PSOC™ Automotive Microcontrollers

Automotive Microcontrollers for human machine interface, smart sensing and general-purpose applications

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Evolution of PSOC™ generations

32-bit ARM Cortex

8-bit original core

Automotive grade

Consumer / industrial grade

- AEC-Q 100 / automotive qualified
- 32-bit Arm cortex M0 / M0+
- Up to 384 KB flash, 32 KB SRAM
- 5th generation CAPSENSE™
- LIN / CAN-FD / CXPI
- Capacitive and Inductive Sensing
- Crypto / ISO 21434-ready
- 12 V direct input operation
- LCD capabilities

The original programmable system-on-chip product, PSOC™ 1, used a SONOS process technology to construct an 8-bit Harvard architecture 24 MHz M8C microcontroller with a programmable mixed-signal array. A key aspect of PSOC™'s are these programmable analog and digital blocks that the microcontroller can reconfigure.

Programmable blocks provide building blocks for discrete circuit functions, for example, op-amps, comparators, counters, timers, pulse-width modulators and switchable passive arrays. Individual blocks can be interconnected to form other functions, such as a programmable gain amplifier (PGA), or a programmable bandpass filter.

Programmable digital peripherals such as the universal digital blocks (UDBs) include a host of primitive logic gates and digital filter blocks while the serial communication block (SCB) can support communication protocols such as SPI, UART, LIN, and I²C.

The PSOC™ 4100S Max microcontroller provides higher flash densities (384KB), more GPIOs(84), CAN-FD, hardware security, Segment LCD and the latest (5th) generation of CAPSENSE™ .

The latest PSOC™ HV devices are tolerant up to 42 V with embedded LIN PHY and high voltage LDO. They also include high resolution 16 – 20bit ΔΣ ADCs.

PSOC™ leverages the experience gained over more than 24 years of the development of automotive grade MCU products.

PSOC™ Automotive product overview

Automotive Microcontrollers for human machine interface, smart sensing and general-purpose applications

Key features

– Low Power ARM® Cortex® M0/M0+ Based
– Robust & Reliable CAPSENSE™, Inductive Sense & Multi-Sense Converter
– "Edge-Connectivity" through LIN, CXPI, CAN-FD options with integrated LIN-SBC-functionality
– Safety: ISO 26262 up to ASIL B (SEooC)/ASIL C (Application-specific)
– Security: ISO 21434-ready - process compliance and partial ("off the shelf") product support

Upcoming

– Extension of the BMS portfolio to higher voltages and with increased safety
– Support for Ultra-Large touchscreens and OLED displays
– Full ISO21434 security compliance (for devices starting development after ISO-release date)

BMS | **High Voltage**

Precision Analog

PSOC™ 4 HVPA family

12 V supply (42 V max), 24-48 MHz Cortex M0+, ASIL C
144 kB Flash, embedded LIN-SBC (12V-LDO & PHY)
16/20-bit ΔΣ ADC for precise V/I measurement

CAPSENSE™

PSOC™ 4 HVMS family

12 V supply (42 V max), 24 – 48 MHz Cortex M0+, ASIL B
32 – 128 kB Flash, embedded LIN-SBC (12V-LDO & PHY)
CAPSENSE™

HMI & Smart Sensing | **3 – 5 V supply**

CAPSENSE™

PSOC™ Automotive 4xxx family

3 – 5 V supply, 24 – 48 MHz Cortex M0/M0+,
16 – 384 kB Flash, Optional Op-Amps, comparators,
CAN/CAN-FD, USB, LCD, Crypto, CAPSENSE™

Multitouch

PSOC™ Automotive Multitouch

8.5" – 15" touchscreens
Multichip-support for up to 35" touchpanels/touchscreens

HMI

Fingerprint

PSOC™ Automotive Fingerprint

Sensor with 8.0×8.0 mm sensing area, 340 DPI,
Self calibration & testing

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PSOC™ Automotive 4xxx

CY	8C	4	A	B	C	D	F	–	G	XYZ	X	X

Company ID
PSOC™
Architecture
Family
CPU-Speed
Flash Capacity
Package Code
Temperature Range
Silicon Family

CY Infineon

8C PSOC™

PSOC™ 4
(ARM Cortex M0/M0+ based)

0 = PSOC™ 4000 Family
1 = PSOC™ 4100 Family
2 = PSOC™ 4200 Family
7 = PSOC™ 4700 Family

1 = 16 MHz
2 = 24 MHz
4 = 48 MHz

4 = 16 KB
5 = 32 KB
6 = 64 KB
7 = 128 KB
8 = 256 KB
9 = 384 KB

T = Tape and reel

No Extension / Z= Frontend /
Backend combination)

Code of feature set in the
specific family*

S = PSOC™ 4 S-Series
M = PSOC™ 4 M-Series
L = PSOC™ 4 L-Series

A = Automotive (AEC-Q100: -40 to +85 °C)
S = Automotive (AEC-Q100: -40 to +105 °C)
E = Automotive (AEC-Q100: -40 to +125°C)

LQ / LW / LD = QFN
AZ = TQFP (0.5-mm pitch)
AX = TQFP (0.8-mm pitch)
PV = SSOP
SX = SOIC
BZ = BGA

*Please refer Microcontroller pocket guide for detail breakdown of product feature set

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PSOC™ 4 HVMS (High Voltage Mixed Signal)

| CY | 8C | 4 | A | B | C | DE | F | HVS | X | Y | Z | X | ES | T |

- Company ID
- Product Family
- Sub-family
- Sub-family
- Core frequency
- Flash size
- Package type
- Temperature range
- Series designator
- LDO output Voltage
- CAPSENSE™
- Number of pins
- CXPI (opt.)
- Engineering sample (opt.)
- Tape/Reel shipment (opt.)

CY Infineon

8C PSOC™

PSOC™ 4 (ARM Cortex M0 / M0+ based)

1 PSOC™ 4100 Family

2 24 MHz
4 48 MHz

5 32 k code flash
6 64 k code flash
7 128 k code flash

LC WQFN (6×6 mm)
LD WQFN (7×7 mm)
LW WQFN (8×8 mm)
LQ WQFN (9×9 mm)

E-grade (-40 … +125 °C)

T Tape and reel
Blank / Tray
Non-T

ES Engineering sample
Blank / Non ES
NonES

X CXPI
BLANK NON-CXPI

3 32-pin
4 48-pin
5 56-pin
6 64-pin

0 No CAPSENSE™
1 CAPSENSE™

0 3.3 V reg output
1 5 V reg output

HVMS Series (High Voltage Multi Sensing)

PSOC™ 4 HVPA (High Voltage Precision Analog)

| CY | 8C | 4 | A | B | C | D | E | HV | X | Y | Z | ES | T |

- Company ID
- Product Family
- Sub-family
- Sub-family
- Core frequency
- Flash size
- Package type
- Temperature range
- Series designator
- Feature Set
- High voltage measurement accuracy
- Number of pins
- Engineering sample (opt.)
- Tape/Reel shipment (opt.)

CY Infineon

8C PSOC™

PSOC™ 4
(ARM Cortex M0/M0+ based)

1 PSOC™ 4100 Family

2 24.576 MHz
4 49.152 MHz

6 64 k code flash
7 128 k code flash

LC QFN (6×6 mm)

E-grade (-40 … +125 °C)

T = Tape and reel

ES Engineering sample
Blank/ Non ES
NonES

3 32-pin

0 0.25 %
1 0.10 %
2 0.15 %

4 Feature-set for IBS application (Intelligent Battery sensing)

HVPA Series
(High Voltage Multi Sensing)

PSOC™ Automotive Fingerprint

| CY | FP | 1 | 0020 | X | YZ |

- Company ID
- Product Family
- Market Segment
- Sensor code
- Temperature range
- Product Feature Set

CY Infineon

Fingerprint

1 = 1st generation of Infineon Fingerprint solution

0020 = Polymer, 73 FBGA, 8.025×8.025 mm sensing, 8.87×9.26×0.70, 7 Caps Option

00 = Default, Solder mask only

A = Automotive
(AEC-Q100: -40 °C to +85 °C)
S = Automotive
(AEC-Q100: -40 °C to +105 °C)

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PSOC™ Automotive Multitouch – Gen6L/6XL/7L

| CY | AT | 8 | 1 | 7 | XX | – | 10 | A | S | 72 | XX | Z | Y |

Company ID · Business Unit · Market Segment · Sensor configuration · Product generation · Product feature set · Package pins · Package type · Temperature Range · Number of sense I/Os · Assembly location indiciator (opt.) · Fab location indicator (opt.) · Tape/Reel shipment (opt.)

CY Infineon
AT Automotive

6 Automotive Slider
7 Automotive trackpad
8 Automotive touchscreen

1 Discrete sensors
3 Multichip Master
4 Multichip Slave

6 Generation 6
7 Generation 7

Gen 6:
XXX: Product feature set for genration 6*
Gen 7:
L: Touch-only (standard touch controller)
LS: System configuration (includes MCU features)

T = Tape and reel
Blank/ Non ES
NonES

Z New fab location
Blank/ Initial fab location
NonES

KA New assembly location
Blank/ Initial assembly
Non-KA location

41, 48, 61,72, 77 or 88

A -40 … +85 °C
S -40 … +105 °C

LW Wettable flank QFN
A TQFP

56/64/100/128

PSOC™ Automotive Multitouch – Gen7XL

| CY | AT | 8 | 1 | 7 | AZ | S | 72 | – | XXXXX |

Company ID · Business Unit · Market Segment · Sensor configuration · Product generation · Configuration · Temperature Range · Number of sense I/Os · Product feature set *

CY Infineon
AT Automotive

8 Automotive touchscreen

1 Discrete sensors
3 Multichip Master
4 Multichip Slave

7 Generation 7

61,72,77,88,98

A -40 … +85 °C
S -40 … +105 °C

AZ TQFP

*Please refer Microcontroller pocket guide for detail breakdown of product feature set

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Peripheral Highlights

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Analog

CAPSENSE™

CAPSENSE™ is a market leading & proprietary capacitive sensing technology.
The CAPSENSE™ block supports low-power operation with both self- and mutual-capacitance sensing using a capacitive sigma-delta (CSD) that can be connected to any pin through an analog multiplex bus.

The latest (5th generation) CAPSENSE™ block provides both capacitance sensing and supports Inductive sensing through it's Multi-Sense Convertor (MSC) block. In addition to relative, capacitive sensing, absolute capacitive sensing is uniquely supported by this block

Features	CAPSENSE™ (5th gen) supports the following features:
	– Multi-sense (capacitive, resistive, impedance, and current sensing)
	– Autonomous scanning (scan multiple sensors without CPU involvement)
	– Water tolerance (uses both passive, and active shields)
	– Higher sensitivity with >14-bit resolution
	– Ratio-metric sensing
	– Capacitance sensing up to 3nF
	– 70 dB CMRR
	– SINC2 filter for noise reduction
Benefits	Signal-to-Noise Ratio
	– High SNR which is indicative of a highly reliable touch interface
	Low Power
	– Ultra-low power standby current
	– Sensing while the CPU is in Deepsleep
	HMI Response
	– Fast reaction to user interaction
	– 120 Hz refresh rate for a smooth user experience
	Noise Immunity
	– Best-In-Class noise immunity
	– Works reliably in harsh conditions
	Additional Benefits
	– Immunity to liquid, snow etc.
	– Operates with thick gloves

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Inductive sensing

Infineon's inductive sensing solution enables touch and proximity detection for human interfaces on a wide variety of metallic materials (including both ferrous and non-ferrous materials). These materials change the magnetic field around the inductive sensor which is detected by PSOC™. Finger touches can be detected, for example, by measuring small deflections of conductive targets when force is applied. PSOC™ supports up to 16 inputs and is insensitive to both environmental changes and non-conductive objects (such as dirt and liquids). Touch sensing over metal overlays provides the ability to design cool aesthetics for product user interfaces. Auto-calibration algorithms automatically compensates for overlay deformations over time and provide for reliable operation.

Benefits	– Supports up to 16 simultaneous inductive sensors
	– Includes a coil auto-tuning algorithm
	– Contains an integrated graphical tuner for Tuning, Testing, and Debugging
	– Low EMI
	– High sensitivity, capable of detecting µm's of deflection in metal

SAR ADC

The 12-bit, 1-Msps SAR Analog-Digital Converter System (SAR ADC) can operate at a maximum clock rate of 18 MHz and requires a minimum of 18 clocks to perform a 12-bit conversion. The Sample-and-Hold (S/H) aperture of the ADC is programmable to adapt to differences in the gain bandwidth of the amplifier driving the SAR inputs and allow more settling time. It is also possible to provide an external reference to the ADC (through a fixed pin) that feeds the internal reference amplifier.

Benefits	– Differential and single-ended modes
	– Both dedicated (for performance) and non-dedicated (standard GPIO) inputs
	– Channel sequencer with signal averaging

Sigma Delta ADC

A 10-bit first order ΔΣ ADC is available with PSOC™. It uses a 48MHz clock and has an input range from 0V to VDDA (3.3 V-5 V). The ADC is only available when not using the CAPSENSE™ block.

Benefits	– 10-bit resolution
	– VDDA input range

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Precision Analog Channel Subsystem

The PSOC™ 4 HVPA Precision Analog Channel Subsystem (PACSS) is a high-performance data acquisition system consisting of two delta-sigma analog-to-digital converters (ADCs) and support circuitry. The two ADCs can quickly switch between input sources to create a third "virtual" ADC. The PACSS includes an analog input multiplexer, input buffer amplifiers, delta-sigma modulators, decimators, and digital signal processing channels. There is also a precision voltage reference, current references, and temperature sensors.

Benefits	– Two precision ΔΣ ADCs (16-20+ bits)
	– Current channel with automatic gain
	– Voltage channel with HV input divider
	– Temperature and diagnostic channels
	– Supports both internal and external temperature sensing
	– Digital filtering, accumulators, and threshold comparisons on all channel

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High Voltage

LIN / CXPI transceiver (PHY)

PSOC-HV has an integrated local interconnect network (LIN)/clock extension peripheral interface (CXPI) transceiver. The LIN transceiver meets the requirements of LIN standard 2.2A and is downward compatible the LIN 2.0. It has a data rate of up to 20kbps with high EM noise immunity. The CXPI transceiver is compliant with the JASO CXPI (JASO D 015-3: 2015), SAE CXPI (J3076_201510), and ISO CXPI (ISO 20794-4: 2020) standards. The CXPI PHY connects to the LIN pin which is externally connected to the LIN bus. The CXPI transceiver connects the CXPI data link controller and the LIN/CXPI bus line and enables direct connection to the vehicle battery with robust surge protection.

Benefits	– Operates directly off 12-V / 24-V battery (tolerates up to 42 V) – High level of integration reduces BOM-cost and PCM footprint

Regulator

The high-voltage regulator (HVREG) includes self-start from the battery without a reference voltage and provides the 3.3 V or 5 V chip supply (VDDD / VDDA). The voltage is selectable by order code (see the PSOC™ HV MS datasheet). It also contains a power good function and Zener diode on the output pin for over-voltage protection. The HVREG operates with stability against automotive battery voltage transients, keeping the output voltage stable if the battery voltage (VBAT) drops during cold cranking or rises in a load dump surge condition.
The HVREG also provides a Thermal Shutdown (TSD) and VBAT voltage divider (VDIVIDER) function. The TSD shuts off the HVREG or notifies the CPU when junction temperatures exceed 170 °C. The VDIVIDER is a voltage divider to scale the battery voltage to levels compatible with the on-chip ADC; this ensures that the battery voltage can be measured directly by PSOC™.

Benefits	– Integrated Low-Drop Out (LDO) voltage regulator that operates directly from the 12 V / 24 V battery – PSOC™ is tolerant of battery voltages up to 42 V – The LDO provides 60mA regulator current (up to a peak of 90 mA with 200 ms transients) with thermal shutdown protection.

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Digital

Smart IO

The Smart I/O is a fabric of switches and LUTs that allows Boolean functions to be performed on signals being routed to the pins of a GPIO port. The Smart I/O can perform logical operations on both input and output pins.

Benefits	– Flexibility using programmable logic built into the I/O

CRYPTO

The Crypto block consists of hardware to accelerate common cryptographic functions and hardware to generate random numbers. Its cryptographic features include encryption/decryption functions using Advanced Encryption Standard (AES) (128-, 192-, 256-bit), a hashing function with Secure Hash Algorithm (SHA) and a 32-bit cyclic redundancy code (CRC) generator. It also supports Pseudo random number generation (PRNG).

Benefits	– Dedicated cryptography block for fast cryptographic functions – AES, SHA, CRC, True and Pseudo random number generation

UDB

The Universal digital block (UDB) has a combination of programmable logic devices (PLDs), structured logic (datapaths), and a flexible routing scheme. Each UDB contains an ALU-based 8-bit datapath, two PLDs, control and status modules and clock and reset modules. The UDB array includes flexible routing and portions of UDBs can be shared or chained to enable larger functions. The UDB supports flexible implementations of multiple digital functions and a register-based interface to the CPU.

Benefits	– A balanced approach between configuration granularity and efficiency

EEPROM emulator

The EEPROM emulator is middleware that emulates EEPROM functionality in flash and can do wear leveling and restore corrupted data from a redundant copy. It provides declaration of the EEPROM storage and details of the EEPROM configuration and context structures. It is abstracted from the flash hardware and maps the application API request to underlying flash addresses and hardware level APIs.

Benefits	– Cost saving by avoiding the need for external EEPROM hardware

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Communication

LIN

A dedicated LIN communication controller that supports autonomous transfer of the LIN frame to offload the CPU. It is certified at C&S in accordance with the LIN 2.2A/ISO 17987 standards. This controller can be used with an external LIN PHY or routed through the internal LIN PHY in PSOC-HV. It supports both master and slave functionality. Some of the key features of this block include a message buffer for PID, data and checksum fields (both classic and enhanced checksum) timeout detection and error detection. Hardware error injection test modes are included. The controller also includes Baud rate detection and 16x oversampling.

Benefits	– Complete LIN controller with both master and slave functionality

CXPI

The CXPI channel is compliant with JASO D015 and ISO standard 20794 (including the controller specification). It supports slave functionality and polling and event trigger for both normal and long frames. Other features include non-return to zero (NRZ) and PWM signaling, collision resolution, wakeup pulse generation and detection, Cyclic Redundancy Checks (CRCs) (for both normal and long frames) and error detection.

Benefits	– Work with external CXPI PHY, or routed through the internal CXPI PHY

CAN / CAN-FD

The CAN block implements CAN 2.0B as defined in the Bosch specifications and conforms to the ISO-11898-1 standard. It supports Time-Triggered CAN (TTCAN). The CAN-FD block includes time-stamp support and has a 4KB message RAM. FD Data rates of up to 5 Mbps are supported. DMA transfers are also supported (avoiding the need for CPU intervention).

Benefits	– CAN 2.0B – Flexible Data-Rate up to 5 Mbps

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Product Families

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PSOC™ Automotive 4xxx

PSOC™ Automotive 4: Your problem-solver on chip

PSOC™ Automotive 4 integrates Infineon's best-in-class capacitive sensing technology for Human Machine Interface(HMI) applications with an ARM Cortex-M0 / M0+ CPU, flash and memory. The analog peripherals (analog front-end, ADC, operational amplifiers, low- power comparators) combine with digital peripherals and communication interfaces (SENT, LIN, CAN and CAN-FD) to provide a single-chip smart sensor with high integration and a small footprint. You can achieve ultimate flexibility in your design with Infineon software defined peripherals embedded in the PSOC™ Automotive 4 architecture. All PSOC™ devices are supported in 3rd party IDE and either PSOC™ Creator and or the ModusToolbox™ IDE.

PSOC™ Automotive 4 (5.5 V)		
ISO 26262 Ready Entry level MCU with CAPSENSE™	**PSOC™ 4200L** 48 MHz, 256KB/32KB, VFBGA-124, USB full speed 3rd Gen. CAPSENSE™ (×2), UDB (×8),CAN (×2)	**PSOC™ 4100S Max** 48 MHz, 384KB/32KB, QFN-48,TQFP-64,TQFP-100 5th Gen. CAPSENSE™ (×2), Crypto, CAN-FD, LCD	
	PSOC™ 4100/4200M 48 MHz, 128KB/16KB, QFN-56,TQFP-48, TQFP-64, LCD Drive, 3rd Gen. CAPSENSE™ (×2), CAN (×2), UDB (×4)	**PSOC™ 4100S Plus** 48 MHz, 128KB/16KB, QFN-40/48/64,TQFP-64,SCB (×5) 4th Gen. CAPSENSE™, CAN, LCD Drive **PSOC™ 4100S** 48 MHz, 64KB/8KB, QFN-40,SSOP-28,LCD Drive, 4th Gen. CAPSENSE™, SCB (×3)	**PSOC™ 4700S Plus** 48 MHz, 128KB/16KB, QFN-40,4th Gen. CAPSENSE™, CAN Inductive Sensing, LCD Drive
	PSOC™ 4100/4200 48 MHz, 32KB/4KB, SSOP-28, UDB (×4), LCD Drive 3rd Gen. CAPSENSE™, SCB (×2) **PSOC™ 4000** 16 MHz, 16KB/2KB, QFN-24, SOIC-16 3rd Gen. CAPSENSE™, SCB(×2)	**PSOC™ 4000S** 48 MHz, 32KB/4KB, QFN-24,QFN-40,SSOP-28 4th Gen. CAPSENSE™, SCB (×2)	

SCB: Serial communication block
UDB: Universal digital block
CAN: Controller area network
CAN-FD: Controller Area Network Flexible Data-Rate

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Features and benefits

Key features

– Up to 384-KB Flash & 32-KB SRAM
– Support multiple data collection methods such as capacitive to resistive, inductive and current sensing
– Low-power compute, optimized at a hardware level
– Up to 84 GPIO pins supporting both analog and digital signals
– CAN,CAN-FD, TX I2S, Fast I²C, Segment LCD, TCPWM x8, SCB x5
– Dedicated HW security block to support AES, SHA, TRNG, PRNG, & CRC functions
– ModusToolbox™ support

Key benefits

– Differentiated HMI features / algorithms running in the MCU (e.g. water rejection)
– High-speed communications from Fast I²C to CAN-FD
– Increased security with encryption support for in-vehicle communication
– Easy-to-use software for prototyping and productizing end applications
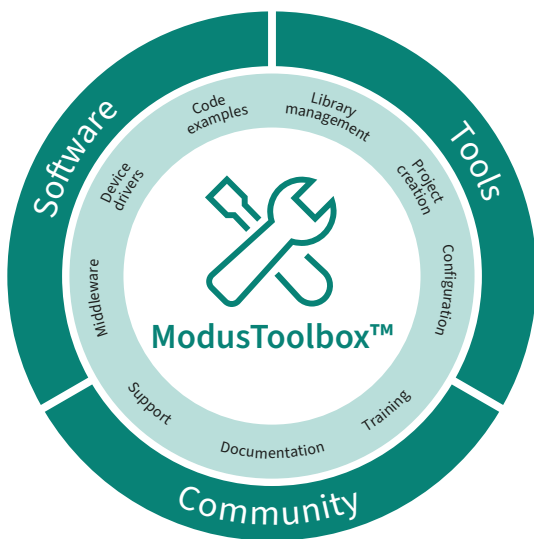
PSOC™ Automotive 4 devices are supported by ModusToolbox™
– Variety of code repositories on GitHub that are comprehensive and flexible
– Repositories include board support packages (BSPs), low-level resources like a hardware abstraction layer (HAL) and peripheral driver library (PDL), and middleware that enables industry-leading features such as CAPSENSE™
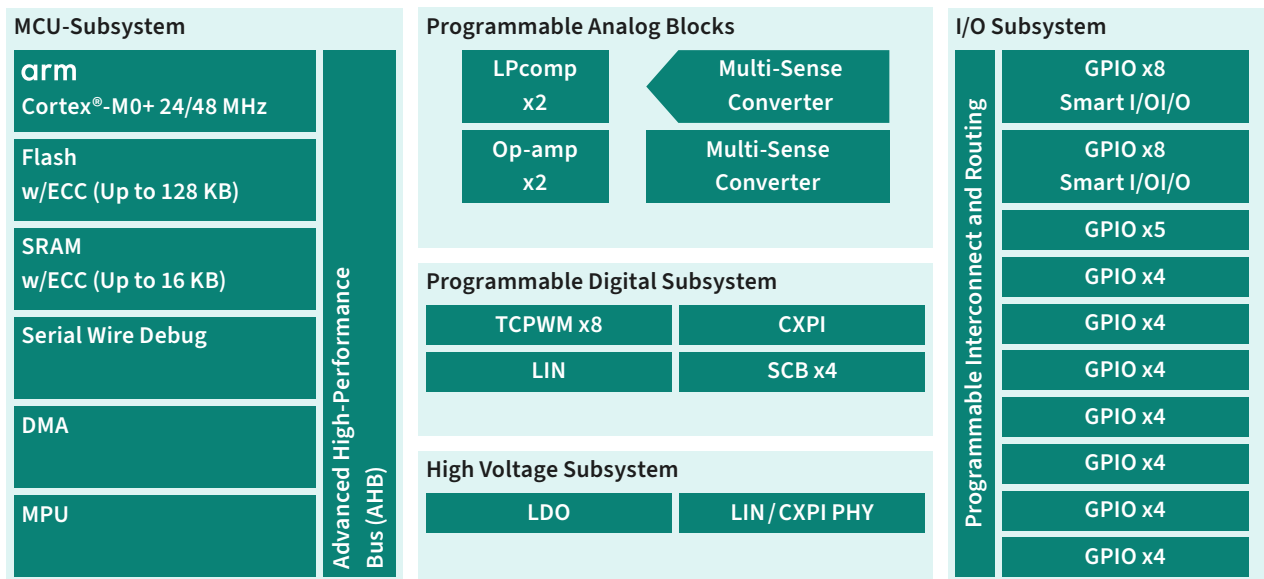(Explanation of the graph or the board)

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PSOC™ 4 HVMS (High Voltage Mixed Signal)

Small footprint solution for smart sensing applications

The PSOC™ 4 High Voltage Mixed Signal (HVMS) series of products, provide a single-chip solution for automotive smart edge-sensing by integrating a multi-sense converter, programmable analog, high-voltage (12 V) LDO, LIN PHY and an ARM™ Cortex CPU. This solution fits HMI/sensing applications such as steering wheel switches, Hands on detection, or door handles, as well as general purples applications like PTC heaters or LED-lighting. The device is developed compliant to ISO 26262, meeting all process requirements for ASIL B and hardware architectural metrics for ASIL B.

Block Diagram – PSoC HVMS 128 k

MCU-Subsystem

arm
Cortex®-M0+ 24/48 MHz

Flash
w/ECC (Up to 128 KB)

SRAM
w/ECC (Up to 16 KB)

Serial Wire Debug

DMA

MPU

Advanced High-Performance Bus (AHB)

Programmable Analog Blocks

LPcomp x2

Multi-Sense Converter

Op-amp x2

Multi-Sense Converter

Programmable Digital Subsystem

TCPWM x8	CXPI
LIN	SCB x4

High Voltage Subsystem

LDO	LIN / CXPI PHY

I/O Subsystem

Programmable Interconnect and Routing

GPIO x8
Smart I/OI/O

GPIO x8
Smart I/OI/O

GPIO x5

GPIO x4

GPIO x4

GPIO x4

GPIO x4

GPIO x4

GPIO x4

GPIO x4

Features and benefits

Key features

- The HV subsystem integrates high voltage LDO (42 V tolerant), and a LIN or CXPI PHY
- Developed according to ISO 26262 for ASIL-B as a safety element out of context
- Multi-sense converter integrating 5th generation CAPSENSE™

Key benefits

- Connects directly to a 12 V battery supply and to the LIN / CXPI network, offering foot-print optimized designs
- Helps design safe automotive sensors with integrated functional safety (up to ASIL-B) features
- Robust capacitive-sensing performance with best-in-class SNR enabling elegant automotive HMI designs
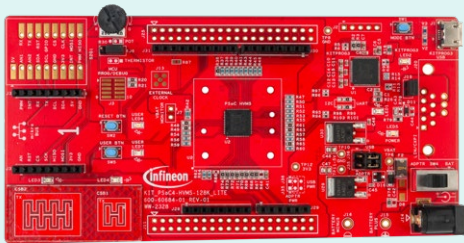
Lite kits and software are available to get started
- Low cost lite kits (KIT_PSOC4-HVMS-128K_LITE / KIT_PSOC4-HVMS-64K_LITE) allows quick getting started
- PSOC™ 4 HVMS is supported by Automotive quality software (PDL, SafeTlib, CAPSENSE™ MW). The users can trial with an evaluation license
- Will be supported free of charge with ModusToolbox™ by Q1 2025

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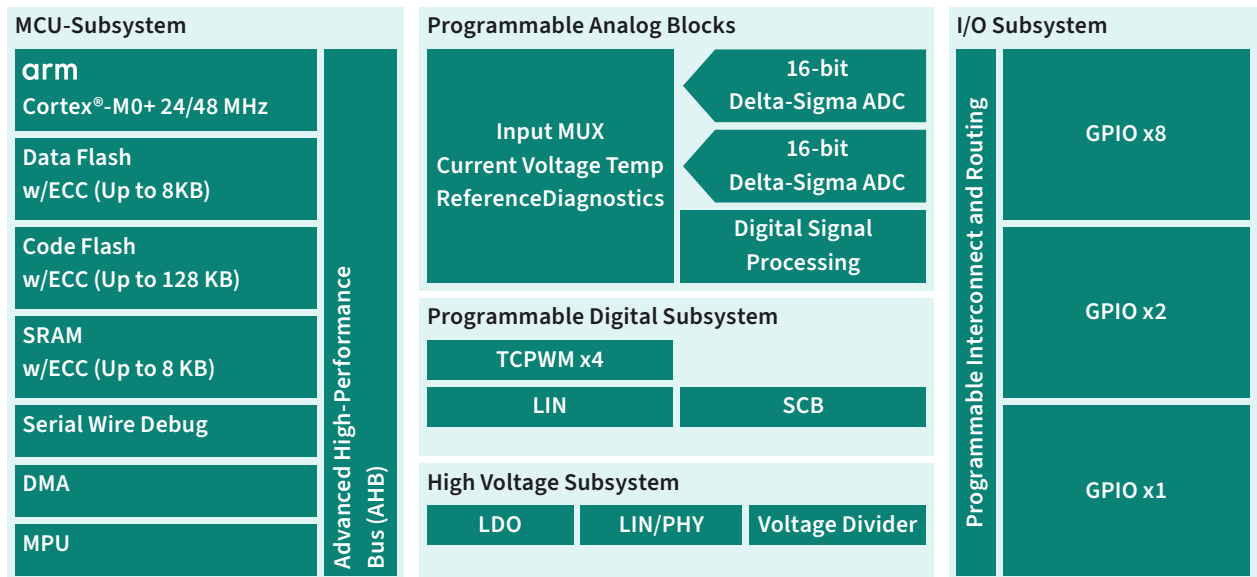Ecosystem and Ease of Use

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PSOC™ 4 HVPA (High Voltage Precision Analog)

One-chip solution for high precision current sensing

The PSOC™ 4 HVPA series of products, provide a single-chip solution for battery management systems integrating high precision analog, high-voltage (12 V) LDO, LIN PHY and an ARM™ Cortex™ CPU which are the required functions for Intelligent battery management system (IBS). The device is developed compliant to ISO 26262, meeting all process requirements for ASIL C and hardware architectural metrics for ASIL B.

Block Diagram – PSOC™ HVPA 144 k

MCU-Subsystem

arm
Cortex®-M0+ 24/48 MHz

Data Flash
w/ECC (Up to 8KB)

Code Flash
w/ECC (Up to 128 KB)

SRAM
w/ECC (Up to 8 KB)

Serial Wire Debug

DMA

MPU

Advanced High-Performance Bus (AHB)

Programmable Analog Blocks

Input MUX
Current Voltage Temp
ReferenceDiagnostics

16-bit
Delta-Sigma ADC

16-bit
Delta-Sigma ADC

Digital Signal Processing

Programmable Digital Subsystem

TCPWM x4

LIN

SCB

High Voltage Subsystem

LDO

LIN/PHY

Voltage Divider

I/O Subsystem

Programmable Interconnect and Routing

GPIO x8

GPIO x2

GPIO x1

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Features and benefits

Key features

– High-precision analog subsystem features two 16-bit delta-sigma ADC and Programmable Gain Amplifier (PGA) with automatic gain control
– PSOC™ 4 device is developed compliant to ISO 26262, meeting all process requirements up to ASIL C and hardware architectural metrics up to ASIL B
– Integrated LIN PHY transceiver and high voltage LDO (42 V tolerant) for direct 12 V operation

Key benefits

– Enable precise State of Charge (SOC) and State of Health (SOH) tracking with high accuracy
– Integrated MCU and software support allow autonomous operation, data storage, and fast time-to-market with flexibility
– Complete solution fits into a compact small foot-print package, enabling smaller PCB area and lower power consumption compared to a multi-chip solution
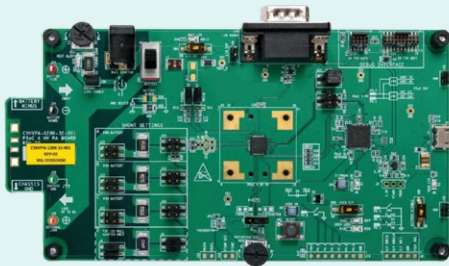
LITE Kit and software available to get started
– The Low cost lite kit (KIT_PSOC4-HVPA-144K_LITE) allows quick getting started
– Evaluation kit (CYHVPA-128K-32-001) is also available for full function evaluation
– PSOC™ 4 HVPA is supported by Automotive quality software (PDL, SafeTlib). The users can trial with an evaluation license
– Will be supported with a free of charge by ModusToolbox™ software by Q2 2025

www.infineon.com/psochvpa

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PSOC™ Automotive Multitouch

Exceptional User Experiences with Cutting-Edge Multitouch solutions

PSOC™ Automotive Multitouch controller provides car manufactures with the ability to design a perfect user experience with their touchscreen HMI systems. Touchscreens that work reliably despite water droplets, condensation or sweat and which enable users to perform touch operations with gloves. All our Multitouch products are supported by an EMC report confirming compliance to automotive electromagnetic conduction / emmissions (EMC) requirements.

Portfolio

Configurable Sense					
	Ultra-large Touchscreen up to 35" Multi-chip	**PSOC™ Multitouch Gen7XL Multi-Chip** 298 I/O, 120 Hz RR			
	Large Touchscreen up to 15" Hover, Force, Haptic, CRYPTO, CAN	**PSOC™ Multitouch Gen7XL** 61-103 I/O, 120 Hz RR			
	Large Touchscreen up to 15"	**PSOC™ Multitouch Gen6XL** 61-88 I/O, 120 Hz RR			
	Small Touchscreen up to 8.5"	**PSOC™ Multitouch Gen6L** 48 I/O, 120-Hz RR	**PSOC™ Multitouch Gen7L** 72 I/O, 100-Hz RR	Medium Touchscreen up to 12.3"	
	PSOC™ Multitouch Gen6L-Slider 41/48 I/O, 200-Hz RR	**PSOC™ Multitouch Gen6L-Trackpad** 41/48 I/O, 120-Hz RR			

Programm-able Sense & MCU			**PSOC™ Multitouch Gen7L+MCU** 72 I/O, 100-Hz RR	MCU Integration
	Sliders	Touchpad	Touchscreen	

Sidebar: PSoC™ Automotive product overview and evolution | Product Nomenclature Decoder | Peripheral Highlights | Product Family | Safety and Security | Artificial Intelligence | Ecosystem and Ease of Use | Applications

Features and benefits

Key features

– Scalable portfolio from 6" up to 35" touch display with multi-chip architectures
– Best in class, working robustly under wet conditions (e.g. droplets, condensation and sweat)
– Tracking with up to 5-mm-thick gloves or thick overlay
– Hover, Force Sensing, Haptics and Acoustic feedback are supported

Key benefits

– Wide displays (>13") are supported
– Better display image quality, requiring thinner module stack-up
– Free form and curved overlay support
– Enable finger tracking under harsh environmental conditions such as with 2/3 wheelers

PSOC™ Multitouch Evalution kits

– Evaluation kits for each product family are available with touch panels and supporting software (CY3290-CYAT8168X for Gen6XL and CY3290-CY-AT817X for Gen7XL

PSOC™ Touch Tuning Host Emulator

– The PSOC™ Touch Tuning Host Emulator is the official front-end tool used to configure, tune, debug, and demonstrate touchscreen devices

www.infineon.com/psocmultitouch

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PSOC™ Automotive Fingerprint

Best-in-class fingerprint authentication and user experience

Fingerprint based biometric user authentication provides the most convenient and secure method for personal identification and authentication. The PSOC™ Automotive Fingerprint device provides fingerprint technology in conjunction with a TRAVEO™ T2G or AURIX™ MCU that include Precise Biometrics' proprietary fingerprint algorithm, Precise Bio Match. Fingerprint enables various applications such as secure payment or automated adjustment of driver settings in-vehicle. The controllers also incorporate: field upgradable firmware, on-sensor image optimization and low power programmable finger detection. The firmware is optimized for both the TRAVEO™ T2G and AURIX™ MCU with an automotive-qualified 8mm × 8mm fingerprint sensor.

Application Benefits	Infineon Solution	All-in-One Fingerprint Solution
Peace of Mind: Provides additional access method in case of forgotten key / Smartphone	32-bit ARM® Cortex®-M0 CPU with 200 KB of flash and 64KB of RAM	**Fingerprint Sensor IC (Infineon):** A Cortex M0+ device with on- chip analog and digital peripherals for FP sensing
Personalization: Identifies who is entering the car, activating personalized interior settings before driving	340 DPI 107×107 pixel array at 8-bits per pixel resolution	**Match Processor IC (Infineon):** A Cortex M4 device which receives image from the sensor. Runs biometric algorithms from Precise Bio. Determines the approved user / imposter.
Convenient and secure: Fingerprint usage in phones and devices has been used extensively. Fingerprint provides the high-security identification without cost and intrusiveness of facial detection technology	8.0×8.0mm Sensing Area	
	ODM adds surface coating	**Mechanical Coating (3rd Party):** A thin layer of material that goes over the bare sensor surface providing mechanical and ESD protection
	Verification and identification up to 15 users	**Biometric Matching Software:** Precise Biometrics AB is a global supplier of identification software. Infineon is partnered with precise to provide best-in-class Fingerprint Authentication.

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Key features

– Field-upgradable firmware.
– On-sensor image optimization
– Low-power programmable finger detection
– Optimized for TRAVEO™ T2G / AURIX™ MCUs
– Automotive-qualified sensor

Key benefits

– Sensing area is decoupled from the silicon
– Ability to create different size sensors with the same silicon
– No need to reduce active area; saves cost
– Customized coatings and covers can be applied on the sensing surface
– Substrate based sensor silicon size can be smaller than the image area vs. in silicon sensor with fixed image area
– Lower cost and less intrusive than face detection

Evaluation Kits for FPG1

– The EVK mounts the fingerprint match module (FPMM), Fingerprint Sensor module (FPSM), and a plastic finger guide onto an easy-to-use demo board that connects via micro-USB to IFXSC + Windows SW
– Today the KIT-FPG1-T2G-B-E-2M kit is available with a TRAVEO™ T2G MCU for initial evaluation

www.infineon.com/psocfpg1

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PSOC™ Automotive Package lineup

	PSOC™ 4100S Max	PSOC™ 4700S Plus	PSOC™ 4100S Plus	PSOC™ 4100S	PSOC™ 4000S	PSOC™ 4200	PSOC™ 4100	PSOC™ 4000	PSOC™ 4200M	PSOC™ 4100M	PSOC™ 4200L	PSOC™ 4 HVMS	PSOC™ 4 HVPA	Multitouch Gen7XL	Multitouch Gen7L	Multitouch Gen6XL	Multitouch Gen6L	Fingerprint
SOIC-16								●										
QFN-24 (Wettable Flank)					●			●										
SSOP-28					●	●	●											
QFN-32 (Wettable Flank)												●	●					
QFN-40 (Wettable Flank)		●	●	●	●													
QFN-48																		
QFN-48 (Wettable Flank)	●		●									●						
TQFP-48									●	●								
QFN-56									●								●	
QFN-56 (Wettable Flank)												●						
QFN-64																		
QFN-64 (Wettable Flank)			●									●						
TQFP-64	●		●						●	●							●	
BGA-73																		●
TQFP-100	●													●	●	●	●	
VFBGA-124											●							
TQFP-128														●	●	●		

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ISO 26262 safety approach

All process requirements and hardware architectural metrics up to ASIL C

PSOC™ 4 HV devices is developed compliant to ISO 26262, meeting all process requirements up to ASIL C and hardware architectural metrics up to ASIL B.

PSOC™ Automotive 4 uses redundant analog measurement paths to achieve up to ASIL B safety level for safety critical application such as current and voltage sensing for battery management.

Additional features such as a Memory protection unit (MPU), Window watchdog timer (WDT) with challenge-response, supply monitoring, hardware error correction for memories and analog diagnostics enable PSOC™ achieve high levels of automotive safety.

PSOC™ Automotive 4xxx devices started their development before ISO26262 publication, therefor cannot claim ASIL compliance. However Infineon is supporting these devices with supportive documentation (Safety manual,FMEDA) for "ASIL readyness

PSOC™ Automotive 4 Safety environement

ASIL Classification	Safety HW features	Document available	Safety software
ASIL Ready		Safety manual, FMEDA	NA
ASIL B	– Memory protection unit (MPU) – Window watchdog timer (WDT) with Challenge-Response functionality – Supply monitoring; detection of over-voltage and brownout events. – Hardware error detection and correction (SECDED ECC) on all safety-critical memories (SRAM, flash)	Safety case report, Safety manual FMEDA	SafetyLib & ASIL B AutoPDL for ASIL B & ASIL C devices
ASIL C	– All ASIL-B safety HW features – Analog diagnostics (backup reference voltage, redundancy in voltage, current, and temperature measurement paths)	Safety case report, Safety manual, FMEDA	SafetyLib, ASIL B Auto PDL

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PSOC™ Automotive 4

Device	ASIL ready(QM)	ASIL Compliant (systematic)	HW Architecture metrics
PSOC™ 4000S	Yes		
PSOC™ 4100S	Yes		
PSOC™ 4100S/ 4700S Plus	Yes		
PSOC™ 4100S Max	Yes		
PSOC™ 4100M/4200M	Yes		
PSOC™ 4000	Yes		
PSOC™ 4100/4200	Yes		

PSOC™ Automotive Fingerprint	Yes		
PSOC™ 4 HVPA 144K			ASIL B→ All functions
PSOC™ 4 HVMS		ASIL C→ All functions	ASIL B→ All functions

www.infineon.com/prosil

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ISO 21434 security approach

Security

ISO21434 Process Compliance

- ISO/SAE 21434 was published at the end of 2021
- Infineon received the certificate for Process Compliance for Cyber Security Management System (CSMS) in 2022

ISO21434 Product Compliance

- PSOC™ Automotive devices covered in this brochure started their development before ISO / SAE 21434 was published
- Hence full ISO21434 ("out of context") compliance cannot be achieved

ISO21434 ready

- Infineon will enhance its PSOC™ microcontrollers to ISO 21434-readiness within 2025
- Supporting customers with
  - A Cybersecurity Application Note
  - A Compliance Matrix
  - ATV Threat Intelligence for Monitoring & Incident Response
- This activity helps customers to reduce design effort, enables application compliance, and speeds up time-to-market

Security Features and Usecases (PSOC Automotive 4100S Max)

Key features

- Symmetric crypto-acceleration in hardware up to AES-256
- Secure Hash Algorithms in hardware up to SHA256
- Pseudo Random (PR) number generation
- True Random (TR) number generation

Key security usecases and benefits

- Increased security performance by encryption/ decryption/hash support in Hardware
- CPU offloaded from performing security related tasks
- Secured communication, protected data storage
- Device security and debug protection available through Boot, Open, Protected or Kill modes
- Flash protection for read and write access possible through various Flash protection levels

www.infineon.com/iso-21434

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IEC 61508 Safety approach

All process requirements and hardware architectural metrics up to SIL-2

Providing Functional Safety for Industrial Applications

Infineon microcontrollers, such as AURIX™, TRAVEO™ T2G, and PSOC™ HV, have proven themselves to be not only excellent choices for Automotive Safety applications but also for Industrial Safety related applications. Their versatility and reliability make them an attractive option for a wide range of safety-critical use cases. When focusing on PSOC™ HV, it takes a holistic system-level approach to Functional Safety. By adhering to the stringent guidelines of ISO 26262 and supporting multiple Safety Standards under the IEC 61508 umbrella, it ensures a robust

safety framework. The PSOC™ HV microcontroller features dedicated safety mechanisms, which supports several industrial safety applications. As a safety-element-out-of-context, the hardware and its accompanying software can support a wide range of safety-critical applications that conform to the IEC 61508 standard. Furthermore, it is designed to support safety-critical applications up to SIL 2 (Safety Integrity Level 2), demonstrating its reliability and robustness.

Applications Examples

– Industrial Robotics
– CNC Machines
– Industrial Automation & PLC
– Human Machine Interface
– Railway Power and Automation
– Elevators
– Tractors & Agricultural machinery
– Construction machinery
– Forklifts
– Aerial Lifts
– Crane
– EVTOL
– Drones

IEC 61508 and relation to other Safety Standards

IEC 61508			PSOC™ HV supports
	Automotive	→ ISO 26262	
	Machinery	→ ISO 13849	
	Railway	→ EN 50129	
	Nuclear Power	→ EN 61513	
	Process Industry	→ IEC 61511	
	Household Appliances	→ IEC 60335	
	Furnaces	→ IEC 50156	
	Agriculture	→ ISO 25119	
	Aviation	→ DO-178	

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Probability of Dangerous Failure per Hour (PFHd)	SIL IEC 61508	SIL EN 62061	PL ISO 13849	AgPL ISO 25119	ASIL ISO 26262
10^{-8}	4	–	–	–	–
10^{-7}	3	3	e	e	D
10^{-6}	2	2	d	d	C
					B
3×10^{-6}	1	1	c	c	A
10^{-5}			b	b	
10^{-3}	–	–	a	a	QM
	–	–	–	QM	

Risk of failure
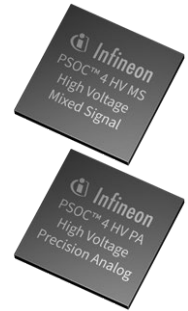
PSOC™ HV supports up to SIL-2 on IEC 61508 with a single device, but can reach higher levels with 2oo2 Architecture

www.infineon.com/functional-safety

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Artificial Intelligence (AI) on PSOC™

AI algorithms enable easier design and tuning

AI Use cases on PSOC™ Automotive	
Sensors	**Liquid-Level Sensing** – Ability to distinguish between liquid and foam – Insensitive to the size and shape of the liquid container – same neural network and AI algorithm for all cases – Tuning time reduction from weeks to hours
Trackpads and Touchscreens	– Support for unusual shapes, sizes, and requirements – Traditional approach: order of months for algorithm development – AI – reduced to weeks after some simple collection of training data

Development flow supported by AI

| Collect data | Preprocess data | Design a model | Train a model | Evaluate Optimize | Convert model | Deploy model | Make interface |

Data management and preprocessing, NN models management and training

NN model quantization, efficient C-code (MTB/TFLM inferences)

Business logic implementation

Deployment

imagimob
An Infineon Technologies Company

Optimal trained model (h5)

Port
C-code (binaries)

FW hex

MTB ML

ModusToolbox™ project

Data for training (Signals from level sensors)

NN model structure

– Infineon's End to End Machine Learning Solution with Imagimob & Modus Toolbox ML are under development
  – Out of the box examples will be provided for easy tailoring

Imagimob makes it easy for you to use machine learning in your edge devices.
At Imagimob, we focus on helping our customers put their Edge AI applications into production. We offer Imagimob Studio, a development platform for machine learning on edge devices. We also offer several Ready Models for companies who don't want to develop machine learning models from scratch.

Ecosystem and Ease of Use

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Preferred Design Houses – PDH

Empower your innovations with MCU experts

Our Microcontroller™ preferred design houses are a trusted partners' ecosystem that extends the support force by tailoring their know-how to meet your specific needs.

By partnering with one of our qualified preferred design houses, you can be assured that you'll receive expert advice and customized support to help you achieve your goals. Our team of professionals brings added value to customer service, working together to optimize your design and help you succeed in your business objectives.

We understand that every customer is unique, which is why we offer tailored solutions to meet your specific needs. From product-specific support to application-specific advice, our preferred design house is fully trained to use AURIX™, TRAVEO™ T2G and PSOC™ Automotive and provides a wealth of knowledge and expertise to help you succeed.

Our preferred design houses are committed to delivering exceptional service and support to ensure your success. So why wait? Contact us today to learn more about how our Preferred design house can help you achieve your goals and take your business to the next level.

Classic – Free of charge

– To be agreed between customers and PDH
– First level customer support covering Infineon products and solutions
– Technical interface and support to the customer
– Driving design at customer
– Basic training for design teams at customer
– 24 h response time to the customer

Premium – Consultancy mode

– Project management and project-specific application support
– Specification of general software architecture, defining required layers, control, safety, security, Multicore and Arm support
– Specification and implementation of custom device drivers and project-specific
– Optimization of software components with regards to speed / code size
– Software testing
– Functional safety engineering and project-specific support for security solution

	Product Family						Supported Region(s)					
	AURIX™	TRAVEO™ T2G Body	TRAVEO™ T2G Cluster	PSOC™ Automotive	PSOC™ High Voltage	PSOC™ Multitouch & Fingerprint	Global	EMEA	AMR	JP	GC	AP
Altia			•				•					
Amarakosha Technologies	•										•	•
Avin Systems	•						•					•
AVL	•			•			•					
Bluewind	•							•				
Candera			•				•					
CATARC	•										•	
Clicktouch				•		•		•				
Colorado Engineering / CEI Colorado Engineering	•								•			
Crevavi	•	•					•					
D3 Engineering	•								•			
Digital Edge Solutions	•											•
DriveXpert / Drive Expert	•	•						•				
Eagle Wings Design	•	•	•	•	•				•			
Eboata											•	
eInfochip	•	•	•	•	•		•					
Embedded Office	•	•	•	•				•				
Embien Technologies			•									•
Elektrobit Automotive GmbH	•	•	•				•					
FESCARO	•											•
Frobas	•						•					
Galaxi Engineering Technology Services	•											•
G-Pulse	•	•	•	•	•						•	
GRINN	•							•				
Hamso				•			•					
Hightec	•	•	•	•	•		•					
Hitachi Industry & Control Solutions, Ltd.										•		
Hitex	•	•	•	•	•		•					
IAV	•							•				
IMST	•							•				
Intecs Solutions	•							•				
Integra Sources	•							•				
Jingwei HiRain	•	•		•							•	
KPIT Technologies Ltd.	•						•					
L4B software			•					•				
Leadmove	•										•	
Macnica	•	•	•	•						•		
MecTronic	•							•				
Microfuzzy	•	•		•				•				
Mixed Mode	•							•				
Neutron Controls	•	•	•	•	•				•			
NEXTY Electronics Corporation	•	•	•	•						•		
Olvia	•							•				
PiNTeam	•							•				
Precise Biometric						•		•				
QianQin	•										•	
QT			•				•					
Revotech	•	•	•									•
RDM Group / RDM Automotive	•							•				
Samsotec				•	•	•		•				
Seasidetech	•							•				
Sigma Connectivity						•	•					
Siili Auto			•					•				
T & S Engineering	•							•				
Tbench Solutions	•							•				
Techrein	•	•	•									•
Tokyo Electron Device	•	•	•	•	•	•				•		
Tongji	•										•	
Tresa Energy	•											•
ULMA Embedded Solutions	•							•				
Vitalcore Technologies	•	•										•
VECENTEK	•										•	
Witekio			•				•					

Evaluation Kits

Something for every design adventure and budget!

Evaluation kits explore the full PSOC™ functionality are available for each product family. The board enabling CAPSENSE™ is available for evaluation and is included amongst them. Low-cost boards for quick start-up with minimal functionality, the lite kits, are also available and include software support.

PSOC™ 4 HVPA Evaluation kit

– Evaluation board for PSOC™ 4 HVPA
– The board including pseudo load provides a convenient and standardized environment for testing and validating intelligent battery sensing technologies

– CYHVPA-128K-32-001

PSOC™ 4 HVPA Lite Kit

– Low-cost kit for rapid proto-typing of smart sensing appli-cations with PSOC™ 4 HVPA
– Precision analog function could be evaluated with mini-mum effort

– KIT_PSOC4-HVPA-144K_LITE

PSOC™ 4 HVMS Evaluation kit

– Evaluation board for PSOC™ 4 HVMS
– CSD linear slider board and CSD / CSX trackpad board are available for the evaluation of the 5th generation multi-sense converter (MSC) block supporting capacitive sensing (CAPSENSE™)

– CYHVMS-64k-56-001
1. CYHVMS-64k-56-001 PSOC™ HV MS board

2. CSD linear slider board

3. CSD / CSX trackpad board

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PSOC™ 4 HVMS Lite Kit

– Low-cost kit for rapid proto-
typing of smart sensing appli-
cations with PSOC™ 4 HVMS
– 5th generation CAPSENSE™
with onboard buttons,
Arduino-compatible headers,
mikroBUS header, and
XENSIV™ bus

– KIT_PSOC4-HVMS-64K_LITE
– KIT_PSOC4-HVMS-128K_LITE
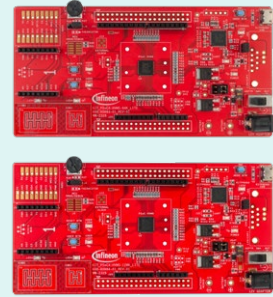
PSOC™ Automotive 4700S Plus Inductive Sensing Evaluation Kit

– Cost effective hardware plat-
form for PSOC™ 4700S Plus
series MCU
– Inductive sense features:
  1) buttons using Metal over
     touch (MOT)
  2) Proximity sensor that sup-
     port metal target detection
– Code examples for both
sequential and parallel
scanning

– CY8CKIT-4700S-PLUS

PSOC™ Automotive 4100S Max Pioneer Kit

– A Low cost platform to design
and debug the PSOC™ 4100S
Max series MCU
– Comes with 2 boards
  1) Pioneer board
  2) Capacitive sensing
     expansion board
– Wide range of code examples
available in ModusToolbox™
for evaluation
– This kit has capacitive sensing
interfaces including buttons, a
slider, a touchpad and a
proximity sensor

– CY8CKIT-041S-Max

www.infineon.com/evaluation-kits

TSG7XL Evaluation Board with 10.2" touchscreen

– A Touchscreen evaluation
  platform based on the
  CYAT817X with Infineon's
  capacitive multitouch all-point
  touchscreen technology
– The kit contains not only the
  CYAT817X sensor board but
  also a 10.2-inch touchscreen
– The software tool installation
  guide is included in the
  documentation

– CY3290-CYAT817X

CYFP10020x00 Fingerprint Sensor Evaluation Kit

– A fingerprint sensing evalu-
  ation platform featuring the
  CYFP10020x00 fingerprint
  sensor, TRAVEOTM T2G MCU,
  and Precise Biometrics AB Bio-
  MatchTM software
– Evaluation GUI included

– CYFP10020x00

PSOC™ Automotive 4100S Plus Prototyping Kit

– Easy-to-use and low-cost proto-
  typing platform for a wide range
  of embedded applications
– ARM Cortex M0+ MCU with
  serial communication blocks,
  analog front-end, digital
  peripherals, and 4th Genera-
  tion CAPSENSE technology
– On-board push-button and
  LEDs for visual feedback
– Three CAPSENSE touch but-
  tons and one six-segment
  CAPSENSE slider with visual
  feedbcak LEDs
– EZ-BLE Module, external ECO
  and WCO crystals
– 1.8V to 5V operation
– Code examples available

– CY8CKIT-149 PSOC™ 4100S
  Plus Prototyping board

www.infineon.com/evaluation-kits

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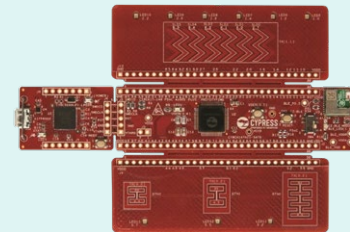
Applications

ModusToolbox™ and AutoPDL

Choose the most suitable development environment based on their application needs

PSOC™ 4 Software Product Portfolio offers various options for developers, including the ModusToolbox™ (MTB) and the Automotive Peripheral Driver Library (AutoPDL). These two options differ in their approach and functionality, catering to distinct application requirements within the PSOC™ 4 ecosystem.

PSOC™ 4 Software Product Portfolio		Features
Professional software (commercial license)	– AutoPDL 1.X – SafeTlib 1.X – CAPSENSE™	– ASPICE v3.1 qualified – MISRA 2012 AMD1 and CERT-C – ISO 26262 compliant – ASIL B – FuSa compliant IAR compiler with safety features based on SEooC
Reference Software (eval and open-source license)	– ModusToolbox™ Software (CA T2 PDL, CAPSENSE™)	– A modern, extensible development ecosystem – A collection of development tools, libraries, and embedded runtime assets

PSoC™ Automotive product overview and evolution

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Software support for PSOC™ Automotive

	PSOC™ Creator	Modus ToolBox software and Tools	Automotive PDL / SafeTLib / CAPSENSE™
PSOC™ 4000	●		
PSOC™ 4100	●		
PSOC™ 4000S	●	●	
PSOC™ 4100S	●	●	
PSOC™ 4100S Plus	●	●	
PSOC™ 4200	●		
PSOC™ 4700S Plus	●	●	
PSOC™ 4100S Max		●	
PSOC™ 4 HVMS-128k		●	●
PSOC™ 4 HVMS-64k		●	●
PSOC™ 4 HVPA-144k		●*	●

Note *: support in future

www.infineon.com/psoc-software

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ModusToolbox™

Architected to provide a flexible and comprehensive development experience

ModusToolbox™ Software is a modern, extensible development ecosystem supporting a wide range of Infineon microcontroller devices, including **PSOC™ Arm® Cortex® Microcontrollers, TRAVEO™ T2G Arm® Cortex® Microcontroller.** Provided as a collection of development tools, libraries, and embedded runtime assets, ModusToolbox™ Software is architected to provide a flexible and comprehensive development experience.

Run-Time Software

Comprised of middleware, device drivers, and code examples is provided via an extensive collection of GitHub-hosted repositories.
Explore the available run-time software resources cataloged within the ModusToolbox™ Software repository overview.

Development Tools

Supporting Windows, Linux, and macOS are available as a tool's setup program from the Infineon Developer Center. These desktop applications enable the creation of new embedded applications, managing software components, configuring device peripherals and middleware, and embedded development tools for compiling, programming, and debugging.

The ModusToolbox™ development tools interface directly with the available run-time software repositories, providing easy access to the latest development resources. Download today to get started with ModusToolbox™.

Community

Forums, knowledge-based articles, and technical blog articles are easily accessible from the Infineon Developer Community. Additional resources to enhance the ModusToolbox™ development experience include comprehensive documentation for both development tools and run-time software, detailed training, and tutorial videos.
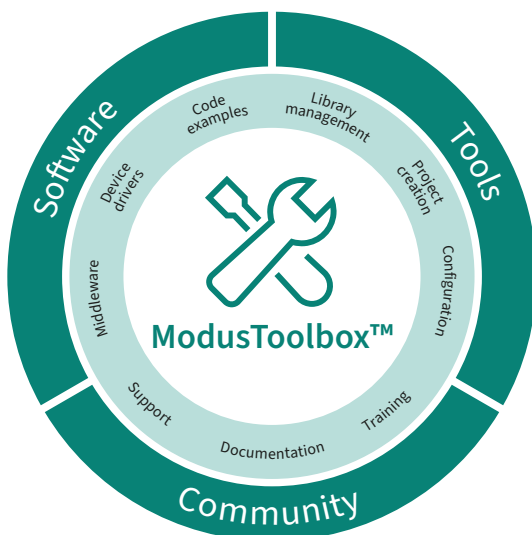
Infineon provides a large collection of code repositories on GitHub
- This include Board Support Packages (BSPs) aligned with Infineon kits
- Low-level resources, including a hardware abstraction layer (HAL) and peripheral driver library (PDL)
- Middleware enabling industry-leading features such as CAPSENSE™
- Libraries
- Code examples
- Training material
- Board support packages

Automotive quality software

- Software packages offered by Infineon for PSOC™ 4 HV devices are developed as per standard Automotive software development processes
- The software is ASPICE qualified (MISRA 2012 AMD1, CERT C) and ISO 26262 compliant. Safety target up to ASIL B

Peripheral driver library (PDL)

- **Complete package of low-level drivers** comprising of analog, digital and communication components
- **Enables shorter time to market** by reducing the development time
- **Functional Safety (ASIL B) compliant software** built as per ASPICE standards, using the FuSa compliant IAR compiler with safety features based on SEooC

CAPSENSE™ middleware library

- **Middleware to implement CAPSENSE™ functionality** such as basic control, filter, data processing and sensing for interface widgets etc.
- **Configurable** various parameters such as number of widgets, capacitance settings, noise threshold settings etc. using a simple GUI based CAPSENSE™ configuration tool
- **Enables shorter time to market** by reducing development time

SafeTlib

- **Integrates critical safety tests** which are mandatory as per the hardware safety manual to achieve ASIL B compliance
- **Enables shorter time to market** by reducing development time
- **Enables safe operation of the chip** during start-up and runtime

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Software and Tools partner ecosystem

PSOC™ Automotive is supported by several software and tool partners who offer compilers, an IDE, a debugger / programmer, and communication protocol software drivers (e.g., LIN). Infineon works closely with these partners to enhance customer support and optimize collaboration.

		PSOC™ 4xxx	PSOC™ 4 HVPA / HVMS
IDE / Compiler	iar	●	●
	arm	●	
Debugger / Programmer	iar	●	●
	arm	●	
	LAUTERBACH DEVELOPMENT TOOLS	●	●
	TASKING	●	●
	SEGGER www.segger.com	●	●
Communication protocol	ihr		●
	VECTOR	●	●

www.infineon.com/psoc-software

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Online Support

The answers they need, right at their fingertips

PSOC™ Community

Introducing the enhanced PSOC™ Automotive experience! Our strategic shift towards the wider mass market has led to the development of the PSOC™ Forum, a dedicated platform designed to support both our mass market and core account customers. We've revolutionized the forum's maintenance to empower our customers to swiftly find the answers they need, right at their fingertips.

To ensure seamless support, we've curated a comprehensive FAQ section covering the most critical topics, resulting in a significant surge in traffic to our PSOC™ forum. With these improvements, our customers can now easily access the support they require, making the forum the go-to destination for all PSOC™ Automotive needs.
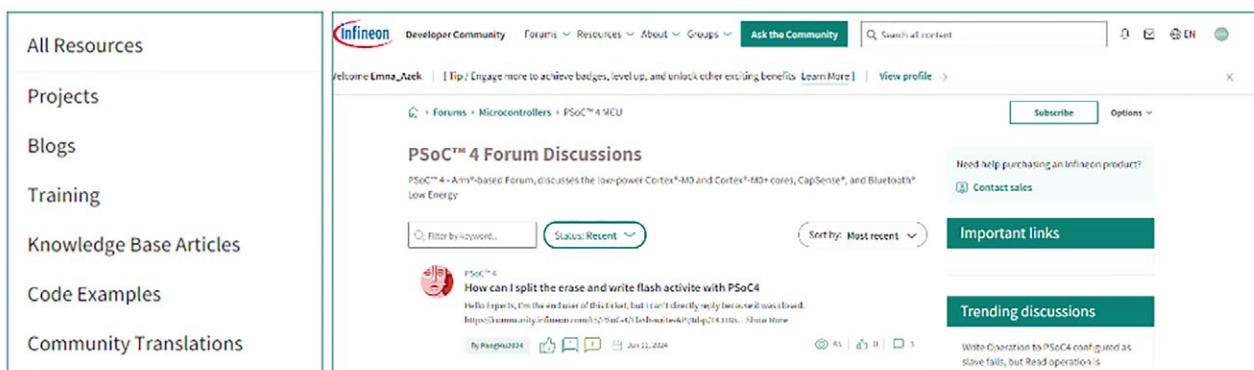
Join our thriving community at Infineon Community and experience the difference!

PSOC™ MyICP

By registering for myInfineon Collaboration Platform you can get access to additional add-on technical documentation, trainings, tools, and much more. Please follow these steps in order to get started:
1. Register for myInfineon
2. For PSOC™ documentation please email to autopsoc@infineon.com
3. You will receive a confirmation which explains how to use your new access

Applications

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Market trends of HMI Applications

– With greater emphasis on and the increase in information interchange between human beings and various systems in cars, Human machine Interface (HMI) technologies have gone through a paradigm shift taking user experience to a whole new level.

– Vehicle electrification has transformed the car into a safe, luxurious and intelligent machine. Engineers are constantly trying to improve HMI systems to make them more intuitive, appear 'cooler', and sense with more precision

– Capacitive sensing is at the heart of this wave of change and revolutionizes the design and implementation of HMI applications by replacing mechanical buttons, sliders and switches.

– Capacitive sensing becomes even more powerful when used with PSOC™ programmable mixed-signal controllers, which enable intelligent measurements like range detection, direction of approach or gesture recognition. Taking a programmable approach can add value by improving performance with programmable sensitivity thresholds, using variable scan speeds to reduce current consumption and provide immunity to noise.

– Artificial Intelligence (AI) using PSOC™ is powerful to enhance user experience by facilitating gestures over non-uniform surfaces or compensating for surface gradients.

– Touchscreens are a great value add to the center console of the car. Not only do they provide an excellent enhancement to the user interface but also act as natural integrators of multiple controls onto one system. Capacitive touchscreens enable multiple-finger recognition, gesture decoding, superior light transparency and increased touch sensitivity. They have become the HMI display technology of choice.

– Capacitive proximity sensing provides an efficient means of implementing 'range' sensitive illumination control for various indoor and outdoor car systems. PSOC™ MCU's can combine, capacitive touch sensing, LIN communication support and LED dimming capability which provide a single chip solution for Interior lighting with dynamic RGB control, and personalized animations.

– The PSOC™ based fingerprint sensor offers great application benefits like personalization and payment authorization, using a well-known and proven technology, without the cost and security concerns of facial recognition.

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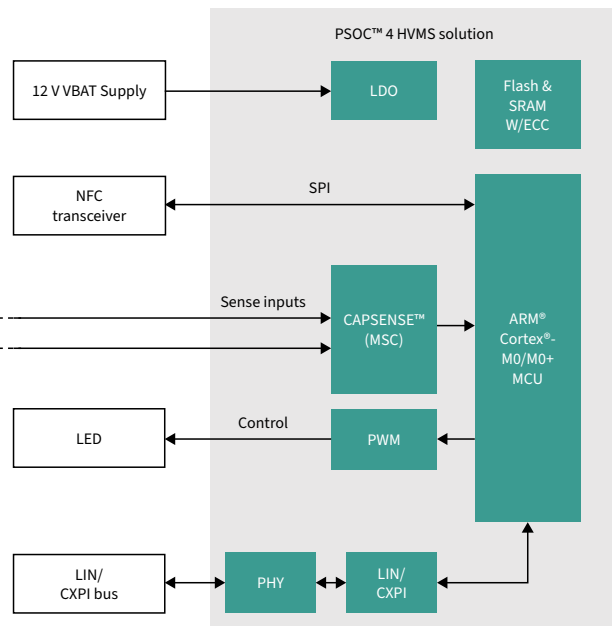
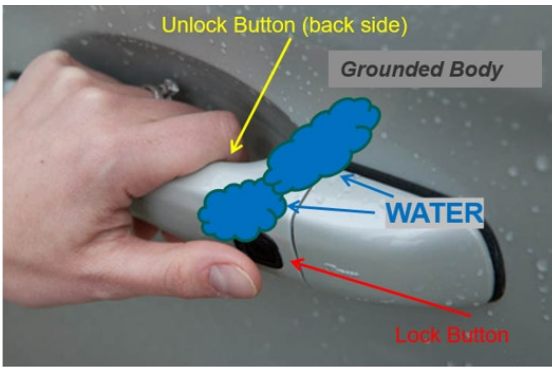Ecosystem and Ease of Use

Applications

Car door handle

Designing touch-based systems to achieve reliable performance in the presence of water and glove touch, in limited space enclosures, such as within door handles, presents several challenges. These include the need for multiple capacitive and inductive sense methods to mitigate the impact of water on touch performance, as well as integrated SBC and LIN PHY for small form-factor solutions that can fit within limited PCB real estate. Designs must achieve high-sensitivity to operate reliably with thick overlays or glove touches, while also utilizing control-lers with ultra-low power consumption for continuous operation, even when the car is switched off. Additionally, a BOM-integrated microcontroller solution offered in a small footprint package is essential to meet the space constraints of door handle PCB designs.

Infineon's PSOC™ 4xxx / HVMS solution effectively addresses various challenges by leveraging the capabilities of Infineon's 5th generation CAPSENSE™ technology. This solution offers improved noise immunity and a robust human-machine interface (HMI) that performs reliably in harsh environments characterized by extreme electrical noises, weather conditions, and temperatures.

Application diagram

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Features and benefits

Application features

- Cortex®-M0+ MCU with DMA, MPU & flash with ECC for processing CAPSENSE™ data
- PWM controls the LED on the door handle
- HV block (LDO and LIN/CXPI PHY) that connects directly to a 12-V battery supply with the integrated HV regulator and communicates directly to the LIN/CXPI bus with an integrated LIN/CXPI Phy
- SPI communication with a NFC transceiver IC

System benefits

- Reliable, liquid-tolerant CAPSENSE™ buttons do not false touch even in presence of grounded-water
- Superior noise immunity with spread spectrum clocking and Multi frequency scanning (MFS)
- Provides fast response time with ultra low power consumption
- Integrated SBC, LIN, CAPSENSE™ and MCU for small form factor and small BoM
- Support of large capacitances (~ 3nF) with MSCV3

Suggested products

- PSOC™ 4xxx
- PSOC™ 4 HVMS

www.infineon.com/door-control

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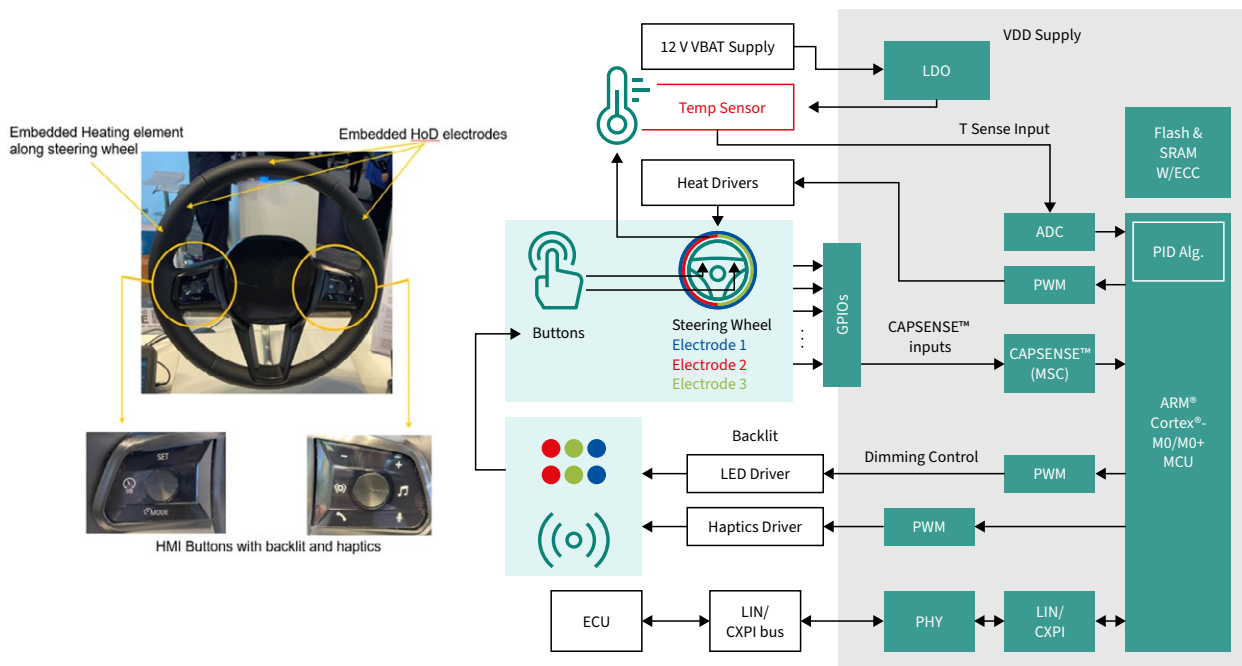Ecosystem and Ease of Use

Applications

Hands on detection

With the increased adoption of ADAS and Autonomous driving, hands-on detection systems are gaining importance. Vehicles with lane keeping assist systems (LKAS) must comply with hands-on detection requirements per UN regulation 79 (R79). The UN R157 regulation requires 'hands-on' detection as a key condition for the transition from automated back to manual driving mode.

Application diagram

Embedded Heating element along steering wheel

Embedded HoD electrodes

HMI Buttons with backlit and haptics

12 V VBAT Supply

Temp Sensor

Heat Drivers

Buttons

Steering Wheel
Electrode 1
Electrode 2
Electrode 3

GPIOs

Backlit

LED Driver

Haptics Driver

ECU

LIN/ CXPI bus

VDD Supply

LDO

T Sense Input

CAPSENSE™ inputs

Dimming Control

Flash & SRAM W/ECC

ADC

PWM

CAPSENSE™ (MSC)

PID Alg.

PWM

PWM

PHY

LIN/ CXPI

ARM® Cortex®-M0/M0+ MCU

Features and benefits

Application features

- Enables robust capacitive sensing using CAPSENSE™ for proximity detection of whether hands are presence or absent
- Infineon provides design guidelines and support for designing capacitive sensors
- Measure the steering wheel temperature and drives the heater with a PWM
- Use temperature compensation algorithms to compensate for temperature changes
- Support of large capacitances (~ 3nF), noise immunity, Directly driven off the 12 V supply and the ability to drive the heater coil

System benefits

- Single chip solution to implement Hands-on-detect
- Supports large parasitic capacitances of up to 3000 pF
- Integrated SBC, LIN, CAPSENSE™ and MCU for small form factor and small BoM
- Both the CAPSENSE™ sensor and the heating coil can be integrated

Suggested products

- PSOC™ 4xxx
- PSOC™ 4 HVMS

www.infineon.com/in-cabin-sensing

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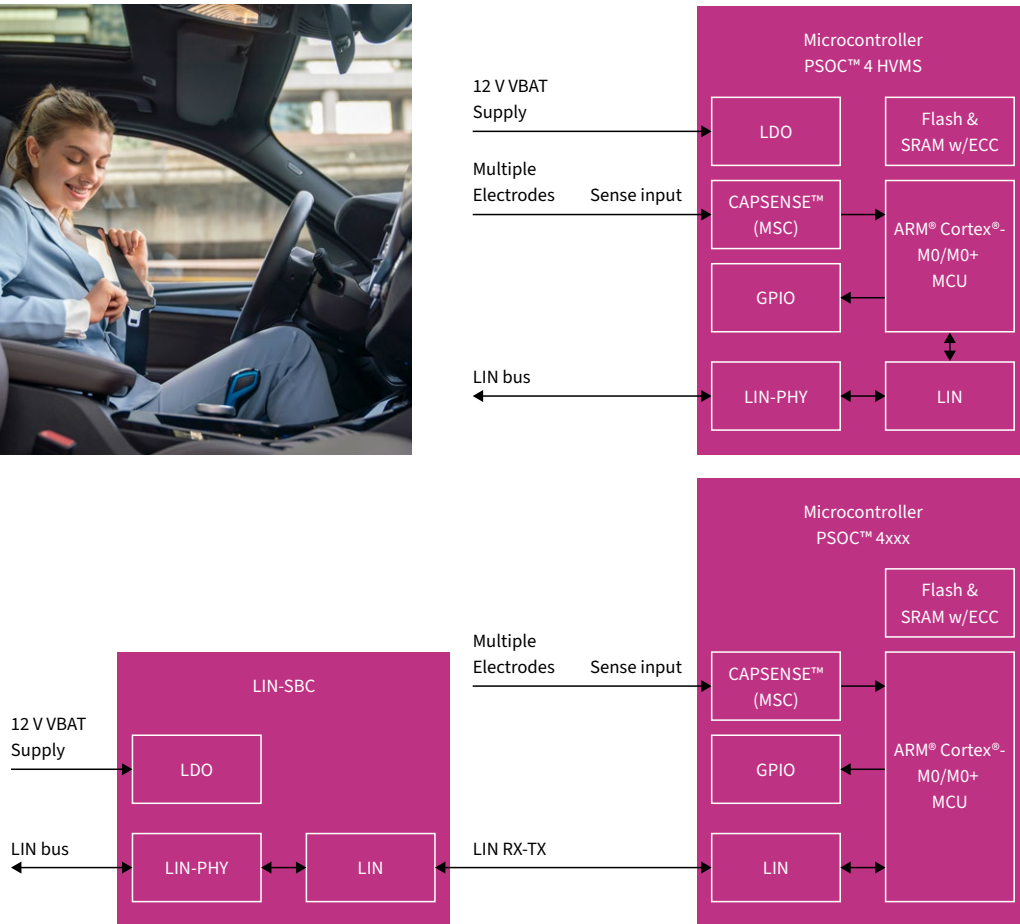Ecosystem and Ease of Use

Applications

Passengers occupancy detection

The increasing focus on passenger safety coupled with the rising adoption of electric vehicles is driving a significant growth in occupant detection systems in passenger vehicles. Government and regulatory bodies worldwide are demanding stringent safety regulations, compelling automakers to install advanced safety systems in vehicles and while at the same time EV manufacturers are prioritizing safety features to enhance customer confidence in electric mobility through Occupant detection systems, for example.

Absolute capacitive sensing uniquely enables accurate occupant detection and classification, leading to effective deployment of these safety measures.

Application diagram

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Features and benefits

Application features

– Occupant detection is achieved using Absolute capacitive sensing using a mesh in the seat
– It can accurately detect a passenger and avoid false detection due to grounding of the occupant through the vehicle body
– Absolute capacitance sensing is uniquely available on Infineon's latest (5th) generation capacitive sensing IP

System benefits

– Can robustly detect capacitance changes in the presence of a large baseline capacitance (of the order of nFs)
– Robust against falsely detecting a bag or object on the seat
– Fully integrated SBC
– Uses a wiring harness instead of pressure sensors
– Supports multiple sensors so zones are possible within the seat
– Not pressure dependent so less false alerts with non-passengers on seats

Suggested products

– PSOC™ 4 HVMS
– PSOC™ 4xxx

www.infineon.com/in-cabin-sensing

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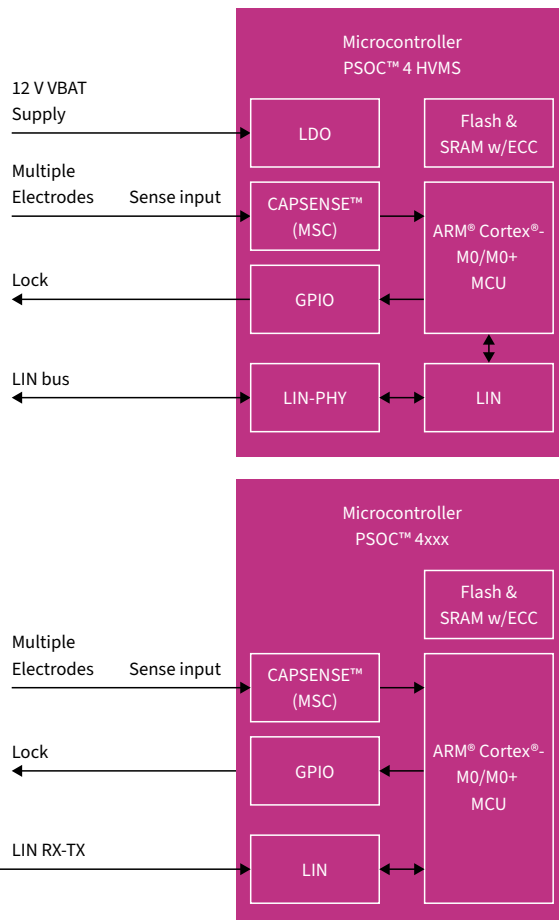
Ecosystem and Ease of Use

Applications

Foot kick opener

Foot kick opener allows drivers to open or close the tailgate of their vehicle simply by kicking their foot underneath the sensor. This sensor detects the movement and triggers the tailgate to open or close automatically, eliminating the need for manual interaction. This technology has gained popularity due to its convenience and ease of use. The increasing demand for smart vehicles and the growing preference for hands-free operation among consumers is driving the adoption of this technology. The Automotive Tailgate Kick Sensor market includes four main types of sensors: Infrared Sensors, Ultrasonic Sensors, Capacitive Sensor and Radar Sensor.

Capacitive proximity sensing provides an efficient means of implementing 'range' sensitive control for various indoor and outdoor car systems. Infineon's PSOC™ 4 (S-Series) can combine capacitive proximity sensing, LIN communication support and LED dimming capability to provide a single chip solution for personalized animations and interior lighting with dynamic RGB control. Further value is added by improving performance with programmable sensitivity thresholds, use of variable scan speeds to reduce current consumption and improve noise immunity.

Application diagram

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Features and benefits

Application features

– Enables reliable capacitive based proximity sensing for gesture detection
– Infineon provides proven design guidelines for proximity sensor layouts
– HV block (LDO and LIN / CXPI PHY) that connects directly to a 12-V battery supply
– Integrates a LIN slave controller for communication to an ECU

System benefits

– One-chip solution simplifies system design
– Enable capacitive touch-buttons and integrate LIN communication
– Superior noise immunity
– Enable system level functional safety full ISO 26262 support up to ASIL with PSOC™ 4 HVMS
– "ASIL-B"

Suggested products

– PSOC™ 4 HVMS
– PSOC™ 4xxx

www.infineon.com/door-control

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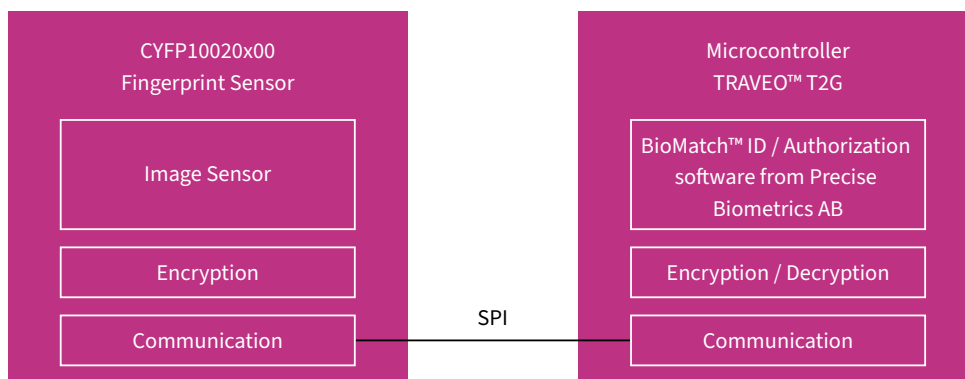Ecosystem and Ease of Use

Applications

Biometric Authentification

Fingerprint (FP) technology became mainstream with its integration into mobile devices for device unlock, password replacement, and secure mobile payments.
– Electronic interconnectivity of devices is creating a greater need for security
– FP-based biometric user authentication provides the most convenient and secure method for personal identification and authentication

The PSOC™ based fingerprint sensor offers great applications benefits like peace of mind, personalization, a well-known and understood sensing technology and a secure and unique way to allow both entry and identification of an occupant.

Application diagram

CYFP10020x00
Fingerprint Sensor

Image Sensor

Encryption

Communication

SPI

Microcontroller
TRAVEO™ T2G

BioMatch™ ID / Authorization software from Precise Biometrics AB

Encryption / Decryption

Communication

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Features and benefits

Application features

– Fingerprint is extensively used in authentication
  and identification
– Fingerprints are unique and don't repeat
  (not even with twins)
– High performance and stable, even with age
– Not easy to spoof

System benefits

– Field upgradable Firmware
– On sensor image optimization
– Low power fingerprint detection
– Optimized for TRAVEO™ T2G MCUs
– Automotive qualified fingerprint sensor
– Lower cost and less intrusive than face detection

Suggested products

– PSOC™ Fingerprint
– TRAVEO™ T2G MCU

www.infineon.com/door-control

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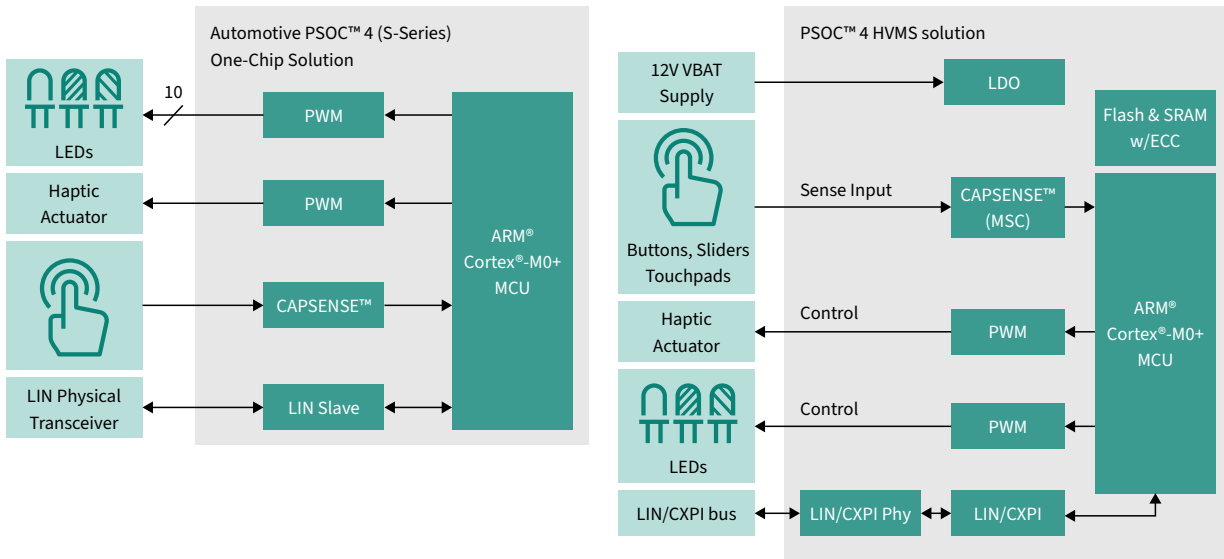Artificial Intelligence

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Steering wheel switch

Automobiles continue to be equipped with additional audio, HVAC and navigation functions which can cause distraction & misoperation, prompting the driver to remove hands their from the Steering Wheel. By creating a multifunctional steering wheel, drivers will be able to spend more time focused on the road thereby ensuring safety. Traditional mechanical buttons are less reliable and wear out over time due to physical movement. In addition, mechanical buttons yield poor aesthetics compared to sleek and elegant touch buttons. Capacitive touch buttons, sliders and touchpads are seeing increasing penetration in steering due to this improved robustness and better aesthetics.

Infineon offers solution with best in class CAPSENSE™ with signal to noise ratio and a very low noise floor that enables reliable detection of touches with thick gloves, and in the presence of water-droplets, condensation and sweat. PSOC™ HV MS It also provides support for system level functional safety compliance to the ISO-26262 ASIL standard.

Application diagram

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Features and benefits

Application features

– Robust sensing in the presence of moisture
– Communicate over LIN to the host ECU. Integrates up to two LIN Slave controllers in a single-chip solution
– Implements capacitive touch buttons for control on the steering wheel
– Drives LEDs and haptics actuators using PWMs
– Provides the latest generation CAPSENSE™ with superior noise immunity

System benefits

– Single-chip solution for BoM reduction
– Enables capacitive sensing with integrated LIN communication
– Superior noise immunity
– Enable system level functional safety support up to ASIL-B with PSOC™ 4 HVMS

Suggested products

– PSOC™ 4xxx
– PSOC™ 4 HVMS

www.infineon.com/infotainment

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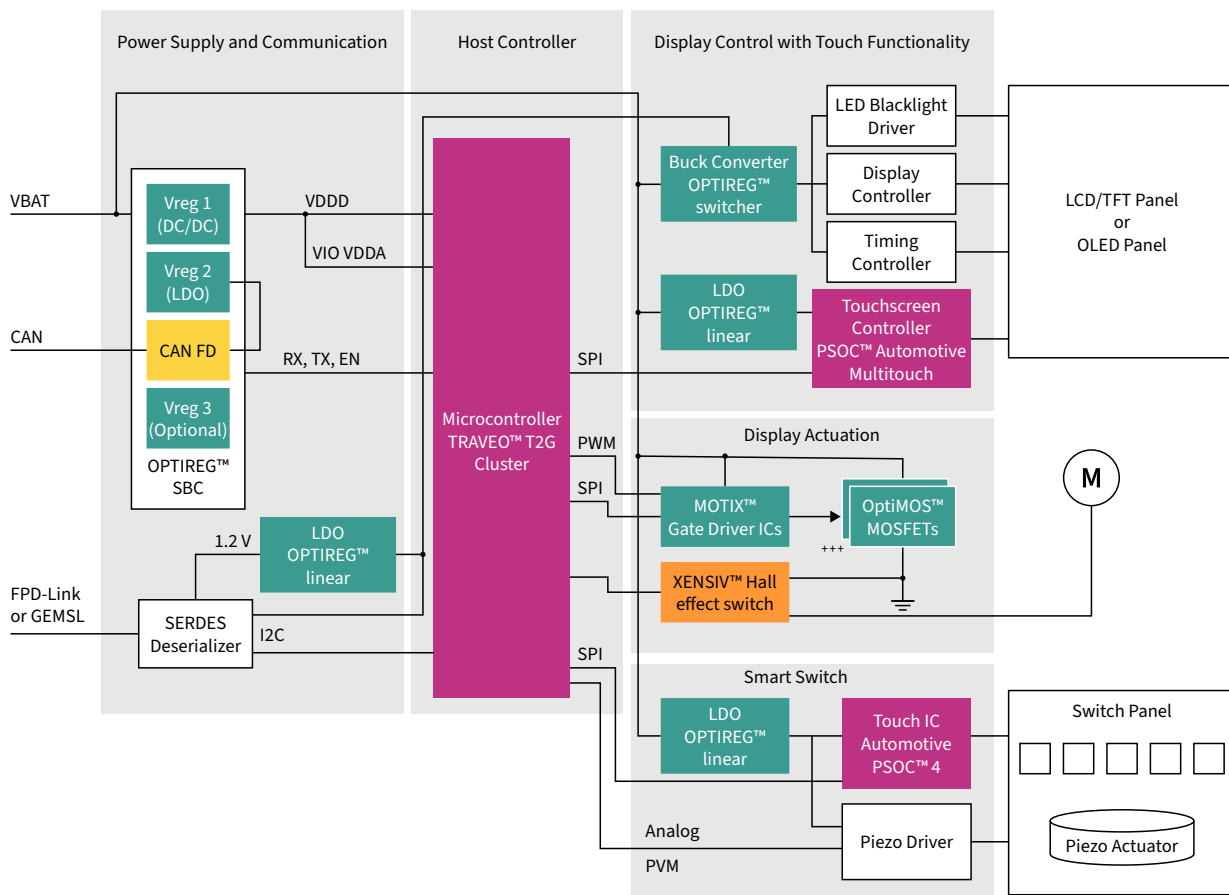Artificial Intelligence

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Touchscreen / Touchpad

Touchscreens are a great value add to the center console of the car. Not only do they provide an excellent enhancement to the user interface but also act as natural integrators of multiple controls onto one system. Capacitive touchscreens enable multiple-finger recognition, gesture decoding, superior light transparency and increased sensitivity. Additionally they interface to pressure sensing and haptics to enhance the touch experience. Today they are the HMI display interface technology of choice.

Infineon PSOC™ Automotive Multitouch family offers solutions for single touch, two-finger touch, and full multi-touch capability for screen sizes up to a 24-inch diagonal with a single chip and a 35-inch diagonal with multi-chip solutions.

Application diagram

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Features and benefits

Application features

– Works with water droplets, condensation, sweat, and supports wet-finger tracking
– Tracking with up to 5-mm-thick gloves or thick overlay

System benefits

– Unrivalled waterproofing capability
– Thick glove support
– Fast refresh & scan rates
– Low power consumption
– Excellent accuracy & high multi-finger linearity

Suggested products

– PSOC™ Automotive Multitouch

www.infineon.com/psoc-information-display

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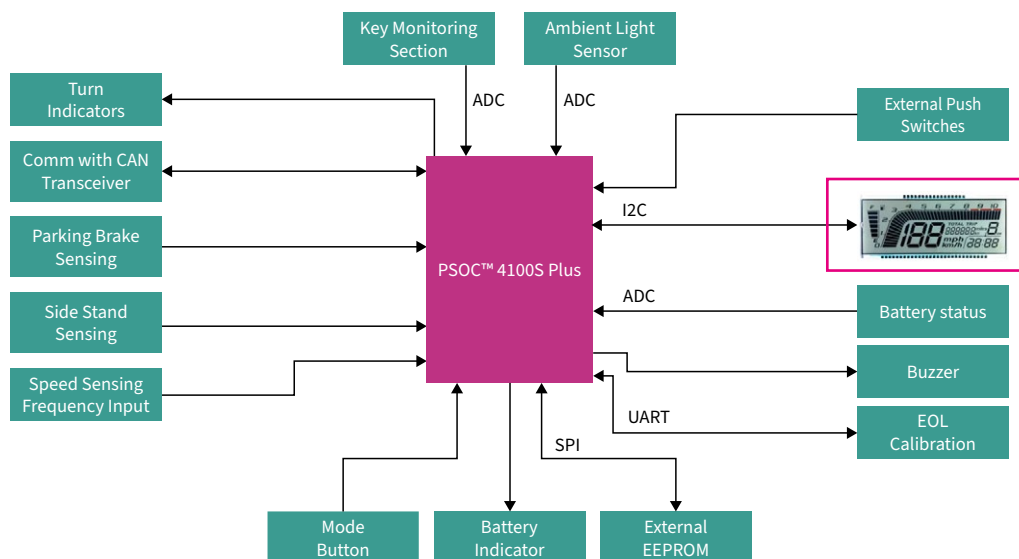Ecosystem and Ease of Use
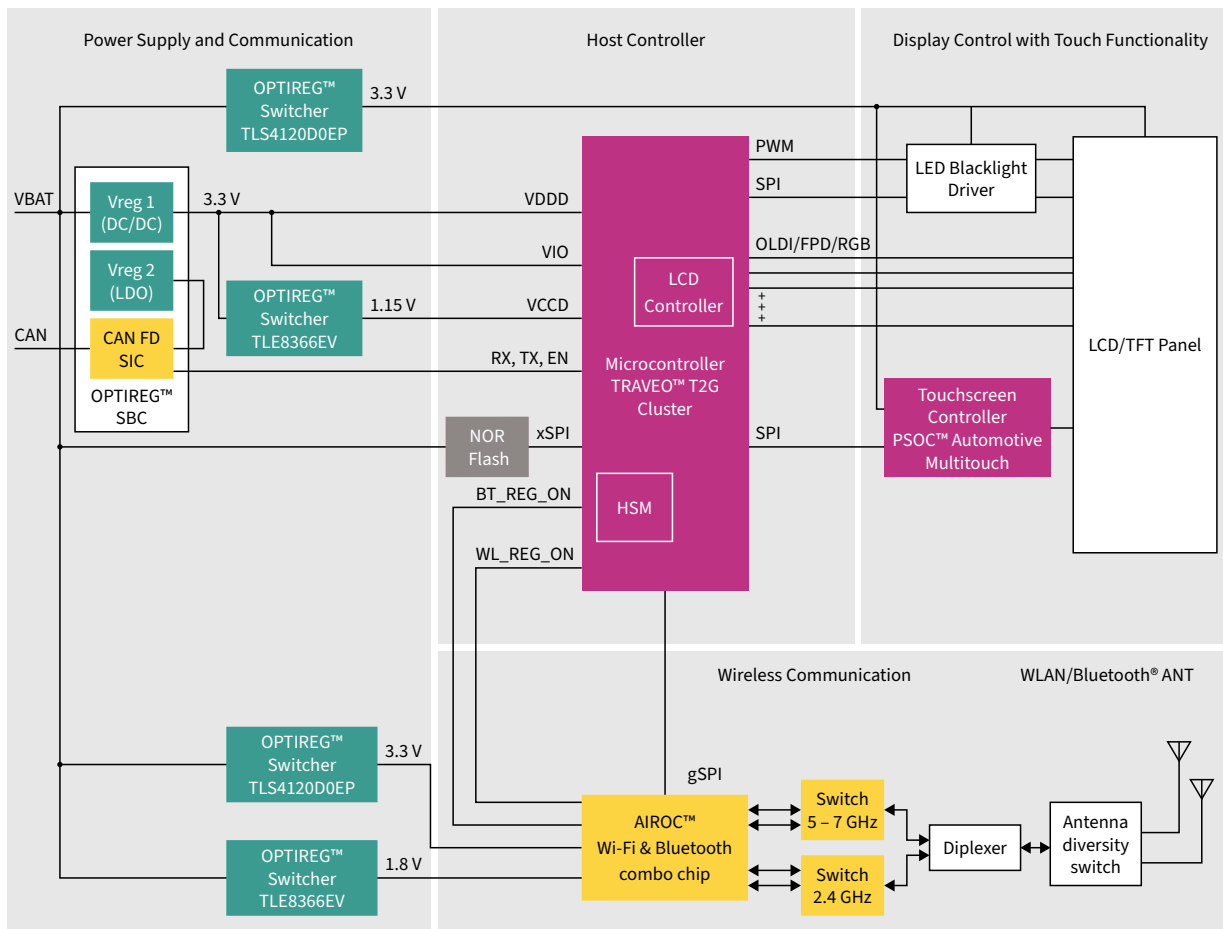
Applications

2/3-wheeler Cluster

One stop shop

Todays two-wheeler market is transforming from a stepper Motor cluster to a full LCD Cluster in entry level/economic models. There are several key factors which are driving this market change such as

1. Dynamic Clusters: Digital cluster can dynamically change the displayed information.
2. Reusability: automakers can deploy the exact same hardware across multiple vehicle models.
3. Simplicity: reduce driver distraction by displaying the required information only.
4. Scalability: OEMs can pack more functionality into digital cluster by changing only software. There is no need to add new physical components.
5. Attractive: digital instruments clusters can enhance appeal of vehicle.

The PSOC™ 4100S Plus and PSOC™ 4100S Max device series hardware flexibility, with their configurable peripherals. These device series offers CAN/CAN-FD communication interfaces to minimize the solution cost. Key features like a direct LCD-Driver and a 12 bit SAR ADC are also included. PSOC™ Automotive Multitouch enables touch control with thick glove and with best in class water rejection.

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Power Supply and Communication	Host Controller	Display Control with Touch Functionality

OPTIREG™ Switcher TLS4120D0EP — 3.3 V

VBAT

Vreg 1 (DC/DC) — 3.3 V

Vreg 2 (LDO)

CAN FD SIC

CAN

OPTIREG™ SBC

OPTIREG™ Switcher TLE8366EV — 1.15 V

VDDD

VIO

VCCD

RX, TX, EN

NOR Flash — xSPI

BT_REG_ON

WL_REG_ON

Microcontroller TRAVEO™ T2G Cluster

LCD Controller

HSM

PWM
SPI
OLDI/FPD/RGB
+ + +
SPI

LED Blacklight Driver

Touchscreen Controller PSOC™ Automotive Multitouch

LCD/TFT Panel

OPTIREG™ Switcher TLS4120D0EP — 3.3 V

OPTIREG™ Switcher TLE8366EV — 1.8 V

Wireless Communication	WLAN/Bluetooth® ANT

gSPI

AIROC™ Wi-Fi & Bluetooth combo chip

Switch 5 – 7 GHz

Switch 2.4 GHz

Diplexer

Antenna diversity switch

Features and benefits

Application features

– 2D dial with illumination
– LED telltales
– Fuel Bar graph, Odo, Trip, Service reminder on the LCD
– Segmented LCD with illumination
– Tracking with up to 5-mm-thick glove and wet finger tracking

System benefits

– CAN / CAN-FD bus interface
– Direct LCD-Drive and PWM drive for LED telltales
– 12 SAR ADC (Analog to digital converter) for sensing information
– Configurable solution using PSOC™
– Touch sensing support

Suggested products

– PSOC™ 4100S Plus / Max

– PSOC™ Automotive Multitouch

www.infineon.com/psoc-2-3-wheeler

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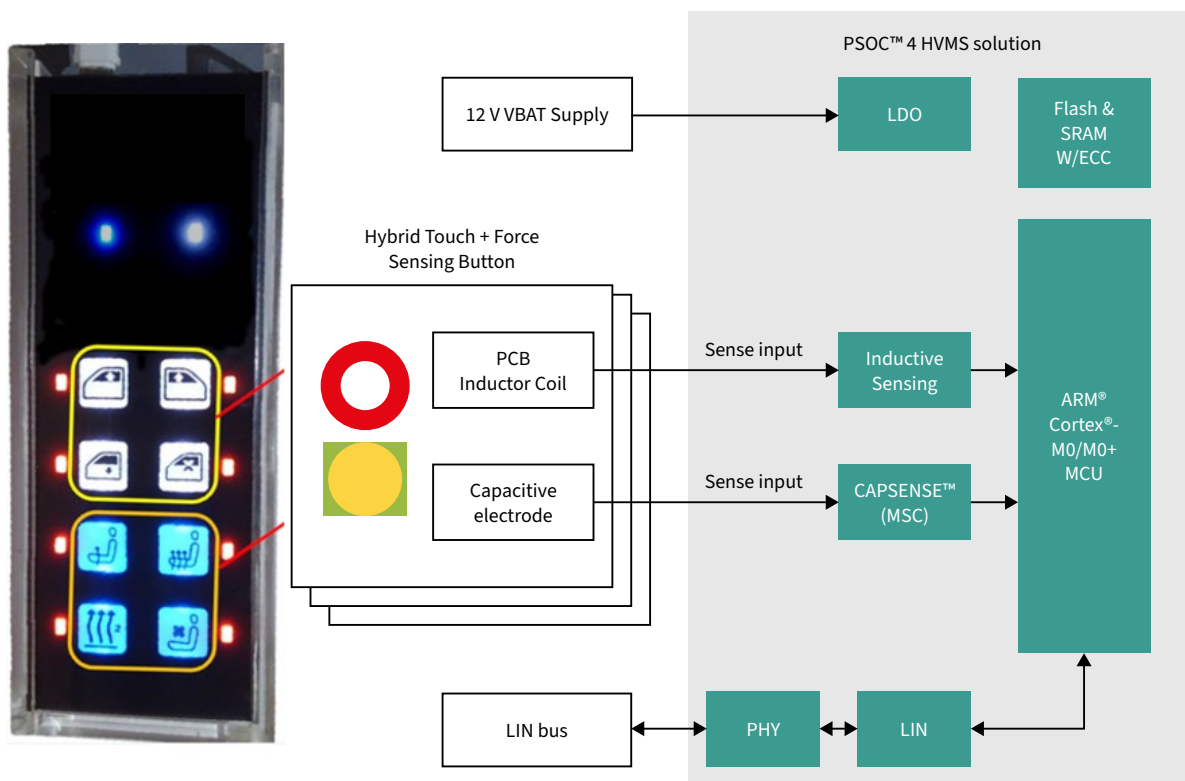Ecosystem and Ease of Use

Applications

Inductive Sensing

Inductive sensing is a low-cost, robust solution that seamlessly integrates with existing user interfaces, and is also used to detect the presence of metallic or conductive objects. It works on the principle of electromagnetic coupling between a sensor coil and the metal target to be detected. Typical applications includes proximity detection, replacing mechanical open/close switches, buttons (industrial keypads and ON/OFF buttons), rotation detection (flow meters, fan speed RPM detection, rotary control knob), linear Encoding and spring compression detection.

Infineon's inductive sensing solution expands on the industries best HMI sensing solutions (CAPSENSE™, MultiTouch) and facilitates Hybrid sensing (the combination of both capacitive and Inductive sensing) offering higher safety levels through redundancy.

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Features and benefits

Application features

– Supports inductive sensing for excitation
  frequencies up to 3 MHz
– Operates at a measurement rate of up to 10 ksps
– Includes a coil auto-tuning algorithm
– Supports up to 16 simultaneous inductive
  proximity widgets
– Contains an integrated graphical tuner for Tuning,
  Testing, and Debugging

System benefits

– Effective for Metal over Touch (MoT) applications
  design
– Works effectively with grounded or ungrounded
  (floating) metal
– Intrinsically safe requiring no electrical connection
  to the metal
– Large distance range for proximity detection

Suggested products

– PSOC™ 4xxx
– PSOC™ 4 HVMS

www.infineon.com/infotainment

PSoC™ Automotive product overview and evolution

Product Nomenclature Decoder

Peripheral Highlights

Product Family

Safety and Security

Artificial Intelligence
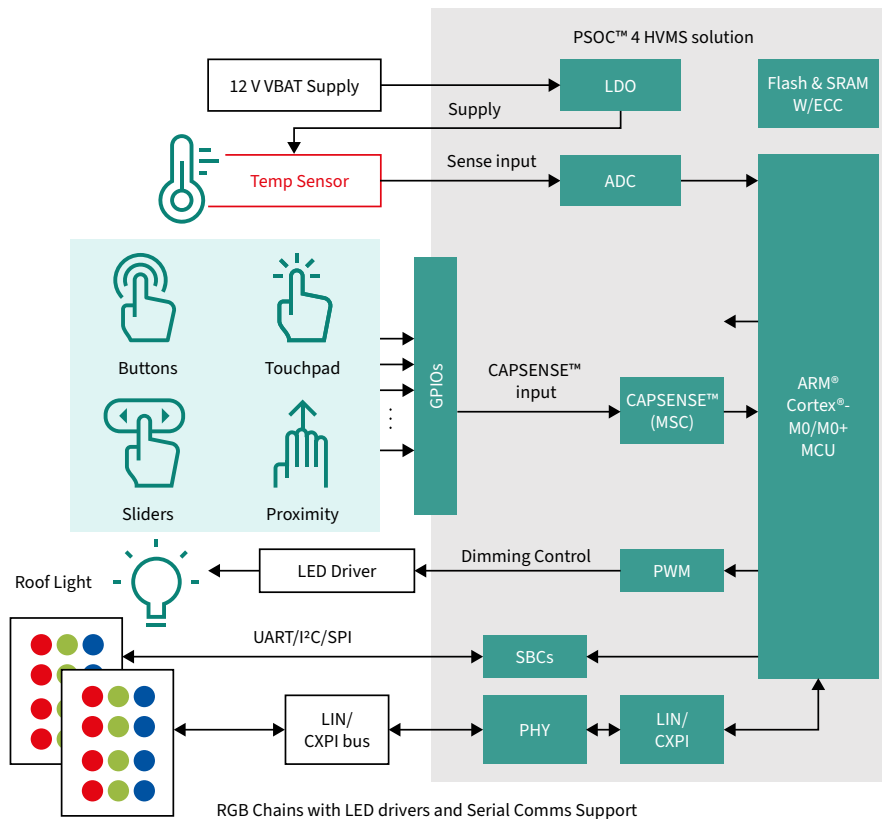
Ecosystem and Ease of Use

Applications

Interior Lighting control

Unleash next level of comfort and convenience

Interior automotive lighting provides a new level of comfort and convenience by enhancing the overall ambiance and functionality of the vehicle's interior. It helps improve visibility and can create a pleasant atmosphere by adding luxury and personalization to the vehicle's interior. Several lighting systems are located inside the vehicle, therefore component size, energy efficiency, and thermal performance are key. Each LED module consists of a controller wired to the vehicle and an LED driver that executes the desired actions for the LED arrays upon receiving instructions from the controller. The driver may provide constant current to power the LEDs when dimming and performing other functions, or can utilize pulse width modulation (PWM). The CAN / LIN bus also provides communication to each lighting module as well as other vehicle systems. (Market, require-ments, pain, solution)

Stable LED control for dimming is possible with Infineon's PSOC™ TCPWM Block. Also PSOC™ devices offer design flexibilty by enabling the control of individual LEDs to maximize funtionality while consuming less component space. The ability to intergrate into various lighting systems is facilitated through the LIN, CAN, CAN-FD communication options.

Application diagram

RGB Chains with LED drivers and Serial Comms Support

PSoC™ Automotive product overview and evolution

Product Nomenclature Decoder

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Ecosystem and Ease of Use

Applications

Features and benefits

Application features

– Task lighting which is ideal for reading lights and, glovebox lights
– Ambient lighting sets the tone of the car. Dimmable ambient lighting is an enhancement possible with PSOC™
– Accent lighting helps draw attention to a specific part of the car

System benefits

– Programmable MCU for full flexibility with CAPSENSE™
– Accurately Drive LEDs brightness / effect using PWMs
– Scalable solution from 16 KB to 384 KB flash – Integrated communication interface (LIN, CAN, CAN-FD)
– Best-in-class EMI / EMC performance

Suggested products

– PSOC™ 4xxx
– PSOC™ 4 HVMS

www.infineon.com/automotive-lighting

Market trends of Smart Sensing Applications

– Many embedded sensing solutions are designed around a domain-oriented approach. Specific domain-ECUs or application-specific ECUs provide a control-, monitor, or-actuator-function with sensors are wired to the ECU

– This works well in many applications, especially where the computation can be performed locally.

– This approach can scale well if the sensor placement remains close to the ECU, but becomes a challenge if sensors are placed far away from the control-ECU

– The challenge in such remote sensing comes with the wiring – transporting analog signals over long wires which introduces measurement errors

– With the trend in automotive from decentral/domain- or application focused ECUs towards zonal architectures there is an increased need for "Smart Sensors"

– The scope of those smart sensors is to sense an analogue quantity with an ADC then feed the subsequent digital signal from the sensor, or sensor-ECU to the zone-controller using a communication interface (such as LIN, CAN, SENT or CXPI)

– For these kind of smart sensing ECUs Infineon PSOC™ Automotive MCUs provide the Analog to digital signal conversion capabilities, enhanced with local intelligence based on an ARM Cortex M0/M0+ for signal-preprocessing and many communication protocols

– Furthermore, the PSOC™ 4 HV devices integrate 12 V-LDO and a LIN-transceiver in a single chip for space-constrained sensing-ECUs

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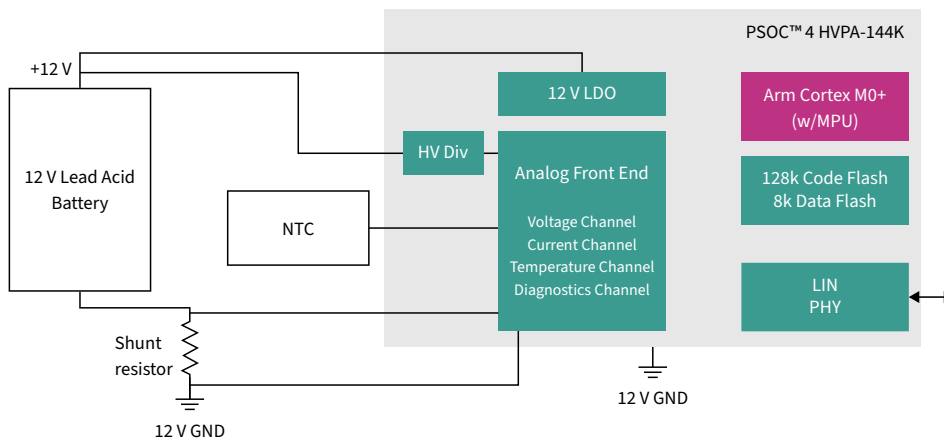
Ecosystem and Ease of Use

Applications

Current sensor

(Intelligent battery management system / IBS)

The automotive industry is witnessing a high demand for electric vehicles (EVs) which require highly efficient and reliable battery monitoring systems. Moreover, with the increasing focus on reducing carbon emissions, start / stop systems are becoming more widely adopted. Intelligent Battery Sensors (IBS) is expected to grow due to the rising trend of vehicle electrification . A 12 V battery management system is crucial for maintaining the 12 V power supply to the vehicle's electrical systems without the engine having to run continuously. This brings new design challenges to the market, not only in terms of safety and analog precision, but also regarding the calculation of the state-of-charge within a limited space for 12-volt batteries within the battery terminal housing.

Infineon developed the PSOC™ 4 HVPA-144K device, as it integrates all the required functions in one device for IBS. This product brings cost effective high integration, high levels of safety, and high accuracy battery management, all within a small device footprint.

Application diagram

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Features and benefits

Application features

– Small foot print
– Performing battery diagnostics locally
– Highly accurate monitoring and storing state of charge / health data of battery
– Supporting sensor fusion in an interface with different sensors, such as temperature and pressure

System benefits

– The high-precision analog subsystem enables highly accurate shunt base current sensing
– Integrated LIN SBC provides a solution that meets any PCB size limitation
– Functional safety supports ISO 26262 ASIL-C as the latest automotive market trend
– The integrated MCU and safety software support enable flexible operation, data storage, and fast time-to-market

Suggested products

– PSOC™ 4 HVPA

www.infineon.com/atvbms

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Artificial Intelligence
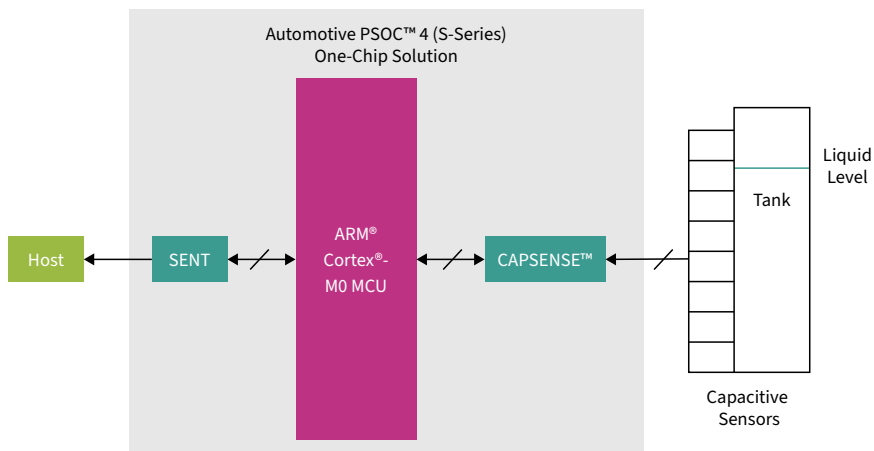
Ecosystem and Ease of Use

Applications

Liquid level sensing

Liquid-Level Sensing (LLS) detects both the presence and level of liquid in a container without any physical contact. There are various types of liquid-level sensors such as capacitive, mechanical float, inductive, magnetic, Hall effect, optical, acoustic density, and ultrasonic; each has advantages and disadvantages. Capacitive liquid-level sensing has become popular due to its low cost, high reliability, low power, sleek aesthetics, and seamless integration with existing control architectures.

Infineon's PSOC™ Automotive 4 (S-Series) enables a robust, Liquid-Level Sensing solution based on CAPSENSE™ to measure the level of Fuel/water/DEF in the tank. It supports liquid-level sensing with resolution down to 1 mm. Capacitive liquid-level sensing is provided through the use of the CAPSENSE_CSD Component available in the free PSOC™ Creator™ Integrated Development Environment (IDE). The CAPSENSE_CSD Component configures the on-chip CAPSENSE™ peripheral hardware and provides the required firmware for operation on PSOC™ Automotive 4 (S-Series) devices.
Infineon offers an AI based LLS solution for fast tuning and robustness against uniformity differences in containers or non-uniform container shapes.

Application diagram

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Applications

Features and benefits

Application features

– Non-contact measurement avoids contamination and cleaning problems
– Sensors located on the exterior of a nonconductive liquid container simplify Inc industrial design and improve product user experience.
– Optimized resolution and accuracy to support varying price points with a single
– Sensors may be constructed out of low-cost materials such as plastic substrates and conductive ink
– AI / ML supports fast development and agnostic to container shape
– Distinguish between liquid and foam

System benefits

– Reduce the overall cost of the Liquid-Level Sensing system.
– Replaces expensive incumbent solution using a magnetic sensor.
– Provide a reliable capacitive Liquid-Level Sensing system with a high SNR (>300:1) that works in the presence of noise
– Use AI to Quickly design and implement a Liquid-Level Sensing solution

Suggested products

– PSOC™ 4xxx
– PSOC™ 4 HVMS

www.infineon.com/powertrain

PSOC™ 4 Automotive
General Purpose Applications

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Product Family

Safety and Security

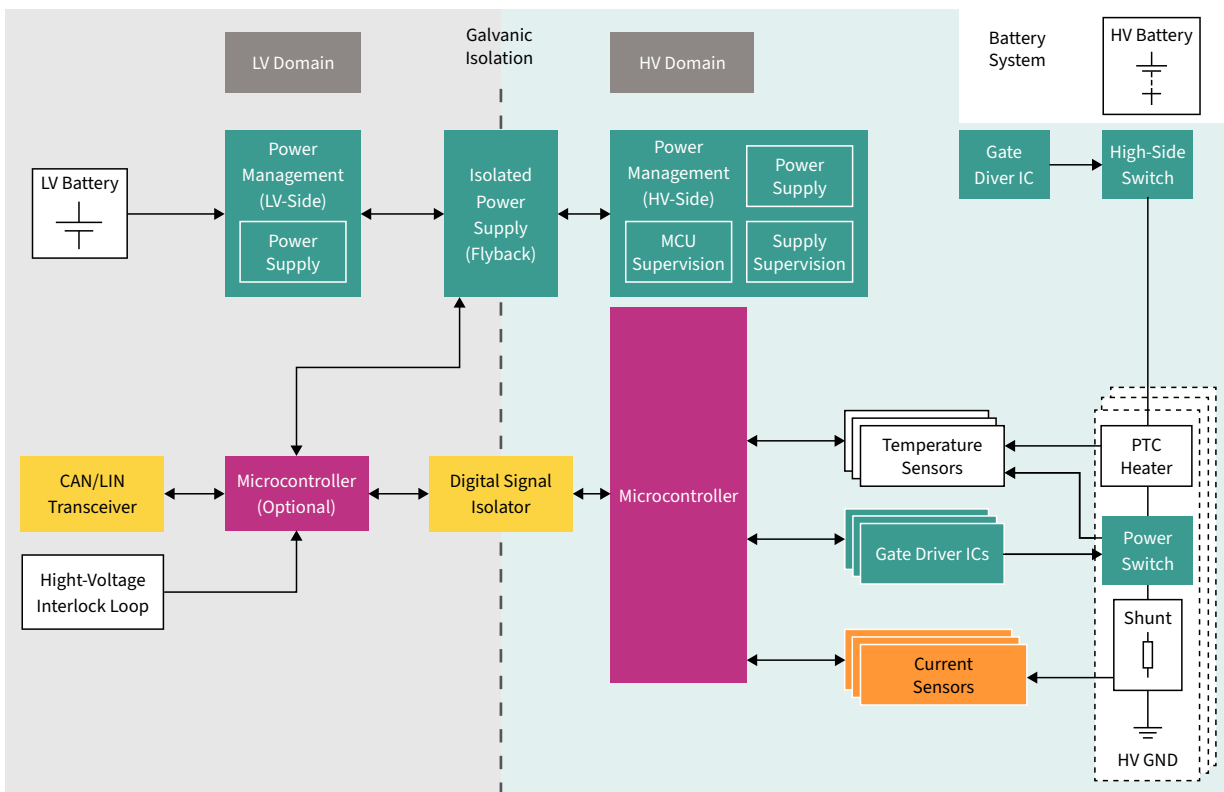Artificial Intelligence

Ecosystem and Ease of Use

Applications

PTC heaters

Positive temperature coefficient (PTC) heaters bring efficiency and safety to electric vehicle heating systems. To increase the power of the heater in an electric vehicle, the high-voltage PTC Heater is supplied by the high-voltage battery. Voltage and current sensors track the input voltage and current draw, while IGBTs or other high power switches turn on and off the different heating elements.

The heater is controlled by a PSOC™ 4 MCU in the high-voltage domain, which interacts with the rest of the vehicle systems across the HV/LV domain isolation barrier. Depending on customer requirements, an OPTIREG™ switcher or a second PSOC™ 4 MCU is used as a fly-back converter in combination with a primary OptiMOS™ MOSFET to power the integrated circuits in the high-voltage domain. The PSOC™ 4 MCU family is particularly suitable for this application due to its integrated analog front end (current sense amplifier) and 42 V rated high voltage subsystem.

Application diagram

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Applications

Features and benefits

Application features

– HV-integration (MCU + LIN-PHY + 12 V-LDO)
– MCU supported control loop (with ADC / PWM peripherals)
– Diagnostics and safety function support

System benefits

– Infineon chip-set covers the complete functional block with supply, communication control, sense and actuation
– Support functional safety critical systems up to ASIL-B

Suggested products

– PSOC™ 4 HVMS
– PSOC™ Automotive 4xxx

www.infineon.com/ptc-heaters

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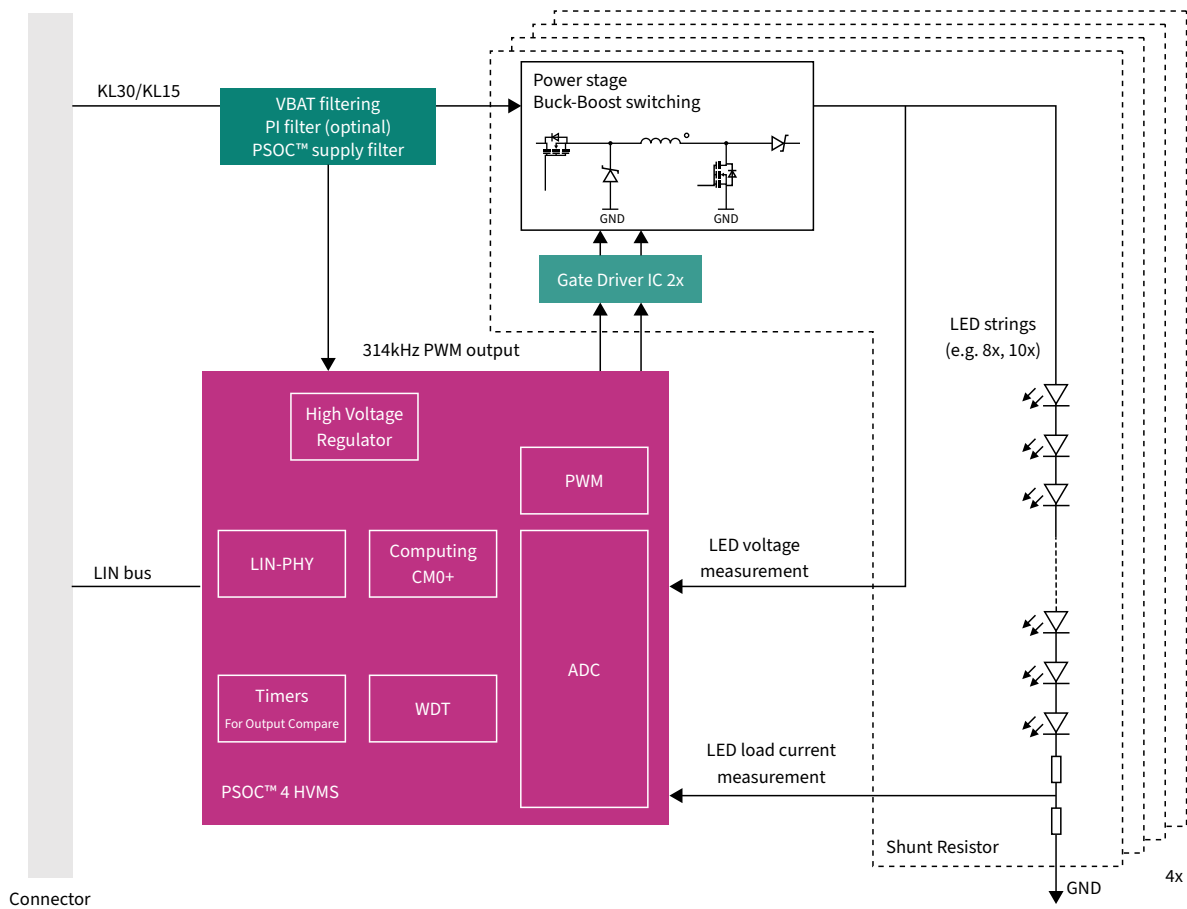Ecosystem and Ease of Use

Applications

LED lighting (external / rear light)

The trend is to use LEDs for external automotive lighting because they offer higher efficiency, longer lifetimes, a higher degree of freedom for the physical design / shape as well as better power efficiency.
Unlike incandescent lamps the LED-current has to be controlled, which requires some local intelligence. In front lighting applications powerful MCUs (eg. AURIX™ or TRAVEO™) are used to control headlights as well as auxiliary lighting. For rear lights less computation is needed and safety levels not higher than ASIL-B. That computation may come from a central / Zone-ECU, or individual MCU (such as PSOC™) sitting in the Light-module. The MCU in such a rear-light module is battery powered, typically has LIN-communication and drives PWM-signals to the powerstage (MOS-Fets) that control the current through LED-strings. Since the current has to be controlled there is a feedback loop supported by an embedded ADC within the MCU (e.g.a PID Controller).

PSOC™ 4 HVMS is a High Voltage MCU that can operate straight from the vehicle 12 V-domain and comes with integrated LIN-PHY for covering main functionality with minimal PCB-footprint.

Application diagram

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Features and benefits

Application features

– HV-integration (MCU + LIN-PHY + 12 V-LDO)
– MCU supported control loop (with ADC / PWM peripherals) for a "digital" DC-DC converter

System benefits

– Ease of use (MCU / LDO / PHY pre-integrated / pretested)
– Reduced PCB-space due to integrated LIN SBC
– Flexibility from the MCU to optimize the control loop, provide diagnostic feedback to the host & support functional safety up to ASIL-B
– Supports a platform based rear light design due to the software configurability for each design without hardware modification.

Suggested products

– PSOC™ 4xxx
– PSOC™ 4 HVMS

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