



## CY3218-CAPEXP1 CapSense Express Evaluation Kit Quick Start

Doc. # 001-44769 Rev. \*A

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# Getting Started

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2. [Explore the Board](#)
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## 1. Review Kit Contents

Each CY3218-CAPEXP1 CapSense Express Evaluation Kit contains:

- CY3218-CAPEXP1 CapSense Express Evaluation Board
- Kit CD, which includes:
  - PSoC Programmer
  - .NET Framework 2.0 (for Windows 2000 and Windows XP)
  - PSoC Express 3
  - CapSense Express Extension Pack
  - CapSense Express Documentation
- Retractable USB Cable (A to Mini-B)
- PSoC CY3240-I2USB Bridge Board
- AAA Battery

## 2. Explore the Board

**Caution: Do not touch the board anywhere other than the edges or the buttons.** Touching the board in the wrong area could lead to a short and an unresponsive board. If this happens, follow the instructions in Section 2 to reset the power to the board.

- 2.1. Insert the AAA battery into the battery holder on the back of the board.
- 2.2. Remove the jumper from J2 (back of board, left side, center).
- 2.3. Touch a button on the board. The LED in the center of the button and the LED above the button lights up.
- 2.4. Press the mechanical button at the bottom of the board. The three LEDs above the buttons turn on.
- 2.5. Turn the board off by replacing the jumper on J2. Note that replacing the jumper disables battery operation.

### 3. Install Software

#### Install PSoC Express Development Software

Insert the Kit CD, wait for the installer to start, and install the following software in the order listed:

- a. Install PSoC Programmer.
- b. Install .NET Framework 2.0.
- c. Install PSoC Express 3.
- d. Install CapSense Express Extension Pack.
- e. Install CapSense Express Kit Documentation.

### 4. CY3218-CAPEXP1 Board Features

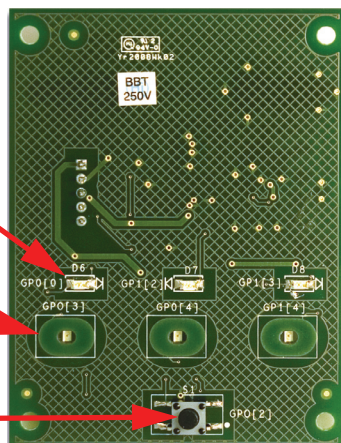
- 3 CapSense Buttons
- 3 Backlighting LEDs (Green)
- 3 Status LEDs (Green)
- 1 Power LED (Red)
- 1 Mechanical Button
- I<sup>2</sup>C Header
- AAA Battery Holder

**Status LEDs**

**CapSense Buttons with Backlight LEDs**

**Mechanical Button**

**Top of Board**




Use the CY3218-CAPEXP1 Evaluation Kit to evaluate the CapSense buttons, LED drive, digital input, and I<sup>2</sup>C features of the CapSense Express device. Via the CapSense Express Configuration Tool in PSoC Express, the three backlighting LEDs and three status LEDs can be controlled by the CapSense buttons and the mechanical button. The CapSense Express device mounted on the board is in the 16-QFN package. The board is powered with a AAA battery mounted in the battery holder. A boost converter converts the input voltage in the range of 0.9V-1.5V to the device operating voltage of 3.3V. The board can also be powered using an I2USB bridge connected to the I<sup>2</sup>C header.

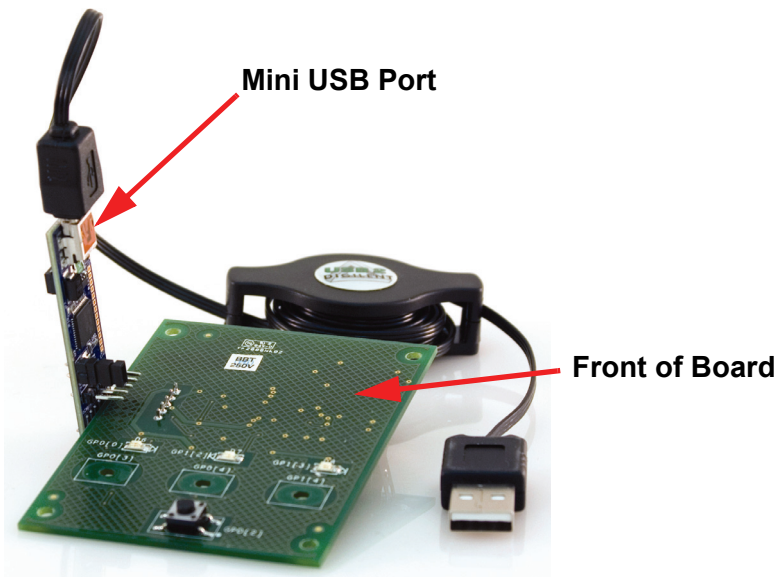
# 5. Tune the CY3218-CAPEXP1 CapSense Express Board

## Functional Description

When any of the three capacitive sensing buttons are pressed, the corresponding status and backlight LEDs are lit. Additionally, pressing the pushbutton causes all of the status LEDs to be lit.

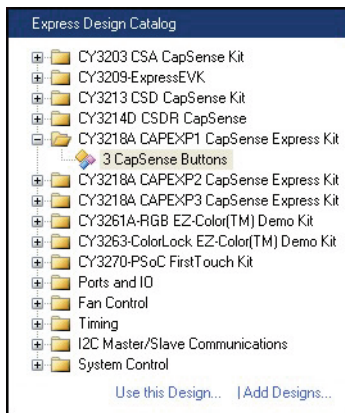
## Tuning Steps

- 5.1. Connect your computer to the CapSense test board I<sup>2</sup>C Connector (J5)  using the CY3240-I2USB Bridge Board and a USB cable. When connected correctly, the USB connector on the CY3240-I2USB Bridge Board is visible when viewing the front of the CY3218-CAPEXP1 board.




- 5.2. Launch PSoc Express.

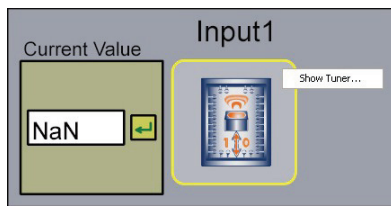
- 5.3. From the Express Design Catalog, open the **CY3218 CAPEXP1 CapSense Express Kit** folder.




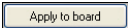
- 5.4. Double-click **3 CapSense Buttons** to open the design.
- 5.5. Name the design **ThreeCapSenseButtons** and save the design in the location of your choice.
- 5.6. Click **Monitor** to open the Monitor view.



- 5.7. The Monitor Status indicator shows Connected .
- 5.8. Right-click **Input1** and select **Show Tuner**.



The Monitor Status indicator changes to Running , and the CapSense Express window opens.

- 5.9. If your board is programmed with another design, click **Apply to board**  in the lower-right area of the CapSense Express window. When the Configure through USB2IIC Bridge status dialog appears, click **OK**. If your board is already programmed with the correct design, the Apply to board button is grayed out.

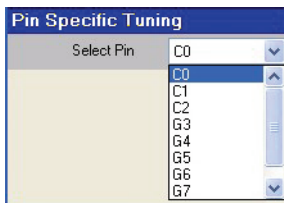
5.10. Test the board by touching the CapSense buttons. The LEDs above each button turn on each time the corresponding button is touched. Notice how the Pin Status and Latched Value indicators change from OFF to ON when a button is touched.

Pin Assignment (16-QFN)	GP0[2]	GP1[4]	GP1[3]	GP1[0]	GP1[1]	GP0[1]	GP0[0]	GP0[3]	GP1[2]	GP0[4]
	C0	C1	C2	G3	G4	G5	G6	G7	G8	G9
Pin Type	CapSens	CapSens	CapSens	GPOut	GPOut	GPOut	GPOut	GPOut	GPOut	GPInput
Inversion	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Interrupt	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Latch Direction	Rising	Rising	Rising	Rising	Rising	Rising	Rising	Rising	Rising	Rising
Drive Mode	Resistiv	Resistiv	Resistiv	Strong L	Strong L	Strong L	Strong L	Strong L	Strong L	Open Dre
Finger Threshold	100	100	100	100	100	100	100	100	100	100
IDAC Settings	14	14	14	14	14	14	14	14	14	14
GPIO Output	Output L	Output L	Output L	Output L	Output L	Output L	Output L	Output L	Output L	Logic 1
Pin Status	ON	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF
Latched Value	ON	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF

5.11. Press the mechanical button at the bottom of the board to turn on the three LEDs above the buttons.

### ***Tune Button C0***

5.12. From the **Select Pin** menu, select **C0**.

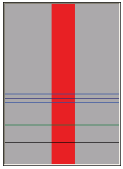


5.13. Touch button C0 (leftmost CapSense button). Anytime the Difference variable (represented as a red, vertical bar) is higher than the Finger Threshold (represented as a dark blue, horizontal bar, set to 100 by default), the touch registers as a Hit.

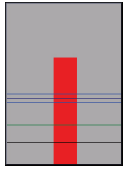


5.14. Cover the C0 button with a piece of paper and then touch the button (with the paper between our finger and the button). Notice how the Difference Count Value changes. Add additional pieces of paper to increase the thickness over the button. With enough sheets of paper added, the Difference variable does not rise above the Finger Threshold, and the button does not register a Hit.

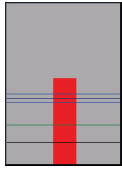
**Zero Sheets**



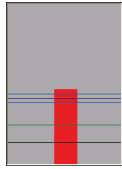
**2 Sheets**



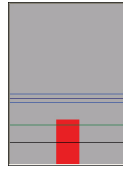
**4 Sheets**



**8 Sheets**



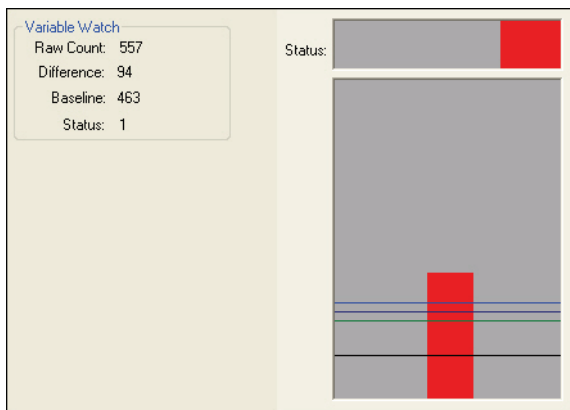
**16 Sheets  
(No Hit)**



5.15. Change the Finger Threshold for C0 from 100 to **50**, and click **Apply to board**.

Pin Assignment (16-QFN)	GPIO[2] C0
Pin Type	CapSense
Inversion	No
Interrupt	OFF
Latch Direction	Rising
Drive Mode	Resistive
Finger Threshold	50
IDAC Settings	14
GPIO Output	Output L

5.16. Cover the button with the paper again, and touch the button. Adjust the Finger Threshold until it is low enough to register a hit with the paper over the button.



5.17. Experiment with other materials such as plastic and wood.


## What's Next

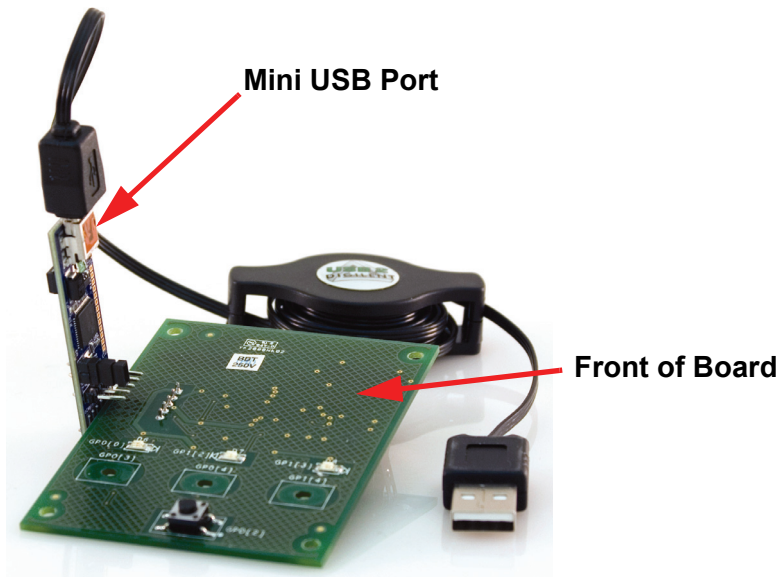
Now that you know how easy it is to tune a CapSense button with PSoC Express, learn how to create the project from scratch in Section 6.



## 6. Create a CY3218-CAPEXP1 CapSense Express Project

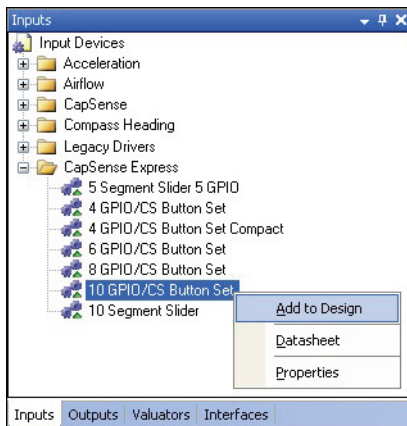
### Start the Project

- 6.1. Connect your computer to the CapSense test board I<sup>2</sup>C Connector (J5)  using the CY3240-I2USB Bridge Board and a USB cable. When connected correctly, the USB connector on the CY3240-I2USB Bridge Board is visible when viewing the front of the CY3218-CAPEXP1 board.



- 6.2. Launch PSoC Express.
- 6.3. Click **New Project**, name the project **ThreeCapSenseButtons**, and save the design in the location of your choice.
- 6.4. Select **View > Driver Catalog**.
- 6.5. At the bottom of the Driver Catalog, select the **Inputs Tab**.

- 6.6. Open the CapSense Express directory, right-click the **10 GPIO/CS Button Set** driver, and select **Add to Design**. The Add Input Driver window opens.



6.7. Name the driver **ThreeButtons** and click **OK**. The CapSense Express 10GPIO / CS BUTTON SET window opens.

In PSoC Express, each CapSense button, LED, and mechanical button requires a separate driver. The 10 GPIO/CS Button Set driver is a special driver that allows you to configure all the buttons, LEDs, and the mechanical button in one interface. Each driver is listed in the Configure Local Parameters pane.

CapSense Express 10 GPIO / CS BUTTON SET : ThreeButtons \* WARNING! You must apply to board to observe chan... ? X

### Configure Local Parameters

Pin Assignment (16-SDIC)	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9
Pin Type	Capsent	Capsent	Capsent	Capsent	Capsent	Capsent	Capsent	Capsent	Capsent	Capsent
Inversion	No	No	No	No	No	No	No	No	No	No
Interrupt	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Latch Direction	Rising	Rising	Rising	Rising	Rising	Rising	Rising	Rising	Rising	Rising
Drive Mode	Resistiv	Resistiv	Resistiv	Resistiv	Resistiv	Resistiv	Resistiv	Resistiv	Resistiv	Resistiv
Finger Threshold	100	100	100	100	100	100	100	100	100	100
IDAC Settings	14	14	14	14	14	14	14	14	14	14
GPIO Output	Output L	Output L	Output L	Output L	Output L	Output L	Output L	Output L	Output L	Output L

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### Pin Specific Tuning

Select Pin

### Configure Global Parameters

- CapSense Specific**
  - Baseline Update Threshc: 100
  - Clock: IMO/4
  - Debounce: 3
  - External Capacitor: Disable
  - Hysteresis: 10
  - Low baseline reset: 20
  - Negative noise threshold: 20
  - Noise Threshold: 40
  - Sensor Auto Reset: Disable
  - Settling time: 160
- Global Parameters**
  - I2C Address: 0
  - I2C pin drive mode: Open drain low

**CapSense Specific**

Ok
Apply to board
Cancel

Export Report

## Configure the Drivers

6.8. By default, all driver types in the Configure Local Parameters pane are set to CapSense Input. To setup the LEDs, set the Pin Type for drivers C3 through C8 to **GPOutput** and the Drive Mode for each of those drivers to **Strong Drive**.

To setup the mechanical button, set the Pin Type for driver C9 to **GPInput**. Set the Drive Mode to **Open Drain Low**.

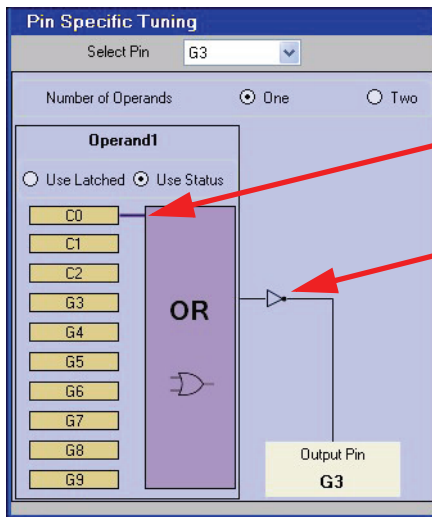
Pin Assignment (16-SQIC)	U C0	U C1	U C2	U G3	U G4	U G5	U G6	U G7	U G8	U C9
Pin Type	Capsens	Capsens	Capsens	GPOutp	GPOutp	GPOutp	GPOutp	GPOutp	GPOutp	Capsens
Inversion	No	No	No	No	No	No	No	No	No	No
Interrupt	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Latch Direction	Rising	Rising	Rising	Rising	Rising	Rising	Rising	Rising	Rising	Rising
Drive Mode	Resistivi	Resistivi	Resistivi	Strong L	Strong L	Strong L	Strong L	Strong L	Strong L	Resistive
Finger Threshold	100	100	100	100	100	100	100	100	100	100
IDAC Settings	14	14	14	14	14	14	14	14	14	14
GPIO Output	Output L	Output L	Output L	Output L	Output L	Output L	Output L	Output L	Output L	Output L

## Configure Button and LED Behavior

6.9. In the Pin Specific Tuning pane, choose **G3** from the **Select Pin** menu.



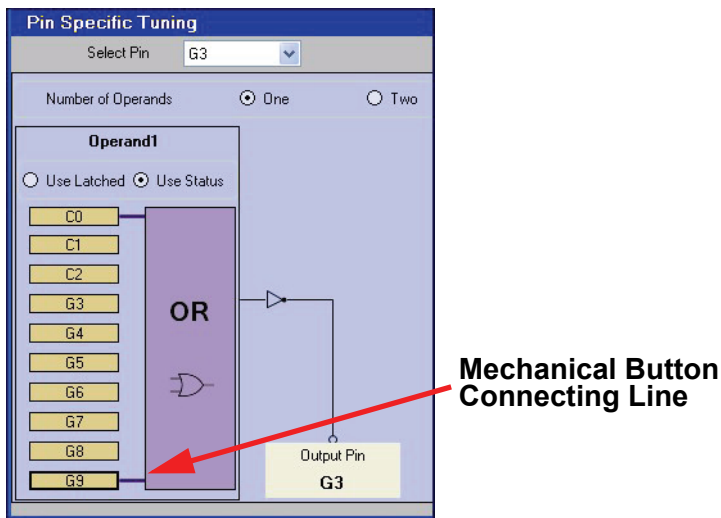
6.10. To assign an LED to a CapSense button, simply click on the yellow box of the CapSense button you want to assign to LED G3. For LED driver G3, select the CapSense button **C0**. A small line will then connect C0 to the purple OR box. To have the LED turn on when the button is pressed, click the little box to the right of the purple OR box. This will change the square to an invert symbol.



**Connecting Line**

**Invert Symbol**

6.11. To have the mechanical button turn the LED on, click the yellow G9 box.



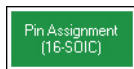
6.12. Repeat [Step 6.10.](#) and [Step 6.11.](#) for drivers G4 through G8 according to the following table:

LED	Control
G3	C0 & G9
G4	C1 & G9
G5	C2 & G9

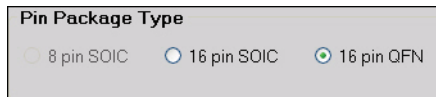
LED	Control
G6	C0
G7	C1
G8	C2

## Assign Drivers to Pins

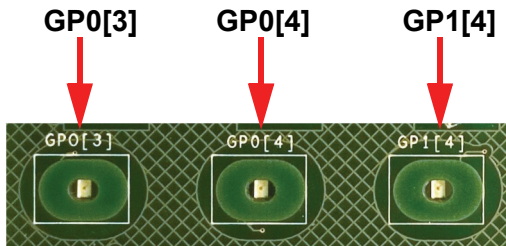
6.13. In the upper-left of the window, click the **Pin Assignment (16-SOIC)** button. The User Pin Assignment window opens.



6.14. For the Pin Package Type, select the **16 pin QFN**.



6.15. Assign each CapSense button, LED, and mechanical button on the board to the pin annotated on the board. For example, the leftmost CapSense button is labeled GP0[3].



Drag each driver from the Unassigned list to the appropriate pin (listed on page 16 for convenience).

The screenshot shows the 'User Pin Assignment' dialog box. The main area displays a pin package diagram for a 'CY8C20110 16 pin QFN'. The pins are numbered 1 through 16. The pins are color-coded: orange for available placements, light blue for locked pins, and green for unassigned pins. The pins are labeled as follows:

- GP0[0] (1), GP0[1] (2), I2C SCL (3), I2C SDA (4), GP1[0] (5), GP1[1] (6), VSS (7), GP1[2] (8), GP0[4] (16), Integrating Cap (15), GP0[3] (14), VDD (13), C0 (12), XRES (11), GP1[4] (10), GP1[3] (9).

The 'Unassigned' list on the right contains the following components:

- Button1 (C0)
- Button2 (C1)
- Button3 (C2)
- Output1 (G3)
- Output2 (G4)
- Output3 (G5)
- Output4 (G6)
- Output5 (G7)
- Output6 (G8)
- Input1 (G9)

A red arrow points from the 'Button1 (C0)' component in the 'Unassigned' list to the C0 pin (pin 12) in the package diagram.

At the bottom left, there is a legend for pin status:

- Locked pins (light blue)
- Available placements (orange)

At the bottom right, there are buttons for 'Unassign All Pins', 'Auto Assign', and 'OK'.

Driver	Pin
Button1 (C0)	GP0[2]
Button2 (C1)	GP1[4]
Button3 (C2)	GP1[3]
Output1 (G3)	GP1[0]
Output2 (G4)	GP1[1]

Driver	Pin
Output3 (G5)	GP0[1]
Output4 (G6)	GP0[0]
Output5 (G7)	GP0[3]
Output6 (G8)	GP1[2]
Input1 (G9)	GP0[4]

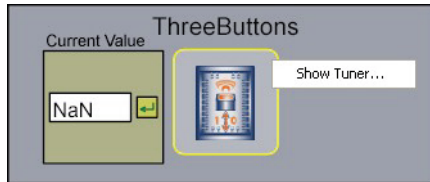
- 6.16. Click **OK** to close the User Pin Assignment window.
- 6.17. Click **Apply to board**. Wait for the Configure through USB2IIC Bridge status window appears and click **OK**.
- 6.18. Click **OK** to close the CapSense Express 10 GPIO/CS Button Set: ThreeButtons window.


## Monitor the Board

- 6.19. In the Design pane, select **Monitor**. The Monitor Status indicator shows Connected



- 6.20. Right-click **ThreeButtons** and select **Show Tuner**.



The Monitor Status indicator changes to Running , and the CapSense Express 10 GPIO / CS BUTTON SET: ThreeButtons window opens.

- 6.21. Touch the leftmost CapSense button. The red bar in the Pin Specific Tuning pane responds to your touch.




## What's Next

Congratulations! You have successfully recreated the factory installed program used in Section 5. To experiment with button and LED behavior, select any LED (G3 through G8) from the Select Pin menu in the Pin Specific Tuning pane and set different buttons to light different LEDs. You can also reverse the inversion so that an LED is on until a button is pressed. To tune the CapSense buttons, follow the steps listed in Section 5.

# 7. Additional CapSense Resources

## PSoC Data Sheets, Application Notes and Technical Articles

Cypress provides a wealth of information about CapSense Express, and more is frequently added. Many sample documents, schematics, layouts, guidelines, and other CapSense Express documents are available on the CD and at [www.cypress.com](http://www.cypress.com) (except where indicated). To find documentation online:

- a. Go to [www.cypress.com](http://www.cypress.com).
- b. Click on the **Documentation** link.
- c. Select the type of documentation you are looking for from the **Resource Types** list.
- d. Type the part number or document number into the **Search in Design Resources** field.
- e. Click the **Search** button .

### **CapSense Express DataSheets** (available on [www.cypress.com](http://www.cypress.com))

- [CY8C20110](#) Up to 10 IOs for touch sensing buttons, LEDs, and GPIOs
- [CY8C201A0](#) Up to 10 IOs for touch sensing buttons/sliders, LEDs, and GPIOs
- [CY8C20180](#) Up to 8 IOs for touch sensing buttons, LEDs, and GPIOs
- [CY8C20160](#) Up to 6 IOs for touch sensing buttons, LEDs, and GPIOs
- [CY8C20140](#) Up to 4 IOs for touch sensing buttons, LEDs, and GPIOs (16-Pin QFN/SOIC)
- [CY8C20142](#) Up to 4 IOs for touch sensing buttons, LEDs, and GPIOs (8-Pin SOIC)

### **CapSense Application Notes**

- [AN44207](#), CapSense Express - API's for Register Configuration (available on [www.cypress.com](http://www.cypress.com))
- [AN44208](#), CapSense Express - I2C Communication Timing Information (available on [www.cypress.com](http://www.cypress.com))
- [AN42137](#), CapSense Express Software Tool
- [AN44203](#), Configuring CapSense Express in Production
- [AN44209](#), CapSense Express Power and Sleep Considerations
- [AN2292](#), Layout Guidelines for PSoC™ CapSense
- [AN2318](#), EMC Design Considerations for PSoC CapSense Applications
- [AN2394](#), CapSense Best Practices
- [AN2397](#), CapSense Data Viewing Tool
- [AN2403](#), Signal-to-Noise Ratio Requirement for CapSense Applications
- [AN14459](#), CapSense Device and Method Selection Guide

## **CapSense Technical Articles**

- [Designer's Guide to Rapid Prototyping of Capacitive Sensors on any Surface](#)
- [Controls & Sensors Touch Sensors Spread Out](#)
- [White Paper Cypress's CapSense Successive Approximation Algorithm](#)
- [The Art of Capacitive Touch Sensing](#)

## **Design Support**

### ***PSoC Development Software Online***

All PSoC development software tools are available for download online. For PSoC Express, visit [www.cypress.com/psocexpress](http://www.cypress.com/psocexpress). For PSoC Designer visit [www.cypress.com/psocdesigner](http://www.cypress.com/psocdesigner). For PSoC Programmer visit [www.cypress.com/psocprogrammer](http://www.cypress.com/psocprogrammer).

### ***PSoC Device Selector Guide***

In the PSoC Application Notes section, search for AN2209—The Device Selection Guide for PSoC. It is a useful tool for determining exactly which PSoC device you should use for a specific design project.

### ***PSoC Development Tools Selector Guide***

In the PSoC Application Notes section, search for AN2402—The PSoC Development Tools Selector Guide. This is a complete catalog and description of all the development tools that support PSoC devices and when to use them in your design cycle—from concept to production.

### ***PSoC On-Demand Training***

Visit [www.cypress.com/psoctraining](http://www.cypress.com/psoctraining) to engage in on-demand self-paced PSoC product and development software training. Learn to design PSoC like the pros, at the introductory, intermediate, and advanced knowledge levels!

### ***PSoC On-Site Training***

Email [training@cypress.com](mailto:training@cypress.com) to enquire about PSoC in-person training seminars at a location near you. Learn design basics, tips, and tricks from the pros to become a PSoC design expert!

### ***Online Technical Support***

For knowledge base articles, customer forums, and online application support, visit [www.cypress.com/support](http://www.cypress.com/support).

# Additional CapSense Kits

## Evaluation Kits

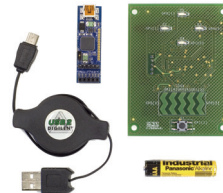
## Development Kit

**CapSense Express:** Quickest and Easiest to Use Touch Sensing

**CY3218  
CAPEXP1/CAPEXP3  
For Buttons  
(Up to 10 or 4 IOs)**



**CY3218  
CAPEXP2  
For Sliders  
(Up to 10 IOs)**



**CapSense:** Programmable Touch Sensing

**CY3203A  
CapSense CSA**



**CY3280-BK1  
Universal CapSense**



**CapSense Plus:** CapSense with Non-Touch Sensing Functionality (Motor Control, Power Management, Gyro Sensing, etc.)

**CY3213A  
CapSense CSD**



**CY3214  
PSoCEvalUSB**



For more information on these kits, please go to [www.cypress.com/CapSense](http://www.cypress.com/CapSense).

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