Automotive PSoC™ 4100S Max New Product Introduction

ATV MC SBS

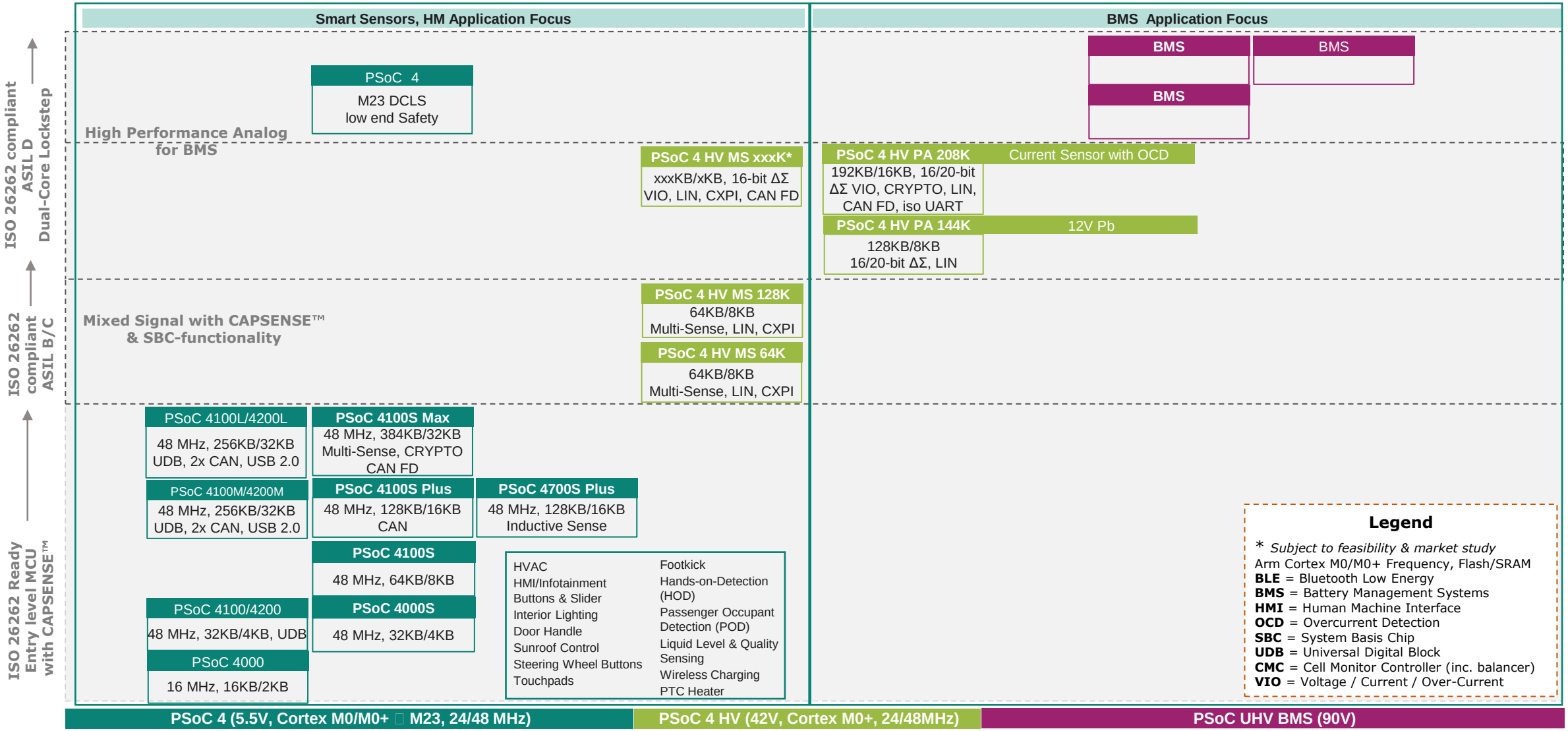
Jan 2024

Agenda

Automotive PSoC™ 4 portfolio introduction

Scalable PSoC™ 4 smart sensing roadmap

From MCU with CAPSENSE™ to Multi-Sense, High Performance Analog, SBC integration



Auto PSoC™ portfolio

PSoC™ 4 S

Arm® M0/M0+ MCU, Programmable Analog, Robust HMI, Scalable platform
16-KB–384-KB Flash

PSoC™ 4 HV MS (Sampling)

Arm® M0+ MCU, Programmable Analog, Robust HMI, **12-V LDO, LIN PHY, ASIL-B compliant**
32-KB–512-KB Flash

PSoC™ 4 HV PA (Sampling)

Arm® M0+ MCU, **Precision Analog, 12V LDO, LIN PHY, ASIL-C compliant**
64-KB–192-KB Flash

PSoC™ 4 HV BMS (Coming Soon)

Arm® M0+ MCU (DCLS), Precision Analog, 110 V, BLE, ASIL-D compliant
128-KB – 256-KB Flash

Multitouch and fingerprint

Register-configurable solutions for HMI applications such as touchscreens and fingerprint
Very highly sensitive capacitive measurements of up to aF (Attofarad)

Key features – Automotive PSoC™ 4 for HMI & Smart Sensors

Scalability	› Complete Portfolio › Memory Density › Package Lineup › Performance
Connectivity	› SENT › LIN incl. 2 Slaves › CAN/CAN FD
Safety & Security	› Supporting documents and FMEDA for multiple devices › ISO 26262 Ready › CRYPTO with AES256, SHA, CRC, Pseudo and True Random number generator
CAPSENSE™ & Inductive Sensing	› Robust and reliable detection › Low-power sensing for wake-up applications › Inductive Sensing › Resistive and current sensing
Temperature	› AEC-Q100 Grade 3, 2, 1 › With mission profile up to +150°C
EMI / EMC	› ISO 11452-2 (RI) › CISPR-25 (RE) › IEC62132-4 (CI) › IEC61967-4 (CE)

PSoC™ 4: One-stop-shop for automotive HMI & smart sensors

Door handle and foot-kick detection

Buttons/sliders

Touchpads

Capacitive navigation

Optical navigation

Occupant detection

Force-sensing, haptics

Hands-on detection

Level sensing

PTC heater

Ignition systems

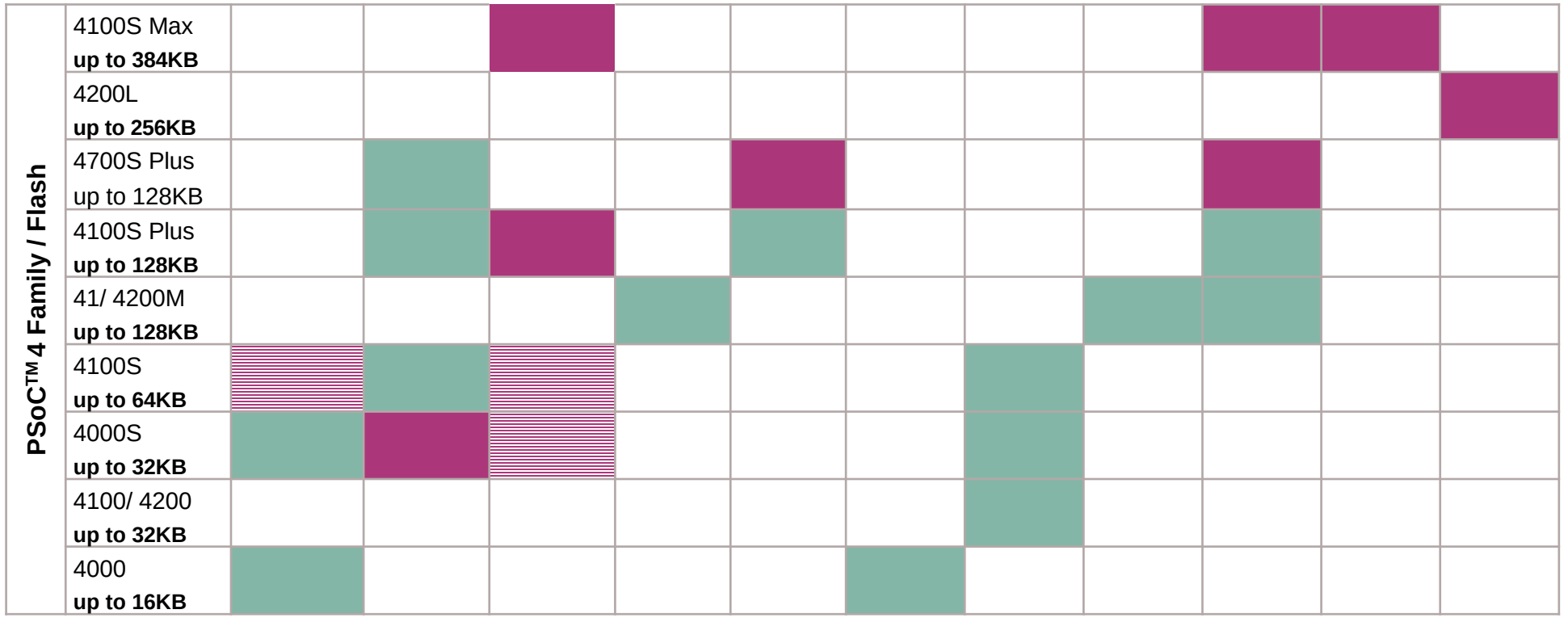
Interior lighting

Legend

- HMI
- Beyond HMI

HMI = Human Machine Interface

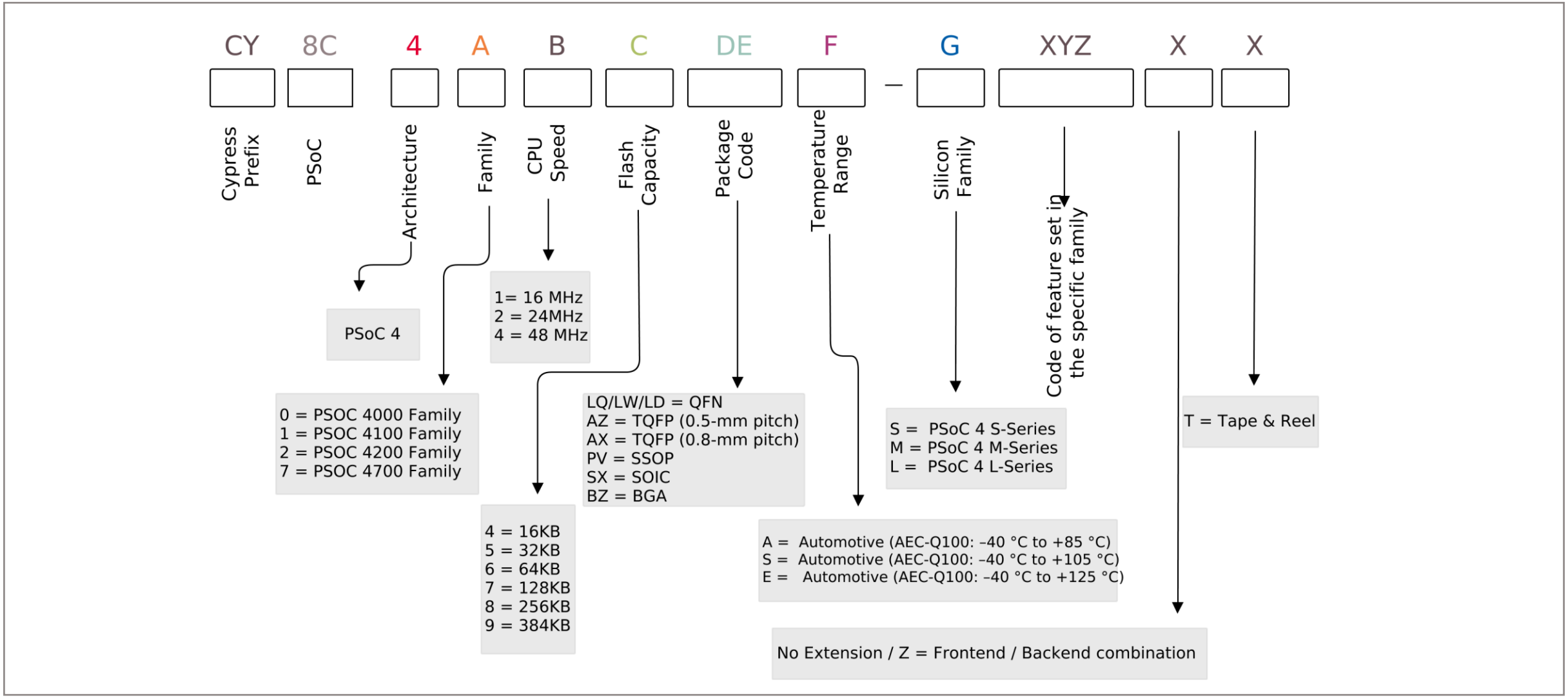
Automotive PSoC™ 4 Packages
Optimized package variants for specific application needs



Pins	24	40	48	56	64	16	28	48	64	100	124
Package	QFN					SOIC	SSOP	TQFP			VFBGA
Body Size (mm)	4 x 4	6 x 6	7 x 7	8 x 8	9 x 9	3.8 x 9.9	5.3 x 10.3	7 x 7	10 x 10	14 x 14	9 x 9
Pitch (mm)	0.5	0.5	0.6	0.5	0.5	1.27	0.65	0.5	0.5	0.5	0.65

Qualified Under Qualification Please reach out to marketing with Business Case

Marketing part number decoder



Where does Automotive PSoC™ 4100S Max fit into the portfolio?

Automotive PSoC™ 4 S-Series: Scalable, Smart MCU portfolio

	PSoC™ 4000	PSoC™4000S	PSoC™ 4100/4200	PSoC™ 4100S	PSoC™ 4100S Plus	PSoC™ 4 M-Series	PSoC™4 L-Series	PSoC™ 4100S Max
Flash Size/SRAM	16KB/2KB	32KB/4KB	32KB/4KB	64KB/8KB	128KB/16KB	128KB/16KB	256KB/32KB	384KB/32KB
DMA channels	0	0	0	0	8	8	8	8
ADC	10-bit Del Sig @ 58 sps	10-bit Single-Slope ADC @ 46.8 ksps	12-bit SAR[1] @ 1 Msps	12-bit SAR @1Msps, 10-bit Single-Slope ADC @ 46.8 ksps	12-bit SAR[1] @ 1 Msps 10-bit Single-Slope ADC @ 46.8 ksps	12-bit SAR[1] @ 1 Msps	12-bit SAR[1] @ 1 Msps	12-bit SAR[1] @ 1 Msps
Opamps	0	0	1	2	2	4	4	2
Comparators[2]	1	4	4	4	4	6	6	2
CAPSENSE™	3rd Generation	4th Generation	3rd Generation	4th Generation	4th Generation	3rd Generation (x2)	3rd Generation (x2)	5th Generation (x2)
CAPSENSE™ Avg. Current[3], SNR	6 µA, >100:1	3 µA, >300:1	6 µA, >100:1	3 µA, >300:1	3 µA, >300:1	6 µA, >100:1	6 µA, >100:1	<3 µA, >300:1
UDB Programmable Logic	0	0	4	0	0	4	8	0
Audio I2S	-	-	Yes (with UDB)	-	-	Yes (with UDB)	Yes (with UDB)	Yes
Timers/Counters/PWMs[4]	1/1/1	5/5/5	4/4/6	5/5/5	8/8/8	12/12/16	12/12/16	8/8/8
SPI/I²C/UART/LIN Slave[5]	0/1/0/0	2/2/2/2	2/2/2/2	3/3/3/2	4/5/5/2	6/4/5/2	6/4/5/2	4/5/5/2
USB Full Speed	-	-	-	-	-	-	Yes	-
Crypto (HW encryption module)	No	No	No	No	No	No	No	Yes
CAN controller	0	-	0	-	1	2	1	1 CAN FD
I/Os, All With CAPSENSE™	16	24	24	34	54	51	98	84
Smart I/Os	0	16	0	16	24	0	0	24

1 Successive approximation register ADC
2 Maximum number of comparators (including comparators configured using opamps)
3 Average current consumption per sensor
4 Maximum number of hardware-based timers, counters and PWMs, using timer/counter/PWM (TCPWM) blocks and universal digital blocks (UDB)
5 Maximum number of hardware-based SPI, I²C, UART, and LIN Slave interfaces, using SCBs and UDBs

What is new about PSoC™ 4100S Max ?

Automotive PSoC™ 4100S Max Intelligent Analog

Applications

User interface for HMI applications, Body Control, and HVAC applications

Features

32-Bit MCU subsystem
- 48-MHz Arm® Cortex®-M0+ CPU with a DMA controller
- 384-KB flash and 32KB SRAM
- External MHz oscillator (ECO) with PLL and 32-KHz watch crystal oscillator (WCO)
- Crypto block include AES, TRNG, CRA, PRNG and SHA

Programmable analog blocks
- One 12-bit, 1-Msps SAR ADC
- Two opamps configurable as programmable gain amplifiers (PGAs), comparators (CMPs), etc.
- Two low-power comparators
- Two MSC (Multi-Sense Convertor) blocks integrating 5th generation CAPSENSE™ and Inductive Sense

Programmable digital blocks
- Eight 16-bit timer/counter/pulse-width modulator (TCPWM) blocks
- Five serial communication blocks (SCBs) that are configurable as I2C, SPI, or UART
- Segment LCD
- Audio I2S for sound output

One CAN-FD (Controller Area Network with Flexible Data-rate) controller

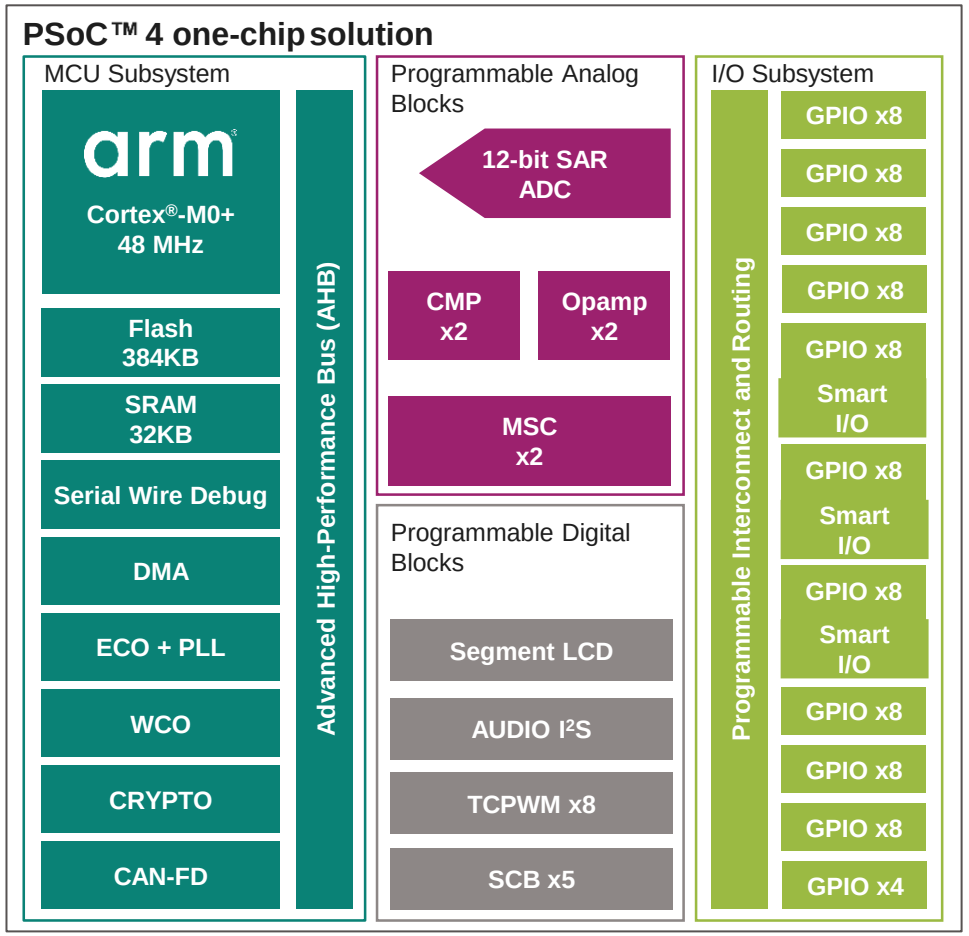
Packages
- 48-QFN, 64-TQFP and 100-TQFP

I/O Subsystem
- Up to 84 GPIOs, including 24 Smart I/Os1

Collateral

Datasheet: Public

[1] Embedded programmable digital logic in the I/O subsystem



Availability

Sampling: Now **Production: Now**

Automotive PSoC™ 4 features and key benefits

Key features

Maximum Memory and I/O Integration –
Up-to 384 KB Flash & 32 KB SRAM
Up-to 84 pins of analog and digital GPIO available.

Dual MSC CAPSENSE™ Blocks –
Support multiple data collection methods from touch to resistive or current sensors.

New variety of on-chip peripherals –
CAN, CAN-FD, TX I2S, Fast I2C, Segment LCD, TCPWM x8, SCB x5

Enhanced Cryptography –
Dedicated HW security block to support AES, SHA, TRNG, PRNG & CRC functions

Modern, Flexible ModusToolbox™ software for developing embedded applications, ready to use code examples, development kits

Key benefits

Low power compute & integration, optimized right from the hardware level

Differentiated Touch HMI features in MCU

Integrate differentiated analog capabilities to support resistive and current sensing.

Highspeed communications from Fast I2C or CAN-FD

Dedicated cryptography block for fast cryptographic functions.

Easy to use software for prototyping and productizing end applications

Value

Reduced system costs with feature integration in single host MCU

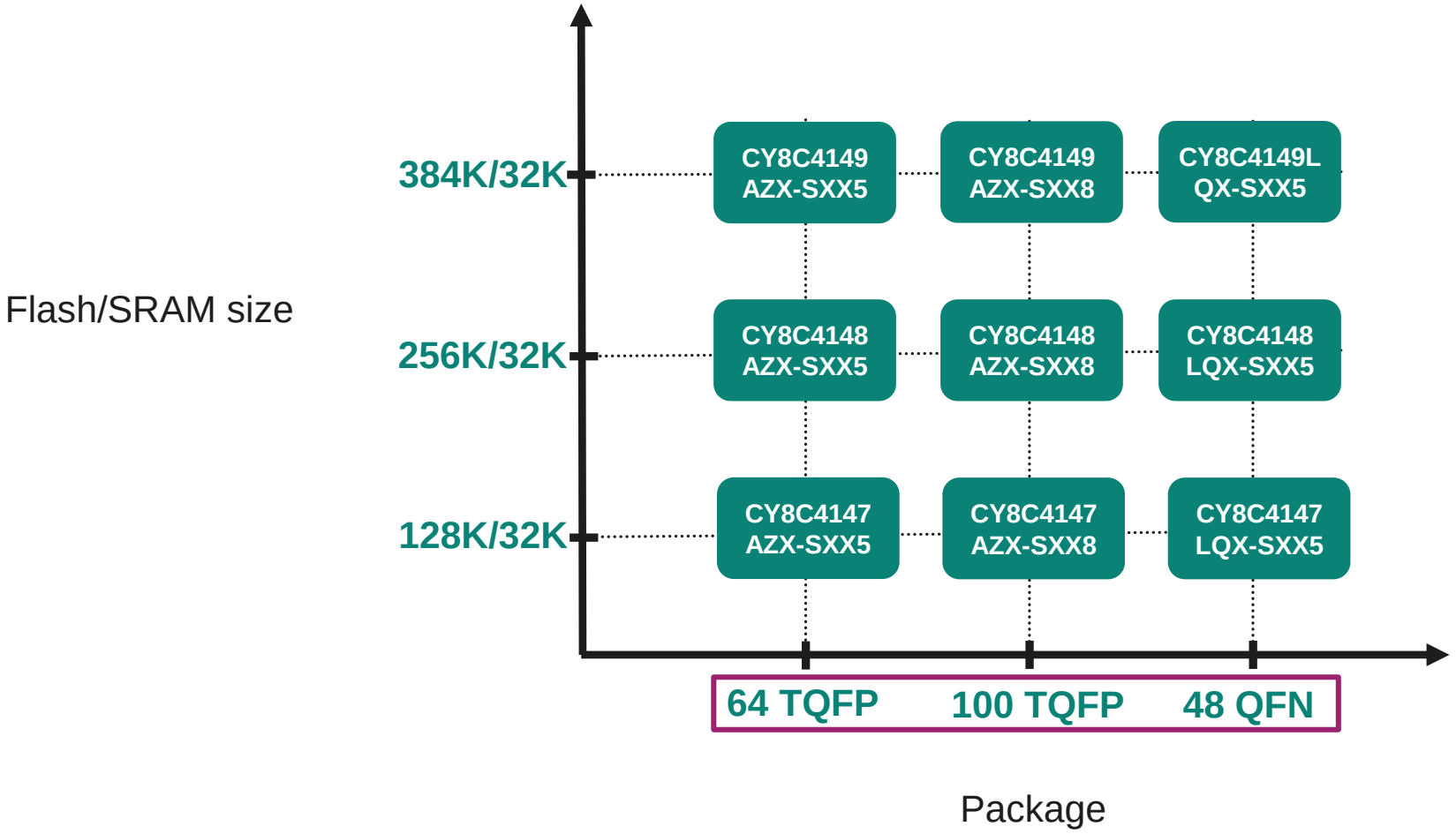
Improve end product user experience with robust touch based user interfaces, and intelligent analog sensing

Flexible options for Automotive applications

Long range wired communication protocols for physically large systems.

Futureproof product upgrades for higher feature options

Automotive PSoC™ 4100S Max portfolio matrix



Fully compliant with Automotive EMC standards

CAPSENSE™ in PSoC™ 4 MCUs meets automotive electromagnetic compatibility (EMC) requirements by:

- Eliminating false touches in harsh automotive environments
- Reducing radiated emissions by following hardware best practices and easily modifying CAPSENSE™ parameters such as frequency hopping in PSoC™ Creator

Infineon's EMI/EMC tests show Automotive PSoC™ 4 meets the most challenging automotive EMC specifications

Conditions	Specifications	No. of Tests[1]	Compliance
Radiated emissions	CISPR 25	14	Pass
Radiated immunity	ISO 11452-2	16	Pass
Bulk current injection	ISO 11452-2	18	Pass
Conducted emissions	IEC61967-4	4	Pass
Conducted immunity	IEC62132-4	6	Pass
Electrostatic discharges	IEC61000-4-2	12	Pass

[1] Compliance tests are done at different frequency ranges, antenna polarizations, and field strengths. Email automotive@infineon.com to get the comprehensive test report

Why is Automotive PSoC™ 4100S Max the preferred choice?

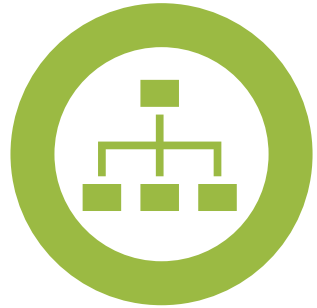
What makes Infineon's CAPSENSE™ solution superior?

HMI response

› Fast reaction to user interaction
› 120 Hz for smooth user experience

Reliable sensing

› Immunity to liquid, snow etc.
› Operate with thick gloves temp



Signal-to-noise ratio

› A high SNR is indicative of highly reliable touch interface

Multi-sensing

› Enable large and complex touch sensing interfaces

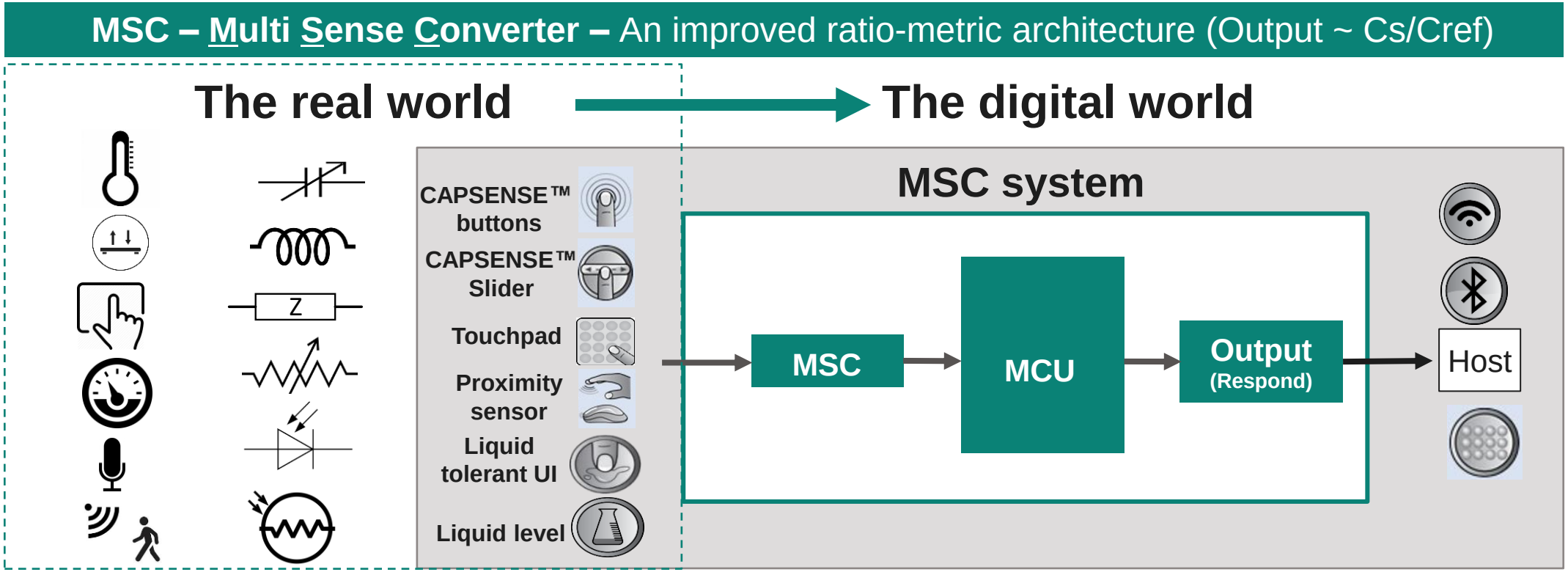
Noise immunity

› Best-in-class noise immunity
› Reliably works in harsh conditions

Low power

› Ultra-low power standby current
› Sensing in DeepSleep domain

Next-generation (5th Gen) sensing technology – Multi Sense Converter



MSC

- Capacitive sensing (self and mutual)
- Inductive sensing
- Sensor (impedance, current & resistor)

16x higher SNR

- <100 aF rms noise floor for Cs = 8 pF
- Supports Cs up to 200 pF

10x lower average power consumption

- Ultra-low power Always-ON sensing
- Autonomous operation without CPU

Enhanced noise immunity

- Differential signal path for high DC noise rejection
- Dithering/Chopping/CIC2/ for improved linearity/noise

CAPSENSE™ technology delivers the best performance

Parameter	3th Gen CAPSENSE™ (CSDv1)	4th Gen CAPSENSE™ (CSDv2)	5th Generation CAPSENSE™ (MSCv3)
Description	Capacitive Sigma-Delta	Capacitive Sigma-Delta	Multi Sense Converter
Product status	In production	In production	Sampling now!
Input dynamic range	1 pF- 50 pF	1 pF- 50 pF	0.5 pF – 200 pF
Noise-free resolution	16-bit	16-bit	16-bit
ENOB (no compensation)	10.59 bits	11.24 bits	13.49 bits
Output raw count	$\infty \frac{C_S V_{ref} \emptyset_{SW}}{I_{MOD}}$	$\infty \frac{C_S V_{ref} \emptyset_{SW}}{I_{MOD}}$	$\infty \frac{C_S}{C_{ref}}$
Shield electrode	Active (< 1.2 nF)	Active (< 1.2 nF)	Active (< 1.2 nF), Passive (Cm < 100 pF)
Compensation range	50 pF	50 pF	200 pF
Capacitance sense modes (Sense clock range)	Self (45 kHz-6 MHz) Mutual (45 kHz-300 kHz)	Self (45 kHz-6 MHz) Mutual (45 kHz-6 MHz)	Relative & absolute (±1%) Self & mutual cap. Sensing (45 kHz-6 MHz)
Inductive sensing	No	No	Yes
Sensing operation	Using CPU (CPU sleep during san)	Using CPU (CPU sleep during san)	Autonomous scan using DMA
Other features	General-purpose IDAC Spread Spectrum frequency hopping	General-purpose IDAC Spread Spectrum frequency hopping	Multi-phase self/mutual Spread Spectrum Clk frequency hopping SINC^2 filter, dithering.

Fifth-generation CAPSENSE™ performance specifications

Sense mode	Parameter	CAPSENSE™ MSC (5th Gen)	Condition, Reference
VDDD		1.75 V – 5.5 V	
Sense frequency		45 kHz – 6 MHz	
Shield load		1.2 nF	
Sense modes		Self + Mutual + Inductive on a single device	
Self-capacitance sensing	Dynamic range (DR)	< 230pF	Condition: Self Cap. 100-fF finger signal, VDDA=5 V, no FW filter.
	ENOB (Typical)	13.49 bits	Measured data on 7147 Datasheet parameter SID.MSC.9, Cp~33 pF,VDDA=5 V Hardware only Compensation + FW filtering can improve noise by 2x-5x
	Compensation range	200 pF	
Mutual-capacitance sensing	Dynamic range	0.5 pF – 30 pF (Autocalibration)	Using FW autocalibration.
	ENOB (Typical)	13.1 bits	Cm~5 pF
	Compensation range	0.5 pF – 30 pF (Autocalibration)	Using FW autocalibration. Higher Cm can be supported with manual tuning.
Power supply rejection (DC)		- 80 dB	
Common mode rejection (AC)		-70 dB	10 VPP, finger capacitance = 100 fF, Freq = 10 kHz-1 MHz, Cs=31 pF. VDDA=5 V.

Fifth generation CAPSENSE™ : Feature vs benefit

Feature	Higher SNR	Lower power	Higher refresh rate	Improved linearity	Supply rejection
Differential (Rail-Rail) sensing	✓				
Replace IDAC with CDAC	✓				
Multi-phase deconvolution	✓		✓		
Autonomous scanning		✓	✓		
Multi-chip/ Multi-channel	✓	✓	✓		
SINC2 hardware filter			✓	✓	
Dithering				✓	
Larger CMOD (0.5 nF-20 nF)					✓
Full wave (2x CMOD)		✓			✓
Passive shield (< 100 pF)					

MSC CAPSENSE™

Key features	Key benefits	Condition
Improved SNR – Up to 48:1 SNR vs 6.1:1 on current fourth generation CAPSENSE™ technology.	› Better sensitivity in a noisy environment.	VDD = 5 V No FW filter Cp = 33 pF Cr = 0.1 pF
Wider parasitic capacitance range – 0.5 pF – 200 pF	› Wider parasitic capacitance allows for greater flexibility in PCB routing.	10-mm CSD button Acrylic overlay Cp = 33 pF Cr = 0.1 pF
Support thicker overlays – Up from 5 mm to 18 mm thick overlays	› Allows for smaller sensors, longer traces, and different PCB material.	7x5 CSX touch 3-mm acrylic overlay SNR = 10:1 Finger size = 8 mm
Faster refresh rates – From 22 Hz to 242 Hz	› Supports tougher HMI solutions for industrial environments.	10x8 CSX touch Scan clock = 1 MHz No of sub-conversions = 70 Refresh rate = 100 Hz
Reduced CPU utilization – From 40% utilization to 7%	› Improved touch response, faster than most displays, for a smooth experience. › Frees up the CPU to perform faster control loops or other peripheral operations.	

Technical documentation for CAPSENSE™

Read our CAPSENSE™ design guides

Comprehensive and ideal documents for those who want to design touch HMI. It guides from concept through production and helps to overcome various system-level challenges to create a robust touch HMI for your product.

› CAPSENSE™ capacitive sensing overview web page
› Getting Started with CAPSENSE™ application note
› CAPSENSE™ Configurator Guide as part of ModusToolbox™
› PSoC™ 4 and PSoC™ 6 MCU CAPSENSE™ design guide

Start with a code example

Start with a code example

Code examples for CAPSENSE™ touch HMI solutions

› Code examples for ModusToolbox™ Software on GitHub

Reach out to us on the Infineon Developer Community for help!

AN64846

Getting started with CAPSENSE™

About this document

Scope and purpose

This guide is an ideal starting point for those who are new to capacitive touch sensing (CAPSENSE™). You can use this guide to:

- **Become familiar with the technology underlying CAPSENSE™ solutions**
- **Understand important design considerations, such as schematic, layout, and EMI (Electro Magnetic Interference)**
- **Select the right device for your application**
- **Find a CAPSENSE™ resource to help with your design**

When you are ready to design your application, consult the **Design Guide** specific to the CAPSENSE™ device family you have selected. See the **Glossary** for the definitions of CAPSENSE™ terms.

Intended audience

This application note is intended for users using (or interested in using) CAPSENSE™ devices.

More code examples? We heard you.

To access an ever-growing list of hundreds of PSoC™ code examples, please visit our **code examples web page**. You can also explore the video training library **here**.

Security features with Crypto

PSoC™ 4 Crypto block offers the following cryptography functionalities:

- AES[1] functionality (block cipher), per FIPS[2] 197 standard
  - Forward block cipher (plaintext to ciphertext) with 128/192/256-bit key
  - Inverse block cipher (ciphertext to plaintext) with 128/192/256-bit key
- SHA[3] functionality (hash), per FIPS 180-4 standard
  - SHA1
  - SHA224, SHA256
- Cyclic Redundancy Check (CRC) functionality
- Pseudo Random (PR) number generator
- True Random (TR) number generator
- Programmable polynomial of up to 32 bits

1 Advanced Encryption Standard
2 Federal Information Processing Standards
3 Secure Hash Algorithm

PSoC™ 4100S Max series of devices integrate a Crypto block for fast cryptographic functions

Functional safety with PSoC™ 4

- Automotive PSoC™ 4 products were not developed according to ISO 26262 process for functional safety
- Infineon provides the following support for enabling functional safety at a system level:
  - FMEDAs for individual PSoC™ 4 products
  - Automotive PSoC™ 4 HW Safety Manual
  - Application notes and training services
- These documents can guide to help achieving functional safety at system-level
- Requirements are derived to detect potential failure modes and to achieve the hardware architectural metrics for ASIL A/B

FMEDA overview

Automotive PSoC 4100S Max

HW metrics

Achieved hardware architectural metrics and residual failure rate:

	permanent	transient	total
SPFM:	94.5%	99.5%	99.4%
LFM:	99.8%	N/A	99.8%
residual failure rate (λ_{RF})[1]:	2.93	7.92	10.85
latent failure rate:	0.11	N/A	0.11
failure rate (λ_{base}):	55.93	1717.48	1773.41
failure rate (safety) (λ):	52.96	1711.37	1764.34
	important metrics		
Achievable ASIL:	B		

HW safety manual

1.3 Document Structure

This document covers the following topics:

Introduction
- Provides an overview of this safety manual

Development Strategy
- Describes component development and resulting duties for the integrator

Architectural Overview
- Describes the architecture of PSoC 4
- Describes the assumed application context of PSoC 4
- Provides information about the intended use

Technical Safety Concept
- Provides assumptions of safety functions and top-level safety requirements
- Describes assumed operating conditions along with the required safety mechanisms
- Provides assumptions on the PSoC 4 safe state
- Describes failure modes
- Provides assumptions on fault tolerant time interval, and detection interval for multiple-point faults
- Provides assumptions of Hardware Requirements outside the PSoC that need to be implemented by the integrator
- Describes features and assumptions for each module

Safety Analysis
- Describes the Failure Modes, Effects and Diagnostics Analysis (FMEDA) with respect to hardware architectural metrics

Application note

AN79953

Getting started with PSoC™ 4 MCU

About this document

Scope and purpose

This application note introduces you to PSoC™ 4, an Arm® Cortex®-M0/M0+ based programmable system-on-chip. It helps you explore the PSoC™ 4 architecture and development tools and explains you how to create your first project using PSoC™ Creator and ModusToolbox™, the development tools for PSoC™ 4; also guides you to more resources to accelerate in-depth learning about PSoC™ 4.

Intended audience

This application note is intended for engineers new to PSoC™ and ModusToolbox™, and those with experience in working with embedded microcontrollers.

Associated part family

All PSoC™ 4 parts

Software version

PSoC™ Creator 4.4 SP2 or higher, ModusToolbox™ 3.1 or higher.

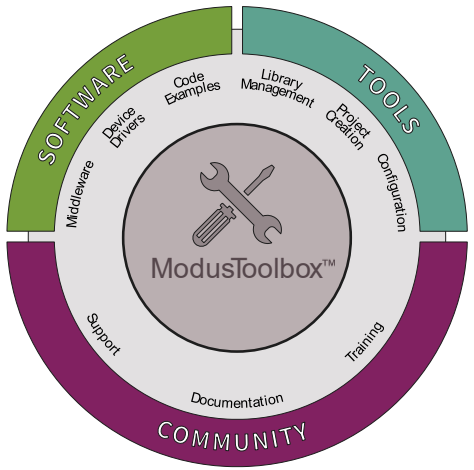
More code examples? We heard you.

To access an ever-growing list of PSoC™ code examples using ModusToolbox™, please visit the GitHub site. You can also explore the PSoC™ video library.

All FMEDAs, safety manuals, application notes, and training services can be found on MyICP

PSoC™ 4100S Max software

ModusToolbox™ Software – Overview



- ModusToolbox™ software is a modern, extensible development environment supporting a wide range of Infineon microcontroller devices.
- Provided as a collection of development tools, libraries, and embedded runtime assets, ModusToolbox™ provides a flexible and comprehensive development experience.

Development tools

The ModusToolbox™ tools package includes desktop programs that enable the creation of new embedded applications, managing software components, configuring device peripherals and middleware, and embedded development tools for compiling, programming, and debugging.

Run-time software

The ModusToolbox™ software includes an extensive collection of GitHub-hosted repositories comprising code examples, board support packages, middleware, and application support.

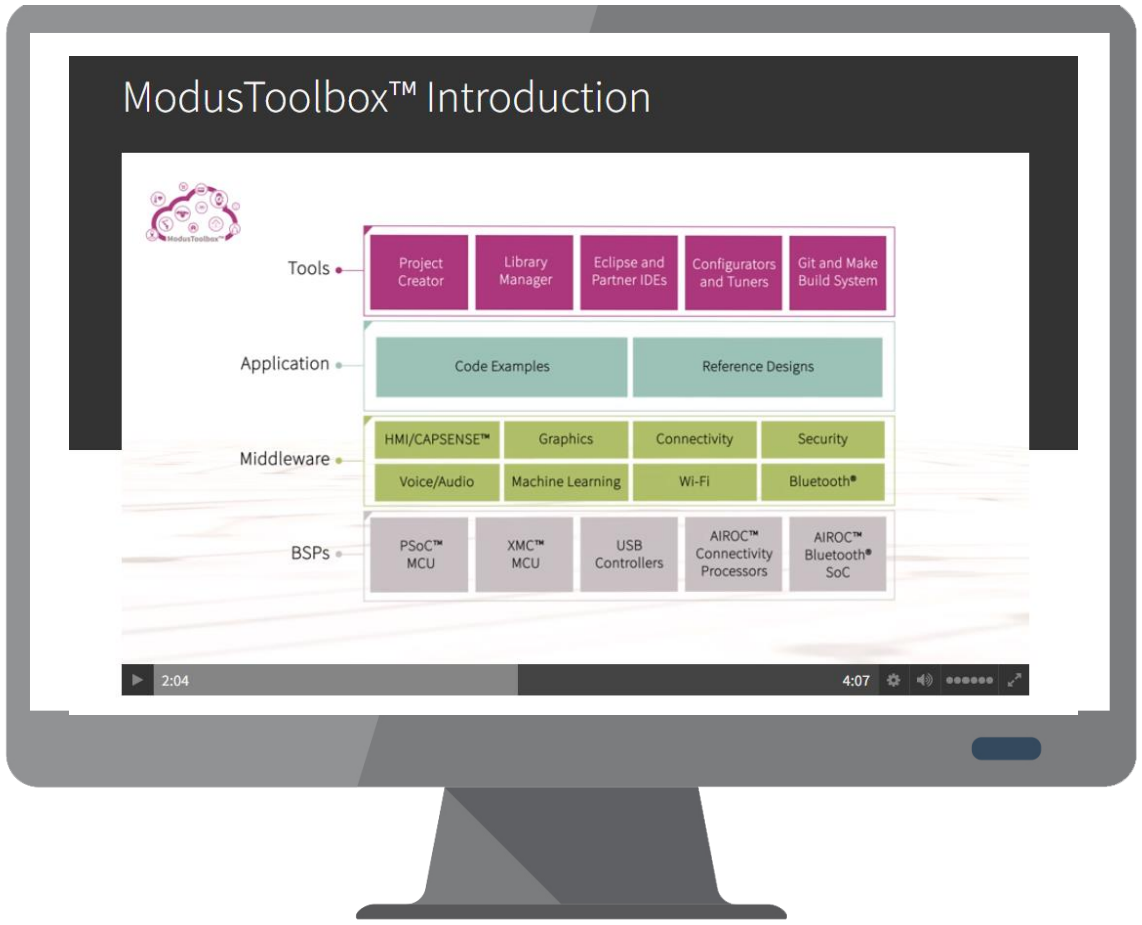
ModusToolbox™ software videos / training

ModusToolbox™ software training

- ModusToolbox™ Software Training Level 1 - Getting Started
  - Introduction to tools within the ModusToolbox™ ecosystem
- ModusToolbox™ Software Training Level 2 – PSoC™ MCUs
  - PSoC™ 6 and PSoC™ 4 MCUs examples demonstrate the use of peripherals such as GPIOs, PWMs, ADCs, UARTs, etc. CAPSENSE™ and DMA
- ModusToolbox™ Software Training Level 3 - Bluetooth®
  - Exercises related to creating and debugging Bluetooth® application
- ModusToolbox™ Software Training Level 3 - Wi-Fi®
  - How to use Wi-Fi within a ModusToolbox™ application

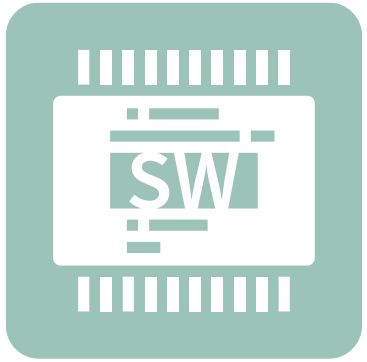
ModusToolbox™ software training

- Overview
  - Introduction / Infographic Video
- Getting Started
  - Installation / Documentation / Creating an application / Exploring an application / Command-Line Interface
- How-To
  - Start with a new application / Blinky LED / PWM / GPIO Interrupt



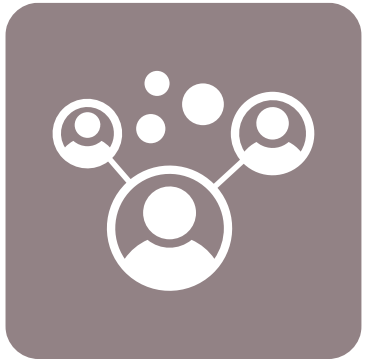
ModusToolbox™ Software – Key reference links for MCU

ModusToolbox™ software and tools product page



ModusToolbox™ Software GitHub Repository

ModusToolbox™ Software Training Repository



ModusToolbox™ community forum

Automotive PSoC™ 4

Automotive PSoC™ 4 Peripheral Driver Library

Automotive PSoC™ 4 Code Examples

ModusToolbox™ support for PSoC™ 4 portfolio

Microcontroller family	Recommended software development tool
32-bit Automotive PSoC™ 4 Arm® Cortex® -M0/M0+	
Automotive PSoC™ 4000	PSoC™ Creator
Automotive PSoC™ 4100	PSoC™ Creator
Automotive PSoC™ 4000S	ModusToolbox™ Software and Tools *
Automotive PSoC™ 4100S	ModusToolbox™ Software and Tools *
Automotive PSoC™ 4100S Plus	ModusToolbox™ Software and Tools *
Automotive PSoC™ 4200	PSoC™ Creator
Automotive PSoC™ 4700S Plus	ModusToolbox™ Software and Tools *
Automotive PSoC™ 4100S Max	ModusToolbox™ Software and Tools

* Existing support is also available in PSoC™ Creator

Target applications with PSoC™ 4100S Max

Automotive PSoC™ 4 (S-Series) solution example: Steering wheel: Hands-on detection

Design problems

- Detect presence or removal of hand from the car steering wheel
- Implement a reliable sensor on the steering wheel
- Maintain the temperature of the steering wheel

Automotive PSoC™4 (S-Series) solution

- Enables robust capacitive sensing through CAPSENSE™ for detection of hand presence or absence
- Infineon provides design guidelines and support for designing capacitive sensors
- Measure the temperature and drive the heater motor with a PWM

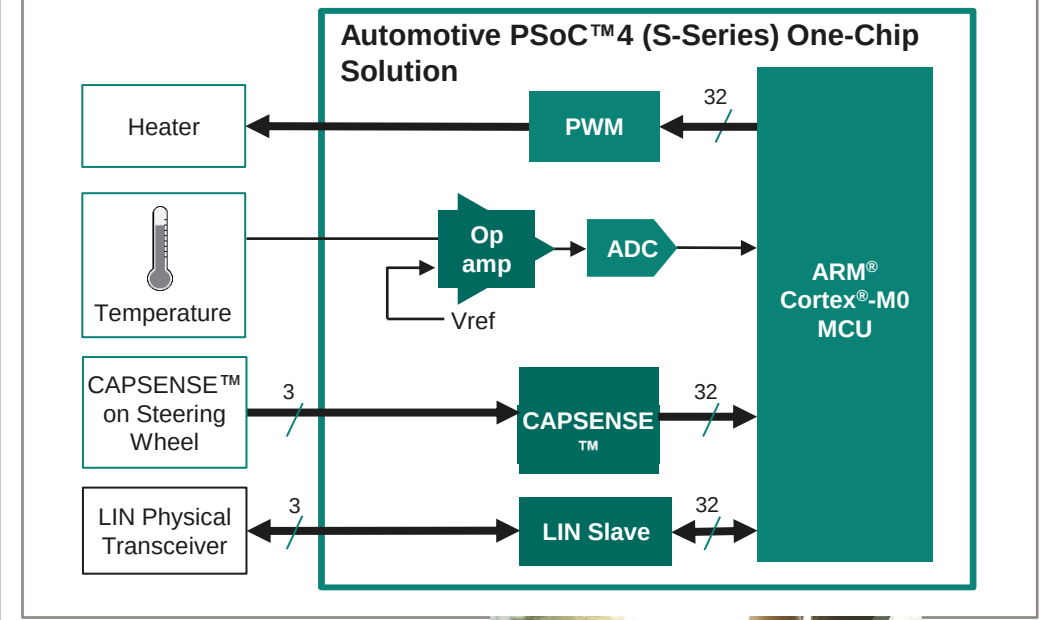
Suggested collateral

- Design software: ModusToolbox™
- App note: Getting Started with PSoC™4 (S-Series)
- Kit: PSoC™4 (S-Series) Pioneer Kit (CY8CKIT-041)
- Design guide: Getting Started with CAPSENSE™

PSoC™ Creator Components

- CAPSENSE™ (implements capacitive touch-sensing)
- LIN Slave (enables local interconnect network protocol)
- PWM (controls the brightness of LEDs)
- Opamps (amplify the signal from an analog sensor output)
- ADC (converts analog voltage to digital values)

Block diagram



The automotive PSoC™4 (S-Series) enables detection of hand and drives PWM for the heater motor

Automotive PSoC™ 4 (S-Series) solution example: Exterior HMI: Door handle

Design problems

- Implement capacitive touch buttons for door lock / unlock function
- Ensure robust operation in wet conditions
- High response time and low power consumption

Automotive PSoC™4 (S-Series) solution

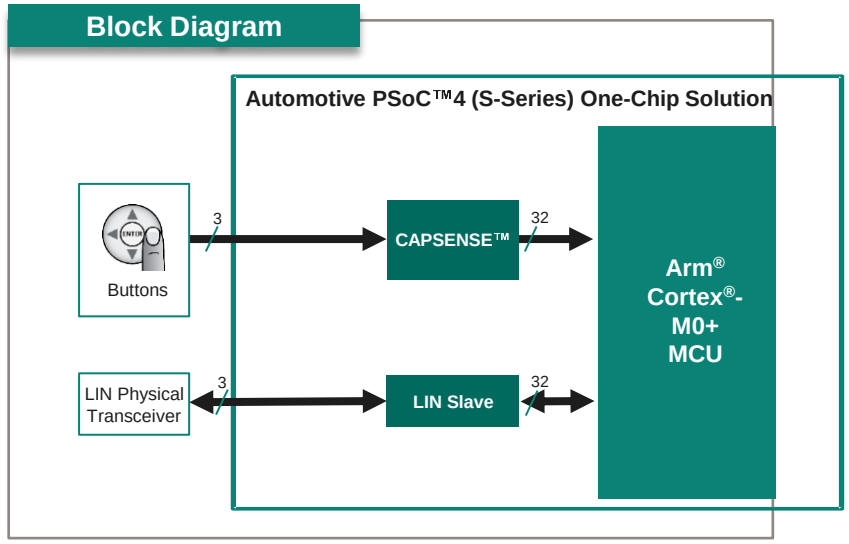
- Provides Infineon's fourth-generation CAPSENSE™ with superior noise immunity (SNR >300:1)
- Implements reliable, liquid-tolerant CAPSENSE™ buttons that do not false touch even with presence of grounded-water
- Provides high response time with ultra low power consumption

Suggested collateral

- Design software: ModusToolbox™
- App Note: Getting Started with PSoC™4 (S-Series)
- Kit: PSoC™4 (S-Series) Pioneer Kit (CY8CKIT-041)
- Design Guide: Getting Started with CAPSENSE™

Automotive PSoC™ Creator Components

- CAPSENSE™ (implements capacitive touch-sensing)
- LIN Slave (enables Local Interconnect Network protocol)



The automotive PSoC™4 (S-Series) enables capacitive touch-buttons for implementing the lock function for car doors

Automotive PSoC™ 4 (S-Series) solution example: Exterior HMI: Trunk-opener/foot-kick

Design problems

- Implement reliable foot-kick detection based on proximity sensing
- Design reliable sensor for measuring maximum proximity distance
- Communicate over LIN to the host ECU

Automotive PSoC™4 (S-Series) solution

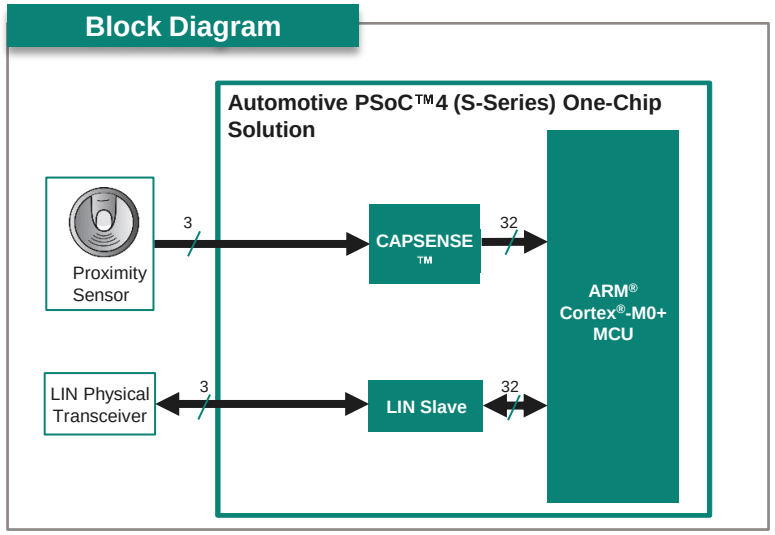
- Enables reliable capacitive-based proximity sensing for gesture detections such as foot-kick
- Provides proven design guidelines for proximity sensor layouts
- Integrates LIN slave controller for communication to ECU

Suggested collateral

- Design software: ModusToolbox™
- App Note: Getting Started with PSoC™4 (S-Series)
- Kit: PSoC™ 4 (S-Series) Pioneer Kit (CY8CKIT-042)
- Design Guide: Getting Started with CAPSENSE™

Automotive PSoC™ Creator Components

- CAPSENSE™ (implements capacitive proximity sensing)
- LIN Slave (enables Local Interconnect Network protocol)



The automotive PSoC™4 (S-Series) enables reliable foot-kick gesture detection based on capacitive proximity sensing

Automotive PSoC™ 4 (S-Series) solution example: Interior HMI – Force touch and touch under metal and gearshift

Design problems

- Power directly for car battery
- Outdoor touch buttons exposed to dirt, water, and moisture
- External temperature monitoring
- Automotive LIN Bus

Automotive PSoC™4 (S-Series) solution

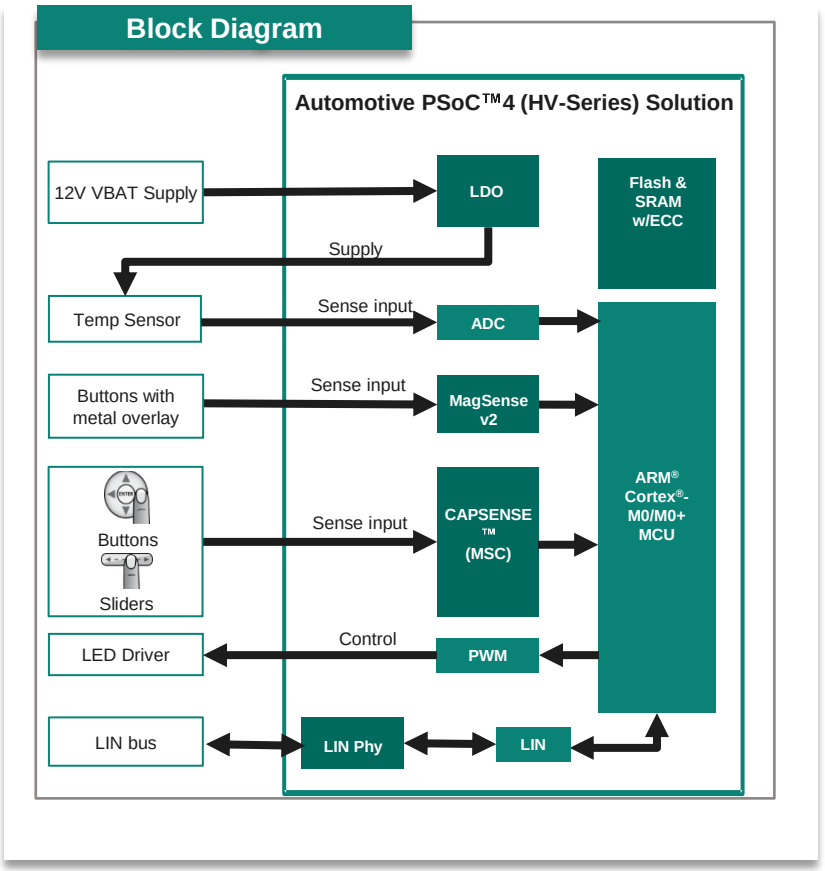
- Integrated LDO with up to 60-mA output current (3.3 V or 5 V)
- Capacitive and Inductive touch sensing
- Integrated LIN PHY block (two independent channels)

Suggested collateral

- Design software: ModusToolbox™
- App Note: Getting Started with PSoC™4 (S-Series)
- Kit: PSoC™4 (S-Series) Pioneer Kit (CY8CKIT-041)
- Design Guide: Getting Started with CAPSENSE™

Automotive PSoC™ Creator Components

- CAPSENSE™ (implements capacitive proximity sensing)
- LIN Slave (enables Local Interconnect Network protocol)



Automotive PSoC™ 4 (S-Series) solution example: Steering wheel: Control

Design problems

- Implement capacitive touch buttons for control on steering wheel
- Communicate over LIN to the host ECU
- Implement LED control

Automotive PSoC™4 (S-Series) solution

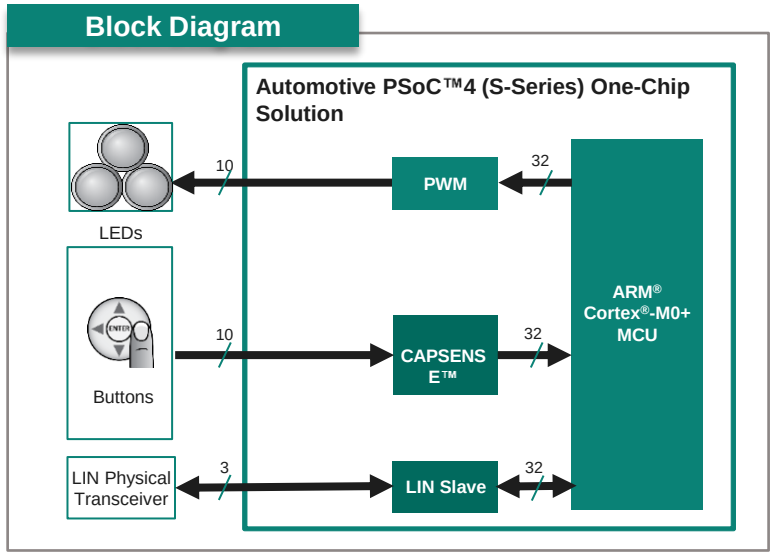
- Provides Infineon's fourth-generation CAPSENSE™ with superior noise immunity (SNR >300:1)
- Integrates up to two LIN Slave controllers in a one-chip solution
- Drives LEDs using PWM

Suggested collateral

- Design software: ModusToolbox™
- App Note: Getting Started with PSoC™4 (S-Series)
- Kit: PSoC™4 (S-Series) Pioneer Kit (CY8CKIT-041)
- Design Guide: Getting Started with CAPSENSE™

Automotive PSoC™ Creator Components

- CAPSENSE™ (implements capacitive touch-sensing)
- LIN Slave (enables Local Interconnect Network protocol)
- PWM (controls the brightness of LEDs)



The automotive PSoC™4 (S-Series) enables capacitive touch-buttons and integrate LIN communication

Automotive PSoC™ 4 (S-Series) solution example: Steering wheel: Hands-on detection

Design problems

- Detect presence or removal of hand from the car steering wheel
- Implement a reliable sensor on the steering wheel
- Maintain the temperature of the steering wheel

Automotive PSoC™4 (S-Series) solution

- Enables robust capacitive sensing through CAPSENSE™ for detection of hand presence or absence
- Infineon provides design guidelines and support for designing capacitive sensors
- Measure the temperature and drive the heater motor with a PWM

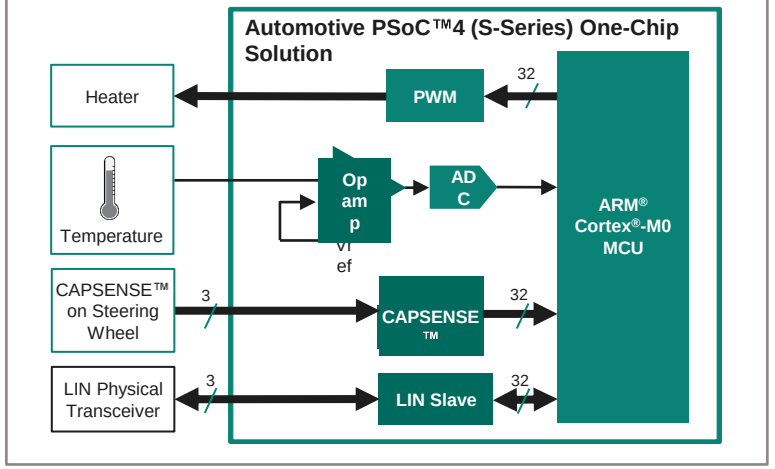
Suggested collateral

- Design software: ModusToolbox™
- App Note: Getting Started with PSoC™4 (S-Series)
- Kit: PSoC™4 (S-Series) Pioneer Kit (CY8CKIT-041)
- Design Guide: Getting Started with CAPSENSE™

Automotive PSoC™ Creator Components

- CAPSENSE™ (implements capacitive touch-sensing)
- LIN Slave (enables Local Interconnect Network protocol)
- PWM (controls the brightness of LEDs)
- Opamps (amplify the signal from an analog sensor output)
- ADC (converts analog voltage to digital values)

Block Diagram



The automotive PSoC™4 (S-Series) enables detection of hand and drives PWM for the heater motor

Automotive PSoC™ 4 (S-Series) solution example: Liquid-level sensing

Design problems

- Reduce the overall cost of the liquid-level sensing system
- Provide a reliable capacitive liquid-level sensing system that works in the presence of noise
- Quickly design and implement a Liquid-Level Sensing solution

Automotive PSoC™4 (S-Series) solution

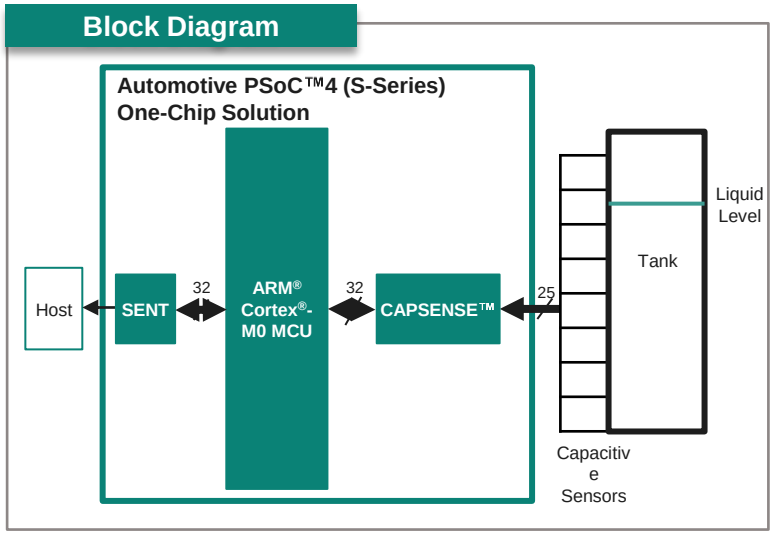
- Enables robust capacitive sensing through CAPSENSE™ for detection of hand presence or absence
- Infineon provides design guidelines and support for designing capacitive sensors
- Measure the temperature and drive the heater motor with a PWM

Suggested collateral

- Design software: ModusToolbox™
- Kit: PSoC™ 4 (S-Series) Pioneer Kit (CY8CKIT-041)
- Liquid-level sensing shield (CY8CKIT-022)
- Design Guide: Getting Started with CAPSENSE™
- App Note: PSoC™ liquid-level sensing (AN202478)

Automotive PSoC™ Creator Components

- CAPSENSE™ (implements capacitive Liquid-Level Sensing)
- SENT (enables single-edge nibble transmission protocol)



Liquid Level sensor

The automotive PSoC™ 4 (S-Series) enables a robust, liquid-level sensing solution based on CAPSENSE™ to measure the level of fuel / water / DEF in the tank

Tools and kits

Getting started with PSoC™ 4 development kits

1. **Choose a PSoC™ MCU development kit using the Infineon Evaluation Board Finder**

2. **Download the recommended board software IDE to start your design**

   A) ModusToolbox™ Software Environment

   B) PSoC™ Creator IDE

   Code examples for ModusToolbox™ Software

   Code examples for PSoC™ Creator

   EZ-Click 2.0 for CAPSENSE™ Mechanical Button Replacement (MBR) solutions

3. **Read Getting Started technical documentation**

   CAPSENSE™ capacitive-sensing overview

   AN64846 Getting Started With CAPSENSE™

   AN85951 PSoC™ 4 and PSoC™ 6 MCU CAPSENSE™ Design Guide

   AN219207 Inductive Sensing Design Guide

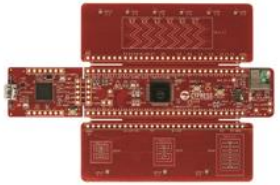
   AN92239 Proximity Sensing with CAPSENSE™

   AN202478 PSoC™ 4 Capacitive Liquid Level Sensing

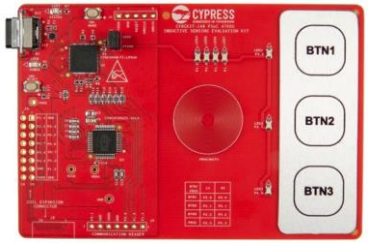
4. **Reach out to us on the Infineon Developer Community for help!**

PSoC™ 4 BLE Pioneer Kit (CY8CKIT-042-BLE-A)

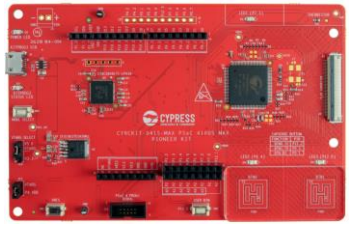
PSoC™ 4 L-Series Pioneer Kit (CY8CKIT-046)



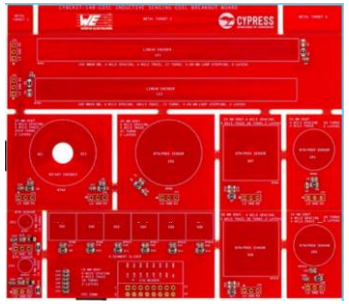
PSoC™ 4100S Plus Prototyping Kit (CY8CKIT-149)



PSoC™ 4700S Inductive Sensing Evaluation Kit (CY8CKIT-148)



PSoC™ 4100S Max Pioneer Kit (CY8CKIT-041S-Max



PSoC™ 4700S Inductive Sensing Breakout Board (CY8CKIT-148-COIL)

Documentation and materials

Documentation/materials

Documentation

- PSoC™ 4 Product Overview
- PSoC™ 4 Product Brochures
- PSoC™ 4 Datasheets
- PSoC™ 4 Technical Documentation
- PSoC™ 4 CAD Librairies
- PSoC™ 4 Application notes
- PSoC™ 4 Programming Specifications
- PSoC™ 4 Product Roadmap
- PSoC™ 4 News Releases
- PSoC™ 4 Blogs
- TrueTouch Tools
- PSoC™ Software
- PSoC™ Programming Solutions

PSoC™ 4 Datasheets

Documentation	Family		Level of security
Datasheet	PSoC™ 4000	PSoC® 4: PSoC 4000 Family Datasheet	Public
	PSoC™ 4000S	PSoC 4: PSoC 4000S Family Datasheet	Public
	PSoC™ 4100	PSoC® 4: PSoC 4100 Family Datasheet	Public
	PSoC™ 4100S	PSoC 4: PSoC 4100S Datasheet	Public
	PSoC™ 4100S PLUS	PSoC 4: PSoC 4100S Plus Datasheet	Public
	PSoC™ 4100M	PSoC® 4: PSoC 4100M Family Datasheet	Public
	PSoC™ 4200	PSoC® 4: PSoC 4200 Family Datasheet	Public
	PSoC™ 4200M	PSoC® 4: PSoC 4200M Datasheet	Public
	PSoC™ 4200L (Industrial version, Automotive coming soon)	PSoC™ 4: PSoC 4200L Datasheet	Public
	PSoC™ 4700S (Industrial version, Automotive coming soon)	PSoC 4: PSoC 4700S Family Datasheet	Public

PSoC™ 4 Product Roadmap

Documentation	Level of security
Automotive HMI Solutions and PSoC (Q4 2020)	Public
Automotive HMI Solutions and PSoC (NDA)	Confidential (NDA needed)

The confidential material can be found at the myInfineon Collaboration Platform (myICP) after an NDA has been signed:

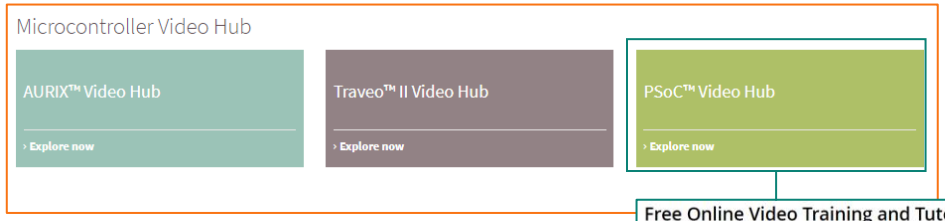
- PSoC documentation
- TrueTouch tools under NDA restriction

1.1. Datasheet - PSoC
1.2 Datasheet - TrueTouch
10. Programming Specifications
11. Technical Reference Manuals
12. News Releases
13. Safety Documents
2. App Notes
3. New Product Introduction
4. CAD Resources
5. Design Guides
6. Product Brochures
7. Blogs
8. Product Overview
9. Product Roadmap

39 Application notes
15 Data Sheets
7 CAD Resources
5 Safety Documents
4 NPIs

For more details, please visit: www.infineon.com/cms/en/product/promopages/MyICP-platform-for-Microcontroller/#PSoC-4-Documentation

Videos



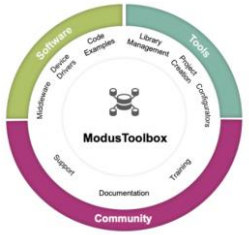
What can you find:
The PSoC™ video hub link contains all PSoC™ 4 video training and tutotials.

Coming soon:
A dedicated page with PSoC™ 4 videos will be launching soon on our microcontroller video hub

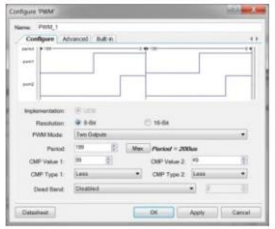
For more details, please visit: www.infineon.com/cms/en/product/promopages/aurix-video-hub/

Tools & Softwares

ModusToolbox™ Software and Tools



PSoC® Creator™ Integrated Design Environment (IDE)



References/links

PSoC™ 4 product webpage	Click here
PSoC™ Creator IDE	Click here
Documentation	Click here
PSoC™ Programmer	Click here
Modus Toolbox™	Click here

Appendix

PSoC™ terms

- **PSoC™ MCUs**
  - Our brand of MCUs that delivers unique and highly differentiated peripherals such as software-defined peripherals, CAPSENSE™, and programmable routing and interconnects
- **Programmable interconnect and routing**
  - Connects the programmable analog blocks, programmable digital blocks, and I/Os
  - Enables flexible connections of internal signals to internal buses and external I/Os
  - Includes Smart I/Os used to implement basic, pin-level digital logic
- **Programmable analog block**
  - A hardware block that is configured using PSoC™ Components to create analog front ends (AFEs), signal conditioning circuits with opamps, and filters
  - Includes continuous time blocks, ADCs, and 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 to implement custom digital peripherals and glue logic
  - Includes serial communication blocks (SCBs) and timer/counter/pulse-width modulator (TCPWM) blocks
- **Serial communication block (SCB)**
  - A PSoC™ programmable digital block that is configurable as a UART, SPI, or I^2C interface

PSoC™ terms

- **Timer/Counter/PWM (TCPWM) block**
  - A PSoC™ programmable digital block that is configurable as a 16-bit timer, counter, pulse-width modulator, or quadrature decoder
- **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 using PSoC™ Components, with the graphical state machine editor, or using Verilog code
- **CAPSENSE™**
  - PSoC™ -based fourth-generation capacitive-sensing solution that “just works” in noisy environments
- **PSoC™ Creator**
  - PSoC™ 3, PSoC™, 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
- **PSoC™ 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, as shown to the right


Infineon