

Residential aircon system solution

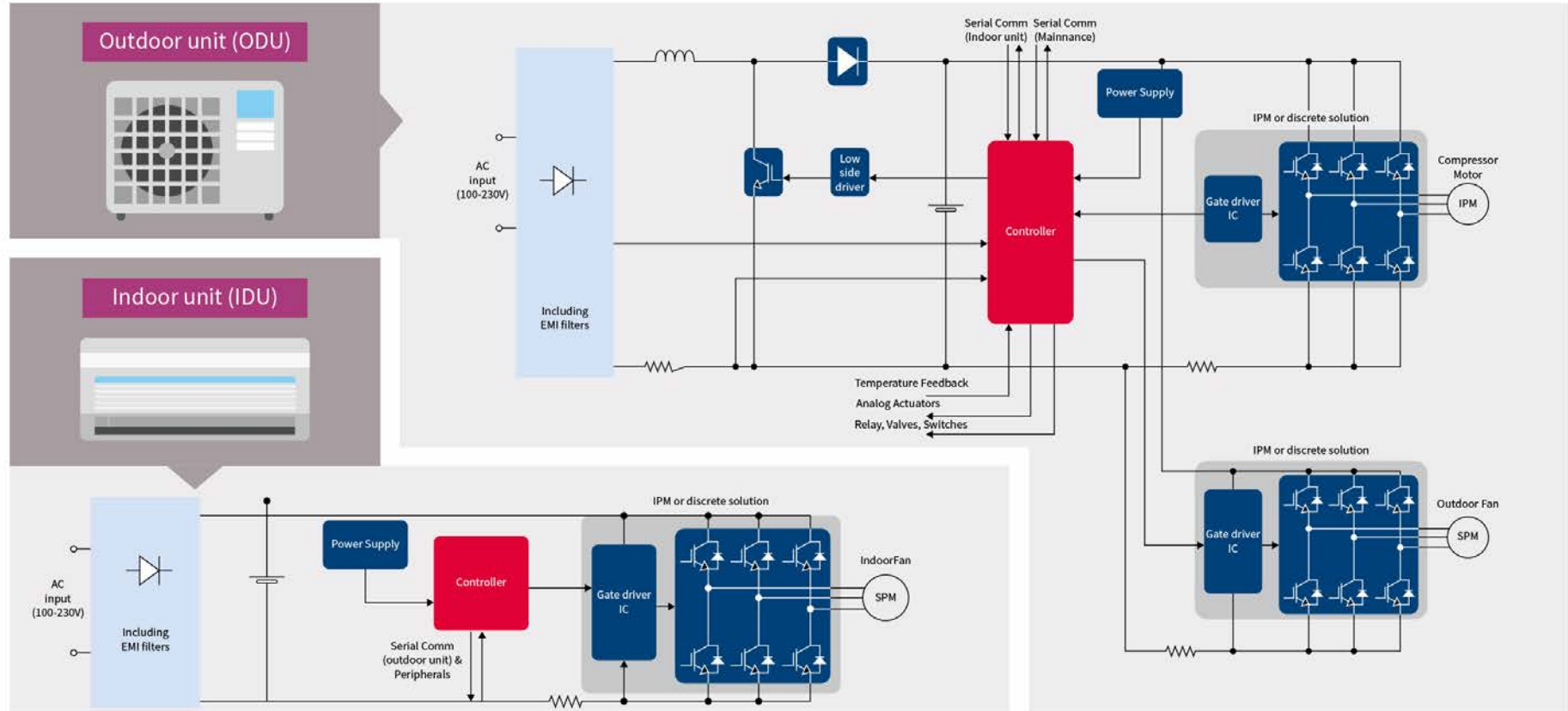


인피니언 전력반도체 솔루션
가상부스에 오신 걸 환영합니다!

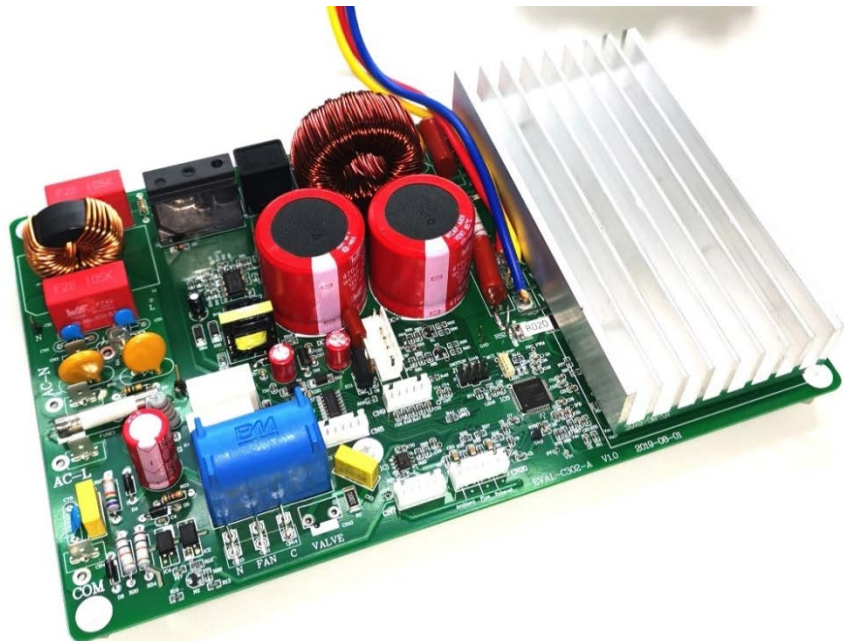


Residential aircon system analysis

Block diagram



Reference board for aircon



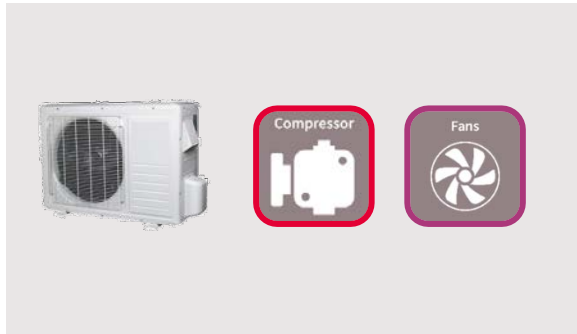
REF-AIRCON_IMC302A_IM564

- › Infineon's latest iMOTION™2.0
- › PFC and compressor control integrated IC
- › High-frequency PFC
- › FOC sensorless PM motor control
- › Low-speed torque compensation
- › 250x137 mm

Infineon parts

- › IMC302A
- › IM564
- › 1ED44175
- › ICE5AR4770

Outdoor unit



Indoor unit



Compressor

- › Main MCU: XMC™ series
- › Inverter: IPM/CIPOS™ MINI
- › PFC: IGBT/H5 series, diode/rapid diodes, gate IC/1ED44176N01F
- › Precise and quick cooling: pressure & temperature sensor combo/DPS422
- › SMPS: CoolSET™/5QR series

AI

- › Voice assistant: Microphone/high-SNR MEMS microphone

HEPA filter

- › Authentication of filter: secure elements match/OPTIGA™ Trust B

Outdoor fan

- › Inverter: IPM/CIPOS™ Micro

Indoor fan

- › Inverter: IPM/smart IPM

Human detection

- › People presence detection, counting, tracking: radar sensor/BTG24xTRxx

Gas sensor

- › CO₂ sensor: PAS CO₂ sensor/real PAS CO₂ sensor module – XMC™, MOSFET, PAS sensor

What is next in air conditioners?

Inverterization → GREEN



Let's go smart

Smart voice recognition



XENSIV™ MEMS microphones +



Smart sensing



Radar sensor:
Human presence detection, tracking



Pressure sensor:
Door open/close detection



Security



WiFi module + OPTIGA™

Security

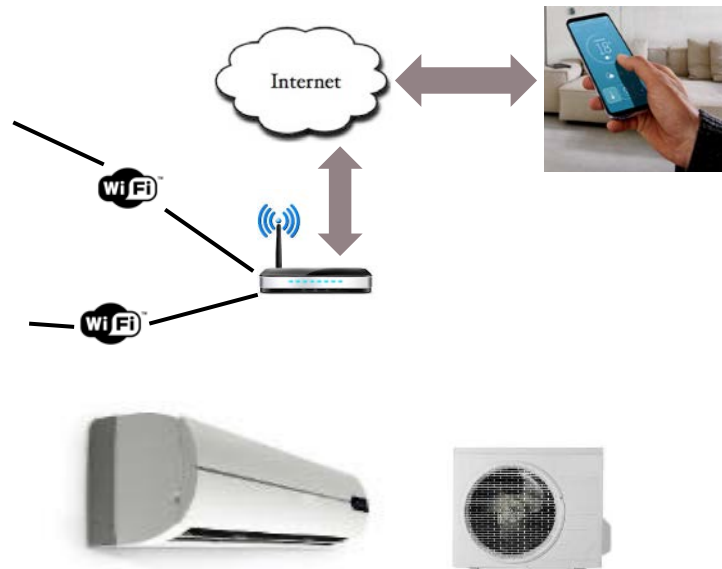


WiFi module + OPTIGA™

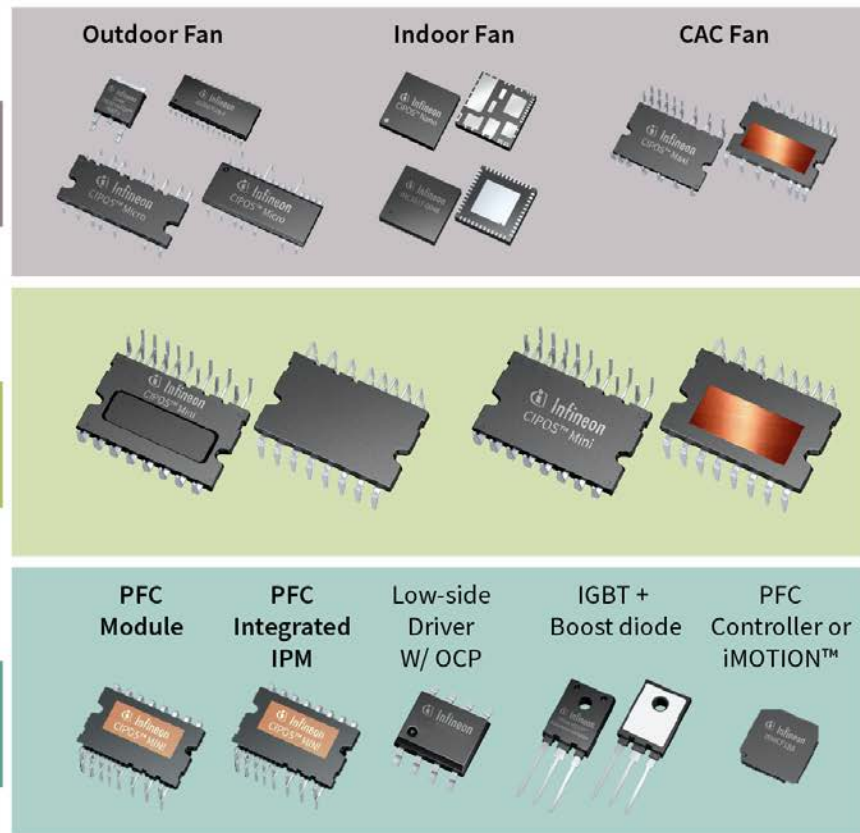
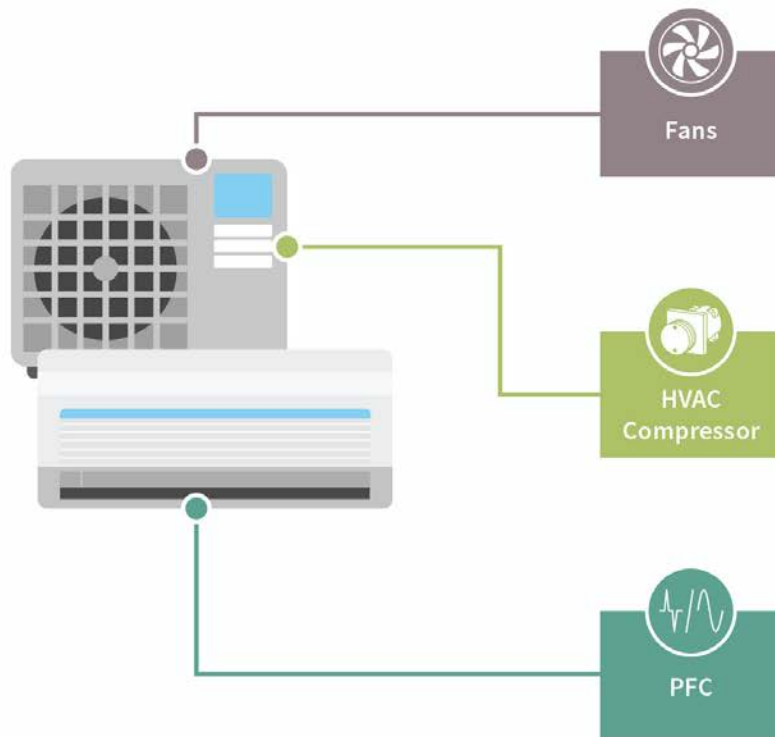
CO₂, PM2.5, VOC: Air quality

connected

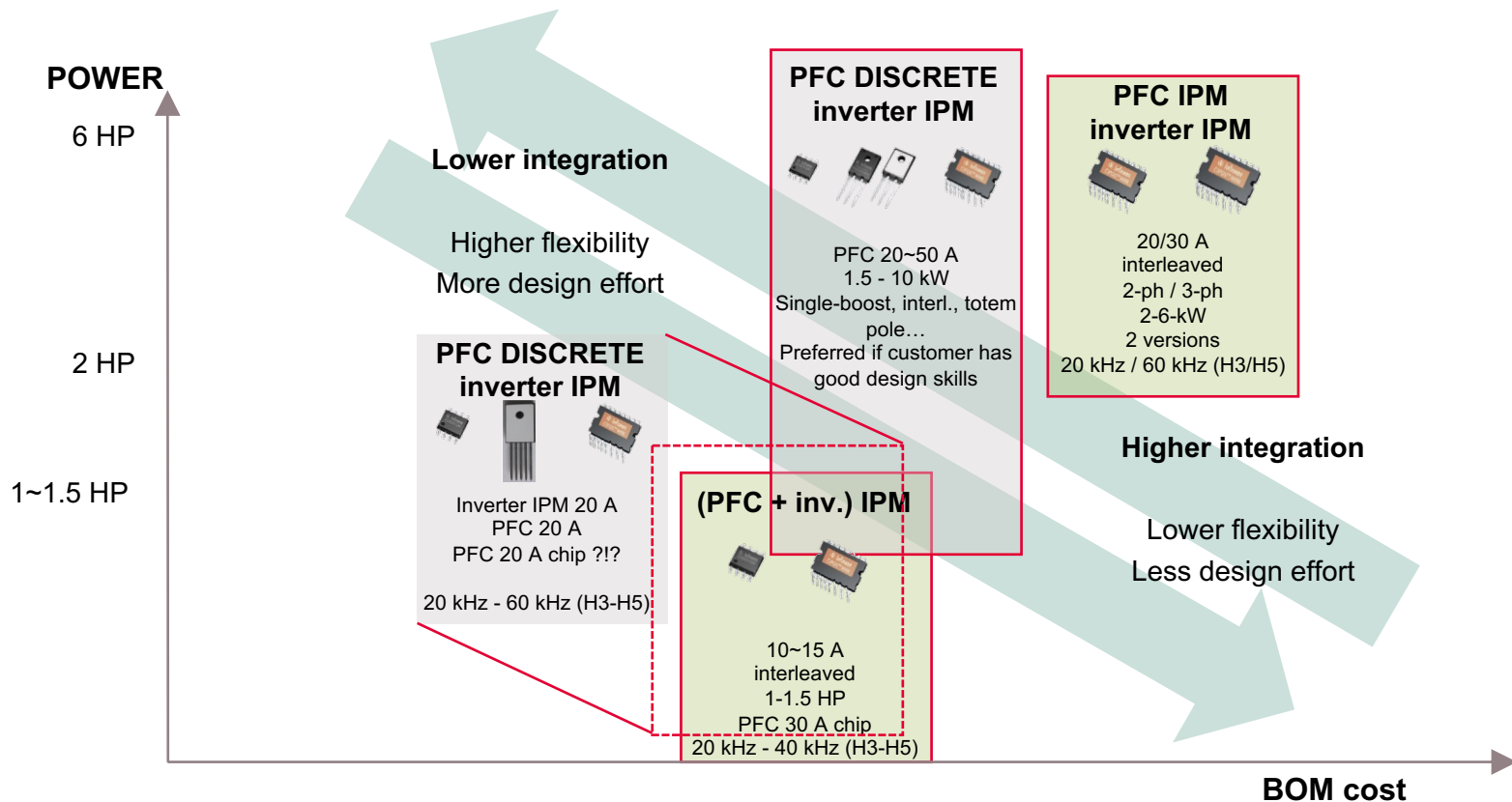
& secure



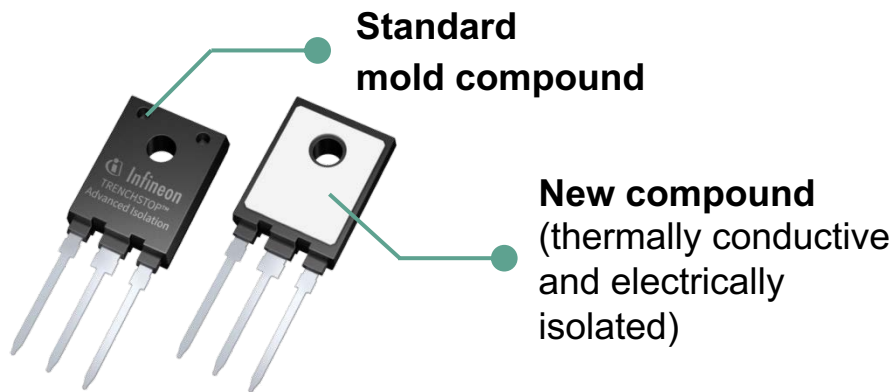
Infineon CIPOS™ IPM and solutions for air conditioners



Total solutions for aircon compressors (PFC + inverter)



A better PFC solution with advanced isolation



Key features	Benefits
2500 V _{RMS} electrical isolation, 50/60 Hz, t = 1 min	Increased power density
Withstands higher voltage	35% reduction in assembly time
Fully tested isolated mounting surface	Elimination of isolation foil
Lowest R _{th(j-h)}	EMI filter reduction
Low coupling capacitance (38 pF)	Reduced heatsink



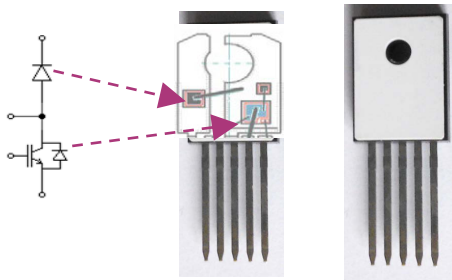
-10°C



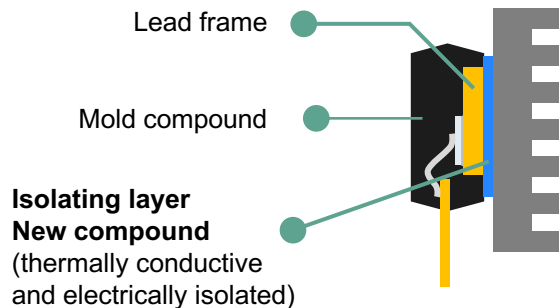
2-in-1 PFC solution with advanced isolation in TO-247-5

Integrated

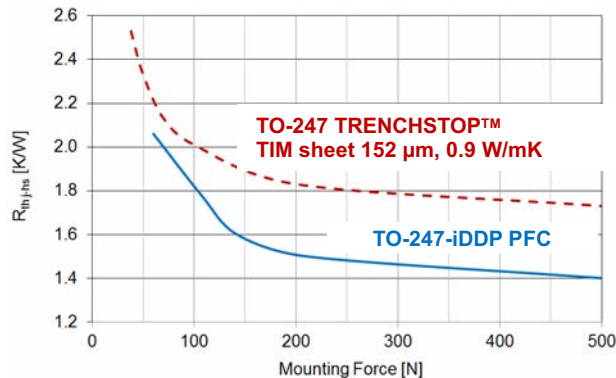
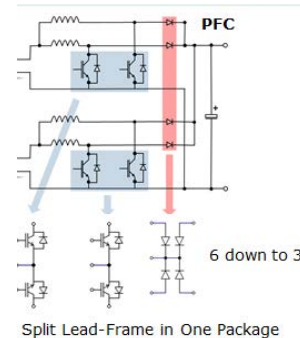
Insulated TO-247 dual-die pad power unit, boost configuration



High level of electrical insulation



Lower system cost

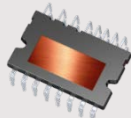


Upcoming new product: IM564-X6D

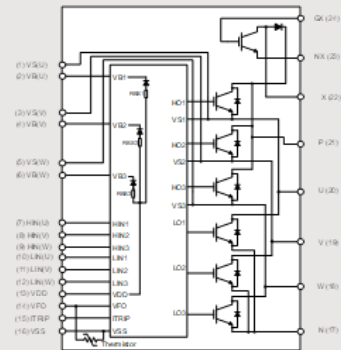
20 A PFC-integrated IPM with CoolMOS™

Key features

- › Dual in-line molded module
- › DCB substrate applied for excellent thermal performance
- › Inverter + PFC in one package
- › Inverter current rating 20 A
- › Robust gate driver in SOI technology
- › PFC switching frequency up to 150 kHz with CoolMOS™ power MOSFET
- › Power capability over 3 kW
- › UL-certified thermistor (85 kΩ)



Internal schematic



Value proposition

- › System size reduction with PFC integration into inverter module
- › Cost down due to lower BOM counts and lower assembly cost
- › Customer can design switching performance of PFC by using external driver circuit

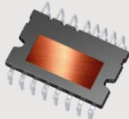
Typical applications



CIPOS™ Mini IPM: PFC-integrated IPM product family at a glance

Key features

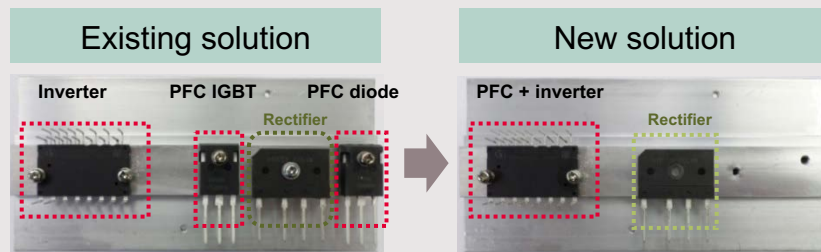
- › Dual in-line molded module with DCB substrate
- › Inverter + PFC in one package
- › Inverter current rating 10/15 A
- › Different PFC switching options available: 20 kHz or 40 kHz
- › PFC 650 V rating for IGBT and diode
- › Customer can control switching speed of IGBT (open gate)
- › Targeting room air conditioning applications
- › Power capability: 2 kW
- › UL-certified thermistor (85 kΩ)



Typical applications



Internal schematic



Value proposition

- › System size reduction with PFC integration into inverter module
- › Cost down due to lower BOM counts and lower assembly cost
- › Smaller and cheaper heatsink
- › Customer can design switching performance of PFC IGBT by using external driver circuit

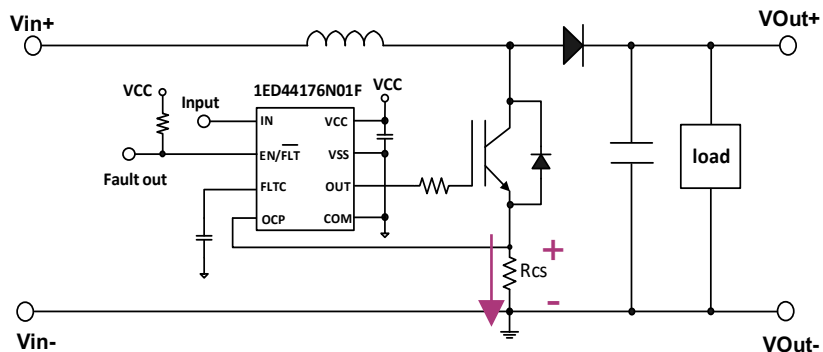
1ED4417x family overview

Feature comparison

Part number	Package options	$I_{O+/-}$ [A]	UVLO [V]	VOCTH [mV]	$t_{on/off}$ [ns]	Ground pins	Enable input	Fault output	Programmable fault clear time
1ED44176	DSO-8	+0.8 / -1.75	11.9 / 11.4	500	50	VSS / COM	EN / FLT		FLTC
1ED44175	SOT23-6	± 2.6	11.9 / 11	-250	50	COM		EN/FLT	
1ED44173	SOT23-6	± 2.6	8 / 7	-250	50	COM		EN/FLT	

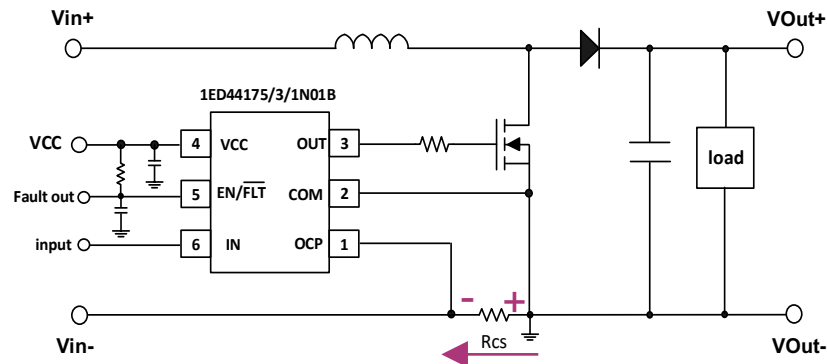
Positive current sensing scheme

PFC boost example
1ED44176



Negative current sensing scheme

PFC boost example
1ED4417(5,3)



1ED44176 1-channel low-side driver with integrated overcurrent protection, fault reporting and enable functionality (+CS)

Available now

Features

- › **Overcurrent detection with positive voltage input**
- › **0.5 V overcurrent threshold with accurate $\pm 5\%$ tolerance**
- › **Single pin for fault output and enable**
- › **Programmable fault clear time**
- › Undervoltage lockout
- › CMOS Schmitt-triggered inputs
- › 3.3 V, 5 V and 15 V input logic-compatible
- › Output in phase with input
- › Separate logic and power ground
- › 2 kV ESD HBM

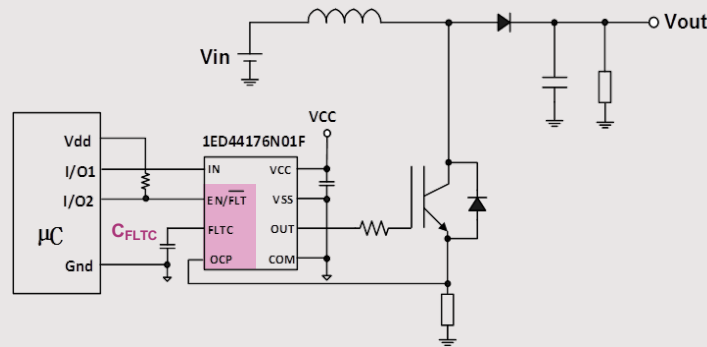


PG-DSO8

Key specifications

V_{CC} max	I_{OCC}	$I_{O+/-}$ typ	UVLO typ (on/off)	Prop. delay typ (on/off)
25 V	750 μ A	+0.8 / -1.75 A	11.9 / 11.4 V	50 ns

Typical connection diagram



Typical applications



General-purpose low-side gate driver for single-ended topologies such as digitally controlled PFC

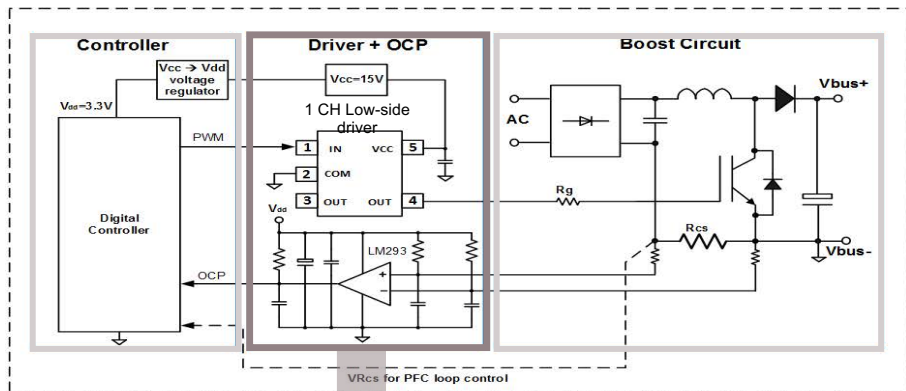
Available resources: [Datasheet](#), [Application Note](#), [Evaluation Board](#)
Simulation: [PSPICE](#), [SiMetrix](#), [IFX designer](#)

1ED44175/3 motivation

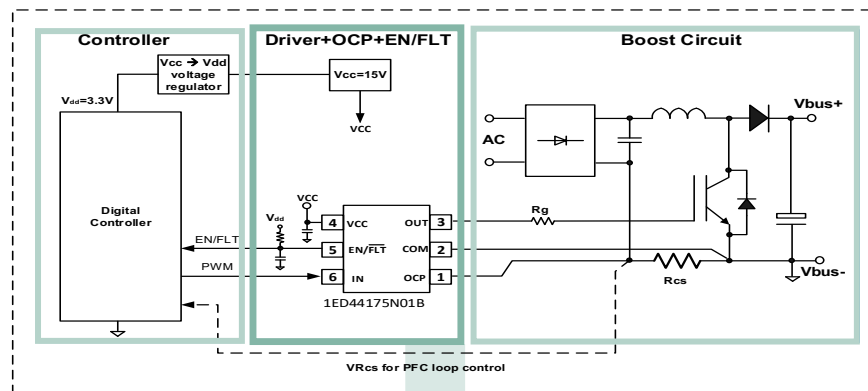
Cost-effective, space-saving and fast time-to-market

Coming soon
1ED44175: CY19Q4
1ED44173: CY20Q1

Discrete solution



1ED44175 solution



SOT23

SO8

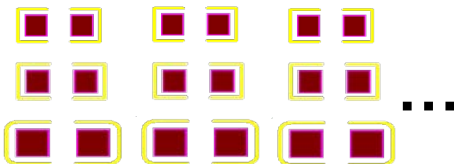
0805 and 1206



+



+



~ 20% cost savings
~ 50% space saving
Easy to design

SOT236



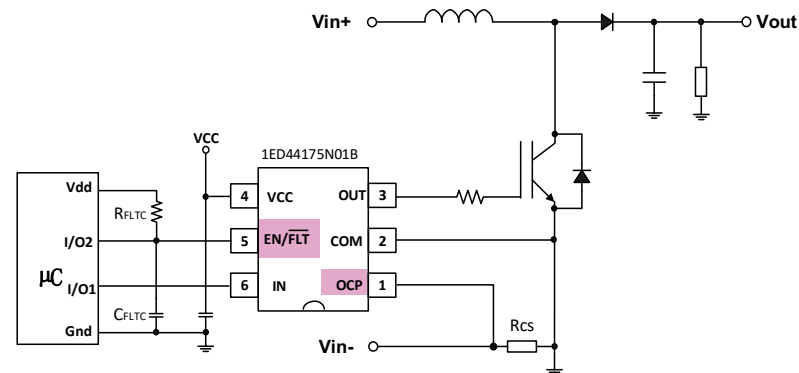
1ED44175/3 1-channel low-side driver with integrated overcurrent protection, fault reporting and enable functionality (-CS)

Features

- › **25 V maximum supply voltage**
- › Typical drive capability: $I_{O+/-} = 2.6 \text{ A}$
- › 3.3 V, 5 V and 15 V input logic compatible
- › **Overcurrent limit with minus voltage input**
- › **-0.25 V overcurrent protection threshold voltage with $\pm 6.75\%$ tolerance @ 25°C**
- › **Single pin for fault output and enable function**
- › **Programmable fault clear time**
- › 11.9/11 V undervoltage lockout protection (1ED44175)
- › 8/7.3 V undervoltage lockout protection (1ED44173)
- › 50 ns propagation delay
- › Output in phase with input



Typical connection diagram



Coming soon
1ED44175: CY19Q4
1ED44173: CY20Q1

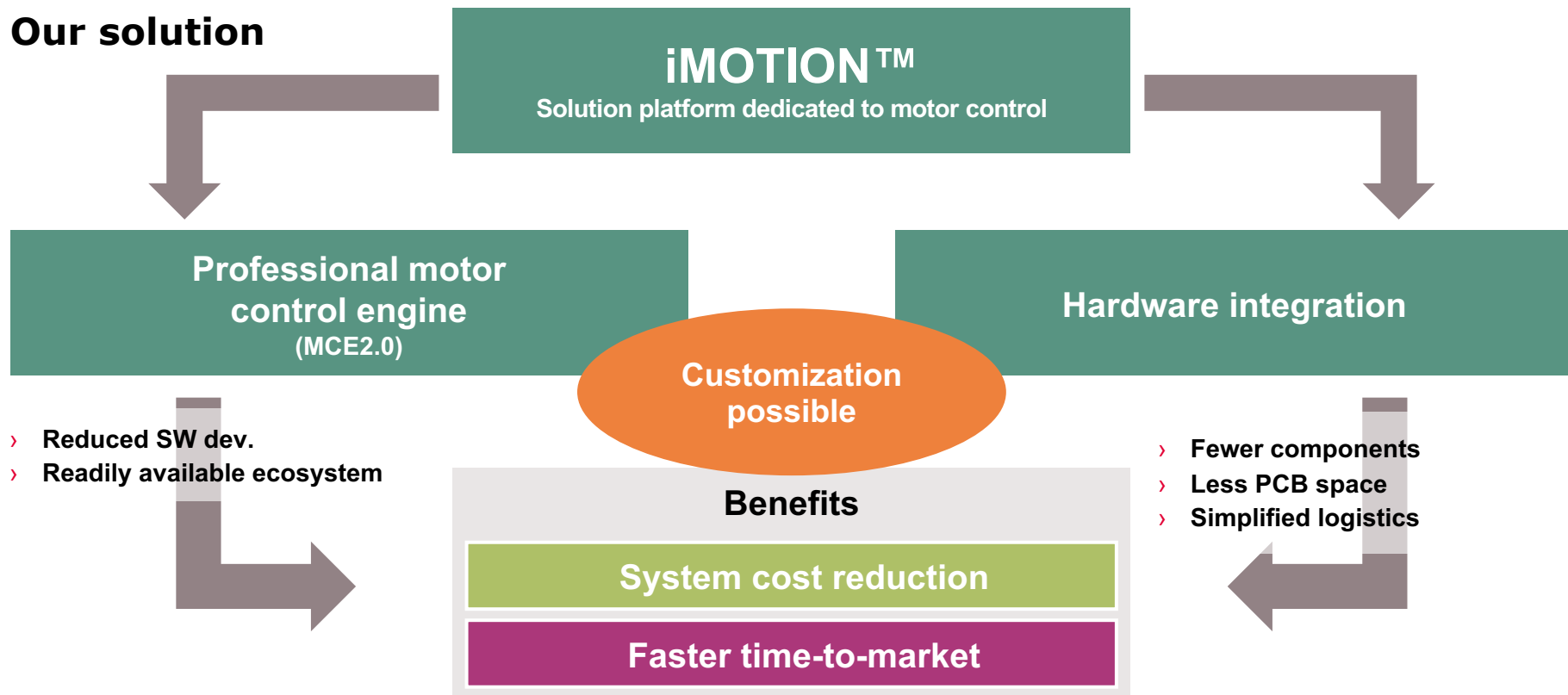
Typical applications



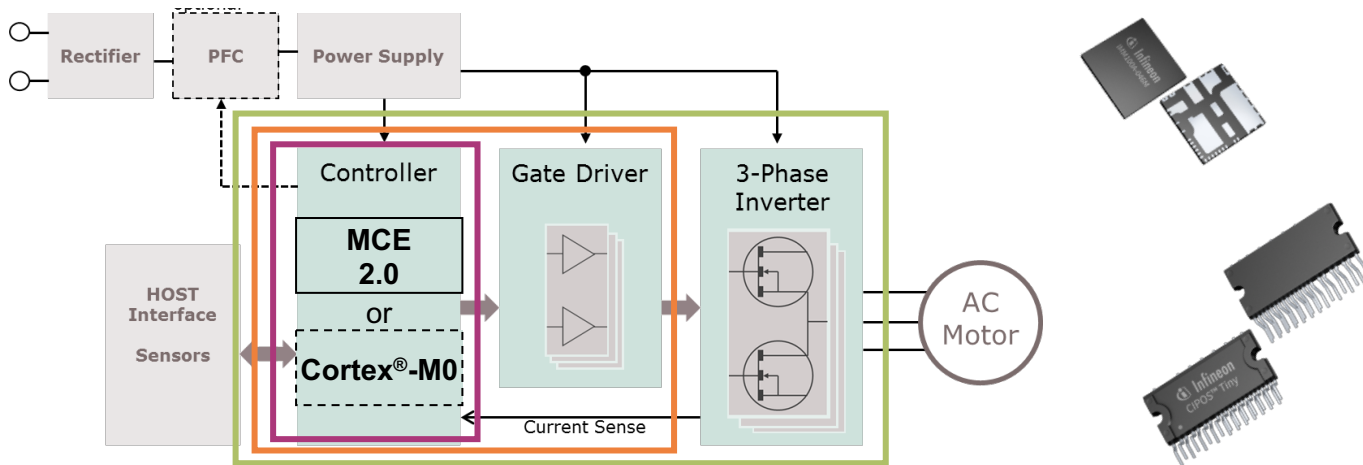
General-purpose low-side gate driver for single-ended topologies such as digitally controlled PFC

Next level of system integration

Our solution



Scalable integration of HW and SW



iMOTION™ controller

MCE 2.0

FOC algorithm allows **reliable and smooth operation at wide speed ranges.**

optionally with

MCU – Cortex®-M0

allowing **customer-specific application code**

iMOTION™ smart driver

Controller + gate driver

Higher level of integration with flexibility regarding power stage
Market-leading 3-phase gate driver

Offered with **MCE or MCU**
- turnkey or programmable

iMOTION™ smart IPM

Controller + gate driver + power MOSFETs or IGBTs

Full inverter system in one compact package

Offered with **MCE or MCU**
- turnkey or programmable

RAC outdoor unit

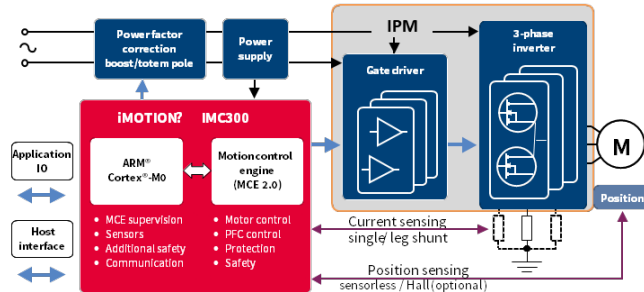
Dual-control solution (recommended)

Compressor + PFC



IMC302A-F064

- › **Ready-to-use solution**, highest **efficiency**
- › Fully integrated **boost or totem-pole PFC**
- › MCE with **scripting engine**
- › Independent **ARM® Cortex®-M0**
- › Real-time **control, streaming and reporting** between MCE & Cortex®



MCE = motion control engine

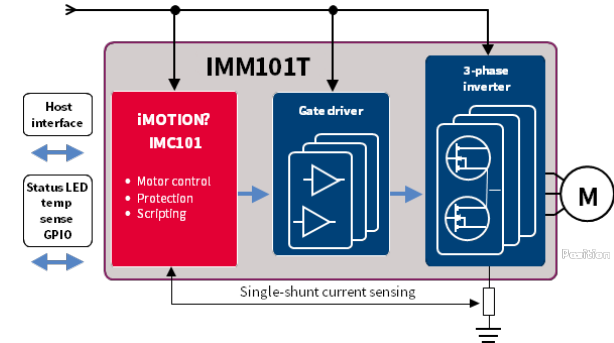
Outdoor fan



IMC101T-T038

IMM101T-046M

- › **Ready-to-use solution**, highest **efficiency**
- › Integrated **protection features** for power stage and motor
- › MCE with **scripting engine**
- › Highest **flexibility** with discrete/IPM solution
- › Smallest footprint and **lowest BOM**



RAC indoor unit

Fan control solution

Indoor fan



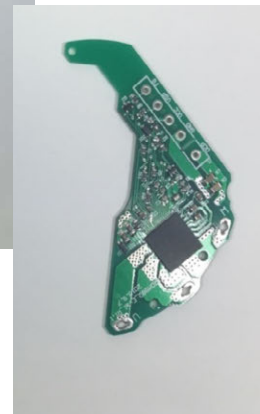
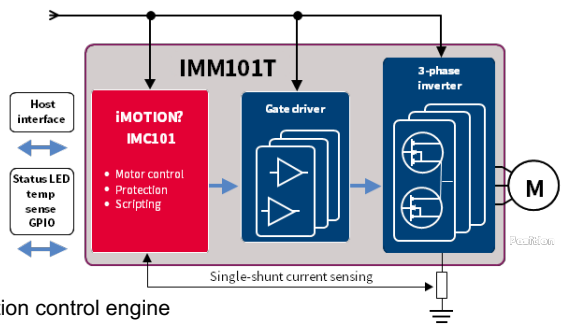
IMC101T-T038

IMM101T-015M

- › Ready-to-use solution, highest efficiency
- › Integrated protection features for power stage and motor
- › MCE with scripting engine

- › highest flexibility with discrete/IPM solution

- › Smallest footprint and lowest BOM



**iMOTION™
smart IPM**

- + significant PCB space savings
- + reduced component count
- + simplified logistics

IMC300 series

Fact sheet

Features

iMOTION™ motion control engine + ARM® Cortex®-M0

MCE 2.0

- > Highly efficient 3-phase motor control
- > Flexible sensing options (single/leg shunt, sensorless, Hall, encoder)
- > Storage of motor parameters
- > PFC control integrated
- > Multiple protection features

ARM® Cortex®-M0

- > 48/96 MHz clock
- > MATH coprocessor
- > 128 kB Flash / 16 kB RAM
- > High-performance timers
- > 12-bit ADC and high-speed comparators
- > Flexible communication options (UART, I²C, SPI, CAN)

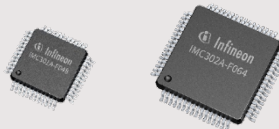
IEC 60335 ('class B')

Support tools

- > iMOTION™ tools for motor configuration and tuning
- ARM® ecosystem for Cortex®-M0

Packages

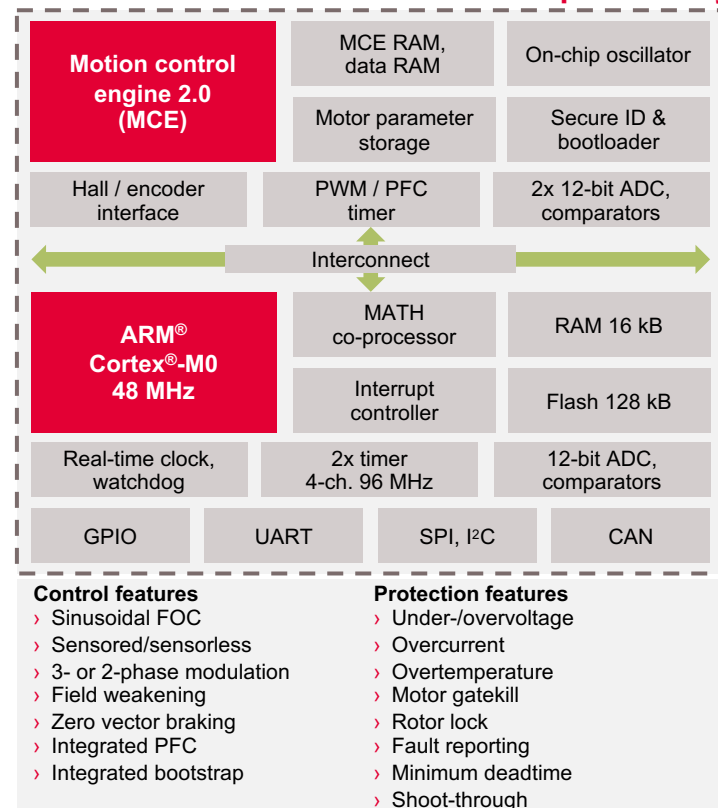
- > QFP-64, QFP-48



Benefits

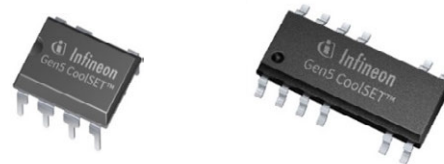
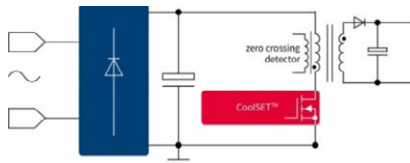
- > **Ready-to-use solution** for variable speed drives using field-oriented control (FOC)
- > **Highest flexibility** with integrated MCU to control the MCE and integrate customer functionality
- > **Reduced system cost** with integrated PFC control algorithm
- > **Easy-to-use** iMOTION™ design tools and standard ARM® ecosystem
- > **Fast time-to-market** by using iMOTION™ form-factor reference design kits which are very close to final customer design

preliminary



Residential aircon

CoolSET™ Gen5 – Aux. power for consumer applications



Key value proposition

- › Choice of quasi-resonant or fixed frequency (100 kHz & 125 kHz) switching scheme
- › Robust line input and pin protection against fault conditions
- › Support for both DCM and CCM operation with integrated slope compensation
- › High level of integration with integrated error amplifier for non-isolated design
- › Highest power delivery of up to 43 W with 800-V integrated MOSFET

Target applications

- › Auxiliary supply circuit in industrial applications (pumps, fans, GPD, robotics,)
- › Adapters, settop boxes, water purifiers & POE
- › Auxiliary power supplies for major home appliances, audio & metering systems, telecom devices & servers

Availability

- › Integrated with either 700 V or 800 V MOSFET in DIP or SMD package
- › More information → <http://www.infineon.com/CoolSET>

5th generation CoolSET™ for auxiliary SMPS

- › Auxiliary SMPS to perform AC/DC power conversion to power the various system blocks within an air-conditioning unit
- › Typical load includes MCU, relay, communication module, gate driver, motor drivers, stepper-motor for vane control and sensors

Broad portfolio

- › Choice of fixed- frequency or quasi-resonant switching scheme
- › Highest power delivery up to 43 W
- › Available in DIP-7 or SMD DSO-12 package

Ease of design


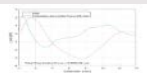


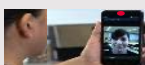



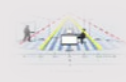











- › Numerous design examples covering both indoor and outdoor aircon
- › Design tools, guide and application note

Robustness

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

Infinion provides a variety of sensor products to make HVAC systems smarter and more reliable



Microphone	Pressure	Environmental	3D radar	3D ToF
 No distortions	 Best-in-class resolution	 World's smallest form factor 6x6mm ²	 Highest energy efficiency	 Best-in-class resolution
 Receive clear audio signals	 Measure height	 Measure CO ₂	 Biometrics	 3D mapping
Smart ears, smart sense of feeling/touch, smart nose			Smart eyes & sixth sense	
Magnetic & current sensors	Connectivity and RF	Microcontroller	Embedded security	Power IC solutions
 Wide variety of types and applications	 Backhaul enablement	 Functional safety	 Hardware security & authentication	 Best-in-class solutions
 Motor control, switches, metering, etc.	 5G	 Industry 4.0, Autonomous cars, etc.	 TPM, mobile phone, edge devices, etc.	 Power supplies & control, LED driver, etc.



Part of your life. Part of tomorrow.