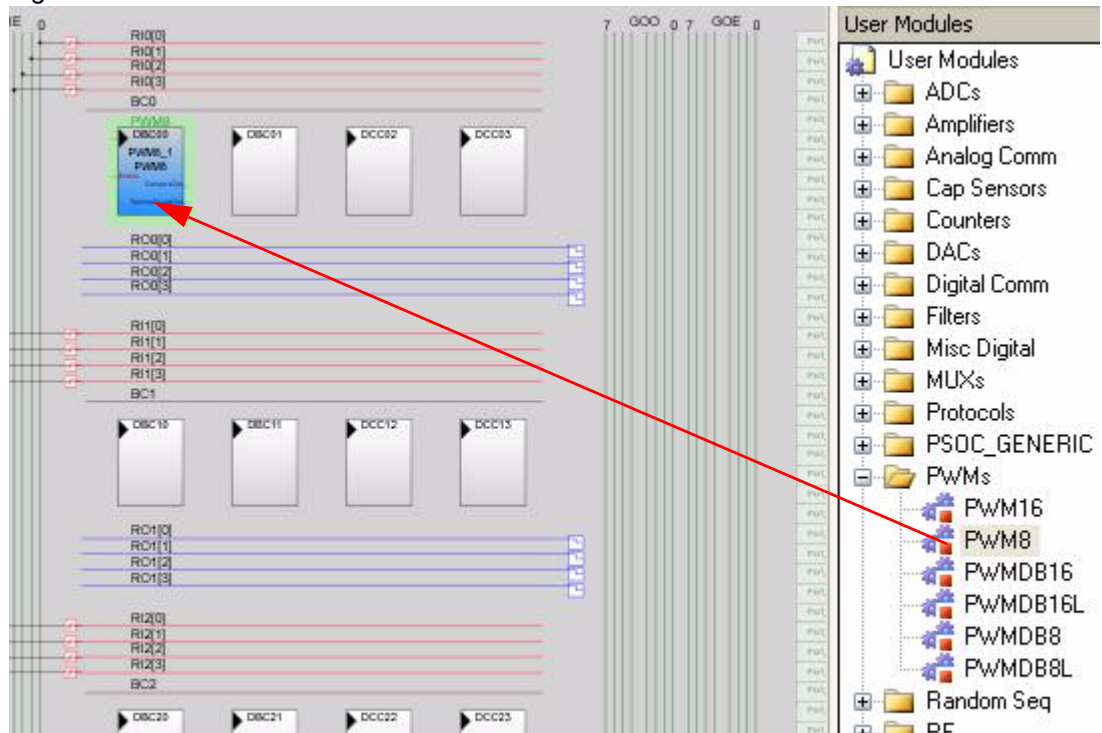
11. In the **User Modules** window, expand the **PWMs** folder.

Figure 3-5. User Modules Window



12. In this folder right click on a **PWM8** and select place. The User Module (UM) is placed in the first available digital block.

Figure 3-6. Place User Module PWM8



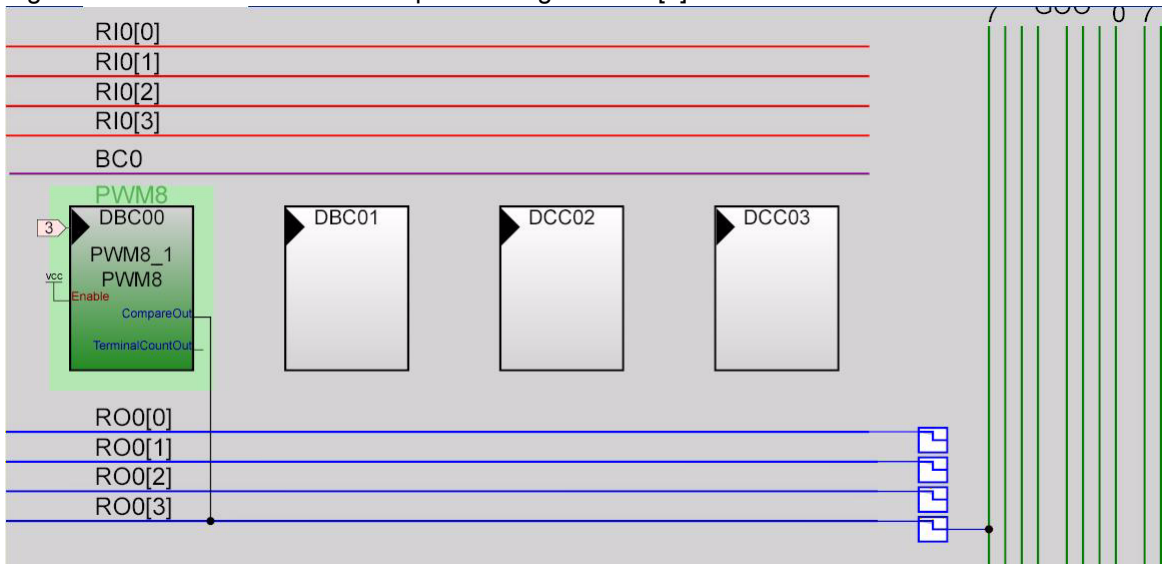
13. Click the placed PWM8_1 UM; the **Properties** window opens on the left side of the screen. Configure the PWM with the settings as in the following figure. If the **Properties** window does not appear, click **View** → **Properties** Window.

Figure 3-7. Properties Window

Properties - PWM8_1	
Name	PWM8_1
User Module	PWM8
Version	2.5
Clock	VC3
Enable	High
CompareOut	Row_0_Output_3
TerminalCountOut	None
Period	100
PulseWidth	50
CompareType	Less Than Or Equal
InterruptType	Terminal Count
ClockSync	Sync to SysClk
InvertEnable	Normal

14. Next, route the PWM **CompareOut** signal to P1[7]. The first step is to configure the Look Up Table (LUT) on **Row_0_Output3**.

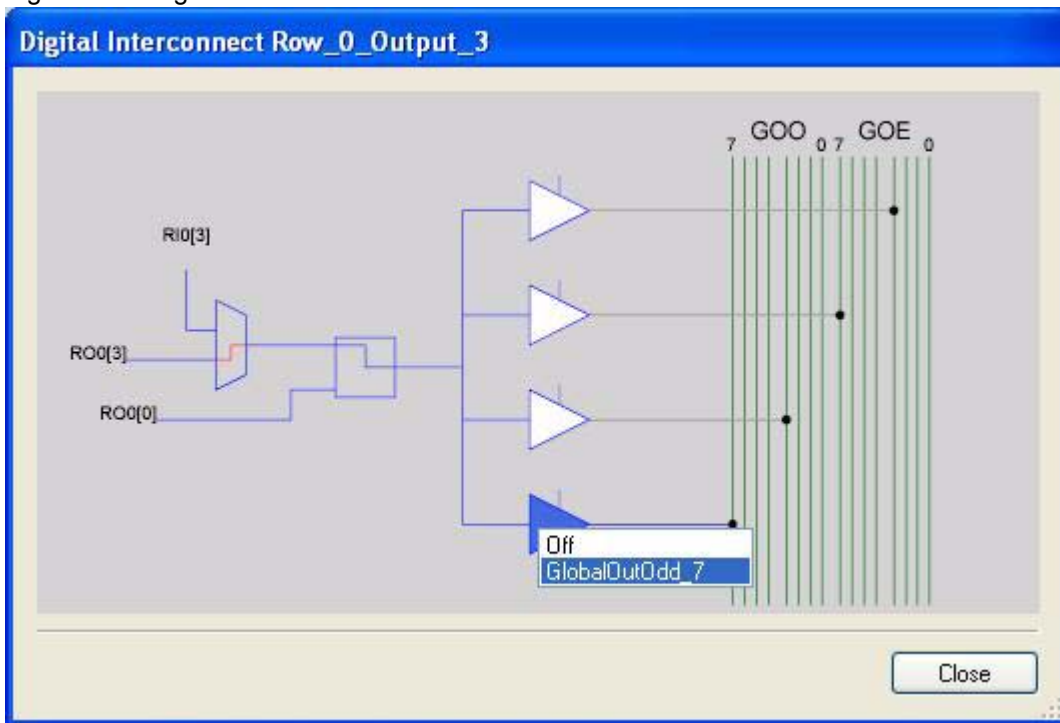
Figure 3-8. Route the PWM8 CompareOut signal to P1[7]



15. Double click the **LUT**, the **Digital Interconnect** window opens.

16. In this window enable **Row_0_Output_3_Drive_3** to connect to **GlobalOutOdd_7**.

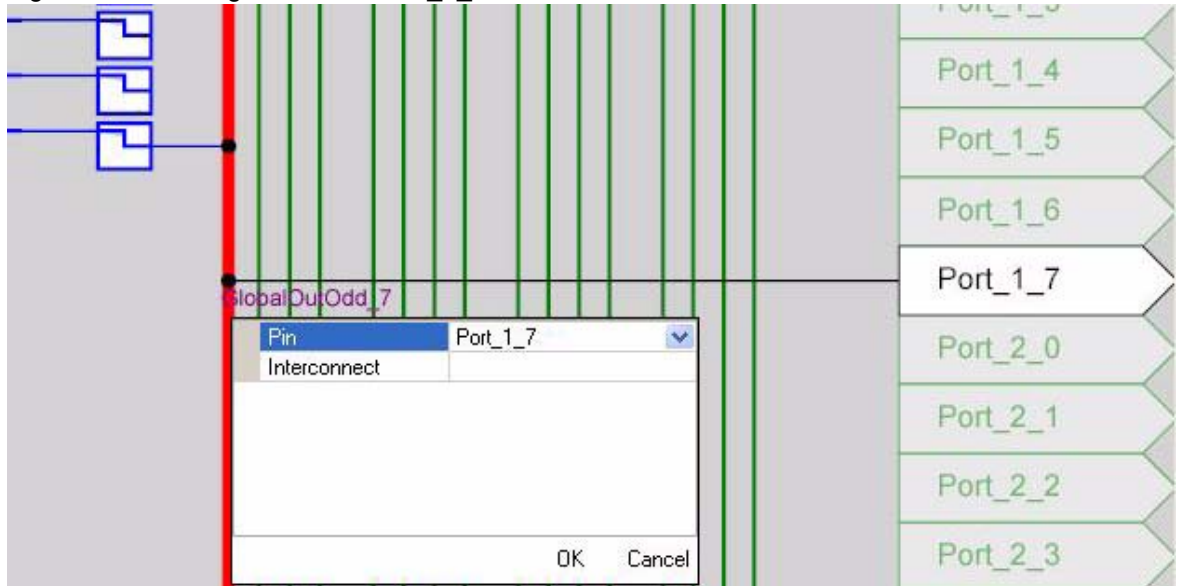
Figure 3-9. Digital Interconnect Window



17. Click **Close**.

18. Click on **GlobalOutOdd_7**. A window appears, in this window configure **PIN** for **Port_1_7**.

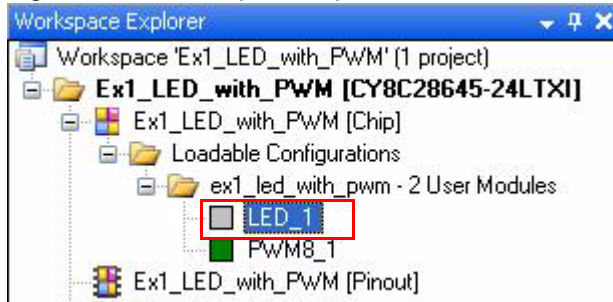
Figure 3-10. Configure PIN for Port_1_7



19. Click **OK** to continue.

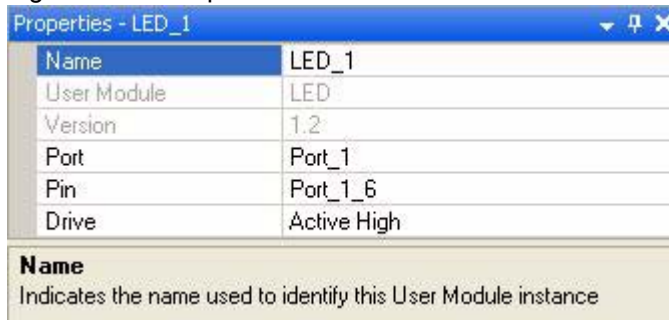
20. In the **User Modules** window expand the **Misc Digital** folder. In this folder right click the **LED** and select place, this adds the UM to the project. This UM does not use digital or analog blocks. It appears in the **Workspace Explorer** → **Ex1_LED_with_PWM[CY8C28]** → **Ex1_LED_with_PWM[Chip]** → **Loadable Configurations** → **Ex1_LED_with_PWM - 2 User Modules**.

Figure 3-11. Workspace Explorer



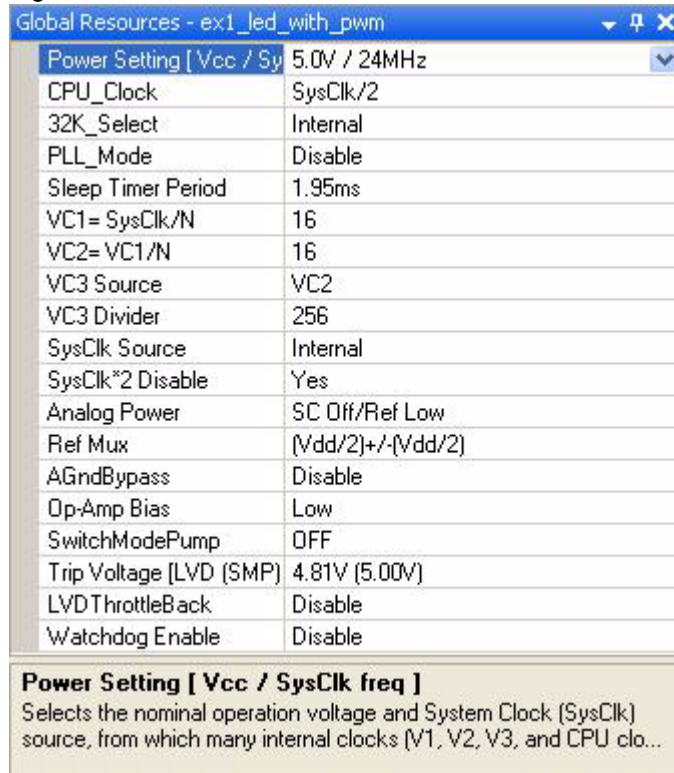
21. Click the **LED_1** UM and navigate to the **Properties** window. Configure the LED for **P1[6]**.

Figure 3-12. Properties Window



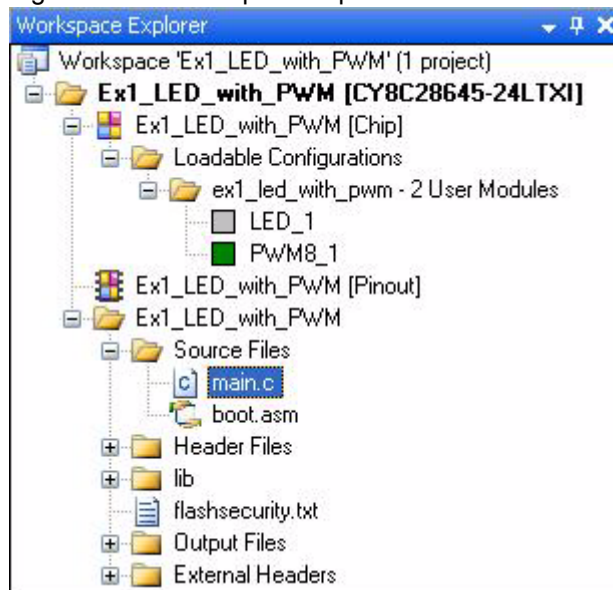
22. Configure the **Global Resources** window to match the following figure.

Figure 3-13. Global Resources Window



23. Open the existing *main.c* file within Workspace Explorer. Replace the existing *main.c* content with the content of the embedded *CY8C28_main_Ex1.c* file, which can be found within the attachments feature of this PDF document.

Figure 3-14. Workspace Explorer



24. Save the project.

25. Build the project. **Build** → **Generate/Build 'Ex1_LED_with_PWM' Project**.

26. Disconnect power to the board.
27. Configure the DVK board SW3 to 5V.
28. Configure the DVK breadboard using the included jumper wires:
 - P1[6] to LED1
 - P1[7] to LED2
29. Reapply power to the board.
30. Use PSoC Designer as described in [Programming My First PSoC 1 Project on page 15](#) to program the device.
31. Reset the DVK, and observe the blinking LEDs.
32. Save and close the project.

3.1.1.2 *main.c*

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C28_main_Ex1.c* file, which can be found within the attachments feature of this PDF document.

Note To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.

```
#include <m8c.h>          /* Part specific constants and macros */
#include "PSoCAPI.h"     /* PSoC API definitions for all User Modules */

/*****
 * Function Name: main
 *****/
*
* Summary:
* The main function initializes the PWM and starts the PWM clock which will
* blink LED1. Then the main loop is entered which delays enough for LED2 to
* blink at a quicker rate than LED1.
*
* Parameters:
* void
*
* Return:
* void
*
*****/
void main(void)
{
    WORD i;              /* Variable used for delay */

    PWM8_1_Start();     /* Turn on the PWM to blink LED on P1.6 */
    LED_1_Start();     /* Enable Software controlled LED */

    /* The following loop controls the software LED connected to P1.7 */
    while(1)
    {
        /* Delay time depends on compiler optimization levels and CPU clock */
        for (i = 0; i < 60000; i++); // Gives approx 450 msec delay with ImageCraft
        // and 170 msec with HiTech
        #ifdef HI_TECH_C
            for (i = 0; i < 60000; i++); // Give some more delay if HiTech compiler is used.
            for (i = 0; i < 40000; i++);
        #else
            #endif
        /* Switch the state of Software LED (on or off) */
        LED_1_Invert();
    } /* End of while(1) */
} /* End of main */

/* [] END OF FILE */
```

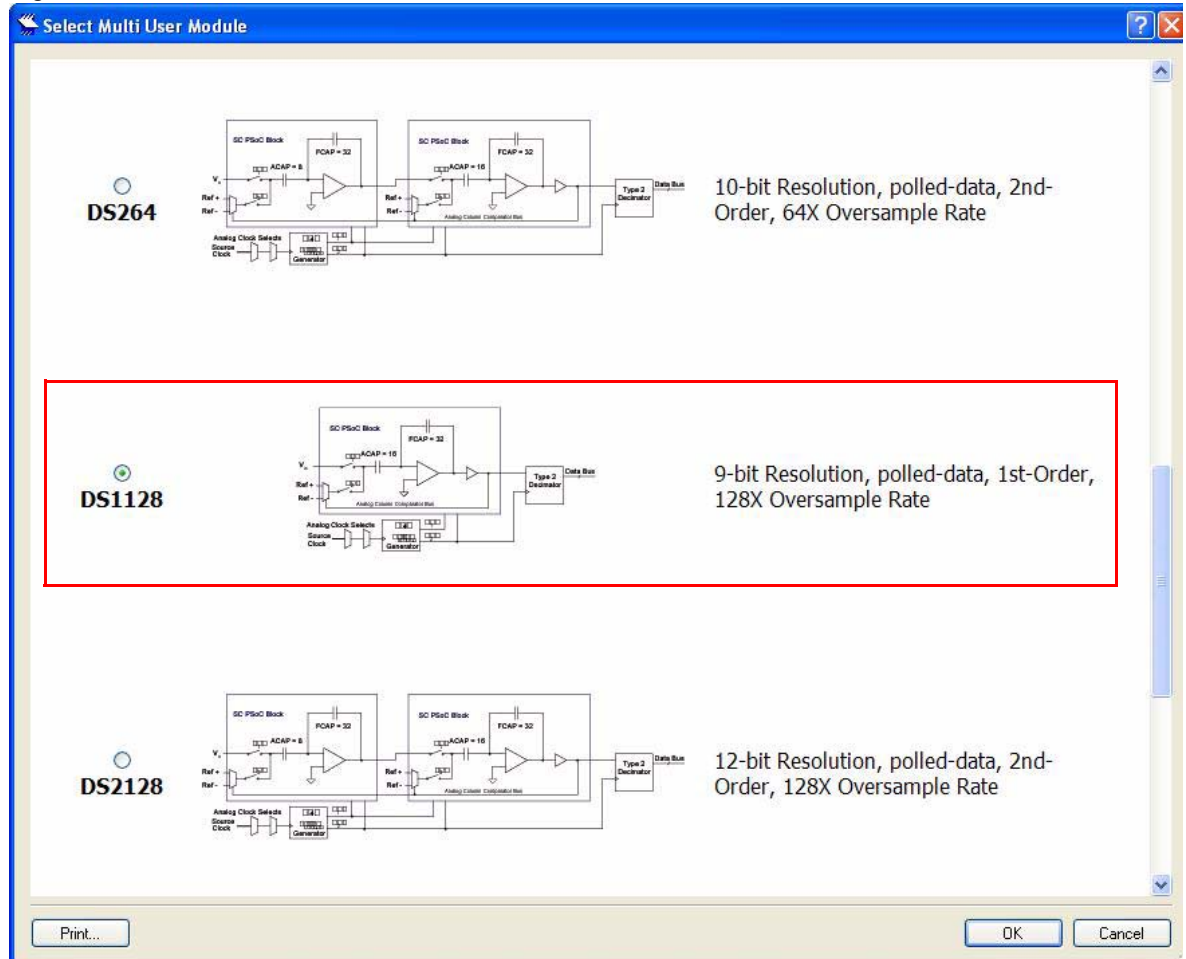
3.1.2 ADC to LCD Project

This project demonstrates a 9-bit Delta Sigma ADC by measuring the voltage of the potentiometer center tap wiper and displaying the result on the LCD. Connect the voltage potentiometer (VR) to the ADC input P0[1]. The program reads the 9-bit ADC result and prints it to the LCD.

3.1.2.1 Creating ADC to LCD Project

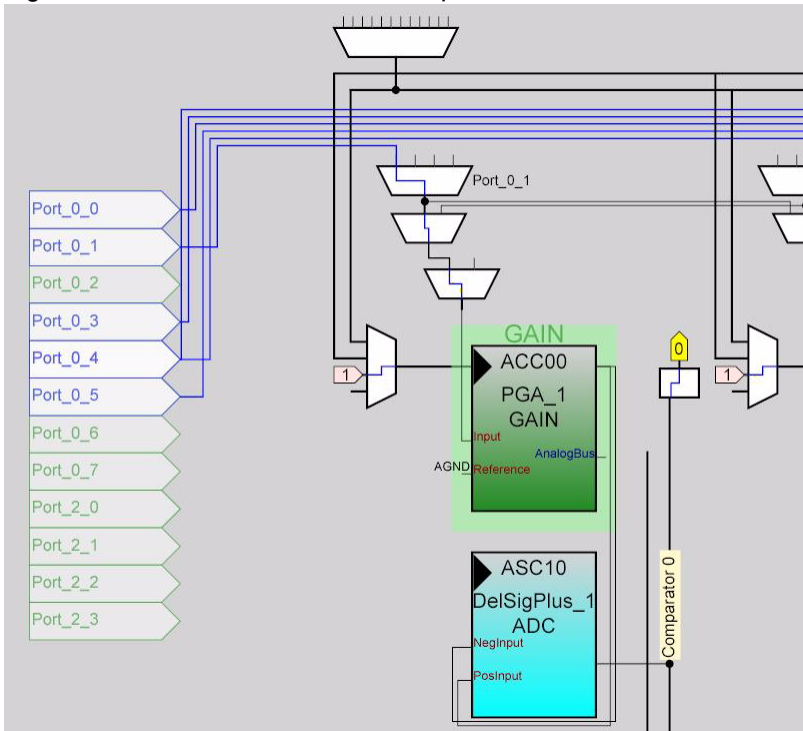
1. Follow steps 1 to 10 in section 3.1.1.1 on page 29, change the **Name** of the project to **Ex2_ADC_to_LCD**.
2. In the **User Modules** window expand the **ADCs** folder, and then right click **DelSigPlus** and choose **Place**. A window opens with multiple options for the DelSigPlus UM. In this case the **DS1128** configuration is used. Scroll down in the window to verify that this is the case.

Figure 3-15. Select Multi User Module Window



3. Click **OK**.
4. Verify that the **DelSigPlus_1** UM is placed in **ASC10**.
5. In the **User Modules** window expand the **Amplifiers** window. Right click **PGA**, select place. Ensure that the **PGA** is placed in **ACC00**.

Figure 3-16. Ensure that the PGA is placed in ACC00.



6. In the **User Modules** window expand **Misc Digital**, Right click **LCD** and click place.
7. Click **PGA_1** and configure the properties to match this figure.

Figure 3-17. PGA_1 Properties

Properties - PGA_1	
Name	PGA_1
User Module	PGA
Version	3.2
Gain	1.000
Input	AnalogColumnMUXBusSwitch_0
Reference	AGND
AnalogBus	Disable

8. Click **DelSigPlus_1** and configure the properties to match this figure.

Figure 3-18. DelSigPlus_1 Properties

Properties - DelSigPlus_1	
Name	DelSigPlus_1
User Module	DelSigPlus
Version	1.0
DataFormat	Unsigned
ClockPhase	Normal
PosInput	ACC00
NegInput	ACC00
NegInputGain	Disconnected

Name
Indicates the name used to identify this User Module instance

9. Click **LCD_1** and configure the properties to match this figure.

Figure 3-19. LCD_1 Properties

Properties - LCD_1	
Name	LCD_1
User Module	LCD
Version	1.5
LCDPort	Port_2
BarGraph	Disable

Name
Indicates the name used to identify this User Module instance

10. Configure the **Global Resources** to match the following figure.

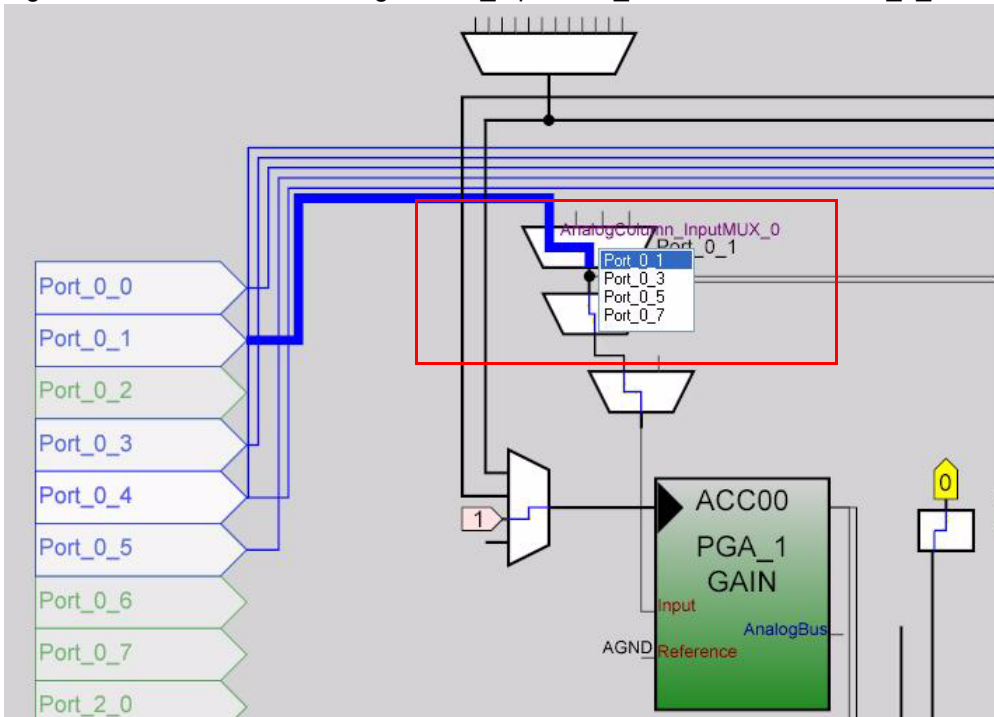
Figure 3-20. Global Resources

Global Resources - ex2_adc_to_lcd	
Power Setting [Vcc / Sys	5.0V / 24MHz
CPU_Clock	SysClk/2
32K_Select	Internal
PLL_Mode	Disable
Sleep Timer Period	1.95ms
VC1= SysClk/N	12
VC2= VC1/N	16
VC3 Source	VC2
VC3 Divider	256
SysClk Source	Internal
SysClk*2 Disable	Yes
Analog Power	SC On/Ref High
Ref Mux	(2 BandGap)+/-BandGap
AGndBypass	Disable
Op-Amp Bias	High
SwitchModePump	OFF
Trip Voltage [LVD (SMP)	4.81V (5.00V)
LVDThrottleBack	Disable
Watchdog Enable	Disable

Power Setting [Vcc / SysClk freq]
Selects the nominal operation voltage and System Clock (SysClk) source, from which many internal clocks (V1, V2, V3, and CPU clo...

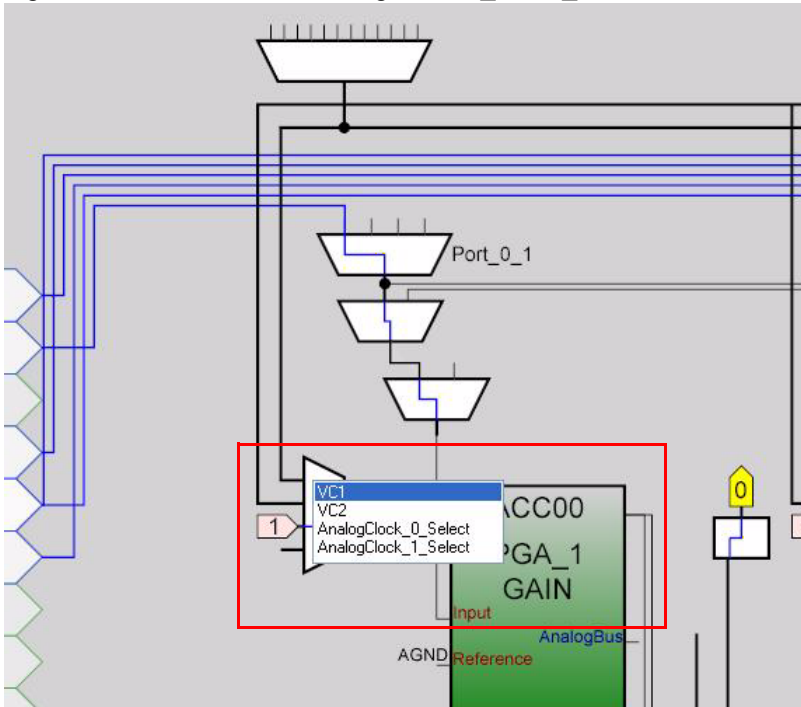
11. Ensure that **AnalogColumn_InputMUX_0** is connected to **Port_0_1**. If it is not configured for this port, double click the **MUX** and choose **Port_0_1**.

Figure 3-21. Ensure that AnalogColumn_InputMUX_0 is connected to Port_0_1



12. Ensure that **AnalogColumn_Clock_0**, is connected to **VC1**. If it is not, double click the **MUX** and choose **VC1**.

Figure 3-22. Ensure that AnalogColumn_Clock_0, is connected to VC1



13. Open the existing *main.c* file within Workspace Explorer. Replace the existing *main.c* content with the content of the embedded *CY8C28_main_Ex2.c* file, which can be found within the attachments feature of this PDF document.

14. Save the project.

15. Build the project. **Build** → **Generate/Build 'Ex2_ADC_to_LCD' Project**.

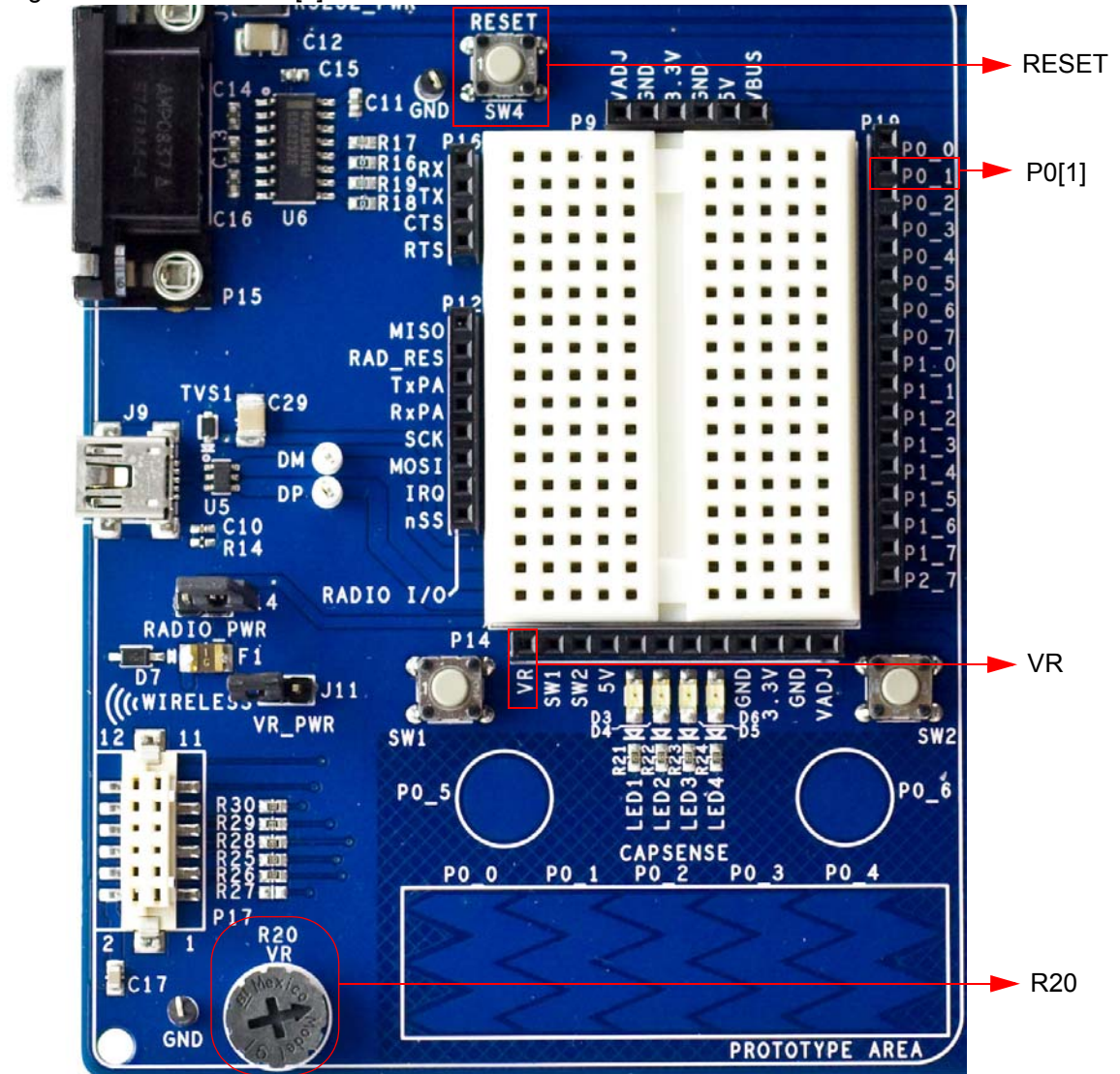
16. Disconnect power to the board.

17. Configure the DVK SW3 to 5V.

18. Configure the DVK breadboard using the included jumper wires:

- P0[1] to VR

Figure 3-23. Connect P0[1] to VR



19. Reapply power to the board.

20. Use PSoC Designer as described in [Programming My First PSoC 1 Project on page 15](#) to program the device.

21. After programming the device, press the reset button and vary the POT (R20) to see the results on the LCD.

Note The ADC output values may not reach full range due to potentiometer and ADC limitations. ADC values may fluctuate several counts due to system noise, and if the potentiometer voltage is at the edge of an ADC count.

22. Save and close the project.

3.1.2.2 *main.c*

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C28_main_Ex2.c* file, which can be found within the attachments feature of this PDF document.

Note To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.

```
#include <m8c.h>          /* part specific constants and macros */
#include "PSoC_API.h"    /* PSoC API definitions for all User Modules */

/* LCD specific */
#define ROW_0    0 /* LCD row 0 */
#define ROW_1    1 /* LCD row 1 */
#define COLUMN_0 0 /* LCD column 0 */
#define COLUMN_9 9 /* LCD column 9 */

/*****
 * Function Name: main
 *****/
*
* Summary:
*   The main function initializes both the ADC and LCD, starts and waits for an
*   ADC conversion, then it displays the raw counts to the LCD.
*
* Parameters:
*   void
*
* Return:
*   void
*
*****/
void main(void)
{
    WORD adcResult; /* Holds the integer ADC result */

    /* Initialize the PGA used to buffer input from the potentiometer (VR) on
       P0.1 to the ADC */
    PGA_1_Start(PGA_1_HIGHPOWER);
    DelSigPlus_1_Start(DelSigPlus_1_HIGHPOWER); /* Initialize the ADC */
    LCD_1_Start(); /* Initialize the LCD */

    LCD_1_Position(ROW_0, COLUMN_0); /* Set the LCD to (Row=0,Column=0) */
    LCD_1_PrCString("V Count: ");

    DelSigPlus_1_StartAD(); /* Start gathering conversions from the ADC */

    M8C_EnableGInt; /* Enable Global interrupts */

    /* This loop waits for a valid ADC result, and displays it on the LCD */
    while (1)
    {
        /* Is there ADC data? */
        if(DelSigPlus_1_fIsDataAvailable())
        {
            /* Store result from ADC */

```

```
        adcResult = DelSigPlus_1_wGetDataClearFlag();
        LCD_1_Position(ROW_0, COLUMN_9); /* Set LCD to (Row=0,Column=9) */
        LCD_1_PrHexInt(adcResult); /* Print ADC result on LCD */
    }
} /* End of while(1) */
} /* End of main */

/* [] END OF FILE */
```

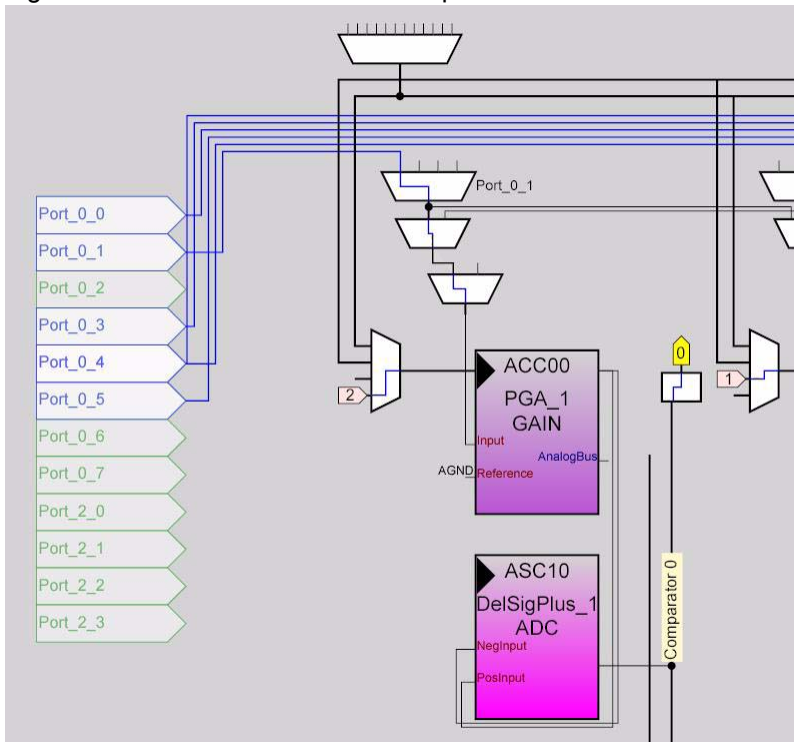
3.1.3 ADC to UART with DAC

This project demonstrates sine wave generation by using a 6-bit DAC. The sine wave period is based on the current value of the ADC. The firmware reads the voltage output by the DVK board potentiometer and displays the raw counts on the DVK board character LCD display similarly to those shown in the previous project. A 6-bit DAC outputs a table generated sine wave at a frequency proportional to the ADC count. The frequency outputs to an oscilloscope. A 38400 BAUD UART outputs the current ADC count as ASCII formatted into a hexadecimal number.

3.1.3.1 Creating ADC to UART with DAC Project

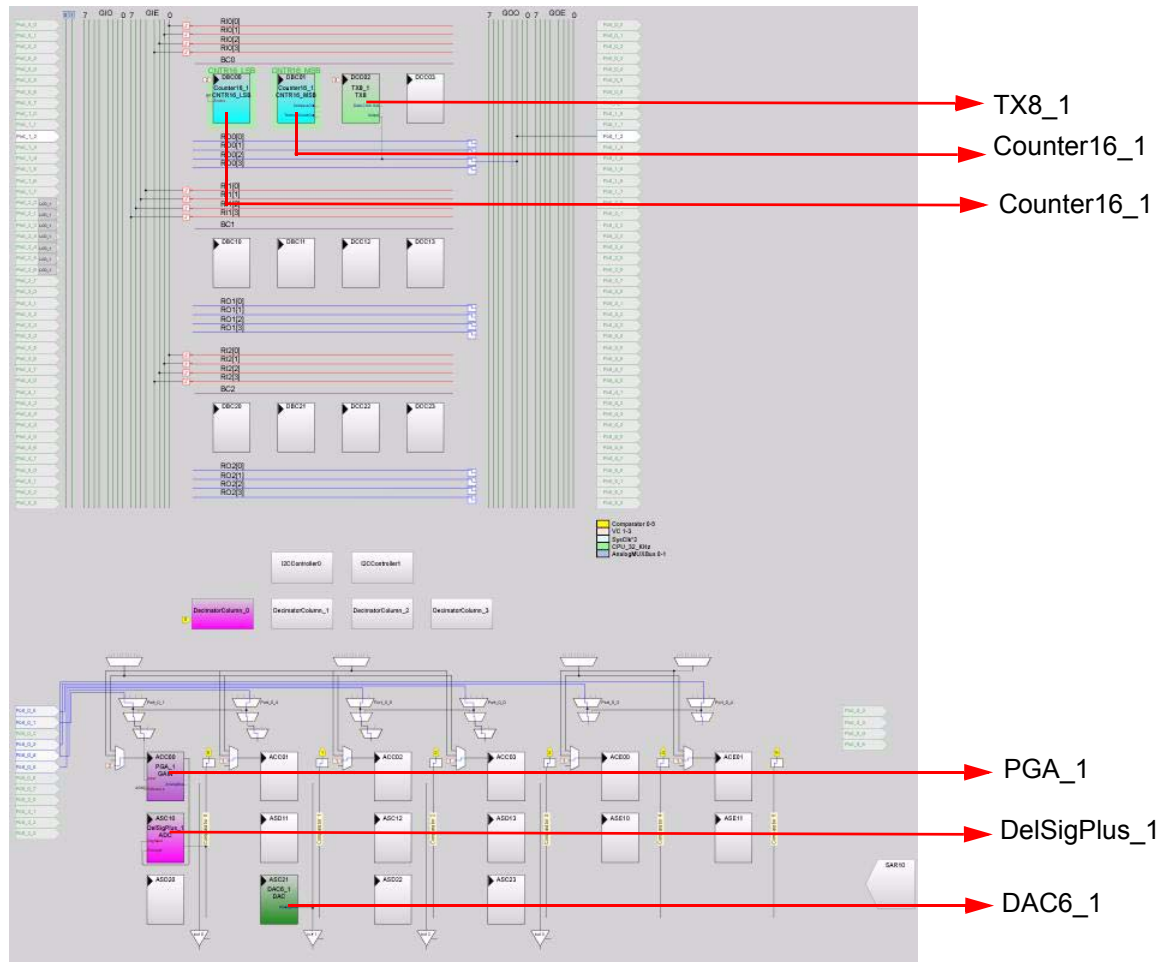
1. Follow steps 1 to 10 in section 3.1.1.1 on page 29, change the **Name** of the project to **Ex3_ADC_to_UART_with_DAC**.
2. In the **User Modules** window expand the **ADCs** folder, and then right click **DeISigPlus** and choose **Place**. A window opens with multiple options for the DeISigPlus UM. In this case the **DS1128** configuration is used. Scroll down in the window to verify that this is the case.
3. Click **OK**.
4. Verify that the UM is placed in **ASC10**.
5. In the **User Modules** window expand the **Amplifiers** window. Right click **PGA**, select place. Ensure that the **PGA** is placed in **ACC00**.

Figure 3-24. Ensure that the PGA is placed in ACC00



6. In the **User Modules** window expand **Misc Digital**, right click **LCD**, and click place.
7. In the **User Modules** window expand **Counters**, right click **Counter16**, and select place.
8. In the **User Modules** window expand **Digital Comm**, right click **TX8**, and click place.
9. In the **User Modules** window expand **DACs**, right click **DAC6**, and click place. User module gets placed in ASD20 analog block by default, Move it to ASC21 block by drag and drop.
10. Move the UMs so that they match the configuration shown in [Figure 3-25 on page 47](#).

Figure 3-25. Configure User Modules



11. Click on **DelSigPlus_1** and configure it to match this figure.

Figure 3-26. DelSigPlus_1 Properties

Properties - DelSigPlus_1	
Name	DelSigPlus_1
User Module	DelSigPlus
Version	1.0
DataFormat	Unsigned
ClockPhase	Normal
PosInput	ACC00
NegInput	ACC00
NegInputGain	Disconnected
Name Indicates the name used to identify this User Module instance	

12. Click **PGA_1** and configure it to match this figure.

Figure 3-27. PGA_1 Properties

Properties - PGA_1	
Name	PGA_1
User Module	PGA
Version	3.2
Gain	1.000
Input	AnalogColumnMUXBusSwitch_0
Reference	AGND
AnalogBus	Disable

13. Click **DAC6_1** and configure it to match this figure.

Figure 3-28. DAC6_1 Properties

Properties - DAC6_1	
Name	DAC6_1
User Module	DAC6
Version	4.3
AnalogBus	AnalogOutBus_1
ClockPhase	Normal
DataFormat	OffsetBinary

14. Click **LCD_1** and configure it to match this figure.

Figure 3-29. LCD_1 Properties

Properties - LCD_1	
Name	LCD_1
User Module	LCD
Version	1.5
LCDPort	Port_2
BarGraph	Disable

15. Click on **Counter16_1** and configure it to match this figure.

Figure 3-30. Counter16_1 Properties

Properties - Counter16_1	
Name	Counter16_1
User Module	Counter16
Version	2.5
Clock	VC2
Enable	High
CompareOut	None
TerminalCountOut	None
Period	0
CompareValue	0
CompareType	Less Than Or Equal
InterruptType	Terminal Count
ClockSync	Sync to SysClk
InvertEnable	Normal

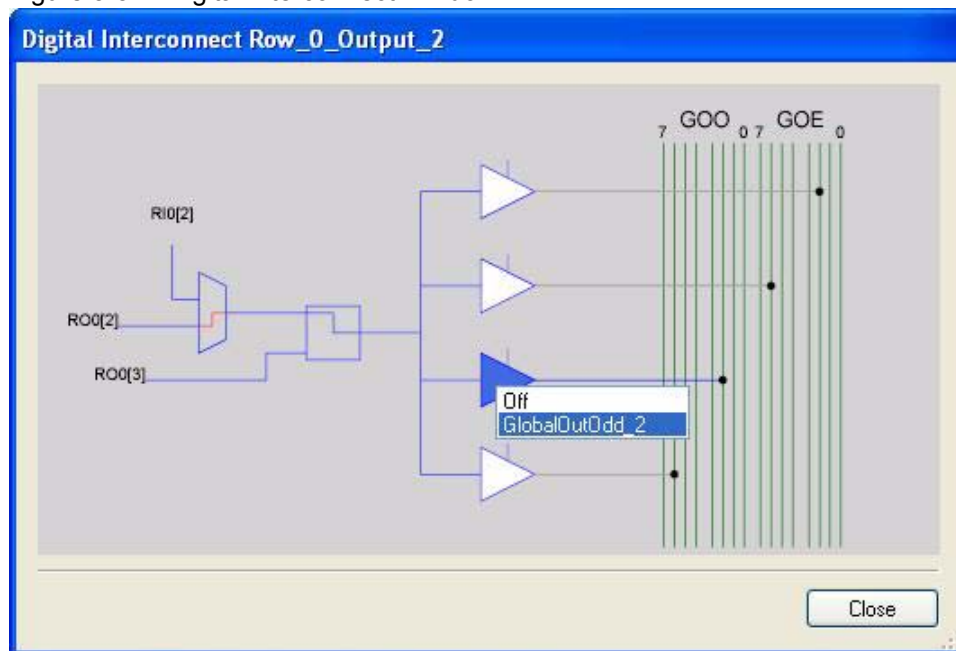
16. Click **TX8_1** and configure it to match this figure.

Figure 3-31. TX8_1 Properties

Properties - TX8_1	
Name	TX8_1
User Module	TX8
Version	3.3
Clock	VC3
Output	Row_0_Output_2
TX Interrupt Mode	TXComplete
ClockSync	Sync to SysClk
Data Clock Out	None

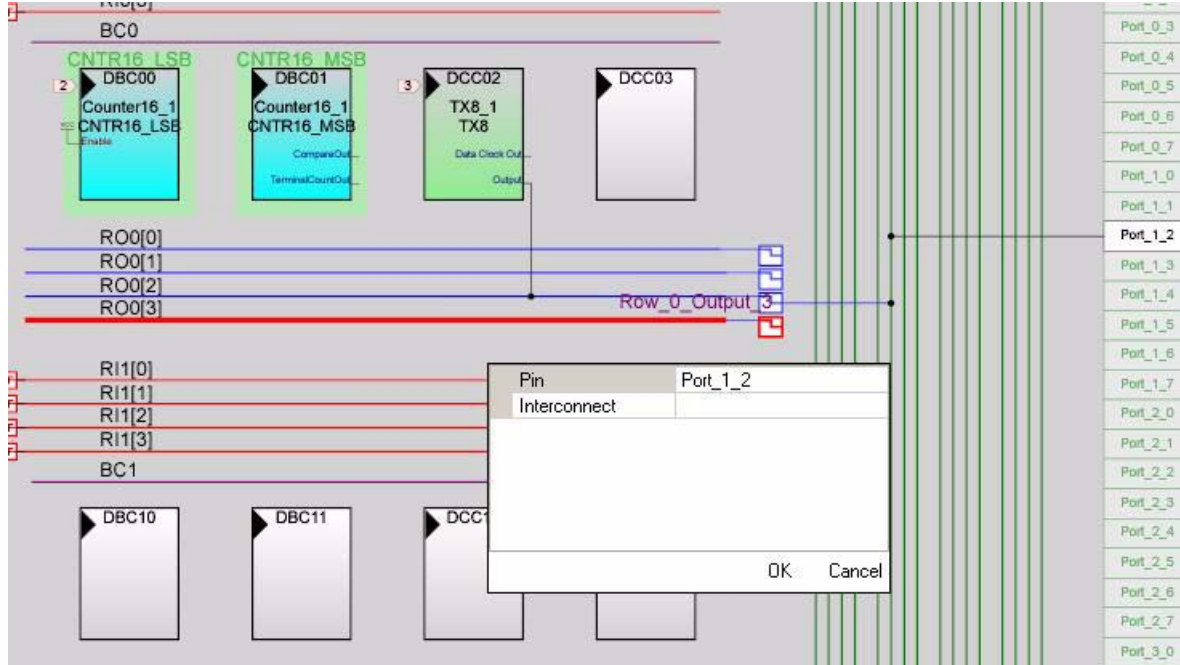
17. Click **RO0[2]** LUT, enable **Row_0_Output_2_Drive_2** to connect **GlobalOutOdd_2**.

Figure 3-32. Digital Interconnect Window



18. Click **GlobalOutOdd_2**. A window appears; in this window configure **PIN** for **Port_1_2**.

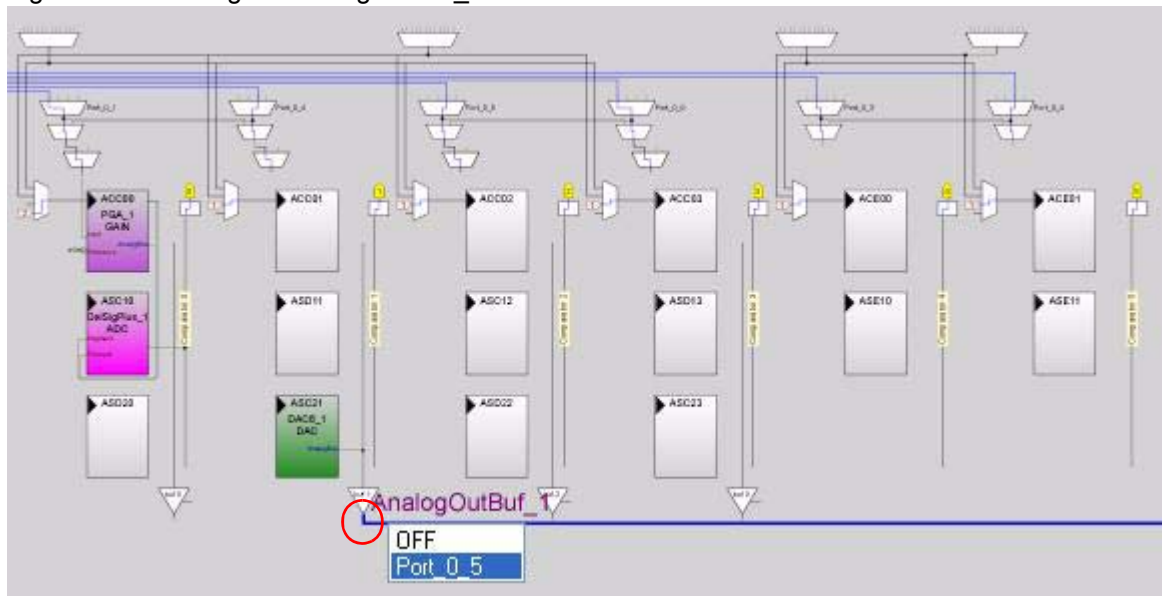
Figure 3-33. Configure PIN for Port_1_2



19. Click **OK** to continue.

20. Click **AnalogOutBuf_1** and configure it for **Port_0_5**.

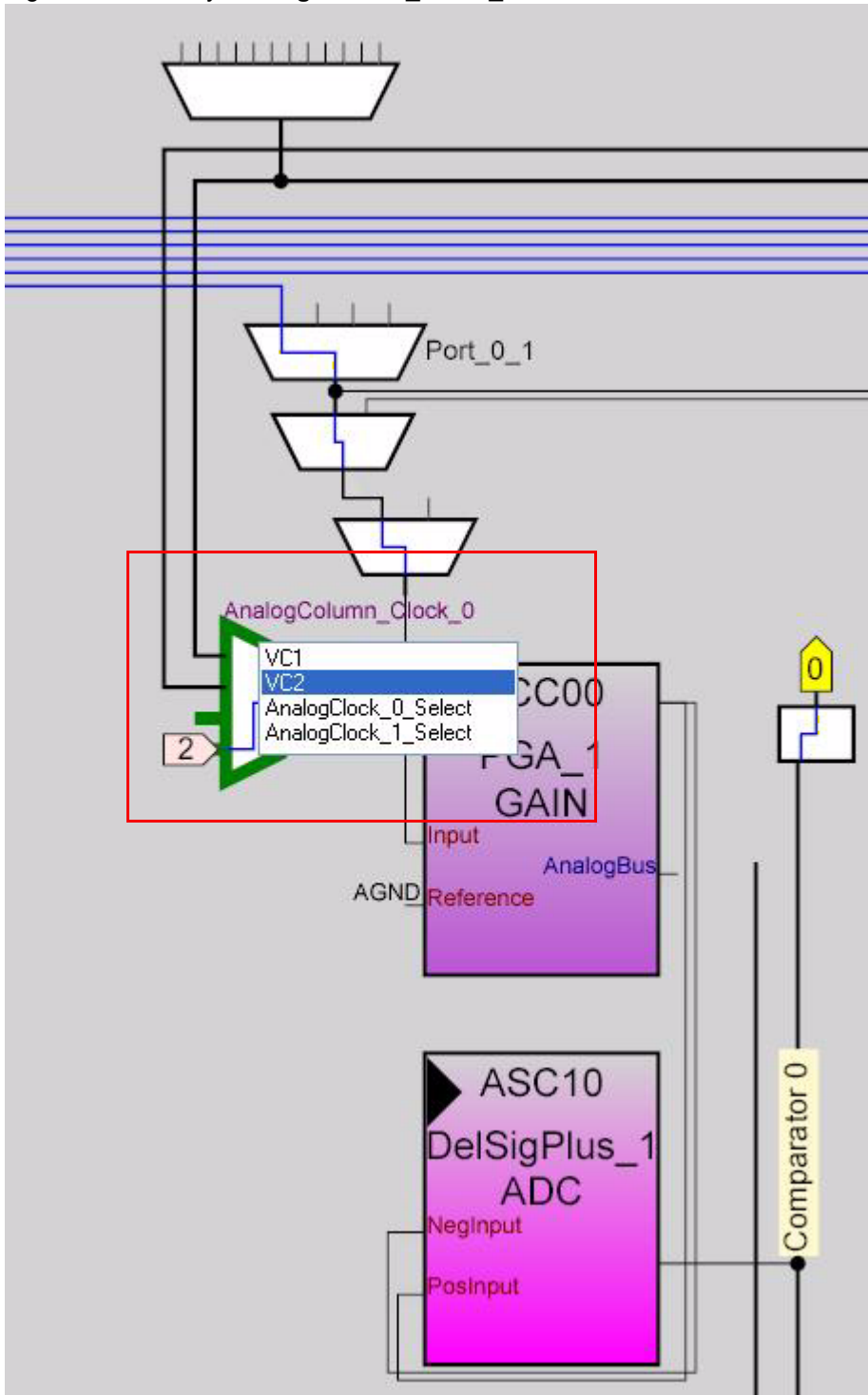
Figure 3-34. Configure AnalogOutBuf_1



21. Verify that **AnalogColumn_InputMUX_0** is connected to **Port_0_1**. If it is not configured for this port, double click the **MUX** and choose **Port_0_1**.

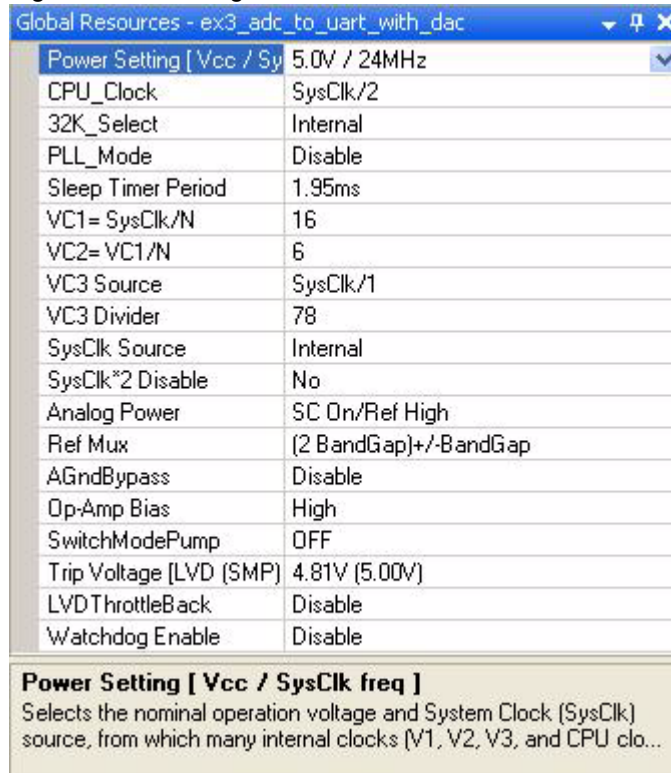
22. Verify that **AnalogColumn_Clock_0** and **AnalogColumn_Clock_1** are connected to **VC2**. If it is not, double click the **MUX** and chose **VC2**.

Figure 3-36. Verify **AnalogColumn_Clock_0** Connection



23. Configure **Global Resources** to match the following figure.

Figure 3-37. Configure Global Resources



24. Open the existing *main.c* file within Workspace Explorer. Replace the existing *main.c* content with the content of the embedded *CY8C28_main_Ex3.c* file, which can be found within the attachments feature of this PDF document.

25. Save the project.

26. To Generate the project, click **Build** → **Generate/Build 'Ex3_ADC_to_UART_with_DAC'** Project.

27. Open your *boot.tpl* file in the project folder **Files** → **Open File**. Select **All Files** for **Files of the type:**

28. Select *boot.tpl* in the list of files and click **Open**.

29. Find the line '@INTERRUPT_9' (for PSoC Block DBC01) and replace that line with:

```
ljmp _Counter16_C_ISR
```

30. Save the project.

31. To Build the project, click **Build** → **Build 'Ex3_ADC_to_UART_with_DAC'** Project.

32. Disconnect power to the board.

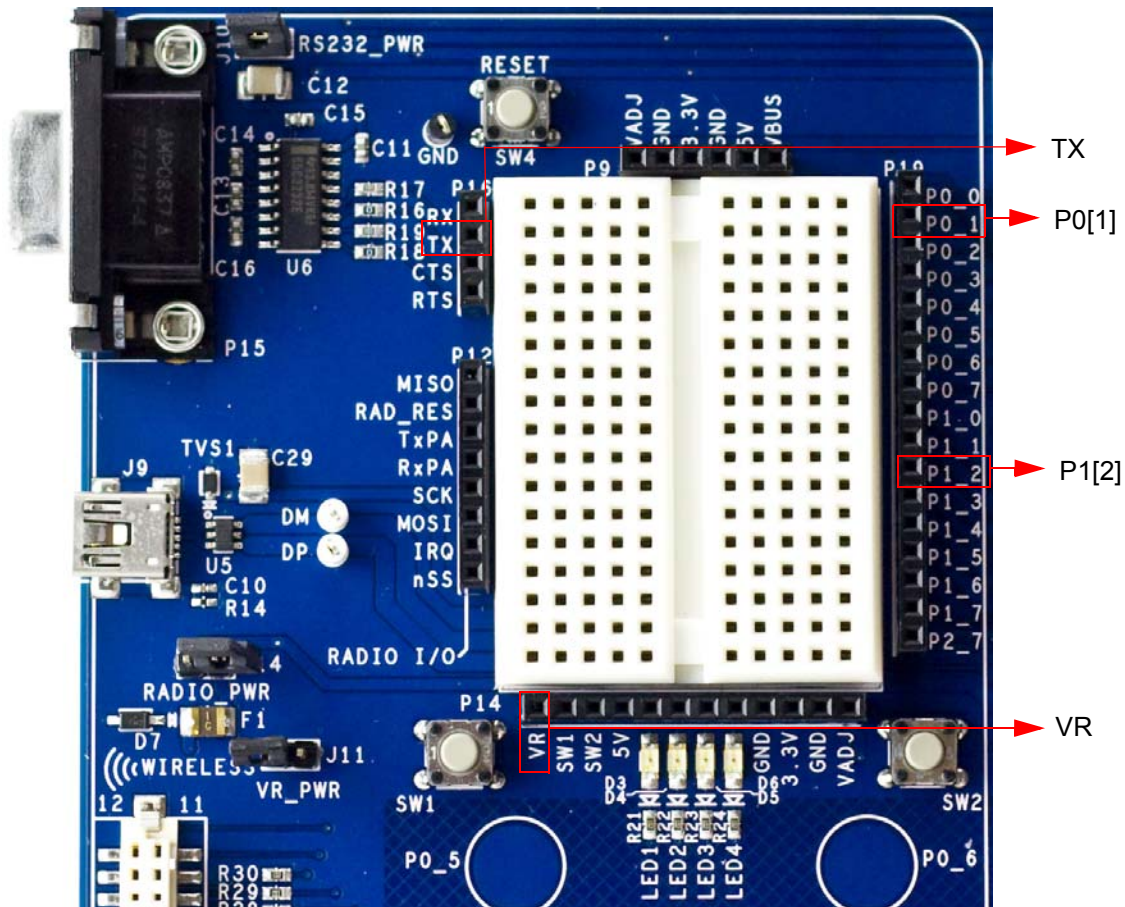
33. Configure the DVK SW3 to 5V.

34. Configure the DVK breadboard using the included jumper wires as follows:

- P0[1] to VR
- P1[2] to TX
- P0[5] to Scope

Note An LED (P0[5] to LED1) by nature does not accurately show the changes in frequency the best way to see this is to use a Scope(P0[5] to Scope).

Figure 3-38. Connect P0[1] to VR, P1[2] to TX, and P0[5] to LED1



35. Connect a serial cable to the PC and the DVK board.

36. On the DVK board, verify that **RS232_PWR(J10)** is jumpered to **ON**.

37. Reapply power to the board.

38. Use a terminal application such as TeraTerm or HyperTerminal with these setup parameters.

- Baud Rate: 38400
- Data: 8-bit
- Parity: none
- Stop: 1bit
- Flow Control: none

39. Use PSoC Designer as described in [Programming My First PSoC 1 Project on page 15](#) to program the device.

After programming the device, press Reset and vary the pot to see the result on the LCD as well as in the terminal application. View the DAC output on a scope or with an LED.

Note The ADC output values may not reach full range due to potentiometer and ADC limitations. ADC values may fluctuate several counts due to system noise, and if the potentiometer voltage is at the edge of an ADC count.

40. Save and close the project.

3.1.3.2 *main.c*

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C28_main_Ex3.c* file, which can be found within the attachments feature of this PDF document.

Note To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.

```
#include <m8c.h>          /* part specific constants and macros */
#include "PSoCAPI.h"     /* PSoC API definitions for all User Modules */

/* Counter16 Interrupt Handler */
#pragma interrupt_handler Counter16_C_ISR

/* LCD specific */
#define ROW_0      0 /* LCD row 0      */
#define ROW_1      1 /* LCD row 1      */
#define COLUMN_0   0 /* LCD column 0   */
#define COLUMN_9   9 /* LCD column 9   */

const BYTE sinTable[]=
{
    0,  0,  1,  2,  3,  4,  6,  7, 10, 12, 14, 17, 20, 23, 26, 29,
    31, 33, 36, 39, 41, 44, 46, 49, 51, 53, 55, 56, 58, 59, 59, 60,
    60, 60, 59, 59, 58, 56, 55, 53, 51, 49, 47, 44, 42, 39, 36, 33,
    31, 28, 25, 22, 19, 16, 13, 11,  9,  7,  5,  3,  2,  1,  0,  0
};

BYTE tablePos = 0;

/*****
 * Function Name: main
 *****/
*
* Summary:
*   The main function initializes the ADC, PGA, LCD, Counter, DAC and UART.
*   In the main loop, it continuously checks for an ADC conversion.  If there is
*   one then it displays the ADC raw count to the LCD, transmits the raw count
*   serially, and updates the Counter16 period (based on the raw count) for the
*   DAC output.
*
* Parameters:
*   void
*
* Return:
*   void
*
 *****/
void main(void)
{
    /* Variable for holding ADC result, and updating counter period */
    WORD adcResult;

    Counter16_1_Start();          /* Enable the counter used for DAC update rate */
    Counter16_1_EnableInt();     /* Enable DAC update interrupt */
}
```

```

/* Start the TX8 UM with no parity (baud rate = 38400) */
TX8_1_Start(TX8_1_PARITY_NONE);

/* Enable to PGA to buffer signal from VR to ADC */
PGA_1_Start(PGA_1_HIGHPOWER);

DAC6_1_Start(DAC6_1_HIGHPOWER);      /* Start the DAC */
DelSigPlus_1_Start(DelSigPlus_1_HIGHPOWER); /* Start the ADC */
DelSigPlus_1_StartAD();              /* Start reading values on the ADC */
LCD_1_Start();                       /* Start the character LCD */

LCD_1_Position(ROW_0, COLUMN_0);     /* Set the LCD to (Row=0,Column=0) */
LCD_1_PrCString("V Count: ");

M8C_EnableGInt;                      /* Enable Global Interrupts */

while(1)
{
    /* Step 1: Get BYTE data from the ADC
    Step 2: Write BYTE data from ADC to the counter in order to
            change the DAC update rate
    Step 3: Move the LCD cursor back to the beginning and display new
            ADC data
    Step 4: Write ADC data out the TX port, and then send a return
    */

    /* Is new data available from the ADC? */
    if (DelSigPlus_1_fIsDataAvailable())
    {
        adcResult = DelSigPlus_1_wGetDataClearFlag(); /* Get new ADC data */

        /* Change DAC update rate counter */
        Counter16_1_WritePeriod((adcResult << 4) + 200);

        LCD_1_Position(ROW_0, COLUMN_9); /* Move LCD (row=0,column=0) */
        LCD_1_PrHexInt(adcResult);       /* Print ADC result to LCD */
        TX8_1_PutSHexInt(adcResult);    /* Write LCD result to TX8 -> PC */
        TX8_1_PutCRLF();                /* Write return character to TX8 */
    }
} /* End of while(1) */
} /* End of Main */

/*****
* Function Name: Counter16_C_ISR
*****/
*
* Summary:
* This is the interrupt service routine for the Counter16 usermodule written
* in C. The boot.tpl has been modified to jump to this ISR every terminal
* count. The related #pragma above is necessary for the boot.asm file to jump
* to it. Every time a terminal count is reached the DAC will get the next
* value from the sinTable.
*
* Parameters:
* void
*
* Return:
* void

```

```
*
*****
#ifdef HI_TECH_C
void Counter16_C_ISR(void) @ 0x24
#else
void Counter16_C_ISR(void)
#endif
{
    // Check to see if we have reached the //
    if (tablePos >= sizeof(sinTable))
    {
        tablePos = 0;
    }
    DAC6_1_WriteBlind(sinTable[tablePos++]);
}

/* [] END OF FILE */
```

3.1.4 CapSense®

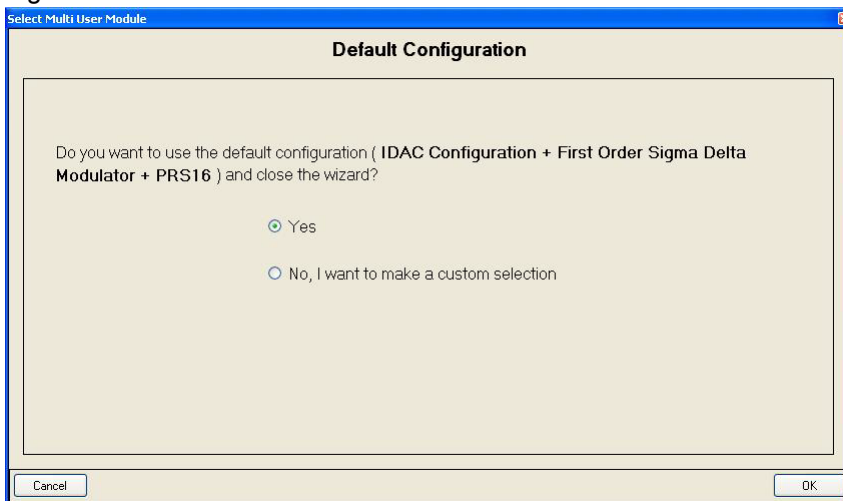
This project demonstrates CapSense. The firmware displays the CapSense button presses on the LCD (row 1) and associated LEDs. It also displays the CapSense slider position on the LCD (row 2).

Note that this project uses IDAC. But if using external Rb with CSD is desired then populate R15 (connected to P3[1]). Rb can range from 2k to 10k. Do refer to CapSense user module datasheet for more information on using Rb.

3.1.4.1 Creating CapSense Project

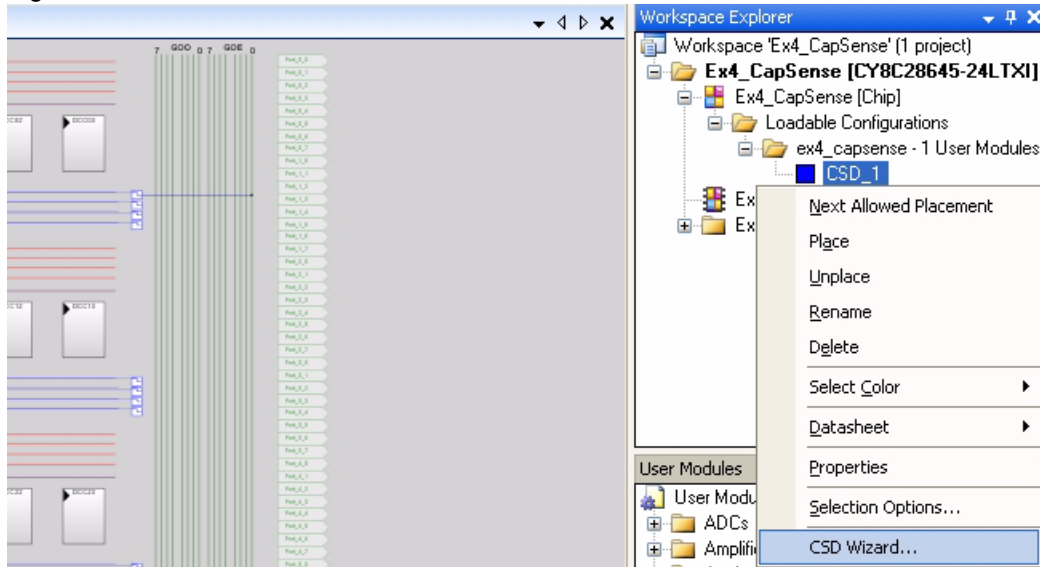
1. Follow steps 1 to 10 in section 3.1.1.1 on page 29, change the **Name** of the project to **Ex4_CapSense**.
2. In the User Modules window expand the Cap Sensors folder. Right click **CSD** and choose **Place**. A window appears with the option to use the default configuration.

Figure 3-39. Select Multi User Module Window



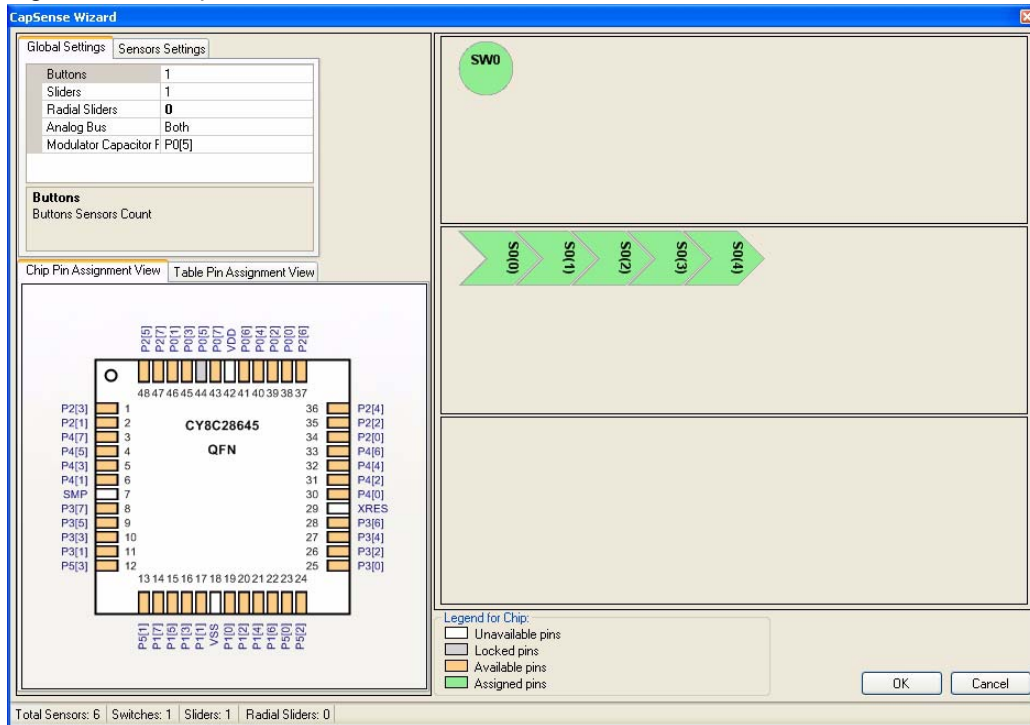
3. Select **Yes** and click **OK**.
4. Right click the **CSD** user module in the workspace explorer and select **CSD Wizard**.

Figure 3-40. Select CSD Wizard



5. CapSense Wizard window opens.

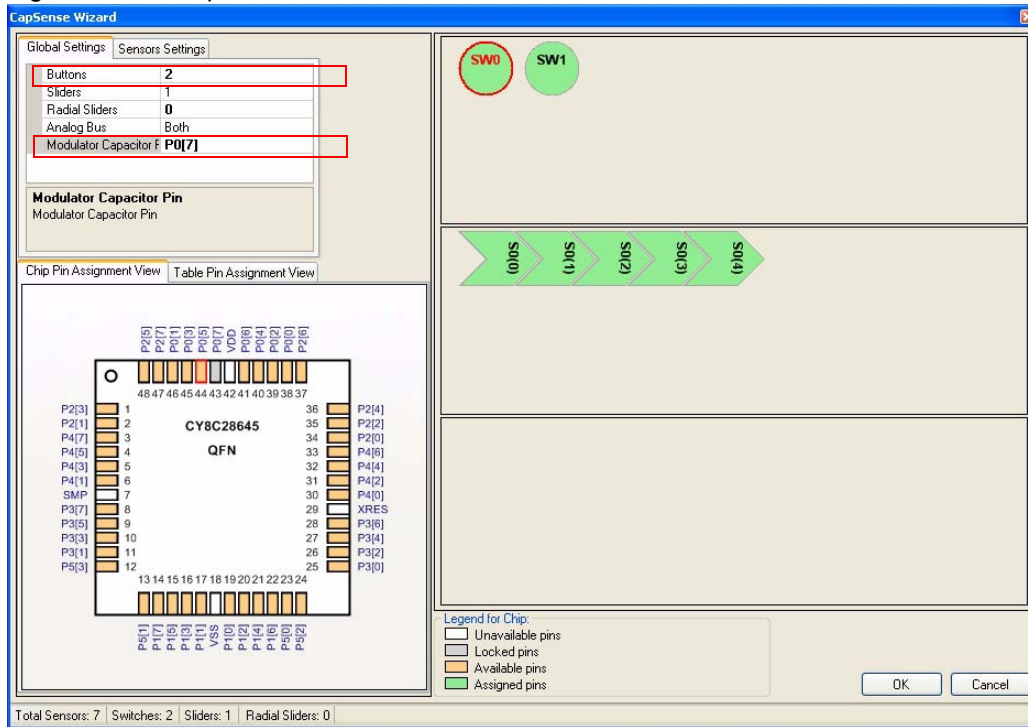
Figure 3-41. CapSense Wizard



6. In the CapSense Wizard window, under the **Global Settings** Tab, set the # of buttons to 2.

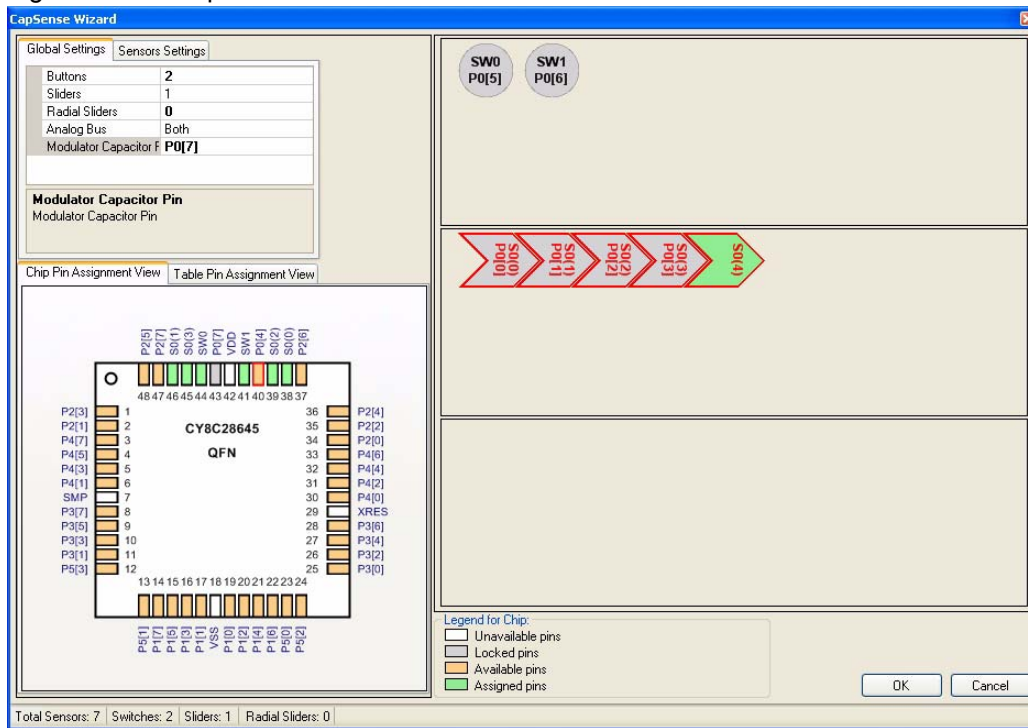
7. Select P0[7] as the Modulator Capacitor Pin.

Figure 3-42. CapSense Wizard Place Buttons



8. Click and hold **SW0** and drag it to P0[5]
9. Do the same for **SW1** and drag it to P0[6]

Figure 3-43. CapSense Wizard Slider Sensors



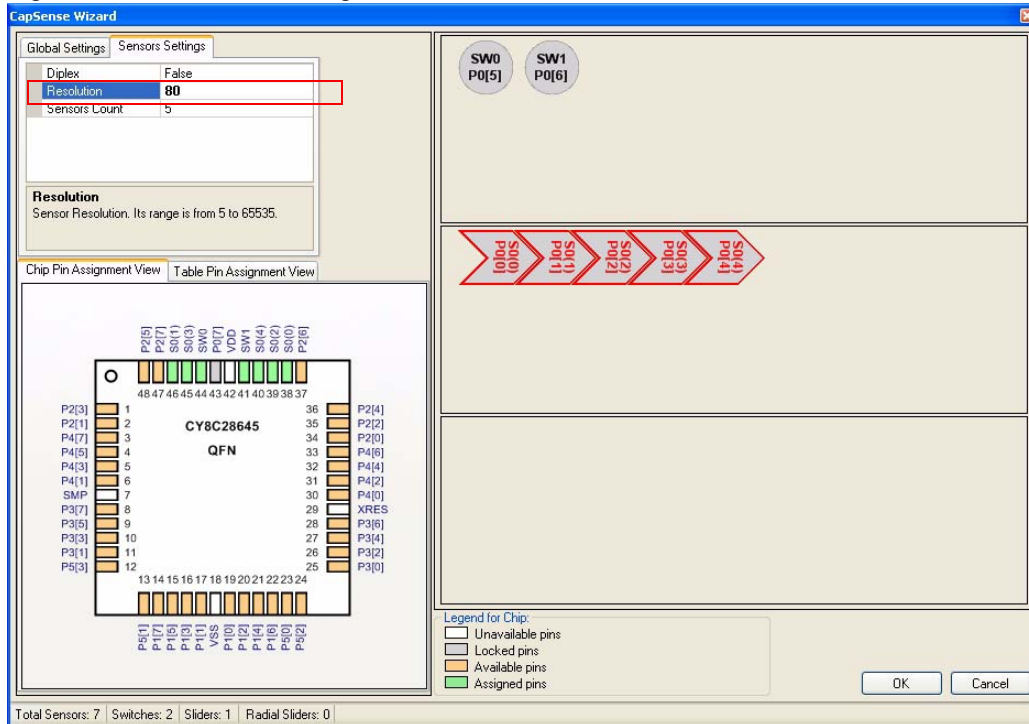
10. Do the same thing for each slider sensor and corresponding pin.

- ❑ S0[0] to P0[0]
- ❑ S0[1] to P0[1]
- ❑ S0[2] to P0[2]
- ❑ S0[3] to P0[3]
- ❑ S0[4] to P0[4]

11. Select the **Sensors Settings** Tab

12. Set the **Resolution** to 80.

Figure 3-44. Sensors Settings Tab



13. Click **OK**

14. In the **User Modules** window expand **Misc Digital**, right click **LCD**, and click place.

15. In the **User Modules** window expand **Misc Digital**, right click **LED**, and click place.

16. In the **User Modules** window expand **Misc Digital**, right click **LED**, and click place.

17. Click **CSD_1** and configure it to match this figure.

Figure 3-45. CSD_1 Properties

Properties - CSD_1	
Name	CSD_1
User Module	CSD
Version	1.3
FingerThreshold	100
NoiseThreshold	80
BaselineUpdateThreshold	100
Sensors Autoreset	Disabled
Hysteresis	10
Debounce	3
NegativeNoiseThreshold	20
LowBaselineReset	50
Scanning Speed	Normal
Resolution	12
Compensation IDAC	0
IDAC	225
IDAC Range	x32
Reference	ASE10
Ref Value	2
PRS_Polynomial	Long
ShieldElectrodeOut	None
Auto Calibration	Enabled

18. Click **LCD_1** and configure it to match this figure.

Figure 3-46. LCD_1 Properties

Properties - LCD_1	
Name	LCD_1
User Module	LCD
Version	1.5
LCDPort	Port_2
BarGraph	Enable

19. Click **LED_1** and configure it to match this figure.

Figure 3-47. Figure . LED_1 Properties

Properties - LED_1	
Name	LED_1
User Module	LED
Version	1.2
Port	Port_1
Pin	Port_1_6
Drive	Active High

20. Click **LED_2** and configure it to match this figure.

Figure 3-48. LED_2 Properties

Properties - LED_2	
Name	LED_2
User Module	LED
Version	1.2
Port	Port_1
Pin	Port_1_7
Drive	Active High

21. Configure Global Resources to match the following figure.

Figure 3-49. Configure Global Resources

Global Resources - ex4_capsense	
Power Setting [Vcc / Sy	5.0V / 24MHz
CPU_Clock	SysClk/2
32K_Select	Internal
PLL_Mode	Disable
Sleep Timer Period	1.95ms
VC1= SysClk/N	1
VC2= VC1/N	1
VC3 Source	SysClk/1
VC3 Divider	26
SysClk Source	Internal
SysClk*2 Disable	No
Analog Power	SC On/Ref High
Ref Mux	BandGap+/-BandGap
AGndBypass	Disable
Op-Amp Bias	High
SwitchModePump	OFF
Trip Voltage [LVD (SMP)	4.81V (5.00V)
LVDThrottleBack	Disable
Watchdog Enable	Disable

22. Open the existing *main.c* file within Workspace Explorer. Replace the existing *main.c* content with the content of the embedded *CY8C28_main_Ex4.c* file, which can be found within the attachments feature of this PDF document.
23. Save the project.
24. To Generate and build the project, click **Build** → **Generate/Build 'Ex4_CapSense'** Project.
25. Disconnect power to the board.
26. Configure the DVK board SW3 to 5V.
27. Configure the DVK breadboard using the included jumper wires:
 - P1[6] to LED1
 - P1[7] to LED2
28. Ensure that P0[1], P0[5], and P0[7] are disconnected.
29. Reapply power to the board.
30. Use PSoC Designer as described in [Programming My First PSoC 1 Project on page 15](#) to program the device.
31. Reset the DVK. An LED lights up when either CapSense button is pushed. If B1 (P0[5]) is pushed it also displays "Button1" in the top row of the LCD display. Likewise, if B2 (P0[6]) is pushed it displays "Button2" in the top row of the LCD display. The bottom row of the LCD displays the Slider position with a Horizontal Bar graph.
32. Save and close the project.

3.1.4.2 *main.c*

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C28_main_Ex4.c* file, which can be found within the attachments feature of this PDF document.

Note To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.

```
#include <m8c.h>          /* part specific constants and macros */
#include "PSoC_API.h"    /* PSoC API definitions for all User Modules */

/* LCD specific */
#define ROW_0      0 /* LCD row 0 */
#define ROW_1      1 /* LCD row 1 */
#define COLUMN_0   0 /* LCD column 0 */
#define NUM_CHARACTERS 16 /* Number of characters on LCD */

/* For clearing a row of the LCD*/
#define CLEAR_ROW_STR      "          "
/* Button 1 only string for row 0 of the LCD */
#define BUTTON_1_STR      "Button1   "
/* Button 2 only string for row 0 of the LCD */
#define BUTTON_2_STR      "      Button2"
/* Button 1 and 2 string for row 0 of the LCD */
#define BUTTON_1_2_STR    "Button1 Button2"
/* Default string for button row of the LCD */
#define DEFAULT_ROW_0_STR "Touch Buttons  "
/* Default string for slider row of the LCD */
#define DEFAULT_ROW_1_STR "Touch The Slider"

/* CapSense specific */
#define SLIDER_RESOLUTION 80
#define SCANSENSOR_BTN_B1 0
#define SCANSENSOR_BTN_B2 1

void UpdateButtonState(BYTE sensor_1, BYTE sensor_2);
void UpdateSliderPosition(BYTE value);

/*****
 * Function Name: main
 *****/
*
* Summary:
* The main function initializes CapSense and the LCD. Then it continuously
* scans all CapSense sensors (slider sensors and buttons), gets the state of
* the buttons and slider and updates the LCD with the current state.
*
* Parameters:
* void
*
* Return:
* void
*
*****/
void main(void)
{
```

```

BYTE pos;          /* Slider Position */
BYTE stateB_1;    /* Button1 State */
BYTE stateB_2;    /* Button2 State */

M8C_EnableGInt; /* Enable Global Interrupts */

/* LCD Initialization */
LCD_1_Start();
/* For Bargraph display on LCD */
LCD_1_InitBG(LCD_1_SOLID_BG);

/* LED1 Initialization */
LED_1_Start();
/* LED2 Initialization */
LED_2_Start();

/* CapSense Initialization */
CSD_1_Start();
/* Initialize the baselines by scanning all sensors and getting the initial
   raw data values */
CSD_1_InitializeBaselines();
/* Load finger thresholds set in user module parameters */
CSD_1_SetDefaultFingerThresholds();

while(1)
{
    /* Scan each CapSense sensor and update their raw data value */
    CSD_1_ScanAllSensors();
    /* Update baselines for each sensor */
    CSD_1_UpdateAllBaselines();

    /* Update state to active/inactive for each button sensor */
    stateB_1 = CSD_1_bIsSensorActive(SCANSENSOR_BTN_B1);
    stateB_2 = CSD_1_bIsSensorActive(SCANSENSOR_BTN_B2);

    /* Get Linear Slider Position */
    pos = CSD_1_wGetCentroidPos(1);

    /* Update LCD and LED's with current Button and Linear Slider states */
    UpdateButtonState(stateB_1, stateB_2);
    UpdateSliderPosition(pos);
}
}

/*****
* Function Name: UpdateButtonState
*****/
*
* Summary:
* Updates the LCD screen with the current button state by displaying which
* button is being touched on row 0. LED's are also updated according to button
* state.
*
* Parameters:
* sensor_1: Button state for B1
* sensor_2: Button state for B2
*
* Return:

```

```

* void
*
*****/
void UpdateButtonState(BYTE sensor_1, BYTE sensor_2)
{
    LCD_1_Position(ROW_0,COLUMN_0);

    /* Check the state of the buttons and update the LCD and LEDs */
    if (sensor_1 && sensor_2)
    {
        /* Display both Button strings on LCD if both button sensors are active */
        LCD_1_PrCString(BUTTON_1_2_STR);
        /* Both LED's are on in this state */
        LED_1_On();
        LED_2_On();
    }
    else if (sensor_1 || sensor_2)
    {
        if (sensor_1)
        {
            /* Display Button 1 state on LCD and LED1 */
            LCD_1_PrCString(BUTTON_1_STR);
            LED_1_On();
            /* Button 2 is not active */
            LED_2_Off();
        }
        else // sensor_2
        {
            /* Display Button 2 state on LCD and LED2 */
            LCD_1_PrCString(BUTTON_2_STR);
            LED_2_On(); /* Turn on LED2 */
            LED_1_Off(); /* Turn off the LED1 */
        }
    }
    else
    {
        /* Display default string on LCD and set LED's to off */
        LCD_1_PrCString(DEFAULT_ROW_0_STR);
        /* Set both LED's off in this state */
        LED_1_Off();
        LED_2_Off();
    }
}

/*****
* Function Name: UpdateSliderPosition
*****
*
* Summary:
* Updates the LCD screen with the current slider position by displaying the
* horizontal bar graph.
*
* Parameters:
* value: Centroid position from CapSense slider.
*
* Return:
* void
*

```

```
*****/
void UpdateSliderPosition(BYTE value)
{
    /* The slider position is 0xFF if there is no finger present on the slider */
    if (value > SLIDER_RESOLUTION)
    {
        /* Clear old slider position (2nd row of LCD) */
        LCD_1_Position(ROW_1, COLUMN_0);
        LCD_1_PrCString(DEFAULT_ROW_1_STR);
    }
    else
    {
        /* Update the bar graph with the current finger position */
        LCD_1_DrawBG(ROW_1, COLUMN_0, NUM_CHARACTERS, value + 1);
    }
}

/* [] END OF FILE */
```

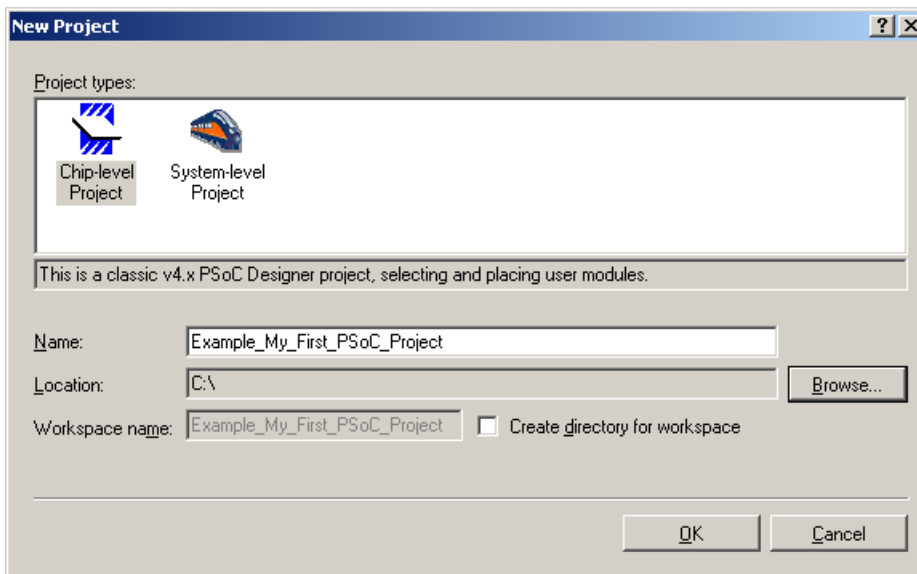
3.2 CY8C29 Family Processor Module Example Projects

3.2.1 My First PSoC 1 (CY8C29) Project

3.2.1.1 *Creating My First PSoC 1 (CY8C29) Project*

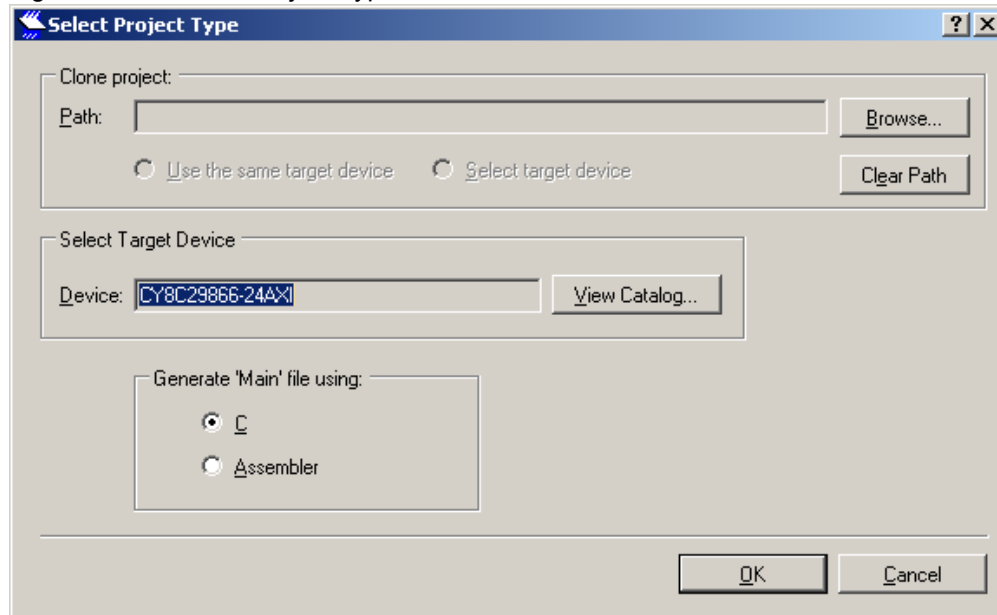
1. Open PSoC Designer 5.0
2. To create a new project, click **File** → **New Project**. The **New Project** window opens.
3. In the **New Project window**, select the **Chip-Level Project**. Name the project **Example_My_First_PSoC_Project**.
4. In **Location**, click **Browse** and navigate to the appropriate directory.

Figure 3-50. New Project Window



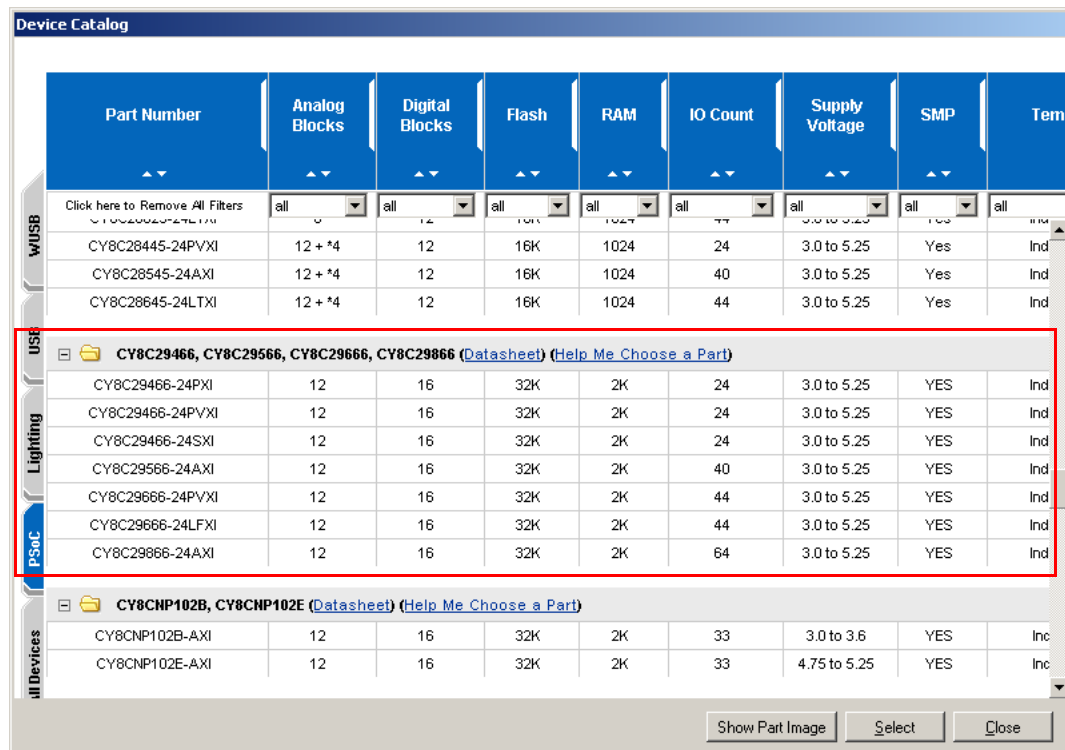
5. Click **OK**. The **Select Project Type** window opens.

Figure 3-51. Select Project Type Window



6. In this window under **Select Target Device**, click **View Catalog**.
7. The **Device Catalog** window opens. Click on the **PSoC** tab, and scroll down to the **CY8C29466, CY8C29566**, section.
8. For this project click any device in this section and then click **Select**.

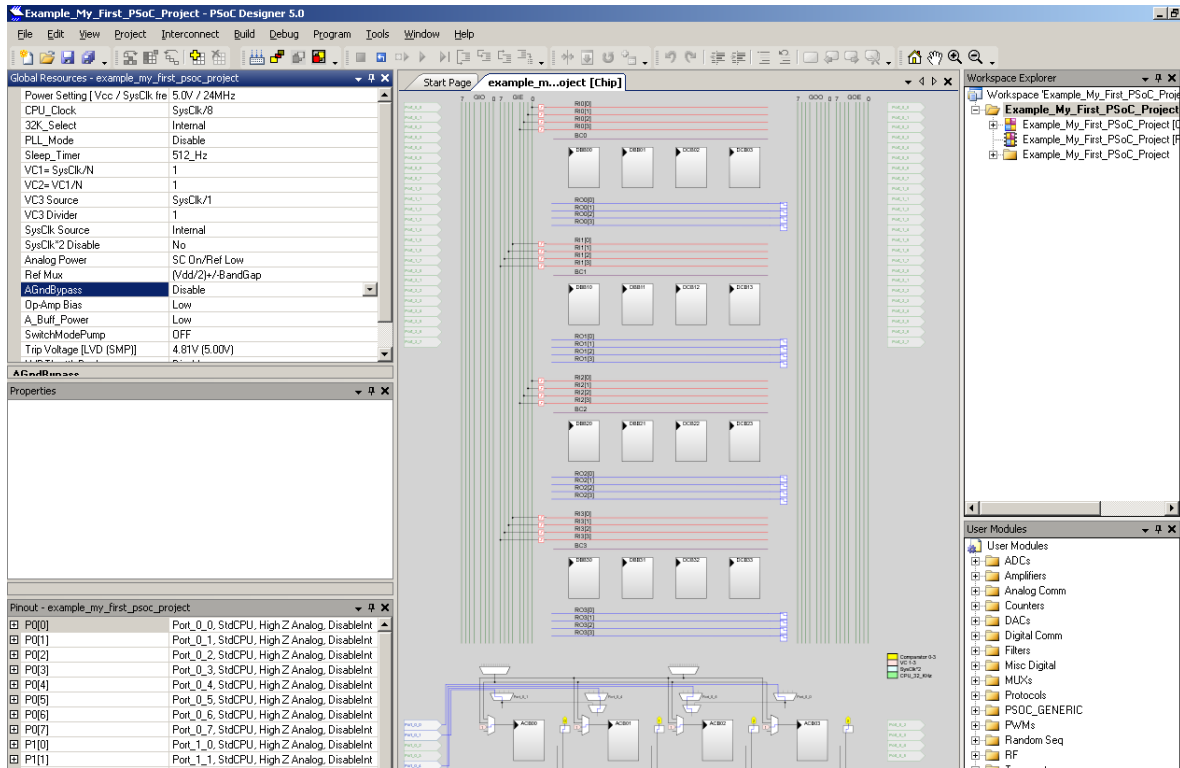
Figure 3-52. Device Catalog Window



9. Under **Generate 'Main' File Using:**, for this project select **C**, then click **OK**.

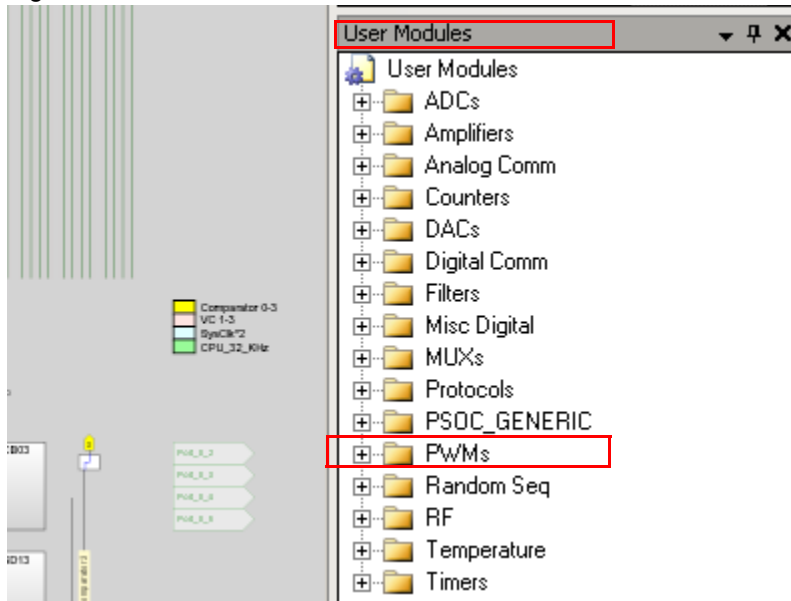
10. By default, the project opens to chip view

Figure 3-53. Default View.



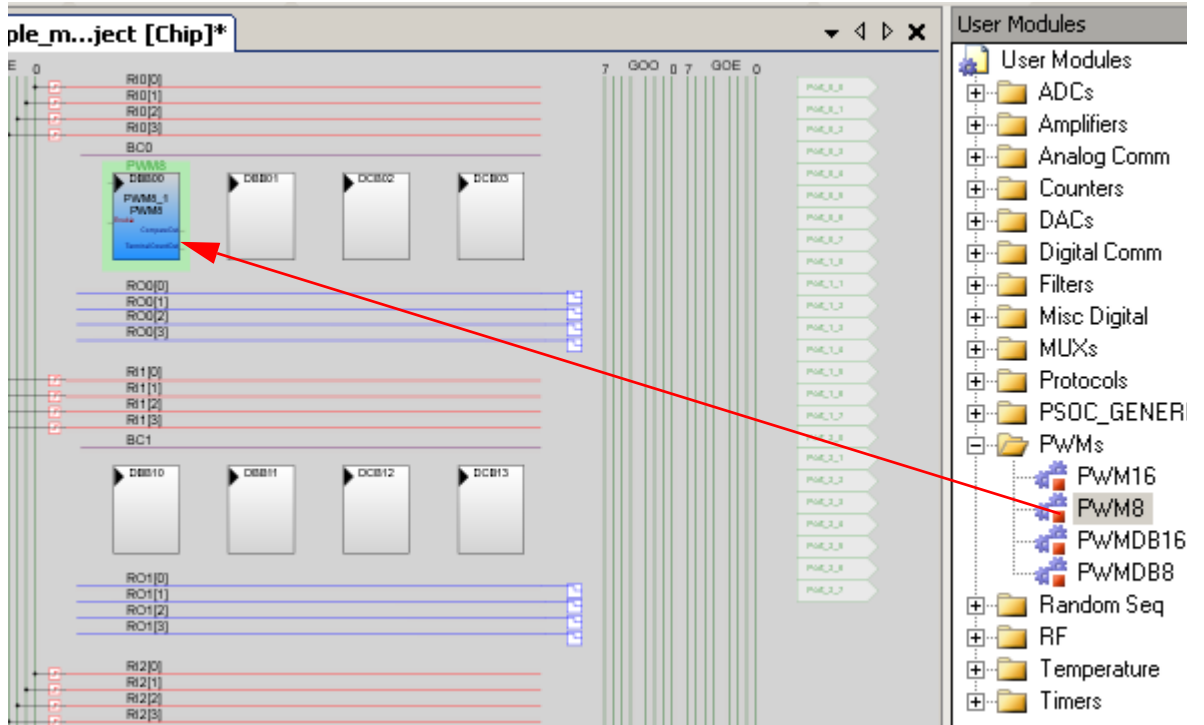
11. In the **User Modules** window, expand the **PWMs** folder.

Figure 3-54. User Modules Window



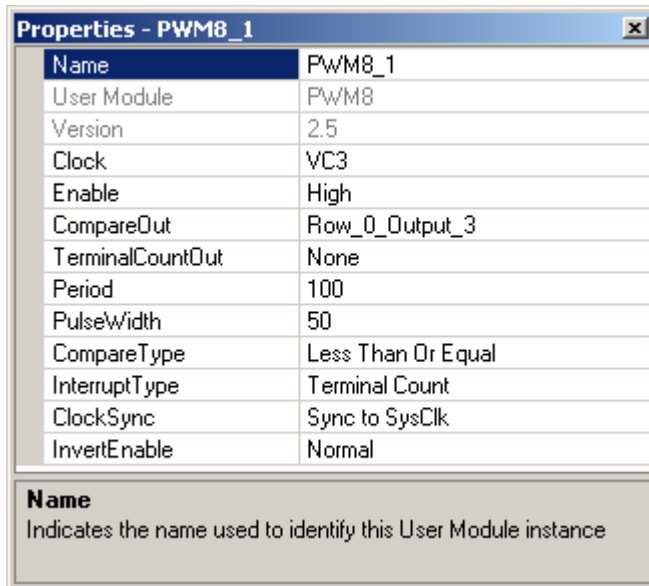
12. In this folder right click on a **PWM8** and select place. The User Module (UM) is placed in the first available digital block.

Figure 3-55. Place User Module PWM8



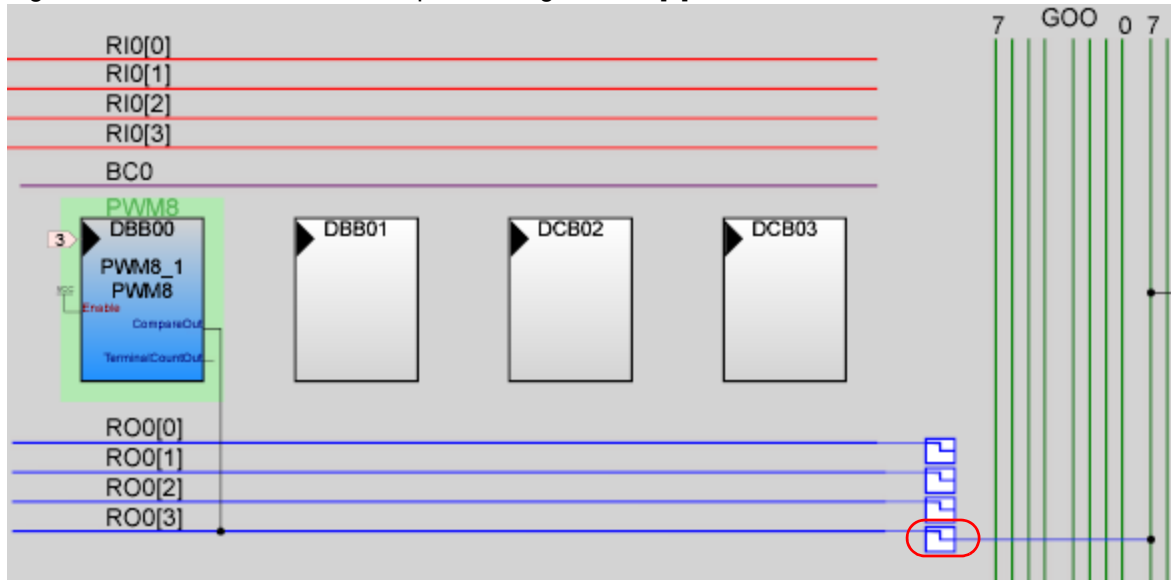
13. Double click the placed PWM8_1 UM; the **Properties** window opens on the left side of the screen. Configure the PWM with the settings as in the following figure. If the **Properties** window does not appear, click **View** → **Properties Window**.

Figure 3-56. Properties Window



14. Next, route the PWM **CompareOut** signal to P0[7]. The first step is to configure the Look Up Table (LUT) on **Row_0_Output3**.

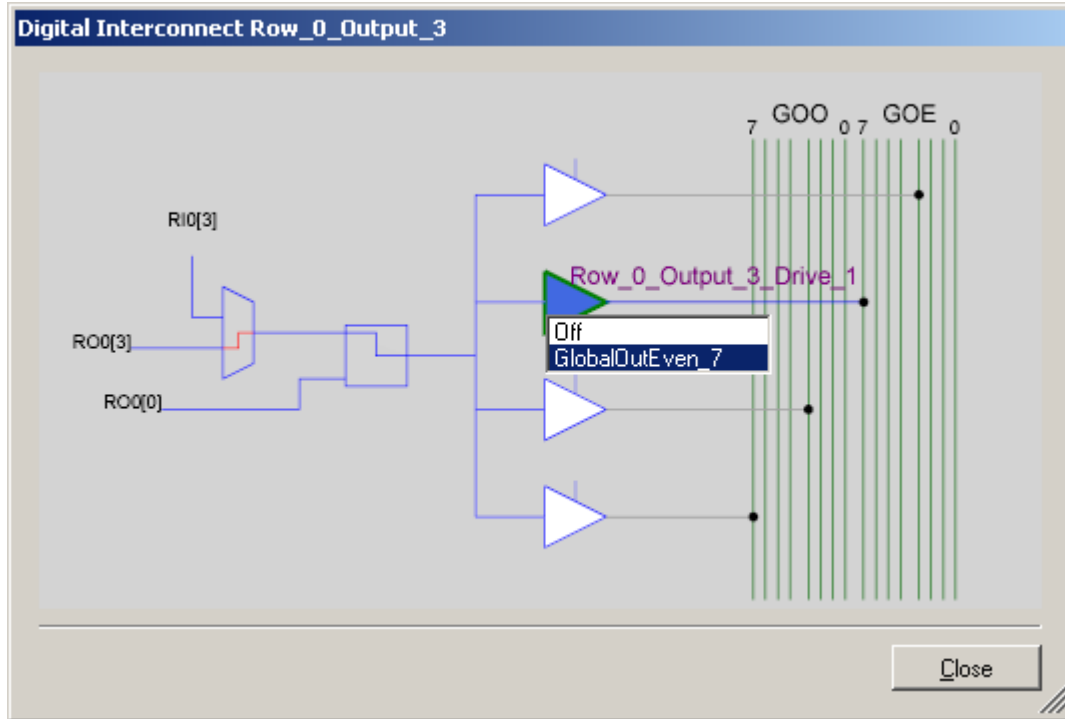
Figure 3-57. Route the PWM CompareOut signal to P0[7]



15. Double click the **LUT**, the **Digital Interconnect** window opens.

16. In this window enable **Row_0_Output_3_Drive_1** to connect to **GlobalOutEven_7**.

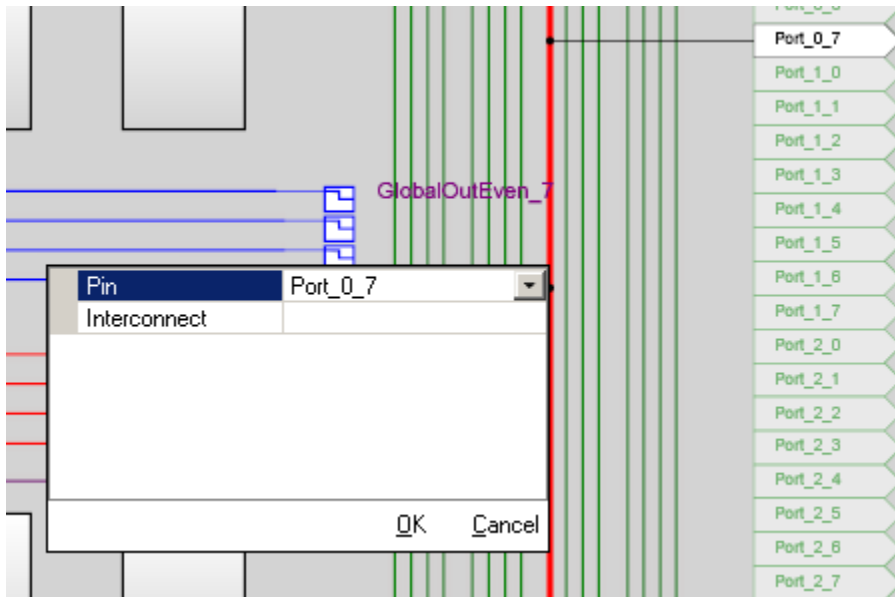
Figure 3-58. Digital Interconnect Window



17. Click **Close**.

18. Click on **GlobalOutEven_7**. A window appears, in this window configure **PIN** for **Port_0_7**.

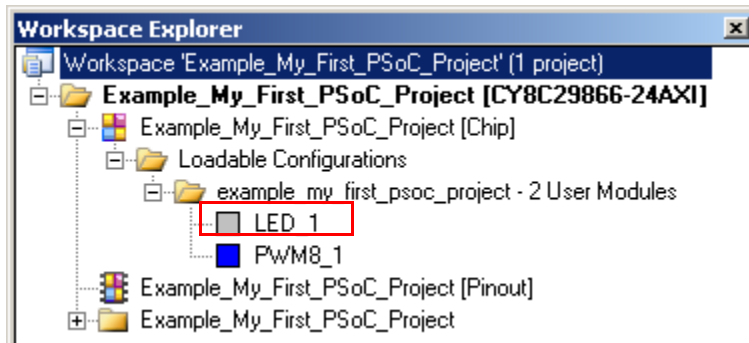
Figure 3-59. Configure PIN for Port_0_7



19. Click **OK** to continue.

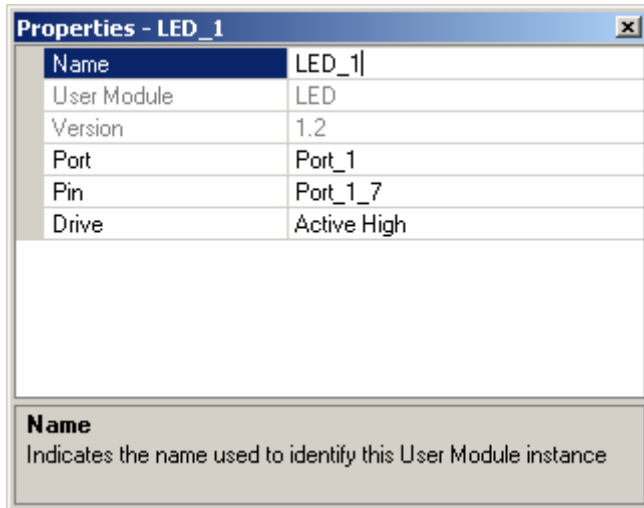
20. In the **User Modules** window expand the **Misc Digital** folder. In this folder right click the **LED** and select place, this adds the UM to the project. This UM does not use digital or analog blocks. It appears in the **Workspace Explorer** → **Example_My_First_PSoC_Project[CY8C29]** → **Example_My_First_PSoC_Project[Chip]** → **Loadable Configurations** → **example_my_first_psoc_project - 2 User Modules**.

Figure 3-60. Workspace Explorer



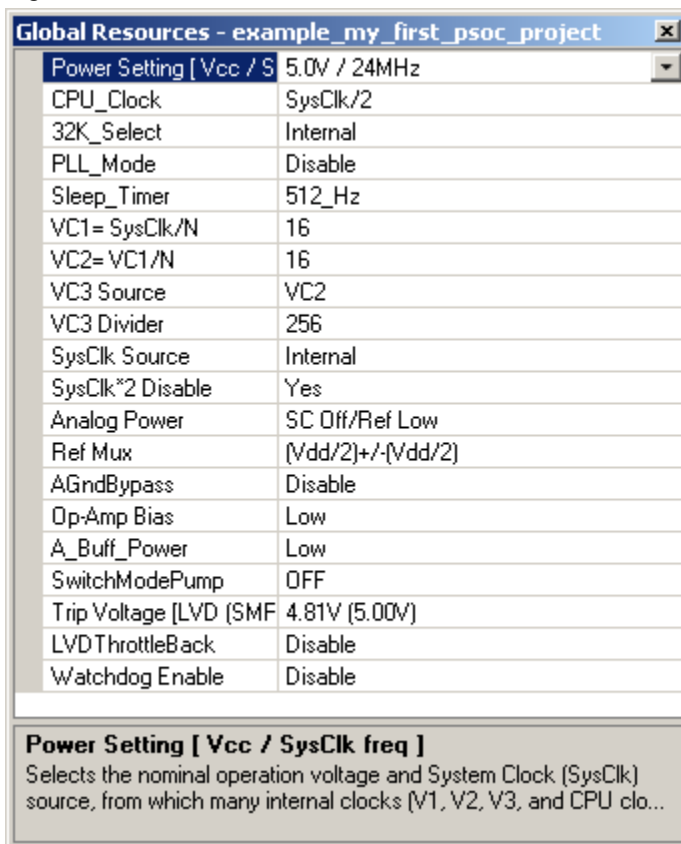
21. Double click the **LED_1** UM and navigate to the **Properties** window. Configure the LED for **Port_1_7**.

Figure 3-61. Properties Window



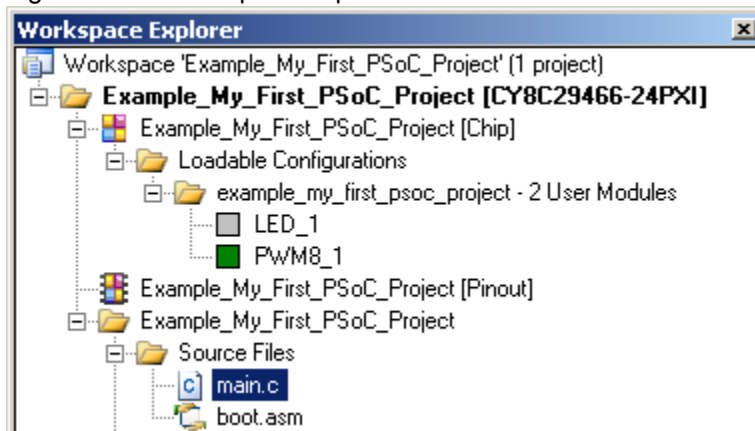
22. Configure the **Global Resources** window to match the following figure.

Figure 3-62. Global Resources Window



23. Open the existing *main.c* file within Workspace Explorer. Replace the existing *main.c* content with the content of the embedded *CY8C29_main_Ex1.c* file, which can be found within the attachments feature of this PDF document.

Figure 3-63. Workspace Explorer



24. Save the project.
25. Build the project. **Build** → **Generate/Build 'Example_My_First_PSoC_Project' Project**.
26. Disconnect power to the board.
27. Configure the DVK board SW3 to 5V.
28. Configure the DVK breadboard using the included jumper wires:
 - P0[7] to LED1
 - P1[7] to LED2
29. Reapply power to the board.
30. Use PSoC Designer as described in [Programming My First PSoC 1 Project on page 19](#) to program the device.
31. Reset the DVK, and observe the blinking LEDs.
32. Save and close the project.

3.2.1.2 *main.c*

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C29_main_Ex1.c* file, which can be found within the attachments feature of this PDF document.

Note To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.

```

/*****
* File Name: main.c
*
* Description:
* This file provides source code for My First PSoC Project example. The
* firmware blinks one LED at about 3.6Hz with a PWM, and blinks another LED
* with a software timing loop.
*
*****/

/*****
* PWM Settings:
*
* Input Clock      = VC3 //VC3 = 24MHz/16/16/256 =366.2Hz
* Enable           = High
* CompareOut       = ROW_0_Output_3
* TerminalCountOut = None
* Period           = 100   Output period = (Period+1)*(1/Input Clock) = 101/
366.2 = .275sec
or 3.6Hz
* PulseWidth      = 50
* CompareType     = Less Than Or Equal
* InterruptType   = Terminal Count
* ClockSync       = Sync to SysClk
* InvertEnable    = Normal
*
*****/

#include <m8c.h>          // part specific constants and macros
#include "PSoC_API.h"    // PSoC API definitions for all User Modules

unsigned int i;         // Variable used for delay

void main(void)
{
    PWM8_1_Start(); // Turn on the PWM to blink LED on P0.7
    LED_1_Start(); // Enable Software controlled LED

    // The following loop controls the software LED conneted to P1.7
    while(1)
    {
        for (i=0;i<60000;i++){ //Length of delay depends on compiler and CPU clock
            LED_1_Invert(); //Switch the state of Software LED, if on turn it off,
            //if off turn it on
        } //End of while(1)
    } //End of main
}

```

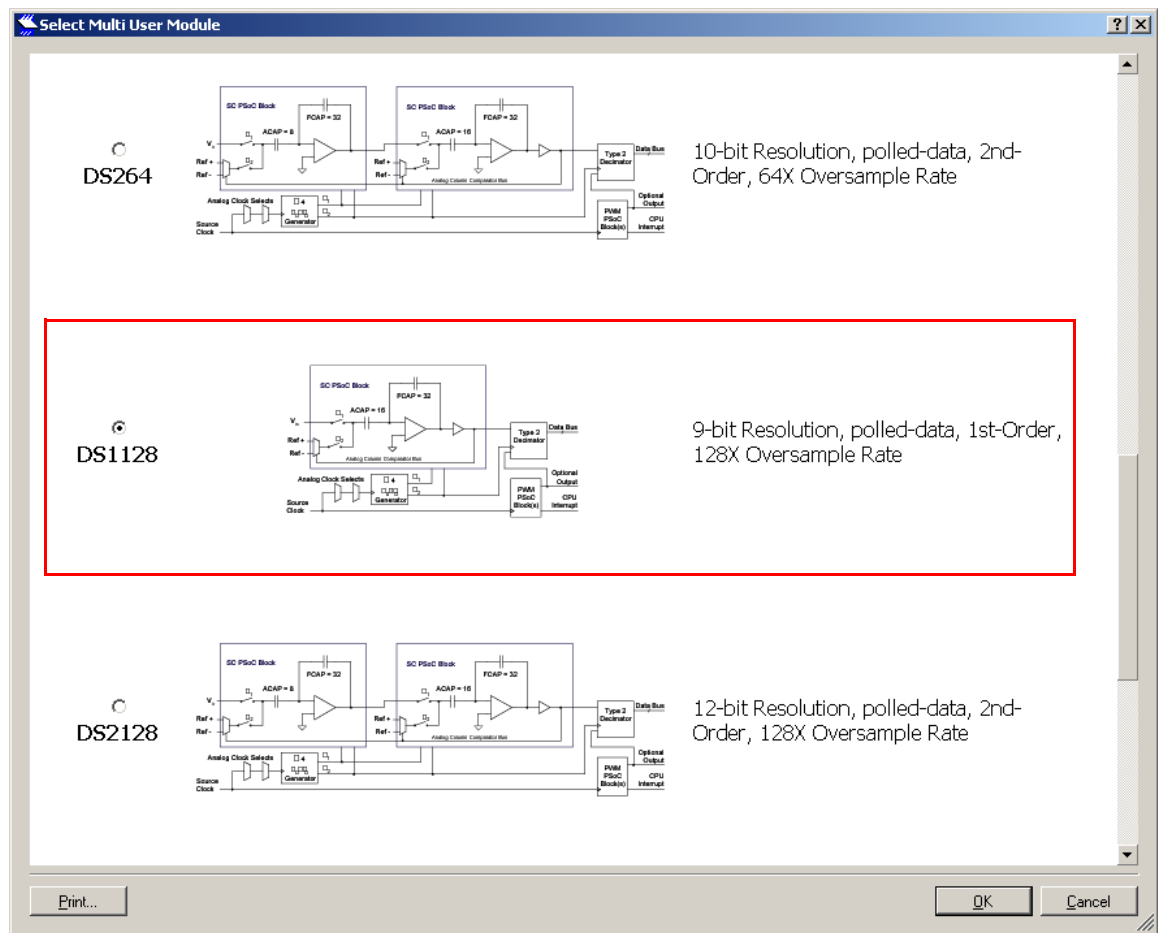
3.2.2 ADC to LCD Project

This project demonstrates a 9-bit Delta Sigma ADC by measuring the voltage of the potentiometer center tap wiper and displaying the result on the LCD. Connect the voltage potentiometer (VR) to the ADC input P0[1]. The program reads the 9-bit ADC result and prints it to the LCD.

3.2.2.1 Creating ADC to LCD Project

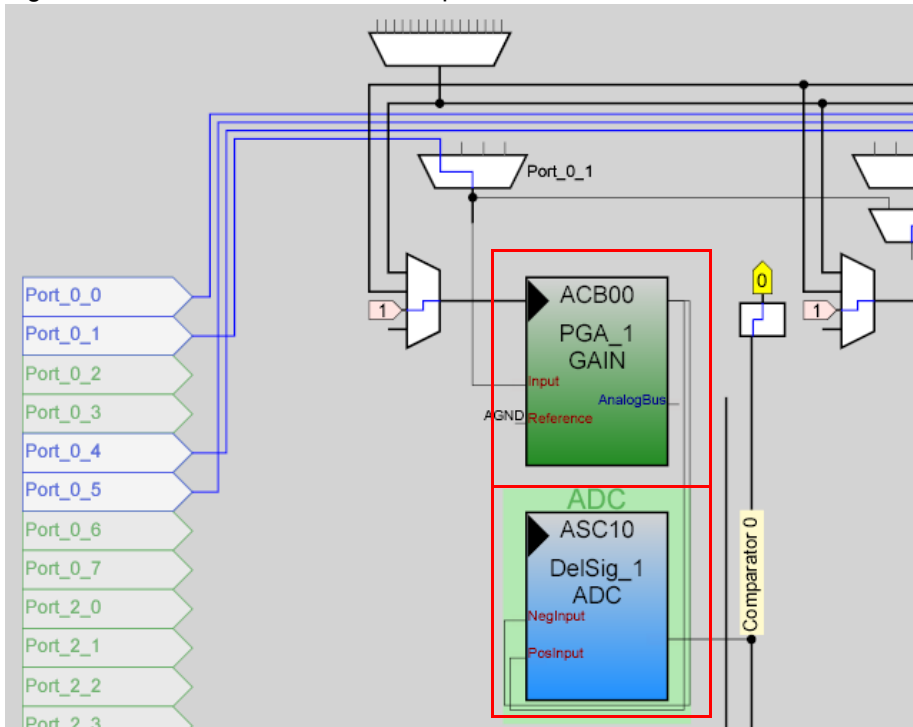
1. Follow steps 1 to 10 in section 3.2.1.1 on page 68, change the **Name** of the project to **Example_ADC_to_LCD**.
2. In the **User Modules** window expand the **ADCs** folder, and then right click **DelSig** and choose **Place**. A window opens with multiple options for the DelSig UM. Scroll down, if necessary, and select the **DS1128** configuration. Click **OK**.

Figure 3-64. Select Multi User Module Window



3. Click **OK**.
4. Verify that the **DelSig_1** UM is placed in **ASC10**.
5. In the **User Modules** window expand the **Amplifiers** window. Right click **PGA**, select place. Ensure that the **PGA** is placed in **ACB00**.

Figure 3-65. Ensure that the PGA is placed in ACB00.



6. In the **User Modules** window expand **Misc Digital**, Right click **LCD** and click place.
7. Double click **PGA_1** and configure the properties to match this figure.

Figure 3-66. PGA_1 Properties

Properties - PGA_1	
Name	PGA_1
User Module	PGA
Version	3.2
Gain	1.000
Input	AnalogColumn_InputMUX_0
Reference	AGND
AnalogBus	Disable

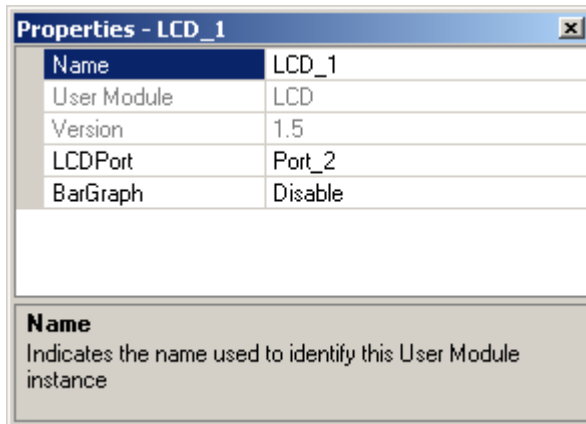
8. Double click **DelSig_1** and configure the properties to match this figure.

Figure 3-67. DelSig_1 Properties

Properties - DelSig_1	
Name	DelSig_1
User Module	DelSig
Version	1.2
DataFormat	Unsigned
Data Clock	VC1
ClockPhase	Normal
PosInput	ACB00
NegInput	ACB00
NegInputGain	Disconnected
PWM Output	None
PulseWidth	1

9. Double click **LCD_1** and configure the properties to match this figure.

Figure 3-68. LCD_1 Properties

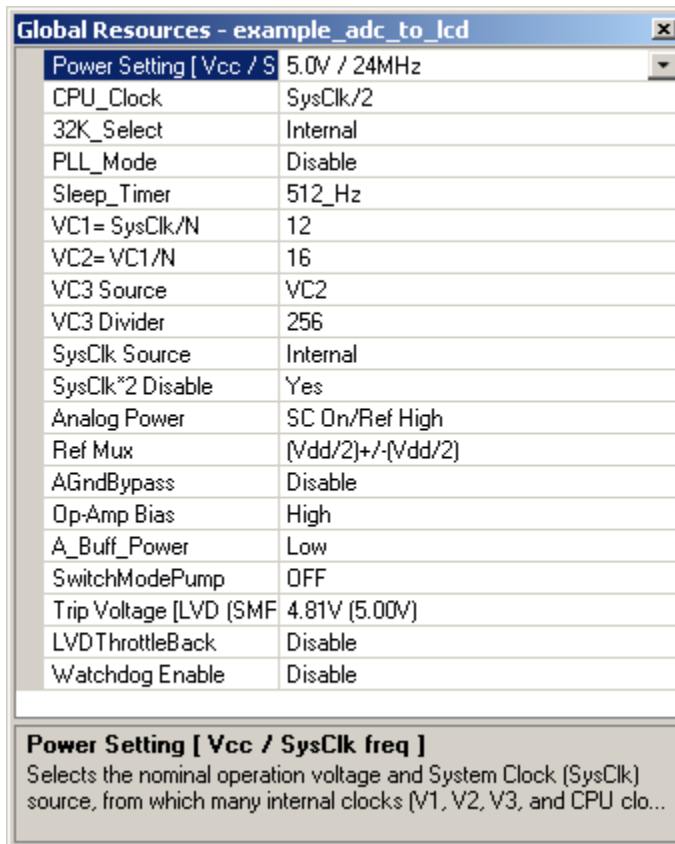


Properties - LCD_1	
Name	LCD_1
User Module	LCD
Version	1.5
LCDPort	Port_2
BarGraph	Disable

Name
Indicates the name used to identify this User Module instance

10. Configure the **Global Resources** to match the following figure.

Figure 3-69. Global Resources Properties

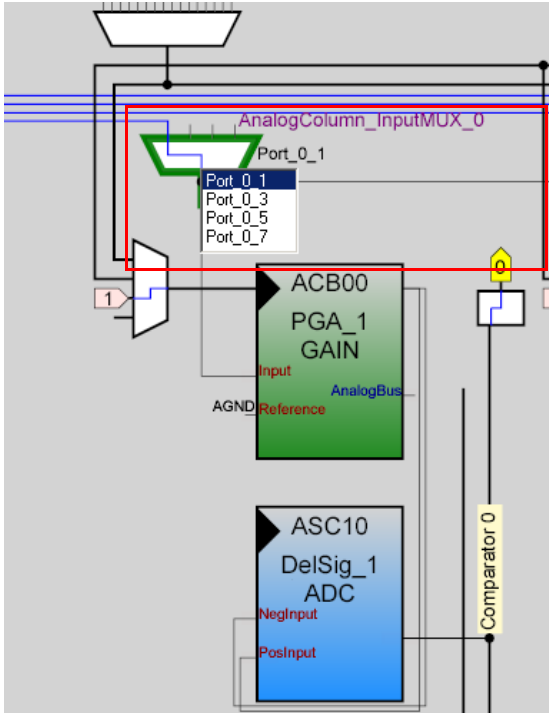


Global Resources - example_adc_to_lcd	
Power Setting [Vcc / S	5.0V / 24MHz
CPU_Clock	SysClk/2
32K_Select	Internal
PLL_Mode	Disable
Sleep_Timer	512_Hz
VC1= SysClk/N	12
VC2= VC1/N	16
VC3 Source	VC2
VC3 Divider	256
SysClk Source	Internal
SysClk*2 Disable	Yes
Analog Power	SC On/Ref High
Ref Mux	(Vdd/2)+/(Vdd/2)
AGndBypass	Disable
Op-Amp Bias	High
A_Buff_Power	Low
SwitchModePump	OFF
Trip Voltage [LVD (SMF	4.81V (5.00V)
LVDThrottleBack	Disable
Watchdog Enable	Disable

Power Setting [Vcc / SysClk freq]
Selects the nominal operation voltage and System Clock (SysClk) source, from which many internal clocks (V1, V2, V3, and CPU clo...

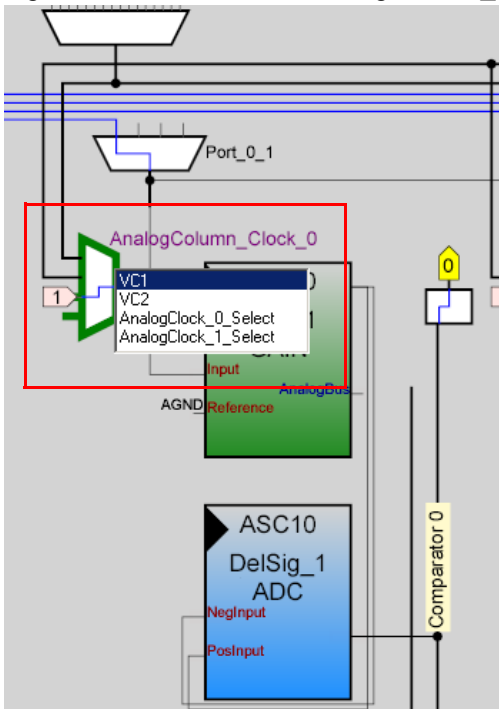
11. Ensure that **AnalogColumn_InputMUX_0** is connected to **Port_0_1**. If it is not configured for this port, double click the **MUX** and choose **Port_0_1**.

Figure 3-70. Ensure that AnalogColumn_InputMUX_0 is connected to Port_0_1



12. Ensure that **AnalogColumn_Clock_0**, is connected to **VC1**. If it is not, double click the **MUX** and chose **VC1**.

Figure 3-71. Ensure that AnalogColumn_Clock_0, is connected to VC1



13. Open the existing *main.c* file within Workspace Explorer. Replace the existing *main.c* content with the content of the embedded *CY8C29_main_Ex2.c* file, which can be found within the attachments feature of this PDF document.

14. Save the project.

15. Build the project. **Build** → **Generate/Build 'Example_ADC_to_LCD' Project.**

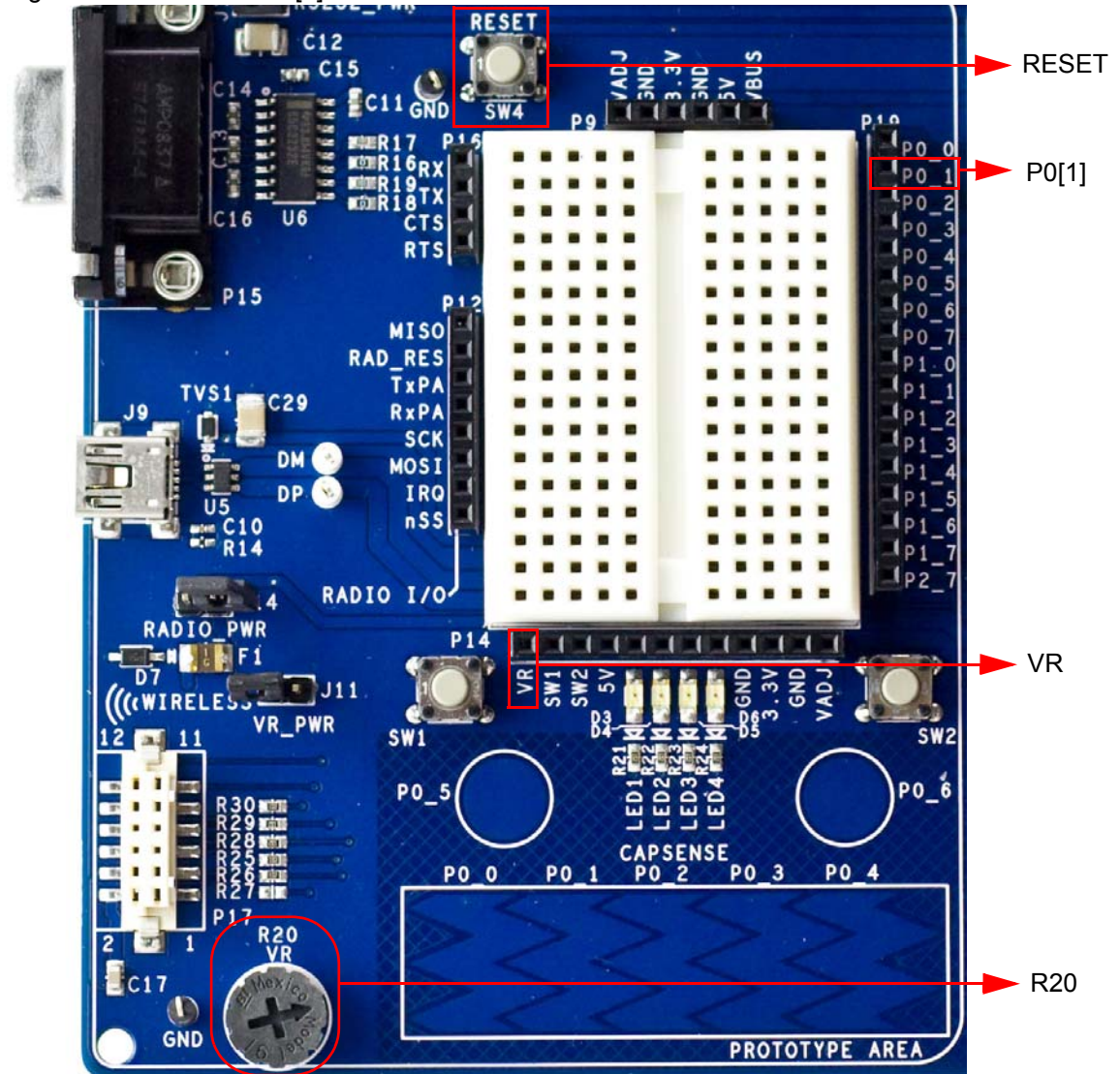
16. Disconnect power to the board.

17. Configure the DVK SW3 to 5V.

18. Configure the DVK breadboard using the included jumper wires:

- P0[1] to VR

Figure 3-72. Connect P0[1] to VR



19. Reapply power to the board.

20. Use PSoC Designer as described in [Programming My First PSoC 1 Project on page 19](#) to program the device.

21. After programming the device, press the reset button and vary the POT (R20) to see the results on the LCD.

Note The ADC output values may not reach full range due to potentiometer and ADC limitations. ADC values may fluctuate several counts due to system noise, and if the potentiometer voltage is at the edge of an ADC count.

22. Save and close the project.

3.2.2.2 *main.c*

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C29_main_Ex2.c* file, which can be found within the attachments feature of this PDF document.

Note To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.

```

/*****
* File Name: main.c
*
* Description:
* This file provides source code for the ADC to LCD example project. The
* firmware takes a voltage output from a potentiometer and displays the raw
* counts on an LCD.
*
*****/

/*****
* PGA Settings:(The PGA buffers the potentiometer voltage on P0.1 into the ADC)
*
* Gain      = 1
* Input     = AnalogColumn_InputMUX_0 (P0.1)
* Reference = AGND
* AnalogBus = Disable
*****/
/*****
* LCD Settings:
* LCDPort  = Port_2
* BarGraph = Disable
*****/
/*****
* DelSig Settings:
* The ADC can read full range values from 0-5V, if the Ref Mux setting is
selected
* as (Vdd/2)+/- (Vdd/2) and Vdd = 5V. The ADC is configured for a resolution of
9 bits,
* this is achieved by selecting the appropriate configuration when placing the
UM.
*
* DataFormat   = Unsigned
* DataClock    = VC1          // VC1 = 24MHz/12 = 2MHz
* ClockPhase   = Normal
* PosInput     = ACB00 (PGA_1)
* NegInput     = ACB00 *Note, this parameter is unused
* NegInputGain = Disconnected
* PWM Output   = None
* PulseWidth  = 1           *Note, this parameter is unused
*****/

#include <m8c.h>          // part specific constants and macros
#include "PSoC_API.h"    // PSoC API definitions for all User Modules

unsigned int wADCResult; // Holds the integer ADC result

void main(void)
{

```

```
PGA_1_Start(PGA_1_HIGHPOWER); //Initialize the PGA, PGA used to buffer input
from the VR on P0.1 to the ADC
DelSig_1_Start(DelSig_1_HIGHPOWER); //Initialize the ADC
LCD_1_Start(); //Initialize the LCD

LCD_1_Position(0,0); //Set the LCD to (Row=0,Column=0)

LCD_1_PrCString("V Count: ");

DelSig_1_StartAD(); //Start gathering conversions from the ADC

M8C_EnableGInt; //Enable Global interrupts

//This loop waits for a valid ADC result, and then displays it on the LCD
while (1)
{
    while (!(DelSig_1_fIsDataAvailable())); //Wait for ADC data to be ready
    wADCResult=DelSig_1_wGetDataClearFlag(); //Store result from ADC
    LCD_1_Position(0,9); //Set LCD to (Row=0,Column=9)
    LCD_1_PrHexInt(wADCResult); //Print ADC result on LCD
}

}
```

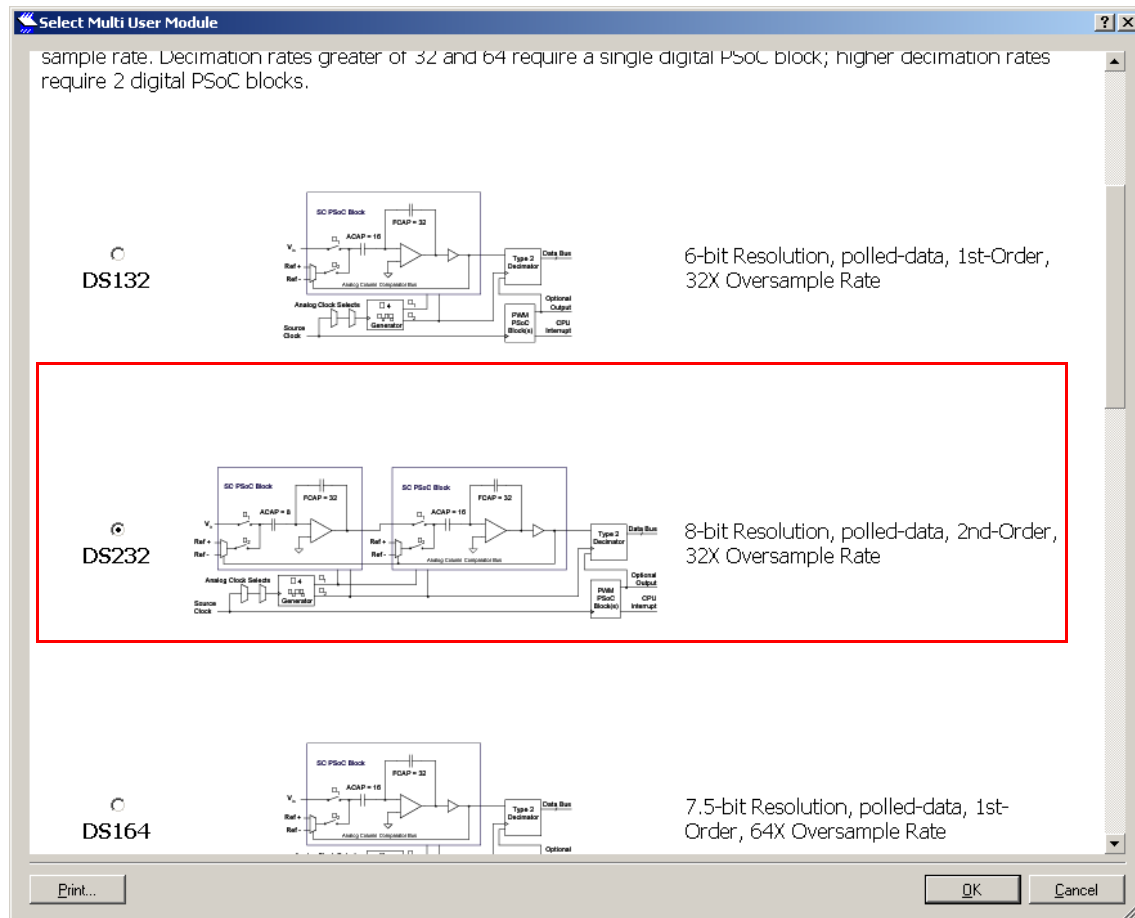
3.2.3 ADC to LCD with DAC and UART

This project demonstrates sine wave generation by using a 6-bit DAC. The sine wave period is based on the current value of the ADC. The firmware reads the voltage output by the DVK board potentiometer and displays the raw counts on the DVK board character LCD display similarly to those shown in the previous project. A 6-bit DAC outputs a table generated sine wave at a frequency proportional to the ADC count. The frequency is in the approximate range of 15 Hz to 350 Hz and outputs to port to observe on scope. A 38400 BAUD UART outputs the current ADC count as ASCII formatted into a hexadecimal number.

3.2.3.1 Creating ADC to LCD with DAC and UART Project

1. Follow steps 1 to 10 in section 3.2.1.1 on page 68, change the **Name** of the project to **Example_ADC_to_LCD_with_DAC_and_UART**.
2. In the **User Modules** window expand the **ADCs** folder, and then right click **DeISig** and choose **Place**. A window opens with multiple options for the DeISig UM. Scroll down, if necessary, and select the **DS232** configuration. Click OK.

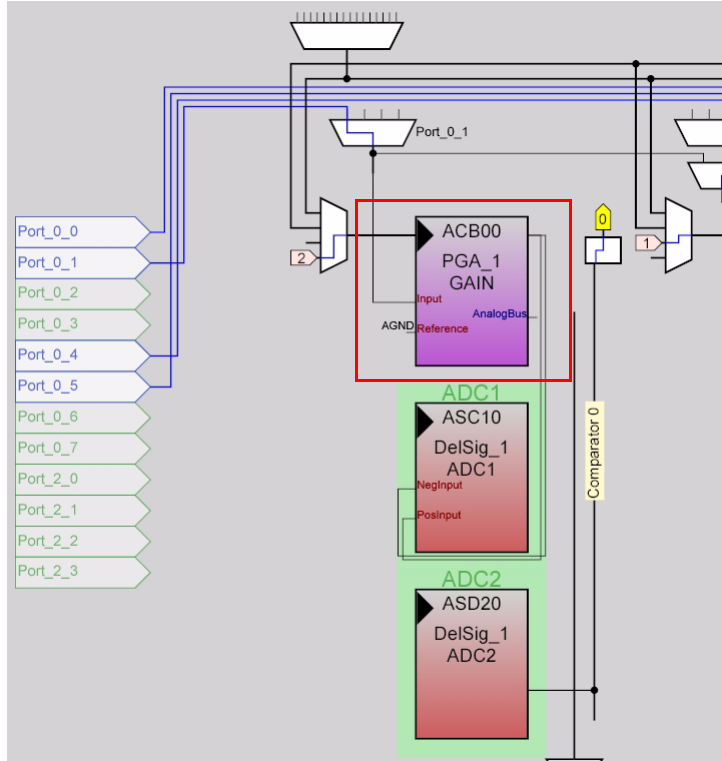
Figure 3-73. Select Multi User Module Window



3. Click **OK**.

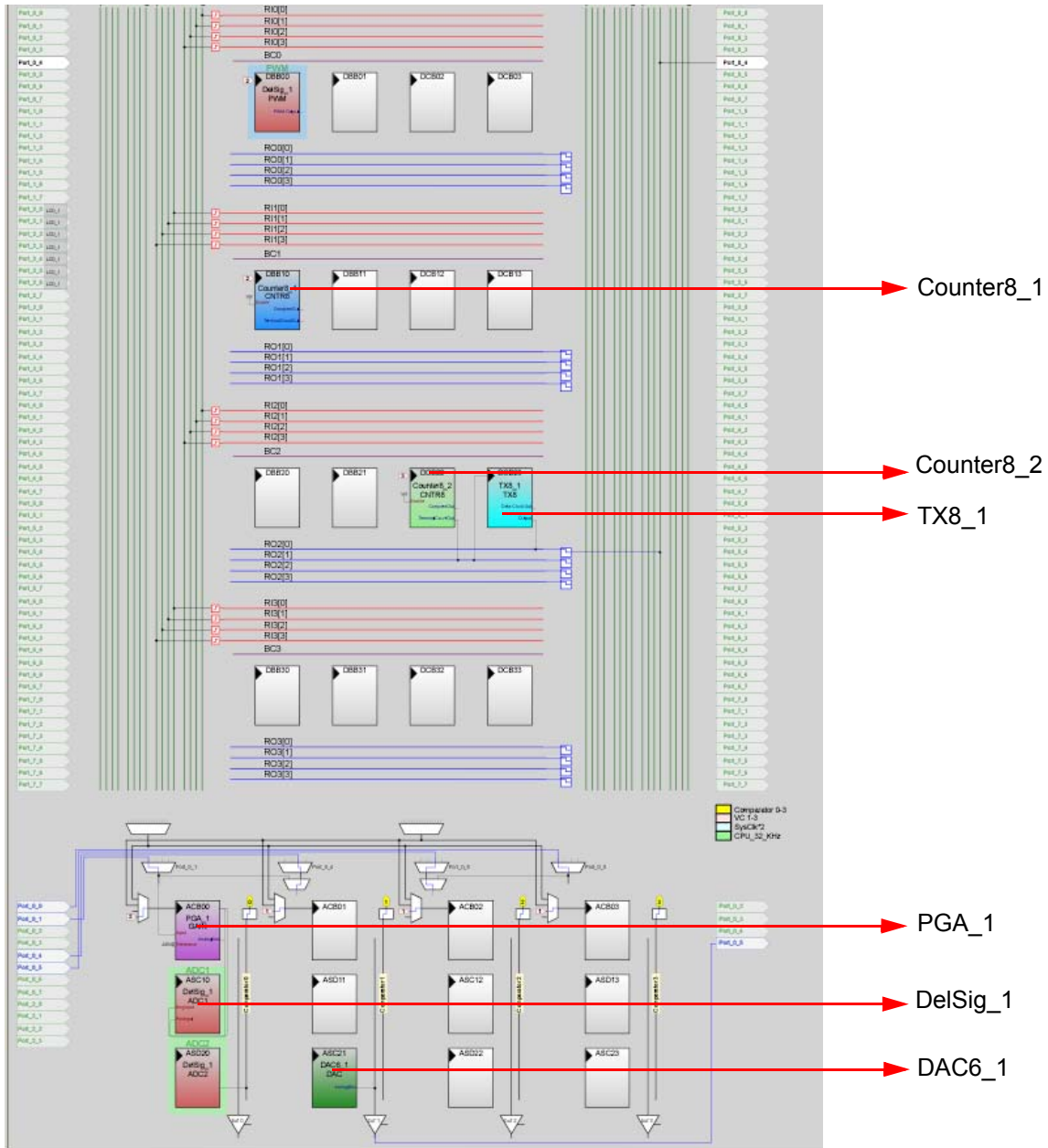
4. Verify that the UM is placed in **ASC10**.
5. In the **User Modules** window expand the **Amplifiers** window. Right click **PGA**, select place. Ensure that the **PGA** is placed in **ACB00**.

Figure 3-74. Ensure that the PGA is placed in ACB00



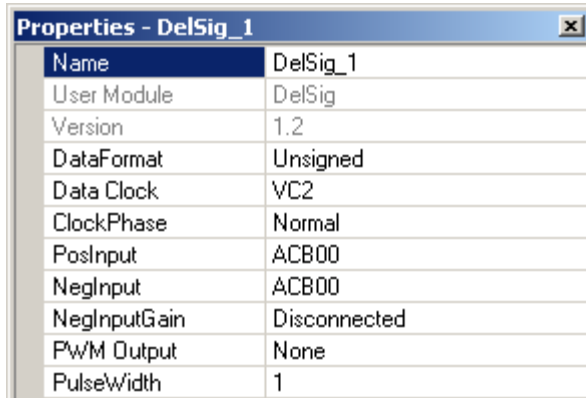
6. In the **User Modules** window expand **Misc Digital**, right click **LCD**, and click place.
7. In the **User Modules** window expand **Counters**, right click **Counter8**, and select place. Complete this step twice to place two **Counter8s**.
8. In the **User Modules** window expand **Digital Comm**, right click **TX8**, and click place.
9. In the **User Modules** window expand **DACs**, right click **DAC6**, and click place.
10. Move the UMs so that they match the configuration shown in [Figure 3-75 on page 86](#).

Figure 3-75. Configure User Modules



11. Double click on **DelSig_1** and configure it to match this figure.

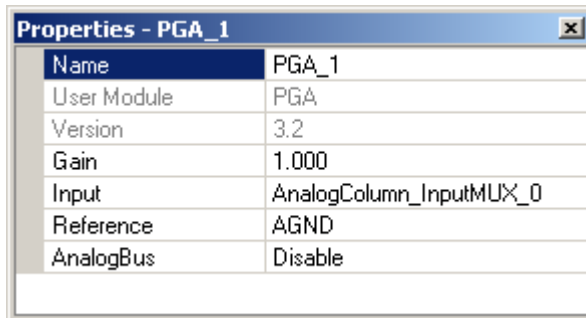
Figure 3-76. DelSig_1 Properties



Properties - DelSig_1	
Name	DelSig_1
User Module	DelSig
Version	1.2
DataFormat	Unsigned
Data Clock	VC2
ClockPhase	Normal
PosInput	ACB00
NegInput	ACB00
NegInputGain	Disconnected
PWM Output	None
PulseWidth	1

12. Double click **PGA_1** and configure it to match this figure.

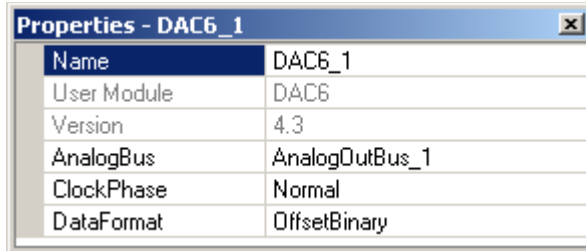
Figure 3-77. PGA_1 Properties



Properties - PGA_1	
Name	PGA_1
User Module	PGA
Version	3.2
Gain	1.000
Input	AnalogColumn_InputMUX_0
Reference	AGND
AnalogBus	Disable

13. Double click **DAC6_1** and configure it to match this figure.

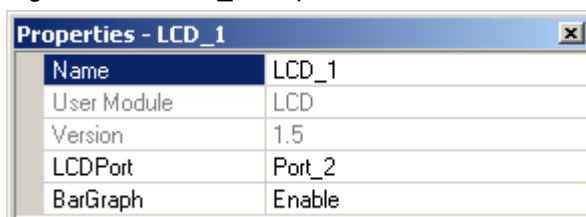
Figure 3-78. DAC6_1 Properties



Properties - DAC6_1	
Name	DAC6_1
User Module	DAC6
Version	4.3
AnalogBus	AnalogOutBus_1
ClockPhase	Normal
DataFormat	OffsetBinary

14. Double click **LCD_1** and configure it to match this figure.

Figure 3-79. LCD_1 Properties



Properties - LCD_1	
Name	LCD_1
User Module	LCD
Version	1.5
LCDPort	Port_2
BarGraph	Enable

15. Double click on **Counter8_1** and configure it to match this figure.

Figure 3-80. Counter8_1 Properties

Properties - Counter8_1	
Name	Counter8_1
User Module	Counter8
Version	2.5
Clock	VC2
ClockSync	Sync to SysClk
Enable	High
CompareOut	None
TerminalCountOut	None
Period	255
CompareValue	0
CompareType	Less Than Or Equal
InterruptType	Terminal Count
InvertEnable	Normal

16. Double click **Counter8_2** and configure it to match this figure.

Figure 3-81. Counter8_2 Properties

Properties - Counter8_2	
Name	Counter8_2
User Module	Counter8
Version	2.5
Clock	VC3
ClockSync	Sync to SysClk
Enable	High
CompareOut	None
TerminalCountOut	Row_2_Output_1
Period	38
CompareValue	0
CompareType	Less Than Or Equal
InterruptType	Terminal Count
InvertEnable	Normal

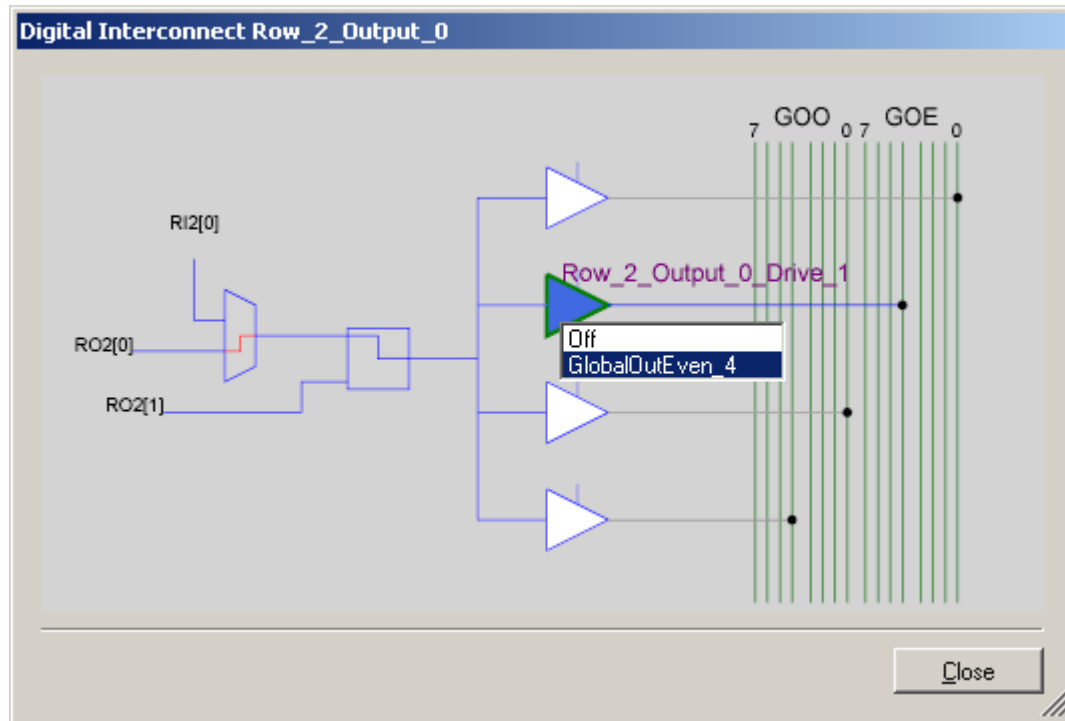
17. Double click **TX8_1** and configure it to match this figure.

Figure 3-82. TX8_1 Properties

Properties - TX8_1	
Name	TX8_1
User Module	TX8
Version	3.3
Clock	Row_2_Output_1
Output	Row_2_Output_0
TX Interrupt Mode	TXComplete
ClockSync	Sync to SysClk
Data Clock Out	None

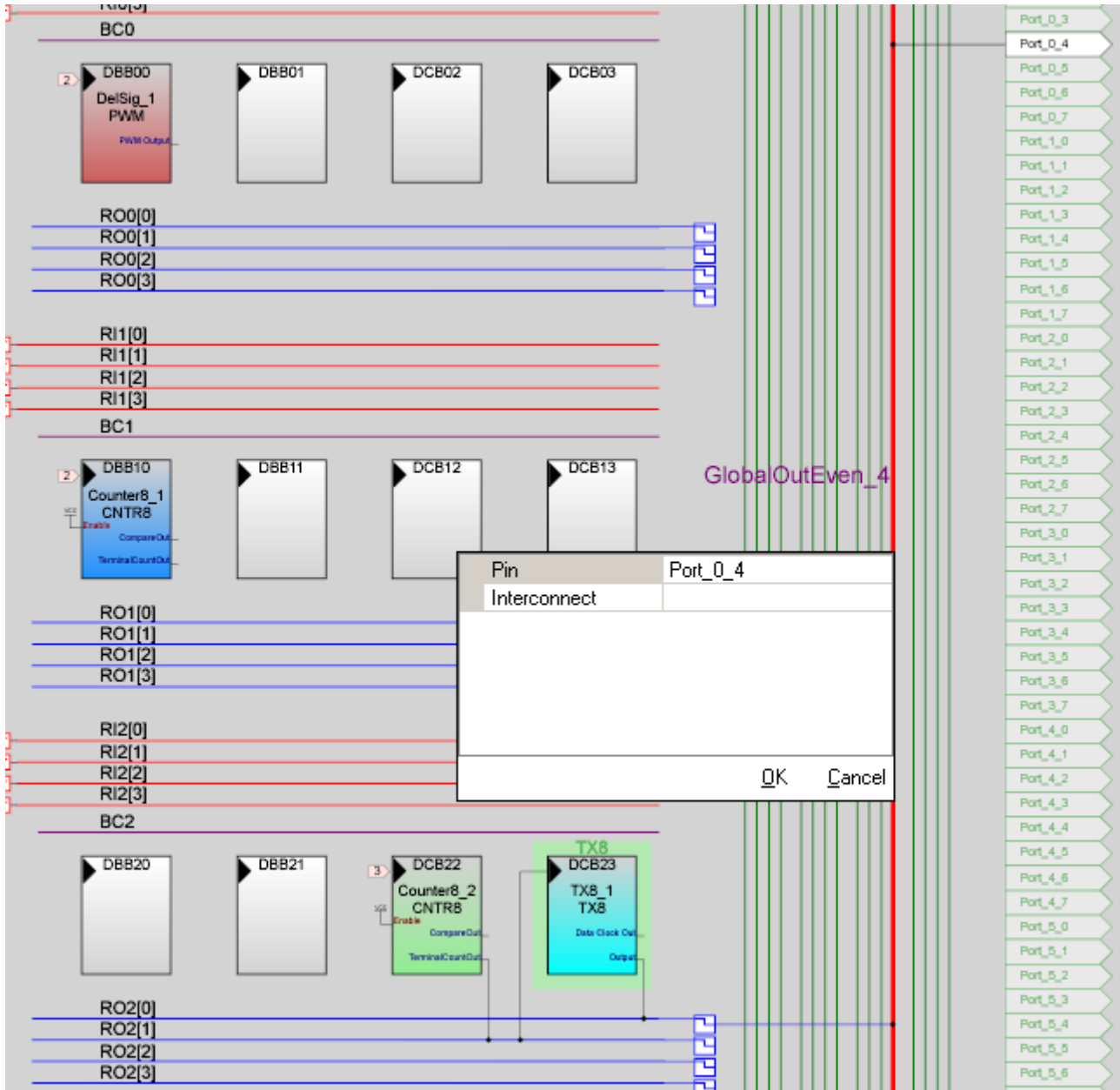
18. Double click **RO2[0]** LUT, enable **Row_2_Output_0_Drive_1** to connect **GlobalOutEven_4**.

Figure 3-83. Digital Interconnect Window



19. Double click **GlobalOutEven_4**. A window appears; in this window configure **PIN** for **Port_0_4**.

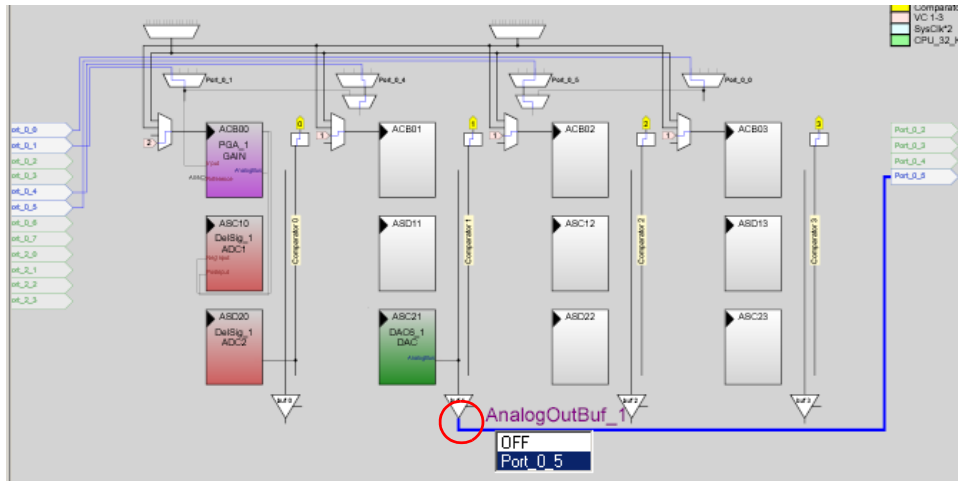
Figure 3-84. Configure PIN for Port_0_4



20. Click **OK** to continue.

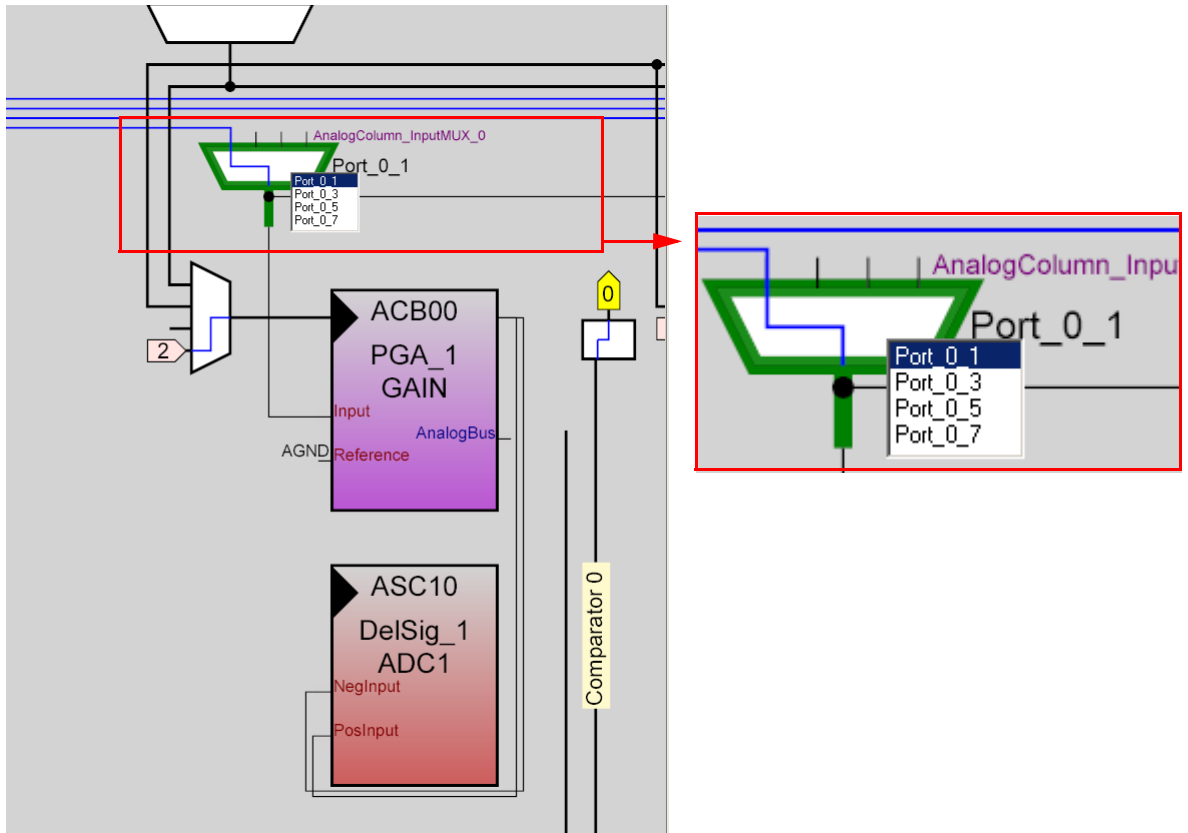
21. Click **AnalogOutBuf_1** and configure it for **Port_0_5**.

Figure 3-85. Configure AnalogOutBuf_1



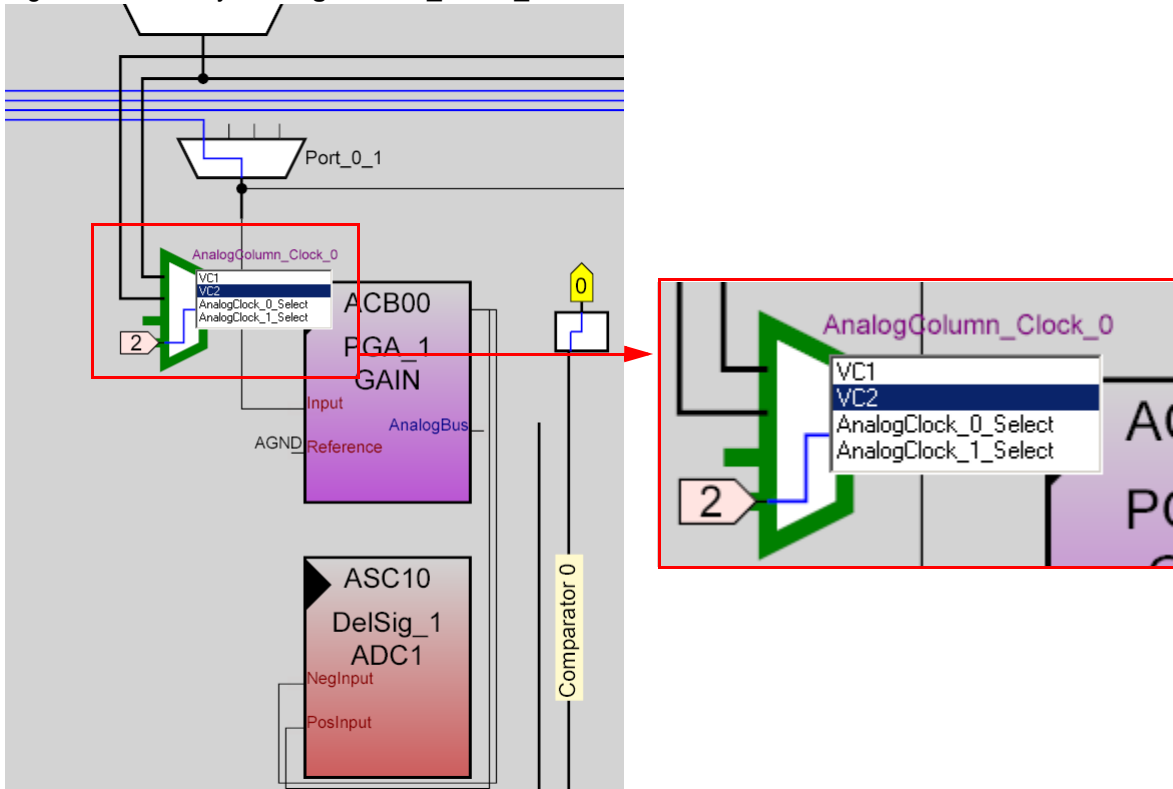
22. Verify that **AnalogColumn_InputMUX_0** is connected to **Port_0_1**. If it is not configured for this port, double click the **MUX** and choose **Port_0_1**.

Figure 3-86. Verify AnalogColumn_InputMUX_0 Connection



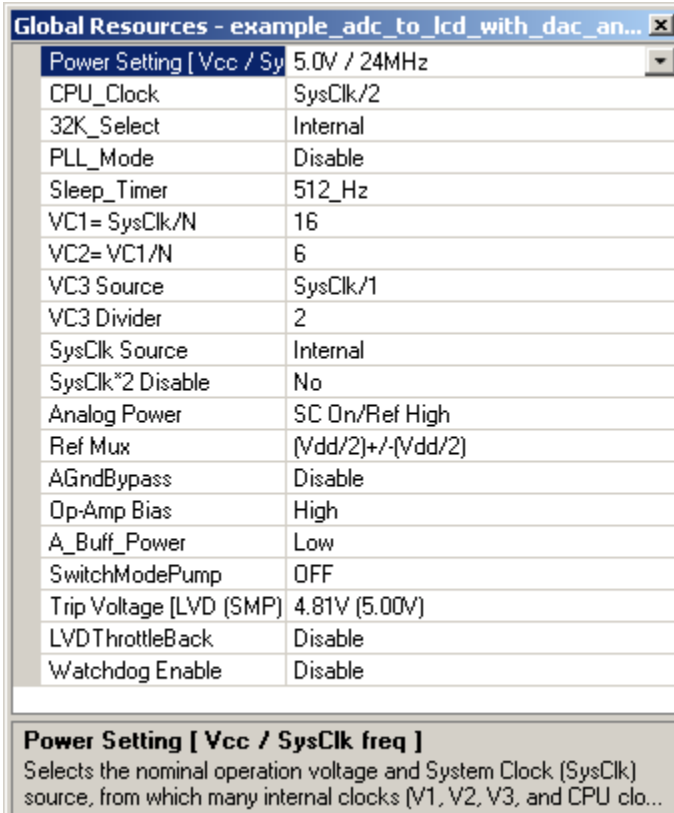
23. Verify that **AnalogColumn_Clock_0** is connected to **VC2**. If it is not, double click the **MUX** and chose **VC2**.

Figure 3-87. Verify **AnalogColumn_Clock_0** Connection



24. Configure **Global Resources** to match the following figure.

Figure 3-88. Configure Global Resources



25. Open the existing *main.c* file within Workspace Explorer. Replace the existing *main.c* content with the content of the embedded *CY8C29_main_Ex3.c* file, which can be found within the attachments feature of this PDF document.

26. Save the project.

27. To Generate the project, click **Build** → **Generate/Build 'Example_ADC_to_LCD_with_DAC_and_UART' Project**.

28. Open your *Counter8_1INT.asm* file in **Files** → **lib** → **Library Source Files**. Copy the code found in the *Counter8_1INT.asm* file in PDF attachment.

29. Save the project.

30. To Build the project, click **Build** → **Build 'Example_ADC_to_LCD_with_DAC_and_UART' Project**.

Note If prompted to reload an out of date file, select Yes.

31. Disconnect power to the board.

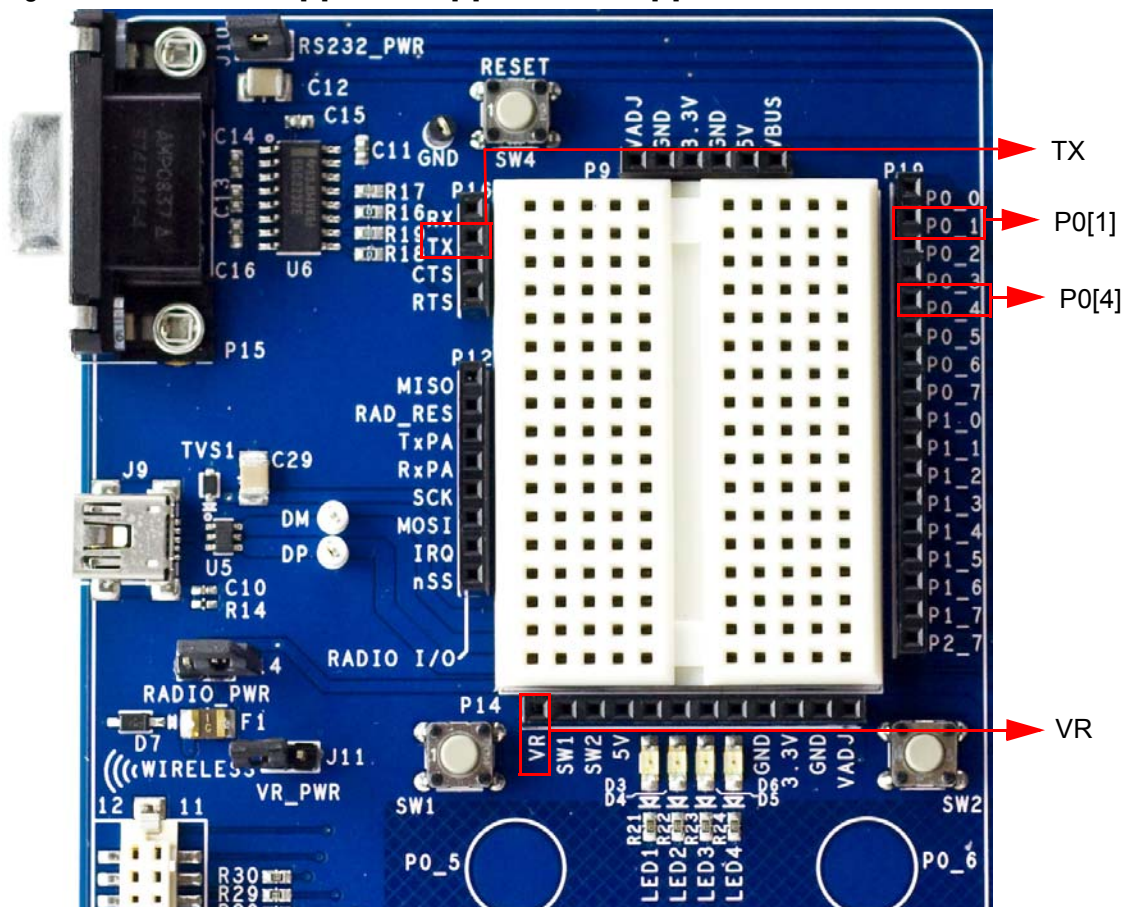
32. Configure the DVK SW3 to 5V.

33. Configure the DVK breadboard using the included jumper wires as follows:

- P0[1] to VR
- P0[4] to TX
- P0[5] to Scope

Note An LED (P0[5] to LED1) by nature does not accurately show the changes in frequency the best way to see this is to use a Scope(P0[5] to Scope).

Figure 3-89. Connect P0[1] to VR, P0[4] to TX, and P0[5] to LED1



34. Connect a serial cable to the PC and the DVK board.
35. On the DVK board, verify that **RS232_PWR(J10)** is jumpered to **ON**.
36. Reapply power to the board.
37. Use a terminal application such as TeraTerm or HyperTerminal with these setup parameters.

- Baud Rate: 38400
- Data: 8-bit
- Parity: none
- Stop: 1bit
- Flow Control: none

38. Use PSoC Designer as described in [Programming My First PSoC 1 Project on page 19](#) to program the device.

After programming the device, press Reset and vary the pot to see the result on the LCD as well as in the terminal application. View the DAC output on a scope or with an LED.

Note The ADC output values may not reach full range due to potentiometer and ADC limitations. ADC values may fluctuate several counts due to system noise, and if the potentiometer voltage is at the edge of an ADC count.

39. Save and close the project.

3.2.3.2 *main.c*

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C29_main_Ex3.c* file, which can be found within the attachments feature of this PDF document.

Note To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.

```

/*****
* File Name: main.c
*
* Description:
* This file provides source code for the ADC to LCD with DAC and UART example
* project. The firmware takes a voltage output from a potentiometer and
* displays the ADC raw count on an LCD. The raw count is also transmitted
* serially. The raw count also determines the clock divider value of the clock
* driving the DAC update rate.

/*****
* PGA_1 Settings:(The PGA buffers the potentiometer voltage on P0.1 into the ADC)
*
* Gain      = 1
* Input     = AnalogColumn_InputMUX_0 (P0.1)
* Reference = AGND
* AnalogBus = Disable
*

*****/
/*****
* LCD_1 Settings:
* LCDPort  = Port_2
* BarGraph = Disable
*

*****/
/*****
* DelSig_1 Settings:
* The ADC can read full range values from 0-5V, if the Ref Mux setting is
selected
* as (Vdd/2)+/- (Vdd/2) and Vdd = 5V. The ADC is configured for a resolution of
8 bits,
* this is achieved by selecting the appropriate configuration when placing the
UM.
*
* DataFormat   = Unsigned
* DataClock    = VC2 //VC2 = 24MHz/16/16 = 250kHz
* ClockPhase   = Normal
* PosInput     = ACB00 (PGA_1)
* NegInput     = ACB00 *Note this parameter is not used
* NegInputGain = Disconnected
* PWM Output   = None
* PulseWidth   = N/A *Note this parameter is not used
*

*****/
/*****
* Counter8_1 Settings:
* The Counter8_1 controls the update rate of the DAC. The DAC is updated during
ever

```

```

* TerminalCount ISR. The frequency of the TerminalCount ISR is determined by the
* Counter Input Clock divided by the (Period value +1). The Period Value of the
counter
* is changed by the ADC reading. Thus the frequency of the TerminalCount ISR can
range
* from 125kHz (Period Value=1) to 977Hz (Period Value = 255)
*
*   Clock           = VC2 // VC2 = 24MHz/16/16 = 250kHz
*   ClockSync       = Sync to SysClk
*   Enable          = High
*   CompareOut      = None
*   TerminalCountOut = None
*   Period          = 255 *Note this parameter is updated in the main loop
*   CompareValue    = 0 *Note this parameter is not used
*   CompareType     = Less Than or Equal
*   InterruptType   = Terminal Count
*   InvertEnable    = Normal
*
*****/
/*****
* Counter8_2 Settings:
* The Counter8_1 provides a clock to the TX8 UM to achieved a desired baud rate.
* For this project the desired baud rate is 38400. The TX8 UM derives the baud
rate
* by dividing its input clock by 8. Thus the input clock to the TX8 needs to be
around
* 307.2kHz to achieve a baud rate of 38400. The Counter8_1 UM provides this
clock by dividing
* VC3 (12MHz) by 39 to get 307.7kHz.
*
*   Clock           = VC3 //VC3 = 24MHz/2 = 12MHz
*   ClockSync       = Sync to SysClk
*   Enable          = High
*   CompareOut      = None
*   TerminalCountOut = Row_2_Output_1
*   Period          = 38
*   CompareValue    = 0*Note this parameter is not used
*   CompareType     = Less Than or Equal
*   InterruptType   = Terminal Count
*   InvertEnable    = Normal
*
*****/
/*****
* TX8_1 Settings:
* The TX8 UM provides serial communication of the ADC data to another device or
PC.
* The TX8 UM send data out at a baud rate of 38400. This baud rate is derived
* by dividing the UM's input clock by 8.
*
*   Clock           = Row_2_Output_1 (From Counter8_1)
*   Output          = Row_2_Output_0
*   Tx Interrupt Mode = TXComplete
*   ClockSync       = Sync to SysClk
*   Data Clock Out   = None
*
*****/
/*****
* DAC6 Settings:

```

```

* The DAC6 outputs a sine wave on P0.5. The shape of the sine wave is determined
* by a 64 element lookup table found in SINTable.asm. The update rate of the
DAC6
* is determined by the Counter8 terminal count ISR. The frequency of the DAC
output
* equals the Counter8 Terminal Count frequency divided by 64 (the number of ele-
ments in the table).
*
* AnalogBus = AnalogOutBus_1
* ClockPhase = Normal
* DataFormat = OffsetBinary
*
*****/

#include <m8c.h> // part specific constants and macros
#include "PSoCAPI.h" // PSoC API definitions for all User Modules

const BYTE SINTable[]=
{
    31, 33, 36, 39, 41, 44, 46, 49, 51, 53, 55, 56, 58, 59, 59,
    60, 60, 60, 59, 59, 58, 56, 55, 53, 51, 49, 47, 44, 42, 39,
    36, 33, 31, 28, 25, 22, 19, 16, 13, 11, 9, 7, 5, 3, 2, 1, 0,
    0, 0, 0, 1, 2, 3, 4, 6, 7, 10, 12, 14, 17, 20, 23, 26, 29
};

BYTE bADCvalue;//Variable for holding ADC result, and updating counter period

void main(void)
{
    Counter8_1_Start();//Enable the counter used for DAC update rate
    Counter8_1_EnableInt();//Enable DAC update interrupt
    Counter8_2_Start();//Enable counter for TX8 clock rate divider
    TX8_1_Start(TX8_1_PARITY_NONE);//Start the TX8 UM with no parity (baud rate =
38400)
    PGA_1_Start(PGA_1_HIGHPOWER);//Enable to PGA to buffer signal from VR to ADC
    DAC6_1_Start(DAC6_1_HIGHPOWER);//Start the DAC
    DelSig_1_Start(DelSig_1_HIGHPOWER);//Start the ADC
    DelSig_1_StartAD();//Start reading values on the ADC
    LCD_1_Start(); //Start the character LCD

    M8C_EnableGInt; // Enable Global Interrupts

    while(1)
    {
        /* Step 1: Get BYTE data from the ADC
        Setp 2: Write BYTE data from ADC to the counter in order to change the
DAC update rate
        Step 3: Move the LCD cursor back to the beginning and dispaly new ADC
data
        Setp 4: Write ADC data out the TX port, and then send a return
        */
        if (DelSig_1_fIsDataAvailable())//Is new data available from the ADC?
        {

            bADCvalue = DelSig_1_bGetDataClearFlag(); // Get new data from ADC
            Counter8_1_WritePeriod(bADCvalue); // Update DAC update rate counter
            LCD_1_Position(0,0); // Move LCD (row=0,column=0)
        }
    }
}

```

```
LCD_1_PrHexByte(bADCvalue); // Print ADC result to LCD
TX8_1_PutSHexByte(bADCvalue); // Write LCD result out TX8 to PC
TX8_1_PutCRLF(); // Send a return character

    }
} //end of while(1)

} //End of Main
```

3.2.3.3 Counter8_1INT.asm

1. Open your *Counter8_1INT.asm* file in **Files** → **lib** → **Library Source Files**.
2. Replace the existing *Counter8_1INT.asm* content with the content of the embedded file, which can be found within the attachments feature of this PDF document.

Note To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.

```

;*****
;*****
;; FILENAME: Counter8_1INT.asm
;; Version: 2.5, Updated on 2009/3/31 at 12:2:49
;; Generated by PSoC Designer 5.0.423.0
;;
;; DESCRIPTION: Counter8 Interrupt Service Routine
;-----
;; Copyright (c) Cypress Microsystems 2000-2004. All Rights Reserved.
;*****
;*****

include "m8c.inc"
include "memory.inc"
include "Counter8_1.inc"

;-----
; Global Symbols
;-----
export _Counter8_1_ISR

AREA InterruptRAM (RAM,REL,CON)

;@PSoC_UserCode_INIT@ (Do not change this line.)
;-----
; Insert your custom declarations below this banner
;-----
export bTablePos// Stores last table position index
export _bTablePos

;-----
; Includes
;-----

;-----
; Constant Definitions
;-----

;-----
; Variable Allocation
;-----
area bss(RAM)
bTablePos:blk 1
_bTablePos:

```

```

;-----
; Insert your custom declarations above this banner
;-----
;@PSoC_UserCode_END@ (Do not change this line.)

AREA UserModules (ROM, REL)

;-----
; FUNCTION NAME: _Counter8_1_ISR
;
; DESCRIPTION: Unless modified, this implements only a null handler stub.
;-----
;
;
 Counter8_1_ISR:

 ;@PSoC_UserCode_BODY@ (Do not change this line.)
;-----
; Insert your custom code below this banner
;-----
; NOTE: interrupt service routines must preserve
; the values of the A and X CPU registers.

push A
push X

dec [bTablePos] ;Go to the next element in the table
mov A, [bTablePos]
jnz SINlookup ;If we are at the end go back to the beginning
mov [bTablePos], 64

SINlookup:
index _SINtable;Get the value in the SINtable pointed to by [bTablePos]
lcall DAC6_1_WriteBlind;Write value from SINtable (stored in A) to the DAC

pop X
pop A

;-----
; Insert your custom code above this banner
;-----
;@PSoC_UserCode_END@ (Do not change this line.)

reti

; end of file Counter8_1INT.asm

```

3.3 CY8C38 / CY8C55 Family Processor Module Example Projects

3.3.1 My First PSoC 3 / PSoC 5 Project

This project demonstrates basic hardware and software functionality with the PSoC 3 / PSoC 5 device. It flashes two LEDs independently, one using hardware, the other with software. The hardware LED uses a hardware enabled digital port and a PWM to generate a duty cycle and flash the LED. The software LED uses a software enabled digital port and a simple delay in the *main.c* to flash the LED at a known rate.

This example project uses these components:

- Digital Output Pin (**Component Catalog** → **Ports and Pins** → **Digital Output Pin**)
- PWM (**Component Catalog** → **Digital Functions** → **PWM**)
- Clock (**Component Catalog** → **System** → **Clock**)
- Logic Low (**Component Catalog** → **Digital** → **Logic** → **Logic Low**)
- Logic High (**Component Catalog** → **Digital** → **Logic** → **Logic High**)

3.3.1.1 Creating My First PSoC 3 / PSoC 5 Project


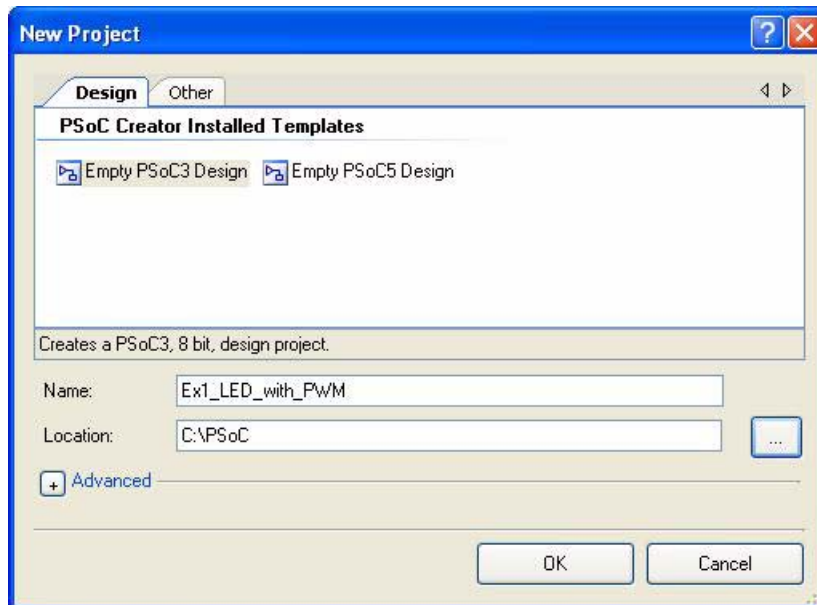
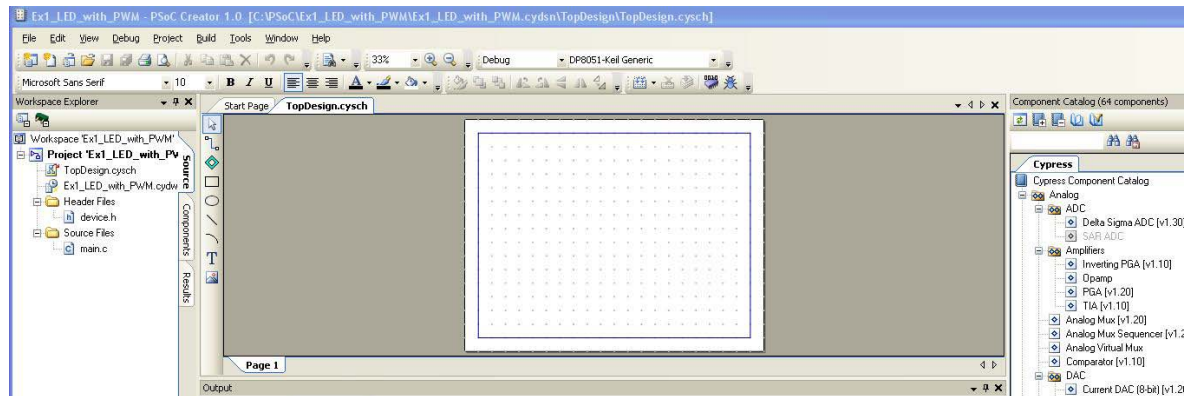
1. Open PSoC Creator.
2. Create a new project by clicking **Create New Project** in the **Start Page** of PSoC Creator.
3. In the **New Project** window, select the **Empty PSoC3 Design** template for a PSoC 3 design, or **Empty PSoC5 Design** template for a PSoC 5 design and name the project **Ex1_LED_with_PWM**.
4. In **Location**, type the path where you want to save the project, or click the  button and navigate to the appropriate directory.

Figure 3-90. New Project Window



5. By default, the design window opens *TopDesign.cysch*. This is the project's schematic entry file within PSoC Creator.

Figure 3-91. Ex1_LED_with_PWM



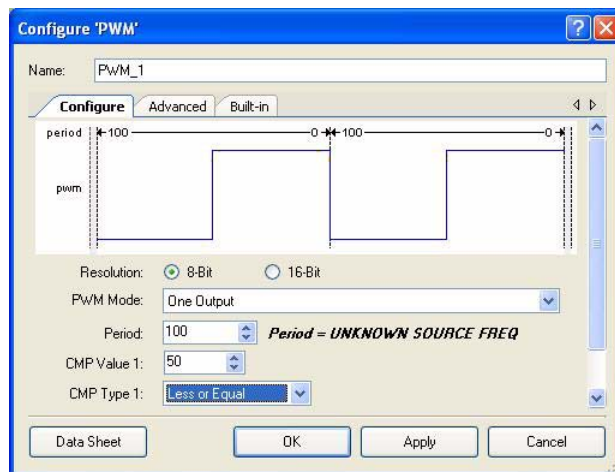
3.3.1.2 Placing and Configuring the PWM

1. Drag-and-drop the **PWM** component (**Component Catalog** → **Digital** → **Functions** → **PWM**) to workspace.
2. Double click the **PWM_1** component in the schematic to open the configuration window.
3. Configure the PWM in this manner:

Configure Tab

- Name:** PWM_1
- Resolution:** 8-Bit
- PWM Mode:** One Output
- Period:** 100
- CMP Value 1:** 50
- CMP Value Type 1:** Less or Equal

Figure 3-92. PWM Component Configuration



Advanced Tab

- Enable Mode:** Hardware Only
- Interrupt On Terminal Count Event:** Select

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

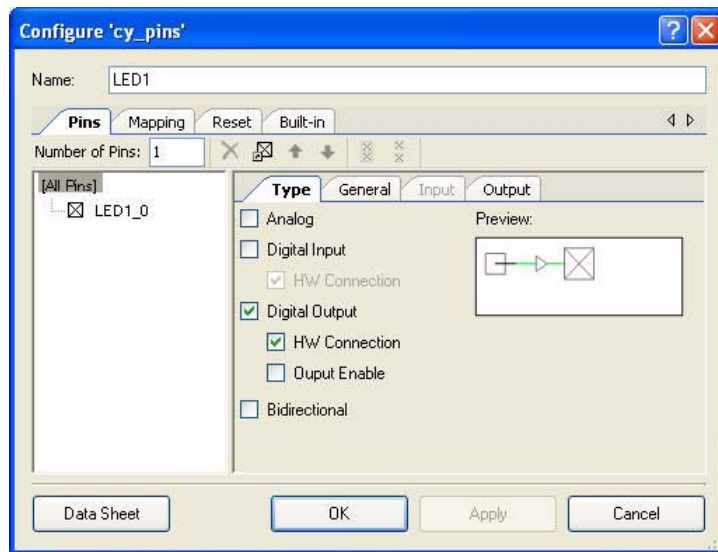
3.3.1.3 *Placing and Configuring Digital Output Pin Hardware*

1. Drag-and-drop the **Digital Output Pin** component (**Component Catalog** → **Ports and Pins** → **Digital Output Pin**).
2. Double click the **Pin_1** component in the schematic to open the configuration window.
3. Configure the digital output pin:

Type Tab

- Name:** LED1
- Select **Digital Output** Check box
- Select **HW Connection** Check box

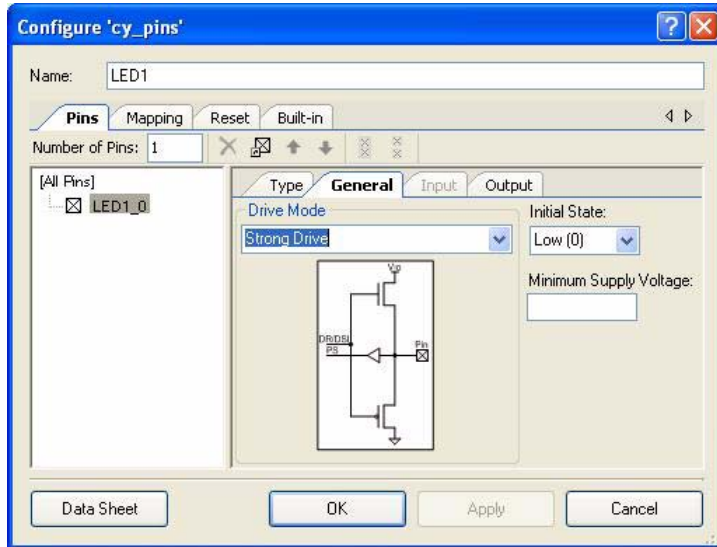
Figure 3-93. LED1 Component Configuration



General Tab

- Drive Mode:** Strong Drive
- Leave remaining parameters as default

Figure 3-94. Pins - LED1 Component Configuration



For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

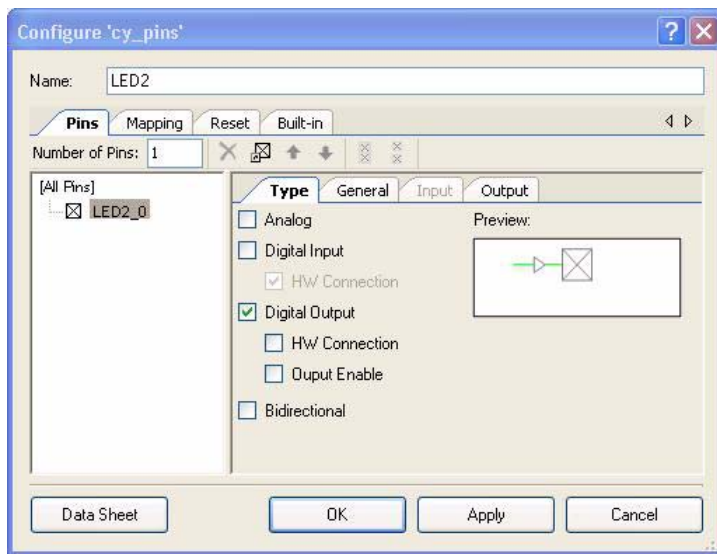
3.3.1.4 Placing and Configuring the Software Digital Output Pin

1. Drag-and-drop the **Digital Output Pin** component (**Component Catalog** → **Ports and Pins** → **Digital Output Pin**).
2. Double click the **Pin_1** component in the schematic to open the configuration window.
3. Configure the digital output pin:

Type Tab

- **Name:** LED2
- Select **Digital Output** Check box (Note all other check boxes are not selected).

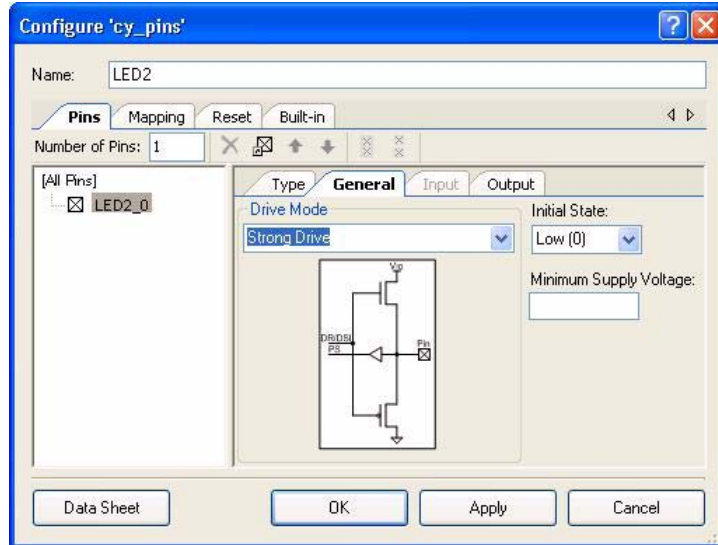
Figure 3-95. LED2 Component Configuration



General Tab


- ❑ **Drive Mode:** Strong Drive
- ❑ Leave remaining parameters as default

Figure 3-96. Pins - LED2 Component Configuration



For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

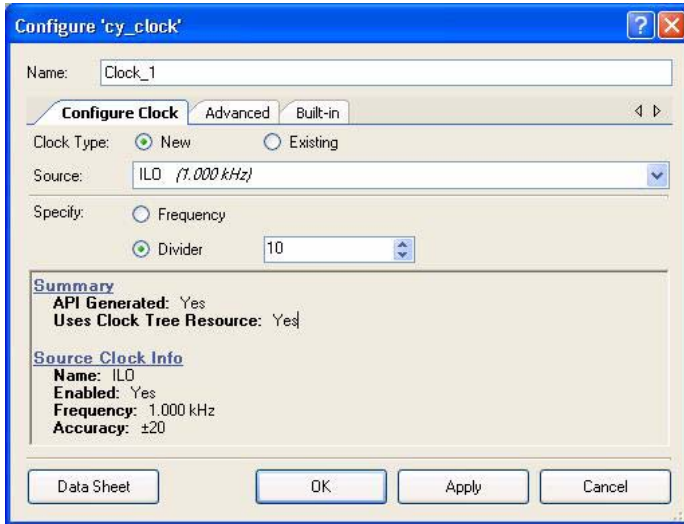
3.3.1.5 Connecting the Components Together

1. Using the Wire Tool , connect **pwm** (in the PWM component) to hardware connection point of LED1.
2. Connect a Logic High component (**Component Catalog** → **Digital** → **Logic** → **Logic High**) to the **enable** on the PWM
3. Connect a Logic Low component (**Component Catalog** → **Digital** → **Logic** → **Logic Low**) to the **reset** on the PWM
4. Connect a Clock component (**Component Catalog** → **System** → **Clock**) to the **clock** on the PWM.
5. Double click the **Clock_1** component to configure.
6. Configure the clock:

Configure Clock Tab

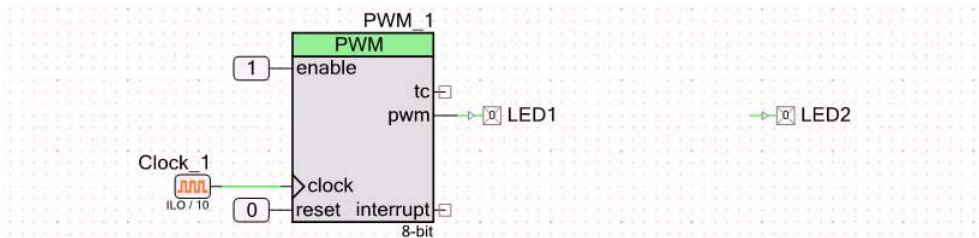
- ❑ **Name:** Clock_1
- ❑ **Source:** ILO (1.000 kHz)
- ❑ Select **Divider** and set the value as 10
- ❑ Leave remaining parameters as default

Figure 3-97. Clock Component Configuration



7. When complete the schematic looks similar to Figure 3-98.

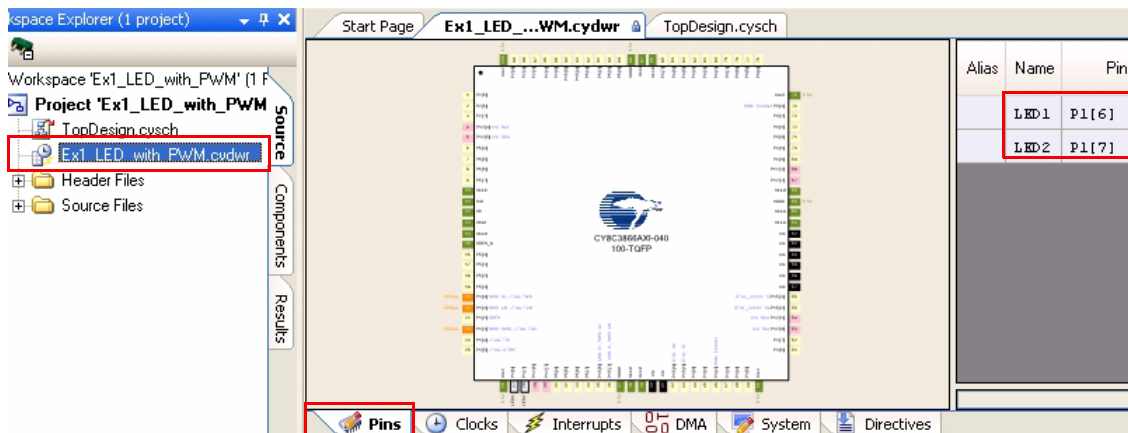
Figure 3-98. Connected Components



3.3.1.6 Configuring the Pins

1. From the **Workspace Explorer**, double click the *Ex1_LED_with_PWM.cydwr* file (see Figure 3-99 on page 106).
2. Click the **Pins** tab.
3. Select pin P1[6] for LED1.
4. Select pin P1[7] for LED2.

Figure 3-99. Pin Assignments



3.3.1.7 Creating the main.c File

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C38_main_Ex1.c* file, which can be found within the attachments feature of this PDF document.

Notes

- To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.
- Use the PSoC 3 family processor module file *CY8C38_main_Ex1.c* to replace the *main.c* content for PSoC 5 CY8C55 family processor module.

```
#include <device.h>

#define MS_DELAY 167u /* For delay, about 167ms */

/*****
 * Function Name: main
 *****/

*
* Summary:
* The main function initializes the PWM and starts the PWM clock which will
* blink LED1 at about once a second. Then the main loop is entered which
* delays enough for LED2 to blink at a quicker rate than LED1.
*
* Parameters:
* void
*
* Return:
* void
*
*****/
void main(void)
{
    uint8 ledState = 0x00; /* Initially set LED2 to off */

    Clock_1_Enable(); /* Start the clock */
    PWM_1_Start(); /* Enable PWM */

    /* Following loop does software blinking of LED2 connected to P1.7 */
    while (1)
    {

        CyDelay(MS_DELAY); /* Have software loop blink control */
        ledState ^= 0x01u; /* Toggle LED2 setting between low and high */
        LED2_Write(ledState); /* Set LED2 */
    }
}

/* [] END OF FILE */
```

3. From the **Build** menu, select **Build Ex1_LED_with_PWM**.
4. PSoC Creator builds the project and displays the comments in the **Output** dialog box. When you see the message "Build Succeeded" the build is complete.

3.3.1.8 *Configuring and Programming the PSoC Development Board*

1. Disconnect the power to the board.
2. Configure the DVK SW3 to 3.3V.
3. Configure the following on the PSoC Development Board's prototyping area using the included jumper wires
 - P1[6] to LED1
 - P1[7] to LED2
4. Apply power to the board.
5. Use PSoC Creator as described in [Programming My First PSoC 3 Project on page 23](#) or [Programming My First PSoC 5 Project on page 27](#) to program the device.
6. After programming the device, press the **Reset** button on the PSoC Development Board. The PWM causes the LED1 to blink at approximately 1 Hz due to PSoC Creator's PWM component and LED2 blinks at a faster rate using a software timing loop to toggle the LED.
7. Save and close the project.

3.3.2 ADC to LCD Project

This project demonstrates the Delta Sigma ADC by measuring the voltage of the potentiometer on the board and displays the result on the Character LCD of the PSoC Development Board.


The ADC is clocked by the internal clock of 3 MHz and the sampling rate is set to 10,000 sps. Connect the voltage potentiometer (labeled "VR" on the PSoC Development Board) to the ADC input (programmed to P0[7] for this example). The program reads the ADC result and prints it to the LCD.

The instructions that follow assume that you have completed My First PSoC 3 / PSoC 5 Project and therefore have a basic understanding of the PSoC Creator software environment.

This example project uses these components:

- Delta Sigma ADC (**Component Catalog** → **Analog** → **ADC** → **Delta Sigma ADC**)
- Character LCD (**Component Catalog** → **Display** → **Character LCD**)
- Analog Pin (**Component Catalog** → **Ports and Pins** → **Analog Pin**)

3.3.2.1 Creating ADC to LCD Project

1. Open PSoC Creator.
2. Create a new project by clicking **Create New Project** in the **Start Page** of PSoC Creator.
3. In the **New Project** window, select the **Empty PSoC3 Design** template for a PSoC 3 design, or **Empty PSoC5 Design** template for a PSoC 5 design and **Name** the project **Ex2_ADC_to_LCD**.
4. In **Location**, type the path where you want to save the project, or click  and navigate to the appropriate directory.
5. By default, the design window opens *TopDesign.cysch*. This is the project's schematic entry file within PSoC Creator.

3.3.2.2 Placing and Configuring Delta Sigma ADC

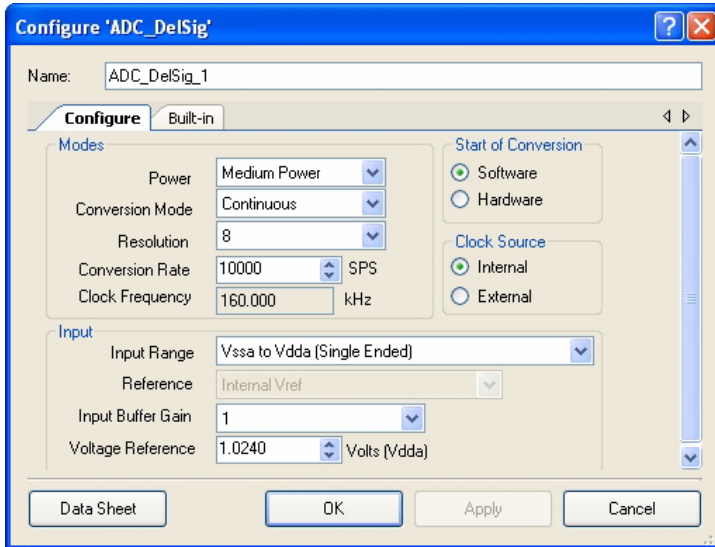
1. Drag and drop the Delta Sigma ADC component (**Component Catalog** → **Analog** → **ADC** → **Delta Sigma ADC**)
2. Double click the **ADC_DelSig_1** component in the schematic to open the configuration window.
3. Configure the Delta Sigma ADC in this manner:

Configure Tab

- **Name:** ADC_DelSig_1
- **Power:** Medium Power
- **Conversion Mode:** Continuous
- **Resolution:** 8
- **Conversion Rate:** 10000
- **Input Range:** Vssa to Vdda (Single Ended)
- **Input Buffer Gain:** 1
- **Reference:** Internal Vref
- **Clock Source:** Internal
- **Start of Conversion:** Software

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-100. ADC Component Configuration



3.3.2.3 Placing and Configuring an Analog Pin

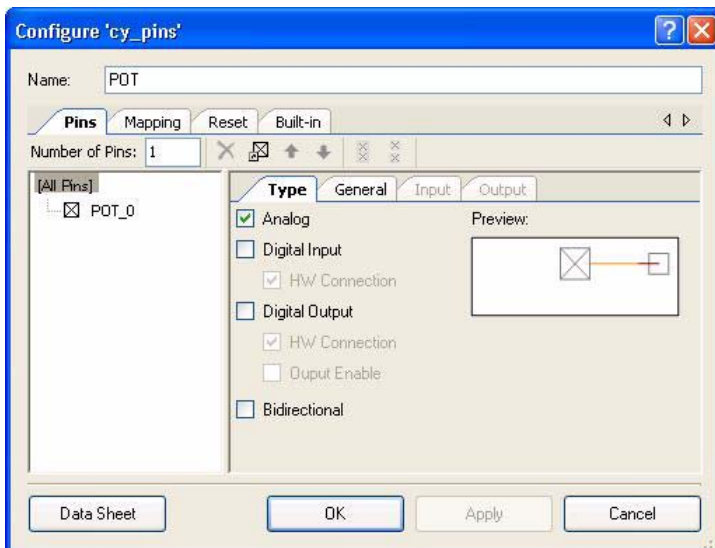
1. Drag-and-drop the analog pin component (**Component Catalog** → **Ports and Pins** → **Analog Pin**).
2. Double click on the **Pin_1** component in the schematic to open the configuration window.
3. Configure the analog pin in this manner:

Type Tab

- Name:** POT
- Select **Analog** check box only

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

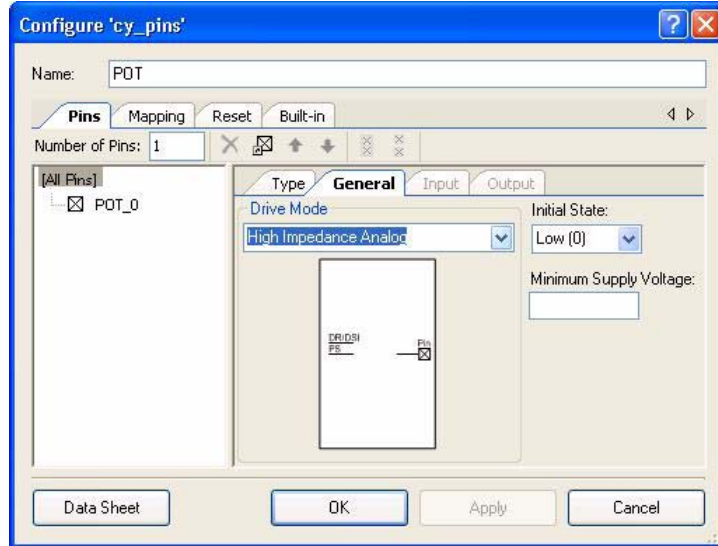
Figure 3-101. Analog Pin Component Configuration



General Tab

- Drive Mode:** High Impedance Analog
- Leave remaining parameters as default

Figure 3-102. Select High Impedance Analog Drive Mode

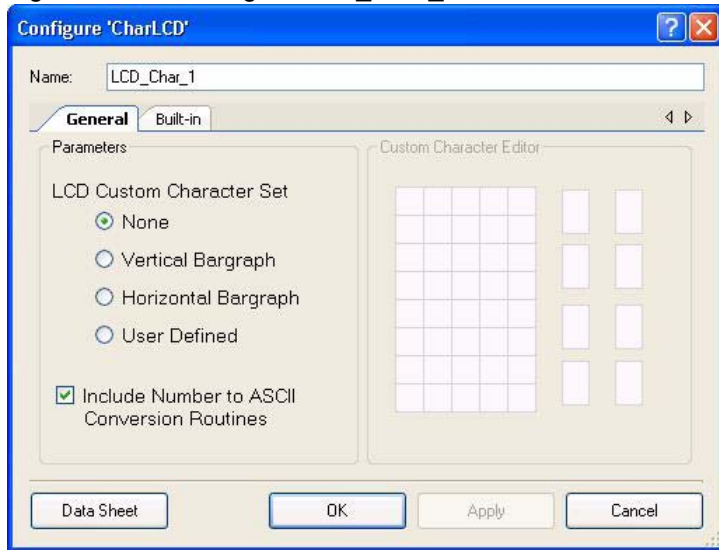


3.3.2.4 Placing and Configuring Character LCD

1. Drag-and-drop the Character LCD component (**Component Catalog** → **Display** → **Character LCD**)
2. Double click the **LCD_Char_1** component in the schematic to open the configuration window.
3. Configure the Character LCD:
 - Name:** LCD_Char_1
 - LCD Custom Character Set:** None
 - Include ASCII to Number Conversion Routines:** Check box

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

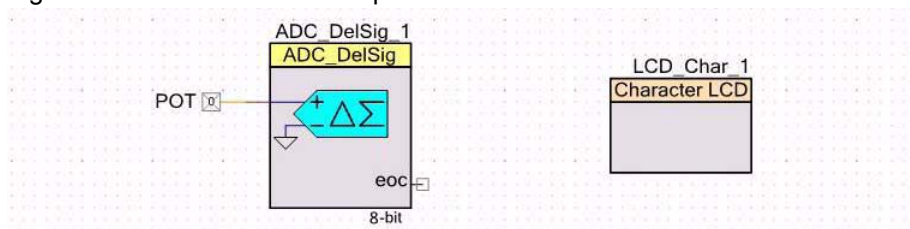
Figure 3-103. Configure LCD_Char_1



3.3.2.5 Connecting the Components Together

1. When complete, the schematic looks like Figure 3-104.

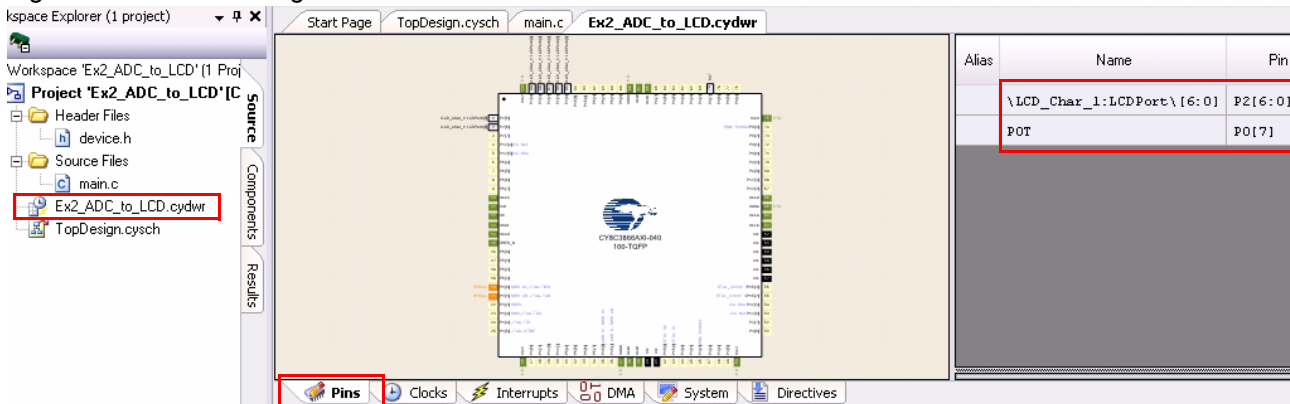
Figure 3-104. Connected Components



3.3.2.6 Configuring the Pins

1. From the **Workspace Explorer**, double click the *Ex2_ADC_to_LCD.cydwr* file.
2. Click the **Pins** tab.
3. Select pins P2[6:0] for LCD_Char_1.
4. Select pin P0[7] for POT.

Figure 3-105. Pins Assignments



3.3.2.7 Creating the main.c File

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C38_main_Ex2.c* file, which can be found within the attachments feature of this PDF document.

Notes

- To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.
- Use the PSoC 3 family processor module file *CY8C38_main_Ex2.c* to replace the *main.c* content for PSoC 5 CY8C55 family processor module.

```
#include <device.h>

/* LCD specific */
#define ROW_0      0 /* LCD row 0 */
#define COLUMN_0   0 /* LCD column 0 */
#define COLUMN_9   9 /* LCD column 9 */
#define COLUMN_10  10 /* LCD column 10 */
#define COLUMN_11  11 /* LCD column 11 */
/* For clearing Tens and Hundreds place */
#define CLEAR_TENS_HUNDREDS " "
/* For clearing Hundreds place */
#define CLEAR_HUNDREDS     " "

void UpdateDisplay(uint16 voltageRawCount);

/*****
 * Function Name: main
 *****/
*
* Summary:
*   The main function initializes both the ADC and LCD, starts and waits for an
*   ADC conversion, then it displays the raw counts to the LCD.
*
* Parameters:
*   void
*
* Return:
*   void
*
*****/
void main()
{
    uint16 voltageRawCount;

    ADC_DelSig_1_Start(); /* Configure and power up ADC */
    LCD_Char_1_Start(); /* Initialize and clear the LCD */

    LCD_Char_1_Position(ROW_0,COLUMN_0); /* Move the cursor to Row 0 Column 0 */

    /* Print Label for the pot voltage raw count */
    LCD_Char_1_PrintString("V Count: ");

    ADC_DelSig_1_StartConvert(); /* Force ADC to initiate a conversion */
}
```

```

while(1)
{
    /* Wait for end of conversion */
    ADC_DelSig_1_IsEndConversion(ADC_DelSig_1_WAIT_FOR_RESULT);
    voltageRawCount = ADC_DelSig_1_GetResult16(); /* Get converted result */

    /* Set range limit */
    if (voltageRawCount > 0x7FFF)
    {
        voltageRawCount = 0;
    }
    else
    {
        /* Continue on */
    }

    UpdateDisplay(voltageRawCount); /* Print result on LCD */
}
}

/*****
* Function Name: UpdateDisplay
*****/
*
* Summary:
*   Print voltage raw count result to the LCD.  Clears some characters if
*   necessary.
*
* Parameters:
*   voltageRawCount: The voltage raw counts being received from the ADC
*
* Return:
*   void
*
*****/
void UpdateDisplay (uint16 voltageRawCount)
{
    /* Move the cursor to Row 0, Column 9 */
    LCD_Char_1_Position(ROW_0,COLUMN_9);
    LCD_Char_1_PrintNumber(voltageRawCount); /* Print the result */

    if (voltageRawCount < 10)
    {
        /* Move the cursor to Row 0, Column 10 */
        LCD_Char_1_Position(ROW_0,COLUMN_10);
        LCD_Char_1_PrintString(CLEAR_TENS_HUNDREDS); /* Clear last characters */
    }
    else if (voltageRawCount < 100)
    {
        /* Move the cursor to Row 0, Column 11 */
        LCD_Char_1_Position(ROW_0,COLUMN_11);
        LCD_Char_1_PrintString(CLEAR_HUNDREDS); /* Clear last characters */
    }
    else
    {
        /* Continue on */
    }
}
}

```

```
/* [] END OF FILE */
```

3. From the **Build** menu, select **Build Ex2_ADC_to_LCD**. PSoC Creator builds the project and displays the comments in the **Output** dialog box. When you see the message "Build Succeeded" the build is complete.

3.3.2.8 *Configuring and Programming the PSoC Development Board*

1. Disconnect power to the board.
2. Configure the DVK SW3 to 3.3V.
3. Using the jumper wires included, configure the PSoC Development Board's prototyping.
 - P0[7] to VR
4. Verify that VR_PWR (J11) is jumpered to ON.
5. Apply power to the board.
6. Use PSoC Creator as described in [Programming My First PSoC 3 Project on page 23](#) or [Programming My First PSoC 5 Project on page 27](#) to program the device.
7. After programming the device, press the **Reset** button on the PSoC Development Board to see the output of the ADC displayed on the LCD. Turning the potentiometer results in the LCD value changing.

Note The ADC output values may not reach full range due to potentiometer and ADC limitations. ADC values may fluctuate several counts due to system noise, and if the potentiometer voltage is at the edge of an ADC count.

8. Save and close the project.

3.3.3 ADC to UART with DAC

This project demonstrates sine wave generation by using an 8-bit DAC and DMA. The sine wave period is based on the current value of the ADC value of the potentiometer.


The firmware reads the voltage output by the DVK board potentiometer and displays the raw counts on the DVK board character LCD display similarly to that shown in the previous project. An 8-bit DAC outputs a table generated sine wave to an LED using DMA at a frequency proportional to the ADC count. A 9600 BAUD 8N1 UART outputs the current ADC count as ASCII formatted into a hexadecimal number.

The instructions below assume that you have completed My First PSoC Project and ADC to LCD Project and therefore have a basic understanding of the PSoC Creator software environment.

This example project uses the following components:

- Delta Sigma ADC (**Component Catalog** → **Analog** → **ADC** → **Delta Sigma ADC**)
- Voltage DAC (**Component Catalog** → **Analog** → **DAC** → **Voltage DAC**)
- Opamp (**Component Catalog** → **Analog** → **Amplifiers** → **Opamp**)
- DMA (**Component Catalog** → **System** → **DMA**)
- Character LCD (**Component Catalog** → **Display** → **Character LCD**)
- UART (**Component Catalog** → **Communications** → **UART**)
- Analog Pin (**Component Catalog** → **Ports and Pins** → **Analog Pin**)
- Digital Output Pin (**Component Catalog** → **Ports and Pins** → **Digital Output Pin**)
- Clock (**Component Catalog** → **System** → **Clock**)
- Logic Low (**Component Catalog** → **Digital** → **Logic** → **Logic Low**)

3.3.3.1 Creating ADC to UART with DAC Project

1. Open PSoC Creator.
2. Create a new project by clicking **Create New Project** in the **Start Page** of PSoC Creator.
3. In the **New Project** window, select the **Empty PSoC3 Design** template for a PSoC 3 design, or **Empty PSoC5 Design** template for a PSoC 5 design and **Name** the project **Ex3_ADC_to_UART_with_DAC**.
4. In **Location**, type the path where you want to save the project, or click  and navigate to the appropriate directory.
5. By default, the design window opens *TopDesign.cysch*. This is the project's schematic entry file within PSoC Creator.

3.3.3.2 Placing and Configuring Delta Sigma ADC

1. Drag-and-drop the Delta Sigma ADC component (**Component Catalog** → **Analog** → **ADC** → **Delta Sigma ADC**)
2. Double click the **ADC_DelSig_1** component in the schematic to open the configuration window.
3. Configure the Delta Sigma ADC in this manner:

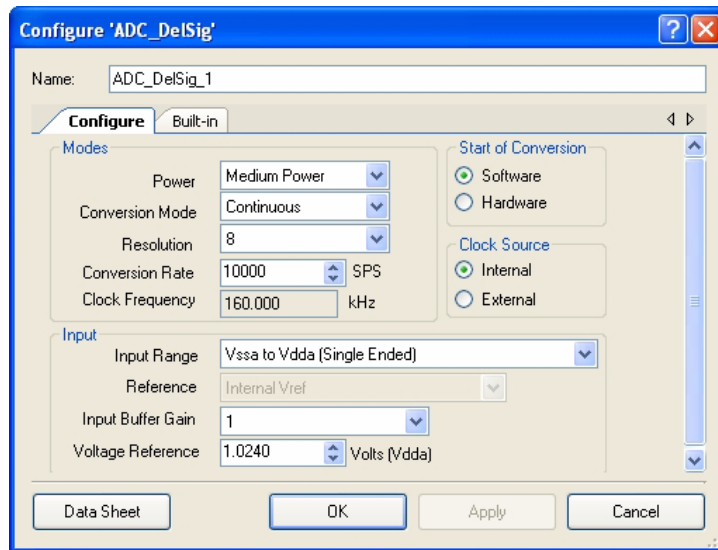
Configure Tab

- **Name:** ADC_DelSig_1
- **Power:** Medium Power
- **Conversion Mode:** Continuous
- **Resolution:** 8
- **Conversion Rate:** 10000

- ❑ **Input Range:** Vssa to Vdda (Single Ended)
- ❑ **Input Buffer Gain:** 1
- ❑ **Reference:** Internal Vref
- ❑ **Clock Source:** Internal
- ❑ **Start of Conversion:** Software

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-106. Delta Sigma ADC Component Configuration



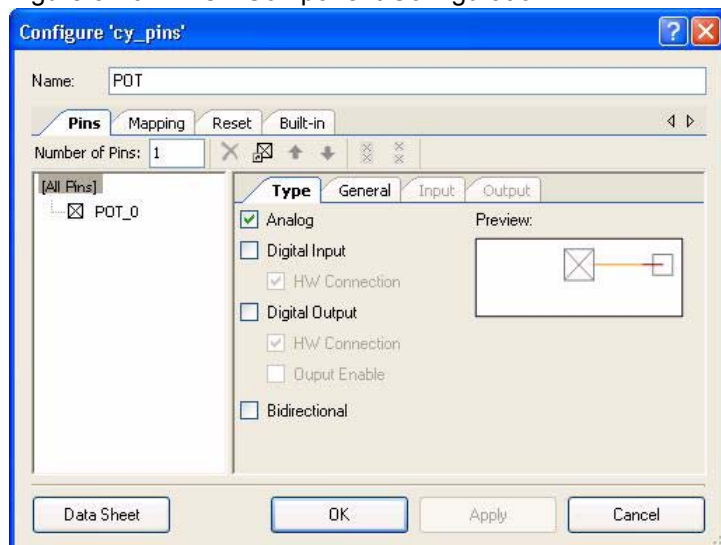
3.3.3.3 *Placing and Configuring an Analog Pin*

1. Drag-and-drop the Analog Pin component (**Component Catalog** → **Ports and Pins** → **Analog Pin**)
2. Double click the **Pin_1** component in the schematic to open the configuration window.
3. Configure the analog pin:

Type Tab

- ❑ **Name:** POT
- ❑ Select **Analog** check box only

Figure 3-107. POT Component Configuration



General Tab

- Drive Mode:** High Impedance Analog
- Leave remaining parameters as default

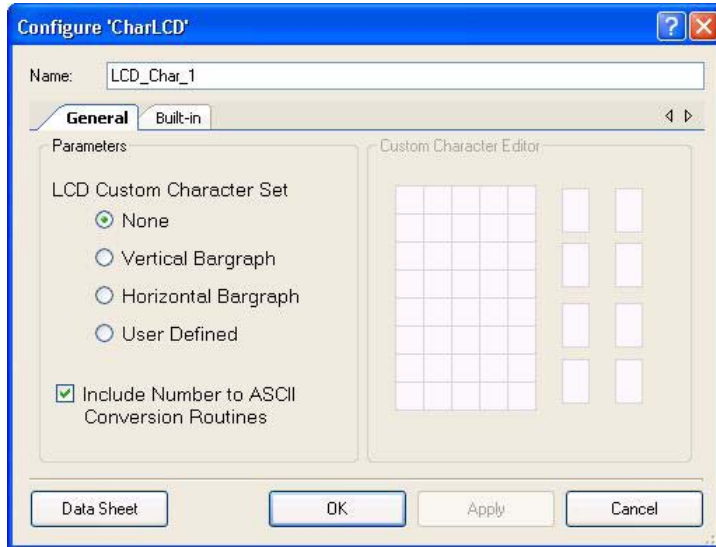
For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

3.3.3.4 *Placing and Configuring Character LCD*

1. Drag-and-drop the Character LCD component (**Component Catalog** → **Display** → **Character LCD**)
2. Double click the **LCD_Char_1** component in the schematic to open the configuration window.
3. Configure the Character LCD:
 - Name:** LCD_Char_1
 - LCD Custom Character Set:** None
 - Include ASCII to Number Conversion Routines:** Check box

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-108. Character LCD Component Configuration



3.3.3.5 Placing and Configuring Voltage DAC

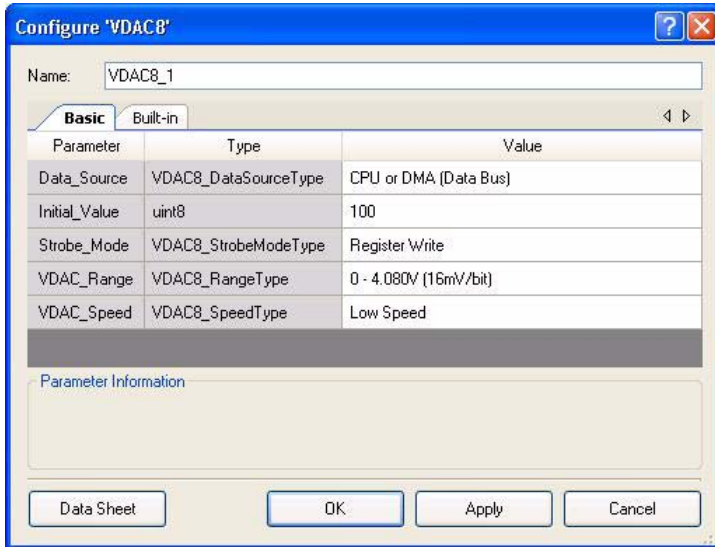
1. Drag-and-drop the Voltage DAC component (**Component Catalog** → **Analog** → **DAC** → **Voltage DAC**)
2. Double click the **VDAC8_1** component in the schematic to open the configuration window.
3. Configure the VDAC:

Basic Tab

- Name:** VDAC8_1
- Data_Source:** CPU or DMA (Data Bus)
- Initial_Value:** 100
- Strobe_Mode:** Register Write
- VDAC_Range:** 0 - 4.080V (16mV/bit)
- VDAC_Speed:** Low Speed

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-109. Voltage DAC Component Configuration



3.3.3.6 Placing and Configuring Opamp

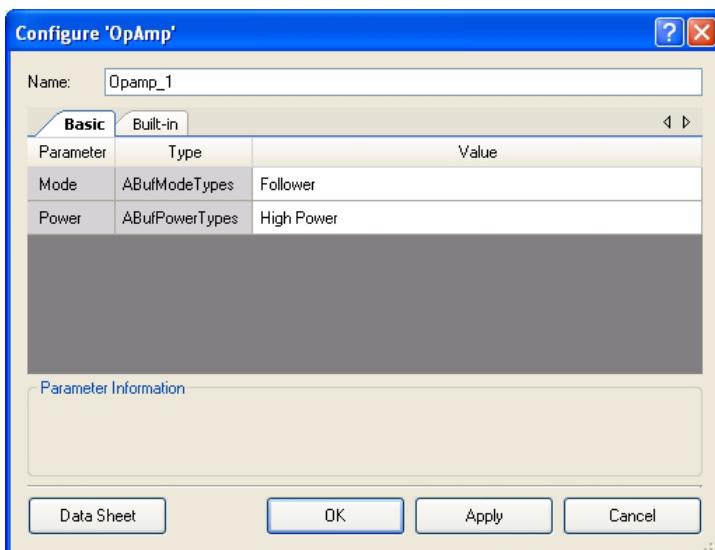
1. Drag-and-drop the Opamp component (**Component Catalog** → **Analog** → **Amplifiers** → **Opamp**)
2. Double click the **Opamp_1** component in the schematic to open the configuration window.
3. Configure the Opamp:

Basic Tab

- Name:** Opamp_1
- Mode:** Follower
- Power:** High Power

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-110. Opamp Component Configuration



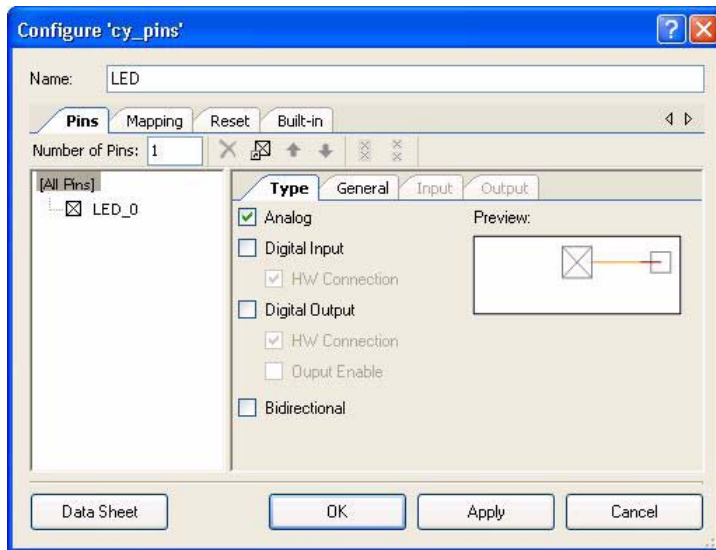
3.3.3.7 *Placing and Configuring Analog Pin*

1. Drag-and-drop the analog pin component (**Component Catalog** → **Ports and Pins** → **Analog Pin**)
2. Double click the **Pin_1** component in the schematic to open the configuration window.
3. Configure the analog pin:

Type Tab

- Name:** LED
- Select Analog check box only

Figure 3-111. LED Component Configuration

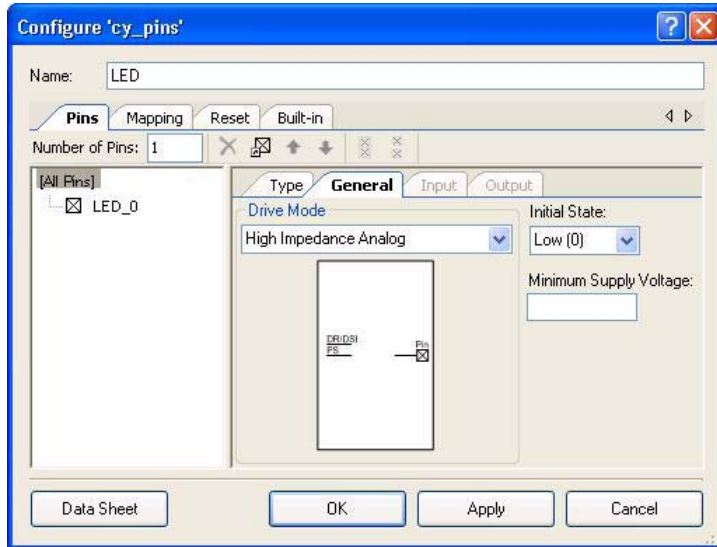


General Tab

- Drive Mode:** High Impedance Analog
- Leave remaining parameters as default**

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-112. LED Component Configuration



3.3.3.8 Placing and Configuring UART

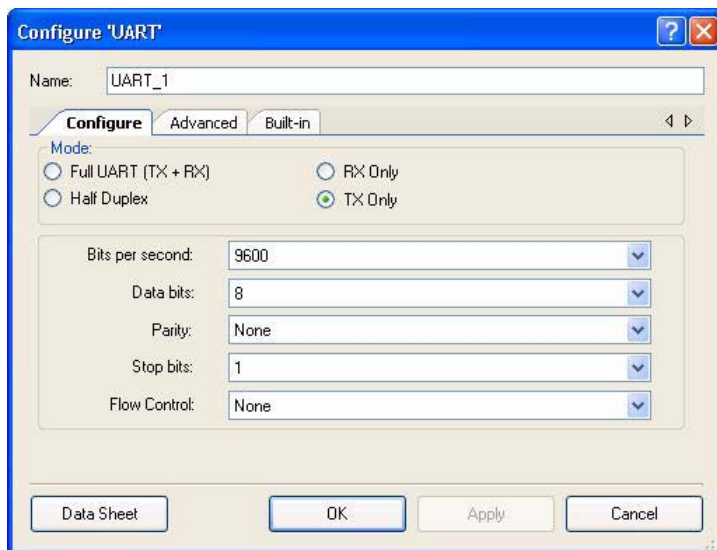
1. Drag-and-drop the UART component (**Component Catalog** → **Communications** → **UART**)
2. Double click the **UART_1** component in the schematic to open the configuration window.
3. Configure the UART:

Configure Tab

- Name:** UART_1
- Mode:** TxOnly
- Bits per second:** 9600
- Leave the remaining parameters to default

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-113. UART Component Configuration



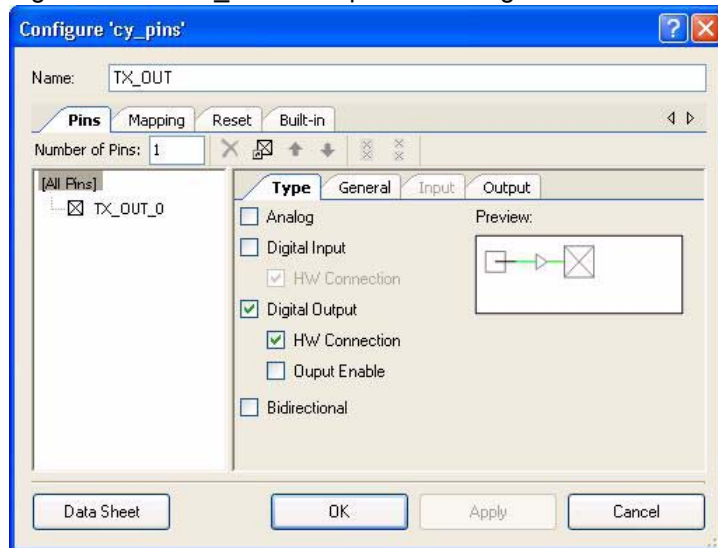
3.3.3.9 Placing and Configuring Digital Output Pin

1. Drag-and-drop the **Digital Output Pin** component (**Component Catalog** → **Ports and Pins** → **Digital Output Pin**)
2. Double click the **Pin_1** component in the schematic to open the configuration window.
3. Configure the digital output pin:

Type Tab

- Name:** TX_OUT
- Select **Digital Output** Check box
- Select **HW Connection** Check box

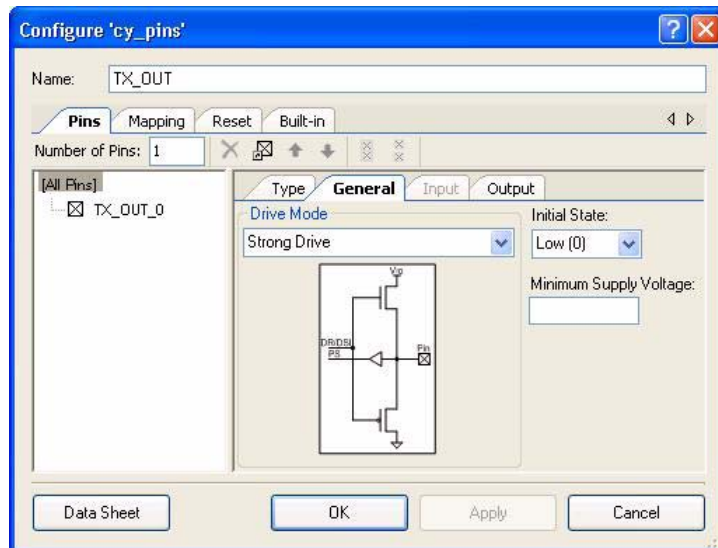
Figure 3-114. TX_OUT Component Configuration



General Tab

- Under **Drive Mode:** Strong Drive
- Leave remaining parameters as default

Figure 3-115. Pins - TX_OUT Component Configuration



For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

3.3.3.10 *Placing and Configuring DMA*

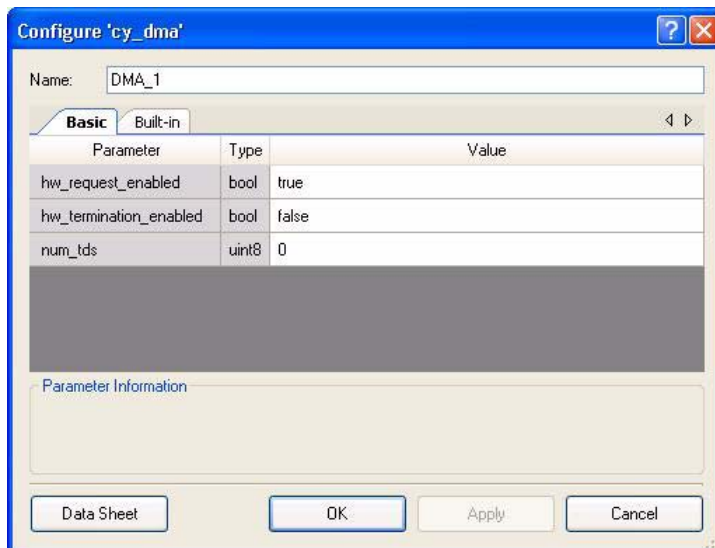
1. Drag-and-drop the DMA component (**Component Catalog** → **System** → **DMA**)
2. Double click the **DMA_1** component in the schematic to open the configuration window.
3. Configure the DMA:

Basic Tab

- Name:** DMA_1
- Hw_request_enabled:** true
- Leave the remaining parameters to default

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-116. DMA Component Configuration



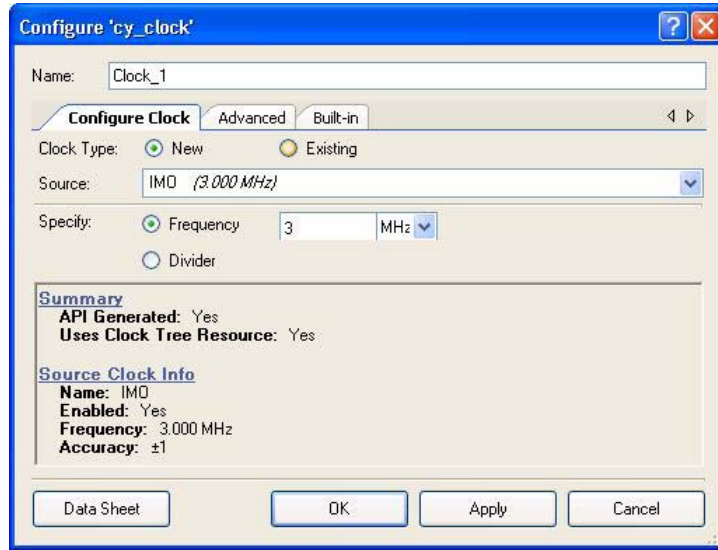
3.3.3.11 *Connecting the Components Together*

1. Connect a Logic Low component (**Component Catalog** → **Digital** → **Logic** → **Logic Low**) to the **reset** of the UART
2. Connect a Clock component (**Component Catalog** → **System** → **Clock**) to the **drq** of the DMA.
3. Double click the **Clock** component to configure.
4. Configure the clock:

Configure Clock Tab

- Name:** Clock_1
- Source:** IMO (3.000 MHz)
- Desired Frequency:** 3 MHz
- Leave remaining parameters set to their default values

Figure 3-117. Clock Component Configuration






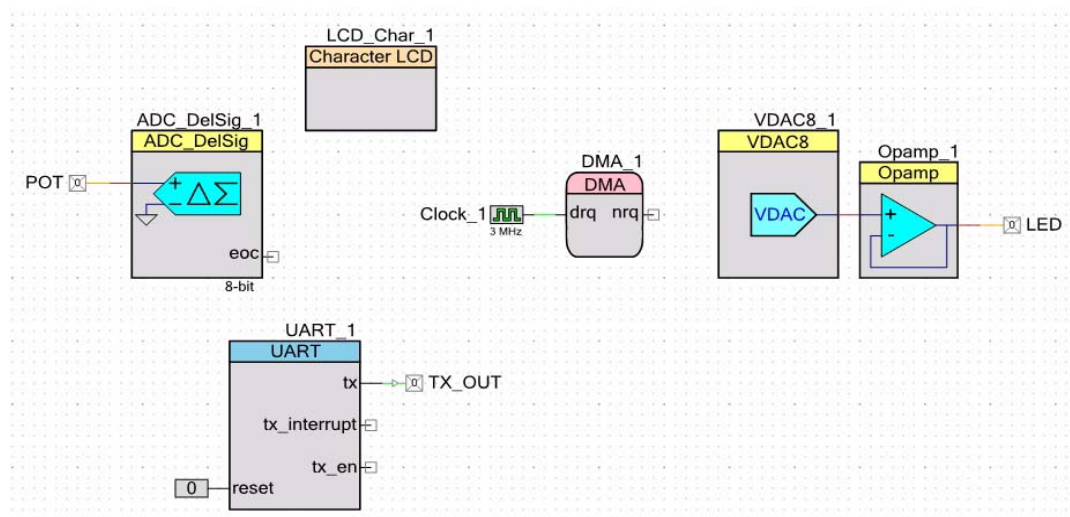
5. Using the Wire Tool , connect **tx** (in the UART component) to HW connection of the TX_OUT digital output pin (TX_OUT).
6. Using the Wire Tool , connect **VDAC8 (VDAC8_1)** to **Opamp (Opamp_1)**.
7. Using the Wire Tool , connect **POT** to **ADC_DeISig (ADC_DeISig_1)**.
8. Right click the LED analog pin, select the **Shape** menu option and then **Flip Horizontal**. This allows the LED pin to line up with the Opamp output.
9. When complete the schematic looks like [Figure 3-118](#).

Figure 3-118. Connected Components



3.3.3.12 Configuring the Pins

1. From the **Workspace Explorer**, double click the *Ex3_ADC_to_UART_with_DAC.cydwr* file.
2. Click the **Pins** tab.
3. Select pins P2[6:0] for LCD_Char_1
4. Select pin P0[7] for POT

5. Select pin P1[6] for LED
6. Select pin P1[2] for TX_OUT

Figure 3-119. Pin Assignments

Alias	Name	Pin
	LED	P1[6]
	TX_OUT	P1[2]
	\LCD_Char_1:LCDPort\[6:0]	P2[6:0]
	POT	P0[7]

3.3.3.13 Creating the main.c File

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C38_main_Ex3.c* file, which can be found within the attachments feature of this PDF document.

Notes

- To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.
- Use the PSoC 3 family processor module file *CY8C38_main_Ex3.c* to replace the *main.c* content for PSoC 5 CY8C55 family processor module.

```
#include <device.h>

/* LCD specific */
#define ROW_0      0 /* LCD row 0      */
#define COLUMN_0   0 /* LCD column 0 */
#define COLUMN_9   9 /* LCD column 9 */
#define COLUMN_10  10 /* LCD column 10 */
#define COLUMN_11  11 /* LCD column 11 */
/* For clearing Tens and Hundreds place */
#define CLEAR_TENS_HUNDREDS "  "
/* For clearing Hundreds place */
#define CLEAR_HUNDREDS     "  "

/* DMA specific */
#define REQUEST_PER_BURST  1 /* One request per burst */
#define BURST_BYTE_COUNT  1 /* Bursts are one byte each */
/* Upper 16-bits of the source address are zero */
#define SOURCE_ADDRESS     0
/* Upper 16-bits of the destination address are zero */
#define DESTINATION_ADDRESS 0

void UpdateDisplay(uint16 * voltageRawCount);
void TxHex (uint16 voltageRawCount);

/* Table of voltage values for DMA to send to the DAC. These values range
 * between 0x3D and 0x9F because these are the two points where the LED
 * is not visible and where the LED is saturated */
const uint8 voltageWave[] =
{
0x6D, 0x6F, 0x71, 0x73, 0x75, 0x77, 0x79, 0x7B, 0x7D, 0x7F, 0x81, 0x83, 0x85,
0x87, 0x89, 0x8B, 0x8D, 0x8F, 0x91, 0x93, 0x95, 0x97, 0x99, 0x9B, 0x9C, 0x9D, 0x9D,
0x9E,
```

```
0x9E, 0x9F, 0x9F, 0x9F, 0x9E, 0x9E, 0x9E, 0x9C, 0x9C, 0x9B, 0x99, 0x97, 0x95, 0x93,
0x91,
0x8F, 0x8D, 0x8B, 0x89, 0x87, 0x85, 0x83, 0x81, 0x7F, 0x7D, 0x7B, 0x79, 0x77,
0x75, 0x73, 0x71, 0x6F, 0x6D, 0x6B, 0x69, 0x67, 0x65, 0x63, 0x61, 0x5F, 0x5D,
0x5B, 0x59, 0x57, 0x55, 0x53, 0x51, 0x4F, 0x4D, 0x4B, 0x49, 0x47, 0x45, 0x43,
0x41, 0x40, 0x40, 0x3F, 0x3F, 0x3D, 0x3D, 0x3D, 0x3D, 0x3D, 0x3D, 0x3D, 0x3F, 0x41,
0x43, 0x45, 0x47, 0x49, 0x4B, 0x4D, 0x4F, 0x51,
0x53, 0x55, 0x57, 0x59, 0x5B, 0x5D, 0x5F, 0x61, 0x63, 0x65, 0x67, 0x69, 0x6B
};
```

```

/*****
* Function Name: main
*****
*
* Summary:
* The main function initializes the ADC, LCD, VDAC, Analog Buffer, and UART.
* It also initializes DMA by allocating/configuring a DMA channel and
* Transaction Descriptor and also copies the voltage table address to the DAC
* address. In the main loop, it starts and waits for an ADC conversion, then
* it displays the ADC raw count to the LCD, transmits the raw count serially,
* and sets the DMA clock divider proportional to the raw count.
*
* Parameters:
* void
*
* Return:
* void
*
*****/

```

```

void main()
{
    uint16 voltageRawCount;
    uint8 myChannel;
    uint8 myTd;

    ADC_DelSig_1_Start(); /* Configure and power up ADC */
    LCD_Char_1_Start(); /* Initialize and clear the LCD */
    VDAC8_1_Start(); /* Initializes VDAC8 with default values */
    Opamp_1_Start(); /* Enables Opamp and sets power level */
    UART_1_Start(); /* Enable UART */
    CyDmacConfigure(); /* Set DMA configuration register */

    /* Allocate and initialize a DMA channel to be used by the caller
    * PSoC 3 */
    #if(CYDEV_CHIP_DIE_EXPECT == CYDEV_CHIP_DIE_LEOPARD)
        myChannel = DMA_1_DmaInitialize(BURST_BYTE_COUNT,
                                        REQUEST_PER_BURST,
                                        SOURCE_ADDRESS,
                                        DESTINATION_ADDRESS);
    #endif

    /* PSoC 5 */
    #if(CYDEV_CHIP_DIE_EXPECT == CYDEV_CHIP_DIE_PANTHER)
        myChannel = DMA_1_DmaInitialize(BURST_BYTE_COUNT,
                                        REQUEST_PER_BURST,
                                        (uint16)((uint32)voltageWave >> 16),
                                        (uint16)(VDAC8_1_viDAC8__D >> 16));
    #endif
}

```

```

/* Allocate a Transaction Descriptor (TD) from the free list */
myTd = CyDmaTdAllocate();

/* Move the LCD cursor to Row 0, Column 0 */
LCD_Char_1_Position(ROW_0, COLUMN_0);

/* Print Label for the pot voltage raw count */
LCD_Char_1_PrintString("V Count: ");

CyDmaTdSetConfiguration(myTd, sizeof(voltageWave),
                        myTd, TD_INC_SRC_ADR ); /* Configure the TD */

/* Copy address of voltageWave to address of DAC. Set the lower 16-bits of
 * the source and destination addresses for this TD
 * PSoC 3 */
#if(CYDEV_CHIP_DIE_EXPECT == CYDEV_CHIP_DIE_LEOPARD)
    CyDmaTdSetAddress(myTd,
                      (uint16)(voltageWave),
                      (uint16)VDAC8_1_viDAC8__D);
#endif

/* PSoC 5 */
#if(CYDEV_CHIP_DIE_EXPECT == CYDEV_CHIP_DIE_PANTHER)
    CyDmaTdSetAddress(myTd,
                      (uint16)((uint32)voltageWave),
                      (uint16)VDAC8_1_viDAC8__D);
#endif

/* Associate TD with channel */
CyDmaChSetInitialTd(myChannel, myTd);

/* Enable DMA channel */
CyDmaChEnable(myChannel, 1);

/* Clock will make burst requests to the DMAC */
Clock_1_Start();

ADC_DelSig_1_StartConvert(); /* Force ADC to initiate a conversion */

while(1)
{
    /* Wait for end of conversion */
    ADC_DelSig_1_IsEndConversion(ADC_DelSig_1_WAIT_FOR_RESULT);
    voltageRawCount = ADC_DelSig_1_GetResult16(); /* Get converted result */

    /* Set range limit */
    if (voltageRawCount > 0x7FFF)
    {
        voltageRawCount = 0;
    }
    else
    {
        /* Continue on */
    }

    UpdateDisplay(&voltageRawCount); /* Print the result to LCD */
}

```

```

TxHex(voltageRawCount); /* Transmit result to UART */

/*
 * The LED blinking frequency is dependent on the Voltage raw count.
 * With a 3MHz clock, the lowest divider (for raw count of 0) should be
 * 1000 to blink at a significantly fast pace. The highest value is
 * about 52,200 (for a raw count of 256) to blink at a significantly
 * slow pace. The following equation is necessary to make the adjusted
 * clock frequency (with the updated divider) linear with the ADC
 * output.
 */
Clock_1_SetDivider((((uint32)voltageRawCount * 1000) / \
                    (261 - (uint32)voltageRawCount)) + 1000);
}
}

/*****
 * Function Name: UpdateDisplay
 *****/
*
* Summary:
* Print voltage raw count result to the LCD. Clears some characters if
* necessary. The voltageRawCount parameter is also updated for use in other
* functions.
*
* Parameters:
* voltageRawCount: Voltage raw count from ADC
*
* Return:
* void
*
*****/
void UpdateDisplay (uint16 * voltageRawCount)
{
    /* Move the cursor to Row 0, Column 9 */
    LCD_Char_1_Position(ROW_0, COLUMN_9);
    LCD_Char_1_PrintNumber(voltageRawCount[0]); /* Print the result */

    if (voltageRawCount[0] < 10)
    {
        /* Move the cursor to Row 0, Column 10 */
        LCD_Char_1_Position(ROW_0, COLUMN_10);
        LCD_Char_1_PrintString(CLEAR_TENS_HUNDREDS); /* Clear last characters */
    }
    else if (voltageRawCount[0] < 100)
    {
        /* Move the cursor to Row 0, Column 11 */
        LCD_Char_1_Position(ROW_0, COLUMN_11);
        LCD_Char_1_PrintString(CLEAR_HUNDREDS); /* Clear last characters */
    }
    else
    {
        /* Continue on */
    }
}

/*****
 * Function Name: TxHex
 *****/

```

```

*****
*
* Summary:
*   Convert voltage raw count to hex value and TX via UART.
*
* Parameters:
*   voltageRawCount: The voltage raw counts being received from the ADC
*
* Return:
*   void
*
*****/
void TxHex (uint16 voltageRawCount)
{
    static char8 const hex[16] = "0123456789ABCDEF";

    /* TX converted MSnibble */
    UART_1_PutChar(hex[(voltageRawCount>>12)&0xF]);
    /* TX converted second nibble */
    UART_1_PutChar(hex[(voltageRawCount>>8)&0xF]);
    /* TX converted third nibble */
    UART_1_PutChar(hex[(voltageRawCount>>4)&0xF]);
    /* TX converted LSnibble */
    UART_1_PutChar(hex[voltageRawCount&0xF]);
    UART_1_PutString("h\r"); /* h for hexadecimal and carriage return */
}

/* [] END OF FILE */

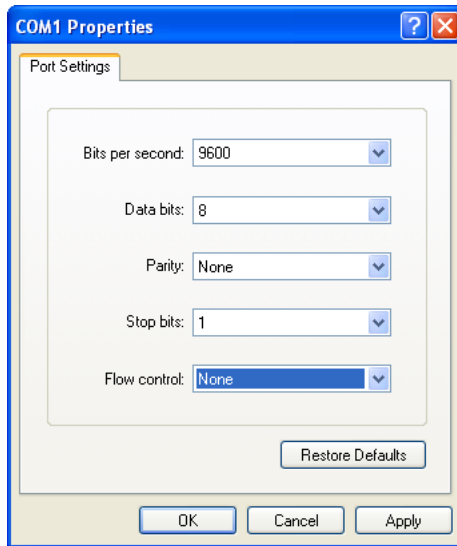
```

3. From the **Build** menu, select **Build Ex3_ADC_to_UART_with_DAC**. PSoC Creator builds the project and displays the comments in the **Output** dialog box. When you see the message "Build Succeeded" the build is complete.

3.3.3.14 *Configuring and Programming the PSoC Development Board*

1. Disconnect power to the board.
2. Configure the DVK SW3 to 3.3V.
3. Using the jumper wires included, configure the PSoC Development Board's prototyping area to:
 - P0[7] to VR
 - P1[2] to TX
 - P1[6] to LED1
4. Verify that VR_PWR (J11) is jumpered to ON.
5. Verify that RS232_PWR (J10) is jumpered to ON.
6. Connect a serial cable from the PSoC Development Board to a PC.
7. Apply power to the board.
8. Install a terminal application such as TeraTerm or HyperTerminal with these setup parameters:
 - Baud Rate:** 9600
 - Data:** 8-bit
 - Parity:** none
 - Stop:** 1-bit
 - Flow Control:** none

Figure 3-120. HyperTerminal Settings



9. Use PSoC Creator as described in [Programming My First PSoC 3 Project on page 23](#) or [Programming My First PSoC 5 Project on page 27](#) to program the device.
10. After programming the device, press the **Reset** button on the PSoC Development Board to see the output of the ADC displayed on the LCD and in the terminal application. LED1 is a sine wave output whose period is based on the ADC. Turning the potentiometer results in the LCD and observed terminal value change.


Notes

- The Variable Resistor (VR) operates at a full range of voltages from 0 to VDD. The ADC input voltage for this project is limited to 0 - 2.048V. This means that the VR reaches the maximum input voltage of 2.048V, with a count of 256, before the VR is fully turned.
 - The ADC output values may not reach full range due to potentiometer and ADC limitations. ADC values may fluctuate several counts due to system noise, and if the potentiometer voltage is at the edge of an ADC count.
11. Save and close the project.

3.3.4 USB HID

This project demonstrates a simple HID keyboard. The firmware begins enabling global interrupts, setting up the button (SW), and initializing USB for 3V operation. The firmware, after allowing the HID device to enumerate, continuously checks for a button press to see if it needs to send the keyboard key sequences for the Cypress website. When you press the button, LED1 also toggles.

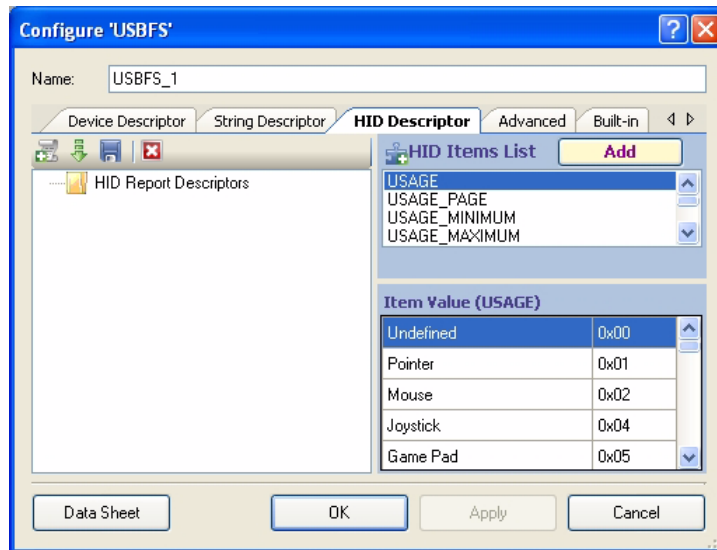
3.3.4.1 Creating USB HID Project

1. Open PSoC Creator.
2. Create a new project by clicking on **Create New Project** in the **Start Page** of PSoC Creator.
3. In the **New Project** window, select the **Empty PSoC3 Design** template for a PSoC 3 design, or **Empty PSoC5 Design** template for a PSoC 5 design and **Name** the project **Ex4_USB_HID**.
4. In **Location**, type the path where you want to save the project, or click  and navigate to the appropriate directory.
5. By default, the design window opens *TopDesign.cysch*. This is the project's schematic entry file within PSoC Creator.

3.3.4.2 Placing and Configuring USBFS

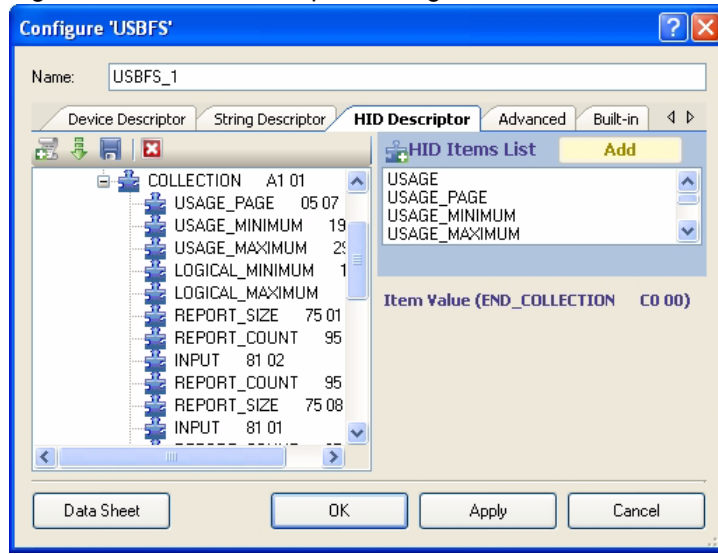
1. Drag-and-drop a **USBFS** component from the **Components Catalog** → **Communication** → **USBFS** to the workspace.
2. Double click the **USBFS_1** component.
3. Select the **HID Descriptor** tab.

Figure 3-121. USBFS Component Configuration



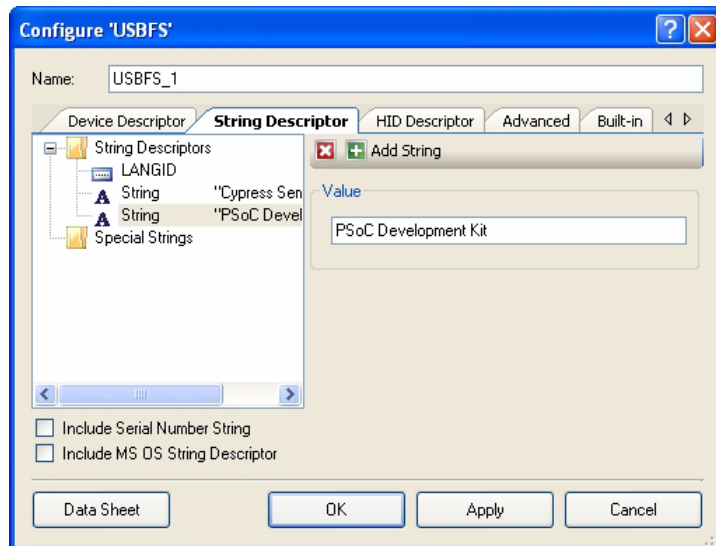
4. Click  to import a report.
5. Browse the **Kit CD** and open the XML descriptor file, *USB_HID_Example.xml*.

Figure 3-122. HID Descriptor Configuration



6. Select the **String Descriptor** tab.

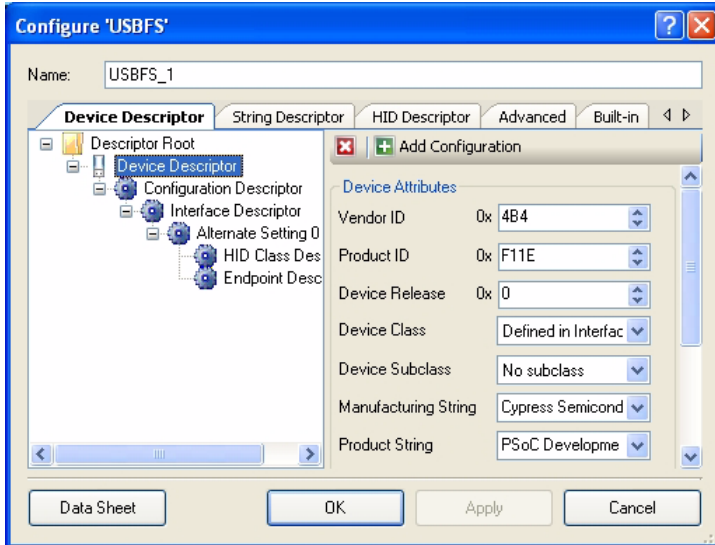
Figure 3-123. String Descriptor Configuration



7. Select **String Descriptors** in the left window.
8. Click **Add String**.
9. Click **Add String** a second time to add a total of two strings.
10. Click the **String** that shows up at the top in the left window.
11. Type **Cypress Semiconductor** in the **Value** field.
12. Click the **String** that shows up at the bottom in the left window.
13. Type **PSoC Development Kit** in the **Value** field.
14. Ensure **Include Serial Number String** and **Include MS OS String Descriptor** check boxes are unchecked.
15. Select the **Device Descriptor** tab.
16. Select **Device Descriptor**

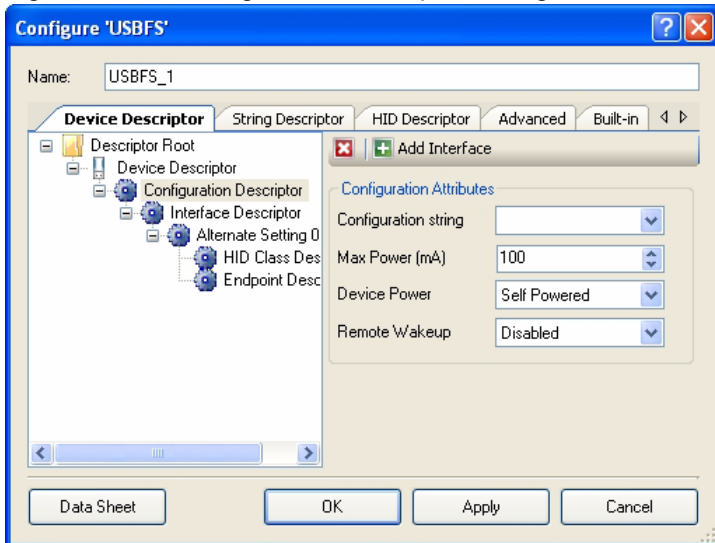
17. Set the **Product ID** to **F11E**.
18. Set the **Manufacturing String** to **Cypress Semiconductor**.
19. Set the **Product String** to **PSoC Development Kit**.

Figure 3-124. Alternating Setting Configuration



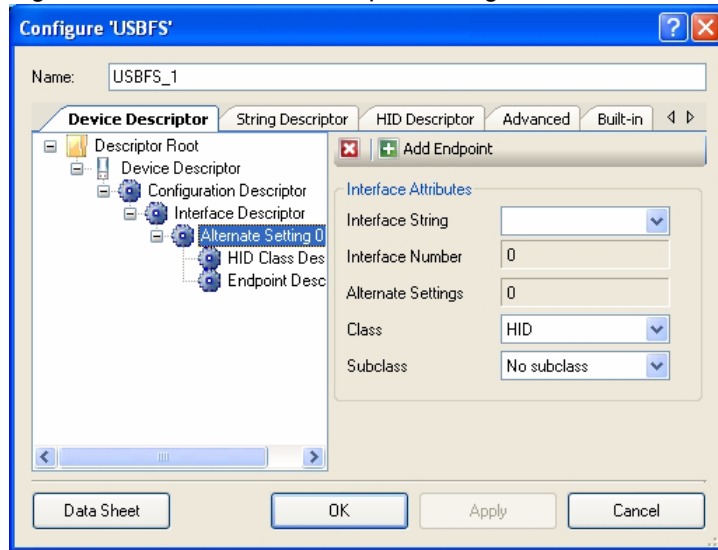
20. Select **Configuration Descriptor**.
21. Set **Device Power** to **Self Powered**.
22. Set **Max Power** to **100 mA**.

Figure 3-125. Configuration Descriptor Configuration



23. Select **Alternate Setting 0**.
24. Set **Class** to **HID**.

Figure 3-126. Interface Descriptor Configuration



25. Select **HID Class Descriptor**.
26. Set **HID Report** to **Keyboard w/LED Feature Report**.
27. Select **Endpoint Descriptor**.
28. Set **Direction** to **IN** and **Transfer Type** to **INT**.

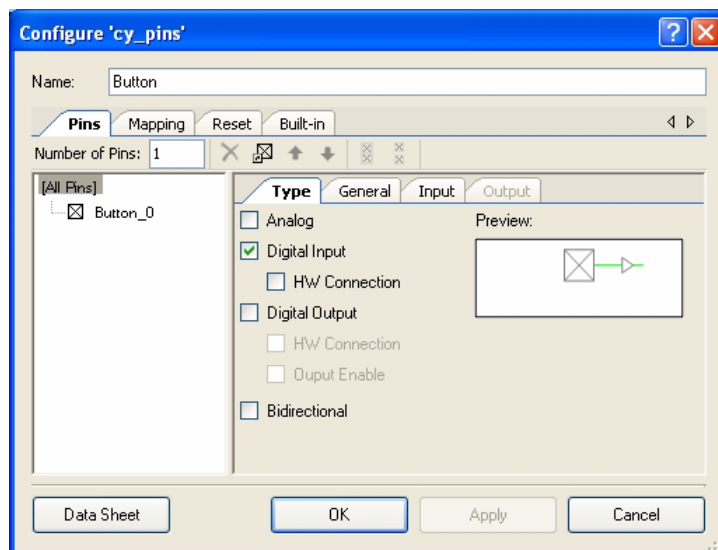
3.3.4.3 *Placing and Configuring Software Digital Input Pin*

1. Drag-and-drop a **Digital Input Pin** component (**Component Catalog** → **Ports and Pins** → **Digital Input Pin**)
2. Configure in this manner.

Type Tab

- Name:** Button
- Select **Digital Input** check box (Note all other check boxes are not selected)

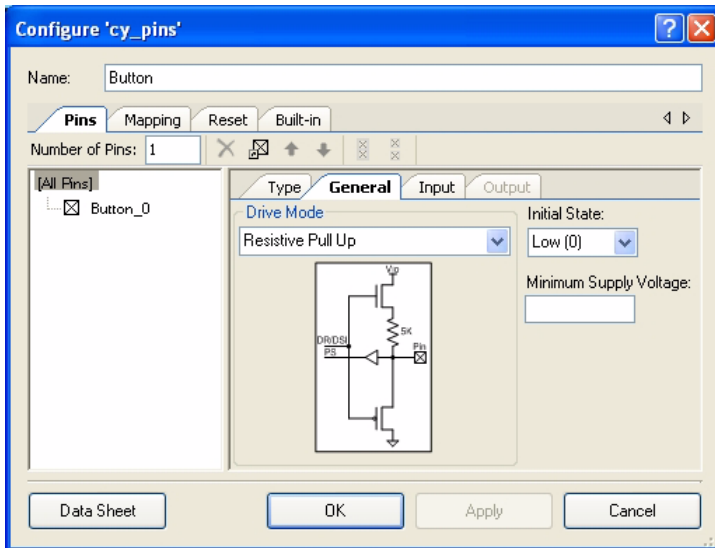
Figure 3-127. SW Digital Input Pin Configuration



General Tab

- Drive Mode:** Resistive Pull up
- Initial State:** Low (0)
- Leave remaining parameters as default

Figure 3-128. Pins - SW Digital Input Pin Configuration



3. Click **OK**.

3.3.4.4 Placing and Configuring LED

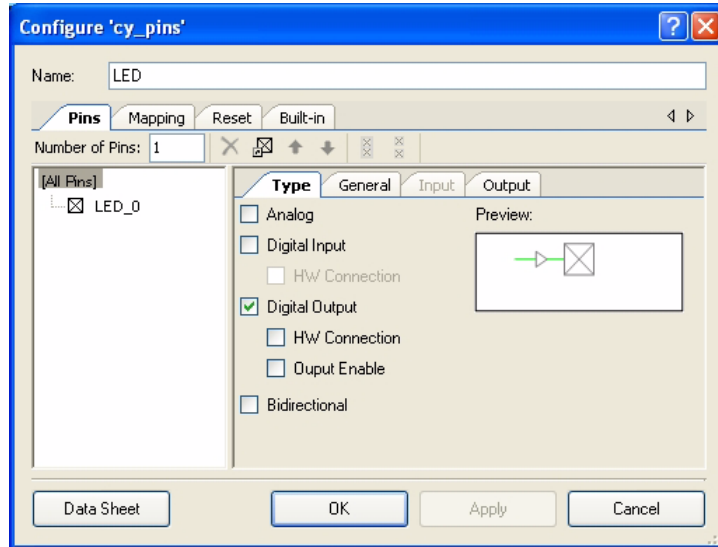
1. Drag-and-drop a **Digital Output Pin** component (**Component Catalog** → **Ports and Pins** → **Digital Output Pin**)

2. Configure in this manner:

Type Tab

- Name:** LED
- Select Digital Output check box (Note all other check boxes are not selected)

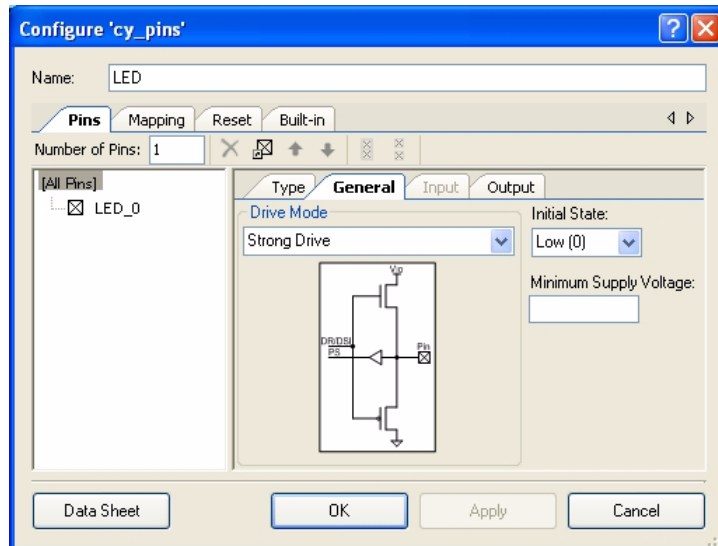
Figure 3-129. LED Component Configuration



General Tab

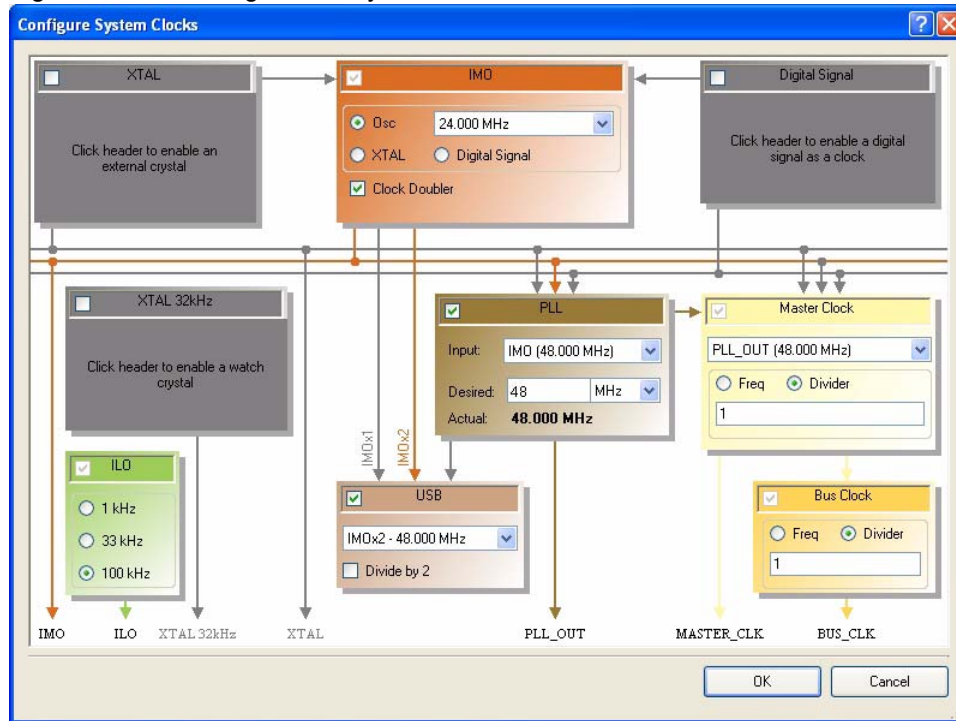
- ❑ **Drive Mode:** Strong Drive
- ❑ Leave remaining parameters as default

Figure 3-130. Pins - LED Component Configuration



3. From the **Workspace Explorer**, open the *Ex4_USB_HID.cydwr* window and select the **Clocks** tab.
4. Double click the **IMO** block and set:
 - ❑ Osc: 24.000 MHz
5. Select **Clock Doubler**.
6. Click the **PLL Clock** block and select **IMO (48.000 MHz)** for the Input.
7. Set **Desired:** to 48 MHz for the PLL clock
8. Enable the USB clock.
9. Set the ILO clock to 100 kHz

Figure 3-131. Configure the System Clocks



10. Click **OK**.

3.3.4.5 Configuring the Pins

1. From the Workspace Explorer, double click the *Ex4_USB_HID.cywrk* file.
2. Click the **Pins** tab.
3. Select and assign the pins in this manner
 - Assign USBFS_dp to P15[6]
 - Assign USBFS_dm to P15[7]
 - Assign LED to P1[6]
 - Assign Button to P1[5]

Figure 3-132. Pin Assignments

Alias	Name	Pin
dp	\USBFS_1: dp\	P15 [6]
dm	\USBFS_1: dm\	P15 [7]
Button		P1 [5]
LED		P1 [6]

3.3.4.6 Creating the main.c File

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C38_main_Ex4.c* file, which can be found within the attachments feature of this PDF document.

Notes

- To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.

- Use the PSoC 3 family processor module file *CY8C38_main_Ex4.c* to replace the *main.c* content for PSoC 5 CY8C55 family processor module.

```
#include "device.h"

/* Keyboard scan codes */
#define WINDOWS_LEFT_MODIFIER 0x80u /* This is the left windows key */
#define LETTER_R 0x15u
#define CARRIAGE_RETURN 0x28u
#define KEY_RELEASE 0x00u

/* For button setup */
#define SET_BUTTON 0x01u

/* USB related */
#define KEYBOARD_ENDPOINT 0x01u
#define KEYBOARD_DEVICE 0x00u
#define KEYBOARD_DATA_SIZE 0x08u
#define KEY_DATA_INDEX 0x02u
#define MODIFIER_KEY_DATA_INDEX 0x00u

/* MACRO for button detection */
#define IS_BUTTON_PRESSED (!Button_Read())

static uint8 ButtonEventDetected(void);
static void SendKey(uint8 key);
static void StartWindowsRun(void); /* Open Windows Run App */
static void GetAckLoadEp(uint8 * keyboardData);

/*****
 * Function Name: main
 *****/
*
* Summary:
* The main function starts out enabling global interrupts, setting up the
* button (SW1), then initializing USB for 5V operation. Then allows the HID
* device to enumerate, and loads the keyboard endpoint to allow an ack to be
* sent before sending the first keyboard data. Then it continuously checks for
* USB plug-and-play and a button press to see if the keyboard data needs sent.
*
* Parameters:
* void
*
* Return:
* void
*
*****/
void main()
{
    uint8 ledState = 0; /* Set initial LED state to off */
    uint8 i;

    /* Data array for the keyboard device endpoint */
    uint8 keyboardData[] = { 0, 0, 0, 0, 0, 0, 0, 0 };

    /* Keyboard scan codes for the cypress website ("www.cypress.com<cr>") */
    uint8 cypressWebsiteCharSequence[] = { 0x1A, 0x1A, 0x1A, 0x37, 0x06, 0x1C,
                                           0x13, 0x15, 0x08, 0x16, 0x16, 0x37,
```

```

0x06, 0x12, 0x10, 0x28 };

CYGlobalIntEnable; /* Enable global interrupts */

Button_Write(SET_BUTTON); /* Set port pin for button (SW1) */

/* Start USBFS operation using keyboard device (0) and with 5V operation */
USBFS_1_Start(KEYBOARD_DEVICE, USBFS_1_5V_OPERATION);

while(!USBFS_1_bGetConfiguration()); /* Wait for Device to enumerate */

/* Enumeration is completed load keyboard endpoint to set up ACK for first
key */
USBFS_1_LoadInEP(KEYBOARD_ENDPOINT, keyboardData, KEYBOARD_DATA_SIZE);

while (1)
{
    if (ButtonEventDetected())
    {
        ledState ^= 0x01u; /* Set/clear (toggle) the LED port pin */
        LED_Write(ledState); /* Toggle LED */

StartWindowsRun(); /* Open Windows Run App */

/* Send the cypress website key sequence */
for (i = 0; i < sizeof(cypressWebsiteCharSequence); i++)
{
    SendKey(cypressWebsiteCharSequence[i]);
}
    }
    else
    {
        /* Continue on */
    }
}

/*****
* Function Name: ButtonEventDetected
*****/
*
* Summary:
* Check to see if the button is pressed.
*
* Parameters:
* void
*
* Return:
* TRUE: button pressed
* FALSE: button not pressed
*
*****/
static uint8 ButtonEventDetected(void)
{
    if(!IS_BUTTON_PRESSED)
    {
        return FALSE;
    }
}

```

```

else
{
    /* Continue on */
}

CyDelay(50); /* Debounce mechanical switch for ~50msec */

if(IS_BUTTON_PRESSED)
{
    /* Wait for the button to be released */
    while(IS_BUTTON_PRESSED);
    return TRUE;
}
else
{
    /* Continue on */
}

return FALSE;
}

/*****
* Function Name: SendKey
*****/
*
* Summary:
* Sends keyboard key.
*
* Parameters:
* key: Keyboard scan code.
*
* Return:
* void
*
*****/
static void SendKey(uint8 key)
{
    /* Data array for the keyboard device endpoint */
    uint8 keyboardData[] = { 0, 0, 0, 0, 0, 0, 0, 0 };

    keyboardData[KEY_DATA_INDEX] = key; /* Send key-down data, make */
    GetAckLoadEp(keyboardData); /* Send USB keyboard data */

    keyboardData[KEY_DATA_INDEX] = KEY_RELEASE; /* Send key-up data, break */
    GetAckLoadEp(keyboardData); /* Send USB keyboard data */
}

/*****
* Function Name: StartWindowsRun
*****/
*
* Summary:
* Sends the Windows Run command by sending Windows Modifier and 'r' (while
* the Windows modifier key is in a down state) and then releasing both keys.
*
* Parameters:
* void
*
*****/

```

```

* Return:
* void
*
*****/
static void StartWindowsRun(void)
{
    /* Data array for the keyboard device endpoint */
    uint8 keyboardData[] = { 0, 0, 0, 0, 0, 0, 0, 0, 0 };

    /* Send Windows modifier key-down data, modifier make */
    keyboardData[MODIFIER_KEY_DATA_INDEX] = WINDOWS_LEFT_MODIFIER;
    GetAckLoadEp(keyboardData); /* Send USB keyboard data */

    /* While Windows modifier key is down send r key, r make */
    keyboardData[KEY_DATA_INDEX] = LETTER_R;
    GetAckLoadEp(keyboardData); /* Send USB keyboard data */

    /* Send up keys for both Windows modifier key and r key */
    keyboardData[KEY_DATA_INDEX] = KEY_RELEASE; /* r break */
    keyboardData[MODIFIER_KEY_DATA_INDEX] = KEY_RELEASE; /* Windows modifier break */
    /*
    GetAckLoadEp(keyboardData); /* Send USB keyboard data */
    CyDelay(500); /* Delay about 0.5 seconds to allow Run window to pop-up */
    */

    /*****
    * Function Name: GetAckLoadEp
    *****/
    *
    * Summary:
    * It first confirms that an Acknowledge transaction occurred on the keyboard
    * endpoint. Once the ACK is confirmed, the endpoint is enabled and loaded.
    *
    * Parameters:
    * keyboardData: Data array for the keyboard device endpoint
    *
    * Return:
    * void
    *
    *****/
    static void GetAckLoadEp(uint8 * keyboardData)
    {
        /* Wait for ACK before loading data */
        while(!USBFS_1_bGetEPAckState(KEYBOARD_ENDPOINT));
        /* ACK has occurred, load the endpoint */
        USBFS_1_LoadInEP(KEYBOARD_ENDPOINT, keyboardData, KEYBOARD_DATA_SIZE);
    }

    /* [] END OF FILE */

```

- From the **Build** menu, select **Build Ex4_USB_HID**. PSoC Creator builds the project and displays the comments in the **Output** dialog box. When you see the message "Build Succeeded" the build is complete.

3.3.4.7 *Configuring and Programming the PSoC Development Board*


Note Due to the nature of the PSoC Development Board, powering the system from USB 'VBUS' could potentially reset other USB devices on the same hub. Refer to Appendix A, section titled [Setting a 3.3V Supply from VBUS on page 174](#).

1. Disconnect the power to the board.
2. Configure the DVK SW3 to 3.3V.
3. Configure the DVK breadboard using the jumper wires.
 - P1[5] to SW1
 - P1[6] to LED1
4. Connect the USB cable to the PC and to the USB port (J9)
5. Reapply power to the board.
6. Use PSoC Creator as described in section [Programming My First PSoC 3 Project on page 23](#) or [Programming My First PSoC 5 Project on page 27](#) to program the device.
7. After programming the device, press **Reset**.
8. When button SW1 is pressed, the Windows Run window opens and the keyboard key sequence for the Cypress website is sent to open the Cypress website. When you press the button, LED1 also toggles.
9. Save and close the project.

3.3.5 CapSense

This project demonstrates CapSense. The firmware begins by initializing the LCD and CapSense components. In the main loop it scans the two buttons for activity. If there is a signal from either or both buttons, the corresponding LED lights up.

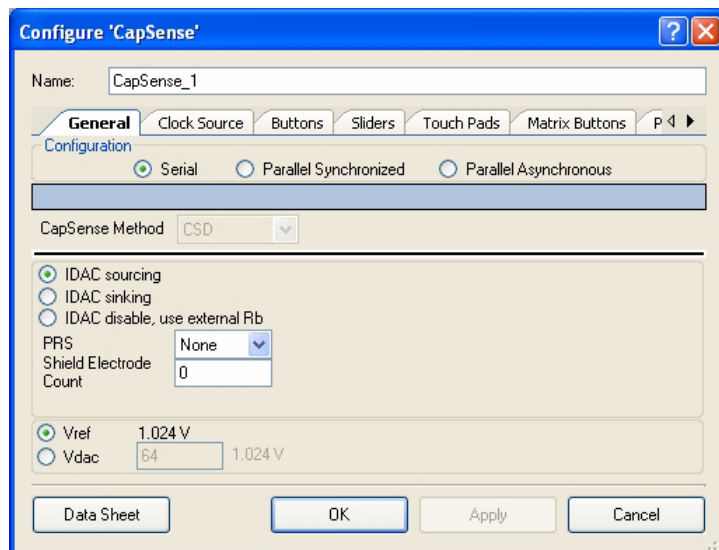
3.3.5.1 Creating CapSense Project

1. Open PSoC Creator.
2. Create a new project by clicking **Create New Project** in the **Start Page** of PSoC Creator.
3. In the **New Project** window, select the **Empty PSoC3 Design** template for a PSoC 3 design, or **Empty PSoC5 Design** template for a PSoC 5 design and name the project **Ex5_CapSense**.
4. In Location, type the path where you want to save the project, or click  and navigate to the appropriate directory.
5. By default, the design window opens *TopDesign.cysch*. This is the project's schematic entry file within PSoC Creator.

3.3.5.2 Placing and Configuring CapSense

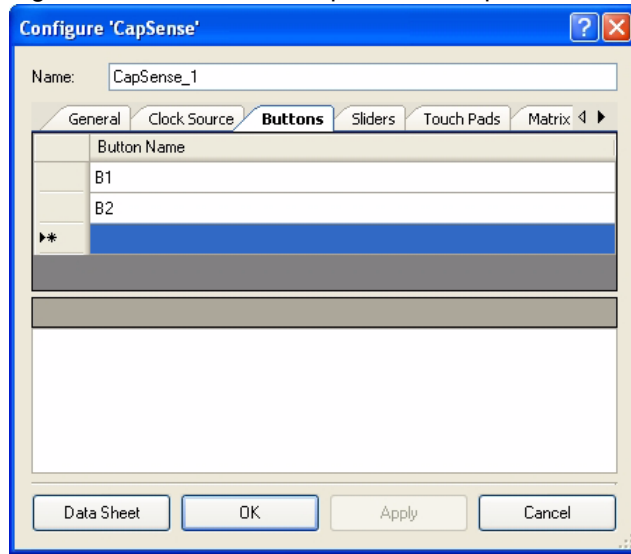
1. Drag-and-drop a CapSense component from the **Component Catalog** → **CapSense** → **CapSense** to the workspace.
2. Double click the **CapSense_1** component
3. Configure CapSense in this manner:
 - General Tab**
 - Name: **CapSense_1**
 - Select **IDAC sourcing**
 - Leave remaining parameters to default

Figure 3-133. CapSense Component Configuration



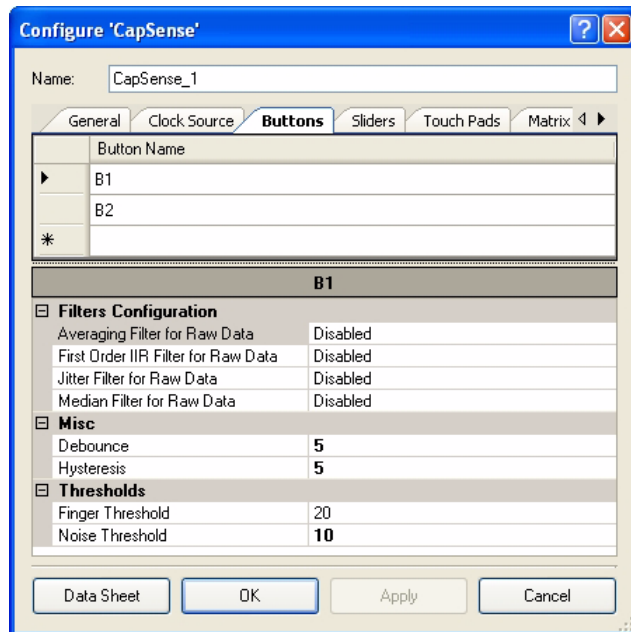
4. Select the **Buttons** tab.

Figure 3-134. Buttons - CapSense Component Configuration



5. Type these names for button one, **B1** and button two, **B2** in the **Button Name** field.

Figure 3-135. B1 Button Configuration



6. Select the **Sliders** tab.
7. Enter **Position** for the **Slider Name**.
8. Select **Linear** for **Type**.
9. Enter **5** for **Number of Elements**.
10. Enter **80** for **Resolution**.

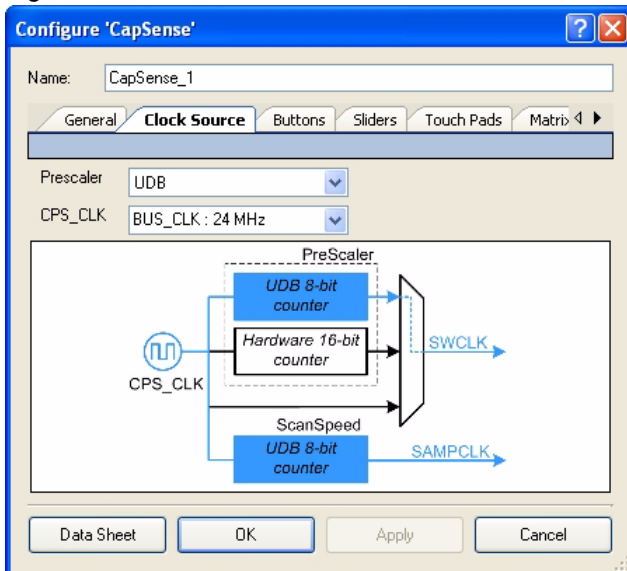
Figure 3-136. Slider Configuration



11. Select the **Clock Source** tab.

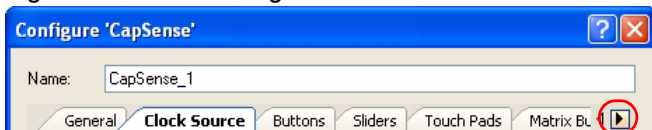
12. Select **UDB** from the **Prescaler** drop down list. This enables the **Prescaler Period** in **Scan Slots** tab.

Figure 3-137. Clock Source Tab



13. Select the **Scan Slots** tab using the right arrow.

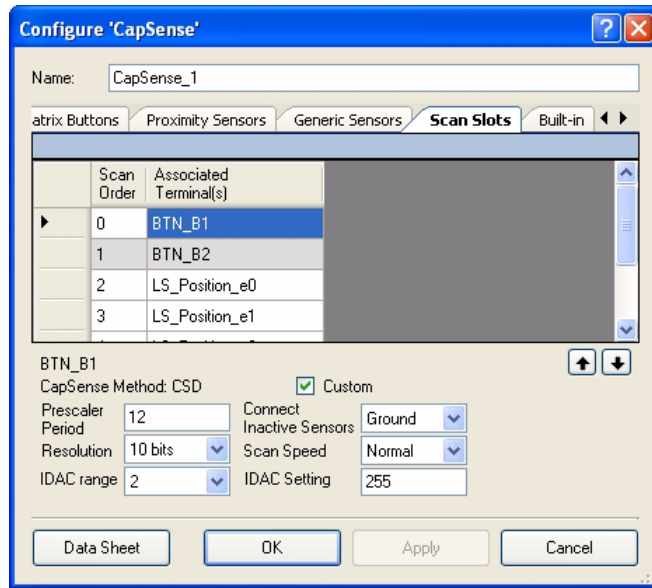
Figure 3-138. Click Right Arrow



14. Configure button **BTN_B1** in the **Scan Slots** tab in this manner.

- Select the **Custom** Check Box
- Prescaler Period:** 12
- Resolution:** 10 bits
- IDAC Range:** 2
- Connect Inactive Sensors:** Ground
- Scan Speed:** Normal
- IDAC Setting:** 255

Figure 3-139. Scan Slots Configuration



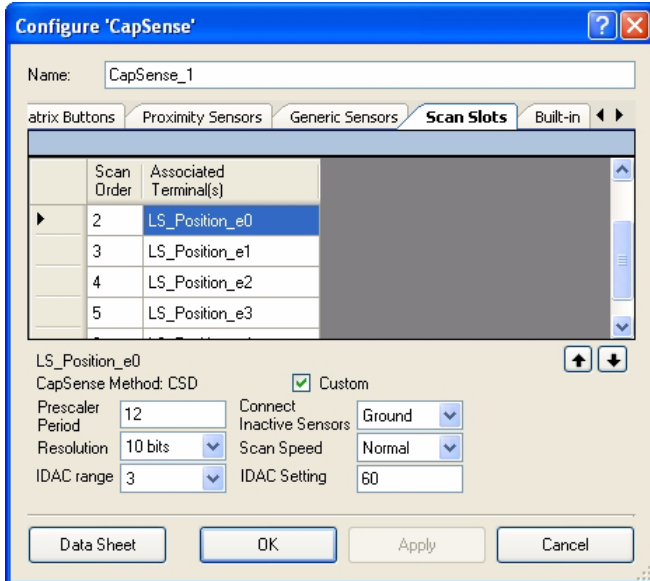
15. Configure **BTN_B2** similar to **BTN_B1**.

16. Click **OK**.

17. Configure slider terminals **LS_Position_e0** through **LS_Position_e4** in the **Scan Slots** tab:

- Select **Custom**
- Prescaler Period:** 12
- Resolution:** 10 bits
- IDAC Range:** 3
- Connect Inactive Sensors:** Ground
- Scan Speed:** Normal
- IDAC Setting:** 60

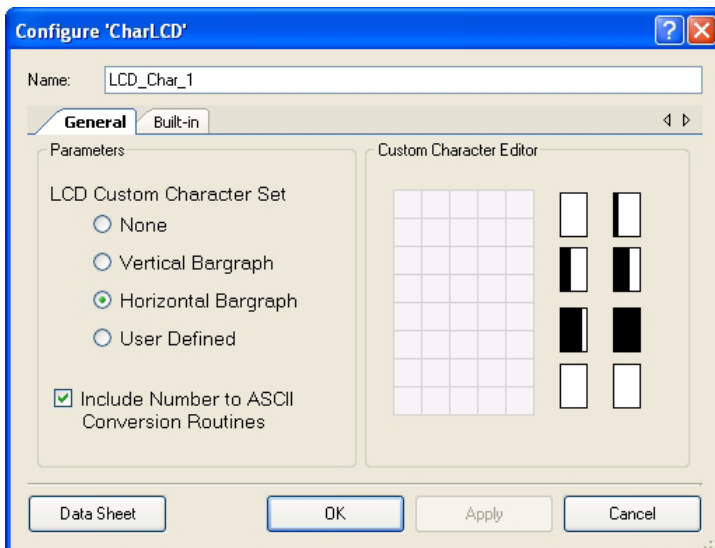
Figure 3-140. Scan Slots Slider Terminals Configuration



3.3.5.3 Placing and Configuring Character LCD

1. Drag-and-drop a Character LCD component from the **Component Catalog** → **Display** → **Character LCD** to the workspace.
2. Double click the **LCD_Char_1** component.
3. Set the parameter **LCD Custom Character Set** to **Horizontal Bargraph**.
4. Select **Include ASCII to Number Conversion Routines**.
5. Click **OK**

Figure 3-141. Horizontal Bargraph Configuration



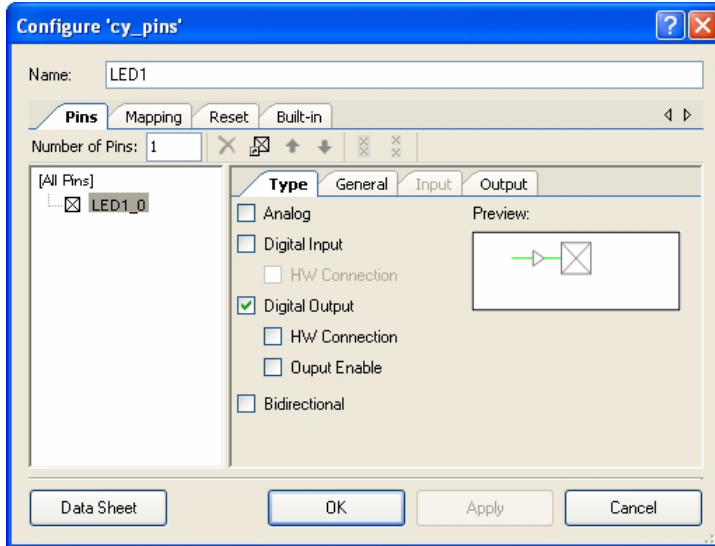
3.3.5.4 Placing and Configuring Digital Output Pin

1. Drag-and-drop two **Digital Output Pin** components from the Component Catalog to the work-space.
2. Configure the two **Digital Port** components for LED1 and LED2.

Type Tab

- ❑ **Name:** LED1
- ❑ Select **Digital Output** check box (Note all other check boxes are not selected)

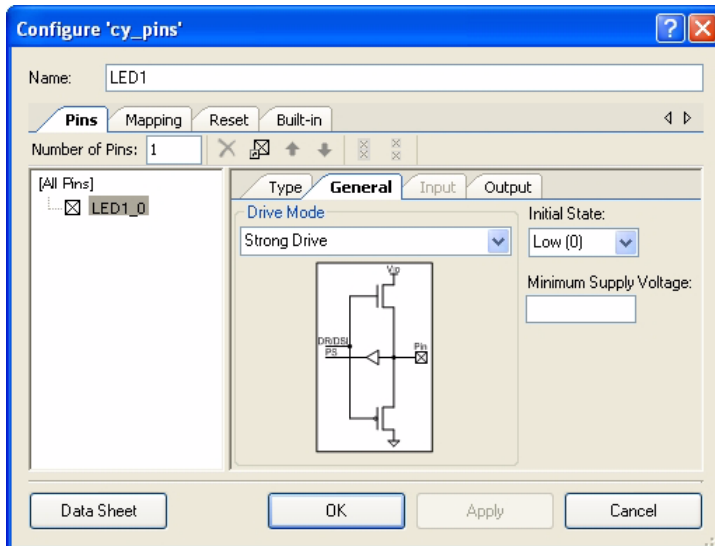
Figure 3-142. LED Configuration



General Tab

- ❑ **Drive Mode:** Strong Drive
- ❑ Leave remaining parameters as default

Figure 3-143. Pins - LED Configuration



3. Click **OK**.
4. Configure **LED2** similar to **LED1**.

3.3.5.5 Configuring the Pins

1. From the Workspace Explorer, double click the *Ex5_CapSense.cywrk* file.
2. Click the **Pins** tab
3. Select and assign the pins in this manner
 - Cmod to P2[7] for CY8C38 Family Processor Module and Cmod to P15[5] for CY8C55 Family Processor Module
 - B1 to P0[5]
 - B2 to P0[6]
 - Position_e0 to P0[0]
 - Position_e1 to P0[1]
 - Position_e2 to P0[2]
 - Position_e3 to P0[3]
 - Position_e4 to P0[4]
 - LED1 to P1[6]
 - LED2 to P1[7]
 - LCD_Char_1 to P2[0] to P2[6] (Drag it to P2[0] and PSoC Creator assigns the pin correctly.)

Figure 3-144. Pin Assignment for CY8C38 Family Processor Module

Alias	Name	Pin
sCmod	\CapSense_1:sbCSD:cCmod\	P2[7]
LS_Position_e4	\CapSense_1:sbCSD:cPort\[6]	P0[4]
LS_Position_e3	\CapSense_1:sbCSD:cPort\[5]	P0[3]
LS_Position_e2	\CapSense_1:sbCSD:cPort\[4]	P0[2]
LS_Position_e1	\CapSense_1:sbCSD:cPort\[3]	P0[1]
LS_Position_e0	\CapSense_1:sbCSD:cPort\[2]	P0[0]
BTN_B2	\CapSense_1:sbCSD:cPort\[1]	P0[6]
BTN_B1	\CapSense_1:sbCSD:cPort\[0]	P0[5]
	\LCD_Char_1:LCDPort\[6:0]	P2[6:0]
	LED1	P1[6]
	LED2	P1[7]

Figure 3-145. Pin Assignment for CY8C55 Family Processor Module

Alias	Name	Pin
LS_Position_e4	\CapSense_1:sbCSD:cPort\[6]	P0[4]
LS_Position_e3	\CapSense_1:sbCSD:cPort\[5]	P0[3]
LS_Position_e2	\CapSense_1:sbCSD:cPort\[4]	P0[2]
LS_Position_e1	\CapSense_1:sbCSD:cPort\[3]	P0[1]
LS_Position_e0	\CapSense_1:sbCSD:cPort\[2]	P0[0]
BTN_B2	\CapSense_1:sbCSD:cPort\[1]	P0[6]
BTN_B1	\CapSense_1:sbCSD:cPort\[0]	P0[5]
sCmod	\CapSense_1:sbCSD:cCmod\	P15[5]
	\LCD_Char_1:LCDPort\[6:0]	P2[6:0]
	LED1	P1[6]
	LED2	P1[7]

3.3.5.6 Creating the main.c File

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C38_main_Ex5.c* file, which can be found within the attachments feature of this PDF document.

Notes

- To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.
- Use the PSoC 3 family processor module file *CY8C38_main_Ex5.c* to replace the *main.c* content for PSoC 5 CY8C55 family processor module.

```
#include <device.h>

/* LCD specific */
#define ROW_0    0 /* LCD row 0 */
#define ROW_1    1 /* LCD row 1 */
#define COLUMN_0 0 /* LCD column 0 */
#define NUM_CHARACTERS 16 /* Number of characters on LCD */

/* For clearing a row of the LCD*/
#define CLEAR_ROW_STR    " "
/* Button 1 only string for row 0 of the LCD */
#define BUTTON_1_STR    "Button1"
/* Button 2 only string for row 0 of the LCD */
#define BUTTON_2_STR    " Button2"
/* Button 1 and 2 string for row 0 of the LCD */
#define BUTTON_1_2_STR  "Button1 Button2"
/* Default string for button row of the LCD */
#define DEFAULT_ROW_0_STR "Touch Buttons"
/* Default string for slider row of the LCD */
#define DEFAULT_ROW_1_STR "Touch The Slider"

/* LED specific */
#define LED_ON 1 /* For setting LED pin high */
#define LED_OFF 0 /* For setting LED pin low */

/* CapSense specific */
#define SLIDER_RESOLUTION 80

extern const uint8 LCD_Char_1_customFonts[];

void UpdateButtonState(uint8 slot_1, uint8 slot_2);
void UpdateSliderPosition(uint8 value);

/*****
 * Function Name: main
 *****/
*
* Summary:
* The main function initializes CapSense and the LCD. Then it continuously
* scans all CapSense slots (slider slots and buttons), gets the state of the
* buttons and slider and updates the LCD with the current state.
*
* Parameters:
* void
*
```

```

* Return:
* void
*
*****/
void main()
{
  uint8 pos;          /* Slider Position */
  uint8 stateB_1; /* Button1 State */
  uint8 stateB_2; /* Button2 State */

  CYGlobalIntEnable; /* Enable global interrupts */

  /* LCD Initialization */
  LCD_Char_1_Start();
  /* For Bargraph display on LCD */
  LCD_Char_1_LoadCustomFonts(LCD_Char_1_customFonts);

  /* CapSense Initialization */
  CapSense_1_Start();
  /* Initialize the baselines by scanning all slots and getting the initial
  raw data values */
  CapSense_1_CSHL_InitializeAllBaselines();

  while(1)
  {
    /* Scan each CapSense slot and update their raw data value */
    CapSense_1_CSD_ScanAllSlots();
    /* Update baselines for each slot */
    CapSense_1_CSHL_UpdateAllBaselines();

    /* Update state to active/inactive for each button slot */
    stateB_1 = CapSense_1_CSHL_CheckIsSlotActive(CapSense_1_SCANSLOT_BTN_B1);
    stateB_2 = CapSense_1_CSHL_CheckIsSlotActive(CapSense_1_SCANSLOT_BTN_B2);

    /* Get Linear Slider Position */
    pos = CapSense_1_CSHL_GetCentroidPos(CapSense_1_CSHL_LS_POSITION);

    /* Update LCD and LED's with current Button and Linear Slider states */
    UpdateButtonState(stateB_1, stateB_2);
    UpdateSliderPosition(pos);
  }
}

/*****
* Function Name: UpdateButtonState
*****
*
* Summary:
* Updates the LCD screen with the current button state by displaying which
* button is being touched on row 0. LED's are also updated according to button
* state.
*
* Parameters:
* slot_1: Button state for B1
* slot_2: Button state for B2
*
* Return:
* void

```

```

*
*****/
void UpdateButtonState(uint8 slot_1, uint8 slot_2)
{
    LCD_Char_1_Position(ROW_0,COLUMN_0);

    /* Check the state of the buttons and update the LCD and LEDs */
    if (slot_1 && slot_2)
    {
        /* Display both Button strings on LCD if both button slots are active */
        LCD_Char_1_PrintString(BUTTON_1_2_STR);
        /* Both LED's are on in this state */
        LED1_Write(LED_ON);
        LED2_Write(LED_ON);
    }
    else if (slot_1 || slot_2)
    {
        if (slot_1)
        {
            /* Display Button 1 state on LCD and LED1 */
            LCD_Char_1_PrintString(BUTTON_1_STR);
            LED1_Write(LED_ON);
            /* Button 2 is not active */
            LED2_Write(LED_OFF);
        }
        if (slot_2)
        {
            /* Display Button 2 state on LCD and LED2 */
            LCD_Char_1_PrintString(BUTTON_2_STR);
            LED2_Write(LED_ON);

            /* Button 1 is not active */
            LED1_Write(LED_OFF);
        }
        else
        {
            /* Display default string on LCD and set LED's to off */
            LCD_Char_1_PrintString(DEFAULT_ROW_0_STR);

            /* Set both LED's off in this state */
            LED1_Write(LED_OFF);
            LED2_Write(LED_OFF);
        }
    }
}

/*****
* Function Name: UpdateSliderPosition
*****
*
* Summary:
*   Updates the LCD screen with the current slider position by displaying the
*   horizontal bar graph.
*
* Parameters:
*   value: Centroid position from CapSense slider.
*
* Return:

```

```

* void
*
*****/
void UpdateSliderPosition(uint8 value)
{
  /* The slider position is 0xFF if there is no finger present on the slider */
  if (value > SLIDER_RESOLUTION)
  {
    /* Clear old slider position (2nd row of LCD) */
    LCD_Char_1_Position(ROW_1, COLUMN_0);
    LCD_Char_1_PrintString(DEFAULT_ROW_1_STR);
  }
  else
  {
    /* Update the bar graph with the current finger position */
    LCD_Char_1_DrawHorizontalBG(ROW_1, COLUMN_0, NUM_CHARACTERS, value +1);
  }
}

/* [] END OF FILE */

```

3. From the **Build** menu, select **Build CapSense**. PSoC Creator builds the project and displays the comments in the **Output** dialog box. When you see the message "Build Succeeded" the build is complete.

3.3.5.7 *Configuring and Programming the PSoC Development Board*

1. Disconnect power to the board.
2. Configure the DVK SW3 to 3.3V.
3. Using the jumper wires, configure the PSoC Development Board's prototyping area:
 - P1[6] to LED1
 - P1[7] to LED2
4. Use PSoC Creator as described in [Programming My First PSoC 3 Project on page 23](#) or [Programming My First PSoC 5 Project on page 27](#) to program the device.
5. After programming the device, press **Reset**.
6. When running the project, an LED lights up when either CapSense button is pushed. If B1 (P0[5]) is pushed it also displays "Button1" in the top row of the LCD display. Likewise, If B2 (P0[6]) is pushed it displays "Button2" in the top row of the LCD display. The bottom row of the LCD displays the Slider position with a Horizontal Bar graph.
7. Save and close the project.

3.3.6 SAR ADC (PSoC 5 Only)

This project demonstrates sine wave generation by using an 8-bit DAC and DMA. The sine wave period is based on the current value of the ADC value of the potentiometer.


The firmware reads the voltage output by the DVK board potentiometer and displays the raw counts on the DVK board character LCD display similarly to that shown in the previous project. An 8-bit DAC outputs a table generated sine wave to an LED using DMA at a frequency proportional to the ADC count. A 9600 BAUD 8N1 UART outputs the current ADC count as ASCII formatted into a hexadecimal number.

The instructions below assume that you have completed My First PSoC Project and ADC to LCD Project and therefore have a basic understanding of the PSoC Creator software environment.

This example project uses the following components:

- SAR ADC (**Component Catalog** → **Analog** → **ADC** → **SAR ADC**)
- Voltage DAC (**Component Catalog** → **Analog** → **DAC** → **Voltage DAC**)
- Opamp (**Component Catalog** → **Analog** → **Amplifiers** → **Opamp**)
- DMA (**Component Catalog** → **System** → **DMA**)
- Character LCD (**Component Catalog** → **Display** → **Character LCD**)
- UART (**Component Catalog** → **Communications** → **UART**)
- Analog Pin (**Component Catalog** → **Ports and Pins** → **Analog Pin**)
- Digital Output Pin (**Component Catalog** → **Ports and Pins** → **Digital Output Pin**)
- Clock (**Component Catalog** → **System** → **Clock**)
- Logic Low (**Component Catalog** → **Digital** → **Logic** → **Logic Low**)
- Logic High (**Component Catalog** → **Digital** → **Logic** → **Logic High**)

3.3.6.1 Creating ADC to UART with DAC Project

1. Open PSoC Creator.
2. Create a new project by clicking **Create New Project** in the **Start Page** of PSoC Creator.
3. In the **New Project** window, select the **Empty PSoC5 Design** template and **Name** the project **Ex6_SAR_to_UART_with_DAC**.
4. In **Location**, type the path where you want to save the project, or click  and navigate to the appropriate directory.
5. By default, the design window opens *TopDesign.cysch*. This is the project's schematic entry file within PSoC Creator.

3.3.6.2 Placing and Configuring SAR ADC

1. Drag-and-drop the SAR ADC component (**Component Catalog** → **Analog** → **ADC** → **SAR ADC**)
2. Double click the **ADC_SAR_1** component in the schematic to open the configuration window.
3. Configure the SAR ADC in this manner:

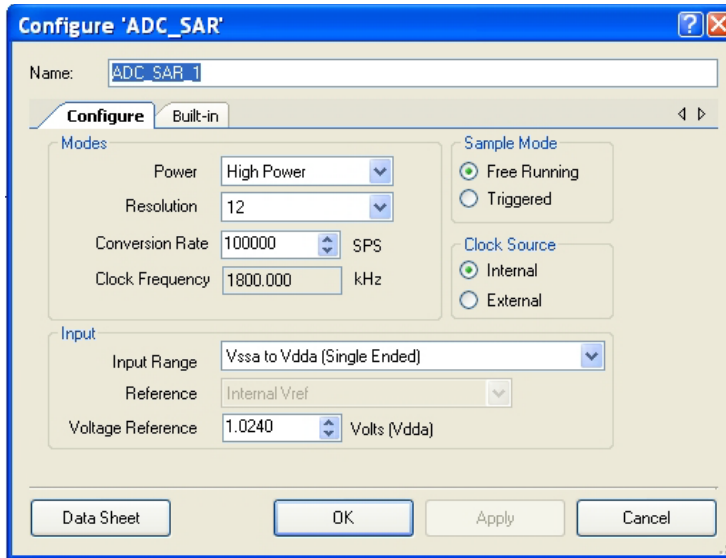
Configure Tab

- **Name:** ADC_SAR_1
- **Power:** High Power
- **Resolution:** 12
- **Conversion Rate:** 100000
- **Clock Frequency:** 1800

- ❑ **Input Range:** Vssa to Vdda (Single Ended)
- ❑ **Reference:** Internal Vref
- ❑ **Voltage Reference:** 1.0240
- ❑ **Sample Mode:** Free Running
- ❑ **Clock Source:** Internal

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-146. SAR ADC Component Configuration



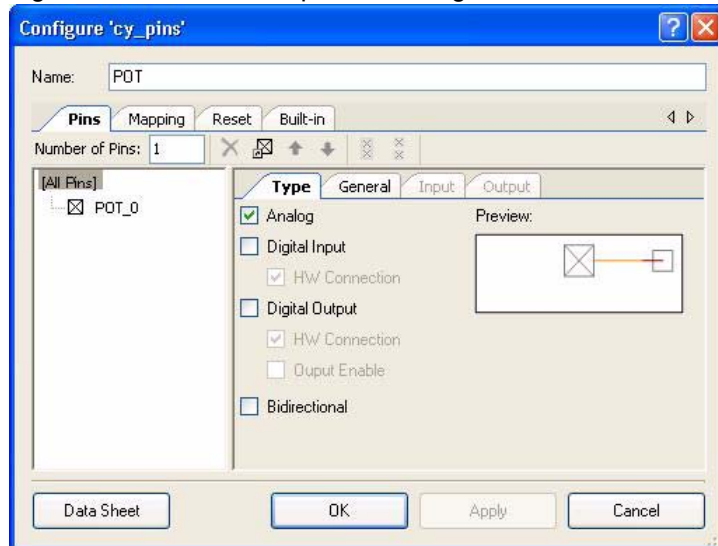
3.3.6.3 Placing and Configuring an Analog Pin

1. Drag-and-drop the Analog Pin component (**Component Catalog** → **Ports and Pins** → **Analog Pin**)
2. Double click the **Pin_1** component in the schematic to open the configuration window.
3. Configure the analog pin:

Type Tab

- ❑ **Name:** POT
- ❑ Select **Analog** check box only

Figure 3-147. POT Component Configuration



General Tab

- Drive Mode:** High Impedance Analog
- Leave remaining parameters as default

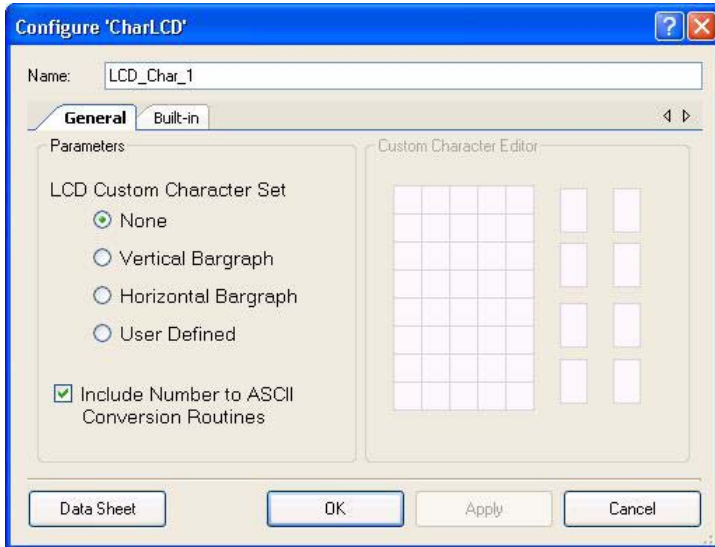
For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

3.3.6.4 Placing and Configuring Character LCD

1. Drag-and-drop the Character LCD component (**Component Catalog** → **Display** → **Character LCD**)
2. Double click the **LCD_Char_1** component in the schematic to open the configuration window.
3. Configure the Character LCD:
 - Name:** LCD_Char_1
 - LCD Custom Character Set:** None
 - Include ASCII to Number Conversion Routines:** Check box

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-148. Character LCD Component Configuration



3.3.6.5 Placing and Configuring Voltage DAC

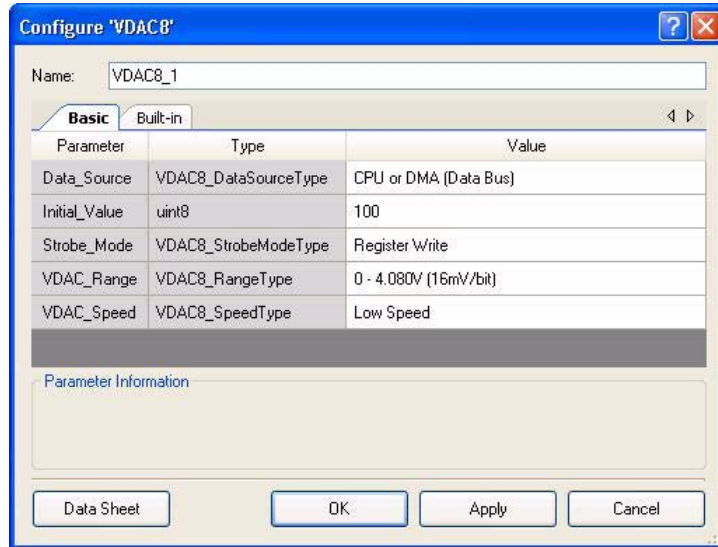
1. Drag-and-drop the Voltage DAC component (**Component Catalog** → **Analog** → **DAC** → **Voltage DAC**)
2. Double click the **VDAC8_1** component in the schematic to open the configuration window.
3. Configure the VDAC:

Basic Tab

- **Name:** VDAC8_1
- **Data_Source:** CPU or DMA (Data Bus)
- **Initial_Value:** 100
- **Strobe_Mode:** Register Write
- **VDAC_Range:** 0 - 4.080V (16mV/bit)
- **VDAC_Speed:** Low Speed

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-149. Voltage DAC Component Configuration



3.3.6.6 Placing and Configuring Opamp

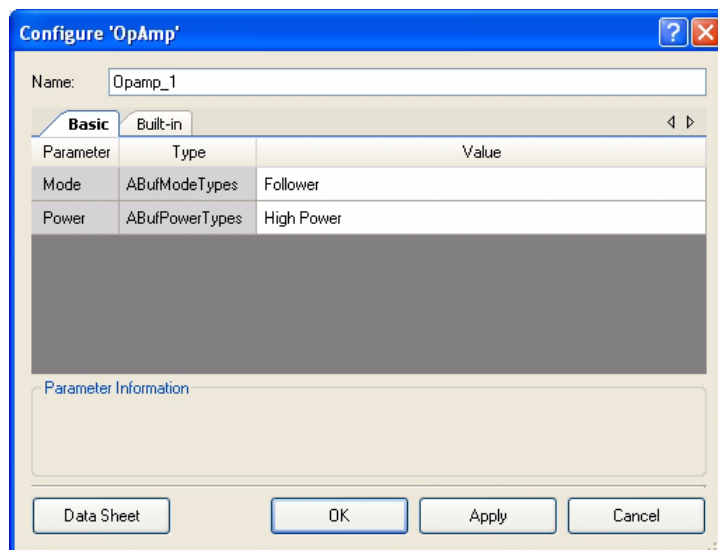
1. Drag-and-drop the Opamp component (**Component Catalog** → **Analog** → **Amplifiers** → **Opamp**)
2. Double click the **Opamp_1** component in the schematic to open the configuration window.
3. Configure the Opamp:

Basic Tab

- Name:** Opamp_1
- Mode:** Follower
- Power:** High Power

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-150. Opamp Component Configuration



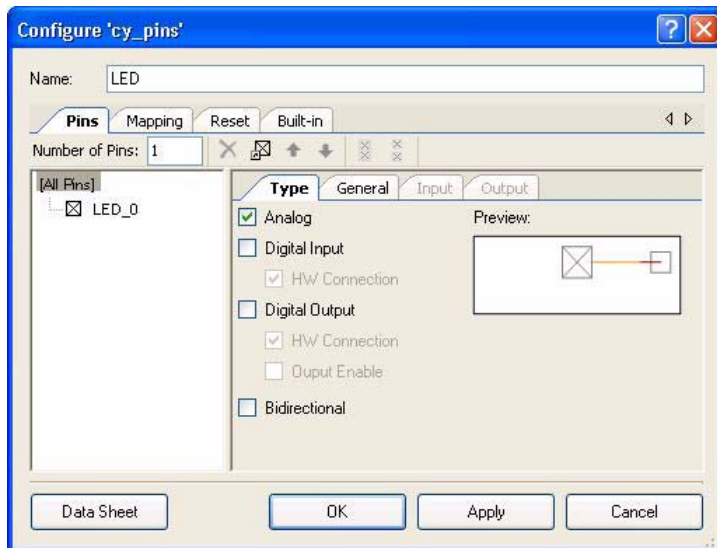
3.3.6.7 Placing and Configuring Analog Pin

1. Drag-and-drop the analog pin component (**Component Catalog** → **Ports and Pins** → **Analog Pin**)
2. Double click the **Pin_1** component in the schematic to open the configuration window.
3. Configure the analog pin:

Type Tab

- Name:** LED
- Select Analog check box only

Figure 3-151. LED Component Configuration

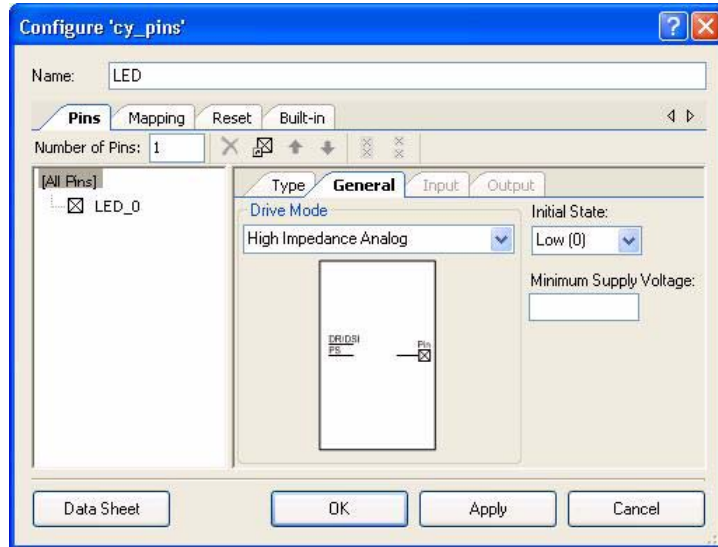


General Tab

- Drive Mode:** High Impedance Analog
- Leave remaining parameters as default**

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-152. LED Component Configuration



3.3.6.8 Placing and Configuring UART

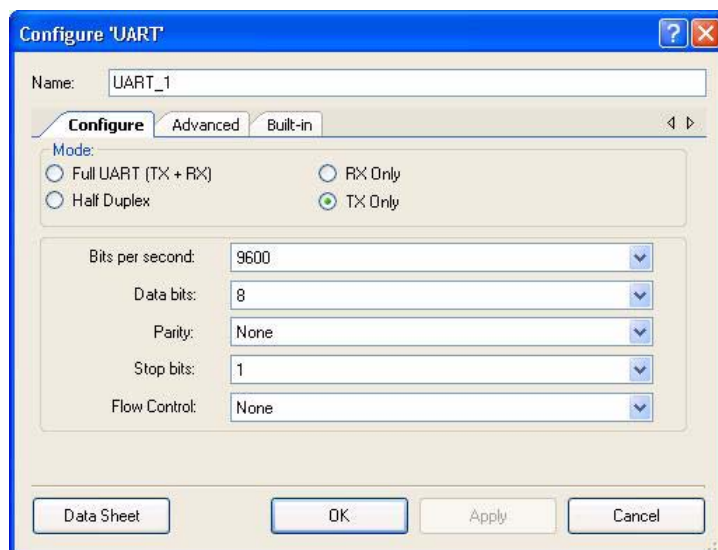
1. Drag-and-drop the UART component (**Component Catalog** → **Communications** → **UART**)
2. Double click the **UART_1** component in the schematic to open the configuration window.
3. Configure the UART:

Configure Tab

- Name:** UART_1
- Mode:** TxOnly
- Bits per second:** 9600
- Leave the remaining parameters to default

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-153. UART Component Configuration



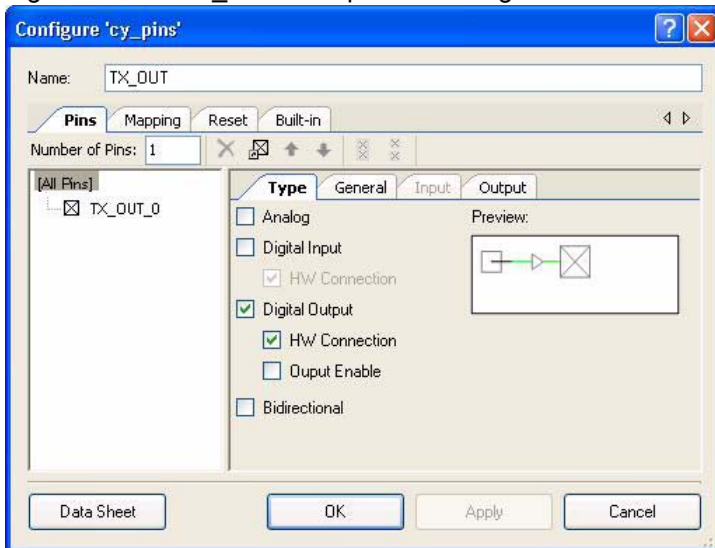
3.3.6.9 Placing and Configuring Digital Output Pin

1. Drag-and-drop the **Digital Output Pin** component (**Component Catalog** → **Ports and Pins** → **Digital Output Pin**)
2. Double click the **Pin_1** component in the schematic to open the configuration window.
3. Configure the digital output pin:

Type Tab

- Name:** TX_OUT
- Select **Digital Output** Check box
- Select **HW Connection** Check box

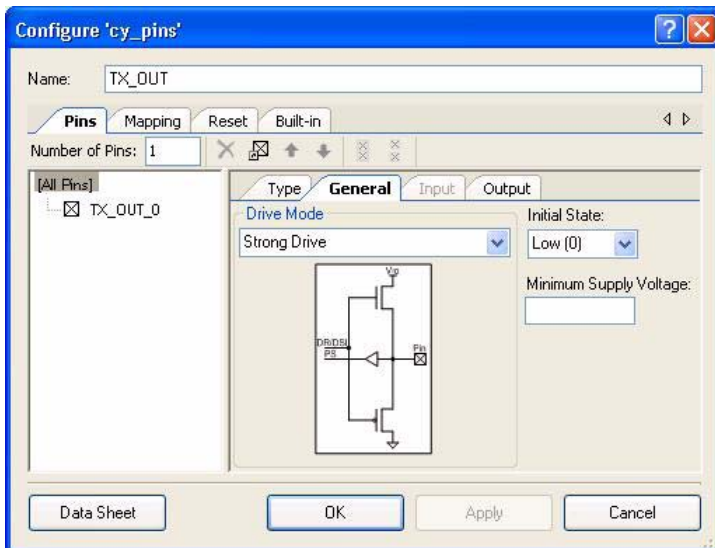
Figure 3-154. TX_OUT Component Configuration



General Tab

- Under **Drive Mode:** Strong Drive
- Leave remaining parameters as default

Figure 3-155. Pins - TX_OUT Component Configuration



For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

3.3.6.10 *Placing and Configuring DMA*

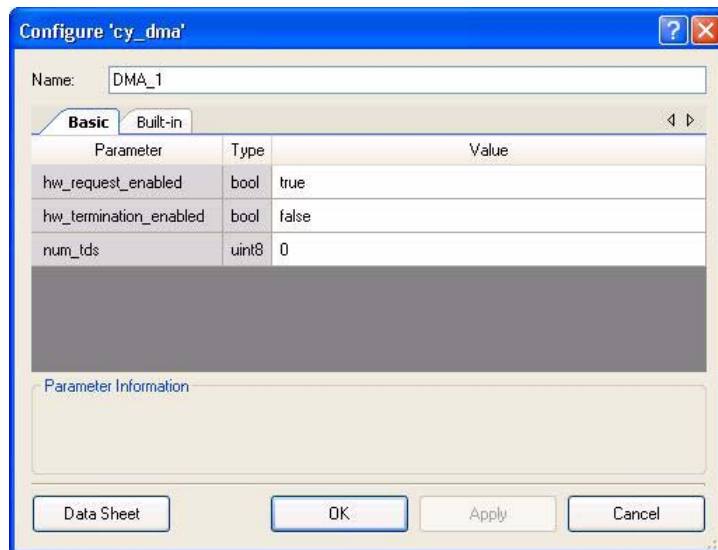
1. Drag-and-drop the DMA component (**Component Catalog** → **System** → **DMA**)
2. Double click the **DMA_1** component in the schematic to open the configuration window.
3. Configure the DMA:

Basic Tab

- Name:** DMA_1
- Hw_request_enabled:** true
- Leave the remaining parameters to default

For more information about what the parameters mean, click the **Data Sheet** button in the configuration window.

Figure 3-156. DMA Component Configuration



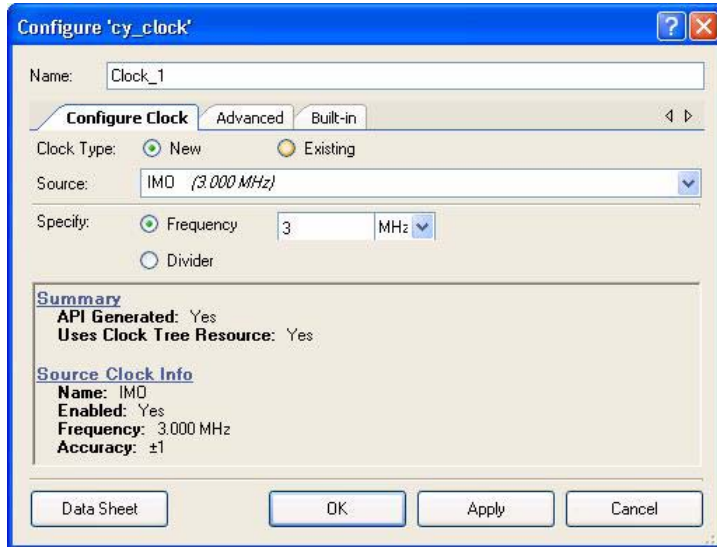
3.3.6.11 *Connecting the Components Together*

1. Connect a Logic Low component (**Component Catalog** → **Digital** → **Logic** → **Logic Low**) to the **reset** of the UART
2. Connect a Clock component (**Component Catalog** → **System** → **Clock**) to the **clock** of the DMA.
3. Double click the **Clock** component to configure.
4. Configure the clock:

Configure Clock Tab

- Name:** Clock_1
- Source:** IMO (3.000 MHz)
- Desired Frequency:** 3 MHz
- Leave remaining parameters set to their default values

Figure 3-157. Clock Component Configuration






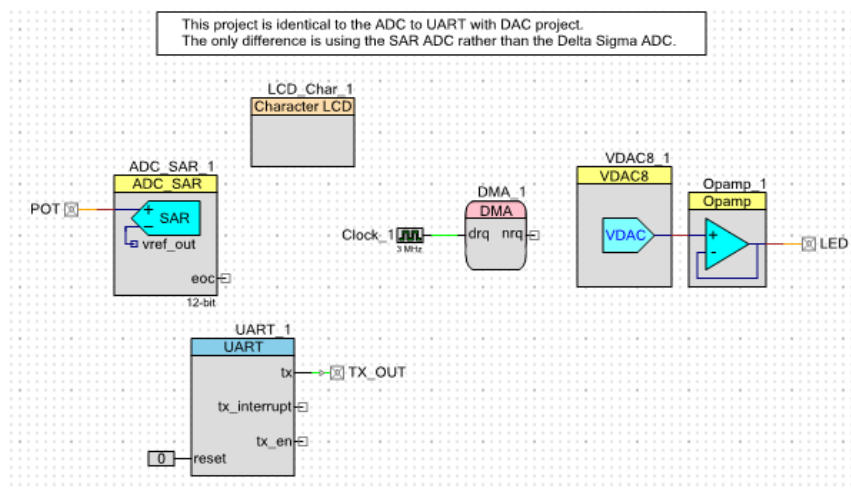
5. Using the Wire Tool , connect **tx** (in the UART component) to HW connection of the TX_OUT digital output pin (TX_OUT).
6. Using the Wire Tool , connect **VDAC8 (VDAC8_1)** to **Opamp (Opamp_1)**.
7. Using the Wire Tool , connect **POT** to **ADC_SAR (ADC_SAR_1)**.
8. Right click the LED analog pin, select the **Shape** menu option and then **Flip Horizontal**. This allows the LED pin to line up with the Opamp output.
9. When complete the schematic looks like [Figure 3-158](#).

Figure 3-158. Connected Components



3.3.6.12 Configuring the Pins

1. From the **Workspace Explorer**, open the *Ex6_SAR_to_UART_with_DAC.cydwr* file.
2. Click the **Pins** tab.
3. Select pins P2[6:0] for LCD_Char_1
4. Select pin P0[7] for POT

5. Select pin P1[6] for LED
6. Select pin P1[2] for TX_OUT

Figure 3-159. Pin Assignments

Alias	Name	Pin
LED		P1[6]
TX_OUT		P1[2]
\LCD_Char_1:LCDPort\[6:0]		P2[6:0]
POT		P0[7]

3.3.6.13 Creating the main.c File

1. Open the existing *main.c* file within **Workspace Explorer**.
2. Replace the existing *main.c* content with the content of the embedded *CY8C55_main_Ex6.c* file, which can be found within the attachments feature of this PDF document.

Note To access the embedded attachments feature in the PDF document, click on the paper clip icon located in the lower left corner of the Adobe Reader application.

```
#include <device.h>

/* LCD specific */
#define ROW_0      0 /* LCD row 0      */
#define COLUMN_0   0 /* LCD column 0 */
#define COLUMN_9   9 /* LCD column 9 */
#define COLUMN_10  10 /* LCD column 10 */
#define COLUMN_11  11 /* LCD column 11 */
/* For clearing Tens and Hundreds place */
#define CLEAR_TENS_HUNDREDS "  "
/* For clearing Hundreds place */
#define CLEAR_HUNDREDS     "  "

/* DMA specific */
#define REQUEST_PER_BURST  1 /* One request per burst */
#define BURST_BYTE_COUNT   1 /* Bursts are one byte each */
/* Upper 16-bits of the source address are zero */
#define SOURCE_ADDRESS      0
/* Upper 16-bits of the destination address are zero */
#define DESTINATION_ADDRESS 0

void UpdateDisplay(uint16 * voltageRawCount);
void TxHex (uint16 voltageRawCount);

/* Table of voltage values for DMA to send to the DAC. These values range
 * between 0x3D and 0x9F because these are the two points where the LED
 * is not visible and where the LED is saturated */
const uint8 voltageWave[] =
{
0x6D, 0x6F, 0x71, 0x73, 0x75, 0x77, 0x79, 0x7B, 0x7D, 0x7F, 0x81, 0x83, 0x85,
0x87, 0x89, 0x8B, 0x8D, 0x8F, 0x91, 0x93, 0x95, 0x97, 0x99, 0x9B, 0x9C, 0x9D, 0x9D,
0x9E,
0x9E, 0x9F, 0x9F, 0x9F, 0x9E, 0x9E, 0x9E, 0x9C, 0x9C, 0x9B, 0x99, 0x97, 0x95, 0x93,
0x91,
0x8F, 0x8D, 0x8B, 0x89, 0x87, 0x85, 0x83, 0x81, 0x7F, 0x7D, 0x7B, 0x79, 0x77,
0x75, 0x73, 0x71, 0x6F, 0x6D, 0x6B, 0x69, 0x67, 0x65, 0x63, 0x61, 0x5F, 0x5D,
0x5B, 0x59, 0x57, 0x55, 0x53, 0x51, 0x4F, 0x4D, 0x4B, 0x49, 0x47, 0x45, 0x43,
```

```

0x41, 0x40, 0x40, 0x3F, 0x3F, 0x3D, 0x3D, 0x3D, 0x3D, 0x3D, 0x3D, 0x3F, 0x41,
0x43, 0x45, 0x47, 0x49, 0x4B, 0x4D, 0x4F, 0x51,
0x53, 0x55, 0x57, 0x59, 0x5B, 0x5D, 0x5F, 0x61, 0x63, 0x65, 0x67, 0x69, 0x6B
};

/*****
* Function Name: main
*****/
*
* Summary:
*   The main function initializes the ADC, LCD, VDAC, Analog Buffer, and UART.
*   It also initializes DMA by allocating/configuring a DMA channel and
*   Transaction Descriptor and also copies the voltage table address to the DAC
*   address. In the main loop, it starts and waits for an ADC conversion, then
*   it displays the ADC raw count to the LCD, transmits the raw count serially,
*   and sets the DMA clock divider proportional to the raw count.
*
* Parameters:
*   void
*
* Return:
*   void
*
*****/
void main()
{
    uint16 voltageRawCount;
    uint8  myChannel;
    uint8  myTd;

    ADC_SAR_1_Start();    /* Configure and power up ADC */
    LCD_Char_1_Start();   /* Initialize and clear the LCD */
    VDAC8_1_Start();      /* Initializes VDAC8 with default values */
    Opamp_1_Start();      /* Enables Opamp and sets power level */
    UART_1_Start();       /* Enable UART */
    CyDmacConfigure();    /* Set DMA configuration register */

    /* Allocate and initialize a DMA channel to be used by the caller */
    myChannel = DMA_1_DmaInitialize(BURST_BYTE_COUNT,
                                    REQUEST_PER_BURST,
                                    (uint16)((uint32)voltageWave >> 16),
                                    (uint16)(VDAC8_1_viDAC8__D >> 16));

    /* Allocate a Transaction Descriptor (TD) from the free list */
    myTd = CyDmaTdAllocate();

    /* Move the LCD cursor to Row 0, Column 0 */
    LCD_Char_1_Position(ROW_0, COLUMN_0);

    /* Print Label for the pot voltage raw count */
    LCD_Char_1_PrintString("V Count: ");

    CyDmaTdSetConfiguration(myTd, sizeof(voltageWave),
                            myTd, TD_INC_SRC_ADR ); /* Configure the TD */

    /* Copy address of voltageWave to address of DAC. Set the lower 16-bits of
     * the source and destination addresses for this TD */
    CyDmaTdSetAddress(myTd,

```

```

        (uint16)((uint32)voltageWave),
        (uint16)VDAC8_1_viDAC8__D);

/* Associate TD with channel */
CyDmaChSetInitialTd(myChannel, myTd);

/* Enable DMA channel */
CyDmaChEnable(myChannel, 1);

/* Clock will make burst requests to the DMAC */
Clock_1_Start();

ADC_SAR_1_StartConvert(); /* Force ADC to initiate a conversion */

while(1)
{
    /* Wait for end of conversion */
    ADC_SAR_1_IsEndConversion(ADC_SAR_1_WAIT_FOR_RESULT);

    /* Get converted result */
    /* Shifting for silicon errata workaround to get 8-bit value */
    voltageRawCount = (ADC_SAR_1_GetResult16())>>4;

    UpdateDisplay(&voltageRawCount); /* Print the result to LCD */

    TxHex(voltageRawCount); /* Transmit result to UART */

    /*
     * The LED blinking frequency is dependent on the Voltage raw count.
     * With a 3MHz clock, the lowest divider (for raw count of 0) should be
     * 1000 to blink at a significantly fast pace. The highest value is
     * about 52,200 (for a raw count of 256) to blink at a significantly
     * slow pace. The following equation is necessary to make the adjusted
     * clock frequency (with the updated divider) linear with the ADC
     * output.
     */
    Clock_1_SetDivider((((uint32)voltageRawCount * 1000) / \
        (261 - (uint32)voltageRawCount)) + 1000);
}

/*****
 * Function Name: UpdateDisplay
 *****/
*
* Summary:
*   Print voltage raw count result to the LCD. Clears some characters if
*   necessary. The voltageRawCount parameter is also updated for use in other
*   functions.
*
* Parameters:
*   voltageRawCount: Voltage raw count from ADC
*
* Return:
*   void
*
*****/
void UpdateDisplay (uint16 * voltageRawCount)

```

```

{
    /* Move the cursor to Row 0, Column 9 */
    LCD_Char_1_Position(ROW_0, COLUMN_9);
    LCD_Char_1_PrintNumber(voltageRawCount[0]); /* Print the result */

    if (voltageRawCount[0] < 10)
    {
        /* Move the cursor to Row 0, Column 10 */
        LCD_Char_1_Position(ROW_0, COLUMN_10);
        LCD_Char_1_PrintString(CLEAR_TENS_HUNDREDS); /* Clear last characters */
    }
    else if (voltageRawCount[0] < 100)
    {
        /* Move the cursor to Row 0, Column 11 */
        LCD_Char_1_Position(ROW_0, COLUMN_11);
        LCD_Char_1_PrintString(CLEAR_HUNDREDS); /* Clear last characters */
    }
    else
    {
        /* Continue on */
    }
}

/*****
 * Function Name: TxHex
 *****/
*
* Summary:
*   Convert voltage raw count to hex value and TX via UART.
*
* Parameters:
*   voltageRawCount: The voltage raw counts being received from the ADC
*
* Return:
*   void
*
*****/
void TxHex (uint16 voltageRawCount)
{
    static char8 const hex[16] = "0123456789ABCDEF";

    /* TX converted MSnibble */
    UART_1_PutChar(hex[(voltageRawCount>>12)&0xF]);
    /* TX converted second nibble */
    UART_1_PutChar(hex[(voltageRawCount>>8)&0xF]);
    /* TX converted third nibble */
    UART_1_PutChar(hex[(voltageRawCount>>4)&0xF]);
    /* TX converted LSnibble */
    UART_1_PutChar(hex[voltageRawCount&0xF]);
    UART_1_PutString("h\r"); /* h for hexadecimal and carriage return */
}

/* [] END OF FILE */

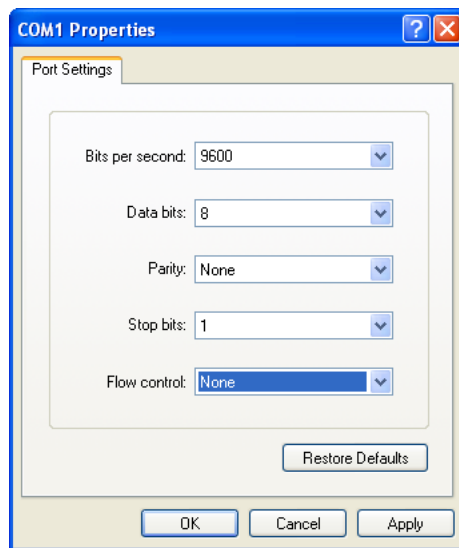
```

3. From the **Build** menu, select **Build Ex6_SAR_to_UART_with_DAC**. PSoC Creator builds the project and displays the comments in the **Output** dialog box. When you see the message "Build Succeeded" the build is complete.

3.3.6.14 *Configuring and Programming the PSoC Development Board*

1. Disconnect power to the board.
2. Configure the DVK SW3 to 3.3V.
3. Using the jumper wires included, configure the PSoC Development Board's prototyping area to:
 - P0[7] to VR
 - P1[2] to TX
 - P1[6] to LED1
4. Verify that VR_PWR (J11) is jumpered to ON.
5. Verify that RS232_PWR (J10) is jumpered to ON.
6. Connect a serial cable from the PSoC Development Board to a PC.
7. Apply power to the board.
8. Install a terminal application such as TeraTerm or HyperTerminal with these setup parameters:
 - **Baud Rate:** 9600
 - **Data:** 8-bit
 - **Parity:** none
 - **Stop:** 1-bit
 - **Flow Control:** none

Figure 3-160. HyperTerminal Settings



9. Use PSoC Creator as described in [Programming My First PSoC 5 Project on page 27](#) to program the device.
10. After programming the device, press the **Reset** button on the PSoC Development Board to see the output of the ADC displayed on the LCD and in the terminal application. LED1 is a sine wave output whose period is based on the ADC. Turning the potentiometer results in the LCD and observed terminal value change.

Note The Variable Resistor (VR) operates at a full range of voltages from 0 to VDD. The ADC input voltage for this project is limited to 0 - 2.048V. This means that the VR reaches the maximum input voltage of 2.048V, with a count of 256, before the VR is fully turned.

11. Save and close the project.

Appendix A. Board Specifications and Layout



This appendix gives detailed specifications of the PSoC Development Kit Board components

A.1 PSoC Development Board

A.1.1 Factory Default Configuration

A.1.1.1 *Power Supply*

The board has several power nets. Below are the definitions of the different power nets.

VIN (9V or 12V) - This is the input power before it is fed to any of the regulators. A 9-12V power supply adapter or a 9V battery is used as the source.

VREG (5V) - This is fed by VIN and is the output of the onboard 5V regulator. VREG can be selected as the main 5V source by using the J8 header.

VBUS (5V) - This is power derived from the USB interface via a USB host. VBUS can be selected as the main 5V source by using the J8 header.

VDD (3.3V or 5V) - This is fed by VREG, VBUS, or the onboard 3.3V regulator. VDD can be chosen either to be 3.3V or 5V by the simple positioning of the VDD select switch.

VADJ (1.25V to 3.9V) - This is fed by VDD and is the output of the onboard adjustable regulator. It is mainly used when the PSoC core must be powered at lower voltages. An adjustable resistor R11 is used for adjusting the voltage.

VDD DIG - This is power derived from either VDD or VADJ. It is used to power the PSoC core. The source for VDD DIG can be chosen as VDD or VADJ using the J7 header.

VDD ANLG - This is power derived from either VDD or VADJ. It is mainly used when user wants to separate the analog power from the digital power. The source for VDD ANLG can be chosen as VDD or VADJ using the J7 header.

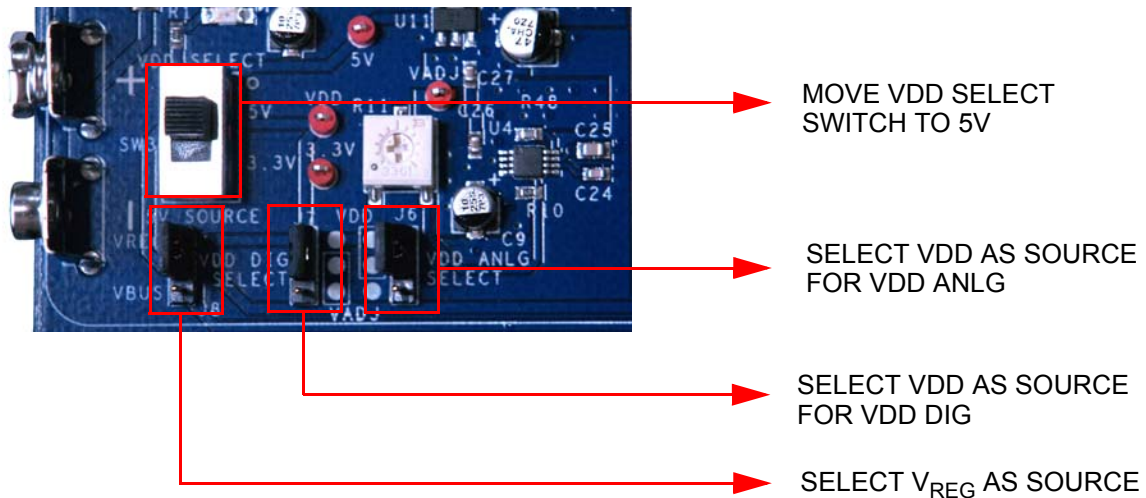
VDDIO - This is power derived from either VDD or VADJ. It is used to power digital I/O on the PSoC device. There are four sections of GPIO, which can be powered to 5V, 3.3V, or VADJ using four headers. It enables you to power the PSoC GPIOs at different voltages.

A.1.2 Power Supply Configuration Examples

A.1.2.1 Setting a 5V Supply from VREG

1. Place the jumper on J8 header to select VREG as the source.
2. Move the VDD select switch to select the 5V.
3. Place the jumper on J6 header to select VDD as source for VDD ANLG.
4. Place the jumper on J7 header to select VDD as source for VDD DIG.

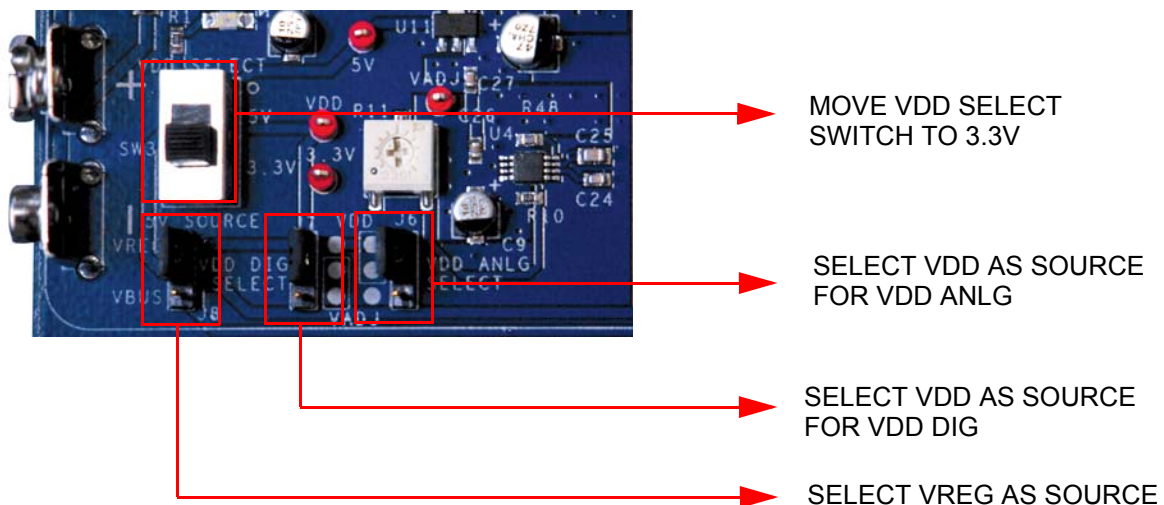
Figure A-1. Setting a 5V Supply from VREG



A.1.2.2 Setting a 3.3V Supply from VREG

1. Place the jumper on J8 header to select VREG as the source.
2. Move the VDD select switch to select 3.3V.
3. Place the jumper on J6 header to select VDD as source for VDD ANLG.
4. Place the jumper on J7 header to select VDD as source for VDD DIG.

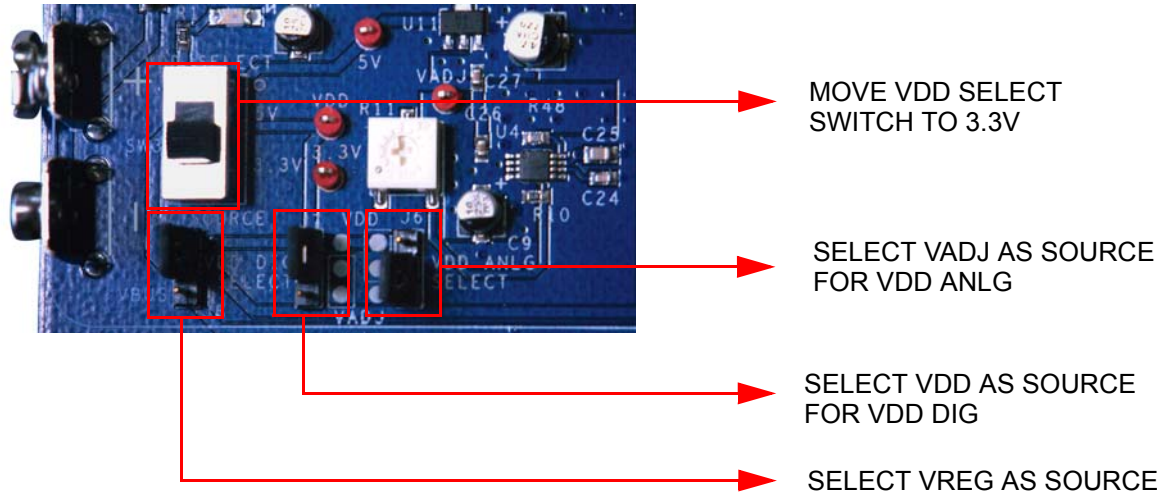
Figure A-2. Setting a 3.3V Supply from VREG



A.1.2.3 Setting VDD ANLG as VADJ and VDD DIG as VDD for VDD = 3.3V

1. Place the jumper on J8 header to select VREG as the source.
2. Move the VDD select switch to select 3.3V.
3. Place the jumper on J6 header to select VADJ as source for VDD ANLG.
4. Place the jumper on J7 header to select VDD as source for VDD DIG.

Figure A-3. Setting VDD ANLG as VADJ and VDD DIG as VDD for VDD = 3.3V

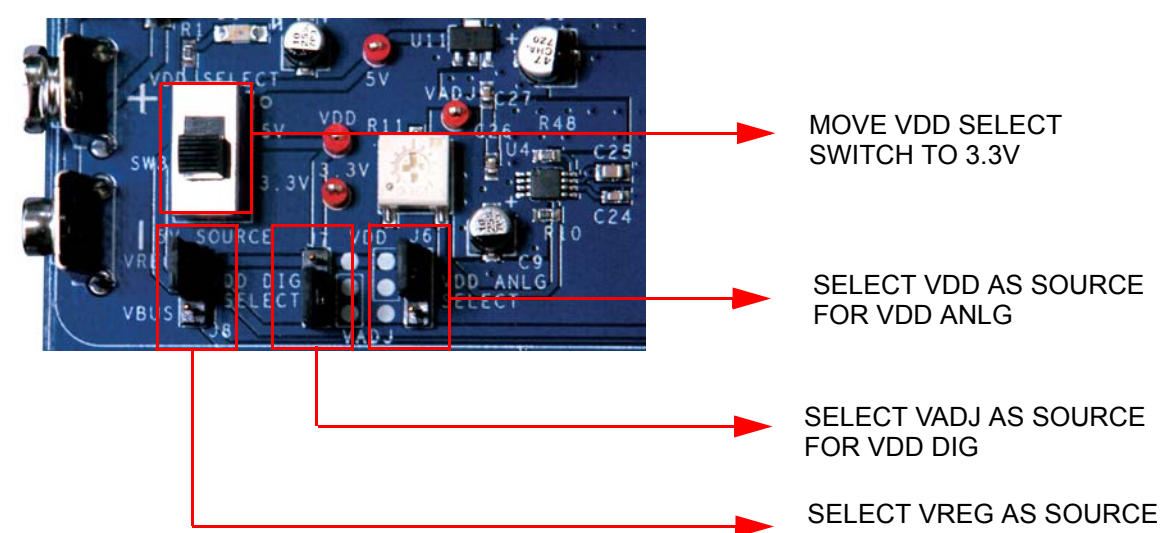


This helps to separate the analog supply from the digital supply and VDD.

A.1.2.4 Setting VDD DIG as VADJ and VDD ANLG as VDD for VDD = 3.3V

1. Place the jumper on J8 header to select VREG as the source.
2. Move the VDD select switch to select 3.3V.
3. Place the jumper on J6 header to select VDD as source for VDD ANLG.
4. Place the jumper on J7 header to select VADJ as source for VDD DIG.

Figure A-4. Setting VDD DIG as VADJ and VDD ANLG as VDD for VDD = 3.3V

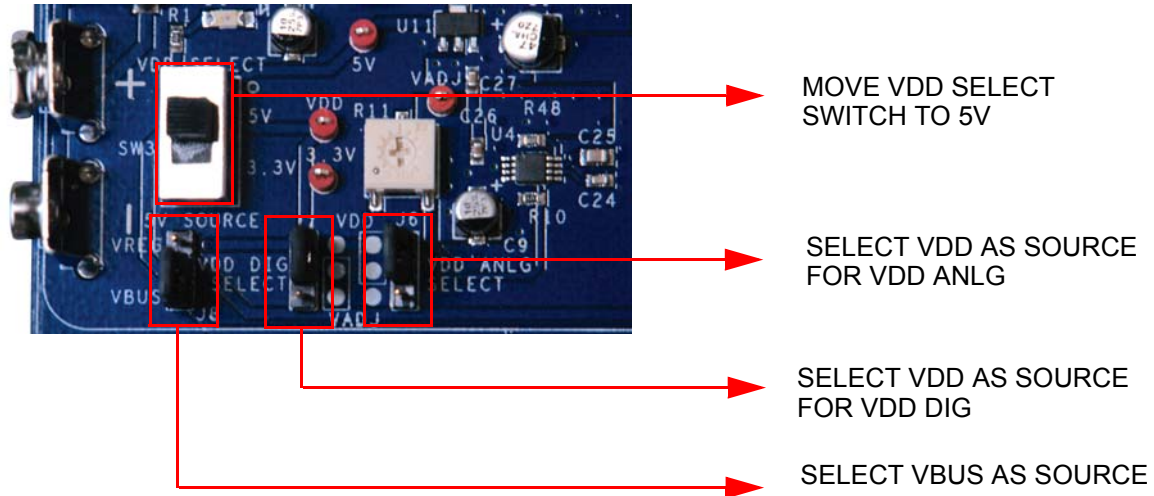


This helps to separate the digital supply from the analog supply and VDD.

A.1.2.5 Setting a 5V Supply from VBUS

1. Place the jumper on J8 header to select VBUS as the source.
2. Move the VDD select switch to select the 5V.
3. Place the jumper on J6 header to select VDD as source for VDD ANLG.
4. Place the jumper on J7 header to select VDD as source for VDD DIG.

Figure A-5. Setting a 5V Supply from VBUS



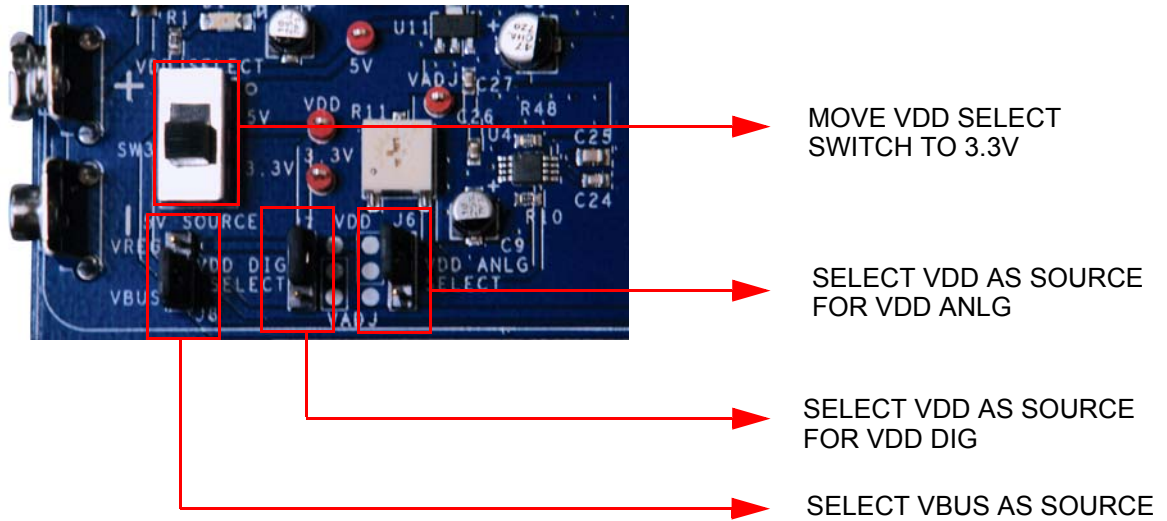
A.1.2.6 Setting a 3.3V Supply from VBUS

Due to the nature of the PSoC Development Board, powering the system from USB 'VBUS' could potentially reset other USB devices on the same hub.

By design, the PSoC Development Board is capable of drawing more than 500mA of current during normal operation, which exceeds USB bus power limits. Additionally, the development board exceeds inrush current limits due to 'VBUS' capacitance greater than 10uF. As a result, plugging the PSoC Development Board into a USB hub could potentially cause other devices on the same hub to reset due to excessive inrush currents. Careful consideration should be taken when powering the PSoC Development Board from 'VBUS'. In general, it is good practice to plug the PSoC Development Board into a host root hub, or a "self-powered" external hub when doing USB development. Bus powered applications done outside the realm of the PSoC Development Board should comply to the USB specification for inrush current limits and recommended bulk capacitance on 'VBUS'. See the [Universal Serial Bus Specification Revision 2.0](#) for more details.

1. Place the jumper on J8 header to select VBUS as the source.
2. Move the VDD select switch to select 3.3V.
3. Place the jumper on J6 header to select VDD as source for VDD ANLG.
4. Place the jumper on J7 header to select VDD as source for VDD DIG.

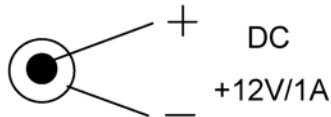
Figure A-6. Setting a 3.3V supply from VBUS



You can measure current from VREG, VBUS, VDD ANLG, VDD DIG and VDDIOs by removing the jumpers and connecting the meter across the respective header.

A.1.2.7 J1 - DC Power Jack

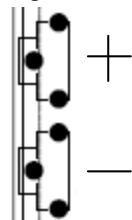
Figure A-7. DC Power Jack



Use a 12V/1A power supply adapter when powering from the barrel power jack. This input power is VIN.

A.1.2.8 9V Battery Terminals

Figure A-8. Battery Terminals



Use a 9V alkaline battery to connect to the 9V battery terminals. This input power is VIN.

A.1.2.9 J8 - 5V Source

This header allows you to select the 5V source from either the onboard 5V regulator (VREG) or from the USB 5V rail (VBUS).

A.1.2.10 VDD Select Switch

This switch allows for selecting either 5V or 3.3V. VDD feeds VDD DIG, VDD ANLG and VDDIO.

A.1.2.11 J7 - VDD DIG Select

This header allows you to select the PSoC core source power. If you need to power the PSoC core at either 5V or 3.3V (based on the position of the VDD select switch), place the jumper on the upper two pins. If you need to power the PSoC core at lower voltages (1.7V to 4.95V), then place the jumper on the lower two pins. When the jumper is on the lower two pins, you must adjust R11 to tune the adjustable regulator to output the desired voltage.

A.1.2.12 J6 - VDD ANLG Select

If you want to separate the analog power from the digital power, you can position the jumper on the upper two pins to source analog power at 5V or 3.3V (based on the position of the VDD select switch), or on the lower two pins to source analog power at lower voltages (1.7V to 4.95V).

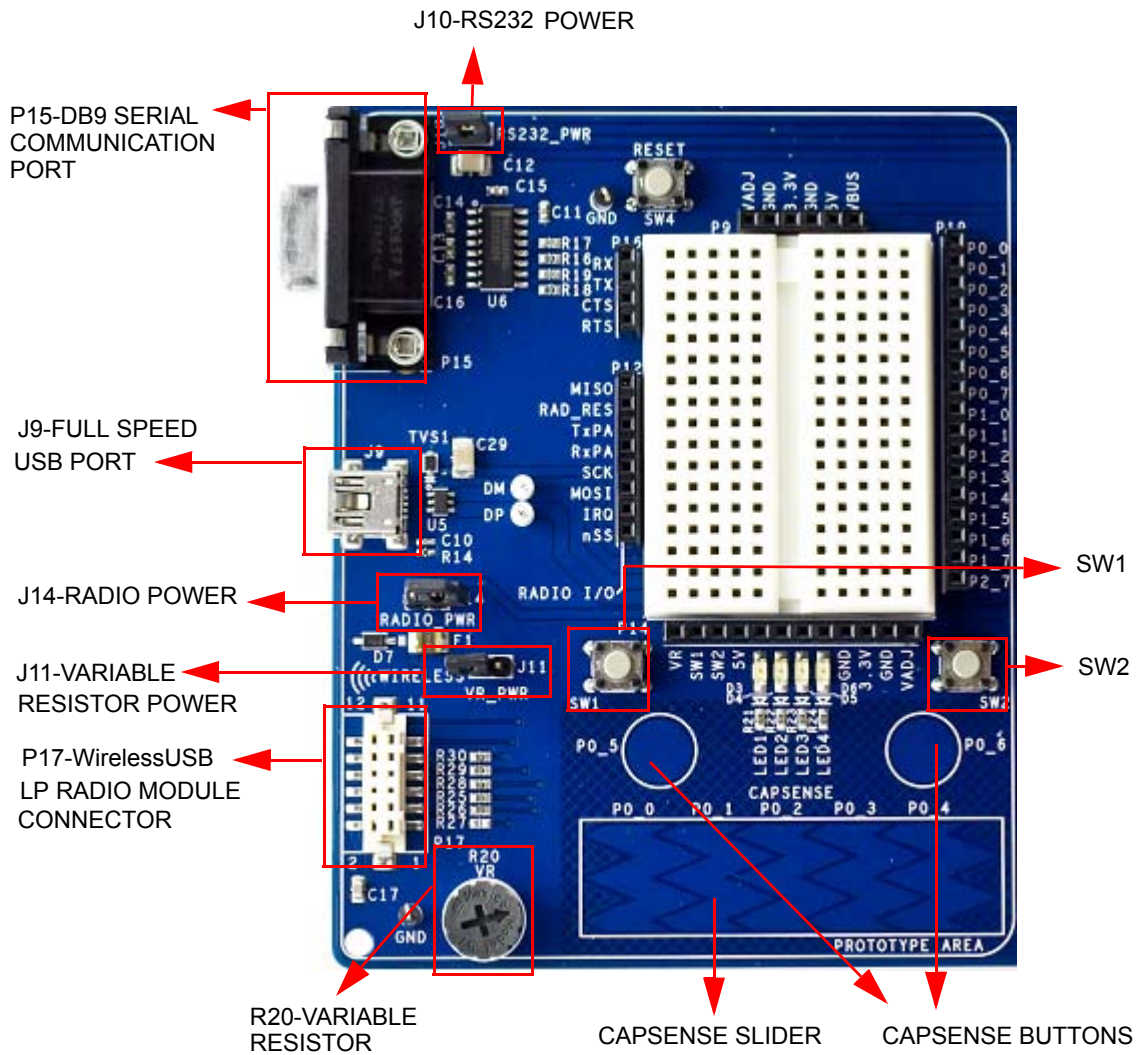
A.1.2.13 R11 - Adjustable Regulator Variable Resistor

This adjustable resistor is used to tune the VADJ voltage. Turning this variable resistor swings the VADJ voltage between 1.6V and 3.29V when the VDD select switch is in the 3.3V position. When the VDD select switch is in the 5V position, turning this variable resistor swings the VADJ voltage between 1.7V and 4.95V.

A.1.3 Prototyping Components

A.1.3.1 Prototyping Area

Note CY8C38 Family modules have a 2200pF capacitor connected between P2[7] and ground. CY8C55 Family modules have a 2200pF capacitor connected between P15[5] and ground. These configurations provide an external modulator capacitor for CapSense designs. If use of P2[7] on CY8C38 Family modules, or use of P15[5] on CY8C55 Family modules is required for anything other than CapSense, it is recommended that C18 on these modules be removed, so as to avoid disrupting digital or analog signals on this I/O pin.



A.1.3.2 P15 - DB9 Serial Communications Port

This is a standard female DB9 serial communications connector. Four signals are brought from the RS232 transceiver to receptacle P16. These signals are Rx, Tx, Clear To Send, and Request To Send. To connect these signals to the PSoC I/O pins, use wires to jumper from P16 to P19, where sockets for ports zero and one are available.

Table A-1. Connector Pin Assignments - RS232 (DTE) Serial Communications Socket

Pin Number	P15
1	(Empty)
2	TX
3	RX
4	(Empty)
5	GND
6	(Empty)
7	CTS
8	RTS
9	(Empty)

A.1.3.3 J10 - Serial Port Power

Header J10 must be jumpered in order to use the serial communications port. Placing a jumper on J10 provides VDD power to the RS232 transceiver. This power can be either 3.3V or 5V, depending on which the position of the VDD select switch.

A.1.3.4 J9 - Full Speed USB Port

The board has a mini-B full speed USB connector. There are also two test points for the differential pair signals D- and D+. These signals are routed to the processor module socket P1, pins 6 and 8 respectively. The power net VBUS is brought into the board through this interface.

A.1.3.5 P17 - Artaflex WirelessUSB LP Radio Module Receptacle

Receptacle P17 is used specifically for the Artaflex AWP24S WirelessUSB module. Eight signals are routed from this receptacle to P12 receptacle. These signals are 4 SPI (serial peripheral interface) signals MISO (master-in-slave-out), MOSI (master-out-slave-in), nSS (slave select), SCK (serial clock), an IRQ (interrupt request) and RD_RESET (radio reset). The other two signals are radio transmit and receive signals.

Note These I/O signals must not be greater than 3.3V.

Table A-2. Connector Pin Assignments - Wireless Radio Module Socket

Pin Number	P17
1	GND
2	V3_3
3	IRQ
4	RD_RESET
5	MOSI
6	nSS
7	SCK
8	MISO

Table A-2. Connector Pin Assignments - Wireless Radio Module Socket (*continued*)

Pin Number	P17
9	GND
10	(Empty)
11	TxPA
12	RxPA

A.1.3.6 J14 - Wireless Radio Module Power

Header J14 must be jumpered in order to use the Artaflex radio module. Placing a jumper on J14 provides 3.3V power to the P17 module socket. This power is drawn directly from the 3.3V regulator.

A.1.3.7 R20 - Multipurpose Variable Resistor

The board is equipped with a 10 k Ω thumbwheel variable resistor referenced to ground. The high side of the resistor is tied to jumper J11. The wiper is tied to a receptacle pin on P14.

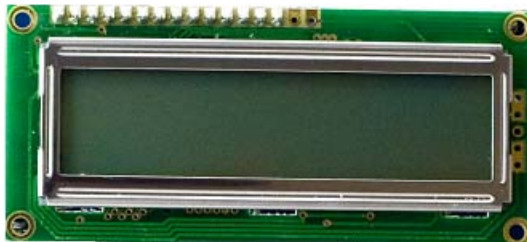
A.1.3.8 J11 - Variable Resistor Power

Header J11 must be jumpered in order to use the variable resistor. Placing a jumper on J11 provides VDD ANLG power to the high side of the resistor.

A.1.3.9 SW1 and SW2 - Multipurpose Push Button Switches

The board has two multipurpose mechanical push buttons, SW1 and SW2, that are referenced to ground. The other sides of the switches are tied to receptacle pins on P14. The switches follow an inverted logic as they connect ground to receptacle pins on P14 when pressed.

A.1.4 LCD Module



The board has a 2x16 alpha-numeric LCD. I/Os of the module are connected to port two of the PSoC device and are routed to the processor module socket P2. This LCD is rated for 5V. However, the I/Os have a level translator inline so that signaling may be as low as 1.8V and still be recognized by the LCD. The header J12 must be jumpered for the LCD Module to be powered. If J12 is not jumpered, it removes power from level translator. If the LCD module is removed, the receptacle pins of P18 can be used as port 2.

Table A-3. Connector Pin Assignments - LCD Module Socket

Pin Number	P18
1	GND
2	VCC_LCD
3	VO
4	RS
5	R/nW

Table A-3. Connector Pin Assignments - LCD Module Socket (*continued*)

Pin Number	P18
6	EN
7	D0
8	D1
9	D2
10	D3
11	D4
12	D5
13	D6
14	D7
15	BACKLT LED ANODE
16	BACKLT LED CATHODE

A.1.4.1 R31 - LCD Contrast Adjustment

The board is equipped with an LCD contrast adjustment resistor R31. Turning the wiper counter-clockwise increases the contrast, while turning the wiper clockwise decreases the contrast.

A.1.4.2 J12 - LCD Module Power

Power for the LCD module is provided through header J12. Placing a jumper on the upper two pins shorts the VCC pin of the module to ground. Placing the jumper on the lower two pins provides 5V to the VCC pin of the module. This 5V power is taken directly from the onboard 5V regulator.

A.1.5 CapSense Elements

The prototyping area has three capacitive sensing elements. There are two CapSense buttons connected directly to port zero pins. In addition, there is a five segment CapSense slider also connected directly to port zero. Series resistors are placed on these port zero I/Os and should be loaded with appropriate values. A value of 0Ω is used for general purpose CapSense applications, but a value of 560Ω should be used for achieving best performance. The board is loaded with 0Ω series resistors by default. The presence of CapSense elements does not affect the general purpose use of port zero pins.

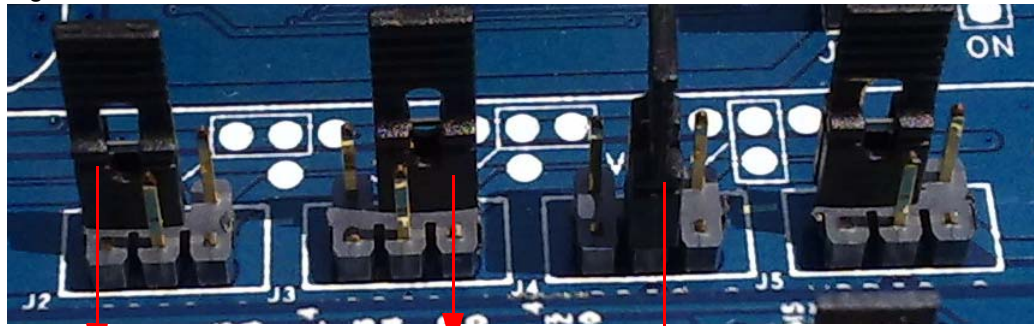
A.1.6 Processor Module

A.1.6.1 J2, J3, J4 and J5 - VDDIO Select

These four headers allow you to power the PSoC GPIOs at different voltages. For instance, some of the I/O may be powered at 5V, some at 3.3V and some at 1.8V. There are four blocks of GPIO, each having its own source power. Each VDDIO header provides power to specific GPIO's and is selectable from VDD, 3.3V or VADJ. For details on which GPIOs are powered by which VDDIO header, refer to the data sheet for the PSoC device used with this board.

For example, VDDIO_0 is configured to VDD, VDDIO_1 is configured to 3.3V and VDDIO_2 is configured to VADJ by placing the jumpers in the respective positions as shown in [Figure A-9](#).

Figure A-9. VDDIO Select



VDDIO_0=VDD(5V/3.3V) VDDIO_1=3.3V VDDIO_2=VADJ

A.1.6.2 SW4 - Processor Reset Button

The board has a push button switch that resets the PSoC device attached to the processor module. One side of the switch is tied to the XRES pin of the processor module socket. The other end of the switch is tied to the HW_RESET pin of the processor module socket. Doing this allows the module designer to tie the HW_RESET line either high or low, depending on which direction the processor reset is active.

Note PSoC 1 devices are active high reset. Therefore, a light pull-down resistor may be necessary on the XRES pin of designs with these devices to avoid unintentional device resets. PSoC 3 and PSoC 5 devices are active low reset. Therefore, a light pull-up resistor may be necessary on the XRES pin of designs with these devices to avoid unintentional device resets.

A.1.6.3 U8 - External MHz Oscillator

The board supports the use of an external high frequency 8-pin PDIP oscillator. The speed of the oscillator supported is dependent on the specifications of the PSoC device used. The output of this oscillator is routed to P15[4] on receptacle P2 and TP62 near P2 of the DVK board.

A.1.6.4 P1, P2, P3 and P4 - Processor Module Receptacles

Processor modules provide modularity to this board. Sockets P1-P4 are used to connect a processor module to the board. All supported GPIOs (including special I/Os), along with VDD DIG, VDD ANLG, 5V, 3.3V, VBUS and VBAT (only connected to a surface mount pad on the board) are connected to these receptacles. In addition, each of the VDDIO power pins are connected to these receptacles. The full speed USB D+ and D- signals are also connected to one of the sockets. Processor reset is connected to P1. Any "no connect" pins are brought out to surface mount test pads.

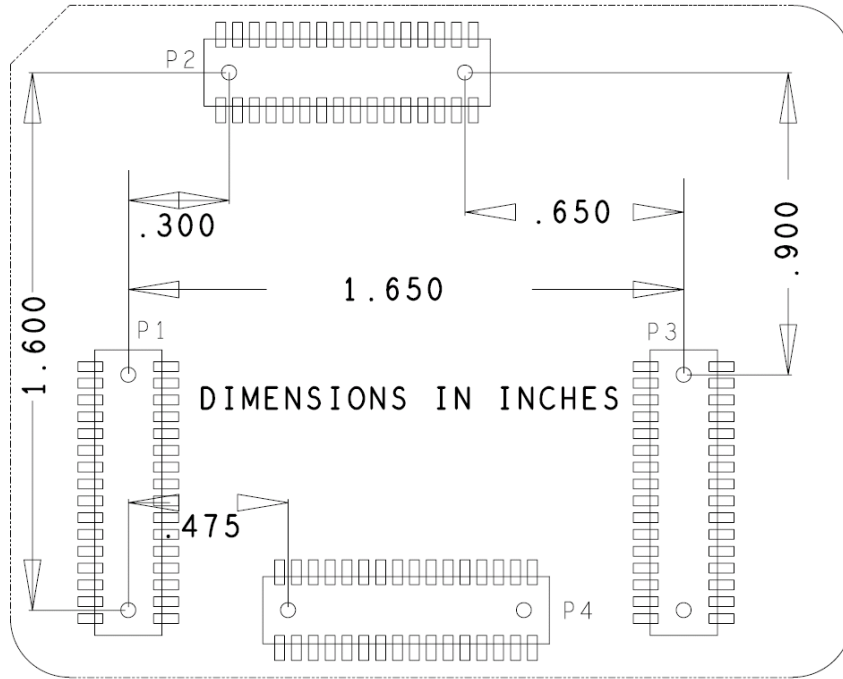
Table A-4. Connector Pin Assignments - Processor Module Sockets

Pin Number	P1 (West)	P2 (North)	P3 (East)	P4 (South)
1	GND	GND	GND	GND
2	VDDD	GND	GND	P7[7]
3	V5_0	P6[1]	P12[2]	NC7
4	GND	P6[0]	P12[3]	NC8
5	VBAT	P6[3]	P8[0]	NC5
6	DM	P6[2]	P8[1]	NC6
7	V3_3	P15[5]	P4[0]	NC3
8	DP	P15[4]	P4[1]	NC4

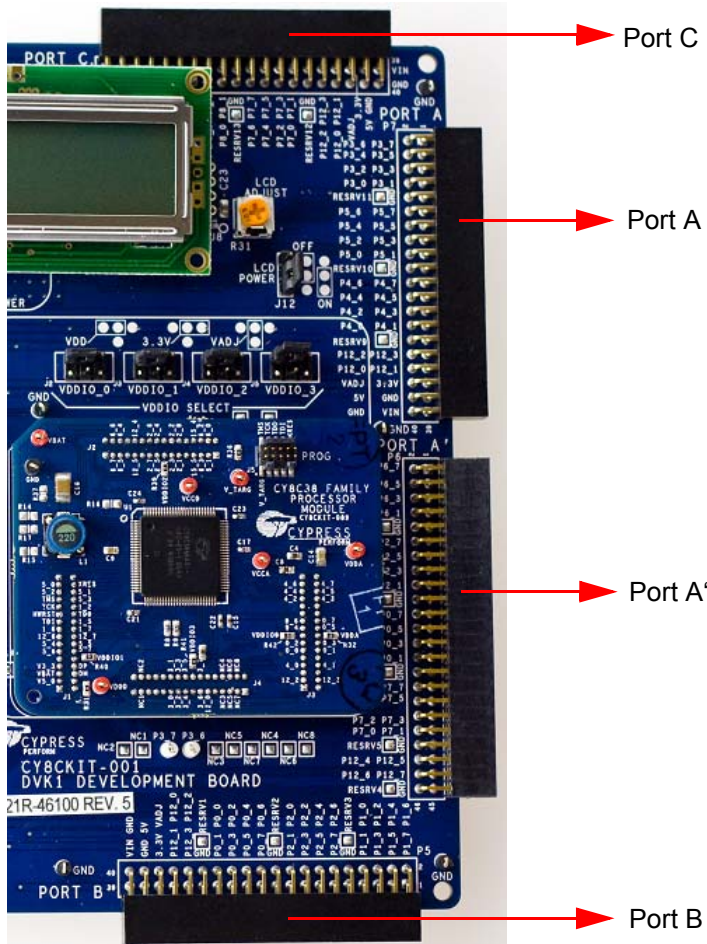
Table A-4. Connector Pin Assignments - Processor Module Sockets (*continued*)

Pin Number	P1 (West)	P2 (North)	P3 (East)	P4 (South)
9	VBUS	P9[2]	P8[2]	P7[6]
10	VDDIO1	P9[0]	P8[3]	P7[5]
11	P5[6]	P2[1]	P0[0]	P12[0]
12	P5[7]	P2[0]	P0[1]	P12[1]
13	P5[4]	P2[3]	P0[2]	P3[6]
14	P5[5]	P2[2]	P0[3]	P3[7]
15	P12[6]	VDDIO2	VDDIO0	P7[4]
16	P12[7]	P9[3]	VDDA	VDDIO3
17	P1[6]	P2[5]	P0[4]	P3[4]
18	P1[7]	P2[4]	P0[5]	P3[5]
19	P1[4]	P2[7]	P0[6]	P3[2]
20	P1[5]	P2[6]	P0[7]	P3[3]
21	HW_RESET	P9[4]	P8[4]	P3[0]
22	P1[3]	P9[5]	P8[5]	P3[1]
23	P1[1]	P12[5]	P8[6]	P7[2]
24	P1[2]	P12[4]	P8[7]	P7[3]
25	P1[0]	P9[6]	P4[2]	(Empty)
26	P5[3]	P9[7]	P4[3]	(Empty)
27	P5[2]	P6[5]	P4[4]	P7[0]
28	P5[1]	P6[4]	P4[5]	P7[1]
29	P5[0]	P6[7]	P4[6]	NC1
30	XRES	P6[6]	P4[7]	NC2
31	GND	GND	GND	GND
32	GND	GND	P9[1]	GND

Figure A-10. Mechanical Layout Details for Processor Module Connector



A.1.7 Expansion Ports



The board accommodates I/O expandability. Around the upper, lower and right sides of the board are 0.100" pitch, dual row right angle receptacles, each having at least three full 8-bit ports (one has four full ports). Each also has four special I/O pins available. Three of the ports have power and ground pins as well. The fourth is simply I/O and ground exclusively. These sockets can be used to join the processor module I/Os with external I/Os through the use of daughter boards.

Table A-5. Connector Pin Assignments - Expansion Port Sockets

Pin Number	P5 (PORT B)	P6 (PORT A')	P7 (PORT A)	P8 (PORT C)
1	P1[7]	P6[7]	P3[7]	P9[7]
2	P1[6]	P6[6]	P3[6]	P9[6]
3	P1[5]	P6[5]	P3[5]	P9[5]
4	P1[4]	P6[4]	P3[4]	P9[4]
5	P1[3]	P6[3]	P3[3]	P9[3]
6	P1[2]	P6[2]	P3[2]	P9[2]
7	P1[1]	P6[1]	P3[1]	P9[1]
8	P1[0]	P6[0]	P3[0]	P9[0]
9	GND	GND	GND	GND

Table A-5. Connector Pin Assignments - Expansion Port Sockets (*continued*)

Pin Number	P5 (PORT B)	P6 (PORT A')	P7 (PORT A)	P8 (PORT C)
10	RESRV3	RESRV8	RESRV11	RESRV14
11	P2[7]	P2[7]	P5[7]	P8[7]
12	P2[6]	P2[6]	P5[6]	P8[6]
13	P2[5]	P2[5]	P5[5]	P8[5]
14	P2[4]	P2[4]	P5[4]	P8[4]
15	P2[3]	P2[3]	P5[3]	P8[3]
16	P2[2]	P2[2]	P5[2]	P8[2]
17	P2[1]	P2[1]	P5[1]	P8[1]
18	P2[0]	P2[0]	P5[0]	P8[0]
19	GND	GND	GND	GND
20	RESRV2	RESRV7	RESRV10	RESRV13
21	P0[7]	P0[7]	P4[7]	P7[7]
22	P0[6]	P0[6]	P4[6]	P7[6]
23	P0[5]	P0[5]	P4[5]	P7[5]
24	P0[4]	P0[4]	P4[4]	P7[4]
25	P0[3]	P0[3]	P4[3]	P7[3]
26	P0[2]	P0[2]	P4[2]	P7[2]
27	P0[1]	P0[1]	P4[1]	P7[1]
28	P0[0]	P0[0]	P4[0]	P7[0]
29	GND	GND	GND	GND
30	RESRV1	RESRV6	RESRV9	RESRV12
31	P12[3]	P7[7]	P12[3]	P12[3]
32	P12[2]	P7[6]	P12[2]	P12[2]
33	P12[1]	P7[5]	P12[1]	P12[1]
34	P12[0]	P7[4]	P12[0]	P12[0]
35	V3_3	P7[3]	V3_3	V3_3
36	VADJ	P7[2]	VADJ	VADJ
37	GND	P7[1]	GND	GND
38	V5_0	P7[0]	V5_0	V5_0
39	VIN	GND	VIN	VIN
40	GND	RESRV5	GND	GND
41	x	P12[5]	x	x
42	x	P12[4]	x	x
43	x	P12[7]	x	x
44	x	P12[6]	x	x
45	x	GND	x	x
46	x	RESRV4	x	x

A.1.7.1 *Expansion Ports A and A'*

Expansion port A can be used as I/O ports with three full 8-bit ports port3, port4 and port5. It has four special I/Os as well as ground and voltage pins. It can be used to join processor module I/Os port3, port4, and port5 with external I/Os through the use of daughter boards.

Expansion port A' can be used as I/O ports with four full 8-bit ports port0, port2, port6 and port7. It has four special I/Os as well as ground pins. It has no voltage pins. It can be used to join processor module I/Os port0, port2, port6 and port7 with external I/Os through the use of daughter boards.

The main use of port A' is that it can be used together with port A to join processor module I/Os port0, port2, port3, port4, port5, port6 and port7 with external I/Os through the use of daughter boards.

A.1.7.2 *Expansion Port B*

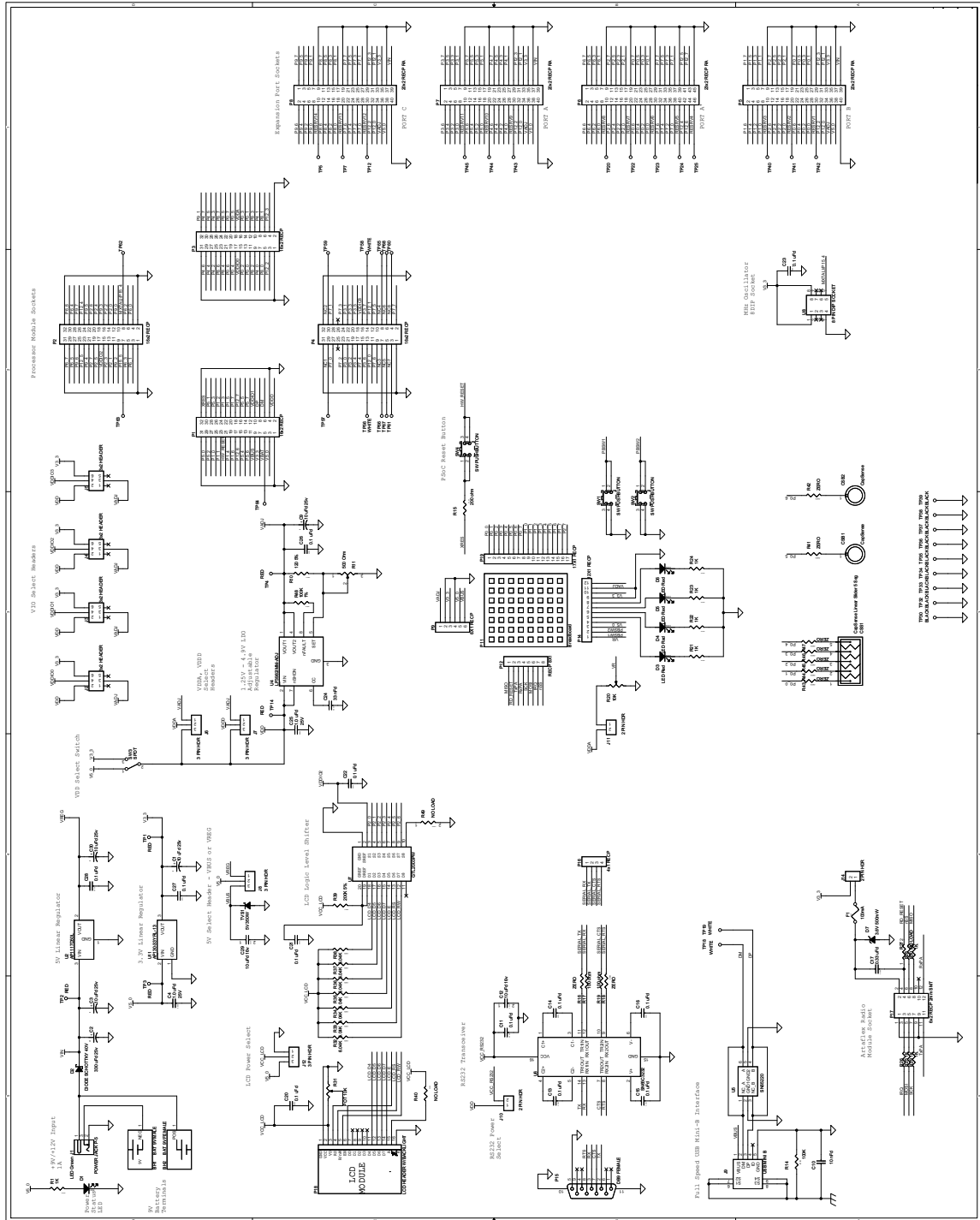
Expansion port B can be used as I/O ports with three full 8-bit ports port0, port1 and port2. It has four special I/Os as well as ground and voltage pins. It can be used to join processor module I/Os port0, port1, and port2 with external I/Os through the use of daughter boards. It is mainly used in devices with fewer I/Os.

A.1.7.3 *Expansion Port C*

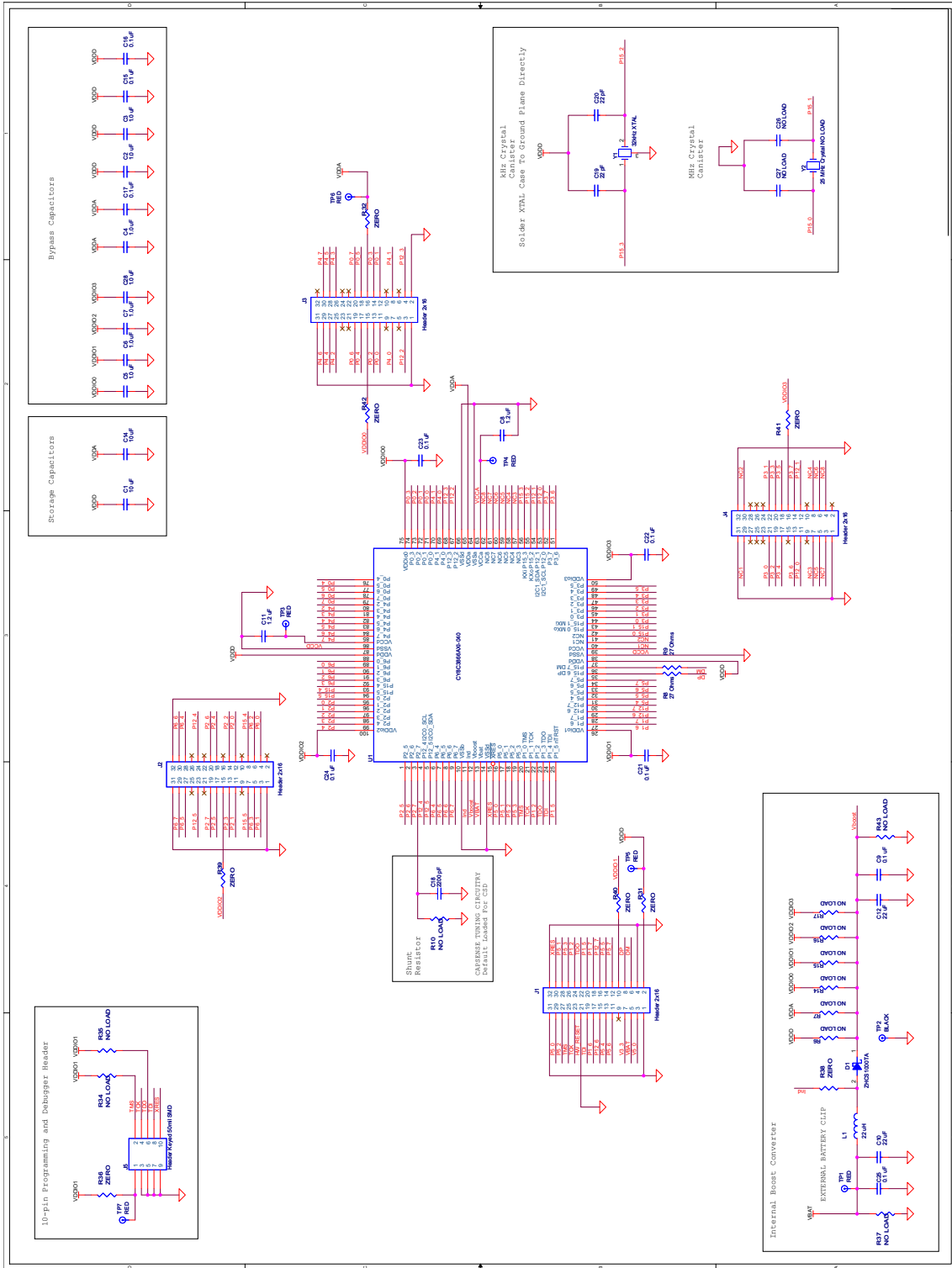
Expansion port C can be used as I/O ports with three full 8-bit ports port7, port8 and port9. It has four special I/Os as well as ground and voltage pins. It can be used to join processor module I/Os port7, port8, and port9 with external I/Os through the use of daughter boards. It is used for devices with a high I/O count.

A.2 Schematics

A.2.1 CY8CKIT-001 PSoC Development Board



A.2.4 CY8C38 Family Processor Module



A.3 Bill of Materials

A.3.1 CY8CKIT-001 PSoC Development Board

Item	Qty	Reference	Description	Manufacturer	Mfr Part Number
1	1	PCB	PRINTED CIRCUIT BOARD	Cypress Semiconductor	PDCR-9461 REV **
2	1	BH1	BATTERY HOLDER 9V Male PC MT	Keystone Electronics	593
3	1	BH2	BATTERY HOLDER 9V Female PC MT	Keystone Electronics	594
4	4	C1,C3,C9,C30	CAP ELECT 10UF 25V VS SMD size B	Panasonic - ECG	EEE-1EA100WR
5	1	C2	CAP ELECT 330UF 25V FK SMD	Panasonic - ECG	EEE-FK1E331P
6	2	C4,C25	CAP CERAMIC 1.0UF 25V X5R 0603 10%	Taiyo Yuden	TMK107BJ105KA-T
7	1	C10	CAP 10000PF 16V CERAMIC X7R 0402	Yageo America	04022R103K7B20D
8	10	C11,C13,C14, C15,C16,C21, C22,C26,C27, C28	CAP .10UF 16V CERAMIC X7R 0603	Kemet	C0603C104J4RACTU
9	2	C12,C29	CAP 10UF 16V CERAMIC X5R 1210	Panasonic - ECG	ECJ-4YB1C106K
10	1	C17	CAP .33UF 16V CERAMIC X7R 0805	Panasonic - ECG	ECJ-2YB1C334K
11	2	C20,C23	CAP .1UF 50V CERAMIC X7R 0805	Panasonic - ECG	ECJ-2YB1H104K
12	1	C24	CAP 33nF 50V CERAMIC X8R 0603	TDK Corporation	C1608X8R1H333K
13	1	D1	LED GREEN CLEAR 1206 SMD	Chicago Miniature Lamp, Inc	CMD15-21VGC/TR8
14	1	D2	DIODE SCHOTTKY 40V 1.5A SMA	Vishay IR	10MQ040NTRPBF
15	4	D3,D4,D5,D6	LED HI EFF RED CLEAR 1206 SMD	Chicago Miniature Lamp, Inc	CMD15-21VRC/TR8
16	1	D7	DIODE ZENER 3.6V 500MW SOD123	ON Semiconductor	MMSZ4685T1G
17	1	F1	FUSE RESETTABLE .10A 30V HLD SMD	Bourns	MF-USMF010-2
18	1	J1	CONN JACK POWER 2.1mm PCB RA	CUI	PJ-102A
19	4	J2,J3,J4,J5	CONN HEADER 6POS .100 STR 15AU	FCI	67996-206HLF
20	4	J6,J7,J8,J12	CONN HEADR BRKWAY .100 03POS STR	Tyco Electronics/Amp	9-146280-0-03
21	1	J9	CONN USB MINI B SMT RIGHT ANGLE	Tyco	1734035-2
22	3	J10,J11,J14	CONN HEADR BRKWAY .100 02POS STR	Tyco Electronics	9-146280-0-02
23	4	P1,P2,P3,P4	CONN FEMALE 32POS DL .050 SMT GOLD	Samtec	RSM-116-02-S-D-LC
24	3	P5,P7,P8	CONN FEMALE 40POS DL .100 R/A GOLD	Sullins Electronics Corp.	PPPC202LJBN-RC
25	1	P6	CONN FEMALE 46POS DL .100 R/A GOLD	Sullins Electronics Corp.	PPPC232LJBN-RC
26	1	P9	CONN RECT 6POS .100 VERT	3M	929850-01-06-RA
27	1	P11	SOLDERLESS BREADBOARD 1.8x1.35	3M	923273-I
28	1	P12	CONN RECT 8POS .100 VERT	3M	929850-01-08-RA
29	1	P14	CONN RECT 12POS .100 VERT	3M	929850-01-12-RA
30	1	P15	CONN D-SUB RCPT R/A 9POS 30GOLD	AMP Division of TYCO	5747844-4
31	1	P16	CONN RECEPT 4POS .100 VERT GOLD	3M	929850-01-04-RA
32	1	P17	CONN RECEPT 12POS 2mm SMD TIN	Hirose Electric Co. LTD.	DF11Z-12DS-2V(20)
33	1	P18	CONN REC .100 14POS for LCM-S01602DSR/A	3M	929850-01-14-RA
34	1	P19	CONN RECT 17POS .100 VERT	3M	929850-01-17-RA

Item	Qty	Reference	Description	Manufacturer	Mfr Part Number
35	10	R1,R21,R22, R23,R24,R25, R26,R28,R29, R30	RES 1.0K OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ102V
36	1	R10	RES 120 OHM 1/10W 5% 0603 SMD	Panasonic-ECG	ERJ-3GEYJ121V
37	1	R11	TRIMPOT 500 OHM 6mm SQ SMD	Bourns Inc.	3361P-1-501GLF
38	1	R14	RES 100K OHM 1/16W 5% 0402 SMD	Panasonic - ECG	ERJ-2GEJ104X
39	1	R15	RES 200 OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ201V
40	9	R16,R18,R41, R42,R43,R44, R45,R46,R47	RES ZERO OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEY0R00V
41	2	R17,R19	RES 100 OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ101V
42	1	R20	10K OHM THUMBWH CERM ST POT	BI Technologies	91AR10KLF
43	1	R31	POT 10K CARBON LAYDOWN (103)	Panasonic - ECG	EVN-D8AA03B14
44	7	R32,R33,R34, R35,R36,R37, R38	RES 6.04K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF6041V
45	1	R39	RES 200K OHM 1/10W 5% 0603 SMD	Panasonic-ECG	ERJ-3GEYJ204V
46	1	R48	RES 100K OHM 1/10W 1% 0603 SMD	Yageo	RC0603FR-07100KL
47	3	SW1,SW2,SW 4	SWITCH TACT 6mm MOM 150GF	Omron	B3F-1022
48	1	SW3	SWITCH SLIDE MINI SPDT PCMNT SLV	APEM Components	GH36P010001
49	5	TP1,TP2,TP3, TP4,TP14	TEST POINT 43 HOLE 65 PLATED RED	Keystone Electronics	5000
50	4	TP18,TP19,TP 56,TP58	TEST POINT 43 HOLE 65 PLATED WHITE	Keystone Electronics	5002
51	9	TP30,TP32,TP 33,TP34,TP35, TP36,TP37,TP 38,TP39	TEST POINT 43 HOLE 65 PLATED BLACK	Keystone Electronics	5001
52	1	TVS1	TVS 5.0 VOLT 350 WATT SOD-323	Semtech	SD05.TCT
53	1	U2	IC REG LDO 1.0A 5.0V TO-252	Diodes Inc	AP1117D50L-13
54	1	U4	IC REG LDO 0.3A ADJ 8MSOP	National Semiconductor	LP3982IMM- ADJ/NOPB
55	1	U5	IC SINGLE USB PORT TVS SOT-23-6	Texas Instruments	SN65220DBV
56	1	U6	IC LINE DRVR/RCVR RS232 16-SOIC	Texas Instrments	SN65C3232ED
57	1	U7	IC XLATR 8BIT LV 20-TSSOP	NXP Semiconductors	GTL2003PW
58	1	U8	IC SOCKET 8PIN MS TIN/TIN .300	Mill-Max Manufacturing	110-44-308-41-001000
59	1	U11	IC REG LDO 300mA 3.3V SOT89R	Diodes Inc	AP130-33YRL-13
60	1	NA	5V LCD Module 16POS w/14 pin header installed	Lumex	LCM-S01602DSR/A
61	5	NA	BUMPER WHITE .500X.23 SQUARE	Richco Plastics Co.	RBS-3R
62	11	NA	SHUNT GOLD W/HANDLE, BLACK	Kobiconn	151-8030-E
No Load Components					
63	2	R27,R49	RES NO LOAD 0603 SMD	NA	NA
64	1	R40	RES NO LOAD 0805 SMD	NA	NA

A.3.2 CY8C28 Family Processor Module

Item	Qty	Reference	Description	Manufacturer	Mfr Part Number
1	1	PCB	PRINTED CIRCUIT BOARD	Cypress Semiconductor	PDC-09547 REV **
2	1	C1	CAP CER 10UF 16V X5R 0805	Murata Electronics North America	GRM21BR61C106KE15L
3	2	C2,C6	CAP .10UF 16V CERAMIC X7R 0603	Kemet	C0603C104J4RACTU
4	1	C10	CAP 100PF 50V CERAMIC 0402 SMD	Panasonic - ECG	ECJ-0EC1H101J
5	1	C16	CAP CER 2200PF 50V 5% C0G 0603	Murata	GRM1885C1H222JA01D
6	4	J1,J2,J3,J4	CONN MALE 32POS DL .050 TH SHR D GOLD	Centronic Precision Electronic Co.	HHLHS32GB1
7	1	J5	CONN HEADER 5POS 0.1 VERT KEYED	Molex	22-23-2051
8	1	P1	HDR VERT 20POS HIROSE	Hirose	DF12-5.0-20DP-0.5V-81
9	4	R1,R3,R5,R7	RES 56 OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ560V
10	5	R2,R4,R6,R8,R11	RES 1.0K OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ102V
11	1	R9	RES ZERO OHM 1/16W 0402 SMD	Panasonic - ECG	ERJ-2GE0R00X
12	4	R10,R16,R17,R18	RES ZERO OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEY0R00V
13	3	TP1,TP3,TP5	TEST POINT 43 HOLE 65 PLATED RED	Keystone Electronics	5000
14	2	TP2,TP4	TEST POINT 43 HOLE 65 PLATED BLACK	Keystone Electronics	5001
15	2	NA	SMT Spacer/nut	PEM	SMTSO-440-8ET
16	1	U1	IC, 56 PIN SSOP OCD	Cypress Semiconductor	CY8C28000-24PVXI
17	1	LABEL1	PCA # Label		120-09547-0 REV **
No Load Components					
18	3	C12,C13,C14	CAP NO LOAD 0805	NA	NA
19	1	C15	CAP 0603 NO LOAD	NA	NA
20	4	R12,R13,R14,R15	RES NO LOAD 0603 SMD	NA	NA
21	1	D1	DIODE SCHOTTKY 40V 1.0A SOT23-3	Zetex	ZHCS1000TA
22	1	L1	INDUCTOR FIXED SMD 2.2uH 10%	Panasonic-ECG	ELJ-FC2R2KF
23	1	Y1	CRYSTAL 32.768 kHz CYL 12.5PF	Citizen America Corporation	CFS206 32.768KDZF-UB
24	2	TP6,TP7	TEST POINT 43 HOLE 65 PLATED WHITE	Keystone Electronics	5002

A.3.3 CY8C29 Family Processor Module

Item	Qty	Reference	Description	Manufacturer	Mfr Part Number
1	1	C1	CAP CER 10UF 16V X5R 0805	Murata Electronics North America	GRM21BR61C106KE15L
2	4	C2,C3,C4, C6	CAP .10UF 16V CERAMIC X7R 0603	Kemet	C0603C104J4RACTU
3	1	C10	CAP 100PF 50V CERAMIC 0402 SMD	Panasonic - ECG	ECJ-0EC1H101J
4	4	J1,J2,J3, J4	CONN MALE 32POS DL .050 TH SHRD GOLD	Centronic Precision Electronic Co.	HHLHS32GB1
5	1	J5	CONN HEADER 5POS 0.1 VERT KEYED	Molex	22-23-2051
6	1	P1	RECP VERT 20POS HIROSE	Hirose	DF12-5.0-20DP-0.5V-81
7	4	R1,R3,R5, R7	RES 56 OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ560V
8	5	R2,R4,R6, R8,R11	RES 1.0K OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ102V
9	1	R9	RES ZERO OHM 1/16W 0402 SMD	Panasonic - ECG	ERJ-2GE0R00X
10	3	R10,R12, R13	RES ZERO OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEY0R00V
11	2	TP1,TP3	TEST POINT 43 HOLE 65 PLATED RED	Keystone Electronics	5000
12	1	TP2	TEST POINT 43 HOLE 65 PLATED BLACK	Keystone Electronics	5001
13	1	U1	PSoC Mixed-Signal Array	Cypress Semiconductor	CY8C29000-24AXI
14	2	NA	SMT Spacer/nut	PEM	SMTSO-440-8ET
15	1	PCB	PRINTED CIRCUIT BOARD	Cypress Semiconductor	PDCR-9464 REV*A
16	1	LABEL1	PCA # Label		121R-46400 REV*B
No Load Components					
17	3	C12,C13, C14	CAP NO LOAD 0805	NA	NA
18	1	D1	DIODE SCHOTTKY 30V 200mW SOT23	Diodes Inc	BAT54-7-F
19	1	L1	INDUCTOR FIXED SMD 2.2uH 10%	Panasonic-ECG	ELJ-FC2R2KF
20	1	Y1	CRYSTAL 32.768 kHz CYL 12.5PF	Citizen America Corporation	CFS206 32.768KDZF-UB

A.3.4 CY8C38 Family Processor Module

Item	Qty	Reference	Description	Manufacturer	Mfr Part Number
1	1	N/A	PCB	Cypress Semiconductor	PDCR-9494 REV **
2	2	C1,C14	CAP CER 10UF 16V X5R 0805	Murata Electronics North America	GRM21BR61C106KE15L
3	7	C2,C3,C4, C5,C6,C7, C28	CAP CERAMIC 1.0UF 10V X5R 0603	Kemet	C0603C105K8PACTU
4	2	C8,C11	CAP CERAMIC 1.2UF 10V X5R 0805	Kemet	C0805C125K8PACTU
5	2	C9,C25	CAP .10UF 16V CERAMIC X7R 0603	Kemet	C0603C104J4RACTU
6	2	C10,C12	CAP CER 22UF 10V 10% X5R 1210	Kemet	C1210C226K8PACTU

7	7	C15,C16, C17,C21, C22,C23, C24	CAP .10UF 10V CERAMIC X5R 0402	Kemet	C0402C104K8PACTU
8	1	C18	CAP CER 2200PF 50V 5% C0G 0603	Murata	GRM1885C1H222JA01D
9	2	C19,C20	CAP CERAMIC 22PF 50V 0603 SMD	Panasonic - ECG	ECJ-1VC1H220J
10	1	D1	DIODE SCHOTTKY 40V 1A SOT23	Zetex	ZHCS1000TA
11	4	J1,J2,J3, J4	CONN MALE 32POS DL .050 TH SHRD GOLD	Centronic Precision Elec- tronic Co.	HHLHS32GB1
12	1	J5	CONN HEADER 10 PIN 50MIL KEYED SMD	Samtec	FTSH-105-01-L-DV-K
13	1	L1	INDUCTOR SHIELD PWR 22UH 7032	TDK Corporation	SLF7032T-220MR96-2-PF
14	2	R8,R9	RES 27 OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ270V
15	8	R31,R32, R36,R38, R39,R40, R41,R42	RES ZERO OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEY0R00V
16	6	TP1,TP3, TP4,TP5, TP6,TP7	TEST POINT 43 HOLE 65 PLATED RED	Keystone Electronics	5000
17	1	TP2	TEST POINT 43 HOLE 65 PLATED BLACK	Keystone Electronics	5001
18	1	U1	PSoC3 Mixed-Signal Array	Cypress Semiconductor	CY8C3866AXI-040ES2
19	1	Y1	CRYSTAL 32.768 kHz CYL 12.5PF	Citizen America Corpora- tion	CFS206 32.768KDZF-UB
No Load Components					
20	2	C26,C27	CAP, CER, 12 pF, 50V, 5%, COG, 0603, SMD	Murata Electronics North America	GRM1885C1H120JA01D
21	6	R6,R7,R14 ,R15,R16, R17	RES NO LOAD 0805 SMD	NA	NA
22	5	R10,R34, R35,R37, R43	RES NO LOAD 0603 SMD	NA	NA
23	1	Y2	CRYSTAL, 24 MHz, 30 ppm, HC49, SMD	ECS Inc.	ECS-240-12-5PX-TR

A.3.5 CY8C55 Family Processor Module

Item	Qty	Reference	Description	Manufacturer	Mfr Part Number
1	1	N/A	PCB	N/A	PDCR-9546 REV **
2	2	C1,C14	CAP, CER, 10 uF, 16 V, 5%, X5R, 0805, SMD	Murata Electronics North America	GRM21BR61C106KE15L
3	7	C2,C3,C4, C5,C6,C7, C28	CAP, CER, 1.0 uF, 10 V, 10%, X5R, 0603, SMD	Kemet	C0603C105K8PACTU
4	2	C8,C11	CAP, CER, 1.0 uF, 10 V, 10%, X5R, 0805, SMD	Murata	GRM219R61A105KC01D
5	2	C9,C25	CAP, CER, 0.1 uF, 16 V, 5%, X7R, 0603, SMD	Kemet	C0603C104J4RACTU
6	2	C10,C12	CAP, CER, 22 uF, 10 V, 10%, X5R, 1210, SMD	Kemet	C1210C226K8PACTU
7	8	C15,C16, C17,C21, C22,C23, C24,C29	CAP, CER, 0.1 uF, 16 V, 10%, X7R, 0402, SMD	Kemet	C0402C104K4RACTU
8	1	C18	CAP, CER, 2200 pF, 50V, 5%, COG, 0603, SMD	Murata	GRM1885C1H222JA01D
9	2	C19,C20	CAP, CER, 22 pF, 50V, 5%, COG, 0603, SMD	Panasonic - ECG	ECJ-1VC1H220J
10	1	D1	DIODE, SCHOTTKY, 40 V, 1 A, ZHCS1000TA, SOT-23, SMD	Zetex	ZHCS1000TA
11	4	J1,J2,J3, J4	CONN, HDR, 2x16, 0.05", GOLD, TH	Centronic Precision Electronic Co.	HHLHS32GB1
12	2	J5,J6	CONN, HDR, KEYED, 2x5, 0.050", Gold, SMD	Digilent	161-026
13	1	L1	IND, FIXED, 22 uH, 20%, .960 A, 7032, SMD	TDK Corporation	SLF7032T-220MR96-2-PF
14	2	R8,R9	RES, 27 Ohms, 1/10 W, 5%, 0603, SMD	Panasonic - ECG	ERJ-3GEYJ270V
15	13	R31,R32, R36,R38, R39,R40, R41,R42, R45,R46, R47,R48, R49	RES ZERO OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEY0R00V
16	1	R44	RES, 0.0 Ohms, 1/8 W, 5%, 0805, SMD	Panasonic - ECG	ERJ-6GEY0R00V
17	7	TP1,TP3, TP4,TP5, TP6,TP7, TP8	CONN, TEST POINT, RED, TH	Keystone Electronics	5000
18	2	TP2,TP9	CONN, TEST POINT, BLACK, TH	Keystone Electronics	5001
19	1	U1	IC, PSoC5, 64K, CY8C5588AXI-060, TQFP-100, SMD	Cypress Semiconductor	CY8C5588AXI-060 ES1
20	1	Y1	CRYSTAL 32.768 KHZ CYL 12.5PF CFS308	Citizen America Corporation	CFS206 32.768KDZF-UB
No Load Components					
21	2	C26,C27	CAP NO LOAD 0603 SMD	NA	NA

Item	Qty	Reference	Description	Manufacturer	Mfr Part Number
22	6	R6,R7,R14 ,R15,R16, R17	RES NO LOAD 0805 SMD	NA	NA
23	5	R10,R34, R35,R37, R43	RES NO LOAD 0603 SMD	NA	NA
24	1	TP10	TEST POINT 43 HOLE 65 PLATED WHITE	NA	NA
25	1	Y2	CRYSTAL, 24 MHz, 30 ppm, HC49, SMD	ECS Inc.	ECS-240-12-5PX-TR

Appendix B. MiniProg3



B.1 MiniProg3 LEDs

MiniProg3 provides five indicator LEDs:

- Upper Left - Busy: A red LED that lights when an operation (such as programming or debug) is in progress.
- Lower Left - Status: A green LED that lights when the device is enumerated on the USB bus and flashes when the MiniProg3 receives USB traffic.
- Upper Right - Target Power: A red LED that lights to indicate that the MiniProg3 is supplying power to the target connectors. Note that it does not light when target power is detected but not being supplied by MiniProg3.
- Lower Right - Aux: A yellow LED reserved for future use.
- Middle - No Label: A yellow LED that indicates the configuration state of the device. It flashes briefly during the initial configuration of the device. If this LED lights solid, a configuration error has occurred and MiniProg3 must be disconnected from the USB port and reconnected.

B.2 Programming in Power Cycle Mode

You should not perform power cycle mode programming with PSoC Programmer on the CY8CKIT-001. This is due to the way the CY8C38 family module is designed. VTARG of the MiniProg3 is wired exclusively to VDDIO1 of the chip on the module. In order for power cycle programming to work, VTARG would need to be wired to VDDD.

B.3 Interface Pin Assignment Table

5-Pin # *	10-Pin # *	JTAG **	SWD	SWV	ISSP	I2C
1	1	Vtarg	Vtarg	Vtarg	Vtarg	Vtarg
2	3,5,7,9	GND	GND	GND	GND	GND
3	10	TRST		SWO	XRES	INT
4	4	TCK	SCK		SCLK	SCLK
5	2	TMS	SDIO		SDAT	SDAT
	6	TDO				
	8	TDI				

- Notes:
- * The 5- and 10-pin connectors are NOT connected together on the I/O pins
 - ** JTAG is supported only on the 10-pin connector
 - *** Future upgrades may be possible to support these modes

B.4 Protection Circuitry

The Vtarg and I/O pins of the two interface connectors are protected from ESD events and momentary short circuits by a group of TVS (Transient Voltage Suppressor) diodes. These diodes provide a 15 KV ESD event protection for each pin, and will clamp the pin levels to a safe voltage in the event of a short circuit. The Vtarg pins are protected by a shared, 5V clamp device capable of shunting 350W of transient power. Each I/O pin is similarly protected by a 5V, 30W device.

B.5 Level Translation

The design provides level translators that interfaces with any I/O voltage in the range of 1.2V to 5.5V without damage and function properly. There are actually two different level translators used in the design.

Appendix C. MiniProg3 Technical Description



The MiniProg3 is a protocol translation device. It enables PC host software to communicate through high speed USB to the target device to be programmed or debugged. This is shown in Figure C-1. The device side communication protocol can be one of several standards, and can occur over either of two connectors. Table C-1 lists the protocols that are supported by each connector. MiniProg3 enables communication with target devices using IO voltage levels from 1.5V to 5.5V. In addition, MiniProg3 can provide power to a simple target board, at one of four voltage levels.

Figure C-1. System Block Diagram

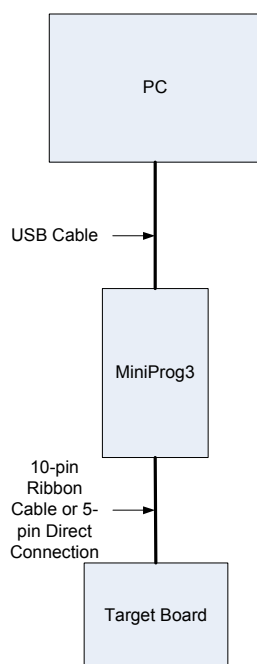


Table C-1. Connectors / Communication Protocol Support

Connector	ISSP	JTAG	SWD and SWV ^a	I ² C
5-pin	Supported	N/A	SWD	Supported
10-pin	N/A	Supported	SWD and SWV	N/A

a. SWV trace is only available with SWD debugging.

C.1 Interfaces

C.1.1 ISSP

In-System Serial Programming (ISSP) is a Cypress legacy interface used to program the PSoC1 family of microcontrollers. MiniProg3 supports programming PSoC1 devices through the 5-pin connector only.

For more information about the ISSP interface, refer to the PSoC1 Technical Reference Manual.

C.1.2 JTAG

The Joint Test Action Group (JTAG) standard interface is supported by many high end microcontrollers, including the PSoC 3/ PSoC 5 families. This interface allows a daisy chain bus of multiple JTAG devices. MiniProg3 supports programming and debugging PSoC 3/ PSoC 5 devices using JTAG, through the 10-pin connector only.

C.1.3 SWD/SWV

Recent ARM based devices have introduced a new serial debugging standard called Serial Wire Debug (SWD). The PSoC 3/ PSoC 5 family implements this standard, which offers the same programming and debug functions as JTAG, except the boundary scan and daisy chain. SWD uses fewer pins of the device than the JTAG standard uses. MiniProg3 supports programming and debugging PSoC 3/ PSoC 5 devices, using SWD, through the 5-pin or 10-pin connector.

The Single Wire Viewer (SWV) interface, also introduced by ARM, is used for program and data monitoring, where the firmware may output data in a method similar to 'printf' debugging on PCs, using a single pin. MiniProg3 supports monitoring of PSoC 3/ PSoC 5 firmware, using SWV, through the 10-pin connector and in conjunction with SWD only.

C.1.4 I²C™

A common serial interface standard is the Inter-IC Communication (I²C) standard by Philips. It is mainly used for communication between microcontrollers and other ICs on the same board, but can also be used for intersystem communications. MiniProg3 implements an I²C multimaster host controller that allows the tool to exchange data with I²C enabled devices on the target board. For example, this feature may be used to tune CapSense designs.

For more information on the PSoC 3/ PSoC 5 JTAG, SWD, SWV, and I²C interfaces, refer to the PSoC 3/ PSoC 5 Technical Reference Manual. For more information on PSoC 1 interfaces, refer to the PSoC 1 Technical Reference Manual.

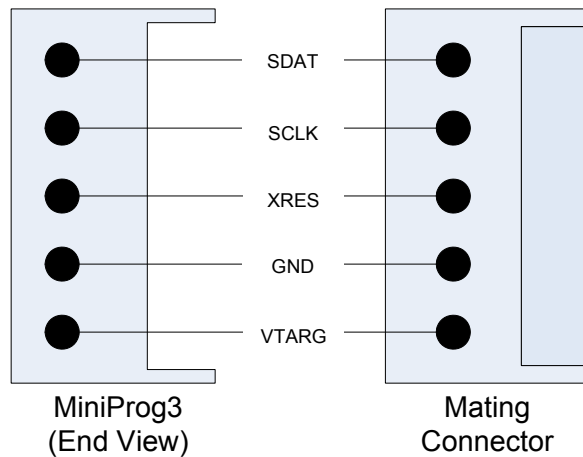
C.2 Connectors

Warning: It is recommended that a keyed 10-pin or 5-pin connector be used on target board applications as programmer/debugger headers for the MiniProg3. The I/O's of the MiniProg3 have very limited series protection against over current. Therefore, plugging the MiniProg3 into a programming/debugger header backwards could potentially damage the MiniProg3.

C.2.1 5-Pin Connector

The 5-pin connector is configured as a single row with 100 mil pitch. It is designed to mate with a Molex model 22-23-2051 (straight) or 22-05-3051 (right angle) male header, with key tab. The signal assignment is shown in this figure.

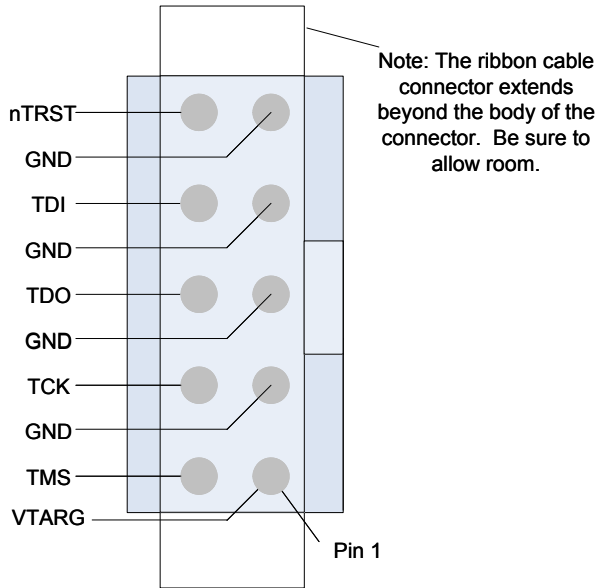
Figure C-2. 5-Pin Connector with Pin Assignments



C.2.2 10-Pin Connector

The 10-pin connector is configured as a dual row with 50 mil pitch. It is used with a ribbon cable (provided) to mate to a similar connector on the target board. The recommended mating connectors are the Samtec FTSH-105-01-L-DV-K (surface mount) and the FTSH-105-01-L-D-K (through hole) or similar available from other vendors. The signal assignment is shown in this figure.

Figure C-3. 10-Pin Connector with Pin Assignments



Here is a summary of the protocols and related pin assignments.

Table Appendix C-2. Communication Protocol Pin Assignments

Protocol	Signal	5-Pin	10-Pin
ISSP	SCLK	4	
	SDAT	5	
	XRES	3	
JTAG	TMS		2
	TCK		4
	TDO		6
	TDI		8
	XRES		10
SWD / SWV	SDIO	5	2
	SCK	4	4
	SWV ^a		6
	XRES	3	10
I2C	SCK	4	
	SDA	5	

a. SWV trace is only available in conjunction with SWD debugging.

C.3 Power

MiniProg3 requires a connection to the Vddio supply of the target device to set the voltage level used for communication. This is required regardless of the communication protocol and the port selected. One of the connectors' VTARG pins must be connected to the Vddio supply of the target device. For PSoC 3/ PSoC 5, this is the Vddio1 supply, because this is the supply used to drive the debug pins. Failing to connect VTARG, or connecting it to the wrong supply results in MiniProg3 being unable to communicate with the target device.

On boards where there is a single power supply for the entire board, the MiniProg3 can, in some cases, supply power to the board. This supply is limited to approximately 200 mA, and is protected against excess current draw. The power supply voltage can be selected from one of 1.8V, 2.5V, 3.3V, or 5V. The 5V supply may be as low as 4.25V or as high as 5.5V, as it is supplied directly from the USB port.

