CY8CKIT-050

PSoC® 5LP Development Kit Guide

Doc. # 001-65816 Rev. *E

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Contents

1. Introduction

Thank you for your interest in the CY8CKIT-050 PSoC® 5 Development Kit. This kit allows you to develop precision analog and low-power designs using PSoC 5LP. You can design your own projects with PSoC Creator™ or alter the sample projects provided with this kit.

The CY8CKIT-050 PSoC 5LP Development Kit is based on the PSoC 5LP family of devices. PSoC 5LP is a Programmable System-on-Chip™ platform for 8-bit, 16-bit, and 32-bit applications. It combines precision analog and digital logic with a high-performance CPU. With PSoC, you can create the exact combination of peripherals and integrated proprietary IP to meet your application requirements.

1.1 Kit Contents

The PSoC 5LP Development Kit contains:

- Development board
- Kit CD
- Quick start guide
- USB A to mini B cable
- 3.3 V LCD module

Inspect the contents of the kit; if you find any part missing, contact your nearest Cypress sales office for help.

1.2 PSoC Creator

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

With PSoC Creator, you can:

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

PSoC Creator also enables you to tap into an entire tools ecosystem with integrated compiler tool chains, RTOS solutions, and production programmers to support both PSoC 3 and PSoC 5LP.

1.3 Additional Learning Resources

Visit http://www.cypress.com/go/psoc5 for additional learning resources in the form of datasheets, technical reference manual, and application notes.

1.3.1 Beginner Resources

AN77759 - Getting Started with PSoC 5

PSoC Creator Training

1.3.2 Engineers Looking for More

AN54460 - PSoC 3 and PSoC 5 Interrupts

AN52705 - PSoC 3 and PSoC 5 - Getting Started with DMA

AN52701 - PSoC 3 - How to Enable CAN Bus Communication

AN54439 - PSoC 3 and PSoC 5 External Crystal Oscillators

AN52927 - PSoC 3: Segment LCD Direct Drive

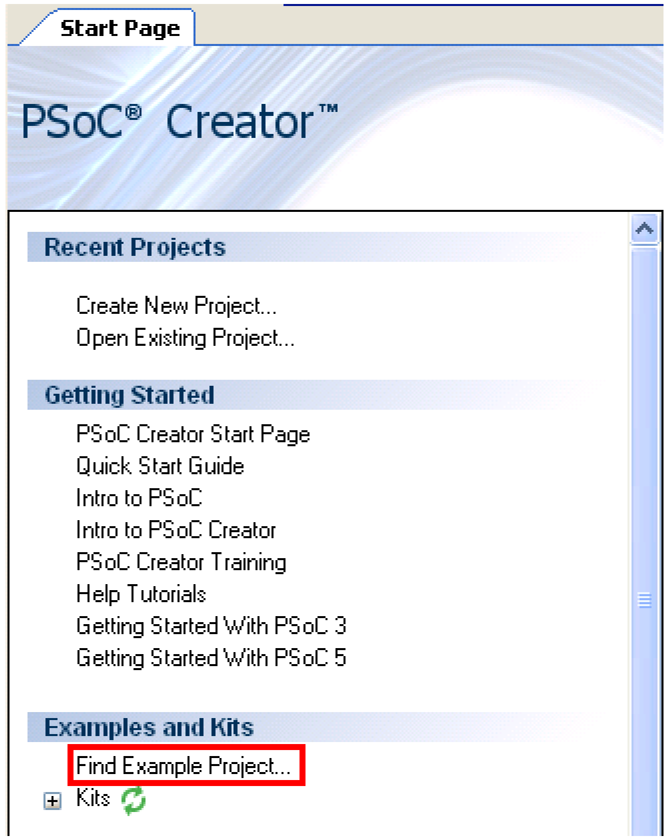
Cypress continually strives to provide the best support. Click here to view a growing list of application notes for PSoC 3 and PSoC 5LP.

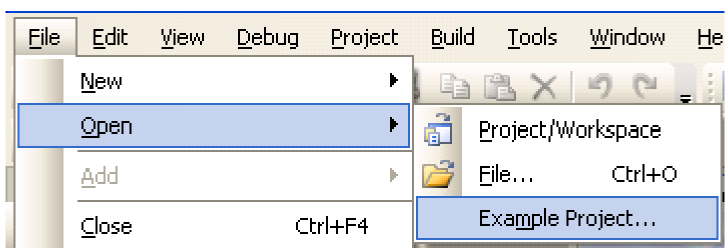
1.3.3 Learn from Peers

Cypress Developer Community Forums

1.3.4 More Code Examples

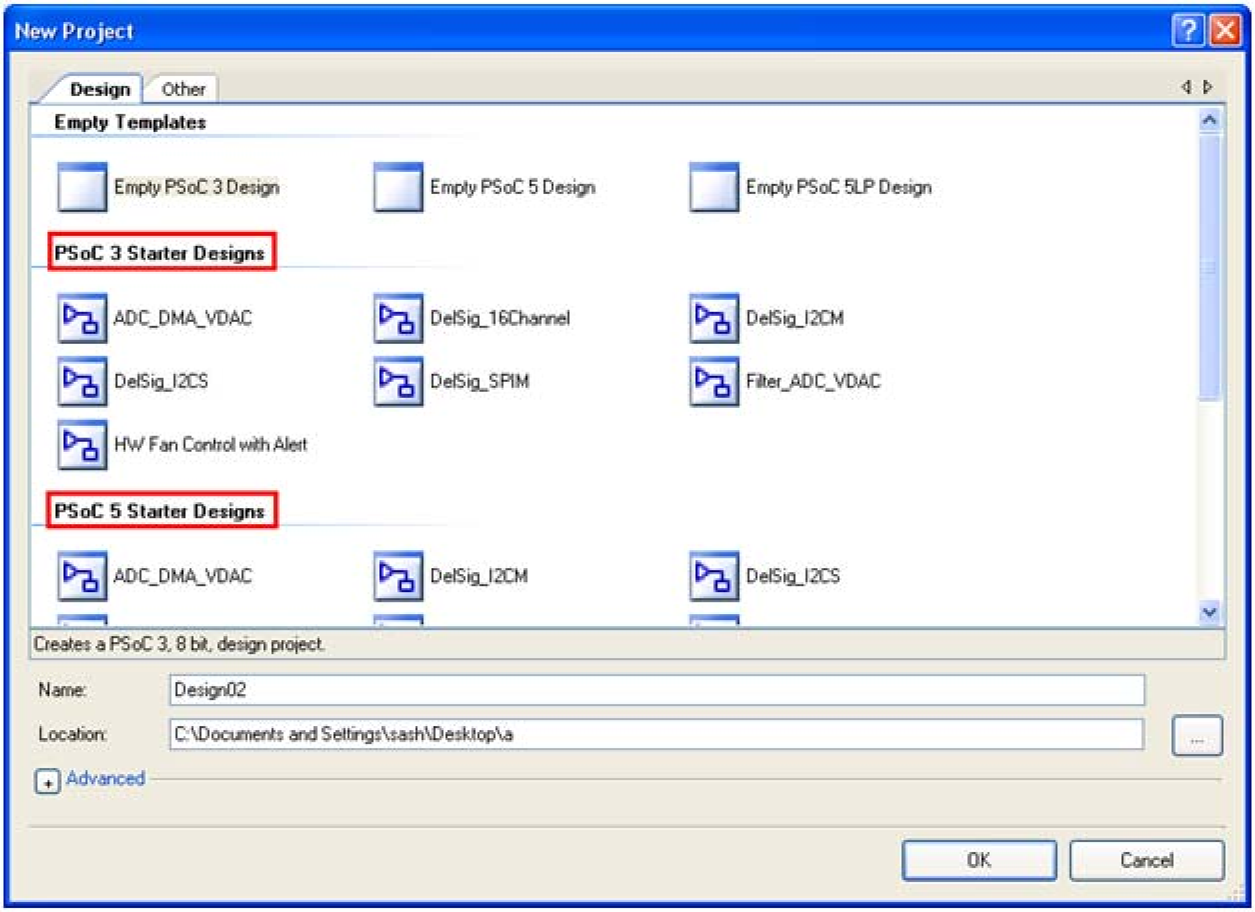
PSoC Creator provides a host of example projects that makes the code development very fast and easy. To access these example projects, click on the **Find Example Project…** under **Example and Kits** section in **Start Page** of PSoC Creator or by navigating to File->Open-Example Project…





The Find Example project has various filters that help you locate the most relevant project you are looking for.

PSoC Creator provides several Starter Designs. These designs highlight features that are unique to PSoC devices. They allow you to create a design with various components and code is also provided, instead of creating a new empty design. To use a starter design for your project, navigate to File->New->Project and select the design required.



The example projects and starter designs are designed for CY8CKIT-001 PSoC Development Kit. However, these projects can be converted for use with CY8CKIT-030 PSoC 3 Development Kit or CY8CKIT-050 PSoC 5 Development Kit by following the procedure in the knowledge base article Migrating project from CY8CKIT-001 to CY8CKIT-030 or CY8CKIT-050.

Apart from the example projects and starter designs that are available within PSoC Creator, Cypress continuously strives to provide the best support. Click here to view a growing list of application notes for PSoC 3 and PSoC 5.

1.4 Document History

Revision	PDF Creation Date	Origin of Change	Description of Change
**	03/01/2011	PVKV	Initial version of kit guide
*A	04/28/2011	RKAD	Updated Schematic
*B	12/15/2011	RKAD	Added sections 4.2.1.4 and 4.2.1.5. Added Pin Assignment table in the Appendix. Updated bill of materials. Content updates throughout the document
*C	05/15/2012	SASH	Updated the Additional Resources section
*D	06/18/2012	SASH	Updated CD Installation on page 11.
*E	11/08/2012	SASH	Updated images

1.5 Documentation Conventions

Table 1-1. Document Conventions for Guides

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

2. Getting Started

2.1 Introduction

This chapter describes how to install and configure the PSoC 5LP Development Kit. Chapter 3 describes the kit operation. It explains how to program a PSoC 5LP device with PSoC Programmer and use the kit with the help of a code example. To reprogram the PSoC device with PSoC Creator, see the CD installation instructions for PSoC Creator. Chapter 4 details the hardware operation. Chapter 5 provides instructions to create a simple code example. The Appendix section provides the schematics and bill of materials associated with the PSoC 5LP Development Kit.

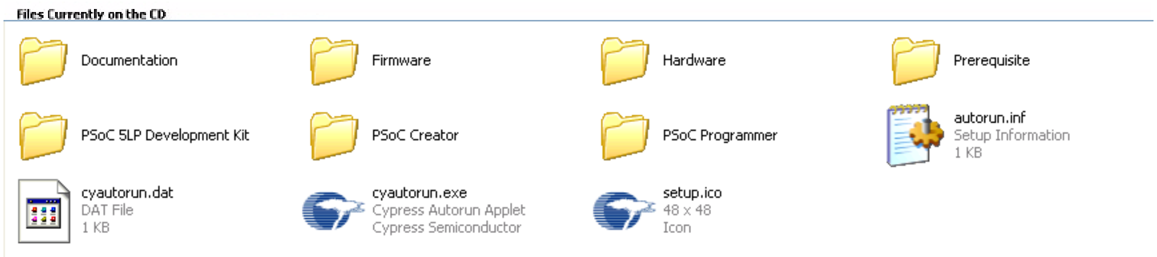
2.2 CD Installation

Follow these steps to install the PSoC 5LP Development Kit software:

1. Insert the kit CD into the CD drive of your PC. The CD is designed to auto-run and the kit menu appears.

Figure 2-1. Kit Menu

Note If auto-run does not execute, double-click *cyautorun.exe* on the root directory of the CD.



After the installation is complete, the kit contents are available at the following location:
<Install_Directory>:\PSoC 5LP Development Kit\<version>

2.3 Install Hardware

No hardware installation is required for this kit.

2.4 Install Software

When installing the PSoC 5LP Development Kit, the installer checks if your system has the required software. These include PSoC Creator, PSoC Programmer, Windows Installer, .NET, Acrobat Reader, and KEIL Complier. If these applications are not installed, the installer prompts you to download and install them.

Install the following software from the kit CD:

- PSoC Creator
- PSoC Programmer 3.16 or later
  Note When installing PSoC Programmer, select **Typical** on the Installation Type page.
- Code examples (provided in the Firmware folder)

2.5 Uninstall Software

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

- Go to **Start** > **Control Panel** > **Add or Remove Programs**; select the **Remove** button.
- Go to **Start** > **All Programs** > **Cypress** > **Cypress Update Manager** > **Cypress Update Manager**; select the **Uninstall** button.
- Insert the installation CD and click **Install PSoC 5LP Development Kit** button. In the **CyInstaller for PSoC 5LP Development Kit 2.1** window, select **Remove** from the Installation Type drop-down menu. Follow the instructions to uninstall.

2.6 Verify Kit Version

To know the kit revision, look for the white sticker on the bottom left, on the reverse of the kit box. If the revision reads CY8CKIT-050B Rev **, then, you own the latest version.

To upgrade CY8CKIT-050/CY8CKIT-050A to CY8CKIT-050B, you can purchase our latest kits at http://www.cypress.com/go/CY8CKIT-050.

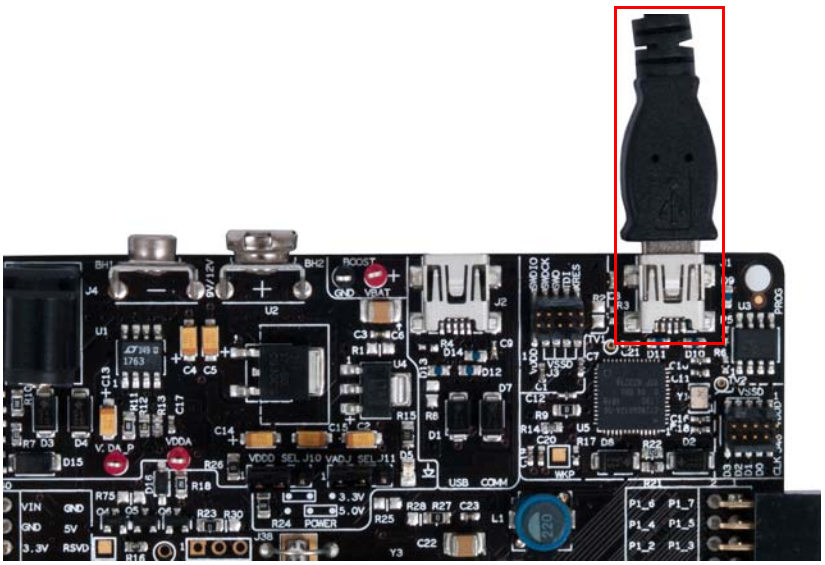
3. Kit Operation

The code examples in the PSoC 5LP Development Kit help you develop applications using the PSoC 5LP family of devices. The kit is designed to develop precision analog applications using PSoC 5LP. The board also has hooks to enable low-power measurements for low-power application development and evaluation.

3.1 Programming PSoC 5LP Device

The default programming interface for the board is a USB-based on-board programming interface. To program the device, plug the USB cable to the programming USB connector J1, as shown in the following figure.

Figure 3-1. Connect USB Cable to J1



When plugged in, the board enumerates as DVKProg5. After enumeration, initiate, build, and then program using PSoC Creator.

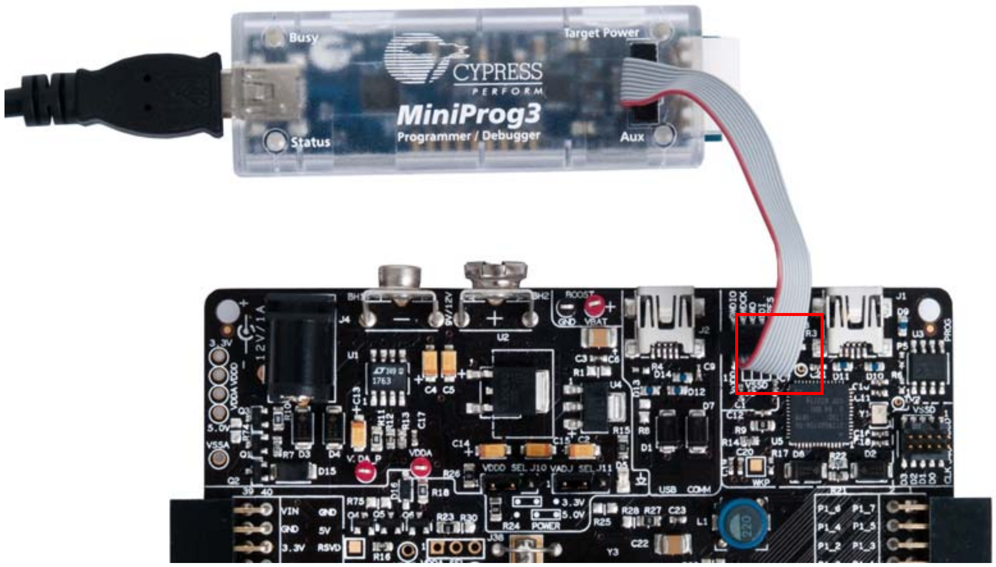
When using on-board programming, it is not necessary to power the board from the 12-V or 9-V DC supply or a battery. The USB power to the programming section can be used.

If the board is already powered from another source, plugging in the programming USB does not damage the board.

The PSoC 5LP device on the board can also be programmed using a MiniProg3 (CY8CKIT-002). To use MiniProg3 for programming, use the connector J3 on the board, as shown in Figure 3-2.

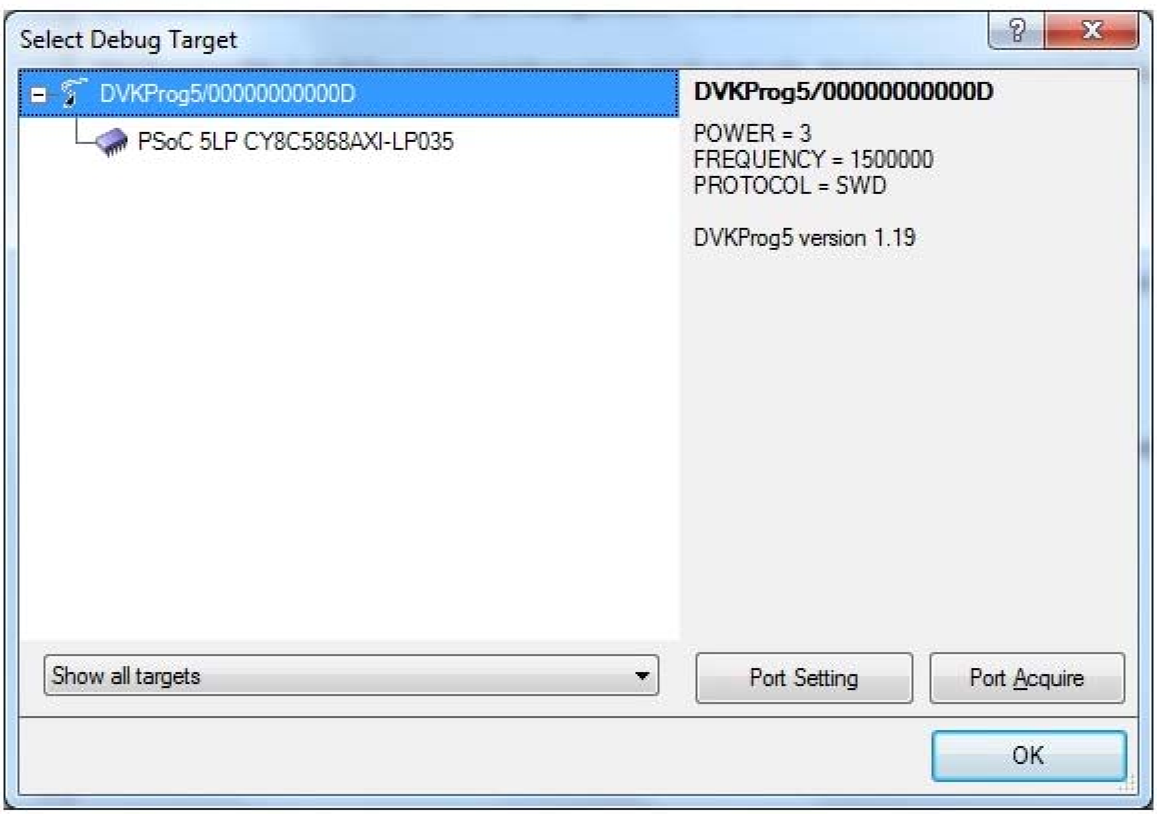
Note The MiniProg3 (CY8CKIT-002) is not part of the PSoC 5LP Development Kit contents. It can be purchased from the Cypress Online Store.

Figure 3-2. Connect MiniProg

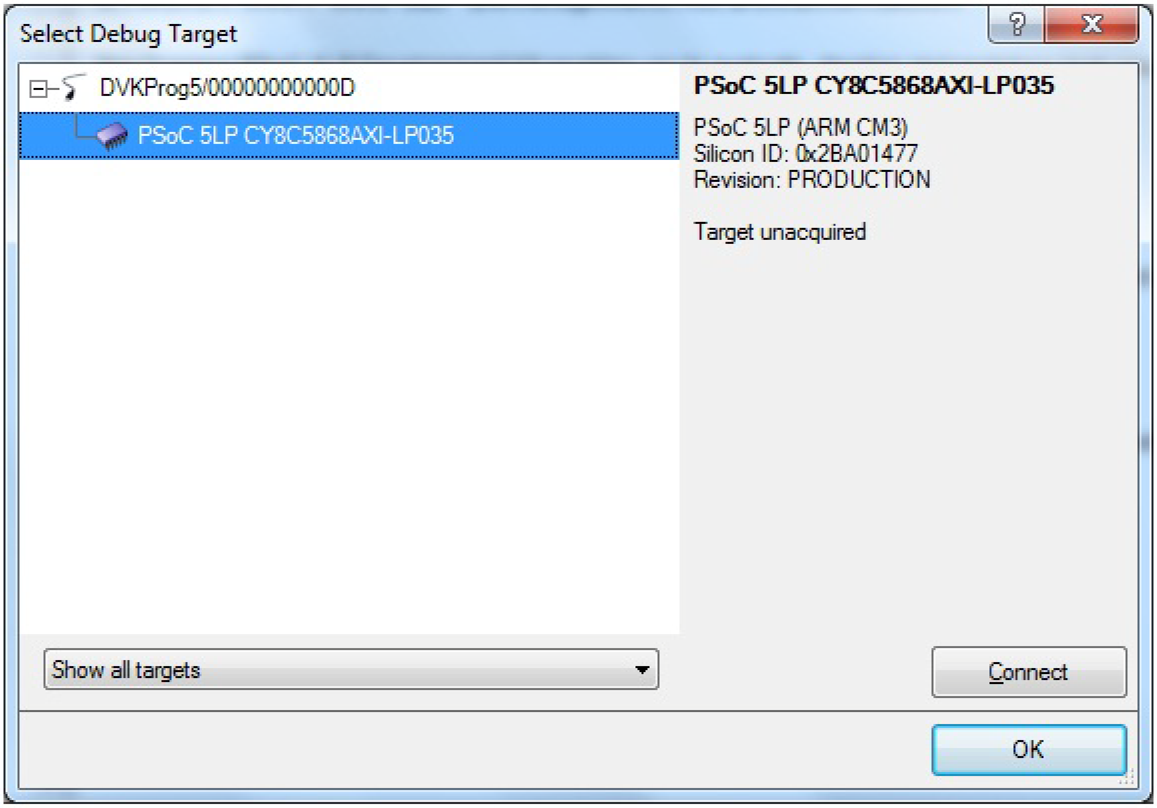


With the MiniProg3, programming is similar to the on-board programmer; however, the setup enumerates as a MiniProg3.

Note Sometimes pop-up window will come as shown in figure below.



Then click on Port acquire, you will get following window.



Then click on connect to start programming.

4. Hardware

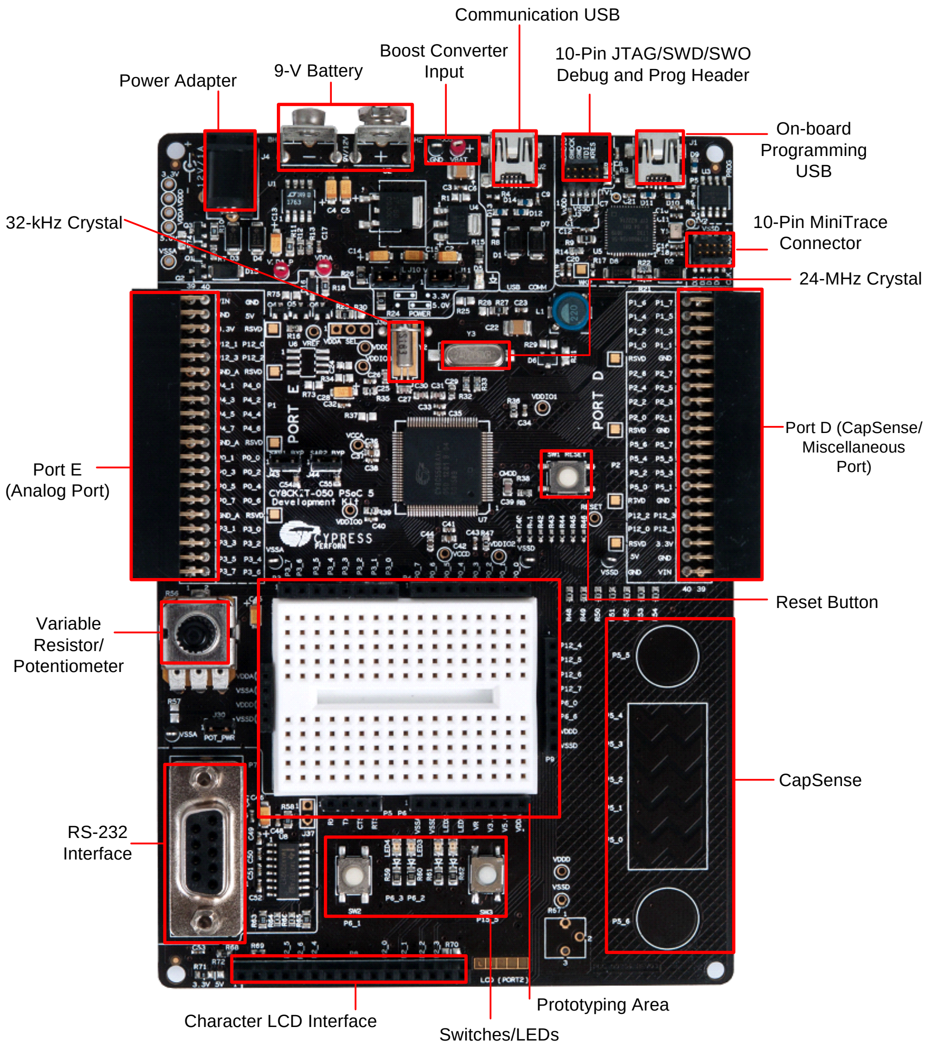
4.1 System Block Diagram

The PSoC 5LP Development Kit has the following sections:

- Power supply system
- Programming interface
- USB communications
- Boost convertor
- PSoC 5LP and related circuitry
- 32-kHz crystal
- 24-MHz crystal
- Port E (analog performance port) and port D (CapSense® or generic port)
- RS-232 communications interface
- Prototyping area
- Character LCD interface
- CapSense buttons and sliders

Note P0[2] is connected to SAR bypass capacitor C40 that can be selected by shorting jumper J43 and P0[4] is connected to SAR bypass capacitor C55 that can be selected by shorting jumper J44.

Figure 4-1. PSoC 5LP Development Kit Details



4.2 Functional Description

4.2.1 Power Supply

The power supply system on this board is versatile; input supply can be from the following sources:

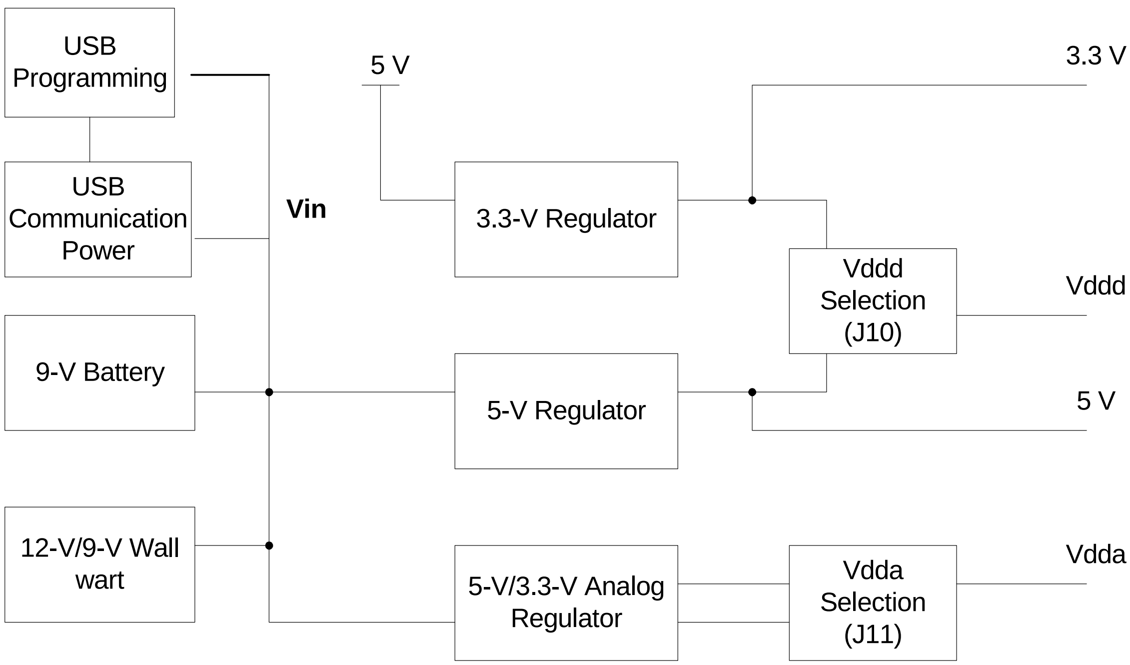
- 9-V or 12-V wall wart supply using connector J4
- 9-V battery connector using connectors BH1 and BH2
- USB power from communications section using connector J2
- USB power from the on-board programming section using connector J1
- Power from JTAG/SWD programming interface using connector J3
- Power through boost convertor that uses the input test points VBAT and GND

The board power domain has five rails:

- **Vin rail**: This is where the input of the on-board regulators are connected. This domain is powered through protection diodes.
- **5-V rail**: This is the output of the 5-V regulator U2. The rail is a fixed 5-V output regardless of jumper settings. The voltage in this rail can be less than 5 V only when the board is powered by the USB. This 5-V rail powers the circuits that require fixed 5-V supply.
- **3.3-V rail**: This is the output of the 3.3-V regulator U4. This rail remains 3.3 V regardless of jumper settings or power source changes. It powers the circuits requiring fixed 3.3-V supply such as the on-board programming section.
- **Vddd rail**: This rail provides power to the digital supply for the PSoC device. It can be derived from either the 5-V or 3.3-V rail. The selection is made using J10 (3-pin jumper).
- **Vdda rail**: This rail provides power to the analog supply of the PSoC device. It is the output of a low noise regulator U1. The regulator is a variable output voltage and can be either 3.3 V or 5 V. This is done by changing the position on J11 (3-pin jumper).

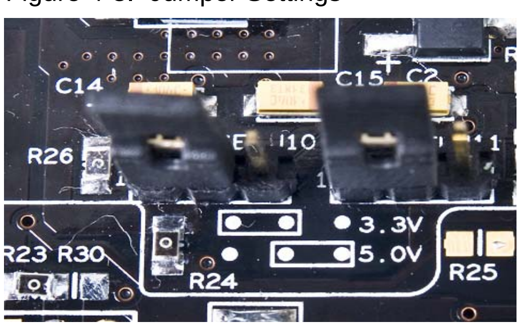
The following block diagram shows the structure of the power system on the board.

Figure 4-2. Power System Structure



4.2.1.1 *Power Supply Jumper Settings*

Figure 4-3. Jumper Settings



Two jumpers govern the power rails on the board. J10 is responsible for the selection of Vddd (digital power) and J11 selects the VADJ of Vdda (analog power).

The jumper settings for each power scheme are as follows.

Powering Scheme	Jumper Settings
Vdda = 5 V, Vddd = 5 V	J10 in 5 V setting and J11 in 5 V setting.
Vdda = 3.3 V, Vddd = 3.3 V	J10 in 3.3 V setting and J11 in 3.3 V setting.
Vdda = 5 V, Vddd = 3.3 V	J10 in 3.3 V setting and J11 in 5 V setting.
Vdda = 3.3 V, Vddd = 5 V	Can be achieved, but is an invalid condition because the PSoC 5LP silicon performance cannot be guaranteed.

Warning:

- The PSoC device performance is guaranteed when Vdda is greater than or equal to Vddd. Failure to meet this condition can have implications on the silicon performance.
- When USB power is used, ensure a 3.3 V setting on both analog and digital supplies. This is because, the 5-V rail of the USB power is not accurate and is not recommended.

4.2.1.2 Grounding Scheme

The board is designed considering analog designs as major target applications. Therefore, the grounding scheme in the board is unique to ensure precision analog performance.

This ground has three types of ground:

- GND - This is the universal ground where all the regulators are referred. Both Vssd and Vssa connect to this ground through a star connection.
- Vssd - This is the digital ground and covers the digital circuitry on the board, such as RS-232 and LCD.
- Vssa - This is the analog ground and covers the grounding for analog circuitry present on the board, such as the reference block.

When creating custom circuitry in the prototyping area provided on the board, remember to use the Vssa for the sensitive analog circuits and Vssd for the digital ones.

Port E on the board is the designated analog expansion connector. This connector brings out ports 0, 3, and 4, which are the best performing analog ports on PSoC 3 and PSoC 5 devices. The expansion connector, port E, has two types of grounds. One is the analog ground (GND_A in silk screen, Vssa in the schematic), which connects directly to the analog ground on the board. The other ground, known as GND, is used for the digital and high current circuitry on the expansion board. This differentiation on the connector grounds helps the expansion board designer to separate the analog and digital ground on any high precision analog boards being designed for port E.

4.2.1.3 Low-Power Functionality

The kit also facilitates application development, which requires low power consumption. Low-power functions require a power measurement capability, also available in this kit.

The analog supply is connected to the device through the zero-ohm resistor (R23). By removing this resistor and connecting an ammeter in series using the test points, Vdda_p and Vdda, you can measure the analog power used by the system.

The digital supply can be monitored by removing connection on the jumper J10 and connecting an ammeter in place of the short. This allows to measure the digital power used by the system.

The board provides the ability to measure analog and digital power separately. To measure power at a single point, rather than at analog and digital separately, remove the resistor R23 to disconnect the analog regulator from powering the Vdda and short Vdda and Vddd through R30. Now, the net power can be measured at the J10 jumper similar to the digital power measurement. To switch repeatedly between R23 and R30, moving around the zero-ohm resistors can be discomforting. Hence, a J38 (unpopulated) is provided to populate a male 3-pin header and have a shorting jumper in the place of R23/R30.

While measuring device power, make the following changes in the board to avoid leakage through other components that are connected to the device power rails.

- Disconnect the RS-232 power by disconnecting R58. An additional jumper capability is available as J37 if you populate it with a 2-pin male header.
- Disconnect the potentiometer by disconnecting J30.
- Ground the boost pins if boost operation is not used by populating R1, R28, and R29. Also make sure R25 and R31 are not populated.

4.2.1.4 *AC/DC Adaptor Specifications*

Use adaptors with the following specifications:

- Input voltage: 100 to 240 VAC, 50 Hz to 60 Hz, 1A
- Output voltage: 12 VDC, 1A
- Power output: 12 W
- Polarization: Positive center
- Certification: CE certified

Some recommended part numbers include EPSA120100U-P5P-EJ (CUI Inc.) and LTE12W-S2 (Li Tone Electronics Co. Ltd).

4.2.1.5 *Battery Specifications*

Use batteries with the following specifications:

- Battery size: 6LR61 (9 V)
- Output voltage: 9 VDC
- Type: Non-rechargeable alkaline consumer batteries
- RoHS status: RoHS compliant
- Lead free status: Pb-free

Some recommended part numbers include 6LR61XWA/1SB (Panasonic), MN1604 (Duracell), and 6LR61 (Energizer).

4.2.2 Programming Interface

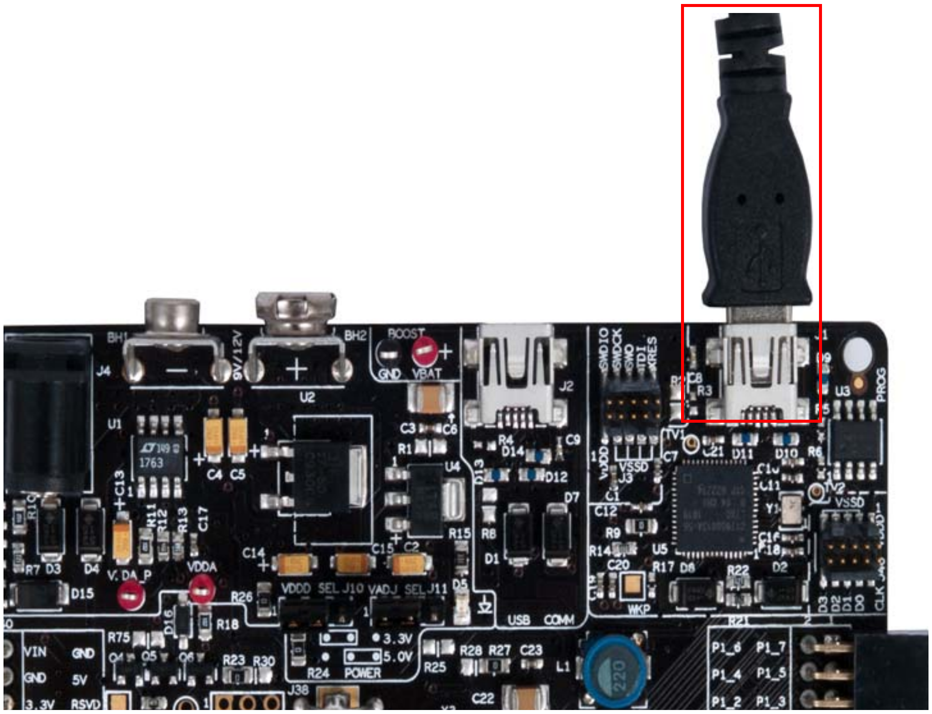
This kit allows programming in two modes:

- Using the on-board programming interface
- Using the JTAG/SWD programming interface with a MiniProg3

4.2.2.1 *On-board Programming Interface*

The on-board programmer interfaces with your PC through a USB connector, as shown in Figure 4-1.

Figure 4-4. On-board Programming Interface



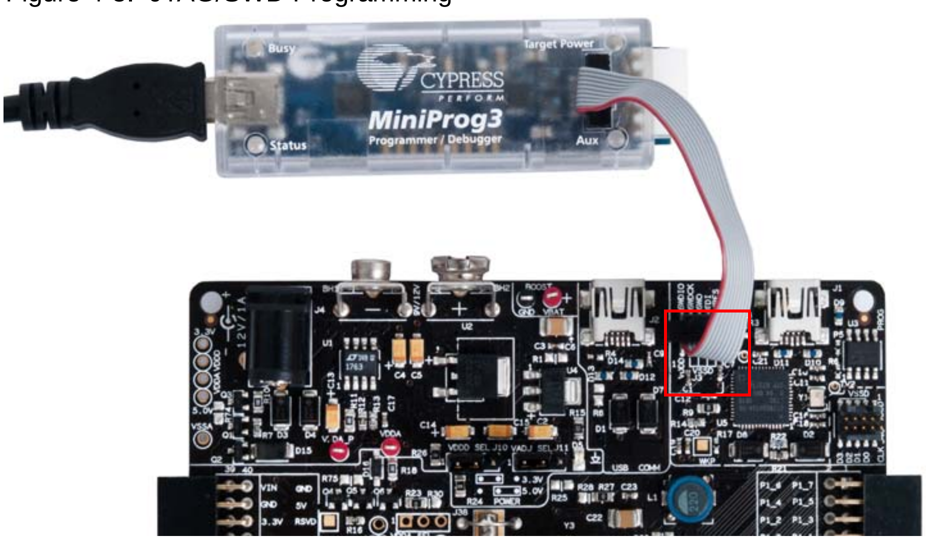
When the USB programming is plugged into the PC, it enumerates as DVKProg5 and you can use the normal programming interface from PSoC Creator to program this board through the on-board programmer.

A zero-ohm resistor R9 is provided on the board to disconnect power to the on-board programmer.

4.2.2.2 JTAG/SWD Programming

Apart from the on-board programming interface, the board also provides the option of using the MiniProg3. This interface is much faster than the on-board program interface. The JTAG/SWD programming is done through the 10-pin connector, J3.

Figure 4-5. JTAG/SWD Programming



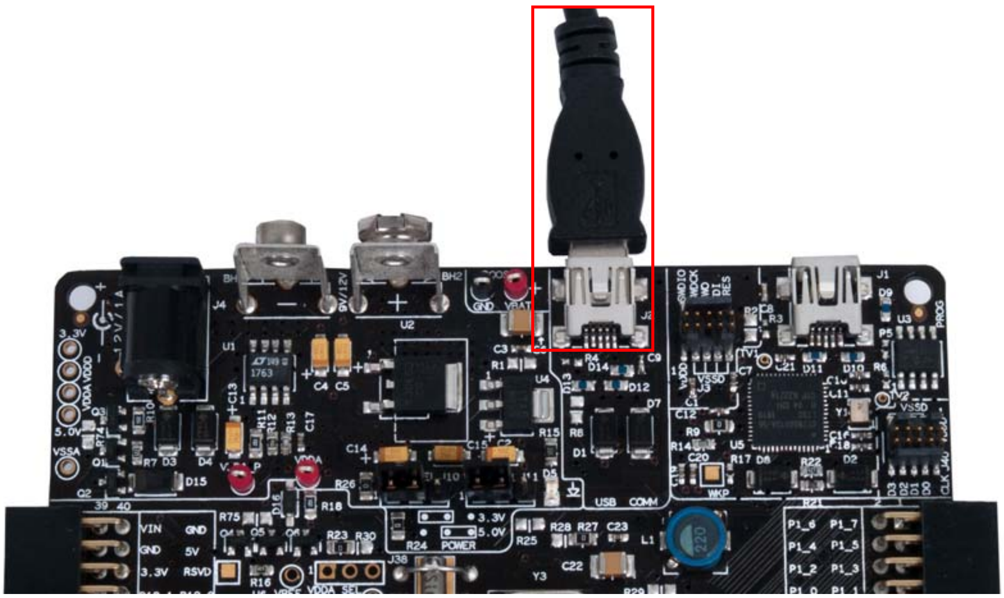
The JTAG/SWD programming using J3 requires the programmer, which can be purchased from http://www.cypress.com/go/CY8CKIT-002.

Note While using MiniProg3, only Reset mode is supported with this Kit.

4.2.3 USB Communication

The board has a USB communications interface that uses the connector, as shown in Figure 4-6. The USB connector connects to the D+ and D– lines on the PSoC to enable development of USB applications using the board. This USB interface can also supply power to the board, as discussed in Power Supply on page 18.

Figure 4-6. USB Interface



4.2.4 Boost Convertor

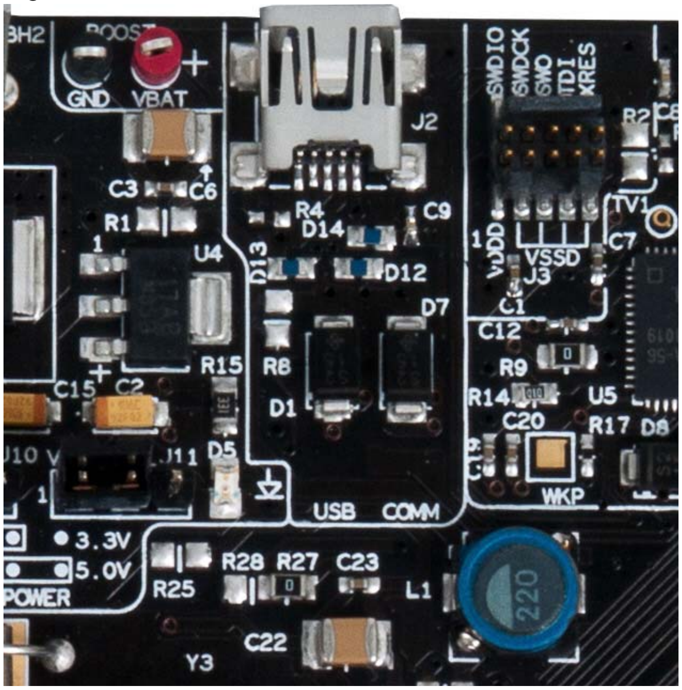
The PSoC 5LP device has the unique capability of working from a voltage supply as low as 0.5 V. This is possible using the boost convertor. The boost convertor uses an external inductor and a diode. These components are prepopulated on the board. Figure 4-7 shows the boost convertor.

To enable the boost convertor functionality, make the following hardware changes on the board.

- Populate resistors R25, R27, R29, and R31
- Ensure that R1 and R28 are not populated

After making these changes, you can configure the project to create a boost convertor-based design. The input power supply to the boost convertor must be provided through the test points marked Vbat and GND.

Figure 4-7. Boost Converter



4.2.5 32-kHz and 24-MHz Crystal

PSoC 5LP has an on-chip real time clock (RTC), which can function in sleep. This requires an external 32-kHz crystal, which is provided on the board to facilitate RTC-based designs. The PSoC 5LP also has an external MHz crystal option in applications where the IMO tolerance is not satisfactory. In these applications, the board has a 24-MHz crystal to provide an accurate main oscillator.

4.2.6 Protection Circuit

A reverse-voltage and over-voltage protection circuit is added at the expansion port on 5 V and 3.3 V lines.

The protection circuit consists of two P-channel MOSFET on the power line allowing the power/current to flow from input to output depending on the voltages applied at the external board connector. Figure 2 and Figure 3 are protection circuits placed between EBK and the on board components on the 5V and 3.3V line.

On 5V power line:

Figure 4-8. Schematic for Protection Circuit on 5-V Power Line

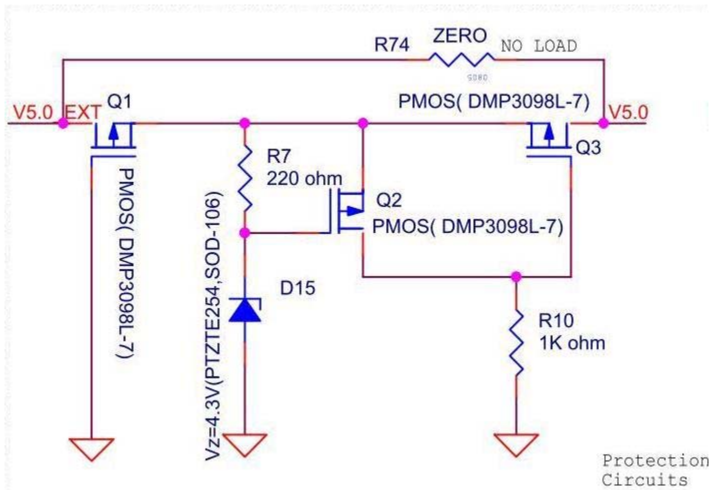
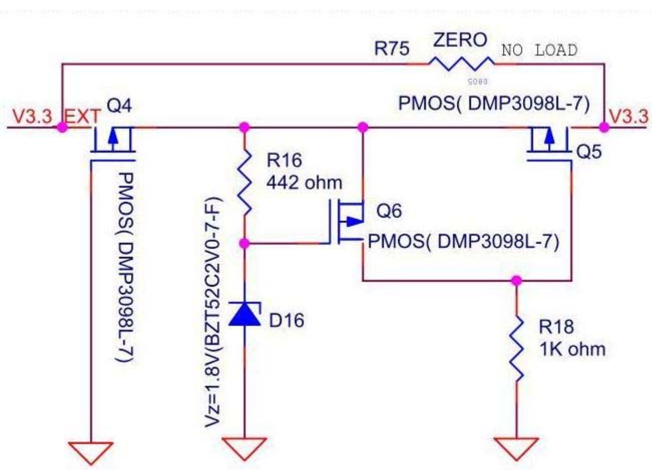


Figure 4-9. Schematic for Protection Circuit on 3.3-V Power Line



4.2.6.1 *Functional Description of Circuit*

The protection circuit will protect from a maximum over-voltage or reverse-voltage of 12 Volts. The cut-off voltage on the 5-V line is 5.7 V and on the 3.3-V line is 3.6 V. This means, if you apply more than this voltage level from the external board connector side, the p-MOS Q5 will turn off, thus protecting the PSoC and other on-board components. The current consumption of these protection circuits is less than 6 mA.

When voltage from the external connector is between 1.8 V and 3.3 V, the p-MOS Q4 conducts. Because the voltage across R16 is less than the threshold voltage (Vth) of p-MOS Q6, it will turn off and the p-MOS Q5 conducts, allowing voltage supply to the DVK.

When the external power supply exceeds 3.3 V, the p-MOS Q5 starts conducting. This eventually turns off p-MOS Q6 at 3.6 V, protecting the DVK from over-voltage.

When a reverse voltage is applied across the protection circuit from the external connector side, Q4 P-MOS will turn off, thus protecting the components on the board from reverse voltage.

If you intend to use the regulator power supply from the board to power the external modules, both the P-MOS Q4 and Q5 will always be on, allowing the flow of current with a maximum of 22 mV drop across the circuit when the current consumed by the external module is 150 mA.

Note The working of protection circuit on the 3.3-V line and 5-V line is as described above. For the purpose of explanation, the annotation of 3.3-V protection circuitry (Figure 4-9) is used.

4.2.7 PSoC 5LP Development Kit Expansion Ports

The PSoC 5LP Development Kit has two expansion ports, port D and port E, each with their own unique features.

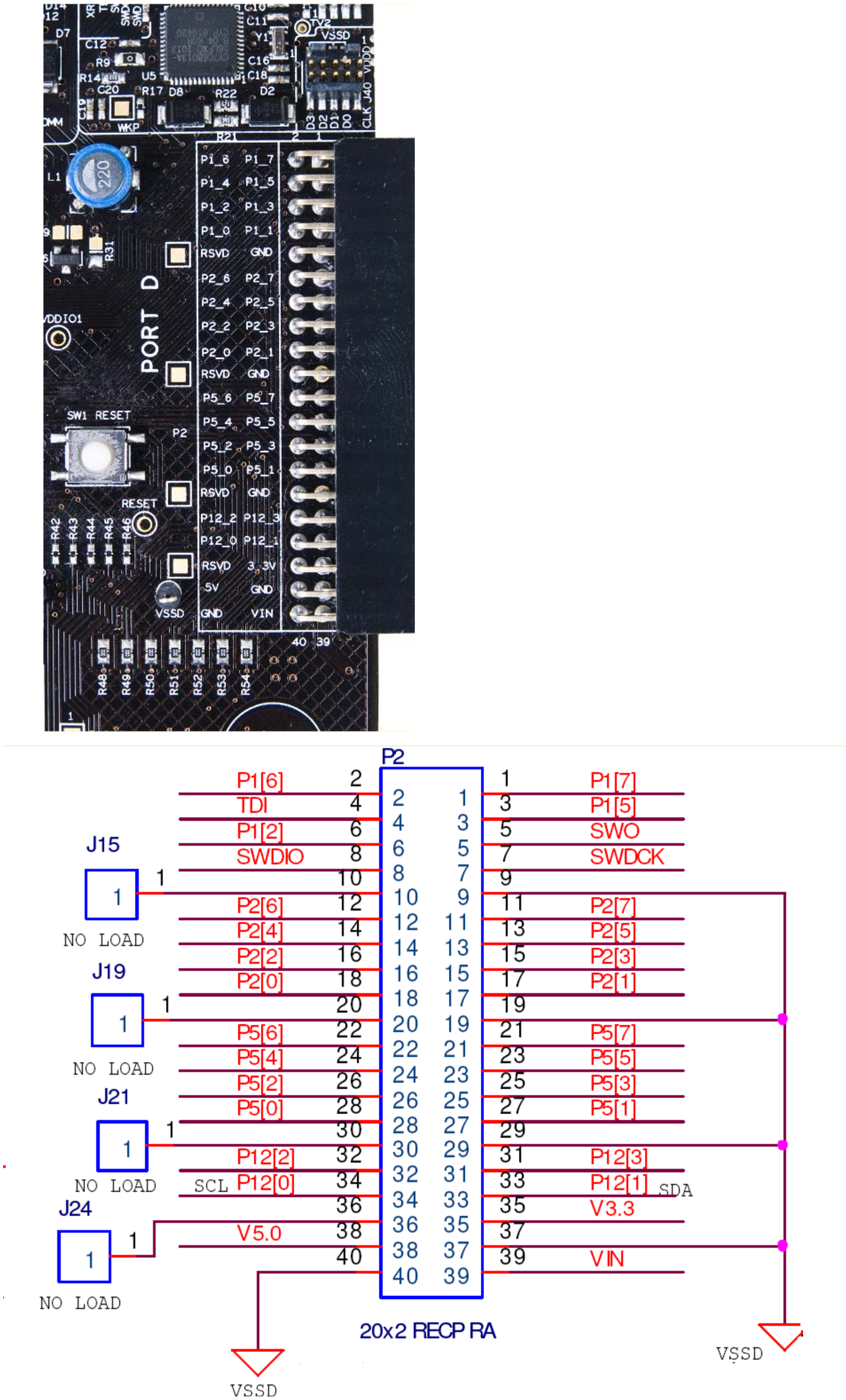
4.2.7.1 Port D

This is the miscellaneous port designed to handle CapSense-based application boards and digital application boards. The signal routing to this port adheres to the stringent requirements needed to provide good performance CapSense. This port can also be used for other functions and expansion board kits (EBKs).

This port is not designed for precision analog performance. The pins on the port are functionally compatible to port B of the PSoC Development Kit. So any project made to function on port B of the PSoC Development Kit can be easily ported over to port D on this board. A caveat to this is that there is no opamp available on this port; therefore, opamp-based designs are not recommended for use on this port.

The following figure shows the pin mapping for the port.

Figure 4-10. Port D

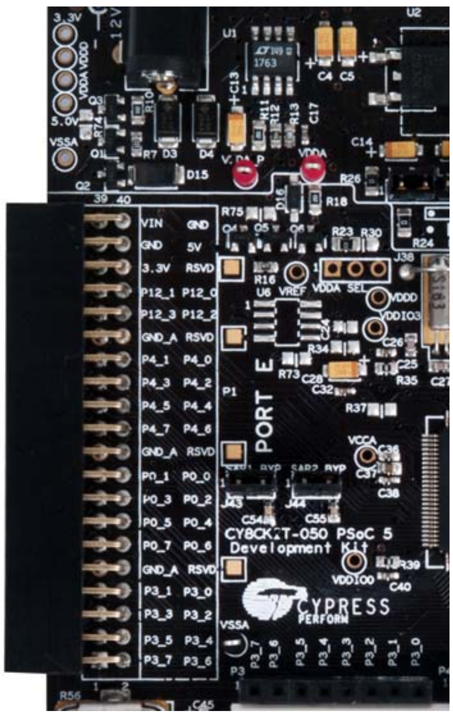


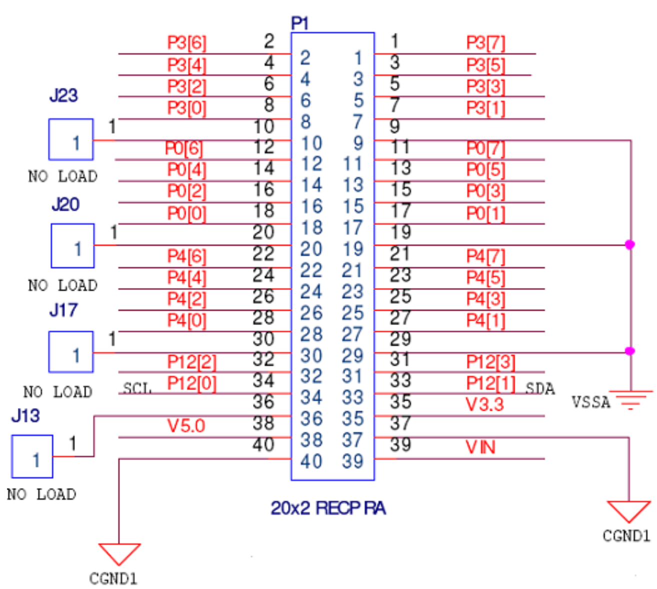
4.2.7.2 Port E

This is the analog port on this kit and has special layout considerations. It also brings out all analog resources such as dedicated opamps to a single connect. Therefore, this port is ideal for precision analog design development. This port is functionally compatible to port A of the PSoC Development Kit and it is easy to port an application developed on port A.

This port has two types of grounds, CGND1 and CGND2. The two grounds are connected to the GND on the board, but are provided for expansion boards designed for analog performance. The expansion boards have an analog and digital ground. The two grounds on this port help to keep it distinct even on this board until it reaches the GND plane.

Figure 4-11. Port E

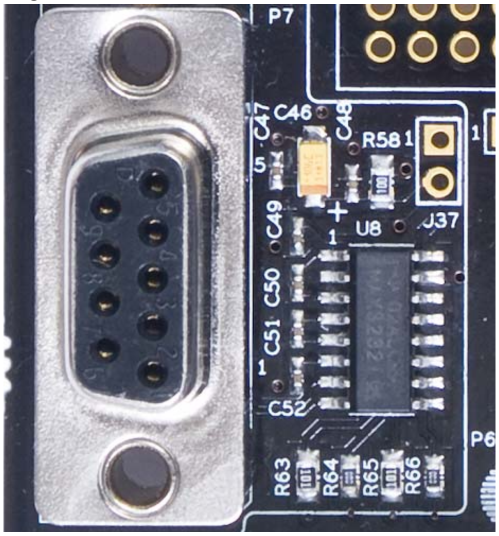




4.2.8 RS-232 Interface

The board has an RS-232 transceiver for designs using RS-232 (UART). The RS-232 section power can be disconnected through a single resistor R58. This is useful for low-power designs.

Figure 4-12. RS-232 Interface

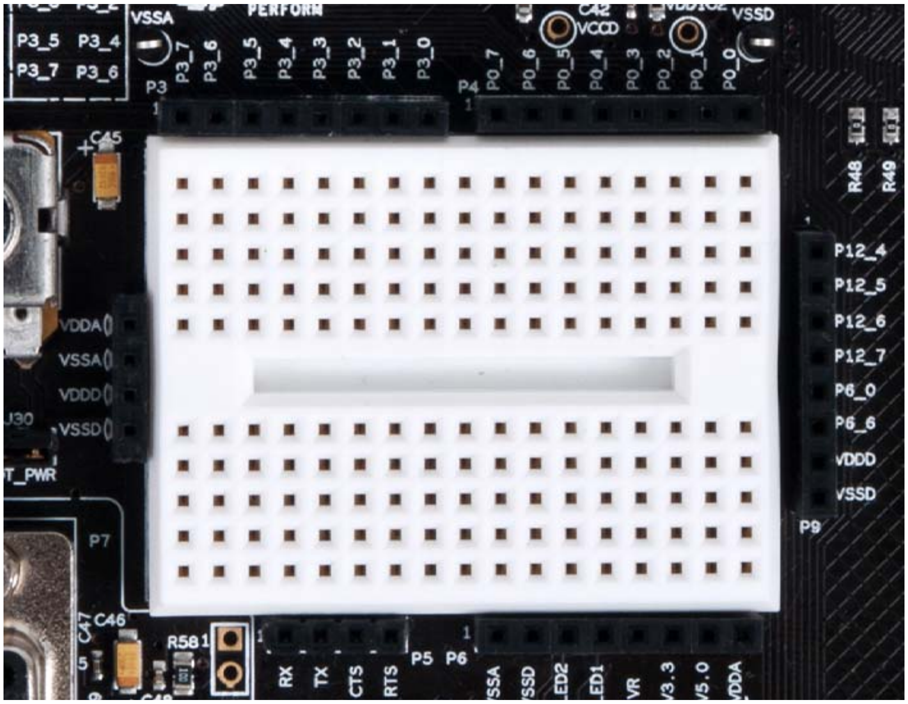


4.2.9 Prototyping Area

The prototyping area on the board has two complete ports of the device for simple custom circuit development. The ports in the area are port 0 and port 3, which bring out the four dedicated opamp pins on the device. Therefore, these ports can be used with the prototyping area to create simple yet elegant analog designs. It also brings SIOs such as port 12[4], port 12[5], port 12[6], and port 12[7] and GPIOs such as port P6[0] and port P6[6]. Power and ground connections are close to the prototyping space for convenience.

The area also has four LEDs and two switches for applications development. The two switches on the board are hard-wired to port 15[5] and port 6[1]. Two LEDs out of the four are hard-wired to port 6[2] and port 6[3] and the other two are brought out on pads closer to the prototyping area.

Figure 4-13. Prototyping Area



This area also comprises of a potentiometer to be used for analog system development work. The potentiometer connects from Vdda, which is a noise free supply and is hence capable of being used for low noise analog applications. The potentiometer output is available on P6[5] and VR on header P6 in the prototyping area.

4.2.10 Character LCD

The kit has a character LCD module, which goes into the character LCD header, P8. The LCD runs on a 3.3-V supply and can function regardless of the voltage on which PSoC is powered. A zero-ohm resistor setting is available on the LCD section (R71/72), making it possible to convert it to a 3.3 V LCD.

CAUTION When the resistor is shifted to support a 5-V LCD module, plugging in a 3.3-V LCD module into the board can damage the LCD module.

Figure 4-14. Pin 1 Indication

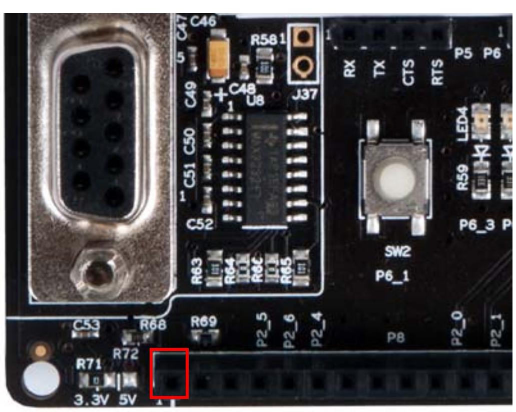
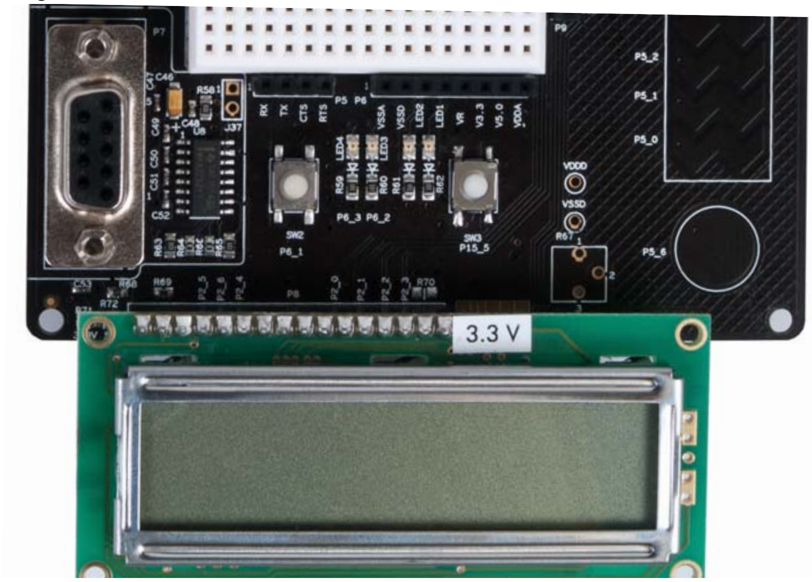


Figure 4-15. LCD Connected on P8 Connector

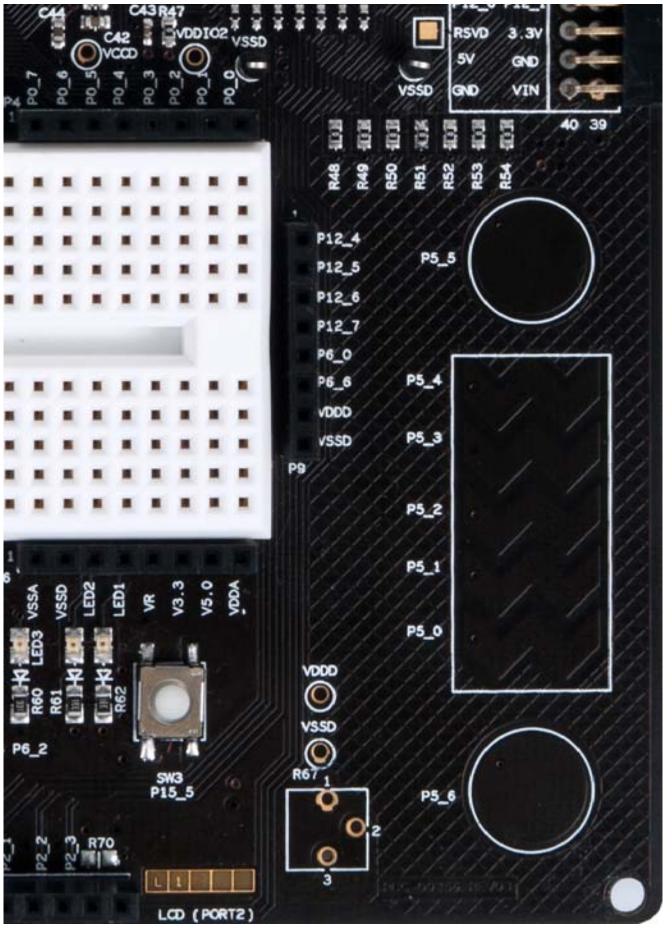


4.2.11 CapSense Sensors

The board layout considers the special requirements for CapSense. It has two CapSense buttons and a 5-element CapSense slider. The CapSense buttons are connected to pins P5[6] and P5[5]. The slider elements are connected to pins P5[0:4].

The Cmod (modulation capacitor) is connected to pin P6[4] and an optional Rb (bleeder resistor) is available on P15[4].

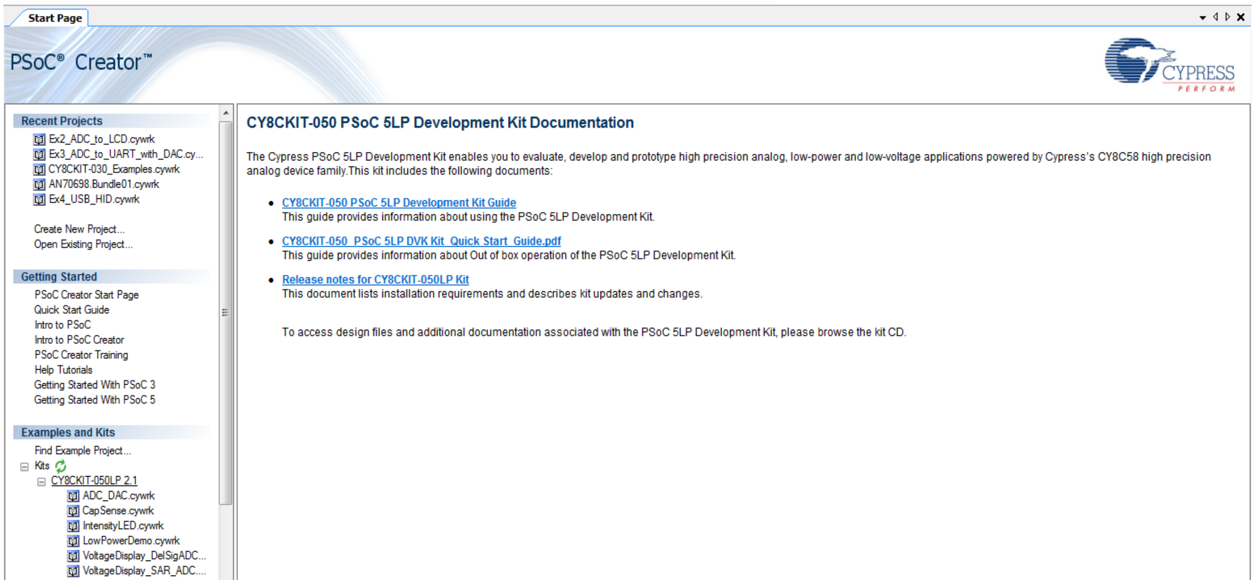
Figure 4-16. CapSense Sensors



5. Code Examples

To access code examples described in this section, open the PSoC Creator Start Page. For additional code examples, visit http://www.cypress.com.

Figure 5-1. PSoC Creator Start Page



Follow these steps to open and program code examples:

1. Click on a code example from **Examples and Kits** on the PSoC Creator Start Page.
2. Create a folder in the desired location and click **OK**.
3. The project opens in PSoC Creator and is saved to that folder.
4. Build the code example to generate the hex file.
5. To program, connect the board to a computer using the USB cable connected to port J1, as described in On-board Programming Interface on page 21. The board is detected as DVKProg5
6. Click **Debug > Program**.
7. The programming window opens up. If the silicon is not yet acquired, select the DVKProg5 and click on the **Connect** button.
8. The silicon is acquired and is shown in a tree structure below the DVKProg5.
9. Click **OK** to exit the window and start programming.

5.1 Project: VoltageDisplay_SAR_ADC

5.1.1 Project Description

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

Note The PSoC 5LP Development Kit is factory-programmed with this example.

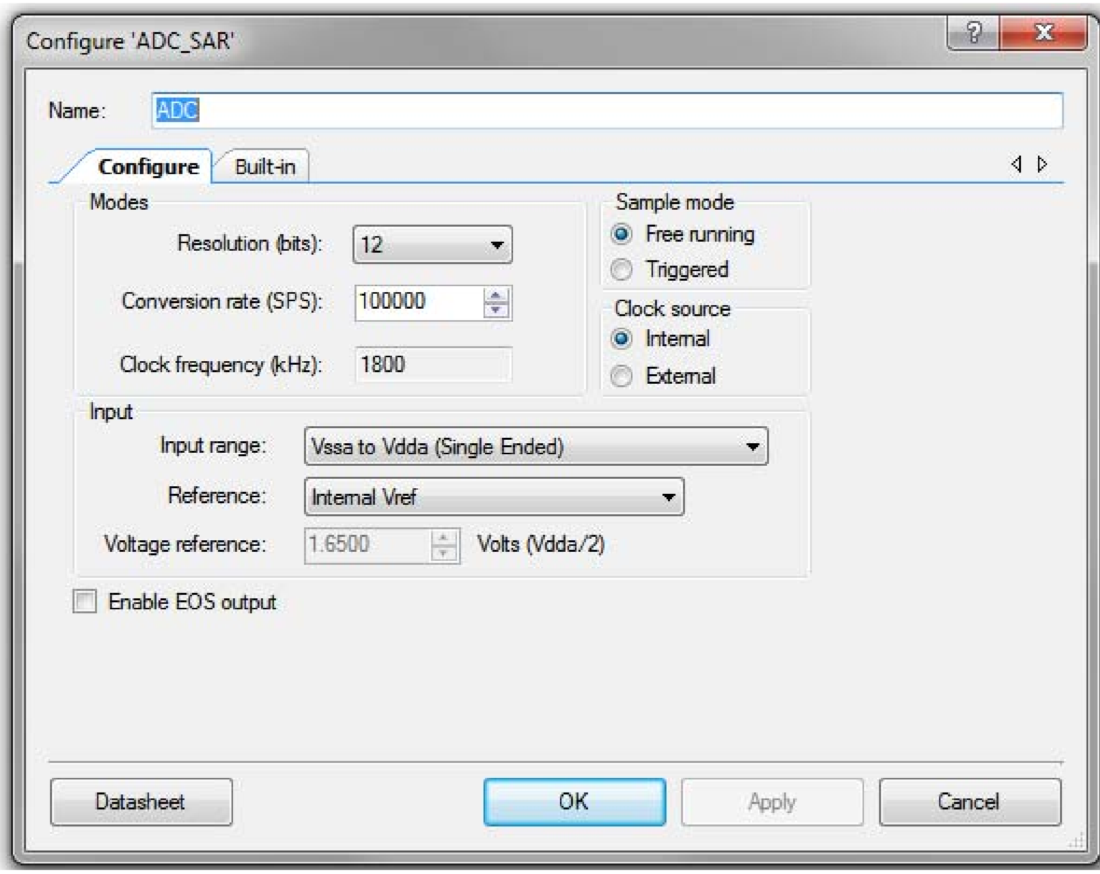
5.1.2 Hardware Connections

The example requires the character LCD on P8. Because it uses the potentiometer, the jumper POT_PWR should be in place. This connects the potentiometer to the Vdda.

5.1.3 SAR ADC Configuration

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

Figure 5-2. SAR ADC Configuration



The SAR ADC is configured as follows:

- Free-running mode of operation is selected because the ADC scans only one channel continuously.
- Conversion rate is set to 100 ksps. The code waits for each sample, processes it, and displays the result on the LCD.

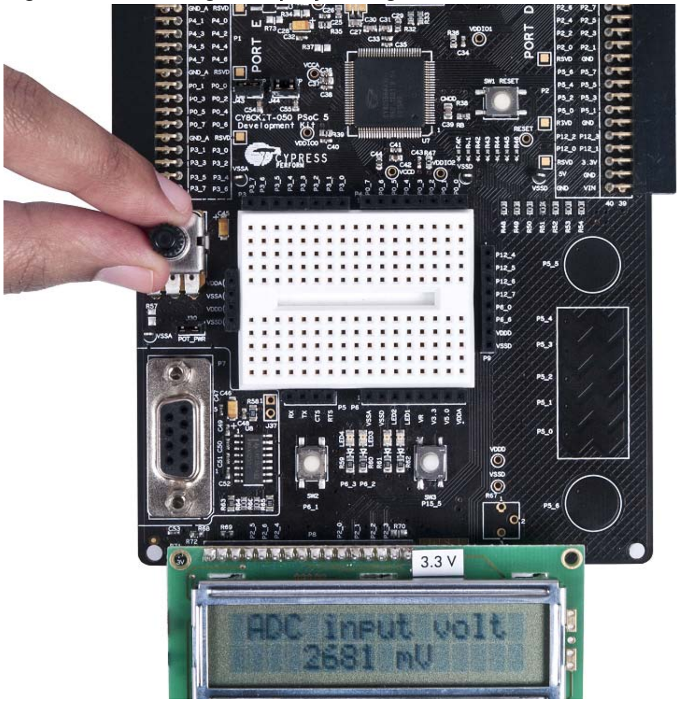
- Range is set to Vssa to Vdda in single-ended mode because the potentiometer output is a single ended signal that can go from 0 to Vdda. Therefore, at 12-bit resolution, the ADC will resolve in steps of $Vdda/2^{12}$.
- Voltage Reference should be set to Vdda/2 supply voltage when input range is set to 'Vssa to Vdda'. It is set to 1.65 V here, because by default Vdda jumper setting on the board is set to 3.3 V. If J11 is changed to select 5 V, then this parameter should be changed to 2.5 V accordingly.

5.1.4 Verify Output

Build and program the code example, and reset the device. The LCD shows the voltage reading corresponding to the voltage on the potentiometer. Figure 5-3 demonstrates the functionality. When you turn the potentiometer, the voltage value changes. You can also verify the voltage on the potentiometer using a precision multimeter.

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

Figure 5-3. Voltage Display using SAR ADC



5.2 Project: VoltageDisplay_DelSigADC

5.2.1 Project Description

This example code measures a simple analog voltage controlled by the potentiometer. The code uses the internal Del-Sig ADC configured for a 20-bit operation; the ADC range is 0 to Vdda. The voltage measurement resolution is in microvolts. The results are displayed on the character LCD module.

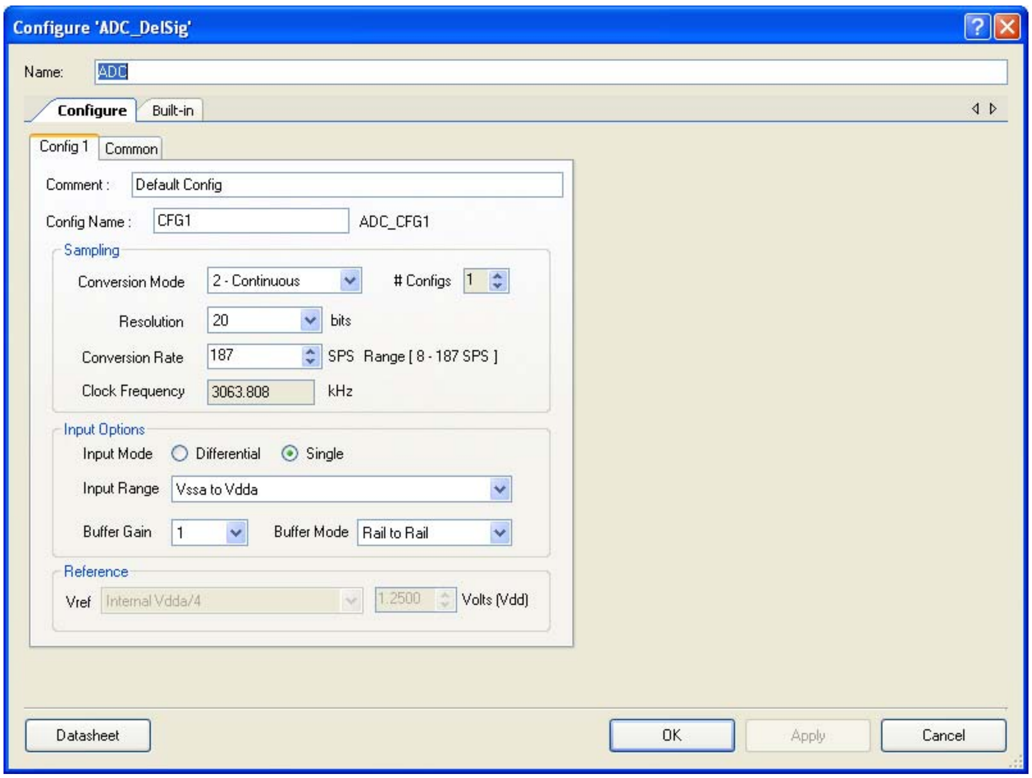
5.2.2 Hardware Connections

The example requires the character LCD on P8. Because it uses the potentiometer, the jumper POT_PWR should be in place. This connects the potentiometer to the Vdda. Move jumper J10 and J11 to position 2-3, this will set Vdda to 5 V.

5.2.3 Del-Sig ADC Configuration

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

Figure 5-4. Delta-Sigma ADC Configuration

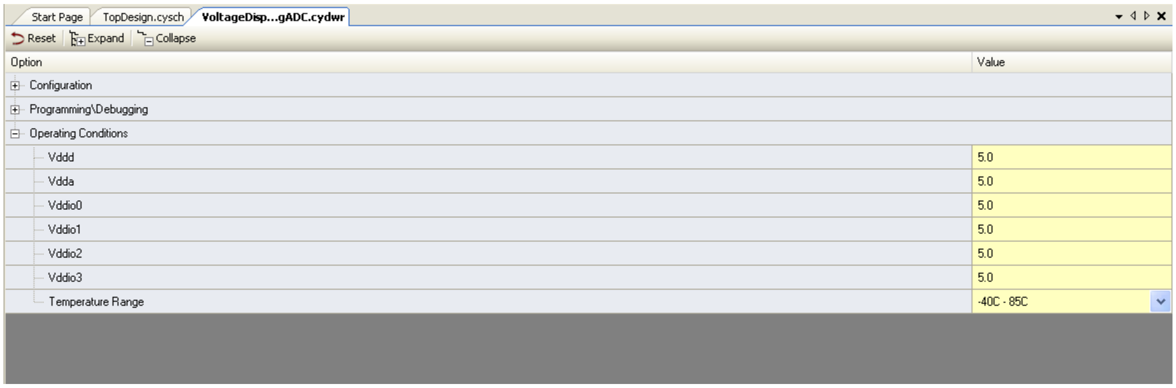


To configure the Del-Sig ADC:

- Select the continuous mode of operation because the ADC scans only one channel.
- Set the conversion rate to 187 samples/sec, which is the maximum sample rate possible at 20-bit resolution.
- Set the range from Vssa to Vdda in single-ended mode because the potentiometer output is a single-ended signal that can go from 0 to Vdda. Therefore, at 20-bit resolution, the ADC will resolve in steps of $Vdda/2^{20}$.

Note Internal Vdda/3 Reference option is not available in the current PSoC 5 silicon. In this project, Vdda = 5 V. The project will not work if Vdda = 3.3 V, because it needs Vdda/3 reference for DelSig

ADC. To set Vdda to 5 V, in the VoltageDisplay_DelSigADC.cydwr window of PSoC Creator, click on the **System** tab, go to **Operating Conditions** options. Set Vdda to 5 V.

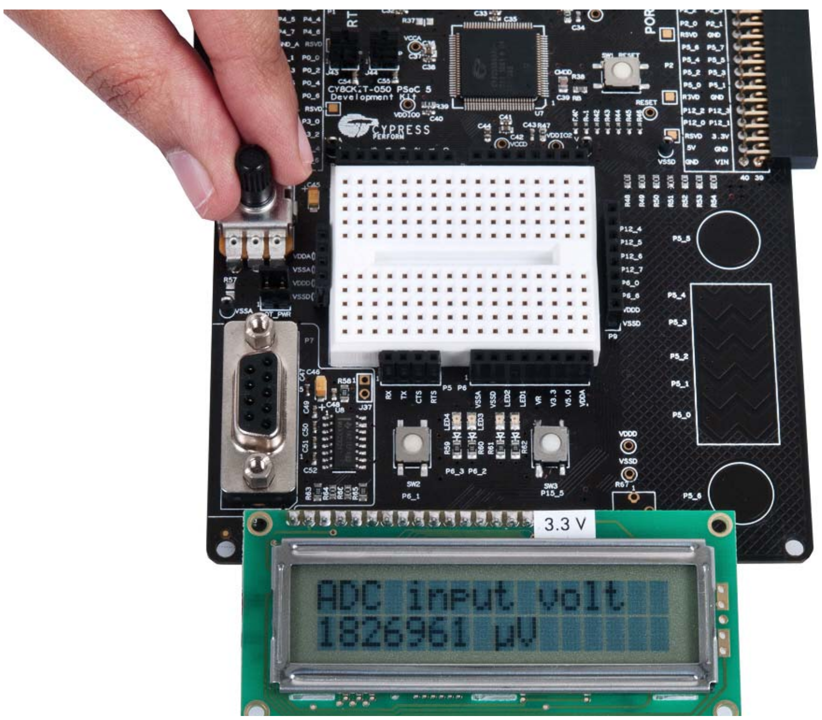


5.2.4 Verify Output

Build and program the code example, and reset the device. The LCD shows the voltage reading corresponding to the voltage on the potentiometer. Figure 5-5 demonstrates the functionality. When you turn the potentiometer, the voltage value changes. You can also verify the voltage on the potentiometer using a precision multimeter.

Note The potentiometer connects to a differential ADC, which works in single ended mode. This means the ADC input is measured against internal Vssa. Any offset in the measurement can be positive or negative. This can result in a small offset voltage even when the potentiometer is zero. Move jumper J10 and J11 back to position 1-2 after verifying the output.

Figure 5-5. Voltage Display using Del-Sig ADC



5.3 Project: IntensityLED

5.3.1 Project Description

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

5.3.2 Hardware Connections

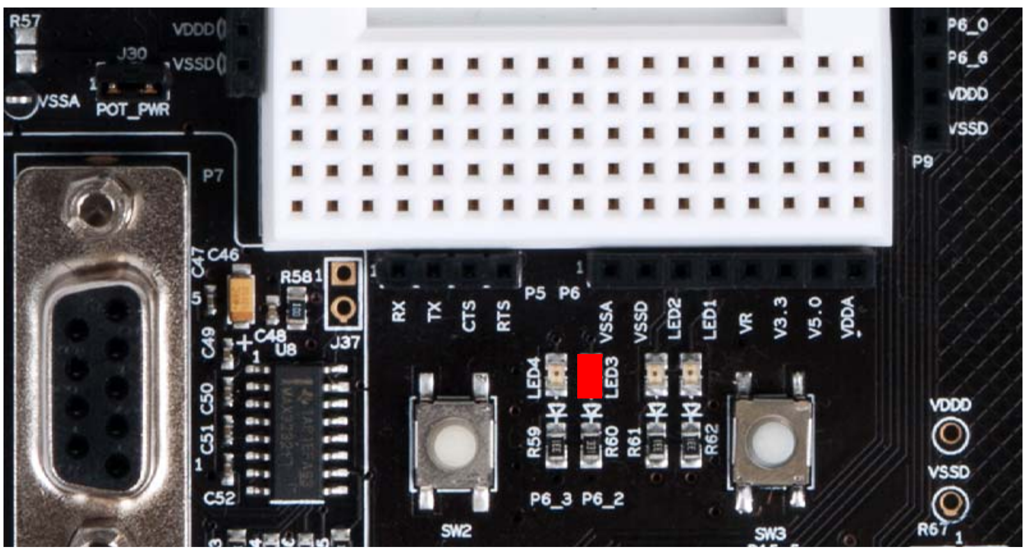
No hardware connections are required for this project, because all the connections are hard-wired to specific pins on the board.

5.3.3 Verify Output

When the example code is built and programmed into the device, reset the device by pressing the Reset button or power cycling the board.

The project output is LED3 glowing with a brightness control that changes with time (see Figure 5-6).

Figure 5-6. Verify Output - Code Example



5.4 Project: LowPowerDemo

5.4.1 Project Description

This example project demonstrates the low power functionality of PSoC 5. The project implements an RTC based code, which goes to sleep and wakes up on the basis of switch inputs.

The RTC uses an accurate 32-kHz clock generated using the external crystal provided on the board.

When there is a key press, the device is put to sleep while the RTC is kept active.

5.4.2 Hardware Connections

The project requires a 3.3 V LCD to view the time display. No extra connections are required for project functionality. To make low power measurements using this project, refer and implement the changes proposed in Low-Power Functionality on page 20.

5.4.3 Verify Output

In normal operation, the project displays the time starting from 00:00:00 when SW2 is pressed. Normal mode is indicated by LED3 in ON state. When you press the SW2 button again, the device is put to sleep. Sleep mode is indicated by LED3 in OFF state. If an ammeter is connected to measure the system current (refer Low-Power Functionality on page 20 for details), a system current of less than 2 µA is displayed.

The device wakes up when SW2 is pressed again and displays the time on the LCD. The following figures show the output display.

Figure 5-7. PSoC 5 in Active Mode

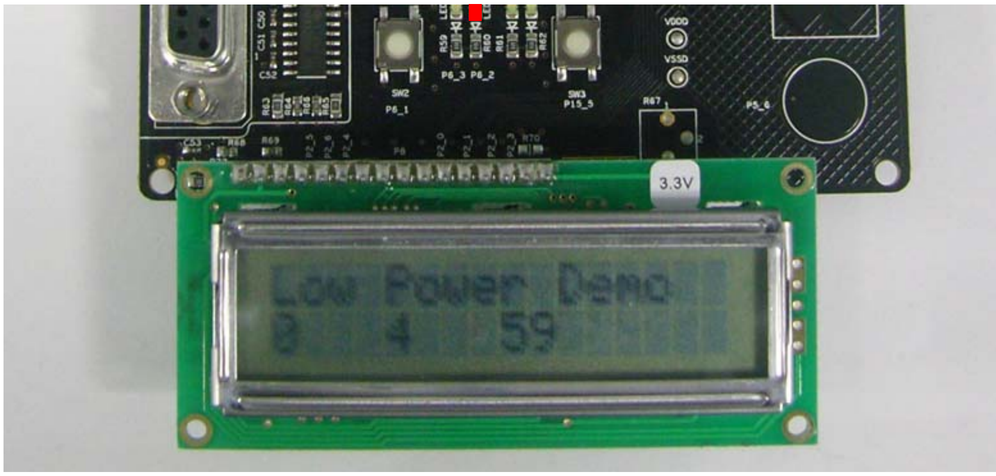
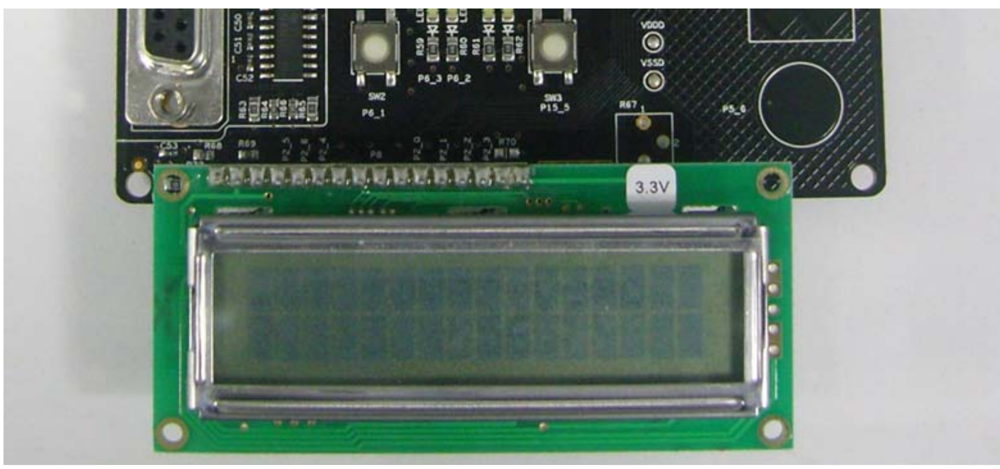


Figure 5-8. PSoC 5 in Sleep Mode



5.5 Project: CapSense

5.5.1 Project Description

This code example provides a platform to build CapSense-based projects using PSoC 5LP. The example uses two CapSense buttons and one 5-element slider provided on the board. Each capacitive sensor on the board is scanned using the Cypress CSD algorithm. The buttons are pre-tuned in the example code to take care of factors such as board parasitic.

5.5.2 Hardware Connections

This project uses the LCD for display; therefore, ensure that it is plugged into the port. No specific hardware connections are required for this project because all connections are hard-wired on the board.

5.5.3 Verify Output

Build and program the code example, and reset the device. The LCD displays the status of the two buttons as On/Off. The LCD also shows the slider touch position as a percentage. When you touch a button, the LCD displays ON; when you remove the finger from the button, the LCD displays OFF. When the slider is touched, the corresponding finger position is displayed as a percentage on the LCD.

Figure 5-9. CapSense Slider

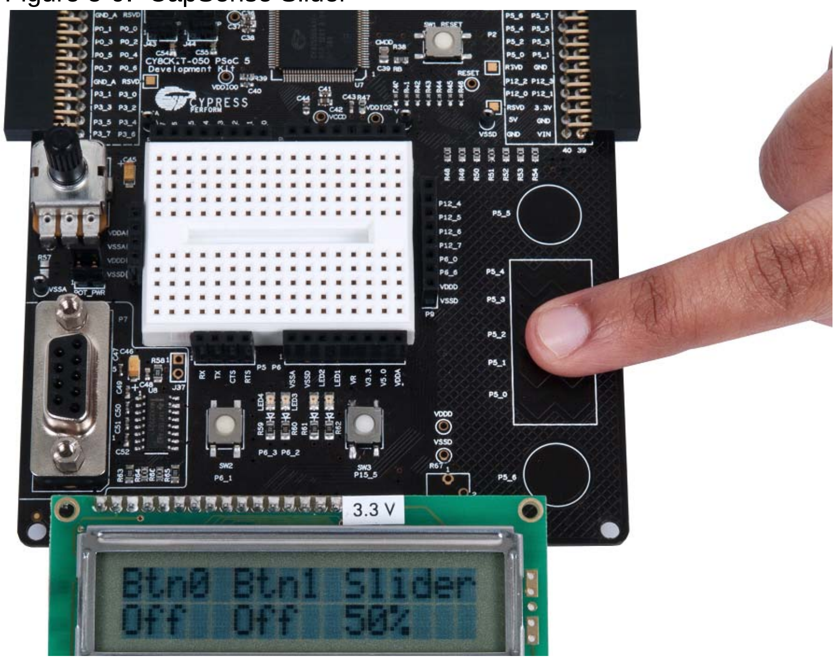
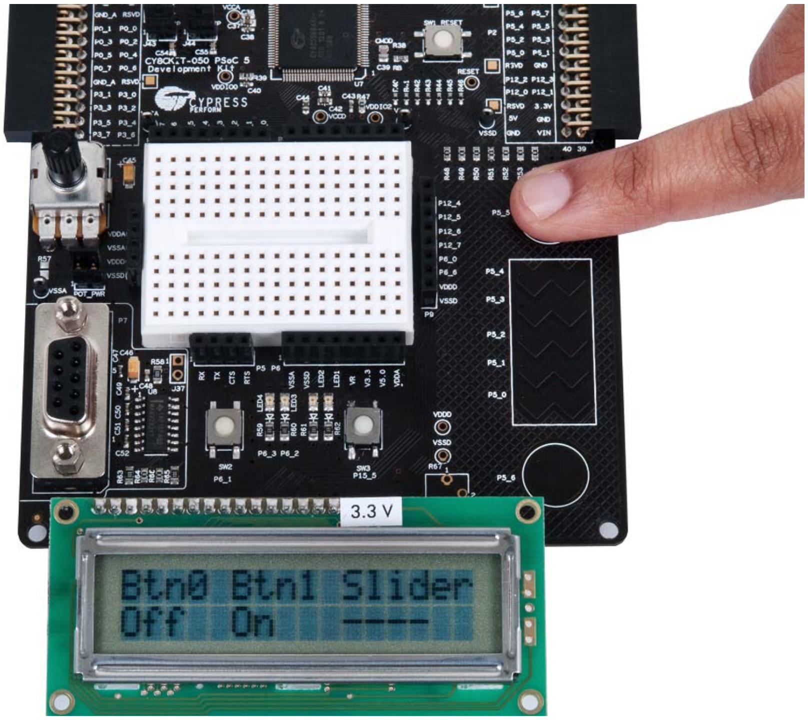


Figure 5-10. CapSense Button



5.6 Project: ADC_DAC

5.6.1 Project Description

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 board potentiometer and displays the raw counts on the board character LCD display. An 8-bit DAC outputs a table generated sine wave to an LED using DMA at a frequency proportional to the ADC count.

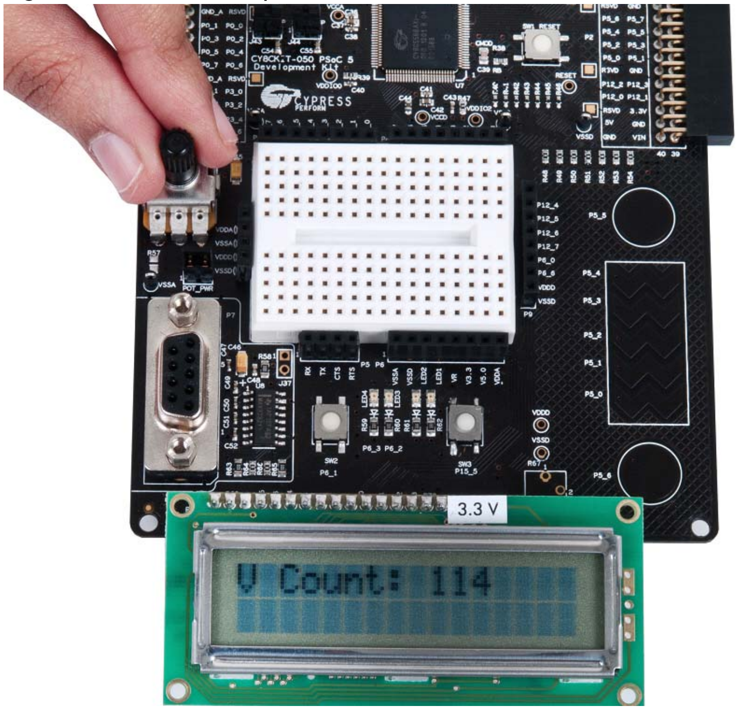
5.6.2 Hardware Connections

For this example, the character LCD must be installed on P8. The example uses the potentiometer; therefore, the jumper POT_PWR should also be in place. This jumper connects the potentiometer to the Vdda.

5.6.3 Verify Output

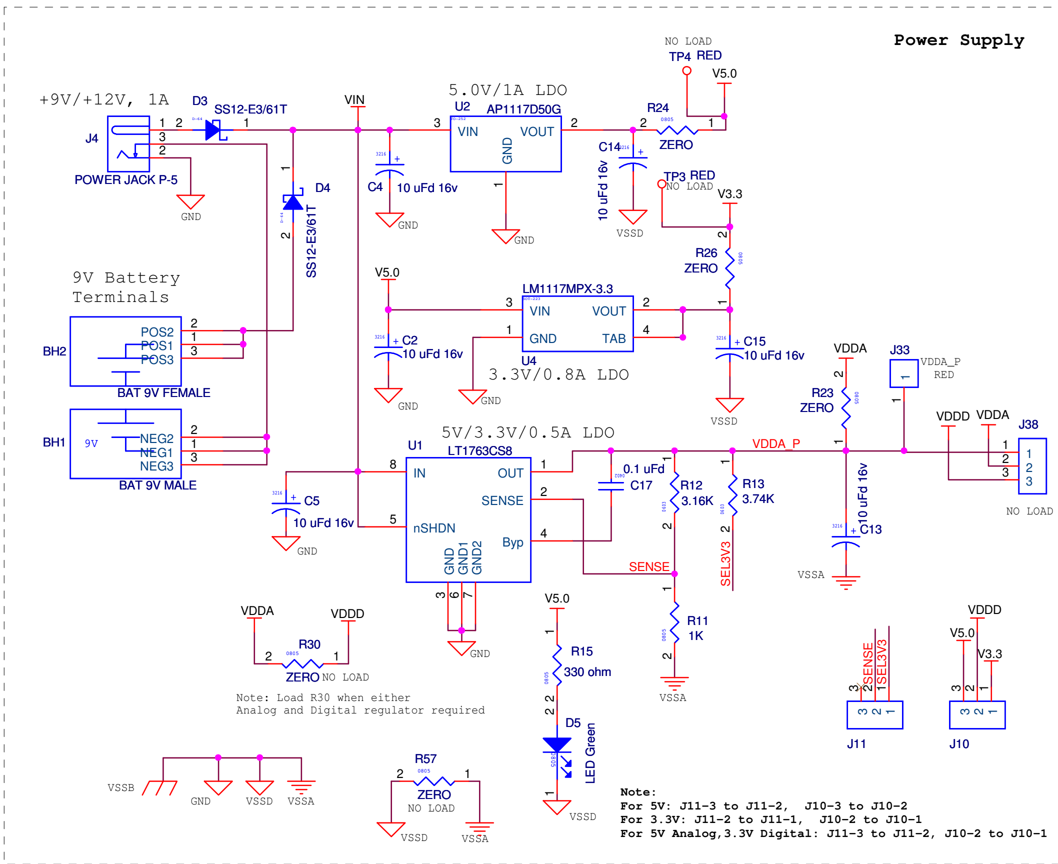
Build and program the code example, and reset the device to view the ADC output displayed on the LCD. LED4 is an AC signal output whose period is based on the ADC. Turning the potentiometer results in LCD value change. This also results in change in the period of the sine wave fed into LED4. When the potentiometer changes, the blinking rate of LED4 changes.

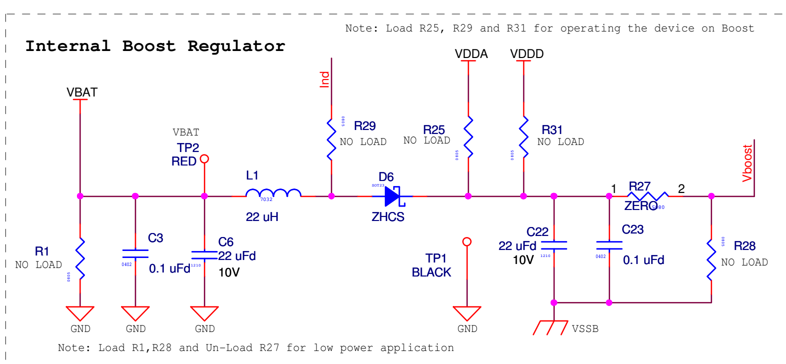
Figure 5-11. ADC Output

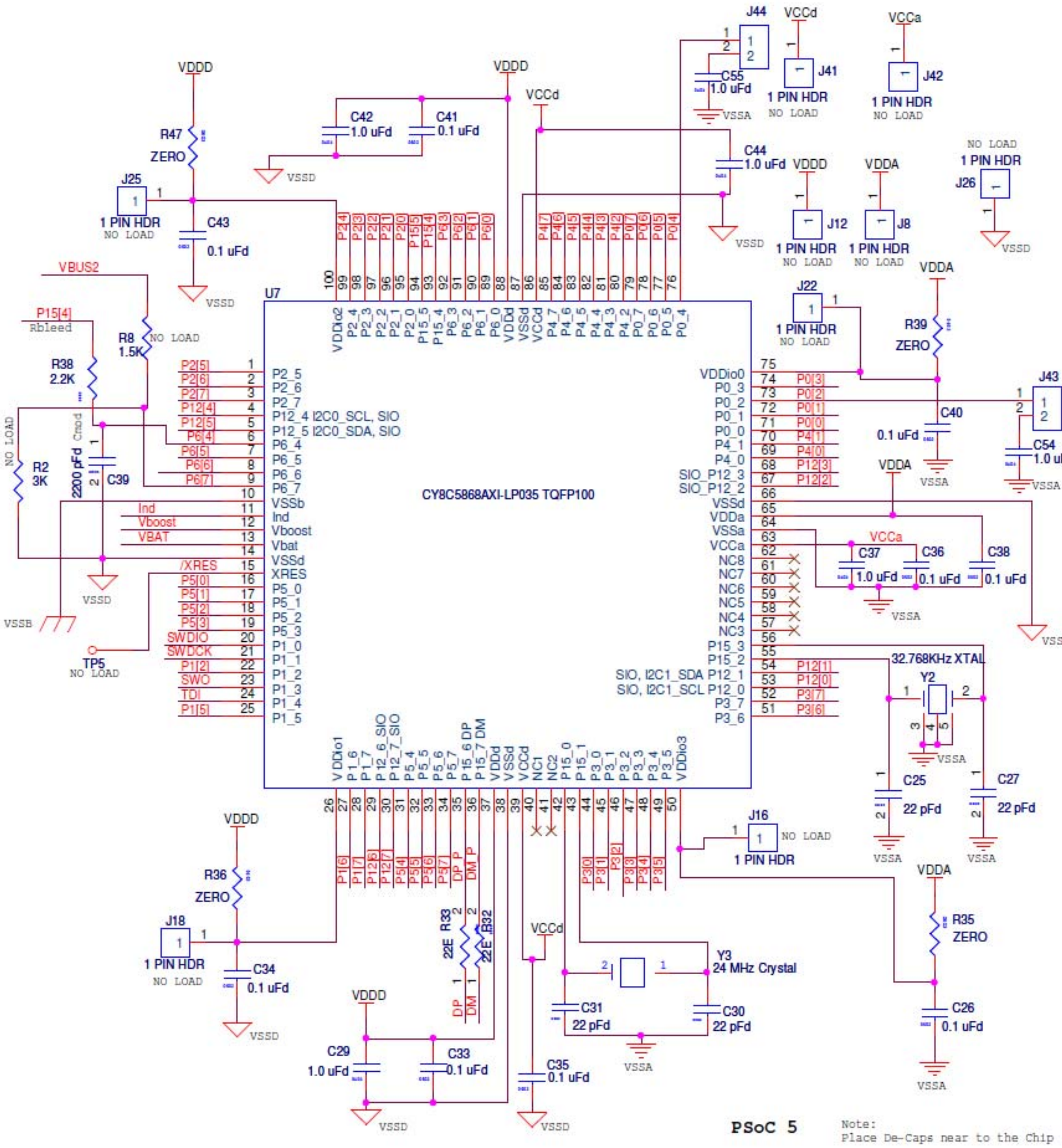


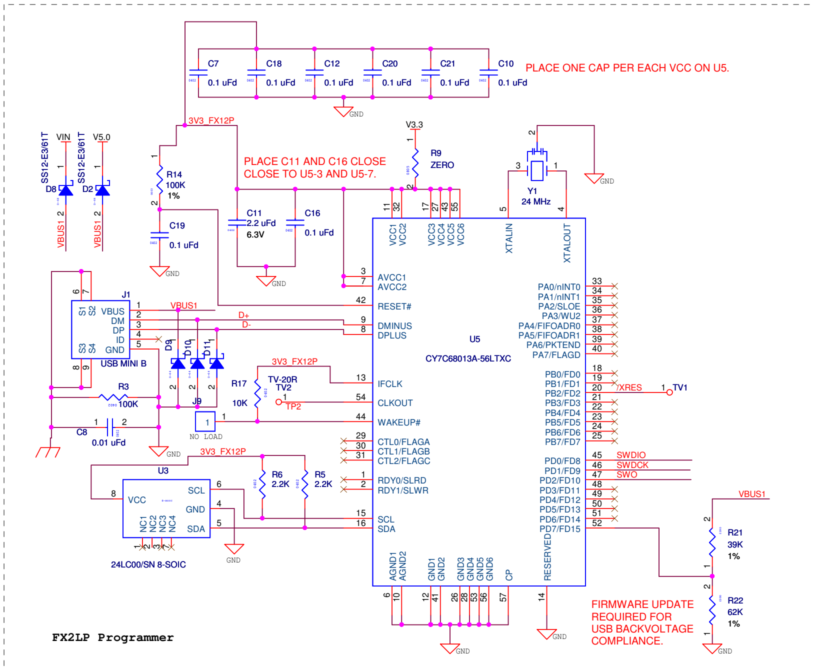
A. Appendix

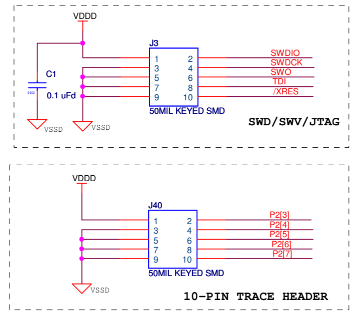
A.1 Schematic

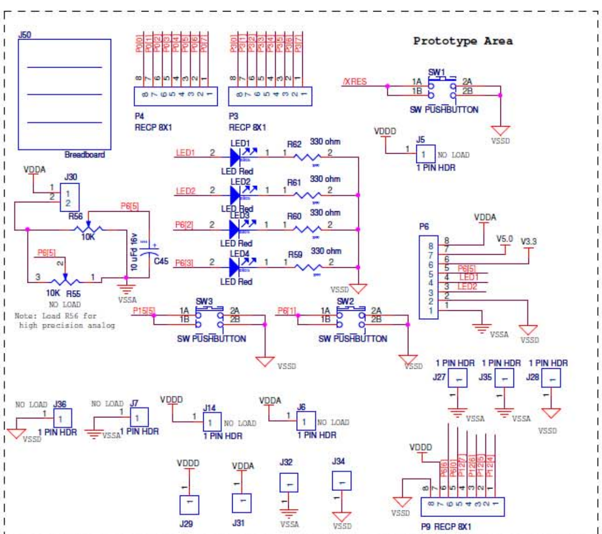


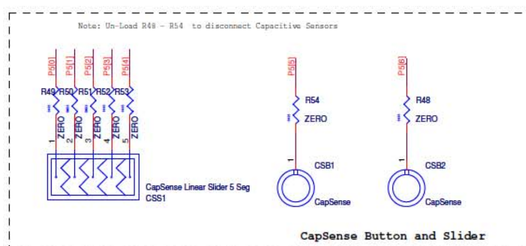


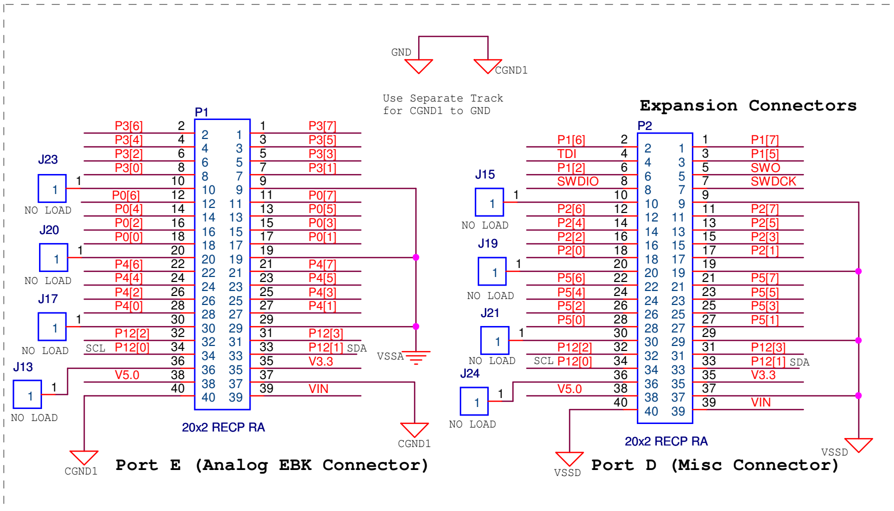

U7
CY8C5868AXI-LP035 TQFP100
J44
J41
J42
J25
J12
J8
J26
J22
J43
J16
J18
TP5
Y2
32.768KHz XTAL
Y3
24 MHz Crystal
R47
R8
R38
R2
R39
R36
R33
R32
R35
C42
C41
C55
C44
C43
C39
C40
C54
C37
C36
C38
C25
C27
C34
C29
C33
C35
C31
C30
C26
VDDD
VCCd
VCCa
VDDA
VSSD
VSSA
VSSB
VBUS2
P15[4]
Rbleed
ZERO
1.5K
2.2K
3K
22E
1 PIN HDR
NO LOAD
1.0 uFd
0.1 uFd
2200 pFd
22 pFd
Cmod
I2C0_SCL, SIO
I2C0_SDA, SIO
SIO, I2C1_SDA
SIO, I2C1_SCL
/XRES
SWDIO
SWDCK
SWO
TDI
Ind
Vboost
VBAT
DP
DM
PSoC 5
Note:
Place De-Caps near to the Chip

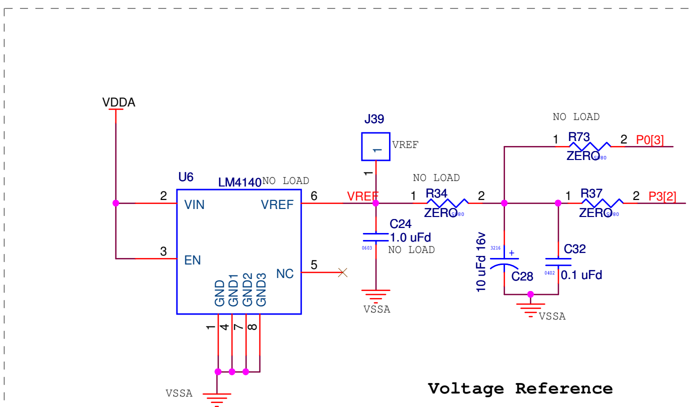

PLACE ONE CAP PER EACH VCC ON U5.
PLACE C11 AND C16 CLOSE
CLOSE TO U5-3 AND U5-7.
CY7C68013A-56LTXC
USB MINI B
24LC00/SN 8-SOIC
FIRMWARE UPDATE
REQUIRED FOR
USB BACKVOLTAGE
COMPLIANCE.
FX2LP Programmer

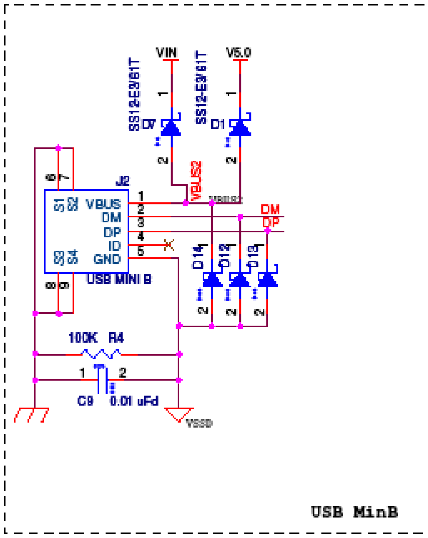

50MIL KEYED SMD
SWD/SWV/JTAG
50MIL KEYED SMD
10-PIN TRACE HEADER

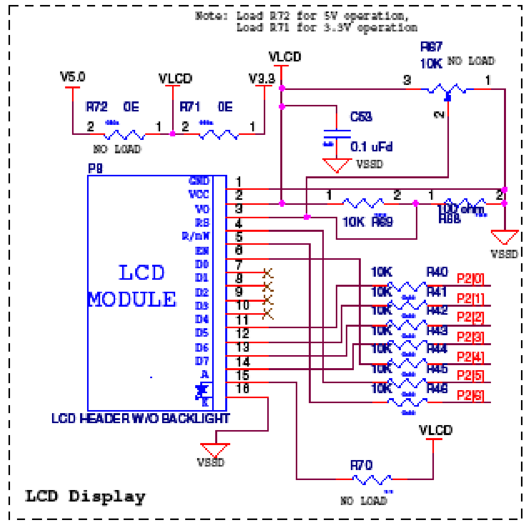

Prototype Area
Breadboard
Note: Load R56 for
high precision analog

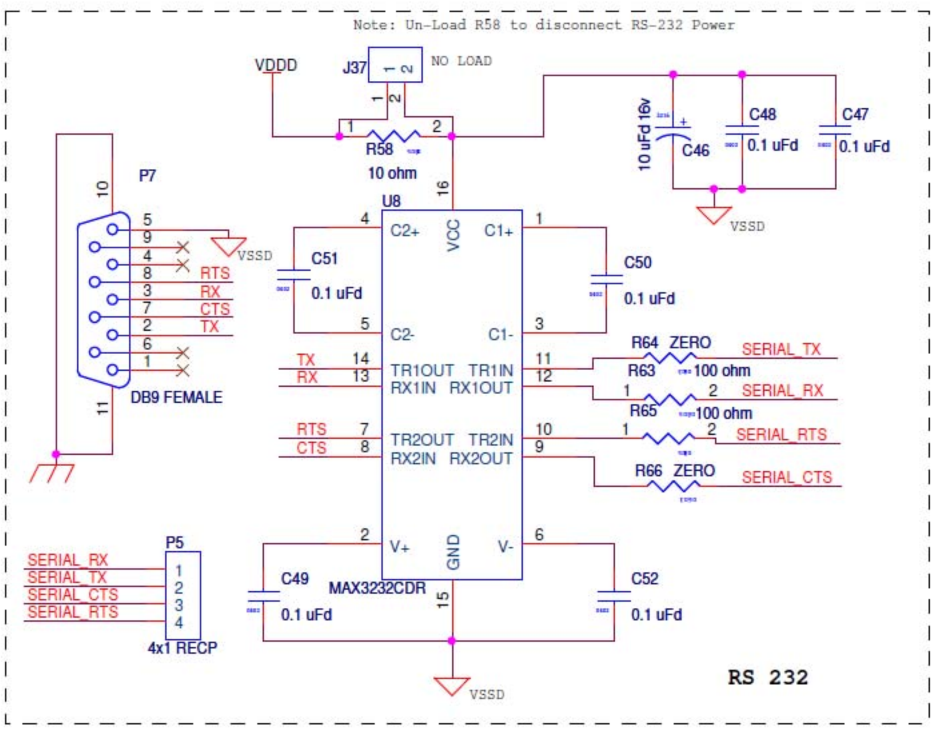

Note: Un-Load R48 - R54 to disconnect Capacitive Sensors
CapSense Linear Slider 5 Seg
CapSense Button and Slider

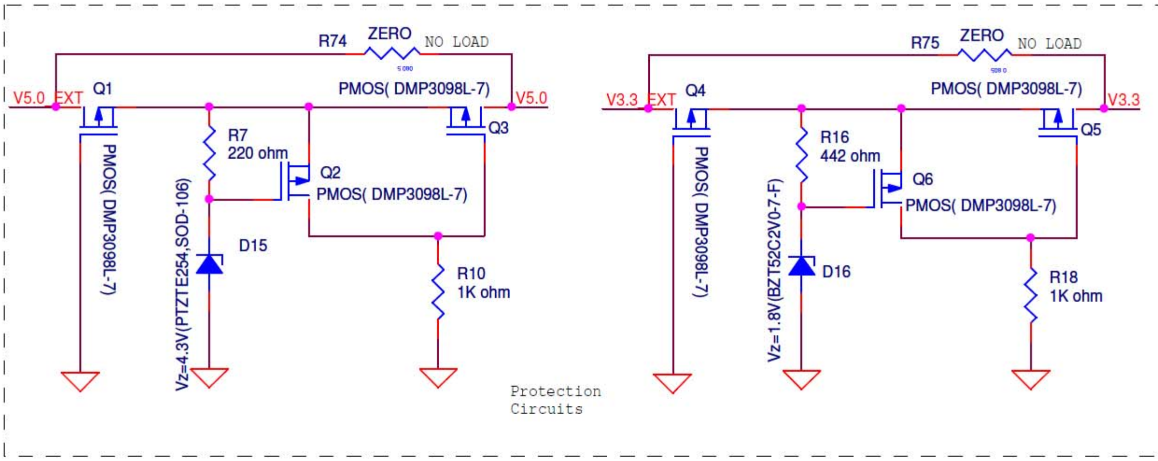

Use Separate Track for CGND1 to GND
Expansion Connectors
Port E (Analog EBK Connector)
Port D (Misc Connector)
20x2 RECP RA


VDDA
U6
LM4140
VIN
VREF
EN
NC
J39
R73
R34
R37
C24
C28
C32
NO LOAD
Voltage Reference


VIN
V5.0
SS12-E3/61T
D7
D1
J2
VBUS
DM
DP
ID
GND
USB MINI B
VBUS2
DM
DP
D14
D12
D13
100K R4
C9 0.01 uFd
VSSD
USB MinB


Note: Load R72 for 5V operation,
Load R71 for 3.3V operation
V5.0
VLCD
V3.3
R72 0E
R71 0E
NO LOAD
R67
10K NO LOAD
C53
0.1 uFd
VSSD
P8
LCD
MODULE
LCD HEADER W/O BACKLIGHT
10K R69
R68
R40
R41
R42
R43
R44
R45
R46
P2[0]
P2[1]
P2[2]
P2[3]
P2[4]
P2[5]
P2[6]
VLCD
R70
NO LOAD
LCD Display

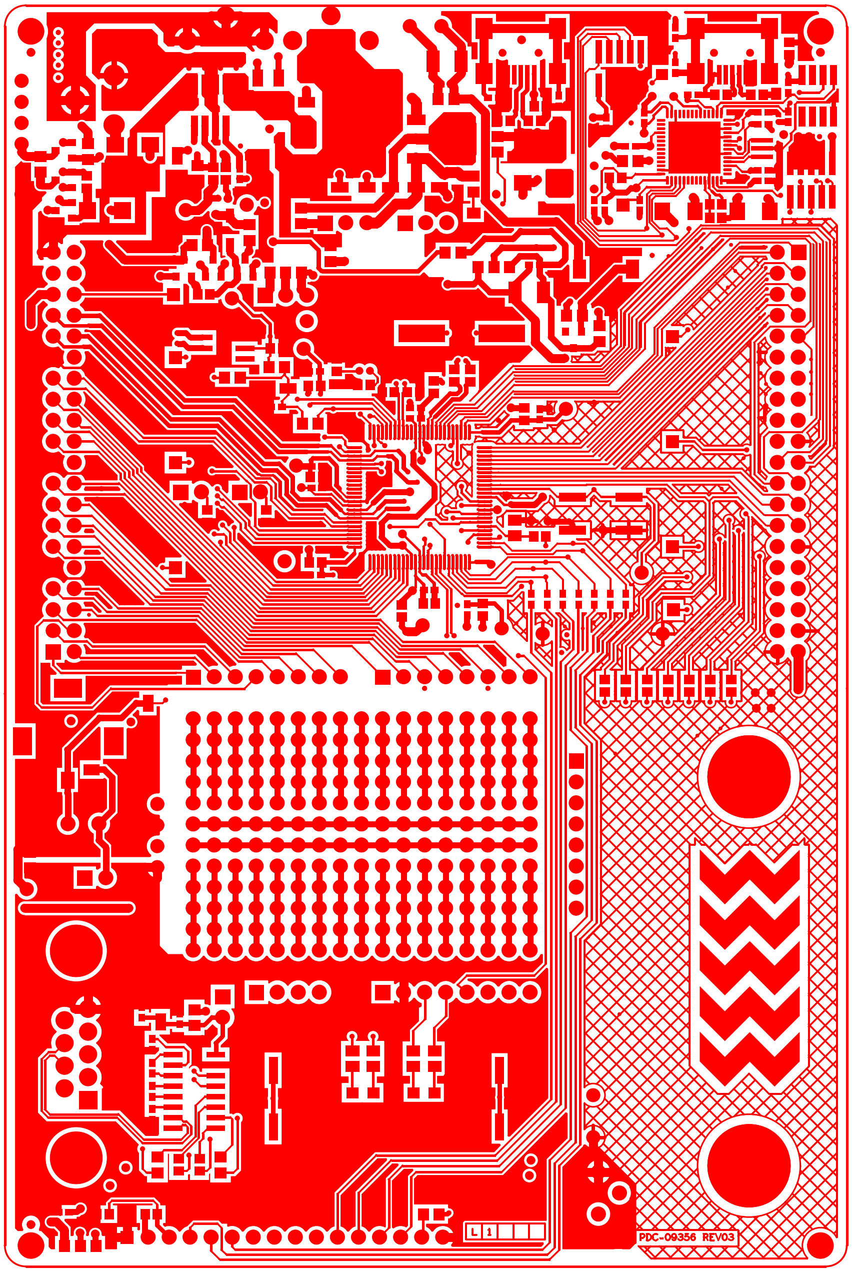

Note: Un-Load R58 to disconnect RS-232 Power
VDDD
J37
NO LOAD
R58
10 ohm
10 uFd 16v
C46
C48
0.1 uFd
C47
0.1 uFd
VSSD
P7
DB9 FEMALE
RTS
RX
CTS
TX
U8
C2+
VCC
C1+
C51
0.1 uFd
C50
0.1 uFd
C2-
C1-
TR1OUT
TR1IN
RX1IN
RX1OUT
TR2OUT
TR2IN
RX2IN
RX2OUT
R64 ZERO
SERIAL_TX
R63 100 ohm
SERIAL_RX
R65 100 ohm
SERIAL_RTS
R66 ZERO
SERIAL_CTS
P5
SERIAL_RX
SERIAL_TX
SERIAL_CTS
SERIAL_RTS
4x1 RECP
V+
GND
V-
C49
0.1 uFd
MAX3232CDR
C52
0.1 uFd
VSSD
RS 232



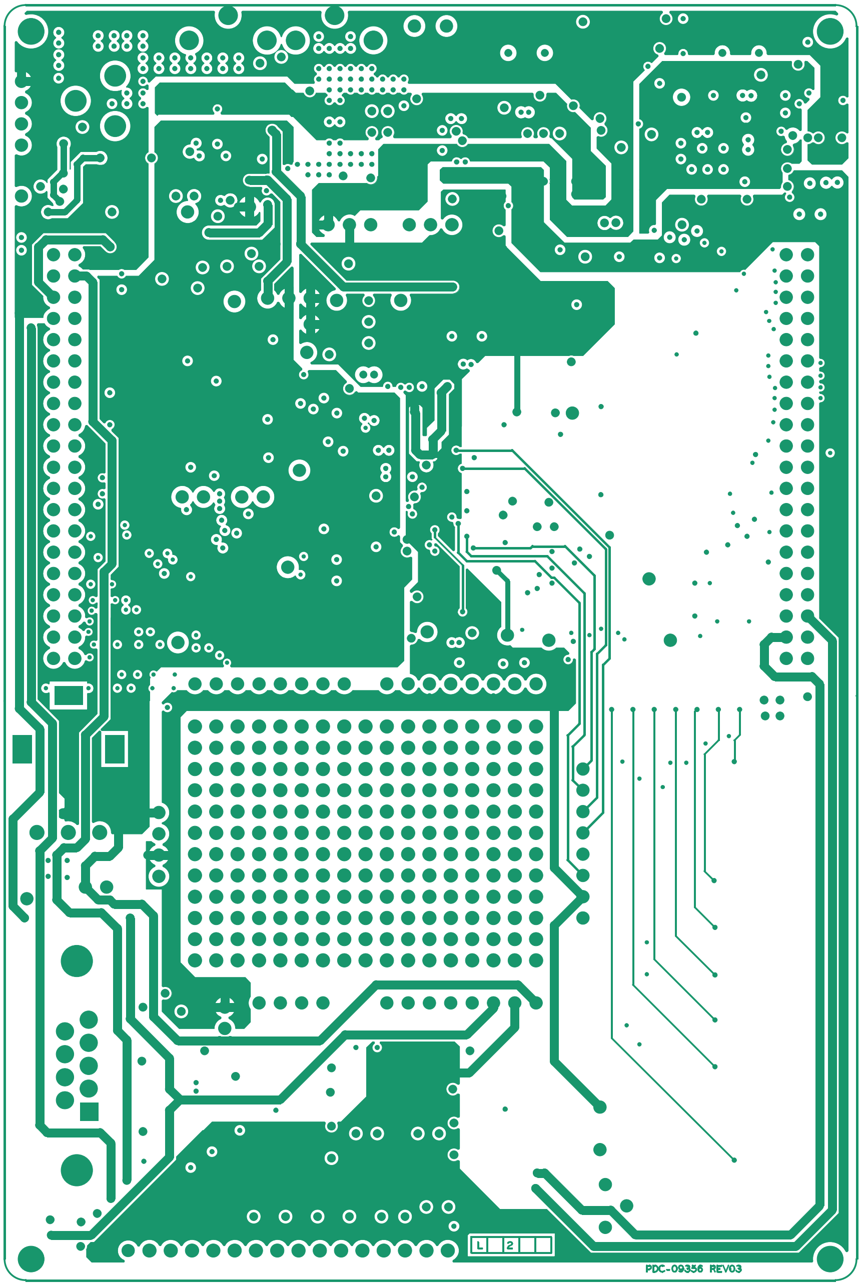
R74
ZERO
NO LOAD
V5.0_EXT
Q1
PMOS(DMP3098L-7)
V5.0
Q3
R7
220 ohm
Q2
PMOS(DMP3098L-7)
PMOS(DMP3098L-7)
Vz=4.3V(PTZTE254,SOD-106)
D15
R10
1K ohm
Protection
Circuits
R75
ZERO
NO LOAD
V3.3_EXT
Q4
PMOS(DMP3098L-7)
V3.3
Q5
R16
442 ohm
Q6
PMOS(DMP3098L-7)
PMOS(DMP3098L-7)
Vz=1.8V(BZT52C2V0-7-F)
D16
R18
1K ohm

A.2 Board Layout

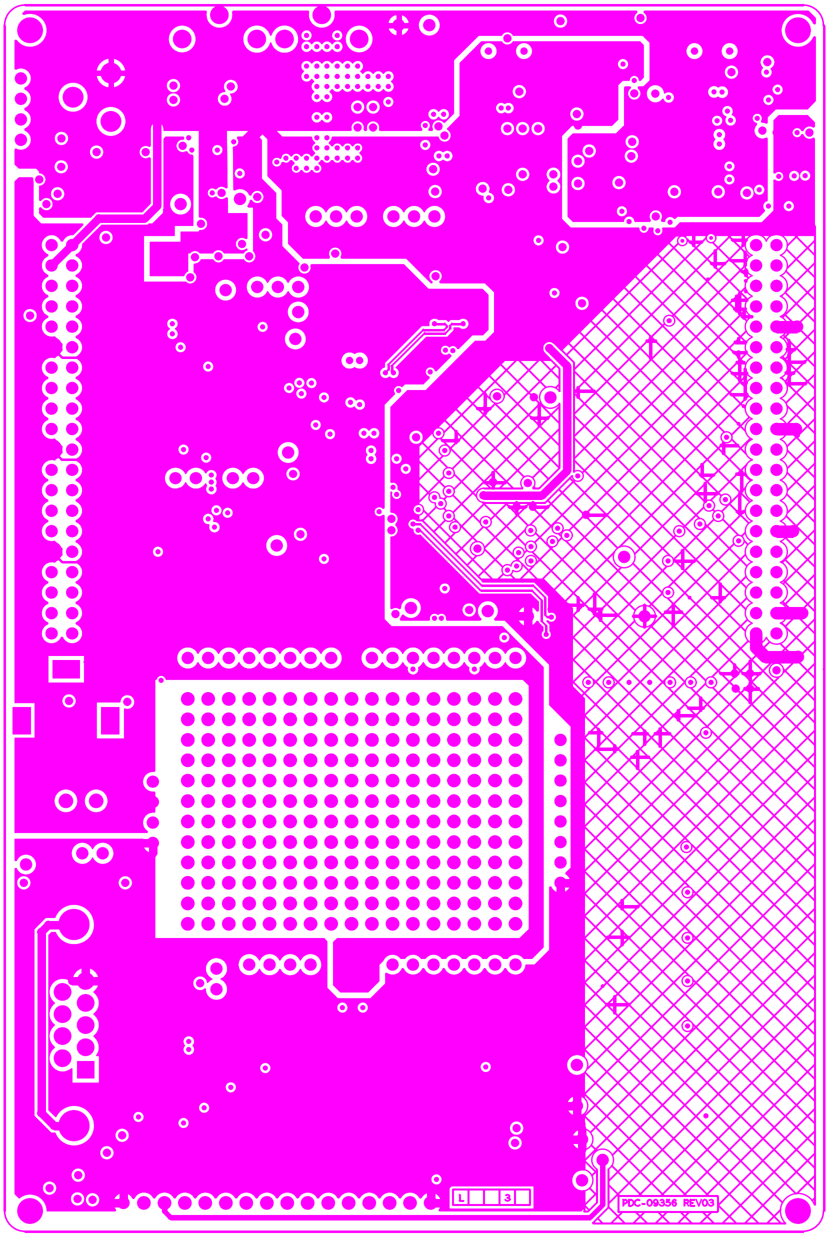
A.2.1 PDC-09356 Top



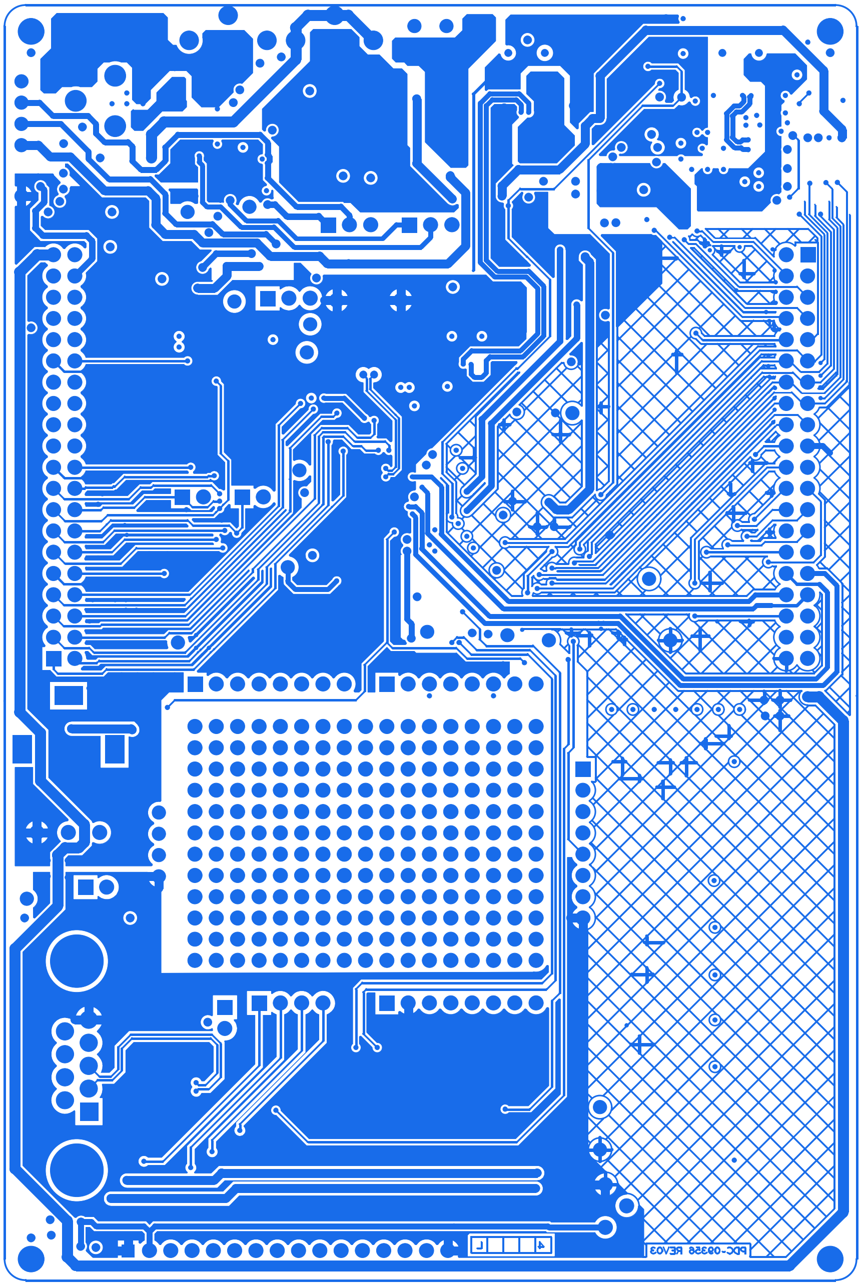
A.2.2 PDC-09356 Power



A.2.3 PDC-09356 Ground



A.2.4 PDC-09356 Bottom



A.3 Bill of Materials (BOM)

Item	Qty	Reference	Value	Description	Manufacturer	Manufacturer Part No.
				PCB	Cypress	PDC-09356
1	1	BH1	BAT 9V MALE	BATTERY HOLDER 9V Male PC MT	Keystone Electronics	593
2	1	BH2	BAT 9V FEMALE	BATTERY HOLDER 9V Female PC MT	Keystone Electronics	594
3	9	C2,C4,C5,C13,C14,C15,C28,C45,C46	10 uFd 16v	CAP 10UF 16V TANTALUM 10% 3216	AVX	TAJA106K016R
4	2	C6,C22	22 uFd	CAP CER 22UF 10V 10% X5R 1210	Kemet	C1210C226K8PACTU
5	29	C7,C10,C12,C16, C17,C18,C19,C20,C21,C26,C32,C33,C34,C35,C36, C38,C40,C41,C43,C47,C48,C49,C50,C51,C52, C53, C1, C3, C23	0.1 uFd	CAP .1UF 16V CERAMIC Y5V 0402	Panasonic - ECG	ECJ-0EF1C104Z
6	2	C8,C9	0.01 uFd	CAP 10000PF 16V CERAMIC 0402 SMD	Panasonic - ECG	ECJ-0EB1C103K
7	1	C11	2.2 uFd	CAP CER 2.2UF 6.3V 20% X5R 0402	Panasonic - ECG	ECJ-0EB0J225M
8	4	C29,C37,C42,C44	1.0 uFd	CAP CERAMIC 1.0UF 25V X5R 0603 10%	Taiyo Yuden	TMK107BJ105KA-T
9	2	C25, C27	22pF	CAP, CER, 22 pF, 50V, 5%, COG, 0603, SMD	Panasonic - ECG	ECJ-0EC1H220J
10	1	C39	2200 pFd	SMD/SMT 0805 2200pF 50volts C0G 5%	Murata	GRM2165C1H222JA01D
11	2	C54,C55	1.0 uFd	CAP CERAMIC 1.0UF 25V X5R 0603 10%	Taiyo Yuden	TMK107BJ105KA-T
12	6	D1,D2,D3,D4, D7, D8	SS12-E3/61T	DIODE SCHOTTKY 20V 1A SMA	Vishay/General Semiconductor	SS12-E3/61T
13	1	D5	LED Green	LED GREEN CLEAR 0805 SMD	Chicago Miniature	CMD17-21VGC/TR8
14	1	D6	ZHCS	DIODE SCHOTTKY 40V 1.0A SOT23-3	Zetex	ZHCS1000TA
15	6	D9, D10, D11, D12, D13, D14	ESD diode	SUPPRESSOR ESD 5VDC 0603 SMD	Bourns Inc.	CG0603MLC-05LE
16	1	D15	4.3V zener diode	DIODE ZENER 4.3V 1W SOD-106	Rohm Semiconductor	PTZTE254.3B
17	1	D16	2.0V Zener Diode	DIODE ZENER 2V 500MW SOD-123	Diodes Inc	BZT52C2V0-7-F
18	2	J1,J2	USB MINI B	CONN USB MINI B SMT RIGHT ANGLE	TYCO	1734035-2
19	2	J3, J40	50MIL KEYED SMD	CONN HEADER 10 PIN 50MIL KEYED SMD	Samtec	FTSH-105-01-L-DV-K
20	1	J4	POWER JACK P-5	CONN JACK POWER 2.1mm PCB RA	CUI	PJ-102A
21	1	J50	Breadboard	BREADBOARD 17x5x2	3M	923273-I

Item	Qty	Reference	Value	Description	Manufacturer	Manufacturer Part No.
22	5	TP1, J26, J27, J35, J28	BLACK TEST POINT	TEST POINT PC MINI .040"D Black	Keystone Electronics	5001
23	4	LED1,LED2,LED3,LED4	LED Red	LED RED CLEAR 0805 SMD	Rohm Semiconductor	SML-210LTT86
24	1	L1	22 uH	INDUCTOR SHIELD PWR 22UH 7032	TDK Corporation	SLF7032T-220MR96-2-PF
25	2	P1,P2	20x2 RECP RA	CONN FMALE 40POS DL .100 R/A GOLD	Sullins Electronics Corp.	PPPC202LJBN-RC
26	1	P7	DB9 FEMALE	CONN DB9 FMALE VERT PRESSFIT SLD	Norcomp Inc.	191-009-223R001
27	1	P8	LCD HEADER W/O BACKLIGHT	CONN RECEPT 16POS .100 VERT AU	Tyco Electronics	1-534237-4
28	4	P3,P4,P6,P9	RECP 8X1	CONN RECT 8POS .100 VERT	3M	929850-01-08-RA
29	6	Q1,Q2,Q3,Q4,Q5,Q6	P-MOS, 30V 3.8A SOT23 in Protection circuit	MOSFET P-CH 30V 3.8A SOT23-3	Diodes Inc	DMP3098L-7
30	1	R7	RES 220 OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF2200V	YES
31	1	R16	RES 442 OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF4420V	YES
32	2	R3,R4	100K	RES 100K OHM 1/16W 5% 0402 SMD	Panasonic - ECG	ERJ-2GEJ104X
33	6	R9,R23,R24,R26,R27,R71	ZERO	RES 0.0 OHM 1/10W 5% 0805 SMD	Panasonic-ECG	ERJ-6GEY0R00V
34	2	R5,R6	2.2K	RES 2.2K OHM 1/16W 5% 0402 SMD	Panasonic - ECG	ERJ-2GEJ222X
35	3	R11,R10,R18	1K	RES 1.0K OHM 1/8W 5% 0805 SMD	Panasonic - ECG	ERJ-6GEYJ102V
36	1	R12	3.16K	RES 3.16K OHM 1/10W .5% 0603 SMD	Yageo	RT0603DRD073K16L
37	1	R13	3.74K	RES 3.74K OHM 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF3741V
38	1	R14	100K	RES 100K OHM 1/10W 1% 0603 SMD	Yageo	RC0603FR-07100KL
39	5	R15,R59,R60,R61,R62	330 ohm	RES 330 OHM 1/10W 5% 0805 SMD	Panasonic - ECG	ERJ-6GEYJ331V
40	8	R17,R40,R41,R42,R43,R44,R45,R46	10K	RES 10K OHM 1/16W 5% 0402 SMD	Stackpole Electronics Inc	RMCF 1/16S 10K 5% R
41	13	R35,R36,R39,R47,R48,R49,R50,R51,R52,R53,R54,R64,R66	ZERO	RES ZERO OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEY0R00V
42	2	R32,R33	22E	RES 22 OHM 1/16W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF22R0V
43	2	R63,R65	100 ohm	RES 100 OHM 1/8W 5% 0805 SMD	Rohm	MCR10EZHJ101

Item	Qty	Reference	Value	Description	Manufacturer	Manufacturer Part No.
44	1	R56	POT 10K	POT 10K OHM 1/8W CARB VERTICAL	CTS Electro-components	296UD103B1N
45	1	R58	10E	RES 10 OHM 1/8W 5% 0805 SMD	Stackpole Elec-tronics Inc	RMCF 1/10 10 5% R
46	1	R68	100 ohm	RES 100 OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ101V
47	1	R69	10K	RES 10K OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ103V
48	3	SW1,SW2,SW3	SW PUSHBUT-TON	LT SWITCH 6MM 160GF H=2.5MM SMD	Panasonic - ECG	EVQ-Q2P02W
49	1	U1	LT1763CS8	IC LDO REG LOW NOISE ADJ 8-SOIC	Linear Technol-ogy	LT1763CS8#PBF
50	1	U2	AP1117D50G	IC REG LDO 1.0A 5.0V TO-252	Diodes Inc	AP1117D50G-13
51	1	U3	24LC00/SN	IC EEPROM 128BIT 400KHZ 8SOIC	Microchip Tech-nology	24LC00/SN
52	1	U4	LM1117MPX-3.3	IC REG 3.3V 800MA LDO SOT-223	National Semi-conductor	LM1117IMP-3.3/ NOPB
53	1	U5	CY7C68013A-56LTXC	IC, FX2 HIGH-SPEED USB PERIPHERAL CONTROLLER QFN56	Cypress Semi-conductor	CY7C68013A-56LTXC
54	1	U7	CY8C5868AXI-LP035 TQFP100	PSoC 5 Mixed-Signal Array	Cypress Semi-conductor	CY8C5868AXI-LP035
55	1	U8	MAX3232CDR	IC 3-5.5V LINE DRVR/RCVR 16-SOIC	Texas Instur-ments	MAX3232IDR
56	1	Y1	24 MHz	CER RESONATOR 24.0 MHz SMD	Murata	CSTCW24M0X53-R0
57	1	Y2	32.768KHz XTAL	CRYSTAL 32.768 KHZ CYL 12.5PF CFS308	Citizen America Corporation	CFS308-32.768KDZF-UB
58	1	Y3	24 MHz Crystal	CRYSTAL 24.000MHZ 20PF SMD	ECS Inc	ECS-240-20-5PX-TR
59	3	J8,J33, TP2	RED TEST POINT	TEST POINT PC MINI .040"D RED	Keystone Elec-tronics	5000
60	1	R38	2.2K	RES 2.2KOHM 1/16W 2700PPM 5%0603	Panasonic - ECG	ERA-V27J222V
61	2	J10,J11	3p_jumper	CONN HEADER VERT SGL 3POS GOLD	3M	961103-6404-AR
62	3	J30,J43,J44	2p_jumper	CONN HEADER VERT SGL 2POS GOLD	3M	961102-6404-AR
63	1	NA	3.3V LCD Module 16POS w/16 pin header installed	3.3V LCD Module 16POS w/16 pin header installed	Lumex	LCM-S01602DTR/A-3
64	1	NA	16 pin header	CONN HEADER VERT SGL 16POS GOLD	3M	961116-6404-AR
65	1	R21	39K	RES 39.0K OHM 1/10W 1% 0603 SMD	Rohm Semicon-ductor	MCR03EZPFX3902
66	1	R22	62K	RES 62.0K OHM 1/10W 1% 0603 SMD	Rohm Semicon-ductor	MCR03EZPFX6202
67	2	C30,C31	22pF	CAP, CER, 22 pF, 50V, 5%, COG, 0603, SMD	Panasonic - ECG	ECJ-1VC1H220J

Item	Qty	Reference	Value	Description	Manufacturer	Manufacturer Part No.
68	1	P5	4x1 RECP	CONN RECEPT 4POS .100 VERT GOLD	3M	929850-01-04-RA
69	1	J31, J32, J29, J34	4x1 RECP	CONN RECEPT 4POS .100 VERT GOLD	3M	929850-01-04-RA
No Load Components						
70	1	C24	1.0 uFd	CAP CERAMIC 1.0UF 25V X5R 0603 10%	Taiyo Yuden	TMK107BJ105KA-T
71	11	J5,J6,J12,J14,J18,J22,J25,TP3,TP4,J16,J39	RED	TEST POINT PC MINI .040"D RED	Keystone Electronics	5000
72	2	J7,J36	BLACK	TEST POINT PC MINI .040"D Black	Keystone Electronics	5001
73	1	TP5	WHITE	TEST POINT PC MINI .040"D WHITE	Keystone Electronics	5002
74	1	R67	10K	POT 10K OHM 1/4" SQ CERM SL ST	Bourns Inc.	3362P-1-103LF
75	12	R30,R34,R57,R72,R25,R31,R70,R37,R29, R73,R74,R75	ZERO	RES 0.0 OHM 1/10W 5% 0805 SMD	Panasonic-ECG	ERJ-6GEY0R00V
76	1	R55	10K	TRIMPOT 10K OHM 4MM TOP ADJ SMD	Bourns Inc.	3214W-1-103E
77	2	R1,R28,	ZERO	RES ZERO OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEY0R00V
78	1	U6	LM4140	IC REF PREC VOLT MICROPWR 8-SOIC	National Semiconductor	LM4140ACM-1.0/NOPB
79	1	R8	1.5K	RES 1.5KOHM 1/10W 1500PPM 5%0805	Panasonic - ECG	ERA-S15J152V
80	1	R2	3K	RES 1/10W 3K OHM 0.1% 0805	Stackpole Electronics Inc	RNC 20 T9 3K 0.1% R
81	1	J38	3p_jumper	CONN HEADER VERT SGL 3POS GOLD	3M	961103-6404-AR
82	1	J37	2p_jumper	CONN HEADER VERT SGL 2POS GOLD	3M	961102-6404-AR
83	2	CSB1,CSB2	CapSense	CapSense Button	Cypress	
84	1	CSS1	CapSense Linear Slider 5 Seg	CapSense Slider	Cypress	
85	11	J9,J13,J15,J17,J19,J20,J21,J23,J24,J41,J42	PADS	PADS		
86	2	TV1,TV2	PADS	PADS		
Install On Bottom of PCB As Close To Corners As Possible						
87	5			BUMPER CLEAR .500X.23" SQUARE	Richco Plastic Co	RBS-3R
Special Jumper Installation Instructions						

Item	Qty	Reference	Value	Description	Manufacturer	Manufacturer Part No.
88	1	J30	Install jumper across pins 1 and 2	Rectangular Connectors MINI JUMPER GF 13.5 CLOSE TYPE BLACK	Kobiconn	151-8030-E
89	2	J10, J11	Install jumper across pins 1 and 2	Rectangular Connectors MINI JUMPER GF 13.5 CLOSE TYPE BLACK	Kobiconn	151-8030-E
90	2	J43,J44	Install jumper across pins 1 and 2	Rectangular Connectors MINI JUMPER GF 13.5 CLOSE TYPE BLACK	Kobiconn	151-8030-E
External Assembly						
91	2		Install 3.3V label as per assembly spec	3.3V label		
92	2		4-40 X 5 +13 Brass Spacer Stud with Nut	Spacer and nut for RS232 Connector P7		

A.4 Pin Assignment Table

Port	Pin	Pin Name	Description
Port 0	71	P0[0]	Connected to Pin 18 on Port E
	72	P0[1]	Connected to Pin 17 on Port E
	73	P0[2]	1. Connected to Pin 16 on Port E 2. Connected to SAR bypass capacitor C54 that can be selected by shorting jumper J43
	74	P0[3]	Connected to 2 points: 1. Voltage reference Chip* 2. Connected to Pin 15 on Port E
	76	P0[4]	1. Connected to Pin 14 on Port E 2. Connected to SAR bypass capacitor C55 that can be selected by shorting jumper J44
	77	P0[5]	Connected to Pin 13 on Port E
	78	P0[6]	Connected to Pin 12 on Port E
	79	P0[7]	Connected to Pin 11 on Port E
Port 1	20	P1[0]	Connected to 3 points: 1. Connected to Pin 2 on programming header J3 2. Connected to Pin 45 on U5 3. Connected to Pin 8 (SWDIO) on Port D
	21	P1[1]	Connected to 3 points: 1. Connected to Pin 4 on programming header 2. Connected to Pin 56 on U5 3. Connected to Pin 7 (SWDCK) on Port D
	22	P1[2]	Connected to Pin 6 on Port D
	23	P1[3]	Connected to 3 points: 1. Connected to Pin 6 on programming header 2. Connected to Pin 47 on U5 3. Connected to Pin 5 (SWO) on Port D
	24	P1[4]	Connected to 2 points: 1. Connected to Pin 8 on programming header 2. Connected to Pin 4 (TDI) on Port D
	25	P1[5]	Connected to Pin 3 on Port D
	27	P1[6]	Connected to Pin 2 on Port D
	28	P1[7]	Connected to Pin 1 on Port D

Port	Pin	Pin Name	Description
Port 2	95	P2[0]	Connected to 2 points: 1. Connected to LCD module 2. Connected to Pin 18 on Port D
	96	P2[1]	Connected to 2 points: 1. Connected to LCD module 2. Connected to Pin 17 on Port D
	97	P2[2]	Connected to 2 points: 1. Connected to LCD module 2. Connected to Pin 16 on Port D
	98	P2[3]	Connected to 3 points: 1. Connected to Pin 2 on trace header J40 2. Connected to LCD module 3. Connected to Pin 15 on Port D
	99	P2[4]	Connected to 3 points: 1. Connected to Pin 4 on trace header J40 2. Connected to LCD module 3. Connected to Pin 14 on Port D
	1	P2[5]	Connected to 3 points: 1. Connected to Pin 6 on trace header J40 2. Connected to LCD module 3. Connected to Pin 13 on Port D
	2	P2[6]	Connected to 3 points: 1. Connected to Pin 8 on trace header J40 2. Connected to LCD module 3. Connected to Pin 12 on Port D
	3	P2[7]	Connected to 3 points: 1. Connected to Pin 10 on trace header J40 2. Connected to LCD module 3. Connected to Pin 11 on Port D
Port 3	44	P3[0]	Connected to Pin 8 on Port E
	45	P3[1]	Connected to Pin 7 on Port E
	46	P3[2]	Connected to 2 points: 1. Voltage reference Chip* 2. Connected to Pin 6 on Port E
	47	P3[3]	Connected to Pin 5 on Port E
	48	P3[4]	Connected to Pin 4 on Port E
	49	P3[5]	Connected to Pin 3 on Port E
	51	P3[6]	Connected to Pin 2 on Port E
	52	P3[7]	Connected to Pin 1 on Port E
Port 4	69	P4[0]	Connected to Pin 28 on Port E
	70	P4[1]	Connected to Pin 27 on Port E
	80	P4[2]	Connected to Pin 26 on Port E
	81	P4[3]	Connected to Pin 25 on Port E
	82	P4[4]	Connected to Pin 24 on Port E
	83	P4[5]	Connected to Pin 23 on Port E
	84	P4[6]	Connected to Pin 22 on Port E
	85	P4[7]	Connected to Pin 21 on Port E

Port	Pin	Pin Name	Description
Port 5	16	P5[0]	Connected to 2 points: 1. Connected to CapSense slider segment 2. Connected to Pin 28 on Port D
	17	P5[1]	Connected to 2 points: 1. Connected to CapSense slider segment 2. Connected to Pin 27 on Port D
	18	P5[2]	Connected to 2 points: 1. Connected to CapSense slider segment 2. Connected to Pin 26 on Port D
	19	P5[3]	Connected to 2 points: 1. Connected to CapSense slider segment 2. Connected to Pin 25 on Port D
	31	P5[4]	Connected to 2 points: 1. Connected to CapSense slider segment 2. Connected to Pin 24 on Port D
	32	P5[5]	Connected to 2 points: 1. Connected to CapSense button CSB1 2. Connected to Pin 23 on Port D
	33	P5[6]	Connected to 2 points: 1. Connected to CapSense button CSB2 2. Connected to Pin 22 on Port D
	34	P5[7]	Connected to Pin 21 on Port D
Port 6	89	P6[0]	Connected to Pin 5 on P9
	90	P6[1]	Connected to SW2 push button
	91	P6[2]	Connected to LED3
	92	P6[3]	Connected to LED4
	6	P6[4]	Connected to CapSense Modulation Capacitor CMOD
	7	P6[5]	Connected to 2 points: 1. Connected to VR POT 2. Connected to Pin 5 on P6
	8	P6[6]	Connected to Pin 6 on P9
	9	P6[7]	Unused/No Connect
Port 12	53	P12[0]	Connected to Pin 34 (SCL) on Port D and Port E
	54	P12[1]	Connected to Pin 33 (SDA) on Port D and Port E
	67	P12[2]	Connected to Pin 32 on Port D and Port E
	68	P12[3]	Connected to Pin 31 on Port D and Port E
	4	P12[4]	Connected to Pin 1 on P9
	5	P12[5]	Connected to Pin 2 on P9
	29	P12[6]	Connected to Pin 3 on P9
	30	P12[7]	Connected to Pin 4 on P9

Port	Pin	Pin Name	Description
Port 15	42	P15[0]	Connected to 24MHz Crystal
	43	P15[1]	Connected to 24MHz Crystal
	55	P15[2]	Connected to 32KHz Crystal
	56	P15[3]	Connected to 32KHz Crystal
	93	P15[4]	Connected to Rbleed resistor
	94	P15[5]	Connected to SW3 push button
	35	P15[6]	Connected to USB D+
	36	P15[7]	Connected to USB D-
Other Pins	13	Vbat	Connected to Vbat
	12	Vboost	Connected to Vboost
	63	VCCa	Connected to VCCa
	39	VCCd	Connected to VCCd
	86	VCCd	Connected to VCCd
	65	VDDa	Connected to VDDa
	37	VDDd	Connected to VDDd
	88	VDDd	Connected to VDDd
	75	VDDio0	Connected to VDDio0
	26	VDDio1	Connected to VDDio1
	100	VDDio2	Connected to VDDio2
	50	VDDio3	Connected to VDDio3
	64	VSSa	Connected to GND
	10	VSSb	Connected to GND
	14	VSSd	Connected to GND
	38	VSSd	Connected to GND
	66	VSSd	Connected to GND
	87	VSSd	Connected to GND
	15	XRES	Connected to 3 points: 1. Connected to Pin 10 on J3 2. Connected to SW1 3. Connected to Pin 20 on U5
	11	Ind	Connected to Inductor
	40	NC1	Unused/No Connect
	41	NC2	Unused/No Connect
	57	NC3	Unused/No Connect
	58	NC4	Unused/No Connect
	59	NC5	Unused/No Connect
	60	NC6	Unused/No Connect
	61	NC7	Unused/No Connect
	62	NC8	Unused/No Connect

Note* To enable voltage reference, populate the resistors R34, R37, R73, and low dropout voltage reference IC LM4140. See the “Bill of Materials (BOM)” on page 53 for component details.