Мікропроцесорна техніка

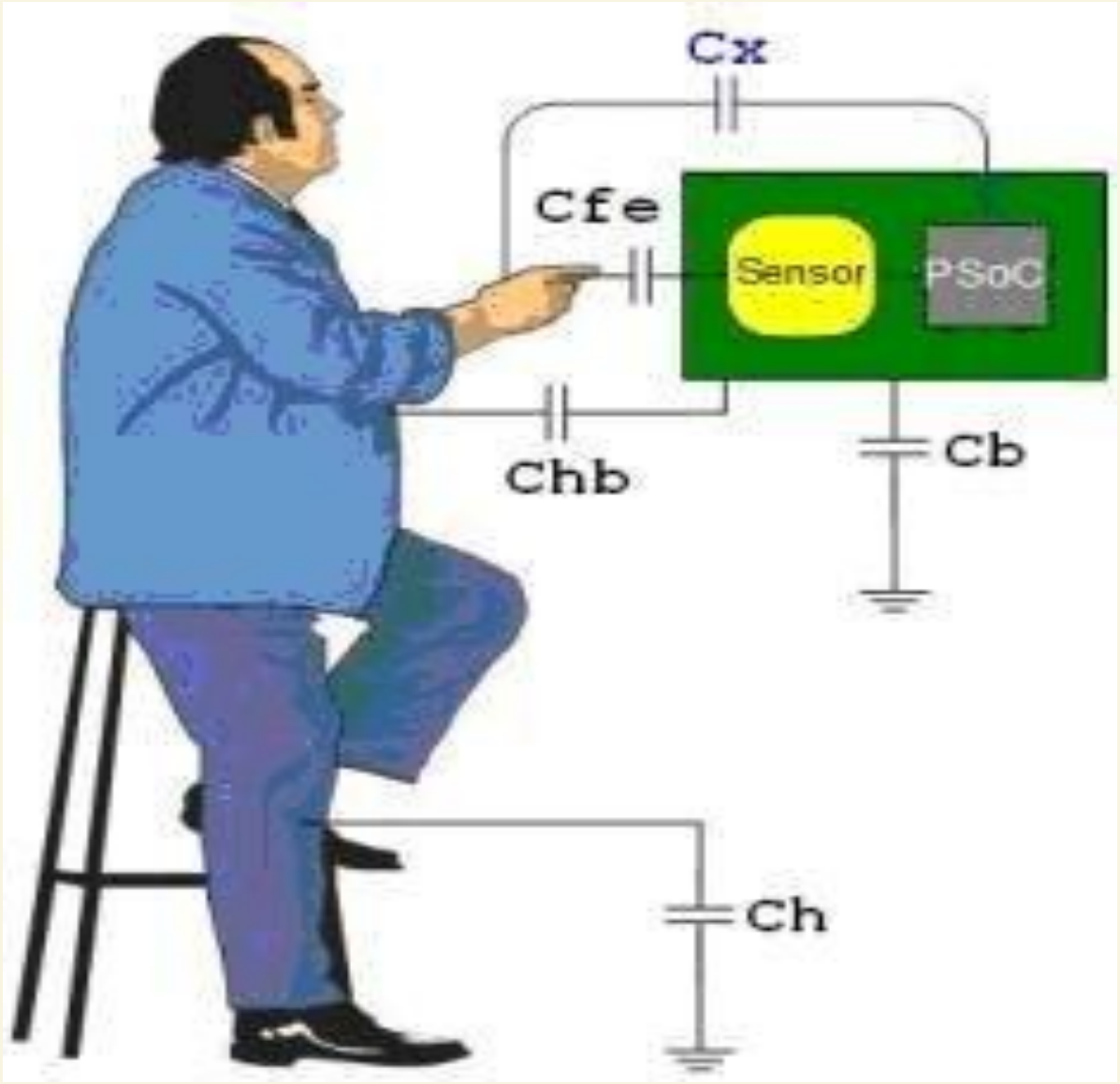
(лекція 3)
Благітко Б.Я.
2019 р.

PSoC Creator 4.2
Designing with PSoC 3/5

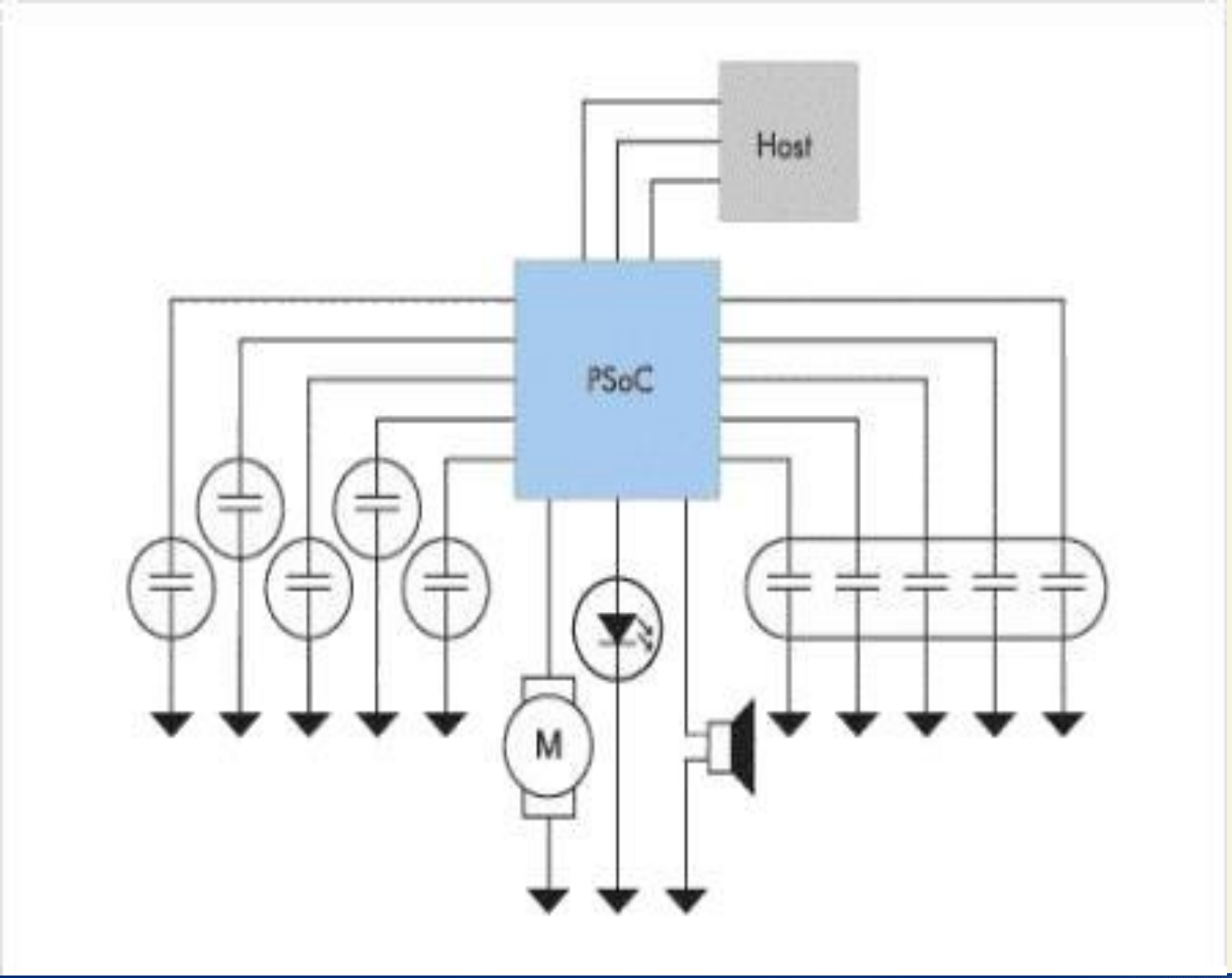
PSoC@3/5 CapSense

PSoC Creator 4.2
Designing with PSoC 3/5

CapSense



CapSense



What is CapSense Touch-Sensing?

Detect presence / absence of conductive object, e.g. a finger

Buttons

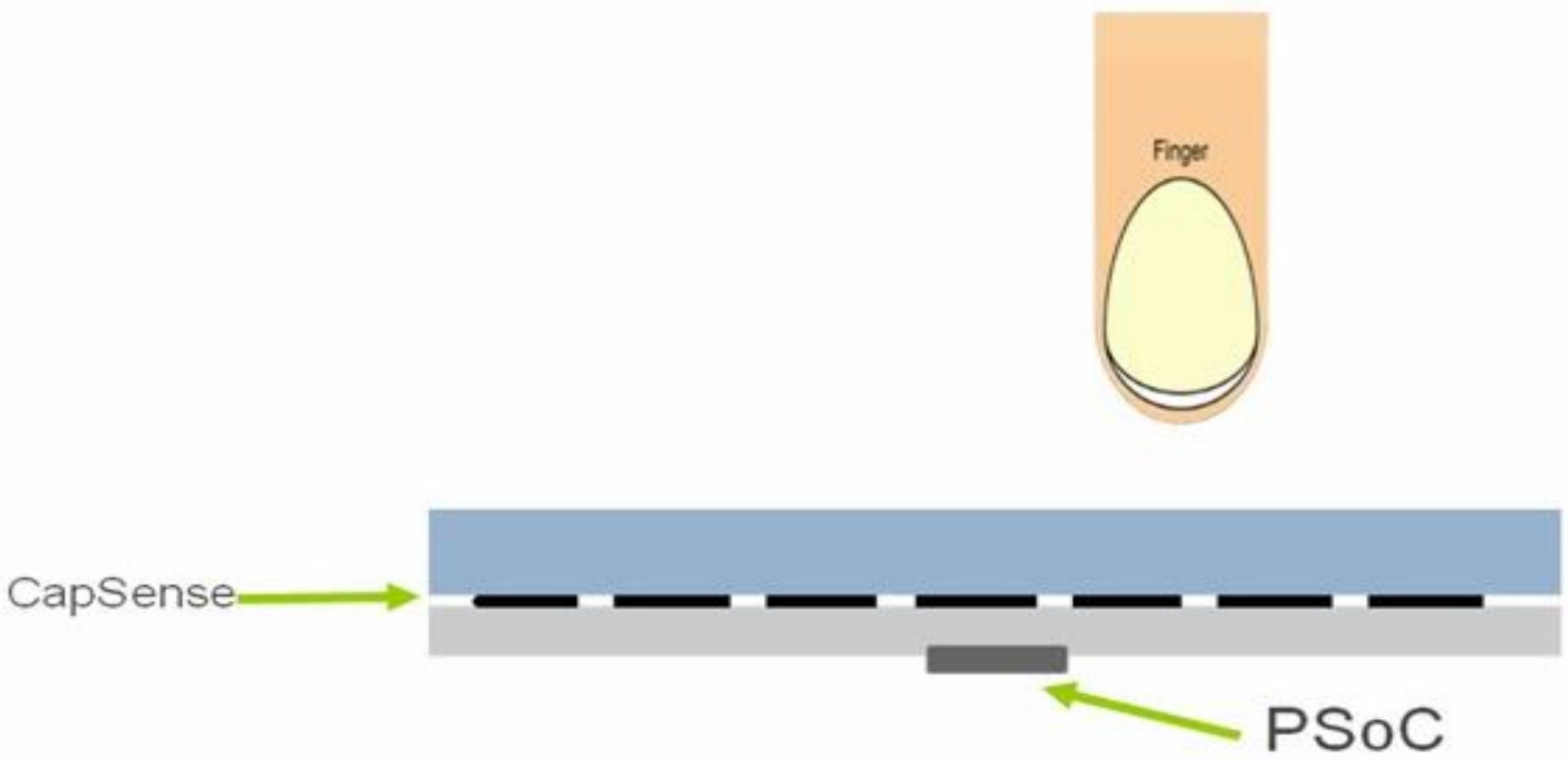
Sliders

Proximity Sensing

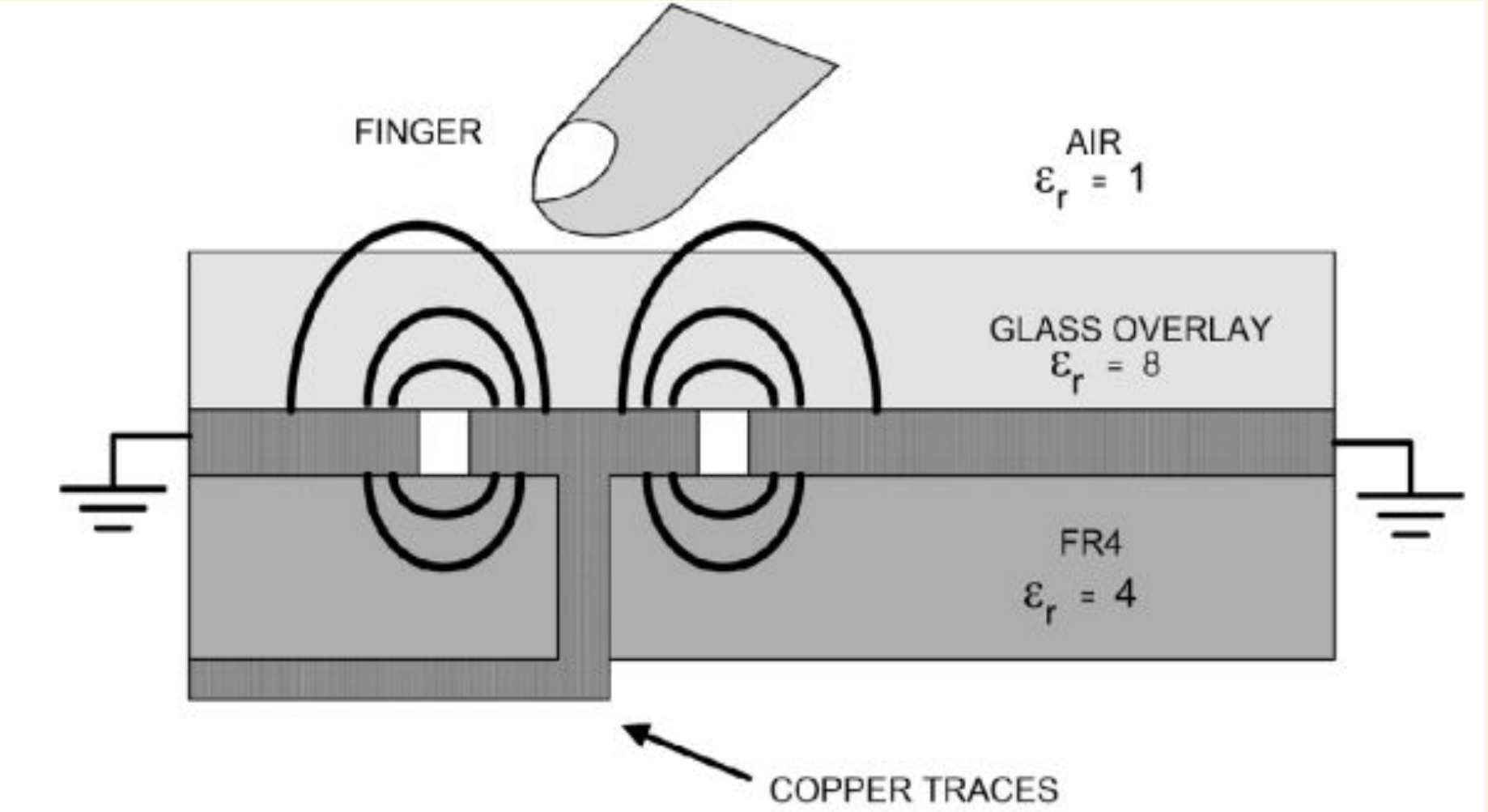
Touchpad
- "Multi-Touch"
- Gestures

What is CapSense Touch-Sensing?

CapSense works Everywhere:



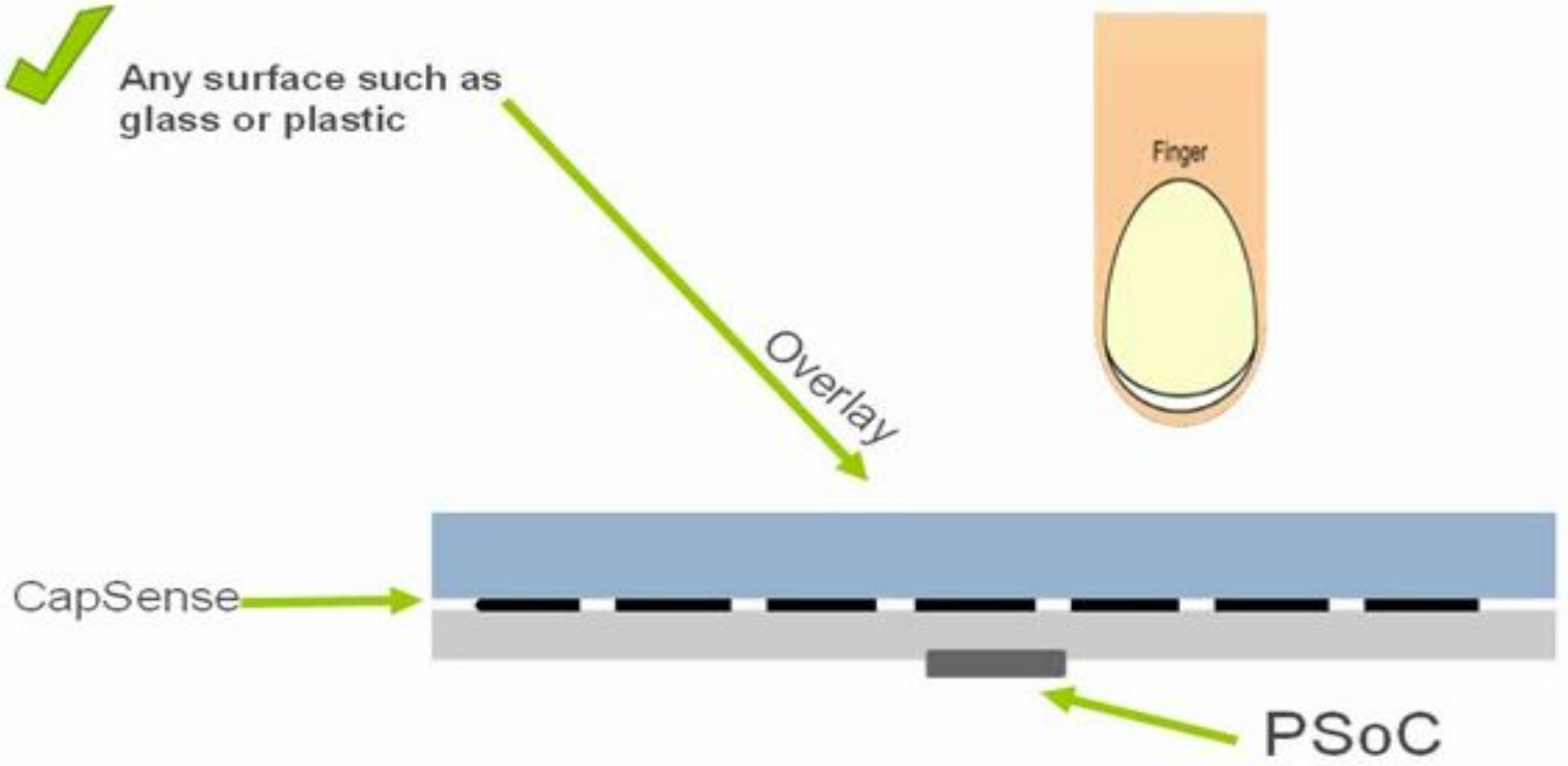
CapSense


FINGER
AIR
$\varepsilon_r = 1$
GLASS OVERLAY
$\varepsilon_r = 8$
FR4
$\varepsilon_r = 4$
COPPER TRACES

CapSense

What is CapSense Touch-Sensing?

CapSense works Everywhere:

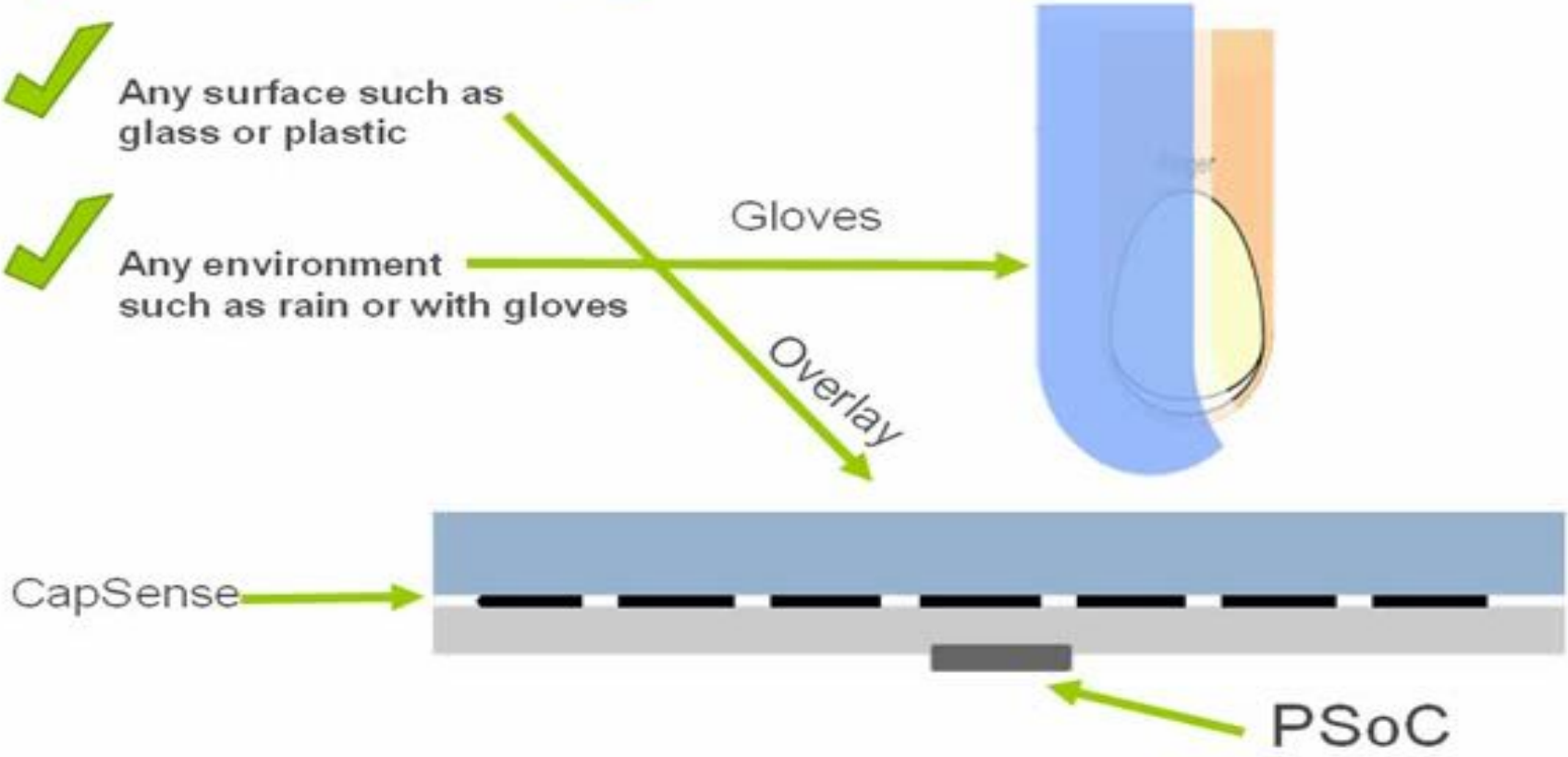


CapSense

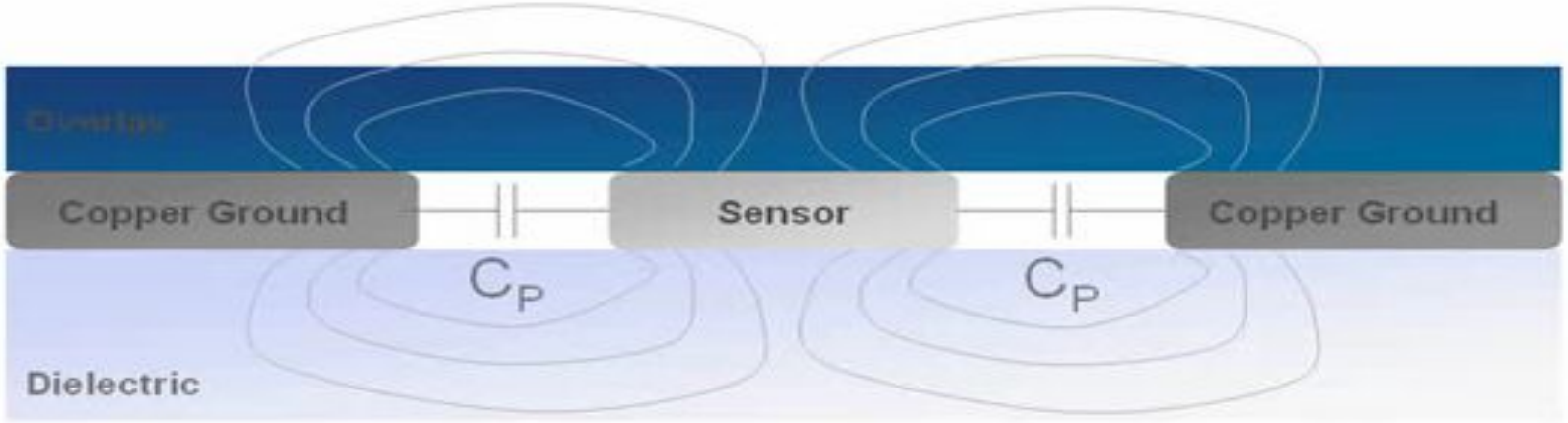
What is CapSense Touch-Sensing?

CapSense works Everywhere:

- Any surface such as glass or plastic
- Any environment such as rain or with gloves

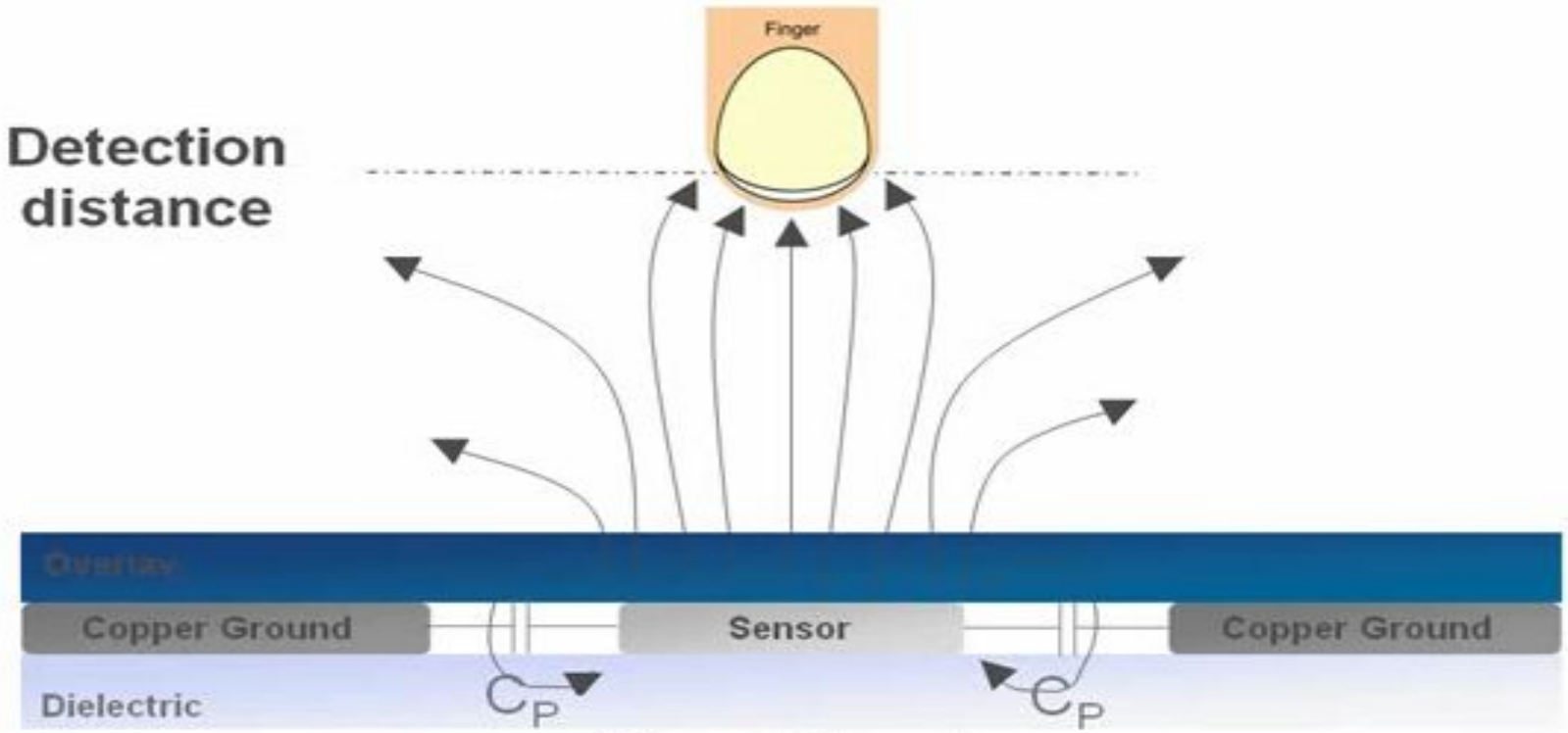


How CapSense Works?



* Diagram not to scale

How CapSense Works?



* Diagram not to scale

How CapSense Works?

Sensor Capacitance = C_X

$C_X = C_P + C_F$

* Diagram not to scale

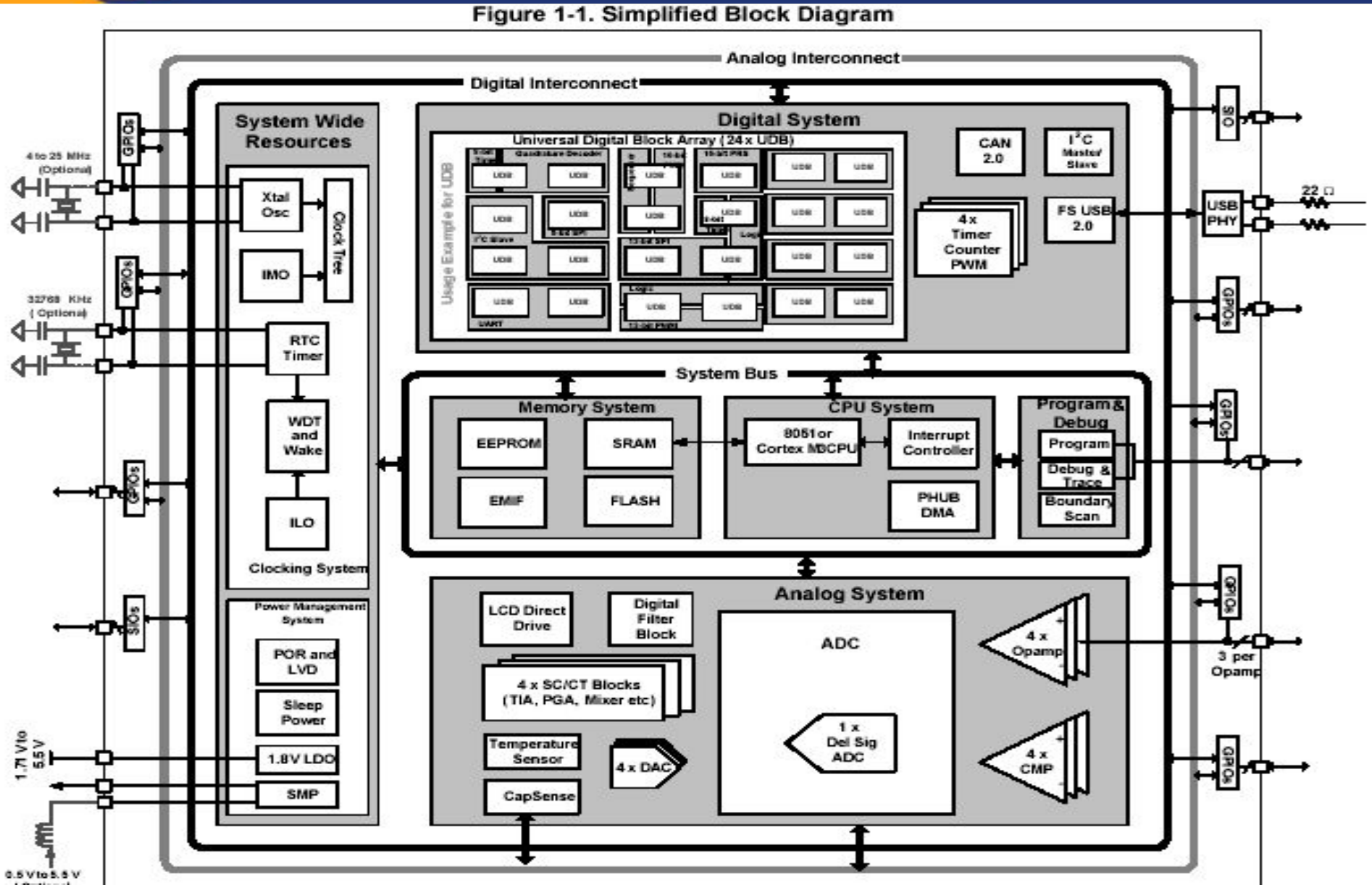
Overview:

Activate and use
the 2 CapSense buttons and linear slider
on the DVK board
and
output the results
to the LCD Character screen and Leds.

Objective:

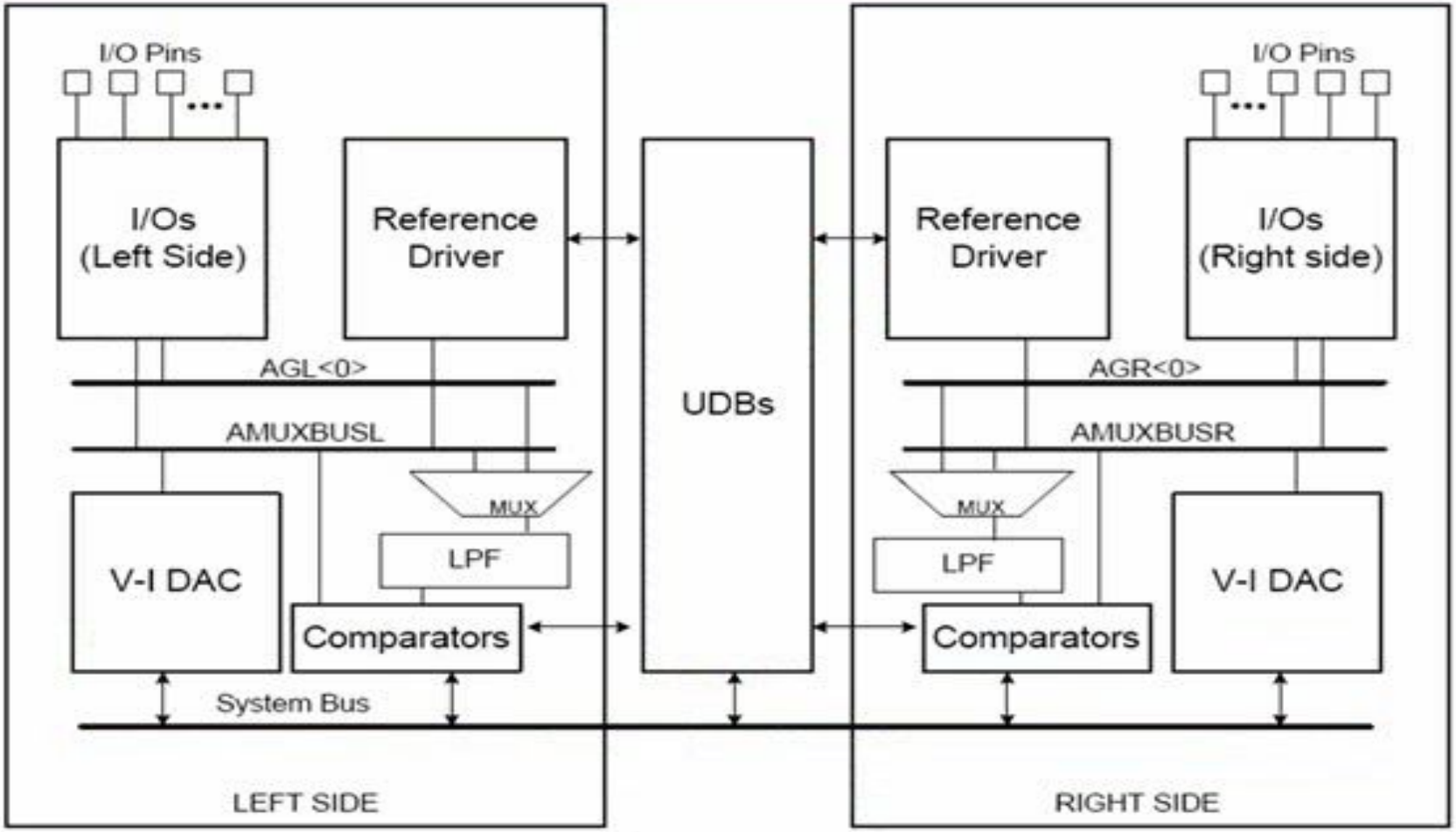
1. For button presses, to indicate which button is on by Leds.
2. For the slider, to display the centered position of the finger on the slider is hexadecimal format and horizontal bar.

Модулі PSoC@3/5



Модулі PSoC@3/5

CapSense in PSoC 3 / PSoC 5



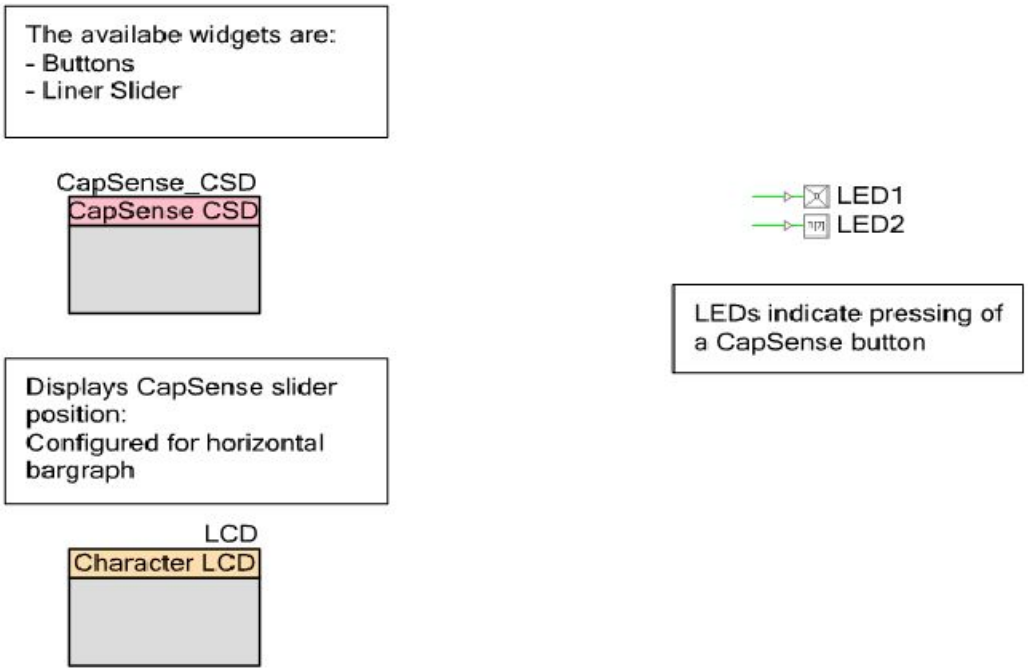
CapSense

Follow the below steps to do this:

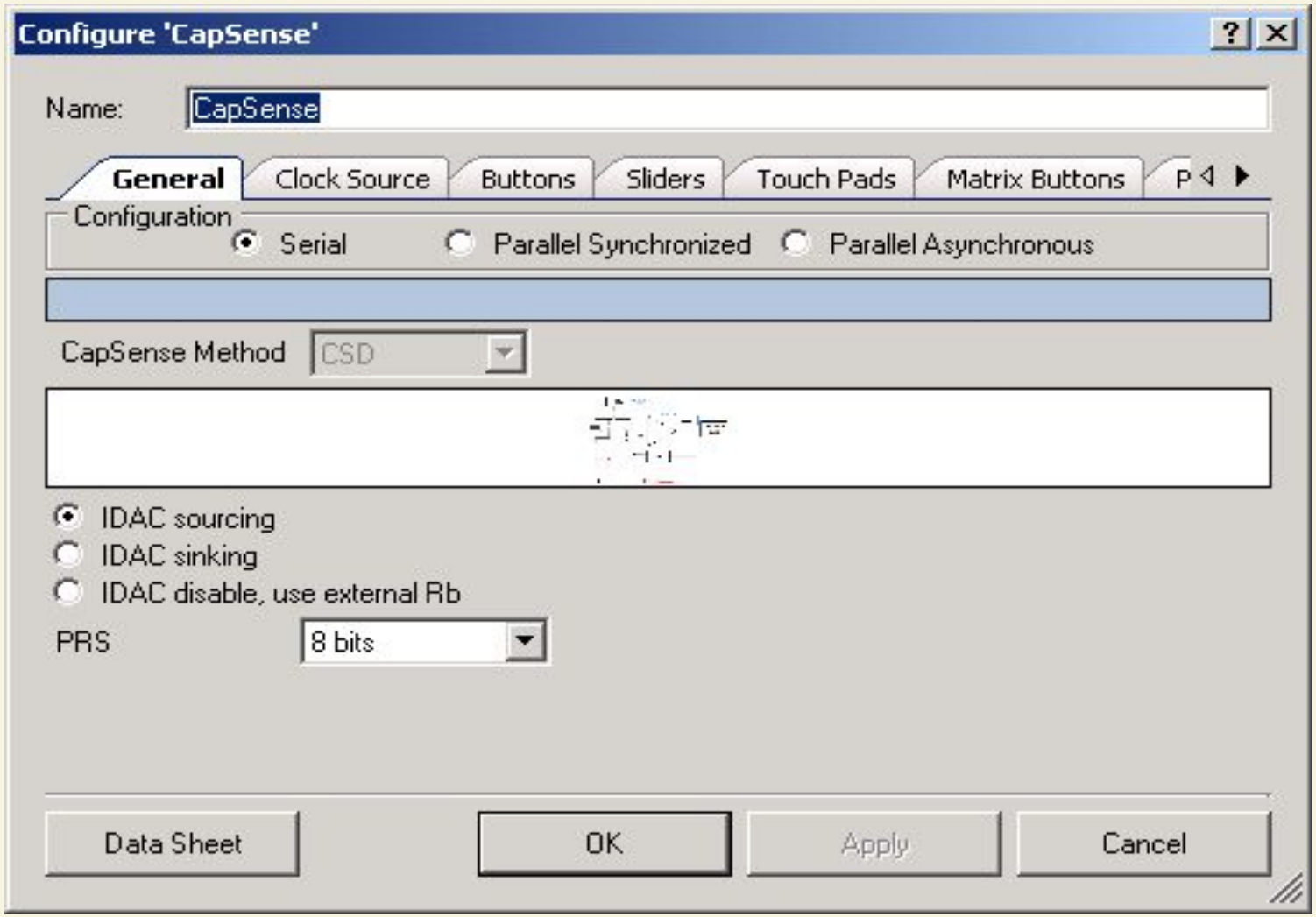
- **The Lab already has the LCD Character component installed and configured.**
- **Add a CapSense component from the component catalog.**
- **In the general tab, configure the CapSense component as in the image below**

Lab_3 CapSense

CapSense_CSD_Design Example Project

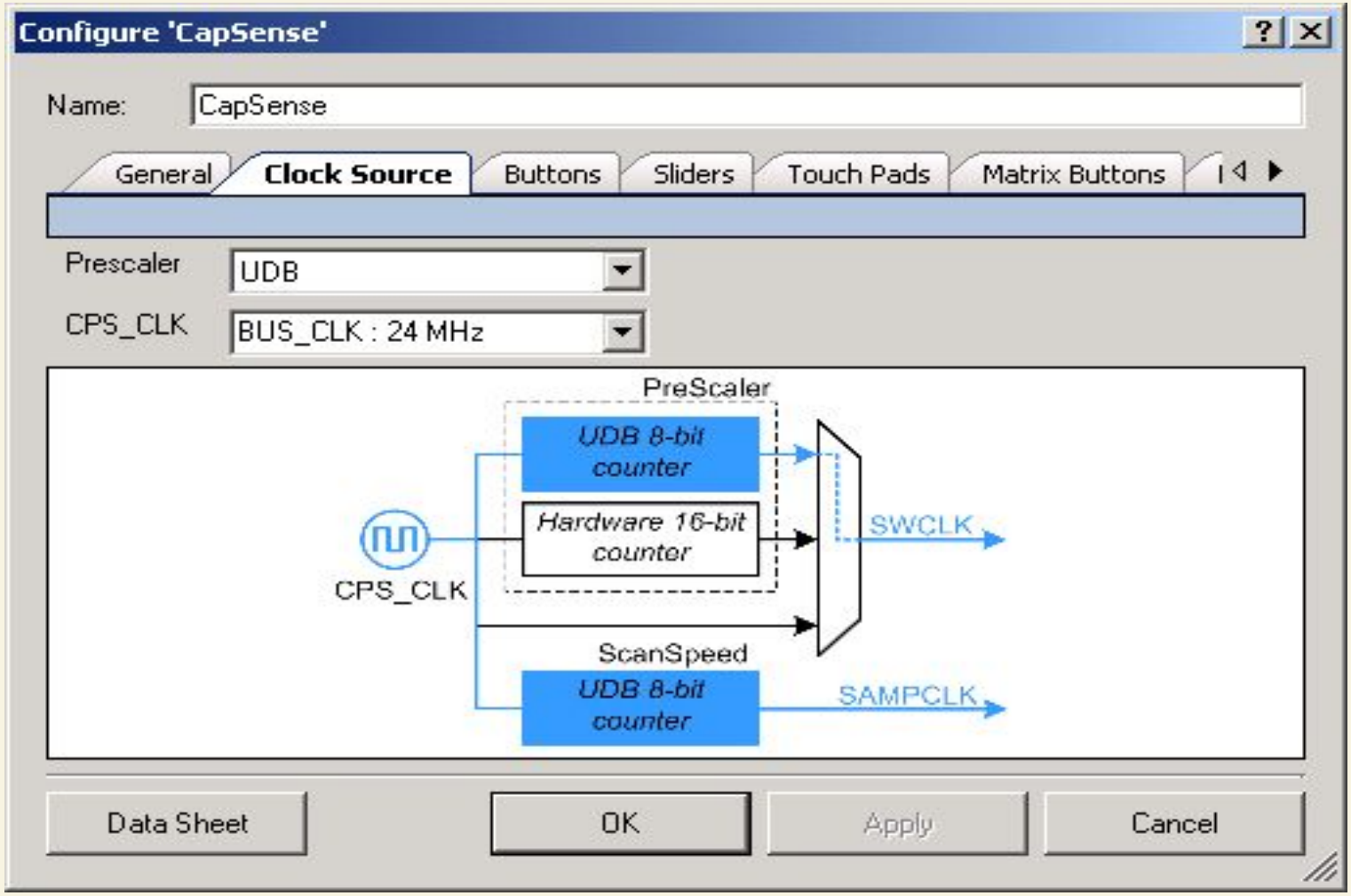


CapSense



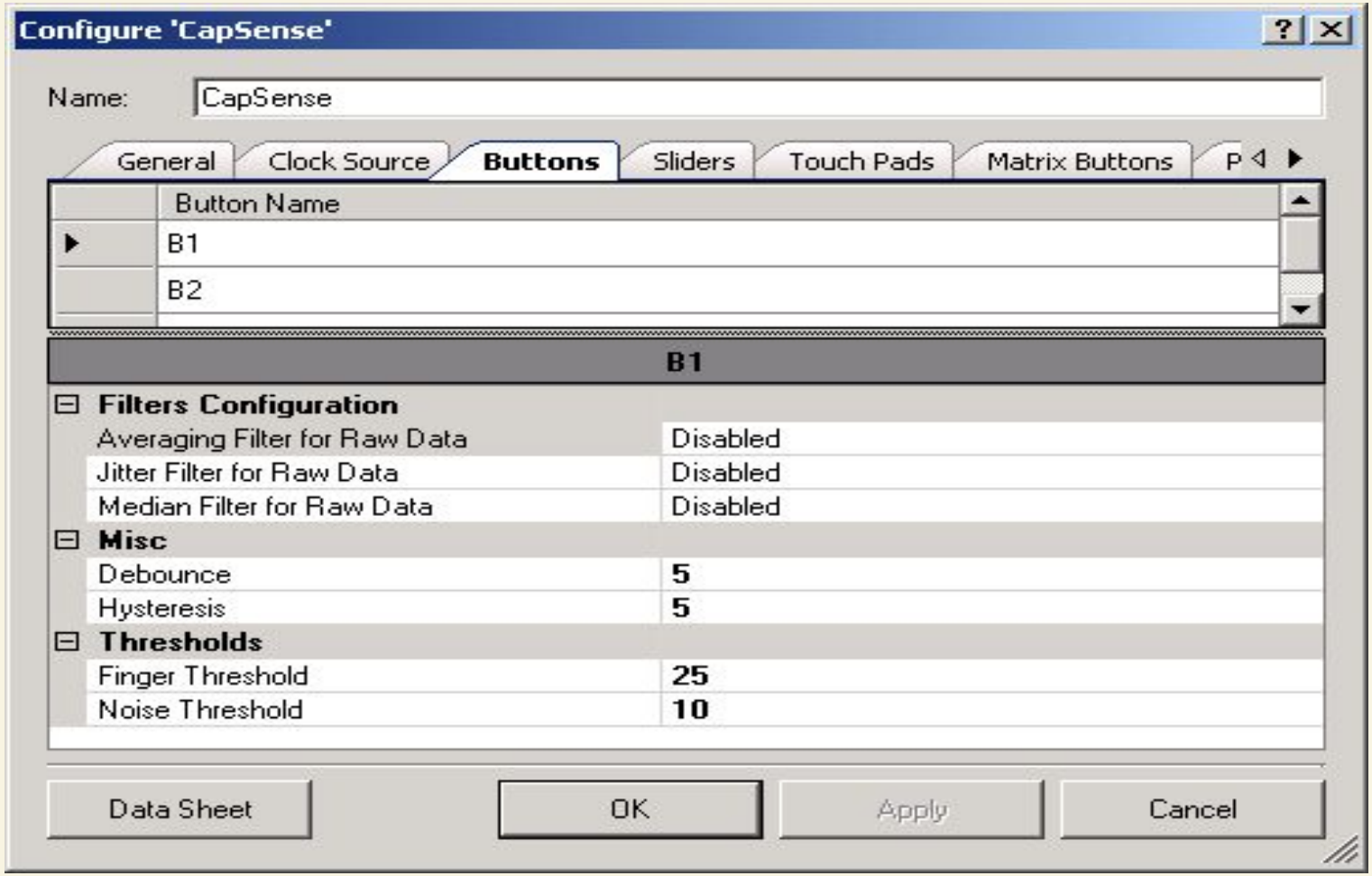
In the general tab configure the CapSense component

CapSense

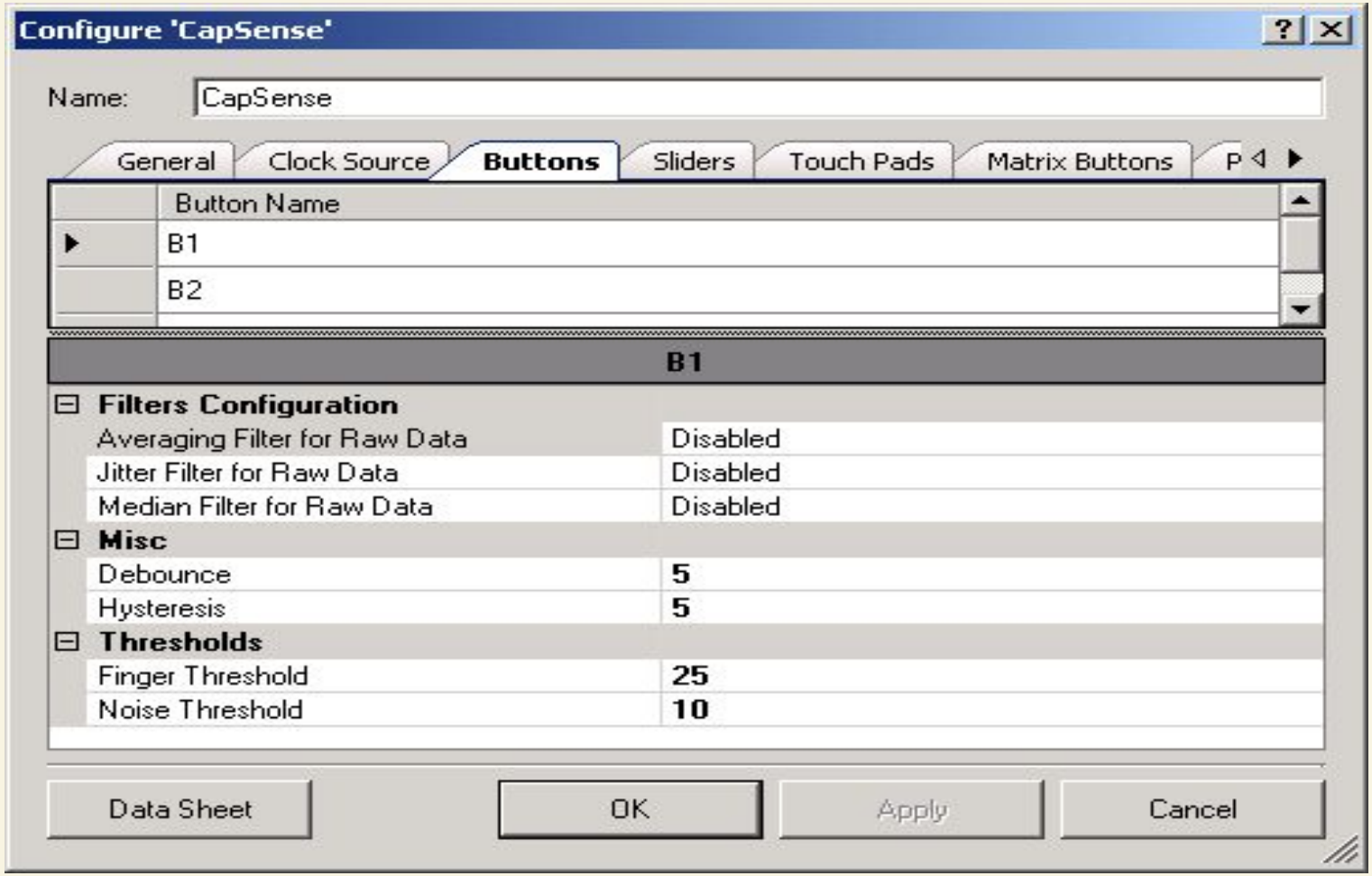


In the clock source tab, configure the CapSense component

CapSense

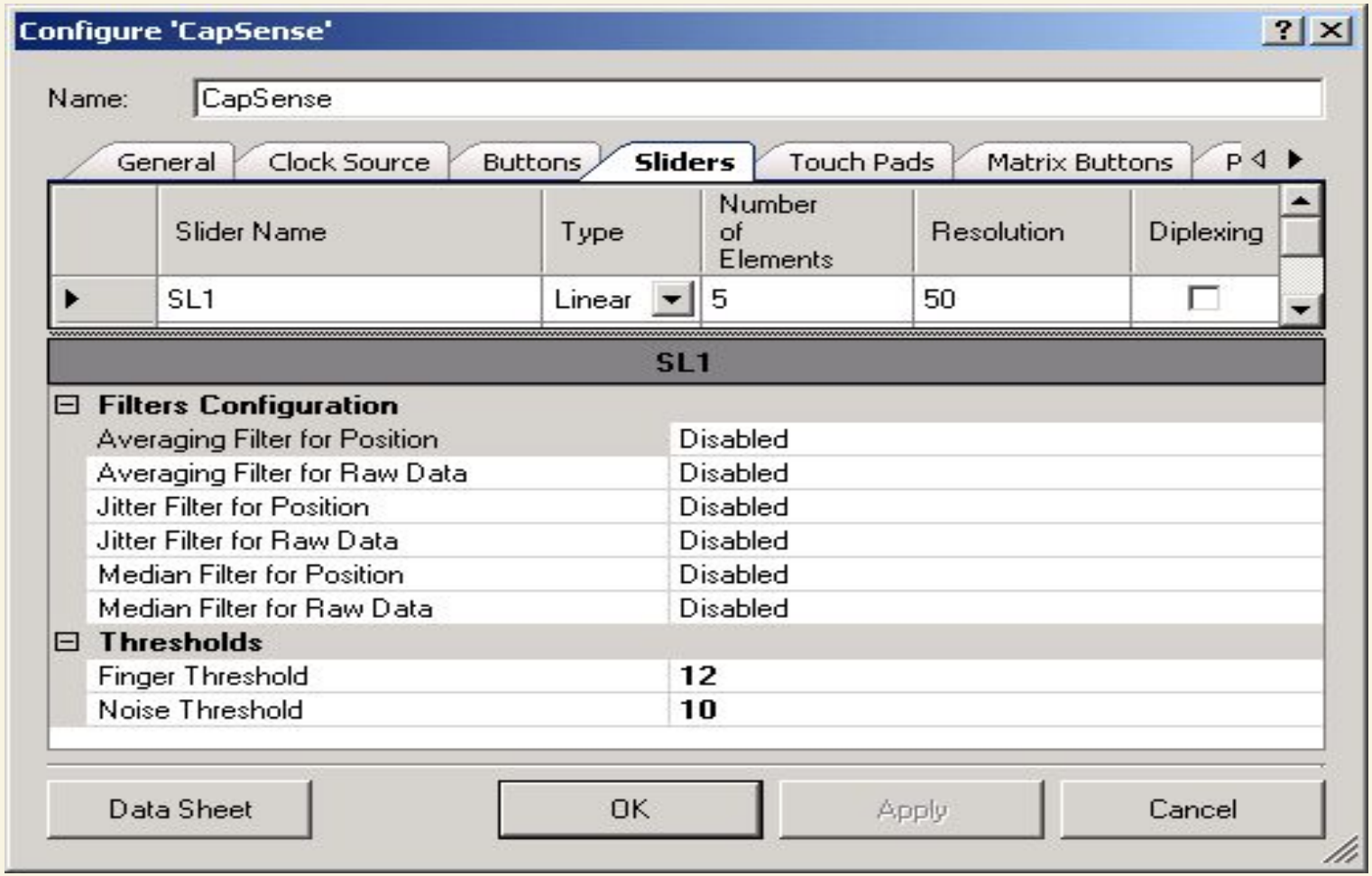

Configure 'CapSense'
Name:
CapSense
General
Clock Source
Buttons
Sliders
Touch Pads
Matrix Buttons
Button Name
B1
B2
B1
Filters Configuration
Averaging Filter for Raw Data
Disabled
Jitter Filter for Raw Data
Disabled
Median Filter for Raw Data
Disabled
Misc
Debounce
5
Hysteresis
5
Thresholds
Finger Threshold
25
Noise Threshold
10
Data Sheet
OK
Apply
Cancel

CapSense



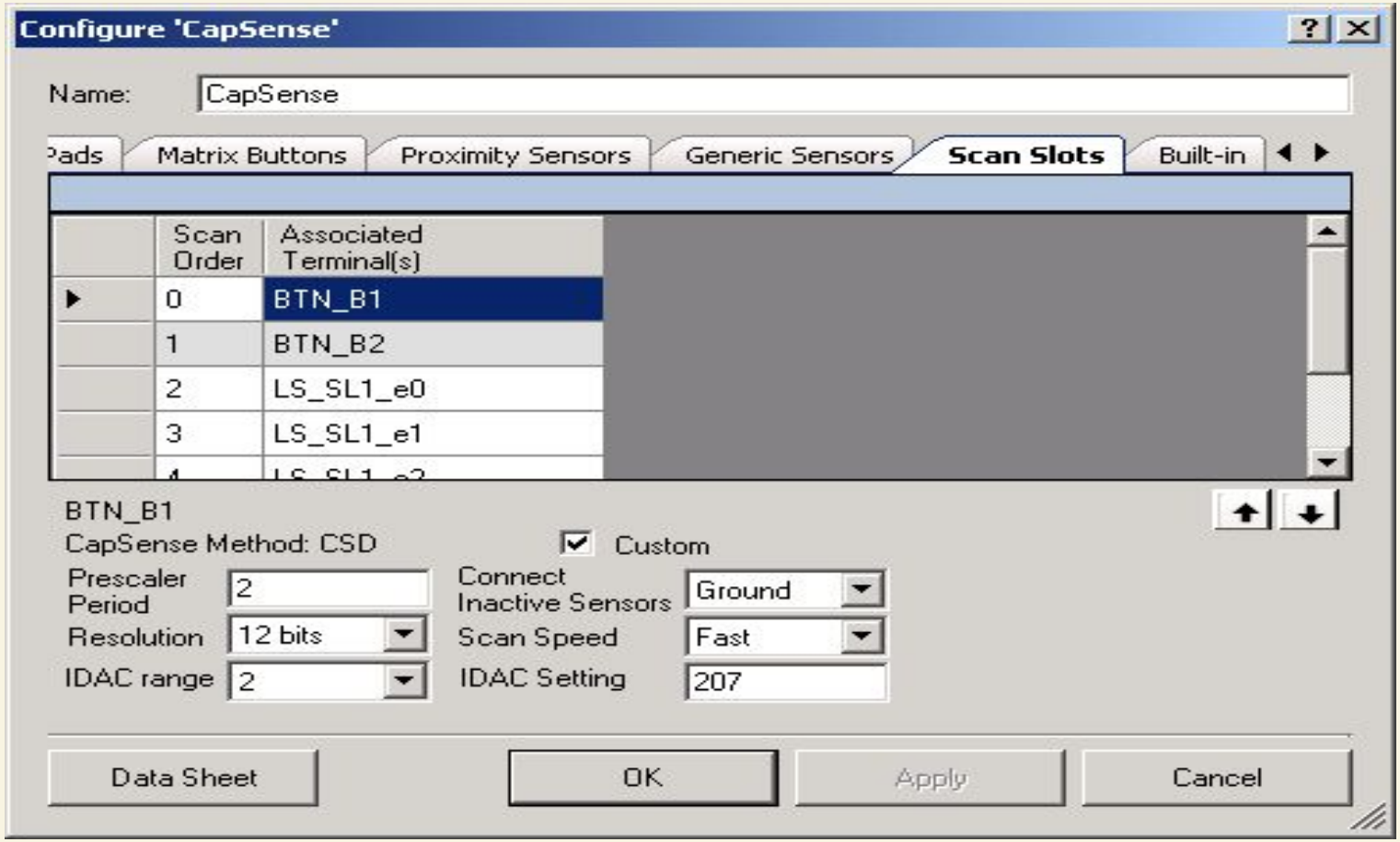
In the buttons tab, configure the component

CapSense

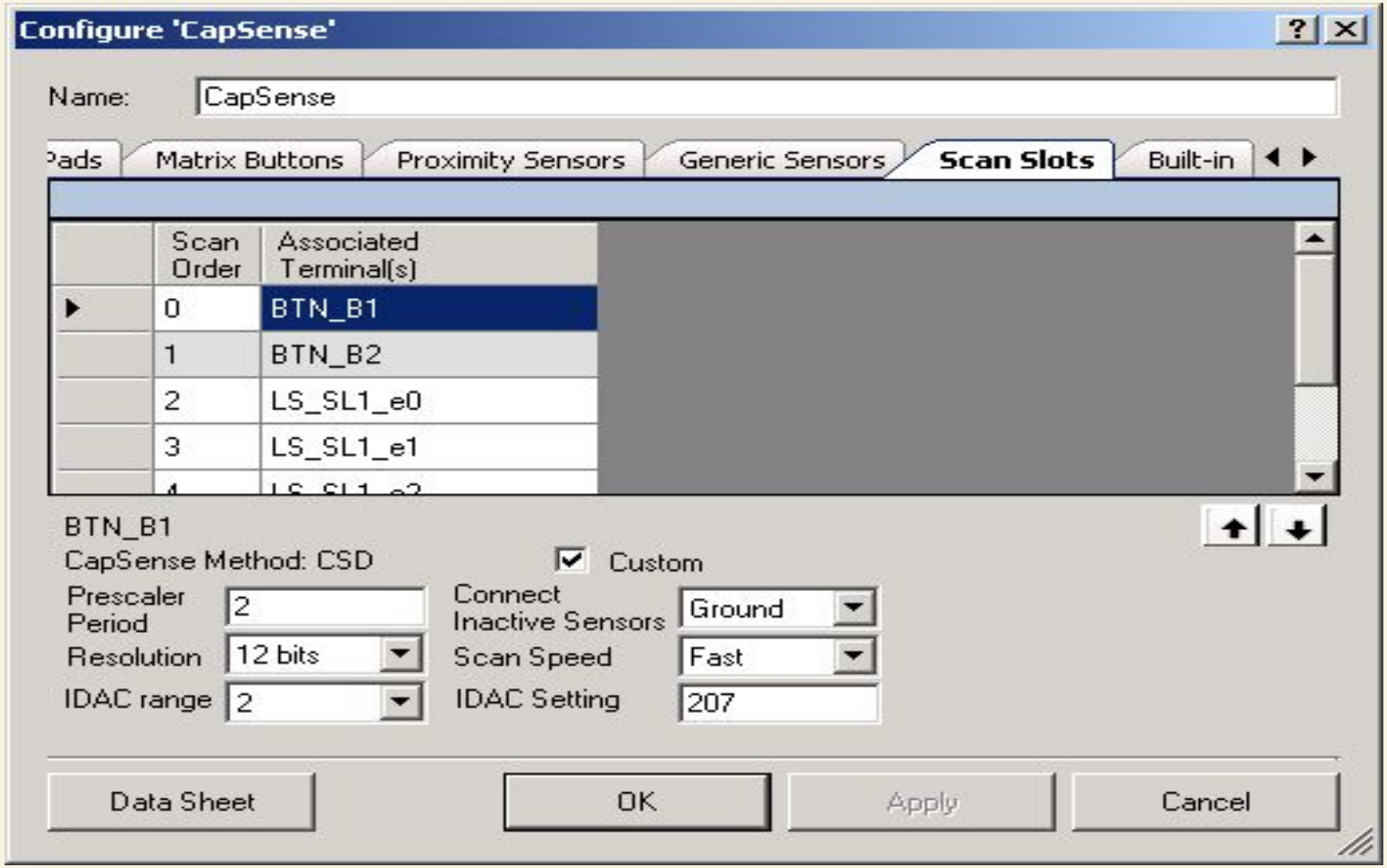


In the sliders tab configure the component

CapSense

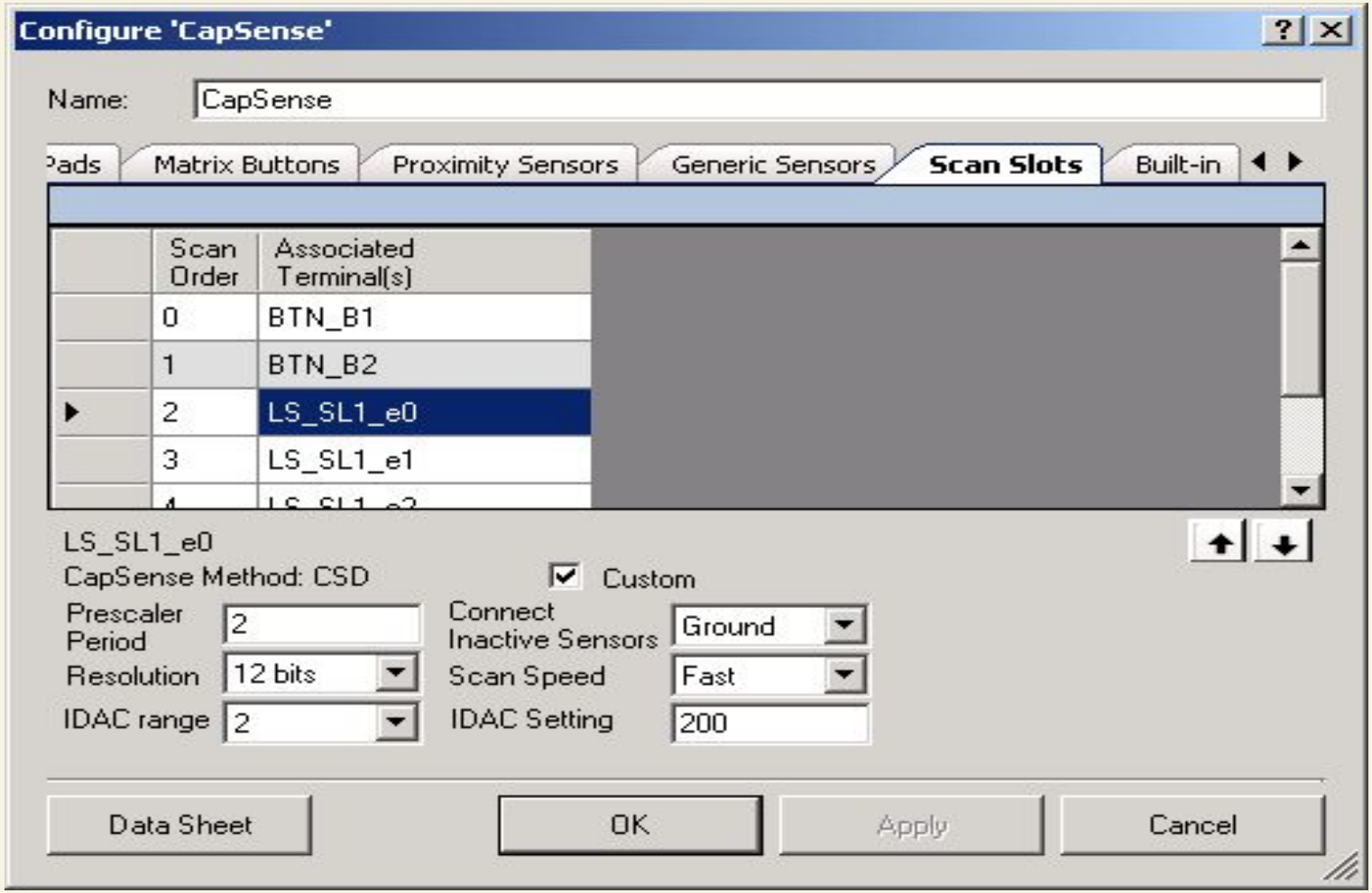

Configure 'CapSense'
Name:
CapSense
Pads
Matrix Buttons
Proximity Sensors
Generic Sensors
Scan Slots
Built-in
Scan Order
Associated Terminal(s)
0
BTN_B1
1
BTN_B2
2
LS_SL1_e0
3
LS_SL1_e1
BTN_B1
CapSense Method: CSD
Custom
Prescaler Period
2
Connect Inactive Sensors
Ground
Resolution
12 bits
Scan Speed
Fast
IDAC range
2
IDAC Setting
207
Data Sheet
OK
Apply
Cancel

CapSense



In the scan slots tab, configure the buttons (BTN_B1 and BTN_B2)

CapSense



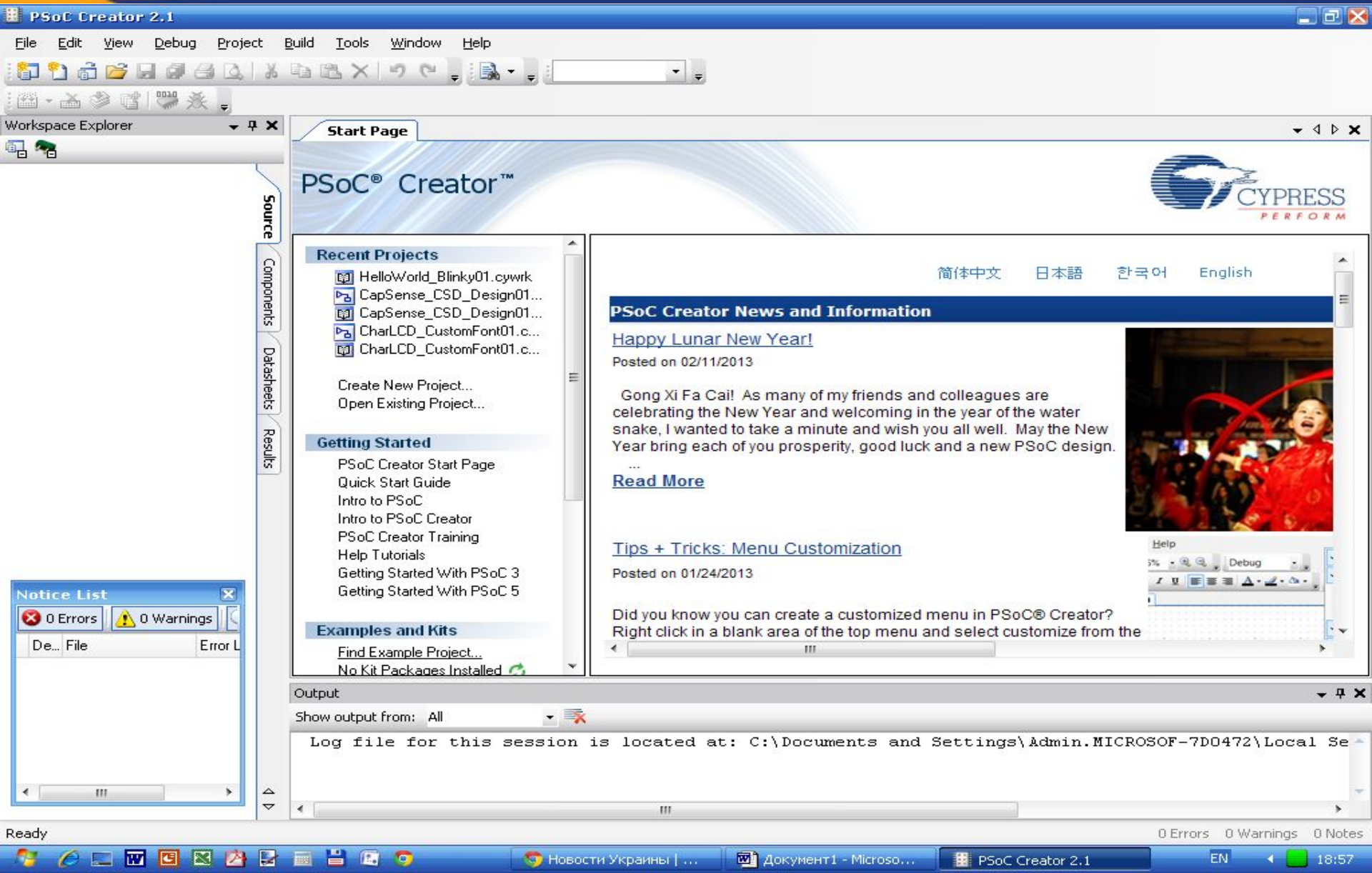
In the scan slots tab configure the slider elements (LS_SL1_e0-to-4)

CapSense

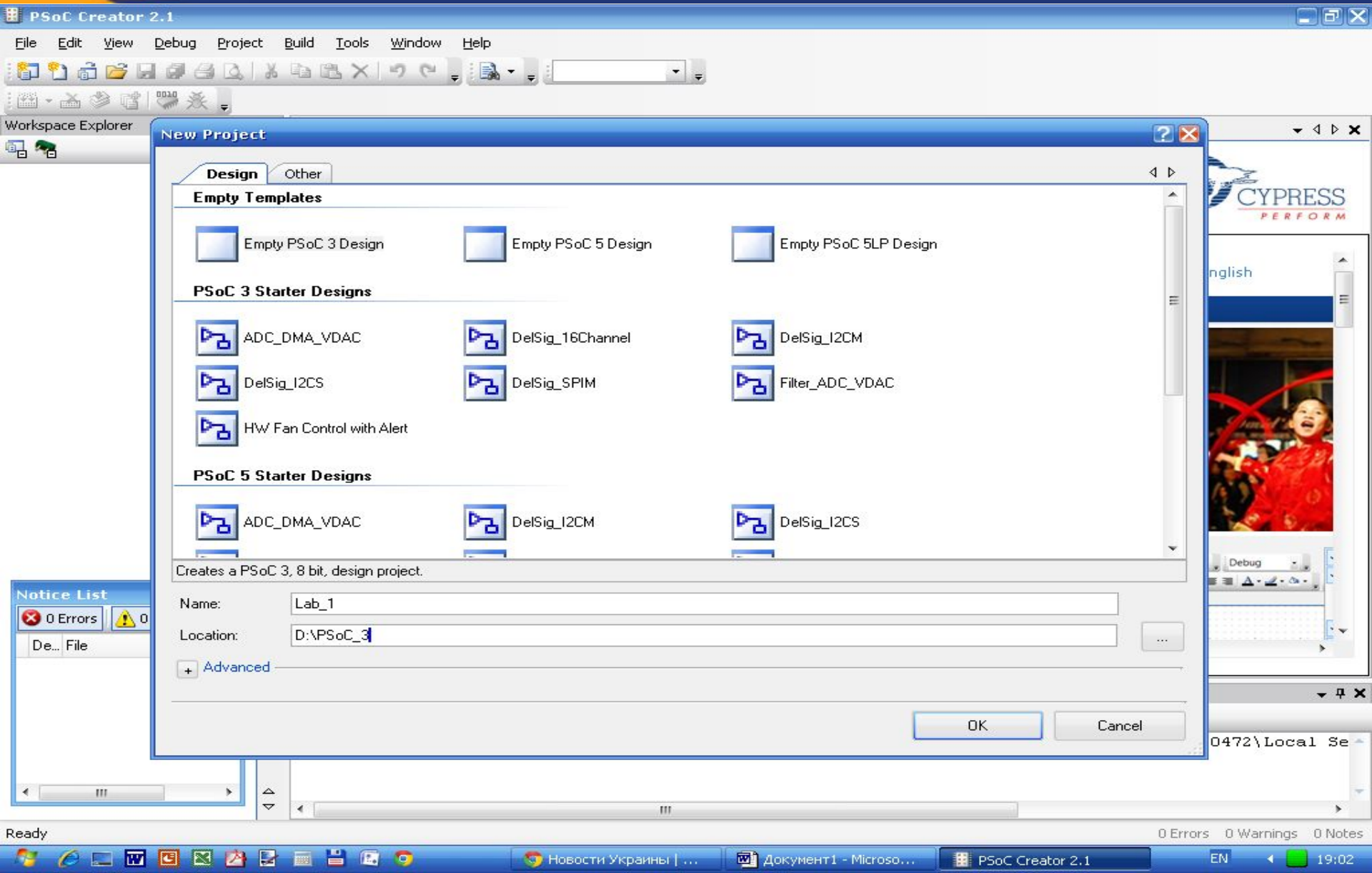
Alias	Name	Pin	Lock	Type
sCmod	CapSense_sbCSD_cCmod	P2[7]	☑	Analog
LS_SL1_e4	CapSense_sbCSD_cPort[6]	P0[4]	☑	Analog
LS_SL1_e3	CapSense_sbCSD_cPort[5]	P0[3]	☑	Analog
LS_SL1_e2	CapSense_sbCSD_cPort[4]	P0[2]	☑	Analog
LS_SL1_e1	CapSense_sbCSD_cPort[3]	P0[1]	☑	Analog
LS_SL1_e0	CapSense_sbCSD_cPort[2]	P0[0]	☑	Analog
BTN_B2	CapSense_sbCSD_cPort[1]	P0[6]	☑	Analog
BTN_B1	CapSense_sbCSD_cPort[0]	P0[5]	☑	Analog
	LCD_LCDPort[6:0]	P2[6:0]	☑	Digital Output

Configure the pins tab in the .cydwr file

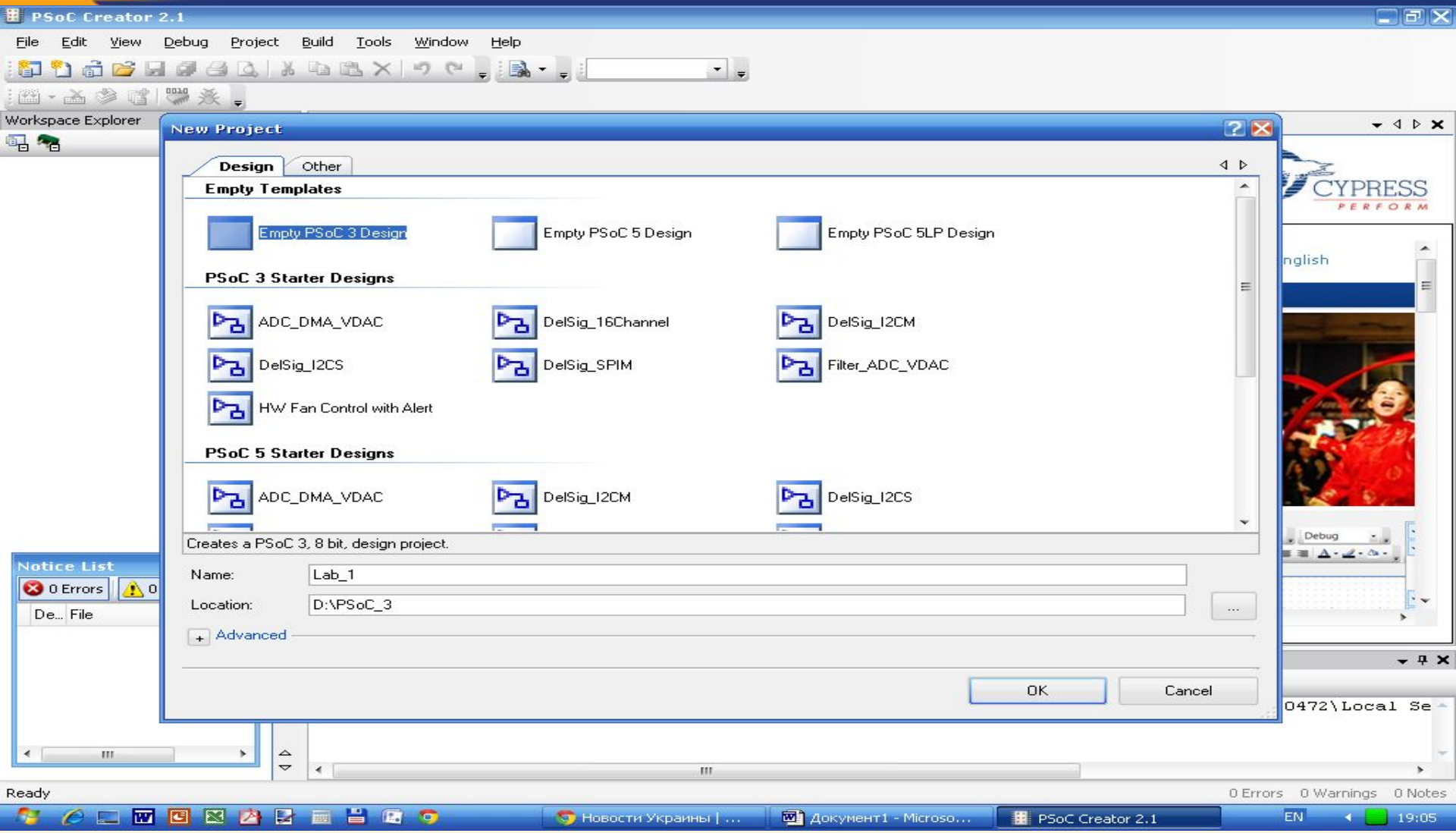
Creator


PSoC Creator 2.1
File Edit View Debug Project Build Tools Window Help
Workspace Explorer
Source
Components
Datasheets
Results
Start Page
PSoC® Creator™
CYPRESS PERFORM
Recent Projects
HelloWorld_Blinky01.cywrk
CapSense_CSD_Design01...
CapSense_CSD_Design01...
CharLCD_CustomFont01.c...
CharLCD_CustomFont01.c...
Create New Project...
Open Existing Project...
Getting Started
PSoC Creator Start Page
Quick Start Guide
Intro to PSoC
Intro to PSoC Creator
PSoC Creator Training
Help Tutorials
Getting Started With PSoC 3
Getting Started With PSoC 5
Examples and Kits
Find Example Project...
No Kit Packages Installed
简体中文 日本語 한국어 English
PSoC Creator News and Information
Happy Lunar New Year!
Posted on 02/11/2013
Gong Xi Fa Cai! As many of my friends and colleagues are celebrating the New Year and welcoming in the year of the water snake, I wanted to take a minute and wish you all well. May the New Year bring each of you prosperity, good luck and a new PSoC design.
...
Read More
Tips + Tricks: Menu Customization
Posted on 01/24/2013
Did you know you can create a customized menu in PSoC® Creator? Right click in a blank area of the top menu and select customize from the
Notice List
0 Errors
0 Warnings
De... File Error L
Output
Show output from: All
Log file for this session is located at: C:\Documents and Settings\Admin.MICROSOF-7D0472\Local Se
Ready
0 Errors 0 Warnings 0 Notes
Новости Украины | ...
Документ1 - Microso...
PSoC Creator 2.1
EN
18:57

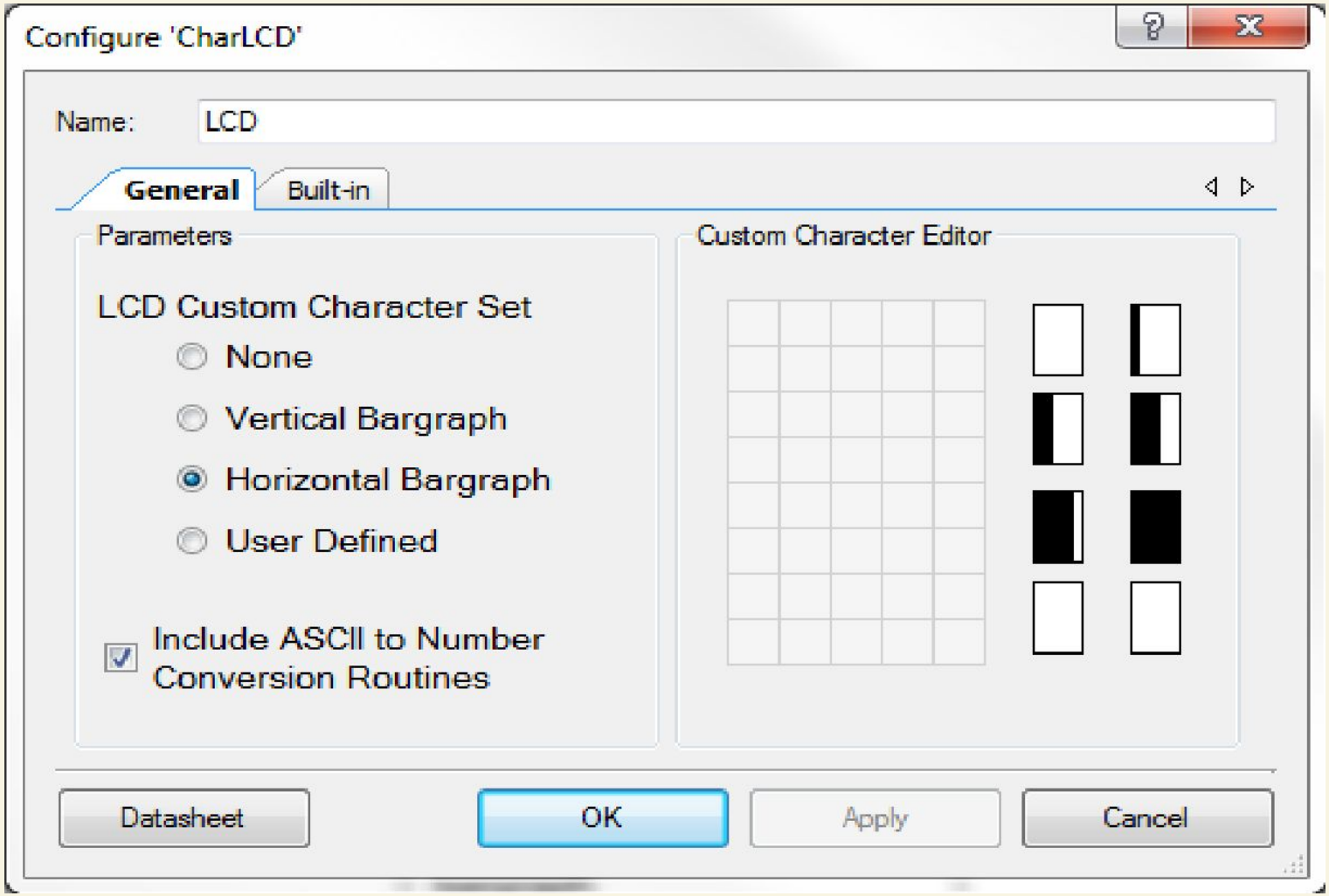
File – New - Projekt



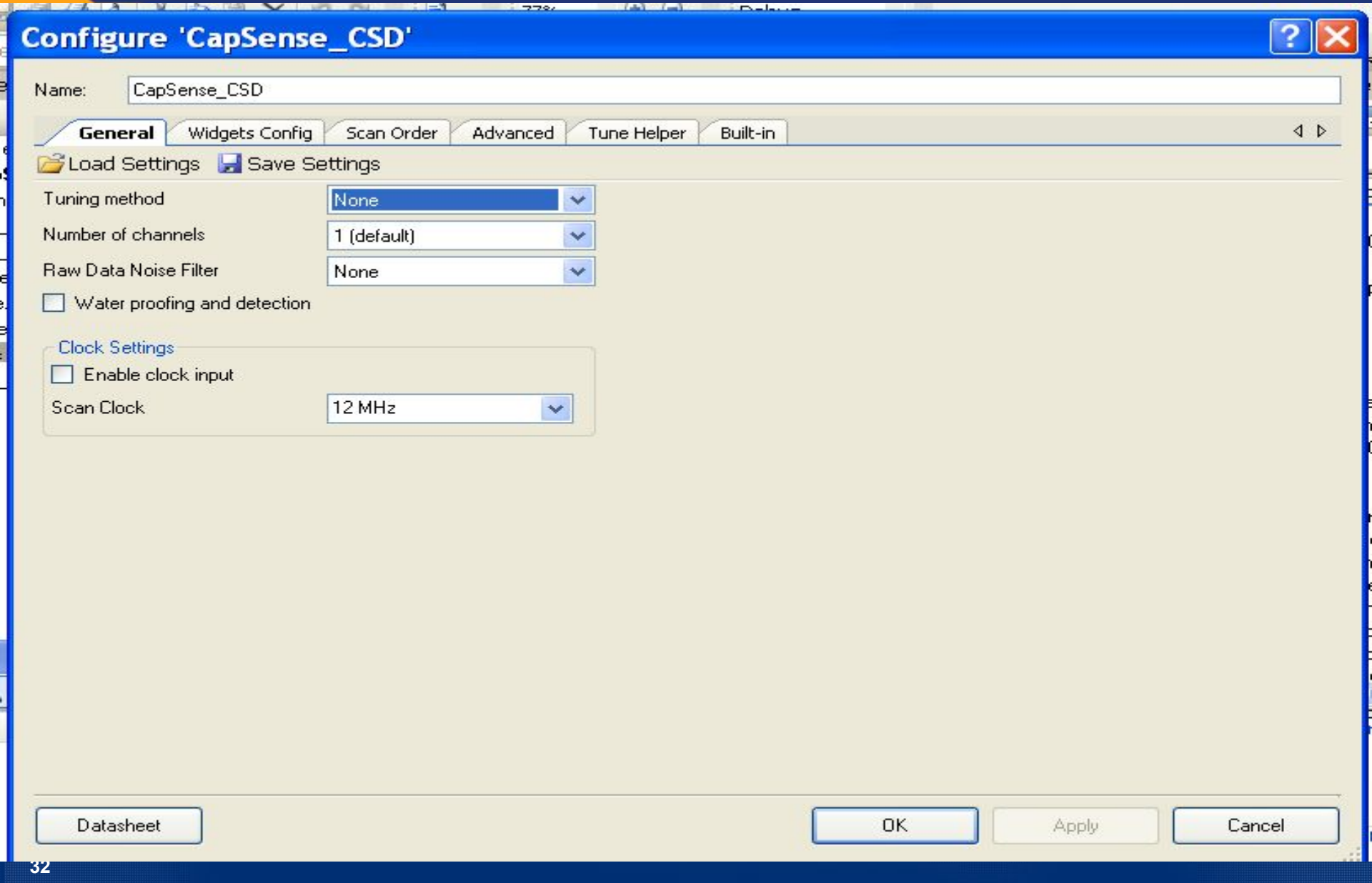
Empty PSoC 3 Design



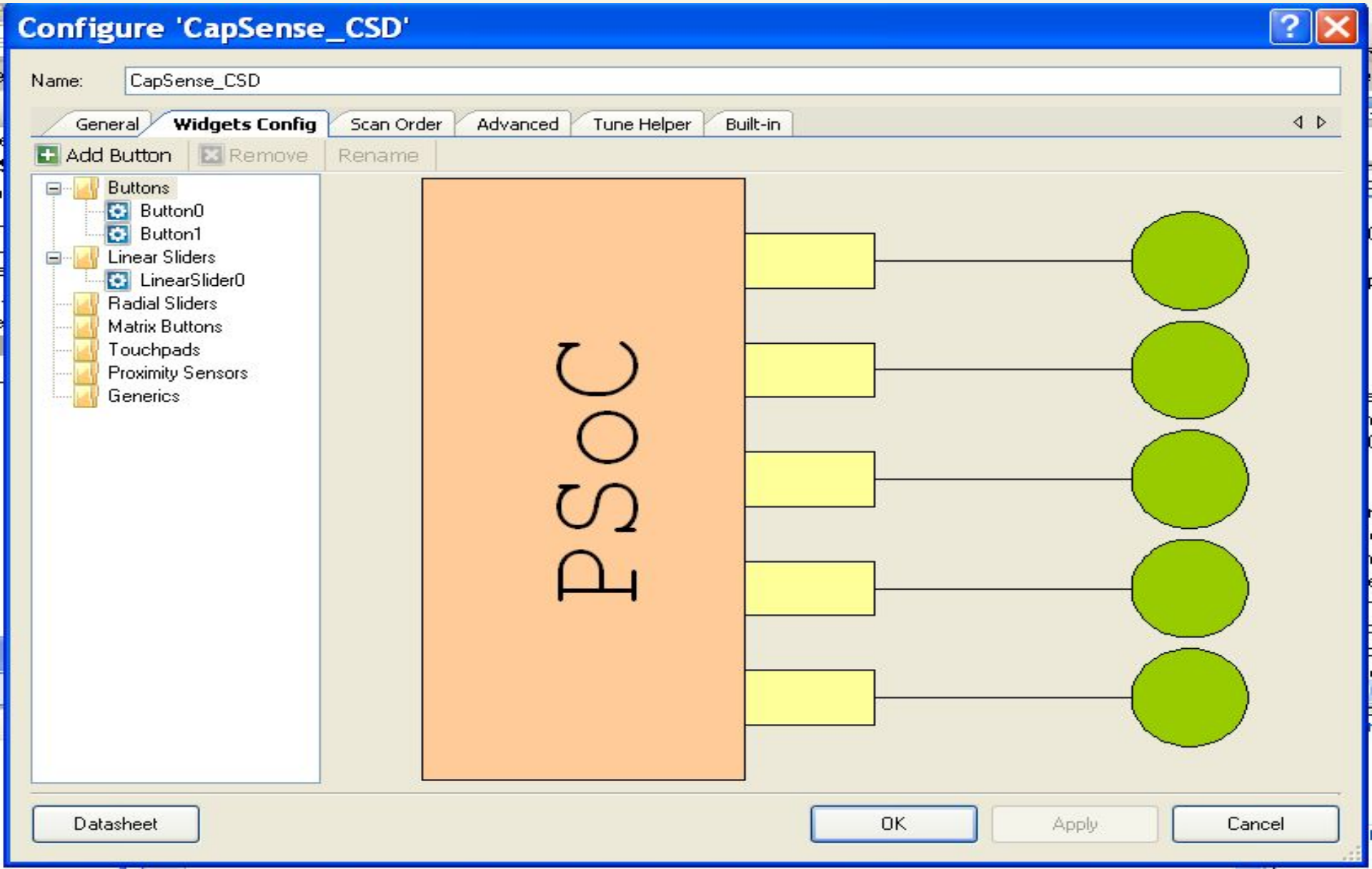
Configure LCD



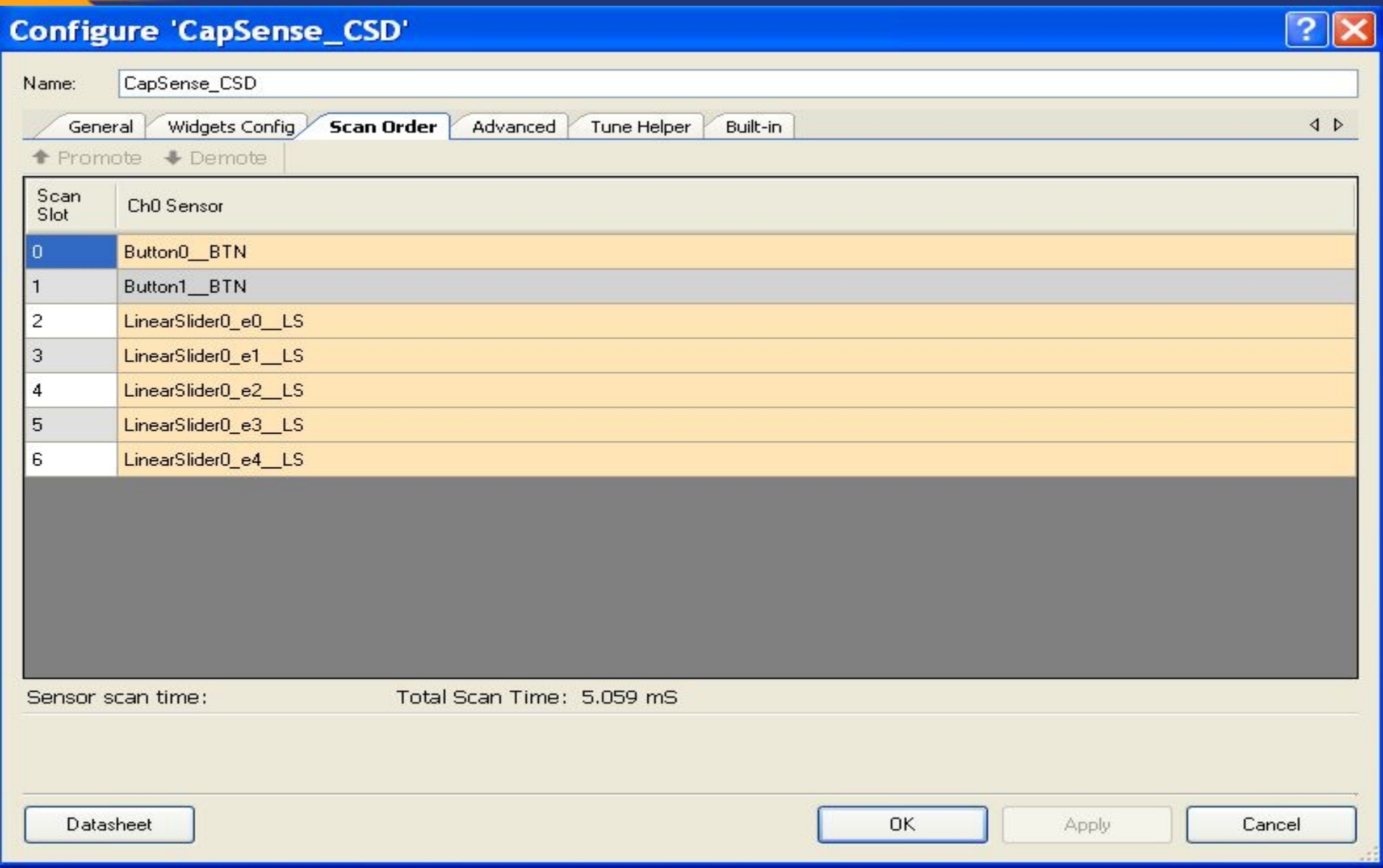
Configure CSD



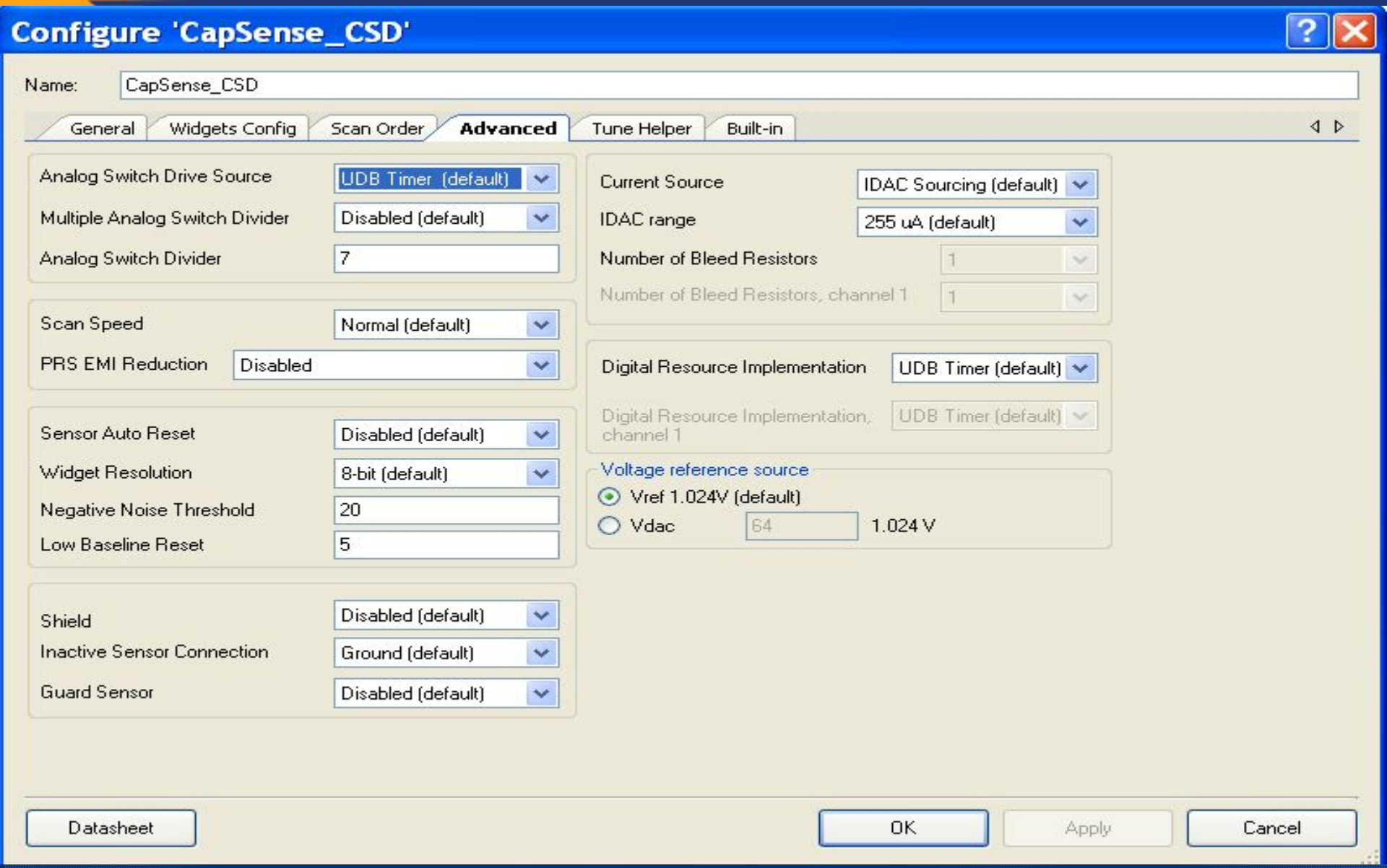
Configure CSD



Configure CSD



Configure CSD



Configure CSD

For CY8CKIT-030 and CY8CKIT-050: Reassign the CapSense LinearSlider and Buttons in the 'Pins' tab of the Design-wide Resources file to port 5. To be precise, reassign the 5 Slider segments to P5[4:0], Button0 to P5[5], and Button1 to P5[6]. Also ensure that the Cmod capacitor is assigned to P6[4] in the pins tab of the Design Wide Resources (.cydwr) file in PSoC Creator.

Lab_3.cywr

Alias	Name	Port	Pin	Loc
Cmod_CH0	\CapSense_CSD:CmodCH0\	P6[4]	6	✓
Button0__BTN	\CapSense_CSD:PortCH0[0]\	P5[5]	32	✓
Button1__BTN	\CapSense_CSD:PortCH0[1]\	P5[6]	33	✓
LinearSlider0_e0__LS	\CapSense_CSD:PortCH0[2]\	P5[0]	16	✓
LinearSlider0_e1__LS	\CapSense_CSD:PortCH0[3]\	P5[1]	17	✓
LinearSlider0_e2__LS	\CapSense_CSD:PortCH0[4]\	P5[2]	18	✓
LinearSlider0_e3__LS	\CapSense_CSD:PortCH0[5]\	P5[3]	19	✓
LinearSlider0_e4__LS	\CapSense_CSD:PortCH0[6]\	P5[4]	31	✓
	\LCD:LCDPort[6:0]\	P2[6:0]	95..99,1..2	✓
	LED1	P12[6]	29	✓
	LED2	P12[7]	30	✓

LED2_0 - Digital

Lab_3 Main.c

```
/*******************************************************************************
* File Name: main.c
*
* Version: 1.00
*
* Description:
*  The project explains the usage of CapSense CSD component. The 2 buttons and
*  linear sliders are used as sensing elements. LED displays buttons active
*  state and slider position is shown on LCD.
*
********************************************************************************
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* CYPRESS AND ITS SUPPLIERS MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED,
* WITH REGARD TO THIS SOFTWARE, INCLUDING, BUT NOT LIMITED TO, NONINFRINGEMENT,
* IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.
*******************************************************************************/

#include <device.h>

/* Needed for Bargraph */
extern uint8 const CYCODE LCD_customFonts[];

```

Lab_3 Main.c_2

```
26
27  uint16 curPos, oldPos;
28
29  /*******************************************************************************
30  * Function Name: main
31  ********************************************************************************
32  * Summary:
33  *  Main function performs following functions:
34  *   1. Enable global interrupts.
35  *   2. Initialize CapSense CSD and Start the sensor scanning loop.
36  *   3. Process scanning results and display it on LCD/LED.
37  * Parameters:
38  *  None
39  * Return:
40  *  None
41  *******************************************************************************/
42  void main()
43  {
44      LCD_Start();
45      CapSense_CSD_Start();
46
47      /* The custom fonts for the bargraph need to be manually loaded */
48      LCD_LoadCustomFonts(LCD_customFonts);
49
50      LCD_Position(0u, 0u);
51      LCD_PrintString("CSD01");
```

Lab_3 Main.c_3

```
50      LCD_Position(0u, 0u);
51      LCD_PrintString("CSD01");
52
53      /* Enable global interrupts */
54      CyGlobalIntEnable;
55
56      /* Initialize baselines */
57      CapSense_CSD_InitializeAllBaselines();
58
59      while(1u)
60      {
61          /* Update all baselines */
62          CapSense_CSD_UpdateEnabledBaselines();
63
64          /* Start scanning all enabled sensors */
65          CapSense_CSD_ScanEnabledWidgets();
66
67          /* Wait for scanning to complete */
68          while(CapSense_CSD_IsBusy() != 0);
69
70          /* Display CapSense state using LED/LCD */
71          CapSense_DisplayState();
72      }
73  }
74
```

Lab_3 Main.c_4

```
75  /*******************************************************************************
76  * Function Name: CapSense_DisplayState
77  ********************************************************************************
78  * Summary:
79  *  Function performs following functions:
80  *   Display Buttons' state using LEDs and Slider state using LCD bargraph
81  *
82  * Parameters:
83  *  None
84  *
85  * Return:
86  *  None
87  *
88  *******************************************************************************/
89  void CapSense_DisplayState(void)
90  {
91      /* Display BUTTON0 state */
92      if (CapSense_CSD_CheckIsWidgetActive(CapSense_CSD_BUTTON0__BTN))
93      {
94          LED1_Write(1u);
95      }
96      else
97      {
98          LED1_Write(0u);
99      }
100
```

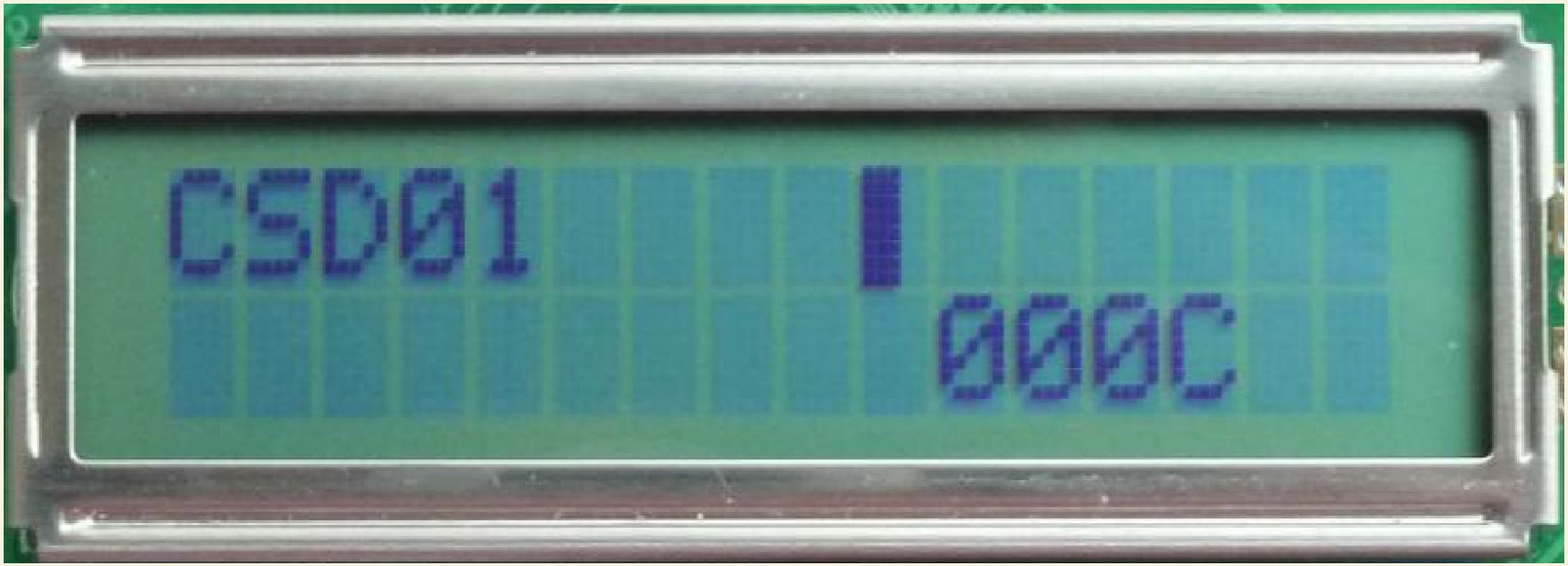
Lab_3 Main.c_5

```
100
101     /* Display BUTTON1 state */
102     if (CapSense_CSD_CheckIsWidgetActive(CapSense_CSD_BUTTON1__BTN))
103     {
104         LED2_Write(1u);
105     }
106     else
107     {
108         LED2_Write(0u);
109     }
110
111     /* Find Slider Position */
112     curPos = CapSense_CSD_GetCentroidPos(CapSense_CSD_LINEARSLIDER0__LS);
113
114     /* Reset position */
115     if(curPos == 0xFFFFu)
116     {
117         curPos = 0u;
118     }
119
120     /* Move bargraph */
121     if (curPos != oldPos)
122     {
123         oldPos = curPos;
124         /* Display Slider bargraph */
125         if (curPos != 0u)
```

Lab_3 Main.c_6

```
114     /* Reset position */
115     if(curPos == 0xFFFFu)
116     {
117         curPos = 0u;
118     }
119
120     /* Move bargraph */
121     if (curPos != oldPos)
122     {
123         oldPos = curPos;
124         /* Display Slider bargraph */
125         if (curPos != 0u)
126         {
127             LCD_DrawHorizontalBG(0u, 9u, 6u, curPos >> 2);
128         }
129
130         /* Display Slider position value */
131         LCD_Position(1u, 10u);
132         LCD_PrintInt16(curPos);
133     }
134 }
135
136
137 /* [] END OF FILE */
138
```

Lab_3 CapSense



Expected output on LCD

References

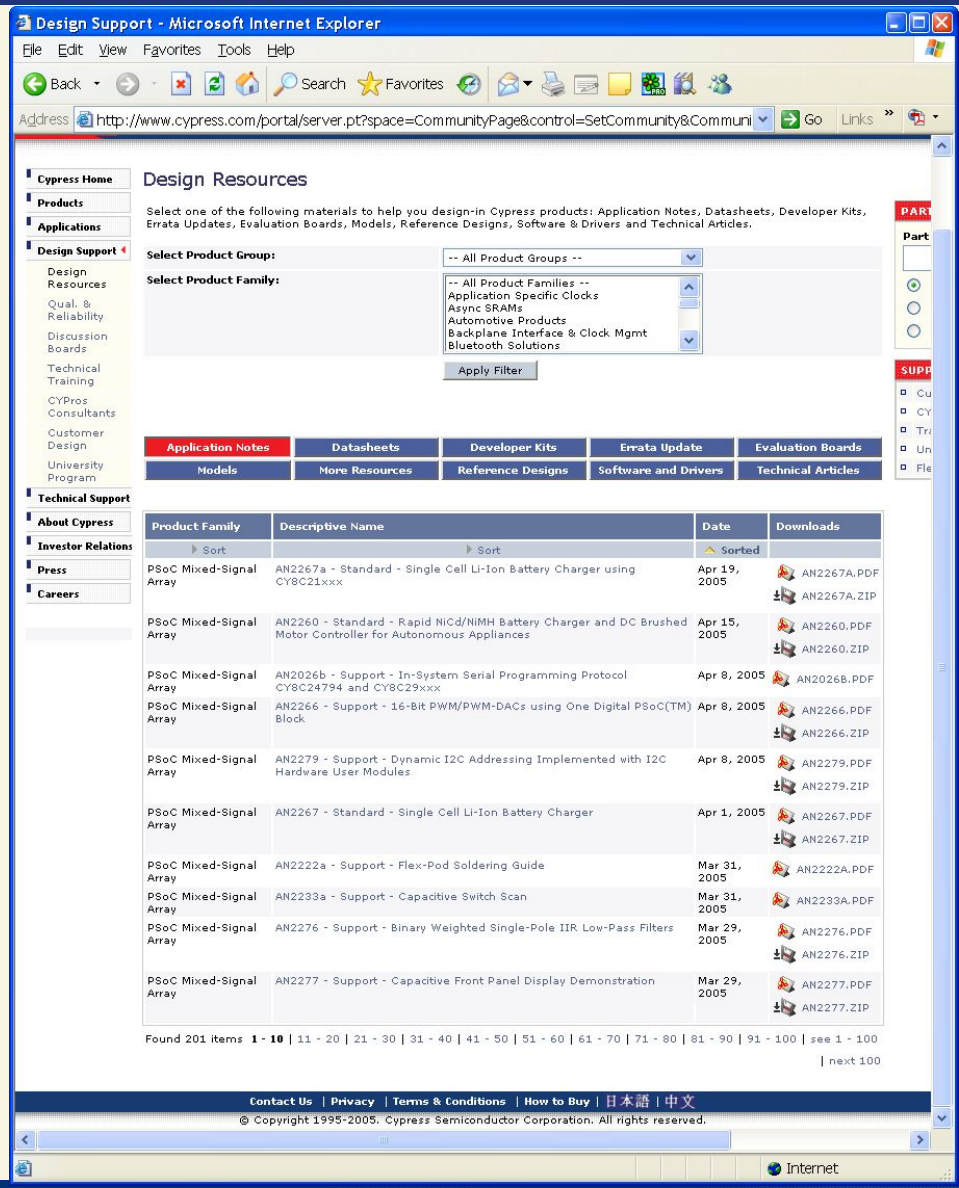
[1] Application Note AN2233a, "Capacitive Switch Scan," Cypress Semiconductor
[2] Application Note AN2403, "Signal-to-Noise Ratio Requirement for CapSense Applications," Cypress Semiconductor
[3] Application Note AN2292, "Layout Guidelines for PSoC CapSense," Cypress Semiconductor
[4] Application Note AN2398, "Waterproof Capacitive Sensing," Cypress Semiconductor
[5] Application Note AN2360, "Power Consumption and Sleep Considerations with CapSense," Cypress Semiconductor

References (continue)

[6] Application Note AN2318, "EMC Design Considerations for PSoC CapSense Applications," Cypress Semiconductor
[7] Application Note AN2394, "CapSense Best Practices," Cypress Semiconductor
[8] Application Note AN2397, "CapSense Data Viewing Tool," Cypress Semiconductor

Приклади застосування МК PSOC

На сайті фірми Cypress знаходиться більше 200 Application Notes і Reference Designs, які ілюструють області застосування мікроконтролерів PSoC.



Мікропроцесорна техніка

(лекція 3, кінець)

Благітко Б.Я.

2019 р.