英飞凌家电生态圈
<赋能课堂>

英飞凌第五代CapSense技术介绍

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智能家电行业耕耘17年

研究方向:

FOC 磁场定向电机变频控制
MCU 微控制器
Capsense 触摸人机界面

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Infineon's CapSense Technology Evolution

Touch Buttons: 2003

LG Chocolate
(First Generation)

Cypress' CapSense research and development begins with buttons and sliders

Liquid Tolerance: 2008

Whirlpool Dishwasher
(Second Generation)

CapSense algorithms offer liquid tolerance, proximity sensing, and improved noise immunity

SmartSense: 2010

HP TouchSmart Printer
(Third Generation)

SmartSense™ Auto-tuning revolutionizes CapSense design by removing manual tuning

PSoC 4 S-Series: 2016

PSoC 4 S-Series
(Fourth Generation)

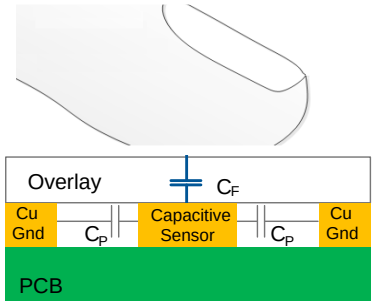
Cypress introduced its fourth-generation CapSense solution and delivered its first inductive sensing solution

Multi-Sense Converter: 2022

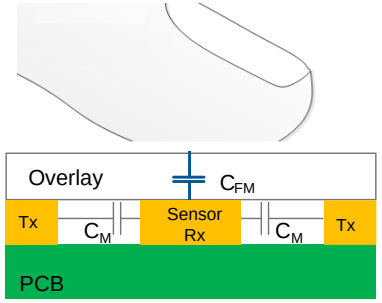
PSoC 4100S Max
(Fifth Generation)

Infineon will introduce the next generation in CapSense solutions in 2020 offering superior touch-sensing, inductive-sensing and ratio-metric conversion capabilities

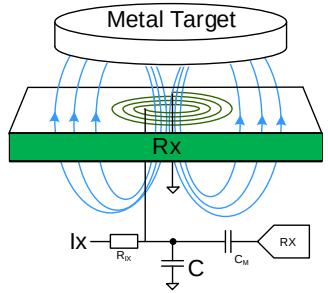
Self-Capacitive Sensing



Mutual-Capacitive Sensing

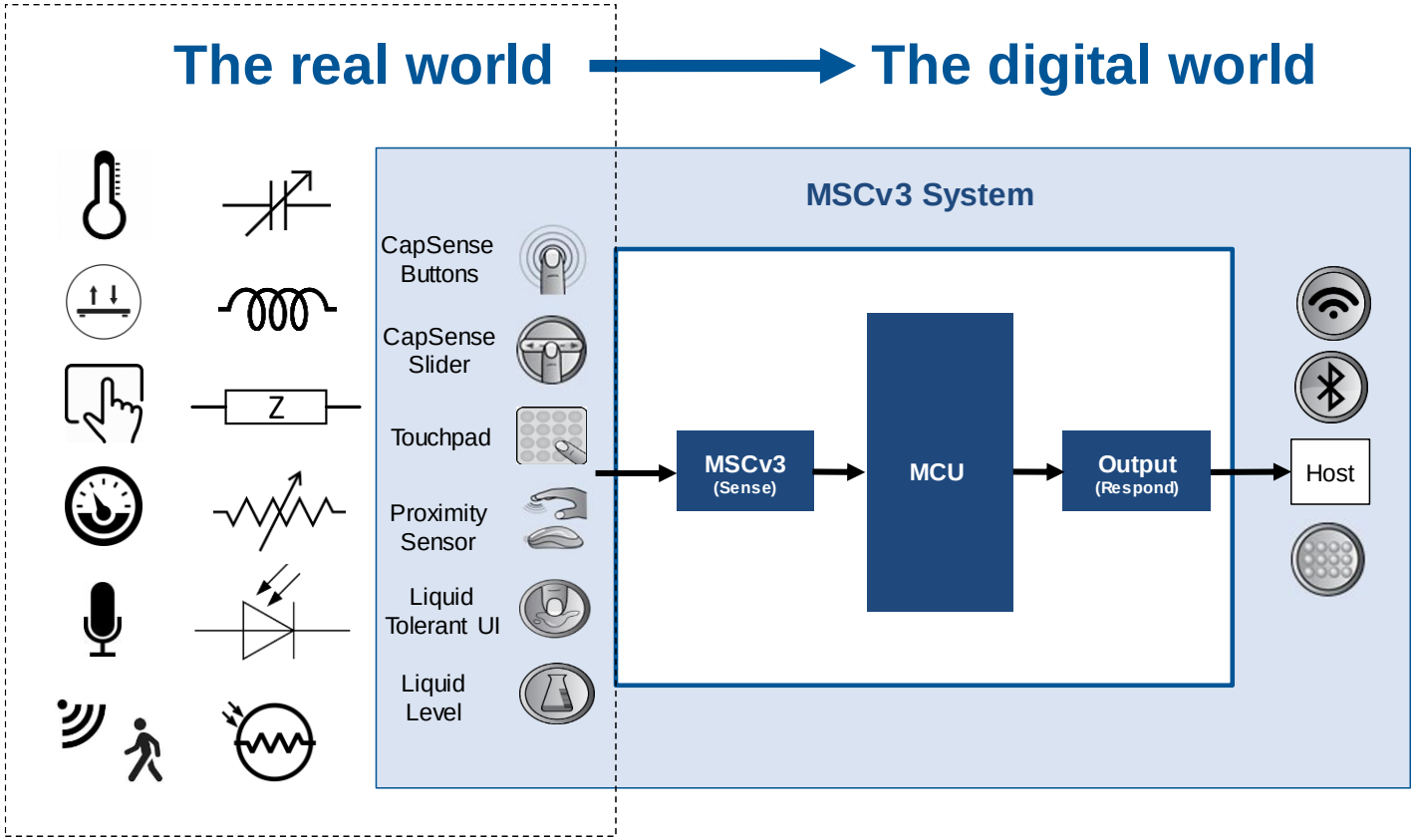


Inductive Sensing



Next Generation Sensing Technology – Multi Sense Converter

Taking World Class Technology Today to Next Level…



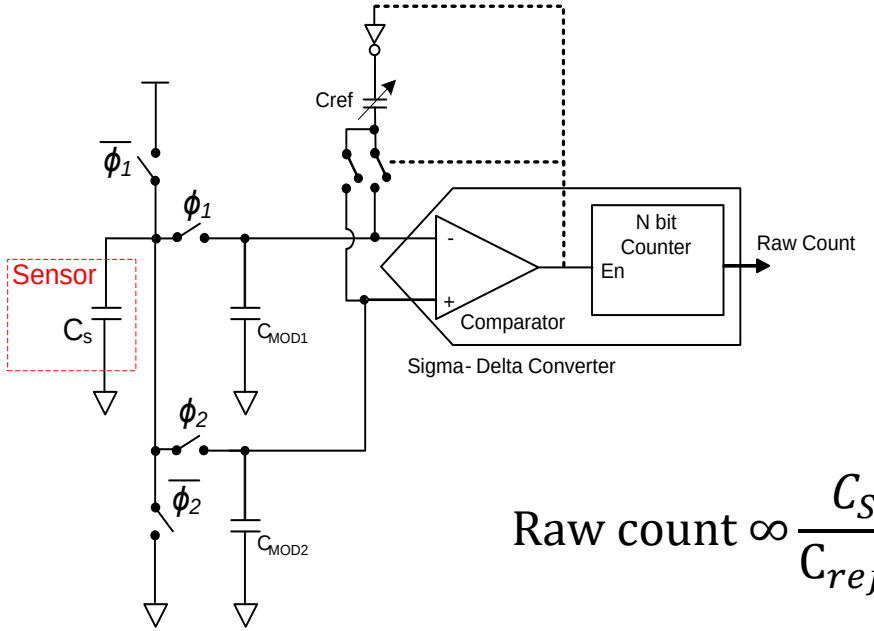
- All-New Ratio-Metric Architecture
- Enhanced Noise Immunity
- Ultra low power Always On sensing
- Multi-Sense Sensor Hub

Next Generation Sensing Technology – Multi Sense Converter

An improved architecture:

- Multi-Sense Converter:
  - Capacitive (Relative and Absolute)
  - Inductive
  - Impedance
  - Sensor (Current & Resistor)
- 16x higher signal-to-noise ratio
  - <100aF rms noise floor for Cs=8pF
  - Supports Cs up to 200pF
- Ratio-metric architecture (Output ~ Cs/Cref)
- Differential signal path for high DC noise rejection
- Dithering/Chopping for improved linearity/noise
- Autonomous operation without the CPU
- Senses with the CPU in Deepsleep for ultra-low power operation

MSCv3 – Multi Sense Converter



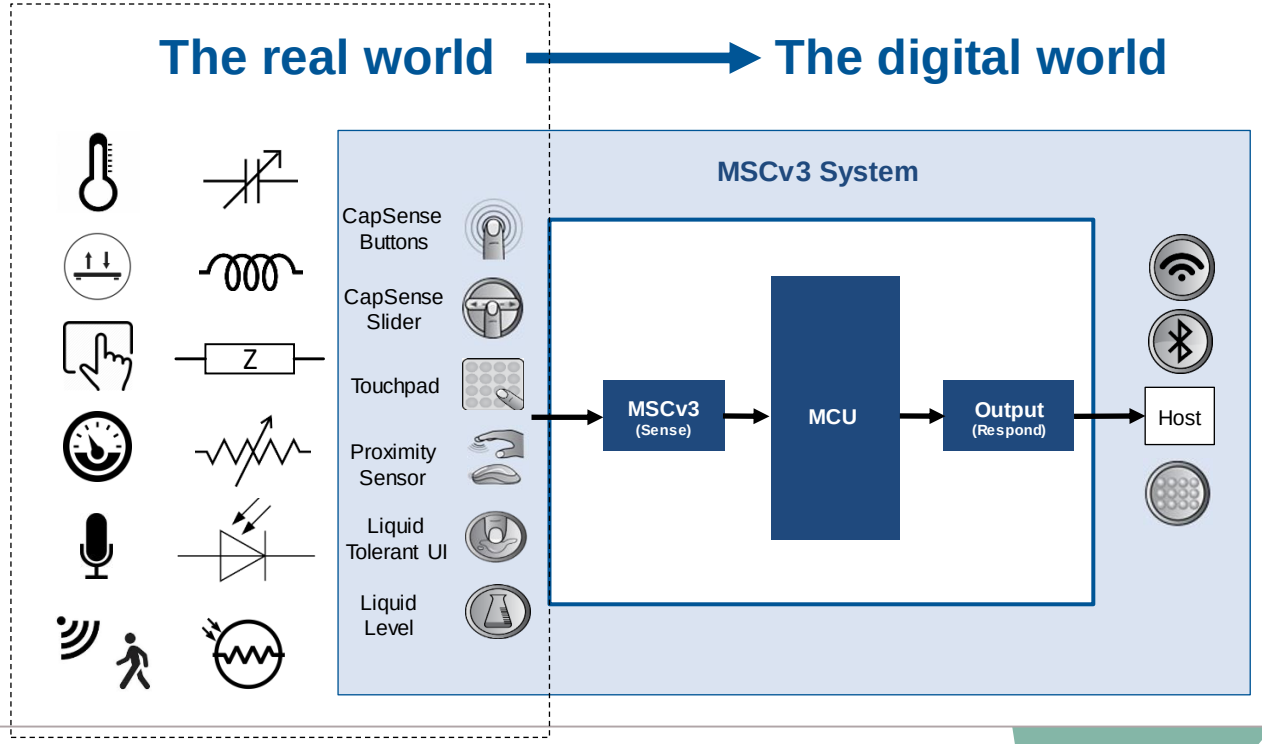
$$\text{Raw count} \propto \frac{C_S}{C_{ref}}$$

Next Generation Sensing Technology - Comparison

Parameters	CSD (4th Gen)	MSC (5th Gen)	Comment
Description	Capacitive Sigma-Delta	Multi Sense Converter	
IP Status	In Production, >2 Bu shipped	Sampling	
Output Raw Count	$\infty \frac{C_S V_{ref} \emptyset_{SW}}{I_{MOD}}$	$\infty \frac{C_S}{C_{ref}}$	
Capacitor Range	50pF	200pF	
Noise	1fF-rms	<100aF-rms	8pF capacitance
Driven Shield	Yes - Active	Yes – Active & Passive	Passive shield = Lower Power for C_{SH} < 100pF
Sensing Modes	Capacitive, Inductive	Capacitive, Inductive, Multi-Sense	
Noise Immunity Features	Spread Spectrum Clock, Freq. Hopping	Spread Spectrum Clock, Freq. Hopping, SINC^2 filter, Chopping Multi-Phase Deconvolution (Self/Mutual)	Improved noise immunity
Autonomous scan	No	Yes	Scan without CPU, up to 32 sensors
Low power scan	Active / Sleep	Active / Sleep / Deep Sleep	Low Power scanning in Deep Sleep
Multi-Chip / Multi-Channel	No	Yes	Faster response rate

Multi-Sense Solutions

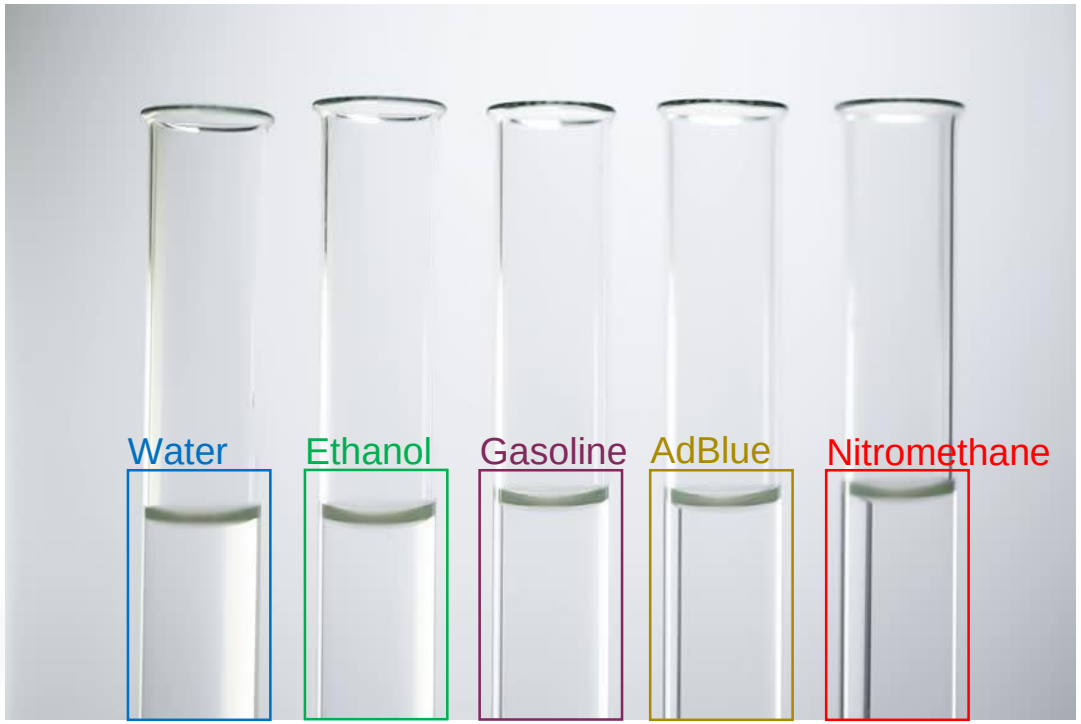
- **Multi-Sensing mode**
  - Re-purposes Infineon's high performance proprietary MSC sensing analog front-end to interface varieties of analog sensors.
  - Can measure **Current, Resistance or Impedance** and interface with sensors without external components.
  - Enables different class of sensing applications
- **Examples**
  - Directly interface analog sensors without external components
  - Robust contactless liquid level and composition sensing
  - Contactless material sensing



Multi-Sense – Enable New Solution Areas

- Non-contact measurement
- Works well with liquid film, form, pumping

- Robust liquid level sensing and classification concept



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