

## CY8CKIT-006 PSoC<sup>®</sup> 3 LCD Segment Drive Evaluation Kit Guide

Doc. # 001-52798 Rev. \*C

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## 1. Introduction



Thank you for purchasing the CY8CKIT-006  $PSoC^{\mathbb{R}}$  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<sup>®</sup> Creator<sup>TM</sup>).

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<sup>®</sup> 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<sup>®</sup> 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\Documentation
- Schematic design files at: C:\Program Files\Cypress\CY8CKIT-006\_PSoC3\_LCD\_Drive\_Kit\1.0\Hardware



### 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.

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

Table 3-2. Main Menu Options

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**.

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.

Table 3-3. PUNCH submenu options

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.

Soc Programmer   Software Ver. 3.10.0.440 might be out of date, check Web!		
File View Help		
Port Selection IV Programmer Utilities JTAG		
MiniProg3/000000002E9       Programming Parameters         File Path:       C:\Program Files\Cypress\CY3CKIT-006_PSoC3_LCD_Drive_Kit\1.0\Firmware\SegLCD_projet         Image: Control of the programming Mode:       Image: Control of the programming Mode:         Device Family       On Image: On Off       Connector:       5p Image: 10p         Device Family       Image: On Off       Connector:       5p Image: 10p         Device Family       Image: On Off       Connector:       5p Image: 10p         Device       Image: 000 Off       Connector:       5p Image: 10p		
Actions Results		
Successfully Connecte MiniProg3 version 2.03 [2.75/1.10] Opening Port at 11:16 Connected at 11:16:54 AM MiniProg3/000000002E9 Active HEX file set a C:\Program Files\Cypress\CY8CKIT-006_PSoC3_LCD_Drive_Kit\1.0\Firm Software Ver. 3.10.0 Select Port in the PortList, then try to connect Device set to CY8C386 65536 FLASH bytes Device Family set to Active HEX file set a C:\Program Files\Cypress\PSoC3 FirstTouch Starter Kit\1.0\Firmwar Session Started at 11 PPCOM Version 3.0		
For Help, press F1 Connected		

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



PSoC Programmer   Soft	ware Ver. 3.10.0.440 might be out of date, check Web!	
File View Help		
🗃 🍹 🗿 BB		
Port Selection	Programmer Utilities JTAG	
MiniProg3/000000002E9	Programming Parameters         File Path:       C:\Program Files\Cypress\CY8CKIT-006_PSoC3_LCD_Drive_Kit\1.0\Firmware\SegLCD_proje         Image: Comparison of the second secon	
Device Family	Verification:         On         Off         Connector:         ○ 5p ● 10p           AutoDetection:         ● On         Off         Clock Speed:         1.6 MHz         ▼	
CY8C38xx 💌	Programmer Characteristics Protocol: O ITAG @ SWD O ISSP O I2C Execution Time: 2.9 seconds	
Device CY8C38664XI-040	Protocol:         ◯ JTAG ● SWD ◯ ISSP ◯ I2C         Execution Time:         2.9 seconds           Voltage:         ○ 5.0 V ● 3.3 V ◯ 2.5 V ◯ 1.8 V         Power Status:         ON           Voltage:         ○ 3620 mV	
Actions	Results	
Program Finished at 1 Programming Succeeded Doing Checksum Doing Protect Programming of Flash Succeeded Programming of Flash Starting Programming of User NVL Succeeded Erase Succeeded WARNING!> Debug mode enabled, this should be turned off from PSoC Creato Device set to CY8C386 65536 FLASH bytes		
Device Family set to	Automatically Detected Device: CY8C3866AXI-040	
for Help, press F1	PASS Powered Connected	

### 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.

Kit Operation



## 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

SI. No.	Device Features	Description
		This switch turns the power supplied by the battery On and Off.
1	Slide Switch (SW1)	<b>Note</b> Switch (SW1) does not control the power supplied by sources through J1(USB) and J2(Wall Power).
		This switch is used to enter (Switch - On) and exit (Switch-Off) the sleep modes.
2	Pushbutton Switch (S1)	<b>Note</b> 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')	CapSense buttons are used to navigate through various modes of operation.
-	CSD3 (Labeled as '-') CSD4 (Labeled as 'SEL')	Table 3-1 on page 9, explains the function of CapSense buttons for each mode of operation.
5	Accelerometer (Memsic	The dual axis accelerometer is used to detect the movement and calculate the force of a punch.
5	MXR2010A (U12))	Accelerometer has a range of $\pm$ 35G at 5V/25°C and can measure both static and dynamic acceleration.
	Buzzer(CUI CMT -1603	It provides audible feedback to the user.
6	(LSI))	A 5V, 4 kHz square wave is applied to the buzzer's input to pro- duce sound.
7		It is used to detect the ambient temperature for use in the Time/ Temp demonstration mode.
1	Thermistor (RT1)	The default firmware supports a 10k thermistor rated to $\pm 0.75\%$ 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.
	GPIO Connector(J4)	The header (J4) provides 3 SIO, 2 GPIO, XRES, VDD, and GND signals, thereby facilitating users to develop their own application.
9 (		Refer to Hardware Schematic and PSoC 3 data sheet for specific details regarding the SIO and GPIO pins connected to these signals.
	ITAC MiniProg2 Connector	The J1 connector provides a programming and debugs connection between the PSoC 3 and MiniProg3 programmer.
10	JTAG MiniProg3 Connector (J1)	<b>Note</b> 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	
В	8X5 Dot-Matrix Display Area	
С	Alarm Indicator	
D	MAX Indicator	
E	Small Seven - Segment Display	
F	AM/PM Alarm Indicator	
G	Cypress Logo	
Н	Large Seven - Segment Display Area	
J	16/14 Segment Display Area	
К	Signal Strength Bars	
L	Progress Bars	
М	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.

SI. No.	Description	Typical Voltage	Connection	Switch - SW1
1	Battery	9V	BH3, BH4	On (Up position) <b>Note</b> SW1 disconnects the 9V bat- tery 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.

# CYPRESS

### 5.1 Top Level Architecture

5. Firmware

Figure 5-1. Top Level Architecture



### 5.1.1 Top Level Design

The top level schematic for the project is shown here.



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



- Buzzer hardware control
- Logic level High for Buzzer OE
- RTC: Enable 32.768 RTC clock
- CapSense:
  - CMod connection
  - RBleed connection
- EEPROM: Persistent memory storage (saved scores, contrast level, clock settings)

### 5.2 Application Descriptions

#### 5.2.1 Punch Gauge Accelerometer Algorithm

The Punch Gauge code runs a peak and hold algorithm in a tight loop continuously updating until there is a change in the program state. Both the X and Y-axis accelerometer outputs are sampled separately and continuously. The higher of the two axis measurements is reported as the score.

#### 5.2.1.1 At Rest Peak and Hold

When the operator initiates a Punch Gauge punch, the punch code begins reading the instantaneous X and Y-axis accelerometer outputs for a period of three seconds. This is to measure maximum at rest acceleration that the board experiences. This is saved as a baseline for the punch measurement.

#### 5.2.1.2 Punch Peak and Hold

After the Punch Gauge has stored the baseline at rest acceleration, the punch code begins continuously sampling both the X and Y-axis accelerometer outputs. The code continues to sample and hold the peak values until the operator terminates the operation by pressing **SEL** button. During this sampling period the operator "throws" a punch or punches. The algorithm continues to peak and hold until the operator presses **SEL** button.

When the **SEL** button is pressed, the punch code subtracts the at rest X-axis baseline reading from the punch X-axis peak reading and subtracts the at rest Y-axis baseline from the punch Y-axis peak reading. The greater of the X and Y-axis results is reported as the punch acceleration.

#### 5.2.2 Temperature Measurements

The temperature sensing demonstration shows how the PSoC is used to sense temperature using a thermistor. The thermistor resistance varies with temperature following a predictable non-linear curve. The temperature-resistance relationship is given by the Steinhart-Hart equation:

#### 1/Tk = A + B.ln(R) + C.(ln(R))3

Where:

- A, B, and C are empirical constants known as Steinhart-Hart coefficients
- R is the resistance of the thermistor in Ohms
- Tk is the temperature in degree Kelvins

The same equation, when converted to Celsius scale is as follows:

Tc = Tk - 273.15; where Tc is temperature in degree Celsius.

The PSoC can measure the voltage across the thermistor but not the resistance value.



### 5.2.2.1 Temperature Sensing Design Principle

The device for temperature sensing uses a voltage divider with a precision resistor on one side and the thermistor on the other to estimate the thermistor resistance. This is shown in Figure 5-3. The temperature calculations are as accurate as the resistance measurement of the thermistor.





This setup significantly removes gain and offset errors from the resistance calculation.

The analog voltage output from the divider is converted to a digital signal using the ADC on the PSoC. To gain additional accuracy, the voltage at the input side of the divider is also measured. The resistor value is calculated using the ratio of the voltages across the two resistors in the resistor ladder.

Rthermistor = Rref \* (V0-V1/V1-V2); where V2 = 0 (Ground voltage)

Any offset errors are removed due to subtraction of the two measured voltages. The ratio of these two values removes the measurement path gain error. The error due to the reference resistor is reduced by using a precision resistance in series with the thermistor.

Temperature is calculated using a table of 165 known points on the resistance/temperature curve using a look up table. The table holds resistance values of the thermistor from -40°C to 125°C, in 1°C increments. Linear interpolation is used between the points in the table for temperature calculation up to two places after the decimal.

Temperature is also calculated using the Steinhart-Hart equation. This project currently feeds in the Steinhart-Hart calculated temperature for display.

For more information on using PSoC family devices with a thermistor, refer to Cypress Application Note, AN2017, Sensing - A Thermistor-Based Thermometer, PSoC Style.

### 5.2.3 RTC Crystal and Clocking

The RTC maintains a high precision based on the application of an accurate crystal input used as the clock source. The RTC component inserted by the PSoC Creator provides API calls that can be used to set the time and date and to read the instantaneous current time and date. When the device is in the Show Time sub mode, the code simply loops on CapSense button scans and reads and displays the instantaneous time and date information. The temperature at the board thermistor is sam-



pled and displayed on alternating cycle with the date readings. Therefore, the date and temperature automatically and continuously alternates on the display. The temperature display can be alternated between °C and °F by pressing the "+" or "-".

#### 5.2.4 Contrast Adjustments

To adjust the contrast dynamically, the project calls the adjust bias API call provided by the Segment LCD component. The higher the bias level set in the call to the API the higher the contrast. The API allows a selection between 0 and 127 with 127 corresponding to the maximum contrast level.

Enter a relative value between 0 and 10; the code maps the contrast setting into bias voltage values within the range 47 to 67 (3.23V to 3.78V).

#### 5.2.5 LCD Demonstration

To demonstrate all the segments of LCD glass, the project sequentially demonstrates the various display sections. Refer to Figure 5-64 to know the details of sequence in which various sections of LCD glass are displayed.

### 5.3 **Project Design and Setup**

### 5.3.1 Analog I/O

#### 5.3.1.1 Thermistor Reference Voltage

The thermistor reference voltage analog connection is configured as an input but is actually an output. The VDAC generates a fixed constant output voltage on the analog port. This reference voltage is also sent through the AMUX to be sampled by the Delta-Sigma ADC during temperature calculation periods.

The output is configured for 1-pin width mapping and Hi-Z Analog during Power-On Reset. The port pin is set for High Impedance Analog. The default Built-In settings are used.

Figure 5-4. Thermistor Reference Analog Port Configuration: General Tab

Configure 'cy_pins'		? 🛛
Name: VRefPort Pins Mapping Number of Pins: 1	Reset Built-in	4 Þ
IAI Pins]	Type General Input Outp Drive Mode High Impedance Analog	Initial State:
Data Sheet	ОК Арр	Cancel



Configure 'cy_pins'		? 🛛
Name: VRefPort Pins Mapping Re Number of Pins: 1 All Pinet All Pinet VRefPort_0	set Built-in Built-in Type General Inpu Analog Digital Input HW Connection Digital Output HW Connection Duput Enable Bidirectional	4 Þ
Data Sheet	ОК	Apply Cancel

Figure 5-5. Thermistor Reference Analog Port Configuration: Pin Type Tab

### 5.3.1.2 Thermistor Signal Voltage

The thermistor signal voltage is sampled during temperature calculations. The circuit compares the difference in voltage drop across the thermistor and the fixed resistor. The thermistor signal voltage is sent through the AMUX to be sampled by the Delta-Sigma ADC during temperature calculation. The input is configured for 1-pin width mapping and Hi-Z Analog during Power-On Reset. The port pin is set for High Impedance Analog. The default Built-In settings are used.

Configure 'cy_pins'		? 🛛
Name: VSignalPort Pins Mapping Re Number of Pins: 1	eset Built-in	4 Þ
IAI Pinsi	Type General Input Out Drive Mode High Impedance Analog	put Initial State: Low (0)
Data Sheet		Cancel

Figure 5-6. Thermistor Signal Analog Port Configuration: General Tab



Pins Mapping R	eset Built-in	4
Yumber of Pins: 1 [All Fins] └── ⊠ VSignalPort_0	<ul> <li>Type General Ing</li> <li>Analog</li> <li>Digital Input</li> <li>HW Connection</li> <li>Digital Output</li> <li>HW Connection</li> <li>Ouput Enable</li> <li>Bidirectional</li> </ul>	but Output Preview:

Figure 5-7. Thermistor Signal Analog Port Configuration: Pin Type Tab

#### 5.3.1.3 Accelerometer Y-Axis

The accelerometer Y-axis is measured during rest acceleration and thrown punch periods. The peak measurement during the measured period is retained as the sampled value. The Y-axis signal is sent through the AMUX to be sampled by the Delta-Sigma ADC during acceleration measurement.

The input is configured for 1-pin width mapping and Hi-Z Analog during Power-On Reset. The port pin is set for High Impedance Analog. The default Built-In settings are used.

Figure 5-8. Accelerometer Y-Axis Analog Port Configuration: General Tab

Configure 'cy_pins'		? 🛚
Name: YInPort		1. 
Pins Mapping	Reset Built-in	4 ۵
Number of Pins: 1		
[All Pins]	Type General Input	Dutput
└──⊠ YInPort_0	Drive Mode	Initial State:
	High Impedance Analog	🖌 Low (0)
	PS Pig	Minimum Supply Voltage:
Data Sheet		oly Cancel



Configure 'cy_pins'		? 🛛
Name: YInPort Pins Mapping Number of Pins: 1	Reset Built-in	4 Þ
<mark>IAII PinsI</mark> └──⊠ YInPort_0	Type       General       In         Analog       Digital Input       In         HW Connection       Digital Output       In         HW Connection       Ouput Enable       Bidirectional	put Output Preview:
Data Sheet	ОК	Apply Cancel

Figure 5-9. Accelerometer Y-Axis Analog Port Configuration: Pin Type Tab

#### 5.3.1.4 Accelerometer X-Axis

The accelerometer X-axis is measured during rest acceleration and thrown punch periods. The peak measurement during the measured period is retained as the sampled value. The X-axis signal is sent through the AMUX to be sampled by the Delta-Sigma ADC during acceleration measurement.

The input is configured for 1-pin width mapping and Hi-Z Analog during Power-On Reset. The port pin is set for High Impedance Analog. The default Built-In settings are used.

Figure 5-10. Accelerometer X-Axis Analog Port Configuration: General Tab

Configure 'cy_pins'		? 🛛
Name: XInPort Pins Mapping R Number of Pins: 1	eset Built-in	4 Þ
[All Pins]	Type General Input Ou Drive Mode High Impedance Analog	tput Initial State: Low (0)
Data Sheet	OK Apply	Cancel



Pins Mapping Jumber of Pins: 1	Reset Built-in	4
IAII Fins]. ⊠ XInPort_0	Type       General       In         Analog       Digital Input       HW Connection         Digital Output       HW Connection       Ouput Enable         Bidirectional       Bidirectional	nput Output Preview:

Figure 5-11. Accelerometer X-Axis Analog Port Configuration: Pin Type Tab

### 5.3.1.5 Battery Monitor - 9V Level

On startup, the project takes a sample measurement of the 9V level. If the level is within a 9V operational range, then the project determines that a 9V battery is connected and enables continuous monitoring of the 9V level. The battery monitor port is measured periodically and the battery icons are updated to reflect the relative charge remaining. The battery monitor signal is sent through the AMUX to be sampled by the Delta-Sigma ADC during sampling periods. TThe input is configured for 1-pin width mapping and Hi-Z Analog during Power-On Reset. The port pin is set for High Impedance Analog. The default Built-In settings are used.





Configure 'cy_pins'		? 🛛
Name: BattSense9V		
Pins Mapping Re Number of Pins: 1	eset Built-in	4 Þ
All Binst.	Drive Mode	Initial State:
	PS	Minimum Supply Voltage:
Data Sheet		ly Cancel

Figure 5-13. Battery Monitor - 9V Level: Pin Type Tab

Configure 'cy_pins'		?
Name: BattSense9V		
Pins Mapping F	eset Built-in	4 Þ
IAU Fins1 BattSense9V_0	Type       General       In         Analog       Digital Input       HW Connection         Digital Output       HW Connection       Digital Output         HW Connection       Ouput Enable       Bidirectional	put Output Preview:
Data Sheet	ОК	Apply Cancel



### 5.3.2 Analog MUX

The analog mux (AMUX) is configured for 6-inputs. The inputs are the analog input and output signals described earlier. The default Built-In settings are used.

Figure 5-14. Configure Analog MUX: Basic Tab

Configure 'AMux'				×
Name: 🦉	AMux_1			
Basic	Built-in		٩	Þ
Parameter	Туре	Value		
Channels	int	6		
MuxType	AMuxType	Single		
Parameter	nformation			
Data Sh	ieet	OK Apply Cance	el	

#### 5.3.3 VDAC

The Voltage DAC provides a specific voltage level at the thermistor reference voltage. Low Speed is selected to reduce power requirements. The default Built-In settings are used.

The project code calls the VDAC SetRange API to select the 4V range and the SetValue API to set the output voltage at value=250. This sets the thermistor reference level at just under 4V to allow operation at Vdda as low as 4V. The VDAC is turned off between thermistor measurements to save power.



#### Figure 5-15. VDAC Configuration: Basic Tab

Configure 'VDA	? 🛛		
Name: VDA	C8_1		
Basic B	uilt-in	4 ۵	
Parameter	Туре	Value	
Data_Source	VDAC8_DataSourceType	CPU or DMA (Data Bus)	
Initial_Value	uint8	100	
Strobe_Mode	VDAC8_StrobeModeType	Register Write	
VDAC_Range	VDAC8_RangeType	0 - 1.020V (4mV/bit)	
VDAC_Speed	VDAC8_SpeedType	Low Speed	
Parameter Infor	mation		
Data Sheet		K Apply Cancel	

### 5.3.4 Delta-Sigma ADC

The Delta-Sigma ADC is used to convert the analog signals of the design. The resolution and conversion rate are selected to provide sufficient accuracy and speed for the accelerometer measurements and match the thermistor conversion tables used in this design. The default Built-In settings are used.

Figure 5-16. ADC Configuration

Configure 'ADC_DelSig			? 🔀
Name: AccIADC			
Configure Built-i	n		4 Þ
Modes	· · · · · · · · · · · · · · · · · · ·	Start of Conversion	<u>^</u>
Power	Medium Power 🛛 🔽	<ul> <li>Software</li> </ul>	
Conversion Mode	Fast Filter 🛛 🐱	<ul> <li>Hardware</li> </ul>	
Resolution	11 🔽	Clock Source	
Conversion Rate	1000 🛟 SPS	<ol> <li>Internal</li> </ol>	
Clock Frequency	131.000 kHz	<ul> <li>External</li> </ul>	
Input			
Input Range	Vssa to Vdda (Single Ended)	~	
Reference	Internal Ref	~	
Input Buffer Gain	1 💌		
Voltage Reference	5.0500 文 Volts (Vdda)		~
Data Sheet	ОК	Apply	Cancel

### 5.3.5 PWM

The PWM provides a signal to the buzzer to create audible alarms and cues. The frequency is selected to match the buzzer used in the design. The design uses a simple 50% duty cycle signal and does not require a high resolution. The default Built-In settings are used.

Configure 'PWM'		? 🛛
Name: PwM_1		
Configure	Advanced Built-in	4 Þ
period ¥-2	0 # 2	-0-#]
pwm		
Resolution: PWM Mode:	8-Bit      16-Bit	~
Period:	2 <b>Period = 500us</b>	
CMP Value 1:	1	
CMP Type 1:	Less or Equal	~
Data Sheet	OK Apply C	Cancel

Figure 5-17. PWM Configuration: Configure Tab

Figure 5-18. PWM Configuration: Advanced Tab

Configure 'PWM'		?×
Name: PWM_1		
Configure Ad	vanced Built-in	4 Þ
Implementation:	Fixed Function O UDB	^
Enable Mode:	Software Only	
Run Mode:	Continuous	
Trigger Mode:	None	
Kill Mode:	Asynchronous 💉 1	
Capture Mode:	None	
	Interrupts:           None           Interrupt On Terminal Count Event           Interrupt On Compare 1 Event           Interrupt On Compare 2 Event	
Data Sheet	OK Apply Cane	el


# 5.3.5.1 PWM 6 kHz Clock Source

The PWM requires a clock source to create the output frequency. The default Built-In settings are used.

Figure 5-19. PWM Clock Source Configurati	on
---	----

С	onfigure 'cy	_clock'	?×
I	Name: cloo	* <u>1</u>	
	Configure	e Clock Advanced Built-in	4 ۵
	Clock Type:	O New ○ Existing	
	Source:	<auto></auto>	~
	Specify:	<ul> <li>● Frequency</li> <li>6</li> <li>kHz ▼</li> <li>✓ Tolerance:</li> <li>- 5%</li> <li>+ 5%</li> </ul>	
	Uses Cloc	rated: Yes :k Tree Resource: Yes	
	Data Shee	t OK Apply Cano	el

Figure 5-20. PWM Clock Source Configuration: Advanced Tab

Configure 'cy_clock'	? 🗙
Name: clock_1	
Configure Clock Advanced Built-in	4 Þ
Sync with BUS_CLK The clock distribution network produces a master clock, BUS_CLK, used for resynchroniz	
This clock is not intended for clocking circuitry outside of the clock distribution network. O clocks can be phase aligned to this clock. Normally BUS_CLK should be the highest freque clock in the chip.	
Generally, all clocks used in the chip must be derived from the same source, or synchroniz the main fast clk_sync clock (BUS_CLK).	ed to
By setting this parameter to false this clock becomes an unsynchronized, divided clock.	
Data Sheet OK Apply Ca	ancel



#### 5.3.5.2 Logic High for PWM Kill Pin

The PWM Kill signal is not used in this design. The Kill pin is wired high to disable the function.

5.3.5.3 Logic Low for PWM Reset Pin

The PWM component requires a signal on the Reset pin to keep it out of reset after power on reset. The design does not require the application of a Reset signal on the PWM during operation.

#### 5.3.6 Timer

The design requires period timing updates. A single timer component is used with an interrupt service. On interrupt various timer counts are updated including:

- A timeout timer for general purpose failsafe looping.
- An ADC operation timeout timer for ADC get result failsafe looping.
- A clock alarm shutoff timer to automatically stop the alarm ringing after a timeout period.
- An activity timer to automatically signal enter sleep after a period of no button presses.
- A data entry blink timer to provide blinking of characters as they are prompted for entry).

The default Built-In settings are used.

Figure 5-21. Timer Configuration

nfigure 'Timer'		?
lame: Timer_1		
Configure Buil	t-in	4 Þ
Resolution:	💿 8-Bit 🔿 16-Bit 🔿 24-Bit 🔿 32-Bit	
Implementation:	O Fixed Function O UDB	
Period:	100 😫 Max Period = 100ms	
Trigger Mode:	None	~
	None	~
Capture Mode:	Enable Capture Counter 2	4.4
Enable Mode:	Software Only	~
Run Mode:	Continuous	~
Interrupts:	On TC On Capture [1-4]	\$
Data Sheet	OK Apply C	Cancel



# 5.3.7 Timer 1 kHz Clock Source

The timer requires a clock source to create the output frequency. The default Built-In settings are used.

Configure 'cy	y_clock'	? 🛛
Name: clo	ock_2	
Configu	re Clock Advanced Built-in	4 ⊳
Clock Type:	New O Existing	
Source:	<auto></auto>	~
Specify:	● Frequency         1         kHz ▼           ▼ Tolerance:         -         5%         +         5%	
	erated: Yes ock Tree Resource: Yes	
Data She	et OK Apply	Cancel

Figure 5-22. Timer Clock Source Configuration

Figure 5-23. Timer Clock Source Configuration: Advanced

Configure	'cy_clock'	?	$\mathbf{X}$
Name:	clock_2		
Config	gure Clock Advanced Built-in	٩	⊳
🔽 Sync w	vith BUS_CLK		
This clock clocks car clock in th Generally,	distribution network produces a master clock, BUS_CLK, used for resynchronization is not intended for clocking circuitry outside of the clock distribution network. Output to be phase aligned to this clock. Normally BUS_CLK should be the highest frequency e chip. all clocks used in the chip must be derived from the same source, or synchronized to st clk_sync clock (BUS_CLK).	t y	~
	this parameter to false this clock becomes an unsynchronized, divided clock.		
			~
Data S	iheet OK Apply Cance		



#### 5.3.7.1 Logic Level Low for Timer

The timer component requires a signal on the Reset pin to keep it out of reset after power on reset. The design does not require the application of a Reset signal on the timer during operation.

#### 5.3.7.2 Timer ISR

The timer is implemented with the use of a Terminal Count (TC) interrupt. After adding the interrupt to the tc-pin of the timer component, PSoC Creator generates source files for the interrupt service. References to the project code interrupt service routine are added to the generated source. In the generated source file for interrupt handling, there are two places where code must be added by hand. This code is protected by source code generator statements that preserve the user added code on subsequent builds. The code that is added is a prototype for the user provided interrupt service routine and a call to the interrupt service routine (user ISR).

The Timer ISR is set for an interval of once every 100 ms. For a timeout period of 1s, the timer is initialized for a 10 count period.

The actual timer component is initialized at the start of the project. When a timing element is required, a global cont variable is added to the timer user ISR code to decrement that count variable. Code is also added for the logic to be executed when the count variable reaches zero.

Configure 'cy_isr'		? 🗙							
Name: timer_isr_1									
Built-in		4 Þ							
Parameter	Туре	Value							
CY_COMPONENT_NAME	string	GetComponentName()							
CY_MAJOR_VERSION	string	1							
CY_MINOR_VERSION	string	0							
CY_REMOVE	bool	false							
CY_SUPPRESS_API_GEN	bool	false							
CY_VERSION	string	PSoC Creator 1.0 BETA1 Nightly Build 4248							
Cr_vension     string     Psoc cleator 1.0 BETAT Nightly Build 4248       Parameter Information									

Figure 5-24. Timer ISR Default Built-In Configuration



# 5.3.8 Segment LCD

A single segment LCD component is selected to handle all displays on the LCD glass panel. The component is used to define all segment assignments for the glass. It presents a grid containing an entry for each addressable element in the glass. An element can be a pixel in the matrix characters, a segment of one of the segment displays, or a specific icon built into the display. Each element is considered a pixel and can be individually addressed at its mapped location and can be turned on or off using the component pixel handling API calls.

There are also helper functions that can be defined. Each helper is specifically designed to allow handling of the different types of characters in the display. Thus, segments of a segment character can be grouped and addressed collectively by a single helper. Each helper has a set of component API calls that you can place in the code for writing digits or characters to the target display areas.

Each icon is turned on or off using a write pixel API call. The matrix display characters are set using a write string API call. The segment displays are written one character at a time using a write character or write digit API call. For demonstration purposes, the large and small 7-segment characters are also written using a write number API call which writes the hex or decimal value to the entire set of large or small 7-segment characters.

In the basic configuration, the bias voltage is selected. To adjust the contrast dynamically, the project calls the adjust bias API call provided by the segment LCD component. The higher the bias level set in the call to the API the higher the contrast. The API allows a selection between 0 and 127 with 127 corresponding to the maximum contrast level (see CONTRAST on page 14). The frame rate is selected to be the maximum rate before the characters in the display begin to reduce in contrast. The Hi Drive Time is set to the maximum drive time for the Type B waveform that is selected.

The glass is of type FSTN with a 6 o'clock viewing angle. The drive method is 1/16 Duty, 1/5 Bias. The operating voltage is 3.3V. The polarizer mode is Reflective/Positive.

Configure 'SegLCD'	? 🔀
Name: SegLCD	
Basic Configuration Driver Po	ower Settings Display Helpers Built-in 4 D
Number of common lines	16
	Enable Ganging Commons
Number of segment lines	28
Bias type	1/5
Waveform type	Type B Low Powe 💙
Frame rate, Hz	30 💌
Bias voltage, V	3.30
Enable Debug Mode	
Data Sheet	OK Apply Cancel

Figure 5-25. Segment LCD Configuration: Basic Tab



Basic Configuration Dr	iver Power Settings	Display Helpers	Built-in	4 Þ
Driver Power Mode	Always Active	~	1	
Hi drive time, μs	2058.9	-		
Low drive mode	Low range			
Low drive time, µs	8.1	10		

Figure 5-26. Segment LCD Configuration: Driver Power Settings

#### 5.3.8.1 LCD Glass Character Pixel Mapping

Refer to the component data sheet for details on mapping helper functions. Note that it is helpful to map groups of icons into single helpers to address each member of the group sequentially with the helper API calls.

In the following pixel mapping dialog, the overall mapping of all of the pixels into helper groups is shown. These mappings are used in the project design to define helpers for the matrix characters, the large 7-segment characters, the small 7-segment characters, the signal strength icons, the progress bar icons, and miscellaneous icon groupings.

Note that the matrix pixels are mapped with the HDOTX\_YZ names where: X is the character number (0 to 7 with character 0 at the left of the helper area), Y is the character matrix row position, and Z is the character matrix column position. The helper allows each pixel to be mapped by clicking and dragging each pixel block in the helper area to a single segment position in the grid. The helper tool allows you to configure the number of characters in a matrix or segment character display.

The 7-segment character segments are shown in the map with the H7SEGX\_A names where X is the character position in the group and A is the Alpha name of the segment within the character. The small 7-segment helper maps are shown in a group of 4-character helpers and the large 7-segment helper maps are shown in a group of 5-character helpers. The 16-segment character is mapped with the H16SEG0... symbols and the 14-character is mapped with the H14SEG0... symbols.





Basic 4	onfiguration	Driver Pr	wer Settings,	Display I	telpers B	it-in											
Ipera			no socargs		cted Helpe												
egne		1		Contraction of the local diversion of the local diversion of the local diversion of the local diversion of the	ser Matax 0												
Segn	ent		1	Hel	per_7Segment	0											
Segn	and Dial			Hel	per_7Segment per_16Segment	1 -											
strice			4		per_14Segmen												
elper i	unction confi	guration															
	× Numb	er of symbols	8 Sel	lected pixel na	me HDOTO	_00											
3	NO DE LOS DE LO	1 10 10 10 10 10 1	the set	No In State	NUME AN OCCUPATION	N FE 10 10 10 1	NAME AND ADDRESS OF A	111									
cel M.	oping Table																
	Com15	Com14	Com13	Com12	Com11	Com 10	Com9	Com8	Com7	Com6	Com5	Com4	Com3	Com2	Com1	Com0	
og0	HDOT7_47	HD017_46	HD017_45	HD017_44	HDOT7_43	HD017_42	HDOT7_41	HD017_40	HDOTO_07	HDOTO_06	HDOT0_05	HDOT0_04	HDOTO_03	HDOT0_02	HDOT0_01	HD OTO_00	
1g1	HDOT7_37	HD017_36	HD017_35	HD017_34	HD0T7_33	HD017_32	HDOT7_31	HD017_30	HDOTO_17	HD010_16	HDOT0_15	HDOT0_14	HDOT0_13	HDOT0_12	HDOTO_11	HDOTO_10	
1g2	HDOT7_27	HD017_26	HD017_25	HD017_24	HD0T7_23	HD017_22	HDOT7_21	HD017_20	HDOT0_27	HD/010_26	HD010_25	HDOT0_24	HDOTD_23	HD0T0_22	HD010_21	HD OTO_20	
93	HD0T7_17	HD017_16	HD017_15	HD0T7_14	HD0T7_13	HD017_12	HDOT7_11	HDOT7_10	HD0T0_37	HD:010_36	HD:070_35	HDOT0_34	HDOTD_33	HD0T0_32	HDOT0_31	HD OTO_30	
194	HDOT7_07	HDOT7_06	HD017_05	HDOT7_04	HDDT7_03	HD017_02	HDOT7_01	HDOT7_00	HDOTD_47	HDOT0_46	HDOT0_45	HDOTD_44	HDOTO_43	HDOT0_42	HDDT0_41	HD DTD_40	
ig5	HDOT6_47	HDOTE_46	HDOT6_45	HDOT6_44	HDOTE_43	HDOT6_42	HDOT6_41	HDOT6_40	HDOT1_07	HDOT1_06	HDOT1_05	HDOT1_04	HDOT1_03	HDOT1_02	HDOT1_01	HDOT1_00	
sg6	HDDT6_37	HDOTE_36		HDOTE_34	and the second second	HDOTE_32	HDOT6_31	and the second second second second	HDOTI_17	HDOT1_16	HDOT1_15	HDOT1_14	HDOT1_13	HDOT1_12	HDOT1_11	account and a constant	
197 108	HD016_27 HD016_17	HDOTE_26 HDOTE_16	HDOTE_25	HDOTE_24 HDOTE_14	HDOTE_23 HDOTE 13	HD016_22 HD016_12	HDOTE_21	HDOT6_20 HDOT6_10	HDOT1_27 HDOT1_37	HDOT1_26 HDOT1_36	HDOT1_25 HDOT1_35	HDOT1_24 HDOT1_34	HDOT1_23 HDOT1_33	HD0T1_22 HD0T1_32	HD0T1_21 HD0T1_31	HD0T1_20 HD0T1_30	
90 199	HDOTE_07	HDOTE_06	HDOTE_05	HDOTE 04	HDOTE_03	HDOT6_02	HDOTS_01	HDOT6_00	HDOT1_47	HDOT1_46	HDOT1_45	HDOT1_44	HDOT1_43	HDOT1_42	HDOT1_41	HDOT1_40	
a10	HDOTS 47	HD015_46	HDOTS_45	HDOTS_44	HDOTS_43	HDOTS 42	HDOTS_41	HDOTS 40	HDOT2 07	HDOT2 06	HDOT2 05	HDOT2 04	HDOT2 03	HDOT2 02	HDOT2 01	HDOT2 00	
011	HDOT5_37	HDOTS_36	HDOTS_35	HDOTS_34	HDOT5_33	HDOT5_32	HD015_31	10000000 - SIG	HD0T2_17	HD0T2_16	HD072_15	HDOT2_14	the second second	a successive statement of	and the second se	And the second se	
g12	HDOTS_27	HDOTS_26	HDOTS_25	HDOTS_24	HDOTS_23	HDOT5_22	HDOTS_21	HDOTS_20	HDOT2_27	HDOT2_26	HDOT2_25	HDOT2_24	HDOT2_23	HDOT2_22	HDOT2_21	HD 0T2_20	
g13	HD015_17	HDOTS_16	HDOTS_15	HDOTS_14	HDOT5_13	HDOTS_12	HDO15_11	HD015_10	HD0T2_37	HDOT2_36	HDOT2_35	HDOT2_34	HDOT2_33	HD0T2_32	HD0T2_31	HD0T2_30	
g14	HDOT5_07	HDOT5_06	HD015_05	HDOT5_04		And other states of the local data of	HDOT5_01	and the state of the state of the	HDOT2_47	HDOT2_46	HDOT2_45	HDOT2_44	and the state of t			ALC: NOT THE OWNER OF THE OWNER OWNER OF THE OWNER OWNE	
g15	HDOT4_47	HDOT4_46	HDOT4_45	HDOT4_44	HDOT4_43	HDOT4_42	HDOT4_41	HDOT4_40	HDOT3_07	HDDT3_06	HDOT3_05	HDOT3_04	HDOT3_03	HDOT3_02	HDOT3_01	HDOT3_00	
g16	HD0T4_37	HD0T4_38	HDOT4_35	HDOT4_34	HDOT4_33	HD074_32	HDOT4_31	HD014_30	HD0T3_17	HD0T3_16	HDOT3_15	HD0T3_14		HD0T3_12	HDOT3_11	HD0T3_10	
917	HDOT4_27	HDOT4_26	HDOT4_25	HDOT4_24	HD0T4_23	HDOT4_22	HDOT4_21	HDOT4_20	HD0T3_27	HD073_26	HDOT3_25	HDOT3_24	HDOT3_23	HD0T3_22	HD073_21	HD073_20	
g18 g19	HDOT4_17 HDOT4_07	HDOT4_16 HDOT4_06	HDOT4_15 HDOT4_05	HD0T4_14 HD0T4_04	HD0T4_13 HD0T4_03	HDOT4_12 HDOT4_02	HDOT4_11 HDOT4_01	HDOT4_10 HDOT4_00	HDOT3_37 HDOT3_47	HD0T3_36 HD0T3_46	HD013_35 HD013_45	HDOT3_34 HDOT3_44	HD0T3_33 HD0T3_43	HD0T3_32 HD0T3_42	HD0T3_31 HD0T3_41	HD0T3_30 HD0T3_40	
	H14SEGO	HI4SEGO	HI4SEGO	HI4SEGO	H14SEGO	H14SEG0 I	and the second se	PM	HIESEGO	H16SEGD	and the second se	CONTRACTOR OF THE OWNER.	and the second se	HIESEGO	HIGSEGO_I	opening of the local division of the local d	
11120	H14SEGO	H14SEG0	H14SEG0	H14SEG0	H14SEGO	H14SEGO.	H14SEG0	19	H16SEGO.		HI6SEGO			HI6SEGO	HI6SEGO	And in case of the local data and	
922	T4	T3	12	T1	Z4	MAX	26	21	02	Q1	P10	P9	P8	P7	P6	P1	
923	Q3	Q4	Q5	Q6	Q7	Q6	Q9	Q10	TO	H7SEG4_D	H7SEG4_C	H7SEG4_E	H7SEG4_G	H7SEG4_B	H7SEG4_F	H7SEG4_A	
g24	AM	H7SEG8_D	H7SEG8_C	H7SEG8_E	H7SEG8_G	H7SEG8_8	H7SEG8_F	H7SEG8_A	17	H7SEG3_D	H7SEG3_C	H7SEG3_E	H7SEG3_G	H7SEG3_8	H7SEG3_F	H7SEG3_A	
925	75				H7SEG7_G	and a second second	H7SEG7_F		COL				H7SEG2_G				
g26	23	and the second second second second	and the second se		H7SEG6_G	and the second second	and the second se	Conception of the second	16				H7SEG1_G				
g27	22	H/SEGS_D	H7SEG5_C	H7SEGS_E	H7SEG5_G	H7SEG5_B	H7SEGS_F	H7SEGS_A	15	H7SEG0_D	H7SEG0_C	H/SEG0_E	H7SEG0_G	H7SEG0_B	H/SEG0_F	H7SEG0_A	



Configure 'SegLCD'	? 🔀
Name: SegLCD	
Basic Configuration Driver Power Settings Displ	lay Helpers Built-in 4 b
Helpers	Selected Helpers
7 Segment 14 Segment 16 Segment Bargraph and Dial Matrix	Helper_Matrix_0
Helper function configuration	
📳 🔀 Number of symbols: 5 Selected pix	xel name H7SEG0_A
A A A F B F B F B F B F G G G G G E C E C E C E C E	A B G C
Pixel Mapping Table	
Data Sheet OK	Apply Cancel

Figure 5-28. Five Character Helper for Large Seven Segment Display

Figure 5-29. Four Character Helper for Small Seven Segment Display

Configure 'SegLCD'		? 🗙
Name: SegLCD		
Basic Configuration Drive	er Power Settings Display Helpers Built-in	4 Þ
Helpers	Selected Helpers	^
7 Segment 14 Segment 16 Segment Bargraph and Dial Matrix	Helper_Matrix_0 Helper_7Segment_0 Helper_7Segment_1 Helper_16Segment_0 Helper_14Segment_0	
Helper function configuration	bols: 4 Selected pixel name H7SEG5_A	
	A A A B F B G G C E C D D D	
Pixel Mapping Table		
Data Sheet	OK Apply Cano	;el



Configure 'SegLCD'	? 🛛
Name: SegLCD	
Basic Configuration Driver Power Settings Di	isplay Helpers Built-in 4 🕨
Helpers	Selected Helpers
7 Segment 14 Segment 16 Segment Bargraph and Dial Matrix	Helper_Matrix_0
Helper function configuration Number of symbols: 1 Selected FHIJB GK	d pixel name H16SEG0_A
E N M L C D D Pixel Mapping Table	<b>_</b>
Data Sheet OK	Apply Cancel

Figure 5-30. One Character Helper for 16-Segment Display

Figure 5-31. One Character Helper for 14-Segment Display

Configure	'SegLCD'	? 🔀
Name:	SegLCD Configuration Driver Power Settings Disg	olay Helpers Built-in ↓ ▷
Helper 7 Segm 14 Segr 16 Segr Bargrap Matrix Helper F H G E N V	s ent nent hent h and Dial function configuration Number of symbols: 1 Selected p	Selected Helpers Helper_Matrix_0 Helper_7Segment_0 Helper_7Segment_1 Helper_14Segment_0
	lapping Table	Apply Cancel



## 5.3.8.2 LCD Glass Icon Pixel Mapping

Refer to the hardware design document included in this package for the glass segment icon mapping and symbol names (*LCD Layout s93043-602.pdf*, page 2). Icons can be grouped together for ease of control, such as signal strength, progress, and battery level bars or they can be individually controlled by direct pixel access.

The icon bar graph helpers allow to specify the number of icon elements in the bar. This information is used by the helper to provide the bar element pixel segment selection and allows you to specify the element position in the graph in the parameters in the API calls for the bar graph.

Figure 5-32. Bar Graph Helper for 10-Element Progress Bar Icons

Configure	'Se	gLC	D'													?	
Name:	ame: SegLCD																
Basic	Conf	iau	ratio	n	D	rive	r Po	wer Seti	inas)	Dis	splay H	elpe	rs	Buil	t-in	4	⊳
-	Helpers Selected Helpers										^						
7 Segm 14 Seg	7 Segment 14 Segment Helper_16Segment_0																
16 Seg	16 Segment Bargraph and Dial																
Matrix																	
Helper	func V	-		_			L _ I -	10	Cal							_	
		<u> </u>	Nun	IDel	ors	sym	DOIS	: 10	Sele	ected	pixei nai	ne				_	
								a									
Q G 1 2	3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	1 0									
Pixel N	1appi	ng '	[abl	e -													~
			٦		_	Г		01	_	-				_	0	1	
Data	shee	t	J			L		OK			Appl	y			Can	icel	:



Configure 'SegLCD'	? 🗙								
Name: SegLCD									
Basic Configuration Driver Power Settings Display Helpers Built-in	4 Þ								
Helpers Selected Helpers	^								
7 Segment 14 Segment 16 Segment Bargraph and Dial Matrix Helper_Bar_0 Helper_Bar_1 Helper_Bar_2									
Helper function configuration           Helper function configuration           Image: Selected pixel name									
РРРРР 1 6 7 8 9 0									
Pixel Mapping Table									
Data Sheet OK Apply Can	;el								

Figure 5-33. Bar Graph Helper for Four Elements Signal Strength Icons (include ZZZ and CyLogo)

Figure 5-34. Bar Graph Helper for Four Element Battery Level Icons

Cor	nfigu	ire	'Se	gL (	:D'																	?	×
Na	Name: SegLCD																						
	Basic Configuration Driver Power Settings Display Helpers Built-in 4											⊳											
Helpers Selected Helpers											^												
	7 Segment       14 Segment       16 Segment       Bargraph and Dial       Matrix																						
	Hel	per	func	tion	i cor	nfigu	irati	on															
	4		X		Nur	nbei	r of :	sym	bols	: 1	9	Ş	Sele	cteo	ł pix	el n	ame	, [					
	Image: Number of symbols:         19         Selected pixel name           T <td></td>																						
	Pixe	el M	аррі	ng	Tab	e																	*
C	Da	ita S	hee	ł						0	K					Ap	ply			Ca	ncel		

It includes remaining icon pixels: four large decimal points, large colon, slash, bell, MAX, AM, PM, small decimal points, and small colon).



#### 5.3.8.3 Pixel Only Mapped Icons

The following icons are only mapped for use as direct pixels:

- BELL (Z6)
- MAX (MAX)
- AM (AM)
- PM (PM)
- Small '1' Icon (Z1)
- Small decimal point 1 (Z2)
- Small decimal point 2 (Z3)
- Small decimal point 3 (Z5)
- Small colon (Z4)

These icons can be turned on and off directly by using the pixel writing API calls.

## 5.3.9 Digital I/O

#### 5.3.9.1 Sleep Button

The sleep button is configured to generate an interrupt on both edges of a button press. The default Built-In settings are used.

If the project is in wake mode, when the button is pressed and released, the button ISR signals a go to sleep command.

If the project is in sleep mode, when the button is pressed, a wake signal is sent and the code returns to normal flow just after the sleep entry point.

**Note** In sleep mode, the PSoC 3 device does not go into sleep; the firmware is just put in a lower power mode. In the low power mode, only RTC component is left running and all other components are powered off. It periodically wakes up the PSoC enough to strobe the ZZZ icon on and off to indicate that the device is in low power mode. To know details on low power operation mode refer to Low Power Entry on page 64.

When the project is powered from a wall supply and the operator is in the RTC/TEMP submenu, then the sleep entry is blocked. If the project is battery powered, there is no sleep blocking.



Pins Mapping	Reset Built-in	4 Þ
umber of Pins: 1	Type General Input	Dutput
Sleep_Btn_0	Drive Mode High Impedance Digital	Initial State:
		Minimum Supply Voltage

Figure 5-36.	Sleep Button	Configuration: Pin	Туре	Tab (includes	dual-edge	interrupt	configuration	٦)
--------------	--------------	--------------------	------	---------------	-----------	-----------	---------------	----

Name: Sleep_Btn		
Pins Mapping Number of Pins: 1	Reset Built-in	4 Þ
<mark>IAI Pins1</mark> ⊠ Sleep_Btn_0	Type     General     Input     Output       Analog     Preview:       Digital Input     Input       HW Connection       Digital Output       HW Connection       Ouput Enable       Bidirectional	



Configure 'cy_p	pins'	? 🔀
Name: Sleep	Btn	
	pping Reset Built-in	4 Þ
[All Fins]. └──⊠ Sleep_Bi	Type General Input Output	
Data Sheet		ancel

Figure 5-37. Sleep Button Configuration: Input Tab (includes dual edge interrupt configuration)

#### 5.3.9.2 Sleep Button ISR

The PSoC Creator generates source files for the Sleep Button ISR. The project Sleep Button code includes project specific code for interrupt handling. References to the project Sleep Button code interrupt service routine are added to the generated source. In the generated source file for the interrupt handling, there are two places where code must be added manually. This code is protected by source code generator statements that preserve the user entered code during subsequent builds. The code added is a prototype for the user provided ISR and a call to the user ISR in the generated source.



Figure 5-38. Sleep Button ISR

Name: Sleep_Btn_ISR Built-in		4 Þ				
Parameter	Туре	Value				
CY_COMPONENT_NAME	string	GetComponentName()				
CY_MAJOR_VERSION	string	1				
CY_MINOR_VERSION	string	10				
CY_REMOVE	bool	false				
CY_SUPPRESS_API_GEN	bool	false				
CY_VERSION	string	PSoC Creator 1.0 Beta 3.1				
Parameter Information		OK Apply Cancel				

#### 5.3.9.3 Wall Supply (Vin) Detect

The Wall Supply (Vin) Detect is configured to allow firmware to poll the port with the Read API call. This signal is used in conjunction with the battery sense pins to communicate the current power configuration to the project. The default Built-In settings are used.

Figure 5-39.	Wall Supply	(Vin)	Detect	Configuration:	General	Tab
. igaio 0 00.	man Cappij	、•···/	201001	ooringaraaorii	00110101	100

Configure 'cy_pins'		? 🛛
Name: WallSupplyDetect		
Pins Mapping Res	et Built-in 🕅	4 Þ
IAII Ansl	Type General Input Outp	
	High Impedance Digital	Initial State: Low (0)
		Minimum Supply Voltage:
Data Sheet	OK Apply	Cancel



ame: WallSupplyDetec			
vanie. waiisuppiyoetec	, a		
Pins Mapping R	eset Built-in		4 1
Number of Pins: 1	X 🗗 🕈 🕴 🕺		
[All Fins]		put Output	
WallSupplyDetect_0	Analog	Preview:	
	🔽 Digital Input		
	HW Connection		->-
	Digital Output		
	HW Connection		
	Ouput Enable		
	Bidirectional		
< i i i i i i i i i i i i i i i i i i i	]		
	2		

Figure 5-40. Wall Supply (Vin) Detect Configuration: Pin Type Tab

Figure 5-41. Wall Supply (Vin) Detect Configuration Input Tab

Configure 'cy_pins'		? 🛛
Name: WallSupplyDetect		, i i i i i i i i i i i i i i i i i i i
Pins Mapping Rev	set Built-ir	n 4 Þ
IAIL Fins]	Type Threshold:	General Input Output CMOS Hysteresis
	Interrupt:	None
		Hot Swap     Input Buffer Enabled
		✓ Input Synchronized
<		
Data Sheet		OK Apply Cancel



#### 5.3.9.4 VBus Detect

The VBus Detect is configured to allow the firmware to poll the port with the Read API call. The VBus Detect signal is used in conjunction with the battery sense pins to help communicate the current power configuration to the project. The default Built-In settings are used.

Configure 'cy_pins' Name: VBUSDetect Pins Mapping R	eset Built-in	
Number of Pins: 1		
IAU Fins]	Drive Mode	Dutput Initial State: Low (0) Minimum Supply Voltage:
Data Sheet		oly Cancel

Figure 5-42. VBus Detect Configuration: General Tab

Figure 5-43. VBus Detect Configuration: Pin Type Tab

Configure 'cy_pins'		? 🛛
Name: VBUSDetect Pins Mapping R Number of Pins: 1 IAI Pins VBUSDetect_0	eset Built-in	
Data Sheet	OK Apply Car	ncel



## 5.3.9.5 Digital Outputs

#### 5.3.9.6 Accelerometer On

The firmware uses API to write to this port to turn on the accelerometer, enabling measurements. The default Built-In settings are used.

Figure 5-44. Accelerometer On Configuration: General Tab

Configure 'cy_pins'		? 🛛
Name: Acc_On		
Number of Pins: 1	Reset Built-in	4 Þ
[All Pins]	Type General Input	Output
	Drive Mode	Initial State:
	Strong Drive	🐱 Low (0) 🔽
		Minimum Supply Voltage:
Data Sheet	ОК	Apply Cancel

Figure 5-45. Accelerometer On Configuration: Pin Type Tab

Configure 'cy_pins'		? 🛛
Name: Acc_On Pins Mapping Number of Pins: 1	Reset Built-in	4 Þ
All Pinst	Type     General     Input     Output       Analog     Preview       Digital Input     Input       HW Connection       Digital Output       HW Connection       Ouput Enable       Bidirectional	
Data Sheet	OK Apply	Cancel



Configure 'cy_pins'			? 🛛
Name: Acc_On Pins Mapping P Number of Pins: 1	teset Built-in		4 Þ
IAII Pinst	Type Slew Rate: Drive Level: Current:	General Input Output Fast Vddio 4mA source, 8mA sink Output Synchronized	
Data Sheet		JK Apply C	ancel

Figure 5-46. Accelerometer on Configuration: Output Tab

#### 5.3.9.7 Buzzer In

This digital port provides a hardware path from PWM to the buzzer. It is configured to use hardware configuration and therefore does not require firmware code to activate it. Because the component is hardware configured, the output pin is exposed in the top level design, which allows a connection from the PWM to the digital port for output mapping. The default Built-In settings are used.

Figure 5-47. Buzzer In Configuration: General Tab

Configure 'cy_pins'		? 🛛
Name: Buzzer_In		j
Pins Mapping Re	set Built-in	4 ۵
Number of Pins: 1		
[All Fins]	Type General Input Outp	put
- Buzzer_In_0	Drive Mode	Initial State:
	Strong Drive 🔽	Low (0) 💉
		Minimum Supply Voltage:
Data Sheet	ОК Арріу	Cancel



Pins Mapping	Reset Built-in	4
IAII Finst	Type       General       Input       Output         Analog       Preview:         Digital Input       Imput       Imput         HW Connection       Imput       Imput         HW Connection       Imput       Imput         Upigital Output       Imput       Imput         Upigital Output       Imput       Imput         Upigital Output       Imput       Imput         Imput       Imput       Imput <t< th=""><th></th></t<>	

Figure 5-48. Buzzer In Configuration: Pin Type Tab

Figure 5-49. Buzzer In Configuration: Output Tab

Pins         Mapping           Jumber of Pins:         1	Reset Built-in	4
[All Pins]	Type General Input (	Dutput
Buzzer_In_0	Slew Rate: Fast 💌	
	Drive Level: Vddio	
	Current: 4mA source, 8mA si	nk 🔽
	🔲 Output Synchror	nized

## 5.3.9.8 Logic Level High for Buzzer In Output Enable

The Buzzer In digital output component requires a signal on the OE pin to enable the output.



# 5.3.10 Real Time Clock (RTC)

The RTC is minimally configured to use Sunday as the start day of the week. The firmware enables the RTC with hours, minutes, and seconds set to zero and the date set to January 1, 2000. After the clock is set, as long as power is provided to the PSoC 3 part, the real time is maintained with high accuracy. For the RTC to function, the 32 kHz crystal must be enabled in the System Clocks dialog.

The RTC function also has complete Alarm Clock settings. The project allows you to set an alarm for any time of the day. The project also provides options to enable or turn off an alarm that has started ringing. The alarm automatically stops ringing after five minutes.

The default Built-In settings are used.

Configure 'RTC'	? 🗙
Name: RTC_1	
Basic Configuration Built-in	4 Þ
Enable Daylight Savings Time Functionality	
Start of week Sunday	
Data Sheet OK Apply Cancel	

Figure 5-50. Real Time Clock (RTC) Configuration: Basic Tab

#### 5.3.10.1 CapSense Buttons

There are four CapSense button capacitive pickup points on the LCD board. The silkscreen identifies each pickup point as a button in the range "+", "-", "SEL", and "RET". These buttons are used for menu navigation and data input.

This design uses the CapSense IDAC enabled as source method. The hardware is wired with an RBleed resistor to allow the IDAC disabled CapSense implementation. The hardware is wired for only one CMod circuit, so the serial CapSense method is used. For this implementation, the CapSense inputs are mapped to button functions. All the buttons are similarly configured.

CapSense button detection is performed using polling method. This requires the firmware to provide button sampling at each user loop in the code flow. The Timer user ISR can be enhanced to provided button sense events.

**Note** The CapSense CPS clock must not be greater than one half the projects bus clock selection (see System Clocks on page 61).



	Clock Source Buttons Sliders Touch Pads Matrix Butt	ons P4
Configuration 💿	Serial O Parallel Synchronized O Parallel Asynchronou	8
CapSense Method	d CSD	
	1 an	
<ul> <li>IDAC sourcing</li> <li>IDAC sinking</li> <li>IDAC disable, u</li> </ul>	use external Rb	
PRS Shield Electrode	None 🖌	

Figure 5-51. CapSense Configuration: General Tab

Figure 5-52. CapSense Configuration: Clock Source Tab





ame:	CapSense				
G	ieneral Clock Source Buttons	s Sliders Touch Pads Matrix Buttons P 4			
	Button Name				
•	B1				
	B2				
	83				
	B4				
*					
		B1			
3 Fil	ters Configuration	01			
	ters Configuration eraging Filter for Raw Data	Disabled			
Av					
Av Fir:	eraging Filter for Raw Data	Disabled			
Av Fir: Jitt	eraging Filter for Raw Data st Order IIR Filter for Raw Data	Disabled Disabled			
Av Fin Jitt Me	eraging Filter for Raw Data st Order IIR Filter for Raw Data er Filter for Raw Data edian Filter for Raw Data	Disabled Disabled Disabled			
Av Fir: Jitt Me E Mi De	eraging Filter for Raw Data st Order IIR Filter for Raw Data er Filter for Raw Data edian Filter for Raw Data sc sc	Disabled Disabled Disabled Disabled <b>5</b>			
Av Fir: Jitt Me De Hy	eraging Filter for Raw Data st Order IIR Filter for Raw Data er Filter for Raw Data edian Filter for Raw Data <b>sc</b> ebounce isteresis	Disabled Disabled Disabled Disabled			
Av Fin Jitt Me De Hy Th	eraging Filter for Raw Data st Order IIR Filter for Raw Data er Filter for Raw Data edian Filter for Raw Data sc ebounce isteresis aresholds	Disabled Disabled Disabled Disabled 5 5			
Av Fin Jitt Me De Hy Fin	eraging Filter for Raw Data st Order IIR Filter for Raw Data er Filter for Raw Data edian Filter for Raw Data <b>sc</b> ebounce isteresis	Disabled Disabled Disabled Disabled <b>5</b>			

Figure 5-53. CapSense Configuration: Buttons Tab

Figure 5-54. CapSense Configuration: Scan Slots Tab

0	Configu	re 'Cap	Sense'		? 🛛
	Name:	Cap!	Sense		
	Pads	Matrix B	uttons Pro	ximity Sensor	sors Generic Sensors Scan Slots Built-in
		Scan Order	Associated Terminal(s)		
	•	0	BTN_B1		-
		1	BTN_B2		
		2	BTN_B3		
		3	BTN_B4		
	BTN_B CapSer		nod: CSD		Custom
	Presca Period	ler 8		Connect Inactive Ser	Sensors Ground 💌
	Resolu	tion 10	) bits 🛛 🔽	Scan Speed	eed Normal 💌
	IDAC ra	ange 2	*	IDAC Setting	ting 127
	Dat	a Sheet			OK Apply Cancel



# 5.3.11 EEPROM

This project uses the default Built-In settings. The EEPROM is 2 KB in two sectors [0, 1]. The project uses Sector 0 starting at the beginning of the sector. Each sector is addressed by 16-byte rows. The API provides a Write function to write data to the EEPROM and simple pointer code is used to provide read access row by row.

The project uses the following organization of the EEPROM for storing Punch saved high scores, display contrast level, and clock alarm settings.

Row	Data	Description
0	"0123456789ABCDEF"	Initialization String – if this string is missing then automatically re-initialize the EEPROM project data
1	High Score #1:Name, Score	Name is String Score is Long
2	High Score #2:Name, Score	Name is String Score is Long
3	High Score #3:Name, Score	Name is String Score is Long
4	High Score #4:Name, Score	Name is String Score is Long
5	High Score #5:Name, Score	Name is String Score is Long
6	Number of saved high scores	Byte (range [0 5])
7	Accumulated score for averaging	Long
8	Average Score	Long
9	Current High Score Index	Byte (range [0 4])
10	Clock Alarm	Hour Byte (range [0 23])
10	(Hour, Minute)	Minute Byte (range [0 59])
11	Display Contrast Level	Byte (range [0 10])
	Clock Data	Day Byte (range [1 31])
12	(Day, Month Index, Year)	Month Index Byte (range $[011] \rightarrow [JAN DEC)$
	(Day, Month Index, Tear)	Year Byte (range [0 99] $\rightarrow$ [2000 2099])
13	Clock Alarm OFF/ON	Byte (range $[0 1] \rightarrow [OFF, ON]$ )
14	Clock Time	Hour Byte (range [0 23])
14	(Hour, Minute)	Minute Byte (range [0 59])

Table 5-1. EEPROM Row Contents



#### Figure 5-55. EEPROM Default Settings

Built-in       4 b         Parameter       Type       Value         CY_COMPONENT_NAME       string       EEPROM_v1_10         CY_MAJOR_VERSION       string       1         CY_MINOR_VERSION       string       10         CY_REMOVE       bool       false						
Name: EEF	ROM_1					
Built-in			4 Þ			
Paran	neter	Туре	Value			
CY_COMPONE	ENT_NAME	string	EEPROM_v1_10			
CY_MAJOR_V	ERSION	string	1			
CY_MINOR_V	ERSION	string	10			
CY_REMOVE		bool false				
CY_SUPPRES	S_API_GEN	bool	false			
CY_VERSION		string	PSoC Creator 1.0 Beta 3.1			
Parameter Info		C	OK Apply Cancel			

## 5.3.12 System Clocks

There are two system clocks to be enabled: the 32 kHz crystal clock for the RTC component and the PLL. The PLL is created from the IMO clock and is set high enough to allow CapSense operations. These clocks are enabled in the Configure Built In Clocks dialog.

To get to this dialog, select *SegLCD\_project.cydwr* in the Workspace Explorer. Select the Clocks tab at the bottom of the workspace and then click **Edit Clock** on top of the workspace.





Figure 5-56. Enable XTAL 32 kHz for RTC and PLL

#### 5.3.13 Pin Mapping

For the design to work, the PSoC3 pins internal connections must be mapped to the corresponding output connections. This is done using the Pins dialog.

To get to this dialog, select the *SegLCD\_project.cydwr* file in the Workspace Explorer. Select the Pins tab at the bottom of the workspace. To connect a pin grab and drop one of the unassigned pins from the pin list panel on the right side onto an unassigned target pin stub on the PSoC3 block in the center panel. To remove a connection, right click the assigned target pin stub and unlock the signal name.





Figure 5-57. Pin Connection Mapping Page 1



ĸ	Start Page *TopDesign.cysch Se	gLCD_project.cydwr		_			1	•
	토 등		T E E	Alias	Name	Pin		1
	D Seg		D Sag		\SegLCD: Seg\[11]	P4[4]	~	
	offee and a second s	segic s segic s s s s s segic s s s s s s s s s s s s s s s s s s s	anglo C		\SegLCD:Seg\[10]	P4[5]	~	
10					\SegLCD:Seg\[9]	P4[6]	~	
					\SegLCD:Seg\[8]	P4[7]	~	
			~					
	iSegLCD:Com(1) 1 P2(5)		*					
	None         None           Internet         Internet           Internet         Internet	\SegLCD:Seg\[5]	P6[2]	~				
					\SegLCD:Seg\[4]	P6[3]	*	
					\SegLCD:Seg\[3]	P15[4]	*	
					\SegLCD: Seg\[2]	P15[5]	~	
					\SegLCD: Seg\[1]	P2[0]	~	
	and the second				\SegLCD: Seg\[0]	P2[1]	~	
	the second s				Acc_On	P12[2]	×	
					J4_5_IN	P12[4]	~	
					J4_3_0UT	P12[1]	~	
				sCmod	\CapSense:sbCSD:cCmod\	P4(0)	~	
	TT XRES_N		n/c G1	BTN_B4	\CapSense:sbCSD:cPort\[3]	P3(3)	~	
		100 1011		BTN_B3	\CapSense:sbCSD:cPort\[2]	P3(2)	~	
				BTN_B2	\CapSense:sbCSD:cPort\[1]	P3(1)	~	
				BTN_B1	\CapSense:sbCSD:cPort\[0]	P3(0)	~	
					J4_6_0UT	P12[5]	~	
					Buzzer_In	P12[6]	~	
		9.5			XInPort	P3[7]	*	
		Long .		Alies         Name         Pin           1         SegLCD: SegV(1)1         P4(4)           1         SegLCD: SegV(10)         P4(5)           1         SegLCD: SegV(19)         P4(6)           1         SegLCD: SegV(19)         P6(1)           1         SegLCD: SegV(11)         P6(1)           1         SegLCD: SegV(11)         P5(1)           1         SegLCD: SegV(11)         P5(1)           1         SegLCD: SegV(11)         P2(1)           1         SegLCD: SegV(10)         P2(1)           2         Acc_On         P2(2)           3         4_5_TN         P12(1)           4<_5_00T	*			
	BattSeventV 25 P1(5) JTAG STRST	ISB D TALO	P3(6) 51 YinPart		VSignalPort	P4(5)         P           P4(6)         P           P6(0)         P           P6(1)         P           P6(1)         P           P6(1)         P           P6(1)         P           P6(1)         P           P6(1)         P           P15(1)         P           P15(4)         P           P15(5)         P           P12(1)         P           P12(5)         P           P12(6)         P           P12(6)         P           P12(6)         P           P12(1)         P <tr< td=""><td>~</td><td></td></tr<>	~	
	5 E E P		6 R R		VRefPort	P3[4]	~	
					VBUSDetect	P12[3]	~	
				-	Sleep_Btn	P12[7]	~	
	5 Cam(t)	Land Class Carlos Carlo	Signal Signal		WallSupplyDetect	P12[0]	~	
	- G276		>			P1[4]	~	
	ð ð					P1(5)	~	
		Control Contro			BattSenseAA	P1(2)	~	

Figure 5-58. Pin Connection Mapping Page 2

#### 5.3.14 Low Power Operation

The design also includes the ability to go to low power operation. When the device goes to low power operation, only the RTC component is left running. It periodically wakes up the PSoC enough to strobe the ZZZ icon on and off to indicate that the device is in low power mode. To bring the device out of low power mode, press and hold the push button switch. When the device wakes up at the next ZZZ strobe interval, it samples the push button and return to normal operations if the button is pressed.

## 5.3.15 Low Power Entry

The following tasks must be performed prior to entering low power:

- 1. Set 32 kHz clock to low power mode (API call).
- 2. Set trim registers (sleep and wake trims).
- 3. Stop timer components (except RTC).
- 4. Disable component clocks.
- 5. Deactivate accelerometer.
- 6. Deactivate thermistor VDAC reference generator.



- 7. Stop CapSense.
- 8. Set segment LCD to low power mode (API call).
- 9. Call CySleep library API.

## 5.3.16 Automatic Low Power Entry

The firmware automatically puts the device into low power mode after 10 minutes of no user activity (no CapSense button presses). The exception is when you are in the RTC/TEMP mode. If the device is powered by a wall supply, then the RTC/TEMP mode blocks entering low power.

However, if the device is powered by a battery source, then the project goes into automatic low power mode even if user is in the RTC/TEMP mode. The automatic low power mode is a sleep operation.

#### 5.3.17 Manual Low Power Entry

When the device is in normal operation, if the push button is pressed and the device is not in the RTC/TEMP mode, then the device enters the low power operation. If the device is powered by a wall supply, the RTC/TEMP mode blocks entering low power.

However, if the device is powered by a battery source, then the project goes into manual low power mode even if the clock is displayed. The pushbutton low power mode is a sleep operation.

#### 5.3.18 Periodic Wake and Return to Sleep

The RTC clocking continues during the sleep low power mode. This allows the RTC clock to continue interrupting the PSoC 3 every second. The PSoC 3 RTC interrupt calls the project interrupt service code which counts RTC interrupt events. Normally, the interrupt service simply returns without action and the device automatically re-enters sleep mode.

However, on every fourth RTC interrupt, the interrupt service reactivates the LCD segment component, turns on the ZZZ icon for three-fourths of a second, and deactivates the LCD segment component. The device then re-enters the sleep mode.

#### 5.3.19 Wake from Sleep

Press the pushbutton to wake from sleep. The pushbutton interrupt wakes up the PSoC 3 device, which resumes processing from the point it went into low power mode. The clock time is preserved during automatic sleep.

#### 5.3.20 Low Power Exit

The following tasks must be performed after waking from low power to continue normal operations:

- 1. Set segment LCD to low power mode (API call).
- 2. Restart CapSense.
- 3. Reactivate component clocks.
- 4. Restart timer components.
- 5. Restart ADC component.



# 5.4 Source Code Description

#### 5.4.1 Top Level Functional Description

On startup, the main process starts the necessary components that operate the main program menu. This includes the LCD segment display component and CapSense buttons. The main function then enters the continuous Main Loop.

#### 5.4.1.1 Main Loop

Figure 5-59 shows the flow of the main code. The Main Loop displays the top level modes of operation in sequential order. These modes are:

- Punch Gauge (PUNCH)
- Time/Temperature (RTC/TEMP)
- Contrast Control (CONTRAST)
- LCD Demo (LCD DEMO).

Press the "+" and "-" buttons to select from one of the modes. A mode is entered when you press the **SEL** button while that mode name is displayed. On selecting a mode of operation, the main process transfers control to a sub mode control level with sub mode menus and controls.

Figure 5-59. Main Code Flow





#### 5.4.1.2 Punch Gauge Mode

Figure 5-60 shows the flow of the Punch Gauge sub mode code. On entering the Punch Gauge mode, the Punch process enters a continuous loop that displays in sequential order the sub modes. These sub modes are

- Throw Punch (1:GAUGE)
- Show High Score (1:HIGH)
- Recall Highest Scores (1:RECALL)
- Clear the saved high scores (1:CLEAR)

Use the "+" and" -" buttons to select from one of the Punch Gauge sub modes. A sub mode is entered when you press **SEL** while that sub mode name is displayed. Pressing **RET**, exits the Punch Gauge sub mode and re-enters the Main Flow.

All the Punch processes display characters on the matrix display.

Figure 5-60. Punch Code Flow





## 5.4.1.3 RTC/TEMP

Figure 5-61 shows the RTC code flow and Figure 5-62 shows the Date/Temperature code flow. On entering the Time/Temperature mode, the RTC process displays the Time/Temperature sub modes in sequential order. The sub modes are:

- Show Time (2:Clock)
- Set Time (2:SetClk)
- Set Date(2:SetDat)
- Set Alarm (2:SetAlm)
- Turn Alarm On/Off (2:Alarm).

Press the "+" and "-" buttons to select from one of the sub modes. A sub mode is entered when you press **SEL** button while that sub mode name is displayed. Upon selecting a sub mode operation, the Time/Temperature mode transfers control to a sub mode control level with sub mode menus and controls.

Figure 5-61. RTC Code Flow







## Figure 5-62. Clock Show Time and Date/Temperature Flow



#### 5.4.1.4 Contrast Control Mode

Refer to Figure 5-63 for the contrast control code flow. On entering the Contrast Control mode, the contrast process displays "Level = X" in the matrix display. The X is the current contrast level, which is a number in the range 0 to 10. The Progress Bar icons are turned on from left to right to display the contrast level. The "+' and "-" buttons control the increment and decrement of the contrast level.



Figure 5-63. Contrast Control Flow



## 5.4.1.5 LCD Demonstration Mode

#### Figure 5-64. LCD Demonstration Code Flow





## 5.4.1.6 Register Descriptions

There are several low power handling registers in PSoC 3 that must be directly set by the project code to allow proper sleep entry and wakeup exit. All other register activity is performed by the component the API calls.

Table 5-2.	Register	Descriptions
------------	----------	--------------

Register Component Name	Register Silicon Name	Register Address	Write Value	Description
CYDEV_MFGCFG_P WRSYS_SLP_TR	PWR- SYS.SLP_TR	0x4683	0x03	Sleep regulator trim: 1. Regulator trim = 3
CYDEV_MFGCFG_P WRSYS_WAKE_TR0	PWR- SYS.WAKE_TR0	0x4685	0xFF	Wake trim: 1. Wake holdoff interval multiplier=16 2. Wake timeout interval multiplier=16
CYDEV_MFGCFG_P WRSYS_WAKE_TR1	PWR- SYS.WAKE_TR1	0x4686	0x38	Wake trim: 1. Wake precount=7 2. Wake IMO frequency = 12 MHz

# A. Appendix



# A.1 Pixel Mapping Table for LCD Glass





#### **Segment Lettering Information** A.2









# A.3 Schematic





# A.4 BOM

CY8CKIT-006 PSoC3/5 LCD Driver

121R-49500 Revision: 5

REF-14890 Revision: 5

Item	Qty.	Reference	Part	Manufacturer	Mfrg. Part No.	RoHS	Sub
1	1	BH3	BATTERY HOLDER 9V Female PC MT	Keystone Elec- tronics	594	Y	Y
2	1	BH4	BATTERY HOLDER 9V Male PC MT	Keystone Elec- tronics	593	Y	Y
3	1	C1	CAP .10UF 16V CERAMIC X7R 0603	Kemet	C0603C104J 4RACTU	Y	Y
4	6	C2,C3,C4,C 8,C11,C12	CAP CERAMIC 1.0UF 10V X5R 0603	Kemet	C0603C105K 8PACTU	Y	Y
5	1	C6	CAP 10UF 16V TANTA- LUM 10% 3216	AVX	TAJA106K01 6R	Y	Y
6	2	C13,C14	CAP CER 10UF 16V X5R 0805	Murata Electron- ics North Amer- ica	GRM21BR61 C106KE15L	Y	Y
7	4	C15,C16,C1 7,C22	CAP .10UF 10V CERAMIC X5R 0402	Kemet	C0402C104K 8PACTU	Y	Y
8	2	C18,C19	CAP 6PF 50V CERAMIC NPO 0603	Panasonic - ECG	ECJ- 1VC1H060D	Y	Y
9	1	C20	CAP ELECT 100UF 25V FK SMD	Panasonic - ECG	EEE- FK1E101P	Y	Y
10	1	C21	CAP 0.01UF 50V CERAMIC X7R 0603	Panasonic	ECJ- 1VB1H103K	Y	Y
11	1	C23	CAP 220UF 16V TANTA- LUM 20% 7343H	AVX	TAJE227M01 6R	Y	Y
12	2	C24,C25	CAP .1UF 16V CERAMIC Y5V 0402	Panasonic - ECG	ECJ- 0EF1C104Z	Y	Y
13	2	D11,D13	DIODE SCHOTTKY 40V 1.5A SMA	Vishay IR	10MQ040NT RPBF	Y	Y
14	1	J1	CONN HEADER 10 PIN 50MIL KEYED SMD	Samtec	FTSH-105- 01-L-DV-K	Y	Y
15	1	J2	CONN JACK POWER 2.1mm PCB RA	CUI	PJ-102A	Y	Y



Item	Qty.	Reference	Part	Manufacturer	Mfrg. Part No.	RoHS	Sub
16	1	J4	CONN HEADER 4x2POS .100 VERT AU	Molex/Waldom Electronics Corp	WM26808- ND	Y	Y
17	1	LS1	BUZZER AUDIO PIEZO 25V SMD	CUI Inc	CMT-1603	Y	Y
18	1	P1	LCD FEMA Custom 60 Pin, 16 Commons, 28 Seg Lines	FEMA	593043-527	Y	Y
19	1	RT1	THERMISTOR NTC 10K OHM LEADED	BC Components	2381 640 66103	Y	Y
20	1	R1	RES 10.0K OHM 1/16W 1% 0603 SMD	Yageo Corpora- tion	RC0603FR- 0710KL	Y	Y
21	4	R23,R25,R5 2,R53	RES 100K OHM 1/16W 5% 0402 SMD	Panasonic - ECG	ERJ- 2GEJ104X	Y	Y
22	4	R14,R15,R1 6,R17	RES 560 OHM 1/16W 5% 0402 SMD	Yageo Corpora- tion	RC0402JR- 07560RL	Y	Y
23	1	R19	RES 4.7K OHM 1/10W 5% 0805 SMD	Panasonic - ECG	ERJ- 6GEYJ472V	Y	Y
24	3	R20,R39,R4 0	RES 10 OHM 1/16W 5% 0402 SMD	Yageo	RC0402JR- 0710RL	Y	Y
25	1	R22	RES 300K OHM 1/10W 5% 0402 SMD	Panasonic - ECG	ERJ- 2GEJ304X	Y	Y
26	2	R24,R51	RES 1.50K OHM 1/16W 1% 0402 SMD	Panasonic - ECG	ERJ- 2RKF1501X	Y	Y
27	2	R37,R38	RES ZERO OHM 1/16W 5% 0603 SMD	Panasonic - ECG	ERJ- 3GEY0R00V	Y	Y
28	3	R41,R57,R5 8	RES ZERO OHM 1/16W 0402 SMD	Panasonic - ECG	ERJ- 2GE0R00X	Y	Y
29	1	R42	RES 100 OHM 1/16W 5% 0402 SMD	Rohm	MCR01MZPJ 101	Y	Y
30	1	R45	RES 39K OHM 1/16W 5% 0402 SMD	Panasonic - ECG	ERJ- 2GEJ393X	Y	Y
31	1	R46	RES 62K OHM 1/10W 5% 0402 SMD	Panasonic - ECG	ERJ- 2GEJ623X	Y	Y
32	3	R49,R50,R5 9	RES 0.0 OHM 1/10W 5% 0805 SMD	Panasonic-ECG	ERJ- 6GEY0R00V	Y	Y



Item	Qty.	Reference	Part	Manufacturer	Mfrg. Part No.	RoHS	Sub
33	1	SW1	SWITCH SLIDE MINI SPDT PCMNT SLV	ITT Industries, C&K Div	1101M2S3C QE2	Y	Y
34	1	S1	LT SWITCH 6MM 100GF H=7MM TH	Panasonic - ECG	EVQ- PAC07K	Y	Y
35	3	TP3,TP4,TP 6	TEST POINT 43 HOLE 65 PLATED RED	Keystone Elec- tronics	5000	Y	Y
36	1	TP5	TEST POINT 43 HOLE 65 PLATED BLACK	Keystone Elec- tronics	5001	Y	Y
37	1	U1	PSoC3 Mixed-Signal Array	Cypress Semi- conductor	CY8C3866A XI-040	Y	Y
38	1	U12	IC Accelerometer Mem- sic 2-axis 3.3V-5V	Memsic	MXR2010A	Y	Y
39	1	U14	IC REG 5.0V 800MA LDO SOT-223	National Semi- conductor	LM1117MPX- 5.0	Y	Y
40	1	Y1	CRYSTAL 32.768 kHz CYL 12.5PF	Citizen America Corporation	CFS206 32.768KDZF- UB	Y	Y
Do No	ot Load	ł					
41	1	C5	CAP 10000PF 16V CERAMIC X7R 0402	Yageo America	04022R103K 7B20D	Y	Y
42	2	C9,C29	CAP .10UF 16V CERAMIC X7R 0603	Kemet	C0603C104J 4RACTU	Y	Y
43	2	C10,C28	CAP CER 22UF 10V 10% X5R 1210	Kemet	C1210C226K 8PACTU	Y	Y
44	2	C26,C27	CAP 0402 NO LOAD	NA	NA	Y	Y
45	1	C30	CAPACITOR TANT 22UF 10V 20% SMD	Kemet	T491A226M0 10AS	Y	Y
46	4	CSD1,CSD2 ,CSD3,CSD 4	CapSense Touch Element F	Manufacturing Process		Y	Y
47	1	D1	DIODE SCHOTTKY 40V 1A SOT23	Zetex	ZHCS1000T A	Y	Y
48	1	D12	DIODE SCHOTTKY 40V 1.5A SMA	Vishay IR	10MQ040NT RPBF	Y	Y
49	1	D10	Diode, Zener, 3W, 5.6V, SMB	ON Semiconduc- tor	1SMB5919B T3	Y	Y



ltem	Qty.	Reference	Part	Manufacturer	Mfrg. Part No.	RoHS	Sub
50	1	J3	CONN USB MINI AB SMT RIGHT ANGLE	ТҮСО	1734035-2	Y	Y
51	1	L1	COIL PWR CHOKE 10UH 1A SMD	Panasonic - ECG	ELL- 6PM100M	Y	Y
52	1	L2	FERRITE CHIP BEAD 120 OHM SMD	TDK Corporation	MMZ1005S1 21C	Y	Y
53	2	BH1,BH2	CLIP BATTERY AA PC MNT	Keystone Elec- tronics	92	Y	Y
54	2	R11,R12	RES 22 OHM 1/16W 1% 0402 SMD	Panasonic - ECG	ERJ- 2RKF22R0X	Y	Y
55	1	R13	RES 100K OHM 1/16W 5% 0402 SMD	Panasonic - ECG	ERJ- 2GEJ104X	Y	Y
56	1	R44	RES 3.00K OHM 1/8W 1% 0805 SMD	Yageo America	RC0805FR- 073KL	Y	Y
57	2	R47,R48	RES NO LOAD 0805 SMD	NA	NA	Y	Y
58	1	R18	RES NO LOAD 0603 SMD	NA	NA	Y	Y
59	4	R54,R55,R6 0,R61	RES NO LOAD 0402 SMD	NA	NA	Y	Y
60	1	R56	RES ZERO OHM 1/16W 0402 SMD	Panasonic - ECG	ERJ- 2GE0R00X	Y	Y
61	1	TP1	TEST POINT 43 HOLE 65 PLATED RED	Keystone Elec- tronics	5000	Y	Y
62	1	TP2	TEST POINT 43 HOLE 65 PLATED BLACK	Keystone Elec- tronics	5001	Y	Y
Insta	ll On B	ottom of PCB N	Near Rounded Corners As N	Noted On SASSY as	sembly drawing	g.	
63	4	n/a	BUMPER CLEAR.370X.19" CYLIN-	Richco Plastic Co	RBS-35	Y	Y

DER



# A.5 PCB Layout and Silkscreen



