



# Mobile Robots - Introduction & Overview

AGV – Automated Guided Vehicles

AMR – Automated Mobile Robots

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2022 Edition





# Infineon is a globally leading semiconductor player



\* over the cycle 9%+ revenue growth; 19% Segment Result margin; investment-to-sales ratio of 13%; targets to be approached as integration progresses

**top 10**

- › semiconductor company

**~46,700**

- › total employees

**~7,800**

- › R&D employees

**leading player**

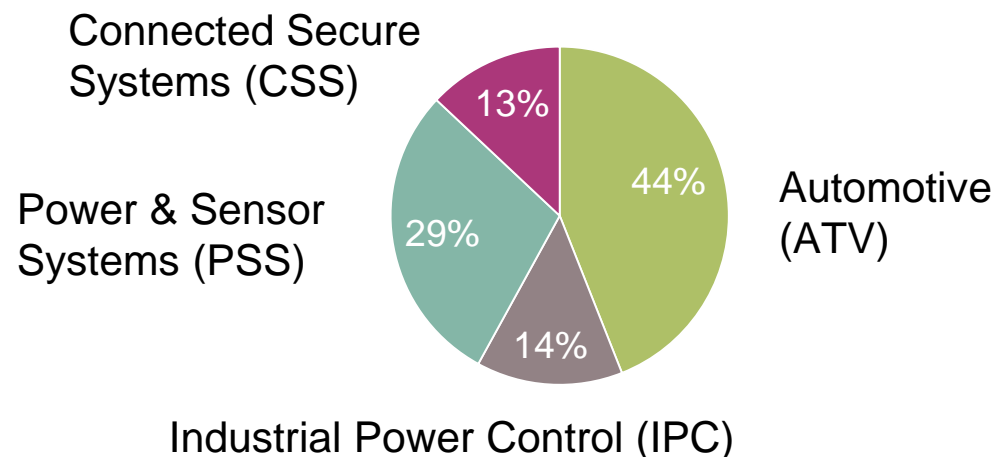
- › in automotive, systems for power management and drives, sensor systems, connected secure systems, wireless combos, differentiated memories

**9%+ | 19% | 13%**

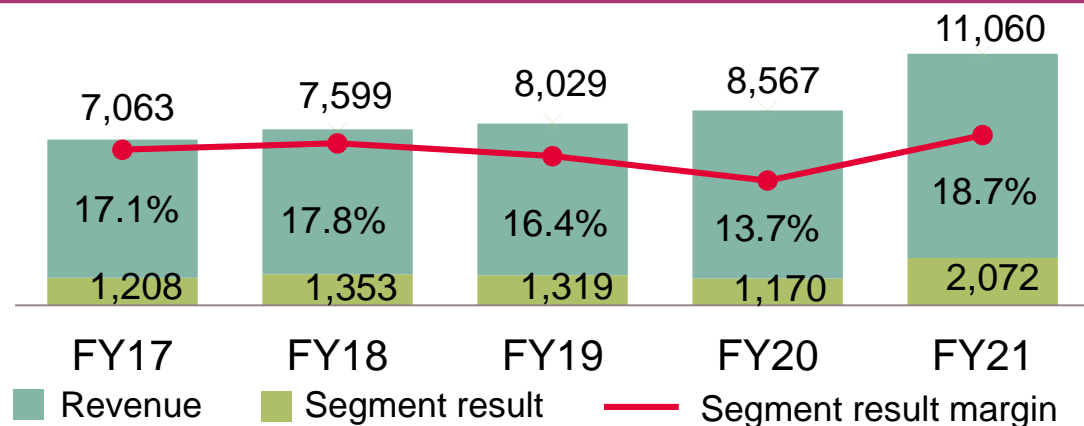
- › target operating model\*

# Infineon at a glance

## Business segments revenue\*



## Financials

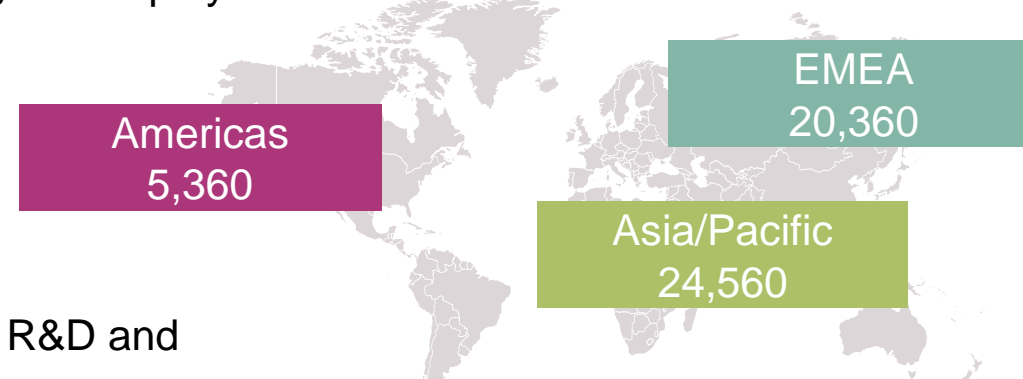


\*2021 Fiscal year (as of 30 September 2021)

\*\*as of 30 September 2021

## Employees\*

**50,280** employees worldwide



**56** R&D and  
**20** manufacturing locations\*\*

## Market position

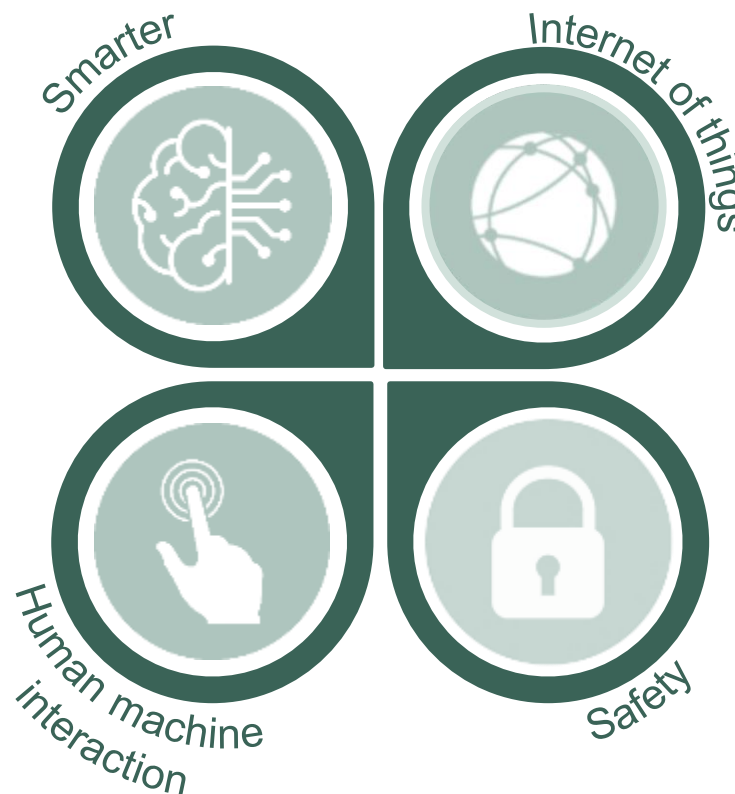


For further information: [Infineon Annual Report 2021](#)

# Main trends and challenges in robot applications

Robots are moving toward Industry 4.0. This brings the need for robots to be smarter and interconnected but also calls for the need for standardization.

Human-robot collaboration is one important trend in robotics. The ability to work mutually with humans, enables robots to adapt to a rapidly changing environment.



Connectivity level and the need of data security correlate, so security must be integrated into all existing and new systems, but once again calls standardization needs for diverse robots & systems to interact properly.

Safety is key when robots interact with their environment with a special focus on human safety, work safety, routing accuracy and collision avoidance

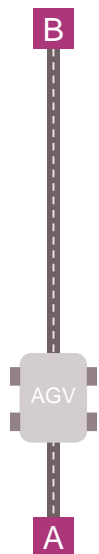
# Types and deployment of mobile robots

On high level mobile robots can be categories into AGVs and AMRs

## AGV

### Automated Guided Vehicle

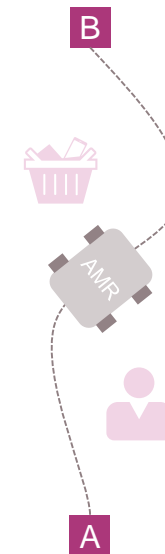
AGVs are “fixed”. They follow predefined paths using lasers, beacons, barcodes or magnetic tape.



## AMR

### Autonomous Mobile Robot

AMRs are not “fixed” and don’t need external paths. Autonomously mapping and navigating by using sensors



**Potential use cases:** warehouse & logistic, last mile delivery, robots in hotels, banks, airports etc.



# Mobile robots are a fast growing market and need sophisticated system solutions for each functional block

## Application requirements

Different types of mobile robots require unique and appropriate solutions

**Precise, efficient & compact motor drives**

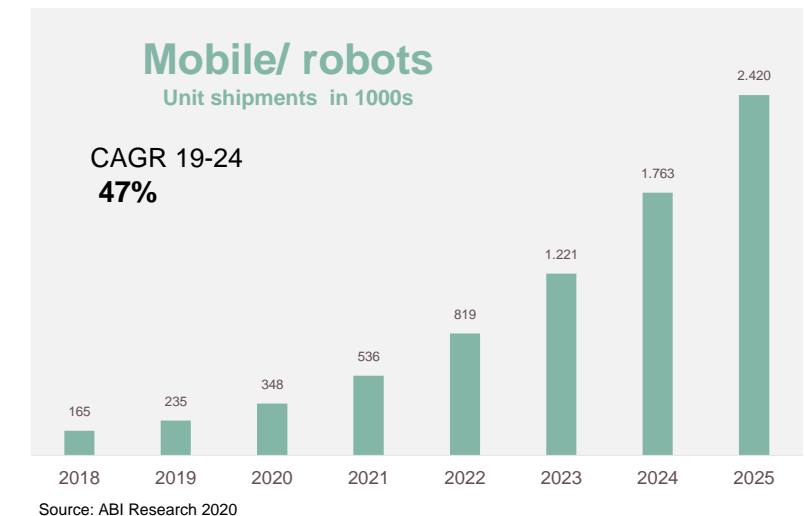
**Fast charging reducing charging and idle time**

**Environmental sensing for navigation and safety**

**Connectivity enabling AI, real time monitoring and IoT**

**Connectivity enabling AI and IoT**

## Market outlook



# Mobile robots contain these key functional blocks ...

## Technical Description

### Motor Control

- › MOSFETs, Drivers, combination
- ›  $\mu$ C specifics for Motor Control
- › Power management and LED driver
- › Sensor: Hall/Magnetic /Current/etc

### BMS

- › MOSFETs, Drivers
- › Battery Management ICs
- › AC/DC charging and USB-C/ PD
- › Security Identification
- ›  $\mu$ C specifics for BMS

### Power management

- › DCDC Converters, LDO

### Charger

- › AC/DC Charging / USB-C/PD
- › MOSFETs / Drivers /  $\mu$ C
- › Wireless charging

### Sensor Systems

- › Time-of-Light (ToF), Radar
- › Pressure sensor, Environmental sensor

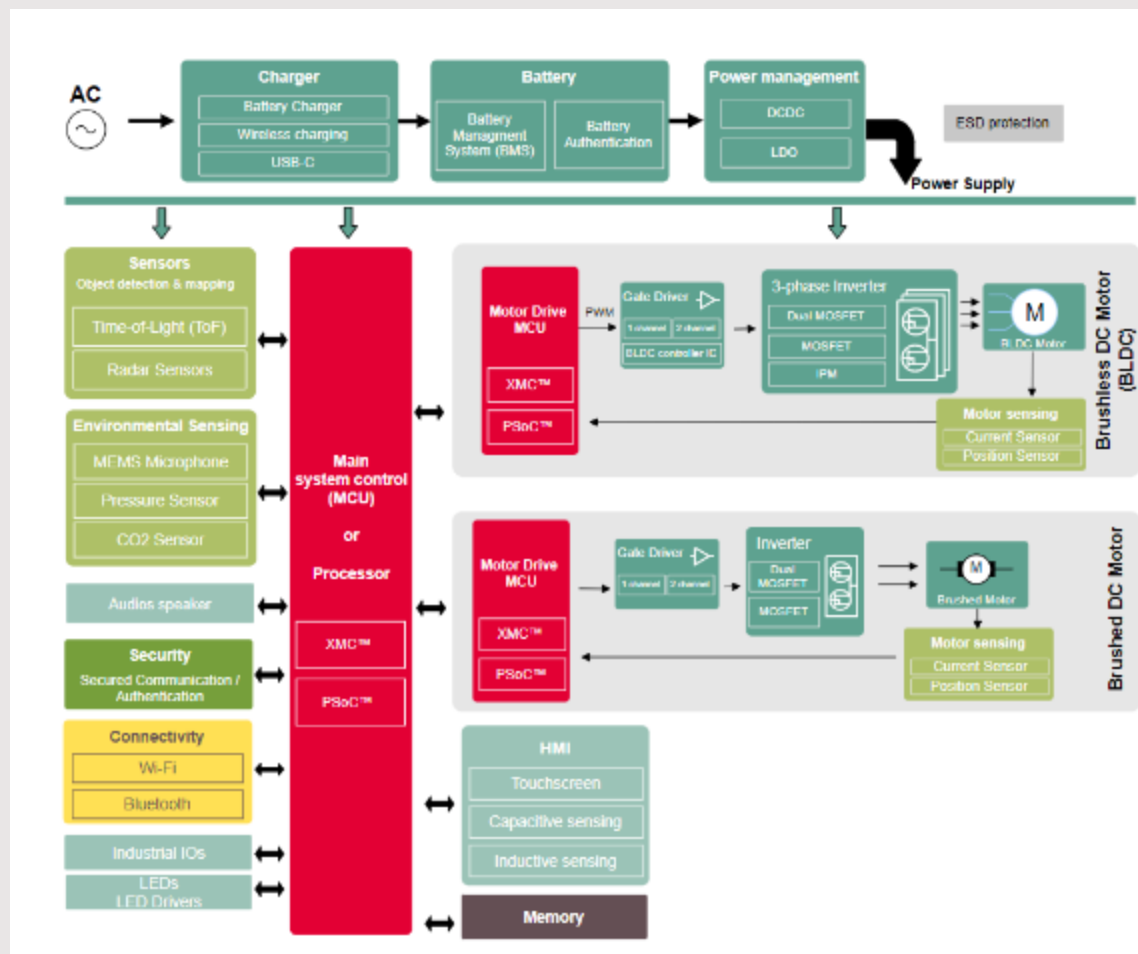
### HMI

- › LCD display/touchscreen
- › Capacitive/inductive sensing, e.g. Switches/Buttons

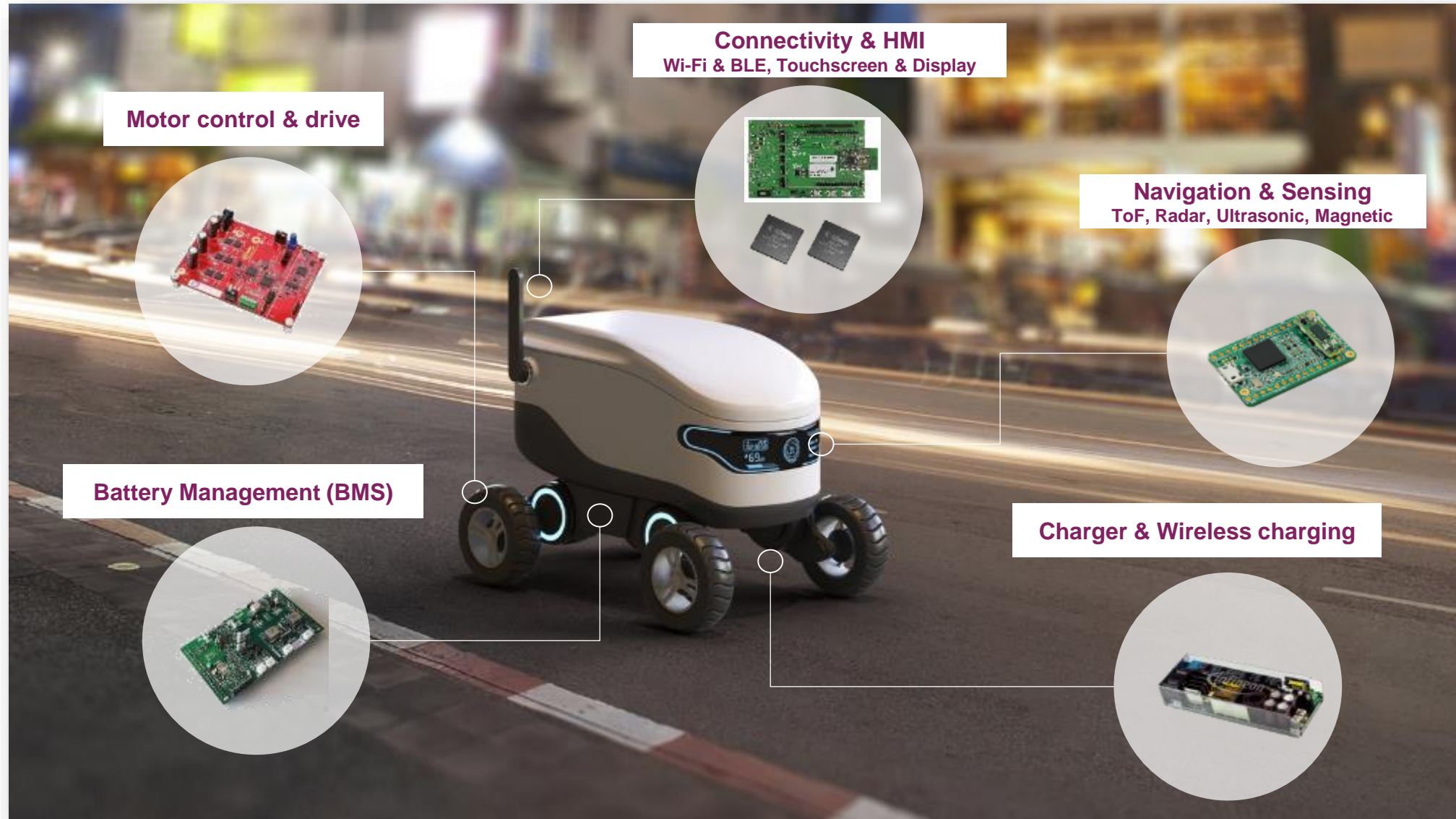
### Connectivity/ Communication

- › Wifi / BLE
- › Security Communication / Identification

## Functional Block Diagram

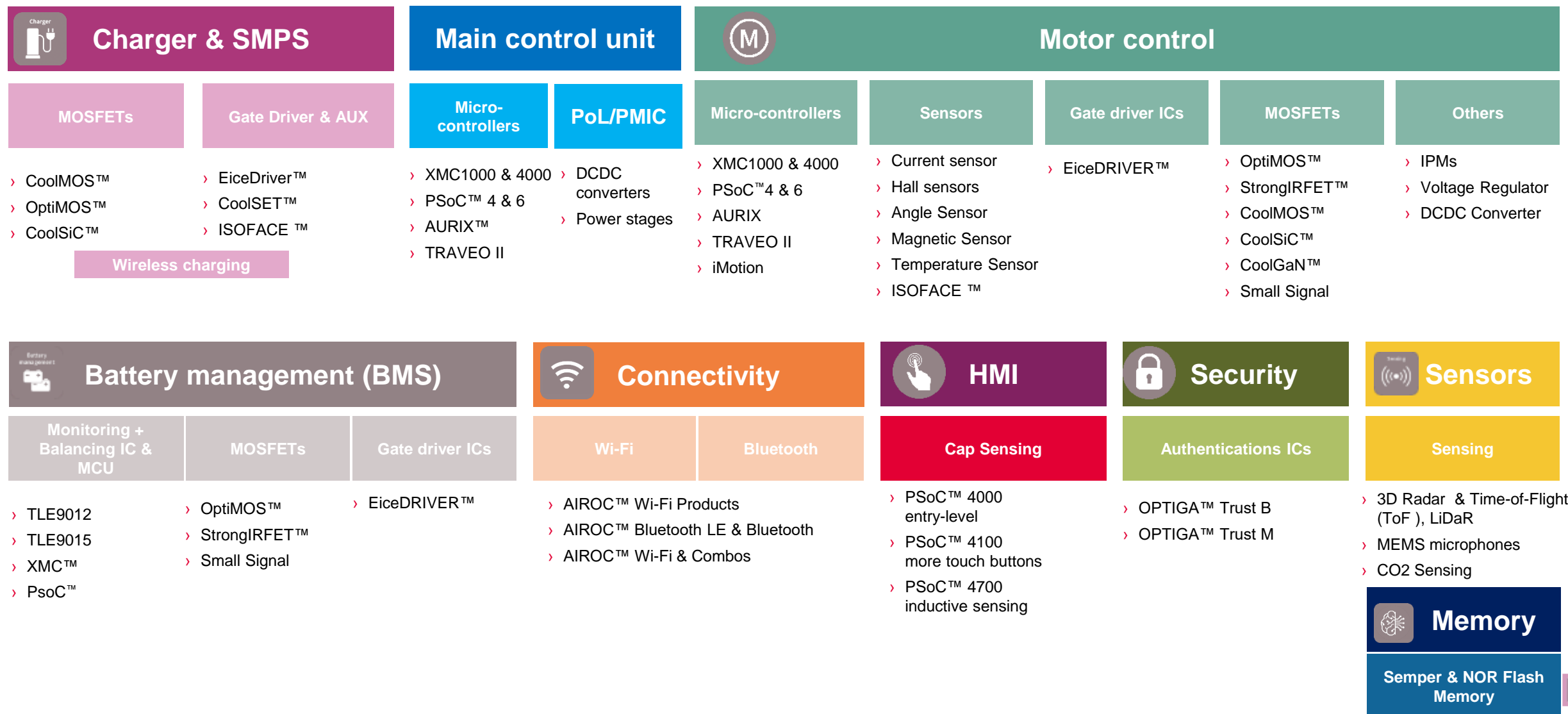


# Infineon's complete portfolio enable fast, easy and efficient designs across functional blocks

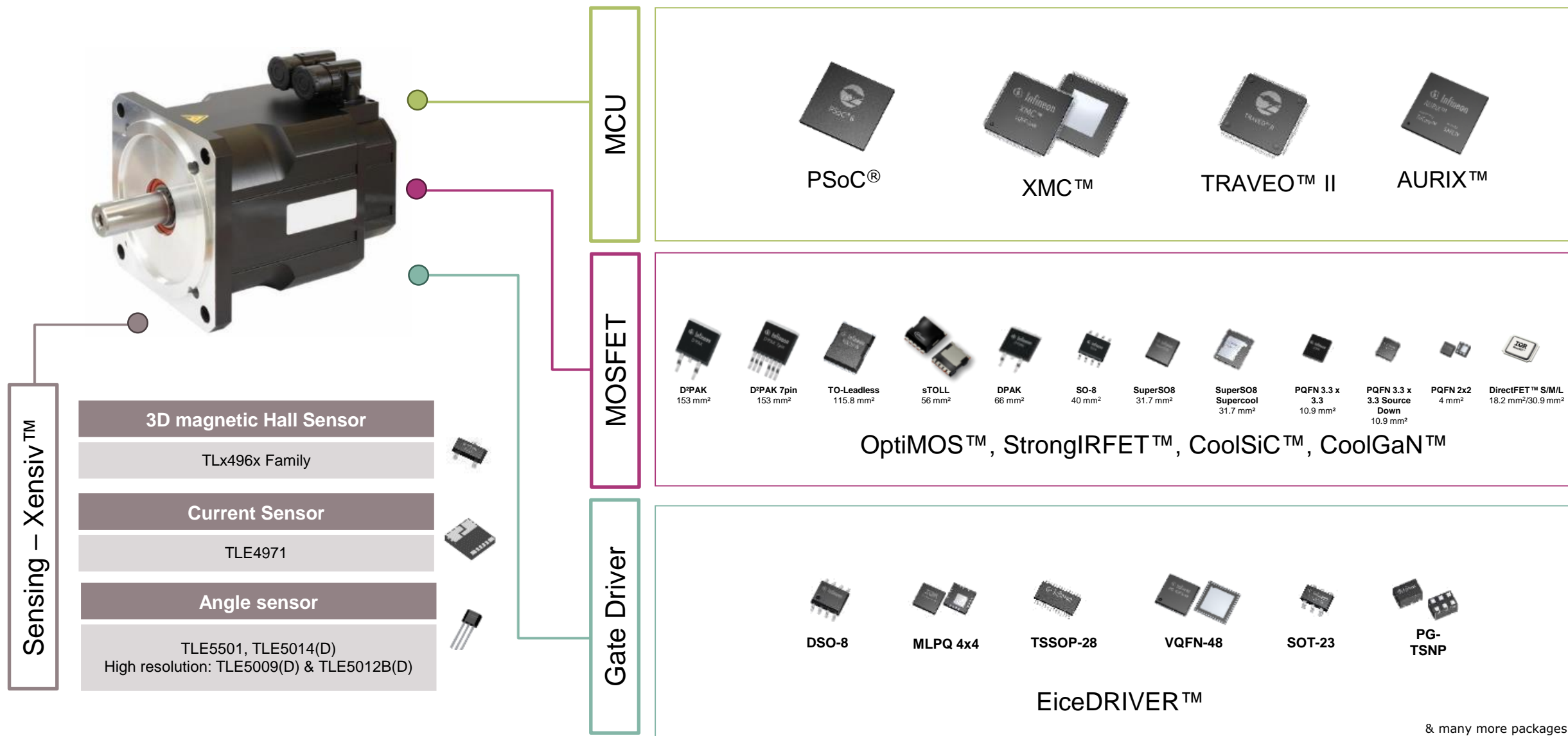




# One-stop-shop with broadest market portfolio for mobile robots



# Full system solution for motor drive & control



# The right choice microcontroller: XMC™, PSoC™, Traveo II or AURIX™

## XMC™ Family

- ✓ Cortex ARM M based MCU
- ✓ XMC1000 – Cortex M0 MCU (48MHz-)
- ✓ XMC4000 – Cortex M4F MCU (144MHz-)
- ✓ DAVE 4.0 Apps available for Motor Control FOC, BLDC, PMSM and more
- ✓ SW security libraries protection

## PSoC™ 4 Family

- ✓ CM0+ 48MHz
- ✓ Up to 384k Flash, 32k SRAM
- ✓ Customer have the knowledge of motor control SW

## PSoC™ 6 Family

- ✓ Dual Core - CM4F 150MHz, CM0+ 100MHz
- ✓ Up to 2M Flash, 1M SRAM
- ✓ Enhanced TCPWM (P6-256k)
- ✓ Customer have the knowledge of motor control SW

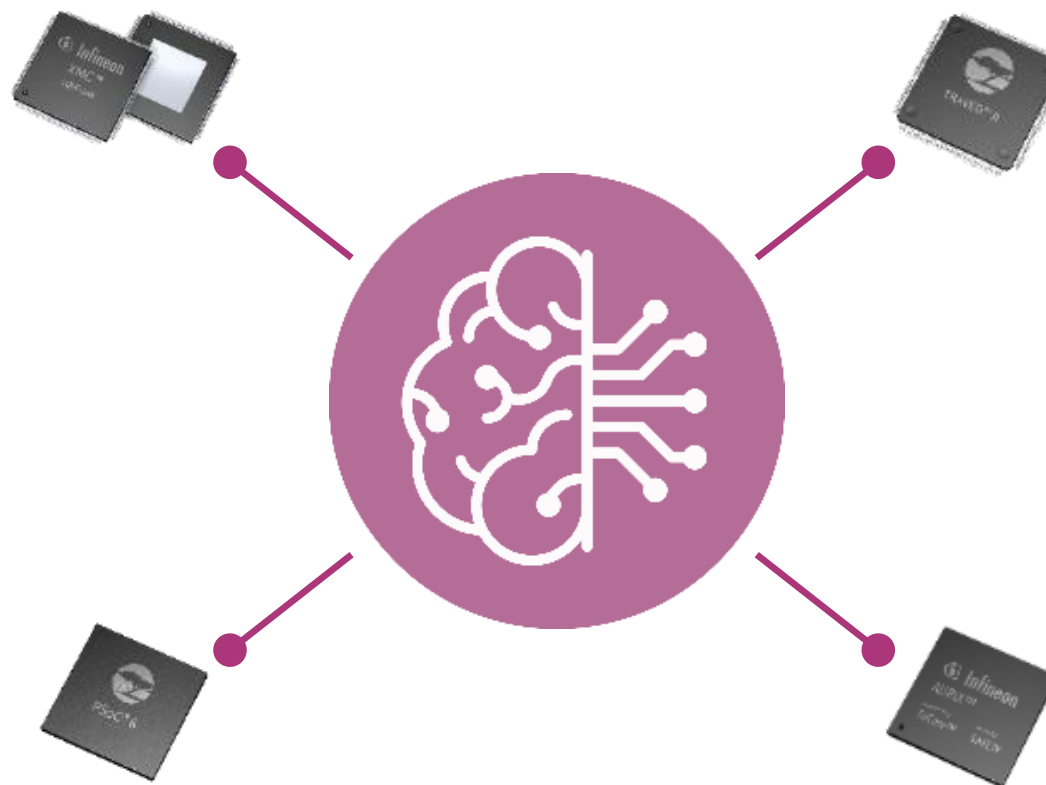
## Traveo II Family

Cortex ARM M based MCU

- ✓ CYT2Bx – Cortex M4 MCU (80 MHz or 160MHz-)
- ✓ CYT3/4x – Dual Cortex M7F MCU (250MHz or 350MHz)
- ✓ HSM (Hardware Security Module)
- ✓ ASIL-B (SIL-2)
- ✓ ECC memory, MPU, Self test Libs
- ✓ Up to 320 pins

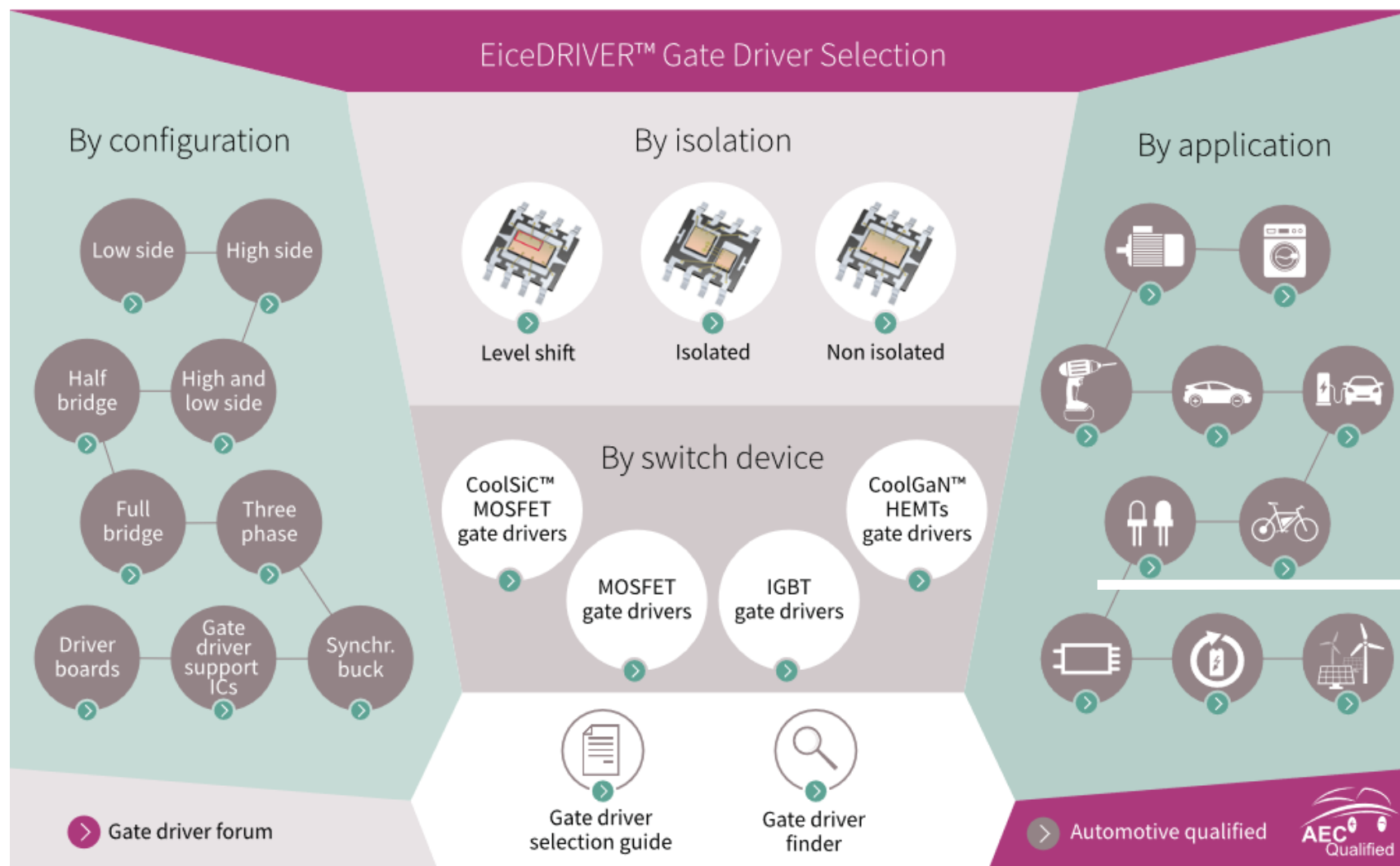
## AURIX™ Family

- ✓ TriCore™ based MCU
- ✓ AURIX™ – Up to 3x multicore (300MHz-)
- ✓ AURIX™ – Up to 6x multicore (300MHz-)
- ✓ SW security libraries protection
- ✓ Functional Safety ASIL-x





# A gate driver portfolio that leaves no wishes open – EiceDRIVER™



Please visit [www.infineon.com/gatedriver](http://www.infineon.com/gatedriver) for entire gate-driver IC portfolio

# Robust sensors for efficiency & safety in motor drives

## Current sensing

### TLI4971

- › Up to 70 A<sub>RMS</sub> (120 A FSR)
- › **High bandwidth** >120 kHz
- › Intrinsic strayfield cancellation
- › Superior **linearity and overload capability**
- › **Analog output signal PLUS** 2x digital **fast overcurrent detection**
- › Integrated Functional Isolation Supporting 1150 V V(IORM)
- › SMD sensor package with **integrated Low sensing resistance current rail (220 µΩ)**

## High resolution rotor position sensing

### TLE5009(D) – Angle Sensor

iGMR

- › iGMR based angle sensor with full 360° Analog Sin/Cos output
- › Pre-amplified temp. compensated signals
- › Very short signal delay
- › For speed up to 30.000 rpm

### TLE5012B(D) – Angle Sensor

iGMR

- › iGMR based angle sensor with full 360°
- › 1° accuracy over Temperature and lifetime
- › Integrated angle calculation
- › Interfaces: SPI, IIF, PWM, SPC, HSM
- › Temp. compensation and auto-calibration

## Lower resolution rotor position sensing

### TLE4961 - Hall Switch

- › High precision Hall Switch
- › Very low current consumption (1.6mA)
- › High supply voltage + overvoltage up to 42 V
- › Versions in leaded packages (SSO) as well as SMD with smallest footprint (SOT23)

### TLE5501 – Angle Sensor “Single Dual Die”

- › First ever Infineon TMR
- › Analog sin/cos
- › ISO26262-compliant development targeting ASIL D(D)

iTMR

### TLE5014(D) – Angle Sensor - Single & Dual

- › Programmable iGMR digital angle sensor, E2PROM and look-up table
- › SENT, SPC, PWM, SPI Interface
- › High accuracy (<1° error)
- › ISO26262-compliant dev. targeting ASIL C(D)

iGMR

# Connecting what matters!

## Bluetooth & Wi-Fi selection guide

### Wireless Connectivity

Our robust portfolio of Bluetooth/BLE & Wi-Fi connectivity enable a host of different functionalities within Service Robots addressing multiple markets






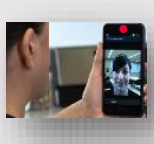



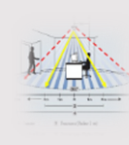


	Recommendation
Long-range connectivity	CYW20820, CYW20735, CYW20706
HMI (capacitive-sensing)	PSoC 6 BLE, PSoC 4 BLE
Ultra-low-power operation	CYW20819, PSoC 6 BLE
Sensor fusion/analytics	PSoC 6 BLE, PSoC 4 BLE
Simple BLE processor	CYW20704, CYW20736
Dual Mode Bluetooth and BLE	CYW20820, CYW20735, CYW20706



	Recommendation
Highest Throughput/Best Range	CYW4373, CYW43439
Dual Band (2.4GHz and 5GHz)	CYW4373
Single Band (2.4 GHz)	CYW43439
Bus Interface (USB, SDIO, PCIe)	USB:CYW4373, PCIe: CYW4373E, SDIO: all
SISO (1x1) antenna configuration	CYW4373, CYW43439
MIMO (2x2) antenna configuration	CYW54590



# XENSIV™ sensors portfolio & robotics use cases

Environmental	Pressure	3D Radar	3D iToF	Microphone & ultrasound TR
 <b>World smallest form factor</b> 6x6mm <sup>2</sup>	 <b>Best-in-class resolution</b>	 <b>24GHz / 60 GHz Application innovation leader</b>	 <b>Power efficient Indirect Time of Flight 3D camera</b>	 <b>Unique SNR, sensitivity and power efficiency</b>
 <b>Best accuracy</b>	 <b>Energy Efficiency</b>	 <b>Best performance &amp; energy efficiency</b>	 <b>High resolution 3D point cloud</b>	 <b>Crystal clear audio signals</b>

## Use cases in robotics

Collision avoidance / obstacle-stairs detection (Radar, ToF, Ultrasound)

Improved User Interface & experience (Gesture, VUI)

Height/floor positioning

Odometry fusion / Positioning / SLAM

Vacuum flow

Material classification

Human Presence/safety

*Requires sensor+MPU/MCU+algo/software integrated system offer*

# Infineon helps speed up your go-to-market time

## Evaluation Board Portfolio

### Charger & Power Supply



[3.3KW bi-directional PFC with SiC](#)



[48V Li-ion battery charger 2kW](#)



[BMS](#)



[BMS](#)



### Motor drive



[3-phase DC Motor Control, VDC 24V, 250W](#)



[Motor Control Evaluation Kit](#)

### Connectivity & HMI

#### Wi-Fi



[CYW43907 Wi-Fi MCU Eval Kit \(CYW943907AEVAL1F\)](#)

#### Bluetooth



[CYW20735 SoC Eval Kit \(CYW920735Q60EVB-01\)](#)

### IP Protection

#### OPTIGA™ Trust M Evaluation Kit

Infineon XMC™ 4800 IoT Connectivity Kit

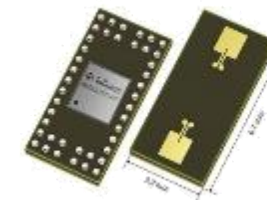


Infineon OPTIGA™ Trust M Shield2Go

Infineon My IoT Adapter

### Collision avoidance & object detection

BGT60LTR11AIP MMIC



BGT60LTR11AIP shield



BGT60LTR11AIP Demo = Radar Baseboard MCUT + BGT60LTR11AIP shield



[Sensor demo - BGT60LTR11AIP](#)

# Technology/market solution

## Quick links



### Microcontroller

#### [XMC™](#)

- › 32 bit
- › Arm® Cortex®-M

#### [PSoC](#)

### Driver ICs

- › [EiceDRIVER](#)

### Magnetic Sensor

#### [Angle Sensors](#)

- › Encoder/Resolver replacement

#### [Current Sensors](#)

- › Phase current
- › Bus current

### Sensors

- › [REAL3 3D Sensor](#)
- › [XENSIV™ 24GHz Radar](#)
- › [XENSIV™ 60 GHz Radar](#)

### Wi-Fi & BLE

#### [AIROC™](#)

- › Wi-Fi
- › Bluetooth

### Discrete Power (MOSFETs)

- › [OptiMOS & StrongIRFET](#)
- › [CoolMOS](#)
- › [CoolGaN & CoolSiC](#)

### Security

- › [OPTIGA™ Trust](#)
- › [OPTIGA™ TPM](#)

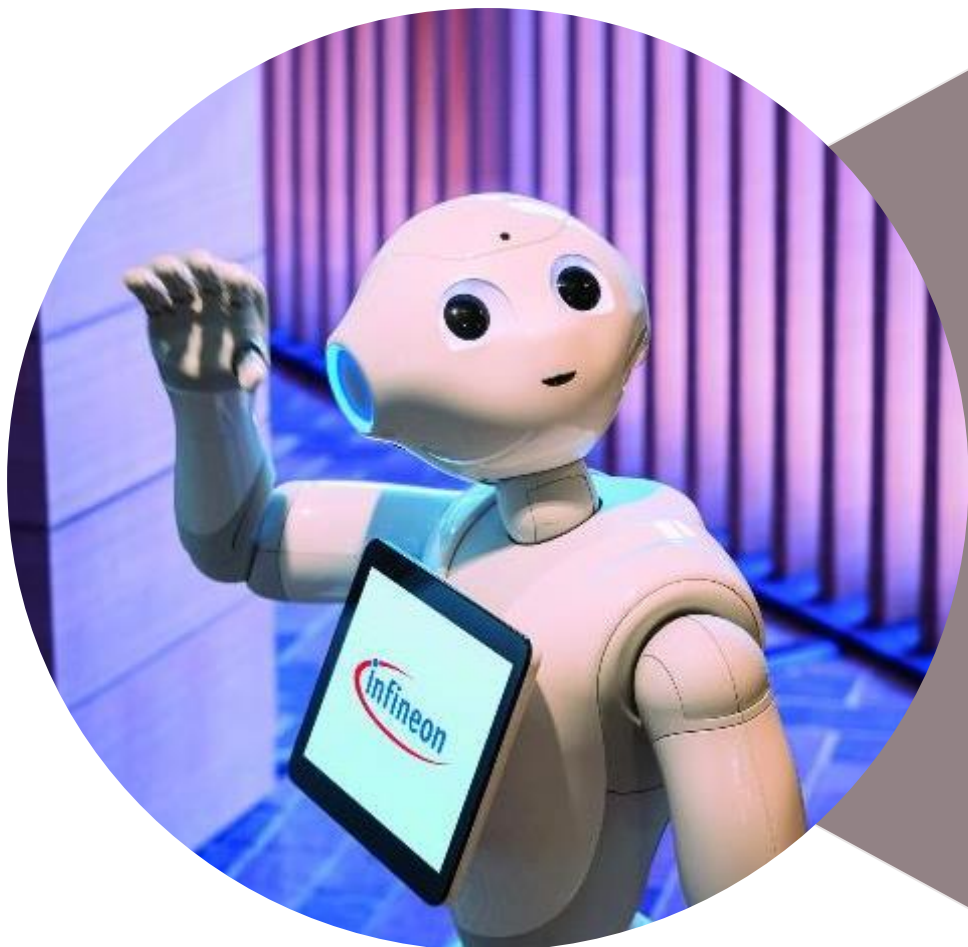
### PMICs

- › [NovalithiC](#)





# Find more information and support material online



Learn more on our [webpage](#)



**Global Application Manager**

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