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Cypress products meet the specifications contained in their particular Cypress PSoC Data Sheets. Cypress believes that its family of PSoC products is one of the most secure families of its kind on the market today, regardless of how they are used. There may be methods, unknown to Cypress, that can breach the code protection features. Any of these methods, to our knowledge, would be dishonest and possibly illegal. Neither Cypress nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as ‘unbreakable’.

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Contents

1. Introduction 5
   1.1 Kit Contents ................................................................................................................ .5
   1.2 PSoC Creator ..............................................................................................................5
   1.3 Additional Learning Resources....................................................................................6
      1.3.1 Beginner Resources...........................................................................................6
      1.3.2 Engineers Looking for More .............................................................................6
      1.3.3 Learn from Peers .............................................................................................6
      1.3.4 More Code Examples.......................................................................................6
   1.4 Document History ........................................................................................................9
   1.5 Documentation Conventions .......................................................................................9

2. Getting Started 11
   2.1 Introduction ................................................................................................................ 11
   2.2 CD Installation ...........................................................................................................11
   2.3 Install Hardware.........................................................................................................12
   2.4 Install Software ..........................................................................................................12
   2.5 Uninstall Software......................................................................................................12
   2.6 Verify Kit Version .......................................................................................................12

3. Kit Operation 13
   3.1 Programming PSoC 5LP Device ....................................................................................13

4. Hardware 17
   4.1 System Block Diagram ..............................................................................................17
   4.2 Functional Description ...............................................................................................18
      4.2.1 Power Supply ......................................................................................................18
      4.2.1.1 Power Supply Jumper Settings.................................................................19
      4.2.1.2 Grounding Scheme ....................................................................................20
      4.2.1.3 Low-Power Functionality ........................................................................20
      4.2.1.4 AC/DC Adaptor Specifications ..............................................................21
      4.2.1.5 Battery Specifications ..............................................................................21
      4.2.2 Programming Interface ..................................................................................21
      4.2.2.1 On-board Programming Interface .........................................................21
      4.2.2.2 JTAG/SWD Programming ......................................................................22
      4.2.3 USB Communication ......................................................................................23
      4.2.4 Boost Convertor ...............................................................................................23
      4.2.5 32-kHz and 24-MHz Crystal ............................................................................24
      4.2.6 Protection Circuit ............................................................................................24
      4.2.6.1 Functional Description of Circuit ............................................................25
      4.2.7 PSoC 5LP Development Kit Expansion Ports ................................................26
      4.2.7.1 Port D.......................................................................................................26
      4.2.7.2 Port E.......................................................................................................28
4.2.8 RS-232 Interface ............................................................................................29
4.2.9 Prototyping Area ............................................................................................29
4.2.10 Character LCD ...............................................................................................30
4.2.11 CapSense Sensors ........................................................................................31

5. Code Examples 33

5.1 Project: VoltageDisplay_SAR_ADC ............................................................................34
  5.1.1 Project Description .........................................................................................34
  5.1.2 Hardware Connections ..................................................................................34
  5.1.3 SAR ADC Configuration .................................................................................34
  5.1.4 Verify Output ..................................................................................................35

5.2 Project: VoltageDisplay_DelSigADC .................................................................35
  5.2.1 Project Description .........................................................................................35
  5.2.2 Hardware Connections ..................................................................................36
  5.2.3 Del-Sig ADC Configuration ............................................................................36
  5.2.4 Verify Output ..................................................................................................37

5.3 Project: IntensityLED ...........................................................................................38
  5.3.1 Project Description .........................................................................................38
  5.3.2 Hardware Connections ..................................................................................38
  5.3.3 Verify Output ..................................................................................................38

5.4 Project: LowPowerDemo .......................................................................................38
  5.4.1 Project Description .........................................................................................38
  5.4.2 Hardware Connections ..................................................................................38
  5.4.3 Verify Output ..................................................................................................39

5.5 Project: CapSense ................................................................................................39
  5.5.1 Project Description .........................................................................................39
  5.5.2 Hardware Connections ..................................................................................40
  5.5.3 Verify Output ..................................................................................................40

5.6 Project: ADC_DAC ..............................................................................................41
  5.6.1 Project Description .........................................................................................41
  5.6.2 Hardware Connections ..................................................................................41
  5.6.3 Verify Output ..................................................................................................41

A. Appendix 43

A.1 Schematic .............................................................................................................43
A.2 Board Layout ........................................................................................................49
  A.2.1 PDC-09356 Top ..........................................................................................49
  A.2.2 PDC-09356 Power ....................................................................................50
  A.2.3 PDC-09356 Ground ..................................................................................51
  A.2.4 PDC-09356 Bottom ..................................................................................52
A.3 Bill of Materials (BOM) .......................................................................................53
A.4 Pin Assignment Table ........................................................................................58
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...
Introduction

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.
Introduction

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

<table>
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<th>PDF Creation Date</th>
<th>Origin of Change</th>
<th>Description of Change</th>
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<td>**</td>
<td>03/01/2011</td>
<td>PVKV</td>
<td>Initial version of kit guide</td>
</tr>
<tr>
<td>*A</td>
<td>04/28/2011</td>
<td>RKAD</td>
<td>Updated Schematic</td>
</tr>
<tr>
<td>*B</td>
<td>12/15/2011</td>
<td>RKAD</td>
<td>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</td>
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<td>*C</td>
<td>05/15/2012</td>
<td>SASH</td>
<td>Updated the Additional Resources section</td>
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<td>*D</td>
<td>06/18/2012</td>
<td>SASH</td>
<td>Updated CD Installation on page 11.</td>
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<tr>
<td>*E</td>
<td>11/08/2012</td>
<td>SASH</td>
<td>Updated images</td>
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1.5 Documentation Conventions

Table 1-1. Document Conventions for Guides

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

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 Compiler. 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.

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.
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 converter
- 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.
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**

![Block Diagram](image)

**4.2.1.1 Power Supply Jumper Settings**

**Figure 4-3. Jumper Settings**

![Jumper Settings](image)
Two jumpers govern the power rails on the board. J10 is responsible for the selection of Vdd (digital power) and J11 selects the VADJ (analog power).

The jumper settings for each power scheme are as follows.

<table>
<thead>
<tr>
<th>Powering Scheme</th>
<th>Jumper Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vdd = 5 V, Vdd = 5 V</td>
<td>J10 in 5 V setting and J11 in 5 V setting.</td>
</tr>
<tr>
<td>Vdd = 3.3 V, Vdd = 3.3 V</td>
<td>J10 in 3.3 V setting and J11 in 3.3 V setting.</td>
</tr>
<tr>
<td>Vdd = 5 V, Vdd = 3.3 V</td>
<td>J10 in 3.3 V setting and J11 in 5 V setting.</td>
</tr>
<tr>
<td>Vdd = 3.3 V, Vdd = 5 V</td>
<td>Can be achieved, but is an invalid condition because the PSoC 5LP silicon performance cannot be guaranteed.</td>
</tr>
</tbody>
</table>

**Warning:**

- The PSoC device performance is guaranteed when Vdda is greater than or equal to Vdd. 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 (Lite 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.
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.
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:
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.
Hardware

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
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](image)

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.

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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
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

![Schematic Diagram](image-url)

**Power Supply**

- +9V/12V, 1A
- 5.0V/1A LDO (AP117050Q)
- 3.3V/0.8A LDO
- 9V Battery
- 5V/3.3V/0.5A LDO

**Internal Boost Regulator**

- Note: Load R30 when either Analog and Digital regulator required
- Note: Load R25, R29 and R31 for operating the device on Boost
- Note: Load R1, R28 and Un-Load R27 for low power application

**9V Battery Terminals**

- POS1, POS2, POS3
- BAT SYM FEMALE
- BAT SYM MALE

- Note: For 5V: J11-3 to J11-2, J10-3 to J10-2
- For 3.3V: J11-2 to J11-1, J10-2 to J10-1
- For 5V Analog, 3.3V Digital: J11-3 to J11-2, J10-2 to J10-1
PLACE ONE CAP PER EACH VCC ON U5.

PLACE C11 AND C16 CLOSE TO U5-3 AND U5-7.

TP2

GND

NO LOAD

GND

FX2LP Programmer

SWD/SWV/JTAG

USB BACKVOLTAGE COMPLIANCE.

3V3_FX12P

SWDCK

VBUS1

SWO

/XRES

D+

VBUS1

D-

3V3_FX12P

VIN

V5.0

VDDD

0402

C20

0.1 uFd

TV2

TV-20R

1

0402

R6

2.2K

0402

C18

0.1 uFd

0402

C19

0.1 uFd

10-PIN TRACE HEADER

SWDIO

TDI

P2[5]

P2[7]

P2[4]

P2[6]

P2[3]

SWDCK

/INT1

/INT0

PA2/SLOE

PA3/WU2

PA4/FIFOADR0

PA5/FIFOADR1

PA6/PKTEND

PA7/FLAGD

PB0/FD0

PB1/FD1

PB2/FD2

PB3/FD3

PB4/FD4

PB5/FD5

PB6/FD6

PB7/FD7

AVCC13

AVCC27

AGND16

CP57

GND112

GND241

GND656

GND326

RESERVED14

WAKEUP#44

PA3/FIFOADR0

PA5/FIFOADR1

PA6/PKTEND

PA7/FLAGD

PB0/FD0

PB1/FD1

PB2/FD2

PB3/FD3

PB4/FD4

PB5/FD5

PB6/FD6

PB7/FD7

PA0/nINT0

PA2/SLOE

PA3/WU2

PA4/FIFOADR0

PA5/FIFOADR1

PA6/PKTEND

PA7/FLAGD

PB0/FD0

PB1/FD1

PB2/FD2

PB3/FD3

PB4/FD4

PB5/FD5

PB6/FD6

PB7/FD7

AVCC13

AVCC27

AGND16

CP57

GND112

GND241

GND656
A.2 Board Layout

A.2.1 PDC-09356 Top
A.2.2 PDC-09356 Power
A.2.3 PDC-09356 Ground
### A.3 Bill of Materials (BOM)

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<td>20x2 RECP RA</td>
<td>CONN FEMALE 40POS DL .100 R/A GOLD</td>
<td>Sullins Electronics Corp.</td>
<td>PPPC202LJB0-RC</td>
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<tr>
<td>26</td>
<td>1</td>
<td>P7</td>
<td>DB9 FEMALE</td>
<td>CONN DB9 FEMALE VERT PRESSFIT SLD</td>
<td>Norcomp Inc.</td>
<td>191-009-223R001</td>
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<tr>
<td>27</td>
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<td>P8</td>
<td>LCD HEADER W/O BACKLIGHT</td>
<td>CONN RECEPT 16POS .100 VERT AU</td>
<td>Tyco Electronics</td>
<td>1-534327-4</td>
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<tr>
<td>28</td>
<td>4</td>
<td>P3, P4, P6, P9</td>
<td>RECP 8X1</td>
<td>CONN RECT 8POS .100 VERT</td>
<td>3M</td>
<td>929850-01-08-RA</td>
</tr>
<tr>
<td>29</td>
<td>6</td>
<td>Q1, Q2, Q3, Q4, Q5, Q6</td>
<td>P-MOS, 30V 3.8A SOT23 in Protection circuit</td>
<td>MOSFET P-CH 30V 3.8A SOT23-3</td>
<td>Diodes Inc</td>
<td>DMP3098L-7</td>
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<tr>
<td>30</td>
<td>1</td>
<td>R7</td>
<td>RES 220 OHM 1/10W 1% 0603 SMD</td>
<td>Panasonic - ECG</td>
<td>ERJ-3EKF2200V</td>
<td>YES</td>
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<td>31</td>
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<td>R16</td>
<td>RES 442 OHM 1/10W 1% 0603 SMD</td>
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<tr>
<td>32</td>
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<td>R3, R4</td>
<td>100K</td>
<td>RES 100K OHM 1/16W 5% 0402 SMD</td>
<td>Panasonic - ECG</td>
<td>ERJ-2GEJ104X</td>
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<tr>
<td>33</td>
<td>6</td>
<td>R9, R23, R24, R26, R27, R71</td>
<td>ZERO</td>
<td>RES 0.0 OHM 1/10W 5% 0805 SMD</td>
<td>Panasonic-ECG</td>
<td>ERJ-6GEY0R00V</td>
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<tr>
<td>34</td>
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<td>R5, R6</td>
<td>2.2K</td>
<td>RES 2.2K OHM 1/16W 5% 0402 SMD</td>
<td>Panasonic - ECG</td>
<td>ERJ-2GEJ222X</td>
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<tr>
<td>35</td>
<td>3</td>
<td>R11, R10, R18</td>
<td>1K</td>
<td>RES 1.0K OHM 1/8W 5% 0805 SMD</td>
<td>Panasonic - ECG</td>
<td>ERJ-6GEYJ102V</td>
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<tr>
<td>36</td>
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<td>R12</td>
<td>3.16K</td>
<td>RES 3.16K OHM 1/10W .5% 0603 SMD</td>
<td>Yageo</td>
<td>RT0603DRD073K16L</td>
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<tr>
<td>37</td>
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<td>R13</td>
<td>3.74K</td>
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<td>38</td>
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<td>R14</td>
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<td>Yageo</td>
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<tr>
<td>39</td>
<td>5</td>
<td>R15, R59, R60, R61, R62</td>
<td>330 ohm</td>
<td>RES 330 OHM 1/10W 5% 0805 SMD</td>
<td>Panasonic - ECG</td>
<td>ERJ-6GEYJ331V</td>
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<tr>
<td>40</td>
<td>8</td>
<td>R17, R40, R41, R42, R43, R44, R45, R46</td>
<td>10K</td>
<td>RES 10K OHM 1/16W 5% 0402 SMD</td>
<td>Stackpole Electronics Inc</td>
<td>RMCF 1/16S 10K 5% R</td>
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<tr>
<td>41</td>
<td>13</td>
<td>R35, R36, R39, R47, R48, R49, R50, R51, R52, R53, R54, R64, R66</td>
<td>ZERO</td>
<td>RES ZERO OHM 1/16W 5% 0603 SMD</td>
<td>Panasonic - ECG</td>
<td>ERJ-3GEY0R00V</td>
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<td>42</td>
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<td>R32, R33</td>
<td>22E</td>
<td>RES 22 OHM 1/16W 1% 0603 SMD</td>
<td>Panasonic - ECG</td>
<td>ERJ-3EKF22R0V</td>
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<td>43</td>
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<td>R63, R65</td>
<td>100 ohm</td>
<td>RES 100 OHM 1/8W 5% 0805 SMD</td>
<td>Rohm</td>
<td>MCR10EZHJ101</td>
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<td>Manufacturer Part No.</td>
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<td>R56</td>
<td>POT 10K</td>
<td>POT 10K OHM 1/8W CARB VERTICAL</td>
<td>CTS Electro-components</td>
<td>296UD103B1N</td>
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<td>45</td>
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<td>R58</td>
<td>10E</td>
<td>RES 10 OHM 1/8W 5% 0805 SMD</td>
<td>Stackpole Electronics Inc</td>
<td>RMCF 1/10 10 5% R</td>
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<tr>
<td>68</td>
<td>1</td>
<td>P5</td>
<td>4x1 RECP</td>
<td>CONN RECEPT 4POS .100 VERT GOLD</td>
<td>3M</td>
<td>929850-01-04-RA</td>
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<tr>
<td>69</td>
<td>1</td>
<td>J31, J32, J29, J34</td>
<td>4x1 RECP</td>
<td>CONN RECEPT 4POS .100 VERT GOLD</td>
<td>3M</td>
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No Load Components

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<tr>
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<th>Manufacturer Part No.</th>
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<tbody>
<tr>
<td>70</td>
<td>1</td>
<td>C24</td>
<td>1.0 uFd</td>
<td>CAP CERAMIC 1.0UF 25V X5R 0603 10%</td>
<td>Taiyo Yuden</td>
<td>TMK107BJ105KA-T</td>
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<tr>
<td>71</td>
<td>11</td>
<td>J5, J6, J12, J14, J18, J22, J25, TP3, TP4, J16, J39</td>
<td>RED</td>
<td>TEST POINT PC MINI .040*D RED</td>
<td>Keystone Electronics</td>
<td>5000</td>
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<td>72</td>
<td>2</td>
<td>J7, J36</td>
<td>BLACK</td>
<td>TEST POINT PC MINI .040*D Black</td>
<td>Keystone Electronics</td>
<td>5001</td>
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<td>73</td>
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<td>TP5</td>
<td>WHITE</td>
<td>TEST POINT PC MINI .040*D WHITE</td>
<td>Keystone Electronics</td>
<td>5002</td>
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<tr>
<td>74</td>
<td>1</td>
<td>R67</td>
<td>10K</td>
<td>POT 10K OHM 1/4&quot; SQ CERM SL ST</td>
<td>Bourns Inc.</td>
<td>3362P-1-103LF</td>
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<tr>
<td>75</td>
<td>12</td>
<td>R30, R34, R57, R72, R25, R31, R70, R37, R29, R73, R74, R75</td>
<td>ZERO</td>
<td>RES 0.0 OHM 1/10W 5% 0805 SMD</td>
<td>Panasonic-EKG</td>
<td>ERJ-6GEY0R00V</td>
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<tr>
<td>76</td>
<td>1</td>
<td>R55</td>
<td>10K</td>
<td>TRIMPOT 10K OHM 4MM TOP ADJ SMD</td>
<td>Bourns Inc.</td>
<td>3214W-1-103E</td>
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<tr>
<td>77</td>
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<td>R1, R28</td>
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<td>RES ZERO OHM 1/10W 5% 0603 SMD</td>
<td>Panasonic-EKG</td>
<td>ERJ-3GEY0R00V</td>
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<td>78</td>
<td>1</td>
<td>U6</td>
<td>LM4140</td>
<td>IC REF PREC VOLT MICROPWR 8-SOIC</td>
<td>National Semiconductor</td>
<td>LM4140ACM-1.0/NOPB</td>
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<td>79</td>
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<td>1.5K</td>
<td>RES 1.5KOHM 1/10W 1500PPM 5%0805</td>
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<td>ERA-S15J152V</td>
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<td>R2</td>
<td>3K</td>
<td>RES 1/10W 3K OHM 0.1% 0805</td>
<td>Stackpole Electronics Inc</td>
<td>RNC 20 T9 3K 0.1% R</td>
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<td>81</td>
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<td>J38</td>
<td>3p_jumper</td>
<td>CONN HEADER VERT SGL 3POS GOLD</td>
<td>3M</td>
<td>961103-6404-AR</td>
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<tr>
<td>82</td>
<td>1</td>
<td>J37</td>
<td>2p_jumper</td>
<td>CONN HEADER VERT SGL 2POS GOLD</td>
<td>3M</td>
<td>961102-6404-AR</td>
</tr>
<tr>
<td>83</td>
<td>2</td>
<td>CSB1, CSB2</td>
<td>CapSense Button</td>
<td>CapSense Button</td>
<td>Cypress</td>
<td></td>
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<tr>
<td>84</td>
<td>1</td>
<td>CSS1</td>
<td>CapSense Linear Slider 5 Seg</td>
<td>CapSense Slider</td>
<td>Cypress</td>
<td></td>
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<tr>
<td>85</td>
<td>11</td>
<td>J9, J13, J15, J17, J19, J20, J21, J23, J24, J41, J42</td>
<td>PADS</td>
<td>PADS</td>
<td></td>
<td></td>
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<tr>
<td>86</td>
<td>2</td>
<td>TV1, TV2</td>
<td>PADS</td>
<td>PADS</td>
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Install On Bottom of PCB As Close To Corners As Possible

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<tr>
<th>Item</th>
<th>Qty</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Manufacturer Part No.</th>
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</thead>
<tbody>
<tr>
<td>87</td>
<td>5</td>
<td>BUMPER CLEAR .500X.23 SQUARE</td>
<td>Richco Plastic Co</td>
<td>RBS-3R</td>
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Special Jumper Installation Instructions
### External Assembly

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
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<th>Value</th>
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<th>Manufacturer</th>
<th>Manufacturer Part No.</th>
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</thead>
<tbody>
<tr>
<td>91</td>
<td>2</td>
<td></td>
<td></td>
<td>Install 3.3V label as per assembly spec</td>
<td>3.3V label</td>
<td></td>
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<tr>
<td>92</td>
<td>2</td>
<td></td>
<td>4-40 X 5 +13 Brass Spacer Stud with Nut</td>
<td>Spacer and nut for RS232 Connector P7</td>
<td></td>
<td></td>
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</table>
## A.4 Pin Assignment Table

<table>
<thead>
<tr>
<th>Port</th>
<th>Pin</th>
<th>Pin Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P0[0]</td>
<td>Connected to Pin 18 on Port E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P0[1]</td>
<td>Connected to Pin 17 on Port E</td>
<td></td>
</tr>
</tbody>
</table>
|      | 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 |
|      | P0[3] | Connected to 2 points:  
1. Voltage reference Chip*  
2. Connected to Pin 15 on Port E |
2. Connected to SAR bypass capacitor C55 that can be selected by shorting jumper J44 |
|      | P0[5] | Connected to Pin 13 on Port E |
|      | P0[6] | Connected to Pin 12 on Port E |
|      | P0[7] | Connected to Pin 11 on Port E |
|      | 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 |
|      | 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 |
|      | P1[2] | Connected to Pin 6 on Port D |
|      | 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 |
|      | P1[4] | Connected to 2 points:  
1. Connected to Pin 8 on programming header  
2. Connected to Pin 4 (TDI) on Port D |
<p>|      | P1[5] | Connected to Pin 3 on Port D |
|      | P1[6] | Connected to Pin 2 on Port D |
|      | P1[7] | Connected to Pin 1 on Port D |</p>
<table>
<thead>
<tr>
<th>Port</th>
<th>Pin</th>
<th>Pin Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port 2</td>
<td>95</td>
<td>P2[0]</td>
<td>Connected to 2 points: 1. Connected to LCD module 2. Connected to Pin 18 on Port D</td>
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<tr>
<td>Port 3</td>
<td>44</td>
<td>P3[0]</td>
<td>Connected to Pin 8 on Port E</td>
</tr>
<tr>
<td>45</td>
<td>P3[1]</td>
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<td>Connected to Pin 7 on Port E</td>
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<tr>
<td>47</td>
<td>P3[3]</td>
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<td>Connected to Pin 5 on Port E</td>
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<tr>
<td>48</td>
<td>P3[4]</td>
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<td>Connected to Pin 4 on Port E</td>
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<td>49</td>
<td>P3[5]</td>
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<tr>
<td>51</td>
<td>P3[6]</td>
<td></td>
<td>Connected to Pin 2 on Port E</td>
</tr>
<tr>
<td>52</td>
<td>P3[7]</td>
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<td>Connected to Pin 1 on Port E</td>
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<tr>
<td>Port 4</td>
<td>69</td>
<td>P4[0]</td>
<td>Connected to Pin 28 on Port E</td>
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<td>70</td>
<td>P4[1]</td>
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<td>Connected to Pin 27 on Port E</td>
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<tr>
<td>81</td>
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<td>85</td>
<td>P4[7]</td>
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<td>Connected to Pin 21 on Port E</td>
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<tr>
<td>Port</td>
<td>Pin</td>
<td>Pin Name</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
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</tbody>
</table>
|      | 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 |
|      | 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  
<p>|      |     |          | 2. Connected to Pin 5 on P6 |
|      | 8   | P6[6]    | Connected to Pin 6 on P9 |
|      | 9   | P6[7]    | Unused/No Connect |
|      | 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 |
|      | 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 |
|      | 30  | P12[7]   | Connected to Pin 4 on P9 |</p>
<table>
<thead>
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<th>Port</th>
<th>Pin</th>
<th>Pin Name</th>
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<tbody>
<tr>
<td>Port 15</td>
<td>42</td>
<td>P15[0]</td>
<td>Connected to 24MHz Crystal</td>
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<tr>
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<td>43</td>
<td>P15[1]</td>
<td>Connected to 24MHz Crystal</td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>P15[2]</td>
<td>Connected to 32KHz Crystal</td>
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<tr>
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<td>56</td>
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<td>94</td>
<td>P15[5]</td>
<td>Connected to SW3 push button</td>
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<td>P15[6]</td>
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<td>36</td>
<td>P15[7]</td>
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<td>Other Pins</td>
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**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.