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THIS SPEC IS OBSOLETE

Spec No: 001-42137

Spec Title: AN42137 - CAPSENSE(TM) EXPRESS SOFTWARE TOOL

Replaced by: None

AN42137

Capsense™ Express Software Tool

Associated Project: No
Associated Part Family: CY8C201xx
Software Version: PSoC Designer 5.0 SP6
Related Application Notes: AN44209, AN64846

To get the latest version of this application note, or the associated project file, please visit http://www.cypress.com/go/AN42137.

This application note explains how to use the PSoC Designer System Level Design to configure the CapSense Express device. How to tune the parameters for required functionalities is also described. This document expects user to a basic level of familiarity with PSoC Designer System Level Design.

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Contents

1 Introduction....1
2 Installing the Software....3
3 Using Drivers to Configure CapSense Express Device....4
3.1 Selecting and Placing the Driver....4
4 Configuring IOs....5
4.1 Configuring Global Properties....6
4.2 Setting Logic Operations....6
4.3 Applying Configuration to the Board....10
4.4 Saving the Configuration....10
4.5 Starting the Tuner....10
4.6 CapSense Parameter Modifications....11
4.7 Observing the Changes....11
4.8 Example of Slider Functionalities....12
5 Summary....14
Document History....15
Worldwide Sales and Design Support....16
Products....16
PSoC® Solutions....16
Cypress Developer Community....16
Technical Support....16

1 Introduction

The CapSense Express Controller enables the control of a maximum of 10 IOs configurable as either capacitive sensing elements (used as buttons or combined to form a slider), or GPIOs, driving LEDs or interrupt signals, based on various IO conditions. The GPIOs are also configurable with interrupt for waking up the device from sleep. The user can configure buttons, outputs, and parameters, through specific commands sent to the I2C port. The IOs pin mapping flexibility (capacitive elements and GPIO functions) enables easy PCB trace routing and reduces the PCB size and stack up. CapSense Express products are designed for easy integration into complex products.

Support for CapSense Express devices is provided in PSoC Designer System Level Design. It is a user friendly software tool used to configure PSoC and CapSense Express devices. CapSense Express devices are offered in six different part numbers. PSoC Designer System Level Design has various drivers to handle the configuration of these devices. Table 1 shows the drivers, the associated devices, package offered, and the number of available IOs.

Table 1. Device and Driver Mapping

Driver Name	Part Number	Pin Packages	Available IOs
10 GPIO/CS Button Set	CY8C20110	16-pin SOIC, 16-pin QFN	10
8 GPIO/CS Button Set	CY8C20180	16-pin SOIC, 16-pin QFN	8
6 GPIO/CS Button Set	CY8C20160	16-pin SOIC, 16-pin QFN	6
4 GPIO/CS Button Set	CY8C20140	16-pin SOIC, 16-pin QFN	4
4 GPIO/CS Button Set Compact	CY8C20142	8-pin SOIC	4
5 Segment Slider/5 GPIO	CY8C201A0	16-pin SOIC, 16-pin QFN	10
10 Segment Slider	CY8C201A0	16-pin SOIC, 16-pin QFN	10

Table 2 lists the functionality offered by each driver. Every driver is associated with a single device.

Table 2. Device or Driver Functionalities

Driver Name	CapSense Button	GPIO	Interrupt	Slider Functionality
10 GPIO/CS Button Set	Y	Y	Y	N
8 GPIO/CS Button Set	Y	Y	Y	N
6 GPIO/CS Button Set	Y	Y	Y	N
4 GPIO/CS Button Set	Y	Y	Y	N
4 GPIO/CS Button Set Compact	Y	Y	Y	N
5 Segment Slider/5 GPIO	Y	Y	Y	5 Segments
10 Segment Slider	N	N	N	10 Segments

The CapSense Express family of devices uses the CapSense Successive Approximation (CSA) algorithm to sense the presence of a finger on a capacitive sensor.

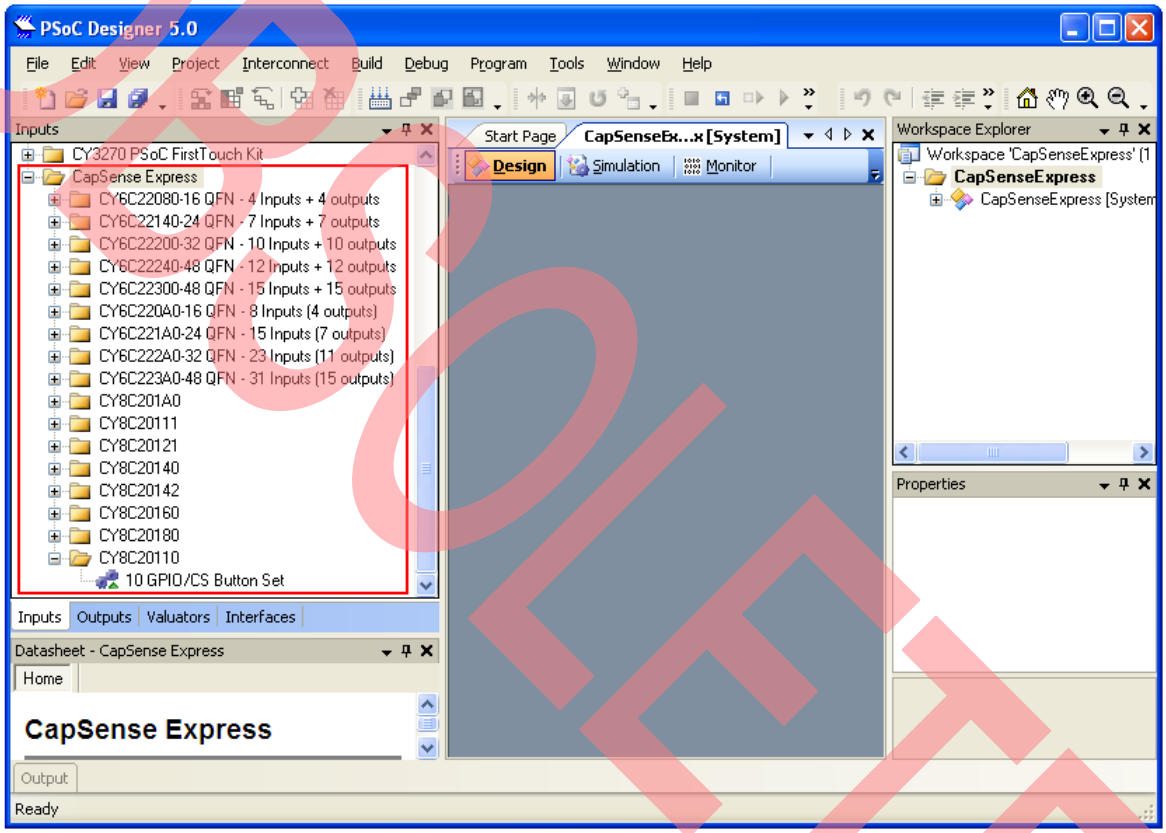
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2 Installing the Software

Download the PSoC Designer 5.0 SP6 setup file from http://www.cypress.com/documentation/software-and-drivers/psoc-designer-50-service-pack-6.

Once PSoC Designer 5.0 SP6 is installed, open the same from the path Start->All Programs->Cypress->PSoC Designer 5. Select System Level Design in the opened window and give a project name. When the project is ready to configure the CapSense Express device, a list of CapSense Express drivers appear in the catalog as shown in Figure 1.

Figure 1. CapSense Express Driver Catalog



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3 Using Drivers to Configure CapSense Express Device

To use CapSense Express Drivers, the following steps must be implemented.

- Make a configuration using CapSense Express drivers
  - Select and place the driver
  - Configure IOs
  - Configure Global Properties
  - Set Logic Operations
- Write the configuration to the device
  - Apply the configuration to the board
  - Save the configuration
- Tune the CapSense parameters
  - Start the tuner
  - CapSense parameter modifications
  - Observe the changes

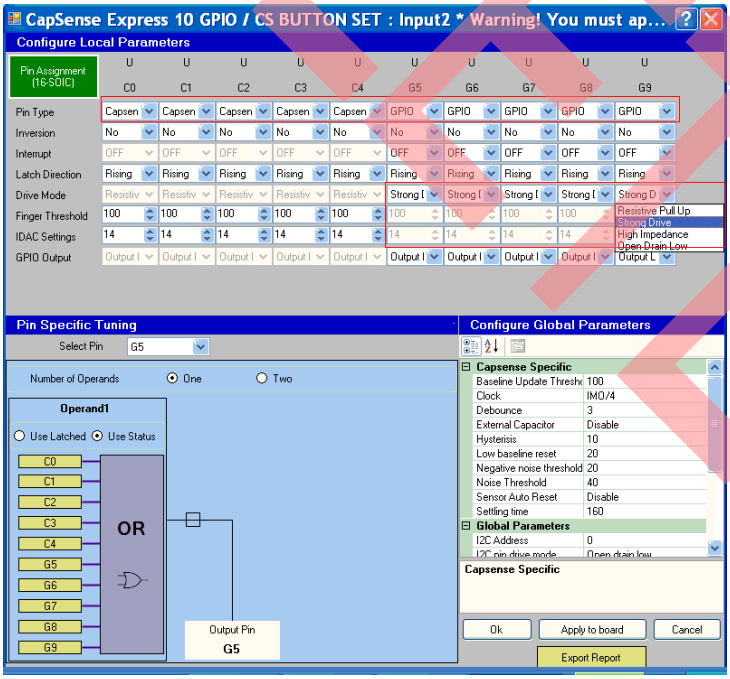
To explain these steps, an application with five CapSense buttons and five GPIOs (as LEDs) is taken as an example. In this application, each button is responsible for switching a different GPIO (for example, connected to an LED) on sensing a touch. This illustrates the CapSense button and GPIO functionalities.

3.1 Selecting and Placing the Driver

Select the appropriate driver from the list of available CapSense Express drivers shown on the left of the PSoC Designer System Level Design Catalog. Select the driver based on the device used (Table 1) or the functionality required (Table 2).

In this example application 10 IOs are required so “10 GPIO / CS Button Set driver” which is listed under “CY8C20110” is selected. Double-click or drag and drop the driver name listed in the catalog. This opens the property window. Different sections of property window are highlighted in Figure 2.

Figure 2. Configure IOs



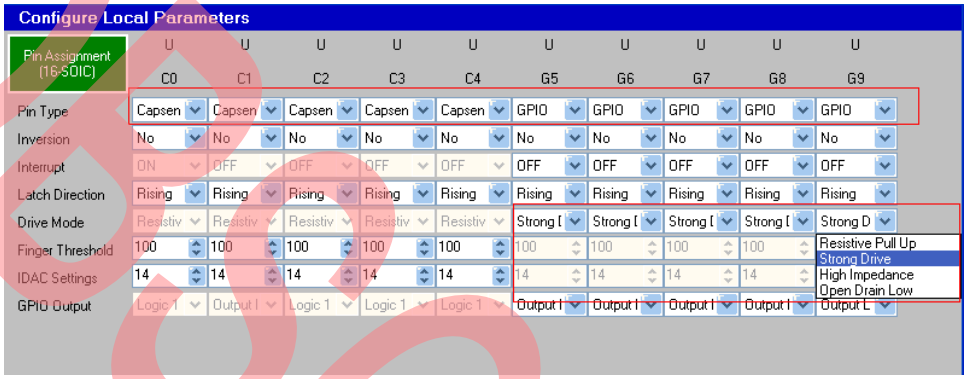
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4 Configuring IOs

There are 10 configurable IOs. You can configure these IOs as CapSense Input, GPInput, GPOutput, GPIO, or None.

Configuring an IO as CapSense Input means that it works as a CapSense button. Configuring an IO as GPInput means that it works as a general purpose input. Configuring an IO as GPOutput means that it works as a general purpose output. Configuring an IO as GPIO means that it works both as a general purpose input or output. When an IO is configured as None, the pin is disabled and put in high impedance state.

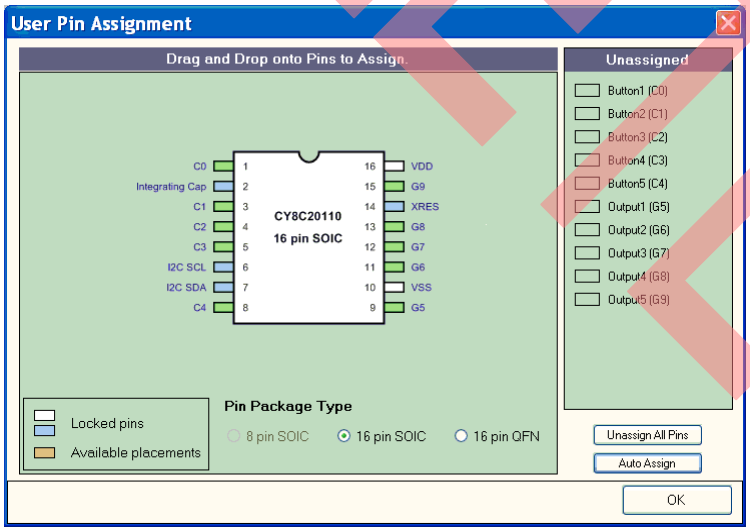
Figure 3. IO Configuration



In our application, five CapSense Buttons and five GPIOs are required. The configuration is shown in Figure 2. Set the pin specific properties, such as inversion, interrupt, drive mode, finger threshold, IDAC setting, and Output for each pin. In Figure 2, the drive modes for all five GPIOs are set as “Strong drive” to drive the LEDs.

After the number of CapSense Buttons and GPIOs are selected, they must be assigned to the actual device pins. Click on the “Pin Assignment” button on the top left corner of the property window to open a pin assignment mini window as shown in Figure 4. The Drag and drop functionality allows you to assign the GPIOs or the CapSense button to the device pins. You can assign them according to your schematics.

Figure 4. Pin Assignment



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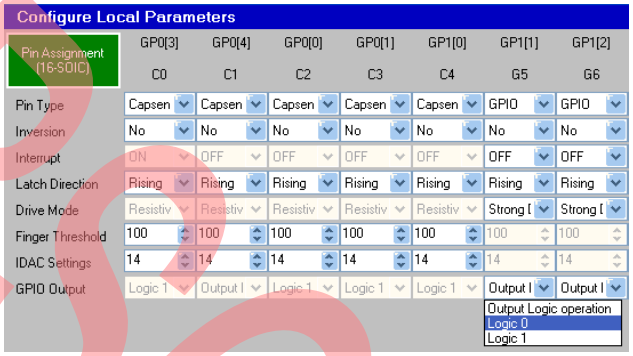
4.1 Configuring Global Properties

The lower right part of the property window displays the global parameters, which include CapSense specific parameters, device settings, CapSense Filter Specific, PWM Specific and sleep management, as shown in Figure 2.

4.2 Setting Logic Operations

Every GPIO works as an output of logic operation which can be configured. You can disable the logic operation output on a GPIO by selecting “Logic 1” or “Logic 0” as the GPIO Output property, making it permanently high or low, as shown in Figure 5.

Figure 5. GPIO Output Property

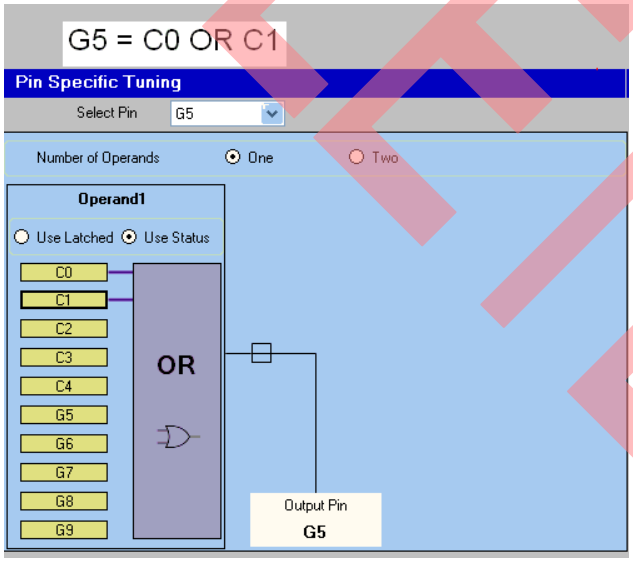


The lower left of the property window corresponds to the logic operations. Select a particular GPIO from the list and choose the logic operation that decides how the inputs are combined to obtain the output.

There are options for passing either one or two operands to the logic operator (AND/ OR/ XOR). An operand is the output of an operator (AND / OR) applied on a mask of all 10 pins.

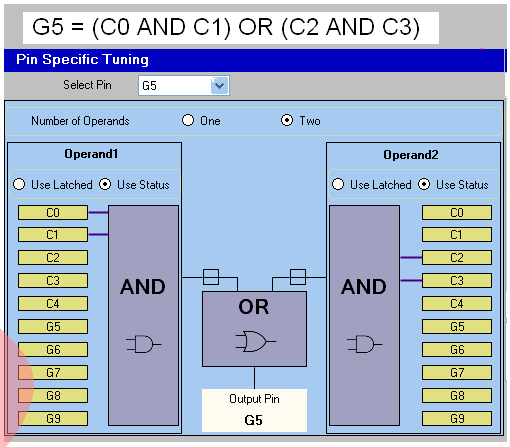
Figure 6 shows one operand logic operation and Figure 7 shows two operands logic operations.

Figure 6. Single Operand Logic Operation



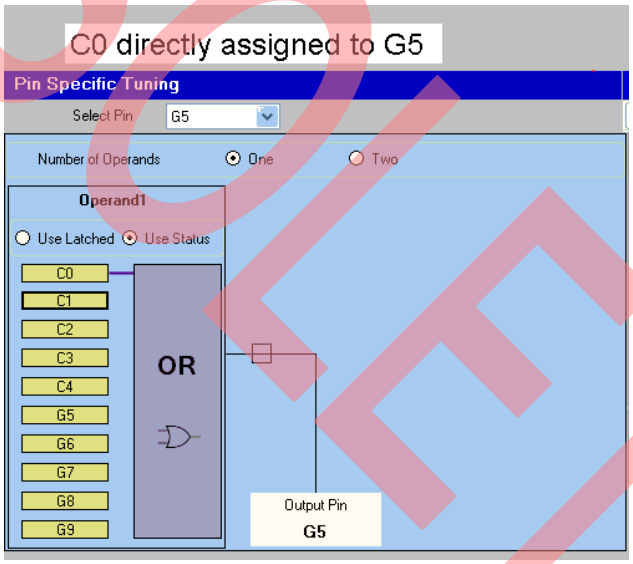
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Figure 7. Two Operands Logic Operation



This application needs one operand logical operation for all five GPIOs, as shown in Figure 8, Figure 9, Figure 10, Figure 11, Figure 12.

Figure 8. Logic Operation Output to G5



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Figure 9. Logic Operation Output to G6

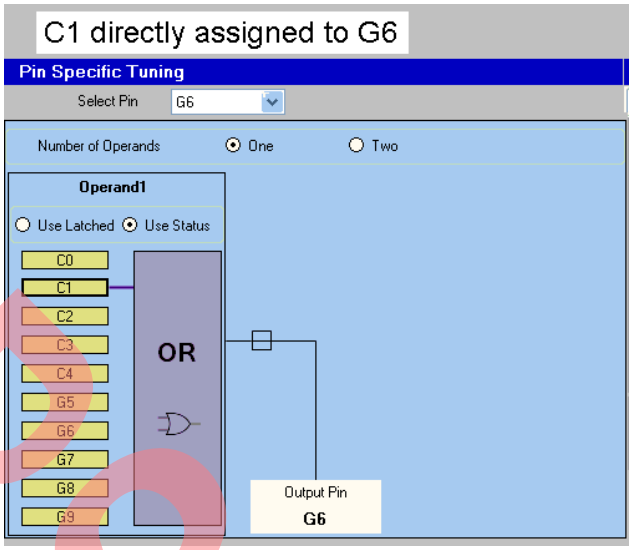
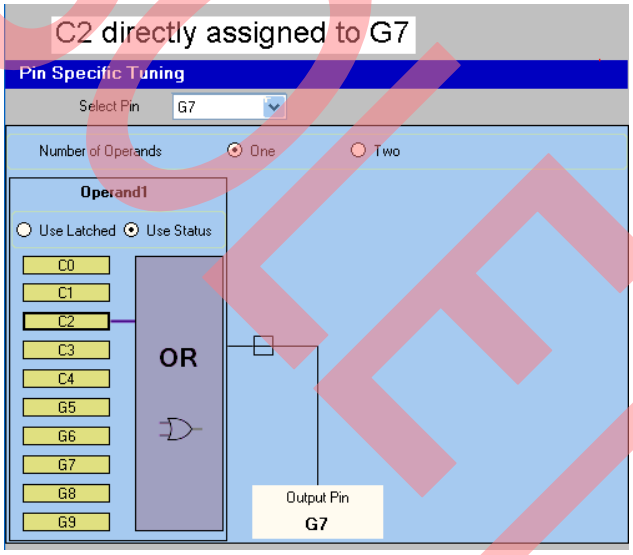


Figure 10. Logic Operation Output to G7



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Figure 11. Logic Operation Output to G8

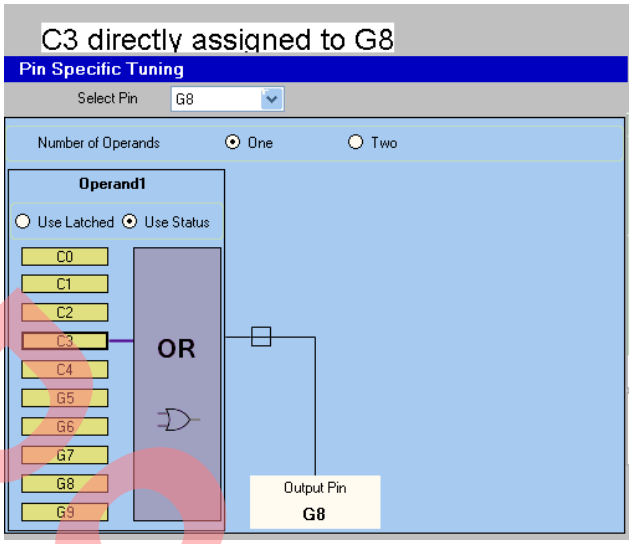
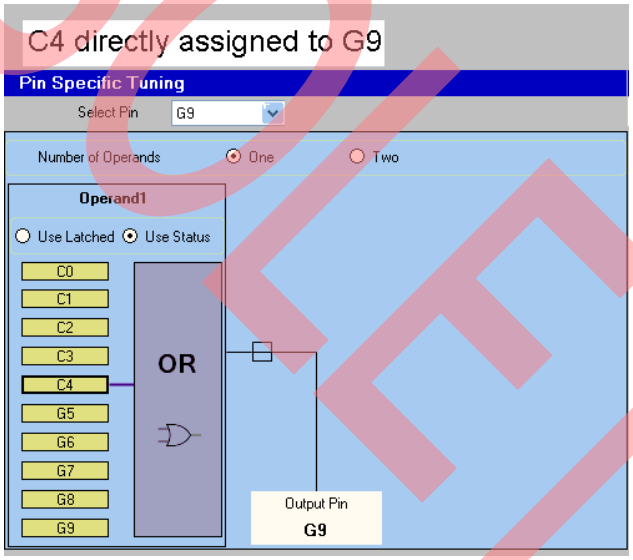


Figure 12. Logic Operation Output to G9

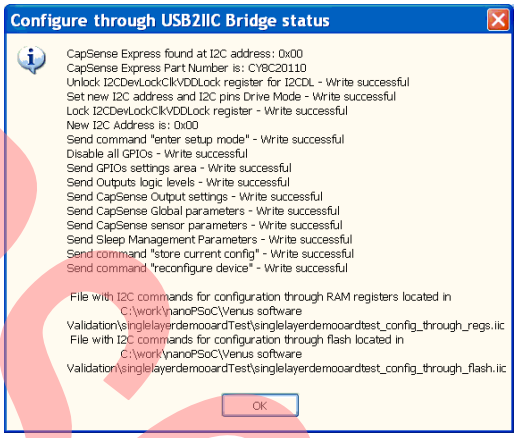


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4.3 Applying Configuration to the Board

Download the configuration made in the PSoC Designer System Level Design to the device by connecting the CY3240-I2CUSB bridge to the computer. Click “Apply to the board” to configure the device with the selected settings. The “Configure through USB2IIC bridge status” window appears, as shown in Figure 13.

Figure 13. Configuration Status



4.4 Saving the Configuration

Click ‘OK’ to save the configuration to your project. You can see the new configuration when opening the PSoC Designer System Level Design project next.

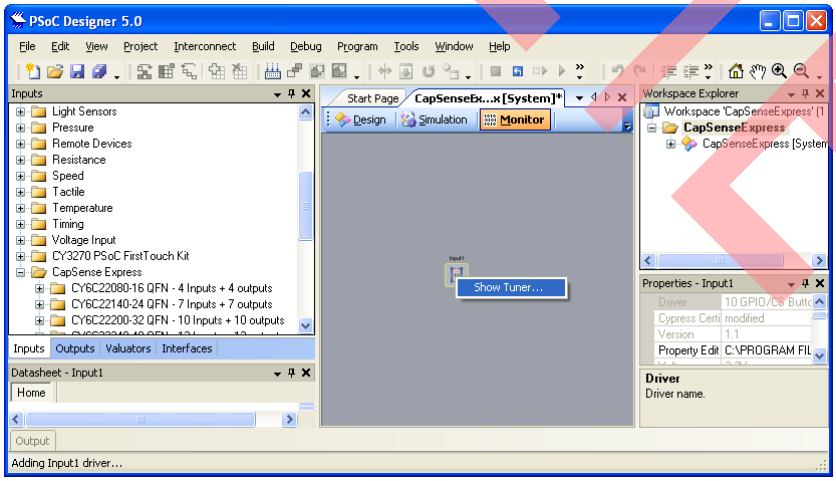
4.5 Starting the Tuner

After the configuration is downloaded to the device you must adjust the CapSense sensitivity parameters to meet the application requirements. This is accomplished in the tuner mode. In the tuner mode, the driver regularly reads the status from the device and displays it on the tuner window.

To enter the tuner mode, go to the monitor tab, right-click the driver icon, and select “Show Tuner” as shown in Figure 14.

Note You can alter all device configuration properties in the tuner mode. This mode has an additional overhead of reading and displaying the status regularly.

Figure 14. Monitor Tab, Tuner Mode



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4.6 CapSense Parameter Modifications

After the tuner mode is started you can see the status of every pin and touch sensed value for CapSense buttons.

Adjust the CapSense local parameters such as Finger threshold, IDAC settings or global parameters like Noise threshold, Baseline update threshold, Hysteresis, and others.

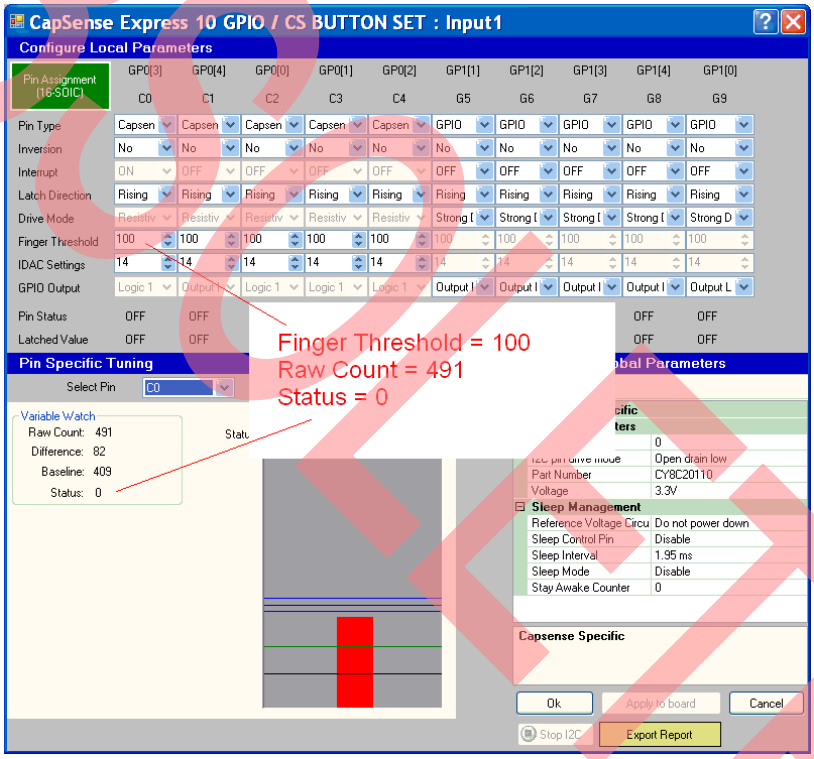
Apply the changes to the board after the parameters are modified.

4.7 Observing the Changes

After the adjusted values are written to the device, observe the status for every pin and touch sensitivity for CapSense buttons. Repeat the process of modifying the parameters until you get the required output.

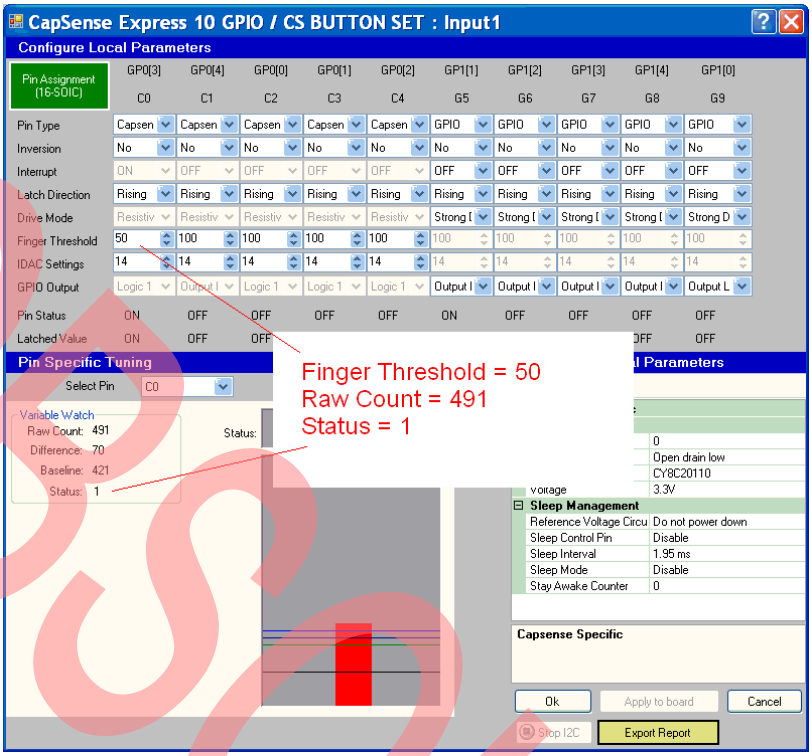
For example, see the effect of changing the Finger threshold of one of the CapSense buttons from 100 to 50. With the same extent of CapSense touch, the status is not high in case of 100 but it is high in the case of 50 (see Figure 15 and Figure 16).

Figure 15. Finger Threshold = 100



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Figure 16. Finger Threshold = 50



4.8 Example of Slider Functionalities

Given below is an example of an application for a five segment slider with a resolution of 100, which shows the centroid position value for the slider.

In this application, each slider segment is responsible for driving a different LED on sensing a touch, similar to the application defined earlier in this application note. The purpose of this application is to show how the tool displays the slider centroid and the status of its segments.

Follow the steps described in the section Installing the Software to make a configuration for this application.

1. Select and Place the Driver. Because a five segment slider and five LEDs are required, a “5 segment slider 5 GPIO” driver that is listed under “CY8C201A0” must be used.
2. Configure IOs. Five pins are already selected as CapSense slider pins. Select five pins as GPIOs for LEDs. Complete the pin assignment according to the schematics. Map the slider segments in correct order as per the schematics.
3. Configure Global Parameters. Put the CapSense specific parameters and device parameters according to your needs. Keep resolution as 100.
4. Set Logic Operations. Assign slider segments to GPIOs one-on-one, similar to the previous application with button and GPIOs.
5. Apply to the Board. Write the settings to the device.
6. Save the Configuration
7. Start the Tuner. A graphical presentation of the slider appears in the tuner window. The five segments of the slider are displayed with their corresponding count value bar for each segment and centroid position, as shown in Figure 17.
8. CapSense Parameters Modifications. Try changing the resolution for the slider. Change the resolution to 200.

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9. Observe the Changes. The position of touch on slider changes with respect to the change in resolution. See Figure 17 and Figure 18.

Figure 17. Slider Centroid Position with Resolution = 100

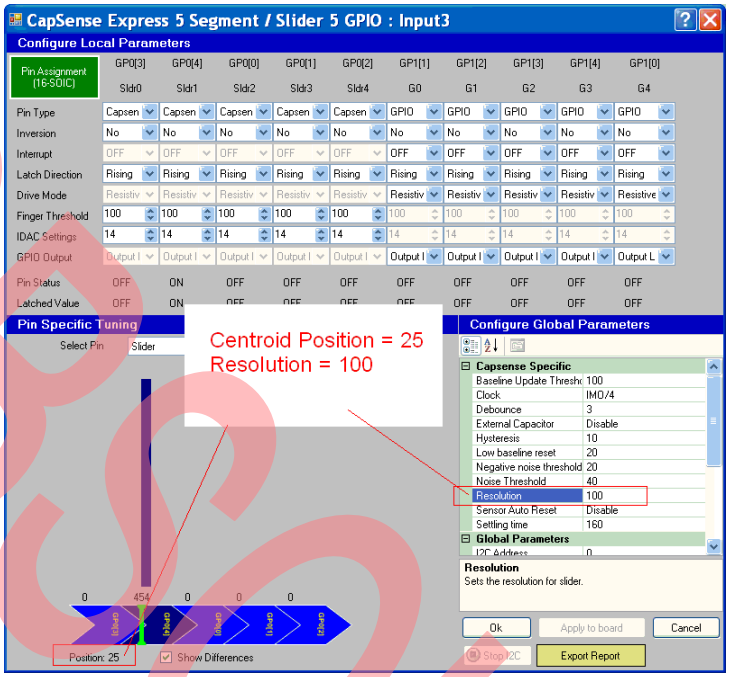
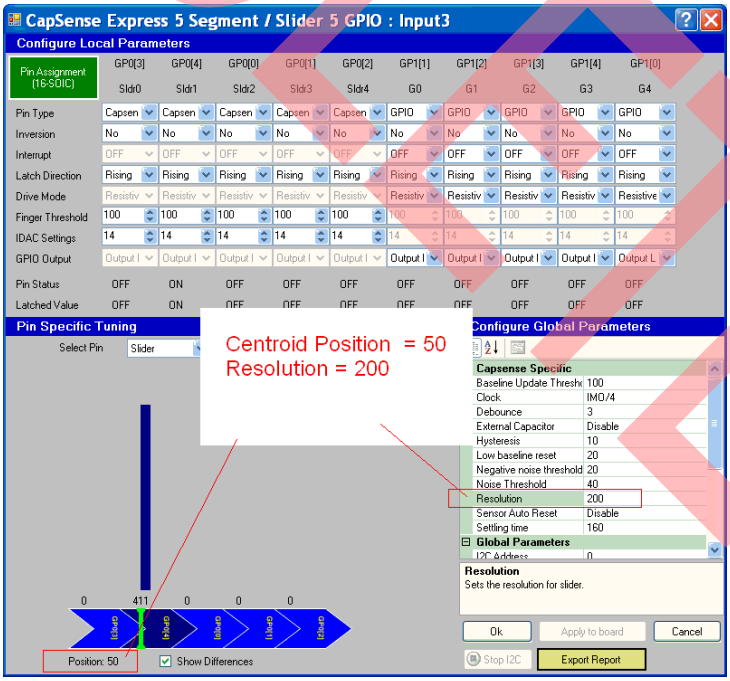


Figure 18. Slider Centoid Position with Resolution = 200



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5 Summary

PSoC Designer System Level Design is a user friendly tool for fast configuration of a CapSense Express device and shows the real time status of IOs in the tuner window.

This application note explains the CapSense Express drivers and the process of configuring CapSense Express devices. Two example applications are demonstrated to show the CapSense Button, GPIO, and Slider functionalities.

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Document History

Document Title: AN42137 - CapSense™ Express Software Tool

Document Number: 001-42137

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	1660164	GRK	10/23/2007	New Application Note.
*A	2040427	GRK	02/05/2008	No technical updates.
*B	2220789	SLAN	03/24/2011	No technical updates.
*C	3216287	SLAN	04/05/2011	No technical updates.
*D	4359068	DIMA	04/24/2014	Replaced “PSoC Express 3.0” with “PSoC Designer 5.0 SP6” in Software Version. Removed reference to AN2403, AN2394, AN2393 and AN2352 and added reference to “Getting Started with CapSense” in Associated Application Notes. Updated to new template. Completing Sunset Review.
*E	4978574	PRIA	12/01/2015	Updated links of Related Application Notes in page 1 and also across the document. Updated to new template.
*F	5092581	PRIA	01/19/2016	Obsoleting the Application Note.

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