



Infineon's comprehensive solutions for Commercial Heating, Ventilation and Air Conditioning (C-HVAC)

August 2023



Table of contents

1	Application scope and market trends	3
2	Infineon's solution offering	9
	Inverter and PFC	13
	Discrete solutions	14
	Gate driver solutions	17
	Power modules	22
	Auxiliary power	26
	Motor control	28
	Wide Bandgap	35
3	Smart HVAC	38
4	Key take-aways	59

Table of contents

1	Application scope and market trends	3
2	Infineon's solution offering	9
	Inverter and PFC	13
	Discrete solutions	14
	Gate driver solutions	17
	Power modules	22
	Auxiliary power	26
	Motor control	28
	Wide Bandgap	35
3	Smart HVAC	38
4	Key take-aways	59



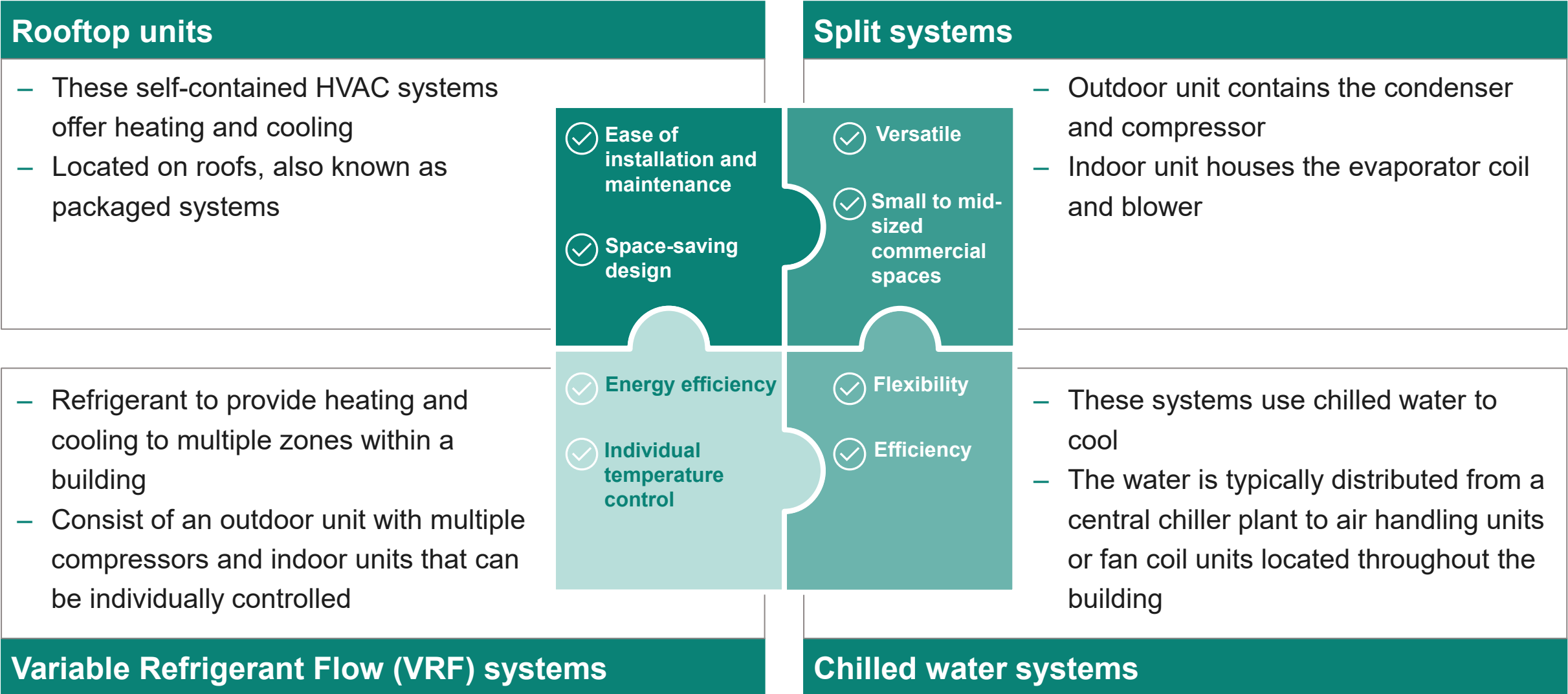
Commercial HVAC systems, serving power ranges from 5 kW to several megawatts, can keep temperatures comfortable, the humidity consistent, and the indoor air quality high.



Infineon offers the optimal products for your C-HVAC, specially designed for larger commercial and industrial buildings such as hospitals, hotels, factories, or multi-level offices.



Different commercial HVAC system types in a nutshell



Key market trends and drivers



Smart HVAC / Sensor function

- Intelligent monitoring of C-HVAC systems for predictive maintenance for system operators (e.g.: monitoring of room temperature, health data, etc.) and for end customers (e.g.: changing room temperature), CO₂ and radar sensing.



Urbanization and global warming

- Urbanization is still in an early stage in developing countries with a lot of potential for new buildings with demand for air conditioning and ventilation. The HVAC industry is focusing more and more on sustainable technology to make its contribution to the environment, which includes e.g.: the use of solar panels and geothermal heating and cooling to reduce energy costs.



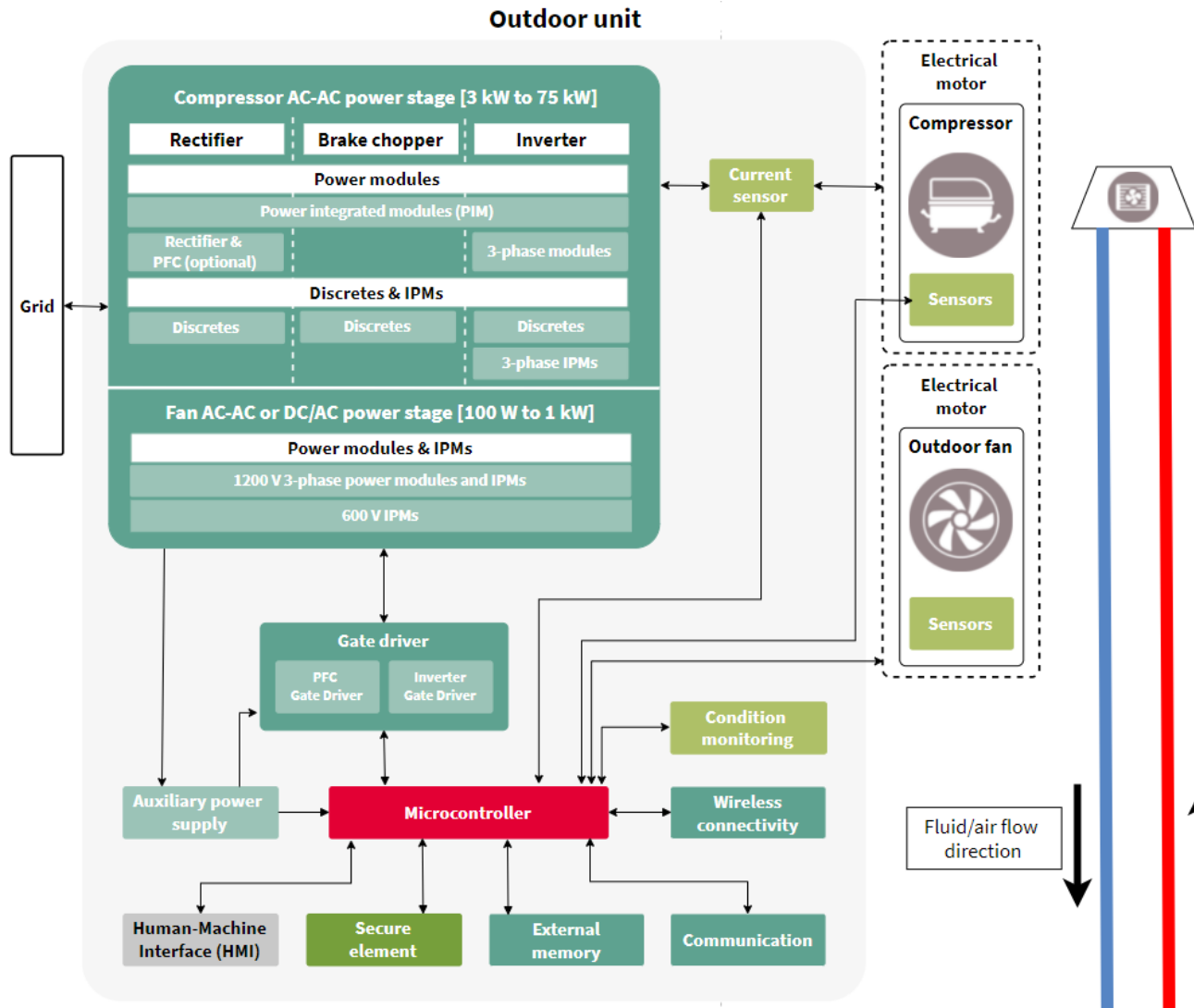
Stringent environmental legislation and fundings

- Strive toward green and other energy efficiency goals that reduce carbon footprints and achieve corporate sustainability goals.

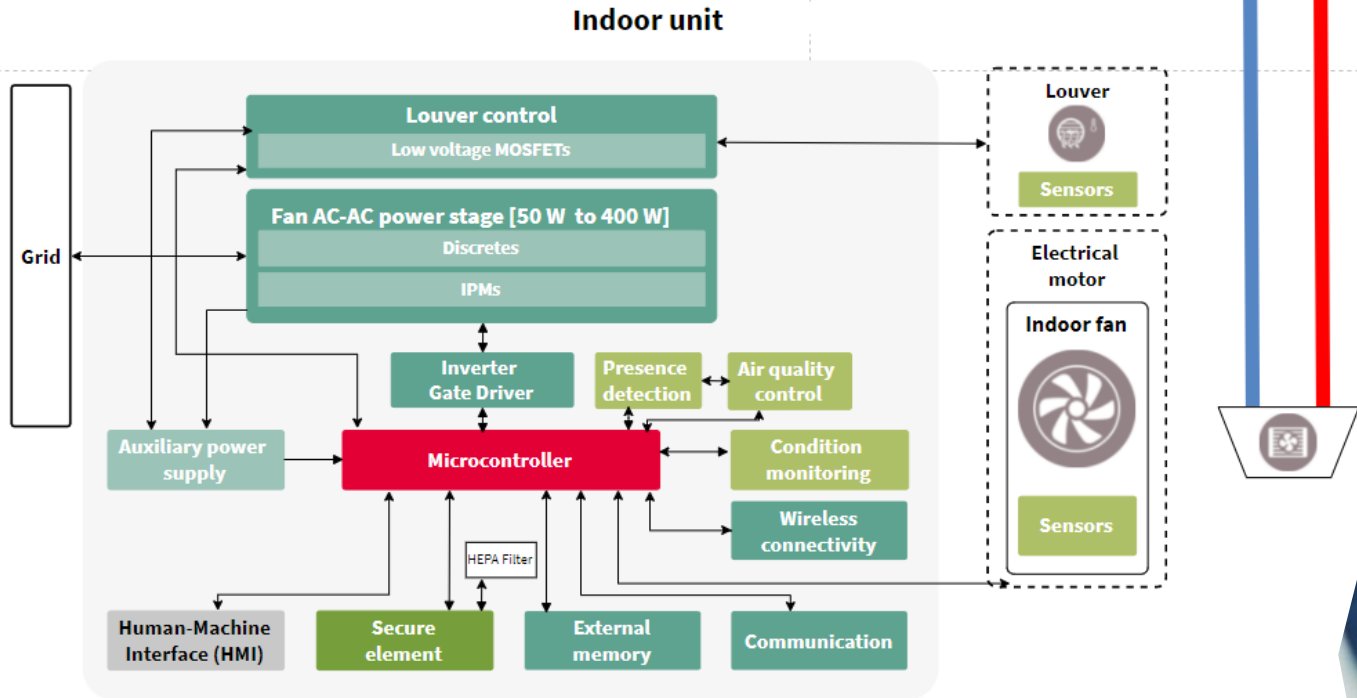
Table of contents

1	Application scope and market trends	3
2	Infineon's solution offering	9
	Inverter and PFC	13
	Discrete solutions	14
	Gate driver solutions	17
	Power modules	22
	Auxiliary power	26
	Motor control	28
	Wide Bandgap	35
3	Smart HVAC	38
4	Key take-aways	59

System block diagram – Outdoor unit



System block diagram – Indoor unit



Infineon's comprehensive product range for C-HVAC applications

Microcontroller

- XMC™
- iMOTION™ motor control

Power stage

- Easy power modules
- EconoPIM™ 2/3
- IGBT and SiC discretes
- Intelligent power modules (IPM)
- EiceDRIVER™ for SiC MOSFETs
- Gate driver ICs for IGBTs

Sensors and condition monitoring

- Sensor fusion reference solution with cloud connectivity
- MEMS microphones
- PAS CO2 sensor
- Magnetic sensors
- Integrated shunts
- Current sensors for automotive and industrial
- Radar sensors
- Angle sensors

Memory

- SEMPER™ NOR Flash
- SEMPER™ secure
- SPI NOR flash
- EXCELON™ F-RAM
- nvSRAM
- Fast Async SRAM
- MOBL™ SRAM
- HYPERRAM™

Technologies

- CoolSiC™
- TRENCHSTOP™

Security

- OPTIGA™ connect IoT – easy, flexible and secured cellular IoT connectivity
- OPTIGA™ authenticate – verifying the authenticity of devices to enable trust
- OPTIGA™ Trust M – Secured communication / secured host firmware update

Wireless

- AIROC™ Wi-Fi® & combos
- AIROC™ Bluetooth®

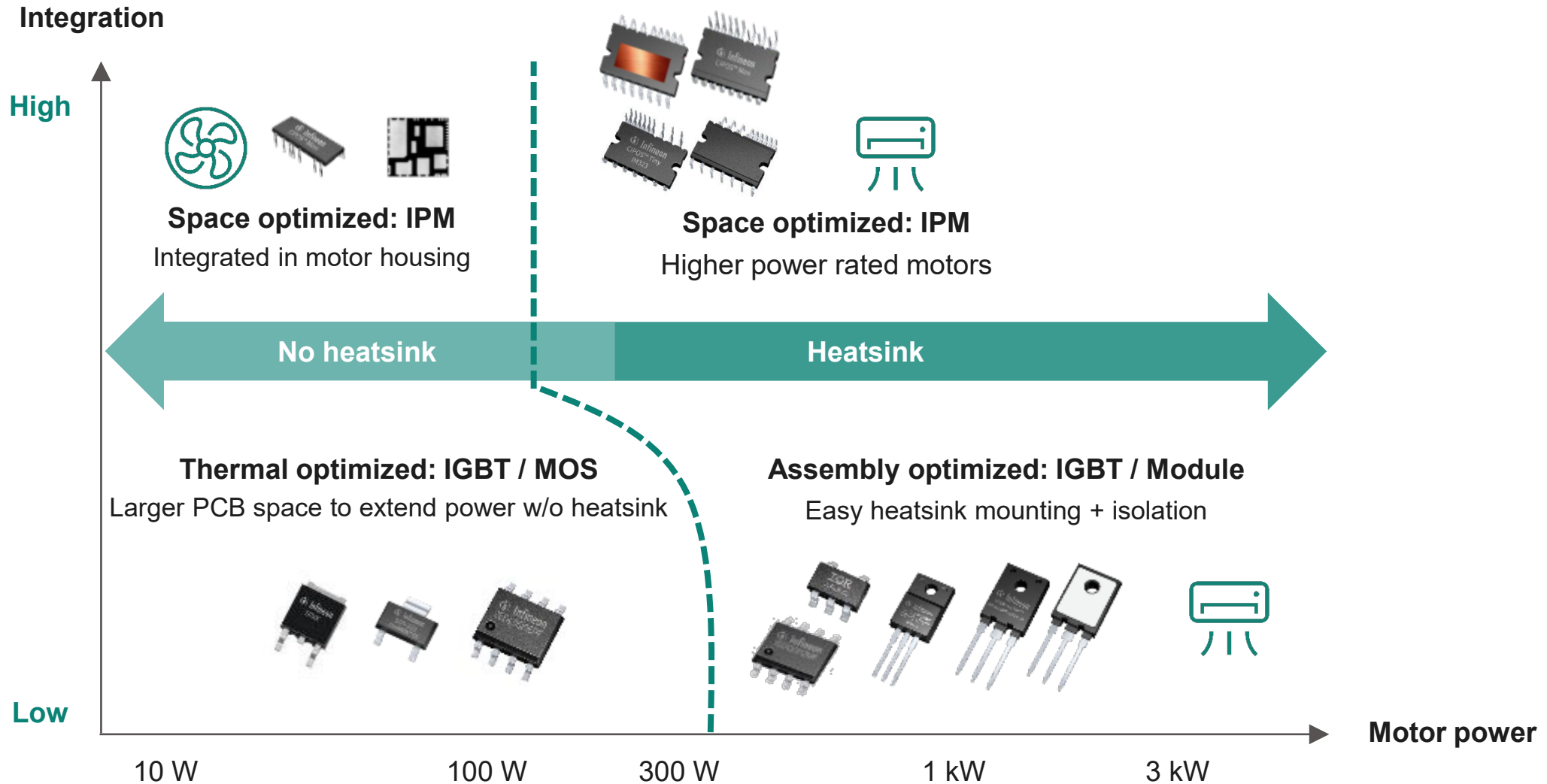
Table of contents

1	Application scope and market trends	3
2	Infineon's solution offering	9
	Inverter and PFC	13
	Discrete solutions	14
	Gate driver solutions	17
	Power modules	22
	Auxiliary power	26
	Motor control	28
	Wide Bandgap	35
3	Smart HVAC	38
4	Key take-aways	59

Table of contents

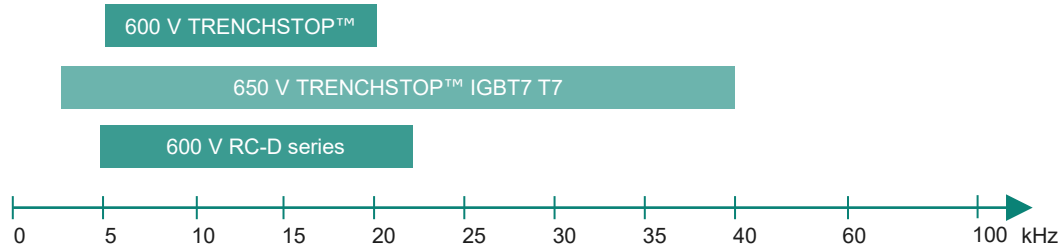
1	Application scope and market trends	3
2	Infineon's solution offering	9
	Inverter and PFC	13
	Discrete solutions	14
	Gate driver solutions	17
	Power modules	22
	Auxiliary power	26
	Motor control	28
	Wide Bandgap	35
3	Smart HVAC	38
4	Key take-aways	59

Power stage and Power Factor Correction (PFC) – Discrete or integrated

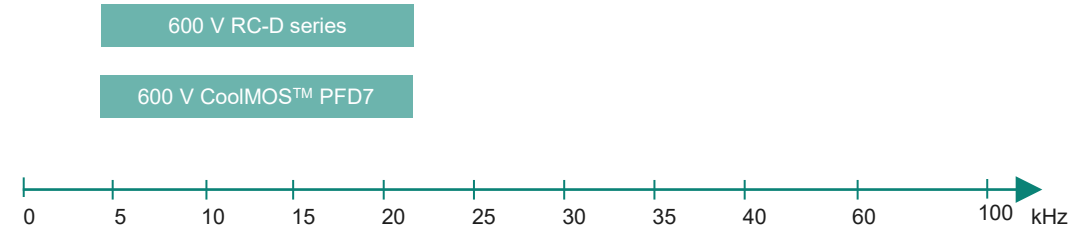


Power stage – Discrete IGBT/ MOS and silicon diode solutions

Compressor



Indoor fan / Outdoor fan



TRENCHSTOP™

Good low frequency performance

Low $V_{ce(sat)}$ and low switching losses
 SC rating up to 5 μ S
 Widest variety of packages including SMD and THT
 Portfolio: 4 A-120 A, D²PAK, TO-220, TO-220FP

IGBT7 T7

Best low-medium frequency IGBT

Benchmark low $V_{ce(sat)}$ and low V_F IGBT
 Enhanced controllability for better EMI
 Portfolio: 20 A-75 A, TO-247-3 pin

RC-D series

Cost optimized monolithically integrated diode in surface mount packages

SC rating up to 3 μ S (RC-D2) and up to 5 μ S (RC-D(F))
 For low to medium frequency converters
 Portfolio: 3 A-15 A in DPAK, 1 A-6 A in SOT-223

RC-D series

Cost optimized monolithically integrated diode in surface mount packages

SC rating up to 3 μ S (RC-D2) and up to 5 μ S (RC-D(F))
 For low to medium frequency converters
 Portfolio: 3 A-15 A DPAK, 1 A-6 A in SOT-223

600 V CoolMOS™ PFD7

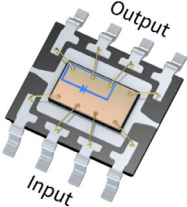
Integrated fast body diode with ultra low Q_{rr}

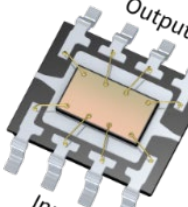
Integrated Zener diode for ESD protection (HBM Class 2)
 Portfolio with wide range of $R_{DS(on)}$ values ≤ 2 Ohm
 Supporting cost effective designs with SMD solutions like SOT-223

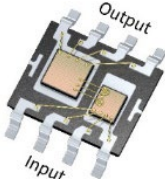
Table of contents

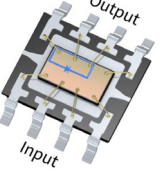
1	Application scope and market trends	3
2	Infineon's solution offering	9
	Inverter and PFC	13
	Discrete solutions	14
	Gate driver solutions	17
	Power modules	22
	Auxiliary power	26
	Motor control	28
	Wide Bandgap	35
3	Smart HVAC	38
4	Key take-aways	59

EiceDRIVER™ gate drivers for commercial HVAC applications

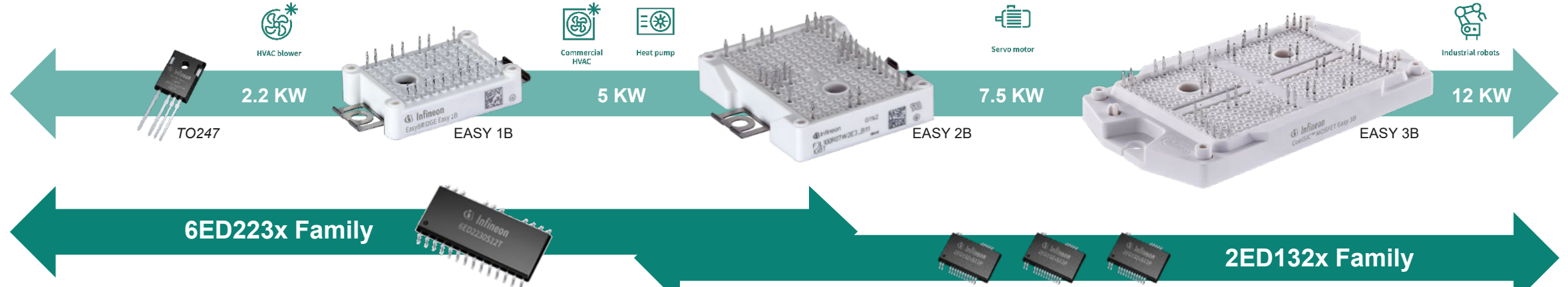
Inverter: 1200 V level-shift drivers	Key products	Differentiation
<ul style="list-style-type: none"> 1200V Level-shift based isolation 30 years of product leadership from IRF portfolio (first HVIC driver in 1989) State-of-the-art Infineon SOI technology for superior operational ruggedness and integrated boot strap diode 	<ul style="list-style-type: none"> 6ED2230/1S12T 2ED132x family 	<p>6ED223x:</p> <ul style="list-style-type: none"> Small footprint Low BOM cost <p>2ED132x:</p> <ul style="list-style-type: none"> Easier thermal management Active miller clamp option

Brake chopper, buffer, or boost PFC: Low-side drivers	Key products	Differentiation
<ul style="list-style-type: none"> Comprehensive families of single and dual channel low-side drivers New feature-rich families with accurate (+/-5%), fast, over-current protection for PFC in home appliances 	<ul style="list-style-type: none"> 1ED44171N01B IRS44273 1ED44175N01B 	<ul style="list-style-type: none"> Cost-effective Market-proven Integrated over-current protection (OCP) and fault reporting

Inverter: Isolated gate drivers	Key products	Differentiation
<ul style="list-style-type: none"> CT-based isolation technology Higher CMTI (300 V/ns) Best-in-class part-to-part matching and prop delay High current with protection Robust against negative VS 	<ul style="list-style-type: none"> EiceDRIVER™ Compact <ul style="list-style-type: none"> 1ED3141MU12F 1EDI20I12MF EiceDRIVER™ Enhanced <ul style="list-style-type: none"> 1ED3321MC12N EiceDRIVER™ Power <ul style="list-style-type: none"> 2EPxxx 	<ul style="list-style-type: none"> Compact family is cost effective and easy to design Miller clamp against parasitic turn-on DESAT and soft-off for short circuit protection Wide output supply voltage enable negative voltage turn off 2EP provides power supply for the isolated gate driver 

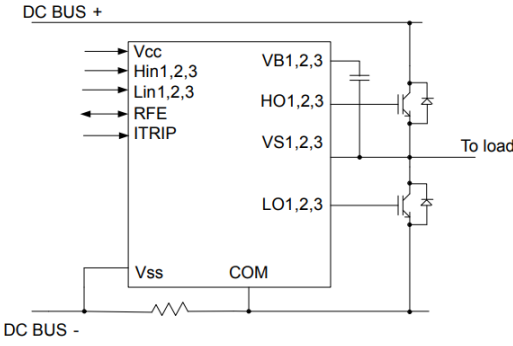
Totem pole PFC: 600 V level shift drivers	Key products	Differentiation
<ul style="list-style-type: none"> 600 V Level-shift based isolation 30 years of product leadership from IRF portfolio (first HVIC driver in 1989) State-of-the-art Infineon SOI technology for superior operational ruggedness, higher frequency switching and integrated boot strap diode 	<ul style="list-style-type: none"> 2EDL23Ix06PJ 2EDL218x4 family 	<ul style="list-style-type: none"> Infineon SOI with best-in-class integrated boot strap diode, high negative Vs robustness Integrated over current and protection features 

1200 V gate driver solutions

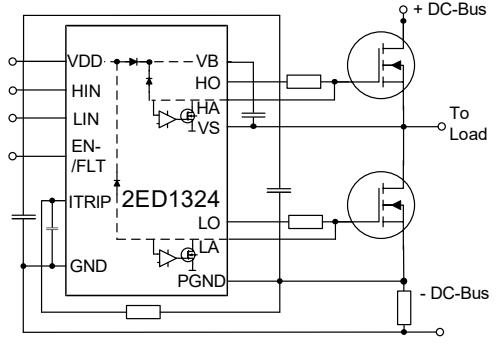


1200 V 6-in-1 SOI gate driver in DSO-24

1200 V Half-bridge gate driver with active miller clamp



- Infineon Thin-Film-SOI technology
- Negative voltage -100 V guaranteed
- Embedded 3 Bootstrap Diode
- Output current +0.35 A / -0.65 A
- 6-in-1 driver solution for motor application
- Full protection function
 - OCP (Over current protection)
 - FO (Fault Out)
 - UVLO (Under voltage Lock Out)
 - Shoot through protection (460 ns)
- 2 different UVLO version
 - 6ED2230S 10.4 V (HS), 11.4 V (LS) for IGBT
 - 6ED2231S 12.2 V (HS/LS) for SiC



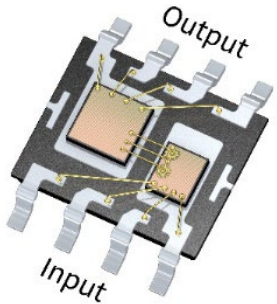
- Infineon Thin-Film-SOI technology
- Negative voltage -100V guaranteed
- Embedded 1 Bootstrap Diode
- Output current +2.3 A / -2.3 A (4.6 A)
- Full protection function
 - Active Miller Clamp (AMC) w/ 2.3 A sink current
 - Short Circuit Clamp (SCC)
 - OCP (Over current protection)
 - FO (Fault Out)
 - UVLO (Under voltage Lock Out)
 - Shoot through protection
- 2 different UVLO version
 - 2ED1321/1322 : DSO-16(300mil) w/o AMC
 - 2ED1323/1324 : DSO-20(300mil) w/ AMC

Every switch needs a driver, the right driver makes a difference

EiceDRIVER™ isolated gate driver portfolio



ED-E
Enhanced

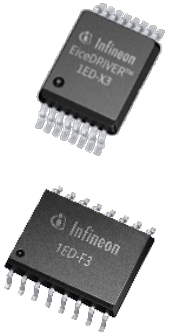


EiceDRIVER™ Enhanced

Up to 2300 V, 9 A
DESAT, Miller clamp

Rich feature-set for advanced protection:

- X3 Digital (1ED38xx): I2C configurable enabling predictive maintenance
- X3 Analog (1ED34xx): Best-in-class DESAT accuracy, Analog Configurability
- **F3 (1ED332x): Cost effective solution with DESAT**



www.infineon.com/gdenhanced

ED-C
Compact

EiceDRIVER™ Compact

Up to 2300 V, 18 A
Miller clamp, 2-level slew-rate-control

Reduced feature-set and easy to design-in:

- 2L-SRC Compact (1ED32xx): EMI & switching loss optimization
- **X3 Compact (1ED31xx): easy to design & cost effective**



www.infineon.com/gdcompact

New products with reinforced isolation (UL 1577 and VDE-11)

EiceDRIVER™ X3 Compact (1ED31xx) family

5.7 kV isolated driver with active miller clamp or separate output



Product highlights

- Single channel isolated gate driver with **6.5 / 10 / 14 A**
- Galvanic functional isolation voltages up to **2300 V**
- **45 ns** propagation delay with **15 ns** input filter, **7 ns** propagation delay matching
- **Active Miller Clamp or Separate outputs**
- Exceptional CMTI robustness > **300 kV/μs**
- **40 V absolute maximum** output supply voltage
- Isolation capabilities & certification
 - 1ED31xxMU12F: **UL 1577 certified** $V_{ISO}=3$ kV(rms)
 - 1ED31xxMU12H: **UL 1577 certified** $V_{ISO}=5.7$ kV(rms)
 - 1ED31xxMC12H: **UL 1577 & VDE 0884-11 certified** $V_{IORM}=1767$ V
- DSO-8 150 mil (4 mm creepage) & 300 mil package (8 mm creepage)
- **Evaluation board available:**
 - EVAL-1ED3121MX12H; EVAL-1ED3122MX12H; EVAL-1ED3124MX12H
 - EVAL-1ED3142MU12F-SiC; REF-22K-GPD-INV-EASY3B

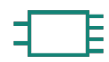


www.infineon.com/gdcompact

Typical Applications



Lighting



SMPS



UPS



EV charging



Solar

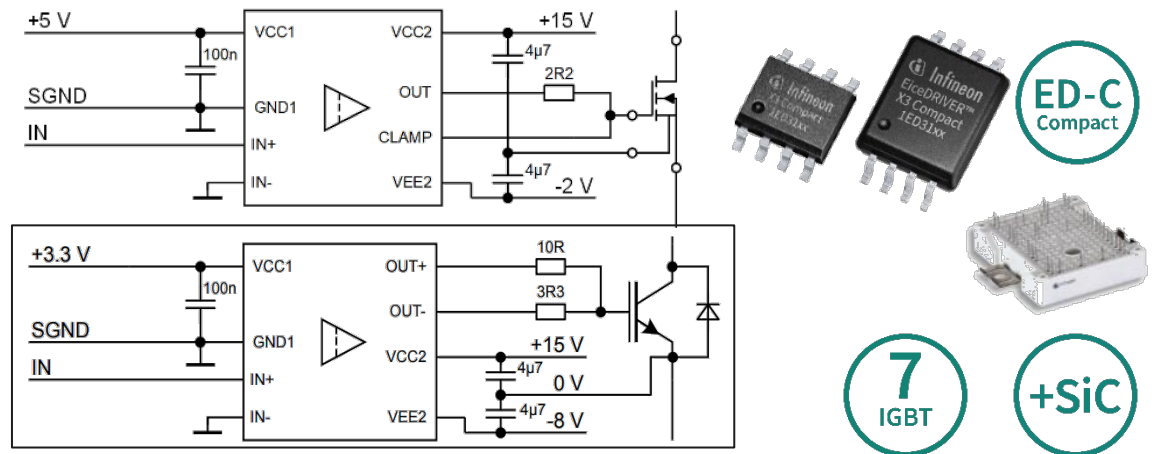


Drives



Aircon

Sample schematic



Value proposition

- **Cost effective 8-pin gate driver, easy to design-in**
- 14 A output current, **no booster required**
- Accurate prop delay matching, **enable high switching frequency**
- 40 V output supply voltage, **bipolar supply with high margin**
- **Optimized specifications** for driving **IGBT7** and **CoolSiC™**, Miller clamp against parasitic turn-on
- Fulfilling **highest isolation standards**: UL 1577 and VDE-11

Table of contents

1	Application scope and market trends	3
2	Infineon's solution offering	9
	Inverter and PFC	13
	Discrete solutions	14
	Gate driver solutions	17
	Power modules	22
	Auxiliary power	26
	Motor control	28
	Wide Bandgap	35
3	Smart HVAC	38
4	Key take-aways	59

EasyPACK™ IGBT power modules

Key features

Benefits

Performance

EasyPACK™ IGBT modules enable the evolutionary IGBT chip performance with the most advanced packaging technology



Best-in-class IGBT chip and package technologies

Reliability

Quality and reliability is one of the core values of IGBT modules, with the experience and commitment for decades



Highest quality and reliability in IGBT module market

Customization

EasyPACK™ modules supports flexible pin grid configurations



Offer **customized** layout and pin out of IGBT modules

Easy to use

Fully integration of power devices that simplifies the system design



Fast time-to-market for innovative new designs

Scalability

EasyPACK™ family offers packages of Easy1B, Easy2B and Easy3B with the same mechanical height



Ease of scalability empowers platform-based designs

EconoPIM™ IGBT power modules

Key features

Benefits

Technology

Equipped with in house state of the art IGBT technology



First to be equipped with **Industrial leading IGBT technology**

Reliability

Well established package with high volume production



High volume production with >20 years proven package technology

Performance

Humidity robustness suited for outdoor compressor



Robustness against harsh environment

Easy to use

Ready for Thermal Interface Material (TIM)



Pre applied Thermal Interface Material ensure **long term stability**

Scalability

Current range of 25 A to 100 A in EconoPIM™ 2 and 75 A to 200 A in EconoPIM™ 3



Scalability **enables platform design** with minimal board re-design

Table of contents

1	Application scope and market trends	3
2	Infineon's solution offering	9
	Inverter and PFC	13
	Discrete solutions	14
	Gate driver solutions	17
	Power modules	22
	Auxiliary power	26
	Motor control	28
	Wide Bandgap	35
3	Smart HVAC	38
4	Key take-aways	59

Auxiliary power – 5th generation CoolSET™

Robustness

- Integrated 700 V, 800 V or 950 V superjunction MOSFET
- Comprehensive protection features
- Auto-restart scheme to minimize interruption

Ease of design

- Numerous design examples covering both indoor and outdoor aircon
- Design tools, guide and application note
- Reference designs

Broad portfolio

- Choice of fixed- frequency or quasi-resonant switching scheme
- Isolated flyback or non-isolated buck topology
- Highest power delivery up to 43 W
- Available in DIP-7 or SMD DSO-12 package



AUX power

Auxiliary SMPS in Flyback or buck topology to perform AC/DC power conversion to power the various system blocks in home appliances.

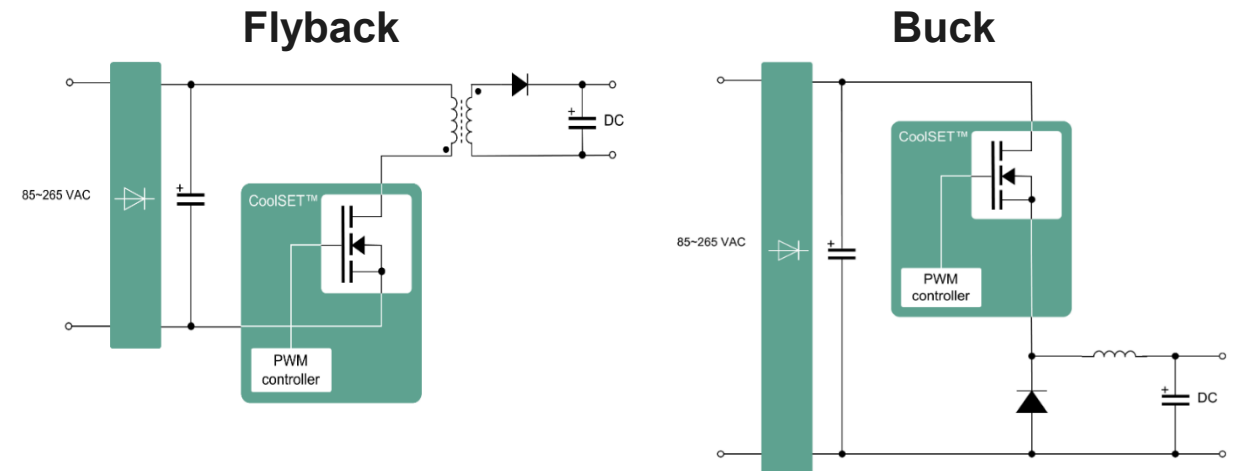


Table of contents

1	Application scope and market trends	3
2	Infineon's solution offering	9
	Inverter and PFC	13
	Discrete solutions	14
	Gate driver solutions	17
	Power modules	22
	Auxiliary power	26
	Motor control	28
	Wide Bandgap	35
3	Smart HVAC	38
4	Key take-aways	59

Infineon offers various motor control solutions to choose from

S/W	MCU	Gate driver	Power switch
iMOTION™ controller		EiceDRIVER™	IGBT
Customer's own S/W	XMC™		HV FET
	PSoC™		LV/MV FET
iMOTION™ controller		CIPOS™ IPM (thermal sensor inside)	
Customer's own S/W	XMC™		
	PSoC™		
iMOTION™ driver			IGBT
			HV FET
			LV/MV FET
iMOTION™ IPM (thermal sensor inside)			

Considerations to select a solution

The value proposition of each offering

e.g., SMD package up to 300 W without heatsink, better EMI performance of IGBT, better light road efficiency of MOSFET

Technical requirements of each application

e.g., 30 A IPM is required for a BLDC blender because peak current is higher than in normal motor applications

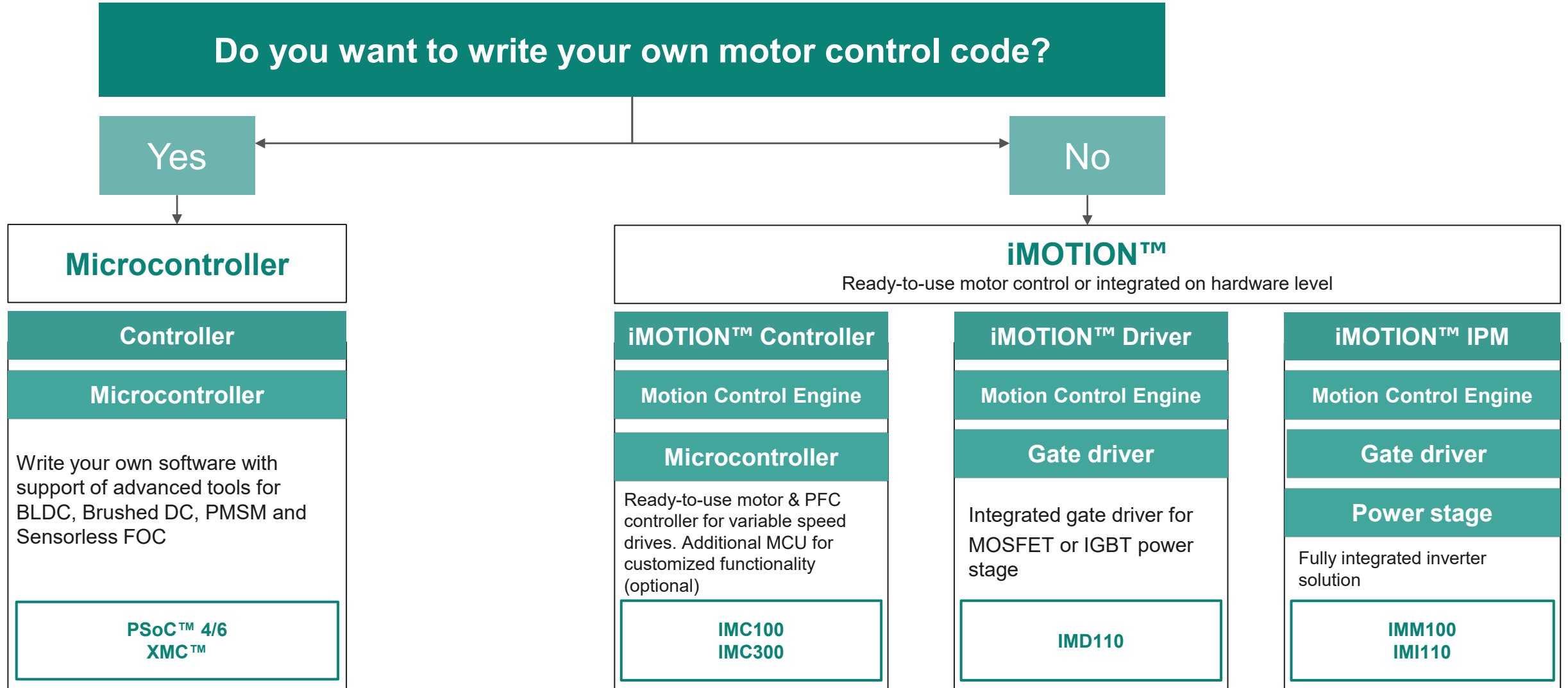
IFX recommended offerings based on customer's preference and system specifications

e.g., switching frequency, power rating, PCB space constraint, assembly process, heatsink-less, multi-source, efficiency, EMI performance, price, high or low voltage motors, internal thermal sensor, control algorithm

Evaluation or simulation results per each application

e.g., loss simulation

Motor Control: iMOTION™ or microcontroller?



Microcontroller portfolio overview

Selected product families

System control, HMI and connectivity

PSoC™ 6

- Highly integrated HMI solution with capacitive touch sensing and TFT display
- PSoC™ 6 + Wi-Fi® & BT Combo: Providing the total solution of IoT connectivity & security (Cloud service, Mesh Gateway)

PSoC™ 4

- HMI + system control (2-in-1 solution): Reliable & stable capacitive touch sensing, large pin pitch package, wide voltage range

Motor control

PSoC™ series

- Integrated with OPA/CMP, TCPWM, reduce BOM cost
- Supported by mature, validated and reliable motor control algorithm and total solution for home appliances, short time to market

XMC™ series

- Versatile real-time motor and power stage control peripherals
- Scalable to various control schemes from single motor up to dual motor and PFC control
- 5 V supported by XMC1000 series

Ready-to-use, highly integrated motor control

iMOTION™

- Integrates all the control and analog interface functions required for sensor-less or hall-based FOC
- Eliminates software coding from the motor control algorithm development process

Infineon microcontrollers for commercial HVAC



Applications

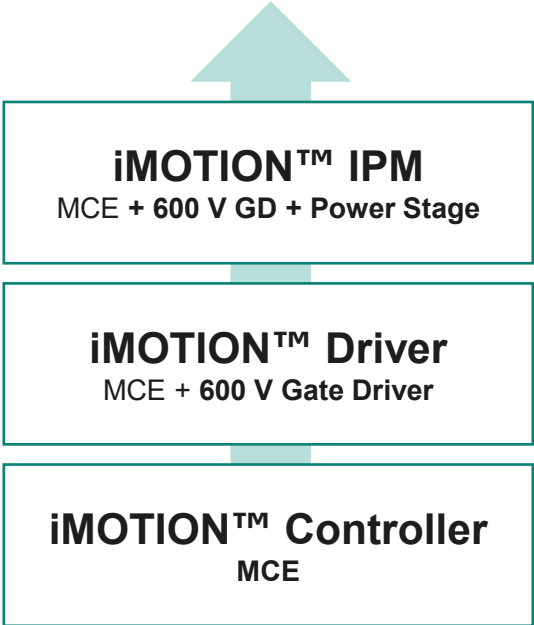
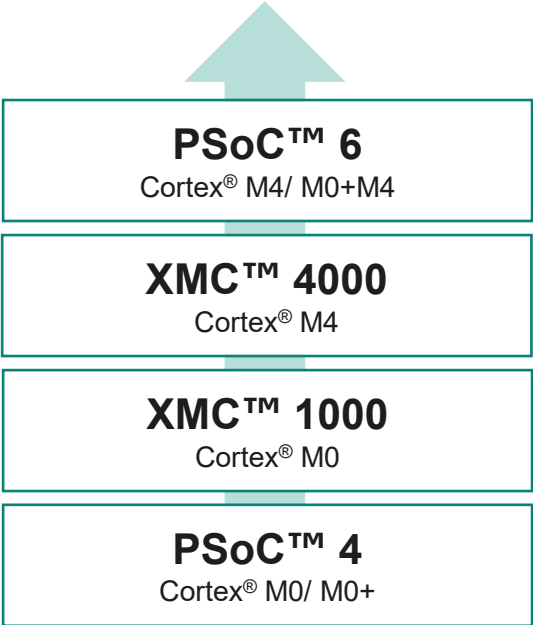
All applications
(HMI, System Control, Motor + PFC)

Motor + PFC

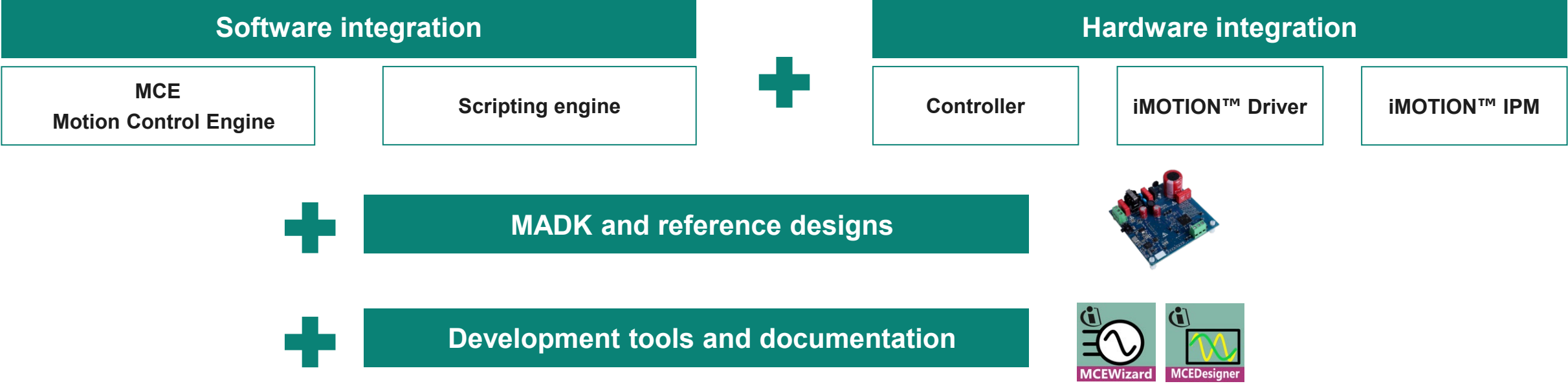
Performance approach

Integration approach

Roadmap / Portfolio



What is iMOTION™?

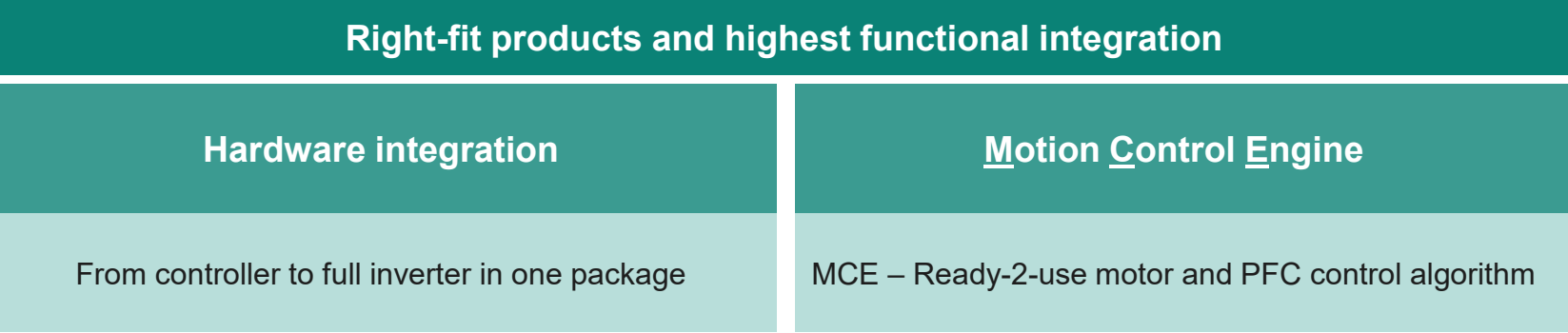


With the objective of making it....

Easier to use than ever!

Faster and cheaper to market!

iMOTION™ solution platform dedicated to motor and PFC control



- iMOTION™ controller
- iMOTION™ driver
- iMOTION™ IPM

+ Less components
+ Reduced PCB space



System cost reduction



Fast time to market

+ Minimized SW coding/test
+ Less certification effort



Less R&D spending

Markets



Major and small home appliances



Industrial pumps and fans

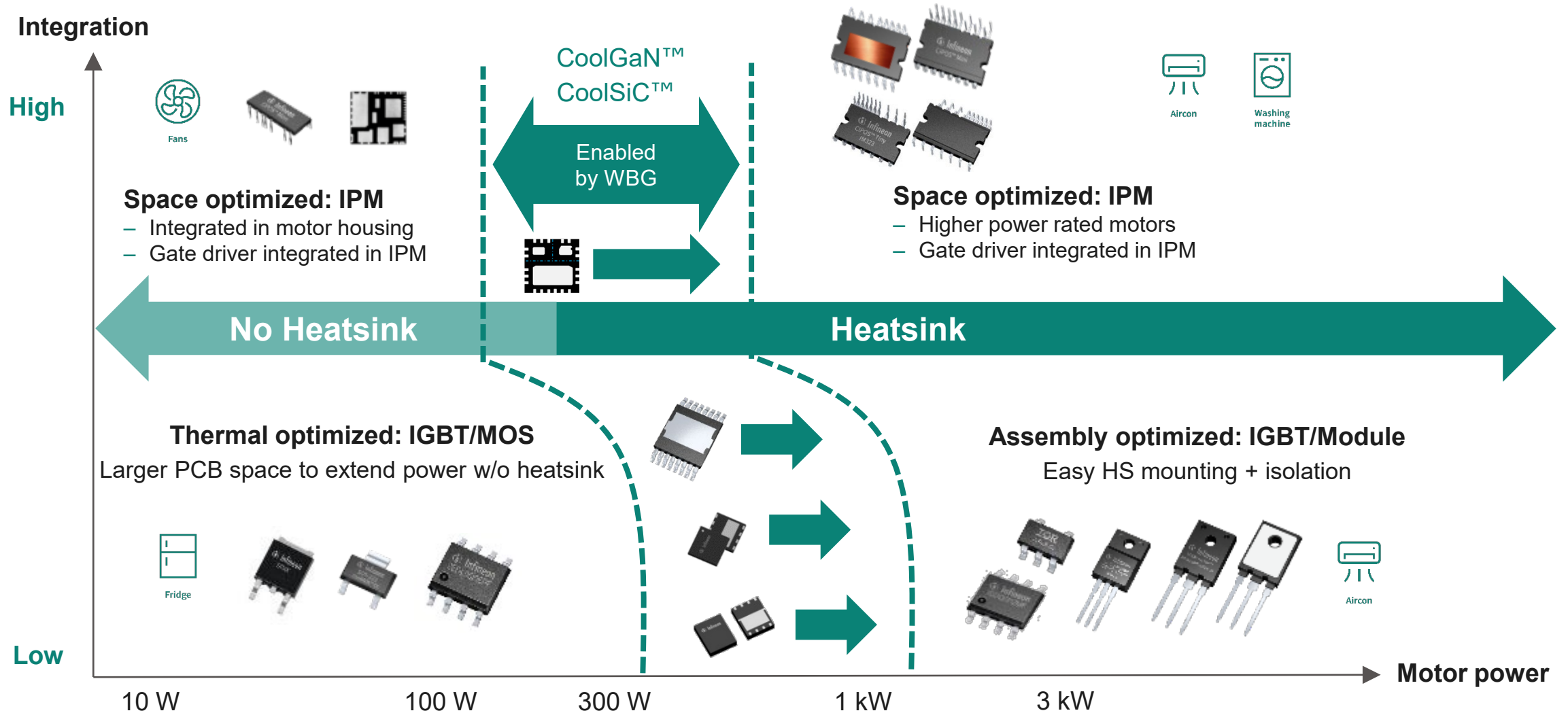


Motion for building automation

Table of contents

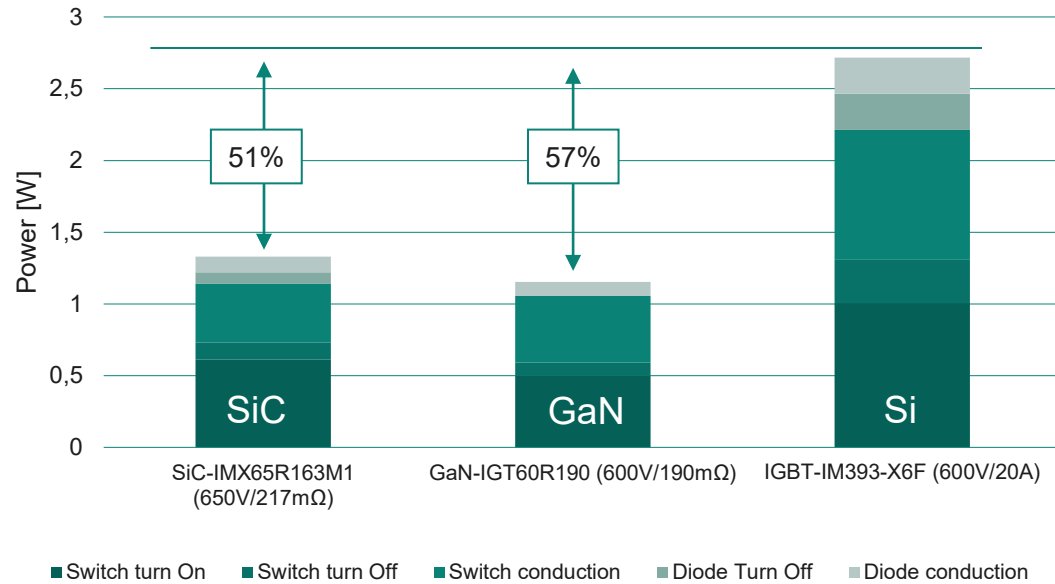
1	Application scope and market trends	3
2	Infineon's solution offering	9
	Inverter and PFC	13
	Discrete solutions	14
	Gate driver solutions	17
	Power modules	22
	Auxiliary power	26
	Motor control	28
	Wide Bandgap	35
3	Smart HVAC	38
4	Key take-aways	59

Discretes or IPMs for inverter solutions? Wide Bandgap (WBG) can increase output power for the same thermal system



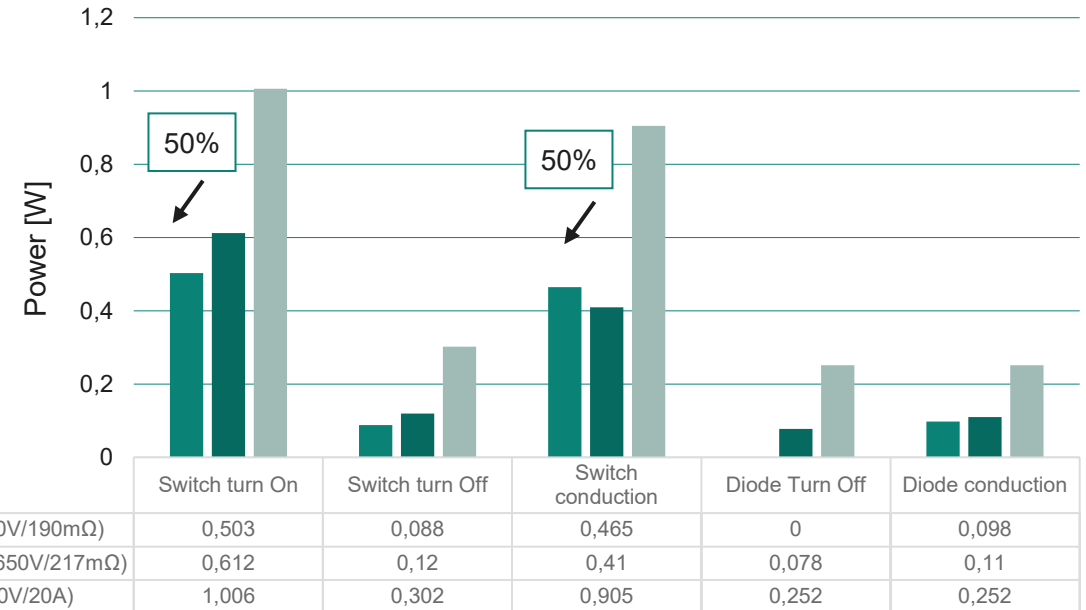
Wide Bandgap has significant > 50% less power dissipation advantage over Si solutions (IGBT)

CoolSiC™ vs CoolGaN™ Vs IGBT



*Washing machine example

Power loss comparison @ 600 W



Wide Bandgap solution has significantly better power dissipation that can be leveraged to:

- Get significantly more output power out of the same thermal system
- Shrink the power stage → miniaturization
- Removing the heatsink
- Meet new efficiency regulations

Table of contents



1	Application scope and market trends	3
2	Infineon's solution offering	9
	Inverter and PFC	13
	Discrete solutions	14
	Gate driver solutions	17
	Power modules	22
	Auxiliary power	26
	Motor control	28
	Wide Bandgap	35
3	Smart HVAC	38
4	Key take-aways	59



Holistic sense-compute-connect approach for HVAC indoor unit







Overview






Connect to the Internet for wireless control

Turn on AC on your way home  

Integrate AC in your smart home, e.g., control via Alexa or Smart Phone  

Buy-and-Unlock features from sensor data      


Condition Monitoring

Detect defects before they happen   

Sense environment for intuitive and autonomous use


Is someone in the room?   How are people in the room doing? 

How many people are in the room?  How is the air quality? 

Where are people in the room? 

User interface

Intuitive display to control the entire smart home

Voice control 

Gesture control 

Holistic sense-compute-connect approach for HVAC indoor unit Enablement



Increasing energy cost and climate change

Required cost savings

Enables demand-controlled ventilation in public buildings

Requires:
Sense
Compute
Connect

Decarbonization

Drives increasing legislations and certifications

Requires:
Sense
Compute
Connect



Data-driven business models

Smart sensing

Room occupancy data can be deduced from CO2 data leading to optimized space management

Requires:
Sense
Compute
Connect

Monetization

Buy-and-unlock peripherals over air based on local data (e.g., air quality-based fan control)

Requires:
Sense
Compute
Connect

Health & well-being

Health

COVID and flu prevention in public places (school, administrations, offices, etc)

Requires:
Sense

Well-Being

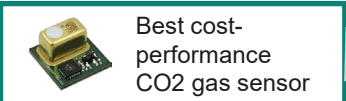
Avoid discomfort and dizziness, improve attention by optimized CO2 levels

Requires:
Sense

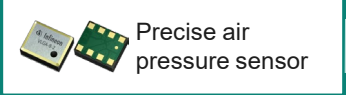
XENSIV™ IoT portfolio that matches indoor HVAC sensing trends

Smart sense

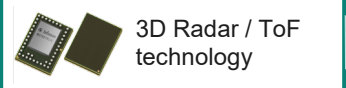
“Monitor Air for demand-controlled ventilation”



“Monitor & Control air flow for comfort”



“Adjust fan based on user positioning”



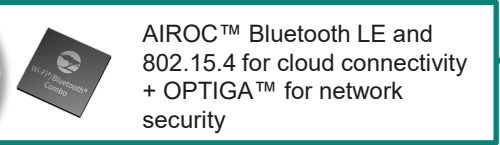
“Voice control to turn on the AC”



Compute

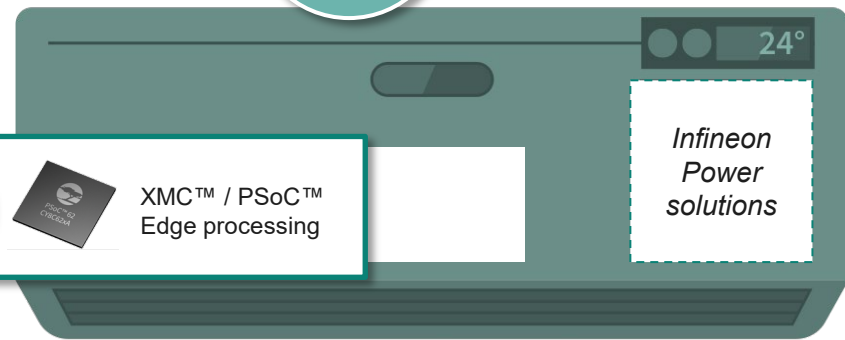


Connect



Connected sensing & monetization

- Buy-and-unlock peripherals over air (e.g. air quality based fan control)
- Smart home / IoT interoperability (e.g. Handheld control, outdoor air flow control, etc.)
- Remote monitoring and event management (e.g. Building management)
- Over-The-Air updates (new algos or comfort scenes)
- Dashboard, historical data and trend analysis
- Sensor-fusion and Machine Learning for Predictive Maintenance and optimized OEE*



Increase well-being



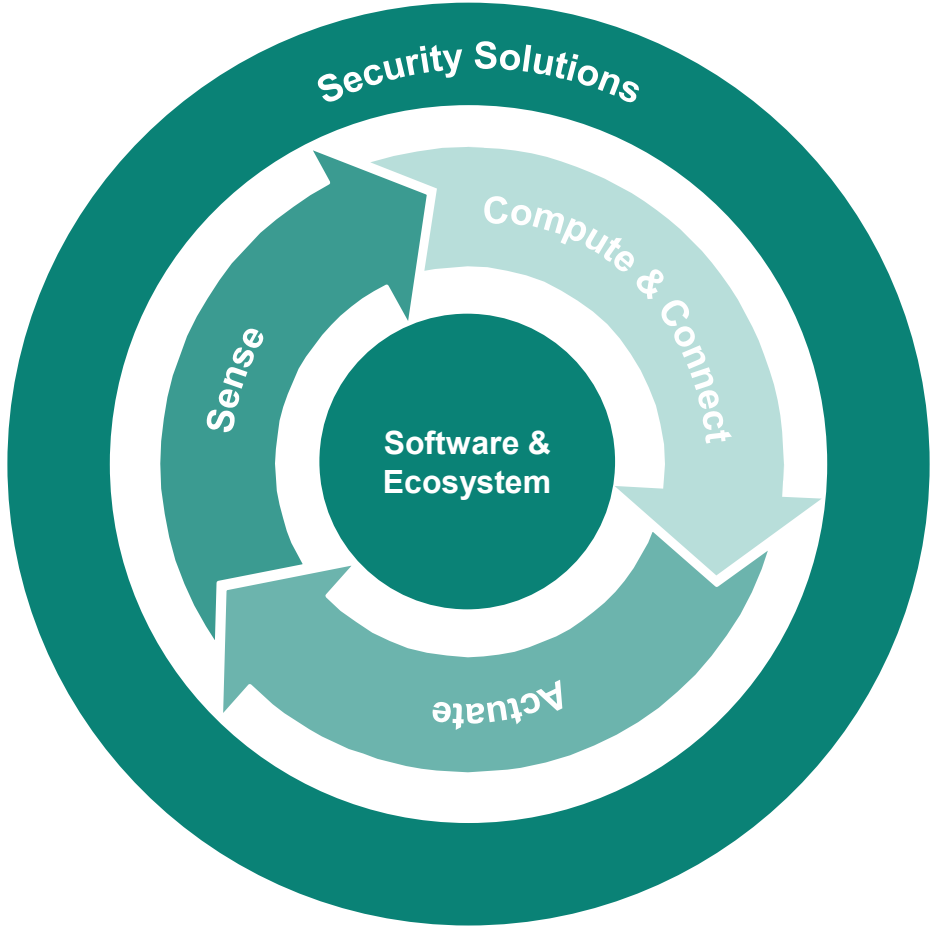
Reduce energy cost



Data-driven business models

OEE = Operational Efficiency of Equipment

Infineon at the core of IoT



Sense	Broad XENSIV™ sensor portfolio
Compute & Connect	PSoC™ and XMC™ microcontrollers and WiFi/BT/USB solutions for embedded applications
Actuate	Power semiconductors enable actuation in end products
Security Solutions	OPTIGA™ and CIRRENT™ Cloud ID: device-to-cloud authentication and robust protection for IoT devices
Software & Ecosystem	ModusToolbox™ Software supports a wide range of Infineon microcontrollers and connectivity solutions

XENSIV™ radar selected target applications

Smart thermostats and displays



- Activation by proximity sensing
- Enhance booting time & user experience
- Support gesture control

Smart lighting systems



- Activate only where people are located
- Indoor & Outdoor
- Higher sensitivity than PIR sensors

Room air conditioners



- Turn on & off devices based on presence & vacancy detection
- Steer airflow away from people's position

Security systems incl. cameras



- Start camera & recording only by movements inside the covered area
- Reduce number of false alarms

Laptops and monitors



- Turn off/ Reduce brightness by absence detection
- Increased battery lifetime
- Lock the screen to protect data

TVs

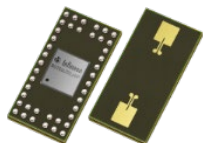


- Turn off screen by absence detection
- Pause & resume streaming content based on presence & absence

XENSIV™ 60 GHz and 24 GHz radar sensor portfolio

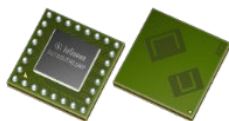
60GHz

1Tx / 1Rx



6.7 x 3.3 mm²

BGT60LTR11AIP
Doppler Radar
Antenna-in-Package

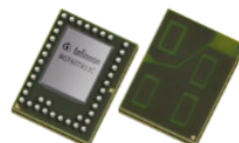


4.05 x 4.05 mm²

BGT60UTR11AIP
FMCW Radar
Antenna-in-Package

Q3/2023

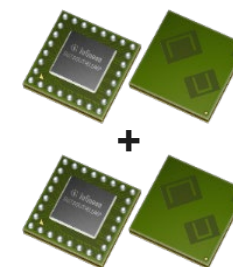
1Tx / 3Rx



5 x 6.5 mm²

BGT60TR13C
FMCW Radar
Antenna-in-Package

2Tx / 2Rx



**Cascading
BGT60UTR11AIP**

Q3/2023

2Tx / 4Rx

Automotive



6 x 6 mm²

BGT60ATR24C
FMCW Radar
Without Antenna

24GHz

1Tx / 2Rx



2.4 x 2.4 mm

BGT 24LTR11



4.5 x 5.5 mm

BGT 24MTR11



4.5 x 5.5 mm

BGT24MTR12

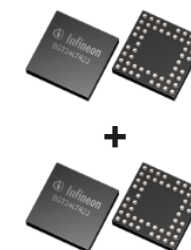


**BGT24MTR11
+ BGT24MR2**



3.6 x 3.6 mm

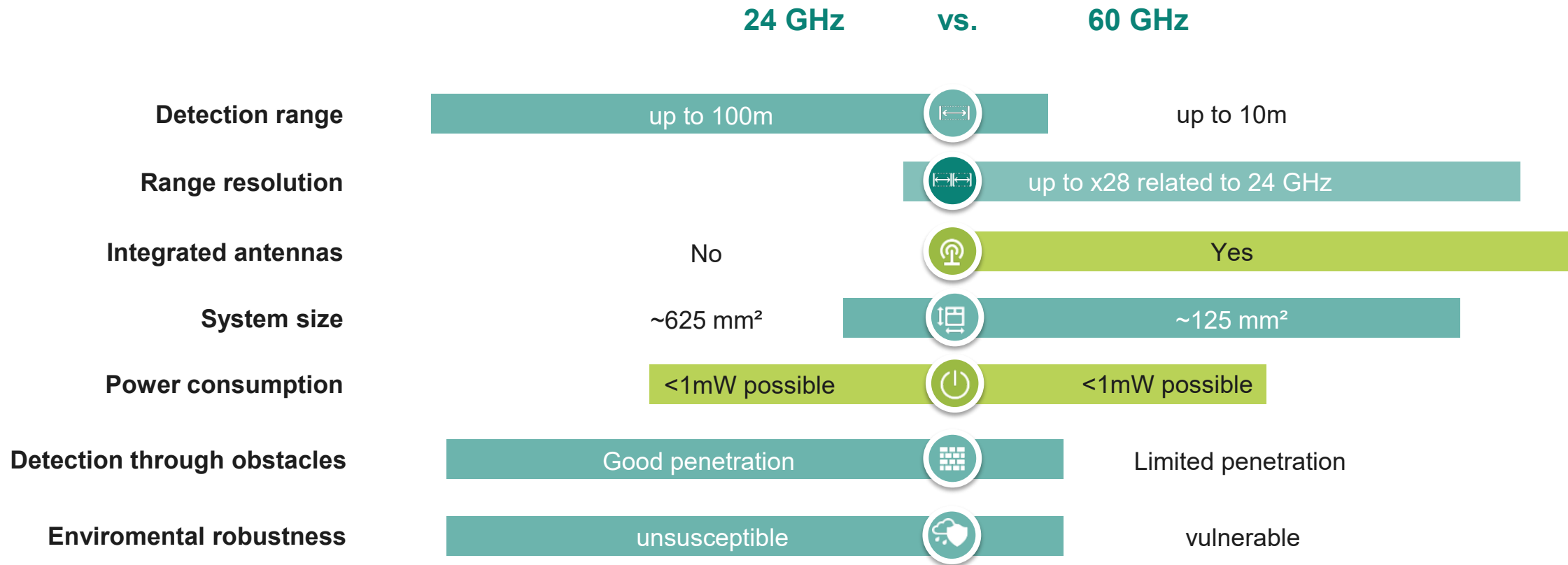
BGT24LTR22



**Cascading
BGT24LTR22**

XENSIV™ radar frequency offerings

● Regulatory aspect
 ● Physical aspect
 ● Product aspect



Infineon offers Doppler and FMCW radar sensors with 24 and 60 GHz

XENSIV™ PAS CO2 selected target applications

HVAC



- Adjust temperature and flow based on air quality in the room

Air quality devices



- Turn on & off based on measured air quality in the room
- Adjust settings based on presence

Consumer Devices



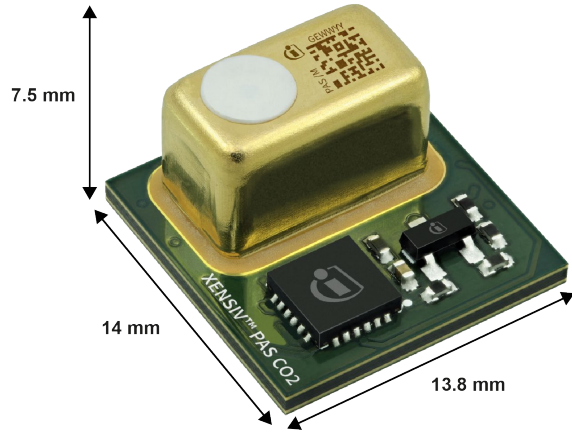
- Indicate air quality via display, voice, or LEDs

Smart home and building appliances



- Turn off screen by absence detection
- Adjust temperature in the room based on presence
- Regulate ventilation based on air quality

Infineon XENSIV™ PAS CO2



Key specifications

XENSIV™ PAS CO2

Operating Mode

Real CO₂ sensor based on Photoacoustic Spectroscopy

Accuracy

High accuracy: +/-30 ppm +/-3 % of reading (up to 5,000 ppm at ambient conditions)

Product lifetime and drift

10 years with < 1 % drift per year with compensation algorithms enabled

Additional Information

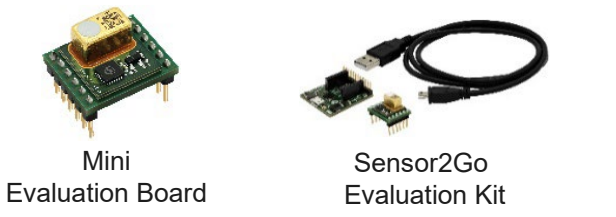
OPN
PASCO2V01BUMA1

Value Proposition and focus applications

- Meeting the accuracy & stability of high-end NDIR CO₂ sensors in a four times smaller size
- Compliance with major standards and regulations for indoor air quality (e.g.: WELL, LEED and ASHRAE 62.1)
- Suitable for high volume standard assembly process

XENSIV™ PAS CO2 evaluation options

Sensor evaluation only



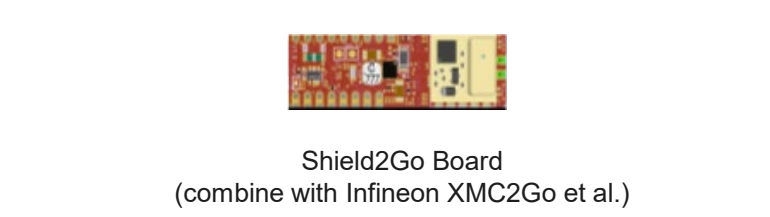
XENSIV™ PAS CO2 Sensor	XENSIV™ PAS CO2 Sensor
------------------------	------------------------

NA	Only USB-UART Bridge
----	----------------------

NA	Fusion GUI
----	------------

Sensor integration in custom prototyping	Visualization of sensor data on local PC
--	--

Sensor evaluation with Arduino platform



XENSIV™ PAS CO2 Sensor	+	XMC1100 ToGo
Compatible with Infineon My IoT Adapter Boards for Arduino & Raspberry Pi		

Arduino library ready

Standard sensor prototyping set-up	Connect to Cypress WiFi/BLE via IoT Adapter Board	<u>CYW920835M2EVB-01 Connectivity kit Cypress</u> or <u>CYW920719B2Q40EVB-01 Connectivity kit Cypress</u>
------------------------------------	---	---

Infineon Prototyping Sensor System



XENSIV™ PAS CO2 + DPS368 Sensors
Controller: PSoC™ 62
Connectivity: WiFi, BLE
Security: OPTIGA™ Trust M

Code examples and Libraries in Modus Toolbox®	Infineon sensor cloud GUI with one year sensor evaluation experience
---	--

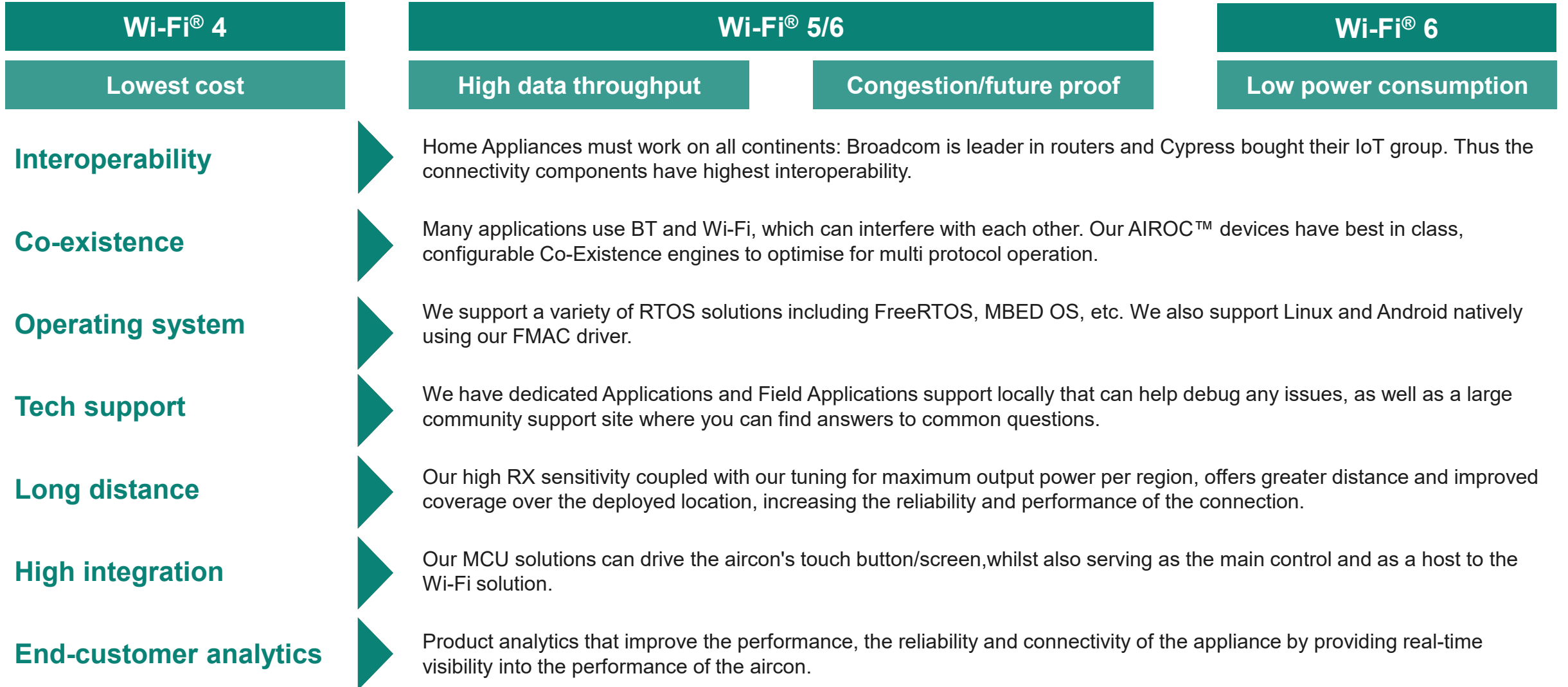
Rapid IoT System Prototyping incl. sense, compute, connect, secure.	Visualization of sensor data in cloud UX dashboard
--	--

Modularity level

SW & tools

Evaluation scope

Value proposition AIROC™ connectivity solutions



Value proposition of individual AIROC™ products

Wi-Fi® 4	Wi-Fi® 5/6		Wi-Fi® 6
Lowest cost	High data throughput	Congestion/future proof	Low power consumption
Wi-Fi® 4: CYW43439	Wi-Fi® 5 (11AC): CYW4373/E	Wi-Fi® 6/5G: CYW55571/2/3	
<ul style="list-style-type: none"> – Unique home appliances solution offering Wi-Fi® 4, Bluetooth® 5 and WPA 3 allowing smart home certification (WFA certificate) 	<ul style="list-style-type: none"> – Wi-Fi® 5 dual band (2.4 GHz and 5 GHz) – Capable of beam-forming for increased range – External PA (E-version) on module also increasing range 	<ul style="list-style-type: none"> – Tri-band, (2.4 GHz, 5 GHz, 6 GHz) – Target wake time (TWT): Today router is master, but it allows end device to negotiate with the router when to wake up – Higher modulation schemes: Even higher data through-put 	

AIROC™ selection guide

Type	Wi-Fi®		Wi-Fi® + Bluetooth®	BT only	BT (BLE) in µC
µC	Integrated processor	External host	External host	Integrated processor	Integrated processor
SW	Library/Modus Toolbox	Drivers for all major µC available	Drivers for all major µC available	SDK	SDK
Products and functions	Wi-Fi® 4: CYW43907	CYW43364	Wi-Fi® 4: CYW43438/9 – WPA3 security – Voice command	BT 5.0: CYW20735	
	Wi-Fi® 5: CYW54907		Wi-Fi® 4: CYW43012 – Low Power Wi-Fi® + Bluetooth®	BT5.2: CYW20829	
			Wi-Fi® 5: CYW4373/E – Audio/Video Transfer		PSoC™ 63xx – M0+ and M4 – Capsense – Motor Control – Main Control
			Wi-Fi® 6/5G: CYW55572 – Audio/Video Transfer		

Touch control: Implement touch with the leading provider of touch solutions



Remote control



Indoor unit



Thermostat

- 1 Replace mechanical buttons with the world's easiest touch solution
- 2 Complex touch HMI interfaces in single MCU platform
- 3 Dual-core high performance touch solution with IoT edge compute capabilities

MBR3 – configurable touch controllers

PSoC™ 4 touch controllers

PSoC™ 6 touch controllers

Why use Infineon touch solutions in your aircon system?

Proven

- #1 provider of touch solutions for many years

Most robust solution

- Water tolerance – Even works with wet fingers
- Works in the noisiest environments

Most sensitive solution

- Appliances usually have thick plastic overlays. The sensitivity of our solution allows you to sense more accurately than any other solution out there.

Ease of integration

- The SmartSense tool helps you to layout your PCB. It will sense the size and the capacitance of buttons to make implementation easy. No more need for tuning

Touch on metal

- The inductive sensing (MagSense™) technology enables sensing of metal objects (e.g. proximity) . A single chip to support hybrid sensing advanced HMI.

High integration

- We offer a wide variety of integrated features such as wired and wireless connectivity, audio and additional compute capabilities for IoT edge

Main security concerns for our customers



Identity protection against fake devices



Protection against eaves dropping



Protection against the manipulation of the data



Protection against illegal update of firmware



Improved smart HVAC system security

Value proposition OPTIGA™ Trust family in aircon systems

Shorter time to market

- By using Infineon's PKI* infrastructure including root CA and HSM infrastructure certificate authorities you can drastically reduce your cost and effort for your smart air con system.

Cost reduction

- With Infineon's OPTIGA™ Trust solution you are able to make use of a one-stop-shop turnkey solution which perfectly matches future requirements of smart air con systems.

Zero touch provisioning

- With Infineon's optimized processes you get the ability for easy certificate-based device registration to all major cloud service providers. It is an automated cloud provisioning of your smart air con without your involvement.

Protection

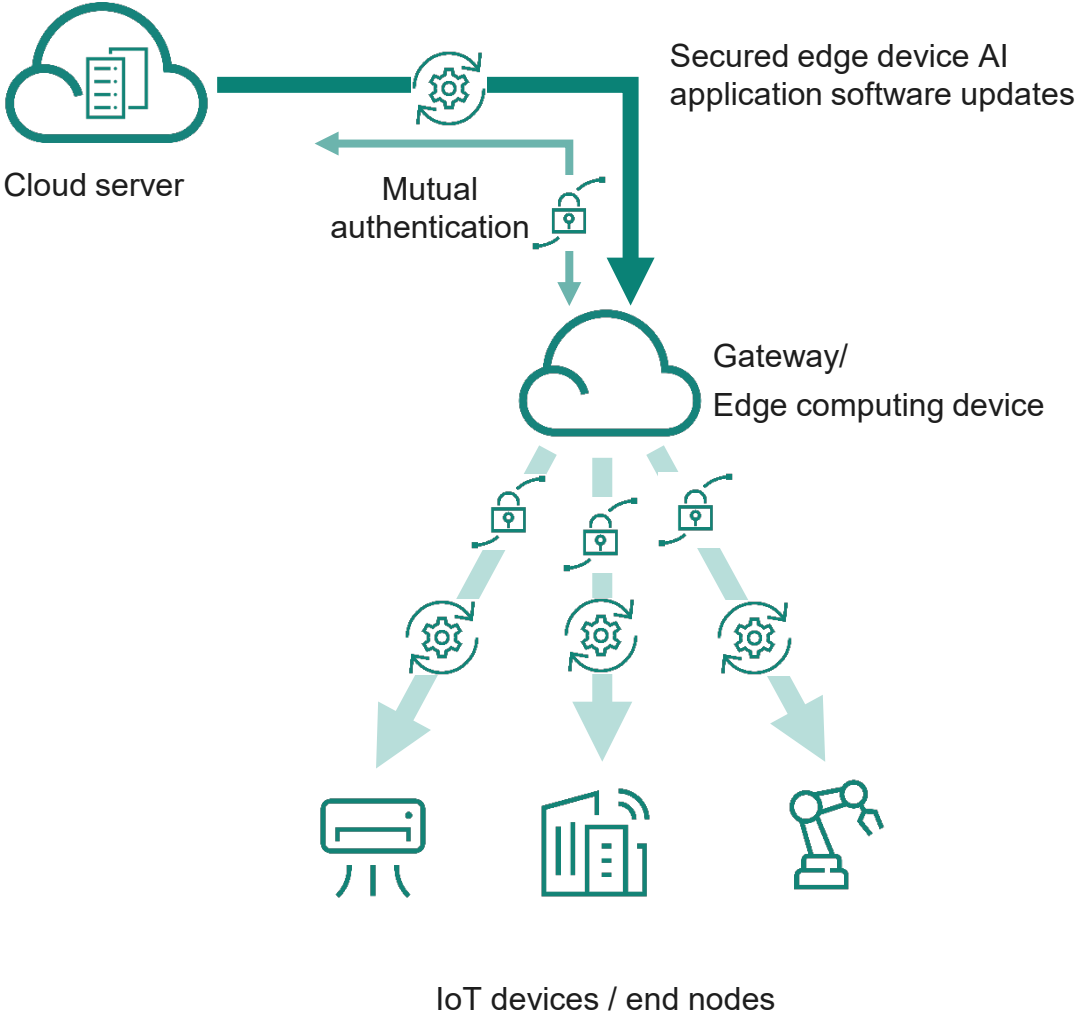
- Infineon's OPTIGA™ Trust family provides an anchor of trust for connecting your smart air con device to the cloud, protects your critical data transferred over your network and thus your application running on your smart air con.

Future proven

- As the #1 supplier in embedded secure elements, we are able to professionally solve our customers' biggest problems and concerns even in difficult security relevant areas like industry or automotive.

*) PKI = Public Key Infrastructure

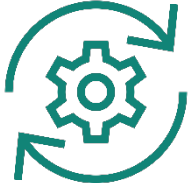
OPTIGA™ Trust M – Protecting the IoT from cloud to end nodes



Secured connectivity



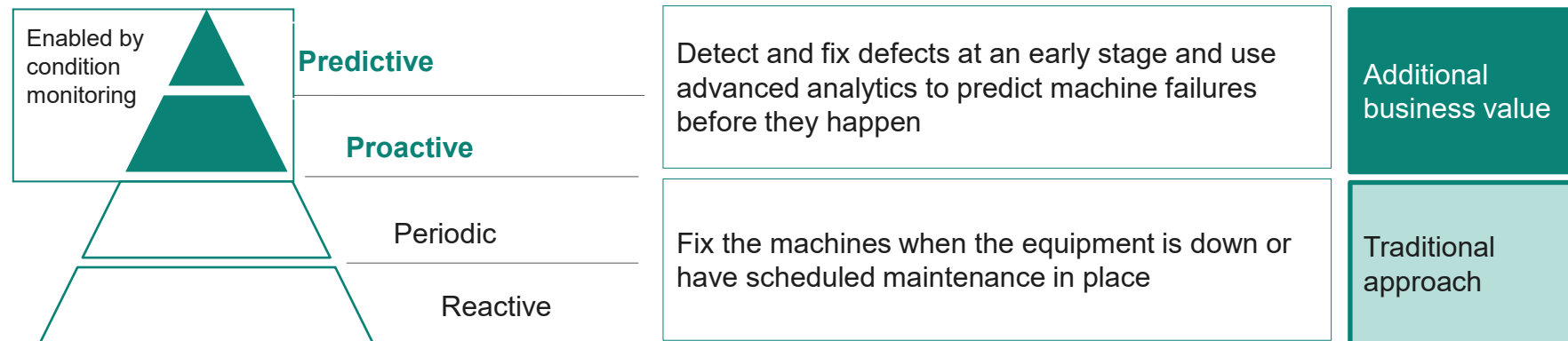
Secured cloud authentication



Secured software update over-the-air

Condition monitoring and predictive maintenance

Predictive maintenance can help **prevent failures** before they happen by **monitoring a device's condition**.



Infineon offering

XENSIV™ DPS368 Barometric Pressure Sensor	– Air flow measurement in the system	XENSIV™ PAS CO2 Sensor	– CO ₂ level monitoring for indoor quality monitoring
XENSIV™ TLI4971 Current Sensor	– Current measurement at fan and compressor	XENSIV™ IM69D130 MEMS Microphone	– Noise monitoring at motor and compressor
XENSIV™ TLI493D-W2BW 3D Magnetic Sensor	– Position monitoring of components	PSoC™ 6, PSoC™ 4, XMC4000	– Data processing and system management
XENSIV™ TLx496x Hall Sensors	– Open/close lid detection	OPTIGA™ Trust M	– Secured connection & communication
XENSIV™ TLI4966G Double Hall Sensor	– Speed & direction monitoring of components	Wi-Fi® and Bluetooth Combo controller	– Connectivity for remote management
XENSIV™ TLE4997E2 Linear Hall Sensor	– Linear movement and vibration		

UV-C LEDs can eliminate bacteria and viruses to equip air conditioners with air purification functions



- UV-C LEDs sterilize airborne contaminants such as bacteria and viruses by disinfecting the surface of the evaporator
- Infineon offers the optimal LED driver ICs for UV-C LEDs

Value proposition

- Constant current enables **homogenous light** output
- Controlling the UV-C LED current ensures **long lifetime** of the UV-C LEDs and the entire product
- Current reduction at increasing ambient or UV-C LED temperature enhances the **reliability** of the UV-C LED product
- Compared to discrete constant current circuits BCR ensures a pretested **easy to use** and cost-effective device
- Best solution for space-constrained UV-C LED applications
- Best solution to drive multiple UV-C LEDs



Table of contents

1	Application scope and market trends	3
2	Infineon's solution offering	9
	Inverter and PFC	13
	Discrete solutions	14
	Gate driver solutions	17
	Power modules	22
	Auxiliary power	26
	Motor control	28
	Wide Bandgap	35
3	Smart HVAC	38
4	Key take-aways	59

Infineon's value proposition for commercial HVAC



Infineon's very complete system solutions for Commercial HVAC systems support designs that are **energy efficient**, **reliable**, and fully **connected**, for improved end-customer experience. Smart HVAC systems are integrated with new features and **secured connectivity**, and new sense-enabled use cases, accessible through **complete documentation** and a **global support** structure for hardware and firmware design.

Secured and connected

- **Wide range of secure products**
OPTIGA™ Trust family of security solutions is designed for easy integration into embedded systems to protect the confidentiality, integrity and authenticity of information and devices.
- **High Integration MCUs:**
PSoC™ 6 integrates HMI, system control and Connectivity HOST on a single chip
- **Connectivity with AIROC™ Wi-Fi® & combos and AIROC™ Bluetooth®:**
Widely-deployed Wi-Fi® and Bluetooth® combo ICs that offer the industry's best interoperability and RF performance.

Innovative and reliable

- **Sense-enabled use cases:**
Wide set of sensors with high accuracy for enablement of innovative use cases (e.g., zoning, condition monitoring & predictive maintenance, voice control) and constant development of new technologies (CO₂ sensor, radar)
- **Reliability:**
Decades of field proven reliability for power semiconductors
- **Design support:**
Ecosystem of proven partners for design-in support to shorten development times

Easy to use

- **Complete solutions with off-the-shelf evaluation and prototyping tools**
A complete eco-system of simulations, documentation, and demonstration boards enable a faster time to market
- **Reduced cost:**
Much lower R&D efforts at the customer, combined with easy-to-use examples of new, innovative functionality
- **Application experience and deep technical knowledge**
Highly experienced global application engineering team for all steps from design through manufacturing

More info on

[Infineon.com/C-HVAC](https://www.infineon.com/C-HVAC)



