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CY8CKIT-006 PSoC® 3 LCD Segment Drive Evaluation Kit Guide

Doc. # 001-52798 Rev. *C

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[+] Feedback

Contents

1. Introduction

Thank you for purchasing the CY8CKIT-006 PSoC® 3 LCD Segment Drive Evaluation Kit (EVK). This is an evaluation kit aimed at showcasing PSoC's LCD segment drive system. It familiarizes users with the LCD segment drive capability of Cypress's Programmable System-on-Chip (PSoC) and the LCD segment drive component in Cypress's Integrated Development Environment (PSoC® Creator™).

The kit has the following features:

■ Large complex custom LCD with 448 LCD segments
■ CapSense buttons
■ Accelerometer
■ Thermistor
■ Buzzer
■ Protoheaders

The kit is factory programmed for an out-of-box demonstration of PSoC's LCD segment drive capability, along with PSoC's superior ability to integrate high performance digital and analog peripherals. You can also reprogram the device and using the protoheaders, develop applications.

The CY8CKIT-006 PSoC 3 LCD Segment Drive EVK is based on the PSoC® 3 family of devices. PSoC is a programmable system-on-chip platform for 8, 16, and 32 bit applications. It combines precision analog and digital logic with a high performance 8051 single cycle per instruction pipelined processor, achieving ten times the performance of previous 8051 processors. With the PSoC, you can create the exact combination of peripherals and integrated proprietary IP to meet the needs of your applications. You are no longer constrained by a catalog.

1.1   Kit Contents

This kit contains:

■ PSoC 3 LCD Segment Drive Evaluation Board
■ 9V Battery
■ 12V Wall Wart Power Supply
■ Miniprog3
■ USB Cable (to connect Miniprog3 to the PC)
■ Kit Stand
■ Quick Start Guide
■ Resource CD

Inspect the contents of the kit; if you do not find any part, 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 software development IDE that introduces a game-changing, hardware and software co-design environment based on classical schematic entry and revolutionary embedded design methodology.

With PSoC Creator, you can:
- Automatically place and route select components and integrate simple glue logic normally residing in discrete muxes.
- Trade-off hardware and software design considerations allowing you to focus on what matters and 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® 5.

1.3 Getting Started

To get started, take a look at Chapter 3 for a description of the kit operation and how to reprogram the device through PSoC Programmer. Refer to the installation instructions that comes with the PSoC Creator software to reprogram the device directly from PSoC Creator. Chapters 4 and 5 provide details on the theory of operation of the hardware and firmware, respectively. The Appendix provides the schematics and BOM associated with the PSoC 3 LCD segment drive evaluation board.

1.4 Additional Learning Resources

Visit www.cypress.com for additional learning resources in the form of data sheets, technical reference manual, and application notes.

1.5 Document History

Revision	PDF Creation Date	Origin of Change	Description of Change
**	04/29/09	TEH	Initial version of kit guide
*A	09/22/09	XKJ/TEH	Extensive content updates
*B	11/09/09	KEV	Updates to text and images for Beta3 release
*C	01/08/10	KEV	Updates to section 3 for Beta4 web release

1.6 Document Conventions

This guide uses the Courier New font to distinguish file names and file location from regular text. The keyboard commands and window selections are given in bold text.

2.   Installation

2.1   CD Installation

Follow these steps to install the CY8CKIT-006 PSoC 3 LCD Segment Drive EVK software:

1.   Insert the kit CD into the CD drive of your computer. The CD is designed to auto-run and PSoC 3 LCD Segment Drive EVK menu appears.

2. The installation allows you to install the following software:

■   PSoC Creator

■   PSoC Programmer

■   Kit Documentation

    ❑   Quick Start Guide

    ❑   User Guide

■   Firmware

    ❑   Demonstration Firmware

    ❑   Example Projects

■   Hardware

    ❑   Schematic

    ❑   Layout

    ❑   BOM

Note If auto-run does not execute, double click **AutoRun** in the root directory of the CD.

2.2   Hardware

WARNING: Static discharges from the human body can easily reach 20,000 volts. This can damage the PSoC 3 LCD Segment Drive Evaluation Kit hardware. Take precautions to ensure that any static is discharged before touching the hardware.

1. Ensure that switch SW1 is in the OFF position prior to adding or removing batteries.

2. Insert a battery into the appropriate terminals or connect a wall transformer to the J2 jack.

3. Slide SW1 to the ON position if using a battery. The wall transformer supply is not controlled by SW1 and is always ON.

2.3   Software

- CY8CKIT-006 PSoC 3 LCD Segment Drive Evaluation Kit
- PSoC Creator IDE
- PSoC Programmer 3.10
- Example Project at
  `C:\Program Files\Cypress\CY8CKIT-006_PSoC3_LCD_Drive_Kit\1.0\Firmware`
- Documents at
  `C:\Program Files\Cypress\CY8CKIT-006_PSoC3_LCD_Drive_Kit\1.0\Documenta-tion`
- Schematic design files at:
  `C:\Program Files\Cypress\CY8CKIT-006_PSoC3_LCD_Drive_Kit\1.0\Hardware`

[+] Feedback

3. Kit Operation

3.1 Introduction

The CY8CKIT-006 PSoC 3 LCD Segment Drive EVK firmware provides examples using a display with many segments (16 common lines by 28 segment lines giving 448 addressable segments).

Figure 3-1. CY8CKIT-006 Kit
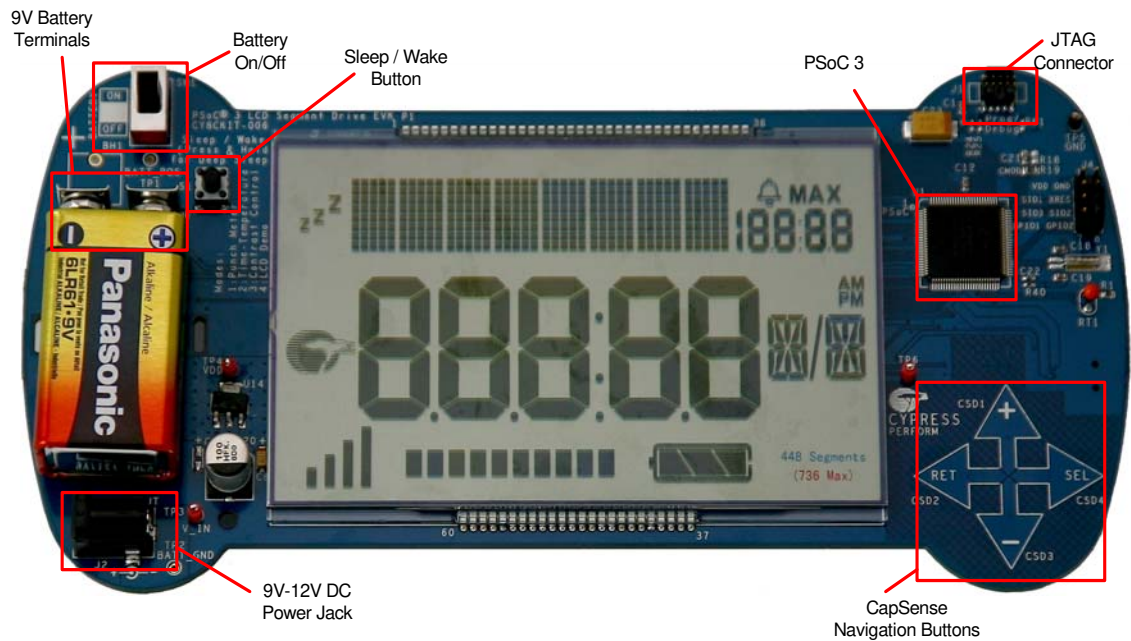
Operator entries are made using the four CapSense buttons that are labeled: SEL, "+", "-", and RET.

Table 3-1. CapSense Button Functionality

Button	Function
SEL (CSD4)	Enter menu levels and select items
"+" (CSD1)	Advance up through menu items
"-" (CSD3)	Advance down through menu items
RET (CSD2)	Return to previous menu levels

3.2 Main Menu

Supply power to the board either through 9V battery, 9V to 12V wall adaptor, or USB. Refer to Power Supply Options on page 22 for more information on options to power the board. On startup, the kit name is scrolled from right to left across the matrix display. When the scrolling is complete, "Push SEL" is flashed to prompt you to press the CapSense Select button. After pressing **SEL**, the first main menu selection, PUNCH is shown on the matrix display. Press the "+" or "-" CapSense buttons to select a mode from one of the main menu selections.

Table 3-2. Main Menu Options

Option	Brief Description
PUNCH	Punch gauge
RTC/TEMP	Real Time Clock Time/Temperature Display with Set Time/Date/Alarm
CONTRAST	Set LCD contrast level
LCD DEMO	Display all icons and segment characters in sequence

To select a mode, press **SEL** when the desired mode name is displayed.

3.3 PUNCH

If you select PUNCH, the project enters the Punch menu item. PUNCH automatically enters the GAUGE sub menu and prompts by scrolling "Push SEL to Start Gauge". If you press the **SEL** button, then the PUNCH Gauge continues (1:GAUGE on page 10 section). By pressing the **RET** button, the PUNCH returns to its sub menu selections. Pressing "+" or "-" allows you to select a Punch sub menu option. The sub menu options are entered by pressing **SEL**.

Table 3-3. PUNCH submenu options

Option	Brief Description
1:GAUGE	Record a punch acceleration.
1:HIGH	View the current high score.
1:RECALL	View the recorded top five high scores and the average score.
1:CLEAR	Clear the saved high scores.

After exiting a Punch sub menu option and returning to the Punch menu, you can either select another Punch sub menu or press **RET** to return to the Main Menu.

3.3.1 1:GAUGE

If you select GAUGE, the display scrolls "Push SEL to Start Gauge". When you press **SEL**, a punch recording session begins. The project automatically starts measuring the peak at rest acceleration of the LCD kit board. During this time, the project displays a three second count down ending in the phrase "PUNCH!". Then the project begins peak and hold acceleration measurements in a continuous loop. During this sampling period, the "Push SEL" prompt is flashed. You can hold the board and "throw" punches. After throwing one or more punches, press the **SEL** button. The project displays the peak acceleration that the board experienced during the punch time.

If the peak acceleration is less than 1G, then the score is displayed as 0.0G. The peak acceleration is displayed on the large 7-segment display in the form X.X with a "G" shown on the 16-segment display (for example, 4.6G). If the peak acceleration is greater than the current lowest score, then the project prompts you to enter a name. **Note** The first five scores after performing a Clear (see 1:CLEAR on page 11) are always recorded. An empty score has a 0G value in the test for lowest score.

A name is one to six alphabetic characters and is entered on the matrix display. The project flashes "Name". Press **SEL**; "A" is flashed across the display. Press "+" and "-" buttons to select a letter in the range "A" to "Z". Press the **RET** button to select a single character name or press **SEL** to enter a second letter. You can enter up to six letters. A short name can be entered by pressing **RET** twice. This enters the name for the characters currently selected and entered.

After entering a user name, the project scrolls the saved high scores along with the name for each high score, from right to left on the matrix display. Then it scrolls the final average score. If your score is the first one entered after the score structure was cleared, then that score and the average score is displayed. In this case, the average score equals user score. The recalled scores continue to scroll until you press **SEL** to start another Punch recording or **RET** to exit the Punch Gauge sub menu and return to the Punch menu.

3.3.2   1:HIGH

When the option 1:HIGH is selected, the project scrolls the name and score of the highest recorded score. The project can store up to five high scores and user entered associated names. This score data structure is stored in persistent memory on the PSoC 3 and is returned through power cycles.

The high score and name are scrolled from right to left continuously on the matrix display in the format "1:MAX SCORE - ABCDEF = X.XG", where ABCDEF is the name of the highest scorer and X.XG is the high score acceleration value.

To exit the HIGH sub menu and return to the Punch menu, press the **SEL** or **RET** buttons.

3.3.3   1:RECALL

When the 1:RECALL option is selected, the project scrolls the five stored high score values along with names. Following the high scores, the average of the high scores is scrolled from right to left across the matrix display.

The first stored high score is displayed as "1: <Name-string> =<score - string>" followed by next high score user name and score value and finally the average of the high scores as "A: AVG SCORE = <score - string>".

Example of <Name string> is JAYA and <score sting> is 5.8G

To exit this sub menu and return to the Punch menu, press the **SEL** or **RET** buttons.

3.3.4   1:CLEAR

When the option 1:CLEAR is selected, the project prompts you to either complete the Clear function or exit to the Punch menu. The Clear function scrolls the instructions "Press SEL to clear or Press RET to abort" from right to left across the matrix display continuously until you press **SEL** or **RET**.

When **SEL** is pressed, the project clears saved score records, exits the Clear sub menu, and returns to the Punch menu (this also clears the RTC alarm settings and the RTC date).

If you press **RET**, the project returns to the Punch menu without clearing the saved scores.

3.4 RTC/TEMP

The RTC/TEMP menu has five sub menus.

Table 3-4. RTC/TEMP Sub Menu Options

Option	Brief Description
2:Clock	Show time, date, and temperature
2:SetTim	Enter time of day
2:SetDat	Enter calendar date
2:SetAlm	Enter alarm time of day
2:Alarm	Turn alarm on/off

Press "+" or "-" to select one of the sub menu items and then **SEL** button to enter the sub menu options.

If you press the **RET** button at anytime in the RTC/TEMP sub menu, the project returns to the RTC/TEMP main menu.

3.4.1 2:Clock

This sub menu displays the current time on large 7-segment display with AM/PM displayed on the 16-segment and 14-segment displays. The colon separator in the 7-segment display flashes on/off automatically marking seconds (one second on; one second off). If the time is set, then it is displayed as 12-hour time with AM or PM. If the time is not set since the last power cycle, the time at the minute that the power was last turned off will flash on/off. Press **SEL** to stop the flashing, but verify the time is correct.

If the alarm is turned on, then the alarm time is displayed on the small 7-segment display with either the small AM or PM icons displayed along with the BELL icon. If the alarm is off, then all the alarm display elements are turned off.

Date and temperature are displayed on the matrix display. The date and temperature are flashed one after the other. The temperature display can be alternated between °C and °F by pressing the "+" or "-" buttons.

When the alarm sounds, press **SEL** to stop the alarm. Press **RET** to return to the RTC/TEMP main menu.

3.4.2 2.SetTim

This submenu allows to set the clock time of the day.

Enter H1H2:M1M2 in 12 hour AM/PM clock time. The clock time is entered and displayed on the large 7-segment displays using the four display characters to the right and the colon icon separating the H1H2 and M1M2 characters. AM and PM are displayed on the 16-segment and 14-segment display characters.

■ The project displays 12:00 the first time that time is set; the left H position (H1) of the large 7-segment display is flashed.

■ Press "+" or "-" button to select the higher hour digit, '0' or '1'.

■ Press **SEL** to advance to the next H position (H2).

■ Press "+" or "-" to select '0' - '9' if H1 is '0' or to select '0' - '2' if H1 is '1'.

■ Press **SEL** to advance to the left M position (M1).

■ Press "+" or "-" to select '0' - '5'.

■ Press **SEL** to advance to the next M position (M2).

- Press "+" or "-" to select '0' - '9'.
- Press **SEL** to advance to the 16-segment display character.
- Press "+" or "-" to select 'A' - 'P'. The 14-segment display character shows 'M'.
- Press **SEL** to enter the time settings. "Push SEL" is prompted on the matrix display.
- Press **SEL** to exit the SetTim sub menu.

When setting the time, pressing **RET** exits the SetTim sub menu immediately without saving the time information.

3.4.3   2:SetDat

This sub menu allows to set the date in the format DDMMM-YY.

Enter D1D2MMMABC - Y1Y2. The date is displayed on the matrix display. This application only displays the last two digits of the year, the year "00" is taken as the year 2000 which is handled as a leap century.

- The project displays the 01JAN-00 the first time the time is set, the left D position (D1) of the matrix display is flashed.
- Press "+" or "-" button to select the higher date digit of the month, '0' - '3'.
- Press **SEL** to advance to the next D position (D2).
- Press "+" or "-" to select '0' - '9'.
- Press **SEL** to advance to select the month of the year.
- Press "+" or "-" to select month names, from "JAN" - "DEC".
- Press **SEL** to advance to the left Y position (Y1) of the year.
- Press "+" or "-" to select '0' - '9'.
- Press **SEL** to advance to the next Y position (Y2).
- Press "+" or "-" to select '0' - '9'.
- Press **SEL** to enter the date settings and return to the "RTC/TEMP" sub menu.

If the day is set for a day greater than the number of days in the selected month, then the project automatically adjusts the day down to 30 or 31 or down to 28 or 29 for February depending on whether the entered year is a leap year.

When setting the date, pressing **RET** exits the SetDat sub menu immediately without saving the date information.

3.4.4   2:SetAlm

This sub menu allows to set the clock alarm time of the day.

Enter H1H2:M1M2 in 12 hour AM/PM alarm clock time. When setting the alarm, the alarm time is displayed on the large 7-segment display characters using the large colon icon to separate the H1H2 and M1M2 characters. AM and PM are displayed on the 16-segment and 14-segment display characters.

- The project displays the 00:00 the first time the alarm is set; the left H position (H1) of the large 7-segment display is flashed.
- Press "+" or "-" to select '0' or '1'.
- Press **SEL** to advance to the next H position (H2).
- Press "+" or "-" to select '0' - '9' if H1 is '0' or '0' -'2' if H1 is '1'.
- Press **SEL** to advance to the left M position (M1).
- Press "+" or "-" to select '0' - '5'.

- Press **SEL** to advance to the next M position (M2).
- Press "+" or "-" to select '0' - '9'.
- Press **SEL** to advance to the 16-segment display character.
- Press "+' or "-" to select AM or PM.
- Press "+" or "-" to select 'A' - 'P'. The 14-segment display character shows 'M'.
- Press **SEL** to enter the alarm settings. "Push SEL" is prompted on the matrix display.
- Press **SEL** to exit the "SetTim" sub menu.

The alarm time is set for the HH:MM selected and the SS is set to 00 by the code. The RTC Alarm interrupt is enabled.

When setting the alarm, pressing **RET** exits the SetAlm sub menu immediately without saving the alarm information

3.4.5 2:Alarm

This sub menu allows to turn the alarm on/off. Upon entering, either "AlarmOFF" or "AlarmON" is displayed based on the current alarm on/off settings.

- Press "+" and "-" button to select "AlarmOFF" or "Alarm ON".
- Press **SEL** to enter the ON/OFF alarm state. "PushSEL" is prompted on the matrix display.
- Press **SEL** to exit the Alarm set sub menu.

In the clock mode, alarm symbol is displayed if alarm is enabled. When the time reaches the set alarm time, the buzzer present on the board will beep. The buzzer will sound for up to 2-minutes before automatically shutting off. If the buzzer is shut off automatically, then the alarm remains on and starts the buzzer the next time the alarm time is reached again. You can manually turn off the alarm in three ways:

1. Press the sleep pushbutton from any state.
2. Press any CapSense button (for example, **SEL**) from any state.
3. Reopen the 2:Alarm sub menu item and set the Alarm state to "OFF".

3.5 CONTRAST

The project is designed for 3.3V operation and this bias level is set in the SegLCD component of the design. The CONTRAST sub menu allows the selection of a value in the range 0 to 10 to set the bias higher or lower to allow viewing the contrast effects.

Press **SEL** to enter the CONTRAST sub menu. The project displays the current contrast setting on the matrix display in the format "Level= X", where X is a value in the range 0 to 10. Press "+" or "-" to increment or decrement the value displayed. The progress bar at the bottom displays the contrast level in graphical format.

Pressing **SEL** or **RET** stores the contrast level in the persistent memory and project returns to the CONTRAST sub menu.

3.6   LCD DEMO

The LCD demonstration shows all the characters, icons, and the range of characters in an automated animation that advances through all characters and icons in sequence culminating in all characters and icons on at the same time.

You can skip sequences in the demonstration to quickly get to the end where all segments are turned on. To skip a sequence, press the **SEL** button.

After showing all the characters and icons, "Push SEL" is flashed on the matrix display. To exit the demonstration and return to the main menu, press the **RET** button.

3.7   Restore Default Firmware

This kit is delivered with the firmware already programmed onto the PSoC 3 silicon. However, if the silicon is erased or replaced, or if a new version of the project is constructed, you can reprogram the kit using PSoC Programmer and the MiniProg3. To program and debug the project interactively, refer to the instructions included with the PSoC Creator software, which is installed by this kit CD.

Here is how to program this project onto the hardware PSoC 3 silicon:

1. Install the kit CD software. This installs PSoC Creator and PSoC Programmer 3.10.

2. Open PSoC Programmer from the Program menu or the installed location on your PC.

3. Connect the Miniprog3 JTAG cable to the JTAG connector on the MiniProg3 and to the JTAG connector on the PSoC 3 LCD kit board. Next, connect the kit MiniProg3 to a host PC USB High Speed port using the kit USB cable.

4. After the MiniProg3 is automatically selected by the Programmer, verify and adjust the Programmer settings shown in Figure 3-2.

5. Select the **File** > **File Load** menu, and choose the demonstration project file from the example project directory: `C:\Program Files\Cypress\CY8CKIT-006_PSoC_3_LCD_Drive_Kit\ 1.0\Firmware\SegLCD_project\SegLCD_project.cydsn\DP8051-Keil_Generic\ Debug\SegLCD_project.hex`

Note The MiniProg3 version numbers may be higher numbers based on release. You should include these version numbers in any request for assistance from Cypress Semiconductor.

Figure 3-2. PSoC Programmer MiniProg3 Port Selection
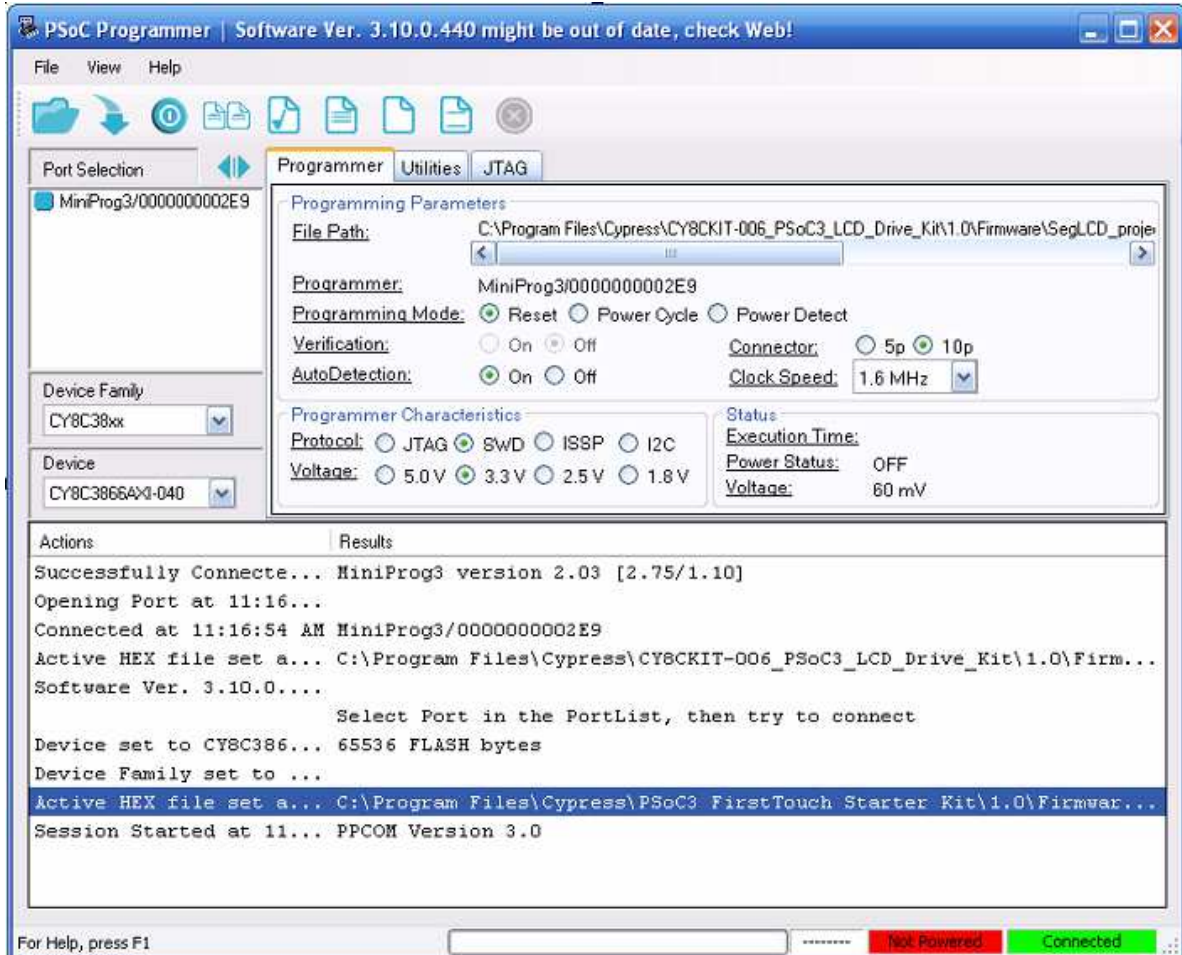
6. Power the LCD kit board using either battery connections or a wall power unit.

7. Verify that the Powered status is green as shown in Figure 3-3.

8. Select **File > Program** to download the kit project to the PSoC 3 silicon.

9. When the program is successfully downloaded, a "Programming Succeeded" message is displayed in the programmer window as shown in Figure 3-3.

10.Rest the device by plugging out and plugging in the power to the board

Figure 3-3. Program Download Succeeded
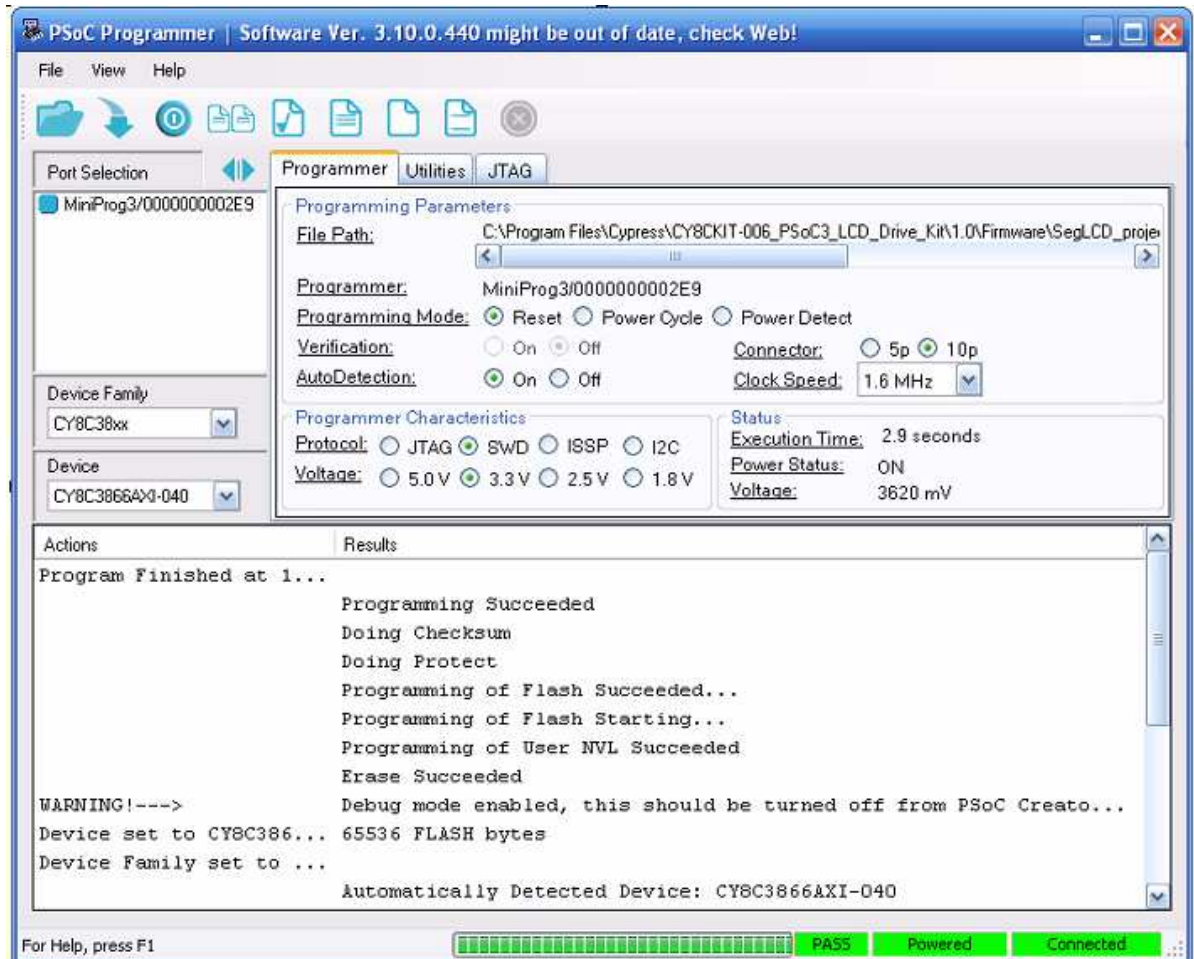
3.8 Example Projects

Refer to Application Note AN52927, *LCD Direct Drive Basics*, for steps to create a simple example project with this kit.

4. Hardware

4.1 System Block Diagram

Figure 4-1. System Block Diagram
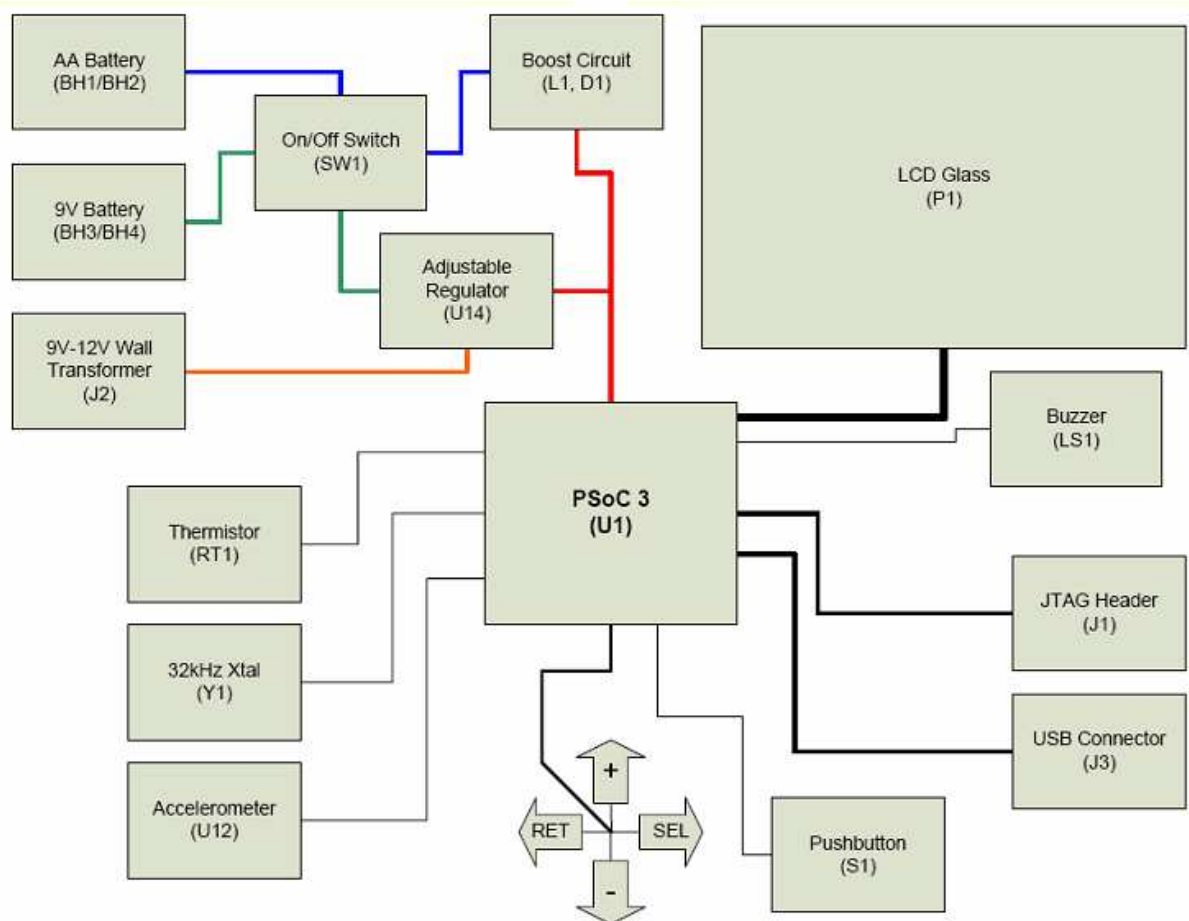
PSoC 3 LCD Segment Drive EVK showcases PSoC's LCD segment drive capability by driving a custom glass with 448 segments (16 common lines by 28 segments lines). This kit also highlights the PSoC's superior ability to integrate high performance digital and analog peripherals by integrating the accelerometer, thermistor, Real Time Clock, CapSense, and buzzer.

Refer to Functional Description on page 21 to know about functional implementation of the applications.

4.2   Operation Theory - All Components

Sl. No.	Device Features	Description
1	Slide Switch (SW1)	This switch turns the power supplied by the battery On and Off. **Note** Switch (SW1) does not control the power supplied by sources through J1(USB) and J2(Wall Power).
2	Pushbutton Switch (S1)	This switch is used to enter (Switch - On) and exit (Switch-Off) the sleep modes. **Note** The project supports all the sleep features described with the exception that PSoC 3 device does not go to sleep; the firmware is just put in a low power mode.
3	LCD Glass (P1)	Provides visual feedback. Custom made glass with 448 segments. Refer to LCD Glass on page 21 for glass details.
4	CapSense Buttons: CSD1 (Labeled as '+') CSD2 (Labeled as 'RET') CSD3 (Labeled as '-') CSD4 (Labeled as 'SEL')	CapSense buttons are used to navigate through various modes of operation. Table 3-1 on page 9, explains the function of CapSense buttons for each mode of operation.
5	Accelerometer (Memsic MXR2010A (U12))	The dual axis accelerometer is used to detect the movement and calculate the force of a punch. Accelerometer has a range of ±35G at 5V/25°C and can measure both static and dynamic acceleration.
6	Buzzer(CUI CMT -1603 (LSI))	It provides audible feedback to the user. A 5V, 4 kHz square wave is applied to the buzzer's input to produce sound.
7	Thermistor (RT1)	It is used to detect the ambient temperature for use in the Time/Temp demonstration mode. The default firmware supports a 10k thermistor rated to ±0.75% at 25°C.
8	RTC Crystal (Y1)	This external crystal is used as a 32.768 kHz clock source for maintaining real-time operation in the Time/Temp demonstration mode.
9	GPIO Connector(J4)	The header (J4) provides 3 SIO, 2 GPIO, XRES, VDD, and GND signals, thereby facilitating users to develop their own application. Refer to Hardware Schematic and PSoC 3 data sheet for specific details regarding the SIO and GPIO pins connected to these signals.
10	JTAG MiniProg3 Connector (J1)	The J1 connector provides a programming and debugs connection between the PSoC 3 and MiniProg3 programmer. **Note** Miniprog3 can be used to supply the power to the board for programming, but this is not recommended for normal or debugs operation.

4.3　Functional Description

4.3.1　LCD Glass

Figure 4-2 shows the image of the LCD Glass and Table 4-1 lists the segments details.

The LCD glass provides visual feedback to the user based upon the current mode of operation.
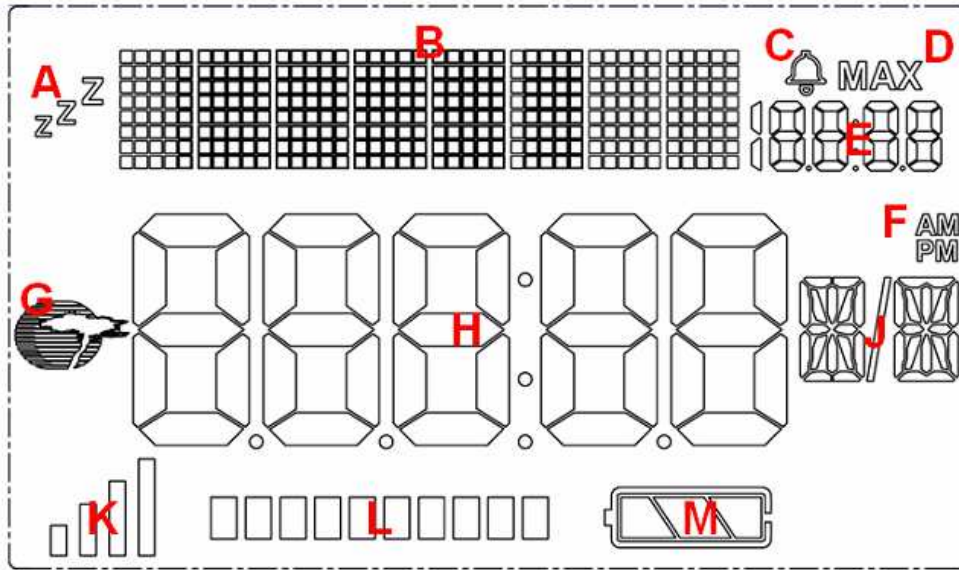
Figure 4-2. LCD Glass Image

Table 4-1. LCD Glass Segment Details

Label	Description
A	Sleep Indicator
B	8X5 Dot-Matrix Display Area
C	Alarm Indicator
D	MAX Indicator
E	Small Seven - Segment Display
F	AM/PM Alarm Indicator
G	Cypress Logo
H	Large Seven - Segment Display Area
J	16/14 Segment Display Area
K	Signal Strength Bars
L	Progress Bars
M	Battery Level Bars

4.3.1.1 Glass Specifications

The specifications for the LCD glass are as follows:

■ Display Type: FSTN

■ Viewing Direction: 6 o'clock

■ Drive Method:1/16 Duty, 1/5 BIAS

■ Operating Voltage: 3.3V

■ Polarizer Mode: Reflective/Positive

■ Operating Temperature: 0 ~ +50°C

■ Storage Temperature: -10 ~ +60°C

Note Refer to Pixel Mapping Table for LCD Glass on page 73.

4.4 Power Supply Options

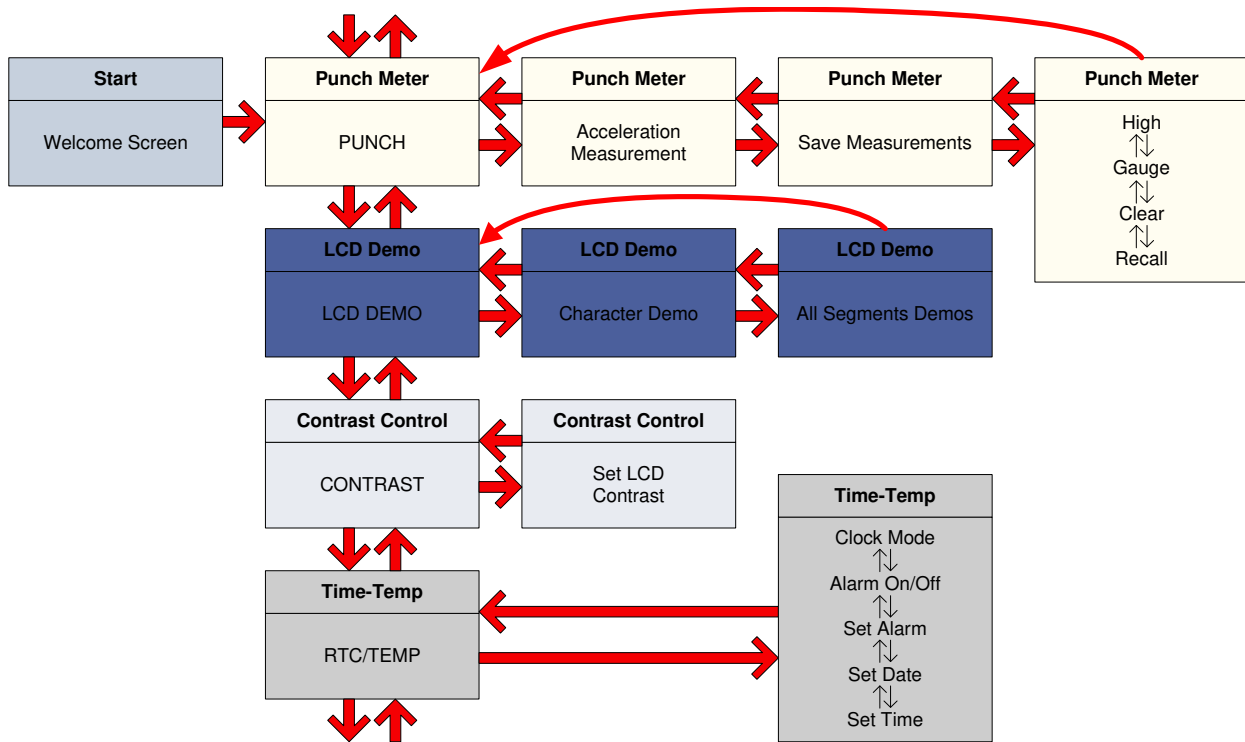The kit can be powered by only one of the three voltage sources.

Sl. No.	Description	Typical Voltage	Connection	Switch - SW1
1	Battery	9V	BH3, BH4	On (Up position) **Note** SW1 disconnects the 9V battery from the 5V regulator.
2	Wall Power	9V to 12V (100 mA minimum)	J2	Don't care.
3	USB Power	5V	J3	Don't care.

5.   Firmware

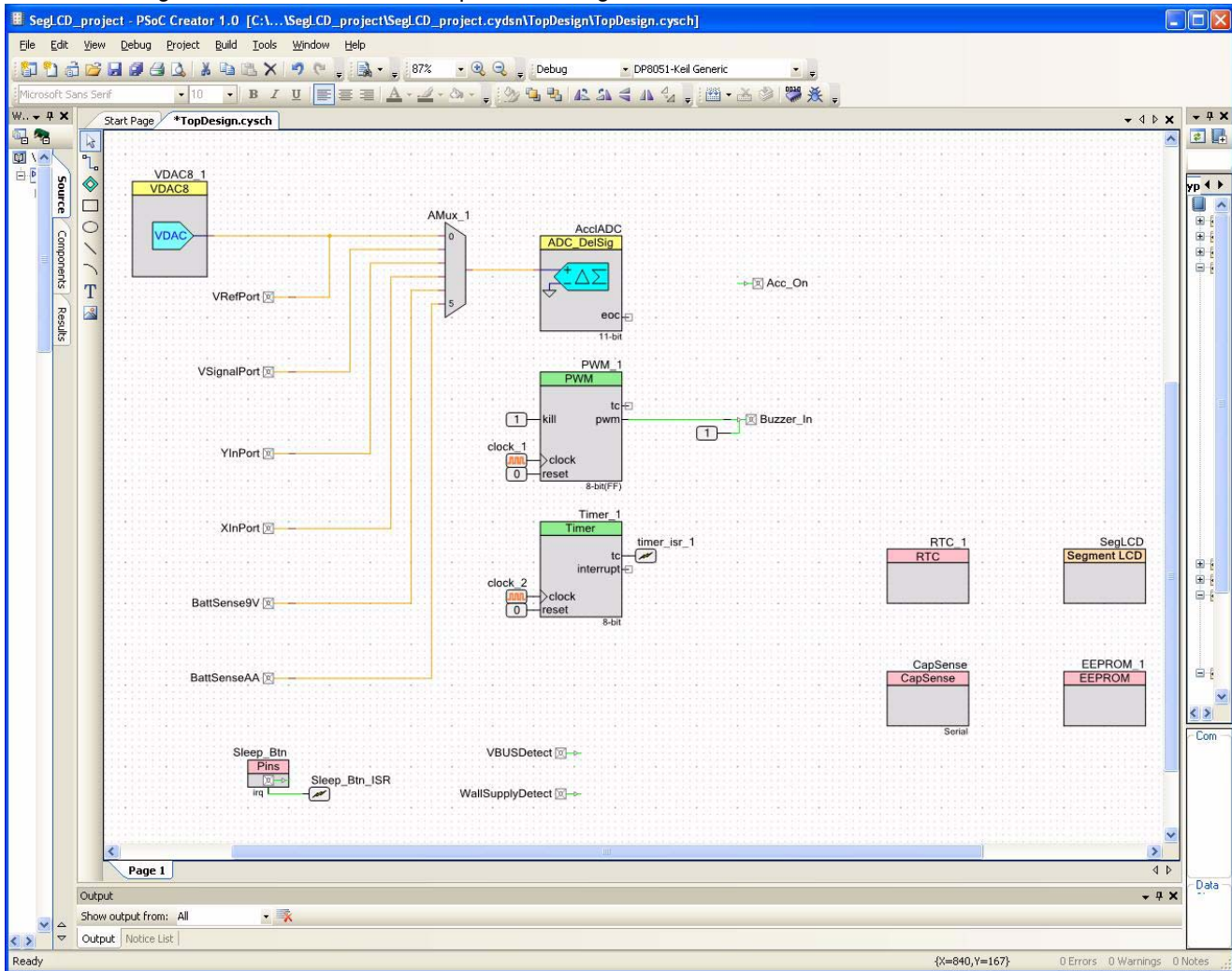## 5.1   Top Level Architecture

Figure 5-1.   Top Level Architecture

5.1.1 Top Level Design

The top level schematic for the project is shown here.

Figure 5-2. PSoC Creator Top Level Design for Firmware

The PSoC Creator project has the following components:

■ Analog outputs:

 ❏ Thermistor reference voltage (also an output for the reference voltage generator VDAC)

■ Analog inputs:

 ❏ Thermistor reference voltage - output of VDAC to AMUX input

 ❏ Thermistor signal voltage

 ❏ Accelerometer Y-axis

 ❏ Accelerometer X-axis

 ❏ Battery level - 9V

 ❏ Battery level - AA

■ Analog mux (AMUX): 6 input

■ VDAC to generate reference voltage for thermistor

- Delta-Sigma ADC to convert one of the six inputs from the AMUX
- PWM to drive the buzzer:
  - 6 kHz clock for PWM
  - Logic level High for PWM Kill
  - Logic level Low for PWM Reset
- Timer to generate 100 mS timing intervals: Timeout timers, No-activity timer, Blink timer
  - 1 kHz clock for timer
  - Logic level Low for Timer Reset
  - Timer ISR
- Segment LCD: Defines character sets and helpers to allow API access to display elements. The icon designators show the mapping to the segment symbol name applied to the segment in the FEMA Electronics drawing number S93043-0-FRPC. This drawing is included in this kit in the hardware design file *93043-602.pdf*. These designators are shown on page 2 of the file.
  - CyLogo icon (1) (icon P6)
  - Matrix characters (8)
  - Large 7-segment characters (5)
  - Large colon icon (1) (icon COL)
  - Large decimal point icons (4) (icons T5, T6, T7, T8)
  - 16-segment character (1)
  - Slash icon (1) (icon T9)
  - 14-segment character (1)
  - Small 7-segment characters (4)
  - Small '1' icon leading 7-segment display (1) (icon Z1)
  - Small colon icon (1) (icon Z4)
  - Small decimal point icons (3) (icons Z2, Z3, Z5)
  - BELL icon (1) (icon Z6)
  - MAX icon (1) (icon MAX)
  - AM icon (1) (icon AM)
  - PM icon (1) (icon PM)
  - ZZZ sleep icon (1) (icon P1)
  - Signal strength icons (4) (icons P7, P8, P9, P10)
  - Progress bar icons (10) (icons Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10)
  - Battery level icons (4):
  Battery case icon (1) (icon T1)
  Battery level icons (3) (icons T2, T3, T4)
- Digital Input:
  - PushButton
  Go to sleep
  Wake from sleep
  - Wall Supply (Vin) Detect - regulated supply input voltage detect
  - VBus Detect - USB VBus supply input voltage detect
- Digital Output:
  - Accelerator ON - firmware control