

Empower your service robots with Infineon's market leading solutions

Xie Lingling
IFAP PSS SMD AP PSB

Burapha University
Infineon Innovation
Launchpad

Infineon

Agenda for today

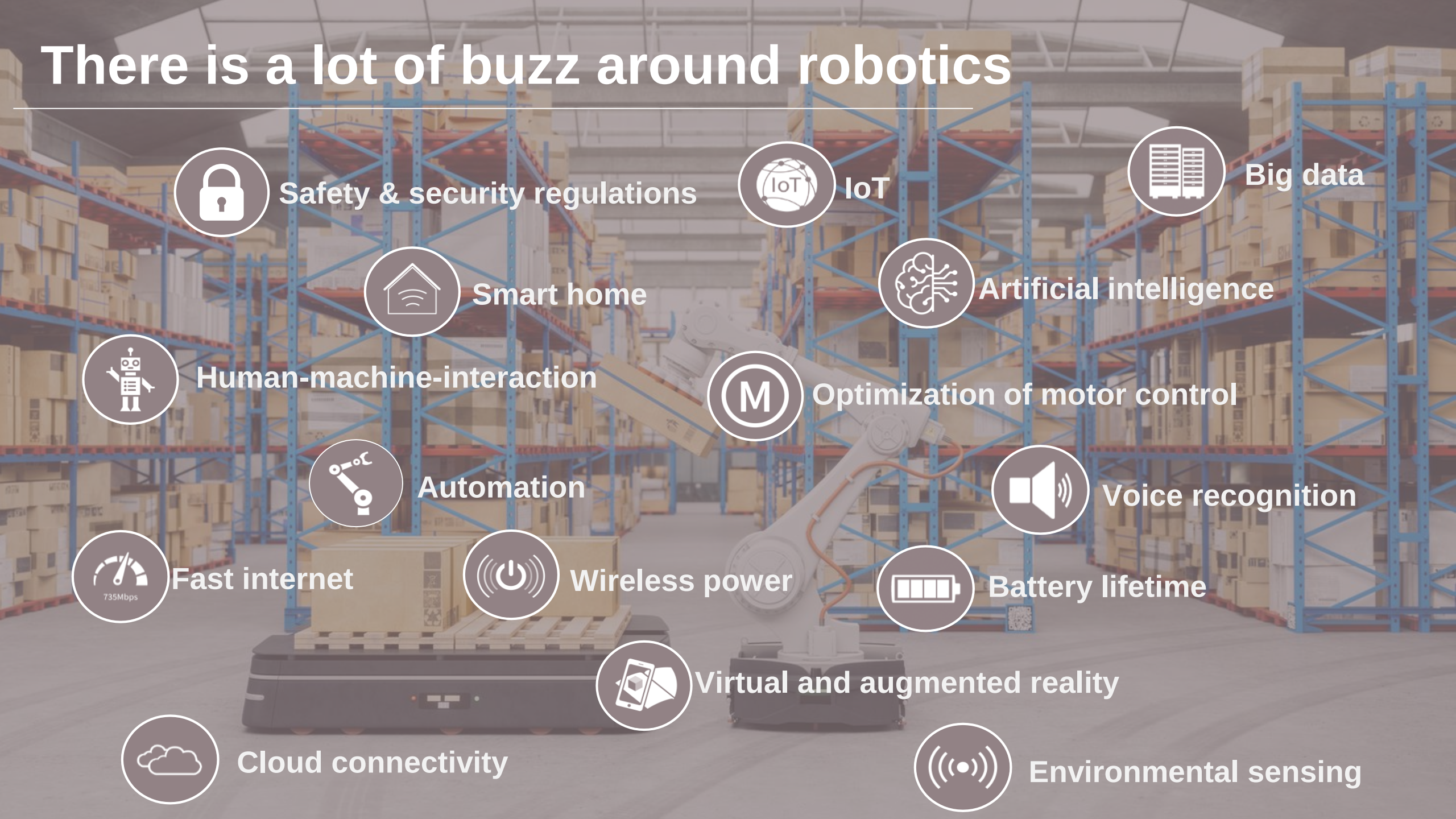
1. Introduction to Service Robots and Market Overview
2. Infineon’s Leading Solutions for Service Robots
3. Q&A

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Introduction to Service Robots and Market Overview

There is a lot of buzz around robotics



A **new age of robotics** is coming with industry 4.0

Such industrial robots have been mostly deployed during the last years and decades







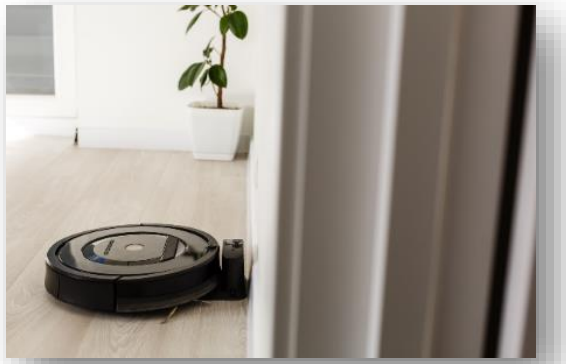
but it’s changing….

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Robotics are getting smarter, mobile and connected

An advanced robot automates tasks performed by humans in the past - ensuring safe operation, storing and transmitting service information with the users, and relying on accurate sensing for most optimized operations.

1. Smarter
2. Autonomous
3. Connected
4. Efficient & Safe





& many more







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Key market drivers shaping the future of robots





Aging population & social acceptance to increase use of robot deployment in everyday life

Automatization (e-commerce, personal assistants) demands automated mode of operation, driving demand for **sensor solution in robots & drones (ToF, Radar, etc)**

Real time operation and AI require stable & secure communication **(Secure Connection) +** open opportunity for **5G & cloud computing**

System innovation, e.g.in motor control (smaller & cheaper drives) or charging solutions will pave the way for new technologies like **WBG, chip embedding** or **wireless charging**

New technologies are widely used in various robot applications, but **standardization and government regulation fall behind** robotics fast development, i.e. regulations to restrict robot/drone deployment

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On a high level robots can be categorized in…

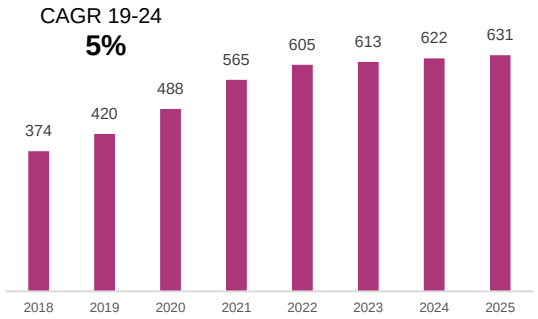
Focus in this presentation

Industrial Robots

Industrial



Articulated
SCARA
Parallel/Delta
Linear/Cartesian

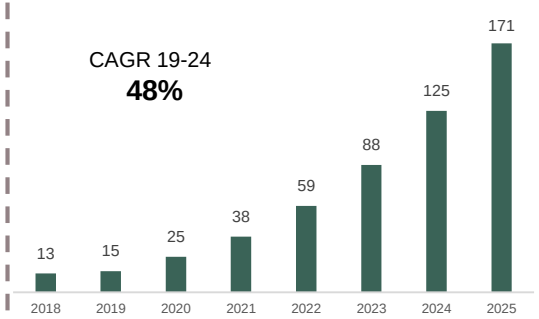


Service Robots

Collaborative



Cobots
Mainly split between lifting weights

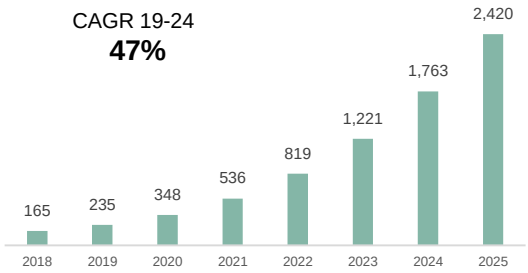


Mobile & Logistic





Mobile & Logistics Robots
AGV – Automated Guided Vehicles
AMR – Autonomous Mobile Robots



Domestic/Personal

Robotic vacuum cleaner



Lawn mower Robots

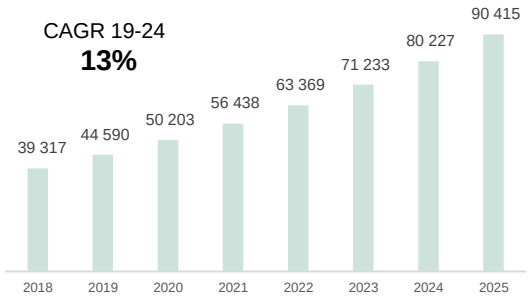


Edutainment and toy/hobby Robot



Companion robots





Source: ABI Research

*Unit shipments in 1000s

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Collaborative Robot (Cobot) VS. Industrial Robot





	Cobot	Industrial Robot
Installation	Flexible deployment	Fixed installation
Programmability	Simple and flexible by “learning” cobot desired movement path	Fixed repeated tasks, time consuming to change tasks
Workspace	Alongside with humans	Separated by fence
Common payload	3-15 kg	30 – 1000 kg
Power	100 – 500 Watt	0.5 – 5 KW
Power supply	48 V DC	100 – 400V (1-3 phase)
Safety regulations	Strict (ISO TS 15066)	Less strict

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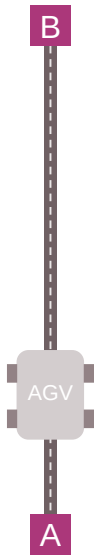
Types and deployment of mobile robots

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

AGV

Automated Guided Vehicle

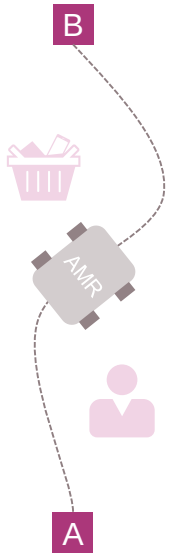
AGVs are “fixed”. They follow predefined paths using lasers, beacons, barcodes or magnetic tape.



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.

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

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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

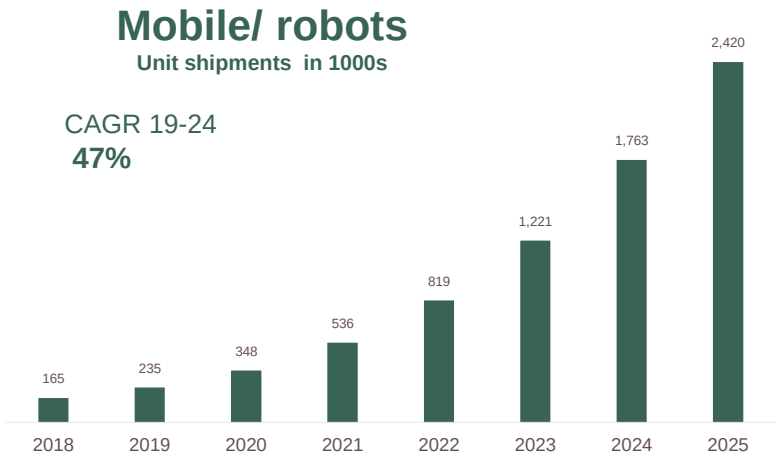
Connectivity enabling AI, real time monitoring and IoT

Connectivity enabling AI and IoT

Market outlook







Source: ABI Research 2020

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Typical application power & voltage






Operating voltage

36-48 V

AGV & AMR

Cobot

12-24 V

Lawn mower robot

Vaccum robot

5W 10W 20w 30W 50W 100W 250W 500W 1kw 3kw

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Quiz Time!

Which of these robots is not service robot?

A. Collaborative robots (Cobots)

B. Personal/Domestic robots (vacuum&Mowing)

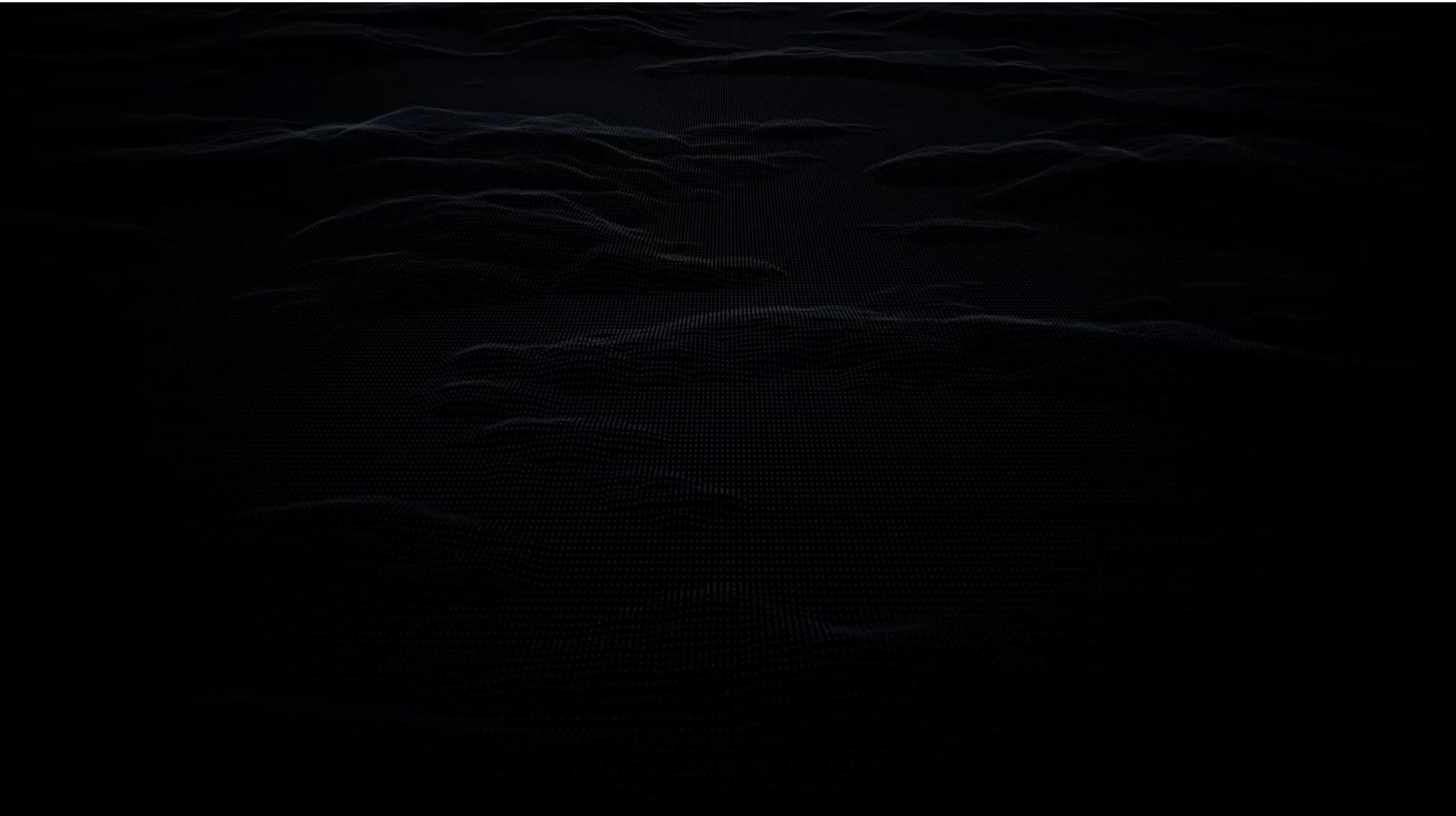
C. Industrial robots (SCARA, Parallel, Linear)

D. Mobile/Professional robots (Delivery&logistics)

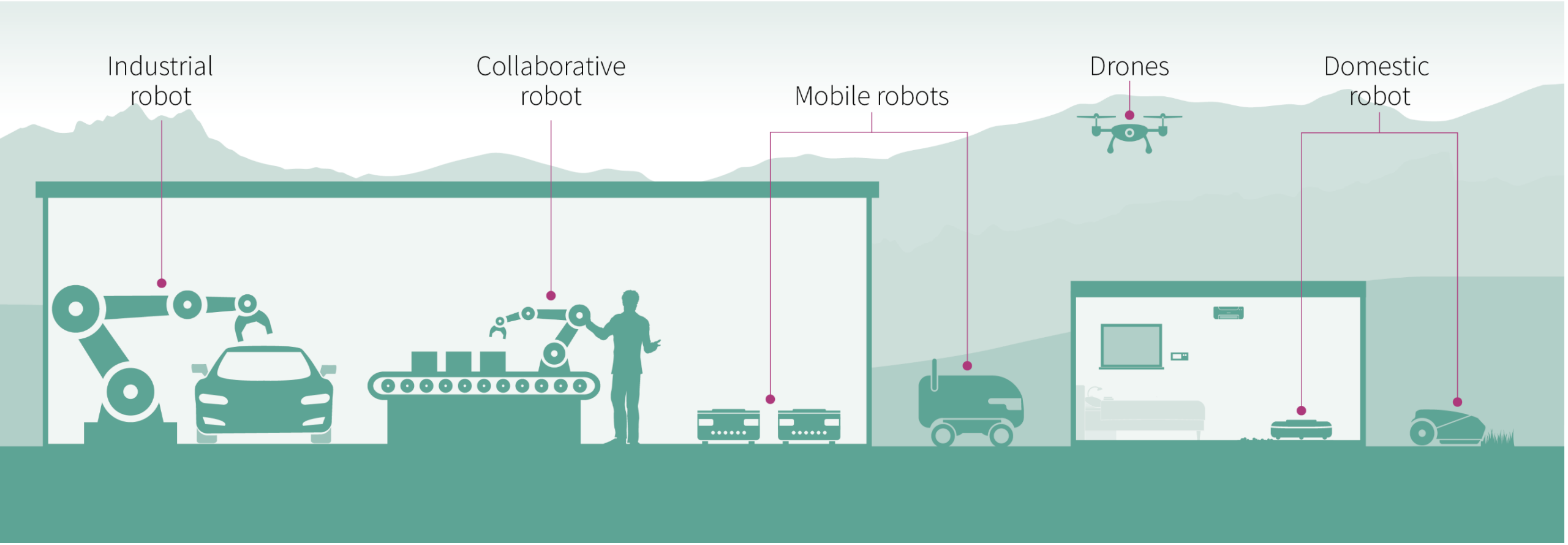
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Infineon’s Leading Solutions for Service Robots



Infineon provides products & solutions for various robotics applications, may it be for industrial or consumer



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Wide range of semiconductor solutions for service robots

Battery Charging

AC-DC Conversion
Microcontroller: *XMC™, PSoC 41 / PSoC 42*
Power MOSFETs: *OptiMOS™ & CoolMOS™*
Gate driver: *EiceDRIVER™*

Wireless Charging
Wireless charging IC
Authentication: *OPTIGA™ Trust CHARGE, OPTIGA™ Authenticate S*

Charging station position sensing
Hall switch, 3D magnetic sensor

Battery Management

Battery Management
Cell monitoring & balancing IC
Isolated transceiver IC
Microcontroller: *XMC™ 1404, 4500*
Current sensing: *TLI4971*

Protection MOSFET: *OptiMOS™*

Battery Authentication
OPTIGA™ Trust B, OPTIGA™ Authenticate S

Power Management

Voltage Conversion
LDO & Step-down Switching Regulator
Single & Dual MOSFETs: *OptiMOS™*
Power Management IC

Small signal Transistors
SIPMOS®

ESD Protection
Multi-purpose ESD diode



Motor Control

Power MOSFETs
Single: *OptiMOS™, StrongIRFET™*
Dual N: *OptiMOS™, HEXFET®*

Gate Driver
3-phase MOTIX™ & EiceDRIVER™:
6EDL7141, 6ED2742S01Q

Microcontroller
XMC™ 1404, 4200 / 4400
PSoC 41 / PSoC 42 / PSoC 45S

Integrated Solutions
MOTIX™ *IMD701A,* NovalithIC™, CIPOS™, iMOTION™

Position sensing
Hall latches, Angle sensors

Main & HMI Control

Microcontroller
XMC™ 4700 / 4800
XMC™ 7100 / 7200
PSoC 62 / PSoC 64 CapSense®

CAN transceiver
TLE6250GV33, TLE9251VLE

USB – Serial bridge
EZ-USB™

Memory
Ferroelectric RAM
Non-volatile SRAM
Quad-SPI NOR Flash

Navigation & HMI Sensing

Radar 24 / 60GHz for
Obstacles detection
Gesture detection
Materials differentiation
Speed over ground

3D IR ToF sensor for
Objects recognition
Obstacles avoidance
Navigation & tracking

MEMS microphone for
Sound detection / HMI
Objects detection & tracking

Air pressure sensor for
Height and touch sensing

3D magnetic sensor for
HMI joystick, jog-wheels, collision detection

Hall latch / switch for
Collision detection

Connectivity & Security

Wi-Fi & Bluetooth / BLE
CYW43438
CYW43907 / CYW54907
CYBT-343052 / CYBT-423054
CYBLE-416045

Embedded-SIM Connectivity
OPTIGA™ Connect IoT

Security
OPTIGA™ Trust X & Trust M

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With our wide product portfolio we can act as one-stop-shop solution provider for Robotics & Drones applications

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Charger & SMPS

MOSFET & HEMT
- CoolMOS™
- OptiMOS™
- CoolSiC™
- CoolGaN™

Gate Driver & Integrated Power
- EiceDRIVER™
- CoolSET™
- CoolGaN™ IPS
- USB-PD

Wireless charging

Battery management (BMS)

MCU
- XMC™
- PsoC™

Memory
- NOR Flash
- EXCELON™ F-RAM

BMS IC
- TLE9012 & TLE9015

MOSFET & Gate driver
- OptiMOS™
- StrongIRFET™
- HEXFET®
- Small signal
- EiceDRIVER™

Sensing
- Current sensor

Power

Management & Others
- Power management IC
- DC-DC converters & LDO
- Integrated Point-of-Load (IPoL)
- Isolation interface ISOFACE™
- ESD protection
- Small signal transistors

Main & HMI Control

Microcontroller & Others
- XMC1000, 4000, 7000
- PSoC™ 4 & 6
- AURIX™
- TRAVEO II
- EZ-USB™ serial bridges
- EZ-PD™ USB-C & PD controllers
- CAN transceivers

Capacitive Sensing
- CAPSENSE™:
  - PSoC™ 4000 entry-level
  - PSoC™ 4100 more touch buttons
  - PSoC™ 4700 inductive & capacitive sensing

Memory
- NOR Flash: SEMPER™, SEMPER™ Secure HYPERFLASH™
- Datalogging RAM: EXCELON™ F-RAM, nvSRAM
- Expansion RAM: HYPERRAM™, SRAM

Motor control

Controller
- XMC1000 & 4000
- PSoC™4 & 6
- AURIX
- TRAVEO II
- iMotion

Memory
- NOR Flash
- Datalogging RAM: F-RAM, nvSRAM, MoBL™ SRAM

Sensing
- Position sensor
- Speed sensor
- Current sensor

Gate driver
- EiceDRIVER™
- MOTIX™

MOSFET & HEMT
- OptiMOS™
- StrongIRFET™
- HEXFET®
- CoolMOS™
- CoolSiC™
- CoolGaN™

Others
- IPMs
- DC-DC converters
- Voltage regulator / LDO

Sensors

Sensing
- Angle & 3D magnetic sensors
- Radar
- 3D Time-of-Flight (ToF)
- Pressure sensor
- CO2 Sensor
- MEMS microphones
- 3D Ultrasonic

Connectivity

Wi-Fi
- AIROC™ Wi-Fi Combos

Bluetooth
- AIROC™ Bluetooth & Bluetooth Low Energy

eSIM
- OPTIGA™ Connect IoT

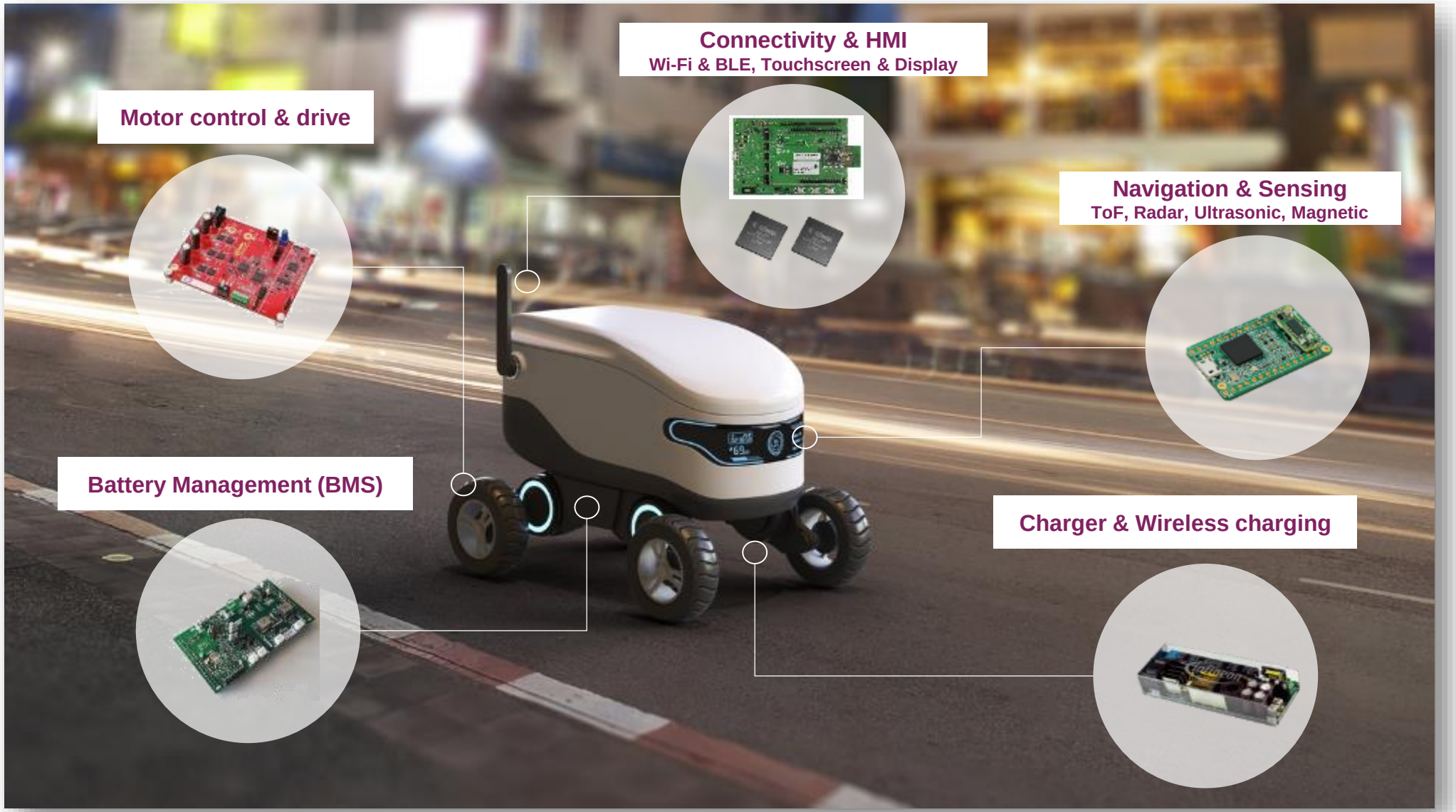
Security

Security IC
- OPTIGA™ Authenticate S
- OPTIGA™ Trust Charge
- OPTIGA™ Trust M

Secure Memory
- NOR Flash: SEMPER™ Secure

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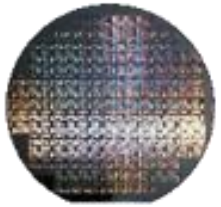
Infineon's portfolio of products and demo boards enable fast, easy and efficient designs across various functional blocks



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Infineon Power Discretes **MOSFET** Philosophy

Wafer Technologies



GaN / SiC

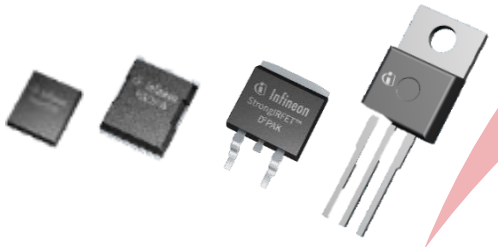
MOSFET application optimized technologies

(e.g. SMPS, Drives)

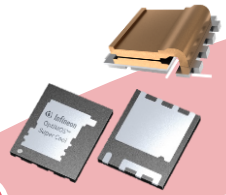
Latest MOSFET technologies

(OptiMOS™ 5 & 6, StrongIRFET™ 2)

MOSFET Standard
(StrongIRFET, OptiMOS™ 3)

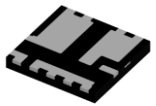


Packaging Standard (5x6, TOLL, D2PAK, etc..)



Packaging Enhancement

- Source Down 5x6 and 3.3x3.3
- TOLX
- DSC



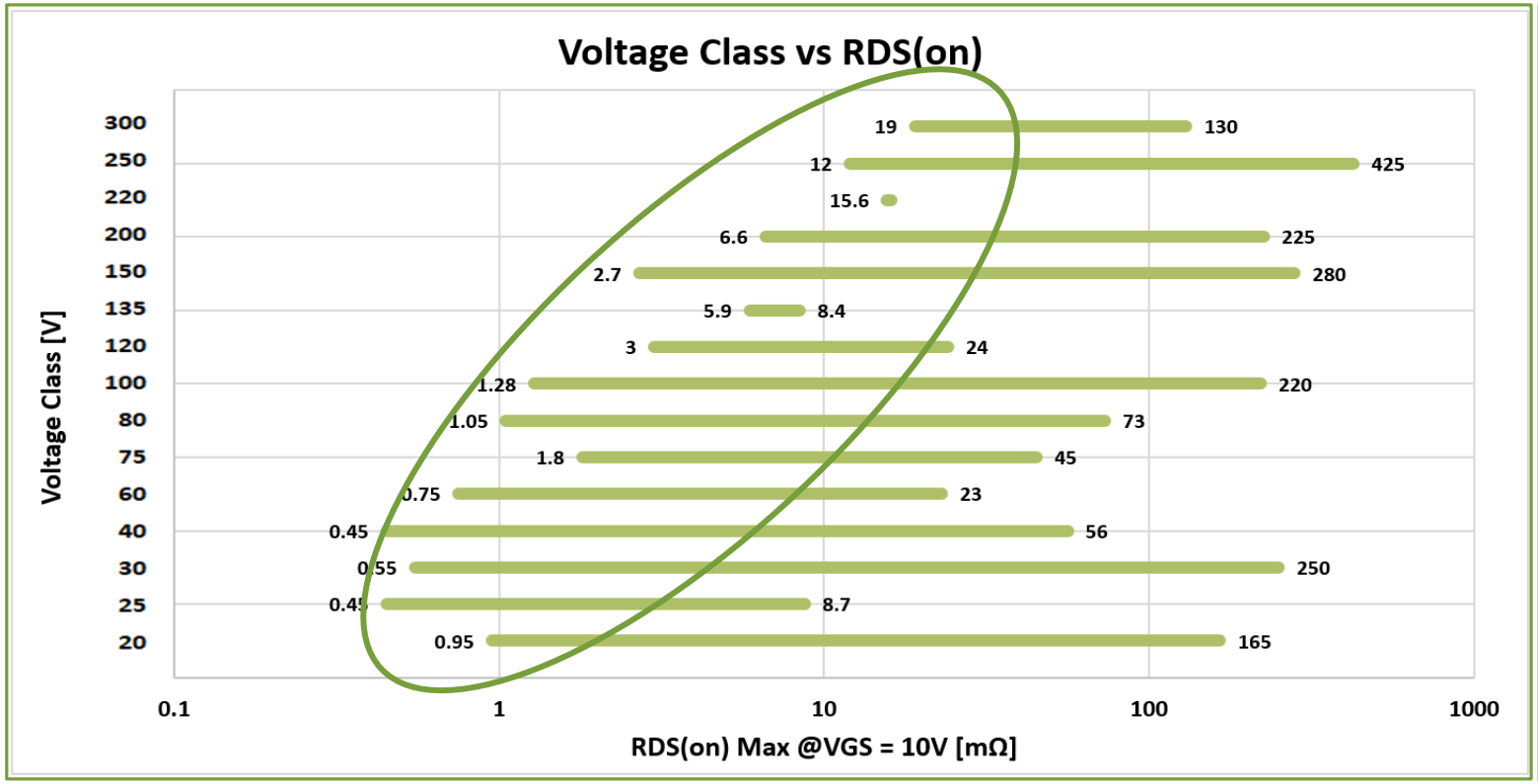
Half Bridge 6x6.3

Packaging Innovation/Integration

Packaging

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Infineon Power Discretes **MOSFET** Value Proposition



Value proposition

- Infineon leads the industry with respect to breath of portfolio
- Infineon offers both best in-class silicon technology including our latest 100 V **OptiMOS™ 6**, and drive optimized devices which includes the new 80-100 V **StrongIRFET™ 2** devices
- Infineon has a broad range of high performance power packages to suit the majority of our customer needs
  - The newest packages include **sTOLL, TOLG, TOLT, SuperSO8 DSC, and PQFN 3.3x3.3 Source Down**

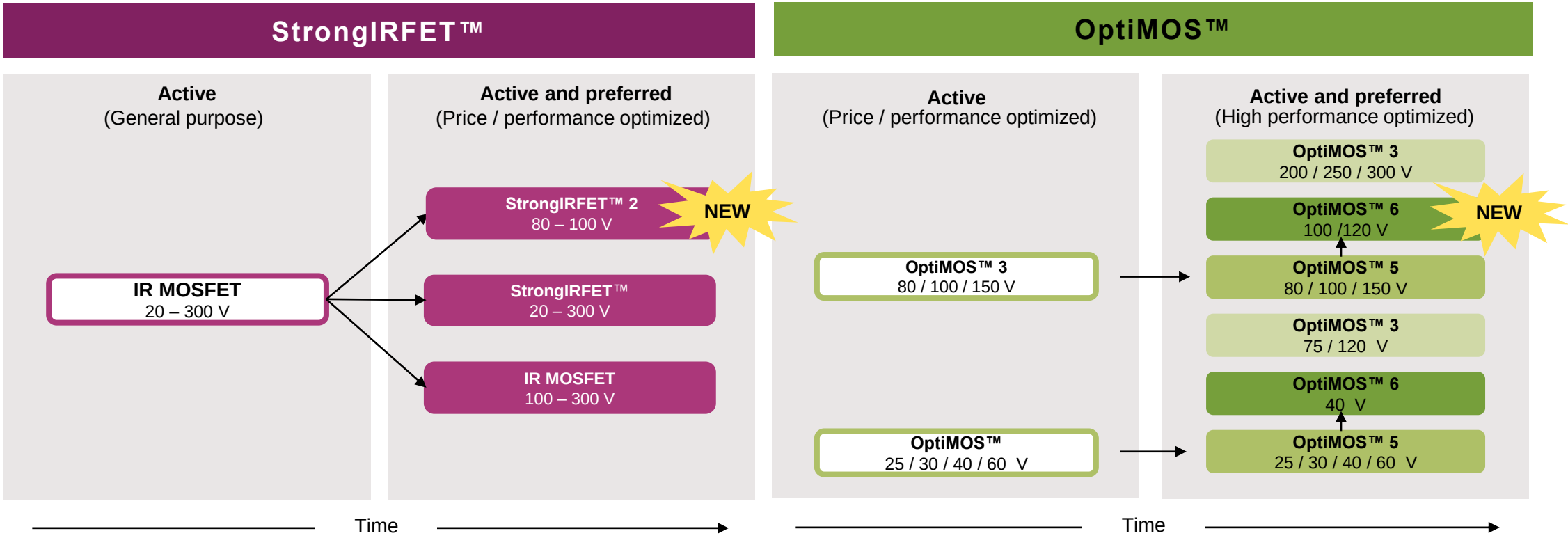


Usage trending up | **New package types**

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Infineon Power Discretes **MOSFET** Product Family

StrongIRFET™ and OptiMOS™



StrongIRFET™

Robust and excellent price/performance ratio

Right fit products for a broad range of application

Easy of design and flexible use

OptiMOS™

Best-in-class technology

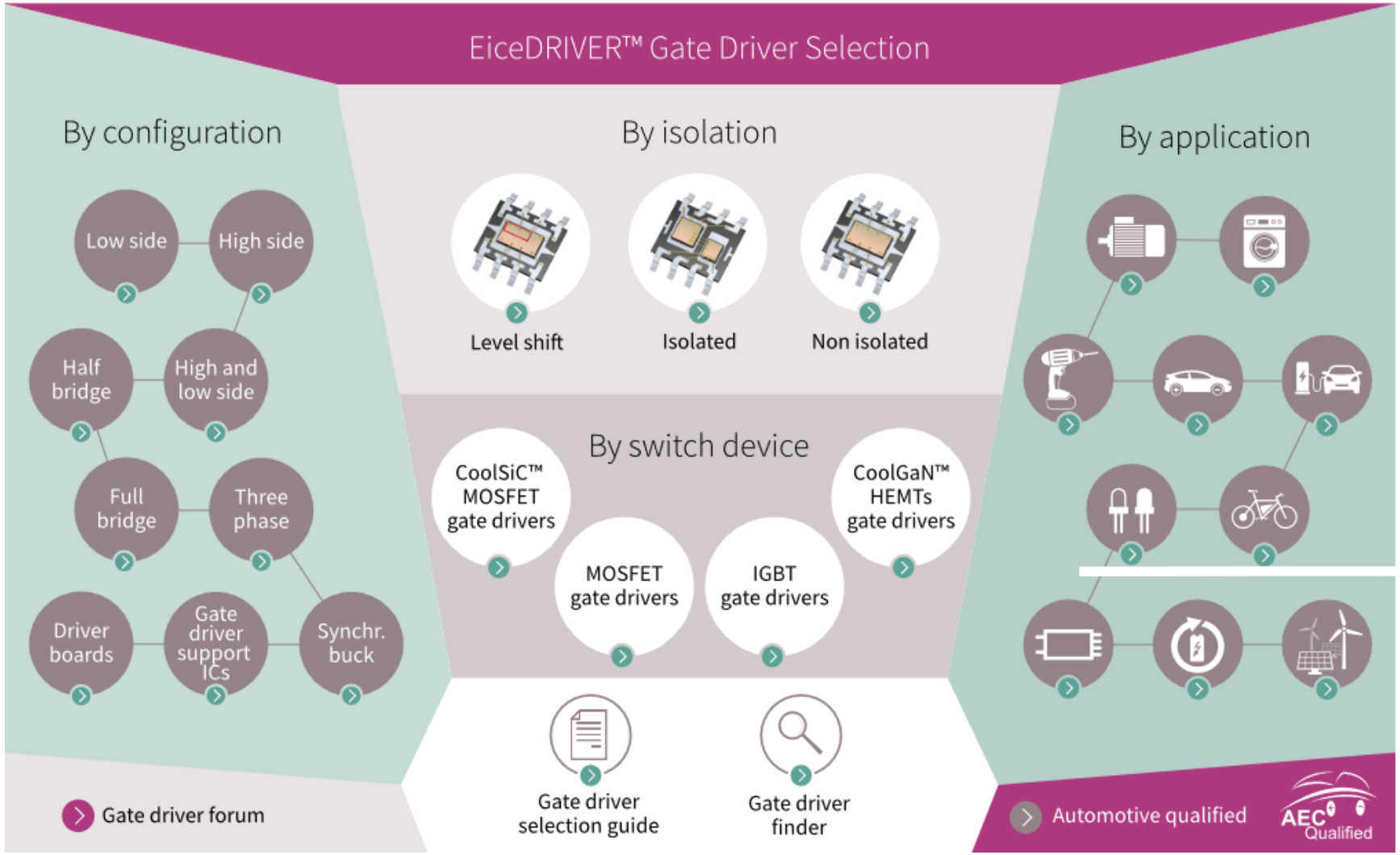
Designed for high performance applications

Industry‘s best figure of merit

High efficiency, power density and current capability

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



Please visit www.infineon.com/gatedriver for entire gate-driver IC portfolio

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MOTIX™ 3-phase motor control gate driver IC for battery supplied BLDC motor controllers

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6EDL7141 spec overview:

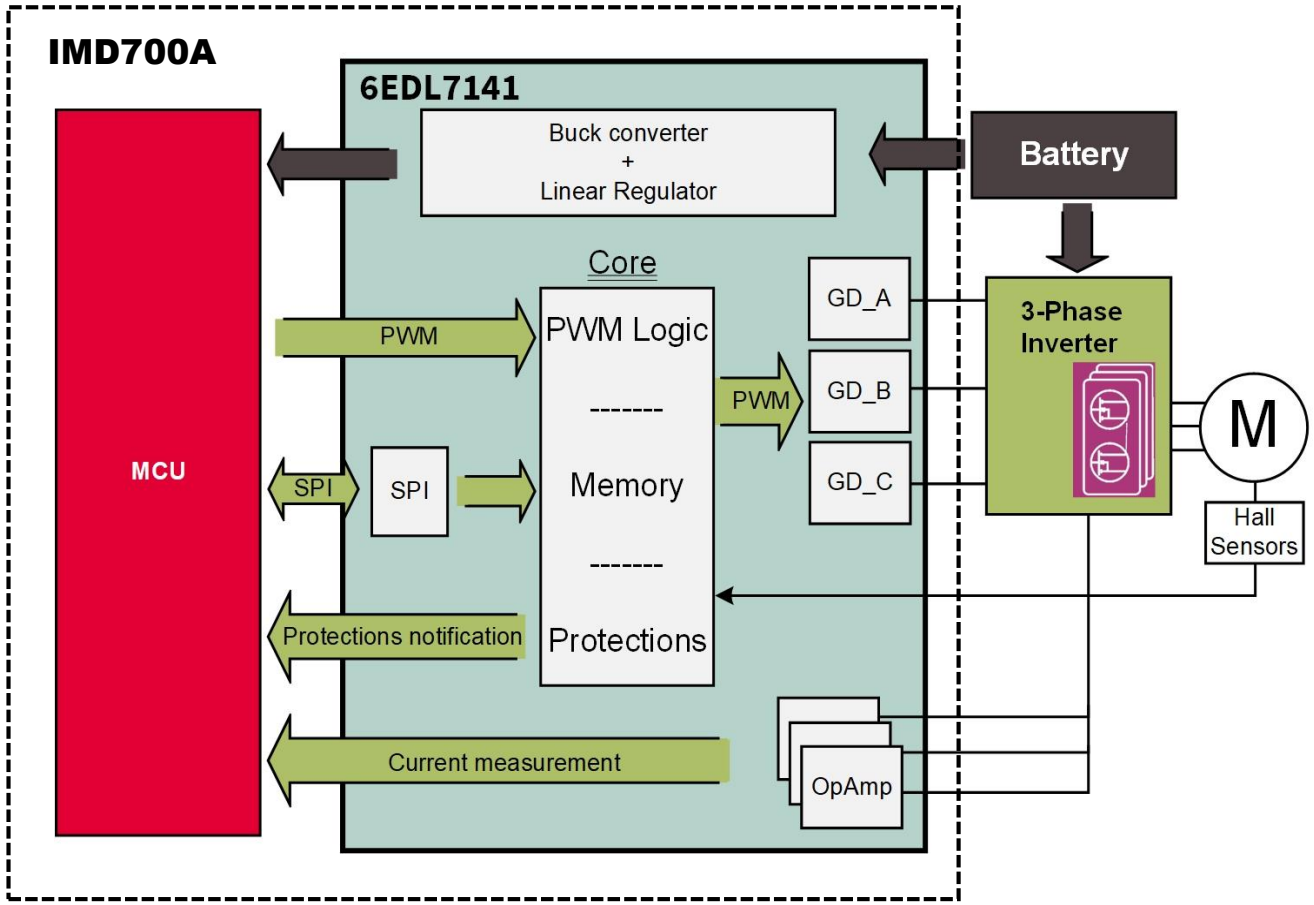
- Operating voltage: **5.5V – 60V**
- LDO **(5V or 3.3V)up to 300mA**, Buck converter up to 600mA (including internal supply)
- OpAmps for shunt or Rdson sensing
- Package options: PG-VQFN-48 (7x7 mm^2)

Integrated modules IMD700A:

- XMC1404 + 6EDL7141 in PG-VQFN-64 9x9 mm^2 package

Common features:

- Multiple integrated protections (braking mode, rotor lock, Hall comparator logic, etc)
- 3 current sense amplifier with adjustable gain and offset
- **Over 50** configurable parameters
  - Buck converter and LDO outputs
  - Inverter slew rate, dead time
  - PWM and motor braking modes
- Communicate with MCU via SPI interface
- Configuration easily done through Infineon GUI tool



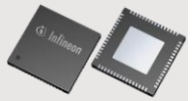




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IMD701A v.s. 6EDL7141

IMD701A 3-phase Motor Drive Controller

Description	Package
Integrated dual die controller • **XMC1400: Cortex M0+Math (Cordic+DIV) core** • 3 phase 60V smart 6EDL7141 driver	PG-VQFN-64 (9x9) 

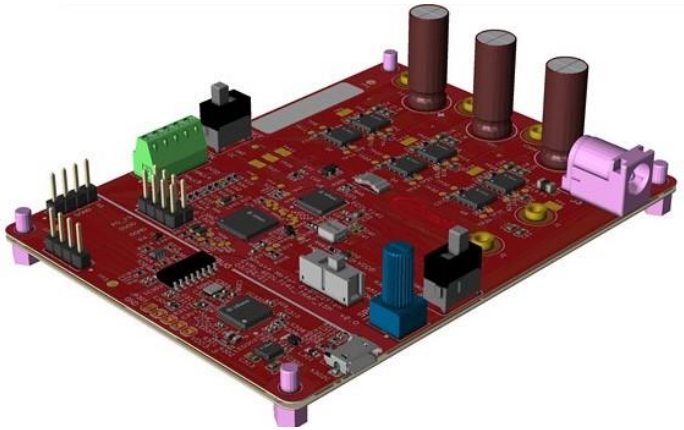
6EDL7141 3-phase smart gate driver

Typical Applications	Package
• Power tools • Gardening tools • **Robotics** • eBikes • LEVs • **Drones**	PG-VQFN-48 (7x7) 

EVAL_6EDL7141_TRAP_1SH

BC 1 shunt 18V battery board

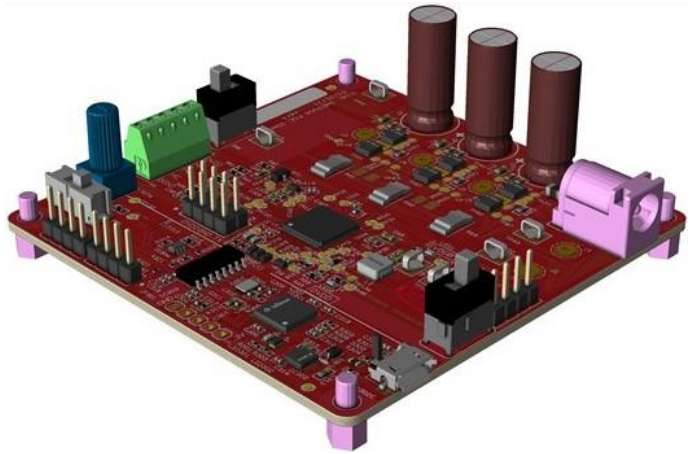
- 40V 0.7mΩ OptiMOS6 PQFN
- XMC1404 MCU



EVAL_IMD700A_FOC_3SH

(XMC1404 MCU + 6EDL7141)
FOC 3 shunt 18V battery board

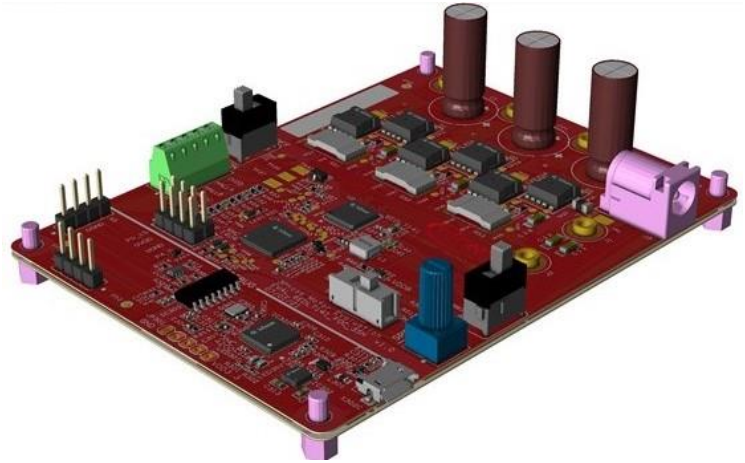
- 40V 1.5mΩ OptiMOS5 PQFN



EVAL_6EDL7141_FOC_3SH

FOC 3 shunt 36V battery board

- 60V OptiMOS5 PQFN
- XMC1404 MCU



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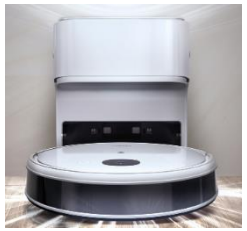
Market proven solution for FOC motor control in **Domestic Robots**

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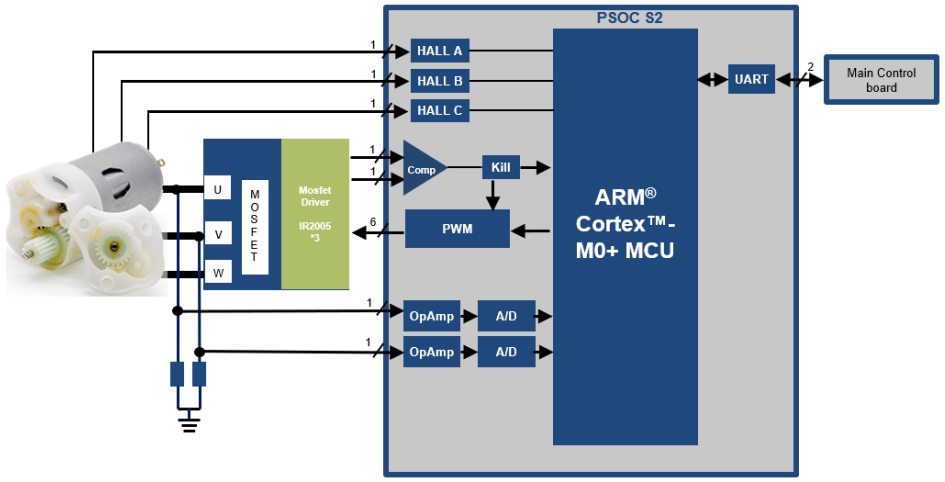
Project description

- One-chip MCU solution to control BLDC motor
- MCU integrated OPAMPs, comparators, IDACs, and a 12-bit 1-Msps ADC
- Combines system control and motor control into one chip
- Support speed adjusting
- Support system protection functions
- Good EMC(4kV) / ESD (Contact 15kV) performance

Block Diagram







Success Factors

Benefits of using this solution

- Low voltage FOC motor control
- Low noise & Strong torque
- High efficiency FOC motor control algorithm to keep device low operation temperature
- Pass 17kV ESD contact discharge with ESD device
- PSOC4 integrates OpAmp & Comparator to keep small PCB size and lower external component
- MOSFETlow on-resistance to keep low operation temperature
- Strong Local support

Function	Part number	QTY
Controller	CY8C4146AZI-S423	1
Driver	IRS2005SPBF	3
MOSFET	BSC097N06NS	6

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Market proven solution for motor control and main control in **Collaborative Robots**

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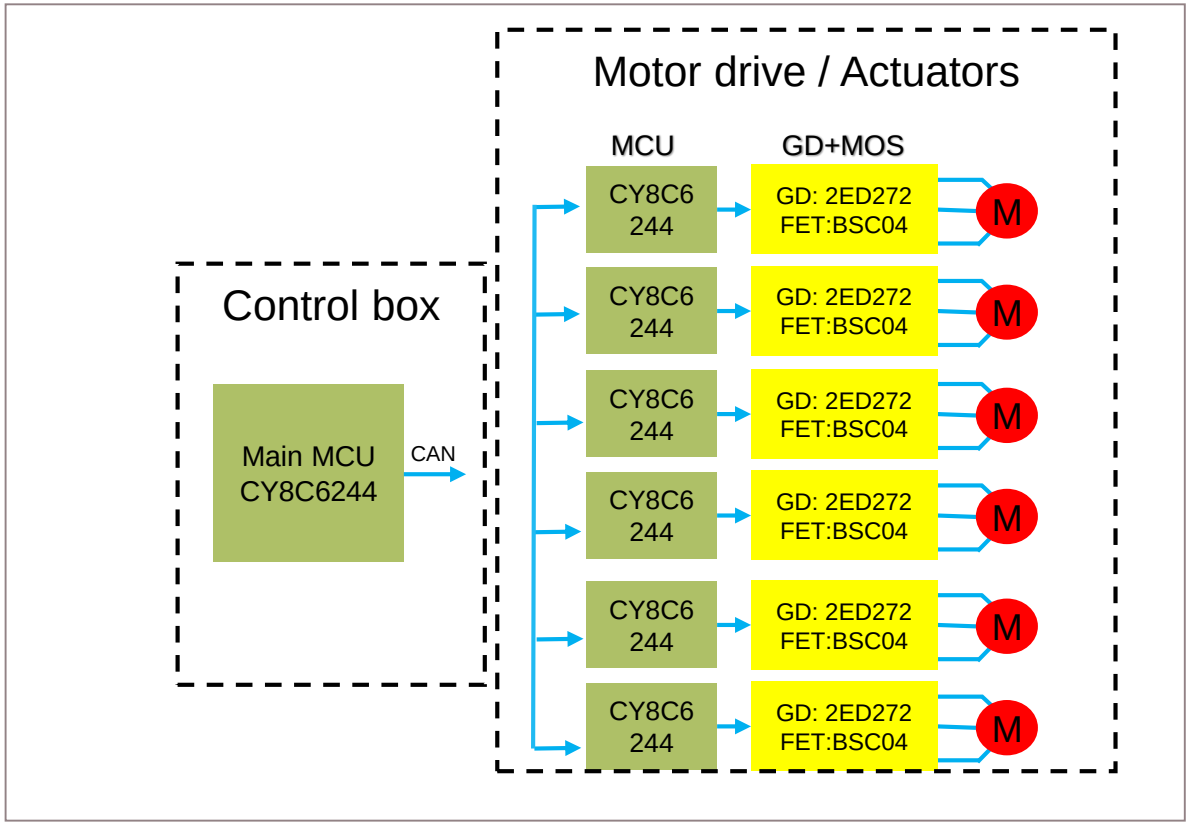
Design Requirements

- >150MHz, Cortex M4 core is must
- CAN FD integrated
- 12-bit ADC
- Supports quadrature and incremental encoders
- High efficiency & power density
- High accuracy & repeatability,

Value proposition

- High integrated with abundant analog features: 12bit ADC/DAC and OPAMP
- CAN FD supported
- CapSense features (Can be used in its consumer product)
- M0+/M4 dual core Architecture enable the SoC performance
- XIP interface for flash expansion
- Security function with M0+/M4 dual core architecture
- Infineon leading MOSFET technology provide high efficiency power solution in limited space inside joint module

Block Diagram



Function	Part number	QTY
Controller	CY8C6244LQI-S4D92	7
Driver	2ED2742, 2ED2183s	18
MOSFET	BSC047N08NS3 / IPTG011N08NM5	36

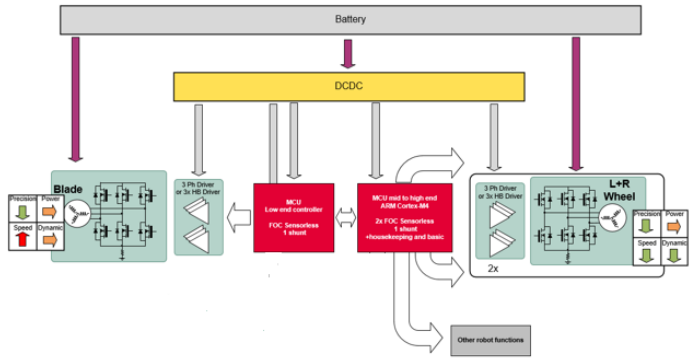
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Market proven system solution for **Mobile Robots**



- Application: **Mobile Robot**
- Delivery Robots Industry Park & Business Development Zone

Block Diagram



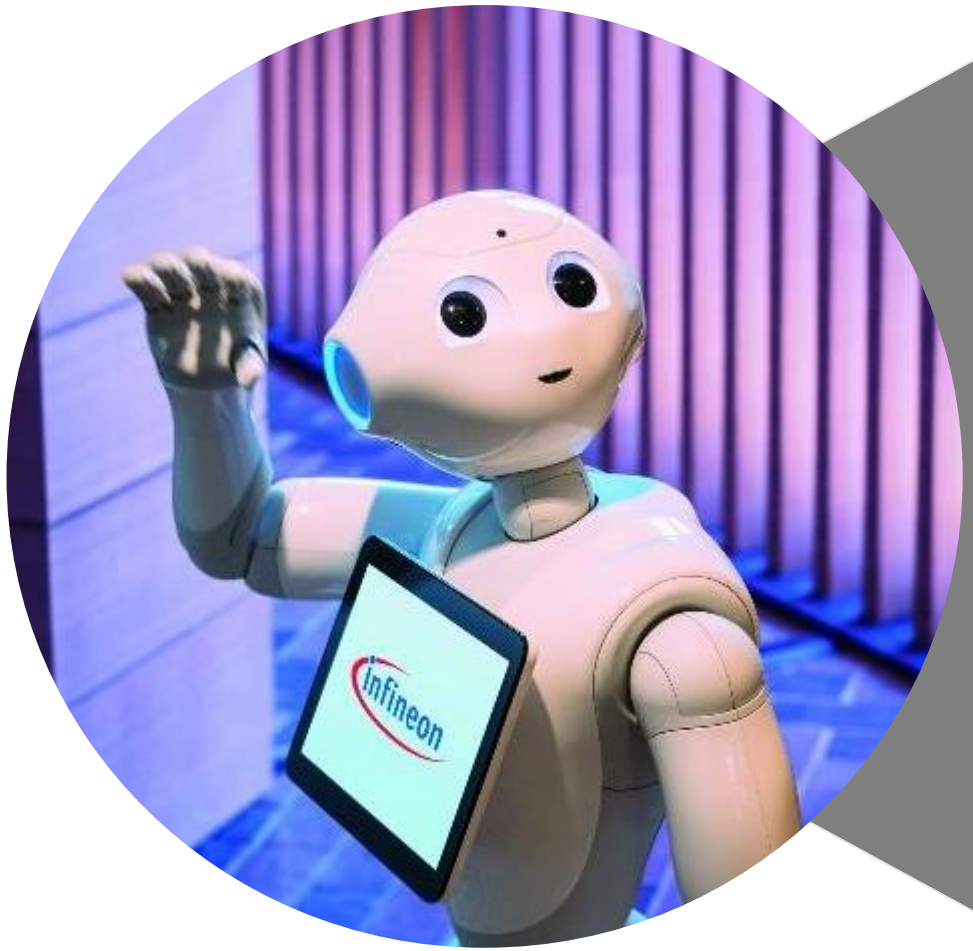
Value propoposition

- Single point of interface and product match offering for whole system
- Infineon leading MOSFET technology provide high efficiency power solution in limited space inside joint module
- Precise, safe and secure navigation through ToF Sensor solutions
- PSoC™ offering industry proven solution for stable and secure connectivity

Function	Device	Part number	Pcs
Motor Drive Board	MOSFET	BSC039N06N	14
	Driver	IRS2005STRPBF	6
	CAN	TLE6250GV33X	2
Power Management	DCDC	TLF51801ELVX	2
	DCDC	TLE8366EVX	2
	MOS	BSC065N06LS5	4
Body Control	Door Switch	ITS5215L	4
	Light Switch	ITS4090Q-EP-D	2
	IOT Security	SLS32AIA010MH	1
Main Board	Wifi6	CYW55572	1
Sensor	ToF	IRS2381	1

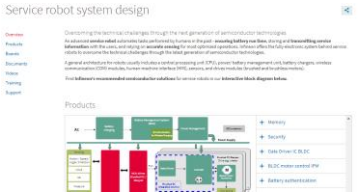
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In need for support or more information?



Link to download our **application brochure**

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Introduction to Robots
Training available: **link**

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