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Spec No: 001-56691

Spec Title: CAPSENSE(R) EXPRESS(TM) - CREATING REFERENCE DESIGNS WITH 1CS/2CS BUTTON DEVICES - AN56691

Replaced by: None

AN56691

CapSense® Express™– Creating Reference Designs with 1CS/2CS Button Devices

Author: Anusha D

Associated Part Family: CY8C20111, CY8C20121

Associated Code Examples: None

Related Application Notes: AN53490, AN54657

CapSense® Express™ family of configurable devices provides a quick way to implement touch sensing functionality. The one- and two-button devices can easily replace mechanical switches in applications requiring low pin count devices. This application note demonstrates a reference schematic and layout design for these devices and also explains how to configure the functionality through PSoC® Designer™ 5.0 SP6.

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1 Introduction

CapSense Express is a family of high-performance, fixed-function devices that provides a robust solution for simple designs (involving few buttons, a slider, LEDs, and general-purpose I/Os). CapSense Express controllers support two capacitive sensing (CapSense) buttons and two general-purpose outputs in CY8C20121, and one CapSense button and one general-purpose output in CY8C20111. The host controller can configure these as I^2C slave devices and read the sensor information in real time. A software tool is also provided for achieving optimal performance in real time using a GUI. These are plug-and-play devices with factory default settings. The 1B/2B devices achieve CapSense functionality without requiring any external components. The ease of use of these devices leads to reduced cost and less time to market the solution. (For more information, refer to the CapSense Express – One-Button and Two-Button Capacitive Controllers datasheet). The topics explained in this application note include:

- Creating schematics for reference designs (1CS/2CS)
- Configuring reference designs with the PSoC Designer software

This application note also has Gerbers attached to create the PCBs.

2 Schematics

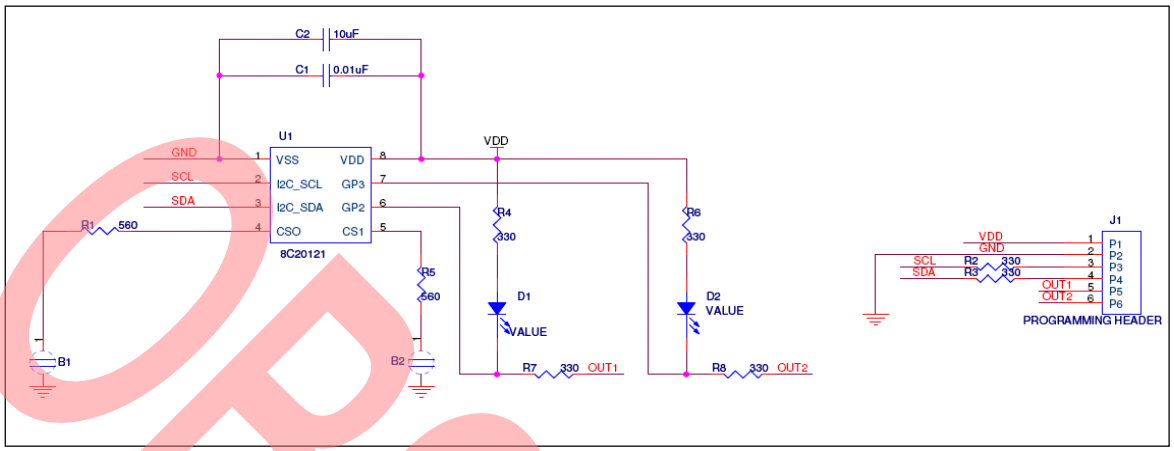
The schematics for the 1B/2B reference designs are made by following the design guidelines provided in application note AN53490 - CapSense Express – Design to Production. The designs shown in this application note can be used directly in any application requiring capacitive sensing with low button count.

The main components in the schematics are the CY8C20111/CY8C20121 chip, CapSense buttons, and status LEDs to indicate the button touch. These devices are configured through standard I^2C serial communication interface.

2.1 Two-Button Board Components

- CY8C20121 chip
- Six-pin header (J1) that contains the VDD, ground, configuring (I2C SCL and SDA) pins and general-purpose outputs
- Two CapSense buttons (on top layer) with 560-Ω series resistors to improve noise immunity
- Two status LEDs to indicate button touch
- 10-µF bulk capacitor to improve decoupling performance
- 0.01-µF bypass capacitor

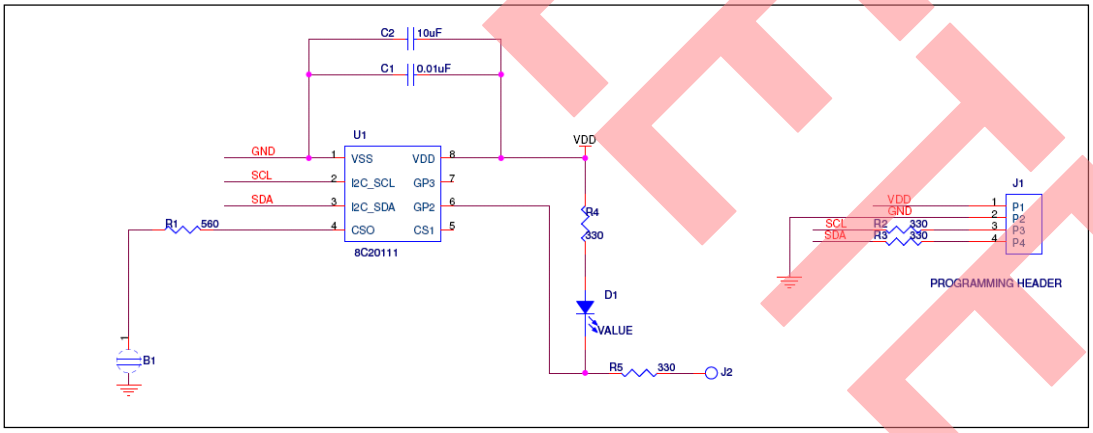
Figure 1. CY8C20121 (Two-Button) Board Schematic



2.2 One-Button Board Components

- CY8C20111 chip
- Five-pin header (J1) that contains the VDD, ground, configuring (I^2C SCL and SDA) pins and general-purpose output
- One CapSense button (on top layer) with 560-Ω series resistor to improve noise immunity
- One status LED to indicate the button touch
- 10-µF bulk capacitor to improve decoupling performance
- 0.01-µF bypass capacitor

Figure 2. CY8C20111 (One-Button) Board Schematic



2.3 Board Details

The One-button and Two-button boards are designed according to the guidelines mentioned in AN64846, Getting Started with CapSense and AN53490. The CapSense buttons are placed on the top layer with all other components on the bottom layer. The status LEDs are present at the bottom layer with corresponding holes on the top layer to facilitate mounting flush to the overlay.

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	Two-Button Board (mm)	One-Button Board (mm)
Dimensions	40.64 x 19.81	27.31 x 19.69
Button diameter	10	10
Button ground clearance	1	1
Button-button spacing	15.875	–
Top layer – hash ground width/spacing	0.18/1.14	0.18/1.14
Bottom layer – hash ground width/spacing	0.18/1.78	0.18/1.78
Overlay thickness (equal to button ground clearance)	1	1
Board thickness	1.6	1.6

Figure 3. Final Design Two-Button Board – Top Layer



Figure 4. Final Design Two-Button Board – Bottom Layer

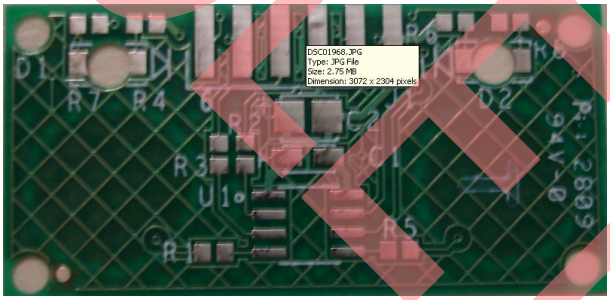
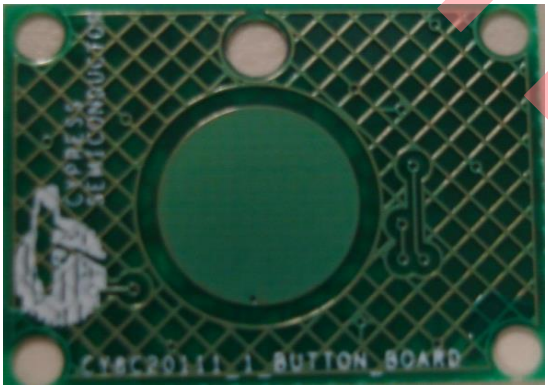
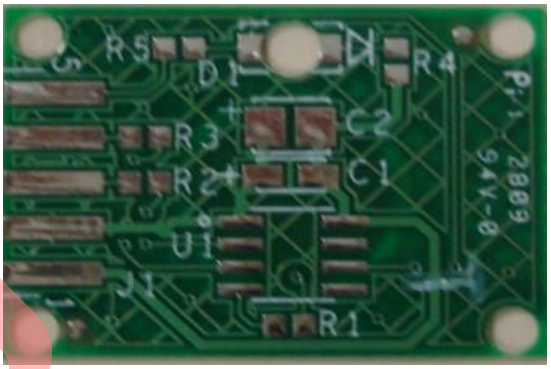


Figure 5. Final Design One-Button Board – Top Layer



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Figure 6. Final Design One-Button Board – Bottom Layer



3 Testing the Functionality with Software Tool

After designing the reference design boards, the next step is to verify the desired functionality of the devices using the PSoC Designer software. The application note AN54657, CapSense Express – 1CS/2CS Button Software Tool Usage explains configuring the 1B/2B devices with PSoC Designer. Follow the steps to verify the functionality of the reference designs.

- Connect the CY3240-I2USB bridge to the board.
- These reference design boards work well with the factory default configurations with a recommended plastic/glass overlay of 1 mm thickness. Power the board (operating voltage VDD = 2.45 V to 2.9 V, 3.10 V to 3.6 V, and 4.75 V to 5.25 V) through the bridge or the external supply.
- The status LEDs turn ON when the buttons are touched.

Figure 7. Status LED Turning ON during Finger Touch



If you do not achieve good sensitivity with factory defaults for the design, or if you need an overlay more than 1 mm, then it should be tuned to get an optimum signal-to-noise ratio (SNR) greater than 5:1.

3.1 Procedure for Tuning for Sensitivity

- Connect the CY3240-I2USB bridge to the board.
- Create a system-level project with PSoC Designer 5.0.
- Select the 1CS (for one-button board) or 2CS (for two-button board) button driver.
- Right-click the driver and open **Properties**. With the default settings, choose the **Apply to Board** option.
- Choose the **Monitor** tab. Right-click the driver and select the **Show Tuner** option. Observe the variation in raw counts in the tuner window for the sensors and calculate the SNR.
- If the SNR is less than 5:1, then change the following parameters.

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- **IDAC** – The value of IDAC can be changed depending on the sensor size, overlay thickness, and sensitivity requirements of the board. Decrease the IDAC value to increase the sensitivity (difference counts). Tune the design by changing IDAC to achieve 5:1 SNR.
- **IMO** – The recommended clock for CapSense is IMO/1. If the sensors in the design have higher C_P, then reduce the clock.
- **Settling time** – Choosing a higher value for this parameter increases scan time but reducing the settling time parameter also results in low sensitivity. Refer to the CSA User Module datasheet for optimum values of settling time.

- Select the **Apply to Board** option.
- Apply power to the board.
- The LEDs turn ON when the buttons are touched.

Refer to AN54657 for details on tuning the board according to the application.

4 Summary

This application note explains the procedure to create simple designs with 1CS/2CS button devices to demonstrate the capability of these devices in a variety of applications involving low button count.

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Document History

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Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	2772870	DZU	10/01/09	New application note.
*A	3741524	PRIA	09/12/2012	No technical change. Completing sunset review. Updated template.
*B	4105029	PRIA	08/28/2013	Updated hyperlinks of related application notes AN53490, AN54657 across the document. Updated in new template. Completing Sunset Review.
*C	4613821	SSHH	01/13/2014	Updated reference to I2USB to CY3240-I2USB Bridge.
*D	4941742	PRIA	09/30/2015	Fixed hyperlinks for AN53490 and AN54657. Modified the abstract. Updated template.
*E	5092581	PRIA	01/19/2016	Obsoleting the Application Note

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