

Collaborative robots

Infineon solutions for cobots

public



Note:

This presentation is build into sections for easier navigation

1. Introduction to Cobots
2. Motor Control & Drive
3. Power Supply (SMPS)
4. Safety Control & Memory
5. Isolation Interface
6. Sensors (3D ToF, Radar, and others)
7. Connectivity
8. Security

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Infineon is a global leader in power systems and IoT



Global leader

in automotive, power management, energy efficiency technologies and IoT

~56,200

total employees[1]

[1]as of 30 September 2022

Market position

Automotive	Power	Microcontroller
		
#1	**#1**	**#5**
TechInsights, March 2023	Omdia, October 2022	Omdia, March 2023

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Infineon at a glance

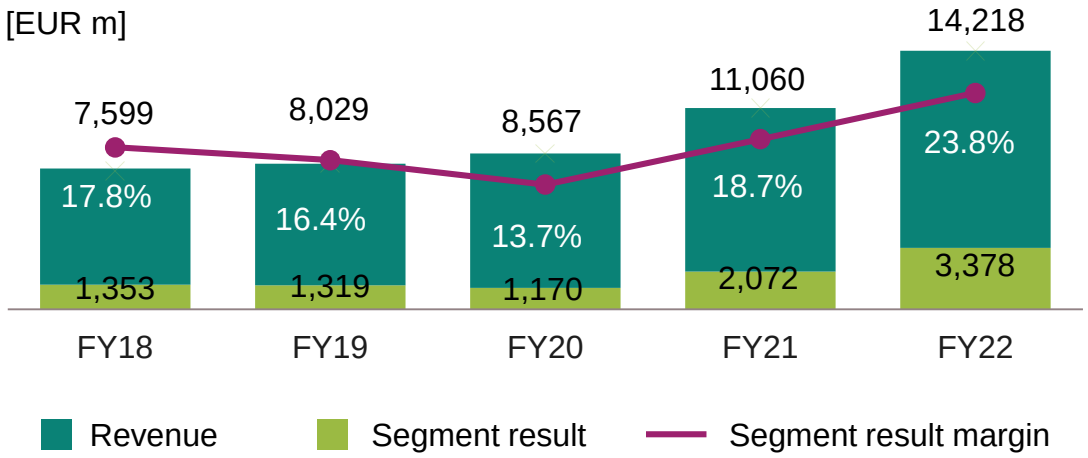
Long-term high-growth trends

Decarbonization

- CO_2 saving
- Energy efficiency
- Sustainability

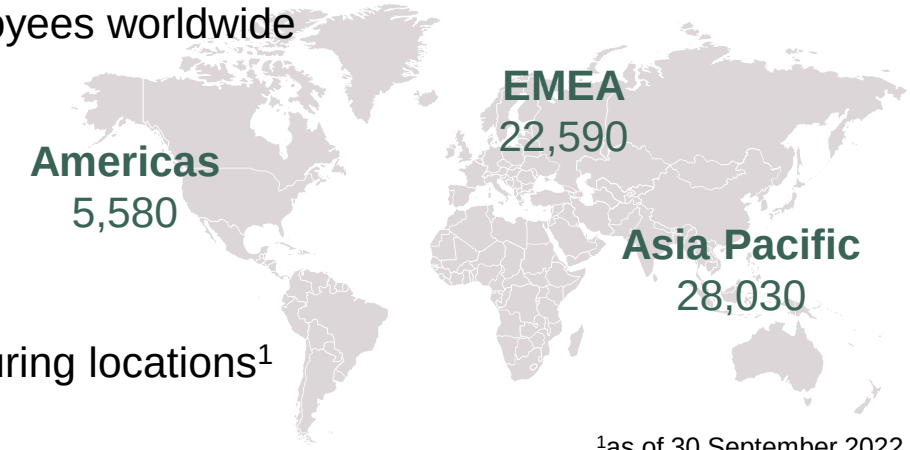
Digitalization

- Productivity
- Comfort
- New use cases



Employees[1]

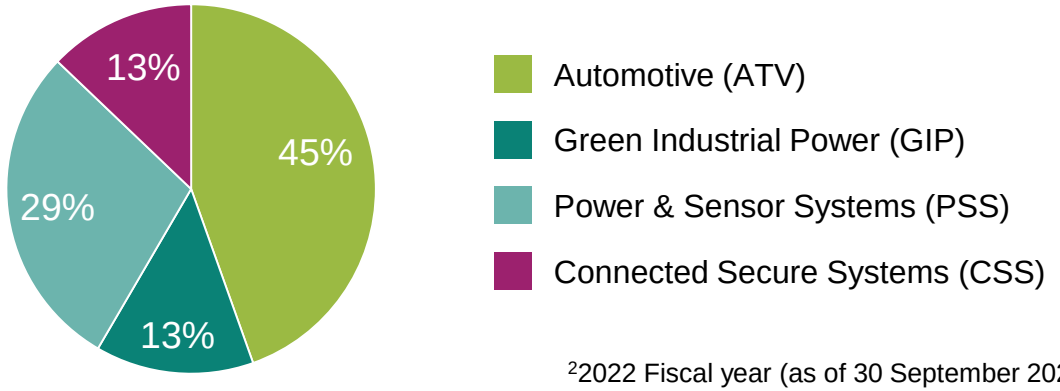
56,200 employees worldwide



59 R&D and
19 manufacturing locations[1]

[1]as of 30 September 2022

Business segments revenue[2]



[2]2022 Fiscal year (as of 30 September 2022)

For further information: Infineon Annual Report 2022.

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Broadest and market leading product portfolio









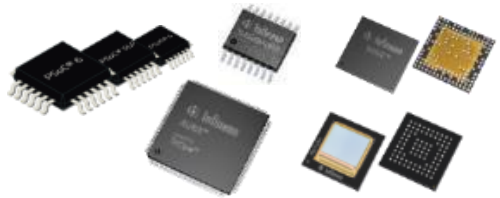
Energy efficiency

Dependable power supply	Dependable networks

- MOSFETs, IGBTs, GaNs
- Integrated power stages
- Gate driver ICs
- Power supply ICs
- Transceivers
- USB bridges & controllers

- Microcontrollers
- Radar ICs
- RF switches
- GPS / GLONASS / COMPASS LNA





Safety

Advanced driver assistance	Intuitive sensing	Individual convenience

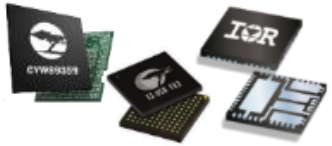
- Magnetic, Capacitive & Pressure sensors
- MEMS microphones
- Image / 3D ToF camera
- ESD and surge protection



Connectivity

Audio	Bluetooth Wi-Fi 5G

- Audio amplifier ICs
- Wi-Fi + Bluetooth
- Cellular eSIM



Security

Data integrity	Privacy

- F-RAM, SRAM, NOR-Flash
- Security (V2X, access, payment, etc.)
- SIM cards for mobile communication
- IoT security for authentication, secured communication etc.



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Collaborative Robots (Cobots)

Introduction

On a high level robots can be categorized in…

Industrial Robot

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 robots

- **Vacuum cleaner Robots**



- **Lawn mower Robots**



- **Edutainment and toy/hobby Robots**



- **Companion Robots**

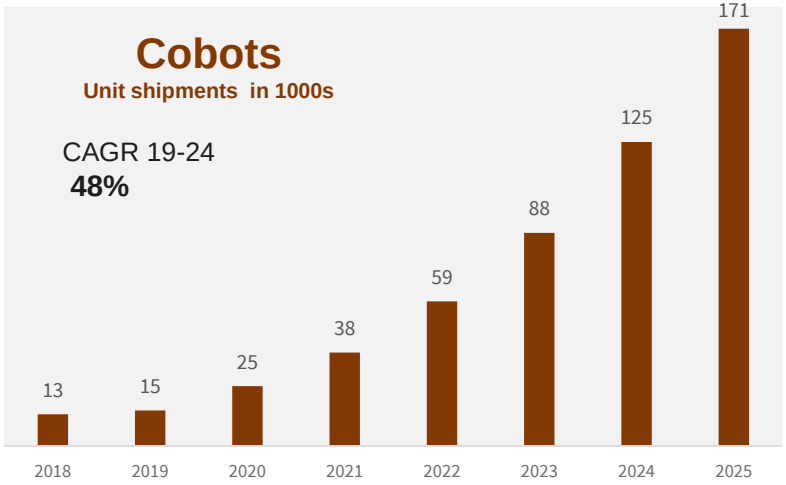


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Service robot market outlook

Collaborative

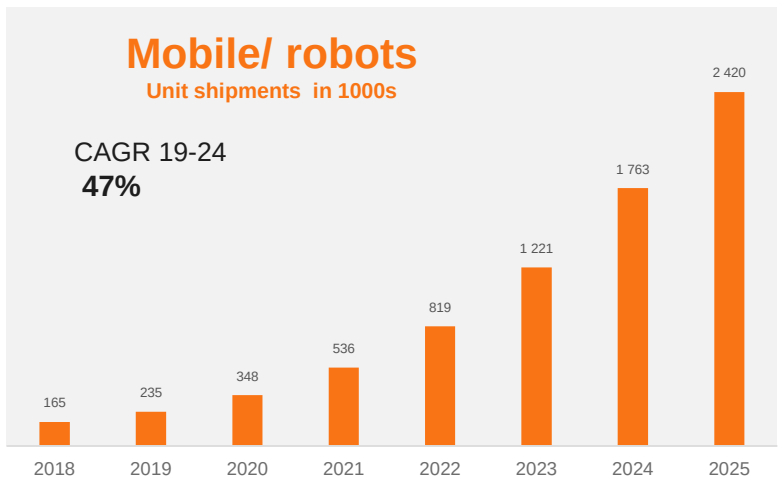




Source: ABI Research 2020

Mobile Robots

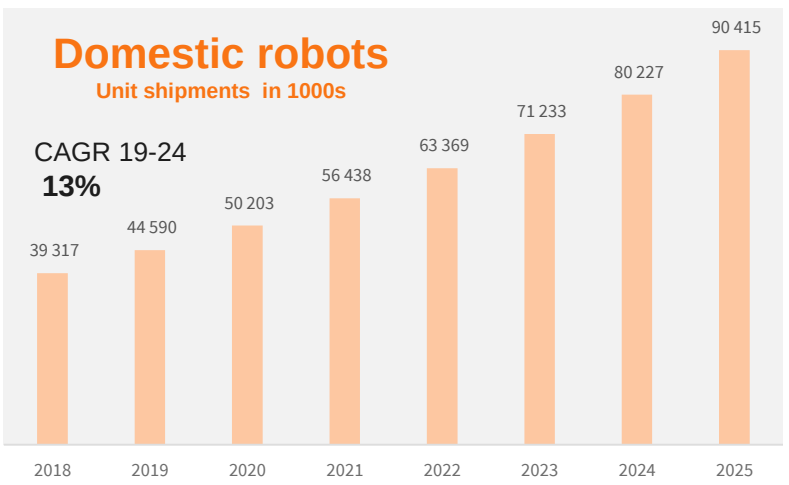




Source: ABI Research 2020

Domestic





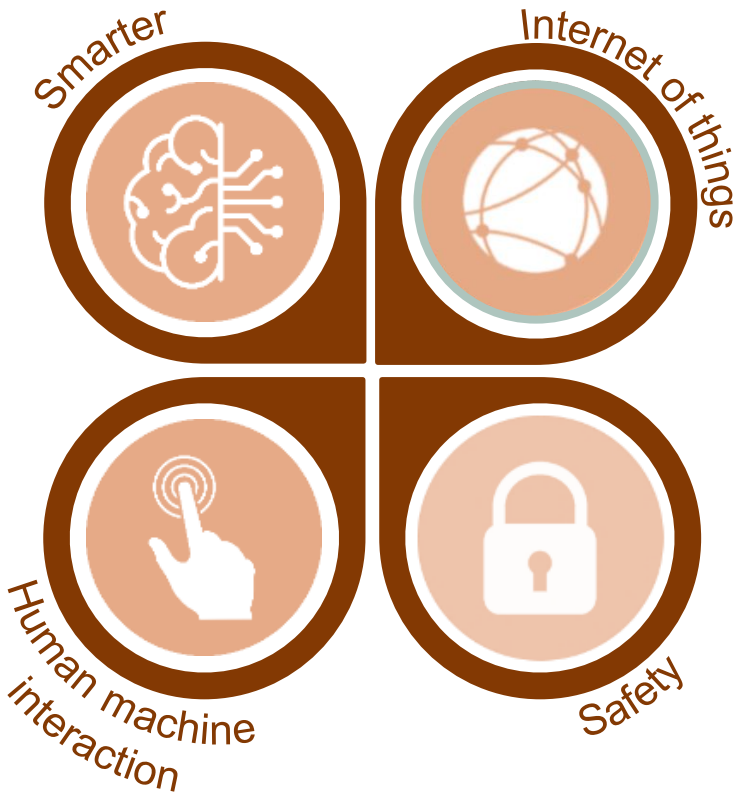
Source: ABI Research 2020

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Main trends and challenges

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.

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Collaborative Robot (Cobot) versus Industrial Robot



Cobot



Industrial Robot

Installation	Flexible deployment	Fixed installation
Programmability	Simple and flexible by “learning” the cobot for the desired movement path	Fixed repeated tasks, time consuming to change tasks
Workspace	Alongside with humans	Separated by fence
Common payload	3-20 kg	30 – 1000 kg
Power	100 – 500 W	0.5 – 5 kW
Power supply	48 V DC	100 – 400 V (1-3 phase)
Safety regulations	Strict (ISO TS 15066)	Less strict (ISO 10218)

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Infineon’s wide array of offerings for Cobots

Power Supply & Management

Enabling efficient, ease of use and price optimized AC-DC conversion solutions and end-to-end application expertise for voltage conversion & power distribution

Safety Control & HMI

PSoC™ 4, PSoC™ 6 & XMC™ MCUs
Industry-leading microcontrollers for central & safety system functions, HMI and comprehensive device control



Motor Control

Extensive motor control solutions
Broad selection of leading semiconductor products to address application requirements for secure motor-control solutions that offer unparalleled performance & safety

Security

OPTIGA™ Trust and Authenticate family of security solutions is designed for easy integration into embedded systems to protect the confidentiality, integrity and authenticity of information and devices

Connectivity

Wi-Fi & BT/BLE combo connectivity
Widely deployed Wi-Fi and Bluetooth combo ICs and modules that offer the industry’s best interoperability and RF performance

Memory

- Leader in high-performance, high-quality, and high-reliability volatile & non-volatile RAM & NOR Flash solutions
- Broadest NOR Flash portfolio in the industry

Sensing

Market leader in radar chips, offering a wide portfolio of mmWave radar sensors, 3D time-of-flight (ToF) solutions and other environmental sensors like pressure, sound, magnetic, and CO2 sensors.

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Enable the most efficient, power dense and smart Cobot system solution



Motor Drive

Efficient
- lower losses
- less heat dissipation
- power savings

→ *Operational Cost savings*

Power dense
- space reduction
- material savings

→ *System cost savings & space savings*

Sensors

- ✓ Highest safety by XENSIV™ 3D environmental scanning maximizes the safety in co-operation with humans
- ✓ Less down-time due to smart robot & human cooperation

Security

- ✓ Secure robot operation/authentication and IP protection
- ✓ Encryption on-the-wire/-air for safeguarded software updates

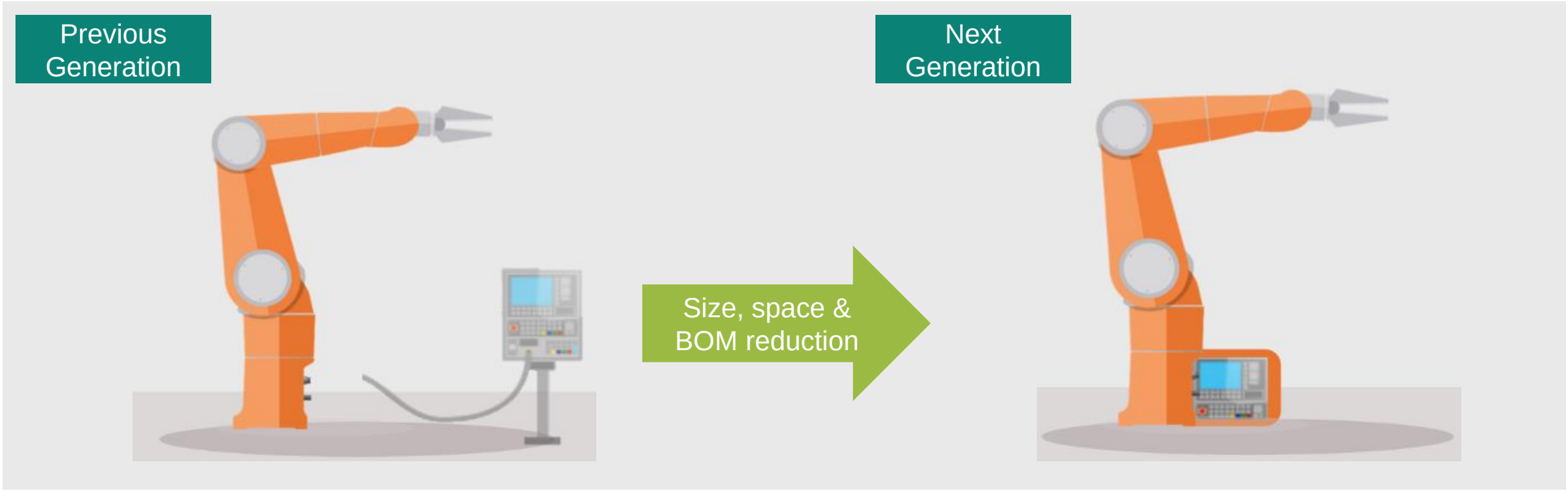
Power Supply SMPS

Get rid of the external control box
Infineon enables the best possible power density in order to assemble the control box in the “foot” of the robot

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Cobots trending towards higher power density

From centralized inverter to de-centralized inverter → inverter power density increases, needs to perform better thermally



Right fit for Wide Band Gap (WBG) Inverter (e.g. GaN HEMT):

- Smaller inverter, lower losses, lower inverter temperature
- Plus: lower torque ripple → more accurate moves - value driver in robots

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Product offerings for Cobots

Power Supply / SMPS

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

Gate driver & Auxiliary supply
- EiceDriver™
- CoolSET™

Others
- Power management IC
- Voltage regulators
- ESD & Surge protection
- Small signal transistors

Safety control & HMI

Microcontroller & Others
- XMC™
- PSoC™
- AURIX™
- TRAVEO II
- EZ-USB™ & EZ-PD™ controllers

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

Isolation Interface
- ISOFACE™

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

Connectivity

Wi-Fi
- AIROC™ Wi-Fi Products
- AIROC™ Bluetooth LE & Bluetooth
- AIROC™ Wi-Fi & Combos

Bluetooth

Motor control

Controller
- XMC™
- PSoC™
- AURIX™
- TRAVEO II
- iMotion

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

Sensing
- Current sensor
- Magnetic position sensor (Hall switches, Angle sensor)

Gate driver
- EiceDRIVER™
- MOTIX™

MOSFET & HEMT
- OptiMOS™
- StrongIRFET™
- CoolGaN™
- Small signal

Others
- Linear voltage regulators
- DC-DC converters

Sensors

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

Security

Security IC
- OPTIGA™ Authenticate IoT
- OPTIGA™ Trust M

Secure memory
- NOR Flash SEMPER™ Secure

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Click on block of interest for detailed information (presentation mode only)

Infineon's wide array of semiconductor solutions for Cobots

SMPS & Charger

Transistor
CoolMOS™ & CoolSiC™ & CoolGaN™
OptiMOS™ & StrongIRFET™

Gate Driver & Auxiliary supply
EiceDRIVER™, CoolSET™

Microcontroller
XMC™, PSoC™

Safety Control & HMI

Microcontroller
XMC™ 4000 / multi-core 7000 & PSoC™ dual core 62 / 64
TRAVEO™ ASIL-B / SIL-2 & AURIX™ ASIL-D / SIL-3

Microcontroller
PSoC™ 4000 / 4100 capacitive sensing
PSoC™ 4700 inductive sensing

CAN transceiver up to 8 Mbps
TLE9251VLE, TLE9371VSJ

USB – Serial bridge
EZ-USB™

Memory
F-RAM, nvSRAM, standard & functional safety NOR Flash

Isolation IC
ISOFACE™ digital inputs & output switches



Sensing

Radar 24 / 60GHz for
Speed & motion detection

3D IR ToF sensor for
Objects recognition
Collision avoidance

MEMS microphone for
Sound & objects detection

Pressure sensor for
touch sensing

3D magnetic & Hall latch / switch for
Collision detection & position sensing

CO2 sensor for
Air quality measurement

Motor Control

Transistor inverter
OptiMOS™, StrongIRFET™, CoolGaN™

Gate Driver
MOTIX™, EiceDRIVER™

Micro Controller
XMC™, PSoC™
TRAVEO™ with up to ASIL-B / SIL-2
AURIX™ with up to ASIL-D / SIL-3

Magnetic Sensors
XENSIV™ Angle, Current & Hall latch

IP Protection

Encryption & Authentication
OPTIGA™ Trust M & TPM
OPTIGA™ Authenticate S

Cloud connectivity & IoT

Wi-Fi & Bluetooth / BLE
AIROC™ Wi-Fi Products
AIROC™ Bluetooth LE & Bluetooth
AIROC™ Wi-Fi & Bluetooth Combos

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Motor control

Saving costs & effort with efficient & compact motor drive solutions

Back to overview

Motor drive specifications in Collaborative Robots



Up to 7 motor drive systems per cobot arm	**48 VDC** motor system	**High precision FOC control**, using encoder or other sensors	Servo drive control with typically in **phase current sensing** (shunts or sensors)
3-phase gate driver with safety functions (e.g. safe disconnect)	**Best in class MOSFETs** (80 V / 100 V)	**Safety critical** (SIL2/3)	**Industrial communication** – Ethernet / EtherCAT

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Infineon offers the needed components to make state-of the art motor control solutions



Sensing – XENSIV™

Hall latch & switch

TLx496x Family

Angle sensor

TLE5501, TLE5014(D)
High resolution: TLE5009(D) & TLx5012B(D)

Current sensor

TLI4971

MOSFET



OptiMOS™, StrongIRFET™, CoolGaN™

Gate Driver



EiceDRIVER™

& many more packages

MCU



PSoC™ XMC™ TRAVEO™ II AURIX™

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Best fit MOSFET solution for motor drive designs



Infineon's market leading MOSFET portfolio enables…

… highest efficiency
- lower losses
- less heat dissipation
- power savings

… power density
- space reduction
- material savings
- compact design

which leads to

Operational Cost Savings

System cost savings & space savings

Recommended packages



PQFN 3x3



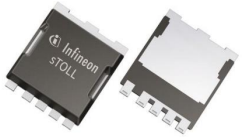
PQFN 3x3
Source Down



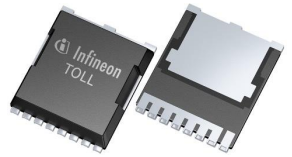
PQFN
5x6



PQFN 5x6
Dual side cooling



sTOLL 7x8



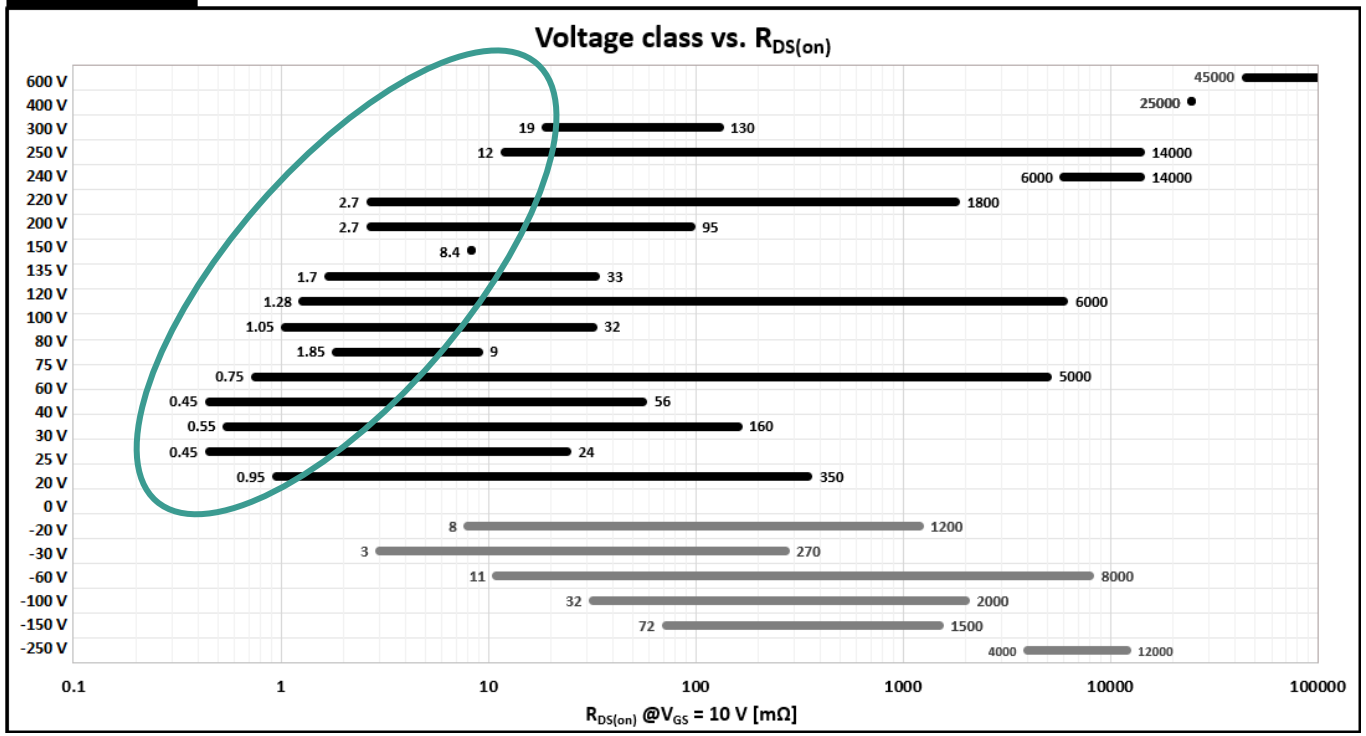
TOLL 10x11.7
+ Package innovations

250 W *500 W* *1000 W*

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Power discretes MOSFET value proposition

Portfolio



Infineon power MOSFET value proposition

Leads the industry with respect to breath of portfolio

Offers best in-class OptiMOS™, robust, price/performance optimized StrongIRFET™, P-channel, and Small Signal silicon technologies

Available in a broad range of high performance packages to suit the majority of our customer needs with the **SuperSO8** and **TO-Leadless** trending up

Newest packages include **sTOLL, TOLG, TOLT, SuperSO8 Dual-Side Cooling (DSC), and PQFN 3.3x3.3 Source Down (SD) to name a few**

Additional **best-in-class** high power density packages coming in CY2023, e.g. SuperSO8 Source-Down & Dual Side Cooling, Scalable Power Block, and PQFN 8x6 & Dual Side Cooling

Active & preferred

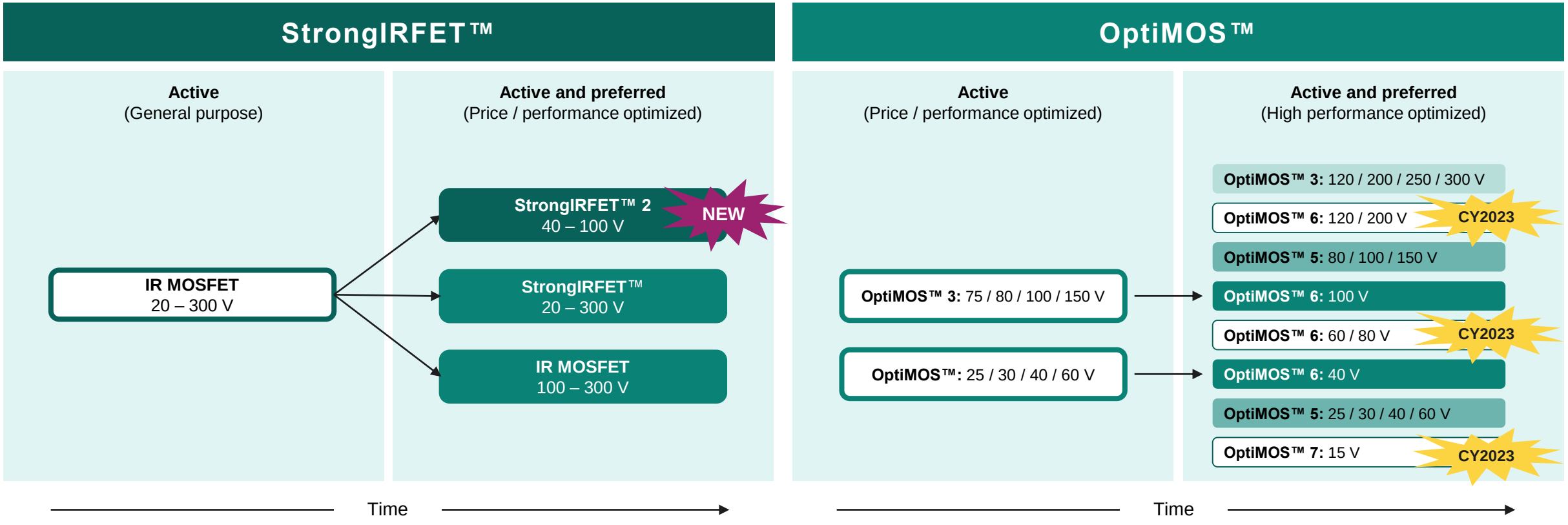
PQFN 2x2 4 mm²	PQFN 3.3x3.3 10.9 mm²	PQFN 3.3x3.3 Source-Down (SD) 10.9 mm²	PQFN 3.3x3.3 SD DSC 10.9 mm²	SuperSO8 31.7 mm²	SuperSO8 Dual-side Cooling (DSC) 31.7 mm²	SuperSO8 SD 31.7 mm²	SuperSO8 SD DSC 31.7 mm²	Scalable Power Block 37.8 mm²	DirectFET™ S/M/L 18.2-63.7 mm²	PQFN 8x6 + DSC 48 mm²	sTOLL 56 mm²	TOLL 115.8 mm²	TOLG 125.0 mm²	TOLT 153.5 mm²	D²PAK **153 mm²**	D²PAK 7pin 153 mm²
																

Usage trending up | **New package types** | **Upcoming packages**

Only SMD packages shown

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Infineon Silicon advancements



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 (FOM)

High efficiency, power density and current capability

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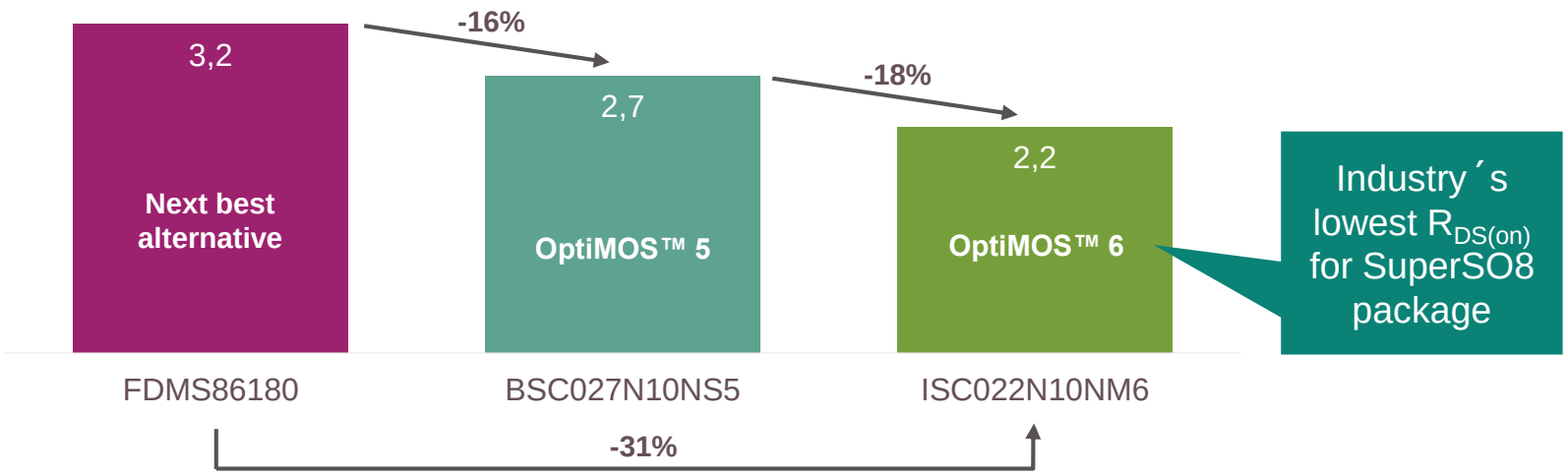
Why OptiMOS™ 6 is the perfect solution for your design?

Key features	Benefits	Value for the customer
18% lower $R_{DS(on)}$ compared to previous generation	› Low conduction losses	High power density
Significantly improved FOMs compared to OptiMOS™ 5: › FOM Q_G x $R_{DS(on)}$ = -30% › FOM Q_{GD} x $R_{DS(on)}$ = -40%	› Low switching losses	
Lower Qrr compared to previous generation	› Fast turn on and off	High efficiency
Optimized for high switching frequency application and synchronous rectification	› Less paralleling required	
MSL 1 classified according to J-STD-020	› RoHS conform, lead free	Superior thermal behaviour High system reliability

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Technology highlight
$R_{DS(on),max}$ @ V_{GS}=10 V [mΩ]





OptiMOS™ 6 in the SuperSO8 package achieves:

31% better ON-state-resistance compared to the **next best alternative**

and **18%** compared to **OptiMOS™ 5**

A low $R_{DS(on)}$ value such as in the new OptiMOS™ 6 products yields:

- increased power density
- up to ~30% reduction in conduction losses compared to next best alternative

***Source**: Comparison based on $R_{DS(on),max}$ @ V_{GS}=10 V available in the product datasheet published on the webpages.*

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OptiMOS™ 6 in 100 V
Setting the new industry standard!

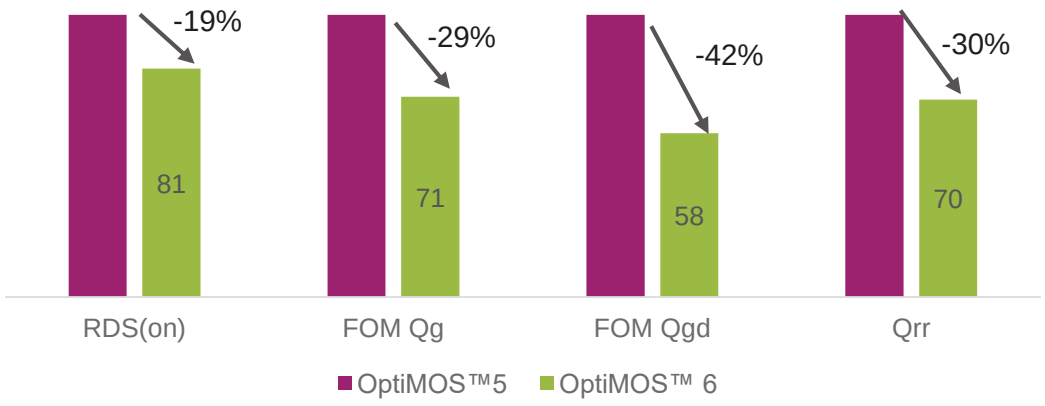


Telecom SMPS | SMPS | Solar | BMS | Power tools | Robotics | Multicopter

Value proposition

- OptiMOS™ 6 100 V represents the next generation of MOSFET performance for high power density designs
- It shows significant improvements in $R_{DS(on)}$, Q_{rr} and FOM compared to other alternatives in the market

OptiMOS™ 6 vs previous generation



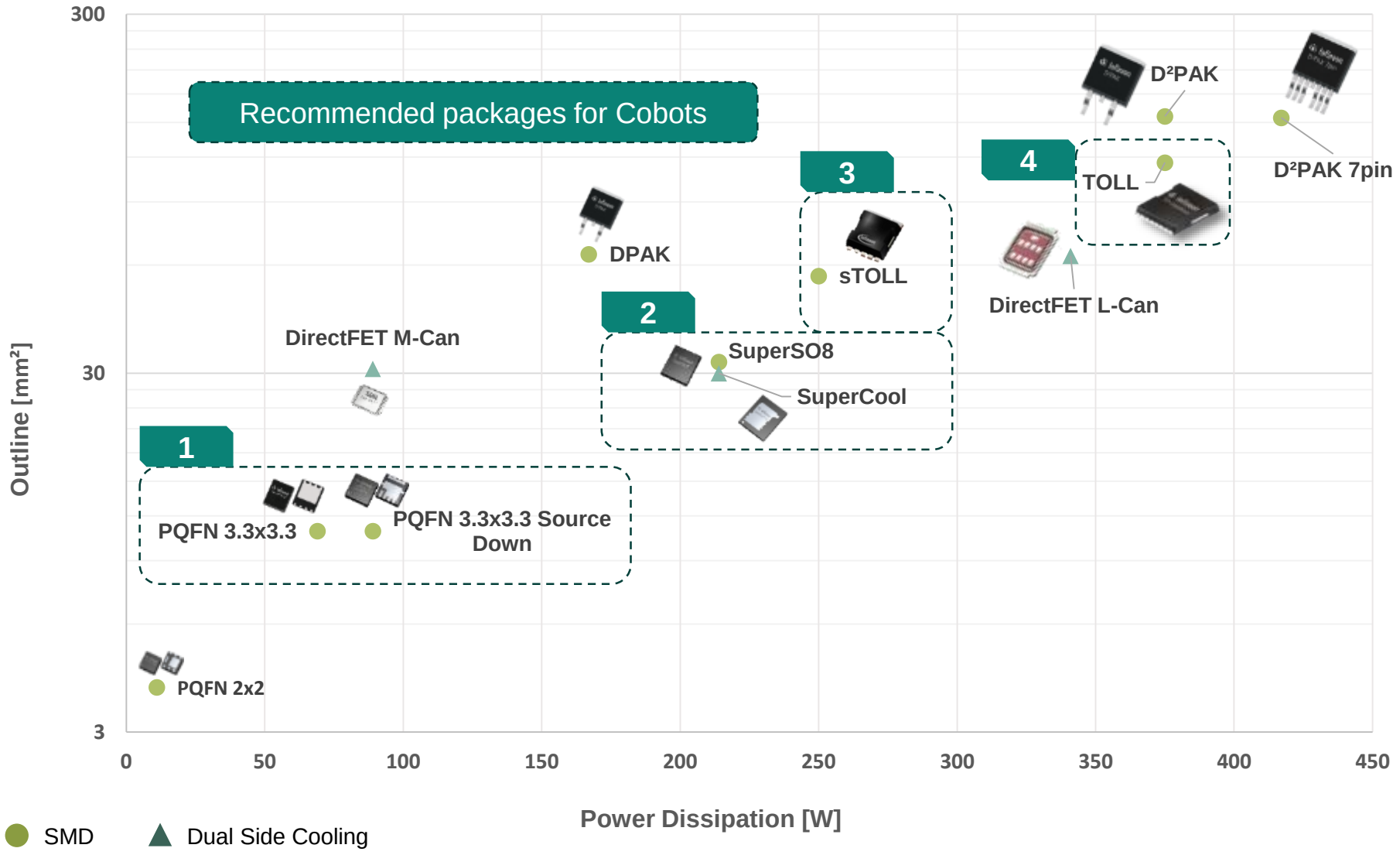
Released

Specifications

Package	V_{DS} [V]	$R_{DS(on)}$ max @10 V [mΩ]	I_D max @T_c = 25°C [A]	Part number
SuperSO8 5x6	100	2.2	230	ISC022N10NM6
		2.7	192	ISC027N10NM6
		3.0	179	ISC030N10NM6
		6.0	97	ISC060N10NM6
		8.0	75	ISC080N10NM6
		23.0	31	ISC230N10NM6
PQFN 3.3x3.3	100	8.0	75	ISZ080N10NM6
		23.0	31	ISZ230N10NM6

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Package value proposition: Power vs Size



- Major market driver for Power MOSFETs continue to be higher power density. This can be achieved by either:
  - Same power level in a smaller footprint, or
  - Higher power level in a similar footprint

- Preferred package types addressing higher power density requirements include the 3x3, SuperSO8, sTOLL, and TOLL

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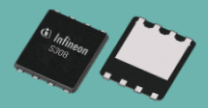
Infineon packaging innovations & advancements

PQFN 3.3x3.3 SD Center Gate

- Optimized for paralleling due to center gate pin placement and increased creepage between source and drain
- 0.70 mm creepage distance vs 0.54 mm for standard Source Down

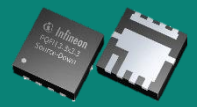
PQFN 3.3 x 3.3

- Industry standard package
- Normal and logic level gate drive
- High current rating



3.40 x 3.40 x 1.10 mm

PQFN 3.3x3.3 Source Down (SD)

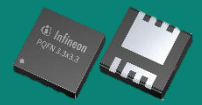


3.40 x 3.40 x 1.10 mm

- **Source down** for the next level of power density
- Same PCB routing
- Increased fused lead area
  - increased I_{max}
- **~31%*** current rating improvement vs PQFN 3.3x3.3

*dependent on breakdown voltage of the MOSFET

PQFN 3.3x3.3 Fused source leads



3.40 x 3.40 x 1.10 mm

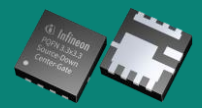
- Industry standard package
- **Fused source leads** for improved current carrying capability
- **~9%*** current rating improvement vs PQFN 3.3x3.3

*dependent on breakdown voltage of the MOSFET

PQFN 3.3x3.3 SD

- 25% improvement in $R_{DS(on)}$ and 22% reduction in R_{thJC} » increased power density
- **Source down** allows for improved die utilization and thermal capabilities
- **Large copper clip** for improved current handling and thermals

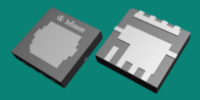
PQFN 3.3x3.3 SD Center Gate



3.40 x 3.40 x 1.10 mm

- Same benefits as PQFN 3.3x3.3 SD
- **Center gate** optimized for parallelization of MOSFETs
- **~31%*** current rating improvement vs PQFN 3.3x3.3

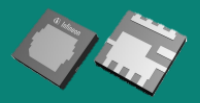
PQFN 3.3x3.3 SD Dual Side Cooling (DSC)



3.40 x 3.40 x 0.75 mm

- Similar benefits of PQFN 3.3x3.3 Source Down (SD)
- Increased power density and enhanced thermals due to dual side cooling
- Lower package profile

PQFN 3.3x3.3 SD Center Gate DSC



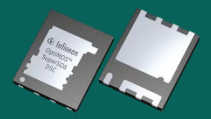
3.40 x 3.40 x 0.75 mm

- Similar benefits of PQFN 3.3x3.3 SD Center Gate
- Increased power density and enhanced thermals due to dual side cooling
- Lower package profile

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Infineon packaging innovations & advancements

SuperSO8 Dual Side Cooling (DSC)



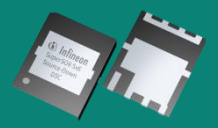
5.05 x 6.05 x 0.75 mm

- Same footprint as SuperSO8 5x6
- **Exposed top** for dual side cooling, improved thermals
- Similar current rating to SSO8

SSO8 Dual Side Cooling

- 41% volume reduction vs SSO8 for improved power density
- 95% improvement in $R_{thJC(top)}$ vs SSO8 for improved thermals

SuperSO8 SD DSC



5.05 x 6.05 x 0.75 mm

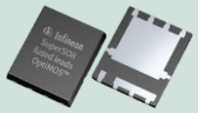
- Same footprint as SuperSO8 5x6
- **Exposed top** for dual side cooling, improved thermals
- ~30%* current rating improvement vs SSO8

*dependent on breakdown voltage, $R_{DS(on)}$ of the MOSFET

SuperSO8 Source Down DSC

- Improved $R_{thJC\text{-}top}$ for better transfer of power losses
- Center-Gate option enables optimized parallelization

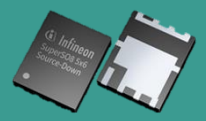
SuperSO8 5x6 (SSO8)



5.35 x 6.10 x 1.20 mm

- Industry standard 5x6 mm package
- **Fused source leads** for improved current carrying capability
- High current rating

SuperSO8 Source Down (SD)



5.05 x 6.05 x 0.75 mm

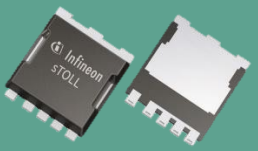
- Allows for higher Power Density in same footprint
- Same PCB routing
- **~30%*** current rating improvement vs SSO8

*dependent on breakdown voltage, $R_{DS(on)}$ of the MOSFET

SuperSO8 Source Down

- Improved R_{thJA} , R_{thJC} for better transfer of power losses
- Center-Gate option enables optimized parallelization

sTOLL shrink TOLL



7.20 x 8.20 x 2.40 mm

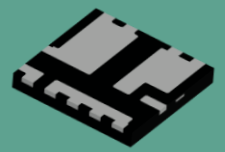
- Bridges the gap between SSO8 and TOLL
- Infineon's solution to onsemi's 8x8 package
- **~55%*** current rating improvement vs SSO8

*dependent on breakdown voltage, $R_{DS(on)}$ of the MOSFET

sTOLL

- High current carrying capability which is ideal for surviving locked rotor events in BLDC motor applications
- Leadless package with low package resistance and minimized stray inductance

Scalable Half Bridge (SHB)



6 x 6.3 mm

- High chip to package ratio for improved form factor
- Power density increase by ~50% vs. 2xSSO8
- Simplicity in layout via SCB configuration

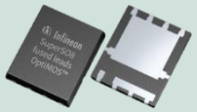
Scalable Half Bridge

- Significantly improved form factor between 40% - 60% compared to standard SSO8 footprint
- Dual Side Cooling variant on roadmap for improved thermals

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Infineon packaging innovations & advancements

SuperSO8 5x6 (SSO8)



5.35 x 6.10 x 1.20 mm

- Industry standard 5x6 mm package
- **Fused source leads** for improved current carrying capability
- High current rating

PQFN 8x6



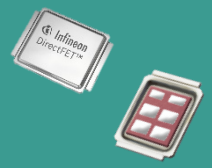
8 x 6 mm

- Best in-class chip to package ratio
- Power density increased by **~25%** vs. PQFN 8x8
- Same pin-placement as PQFN 5x6 for scalability

PQFN 8x6

- Significantly improved form factor by ~60% compared to similarly specified TOLL device
- Dual Side Cooling variant on roadmap for improved thermals

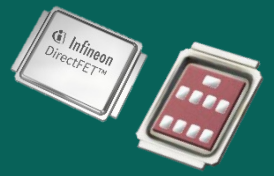
DirectFET™ Medium Can



5.05 x 6.35 x 0.70 mm

- **Source down** for improved thermals thru the PCB
- **Exposed top** for dual side cooling, improved thermals
- RoHS 6/6 compliant

DirectFET™ Large Can



7.10 x 9.15 x 0.74 mm

- **Source down** for improved thermal thru the PCB
- **Exposed top** for dual side cooling, improved thermals
- Similar current rating to SSO8

DirectFET™ Mcan

- 43% volume reduction vs SSO8 for improved power density
- 90% improvement in $R_{thJC(top)}$ vs SSO8 for improved thermals
- RoHS 6/6 compliant

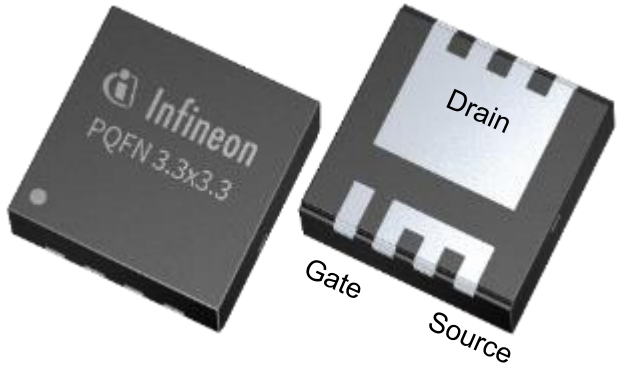
DirectFET™ Lcan

- Limited to StrongIRFET™ silicon technology
- Can replace 2x Mcan DirectFET™, SuperSO8, SuperSO8 Super Cool devices in many apps

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New PQFN 3.3x3.3 Source-Down (SD) MOSFET package

The Drain-Down Industry Standard

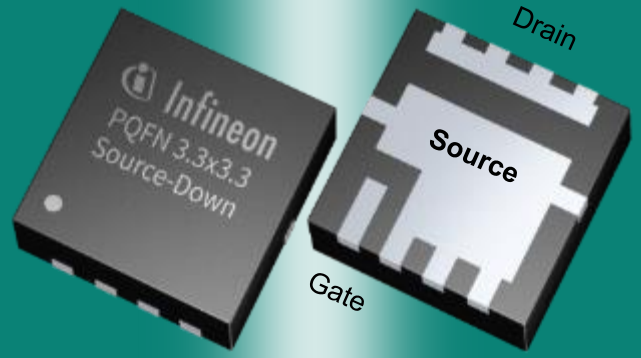


Easy adoption to existing designs

Todays industry standard
PQFN 3.3x3.3 mm package

Power MOSFETs in a small package to realize
high power densities in end applications

The Source-Down Innovation





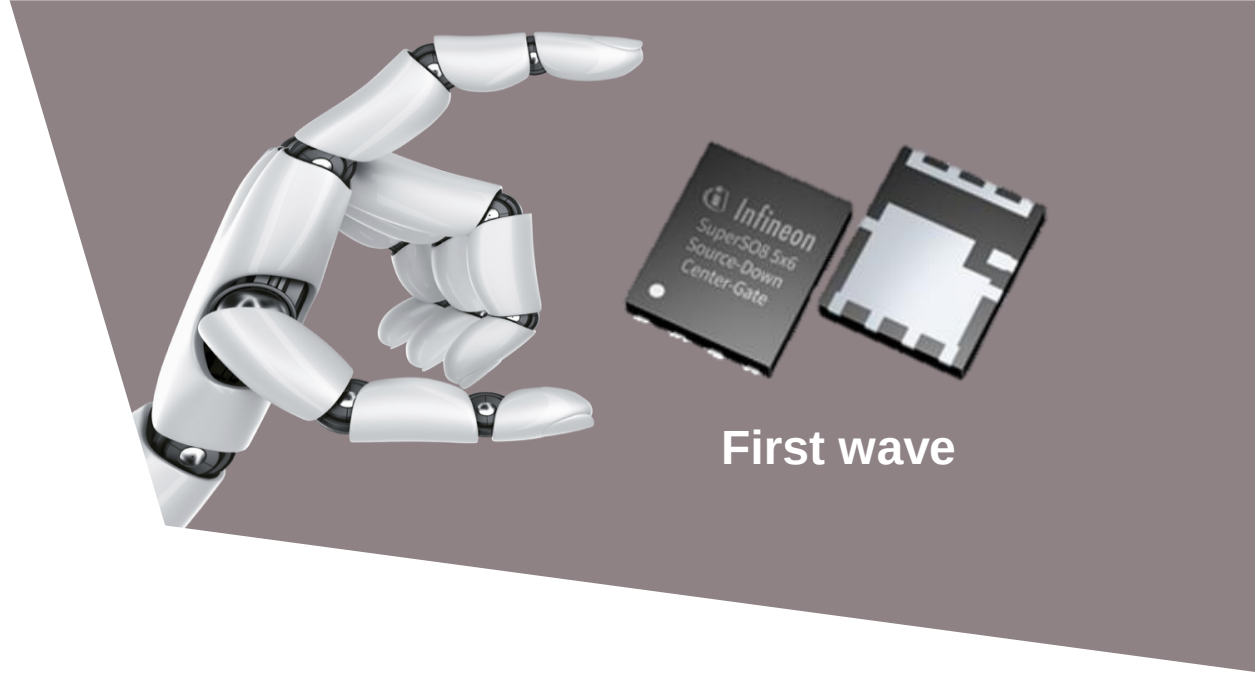
Optimized paralleling due to gate pin placement
and increased Creep-age between Source and Drain

The new, innovative
PQFN 3.3x3.3 mm Source-Down Package

Enabling the **next level of power density**
and efficiency in the end application

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New **Source-Down**, industry standard PQFN 5x6 **center-gate** package



Key features

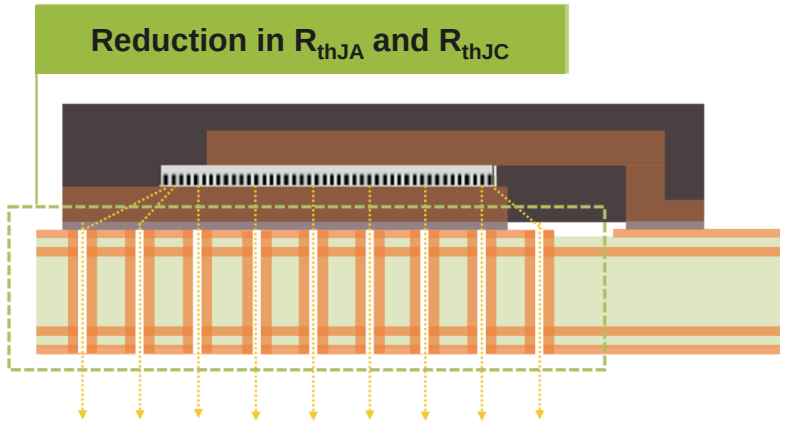
- Major reduction in $R_{DS(on)}$ by up to 36% compared to current technology
- Improved R_{thJC} over current PQFN package technology
- Standard and center-gate footprints available
- Optimized layout possibilities
- Available in Dual-Side Cooling (DSC) packages



Key benefits

- Enabling highest power density and performance
- Superior thermal performance
- Optimized layout possibilities for efficient use of
- real-estate
- Simplifying parallel configuration of multiple MOSFETs with Center-Gate footprint
- Improved PCB losses, reduced parasitics

Source-Down PQFN 5.0 x 6.0 package

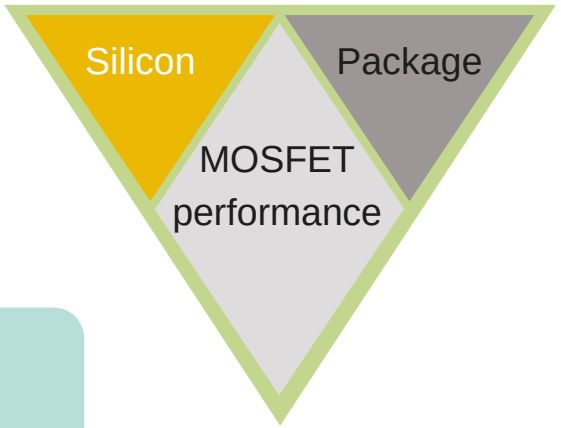


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Why Source-Down?
Innovation on Silicon technology is not enough

MOSFET performance is limited by two dimensions:

- Silicon technology
- Package limitations



Optimized Thermal Managemet

Source-Down concept enables direct connection of active area to leadframe → **Reduction of R_{thJC}**

- Thermal pad connected to source potential can be:
  - connected directly to the ground plane, e.g. for a low-side FET in a half-bridge configuration
  - thermal vias can be used to connect to other layers → **Decrease of the R_{thJA} and R_{thJC}**
- Areas connected to GND do not need to be minimized

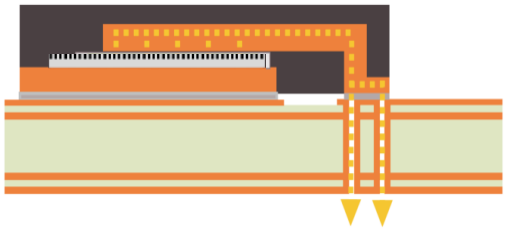
General trends in power management

1. Higher efficiency
2. Higher power density
3. BOM (Bill Of Material) cost reduction

New Source-Down, industry standard package enables higher power density by:

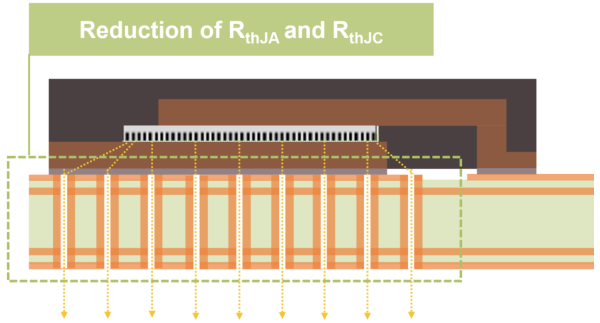
- Lower $R_{DS(on)}$ in both PQFN 3x3 and 5x6 mm package outline
- Improved thermal performance
- More effective layout for thermal management

Normal Drain-Down



Only indirect cooling via outer leads - no thermal vias normally allowed for switch potential

Source-Down



Heat can be dissipated efficiently into ground plane instead of switch node

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OptiMOS™ 3x3 Source Down: Portfolio Positioning



Voltage class	PQFN 3.3x3.3 Drain Down (max value, I_D @T_C 25°C)	Source Down vs. Drain Down 3x3 package $R_{DS(on)}$ improvement	PQFN 3.3x3.3 Source Down (max value, I_D @T_C 25°C)	SuperSO8 5x6 (max value, I_D @T_C 25°C)
25 V	BSZ009NE2LS5 $R_{DS(on)}$ = 0.9 mΩ, I_D = 223 A	**28%**	IQE006NE2LM5* $R_{DS(on)}$ = 0.65 mΩ, I_D = 298 A	BSC004NE2LS5 $R_{DS(on)}$ = 0.4 mΩ, I_D = 479 A
30 V	BSZ0500NSI $R_{DS(on)}$ = 1.5 mΩ, I_D = 173 A	**43%**	IQE008N03LM5* $R_{DS(on)}$ = 0.85 mΩ, I_D = 253 A	BSC011N03LS $R_{DS(on)}$ = 1.1 mΩ, I_D = 230 A
40 V	BSZ018N04LS6 $R_{DS(on)}$ = 1.8 mΩ, I_D = 158 A	**28%**	IQE013N04LM6* $R_{DS(on)}$ = 1.3 mΩ, I_D = 205 A	ISC012N04NM6 $R_{DS(on)}$ = 1.2 mΩ, I_D = 232 A
60 V	ISZ034N06LM5* $R_{DS(on)}$ = 3.4 mΩ, I_D = 112 A	**12%**	IQE030N06NM5* $R_{DS(on)}$ = 3.0 mΩ, I_D = 137 A	BSC028N06NS $R_{DS(on)}$ = 2.8 mΩ, I_D = 132 A
	BSZ039N06NS $R_{DS(on)}$ = 3.9 mΩ, I_D = 102 A	**23%**		
	ISZ0702NLS* $R_{DS(on)}$ = 4.5 mΩ, I_D = 86 A	**33%**		
80 V	BSZ075N08NS5 $R_{DS(on)}$ = 7.5 mΩ, I_D = 73 A	**33%**	IQE050N08NM5* $R_{DS(on)}$ = 5.0 mΩ, I_D = 101 A	BSC052N08NS5 $R_{DS(on)}$ = 5.2 mΩ, I_D = 95 A
100 V	ISZ080N10NM6 $R_{DS(on)}$ = 8.0 mΩ, I_D = 75 A	**19%**	IQE065N10NM5* $R_{DS(on)}$ = 6.5 mΩ, I_D = 85 A	BSC070N10NS5 $R_{DS(on)}$ = 7.0 mΩ, I_D = 80 A

Source Down 3x3 has comparable $R_{DS(on)}$ to 5x6:

Potentially allowing for similiar power density with 65% footprint reduction

Source Down PQFN 5x6
Centre & Corner Gate
to be released in
CY2023

* Also available in center-gate version

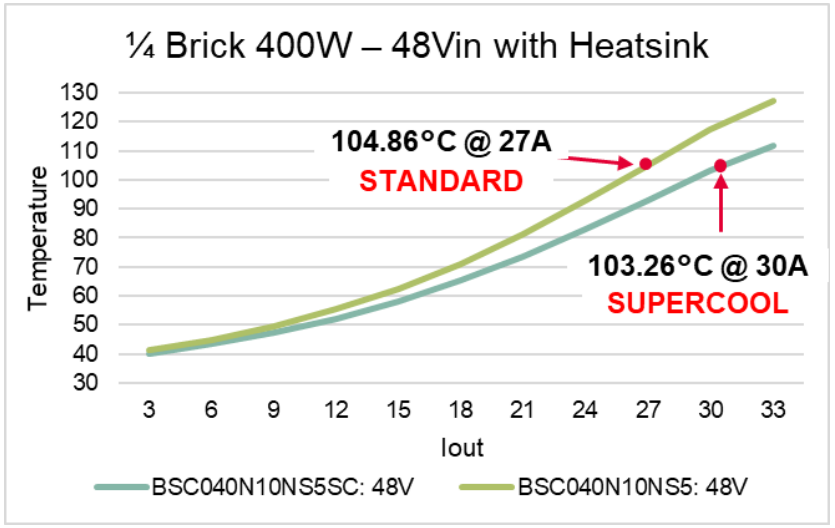
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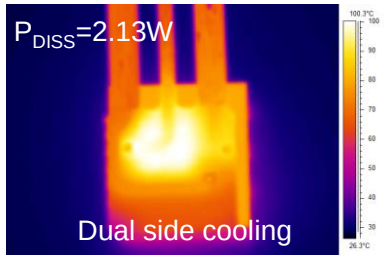
Discrete MOSFET – High efficiency & thermal performance

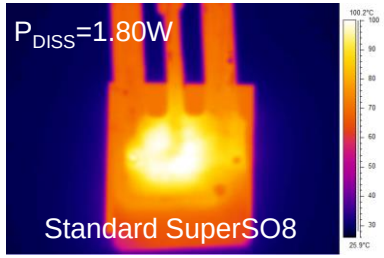
SuperSO8 5x6 DSC: Value proposition

- Drop-in replacement for standard SuperSO8 and PQFN 5x6 products → easy to design-in solution, no PCB layout change
- Superior thermal performance through top-side (R_{thJC} < 1 K/W in Best-in-Class parts) → enabling the use of simple FR4 PCB
- SuperSO8 DSC can drive 10% higher current at same temperature and offers 20% more power density than standard SSO8 → Highest system efficiency
- Dual-side cooling → relieving thermal requirements on PCB design, improving reliability and longer life time

10% higher current vs. standard SSO8

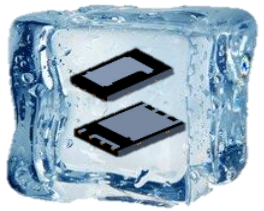


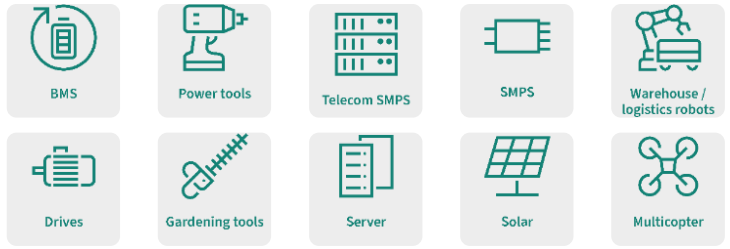




P/N	V_{DS} [V]	$R_{DS(on)}$ max. @10V [mΩ]	Rth_{JC_top} / Rth_{JC_bot} max. [K/W]	Id Max @T_c = 25C (A)	Release Schedule
BSC007N04LS6SC	40	0.7	0.72 / 0.80	381	Released
BSC009N04LSSC	40	0.9	0.86 / 0.90	301	Released
BSC014N06NSSC	60	1.4	0.72 / 0.80	261	Released
BSC016N06NSSC	60	1.6	0.86 / 0.90	234	Released
BSC028N06NSSC	60	2.8	1.40 / 1.50	137	Released
BSC023N08NS5SC	80	2.3	0.72 / 0.80	202	Released
BSC033N08NS5SC	80	3.3	0.86 / 1.10	144	Released
BSC030N10NS5SC	100	3.0	0.72 / 0.80	171	Released
BSC040N10NS5SC	100	4.0	0.86 / 0.90	140	Released
BSC070N10NS5SC	100	7.0	1.40 / 1.50	82	Released
BSC093N15NS5SC	150	9.3	0.72 / 0.90	89	Released
BSC110N15NS5SC	150	11.0	0.72 / 1.00	77	Released
BSC160N15NS5SC	150	16.0	0.94 / 1.30	56	Released

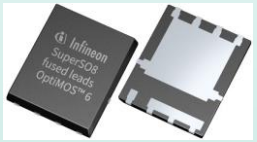
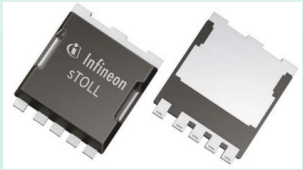
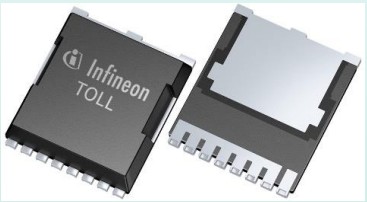
Target applications





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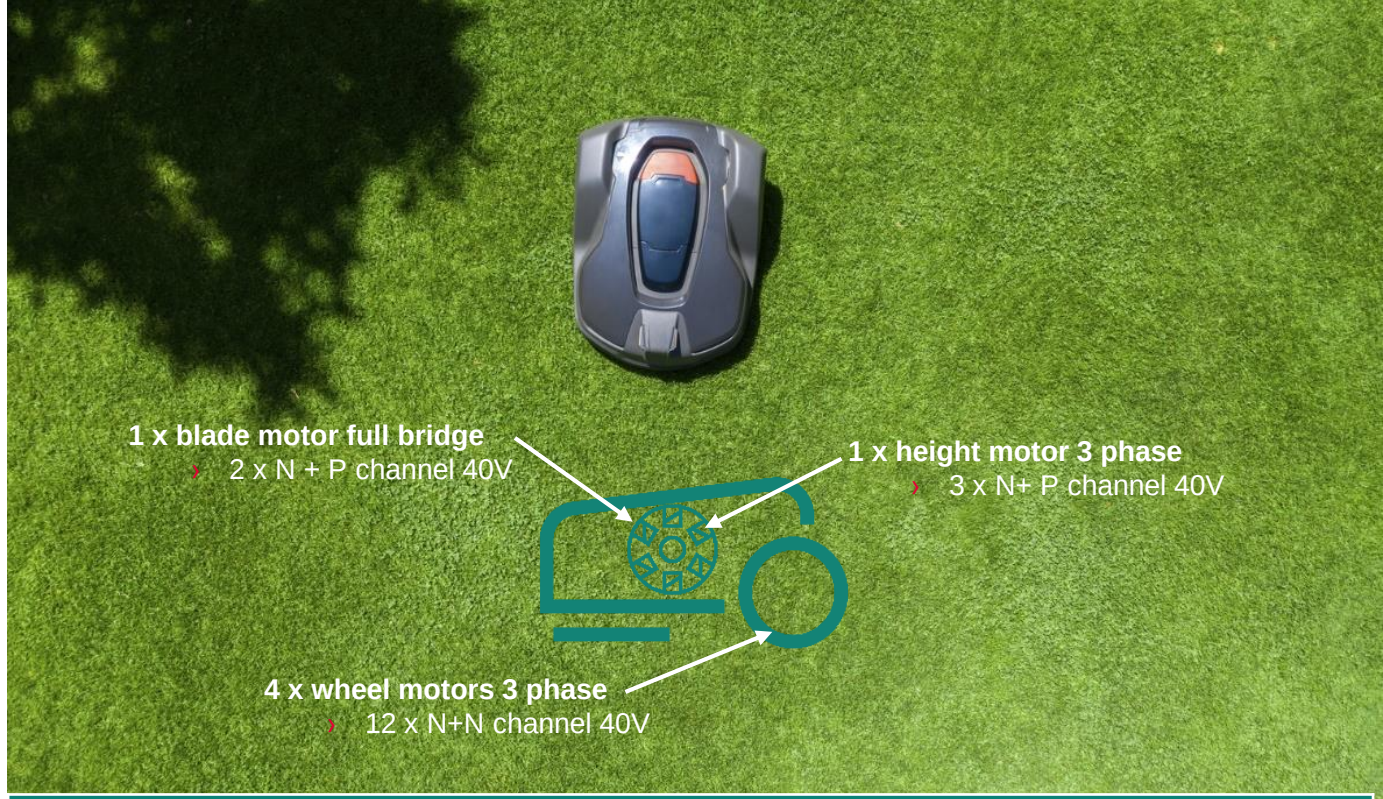
NEW sTOLL: (Shrink TOLL) Fill the gap for leadless packages (PQFN)

Single SuperSO8	sTOLL	TOLL
		
L x W 6 x 5 mm^2	L x W 7 x 8 mm^2	L x W 11x10 mm^2
Current released products BiC 80 V 2.5 mΩ, BiC 100 V 2.2 mΩ	Current released products BiC 80 V 1.9 mΩ, BiC 100 V 2.6 mΩ	Current released products BiC 80 V 1.05 mΩ, BiC 100 V 1.4 mΩ
BiC 80 V I_D = 187 A BiC 100 V I_D = 230 A	BiC 80 V I_D = 290 A BiC 100 V I_D = 248 A	BiC 80 V I_D = 425 A BiC 100 V I_D = 362 A
Cu-Clip soldered	Cu-Clip soldered	Al bond wire
BSC025N08LS5, ISC022N10NM6	**IST019N08NM5, IST026N10NM5**	**IPT010N08NM5, IPT014N10N5**

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30 V and 40 V Dual MOSFET in SO-8 package

Home & garden | Multicopter | Service robots | Vacuum cleaner | Consumer



Value proposition



- New Dual **N+P Channel** and **N+N Channel MOSFET in SO-8 package**
- **Right price vs. performance fit**
- **Ease of use**
- **Fast Switching**
- 100% lead-free; RoHS compliant
- Product qualification according to JEDEC standard

Target portfolio and specifications

Part number	V_{DS} [V]	$R_{DS(on)}$ max. @10 V [mΩ]	$R_{DS(on)}$ max. @10 V [mΩ]	Polarity [V]	Package	Target release schedule
ISA220280C03LMDS	30	22	28	N+P	SO-8	CYQ4/2024
ISA150233C03LMDS	30	15	23	N+P	SO-8	
ISA250300C04LMDS	40	25	30	N+P	SO-8	
ISA170230C04LMDS	40	17	23	N+P	SO-8	Samlpes available for all parts
ISA250250N04LMDS	40	25	25	N+N	SO-8	
ISA170170N04LMDS	40	17	17	N+N	SO-8	

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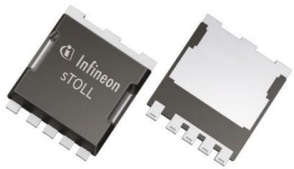
OptiMOS™ 5/6 40 – 100 V in sTOLL for high current density



BMS | Drives | Power tools | Gardening tools | LEV | Robotics

Value proposition

- Bridges the gap between SuperSO8 and TO-leadless packages
- Super low ohmic high current capability with latest state of the art silicon technology
- Reduced form factor by ~15% compared to DPAK, 60% to D²PAK, and 50% to TOLL, resulting in reduction of PCB space (7x8 mm²) and therefore reduced system costs
- Reduced conduction losses & optimized switching behavior
- Package JEDEC listed (Industry package standard JEDEC MO-319A)



Specifications

V_{DS} [V]	$R_{DS(on)}$ max @V_{GS} = 10 V [mΩ]	I_D max @T_C = 25°C [A]	Part number (normal level)
40	0.6	475	IST006N04NM6
	0.7	440	IST007N04NM6
60	1.1	399	IST011N06NM5
80	1.9	290	IST019N08NM5
100	2.6	248	IST026N10NM5

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OptiMOS™ 5 80 V in TOLL



BMS | Telecom SMPS | Power tools | Multicopter | Robotics | Scooter | LV-drives

Value proposition

Thermal behavior

› High currents applications which require best thermal behavior

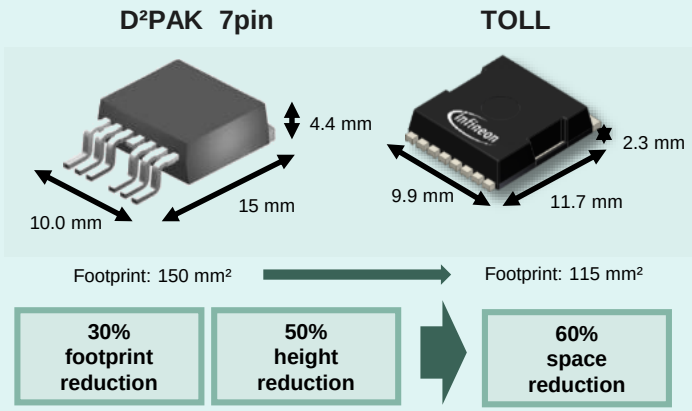
Space

› When space reduction in the application is required

Efficiency

› Applications which require highest efficiency and best EMI behavior

TOLL vs. D²PAK 7pin



Target specifications

V_{DS} [V]	$R_{DS(on)}$ max. @10V [mΩ]	I_D max @T_c = 25°C [A]	Part number
80	1.05	425	IPT010N08NM5
	1.40	331	IPT014N08NM5

BiC

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Recommended MOSFETs for efficient and power dense motor drives



MOSFET



PQFN 3x3 | PQFN 3x3 Source Down | SuperSO8 | Dual Side Cooling | sTOLL | TOLL

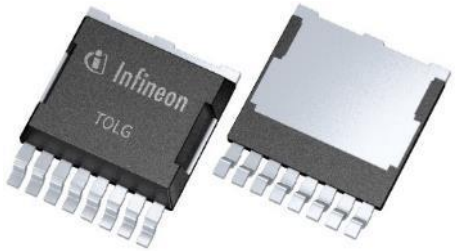
250 W — *500 W* — *1000 W*

Package	$V_{BRDSS(max)}$	Recommended part	$R_{DS(on)}$ max
PQFN 3x3	80 V / 80 V Source Down	BSZ075N08NS5 / IQE050N08NM5	7.5 mΩ / 5.0 mΩ
	100 V / 100 V Source Down	ISZ080N10NM6 / IQE065N10NM5	8.0 mΩ / 6.5 mΩ
SuperSO8	80 V / 80 V Dual Side Cooling	BSC026N08NS5 / BSC023N08NS5SC	2.6 mΩ / 2.3 mΩ
	100 V / 100 V Dual Side Cooling	ISC022N10NM6 / BSC030N10NS5SC	2.2 mΩ / 3.0 mΩ
sTOLL	80 V	IST019N08NM5	1.9 mΩ
	100 V	IST026N10NM5	2.6 mΩ
TOLL	80 V	IPT014N08NM5	1.4 mΩ
	100 V	IPT020N10N5	2.0 mΩ

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TOLG = TOLL
with Gullwing Geometry

TOLG



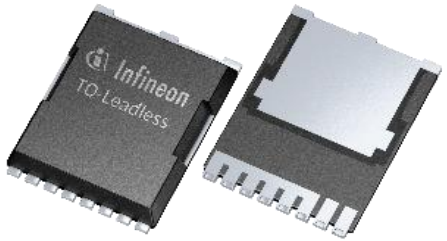
(10 x 11.7 x 2.3 mm)

› **TOLG**

TOLL derivative which improves thermal cycling on board (TCoB) performance on Al-core IMS board

› Compatible footprint and performance ($R_{DS(on)}$ / I_D rating) as **TOLL**

TOLL



(10 x 11.7 x 2.3 mm)

› 60% space reduction vs. **D²PAK-7pin** with same lead flexibility

D2PAK 7pin
(15 x 10 x 4.4mm)

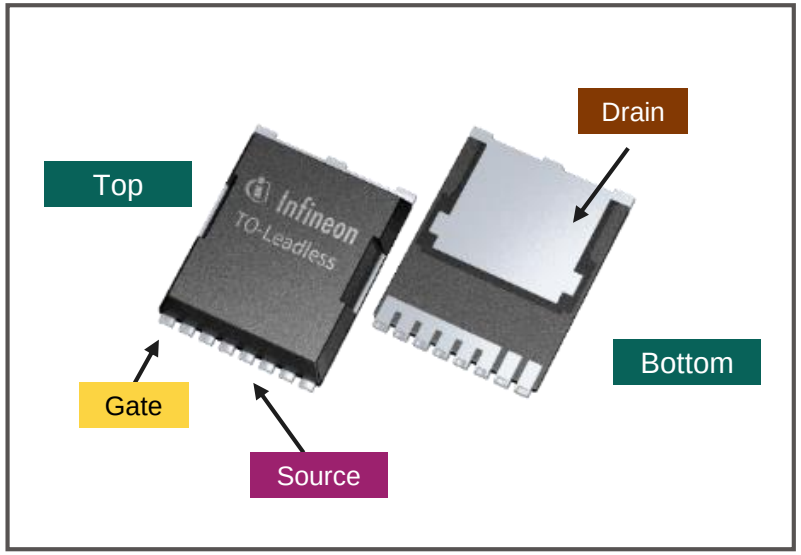


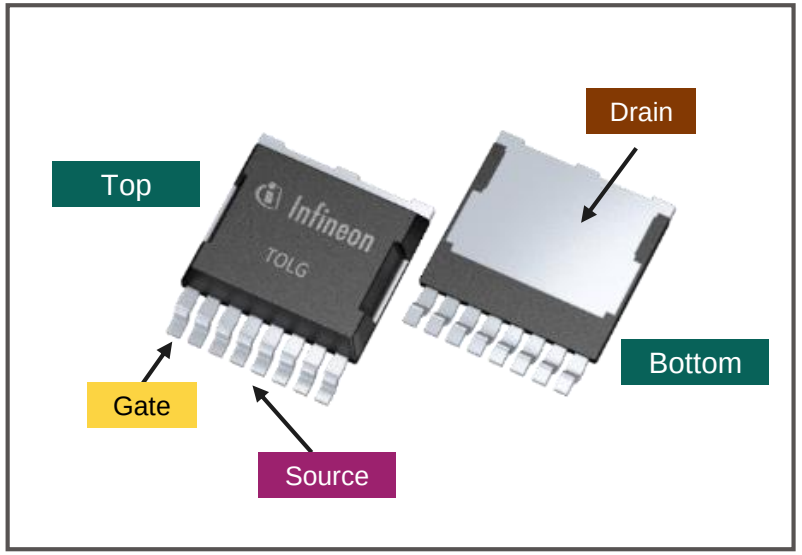
(15 x 10 x 4.4 mm)

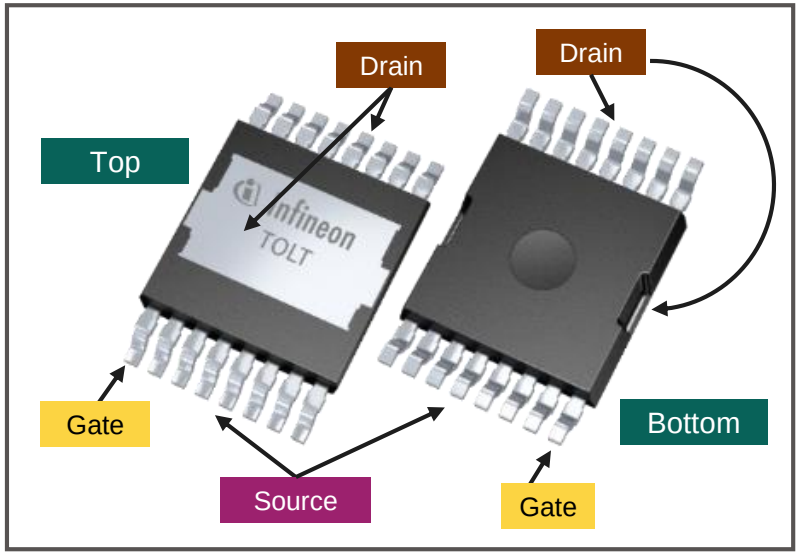


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TOLT vs TOLL and TOLG



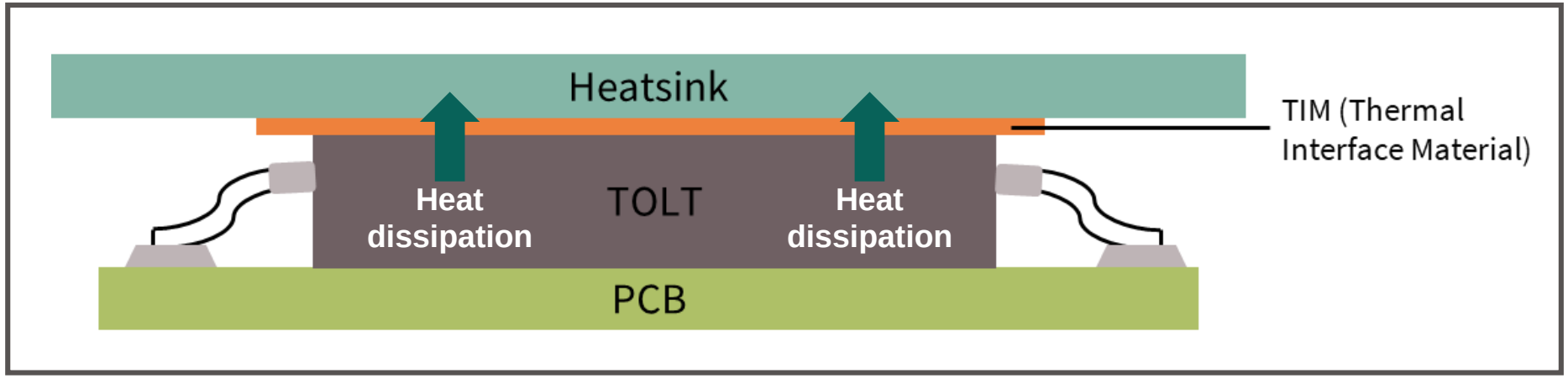




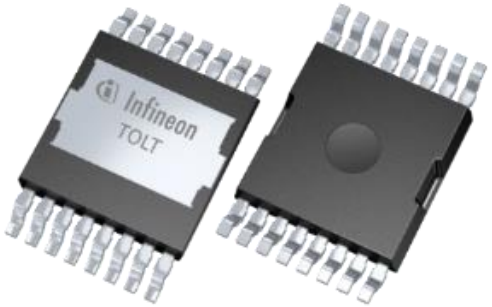
TOLL	TOLG	TOLT
TO-Leadless	TO-Leadless with **Gullwing leads**	TO-Leadless **Top Side Cooling**
Optimized for high power applications	Optimized for better TCoB robustness	Optimized for superior thermal performance

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TOLT – Cooling concept: Mechanical structure of inverter board



TOLT



With top side cooling setup, the drain is exposed at the surface of the package:

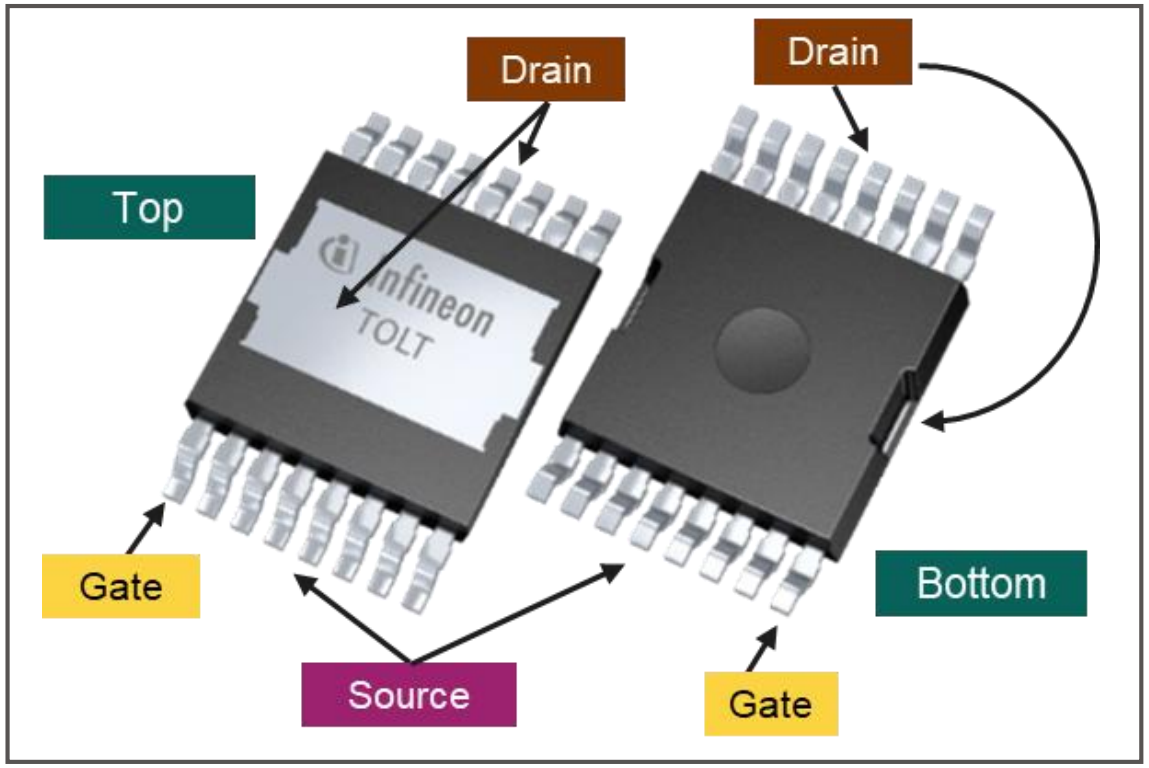
For this reason, **heat dissipation** can be **promoted directly to the heatsink**

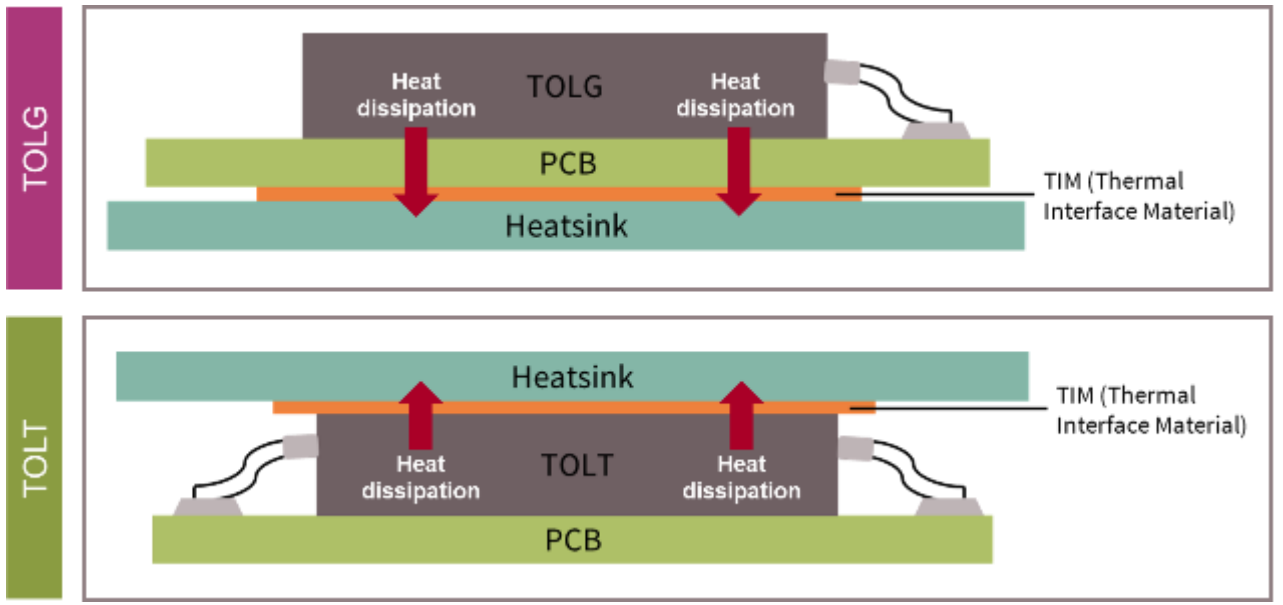
Achieving at least 20% better R_{thJA} compared to TOLL.

MOSFET
(including chip, die attached and drain tab) → TIM / Thermal grease → Heatsink

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OptiMOS™ 5 in TOLT – Top side cooling





Value proposition

- BiC performance (very low $R_{DS(on)}$ and high current capability)
- Heat dissipation promoted directly to the heatsink ➔ 20% better R_{thJA} compared to bottom side cooling packages
- Only 5% of the heat is getting dissipated through the PCB

Product portfolio

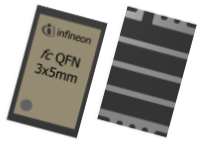
V_{DS} [V]	Part number	$R_{DS(on)\ max}$ @10V [mΩ]	$I_{D\ max}$ @10V, T_C 25°C [A]
80	IPTC011N08NM5	1.1	408
	IPTC014N08NM5	1.4	330
100	IPTC014N10NM5	1.4	365
	IPTC019N10NM5	1.9	279

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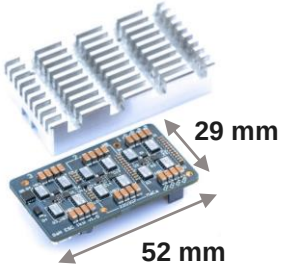
CoolGaN™ & Field-Oriented Control (FOC): Overall value position

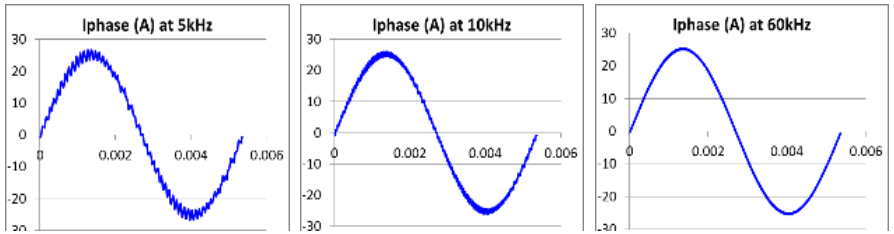
Advantages of CoolGaN™...

- Low specific on-resistance
- Lower Q_{OSS} & more linear C_{OSS}
- Lower Q_{GS}
- No Q_{rr}
- Low inductance package

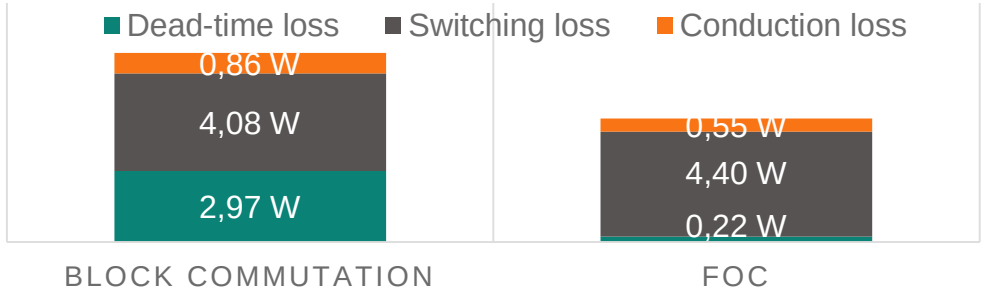


100 V, 3 mΩ
QFN 3x5
CoolGaN™





Example loss breakdown for a power tool motor drive:



Combine with FOC to produce ...

- **Lower** switching loss
- **Higher** switching frequency
- **Cleaner** switching waveforms
- **Shorter** dead-times

… new possibilities!

Higher power density
- Smaller power stage
- Smaller bulk capacitance
- Smaller heatsink
- Enables integration of drive + motor

Lower current ripple
- Higher motor efficiency & overall system efficiency
- Lower torque ripple enables smoother and more accurate motor movement

Lower acoustic noise
- f_{sw} >> 20 kHz avoids audible modulation
- Shorter dead-time further reduces noise

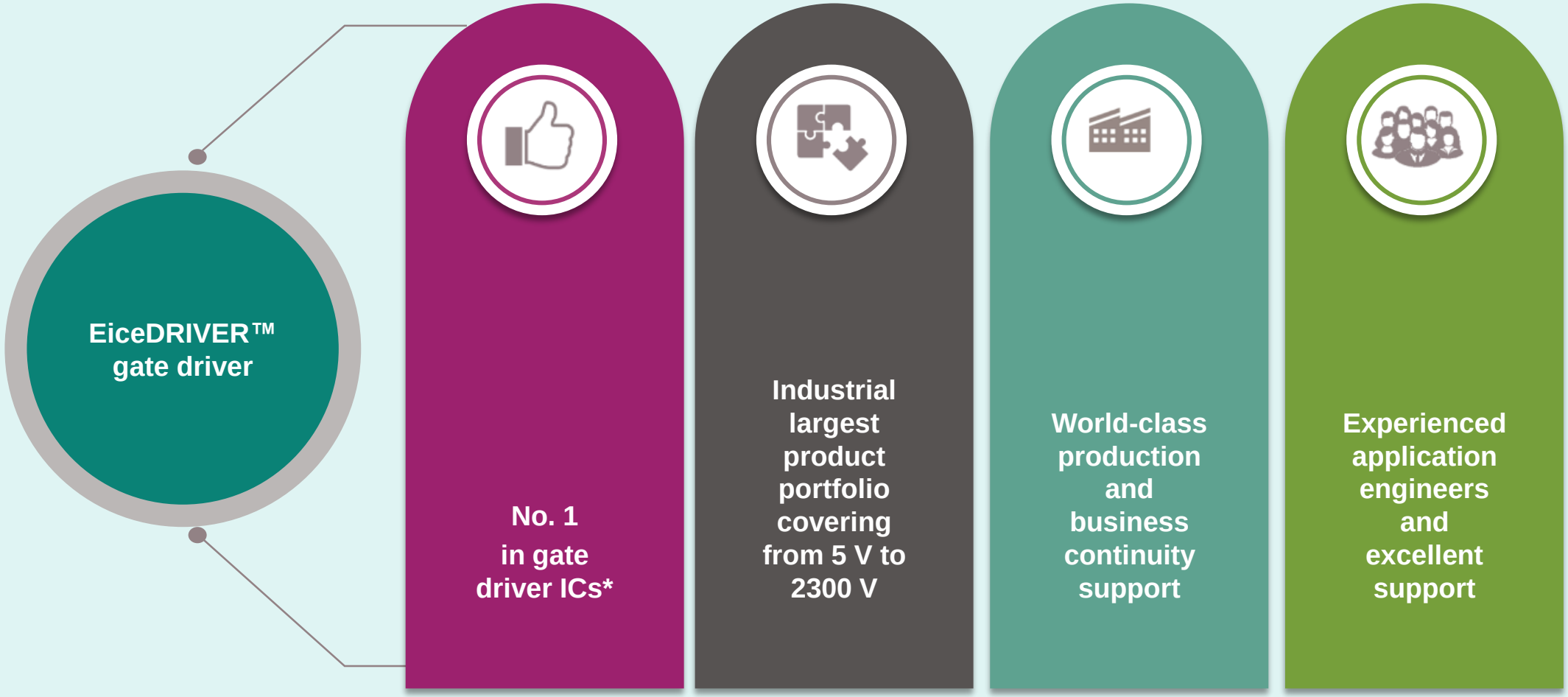
Motor control dynamics
- Higher control loop bandwidth
- Faster step response

Increased motor efficiency
- More sinusoidal current increases motor efficiency and extends motor lifetime

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Why EiceDRIVER™ gate driver?

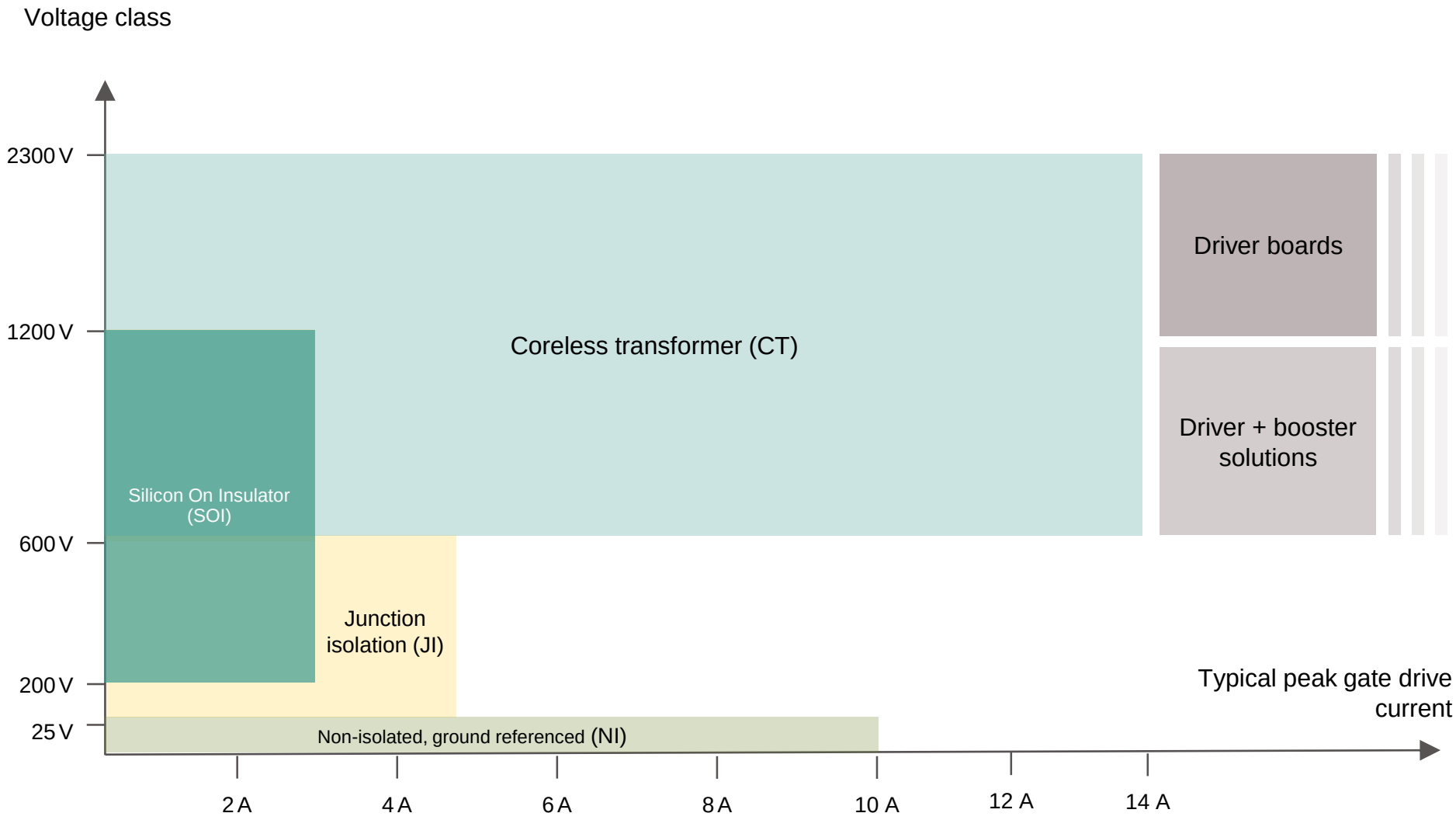
www.infineon.com/gatedriver



*IHS market report 2019

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Infineon provides a comprehensive portfolio of gate driver solutions in the market

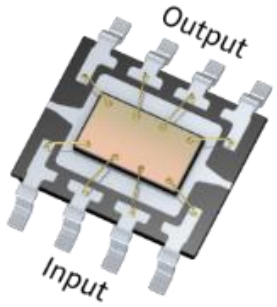


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Gate driver IC technology overview
Wide portfolio to best fit with application requirements

Non-isolated GD

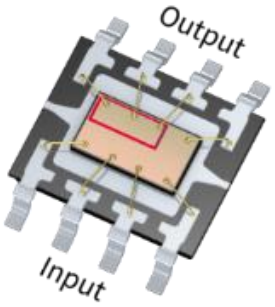
Low-side



- **Comprehensive families** of single- and dual-low-side drivers with flexible options for output current, logic configurations and UVLOs (plus non-isolated TDI)
- **Rugged technology** of the high-voltage gate drivers, and on the latest state-of-the-art 130-nm process
- **Industry-standard** DSO-8 and small form-factor SOT23, WSON and TSNP packages

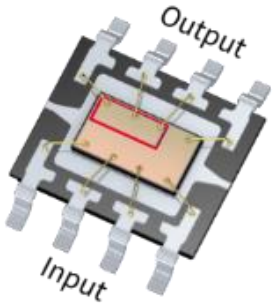
Level-shift GD

Junction isolation (JI)



- **Proven technology** trustfully used in all high-voltage gate drive applications for over 20 years
- **Largest portfolio** of 120V, 200 V, 600 V, and 1200 V industry standard gate drivers using rugged proprietary HVIC process
- **Solution-specific** motor-control and switch-mode power applications

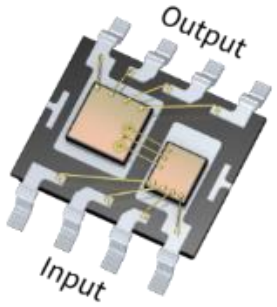
Silicon on insulator (SOI)



- **Infineon SOI technology** for high-voltage applications with **inherent integrated boot-strap diode** capability and lower level-shift losses
- Industry **best-in-class robustness against negative VS transient spikes**
- Higher level of integration reduces BOM and total system cost

Isolated GD

Coreless transformer



- **Magnetically-coupled isolation technology** provides galvanic isolation for industrial applications
- **Strongest gate-drive output currents** (up to 14 A) reducing need for external booster circuits
- **Reliable and accurate protection** precise & fast on-/off-switching, desat protection, active Miller clamp, isolation rating in different packages, VDE 0884-11 certification

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Recommended gate drivers for easy and efficient MOSFET switching

V. Class	Package	Part Number	Type	Output Current (A)	Features	Rational
650 V	DSO-8	2ED210x	Half-bridge, High-side & Low-side	290 mA / 700 mA	SOI, VCC up to 20 V, integrated BSD, independent UVLOs, Shutdown	Cost effective, higher voltage applications, SOI ruggedness
600 V	DSO-28	6EDL04x06xT	3-Phase	165 mA / 375 mA	Integrated bootstrap diode, OCP, UVLO, enable, fault reporting	Performance, SOI ruggedness, Space / cost saving
	SOIC-8	IRS2308S	Half-bridge	290 mA / 600 mA	Shoot-through protection	Cost effective, higher voltage applications
200 V	TSNP-6	1EDN7550U	Single-channel / High-side	4 A / 8 A	Truly Differential Inputs, allowing high-side driving in half-bridge or full-bridge configurations, VDD up to 20 V 3.3 V PWM – 150 VAC dynamic, 72 VDC static 5.0 V PWM – 200 VAC dynamic, 108 VDC static	Small size - 1.1x1.5 mm2, strong gate driver (4A / 8A), split sink and source outputs, tight prop delay accuracy (-7 / +10 ns)
	SOT23-6	1EDN7550B				
	DSO-8 MLPQ4x4	IRS2005	High-side & Low-side	290 mA / 600 mA	VCC up to 20 V, Independent VCC and VBS UVLOs	Reliable start-up operation DSO-8: cost effective MLPQ 4x4: space-saving
		IRS2007	Half-bridge	290 mA / 600 mA	VCC up to 20 V, integrated deadtime, independent VCC and VBS UVLOs	
		IRS2008	Half-bridge	290 mA / 600 mA	VCC up to 20 V, integrated deadtime, independent UVLOs, Shutdown	
	DSO-8	IRS2011	High-side & Low-side	1 A / 1 A	VCC up to 20 V, matched on/off 60 ns typ. propagation delay	Faster on/off
	TSSOP-28	6EDL04N02	3-Phase	165 mA / 375 mA	SOI, integrated BSD, integrated OCP, fault reporting, EN, deadtime	Performance, SOI ruggedness, Space / cost saving
160 V	VQFN-48	6ED2742S01Q	3-Phase	1 A / 2 A	6 – 140 V input voltage, SOI, PMU, integrated OCP, integrated BSD	Performance, 100% duty cycle
120 V	VSON-10	2EDL8124G3C	Half-bridge	4 A / 5 A	TDI, shoot-through protection	High current , 3x3 mm2
72 V	TSDSO-32	TLE9140EQW	3-Phase	230 nC at 20 kHz	Integrated charge pump and protection features, T_J max 175°C, ISO26262 compliant	Suitable for 24 / 48 V BLDC motor drive system, safe switch off path fulfilling ASIL-B metric, high reliability
60 V	VQFN-48	6EDL7141	3-Phase smart	1.5 A / 1.5 A	>60 SPI programmable parameters. Slew rate control, 3 OpAmps, Buck converter + LDO, dual Charge Pump	High performance, highly integrated, programmable, PSU integrated, space saving, slew rate control
	VQFN-64	IMD700A	3-Phase smart + microcontroller	1.5 A / 1.5 A	>60 SPI programmable parameters. Slew rate control, 3 OpAmps, Buck converter + LDO, dual Charge Pump, MCU XMC1404 ARM CM0 48 MHz	Further highly integrated reducing the PCB footprint significantly



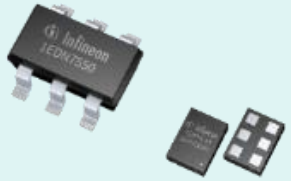
Note : Above guidelines are for reference purpose only and customer's application requirements need to be considered for final decision
Please visit https://www.infineon.com/cms/en/product/power/gate-driver-ics/ for entire gate-driver IC portfolio

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1EDN-TDI: Efficiency booster for BLDC motor drives

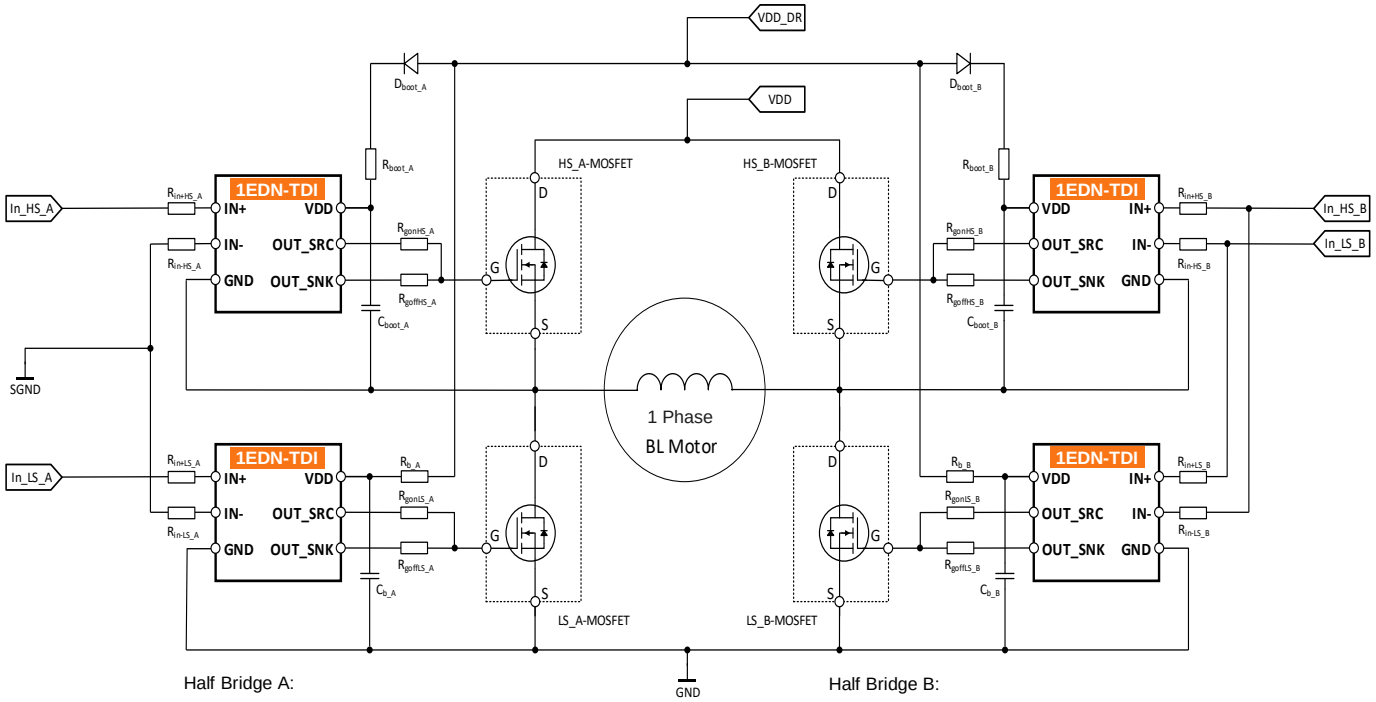
1EDN-TDI

1-channel gate-driver ICs:
- 6-pin SOT23
- 6-pin TSNP



Truly differential inputs:
- +/- 80 V common mode rejection

Low ohmic source/sink outputs:
- 4 A source / 0.85 Ω
- 8 A sink / 0.35 Ω



Half-bridge gate-driver
Typ. challenges
Asymmetric high- and low-side gate-drive PCB-layout
Bipolar output stages

1EDN-TDI Advantage		
Feature	Benefit	System Value
PCB layout symmetry	Shorter dead-times required	Better efficiency
Short gate-drive loops	Less voltage overshoots from parasitics	Lower MOSFET stress
Low-ohmic rail-to-rail outputs	Fast transition through Miller plateau	Less switching losses

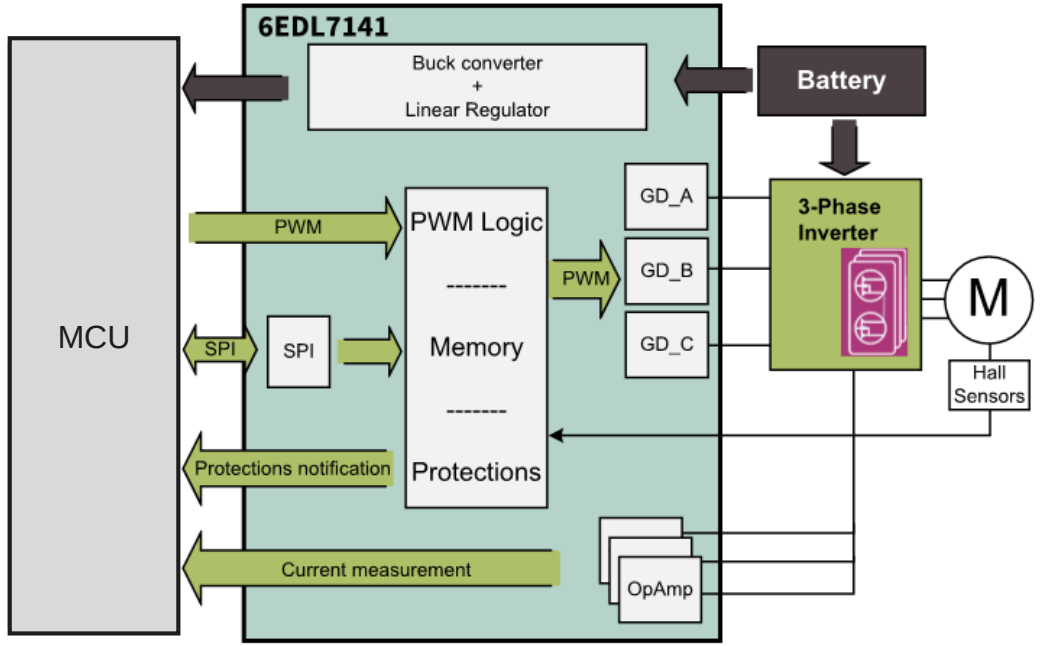
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6EDL7141: Smart 3-phase 60V motor driver for power tools, garden tools and robotics

6EDL7141

- 3-phase motor driver IC
- 60 V operating voltage
- 1.5 A sink/source driver currents
- 1 or 3 or 6 PWM inputs
- Programmable slew-rates and dead-times
- 3 integrated high performance OpAmps
- Integrated buck regulator
- 300 mA LDO integrated
- Protection features: OTW, OTS, OCP, UVLO
- VQFN-48





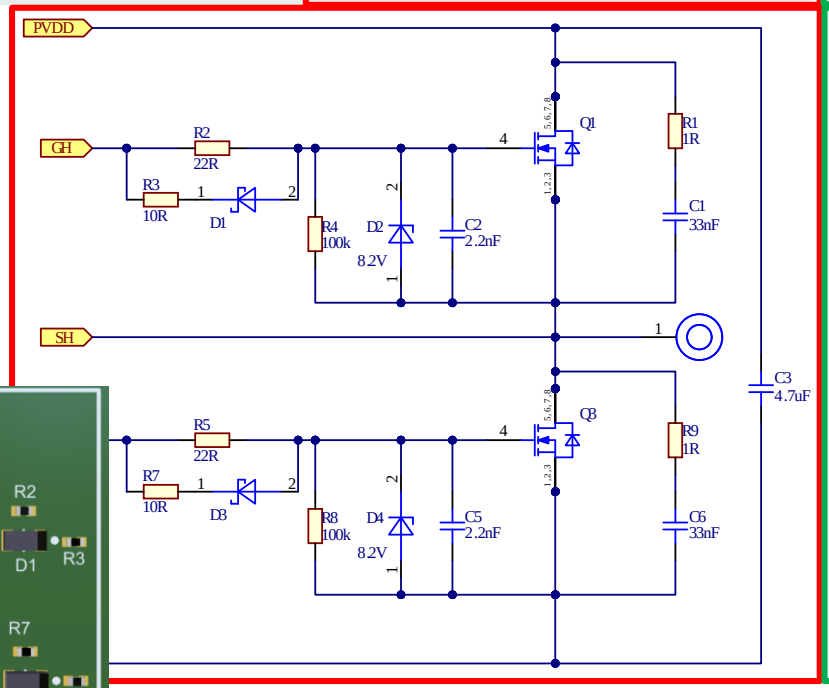
6EDL7141 Advantages		
6EDL7141 Features	Best in Class Competitor	6EDL7141 System Value
5.5V to 60V voltage range	6V to 60V voltage range	**up to 48V**
3 high performance OpAmps integrated	External OpAmp required	**3~ feedback loop for accurate motor drive**
Integrated buck regulator	External boost-diode and capacitor required	**Small foot-print**
300 mA LDO integrated	30 mA LDO only	

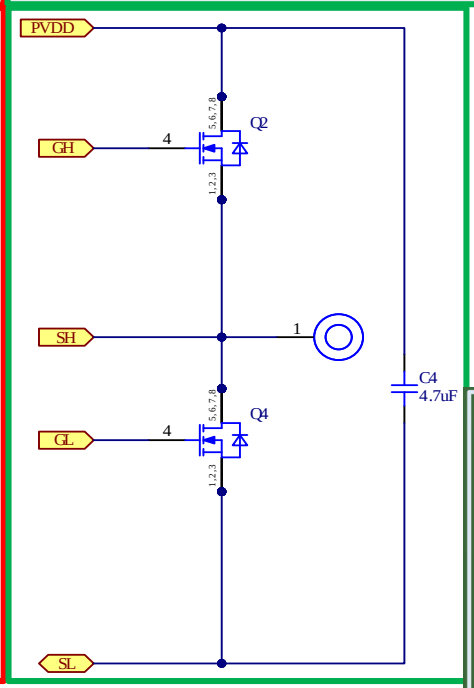
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Voltage vs Current Controlled (6EDL7141) Gate Driver - BOM Reduction Example

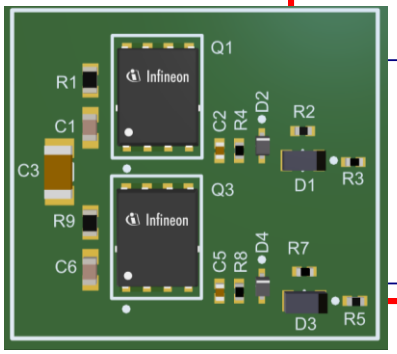
BOM / Schematics / Layout comparison of HB passive components

Component	Voltage source GD	Current source GD (6EDL7141)	Why can remove?
Rg	6x or 12x	None	Current control via digital settings
Rgs	6x	None	Internal pull downs both weak and strong
Diode (discharge)	6x	None	Independently programmable source/sink values
Snubber (Cds+Rds)	6x or 12x	None	Able to optimize dv/dt and di/dt and tune down ringing
Cbypass (HS Drain to LS src)	3x	3x or none	Able to optimize dv/dt and di/dt and tune down ringing
TOTAL Possible savings	-	18x-24x R, 6x D, 6x-10x C	-

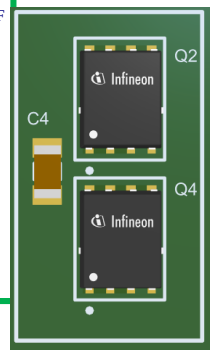




20x20mm



20x10mm



Benefits:

Cheaper BOM

Smaller PCB
inverter stage smaller for 50%

Compact layout enables:
1. *Low loop inductance,*
2. *Better EMI,*
3. *Higher efficiency,*
4. *Easier thermal design*

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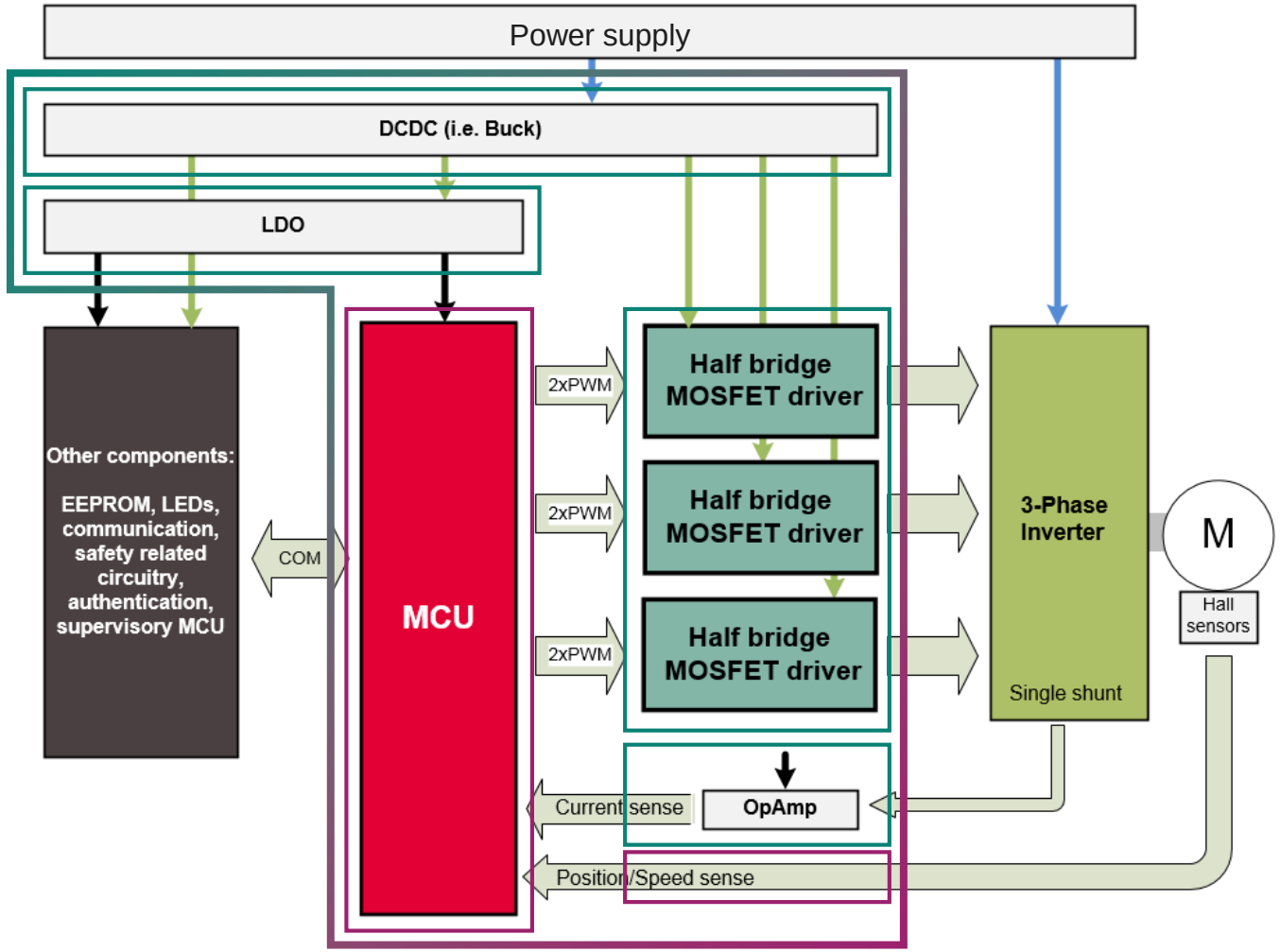
Increasing Power Density by Integration
BLDC electronic system overview

3-phase gate driver: 6EDL7141

- **Integrates** power supply, gate driver and current sensing
- **Extends** features: flexibility, protections, system support (braking, stall detection)

Motor controller: IMD700A

- **6EDL7141 + MCU ARM® Cortex-M0**
- **Peripherals** tailored for motor control: ADC, timers, comparators, positioning, co-processor



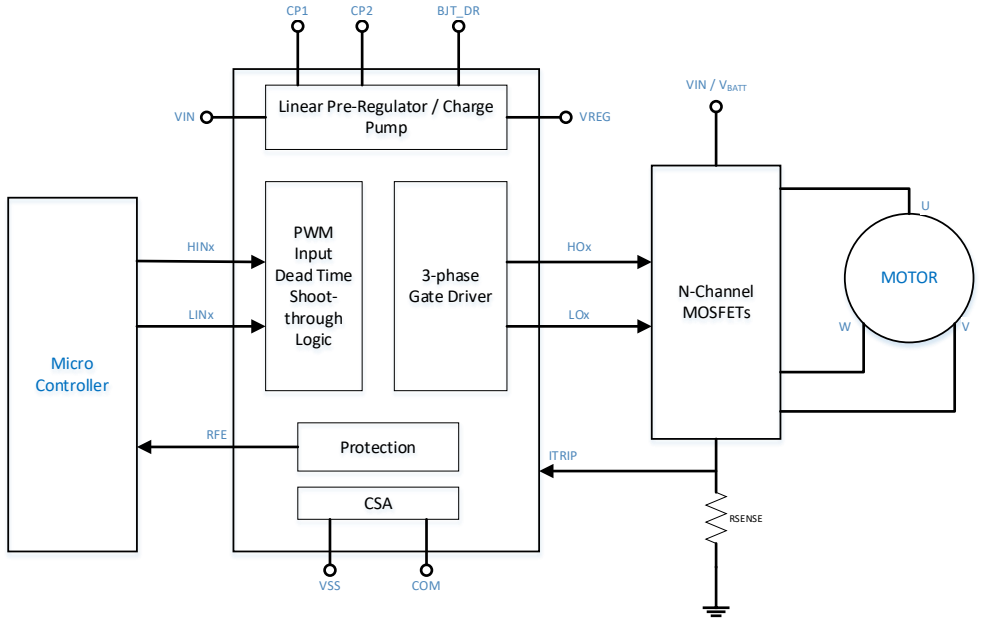
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6ED2742S01Q 160 V 3-phase SOI gate driver with PMU

Key features

- Bootstrap voltage (VB node) of +160 V
- **Wide input voltage range VIN of 6V to 140V**
- **I_{o+} / I_{o-} 1 A / 2 A** drive current (typical - peak)
- **Integrated power management unit (PMU) with:**
  - Linear pre-regulator to enable wide input VIN range
  - Integrated charge pump for stable VCC
- **Integrated trickle charge pumps for 100% duty cycle**
- **Integrated current sense amplifier w/four selectable gains**
- **Integrated ITRIP w/four selectable +/-5% accuracy thresholds**
- **Integrated** ultra-fast, low R_{DSON} **bootstrap diode**
- Independent, per channel under voltage lockouts (UVLO)
- Integrated shoot-through protection with built-in dead time
- **Integrated pre-regulator output drive for external BJT for high voltage / current parallel MOSFET applications**
- **Schmitt trigger inputs with hysteresis**
- **Integrated short pulse / noise rejection input filter**
- 2kV HBM ESD (JEDEC)
- 5x5mm QFN32 package

Sample schematic



Value proposition

- Widest input voltage operating range: 6 V to 140 V
- Lower system level BOM cost with integrated PMU, monolithic bootstrap diodes, ITRIP, Current Sense Amplifier, trickle charge pumps for 100% duty cycle operation
- Superior latch-up immunity with SOI
- Simple, low-cost solution for multiple applications

Applications

- BLDC motor control
- Power tools
- Home & garden
- Robotics
- LEV

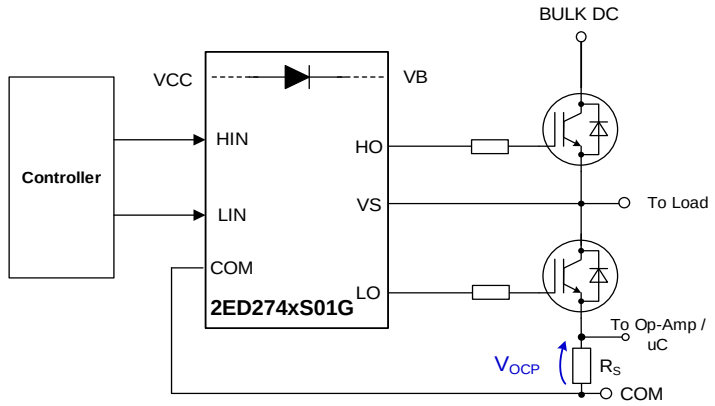
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2ED2742 / 44 / 48S01G 160 V SOI Half-bridge gate driver family
With integrated bootstrap diode, separate logic and power grounds

Key features

- 160V SOI Half-bridge drivers
  - I_{O+} / I_{O-} Peak source / sink current drive: 1A / 2A, 2A / 4A, 4A / 8A
- Bootstrap voltage support up to 160 V max.
- Separate VSS / COM grounds for improved noise immunity
- Three current drive versions as noted in table below
- Integrated ultra-fast, low R_{DSON} bootstrap diode
- Independent, per channel under voltage lockouts (UVLO)
- Integrated dead time
- Integrated shoot-through protection logic
- Schmitt trigger inputs with hysteresis
- Integrated short pulse / noise rejection input filter
- 2kV HBM ESD compliance
- 3x3 mm DFN10 with thermal pad
  - Footprint compatible with MP1921 series

Sample system block diagram (HB)



Value proposition

- Lower system level BOM cost with integrated monolithic bootstrap diodes
- Superior latch-up immunity with SOI
- Small, simple, low-cost solution for multiple applications
- High current drive for parallel MOSFET applications
- High current drive for higher frequency or power applications
- Thermal pad for more efficient heat transfer

Part No.	Package	Drive current source / sink	Input logic	Cross conduction prevention logic	Dead-time (ns)	Ground pins	t_{ON} / t_{OFF}
2ED2742S01G	DFN10 3 x 3 mm	+ 1 A / - 2 A	HIN, LIN	Yes	100 ns	VSS / COM	50 ns / 50 ns
2ED2744S01G		+ 2 A / - 4 A					
2ED2748S01G		+ 4 A / - 8 A					

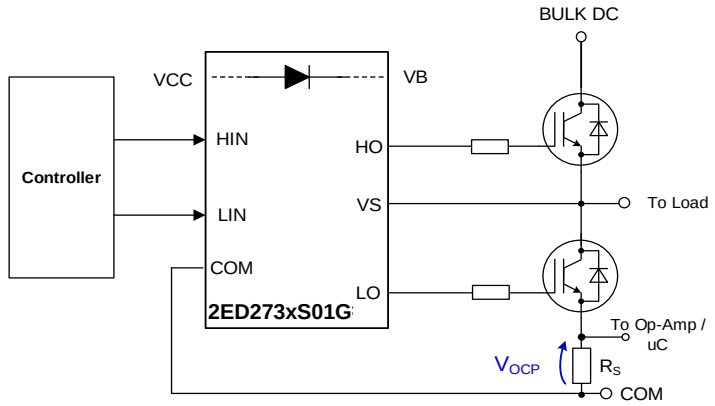
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2ED2732 / 34 / 38S01G 160 V SOI HS+LS gate driver family
With integrated bootstrap diode, separate logic and power grounds

Key features

- 160V SOI High-side and low-side drivers
  - I_{O+} / I_{O-} Peak source / sink current drive: 1A / 2A, 2A / 4A, 4A / 8A
- Bootstrap voltage support up to 160 V max.
- Separate VSS / COM grounds for improved noise immunity
- Three current drive versions as noted in table below
- Integrated ultra-fast, low R_{DSON} bootstrap diode
- Independent, per channel under voltage lockouts (UVLO)
- Schmitt trigger inputs with hysteresis
- Integrated short pulse / noise rejection input filter
- 2kV HBM ESD compliance
- 3x3 mm DFN10 with thermal pad
  - Footprint compatible with MP1921 series

Sample system block diagram (HS+LS)



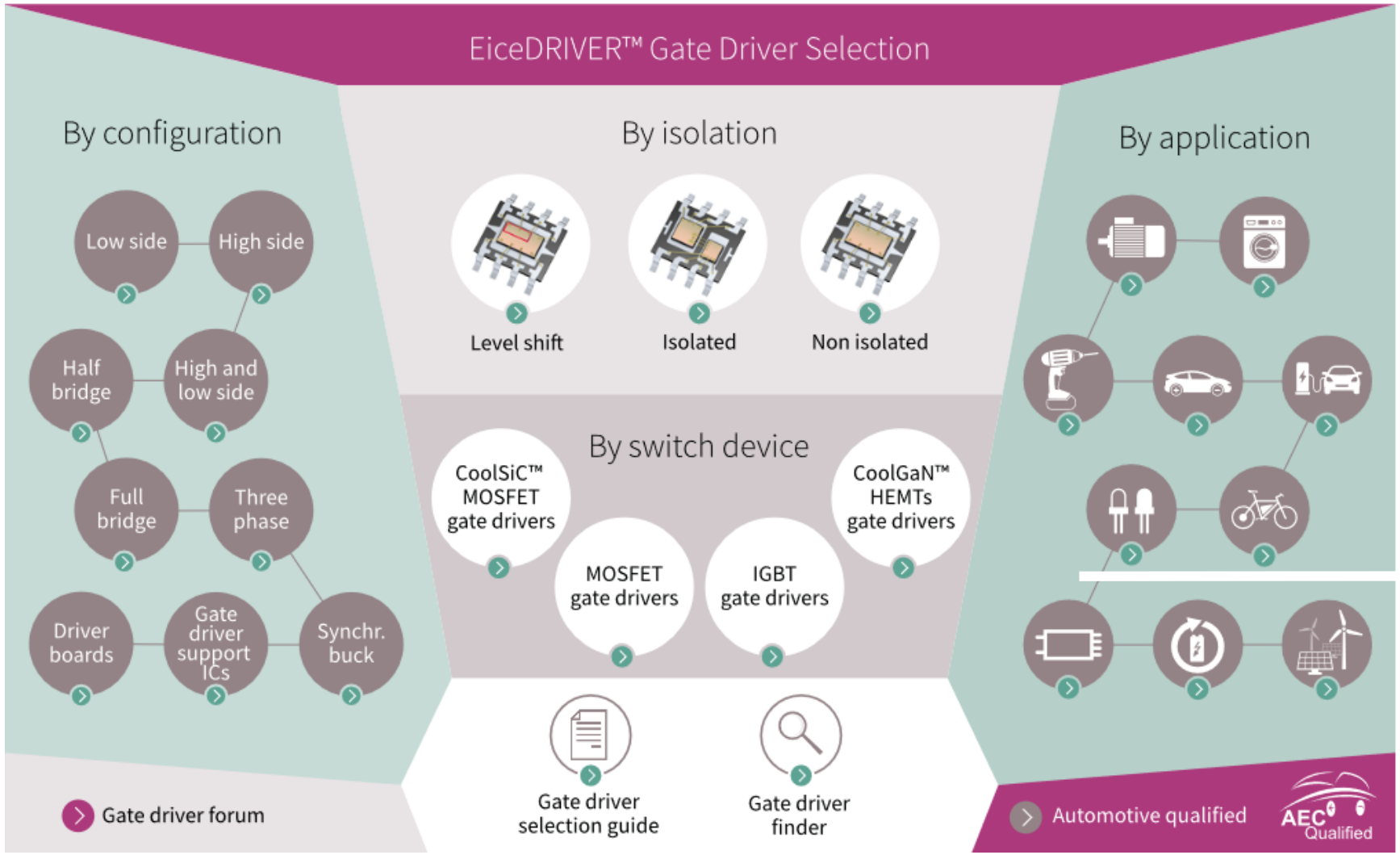
Value proposition

- Lower system level BOM cost with integrated monolithic bootstrap diodes
- Superior latch-up immunity with SOI
- Small, simple, low-cost solution for multiple applications
- High current drive for parallel MOSFET applications
- High current drive for higher frequency or power applications
- Thermal pad for more efficient heat transfer

Part No.	Package	Drive current source / sink	Input logic	Cross conduction prevention logic	Dead-time (ns)	Ground pins	t_{ON} / t_{OFF}
2ED2732S01G	DFN10 3 x 3 mm	+ 1 A / - 2 A	HIN, LIN	No	None	VSS / COM	50 ns / 50 ns
2ED2734S01G		+ 2 A / - 4 A					
2ED2738S01G		+ 4 A / - 8 A					

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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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iMotion™, XMC™, PSoC, Traveo II or AURIX™

Infineon has the right micro controller for your needs

iMotion™



- ✓ Turnkey solution (MCE 2.0)
- ✓ IMC100/300
- ✓ ready2use motor control
- ✓ Integration with controller and drivers
- ✓ Customer need a “ready-to-go” solution

XMC™



- ✓ Cortex ARM M based MCU
- ✓ XMC1000 – Cortex M0 (48MHz-)
- ✓ XMC4000 – Cortex M4F (144MHz-)
- ✓ Modus ToolBox application & GUI available for Motor Control FOC, BLDC, PMSM and more
- ✓ SW security libraries protection

PSoC™ 4



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

PSoC™ 6

- ✓ Dual Core – CM4F 150MHz, CM0+ 100MHz
- ✓ Up to 2M Flash, 1M SRAM
- ✓ Enhanced TCPWM (P6-256k)

Traveo II



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

AURIX™



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

	iMotion™	XMC™	PSoC™ 4	PSoC™ 6	Traveo II	AURIX™
Does the customer write their own motor control SW?	No	Yes	Yes	Yes	Yes	Yes
Does the customer want standalone driver and controller?	No	Yes	Yes	Yes	Yes	Yes
Does the customer need SW update and security features?	No	Yes	Yes / No	Yes / Yes	Yes	Yes
Is functional safety required (e.g. SIL-x) for the application?	IEC60730 Class B	IEC60730 Class B	IEC60730 Class B	IEC60730 Class B	Yes – up to ASIL-B	Yes – up to ASIL-D
Low power consumption	Low power	Low power	Low power	Ultra low power	No	No
CPU performance	Medium	Medium to High	Medium	High to Very High	Highest	Highest
Special features	PFC option Integrated with gate drivers and power switches	Robustness Peripherals tailored for motor control	IoT features	IoT features	Security and safety in ARM Cortex, high processing power	Automotive qualified, high processing power

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Recommended MCUs for the right fit solution



MCU			
			
PSoC™	XMC™	TRAVEO™ II	AURIX™

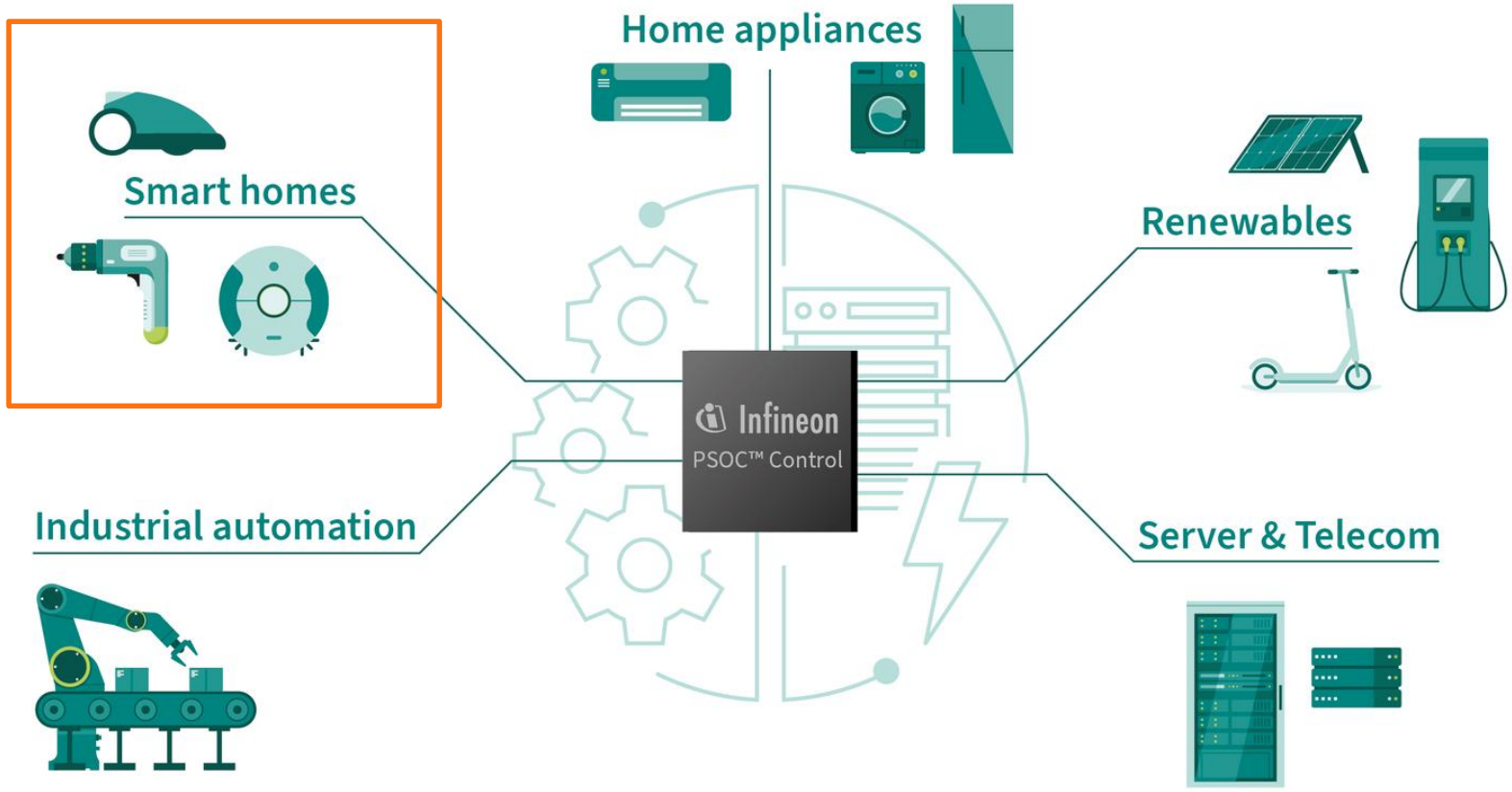
	Part number	Core	Core Frequency	Package	Memory Flash / RAM	Safety/Security	Rational
PSoC	CY8C61x8	ARM Cortex M4F+M0	150 MHz 100 MHz	TQFP128, BGA124, 100-WLCSP (4.1x3.9mm)	Up to 2 MB / 1 MB	Class B Lib	General purpose, flexible dual
XMC	XMC4800	ARM Cortex M4F	144 MHz	LQFP100, LQFP144, LFBGA196	Up to 2 MB / 352 kB	Class B Lib	EtherCAT support, up to 125°C
Traveo II	CYT4BF8CD	ARM Cortex M7 Dual Core + ARM Cortex M0+	350 MHz 100 MHz	TEQFP-176, BGA272, BGA320	Up to 8 MB / 1 MB	ASIL-B (SIL 2) / Cryptography engine (e-SHE & HSM)	Ethernet support, Automotive qualified, up to 125°C
AURIX	TC337	TriCore	Up to 300 MHz	TQFP80 till LFBGA292	2 MB / 248 kB	ASIL-D (SIL 3) / Optional HSM	Robust, TriCore, Automotive qualified, up to 150°C

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PSOC™ Control C3 – Infineon's new Arm® Cortex®-M33 based MCU family with real-time control and differentiating control peripherals

PSOC™ Control C3

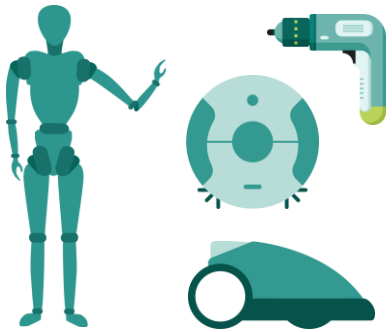
- **Arm® Cortex®-M33** based micro-controllers with up to 180 MHz
- **Real-time control** for motor and power conversion solutions
- **Scalable and compatible portfolio** in features, packages, pinouts, memory and performance
- **Differentiating control peripherals,** ready for Wide-bandgap solutions
- **PSA L2 / EPC2 security**
- **Class B / SIL 2 compliant** Safety libraries



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PSOC™ Control – Focus on Industrial & Consumer applications, ready for WBG and part of optimized Infineon solution offering

Smart Home



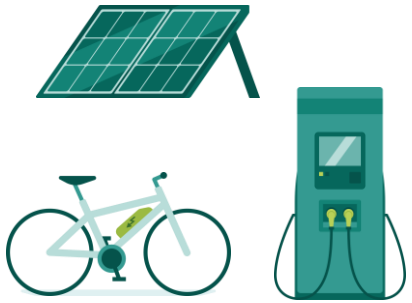
- Power/Gardening tools
- Lawn mower robots
- Home robots

Home Appliances



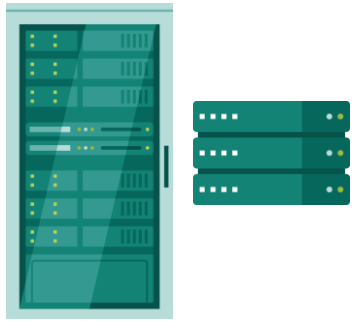
- Residential aircon ODU
- Large and medium Home Appliances Drives

Renewables



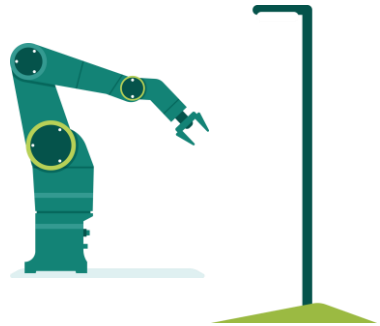
- PV inverters
- LEV
- EV charging

Server & Telecom (SMPS)



- Telecom PSUs
- Server PSUs
- Workstation PSUs

Industrial



- General purpose drives
- LED Lighting
- Servo Drives
- Commercial aircons

Motor Control

Power Conversion

Communication

SiC

GaN

Wide-bandgap (WBG) ready

System solution offering with other Infineon products

PSOC™ Control C3

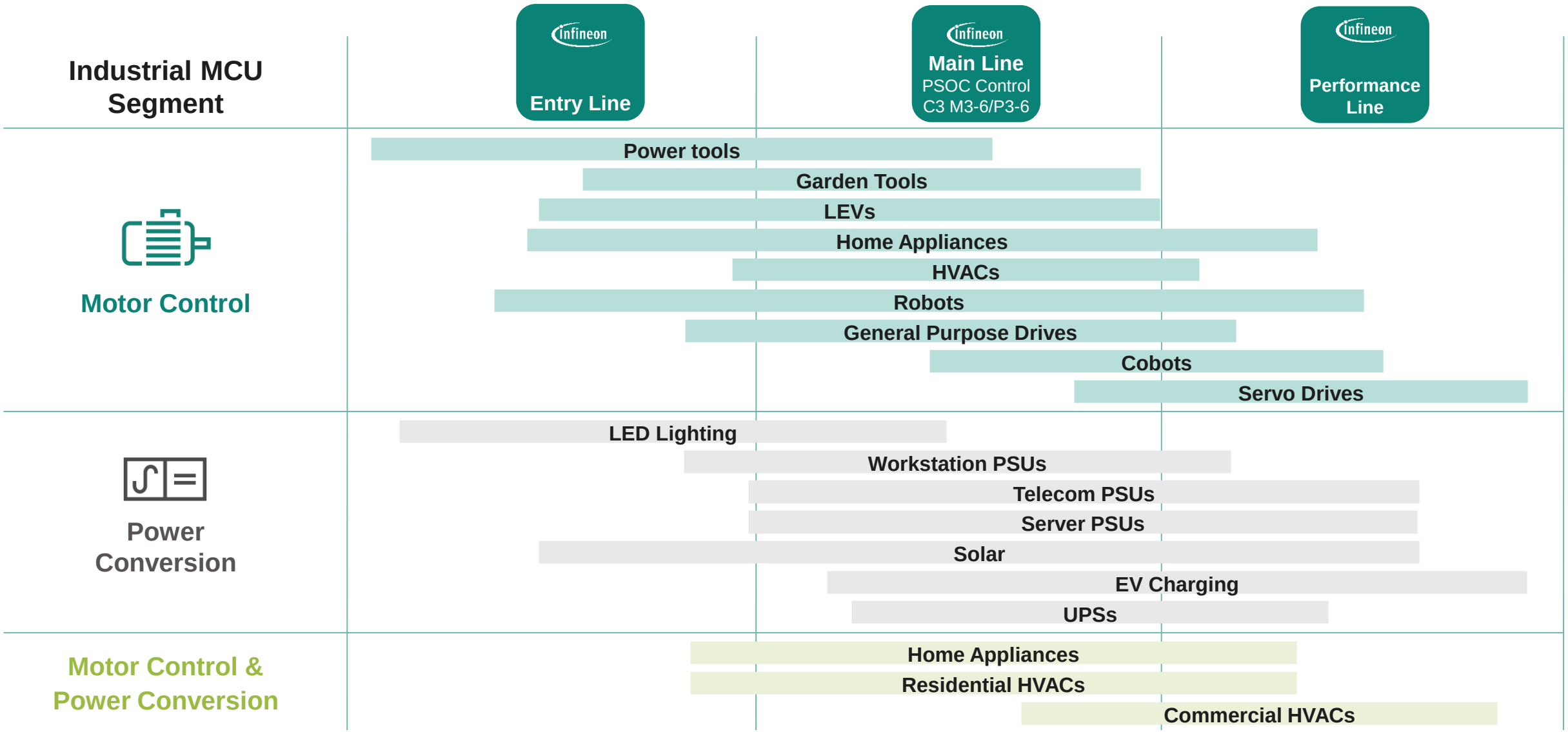
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PSOC™ Control C3 – Enabling developers to create high-performance, highly efficient and secured motor control and power systems with ease

	Customer and System Benefits	Features
Real-time control	**Enable high-performance systems to respond to real-time events** with minimal delay and low utilization – Systems combining dual-motor control and high-frequency multi-phase PFC – Very high RPM motor control systems with full dynamic control range	– **Fast analog and digital peripherals**, e.g. 12 MSPS ADC with 16 parallel S&H channels, 240MHz timers – HW Accelerators (DSP, FPU, CORDIC) for **boosted task execution** – **Trigger Matrix with direct interconnects** between ADC, timer, ACOMP for minimal control latency
System efficiency	**WBG-ready with fast, precise analog processing and digital control** to improve control loop accuracy and system efficiency – Power Conversion systems in Power Supply Units (PSUs) – FOC for motor systems **Low standby power** for battery powered applications	– **High sample rate, autonomous** analog with full control flexibility and digital IPs – **Versatile timers with 80ps high-resolution option** for finest control – Flexible topology coverage for increased efficiency
Ease-of-use for developers	**Quick time-to-market with ModusToolbox™** as unified and comprehensive software and ecosystem platform for developers	– **Turnkey solution** for complete development flow – **Motor and Power Suite** with multi-functional GUI as well as dedicated tools, advanced libraries, etc.
Advanced security	**Enable secure on-site and cloud-based systems** with secure Over-the-air (OTA) updates, software IP protection, and secure key storage	– **PSA L2 certified** with crypto accelerator, TrustZone, key management, secure storage for various security options

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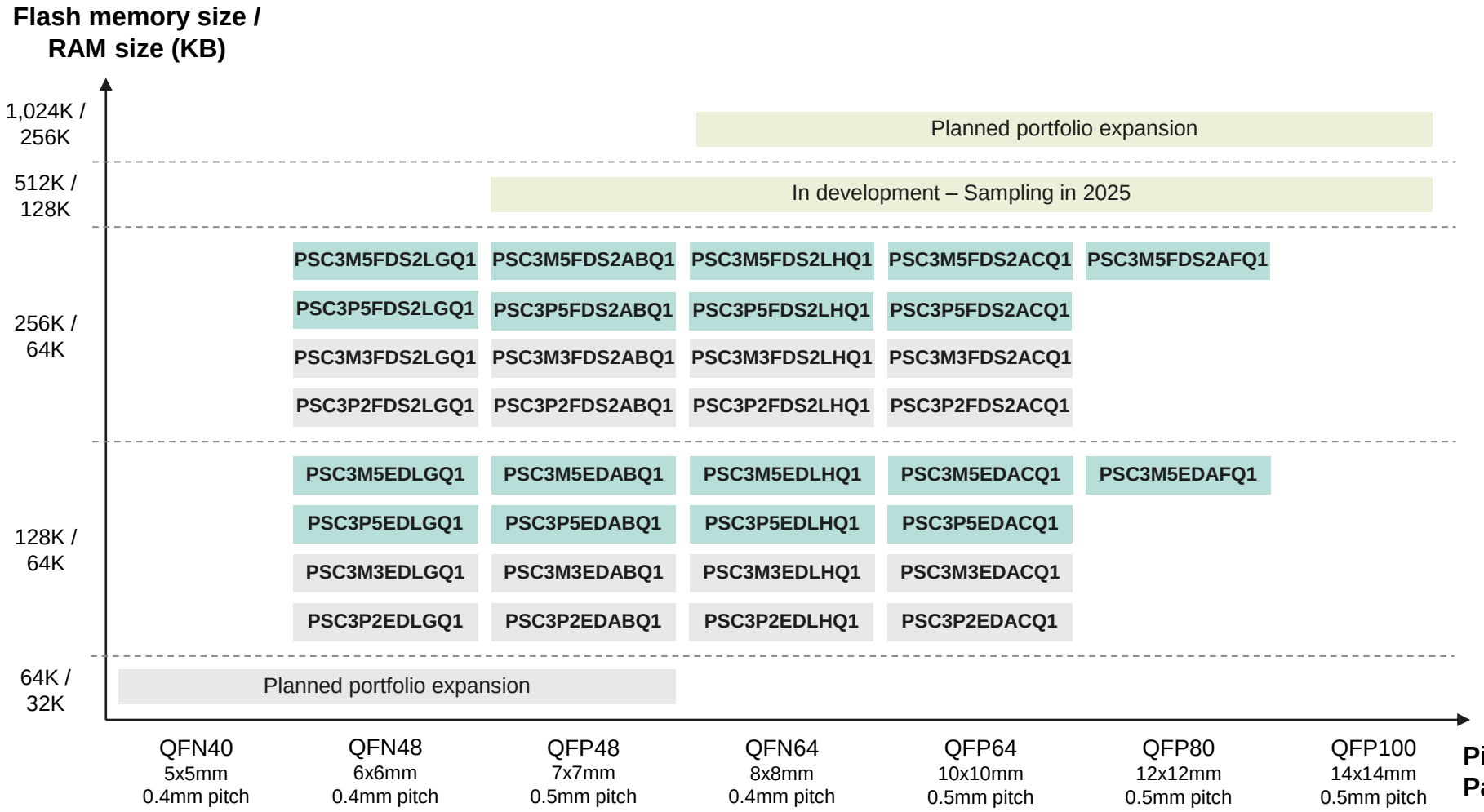
To enable a variety of applications with optimized solutions, we offer three different PSOC™ C3 product lines: Entry, Main & Performance



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PSOC™ Control C3 Portfolio – We are launching Main Line and Entry Line with 34 available parts for active design in

PSOC™ Control C3 – Portfolio and Device Overview



PSOC™ C3 Product Lines with full Software Compatibility

PSOC™ C3 Performance Line

PSOC™ C3 Main Line

ARM® Cortex® M33 up to 180MHz
DSP/FPU and CORDIC (option)
12-bit 12-MSPS ADC w/ 16 S&H
240MHz 16/32-bit TCPWM
100ps HRPWM Timers
PSA L2 Security and CAN-FD

PSOC™ C3 Entry Line

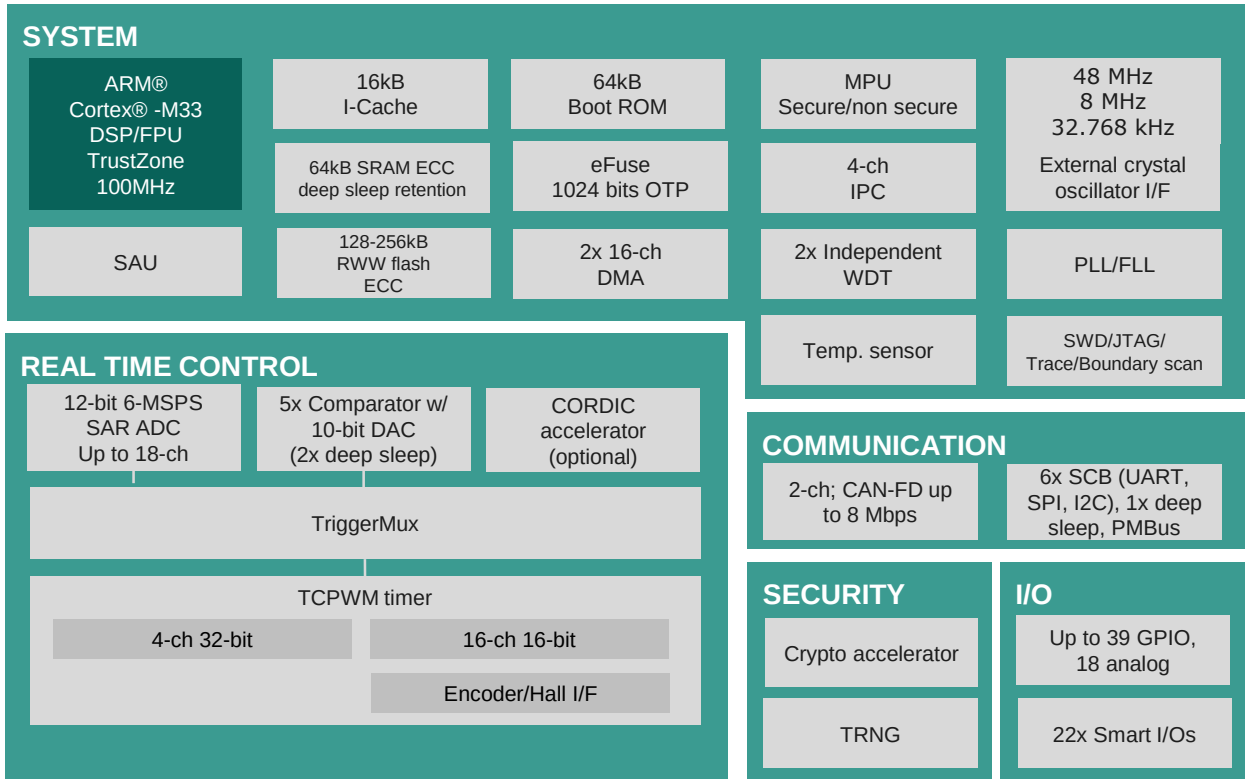
ARM® Cortex® M33 up to 100MHz
DSP/FPU and CORDIC (option)
12-bit 6-MSPS ADC w/ 16 S&H
120MHz 16/32-bit TCPWM
PSA L2 Security and CAN-FD

PSC3**M**: **Motor** (Cordic + MOTIF)
PSC3**P**: **Power** (PMBus)

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PSOC™ Control C3 Entry Line
C3P2 and C3M3

Block diagram



Status/Availability

- **In Development, prelim. DS available**
- **Samples & EVK** available
- **Qualified samples** Q3 2024
- **SOP:** Q4 2024

Packages

QFP-48 (7x7mm, 0.5mm)	QFN-48 (6x6mm, 0.4mm)
QFP-64 (10x10mm, 0.5mm)	QFN-64 (8x8mm, 0.4mm)

Applications and Target Markets

- **Industrial ready**
- Single and dual motor control, or PFC
- PFC, Power & Gardening tools, MHA and Aircon drives and compressors, LEV drives, SPMS

Product Highlights

- **Low power modes**: deep sleep (<10uA), sleep, hibernate (<1uA)
- **Idle sampling ADC**:
  - Low jitter and high performance, obsoleting external buffer caps
  - 6 MSPS, 24 ch sync. sampling, 16-bit oversampling, in-built gain
- **Comparators**: < 10ns in-built 10-bit DAC and slope generator
- 10-clock-cycles CORDIC Accelerator
- **Timer/Counter/PWM (TCPWM)**:
  - Complementary output/ch, multi-ch control, shadow update, input glitch filter, PRNG dithering
- **TriggerMux:** < 1ns latency programmable peripheral interconnects
- **Memory:**
  - 128-bit RWW Flash @ 20 Mhz, ECC on Flash & RAM
  - 16 kB Instruction Cache
- **Security**: PSA L2 certified, Configurable Flash Partitioning / Protection
- **Safety:** Class B & SIL 2 compliant

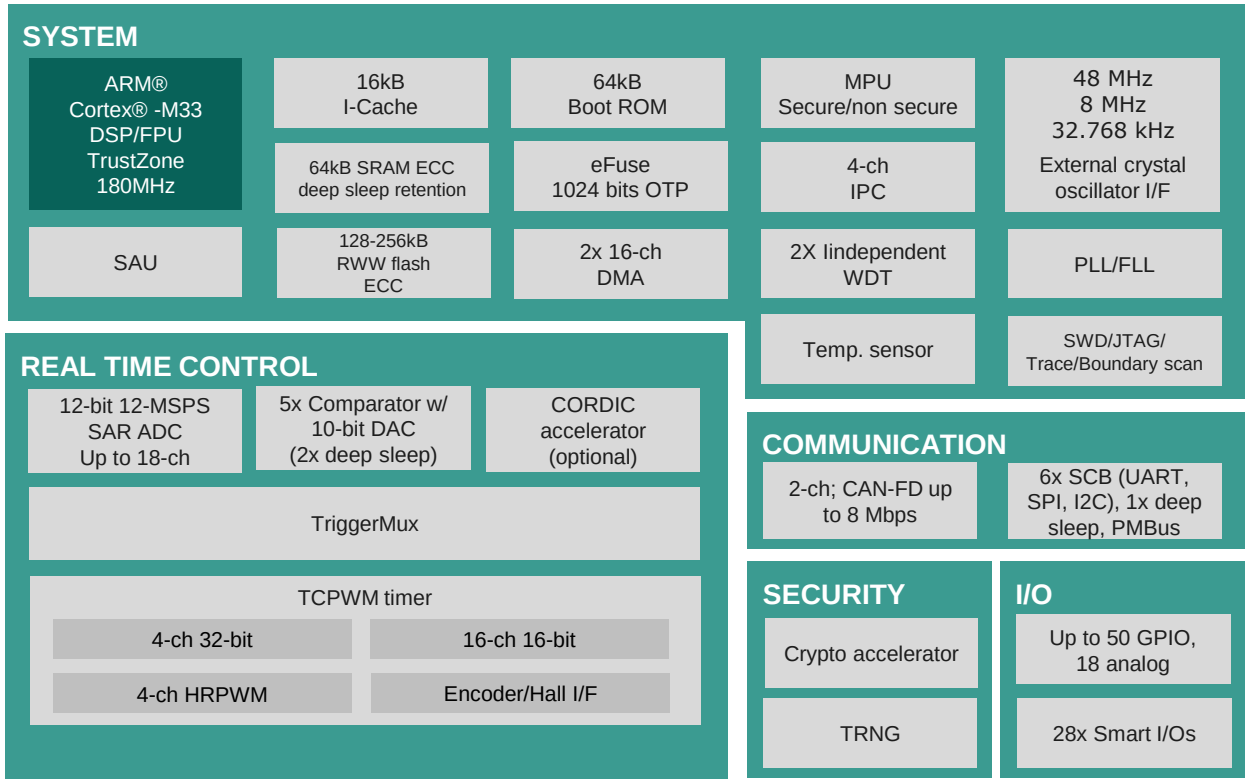
Operating Range

- 1.71 – 3.3V
- <1 – 10 µA low power modes
- -40 – 115°C Ta

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PSOC™ Control C3 Main Line
C3P5 and C3M5

Block diagram



Applications and Target Markets

- **Industrial ready**
- Single and dual motor control, and PFC
- PFC, Power & Gardening tools, MHA and Aircon drives and compressors, LEV drives, SPMS

Product Highlights

- **Low power modes**: deep sleep (<10uA), sleep, hibernate (<1uA)
- **Idle sampling ADC**:
  - Low jitter and high performance, obsoleting external buffer caps
  - 12 MSPS, 24 ch sync. sampling, 16-bit oversampling, in-built gain
- **Comparators**: < 10ns in-built 10-bit DAC and slope generator
- 10-clock-cycles CORDIC Accelerator
- **Timer/Counter/PWM (TCPWM)**:
  - Complementary output/ch, multi-ch control, shadow update, input glitch filter, PRNG dithering
  - < 100 ps high resolution PWM (HRPWM) for period, duty & dead time
- **TriggerMux:** < 1ns latency programmable peripheral interconnects
- **Memory:**
  - 128-bit RWW Flash @ 20 Mhz, ECC on Flash & RAM
  - 16 kB Instruction Cache
- **Security**: PSA L2 certified, Configurable Flash Partitioning / Protection
- **Safety:** Class B & SIL 2 compliant

Operating Range

- 1.71 – 3.3V
- <1 – 10 µA low power modes
- -40 – 115°C Ta

Status/Availability

- **In Development, prelim. DS available**
- **Samples & EVK** available
- **Qualified samples** Q3 2024
- **SOP:** Q4 2024

Packages

QFP-48 (7x7mm, 0.5mm)
QFN-48 (6x6mm, 0.4mm)
QFP-80 (12x12mm, 0.5mm)
QFP-64 (10x10mm, 0.5mm)
QFN-64 (8x8mm, 0.4mm)

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Discrete XMC microcontrollers for Motor Controller

ARM® Cortex® - M4F
- CPU Core up to 144 MHz
- High performance Flash
- Timer CCU4, CCU8, POSIF
- USB, up to 4x CAN
- Up to 6x serial channels
- Up to 4x 12-bit ADC / 2x DAC
- T_A = -40 to 105°C

XMC4100 / 4200
up to 256 kB Flash
40 kB RAM
48 – 64 pins

Mid-range motor control

XMC4400 120 MHz
up to 512 kB Flash
80 kB RAM
64 – 100 pins
Ethernet, ΔΣ-demod

XMC4500 120 MHz
up to 1 MB Flash
160 kB RAM
100 – 144 pins
EBU, SD card

XMC4700 144 MHz
up to 2 MB Flash
352 kB RAM
100 – 196 pins
6-ch CAN

XMC4300 144 MHz
up to 256 kB Flash
128 kB RAM, 100 pins

EtherCAT

XMC4800 144 MHz
up to 2 MB Flash, 352 kB RAM
100 – 196 pins

High end motor control

QFN48 – LQFP64 / 100 / 144 – BGA196

Long product life cycle (min. 2031)

Application specific peripherals

High Resolution PWM | **Event Request Unit** | **Analog comparators + sloge generator** | **PWM Timer (CCU8)** | **ΔΣ-demodulator**

ARM® Cortex® - M0
- Core up to 48 MHz
- Peripherals up to 96 MHz
- Timer CCU4
- Up to 4x serial channels
- 12-bit ADC
- T_A = -40 to 105°C

XMC1200
up to 200 kB Flash, 16 – 40 pins
9-ch LED control BCCU
3x analog comparators

XMC1100
up to 64 kB Flash, 16 – 40 pins

XMC1300
up to 200 kB Flash, 16 – 40 pins
MATH Co-Processor
CCU8 PWM timer
Hall & Encoder I/F

XMC1400
up to 200 kB Flash, 40 – 64 pins
2x CAN
2x CCU8
Up to 4 serial channels

Low end motor control

TSSOP16 / 28 / 38 – VQFN24 / 40 / 64 – TQFP64

Wide supply voltage range 1.8 – 5.5V

Secure bootloader – ensure IP protection

Application specific peripherals

MATH Co-Processor | **Event Request Unit** | **Analog comparators** | **PWM Timer (CCU8)** | **LED control (BCCU)**

XMC7100
4 MB Flash / 768 kB RAM,
250 MHz single/dual core
100 – 272 pins

XMC7200
8 MB Flash / 1 MB RAM,
350 MHz single/dual core
176 – 272 pins

› CPU Frequency up to **350 MHz**
› Single and **dual core** Arm® Cortex®-M7 and Cortex®-M0+
› Robust Flash technology: **Ta = -40 to 125°C**
› Up to 8 MB Flash, 1 MB RAM
› Interfaces such as CAN-FD, Gigabit Ethernet
› Extended voltage operating range: **2.7 to 5.5 V**
› External memory & SDHC interfaces, ADC, Timer/Counter/PWM, serial comm. channels

NEW

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Discrete MCU for Motor Controller – XMC4800 with EtherCAT

SYSTEM

ARM® Cortex®-M4F 144 MHz	**FPU**	SysTick	RTC	System Control Unit (SCU)
	DMA Up to 12 channels	CRC Engine	Instruction CACHE 8 kB	
	Programmable Interconnect Matrix		WDT	Temperature sensor

TIMER / PWM

4x PWM Timers (CCU4) 4 channels, 16 to 64-bit, 96 MHz	**2x PWM Timers (CCU8) 8 channels, 16 to 64-bit, 96 MHz + dead-time**

ANALOG

4x 8 channels 12-bit ADC 4 Msps	
4x ΔΣ-Demodulator	2x 12-bit DAC

MEMORY

96 kB + 128 kB + 128 kB RAM
2048 kB Flash with 8 kB i-cache

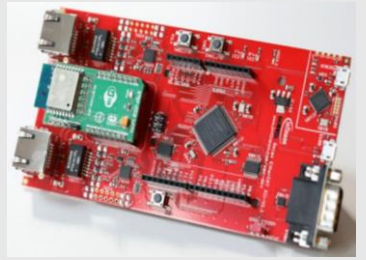
COMMUNICATION

6x USIC usable as: Double-SPI, Quad-SPI, UART, I²C, I²S, LIN	**6x CAN 256 Message Objects**	USB (FS OTG)	
2x Hall & Encoder I/F (POSIF)	10/100 Ethernet MAC (IEEE 1588)	LED & Touch-Sense (LEDTS) for HMI	
100 Mbps **EtherCATSlave** Interface EtherCAT		SDIO/SD/MMC Interface	External Memory Interface (EBU)

Description

Application / target markets

- Medium to higher-end industrial control
- Industrial communication
- Transportation



XMC4800 IoT AWS WIFI Kit

Key features

- Cortex-M4F @ 144 MHz with FPU
- **EtherCAT** interface
- Large on-chip memories up to **2 MB Flash, 352 kB RAM**
- Up to **6 CAN nodes with 256 message objects**
- Rich industrial and external media connectivity
- **125°C** extended temperature range
- Long-term availability with >15 years
- IEC 60730 class B compliant LIB
- Free DAVE™ IDE and DAVE Apps

Packages

LQFP100
LQFP144
LFBGA196



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Discrete MCU for Motor Controller – XMC4400 with HRPWM

SYSTEM

ARM® Cortex®-M4F 120 MHz	**FPU**	SysTick	RTC	System Control Unit (SCU)
	DMA Up to 8 channels	CRC Engine	Instruction CACHE 4 kB	
	Programmable Interconnect Matrix	PRNG	WDT	Temperature sensor

TIMER / PWM

4x PWM Timers (CCU4) 4 channels, 16 to 64-bit, 96 MHz	**2x PWM Timers (CCU8) 4 channels, 16 to 64-bit, 96 MHz + dead-time**	**4x HRPWM 150 ps**

ANALOG

2x 8 channels 12-bit ADC 4 Msps	
4x ΔΣ-Demodulator	2x 12-bit DAC

MEMORY

16 kB + 32 kB + 32 kB RAM
512 kB Flash with 4 kB i-cache

COMMUNICATION

4x USIC usable as: Double, & Quad SPI, UART, I²C, I²S, LIN	**2x CAN 64 Message Objects**	USB (FS OTG)
2x Hall & Encoder I/F (POSIF)	**10/100 Ethernet MAC (IEEE 1588)**	LED & Touch-Sense (LEDTS) for HMI

Description

Application / target markets

- Motor Control
- Solar inverters
- Switched mode power supplies



XMC4400 Drive Card

Key features

- Cortex-M4F @ 120 MHz with FPU
- High resolution PWM 150 ps
- Up to 512 kB Flash and 80 kB RAM on-chip memories
- Motor control Hall and encoder interface (POSIF)
- Rich industrial connectivity
- 125°C extended temperature range
- Peripherals Clock: 120 MHz
- IEC 60730 class B compliant LIB
- Free DAVE™ IDE and DAVE Apps



XMC4400 Platform2Go

Packages

LQFP64
LQFP100



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Discrete MCU for Motor Controller – XMC1404

SYSTEM

ARM® Cortex®-M0 48MHz	**96 MHz MATH Co-Processor**	On-chip Oscillator	RTC
	SysTick	Clock Input 4-20 MHz & 32 kHz	System Control Unit (SCU)
	Programmable Interconnect Matrix	Secure Bootloader (optional)	PRNG
	Temperature Sensor	VREG	WDT

TIMER / PWM

2x PWM Timers (CCU4) 4 channels, 16 to 64-bit, 96 MHz	**2x PWM Timers (CCU8) 4 channels, 16 to 64-bit, 96 MHz + Dead-Time**

COMMUNICATION

2x CAN 32 Message Objects	4x USIC usable as: Single-SPI, Double-SPI, Quad-SPI, SCI/UART, I²C, I²S, LIN

ANALOG

12-bit ADC 2x Sample & Hold, up to 12 channels	Up to 4x Analog Comparator

MEMORY

FLASH 200 kB ECC, Pre-fetch	RAM 16 kB

APPLICATION SPECIFIC

2x Hall & Encoder I/F (POSIF)	Touch-Sense Up to 24 pads	LED control 9 channels	LED Matrix 3 x 64 segments

Description

Why XMC1404?

- Peripherals tailored for Motor control with Field Oriented Control (FOC)
- CPU performance fit to the application
- Applicable as motor control in addition to main MCU for simple designs
- 105°C extended temperature range

Motor Control Features

- MATH Co-processor featuring CORDIC: hardware-efficient iterative method to calculate elementary functions
- CCU8 – 96 MHz PWM timer dedicated to motor or engine control with dead time
- POSIF - Hall position sensor & Encoder interface
- 1 Msps ADC with additional internal reference multiple signal processing features

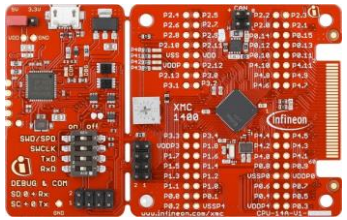
Connectivity

- Universal Serial Interface Channel (USIC)
  - One channel used internally for SPI communication with 6EDL7141
  - 3 channels programmable as serial Protocols
- 2x CAN & Programmable GPIOs

Packages

VQFN48
VQFN64
LQFP64





XMC1404 Boot Kit

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Robust sensors for efficiency & safety in motor drives

Current sensing

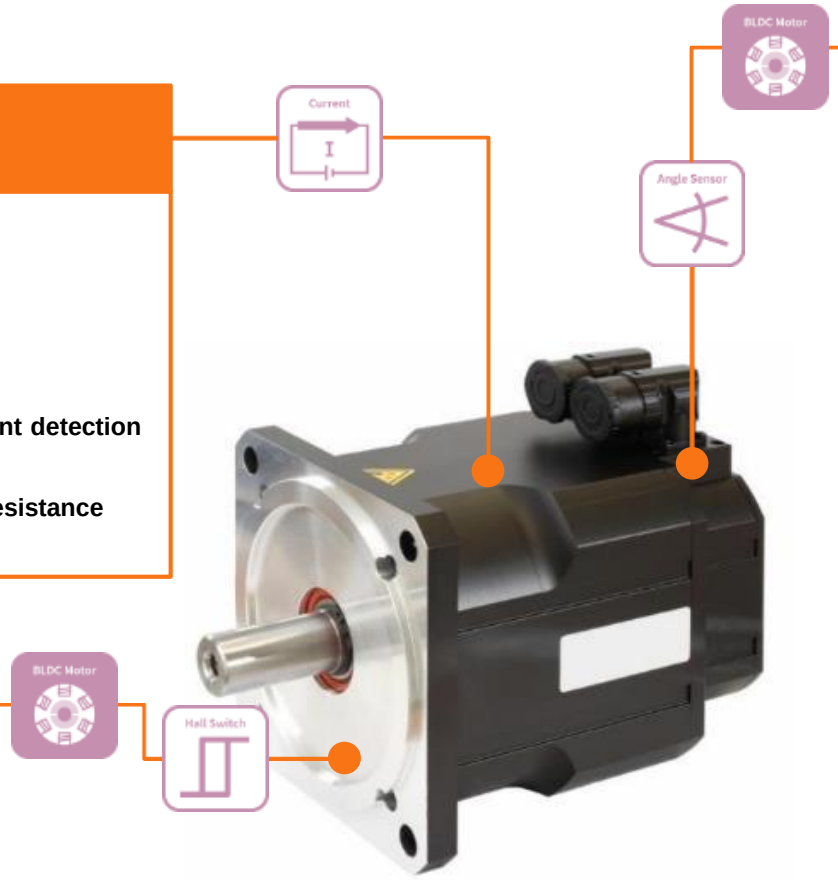
TLI4971

- Up to 70 A_{RMS} (120A FSR)
- **High bandwidth** of 240 kHz
- Intrinsic stray-field cancellation
- Superior **linearity and overload capability**
- **Analog output signal PLUS** 2x digital **fast overcurrent detection**
- Integrated Functional Isolation supporting 1150 V_{IORM}
- SMD sensor package with **integrated Low sensing resistance current rail (220 µΩ)**

Lower resolution rotor position sensing

TLI4961 / TLI4963 - Hall Latch

- High sensitivity bipolar Hall latch
- Very low current consumption (1.6 mA)
- High supply voltage + overvoltage up to 42 V (TLI4961)
- Low cost with supply voltage range 3 – 5.5 V (TLI4963)
- Versions in leaded packages (SSO) as well as SMD with smallest footprint (SOT23)



High resolution rotor position sensing

TLE5009(D) – Angle Sensor

- iGMR based angle sensor with full 360º Analog Sin/Cos output
- Pre-amplified temperature compensated signals
- Very short signal delay
- For speed up to 30000 rpm

iGMR

TLI5012B(D) – Angle Sensor

- iGMR based angle sensor with full 360°
- ≤ 1.9º angle error over temperature and lifetime
- Integrated angle calculation
- Interfaces: SPI, IIF, PWM, SPC, HSM
- Temperature compensation and auto-calibration

iGMR

TLE5501 – Angle Sensor “Single Dual Die”

- 360º TMR-based sensor
- Analog sin/cos
- Large output signals of up to 0.37 V/V enabling direct MCU connection
- ISO26262-compliant development targeting ASIL D(D)

iTMR ASIL

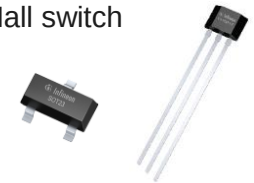
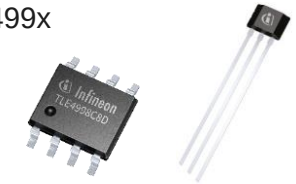
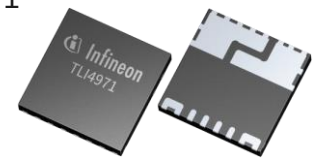
TLE5014(D) – Angle Sensor – Single & Dual

- Programmable iGMR digital angle sensor with E2PROM and look-up table
- 12-bit resolution
- SENT, SPC, PWM, SPI interface
- High accuracy (<1º error)
- ISO26262-compliant development targeting ASIL C(D)

iGMR ASIL

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Overview of magnetic sensors

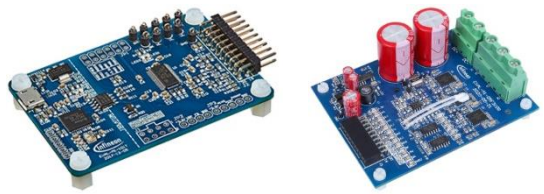
	Position				Current
	Hall Switch	**Angle Sensor**	**3D Hall**	**Linear Hall**	**Current Sensor**
Features	› Halogen free › SOT23/TO92 package › Leaded package for BLDC applications › 1.6 mA current consumption › Overvoltage capability up to 42 V › 3 V to 32 V or 5V operating supply voltage › Integrated temperature compensation of magnet characteristics	› DSO8 package › High accuracy, short delay times ideal for fast turning BLDC application › Signal output is independent from magnetic field strength and temperature › On-chip temperature compensation › Multiple interfaces (SPI, PWM, Incremental, Analog)	› Min. current consumption: 7 nA › Temperature range: -40°C to +125°C › Max. magnetic field +/- 130 mT › Data resolution 12-bit › Interface: 1²C digital	› Fully digital signal processing › EEPROM for end-of-line programming › Various leaded and SMD packages available TLE4997 › Analog ratiometric DAC-output › Potentiometer replacement TLE4998 › Integrated stress compensation › Interfaces: PWM, SENT, SPC	› Galvanic isolated › Easy to implement: package with integrated current rail › No hysteresis due to coreless concept › Inherent suppression of magnetic stray field › AC & DC range: ±120 A › Overcurrent detection › No external components required
Benefits	› Small form factor package › Energy efficiency › ESD robustness › Compact system design › Reliable system operation › Design flexibility	› Small form factor package › Full turn 360° resolution › Highest motor efficiency › Stable and reliable operation › Low BOM count	› High flexibility – allowing 1-3 dimensions and angle measurement › Small 6-pin SMD package › Extremely small WLB package available	› Easy implementation › High accuracy › Single and Dual Die versions available › Portfolio offers high flexibility for Safety critical applications	› Electronic torque & speed control › Remaining battery lifetime › Remaining charging time › Increased battery use cycles
Products	TLx496x Hall switch 	Angle sensor TLI5012B, TLE5501 	3D Sensor TLx493D 	TLE499x 	TLI4971 

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BLDC Motor Control – IMC101T & IRSM005-301 Evaluation (320 W)

Technical Details

Nominal input voltage	30 V to 72 V (typical 48 V)
Maximum current	6.5 A / phase
Rated power	320 W (without heatsink)



Overview

- **Typical 48 V BLDC Motor operation**
- Single-shunt current sensing configuration on power stage + gate driver board
- Control algorithm: Hall sensored/sensorless FOC, Sinusoidal
- OPN: EVALM105F310RTOBO1 (power stage + gate driver evaluation board)
- Overcurrent protection leading to PWM shutdown signal
- Overheating protection with on-board NTC thermistor
- OPN: EVALM1101TTOBO2 (Motion Control Engine evaluation board) of 65 x 45mm
- On-board debugger compatible to XMC Link/SEGGER J-Link

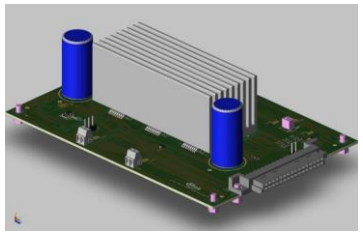
Product type	Function	Part number	Description	Package mm x mm	Qty
Intelligent power module	Half-bridge power module	IRSM005-301MH	100 V CIPOS™ Nano general purpose half-bridge with integrated gate driver, max. 21 mΩ at T_J 25°C & typ. Q_g 36 nC at V_{GS} = 10 V, max. DC current per MOSFET 30 A at T_C 25°C, UVLO, gate drive supply 10 – 20 V, logic input compatible for 3.3 V, 5 V, and 15 V	PQFN 7x8	3
Buck converter	15 V producer	ICE5GR4780AG	Integrated power IC CoolSET™ for offline SMPS with integrated 800V CoolMOS™ of typ. 4.13 Ω $R_{DS(on)}$, 125 kHz switching frequency, IC power supply 10 – 25.5 V, input bus voltage 30 – 600 V	DSO12 6x10	1
Schottky diode	Diode	BAS3005A-02V	30 V Schottky diode with forward current 0.5 A & typ. 0.45 V forward voltage, AEC qualified	SC79	8
Controller	Motor control IC	IMC101T-T038	Motor Control Engine (MCE) ready solution for variable speed drives of single motor, single/leg shunt current sensing, analog/digital Hall sensored & sensorless operation, Encoder interface, FOC algorithm & space vector PWM with sinusoidal commutation, host interface options: UART, PWM, analog input signal, T_A -40 to 105°C, DC bus input voltage 12 – 400 V, digital supply voltage 3 – 5.5 V	TSSOP38 6.4x9.7	1
LDO	Voltage regulator	IFX1117MEV33	3.3 V LDO 1 A output, ±2% precision, short circuit & over-temperature protection, input voltage 4.7 V to 15 V – similar I_{OUT} replacement TLE4284DV33 (different packaging – DPAK)	SOT223	1
Schottky diode	Diode	BAS3010A-03W	30 V Schottky diode with forward current 1 A & typ. 0.41 V forward voltage, AEC qualified	SOD323	1
TVS diode	ESD protection	ESD237-B1-W0201	Bidirectional ESD diode 16 kV, max. working voltage ±8 V, 7 pF line capacitance, clamping voltage 13 V	0201	1

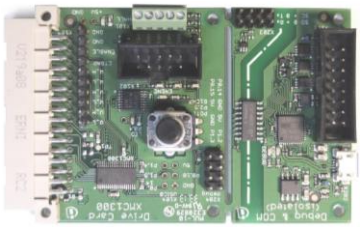
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BLDC Motor Control – 2EDL8124G & IPTC015N10NM5 Evaluation (3000 W)

Technical Details

Nominal input voltage	32 V to 52 V (typical 48 V)
Maximum current	65 A rms (per phase)
Rated power	3000 W





Overview

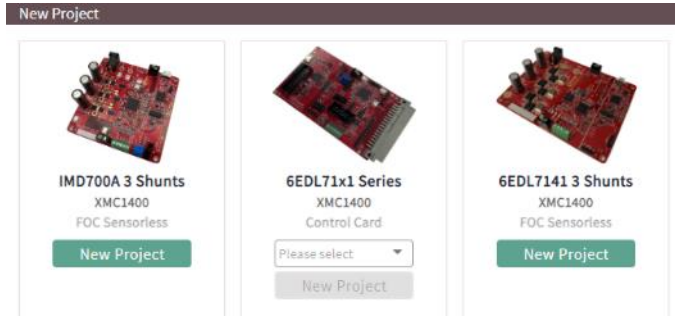
- **Typical 48 V BLDC motor operation up to 65 A load**
- **Integrated half-bridge TDI gate driver IC** including bootstrap diode
- Dual-side cooled power stage
- 10 kHz switching frequency & three current shunts
- Output over current protection & thermal shutdown
- Control algorithm: Trapezoidal/6-step/block commutation with Hall sensors & FOC
- OPN: EVALTOLTDC48V3KWTOBO2
- To be used with XMC1300 (or above) Drive Card (KITXMC1300DCV1TOBO1 with on-board debugger compatible with XMC Link)

Product type	Function	Part number	Description	Package mm x mm	Qty
N-MOSFET	3-phase power stage	IPTC015N10NM5	100 V OptiMOS™ 5 Power Transistor 1.5 mΩ with continuous I_D 354 A at T_C 25°C & V_{GS} 10 V & typ. Q_g 166 nC, top-side cooling package	HDSOP16 9.9x15	6
Gate driver	Dual channel gate driver	2EDL8124G	120 V high-side & low-side gate driver with true differential input (TDI), integrated bootstrap diode, I_O source 4 A & sink 6 A, shoot-through protection & UVLO, operating frequency up to 1MHz, supply voltage 8 – 17 V	VDSON8 4x4	1
N-MOSFET		IRLML6346TRPBF	30 V HEXFET™ Power MOSFET 63 mΩ at V_{GS} 4.5 V with continuous I_D 3.4 A at T_C 25°C & V_{GS} 10 V & typ. Q_g 2.9 nC	SOT-23	1
Buck converter	Voltage regulator	ILD8150E	DC-DC buck converter with hysteretic current regulation, output current up to 1.5 A, integrated 80V high-side MOSFET, UVLO & thermal protection, operating voltage 8 – 80 V, T_J -40 to 150°C	DSO8 4.9x6	1
MCU	Control PWM input	XMC1302-T038X0200	Cortex-M0 32-bit 32/64 MHz C/P clock 16 KB SRAM & 128 KB Flash with CCU8 PWM for easy 3-phase inverter implementation & POSIF interface for hall sensors/encoder, T_A -40 to 105°C	TSSOP38 9.7x6.4	1

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ModusToolbox™ Motor Suite
Where Visualization Meets Ease of Debugging

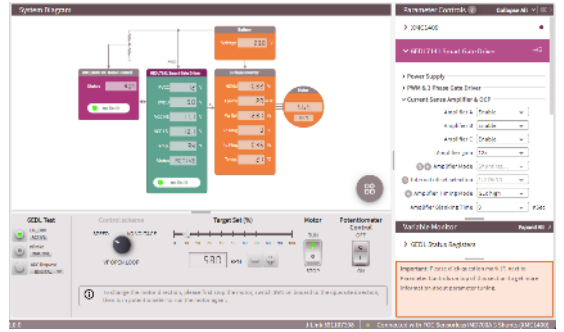
One Graphical Interface to operate **multiple** evaluation boards and control schemes

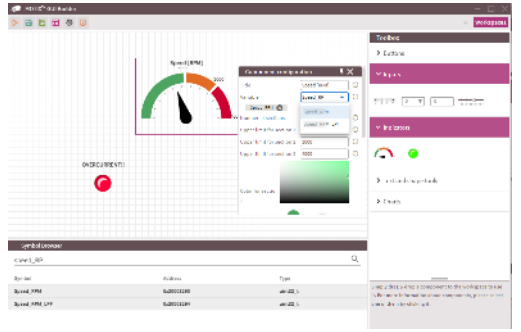




Motor Suite

Clear motor control parameters explanation with **user friendly** testbench updated **LIVE**





Easy visual evaluation with embedded Oscilloscope

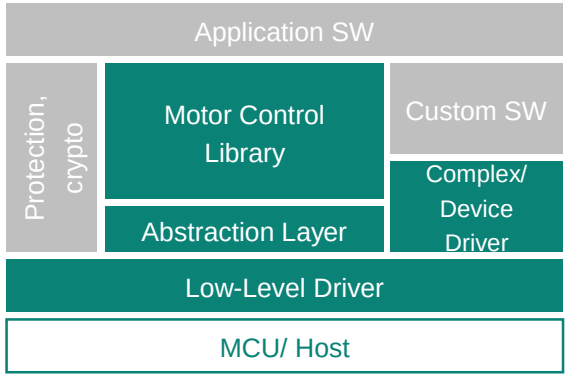
Build your own GUI Layout for **quick and easy** debugging / troubleshooting

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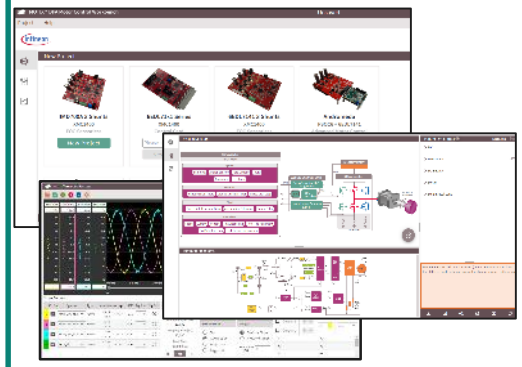
ModusToolbox™ Motor Suite: Delivering full Motor Control Offering

Motor Control Firmware Solution

- **Motor Control** FOC of BLDC/ACIM/PMSM Motor for applications such as **MHA**, **Fans**, **drives** etc,
- **Floating point** based Library implementation using MCU FPU advantages
- **1 and 3 shunt sensorless** FOC support
- **Trapezoidal control** with HALL sensor
- Current, speed,Torque control mode support
- Advance flux observer supporting SFO/RFO
- **High freq injection**, 6 pulse injection support
- **Dual PMSM motor control support**



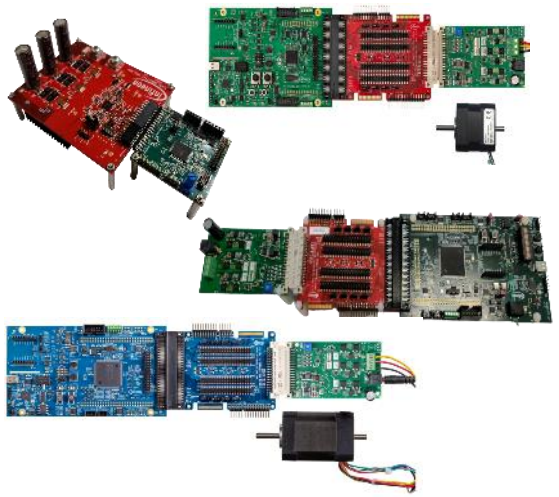
Tools



- Tool support for Motor Control Evaluation and design
- Motor parameter **tuning -configuration**
- Static and run-time parametrization
- **Test Bench View** –control , command , fault, protection panels
- **High-sampling-rate oscilloscope**
- Dual motor control support
- **Motor Profiler** for auto tuning
- GUI builder for customized GUI
- System and parameters block diagram views
- Exporting configuration to .csv format
- Generate files that will be used by MTB

Eval boards and Kits

- **PSOC Control C3** complete motor system kit for getting started
- **XMC7000** complete motor system kit for getting started



Collaterals



- Code example:
  - 1 shunt sensorless FOC PMSM motor
  - 3 shunt sensorless FOC PMSM motor
  - Trapezoidal control using HALL sensor
  - Dual motor sensorless FOC control
  - V-F 3 phase ACIM motor control
- App notes
  - 1-3 shunt sensorless FOC app note
  - Field oriented control for dual motor
- Training material
  - Getting started guide for motor control
  - E3 level deep dive training with hands ON for motor control
  - Tuning guide for adapting different motors and power cards

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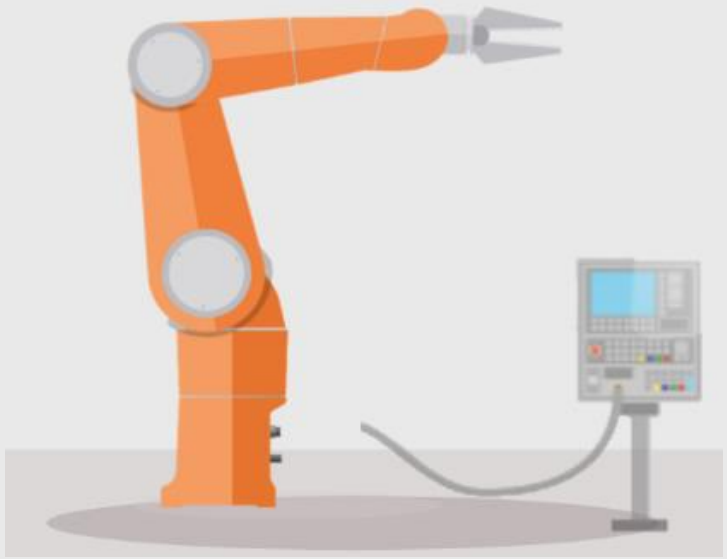
Power Supply (SMPS)

Efficient power conversion and power density for control box integration

Back to overview

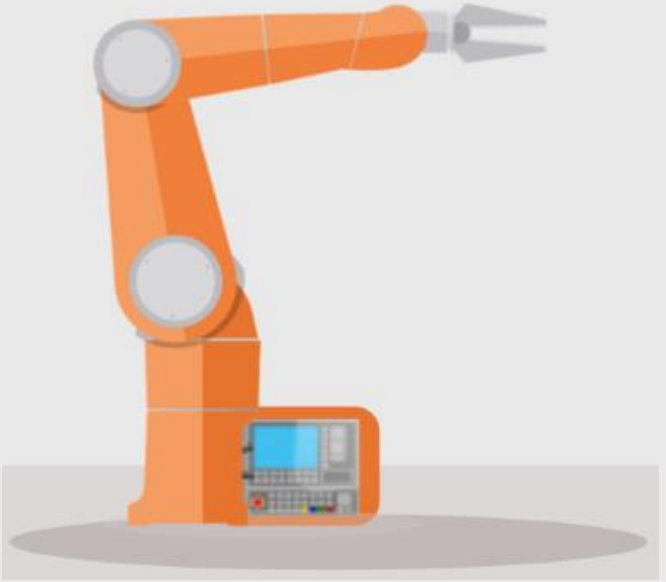
1st Application trend in Robotics SMPS: Power density

Previous Generation



Size, space & BOM reduction

Next Generation



Goal:

- get rid of the Control Box
- Assemble it in the “foot” of the robot

Impact on SMPS:

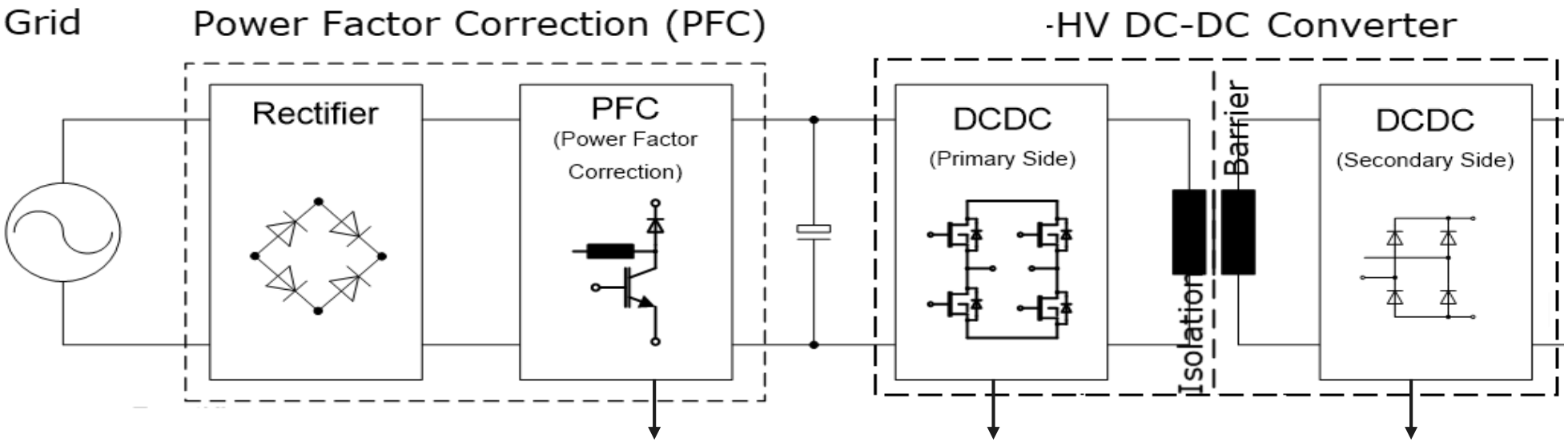
- Increasing power density requirement

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AC/DC SMPS for Cobots

PFC

HV DCDC



MOSFET	CoolMOS™ CoolGaN™ CoolSiC™
IGBT	TRENCHSTOP™ 5
Gate Driver	EiceDRIVER™
AUX Power	CoolSET™

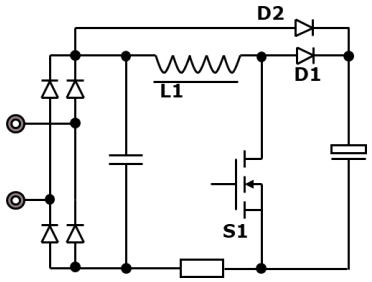
MOSFET	OptiMOS™ CoolGaN™
Gate Driver	EiceDRIVER™

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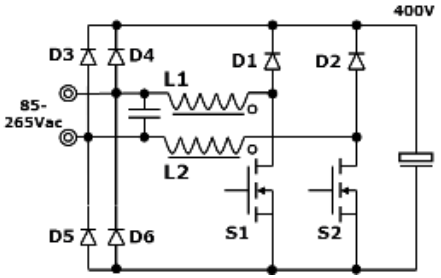
Typical topologies used in AC/DC SMPS

PFC

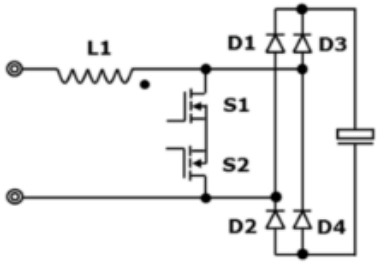
CCM Classic



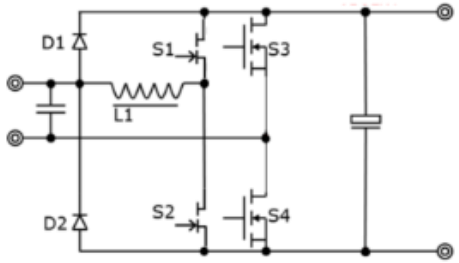
Dual Boost



H4 / H-Bridge

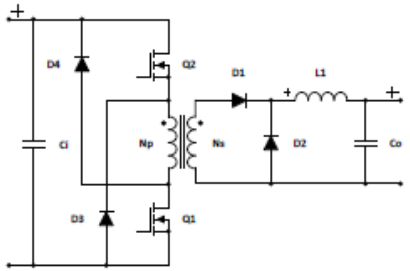


CCM Totem Pole

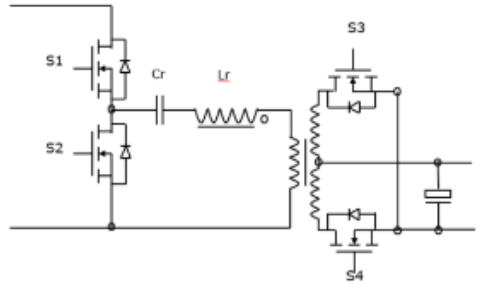


HV DCDC

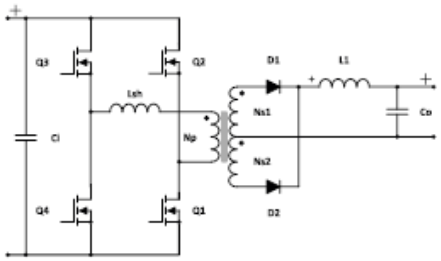
TTF



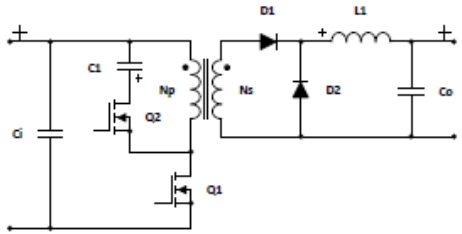
HB LLC



ZVS PSFB



Active Clamp



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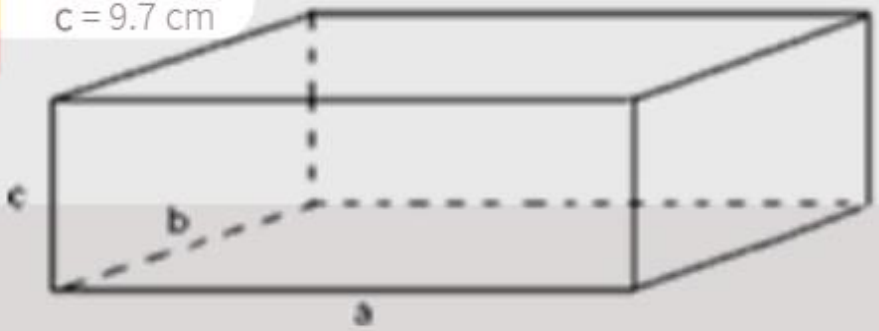
Current typical solution in industrial robots vs. Infineon high power density 1.6kW ACDC SMPS demo board

24 V/66 A SMPS for industrial robots



a = 39.5 cm
b = 20.5 cm
c = 9.7 cm

Volume =7854.5 cm³
Power density ~3.27 W/inch³



VS

90% Peak efficiency 96%

› Use of SMD power devices
› Full digital control
› Advanced planar transformer design

13 x smaller form factor

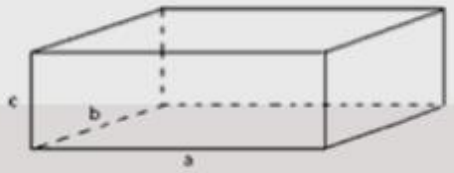
12 V/133 A IFX SMPS demo board



Same P_{out}, but double output current!

a = 19.3 cm
b = 7 cm
c = 4.4 cm

Volume =594.4 cm³
Power density ~44.2 W/inch³



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CoolMOS™, CoolSiC™, and CoolGaN™ in the 600V / 650V segment

CoolMOS™ SJ MOSFETs

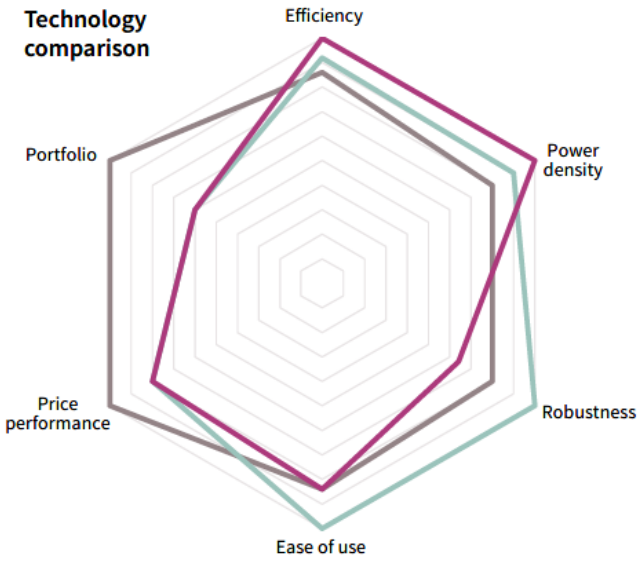
- Best price/performance for most efficiency requirements
- Largest super junction (SJ) MOSFET portfolio on the market
- Mature, stable, well established

CoolSiC™ MOSFETs

- High performance combined with robustness and ease of use
- High reliability especially with high temperature and in harsh environments
- Smaller system size

CoolGaN™ HEMTs

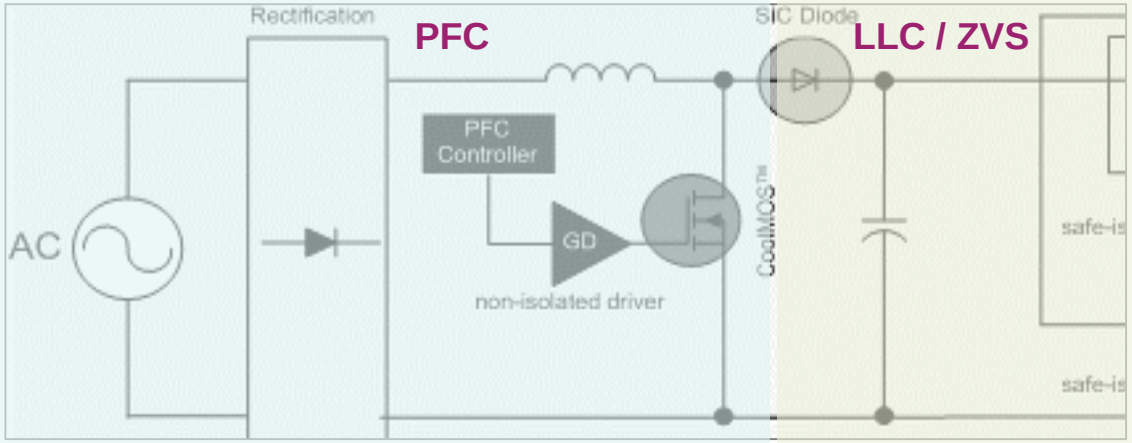
- Highest efficiency at the highest frequency
- Smallest system size
- Enables system integration

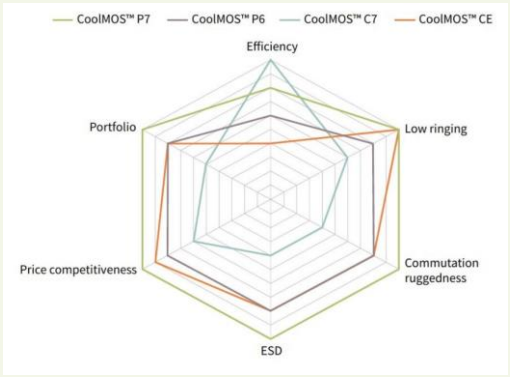


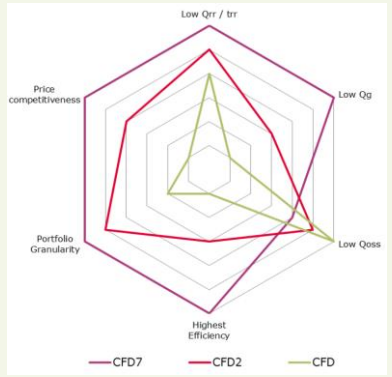
Parameter	CoolMOS™	CoolSiC™	CoolGaN™
Efficiency	★★★★☆	★★★★★	★★★★★
Frequency	★★★★☆	★★★★★	★★★★★
Power density	★★★★☆	★★★★★	★★★★★
Efficiency at max. Power density	★★★☆☆	★★★★☆	★★★★★
Robustness	★★★★☆	★★★★★	★★★☆☆
High temperature operations	★★★★☆	★★★★★	★★★★☆
Fit for bidirectional topologies	★★★☆☆	★★★★★	★★★★★
Ease of use	★★★★☆	★★★★★	★★★★☆
Price performance (greatly dependent on the application)	★★★★★	★★★☆☆	★★★☆☆
Portfolio granularity	★★★★★	★★★☆☆	★★★☆☆

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CoolMOS™ SJ: P7, C7, G7, and CFD7 with distinctive positioning







High performance

S7 600 V	C7 600 / 650 V	G7 600 V	CFD2 650 V	CFD7 600 / 650 V	PFD7 950 V	C7 600 / 650 V	G7 600 V
› Slow switching	› Minimized switching losses		› Fast recovery / body diode			› Minimized switching losses	
› Best $R_{DS(on)}$ * A * Price	› Efficiency & power density		› Reduced gate charge (CFD7 & PFD7)			› Efficiency & power density	
› Improved thermal resistance	› 4-pin Kelvin source for faster switching		› Lowest reverse recovery time (CFD7)			› 4-pin Kelvin source for faster switching	
› Minimized conduction losses	› Improved thermal properties		› Excellent thermal behaviour			› Improved thermal properties	
› Eliminated / reduced heatsink in solid-state design	› Highest performance		› Efficiency, reliability & ruggedness			› Highest performance	
			› ZVS / LLC / LCC (PFD7)			› High-end LLC	

Price / performance

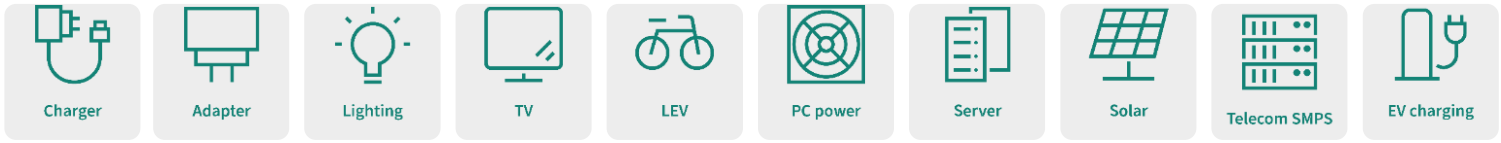
P6 600 V	P7 600 V	C3 800 / 900 V	P6 600 V	P7 600 V
› Ease of use		› Low specific on-state resistance ($R_{DS(on)}$ * A)	› Ease of use	
› Body diode ruggedness		› Outstanding cost/performance ratio	› Body diode ruggedness	
› Best price/performance ratio		› Low Figure of Merit (900 V)	› Best price/performance ratio	
› ESD robustness >2kV (P7)			› ESD robustness >2kV (P7)	

Drive your CoolMOS™ to best performance with a cool EiceDRIVER™

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600 V CoolMOS™ P7 portfolio

	$R_{DS(ON)}$ [mΩ] max.	DPAK	D²PAK	ThinPAK 8x8	TO220 FullPAK	TO220	TO220 FP NL	TO220 FP WC	TO247	TO247-4	SOT223
Industrial grade	600	IPD60R600P7			IPA60R600P7	IPP60R600P7					
	360/365	IPD60R360P7	IPB60R360P7	IPL60R365P7	IPA60R360P7	IPP60R360P7					
	280/285	IPD60R280P7	IPB60R280P7	IPL60R285P7	IPA60R280P7	IPP60R280P7					
	180/185	IPD60R180P7	IPB60R180P7	IPL60R185P7	IPA60R180P7	IPP60R180P7			IPW60R180P7	IPZA60R180P7	
	160				IPA60R160P7	IPP60R160P7					
	120/125		IPB60R120P7	IPL60R125P7	IPA60R120P7	IPP60R120P7			IPW60R120P7	IPZA60R120P7	
	99/105		IPB60R099P7	IPL60R105P7	IPA60R099P7	IPP60R099P7			IPW60R099P7	IPZA60R099P7	
	80/85		IPB60R080P7	IPL60R085P7	IPA60R080P7	IPP60R080P7			IPW60R080P7	IPZA60R080P7	
	60/65		IPB60R060P7	IPL60R065P7	IPA60R060P7	IPP60R060P7			IPW60R060P7	IPZA60R060P7	
	45		IPB60R045P7						IPW60R045P7	IPZA60R045P7	
	37								IPW60R037P7	IPZA60R037P7	
	24								IPW60R024P7	IPZA60R024P7	
Standard grade	600	IPD60R600P7S			IPA60R600P7S		IPAN60R600P7S	IPAW60R600P7S			IPN60R600P7S
	360	IPD60R360P7S			IPA60R360P7S		IPAN60R360P7S	IPAW60R360P7S			IPN60R360P7S
	280	IPD60R280P7S			IPA60R280P7S		IPAN60R280P7S	IPAW60R280P7S			
	180	IPD60R180P7S			IPA60R180P7S		IPAN60R180P7S	IPAW60R180P7S			



- Large $R_{DS(on)}$ and package variety
- Offering through hole and SMD packages
- Suitable for a wide variety of applications and power ranges

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600 V CoolMOS™ CFD7 product portfolio
Recommended for LLC and ZVS PSFB topologies

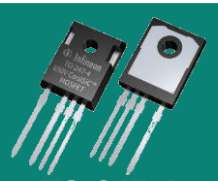
600 V CoolMOS™ CFD7 SJ MOSFETs

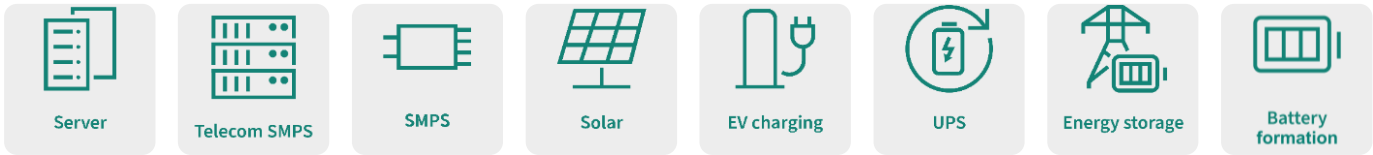
$R_{DS(on)}$ [mΩ] max.	 TO-262 D-PAK	 TO-263 D²PAK	 ThinPAK 8x8	 TO-220 FullPAK	 TO-220	 TO-247	 TOLL	 DDPAK	 QDPAK
360	IPD60R360CFD7	IPB60R360CFD7		IPA60R360CFD7	IPP60R360CFD7				
280	IPD60R280CFD7	IPB60R280CFD7		IPA60R280CFD7	IPP60R280CFD7				
210/215	IPD60R210CFD7	IPB60R210CFD7	IPL60R215CFD7	IPA60R210CFD7	IPP60R210CFD7				
170/185	IPD60R170CFD7	IPB60R170CFD7	IPL60R185CFD7	IPA60R170CFD7	IPP60R170CFD7	IPW60R170CFD7		IPDD60R170CFD7	
145/160	IPD60R145CFD7	IPB60R145CFD7	IPL60R160CFD7	IPA60R145CFD7	IPP60R145CFD7	IPW60R145CFD7	IPT60R145CFD7	IPDD60R145CFD7	
125/140		IPB60R125CFD7	IPL60R140CFD7	IPA60R125CFD7	IPP60R125CFD7	IPW60R125CFD7	IPT60R125CFD7	IPDD60R125CFD7	
105/115		IPB60R105CFD7	IPL60R115CFD7		IPP60R105CFD7	IPW60R105CFD7	IPT60R105CFD7	IPDD60R105CFD7	
90/95		IPB60R090CFD7	IPL60R095CFD7		IPP60R090CFD7	IPW60R090CFD7	IPT60R090CFD7	IPDD60R090CFD7	
70/75		IPB60R070CFD7	IPL60R075CFD7		IPP60R070CFD7	IPW60R070CFD7	IPT60R075CFD7	IPDD60R075CFD7	
55/60		IPB60R055CFD7	IPL60R060CFD7			IPW60R055CFD7	IPT60R055CFD7	IPDD60R055CFD7	
40/45		IPB60R040CFD7				IPW60R040CFD7	IPT60R045CFD7	IPDD60R045CFD7	IPDQ60R045CFD7
31/35						IPW60R031CFD7	IPT60R035CFD7		
24						IPW60R024CFD7			
18						IPW60R018CFD7			



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650 V CoolSiC™ MOSFET portfolio

$R_{DS(on),max}$ [mΩ] @ V_{GS} 18 V	$R_{DS(on),max}$ [mΩ] @ V_{GS} 18 V	 TO-247-3	 TO-247-4 (asymmetric leads)	 TO-263-7	 TOLL
30/34	22/27	IMW65R027M1H	IMZA65R027M1H	IMBG65R022M1H	IMT65R022M1H
42	30	IMW65R030M1H	IMZA65R030M1H	IMBG65R030M1H	IMT65R030M1H
50	39	IMW65R039M1H	IMZA65R039M1H	IMBG65R039M1H	IMT65R039M1H
64	48	IMW65R048M1H	IMZA65R048M1H	IMBG65R048M1H	IMT65R048M1H
74	57	IMW65R057M1H	IMZA65R057M1H	IMBG65R057M1H	IMT65R057M1H
94	72	IMW65R072M1H	IMZA65R072M1H	IMBG65R072M1H	IMT65R072M1H
111	83	IMW65R083M1H	IMZA65R083M1H	IMBG65R083M1H	IMT65R083M1H
142	107	IMW65R107M1H	IMZA65R107M1H	IMBG65R107M1H	IMT65R107M1H
217	163			IMBG65R163M1H	IMT65R163M1H
346	260			IMBG65R260M1H	IMT65R260M1H



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Gate-driver IC recommendation for 650V CoolSiC™

Example use-case	Power class	Recommended 650 V CoolSiC™ $R_{DS(on)}$ class	Gate-driver IC recommendation
CCM totem pole PFC**	3.9 kW	IMx65R027M1H (32 A*)	2EDF9275F or 2x 1EDB9275F or 2x 1ED3122MC12H or 2 x 1ED3125MU12F
	3.3 kW	IMx65R048M1H (27 A*)	
	2.8 kW	IMx65R072M1H (23 A*)	
	2.3 kW	IMx65R107M1H (19 A*)	
	-	any	2EDL05, 2EDL23, 2ED218xS06F
LLC DC-DC**	-	any	2ED210xS06F, 2ED218xS06F
LLC DC-DC***	-	any	2EDS9265H

* RMS peak current at worst nominal case (176 V_{IN} RMS, 97.4% efficiency at full-load); for the real peak value a 30% ripple has to be considered on top

** Functional solation required

*** Reinforced isolation required

UVLO protects the CoolSiC™ in case the supply drops from the nominal value (V_{GS} 18 V) to a lower value (12.6 V V_{GS}).

A proper thermal design is needed in addition.

2EDx9275x, 1EDB9275F UVLO rating

Table 10 Undervoltage Lockout V_{DDA}, V_{DDB} 13 V-versions for SiC MOSFETs (see Figure 12)

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Undervoltage Lockout (UVLO) turn-on threshold V_{DDA}, V_{DDB}	UVLO_CM$_{on}$	13.0	13.7	14.2	V	–
Undervoltage Lockout (UVLO) turn-off threshold V_{DDA}, V_{DDB}	UVLO_CM$_{off}$	12.6	12.9	–	V	–
UVLO threshold hysteresis V_{DDA}, V_{DDB}	UVLO_CM$_{hys}$	0.4	0.8	1.2	V	–

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Discrete MCU for SMPS Controller – XMC1302

SYSTEM

ARM® Cortex®-M0 32MHz	**64 MHz MATH Co-Processor**	On-chip Oscillator	RTC
	SysTick	System Control Unit (SCU)	
	Programmable Interconnect Matrix	Secure Bootloader (optional)	PRNG
	Temperature Sensor	VREG	WDT

TIMER / PWM

PWM Timers (CCU4) 4 channels, 16 to 64-bit, 64 MHz	**PWM Timers (CCU8)** **4 channels, 16 to 64-bit, 64 MHz + Dead-Time**

COMMUNICATION

2x USIC usable as:
Double-SPI, Quad-SPI, SCI/UART, I²C, I²S, LIN

ANALOG

12-bit ADC 2x Sample & Hold, up to 12 channels	Up to 3x Analog Comparator

MEMORY

FLASH 200 kB ECC	RAM 16 kB

APPLICATION SPECIFIC

Hall & Encoder I/F (POSIF)	LED control 9 channels

Description

Applications / Target markets

- Digital Power / Wireless Charging
- Motor Control
- LED Lighting

Key Features

- On-chip connectivity of peripherals offloads CPU and improves real time performance
- MATH Co-processor boosts Cortex®-M0 core performance by adding complex math computing engine running in parallel to the main core
- Extended 1.8 – 5.5 V supply range and -40°C to 105°C temperature range
- High control performance: 64 MHz PWM, 1 Msps ADC and 25 ns Comparators
- Best in class LED dimming & color control unit, flicker-free, easy to use
- Motor control Hall and Encoder Interface
- IEC 60730 class B compliant LIB

Packages

VQFN24 / 40

TSSOP16 / 28 / 38







XMC1300 Boot Kit

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Discrete MCU for SMPS Controller – XMC1402 / 1403 / 1404

SYSTEM

ARM® Cortex®-M0 48MHz	**96 MHz MATH Co-Processor**	On-chip Oscillator	RTC
	SysTick	Clock Input 4-20 MHz & 32 kHz	System Control Unit (SCU)
	Programmable Interconnect Matrix	Secure Bootloader (optional)	PRNG
	Temperature Sensor	VREG	WDT

TIMER / PWM

2x PWM Timers (CCU4) 4 channels, 16 to 64-bit, 96 MHz	**2x PWM Timers (CCU8) – XMC1402 & 1404 4 channels, 16 to 64-bit, 96 MHz + Dead-Time**

COMMUNICATION

2x CAN (XMC1403 & 1404) 32 Message Objects	4x USIC usable as: Single-SPI, Double-SPI, Quad-SPI, SCI/UART, I²C, I²S, LIN

ANALOG

12-bit ADC, 2x Sample & Hold, up to 12 channels	Up to 4x Analog Comparator (XMC1402 & 1404)

MEMORY

FLASH Up to 200 kB ECC	RAM 16 kB

APPLICATION SPECIFIC

2x Hall & Encoder I/F (XMC1402 & 1404)	Touch-Sense (XMC1404) Up to 24 pads	LED control 9 channels	LED Matrix 3 x 64 segments

Description

Applications / Target markets

- Digital Power / LED Lighting
- I/O Modules
- Motor Control

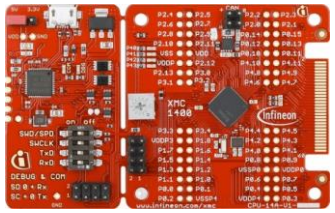
Key Features

- On-chip connectivity of peripherals offloads CPU and improves real time performance
- MATH Co-processor featuring CORDIC: hardware-efficient iterative method to calculate elementary functions
- Extended 1.8 – 5.5 V supply range and -40°C to 105°C temperature range
- High control performance: 96 MHz PWM, 1 Msps ADC and 25 ns Comparators
- Best in class LED dimming & color control unit, flicker-free, easy to use
- Motor control Hall and Encoder Interface (XMC1402 & 1404)
- IEC 60730 class B compliant LIB
- Programmable GIPOs and 2x CAN interface (XMC1403 & 1404)

Packages

TSSOP38
VQFN40 / 48 / 64
LQFP64





XMC1404 Boot Kit

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Discrete MCU for SMPS Controller – XMC4200 with HRPWM

SYSTEM

ARM® Cortex®-M4F 80 MHz	**FPU**	SysTick	RTC	System Control Unit (SCU)
	DMA Up to 8 channels	CRC Engine	CACHE 1 kB	
	Programmable Interconnect Matrix		WDT	Temperature sensor

TIMER / PWM

2x PWM Timers (CCU4) 4 channels, 16 to 64-bit, 96 MHz	**PWM Timers (CCU8) 4 channels, 16 to 64-bit, 96 MHz + dead-time**	**4x HRPWM 150 ps**

ANALOG

- 2x 8 channels 12-bit ADC (t_{C12PC} 566 ns)
- 2x 12-bit DAC

MEMORY

- 16 kB + 24 kB RAM
- 256 kB Flash with 1 kB i-cache

COMMUNICATION

4x USIC usable as: Double-SPI, Quad-SPI, UART, I²C, I²S, LIN	2x CAN 64 Message Objects	USB
Hall & Encoder I/F (POSIF)	LED & Touch-Sense (LEDTS) for HMI	

Description

Application / target markets

- Digital Power
- Low to Medium-end Industrial Drives

Key features

- Cortex-M4F @ 80 MHz with FPU
- 256 kB Flash, 40 kB RAM on-chip memories
- High resolution PWM 150 ps
- Industrial connectivity
- 125°C extended temperature range
- Long term availability with >15 years
- Motor control Hall and encoder interface
- IEC 60730 class B compliant LIB
- Free DAVE™ IDE and DAVE Apps



XMC4200 Platform2Go

Packages

VQFN48

TQFP64





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Infineon LLC converter 300 W evaluation board

EVAL-2HS01G-300W-1

Features summary

- Resonant mode controller for half-bridge LLC converter with synchronous rectification
- 30 kHz to 1 MHz switching frequency
- Adjustable minimum switching frequency with high accuracy
- 50% duty cycle for both primary and secondary gate drives
- Adjustable dead time with high accuracy
- Driving signal for synchronous rectification which supports full operation of a half-bridge LLC resonant converter
- Internal and External disable functions for synchronous rectification
- Mains input under voltage protection with adjustable hysteresis
- Three levels of overcurrent protection for enhanced dynamic performance
- Open-loop/overload protection with adjustable blanking time and restart time
- Adjustable over-temperature protection with latch-off
- External latch-off enable pin

Technical specifications

Key parameters	Value
Input voltage	400 V_{DC} nominal & 15 V_{DC} for aux. power supply
Output voltage	12 V_{DC} nominal
Output current	25 A nominal
Output power	300 W nominal
Efficiency	> 97% at full load
Switching frequency	85 kHz at nominal input voltage & 12 V_{DC} 25 A output
Board dimension	140 x 85 x 35 mm

Key components

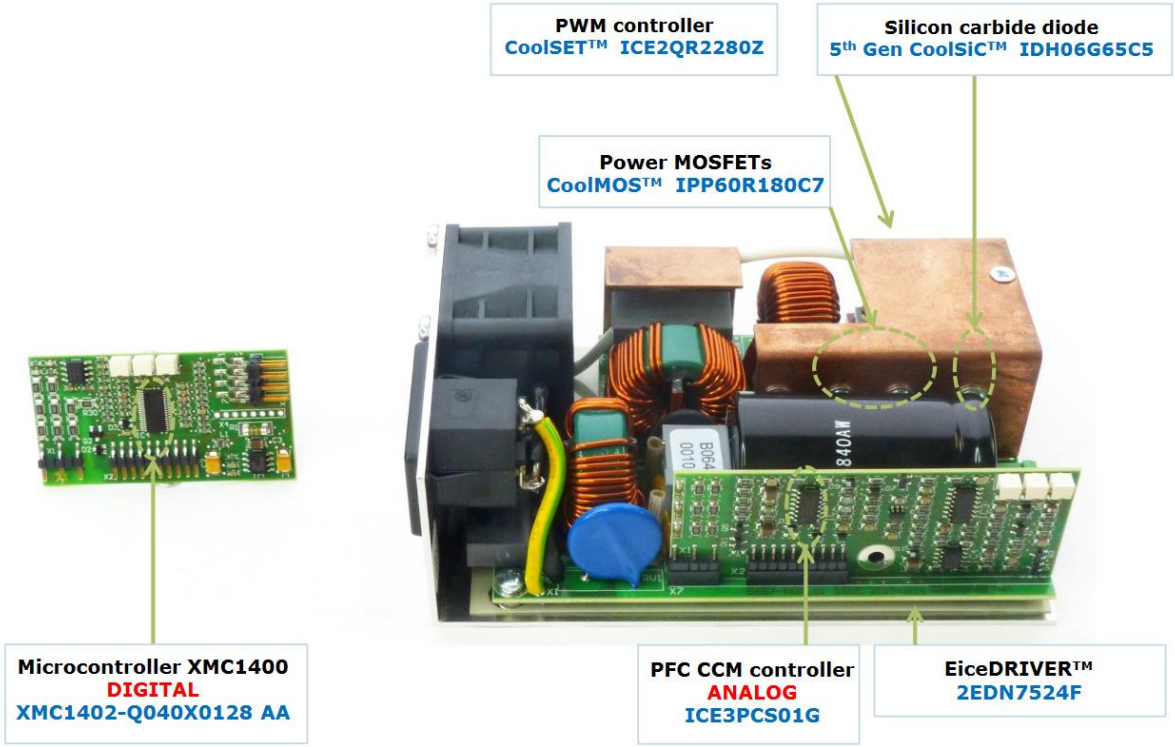
Infineon components	› 2 x IPP60R190E6 › 2 x IPB011N04N › 2EDL05N06PF › ICE2HS01G



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Infineon 800 W 130 kHz PFC demonstration board

EVAL_800W_PFC_C7_V2



On-board Infineon components

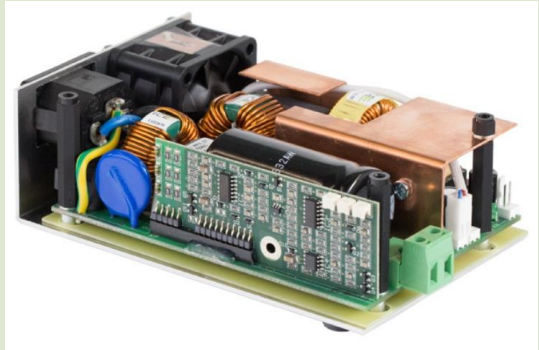
- Continuous Conduction Mode (CCM) PFC boost converter
- Analog & digital control

Technical specifications

Key parameters	Value
Input voltage	90 – 265 V_{AC} (Nominal 230 V_{AC})
AC line frequency range	47 – 64 Hz
Power Factor Correction (PFC)	> 0.95 from 20% rated load and above
Switching frequency	130 kHz
Output voltage & current	380 V_{DC} & 2.1 A
Output voltage ripple	20 V_{pk-pk} max. at nominal output voltage & current
Output power	800 W (max)
Efficiency	> 97% at full load with input 230 V_{AC}
Output overvoltage threshold	420 – 450 V_{DC}
Board dimension	120 x 80 x 40 mm

Key components

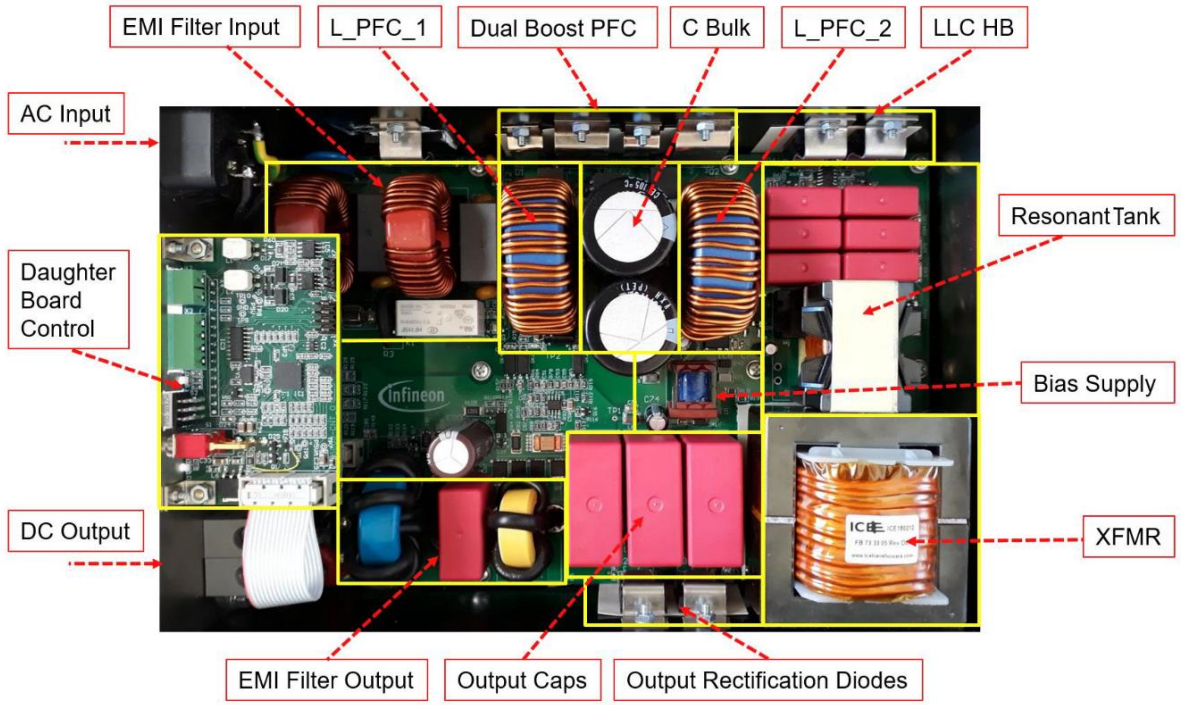
Infineon components	› IPP60R180C7 › IDH06G65C5 › 2EDN7524F › ICE3PCS01G › ICE2QR2280Z › XMC1402-Q040X0128AA



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Infineon 48 V battery charger 2000 W evaluation board

EVAL_2KW_48V_CHAR_P7



Functional groups of the 2000 W battery charger design

- Continuous full power at an ambient temperature 45°C
- Natural convection cooling
- Portable unit

Technical specifications

Key parameters	Value
Input voltage	90 – 265 V_{AC} (Nominal 200 – 265 V_{AC})
AC line frequency range	47 – 63 Hz
Output voltage	40 – 60 V_{DC}
Output current	Up to 50 A
Output power	2000 W (at input 178 – 265 V_{AC} and 12 A_{AC})
Output voltage ripple	20 V_{pk-pk} max. at nominal output voltage & current
Output overvoltage threshold	60.2 – 60.9 V_{DC}
Efficiency	94.5% at full load
System dimension & mass	258 x 123 x 80 mm & 7.5 kg

Key components

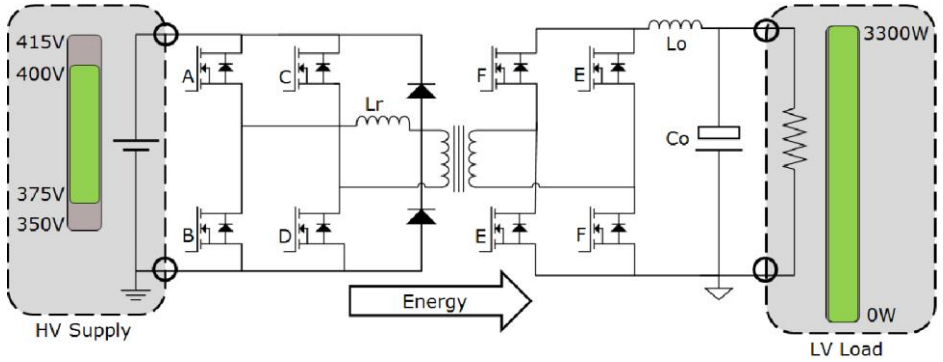
Infineon components	› 2 x IPW60R080P7 › 2 x IPW60R060P7 › 6 x BSC030N08NS5 › 2 x IDH16G65C6 › ICE3PCS01G › ICE2HS01G › ICE5QR4780AZ › 2EDN7524F › IRS21814 › XMC1403-Q64X0128AA



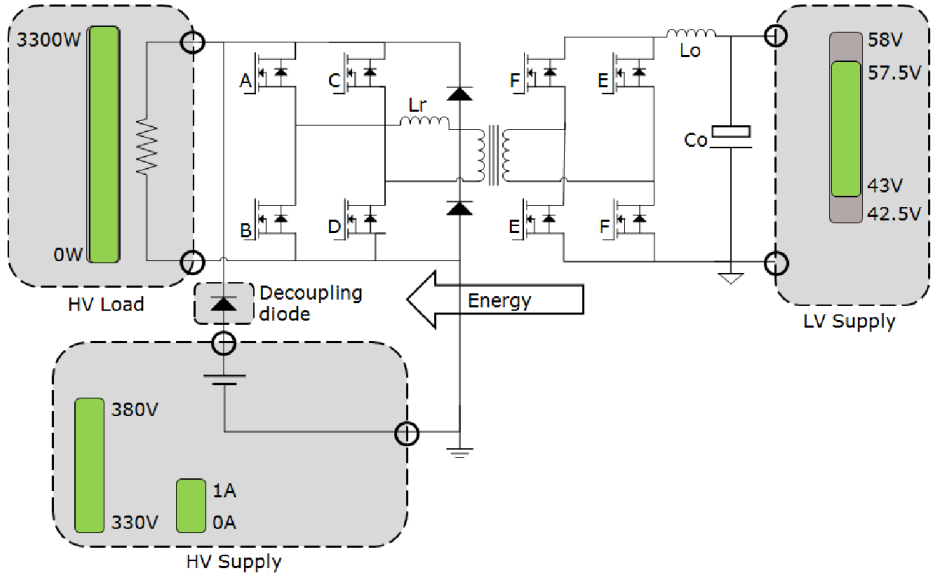
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Infineon bi-directional Phase-shift Full-bridge 3300 W evaluation board

EVAL_3k3W_BIDI_PSFB



Buck mode validation setup



Boost mode validation setup

Technical specifications

Key parameters	Value
Buck input voltage	400 V_{DC_NOM} (350 – 415 V_{DC})
Buck output voltage	54.5 V_{DC_NOM} (40 – 60 V_{DC})
Boost input voltage	330 – 380 V_{DC} 1A and 43 – 58 V_{DC}
Buck output voltage	Up to 400 V_{DC}
Output current	60.5 A
Output power	3300 W
Peak Efficiency (Buck mode)	98% (50% load) and 97.5% (100% load)
Peak Efficiency (Boost mode)	97% (50% load)
Board dimension	208 x 83 x 44 mm
Power density	~71.2 W/inch³ / ~4.34 W/cm³

Key components

Infineon components	› 8 x IPL60R075CFD7 › 16 x BSC093N15NS5 › 2 x IDH08G65C6 › 4 x BAT165 › 2 x 2EDS8265H › 2 x 2EDF7275F › XMC4200-F64K256AB › ICE5QSAG › IPU80R4K5P7



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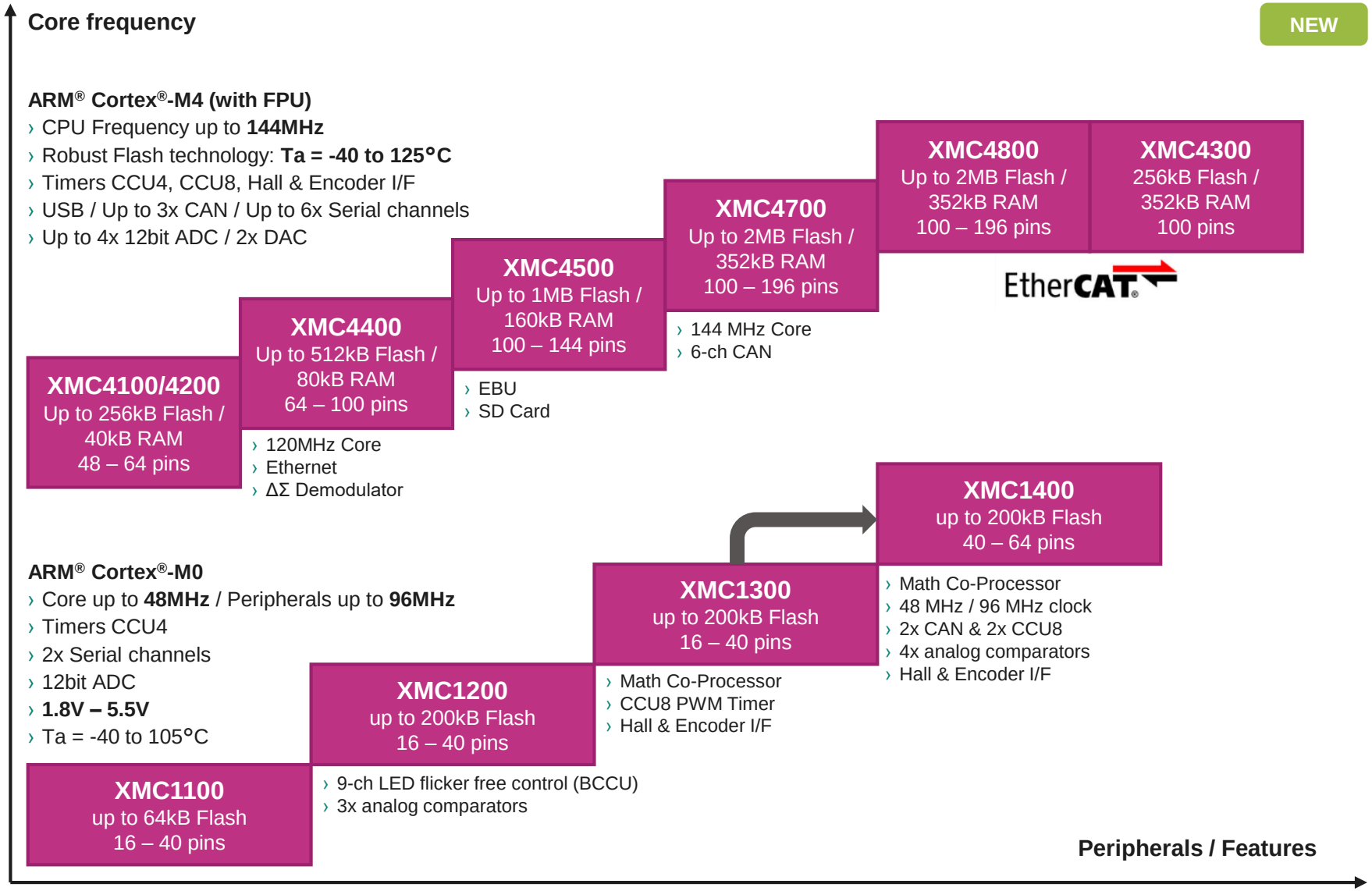


Safety Control & Memory

Industrial & Programmable microcontrollers with secure & powerful memory solutions

Back to overview

XMC7000 Extends XMC™ Portfolio

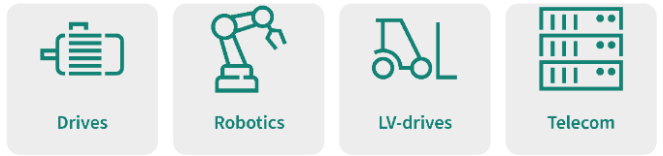


NEW

XMC7100
4MB Flash / 768kB RAM,
250MHz single/dual core
100 – 272 pins

XMC7200
8MB Flash / 1MB RAM,
350MHz single/dual core
176 – 272 pins

- **Single** or **dual core** Arm® Cortex®-M7 and Cortex®-M0+
- M7 CPU core Frequency up to **350 MHz**
- Temperature range: **Ta = -40 to 125°C**
- Memory Up to **8 MB Flash, 1 MB RAM**
- **TCPWM** timers of 102Ch 16-bit and 16Ch 32-bit
- **Cryptography** Engine support
- Interfaces such as CAN-FD, **Gb Ethernet**
- **SMIF** and SDHC interface supported
- Extended voltage operating range: **2.7 to 5.5V**
- low power modes(LP/deep sleep, **hibernate**..)
- Add. timer, ADC and Serial COM. channels



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NEW

XMC™ 7000-Series Microcontroller ARM Cortex-M7 & Cortex-M0+

Key Features

Upgrade to 32-bit XMC4000 family by adding more CPU performance, dual-core options, more memory, hibernate mode, and hardware security support

- **Single/Dual cores of ARM Cortex-M7 up to 350 MHz** and **memory up to 8 MB** providing higher processing performance & ability for tasks distribution
- **Comprehensive set of advanced peripherals** (ADCs, TCPWM Timers) along with **competitive set of security** offering providing **real time control, optimal solution for motor control & power conversion applications**, and **advanced security options**
- High quality and **temperature grade of 125ºC** enabling operations in high ambient temperature environments
- **Lower-power modes down to 5 µA** enabling power-saving in energy-critical applications
- **Four footprint versions available** in 17 different part numbers making it easy to adapt on existing PCB

Typical Applications

Drives | Robotics | Multicopter | eBike | LV-drives | Telecom | Solar

Package



QFP-100
QFP-144
QFP-176



BGA-272

Block Diagram

SYSTEM

ARM® Cortex-M7 (Single/Dual) FPU **250 MHz / 350 MHz**	1-4 MB / 8 MB RWW code flash	I-Cache D-Cache	Power Mode Management	PLL/FLL
	256 kB work flash	DMA	LVD/BOD	RC Oscillators
ARM® Cortex-M0+ **100 MHz**	512-768 kB / 1 MB SRAM	MPU, PPU	RTC	Event Generation Timer
Crypto	Boot ROM eFuse	HSM	WDT	SWD/JTAG/ Trace

REAL TIME CONTROL

16-bit TCPWM	up to 72-ch / 96-ch ADC (3x SAR ADC)	
32-bit TCPWM		Programmable trigger matrix
16-bit Motor TCPWM		

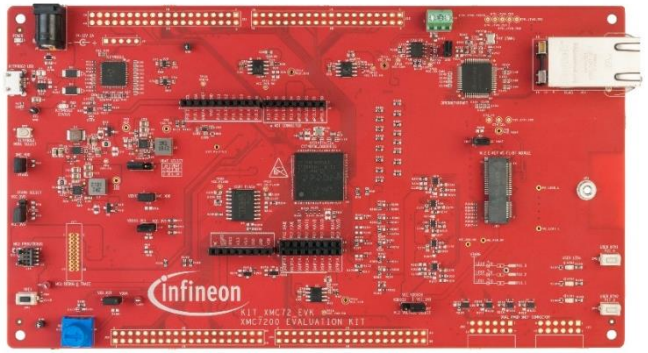
PERIPHERALS

GPIOs	Smart I/Os	8-ch / 10-ch CAN-FD
SMIF	eMMC	16-ch / 20-ch UART
Up to 11-ch SCB	Ethernet / Gb Ethernet	I2S/TDM

Status

Available – in Production

Evaluation Board



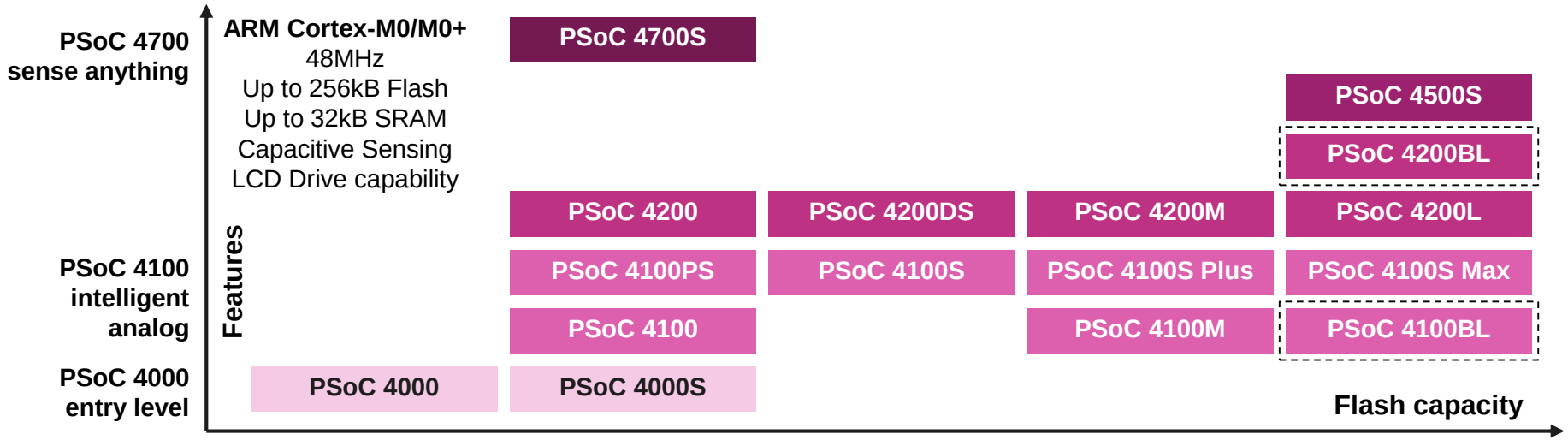
Features & Customer Benefits

- **Dual-core ARM Cortex-M7** up to 350 MHz & single-core **ARM Cortex-M0+** up to 100 MHz
- Full system approach on the board, featuring **Gigabit Ethernet** PHY and connector, **CAN-FD transceiver, NOR flash memory, user LEDs, buttons and potentiometers**
- Modular system enablement through Arduino and M.2 connectors
- Out-of-the box experience with on-board-debugger and DC power supply provided
- **Full integration in Modus Toolbox IDE** through Board Support Package (BSP)
- Easy access and evaluation of all peripherals using code examples available in BSP

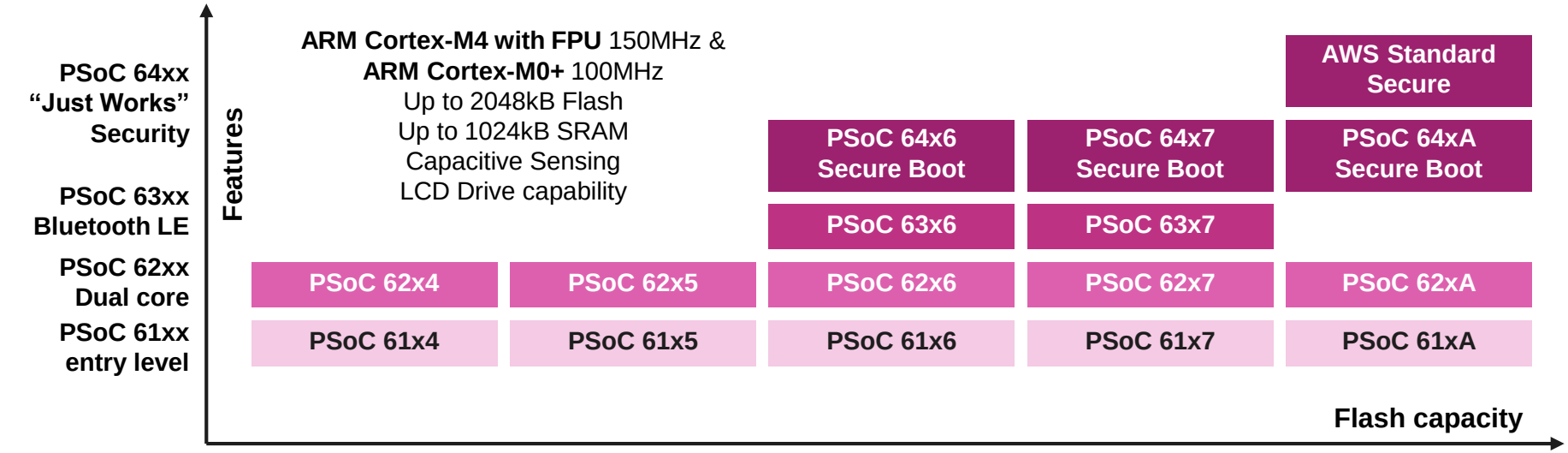
https://www.infineon.com/cms/en/product/microcontroller/32-bit-industrial-microcontroller-based-on-arm-cortex-m/32-bit-xmc7000-industrial-microcontroller-arm-cortex-m7

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Infineon‘s PSoC™ portfolio with integrated HMI CapSense® and Connectivity subsystem



- On-chip Bluetooth® Low Energy
- Inductive and capacitive sensing
- Divide and Square-root compute accelerators
- Intelligent analog features plus programmable digital blocks, USB 2.0, CAN
- Entry-level features plus programmable analog blocks, up to 1-Msps ADC
- Entry-level family



- Ultra-Low-Power, Dual-Core, “Just Works” Secure Host MCU Series
- High-Integration Bluetooth LE Wireless Connectivity MCU Series
- Ultra-Low-Power, Dual-Core, and High-Performance MCU Series
- Ultra-Low-Power and High-Performance MCU Series

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Touch for HMIs: Capacitive-Sensing Applications

CapSense™ capacitive touch sensing solutions have replaced more than six billion mechanical buttons, and it enables hundreds of diverse types of sensing applications.





“Buttons”



“Proximity”



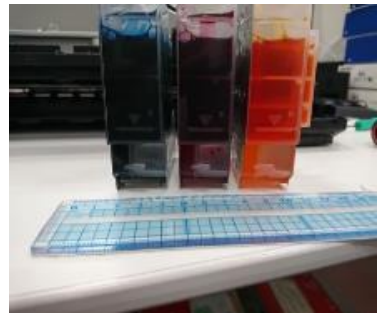


“Sliders”
(Linear arrays)

Coffee machine Liquid Level



Ink printer cartridge detect



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PSoC™ 4: Problem Solver on Chip

Sense anything

Programmable analog and digital blocks in PSoC 4 enable you to customize your analog-front-end, apply simple glue logic and easily integrate intelligent analog sensors into an application

Intelligent sensor integration

Easy-to-use HMI

PSoC 4 simplifies complex HMI interfaces such as capacitive and inductive sensing enabling sleek, robust, and easy-to-use interfaces

Capacitive and inductive sensing

Connected

Bluetooth Low Energy (BLE) integrated into some PSoC 4 devices simplifies RF design. Additional wired interfaces such as USB and CAN are also available

Wired and wireless connectivity

Touch-sensing technology leadership

Touch Buttons: 2003



LG Chocolate
(First Generation)

Liquid Tolerance: 2008



Whirlpool Dishwasher
(Second Generation)

SmartSense: 2010



HP TouchSmart Printer
(Third Generation)

PSoC 4 S-Series: 2016



PSoC 4 S-Series
(Fourth Generation)

Multi-Sense Converter: 2020



PSoC 4100S Max
(Fifth Generation)

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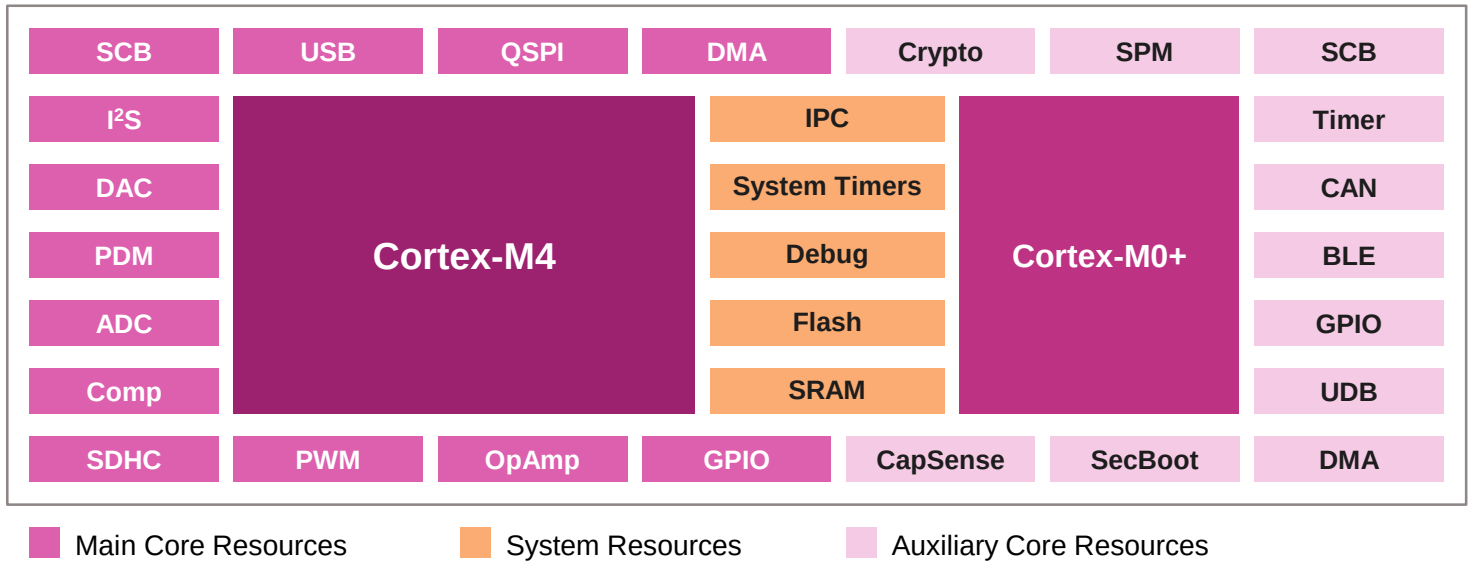
PSoC™ 6: High-performance dual-core architecture

- Most flexible, high-performance, dual-core architecture designed for robots & IoT applications
  - High-performance dual-core architecture to optimize system power consumption and performance
  - Multiple wired and wireless connectivity options such as BLE, WLAN, and USB to support Internet, cloud-based services
  - CapSense™, the industry's best capacitive sensing solution to support sleek & next-generation user interfaces
  - Software-defined peripherals to create custom AFEs and to support last-minute design changes while minimizing PCB redesign

PSoC 6 High-Performance, Dual-Core MCU Architecture

Cortex-M4F Usage Examples:

RTOS
Displays
Sensor Analytics
Audio Interface
USB/BLE HCI



Cortex-M0+ Usage Examples:

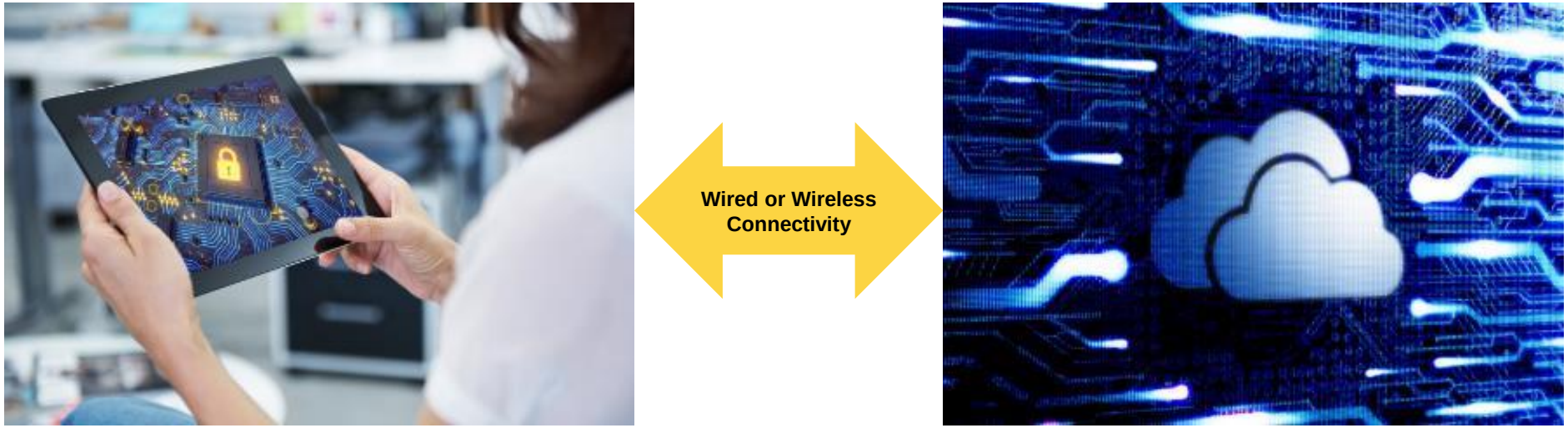
BLE Stack
CapSense
Secure Functions
I/O Data Control
Sensor Aggregation

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PSoC™ 6: Built-in hardware-based security for Robots

- Supports multiple, simultaneous secured environments without external memories or secured elements
  - Offers scalable secure memory for multiple, independent user-defined security policies
  - Implements industry-standard cryptographic algorithms including elliptical-curve cryptography and advanced encryption standard (AES) with an integrated hardware-based secure coprocessor
  - Provides secured internal storage for firmware, applications, and secured assets such as cryptographic keys

PSoC 6 delivers an integrated, hardware-based Secured Execution Environment with secure data storage for autonomous solutions



PSoC 6 establishes the new standard for IoT security with a trusted product

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PSoC™ 6: Secured MCU Features, isolated Processing Environments

NON-SECURE PROCESSING ENVIRONMENT (NSPE)

The Cortex-M4 MCU enables you to develop your application and utilize IoT platform software libraries to establish a secure cloud connection.

Arm Cortex-M4

Arm Cortex-M0+

Root-of-Trust

SECURE PROCESSING ENVIRONMENT (SPE)

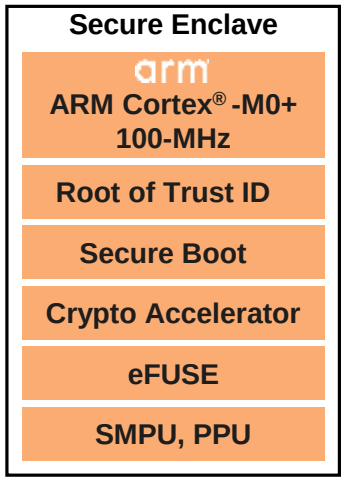
The Cortex-M0+ is used to establish an isolated processing environment for trusted applications.

HARDWARE-BASED ROOT-OF-TRUST (RoT) AND TRUSTED SERVICES

Further isolated from the SPE is a hardware-based root-of-trust with trusted services. The root-of-trust is an immutable, unclonable identity. It securely stores keys and performs security services such as secure boot, attestation, and firmware over-the-air (FOTA) updates.

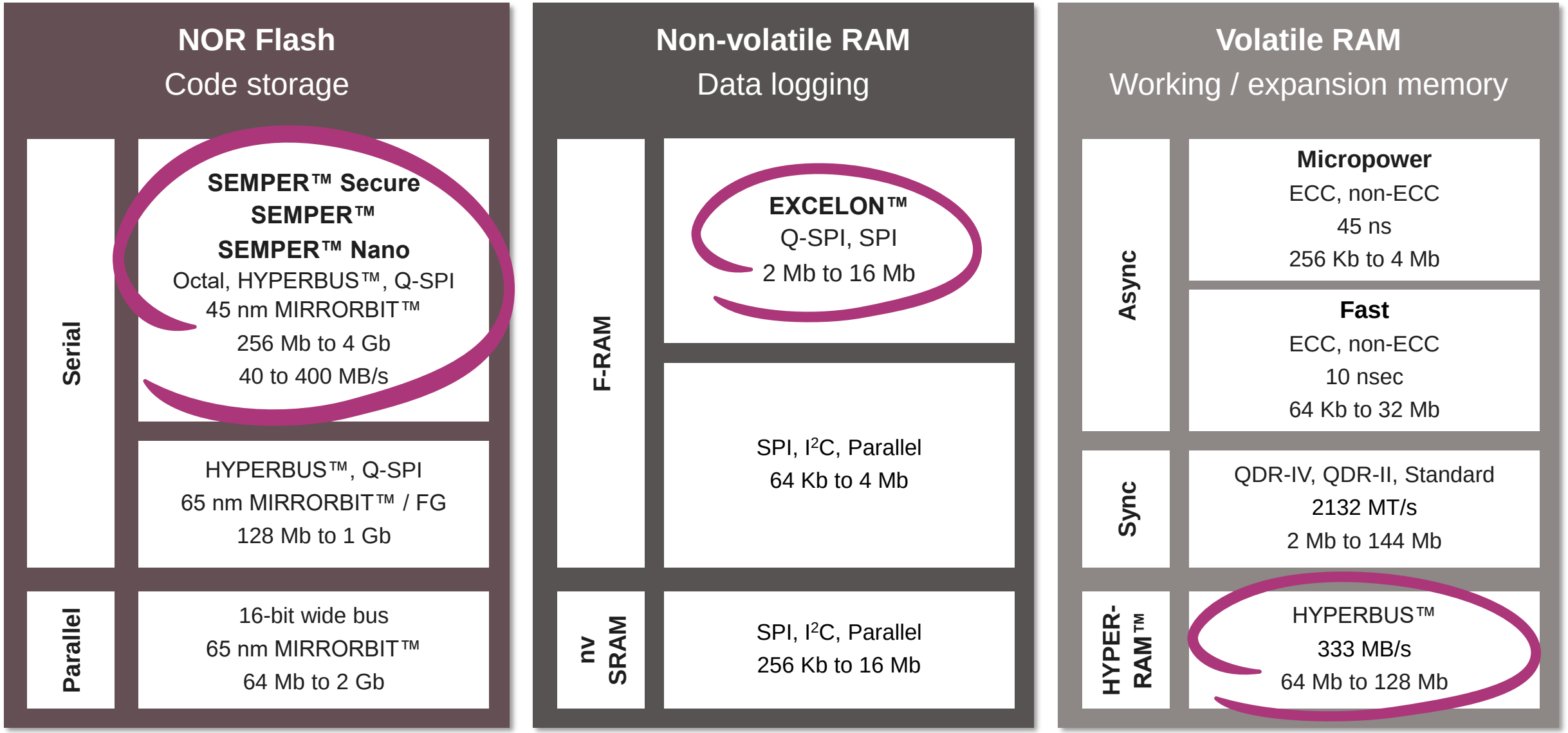
psacertified™ functional API

psacertified™ level one



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Anywhere there is computing, there might be a need for memory



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Infineon NOR Flash family

	Standard Parallel	Standard SPI	HYPERFLASH™	SEMPER™	SEMPER™ Nano	SEMPER™ Secure
Features	✓ 16/8-bit page mode ✓ Dependable memory with parallel interfaces	✓ Wide range of industry-proven solutions for industrial, automotive and communications	✓ High performance for systems tailored to the HYPERBUS™ interface	✓ Architected and designed for functional safety and ISO 26262 compliance	✓ Tiny footprint ✓ Low power	✓ Safe and secured ✓ Security enabled by a hardware root-of-trust
Density	64 Mb, 128 Mb, 256 Mb, 512 Mb, 1 Gb, and 2 Gb	64 Mb, 128 Mb, 256 Mb, 512 Mb, and 1 Gb	128, 256, and 512 Mb	256 Mb, 512 Mb, 1 Gb, 2 Gb, and 4 Gb	256 Mb	128 Mb, 256 Mb, 512 Mb, and 1 Gb
Voltage	3.0 V	1.8 V, 3.0 V	1.8 V, 3.0 V	1.8 V, 3.0 V	1.8 V	1.8 V, 3.0 V
Interface	8-bit parallel	Q-SPI	HYPERBUS™	Q-SPI, Octal, HYPERBUS™ (xSPI Profiles 1,2)	Q-SPI	Q-SPI, Octal, HYPERBUS™ (xSPI Profiles 1,2)
Speed	Down to 55 ns / 20 ns	Up to 80 MB/s	Up to 333 MB/s	Up to 400 MB/s	Up to 40 MB/s	Up to 400 MB/s
Process	45 / 65 / 90 nm MIRRORBIT™	65 nm MIRRORBIT™, 65 nm floating gate	65 nm MIRRORBIT™	45 nm MIRRORBIT™	45 nm MIRRORBIT™	45 nm MIRRORBIT™
Package	BGA, TSOP, KGD	BGA, TSOP, KGD	BGA, SOIC, WSON, KGD	BGA, SOIC, WSON	KGC, WLCSP, BGA	BGA, SOIC, WSON
Availability	Production	Production	Production	Production	Production	Samples

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Infineon SEMPER™ NOR Flash

HIGHER SYSTEM SAFETY

World's first NOR Flash with functional safety

- Architected and designed to ISO 26262 standards
- Achieves ASIL-B compliance and ASIL-D ready
- Real-time safety diagnostics and reporting

LOW TOTAL COST OF OWNERSHIP

Best-in-class reliability

- Innovative endurance flex architecture
- 1+ million program/erase cycles for data logging
- 25 years data retention for code storage

SIMPLIFIED SYSTEM DESIGN

Highest density & easy to use

- Up to 4Gb with 45nm MIRRORBIT™ technology
- Standards-based: JEDEC xSPI compliant
- Broad chipsets and solutions partner ecosystem



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Introducing SEMPER™ Secure: the Flash you can trust

ROBUST SECURITY

World's most-secure NOR Flash

- Hardware root-of-trust
- End-to-end protection
- Flexible architecture

LOW TOTAL COST OF OWNERSHIP

First NOR Flash to combine safety with security

- Most-advanced functional safety and reliability
- ISO 26262 ASIL-B and ASPICE Level 2 compliant
- Real-time safety diagnostics and reporting

FAST TIME TO MARKET

Easy to use

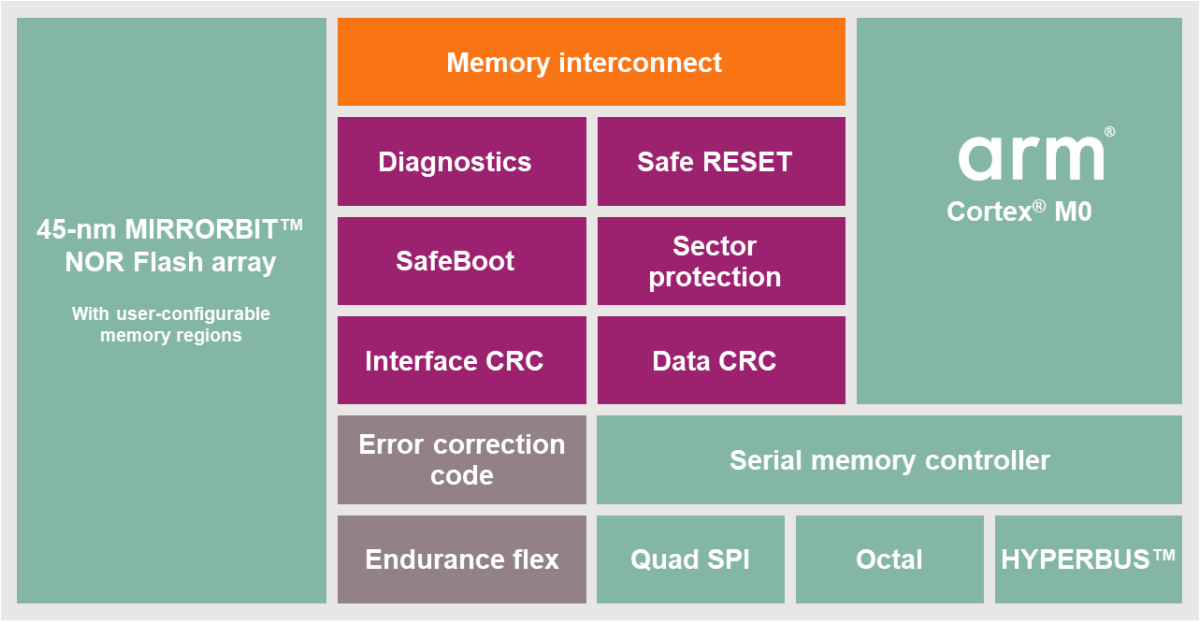
- Software Development Kit (SDK) to accelerate development
- Standards-based: TCG DICE-based, FIPS 140-3 ready, ISO 21434 under evaluation
- Broad chipsets and solution partners ecosystem



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SEMPER™ & SEMPER™ Secure NOR Flash family architectures

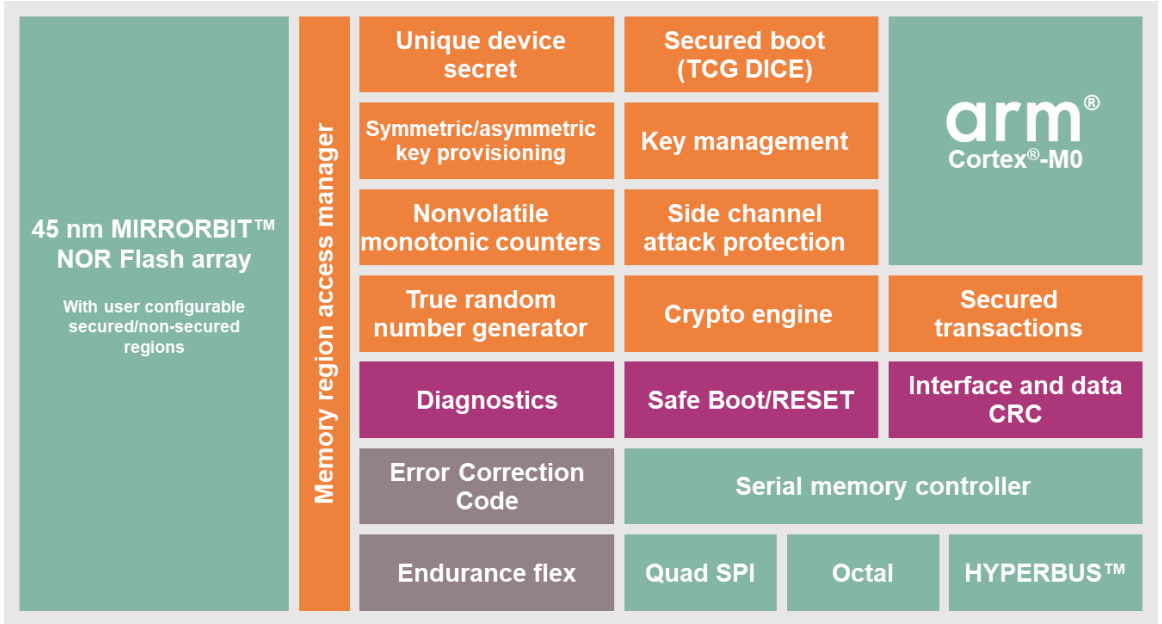
SEMPER™ NOR Flash



Functional safety | Reliability | Performance

- Density: 256 Mb, 512 Mb, 1 Gb, 2 Gb, 4 Gb
- Voltage: 1.8 V and 3.0 V
- Performance: JEDEC xSPI: 400 MB/s, QSPI: 102 MB/s
- Reliability: 1+ million cycles endurance, 25 years retention
- Temperature: -40°C to 125°C
- Package: BGA, SOIC, WSON

SEMPER™ Secure NOR Flash

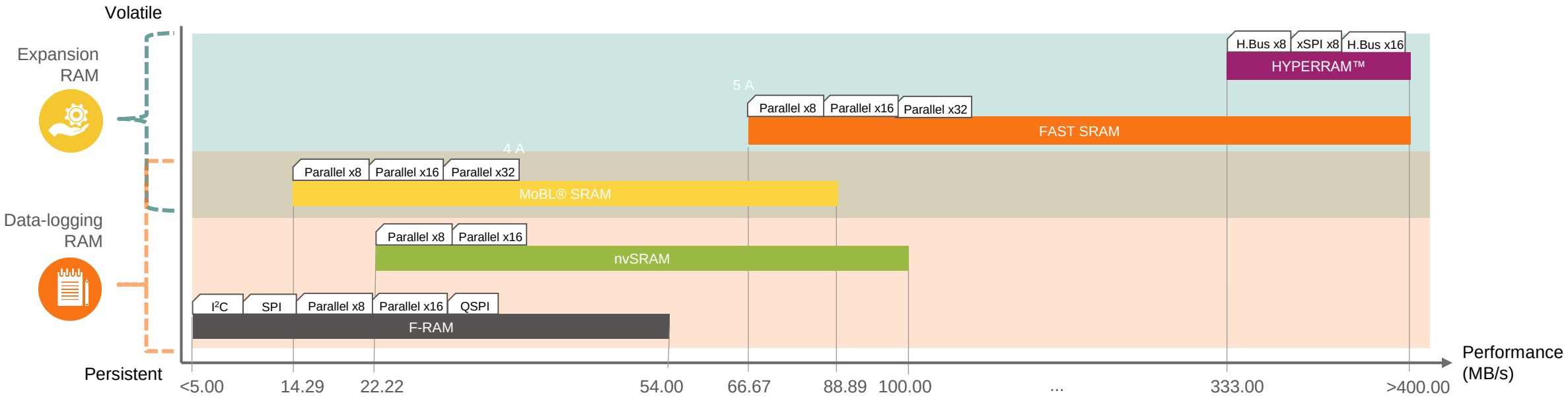


Security | Functional safety | Reliability | Performance

- Density: Lead: 256 Mb, Concept: 128 Mb, 512 Mb, 1Gb
- Voltage: 1.8 V and 3.0 V
- Performance: JEDEC xSPI: 400 MB/s, QSPI: 102 MB/s
- Reliability: 500K+ cycles endurance, 25 years retention
- Temperature: -40°C to 125°C
- Package: BGA, SOIC, WSON

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Broad RAM product portfolio to meet performance requirements

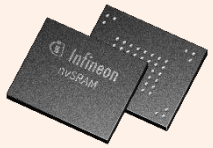


F-RAM



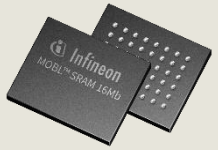
- 4 Kbit to 16 Mbit
- Serial and Parallel interface
- Instant non-volatility
- Optimized solution for low-power data-logging

nvSRAM



- 64 Kbit to 16 Mbit
- Access time: 20 ns – 45 ns
- Unlimited endurance
- Optional features including RTC, timer and alarm

MoBL® SRAM



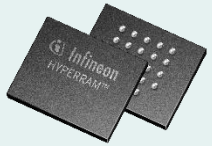
- 256 Kbit to 64 Mbit
- Access time: 45 ns – 70 ns
- SER < 0.1 FIT/Mbit
- Ultra-low standby currents for extending battery life

FAST SRAM



- 256 Kbit to 32 Mbit
- Access time: 10 ns – 15 ns
- SER < 0.1 FIT/Mbit
- Optimized solution for a high-speed cache memory

HYPERRAM™



- 64 Mbit to 128 Mbit
- Serial HYPERBUS™ & xSPI
- Up to 400 MB/s speeds
- Ideal solution for a high-speed serial buffer memory

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The Infineon Advantages for non-volatile F-RAM solutions



PLC



HMI



Motor Control



Multi-Axis Robot



Industrial Robots

Design Challenges	Infineon Solution
Reliable Code and Data Storage	Broad product portfolio with highest reliability and performance
High endurance and Data retention	Infinite endurance with 100+ years data retention on F-RAM
Protect system against attacks	Memory protection with built in hardware root-of-trust and advanced sector protection
Operation under Harsh environments	Support for extended temperature range up to +125C
Easy Design and Fast Time to Market	Functional safety compliance and broad ecosystem support
Supply Longevity	Longevity of Supply > 10 years and Infineon commitment

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Industrial Robots - Controller

Design Challenges

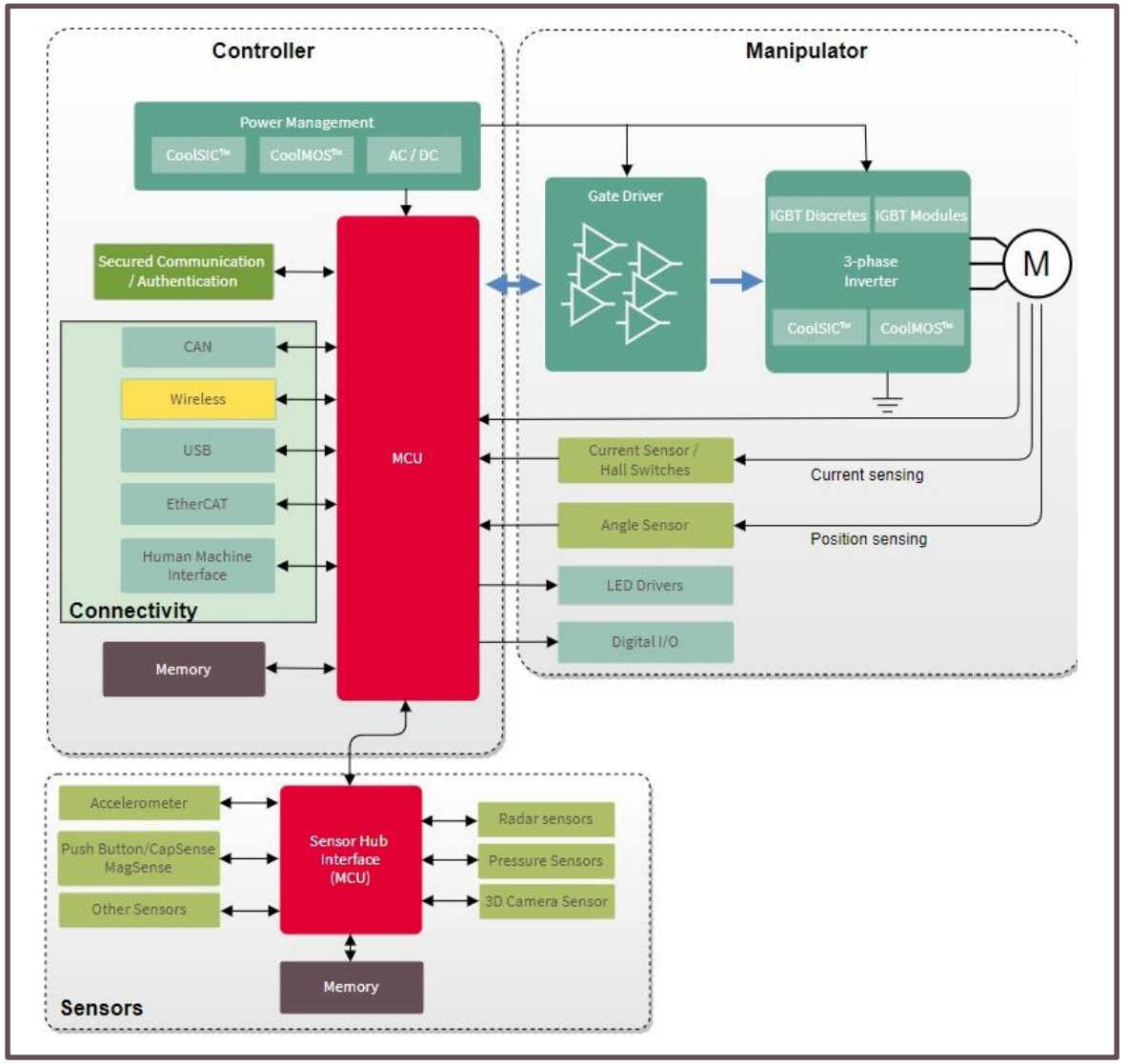
- Write real-time IO data over a low-pin-count interface with similar performance as a parallel interface with 35 ns access time
- Capture real-time data instantly and reliably on power disruption
- Log real-time data continuously over a 15-year product lifespan
- Long product lifecycle with minimal BOM change during lifespan
- Extend system battery life with low active and standby currents

Infineon solutions

- Broadest memory portfolio for varied system requirements
- NVRAM – densities up to 16 Mb
  - Infinite (10^{14}) endurance; reliable datalogging; 100 years retention
- Instant non-volatility with no delay writes and freedom from soft errors
- Data throughput up to 54 MB/s over a 4-pin QSPI bus at 108-MHz
- Low power consumption
  - 16 Mb ULP SRAM: < 8 µA at 85°C
  - F-RAM consume 200 times lesser energy than comparable EEPROMs
- Longevity program with support of minimum 10 years

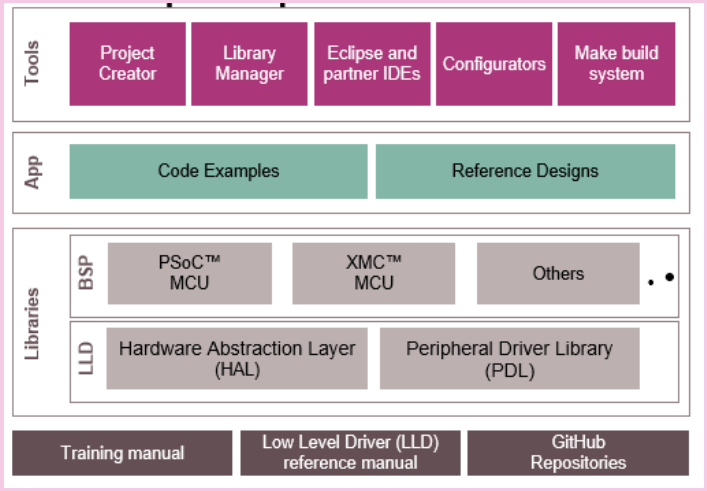
Why does this matter?

- The controller is the robot's interface to the outside world – it takes in and organizes action requests according to the production process and supervises the execution. All real-time communication with users and the production line goes through the robot control unit.
- The controller logs data on a real-time basis to manage motion tracking and coordination, safety control, sensor feedback and power consumption



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ModusToolbox™ Software – Comprehensive selection of tools for Infineon MCU and Wireless Connectivity Products



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

Development Tools

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



Run-Time Software

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

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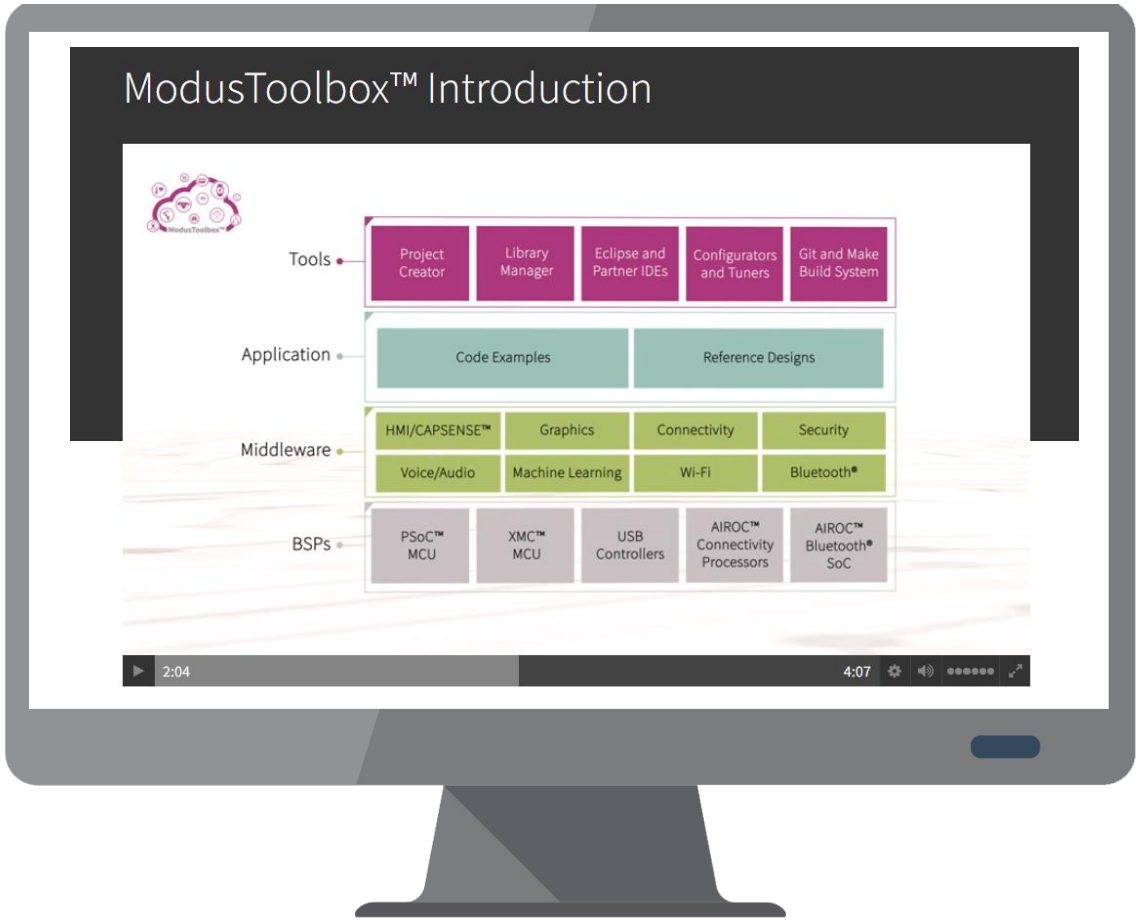
ModusToolbox™ Software Videos / Training

ModusToolbox™ Software Training

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

ModusToolbox™ Software Technical Videos

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



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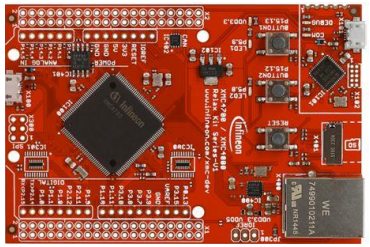
Examples of Infineon‘s evaluation boards for Main & HMI Control including Connectivity and Memory

PSoC42 HMI & BLE



- ✓ ARM Cortex-M0 48 MHz
- ✓ HMI control via Bluetooth Low Energy (BLE) with data rate up to 1 Mbps
- ✓ Battery operation BLE module and USB powered BLE dongle
- ✓ On-board programmer, FRAM, and CapSense evaluation components
- ✓ Evaluation software available in Infineon website (PSoC Creator)
- ✓ Compatible with Arduino UNO

XMC4700 144 MHz



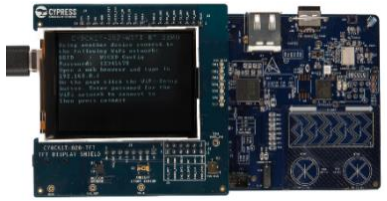
- ✓ ARM Cortex-M4 144 MHz
- ✓ On-board CAN transceiver, RTC crystal, and quadSPI Flash memory
- ✓ Ethernet 10/100 Mbps
- ✓ On-board debugger
- ✓ FreeRTOS demo code available in Github
- ✓ Possibility to mount security controller OPTIGA™ Trust X or M S2GO board

XMC7200 350 MHz



- ✓ Dual ARM Cortex-M7 350 MHz and ARM Cortex-M0+ 100 MHz
- ✓ Gigabit Ethernet and CAN-FD & M.2 interface connector for interfacing radio modules
- ✓ Headers compatible with Arduino to interface with Arduino shields
- ✓ Fully compatible with ModusToolbox™ v3.0
- ✓ On-board programmer, 512 Mb SPI NOR flash, user buttons, LEDs, and potentiometer

PSoC62 WLAN & BT



- ✓ Dual-core PSoC62
- ✓ On-board 2.4GHz WLAN + Bluetooth & BLE module & the antenna
- ✓ Included TFT kit: TFT display, 6-axis IMU, ambient light sensor, PDM microphone, and 32-bit audio code
- ✓ Evaluation software available in Infineon website (Modus Toolbox™)
- ✓ On-board programmer, FRAM, QuadSPI Flash, CapSense evaluation component, and USB-C & PD controller

PSoC63 BLE & USB-PD



- ✓ Dual-core PSoC63 with integrated BLE subsystem with data rate up to 2Mbps
- ✓ Included BLE4.2 USB dongle & E-ink display shield: TFT EPD, 6-axis IMU, PDM microphone, and thermistor
- ✓ Evaluation software available in Infineon website (PSoC Creator)
- ✓ On-board programmer, QuadSPI Flash, CapSense evaluation component, and USB-C & PD controller and smart power switch

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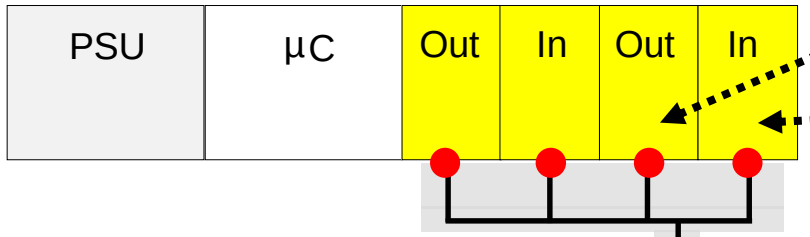
Isolation Interface

Highest reliability and reinforced isolation for high voltage applications

Back to overview

ISOFACE™
Where the harsh factory floor interfaces with control systems

3.3 V/5 V µC domain
› „Control Side“



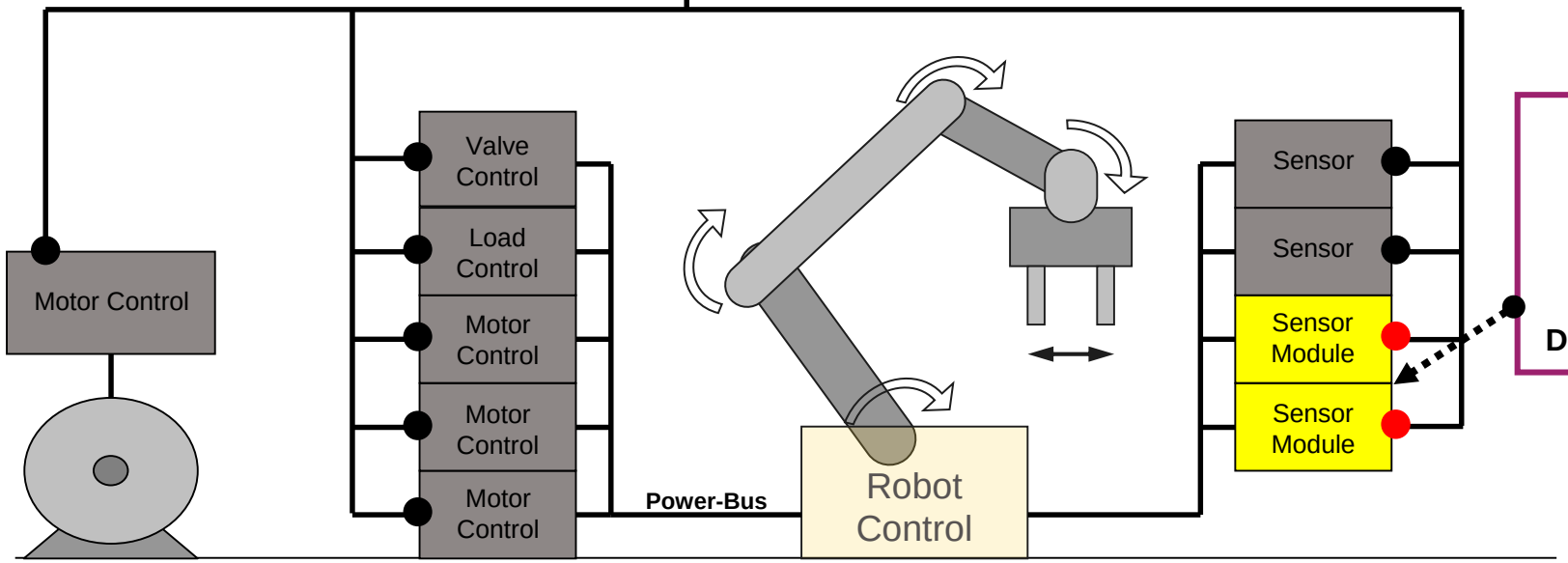


ISOFACE™ Output Switches



ISOFACE™ Digital Input ICs

24 V Factory Floor
› „Process Side“



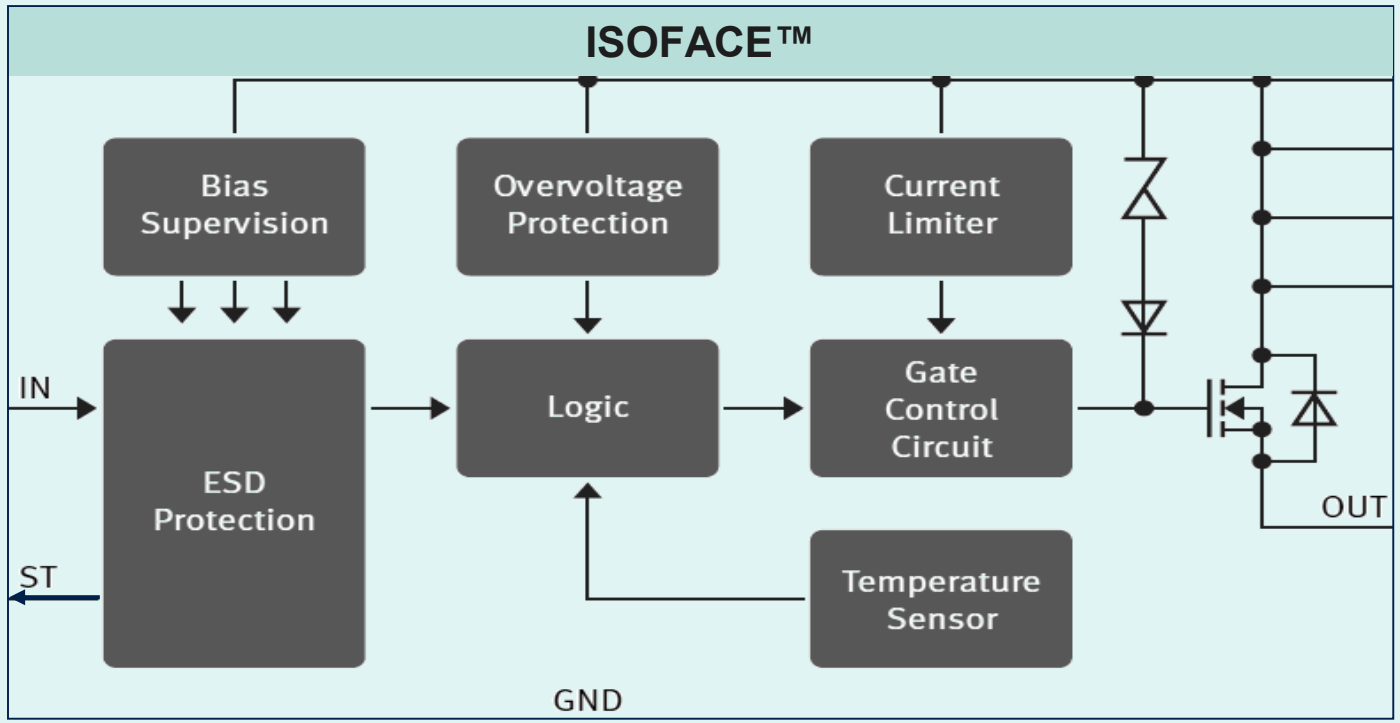


ISOFACE™ Digital Input ICs

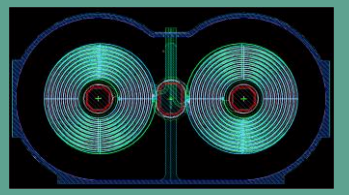
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ISOFACE™
Integrated Galvanic Isolation

ISOFACE™ High-Side Digital Output ICs



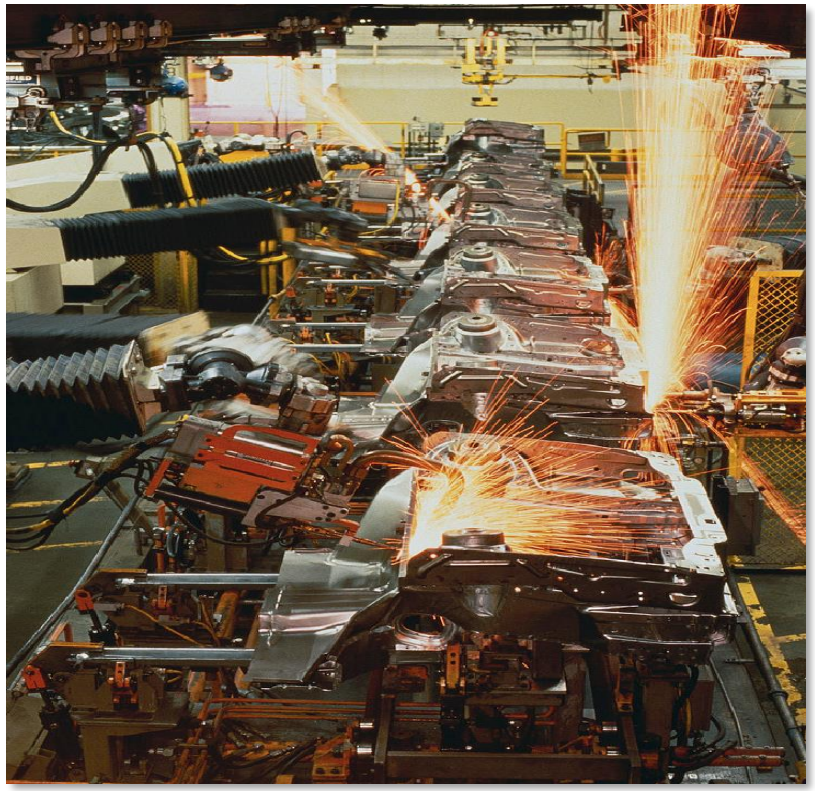
Galvanic isolation



- Under-voltage Lockout
- Over-voltage Protection
- Short-circuit Protection
- Loss of GND Protection
- Overload & over-temperature
- Drain to Source Clamping

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The real world is full of disturbances





Outputs or Inputs
are in close proximity to
strong Electro-Magnetic Fields

Long cables (up to 1 km):
Capacitive supplying or Inductive Coupling
from Switching of Large Loads

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ISOFACE™ product family: Galvanic isolation & diagnostics integrated

2nd Generation



- ISO2H823V 8x 0.6 A
  VQFN 12x12

8-Channel Output Switch IC

- 2.5 kV Galvanic Isolation
- 3.3 V µC Interface (SPI, parallel)
- Diagnostics per Channel:
  - Open load
  - Short to Vbb
  - Short to GND & Overload
  - Over temperature
- 5-fold Global Diagnostics



- ISO2I828V 24 V / 48 V sensors
  VQFN 8x8

8-Channel Digital Input IC

- 2.5 kV Galvanic Isolation
- 3.3 V µC Interface (SPI serial, parallel)
- Diagnostics:
  - Wire break
  - Under/Over-Voltage monitoring
  - Over-Temperature
- Digital filtering settable for channel
- Interrupt on change signal

1st Generation



- ISO1H811G 8x 0.6 A Parallel
- ISO1H812G 8x 0.6 A SPI
- ISO1H815G 8x 1.2 A Parallel
- ISO1H816G 8x 1.2 A SPI

8-Channel Output Switch ICs

- Integrated Galvanic Isolation
- Direct interface to µC
  - 3.3 V / 5 V
  - Serial or parallel
- Short-circuit protection
- Inductive load switching
- Up to 1.2 A load current
- Integrated Diagnostics:
  - Overload & Short circuit



8-Channel Digital Input ICs

- Integrated Galvanic Isolation
- Direct interface to µC
  - 3.3 V / 5 V
  - Serial or parallel
- IEC-Input Types: 1/2/3

TSSOP-48 8mm x 12.5	Sampling speed	Filter settings	Diagnostics	
			Vbb-monitor	Wire-break
ISO1I811T	125 kHz	4 / IC		
ISO1I813T	500 kHz	9 / channel	✓	✓

8-channel Output Switch ICs

8-channel Digital Input ICs

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ISOFACE™ 8-channel digital input ICs ISO1I81xT

ISO1I81x:

- I811: More integration & robustness than opto-couplers
- I813: Digital input solutions with diagnostics



Common Features

- **Input: IEC61131-2 (Type 1/2/3)**
- **500 V_{rms} Isolation (UL1577)**

Common Benefits

- **Shortens R&D time**
- **No need to develop & test discrete circuitry**

I813 Key Features

- **Up to 500 kHz sampling frequency**
- **Deglitching filters programmable**
- **Diagnostics: wire-break per channel, V_{BB} monitoring**

Highly Integrated Solution

- **Fast**
- **Superior Robustness**
- **System integrity verification**

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ISOFACE™ ISO2H823V output switch IC: 2.5kV isolation integrated

Main Features

- 8-Channel High-side Switch with output current 600 mA
- Inductive capacitive loads compatibility
- V_{ISO}: Rated dielectric voltage (1 min): 2.5 kV_{AC}
- V_{IOTM}: Short-term overvoltage (1 sec): 4250 V_{peak}
- Clearance & Creepage: 3.5 mm

I813 Key Features:

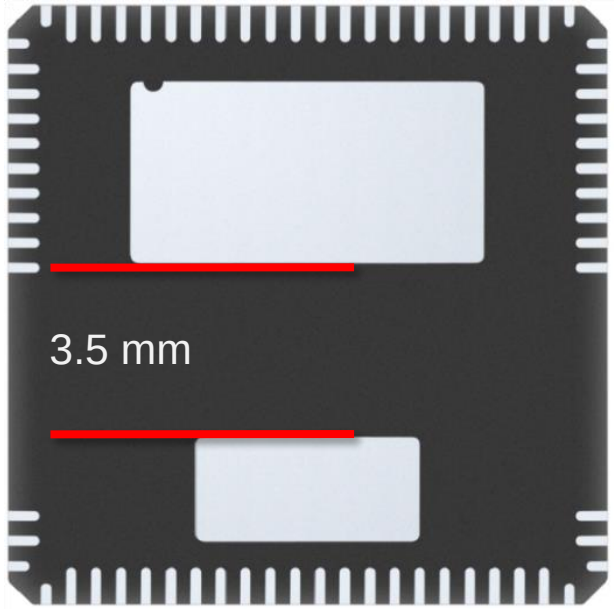
Global Diagnostics

- ✓ V_{BB} monitoring
- ✓ Over temperature
- ✓ Actual output status
- ✓ Incandescent lamp
- ✓ Transmission error

Per Channel Diagnostics

- ✓ Open load
- ✓ Short to V_{BB}
- ✓ Short to GND / Overload
- ✓ Over temperature

Meets IEC 61131-2 requirements for Reinforced Isolation, proper system design provided



12 x 12 mm Package
Bottom View



CERTIFICATE OF COMPLIANCE

Certificate Number 20120903-E329661
Report Reference E329661-20090513
Issue Date 2012-September-03

Issued to: INFINEON TECHNOLOGIES AG
AM CAMPEON 1-12
85579 NEUBIBERG GERMANY

This is to certify that representative samples of: COMPONENT - AUXILIARY DEVICES
Auxiliary Devices Component ISO1H801G/811G, with Parallel Interface and ISO1H802G/812G, with Serial Interface, ISO2H827V and ISO2H823V.

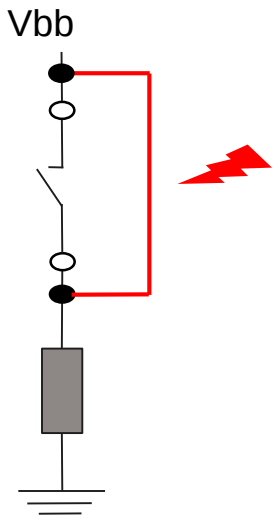
Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

Standard(s) for Safety: UL508, Industrial Control Equipment
CSA C22.2 No. 14-10, Industrial Control Equipment
Additional Information: See the UL Online Certifications Directory at www.ul.com/database for additional information

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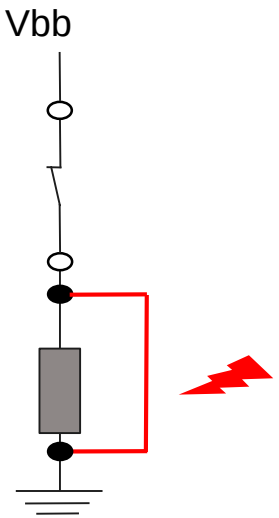
ISO2H823V Diagnostics Examples

Short to V_{BB}
[SCV]



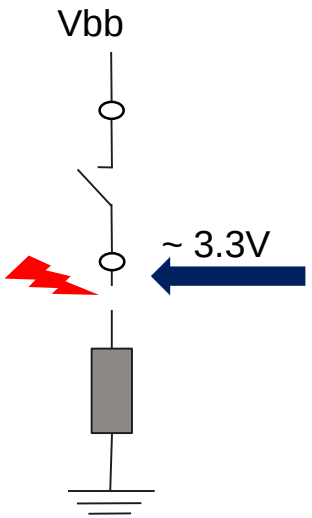


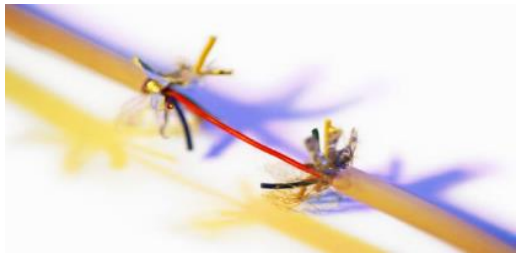
Short to GND
[OCL]



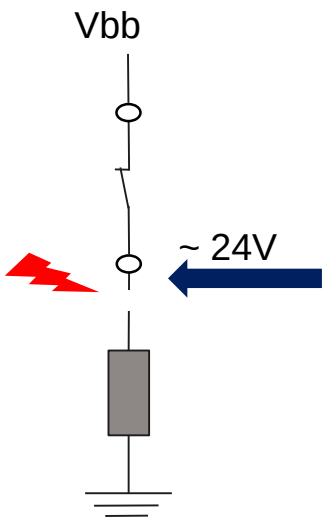


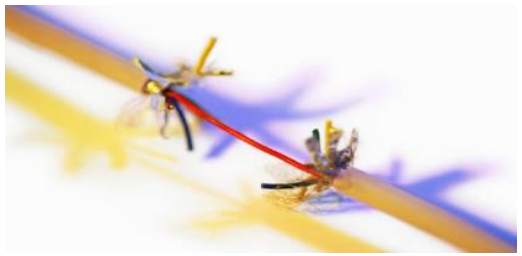
Open Load Inactive
[OLI]





Open Load Active
[OLA]



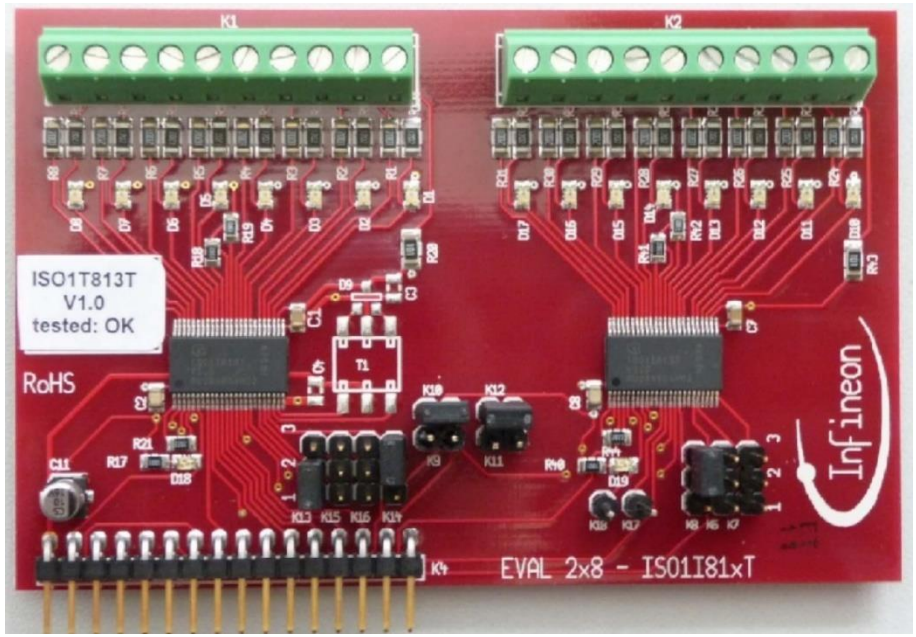


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Digital Inputs Isolation IC evaluation board

Overview

- **Robust 2.5 kV galvanic isolation based on coreless transformer technology for MCU protection from noisy environment/process-side**
- Complete integration of 8 channels of digital input, galvanic isolation & MCU/ASIC interface
- Status LED output for each digital input
- Parallel/Serial (SPI) data output interface to the external MCU
- OPN: EVALISO1I811TTOBO1 (up to 125 kHz sampling frequency)
- OPN: EVALISO1I813TTOBO1 (up to 500 kHz sampling frequency, programmable filter setting of each channel input, synchronous capture of input signals from multiple input Ics, comprehensive diagnostics enabling Preventive Maintenance)



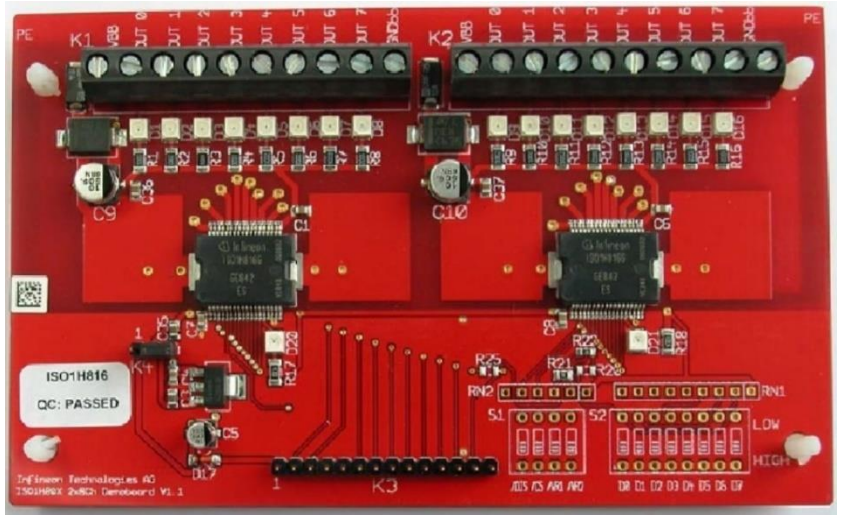
Product type	Function	Part number	Description	Package mm x mm	Qty
Isolated interface	Input isolation	ISO1I811T	24 V isolated 8-channel digital input, with 8-bit parallel/serial interface, up to 125 kHz sampling frequency, 1-state of the ERROR pin for process-side supply voltage V_{BB} < Vthreshold, V_{BB} 9.6 – 35 V, T_J -40 to 125°C	TSSOP48 8x12.5	2
Isolated interface	Input isolation	ISO1I813T	24 V isolated 8-channel digital input, with 8-bit parallel/serial interface, up to 500 kHz sampling frequency, comprehensive diagnostics (e.g. wire-break detection), 3-state of the ERROR pin for process-side supply voltage V_{BB} monitoring, V_{BB} 9.6 – 35 V, T_J -40 to 125°C	TSSOP48 8x12.5	2

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Output Switches Isolation IC evaluation board

Overview

- **Robust 2.5 kV galvanic isolation based on coreless transformer technology for MCU protection from noisy environment/process-side**
- Complete integration of MCU/ASIC interface, galvanic isolation & 8 high-side output switches
- Maximum current limit, short-circuit & overcurrent & overvoltage & ESD protections, undervoltage shutdown with autorestart & hysteresis, thermal shutdown with restart
- Parallel/Serial (SPI) data output interface to the external MCU
- OPN: EVALISO1H811GTOBO1 (up to nominal 0.7 A load output/channel & parallel interface)
- OPN: EVALISO1H812GTOBO1 (up to nominal 0.7 A load output/channel & serial interface)
- OPN: EVALISO1H815GTOBO1 (up to nominal 1.4 A load output/channel & parallel interface)
- OPN: EVALISO1H816GTOBO1 (up to nominal 1.4 A load output/channel & serial interface)



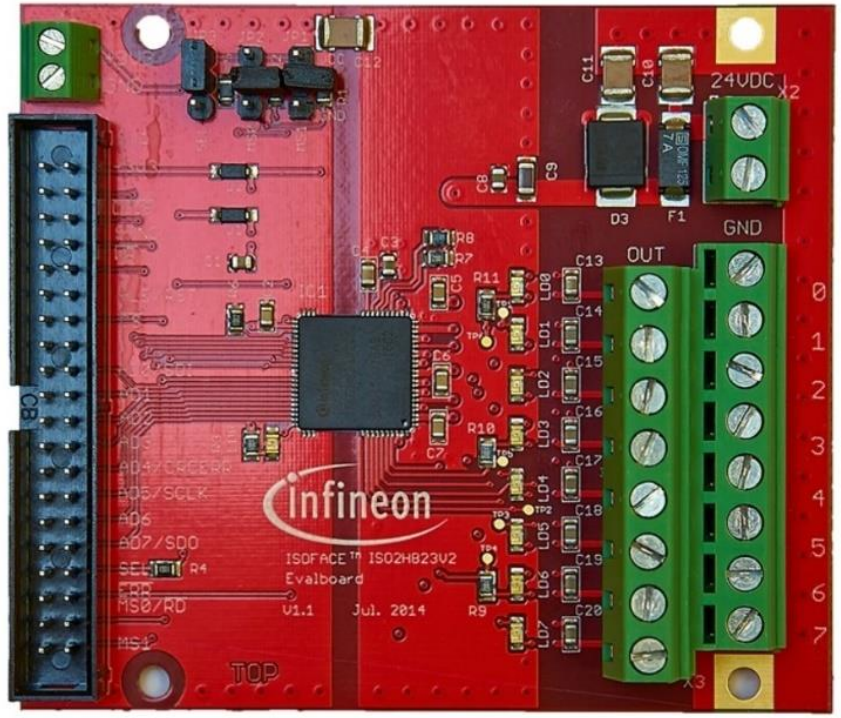
Product type	Function	Part number	Description	Package mm x mm	Qty
Isolated interface	Output isolation	ISO1H811G	24 V isolated 8-channel high-side switches of 0.7 A each with 8-bit parallel 3.3/5 V CMOS operation compatible interface, V_{BB} monitoring, V_{BB} 11 – 35 V, T_J -25 to 125°C	DSO36 14x16	2
Isolated interface	Output isolation	ISO1H812G	24 V isolated 8-channel high-side switches of 0.7 A each with 8-bit SPI 3.3/5 V CMOS operation compatible interface, V_{BB} monitoring, V_{BB} 11 – 35 V, T_J -25 to 125°C	DSO36 14x16	2
Isolated interface	Output isolation	ISO1H815G	24 V isolated 8-channel high-side switches of 1.4 A each with 8-bit parallel 3.3/5 V CMOS operation compatible interface, V_{BB} monitoring, V_{BB} 11 – 35 V, T_J -25 to 125°C	DSO36 14x16	2
Isolated interface	Output isolation	ISO1H816G	24 V isolated 8-channel high-side switches of 1.4 A each with 8-bit SPI 3.3/5 V CMOS operation compatible interface, V_{BB} monitoring, V_{BB} 11 – 35 V, T_J -25 to 125°C	DSO36 14x16	2

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Output Switches Isolation IC evaluation board

Overview

- **Robust 2.5 kV galvanic isolation based on coreless transformer technology for MCU protection from noisy environment/process-side with comprehensive diagnostics**
- Complete integration of MCU/ASIC interface, galvanic isolation & 8 high-side output switches
- Comprehensive diagnostics enabling Preventive Maintenance
- Maximum current limit, short-circuit & overcurrent & reverse output voltage & ESD protections, undervoltage shutdown with autorestart & hysteresis, thermal shutdown & diagnostics per channel with auto-restart
- Parallel/Serial (SPI) data output interface to the external MCU
- OPN: EVALISO2H823V25TOBO1 (up to 0.6 A load output/channel)



Product type	Function	Part number	Description	Package mm x mm	Qty
Isolated interface	Output isolation	ISO2H823V2.5	24 V isolated 8-channel high-side switches of 0.6 A each with 8-bit parallel/serial 3.3 V CMOS operation compatible interface, common output disable & error indication pins, 3-state of V_{BB} monitoring, V_{BB} 11 – 35 V, T_J -25 to 125°C	VQFN70 12x12	2

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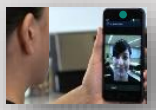
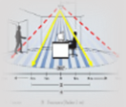


Sensors

3D Time-of-Flight (ToF), Radar and other environmental sensor solutions – Enabling smart and safe systems

Back to overview

XENSIV™ sensors portfolio & Robotics use cases

Environmental	Pressure	3D Radar	3D iToF	Microphone & ultrasound TR
 6x6mm²				
World smallest form factor	Best-in-class resolution	24GHz / 60GHz Application innovation leader	Power efficient Indirect Time of Flight 3D camera	Unique SNR, sensitivity and power efficiency
				
Best accuracy	Energy Efficiency	Best performance & energy efficiency	High resolution 3D point cloud	Crystal clear audio signals

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 + algorithm / software integrated system offer

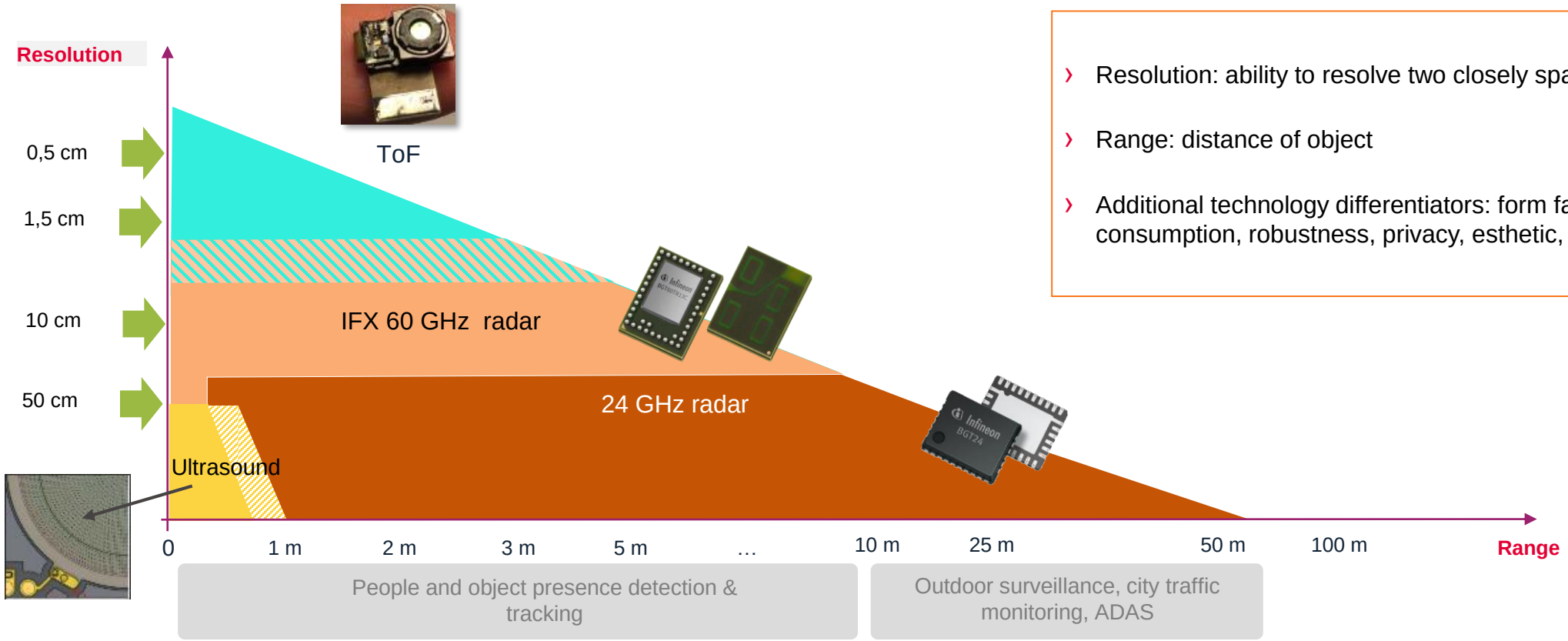
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Cobot use cases of Sensors: Value proposition

	Fenceless safety Certification takes time	2D/3D Object detection Human presence	Gesture control	Voice recognition
Current solutions	1. Safety laser scanners 2. ToF improved sick scanner/solid state scanner	1. RGB cameras 2. Stereo cameras 3. ToF cameras	1. RGB cameras 2. ToF cameras	1. Microphones
Problem	• No positioning in 3D • High costs • Big size	RGB: Big Size • No positioning in 3D • Doesn‘t work in dark environment • False positives from images Stereo: Big Size • Less range accuracy • Limited working distance • Doesn‘t work in dark environment	RGB: • No positioning in 3D • Doesn‘t work in dark environment • False positives Stereo: • Less range accuracy • Limited working distance • Doesn‘t work in dark environment	
Our Solution	• ToF cameras • 24/60 Ghz Radars	• ToF cameras • 24/60 Ghz Radars	• ToF cameras • 60 Ghz Radars	• IM69D MEMS Microphone
Infineon‘s Differentiators	**3D sensing** ToF Precise target localization & detection, special design via module maker partners Radar Precise range & velocity & direction of movement estimation, Real human presence, Human segmentation, Anonymity	**3D sensing (**works in dark environment) ToF Precise target localization & detection, special design via module maker partners, small form factor Radar Precise range & velocity & direction of movement estimation, Real human presence, Human segmentation, Anonymity, small form factor	Radar: • Hide behind cover • Anonymity • Low power consumption	• High SNR • Crystal clear audio signal

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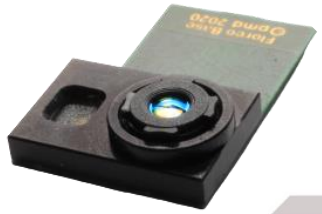
Infineon has a broad 3D sensing technology portfolio with Time-of-Flight (ToF) Imaging, Radar 24 and 60 GHz, and Ultrasonic MEMS



- Resolution: ability to resolve two closely spaced objects
- Range: distance of object
- Additional technology differentiators: form factor, power consumption, robustness, privacy, esthetic, price, sensitivity to light

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Time-of-Flight (ToF) Principle:
Depth and amplitude is measured in every pixel





3D scene

modulated IR light

reflected IR light

ToF camera module

IR illumination

lens

3D Image Sensor REAL3™

imager control

I²C

3D image raw data

CSI-2 or PIF

ECU / application processor

depth map calculation

amplitude

depth

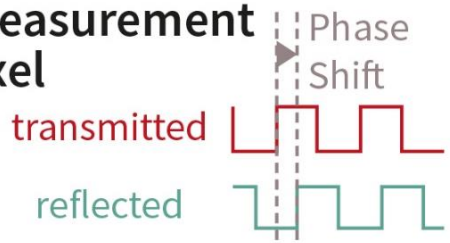
middleware / application SW

action

1 Active illumination

- Modulated near infrared light
- 850 or 940 nm

2 Distance measurement in every pixel



3 Processing

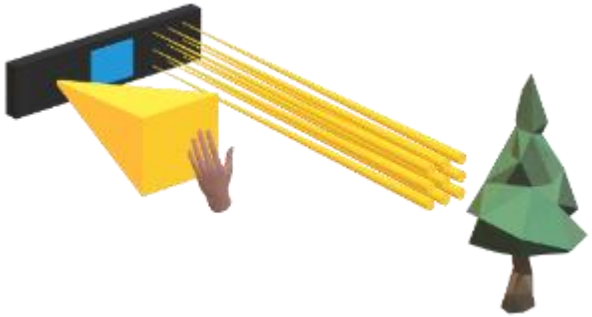
- Depth map calculation
- Calibration data
- Post processing

High quality depth map

4 Application algorithms

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REAL3™ Long Range Time of Flight offer: Get the right solution for your product

	IRS2381C Ready to use	**IRS2875C** Smallest low power long range system	**IRS2877C** Long range hybrid
			
	Flood		Flood & Spot
Resolution	38 k pixel up to 3 m 9,6 k pixel up to 5 m 2,4 k pixel up to 10 m	43 k pixel up to 3 m 10,8 k pixel up to 5 m 2,7 k pixel up to 10 m	307 k resolution up to 3 m 4.5k dots up to 6 m
Power	250 mW for 5 m range 350 mW for 10 m range	200 mW for 5 m range 300 mW for 10 m range	500 mW for 3 m (VGA) 500 mW for 6 m (4.5k dots)
Module Size (ES)	14,5 x 8 mm	10,6 x 7 mm	14,9 x 9,4 mm
Availability	available today	EES Feb 21 Production June 21	IRS2877C available today Hybrid solution: Demo Q1/21

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The new REAL3™ imager system provides best depth data quality & resolution for best user experiences

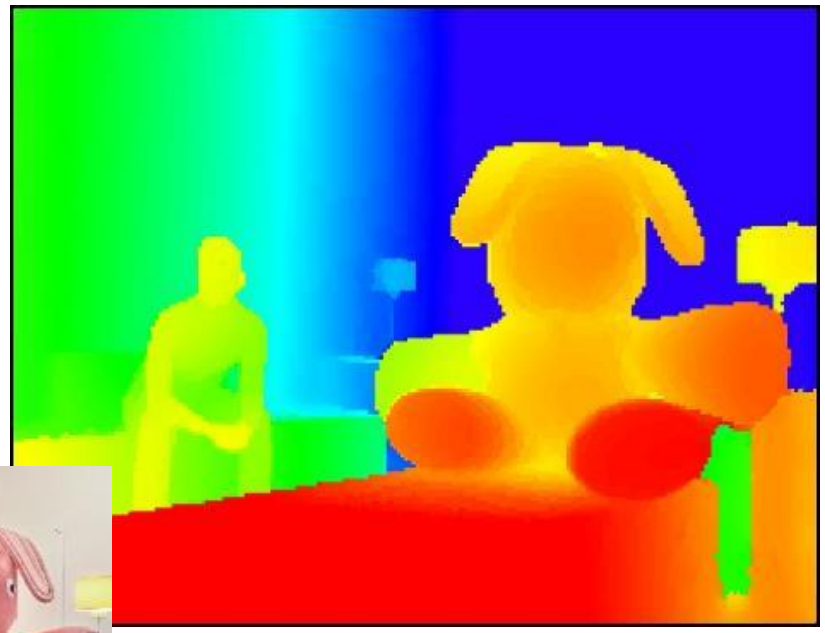
Full scale of AR applications



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Smartest and most immersive Augmented Reality

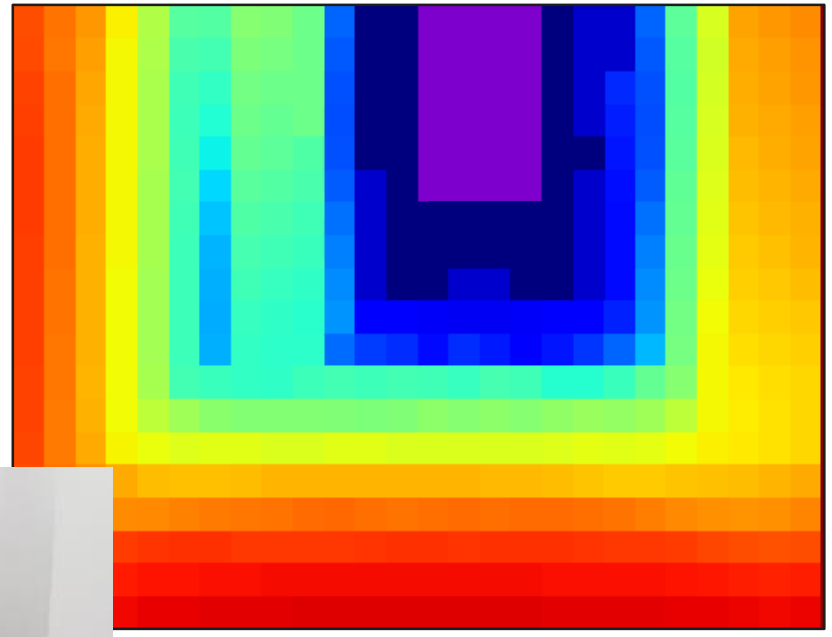
Resolution of 40k pixels





[Max distance 5 m]

Resolution of 0.6k pixels





[Max distance 10 m]

Flexible and superior resolution for most immersive and smart Augmented Reality experience

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3D IR-ToF Imaging Sensor Evaluation Board

Overview

- **3D camera module: flexx2 by pmd and System on Module (SoM) by Emcraft fitted with a camera module by pmd**
- flexx2 and Sunny MTP006 SoM use IRS2381C Infineon® REAL3™ 3D Image Sensor
- Liteon A65 Kit SoM uses IRS1645C Infineon® REAL3™ 3D Image Sensor

Parameter	flexx2	Sunny MTP006	Liteon A65 Kit
Dimensions (mm)	71.9 x 19.2 x 10.6 mm	18.9 x 18.6 x 5.3 mm	24.7 x 10.7 x 5.8 mm
3D ToF sensor	IRS2381C REAL3™	IRS2381C REAL3™	IRS1645C REAL3™
Illumination	940 nm 1 Watt VCSEL (LC1)	940 nm 1 Watt VCSEL (LC1)	940 nm 1 Watt VCSEL (LC1)
Resolution (pixels)	224 x 172	224 x 172	224 x 172
Field of View (H x V)	56° x 44°	60° x 40°	105° x 85°
Framerate (fps)	Up to 60 (3D frames)	Up to 60 (3D frames)	Up to 60 (3D frames)
Measurement range	0.1 to 4 m	0.1 to 4 m	0.1 to 3 m
Interfaces	USB3 Type-C	i.MX 8M Mini via 2-lane MIPI-CSI2 and I2C	i.MX 8M Mini via 2-lane MIPI-CSI2 and I2C
Accuracy	≤ 1% of distance (0.5 – 4 m @ 5 fps), ≤ 2% of distance (0.1 – 1 m @ 45 fps)	≤ 1% of distance (0.5 – 3 m @ 5 fps)	≤ 1% of distance (0.5 – 3 m @ 5 fps)
Software	Royale SDK C/C++ based supports Matlab, OpenCV, ROS 1, ROS 2	Linux and binary pmd Royale/Spectre	OpenEmbedded Linux OS running Royale SDK, C/C++ based, ROS 1 support available
Others	DevKit: encased, CE certified, Class 1 Laser product	i.MX 8M Mini Quad, 2 GB LPDDR4, 16 GB eMMC, WiFi/BT	i.MX 8M Mini Quad, 2 GB LPDDR4, 16 GB eMMC, WiFi/BT

Product type	Part number	Description
IR 3D ToF sensor	IRS2381C	224 x 172 pixels with micro-lenses at 14 µm pixel size, optimized for 940 nm wavelength, and for small size, low cost, & reduced power consumption applications
IR 3D ToF sensor	IRS1645C	224 x 172 pixels with micro-lenses optimized for 850nm wavelength, and for small size, low cost, & reduced power consumption applications





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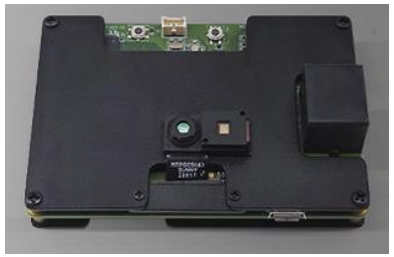
3D IR-ToF Imaging Sensor Evaluation Board (by Sunny Optical)

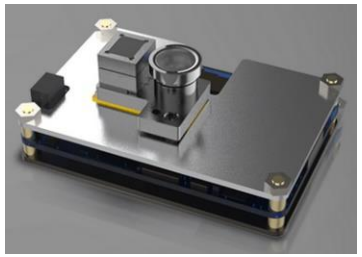
Overview

- **Mars and Cleaner 3D camera modules by Sunny Optical based on IRS2381C**
- Domestic robots and Consumer applications with low cost 3D IR ToF image sensor
- High resolution module to be integrated into the customer hardware platform

Parameter	Mars01E	Cleaner01A
Dimensions (mm)	72.5 x 48 x 33.5	65 x 48 x 23
3D ToF sensor	IRS2381C REAL3™	IRS2381C REAL3™
Illumination	940 nm VCSEL	850 nm or 940 nm VCSEL
Resolution (pixels)	224 x 172	224 x 10/15/42
Field of View (H x V)	60° x 45°	120° x 8/10/27.5°
Framerate (fps)	Up to 10	Up to 30
Measurement range	0.2 to 2 m	0.2 to 4 m
Interfaces	USB2.0, Ethernet	USB2.0, Rockchip RK11xx processing platform
Software frameworks	Linux Ubuntu, Windows	Windows, Linux, Android
Power consumption	2.3 W average	1.7 W average
Others	Detection accuracy ≤ 1% of distance (0.2 m - 3.2 m)	Detection accuracy ≤ 2% (0.2 m – 1 m @30 fps), global shutter, data output: point cloud, depth & IR map, IMU data

Product type	Part number	Description
IR 3D ToF sensor	IRS2381C	224 x 172 pixels with micro-lenses at 14 µm pixel size, optimized for 940 nm wavelength, and for small size, low cost, & reduced power consumption applications
IR 3D ToF sensor	IRS2877C	640 x 480 pixels with micro-lenses optimized for 940 nm wavelength





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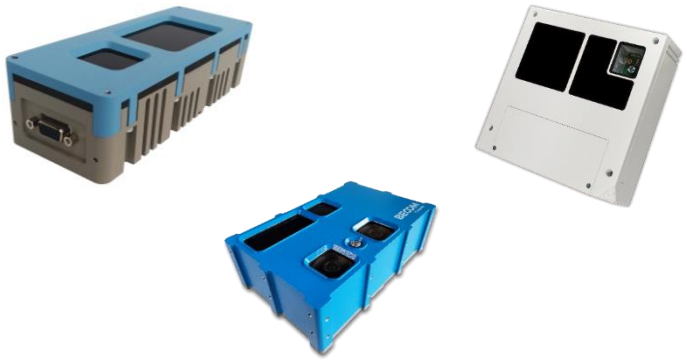
3D IR-ToF Imaging Sensor Evaluation Board (by BECOM)

Overview

- **Argos3D and Toreo 3D camera modules by BECOM based on IRS2877A and IRS1125A**
- Consumer and Industrial applications with standard and high resolution 3D IR ToF image sensor

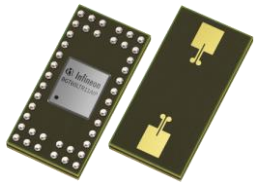
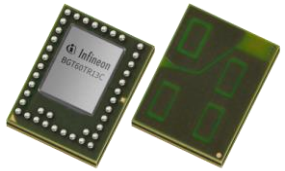
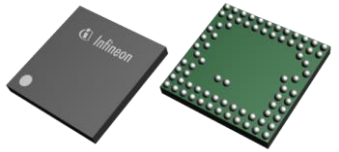
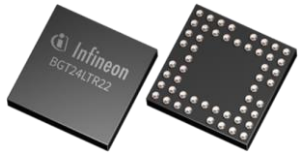
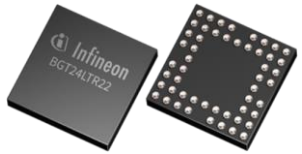
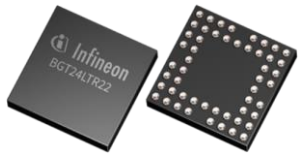
Parameter	Argos3D Pulse	Toreo P650	Argos3D P230/P231	Argos3D P330
Dimensions (mm)	173 x 46 x 65	230 x 148 x 106	173 x 46 x 65	200 x 200 x 62
3D ToF sensor	IRS2877A REAL3™	IRS2877A REAL3™	IRS1125A REAL3™	IRS1125A REAL3™ OV5640 CMOS RGB
Illumination	2x Active IR 850 nm/940 nm, 8x Laser diodes, 8 W average	850 nm, 16x Laser diodes	850 nm, 8x Laser diodes, 8 W average output	850 nm, 16x Laser diodes
Resolution (pixels)	640 x 480	640 x 480	352 x 287	352 x 287
Field of View (H x V)	80° x 60°	60° x 40°	80° x 60°	80° x 65°/90° x 70°
Framerate (fps)	Up to 40	Up to 30	Up to 40 for 3D data	Up to 40 for 3D data
Measurement range	5 m indoor	5 m indoor	3.5 m indoor	10 m indoor/3 m outdoor
Interfaces	Gigabit Ethernet, GPIO, trigger in	Gigabit Ethernet, reset, trigger in, 2x output	Ethernet, GPIO, trigger in	Gigabit Ethernet, RS232, RS485, UART, trigger in and out
Software frameworks	Matlab, Halcon, MetriCam, LabView	DataSpree DataStudio (DL)	Matlab, Halcon, MetriCam	Matlab, Halcon, MetriCam
Temperature range & cooling system	-20°C to 45°C with passive cooling	-40°C to 60°C with passive cooling	-20°C to 45°C with passive cooling	0°C to 50°C with passive cooling
Others	IP 67	IP 67, NVIDIA Tegra TX2 processing module, 2 RGB sensor modules	IP 65 & Power over Ethernet for P231	IP 42, Quad core Cortex A9 CPU, dual imaging capability (RGB & 3D IR)

Product type	Part number	Description
IR 3D ToF sensor	IRS1125A	352 x 288 pixels with micro-lenses optimized for both 850 nm & 940 nm wavelengths, and for long range & wide FoV applications, automotive qualified
IR 3D ToF sensor	IRS2877A	640 x 480 pixels with micro-lenses optimized for 940 nm wavelength, automotive qualified



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Broad Product Portfolio for 60GHz and 24GHz

	1Tx / 1Rx	1Tx / 2Rx	1Tx / 3Rx	2Tx / 2Rx	2Tx / 4Rx
60GHz	Passive IR replacement  3.3x6.5 mm² **BGT60LTR11AIP** Doppler Radar **Antenna-in-Package**		Consumer  5 x6.5 mm² **BGT60TR13C** FMCW Radar **Antenna-in-Package**		Automotive Qualified  6 x 6 mm² **BGT60ATR24C** FMCW Radar **Without Antenna**
24GHz	 *2.4 x 2.4 mm* **BGT24LTR11N16**  *4.5 x 5.5 mm* **BGT24MTR11**	 *4.5 x 5.5 mm* **BGT24MTR12**	 +  **BGT24MTR11** **+ BGT24MR2**	 *3.6 x 3.6 mm* **BGT24LTR22**	 +  **Cascading** **BGT24LTR22**

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60 GHz Radar development kits with modular concept

BGT60LTR11AIP



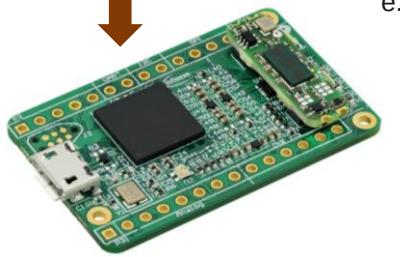
6.3 x 20 mm
BGT60LTR11AIP shield



Compatible to **Arduino MKR**
e.g. **Wifi1010** board



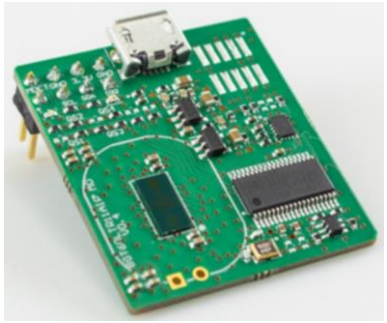
DEMO_60LTR11_AUTO_BLE
Wireless XENSIV™ Presence Detection demo kit:
BGT60LTR11AIP + CYBLE-222014-1 BLE module



64 x 25 mm
DEMO BGT60LTR11AIP:
BGT60LTR11AIP shield
+ Radar baseboard
MCU ARM CM7 300 MHz



S2GO RADAR BGT60LTR11:
Arduino compatible i.e.
form factor & programmability



REF_BGT60LTR11AIP_M0:
BGT60LTR11AIP +
XMC1302 MCU ARM CM0 32 MHz

BGT60TR13C

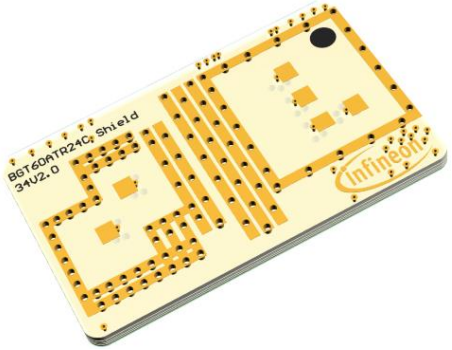


64 x 25 mm **DEMO BGT60TR13C**:
BGT60TR13C shield +
Radar baseboard MCU ARM CM7 300 MHz

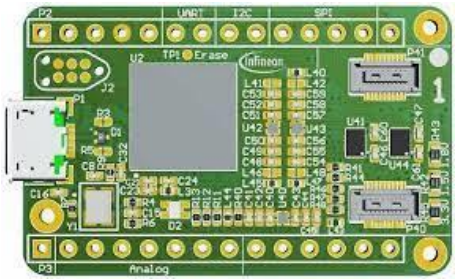


22.5 x 63 x 30 mm
KIT_CSK_BGT60TR13C
Rapid prototyping IoT sensors platform for IoT device development:
BGT60TR13C + DPS368 pressure sensor +
PSoC 62 dual-core ARM CM4 150 MHz & CM0+ 100 MHz with Wi-Fi & Bluetooth Combo
CYW43012 + OPTIGA Trust M security controller

BGT60ATR24C



26 x 16 mm **SHIELD_60ATR24ES_01**:
BGT60ATR24C shield



64 x 25 mm **Radar Baseboard MCU7**:
MCU ARM CM7 300 MHz

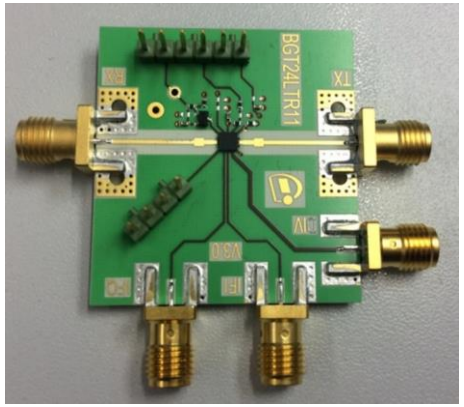
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24 GHz Radar development kits

BGT24LTR11



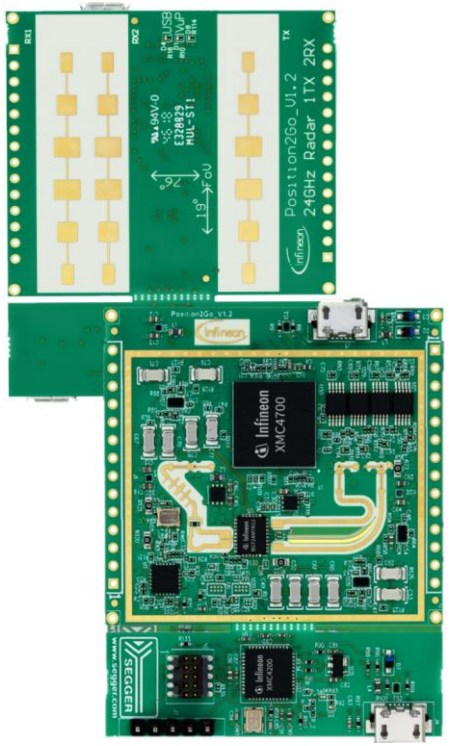
DEMO SENSE2GOL PULSE
24 GHz Radar sensor pulsed Doppler demo board, for motion, speed, and direction of movement detection:
BGT24LTR11 shield with 4x1 array antenna + XMC4700 MCU ARM CM4 144 MHz



EVAL BGT24LTR11 BOARD:
to test all datasheet parameters of the BGT24LTR11 through dedicated PCB connectors

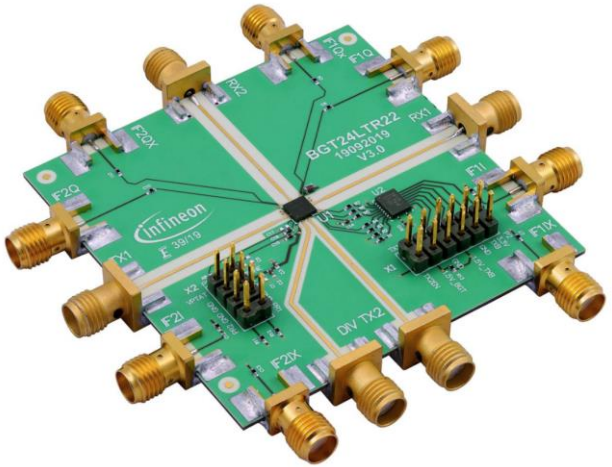
DEMO DISTANCE2GOL
24 GHz Radar sensor SW-controlled FMCW demo board for range measurements and 1D tracking of humans:
BGT24LTR11 shield with 4x1 array antenna + XMC4700 MCU ARM CM4 144 MHz

BGT24MTR12



DEMO POSITION2GO
24 GHz Radar sensor fast chirp FMCW demo board for tracking (angle, distance, speed, and direction of movement detection):
BGT24MTR12 +
XMC4700 MCU ARM CM4 144 MHz

BGT24LTR22



EVAL BGT24LTR11 BOARD:
to test all datasheet parameters of the BGT24LTR22 through dedicated PCB connectors

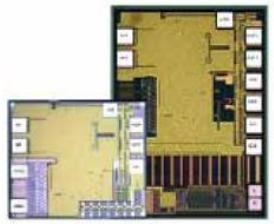
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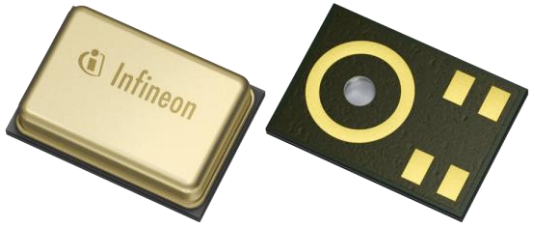
High performance analog and digital XENSIV™ MEMS microphones

Infineon microphone system

MEMS	ASIC	PACKAGE



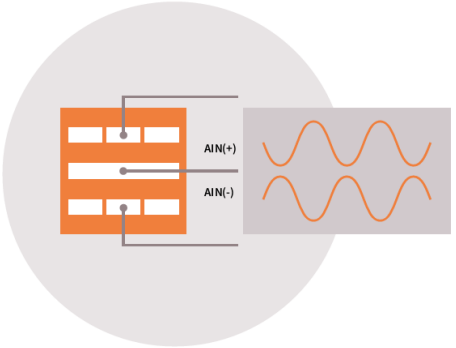




Features

- Ultra High Signal to Noise Ratio (SNR) – available to choose from 68 to 73 dB(A)
- High Acoustic Overload Point (AOP) – available to choose from 120 to 135 dBSPL
- Very good sensitivity – down to -37 dBFS for digital & -38 dBV for analog microphone
- Wide dynamic range
- Good phase and sensitivity matching
- Low power consumption resulting in lasting battery-powered devices
- Robust against dust, water, mechanical shock
- Available in both analog differential and digital PDM interfaces

Infineon's MEMS Technology Sealed Dual Membrane (SDM)



- Delivers high ingress protection (IP57) at a microphone level
- The sealed MEMS design prevents water or dust from entering between membrane and back-plate, preventing mechanical blockage or electric leakage issues commonly observed in MEMS microphones
- Microphones built with the SDM technology can be used to create IP68 devices, requiring only minimal mesh protection

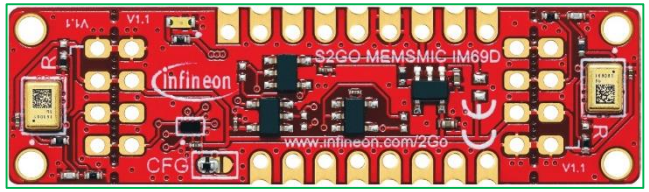
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MEMS Microphone IM69D130 evaluation board

Overview

- **Digital omnidirectional sound pressure sensor based on dual-backplate MEMS technology and capacitance change processed by the integrated ASIC**
- High linearity of the output signal within a dynamic range of 105 dB
- Pre-calibrated device resulting in sensitivity tolerance within ±1 dB
- Included audio processing IC converting PDM data stream to PCM audio data
- OPN: S2GOMEMSMICIM69DTOBO1
- PCB: 38.5 x 14 mm , 2-layer FR4
- Easy to use with Arduino Uno using the available adapter (MYIOTADAPTERTOBO1) or with XMC1100 S2GO (KITXMC2GOXMC1100V1TOBO1) / XMC1100 Boot Kit (KITXMC11BOOT001TOBO1)
- Evaluation software for the 2 baseboard types above is available in GitHub
- On-board debugger compatible with XMC Link for XMC1100 S2GO/Boot Kit board









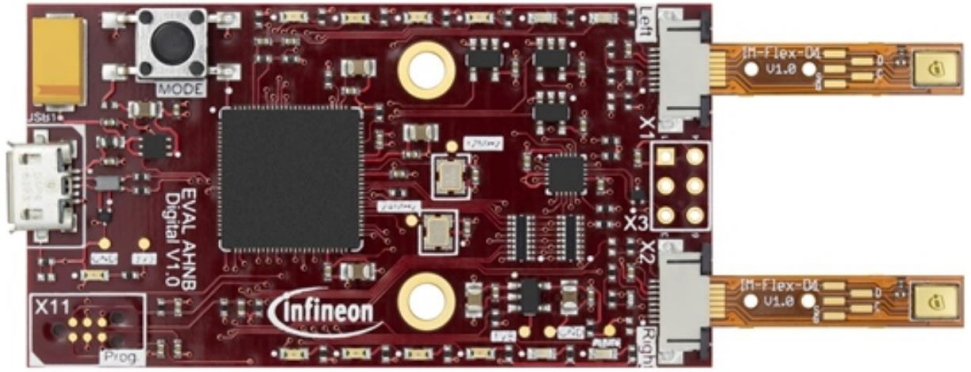
Product type	Function	Part number	Description	Package mm x mm	Qty
MEMS Microphone	Right & Left sound sensing	IM69D130	Digital sound sensor, omnidirectional directivity, audio bandwidth 20 Hz – 20 kHz, max. sensitivity -35 dBFS, typical accoustic overload point 130 dBSPL, PDM data output, max. PDM clock frequency 3.3MHz, typical SNR up to 69 dB, typical noise floor -105 dBFS, V_{DD} 1.62 – 3.6 V, T_A 0 to 70°C	3x4	2
MCU	Read sensors output	XMC1100-Q024F0064	32-bit Cortex-M0 32/64MHz C/P clock 16 KB RAM & 64 KB Flash with 12-bit ADC, 2 universal serial interface, T_A -40 to 85°C	VQFN24 4x4	1
LDO	Voltage regulator for MCU 3.3 V	IFX54211MBV33	3.3 V linear voltage regulator, ±3% output voltage accuracy, 150 mA output current, V_{IN} 2.7 – 18 V, output current limitation, short circuit protection, over-temperature shutdown, T_J -40 to 125°C – replaceable with automotive qualified TLS202B1MBV33	SCT595 2.5x2.9	1

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MEMS Microphone IM72D128 evaluation board

Overview

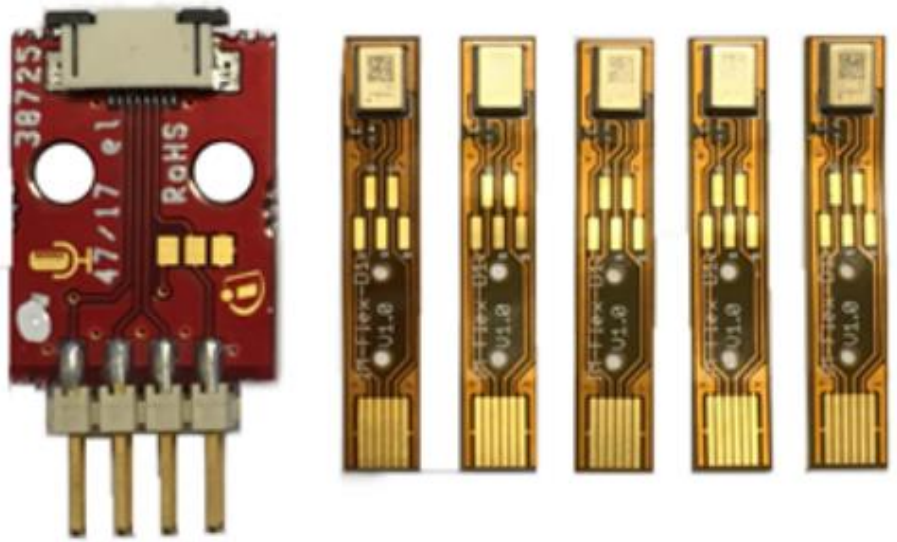
- **Digital omnidirectional sound pressure sensor based on dual-backplate MEMS technology and capacitance change processed by the integrated ASIC**
- High linearity of the output signal within a dynamic range of 106 dB
- Pre-calibrated device resulting in sensitivity tolerance within ±1 dB
- OPN: EVALAHNBDIGITALV01TOBO1
- Consists of Infineon Audiohub Nano and four IM72D128 digital microphones on flex board
- Audio streaming over USB interface and powered through micro-USB
- 48 kHz sampling rate and 24-bit audio data (stereo)
- Mode switch for toggling between normal mode and low power mode with 4 pre-defined gain configurations
- LEDs indication for the configured gain level in normal mode and low power mode
- Volume unit meter display with on board LEDs



Product type	Function	Part number	Description	Package mm x mm	Qty
MEMS Microphone	Right & Left sound sensing	IM72D128	Digital sound sensor, omnidirectional directivity, audio bandwidth 20 Hz – 20 kHz, max. sensitivity -35 dBFS, typical accoustic overload point 128 dBSPL, PDM data output, max. PDM clock frequency 3.3MHz, typical SNR up to 72 dB, V_{DD} 1.62 – 3.6 V, T_A 0 to 85°C	3x4	2

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MEMS microphone FLEX evaluation kits



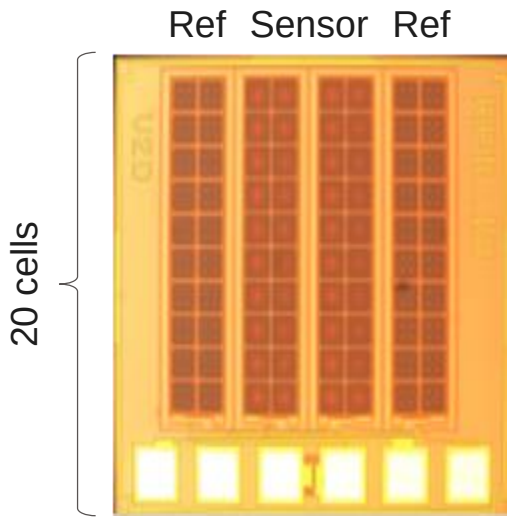
- Each kit includes five flex boards and one adapter board
- Flex board size: 4.5 x 25 mm
- Pre-soldered MEMS microphone
- Configurable select pin configuration for digital microphones
- Flex board can be easily connected to an audio testing setup with the included adapter board via a 6-position ZIF connector

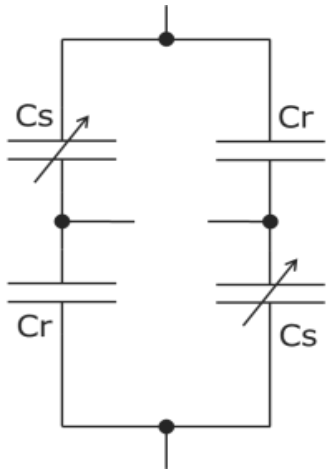
Evaluation kit	Component	SNR	AOP	Sensitivity
KIT_IM68A130V01_FLEX	IM68A130	68 dB(A)	130 dBSPL	-38 dBV
EVAL_IM69D120_FLEXKIT	IM69D120	69 dB(A)	120 dBSPL	-26 dBFS
KIT_IM69D127V11_FLEX	IM69D127	69 dB(A)	127 dBSPL	-34 dBFS
KIT_IM69D128SV01_FLEX	IM69D128S	69 dB(A)	128 dBSPL	-37 dBFS
EVAL_IM69D130_FLEXKIT	IM69D130	69 dB(A)	130 dBSPL	-36 dBFS
KIT_IM70D122V01_FLEX	IM70D122	70 dB(A)	122 dBSPL	-26 dBFS
KIT_IM70A135V01_FLEX	IM70A135	70 dB(A)	135 dBSPL	-38 dBV
KIT_IM72D128V01_FLEX	IM72D128	72 dB(A)	128 dBSPL	-36 dBFS
KIT_IM73D122V01_FLEX	IM73D122	73 dB(A)	122 dBSPL	-26 dBFS
KIT_IM73A135V01_FLEX	IM73A135	73 dB(A)	135 dBSPL	-38 dBV

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XENSIV™ Pressure sensor: Small size, low power consumption and highest precision for air pressure sensing

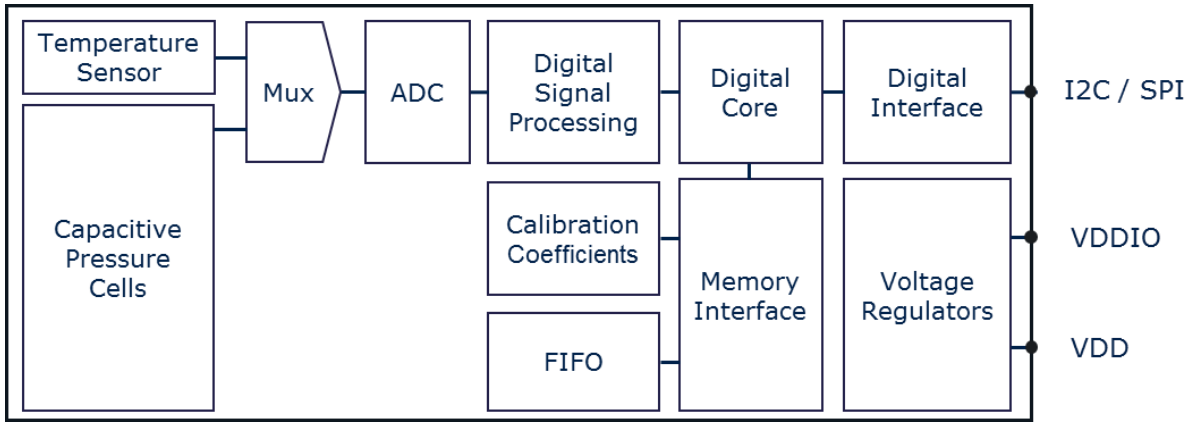
Infineon digital barometric pressure sensor: cell structure & block diagram







8-Pin LGA
2 x 2.5 x 1.1 mm



- Capacitive bridge configuration leading to better thermal stability
- Cell size optimized for sensitivity and mechanical reliability
- Low-power differential measurement between sensing cells and reference cells
- Integrated FIFO can store up to 32 pressure / temperature measurements

Features

- Pressure operation range: 300 – 1200 hPa / mbar
- Temperature operation range: -40 to 85°C
- Precision: ± 0.002 hPa (or ±0.02 m)
- Relative accuracy: ± 0.06 hPa (or ±0.5 m)
- Absolute accuracy: ± 1 hPa (or ±8 m)
- Temperature accuracy: ± 0.5°C
- Active average current consumption: 1.7 µA @1Hz sampling rate
- Waterproof: fully functional 50 m under water for 1 hour (IPX8)

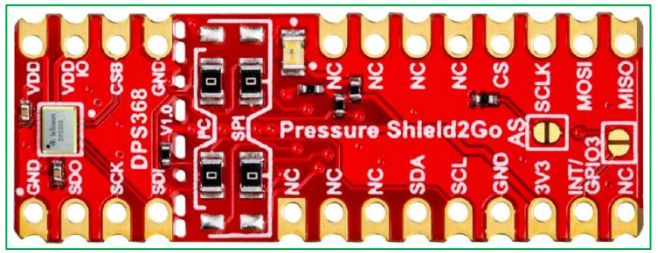
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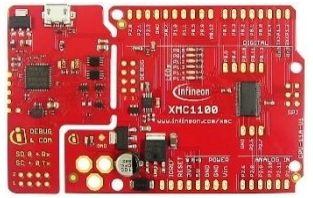
Pressure Sensor DPS368 Evaluation Board

Overview

- **Digital barometric air pressure sensor based on capacitive sensing principle with IPx8 certification (waterproof testing/robustness against water, humidity, and dust)**
- Miniaturized and high precision ±0.002 hPa or ±2 cm
- 24-bit resolution of pressure and temperature readings
- OPN: S2GOPRESSUREDPS368TOBO1
- Easy to use with Arduino Uno using the available adapter (MYIOTADAPTERTOBO1) or with XMC1100 S2GO (KITXMC2GOXMC1100V1TOBO1)/XMC1100 Boot Kit (KITXMC11BOOT001TOBO1)
- Evaluation software for the 2 baseboard types above is available in GitHub
- On-board debugger compatible with XMC Link for XMC1100 S2GO/Boot Kit board
- Use cases: height/altitude sensing, air flow control, displacement sensing







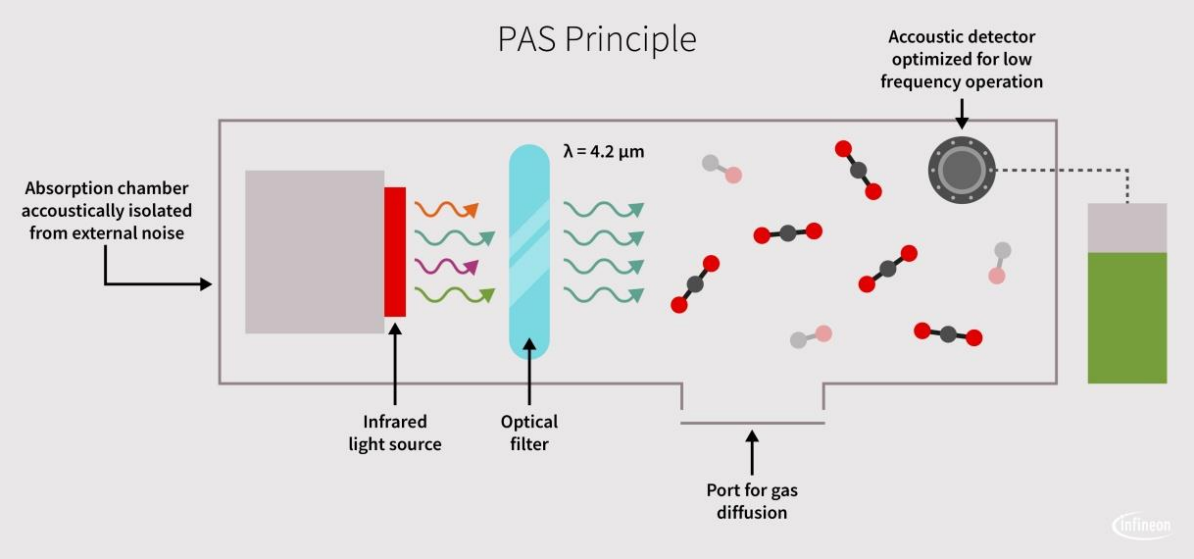


Product type	Function	Part number	Description	Package mm x mm	Qty
Pressure sensor	Barometric air pressure sensing	DPS368	Digital air pressure sensor, 300 – 1200 hPa operating pressure range, ±0.002 hPa/±0.02 m precision, ±0.06 hPa/±0.5 m relative accuracy, embedded temperature sensor with ±0.5°C accuracy, 24-bit resolution, I^2C or SPI interface, FIFO memory up to up to 32 pressure or temperature measurements, IPx8 certified, V_{DD} 1.7 – 3.6 V, T_A 0 to 65°C	VLGA8 2x2.5	1
MCU	Read sensor output	XMC1100-Q024F0064	32-bit Cortex-M0 32/64 MHz C/P clock 16 KB RAM & 64 KB Flash with 12-bit ADC, 2 universal serial interface, T_A -40 to 85°C	VQFN24 4x4	1
LDO	Voltage regulator for MCU 3.3 V	IFX54211MBV33	3.3 V linear voltage regulator, ±3% output voltage accuracy, 150 mA output current, V_{IN} 2.7 – 18 V, output current limitation, short circuit protection, over-temperature shutdown, T_J -40 to 125°C – replaceable with automotive qualified TLS202B1MBV33	SCT595 2.5x2.9	1

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A disruptive CO_2 sensor based on Photo-Acoustic Spectroscopy

Infineon's Photo-Acoustic Spectroscopy (PAS) CO_2 sensor





PCB integration:

- PAS transducer including a detector, infrared source and optical filter
- MOSFET chip to drive the infrared source
- microcontroller for signal processing and algorithms: ppm calculations as well as advanced compensation and configuration algorithms

Features

- Exceptionally **small form factor** (14 x 13.8 x 7.5 mm)
- Accurate and robust performance at **ppm level (±30 ppm ±3% of reading)**
- SMD package delivered in tape and reel
- Advanced compensation and self-calibration algorithms
- Various configuration options (e.g. sampling rate, baseline calibration) and interfaces (UART, I2C, PWM)

Benefits

- Space savings in customers' end products
- High-quality data and compliance with smart building standards
- Cost-effective high-volume assembly and easy system integration
- Plug & play for fast design-to-market
- Customer flexibility thanks to variety of configuration options

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CO_2 Sensor PASCO2V01 Evaluation Board

Overview

- **Digital gas CO_2 sensor based on photoaccoustic spectroscopy (PAS) principle & leveraging on the MEMS sound pressure sensor that detects pressure changes generated by CO_2 molecules in the sensor cavity**
- Direct concentration reading in ppm (part per million) enabled by the integrated MCU
- OPN: EVALPASCO2MINIBOARDTOBO1
- To be used with PSoC™ 6 Wi-Fi Bluetooth® Pioneer Kit (CY8CKIT-062-WIFI-BT) or Arduino board
- OPN: EVALPASCO2SENSOR2GOTOBO1 (for direct interface to USB of PC/Laptop)
- Evaluation software available in Github and Infineon website



Product type	Function	Part number	Description	Package mm x mm	Qty
CO_2 sensor	CO2 gas sensing	PASCO2V01	Digital gas CO_2 sensor, concentration range 0 – 32000 ppm, accuracy ± (30 ppm ± 3% tolerance) at 400 – 5000 ppm concentration range, P_{OP} 1013 hPa, I^2C, UART and PWM interfaces, typical digital V_{DD} 3 – 3.6 V, emitter V_{DD} 9.6 – 14.4 V, T_A 0 to 50°C with relative humidity range 0 – 85%	14x14x7.5	1
USB – UART bridge controller	USB – UART converter	CY7C65213-32LTXI	USB to UART bridge, USB2.0 Full Speed 12 Mbps, 1-channel configurable UART up to 3 Mbps, integrated 48 MHz clock oscillator, compatible with USB2 and USB3 host controllers, operating voltage 1.71 – 5.5 V, T_A -40 to 85°C	QFN32 5x5	1
LDO	Voltage regulator for MCU 3.3 V	TLS202B1MBV33	3.3 V linear voltage regulator, ±3% output voltage accuracy, 150 mA output current, V_{IN} 2.7 – 18 V, output current limitation, short circuit protection, over-temperature shutdown, T_J -40 to 150°C , automotive qualified	SCT595 2.5x2.9	1
MCU	Read sensor output	CY8C6247BZI-D54	32-bit Cortex-M4F 150MHz with single-cycle multiply, FPU & MPU & Cortex-M0+ 100MHz with single-cycle multiply & MPU, 288kB SRAM & 1MB application Flash, QuadSPI/Serial memory interface, 9 configurable serial communication blocks, 2 PDM & 1 I2S audio channels, 32 TCPWM, 12-bit ADC 1Msps, 2 OpAmps, CAPSENSE™, Cryptography accelerator, V_S 1.7 – 3.6 V, T_A -40 to 85°C	BGA124 9x9	1

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Connectivity

Wi-Fi & Bluetooth solutions – Connecting what matters

Back to overview

Infineon leading IoT Compute & Wireless solutions

Category Leading Products

- Delivering compute, Wi-Fi, Bluetooth, and HMI products
- Flexible, secure, low-power MCU family
- Low-power, robust Wi-Fi and Bluetooth optimized for IoT
- Rich, easy-to-use software

Longstanding IoT Leader

- Growing PSoC MCU family since 2002
- Acquired market-leading Broadcom IoT business in 2016 led to more than doubled the business
- Key IoT-focused driver of Wi-Fi Alliance and Bluetooth SIG

Trusted Partner

- Compelling roadmap focused on the IoT
- Proven track record of commitment and quality
- Core supplier to 8 of top 10 IoT companies



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Infineon Connectivity: Unique capabilities that deliver powerful Wi-Fi for Robotics and IoT applications

Reliable

Most widely deployed wireless IP with more than 1 Billion AIROC™ Wi-Fi and Bluetooth devices in the field leading to the **best interoperability**

Robots get deployed everywhere

Secure connection to the cloud and **prevent counterfeits**, with OPTIGA™ secure elements

YOUR ROBOT IS SECURE





Low power

Ultra low power by design – very low sleep, transmit, and receive current

Low power system architecture – offloads host processor so it sleeps for longer periods

High performance RF – ensures the **most robust connection** that reduces power consumption significantly

NO NEED TO RECHARGE YOUR ROBOT TOO OFTEN



High performance SoCs

High-performance RF design for **longer range**

Robots operate in congested environments

Data-driven Wi-Fi with 300 M datapoints per day in real-world conditions (CIRRENT™)

YOUR ROBOT KEEPS LEARNING



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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 Robots addressing multiple markets

	Recommendation
Long-range connectivity	CYW20820, CYW20706, CYW20835
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	CYW20736, CYW20819
Dual Mode Bluetooth & BLE	CYW20706, CYW20719, CYW20820

	Recommendation	
Highest Throughput/Best Range	CYW55573, CYW4373, CYW43439	
Triple Band (2.4, 5, & 6 GHz)	CYW55573	
Dual Band (2.4 GHz & 5 GHz)	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	CYW55573, CYW54590	

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Wi-Fi & Wi-Fi + Bluetooth Combo product portfolio

Wi-Fi 4 (802.11n)

43364
2.4 GHz, 1x1, 11n SDIO

43438
2.4 GHz, 1x1, 11n SDIO/SPI
BT5.1 UART/PCM

43439
2.4 GHz, 1x1, 11n SDIO/SPI
BT5.0 UART/PCM

43012
Ultra low power
2.4 & 5 GHz, 1x1, 11n SDIO
BT5.0 UART/I2S/PCM
WLBGA/WLCSP

43907
2.4 & 5 GHz, 1x1, 11n +
320 MHz Cortex-R4

Wi-Fi 5 (802.11ac)

43455
2.4 & 5 GHz, 1x1, 11ac SDIO/UART
BT5.0 UART/I2S/PCM

4373
2.4 & 5 GHz, 1x1, 11ac SDIO/USB
BT5.0 UART/PCM

43022
Ultra low power
2.4 & 5 GHz, 1x1, 11ac SDIO/SPI
BT5.3 UART/SDIO/I2S/PCM
Pin-to-Pin with 43012

54590 MIMO
2.4 & 5 GHz, 2x2, 11ac SDIO/UART/PCIe
BT5.1 UART/I2S/PCM

54591 RSDB
2.4 & 5 GHz, 2x2, 11ac, SDIO/UART/PCIe
BT5.1 UART/I2S/PCM

54907
2.4 & 5 GHz, 1x1, 11ac +
320 MHz Cortex-R4

Wi-Fi 6 (802.11ax)

55513
2.4, 5 & 6 GHz, 1x1, 11ax SDIO/SPI
BT/BLE5.3 UART/PCM

55572
2.4, 5 GHz, 2x2, 11ax PCIe/SDIO
BT5.3 UART/PCM

55573
2.4, 5 & 6 GHz, 2x2, 11ax PCIe/SDIO
BT5.3 UART/PCM

55571
2.4, 5 & 6 GHz, 1x1, 11ax PCIe/SDIO
BT5.3 UART/PCM

55913
2.4, 5 & 6 GHz, 1x1,
11ax + Cortex-M33

Wi-Fi + Bluetooth Combos

Infineon's Wi-Fi and Bluetooth combos use production-ready, fully-certified Wi-Fi + Bluetooth combo modules based on both Linux and RTOS based platforms.
Many of the Wi-Fi + Bluetooth combos are supported on Infineon's WICED Wi-Fi and ModusToolbox Software Development Kits (SDK) which provide code examples, tools and development support **for easier and faster development.**



Wi-Fi

Infineon's Wi-Fi portfolio provides high-performance, flexible connectivity for Linux, Android, and RTOS.
Many of the Wi-Fi + Bluetooth combos are supported on Infineon's WICED Wi-Fi and ModusToolbox Software Development Kits (SDK) which provide code examples, tools and development support.



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Infineon IoT Software Solutions For Wi-Fi Designs

Infineon provides **easy-to-use, reliable,** and **consistently updated software development platforms** for flexible development of your connected product

Solutions for RTOS Designs

Infineon delivers compute, connectivity, and HMI capabilities in a single unified platform:

- ModusToolbox is a set of multi-platform tools and a comprehensive suite of GitHub-hosted middleware libraries enabling industry-leading feature-sets like CapSense® capacitive-sensing, mesh, and system power optimization
- Enables an immersive development experience for customers using Infineon MCU and wireless devices. You can use our ModusToolbox Eclipse IDE, or 3rd party IDEs such as: Visual Studio Code, IAR Embedded Workbench, and Keil µVision
- Extensive support for 3rd party cloud ecosystems as well as our own AnyCloud cloud management solution using the Infineon ultra-low-power, secure PSoC® 6 MCU and robust Wi/Fi Bluetooth combo devices



Solutions for Linux/Android Designs

Delivering integrated wireless products for Linux and Android designs. Infineon Partners with the open source community to provide quality and secure connectivity:

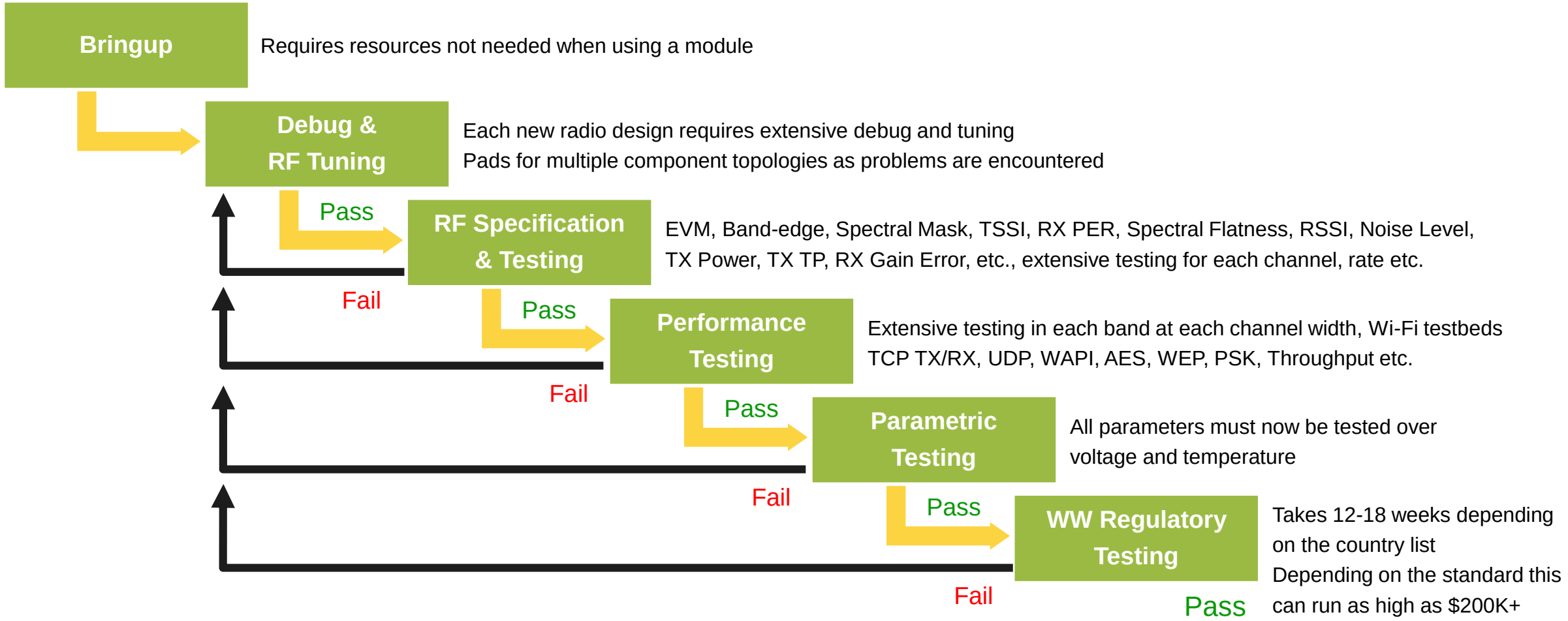
- Enabling a broad set of Wi-Fi and Bluetooth / Bluetooth LE advanced feature sets for a wide variety of designs
- Supporting the latest Linux and Android distributions along with backward compatibility for previous versions
- Infineon RF and regulatory tools bring your Linux or Android based prototype to production faster than ever



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Certified Modules minimize design complexity

Simplified WLAN RF Design Flow



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Infineon AIROC™ Wi-Fi ecosystem partners

A global partner ecosystem enables **support and development** for your IoT application

Design, build and sell RF Modules with limited software and hardware certification support

Provide certified, ready-to-use modules with integrated software and custom services

Integrate modules, software and plastics into a finished product with customization options

Wi-Fi Mesh, RF expertise, Wi-Fi Driver & Bluetooth, camera software

Module Makers

muRata INNOVATOR IN ELECTRONICS

USI

AzureWave

Value-Added Resellers

LANTRONIX®

Laird

Inventek Systems Embedding Connectivity Everywhere

ODMs

Chicony

FOXCONN

PEGATRON

Software & Services

embedUR

VIRSCIENT

RHONDA

Packet Path

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Modules for Recommended AIROC™ Wi-Fi Combo Products

Wi-Fi 4 CYW43439 Modules

Type 1YN
(Footprint compatible with 1DX/1LH)

Sterling™-LWB+

AW-NM512

FC909A

Wi-Fi 5 CYW4373/E Modules

Type 2BC (4373)
Type 2AE (4373E)

Sterling™-LWB5+ / USB Adapter

AW-CM467
AW-CM467-USB

Wi-Fi 5 CYW54590/1 Modules

Type 1XA

AW-CM572

FC80A

Wi-Fi 6 CYW5557x Modules

Type 2EA (sampling)

AW-XH316 (sampling)

WM-BAX-CYW-61 (sampling)

Wi-Fi 4 CYW43012 Modules

Type 1LV

AW-AM497

WM-BAC-CYW-50

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CYW43439 – 1x1 Antenna Configuration
Single band 2.4 GHz Wi-Fi 4 802.11n + BT 5.2

Key Features / Value Propositions

- Enhanced follow-on device for widely popular CYW4343W with patch space freed up
- SDIO 2.0 interface can be shared for Wi-Fi and BT/LE, also supports UART (BT) and SPI (Wi-Fi) host interfaces
- Supports Wi-Fi Certified WPA3 -Personal, -Enterprise and -Soft AP (up to 4 clients)
- Supports TCP Keepalive & other offloads as well as DPP for Wi-Fi Easy Connect™
- Support for both RTOS designs and Linux/Android (A-Class) host designs

Target Applications

- Home Automation: IP Camera, IoT Hub, etc.
- Wearable, Handheld, Portable Devices
- Can be used very broadly (1X1, SB, 11n) – will be a workhorse for 2021 and beyond

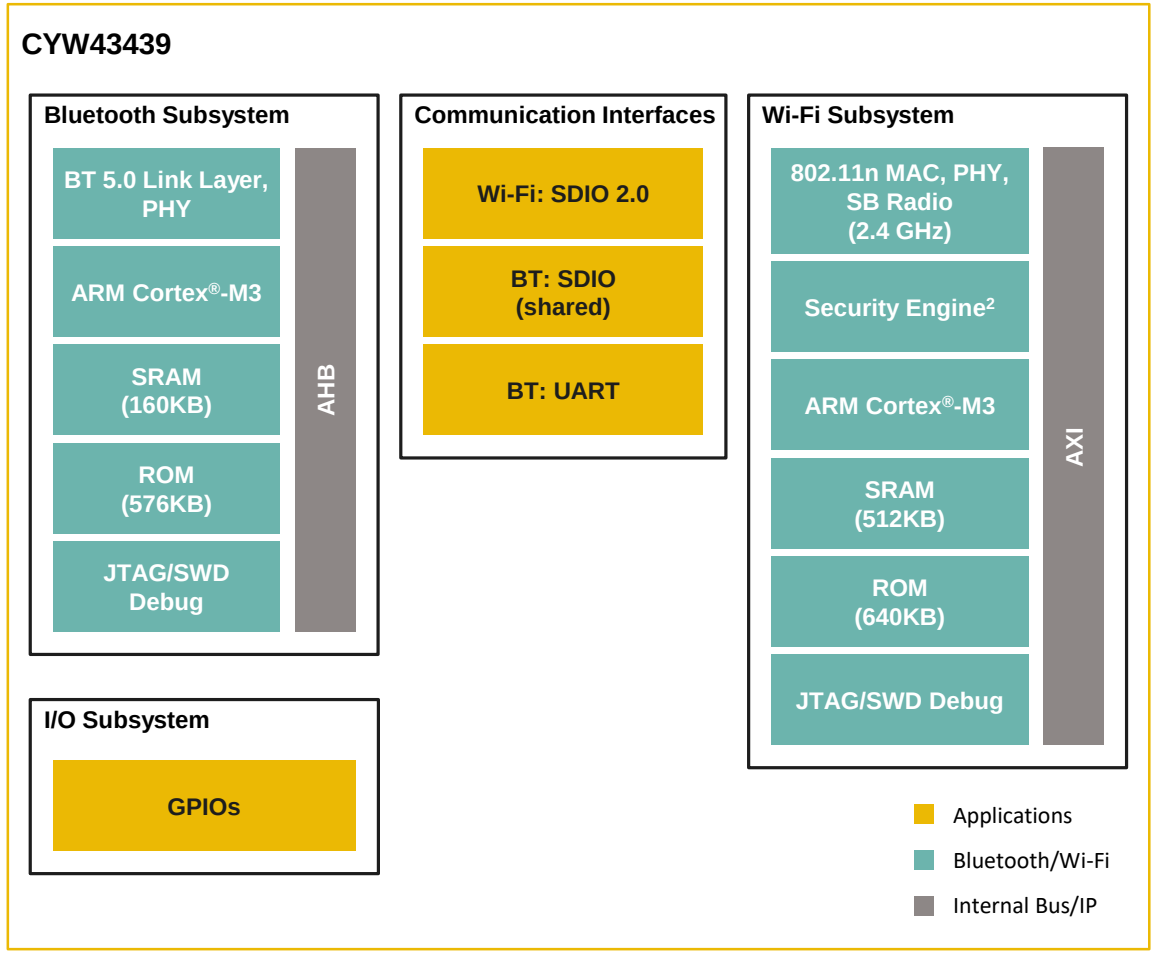
Development Kits

- IFX PCB layout guidelines
- Embedded Artists 1YN M.2 Module / Card with Murata Type 1YN
- IFX Kit: Replacing current PSoC 62 Pioneer/Prototyping Kits hosting the Murata 1DX with CYW43439 based Murata 1YN (in progress, PSoC 64 to follow)

Modules Availability

- AzureWave (AW-NM512): Production Now
- Murata Type 1YN (LBEE5KL1YN): Production Now
- Laird Sterling-LWB+: Production Now
- Quectel 909A: Production Now

CYW43439: 802.11n Wi-Fi and Bluetooth 5.2 Combo SoC



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CYW43439 – Partner Module Type 1YN

Partner Module Part Number

- Murata MPN: LBEE5KL1YN

Partner Module Key Features

- Integrates Infineon CYW43439: 1x1 802.11n + Dual-Mode Bluetooth 5.2
- Drop-in compatible with the widely popular Murata 1DX (CYW4343W based)
  - Footprint is x/y/z compatible, with small change to GPIO list
  - RF specifications are same as existing, plus new 43439 chip features
- Small footprint (6.95 mm x 5.15 mm)
- Updates best-selling Murata IoT module to the latest Wi-Fi security specs
- Also supports latest Bluetooth and Bluetooth LE certification, with patch space for future enhancements
- M.2 carrier board from Embedded Artists to be available on launch

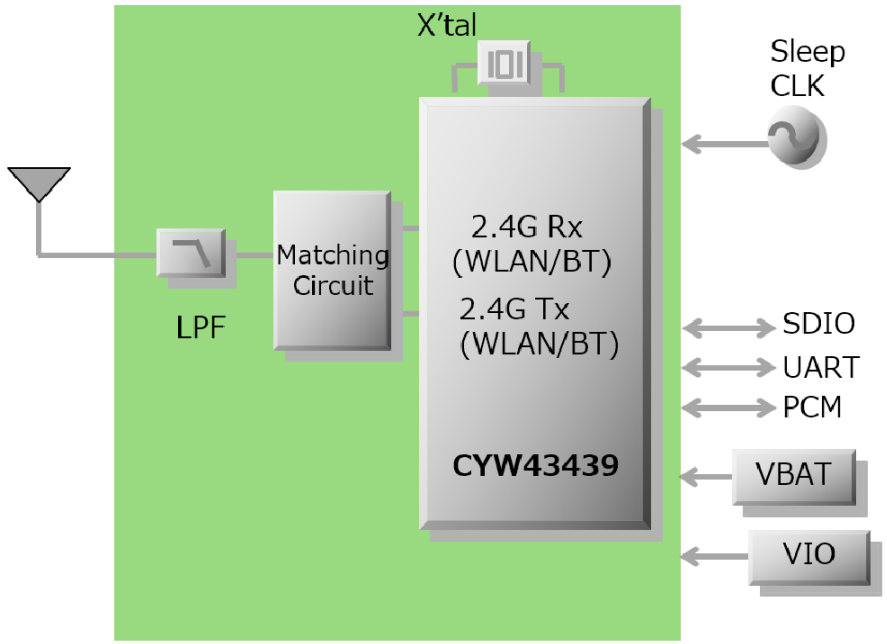
Partner Module Certifications

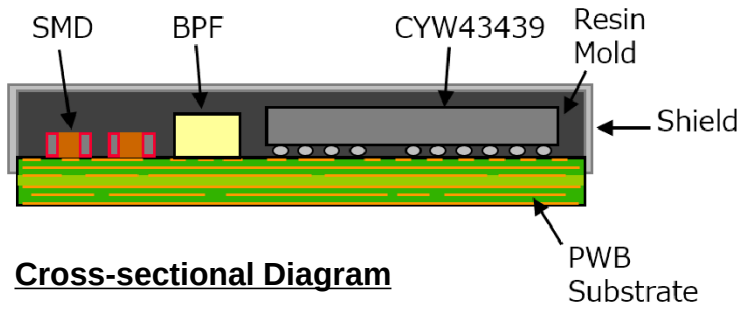
- Bluetooth QDID: 140301, FCC/IC, MIC (Japan)

Partner Module Availability

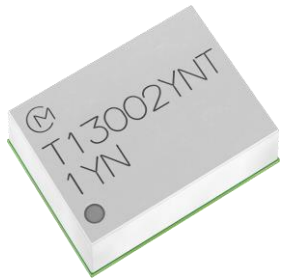
- Production Now

Type 1YN Block Diagram





Cross-sectional Diagram



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CYW43012 Ultra low power – 1x1 Antenna Configuration
Dual band 2.4 GHz & 5 GHz Wi-Fi 4 802.11n & 11ac-friendly + BT 5.0

Key Features / Value Propositions

- 802.11n and 802.11ac-friendly - MCS8 (256-QAM) for 20 MHz channels
- 802.11ac explicit beamforming supported
- Best-in-class power consumption in active and power saving modes
- SDIO for Wi-Fi with HCI over UART/SPI for embedded Bluetooth host stack in ROM
- Integrated IPv4/ IPv6 network stack on-chip
- Operating temperature range: -20 to +70C
- Support for both RTOS and Linux/Android (A-Class) host designs

Target Applications

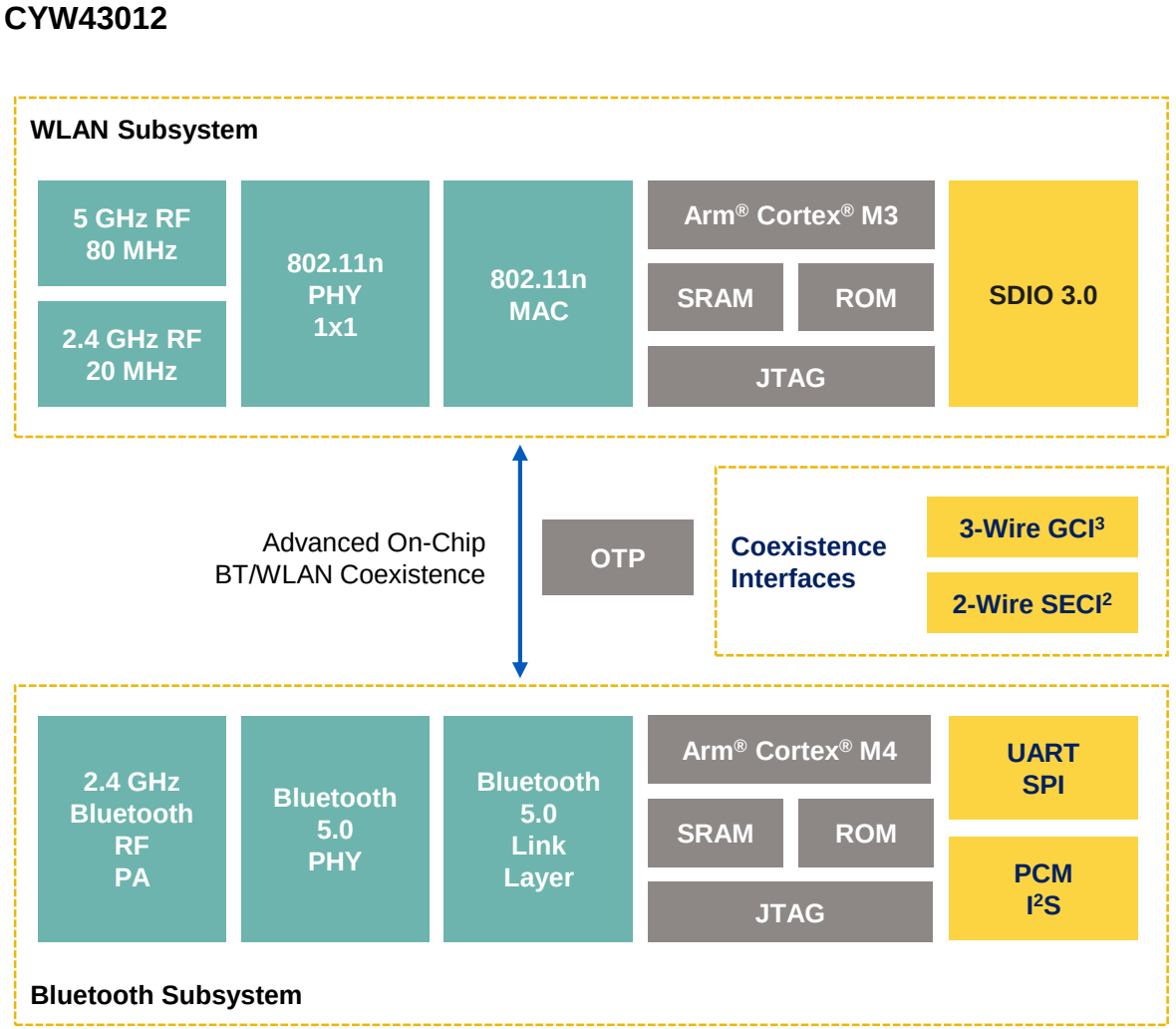
- Wearables, IP Cameras and other Smart Home products, Portable Audio devices
- Any smart consumer products where maximum battery life is required
- IoT edge sensor nodes requiring optimized system power (PSoC 6 and LPA)

Development Kits

- IFX Kit: CY8CKIT-062S2-43012 (PSoC 62 + Murata 1LV)
- IFX Kit: CYW9P62S1-43012EVB-01 (USI Integrated Module PSoC 62 + CYW43012)
- Embedded Artist 1LV M.2 Module / Card with Murata Type 1LV

Module Availability

- Murata Type 1LV (LBEE59B1LV): Production Now
- USI PSoC 62 + 43012 Integrated Module (WM-BAC-CYW-50): Production Now
- Azurewave (AW-AM497): Production Now



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CYW43012 – Partner Module Type 1LV

Partner Module Part Number

- Murata MPN: LBEE59B1LV

Partner Module Key Features

- Integrates Infineon CYW43012: 1x1 802.11n/ac-friendly + Dual-Mode Bluetooth 5.0
- Small footprint (10.0mm x 7.2mm)
- Retains ultra-low-power feature-sets of CYW43012 chipset
- Has integrated Shielded Resin Mold
- Operating temperature range: -20 to +70C
- Used on multiple PSoC 62 Pioneer Kits (RTOS) and M.2 Module Card by Embedded Artists (Linux)

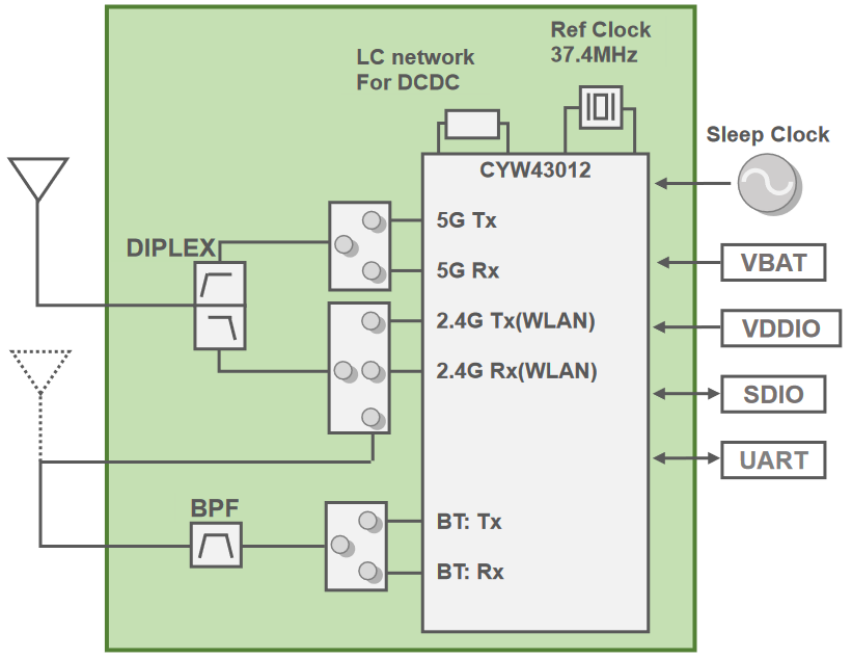
Partner Module Certifications

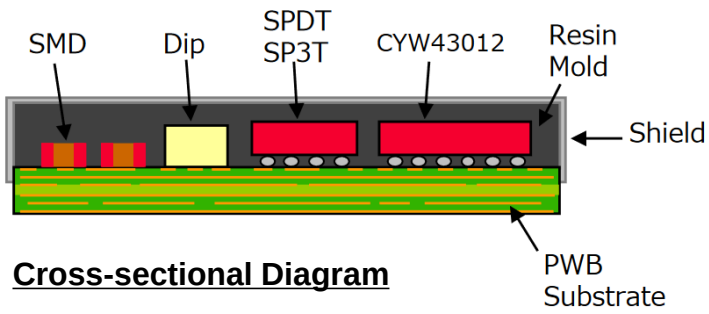
- Bluetooth QDID: 125836, FCC/IC, MIC (Japan), CE (conduction) and TELEC

Partner Module Availability

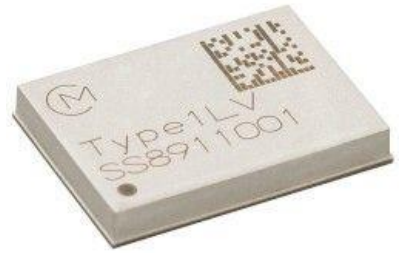
- Production Now

Type 1LV Block Diagram





Cross-sectional Diagram



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Wi-Fi & Bluetooth Combo CYW43012 Evaluation Board

Overview

- **Dual band Wi-Fi 4 (802.11an) up to 78 Mbps & Bluetooth® 5.0 compliant up to 3 Mbps connectivity in addition to HMI control**
- Included radio module Wi-Fi 4 + Bluetooth® 5.0 from Murata (Type 1LV of size 10 x 7.2 x 1.4 mm) based on CYW43012
- Included also CAPSENSE™ evaluation components (buttons & 5-segment slider)
- Evaluation software available in Infineon website (ModusToolbox™)
- On-board programmer & debugger compatible with PSoC™ programmer & debugger based on KitProg3 firmware
- Headers compatible with Arduino Uno R3 for hardware expansion using Arduino shields
- OPN: CY8CKIT-062S2-43012
- Additional features: Serial NOR Flash, F-RAM, MicroSD interface, PDM microphone, thermistor, and user LEDs





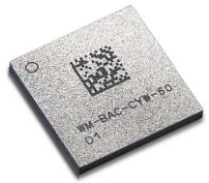
Product type	Function	Part number	Description	Package mm x mm	Qty
WLAN & BT IC	WLAN & BT IC in radio module	CYW43012	Integrated dual-band 2.4 & 5 GHz IEEE 802.11 a/b/g/n and 802.11 ac-friendly with internal power amplifier, LNA, and support RF T/R switch for 2.4 GHz band, Bluetooth® 5.0 supporting BR/EDR/BLE with integrated Class-1 or Class-2 PA, tested compliant to Bluetooth® 5.0, WLAN ac-friendly 256-QAM enabling data rate up to 78 Mbps, BT UART up to 4 Mbps,, V_{BAT} 3.2 - 4.6 V/V_{DDIO} 1.62 – 1.98 V, T_A -20 to 70°C	WLBGA128 4.5x5.4	1
MCU	MCU onboard	CY8C624ABZI-S2D44	32-bit Cortex-M4F 150 MHz with FPU & MPU & Cortex-M0+ 100 MHz with MPU, 1024 kB SRAM & 2 MB application Flash, QuadSPI/Serial memory interface, 13 configurable serial communication blocks, USB-FS, 2 PDM & 2 I2S audio channels, 32 TCPWM, 12-bit ADC 2 Msps, 2 comparators, CAPSENSE™ touch sensing, Cryptography accelerator, V_S 1.7 – 3.6 V, T_A -40 to 85°C	BGA124 9x9	1
Serial Flash	Memory	S25FL512SAGMFI010	512 Mb Quad-SPI NOR Flash 3 V, 133 MHz, uniform 256kB sectors, Enhanced High Performance Latency Code, T_A -40 to 85°C	DSO-16 10.3x10.3	1
Ferroelectric RAM	Memory	CY15B104QSN-108SXI	4 Mb non-volatile FRAM with endurance of 100 trillion R/W cycles, 151-year data retention, single and multi SPI (quad SPI), up to 108 MHz SDR & 54 MHz DDR, V_{DD} 1.8 – 3.6 V, T_A -40 to 85°C	SOIC8 5x8	1

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Wi-Fi & Bluetooth Combo CYW43012-SiP Evaluation Board

Overview

- **Dual band Wi-Fi 4 (802.11an) up to 78 Mbps & Bluetooth® 5.0 compliant up to 3 Mbps connectivity in addition to HMI control**
- Included integrated module PSoC 62 MCU and Wi-Fi 4 + Bluetooth® 5.0 CYW43012 from USI (WM-BAC-CYW-50 of size 10.9 x 10.9 mm 129-LGA SiP) with 46 MCU GPIOs
- Included also CAPSENSE™ evaluation components (buttons & 5-segment slider)
- Evaluation software available in Infineon website (ModusToolbox™)
- On-board programmer & debugger compatible with PSoC™ programmer & debugger based on KitProg3 firmware
- Headers compatible with Arduino Uno R3 for hardware expansion using Arduino shields
- OPN: CYW9P62S1-43012EVB-01
- Additional features: Serial NOR Flash, F-RAM, MicroSD interface, and user LEDs





Product type	Function	Part number	Description	Package mm x mm	Qty
WLAN & BT IC	WLAN & BT IC in radio module	CYW43012	Integrated dual-band 2.4 & 5 GHz IEEE 802.11 a/b/g/n and 802.11 ac-friendly with internal power amplifier, LNA, and support RF T/R switch for 2.4 GHz band, Bluetooth® 5.0 supporting BR/EDR/BLE with integrated Class-1 or Class-2 PA, tested compliant to Bluetooth® 5.0, WLAN ac-friendly 256-QAM enabling data rate up to 78 Mbps, BT UART up to 4 Mbps,, V_{BAT} 3.2 - 4.6 V/V_{DDIO} 1.62 – 1.98 V, T_A -20 to 70°C	WLBGA128 4.5x5.4	1
MCU	MCU onboard	PSoC 62	32-bit Cortex-M4F 150 MHz with FPU & MPU & Cortex-M0+ 100 MHz with MPU, 288 kB SRAM & 1 MB application Flash, QuadSPI/Serial memory interface, configurable serial communication blocks, USB-FS, PDM & I2S audio channels, 32 TCPWM, 12-bit ADC 2 Msps, comparators, CAPSENSE™ touch sensing, Cryptography accelerator, V_S 1.7 – 3.6 V, T_A -40 to 85°C		1
Serial Flash	Memory	S25FL512SAGMFI010	512 Mb Quad-SPI NOR Flash 3 V, 133 MHz, uniform 256kB sectors, Enhanced High Performance Latency Code, T_A -40 to 85°C	DSO-16 10.3x10.3	1
Ferroelectric RAM	Memory	CY15V104QSN-108LPXI	4 Mb non-volatile FRAM with endurance of 100 trillion R/W cycles, 151-year data retention, single and multi SPI (quad SPI), up to 108 MHz SDR & 54 MHz DDR, V_{DD} 1.71 – 1.89 V, T_A -40 to 85°C	VQFN8 3.3x3.3	1

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CYW4373 – 1x1 Antenna Configuration
Dual band 2.4 GHz & 5 GHz Wi-Fi 5 802.11ac + BT 5.2

Key Features / Value Propositions

- Enhanced follow-on device for CYW43455
- USB, SDIO, PCIe host interfaces available, with USB Hub allowing for Wi-Fi/BT to share single host interface
- Both shared antenna (sLNA) and dedicated antenna (dLNA) available
- Expanded memory for feature enhancements, patches, etc.
- Expanded temperature range option: (CYW4373E): -40 to +85C
- Support for both RTOS designs and Linux/Android (A-Class) host designs

Target Applications

- Printers, IP Cameras, other enterprise or industrial
- Appliances, Smart Speakers, Doorbells or other consumer
- Can be used very broadly (1X1, DB, 11ac) – will be a workhorse for 2021 & beyond

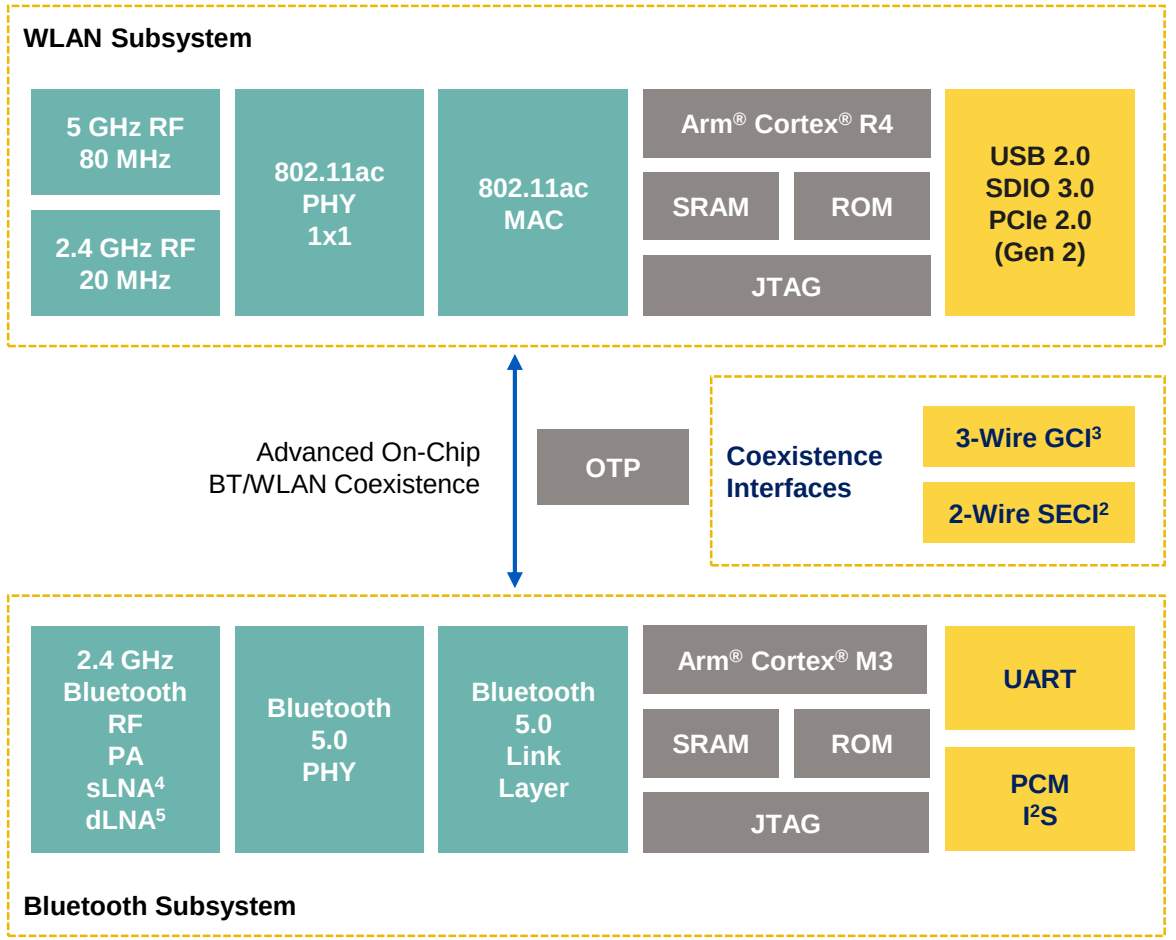
Development Kits

- IFX Kit: PSoC 62 + 4373 M.2 Dev Kit + OPTIGA Trust M (Available Now)
- IFX Kit: PSoC 64 + 4373 M.2 Dev Kit + OPTIGA Trust M (in progress)

Modules Availability

- Laird Sterling-LWB5+ Standard, M.2, and USB dongle: Production Now
- Azurewave (AW-CM467 & AW-CM467-USB): Production Now
- Murata Type 2BC (LBEE5PK2BC) and Type 2AE (LBEE5PK2AE): Production Now

Wireless Connectivity Family | CYW4373/4373E/43732



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Family of CYW4373 – 1x1 Antenna Configuration
Dual band 2.4 GHz & 5 GHz Wi-Fi 5 802.11ac + BT 5.2

4373	4373E 	43732
802.11ac, 1x1, Dual-band	802.11ac, 1x1, Dual-band	802.11ac, 1x1, Dual-band
Dual-mode Bluetooth® 5.2	Dual-mode Bluetooth® 5.2	Dual-mode Bluetooth® 5.2
SDIO / USB Hub	SDIO / USB Hub	SDIO / USB Hub
Shared LNA: Lower BOM Cost 1-Antenna Design 2-Antenna Design with Antenna Diversity for improved range	Shared LNA: Lower BOM Cost 1-Antenna Design 2-Antenna Design with Antenna Diversity for improved range	**Dedicated LNA: Improved Wi-Fi / Bluetooth® Coex performance** **Separate Wi-Fi and Bluetooth® Antennas**
-20°C to +70°C	**-40°C to +85°C for Industrial Applications**	-20°C to +70°C
WLBGA 0.40mm pitch	WLBGA 0.40mm pitch	WLBGA 0.40mm pitch

Footprint Compatible Devices

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CYW4373E – Partner Module Sterling-LWB5+

Partner Module Part Numbers

- Laird Connectivity MPN: 453-0004x (depends on antenna type)
- Laird Connectivity MPN: 450-00137/B USB dongle

Partner Module Key Features

- Integrates Infineon CYW4373E: 1x1 802.11ac + Dual-Mode Bluetooth 5.2
- Small footprint (12 mm x 17 mm) including on-board antenna
- Multiple Module Options: External antenna (MHF4), Internal Chip Antenna, PCB Trace, M.2 E-Key
- Compared to the CYW4343W Sterling-LWB5:
  - 50% less expensive, 35% smaller
  - 4dB higher TX (2.4GHz), 4.5dB higher TX (5GHz)
  - 5dB better RX (2.4GHz), 2.5dB RX (5GHz)
- Rugged Design – solder down form factor & M.2 E-Key Modules
- Multiple Dev Kit options: Internal/external Antenna, M.2 carrier boards, PSoC 6
- Robust SW support through Linux backports for broad kernel support and RTOS support in ModusToolbox

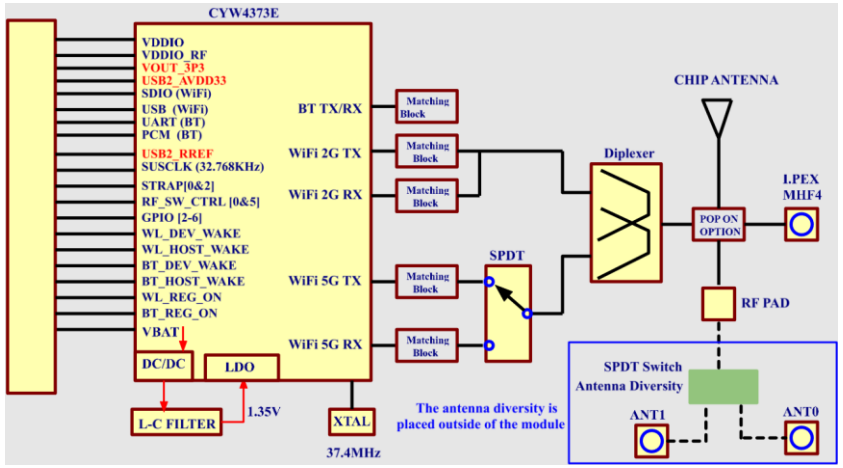
Partner Module Certifications

- FCC, IC, CE, Giteki, RCM

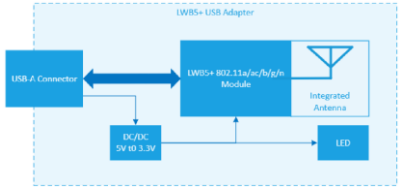
Partner Module Availability

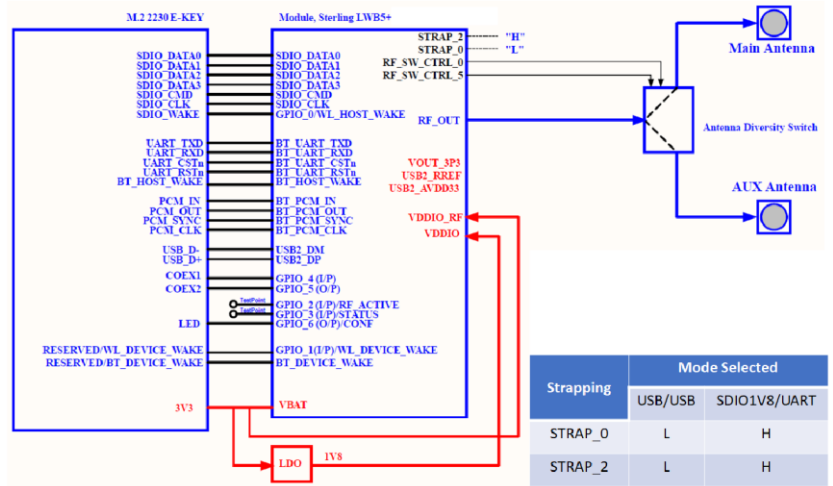
- Production Now

LWB5+ Block Diagram









Strapping	Mode Selected	
	USB/USB	SDIO1V8/UART
STRAP_0	L	H
STRAP_2	L	H





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Wi-Fi & Bluetooth Combo CYW4373E Evaluation Board

Overview

- **Dual band Wi-Fi 5 (802.11ac) up to 433 Mbps & Bluetooth® 5.2 compliant up to 3 Mbps connectivity in addition to HMI control**
- Included radio module Wi-Fi 5 + Bluetooth® 5.2 from Laird Connectivity (Sterling™-LWB5+ M.2 of size 30 x 22 x 2.9 mm) with antenna connectors, M.2 interface connection & based on CYW4373E
- Included also CAPSENSE™ evaluation components (buttons & 5-segment slider)
- Evaluation software available in Infineon website (ModusToolbox™)
- On-board programmer & debugger compatible with PSoC™ programmer & debugger based on KitProg3 firmware
- Headers compatible with Arduino Uno R3 for hardware expansion using Arduino shields
- OPN: CY8CEVAL-062S2
- Additional features: Serial NOR Flash, F-RAM, OPTIGA™ Trust-M security controller, potentiometer, and user LEDs





Product type	Function	Part number	Description	Package mm x mm	Qty
WLAN & BT IC	WLAN & BT IC in radio module	CYW4373EUBGT	Integrated dual-band 2.4 & 5 GHz IEEE 802.11 a/b/g/n/ac with internal power amplifier, LNA, and support RF T/R switch for 2.4 GHz band, Bluetooth® 5.0 supporting BR/EDR/BLE with integrated Class-1 or Class-2 PA, tested compliant to Bluetooth® 5.2, WLAN 256-QAM enabling data rate up to 433.3 Mbps, BT UART up to 4 Mbps,, V_{BAT} 3.2 - 4.8 V/V_{DDIO} 1.62 - 3.63 V, T_A -20 to 70°C	WLBGA128 4.5x5.4	1
MCU	MCU onboard	CY8C624ABZI-S2D44	32-bit Cortex-M4F 150 MHz with FPU & MPU & Cortex-M0+ 100 MHz with MPU, 1024 kB SRAM & 2 MB application Flash, QuadSPI/Serial memory interface, 13 configurable serial communication blocks, USB-FS, 2 PDM & 2 I2S audio channels, 32 TCPWM, 12-bit ADC 2 Msps, 2 comparators, CAPSENSE™ touch sensing, Cryptography accelerator, V_S 1.7 – 3.6 V, T_A -40 to 85°C	BGA124 9x9	1
Serial Flash	Memory	S25FL512SAGMFIR10	512 Mb Quad-SPI NOR Flash 3 V, 133 MHz, uniform 256kB sectors, Enhanced High Performance Latency Code, with RESET# and V_{IO}, T_A -40 to 85°C	DSO-16 10.3x10.3	1
Ferroelectric RAM	Memory	CY15B104QSN-108SXI	4 Mb non-volatile FRAM with endurance of 100 trillion R/W cycles, 151-year data retention, single and multi SPI (quad SPI), up to 108 MHz SDR & 54 MHz DDR, V_{DD} 1.8 – 3.6 V, T_A -40 to 85°C	SOIC8 5x8	1
HW security controller	Security controller	SLS32AIA010MKUSON10XTMA2	High-end security controller for connecting IoT devices to the cloud, with cryptography support for ECC, RSA, AES, HMAC, HKDF, & TLS algorithm, I^2C interface up to 1 MHz with Fast Mode Plus, V_{CC} 1.62 – 5.5 V, temperature range -25 to 85°C	USON10 3x3	1

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CYW43907 / CYW54907 – 1x1 Antenna Configuration
Dual band 2.4 GHz & 5 GHz Wi-Fi 4 802.11n / Wi-Fi 5 802.11ac

Key Features

- CYW43907: 802.11b/g/n compliant, 20/40 MHz channels, up to 150 Mbps PHY data rate
- CYW54907: 802.11b/g/n/ac compliant, 20/40/80 MHz channels, up to 433.3 Mbps PHY data rate
- VHT20/40/80 for 5 GHz, HT20 for 2.4 GHz, Legacy rates
- Internal PA/LNA for WLAN
- Optional external PA for 5GHz
- VHT20/40 for 5 GHz, HT20 for 2.4 GHz, Legacy rates

Target Applications

- Printers, IP Cameras, other enterprise or industrial
- Appliances, Smart Speakers, Doorbells or other consumer
- Can be used very broadly (1X1, DB, 11n/ac) – will be a workhorse for 2021 & beyond

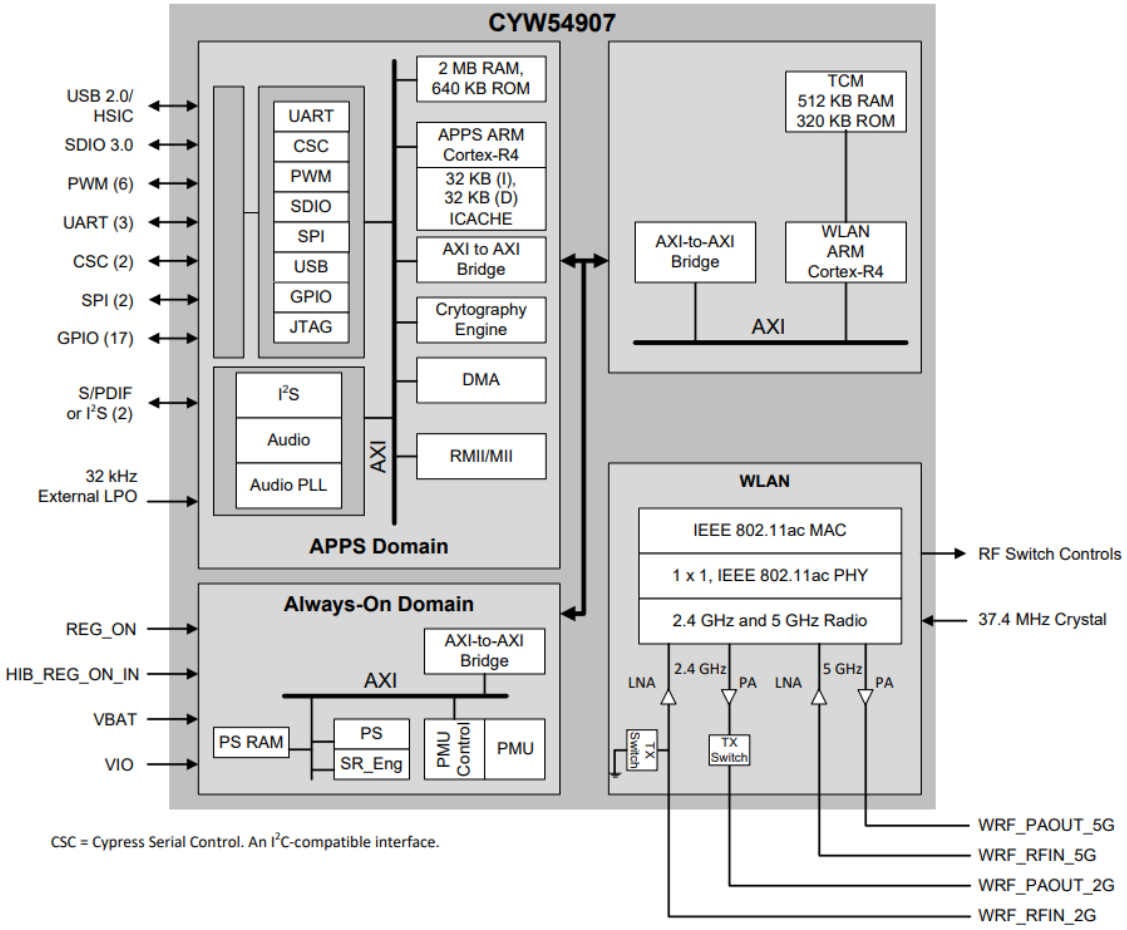
Development Kits

- IFX CYW43907 Kit: Murata LBWA1UZ1GC module with on-board PCB antenna
- IFX CYW54907 Kit: Murata LBWA1UZ1PS-241v module with on-board PCB antenna

Modules Availability

- CYW43907: Murata Type 1GC (LBWA1UZ1GC), Lantronix xPico 240, USI WM-AN-BM-23, and Inventek ISM43907-WM-L170
- CYW54907: Murata Type 1PS (LBWA1UZ1PS), and Inventek ISM54907-WM-L170

CYW54907 Functional block diagram

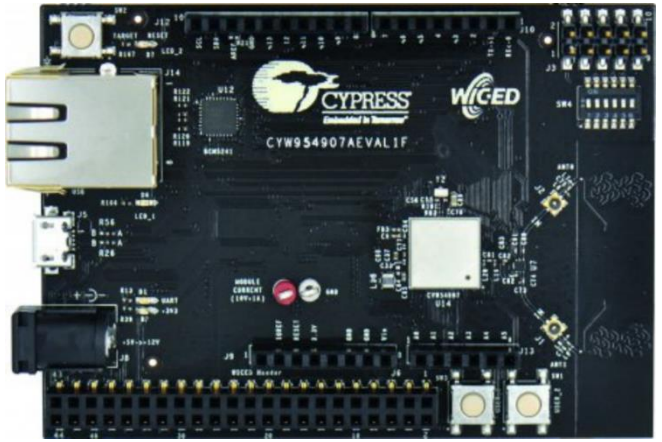


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Wi-Fi Connectivity CYW43907 / CYW54907 Evaluation Board

Overview

- **System in Package (SiP) module for Wireless LAN connectivity with option for on-board or external antenna**
- Evaluation software available on Infineon website (WICED™ Studio)
- FreeRTOS libraries support & compatible with Arduino Uno connection
- On-board programmer & debugger via UART-USB bridge and direct USB interface to PC/Laptop
- Additional features (non-IFX devices): Ethernet, Serial Flash, microSD card interface
- OPN: CYW943907AEVAL1F
- SiP WLAN from Murata LBWA1UZ1GC of size 10 x 10 x 1.2 mm, based on CYW43907
- Single-stream multiplexing up to 150 Mbps, 20/40 MHz channels support, IEEE 802.11 a/b/g/n transfer rates
- OPN: CYW954907AEVAL1F
- SiP WLAN from Murata LBWA1UZ1PS-241 of size 10 x 10 x 1.2 mm, based on CYW54907
- Single-stream multiplexing up to *433.3 Mbps*, 20/40/*80* MHz channels support, IEEE 802.11 a/b/g/n/*ac* transfer rate, *256-QAM* compliant



Product type	Function	Part number	Description	Package mm x mm	Qty
WLAN IC	WLAN IC in SiP 1GC	CYW43907KWBGT	Integrated Dual-band 2.4 & 5 GHz IEEE 802.11a/b/g/n with internal power amplifier & LNA, antenna diversity support, 32-bit Cortex-R4 RISC 320 MHz, 2 MB SRAM, 640 KB ROM, cryptography core, USB2.0, serial & audio interfaces, integrated power supplies, programmable data rate 1 – 150 Mbps, V_{BAT} 3 - 4.8 V/V_{DDIO} 1.8-3.3 V, T_A -30 to 85°C	WLCSP316 45x5.5	1
WLAN IC	WLAN IC in SiP 1PS	CYW54907KWBGT	Integrated Dual-band 2.4 & 5 GHz IEEE 802.11a/b/g/n/ac with internal power amplifier & LNA, antenna diversity support, 32-bit Cortex-R4 RISC 320 MHz, 2 MB SRAM, 640 KB ROM, cryptography core, USB2.0, serial & audio interfaces, integrated power supplies, programmable data rate 1 – 433.3 Mbps, V_{BAT} 3 - 4.8 V/V_{DDIO} 1.8-3.3V, T_A -30 to 85°C	WLCSP316 45x5.5	1

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Updated Infineon Wi-Fi Bluetooth Partner Module Selector Guide

- Updated with **the latest module partner data** and streamlined with Infineon branding
- EOQ updates coming from now on

Get the latest version on the Developer Community!



Infineon AIROC™ Wi-Fi and Bluetooth®
IoT partner module selection guide

www.infineon.com

Internet of Things (IoT) Solutions

Wi-Fi 6 (802.11ax) + Dual-Mode Bluetooth® combo partner module portfolio

Partner	PN	Wi-Fi/ Bluetooth® PN	Wi-Fi/Bluetooth® Support	WLAN Stream	Area (mm)	Regulatory	Linux	Interfaces	Highlights
Azurewave	AW-XH325	CYW55571	11a/b/g/n/ac/ax Tri-Band	1T1R	10 x 10	No plan so far	Y	SDIO/PCIe+UART	XTAL inside; MP in Q2'23
Azurewave	AW-XB325MA	CYW55571	11a/b/g/n/ac/ax Tri-Band	1T1R	22 x 30	No plan so far	Y	SDIO/PCIe+UART	XTAL inside; SiP on FR4; MP in Q2'23
USI	WM-BAC-CYW-51	CYW55572	2.4/5 GHz, 802.11a/ac/ax/b/g/n, Bluetooth®/ Bluetooth® LE v5.2	2T2R	11 x 11	No plan so far	Y	SDIO/PCIe+UART	MP in Q2'23
Azurewave	AW-XH327	CYW55572	11a/b/g/n/ac/ax Dual Band	2T2R	10 x 10	No plan so far	Y	SDIO/PCIe+UART	XTAL inside; MP in Q2'23
Azurewave	AW-XB327MA	CYW55572	11a/b/g/n/ac/ax Dual Band	2T2R	22 x 30	No plan so far	Y	SDIO/PCIe+UART	XTAL inside; SiP on FR4; MP in Q3'22
Azurewave	AW-XM612	CYW55572 (WLBGA)	11a/b/g/n/ac/ax Dual Band	2T2R	13 x 15	No plan so far	Y	SDIO/PCIe+UART	XTAL inside; MP in Q4'23
Murata	Type 2EA (LBEE5XV2EA-802)	CYW55573	2.4/5GHz/6 GHZ, 802.11a/b/g/n/ac /ax MIMO, Bluetooth®/Bluetooth® LE	2T2R	12.5 x 9.4	CE/FCC/IC/ TELEC	Y	WLAN: PCIe/ SDIO Bluetooth®: UART/PCM	2x2 MIMO 11ac + Bluetooth® solution (Bluetooth® 5.3) Support Wi-Fi6E (6GHz), -40°C to +85°C
Laird Connectivity	Sona IF573	CYW55573	2.4/5/6 GHz, 802.11a/ac/ax/b/g/n, Bluetooth®/ Bluetooth® LE , v5.4	2T2R	13 x 18mm (M.2 1318 SMT)	FCC,ISED, CE, UKCA, MIC, & Bluetooth® SIG	Y	SDIO, PCIe, UART, I²S, PCM	Industrial temperature Range (-40°C to +85°C) RF Trace Antenna (Tape & Reel)
Laird Connectivity	Sona IF573	CYW55573	2.4/5/6 GHz, 802.11a/ac/ax/b/g/n, Bluetooth®/ Bluetooth® LE , v5.4	2T2R	13 x 18mm (M.2 1318 SMT)	FCC,ISED, CE, UKCA, MIC, & Bluetooth® SIG	Y	SDIO, PCIe, UART, I²S, PCM	Industrial temperature Range (-40°C to +85°C) MHF4 Antenna (Tape & Reel)
Laird Connectivity	Sona IF573	CYW55573	2.4/5/6 GHz, 802.11a/ac/ax/b/g/n, Bluetooth®/ Bluetooth® LE , v5.4	2T2R	13 x 18mm (M.2 1318 SMT)	FCC,ISED, CE, UKCA, MIC, & Bluetooth® SIG	Y	SDIO, PCIe, UART, I²S, PCM	Industrial temperature Range (-40°C to +85°C) RF Trace Antenna (Cut Tape)
Laird Connectivity	Sona IF573	CYW55573	2.4/5/6 GHz, 802.11a/ac/ax/b/g/n, Bluetooth®/ Bluetooth® LE , v5.4	2T2R	13 x 18mm (M.2 1318 SMT)	FCC,ISED, CE, UKCA, MIC, & Bluetooth® SIG	Y	SDIO, PCIe, UART, I²S, PCM	Industrial temperature Range (-40°C to +85°C) MHF4 Antenna (Cut Tape)
Laird Connectivity	Sona IF573	CYW55573	2.4/5/6 GHz, 802.11a/ac/ax/b/g/n, Bluetooth®/ Bluetooth® LE , v5.4	2T2R	22 x 30mm (M.2 2230 Plug In Card)	FCC,ISED, CE, UKCA, MIC, & Bluetooth® SIG	Y	SDIO, UART, I²S, PCM	Industrial temperature Range (-40°C to +85°C) MHF4 Antenna (Carton)
Laird Connectivity	Sona IF573	CYW55573	2.4/5/6 GHz, 802.11a/ac/ax/b/g/n, Bluetooth®/ Bluetooth® LE , v5.4	2T2R	22 x 30mm (M.2 2230 Plug In Card)	FCC,ISED, CE, UKCA, MIC, & Bluetooth® SIG	Y	PCIe, UART, I²S, PCM	Industrial temperature Range (-40°C to +85°C) MHF4 Antenna (Carton)
USI	WM-BAC-CYW-61	CYW55573	2.4/5/6 GHz, 802.11a/ac/ax/b/g/n, Bluetooth®/ Bluetooth® LE v5.2	2T2R	11 x 11	No plan so far	Y	SDIO/PCIe+UART	MP in Q2'23
Azurewave	AW-XH323	CYW55573	11a/b/g/n/ac/ax Tri-Band	2T2R	10 x 10	No plan so far	Y	SDIO/PCIe+UART	XTAL inside; MP in Q2'23
Azurewave	AW-XB583	CYW55573	11a/b/g/n/ac/ax Tri-Band	2T2R	22 x 30	No plan so far	Y	SDIO/PCIe+UART	XTAL inside; SiP on FR4; MP in Q2'23

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Infineon Bluetooth: Robustness, proven and most widely deployed



Robust and widely deployed

- Infineon Bluetooth Inherits the same core IP that has been proven and widely deployed across more than a billion Bluetooth devices
- Infineon SW stack derives from the Widcomm Bluetooth Stack, the world's first commercial Bluetooth stack and most extensively deployed
- Infineon Bluetooth SoCs deliver robust coexistence performance leveraging the experience gained form an extensive Wi-Fi and Combo portfolio
- Infineon architecture leverages the best of ROM and Flash based architectures providing flexible and scalable solutions
- Infineon SW, SDK and tools are tightly integrated providing ease-of-use for faster application development

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Bluetooth & Bluetooth Low Energy product portfolio

32-bit Arm Cortex-M0 or Cortex-M3	32-bit Arm Cortex-M4	32-bit Arm Dual Core Cortex-Mx

Today

World's most widely deployed Bluetooth IP & Stack.
BT- Classic and BLE combo with Low power Consumption



20706
BT5.2/BLE CM3 SoC
9 dBm Tx, Audio

20736
BLE-5.2 CM3 SoC
4 dBm Tx

PSoC 4 BLE
BLE-4.2/5.1
CM0 SoC w/ flash
3 dBm Tx

20719
BT5.1/BLE CM4 SoC
1 M Flash/512 K
5 dBm Tx, Mesh

20721
BT5.1/BLE CM4 SoC
1 M Flash/512 K
5 dBm Tx, Audio

20819
BT5.2/BLE CM4 SoC
256 K/176 K, Mesh
4.5 dBm Tx

20820
BT5.2/BLE CM4 SoC
256 K/176 K, Mesh
11.5 dBm Tx

20835
BLE-5.2 CM4 SoC
10 dBm Tx, Mesh

20830
BLE-5.2 2xCM33, HADM
512 K/224 K, Mesh
10 dBm

20831
BT/BLE5.2, 2xCM33
0 K/1024 K, Audio
11 dBm Tx, HADM

20829
BLE-5.2 2xCM33, HADM
0 K/224 K, Mesh
10 dBm

20809
BLE-5.2 2xCM33 HADM
0 K/32 K
10 dBm TX, Thin HCI

PSoC 6 BLE
BLE-5.2 CM4 & CM0+ SoC
Up to 1 M Flash/288 K
4 dBm Tx

Tomorrow

BT 5.2 & 5.3 optimized for low power, Form factor and best in class feature support



- **Faster Throughput : 2 Mbps LE enables Faster FW updates**
- **Advt. Extension: Enables additional services via more application data**
- **LE Long Range: Low duty cycle tethering or asset tracking**
- **AoA/AoD + HADM: Rich application using accurate location data**
- **Isochronous Channels: Enable audio over BLE in addition to EDR**

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Bluetooth & Bluetooth LE module portfolio

	Standard	Size	External Antenna	Extended Range	Extended Temp
PSoC6 CM4 & CM0+ SoC, 2Mbps PHY Single Mode BLE 5.0, CapSense	CYBLE-416045-02 1 MB Flash, 2 Mbps BLE, 36 GPIOs 14 x 18.5 x 2.00 mm SMT				
20719/20721 CM4 SoC Dual Mode BT 5.0 2Mbps PHY	Mesh CYBT-413055-02 EZ-S 1 MB Flash, 17 GPIOs, 12 x 16.3 x 1.70 mm SMT Mesh CYBT-413061-02 EZ-S Audio 1 MB Flash, 17 GPIOs 12 x 16.3 x 1.70 mm SMT	Mesh CYBT-423054-02 EZ-S 1 MB Flash, 17 GPIOs 11 x 11 x 1.70 mm SMT Mesh CYBT-423060-02 EZ-S Audio 1 MB Flash, 17 GPIOs 11 x 11 x 1.70 mm SMT		Mesh CYBT-483056-02 EZ-S 1 MB FlashPA/LNA (20 dBm) , 15 GPIOs, 12.75 x 18.59 x 1.8 mm SMT Mesh CYBT-483062-02 EZ-S Audio 1 MB Flash, PA/LNA (20 dBm) , 15 GPIOs, 12.75 x 18.59 x 1.8 mm SMT	
20820 CM4 SoC Dual Mode BT 5.0 2Mbps PHY	Mesh CYBT-243053-02 256 KB Flash, 22 GPIOs, +10 dBm TX, 12 x 16.61 x 1.70 mm SMT External 512 KB SFLASH needed to support MESH	Mesh CYBT-253059-02 256 KB Flash, 22 GPIOs, +10 dBm TX, 11 x 11 x 1.70 mm SMT External 512 KB SFLASH needed to support MESH			Mesh CYBT-243068-02 512 KB SFlash, 22 GPIOs, +10 dBm TX, 12 x 16.61 x 1.70 mm SMT
20819 CM4 SoC Dual Mode BT 5.0 2Mbps PHY	Mesh CYBT-213043-02 256 KB Flash, 22 GPIOs, 12 x 16.61 x 1.70 mm SMT External 512 KB SFLASH needed to support MESH	Mesh CYBT-223058-02 256 KB Flash, 22 GPIOs 11 x 11 x 1.70 mm SMT External 512 KB SFLASH needed to support MESH	Mesh CYBT-2630xx-02 256 KB Flash, PA/LNA (20 dBm), Ext. Antenna via RF Pad or u.FL 20 GPIOs 12.5 x 19 x 1.95 mm SMT External 512 KB SFLASH needed to support MESH	Mesh CYBT-273063-02 256 KB Flash, PA/LNA (20 dBm) 20 GPIOs 12.5 x 19 x 1.95 mm SMT External 512 KB SFLASH needed to support MESH	
20735 CM4 SoC Dual Mode BT 5.0	Mesh CYBT-343052-02 512 KB SFlash, 24 GPIOs, +10 dBm TX, 13.31 x 22.4 x 1.95 mm SMT				
20706/20707 CM3 SoC Dual Mode BT 5.0	Mesh EZ-S CYBT-343026-01 512 KB SFlash, 11 GPIOs. +10 dBm TX, 12 x 15.5 x 1.95 mm SMT Audio	Mesh EZ-S CYBT-353027-02 512 KB SFlash , 8 GPIOs, +10 dBm TX, 9 x 9 x 1.75 mm SMT Audio	Mesh CYBT-3330xx-02 EZ-S 512 KB SFlash, LMA[3], , 11 GPIOs +10dBm TX, Ext. Antenna via RF Pad or u.FL Audio 12 x 12 x 1.95 mm SMT		Mesh EZ-S CYBT-343151-02 512 KB SFlash, 11 GPIOs, +10 dBm TX, 12 x 15.5 x 1.95 mm SMT Audio
20737 CM3 SoC BLE 4.1 Low Cost	CYBLE-0130xx-00 EZ-S 128 KB/0 KB SFlash, 16/18 GPIOs 14 x 19 x 2.25 mm SMT				
PSoC4 CM0 SoC Single Mode BLE 4.2/5.1 CapSense	CYBLE-x120xx-0x EZ-S **128/256 KB Flash, 23 GPIOs** **14 x 19 x 2.00 mm SMT**	CYBLE-x220xx-0x EZ-S **128/256 KB Flash, 16 GPIOs** **10 x 10 x 1.80 mm SMT** CYBLE-x140xx-0x EZ-S **PSoC 4 BLE, 128/256 KB Flash,** **Opamp, CMP, 4 UDBs, 25 GPIOs** **11 x 11 x 1.70 mm SMT**	CYBLE-2020xx-01 EZ-S **256 KB Flash, PA/LNA (20 dBm),** **Ext. Antenna via RF Pad or u.FL,** **19 GPIOs** **15 x 23 x 2.05/1.55 mm SMT**	CYBLE-212006-01 EZ-S **256 KB Flash, PA/LNA** **PCB Antenna, 19 GPIOs** **15 x 23 x 2.00 mm SMT**	CYBLE-22411x-0x EZ-S 256 KB Flash, PA/LNA (+20 dBm) Opamp, CMP[6], 4 UDB[7], 25 GPIOs 9.5 x 15.4 x 1.80 mm SMT

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CYW20719 – Dual-Mode Bluetooth 5.1 and Bluetooth LE

Key Features

- Highest performance standalone Bluetooth 5.1 SoC with support for BR, EDR, and Bluetooth LE integrating 1MB flash, 512KB RAM
- Supports 5 dBm TX and -95.5 dBM RX
- Supports RX current 5.9 mA (BLE), TX current 5.6 mA @ 0 dBm (BLE)
- Supports Bluetooth Mesh
- Extensive code example support in the Bluetooth SDK within ModusToolbox, including:
  - Multiple Mesh Code examples / snips, Bluetooth LE data transfer, Watch Code example, Sensor Hub, etc.

Target Applications

- Home Automation, Smart Lighting, Consumer Robotics, Medical, Industrial
- Applications wanting a highly integrated, full host MCU with Dual-Mode Bluetooth
- Applications wanting to integrate ML and/or Mesh into a Bluetooth design

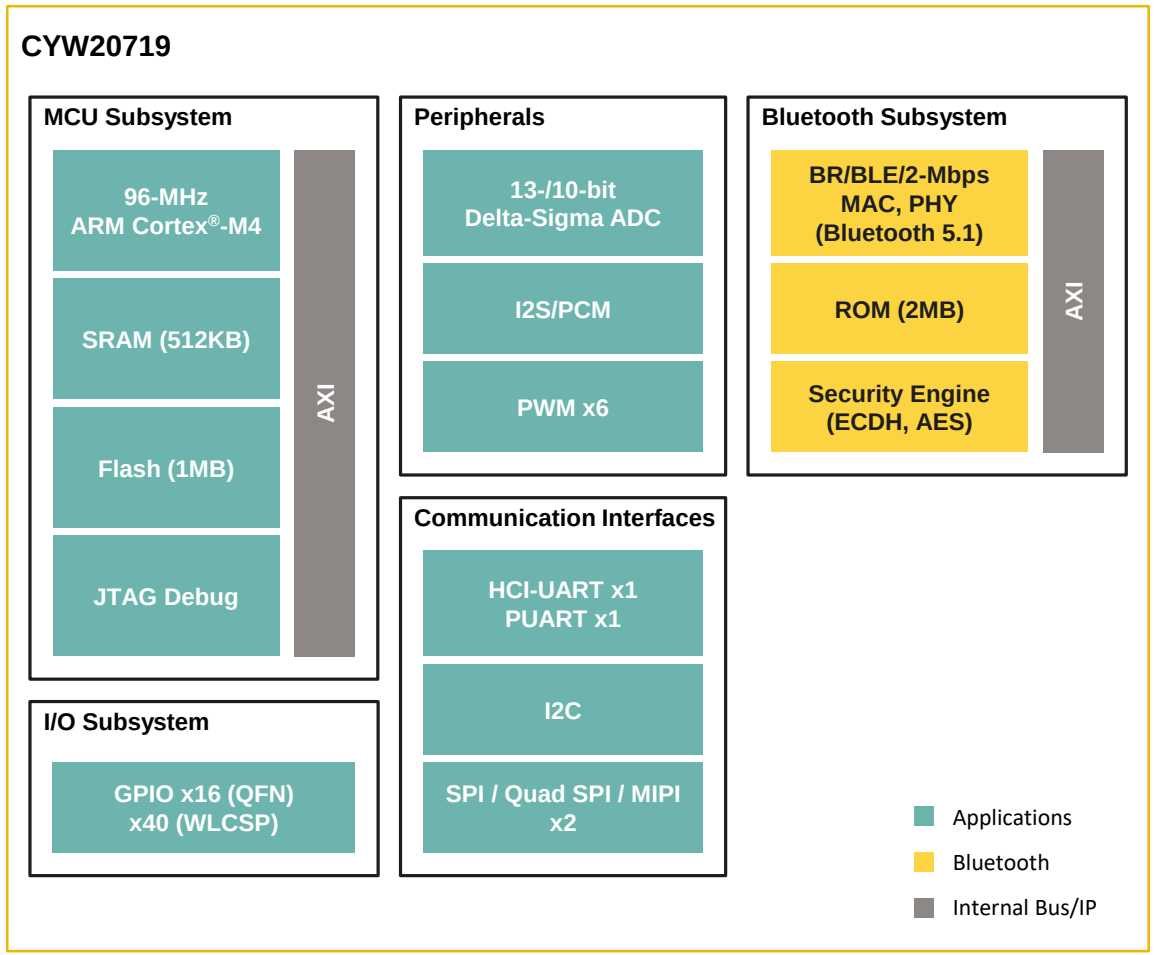
Development Kits

- IFX Kit: CYW20719 Arduino Silicon Evaluation Kit (CYW920719B2Q40EVB-01)
- IFX Kit: CYW20719 Module-Based Arduino Evaluation Kits:
  - CYBT-413055-EVAL, CYBT-423054-EVAL, CYBT-483056-EVAL

Modules Availability

- CYBT-413055-02: Standard CYW20719 Bluetooth Module (Production Now)
- CYBT-423054-02: Small form-factor (11x11) CYW20719 Bluetooth Module (Prod. Now)
- CYBT-483056-02: CYW20719 Bluetooth Module integrated External PA (Prod. Now)

CYW20719 High-Performance, Low Power Bluetooth MCU



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CYW20719 – Infineon Bluetooth & BLE Module: CYBT-483056-02

IFX Bluetooth Module Part Number

› Infineon MPN: CYBT-483056-02

IFX Bluetooth Module Key Features

› Integrates a PA enabling **ultra-long-range** connectivity – up to 20 dBm transmitting power and up to 1 km line-of-sight range
› Form Factor: 12.75 mm x 18.59 mm x 1.8 mm, 34-pad SMT with 15 GPIOs
› Supports Bluetooth Mesh
› Integrates a PCM/I2S audio interface with wideband speech support
› Supports secure over-the-air (OTA) firmware upgrade
› Preprogrammed with EZ-Serial firmware
› IFX Arduino Eval Kit available as well: CYBT-483056-EVAL for rapid development

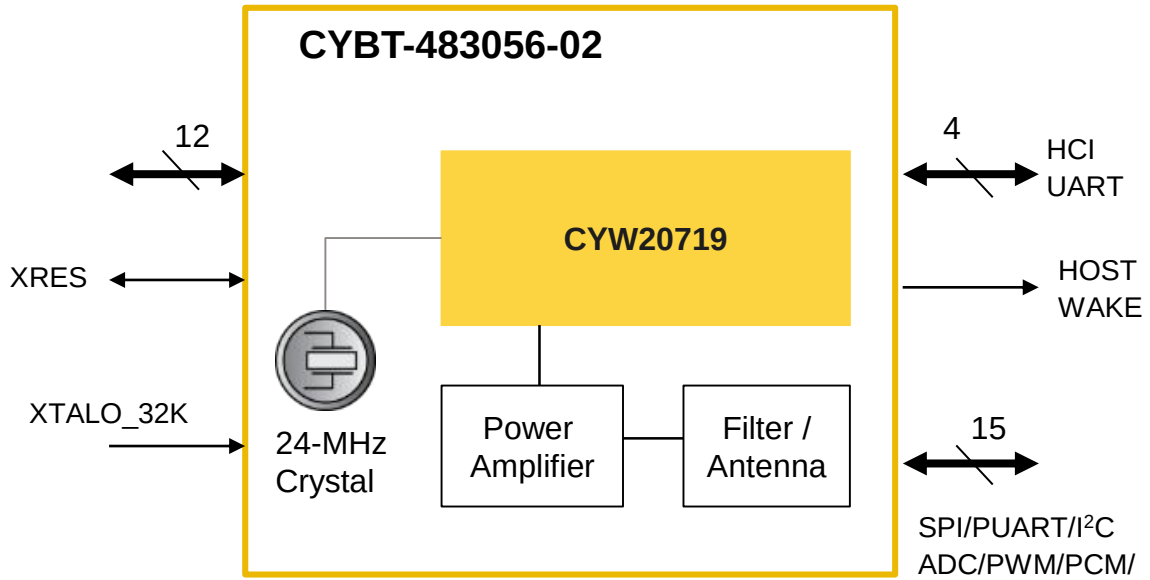
IFX Bluetooth Module Certifications

› Bluetooth SIG QDID, FCC, CE, MIC, and ISED

IFX Bluetooth Module Availability

› Production Now

Type 1LV Block Diagram



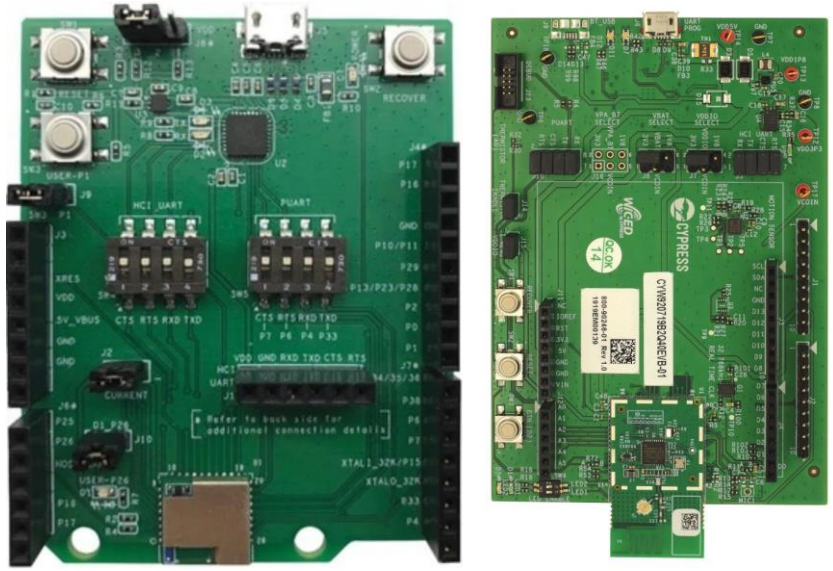


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Bluetooth & BLE Connectivity CYW20719 Evaluation Board

Overview

- **Highly miniaturized & fully integrated dual-mode Bluetooth® BR/EDR & BLE and Flash memory module of size 11 x 11 x 1.7 mm**
- Up to 3 Mbps for Bluetooth® and 2 Mbps for BLE
- Compatible with Arduino Uno connection
- Evaluation software available in Infineon website (ModusToolbox™)
- Direct interface to USB of PC/Laptop for quick evaluation
- OPN: CYBT-423054-EVAL
- OPN: CYW920719B2Q40EVB-01 (non-module based & including battery operation and non-IFX sensors: analog microphone, 9-axis IMU, and thermistor)



Product type	Function	Part number	Description	Package mm x mm	Qty
BT module	BT module	CYBT-423054-02	Fully integrated Bluetooth® module with onboard crystal oscillators, passive components, 512 KB serial flash & BLE MCU CYW20719 compatible with Bluetooth® 5.1, TX output power up to 4 dBm, V_S 2.5 – 3.6 V, T_A -30 to 85°C	SMT28 11x11	1
USB – UART bridge controller	USB – UART converter	CY7C65215-32LTXI	USB to Serial Dual channel bridge, USB2.0 Full Speed 12 Mbps, 2-channel configurable UART/SPI up to 3 Mbps, 2-channel configurable I^2C up to 400 kHz, CAPSENSE™, battery-charge detection (BCD) compliant, operating voltage 1.71 – 5.5 V, T_A -40 to 85°C	QFN32 5x5	1
MCU	BT MCU in EVB	CYW20719	32-bit Cortex-M4 96 MHz with FPU, 1MB Flash, 512 KB RAM & 2 MB ROM, Bluetooth® 5.1 with BLE 2 Mbps & BT up to 3 Mbps, PDM, PCM, & I2S audio channels, 6 16-bit PWM, 48-bit RTC, ADC, 2 SPI, UART, I^2C, V_S 1.76 – 3.6 V, T_A -40 to 85°C	QFN40 5x5	1

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CYW20835 – Bluetooth Low Energy MCU

Key Features

- Bluetooth 5.2, Bluetooth Low Energy
- Industry's most widely deployed Bluetooth stack
- 2-Mbps Bluetooth LE support
- Secure over-the-air (OTA) firmware upgrade
- Cryptographic support for RSA, X.509, SHA, AES128
- Integrated power amplifier (up to 10 dBm)
- MCU Subsystem: 96-MHz Arm® Cortex®-M4
- 384KB SRAM
- Packages: 60-pin QFN (7 mm x 7 mm)
- Supported in ModusToolbox®

Target Applications

- Remote control, keyboard, PC accessories, toys, and smartphone accessories
- Medical, industrial, and mesh

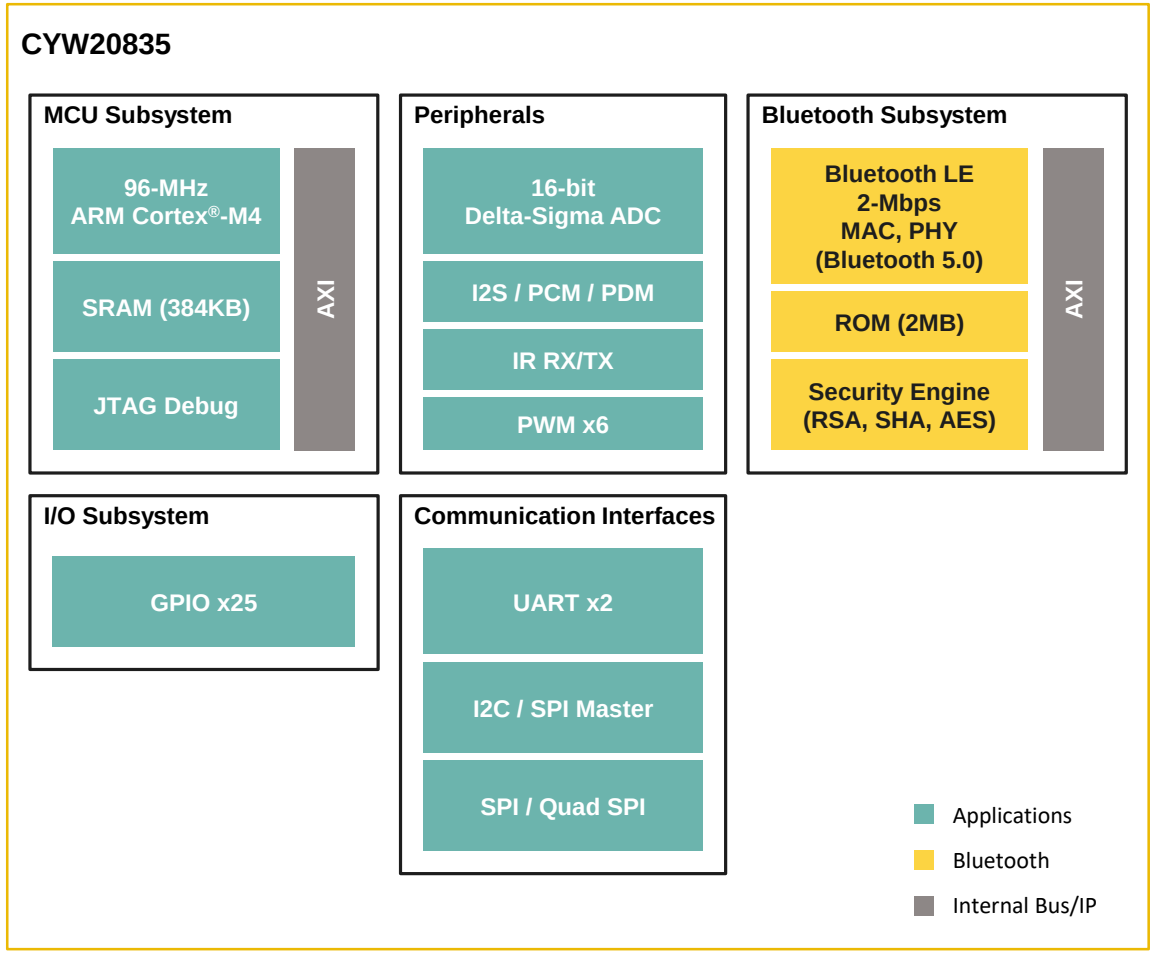
Development Kit

- IFX Kit: CYBLE-343072-EVAL-M2B (CYBLE-343072-02 BLE module)

Modules Availability

- CYBLE-333073-02: BLE Module with ext. antenna via RF solder pad (Production Now)
- CYBLE-333074-02: BLE Module with ext. antenna via u.FL connector (Production Now)
- CYBLE-343072-02: BLE Module with PCB trace antenna (Production Now)

CYW20835 Functional block diagram

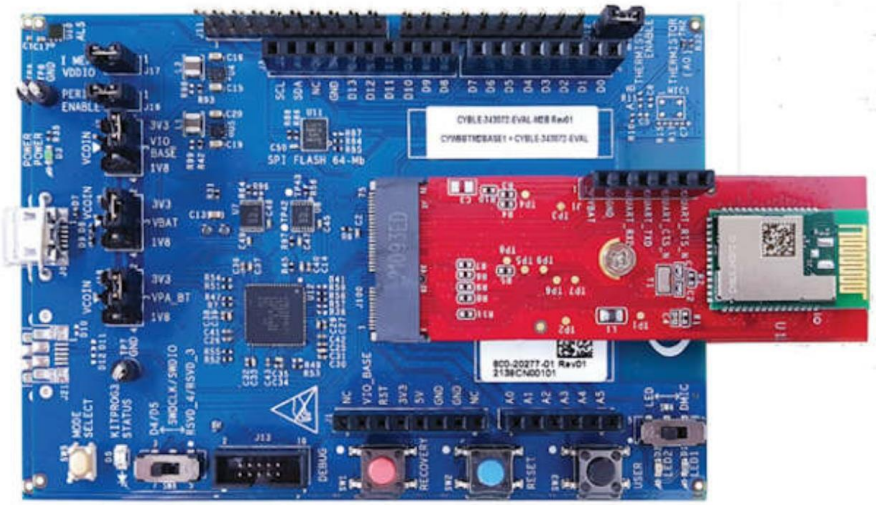


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Bluetooth LE Connectivity CYBLE-343072-02 Evaluation Board

Overview

- **Miniaturized and fully integrated BLE module including antenna of size 13.3 x 21.9 x 2 mm**
- Support various Bluetooth protocols including Generic Access Profile (GAP), Generic Attribute Profile (GATT), MESH, Find Me profile (FMP), HID Over GATT (HOGP), Health Thermometer Profile (HTP) and Proximity Profile (PXP)
- Up to 2 Mbps data rate
- On-board debugger compatible with PSoC™ programmer & debugger based on KitProg2 firmware
- Evaluation software available on Infineon website (PSoC™ Creator)
- OPN: CYBLE-343072-EVAL-M2B
- Integrated serial flash, 24MHz crystal oscillator, and Interfaces to USB power or to a coin cell



Product type	Function	Part number	Description	Package mm x mm	Qty
BLE module	BLE module	CYBLE-343072-02	Fully certified and qualified BLE module with onboard crystal oscillators, trace antenna, passive components & BLE MCU compatible with Bluetooth® 5.2 up to 2 Mbps, TX output power up to 12 dBm, V_S 2.5 – 3.6 V, T_A -30 to 85°C	SMT43 13x22	1
MCU	Basis BLE MCU	CYW20835	32-bit Cortex-M4F 96 MHz with FPU & MPU, 384 KB SRAM & 2 MB ROM, BLE subsystem, 24 GPIOs, Audio interfaces: I2S, PCM, PDM, AFE for analog microphone, 6x 16-bit PWM, UART, SPI, I2C, V_S 1.62 – 3.63 V, T_A -30 to 85°C	--	--
MCU	KitProg programmer	CY8C5868LTI-LP039	32-bit Cortex-M3 67 MHz with DMA controller & digital filter processor, 64 kB SRAM & 256 kB Flash & 2 kB EEPROM, Full Speed USB 2.0 & Full CAN, 4 TCPWM blocks, configurable 8 - 20-bit ADC, 4 comparators, 4 OpAmps, V_S 1.71 – 5.5 V, T_A -40 to 85°C	QFN68 8x8	1

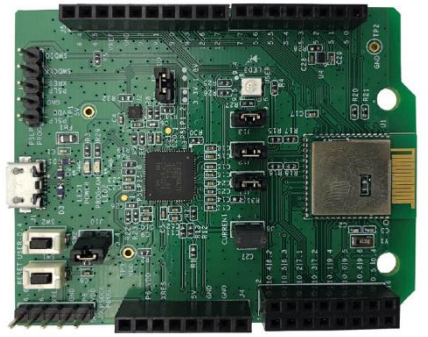
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Bluetooth LE Connectivity CYBLE-416045 Evaluation Board

Overview

- **Miniaturized and fully integrated BLE module including antenna of size 14 x 18.5 x 2 mm**
- Up to 2 Mbps data rate
- On-board debugger compatible with PSoC™ programmer & debugger based on KitProg2 firmware
- Evaluation software available on Infineon website (PSoC™ Creator)
- OPN: CY8CPROTO-063-BLE (independent usage)
- OPN: CYBLE-416045-EVAL (compatible with Arduino Uno connection)



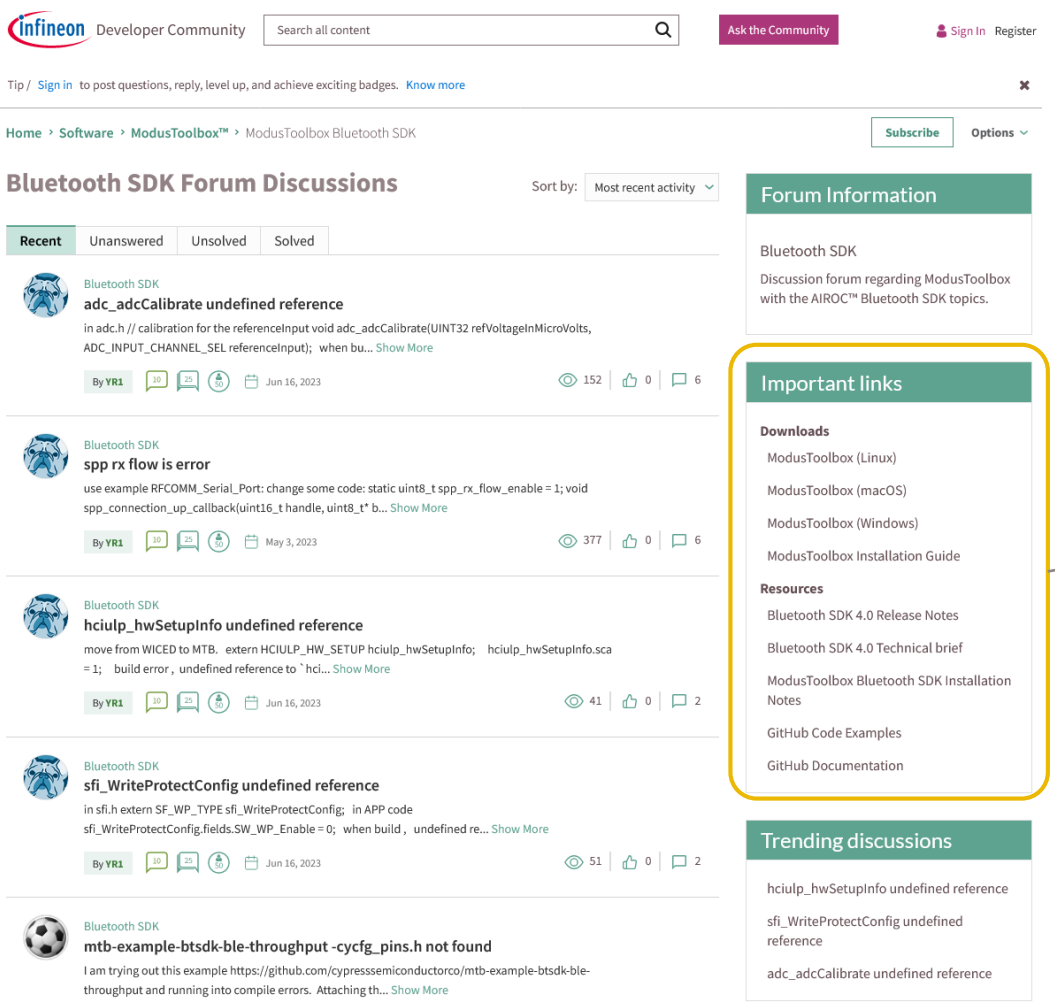


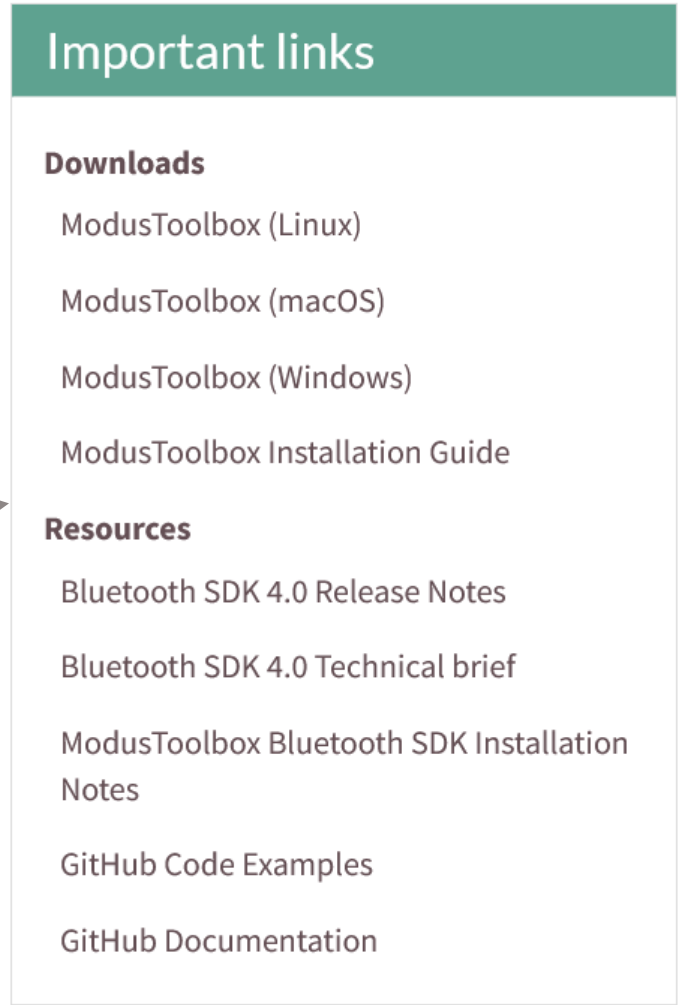
Product type	Function	Part number	Description	Package mm x mm	Qty
BLE module	BLE module	CYBLE-416045-02	Fully certified and qualified BLE module with onboard crystal oscillators, trace antenna, passive components & BLE MCU PSoC™ 63 BLE compatible with Bluetooth® 5.0 up to 2 Mbps, TX output power up to 4 dBm, V_S 1.7 – 3.6 V, T_A -40 to 85°C	SMT43 14x18.5	1
MCU	Basis BLE MCU	PSoC6 CY8C63x6 / CY8C63x7	32-bit Cortex-M4F 150 MHz with FPU & MPU & Cortex-M0+ 100 MHz with MPU, 288 KB SRAM & 1 MB application Flash, BLE subsystem, QuadSPI/Serial memory interface, 9 configurable serial communication blocks, 2 PDM & 1 I2S audio channels, 32 TCPWM, 12-bit ADC 1 Msps, CAPSENSE™ touch sensing, Cryptography accelerator, LCD Drive, Secure Boot, V_S 1.7 – 3.6 V, T_A -40 to 85°C	--	--
MCU	KitProg programmer	CY8C5868LTI-LP039	32-bit Cortex-M3 67 MHz with DMA controller & digital filter processor, 64 kB SRAM & 256 kB Flash & 2 kB EEPROM, Full Speed USB 2.0 & Full CAN, 4 TCPWM blocks, configurable 8 - 20-bit ADC, 4 comparators, 4 OpAmps, V_S 1.71 – 5.5 V, T_A -40 to 85°C	QFN68 8x8	1

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Bluetooth SDK Developer Community

Go-to link for everything related to the Bluetooth SDK





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Security

Protecting Intellectual property (IP) and know-how

Back to overview

Infineon's security solutions are widely used in everyday life



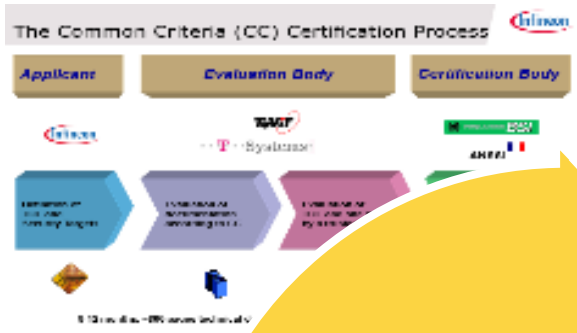
- Every second banking card issued in 2017 has an Infineon security chip inside
- Infineon powers Identity (ID) cards in ~70 countries representing almost 75% of world's population
- Every second business laptop come with a Trusted Platform Module (TPM) from Infineon
- Emergency call (eCall) functionality in majority of cars feature an Infineon chip

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Infineon takes comprehensive measures to increase the security in the connected world

Standards and Certifications



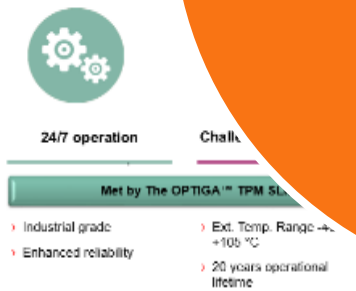


Customers and Partners

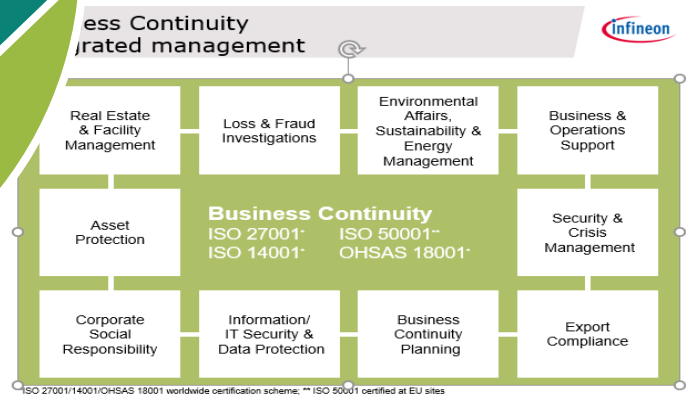


Innovation





Business Continuity



Commitment to Security

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ESS – Trust anchor and one-way authentication solutions for embedded applications

Device Authentication


Battery Authentication


Device Authentication


Printer


Smart Inhaler


Water Filter


Wireless Charging

IoT Security


Automotive Security


Cellular IoT Nodes


Cloud Security


Enterprise


Security in PC, Laptop & Tablets


Industrial Security


IoT Networking


Non-Cellular IoT Nodes


Smart Home

Use cases

One-way authentication e.g.:

- IP & brand protection
- Spare part / disposable authentication
- Battery & Charger, accessory authentication
- User authentication

Use cases

Mutual authentication e.g.:

- Secured Cloud onboarding

Confidentiality e.g.:

- Cellular connection (eSIM applications)

Integrity e.g.:

- SOTA (Software over the air)
- Secured (re)boot

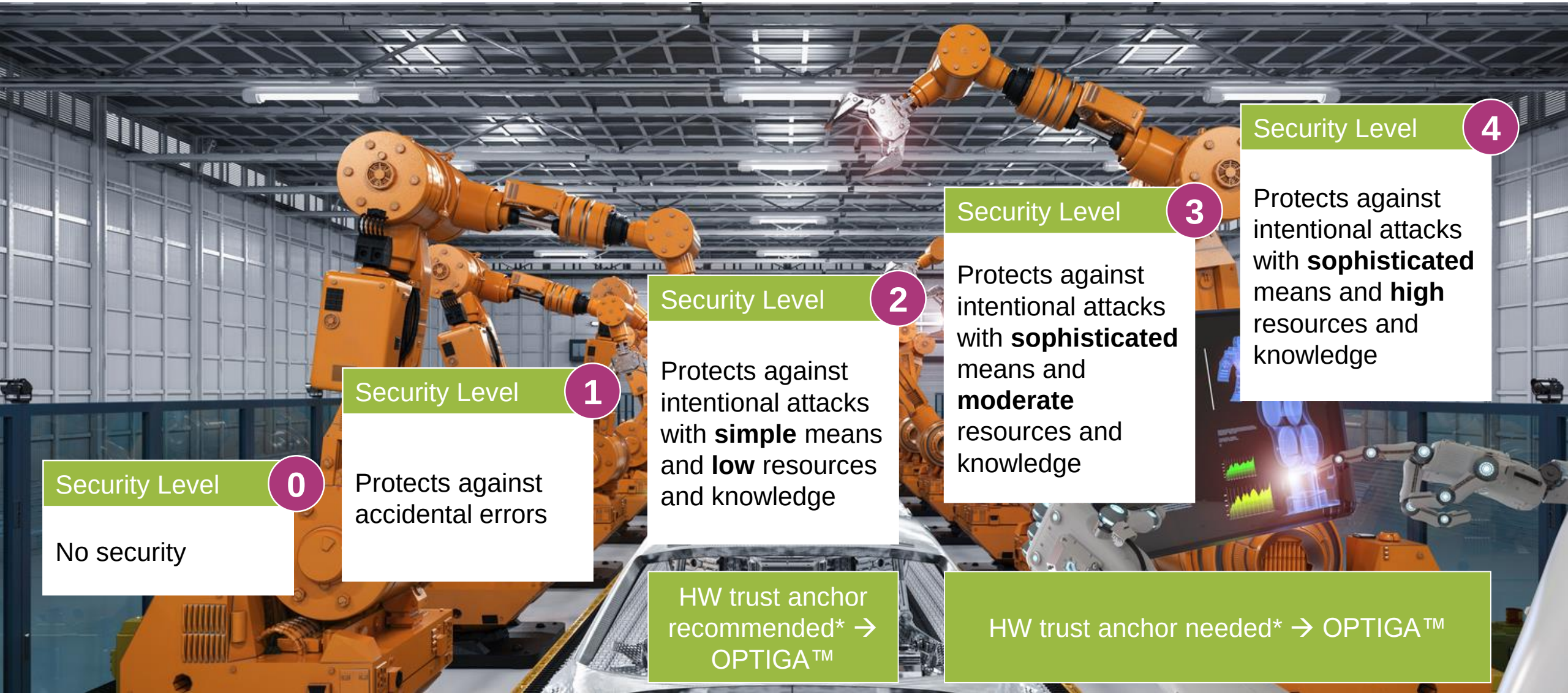
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IEC 62443 introduces multiple security layers

General	IEC 62443-1-1 Terminology, concepts and models	IEC TR-62443-1-2 Master glossary of terms and abbreviations	IEC 62443-1-3 System security conformance metrics	IEC TR-62443-1-4 IACS security lifecycle and use-cases
Policies & Procedures	IEC 62443-2-1 Establishing an industrial automation and control system security program	IEC TR-62443-2-2 Implementation guidance for an IACS security management system	IEC TR-62443-2-3 Patch management in the IACS environment	IEC 62443-2-4 Security program requirements for IACS service providers
System	IEC TR-62443-3-1 Security technologies for industrial automation and control systems	IEC 62443-3-2 Security risk assessment and system design	IEC 62443-3-3 System security requirements and security levels	
Component	IEC 62443-4-1 Product development requirements	IEC 62443-4-2 Technical security requirements for IACS components		

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Hardware Security required to meet Industrial Security Standard IEC 62443, levels 3 and 4



Security Level 0

No security

Security Level 1

Protects against accidental errors

Security Level 2

Protects against intentional attacks with **simple** means and **low** resources and knowledge

HW trust anchor recommended* → OPTIGA™

Security Level 3

Protects against intentional attacks with **sophisticated** means and **moderate** resources and knowledge

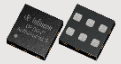
Security Level 4

Protects against intentional attacks with **sophisticated** means and **high** resources and knowledge

HW trust anchor needed* → OPTIGA™

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OPTIGA™ Family

	OPTIGA™ Authentication S	OPTIGA™ Trust M / M Express	OPTIGA™ Trust X	OPTIGA™ Trust CHARGE	OPTIGA™ TPM
					
Security Level Certification	CC EAL 6+	CC EAL 6+*	CC EAL 6+*	CC EAL 6+*	CC EAL 4+ FIPS 140-2 L2
Functionality	Authentication	Connected device security	Connected device security	Wireless power authentication	Connected device security
Non-volatile memory (user data)	Up to 5 kbit	10 kByte	10 kByte	10 kByte	51 kByte
Cryptography Private key stored in secure HW	ECC 163	ECC 384 RSA 2048	ECC 384	ECC 384	ECC 384 RSA 4096
Type of Host System	MCU without OS / proprietary OS / RTOS				
	Embedded Linux				
					Windows / Linux
Interface	I2C, SWI, GPO	I2C (shielded)	I2C	I2C (shielded)	I2C, SPI
System integration	✓	✓	✓	✓	Platform vendor

✓ Done by IFX

* Based on certified HW

Security and Feature

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OPTIGA™ Trust M:
Secured cloud service provisioning – the easy way!

Easy to Integrate
- Full turnkey solution
- Customer specific certificate provided for zero-touch provisioning
- Host code with abstraction layer
- Evaluation kit

Premium Security
- Based on CC EAL 6+ (high) certified security controller
- Cryptographic support:
  - ECC, RSA, AES, HMAC, TLS, HKDF
- X.509 certificate supported
- TRNG AIS-31 certified
- OPTIGA™ Shielded Connection
- CA certificate in-field update

Cryptographic ToolBox
- TLS/DTLS implementation
- Arbitrary security schemes

Extensive Set of Use Cases
- Mutual Authentication
- Secure Communication
- Data Store Protection
- Lifecycle Management
- Power Management
- Secure Update
- Platform Integrity Protection

Endurance
- Up to 1.6 M write cycles

Product Details

Temperature range	-40 to +105°C	Interface	I2C
Data Store	10kB	Interface Speed	1 Mbit/sec
Cryptography	ECC, RSA, AES, SHA	Package	USON-10
Availability	Available	Size	3 x 3 mm



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OPTIGA™ TPM v2.0 certified platform protection

Trusted Platform Module: Secure your Software and Data

- Strong Authentication of Platform and Users
  - Unique embedded Endorsement Certificate
- Secured Storage and Management of Keys and Data
- Platform protection for embedded systems
  - Measured/Trusted Boot
- RNG, Tick-Counter, Dictionary Attack Lock-out
- Built-in algorithms including RSA, ECC, SHA-256





Certified & Standardized Security

- Official TPM product listed at Trusted Computing Group (TCG)
- Independently security evaluated and certified: According to the international standard Common Criteria

Infineon OPTIGA™ TPM products

Product	Qualification	Reliability	Temperature	Domain
SLB9673	Standard	Standard	-40 to +85°C	I2C 32-bit: ARM architectures
SLB9672	Standard	Standard	-40 to +85°C	SPI 32-bit: Intel x86 / ARM arch.
SLB9670	Standard	Standard	-40 to +85°C	SPI 32-bit: Intel x86 / ARM arch.
SLM9670	Industrial JEDEC JESD-47	Flash hardening	-40 to +105°C	SPI 16-bit

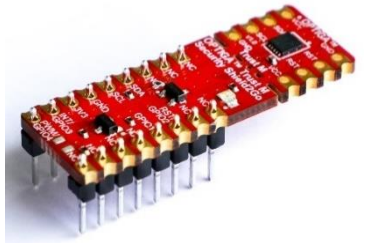
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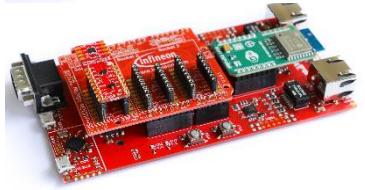
OPTIGA™ Trust M security controller evaluation board

Overview

- **Pre-programmed security controller supporting cryptography algorithms ECC NIST curves up to P-521, ECC Brainpool curve up to P-512, RSA® up to 2048, AES key up to 256, HMAC up to SHA512, HKDF up to SHA512 and SHA-256**
- Generation & Verification of digital signatures
- Encryption & Decryption of cryptographic keys
- OPN: S2GOOPTIGAMCLOUDTOBO1 (without MCU Kit board)
- To be used with the adapter (MYIOTADAPTERTOBO1) and XMC4800 IoT Kit (KITXMC48IOTAWSWIFITOBO1)
- Getting started guide & FreeRTOS demo code available in Github
- Other features available for evaluation in XMC4800 IoT Kit: CAN bus communication, Ethernet Control Automation Technology (CAT) slave protocol, 2.4 GHz Wi-Fi module (based on ESP8266EX IC – non IFX device), and FreeRTOS operation
- Possibility to interface with XMC4700 Relax Kit (KITXMC47RELAXV1TOBO1) with FreeRTOS demo code in Github







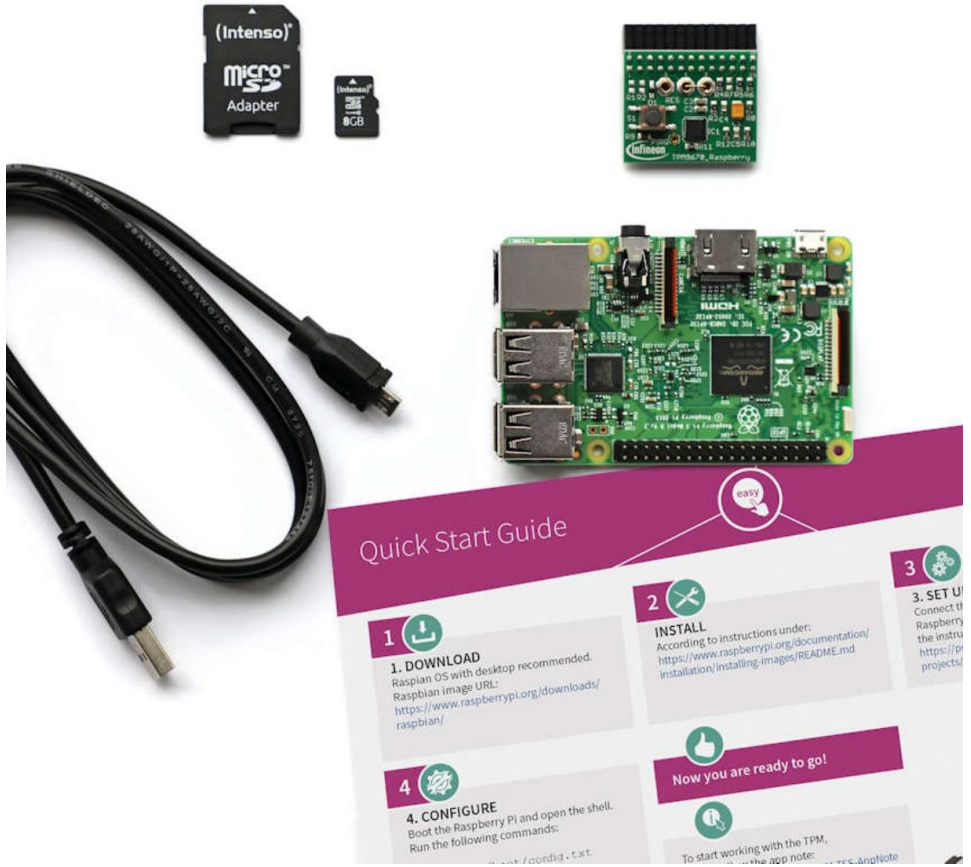
Product type	Function	Part number	Description	Package mm x mm	Qty
Security controller IC	Security controller	SLS32AIA010ML	Embedded security controller for connected devices, with symmetric/asymmetric cryptography engines supporting ECC, RSA, AES, HMAC, & HKDF algorithm, I^2C interface up to 1MHz with Fast Mode Plus, V_S 1.62 – 5.5 V, T_J -40 to 105°C	USON10 3x3	1
MCU	Control interface	XMC4800-F100K2048	32-bit Cortex-M4 144 MHz with FPU & MPU, 352 KB SRAM & 2048 KB Flash with configurable 6 serial channels, CAN & EtherCATSlave interface, Ethernet MAC module, USB, EBU for external memories, SDMMC, Touch-Sense controller, T_A -40 to 125°C	LQFP100 16x16	1
CAN transceiver	CAN transceiver	IFX1051LE	Industrial qualified CAN transceiver up to 1 Mbps transmission rate suitable for 12 & 24 V applications – replaceable with TLE9250XLE, automotive qualified	TSON8 3x3	1
LDO	1.8V for Ethernet PHY IC	IFX54441LDV	LDO 300 mA output, 2.5% output voltage accuracy, reverse polarity, overcurrent, over-temperature protection, input voltage 1.8 V to 20 V – replaceable with TLS203B0EJV	TSO10 3.3x3.3	1
LDO	Voltage regulator	IFX1117MEV33	3.3 V LDO 1A output, ±2% precision, short circuit & over-temperature protection, input voltage 4.7 V to 15 V – similar I_{OUT} replacement TLE4284DV33 (different packaging – DPAK)	SOT223	1

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OPTIGA™ TPM SLM9670 security controller evaluation board

Overview

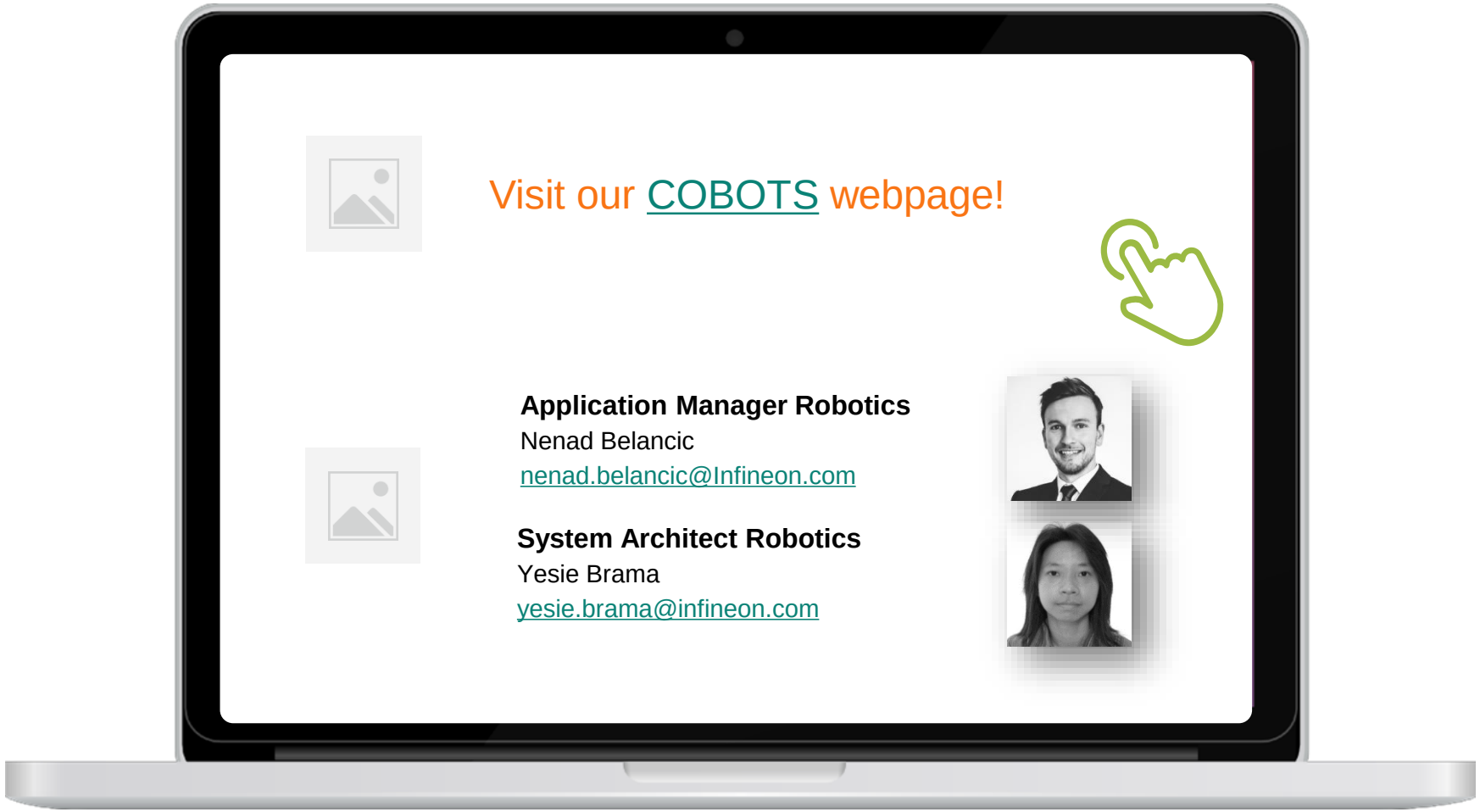
- **Industrial security solution with support of various cryptographic algorithms**
- RSA-1024 and RSA-2048, SHA-1 and SHA-256, ECC NIST P256, ECC BN256
- Iridium board with SLM 9670 TPM2.0 compatible to Raspberry Pi 1, 2, and 3
- Complemented with an easy-to-use Quick Start Guide and a link to step-by-step instructions for
  - OPTIGA™ TPM on GNU / Linux based systems by using the Open Source TPM Software Stack 2.0 (TSS 2.0)
  - OPTIGA™ TPM as a Hardware Security Module (HSM) for AWS Greengrass using the PKCS#11 Hardware Security Integration (HSI)
  - OPTIGA™ TPM in Azure as secured key storage
- OPN: OPTIGATPMEVALSLM967TOBO1



Product type	Function	Part number	Description	Package mm x mm	Qty
Security IC	Security IC	SLM9670	Security TPM 2.0 IC qualified for industrial application, SPI interface up to 43 MHz, up to 3 keys in volatile and 7 keys in non-volatile memory, various cryptographic algorithms, V_S 1.8 V or 3.3 V, T_A -40 to 105°C	VQFN32 5x5	1

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