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CY3213A-CapSense Kit Quick Start

Spec. # 001-17834 Rev. **

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1. Getting Started

Install PSoC Express Development Software

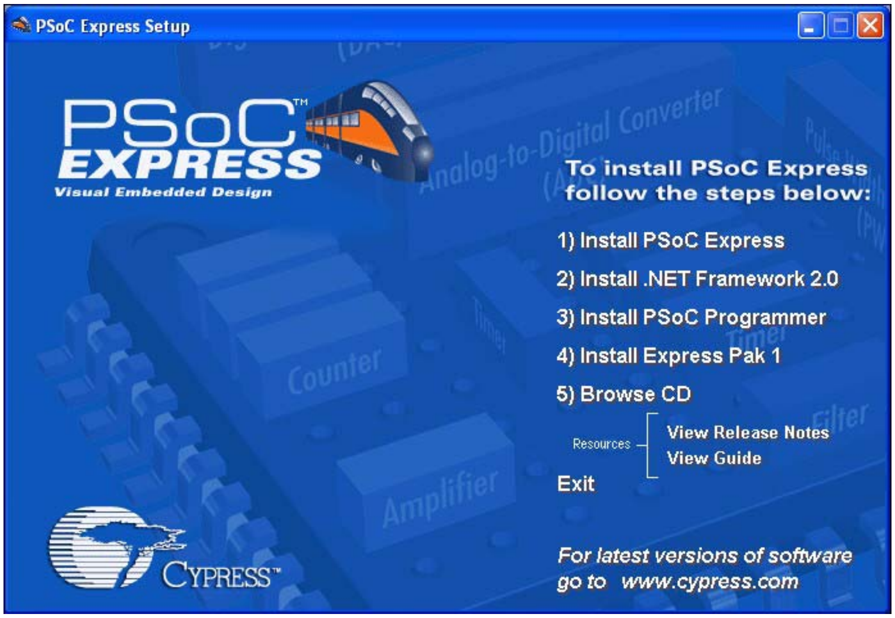
1.1. Insert the PSoC Development Software Suite CD into your CD-ROM drive.

1.2. Install PSoC Express.

1.3. Install .NET Framework 2.0.

1.4. Install PSoC Programmer.

1.5. Install Express Pak 1.



To install PSoC Express follow the steps below:

For latest versions of software go to www.cypress.com

For the latest versions of all Cypress software, go to www.cypress.com.

Additional Content on CD

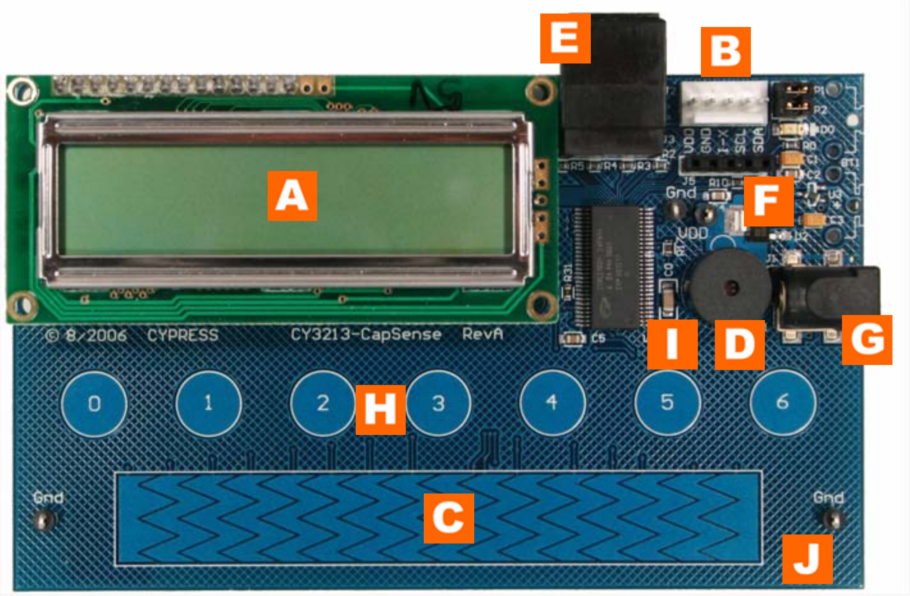
1.6. Kit Documentation

1.7. Application Notes

1.8. Design Files

1.9. Schematics

CY3213A-CapSense Board Details



LCD:

16x2 Dot Matrix LCD. Hitachi 44780 compatible model.

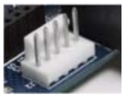
A

LCD DB4 —P2[0]
LCD DB5 —P2[1]
LCD DB6 —P2[2]
LCD DB7 —P2[3]

LCD E —P2[4]
LCD RS —P2[5]
LCD R/W —P2[6]

ISSP Connector (J2):

In-System Serial Programmer (ISSP) connector. Connect MiniProg for Programming or I^{2}C USB Bridge for monitoring.



B

Data, Clock, Ground and VDD are all labeled. Data is routed to P1[0] and Clock is routed to P1[1].

CapSense Slider:

C

16 CapSense slider pads are routed to the following I/O (Slider 8-15 are not shown in CSD Wizard):

Slider 0 —P0[0]
Slider 1 —P0[1]
Slider 2 —P0[2]
Slider 3 —P2[7]
Slider 4 —P0[4]
Slider 5 —P0[5]
Slider 6 —P0[6]
Slider 7 —P0[7]

Slider 8 —P0[0]
Slider 9 —P2[0]
Slider 10 —P0[6]
Slider 11 —P0[1]
Slider 12 —P0[4]
Slider 13 —P0[7]
Slider 14 —P0[2]
Slider 15 —P0[5]

For more information on Slider Diplexing, please see application note AN2292 and the CSD User Module datasheet.

Loudspeaker (LS1):

Magnetic buzzer accessible via LS1. CEM-1206S. (Active high, set to drive strong, drive high.)

D

ICE-Cube Connector (J3):

Connects to blue cat5e cable for use with ICE-Cube (available in the CY3215-DK).

E

I2C Monitoring (J5):

Data, Clock, Ground and VDD are all labeled. Data is routed to P1[5] and Clock is routed to P1[7]. (The I2C interrupt is not connected at this time.)

F

Power Supply Connector:

Connect a 9-12V power supply to power the board. (Recommended Digikey Part T561-P5P-ND.)

G

CapSense Buttons:

H

Seven CapSense button pads are routed to the following I/O:

Button 0 —P1[2]
Button 1 —P1[4]
Button 2 —P1[6]
Button 3 —P3[2]

Button 4 —P3[3]
Button 5 —P3[0]
Button 6 —P1[3]

Modification Capacitor C0:

C0 is port assignment P0[3].

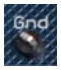
I

R17 (Bleed Resistor):

R17 is port assignment P3[1].

Test Points:

Several Ground and VDD.



J

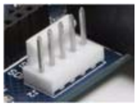
Note: The PSoC part used on this evaluation board is different than the parts you will use in your designs.

2. Use the Board as Factory Programmed

Note: The CY3213A board is preprogrammed as an LCD with seven buttons and a slider. When powered by a PSoC MiniProg, the LCD displays a graphical representation of the button(s) that are being pressed and where the finger is at on the slider.

These instructions assume your board has not been reprogrammed from the factory settings. If it has, and you would like to follow along with this demonstration, follow the instructions in the Resetting the Board to the Original Factory Programming section on page 6, and then start this example with the Power the Board section below.

Power the Board



2.1. Connect your computer to the CapSense test board ISSP Connector (J2) using the PSoC MiniProg and a USB cable. If this is your first time using the MiniProg, you will need to install the driver using these steps before proceeding:

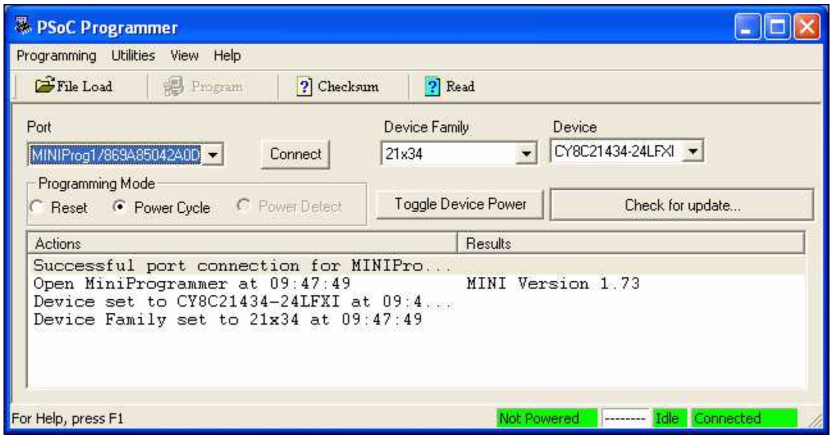
   a. When the Found New Hardware Wizard opens, select one of the **Yes** options and click **Next**.

   b. Select the **Install the software automatically (Recommended)** option and click **Next**.

   c. A warning message may tell you the software you are trying to install has not passed Windows Logo testing. Click **Continue Anyway** each time it appears.

   d. When the installation is complete, click **Finish**.

2.2. Open **PSoC Programmer** by going to the Windows Start menu and selecting **All Programs → Cypress MicroSystems → PSoC Programming → PSoC Programmer**.



Port: MINIProg1/869A85042A0D

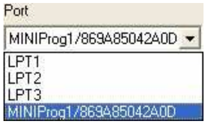
Device Family: 21x34

Device: CY8C21434-24LFXI

Programming Mode: ○ Reset ● Power Cycle ○ Power Detect

```
Successful port connection for MINIPro...
Open MiniProgrammer at 09:47:49          MINI Version 1.73
Device set to CY8C21434-24LFXI at 09:4...
Device Family set to 21x34 at 09:47:49
```

2.3. From the Port menu, select **MiniProg1/<Identification Code>**.



2.4. Click **Toggle Device Power**. The D0 LED on the board lights red.

Test the Board

2.5. Touch the slider on the board with your finger. The LCD shows a block representing where your finger is on the slider. The block on the LCD changes position as you move you finger across the slider.

2.6. Touch one button at a time with your finger. The LCD shows two blocks representing the button being pressed. When you are done experimenting, click **Toggle Device Power** to turn the power off and close PSoC Programmer.

Resetting the Board to the Original Factory Programming

Follow these steps if you wish to reset the board to the original factory installed programming:

2.7. Download and extract the CY3213_Demo_CSD.zip example project at:

http://www.cypress.com/design/DK10069

2.8. To reset the board to the factory conditions, connect your computer to the CapSense test board ISSP Connector (J2) using the PSoC MiniProg and a USB cable.

2.9. Open **PSoC Programmer** by going to the **Windows Start** menu and selecting:

All Programs → Cypress MicroSystems → PSoC Programming → PSoC Programmer

2.10. Click **File Load**, navigate to, and open the *cy3213_demo.hex* file at:

/output/cy3213_demo.hex

2.11. From the Device Family menu, select **21x34**.

2.12. From the Device menu, select **CY8C21434-24LFXI**.

2.13. Click **Program**. “Programming Succeeded...” appears in the Actions pane when programming is complete.

2.14. To use the board with the factory program, go to the Power the Board section on page 5.

Note: The cy3213_demo example project is a PSoC Designer project, and will not open with PSoC Express. PSoC Programmer uses *.hex* files generated with both PSoC Express and PSoC Designer.

3. Create a CapSense Project

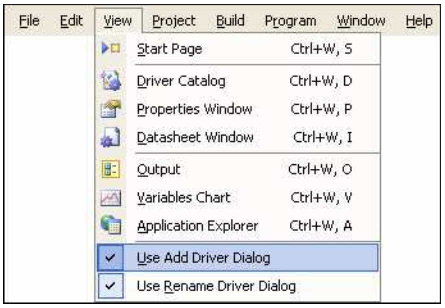
This project walks you through the steps of creating a PSoC Express project from scratch. At the end of the project, you will be able to touch a button or the slider on the board and see the results on the LCD screen.

Start a New Project

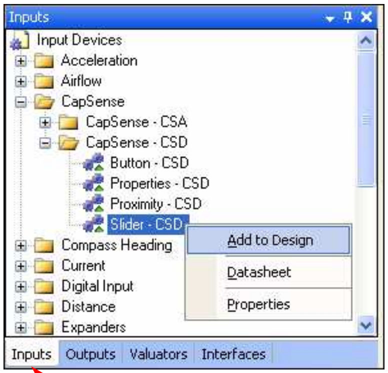
3.1. Open PSoC Express 3.
3.2. Select **File** → **New Project**.
3.3. Name the project **My3213ExpressProject**.
3.4. If needed, click **Browse** to save the project in a different location.
3.5. Click **OK**.

Add a CSD Slider Driver to Your Design

3.6. Ensure the Driver Catalog pane is visible by selecting **View** → **Driver Catalog**.
3.7. Each driver and valuator has certain properties associated with it. For the purposes of this example, ensure **View** → **Use Add Driver Dialog** is checked.


File
Edit
View
Project
Build
Program
Window
Help
Start Page Ctrl+W, S
Driver Catalog Ctrl+W, D
Properties Window Ctrl+W, P
Datasheet Window Ctrl+W, I
Output Ctrl+W, O
Variables Chart Ctrl+W, V
Application Explorer Ctrl+W, A
✓ Use Add Driver Dialog
✓ Use Rename Driver Dialog

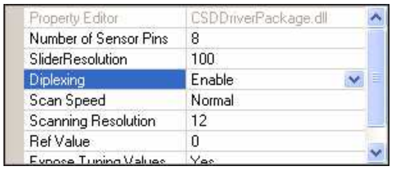
3.8. In the Driver Catalog pane, go to **Inputs** tab → **CapSense** → **CapSense - CSD**, right-click on **Slider - CSD**, and select **Add to Design**. The Add Input Driver window will open.



Inputs Tab

3.9. In the Add Input Driver window, name the driver **Slider**.

3.10. In the properties pane at the bottom of the window, set the Diplexing field to **Enable**.



Property Editor	CSDDriverPackage.dll
Number of Sensor Pins	8
SliderResolution	100
Diplexing	Enable
Scan Speed	Normal
Scanning Resolution	12
Ref Value	0
Expose Tuning Values	Yes

3.11. Click **OK** to accept the default settings. Another Add Input Driver window will open automatically.

3.12. Name this driver **CapSenseProperties**.

3.13. In the Properties pane, set Sensors Autoreset to **Disabled**.

3.14. Click **OK**.

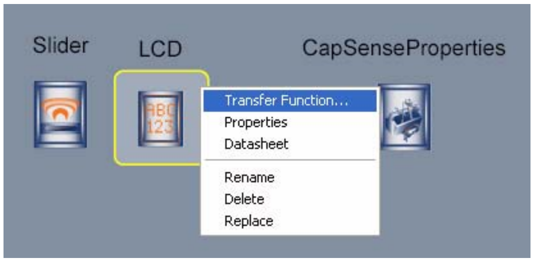
Add an LCD Value Driver to Your Design

3.15. In the Driver Catalog pane, go to **Outputs** tab → **Display** → **LCD**, and add an **LCD Value** driver to your design. The Add Output Driver window will open.

3.16. In the Add Output Driver window, name the driver **LCD** and click **OK** to accept the default settings.

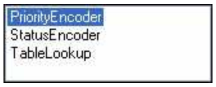
Define the LCD Transfer Function

3.17. You now have three drivers on your design desktop: Slider, LCD, and CapSenseProperties. Right-click the LCD driver and select **Transfer Function**.

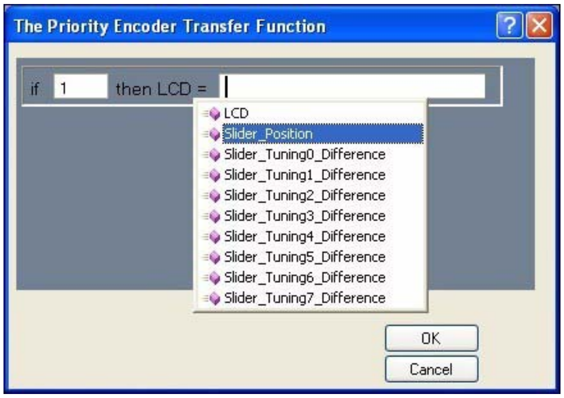


Note: If your driver icons are stacked on top of each other, simply use your mouse to click and drag each driver to a new location until all three drivers are clearly visible. You may also click your mouse button while holding the [**Ctrl**] or [**Ctrl**] + [**Shift**] keys to zoom in and out respectively.

3.18. In the Select Transfer Function window, select **PriorityEncoder** and click **OK**.



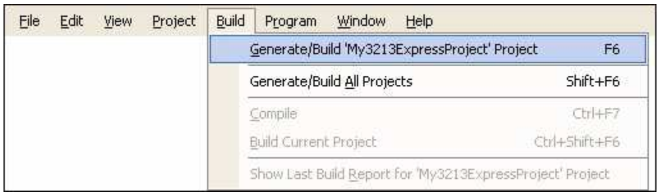
3.19. In the Priority Encoder Transfer Function window, type **1** in the If field. Click in the Then field, and select **Slider_Position** from the menu.


The Priority Encoder Transfer Function
if 1 then LCD =
LCD
Slider_Position
Slider_Tuning0_Difference
Slider_Tuning1_Difference
Slider_Tuning2_Difference
Slider_Tuning3_Difference
Slider_Tuning4_Difference
Slider_Tuning5_Difference
Slider_Tuning6_Difference
Slider_Tuning7_Difference
OK
Cancel

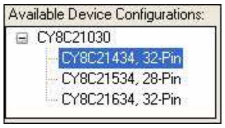
3.20. Click **OK**.

Build Your Project

3.21. Select **Build** → **Generate/Build 'My3213ExpressProject' Project**


File Edit View Project Build Program Window Help
Generate/Build 'My3213ExpressProject' Project F6
Generate/Build All Projects Shift+F6
Compile Ctrl+F7
Build Current Project Ctrl+Shift+F6
Show Last Build Report for 'My3213ExpressProject' Project

3.22. In the PSoC Device Configuration Selection window, select the **CY8C21434, 32-Pin** part in the Available Device Configurations pane.



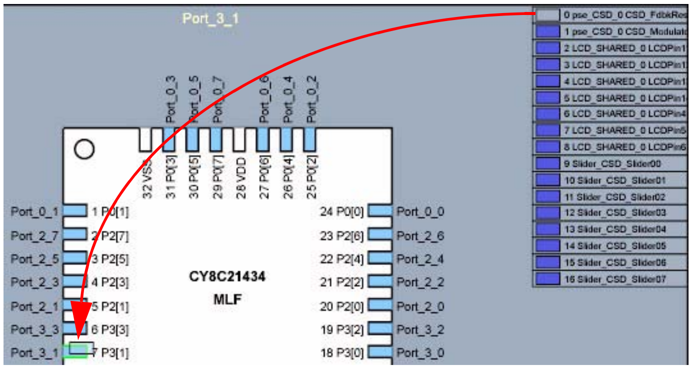
3.23. Ensure the **Assign pins automatically** check box is **NOT** selected.

3.24. Click **Next**.

Assign Drivers to Pins

3.25. In the User Pin Assignment window, click **Unassign All Pins**. All drivers move to the Unassigned Drivers list.

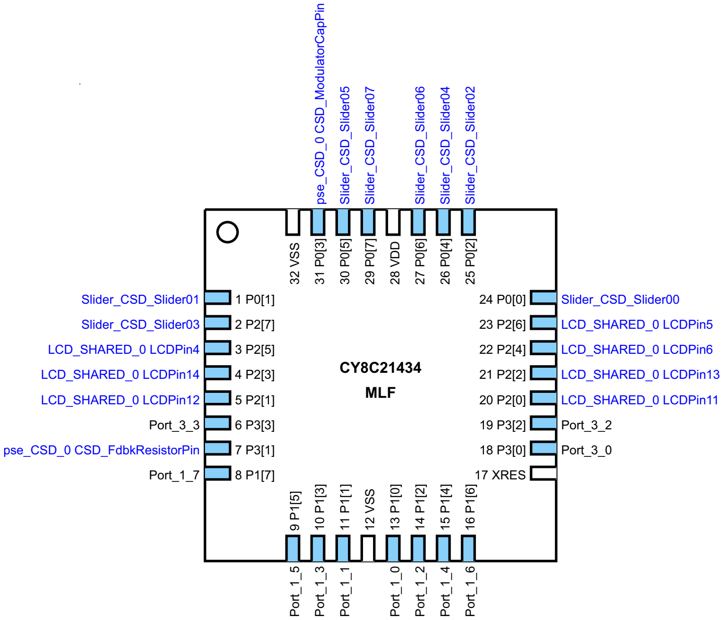
3.26. To assign drivers to pins, drag and drop drivers from the Unassigned Drivers list onto a pin. Assign the pse_CSD_0_CSD_FdbkResistorPin driver to port P3[1].



3.27. Assign the rest of the drivers according to the following table.

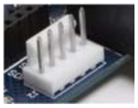
pse_CSD_0_CSD_FdbkResistorPin	P3[1]
pse_CSD_0_CSD_ModulatorCapPin	P0[3]
LCD_SHARED_0LCDPin11	P2[0]
Slider_CSD_Slider00	P0[0]
Slider_CSD_Slider01	P0[1]
Slider_CSD_Slider02	P0[2]
Slider_CSD_Slider03	P2[7]
Slider_CSD_Slider04	P0[4]
Slider_CSD_Slider05	P0[5]
Slider_CSD_Slider06	P0[6]
Slider_CSD_Slider07	P0[7]

←**Note**: The LCD has more than one driver that must be assigned. PSoC Express Automatically assigns all the drivers for the LCD when the first driver is assigned to pin P2[0].



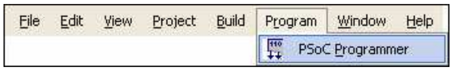
3.28. Click **Next**. PSoC Express builds your project (this may take a few minutes).

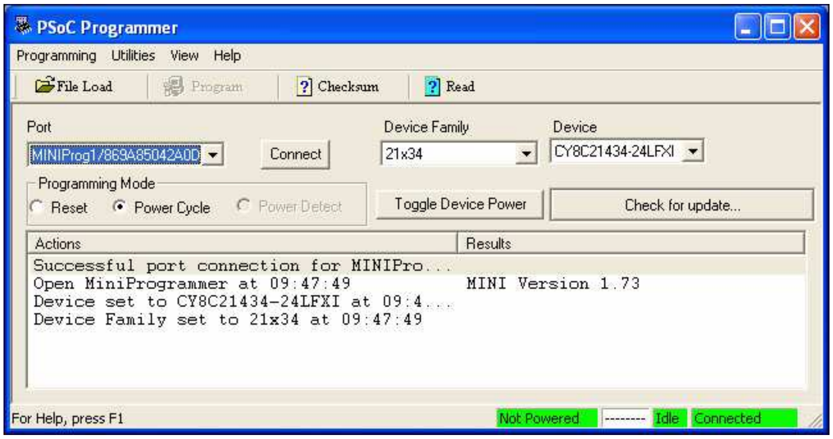
Program the CY3213 Board

3.29. Connect your computer to the CapSense test board ISSP Connector (J2)  using the PSoC MiniProg and a USB cable.

If this is your first time using the MiniProg, you will need to install the driver before proceeding. Follow the instructions in the Power the Board section on page 5.

3.30. In PSoC Express, select **PSoC Programmer** from the Programmer menu. The PSoC Programmer application opens.

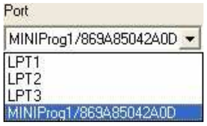




Port: MINIProg1/869A85042A0D
Device Family: 21x34
Device: CY8C21434-24LFXI
Programming Mode: ○ Reset ● Power Cycle ○ Power Detect

Actions	Results
Successful port connection for MINIPro...	
Open MiniProgrammer at 09:47:49	MINI Version 1.73
Device set to CY8C21434-24LFXI at 09:4...	
Device Family set to 21x34 at 09:47:49	

3.31. From the Port menu, select **MiniProg1/<Identification Code>**.



Port
MINIProg1/869A85042A0D
LPT1
LPT2
LPT3
MINIProg1/869A85042A0D

3.32. Click **Program**.

"Programming Succeeded..." appears in the Actions pane when programming is complete.

Test the Board

3.33. Click **Toggle Device Power**.

3.34. Touch the slider on the board with your finger. The LCD displays the position of your finger.

3.35. When you are done experimenting, click **Toggle Device Power**, and close PSoC Programmer.

3.36. Return to PSoC Express and select **File** → **Save Application**.

What's Next?

You have now completed the PSoC Express CapSense project. The next example walks you though adjusting the settings so the slider is not as sensitive, a process known as tuning.

4. Tune a CapSense Project

Note: A CY3240 I^{2}C Bridge is needed for CapSense Tuning. If you do not have an I^{2}C Bridge board, purchase one online by going to http://www.cypress.com/design/DK10063, and clicking **Buy Online**.

The goal of tuning a capacitive sensing application is to adjust the sensitivity of the buttons or slider so that they accurately detect finger presses. This involves determining which raw counts coming from the sensor are actual finger presses, or if it is some other stimuli that changes the raw count.

Detailed tuning information is available in the CapSense Guide. In PSoC Express, select **Help** → **Documentation**, and select **CapSense Guide**.

Open You PSoC Express Project

4.1. In PSoC Express, if the project from the previous example is closed, select **My3213ExpressProject** in the Recent Project pane (or click **browse** and open the project).

4.2. If you are not in the Design view, click Design **Design**.

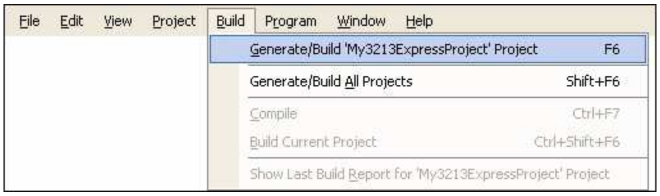
Add an I^{2}C Slave Driver to Your Design

4.3. In the Driver Catalog pane, go to **Interfaces** tab → **Communication** → **I2C**, and add a **Slave** driver to your design.

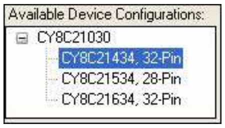
4.4. In the Add Interface window, name the driver **I2CSlave** and click **OK**.

Build the Project

4.5. Select **Build** → **Generate/Build 'My3213ExpressProject' Project**


File
Edit
View
Project
Build
Program
Window
Help
Generate/Build 'My3213ExpressProject' Project F6
Generate/Build All Projects Shift+F6
Compile Ctrl+F7
Build Current Project Ctrl+Shift+F6
Show Last Build Report for 'My3213ExpressProject' Project

4.6. In the PSoC Device Configuration Selection window, select the **CY8C21434, 32-Pin** part in the Available Device Configurations pane.



4.7. Ensure the **Assign pins automatically** check box is **NOT** selected.

4.8. Click **Next**.

Assign Drivers to Pins

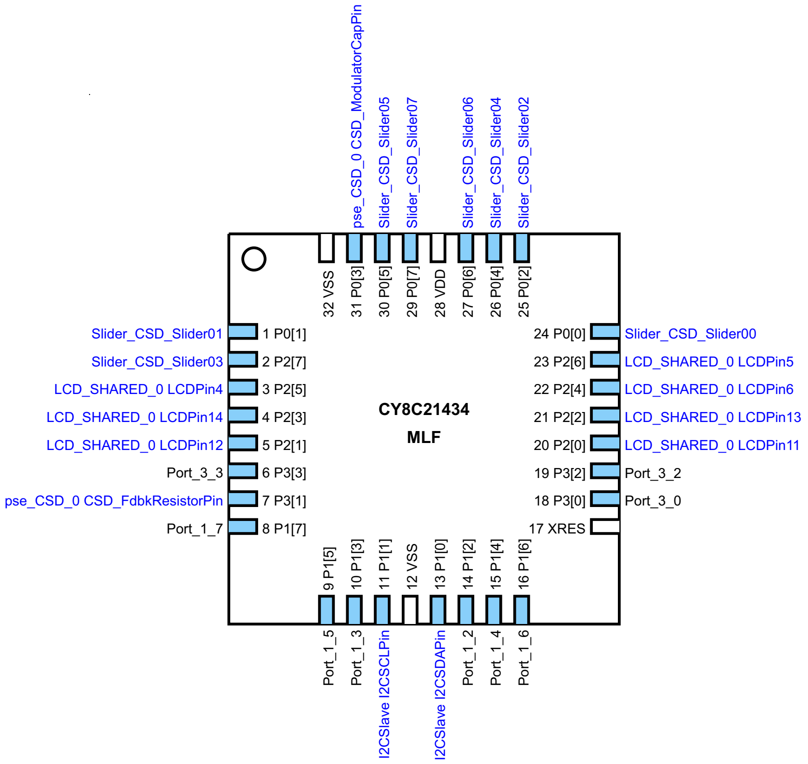
4.9. In the User Pin Assignment window, click **Unassign All Pins**. All drivers move to the Unassigned Drivers list.

4.10. To assign drivers to pins, drag and drop drivers from the Unassigned Drivers list onto a pin. Assign the pse_CSD_0_CSD_FdbkResistorPin driver to port P3[1].

4.11. Assign the rest of the drivers according to the following table.

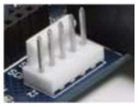
pse_CSD_0_CSD_FdbkResistorPin	P3[1]
pse_CSD_0_CSD_ModulatorCapPin	P0[3]
I2CSlave I2CSCLPin	P1[1]
LCD_SHARED_0LCDPin11	P2[0]
Slider_CSD_Slider00	P0[0]
Slider_CSD_Slider01	P0[1]
Slider_CSD_Slider02	P0[2]
Slider_CSD_Slider03	P2[7]
Slider_CSD_Slider04	P0[4]
Slider_CSD_Slider05	P0[5]
Slider_CSD_Slider06	P0[6]
Slider_CSD_Slider07	P0[7]

←**Note**: The LCD and I2C each have more than one driver that must be assigned. PSoC Express automatically assigns all the drivers for the LCD and I2C when the first driver for each is assigned to a pin.



4.12. Click **Next**. PSoC Express builds your project (this may take a few minutes).

Program the CY3213 Board

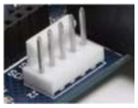
4.13. Connect your computer to the CapSense test board ISSP Connector (J2)  using the PSoC MiniProg and a USB cable.

4.14. Select **Program** → **Programmer**. When PSoC Programmer opens, click **Program**.

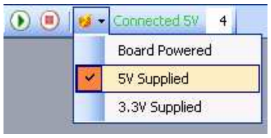
4.15. When programming has successfully completed, close PSoC Programmer and return to PSoC Express.

Tune the Slider

4.16. Click the **Monitor** Monitor button.

4.17. Connect your computer to the CapSense test board ISSP Connector (J2)  using the USB-I2C bridge and a USB cable.

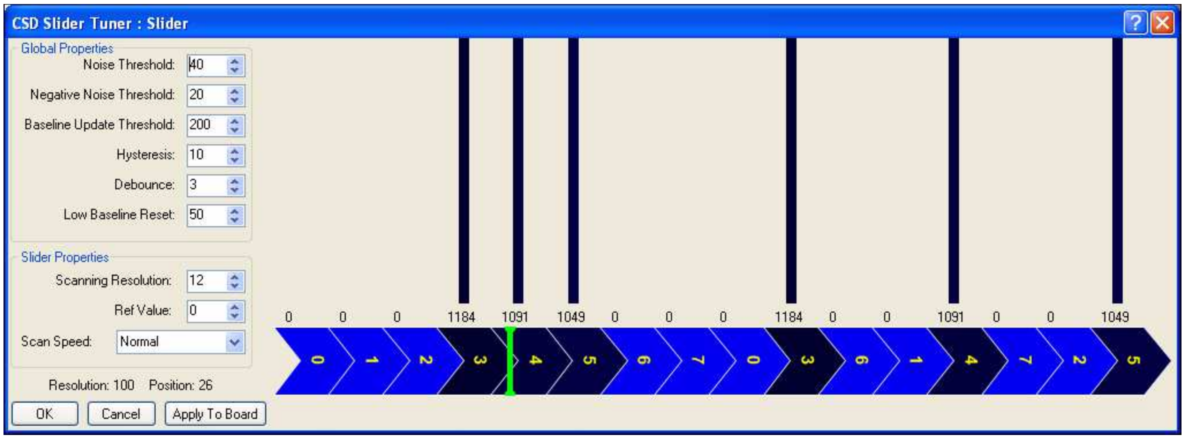
4.18. From the Power Selection menu, select **5V Supplied**.



4.19. Click the **Start** ▶ button.

4.20. Right-click the **Slider** driver and select **Show Tuner** to open the CSD Slider Tuner Window.

4.21. Touch the slider with your finger. You can easily see the slider is too sensitive because the sensors on the left and right of the middle sensor easily report a full-finger contact.



CSD Slider Tuner : Slider

Global Properties
Noise Threshold: 40
Negative Noise Threshold: 20
Baseline Update Threshold: 200
Hysteresis: 10
Debounce: 3
Low Baseline Reset: 50

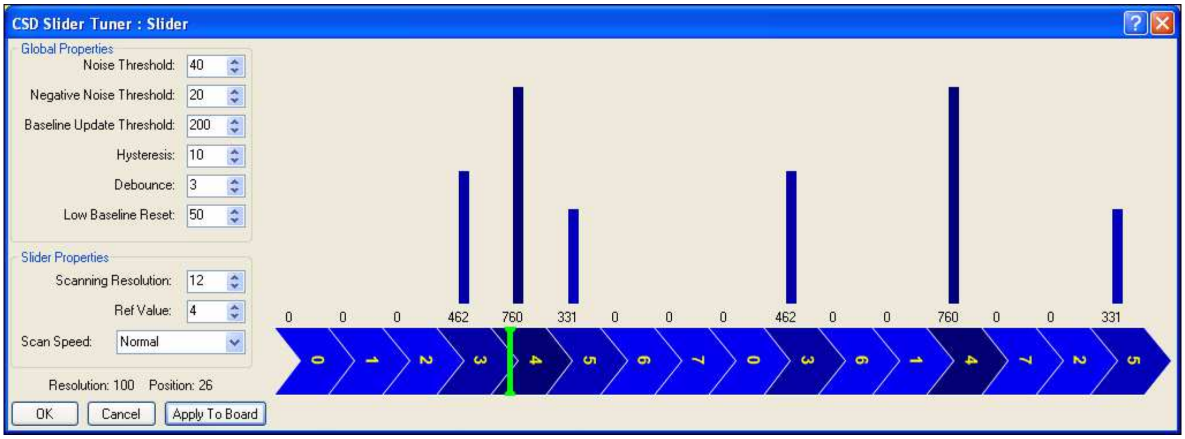
Slider Properties
Scanning Resolution: 12
Ref Value: 0
Scan Speed: Normal

Resolution: 100 Position: 26

4.22. Increase the **Ref Value** settings to **4**. If your design has sensors with substantial capacitance differences (for example sensors with different sizes or shapes), the raw count values can be balanced by selecting a higher reference level for the sensors with larger capacitance. An increased reference level will decrease sensor sensitivity, but increase the influence of the shielding electrode.

4.23. Click **Apply to Board** to write the changed parameter to Flash on the PSoC device.

4.24. Touch the slider with your finger. The slider is now less sensitive. Click **OK** when you finish experimenting.



CSD Slider Tuner : Slider

Global Properties

Noise Threshold: 40

Negative Noise Threshold: 20

Baseline Update Threshold: 200

Hysteresis: 10

Debounce: 3

Low Baseline Reset: 50

Slider Properties

Scanning Resolution: 12

Ref Value: 4

Scan Speed: Normal

Resolution: 100 Position: 26

4.25. Click **Stop** ⏹. Anytime that you are not actively using the board monitor you should stop monitoring. Monitoring a design consumes a lot of processor cycles on your PC.

Congratulations! You have successfully completed this example. To experiment with additional CY3213 designs, go to the Start Page tab in PSoC Express, and look in the CY3213 CSD CapSense Kit folder in the Express Design Catalog pane.

5. Design Support and Resources

PSoC Development Software Online

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

PSoC Data Sheets and Application Notes

For all PSoC device data sheets and detailed application notes, many with complete starter projects, visit www.cypress.com/designresources. In the Products column, select “PSoC Mixed-Signal Controllers” and in the Resource Type column, select either “Application Notes” or “Datasheets.”

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 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

Visit www.cypress.com/psocseminars to sign up for a PSoC in-person training seminar 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.

Additional CapSense Resources

A wealth of information about PSoC Express and CapSense is available on the Cypress.com web site, and more is frequently added. The following list is just a sample of what is available.

CapSense DataSheets

- *CY8C20434 Mixed Signal Array*
- *CY8C20334 Mixed Signal Array*
- *CY8C20234 Mixed Signal Array*

CapSense Application Notes

- *AN2292, Layout Guidelines for PSoC™ CapSense*
- *AN2318, EMC Design Considerations for PSoC CapSense Applications*
- *AN2355, Calibrating CapSense with the CSR User Module*
- *AN2360, Power and Sleep Considerations*
- *AN2393, Migrating from CSR to CSA*
- *AN2394, CapSense Best Practices*
- *AN2397, CapSense Data Viewing Tool*
- *AN2398, Waterproof Capacitive Sensing*
- *AN2403, Signal-to-Noise Ratio Requirement for CapSense Applications*
- *AN2408, Migrating from CSR to CSD*
- *AN14459, CapSense Device and Method Selection Guide*

CapSense Technical Articles

- *TA1186, Designer's Guide to Rapid Prototyping of Capacitive Sensors on any Surface*
- *TA1179, Controls & Sensors Touch Sensors Spread Out*
- *TA1168, White Paper Cypress's CapSense Successive Approximation Algorithm*
- *TA1193, The Art of Capacitive Touch Sensing*

CapSense Developer Kits

- *DK10068, CapSense Successive Approximation (CSA)*
- *DK10069, CapSense Sigma-Delta (CSD)*
- *DK10064, CapSense Proximity Detection Demonstration*
- *DK10059, CapSense Demo Board*