



Application presentation on Commercial Heating, Ventilation and Air Conditioning (C-HVAC)

November 2021



High level definition of Commercial HVAC

Commercial HVAC systems, serving power ranges from 3 kW to 75 kW, 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.

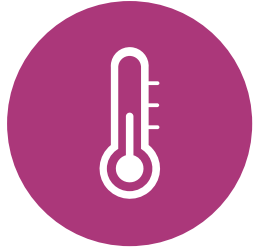


Key market trends and drivers



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).



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

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



COVID19 impact

Commercial shutdowns and disruptions of construction projects affect demand (but: ad hoc demand by hospitals offset the negative impact of disruptions).

New trends change the business model

Machine builders developing their own VFD

- › Machine builders are likely to shape the future outlook for the low-voltage drives market in commercial HVAC applications. By developing their own variable-frequency drive (VFD) technology that meets the latest legislative standards, they will compete with comparable drives from more established drive suppliers.



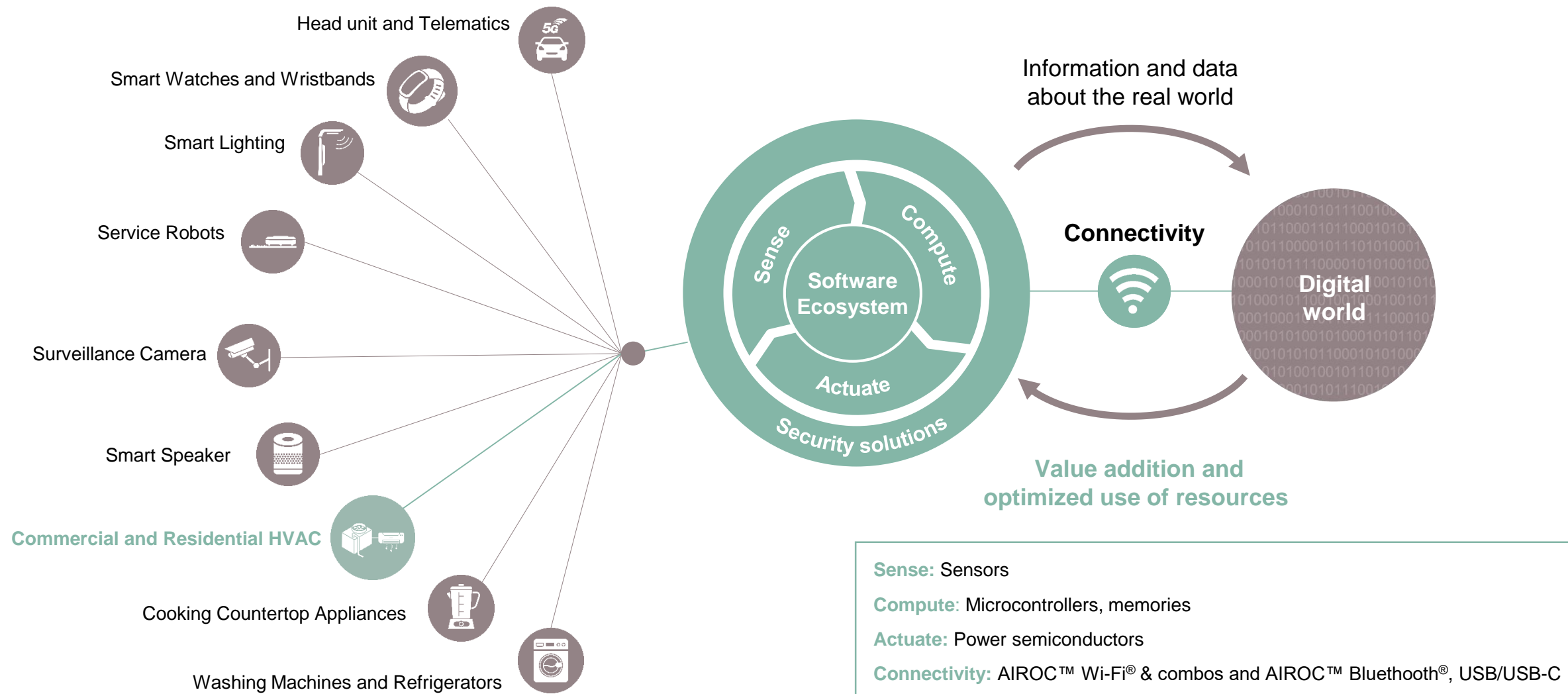
Connectivity and security trend

- › For system operators predictive maintenance of highest interest
- › For end users platform independent control (e.g. smart home)

Energy efficiency as worldwide trend

- › US: New standard for furnace fan efficiency will force many suppliers to reduce their product's wattage requirements drastically
- › Greater China: Standards and regulations in place

Benefit from Infineon's focus on IoT and its broad portfolio



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.

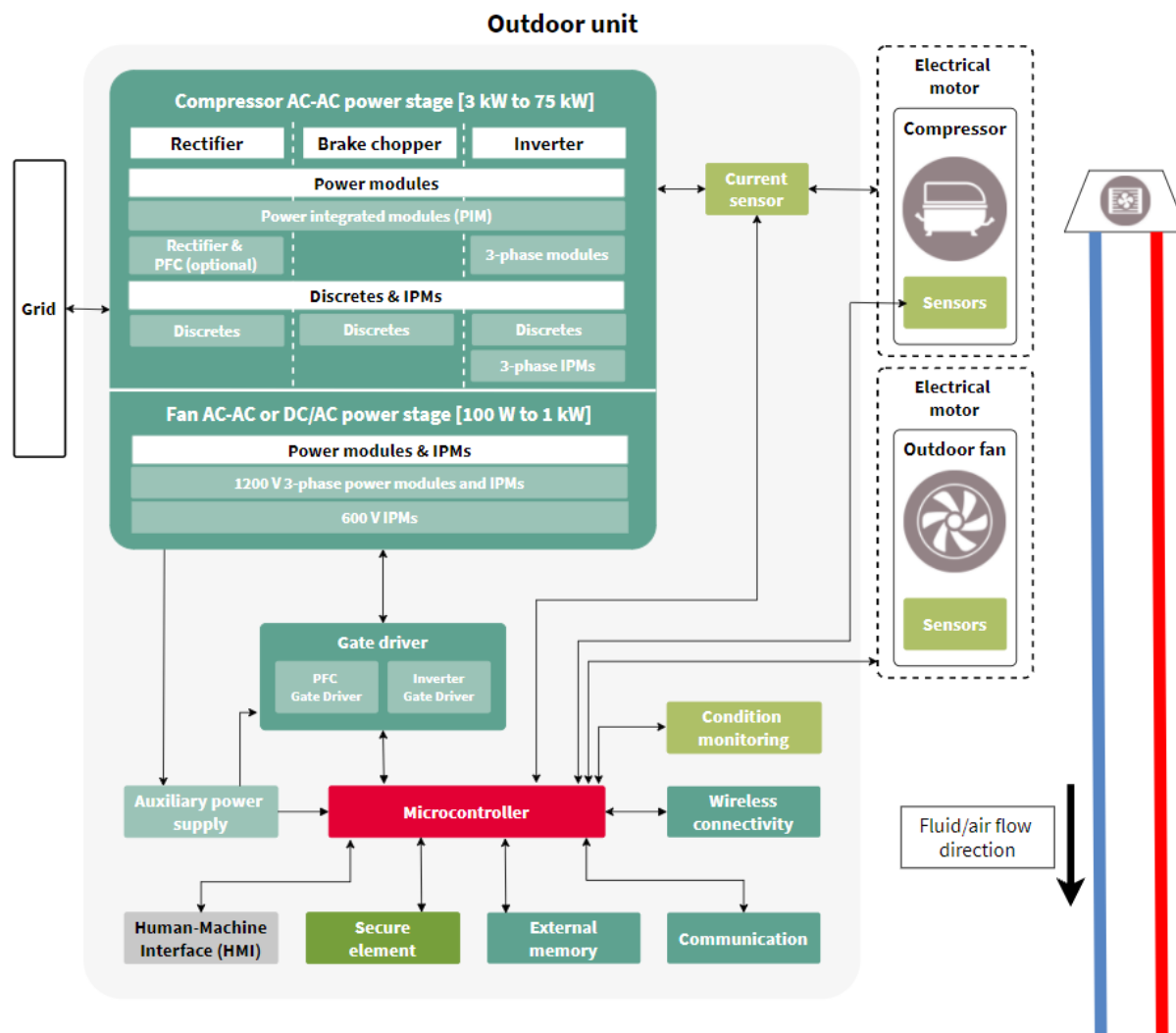
Innovative & reliable

- › **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

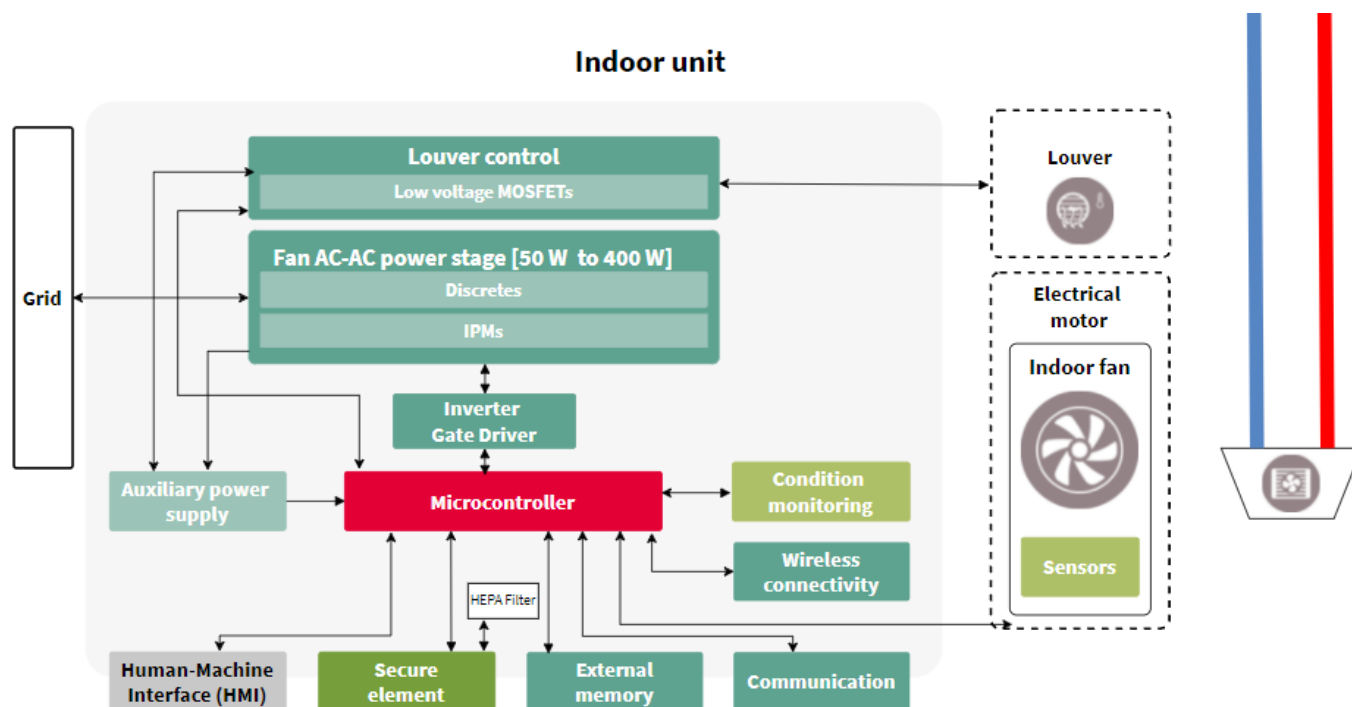
Easy to Use

- › **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

System block diagram – Outdoor unit



System block diagram – Indoor unit



Infineon's comprehensive product range for C-HVAC applications

Energy efficiency

System and motor control

- › XMC™
- › iMOTION™ motor control

Power stage

- › Easy Power Modules
- › EconoPIM™ 2/3
- › IGBT Discretes
- › Intelligent Power Modules (IPM)
- › EiceDRIVER™ for SiC MOSFETs
- › Gate Driver ICs for IGBTs

Technologies

- › CoolSiC™
- › TRENCHSTOP™ IGBT7
- › Advanced H2S protection

Reliability

Condition monitoring

- › Sensor fusion reference solution with cloud connectivity
- › MEMS microphones
- › PAS CO₂ Sensor

Communication

- › XMC4300
- › Isolated industrial interface
- › HMI

Memory

- › SEMPER™ NOR Flash
- › SEMPER™ Secure
- › SPI NOR Flash
- › EXCELON™ F-RAM
- › nvSRAM
- › Fast Async SRAM
- › MOBL™ SRAM
- › HYPERRAM™

Sensors

- › Magnetic sensors
- › Integrated shunts
- › Current sensors for automotive and industrial

Connectivity

Security

- › OPTIGA™ Connect - easy, flexible and secured cellular IoT connectivity
- › Authentication: OPTIGA™ Trust B
- › Secured communication / secured host firmware update OPTIGA™ Trust M

Wireless

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

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

EiceDRIVER™ Compact family gate driver ICs

Key features		Benefits
Robustness and Reliability	Based on coreless transformer (CT) technology, enabling 200 kV/μs CMTI; reinforced isolation with VDE-11, 2300 V functional isolation	Enables reliable and robust systems in harsh environment
Cost optimization	Output current up to 14 A, in small cost-effective DSO-8 package, no need of booster, prefect for IGBT7 and CoolSiC™	Space-saving integration into device
Performance	Best in class propagation delay matching, with shorter deadtime and better accuracy	Improved efficiency and lower operating temperature
Protection	Miller clamp to protect against parasitic turn-on; slew rate control to reduce EMI & switching losses	Protect power switch and improve EMI performance
Ease of use	Small DSO-8 package with basic functionality, easy to design, fast time to market	Fast time to market with compact design

EiceDRIVER™ Enhanced family gate driver ICs

Key features

Benefits

Robustness and Reliability

Based on coreless transformer (CT) technology, enabling 200 kV/μs CMTI; reinforced isolation with VDE-11, 2300 V functional isolation

Enables reliable and robust systems in **harsh environment**

Flexibility

X3 Analog / Digital offers resistor- / I2C-configurability. Configurable UVLO, DESAT², Soft-off, Miller clamp, thermal monitoring

Rapid prototyping and **predictive maintenance**

Performance

Best in class propagation delay matching, with shorter deadtime and better accuracy. High output current up to 9 A

Improved efficiency and lower operating temperature

Protection

Best in class DESAT, Miller clamp and Soft-off protection feature, simplify the design of highly reliable systems

Protect power **switch** and improve **system safety**

Ease of use

Integrated protection feature in small package, easy to design

Fast time to market with **safe design**

SOI 1200 V EiceDRIVER™ gate driver ICs

Key features		Benefits
Robustness and Reliability	Operating voltages up to +1200 V Superior negative V_S transient voltage immunity of 100 V	Enables reliable and robust systems in harsh environment
Cost optimization	Ultra-fast reverse recovery and low R_{ON} integrated boot-strap diode	Space-saving integration into device
Performance	Reduced level-shift losses and reduced parasitic in high frequency applications	Improved efficiency and lower operating temperature
Protection	Integrated protection features (under-voltage lock-out protection, shoot through prevention logic , accurate and fast over-current protection and fault repotting)	Protect power switch against external fault
Ease of use	EVAL-M1-6ED2230-B1 (6ED2230S12T and EasyPIM™) enables fast design to production release with first PCB design vs. opto which would take 3 to 4 PCB spins	Fast time to market with compact design

SEMPER™ NOR Flash memory platform

	Key features		Benefits
Reliability	Infineon endurance flex architecture with 1+ million program/erase cycles and 25 years data retention.	▶	Utmost reliability and safety for harsh environment operation
Performance	JEDEC standard xSPI interfaces up to 400 MB/s read bandwidth and Quad SPI interface up to 102 MB/s	▶	Advanced capabilities for and datalogging and predictive maintenance
Easy to use	Broad support from chipsets and ecosystem partners Semper SDK provides production-grade drivers	▶	Fast time-to-market for innovative new designs
Long term	>10yr product longevity backed by long-term commitment to NOR. Market broadest portfolio with 35 years of experience	▶	Long term commitment and technology investment
Scalability	Density range from 256 Mb to 4 Gb, supporting 1.8 V and 3 V interfaces, with scalable feature set	▶	Code and data size changes without re-design

EXCELON™ F-RAM memory family

Key features

Benefits

Instant non-volatility

Instantly capture critical event data

Ideal data-logger for diagnostics and recovery

Reliability

Virtually unlimited endurance and long data-retention over automotive temperatures

Reliable data-logger for long product lifespan

Functional safety

ISO26262 ASIL-B functional safety compliant

Dependability for safety systems

Performance

Industry leading SPI/QSPI performance with no write delays

High throughput for continuous data-logging

Scalability

Industry's broadest product portfolio with flexible architecture for value-added solutions

Scalability optimizes **time to market** and **variant costs**

HYPERRAM™ 2.0

Key features		Benefits
Flexibility	Offers both HyperBus and Octal SPI interfaces	Flexibility enables multiple chipset options
Low-pin-count	12-pins interface vs. 40+ pins for parallel interface solutions	Reduces chipset pin-count required to interface with memory
Compatibility	Compatible with NOR flash HyperBus interface	Enables a shared bus to further reduce pin-count
Small footprint	Offers a small FBGA package vs. larger packages for parallel interface solutions	Reduces PCB area
Performance	Industry leading HyperBus/Octal SPI performance	High throughput for expansion memory

Non-volatile Static Random-Access Memory (nvSRAM)

Key features

Benefits

Instant non-volatility

Retain data Instantly on power-loss or system shutdown

Ideal data-logger for mission-critical system data

Reliability

Unlimited read/write endurance, Data retention of 20 years, 1 million STORE cycles on power-loss and eliminates battery for power back-up

Reliable data-logger for long product lifespan

Performance

Industry fastest parallel nonvolatile RAM solutions with access time as low as 20 ns

High throughput for mission-critical data-logging

Scalability

Density range from 256 Kb to 16 Mb, supporting 3 V and 5 V interfaces, with common feature set

Scalability optimizes **time to market and variant costs**

Asynchronous Static Random-Access Memory (Async SRAMs)

Key features

Benefits

Versatility

Broadest portfolio of Fast and Micropower (MoBL[®]) SRAMs with support for multiple operating voltages across densities and speeds

Easy to tune **selection for best performance fit**

Reliability

On-chip error correcting code (ECC) hardware block for single-bit error correction and detection

Reliable data integrity with soft-error rates < 0.1 FIT/Mb

Compatibility

Form-fit-function compatible with older generation asynchronous SRAMs

Improves system reliability **without PCB re-design**

Dependability

Long-term product availability and support for up to 20 years, with flexible manufacturing initiatives to meet delivery commitments

Shorter lead times and on-time delivery

Low energy consumption

Industry-leading standby current specifications (I_{SB2}) with $\leq 6.5\mu A$ for 8Mb SRAMs and $\leq 8.0\mu A$ for 16Mb SRAMs at 85°C and

Longer battery life and improved product costs

AIROC™ Wi-Fi & Combos and AIROC™ Bluetooth®

Key features	Benefits
Interoperability Unparalleled industry-leading interoperability with infrastructure devices and smartphones	Best end-customer experience
Best RF performance Tx power and Rx sensitivity that surpasses that of competing devices, often by > 1dB	Longer range and more stable connections
Multiple performance options Range of devices from Wi-Fi® 4 to Wi-Fi® 6 2.4 GHz and 2.4 GHz/5 GHz bands SISO and MIMO	Easy to tune selection for best price/performance
Software support High-quality software support for Linux/Android and portable solution for integration into MCU/RTOS systems	Easy to integrate into CPU and MCU-based host systems
Complete partner ecosystem A global partner ecosystem that enables support and development for your robotics application	Wide selection of 3 rd -party module options and integration support

XENSIV™ MEMS microphones

Key features

Benefits

Performance

Very high performance with exceptionally low distortion level

Optimized speech signal clarity

Manufacturability

Resistant to high temperatures and reflow soldering in an automated PCB assembly process

Assembly on **SMD** production lines

Compatibility

Digital PDM output allows easy system integration with specialized audio DSPs or AURIX™

Easy integration

Compact footprint

Reduced size allows smallest module design and arrays of multiple MEMS microphones

Enable **flexible integration** in a system

MOTIX™ TLE985x H-Bridge MOSFET driver IC product family

	Key features		Benefits
Single chip solution	Single chip solution (MCU, LIN Transceiver, power management & supply, gate drivers) for motor control based on industry-standard Arm® Cortex® M0 and M3 core	➤	High integration help to design more compact solutions
Scalability	Each Embedded product family is scalable in Flash & RAM and TLE987x family offers package scalability (VQFN-48 and TQFP-48)	➤	Scalability allows software re-use and design optimization
Robust EMC behavior	Embedded Power TLE987x family enables EMC tuning via SW & multi-stage gate charge sequencer provides independent control of gates	➤	Re-use of same PCB layout and Bill-of-Material
Grade-0 qualified	Embedded Power support in-cabin and under hood applications (AEC-Q100 Grade 0: ambient temperature up to 150°C) with the same design	➤	Increased output power enables platform designs
Sensor less field oriented control	Embedded Power TLE987x family (Arm® Cortex® M3 based) supports sensor less field oriented control algorithms	➤	Improved motor control efficiency & less noise to tackle NVH problems

XENSIV™ DPS368 air pressure sensors

	Key features		Benefits
Robustness	DPS368 is robust against water (IPx8) ¹ , dust & humidity	➤	Easy operation in harsh environment
Small size	2x2.5x1.1 mm → smallest IPx8 (50 m) certified pressure sensor	➤	Space-saving integration into device
High sensitivity	Precision: ±0.002 hPa (2 cm) Rel. accuracy: ± 0.06 hPa Abs. accuracy: ± 1.0 hPa Fast read-out of pressure change	➤	Precise detection of altitude, activity, air volume, etc.
Excellent temperature stability	Pressure temperature sensitivity: 0.005 hPa / K No hysteresis	➤	No drift over wide temperature range
Low energy consumption	Peak current: 345 µA (pressure measurement) Standby: 0.5 µA (configurable for different use cases) Power consumption @1 Hz readout rate: 1.7 µA	➤	Increased battery lifetime
Hardware Security	The OPTIGA™ Trust product family offers a full range of security chips to address individual needs in the field of embedded authentication and brand protection and further security applications	➤	Secured authentication, communication and FW update

XENSIV™ magnetic position sensors

Key features

Benefits

Flap position



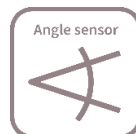
TLE4966-xG

Speed and direction detection in one sensor

TLE496x-xM

Family of Hall switches and latches

Simple, robust and cost efficient



TLE5501

Simple TMR bridge providing sin/cos analog output

Simple analog interface, robust and cost efficient

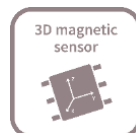
TLE5012B

Easy to use GMR angle sensor providing ready calculated digital angle value, var. interface options (PWM, SPI, SPC, IIF, HSM)

Easy to use, interface flexibility, high accuracy (1° angle error)*

*1° over temp and lifetime with Autocal, 1,9° without Autocal

Control elements



TLE493D-A2B6

Contactless position sensing of a magnetic field for three dimensional movement, 360 degree angle rotation and linear slide movement.

High performance over entire life time – insensitive to dust, abrasion and vibration

XENSIV™ TLI4971 current sensors

Key features

Benefits

Multiple options

The TLI4971 offers **broad flexibility** as many settings can be optimized by customers in the application. Additionally pre-programmed devices are available

8 different variants
120A, 75A, 50A and 25A
(UL and non-UL)

Application range

A **bandwidth of 240 kHz**, the intrinsic linearity and the very low insertion **resistance of 220 $\mu\Omega$** and **low inductance** allows a wide range applications, also GaN and SiC applications

Wide range of applications

Optimized motor control

Stray field robust design with differential measurement of magnetic field allows **accurate in-phase measurement** in harsh environments

Optimized **in-phase** measurement **for motor control**

Cost optimization

Reduced BOM cost due to two integrated OCD (Over-Current Detection) pins with less than 1 μ s reaction time

Reduced system costs due to **less external components**

Robust design

With the **8x8mm power package** a galvanic isolated measurement for **high voltage applications** is possible

Outstanding **small package size** meets **high performance**

OPTIGA™ Trust family – embedded security solutions

	Key features		Benefits
Brand protection	OPTIGA™ Trust B can be used in accessories / consumables to verify that genuine parts are used	➤	Security level
Mutual authentication	OPTIGA™ Trust M can secure multiple secret keys and certificates. It can be used to perform mutual authentication with clouds and other systems	➤	Authenticate with other entities
Secured storage	OPTIGA™ Trust M adopts a common criteria EAL6+ certified hardware trust anchor which offers protection against various physical and reverse-engineering attacks	➤	Protected against extraction techniques
Secured communication	OPTIGA™ Trust M can be used to establish secured communication with a cloud or other service or device	➤	Encrypted communication
Secured firmware update	OPTIGA™ Trust M can be used to cryptographically verify and perform secured firmware updates.	➤	Encrypted firmware updates

Find more information on our application webpage

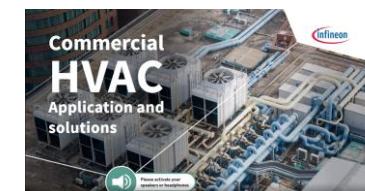
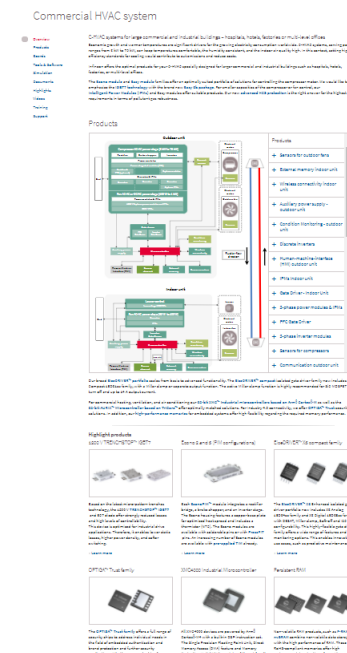


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