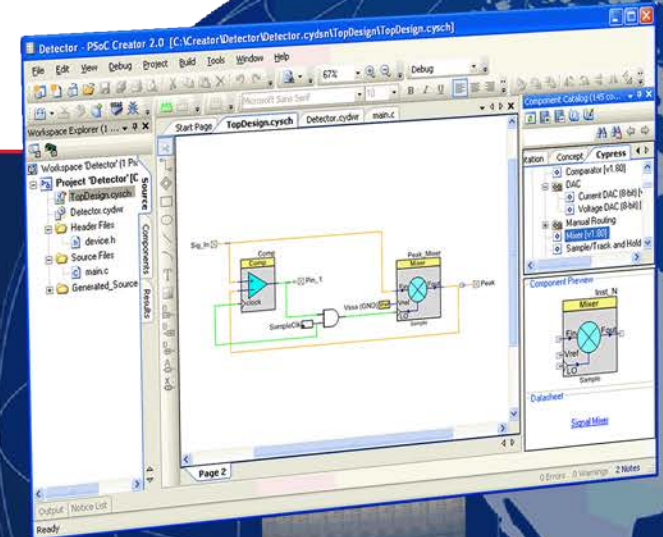


Quick Presentation: CapSense® Suitcase Challenge

Evaluate CapSense vs. Two Competing
Touch-Sensing Solutions In a Blind Comparison



Take the CapSense Suitcase Challenge



The CapSense Suitcase Challenge is a “blind” competitive comparison of touch-sensing performance

Compare the actual end-product performance¹ of three MCUs that **claim** to offer robust touch-sensing capabilities

Evaluate how touch-sensing performance changes when button size or overlay thickness is changed

Evaluate advanced features such as glove touch and Proximity Sensing

Evaluate touch-sensing performance in the presence of different liquids such as water, coffee and soda

CapSense Suitcase and Contents



¹ The user-interface layout and firmware were developed according to the best practices of each competitor and verified through their technical support teams

Evaluate Capacitive-Sensing Performance



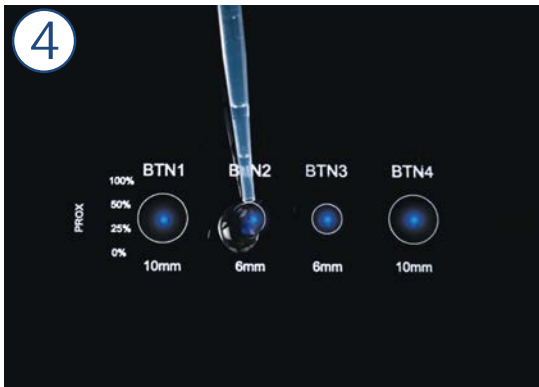
Place your hand above each user-interface panel and observe the distance at which the blue Proximity LEDs turn on



Touch the large and small buttons to observe the difference in button performance



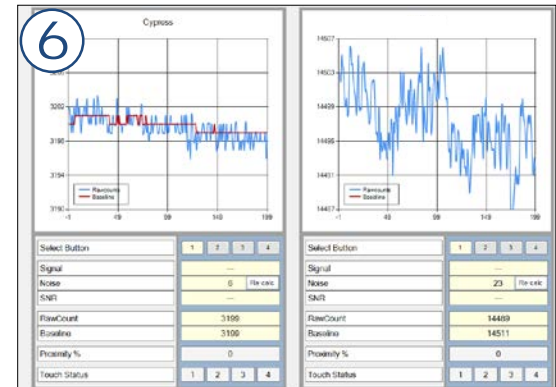
Touch the buttons while wearing gloves of varying thickness and observe the difference in button performance



Place water or any other liquid on each of the user interface panels using the provided dropper or sprayer. Observe false touches and the difference in button performance

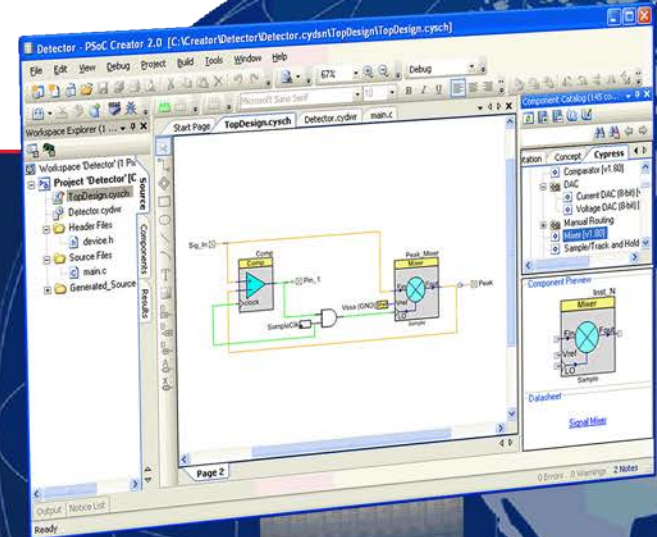


Add an additional overlay on top of the user interfaces and re-evaluate button and proximity performance



Observe the measured SNR and other button parameters using the provided GUI tool

APPENDIX



PSoC

PSoC is the world's only programmable embedded **system-on-chip** integrating an MCU core, **Programmable Analog Blocks**, **Programmable Digital Blocks**, **Programmable Interconnect and Routing**¹ and **CapSense**

Programmable Analog Block

A hardware block that is configured using **PSoC Components**² to create Analog Front Ends (AFEs), among other capabilities

Includes **Continuous Time Blocks**, analog-to-digital converters (ADCs) and digital-to-analog converters (DACs)

Continuous Time Block (CTB)

A **Programmable Analog Block** that is used to implement continuous time analog circuits such as opamps and programmable gain amplifiers (PGAs)

Programmable Digital Block

A hardware block that is configured using **PSoC Components**² to implement custom digital peripherals and glue logic

Includes **Universal Digital Blocks**, Serial Communication Blocks (SCBs) and TCPWMs³

Universal Digital Block (UDB)

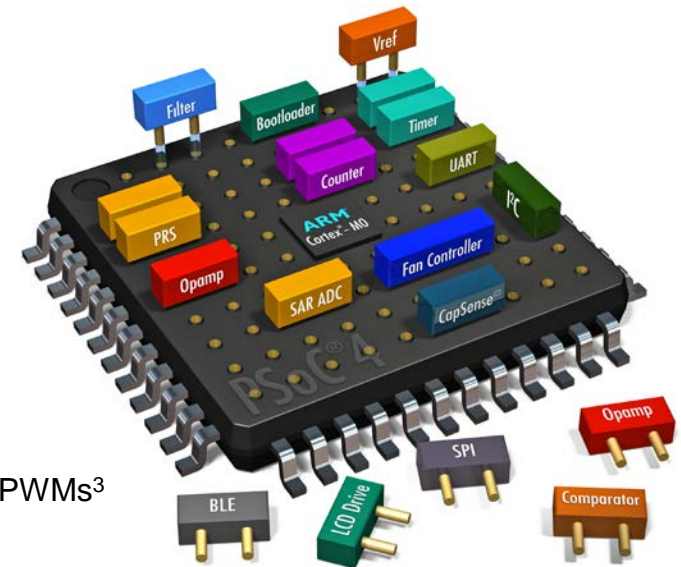
A PSoC **Programmable Digital Block** that contains: two programmable logic devices (PLDs), one programmable data path with an arithmetic logic unit (ALU), one status register and one control register

Configured in **PSoC Creator**⁴ using **PSoC Components**², or the graphical state machine editor or Verilog code

Serial Communication Block (SCB)

A PSoC **Programmable Digital Block** that is configurable as a UART, SPI or I²C interface

Illustration of a PSoC Device Being Flexibly Configured by Plugging in PSoC Components²



¹ Connects the Programmable Analog Blocks, Programmable Digital Blocks and I/Os

² Free embedded ICs represented by an icon in PSoC Creator software

³ Timer, counter, pulse-width modulator (PWM) block

⁴ PSoC 3, PSoC 4 and PSoC 5 Integrated Design Environment (IDE) software that installs on your PC

Timer, Counter, PWM (TCPWM) Block

A PSoC **Programmable Digital Block** that is configurable as a 16-bit timer, counter, PWM or quadrature decoder

CapSense®

Cypress's third-generation touch-sensing user interface solution that “just works” in noisy environments and in the presence of water

The industry's No. 1 solution in sales by 4x over No. 2

Programmable Interconnect and Routing

Connects the Programmable Analog Blocks, Programmable Digital Blocks and I/Os

Enables flexible connections of internal analog and digital signals to internal buses and external I/Os

PSoC Creator™

PSoC 3, PSoC 4 and PSoC 5 Integrated Design Environment (IDE)

Software that installs on your PC that allows:

- Concurrent hardware and firmware design of PSoC systems, or
- PSoC hardware design followed by export to popular IDEs

Components

Free embedded ICs represented by an icon in **PSoC Creator** software

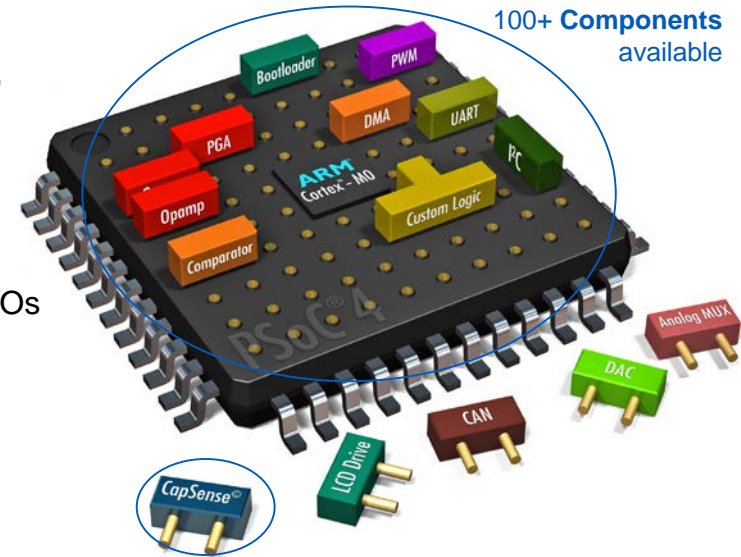
Used to **integrate multiple ICs** and system interfaces into one **PSoC**

Dragged and dropped as icons to design systems in PSoC Creator

Component Configuration Tools

Simple graphical user interfaces in PSoC Creator embedded in each Component

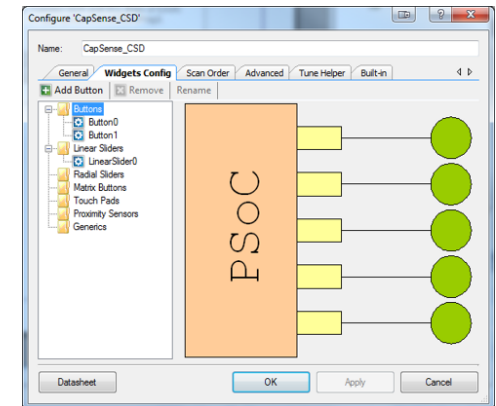
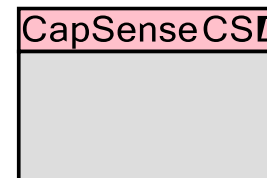
Used to customize Component parameters



CapSense is used to create **touch buttons and sliders**

Component Icon

Component Configuration Tool



PSoC 4

A PSoC with an ARM® Cortex®-M0 MCU

Signal-to-Noise Ratio (SNR)

The ratio of the sensor signal, when touched, to the noise signal of an untouched sensor

Liquid Tolerance

The ability of a capacitive sensing system to work properly in the presence of liquid droplets, streaming liquids or mist

Proximity Sensing

The process of detecting the presence of nearby objects without any physical contact

CapSense: The Industry's Leading Capacitive Sensing Technology

CapSense is Cypress's capacitive-sensing technology

CapSense is the industry's No. 1 solution in sales by 4x over No.2

Over one billion CapSense controllers have replaced more than five billion mechanical buttons

CapSense is found everywhere, including smartphones, home appliances and printers

Touch Buttons: 2003



LG Chocolate Mobile Phone

Liquid Tolerance: 2008



Whirlpool Dishwasher

Noise Immunity: 2010



HP TouchSmart Printer

Configurability: 2011



Microsoft Arc Touch Mouse

1B Units Shipped: 2013



Samsung Galaxy Note 3

Cypress's CapSense research and development begins with buttons and sliders

CapSense algorithms offer Liquid Tolerance, Proximity Sensing and improved noise immunity

SmartSense™ Auto-tuning revolutionizes CapSense design by removing manual tuning and improving noise immunity

CapSense Express™ offers configurable solutions that do not require firmware development






One billionth CapSense controller shipped

“We selected CapSense for its **flexibility as well as for its durability and performance** given the harsh operating environment that washing machines face. Having previously designed CapSense into our oven products, we are well aware of the **stylish interfaces it enables** for home appliances.”

- Davide Aloj, Electronic Development Manager, Indesit

PSoC 4000 With CapSense vs. MCUs With Capacitive Sensing



					
<u>Feature</u>	<u>PSoC 4000</u>	<u>SAMD20G</u>	<u>Kinetis KL25</u>	<u>PIC16F1513</u>	<u>MSP430G</u>
CPU Core	Cortex-M0	Cortex-M0+	Cortex-M0+	8-bit	16-bit
Flash/RAM	16/1KB	32/4KB	128/16KB	7/0.25KB	8/0.25KB
Capacitive Sensing:					
Sensing Channels/GPIOs	16/16	10/48	16/66	17/25	16/16
SNR	>100:1	Not published	Not published	Not published	Not published
Tuning Method	Auto (SmartSense ¹)	Manual	Manual	Manual	Manual
Liquid Tolerance	Yes (any liquid)	Yes (Water Rejection) ²	Yes (Water Rejection)	No	No
Lowest Average Current Consumption	4µA	8µA ³	Not specified	5µA ³	6µA ³
ADC	10-bit Del-Sig	12-bit SAR	16-bit SAR	10-bit SAR	10-bit SAR
SPI/I²C/UART Interfaces	0/1/0	6/6/6	2/2/3	1/1/1	1/1/1
Supply Voltage	1.71-5.5V	1.62-3.63V	1.71-3.6V	1.8-5.5V	1.8-3.6V

Cypress's CapSense delivers superior capacitive touch-sensing performance, but seeing is believing with the CapSense Suitcase Challenge

¹ A Cypress algorithm that automatically sets parameters to optimize performance after the design phase and continuously compensates for system, manufacturing and environmental changes
² Atmel recommends using its mutual-capacitance technology (Qmatrix) to implement water rejection
³ Source: Application notes published by each vendor

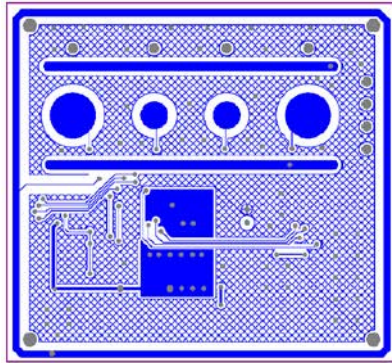
Layout and Firmware Considerations

Layout and firmware development for each user interface were:

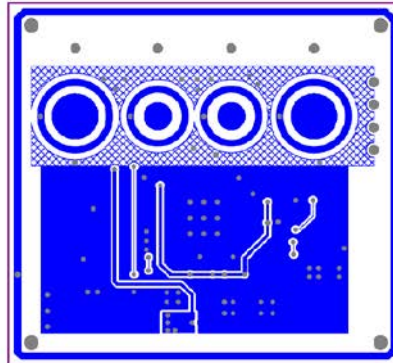
Completed per best practices outlined by each competitor

Verified by the technical support teams of each competitor

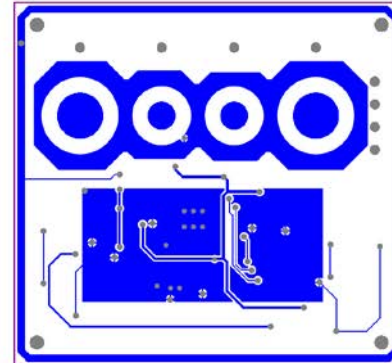
User-Interface Layout - Top



Vendor A

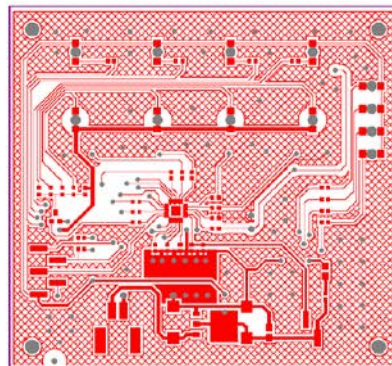


Vendor B

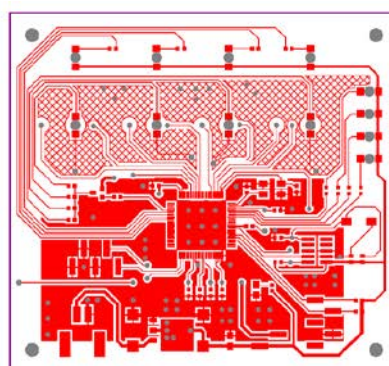


Vendor C

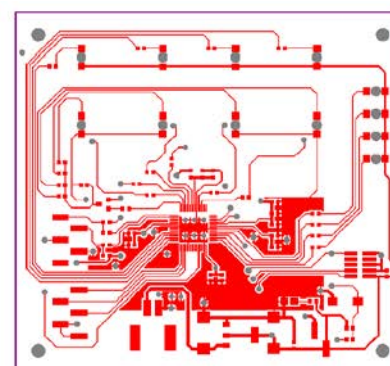
User-Interface Layout - Bottom



Vendor A



Vendor B



Vendor C