# IFX solution for consumer robotics

Christina Guggenberger, Anita Erlacher

March 2017

# Infineon's industrial microcontrollers, power and sensor components complement each other

**Small signal MOSFET**


Copyright © Infineon Technologies AG 2017. All rights reserved.

# Small signal MOSFETs

**Typical small signal MOSFET application areas**

**Packages**

**4.5 x 4.0 x 1.5 mm**

**6.5 x 7.0 x 1.6 mm**

**2.9 x 2.5 x 1.1 mm**

**3.0 x 2.8 x 1.1 mm**

**2.9 x 2.4 x 1.0 mm**

**2.0 x 2.1 x 0.9 mm**

**2.0 x 2.1 x 0.9 mm**


Copyright © Infineon Technologies AG 2017. All rights reserved.

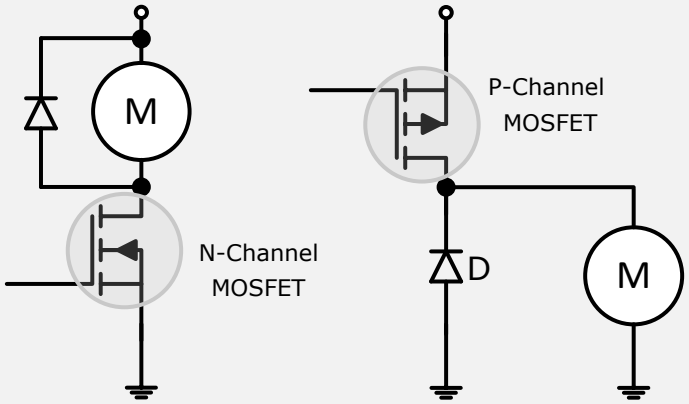
# Small signal MOSFET overview

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Polarity** | **N-Channel Enhancement / N-Channel Depletion**<br>**P-Channel Enhancement with and without ESD protection** | | | | | | |
| **$V_{DS}$ range** | from -250 V up to 800 V | | | | | | |
| **Configuration** | Single, dual and complementary | | | | | | |
| **Gate drive voltage** | 1.8 V (ULL), 2.5 V (SLL), 4.5 V (LL), 10 V (NL) | | | | | | |
| **Packages** | SOT-223 | SOT-89 | TSOP-6 | SC59 | SOT-23 | SOT-323 | SOT-363 |
| | | | | | | | |
| **Qualification** | Automotive AEC Q101 (except where indicated) | | | | | | |

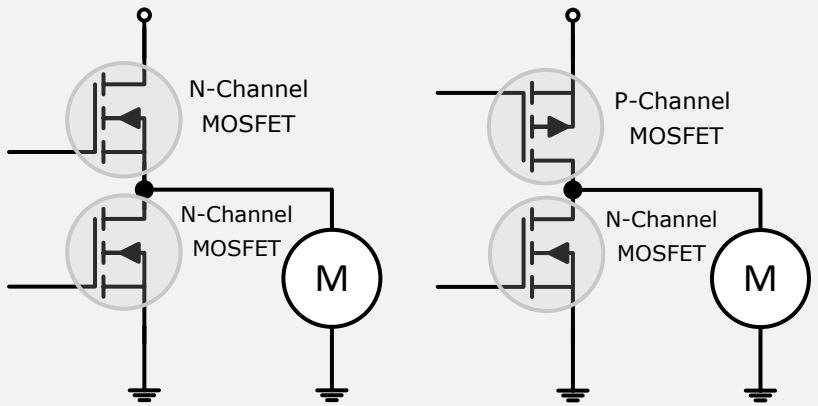
ULL: Ultra Logic Level
SLL: Super Logic Level
LL: Logic Level
NL: Normal Level


Copyright © Infineon Technologies AG 2017. All rights reserved.

# Low voltage drives




| N-Channel Examples | | |
|---|---|---|
| IFX Part | Package | Parameters |
| IRLML6244 | SOT-23 | 20 V LL 21.0 mΩ |
| BSL202SN | TSOP-6 | 20 V SLL 22.0 mΩ |
| BSR802SN | SC59 | 20 V ULL 23.0 mΩ |
| BSS606N | SOT-89 | 60 V LL 60.0 mΩ |
| BSP373N | SOT-223 | 100 V NL 240.0 mΩ |




| P-Channel Examples | | |
|---|---|---|
| IFX Part | Package | Parameters |
| BSL207SP | TSOP-6 | -20 V LL 41.0 mΩ |
| IRLML2244 | SOT-23 | -20 V LL 54.0 mΩ |
| BSS308PE | SOT-23 | -30 V LL 80.0 mΩ |
| BSP612P | SOT-223 | -60 V LL 130.0 mΩ |


Copyright © Infineon Technologies AG 2017. All rights reserved.

# Small signal MOSFETs
# Features and benefits

**Key features**

- Most products qualified to AEC Q101
- Four $V_{GS(th)}$ classes
- ESD protected P-Channel parts
- $V_{DS}$ range -250 V to 800 V
- RoHS compliant and halogen free

**Technical benefits**

- Easy interface to MCU
- Improved efficiency at low loads due to low $Q_g$
- Fast switching

**Customer benefits**

- Suitable for automotive and high quality demanding applications
- Reduction of design complexity
- Industry standard small outline packages


Copyright © Infineon Technologies AG 2017. All rights reserved.

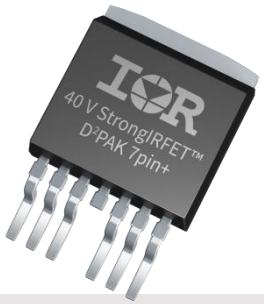
# Infineon's industrial microcontrollers, power and sensor components complement each other

**Low Voltage MOSFETs**
**OptiMOS™ & StrongIRFET™**


Copyright © Infineon Technologies AG 2017. All rights reserved.

# OptiMOS™ and StrongIRFET™ family attributes

| OptiMOS™ | StrongIRFET™ |
| --- | --- |
| Designed for high performance applications | Designed for industrial applications |
| Ultra-low $R_{DS(on)}$ | Low $R_{DS(on)}$ |
| Ideal for high switching frequency | Ideal for low switching frequency |
| Provide best-in-class and price/performance products | 3.0 V Threshold voltage<br>4.5 V Logic level available |
| Industry's best figure of merit | High current carrying capability |
| High efficiency and power density | Rugged silicon |





Copyright © Infineon Technologies AG 2017. All rights reserved.

# A powerful MOSFET combination

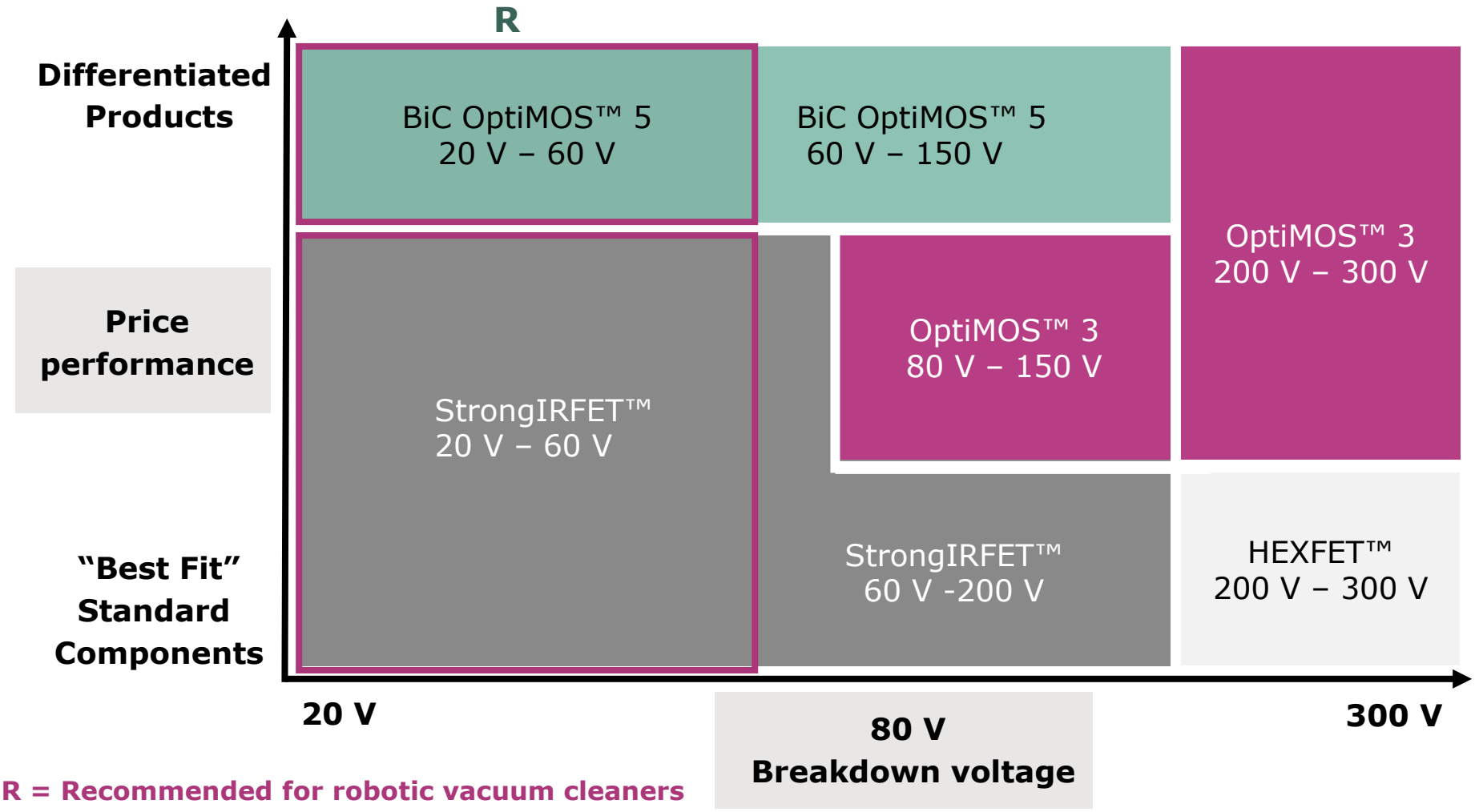
Best in class technology **OptiMOS™**

Robust, price/performance ratio **StrongIRFET™**

- **Expanded product portfolio 20 V – 300 V**
- **Able to address a larger range of customer needs**


Copyright © Infineon Technologies AG 2017. All rights reserved.

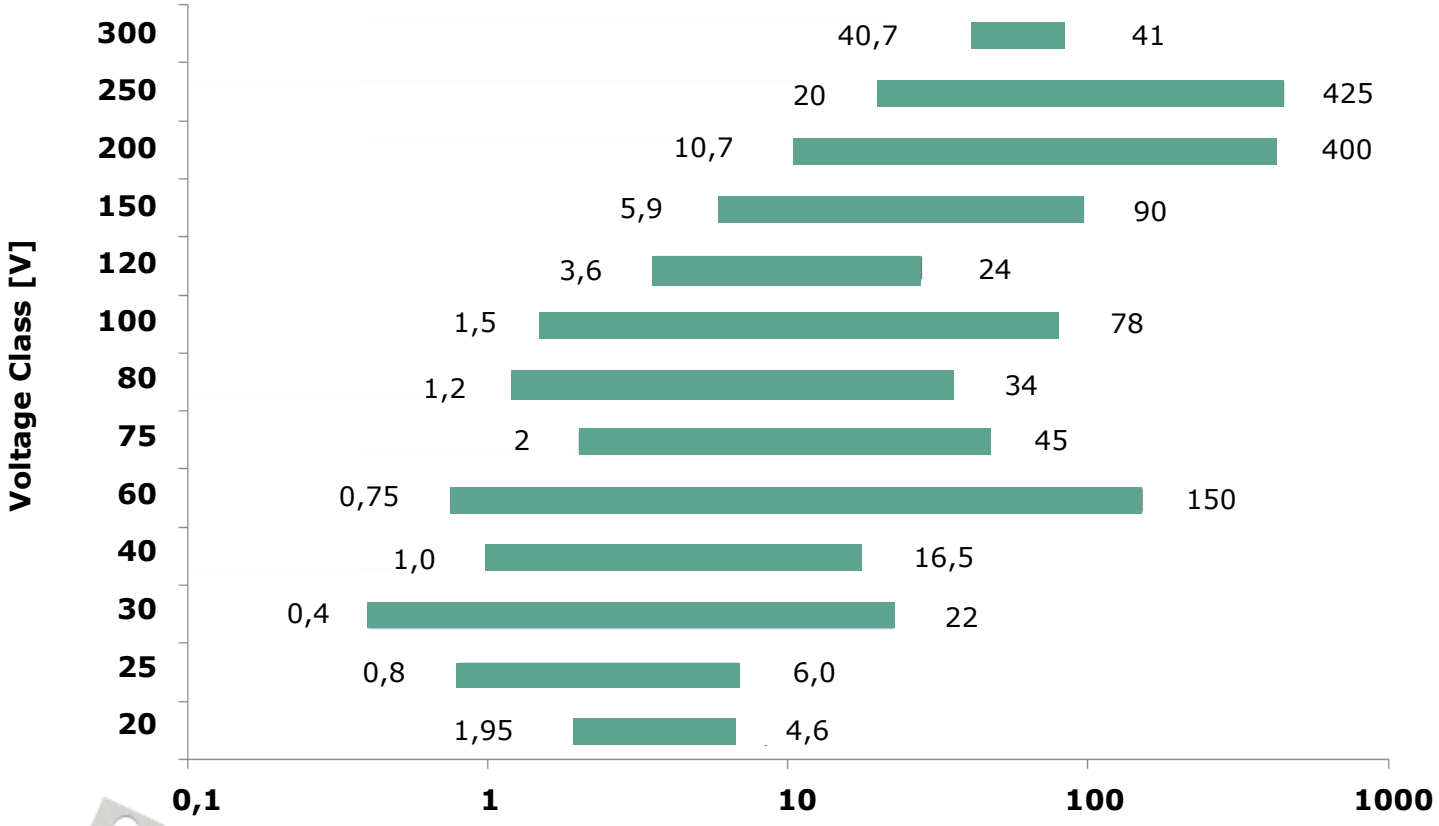
# OptiMOS™ vs. StrongIRFET™ positioning low frequency applications < 100 kHz

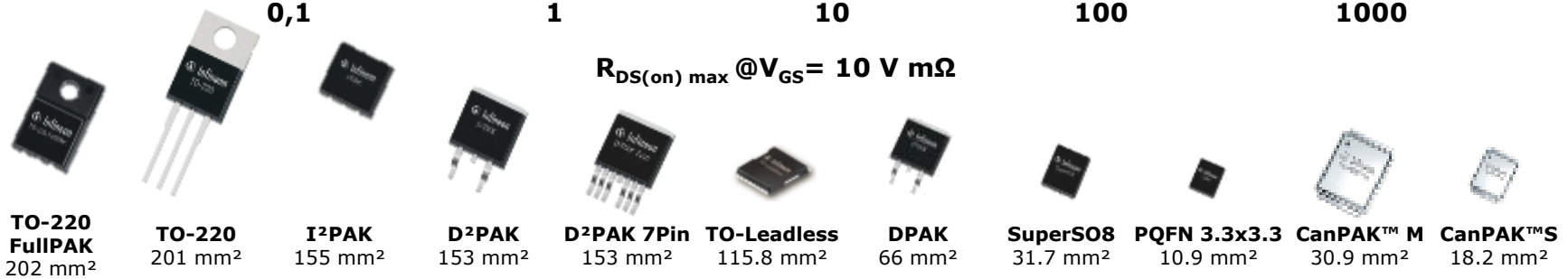



**R = Recommended for robotic vacuum cleaners**


Copyright © Infineon Technologies AG 2017. All rights reserved.

# OptiMOS™ products by voltage class & $R_{DS(on)}$ max. in various packages



| TO-220 FullPAK | TO-220 | I²PAK | D²PAK | D²PAK 7Pin | TO-Leadless | DPAK | SuperSO8 | PQFN 3.3x3.3 | CanPAK™ M | CanPAK™S |
|---|---|---|---|---|---|---|---|---|---|---|
| 202 mm² | 201 mm² | 155 mm² | 153 mm² | 153 mm² | 115.8 mm² | 66 mm² | 31.7 mm² | 10.9 mm² | 30.9 mm² | 18.2 mm² |


Copyright © Infineon Technologies AG 2017. All rights reserved.

# OptiMOS™ 5 40 V and 60 V Features and benefits

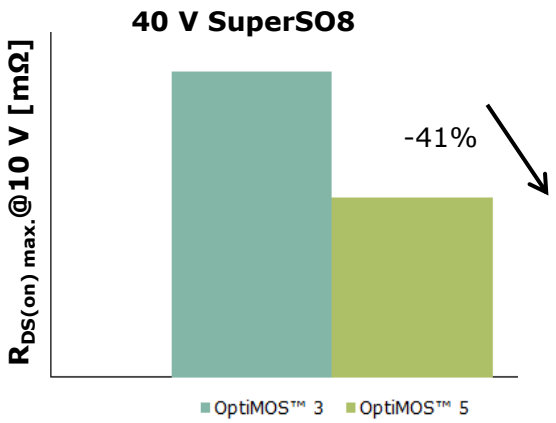
## Features

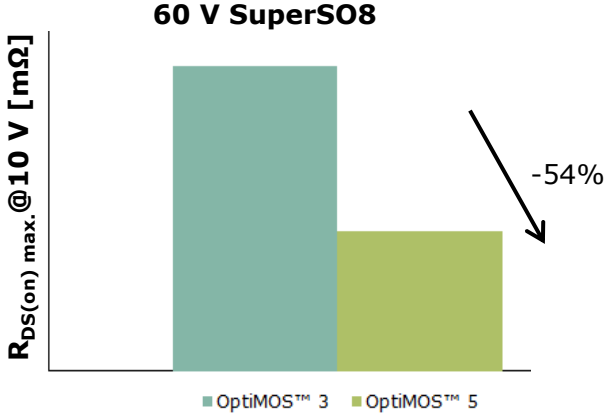
- Optimized for synchronous rectification
- $R_{DS(on)}$ up to 54% lower than OptiMOS™ 3
- $FOM_g$ up to 55% lower than OptiMOS™ 3
- Integrated Schottky-like diode
- RoHS compliant, halogen free
- MSL1 rated

## Key benefits

- Highest system efficiency
- Less paralleling required
- Increased power density
- Very low voltage overshoot
- Reduced need for a snubber circuit
- System cost reduction
- Reduction of engineering costs and effort

**Lower $R_{DS(on)}$ in OptiMOS™ 5 compared to previous generation**

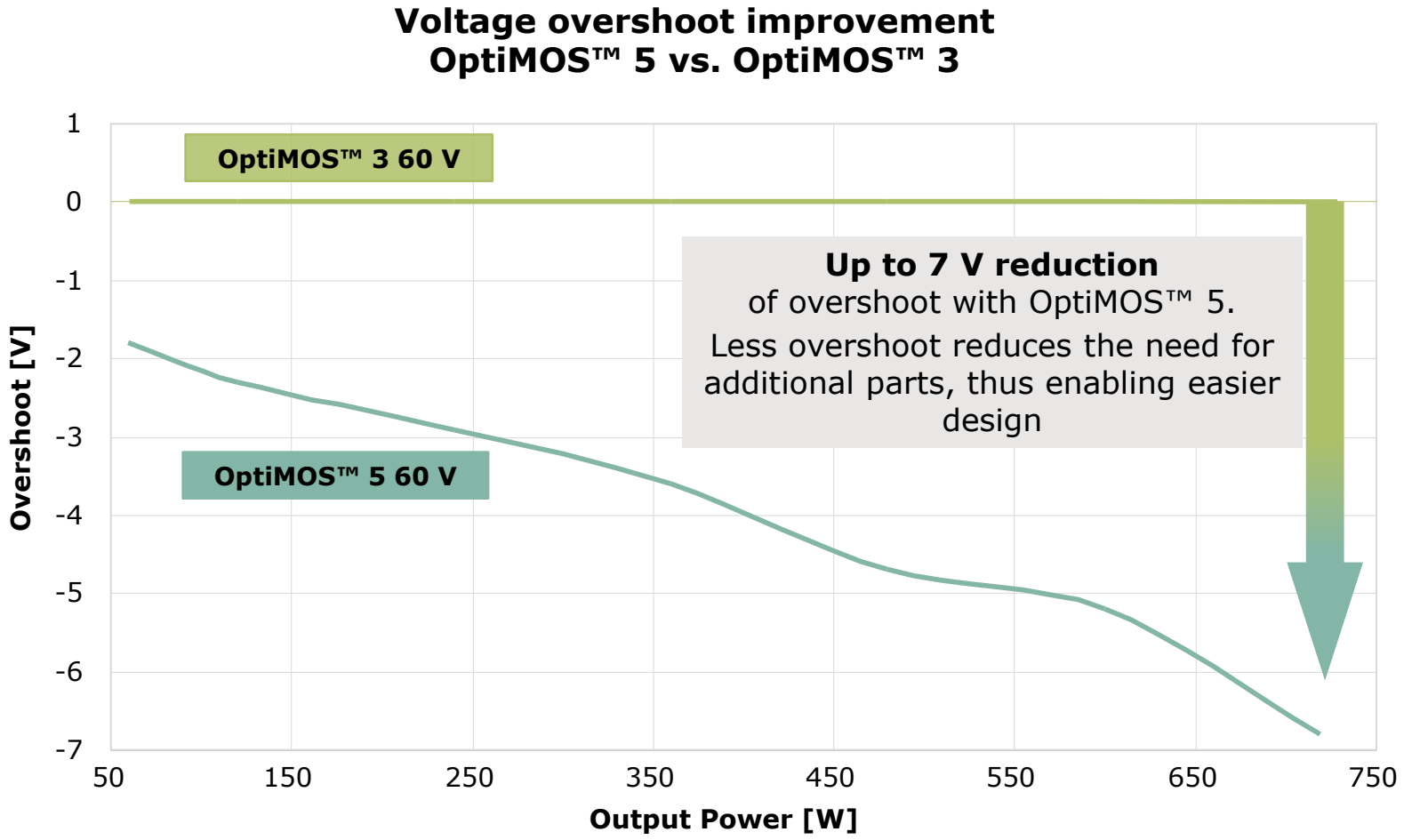




Copyright © Infineon Technologies AG 2017. All rights reserved.

# OptiMOS™ 5 60 V easy-to-use products

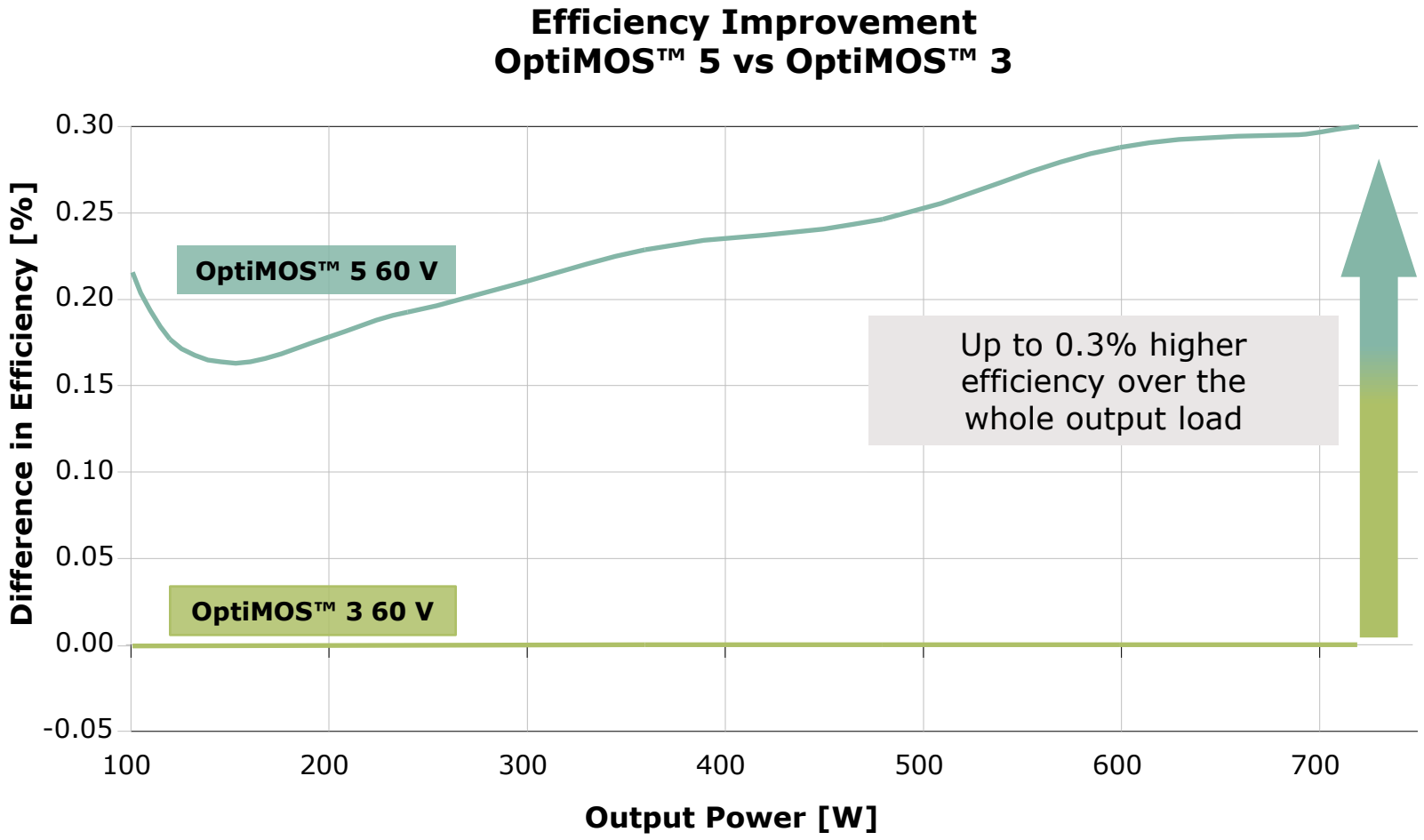



IPP032N06N3
IPP029N06N5

Conditions: 12 V-750 W server PSU, 140 kHz switching frequency, phase shifted full bridge, current doubler rectifier


Copyright © Infineon Technologies AG 2017. All rights reserved.

# OptiMOS™ 5 60 V highest efficiency




IPP032N06N3
IPP020N06N5

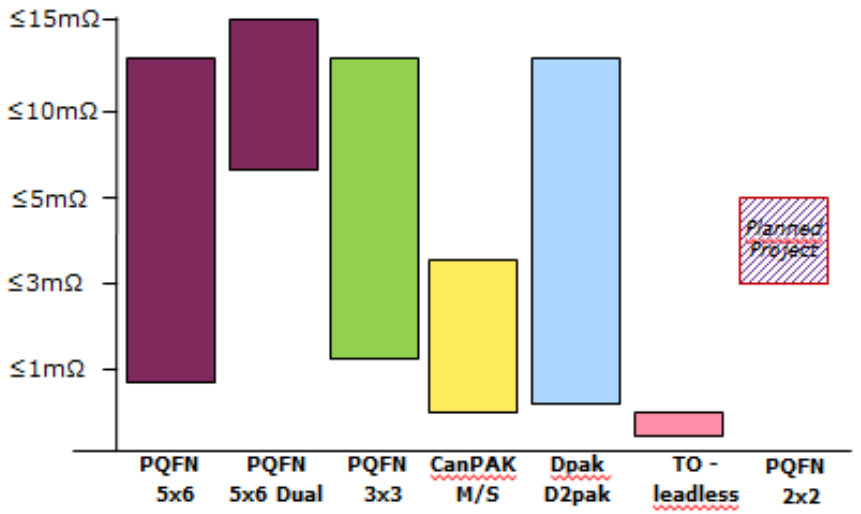
Conditions: 12 V-750 W server PSU, 140 kHz switching frequency, phase shifted full bridge, current doubler rectifier


Copyright © Infineon Technologies AG 2017. All rights reserved.

# New low voltage OptiMOS™5 (25 V/ 30 V)

- Industrial benchmark **highest efficiency** (from 0.7% to 1.5% better than OptiMOS™)
- Best-in-class **on-state resistance** S3O8 and **highest power density** (0.5 mOhm better than OptiMOS™)
- **Power block** (new package technology) with **optimized layout and thermal capability** (source down) products available (not available in OptiMOS™)
- **Benchmark switching performance** (lowest Figure of Merits Ron x $Q_g$ and Ron x $Q_{gd}$) 30% better than OptiMOS™

**PL12 Product Portfolio (25 V/ 30 V)**

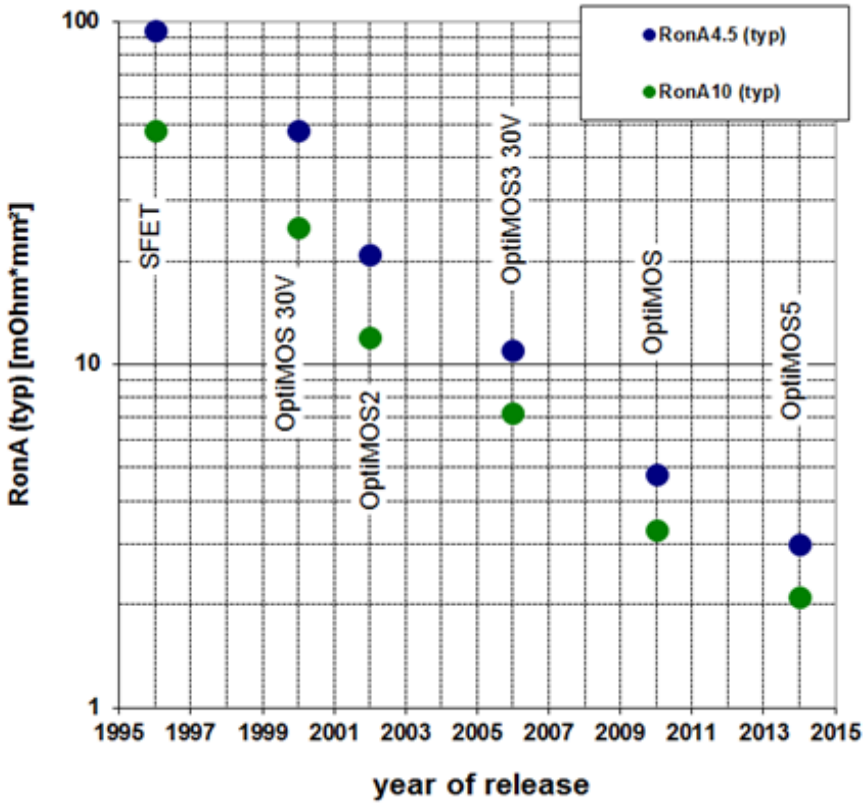



| | |
|---|---|
| Reduction of performance relevant figure of merits ($Q_g$, $Q_{gd}$,..) up to 30% | Reduces power losses -> significant improvement in efficiency |
| Reduction of switching losses (Qswitch) of ~50% | Enables operation at high switching frequencies without compromises in efficiency |
| OptiMOS™ 5 Power block products: source down orientation for low side MOSFET | Big GND pad for better thermal connection to the PCB and higher current capability |
| Integrated damping network | Optimized EMI behavior and reduction of voltage overshoot |

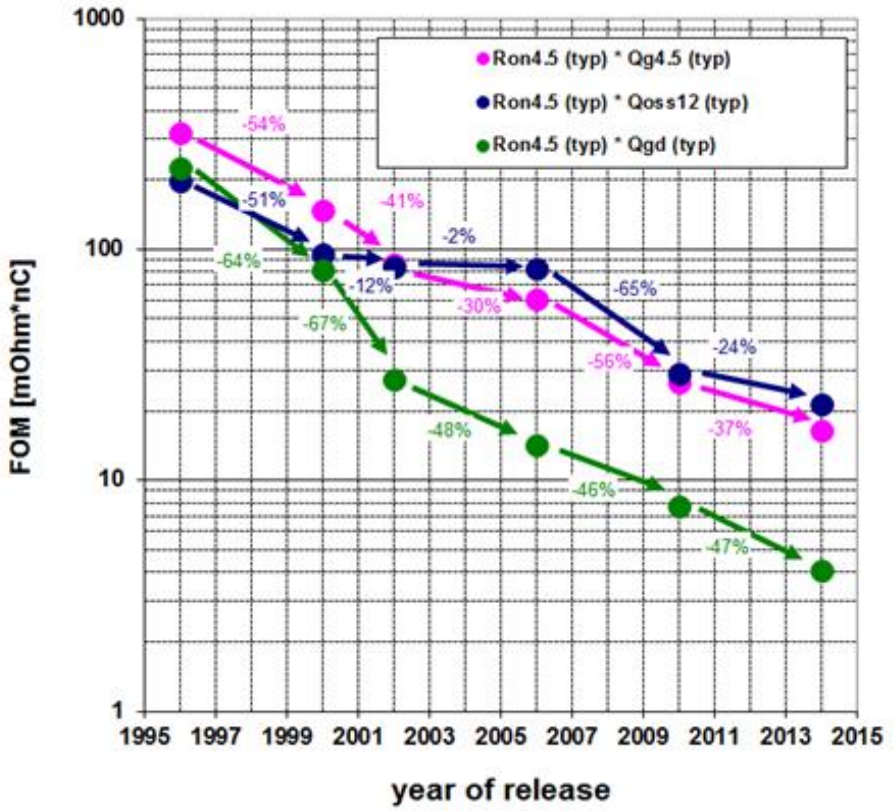

Copyright © Infineon Technologies AG 2017. All rights reserved.

# Advancements in OptiMOS™ technology

## Specific On-resistance




## Gate (QG) and output charge (Qoss)




Enables **smallest devices** to save PCB space and delivers highest efficiency for **best thermal performance and lowest power consumption**


Copyright © Infineon Technologies AG 2017. All rights reserved.

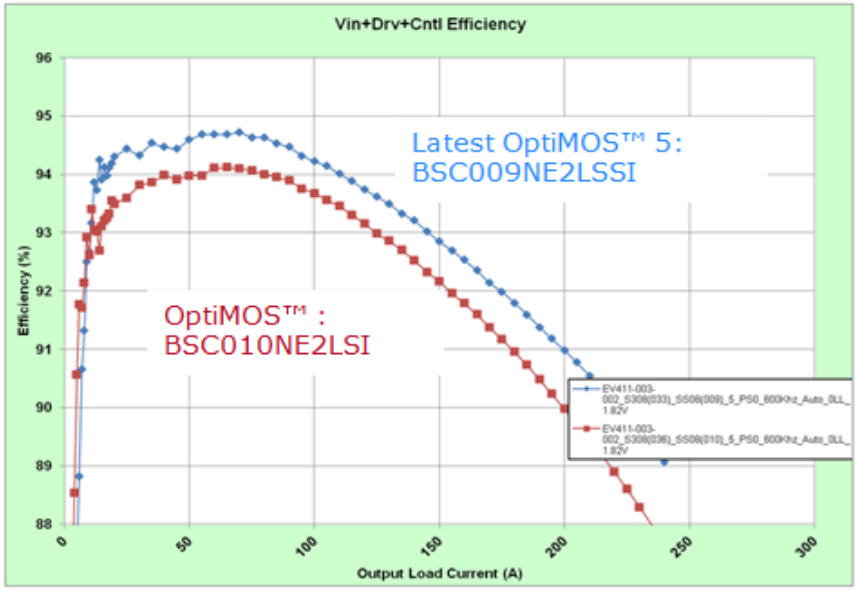
# Extended discrete portfolio

## Portfolio Outlook OptiMOS™ 5

| RDS(on) max @$V_{GS}$=10V[mΩ] | SuperSO8 25V | S3O8 25V | SuperSO8 30V | S3O8 30V |
|---|---|---|---|---|
| <2 | BSC009NE2LS5 $R_{DS(on)}$=0.9mΩ | BSZ013NE2LS5I $R_{DS(on)}$=1.3mΩ | BSC0500NSI $R_{DS(on)}$=1.3mΩ | BSZ0500NSI $R_{DS(on)}$=1.55mΩ |
| | BSC009NE2LS5I $R_{DS(on)}$=0.95mΩ | BSZ014NE2LS5IF** $R_{DS(on)}$=1.45mΩ | BSC0501NSI $R_{DS(on)}$=1.9mΩ | |
| | BSC015NE2LS5I RDS(on)=1.5mΩ | BSZ017NE2LS5I $R_{DS(on)}$=1.7mΩ | | |
| 2-4.4 | BSC026NE2LS5 RDS(on)=2.6mΩ | BSZ031NE2LS5 RDS(on)=3.1mΩ | BSC0502NSI $R_{DS(on)}$=2.4mΩ | BSZ0501NSI $R_{DS(on)}$=2.0mΩ |
| | | BSZ033NE2LS5 $R_{DS(on)}$=3.3mΩ | BSC0503NSI $R_{DS(on)}$=3.2mΩ | BSZ0502NSI $R_{DS(on)}$=2.8mΩ |
| | | | BSC0504NSI $R_{DS(on)}$=3.7mΩ | BSZ0503NSI $R_{DS(on)}$=3.4mΩ |
| | | | | BSZ0506NSI $R_{DS(on)}$=4.4mΩ |

** optimized for resonant applications (e.g.. LLC converter)

## Efficiency comparison OptiMOS™ vs. latest OptiMOS™ 5




Latest MOSFET technology improves efficiency relevant figures of merits by **>30%**
All OptiMOS™5 products do have mass production readiness


Copyright © Infineon Technologies AG 2017. All rights reserved.

# StrongIRFET™ current ratings = reliability

| Package | StrongIRFET™ Max Id @ 25C (A) | Comp #1 | Comp # 2 | Comp # 3 |
|---|---|---|---|---|
| TO220 | **195** | 120 | 120 | 120 |
| TO247 | | | 156 | |
| D2PAK | | | 120 | |
| D2PAK-7 | **240** | 180 | | 180 |

StrongIRFET™ is the only MOSFET Technology that offers **higher max current ratings** than the rest of the market

**Benefit:** can provide better reliability in designs with high surge currents

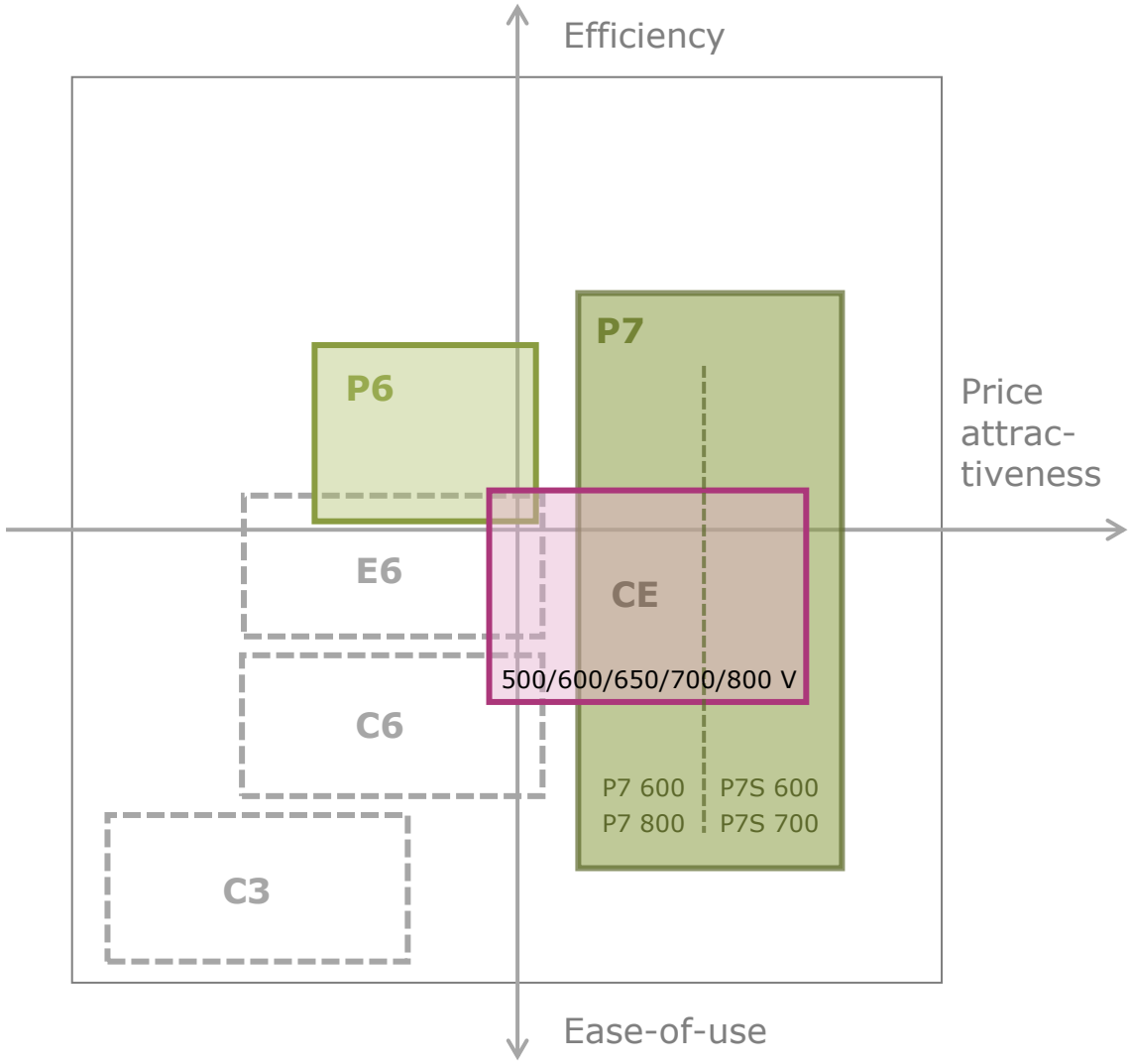
Copyright © Infineon Technologies AG 2017. All rights reserved.

# Infineon's industrial microcontrollers, power and sensor components complement each other

**High Voltage MOSFETs**
**CoolMOS™**


Copyright © Infineon Technologies AG 2017. All rights reserved.

# CoolMOS™ product families low power

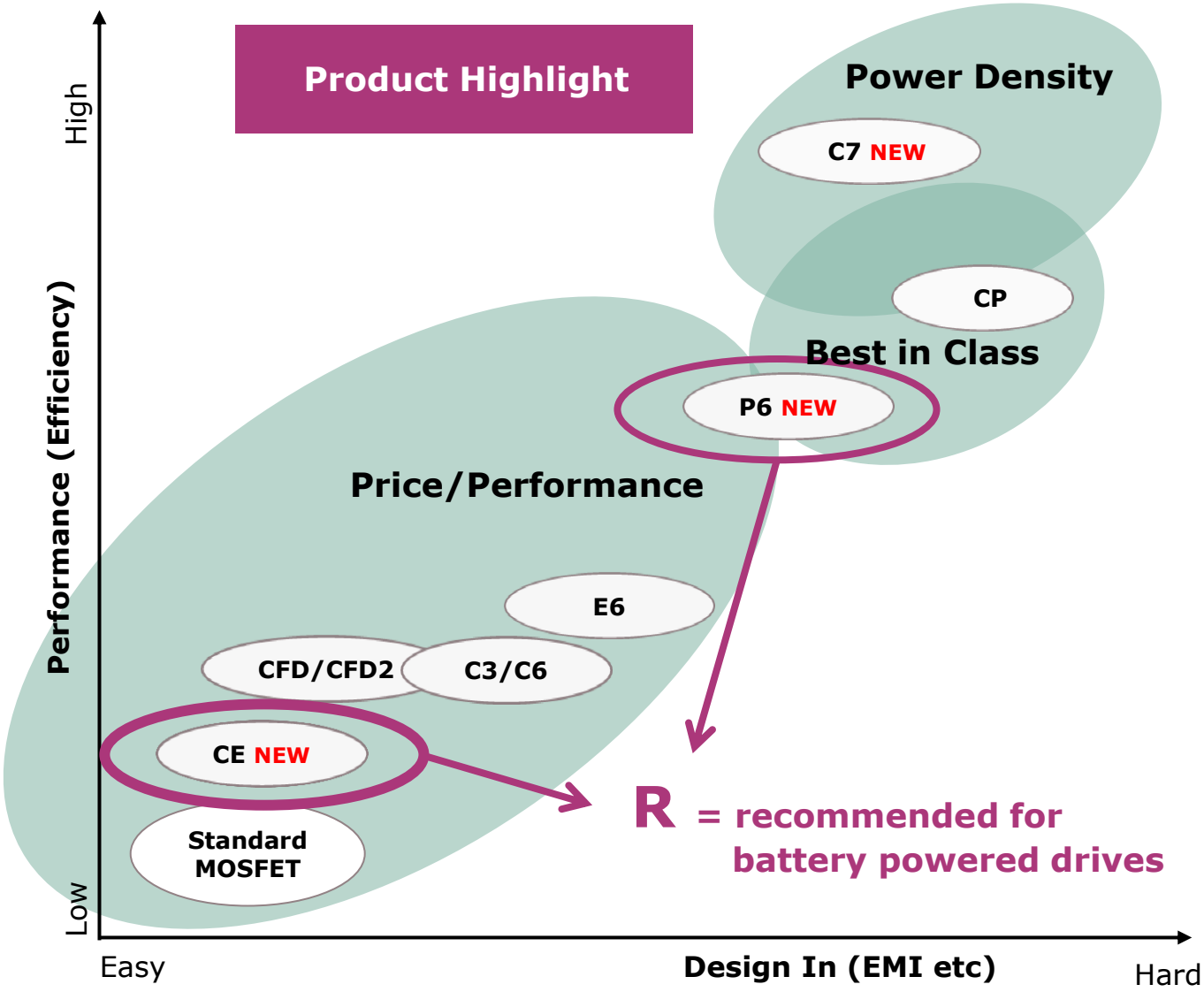



## Why CoolMOS™ CE ?

- **Superjunction device** (SJ): as such it delivers low conduction and switching losses, improves efficiency and ultimately reduces power consumption
- **Attractive price position:** with no compromise on proven CoolMOS™ quality and reliability
- **Fast design-in:** ease of use enables customers to reduce the design in cycle and compete in dynamic markets


Copyright © Infineon Technologies AG 2017. All rights reserved.

# CoolMOS™ CE and P6 – the right fit for all kind of chargers used for battery powered drives





Copyright © Infineon Technologies AG 2017. All rights reserved.

# CoolMOS™ CE

## What is CoolMOS™ CE?

- **CoolMOS™ CE** is a technology platform of Infineon´s market leading high voltage power MOSFET designed according to the superjunction principle (SJ) and conceived to fulfill **consumer requirements**
- **CoolMOS™ CE** portfolio offers 500 V, 600 V, 650 V and 800 V devices targeting low power chargers, adapters, LCD, LED TV and LED lighting and power tools applications
- This new series of CoolMOS™ is **cost optimized** to meet typical **requirements in consumer** with no compromise on proven CoolMOS™ quality and reliability while still been price attractive
- **CoolMOS™ CE** is suitable for hard and soft switching applications and as modern SJ, it delivers low conduction and switching losses improving efficiency and ultimately reduces power consumption
- **CoolMOS™ CE ease of use** enables customers to reduce the design in cycle and compete in dynamic markets

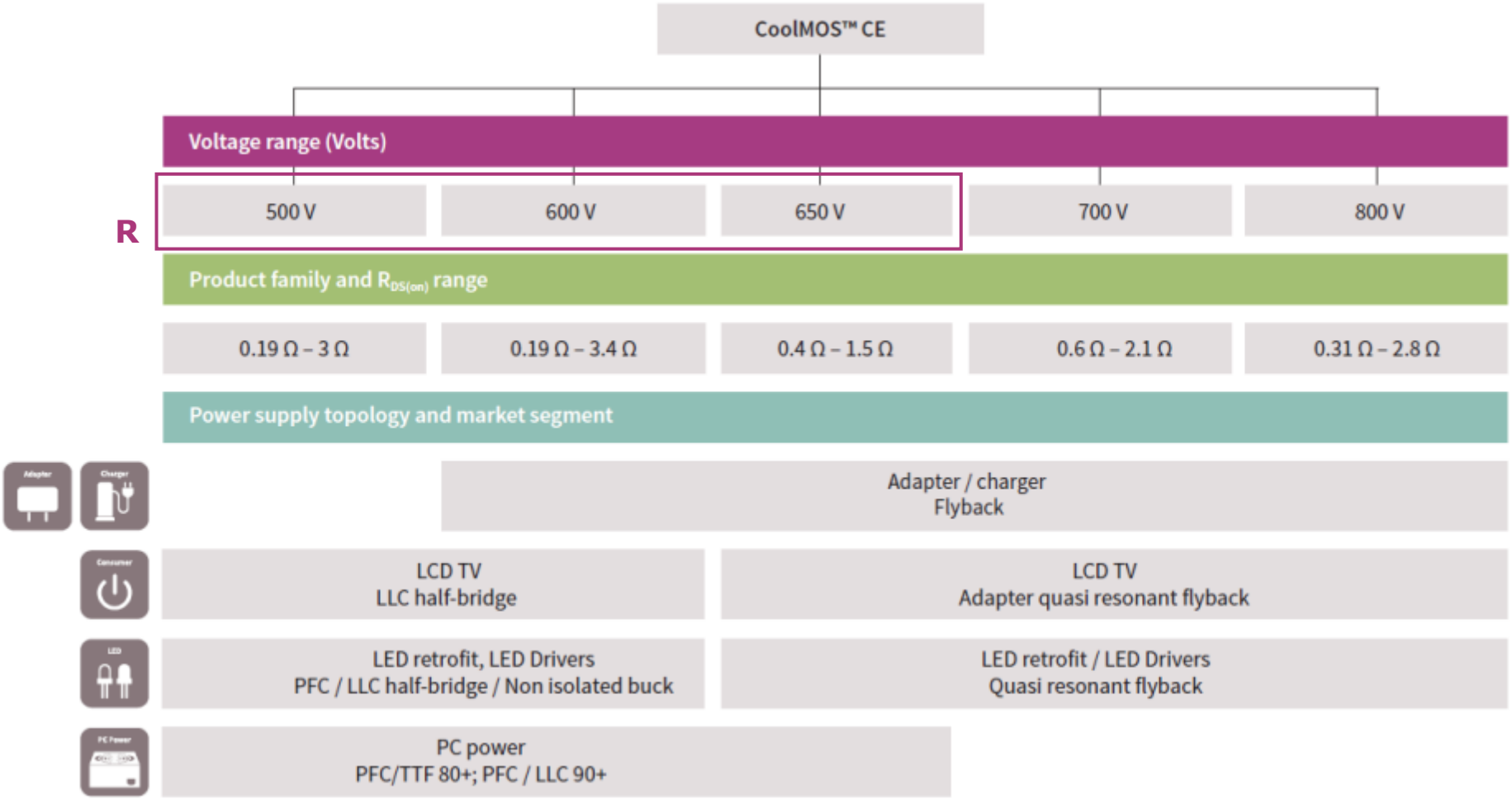

Copyright © Infineon Technologies AG 2017. All rights reserved.

# Top 5 reasons for choosing CoolMOS™ CE

| Benefits | Provided by our CE solution… |
|---|---|
| 1 Price competitiveness | › Economy of scale and improved cost structure from 300 mm production |
| 2 Lead time and supply flexibility | › We understand consumer and lighting market dynamics and offer a lead time for middle-sized orders of 4-6 weeks |
| 3 Supply security | › 3 frontend and 5 backend facilities (incl. subcons) secure supply<br>› ≥ 96% of all orders shipped before commit date |
| 4 Portfolio breadth | › Granular portfolio in 500, 600, 650, 700 and 800 V allows for the tuning of $R_{DS(ON)}$ and package |
| 5 Design-in support | › We have a large field application engineering team to provide professional & flexible support for your design |


Copyright © Infineon Technologies AG 2017. All rights reserved.

# CoolMOS™ CE targets a broad range of applications




**R = Recommended for battery powered applications**


Copyright © Infineon Technologies AG 2017. All rights reserved.

# CoolMOS™ CE: optimized platform addressing and meeting chargers customer needs

| Customer concerning factors charger/ flyback in low power | CoolMOS™ value proposition (600 V and 650 V for flyback) |
|---|---|
| Thermal behavior<br>≤ 90°C on device, open case<br>≤ 50°C/70°C close case temperature | Low conduction losses from large margin between $R_{DS(on)}$ typ to nom<br>Low switching losses from optimized $E_{oss}$ |
| EMI within EN55022B standard | Optimized EMI to balance switching speed and EMI behavior |
| EMI within EN55022B standard | Good controllability given the integrated $R_g$ |

| Customer benefits |
|---|
| High efficiency and consequent reduction of power consumption within large safety thermal margins<br><br>Reduced design-in effort |

Copyright © Infineon Technologies AG 2017. All rights reserved.

# Infineon's industrial microcontrollers, power and sensor components complement each other

**Microcontrollers**
**XMC™ & iMOTION™**


Copyright © Infineon Technologies AG 2017. All rights reserved.

# Microcontroller solutions from Infineon

## Industrial µController - XMC™

- **XMC1000 – Family:** arm based µController (ARM Cortex™ - M0)
  - XMC1300: up to 200 kB Flash / 16 – 40 pins
  - XMC1400: up to 200 kB Flash / 40 – 64 pins
  - all products **are available until min. 2031**

Hardware Solution

## iMOTION™ Controller

- **IRMCK099M**
  - 8 bit high speed 8051 microcontroller, 64 KB Flash
  - Motion Control Engine (MCETM) 16 bit RISC for motor control algorithm execution
  - sensorless Field Oriented Control block, including flux estimator, angle PLL
  - Speed loop customizable

Turnkey Solution

## Embedded Power

- **Space optimized solution: entire motor control solution fits in 33 mm X 33 mm**
- **Programmable** FET driver enables an **easy** design for **wide range of power loads**
- Enables **decentralized intelligent motor control architecture**

ASP

| | |
|---|---|
| Turnkey Solution | Software from IFX, Parametrization only |
| Hardware Solution | Software developed by customer |
| ASP | MC Software from IFX, combined with customer application code |


Copyright © Infineon Technologies AG 2017. All rights reserved.

# XMC™ MCUs powered by ARM® Cortex™ M0 one microcontroller platform

**ARM Cortex™ - M0**
- Core 32 MHz / Peripherals up to 64 MHz
- Capture Compare Units (CCU4)
- 2x Serial Channels
- **12Bit ADC**
- **Interconnect Matrix**
- **Secure Bootloader**
- **1.8 V – 5.5 V Supply Voltage Range**
- **TA = -40C to 105C**

| | | | |
|---|---|---|---|
| | XMC1100 | Up to 64 kB Flash<br>TSOP16/38, VQFN24/40 | |
| | XMC1200 | Up to 200 kB Flash<br>TSOP16/28/38, VQFN24/40 | 9 ch LED Control (BCCU)<br>3 x Analog comparators |
| R | **XMC1300** | Up to 200 kB Flash<br>TSOP16/28/38, VQFN24/40 | Math Co-Processor<br>CCU8 PWM Timer<br>Hall & Encoder I/F |
| R | **XMC1400** | Up to 200 kB Flash<br>**VQFN40/48/64, TQFP64** | 48 MHz Core / 96 MHz Peripherals<br>2x CAN FD<br>2x CCU8 / Up to 4 Serial Channels |

**R = recommended for robotic vacuum cleaner and lawn mowers**

## PRODUCT DIFFERENTIATORS

**MATH co-processor**
speeds up your arithmetic calculations by up to 94% - enables sensorless FOC motor control on M0 class device

**Event Request Unit (ERU)**
enables interconnection between analog, PWM and sensor interface peripherals

**Supply Voltage Range**
wide Supply Voltage Range from 1.8 V – 5.5 V

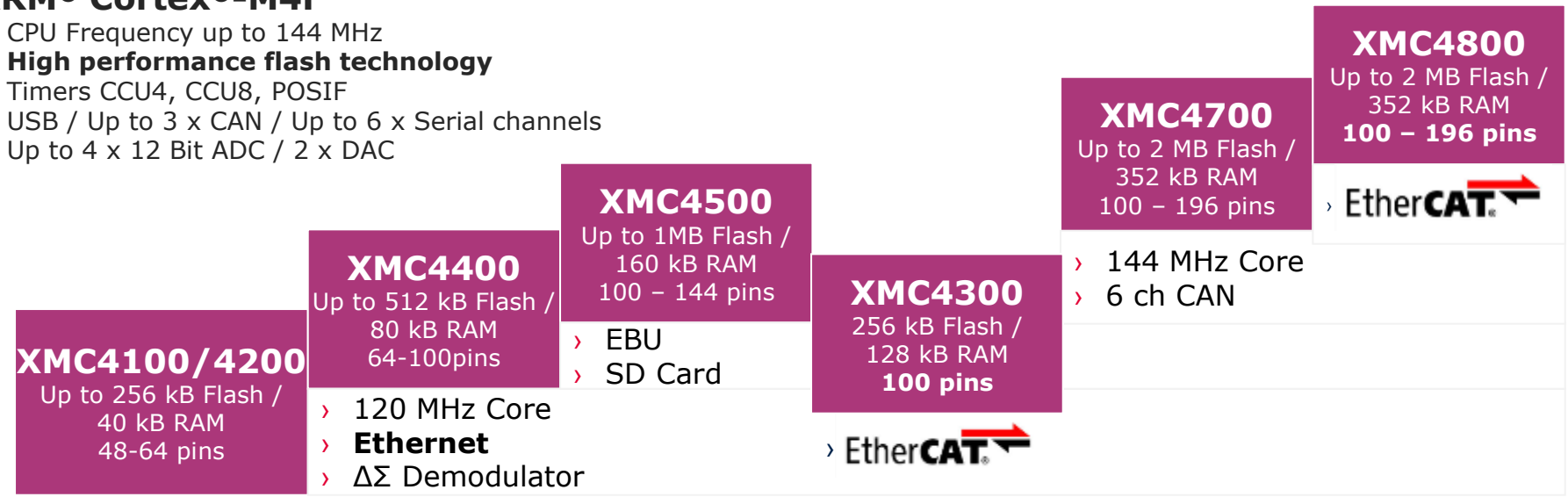
**Secure boot loader**
embedded code can be programmed to flash memory in a protected way using AES 128-bit cryptography. Protects IP if manufacturing is outsourced


Copyright © Infineon Technologies AG 2017. All rights reserved.

# XMC4000 MCUs powered by ARM® Cortex® - M4F

## ARM® Cortex®-M4F

- CPU Frequency up to 144 MHz
- **High performance flash technology**
- Timers CCU4, CCU8, POSIF
- USB / Up to 3 x CAN / Up to 6 x Serial channels
- Up to 4 x 12 Bit ADC / 2 x DAC




**QFN 48 – 64-144 LQFP – 196 BGA**

**Long product life cycle (min. 2027)**

**Extended temperature range – up to Ta 125°C + continues up time of 20years@Tj 110C**

**Application specific peripherals**

| EtherCAT | Event request unit (ERU) | CSG - High-speed comparators + high resolution PWM | Timer for inverter control (CCU8) | Delta Sigma demodulator |
|---|---|---|---|---|
| Enable RT-Ethernet without the need of an external ASIC / FPGA → System Cost Saving | enables interconnection between analog, PWM and sensor interface peripherals → improves real-time behavior and reduces CPU load | reaching analog control performance with all the flexibility of digital control | dedicated timer for motor and inverter based designs → helps to reduce software workarounds + reduces CPU load | with integrated filters for cost- and size-efficient galvanic isolated current measurement. |


Copyright © Infineon Technologies AG 2017. All rights reserved.

# XMC1000 success story

**XMC1000 Microcontrollers**
32 MHz ARM® Cortex® - M0

**XMC1100**

**XMC1200**
LED Lighting, SMPS

**XMC1300**
Motor Control, SMPS

XMC1000 **customers** are **market leaders** in our **target applications**

Some Examples

Power Tools
Drives

Fans

LED Power
Supplies

XMC1000 is **award winning**

„Product of the Year 2013
electronic industry"

„Infineon High Performance
Award 2013"


Copyright © Infineon Technologies AG 2017. All rights reserved.

# XMC1400: NEW opportunities in new and existing markets

**Value proposition**

- **70%+ performance** over XMC1300
- Peripherals and on-chip-connectivity for **dual-motor control** and **dual-channel buck converters**

NEW opportunities in EXISTING markets

**Power Tools, e-Bikes, Fans, Pumps, LED ballasts**

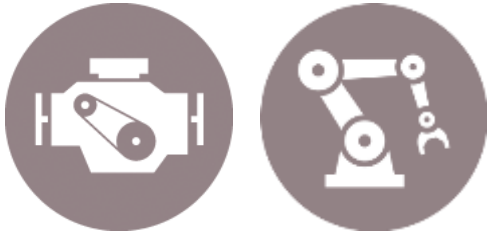
+

- 2 nodes **MultiCAN**
- **PWM timer** for **combustion engine control**
- Application know how as **#1 in Powertrain MCUs**

NEW opportunities in NEW markets

**I/O Modules Factory Automation**

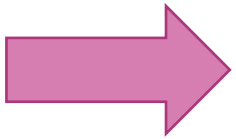
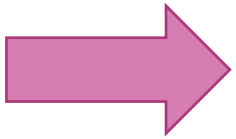
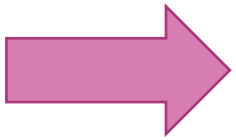
**Small combustion engines**




Copyright © Infineon Technologies AG 2017. All rights reserved.

# The value proposition of XMC1400 lies in its taylored features and broad scalability

## Taylored features (some examples)

| | | |
|---|---|---|
| MATH Co-processor |  | › Trigonometric operations and divisions allow control algorithms impossible with standard Cortex® M0 Microcontrollers |
| Motor Position Interface |  | › Direct interfacing to Hall sensors eliminates costly additional ICs |
| On-chip interconnects |  | › Peripherals like timers, ADCs or comparators can be directly connected<br>› This allows fast and deterministic control loops |

## Scalability

- Reuse of peripherals across XMC1000 family
- Pin-compatible VQFN-40 products to scale from XMC1300
- 32KB to 200KB Flash memory derivatives
- DAVE™ Development environment
- XMC™ Lib (peripheral driver)
- DAVE™ Apps


Copyright © Infineon Technologies AG 2017. All rights reserved.

# TinyMCE (IRMCK099M) features

iMOTION™

**Integrated Design Platform**

- Sensorless motor control
- Simplified system solution
- Sinusoidal
- Robust algorithm
- Hardware accelerators
- Flexibility
- Fast time to market
- 10+ years of application know how in home appliances

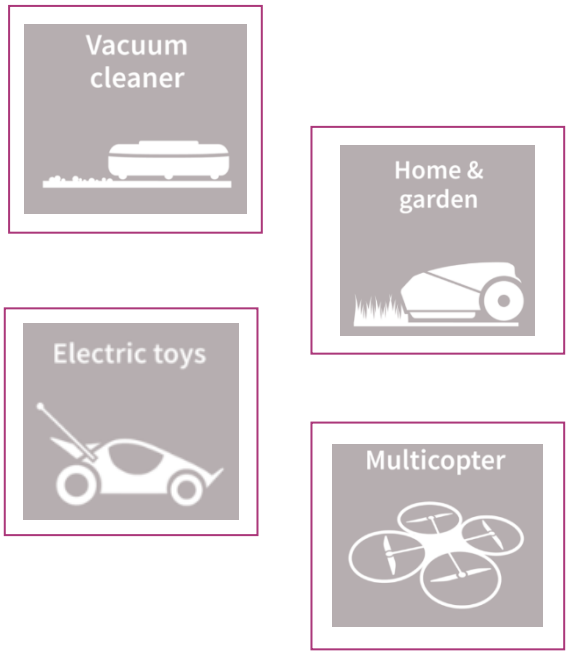
- 32 bit MCE computation engine
- 100 MIPS by internal calibrated 100 MHz system clock
- Hardware accelerator (multiply, divide, Cordic vector rotate, ATAN) for fast FOC algorithm execution
- Zero offset/gain 8-channel 12-bit ADC (0-1.2 V)
- Integrated OP amps and comparator for current sensing
- 31 times re-writable parameters with 16 K byte OTP memory
- Low power standby mode, wake up by analog input (Vsp.)
- Internal temperature sensor
- Configurable digital IO
- Internal overcurrent hardware comparator
- UART, I2C, analog (PWM) output and capture input


Copyright © Infineon Technologies AG 2017. All rights reserved.

# Benefits of iMOTION™

**iMOTION™**

**Integrated Design Platform**




- No hall sensors – this **lowers system cost** and increases reliability
- No active components

- **Higher efficiency** due to IPM reluctance torque.
- Smooth operation and **low acoustic noise**

- **High performance** with FOC
- Control 1 motor, 1 motor & PFC or 2 motors & PFC
- Integrated digital PFC

- **Save time and money** in motor control development
- Zero risk, yet **innovative architecture**

- Can control 3 phase permanent magnet motor/ IPM and BLDC motors
- **Large speed range operation**
- Vibration suppression control


Copyright © Infineon Technologies AG 2017. All rights reserved.

# Infineon's industrial microcontrollers, power and sensor components complement each other

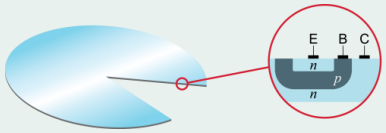
## Industrial Gate Driver ICs EiceDRIVER™


Copyright © Infineon Technologies AG 2017. All rights reserved.

# Choose the technology that fits your needs
# Key technology performance parameters

## Level-shift

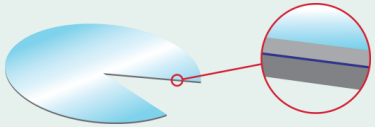
### Junction isolation R




- Largest product lineup with industry standard gate driver portfolio
- Many drivers are tailored towards specific application needs at best price performance

- FET-based bootstrap circuit (typically 200 Ω)
- Active negative transient immunity (typically -90 V for a period of 1 µs) to prevent latch-up
- Common mode transient immunity (CMTI) typically 50 V/ns
- Resilient against positive voltage spikes

### Silicon on insulator R

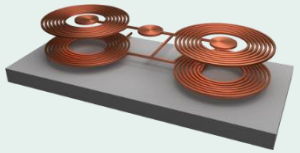


- Total system cost oriented, enabled through higher level of integration
- Increased robustness, e.g. against negative voltage transients

- PN-based bootstrap diode (typically 40 Ω)
- Negative transient immunity (-200 V for 1 µs) to prevent latch-up
- Common mode transient immunity (CMTI) typically 50 V/ns

## Galvanic isolation

### Coreless transformer



- Performance oriented
- Competitive alternative to optocoupler solutions
- Enables innovative applications and caters to early adopters (market leaders)

- Galvanic isolation
- Continuous immunity against negative and positive transients due to floating output chip, up to ±1200 V
- Exceptional common-mode transient immunity (CMTI) of more than 150 V/ns
- 6 kV basic isolation capabilities

**R = Recommended for battery powered drives**


Copyright © Infineon Technologies AG 2017. All rights reserved.

# Infineon offers a wide variety of driver types for a large range of voltage classes

| Driver Configuration | 5 V | 25 V | 100 V | 200 V | 500 V | 600 V | 700 V | 1200 V |
|---|---|---|---|---|---|---|---|---|
| Single channel high side | | | | | ● | ● | | ● |
| Single channel low side | ● | ● | | | | | | |
| Dual channel high side | | | | | | ● | | ● |
| Dual channel low side | | ● | | | | | | |
| High and low side | | | | ● ● | ● | ● ● | ● | ● |
| Half bridge | | | ● | ● | | ● ● | ● | ● ● |
| Half bridge plus single low side | | | | | | ● | | |
| H bridge | | | ● | | | ● | | |
| 3-phase bridge | | | | ● | | ● ● | | ● |
| Current sense | | | | | | ● | | ● |

● Non-isolated
● Junction Isolation (JI)
● Silicon On Insulator (SOI)
● Coreless Transformer (CT)

**= Recommended for battery powered drives**


Copyright © Infineon Technologies AG 2017. All rights reserved.

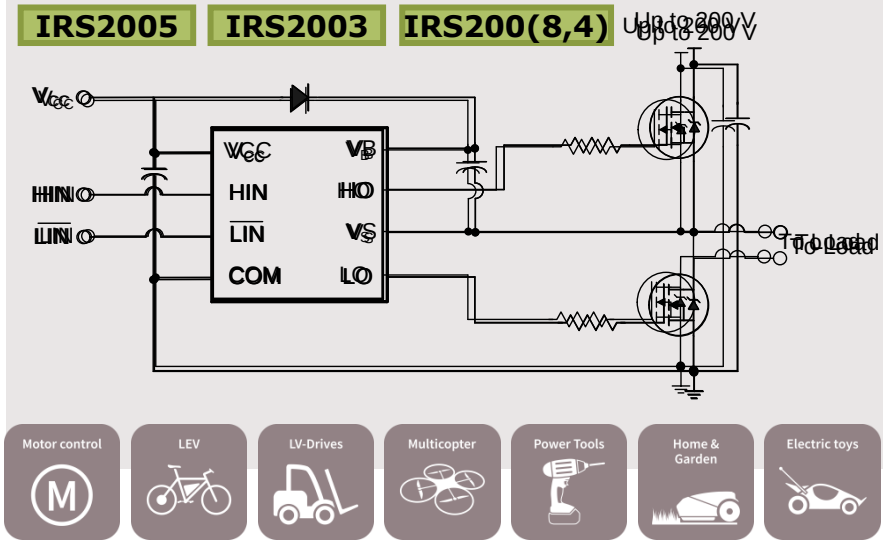
# IRS200x 200 V Gate Drivers at a Glance

## Now including new IRS2008 half-bridge driver

### Features

- Fully operational up to +200 V offset voltage
- Designed for use with bootstrap power supplies
- Gate drive supplies up to 20 V per channel
- 3.3 V, 5 V, 15 V input logic compatible
- VCC and VBS undervoltage lockout (UVLO) protection
- Integrated deadtime & cross-conduction prevention logic (IRS2008, IRS2004, IRS2003)
- Matched propagation delays for all channels
- Tolerant to negative transient voltage, dV/dt immune

### Typical Connection




| Part Number | Voltage Class [V] | $I_{O+/-}$ (typ) [mA] | Ton/off (typ) [ns] | MT (max) [ns] | DT (typ) [ns] | Tr/f (typ) [ns] | Control Inputs | VCCUV typ. [V] | VBSUV typ. [V] | Package |
|---|---|---|---|---|---|---|---|---|---|---|
| IRS2008S | 200 | 290/600 | 680/150 | 50 | 520 | 70/35 | IN, /SD | 8.2-8.9 | 8.2-8.9 | SOIC-8 |
| IRS2005S<br>IRS2005M | 200 | 290/600 | 160/150 | 50 | - | 70/30 | HIN, LIN | 8.2-8.9 | 8.2-8.9 | SOIC-8<br>MLPQ4x4 |
| IRS2004S<br>IRS2004 | 200 | 290/600 | 680/150 | 60 | 520 | 70/35 | IN, /SD | 8.2-8.9 | - | SOIC-8<br>PDIP-8 |
| IRS2003S<br>IRS2003 | 200 | 290/600 | 680/150 | 60 | 520 | 70/35 | HIN, /LIN | 8.2-8.9 | - | SOIC-8<br>PDIP-8 |

**For more information visit www.infineon.com/200VHVIC**

*Note: IRS2008 can replace IRS2004. IRS2005 replaces IRS2001.


Copyright © Infineon Technologies AG 2017. All rights reserved.

# Infineon Solution Finder
# www.infineon.com/driver-finder

Visit Infineon's online **Solution Finder**. To simplify the gate driver selection process, Infineon offers an online easy-to-use tool. By selecting a few key switch or driver parameters, the tool quickly guides you in finding the right driver for your application.

**Switch based selection**

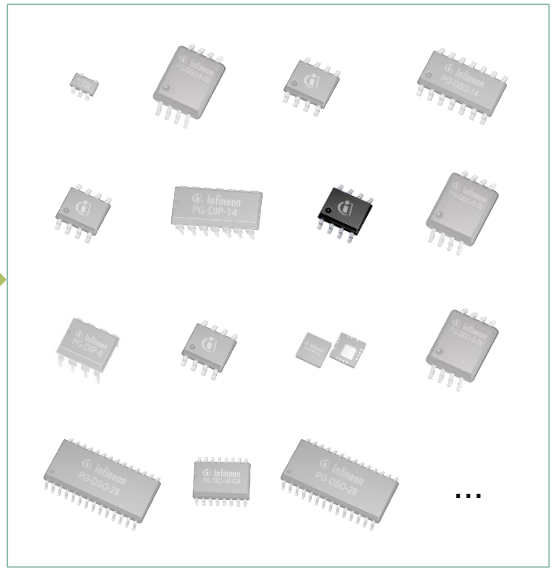
1. Switch Type or Product
2. Voltage Class
3. Gate Resistance
4. VGE/VGSS

-or-

**Driver based selection**

1. Driver Current
2. Voltage Class
3. Switching Frequency
4. Driver Topology
5. Isolation Requirement
6. Qualification Level
7. Package

**Infineon Gate Driver IC Portfolio**





Copyright © Infineon Technologies AG 2017. All rights reserved.

Part of your life. Part of tomorrow.

Infineon