



# PSOC™ Automotive Microcontrollers

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

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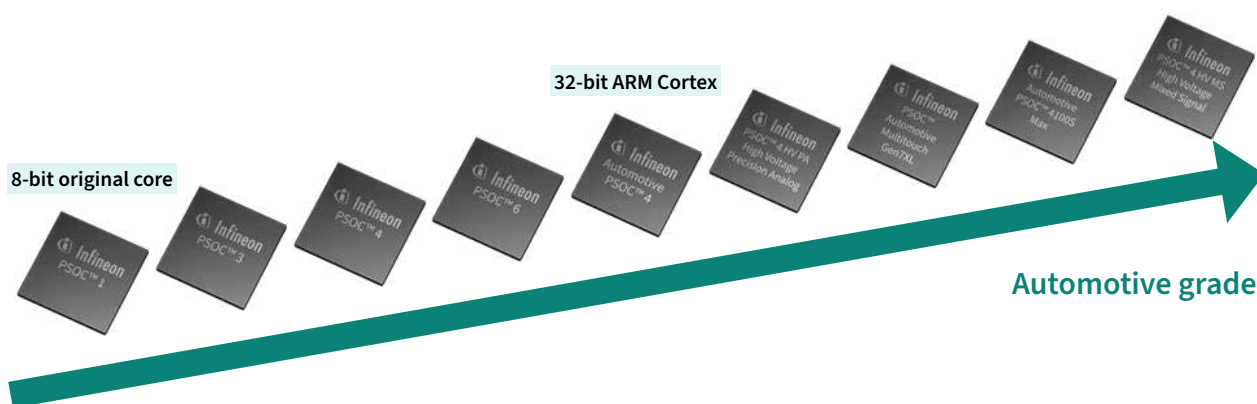
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# PSOC™ Automotive product overview and evolution

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# Evolution of PSoC™ generations



## Consumer/industrial grade



- AEC-Q 100/automotive qualified
- 32-bit Arm cortex M0/M0+
- Up to 384 KB flash, 32 KB SRAM
- 5<sup>th</sup> generation CAPSENSE™
- LIN/CAN-FD/CXPI/iso UART
- Capacitive and Inductive Sensing
- Crypto/ISO 21434-ready
- 12 V direct input operation
- LCD capabilities
- ISO 26262 compliant

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 I<sup>2</sup>C.

The PSoC™ 4100S Max is the biggest member of scalable PSoC™ 4 portfolio provides higher flash (384KB), more GPIO's (84), CAN-FD, hardware security. Newest member PSoC™ 4000T comes 5th Gen. CAPSENSE™ (MSCV3-LP) which provides 10X higher SNR and 10X lower power consumption (always on sensing).

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  $\Delta\Sigma$  ADCs. They are also compliant to ISO 26262 up to ASIL D.

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        | <ul style="list-style-type: none"> <li>– Low Power ARM® Cortex® M0/M0+ Based</li> <li>– Robust &amp; Reliable CAPSENSE™, Inductive Sense &amp; Multi-Sense Converter</li> <li>– “Edge-Connectivity” through LIN, CXPI, CAN-FD, iso UART options with integrated SBC-functionality</li> <li>– Safety: ISO 26262 up to ASIL D (All process requirements and hardware architectural metrics for application specific functions)</li> <li>– Security: ISO 21434-ready – process compliance and partial (“off the shelf”) product support</li> </ul> |                                                                                     |                                                                                                                                                                  |  |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|                     | <ul style="list-style-type: none"> <li>– Extension of the BMS portfolio to higher voltages and with increased safety</li> <li>– Support for Ultra-Large touchscreens and OLED displays</li> <li>– Full ISO21434 security compliance (for devices starting development after ISO-release date)</li> </ul>                                                                                                                                                                                                                                        |                                                                                     |                                                                                                                                                                  |  |
| Upcoming            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                     |                                                                                                                                                                  |  |
|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                     |                                                                                                                                                                  |  |
| BMS                 | High Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Precision Analog                                                                    | PSOC™ 4 HVPA family                                                                                                                                              |  |
|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   | 12 V supply (42 V max), 24 – 48 MHz Cortex M0+, ASIL D, 144 kB Flash, embedded LIN/iso UART-SBC (12V-LDO & PHY), 16/20-bit ΔΣ ADC for precise V/I measurement    |  |
| HMI & Smart Sensing | 3 – 5 V supply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | CAPSENSE™                                                                           | PSOC™ 4 HVMS family                                                                                                                                              |  |
|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  | 12 V supply (42 V max), 24 – 48 MHz Cortex M0+, ASIL B, 32 – 128 kB Flash, embedded LIN/CXPI-SBC (12V-LDO & PHY), CAPSENSE™ (button, slider & touchpad)          |  |
| HMI                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 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™ (button, slider & touchpad) |  |
|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Multitouch                                                                          | PSOC™ Automotive Multitouch                                                                                                                                      |  |
|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  | 8.5” – 15” touchscreens<br>Multichip-support for up to 35” touchpanels/touchscreens<br>Supports for LCD/TFT to OLED touchscreen                                  |  |

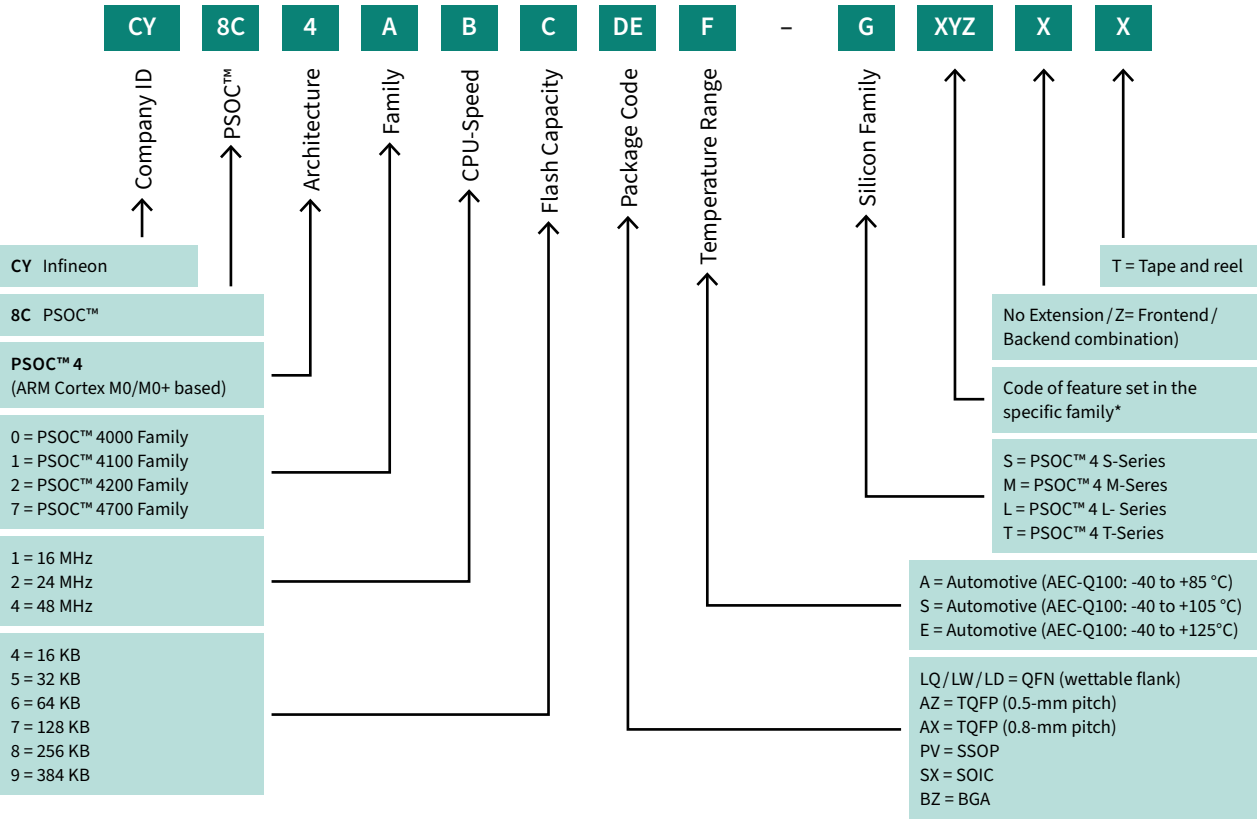


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# Product Nomenclature Decoder

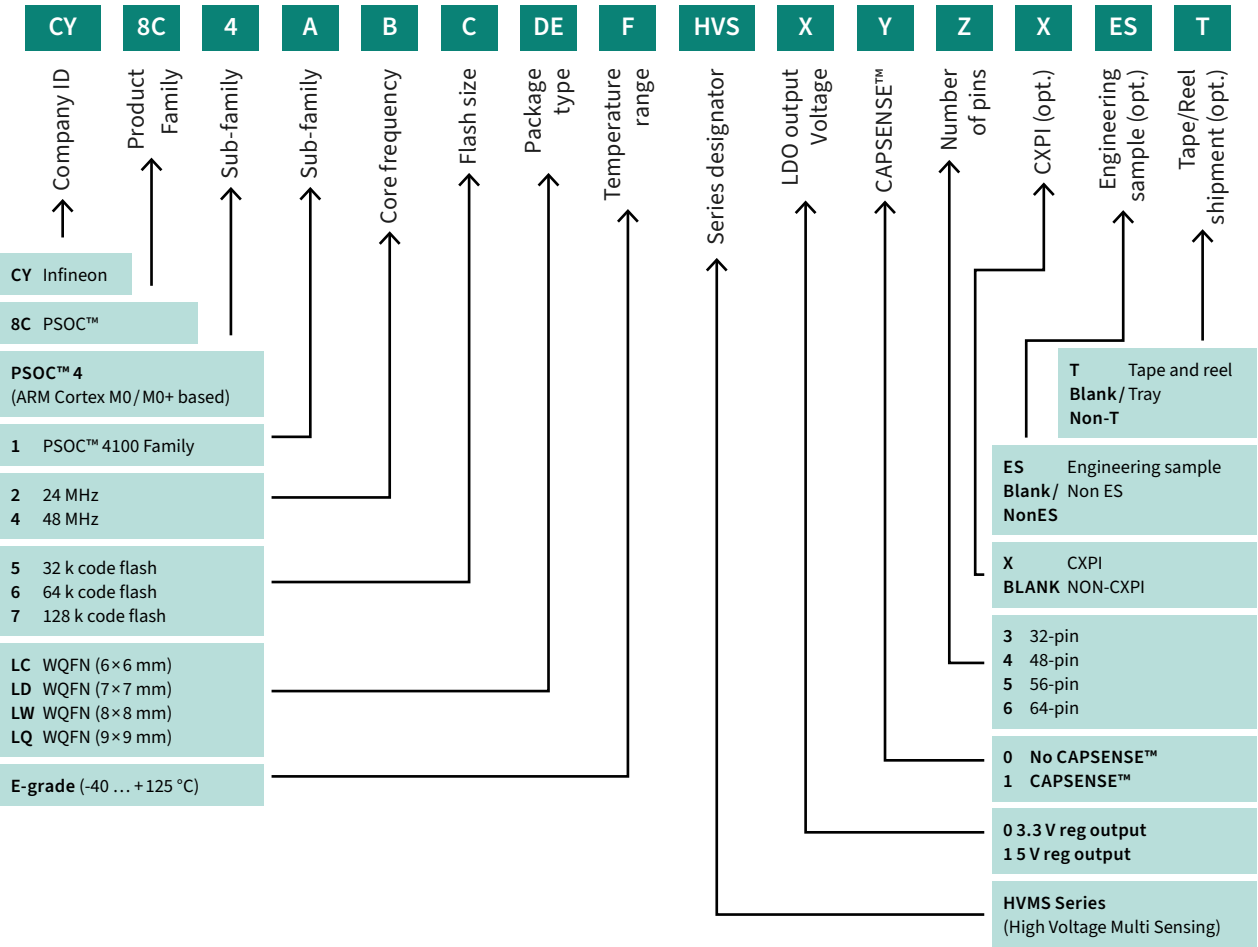
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# PSOC™ Automotive 4xxx

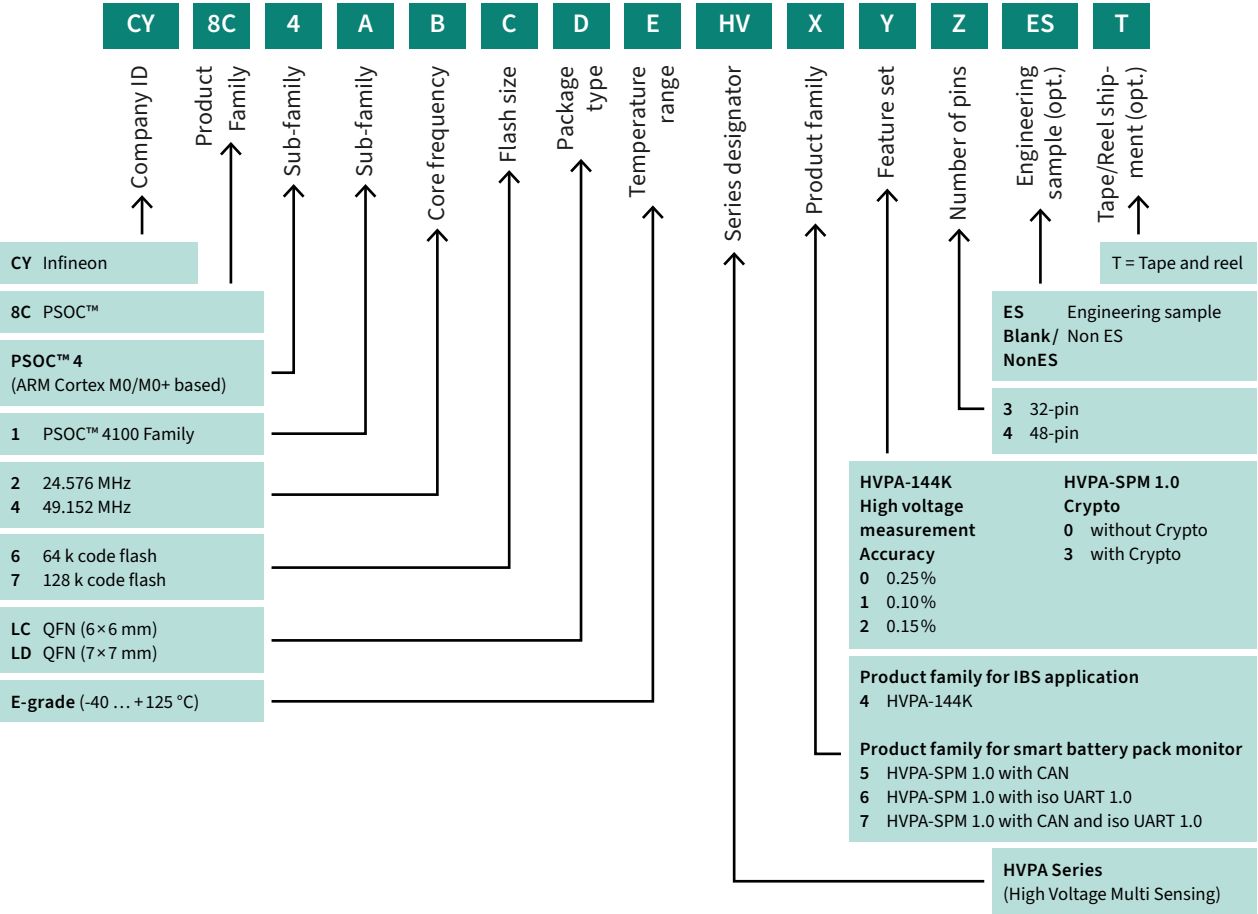


\*Please refer [Microcontroller pocket guide](#) for detail breakdown of product feature set

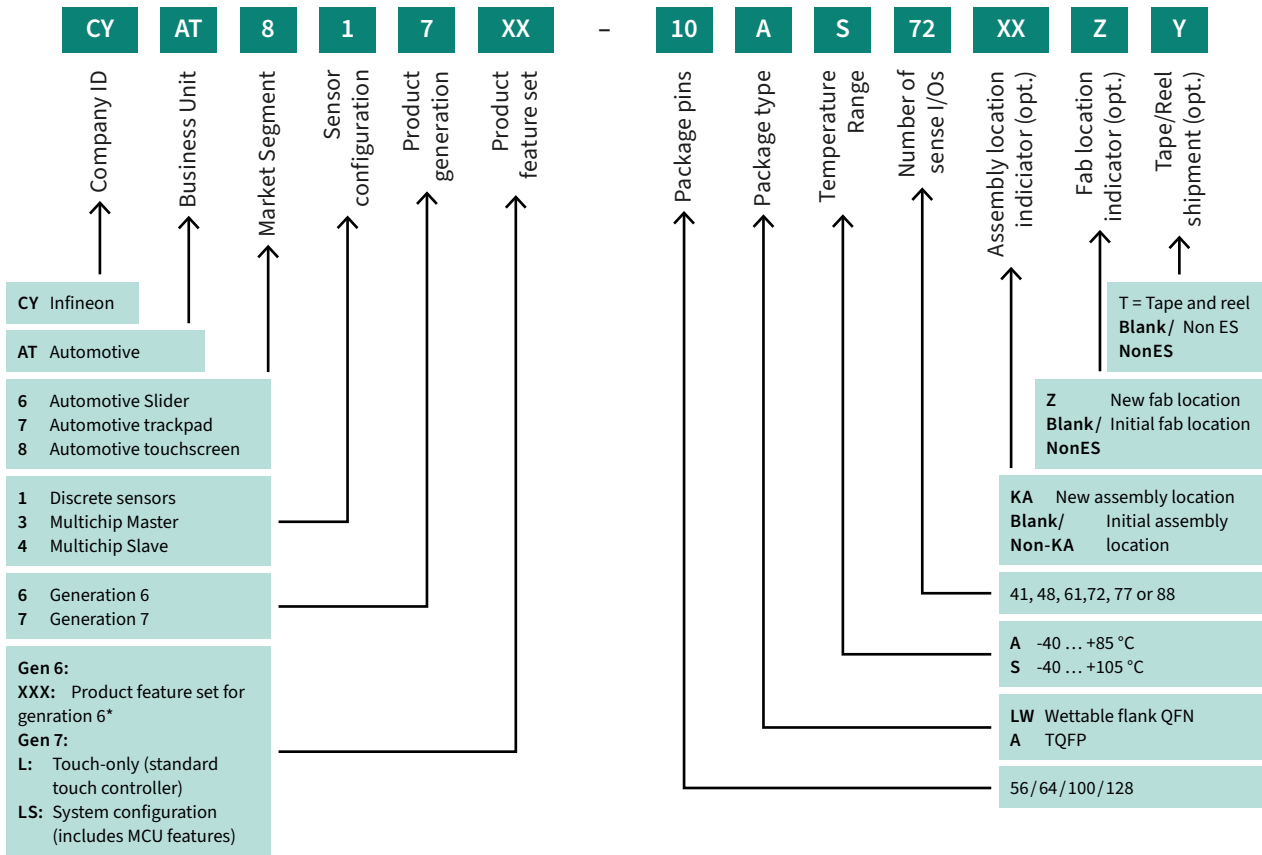
# PSOC™ 4 HVMS (High Voltage Mixed Signal)



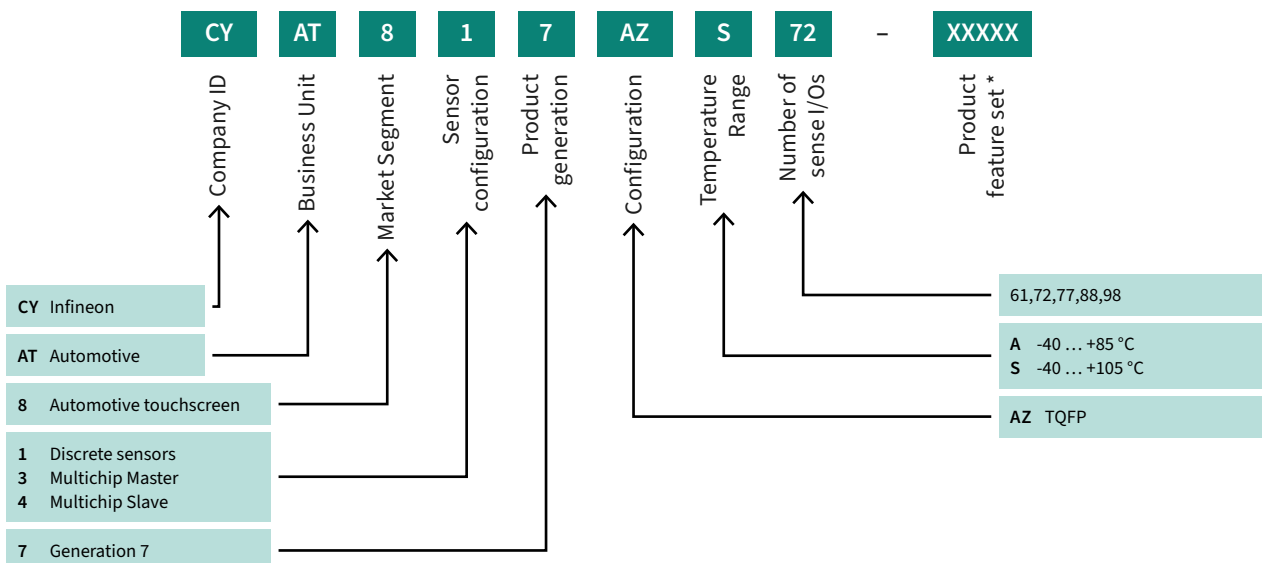
# PSOC™ 4 HVPA (High Voltage Precision Analog)



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



# PSOC™ Automotive Multitouch – Gen7XL



\*Please refer [Microcontroller pocket guide](#) for detail breakdown of product feature set

# 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 (5<sup>th</sup> 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 | <p>CAPSENSE™ (5<sup>th</sup> gen) supports the following features:</p> <ul style="list-style-type: none"> <li>– Multi-sense (capacitive, resistive, impedance, and current sensing)</li> <li>– Autonomous scanning (scan multiple sensors without CPU involvement)</li> <li>– Water tolerance (uses both passive, and active shields)</li> <li>– Higher sensitivity with &gt;14-bit resolution</li> <li>– Ratio-metric sensing</li> <li>– Capacitance sensing up to 3nF</li> <li>– 70 dB CMRR</li> <li>– SINC2 filter for noise reduction</li> </ul>                                                                                                                                                                                                                                   |
| Benefits | <p>Signal-to-Noise Ratio</p> <ul style="list-style-type: none"> <li>– High SNR which is indicative of a highly reliable touch interface</li> </ul> <p>Low Power</p> <ul style="list-style-type: none"> <li>– Ultra-low power standby current</li> <li>– Sensing while the CPU is in Deepsleep</li> </ul> <p>HMI Response</p> <ul style="list-style-type: none"> <li>– Fast reaction to user interaction</li> <li>– 120 Hz refresh rate for a smooth user experience</li> </ul> <p>Noise Immunity</p> <ul style="list-style-type: none"> <li>– Best-In-Class noise immunity</li> <li>– Works reliably in harsh conditions</li> </ul> <p>Additional Benefits</p> <ul style="list-style-type: none"> <li>– Immunity to liquid, snow etc.</li> <li>– Operates with thick gloves</li> </ul> |



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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  $\mu\text{m}$ '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  $\Delta\Sigma$  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 | <ul style="list-style-type: none"><li>– Two precision <math>\Delta\Sigma</math> ADCs (16-20+ bits)</li><li>– Current channel with automatic gain</li><li>– Voltage channel with HV input divider</li><li>– Temperature and diagnostic channels</li><li>– Supports both internal and external temperature sensing</li><li>– Digital filtering, accumulators, and threshold comparisons on all channel</li></ul> |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



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# High Voltage

## LIN / CXPI / iso UART transceiver (PHY)

PSOC™ HV has an integrated local interconnect network (LIN) / clock extension peripheral interface (CXPI) / iso UART 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. Iso UART transceiver enables communication between different potential ground.

### 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 data-sheet). 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 | <ul style="list-style-type: none"><li>– Dedicated cryptography block for fast cryptographic functions</li><li>– AES, SHA, CRC, True, and Pseudo random number generation</li></ul> |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 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

## Iso UART

The device features Infineon's proprietary BMS daisy-chain communication interface, iso UART, that enables compatibility with Infineon's cell-monitoring devices. Iso UART provides robust interface between products with different potential ground. It supports high speed communication up to 3 Mbps, with differential robust serial interface. It supports both iso UART host and node mode with all six transfer formats. Some of the key features of this block includes an automatic low latency forwarding of signal bits, wakeup and emergency notifications, CRC protected messages.

### Benefits

- Enable communication between different potential ground
- High speed up to 3 Mbps



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# Product Family

|                                              |    |
|----------------------------------------------|----|
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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 3<sup>rd</sup> party IDE and either PSOC™ Creator and or the ModusToolbox™ IDE.

| PSOC™ Automotive 4 (5.5 V)                           |                                                                                                                                                        |                                                                                                                                         |                                                                                                                              |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| ISO 26262 Ready<br>Entry level MCU<br>with CAPSENSE™ | <b>PSOC™ 4200L</b><br>48 MHz, 256KB/32KB,<br>VFBGA-124, USB full speed<br>3 <sup>rd</sup> Gen. CAPSENSE™ (×2),<br>UDB (×8), CAN (×2)                   | <b>PSOC™ 4100S Max</b><br>48 MHz, 384KB/32KB,<br>QFN-48,TQFP-64,TQFP-100<br>5 <sup>th</sup> Gen. CAPSENSE™ (×2), Crypto,<br>CAN-FD, LCD |                                                                                                                              |
|                                                      | <b>PSOC™ 4100/4200M</b><br>48 MHz, 128KB/16KB,<br>QFN-56,TQFP-48,<br>TQFP-64, LCD Drive, 3 <sup>rd</sup> Gen.<br>CAPSENSE™ (×2), CAN (×2),<br>UDB (×4) | <b>PSOC™ 4100S Plus</b><br>48 MHz, 128KB/16KB,<br>QFN-40/48/64,TQFP-64,SCB (×5)<br>4 <sup>th</sup> Gen. CAPSENSE™, CAN, LCD Drive       | <b>PSOC™ 4700S Plus</b><br>48 MHz, 128KB/16KB,<br>QFN-40,4 <sup>th</sup> Gen. CAPSENSE™, CAN<br>Inductive Sensing, LCD Drive |
|                                                      |                                                                                                                                                        | <b>PSOC™ 4100S</b><br>48 MHz, 64KB/8KB,<br>QFN-40,SSOP-28,LCD Drive,<br>4 <sup>th</sup> Gen. CAPSENSE™, SCB (×3)                        | <b>PSOC™ 4000T</b><br>48 MHz, 64KB/8KB, QFN-24<br>5 <sup>th</sup> Gen. CAPSENSE™ (MSC-LP),<br>SCB(x2)                        |
|                                                      | <b>PSOC™ 4100/4200</b><br>48 MHz, 32KB/4KB,<br>SSOP-28, UDB (×4), LCD Drive<br>3 <sup>rd</sup> Gen. CAPSENSE™, SCB (×2)                                | <b>PSOC™ 4000S</b><br>48 MHz, 32KB/4KB,<br>QFN-24,QFN-40,SSOP-28<br>4 <sup>th</sup> Gen. CAPSENSE™, SCB (×2)                            |                                                                                                                              |
|                                                      | <b>PSOC™ 4000</b><br>16 MHz, 16KB/2KB,<br>QFN-24, SOIC-16<br>3 <sup>rd</sup> Gen. CAPSENSE™, SCB(×2)                                                   |                                                                                                                                         |                                                                                                                              |
|                                                      |                                                                                                                                                        |                                                                                                                                         |                                                                                                                              |

SCB: Serial communication block

UDB: Universal digital block

CAN: Controller area network

CAN-FD: Controller Area Network Flexible Data-Rate

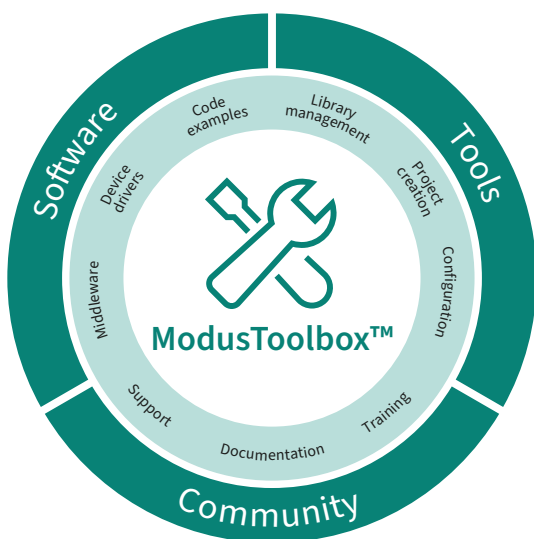
## Features and benefits

### 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™



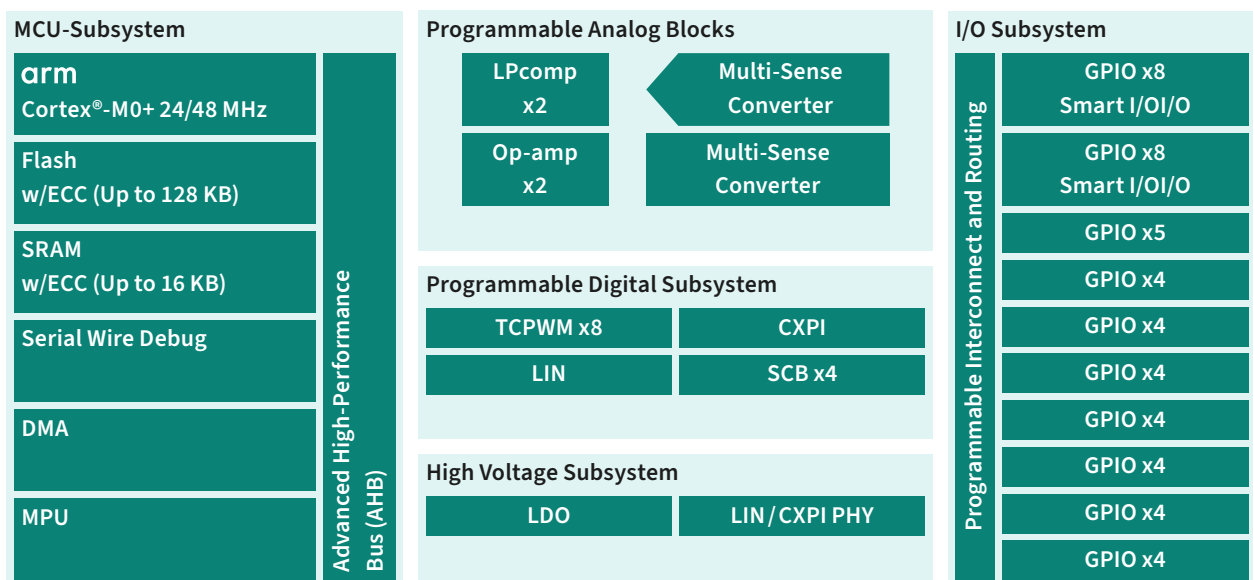
[www.infineon.com/autopsoc](http://www.infineon.com/autopsoc)

# 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™ 4 HVMS-128K



## 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 5<sup>th</sup> 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, 3<sup>rd</sup> party small footprint OS) and partner tools. Drive Core Control enables quick getting started and accelerates software development to reduce Time-to-Market
- Free of charge software ModusToolbox™ also supports PSOC™ 4 HVMS



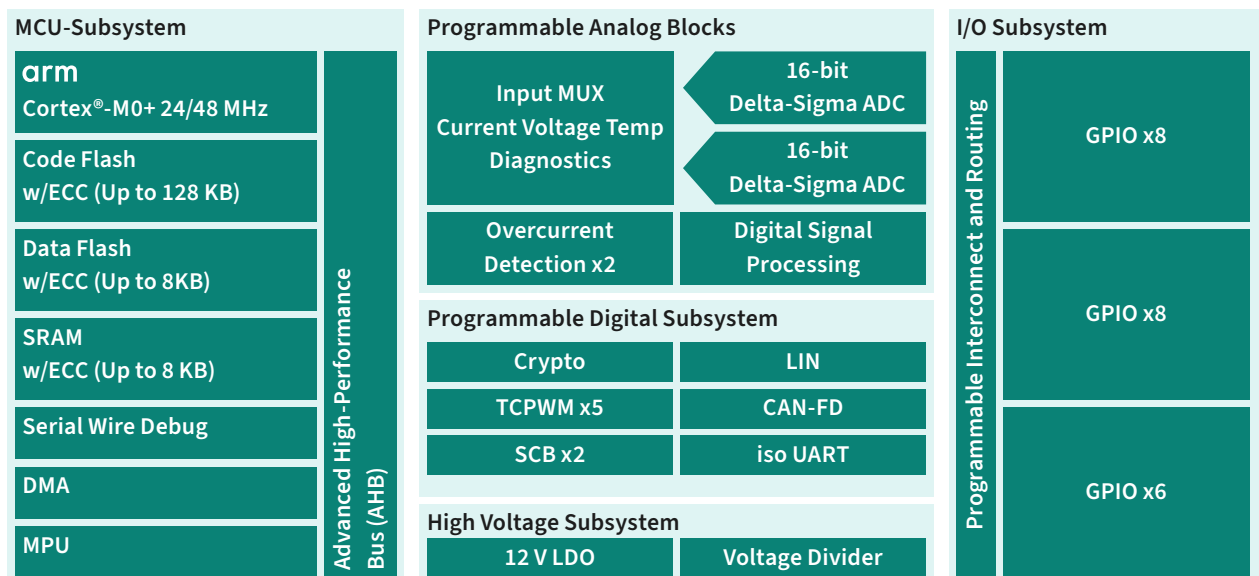
[www.infineon.com/psochvms](http://www.infineon.com/psochvms)

# PSOC™ 4 HVPA (High Voltage Precision Analog)

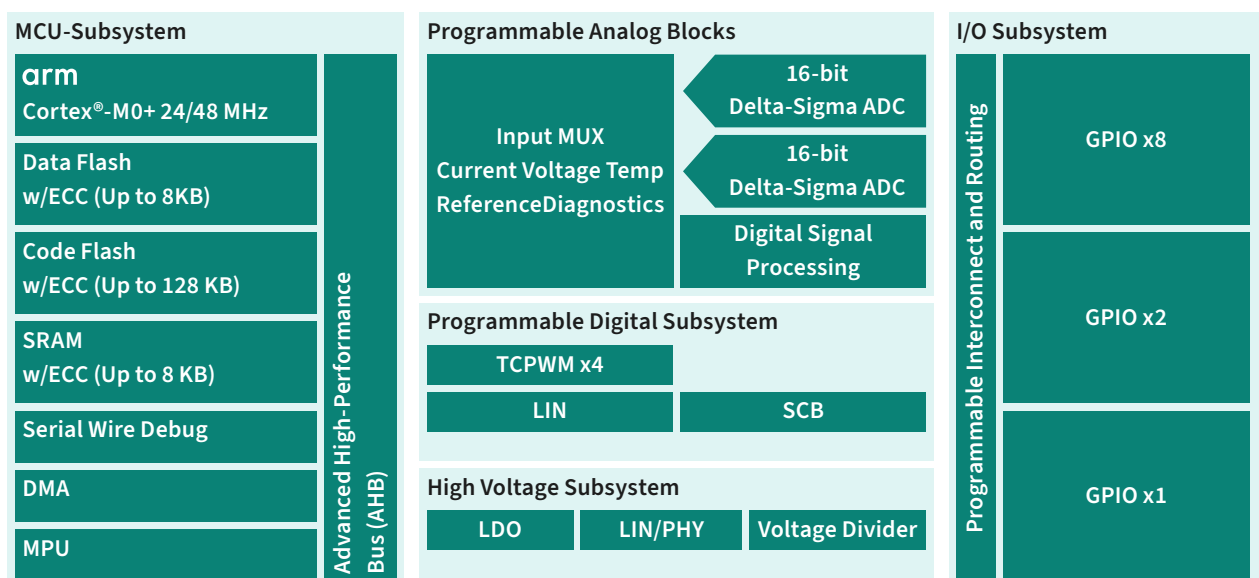
## One-chip solution for high precision current sensing

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/iso UART PHY and an ARM™ Cortex™ CPU which are the required functions for intelligent battery sensor (IBS) for 12 V lead-acid battery and smart battery pack monitoring system for xEV Li-ion battery. The device is developed compliant to ISO 26262, meeting all process requirements and application specific hardware architectural metrics up to ASIL D.

### Block Diagram – PSOC™ HVPA-SPM 1.0



### Block Diagram – PSOC™ 4 HVPA-144K



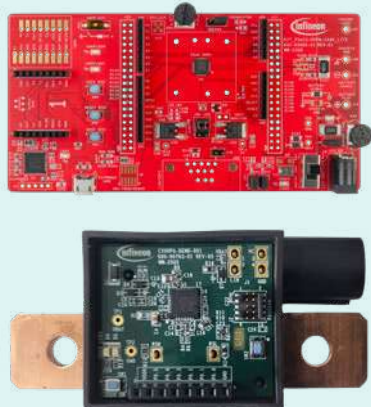
## Features and benefits

### Key features

- High-precision analog subsystem features two 16-bit delta-sigma ADC and Programmable Gain Amplifier (PGA) with automatic gain control and dedicated OCD comparators for triggering pyro fuse
- PSOC™ 4 device is developed compliant to ISO 26262, meeting all process requirements and application specific hardware architectural metrics up to ASIL D
- Integrated LIN and iso UART transceiver (PHY) for application suitable communication and high voltage LDO (42 V tolerant) for direct 12 V operation
- ISO 21434 compliance under assessment (HVPA-SPM 1.0)

### Key benefits

- Enable precise State of Charge (SOC) and State of Health (SOH) tracking and EIS function 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 footprint 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\_PSOC-HVPA-SPM1\_LITE, KIT\_PSOC4-HVPA-144K\_LITE) allows quick getting started
- Evaluation kit with shunt resistor (CYHVPA-DEMO-001) is also available for IBS application basis evaluation
- PSOC™ 4 HVPA is supported by Automotive quality software (PDL, SafeTlib). The users can trial with an evaluation license
- Free of charge software ModusToolbox™ also supports PSOC™ 4 HVPA



[www.infineon.com/psochvpa](http://www.infineon.com/psochvpa)

# 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/emissions (EMC) requirements.

## Product portfolio

From capacitive buttons/sliders over touchpads up to 55" touchscreens

|                          |                                                                  |                                                         |                                                                     |                                                                     |                                                      |
|--------------------------|------------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------|
| Configurable Sense       | Ultra-large Touchscreen up to 35”<br>Multi-chip                  |                                                         | PSOC™ Multitouch Gen7XL Multi-Chip<br>298 I/O, 192 Rx-xh, 120 Hz RR | PSOC™ Multitouch Gen8XL Multi-Chip<br>126 I/O, 300 Rx-Ch, 120 Hz RR | OLED, ISO 26262<br>Ultra-large Touchscreen up to 55” |
|                          | Large Touchscreen up to 15”<br>Hover, Force, Haptic, CRYPTO, CAN |                                                         | PSOC™ Multitouch Gen7XL<br>61-103 I/O, 64 Rx-ch, 120 Hz RR          | PSOC™ Multitouch Gen8XL<br>126 I/O, 100 Rx-ch, 120 Hz RR            | OLED, ISO 26262<br>Ultra-large Touchscreen up to 24” |
|                          | Large Touchscreen up to 15”                                      |                                                         | PSOC™ Multitouch Gen6XL<br>61-88 I/O, 54 RX-ch, 120 Hz RR           | PSOC™ Multitouch Gen7L<br>72 I/O, 21 Rx-ch, 100-Hz RR               | Medium Touchscreen up to 12.3”                       |
|                          | Small Touchscreen up to 8.5”                                     |                                                         | PSOC™ Multitouch Gen6L<br>48 I/O, 17 Rx-ch 120-Hz RR                |                                                                     |                                                      |
|                          | PSOC™ Multitouch Gen6L-Slider<br>41/48 I/O, 200-Hz RR            | PSOC™ Multitouch Gen6L-Trackpad<br>41/48 I/O, 120-Hz RR |                                                                     |                                                                     |                                                      |
|                          |                                                                  |                                                         |                                                                     |                                                                     |                                                      |
| Programmable Sense & MCU |                                                                  |                                                         | PSOC™ Multitouch Gen7L+MCU<br>72 I/O, 21 Rx-ch, 12.3“, 100-Hz RR    | MCU Integration                                                     |                                                      |
|                          | Sliders                                                          | Touchpad                                                | Touchscreen (On-cell/ Out-cell)                                     |                                                                     |                                                      |

## 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



### Multitouch QuickStart Assistant

- PSOC™ Multitouch standalone tool to identify the touch MPN, suggest a pinout, create a TTHE (touch tuning host emulator) project, and even create the blind-build for manufacturing



[MQA tool](#)

### Multitouch Debug Assistant

- PSOC Multitouch tool that can identify issues with touch panel sensors using a range of debug test and produce engineering reports describing its function



[MDA tool](#)



[www.infineon.com/psocmultitouch](http://www.infineon.com/psocmultitouch)

# PSOC™ Automotive Package lineup

|                         | PSOC™ 4100S Max | PSOC™ 4700S Plus | PSOC™ 4100S Plus | PSOC™ 4100S | PSOC™ 4000S | PSOC™ 4000T | 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 |
|-------------------------|-----------------|------------------|------------------|-------------|-------------|-------------|------------|------------|------------|-------------|-------------|-------------|--------------|--------------|-------------------|------------------|-------------------|------------------|
| SOIC-16                 |                 |                  |                  |             |             |             |            |            | •          |             |             |             |              |              |                   |                  |                   |                  |
| QFN-24                  |                 |                  |                  |             |             |             |            |            | •          |             |             |             |              |              |                   |                  |                   |                  |
| QFN-24 (Wettable Flank) |                 |                  |                  |             | •           | •           |            |            |            |             |             |             |              |              |                   |                  |                   |                  |
| SSOP-28                 |                 |                  |                  | •           | •           |             | •          | •          |            |             |             |             |              |              |                   |                  |                   |                  |
| QFN-32 (Wettable Flank) |                 |                  |                  |             |             |             |            |            |            |             |             |             | •            | •            |                   |                  |                   |                  |
| QFN-40 (Wettable Flank) |                 | •                | •                | •           | •           |             |            |            |            |             |             |             |              |              |                   |                  |                   |                  |
| QFN-48 (Wettable Flank) | •               |                  | •                |             |             |             |            |            |            |             |             |             | •            | •            |                   |                  |                   |                  |
| TQFP-48                 |                 |                  |                  |             |             |             |            |            |            | •           | •           |             |              |              |                   |                  |                   |                  |
| QFN-56                  |                 |                  |                  |             |             |             |            |            |            |             |             |             |              |              |                   |                  |                   | •                |
| QFN-56 (Wettable Flank) |                 |                  |                  |             |             |             |            |            |            | •           |             |             | •            |              |                   |                  |                   |                  |
| QFN-64 (Wettable Flank) |                 |                  | •                |             |             |             |            |            |            |             |             |             | •            |              |                   |                  |                   |                  |
| TQFP-64                 | •               |                  | •                |             |             |             |            |            |            | •           | •           |             |              |              |                   |                  |                   | •                |
| BGA-73                  |                 |                  |                  |             |             |             |            |            |            |             |             |             |              |              |                   |                  |                   |                  |
| TQFP-100                | •               |                  |                  |             |             |             |            |            |            |             |             |             |              |              | •                 | •                | •                 | •                |
| VFBGA-124               |                 |                  |                  |             |             |             |            |            |            |             |             | •           |              |              |                   |                  |                   |                  |
| TQFP-128                |                 |                  |                  |             |             |             |            |            |            |             |             |             |              |              | •                 | •                | •                 |                  |



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# Safety and Security

|                             |    |
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| ISO 21434 security approach | 35 |



# ISO 26262 safety approach

## All process requirements and hardware architectural metrics up to ASIL D

PSOC™ Automotive 4 HV devices is developed compliant to ISO 26262, meeting all process requirements and application specific hardware architectural metrics up to ASIL D. PSOC™ 4 HVPA uses redundant analog measurement paths to achieve up to ASIL D 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 Application Note (SAN), FMEDA) for “ASIL readiness”.

## PSOC™ Automotive 4 Safety environment

| ASIL Classification | Safety HW features                                                                                                                                                                                                                                                                                                       | Document available                       | Safety software                 |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------------------------|
| ASIL Ready          | <ul style="list-style-type: none"> <li>Power-On Reset (POR), Brown-Out Reset (BOR), low-voltage detection (LVD), Watchdog Timer (WDT) + Internal Oscillator, Non-Maskable Interrupts</li> </ul>                                                                                                                          | Safety Application Note (SAN), FMEDA     | N/A                             |
| ASIL B              | <ul style="list-style-type: none"> <li>Memory protection unit (MPU)</li> <li>Window watchdog timer (WDT) with Challenge-Response functionality</li> <li>Supply monitoring; detection of over-voltage and brownout events</li> <li>Hardware error detection and correction (SECDED ECC) on all safety-critical</li> </ul> | Safety case report, Safety manual, FMEDA | SafetyLib, AutoPDL, CAPSENSE MW |
| ASIL C              | <ul style="list-style-type: none"> <li>All ASIL-B safety HW features</li> <li>Analog diagnostics (backup reference voltage, redundancy in voltage, current, and temperature measurement paths)</li> </ul>                                                                                                                | Safety case report, Safety manual, FMEDA | SafetyLib, AutoPDL              |
| ASIL D              | <ul style="list-style-type: none"> <li>All SIL-C safety HW features</li> <li>Checksum for analog measurement results</li> <li>Redundancy in comparators</li> <li>Fast and safe pyro-fuse driving</li> </ul>                                                                                                              | Safety case report, Safety manual, FMEDA | SafetyLib, AutoPDL              |

## PSOC™ Automotive 4

| Device                              | ASIL ready (QM) | ASIL Compliant |                             |
|-------------------------------------|-----------------|----------------|-----------------------------|
|                                     |                 | Systematic     | HW Architecture metrics     |
| PSOC™ 4000                          | Yes             |                |                             |
| PSOC™ 4000S                         | Yes             |                |                             |
| PSOC™ 4100 / 4200                   | Yes             |                |                             |
| PSOC™ 4100S                         | Yes             |                |                             |
| PSOC™ 4100S Plus                    | Yes             |                |                             |
| PSOC™ 4100S Max                     | Yes             |                |                             |
| PSOC™ 4000T                         | Yes             |                |                             |
| PSOC™ 4100M / 4200M                 | Yes             |                |                             |
| PSOC™ 4 HVMS                        |                 | ASIL B         | ASIL B → All functions      |
| PSOC™ 4 HVPA-144K                   |                 | ASIL C         | ASIL B → All functions      |
| PSOC™ 4 HVPA-SPM 1.0                |                 | ASIL D         | ASIL D → Specific functions |
| PSOC™ Automotive Multitouch Gen 6/7 | Yes             |                |                             |
| PSOC™ Automotive Multitouch Gen 8   |                 | ASIL B         | ASIL B → All functions      |



[www.infineon.com/prosil](http://www.infineon.com/prosil)



# 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.

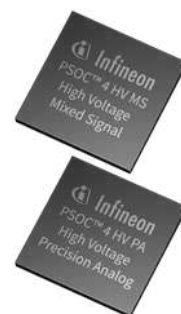
### Applications Examples

- 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 | Automotive           | → | ISO 26262 | PSOC™ HV supports |
|           | 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    |                   |

| Risk of failure | 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              |
|                 | $3 \times 10^{-6}$                               | 1             | 1            | c            | c              | A              |
|                 | $10^{-5}$                                        |               |              | b            | b              |                |
|                 | $10^{-3}$                                        | –             | –            | a            | a              | QM             |
|                 |                                                  | –             | –            | –            | QM             |                |



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](http://www.infineon.com/functional-safety)



# 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



# 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](http://www.infineon.com/iso-21434)

# Artificial Intelligence

Artificial Intelligence (AI) on PSOC™

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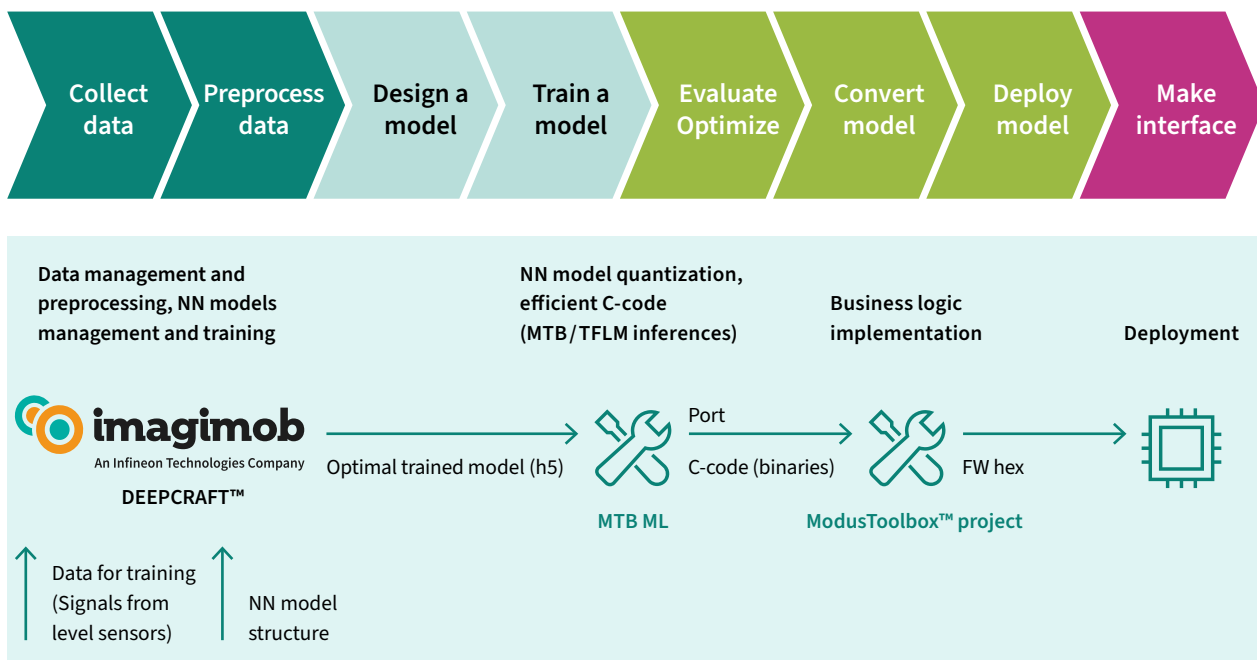
# Artificial Intelligence (AI) on PSoC™

## AI algorithms enable easier design and tuning

### AI Use cases on PSoC™ Automotive

|                                   |                                                                                                                                                                                                                                                                                                               |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Sensors</b>                    | <b>Liquid-Level Sensing</b> <ul style="list-style-type: none"> <li>– Ability to distinguish between liquid and foam</li> <li>– Insensitive to the size and shape of the liquid container – same neural network and AI algorithm for all cases</li> <li>– Tuning time reduction from weeks to hours</li> </ul> |
| <b>Trackpads and Touchscreens</b> | <ul style="list-style-type: none"> <li>– Support for unusual shapes, sizes, and requirements</li> <li>– Traditional approach: order of months for algorithm development</li> <li>– AI – reduced to weeks after some simple collection of training data</li> </ul>                                             |

## Development flow supported by AI



- 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 is 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 automotive PSoC™ and provides a wealth of knowledge and expertise to help you succeed.

Together with our partners, we offer optimized customer support for systems using our products. 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) |      |     |    |    |    |
|--------------------------------------------|------------------|--------------------|------------|---------------------|------|-----|----|----|----|
|                                            | Automotive PSOC™ | PSOC™ High Voltage | Multitouch | Global              | EMEA | AMR | JP | GC | AP |
| Clicktouch                                 | ●                |                    | ●          |                     | ●    |     |    |    |    |
| Crossware.io                               | ●                |                    |            |                     | ●    |     |    |    |    |
| Embedded Office                            | ●                |                    |            |                     | ●    |     |    |    |    |
| EMBITEL                                    | ●                | ●                  | ●          |                     |      |     |    |    | ●  |
| Galaxi Engineering Technology Services     | ●                | ●                  | ●          |                     |      |     |    |    | ●  |
| Hamso                                      | ●                | ●                  | ●          | ●                   |      |     |    |    |    |
| Hightec                                    | ●                | ●                  |            | ●                   | ●    |     |    |    |    |
| Hitachi Industry & Control Solutions, Ltd. | ●                | ●                  |            |                     |      |     | ●  |    |    |
| Hitex                                      | ●                | ●                  |            | ●                   | ●    |     |    |    |    |
| Macnica                                    | ●                | ●                  | ●          |                     |      |     | ●  |    |    |
| Neutron Controls                           | ●                | ●                  |            |                     |      | ●   |    |    |    |
| NEXTY Electronics Corporation              | ●                | ●                  | ●          |                     |      |     | ●  |    |    |
| Samsotec                                   | ●                | ●                  | ●          |                     | ●    |     |    |    |    |
| SCSK                                       | ●                |                    |            |                     |      |     | ●  |    |    |
| Sigma Connectivity                         |                  |                    | ●          | ●                   |      |     |    |    |    |
| Tokyo Electron Device LTD.                 | ●                | ●                  | ●          |                     |      |     | ●  |    |    |

|                                            | Application                     |                                  |                               |                             |               |                                                          |                                     |                              |                    |                    |                        |                       |                             |     |                             |
|--------------------------------------------|---------------------------------|----------------------------------|-------------------------------|-----------------------------|---------------|----------------------------------------------------------|-------------------------------------|------------------------------|--------------------|--------------------|------------------------|-----------------------|-----------------------------|-----|-----------------------------|
|                                            | Automotive UX HMI (Cockpit HMI) | Automotive UX Door & Closure Sys | Automotive Thermal Management | Automotive UX Cabin Systems | Smart Sensors | Automotive Drivetrain: BMS, Energy Management, Fuel Cell | Transportation // CAV // Industrial | Automotive Exterior Lighting | Automotive ADAS/AD | Automotive Chassis | Vehicle Motion Control | Automotive Drivetrain | Automotive UX Cabin Systems | LEV | Automotive E/E Architecture |
| Clicktouch                                 |                                 |                                  |                               |                             |               |                                                          |                                     |                              |                    |                    |                        |                       |                             |     | ●                           |
| Crossware.io                               | ●                               |                                  |                               |                             | ●             |                                                          |                                     |                              |                    |                    | ●                      |                       |                             |     |                             |
| Embedded Office                            |                                 |                                  |                               |                             |               |                                                          |                                     |                              |                    |                    |                        |                       |                             |     |                             |
| EMBITEL                                    | ●                               | ●                                | ●                             | ●                           | ●             | ●                                                        | ●                                   | ●                            | ●                  | ●                  | ●                      | ●                     | ●                           | ●   |                             |
| Galaxi Engineering Technology Services     |                                 |                                  |                               |                             |               |                                                          |                                     |                              |                    |                    |                        |                       | ●                           |     |                             |
| Hamso                                      |                                 |                                  |                               |                             |               |                                                          |                                     |                              |                    |                    |                        |                       |                             |     |                             |
| Hightec                                    |                                 |                                  |                               |                             |               |                                                          |                                     |                              |                    |                    |                        |                       |                             |     |                             |
| Hitachi Industry & Control Solutions, Ltd. | ●                               | ●                                |                               |                             |               | ●                                                        |                                     | ●                            |                    |                    | ●                      |                       | ●                           |     | ●                           |
| Hitex                                      |                                 |                                  |                               |                             |               |                                                          |                                     |                              |                    |                    |                        |                       |                             |     |                             |
| Macnica                                    | ●                               | ●                                | ●                             | ●                           | ●             | ●                                                        | ●                                   | ●                            | ●                  | ●                  | ●                      | ●                     | ●                           | ●   | ●                           |
| Neutron Controls                           |                                 |                                  |                               |                             |               | ●                                                        |                                     |                              |                    |                    |                        |                       |                             |     |                             |
| NEXTY Electronics Corporation              | ●                               | ●                                | ●                             | ●                           | ●             | ●                                                        | ●                                   | ●                            | ●                  | ●                  | ●                      | ●                     | ●                           | ●   | ●                           |
| Samsotec                                   | ●                               |                                  |                               |                             |               |                                                          |                                     |                              |                    |                    |                        |                       |                             |     | ●                           |
| SCSK                                       |                                 |                                  |                               |                             |               |                                                          |                                     |                              | ●                  | ●                  | ●                      | ●                     | ●                           |     | ●                           |
| Sigma Connectivity                         | ●                               |                                  |                               |                             |               |                                                          |                                     |                              | ●                  |                    |                        |                       |                             |     |                             |
| Tokyo Electron Device LTD.                 | ●                               | ●                                | ●                             | ●                           | ●             | ●                                                        | ●                                   | ●                            | ●                  | ●                  | ●                      | ●                     | ●                           | ●   | ●                           |

# 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™ Automotive 4xxx

#### PSoC™4000T CAPSENSE™ Proto kit

- This proto-typing kit is easy to use, connect external sensors on your own hardware and enables quick proof of concept development and evaluation of 5th Gen CAPSENSE™
- It comes with one self cap & one mutual cap button, also 5 segment linear slider – self and mutual sensing capable.



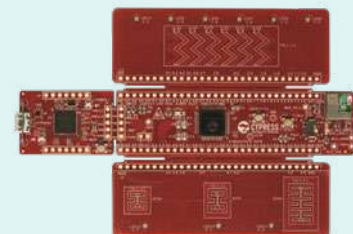
#### PSoC™ Automotive 4100S Max Pioneer Kit

- 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



#### 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 Generation CAPSENSE technology
- On-board push-button and LEDs for visual feedback
- Three CAPSENSE touch buttons and one six-segment CAPSENSE slider with visual feedback LEDs
- EZ-BLE Module, external ECO and WCO crystals
- 1.8V to 5V operation
- Code examples available
- CY8CKIT-149 PSoC™ 4100S Plus Prototyping board



## PSOC™ Automotive 4700S Plus Inductive Sensing Evaluation Kit

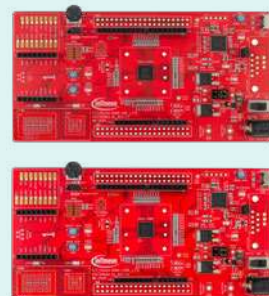
- Cost effective hardware platform for PSOC™ 4700S Plus series MCU
- Inductive sense features:
  - 1) buttons using Metal over touch (MOT)
  - 2) Proximity sensor that support metal target detection
- Code examples for both sequential and parallel scanning
- CY8CKIT-4700S-PLUS



## PSOC™ 4 HVMS

### PSOC™ 4 HVMS Lite Kit

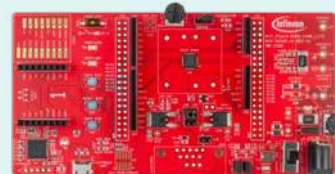
- Low-cost kit for rapid prototyping of smart sensing applications with PSOC™ 4 HVMS
- 5<sup>th</sup> generation CAPSENSE™ with onboard buttons, Arduino-compatible headers, mikroBUS header, and XENSIV™ bus
- DRIVECORE Control supports quick getting started
- KIT\_PSOC4-HVMS-64K\_LITE
- KIT\_PSOC4-HVMS-128K\_LITE



## PSOC™ 4 HVPA

### PSOC™ 4 HVPA Lite Kit

- Low-cost kit for rapid prototyping of smart sensing applications with PSOC™ 4 HVPA
- Precision analog function could be evaluated with minimum effort
- KIT\_PSOC4-HVPA-144K\_LITE
- KIT\_PSOC-HVPA-SPM1\_LITE



### PSOC™ 4 HVPA-144K IBS Reference Kit

- Reference kit for intelligent battery sensor (IBS) with PSOC™ 4 HVPA-144K
- Small footprint board with shunt resistor enables application base quick getting started
- Current, voltage, temperature and SoC can be monitored by GUI software
- CYHVPA-DEMO-001



[www.infineon.com/evaluation-kits](http://www.infineon.com/evaluation-kits)

## PSOC™ Automotive Multitouch

### TSG6XL Evaluation Board with 10.1" touchscreen CY3290-CYAT8168X

- This Evaluation Kit (EVK) is a touchscreen evaluation platform based on CYAT8168X, Infineon's capacitive multi-touch all-point touchscreen technology.
- The CYAT8168X family of PSOC™ Automotive Multitouch touchscreen controllers is optimized for performance and supports advanced features such as superior electromagnetic immunity performance as per automotive standards, thick glove ( $\leq 5$  mm thick), water rejection, and CAPSENSE™.
- This kit contents : EVK assembly, CYAT8168X sensor board. Isolation bridge board, 10.1" touchscreen sensor.
- Software tool installation guide is included in the documentation



### 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



[www.infineon.com/evaluation-kits](http://www.infineon.com/evaluation-kits)



# 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)        | <ul style="list-style-type: none"><li>– AutoPDL 1.X</li><li>– SafeTlib 1.X</li><li>– CAPSENSE™</li></ul> | <ul style="list-style-type: none"><li>– ASPICE v3.1 qualified</li><li>– MISRA 2012 AMD1 and CERT-C</li><li>– ISO 26262 compliant</li><li>– ASIL D</li><li>– FuSa compliant IAR compiler with safety features based on SEooC</li></ul> |
| Reference Software (eval and open-source license) | <ul style="list-style-type: none"><li>– ModusToolbox™ Software (CAT2 PDL, CAPSENSE™)</li></ul>           | <ul style="list-style-type: none"><li>– A modern, extensible development ecosystem</li><li>– A collection of development tools, libraries, and embedded runtime assets</li></ul>                                                      |



# Software support for PSoC™ Automotive

|                      | PSoC™ Creator | Modus ToolBox software and Tools | Automotive PDL / SafeTLlib / CAPSENSE™ |
|----------------------|---------------|----------------------------------|----------------------------------------|
| PSoC™ 4000           | •             |                                  |                                        |
| PSoC™ 4100           | •             |                                  |                                        |
| PSoC™ 4000S          | •             | •                                |                                        |
| PSoC™ 4100S          | •             | •                                |                                        |
| PSoC™ 4100S Plus     | •             | •                                |                                        |
| PSoC™ 4200           | •             |                                  |                                        |
| PSoC™ 4700S Plus     | •             | •                                |                                        |
| PSoC™ 4100S Max      |               | •                                |                                        |
| PSoC™ 4000T          |               | •                                |                                        |
| PSoC™ 4 HVMS-128k    |               | •                                | •                                      |
| PSoC™ 4 HVMS-64k     |               | •                                | •                                      |
| PSoC™ 4 HVPA-144k    |               | •                                | •                                      |
| PSoC™ 4 HVPA-SPM 1.0 |               | •                                | •                                      |



[www.infineon.com/psoc-software](http://www.infineon.com/psoc-software)



# 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.

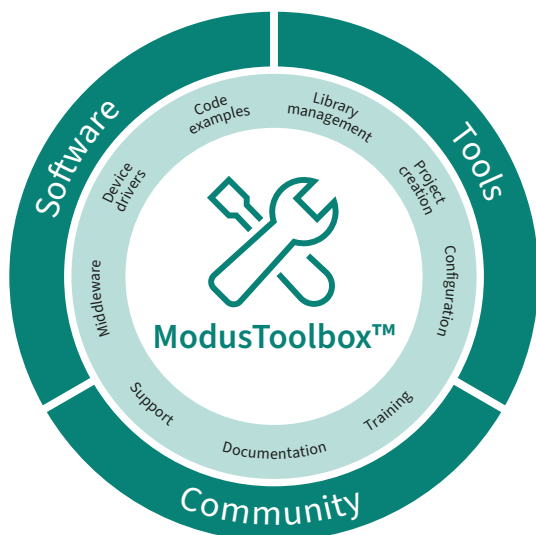
### Development Tools

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 D

## Automotive Peripheral driver library (AutoPDL)

- **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 D) 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 D compliance
- **Enables shorter time to market** by reducing development time
- **Enables safe operation of the chip** during start-up and runtime

# Software and Tool 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           |         | •          | •                 |
|                        | arm                                                                                      | •          |                   |
| Debugger/Programmer    |         | •          | •                 |
|                        | arm                                                                                      | •          |                   |
|                        |         | •          | •                 |
|                        | TASKING                                                                                  | •          | •                 |
|                        |         | •          | •                 |
| Communication protocol |         |            | •                 |
|                        | VECTOR  | •          | •                 |



[www.infineon.com/psoc-software](http://www.infineon.com/psoc-software)

# DRIVECORE

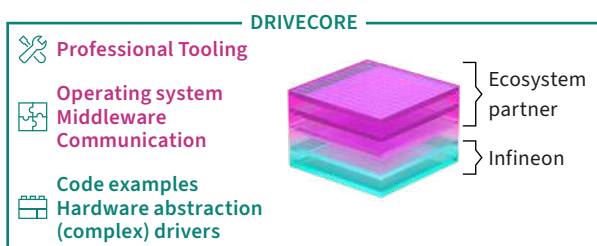
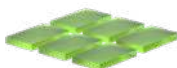
## Accelerating and simplifying development

DRIVECORE is a scalable software bundle portfolio designed for AURIX™, TRAVEO™, and PSoC™ microcontroller families. DRIVECORE brings together pre-integrated software and tools from Infineon and best-in-class Partner Companies of the automotive ecosystem, simplifying license management and facilitating hardware evaluation. With DRIVECORE, Infineon leads ecosystem collaboration delivering a

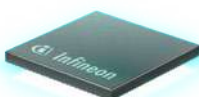
comprehensive one-stop-shop solution that simplifies and accelerates automotive software development. By unlocking the potential of software-defined vehicles (SDVs), Infineon combines its deep expertise in computing, connectivity, power distribution, and cybersecurity with the strengths of the entire automotive ecosystem.



### Customer Applications



### Microcontroller/Board AURIX™ TRAVEO™ PSoC™



Infineon

### Objectives

- Accelerate and simplify software development and reduce migration efforts on AURIX™, TRAVEO™ and PSoC™
- Reduce commercial complexity on supplier management

### Key Benefits of DRIVECORE

- **All-in-One:** All necessary Infineon and Partner software licenses in one place
- **Seamless compatibility:** Pre-integrated, certified software for immediate microcontroller evaluation.
- **Risk-Free:** Free three-month evaluation license included with every bundle
- **Comprehensive portfolio:** A versatile portfolio addressing a wide range of automotive application use cases

### Committed partners



TASKING

VECTOR

SYNOPSYS

iar

Qt

EB

MathWorks

REACH

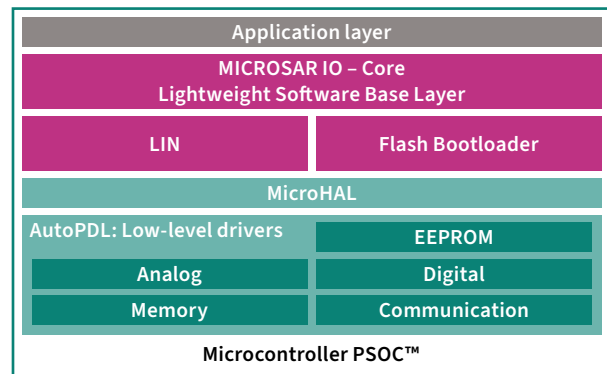
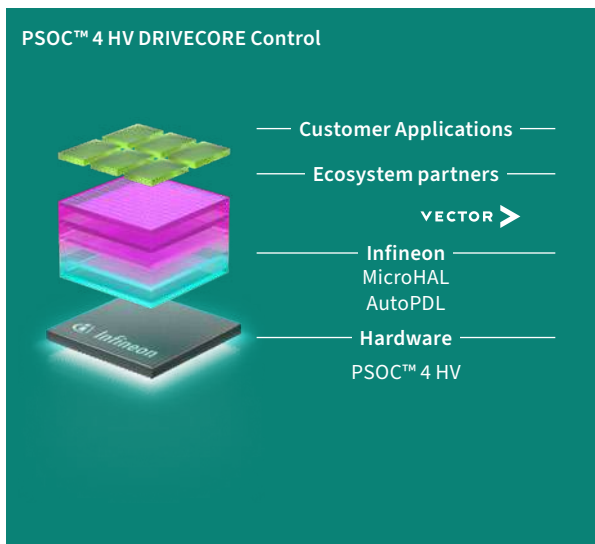


[www.infineon.com/drivecore](http://www.infineon.com/drivecore)

# PSOC™ Automotive DRIVECORE Control

The PSOC™ Automotive DRIVECORE Control is a software bundle that accelerates and simplifies the development of edge controllers and small mechatronic electronic control units (ECUs) for automotive subsystems, with a focus on cost efficiency, reusability, and OEM independence. Target applications include automotive systems/subsystems such as lighting, parking sensors, HMI, HVAC and BMS. The software bundle includes tools and software components from Infineon, Vector and IAR. These tools allow developers to start developing applications

instantly based on Vector's MICROSAR IO, a lightweight, secure, and efficient base layer. The platform ensures a lightweight, scalable, and flexible communication protocol perfectly suited for automotive applications, facilitating seamless service-oriented communication and enhancing interoperability and performance. In combination with Infineon's PSOC™ 4 HV microcontroller, the bundle provides a resource-efficient solution, reducing the overall system cost and ensuring reliable functionality in mission-critical domains.



## Premium Software (licensed)

- Productive Infineon code
- Productive Partner code (Vector)
- Customer code

## Tool



## Key features

- Lightweight and Efficient Software Platform: MICROSAR IO for small mechatronic ECUs
- Pre-integrated, qualified & certified drivers with Vector OS
- Safety-Critical ASIL-B Support
- Easy-to-use tooling

## Key benefits

- Streamlined Development Process: Reduced development time and effort for small mechatronic ECUs
- Improved Cost Efficiency, Reusability, and OEM independence
- Combining a lightweight software stack with a service-based protocol reduces the overall system complexity



[www.infineon.com/drivecore](http://www.infineon.com/drivecore)

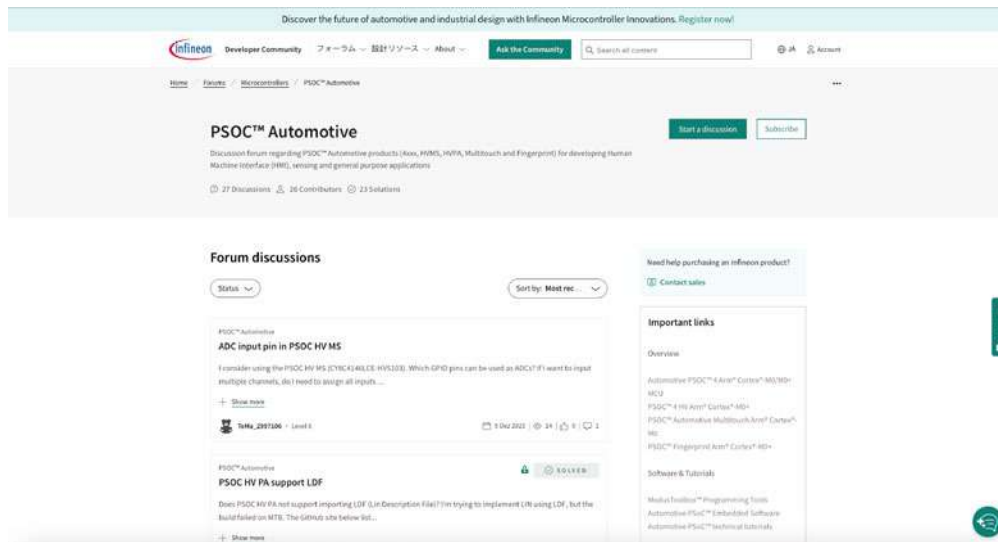
# Online Support

## 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](mailto:autopsoc@infineon.com)
3. You will receive a confirmation which explains how to use your new access



[PSOC™ Automotive](#)

# 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.

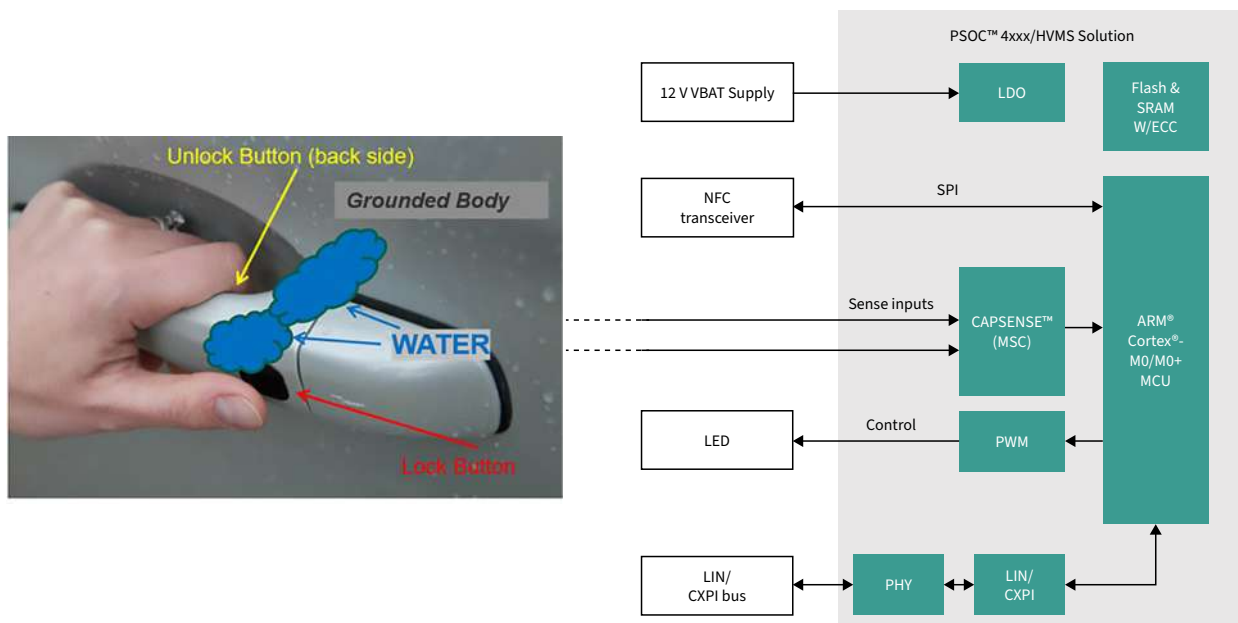


## Car door handle

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 controllers 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 5<sup>th</sup> 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



## 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

- PSoC™ 4000T MCU offers advance HMI capabilities by supporting capacitive, inductive sensing.
- It offers always-on sensing feature – low power sensing supported in deep sleep current <6uA for door handle application
- PSoC™ 4000T comes with 5<sup>th</sup> gen. MSC-LP CAPSENSE™ which 10x higher SNR & low power consumption

## Suggested products

- PSoC™ 4xxx
- PSoC™ 4 HVMS



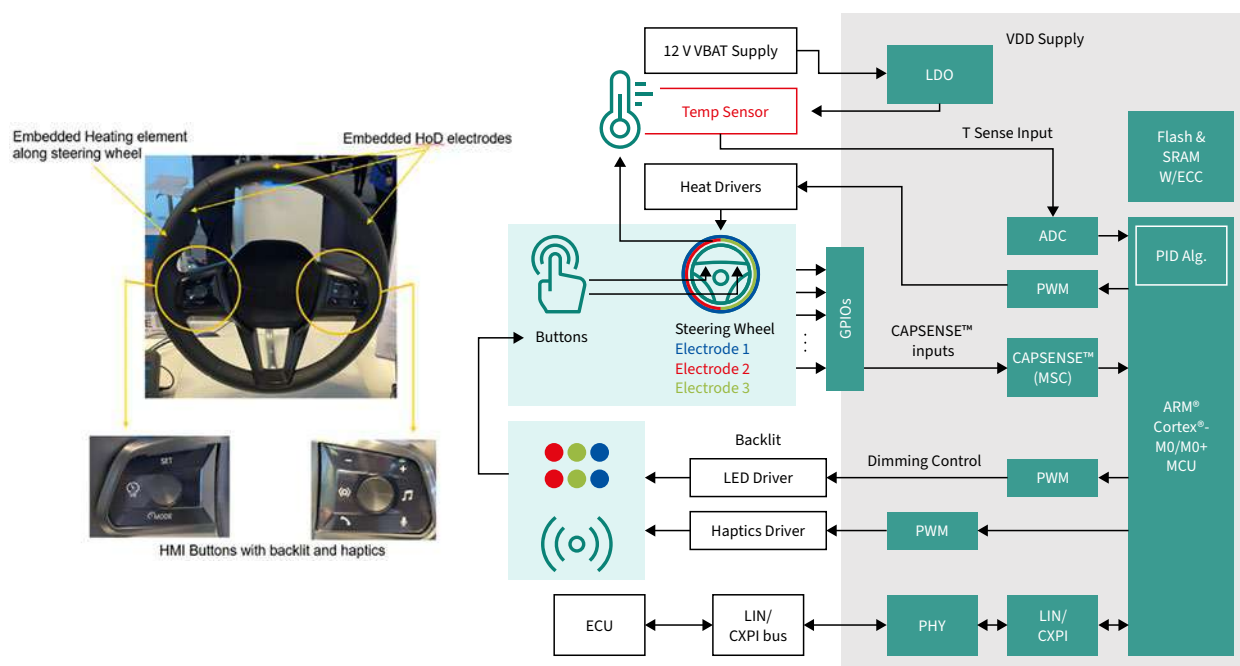
[www.infineon.com/door-control](http://www.infineon.com/door-control)



# 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



## 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](http://www.infineon.com/in-cabin-sensing)



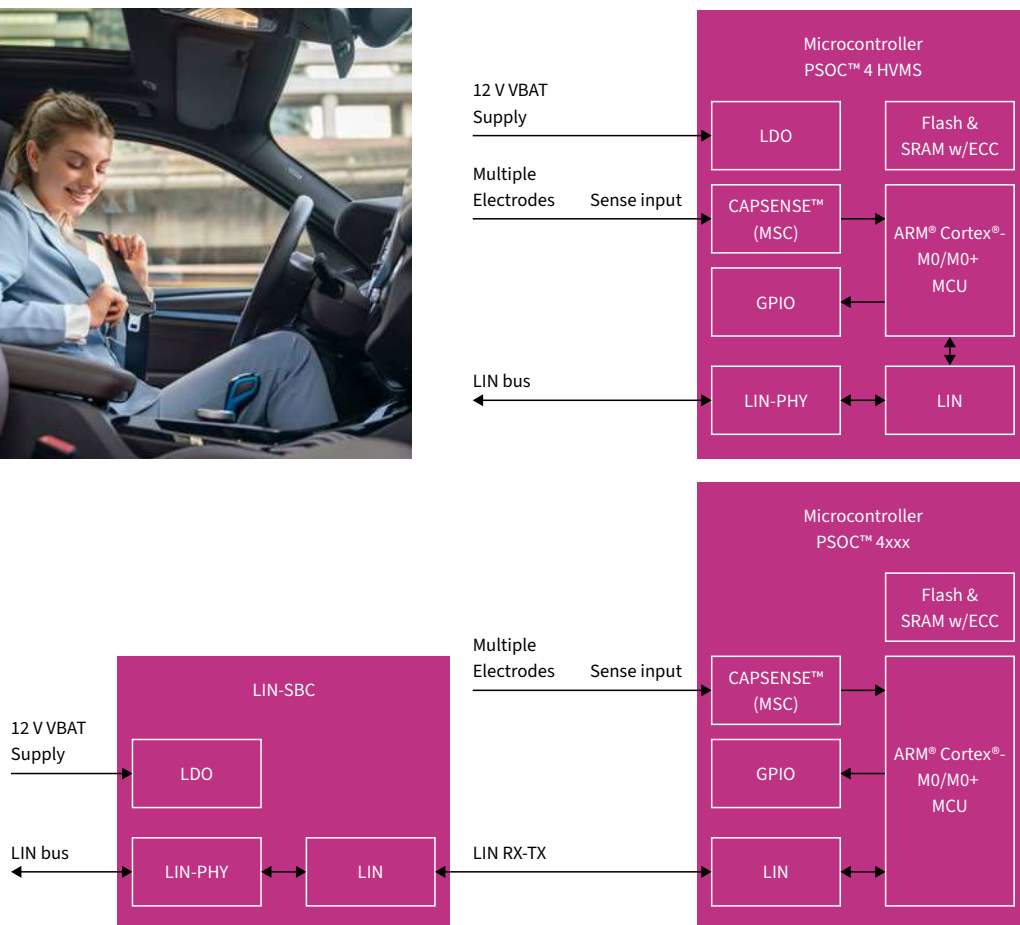
# Passengers occupancy detection

## POD

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



# 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 (5<sup>th</sup>) 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](http://www.infineon.com/in-cabin-sensing)



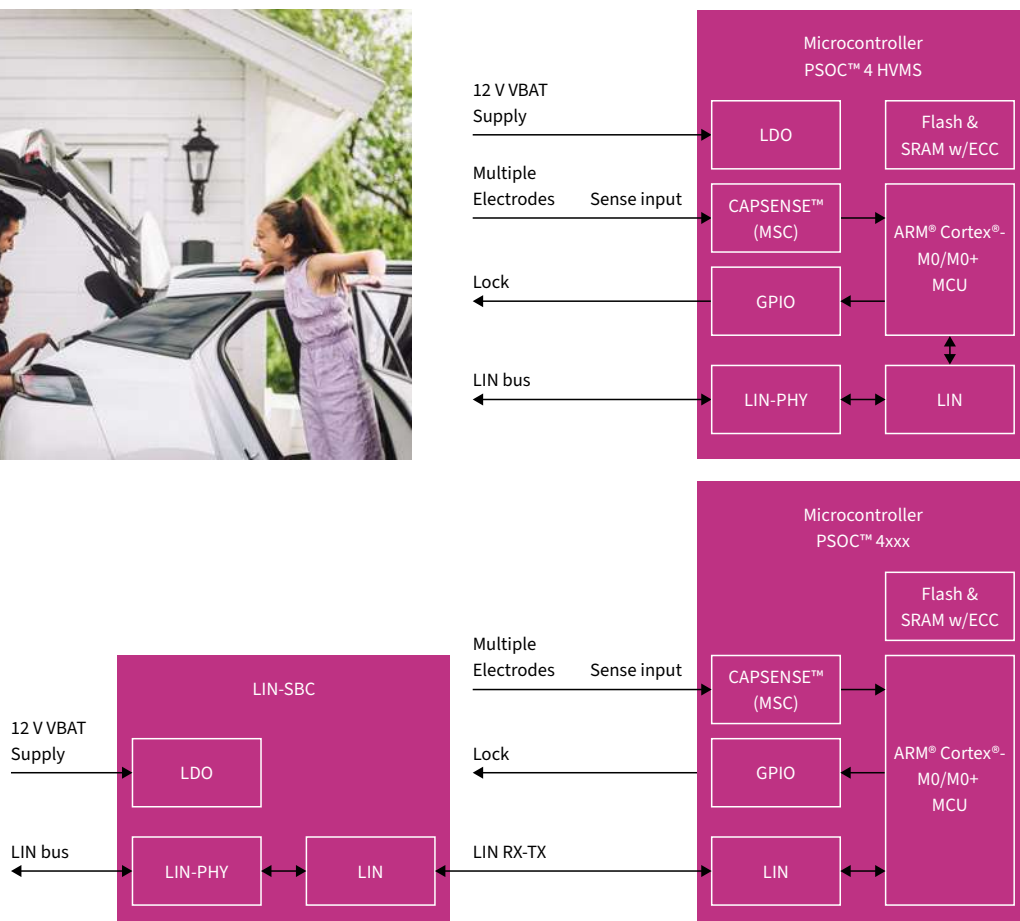
# Foot kick opener

## COD

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



# 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

## Suggested products

- PSOC™ 4 HVMS
- PSOC™ 4xxx



[www.infineon.com/door-control](http://www.infineon.com/door-control)

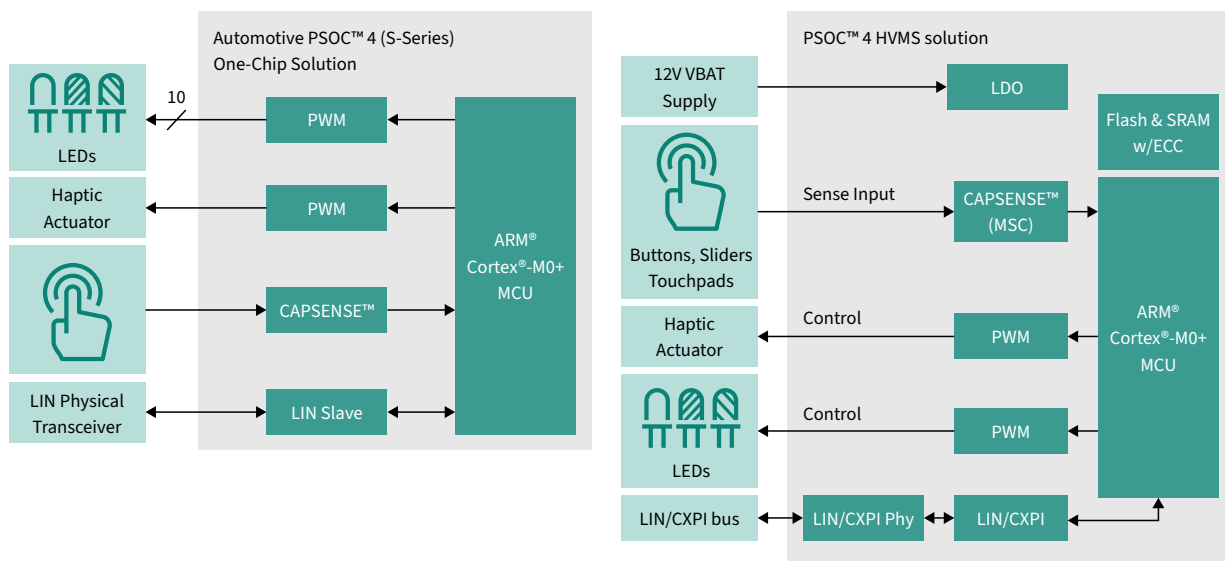


# Steering wheel switch

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 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™ 4 HVMS provides support for system level functional safety compliance to the ISO-26262 ASIL standard.

## Application diagram



# 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

## Suggested products

- PSOC™ 4xxx
- PSOC™ 4 HVMS



[www.infineon.com/infotainment](http://www.infineon.com/infotainment)

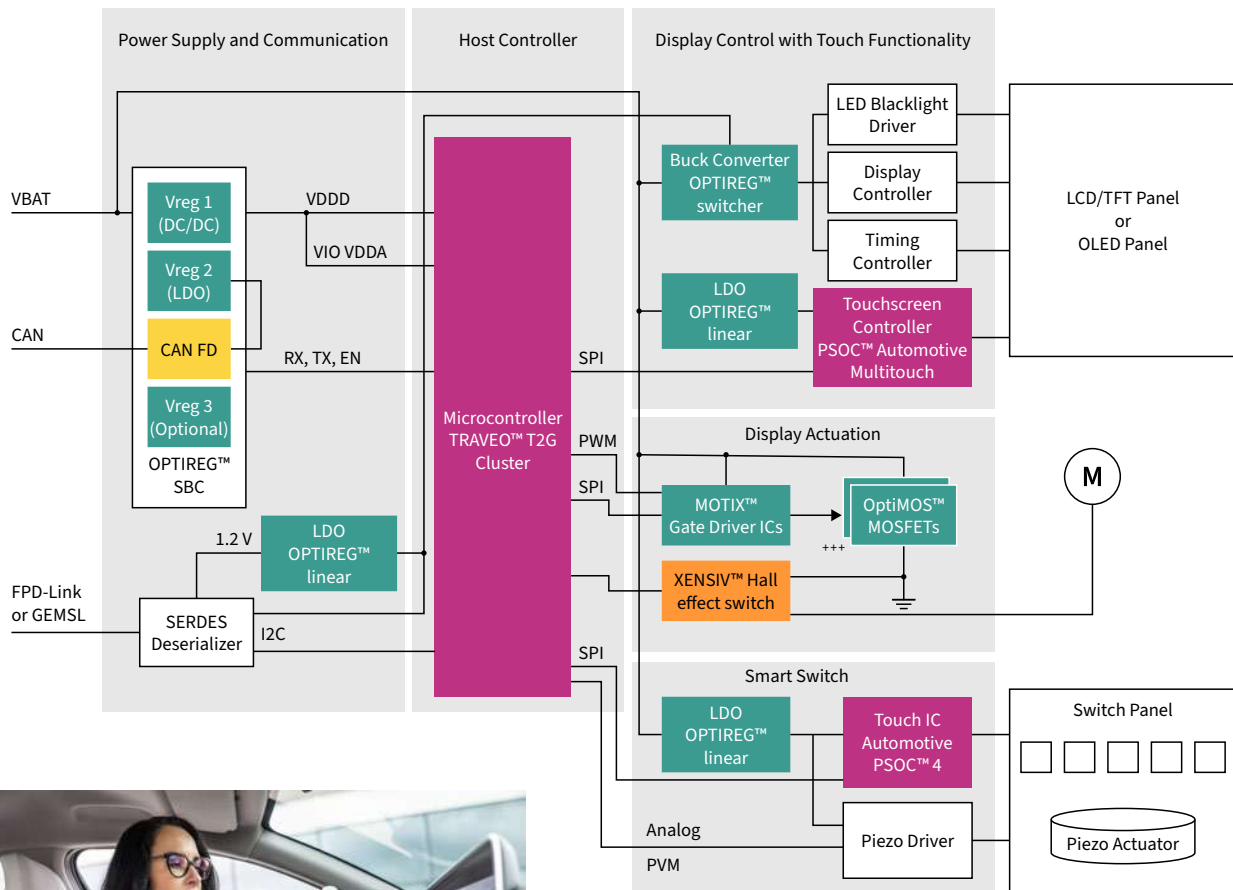


# Touchscreen / Touchpad

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



# 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](http://www.infineon.com/psoc-information-display)



## 2/3-wheeler Cluster

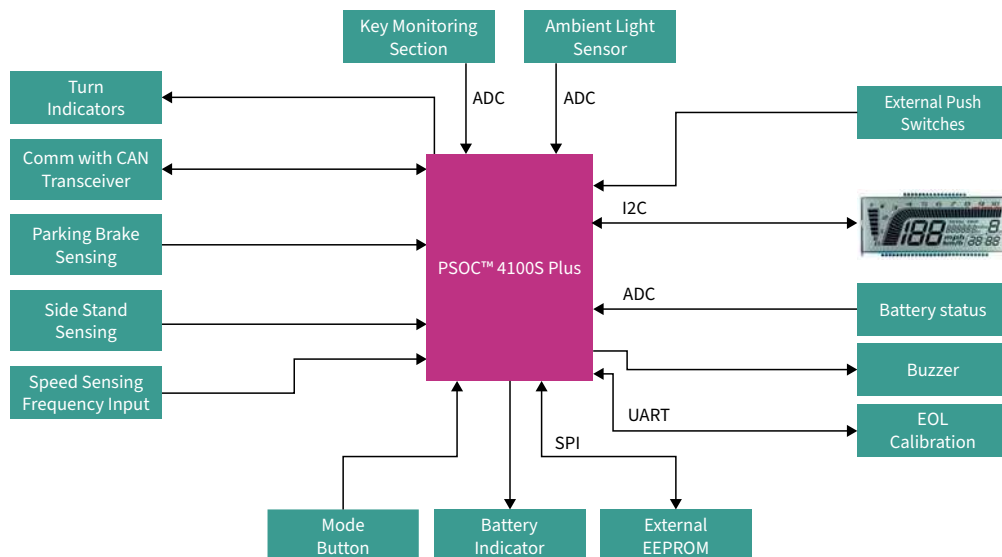
### One stop shop

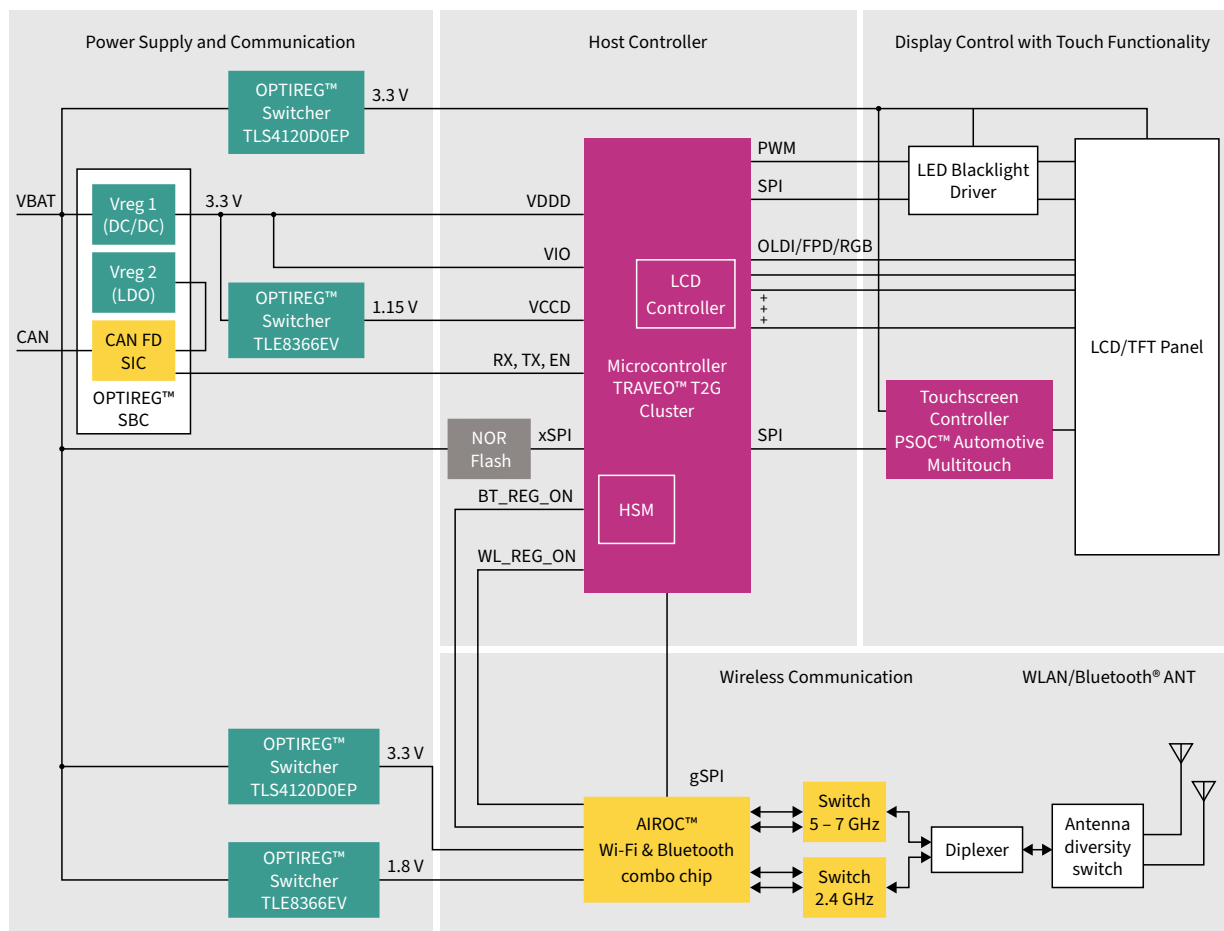
Today's two-wheeler market is transforming from a stepper motor cluster to a full LCD cluster in entry level/economic models. There are several key factors which are driving this market change such as

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.

### Application diagram





## 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](http://www.infineon.com/psoc-2-3-wheeler)

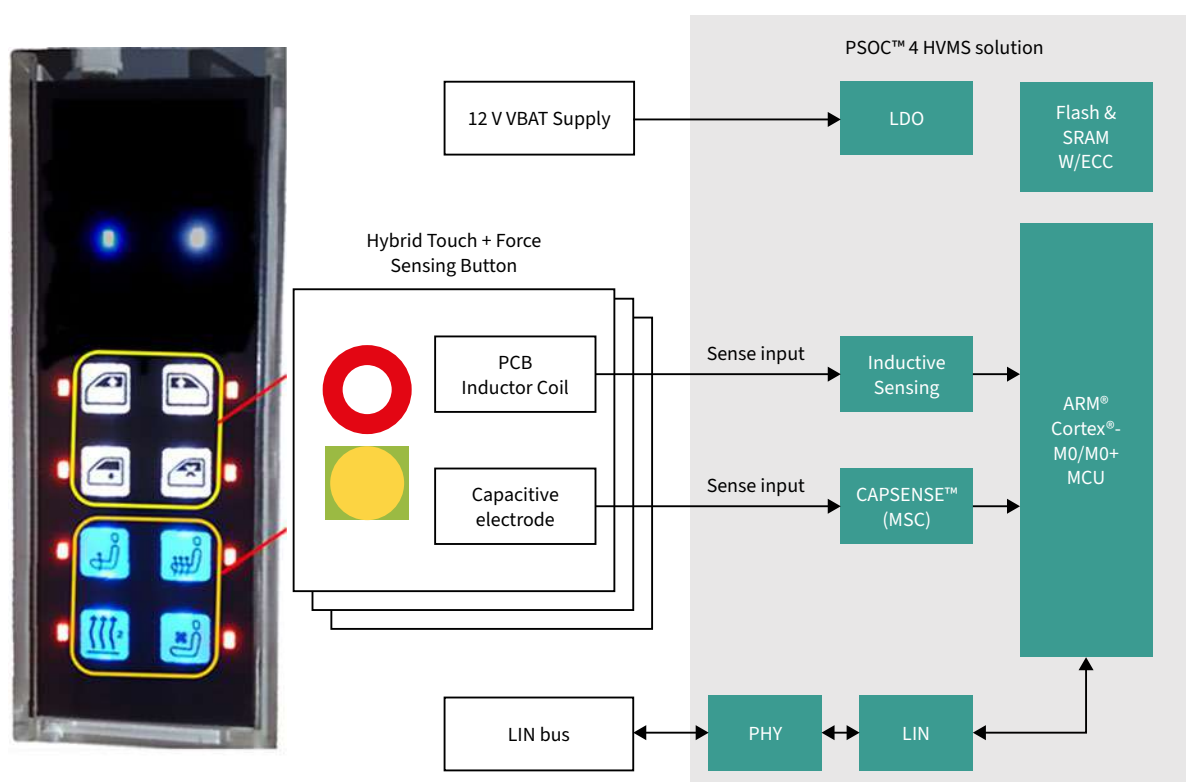


# Inductive Sensing

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.

## Application diagram



## Features and benefits

### Application features

- Supports inductive sensing for excitation frequencies up to 3 MHz
- Operates at a measurement rate of up to 10 ksp/s
- 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](http://www.infineon.com/infotainment)



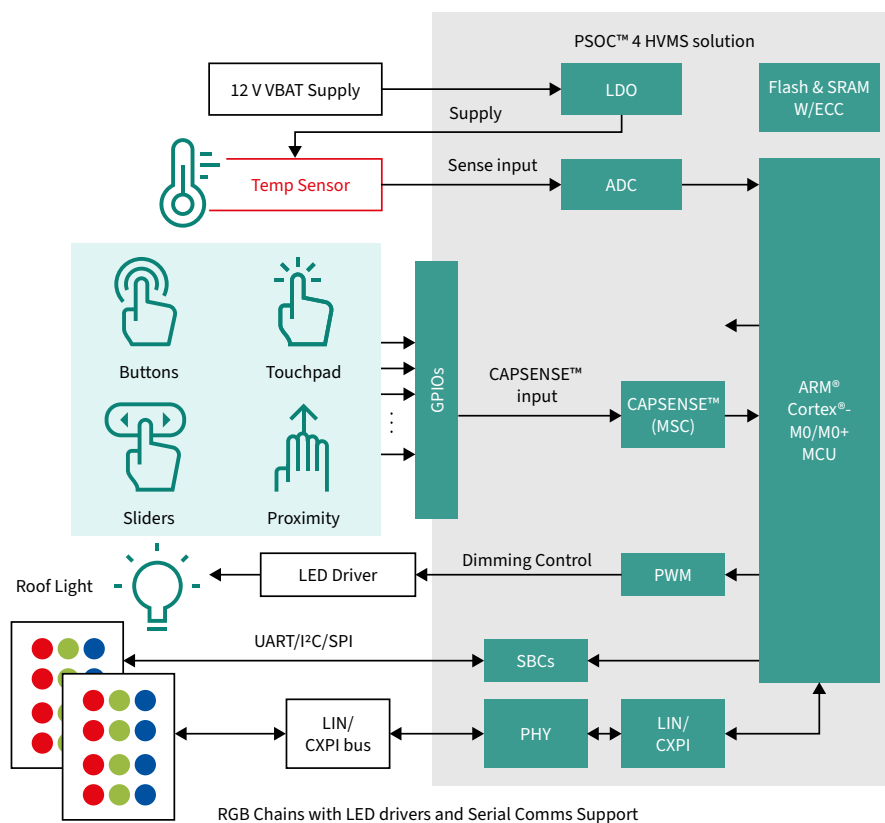
# Interior Lighting control

## 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.

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

## Application diagram



# 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, CXPI)
- Best-in-class EMI/EMC performance

# Suggested products

- PSOC™ 4xxx
- PSOC™ 4 HVMS



[www.infineon.com/automotive-lighting](http://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, CXPI or iso UART)
- 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/CXPI/iso UARAT-transceiver in a single chip for space-constrained sensing-ECUs

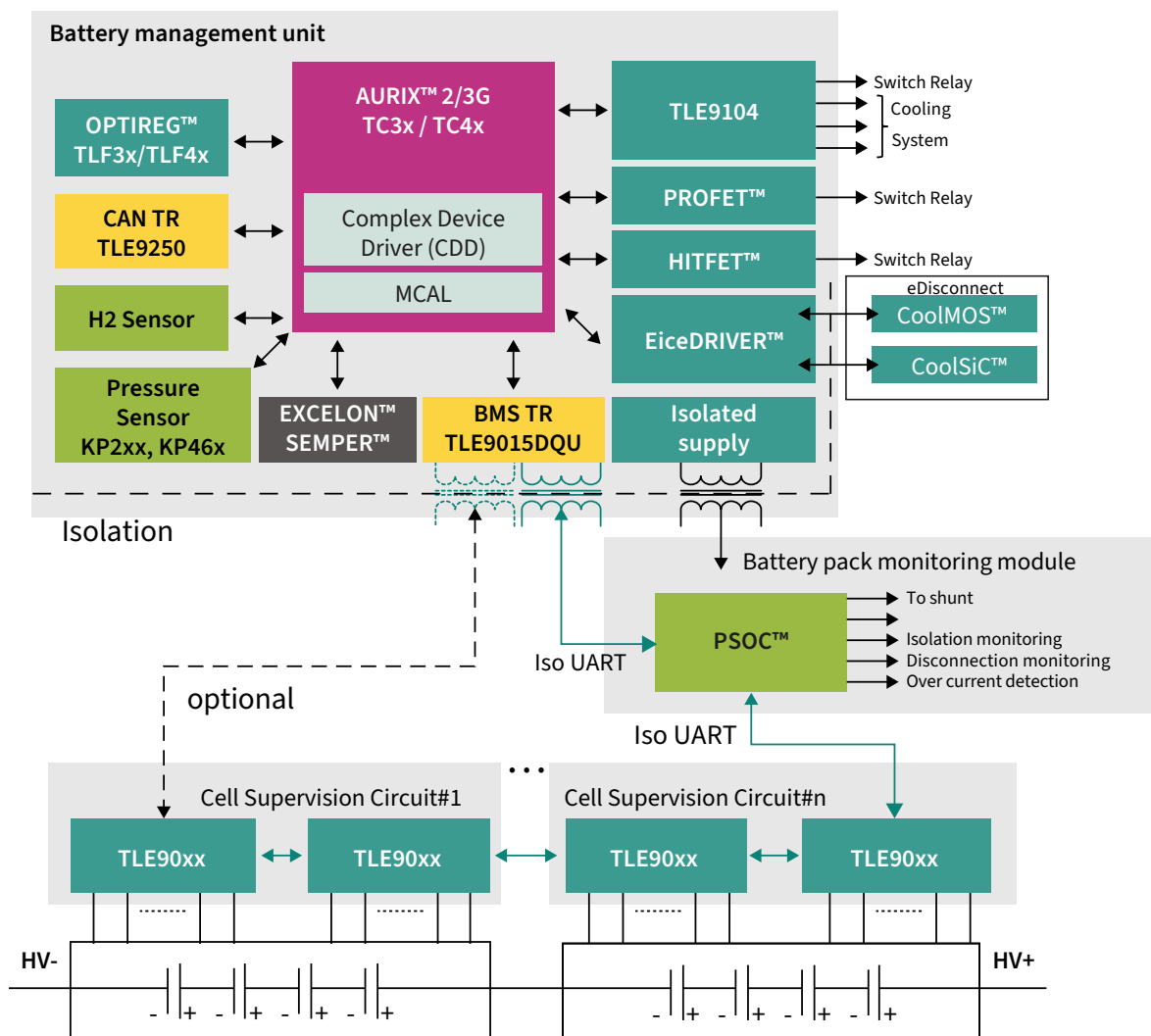


# Automotive battery pack monitoring

A high-voltage battery management system (BMS) requires reliable monitoring and control of charging, discharging, and cell parameters. High-voltage batteries, which can reach up to 1200 V, demand a comprehensive ISO 26262 ASIL-D compliant system solution. This solution must cover battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), fuel cell hybrid electric vehicles (FHEVs), commercial vehicles, and energy storage systems. To ensure passenger safety and regulatory compliance, advanced battery pack monitoring is essential.

Infineon has developed the PSoC™ 4 HVPA-SPM device, which integrates all necessary functions into a single device for automotive battery pack monitoring. This product provides not only current sensing but also thermal runaway detection, battery disconnection monitoring, isolation monitoring, and overcurrent detection, making it a robust solution for modern automotive applications.

## Application diagram



## Features and benefits

### Application features

- Increase flexibility in the BMS by programming own software for OEMs/T1s to eliminate the local BMS host, minimize SW overhead and differentiate value
- General trend to higher accuracy, higher precision in the analog front end for increased safety of the battery state-of-health & -charge and car passengers, as well as early detection of OCD events and resulting pyro-fuse triggering

### System benefits

- The integrated MCU and safety software support enable flexible operation, data storage, and fast time-to-market
- Fast-detection ( $\mu$ s) of overcurrent event and triggering the pyro-fuse to disconnect the battery and avoid thermal runaway by dedicated OCD comparators and ADC
- One-stop-shop for BMS: Infineon offers Battery Pack Monitors + Cell monitors & balancers, as well as further components

## Suggested products

- PSoC™ 4 HVPA



[www.infineon.com/atvbms](http://www.infineon.com/atvbms)

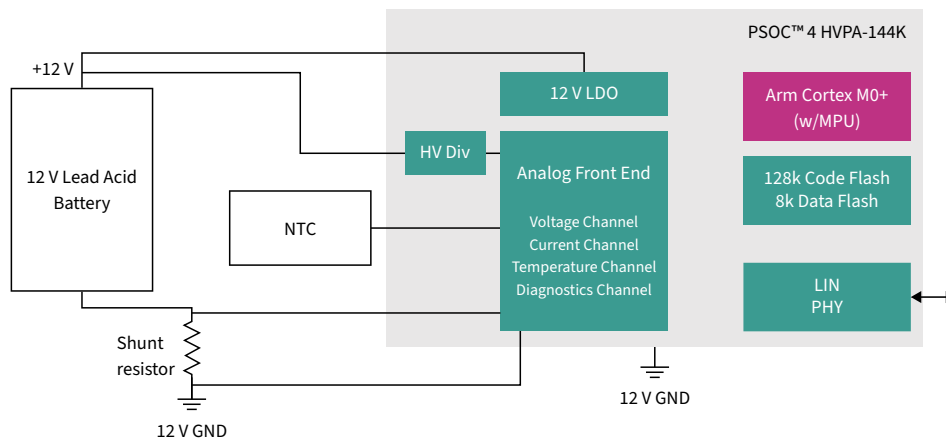


# Intelligent Battery Sensors (IBS)

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



## 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](http://www.infineon.com/atvbms)



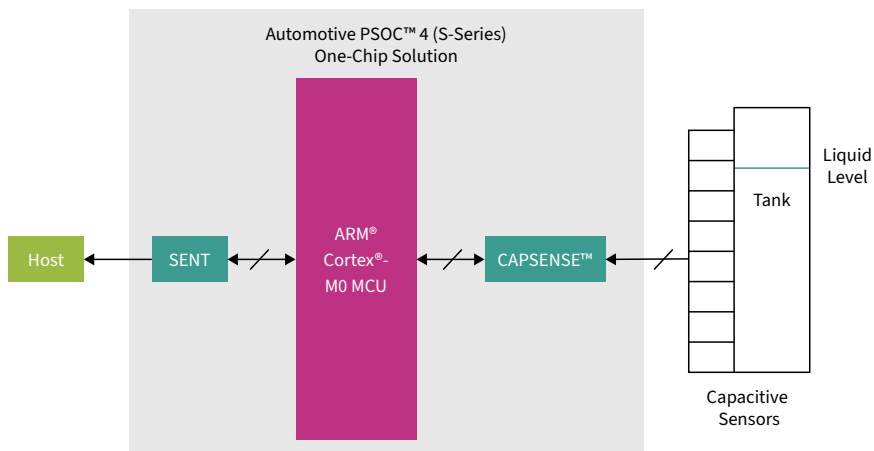
# Liquid level sensing

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



## 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](http://www.infineon.com/powertrain)

# General Purpose



[www.infineon.com/automotive-applications](http://www.infineon.com/automotive-applications)



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

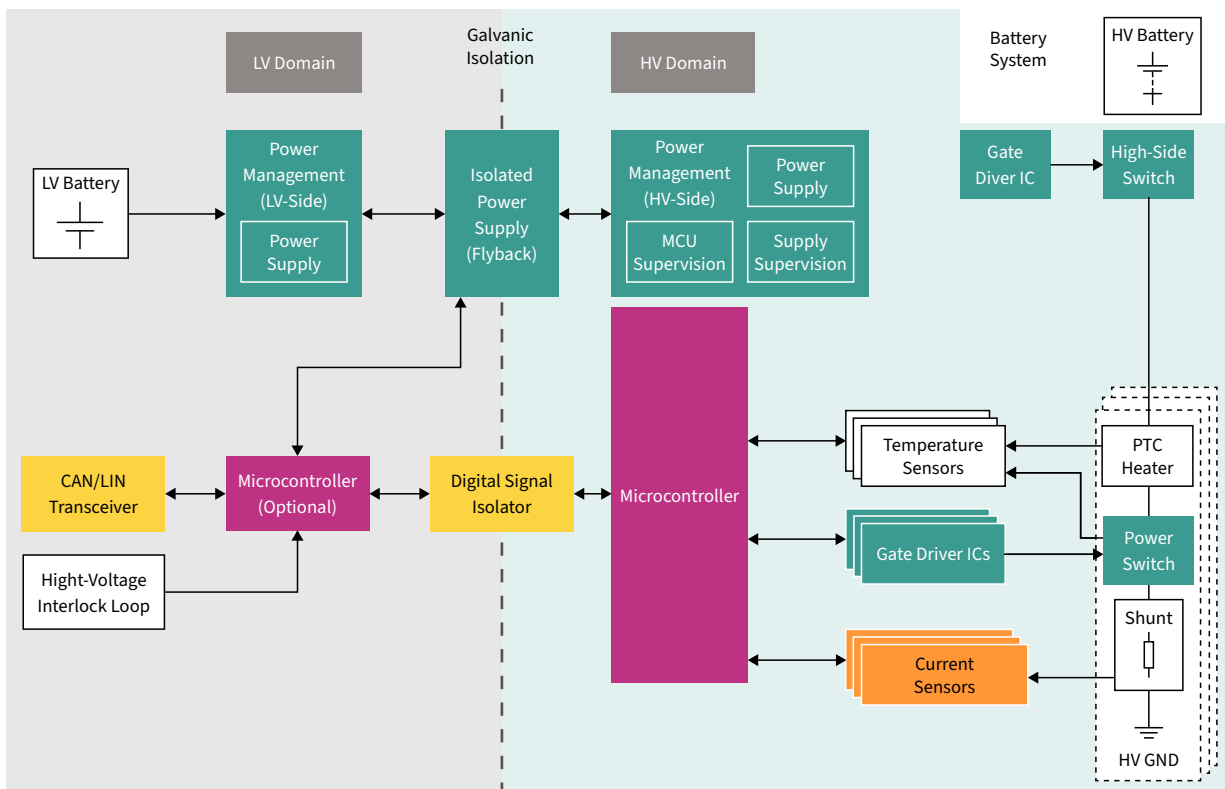


## PTC heaters

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



# 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](http://www.infineon.com/ptc-heaters)



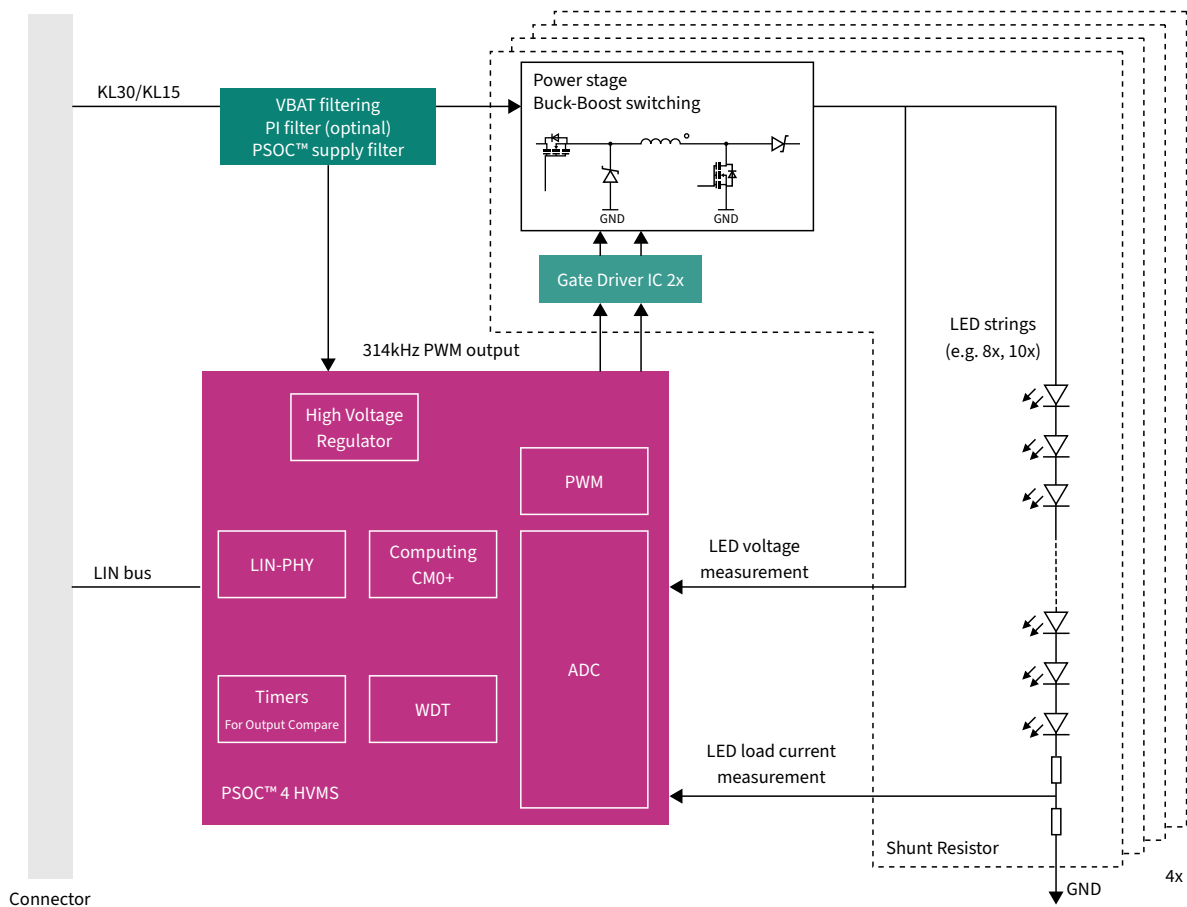
## LED lighting (external / rear light)

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 traditional incandescent lamps, LEDs require precise current control. Addressing rear lighting trends such as brand recognition and C2X communication for automated driving, the number of LEDs and safety requirements are increasing. As a result, the power and safety requirements of the rear light system are also increasing. To meet these demands, new solutions like PSOC™ HVMS and DC-DC converters can be helpful for achieving efficient power and safety with a small footprint, which is also a key system requirement. 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 power stage (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. 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



## 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



[www.infineon.com/automotive-lighting](http://www.infineon.com/automotive-lighting)

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