Power Management

Selection Guide 2017

www.infineon.com/powermanagement-selectionguide

Dear Customer,

The world is evolving into a place of always-on interconnectivity – demanding reliable, high performance and energy efficient solutions. Tiny, barely visible electronic components have become an indispensable part of our daily lives. They help to feed regenerative energy into power grids with almost zero losses, tame power-hungry computers, give us new invisible radar interfaces to control hardware, safeguard the data flying through cyberspace, make our cars more energy-efficient and enable new technologies such as wireless charging. Smart cities with smart homes, Internet of Things, Industry 4.0, building and industrial automation as well as smart vehicles are environments with a new demand on capacity and size of our system solutions.

Infineon Technologies translates future lifestyle trends into system requirements for next generation semiconductor solutions. The new Power Management Selection Guide illustrates our very broad portfolio of advanced, high performance technologies for the interconnected world of tomorrow. It meets your requirements by providing the right-fit solution with leadership of technologies, innovation and quality standards unrivalled in the industry.

As innovation and quality leader, we offer our long term expertise, our supply chain – delivery reliability, flexibility and supply security – and our professional support. Please feel invited to find the right products and solutions for your purpose.

Andreas Urschitz
Division President of
Power Management & Multimarket

电源管理及多元化市场总裁

尊敬的客户，

我们所处的这个世界正演变成一个无时无刻都处于互连状态的世界，需要可靠高效且节能的解决方案。 那些微小的，几乎看不到的电子元件已经成为日常生活中不可或缺的一部分。 这些电子元件能够使再生能源几乎零损失地馈入电网，减少计算机的耗电量，提供新的可以控制硬件的隐形雷达接口，保护通过网络空间传输的数据，使汽车更加节能并实现诸如无线充电等新技术。 智慧城市是一个综合环境，包含智能家居、物联网、工业4.0、建筑和工业自动化以及智能车辆等方面，对系统解决方案的容量和规模提出了新的需求。

英飞凌科技将未来的生活趋势转化为下一代半导体解决方案的系统需求。 新的电源管理选型指南展示了英飞凌为未来的互连世界准备的各种先进的高性能技术组合。 这些组合将领先的技术与创新以及行业内无与伦比的质量标准结合起来，为您提供适合的解决方案，能够满足您的各种需求。

作为行业创新和质量的领导者，英飞凌提供久经考验的专业知识，我们的供应链交付方式可靠、灵活，保障供应，并且还提供专业的支持。 期待您能接受我们的邀请，为您的需求找到合适的产品和解决方案。

Content

From product thinking to system understanding

Infineon enables efficient generation, transmission and conversion of electrical energy

We make life easier, safer and greener – with technology that achieves more, consumes less and is accessible to everyone.

www.infineon.com/power

3D printer

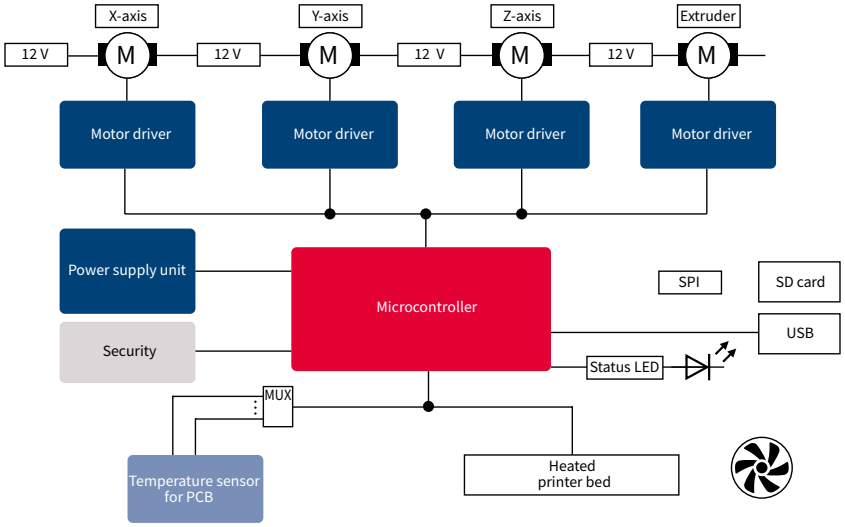
Industry-leading full system solution

Today, consumers can create a growing list of objects with nothing more than a digital file and a 3D printer. While the excitement is understandably big, 3D printers continue to face a number of limitations – most notably size and speed – that currently prevent the technology from fully replacing a number of assembly line manufacturing processes. Moving beyond these limitations to create winning 3D printing designs requires a highly reliable motor control solution with excellent speed control and position detection capabilities. Furthermore, the compact power supply must offer top energy efficiency and power density.

With Infineon's complete portfolio of semiconductor solutions, you will find components for 3D printing designs destined for high acclaim. We offer system solutions with every product you require – such as 40 V-800 V MOSFETs, CoolSET™ or integrated point-of-load converters (SupIRBuck™) for power management, our CIPOS™ Nano, NovalithIC™, IFX9201, sensor solutions and XMC4500 microcontroller for motor control, our OPTIGA™ Trust E for authentication and OPTIGA™ Trust TPM for security of data communication. As a leader in power management, Infineon offers benchmark product solutions for your power supply designs, ensuring highest efficiency ratings and higher power density. Our high level of integration of motor control solutions (up to 300 W), for example with our H-bridge IFX9201, CIPOS™ Nano or NovalithIC™, allows you to significantly reduce PCB space and system cost.

Our sensor solutions enable precise rotor position detection and more accurate switching points to ensure higher torque in our motor solutions. As proven by Infineon's exceptional track record, every component bearing the Infineon name is as robust as it is reliable.

Block diagram



www.infineon.com/3dprinter

Infineon's product recommendation for 3D printer

Functional block	Products	Selection/benefit
Motor control	CIPOS™ Nano	High integration
	NovalithIC™	Integrated solution with fast signal processing and short delay times
	Angle sensor	Low power consumption and high accurate angular and linear position detection
	IFX9201	DC motor control for industrial applications – high integration, small package, protection features
	Hall switches	Recommendation
	Industrial microcontroller XMC1100/XMC4500	Recommendation
	Industrial transceiver	Recommendation
Power supply: PFC stage	600 V CoolMOS™ P6/CE	Ease-of-use and high efficiency
	650 V PFC control IC	High efficiency
	650 V CoolSET™ F3	High efficiency
	650 V rapid 1/rapid 2 diodes	Efficiency
	650 V CoolSiC™ diodes generation 5	Ease-of-use and cost-optimized solution
	EiceDRIVER™ 2EDN gate driver	Fast and robust gate driver
Power supply: Main stage	650 V quasi-resonant controller	High efficiency
	650 V LLC controller	High efficiency
	800 V CoolMOS™ CE/C3	High efficiency
	EiceDriver™ 2EDN gate driver	Fast and robust gate driver
Main stage: Synchronous rectification	40 V - 60 V OptiMOS™	High efficiency
	60 V synchronous rectification MOSFET IRLR3636	High efficiency
	EiceDRIVER™ 2EDN gate driver	Fast and robust gate driver
Power supply: DC-DC point-of-load	Integrated power stages DC-DC: PowIRstage™, DrMOS	High performance
	Fully integrated point-of-load converter SupIRBuck™	High performance DC-DC point-of-load solution
Recommended microcontroller + DC-DC converter	Industrial microcontroller XMC1300, XMC4xxx-series	Recommendation
	DC-DC voltage regulator (IFX90121, IFX91041, IFX81481, IFX80471)	High performance
Security	OPTIGA™ Trust E/OPTIGA™ TPM	Enhanced embedded security

www.infineon.com/3dprinter

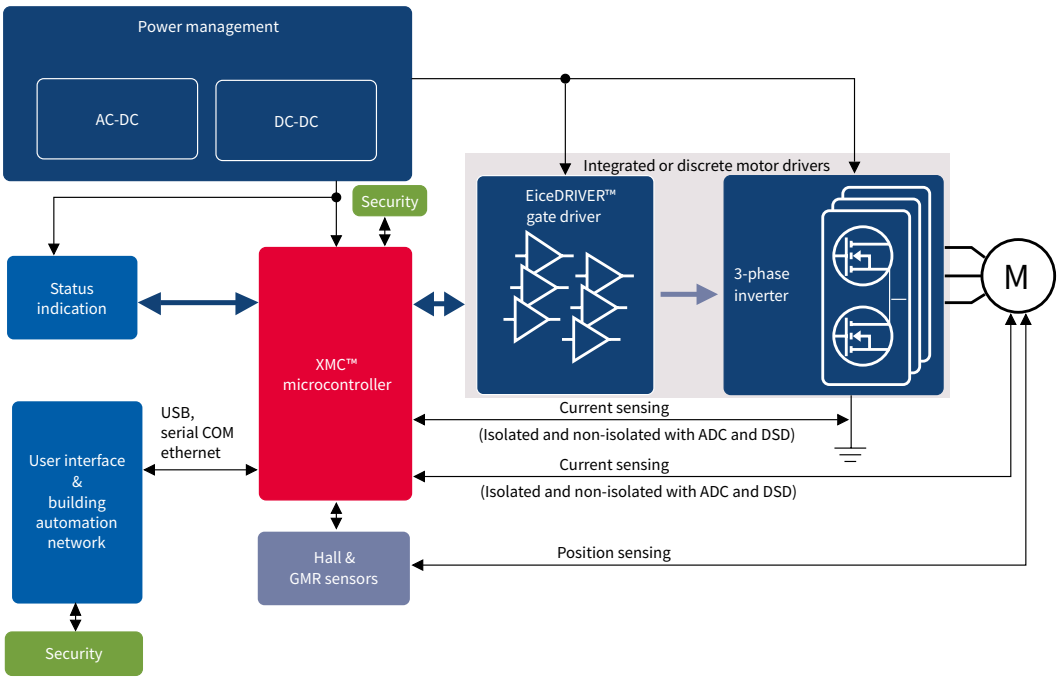
Automatic opening system

Benchmark efficiency solutions for your motor control and power management

Every building and household utilizes openings at numerous positions in and around the building: sliding and swing doors, garage doors, sun-blinds and automated gates. When automated, these doors are equipped with systems that are able to manage the opening action, avoid unintentional opening, control the speed and torque, detect the presence of objects along the path, and a number of other functions. Automatic opening systems incorporate smart sensors, motor controls, supplies and battery management, which help to reduce energy losses in all conditions. This is where Infineon comes into place.

With Infineon's complete portfolio of semiconductor solutions, we offer system solutions for every product you require, ranging from power semiconductors over sensors to security products. Infineon products make your motor designs more energy efficient and secure against unauthorized manipulation of firmware update while our radar solutions cover a 16 times larger area than infrared solutions.

Block diagram



www.infineon.com/automaticopeningsystem

Functional block	Products	Selection/benefit
Motor control	650 V TRENCHSTOP™ IGBT	Recommendation
	Low voltage MOSFETs – OptiMOS™/StrongIRFET™	Recommendation
	Intelligent power modules/CIPOS™	High integration
	Intelligent power modules – NovalithIC™	High integration
	Angle sensors	Integrated solution with fast signal processing, short delay times
	Hall switches	Low power consumption and high accurate angular and linear position detection
	Double hall switches (TLE4966)	High integrated sensor solution for position detection including direction detection
	Gate driver ICs – EiceDRIVER™ 2EDL Compact/Enhanced	Recommendation
	Industrial microcontroller XMC1000/XMC4000	Recommendation
	DC-DC converter	High performance
Power management	AC-DC integrated power stage – 650 V CoolSET™ F3	High efficiency
	High voltage MOSFETs – 600 V CoolMOS™ P6	High efficiency
	650 V TRENCHSTOP™ IGBT	High efficiency
	Low voltage MOSFETs – OptiMOS™ (20 V - 300 V)	High efficiency
	PWM ICs for PFC/LLC/Combi PFC+LLC	High efficiency
	Gate driver ICs – EiceDRIVER™ 2EDL Compact/ Enhanced	Recommendation
Motion sensor	24GHz radar sensor – BGT24MTR11/BGT24LTR11	High performance
	24GHz radar sensor – BGT24MR2	High performance
	24GHz radar sensor – BGT24MTR12	High performance
Security	Security controller ICs – OPTIGA™ Trust E/OPTIGA™ TPM	Enhanced embedded security

www.infineon.com/automaticopeningsystem

Motor Control

Battery powered applications

Highest performance in your motor control

Based on industry leading technology and the highest quality and manufacturing expertise, Infineon provides a variety of innovative power semiconductors which enable designers to develop highly reliable and efficient solutions for all kinds of battery powered drive applications.

Key enabling products

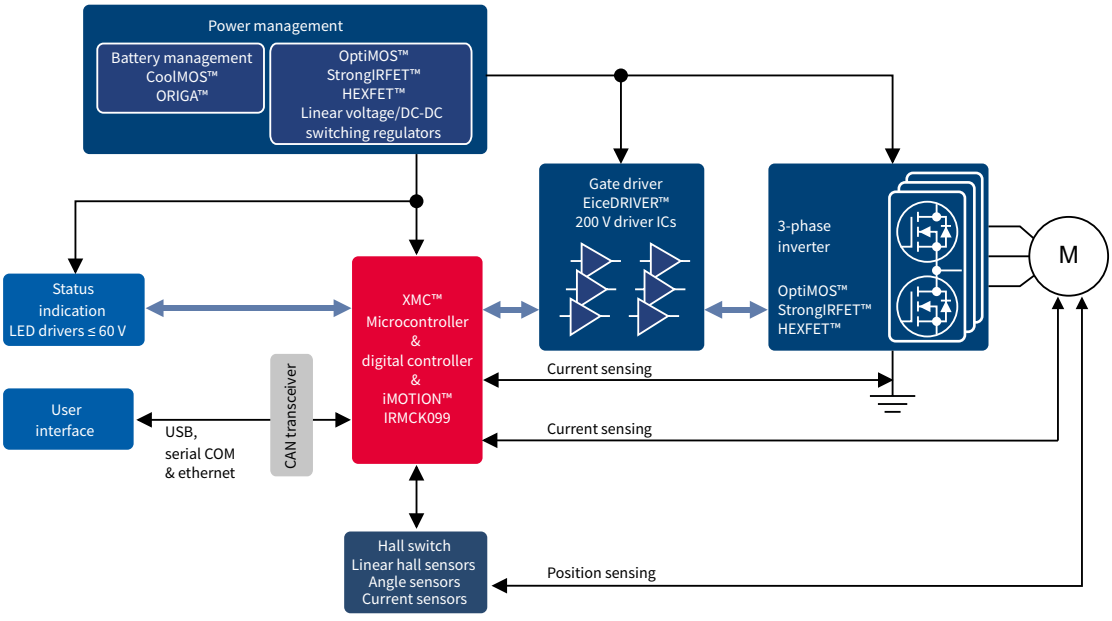
- Low voltage power MOSFETs – OptiMOS™ and StrongIRFET™
- Small Signal products
- High voltage power MOSFETs – CoolMOS™
- Gate driver ICs – EiceDRIVER™ Compact and 100 V/200 V
- Microcontrollers – XMC™
- Magnetic sensors and voltage regulators
- Motion control IC – iMOTION™ IRMCK099

Infineon offers a comprehensive portfolio to address a broad range of battery powered motor control applications such as power tools, forklift, all kind of light electric vehicles e.g. e-skateboards, e-scooter, pedelecs, low speed cars and many others. For further information please explore our homepage: www.infineon.com/motorcontrol

Many end markets for the same circuit

Industrial drives	Consumer drives	Light electric vehicles	Toys	DC drives
Forklift trucks, industrial automation	Power and gardening tools, vacuum cleaner	E-scooter, e-bike, e-skateboard, LSEV	RC toys and multicopters	Pumps and fans
				

Typical battery powered three-phase system: a one-stop-shop for battery powered drives



www.infineon.com/motorcontrol

A complete set of components that ensure system-cost competitiveness and high performance solution

	RC toys and multicopters	Consumer drives	DC drives	Light electric vehicles	Industrial drives
MOSFETs	20 V-200 V StrongIRFET™				
	20 V-300 V OptiMOS™				
	CoolMOS™ CE			CoolMOS™ P6	
Driver ICs	EiceDRIVER™				
	100 V/200 V gate drivers				
Microcontrollers	XMC1000				
	iMOTION™ IRMCK099				
			XMC1000, XMC4000		
Voltage regulators	Linear voltage and DC-DC switching regulators				
Magnetic sensors	Hall sensors, Hall latches and angle sensors				

Infineon product offering		Power tools	Industrial drives	Light electric vehicles	RC toys, multicopters
Low voltage MOSFETs OptiMOS™ StrongIRFET™	Voltage	20 V-200 V	60 V-150 V	60 V-300 V	25 V-100 V
	Package	TO-220, DPAK, D²PAK, SuperSO8, PQFN 3x3, DirectFET™	DPAK, D²PAK, D²PAK 7pin, TOLL	TO-220, DPAK, D²PAK, D²PAK 7pin, TOLL	SuperSO8, PQFN 3x3 , DirectFET™
High voltage MOSFETs CoolMOS™ CE [1]	Voltage	500 V, 600 V, 650 V	-	-	500 V, 600 V, 650 V
	Package	TO-220, TO-220 FullPAK	-	-	TO-220, TO-220 FullPAK
High voltage MOSFETs CoolMOS™ P6	Voltage	-	600 V	600 V	-
	Package	-	TO-220, TO-220 FullPAK	TO-220, TO-220 FullPAK	-
Driver ICs EiceDRIVER™ Compact		2EDL05N06 1EDN/2EDN EiceDRIVER™	2EDL23N06	2EDL05N06 2EDL23N06 1EDN/2EDN EiceDRIVER™	2EDL05N06
100 V/200 V gate drivers		IR210x/IR218x (Gen2)/IRS210x/IRS218x (Gen5)/IR233x (Gen2)/IRS233x (Gen5)			IR2011 (Gen2) IRS2011 (Gen5) IRS200x (Gen5)
Authentication IC [2]		ORIGA™ 1	-	-	ORIGA™ 1
Microcontrollers/Motor control ICs		XMC1300	XMC4400/4500	XMC1300, XMC4400/4500	XMC1000, IRMCK099
Microcontrollers and driver supply		IFX1763/IFX54441/IFX54211/IFX21003/IFX30081/IFX90121/IFX91041			
Sensors		Hall latches: TLx4961/TLx4963; Angle sensors: TLE5009/TLI5012B			

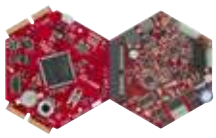
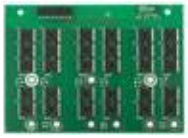
Application requirements

- Efficiency: reduction of overall system energy consumption, increasing battery operating and life time, optimized thermal management
- Reliability: reliable operating in harsh environments and avoiding system downtime
- Maintenance: low maintenance and long lifetime of components
- Size and cost: reduction of overall system size and cost
- Time-to-market: reduction of development time and cost

Benefits of Infineon components

- Portfolio: complete portfolio out of one hand – enables scalability
- Reliability: increased lifetime due to Infineon's reliability and quality
- Size and cost: smallest area required for highest power density and BOM cost reduction due to lowest $R_{DS(on)}$
- Time-to-market: complete eco-system: simulations, documentation and demoboard solution for high-end solutions available

To shorten customer development cycle time and cost we offer a complete portfolio of low voltage motor control application kits:

XMC1000 motor control application kit	XMC4000 motor control application kit	iMOTION™ modular application design kit (MADK)	Evaluation board 5 kW TO-Leadless
			

1) Focus on power tool chargers
2) Focus on authentication for power tool chargers

E-mobility

Best solutions for battery chargers, wireless charging and battery management

To recharge the battery of an electric or hybrid/electric car, a charger is needed. Chargers can be implemented on-board or off-board the vehicle. Electric energy may be transferred to the vehicle by wire or by wireless methods like resonant inductive power transfer. Power units on-board the vehicle require automotive-grade components, while the wider product selection of industrial-grade components can be used for off-board units.

On-board chargers

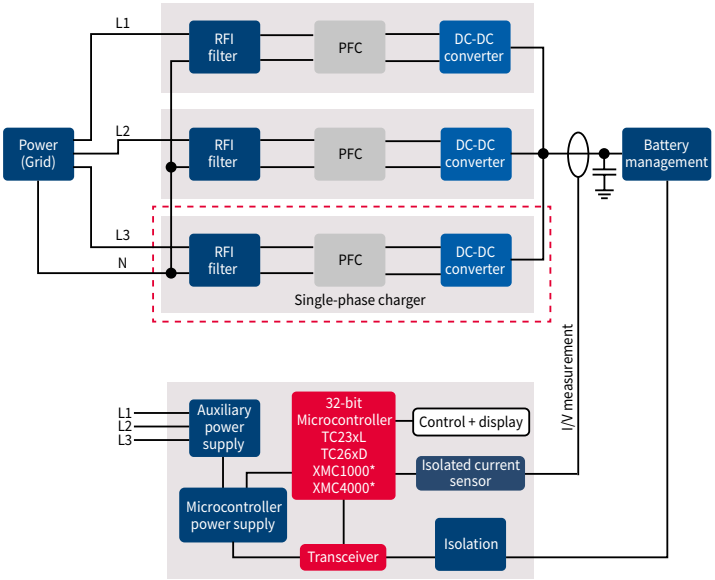
In cars with on-board chargers the batteries can be recharged from any standard AC power outlet, which provides maximum power of 3.6 kW best case (single-phase 230 V/16 A). This standard charging at low power takes several hours (overnight). Battery charging via the power grid requires a flexible power converter topology to handle different voltage and power ratings wherever the car may go to, and on-board chargers need to be as efficient and small as possible to stay cool at lowest possible weight.

Off-board chargers

In off-board chargers, the power conversion from AC grid voltage to DC battery voltage is done outside the car and the resulting DC power is transmitted by wire to the EV's DC-charging socket. Ultra-fast chargers with power ratings at 50 kW and more have been designed in this way. As the power converter is off-board, automotive grade qualification is not required for the respective electronic components.

Apart from fast and ultra-fast chargers, there may be a market for off-board chargers in the power range up to 10 kW, for example to charge small and economic electric vehicles (LEVs). Also in case of the off-board chargers, selecting the right topology to enable maximum conversion efficiency is an important design criterion.

AC-DC battery chargers: functional blocks



www.infineon.com/emobility

*For off-board chargers only

Product portfolio for on-board and off-board charger applications

Infineon's comprehensive portfolio of semiconductors (sensors, microcontrollers, power semiconductors, etc.) lends itself perfectly to designs of compact units for on-board, off-board and wireless charging. Our products in this sector support high switching frequencies at lowest possible $R_{DS(on)}$ to enable compact and efficient designs: MOSFETs such as CoolMOS™, IGBTs such as TRENCHSTOP™ 5 and SiC Schottky diodes, like 650 V CoolSiC™ diode. In addition, integrated MOSFET and IGBT drivers, controller ICs for active CCM PFC high-performance microcontroller solutions and highly accurate current sensors complete our product portfolio.

Automotive products for on-board units

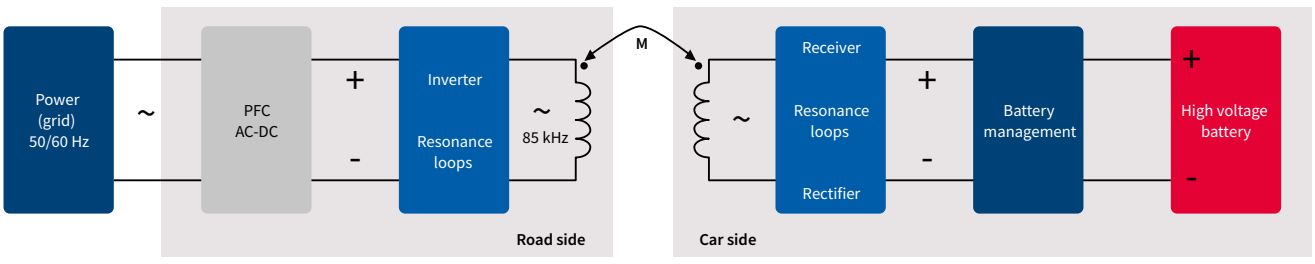
Typical part number	Product family	Description
1ED020I12FA2	Automotive EiceDRIVER™	Single-channel isolated driver for 650 V/1200 V IGBTs and MOSFETs
1ED020I12FTA	Automotive EiceDRIVER™	Single-channel isolated driver, two-level turn-off for 650 V/1200 V IGBTs
2ED020I12FA	Automotive EiceDRIVER™	Dual-channel isolated driver for 650 V/1200 V IGBTs and MOSFETs
IPx65RxxxCFDA	CoolMOS™	650 V MOSFET with integrated fast body diode
TC23xL, TC26xD	AURIX™	32-bit lockstep microcontroller
TLF35584 [1]	System supply	New ISO26262-system-supply optimized for AURIX™
TLE7250G	Transceiver	High-speed automotive CAN transceiver
TLE6251D	Transceiver	High-speed automotive CAN transceiver, with wake-up

Industrial products for off-board units

Typical part number	Product family	Description
IKWxxN65F5	TRENCHSTOP™ 5	650 V fast IGBT with rapid 1 diode
IGWxxN65F5	TRENCHSTOP™ 5	650 V fast IGBT single
IDWxxG65C5	CoolSiC™ diode	650 V/1200 V SiC Schottky diode generation 5
IPW65RxxxC7	CoolMOS™	650 V MOSFET, CoolMOS™ C7 series for hard switching topologies
HYBRIDPACK™ 1	Power module	1200 V/200 A for fast and ultra-fast charging (>10 kW/phase)
XMC1000 [2], XMC4000 [2]	XMC™ microcontroller	32-bit ARM® Cortex® M0/M4F microcontrollers, up to 125°C ambient temperature (XMC4000)
IFX1763, IFX54441, IFX54211	Linear voltage regulator	Linear voltage regulator family with output current capability of 500 mA/300 mA/150 mA respectively
IFX1050, IFX1021	Transceiver	High-speed CAN transceiver/LIN transceiver
TLI4970	Current sensor	600 V functional isolation, ± 50 A

Wireless charging

Wireless methods for power transfer to charge the batteries of electric vehicles are gaining attention. Several concepts for wireless power transfer systems have been proposed, which in general seek to compensate the significant stray inductances on primary and secondary sides of the magnetic couplers by adaptive resonant methods. By the end of 2013, SAE announced a future standard for inductive charging which will define three power levels at 85 kHz. Infineon's TRENCHSTOP™ 5 IGBT and CoolSiC™ diodes are perfectly suited for driving inductive power transfer systems (on the road side) which operate inside the 80 kHz to 90 kHz band.



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1) in development
2) for external chargers

Automotive products for the car side*

Typical part number	Product family	Description
1ED020I12FA2	Automotive EiceDRIVER™	Single-channel isolated driver for 650 V/1200 V IGBTs and MOSFETs
1ED020I12FTA	Automotive EiceDRIVER™	Single-channel isolated driver, 2-level turn-off for 650 V/1200 V IGBTs
2ED020I12FA	Automotive EiceDRIVER™	Dual-channel isolated driver for 650 V/1200 V IGBTs and MOSFETs
IPx65RxxxCFDA	CoolMOS™	650 V MOSFET with integrated fast body diode
TC23xL, TC26xD	AURIX™	32-bit lockstep microcontroller
TLF35584 [1]	System supply	New ISO26262-system-supply optimized for AURIX™

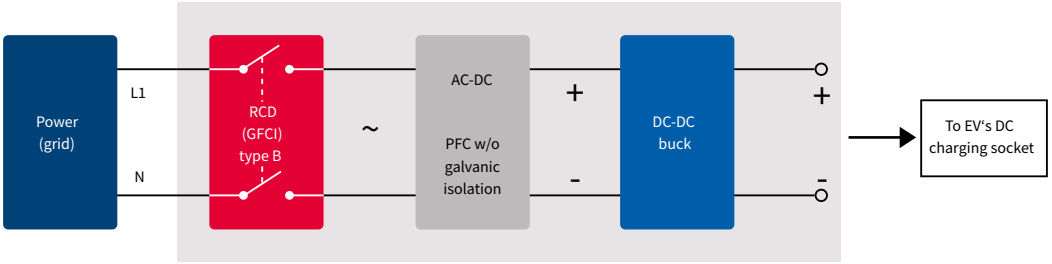
Industrial products for the road side*

Typical part number	Product family	Description
IKW40N65F5	TRENCHSTOP™ 5	Fast IGBT with rapid 1 Diode, 40 A, TO-247
IGW40N65F5	TRENCHSTOP™ 5	Fast IGBT, single, 40 A, TO-247
IDW40G65C5	CoolSiC™ diode	650 V SiC Schottky diode generation 5, 40 A, TO-247 [2]
XMC4000	XMC™ Microcontroller	32-bit ARM® Cortex® -M4F microcontrollers, up to 125 °C ambient temperature
IFX1763, IFX54441	Linear voltage regulator	Linear voltage regulator family with output current capability of 500 mA or 300 mA respectively
TLI4970	Current sensor	600 V functional isolation, +/- 50 A

*Available in different current ratings

Charger concepts without galvanic isolation of the power stages

Transformerless design, without galvanic isolation inside the power stages, are economic and efficient. But enhanced safety measures may be required to operate such designs from standard AC-grid power outlets. There need to be type-B RCD (GFCI) safety switches on the grid side to immediately break the circuit in case an unintended feedback of DC-voltage from the HV-battery into the AC-grid occurs under worst case failure conditions, but type-B safety switches on the grid side are not standard by today. This is a main reason why non-isolated designs are currently not accepted for on-board chargers as the level of safety measures on the grid side of the charging spot is uncertain. However, inside an off-board charger installation with an integrated type-B safety switch, the use of non-isolated concepts may be indicated. To highlight their opportunities, Infineon has investigated non-isolated concepts, built and evaluated laboratory-demonstrators of single-phase 3 kW chargers without galvanic isolation inside the power stages.



Concept demonstrator of lean and efficient off-board DC-charger without galvanic isolation

Input 230 V/50 Hz single-phase AC

Output 220 V-390 V_{DC}, max. power 3.3 kW at 350 V with 96.2 percent efficiency

More detailed information about this demonstrator is available upon request.

Industrial products for the road side

Typical part number	Product family	Description
ICE3PCS01G	Integrated controller	For active CCM PFC, PG-DSO-14
IPW65R019C7	CoolMOS™ C7	650 V MOSFET, 19 mΩ, TO-247
IDW30G65C5	CoolSiC™ diode	650 V SiC Schottky diode generation 5, 30 A, TO-247
TLI4970	Current sensor	600 V functional isolation, ± 50 A

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1) in development
2) Automotive version under consideration

Best solution for battery management

An intelligent Battery Management System (BMS) is necessary to sustain battery performance throughout its entire life-time – the challenge there is to tune the utilization of each battery cell individually. Passive cell balancing is the default approach where the weakest one of the cells sets the limits for battery lifetime and cruising range. Infineon's microcontrollers and sensors, in combination with our power devices, enable active cell balancing while charging and discharging. An active cell balancing system helps to increase the effective cruising range and the battery's lifetime by 5 to 10 percent, compared to passive balancing. In this context we want to highlight our 8-bit XC886CM microcontroller family for the slave blocks and the new 32-bit AURIX™ microcontroller family for the master block, our OptiMOS™ low voltage MOSFETs, our automotive CAN transceivers TLE7250G, TLE6251D, as well as step-down DC-DC controllers TLE6389-2GV and brand-new TLF35584.

Main switch

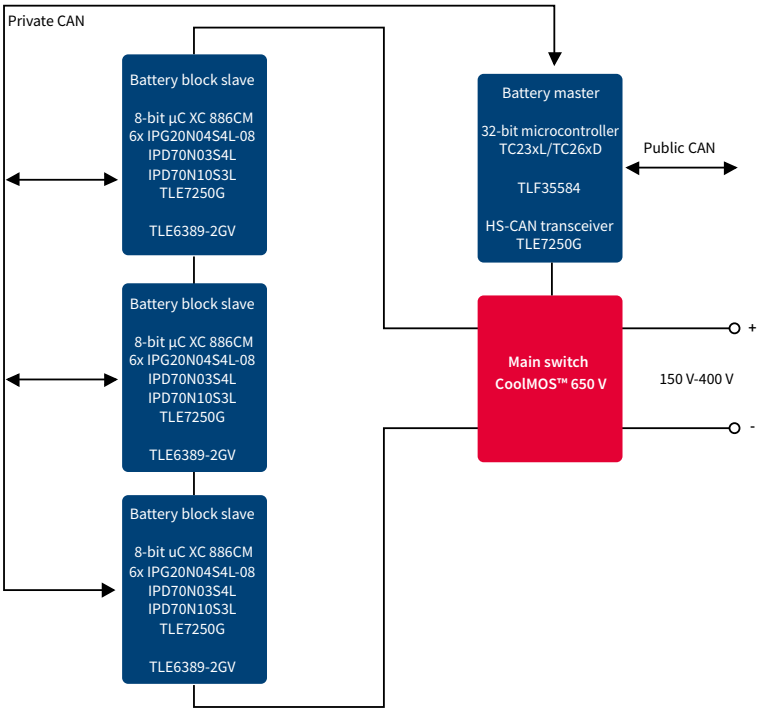
Typical part number	Product family	Description
IPx65RxxxCFDA	CoolMOS™ CFDA	650 V MOSFET with integrated fast body diode

Battery master

Typical part number	Description
TC23xL, TC26xD	New 32-bit AURIX™ lockstep microcontroller
TLF35584 [1)]	New ISO26262-system-supply optimized for AURIX™
TLE7250G	High-speed automotive CAN transceiver
TLE6251D	High-speed automotive CAN transceiver, with wake-up

Battery master

Typical part number	Description
XC886CM	8051 compatible 8-bit automotive microcontroller
TLE6389-2GV	Step-down DC-DC controller
TLE7250G	High-speed automotive CAN transceiver
IPG20N04S4L	OptiMOS™ -T2 power transistor, logic level, dual, 40 V/8.2 mW
IPD70N03S4L	OptiMOS™ -T2 power transistor, logic level, 30 V/4.3 mW
IPD70N10S3L	OptiMOS™ -T2 power transistor, logic level, 100 V/11.5 mW



www.infineon.com/emobility

1) in development

PowIRaudio™ class D audio amplifier

Attractive solutions for highest efficiency and power density

Infineon's audio solutions enable designers to improve the performance of their power amplifiers while increasing efficiency and reducing system size. Advances in semiconductor processes are behind a portfolio of class D technologies that allow professional home audio and car audio to benefit from the performance, power density and reliability that previously have been the domain of high-end systems.

Integrated class D audio modules

The integrated class D audio module family of devices integrates PWM controller and digital audio power MOSFETs in a single package to offer a highly efficient, compact solution that reduces component count, shrinks PCB size up to 70 percent and simplifies class D amplifier design.

Class D audio ICs

Infineon's family of ICs developed specifically for class D audio applications enable audio system manufacturers to safely and efficiently design audio amplifiers with superior audio performance.

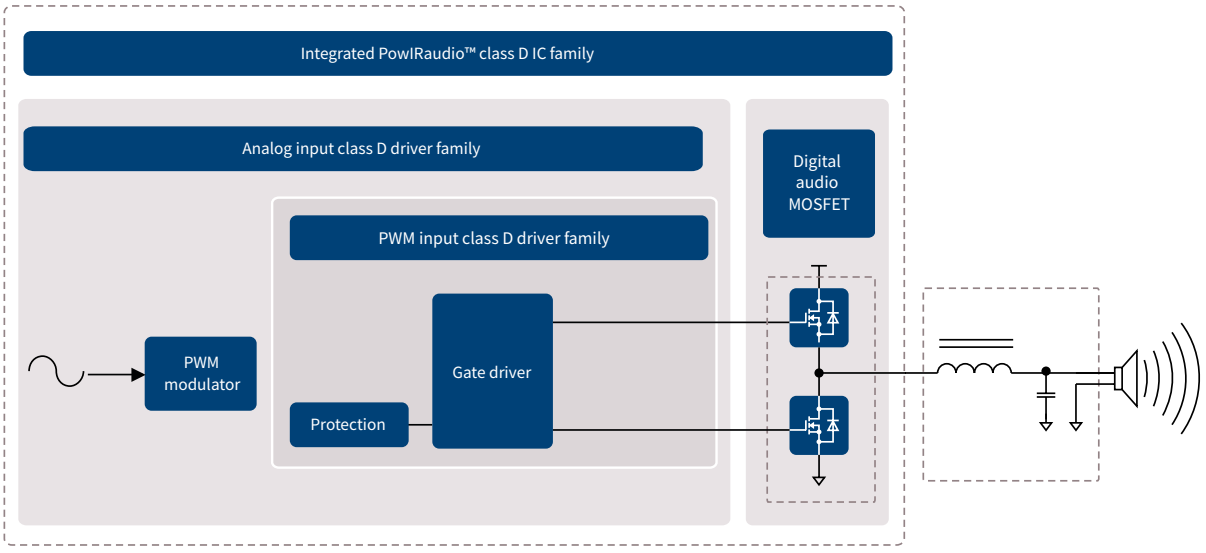
Class D MOSFETs

Audio MOSFETs are specifically designed for class D audio amplifier applications. Key parameters such as $R_{DS(on)}$, Q_G, and Q_{rr} are optimized for maximizing efficiency, THD and EMI amplifier performance.

The Infineon advantage

- Unified design platform; scalable output power by replacing the MOSFETs
- Best-in-class power efficiency
- Class D tailored MOSFETs offer high efficiency and improve audio performance
- Large voltage and current headroom

Block diagram



www.infineon.com/audio

Integrated class D audio modules

		IR4301M	IR4321M	IR4311M	IR4302M	IR4322M	IR4312M
Specifications	Number of audio channels	1	1	1	2	2	2
	Max. power per channel	160 W	90 W	45 W	130 W	100 W	40 W
	Supply voltage	~ +/-3 4 V or 68 V	~ +/-25 V or 50 V	~ +/-15 V or 32 V	~ +/-32 V or 64 V	~ +/-25 V or 50 V	~ +/-16 V or 32 V
	Max. PWM frequency	500 kHz	500 kHz	500 kHz	500 kHz	500 kHz	500 kHz
Features	Differential audio input	✓	✓	✓	✓	✓	✓
	Over-current protection	✓	✓	✓	✓	✓	✓
	Integrated power MOSFET	✓ (80 V)	✓ (60 V)	✓ (40 V)	✓ (80 V)	✓ (60 V)	✓ (40 V)
	PWM controller	✓	✓	✓	✓	✓	✓
	Thermal shutdown	✓	✓	✓	✓	✓	✓
	Click noise reduction	✓	✓	✓	✓	✓	✓
	Clip detection				✓	✓	✓
	Fault output				✓	✓	✓
	Package type	5 x 6 mm QFN	5 x 6 mm QFN	5 x 6 mm QFN	7 x 7 mm QFN	7 x 7 mm QFN	7 x 7 mm QFN
	Reference design	IRAUDAMP12, IRAUDAMP19	IRAUDAMP21	IRAUDAMP15	IRAUDAMP16, IRAUDAMP17	IRAUDAMP22	IRAUDAMP18

Class D driver IC selection guide

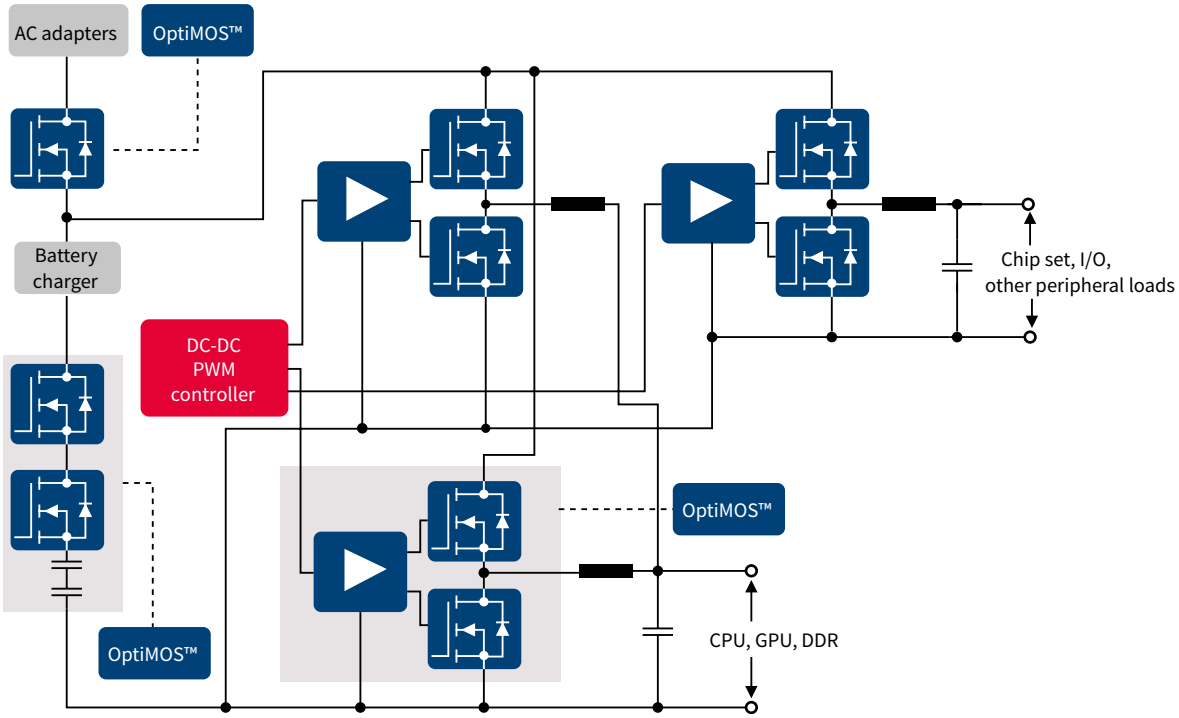
		IRS20965S	IRS20957S	IRS2092S	IRS2052M	IRS2093M	IRS2452AM
Specifications	Number of audio channels	1	1	1	2	4	2
	Max. power per channel	500 W	500 W	500 W	300 W	300 W	500 W
	Supply voltage	+/-100 V	+/-100 V	+/-100 V	+/-100 V	+/-100 V	+/-200 V
	Gate sink/source current	2.0/2.0 A	1.2/1.0 A	1.2/1.0 A	0.6/0.5 A	0.6/0.5 A	0.6/0.5 A
Features	Over-current protection	✓	✓	✓	✓	✓	✓
	Over-current flag	✓					
	PWM input	✓	✓				
	Floating input	✓	✓	✓	✓	✓	✓
	Dead time		✓	✓	✓	✓	✓
	Protection control logic	✓	✓	✓	✓	✓	✓
	PWM controller			✓	✓	✓	✓
	Clip detection				✓		
	Click noise reduction			✓	✓	✓	✓
	Temperature sensor input				✓		✓
	Thermal shutdown				✓		
	Clock input				✓		✓
	Package type	16pin SOIC narrow	16pin SOIC narrow	16pin SOIC narrow	MLPQ48	MLPQ48	MLPQ32
	Reference design	-	IRAUDAMP4A, IRAUDAMP6	IRAUDAMP5, IRAUDAMP7S, IRAUDAMP7D, IRAUDAMP9	IRAUDAMP10	IRAUDAMP8	IRAUDAMP23

www.infineon.com/audio

DC-DC enterprise power solution for data processing applications

Multiphase and point-of-load DC-DC solution

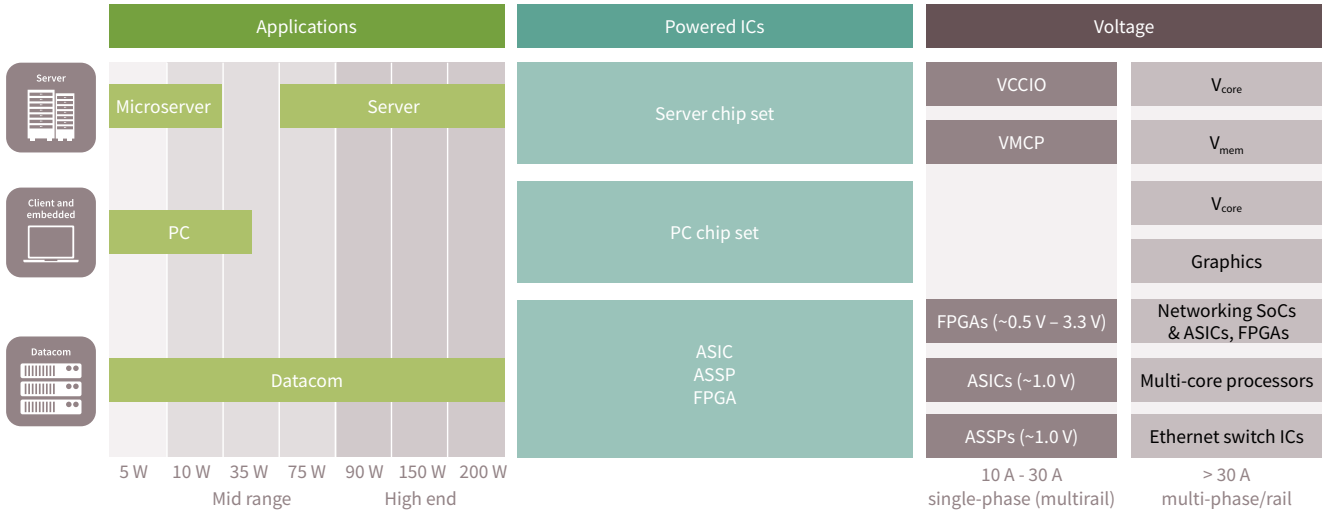
An industry leader in digital power management, Infineon delivers solutions for the next generation server, communication, storage and client computing applications. Infineon offers a complete portfolio, including digital PWM controllers, integrated power stages, integrated point-of-load (PoL), MOSFET drivers, power blocks and discrete MOSFETs. These proven technologies offer full flexibility to our customers to optimize a complete system solution for space, performance, ease-of-design and cost to meet critical design goal objectives.
In addition, our latest software tools help simplify design, shorten design cycles and improve time-to-market.



Benefit	Advantage
Best-in-class efficiency	Digital controller + power stage provide Industry‘s best efficiency of more than 95%
Support all major VID interface and control schemes	Intel SVID, AMD SVI2, NVIDIA PWM VID, Parallel VID (up to 8-bit) , PMBus™ Rev1.3, AVS Bus (PMBus™ Rev1.3)
Complete system solution	A broad portfolio of fully integrated point-of-load, integrated power stage and digital controller solutions in addition to discrete drivers & MOSFETs offers full flexibility to optimize complete system solutions requiring 1 A to 300 A+, single output/single phase to multiple output/multiphase
Digital controller flexibility	The industry’s benchmark full featured 8-phase, multiple output, flexible configuration digital controllers
Ease-of-design	GUI based optimization and configuration significantly reduces design cycle time
Smallest solution size	High density packaging and unique control schemes enable reduced external component count and overall board space

www.infineon.com/dataprocessing

Multiphase DC-DC system solution



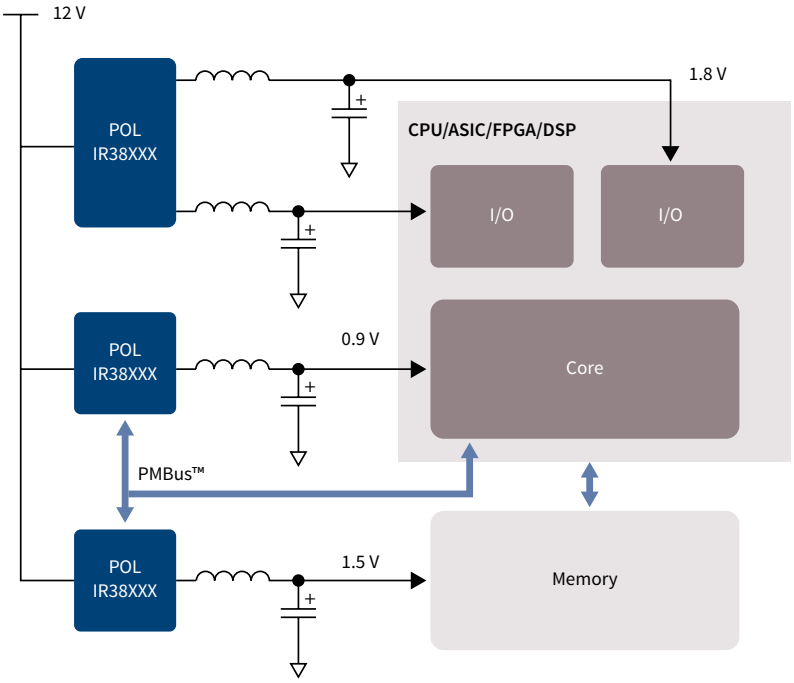
www.infineon.com/dataprocessing

DC-DC enterprise power solution for data processing applications

Integrated point-of-load converters

Infineon's point-of-load converters integrate a PWM controller, driver and MOSFETs into a small PQFN package for ease-of-use. The patented PWM modulation scheme allows greater than 1 MHz switching frequencies to deliver ultra compact layouts and smallest bill of materials. A PMBus™ interface is available for monitoring and control in systems that use advanced CPUs, ASICs and FPGAs.

Block diagram



Key features

- Input voltage range 4.5 V-21 V
- Output current 1 A-35 A
- Operating temperature range of -40°C to 125°C

Key benefits

- Integrated controller, driver, MOSFETs for small footprint
- High efficiency MOSFETs and thermally enhanced packages for operation without heat sinks

Di-PoL

Product overview

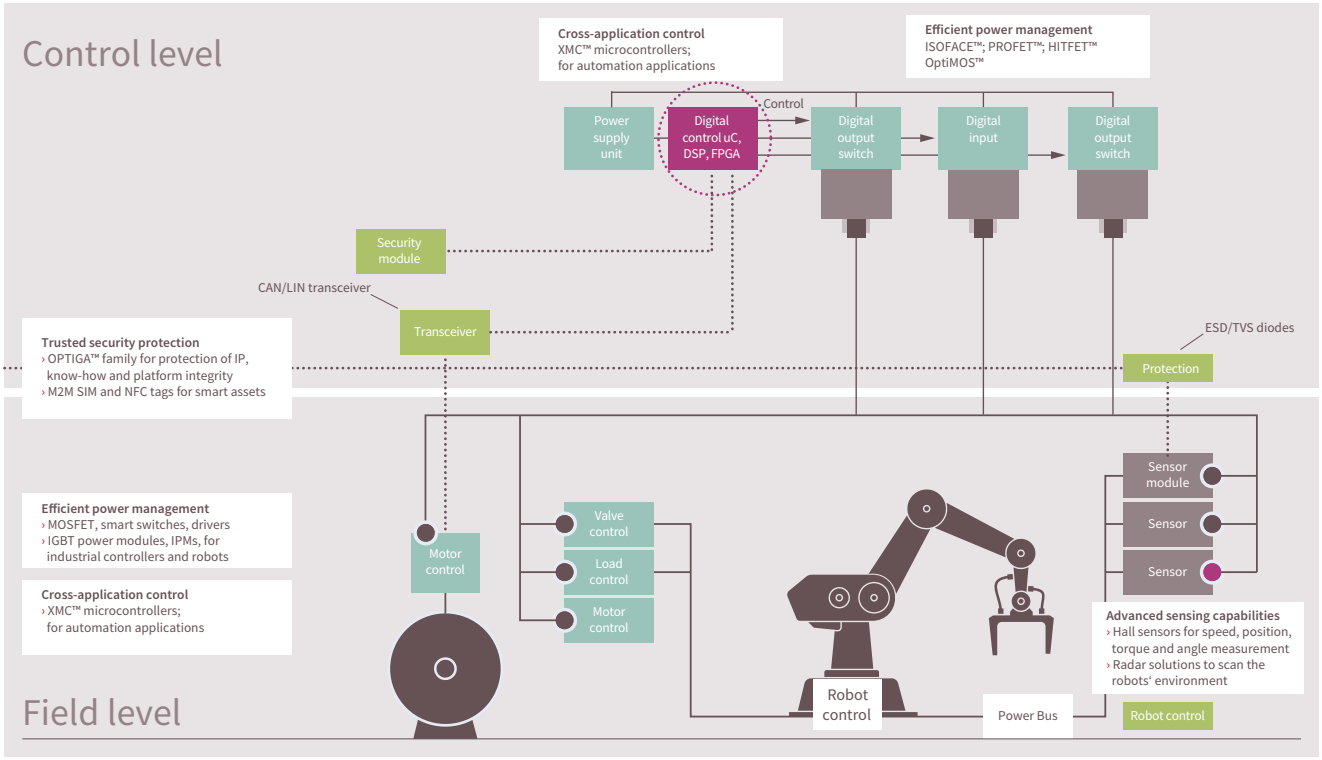
Part number	Family	I_{out} [A]	V_{in} max. [V]	f_{sw} [MHz]	Package [mm]	Key features
IR38064	Digital PMBus™	35	21	0.2-1.5	5x7	PMBus™ interface
IR38063		25	21	0.2-1.5	5x7	
IR38062		15	21	0.2-1.5	5x7	
IR38060		6	16	0.2-1.5	5x6	
IR3846	Voltage mode	35	21	0.2-1.5	5x7	Differential remote sense
IR3847		25	21	0.2-1.5	5x6	
IR3448		16	21	0.2-1.5	5x6	
IR3895		16	21	0.2-1.5	5x6	Tracking, sequencing, margining
IR3894		12	21	0.2-1.5	5x6	
IR3899		9	21	0.2-1.5	4x5	
IR3898		6	21	0.2-1.5	4x5	
IR3897		4	21	0.2-1.5	4x5	
IR3892		6+6	21	0.2-1.5	5x6	Dual output
IR3891		4+4	21	0.2-1.5	5x6	
IR3823		3	21	0.2-1.5	3.5x3.5	Programmable soft-start
IR3883	Constant on-time	3	14	0.8	3x3	No compensation

www.infineon.com/dataprocessing

Automation

Industrial automation

The smart choice for smart factories



The growing pace of industrial automation and networking across industrial control systems presents manufacturers with evolving challenges. They need industrial-grade components that can withstand harsh manufacturing environments, meet the latest energy efficiency standards and offer robust levels of security. A microcontroller, for example, that does not support an extended temperature range is simply not fit for purpose. Other success factors include the right price/performance ratio, long term availability, thanks to guaranteed roadmaps and design support.

At Infineon, we are committed to making your automation designs as simple, energy efficient, secure and reliable as possible. Not only do we cover the full automation design flow from power management through control to interfacing and security, we also support our high quality, industrial-grade semiconductor offering with proven reference designs for easy design-in and rapid time-to-market. Benefit from our wide portfolio of smart switches for highly integrated and discrete solutions of I/O modules. In addition, we are the only manufacturer with a comprehensive portfolio of isolated I/O devices (ISOFACE™). As connectivity continues to boom, security is key to protecting your customers' operations. As the market-leading supplier, we offer embedded security solutions, such as OPTIGA™ Trust and OPTIGA™ TPM, to protect against attacks, counterfeiting, and manipulation. Infineon products are also engineered to allow a high level of integration while saving valuable space. Our semiconductor solutions are also speeding the transition towards the fourth "industrial revolution" by optimizing processes and sharing information across the entire value chain. An increasingly automated, connected environment presents new security challenges. Here, Infineon's hardware-based authentication systems and encryption solutions provide robust protection for product specifications, design blueprints, production schedules and industrial secrets as they fly through cyberspace.

www.infineon.com/automation

Industrial welding*

High efficiency, easy design and cost competitive solutions

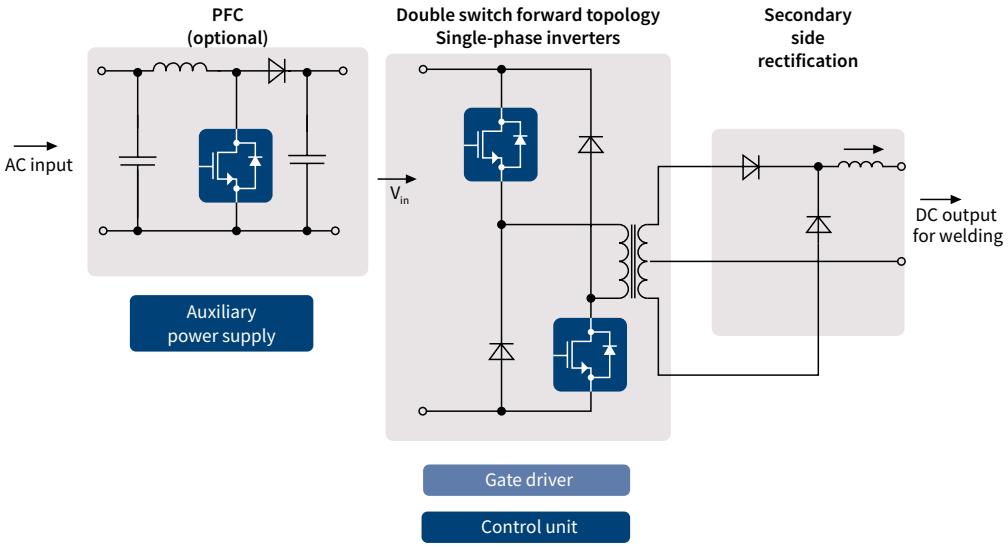
Discrete IGBTs are used in small inverterized single-phase hand-held welders with current output from 120 A to 200 A and three-phase industrial welding machines with current output up to 280 A. Infineon offers a wide product range to address key industry trends.

Price competitive 650 V TRENCHSTOP™ 5 WR5 series has been specifically developed for the low power single-phase welding machine market. The TRENCHSTOP™ 5 WR5 offers low switching losses coupled with low conduction losses to provide efficiency to customers and outstanding thermal performance.

For the best-in-class performance, where customers strive for differentiation, the 650 V TRENCHSTOP™ 5 H5 series offers outstanding efficiency for optimized, low inductance designs.

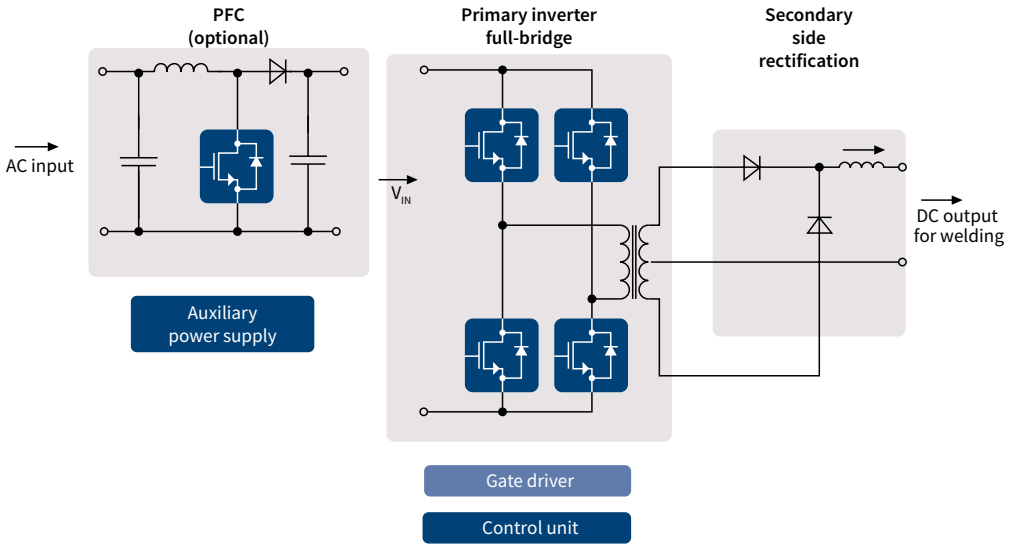
The new high speed, soft switching 650 V TRENCHSTOP™ 5 S5 series have soft and smooth switching behavior with no tail current, while keeping very competitive switching performance. The TRENCHSTOP™ 5 S5 series can be used as plug and play replacement of previous generations of Infineon's IGBTs. The low $V_{CE(sat)}$ 650 V TRENCHSTOP™ 5 L5 series is an excellent solution for secondary Inverter AC output welding machines used for Aluminum (Al) or Magnesium (Mg) welding. For three-phase welding Inverters the 1200 V HighSpeed 3 family keeps leading market position for the best efficiency and highest reliability.

Typical topologies for inverter welding machine < 280 A



*(MMA/TIG < 280 A)

www.infineon.com/welding



Stage		Topology	Voltage class	Technology/product family	Selection
PFC	AC-DC	Boost converter/switch	650 V	TRENCHSTOP™ 5 WR5	Cost/performace
		Boost converter/switch	650 V	TRENCHSTOP™ 5 S5	Efficiency and ease-of-use
		Boost converter/switch	650 V	TRENCHSTOP™ 5 H5	Best efficiency
		Boost converter/switch	1200 V	HighSpeed 3	Efficiency
Inverter	DC-DC	Two transistor forward	650 V	TRENCHSTOP™ 5 WR5	Cost/performace
		Two transistor forward	650 V	Rapid 1 diode	Efficiency
		Full-bridge/half-bridge	650 V	TRENCHSTOP™ 5 WR5	Cost/performace
		Full-bridge/half-bridge	650 V	TRENCHSTOP™ 5 S5	Efficiency and ease-of-use
		Full-bridge/half-bridge	650 V	TRENCHSTOP™ 5 H5	Best efficiency
	DC-AC	Al/Mg welding secondary inverter	650 V	TRENCHSTOP™ 5 L5 Low $V_{CE(sat)}$	Efficiency
Secondary side rectification	DC-DC	Output rectifier	650 V	Rapid 1 diode	Efficiency
		Output rectifier	650 V	Rapid 1 diode – common cathode	Efficiency
IGBT driver	PFC/inverter	Half-bridge single channel	650 V/1200 V	EiceDRIVER™ (1ED-S compact)	Efficiency
Controller	Controller	Boost converter	650 V	CoolSET™ F3	Recommendation
		Boost converter	-	XMC1000	Flexibility
	Microcontroller supply	Linear voltage regulator	up to 20 V	IFX54211	Efficiency

www.infineon.com/welding

LED lighting

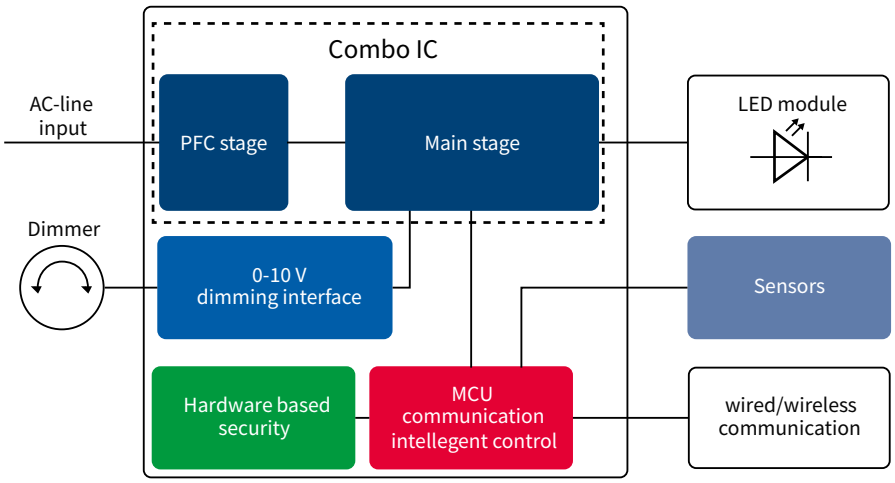
Solutions for cost sensitive applications as well as for smart lighting

Our focus at Infineon lies on supplying tailored products for LED drivers , LED tubes, LED controls and LED strips. Our portfolio of high-quality, energy-efficient products and solutions comprises LED driver ICs, MOSFETs and microcontrollers suited for LED drivers as well as sensors and ICs for secure communication. In addition to offering products of proven quality, a highly competent global lighting team, in collaboration with channel partners, optimally supports our lighting customers in designing LED lighting products and systems.

Key trends and challenges in LED lighting and our offering:

- Light quality and human centric light
  - No current ripple by using two stage topologies (i.e. ICL5101)
  - Avoiding light flicker with analog dimming or puls density modulation (XMC1300) to very low dimming levels
  - Easy implementation of tunable light color
- Designing smaller and flatter LED drivers
  - Integrating up to 25 discrete components in one 0 V-10 V dimming interface IC (CDM10V)
  - Primary control with wide range input and output voltage range enabled by digital LED driver ICs (i.e. XDPL8105)
- Cost effectiveness
  - High voltage MOSFETs in SOT-223 housing
- Smart lighting enabled by sensors
  - Reliable presence detection and large area coverage up to 300 m^2 enabled by 24GHz radar transceiver solutions (BGT24LTR11)

LED drivers

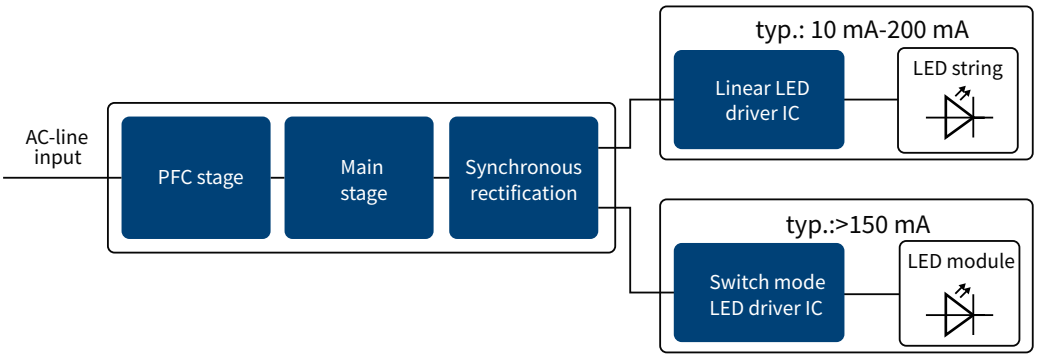


www.infineon.com/lighting

LED drivers

Functional block	Product type	IC product family	MOSFET technology	Voltage class
PFC stage	PFC	IRS2505	CoolMOS™ CE	600 V/650 V
		TDA4863	CoolMOS™ CE	600 V/650 V
Combo solutions for PFC and main stage	PFC+LLC (constant current /constant voltage)	ICL5101	CoolMOS™ CE	600 V/650 V
			CoolMOS™ P6	600 V
	PFC/FB primary constant voltage + secondary buck	IRS2982S + see below	CoolMOS™ CE	800 V
			CoolMOS™ P7	800 V
	PFC + flyback (dual-stage)	XDPL8220	CoolMOS™ CE	600 V/650 V/800 V
			CoolMOS™ P7	800 V
	PFC/flyback (single-stage)	XDPL8105	CoolMOS™ CE	800 V
			CoolMOS™ P7	800 V
Buck solutions	Buck (single-stage)	ICL8201	CoolMOS™ CE	500 V/600 V
	Secondary buck	ILD2111	OptiMOS™	100 V/150 V/200 V/250 V/ 300 V
		ILD6150	Integrated	-
		XMC1300/XMC1400*	OptiMOS™	100 V/150 V/ 200 V/250 V/ 300V
Synchronous rectification	Synchronous rectification controller	IR116xx	OptiMOS™	100 V/150 V/200 V
0 V-10 V dimming interface	0 V-10 V dimming interface	CDM10V	-	-
Hardware based security	OPTIGA™	OPTIGA™ Trust	-	-
MCU	XMC™ microcontroller	XMC1100	-	-
Sensors	Radar sensor	BGT24LTR11	-	-
	Barometric pressure sensor	DPS310	-	-

LED driver with constant voltage output + linear/switch mode LED driver ICs



Linear/switch mode LED driver ICs

Functional block	Topology	IC product family	MOSFET technology	Voltage class
Linear LED driver IC	Linear	BCR400 series	Integrated (extra transistor for BCR450)	-
Switch mode LED driver IC	Buck	ILD4000 series	Integrated (OptiMOS™ for ILD4001)	30 V/60 V
		ILD6000 series	Integrated	-
		XMC1300/XMC1400*	OptiMOS™	100 V/150 V/200 V/250 V/ 300 V
	Buck/boost	ILD1151	OptiMOS™	60 V/100 V

*including communication

www.infineon.com/lighting

Major home appliance

Highest performance and efficiency for induction cooking

Resonant-switching applications such as induction cooktops and inverterized microwave ovens have unique system requirements. The consumer marketplace demands that they be cost effective, energy efficient and reliable. To achieve these goals, designers need devices that are created specifically for these applications.

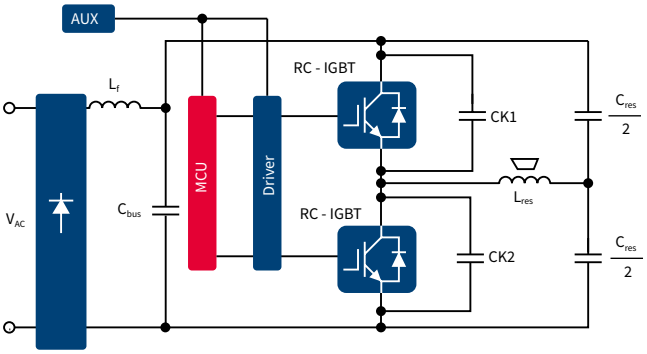
Infineon's RC discrete IGBTs were developed for resonant switching with a monolithically integrated reverse conducting diode. With this technology leadership and a broad portfolio of devices from 650 V to 1600 V, it is the market leader and provides the industry benchmark performance in terms of switching and conduction losses.

The newest family, RC-E, is cost- and feature-optimized specifically for low- to mid-range induction cookers and other resonant applications. This new family offers Infineon's proven quality in RC IGBTs with the best price versus performance and ease-of-use.

Infineon also offers a range of complementary products which can be used with the IGBTs, as well as in the central control and power supply subsystems of induction cooking appliances.

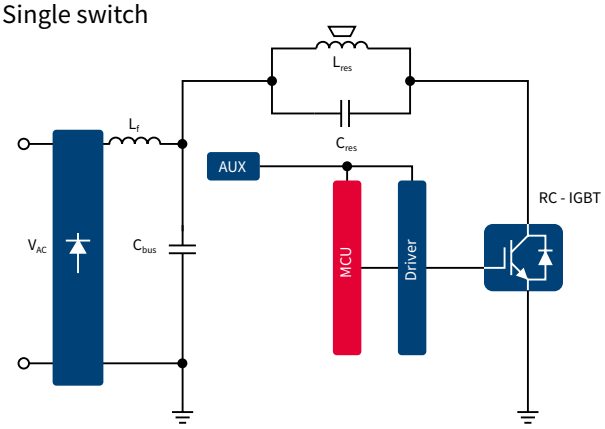
Induction heating inverter (current resonance)

Half-bridge



Induction heating inverter (voltage resonance)

Single switch



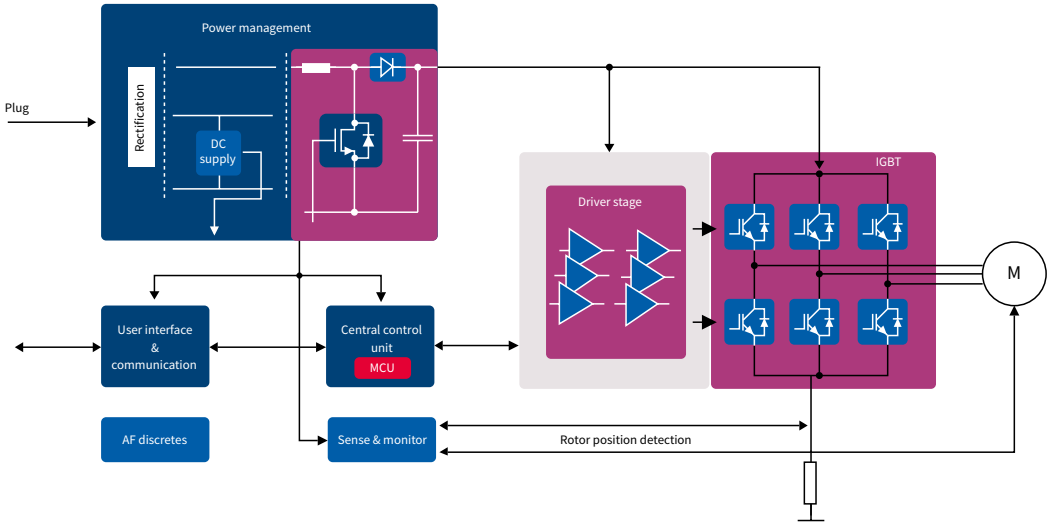
Induction heating	Topology	Voltage class	Technology/product family	Selection
DC-AC	Series-resonant half-bridge	650 V	RC-H5	Recommendation
	Quasi-resonant single switch	1100 V	RC-H3	Recommendation
	Quasi-resonant single switch	1200 V	RC-H5, RC-E	Recommendation
	Quasi-resonant single switch	1350 V	RC-H5	Recommendation
	Quasi-resonant single switch	1600 V	RC-H2	Recommendation
IGBT driver	Single channel and half-bridge	600 V and 1200 V	General purpose gate driver ICs	Recommendation
Microcontroller	32-bit ARM® Cortex®-M0	-	XMC1302	Recommendation
Microcontroller supply	Linear voltage regulator	Up to 20 V	IFX54211	Efficiency
AUX	Flyback fixed-frequency	800 V	CoolSET™ F3 (VJZ-series)	Recommendation

www.infineon.com/homeappliance

Major home appliance

Innovative approach for air conditioning

Product designers are facing the daunting challenge of delivering smaller, smarter, more powerful and more energy-efficient appliances. Based on industry-leading technology and manufacturing expertise, our line of innovative components for household appliances meets and exceeds even the most rigorous requirements for reliability and quality. The following block diagram example of an air conditioning system, together with the product selection table, provides effective guidelines for engineers in selecting the right component for each power management stage inside major home appliances.



Air conditioning

Functional block	Topology	Voltage class	Technology/product family	Selection
PFC AC-DC	IGBT – PFC CCM (high frequency – SC)	600 V	HighSpeed 3	Recommendation
	IGBT – PFC CCM (low frequency – SC)	600 V	TRENCHSTOP™ Performance	Recommendation
	IGBT – PFC CCM (cost competitive – No SC)	650 V	TRENCHSTOP™ 5 – H5	Recommendation
	MOSFET – PFC CCM	600 V	CoolMOS™ P6	Reference
	Diode – PFC CCM	650 V	Rapid 1 and Rapid 2 diodes	Recommendation
	Controller – PFC CCM	–	ICE2PCS0xG, ICE3PCS0xG	Recommendation
	IPM - PFC CCM	600 V	CIPOS™	Recommendation
DC-AC	IGBT – B6-VSI	600 V	TRENCHSTOP™	Efficiency
	IGBT – B6-VSI	600 V	RC-Drives Fast	Recommendation
	IPM – B6-VSI	600 V	CIPOS™	Recommendation
IGBT driver	Driver for B6 bridge	600 V	EiceDRIVER™ (6ED)	Recommendation
	Driver for B6 bridge	600 V	Gate driver ICs	Recommendation
AUX	Flyback fixed-frequency	800 V	CoolSET™ F3R (VJZ-series)	Recommendation
Microcontroller/motor control IC	32-bit ARM® Cortex®-M4	-	XMC4100/XMC4200	Recommendation
	iMOTION™	-	IRMCxx motor control IC (incl. motion control algorithm)	Recommendation
Microcontroller supply	Linear voltage regulator	Up to 20 V	IFX1763, IFX54441, IFX54211, IFX3008	Efficiency
Communication	CAN transceiver	-	IFX1050, IFX1051, IFX1040	Robustness
Position sensing	Angle sensor	-	TLE5009, TLI5012B	Recommendation
	Hall switch	-	TLI496x	Recommendation

www.infineon.com/homeappliance

Microwave

Solid state RF powered oven solutions

Technology improving life quality

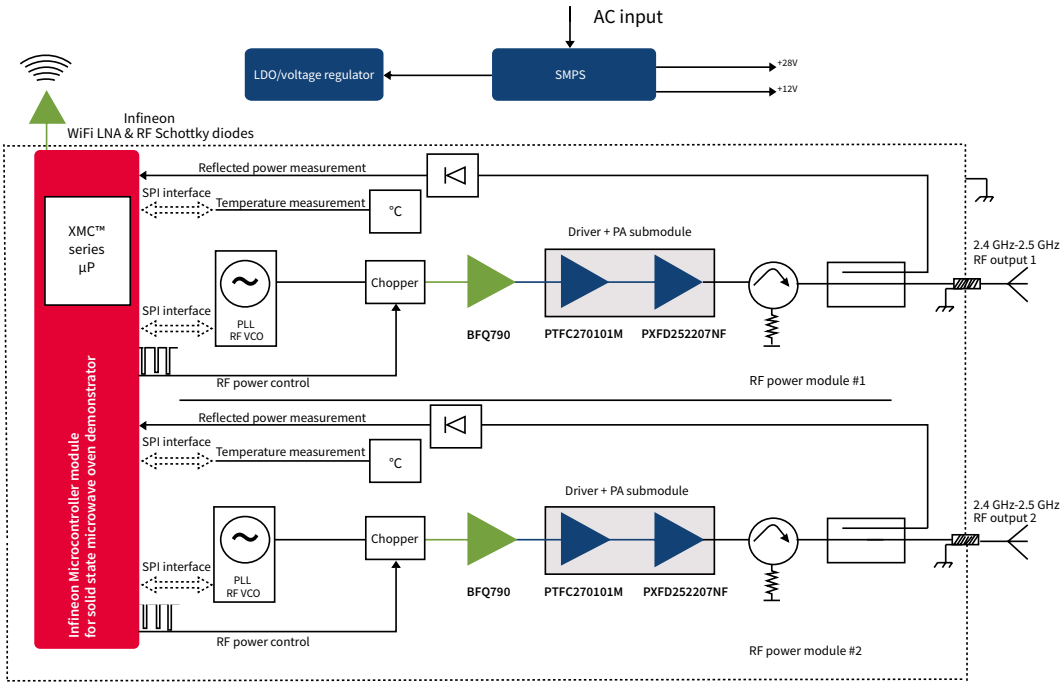
In the 1970s, Radio Frequency (RF) heating brought a convenient cooking experience to every household by using electromagnetic radiation in the microwave spectrum. With this technology consumers can reheat leftover meals, defrost frozen foods, etc. It has changed the way we cook meals by allowing families to rapidly heat food. However, the quality of the food cooking does not fulfill modern life standards due to the microwave's current design, as they cook unevenly and tend to lose power over time. These aspects will destroy user experience. Furthermore, microwave ovens are traditionally considered to pose safety risks due to the high voltages during operation or even while unplugged, as there is a high voltage magnetron and a high voltage capacitor inside that can retain a dangerous charge for a long time after being disconnected.

Solid state RF powered oven solutions from Infineon

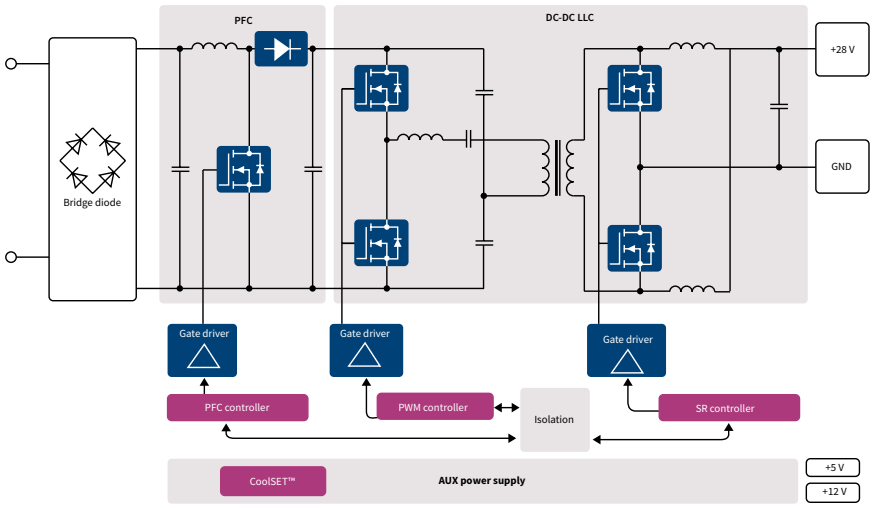
With the latest solid state RF powered oven solution from Infineon, consumers will reach a higher level of cooking experience. Families can enjoy more precise cooking, improved food quality, greater consistency in quality of cooking, selective heating, and versatile and complex cooking combinations. Using the latest LDMOS, manufacturers can use one or several of these 250 W units to build a microwave oven with the desired power level. The RF power transistors and architectures will provide a full range of power control, phase shifting, and frequency adjustment, allowing microwaves to cook complex food combinations. Also, safety is improved due to the 30 V operational voltage, which will replace the magnetron's 4 kV power supply, and the product lifetime is significantly greater. Moving in alignment with the home appliance trend, the solution from Infineon includes a reliable WIFI interface. Users can enjoy and share the cooking experience with the cloud community through the sensitivity, strong signal capability and interference immunity of this solution.

Infineon's solution differentiates through important value drivers

By enabling OEMs innovation of smart, intelligent and connected home appliances, it helps OEMs to go from being an 'appliance manufacturer' to becoming a vital 'technology provider.'



www.infineon.com/microwave



Infineon's highly efficient and cost effective switching power solution enhance the microwave oven performance.

Infineon offers a comprehensive portfolio to address a broad range. For further information visit our homepage.

Product recommendation

Sub Application	Recommendation	Key benefits
Power supply	CoolSET™: ICE2QR1765G, etc.	High integrated AC-DC power controller, low standby, balancing of cost and performance
	PFC controller: ICE3PCS01G	CCM, high power factor, low THD, multi-functional protection
	PFC MOS: IPW60R070P6	CoolMOS™ proven quality and performance, balancing of cost and performance
	PFC diode: IDH06G65C5	SiC generation 5, low FOM V_f * Q_c
	LLC controller: ICE1HS01G-01	DSO-8, high performce, low cost
	LLC HB MOS driver: IRS21834	Noise immunity, robust, ease-of-use
	LLC HB MOS: IPW60R099P6	CoolMOS™ proven quality and performance, balancing of hard and soft switching
	SR MOS: IPP020N08N5	OptiMOS™ 5, best-in-class FOM
	SR driver controller: IR11672	200 V proprietary IC technology, 7 A peak turn off drive current, V_{cc} range from 11.3 V to 20 V
	LDO: IFX1963TEV	Low dropout, Low current consumption, wide temperature range, multi-protection
RF power	Medium power amplifier: BFQ790	Silicon Germanium (SiGe) technology, highly linear output stages
	LDMOS driver: PTFC270101M	Operating from 900 MHz to 2700 MHz, excellent gain, efficiency and linearity performance
	LDMOS: PXFD252207NF	Thermally-enhanced high power RF LDMOS FET, high reliability and consistency
WiFi	5 G band LNA: BFP840ESD	Best-in-class noise figure (0.95 dB), high transition, highest gain (18 dB)
	2.3 – 3.5 GHz LNA: BFP842ESD	High linearity , high transition frequency, high robustness
MCU	XMC4500	ARM® Cortex®-M4 core, 32-bit, 120 MHz, 160 kB SRAM

www.infineon.com/microwave

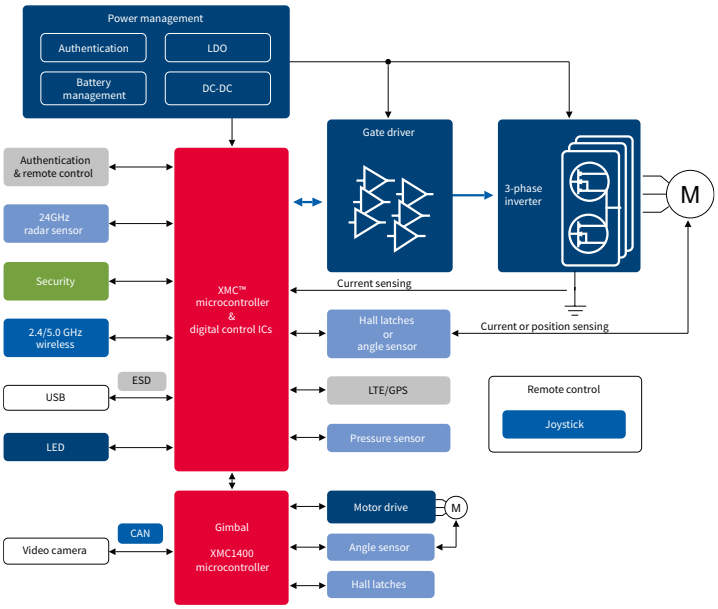
Multicopter

A new cost effective system solution

Multicopters are well on their way to become a huge hit in the consumer market. Currently, seldom manufacturers offer a system solution including everything from power electronics to controllers and sensors. But that is precisely what you need to design a highly efficient multicopter capable of what counts most among consumers: exceptionally long airtime. With great development progress in the field of data processing, navigation and control, the overall system performance is determined from reliable and efficient power management. Flying is the most critical application in terms of performance, efficiency and control. The high quality standards and system knowledge in automotive and industrial power electronics offer customers a wide spectra of system solutions, with the highest quality and performance standards.

Multicopter solutions from Infineon

With Infineon's comprehensive portfolio of high quality products, you will find the best-possible components for multicopter designs. We offer a near system solution – everything from XMC™ microcontrollers, to iMOTION™ motor control ICs, to magnetic sensors and more – with the exception of one commodity, an IMU (Inertial Measurement Units) for existing solutions. Infineon is quickly becoming a one-stop-shop for existing multicopter applications. In the very fast growing multicopter market, energy efficiency and reliability are becoming more important. Camera applications, autonomous flying and sophisticated on-board equipment are pushing the limits of power management and reliability. Being a recognized leader in automotive and industrial power electronic systems, Infineon offers high quality system solutions for the next generation of multicopters.



Benefits	Offer
Development effort and cost reduction	› With no or little experience in motor control, customers can implement the iMOTION™ motor control IC and take flight › Project development can be reduced up to 30 percent by using reference designs and the DAVE™ platform for microcontroller programming
Authentication	› Infineon's solutions enable authentication of components connected to the system › Guaranteed safety and protection of the product, avoiding liability
Ease of precision control for flight and data	› Through the benefits of multifunction sensors, the user can experience an easy, stable, smooth and accurate control of the multicopter › Closed loop control of gimbal motor, sensors enhanced camera stability and data transmission when recording video
Lighter	› The highly efficient components and effective flight control can make the multicopter lighter, which results in longer flight time
Collision avoidance	› 24/60GHz radar sensors have the capability of detecting the proximity of objects such as trees, buildings, etc.
Broader portfolio	› Infineon can provide all the necessary critical semiconductor components for multicopters

www.infineon.com/multicopter

Infineon offers a comprehensive portfolio to address a broad range of multicopters. For further information please explore our homepage.

Solution tree for multicopters

Flight control

Microcontroller
- XMC4000 family
- XMC1300 series
- iMOTION™ IRMCK099

CAN transceiver
- HS CAN IFX1050G
- IFX1050GVIO

DC-DC module
- IFX90121ELV50
- IFX91041EJV33
- IFX91041EJV50

LDO
- IFX1117ME
- IFX54441EJV
- IFX1763XEJV33

GPS LNA
- BGA524N6
- BGA824N6

Sensor
- Pressure sensor: DSP310
- Hall sensor: TLI4961
- Angle sensor: TLI5012B

WiFi LNA
- BFP842ESD
- BFR840L3RHESD
- BFR843EL3
- BGS12SSN6

LED driver
- BCR450
- BCR321U
- BCR421U

Low voltage MOSFET
- OptiMOS™ 5 25 V–30 V
- StrongIRFET™ 20 V–30 V

CIPOS™ Nano/integrated half-bridge driver
- IRSM005-800MH
- IRSM836-084MA
- NovalithIC™

Interface protection diode
- ESD102 series

MOSFET gate driver
- IRS2301S
- 2EDL05N07PF
- IRS2336S

Charger

High voltage MOSFET
- CoolMOS™ CE 600 V–650 V in TO-220, DPAK, IPAK

Low voltage MOSFET
- OptiMOS™ 5 40 V–80 V in TO-220, SuperSO8
- StrongIRFET™ 40 V–75 V

Stand alone PWM controller
- ICE2QS03G

Battery management

Authentication IC
- ORIGA™

Low voltage MOSFET
- OptiMOS™ 5 in SuperSO8, S308/PQFN 3.3x3.3, DirectFET™
- StrongIRFET™ 40 V–80 V

Cell balancing
- OptiMOS™ 30 V in SuperSO8, S308/PQFN 3.3x3.3, DirectFET™
- StrongIRFET™ 30 V

Schottky diode
- BAS4002
- 3005A
- 3010S series

Gimbal control

Microcontroller
- XMC1400 family
- iMOTION™ IRMCK099

Angle sensor
- TLI5012B

DC-DC module
- IFX90121ELV50
- IFX91041EJV33
- IFX91041EJV50

LDO
- IFX1117ME
- IFX54441EJV
- IFX1763XEJV33

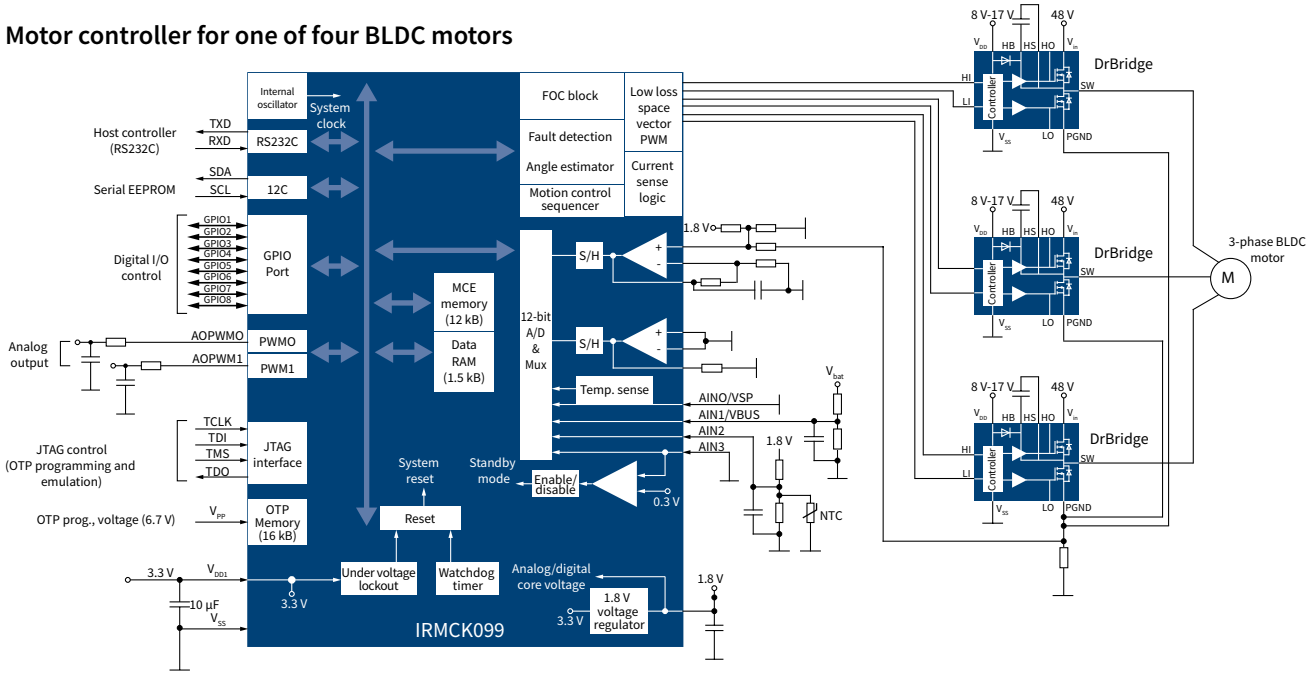
CAN transceiver
- HS CAN IFX1050G
- IFX1050GVIO

Low voltage MOSFET
- OptiMOS™ 5 25 V–30 V
- StrongIRFET™ 20 V–30 V

www.infineon.com/multicopter

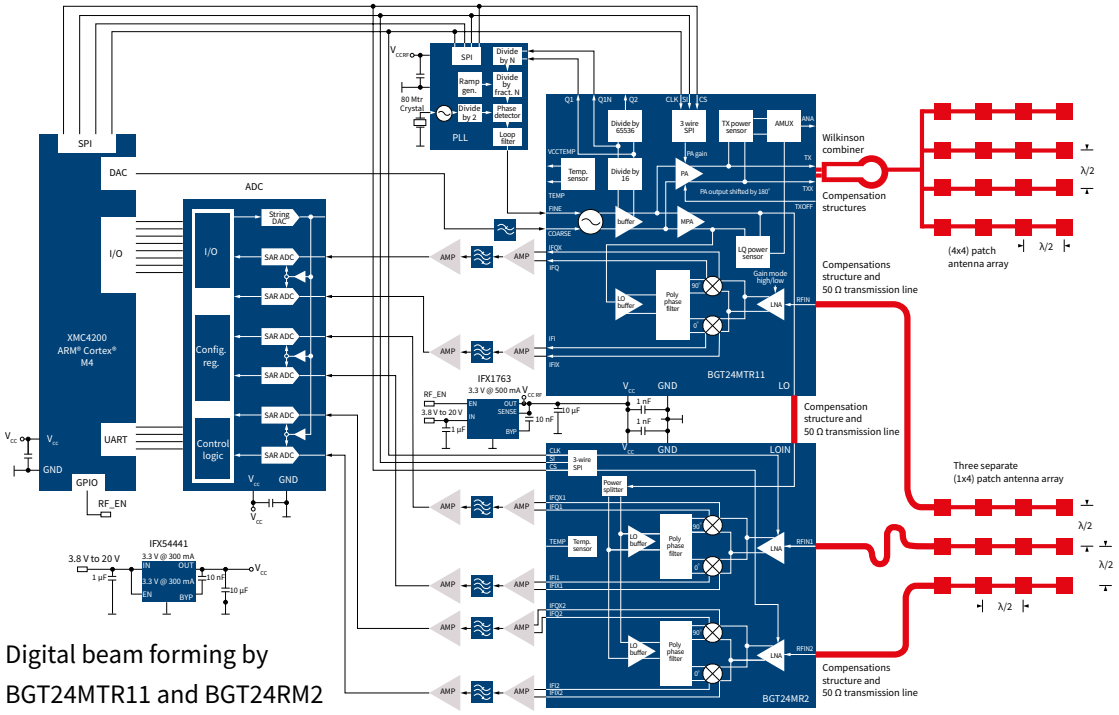
The ready-to-use solution can bring differentiation and innovation

Motor controller for one of four BLDC motors



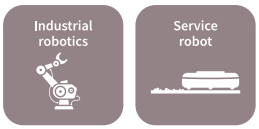
iMOTION™ ICs integrate all the control and analog interface functions required for sensorless field oriented control (FOC) of PM motors using DC link or leg shunt current measurements. In addition, they feature Infineon's patented and field proven motor control engine (MCE) that eliminates software coding from the motor control algorithm development process. Implementing a variable speed drive is reduced to configuring the MCE for the respective motor. Assisted by powerful tools like MCEwizard and MCEDesigner it is possible to have the motor up and running in less than an hour.

The multi-functional 24GHz radar solutions bring innovation



Digital beam forming by BGT24MTR11 and BGT24RM2

www.infineon.com/multicopter



Robotics

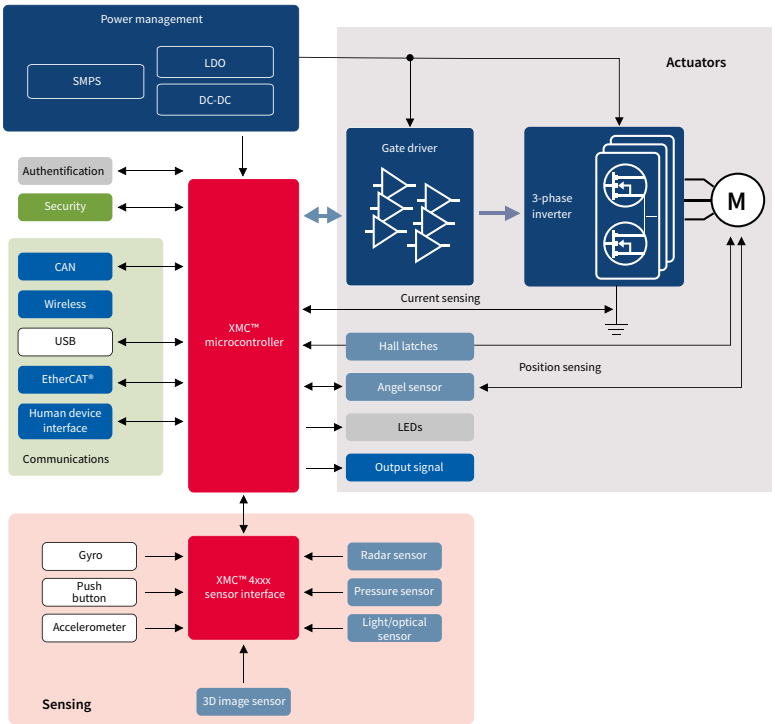
Superior solutions for industrial and service robotics

The robotic revolution has started – new technologies and applications have transformed our professional and private spheres of everyday life. Robots are now about to join the ranks of such innovative and disruptive technologies by revolutionizing traditional habits and processes. Therefore, we at Infineon offer dedicated solutions for the industrial and service robot market addressing the different needs of our customers. Discover our solutions and product portfolios for robotics and drive the robotics revolution in domestic as well as in industrial environments.

Industrial robotics

Industrial robots came a long way from their invention to their newest generations. Historically, industrial robots are commonly seen as the working horses of highly automated production lines performing extremely repetitive tasks with highest accuracy. The robot's workspace is protected by safety cells, which clearly separate workers and robots in order to prevent from collision and clamping situations. They perform high precision tasks for example in welding environments or handle heavy loads such as carrying car bodies in automotive production sites. But times are changing: The new generation of industrial robots called collaborative robots or "cobots" will work alongside humans without safety cells, assisting them and thereby augmenting the robot's and the worker's skills, thus creating new kinds of collaboration. In addition, they will be equipped with a higher number of axes in order to enable full freedom of movement. Nevertheless, this kind of boundless collaboration requires highest safety standard for the robots (EN ISO 10218 and ISO/TS 15066). Infineon is able to address all the requirements of "traditional" industrial robots and the new demands of collaborative robots.

Block diagram – industrial robotics

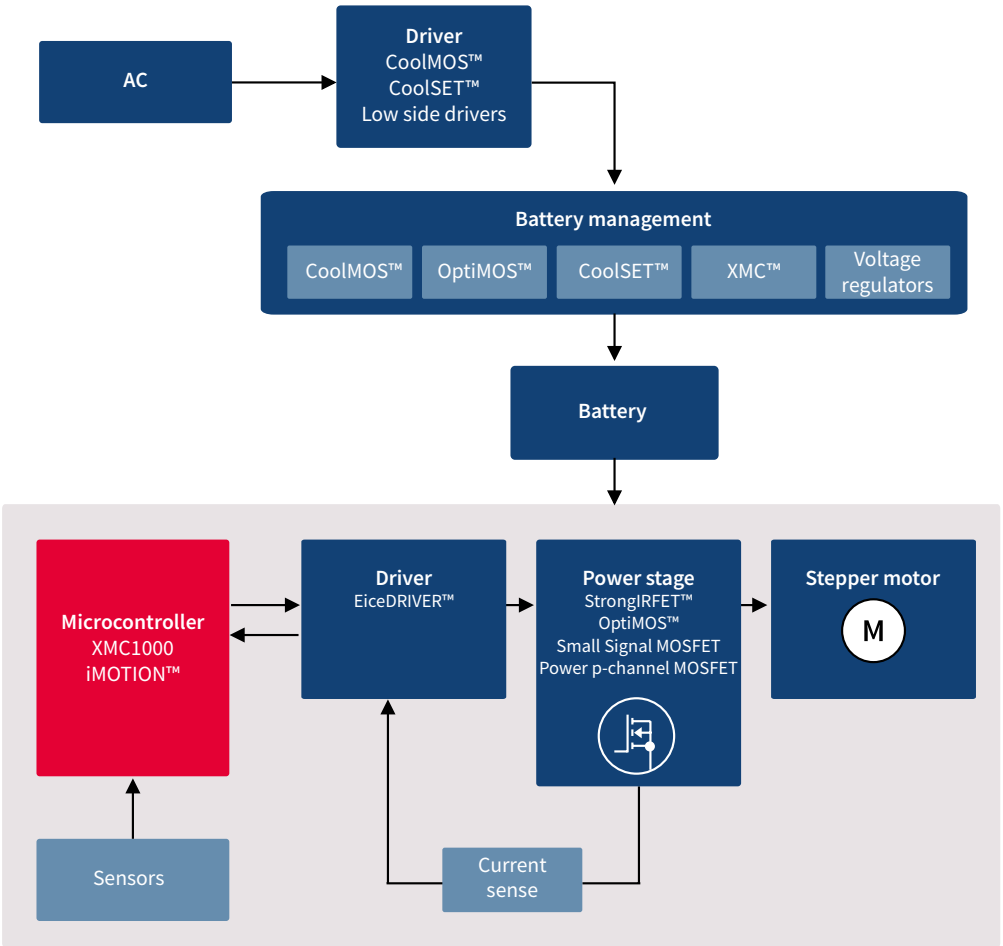


www.infineon.com/industrial-robotics
www.infineon.com/service-robotics

Service robotics – powerful and quiet solutions

The consumer robot or the so called service robot segment is the fastest growing market within the whole robotics market. This segment is growing with a CAGR of 15 percent within the next 5 years. Key applications within this segment are electric vacuum cleaners and lawn movers. The reason for this tremendous growth is that this application, e.g. in domestic environments, will dramatically improve our quality of life by reducing the household work (e.g. vacuuming, moving the lawn). This is one of the reasons why these applications are well on their way to become a huge market in the robotic segment. Within many countries, consumers are more than ready for household robots and they are willing to spend money on them. Therefore, Infineon offers dedicated solutions for service robots.

Block diagram – service robotics



www.infineon.com/industrial-robotics
www.infineon.com/service-robotics

Infineon's product recommendation for robotics

Functional block	Products	Selection/benefit
Power management	600 V CoolMOS™ P6	Ease-of-use
	600 V/650 V CoolMOS™ C7	Best power density
	800 V CoolMOS™ C3	Higher MTBF
	EiceDRIVER™ ICs	Higher drive capability
	650 V CoolSiC™ G5 SiC diode	Improved density
	650 V CoolMOS™ CFD2	Better reliability
	OptiMOS™ 5	Higher output current
	650 V and 800 V CoolSET™	Quasi-resonant operation for better EMI
	DC-DC switching regulators	Small system design
	LDOs	Energy efficiency
Motor control	IGBT modules	High power density – save space in the switch cabinet
	IGBT modules – IPOSIM	Lifetime calculation of converter based on power cycling capability
	IPMs (low power up to ~2 kW)	Compact converter size due to high integration, high power density
	Smart high side switches/PROFET™	Robustness including diagnosis and protection
	OptiMOS™ 30 V-300 V	Highest system efficiency, best-in-class performance (industry's lowest $R_{DS(on)}$)
	StrongIRFET™	High current carrying capability – high system reliability
	XMC1000/XMC4000 microcontroller family	Precise motor control and current sensing, realization of precise position measurement
	EiceDRIVER™ IC with coreless transformer technology	Small system design – high power density, excellent position accuracy
	Angle sensors – rotor position sensing (FOC, sinusoidal)	Highest accuracy, dual die concept – redundancy in signal generation fulfilling highest safety standards
	Hall latches – rotor position sensing (BLDC, prediction for sinusoidal)	Small system design
	Linear hall sensors – torque sensing	Dual die concept – redundancy in signal generation fulfilling highest safety standards, high accuracy over whole temperature range
Radar sensing and microphone	BGT24LTR11	24 GHz – radar intelligent motion sensing and object classification, direction of movement, speed detection for highest safety requirements
	BGT60TR24	60 GHz – intelligent motion sensing and object classification, direction of movement, speed detection for highest safety requirements
	Silicon microphone	Comfortable voice controlled teaching
Security/authentication	OPTIGA™ family	Protection of business model
		Prevent from line-down
		IP protection
		Brand protection
		Prevent from counterfeit products
Communication	CAN transceivers	High EMI robustness
	XMC4000 family	Ethernet – easy realization of embedded servers
		Easy and code efficient implementation of standard filed bus interface mode
		USIC (serial communication for SPI, dSPI, qSPI, UART, IIC)
		USB – standardized interface for easy maintenance
	XMC4300 and XMC4800 series	Integrated EtherCAT® slave controller – most cost and time efficient EtherCAT® implementation on the market

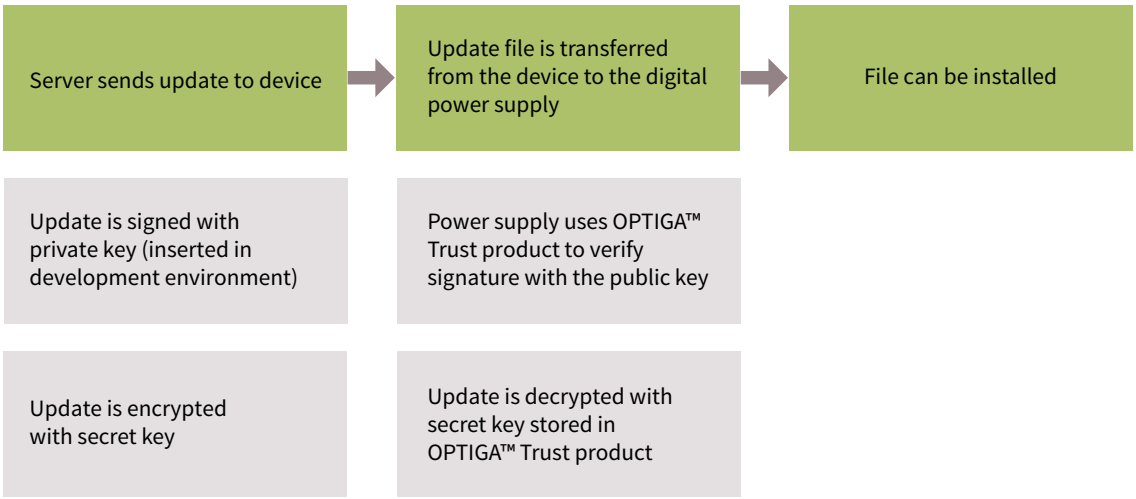
www.infineon.com/industrial-robotics
www.infineon.com/service-robotics

OPTIGA™ Trust product family

Enabling secured communication for IoT

An increasingly connected world enables offering new services and features leading to new business models. For these services high system reliability and data integrity is a key necessity. The Internet of Things generates an increased amount of data due to the proliferation of sensors and actuators that have become available at attractive cost. Intelligent lighting systems represent one of the leading applications that enable collection of information that goes beyond pure lighting functionality. Lighting system manufacturers are looking into new functions like gas, pressure and sound sensing in order to increase customer value in smart buildings and smart cities. Proliferation of interconnected nodes poses serious challenges in terms of ensuring that the Internet of Things does not offer backdoors to cybercrimes. Infineon offers several products that build an "anchor of trust" in order to ensure secure data communication with the OPTIGA™ Trust product family.
In a connected world, digitally controlled power supplies have been adopted for their higher performance and reliability. The performance and security of these systems can be continuously improved by firmware updates. However, at the same time, system reliability is incredibly important and can be at danger when unauthorized updates are pushed into a system.
The firmware of digitally controlled power supplies typically need to be updated, and given the potential physical damage (e.g. overvoltage) caused by unauthorized updates, the implementation of a high security standard when authenticating, decrypting and checking authenticity of a firmware update for a digital power supply is fundamental.
To prevent unauthorized firmware updates, updates can be sent with a cryptographic signature and as encrypted files allowing the receiving system to verify and decrypt the update before installing it. With Infineon's OPTIGA™ Trust product family, the keys used for the signature and encryption are stored in the hardware-based OPTIGA™ security solution and can therefore not be easily read out or altered.

Application flow for secure software update



Key benefits of OPTIGA™ security

Combining state-of-the-art hardware security controllers with software

- Reliable turnkey products with a proven track record
- Strong security based on the latest cryptography
- Offering a variety of interfaces to match your system architecture
- Easy to integrate based on evaluation kits, host code and reference applets
- Developed and manufactured in certified environment

www.infineon.com/optiga

Embedded security with OPTIGA™ Trust product family

Enabling secured software update onto digital power supplies

Learn more about OPTIGA™:
www.infineon.com/optiga

SMPS

Broad portfolio for highly efficient laptop adapter

Manufacturing of slimmer and lighter adapters requires ICs enabling high efficiency with good EMI performance and low standby power. It also requires cost effective MOSFETs in small packages that feature good electromagnetic interference (EMI) and excellent thermal performance. Infineon offers a wide range of products specifically designed for adapters including high voltage MOSFETs and control ICs for PFC and PWM stages, as well as low voltage MOSFETs for synchronous rectification. With these products, Infineon supports the trend towards a significantly higher efficiency level, especially in partial load conditions, as well as miniaturization of the adapter. Especially versatile are the CoolMOS™ P6 and CE families as well as the recent released P7 series which combine high efficiency with ease-of-use. Infineon developed specifically for adapters a family of packages, characterized by short lead, IPAK Short Lead with ISO-Standoff and wide creepage that enable our customers cheap and reliable manufacturing. High power density at low manufacturing cost can be delivered using Infineon's SOT-223 cost effective package which enables SMT manufacturing maintaining very good thermal performances. For synchronous rectification, Infineon's OptiMOS™ series offers extremely low on-state resistance and low capacitances.

New control ICs support topologies such as quasi-resonant flyback and forced frequency resonant flyback (zero voltage switching) operation, ideal to implement high power density adapters and well supporting USB-PD requirements.

Regional regulations and a general increased sensitivity toward the containment of electronic waste are pointing toward the adoption of universal adapters. The implementations, methodologies and protocols are not yet harmonized, however Infineon is already closely monitoring and partnering with the decision makers to timely ensure the offer of a competitive semiconductor solution. The capability to efficiently manage different power classes and protocols will be key in this application, and Infineon is getting ready for supporting adapter makers in this challenge.

Functional block	Product category	Topology	Product family	Benefits
Flyback converter	High voltage MOSFETs	Flyback	600 V/700 V/800 V CoolMOS™ P7	› Fast switching speed for improved efficiency and thermals › Reduced gate charge for enhanced light load efficiency › Optimized V_{GS} threshold for lower turn-off losses
		Flyback	500 V/600 V/650 V/700 V/800 V CoolMOS™ CE and P6	› Easy control of switching behavior due to higher $R_{G,int}$ › Better transition losses versus standard MOSFET
	Low voltage MOSFETs	Flyback/auxiliary synchronous rectification	80 V-120 V OptiMOS™	› Low conduction losses, reduced overshoot
	Control ICs	QR flyback IC	ICE2QS03G, ICE5QSAG	› High efficiency, high standby power
		FFR flyback IC	IPD2105	› High power density, ideal for USB-PD
PFC	High voltage MOSFETs	DCM PFC	600 V CoolMOS™ P6 and P7	› Fast switching speed for improved efficiency and thermals › Reduced gate charge for enhanced light load efficiency › Optimized V_{GS} threshold for lower turn-off losses
		DCM/CCM PFC	600 V/650 V CoolMOS™ CE	› Easy control of switching behavior even in not optimized layout › Better switching losses in comparison with its predecessor › Rugged body Diode which prevents device failure during hard commutation
		DCM PFC	650 V rapid 1	› Easy control of switching behavior due to higher $R_{G,int}$ › Better transition losses versus standard MOSFET
	Boost diode	DCM/PFC	650 V rapid 1	› Low conduction losses
	Control ICs	DCM PFC ICs	TDA4863G, IRS2505LTRPBF	› Simple external circuitry › High PFC, low THD
Main stage	High voltage MOSFETs	HB LLC	600 V CoolMOS™ P6 and P7	› Fast switching speed for improved efficiency and thermals › Reduced gate charge for enhanced light load efficiency › Optimized V_{GS} threshold for lower turn-off losses
			500 V/600 V CoolMOS™ CE	› Easy control of switching behavior due to higher $R_{G,int}$ › Better transition losses versus standard MOSFET
Synchronous rectification	Low voltage MOSFETs	Synchronous rectification	60 V-150 V OptiMOS™ 5	› Low conduction losses, reduced overshoot › Logic level switching
	Control ICs	Synchronous rectification	IR1161LTRPBF	› High efficiency › Simple external circuitry

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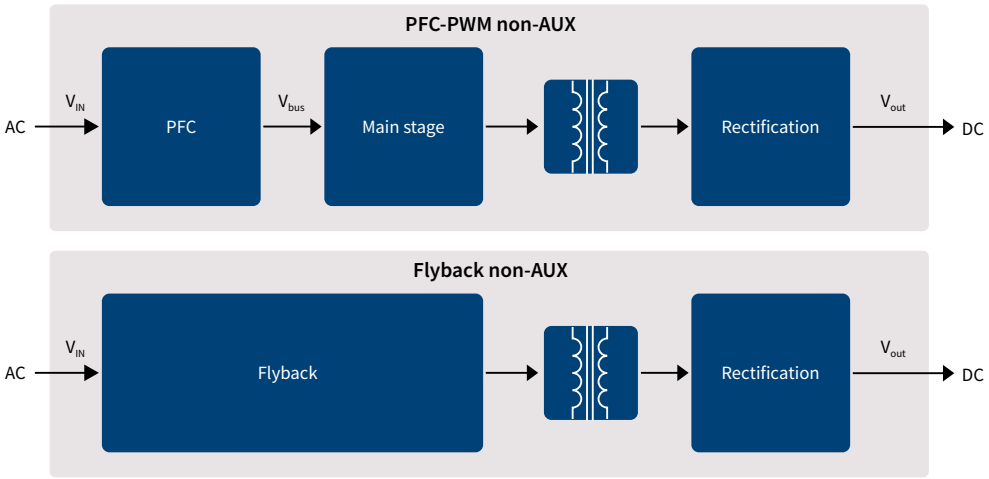
Block diagram



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SMPS

Best solutions for mobile charger

Modern mobile devices require a charger that provides faster charging but comes in a small size. High power density and cost effective power supplies can be designed by operating the converter at a higher switching frequency to avoid a considerable increase in transformer and output capacitor size. In realizing the required thermal performance and EMI behavior, power devices with lower losses and controlled switching behavior enable effective and fast product development.

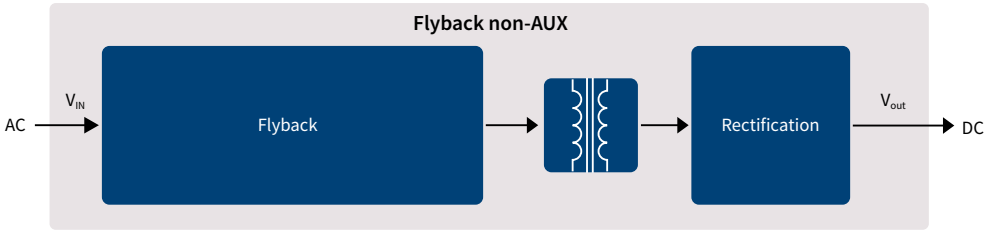
Infineon's new control ICs support topologies such as quasi-resonant flyback and forced frequency resonant flyback (zero voltage switching) operation, ideal to implement high power density adapters and well supporting USB-PD requirements.

Infineon designed its new CoolMOS™ P7 MOSFET family for adapters and chargers. Special care has been taken to ensure very good thermal behavior, increased efficiency and fulfillment of all EMI requirements, enabling our customers to easily design products based on this new family. In addition, power devices in IPAK/SMD packages enable optimal PCB layout through minimal footprint. SMD packages offer additional benefits for automatized large volume production. Specifically, high power density at low manufacturing cost can be delivered using Infineon's SOT-223 cost effective package which enables SMT manufacturing maintaining very good thermal performances.

The CoolMOS™ high voltage MOSFETs, OptiMOS™ low voltage MOSFETs and synchronous rectification IC portfolios, enable high power density designs whilst meeting the thermal requirements.

Functional block	Product category	Topology	Product family	Benefits
Flyback converter	High voltage MOSFETs	Flyback	600 V/650 V/700 V/800 V CoolMOS™ CE 700 V/800 V CoolMOS™ P7	› Best price competitive CoolMOS™ family › Lower switching losses versus standard MOSFET › Controlled dV/dt and di/dt for better EMI
	Control ICs	QR flyback	ICE5QSAG , ICE5QSAG	› High efficiency, low standby power
		FFR flyback IC	IPD2105	› High power density, ideal for USB-PD
Synchronous rectification	Low voltage MOSFETs	Synchronous rectification	60 V-150 V OptiMOS™ 5	› Low conduction losses, reduced overshoot › Logic level switching › S308/PQFN 3.3x3.3 package available
	Control ICs	Synchronous rectification	IR1161LTRPBF	› High efficiency › Simple external circuitry

Block diagram



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SMPS

More efficient PC power supply

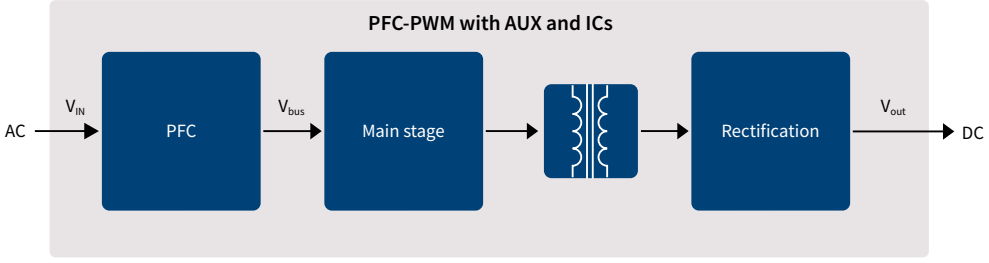
The PC power market is diversified into high-end gaming PC and better cost-performance sectors, to achieve a better price performance goal for desktop SMPS. The PC OEMs are implementing the desktop SMPS by removing the AUX power block, to save the cost of flyback circuit.

Infineon's IDP2321 is the first digital PFC + LLC combo IC worldwide to meet world leading PC manufacturers' specifications, with integrated drivers and 600 V depletion cell to achieve low standby power and lower cost. The PFC controlling loop is a configurable CrCM/DCM multimode to meet highest light-load efficiency. And the most important of all, IDP2321 has around 30~40 less part counts than traditional analogue solutions, thanks to the state-of-the-art digital control.

Furthermore, Infineon's IDP2321 offers flexible IC parameter configuration with friendly GUI, R&D engineers can key in the parameters on PC to fine tune and debug the system performance instead of soldering the passive components. Infineon offers the best total system solutions for non-AUX PC power, together with Infineon's SMD and through-hole MOSFETs.

Functional block	Topology	Voltage class	Technology	Benefits
PFC/Main stage	High voltage MOSFETs	CrCM/DCM PFC	600 V CoolMOS™ P7	› Best thermal performance › Rugged body diode › ESD enhancement for production line › Wide $R_{DS(on)}$ portfolio including both through-hole and SMD packages available
			600 V CoolMOS™ P6	› Fast switching speed for improved efficiency and thermals › Low gate charge for enhanced light load efficiency and low power consumption at no load condition › Optimized V_{GS} threshold for low turn-off losses
			500 V CoolMOS™ CE	› Optimize cost/performance › Better transition losses versus standard MOSFET
	Boost diodes	DCM PFC	650 V Rapid 1	› Low conduction losses
		CCM PFC	650 V Rapid 2	› Low reverse recovery losses and PFC switch turn-on losses
	Control ICs	CCM PFC IC	ICE3PCS0xG	› High PFC, low THD
Main stage	Control ICs	HB LLC IC	650 V – ICE1HS01G-1 / ICE2HS01G	› High efficiency, low EMI
Synchronous rectification	Mid. voltage diodes	HB LLC + center-tap	40 V OptiMOS™	› Optimized cost/performance and low thermal
			60 V OptiMOS™	› Layout tolerance, low thermals

Block diagram



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SMPS

TV power supply with lowest power consumption

In addition to their outstanding image quality, new generation TVs gain attention for their user interface, low power consumption and for the slim silhouette. This requires the power supply unit (PSU) to keep a low profile to maintain the TV's slim appearance and a low thermal dissipation image or an external adapter. In addition, a growing number of TV manufacturers will use external adapters to deliver DC power to the TV. Infineon introduced two products based on digital power technology, designed to meet challenging efficiency and standby power requirements for Internet of Things (IoT) enabled TVs (both embedded PSU and adapter). Thanks to digital power, our customers can reduce the number of TV power supplies by adapting the digital IC parameters to different TV and screen models by flexible and easy parameter setting. On top, Infineon recently introduced the 5th generation of low standby power flyback controllers, ideal to implement low power adapters for TVs and monitors. The new 600 V CoolMOS™ P7 is the logical successor of the current 600 V CoolMOS™ P6. The series has been developed to cover a broad spectrum of different applications where excellent performance and perfect ease-of-use is required. The rugged body diode enables not only the use in hard switching topologies such as power factor correction, boost and two transistor forward but also resonant topologies such as LLC where the technologies leads to high efficiency in both hard switching and resonant circuits. For higher $R_{DS(on)}$s there is a new feature of an integrated ESD diode that helps improve the quality in manufacturing. At the same time the low $R_{DS(on)}$ and gate charge Q_g enable high efficiency in the various topologies. The 600 V CoolMOS™ P7 comes with a wide variety of $R_{DS(on)}$s and packages on both industrial and consumer grade to make it suitable for applications such as server, telecom, PC, solar as well as lighting, adapters and TV. Infineon developed specifically for TV power supplies a family of packages, characterized by short lead, mold stopper and wide creepage distance, which enable our customers cheap and reliable manufacturing.

Functional block	Product category	Topology	Product family	Benefits
Main stage/PFC	High voltage MOSFETs	DCM PFC, HB LLC	600 V CoolMOS™ P6 and P7	› Fast switching speed for improved efficiency and thermals › Low gate charge for enhanced light load efficiency and low power consumption at no load condition › Optimized V_{GS} threshold for lower turn-off losses › Rugged body diode for HB LLC application
			500 V/600 V/650 V/800 V CoolMOS™ CE	› Easy control of switching behavior even in not optimized layout › Better switching losses in comparison with its predecessor › Rugged body diode which prevents device failure during hard commutation
	Control ICs	IDP2303	PFC-LLC non-AUX combo IC for TV embedded PSU	› Low BOM count/system cost due to high integration › Low standby power › High system reliability › Shorter development cycles and higher design and production flexibility
		IDP2303A	PFC-LLC non-AUX combo IC for TV adapter	› Low BOM count/system cost due to high integration › Low standby power › Small form factor designs › High system reliability
PFC	Boost diodes	DCM PFC	650 V Rapid 1	› Low conduction losses
	Control ICs	CCM PFC IC	800 V – ICE3PCS0xG	› High PFC, low THD
Main stage	Control ICs	HB LLC IC	650 V – ICE1HS01G-1 / ICE2HS01G	› High efficiency, low EMI
Auxiliary power supply	Control ICs	QR/FF flyback CoolSET™	600 V/800 V – ICE2QRxx65/80(Z)(G), ICE3xRxx65/80J(Z)(G), ICE5QRxx70/80A(Z)(G)	› Low standby power, high efficiency and robustness
Flyback	Control ICs		ICE5QSAG	› Selectable active burst mode entry/exit profile to optimize standby power › Adjustable line input over- and under voltage protection against abnormal line input › V_{CC} and CS pin short to ground protection against abnormal operation
Synchronous rectification	Low voltage MOSFETs	Flyback	60 V/80 V/100 V OptiMOS™ 5	› Low conduction losses, reduced overshoot

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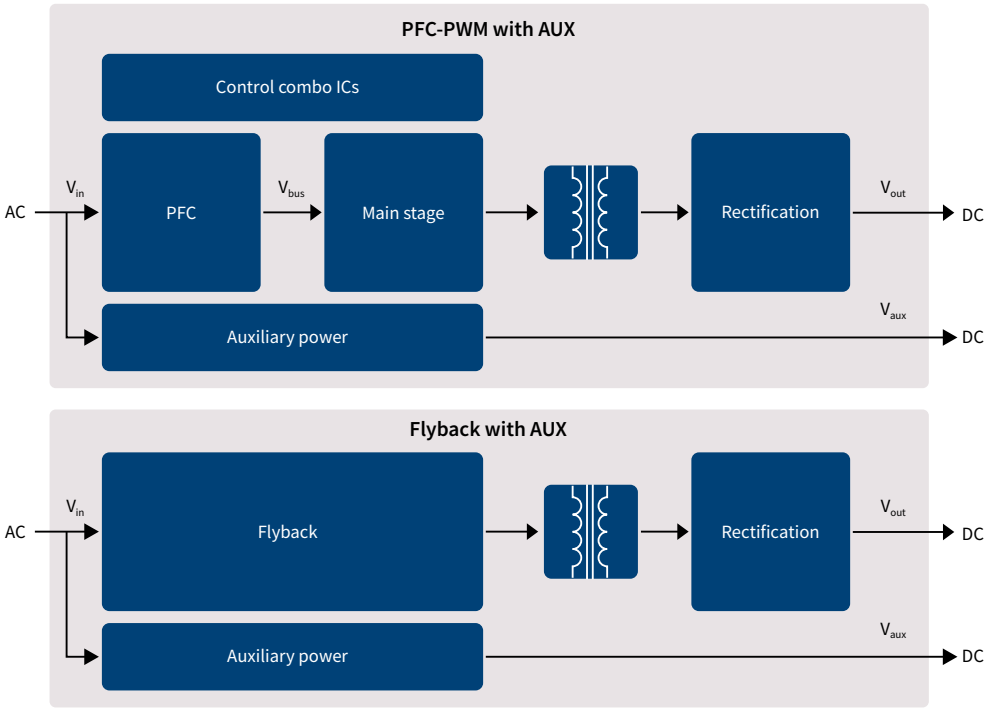
Block diagram



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SMPS

Full system solutions for embedded power supplies

Customers who design or manufacture a product that needs embedded intelligence typically want to focus on the system design of their product, be it a white good, a vending machine, an automatic door opener or any other product. They do not want to spend valuable efforts and time in designing the power supply systems. They just want to use them, having a trouble less, EMI friendly and reliable power supply.

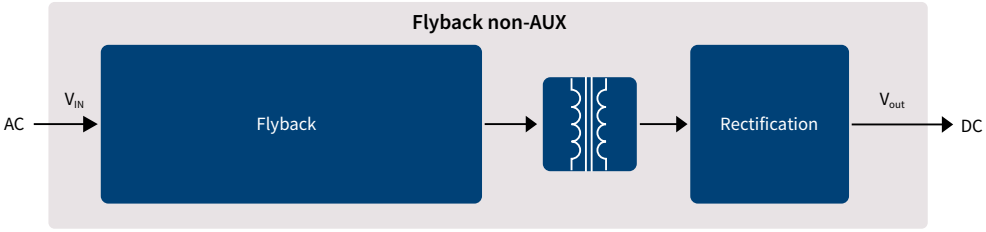
Infineon decided to build a scalable, broad range of products and flexible scalable and easy to reuse reference designs aimed at helping its customers with best fitting solutions tailored for different customer needs.

Depending on their specific needs our customers can select very low cost power supply reference designs featuring high integration or using a platform approach to reuse the same power designs for different products that need different power supplies. Or if high efficiency is needed, for example to meet energy star labels or to improve overall thermal performance, Infineon offers highest efficiency power supply reference designs.

In addition, Infineon offers a comprehensive reference designs and application notes helping customers to drastically improve the efficiency of their power supply by using secondary side synchronous rectification instead of a rectifier diode. Benefits of synchronous rectification are better efficiency, and better thermal performance of your power supply.

Functional block	Product category	Topology	Technology	Selection
Auxiliary power supply	Control ICs	QR/FF flyback CoolSET™	600 V/800 V – ICE2QRxx65/80(Z)(G), ICE3xRxx65/80J(Z)(G), ICE5QRxx70/80A(Z)(G)	› Low standby power, high efficiency and robustness
Flyback	Control ICs	QR flyback	ICE2QS03G, ICE5QSAG	› High efficiency, low standby power
	High voltage MOSFET	Flyback	600 V/650 V/700 V/800 V CoolMOS™ CE 700 V/800 V CoolMOS™ P7	› Best price competitive CoolMOS™ family › Lower switching losses versus standard MOSEFET › Controlled dV/dt and di/dt for better EMI

Block diagram



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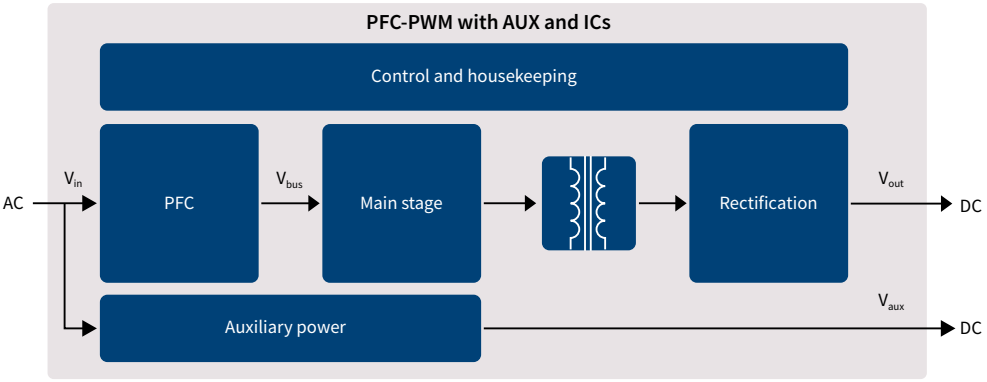
SMPS

Highly efficient server power supply

The trend of the enterprise server and datacenter server is to deliver more power per rack, meanwhile the higher rising cost of energy and environmental concerns make SMPS efficiency optimization a key requirement across the entire load range for server and data center design. This challenging task is combined with the requirement for higher power and higher power density with cost effective design. In the PFC stage and in general hard switching topologies used in server applications, Infineon proposes 600 V CoolMOS™ C7 family with the lowest FOM $R_{DS(on)}$ *Q_G and $R_{DS(on)}$ *E_{oss}. This provides the lowest switching losses, which are necessary in fast switching needed in high-end server SMPS, thus optimizing the efficiency starting from very light load operation. The very compact SMD packages such as ThinPAK, offer benefits in space and power density, and are used with Infineon's new industry standard non-isolated driver family 2EDN752x.

Complementary to 600 V CoolMOS™ C7 in high efficiency PFC is the CoolSiC™ diodes generation 5 family.
The 600 V CoolMOS™ P6 family offers a good compromise between price and performance. This is valuable in both PFC and HV DC-DC stages where the low Q_G and turn-off losses are important benefits, especially in the case of high switching frequency operation and high light load efficiency requirements. In applications with a low output voltage and high output current, further efficiency improvements have been made possible by the continuous reduction of on-resistance by Infineon's low voltage OptiMOS™ MOSFET series used in the synchronous rectification stage. Infineon's low voltage families are complemented by StrongIRFET™ which is optimized for lower switching frequencies and highest system robustness.

Block diagram



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Functional block	Product category	Topology	Product family	Benefit
PFC	High voltage MOSFETs	CCM/interleaved PFC; TTF	600 V/650 V CoolMOS™ C7 600 V/650 V CoolMOS™ C7 Gold in TOLL	› Best FOM $R_{DS(on)}$*Q_G and $R_{DS(on)}$*E_{oss} › Lowest $R_{DS(on)}$ per package › Low dependency of switching losses form $R_{g,ext}$
	SiC diodes	CCM/interleaved PFC	650 V CoolSiC™ Schottky diode generation 5	› Low FOM V_F*Q_G
	Control ICs	CCM PFC IC	ICE3PCS0xG	› Ease-of-use
	IGBTs	CCM/interleaved PFC	650 V TRENCHSTOP™ H5	› High PFC, Low THD
			650 V TRENCHSTOP™ F5	› High efficiency in low inductance designs
Main stage	High voltage MOSFETs	ITTF	600 V CoolMOS™ C7/P6	› Fast switching speed for improved efficiency and thermals › Low gate charge for enhanced light load efficiency and low power consumption at no load condition › Optimized V_{GS} threshold for lower turn-off losses › Rugged body diode which prevents device failure during hard commutation
		LLC, half-bridge below 1 kW	600 V CoolMOS™ C7/P6	› Low turn-off losses › Low Q_{oss} › Low Q_G
		LLC, phase shift full-bridge below 1 kW	650 V CoolMOS™ CFD2	› Fast and rugged body diode › Highest reliability for 650 V V_{DS} › Low Q_G and soft commutation behavior
	IGBTs	ZVS PS FB; LLC	650 V TRENCHSTOP™ H5	› Improved ruggedness and ease-of-use
		ZVS PS FB; LLC, TTF	650 V TRENCHSTOP™ F5	› Improved ruggedness and high efficiency in low inductance designs
	Control ICs	HB LLC IC	ICE1HS01G-1	› High efficiency, low EMI
			ICE2HS01G	
Sychronous rectification	Low voltage MOSFETs	HB LLC and centertap	40 V OptiMOS™	› High efficiency over whole load range, layout tolerance
			40 V StrongIRFET™	› High robustness and ruggedness
		ITTF	60 V OptiMOS™	› High efficiency, low thermals, low V_{DS} overshoot
			60 V StrongIRFET™	› High robustness and ruggedness
		ZVS PS FB and center-tap	80 V OptiMOS™	› High efficiency over whole load range, low V_{DS} overshoot and oscillations
			80 V StrongIRFET™	› High robustness and ruggedness
Auxiliary power supply	Control ICs	QR/FF flyback CoolSET™	800 V – ICE2QRxx80(Z)(G) ICE3xRxx80J(Z)(G) 700 V ICE5QRxx70A(Z)(G) 800 V ICE5QRxx80A(Z)(G)	› Low standby power, high efficiency and robustness › An integrated 700 V/800 V superjunction power MOSFET with avalanche capability › Burst mode entry/exit to optimize standby power at different low load conditions
Housekeeping	Microcontrollers	-	XMC1xxx	› Flexibility, HR PWM, digital communication › ARM® based standard MCU family, wide family
Conversion	Microcontrollers	-	XMC4xxx	› Flexibility, HR PWM, digital communication
PFC, PWM/resonant converter, synchronous rectification	Driver ICs	-	1EDix EiceDRIVER™	› 100 ns typ. propagation delay time › Functional isolation › Separate source
		-	2EDNx EiceDRIVER™	› 8 V UVLO option › -10 V input robusteness › Output robust against reverse current

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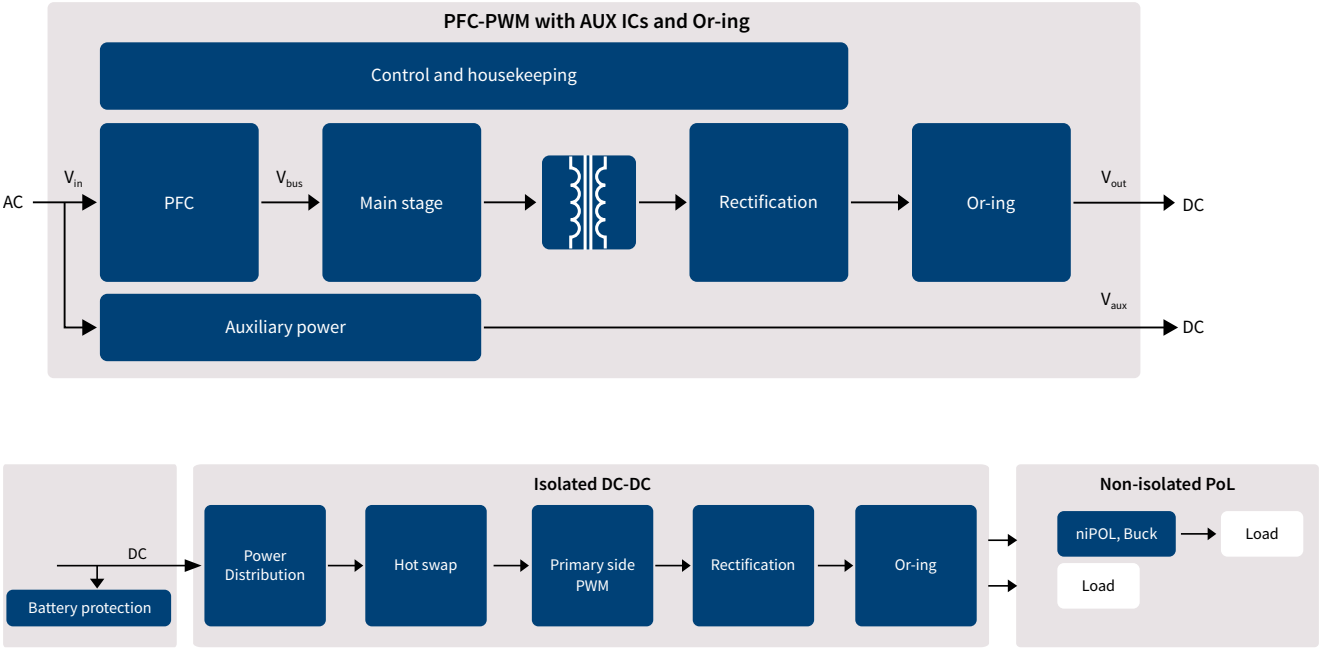
SMPS

Full system solution for telecom power supply

The telecommunication industry providing data, voice and video is continuously growing supported by the expansion into new markets and accelerated by the spread of wireless and broadband technologies. The outstanding improvements in telecom SMPS performance achieved in the past 10 years have been primarily brought by the dramatic reduction of the on-resistance achieved in high voltage MOSFETs, using the revolutionary superjunction principle. This principle was introduced by Infineon at the end of the nineties in the CoolMOS™ series. Equally impressive improvements in reverse-recovery characteristics have been achieved for high voltage SiC (Silicon Carbide) diodes. In order to achieve the new challenging efficiency targets, the synchronous rectification utilizing the unique performance of OptiMOS™ low voltage MOSFETs has become increasingly popular even in the typically high output voltage of telecom rectifiers.

Block diagram



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Functional block	Product category	Topology	Product family	Benefit
PFC	High voltage MOSFETs	CCM/interleaved PFC; TTF	600 V/650 V CoolMOS™ C7	› Best FOM $R_{DS(on)}$*Q_G and $R_{DS(on)}$*E_{oss} › Lowest $R_{DS(on)}$ per package › Low dependency of switching losses form $R_{g,ext}$
			600 V CoolMOS™ P7	› Low turn-off losses › Low Q_{oss} › Low Q_G
	SiC diodes	CCM/interleaved PFC	650 V CoolSiC™ Schottky diode generation 5	› Low FOM V_F*Q_C
	Control ICs	CCM PFC IC	800 V – ICE3PCS0xG	› High PFC, Low THD
Main stage	High voltage MOSFETs	CCM/interleaved PFC; TTF HB LLC	600 V CoolMOS™ C7/P7	› Fast switching speed for improved efficiency and thermals › Low gate charge for enhanced light load efficiency and low power consumption at no load condition › Optimized V_{GS} threshold for lower turn-off losses › Rugged body diode which prevents device failure during hard commutation
		LLC	600 V CoolMOS™ C7	› Low turn-off losses › Low Q_{oss} › Low Q_G
		CCM/interleaved PFC; TTF HB LLC	650 V CoolMOS™ CFD2	› Fast and rugged body diode › Low Q_G › Soft commutation behavior
PWM	Control ICs	HB LLC IC	ICE1HS01G-1 ICE2HS01G	› High efficiency, low EMI
Sychronous rectification	Low voltage MOSFETs	Synchronous rectification MOSFET	80 V-100 V OptiMOS™	› Industry's lowest FOM ($R_{DS(on)}$*Q_G) leading to high efficiency at good price/performance › Low voltage overshoots enabling easy design-in › Industry's lowest $R_{DS(on)}$ › Highest system efficiency and power density › Outstanding quality and reliability › Reduces the need for a snubber circuit
Auxiliary power supply	Control ICs	QR/FF flyback CoolSET™	800 V – ICE2QRxx80(Z)(G) ICE3xRxx80J(Z)(G)	› Low standby power, high efficiency
Housekeeping	Microcontrollers	-	XMC1xxx	› Flexibility, HR PWM, digital communication › ARM® based standard MCU family, wide family
Conversion	Microcontrollers	-	XMC4xxx	› Flexibility, HR PWM, digital communication › ARM® based standard MCU family, wide family
PFC, PWM/resonant converter, synchronous rectification	Driver ICs	-	1EDix EiceDRIVER™	› 100 ns typ. propagation delay time › Functional isolation › Separate source
		-	2EDNx EiceDRIVER™	› 8 V UVLO option › (-)10 V input robusteness › Output robust against reverse current
Or-ing	Low voltage MOSFETs	Or-ing MOSFET	60 V-200 V OptiMOS™	› Industry's lowest FOM ($R_{DS(on)}$*Q_G) leading to high efficiency at good price/performance › Low voltage overshoots enabling easy design-in
Battery protection	Low voltage MOSFETs	MOSFET	60 V-150 V OptiMOS™	
Isolated DC-DC	Low voltage MOSFETs	Primary side PWM MOSFET	60 V-200 V OptiMOS™	› Industry's lowest $R_{DS(on)}$ › Highest system efficiency and power density › Outstanding quality and reliability › Reduces the need for a snubber circuit
			60 V-200 V StrongIRFET™	
			60 V-200 V Small Signal	
		Synchronous rectification MOSFET	40 V-100 V OptiMOS™	
			40 V-100 V StrongIRFET™	
		Or-ing MOSFET	25 V-30 V OptiMOS™	
			25 V-30 V StrongIRFET™	
Non-isolated POL buck	For more detailed information see chapters DC-DC multiphase enterprise power solution for data processing applications (page 18) and non-isolated DC-DC (page 174)			

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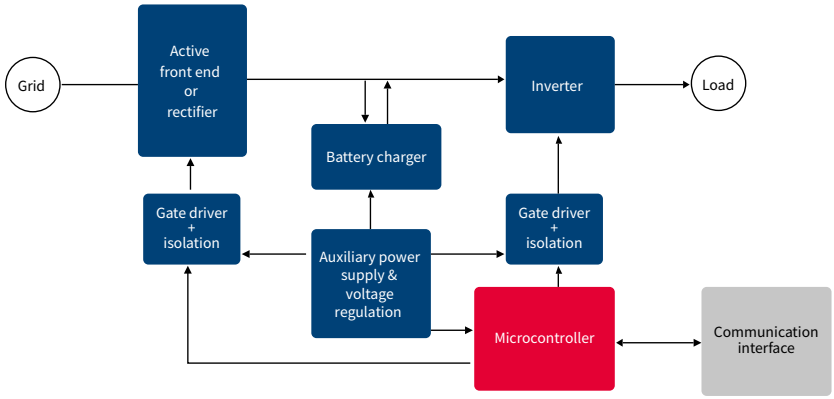
Uninterruptible power supply (UPS)

Attractive solutions for highest efficiency and power density

Today's uninterruptible power supply systems introduce a wide range of challenges. Overcoming them requires an increase in output power, power density and energy efficiency. For all your UPS power supply applications, Infineon's high quality products provide you with complete system level solutions. Equipped with our semiconductors, UPS applications can achieve best-possible power conversion efficiency and cutting-edge power density. The benefits: cost reduction and fewer passive components – regardless of the topology used. By choosing Infineon for UPS applications you get solutions that fulfill the latest market requirements. This includes the trend of modularization of UPS brick units due to scalable power demand from datacenter, as well as the topology shift from 2-level to 3-level to achieve higher efficiency. Our products are suitable for any kind of uninterruptible power supplies in telecom, datacenter, servers or industrial automation environment.



Stage	Topology	Voltage class	Technology	Selection
Rectifier	3-phase	800 V/1600 V	EasyBRIDGE, EconoBridge™	Recommendation
PFC	Boost PFC	1200 V	TRENCHSTOP™	Ease-of-use
	Boost PFC	1200 V	HighSpeed 3	Efficiency
	Boost PFC	650 V	TRENCHSTOP™ 5 H5	Efficiency
	Boost PFC	650 V	TRENCHSTOP™ 5 S5	Efficiency and ease-of-use
	Boost PFC	650 V	Rapid diode	Efficiency
	Boost PFC	600 V/1200 V	EASYPACK™	Recommendation
	PFC	600 V	CoolMOS™ P6	Recommendation
	PFC	600 V	CoolMOS™ C7	Recommendation
Inverter	NPC 1	650 V	TRENCHSTOP™ 5 H5	Efficiency
	NPC 1	650 V	TRENCHSTOP™ 5 S5	Efficiency and ease-of-use
	NPC 1	650 V	Rapid diode	Efficiency
	NPC 2	1200 V	TRENCHSTOP™	Ease-of-use
	NPC 2	1200 V	HighSpeed 3	Efficiency
	NPC 2	650 V	TRENCHSTOP™ 5 H5	Efficiency
	NPC 2	650 V	TRENCHSTOP™ 5 S5	Efficiency and ease-of-use
	NPC 2	650 V	Rapid diode	Efficiency
	2-level	600 V/1200 V	EconoPACK™ , EASYPACK™ ,	Efficiency and ease-of-use, power density
	2-level	600 V/1200 V	EconoPIM™, EconoDUAL™	Efficiency and ease-of-use, power density
	3-level NPC1	600 V/1200 V	EconoPACK™ , EASYPACK™	Power density, ease-of-use
	3-level NPC2	600 V/1200 V	EconoPACK™ , EASYPACK™, 62 mm	Power density, ease-of-use high integration
Charger controller	Half-bridge	1200 V	HighSpeed 3	Efficiency
Driver IC	-	1200 V	EiceDRIVER™ Compact	Recommendation
AUX	-	650 V-800 V	CoolSET™	Recommendation

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Gate driver application guide

		Industrial, server, telecom SMPS and inverters							
		PFC				High voltage DC-DC			
Functionality		Primary side controlled				Primary side controlled	Secondary side controlled		
Topology		Boost PFC („classic“: Diode + FET)	Interleaved Boost- PFC („classic“: Diode + FET)	Bridgeless PFC (Vienna)		LLC	LLC	ZVS	(i)TTF
Switching device	High-side	SiC diode gen5	SiC diode gen5	CoolMOS™ C7, P6		CoolMOS™ CFD2, P6	CoolMOS™ CFD2, P6	CoolMOS™ CFD2	CoolMOS™ C7, P6
	Low-side	CoolMOS™ C7, P6	CoolMOS™ C7, P6	CoolMOS™ C7, P6		CoolMOS™ CFD2, P6	CoolMOS™ CFD2, P6	CoolMOS™ CFD2	CoolMOS™ C7, P6
Gate-Driver IC	High-side	n.a.	n.a.	2EDL	1EDI	IR(S)21834 IR(S)2183 IR(S)2184	2EDN[1] 1EDN[1]	2EDN[1] 1EDN[1]	2EDN[1] 1EDN[1]
	Low-side	2EDN 1EDN	2EDN 1EDN		2EDN 1EDN		2EDN[1] 1EDN[1]	2EDN[1] 1EDN[1]	2EDN[1] 1EDN[1]

		EV charging			
		PFC			High voltage DC-DC
Functionality					
Topology		Interleaved boost PFC	Vienna PFC		Phase-shift ZVS Full-bridge
Switching device	High-side	SiC diode gen5	CoolMOS™ C7, P6		CoolMOS™ CFD2
	Low-side	CoolMOS™ C7	CoolMOS™ C7, P6		CoolMOS™ CFD2
Gate-Driver IC	High-side	n.a.	2EDL	1EDICompact	2EDN[1] 1EDN[1]
	Low-side	2EDN 1EDN		2EDN 1EDN	2EDN[1] 1EDN[1]

[1] Requires pulse-transformer
[2] Secondary side controlled
[3] 600 V for soft- and hard-switching high-performance, 650 V for hard-switching
[4] Rugged hard- and soft-switching

	Synchronous rectification			General DC-DC supplies			
				Without transformer		With transformer	
400 V DC-link	Classic		Telco brick 48 V to 12 V	< 200 W		> 200 W	
Full-bridge	Center tapped	Full-bridge	Center tapped SR	Active clamp	Buck	Full-/half-bridge	Push-pull
CoolMOS™ C7[3], P6[4]	n.a.	OptiMOS™ 5	OptiMOS™ 3, 5	OptiMOS™ 3, 5; StrongIRFET™			n.a.
CoolMOS™ C7[3], P6[4]	OptiMOS™ 5	OptiMOS™ 5	OptiMOS™ 3, 5	OptiMOS™ 3, 5; StrongIRFET™			HEXFET™
2EDN[1] 1EDN[1]	n.a.	2EDL	n.a.	n.a.	PX3517 PX3519 2EDL	2EDL	n.a.
2EDN[1] 1EDN[1]	2EDN 2 x 1EDN		2EDN	2EDN 2 x 1EDN			2EDN 2 x 1EDN

Low voltage drives							
Power tools				Light electric vehicles			
Motor control	Battery management			Motor control	Charger		
	Battery protection				Boost PFC	LLC	Synchronous rectification
n.a.	n.a.			n.a.	n.a.	CoolMOS™ P6	n.a.
OptiMOS™ 3, 5; StrongIRFET™	OptiMOS™ 3, 5; StrongIRFET™			OptiMOS™ 3, 5; StrongIRFET™	CoolMOS™ P6	CoolMOS™ P6	OptiMOS™ 3, 5; StrongIRFET™
IRS2127(1)	IRS2127(1)	IRS2005 IRS21867 IRS2301 2EDL05N06PF		IRS2127(1)	n.a.	2EDN[1] 1EDN[1]	n.a.
2EDN 1EDN	2EDN 1EDN			2EDN 1EDN	2EDN 1EDN 2EDL05N06PF IRS2005 IRS21867	2EDN[1] 1EDN[1]	2EDN 1EDN

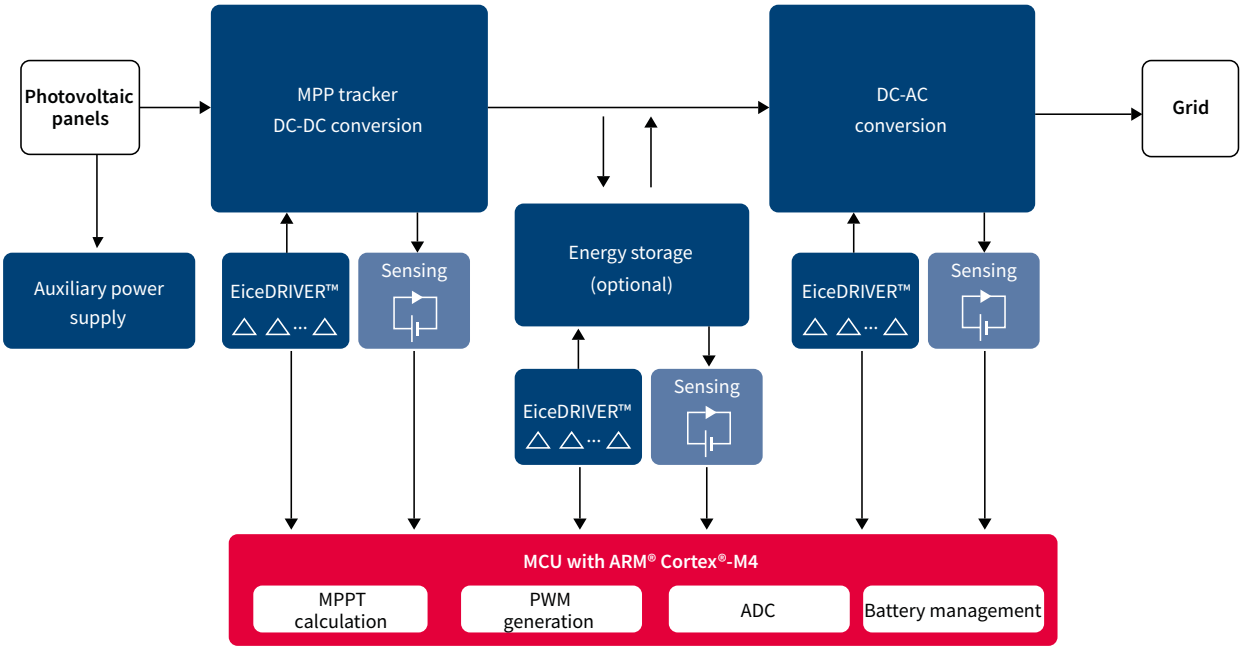
Solar

Leading products for solar power systems

Infineon provides a comprehensive portfolio to deliver the best efficiency and reliability for solar applications. Infineon's leading edge technology like superjunction MOSFET, HighSpeed 3 and TRENCHSTOP™ 5, SiC Schottky diodes, coreless transformer driver etc., combined with rich experience and the highest quality, ensured our number 1 position in solar applications. The newest add ARM® Cortex®-M4 based MCU enables easy and high efficiency design.

	Optimizer 250 W - 750 W	Single/Dual microinverter 250 W-600 W; 900 W		String inverter 1 kW-30 kW
MOSFET	OptiMOS™ SuperSO8/DirectFET™ | 75 V-150 V	OptiMOS™ SuperSO8 | 60 V-200 V	CoolMOS™ D²PAK/ThinPAK 600 V-800 V	CoolMOS™ TO-247 | 600 V/650 V | 19 mΩ-99 mΩ
SiC diode		CoolSiC™ diode DPAK/TO-220 | 1200 V		CoolSiC™ diode TO-220/TO-247 | 650 V/1200 V
IGBT				TRENCHSTOP™/HighSpeed 3 TO-247 single/TO-247 DuoPack | 600 V/650 V/1200 V
Power module and stack				EASYPACK™ 1B/2B Press FIT
Driver		2EDN EiceDRIVER™		IGBT driver: 1ED020I12-F2, 2ED020I12-F2
Schottky diode				BAT165 Schottky diode
Auxiliary power supply				CoolSET™ 800 V
Microcontroller	XMC1xxx ARM® Cortex®-M0	XMC1xxx ARM® Cortex®-M0		XMC1xxx ARM® Cortex®-M0
	XMC45xx ARM® Cortex®-M4	XMC45xx ARM® Cortex®-M4		XMC45xx ARM® Cortex®-M4

Infineon leading products for complete solar system



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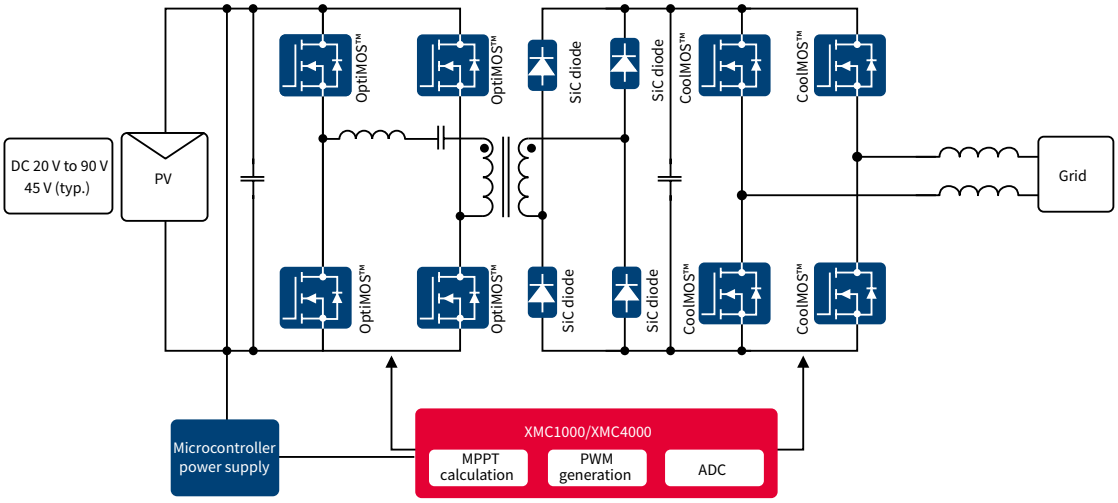
Microinverter



OptiMOS™ MOSFETs for microinverter

Input voltage	Topology	MOSFET breakdown voltage	SuperSO8	DirectFET™	D²PAK
Up to 48 V	Half-bridge, full-bridge, LLC and other resonant	60 V	BSC014N06NS BSC016N06NS BSC028N06NS BSC039N06NS	BSB028N06NN3G	–
Up to 64 V	Half-bridge, full-bridge, LLC and other resonant	80 V	BSC030N08NS5 BSC037N08NS5 BSC052N08NS5	BSB044N08NN3G	–
Up to 80 V	Half-bridge, full-bridge, LLC and other resonant	100 V	BSC035N10NS5 BSC040N10NS5	–	IPB020N10N5
Up to 60 V	Flyback	150 V	BSC091N15NS5 BSC108N15NS5 BSC160N15NS5 BSC175N15NS5	BSB165N15NZ3	IPB041N15N5 IPB063N15N5 IPB108N15N3G
	Push-pull	200 V	BSC320N20NS3G	–	IPB107N20N3G

CoolMOS™ MOSFETs for microinverter

Topology	Package	Voltage class	CoolMOS™
Current source	D²PAK	800 V	SPB17N80C3
Current/voltage source	D²PAK	650 V	IPB65R190C6
			IPB65R190C7
			IPB65R125C7
			IPB65R095C7
			IPB65R065C7
			IPB65R045C7
	ThinPAK 8x8	600 V	IPL60R210P6
		650 V	IPL65R195C7
			IPL65R130C7
			IPL65R099C7
			IPL65R070C7

CoolSiC™ diodes for microinverter

Topology	Package	Voltage class	Part number
Rectifier	TO-252 (DPAK)	1200 V	IDM02G120C5
			IDM05G120C5
			IDM08G120C5

Functional block	Product category	Product family	Benefits
PFC, PWM/ resonant converter, synchronous rectification	Driver ICs	1EDix EiceDRIVER™	› 100 ns typ. propagation delay time › Functional isolation › Separate source
		2EDNx EiceDRIVER™	› 8 V UVLO option › (-)10 V input robusteness › Output robust against reverse current

Microcontrollers for microinverter

Topology	Package	Voltage class	Technology
Microcontroller	All	All	XMC1000
Microcontroller supply	Linear voltage regulator	Up to 20 V	IFX1763, IFX54441, IFX54211
Microcontroller	All	All	XMC4000

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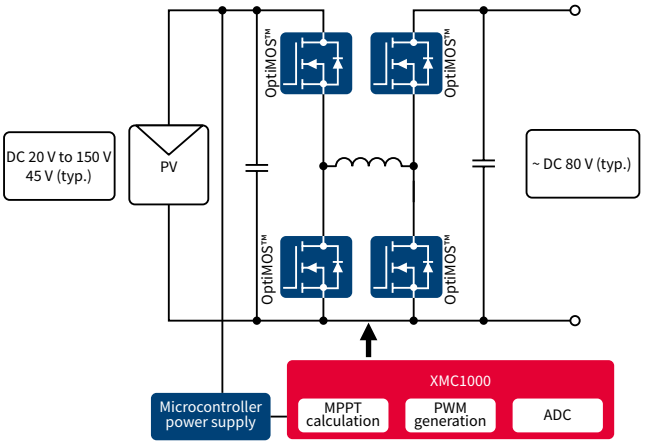
Optimizer



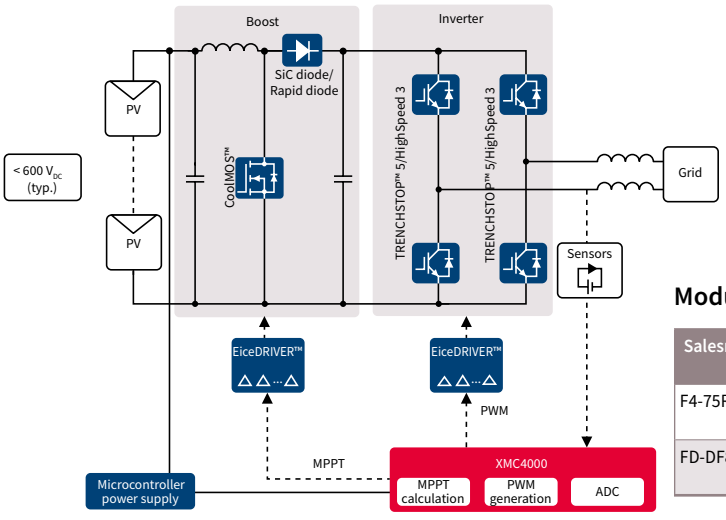
OptiMOS™ MOSFETs for optimizer DC-DC power conversion

Input voltage	Topology	MOSFET Breakdown voltage	SuperSO8	S308/PQFN 3.3x3.3	DirectFET™	D²PAK and DPAK
Up to 48 V	Buck-boost	60 V	BSC014N06NS BSC016N06NS	BSZ042N06NS	BSB028N06NN3G	IPB026N06N
Up to 64 V	Buck-boost	80 V	BSC027N08NS5 BSC040N08NS5 BSC052N08NS5 BSC117N08NS5	BSZ075N08NS5 BSZ084N08NS5 BSZ110N08NS5	BSB044N08NN3G BSF134N10NJ3G	IPB017N08N5 IPB031N08N5 IPB049N08N5
Up to 80 V	Buck-boost	100 V	BSC035N10NS5 BSC040N10NS5 BSC060N10NS3	BSZ097N10NS5	BSB056N10NN3	IPB020N10N5
Up to 125 V	Buck-boost	200 V	BSC320N20NS3G	BSZ900N20NS3 G	–	IPD320N20N3G

Microcontrollers for power optimizer

Topology	Package	Voltage class	Technology
Microcontroller	All	All	XMC1000
Microcontroller supply	Linear voltage regulator	Up to 20 V	IFX1763, IFX54441, IFX54211
Microcontroller	All	All	XMC4000

String inverter (non-isolated)



Modules for string inverter

Salesname	Package	Pin	Description	Voltage class
F4-75R07W2H3_B51	EASYPACK™ 2B	PressFIT	Integrated booster/inverter module (3 kVA–8 kVA)	1200 V
FD-DF80R12W1H3_B52	EASYPACK™ 2B	PressFIT	Buck and boost module (3 kVA-8 kVA)	

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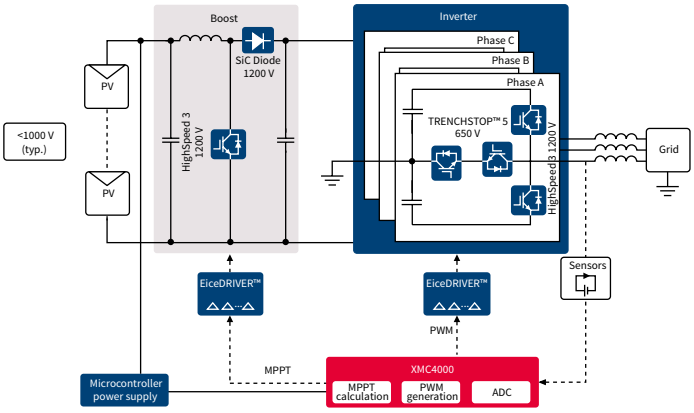
String inverter (three-phase)



Three-phase modules for string inverter

Salesnames	Voltage class
F3L75R12W1H3_B11	1200 V
F3L150R12W2H3_B11	
F3L200R12W2H3_B11	
F3L100R12W2H3_B11	
FS3L25R12W2H3_B11	
FS3L15R12W2H3_B11	

Booster modules for string inverter

Salesnames	Voltage class
DF80R12W2H3F_B11	1200 V
DF160R12W2H3F_B11	

Discrete power device for string inverter

Inverter type	Function	Product series	Part number	Voltage class
Single-phase	Boost	CoolMOS™ C7	IPW60R040C7	600 V
		CoolSiC™ diode	IDW20G65C5	650 V
	DC-DC	CoolMOS™ P6	IPW60R041P6	600 V
		CoolSiC™ diode	IDW20G65C5	650 V
		Rapid diode	IDW15E65D2	650 V
	Inverter	HighSpeed 3	IKW40N60H3	600 V
		TRENCHSTOP™ 5 H5	IKW40N65H5	650 V
		CoolMOS™ P6	IPW60R041P6	600 V
Three-phase	Boost	HighSpeed 3	IKW40N120H3	1200 V
		CoolSiC™ diode	IDW40G120C5B	1200 V
		TRENCHSTOP™ 5 S5	IKW40N65ES5	650 V
		TRENCHSTOP™ 5 L5	IKW30N65EL5	650 V
	Inverter	HighSpeed 3	IKW40N120H3	1200 V

EiceDRIVER™ for string inverter

Power device	Driving method	Voltage class	Part number
IGBT	Single channel	1200 V	1ED020I12-F2/B2
IGBT	Half-bridge	1200 V	2ED020I12-FI

CoolSET™ for string inverter

Voltage class	Part number
800 V	ICE3AR2280JZ
650 V	ICE3BR1765JZ

Microcontrollers for string inverter

Topology	Package	Voltage class	Technology
Microcontroller	All	All	XMC1000
Microcontroller supply	Linear voltage regulator	Up to 20 V	IFX1763, IFX54441, IFX54211
Microcontroller	All	All	XMC4000

www.infineon.com/solar
www.infineon.com/igbtmodules1200v

Wireless charging for consumer

Highest efficiency for the next level of charging

Within the last years, wireless charging gained more and more traction in the market and will heavily influence our daily lives in the coming years. Infineon offers a variety of innovative components to develop highly reliable and efficient solutions for the transmitter and adapter/charger (see page 38 and 40) parts of a wireless charging system by serving the key requirements of the dominating standards in the market: inductive (AirFuel and Qi (WPC)) and resonant (AirFuel).

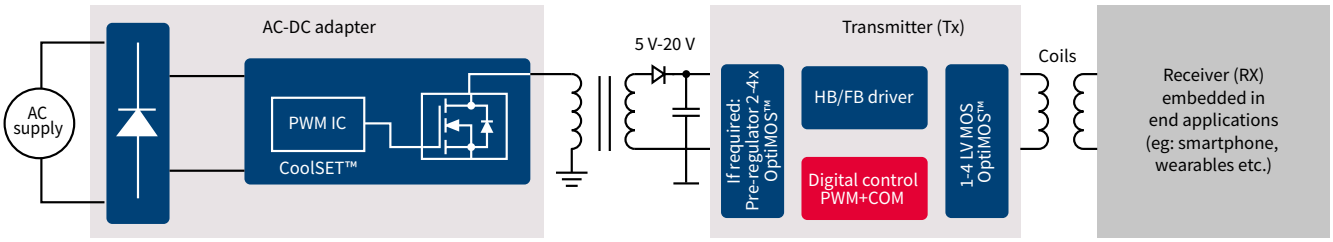
Many end markets for wireless battery charging

Key enabling products for transmitter and adapter

- Low and mid voltage power MOSFETs – OptiMOS™
- Driver ICs – EiceDRIVER™
- Microcontrollers – XMC™
- High voltage power MOSFETs – CoolMOS™ CE/P7
- PWM/flyback controllers and integrated power stage ICs – CoolSET™
- Synchronous rectification ICs and MOSFETs – OptiMOS™

Key application requirements	Benefits of Infineon products
Efficient and easy to design transmitter solutions	› Right fit as well as high performance MOSFETs, ICs and microcontrollers
Smart heat management to provide cooling for receiver and transmitter	› Highest efficiency components reduces need for extra cooling
Small package sizes to enable small form factor designs (e.g. wearables)	› Smallest possible package size for low power MOSFETs 30 V-100 V
Higher power ratings for faster charge speed	› Highest power density with low and high voltage MOSFETs

Block diagram



www.infineon.com/wirelesspower

Components for inductive (AirFuel and Qi) and low switching frequency transmitter solutions

Especially for the emerging higher power (15 W+) transmitter applications equipping your half- or full-bridge with components from the OptiMOS™ 30 V product family will pay off with superior power transfer performance. Single and dual n-channel OptiMOS™ versions with excellent $R_{DS(on)}$ and charge characteristics are available in small footprint packages for your wireless power transmitter design. For multi-coil designs, there are very suitable IR MOSFET™ devices in 2x2 mm packages ready to use.

Sub-application	Voltage class	Package	Part number	$R_{DS(on)}$ max @ V_{GS} = 4.5 V [mQ]
Inverter MOSFETs	30 V	SuperSO8	BSC0996NS	11.8
			BSC0993ND	7.0
		PQFN 3.3 x 3.3	BSZ0589NS	4.4
			BSZ0994NS	8.6
		PQFN 2 x 2	IRFHS8342PbF	25
			IRLHS6342PbF	15.5
Coil selection switch	20 V	PQFN 2 x 2	IRLHS6242PbF	11.7 (2.5 V drive capable)
	25 V		IRFHS8242PbF	21
	30 V		IRFHS8342PbF	25
			IRLHS6342PbF	15.5 (2.5 V drive capable)
		PQFN 3.3 x 3.3	BSZ0994NS	8.6
Microcontroller	XMC1302 or XMC1404 or XMC4108 (for details please check page 230)			

www.infineon.com/wirelesspower

Components for resonant (AirFuel) and high switching frequency transmitter solutions

Infineon offers superior power MOSFET technology especially in the 30 V-100 V areas for class D inverter designs and in the 150 V-250 V voltage class for class E inverter to address MHz switching implementations. We provide leading products in the industry when it comes to fast switching and have the best figure-of-merit for gate charge times $R_{DS(on)}$ and for C_{oss} thus allowing you to achieve 6.78 MHz inverter designs using robust silicon MOSFET technology. There are even more targeted products in the pipeline and Infineon is working on its own medium voltage GaN technology and will bring it to the market with a significant performance increase over silicon MOSFETs. Infineon offers the "coolest" driver ICs in the industry, already available as low side drivers for class E implementations and soon as level shifted half-bridge driver for class D topologies. If your transmitter design uses a pre-regulator (buck or buck/boost) to control the input voltage of your amplifier you can find OptiMOS™ solutions in the 20 V-400 V MOSFETs section.

Sub-application	Voltage class	Package	Part number	$R_{DS(on)}$ max @ V_{GS} = 4.5 V [mQ]	Q_g typical [nC]	C_{oss} typical [pF]	Topology
Inverter MOSFETS	30 V	PQFN 2 x 2 Dual	IRLHS6376PbF	48	2.8	32	Class D
		PQFN 3.3 x 3.3 Dual	BSZ0909ND	18.5	2.0	~120	Class D
		PQFN 3.3 x 3.3	BSZ0506NS	4.4	5.7	220	Class D
			BSZ065N03LS	6.9	5.2	270	Class D
	60 V	PQFN 2 x 2	IRL60HS118*	19	4.5	118	Class D
	80 V		IRL80HS120*	32	3.5	68	Class D/E
	100 V		IRL100HS121*	42	2.7	62	Class D/E
	150 V	PQFN 3.3 x 3.3	BSZ300N15NS5	28**	8.4**	180	Class E
			BSZ900N15NS3	75**	4.1**	46	Class E
	200 V		BSZ900N20NS3	78**	7.2**	52	Class E
			BSZ22DN20NS3	200**	3.5**	24	Class E
	250 V		BSZ42DN25NS3	375**	3.6**	21	Class E
Driver ICs	EiceDRIVER™ 1EDN (for details please check page 212)						
Microcontroller	XMC1302 or XMC1404 or XMC4108 (for details please check page 230)						

*In development
**V_{GS} = 8 V

www.infineon.com/wirelesspower

Infineon support for applications

Useful links and helpful information

Learn more about our system solutions for your application.
Find block diagrams, evaluation boards, videos, tools and related material for download.

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OptiMOS™ and StrongIRFET™

20 V–300 V n-channel power MOSFETs

Infineon's semiconductors are designed to bring more efficiency, power density and cost effectiveness. The full range of OptiMOS™ and StrongIRFET™ power MOSFETs enables innovation and performance in applications such as switch mode power supplies (SMPS), motor control and drives, inverters and computing.

Infineon's highly innovative OptiMOS™ and StrongIRFET™ families consistently meet the highest quality and performance demands in key specifications for power system design such as on-state resistance and figure of merit characteristics.

OptiMOS™ power MOSFETs provide excellent best-in-class performance. Features include ultra-low $R_{DS(on)}$, as well as low charge for high switching frequency applications. StrongIRFET™ power MOSFETs are designed for rugged industrial applications and are ideal for designs with a low switching frequency as well as those that require a high current carrying capability.

OptiMOS™ family attributes

Designed for high performance applications	Primarily aimed at replacing trench power MOSFETs	Provide best-in-class and price/performance products
Ideal for high switching frequency		Industry best figure-of-merit
Ultra low $R_{DS(on)}$	20 V–300 V portfolio	High efficiency and power density

StrongIRFET™ family attributes

Designed for industrial applications	Primarily aimed at replacing planar power MOSFETs	Provide value in traditional trench MOSFET space
Ideal for low switching frequency		High current carrying capability
Low $R_{DS(on)}$	3.0 threshold voltage logic level also available	Rugged silicon

www.infineon.com/powermosfet-20V-300V

OptiMOS™ and StrongIRFET™

Space saving and high performance packages

Best thermal behavior in a tiny footprint

DirectFET™

The DirectFET™ portfolio is the best fit for a broad number of industrial applications such as voltage regulator for servers, DC-DC converters in telecom, solar microinverters and Maximum Power Point Trackers (MPPT), low voltage drives and synchronous rectification in server and desktop. With only a 31 mm^2 footprint, DirectFET™ M allows 79 percent space reduction in power components on the board compared to traditional D^2PAK. In addition, the metal can enables double-sided cooling along with almost no package parasitic inductances, leading to a higher system efficiency. DirectFET™ Corner Gate offers the same benefits but in addition reduced package resistance, improved thermal behavior as well as increased current rating.

For highest efficiency and power management

SuperSO8/PQFN 3.3 x 3.3

In applications such as synchronous rectification in server and desktop, motor drives and DC-DC converters in telecom, high power density and high efficiency are the main objectives. The trend set by Infineon to move from TO-220 to SuperSO8 and PQFN 3.3 x 3.3 reduces the area consumption considerably. With a three times lower resistance parasitic compared to TO-220, SuperSO8 offers high system efficiency and low design effort due to reduced spikes.

Enables significant space saving

PQFN 2 x 2

The PQFN 2 x 2 package is especially suited for high speed switching and form factor critical applications such as wireless chargers, DC-DC converters and adapters. It enables higher power density and improved efficiency as well as significant space saving.

Optimized for high power applications

TO-Leadless

TO-Leadless is especially designed for high current applications with high power and reliability requirements such as forklift, light electric vehicles, eFuse, PoL (point-of-load) and telecom. The outstanding current capability of up to 300 A is a key feature of TO-Leadless. Furthermore, this package offers benefits in terms of optimized board space. The significantly smaller package size, reduced by 60 percent, enables a very compact design. Compared to D^2PAK 7pin, TO-Leadless shows a 30 percent reduction in footprint. This allows a board space reduction in forklift applications. Additionally, the 50 percent height reduction offers a significant advantage in narrow applications such as rack or blade servers.

www.infineon.com/powermosfet-20V-300V

Significant design shrink

Power Block

OptiMOS™ 5 Power Block is a leadless SMD package in a 5.0 x 6.0 mm² package outline, including a low-side and a high-side MOSFET in a synchronous buck converter configuration. Replacing two separate discrete packages, such as SO-8 or SuperSO8, with the OptiMOS™ 5 Power Block enables a design shrink of at least 50 percent.

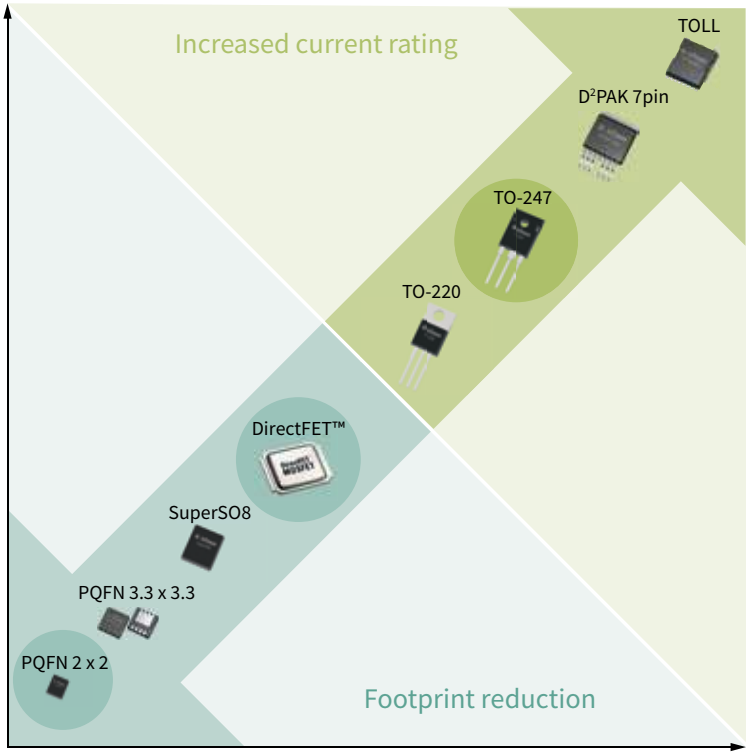
OptiMOS™ 5 in additional packages

With the latest OptiMOS™ portfolio extension, OptiMOS™ 5 silicon is now available in more packages to address the demands for higher current carrying capability and significant space saving.

For the first time best-in-class OptiMOS™ 5 logic level silicon is available in a PQFN 2 x 2 package to achieve benchmark performance in high speed switching and form factor critical applications.

OptiMOS™ 5 die in a TO-247 package is the perfect fit for rugged high power applications enabling increased current carrying capability and a more robust and reliable performance.

DirectFET™ is optimized for high frequency applications by offering lowest parasitic resistance and inductance and together with OptiMOS™ 5 achieves the lowest FOM_g and FOM_{gd}.



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OptiMOS™ Linear FET

Combining low $R_{DS(on)}$ with wide safe operating area

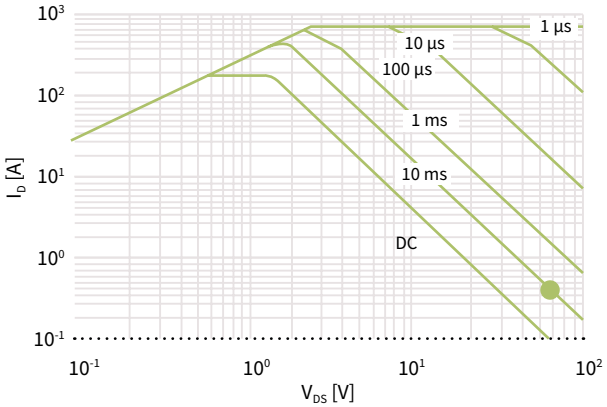
OptiMOS™ Linear FET is a revolutionary approach to avoid the trade-off between on-state resistance ($R_{DS(on)}$) and linear mode capability – operation in the saturation region of an enhanced mode MOSFET. It offers the state-of-the-art $R_{DS(on)}$ of a trench MOSFET as well as the wide safe operating area of a classic planar MOSFET.

This new product is the perfect fit for hot-swap and e-fuse applications commonly seen in telecom and battery management systems. OptiMOS™ Linear FET prevents damage at the load in case of a short circuit by limiting high inrush currents.

OptiMOS™ Linear FET will be available in three voltage classes – 100 V, 150 V, and 200 V – in either D²PAK or D²PAK-7 package.

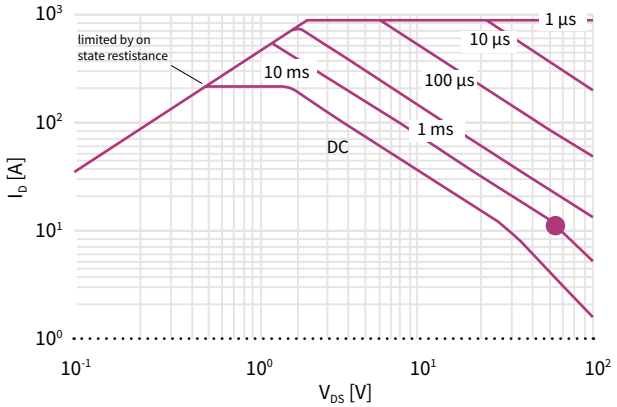
Safe operating area comparison

OptiMOS™ 5
$R_{DS(on)}$ = 1.7 mΩ



0.5 A @ 54 V, tp= 10 ms

OptiMOS™ Linear FET
$R_{DS(on)}$ = 1.7 mΩ



11.5 A @ 54 V, tp= 10 ms

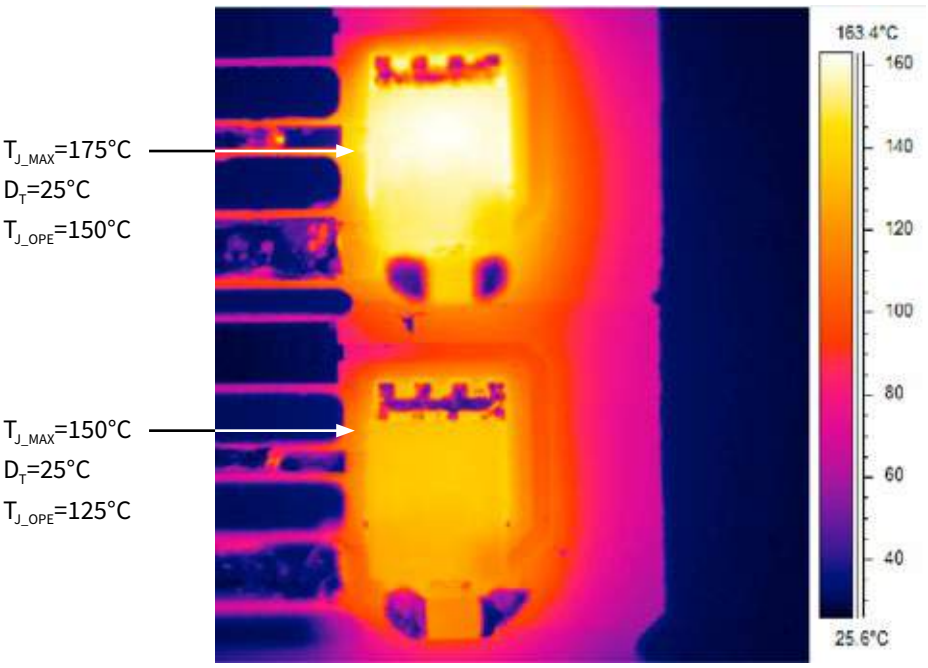
www.infineon.com/optimos-linearfet

175°C SuperSO8

Improved ruggedness and enhanced temperature rating

Future Infineon products in SuperSO8 will offer an enhanced temperature capability of 175°C to support higher power density designs and improved robustness.

Over and above 150°C rated devices, a 175°C offers either more power at a higher operating junction temperature or longer lifetime at the same operating junction temperature.



The new OptiMOS™ fast diode products in 200 V, 250 V and 300 V are the first ones in SuperSO8 that make use of the extended junction temperature (T_j). They are especially designed to withstand extreme conditions such as in fan-less or hot-airflow environments. Fast diode products are furthermore optimized for body diode hard commutation by significantly decreasing reverse recovery charge (Q_{rr}).

www.infineon.com/powermosfet-20V-300V

OptiMOS™ & StrongIRFET™ 20 V (Super) logic level

$R_{DS(on)}$ max @ V_{GS}=10 V [mΩ]	TO-252 (DPAK)	DirectFET™	PQFN 2 x 2	PQFN 3.3 x 3.3	SuperSO8	SO-8	SOT-23
< 1		IRL6283MTRPBF $R_{DS(on)}$=0.65 mΩ			IRFH6200TRPBF $R_{DS(on)}$=0.99 mΩ		
1-2					BSC019N02KS G $R_{DS(on)}$=1.9 mΩ		
2-4					BSC026N02KS G $R_{DS(on)}$=2.6 mΩ	IRF6201TRPBF $R_{DS(on)}$=2.45 mΩ	
	IRLR6225TRPBF $R_{DS(on)}$=4.0 mΩ	IRL6297SDTRPBF** $R_{DS(on)}$=3.8 mΩ; dual			IRLH6224TRPBF $R_{DS(on)}$=3.0 mΩ		
4-10					BSC046N02KS G $R_{DS(on)}$=4.6 mΩ		
> 10			IRLHS6242TRPBF $R_{DS(on)}$=11.7 mΩ				IRLML6244 [1] *** $R_{DS(on)}$=21 mΩ
			IRLHS6276TRPBF** $R_{DS(on)}$=45.0 mΩ; dual				IRLML6246 [1] *** $R_{DS(on)}$=46 mΩ

OptiMOS™ & StrongIRFET™ 25 V logic level

$R_{DS(on)}$ max @ V_{GS}=10 V [mΩ]	DirectFET™	PQFN 2 x 2	PQFN 3.3 x 3.3	SuperSO8	SO-8	SOT-23
< 1	IRF6718L2TRPBF $R_{DS(on)}$=0.7 mΩ			BSC009NE2LS $R_{DS(on)}$=0.9 mΩ		
	BSB008NE2LX $R_{DS(on)}$=0.8 mΩ			BSC009NE2LS5 $R_{DS(on)}$=0.9 mΩ		
				BSC009NE2LS5I** $R_{DS(on)}$=0.95 mΩ		
1-2	IRF6898MTRPBF** $R_{DS(on)}$=1.1 mΩ		BSZ013NE2LS5I** $R_{DS(on)}$=1.3 mΩ	BSC010NE2LS $R_{DS(on)}$=1.0 mΩ		
	BSB012NE2LXI** $R_{DS(on)}$=1.2 mΩ		BSZ014NE2LS5IF * ** $R_{DS(on)}$=1.4 mΩ	BSC010NE2LSI** $R_{DS(on)}$=1.05 mΩ		
	IRF6717MTRPBF $R_{DS(on)}$=1.25 mΩ		BSZ017NE2LS5I** $R_{DS(on)}$=1.7 mΩ	BSC014NE2LSI** $R_{DS(on)}$=1.4 mΩ		
	IRF6894MTRPBF** $R_{DS(on)}$=1.3 mΩ		BSZ018NE2LS $R_{DS(on)}$=1.8 mΩ	BSC015NE2LS5I** $R_{DS(on)}$=1.5 mΩ		
	BSB013NE2LXI** $R_{DS(on)}$=1.3 mΩ		BSZ018NE2LSI** $R_{DS(on)}$=1.8 mΩ	BSC018NE2LS $R_{DS(on)}$=1.8 mΩ		
	IRF6797MTRPBF** $R_{DS(on)}$=1.4 mΩ			BSC018NE2LSI** $R_{DS(on)}$=1.8 mΩ		
	IRF6715MTRPBF $R_{DS(on)}$=1.6 mΩ					
	IRF6893MTRPBF** $R_{DS(on)}$=1.6 mΩ					
	IRF6892STRPBF** $R_{DS(on)}$=1.7 mΩ					
	IRF6795MTRPBF** $R_{DS(on)}$=1.8 mΩ					
2-4	IRF6714MTRPBF $R_{DS(on)}$=2.1 mΩ		BSZ031NE2LS5 $R_{DS(on)}$=3.1 mΩ	BSC024NE2LS $R_{DS(on)}$=2.4 mΩ		
	BSF030NE2LQ $R_{DS(on)}$=3.0 mΩ		BSZ033NE2LS5 $R_{DS(on)}$=3.3 mΩ	BSC026NE2LS5 $R_{DS(on)}$=2.6 mΩ	IRF8252 $R_{DS(on)}$= 2.7 mΩ	
	BSF035NE2LQ $R_{DS(on)}$=3.5 mΩ		BSZ036NE2LS $R_{DS(on)}$=3.6 mΩ	BSC032NE2LS $R_{DS(on)}$=3.2 mΩ		
	IRF6811STRPBF** $R_{DS(on)}$=3.7 mΩ					
4-10	IRF6710S2TRPBF $R_{DS(on)}$=4.5 mΩ		IRFHM8228TRPBF $R_{DS(on)}$=5.2 mΩ	BSC050NE2LS $R_{DS(on)}$=5.0 mΩ		
	IRF6712STRPBF $R_{DS(on)}$=4.9 mΩ		BSZ060NE2LS $R_{DS(on)}$=6.0 mΩ			
	IRF6810STRPBF** $R_{DS(on)}$=5.2 mΩ		IRFHM8235TRPBF $R_{DS(on)}$=7.7 mΩ			
> 10		IRFHS8242 $R_{DS(on)}$=13 mΩ				IRFML8244 $R_{DS(on)}$= 24 mΩ

www.infineon.com/powermosfet-20V-30V

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

** Monolithically integrated Schottky-like diode

*** $R_{DS(on)}$ max @ V_{GS}=4.5 V

[1] 2.5 V_{GS} capable

OptiMOS™ & StrongIRFET™ 25 V/30 V in power stage 5x6

Part number	Package	Monolithically integrated Schottky like diode	BV_{DSS} [V]	$R_{DS(on),max.}$ [mΩ] @ V_{GS}=4.5 V max.		Q_g [nC] @ V_{GS}=4.5 V typ.	
				High-side	Low-side	High-side	Low-side
BSC0910NDI	TISON 5x6	✓	25	5.9	1.6	7.7	25.0
BSC0911ND	TISON 5x6	–	25	4.8	1.7	7.7	25.0
BSC0921NDI	TISON 5x6	✓	30	7.0	2.1	5.8	21.0
BSC0923NDI	TISON 5x6	✓	30	7.0	3.7	5.2	12.2
BSC0924NDI	TISON 5x6	✓	30	7.0	5.2	5.2	8.6
BSC0925ND	TISON 5x6	–	30	6.4	6.4	5.2	6.7

OptiMOS™ & StrongIRFET™ 25 V/30 V in Power Block 5x6 and 5x4

Part number	Package	Monolithically integrated Schottky like diode	BV_{DSS} [V]	$R_{DS(on),max.}$ [mΩ] @ V_{GS}=4.5 V max.		Q_g [nC] @ V_{GS}=4.5 V typ.	
				High-side	Low-side	High-side	Low-side
BSG0810NDI	TISON 5x6	✓	25	4.0	1.2	5.6	16.0
BSG0811ND	TISON 5x6	–	25	4.0	1.1	5.6	20.0
BSG0813NDI	TISON 5x6	✓	25	4.0	1.7	5.6	12.0
IRFH4257DTRPBF	PQFN 5x4	✓	25	4.7	1.8	9.7	23.0

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OptiMOS™ & StrongIRFET™ 30 V logic level

$R_{DS(on),\ max.}$ @ V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-263 (D^2PAK 7pin)	TO-251 / TO-251 Short Lead (IPAK/IPAK Short Lead)	TO-220
<1			IPB009N03L G $R_{DS(on)}$=0.95 mΩ		
1-2		IRLS3813TRLPBF $R_{DS(on)}$=1.95 mΩ			IRLB3813PBF $R_{DS(on)}$=1.95 mΩ
2-4	IRLR8743TRPBF $R_{DS(on)}$=3.1 mΩ			IPS031N03L G $R_{DS(on)}$=3.1 mΩ	IRLB8314PBF $R_{DS(on)}$=2.4 mΩ
	IPD031N03L G $R_{DS(on)}$=3.1 mΩ				IRL3713PBF $R_{DS(on)}$=3.0 mΩ
		IPB034N03L G $R_{DS(on)}$=3.4 mΩ			IRLB8743PBF $R_{DS(on)}$=3.2 mΩ
	IPD040N03L G $R_{DS(on)}$=4.0 mΩ			IPS040N03L G $R_{DS(on)}$=4.0 mΩ	IPP034N03L G $R_{DS(on)}$=3.4 mΩ
4-10	IPD050N03L G $R_{DS(on)}$=5.0 mΩ	IPB042N03L G $R_{DS(on)}$=4.2 mΩ			IPP042N03L G $R_{DS(on)}$=4.2 mΩ
	IRLR8726TRPBF $R_{DS(on)}$=5.8 mΩ	IPB055N03L G $R_{DS(on)}$=5.5 mΩ			IRLB8748PBF $R_{DS(on)}$=4.8 mΩ
	IPD060N03L G $R_{DS(on)}$=6.0 mΩ	IPB065N03L G $R_{DS(on)}$=6.5 mΩ		IPS050N03L G $R_{DS(on)}$=5.0 mΩ	IPP055N03L G $R_{DS(on)}$=5.5 mΩ
	IPD075N03L G $R_{DS(on)}$=7.5 mΩ	IPB080N03L G $R_{DS(on)}$=8.0 mΩ		IPS060N03L G $R_{DS(on)}$=6.0 mΩ	IRL8113PBF $R_{DS(on)}$=6.0 mΩ
	IRLR8729TRPBF $R_{DS(on)}$=8.9 mΩ			IPS075N03L G $R_{DS(on)}$=7.5 mΩ	IRLB8721PBF $R_{DS(on)}$=8.7 mΩ
	IPD090N03L G $R_{DS(on)}$=9.0 mΩ			IPS090N03L G $R_{DS(on)}$=9.0 mΩ	
10-25	IPD135N03L G $R_{DS(on)}$=13.5 mΩ				

OptiMOS™ & StrongIRFET™ 30 V logic level

$R_{DS(on),\ max.}$ @ V_{GS}=10 V [mΩ]	Bare Die ($R_{DS(on)\ typ.}$)	DirectFET™	PQFN 3.3 x 3.3	SuperSO8	TO-Leadless	PQFN 2 x 2
<1					IPT004N03L $R_{DS(on)}$=0.4 mΩ	
1-2				IRFH8303TRPBF $R_{DS(on)}$=1.1 mΩ		
				BSC011N03LS $R_{DS(on)}$=1.1 mΩ		
				BSC011N03LSI** $R_{DS(on)}$=1.1 mΩ		
				IRFH8307TRPBF $R_{DS(on)}$=1.3 mΩ		
				BSC0500NSI** $R_{DS(on)}$=1.3 mΩ		
		IRF8301MTRPBF $R_{DS(on)}$=1.5 mΩ		BSC014N03LS G $R_{DS(on)}$=1.4 mΩ		
			BSZ0500NSI** $R_{DS(on)}$=1.55 mΩ	BSC016N03LS G $R_{DS(on)}$=1.6 mΩ		
	IPC055N03L3 $R_{DS(on)}$=1.7 mΩ	IRF8302MTRPBF** $R_{DS(on)}$=1.8 mΩ	BSZ019N03LS $R_{DS(on)}$=1.9 mΩ	BSC0901NS $R_{DS(on)}$=1.9 mΩ		
			BSZ0901NS $R_{DS(on)}$=2.0 mΩ	BSC0501NSI** $R_{DS(on)}$=1.9 mΩ		
			BSZ0501NSI** $R_{DS(on)}$=2.0 mΩ	BSC0901NSI** $R_{DS(on)}$=2.0 mΩ		
>10						IRLHS6342*** $R_{DS(on)}$= 16 mΩ
						IRFHS8342 $R_{DS(on)}$= 16 mΩ
						IRLHS6376*** $R_{DS(on)}$= 63 mΩ; dual

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** Monolithically integrated Schottky-like diode

*** $R_{DS(on)}$ max @ V_{GS}=4.5 V

OptiMOS™ & StrongIRFET™ 30 V logic level

$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	Bare Die ($R_{DS(on)\ typ.}$)	DirectFET™	PQFN 3.3 x 3.3	SuperSO8	SO-8	SO-8 Dual
< 4	IPC028N03L3 $R_{DS(on)}$=0.5 mΩ	IRF8304MTRPBF $R_{DS(on)}$=2.2 mΩ	BSZ0901NSI** $R_{DS(on)}$=2.1 mΩ	BSC020N03LS G $R_{DS(on)}$=2.0 mΩ		
	IPC042N03L3 $R_{DS(on)}$=2.3 mΩ		IRLHM620TRPBF $R_{DS(on)}$=2.5 mΩ	BSC0502NSI** $R_{DS(on)}$=2.4 mΩ		
		IRF8306MTRPBF** $R_{DS(on)}$=2.5 mΩ	BSZ0902NS $R_{DS(on)}$=2.6 mΩ	BSC025N03LS G $R_{DS(on)}$=2.5 mΩ		
				BSC0902NS $R_{DS(on)}$=2.6 mΩ		
				IRF8252TRPBF $R_{DS(on)}$=2.7 mΩ		
			BSZ0902NSI** $R_{DS(on)}$=2.8 mΩ	BSC0902NSI** $R_{DS(on)}$=2.8 mΩ	IRF8788TRPBF $R_{DS(on)}$=2.8 mΩ	
			BSZ0502NSI** $R_{DS(on)}$=2.8 mΩ	IRFH8316TRPBF $R_{DS(on)}$=2.95 mΩ		
				BSC030N03LS G $R_{DS(on)}$= 3.0 mΩ		
			BSZ0503NSI** $R_{DS(on)}$=3.4 mΩ	IRFH8318TRPBF $R_{DS(on)}$=3.1 mΩ		
			IRLHM630*** $R_{DS(on)}$= 3.5 mΩ	BSC0503NSI** $R_{DS(on)}$=3.2 mΩ	IRF7862TRPBF $R_{DS(on)}$=3.3 mΩ	
			BSZ035N03LS G $R_{DS(on)}$=3.5 mΩ	BSC034N03LS G $R_{DS(on)}$=3.4 mΩ	IRF8734TRPBF $R_{DS(on)}$=3.5 mΩ	
			IRFHM830 $R_{DS(on)}$= 3.8 mΩ	BSC0504NSI** $R_{DS(on)}$=3.7 mΩ		
			BSZ0904NSI** $R_{DS(on)}$=4.0 mΩ	BSC0904NSI** $R_{DS(on)}$=3.7 mΩ		
4-10			IRFHM830D $R_{DS(on)}$= 4.3 mΩ	IRFH8324TRPBF $R_{DS(on)}$=4.1 mΩ		
			BSZ0506NS $R_{DS(on)}$=4.4 mΩ	BSC042N03LS G $R_{DS(on)}$=4.2 mΩ		
			IRFHM8326TRPBF $R_{DS(on)}$=4.7 mΩ	BSC0906NS $R_{DS(on)}$=4.5 mΩ		
				IRFH8321TRPBF $R_{DS(on)}$=4.9 mΩ		
			BSZ050N03LS G $R_{DS(on)}$=5.0 mΩ	IRFH8325TRPBF $R_{DS(on)}$=5.0 mΩ	IRF8736TRPBF $R_{DS(on)}$=4.8 mΩ	
			BSZ058N03LS G $R_{DS(on)}$=5.8 mΩ	BSC050N03LS G $R_{DS(on)}$=5.0 mΩ		
	IPC022N03L3 $R_{DS(on)}$=5.3 mΩ		IRFHM8329TRPBF $R_{DS(on)}$=6.1 mΩ	BSC052N03LS $R_{DS(on)}$=5.2 mΩ		
			BSZ065N03LS $R_{DS(on)}$=6.5 mΩ	BSC057N03LS G $R_{DS(on)}$=5.7 mΩ		
		IRF8327S2 $R_{DS(on)}$= 7.3 mΩ	IRFHM8330TRPBF $R_{DS(on)}$=6.6 mΩ	IRFH8330TRPBF $R_{DS(on)}$=6.6 mΩ		
			IRFHM831 $R_{DS(on)}$= 7.8 mΩ	BSC080N03LS G $R_{DS(on)}$=8.0 mΩ		
			BSZ088N03LS G $R_{DS(on)}$=8.8 mΩ	IRFH8334TRPBF $R_{DS(on)}$=9.0 mΩ	IRF8721TRPBF $R_{DS(on)}$=8.5 mΩ	
			IRFHM8334TRPBF $R_{DS(on)}$=9.0 mΩ	BSC090N03LS G $R_{DS(on)}$=9.0 mΩ	IRF8714TRPBF $R_{DS(on)}$=8.7 mΩ	
				BSC0909NS $R_{DS(on)}$=9.2 mΩ		
			BSZ100N03LS G $R_{DS(on)}$=10.0 mΩ			
10-25	IPC014N03L3 $R_{DS(on)}$=10.3 mΩ		BSZ0909NS $R_{DS(on)}$=12.0 mΩ	BSC120N03LS G $R_{DS(on)}$=12.0 mΩ	IRF8707TRPBF $R_{DS(on)}$=11.9 mΩ	IRF7907TRPBF $R_{DS(on)}$=11.8 mΩ+16.4 mΩ
			IRFHM8337TRPBF $R_{DS(on)}$=12.4 mΩ	IRFH8337TRPBF $R_{DS(on)}$=12.8 mΩ	IRL6342[1)] *** $R_{DS(on)}$ = 14.6 mΩ	IRF8513TRPBF $R_{DS(on)}$=2.7 mΩ+15.5 mΩ
			BSZ130N03LS G $R_{DS(on)}$=13.0 mΩ		IRL6372[1)] *** $R_{DS(on)}$ = 18 mΩ; dual	IRF8313TRPBF $R_{DS(on)}$=15.5 mΩ+15.5 mΩ
			IRFHM8363TRPBF $R_{DS(on)}$=14.9 mΩ			IRF7905TRPBF $R_{DS(on)}$=17.1 mΩ+21.8 mΩ
2 x 7.2				BSC072N03LD G $R_{DS(on)}$=7.2 mΩ		
2 x 9.0			BSZ0909ND $R_{DS(on)}$=9.0 mΩ			
2 x 15				BSC150N03LD G $R_{DS(on)}$=15.0 mΩ		

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** Monolithically integrated Schottky-like diode
*** $R_{DS(on)}$ max @ V_{GS}=4.5 V
[1)] 2.5 V_{GS} capable

OptiMOS™ & StrongIRFET™ 30 V logic level 5 V optimized

$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	PQFN 3.3 x 3.3	SuperSO8	SO-8	SO-8 Dual	SOT-23	TSOP-6
1-2		BSC014N03MS G $R_{DS(on)}$=1.4 mΩ				
		BSC016N03MS G $R_{DS(on)}$=1.6 mΩ				
		BSC020N03MS G $R_{DS(on)}$=2.0 mΩ				
2-4		BSC025N03MS G $R_{DS(on)}$=2.5 mΩ	BSO033N03MS G $R_{DS(on)}$=3.3 mΩ			
	BSZ035N03MS G $R_{DS(on)}$=3.5 mΩ	BSC030N03MS G $R_{DS(on)}$=3.0 mΩ	BSO040N03MS G $R_{DS(on)}$=4.0 mΩ			
4-10		BSC042N03MS G $R_{DS(on)}$=4.2 mΩ				
	BSZ050N03MS G $R_{DS(on)}$=5.0 mΩ	BSC050N03MS G $R_{DS(on)}$=5.0 mΩ				
		BSC057N03MS G $R_{DS(on)}$=5.7 mΩ				
	BSZ058N03MS G $R_{DS(on)}$=5.8 mΩ	BSC080N03MS G $R_{DS(on)}$=8.0 mΩ				
	BSZ088N03MS G $R_{DS(on)}$=8.8 mΩ	BSC090N03MS G $R_{DS(on)}$=9.0 mΩ				
	BSZ100N03MS G $R_{DS(on)}$=10.0 mΩ	BSC100N03MS G $R_{DS(on)}$=10.0 mΩ				
>10	BSZ130N03MS G $R_{DS(on)}$=13.0 mΩ	BSC120N03MS G $R_{DS(on)}$=12.0 mΩ	BSO110N03MS G $R_{DS(on)}$=11.0 mΩ		IRLML0030 $R_{DS(on)}$=27 mΩ	IRLTS6342*** $R_{DS(on)}$=14.6 mΩ
					IRLML6344 [1] *** $R_{DS(on)}$=29 mΩ	IRFTS8342 $R_{DS(on)}$=19 mΩ
					IRLML6346 [1] *** $R_{DS(on)}$=63 mΩ	
					IRLML2030 $R_{DS(on)}$=100 mΩ	
2 x 15				BSO150N03MD G $R_{DS(on)}$=15.0 mΩ		
2 x 22				BSO220N03MD G $R_{DS(on)}$=22.0 mΩ		

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$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-263 (D^2PAK 7pin)	TO-220	TO-247	Bare Die ($R_{DS(on)\ typ.}$)	DirectFET™	PQFN 3.3 x 3.3	SuperSO8	TO-220 FullPAK
<1			IRFS7430TRL7PP $R_{DS(on)}$=0.75 mΩ			IPC218N04N3 $R_{DS(on)}$=0.5 mΩ				
1-2		IRFS7430TRLPBF $R_{DS(on)}$=1.3 mΩ	IRFS7434TRL7PP $R_{DS(on)}$=1.0 mΩ	IRFB7430PBF $R_{DS(on)}$=1.3 mΩ	IRFP7430PBF $R_{DS(on)}$=1.3 mΩ	IPC171N04N $R_{DS(on)}$=1.1 mΩ	IRF7739L1TRPBF $R_{DS(on)}$=1.0 mΩ		IRFH7084TRPBF $R_{DS(on)}$=1.25 mΩ	
		IPB015N04N G $R_{DS(on)}$=1.5 mΩ	IPB011N04N G $R_{DS(on)}$=1.1 mΩ	IPP015N04N G $R_{DS(on)}$=1.5 mΩ			IRF7480MTRPBF $R_{DS(on)}$=1.2 mΩ		IRFH7004TRPBF $R_{DS(on)}$=1.4 mΩ	
							IRF7946TRPBF $R_{DS(on)}$=1.4 mΩ		BSC017N04NS G $R_{DS(on)}$=1.7 mΩ	
		IRFS7434TRLPBF $R_{DS(on)}$=1.6 mΩ	IRFS7437TRL7PP $R_{DS(on)}$=1.4 mΩ	IRFB7434PBF $R_{DS(on)}$=1.6 mΩ			BSB015N04NX3 G $R_{DS(on)}$=1.5 mΩ		IRF40H210 $R_{DS(on)}$=1.7 mΩ	
		IRFS7437TRLPBF $R_{DS(on)}$=1.8 mΩ	IPB020N04N G $R_{DS(on)}$=2.0 mΩ	IRFB7437PBF $R_{DS(on)}$=2.0 mΩ			IRF40DM229 $R_{DS(on)}$=1.85 mΩ		BSC019N04NS G $R_{DS(on)}$=1.9 mΩ	
2-4	IRFR7440TRPBF $R_{DS(on)}$=2.4 mΩ			IPP023N04N G $R_{DS(on)}$=2.3 mΩ			IRF7483MTRPBF $R_{DS(on)}$=2.3 mΩ		IRFH7440TRPBF $R_{DS(on)}$=2.4 mΩ	
	IRFR7446TRPBF $R_{DS(on)}$=3.9 mΩ	IRFS7440TRLPBF $R_{DS(on)}$=2.5 mΩ		IRFB7440PBF $R_{DS(on)}$=2.5 mΩ					BSC030N04NS G $R_{DS(on)}$=3.0 mΩ	
				IRFB7446PBF $R_{DS(on)}$=3.3 mΩ					IRFH7446TRPBF $R_{DS(on)}$=3.3 mΩ	
4-10				IPP041N04N G $R_{DS(on)}$=4.1 mΩ				BSZ042N04NS G $R_{DS(on)}$=4.2 mΩ	BSC054N04NS G $R_{DS(on)}$=5.4 mΩ	IPA041N04N G $R_{DS(on)}$=4.1mΩ
	IRF40R207 $R_{DS(on)}$=5.1 mΩ			IRF40B207 $R_{DS(on)}$=4.5 mΩ						
				IPP048N04N G $R_{DS(on)}$=4.8 mΩ						
>10								BSZ105N04NS G $R_{DS(on)}$=10.5 mΩ		
								BSZ165N04NS G $R_{DS(on)}$=16.5 mΩ		

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OptiMOS™ & StrongIRFET™ 40 V logic level

$R_{DS(on),max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-263 (D^2PAK 7pin)	TO-220	TO-247	DirectFET™	PQFN 3.3 x 3.3	SuperSO8
<1			IRL40SC228 $R_{DS(on)}$ =0.65 mΩ					
			IRL40SC209 $R_{DS(on)}$ =0.8 mΩ					
1-2		IPB015N04L G $R_{DS(on)}$ =1.5 mΩ	IPB011N04L G $R_{DS(on)}$ =1.1 mΩ	IRL40B209 $R_{DS(on)}$ =1.25 mΩ	IRLP3034PBF $R_{DS(on)}$ =1.7 mΩ	BSB014N04LX3 G $R_{DS(on)}$ =0.97 mΩ		BSC010N04LS $R_{DS(on)}$ =1.0 mΩ
		IRLS3034TRLPBF $R_{DS(on)}$ =1.7 mΩ	IRLS3034TRL7P $R_{DS(on)}$ =1.4 mΩ	IRLB3034PBF $R_{DS(on)}$ =1.7 mΩ		IRL7486MTRPBF $R_{DS(on)}$ =1.4 mΩ		BSC010N04LSI $R_{DS(on)}$ =1.05 mΩ
		IRL40S212 $R_{DS(on)}$ =1.9 mΩ		IRL40B212 $R_{DS(on)}$ =1.9 mΩ		IRL7472L1TRPBF $R_{DS(on)}$ =2.0 mΩ		BSC014N04LS $R_{DS(on)}$ =1.4 mΩ
								BSC014N04LSI $R_{DS(on)}$ =1.45 mΩ
								BSC016N04LS G $R_{DS(on)}$ =1.6 mΩ
								BSC018N04LS G $R_{DS(on)}$ =1.8 mΩ
								BSC019N04LS $R_{DS(on)}$ =1.9 mΩ
2-4				IRL40B215 $R_{DS(on)}$ =2.7 mΩ				BSC022N04LS $R_{DS(on)}$ =2.2 mΩ
				IPP039N04L G $R_{DS(on)}$ =3.9 mΩ			BSZ025N04LS $R_{DS(on)}$ =2.5 mΩ	BSC026N04LS $R_{DS(on)}$ =2.6 mΩ
							BSZ028N04LS $R_{DS(on)}$ =2.8 mΩ	BSC027N04LS G $R_{DS(on)}$ =2.7 mΩ
								BSC032N04LS $R_{DS(on)}$ =3.2 mΩ
	IPD036N04L G $R_{DS(on)}$ =3.6 mΩ						BSZ034N04LS $R_{DS(on)}$ =3.4 mΩ	BSC035N04LS G $R_{DS(on)}$ =3.5 mΩ
4-10	IRLR31142TRPBF $R_{DS(on)}$ =4.5 mΩ						BSZ040N04LS G $R_{DS(on)}$ =4.0 mΩ	BSC050N04LS G $R_{DS(on)}$ =5.0 mΩ
							BSZ097N04LS G $R_{DS(on)}$ =9.7 mΩ	BSC059N04LS G $R_{DS(on)}$ =5.9 mΩ
								BSC093N04LS G $R_{DS(on)}$ =9.3 mΩ

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$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-263 (D^2PAK 7pin)	TO-262 (I^2PAK)	TO-220	TO-220 FullPAK	TO-247
1-2			IPB010N06N [2] $R_{DS(on)}$=1.0 mΩ				
			IRFS7530TRL7PP $R_{DS(on)}$=1.4 mΩ				
			IPB014N06N [2] $R_{DS(on)}$=1.4 mΩ				
			IPB017N06N3 G $R_{DS(on)}$=1.7 mΩ				
		IRFS7530TRLPBF $R_{DS(on)}$=2.0 mΩ	IRFS7534TRL7PP $R_{DS(on)}$=1.95 mΩ	IPI020N06N [2] $R_{DS(on)}$=2.0 mΩ	IRFB7530PBF $R_{DS(on)}$=2.0 mΩ		IRFP7530PBF $R_{DS(on)}$=2.0 mΩ
2-4	IPD025N06N [2] $R_{DS(on)}$=2.5 mΩ				IPP020N06N [2] $R_{DS(on)}$=2.0 mΩ		
		IRFS7534TRLPBF $R_{DS(on)}$=2.4 mΩ		IPI024N06N3 G $R_{DS(on)}$=2.4 mΩ	IRFB7534PBF $R_{DS(on)}$=2.4 mΩ		
		IPB026N06N [2] $R_{DS(on)}$=2.6 mΩ			IPP024N06N3 [2] $R_{DS(on)}$=2.4 mΩ		IRFP3006PBF $R_{DS(on)}$=2.5 mΩ
		IPB029N06N3 G $R_{DS(on)}$=2.9 mΩ		IPI029N06N [2] $R_{DS(on)}$=2.9 mΩ	IPP029N06N [2] $R_{DS(on)}$=2.9 mΩ	IPA029N06N [2] $R_{DS(on)}$=2.9 mΩ	IRFP3206PBF $R_{DS(on)}$=3.0 mΩ
	IPD033N06N [2] $R_{DS(on)}$=3.3 mΩ			IPI032N06N3 G $R_{DS(on)}$=3.2 mΩ	IPP032N06N3 G $R_{DS(on)}$=3.2 mΩ	IPA032N06N3 G $R_{DS(on)}$=3.2 mΩ	
	IPD034N06N3 G $R_{DS(on)}$=3.4 mΩ	IRFS7537TRLPBF $R_{DS(on)}$=3.3 mΩ			IRFB7537PBF $R_{DS(on)}$=3.3 mΩ		IRFP7537PBF $R_{DS(on)}$=3.3 mΩ
	IPD038N06N3 G $R_{DS(on)}$=3.8 mΩ	IPB037N06N3 G $R_{DS(on)}$=3.7 mΩ			IPP040N06N3 G $R_{DS(on)}$=4.0 mΩ		
				IPI040N06N3 G $R_{DS(on)}$=4.0 mΩ	IPP040N06N [2] $R_{DS(on)}$=4.0 mΩ	IPA040N06N [2] $R_{DS(on)}$=4.0 mΩ	
4-10	IRFR7540TRPBF $R_{DS(on)}$=4.8 mΩ	IRFS7540TRLPBF $R_{DS(on)}$=5.1 mΩ			IRFB7540PBF $R_{DS(on)}$=5.1 mΩ	IPA057N06N3 G $R_{DS(on)}$=5.7 mΩ	
	IPD053N06N [2] $R_{DS(on)}$=5.3 mΩ	IPB054N06N3 G $R_{DS(on)}$=5.4 mΩ			IPP057N06N3 G [2] $R_{DS(on)}$=5.7 mΩ		
		IPB057N06N [2] $R_{DS(on)}$=5.7 mΩ			IRFB7545PBF $R_{DS(on)}$=5.9 mΩ		
	IRFR7546TRPBF $R_{DS(on)}$=7.9 mΩ				IPP060N06N [2] $R_{DS(on)}$=6.0 mΩ	IPA060N06N [2] $R_{DS(on)}$=6.0 mΩ	
	IPD088N06N3 G $R_{DS(on)}$=8.8 mΩ				IRF60B217 $R_{DS(on)}$=9.0 mΩ	IPA093N06N3 G $R_{DS(on)}$=9.3 mΩ	
	IRF60R217 $R_{DS(on)}$=9.9 mΩ	IPB090N06N3 G $R_{DS(on)}$=9.0 mΩ			IPP093N06N3 G $R_{DS(on)}$=9.3 mΩ		
>10	IPD400N06N G $R_{DS(on)}$=40.0 mΩ						

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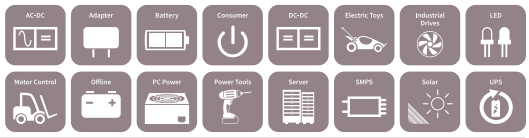
[2] 6 V rated ($R_{DS(on)}$ also specified @ V_{GS}=6 V)

OptiMOS™ & StrongIRFET™ 60 V normal level

$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	Bare Die ($R_{DS(on)\ typ.}$)	DirectFET™	PQFN 3.3 x 3.3	SuperSO8	TO-Leadless
<1					IPT007N06N [2] $R_{DS(on)}$=0.7 mΩ
1-2	IPC218N06N3 $R_{DS(on)}$=1.3 mΩ	IRF7749L1TRPBF $R_{DS(on)}$=1.5 mΩ		BSC014N06NS [2] $R_{DS(on)}$=1.4 mΩ	
				BSC016N06NS [2] $R_{DS(on)}$=1.6 mΩ	
2-4		IRF7748L1TRPBF $R_{DS(on)}$=2.2 mΩ		BSC028N06NS [2] $R_{DS(on)}$=2.8 mΩ	
		BSB028N06NN3 G $R_{DS(on)}$=2.8 mΩ		BSC031N06NS3 G $R_{DS(on)}$=3.1 mΩ	
		IRF60DM206 $R_{DS(on)}$=2.9 mΩ		IRFH7085TRPBF $R_{DS(on)}$=3.2 mΩ	
				BSC034N06NS [2] $R_{DS(on)}$=3.4 mΩ	
		IRF7580MTRPBF $R_{DS(on)}$=3.6 mΩ		BSC039N06NS [2] $R_{DS(on)}$=3.9 mΩ	
4-10			BSZ042N06NS [2] $R_{DS(on)}$=4.2 mΩ	IRLH5036TRPBF $R_{DS(on)}$=4.4 mΩ	
				IRFH7545TRPBF $R_{DS(on)}$=5.2 mΩ	
			BSZ068N06NS [2] $R_{DS(on)}$=6.8 mΩ	BSC066N06NS [2] $R_{DS(on)}$=6.6 mΩ	
			BSZ076N06NS3 G $R_{DS(on)}$=7.6 mΩ	BSC076N06NS3 G $R_{DS(on)}$=7.6 mΩ	
			BSZ100N06NS [2] $R_{DS(on)}$=10.0 mΩ	BSC097N06NS [2] $R_{DS(on)}$=9.7 mΩ	
>10			BSZ110N06NS3 G $R_{DS(on)}$=11.0 mΩ	BSC110N06NS3 G $R_{DS(on)}$=11.0 mΩ	



OptiMOS™ & StrongIRFET™ 60 V logic level

$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-263 (D^2PAK 7pin)	TO-262 (I^2PAK)	TO-220	Bare Die ($R_{DS(on)\ typ.}$)	PQFN 2 x 2	PQFN 3.3 x 3.3	SuperSO8	SOT-23
1-2		IPB019N06L3 G $R_{DS(on)}$=1.9 mΩ	IPB016N06L3 G $R_{DS(on)}$=1.6 mΩ			IPC218N06L3 $R_{DS(on)}$=1.2 mΩ			BSC014N06LS5 [3] $R_{DS(on)}$=1.4 mΩ	
		IRL60S216 $R_{DS(on)}$=1.95 mΩ		IRL60SL216 $R_{DS(on)}$=1.95 mΩ	IRL60B216 $R_{DS(on)}$=1.9 mΩ					
2-4		IRLS3036TRLPBF $R_{DS(on)}$=2.4 mΩ			IRLB3036PBF $R_{DS(on)}$=2.4 mΩ				BSC027N06LS5 [3] $R_{DS(on)}$=2.7 mΩ	
	IPD031N06L3 G $R_{DS(on)}$=3.1 mΩ	IPB034N06L3 G $R_{DS(on)}$=3.4 mΩ			IPP037N06L3 G $R_{DS(on)}$=3.7 mΩ				BSC028N06LS3 G $R_{DS(on)}$=2.8 mΩ	
4-10	IPD048N06L3 G $R_{DS(on)}$=4.8 mΩ				IPP052N06L3 $R_{DS(on)}$=5.2 mΩ			BSZ040N06LS5 $R_{DS(on)}$=4.0 mΩ	IRLH5036TRPBF $R_{DS(on)}$=4.4 mΩ	
	IRLR3636TRPBF $R_{DS(on)}$=6.8 mΩ							BSZ065N06LS5 $R_{DS(on)}$=6.5 mΩ	BSC064N06LS5 [3] $R_{DS(on)}$=6.4 mΩ	
	IPD079N06L3 G $R_{DS(on)}$=7.9 mΩ	IPB081N06L3 G $R_{DS(on)}$=8.1 mΩ		IPI084N06L3 G $R_{DS(on)}$=8.4 mΩ	IPP084N06L3 G $R_{DS(on)}$=8.4 mΩ			BSZ067N06LS3 G $R_{DS(on)}$=6.7 mΩ	BSC067N06LS3 G $R_{DS(on)}$=6.7 mΩ	
								BSZ099N06LS5 $R_{DS(on)}$=9.9 mΩ	BSC096N06LS5 [3] $R_{DS(on)}$=9.6 mΩ	
								BSZ100N06LS3 G $R_{DS(on)}$=10.0 mΩ	BSC100N06LS3 G $R_{DS(on)}$=10.0 mΩ	
>10	IPD350N06L G $R_{DS(on)}$=35.0 mΩ						IRL60HS118 [3] $R_{DS(on)}$=19.0 mΩ			IRLML0060 $R_{DS(on)}$=92 mΩ
	IPD640N06L G $R_{DS(on)}$=64.0 mΩ									IRLML2060 $R_{DS(on)}$=480 mΩ

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[2] 6 V rated ($R_{DS(on)}$ also specified @ V_{GS} = 6 V)

[3] In development

OptiMOS™ & StrongIRFET™ 75 V normal level

$R_{DS(on),max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-263 (D^2PAK 7pin)	TO-220	TO-247	Bare Die ($R_{DS(on)typ.}$)	DirectFET™	SuperSO8
1-2		IPB020NE7N3 G $R_{DS(on)}$=2.0 mΩ	IRFS7730TRL7PP $R_{DS(on)}$=2.0 mΩ		IRFP7718PBF $R_{DS(on)}$=1.8 mΩ	IPC302NE7N3 $R_{DS(on)}$=1.2 mΩ		
2-4		IRFS7730TRLPBF $R_{DS(on)}$=2.6 mΩ		IPP023NE7N3 G $R_{DS(on)}$=2.3 mΩ				
		IPB031NE7N3 G $R_{DS(on)}$=3.1 mΩ	IRFS7734TRL7PP $R_{DS(on)}$=3.05 mΩ	IRFB7730PBF $R_{DS(on)}$=2.6 mΩ				BSC036NE7NS3 G $R_{DS(on)}$=3.6 mΩ
		IRFS7734TRLPBF $R_{DS(on)}$=3.5 mΩ		IPP034NE7N3 G $R_{DS(on)}$=3.4 mΩ				
				IRFB7734PBF $R_{DS(on)}$=3.5 mΩ				
4-10		IPB049NE7N3 G $R_{DS(on)}$=4.9 mΩ		IPP052NE7N3 G $R_{DS(on)}$=5.2 mΩ				BSC042NE7NS3 G $R_{DS(on)}$=4.2 mΩ
		IRFS7762TRLPBF $R_{DS(on)}$=6.7 mΩ		IPP062NE7N3 G $R_{DS(on)}$=6.2 mΩ			IRF7780MTRPBF $R_{DS(on)}$=5.7 mΩ	
	IRFR7740TRPBF $R_{DS(on)}$=7.2 mΩ			IRFB7740PBF $R_{DS(on)}$=7.3 mΩ				
		IRFS7787TRLPBF $R_{DS(on)}$=8.4 mΩ		IRFB7787PBF $R_{DS(on)}$=8.4 mΩ				IRFH7787TRPBF $R_{DS(on)}$=8.0 mΩ
>10	IRFR7746TRPBF $R_{DS(on)}$=11.2 mΩ			IRFB7746PBF $R_{DS(on)}$=10.6 mΩ			BSF450NE7NH3 [1] $R_{DS(on)}$=45.0 mΩ	

OptiMOS™ & StrongIRFET™ 80 V normal level – logic level

$R_{DS(on),max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-263 (D^2PAK 7pin)	TO-262 (I^2PAK)	TO-220	TO-220 FullPAK	Bare Die ($R_{DS(on)typ.}$)	DirectFET™	PQFN 2 x 2	PQFN 3.3 x 3.3	SuperSO8	TO-Lead-less
1-2		IPB017N08N5 $R_{DS(on)}$=1.7 mΩ	IPB015N08N5 $R_{DS(on)}$=1.5 mΩ				IPC302N08N3 $R_{DS(on)}$=1.2 mΩ					IPT012N08N5 $R_{DS(on)}$=1.2 mΩ
		IPB020N08N5 $R_{DS(on)}$=2.0 mΩ	IPB019N08N3 G $R_{DS(on)}$=1.9 mΩ		IPP020N08N5 $R_{DS(on)}$=2.0 mΩ							
2-4		IPB024N08N5 $R_{DS(on)}$=2.4 mΩ			IPP023N08N5 $R_{DS(on)}$=2.3 mΩ						BSC025N08LS5 [3] $R_{DS(on)}$=2.5 mΩ	
		IPB025N08N3 G $R_{DS(on)}$=2.5 mΩ	IPB030N08N3 G $R_{DS(on)}$=3.0 mΩ		IPP027N08N5 $R_{DS(on)}$=2.7 mΩ						BSC026N08NS5 $R_{DS(on)}$=2.6 mΩ	
					IPP028N08N3 G $R_{DS(on)}$=2.8 mΩ	IPA028N08N3 G $R_{DS(on)}$=2.8 mΩ					BSC030N08NS5 $R_{DS(on)}$=3.0 mΩ	
		IPB031N08N5 $R_{DS(on)}$=3.1 mΩ			IPP034N08N5 $R_{DS(on)}$=3.4 mΩ						BSC037N08NS5 $R_{DS(on)}$=3.7 mΩ	
		IPB035N08N3 G $R_{DS(on)}$=3.5 mΩ		IPI037N08N3 G $R_{DS(on)}$=3.7 mΩ	IPP037N08N3 G $R_{DS(on)}$=3.7 mΩ	IPA037N08N3 G $R_{DS(on)}$=3.7 mΩ					BSC040N08NS5 $R_{DS(on)}$=4.0 mΩ	
4-10	IPD046N08N5 [3] $R_{DS(on)}$=4.6 mΩ	IPB049N08N5 $R_{DS(on)}$=4.9 mΩ			IPP052N08N5 $R_{DS(on)}$=5.2 mΩ			BSB044N08NN3 G $R_{DS(on)}$=4.4 mΩ			BSC047N08NS3 G $R_{DS(on)}$=4.7 mΩ	
	IPD053N08N3 G $R_{DS(on)}$=5.3 mΩ	IPB054N08N3 G $R_{DS(on)}$=5.4 mΩ			IPP057N08N3 G $R_{DS(on)}$=5.7 mΩ	IPA057N08N3 G $R_{DS(on)}$=5.7 mΩ					BSC052N08NS5 $R_{DS(on)}$=5.2 mΩ	
		IPB067N08N3 G $R_{DS(on)}$=6.7 mΩ								BSZ070N08LS5 $R_{DS(on)}$=7.0 mΩ	BSC057N08NS3 G $R_{DS(on)}$=5.7 mΩ	
										BSZ075N08NS5 $R_{DS(on)}$=7.5 mΩ	BSC061N08NS5 $R_{DS(on)}$=6.1 mΩ	
	IPD096N08N3 G $R_{DS(on)}$=9.6 mΩ				IPP100N08N3 G $R_{DS(on)}$=9.7 mΩ	IPA100N08N3 G $R_{DS(on)}$=10.0 mΩ				BSZ084N08NS5 $R_{DS(on)}$=8.4 mΩ	BSC072N08NS5 $R_{DS(on)}$=7.2 mΩ	
>10								BSB104N08NP3 $R_{DS(on)}$=10.4 mΩ	IRL80HS120 [3] $R_{DS(on)}$=32.0 mΩ	BSZ110N08NS5 $R_{DS(on)}$=11.0 mΩ	BSC117N08NS5 $R_{DS(on)}$=11.7 mΩ	
	IPD135N08N3 G $R_{DS(on)}$=13.5 mΩ									BSZ123N08NS3 G $R_{DS(on)}$=12.3 mΩ	BSC123N08NS3 $R_{DS(on)}$=12.3 mΩ	
										BSZ340N08NS3 G $R_{DS(on)}$=34.0 mΩ	BSC340N08NS3 G $R_{DS(on)}$=34.0 mΩ	

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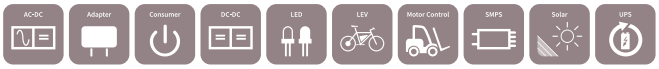
[1] DirectFET™ S

[2] 6 V rated ($R_{DS(on)}$ also specified @ V_{GS} = 6 V)

[3] In development

OptiMOS™ & StrongIRFET™ 100 V normal level



$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-263 (D^2PAK 7pin)	TO-262 (I^2PAK)	TO-220	TO-220 FullPAK	TO-247
1-2		IPB020N10N5 [2] $R_{DS(on)}$=2.0 mΩ	IPB017N10N5 [2] $R_{DS(on)}$=1.7 mΩ				
		IPB020N10N5LF [3] $R_{DS(on)}$=2.0 mΩ	IPB017N10N5LF [3] $R_{DS(on)}$=1.7 mΩ				
2-4		IPB027N10N3 G $R_{DS(on)}$=2.7 mΩ	IPB025N10N3 G $R_{DS(on)}$=2.5 mΩ		IPP023N10N5 [2] $R_{DS(on)}$=2.3 mΩ		IRFP4468PBF $R_{DS(on)}$=2.6 mΩ
		IPB027N10N5 [2] $R_{DS(on)}$=2.7 mΩ	IPB039N10N3 G $R_{DS(on)}$=3.9 mΩ	IPI030N10N3 G $R_{DS(on)}$=3.0 mΩ	IPP030N10N3 $R_{DS(on)}$=3.0 mΩ	IPA030N10N3 G $R_{DS(on)}$=3.0 mΩ	
		IPB033N10N5LF [3] $R_{DS(on)}$=3.3 mΩ			IPP030N10N5 $R_{DS(on)}$=3.0 mΩ		
					IPP039N10N5 [3] $R_{DS(on)}$=3.9 mΩ		
4-10	IPD050N10N5 [3] $R_{DS(on)}$=5.0 mΩ	IPB042N10N3 G $R_{DS(on)}$=4.2 mΩ		IPI045N10N3 G $R_{DS(on)}$=4.5 mΩ	IRFB4110PBF $R_{DS(on)}$=4.5 mΩ	IPA045N10N3 G $R_{DS(on)}$=4.5 mΩ	IRFP4110PBF $R_{DS(on)}$=4.5 mΩ
	IPD068N10N3 G $R_{DS(on)}$=6.8 mΩ	IRFS4010TRLPBF $R_{DS(on)}$=4.7 mΩ			IPP045N10N3 G $R_{DS(on)}$=4.5 mΩ	IPA083N10N5 [2] $R_{DS(on)}$=8.3 mΩ	IRFP4310ZPBF $R_{DS(on)}$=6.0 mΩ
		IRFS4310ZTRLPBF $R_{DS(on)}$=6.0 mΩ			IRFB4310ZPBF $R_{DS(on)}$=6.0 mΩ	IPA086N10N3 G $R_{DS(on)}$=8.6 mΩ	
					IPP065N10N5 [3] $R_{DS(on)}$=6.5 mΩ		
		IPB065N10N3 G $R_{DS(on)}$=6.5 mΩ					
				IPI072N10N3 G $R_{DS(on)}$=7.2 mΩ	IPP072N10N3 G $R_{DS(on)}$=7.2 mΩ		
	IPD082N10N3 G $R_{DS(on)}$=8.2 mΩ				IPP083N10N5 [2] $R_{DS(on)}$=8.3 mΩ		
		IPB083N10N3 G $R_{DS(on)}$=8.3 mΩ		IPI086N10N3 G $R_{DS(on)}$=8.6 mΩ	IPP086N10N3 G $R_{DS(on)}$=8.6 mΩ		
		IRFS4410ZTRLPBF $R_{DS(on)}$=9.0 mΩ			IRFS4410ZTRLPBF $R_{DS(on)}$=9.0 mΩ		IRFP4410ZPBF $R_{DS(on)}$=9.0 mΩ
10-25	IPD12CN10N G $R_{DS(on)}$=12.0 mΩ						
	IPD122N10N3 G $R_{DS(on)}$=12.2 mΩ	IPB123N10N3 G $R_{DS(on)}$=12.3 mΩ				IPA126N10N3 G $R_{DS(on)}$=12.6 mΩ	
	IRFR4510TRPBF $R_{DS(on)}$=13.9 mΩ	IRFS4510TRLPBF $R_{DS(on)}$=13.9 mΩ					
	IPD180N10N3 G $R_{DS(on)}$=18.0 mΩ			IPI180N10N3 G $R_{DS(on)}$=18.0 mΩ		IPA180N10N3 G $R_{DS(on)}$=18.0 mΩ	
	IPD25CN10N G [2] $R_{DS(on)}$=25.0 mΩ						
>25	IPD33CN10N G $R_{DS(on)}$=33.0 mΩ						
	IPD78CN10N G $R_{DS(on)}$=78.0 mΩ						

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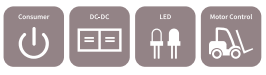
[2] 6 V rated ($R_{DS(on)}$ also specified @ V_{GS} = 6 V)
[3] In development

OptiMOS™ & StrongIRFET™ 100 V normal level

$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	Bare Die ($R_{DS(on)\ typ.}$)	DirectFET™	PQFN 3.3 x 3.3	SuperSO8	SO-8	TO-Leadless
1-2	IPC302N10N3 $R_{DS(on)}$=1.7 mΩ					IPT015N10N5 [2] $R_{DS(on)}$=1.5 mΩ
	IPC313N10N3R $R_{DS(on)}$=1.9 mΩ					IPT020N10N3 [2] $R_{DS(on)}$=2.0 mΩ
2-4	IPC26N10NR $R_{DS(on)}$=3.2 mΩ	IRF7769L1TRPBF $R_{DS(on)}$=3.5 mΩ		BSC035N10NS5 [2] $R_{DS(on)}$=3.5 mΩ		
	IPC173N10N3 $R_{DS(on)}$=3.6 mΩ			BSC040N10NS5 [2] $R_{DS(on)}$=4.0mΩ		
4-10		IRF100DM116 [3] $R_{DS(on)}$=4.3 mΩ		BSC046N10NS3 G $R_{DS(on)}$=4.6 mΩ		
		BSB056N10NN3 G $R_{DS(on)}$=5.6 mΩ		BSC060N10NS3 G $R_{DS(on)}$=6.0 mΩ		
				BSC070N10NS3 G $R_{DS(on)}$=7.0 mΩ		
				BSC070N10NS5 [2] $R_{DS(on)}$=7.0 mΩ		
				IRFH5010TRPBF $R_{DS(on)}$=9.0 mΩ		
			BSZ097N10NS5 [2] $R_{DS(on)}$=9.7 mΩ	BSC098N10NS5 [2] $R_{DS(on)}$=9.8 mΩ		
10-25				BSC109N10NS3 G $R_{DS(on)}$=10.9 mΩ		
				BSC118N10NS G $R_{DS(on)}$=11.8 mΩ		
		BSF134N10NJ3 G [1] $R_{DS(on)}$=13.4 mΩ		IRFH7110TRPBF $R_{DS(on)}$=13.5 mΩ		
			BSZ160N10NS3 G $R_{DS(on)}$=16.0 mΩ	BSC160N10NS3 G $R_{DS(on)}$=16.0 mΩ		
		IRF6662TRPBF $R_{DS(on)}$=22.0 mΩ		BSC196N10NS G $R_{DS(on)}$=19.6 mΩ	IRF7853TRPBF $R_{DS(on)}$=18.0 mΩ	
>25		IRF6645TRPBF $R_{DS(on)}$=35.0 mΩ	BSZ440N10NS3 G $R_{DS(on)}$=44.0 mΩ	BSC440N10NS3 G $R_{DS(on)}$=44.0 mΩ		
		IRF7665S2TRPBF $R_{DS(on)}$=62.0 mΩ				
2 x 75				BSC750N10ND G $R_{DS(on)}$=75.0 mΩ		
2 x 195			IRFHM792TRPBF $R_{DS(on)}$=195.0 mΩ			

OptiMOS™ & StrongIRFET™ 100 V logic level



$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-263 (D^2PAK 7pin)	TO-220	Bare Die ($R_{DS(on)\ typ.}$)	PQFN 2 x 2	PQFN 3.3 x 3.3	SuperSO8	SOT-23
2-4			IRLS4030TRL7PP $R_{DS(on)}$=3.9 mΩ					BSC035N10LS5 [3] $R_{DS(on)}$=3.5 mΩ	
4-10		IRLS4030TRLPBF $R_{DS(on)}$=4.3 mΩ		IRLB4030PBF $R_{DS(on)}$=4.3 mΩ			BSZ096N10LS5 $R_{DS(on)}$=9.6 mΩ	BSC082N10LS G $R_{DS(on)}$=8.2 mΩ	
10-25				IPP12CN10L G $R_{DS(on)}$=12.0 mΩ				BSC105N10LSF G $R_{DS(on)}$=10.5 mΩ	
	IRLR3110ZTRPBF $R_{DS(on)}$=14.0 mΩ						BSZ146N10LS5 $R_{DS(on)}$=14.6 mΩ	BSC123N10LS G $R_{DS(on)}$=12.3 mΩ	
					IPC045N10N3 $R_{DS(on)}$=15.2 mΩ		BSZ150N10LS3 $R_{DS(on)}$=15.0 mΩ	BSC152N10LS5 [3] $R_{DS(on)}$=15.2 mΩ	
>25					IPC020N10L3 $R_{DS(on)}$=33.0 mΩ	IRL100HS121 [3] $R_{DS(on)}$=43.0 mΩ		BSC265N10LSF G $R_{DS(on)}$=26.5 mΩ	IRLML0100 $R_{DS(on)}$=220 mΩ

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[1] DirectFET™ S
[2] 6 V rated ($R_{DS(on)}$ also specified @ V_{GS} = 6 V)
[3] In development

OptiMOS™ & StrongIRFET™ 120 V normal level

$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-263 (D^2PAK 7pin)	TO-251 / TO-251 Short Lead (IPAK/IPAK Short Lead)	TO-262 (I^2PAK)	TO-220	Bare Die ($R_{DS(on)\ typ.}$)	PQFN 3.3 x 3.3	SuperSO8
2-4							IPC302N12N3 $R_{DS(on)}$=2.5 mΩ		
							IPC26N12N $R_{DS(on)}$=3.0 mΩ		
		IPB038N12N3 G $R_{DS(on)}$=3.8 mΩ	IPB036N12N3 G $R_{DS(on)}$=3.6 mΩ				IPC26N12NR $R_{DS(on)}$=3.2 mΩ		
4-10					IPI041N12N3 G $R_{DS(on)}$=4.1 mΩ	IPP041N12N3 G $R_{DS(on)}$=4.1 mΩ			
						IPP048N12N3 G $R_{DS(on)}$=4.8 mΩ	IPC300N15N3R $R_{DS(on)}$=4.9 mΩ		
					IPI076N12N3 G $R_{DS(on)}$=7.6 mΩ	IPP076N12N3 G $R_{DS(on)}$=7.6 mΩ			BSC077N12NS3 G $R_{DS(on)}$=7.7 mΩ
10-25	IPD110N12N3 G $R_{DS(on)}$=11.0 mΩ			IPS110N12N3 G $R_{DS(on)}$=11.0 mΩ		IPP114N12N3 G $R_{DS(on)}$=11.4 mΩ			
		IPB144N12N3 G $R_{DS(on)}$=14.4 mΩ			IPI147N12N3 G $R_{DS(on)}$=14.7 mΩ	IPP147N12N3 G $R_{DS(on)}$=14.7 mΩ		BSZ240N12NS3 G $R_{DS(on)}$=24.0 mΩ	BSC190N12NS3 G $R_{DS(on)}$=19.0 mΩ

OptiMOS™ & StrongIRFET™ 135 V-150 V normal level

$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-263 (D^2PAK 7pin)	TO-251 / TO-251 Short Lead (IPAK/IPAK Short Lead)	TO-262 (I^2PAK)	TO-220	TO-220 FullPAK	TO-247
4-10		IPB048N15N5 [2] $R_{DS(on)}$=4.8 mΩ	IPB044N15N5 [2] $R_{DS(on)}$=4.4 mΩ		IPI051N15N5 [2] $R_{DS(on)}$=5.1 mΩ	IPP051N15N5 [2] $R_{DS(on)}$=5.1 mΩ		
		IPB048N15N5LF [3] $R_{DS(on)}$=4.8 mΩ						
		IPB072N15N3 G [2] $R_{DS(on)}$=7.2 mΩ	IPB065N15N3 G [2] $R_{DS(on)}$=6.5 mΩ		IPI075N15N3 G [2] $R_{DS(on)}$=7.5 mΩ	IPP075N15N3 G [2] $R_{DS(on)}$=7.5 mΩ		IRFP4568PBF $R_{DS(on)}$=5.9 mΩ
		IPB073N15N5 [2] $R_{DS(on)}$=7.3 mΩ	IRF135SA204 [5] $R_{DS(on)}$=7.7 mΩ		IPI076N15N5 [2] $R_{DS(on)}$=7.6 mΩ	IPP076N15N5 [2] $R_{DS(on)}$=7.6 mΩ	IPA075N15N3 G $R_{DS(on)}$=7.5 mΩ	
		IPB083N15N5LF [3] $R_{DS(on)}$=8.3 mΩ						
		IRF135S203 [5] $R_{DS(on)}$=9.16 mΩ				IRF135B203 [5] $R_{DS(on)}$=9.16 mΩ		
10-25		IPB108N15N3 G [2] $R_{DS(on)}$=10.8 mΩ	IRFS4115TRL7PP $R_{DS(on)}$=11.8 mΩ		IPI111N15N3 G [2] $R_{DS(on)}$=11.1 mΩ	IPP111N15N3 G [2] $R_{DS(on)}$=11.1 mΩ	IPA105N15N3 G $R_{DS(on)}$=10.5 mΩ	
		IRFS4321 $R_{DS(on)}$=15.0 mΩ	IRFS4321TRL7PP $R_{DS(on)}$=14.7 mΩ			IRFB4321PBF $R_{DS(on)}$=15.0 mΩ		IRFP4321PBF $R_{DS(on)}$=15.5 mΩ
	IPD200N15N3 G [2] $R_{DS(on)}$=20.0 mΩ	IPB200N15N3 G [2] $R_{DS(on)}$=20.0 mΩ				IPP200N15N3 G [2] $R_{DS(on)}$=20.0 mΩ		
>25		IRFS4615PBF $R_{DS(on)}$=42.0 mΩ				IRFB4615PBF $R_{DS(on)}$=39.0 mΩ		
	IRFR4615 $R_{DS(on)}$=42.0 mΩ	IRFS5615PBF $R_{DS(on)}$=42.0 mΩ		IRFU4615PBF $R_{DS(on)}$=42.0 mΩ		IRFB5615PBF $R_{DS(on)}$=39.0 mΩ		
	IPD530N15N3 G [2] $R_{DS(on)}$=53.0 mΩ	IPB530N15N3 G [2] $R_{DS(on)}$=53.0 mΩ			IPI530N15N3 G [2] $R_{DS(on)}$=53.0 mΩ	IPP530N15N3 G [2] $R_{DS(on)}$=53.0 mΩ		
						IRFB4019PBF $R_{DS(on)}$=95.0 mΩ		

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[2] 8 V rated ($R_{DS(on)}$ also specified @ V_{GS} = 8 V)
[3] In development
[5] 135 V

OptiMOS™ & StrongIRFET™ 135 V-150 V normal level

$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	Bare Die ($R_{DS(on)\ typ.}$)	DirectFET™	PQFN 3.3 x 3.3	SuperSO8	SO-8
4-10	IPC302N15N3 $R_{DS(on)}$=4.9 mΩ			BSC093N15NS5 [2] $R_{DS(on)}$=9.3 mΩ	
10-25		IRF7779L2TRPBF [5] $R_{DS(on)}$=11.0 mΩ		BSC110N15NS5 [2] $R_{DS(on)}$=11.0 mΩ	
		IRF150DM115 [3] $R_{DS(on)}$=11.4 mΩ		BSC160N15NS5 [2] $R_{DS(on)}$=16.0 mΩ	
		BSB165N15NZ3 G [2] $R_{DS(on)}$=16.5 mΩ		BSC190N15NS3 G [2] $R_{DS(on)}$=19.0 mΩ	
>25		BSB280N15NZ3 G [2] $R_{DS(on)}$=28.0 mΩ	BSZ300N15NS5 [2] $R_{DS(on)}$=30.0 mΩ	BSC360N15NS3 G [2] $R_{DS(on)}$=36.0 mΩ	
		IRF6643TRPBF $R_{DS(on)}$=34.5 mΩ	BSZ520N15NS3 G [2] $R_{DS(on)}$=52.0 mΩ	BSC520N15NS3 G [2] $R_{DS(on)}$=52.0 mΩ	
		IRF6775MTRPBF $R_{DS(on)}$=56.0 mΩ	BSZ900N15NS3 G [2] $R_{DS(on)}$=90.0 mΩ		

OptiMOS™ & StrongIRFET™ 200 V normal level

$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-251 / TO-251 Short Lead (IPAK/IPAK Short Lead)	TO-262 (I^2PAK)	TO-220	TO-247
4-10						IRF200P222 $R_{DS(on)}$=6.6 mΩ
						IRFP4668PBF $R_{DS(on)}$=9.7 mΩ
10-25		IPB107N20N3 G $R_{DS(on)}$=10.7 mΩ		IPI110N20N3 G $R_{DS(on)}$=11.0 mΩ	IPP110N20N3 G $R_{DS(on)}$=11.0 mΩ	IRF200P223 $R_{DS(on)}$=11.5 mΩ
		IPB107N20NA [4] $R_{DS(on)}$=10.7 mΩ			IPP110N20NA [4] $R_{DS(on)}$=11.0 mΩ	
		IPB110N20N3LF [3] $R_{DS(on)}$=11.0 mΩ			IPP120N20NFD $R_{DS(on)}$=12.0 mΩ	IRFP4127PBF $R_{DS(on)}$=21.0 mΩ
		IPB117N20NFD $R_{DS(on)}$=11.7 mΩ			IRFB4127PBF $R_{DS(on)}$=20.0 mΩ	IRFP4227PBF $R_{DS(on)}$=25.0 mΩ
		IRFS4127TRLPBF $R_{DS(on)}$=22.0 mΩ				
>25		IRFS4227TRLPBF $R_{DS(on)}$=26.0 mΩ			IRFB4227PBF $R_{DS(on)}$=26.0 mΩ	
	IPD320N20N3 G $R_{DS(on)}$=32.0 mΩ	IPB320N20N3 G $R_{DS(on)}$=32.0 mΩ		IPI320N20N3 G $R_{DS(on)}$=32.0 mΩ	IPP320N20N3 G $R_{DS(on)}$=32.0 mΩ	
					IRFB4620PBF $R_{DS(on)}$=72.5 mΩ	
	IRFR4620TRLPBF $R_{DS(on)}$=78.0 mΩ	IRFS4620TRLPBF $R_{DS(on)}$=78.0 mΩ	IRFU4620PBF $R_{DS(on)}$=78.0 mΩ		IRFB5620PBF $R_{DS(on)}$=72.5 mΩ	
		IRFS4020TRLPBF $R_{DS(on)}$=105.0 mΩ		IRFSL4020PBF $R_{DS(on)}$=105.0 mΩ	IRFB4020PBF $R_{DS(on)}$=100.0 mΩ	
					IRF200B211 $R_{DS(on)}$=170.0 mΩ	

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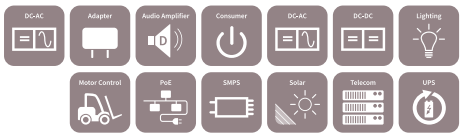
[2] 8 V rated ($R_{DS(on)}$ also specified @ V_{GS}=8 V)
[3] In development
[4] Part qualified according to AEC Q101
[5] DirectFET™ L

OptiMOS™ & StrongIRFET™ 200 V normal level

$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	Bare Die ($R_{DS(on)\ typ.}$)	DirectFET™	PQFN 3.3 x 3.3	SuperSO8	SO-8	TO-Leadless
4-10	IPC300N20N3 $R_{DS(on)}$=9.2 mΩ					
	IPC302N20N3 $R_{DS(on)}$=9.2 mΩ					
>25				BSC320N20NS3 G $R_{DS(on)}$=32.0 mΩ		IPT111N20NFD $R_{DS(on)}$=11.1 mΩ
				BSC350N20NSFD $R_{DS(on)}$=35.0 mΩ		
				BSC500N20NS3G $R_{DS(on)}$=50.0 mΩ		
		IRF6641TRPBF $R_{DS(on)}$=59.9 mΩ		IRFH5020 $R_{DS(on)}$=55.0 mΩ		
			BSZ900N20NS3 G $R_{DS(on)}$=90.0 mΩ	BSC900N20NS3 G $R_{DS(on)}$=90.0 mΩ	IRF7820TRPBF $R_{DS(on)}$=78.0 mΩ	
		IRF6785TRPBF $R_{DS(on)}$=100.0 mΩ	BSZ12DN20NS3 G $R_{DS(on)}$=125.0 mΩ	BSC12DN20NS3 G $R_{DS(on)}$=125.0 mΩ		
			BSZ22DN20NS3 G $R_{DS(on)}$=225.0 mΩ	BSC22DN20NS3 G $R_{DS(on)}$=225.0 mΩ		



OptiMOS™ & StrongIRFET™ 250 V normal level

$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-262 (I^2PAK)	TO-220	TO-247	Bare Die ($R_{DS(on)\ typ.}$)	DirectFET™	PQFN 3.3 x 3.3	SuperSO8	TO-Leadless
10-25		IPB200N25N3 G $R_{DS(on)}$=20.0 mΩ	IPI200N25N3 G $R_{DS(on)}$=20.0 mΩ	IPP200N25N3 G $R_{DS(on)}$=20.0 mΩ	IRF250P224 $R_{DS(on)}$=12.0 mΩ					
				IPP220N25NFD $R_{DS(on)}$=22.0 mΩ	IRFP4768PBF $R_{DS(on)}$=17.5 mΩ	IPC302N25N3 $R_{DS(on)}$=16.0 mΩ				IPT210N25NFD $R_{DS(on)}$=21.0 mΩ
					IRF250P225 $R_{DS(on)}$=22.0 mΩ					
>25		IRFS4229TRLPBF $R_{DS(on)}$=48.0 mΩ		IRFB4332PBF $R_{DS(on)}$=33.0 mΩ	IRFP4332PBF $R_{DS(on)}$=33.0 mΩ		IRF7799L2TRPBF $R_{DS(on)}$=38.0 mΩ		BSC600N25NS3 G $R_{DS(on)}$=60.0 mΩ	
									BSC670N25NSFD $R_{DS(on)}$=67.0 mΩ	
	IPD600N25N3 G $R_{DS(on)}$=60.0 mΩ	IPB600N25N3 G $R_{DS(on)}$=60.0 mΩ	IPI600N25N3 G $R_{DS(on)}$=60.0 mΩ	IRFB4229PBF $R_{DS(on)}$=46.0 mΩ	IRFP4229PBF $R_{DS(on)}$=46.0 mΩ			BSZ16DN25NS3 G $R_{DS(on)}$=165.0 mΩ	IRFH5025 $R_{DS(on)}$=100.0 mΩ	
				IPP600N25N3 G $R_{DS(on)}$=60.0 mΩ		IPC045N25N3 $R_{DS(on)}$=146.0 mΩ		BSZ42DN25NS3 G $R_{DS(on)}$=425.0 mΩ	BSC16DN25NS3 G $R_{DS(on)}$=165.0 mΩ	

OptiMOS™ & StrongIRFET™ 300 V normal level

$R_{DS(on),\ max.}$ @V_{GS}=10 V [mΩ]	TO-263 (D^2PAK)	TO-220	TO-247	SuperSO8
>25	IPB407N30N $R_{DS(on)}$=40.7 mΩ	IPP410N30N $R_{DS(on)}$=41.0 mΩ	IRFP4868PBF $R_{DS(on)}$=32.0 mΩ	
		IRFB4137PBF $R_{DS(on)}$=69.0 mΩ	IRFP4137PBF $R_{DS(on)}$=69.0 mΩ	BSC13DN30NSFD $R_{DS(on)}$=130.0 mΩ

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Small Signal p-channel

Voltage [V]		SOT-223	TSOP-6	SOT-89	SC59	SOT-23	SOT-323	SOT-363
P-channel MOSFETs	-250	BSP317P 4 Ω, -0.43 A, LL		BSS192P 12 Ω, -0.19 A, LL	BSR92P 11 Ω, -0.14 A, LL			
		BSP92P 12 Ω, -0.26 A, LL						
	-100	BSP321P 900 mΩ, -0.98 A, NL						
		BSP322P 800 mΩ, -1.0 A, LL						
		BSP316P 1.8 Ω, -0.68 A, LL			BSR316P 1.8 Ω, -0.36 A, LL			
	-60	BSP612P 120 mΩ, 3 A, LL				BSS83P 2 Ω, -0.33 A, LL	BSS84PW 8 Ω, -0.15 A, LL	
		BSP613P 130 mΩ, 2.9 A, NL				BSS84P 8 Ω, -0.17 A, LL		
		BSP170P 300 mΩ, -1.9 A, NL						
		BSP171P 300 mΩ, -1.9 A, LL						
		BSP315P 800 mΩ, -1.17 A, LL			BSR315P 800 mΩ, -0.62 A, LL			
	- 30		BSL303SPE ~30 mΩ, ~-6.6 A, LL			BSS308PE 80 mΩ, -2.1 A, LL, ESD		BSD314SPE 140 mΩ, -1.5 A, LL, ESD
			BSL305SPE ~50 mΩ, ~-5.3 A, LL			BSS314PE 140 mΩ, -1.5 A, LL, ESD		
			BSL307SP 43 mΩ, -5.5 A, LL			BSS315P 150 mΩ, -1.5 A, LL		
			BSL308PE 80 mΩ, -2.1 A, LL, dual, ESD					
			BSL314PE 140 mΩ, -1.5 A, LL, ESD, dual					
	-20		BSL207SP 41 mΩ, -6 A, SLL			BSS215P 150 mΩ, -1.5 A, SLL	BSS209PW 550 mΩ, -0.58 A, SLL	BSV236SP 175 mΩ, -1.5 A, SLL
			BSL211SP 67 mΩ, -4.7 A, SLL				BSS223PW 1.2 Ω, -0.39 A, SLL	BSD223P 1.2 Ω, -0.39 A, SLL, dual

Small Signal complementary

Voltage [V]		SOT-223	TSOP-6	SOT-89	SC59	SOT-23	SOT-323	SOT-363
Complementary	-20/20		BSL215C N: 140 mΩ, 1.5 A, SLL P: 150 mΩ, 1.5 A, SLL					BSD235C N: 350 mΩ, 0.95 A, SLL P: 1.2 Ω, 0.53 A, SLL
	-30/30		BSL316C N: 160 mΩ, 1.4 A, LL P: 150 mΩ, -1.5 A, LL					
			BSL308C N: 57 mΩ, 2.3 A, LL P: 80 mΩ, -2.0 A, LL					

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All products are qualified to Automotive AEC Q101

Small Signal n-channel

	Voltage [V]	SOT-223	TSOP-6	SOT-89	SC59	SOT-23	SOT-323	SOT-363
N-channel	20		BSL802SN 22 mΩ, 7.5 A, ULL		BSR802N 23 mΩ, 3.7 A, ULL			
			BSL202SN 22 mΩ, 7.5 A, SLL		BSR202N 21 mΩ, 3.8 A, SLL	BSS806NE 57 mΩ, 2.3 A, ULL, ESD		
			BSL806N 57 mΩ, 2.3 A, ULL, dual			BSS806N 57 mΩ, 2.3 A, ULL		BSD816SN 160 mΩ, 1.4 A, ULL
			BSL205N 50 mΩ, 2.5 A, SLL, dual			BSS205N 50 mΩ, 2.5 A, SLL		BSD214SN 140 mΩ, 1.5 A, SLL
			BSL207N 70 mΩ, 2.1 A, SLL, dual			BSS214N 140 mΩ, 1.5 A, SLL	BSS816NW 160 mΩ, 1.4 A, ULL	BSD840N 400 mΩ, 0.88 A, ULL, dual
			BSL214N 140 mΩ, 1.5 A, SLL, dual				BSS214NW 140 mΩ, 1.5 A, SLL	BSD235N 350 mΩ, 0.95 A, SLL, dual
	30		BSL302SN 25 mΩ, 7.1 A, LL		BSR302N 23 mΩ, 3.7 A, LL	BSS306N 57 mΩ, 2.3 A, LL		BSD316SN 160 mΩ, 1.4A, LL
			BSL306N 57 mΩ, 2.3 A, LL, dual			BSS316N 160 mΩ, 1.4 A, LL		
	55					BSS670S2L 650 mΩ, 0.54 A, LL		
	60	BSP318S 90 mΩ, 2.6 A, LL	BSL606SN 60 mΩ, 4.5 A, LL	BSS606N 60 mΩ, 3.2 A, LL	BSR606N 60 mΩ, 2.3 A, LL	BSS138N 3.5 Ω, 0.23 A, LL	BSS138W 3.5 Ω, 0.28 A, LL	2N7002DW 3 Ω, 0.3 A, LL, dual
		BSP320S 120 mΩ, 2.9 A, NL				BSS7728N 5 Ω, 0.2 A, LL	SN7002W 5 Ω, 0.23 A, LL	
		BSP295 300 mΩ, 1.8 A, LL				SN7002N 5 Ω, 0.2 A, LL		
						2N7002 3 Ω, 0.3 A, LL		
						BSS159N 8 Ω, 0.13 A, depl.		
	75	BSP716N 160 mΩ, 2.3 A, LL	BSL716SN 150 mΩ, 2.5 A, LL					
	100	BSP373N 240 mΩ, 1.8 A, NL	BSL373SN 230 mΩ, 2.0 A, NL			BSS169 12Ω, 0.09A, depl.		
		BSP372N 230 mΩ, 1.8 A, LL	BSL372SN 220 mΩ, 2.0 A, LL			BSS119N 6 Ω, 0.19 A, LL $V_{GS(th)}$ 1.8 V to 2.3 V		
		BSP296N 600 mΩ, 1.2 A, LL	BSL296SN 460 mΩ, 1.4 A, LL			BSS123N 6 Ω, 0.19 A, LL $V_{GS(th)}$ 0.8 V to 1.8 V		
	200	BSP297 1.8 Ω, 0.66 A, LL						
		BSP149 3.5 Ω,0.14 A, depl.						
	240	BSP88 6 Ω, 0.35 A, 2.8 V rated		BSS87 6 Ω, 0.26 A, LL		BSS131 14 Ω, 0.1 A, LL		
		BSP89 6 Ω, 0.35 A, LL						
		BSP129 6 Ω, 0.05 A, depl.						
	250					BSS139 30 Ω, 0.03 A, depl.		
	400	BSP179 24 Ω, 0.04 A, depl.						
		BSP298 3 Ω, 0.5 A, NL						
		BSP324 25 Ω, 0.17 A, LL						
	500	BSP299 4 Ω, 0.4 A, NL						
	600	BSP125 45 Ω, 0.12 A, LL		BSS225 45 Ω, 0.09 A, LL		BSS127 500 Ω, 0.023 A, LL		
		BSP135 60 Ω, 0.02 A, depl.				BSS126 700 Ω, 0.007 A, depl.		
	800	BSP300 20 Ω, 0.19 A, NL						

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All products are qualified to Automotive AEC Q101 (except 2N7002)

Power p-channel MOSFETs

	Voltage [V]	TO-252 (DPAK)	DirectFET™	SOT-23	PQFN 3.3 x 3.3	SuperSO8	SO-8	PQFN 2 x 2	TSOP-6
P-channel MOSFETs	-20						BSO201SP H $R_{DS(on)}$=7.0 mΩ		
							BSO203SP H $R_{DS(on)}$=21.0 mΩ		
							BSO203P H $R_{DS(on)}$=21.0 mΩ		
								IRLHS2242TRPBF** $R_{DS(on)}$=31.0 mΩ	IRLTS2242 $R_{DS(on)}$=39 mΩ
				IRLML2244[2] *** $R_{DS(on)}$=54 mΩ			BSO207P H $R_{DS(on)}$=45.0 mΩ		
				IRLML2246[2] *** $R_{DS(on)}$=135 mΩ			BSO211P H $R_{DS(on)}$=67.0 mΩ		
	-30					BSC030P03NS3 G $R_{DS(on)}$=3.0 mΩ	IRF9310 $R_{DS(on)}$=4.6 mΩ		
		IPD042P03L3 G $R_{DS(on)}$=4.2 mΩ				BSC060P03NS3E G $R_{DS(on)}$=6.0 mΩ; ESD	IRF9317 $R_{DS(on)}$=6.6 mΩ		
		IPD068P03L3 G $R_{DS(on)}$=6.8 mΩ			BSZ086P03NS3 G $R_{DS(on)}$=8.6 mΩ		IRF9321 $R_{DS(on)}$=7.2 mΩ		
		SPD50P03L G[1]* $R_{DS(on)}$=7.0 mΩ	IRF9395M $R_{DS(on)}$=7.0 mΩ; dual		BSZ086P03NS3E G $R_{DS(on)}$=8.6 mΩ	BSC080P03LS G $R_{DS(on)}$=8.0 mΩ	BSO080P03NS 3 G $R_{DS(on)}$=8.0 mΩ		
						BSC084P03NS3 G $R_{DS(on)}$=8.4 mΩ	BSO080P03NS3E G $R_{DS(on)}$=8.0 mΩ; ESD		
						BSC084P03NS3E G $R_{DS(on)}$=8.4 mΩ; ESD	BSO080P03S H $R_{DS(on)}$=8.0 mΩ		
					BSZ120P03NS3 G $R_{DS(on)}$=12.0 mΩ		BSO301SP H $R_{DS(on)}$=8.0 mΩ		
					BSZ120P03NS3E G $R_{DS(on)}$=12.0 mΩ; ESD		IRF9328 $R_{DS(on)}$=11.9 mΩ		
						BSC130P03LS G $R_{DS(on)}$=13.0 mΩ	BSO130P03S H $R_{DS(on)}$=13.0 mΩ		
							IRF9358 $R_{DS(on)}$=16 mΩ; dual		
					IRFHM9331[2] $R_{DS(on)}$=15 mΩ		IRF9332 $R_{DS(on)}$=17.5 mΩ		
					BSZ180P03NS3 G $R_{DS(on)}$=18.0 mΩ		IRF9333 $R_{DS(on)}$=19.4 mΩ		
					BSZ180P03NS3E G $R_{DS(on)}$=18.0 mΩ; ESD		BSO200P03S H $R_{DS(on)}$=20.0 mΩ		
							BSO303SP H $R_{DS(on)}$=21.0 mΩ	IRFH9301TRPBF $R_{DS(on)}$=37.0 mΩ	
				IRLML9301TRPBF $R_{DS(on)}$=64 mΩ			BSO303P H $R_{DS(on)}$=21.0 mΩ, dual		
				IRLML9303TRPBF $R_{DS(on)}$=165 mΩ			IRF9362 $R_{DS(on)}$=21 mΩ; dual	IRFHS9351TRPBF $R_{DS(on)}$=170.0 mΩ, dual	IRFTS9342*** $R_{DS(on)}$=32 mΩ
							IRF9335 $R_{DS(on)}$=59 mΩ		

Power p-channel MOSFETs

	Voltage [V]	TO-252 (DPAK)	TO-263 (D2PAK)	TO-220	PQFN 3.3 x 3.3	SuperSO8	SO-8	PQFN 2 x 2
P-channel MOSFETs	-60		SPB80P06P G* $R_{DS(on)}$=23.0 mΩ	SPP80P06P H* $R_{DS(on)}$=23.0 mΩ				
		SPD30P06P G* $R_{DS(on)}$=75.0 mΩ						
		SPD18P06P G* $R_{DS(on)}$=130.0 mΩ	SPB18P06P G* $R_{DS(on)}$=130.0 mΩ	SPP18P06P H* $R_{DS(on)}$=130.0 mΩ			BSO613SPV G* $R_{DS(on)}$=130.0 mΩ	
		SPD09P06PL G* $R_{DS(on)}$=250.0 mΩ						
		SPD08P06P G* $R_{DS(on)}$=300.0 mΩ	SPB08P06P G* $R_{DS(on)}$=300.0 mΩ					
	-100	SPD15P10PL G* $R_{DS(on)}$=200.0 mΩ		SPP15P10PL H* $R_{DS(on)}$=200.0 mΩ				
		SPD15P10P G* $R_{DS(on)}$=240.0 mΩ		SPP15P10P H* $R_{DS(on)}$=240.0 mΩ				
				SPP08P06P H* $R_{DS(on)}$=300.0 mΩ				
		SPD04P10PL G* $R_{DS(on)}$=850.0 mΩ						
		SPD04P10P G* $R_{DS(on)}$=1000.0 mΩ						

www.infineon.com/pchannel

[1] 5-leg

[2] 2.5 V_{GS} capable

* Products are qualified to Automotive AEC Q101

** $R_{DS(on)}$ specified at 4.5 V

*** $R_{DS(on)}$ max @V_{GS}=4.5 V

Power p-channel MOSFETs complementary

Voltage [V]			TO-252 (DPAK)	TO-263 (D^2PAK)	TO-220	PQFN 3.3 x 3.3	SuperSO8	SO-8
Complementary	-20/20	>50 mΩ				BSZ15DC02KD H* ** N: 55 mΩ, 5.1 A P: 150 mΩ, -3.2 A		
						BSZ215C H* ** N: 55 mΩ, 5.1 A P: 150 mΩ, -3.2 A		
	-60/60	11-30 Ω						BSO612CV G* N: 0.12 Ω, 3.0 A P: 0.30 Ω, -2.0 A
								BSO615C G* N: 0.11 Ω, 3.1 A P: 0.30 Ω, -2.0 A

www.infineon.com/complementary

*Products are qualified to Automotive AEC Q101

**$R_{DS(on)}$ specified at 4.5 V

Naming system

OptiMOS™

Package type
BSB = DirectFET™ (M Can)
BSC = SuperSO8
BSF = DirectFET™ (S Can)
BSK = PQFN 2x2
BSO = SO-8
BSZ = PQFN 3.3x3.3
IPA = FullPAK
SPB/IPB = D²PAK
IPC = Chip product
SPD/IPD = DPAK
IPI = I²PAK
SPP/IPP = TO-220
IPS = IPAK Short leads
IPT = TO-Leadless

$R_{DS(on)}$ [mΩ]
Divide by 10 to get $R_{DS(on)}$ value e.g. 014 = 1.4 mΩ

However, if the sixth character is a C, the fourth and the fifth character indicate the $R_{DS(on)}$ e.g. 12C=12 mΩ
For chip products chip area in mm² multiplied by 10

N = N-channel
P = P-channel
C = Complementary

Breakdown voltage [V]
Multiply by 10 to get voltage class e.g. 03 = 30 V
E = Extended, +5 V, e.g. E2 = 25 V

RoHS compliant

Features
F = Fast switching
R = Integrated gate resistor
E = ESD protection
A = Qualified according to AECQ 101

3 = Technology generation
I = Monolithically integrated Schottky like diode
FD = Fast diode
LF = Linear mode capability

Package options
SO-8/SuperSO8/PQFN 3.3 x 3.3/PQFN 2 x 2
S = Single chip
D = Dual chip

DirectFET™
X = MX footprint
N = MN footprint
Z = MZ footprint
Q = SQ footprint
T = ST footprint
H = SH footprint
J = SJ footprint

Level

		to be used from V_{GS}
N = Normal level	(NL)	10.0
M = Logic level 5 V opt.	(LL)	4.5
L = Logic level	(ELL)	4.5
K = Super logic level	(SLL)	2.5
J = Ultra logic level	(ULL)	1.8

OptiMOS™ 30 V

Package type

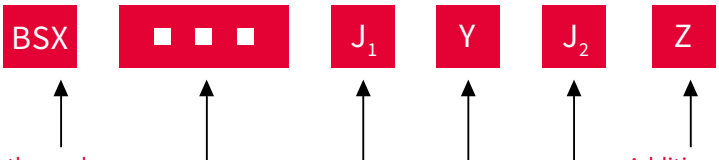
Consecutive number
without any correlation to product specification

Channels
N = N-channel
P = P-channel

I = Monolithically integrated Schottky like diode

D = Dual
E = ESD
S = Single

Small Signal



"X" indicates the package
D = SOT-363
P = SOT-223
R = SC59
S = SOT-89, SOT-23, SOT-323
L = TSOP-6

3 digits product identifier
meaning dependent on
product generation

Only present in following case
S = Single (only for packages which
are also used for multichip products)

Additional features
E = ESD protected MOSFET

Only present in following case
W= to distinguish SOT-323 from SOT-23

Polarity
N = N-channel
P = P-channel
C = Complementary
(N-ch + p-ch)

StrongIRFET™ (from May 2015 onwards)

3 sequential digits
3 digits issued sequentially

Drive voltage
F = 4.5 V_{GS} capable for BV ≤ 30 V
L = 2.5 V_{GS} capable for BV ≤ 30 V, 4.5 V_{GS} capable for BV ≥ 40 V

2 to 3 digit voltage
For example:
25 = 25 V
135 = 135 V

Package
1 or 2 letters
B = TO-220
BA = Super220
C = Bare die or wafer
DL = DirectFET™ 1.5 Large Can
DM = DirectFET™ 1.5 Medium Can
DS = DirectFET™ 1.5 Small Can
FF = TO-220 FullPAK
H = PQFN 5 x 6
HB = Power Block 5 x 6
HM = PQFN 3.0 x 3.0 or 3.3 x 3.3
HS = PQFN 2 x 2
I = TO-220 FullPak
K = SO-8
L = SOT-223
ML = SOT-23
P = TO-247
PS = Super247
R = DPAK
S = D^2PAK
SL = TO-262
SA = D2 7pin with pin 2 void
SN = D2 7pin with pins void
SC = D2 7pin with pin 4 void
T = TollFET
TS = TSOP-6
U = IPAK

Infineon support for low voltage MOSFETs

Useful links and helpful information

Further information, datasheets and documents

www.infineon.com/powermosfet-20V-30V
www.infineon.com/powermosfet-40V-75V
www.infineon.com/powermosfet-80V-100V
www.infineon.com/powermosfet-120V-300V
www.infineon.com/smallsignal
www.infineon.com/pchannel
www.infineon.com/depletion
www.infineon.com/complementary
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www.infineon.com/optimos-latest-packages
www.infineon.com/optimos-strongirfet-family-selection

Evaluationboards and simulation models

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Videos

www.infineon.com/mediacenter

Info | Document | Evaluation Board | Simulation | Play

CoolMOS™

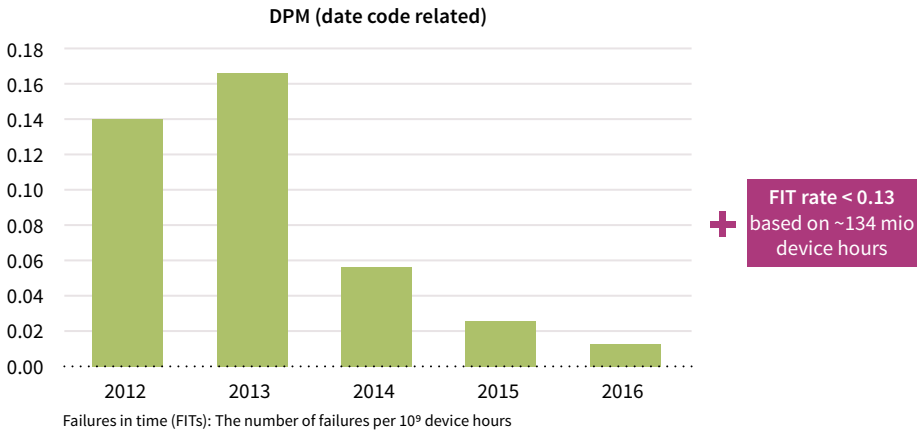
Trusted leader in high voltage MOSFETs

The revolutionary CoolMOS™ power MOSFET family sets new standards in the field of energy efficiency. Our CoolMOS™ products offer a significant reduction of conduction, switching and driving losses and enable high power density and efficiency for superior power conversion systems. Especially, the latest state-of-the-art generation of high voltage power MOSFETs makes AC-DC power supplies more efficient, more compact, lighter and cooler than ever before. Each application has its own requirements and optimization criteria, which are reflected in the available technologies paired with innovative package solutions. Driving factors like efficiency, power density, controllability, EMI, layout resistance, commutation behavior and cost, cannot be fulfilled at the same time and lead to different technologies and solutions. Designers will select the most suitable part based on:

- **Efficiency:** Reflects the switching, gate drive and on-state losses, in hard switching topologies, such as PFC, the turn-off and turn-on losses are fully reflected, whereas in soft switched these losses are widely avoided.
- **Ease of use:** Describes the effort needed for design-in of the part: ringing behavior, controllability of slopes dV/dt and dI/dt via gate resistor, as well as the EMI signature of the part fold into the ease-of-use category. Highest efficiency parts typically require higher effort for design-in. For example, using fast parts, the layout must be optimized by avoiding large areas in commutation and gate loops. Secondly, parasitic should be minimized. This can be easily done via bifilar arrangements and small capacitive coupling areas on jumping potentials, including coupling capacitances of magnetics. Infineon has developed an in-depth understanding of these topics and our engineers are happy to support your design.
- **Commutation (suitability in PFC, LLC and ZVS):** Reflects the behavior at hard commutation on the body diode. The intrinsic damping circuits or reverse recovery charge reduction lowers the overvoltage spike in the current cut-off phase. Some parts are suitable only for hard switching (PFC like) applications, for example 650 V CoolMOS™ C7, others such as 600 V CoolMOS™ C7 have a body diode robust enough to serve as a broad liner for both PFC and LLC applications. In topologies exposed to repeated hard commutation, we recommend the CoolMOS™ CFD2 series, which is designed to have a fast body diode.

CoolMOS™ quality – benchmark in short term and long term reliability

CoolMOS™ technology is legendary in the industry differentiated by high quality and reliability. Our quality has been proven over the past many years across billions of devices shipped with continuous improved DPM down to less than 0.10 DPM. On reliability, the same performance has been proven down to less than 0.13 FIT measured across ~340 million device hours. Infineon has implemented firm and proven measures from the beginning with design-for-quality program and continuous improvement in production. There is a constant proactive collaboration among technology, design, quality, reliability and manufacturing teams to achieve this result. This effort is above and beyond the fact that all Infineon sites are ISO/TS16949 certified.



CoolMOS™ comes with a DPM << 0.10 and FIT rate less than 0.13

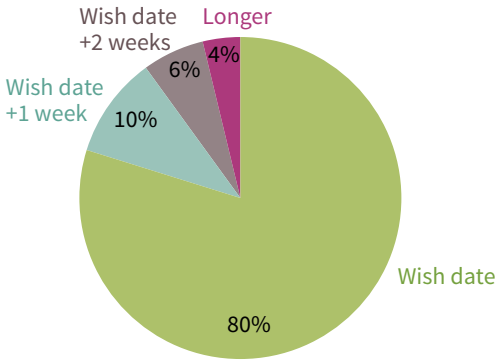
www.infineon.com/coolmos

CoolMOS™ supply chain – delivery reliability, flexibility and supply security

Our customers value CoolMOS™ not only for its technical merits but also for the outstanding delivery reliability: Once a CoolMOS™ order date is committed, more than 96 percent of orders are shipped at or before the committed date. And CoolMOS™ orders are committed to more than 80 percent to the date that the customers request. Security of supply and flexibility to demand changes are focus targets and enabled by a well balanced production network. For example more than 90 percent of our products are qualified for production in at least two back end locations and more than 80 percent of the volumes in two wafer fabs. This enables CoolMOS™ supply chain to react fast to changes in customer and market requirements.

Delivery reliability: ship date = commited date

Delivery capability: confirmed customers wish date



≥ 96% of CoolMOS™ orders are shipped at committed date and ≥ 80% of wish dates can be met

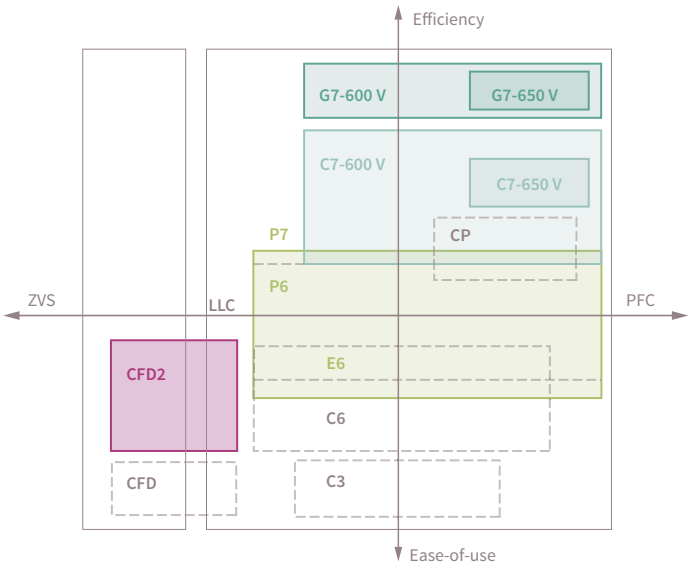
The following pages provide help in the selection of the most suitable part for your application. The applications have been divided into high power (more than 150 W) and low power (less than 150 W) ones, because each segment comes with different requirements. Our nomenclature guides you through different optimization criteria, and will help to select and find the perfect matching part for your application.

www.infineon.com/coolmos

CoolMOS™ for high power SMPS (>150 W)

Pushing the edge of silicon MOSFET performance

In high power SMPS, high voltage superjunction MOSFETs address applications such as server, telecom, TV, PC power, solar, UPS and industrial power supplies. In 2017, we recommend to our customers the design-in of the CoolMOS™ C7 and G7, CFD2 as well as P6/P7 product families, which come with the most attractive balance of performance versus price.



Active and preferred:
- Infineon recommendation for new designs

Active:
- Production continued for extended period of time (~ 10 years)
- Replaced by better performance/ priced products

The CoolMOS™ high power portfolio addresses the complete application landscape across PFC, LLC and ZVS topologies with product families addressing different sub-segments in terms of efficiency and ease-of-use. The CoolMOS™ C7 and G7 product families target the highest efficiency segment and are the successors of CoolMOS™ CP. With the 600 V CoolMOS™ C7 and G7, we have been cutting switching losses by 50 percent. CoolMOS™ G7 offers even further reduction, reaching a performance close to GaN in hard switching applications. In contrast, CoolMOS™ P-series comes with a high efficiency but better ease-of-use, i.e., less ringing and voltage overshoot.

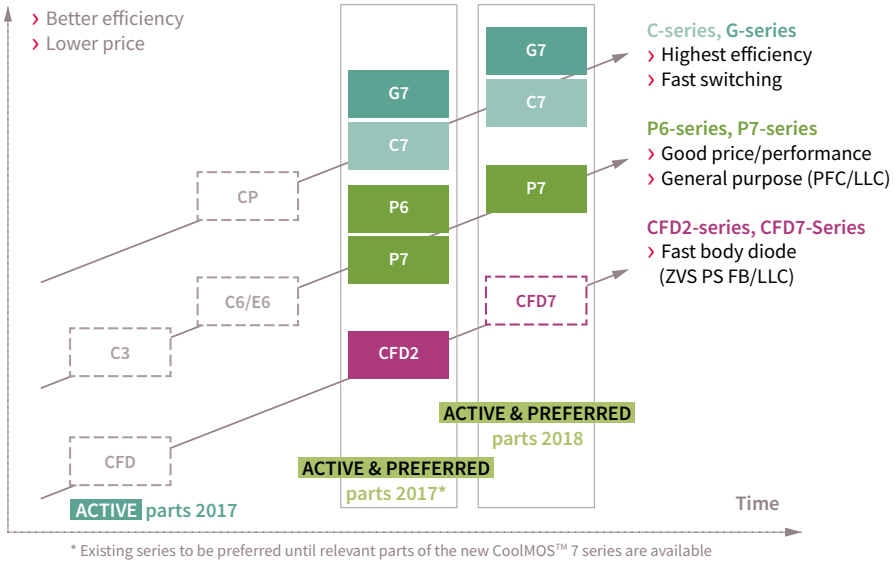
Active and preferred CoolMOS™ product families ACTIVE & PREFERRED

Product name	Voltage	Benefits
CoolMOS™ C7 CoolMOS™ G7	600 V	› Highest efficiency in PFC, up to 0.7 percent ahead of CoolMOS™ CP › Fast switching up to 200 kHz from 50 percent reduced turn-off losses › Performance coming close to GaN in hard switching applications › Use in PFC and high-end LLC
CoolMOS™ C7 CoolMOS™ G7	650 V	› Best-in-class efficiency if additional breakdown voltage needed (650 V) › Use in PFC and hard switching applications only, higher losses in resonant stages
CoolMOS™ P6 CoolMOS™ P7*	600 V	› General purpose part with excellent performance recommended for most designs in high power SMPS applications (100 W... 3 kW) › High efficiency combined with ease-of-use and low design-in effort › Suitable for both soft and hard switching applications (PFC/LLC) › Price/performance optimized for cost effective designs
CoolMOS™ CFD2	650 V	› Fast body diode with fastest recovery time on the market › Very low ringing and voltage overshoot for ease-of-use › Ahead of competitors in mid load to full load efficiency range › Designed for ZVS/LLC

* Coming soon

www.infineon.com/coolmos

Evolution of the CoolMOS™ high power portfolio



* Existing series to be preferred until relevant parts of the new CoolMOS™ 7 series are available

› The CoolMOS™ high power portfolio has evolved continually along three main lines of products:
  – **C-series:** highest efficiency and lowest switching losses are covered by the C-series. Our CoolMOS™ C7 can bring up to 0.7 percent efficiency gain over the current industry standard, CoolMOS™ CP
  – **G-series:** even higher efficiency versus CoolMOS™ C7 series, with ~15 percent reduced gate charge and switching losses
  – **P-series:** the general purpose segment requires high efficiency, but also good ease-of-use in terms of ringing, EMI and controllability via R_G, as well as an attractive price. This segment is addressed with CoolMOS™ P6, offering performance and cost benefit over CoolMOS™ C3 and CoolMOS™ C6/E6
  – **CFD-series:** topologies which require a fast body diode such as ZVS and LLC are addressed with the CoolMOS™ CFD-series. The CoolMOS™ CFD2 comes with significant benefits in full load, and the fastest reverse recovery time in the industry
› Active (older) CoolMOS™ product families – to be continued in production for an extended period of time.
  – Older CoolMOS™ generations like C3, CP, C6 and CFD, will be continued for an extended period of time. In special cases, their properties offer an excellent fit to a particular design, while for the majority of applications the newer series offer higher customer value at lower price

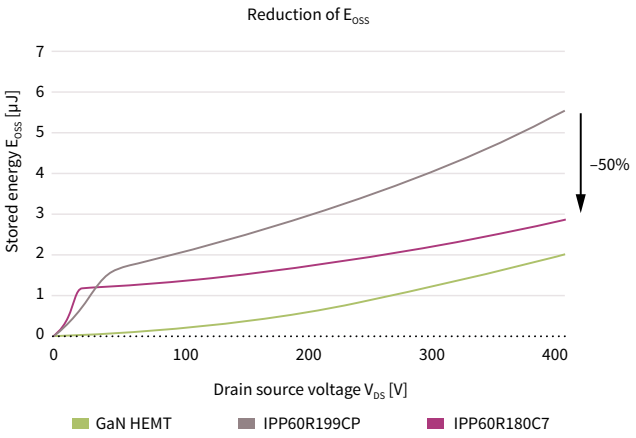
Active CoolMOS™ product families ACTIVE

Product name	Voltage	Benefits
CoolMOS™ CP	500 V 600 V	› High efficiency, fast switching up to 100 kHz › PFC as main application › Replaced by C7 with better efficiency and better price
CoolMOS™ C6/E6	600 V 650 V	› General purpose use with good ease-of-use an low EMI › PFC/LLC/FB applications › Replaced by P6 with better efficiency and better price
CoolMOS™ C3	500 V 600 V 650 V 800 V 900 V	› General purpose use with excellent ease-of-use an low EMI › Premium price for highest ruggedness › PFC/LLC/FB general purpose use
CoolMOS™ CFD	600 V	› Fast body diode part for ZVS and LLC › Replaced by CFD2 with better efficiency and better price

www.infineon.com/coolmos

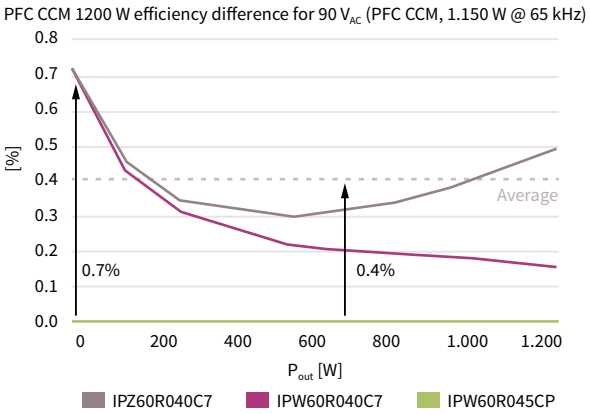
600 V CoolMOS™ C7 series

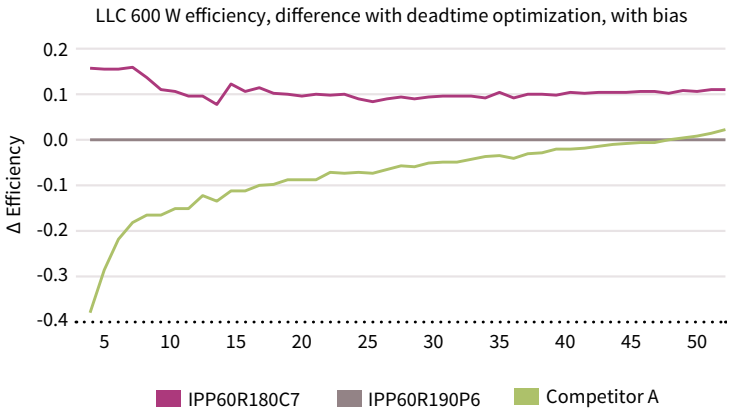
Highest efficiency superjunction MOSFET for hard and soft switching applications (PFC and LLC)



The new 600 V CoolMOS™ C7 series from Infineon offers approximately 50 percent reduction in turn-off losses (E_{oss}) compared to the CoolMOS™ CP. It offers a GaN-like level of performance in PFC, TTF and other hard-switching topologies and extends the use of silicon MOSFETs to the next generation of highest efficiency power designs.

CoolMOS™ C7 offers best-in-class performance in PFC and LLC topologies





CoolMOS™ C7 offers gains of 0.3 percent to 0.7 percent in PFC stages versus its predecessor CoolMOS™ CP. Further efficiency gains can be realized in highest power designs with the TO-247 4pin package. On average, CoolMOS™ C7 with TO-247 4pin package boosts efficiency by 0.4 percent. In the case of a 2.5 kW server PSU, for example, use of 600 V CoolMOS™ C7 MOSFETs in a TO-247 4pin package can result in energy cost reductions of approximately 10 percent. Furthermore, 600 V CoolMOS™ C7 is well suited for high-end LLC stages due to its rugged body diode that withstands slew rates up to 20 V/ns. Here, efficiency gains versus CoolMOS™ P6 of approximately 0.1 percentage are observed.

Customer benefits – higher efficiency or BOM cost reduction

Customers can use the high performance of 600 V CoolMOS™ C7 in two distinct ways:

- **In efficiency driven applications** the reduced switching losses boost efficiency and translate into lower thermal losses and lower power consumption. Ideally, the CoolMOS™ C7 efficiency is further boosted by using a package with a Kelvin source (TO-247 4pin or ThinPAK 8x8).
- **BOM cost driven applications** can use the efficiency gains for increasing the switching frequency, which allows to reduce the cost of the magnetic components by up to 35 percent.

www.infineon.com/600V-C7

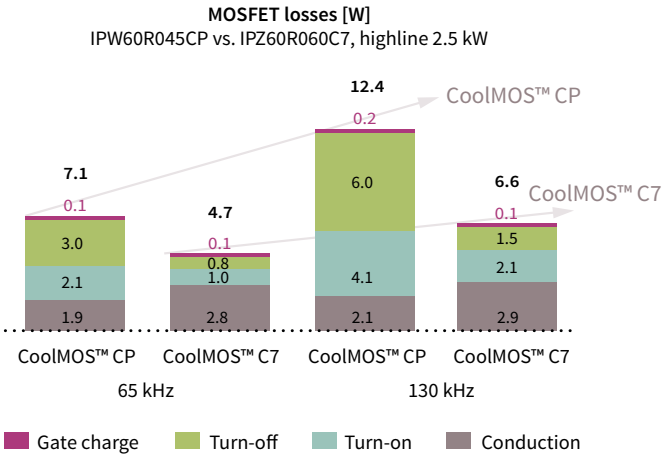
Key features

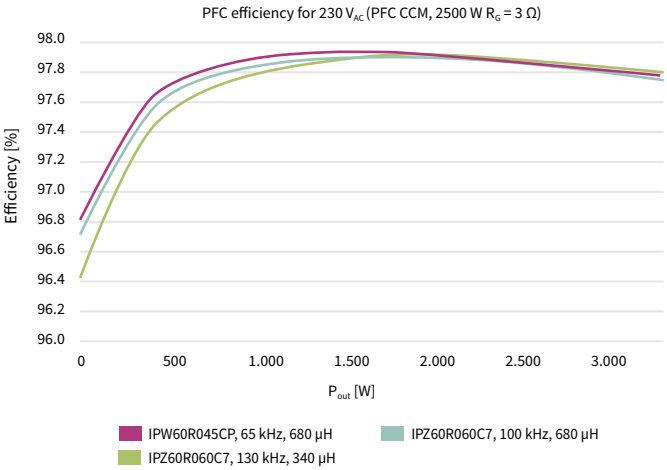
- Reduced switching loss parameters such as Q_G, C_{OSS}, enabling higher switching frequency
- 50% E_{oss} reduction compared to older CoolMOS™ CP technology and close to GaN
- Lowest $R_{DS(on)}$ * A in the world (<1 Ω.mm²)
- Suitable for high-end resonant topologies

Key benefits

- Doubling the switching frequency will reduce the size and cost of magnetic components (e.g. 65 kHz -130 kHz)
- Increased efficiency in hard switching topologies such as PFC and TTF
- Smaller packages for same $R_{DS(on)}$ lead to power density benefits
- Suitable for high-end LLC circuits

Increasing switching frequencies without penalty

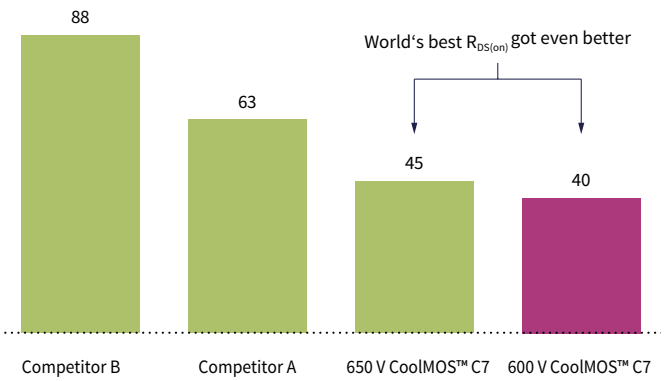




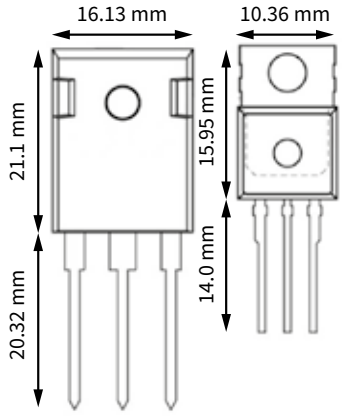
In designs based on 600 V CoolMOS™ C7 switching frequencies can be increased by up to two times with very limited penalty. This is possible due to the 50 percent reduction of turn-off losses in CoolMOS™ C7. Switching losses in a 600 V CoolMOS™ C7 based design at 130 kHz are lower than in a CoolMOS™ CP based design at 65 kHz (see figure above).
A further loss reduction is achieved when the CoolMOS™ C7 is used in a package with Kelvin source (e.g. TO-247 4pin or ThinPAK 8x8): the higher full load efficiency provided by the 4pin package can be used to increase $R_{DS(on)}$ by on step (e.g. from 40 to 70 mΩ). As a result, light load switching losses decrease even further.

New best-in-class package options

600 V CoolMOS™ C7 comes with the lowest $R_{DS(on)}$ in TO-220/TO-262/TO-263



Customer benefit – space savings



The 600 V CoolMOS™ C7 offers new best-in-class $R_{DS(on)}$ values in TO-220/TO-262/TO-263 packages – a 36 percent lower on-state resistance versus to the nearest competitor is realized. The smaller package offers a 50 percent cross section reduction compared to TO-247, opening ways toward higher power density. Also in TO-247 package, a new record in form of a 17 mΩ die is achieved.

www.infineon.com/600V-C7

650 V CoolMOS™ C7 series

Highest efficiency MOSFET for hard switching applications

The CoolMOS™ C7 series brings a new level of performance in hard switching applications such as power factor correction (PFC) when additional 50 V of breakdown voltage is needed versus 600 V CoolMOS™ C7. It provides efficiency benefits across the whole load range through balancing a number of key parameters. The best-in-class $R_{DS(on)}$ leads to increased full load efficiency and enables power density benefits by using smaller packages for the same $R_{DS(on)}$. The E_{oss} reduction brings efficiency benefits at light load and the low Q_G correlates to faster switching. The very low E_{oss} and Q_G are the two key parameters in enabling no efficiency loss when moving up in switching frequency. This also enables power density benefits by reducing the size of the circuits magnetic components.

Key features

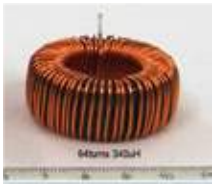
- Revolutionary best-in-class $R_{DS(on)}$ /package
- Reduced energy stored in output capacitance E_{OSS}
- Low gate charge Q_G

Key benefits

- Lowest conduction loss/package
- Power density by use of smaller packages
- Low switching losses
- Enabler to power density by not losing efficiency at higher switching frequencies
- Improved light load efficiency

Power density – increased switching frequency

CoolMOS™ C7 is an enabler technology that gives customers the stepping stone to new higher switching frequency technologies like GaN but with the proven reliability of superjunction technology.

Parameter	Competitor A	Competitor B	CoolMOS™ C7
$R_{DS(on)}$ [mΩ]	45	36	45
Q_G typ [nC]	143	218	93
E_{oss} [µJ]	13	27.5	11.7
	 65 kHz		 120 kHz

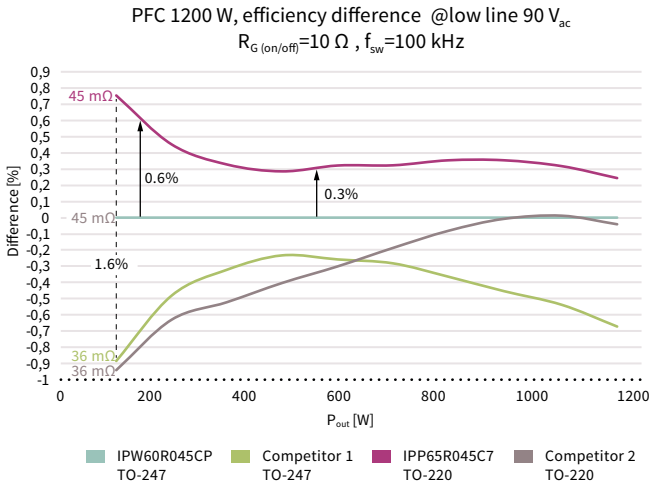
Same losses at higher frequency leads to size reduction of magnetic components for improved power density

Power density with CoolMOS™ C7

The higher up the switching frequency of an application goes, the more important parameters such as E_{oss} and Q_G become due to losses of efficiency. The very low values of these parameters in CoolMOS™ C7 minimize losses in a power factor correction (PFC) circuit – at 120 kHz the same efficiency can be reached as with the predecessor series at 65 kHz. This brings a benefit in power density because the sizes of magnetic components can be reduced.

www.infineon.com/650V-C7

Best-in-class efficiency at 650 V in the industry



Measured PFC CMM efficiency (plug and play)

650 V CoolMOS™ C7 advantage enables the customer to:

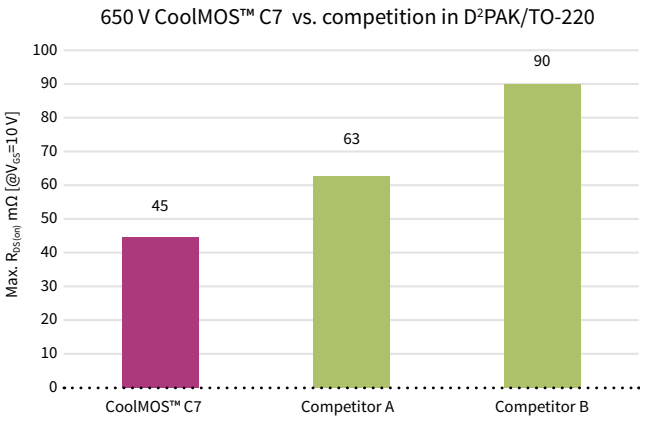
› Improve efficiency with smaller footprint and enable higher switching frequency

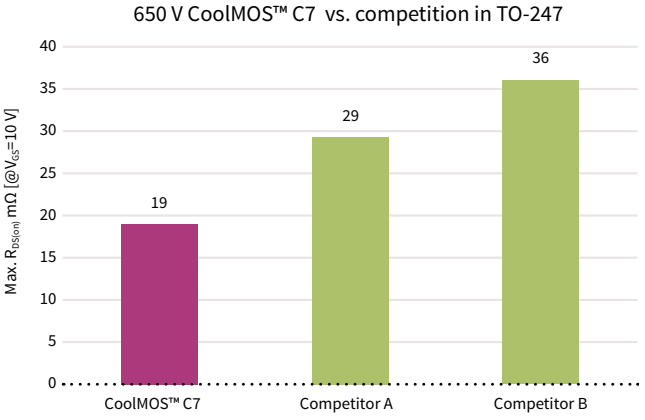
CoolMOS™ C7 offers the highest efficiency of competitor devices at the same $R_{DS(on)}$, especially at light load, the difference is remarkable. The graph shows the high efficiency when switching at 100 kHz in PFC, whereas older technologies such as CoolMOS™ CP and competitor technologies reduce in efficiency, CoolMOS™ C7 remains high. Our customers make use of this in two ways:

› **Increasing power density** – higher switching frequencies are enabled by CoolMOS™ C7. This allows for even smaller magnetic components in the circuit and thus a significantly improved form factor

› **Reduced power losses** – some customers use CoolMOS™ C7 for their highest efficiency designs. 650 V CoolMOS™ C7 allows to reduce energy consumption and offers a total cost of ownership reduction

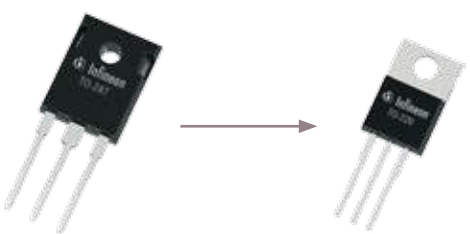
World leading area effectiveness leading to power density benefits





› Previous 45 mΩ CoolMOS™ CP in TO-247 (IPW60R045CP)

› Now 45 mΩ CoolMOS™ C7 in TO-220 (IPP65R045C7)



› World leading $R_{DS(on)}$ package
  – TO-247 package with a 34% lower $R_{DS(on)}$ than the nearest competitor
  – TO-220/D²PAK with 29% lower $R_{DS(on)}$ than the nearest competitor

› As well as improving efficiency, the new $R_{DS(on)}$ values mean a benefit in power density with the ability to now use smaller packages than ever before

www.infineon.com/650V-C7

New 600 V and 650 V CoolMOS™ C7 Gold in TO-Leadless package (G7 series)

The perfect balance of high efficiency and ease-of-use

The combination of improved 650 V CoolMOS™ C7 and 600 V C7 technology (C7 Gold) plus the low parasitic inductance from both the package and 4pin Kelvin source option, and the improved thermal performance of the TOLL package all add together to enable for the first time the possibility of using an surface mount (or SMD) solution in mid to high power boost or power factor correction circuits (PFC). This leads to customer benefits in both power density and manufacturing cost reduction all of with high quality and an easy to use part. The 650 V C7 Gold is optimized for hard switching topologies such as power factor correction, boost circuits or two transistor forward. The 600 V C7 Gold as well as being suitable for the above hard switching topologies, it also gives excellent performance in resonant topologies such as LLC.

Key features 600 V and 650 V C7 Gold

- Best-in-class figure of merit: $R_{DS(on)}$ x Q_G and $R_{DS(on)}$ x E_{oss}
- World's lowest $R_{DS(on)}$/package

Key benefits 600 V and 650 V C7 Gold

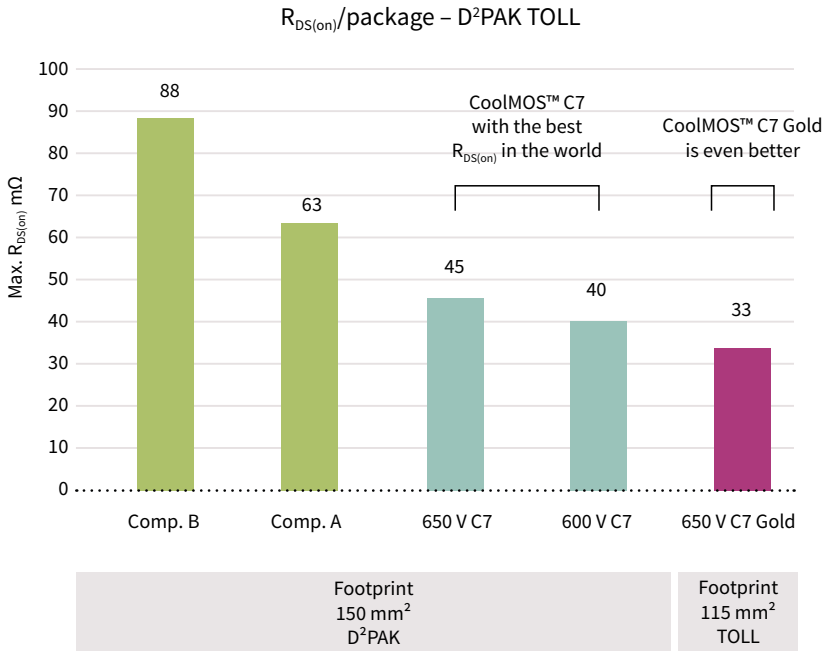
- Higher system efficiency by lower switching losses
- Improved performance and power density

TO-Leadless package

- Space reduction versus D²PAK and TO-220
- MSL1 compliant, wave and reflow solderable
- Visual inspection due to grooved leads
- 4 pin option for Kelvin source connection, low parasitic inductance
- Thermal improvement over D²PAK and similar to TO-220

TO-Leadless package

- Improved power density
- High quality and ease-of-use
- Improved manufacturing
- Improved efficiency and ease of use
- Can be used in higher current applications

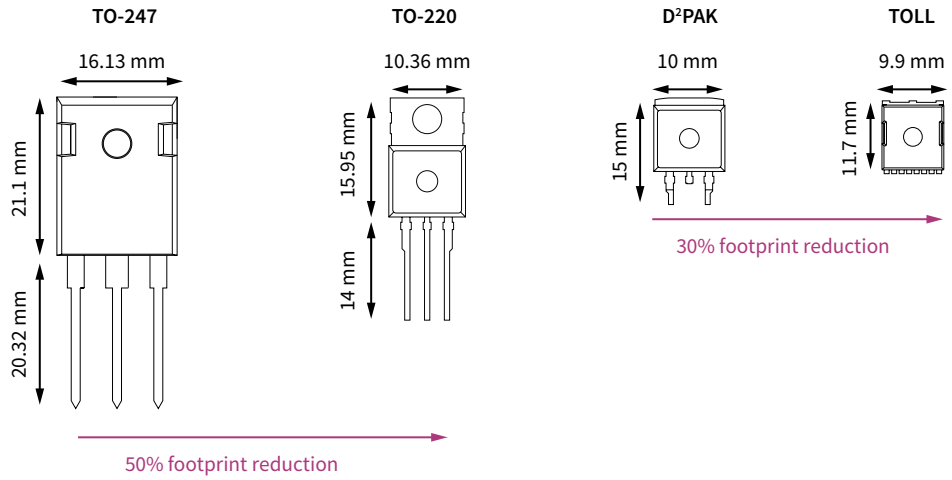


Infineon already has the best $R_{DS(on)}$ in D²PAK

Now improved again with C7 Gold and TOLL package with smaller footprint.

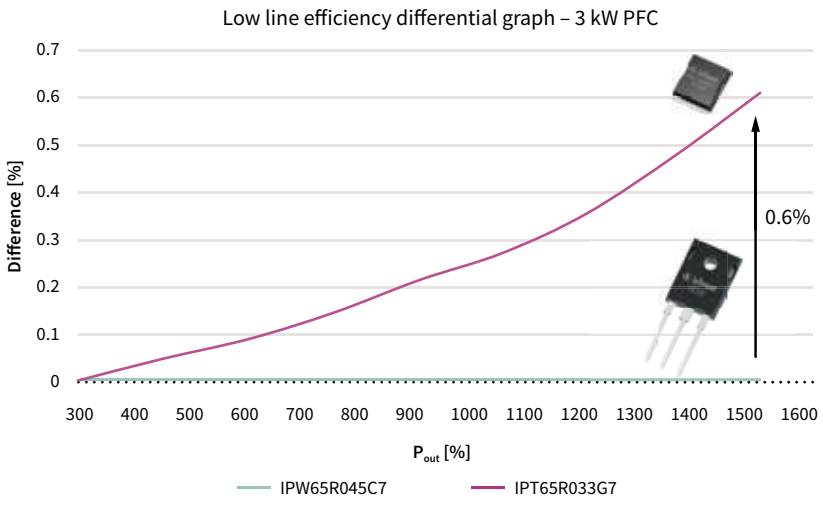
www.infineon.com/c7-gold-toll

Power density – package and $R_{DS(on)}$



Package inductance	15 nH →	10 nH →	5 nH →	1 nH
650 V CoolMOS™ C7	IPW65R019C7 19 mΩ	IPP65R045C7 45 mΩ	IPB65R045C7 45 mΩ	**IPT65R033G7** **33 mΩ**
600 V CoolMOS™ C7	IPW60R017C7 17 mΩ	IPP60R040C7 40 mΩ	IPB60R040C7 40 mΩ	**IPT60R028G7** **28 mΩ**

The parasitic source inductance that slows down the MOSFET and reduces the efficiency is linked to the length of the leads, with the long leaded TO-247 having the largest at 15 nH and the TO-Leadless having the smallest at 1 nH. The benefit of the C7 Gold technology also enables a low ohmic 28 mΩ-33 mΩ part in the TO-Leadless package.



This chart illustrates the C7 Gold technology and TO-Leadless package efficiency improvements due to:

- $R_{DS(on)}$ (45 mΩ TO-247 vs. 33 mΩ for TO-Leadless)
- Gate charge Q_G and energy stored in the output capacitor E_{oss}
- Plus the 4pin Kelvin source in the TO-Leadless package

All combine together to give a 0.6 percent higher efficiency at full load in a low line 3 kW power factor correction circuit.

www.infineon.com/c7-gold-toll

New 600 V CoolMOS™ P7

The perfect combination between high efficiency and ease-of-use

The 600 V CoolMOS™ P7 is a follower of the 600 V CoolMOS™ P6 as a general purpose part suitable for a variety of applications and power ranges and will be released in waves throughout 2017. It combines the benefits of a fast switching superjunction MOSFET with excellent ease-of-use, outstanding robustness of body diode against hard commutation and excellent ESD capability and can be used in hard switching topologies as well as in resonant topologies such as LLC. Furthermore, as part of the P-series, it offers a price/performance benefit over older product families.

The optimized integrated gate resistor enables ease-of-use in the design process and the feature of an excellent ESD robustness helps to improve the quality in manufacturing. At the same time the low $R_{DS(on)}$ and gate charge Q_G enable high efficiency in the various topologies.

The 600 V CoolMOS™ P7 has a wide variety of $R_{DS(on)}$s and packages to both industrial and consumer grade to make it suitable for applications such as server, telecom, PC, solar, lighting, adapters and TV.

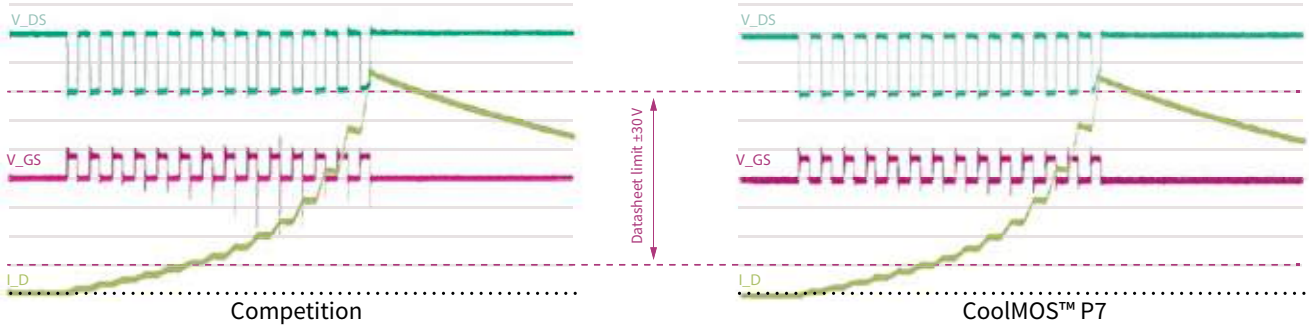
Key features

- Suitable for hard and soft switching (PFC and LLC) due to an outstanding commutation ruggedness
- Optimized balance between efficiency and ease-of-use
- Significant reduction of switching and conduction losses leading to low MOSFET temperature
- Excellent ESD robustness >2 kV (HBM) for all products
- Better $R_{DS(on)}$/package products compared to competition enabled by a low $R_{DS(on)}$*A (below 1 Ω*mm^2)
- Large portfolio with granular $R_{DS(on)}$ selection qualified for a variety of industrial and consumer grade applications according to JEDEC (J-STD20 and JESD22)

Key benefits

- Ease-of-use and fast design-in through low ringing tendency and usage across PFC and PWM stages
- Simplified thermal management due to low switching and conduction losses
- Higher manufacturing quality due to >2 kV ESD protection
- Increased power density solutions enabled by using products with smaller footprint
- Suitable for a wide variety of applications and power ranges

600 V CoolMOS™ P7 ringing



Competition CoolMOS™ P7

600 V CoolMOS™ P7 is a very smooth switching device and offers better ringing behavior than competition.

www.infineon.com/600V-p7

600 V CoolMOS™ P7 ease-of-use

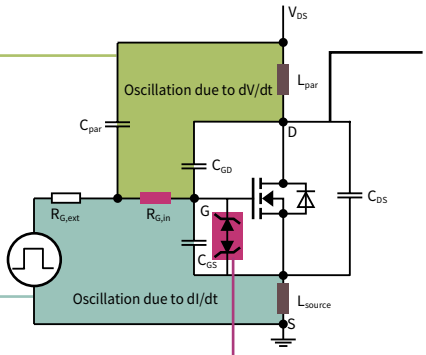
Challenges in PFC

› V_{GS} out of spec.

› High switching loss

› High device stress

→ CoolMOS™ P7 optimized for improved oscillation



Challenges in LLC

Body diode hard commutation

› High voltage overshoot

› High current spike

› High device stress

→ CoolMOS™ P7 with good commutation ruggedness

Challenges from fast switching

› EMI and oscillations from high dI/dt

→ CoolMOS™ P7 with good controllability for ease-of-use

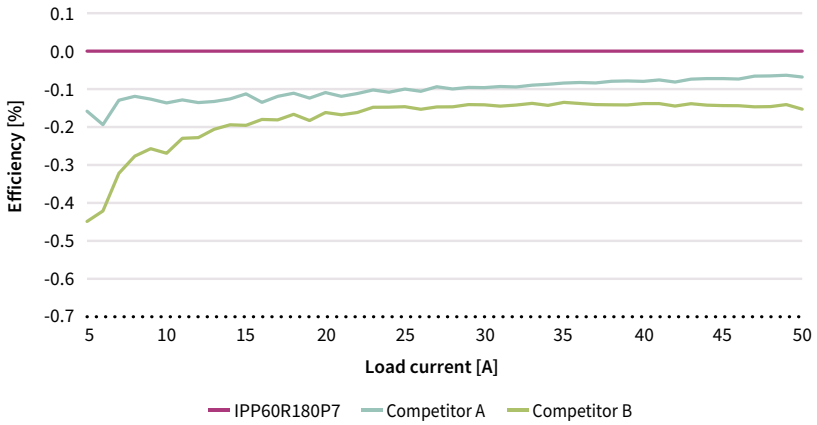
Challenges in ESD:

Protecting device from electro static discharge damage in manufacturing

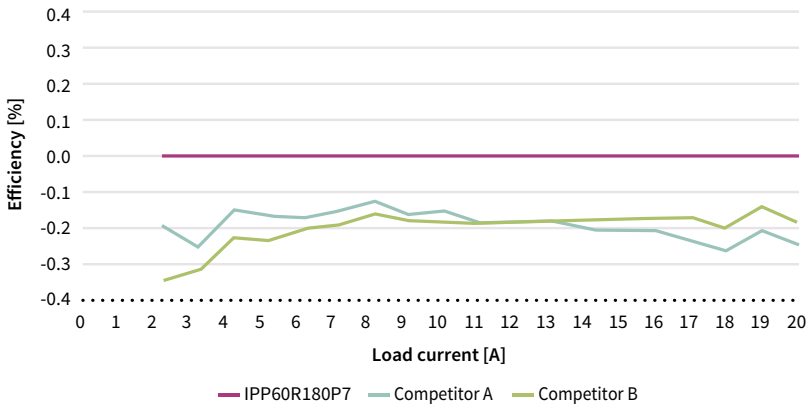
→ CoolMOS™ P7 offers an excellent ESD capability

600 V CoolMOS™ P7 efficiency

600 W LLC board
Optimized deadtime with bias



240 W PFC PC power
Full unit efficiency low line 90 V_{AC}



The 600 V CoolMOS™ P7 enables high efficiency in both hard switching power factor correction circuit and resonant LLC circuit.

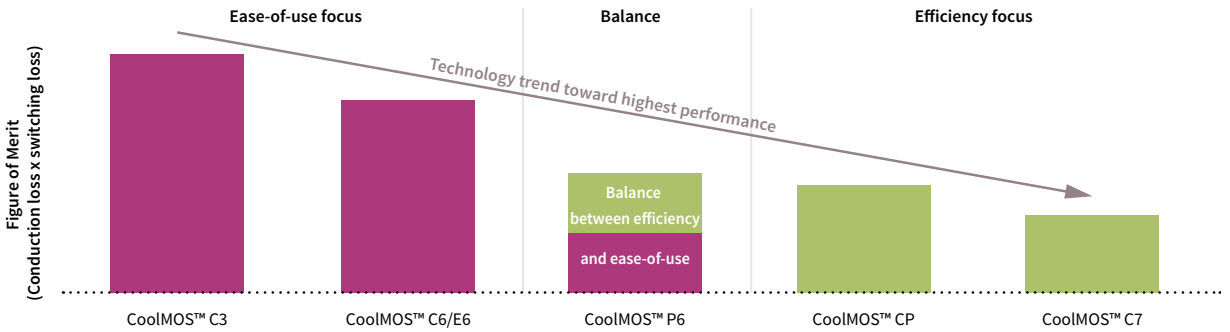
Its wide $R_{DS(on)}$ range from 37 mΩ to 600 mΩ in both surface mount and through hole packages makes it suitable for a wide variety of applications.

www.infineon.com/600V-p7

600 V CoolMOS™ P6 series

Superior efficiency combined with ease-of-use

600 V CoolMOS™ P6 is a general purpose part suitable for most high power applications, which require excellent performance, yet also a high level of ease-of-use in the design-in process. The successor for 600 V CoolMOS™ P6 is the 600 V CoolMOS™ P7 that will be released part by part throughout 2017. CoolMOS™ P6 is suitable for both soft and hard switching applications due to its good body diode ruggedness. Optimizations such as Q_G, V_{th}, E_{on}, and E_{off} enable its superior efficiency, while its ease-of-use feature is attributed to the optimized dV/dt (dI/dt) controllability, internal R_G, and improved oscillation behavior. CoolMOS™ P6 achieves very low conduction and switching losses especially in light load condition, enabling switching applications to work more efficient and be designed more compact, lighter and cooler. Moreover, with its granular portfolio, CoolMOS™ P6 addresses the specific needs of applications such as server, pc power, telecom rectifiers and consumer applications, meanwhile offers the best price/performance ratio on the market today.



CoolMOS™ P6 is optimized for ease-of-use and addresses typical design challenges in high power SMPS while offering best-in-class efficiency on a level close to CoolMOS™ CP:

- CoolMOS™ P6 offers good **controllability** for managing dV/dt (dI/dt) and EMI: with an external gate resistor $R_{G,ext}$ the switching speed can be controlled very well offering the power system designer high flexibility in balancing efficiency versus EMI
- CoolMOS™ P6 is optimized for **improved oscillation**: parasitic capacitances and inductances in the PCB often lead to unstable designs. CoolMOS™ P6 comes with a moderate internal R_G providing ease-of-use in the design-in process, yet without reducing switching speed and efficiency (CoolMOS™ P6 is at the level of CoolMOS™ CP)
- CoolMOS™ P6 is **suitable for LLC due to its rugged body diode**: CoolMOS™ P6 has a commutation ruggedness sufficient for LLC applications. Combined with its best-in-class efficiency in LLC this makes CoolMOS™ P6 a premier choice for this topology

Features

- Reduced gate charge (Q_G)
- Optimized V_{th} for soft switching
- Good body diode ruggedness
- Optimized integrated R_G
- Improved dV/dt

Benefits

- Improved efficiency in light load condition
- Better efficiency in soft switching applications due to earlier turn-off
- Suitable for hard and soft switching topologies
- Excellent ease-of-use and good controllability of switching behavior
- High robustness, better efficiency
- Outstanding quality and reliability

www.infineon.com/p6

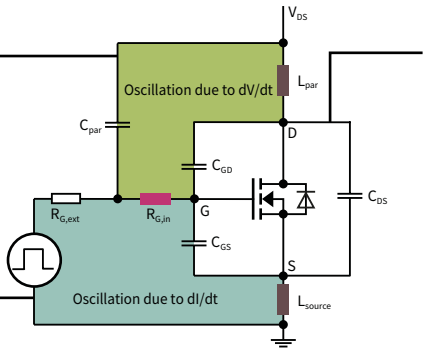
CoolMOS™ P6 is optimized for ease-of-use and addresses typical design challenges

Challenges in PFC

› V_{GS} out of spec.
› High switching losses
› High device stress
→ CoolMOS™ P6 optimized for improved oscillation

Challenges from fast switching

› EMI and oscillations from high dI/dt
→ CoolMOS™ P6 with good controllability for ease-of-use

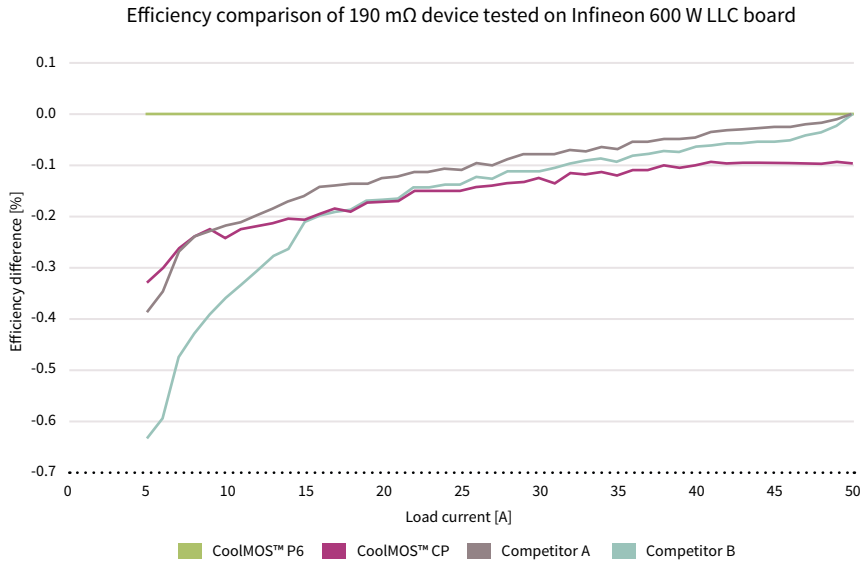


Challenges in LLC

› Body diode hard commutation
› High voltage overshoot
› High current spike
› High device stress
→ CoolMOS™ P6 with good commutation ruggedness

L_{par}: Layout parasitic inductance
C_{par}: Layout parasitic capacitance

LLC – CoolMOS™ P6 with best-in-class performance

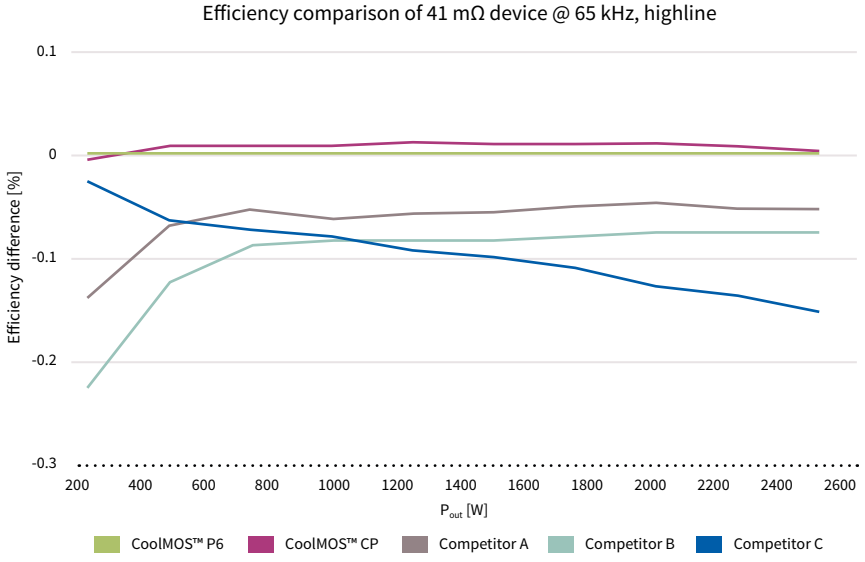


CoolMOS™ P6 shows the best-in-class efficiency over full load range especially at the light load conditions thanks to its low Q_G and higher V_{th}. Main competitor products are at the level of below CoolMOS™ P6 or lower than CoolMOS™ C6.

CoolMOS™ P6 sets benchmark in LLC efficiency

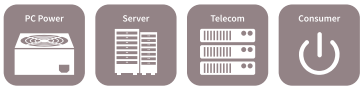
› Low Q_G improves the light load efficiency
› Higher V_{th} improves efficiency due to lower turn-off losses

PFC – CoolMOS™ P6 offers CP-like performance



The efficiency of CoolMOS™ P6 is at the level of CoolMOS™ CP and well ahead of competitors while offering much better ease-of-use. This graph shows the PFC efficiency difference at highline for 41 mΩ device tested on 2500 W board.

› CoolMOS™ P6 reaches similar performance as CoolMOS™ CP
› CoolMOS™ P6 efficiency one step ahead of competitors

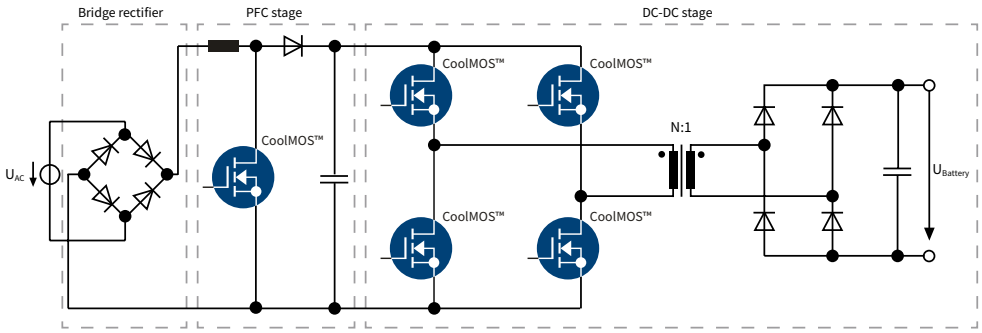


www.infineon.com/p6

CoolMOS™ CFD2 series with fast body diode

Balance between efficiency and robustness with fast body diode

A recent trend in high power conversion is the move toward higher and higher power density. High power density can be achieved best by resonant switching topologies such as zero voltage or zero current switching, which enable higher efficiency by eliminating the turn-on losses.

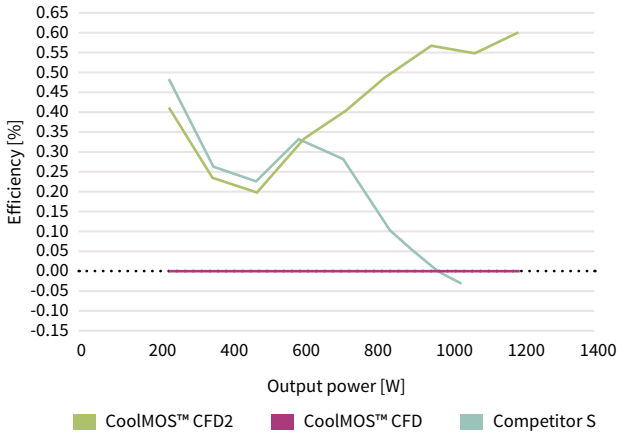


Example of a ZVS based power converter using CoolMOS™ CFD2

CoolMOS™ CFD2 is Infineon's latest series with an integrated fast body diode. It is the ideal choice for high power applications such as in telecom and server markets, in which high efficiency levels need to be reached while not compromising on highest reliability and ease-of-use.

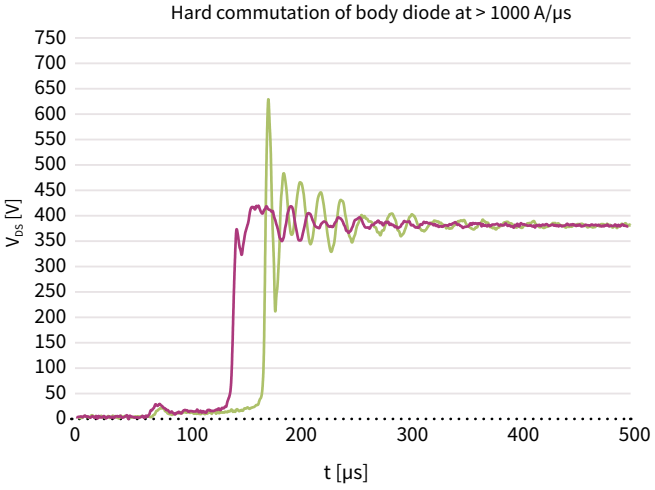
Higher efficiency performance in mid-load to full-load conditions

CoolMOS™ CFD2 offers efficiency benefits of up to 0.6 percent over competing products in the critical range of mid-load to full-load conditions. This characteristic is found throughout parts of the CoolMOS™ CFD2 series and stems from reduced switching losses and the possibility to use lower external gate resistor values because of the smooth switching behavior.



Highest ease-of-use for fast design-in

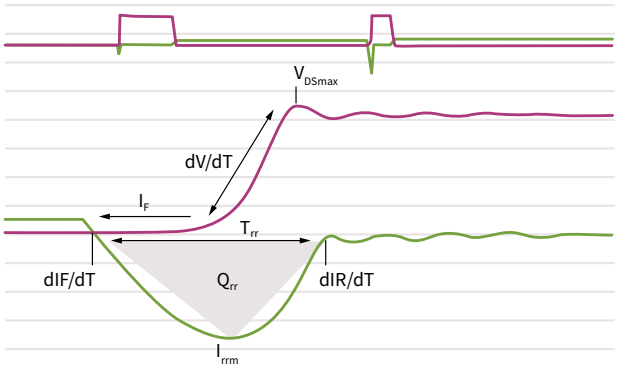
CoolMOS™ CFD2 comes with a very low voltage overshoot and minimal ringing behavior. Reduced gate spikes combined with the high safety margin of 200 V along with enable fast design-in without the need for additional ringing control. Furthermore, CoolMOS™ CFD2 offers good controllability through a broad range of $R_{G, ext.}$ values. Even at very low external R_G values low ringing is observed. As a result, the broad range of suitable R_G values offers an additional lever to increase efficiency while still withstanding typical commutation conditions.



www.infineon.com/cfd2

Highest reliability from lowest reverse recovery charge and reverse recovery time

Hard commutation prevails in ZVS topologies and requires a device with excellent fast body diode performance mainly dependent on a low Q_{rr} (reverse recovery charge) and T_{rr} (reverse recovery time) as depicted in the graph on the left.



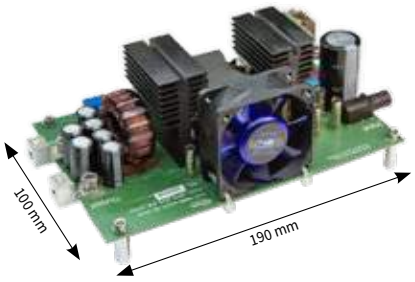
The fast reverse recovery of CoolMOS™ CFD2 offers designers the benefits of

- Reduced stress on the device while body diode is not fully recovered and
- Extra safety margin for repetitive hard commutation in designs which translates into reduced design-in effort

ZVS phase shift full-bridge evaluation board available

The ZVS phase shift full-bridge evaluation board (CoolMOS™ CFD2 IPW65R080CFD) represents the new developed ZVS DC-DC converter for telecom rectifiers with an output power of 2 kW.

Specification	
V_{in}	300...420 V_{DC}
V_{in_nom}	385 V_{DC}
V_{out_nom}	45...56 V_{DC}
I_{out}	50 A
P_o	2 kW
f	100 kHz



Benefits:

- Full ZVS achieved even in the leading leg of the bridge starting from 25 percent load onwards
- Optimized primary and secondary delay times

Target applications:

- Telecom rectifiers/SMPS
- Industrial high power SMPS
- High power battery chargers

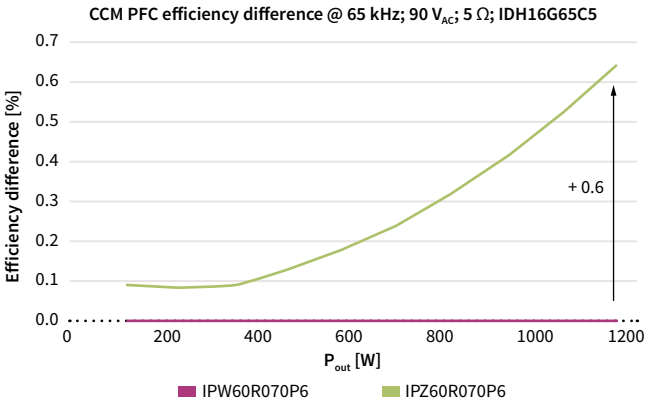
www.infineon.com/cfd2

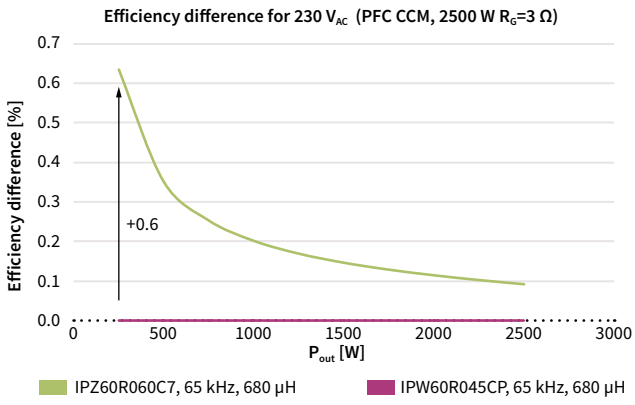
CoolMOS™ in TO-247 4pin package

A new innovative package using Kelvin source concept

Infineon Technologies introduces the new TO-247 4pin package in conjunction with the latest CoolMOS™ technologies of 600 V CoolMOS™ C7, 650 V CoolMOS™ C7 and 600 V CoolMOS™ P6. With new generations of power switches becoming faster and faster, the effect of the parasitic elements of package and board limit more and more the overall system performance. An effective measure to overcome this problem is to provide an additional connection to the source (Kelvin connection), that is used as a reference potential for the gate driving voltage, thereby eliminating the effect of voltage drops over the source inductance. The achievable efficiency improvement, resulting from faster switching transients, can in fact be significant.

Benefits in efficiency of 4pin versus 3pin variants





Performance gain of 0.6% full load efficiency can be achieved if the same die is used in a 4pin versus a 3pin package

- Better full load efficiency

Lower full load losses with 4pin part allow for next 'smaller' MOSFET (60 mΩ instead of 45 mΩ) enabling a customer to have BOM cost reduction from the smaller MOSFET $R_{DS(on)}$ with better low load efficiency:

- Low BOM cost
- Better light load efficiency

Features and benefits of the 4pin package for CoolMOS™ C7

Features

- 4th pin (Kelvin source)
- Increased creepage distance between high voltage pins
- Gate signal optimization

Benefits

- Reduces parasitic source inductance effects on the gate circuit enabling faster switching and increased efficiency
- Using benefits of Kelvin source efficiency to increase MOSFET $R_{DS(on)}$ and reduce BOM cost
- Creepage distance meets 5000 m altitude requirement
- Easier to design by customer

www.infineon.com/to247-4

CoolMOS™ high power selection by application requirement and topology

Highest efficiency – fastest switching (≥100 kHz)

PFC	LLC	ZVS PS
600 V CoolMOS™ C7 650 V CoolMOS™ C7 600 V CoolMOS™ C7 Gold 650 V CoolMOS™ C7 Gold	600 V CoolMOS™ C7 600 V CoolMOS™ C7 Gold Partly: 650 V CoolMOS™ CFD2[2)]	650 V CoolMOS™ CFD2
500 V CoolMOS™ CP 600 V CoolMOS™ CP	N/A	N/A

High efficiency – ease-of-use

PFC	LLC	ZVS PS
600 V CoolMOS™ P6 600 V CoolMOS™ P7 Partly: 650 V CoolMOS™ C6[1)]	600 V CoolMOS™ P6 600 V CoolMOS™ P7 Partly: 650 V CoolMOS™ CFD2[2)]	650 V CoolMOS™ CFD2
600 V CoolMOS™ C6 650 V CoolMOS™ C3 800 V CoolMOS™ C3 900 V CoolMOS™ C3	600 V CoolMOS™ C6 800 V CoolMOS™ C3 900 V CoolMOS™ C3	600 V CoolMOS™ CFD

Automotive applications

PFC	LLC	ZVS PS
600 V CoolMOS™ CPA 800 V CoolMOS™ C3A	650 V CoolMOS™ CFDA	650 V CoolMOS™ CFDA

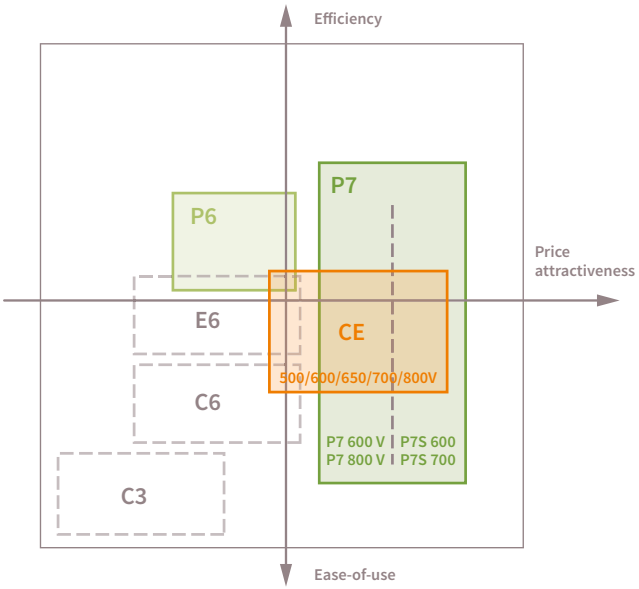
Active & preferred part
Active part

[1)] Where 650 V breakdown voltage is needed
[2)] Where fast body diode is needed

www.infineon.com/coolmos

CoolMOS™ for low power SMPS (<150 W)

Efficiency accessible at an attractive price



In low power SMPS, high voltage superjunction MOSFETs address applications such as smartphone/tablet chargers, notebook adapters, TV sets and LED lighting et al. Increasingly, customers replace standard MOSFETs by superjunction MOSFETs to benefit from higher efficiency and an attractive cost-down roadmap going forward. In many designs, a trade-off decision between highest efficiency, good ease-of-use (typically EMI) and an attractive cost position needs to be made. The CoolMOS™ portfolio for low SMPS offers a number of choices for power engineers.
For new designs in low power SMPS design Infineon recommends CoolMOS™ P7, P6 and CoolMOS™ CE.

600 V/700 V/800 V CoolMOS™ P7 – latest technologies for SMPS low power applications

The CoolMOS™ P7 series target customers looking for high performance and at the same time being price sensitive. The 700 V and 800 V CoolMOS™ P7 series target flyback based low power SMPS applications; while 600 V CoolMOS™ P7 can be used in both soft and hard switching topologies including PFC, flyback, LLC, TTF, et al. They fully address market concerns in performance, ease-of-use and price/performance ratio, delivering best-in-class performance with exceptional ease-of-use, while still not compromising the price/performance ratio. The 600 V CoolMOS™ P7 is designed to replace CoolMOS™ P6, for parts which are not ready yet with CoolMOS™ P7 then CoolMOS™ P6 is recommended for its high performance and ease-of-use. CoolMOS™ P7 is an advanced product which offers specific customer benefits.

CoolMOS™ CE – efficiency, cost effectiveness and part availability in focus

Good efficiency, ease-of-use and EMI performance at an attractive cost position make the CoolMOS™ CE series the product of choice for many low power applications such as flyback-based adapters and also PFC and LLC. CoolMOS™ CE offers benefits in efficiency and thermal behavior versus standard MOSFETs.

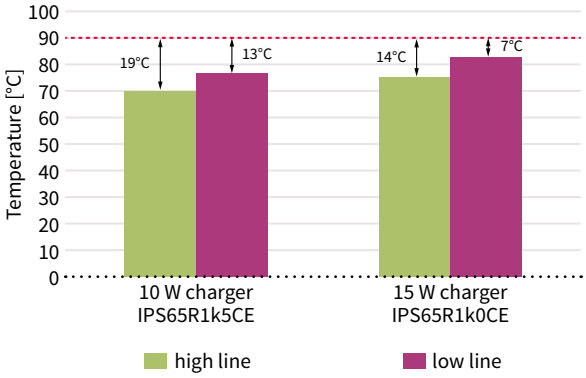
CoolMOS™ CE is designed for the consumer market and is developed to be easy to design-in.

www.infineon.com/coolmos

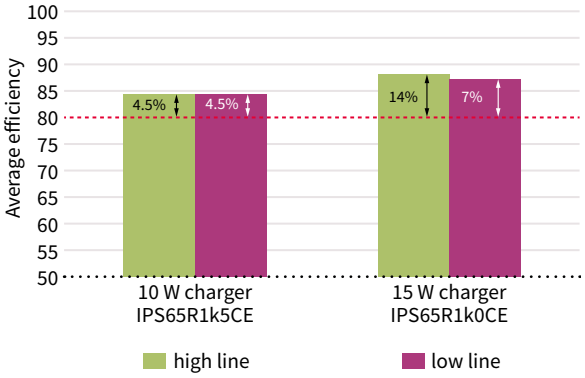
CoolMOS™ CE series

CoolMOS™ CE: application example smartphone charger

CoolMOS™ CE meets typical MOSFET
case temperature requirements in charger application



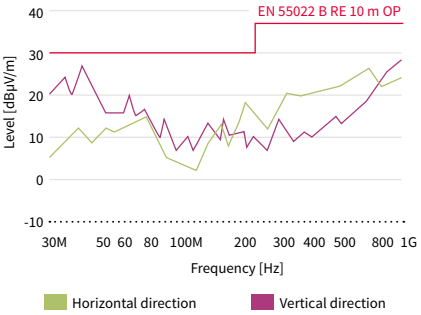
CoolMOS™ CE meets the standard
efficiency requirements in charger application



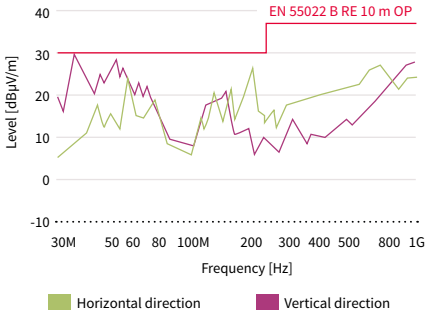
This figure shows the CoolMOS™ CE case temperature in 10 W and 15 W charger applications. The maximum MOSFET case temperature is required to be below 90°C. CoolMOS™ CE could easily meet this requirement while still offering enough margin required by design-in flexibilities.

This figure shows the CoolMOS™ CE efficiency performance in 10 W and 15 W charger applications. CoolMOS™ CE could easily meet the 80 percent standard efficiency requirement while still offer enough margin required by design-in flexibilities.

10 W design: IPS65R1K5CE
EN 55022 B radiated HF-field
30 MHz – 1 GHz position



15 W design: IPS65R1K0CE
EN 55022 B radiated HF-field
30 MHz – 1 GHz position



This figure shows the CoolMOS™ CE EMI performance in 10 W and 15 W charger applications. Maximum EMI limits are indicated in the figure. CoolMOS™ CE could meet the EMI requirement thus offering design in flexibilities

Further reasons to choose CoolMOS™ CE

Non-technical benefits provided by CoolMOS™ CE	
Product portfolio	We own a broad portfolio covering five voltage classes in both through-hole and SMD packages and exceed by more than three times our closest competitor
Capacity	We own the world largest capacity for power devices, with three dedicated frontends, and four backends We secure supply during market upswing, for example from constant invests in our own production facilities
Lead time	We understand consumer and lighting market's dynamics and offer lead time as short as 4-6 weeks
Delivery performance	Our supply chain performance is constantly more than or equal to 96 percent (keeping customer commit date)
Quality	Our field failure rates are as low as 0.1 PPM
Design-in support	We have a large field application engineering team to provide professional and flexible support for your design

www.infineon.com/ce

New 800 V CoolMOS™ P7 series

A new benchmark in efficiency and thermal performance

800 V CoolMOS™ P7: overview

The latest 800 V CoolMOS™ P7 series sets a new benchmark in 800 V superjunction technologies and combines best-in-class performance with state-of-the-art ease-of-use. This new product family is a perfect fit for flyback based low power SMPS applications, fully addressing market needs in performance, ease-of-use, and price/performance ratio. In addition this product family could also be used in PFC stage for solar and consumer applications.

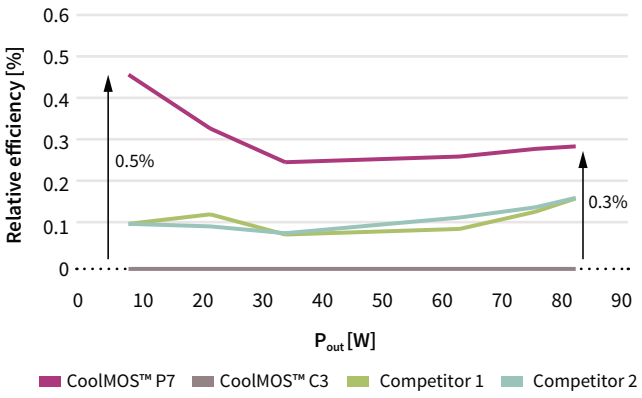
800 V CoolMOS™ P7: best-in-class performance

CoolMOS™ P7 has been fully optimized in key parameters to deliver best-in-class efficiency and thermal performance, in addition it also sets a new benchmark in lowest $R_{DS(on)}$ in DPAK enabling high power density and cost saving.

Key parameter comparison for P7 and its superjunction competitors

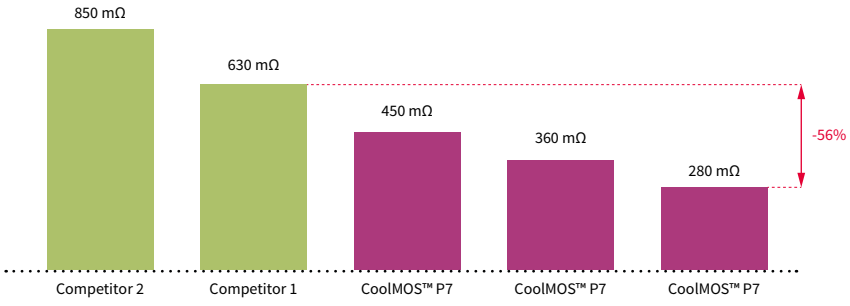
Parameter	P7	Competitor 1	Competitor 2	C3
TO-220 FullPAK $R_{DS(on)}$ [Ω]	0.45	0.45	0.4	0.45
Q_G [nC]	24	29	43	64
E_{oss} [uJ]	2.7	6.3	4.9	6.1
C_{iss} [pF]	770	860	1813	1583
C_{oss} [pF]	14	35	24.7	32

Plug and play in an 80 W LED driver from market



As shown in table above, for key parameters related to performance there is a significant improvement for CoolMOS™ P7 as compared to competitors: over 45 percent reduction in E_{OSS}, and C_{OSS} as well as significant improvement in C_{iss} and Q_G. These improvements lead to best-in-class efficiency and thermal performance as demonstrated by test results on an 80 W LED driver bought on the market. CoolMOS™ P7 delivers 0.5 percent better efficiency at light load which helps to reduce standby power. At full load 6°C better thermal has been observed due to better efficiency of 0.3 percent.

Overview of lowest DPAK $R_{DS(on)}$ for 800 V superjunction MOSFET



CoolMOS™ P7 sets a new benchmark in best-in-class DPAK $R_{DS(on)}$

Customer benefits:

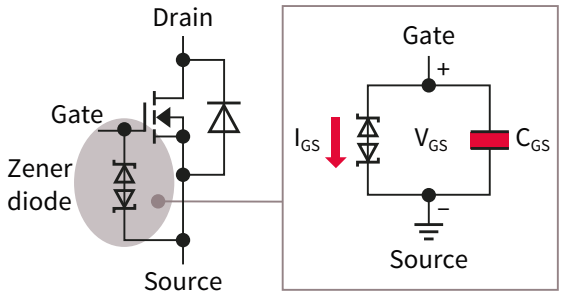
- High power density
- Lower BOM cost
- Less production cost

www.infineon.com/800V-p7

800 V CoolMOS™ P7: state-of–the-art ease-of-use

CoolMOS™ P7 delivers exceptional ease-of-use. The integrated Zener diode ESD protection ensures ESD ruggedness up to class 2 for HBM mode, while $V_{GS(th)}$ optimization makes CoolMOS™ P7 easy to drive and to design-in. In addition, CoolMOS™ P7 is also EMI friendly.

CoolMOS™ P7 integrated Zener diode ESD protection



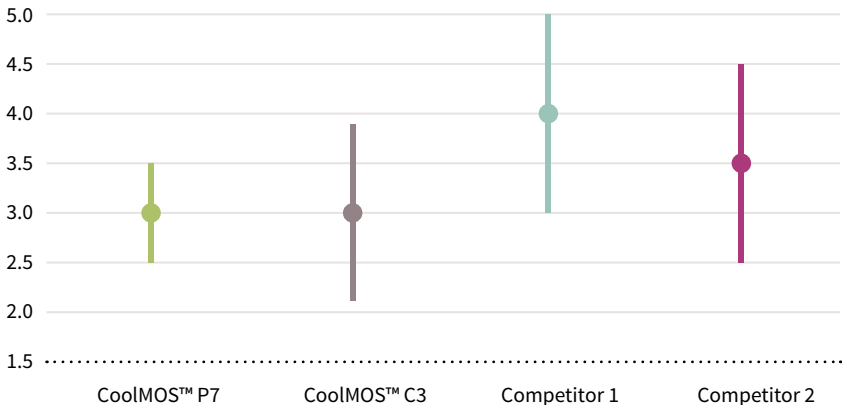
CoolMOS™ P7 ESD robustness

HBM: › 2 Ω-4.5 Ω: class 1C (1 kV-2 kV)
› 0.28 Ω-1.4 Ω: class 2 (2 kV-4 kV)

CDM: Class C3 (≥1 kV)

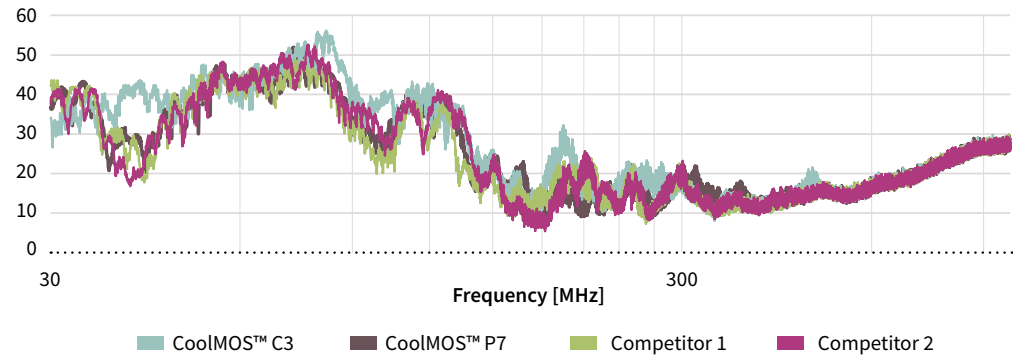
CoolMOS™ P7 integrated Zener diode reduces ESD related failures, thus improves quality and reliability. During the ESD event V_{GS} is clamped and current also mainly flows through the Zener diode, by this way the possibility to overstress gate oxide is limited.

800 V CoolMOS™ P7 $V_{GS(th)}$ and its deviation [V]



As compared to competitors CoolMOS™ P7 comes with lowest $V_{GS(th)}$ of 3 V, at the same time it offers lowest $V_{GS(th)}$ deviation of +/-0.5 V. The lowest $V_{GS(th)}$ ensures CoolMOS™ P7 lowest driving losses and avoiding linear mode operation. In addition the best $V_{GS(th)}$ tolerance guarantees best MOSFET consistency and thus, more design-in freedom.

800 V CoolMOS™ exceptional EMI performance



EMI is a system level topic and the optimization should be done on system level. A plug and play test on an Infineon 45 W adapter reveals that CoolMOS™ P7 shows similar EMI performance as compared to market offers.

www.infineon.com/800V-p7

New 700 V CoolMOS™ P7 series

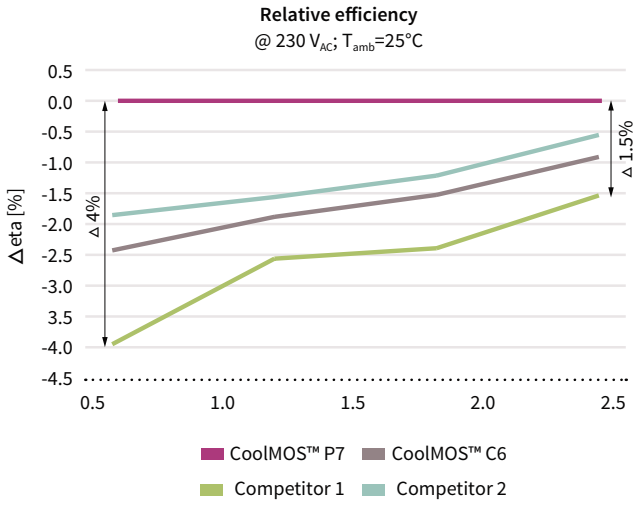
Our answer for flyback topologies

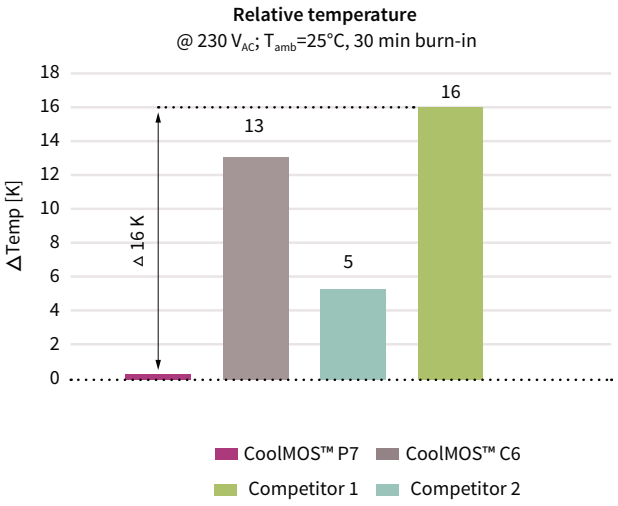
The new 700 V CoolMOS™ P7 series has been developed to serve today's and especially tomorrow's trends in flyback topologies. The technology addresses the low power SMPS market, mainly focusing on mobile phone chargers and notebook adapters but suitable for power supplies used within lighting applications, home entertainment (TV, game consoles or audio) as well as auxiliary power supplies.

By combining customers feedback with over 20 years of superjunction MOSFET experience, 700 V CoolMOS™ P7 comes with fundamental performance gains compared to similar technologies used today. It enables best fit for target applications in terms of:

- Efficiency and thermals
- Ease-of-use
- EMI behavior

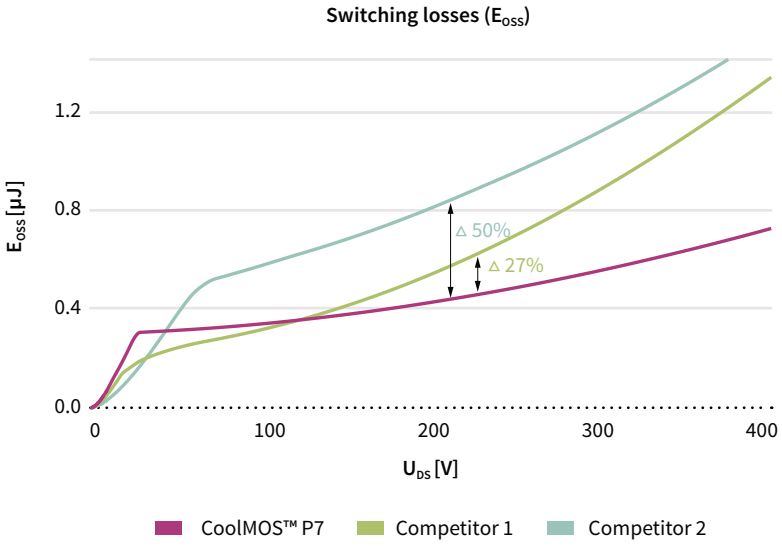
700 V CoolMOS™ P7 convinces with outstanding efficiency gains of up to 4 percent and impressively up to 16 K lower device temperature against competition. Compared to previous 650 V CoolMOS™ C6 technology it offers 2.4 percent gain in efficiency and 12 K lower device temperature, measured at a flyback based charger application, operated at 140 kHz switching speed.



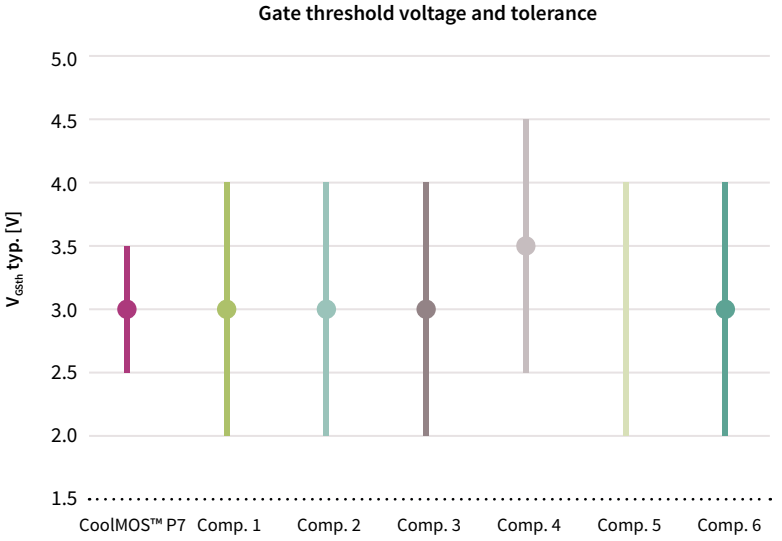


These measurements underpin, that the new P7 platform is the right choice for high power density designs and very slim form factors. 700 V CoolMOS™ P7 results in best-in-class product performance especially when operating at high switching frequencies.

www.infineon.com/700V-p7



With the new technology Infineon made it happen to lower the switching losses (E_{OSS}) in a range of 27 percent to 50 percent whilst still fulfilling all required EMI regulations.



Keeping the ease-of-use in mind, Infineon kept an eye of launching the technology with a low $V_{GS(th)}$ of 3 V and a very narrow tolerance of ±0.5 V. This makes the P7 easy to design-in and enables the usage of lower gate source voltage, which makes it easy to drive and leads to less idle losses. To increase the ESD ruggedness up to HBM Class 2 level, 700 V CoolMOS™ P7 has an integrated Zener diode. This helps to support increased assembly yield, leads to less production related failures and finally manufacturing cost savings on customer side.

Key features

- Extremely low FOM $R_{DS(on)}$ x E_{oss}; lower Q_G, E_{on} and E_{off}
- Highly performant technology
  - Low switching losses (E_{OSS})
  - Highly efficient
  - Excellent thermal behavior
- Allowing high speed switching
- Integrated protection Zener diode
- Optimized $V_{GS(th)}$ of 3 V with very narrow tolerance of ±0.5 V
- Finely graduated portfolio

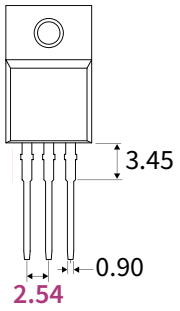
Key benefits

- Cost competitive technology
- Up to 2.4 percent efficiency gain and 12 K lower device temperature compared to C6 technology
- Further efficiency gain at higher switching speed
- Supporting less magnetic size with lower BOM costs
- High ESD ruggedness up to HBM class 2 level
- Easy to drive and design-in
- Enabler for smaller form factors and high power density designs
- Excellent choice in selecting the best fitting product

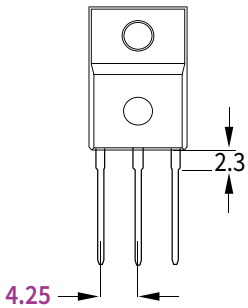
www.infineon.com/700V-p7

New TO-220 FullPAK Wide Creepage package for CoolMOS™

TO-220 FullPAK standard



TO-220 FullPAK Wide Creepage



Wider creepage for applications susceptible to pollution

The TO-220 FullPAK Wide Creepage increases the creepage distance to 4.25 mm compared to 2.54 mm for a standard TO-220 package. It fully meets requirements of the EN60664-1 standard that requires at least 3.6 mm for open frame electrical power supplies which are often found in LED TV, PC power or industrial power supplies: in these applications, air vents in the external casing to allow some air flow which will assist in cooling the internal components. This makes the inside susceptible to pollutants such as dust particles. These pollutants reduce the effective creepage between pins. High voltage arcing can destroy the MOSFET used in SMPS when the pollutants reduce the effective creepage distance.

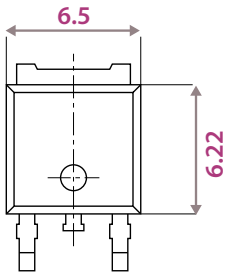
The TO-220 FullPAK Wide Creepage reduces system cost by offering an alternative to frequently used approaches to increase creepage distance: the application of potting, the usage of sleeves, pre-bending of leads and other workarounds come at an extra cost of estimated 2-5 USD cents. This cost and the additional process steps can be removed with the wide creepage package.

Benefits

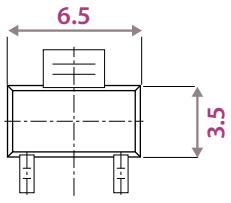
- Wide creepage of 4.25 mm to avoid arcing even in polluted environment
- Cost savings of 2-5 USD cent in creepage protection by removing additional process steps
- Fully automated PCB assembly eliminating process variation
- FullPAK benefit of isolation, lower package capacitances, lower EMI

New SOT-223 package for cost reduction in low power applications

TO-252 3pin



SOT-223 3pin



Cost reduction in low power applications

Cost improvement over DPAK

SOT-223 is an optimized package with cost benefit where Infineon shares the lowest package BOM with the customer.

Pin-to-pin DPAK replacement

SOT-223 is a one to one replacement of DPAK on footprint leading to a moderate temperature increase of 2-3°C.

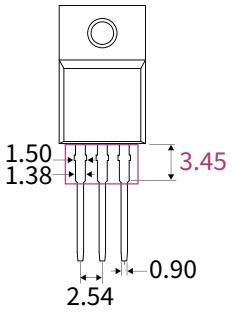
Benefits

- Cost improvement over DPAK
- With pin-to-pin compatibility
- At almost no disadvantage in thermals and efficiency

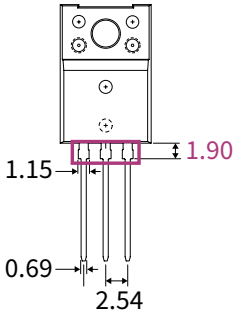
www.infineon.com/sot-223
www.infineon.com/to220-fp-widecreepage

New TO-220 FullPAK Narrow Lead package for CoolMOS™

TO-220 FullPAK standard



TO-220 FullPAK Narrow Lead



Key benefits

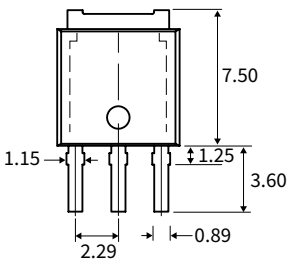
- Package can be fully inserted into PCB without any issues
- Meeting height challenges in adapter and charger applications
- Increased creepage distance

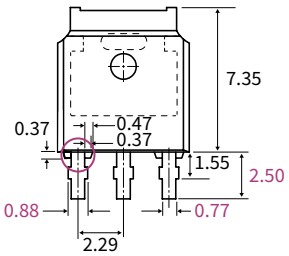
For charger and adapter applications with power over 20 W, TO-220 FullPAK is the preferred package because of its ease of handling and superior thermal performance. However, the need for height reduction in slim and semi-slim adapters forces manufactures to fully insert the TO-220 FullPAK into the PCB rather than up to its standoff. This often causes yield and reliability challenges due to:

- Significantly increased hole size on PCB to accommodate wider standoff as compared to leg
- Deceased effective creepage distance (shortest hole-to-hole distance)
- Increased possibility to have solder short on PCB

With fully optimized lead geometry: 24 percent reduction in standoff width; 44 percent reduction in standoff height; 23 percent reduction in leg width. The TO-220 FullPAK Narrow Lead package can be fully inserted into the PCB without any of the challenges mentioned above.

New IPAK Short Lead with ISO Standoff for CoolMOS™





Key benefits

- More effective cleaning in terms of residue removing, resulting in better assembly yield
- Larger effective creepage distance between legs
- More suitable for charger application

The Infineon IPAK Short Lead with ISO Standoff package offers a well-defined mold feature at the bottom of the package body: It allows to fully insert the MOSFET into the PCB while still having a well-defined isolation distance of 0.37 mm (maximum value) between PCB and package body. This way, the residues between package and PCB can be effectively removed after cleaning, which improves yield and reduces cost. This feature also helps to increase the effective creepage distance between the legs. In addition, the optimized leg width and length make this package more suitable for charger applications.

www.infineon.com/to220-fp-narrowlead

CoolMOS™ automotive

600 V CoolMOS™ CPA and 650 V CoolMOS™ CFDA – automotive technology in pole position

Highest system performance in a size and weight constrained environment, outstanding and proven product quality and reliability as well as 100 percent reliable delivery are the needs of our automotive customers. With the high voltage automotive MOSFET series , 600 V CoolMOS™ CPA and 650 V CoolMOS™ CFDA Infineon is perfectly prepared to take the challenges in the strongly growing automotive market. Based on the established 600 V CoolMOS™ CP and 650 V CoolMOS™ CFD2 series the 600 V CoolMOS™ CPA and 650 V CoolMOS™ CFDA provide all benefits of our fast switching superjunction MOSFETs. Special screening measures in front end, back end and mission-profile based qualification procedures ensure a quality level well beyond the formal requirements of the AEC Q101 standard.
While the 600 V CoolMOS™ CPA is the best choice for demanding hard switching applications such as boost PFCs in on board chargers (OBC), the 650 V CoolMOS™ CFDA series targets resonant switching applications such as the DC-DC stage of OBC's as well as DC-DC converters. The integrated fast body diode of the 650 V CoolMOS™ CFDA enables lowest losses, soft commutation behavior with limited voltage overshoots, high commutation robustness and low EMI levels in these resonant applications. This combination of highest efficiency with features allowing for an easy implementation of layout and design give the 650 V CoolMOS™ CFDA a clear advantage in comparison to competitor parts.

Common key features CoolMOS™ "A"

- First 600 V/650 V automotive qualified high voltage technologies for automotive market
- Compliant to AEC Q101 standard

Key features 600 V CoolMOS™ CPA

- Lowest $R_{DS(on)}$ per package
- Lowest gate charge value Q_G

Applications 600 V CoolMOS™ CPA

- Hard switching topologies
- PFC boost stages in on-board charger
- Active clamp or two transistor forward in DC-DC converter

Key features 650 V CoolMOS™ CFDA

- Limited voltage overshoot during hard commutation – self-limiting dI/dt and dV/dt
- Low Q_{rr} at repetitive commutation on body diode and low Q_{oss}

Applications 650 V CoolMOS™ CFDA

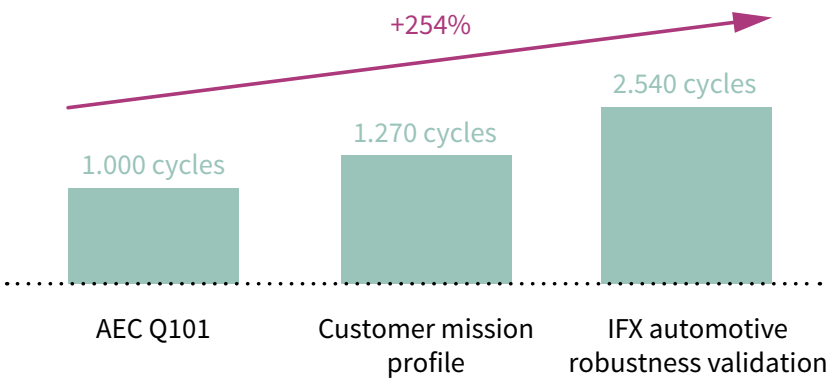
- Resonant switching topologies
- LLC or full-bridge ZVS in DC-DC converter
- HID lamp

www.infineon.com/cfda
www.infineon.com/coolmos-automotive

CoolMOS ™ automotive – benchmark in quality and reliability

Focus on top-notch quality and reliability without any compromise – that is the principle Infineon applies during development and qualification of all CoolMOS™ technologies. For our automotive grade derivatives the great quality levels of the industrial base technologies are further boosted by special screening measures in front end and back as well as by extended qualification procedures. The Infineon robustness validation approach with extended stress-test procedures doubling the real application requirements is one of our key elements to ensure a quality level well beyond the formal requirements of the AEC Q101 standard. Aside from extended stress times on standard qualification tests it comprises test procedures specially developed by Infineon to ensure highest quality of e.g. the power metallization of our devices. Usage of robust package technologies, 100 percent gate oxide screening and top-notch production monitoring including yield screening measures, part average testing (PAT), statistical bin alarm (SBA) and pattern recognition procedures complete our package to guarantee highest automotive quality. This holistic approach results in an unrivalled quality position of our 600 V CoolMOS™ CPA and 650V CoolMOS™ CFDA.

Robustness validation – example for thermal cycling test

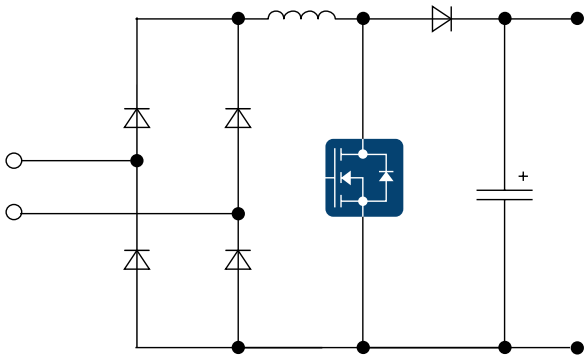


www.infineon.com/coolmos-automotive

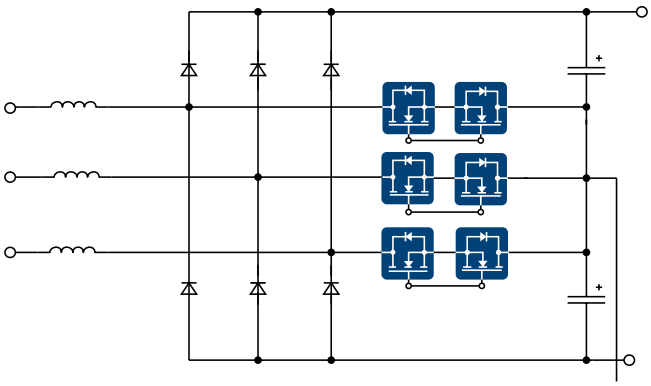
CoolMOS ™ automotive – ready to support future application trends

Driven by the CO_2 reduction initiatives the market of plug in hybrid PHEV and pure EV is strongly growing. Higher ranges of the electric vehicles are realized by increasing the battery capacity and the energy efficiency of the used electric components. The used battery voltage classes tend to become standardized at 270 V, 480 V and 870 V with a trend towards the higher voltages as this supports faster charging times and enables lighter cabling within the vehicle. Discrete high voltage components are used widely for on board charger (OBC) and DC-DC converter (LDC) applications as price pressure more and more displaces module based solutions. The trend towards fast charging impacts on the power range demanded from OBC topologies. While in the past and still today a vast majority of OBC topologies is found in the range from 3.2 kW to 7.2 kW the future trend goes to 11 kW or even up to 22 kW. This development paired with a demand for high efficiency and power density at low system cost is a strong driver for the usage of 3-phase solutions.

Classic PFC stage for OBC



OBC Vienna Rectifier for 3-phase PFC in OBC



While for the lower power OBC solutions classic PFC approaches are the well-established approach in the market, the Vienna Rectifier is the optimal solution for the higher power levels. As a true 3-phase topology it delivers full power if attached to a 3-phase input but is flexible enough to run on a single phase if required. The 3-level topology minimizes the filter effort compared to other solutions. By using the doubled frequency on the magnetic components it also helps to significantly reduce the size of the passives. As a 3-level topology the Vienna Rectifier followed by two paralleled DC-DC stages furthermore leads to a relaxed voltage stress level on the power MOSFETs. This way it enables to handle upcoming higher battery voltage levels. The $R_{DS(on)}$ required to yield a desired efficiency level in a Vienna Rectifier is a function of applied switching frequency and demanded power level. With our 600 V CoolMOS™ CPA and 650 V CoolMOS™ CFDA portfolio covering an $R_{DS(on)}$ range from 48 mΩ to 660 mΩ we are well prepared to support your next generation 3-phase Vienna Rectifier design. 650 V CoolMOS™ CFDA is furthermore the perfect choice for the PWM stage of your on board charger as well as for your DC-DC converter solution. With CoolMOS™ you are ready to grab your share in the emerging high-power on board charger markets!

www.infineon.com/coolmos-automotive

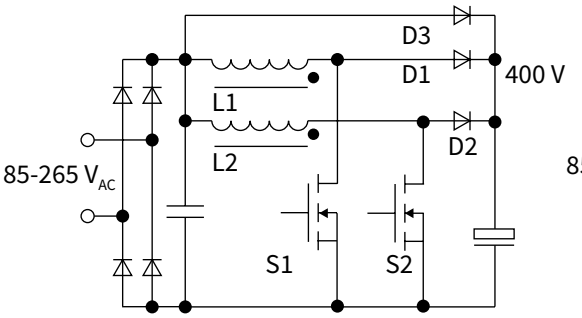
Coming soon! Infineon 600 V CoolGaN™

Infineon is completing the qualification of 600 V GaN transistor devices for server power, data center and telecom applications (70 mΩ and 190 mΩ initially).

- Highest efficiency PFC
- Highest density in LLC and phase shift full-bridge with high efficiency
- GaN application specific qualification above industry present practices leading to enhanced quality standards for wide-bandgap

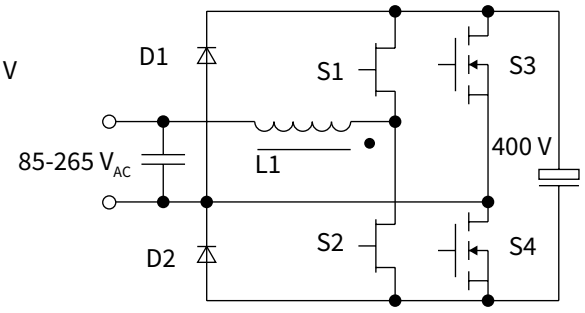
1. SMPS PFC stage: 600 V CoolGaN™ offers highest efficiency

Best CoolMOS™ solution



Dual interleaved PFC

GaN solution



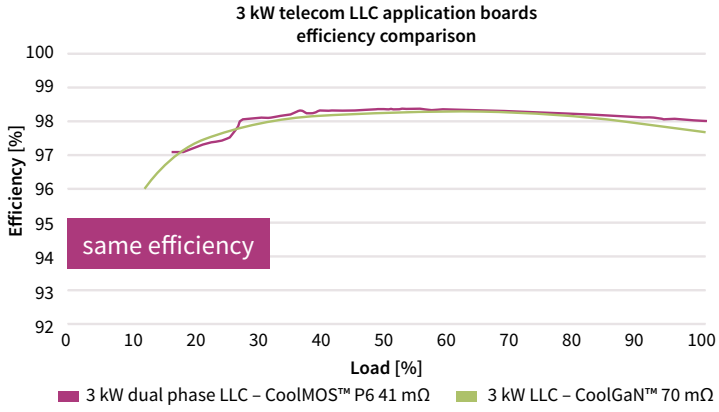
Full bridge totem pole (S1 and S2 are GaN devices)

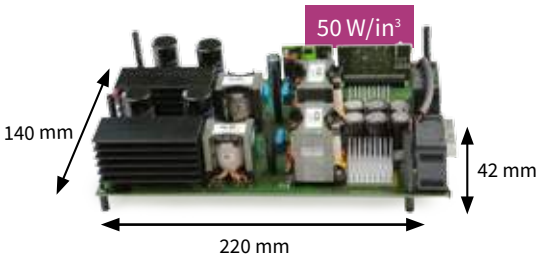
2. SMPS DC-DC stage: 600 V CoolGaN™ for the highest density

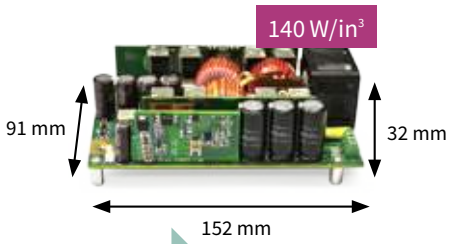
State-of-the-art 3 kW LLC

In ZVS applications, GaN devices switch faster than CoolMOS™ enabling much higher frequency and therefore higher power density for the same efficiency level

- Reduced switching losses as well as gate losses
- 10x lower charge (Q_{oss}) means faster switching in ZVS applications







~3x density increase!

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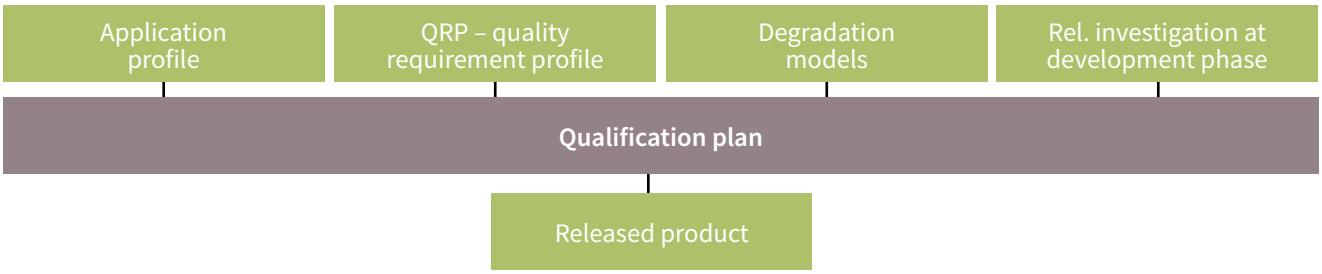
3. No compromises on quality

The qualification of GaN switches requires a dedicated approach, well beyond existing silicon standards

- JEDEC qualification is insufficient
- Application profiles are an integral part of the qualification
- Failure models, based on accelerated test conditions, ensure target lifetime and quality are met
- Infineon sets next level of wide-bandgap quality



Conclusions

GaN is the technology of choice for highly efficient, high density designs. Benefits can be achieved in several dimensions:

- Higher density with lower losses and fast payback of system cost increase
- With time GaN BOM cost trend is down and should be lower than closest high efficiency silicon based solution
- In LLC 3x or greater power density is achievable

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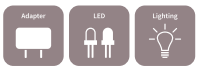
900 V CoolMOS™ C3 ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-262 (I^2PAK)	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)
120					IPW90R120C3	
340	IPP90R340C3	IPI90R340C3	IPB90R340C3	IPA90R340C3	IPW90R340C3	
500	IPP90R500C3	IPI90R500C3		IPA90R500C3	IPW90R500C3	
800	IPP90R800C3	IPI90R800C3		IPA90R800C3	IPW90R800C3	
1000	IPP90R1K0C3			IPA90R1K0C3	IPW90R1K0C3	
1200	IPP90R1K2C3	IPI90R1K2C3		IPA90R1K2C3	IPW90R1K2C3	IPD90R1K2C3

800 V CoolMOS™ P7 ACTIVE & PREFERRED

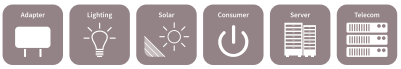
$R_{DS(on)}$ [mΩ]	TO -220	TO-220 FullPAK	TO-247	TO-252 (DPAK)	TO-251 (IPAK)	TO-251 (IPAK Short Lead)
280	IPP80R280P7	IPA80R280P7	IPW80R280P7	IPD80R280P7		
450	IPP80R450P7	IPA80R450P7		IPD80R450P7		
1400	IPP80R1K4P7	IPA80R1K4P7		IPD80R1K4P7	IPU80R1K4P7	IPS80R1K4P7
4500				IPD80R4K5P7	IPU80R4K5P7	

800 V CoolMOS™ CE ACTIVE & PREFERRED



$R_{DS(on)}$ [mΩ]	TO-220	TO-220 FullPAK	TO-247	TO-252 (DPAK)	TO-251 (IPAK)	TO-251 (IPAK Short Lead)
310		IPA80R310CE				
460		IPA80R460CE				
650		IPA80R650CE				
1000		IPA80R1K0CE		IPD80R1K0CE	IPU80R1K0CE	
1400		IPA80R1K4CE		IPD80R1K4CE	IPU80R1K4CE	
2800				IPD80R2K8CE	IPU80R2K8CE	

800 V CoolMOS™ C3 ACTIVE & PREFERRED



$R_{DS(on)}$ [mΩ]	TO-220	TO-262 (I^2PAK)	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)
85					SPW55N80C3	
290	SPP17N80C3		SPB17N80C3	SPA17N80C3	SPW17N80C3	
450	SPP11N80C3			SPA11N80C3	SPW11N80C3	
650	SPP08N80C3	SPI08N80C3		SPA08N80C3		
900	SPP06N80C3			SPA06N80C3		SPD06N80C3
1300	SPP04N80C3			SPA04N80C3		SPD04N80C3
2700	SPP02N80C3			SPA02N80C3		SPD02N80C3

700 V CoolMOS™ P7 ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO -220	TO – 262 (I^2PAK)	TO-251 (IPAK Short Lead)	TO-220 FullPAK	TO-247	TO-252 (DPAK)
360			IPS70R360P7S	IPA70R360P7S		IPD70R360P7S
600			IPS70R600P7S	IPA70R600P7S		IPD70R600P7S
900			IPS70R900P7S			IPD70R900P7S
1400			IPS70R1K4P7S			IPD70R1K4P7S

700 V CoolMOS™ CE ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-220 FullPAK Wide Creepage	TO-262 (I^2PAK)	TO-251 (IPAK Short Lead with ISO Standoff)	TO-252 (DPAK)	TO-251 (IPAK)	TO-251 (IPAK Short Lead)	SOT-223	ThinPAK 5x6
600		IPAW70R600CE		IPSA70R600CE	IPD70R600CE		IPS70R600CE		
950		IPAW70R950CE	IPI70R950CE	IPSA70R950CE	IPD70R950CE		IPS70R950CE		
1000								IPN70R1K0CE	
1400				IPSA70R1K4CE	IPD70R1K4CE		IPS70R1K4CE		
1500								IPN70R1K5CE	
2000				IPSA70R2K0CE	IPD70R2K0CE		IPS70R2K0CE		
2100									IPL70R2K1CES

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650 V CoolMOS™ C7 Gold (G-series) ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO -220	TO-Leadless (TOLL)	TO-263 (D2PAK)	TO-220 FullPAK	TO-247	TO -252 (DPAK)
33		IPT65R033G7				
105		IPT65R105G7				
195		IPT65R195G7				

650 V CoolMOS™ C7 ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-247 4pin	TO-252 (DPAK)	ThinPAK 8x8
19				IPW65R019C7	IPZ65R019C7		
33							
45	IPP65R045C7	IPB65R045C7	IPA65R045C7	IPW65R045C7	IPZ65R045C7		
65	IPP65R065C7	IPB65R065C7	IPA65R065C7	IPW65R065C7	IPZ65R065C7		
70							IPL65R070C7
95	IPP65R095C7	IPB65R095C7	IPA65R095C7	IPW65R095C7	IPZ65R095C7		
99							IPL65R099C7
105							
125	IPP65R125C7	IPB65R125C7	IPA65R125C7	IPW65R125C7			
130							IPL65R130C7
190	IPP65R190C7	IPB65R190C7	IPA65R190C7	IPW65R190C7		IPD65R190C7	
195							IPL65R195C7
225	IPP65R225C7	IPB65R225C7	IPA65R225C7			IPD65R225C7	
230							IPL65R230C7

650 V CoolMOS™ CE ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-220 FullPAK	TO-247	TO-252 (DPAK)	TO-251 (IPAK)	TO-251 (IPAK Short Lead)	SOT-223	TO-220 FullPAK Narrow Lead
400		IPA65R400CE		IPD65R400CE		IPS65R400CE		
650		IPA65R650CE		IPD65R650CE		IPS65R650CE		IPAN65R650CE
1000		IPA65R1K0CE		IPD65R1K0CE		IPS65R1K0CE		
1500		IPA65R1K5CE		IPD65R1K5CE		IPS65R1K5CE	IPN65R1K5CE	

650 V CoolMOS™ CFD2 ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-262 (I^2PAK)	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)	ThinPAK 8x8
41					IPW65R041CFD		
80					IPW65R080CFD		
110	IPP65R110CFD	IPI65R110CFD	IPB65R110CFD	IPA65R110CFD	IPW65R110CFD		
150	IPP65R150CFD	IPI65R150CFD	IPB65R150CFD	IPA65R150CFD	IPW65R150CFD		
165							IPL65R165CFD
190	IPP65R190CFD	IPI65R190CFD	IPB65R190CFD	IPA65R190CFD	IPW65R190CFD		
210							IPL65R210CFD
310	IPP65R310CFD	IPI65R310CFD	IPB65R310CFD	IPA65R310CFD	IPW65R310CFD		
340							IPL65R340CFD
420	IPP65R420CFD	IPI65R420CFD	IPB65R420CFD	IPA65R420CFD	IPW65R420CFD	IPD65R420CFD	
460							IPL65R460CFD
660	IPP65R660CFD	IPI65R660CFD	IPB65R660CFD	IPA65R660CFD	IPW65R660CFD	IPD65R660CFD	
725							IPL65R725CFD
950						IPD65R950CFD	
1400						IPD65R1K4CFD	

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650 V CoolMOS™ C6 ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-251 (IPAK Short Lead)	TO-262 (I^2PAK)	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)	ThinPAK 5x6
37						IPW65R037C6		
70						IPW65R070C6		
74	IPP65R074C6							
99	IPP65R099C6		IPI65R099C6	IPB65R099C6	IPA65R099C6	IPW65R099C6		
190	IPP65R190C6		IPI65R190C6	IPB65R190C6	IPA65R190C6	IPW65R190C6		
250							IPD65R250C6	
280	IPP65R280C6		IPI65R280C6	IPB65R280C6	IPA65R280C6	IPW65R280C6		
380	IPP65R380C6		IPI65R380C6	IPB65R380C6	IPA65R380C6		IPD65R380C6	
600	IPP65R600C6		IPI65R600C6	IPB65R600C6	IPA65R600C6		IPD65R600C6	
650								IPL65R650C6S
950		IPS65R950C6					IPD65R950C6	
1000								IPL65R1K0C6S
1400		IPS65R1K4C6					IPD65R1K4C6	
1500								IPL65R1K5C6S

650 V CoolMOS™ E6 ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-251 (IPAK Short Lead)	TO-262 (I^2PAK)	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)	ThinPAK 8x8
190	IPP65R190E6				IPA65R190E6	IPW65R190E6		IPL65R190E6
250							IPD65R250E6	
280	IPP65R280E6		IPI65R280E6	IPB65R280E6	IPA65R280E6	IPW65R280E6		
310								IPL65R310E6
380	IPP65R380E6				IPA65R380E6		IPD65R380E6	
420								IPL65R420E6
600	IPP65R600E6	IPS65R600E6			IPA65R600E6		IPD65R600E6	
660								IPL65R660E6

650 V CoolMOS™ C3 ACTIVE

$R_{DS(on)}$ [mΩ]	TO-220	TO-262 (I^2PAK)	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)
70					SPW47N65C3	
190	SPP20N65C3			SPA20N65C3		
280		SPI15N65C3		SPA15N65C3		
380	SPP11N65C3	SPI11N65C3		SPA11N65C3		
600	SPP07N65C3			SPA07N65C3		

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600 V CoolMOS™ P7 ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO -220	TO-220 FullPAK	TO-247	TO-247 4pin	TO-252 (DPAK)	TO-220 FullPAK Wide Creepage	ThinPAK
37			IPW60R037P7	IPZ60R037P7			
180	IPP60R180P7	IPA60R180P7	IPW60R180P7		IPD60R180P7	IPAW60R180P7S	
185							IPL60R185P7
360	IPP60R360P7	IPA60R360P7			IPD60R360P7	IPAW60R360P7S	
365							IPL60R365P7
600	IPP60R600P7				IPD60R600P7		

600 V CoolMOS™ C7 Gold (G-series) ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO -220	TO-Leadless (TOLL)	TO-220 FullPAK	TO-247	TO-247 4 pin	TO -252 (DPAK)	ThinPAK 8x8
28		IPT60R028G7					
50		IPT60R050G7					
80		IPT60R080G7					
102		IPT60R102G7					
125		IPT60R125G7					
150		IPT60R150G7					

600 V CoolMOS™ C7 ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-247 4pin	TO-252 (DPAK)	ThinPAK 8x8
17				IPW60R017C7	IPZ60R017C7		
40	IPP60R040C7	IPB60R040C7		IPW60R040C7	IPZ60R040C7		
60	IPP60R060C7	IPB60R060C7	IPA60R060C7	IPW60R060C7	IPZ60R060C7		
65							IPL60R065C7
99	IPP60R099C7	IPB60R099C7	IPA60R099C7	IPW60R099C7	IPZ60R099C7		
104							IPL60R104C7
120	IPP60R120C7	IPB60R120C7	IPA60R120C7	IPW60R120C7			
125							IPL60R125C7
180	IPP60R180C7	IPB60R180C7	IPA60R180C7	IPW60R180C7		IPD60R180C7	
185							IPL60R185C7

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600 V CoolMOS™ P6 ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-247 4pin	TO-252 (DPAK)	ThinPAK 5x6	ThinPAK 8x8
41				IPW60R041P6	IPZ60R041P6			
70				IPW60R070P6	IPZ60R070P6			
99	IPP60R099P6		IPA60R099P6	IPW60R099P6	IPZ60R099P6			
125	IPP60R125P6		IPA60R125P6	IPW60R125P6	IPZ60R125P6			
160	IPP60R160P6	IPB60R160P6	IPA60R160P6	IPW60R160P6				
180								IPL60R180P6
190	IPP60R190P6	IPB60R190P6	IPA60R190P6	IPW60R190P6				
210								IPL60R210P6
230	IPP60R230P6	IPB60R230P6	IPA60R230P6	IPW60R230P6				
255								IPL60R255P6
280	IPP60R280P6	IPB60R280P6	IPA60R280P6	IPW60R280P6				
330/360	IPP60R330P6	IPB60R330P6	IPA60R330P6	IPW60R330P6			IPL60R360P6S	
380	IPP60R380P6	IPB60R380P6	IPA60R380P6			IPD60R380P6		
600	IPP60R600P6	IPB60R600P6	IPA60R600P6			IPD60R600P6		
650							IPL60R650P6S	

600 V CoolMOS™ CE ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220 FullPAK	TO-220 FullPAK Wide Creepage	TO-247	TO-252 (DPAK)	TO-251 (IPAK)	TO-251 (IPAK Short Lead)	SOT-223	TO-220 FullPAK Narrow Lead
190		IPAW60R190CE						
280		IPAW60R280CE						
380		IPAW60R380CE						
400	IPA60R400CE			IPD60R400CE		IPS60R400CE		
460	IPA60R460CE			IPD60R460CE		IPS60R460CE		
600		IPAW60R600CE						
650	IPA60R650CE			IPD60R650CE		IPS60R650CE		IPAN60R650CE
800	IPA60R800CE			IPD60R800CE		IPS60R800CE		IPAN60R800CE
1000	IPA60R1K0CE			IPD60R1K0CE	IPU60R1K0CE	IPS60R1K0CE	IPN60R1K0CE	
1500	IPA60R1K5CE			IPD60R1K5CE	IPU60R1K5CE	IPS60R1K5CE	IPN60R1K5CE	
2100				IPD60R2K1CE	IPU60R2K1CE	IPS60R2K1CE	IPN60R2K1CE	
3400				IPD60R3K4CE	IPU60R3K4CE	IPS60R3K4CE	IPN60R3K4CE	

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600 V CoolMOS™ C6 ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-251 (IPAK)	TO-262 (I^2PAK)	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)	ThinPAK 5x6
41						IPW60R041C6		
70						IPW60R070C6		
74	IPP60R074C6							
99	IPP60R099C6			IPB60R099C6	IPA60R099C6	IPW60R099C6		
125	IPP60R125C6			IPB60R125C6	IPA60R125C6	IPW60R125C6		
160	IPP60R160C6			IPB60R160C6	IPA60R160C6	IPW60R160C6		
190	IPP60R190C6		IPI60R190C6	IPB60R190C6	IPA60R190C6	IPW60R190C6		
280	IPP60R280C6		IPI60R280C6	IPB60R280C6	IPA60R280C6	IPW60R280C6		
380	IPP60R380C6		IPI60R380C6	IPB60R380C6	IPA60R380C6		IPD60R380C6	
520	IPP60R520C6				IPA60R520C6		IPD60R520C6	
600	IPP60R600C6	IPU60R600C6		IPB60R600C6	IPA60R600C6		IPD60R600C6	
950	IPP60R950C6	IPU60R950C6		IPB60R950C6	IPA60R950C6		IPD60R950C6	
1400	IPP60R1K4C6	IPU60R1K4C6					IPD60R1K4C6	
1500								IPL60R1K5C6S
2000		IPU60R2K0C6					IPD60R2K0C6	
2100								IPL60R2K1C6S
3300							IPD60R3K3C6	

600 V CoolMOS™ E6 ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-262 (I^2PAK)	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)	ThinPAK 8x8
190	IPP60R190E6			IPA60R190E6	IPW60R190E6		
280	IPP60R280E6			IPA60R280E6	IPW60R280E6		
380	IPP60R380E6			IPA60R380E6		IPD60R380E6	
450	IPP60R450E6			IPA60R450E6		IPD60R450E6	
520	IPP60R520E6			IPA60R520E6		IPD60R520E6	
600	IPP60R600E6			IPA60R600E6		IPD60R600E6	
750	IPP60R750E6			IPA60R750E6		IPD60R750E6	

600 V CoolMOS™ C3 ACTIVE

$R_{DS(on)}$ [mΩ]	TO-220	TO-251 (IPAK)	TO-251 (IPAK Short Lead)	TO-262 (I^2PAK)	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)
70							SPW47N60C3	
100							SPW35N60C3	
160	SPP24N60C3						SPW24N60C3	
190	SPP20N60C3			SPI20N60C3	SPB20N60C3	SPA20N60C3	SPW20N60C3	
280	SPP15N60C3					SPA15N60C3	SPW15N60C3	
380	SPP11N60C3			SPI11N60C3	SPB11N60C3	SPA11N60C3	SPW11N60C3	
600	SPP07N60C3	SPU07N60C3		SPI07N60C3	SPB07N60C3	SPA07N60C3		SPD07N60C3
750	SPP06N60C3					SPA06N60C3		SPD06N60C3
950	SPP04N60C3	SPU04N60C3			SPB04N60C3	SPA04N60C3		SPD04N60C3
1400	SPP03N60C3	SPU03N60C3	SPS03N60C3			SPA03N60C3		SPD03N60C3
3000	SPP02N60C3	SPU02N60C3	SPS02N60C3					
6000		SPU01N60C3						

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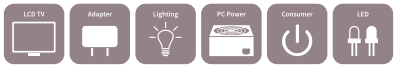
600 V CoolMOS™ CP ACTIVE

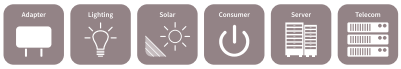


$R_{DS(on)}$ [mΩ]	TO-220	TO-220 FullPAK	TO-247	TO-252 (DPAK)	TO-262 (I^2PAK)	TO-263 (D^2PAK)	ThinPAK 8x8
45			IPW60R045CP				
75			IPW60R075CP				
99	IPP60R099CP		IPW60R099CP		IPI60R099CP	IPB60R099CP	
125	IPP60R125CP	IPA60R125CP	IPW60R125CP		IPI60R125CP	IPB60R125CP	
165	IPP60R165CP	IPA60R165CP	IPW60R165CP		IPI60R165CP	IPB60R165CP	
199	IPP60R199CP	IPA60R199CP	IPW60R199CP		IPI60R199CP	IPB60R199CP	IPL60R199CP
250	IPP60R250CP	IPA60R250CP					
299	IPP60R299CP	IPA60R299CP	IPW60R299CP		IPI60R299CP	IPB60R299CP	IPL60R299CP
385	IPP60R385CP	IPA60R385CP		IPD60R385CP	IPI60R385CP	IPB60R385CP	IPL60R385CP

500 V CoolMOS™ CE ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-220 FullPAK	TO-247	TO-252 (DPAK)	TO-251 (IPAK)	TO-251 (IPAK Short Lead)	SOT-223	TO-200 FullPAK Narrow Lead
190	IPP50R190CE	IPA50R190CE	IPW50R190CE					
280	IPP50R280CE	IPA50R280CE	IPW50R280CE	IPD50R280CE				
380	IPP50R380CE	IPA50R380CE		IPD50R380CE				
500	IPP50R500CE	IPA50R500CE		IPD50R500CE				IPAN50R500CE
650		IPA50R650CE		IPD50R650CE			IPN50R650CE	
800		IPA50R800CE		IPD50R800CE			IPN50R800CE	
950		IPA50R950CE		IPD50R950CE	IPU50R950CE		IPN50R950CE	
1400				IPD50R1K4CE	IPU50R1K4CE		IPN50R1K4CE	
2000				IPD50R2K0CE	IPU50R2K0CE		IPN50R2K0CE	
3000				IPD50R3K0CE	IPU50R3K0CE		IPN50R3K0CE	

500 V CoolMOS™ C3 ACTIVE



$R_{DS(on)}$ [mΩ]	TO-220	TO-262 (I^2PAK)	TO-263 (D^2PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)
70					SPW52N50C3	
110					SPW32N50C3	
190	SPP21N50C3	SPI21N50C3	SPB21N50C3	SPA21N50C3	SPW21N50C3	
280	SPP16N50C3		SPB16N50C3	SPA16N50C3	SPW16N50C3	
380	SPP12N50C3	SPI12N50C3	SPB12N50C3	SPA12N50C3		
600	SPP08N50C3	SPI08N50C3		SPA08N50C3		SPD08N50C3
950	SPP04N50C3		SPB04N50C3			SPD04N50C3
1400						SPD03N50C3
3000						SPD02N50C3

500 V CoolMOS™ CP ACTIVE

$R_{DS(on)}$ [mΩ]	TO-220	TO-220 FullPAK	TO-247	TO-252 (DPAK)	TO-262 (I^2PAK)	TO-263 (D^2PAK)	TO-251 (IPAK Short Lead)
140	IPP50R140CP	IPA50R140CP	IPW50R140CP		IPI50R140CP	IPB50R140CP	
199	IPP50R199CP	IPA50R199CP	IPW50R199CP		IPI50R199CP	IPB50R199CP	
250	IPP50R250CP	IPA50R250CP	IPW50R250CP		IPI50R250CP	IPB50R250CP	
299	IPP50R299CP	IPA50R299CP	IPW50R299CP		IPI50R299CP	IPB50R299CP	
350	IPP50R350CP	IPA50R350CP	IPW50R350CP		IPI50R350CP		
399	IPP50R399CP	IPA50R399CP	IPW50R399CP	IPD50R399CP	IPI50R399CP		
520	IPP50R520CP	IPA50R520CP		IPD50R520CP			IPS50R520CP

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CoolMOS™ automotive

650 V CoolMOS™ CFDA ACTIVE & PREFERRED

Product type	$R_{DS(on)}$ @ T_j = 25°C V_{GS} = 10 V [mΩ]	$I_{D,max.}$ @ T_j = 25°C [A]	$I_{D\_puls,max}$ [A]	$V_{GS(th),min-max}$ [V]	$Q_{G,typ.}$ [nC]	$R_{thJC,max.}$ [K/W]	Package
IPD65R420CFDA	420	8.7	27	3.5...4.5	32	1.5	TO-252
IPD65R660CFDA	660	6	17	3.5...4.5	20	2	TO-252
IPB65R110CFDA	110	31.2	99.6	3.5...4.5	11	0.45	TO-263
IPB65R150CFDA	150	22.4	72	3.5...4.5	86	0.64	TO-263
IPB65R190CFDA	190	17.5	57.2	3.5...4.5	68	0.83	TO-263
IPB65R310CFDA	310	11.4	34.4	3.5...4.5	41	1.2	TO-263
IPB65R660CFDA	660	6	17	3.5...4.5	20	2	TO-263
IPP65R110CFDA	110	31.2	99.6	3.5...4.5	11	0.45	TO-220
IPP65R150CFDA	150	22.4	72	3.5...4.5	86	0.64	TO-220
IPP65R190CFDA	190	17.5	57.2	3.5...4.5	68	0.83	TO-220
IPP65R310CFDA	310	11.4	34.4	3.5...4.5	41	1.2	TO-220
IPP65R660CFDA	660	6	17	3.5...4.5	20	2	TO-220
IPW65R048CFDA	48	63.3	228	3.5...4.5	27	0.25	TO-247
IPW65R080CFDA	80	43.3	127	3.5...4.5	16	0.32	TO-247
IPW65R110CFDA	110	31.2	99.6	3.5...4.5	11	0.45	TO-247
IPW65R150CFDA	150	22.4	72	3.5...4.5	86	0.64	TO-247
IPW65R190CFDA	190	17.5	57.2	3.5...4.5	68	0.83	TO-247

600 V CoolMOS™ CPA ACTIVE & PREFERRED

Product type	$R_{DS(on)}$ @ T_j = 25°C V_{GS} = 10 V [mΩ]	$I_{D,max.}$ @ T_j = 25°C [A]	$I_{D\_puls,max}$ [A]	$V_{GS(th),min-max}$ [V]	$Q_{G,typ.}$ [nC]	$R_{thJC,max.}$ [K/W]	Package
IPB60R099CPA	105	31	93	-20 … 20	60	0.5	TO-263
IPB60R199CPA	199	16	51	-20 … 20	32	0.9	TO-263
IPB60R299CPA	299	11	34	-20 … 20	22	1.3	TO-263
IPP60R099CPA	105	31	93	-20 … 20	60	0.5	TO-220
IPW60R045CPA	45	60	230	-20 … 20	150	0.29	TO-247
IPW60R075CPA	75	39	130	-20 … 20	87	0.4	TO-247
IPW60R099CPA	105	31	93	-20 … 20	60	0.5	TO-247
IPI60R099CPA	105	31	93	-20 … 20	60	0.5	TO-262

www.infineon.com/coolmos-600v
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www.infineon.com/coolmos-automotive
www.infineon.com/cfda

SOT-223

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	CE								650/800	950/1400	2000/3000
600	CE									1000/1500	2100/3400
650	CE									1500	
700	CE									1000/1500	

TO-247

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	CE				190	280					
	C3		70	110	190	280					
	CP			140	199	250/299	350/399				
600	P7	37			180						
	C6	41	70	99/125	160/190	280					
	C7	17/40	60	99/120	180						
	E6				190	280					
	P6	41	70	99/125	160/190	230/280	330				
	C3		70	100	160/190	280	380				
	CP	45	75	99/125	165/199	250/299					
650	C6	37	70	99	190	280					
	C7	19/45	65	95/125	190						
	CFD2	41	80	110	150/190		310	420	660		
	E6				190	280					
	C3		70								
800	P7					280					
	C3		85			290		450			
900	C3			120			340	500	800	1000/1200	

TO-247 4pin

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
600	P7	37									
	C7	17/40	60	99							
	P6	41	70	99/125							
650	C7	19/45	65	95							

IPAK

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	CP									950/1400	2000/3000
600	C6							600		950/1400	2000
	CE									1000/1500	2100
	C3							600		950/1400	3000/6000
800	P7									1400	4500
	CE									1000/1400	2800

ACTIVE & PREFERRED ACTIVE

IPAK Short Lead

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	CP							520			
600	CE						400	460	650/800	1000/1500	2100/3400
	C3									1400	3000
650	C6									950/1400	
	CE						400		650	1000/1500	
	E6							600			
700	P7						360/600			900/1400	
	CE							600		950/1400	2000
800	P7									1400	

IPAK Short Lead with ISO Standoff

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
700	CE							600		950/1400	2000

DPAK

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	CE					280	380	500	650/800	950/1400	2000/3000
	C3							600		950/1400	3000
	CP						399	520			
600	P7				180		360	600			
	C6						380	520/600		950/1400	2000/3300
	C7				180						
	CE						400	460	650/800	1000/1500	2100/3400
	E6						380	450/520/600	750		
	P6						380	600			
	C3							600	750	950/1400	
	CP						385				
650	C6					250	380	600		950/1400	
	C7				190	225					
	CE						400		650	1000/1500	
	E6						250	380	600		
	CFD2							420	660	950/1400	
700	P7						360	600		900/1400	
	CE							600		950/1400	2000
800	P7					280		450		1400	4500
	C3									900/1300	2700
	CE									1000/1400	2800
900	C3									1200	

I²PAK

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	C3				190		380	600			
	CP			140	199	250/299	350/399				
600	C6				190	280	380				
	C3				190		380	600			
	CP			99/125	165/199	250/299	385				
650	C6			99	190	280	380	600			
	CFD2			110	150/190		310	420	660		
	E6					280					
	C3					280	380				
700	CE									950	
800	C3								650		
900	C3						340	500	800	1200	

ACTIVE & PREFERRED ACTIVE

D²PAK

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	C3				190	280	380			950	
	CP			140	199	250/299					
600	C6			99/125	160/190	280	380	600		950	
	C7	40	60	99	120/180						
	P6				160/190	230/280	330/380	600			
	C3				190		380	600		950	
	CP			99/125	165/199	250/299	385				
650	C6			99	190	280	380	600			
	C7	45	65	95/125	190	225					
	CFD2			110	150/190			420	660		
	E6					280					
800	C3					290					
900	C3						340				

TO-220 FullPAK

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	CE				190	280	380	500	650/800	950	
	C3				190	280	380	600			
	CP			140	199	250/299	350/399	520			
600	P7				180		360				
	C6			99/125	160/190	280	380	520/600		950	
	C7		60	99/120	180						
	CE						400	460	650/800	1000/1500	
	E6				190	280	380	450/520/600	750		
	P6			99/125	160/190	230/280	330/380	600			
	C3				190	280	380	600	750	950/1400	
	CP			125	165/199	250/299	385				
650	C6			99	190	280	380	600			
	C7	45	65	95/125	190	225					
	CE						400		650	1000/1500	
	CFD2			110	150/190		310	420	660		
	E6				190	280	380	600			
	C3				190	280	380	600			
700	P7						360	600			
800	P7					280		450		1400	
	C3					290		450	650	900/1300	2700
	CE						310	460	650	1000/1400	
900	C3						340	500	800	1000/1200	

TO-220 FullPAK Narrow Lead

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	CE							500			
600	CE								650 / 800		
650	CE								650		

TO-Leadless

		$R_{DS(on)}$ group [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
600	G7	28/50	80	102/125	150						
650	G7	33		105	195						

*CoolMOS™ C7 Gold (G-series)

ACTIVE & PREFERRED ACTIVE

TO-220

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	CE				190	280	380	500			
	C3				190	280	380	600		950	
	CP			140	199	250/299	350/399	520			
600	P7				180		360	600			
	C6		74	99/125	160/190	280	380	520/600		950/1400	
	C7	40	60	99/120	180						
	E6				190	280	380	450/520/600	750		
	P6			99/125	160/190	230/280	330/380	600			
	C3				160/190	280	380	600	750	950/1400	3000
	CP			99/125	165/199	250/299	385				
650	C6		74	99	190	280	380	600			
	C7	45	65	95/125	190	225					
	CFD2			110	150/190		310	420	660		
	E6				190	280	380	600			
	C3				190		380	600			
800	P7					280		450		1400	
	C3					290		450	650	900/1300	2700
900	C3						340	500	800	1000/1200	

TO-220 FullPAK Wide Creepage

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
600	P7				180		360				
	CE				190	280	380	600			
700	P7							600			

ThinPAK 5x6

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
600	C6									1500	2100
	P6						360		650		
650	C6								650	1000/1500	
700	CE										2100

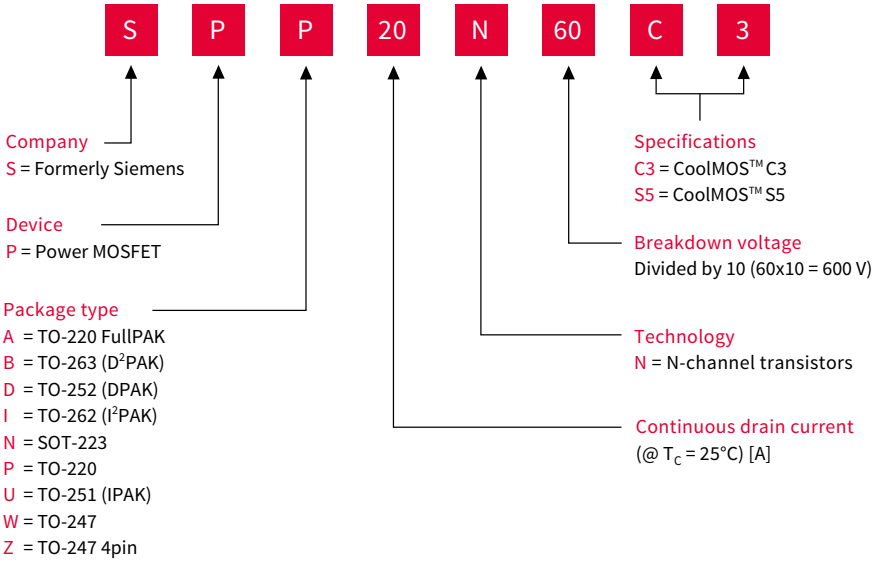
ThinPAK 8x8

		$R_{DS(on)}$ [mΩ]									
Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
600	P7				185		365				
	C7		65	104/125	185						
	P6				180	210/255					
	CP				199	299	385				
650	C7		70	99/130	195	230					
	CFD2				165	210	340	460	725		
	E6				190		310	420	660		

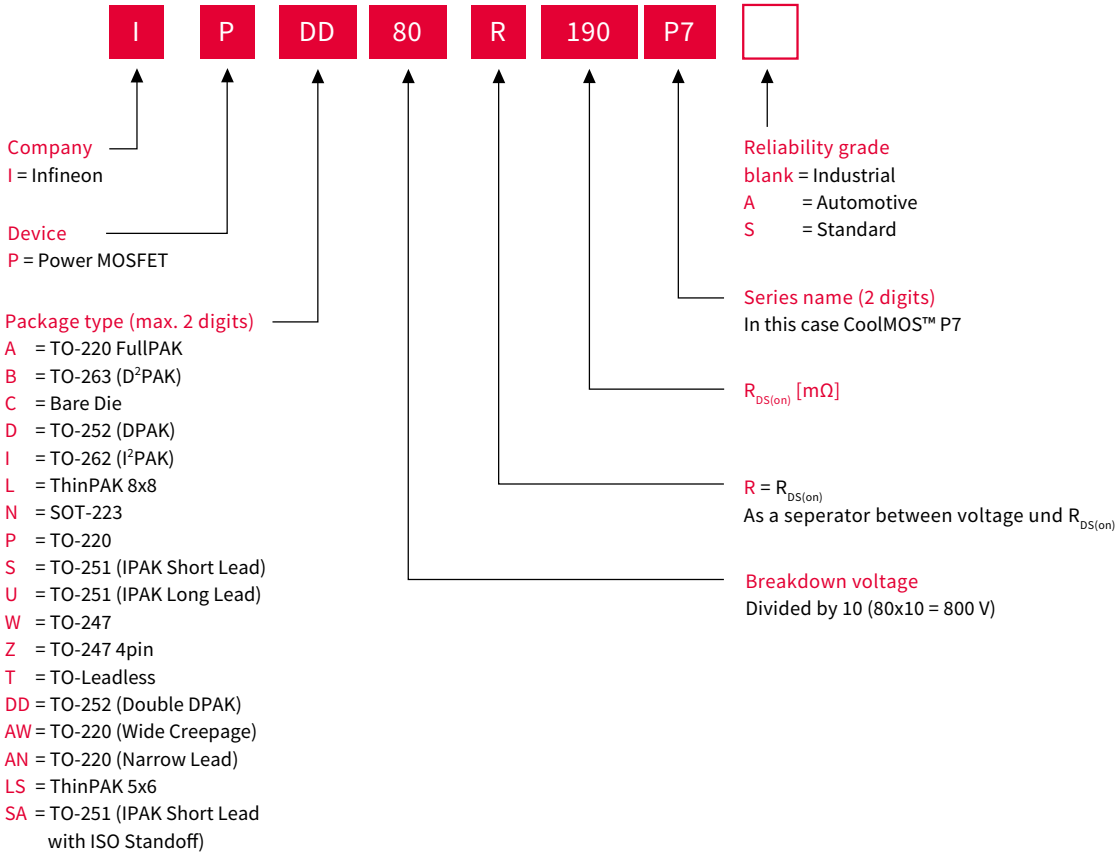
ACTIVE & PREFERRED ACTIVE

Naming system

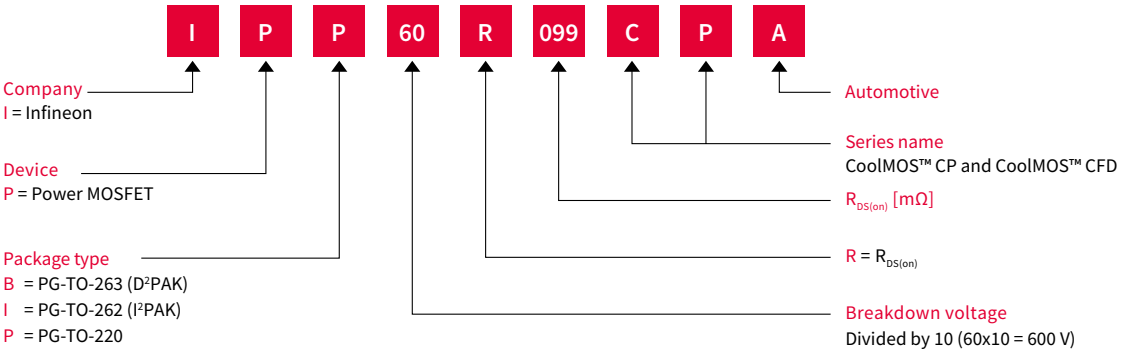
Power MOSFETs (naming system until 2005)



Power MOSFETs (naming system from 2005 onwards)



Automotive MOSFETs



Infineon support for high voltage MOSFETs

Useful links and helpful information

Further information, datasheets and documents

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Silicon Carbide

Improve efficiency and solution costs

Silicon Carbide (SiC) devices belong to the so-called wide band gap semiconductor group, which offers a number of attractive characteristics for high voltage power semiconductors when compared to commonly used Silicon (Si). In particular, the much higher breakdown field strength and thermal conductivity of Silicon Carbide allow creating devices, which by far outperform the corresponding Si ones, and enable efficiency levels unattainable otherwise. The Infineon portfolio of SiC devices covers 600 V and 650 V to 1200 V Schottky diodes, in 2016 the revolutionary CoolSiC™ MOSFET was announced.

CoolSiC™ Silicon Carbide Schottky diodes

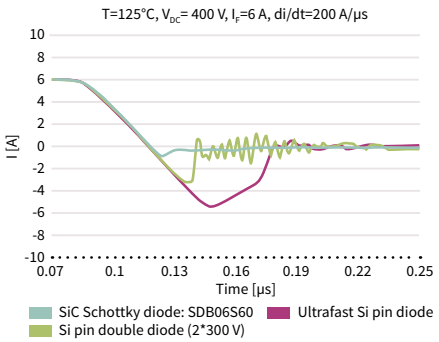
The differences in material properties between Silicon Carbide and Silicon limit the fabrication of practical Silicon unipolar diodes (Schottky diodes) to a range up to 100 V–150 V, with relatively high on-state resistance and leakage current. In SiC material Schottky diodes can reach a much higher breakdown voltage. Infineon offers products up to 1200 V in discrete packages and up to 1700 V in modules.

Features
- No reverse recovery charge
- Purely capacitive switching
- High operating temperature ($T_{j, max}$ 175°C)

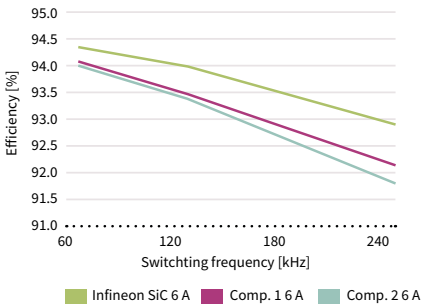
Advantages
- Low turn-off losses
- Reduction of CoolMOS™ or IGBT turn-on loss
- Switching losses independent from load current, switching speed and temperature

Benefits
- System efficiency improvement compared to Si diodes
- Reduced cooling requirements
- Enabling higher frequency/increased power density
- Higher system reliability due to lower operating temperature
- Reduced EMI

Applications
- Server
- Telecom
- Solar
- UPS
- Energy storage, chargers
- PC power
- Motor drives
- Lighting



Reverse recovery charge of SiC Schottky diodes versus Si pin diodes
The majority carrier characteristics of the device imply no reverse recovery charge and the only contribution to the switching losses comes from the tiny displacement charge of capacitive nature. In the same voltage range, Silicon devices show a bipolar component resulting in much higher switching losses. The graph shows the comparison between various 600 V devices.



Improved system efficiency (PFC in CCM mode operation, full load, low line)
The fast switching characteristics of the SiC diodes provide clear efficiency improvements at system level. The performance gap between SiC and high-end Silicon devices increases with the operating frequency.

www.infineon.com/sic

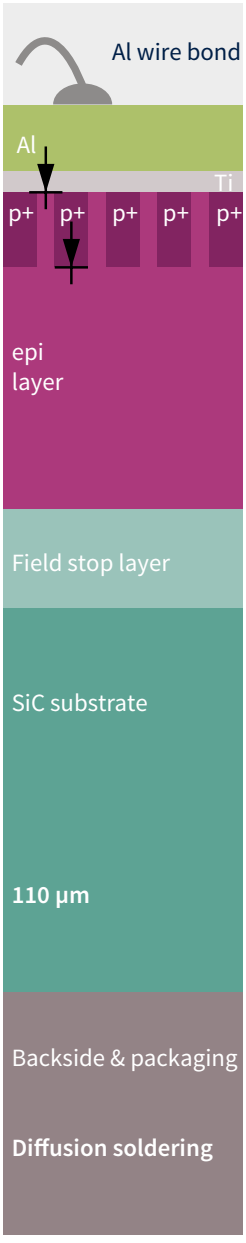
Infineon is the world's first SiC discrete power supplier. Long market presence and experience enable Infineon to deliver highly reliable, industry-leading SiC performance. With over 10 years pioneering experience in developing and manufacturing SiC diodes, Infineon's latest CoolSiC™ Schottky diodes generation 5 family sets benchmark in quality, efficiency and reliability.

650 V CoolSiC™ Schottky diodes generation 5: best price/performance

The CoolSiC™ 650 V generation 5 product family has been optimized regarding all key aspects including junction structure, substrate and die attach. It represents a well-balanced product family which offers state of the art performance and high surge current capability at competitive cost level.

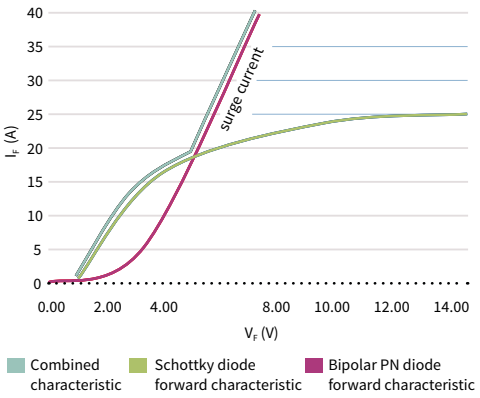
Innovation: optimized junction, substrate and die attach

Infineon SiC Schottky diode generation 5 is optimized with regard to all key aspects relevant for high power and high efficiency SMPS applications.



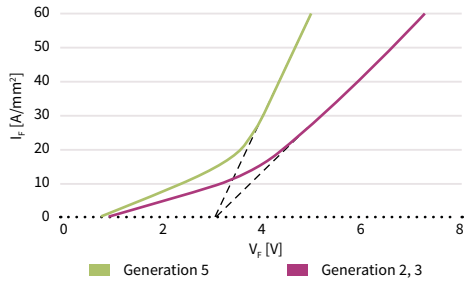
Junction: merged PN structure

On the junction level, it has an optimized merged PN structure. Compared to competitors, Infineon's SiC diode has additional P doped area, together with the N doped EPI layer, it forms a PN junction diode. Thus it is a combination of Schottky diode and PN Junction diode. Under normal conditions it works like a standard Schottky diode. Under abnormal conditions such as lighting, AC line drop-out, it works like a PN Junction diode. At high current level, the PN Junction diode has significantly lower V_F than Schottky diode, this leads to less power dissipation, thus significantly improving the surge current capability.



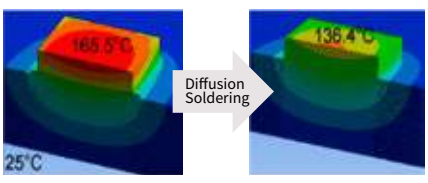
Substrate: thin wafer technology

On the substrate level, Infineon introduced thin wafer technology, at the later stage of our SiC diode production thin wafer process is used to reduce the wafer thickness by about 2/3, this significantly reduces the substrate resistance contribution thus improve both V_F and thermal performance.



Die attach: diffusion soldering

On the backside, package level diffusion soldering is introduced, which significantly improves the thermal path between lead frame and the diode, enhancing the thermal performance. With the same chip size and power dissipation, the junction temperature is reduced by 30°C.



R_{thJC}=2.0 K/W R_{thJC}=1.5 K/W

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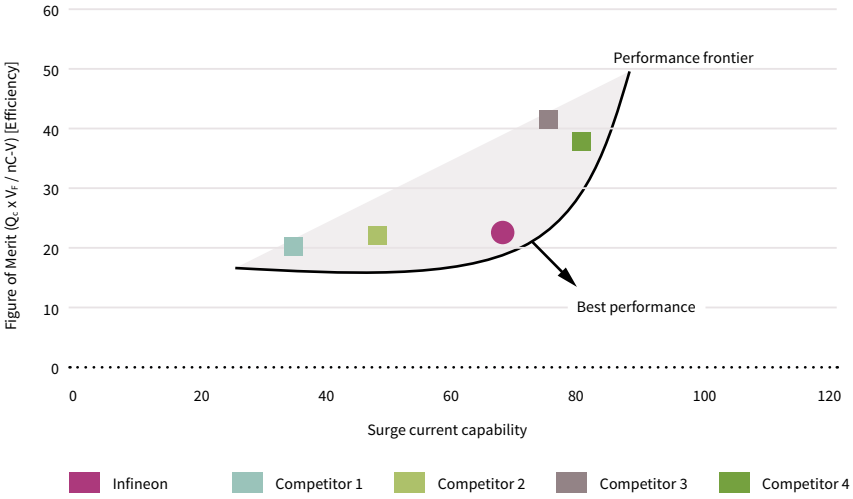
Excellent efficiency and surge current capability

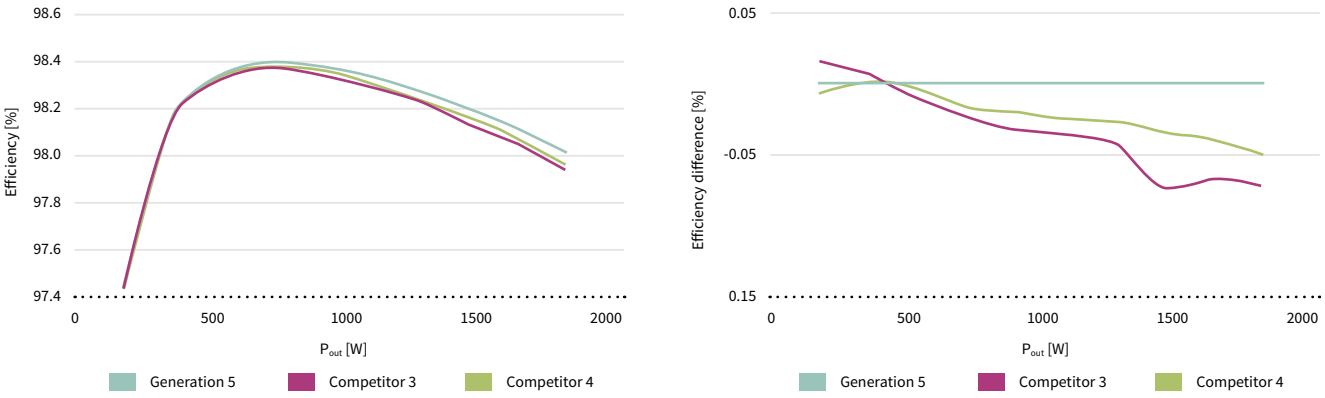
8 A SiC diode comparison from different suppliers



SiC Schottky diode generation 5 offers the optimum efficiency and ruggedness. Lower V_F means lower conduction loss and lower Q_c means lower switching loss. Q_c x V_F is the figure of merit for efficiency and comparison indicates that generation 5 matches the best competitors on the market. In addition, SiC generation 5 offers a surge current robustness far better than the one offered by the most efficient products. Thus, under abnormal conditions this surge current capability offers excellent device robustness. All around, SiC generation 5 offers excellent efficiency and surge current capability at the same time. No other SiC diode product on the market offers such good balance between efficiency and surge current capability. Some vendors offer better efficiency but weak surge current, while others offer better surge current but are less attractive in efficiency.

Efficiency comparison

CCM mode PFC, high line, P_{max} = 1800 W, f_{SW} = 65 kHz; MOSFET: IPW65R095C7, SiC diode: TO-220 8 A



In terms of efficiency, the 8 A device has been tested in CCM PFC. The maximum output power is 1.8 kW and the switching frequency is 65 kHz. The left figure shows the absolute efficiency as a function load power, while the right figure shows efficiency difference compared to our SiC Schottky diode generation 5. This clearly shows that Infineon's SiC Schottky diode generation 5 delivers better efficiency over full load range.

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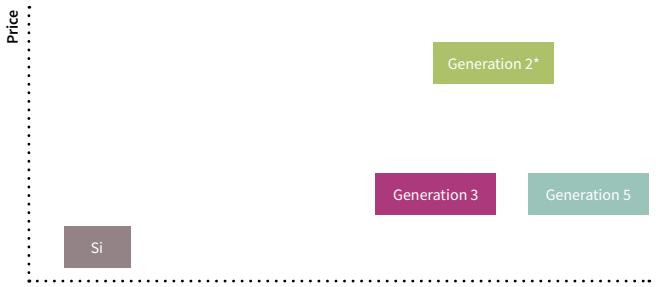
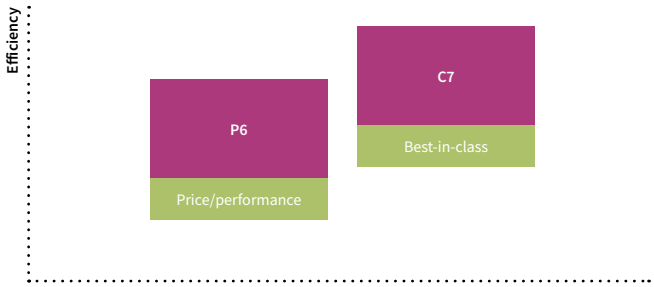
System solution for PFC

The CoolSiC™ Schottky diode generation 5 is in perfect combination with Infineon's CoolMOS™ for best performance and efficiency in PFC stages. The target applications in this case are telecom, server, etc. We recommend CoolSiC™ Schottky diode generation 5 for new designs. The selection of CoolMOS™ and CoolSiC™ depends on target efficiency and cost.





* Discontinuation in 2017

Infineon system solution in PFC

CCM PFC Power [W]	CoolMOS™ $R_{DS(on)}$ [mΩ]		CoolSiC™ diode I_F [A]
	Server	Telecom	Server and telecom
500	1 x 190	1 x 190	1 x (4~6)
750	1 x 99/2 x 190	2 x 190	1 x (6~8)
1200	2 x (70~99)		1 x (8~10)
2000		2 x 99	2 x (6~8)/1 x (12~16)
2700	3 x (41~80)		2 x (8~10)/1 x (16~20)
3000		2 x 65/1 x 19	2 x (8~10)/1 x (16~20)

- $R_{DS(on)}$ depends on target efficiency level, switching frequency and thermal management
- SiC diode current level depends on switching frequency, current limitation and thermal management

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1200 V CoolSiC™ Schottky diodes generation 5: best price/performance

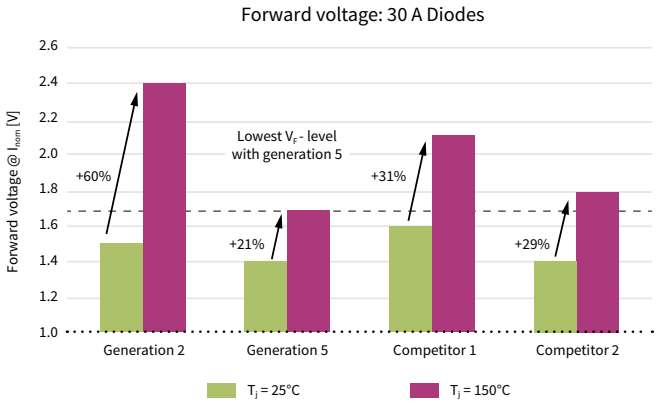
By using hybrid Si IGBT/SiC diode sets, designers of industrial applications will gain flexibility for system optimization compared to Silicon only based solution. System improvements by higher efficiency, higher output power or higher switching frequency are enabled by SiC diodes. In the new 1200 V CoolSiC™ Schottky diodes generation 5 technology, the zero reverse recovery charge comes with a reduction of forward voltage and extended surge current capability compared to previous generation. The ultra-low forward voltage, even at high operating temperature, results in 30 percent static loss gain versus previous generation during full-load condition. Implementing generation 5 CoolSiC™ diodes in combination with Infineon's 1200 V HighSpeed 3 IGBT, designers can achieve outstanding system level performance and reliability.

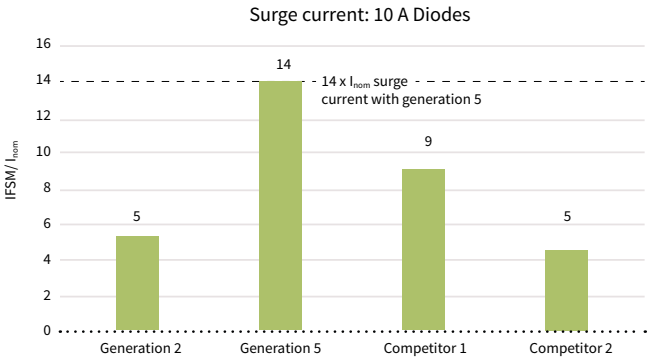
Key features generation 5 versus generation 2

- Low forward voltage (V_F)
- Mild positive temperature dependency of V_F
- Extended surge current capability up to 14 times nominal current
- Up to 40 A rated diode

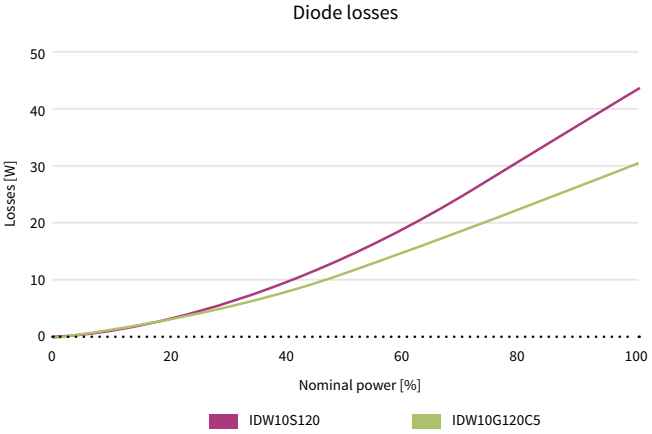
Key benefits 1200 V generation 5 versus 1200 V generation 2

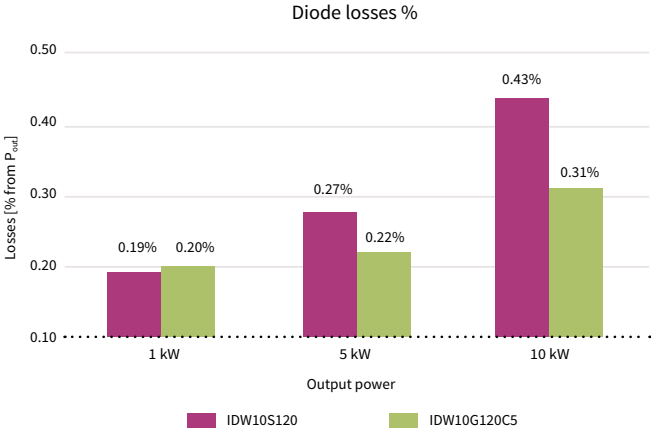
- Up to 30% lower static losses
- Reduced cooling requirements through lower diode losses and lower case temperatures
- High system reliability by extended surge current





Front-end booster stage of a photovoltaic inverter: V_{in} = 500 V, V_{out} = 800 V, 20 kHz, T_j = 125°C





Infineon system solution examples for booster stage with 1200 V components*

Inverter function	SiC diode	IGBT	IGBT driver	Microcontroller
Boost	IDH08G120C5	IKW15N120H3	1ED020I12-F2	XMC400
Boost	IDH10G120C5	IKW25N120H3	1ED020I12-F2	XMC400
Boost	IDW10G120C5B	IKW40N120H3	1ED020I12-F2	XMC400

www.infineon.com/sic

*As rule of thumb for boost design: 3 kW for a 10 A SiC diode or 30 A Si diode

CoolSiC™ Silicon Carbide MOSFET – Revolution to rely on

Infineon's CoolSiC™ technology enables radical new product designs

Silicon Carbide (SiC) opens up new degrees of freedom for designers to harness never before seen levels of efficiency and system flexibility. In comparison to traditional silicon (Si) based switches like IGBTs and MOSFETs, the SiC MOSFET offers a series of advantages. These include, the lowest gate charge and device capacitance levels seen in 1200 V switches, no reverse recovery losses of the internal commutation proof body diode, temperature independent low switching losses, and threshold-free on-state characteristics. Based on volume experience and compatibility know-how, Infineon introduces the revolutionary SiC technology which enables radical new product designs. CoolSiC™ MOSFET first products are targeted for photovoltaic inverters, battery charging and energy storage.

Unique SiC MOSFET characteristics over traditional 1200 V silicon devices

- Low Q_G and intrinsic capacitances
- Zero reverse recovery losses of body diode
- Temperature independent switching losses
- Threshold-free on-state characteristic compared to IGBT

Benefits

- Best-in-class system performance
- Efficiency improvement and reduced cooling effort
- Significant reduction in junction temperature for longer lifetime and higher reliability
- Enables higher frequency operation for reduction in system cost and shrink
- Allows for increase in power density
- 2-level topologies can replace 3-level with same efficiency for lower complexity and cost
- Ease of design and implementation
- Excellent for hard switching and resonant switching topologies like LLC and ZVS

CoolSiC™ MOSFET

Sales product	$R_{DS(on)}$	V_{DS}	Package
IMW120R045M1**	45 mOhm	1200 V	TO-247 3pin
IMZ120R045M1**	45 mOhm	1200 V	TO-247 4pin

TO-247 4pin package contains an additional connection to the source (Kelvin connection) that is used as a reference potential for the gate driving voltage, thereby eliminating the effect of voltage drops over the source inductance. The result is even lower switching losses than for TO-247 3pin version, especially at higher currents and higher switching frequencies.

www.infineon.com/coolsic-mosfet

** Release in 2017

650 V CoolSiC™ generation 5 ACTIVE & PREFERRED

I_F [A]	TO-220 R2L	TO-247 Dual Die	TO-247	DPAK DML	D²PAK R2L	ThinPAK 8x8
2	IDH02G65C5				IDK02G65C5	IDL02G65C5
3	IDH03G65C5				IDK03G65C5	
4	IDH04G65C5				IDK04G65C5	IDL04G65C5
5	IDH05G65C5				IDK05G65C5	
6	IDH06G65C5				IDK06G65C5	IDL06G65C5
8	IDH08G65C5				IDK08G65C5	IDL08G65C5
9	IDH09G65C5				IDK09G65C5	
10	IDH10G65C5		IDW10G65C5		IDK10G65C5	IDL10G65C5
12	IDH12G65C5		IDW12G65C5		IDK12G65C5	IDL12G65C5
16	IDH16G65C5		IDW16G65C5			
20	IDH20G65C5	IDW20G65C5B	IDW20G65C5			
24		IDW24G65C5B				
30/32		IDW32G65C5B	IDW30G65C5			
40		IDW40G65C5B	IDW40G65C5			

www.infineon.com/sic

650 V CoolSiC™ generation 3 ACTIVE

I_F [A]	TO-220 R2L	TO-247 Dual Die	TO-247	DPAK DML	D²PAK	ThinPAK 8x8
3	IDH03SG60C			IDD03SG60C		
4	IDH04SG60C			IDD04SG60C		
5	IDH05SG60C			IDD05SG60C		
6	IDH06SG60C			IDD06SG60C		
8	IDH08SG60C			IDD08SG60C		
9	IDH09SG60C			IDD09SG60C		
10	IDH10SG60C			IDD10SG60C		
12	IDH12SG60C			IDD12SG60C		

1200 V CoolSiC™ generation 5 ACTIVE & PREFERRED

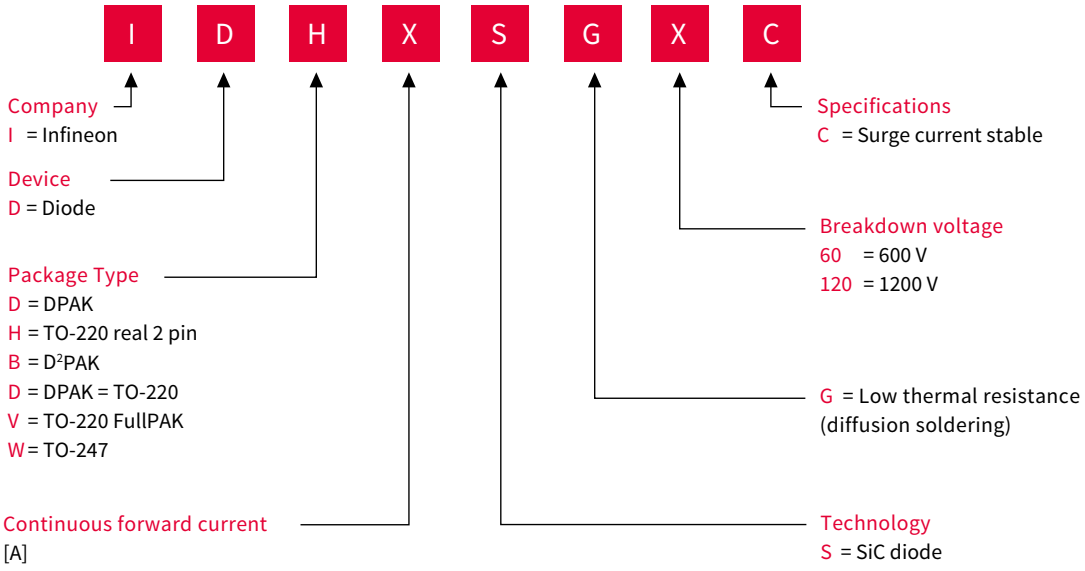
I_F [A]	TO-220 R2L	TO-247 Dual Die	TO-247	DPAK DML	TO220-2 R2L	DPAK R2L
2				IDM02G120C5	IDH02G120C5	
5				IDM05G120C5	IDH05G120C5	
8				IDM08G120C5	IDH08G120C5	
10		IDW10G120C5B		IDM10G120C5	IDH10G120C5	
15/16		IDW15G120C5B			IDH16G120C5	
20		IDW20G120C5B			IDH20G120C5	
30		IDW30G120C5B				
40		IDW40G120C5B				

„B“ refers to common-cathode configuration

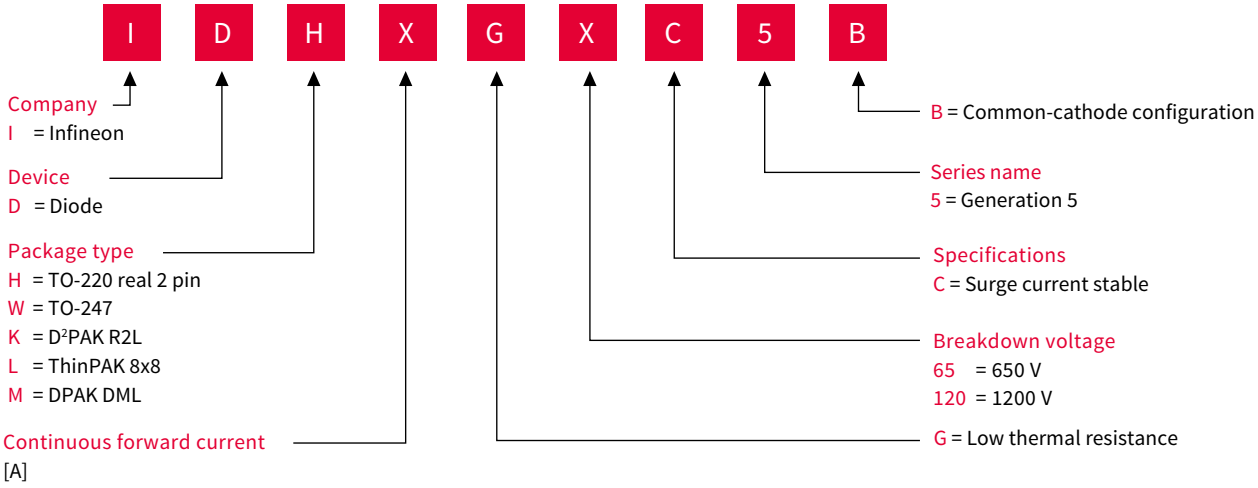
www.infineon.com/sic

Naming system

CoolSiC™ Silicon Carbide Schottky diodes generation 2 and 3

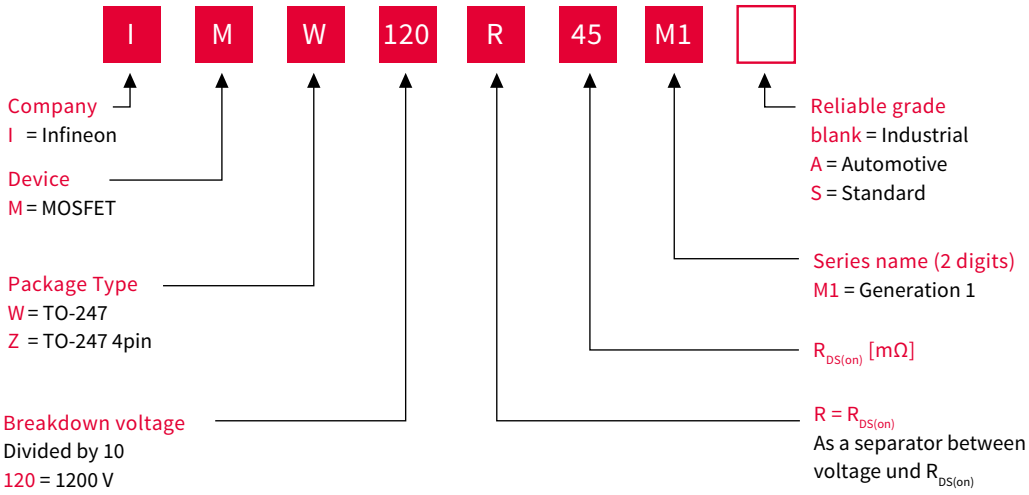


CoolSiC™ Silicon Carbide Schottky diodes generation 5



www.infineon.com/sic

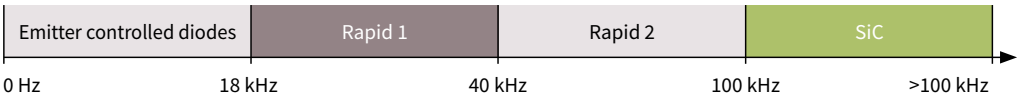
CoolSiC™ MOSFET



Silicon power diodes

Filling the gap between SiC diodes and emitter controlled diodes

The rapid diode family complements Infineon's existing high power 600 V/650 V diode portfolio by filling the gap between SiC diodes and previously released emitter controlled diodes. They represent a perfect cost/performance balance and target high efficiency applications switching between 18 kHz and 100 kHz. rapid 1 and rapid 2 diodes are optimized to have excellent compatibility with CoolMOS™ and high speed IGBTs (Insulated Gate Bipolar Transistor) such as the TRENCHSTOP™ 5 and HighSpeed 3.



The rapid 1 diode family

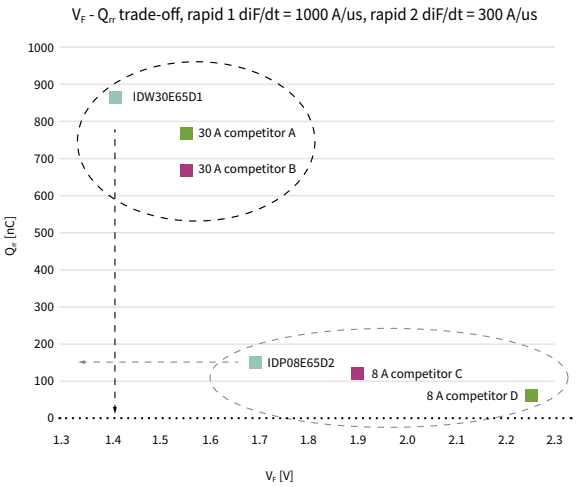
Rapid 1 is forward voltage drop (V_F) optimized to address low switching frequency applications between 18 kHz and 40 kHz, for example air conditioner and welder PFC stages.

- 1.35 V temperature-stable forward voltage (V_F)
- Lowest peak reverse recovery current (I_{rrm})
- Reverse recovery time (t_{rr}) < 100 ns
- High softness factor

The rapid 2 diode family

Rapid 2 is $Q_{rr/trr}$ optimized hyperfast diode to address high speed switching applications between 40 kHz and 100 kHz, typically found in PFCs in high efficiency switch mode power supplies (SMPS) and welding machines.

- Lowest reverse recovery charge (Q_{rr}): V_F ratio for best-in-class performance
- Lowest peak reverse recovery current (I_{rrm})
- Reverse recovery t_{rr} < 50 ns
- High softness factor



www.infineon.com/rapiddiodes
www.infineon.com/ultrasoftdiodes

Rapid 1 diodes

650 V product family

Continuous current I_c @T_c=100°C [A]	TO-220 Halogen-Free	TO-220 FullPAK Halogen-Free	TO-220 Common Cathode Halogen-Free	TO-247 Halogen-Free	TO-247 Common Cathode Halogen-Free
8	IDP08E65D1				
15	IDP15E65D1				
20		IDV20E65D1			
30	IDP30E65D1			IDW30E65D1	IDW30C65D1
40				IDW40E65D1	
60					IDW60C65D1
75					IDW75D65D1
80					IDW80C65D1

Rapid 2 diodes

650 V product family

Continuous current I_c @T_c=100°C [A]	TO-220 Halogen-Free	TO-220 FullPAK Halogen-Free	TO-220 Common Cathode Halogen-Free	TO-247 Halogen-Free	TO-247 Common Cathode Halogen-Free
8	IDP08E65D2	IDV08E65D2			
15	IDP15E65D2	IDV15E65D2		IDW15E65D2	
20	IDP20E65D2		IDP20C65D2		IDW20C65D2
30	IDP30E65D2	IDV30E65D2	IDP30C65D2		IDW30C65D2
40	IDP40E65D2			IDW40E65D2	
80					IDW80C65D2

www.infineon.com/rapiddiodes

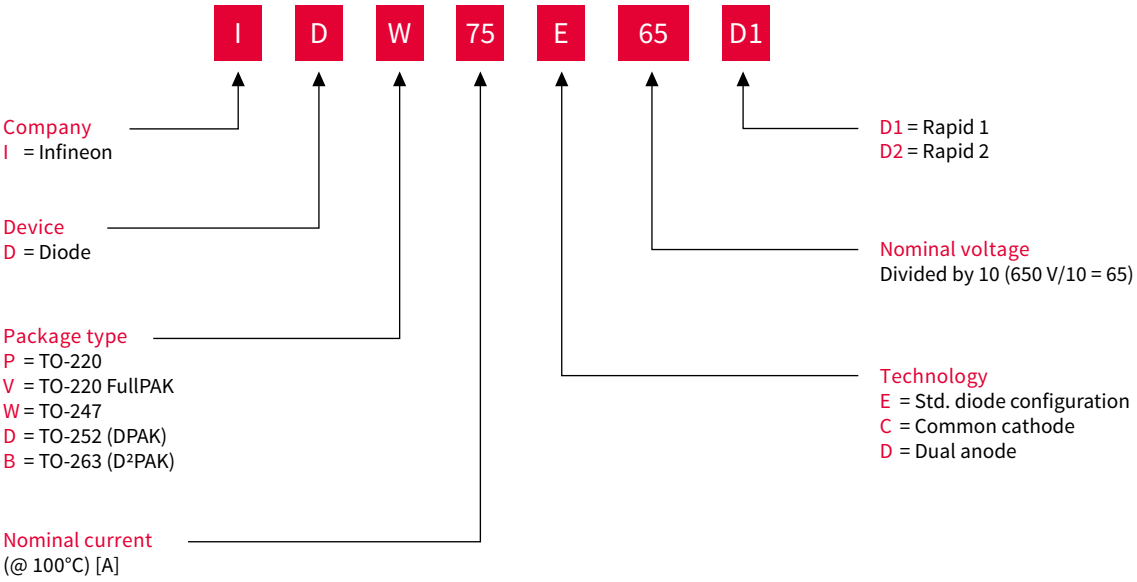
Emitter controlled diodes

600 V and 1200 V product families

	Continuous current I_c @T_c=100°C [A]	TO-252 (DPAK) Halogen-Free	TO-263 (D^2PAK) Halogen-Free	TO-220 Real 2pin Halogen-Free	TO-247 Halogen-Free
600 V	6	IDD06E60			
	9	IDD09E60			
	15	IDD15E60	IDB15E60	IDP15E60	
	30		IDB30E60	IDP30E60	IDW30E60
	45			IDP45E60	
	50				IDW50E60
	75				IDW75E60
	100				IDW100E60
1200 V	12			IDP12E120	
	18			IDP18E120	
	30		IDB30E120	IDP30E120	

Naming system

Silicon power diodes



www.infineon.com/ultrasoftdiodes

Infineon support for SiC discretes and Si diodes

Useful links and helpful information

Further information, datasheets and documents
www.infineon.com/sic
www.infineon.com/rapiddiodes
www.infineon.com/ultrasoftdiodes

Videos
www.infineon.com/mediacenter

Info Document Play

Discrete IGBTs

Market leadership through groundbreaking innovation and application focus

Striving for the highest standards in performance and quality, Infineon offers comprehensive application specific discrete IGBTs.

Overview discrete IGBTs

Product portfolio

	TO-252 (DPAK)	TO-263 (D^2PAK)	TO-220	TO-220 FullPAK	TO-247	TO-247 4pin	TO-247PLUS
Package options						 NEW!	 NEW!
Voltage class	600 V, 650 V, 900 V, 1100 V, 1200 V, 1350 V, 1600 V						
Configuration	DuoPack (with diode), single IGBTs						
Continuous collector current T_c = 100°C	2 A – 120 A						

New products are application specific developed to achieve highest value.

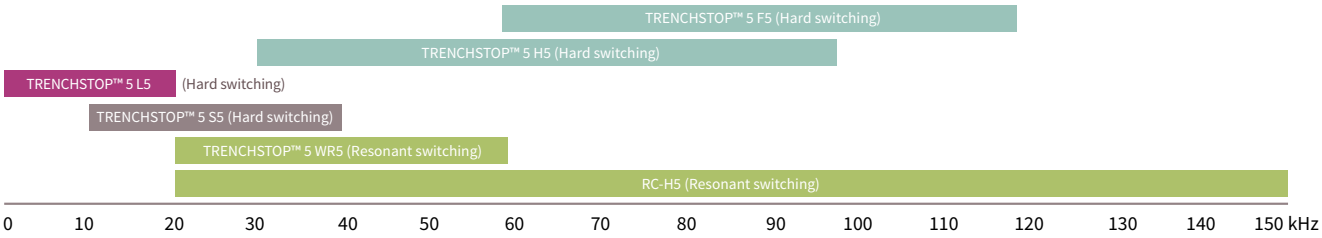
New best-in-class technologies and applications

Technology	Application
TRENCHSTOP™ 5 H5/F5 650 V	Welding, Solar, UPS, Telecom, Server, Battery, Storage
TRENCHSTOP™ 5 L5 650 V	Solar, UPS, Welding
Rapid diode 650 V	Aircon, Welding, SMPS, UPS
RC-H5 650 V/1200 V/1350 V	Induction
RC-E 1200 V	Induction
WR5 650 V	Welding, PFC
RC-drives RC-drives fast 600 V	Home Appliance
TRENCHSTOP™ 5 S5 650 V	Solar, UPS, Storage, Welding

www.infineon.com/igbtdiscretes

650 V TRENCHSTOP™ 5 IGBT

In terms of switching and conduction losses, there is no other IGBT on the market that can match the performance of the TRENCHSTOP™ 5. Wafer thickness has been reduced by more than 25 percent, which enables a dramatic improvement in both switching and conduction losses, whilst providing an increased breakthrough voltage of 650 V. Based on TRENCHSTOP™ 5 IGBT technology, Infineon has developed six different product families optimized for specific applications, allowing designers to optimize for high efficiency, system cost or reliability demands of the market. The quantum leap of efficiency improvement provided by the TRENCHSTOP™ 5 IGBT families opens up new opportunities for designers to explore.



TRENCHSTOP™ 5 L5	**Best-in-class IGBT low $V_{CE(sat)}$ IGBT** $V_{CE(sat)}$ IGBT – 1.05 V Best trade-off $V_{CE(sat)}$ V_{ss} E_{ts} for frequencies below 20 kHz	**Solar, welding, UPS, PFC** › Ultra low frequency converters › 3-level inverter type I NPC 1 and NPC 2 › Modified HERIC inverter › AC output (Aluminum/Magnesium welding)
TRENCHSTOP™ 5 S5	**Best-in-class ease-of-use IGBT** Elimination of: › Collector-emitter snubber capacitor and gate capacitor in low inductance designs (<100 nH) › Softer switching than TRENCHSTOP™ 5 H5	**Solar, welding, UPS, battery charger** › Medium frequency converters › Multilevel inverter stages › Output stages › PFC
TRENCHSTOP™ 5 H5/F5	**Best-in-class high frequency IGBT** › Bridge to superjunction MOSFET performance › Highest efficiency, especially under light load conditions	**Solar, welding, UPS** › High frequency converters › Multilevel inverter stages › Output stages › PFC
TRENCHSTOP™ 5 R5	**Price/performance optimized application specific IGBT**	**Induction heating – RC-H5** Half-bridge topologies in induction cooking appliances and other resonant switching applications
TRENCHSTOP™ 5 WR5	**Price optimized application specific IGBT for zero current switching (ZCS)** › Optimized full rated hard switching turn-off typically found in welding › Excellent R_G controllability › Soft recovery plus low Q_{rr} for diode	**Welding, PFC** › Medium frequency converters › Zero-voltage switching › PFC

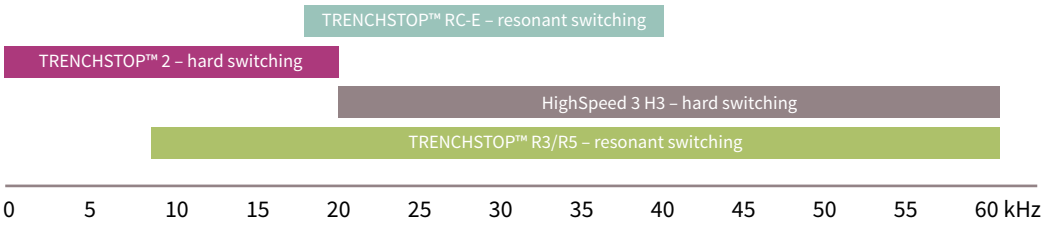
www.infineon.com/trenchstop5

Overview of 1200 V IGBT families

Infineon's 1200 V TRENCHSTOP™ 2 IGBT technology combines trench top-cell and field stop concepts to offer significant improvement of static as well as dynamic performance of the device.
The combination of IGBT with a soft recovery emitter controlled diode further minimizes the turn-on losses. The highest efficiency is reached due to the best compromise between switching and conduction losses.

The 1200 V HighSpeed 3 discrete IGBTs provides the lowest losses and highest reliability for switching above 20 kHz. Transition to fast switching high speed devices allows reduction in the size of the active components (25 kHz – 70 kHz). The smaller size of the components allows high power density designs with less system costs.

The RC-H5 family is the latest generation in the RC-H series of reverse conducting IGBT. With a monolithically integrated diode, they offer optimized performance for resonant switching applications such as induction cooking. R5 devices are also available in 1350 V blocking voltage.



RC-H5	**World famous TRENCHSTOP™ RC-H products** High performance and low losses	**Induction cooking** **Resonant switching** Medium to high frequency converters
RC-E	**New TRENCHSTOP™ RC-E** Price versus performance leader	**Induction cooking** **Resonant switching** Low to medium power cookers
TRENCHSTOP™ 2	**Best-in-class 1200 V IGBT** › Outstanding efficiency › Lowest conduction and switching losses › Market proven and recognized quality leader	**Motor control, drives, solar, UPS** Low frequency converters
HighSpeed 3 H3	**High speed/high power IGBT** › First tail-less/low loss IGBT on market › Market proven and recognized quality leader	**Solar, UPS, welding** Medium frequency converters

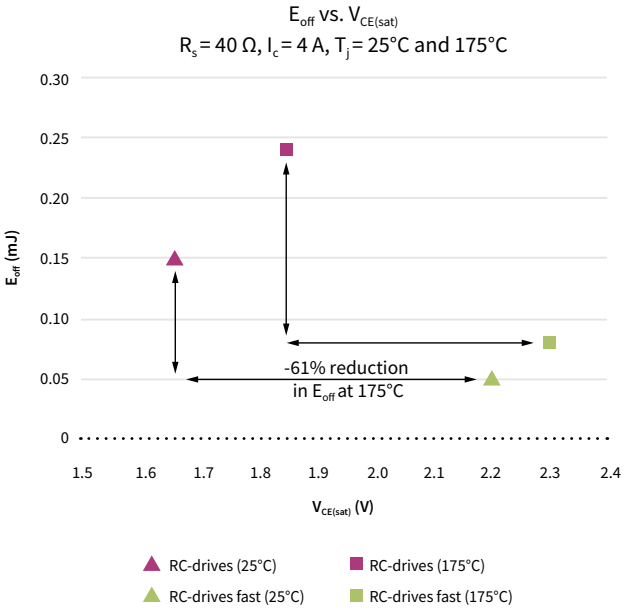
www.infineon.com/600V-1200V-trenchstop
www.infineon.com/highspeed3
www.infineon.com/rch5
www.infineon.com/rc-e

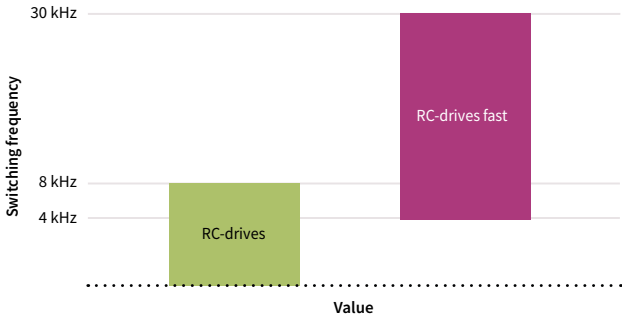
RC-drives and RC-drives fast

The RC-drives (RC-D) IGBT technology is a cost optimized solution for permanent magnet synchronous and brushless DC motors in the price-sensitive consumer drives market. The RC-drives fast (RC-DF) family extension was developed to provide outstanding performance at switching frequencies above 8 kHz.

- IGBT and diode were optimized to reduce losses at frequencies of 18-30 kHz
- Audible noise can be reduced to absolutely silent level for high efficiency Inverters operating above 16 kHz

Highly precise vector control techniques can be used to provide more torque in operation at low speed and high performance dynamics in the control at high speed. Furthermore, the small size of RC-drives allows high power density designs with less system costs.





Features

- Optimized E_{on}, E_{off} and Q_{rr} for up to 20% lower switching losses
- Operating range from DC to 30 kHz
- Max. junction temperature 175°C
- Short circuit capability of 5 µs
- Very tight parameter distribution
- Best-in-class current versus package size performance
- Smooth switching performance leading to low EMI levels
- Complete product portfolio and PSpice models on the internet

Benefits

- Excellent cost/performance for hard switching applications
- Outstanding temperature stability
- Very good EMI behavior
- Up to 60% space saving on the PCB
- Higher reliability due to monolithically integrated IGBT and diode due to less thermal cycling during switching

Applications RC-drives (f_{sw} < 4 kHz)

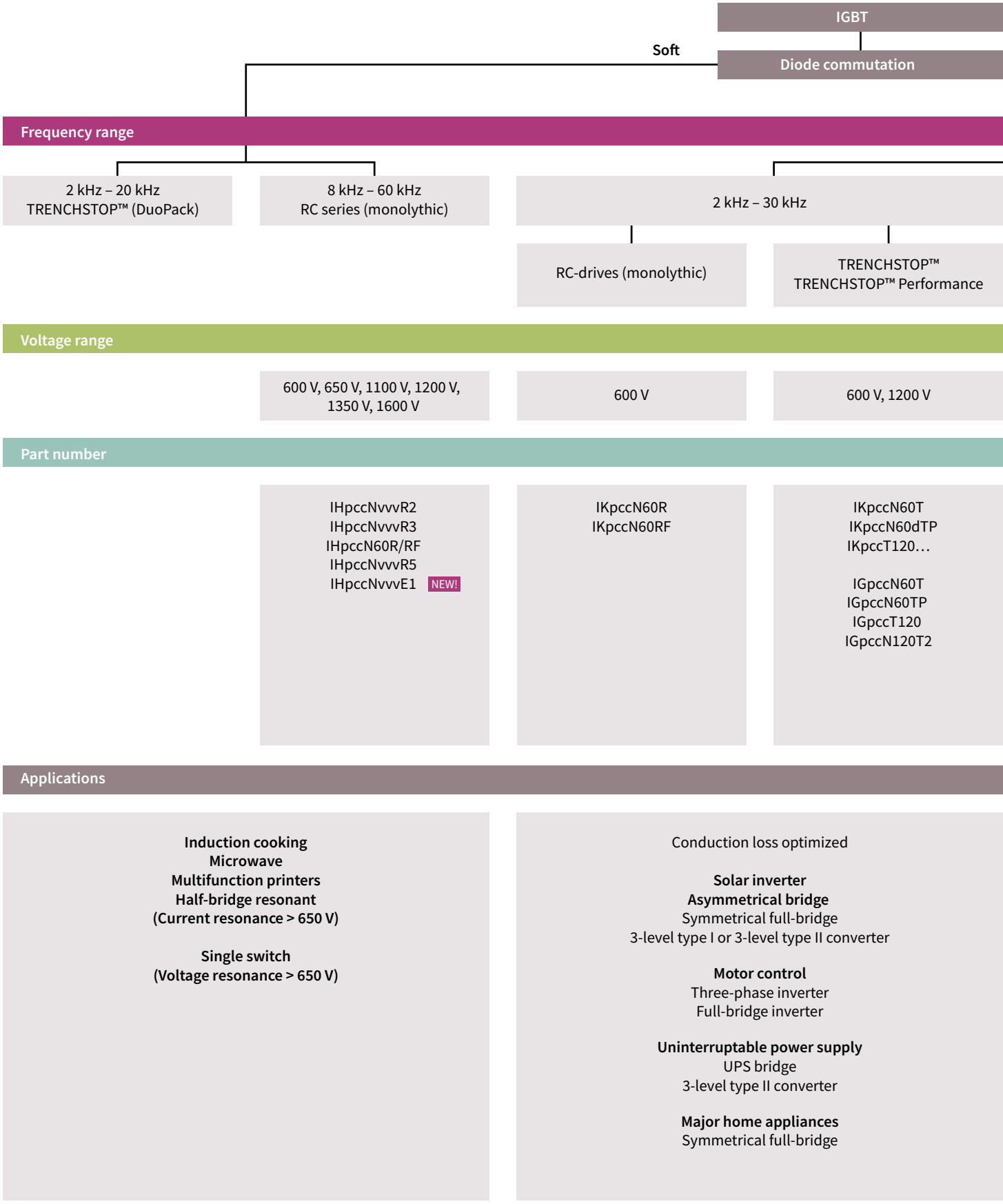
- Fridge compressors
- Pumps
- Fans
- Aircon compressors

Applications RC-drives fast (4 kHz < f_{sw} < 30 kHz)

- Washing machines
- General purpose inverters
- Aircon compressors
- Hard switching topologies up to 1.0 kW

www.infineon.com/rcdf

IGBT selection tree

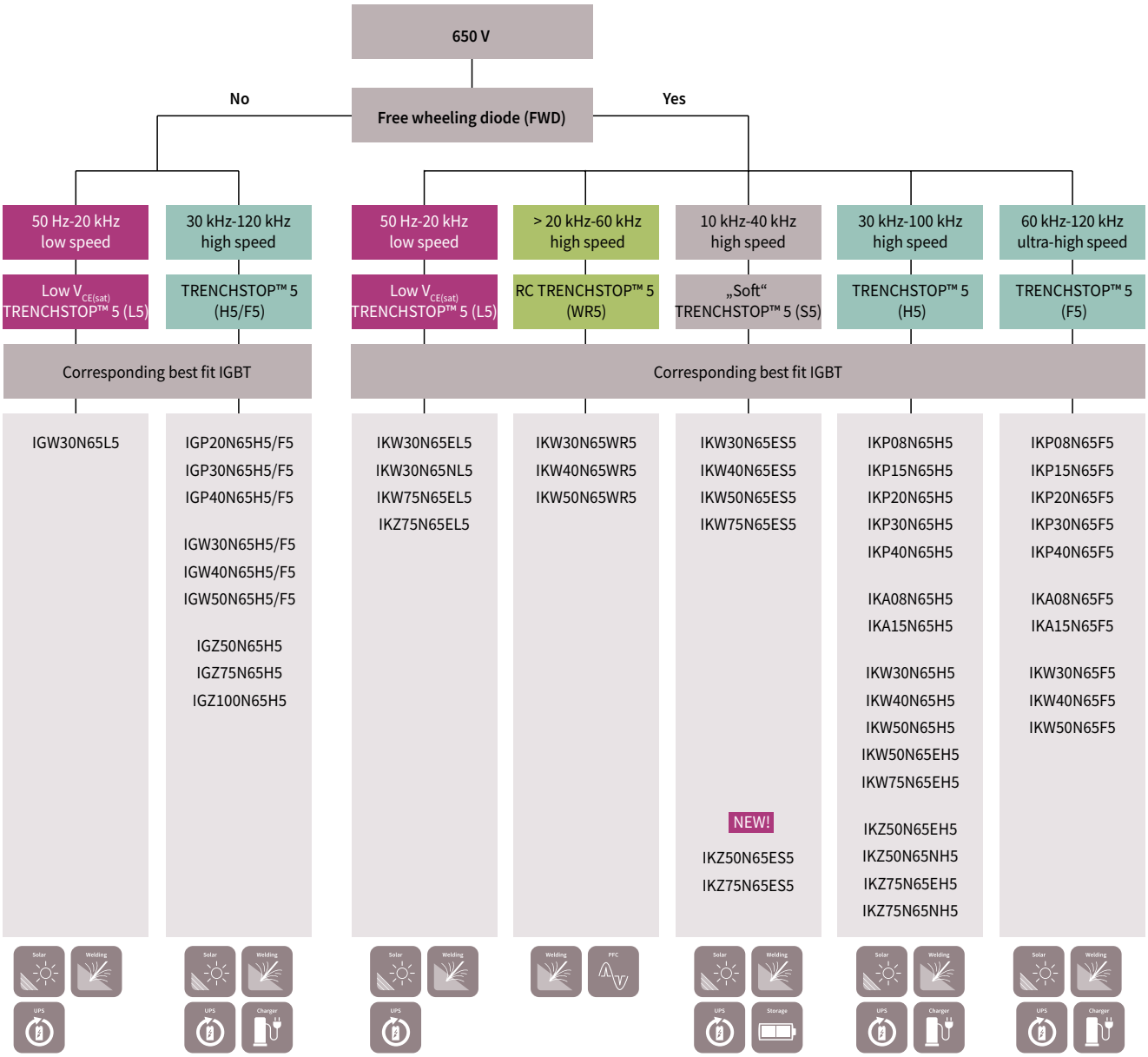


www.infineon.com/igbtdiscretes

Hard/no diode for IG parts**

10 kHz – 40 kHz medium speed	> 18 kHz – 60 kHz high speed	10 kHz – 100 kHz high speed	> 18 kHz – 60 kHz high speed	50 Hz – 20 kHz low speed
Soft turn-off TRENCHSTOP™ 5 (S5)	HighSpeed 3 (H3)	TRENCHSTOP™ 5 H5/F5	RC TRENCHSTOP™ 5 (WR5)	Low $V_{CE(sat)}$ TRENCHSTOP™ 5 (L5)
650 V	600 V, 1200 V	650 V	650 V	650 V
IKpccN65dS5	IKpccN60H3 IKpccN120H3 IGpccN60H3 IGpccN120H3	IKpccN65H5 IKpccN65F5 IGpccN65H5 IGpccN65F5	IKpccN65dR5	IKpccN65dL5 IGpccN65L5
UPS **Energy storage** **Battery charger** **Welding** **Solar Inverter**	**PFC** **Battery charger** **Welding** **UPS** **Solar** **Energy storage** **SMPS** **Air conditioning** **HVDC (Telecom/data centers)**		**PFC** **Welding inverter** Full-brigde Half-bridge Two transistor forward	**UPS** 3-level NPC1 and NPC2 topology, inner switches **Solar** 3-level NPC1 and NPC2 topology, inner switches **Welding** AC output (Al/Mag welding)

TRENCHSTOP™ 5 selection tree



www.infineon.com/trenchstop5

TRENCHSTOP™ and RC-drives

600 V product family

Continuous collector current @ T_c=100°C [A]		TO-251 (IPAK) Halogen-Free	TO-252 (DPAK) Halogen-Free	TO-263 (D^2PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I^2PAK) Halogen-Free	TO-220 FullPAK Halogen-Free	TO-247 Halogen-Free	TO-247PLUS/ Super 247 (TO247AA) Halogen-Free
Single IGBT	4	IGU04N60T							
	6		IGD06N60T		IGP06N60T				
	10			IGB10N60T	IGP10N60T				
	15			IGB15N60T	IGP15N60T				
	30			IGB30N60T				IGW30N60T IGW30N60TP NEW!	
	40							IGW40N60TP NEW!	
	50			IGB50N60T	IGP50N60T			IGW50N60T IGW50N60TP NEW!	
	75							IGW75N60T	
IGBT and diode	3		IKD03N60RF						
	4		IKD04N60RF IKD04N60R		IKP04N60T				
	6		IKD06N60RF IKD06N60R	IKB06N60T	IKP06N60T		IKA06N60T		
	10		IKD10N60RF IKD10N60R	IKB10N60T	IKP10N60T		IKA10N60T		
	15		IKD15N60RF IKD15N60R	IKB15N60T	IKP15N60T		IKA15N60T		
	20			IKB20N60T	IKP20N60T			IKW20N60T	
	30							IKW30N60T IKW30N60DTP NEW!	
	40							IKW40N60DTP NEW!	
	50							IKW50N60T IKW50N60DTP NEW!	
	75							IKW75N60T	
	100								IKQ100N60T
	120								IKQ120N60T

TRENCHSTOP™

1200 V product family

Continuous collector current @ T_c=100°C [A]		TO-251 (IPAK)	TO-252 (DPAK) Halogen-Free	TO-263 (D^2PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I^2PAK) Halogen-Free	TO-220 FullPAK	TO-247 Halogen-Free	
								TRENCHSTOP™	TRENCHSTOP™ 2
Single IGBT	8							IGW08T120	
	15							IGW15T120	
	25							IGW25T120	
	40							IGW40T120	
	60							IGW60T120	
DuoPack	8							IKW08T120	
	15							IKW15T120	IKW15N120T2
	25							IKW25T120	IKW25N120T2
	40							IKW40T120	IKW40N120T2

www.infineon.com/600V-1200V-trenchstop

Induction cooking series

650 V, 1100 V, 1200 V, 1350 V and 1600 V product families

Continuous collector current @ T_c=100°C [A]		TO-247 Halogen-Free				
		650 V	1100 V	1200 V	1350 V	1600 V
	15			IHW15N120E1 NEW!		
	20	IHW20N65R5				
				IHW20N120R5	IHW20N135R5	
	25			IHW25N120E1 NEW!		
	30	IHW30N65R5	IHW30N110R3	IHW30N120R3	IHW30N135R3	IHW30N160R2
	40	IHW40N65R5		IHW40N120R3	IHW40N135R3	
	50	IHW50N65R5				

HighSpeed 3

600 V product family

Continuous collector current @ T_c=100°C [A]		TO-251 (IPAK)	TO-252 (DPAK) Halogen-Free	TO-263 (D^2PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I^2PAK) Halogen-Free	TO-220 FullPAK Halogen-Free	TO-247 Halogen-Free
IGBT	20			IGB20N60H3	IGP20N60H3			IGW20N60H3
	30			IGB30N60H3	IGP30N60H3			IGW30N60H3
	40							IGW40N60H3
	50							IGW50N60H3
	60							IGW60N60H3
	75							IGW75N60H3
	100							IGW100N60H3
DuoPack	20			IKB20N60H3	IKP20N60H3			IKW20N60H3
	30							IKW30N60H3
	40							IKW40N60H3
	50							IKW50N60H3
	60							IKW60N60H3
	75							IKW75N60H3

HighSpeed 3

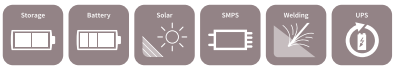
1200 V product family

Continuous collector current @ T_c=100°C [A]		TO-251 (IPAK)	TO-252 (DPAK) Halogen-Free	TO-263 (D^2PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I^2PAK) Halogen-Free	TO-220 FullPAK Halogen-Free	TO-247 Halogen-Free
IGBT	15							IGW15N120H3
	25							IGW25N120H3
	40							IGW40N120H3
DuoPack	15							IKW15N120H3
	25							IKW25N120H3
	40							IKW40N120H3

www.infineon.com/rch5
www.infineon.com/rc-e
www.infineon.com/highspeed3

TRENCHSTOP™ 5 F5 and H5

650 V product family



Continuous collector current @ T_c=100°C [A]		TO-251 (IPAK)	TO-252 (DPAK) Halogen-Free	TO-263 (D^2PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I^2PAK) Halogen-Free	TO-220 FullPAK Halogen-Free	TO-247 Halogen-Free	TO-247 4pin Halogen-Free
IGBT	20				IGP20N65F5/H5				
	30				IGP30N65F5/H5				
	40				IGP40N65F5/H5			IGW40N65F5/H5	
	50							IGW50N65F5/H5	IGZ50N65H5
	75							IGW75N65H5	IGZ75N65H5
	100								IGZ100N65H5
DuoPack	8				IKP08N65F5/H5		IKA08N65F5/H5		
	15				IKP15N65F5/H5		IKA15N65F5/H5		
	20				IKP20N65H5/F5				
	30				IKP30N65H5/F5			IKW30N65H5	
	40				IKP40N65F5/H5			IKW40N65F5/H5	
	50							IKW50N65F5/H5 IKW50N65EH5	IKZ50N65EH5 IKZ50N65NH5
	75							IKW75N65EH5	IKZ75N65NH5 IKZ75N65EH5

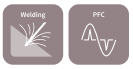
TRENCHSTOP™ 5 L5 low $V_{CE(sat)}$

650 V product family

Continuous collector current @ T_c=100°C [A]		TO-251 (IPAK)	TO-252 (DPAK) Halogen-Free	TO-263 (D^2PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I^2PAK) Halogen-Free	TO-220 FullPAK Halogen-Free	TO-247 Halogen-Free	TO-247 4pin Halogen-Free
IGBT	30							IGW30N65L5	
DuoPack	30							IKW30N65EL5 IKW30N65NL5	
	75							IKW75N65EL5	IKZ75N75EL5

TRENCHSTOP™ 5 WR5

650 V product family



Continuous collector current @ T_c=100°C [A]		TO-251 (IPAK)	TO-252 (DPAK) Halogen-Free	TO-263 (D^2PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I^2PAK) Halogen-Free	TO-220 FullPAK Halogen-Free	TO-247 Halogen-Free	TO-247 4pin Halogen-Free
DuoPack	30							IKW30N65WR5	
	40							IKW40N65WR5	
	50							IKW50N65WR5	

TRENCHSTOP™ 5 S5

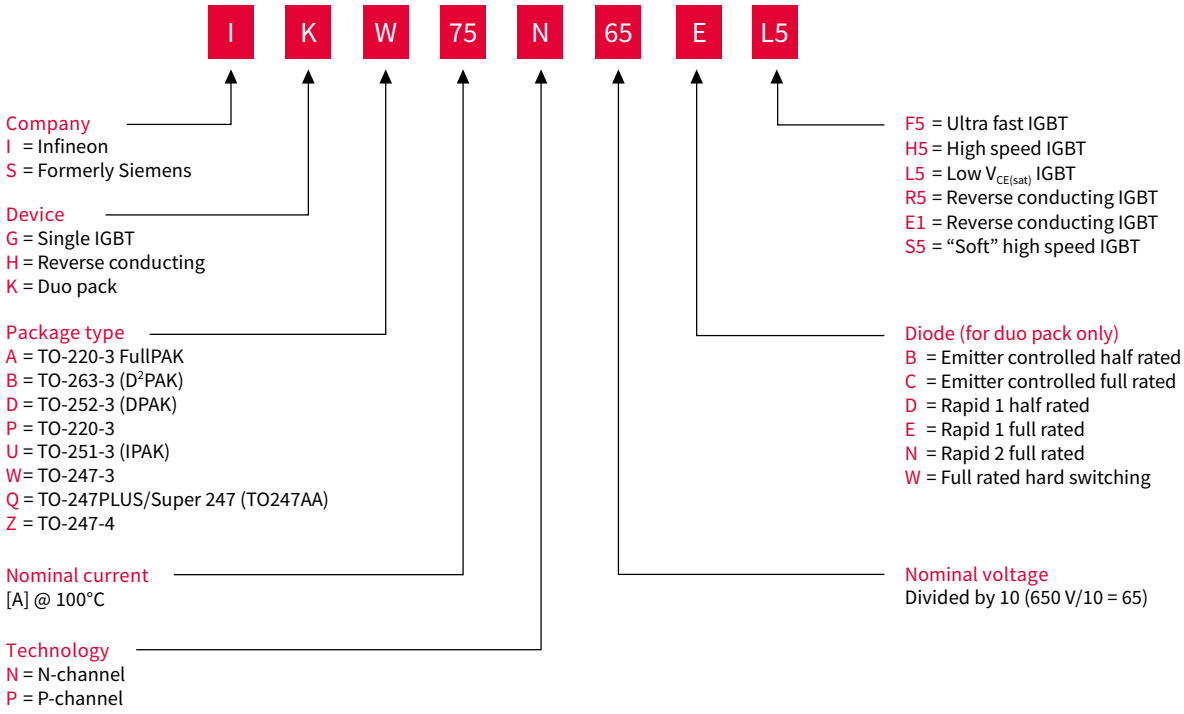
650 V product family

Continuous collector current @ T_c=100°C [A]		TO-251	TO-252 (DPAK) Halogen-Free	TO-263 (D^2PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I^2PAK) Halogen-Free	TO-220 FullPAK Halogen-Free	TO-247 Halogen-Free	TO-247 4pin Halogen-Free
DuoPack	30							IKW30N65ES5	
	40							IKW40N65ES5	
	50							IKW50N65ES5	IKZ50N65ES5 NEW!
	75							IKW75N65ES5	IKZ50N65ES5 NEW!

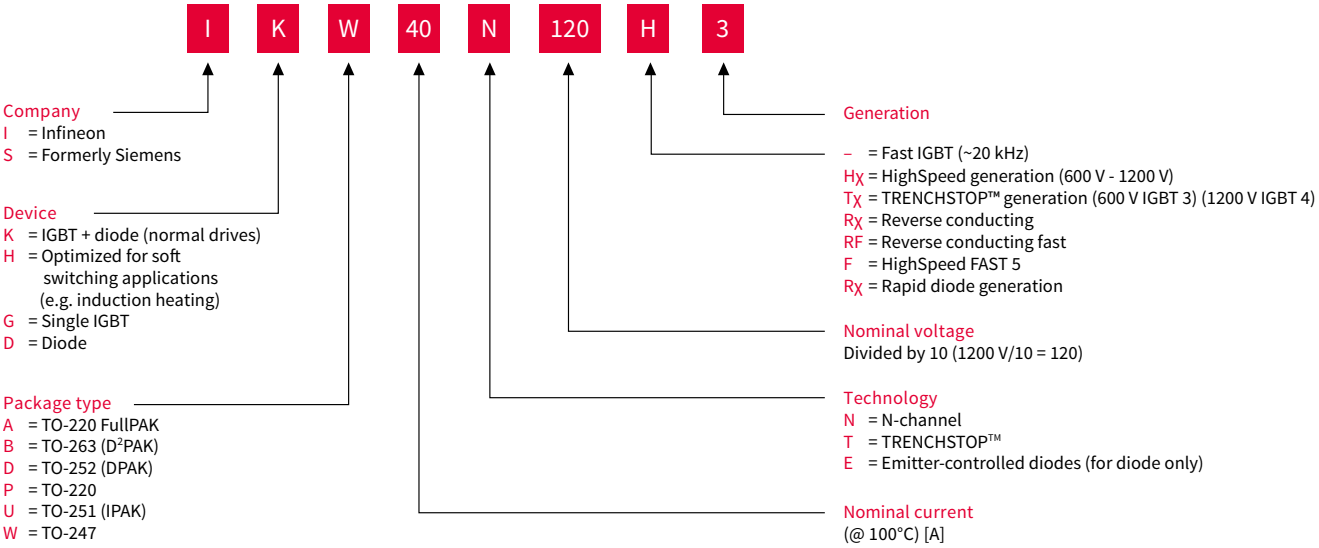
www.infineon.com/trenchstop5

Naming system

IGBT (products launched after 03/2013)



IGBT (products launched before 03/2013)



www.infineon.com/igbtdiscretes

Infineon support for discrete IGBTs

Useful links and helpful information

Further information, datasheets and documents

www.infineon.com/igbt
www.infineon.com/igbtdiscretes
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Evaluationboards and simulation models

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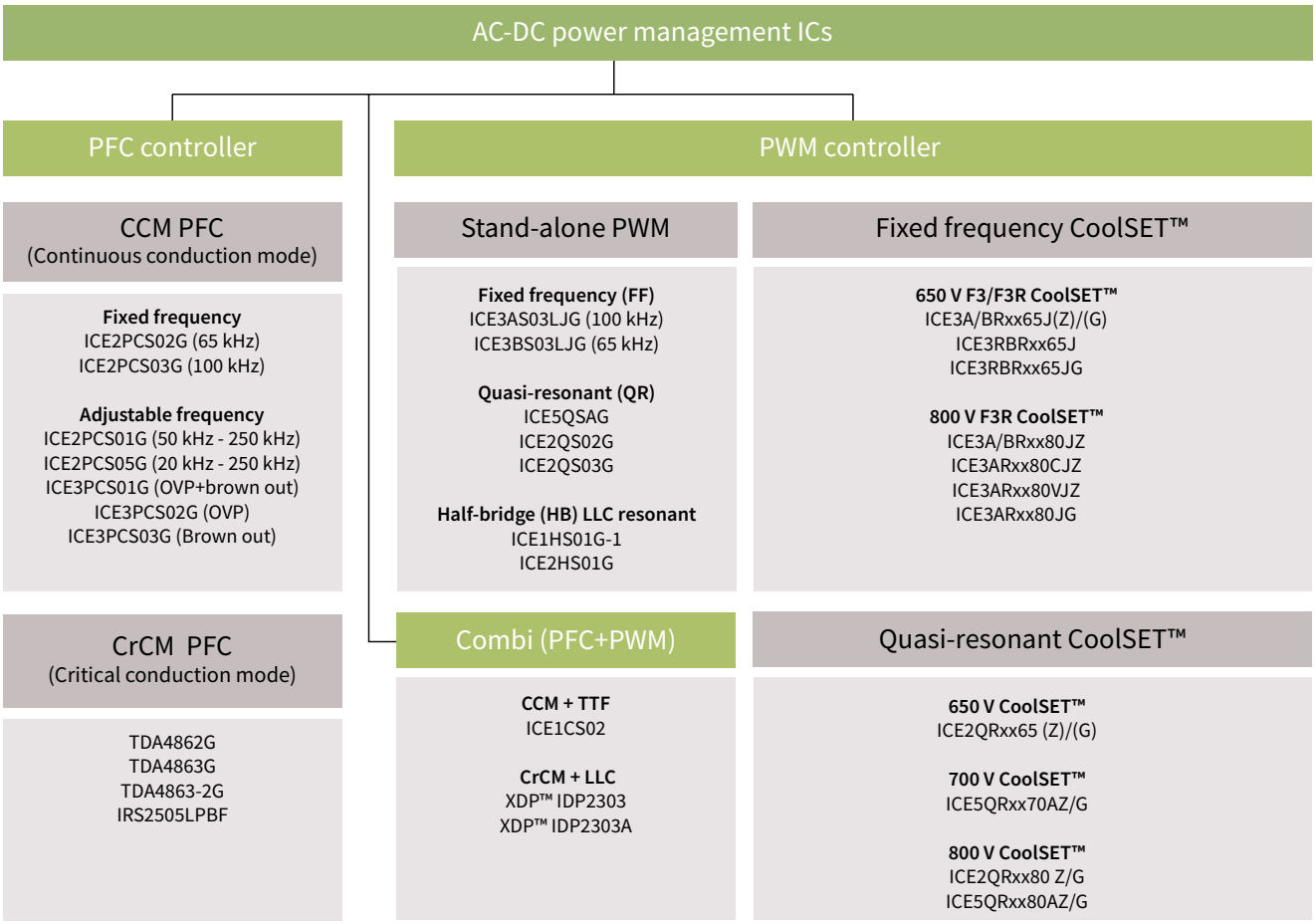
Videos

www.infineon.com/mediacenter

Info | Document | Evaluation Board | Simulation | Play

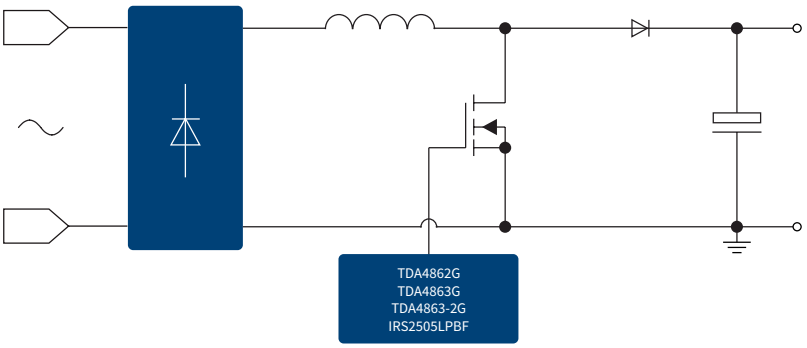
Power management ICs

Technology leadership in power supply



Power factor correction and combo controller

Critical conduction mode PFC ICs



TDA4862G

Power factor controller (PFC) IC for high-power factor and active harmonic filter

- IC for sinusoidal line-current consumption
- Power factor approaching 1
- Controls boost converter as an active harmonics filter
- Internal start-up with low current consumption
- Zero current detector for discontinuous operation mode
- High current totem pole gate driver
- Trimmed +/-1.4% internal reference
- Undervoltage lock out with hysteresis
- Very low start-up current consumption
- Pin compatible with world standard
- Output overvoltage protection
- Current sense input with internal low pass filter
- Totem pole output with active shutdown during UVLO
- Junction temperature range -40°C to +150°C
- Available in DIP-8 and SO-8 packages

TDA4863G/TDA4863-2G

Power factor controller IC for high-power factor and low THD additional features to TDA4862

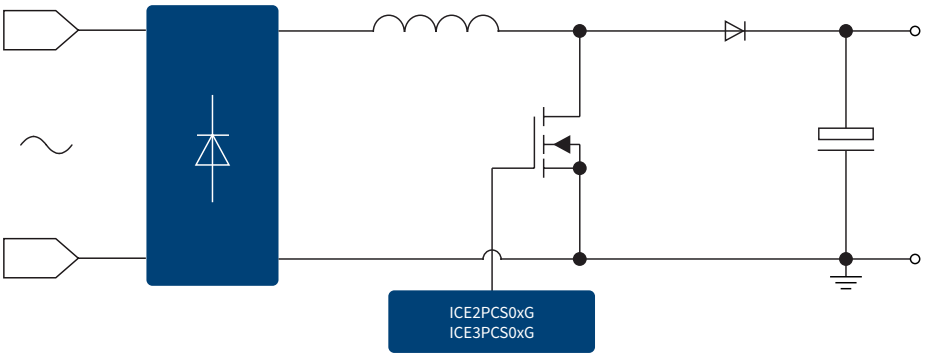
- Reduced tolerance of signal levels
- Improved light load behavior
- Open loop protection
- Current sense input with leading edge blanking LEB
- Undervoltage protection
- SO-8 package

IRS2505LPBF

- Critical-conduction mode PFC control
- High PF and ultra-low THD
- Wide load and line range
- Regulated and programmable DC bus voltage
- No secondary winding required
- MOSFET cycle-by-cycle over-current protection
- DC bus over-voltage protection
- Low EMI gate drive
- Ultra-low start-up current
- 20.8 V internal zener clamp on V_{CC}
- Excellent ESD and latch immunity
- RoHS compliant
- 5pin SOT-23 package

www.infineon.com/acdc

Continuous conduction mode PFC ICs



2nd generation continuous conduction mode (CCM) Power factor correction IC features

- Fulfills class D requirements of IEC 61000-3-2
- Lowest count of external components
- Adjustable and fixed switching frequencies
- Frequency range from 20 kHz to 250 kHz
- Versions with brown out protection available
- Wide input range supported
- Enhanced dynamic response during load jumps
- Cycle by cycle peak current limiting
- Integrated protections OVP, OCP
- DIP-8 and DSO-8
- Lead free, RoHS compliant

2nd generation continuous conduction mode (CCM) power factor correction IC product portfolio

Product	Frequency – f_{sw}	Current drives	Package
ICE2PCS01G	50 kHz-250 kHz	2.0 A	DSO-8
ICE2PCS02G	65 kHz	2.0 A	
ICE2PCS03G	100 kHz	2.0 A	
ICE2PCS05G	20 kHz-250 kHz	2.0 A	

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3rd generation continuous conduction mode (CCM) Power factor correction IC features

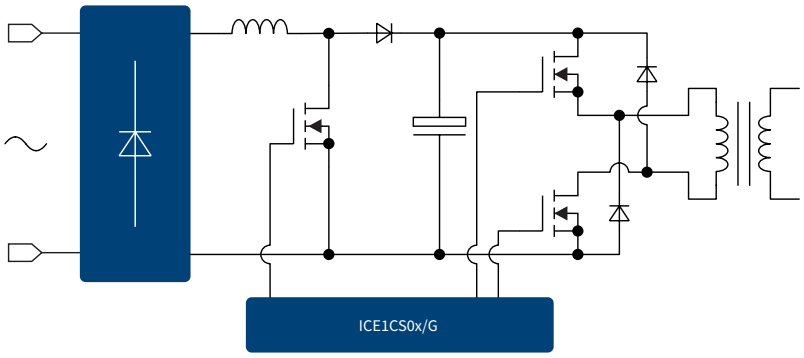
- Fulfills class D requirements of IEC 61000-3-2
- Integrated digital voltage loop compensation
- Boost follower function
- Bulk voltage monitoring signals, brown out
- Multi protections such as double OVP
- Fast output dynamic response during load jump
- External synchronization
- Extra low peak current limitation threshold
- SO-8 and SO-14
- Lead free, RoHS compliant

Fixed frequency PWM IC and CoolSET™ product portfolio

Product	Frequency – f_{sw}	Current drives	Features	Package
ICE3PCS01G	Adjustable	0.75 A	OVP+Brown out	SO-14
ICE3PCS02G		0.75 A	OVP	SO-8
ICE3PCS03G		0.75 A	Brown out	SO-8

CCM PFC by feature	ICE2PCS01G ICE2PCS05G	ICE2PCS02G ICE2PCS03G	ICE3PCS03G	ICE3PCS02G	ICE3PCS01G
Digital control voltage loop	–		✓	✓	✓
Variable frequency	✓	–	✓	✓	✓
Synchronous frequency	–		✓	✓	✓
Open loop protection	✓	✓	✓	✓	✓
Low peak current limit	-1 V	-1 V	-0.4 V	-0.4 V	-0.2 V
Brown out protection	–	✓	✓	–	✓
Over voltage protection	✓	✓	✓	✓	✓
Second over voltage protection	–			✓	✓
PFC enable function	–				✓
Boost follower mode	–				✓
5 V regulator	–				✓

Combination of continuous conduction mode PFC with two-transistor forward PWM IC



- Pre-short protection
- Trimmed reference voltage +/-2.5% (+/-2% at 25°C)
- BiCMOS technology for wider V_{CC} range

Power factor correction block

- Fulfills class D requirements of IEC 61000-3-2
- Fixed switching frequency (sync. to half PWM freq.)
- AC brown out protection
- Average current control
- Max. duty cycle of 95%
- Enhanced dynamic response for fast load response
- Unique soft start to limit start up current
- Over voltage protection

Pulse-width-modulation block

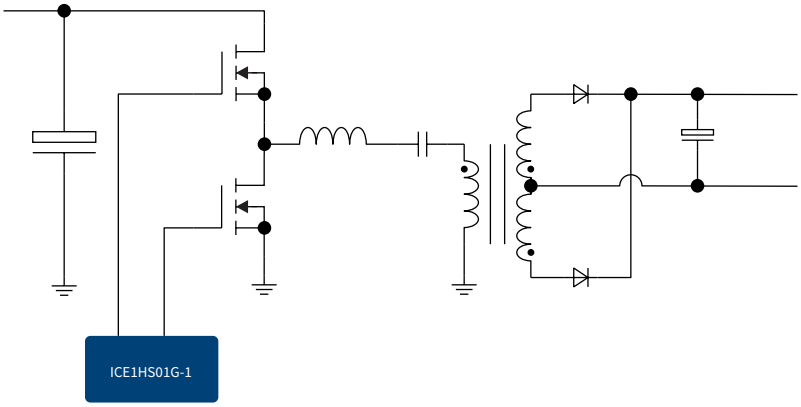
- Fixed switching frequency
- Option for external control synchronization
- Built in soft start for higher reliability
- Max. duty cycle 47% or 60%
- Overall tolerance of current limiting < +/-5%
- Internal leading edge blanking
- Slope compensation
- Fast, soft switching totem pole gate drive (2 A)
- Pb-free lead plating and RoHS compilant
- All protection features available

Product	Frequency – f_{sw}	Current drives	Package
ICE1CS02	PFC=65 kHz PWM=130 kHz	2.0 A	DIP-16

www.infineon.com/acdc

Resonant LLC half-bridge controller IC

LLC resonant (No SR)

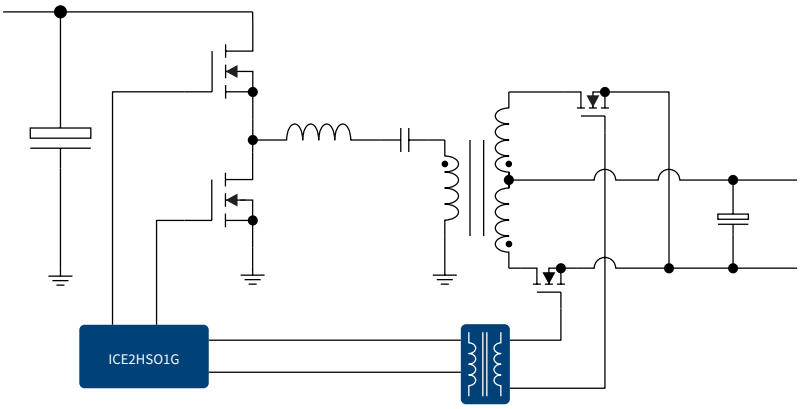


- Novel and simple design (12 components + HB driver)
- Minimum operating frequency is adjustable externally
- Burst mode operation for output voltage regulation during no load and/or bus over-voltage
- Multiple protections in case fault
- Input voltage sense for brown out protection
- Open loop/over load fault detection by FB pin with auto-restart and adjustable blanking/restart time
- Frequency shift for over-current protection
- Lead free, RoHS compliant package
- DSO-8 package

Product	Frequency – f_{sw}	Dead time	Current drives	Package
ICE1HS01G-1	30 kHZ~600 kHz	380 ns	1.5 A	DSO-8

Resonant LLC half-bridge controller IC with integrated synchronized rectifier control

LLC resonant + SR



- Novel LLC/SR operation mode and controlled by primary side Controller
- Multiple protections for SR operation
- Tight tolerance control
- Accurate setting of switching frequency and dead time
- Simple system design
- Optimized system efficiency
- Multiple Converter protections: OTP, OLP, OCP, latch-off enable
- External disable for either SR switching or HB switching
- Lead free, RoHS compliant package
- DSO-20 package

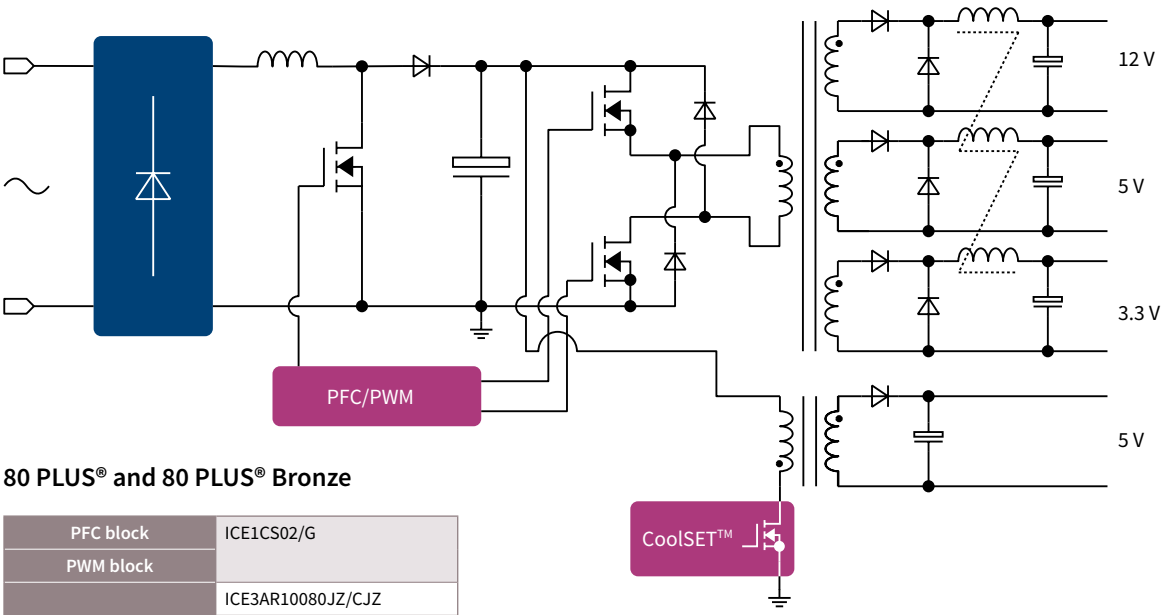
Product	Frequency - f_{sw}	Dead time	Current drives	Package
ICE2HS01G	30 kHz~1 MHz	100~1000 ns	0.3 A	DSO-20

www.infineon.com/acdc

LLC half-bridge controller IC	ICE1HS01G-1	ICE2HS01G
Package	DSO-8	DSO-20
Switching frequency range	up to 600 kHz	up to 1 MHz
LLC softstart	✓	✓
LLC burst mode	✓	✓
Adjustable minium frequency	✓	✓
Over load/open loop protection	✓	✓
Mains under-voltage protection with hysteresis	✓	✓
Over current protection	2-level	3-level
Drive signal for synchronous rectification	–	✓
Adjustable dead time	–	✓
External latch-off and OTP	–	✓
Target application	LCD-TV, audio, etc.	Server, PC, LCD-TV, etc.

www.infineon.com/acdc

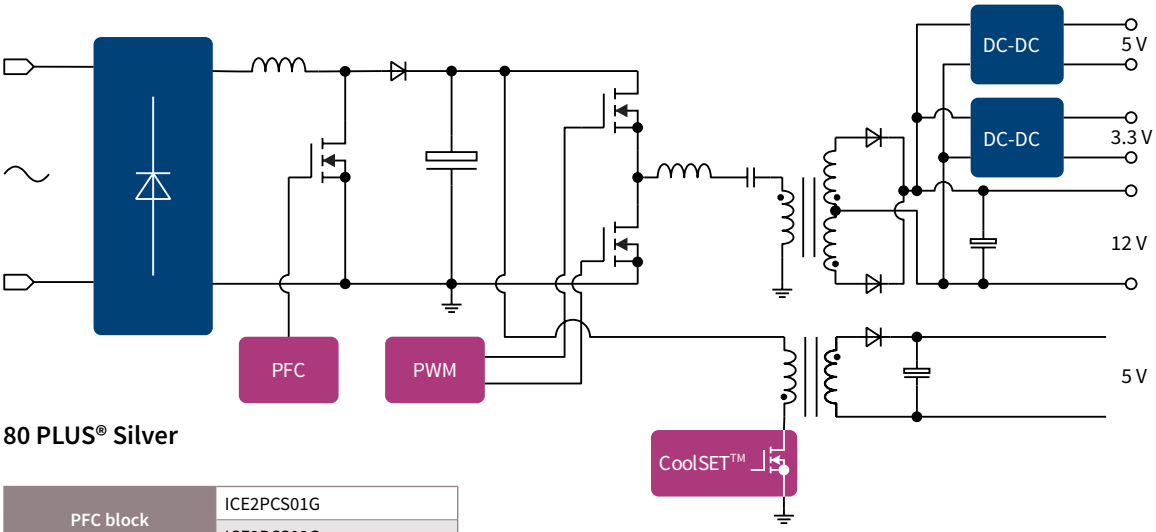
Climate saver 80 PLUS® and 80 PLUS® Bronze



80 PLUS® and 80 PLUS® Bronze

PFC block	ICE1CS02/G
PWM block	
Standby block CoolSET™	ICE3AR10080JZ/CJZ
	ICE3AR4780JZ/JG
	ICE3AR2280JZ/CJZ/JG
	ICE3AR0680JZ
	ICE3AR4780CJZ
	ICE3AR1080JG

Climate saver 80 PLUS® Silver



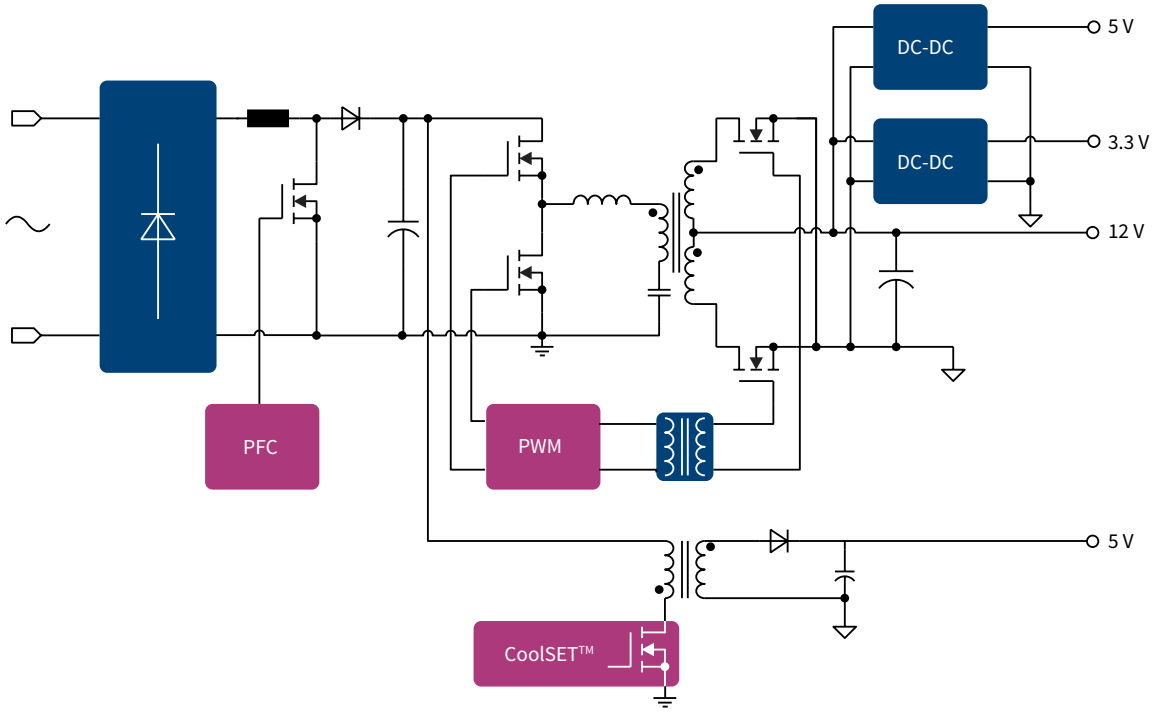
80 PLUS® Silver

PFC block	ICE2PCS01G
	ICE2PCS02G
PWM block	ICE1HS01G-1
Standby block CoolSET™	ICE3AR10080JZ/CJZ
	ICE3AR4780JZ/JG
	ICE3AR2280JZ/CJZ/JG
	ICE3AR0680JZ
	ICE2QR4765(G)
	ICE2QR1765(G)
	ICE2QR0665(G)
	ICE3AR4780CJZ
	ICE3AR1080JG

Climate saver 80 PLUS® Gold

Climate saver 80 PLUS® Platinum

Certification for Infineon's PC power reference design



80 PLUS® Gold

PFC block	ICE3PCS01G
	ICE3PCS02G
	ICE3PCS03G
PWM block	ICE2HS01G
Standby block CoolSET™	ICE3AR10080JZ/CJZ
	ICE3AR4780JZ/JG
	ICE3AR2280JZ/CJZ/JG
	ICE3AR0680JZ
	ICE3BR2280JZ
	ICE3BR0680JZ
	ICE3AR4780CJZ
	ICE3AR1080JG

80 PLUS® Platinum

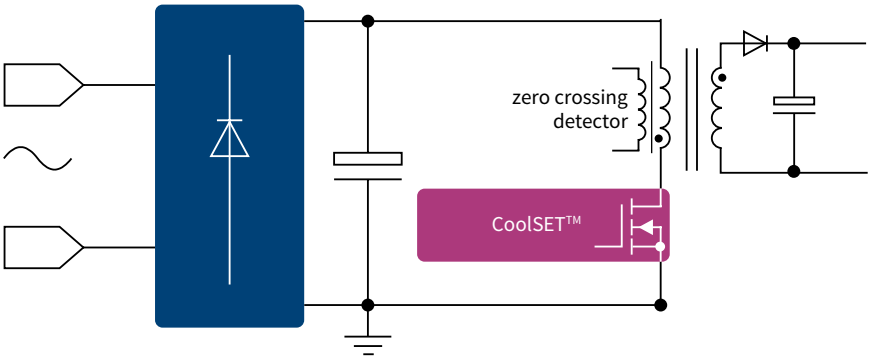
Certification for Infineon's PC power reference design

PFC block	ICE3PCS01G
	ICE3PCS02G
	ICE3PCS03G
PWM block	ICE2HS01G
Standby block CoolSET™	ICE2QR4780Z/G
	ICE2QR2280Z
	ICE2QR0680Z
	ICE2QR2280G-1
	ICE2QR1080G

www.infineon.com/pcpower
www.infineon.com/acdc
www.infineon.com/coolset

Isolated AC-DC

5th generation quasi-resonant PWM IC and CoolSET™ features



- Integrated CoolMOS™ in both 700 V and 800 V MOSFET with cascode configuration
- Digital frequency reduction with reducing load
- Novel quasi-resonant to minimize the spread of switching frequency between low and high line AC input
- Selectable active burst mode entry/exit profile
- Auto restart mode for line over voltage protection
- Auto restart mode for brown out protection
- Auto restart mode for V_{CC} under voltage/over voltage protection
- Auto restart mode for open-loop and output overload protection
- Auto restart mode for over-temperature protection with hysteresis
- Auto restart mode for output over voltage
- Auto restart mode for CS pin short to ground protection
- Limited charging current during V_{CC} pin short to ground protection
- Peak power limitation with input voltage compensation
- Minimum switching frequency limitation (no audible noise on power units on/off)
- DSO package (Controller) and DIP-7/DSO-12 (CoolSET™)

Halogen-Free RoHS

5th generation QR CoolSET™

Output power[1] 85 V_{AC}~300 V_{AC} T_a=50°C		15 W	23 W	27 W	32 W	44 W~46 W
$R_{DS(on)}$ max		4.83 Ω	2.33 Ω	1.73 Ω	1.23 Ω	0.78 Ω
700 V	DIP-7	ICE5QR4770AZ	ICE5QR2270AZ		ICE5QR1070AZ	
	DSO-16/12	ICE5QR4770AG				
800 V	DIP-7	ICE5QR4780AZ	ICE5QR2280AZ			ICE5QR0680AZ
	DSO-16/12			ICE5QR1680AG		ICE5QR0680AG

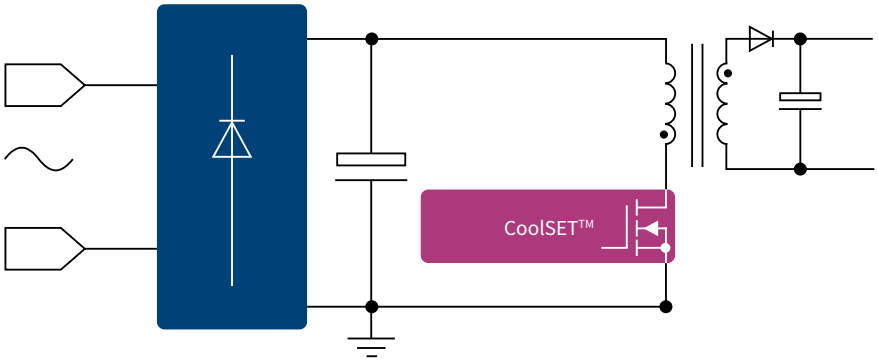
2nd Generation QR CoolSET™

Output power[1] 85 V_{AC}~300 V_{AC} T_a=50°C		14 W~15 W	20 W~21 W	23 W~26 W	31 W~34 W	38 W~42 W
$R_{DS(on)}$ max		5.18 Ω ~ 5.44 Ω	2.62 Ω	1.96 Ω	1.05 Ω~1.1 Ω	0.71 Ω~0.75 Ω
650 V	DIP-7	ICE2QR4765Z		ICE2QR1765Z		ICE2QR0665Z
	DIP-8	ICE2QR4765		ICE2QR1765		ICE2QR0665
	DSO-16/12	ICE2QR4765G		ICE2QR1765G		ICE2QR0665G
800 V	DIP-7	ICE2QR4780Z	ICE2QR2280Z			ICE2QR0680Z
	DSO-16/12	ICE2QR4780G	ICE2QR2280G ICE2QR2280G-1		ICE2QR1080G	

www.infineon.com/coolset

[1] Calculated maximum output power in an open frame design at T_a=50°C, T_j=125°C and without copper area as heat sink

Fixed frequency PWM IC and CoolSET™ features



- Active burst mode to achieve the lowest standby power requirements < 50 mW
- Optional latched off mode (L) to increase robustness and safety of the system
- Adjustable blanking window for high load jumps to increase reliability
- DCM, CCM
- Startup cell switched off after start-up
- 65 kHz/100 kHz/130 kHz internally fixed switching frequency
- Over-temperature, over voltage, short-winding, overload and open-loop, V_{CC} under voltage, brown out protections, fast AC reset, input overvoltage protection
- Fixed softstart time
- Overall tolerance of current limiting < +/-5%
- Internal leading edge blanking time
- Max. duty cycle 72%
- DIP, DSO and FullPAK packages

Halogen-Free RoHS

Fixed frequency PWM IC and CoolSET™ 650 V

P_{out} [1] 85 V_{AC} ... 265 V_{AC}		11 W~12 W	13 W~14 W	18 W	24 W~25 W	34 W	39 W~40 W
$R_{DS(on)}$		6.5 Ω	4.7 Ω	3.0 Ω	1.7 Ω	1.0 Ω	0.6 Ω
Package	PWM Only	650 V Depletion CoolMOS™					
DIP-7			ICE3RBR4765JZ		ICE3RBR1765JZ		ICE3RBR0665JZ
DIP-8		ICE3B0365J	ICE3BR4765J	ICE3A1065ELJ	ICE3BR1765J	ICE3A2065ELJ	ICE3BR0665J
DSO-8	ICE3AS03LJG ICE3BS03LJG						
DSO-12			ICE3RBR4765JG		ICE3RBR1765JG		ICE3RBR0665JG

Fixed frequency PWM IC and CoolSET™ 800 V

P_{out} [1] 85 V_{AC} ... 265 V_{AC}	11 W	16 W	22 W	30 W	37 W	43 W
$R_{DS(on)}$	10.0 Ω	4.7 Ω	2.2 Ω	1.5 Ω	1.0 Ω	0.6 Ω
Package	800 V Depletion CoolMOS™					
DIP-7	ICE3AR10080JZ ICE3AR10080CJZ	ICE3AR4780JZ ICE3AR4780VJZ ICE3AR4780CJZ	ICE3AR2280JZ ICE3AR2280CJZ ICE3AR2280VJZ ICE3BR2280JZ	ICE3AR1580VJZ	ICE3AR1080VJZ	ICE3AR0680JZ ICE3AR0680VJZ ICE3BR0680JZ
DSO-12		ICE3AR4780JG	ICE3AR2280JG		ICE3AR1080JG	

www.infineon.com/coolset

[1] Output power assume 76~83% efficiency. T_a=50°C, T_j=125°C and no copper area

Fixed frequency PWM IC

FF PWM IC	ICE3AS03LJG	ICE3BS03LJG
Package	DSO-8	
Operating temperature	-25°C~130°C	
Switching frequency	**100 kHz**	**65 kHz**
Max V_{cc} voltage	27 V	
V_{cc} on/off threshold	18 V/10.5 V	
Soft start time	**10 ms**	**20 ms**
Gate drive capability	-0.17 A/0.39 A	
Jitter feature for low EMI	✓	
Modulated gate drive	✓	
Active burst mode	✓	
Over load/open loop	Auto restart	
V_{cc} under voltage/short opto-coupler	Auto restart	
Short winding/short diode	Latch-off	
V_{cc} over voltage	Latch-off	
Over temperature	Latch-off	
External protection enable pin	Latch-off	

Quasi-resonant PWM IC

Feature	ICE5QSAG	ICE2QS02G	ICE2QS03G
Package	DSO-8	DSO-8	DSO-8
Switching scheme	Novel QR with 10 zero crossing counters	QR with 7 zero crossing counters	QR with 7 zero crossing counters
Operating temperature	-40°C~129°C	-25°C~130°C	-25°C~130°C
Startup cell	Cascode	-	✓
V_{cc} on/off	16 V/10 V	12 V/11 V	18 V/10.5 V
Power saving during standby	Yes, active burst mode in QR switching 2-level selectable burst mode entry/exit level	–	Yes, active burst mode 52 kHz
Digital frequency reduction for high average efficiency	✓	✓	✓
OLP blanking time	Fixed	Adjustable	Fixed
Auto restart timer	Through V_{cc} charging/discharging	Setting with external components	Through V_{cc} charging/discharging
Maximum input power limitation	V_{in} pin voltage dependent	Adjustable through ZC resistor	Adjustable through ZC resistor
V_{cc} under voltage protection	Yes with auto restart	Yes with latch	Yes with auto restart
Adjustable output overvoltage protection	Yes with auto restart	Yes with latch	Yes with latch
Adjustable line input overvoltage protection	✓	–	–
Brownout feature	✓	✓	–
V_{cc} and CS pin short to ground protection	✓	–	–
Target application	Home Appliances, set-top-box, AUX SMPS	AUX power supply to V_{cc} eg. LCD TV multi/main, audio main, PDP TV multi/address	Self-power supply to V_{cc} eg. smart meter, industrial applications

www.infineon.com/acdc

Quasi-resonant CoolSET™

	2nd generation ICE2QRxxxxZ/G	2nd generation ICE2QRxx80G-1	5th generation ICE5QRxxxxAZ/G
Switching scheme	QR with 7 zero crossing counters		Novel QR with 10 zero crossing counters
Integrated MOSFET	650 V and 800 V	800 V	700 V and 800 V
High voltage start-up cell	Yes		Cascode
Power saving during standby	Active burst mode F_{sw} @ 52 kHz		2 level selectable active burst mode quasi-resonant
V_{cc} on/off threshold (typ.)	18 V/10.5 V	18 V/9.85 V	16 V/10 V
Adjustable output over voltage protection	Yes (Latch)		Yes (Auto restart)
V_{cc} over/undervoltage protection	Yes (Auto restart)		Yes (Auto restart)
Overload/open loop protection	Yes (Auto restart)		Yes (Auto restart)
Over temperature protection	Yes (Auto restart)		Yes (Auto restart with hysteresis)
Adjustable line input overvoltage protection	-		Yes (Auto restart)
Brown out	-		Yes (Auto restart)
CS pin short to ground	-		Yes (Auto restart)
V_{cc} pin short to ground	-		Yes (No start-up)
Package	DIP-7 DIP-8 DSO-16/12	DIP-7 DSO-16/12	DIP-7 DSO-16/12

www.infineon.com/coolset

DFR= Digital Frequency Reduction, PPR= Peak Power Limitation/Control

Fixed frequency CoolSET™

	650 V CoolSET™			
	F3 (Jitter) ICE3Bxx65J(G)	F3 (Latch & Jitter) ICE3Axx65ELJ	F3R ICE3BRxx65J(G)	F3R ICE3RBRxx65JZ ICE3RBRxx65JG*
Package	DIP-8, DSO-16/12	DIP-8	DIP-8, DSO-16/12	DIP-7, DSO-16/12
Output power range[1]	11 W~12 W	18 W~34 W	13 W~40 W	13 W~40 W
MOSFET (rugged avalanche capability)	650 V			
Min. operating temperature	-25°C			-40°C
Switching frequency	67 kHz	100 kHz	65 kHz	65 kHz
Max V_{cc} voltage	27 V			
V_{cc} on/off threshold	18 V/10.3 V	18 V/10.5 V		
Jitter feature for low EMI	✓ (by CSOFTS)	✓		
Modulated gate drive	–	✓		
Soft start time	by CSOFTS	20 ms		
Active burst mode selection	1 level			
Over load/open loop	Auto restart			
V_{cc} under voltage/short opto-coupler	Auto restart			
V_{cc} over voltage	Auto restart	Latch	Auto restart	
Over temperature	Auto restart	Latch	Auto restart	
External protection enable pin	–	Latch	Auto restart	
Brown out	–			
Input OVP	–			
Fast AC reset	–			
Slope compensation for CCM mode	–			
Product available	ICE3B0365J ICE3B0565J ICE3B0565JG	ICE3A1065ELJ ICE3A2065ELJ	ICE3BR4765J ICE3BR1765J ICE3BR0665J ICE3BR4765JG	ICE3RBR4765JZ ICE3RBR1765JZ ICE3RBR0665JZ ICE3RBR4765JG ICE3RBR1765JG ICE3RBR0665JG

www.infineon.com/coolset

[1] Output power assume 76~83% efficiency. T_a=50°C, T_j=125°C and no copper area

800 V CoolSET™				
F3R 800 V ICE3ARxx80JZ	F3R 800 V ICE3BRxx80JZ	F3R CCM 800 V ICE3ARxx80CJZ	F3R 800 V ICE3ARxx80JG	F3R 800 V ICE3ARxx80VJZ
DIP-7	DIP-7		DSO-16/12	DIP-7
11 W~43 W		11 W~22 W	15 W~32 W	16 W~43 W
800 V				
-25°C			-40°C	
100 kHz	65 kHz	100 kHz	100 kHz	100 kHz
27 V				
17 V/10.5 V				
✓				
YES (with 50 Ω gate turn-on resistor)				
10 ms				
4 levels		3 levels	4 levels	
Auto restart				
Auto restart				
Auto restart				
Auto restart with hysteresis				
Auto restart		Latch	Auto restart	–
✓				–
–				✓
–		✓	–	
–		✓	–	
ICE3AR10080JZ ICE3AR4780JZ CE3AR2280JZ ICE3AR0680JZ	ICE3BR2280JZ ICE3BR0680JZ	ICE3AR10080CJZ ICE3AR4780CJZ ICE3AR2280CJZ	ICE3AR4780JG ICE3AR2280JG ICE3AR1080JG	ICE3AR4780VJZ ICE3AR2280VJZ ICE3AR0680VJZ ICE3AR1080VJZ ICE3AR1580VJZ

Non-isolated DC-DC

MOSFET gate driver IC

The OptiMOS™ driver products PX3517 and PX3519 are high speed drivers, designed to drive a wide range of dual high-side and low-side n-channel power MOSFETs in applications such as computing and telecom point-of-load (POL).

Combining the new devices with the Primarion™/Infineon digital multi-phase controllers IC family and Infineon n-channel MOSFETs, the new devices form a complete core-voltage regulator solution for advanced micro and graphic processors as well as point-of-load applications.

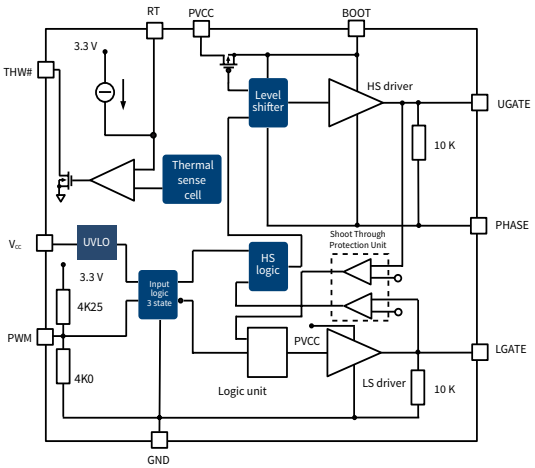
To tailor the efficiency of the system based on the customer conditions and needs, the OptiMOS™ driver devices provide the capability of driving the high-side gate and low-side gate with a variable gate driving voltage ranging from 4.5 V up to 8 V.

General features

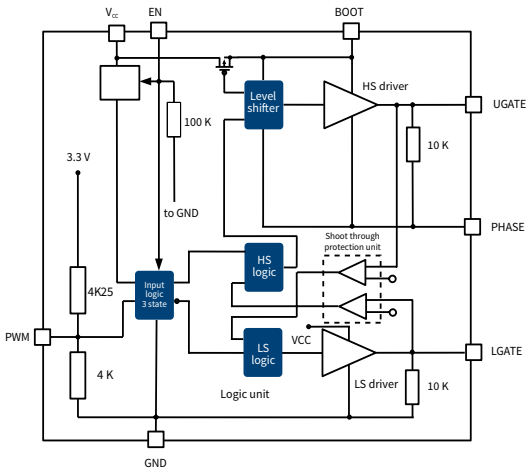
- High frequency operation up to 1.2 MHz
- Wide V_{CC} input voltage range from 4.5 V to 8 V
- Capability to drive MOSFET at 50 A continuous current per phase
- Wide input voltage range: up to 16 V
- Low power dissipation
- Includes bootstrap diode
- Adaptive shoot through protection
- Compatible with standard + 3.3 V PWM controller ICs
- Tri-state PWM input functionality
- RoHS compliant

Application diagrams

PX3517 offers a thermal warning report function.



PX3519 features a gate disable pin (EN) for low power consumption.



Gate driver	PX3517	PX3519
Package	3x3 mm TDSON-10	3x3 mm VDSON-8
RoHS compliant	✓	✓
Max. junction temperature	-40°C to 125°C	-40°C to 125°C
Supply voltage and driving voltage, V_{CC}	+4.5 V to 8 V	+4.5 V to 8 V
Boot to GND	30	30
PWM inputs	Tri-state compatibility	Tri-state compatibility
Quiescent current I_Q	660 µA	780 µA
Features	Thermal warning	Driver enable pin

www.infineon.com/optimosdriver

Integrated power stages

TDA21231 – 5x5 high performance driver+MOS

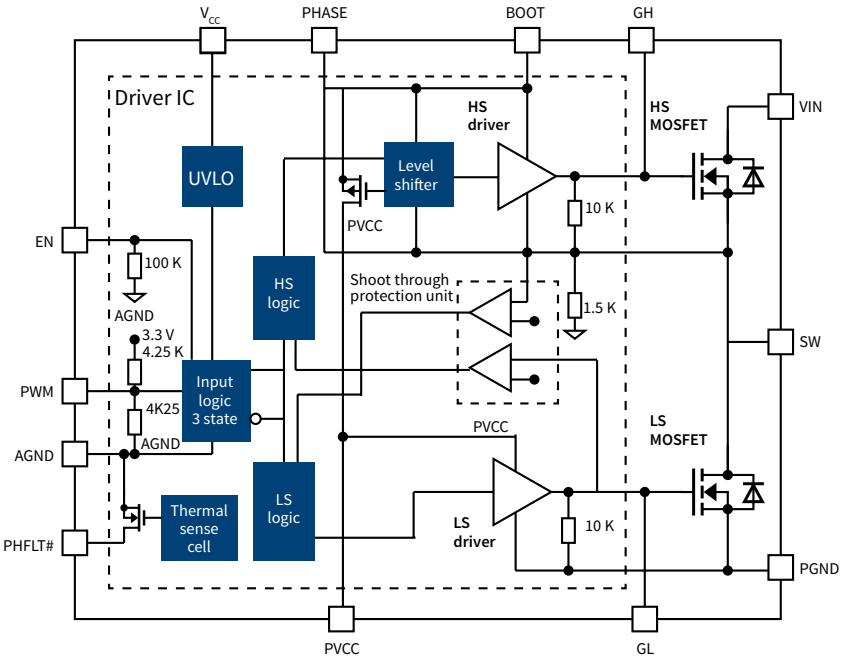
Features

- Recommended input voltage 4.5 V to 16 V
- Low-side source-down for lowest parasitics and max. performance
- Fast switching technology for 500 kHz to 1 MHz high-switching frequencies

Benefits

- More than 95% peak efficiency
- Thermal warning
- Remote driver disable function
- Integrated bootstrap diode (no need of ext. diode) with refresh circuit

DrMOS application diagram



	TDA21231
Input voltage range	4.5 V to 16 V
Peak efficiency	> 95%
Heavy load efficiency @ 40 A	> 95%
PWM interface	3.3 V
Max. average load current	55 A
Temperature monitor and OTP	Thermal warning
RoHS compliant	yes

www.infineon.com/drmos

Integrated power stages

40 A, 50 A and 60 A with integrated current sense

Infineon's integrated Power Stage family contains a synchronous buck gate driver IC which is co-packed with control and synchronous MOSFETs and a Schottky diode to further improve efficiency. The package is optimized for PCB layout, heat transfer, driver/MOSFET control timing, and minimal switch node ringing when layout guidelines are followed. The paired gate driver and MOSFET combination enables higher efficiency at lower output voltages required by cutting edge CPU, GPU, ASIC and DDR memory designs. The IR3555 integrated power stages internal MOSFET current sense algorithm with integrated temperature compensation achieves superior current sense accuracy versus best-in-class controller based inductor DCR sense methods. Up to 1.0 MHz switching frequency enables high performance transient response, allowing miniaturization of output inductors, as well as input and output capacitors while maintaining industry leading efficiency. The IR3555 is optimized for CPU core power delivery in server applications. The ability to meet the stringent requirements of the server market also makes the IR3555 ideally suited for powering GPU, ASIC, DDR memory, and other high current designs.

Features

- Integrated driver, Schottky diode, control MOSFET and synchronous MOSFET
- 5 mV/A on-chip MOSFET current sensing with temperature compensated reporting
- Input voltage (V_{in}) range of 4.5 V to 15 V
- V_{CC} and VDRV supply of 4.5 V to 7 V
- Output voltage range from 0.25 V up to 5.5 V
- Output current capability of 60 A
- Operation up to 1.0 MHz
- V_{CC} undervoltage lockout (UVLO)
- 8 mV/°C temperature analog output and thermal flag pull-up to 3.3 V
- Over-temperature protection (OTP)
- Cycle-by-cycle self-preservation overcurrent protection (OCP)
- MOSFET phase fault detection and flag
- Preliminary overvoltage protection (Pre-OVP)
- Compatible with 3.3 V tri-state PWM input
- Body-Braking™ load transient support through PWM tri-state
- Diode emulation mode (DEM) for improved light load efficiency
- Efficient dual sided cooling
- Small 6x6x0.9 mm^3 PQFN package

Applications

- High frequency, high current, low profile DC-DC converters
- Voltage regulators for CPUs, GPUs, ASICs, and DDR memory arrays

Part type	I_{out} [A]	Package
IR3555	60	Over-mold
IR3556	55	Over-mold
IR3557	45	Over-mold
IR3578	50	Exposed
IR3579	60	Exposed

www.infineon.com/integrated-powerstages

Digital controllers

Point-of-load power management

Infineon's digital multi-phase and multi-rail controllers provide power for today's medium and high current PoL applications used in telecom/datacom and server and storage environments. Infineon's digital controller family enables OEMs and ODMs to improve efficiency and total cost of ownership while increasing power density and optimizing the total system footprint of the voltage regulator. The PX7247, PX7241, PX7143, PX7242 and PX7141 are the first products out of our fourth generation digital controller family and support up to two rails with 1-6 phases on individual rails. The I²C/PMBus™ interface connects the digital controllers to the application system and provides real time telemetry information, monitoring and control capabilities. The digital controllers are fully configurable through our PowerCode™ graphical user interface that allows for easy to use and simplified design optimization.

Multiple-phase configurations are supported for best power optimization

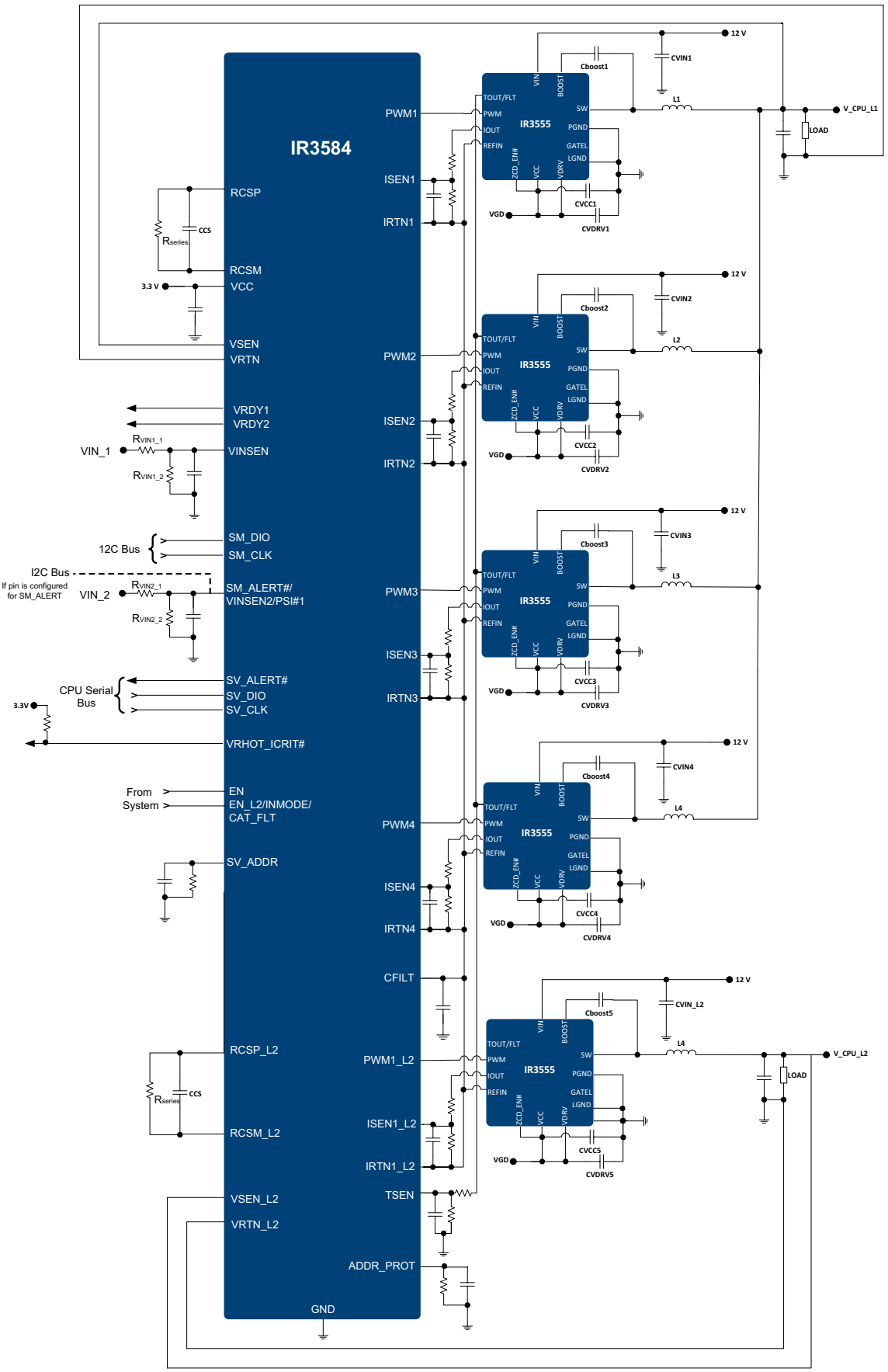
Feature		Controller family							
Configurable output rails		Dual/single rail	Dual rail	Single rail	Dual rail	Single rail	Single rail	Dual rail	Dual rail
Part No.	PMBus™	PX7247HDN	PX7241HDN	PX7143HDM	PX7242HDM	PX7141HDM	IR3580	IR3581	IR3584
Phase configuration	Main	6+1	3+3	3 ph	1+1	1 ph	8 ph	6+1	4+1
	Sub configurations	6+0, 5+1, 5+0, 4+1	3+2, 3+1, 2+2, 2+1	2 ph	-	-	NA	NA	NA
V_{out_max}		5 V	5 V	5 V	5 V	5 V	3.3 V	3.3 V	3.3 V
Switching frequency		Up to 2 MHz	Up to 2 MHz	Up to 2 MHz	Up to 2 MHz	Up to 2 MHz	Up to 2 MHz	Up to 2 MHz	Up to 2 MHz
Operating temperature range		0°C…85°C	0°C…85°C	0°C…85°C	0°C…85°C	0°C…85°C	0°C…125°C	0°C…125°C	0°C…125°C
VQFN package		48-lead (6x6) 0.4 mm pitch	48-lead (6x6) 0.4 mm pitch	40-lead (5x5) 0.4 mm pitch	40-lead (5x5) 0.4 mm pitch	40-lead (5x5) 0.4 mm pitch	48-lead (6x6) 0.4 mm pitch	48-lead (6x6) 0.4 mm pitch	40-lead (5x5) 0.4 mm pitch

Advantages of a digital controller

Protection features include a set of sophisticated overvoltage, undervoltage, over-temperature, and overcurrent protections. PX7247, PX7241, PX7143, PX7242 and PX7141 also detect and protect against an open circuit on the remote sensing inputs. These attributes provide a complete and advanced protection feature set for microprocessor, DSP, FPGA or ASIC power systems. Accurate current sense telemetry is achieved through internal calibration that measures and corrects current sense offset error sources upon startup. Programmable temperature compensation provides accurate current sense information even when using DCR current sense.

www.infineon.com/digital-controller

Typical multiphase application circuit



Infineon support for Power ICs

Useful links and helpful information

Further information, datasheets and documents

www.infineon.com/acdc
www.infineon.com/coolset
www.infineon.com/optimosdriver
www.infineon.com/integrated-powerstages
www.infineon.com/drmos
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LED driver ICs for general lighting

Professional lighting

Infineon's innovative multi-mode LED driver ICs deliver high efficiency, high power factor and low harmonics to LED lighting applications while supporting dimming levels down to one percent. The high level of integration simplifies designs by reducing the need for external components. The XDP™ digital power technology supports quick design and simplifies logistics handling, hence saving effort and cost.

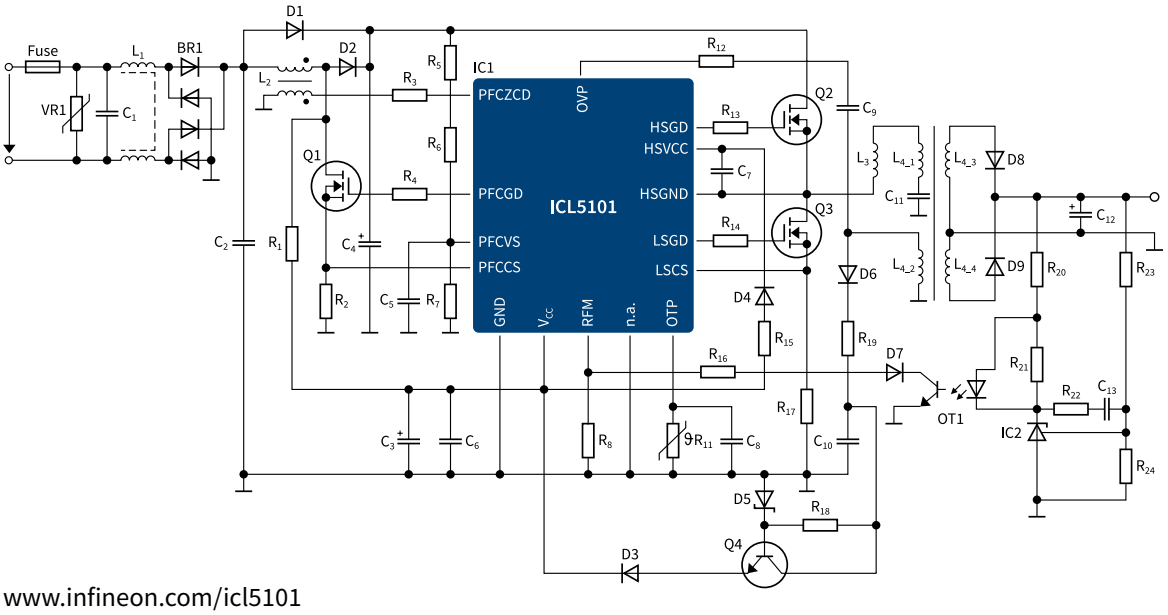
ICL5101– resonant controller with PFC for LED driver

The ICL5101 integrates a half-bridge controller with a PFC stage in a single package. The high level of integration assures a low count of external components, enabling small form factor designs ideal for compact power supplies in lighting applications, such as LED driver. All operation parameters of the IC are adjustable by simple resistors, this being the ideal choice for affordable and reliable configuration. A comprehensive set of protection features including an adjustable external over temperature protection and capacitive load protection, ensures the detection of fault conditions to increase the system safety.

Features and benefits

- Secondary-side constant voltage or constant current control
- PFC in CCM mode during nominal load and DCM mode in low-load condition down to 0.1% for operation without audible noise
- High-power quality with PF > 0.96, THD < 10%
- Highest efficiency of up to 95% due to resonant topology
- Allows secondary-side IC dimming down to 1%
- PFC/LLC combo IC allows the best matching of PFC stage and LLC stage timing control
- Supports a wide input voltage range from 90 V-305 V
- Ultra-fast time-to-light < 200 ms
- Complete set of protection features including external thermal protection

Typical application schematic



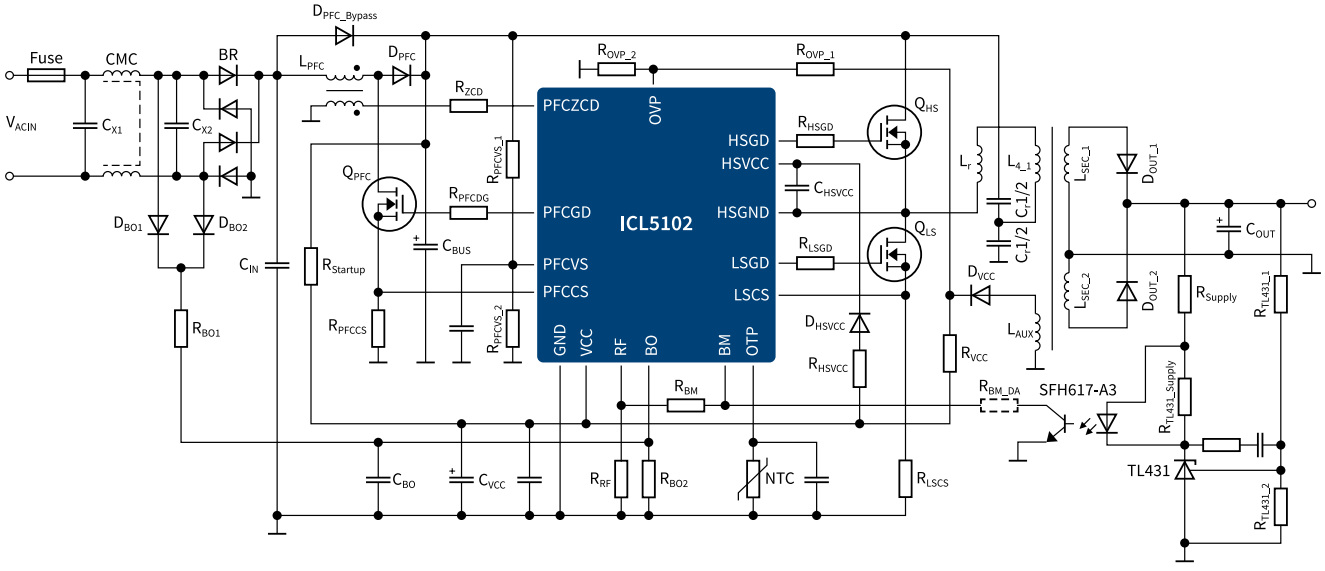
www.infineon.com/icl5101

New ICL5102 - High performance PFC + resonant controller for LCC and LLC

Features and benefits

- **Small form factor LED driver and low BOM**
  The high level of integration assures a low count of external components, enabling small form factor designs ideal for compact and slim line power supplies for lighting, such as LED driver for indoor and outdoor applications
- **High performance, digital PFC and advanced HB driver**
  The high performance digital PFC stage achieves power factor of 99 %, through operation in CrCM and DCM mode, in a frequency range of 22 kHz to 500 kHz. This supports stable operation even at low load conditions down to 0.1 % of the nominal power without audible noise
- **Fast time-to-light and low standby**
  With startup current of less than 100 µA the controller provides very fast time-to-light within less than 300 ms. While standby the controller changes into active burst mode which reduces power consumption to less than 300 mW
- **Safety first**
  The controller has a comprehensive set of protection features built in to increase the system safety. It monitors in the run mode the complete system regarding bus over- and undervoltage, open loop, overcurrent of PFC and/or inverter, output overvoltage, over temperature and capacitive load operation

Typical application schematic



Type	Description[1]	Ordering code
ICL5102	PFC and resonant controller for LCC and LLC	SP001609012
EVALEDICL5102E2	PFC/LLC-CC constant current evaluation board 130 W LED driver	t.b.a.

www.infineon.com/icl5102

XDP™ LED

The digital IC family XDP™ digital power is the first all-in-one package solutions that integrates a digital power controller with key peripherals to simplify your innovations. XDP™ LED is tailor-made for LED lighting applications.

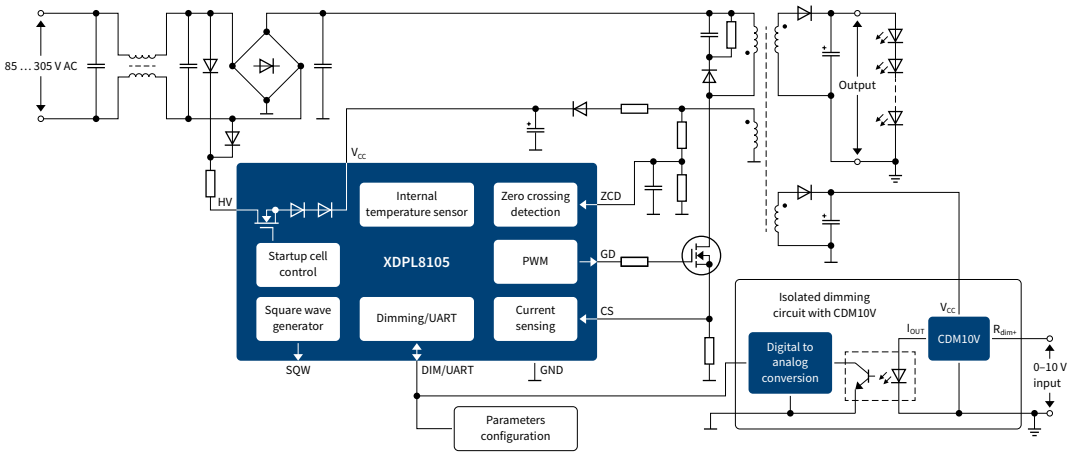
XDPL8105 – Digital flyback controller IC for LED driver

The XDPL8105 is a high performance microcontroller based digital single-stage flyback controller with power factor correction (PFC) for constant output current LED driver. The IC is available in a DSO-8 package and supports a wide feature set, requiring a minimum of external components. The digital engine offers the possibility to configure operation parameters and protection modes, which helps to ease the design phase and allow a reduce number of hardware variants. Accurate primary side output current control is implemented to eliminate the need for secondary side feedback circuitry.

Features and benefits

- Smooth operation with extended dimming capability
- Shorter product development at less hardware variants
- Low BOM
- Cost optimized dimming
- Supports AC and DC input
- AC input voltage 90 V_{AC}-305 V_{AC}
- Highly accurate primary side control output current typ. +/-3 %
- Configurable output current with no BOM change
- Efficiency up to 91 %
- High power quality, typical power factor up to 0.99 and THD <10 %
- Integrated 600 V startup cell
- Internal temperature guard with adaptive thermal management
- All relevant error conditions are monitored and protected
  - Undervoltage
  - Overvoltage
  - Open load
  - Output shorted

Typical application schematic



Order information for XDPL8105

Type	Description	Ordering code
XDPL8105	Digital flyback controller IC	SP001639446
REF-XDPL8105-CDM10V	40 W reference design with CDM10V isolated 0 V-10 V dimming interface	SP001649474
System simulation design creation tool	MS Excel based software tool	http://www.infineon.com/XDPL8105
.dp interface Gen2	Interface board to PC	http://www.hitex.com/dp
.dp vision	Graphical user interface to configure parameters during development	http://download.hitex.de/dpvisioncustomerdistribution
XDP™ GUI builder	Parameter configuration tool	http://www.infineon.com/XDPL8105

www.infineon.com/xdpl8105

XDPL8220 - The simple and innovative entry point to smart lighting*

Modern LED technology offers many advanced possibilities for lighting applications. The digital and configurable LED driver IC XDPL8220 enables the lighting industry to realize essential features for smart lighting and increases the benefits to the end user and the manufacturers.

Features and benefits

- **Flexibility saves efforts and cost**
  The digital core of the XDPL8220 enables a variety of systems based on the same device. Its advanced control algorithms provide the possibility to realize lighting Electronic Control Gear (ECG) for constant current or constant voltage mode in the same circuit.
- **Essentially now low frequency flicker**
  The modern two stage architecture offered by the XDPL8220 significantly eases the implementation of up and coming flicker standards by eliminating the low frequency variation from the mains supply and guaranteeing a stable output.
- **Low stand-by power facilitates permanent operation of the ECG**
  Supporting a standby power of less than 70 mW, the XDPL8220 significantly reduces the non-active power consumption while still reacting to external events or user requests.
- **Intelligent temperature management protects longevity of luminaries**
  Any over temperature of external components, measured via an external NTC resistor, managed intelligently by gradually reducing the output current until the over temperature situation is resolved. As last resort when the temperature still exceeds the limit the device will shut down.
- **Small BOM due to integration and primary side control**
  The primary side control saves extra components especially an optocoupler, thus reducing cost and effort and increasing reliability. The digital control loop saves the parts and efforts for external loop compensation. With its integrated functionality the XDPL8220 enables an increase of the feature set without external parts.

Order information for XDPL8220

Type	Description	Ordering code
XDPL8220	Digital dual-stage PFC and flyback lighting controller	SP001398160

www.infineon.com/xdpl8220

* Learn more in the XDP™ digital power section (page 202)

Linear current regulators

BCR401W/BCR402W/BCR401U/BCR402U/BCR405U/BCR205W

The BCR40x family is the smallest size and lowest cost series of LED drivers. These products are perfectly suited for driving low power LEDs in general lighting applications. Thanks to AEC-Q101 qualification, it may also be used in automotive applications such as brake lights or interior.

The advantage versus resistor biasing is:

- Long lifetime of LEDs due to constant current in each LED string
- Homogenous LED light output independent of LED forward voltage binning, temperature increase and supply voltage variations
- See application note AN182 for details on replacing resistors

The advantage versus discrete semiconductors is:

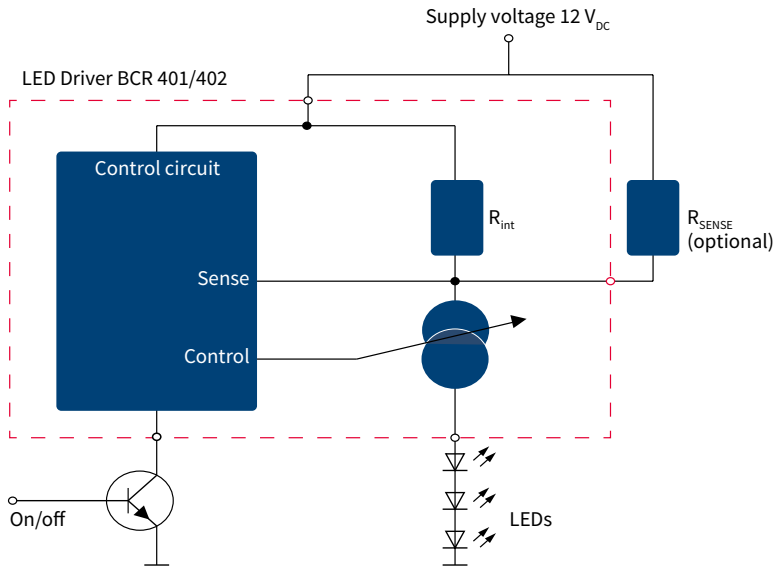
- Reduced part count and assembly effort
- Pretested output current
- Defined negative temperature co-efficient protection

Features and benefits:

- Output current from 10 mA to 65 mA (adjustable by external resistor)
- Supply voltage up to 18 V (BCR401W, BCR402W) and up to 40 V (BCR401U, BCR402U, BCR405U)
- Reduction of output current at high temperature, contributing to long lifetime LED systems
- Ease-of-use
- Very small form factor packages with up to 750 mW max. power handling capability

Low-power LED driver ICs (5 mA-65 m A)

Product type	Group	Topology	V_s (min.) [V]	V_s (max.) [V]	I_{out} (typ.) [mA]	I_{out} (max.) [mA]	Dimming	Package	P_{tot} (max.) [mW]
BCR205W	LED controller	Linear	1.8	18	0.5	ext. switch	No	SOT343	100
BCR401U	LED drivers for low-power LEDs	Linear	$1.4+V_{fLED}$	40	10.0	65	Digital	SC74	750
BCR401W	LED drivers for low-power LEDs	Linear	$1.2+V_{fLED}$	18	10.0	60	Digital	SOT343	500
BCR402U	LED drivers for low-power LEDs	Linear	$1.4+V_{fLED}$	40	20.0	65	Digital	SC74	750
BCR402W	LED drivers for low-power LEDs	Linear	$1.4+V_{fLED}$	18	20.0	60	Digital	SOT343	500
BCR405U	LED drivers for low-power LEDs	Linear	$1.4+V_{fLED}$	40	50.0	65	Digital	SC74	750



www.infineon.com/bcr

BCR320U/BCR321U/BCR420U/BCR421U/BCR450

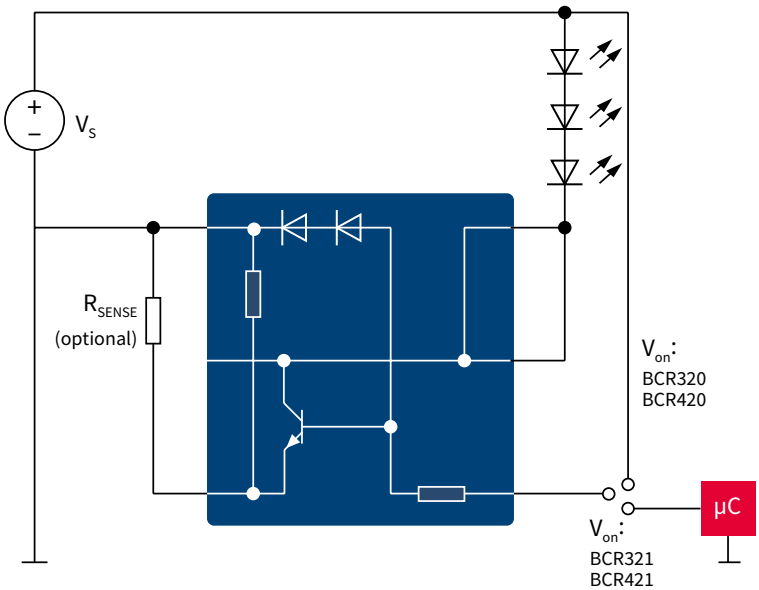
The BCR32x and BCR42x LED drivers are dedicated linear regulators for 0.5 W LEDs with a maximum output current of 250 mA. They are optimized in terms of cost, size and feature set for medium power LEDs in general lighting applications. Thanks to AEC-Q101 qualification, it may also be used in automotive applications such as brake lights or interior.

Features and benefits

- Output current from 10 mA up to 300 mA for BCR32x (200 mA for BCR42xU), adjustable by external resistor
- Supply voltage up to 40 V for BCR42x (24 V for BCR32x)
- Direct Microcontroller interface for PWM dimming with BCR321U/BCR421U
- Reduction of output current at high temperature, contributing to long lifetime LED systems
- Ease-of-use
- Very small form factor packages with up to 1.000 mW max. power handling capability

Medium- and high-power LED driver ICs (65 mA-500 mA)

Product type	Group	Topology	V_s (min.) [V]	V_s (max.) [V]	I_{out} (typ.) [mA]	I_{out} (max.) [mA]	Dimming	Package	P_{tot} (max.) [mW]
BCR320U	LED drivers for mid-power LEDs	Linear	$1.4+V_{fLED}$	$24+V_{fLED}$	250	300	Digital	SC74	1000
BCR321U	LED drivers for mid-power LEDs	Linear	$1.4+V_{fLED}$	$24+V_{fLED}$	250	300	Digital	SC74	1000
BCR420U	LED drivers for mid-power LEDs	Linear	$1.4+V_{fLED}$	$40+V_{fLED}$	150	200	Digital	SC74	1000
BCR421U	LED drivers for mid-power LEDs	Linear	$1.4+V_{fLED}$	$40+V_{fLED}$	150	200	Digital	SC74	1000
BCR450	LED controller	Linear	3.0	27	70	ext. switch	Digital	SC74	500



DC-DC switch mode LED driver ICs

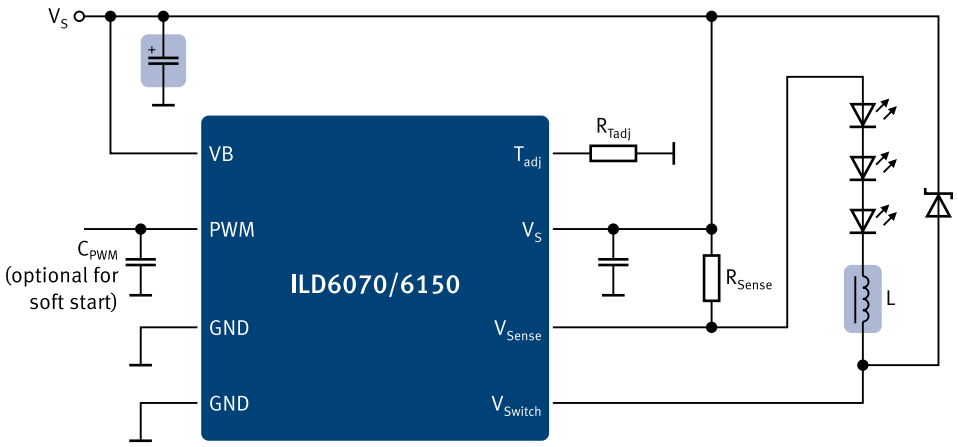
ILD1151/ILD4001/ILD4035/ILD2111/IRS25411/ILD6070/ILD6150

The ILD series are switch mode LED driver ICs for high power LEDs. They combine protection features that contribute to the lifetime of LEDs with the flexibility in output current range from 150 mA up to multiple amperes. The new ILD series include LED driver ICs with integrated power stage as well as with external MOSFET achieving up to 98 percent driver efficiency across a wide range of general lighting applications.

Features and benefits

- Wide input voltage range
- Scalability in output current from 150 mA up to multiple amperes
- Alternative dimming concepts: digital or analog
- Overvoltage and overcurrent protection
- Smart thermal protection for ILD6070, ILD6150, ILD4035 and ILD2111 contributing to longer LED lifetime
- ILD1151 supports boost, buck-boost and SEPIC topologies

	V_s (min.) [V]	V_s (max). [V]	I_{out} (typ.) [mA]	I_{out} (max.) [mA]	Package	Dimming	Topology	f_{sw}	Features
ILD1151	4.5	45	90.0	3.000	SSOP-14	Analog/ digital	Boost, buckboost SEPIC	Adjustable 100 kHz-500 kHz	Multi topology controller, constant current or constant voltage mode, overvoltage, overcurrent, short on GND protection
ILD4001	4.5	42	10.0	3.000	SC74	Analog/ digital	Hysteretic buck	< 500 kHz	Thermal protection, scalable by external switch
ILD4035	4.5	40	350	400	SC74	Analog/ digital	Hysteretic buck	< 500 kHz	Smart thermal protection, over-voltage, over-current protection
ILD2111	2.5	600	10	3000	DSO-8	Analog, PWM	Hysteretic buck	Preset operation window with output ripple control	› Output current setting via simple resistor (LEDset like) › Internal and external adaptive temperature guard › Digitally configurable profection features
ILD6070	4.5	60	700	700	DSO-8-27	Analog/ digital	Hysteretic buck	< 1000 kHz	Integrated switch rated up to 700 mA, PWM or analog dimming, adjustable over tempe-rature protection, overcurrent protection
ILD6150	4.5	60	1.500	1.500	DSO-8-27	Analog/ digital	Hysteretic buck	< 1000 kHz	Integrated switch rated up to 1.500 mA, PWM or analog dimming, adjustable over temperature protection, overcurrent protection



www.infineon.com/bcr

Ballast control IC for fluorescent lamp

Ballast control ICs from Infineon integrate all functions required to operate FL lamps such as preheat, ignition and run-mode and protection features.

- Integrated high performance PFC stage
- Intelligent digital/mixed signal power control
- Integrated high voltage half-bridge driver
- All parameters set using only resistors
- Highly accurate timing and frequency control over a wide temperature range
- Different types for single, series and parallel lamps

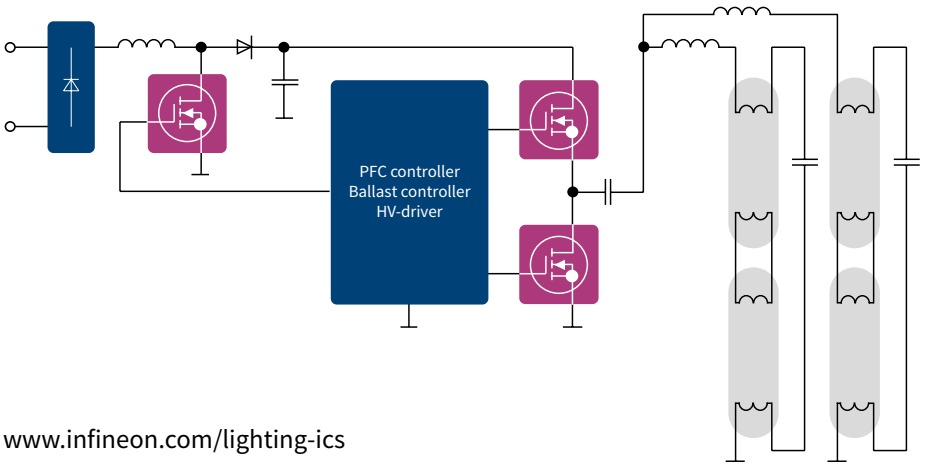
Features

- Able to handle lamp chokes with higher saturation behavior
- Separate adjustable levels of lamp overload and rectifier effect detection
- Adjustment of the preheat time
- No high voltage capacitor required for detection of lamp removal (capacitive mode operation)
- Automatically restarts by surge and inverter overcurrent events
- Self-adapting dead time adjustment of the half-bridge driver

Benefits

- Optimized lamp choke size and reduced BOM costs
- Dramatically reduced time for key tests such as end of life detection, preheat/ignition timeout and pre-run operation modes
- Suitable for dimming and multi-power ballasts
- Enables ballast compatibility with a wider range of lamp types
- Flexible support of both current and voltage mode preheating
- Reduced BOM costs
- Intelligent discrimination between surge and half-bridge overcurrent events
- Meets standards for emergency lighting (according to DIN VDE 0108)
- Eases design of multi-power ballasts and reduces EMI
- Enhanced reliability of ballasts

Function	ICB2FL03G	ICB2FL02G	ICB2FL01G
Capacitive load protection	Activated	Deactivated	Activated
Suitable for dimming	✓	✓	✓
Max. adjustable run frequency	140 kHz	140 kHz	120 kHz
Package	SO-16 small body	SO-19 wide body	SO-19 wide body
Driver capability	650 V	900 V	900 V
Lamp connection	Single and series	Single, series and parallel	Single, series and parallel



www.infineon.com/lighting-ics

ISOFACE™

Galvanic isolated high-side switches and input ICs

Our ISOFACE™ product family provides robust and intelligent galvanic isolation for industrial control applications such as programmable logic controllers, sensor input modules, control panels and general control equipment. The output switches are compact in design, enabling robust and reliable operation at low system cost. Ideal for high speed applications, input ICs are equally robust, reliable and compact – also offering superior EMI robustness and diagnostics.

Isolated output switches

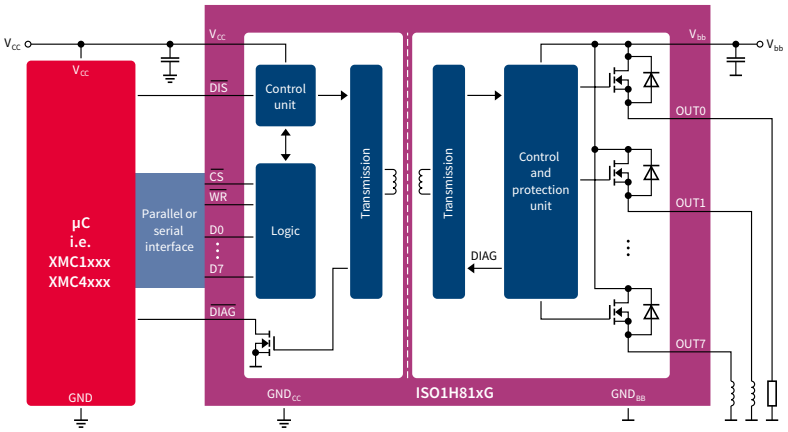
Key features

- Integrated galvanic isolation (500 V)
- Eight channels (0.6 or 1.2 A, each)
- Inductive load switching
- Diagnostic feedback (over-temperature, over-load)
- Serial and parallel MCU interface

Key benefits

- Robust and reliable
- Compact system solution
- Lower system cost
- System status feedback
- Directly interfacing with all MPUs and MCUs

Typical block diagram isolated output switch



Product overview		ISO1H801G	ISO1H811G	ISO1H812G	ISO1H815G	ISO1H816G
Switch	V_{bb} operational range: 11 V to 35 V	✓	✓	✓	✓	✓
	Max. continuous load current per channel	0.6 A	0.6 A	0.6 A	1.2 A	1.2 A
	Load current increase by using outputs in parallel	✓	✓	✓	✓	✓
	Inductive clamping energy per channel: 1 Joule	✓	✓	✓	✓	✓
µC interface	Type	Parallel	Parallel	Serial	Parallel	Serial
	Nominal voltages	5 V	3.3 V / 5 V	3.3 V / 5 V	3.3 V / 5 V	3.3 V / 5 V
Safety features	Isolation voltage: V_{ISO} = 500 V UL508 and EN 61131-2 certified	✓	✓	✓	✓	✓
	Active current limitation	✓	✓	✓	✓	✓
	Thermal shut-down	✓	✓	✓	✓	✓
	Common output disable pin	✓	✓	✓	✓	✓
Diagnostics feedback	Over-temperature		✓	✓	✓	✓
	V_{bb} under-voltage		✓	✓	✓	✓
Package DSO-36 (16x14mm)		✓	✓	✓	✓	✓
Infineon ordering code		SP000722122	SP000413798	SP000413800	SP000555576	SP000555578

www.infineon.com/isoface

Isolated digital input ICs

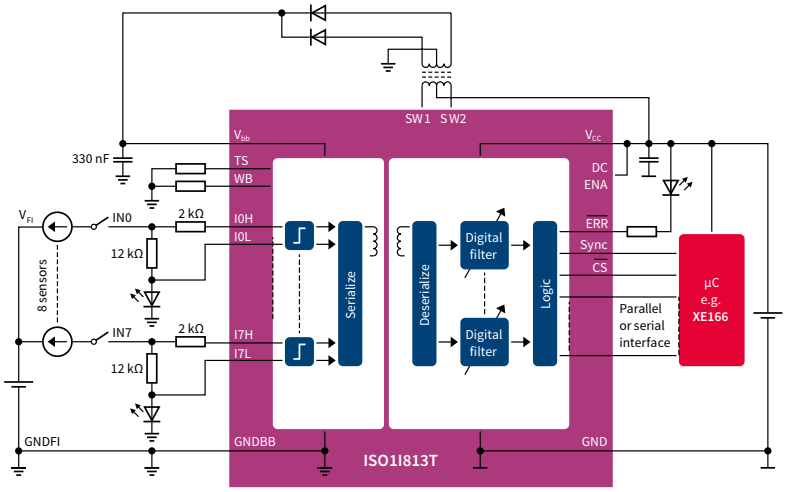
Key features

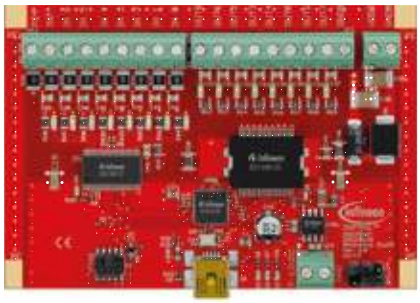
- Integrated galvanic isolation (500 V)
- Eight channels (IEC type 1/2/3)
- Up to 500 kHz sampling speed
- Programmable input filters
- Channel-specific diagnostics (wire-break, under-voltage)

Key benefits

- Robust and reliable
- Compact system solution
- High-speed applications
- Superior EMI robustness
- System status feedback
- Valuable maintenance support

Typical block diagram digital input switch





ISOFACE ™ reference design with microcontroller XMC™

The EMI-tested reference design is a complete and proven template for product design and shortens development time:

- Layout proposal which meets IEC 61131-2 (zone C) requirements
- Optimized bill-of-materials
- Example firmware

Ordering code: SP0012831904

Product overview		ISO1I811T	ISO1I813T
Input characteristics	IEC type: I, II, III	✓	✓
	Input status LED	✓	✓
	Max. sampling frequency	125 kHz	500 kHz
	Deglitching filter setting	Hard wired	Software, individual per channel
	Synchronous data acquisition	–	✓
µC interface	3.3 V/5 V	✓	✓
	Serial and parallel	✓	✓
Safety features	500 V isolation voltage	✓	✓
	Wire break, channel-specific	–	✓
	V_{bb} under-voltage	–	✓
Support for external V_{bb} supply		–	✓
Package TSSOP-48 (8x12.5 mm)		✓	✓
Infineon ordering code		SP000876494	SP000876504

www.infineon.com/isoface

Integrated point-of-load converters

The IR MOSFET™ IPOL based on former SupIRBuck™ family of integrated POL converters combine a controller and MOSFETs in a single package to deliver high power densities with reduced component count and improved performance for best-in-class efficiency over the entire load range.

Control IC **Benchmark MOSFETs** **IR MOSFET™ IPOL**

Constant on-time IR MOSFET™ IPOL

The IR MOSFET™ IPOL product family features Infineon's constant on-time with enhanced stability engine to offer simplicity (no compensation), reduced component count and light load efficiency.

Part number	I_{out} [A]	V_{in} max. [V]	f_{sw} [MHz]	Package [mm]	Selectable OCP
IR3883	3	14	0.8	3x3	✓

PMBus™ digital IR MOSFET™ IPOL

Converters that offer all the benefits of an analog voltage mode engine with the addition of a PMBus™ digital interface. Easy-to-use IR PowIRCenter software allows configuration, monitoring and control of an entire power system.

Part number	I_{out} [A]	V_{in} max. [V]	f_{sw} [MHz]	Package [mm]	PMBus™ commands
IR38064	35	21	0.2-1.5	5x7	66
IR38063	25	21	0.2-1.5	5x7	66
IR38062	15	21	0.2-1.5	5x7	66
IR38060	6	21	0.2-1.5	5x6	66

Key features

› 66 PMBus™ commands

www.infineon.com/ipol

Voltage mode IR MOSFET™ IPOL

The voltage mode engine offers high output voltage accuracy and robust, predictable performance. A patented PWM modulation scheme in the latest (3rd) generation virtually eliminates jitter allowing much higher closed-loop bandwidths (as much as 1/6 of the switching frequency) and more than 1 MHz switching frequency for less capacitor and to deliver the smallest voltage regulator solutions.

Part	Current	Feature
IR3846	35 A	Remote sense Single output
IR3847	25 A	
IR3448	15 A	
IR3895	15 A	Single output
IR3899	9 A	
IR3898	6 A	
IR3887	4 A	
IR3823	3 A	
IR3892	6 A+6 A	Dual output
IR3891	4 A+4 A	

Point-of-load products – how to choose

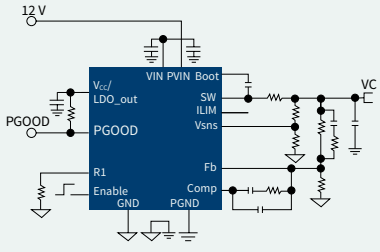
DC-DC products
1 A to 35 A

Analog (VM) IR MOSFET™ IPOL

Flexibility/low jitter
IR389x / IR384x: 3 A-35 A

Programmable

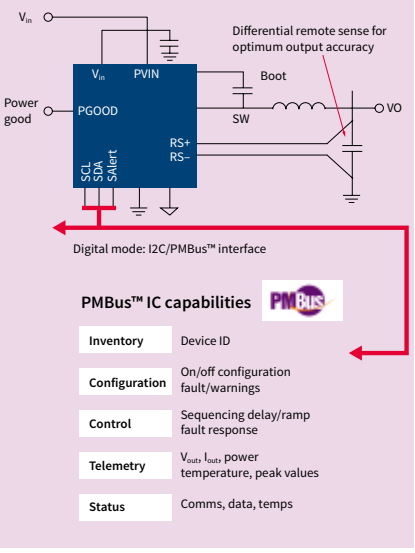
- F_{sw}
- Transient
- Tracking
- Remote sense



PMBus™ digital IR MOSFET™ IPOL

Digital interface
IR3806x: 6 A-35 A

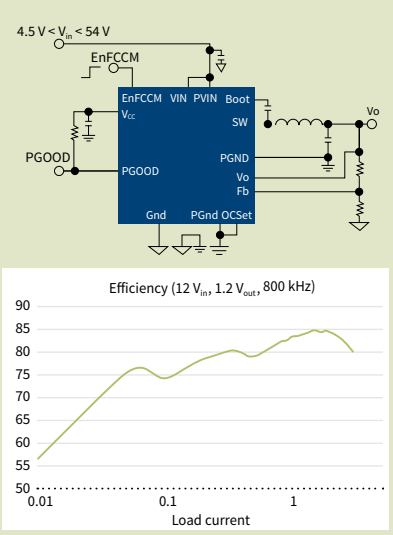
- Telemetry
- Margining



Constant on-time IR MOSFET™ IPOL

Easy/light-load efficiency
IR3883: 3 A **NEW!**

- 50 mA light load efficiency = 75% (12 V_{in} →1.2 V_{out})



www.infineon.com/ipol
www.infineon.com/analog-ipol

CAN transceivers

Proven quality for power management applications

Our CAN transceivers provide proven quality, reliable track records and high robustness in automation applications. Features include excellent electromagnetic performance and low levels of electromagnetic interference (EMI). They are also designed for ISO compliance. While our IFX1050G, IFX1050 GVIO and IFX1040SJ devices are optimized for high-speed CAN communication the new IFX1051 transceiver family addresses the upcoming CAN FD (flexible data rate) markets beyond 1Mbit/s.

Key features

- Transmission rates up to 2 Mbit/s ISO11898 compliant
- Low-power modes
- Receive-only mode
- Standby/sleep mode
- Bus wake up
- Thermal protection
- CAN FD compliance

Key benefits

- Low current consumption
- Thermal protection
- Low power modes
- Excellent EMI performance and EMI robustness
- Standby/sleep mode
- Pin-to-pin replacements for industry-standard parts

Product portfolio

Product number	Package	Transceiver type	ISO compliance	Transmission rate (max.)
IFX1050G	PG-DSO-8	High speed CAN	ISO11898-2	1 Mbps
IFX1050GVIO	PG-DSO-8	High speed CAN	ISO11898-2	1 Mbps
IFX1040SJ	PG-DSO-8	High speed CAN	ISO11898-2, ISO11898-5	1 Mbps
IFX1051SJ	PG-DSO8	CAN FD	ISO 11898-2	2 Mbps
IFX1051LE	PG-TSON8	CAN FD	ISO 11898-2	2 Mbps

CAN FD transceiver

In addition to the classic CAN transceiver portfolio, Infineon is also offering a CAN FD transceiver. By using two reserved bits in the protocol, CAN-FD will boost the baudrate of CAN systems. The so-called “Bit-Rate-Switch"(BRS) bit increases the bit rate within the CAN data field from 1 to 2Mbit/s whereas the so-called "Extended-Data-Length" (EDL) bit increased "payload" from 8 bytes to 64 bytes resulting in higher bandwith.

The Infineon CAN FD transceiver IFX1051, being designed for HS CAN networks in industrial applications, acts as an interface between the physical bus layer and the CAN protocol controller: it drives the signals to the bus and protects the microcontroller against interferences generated within the network. Based on the high symmetry of the CANH and CANL signals, the IFX1051 provides a very low level of electromagnetic emission (EME) within a wide frequency range.

www.infineon.com/industrial-transceivers

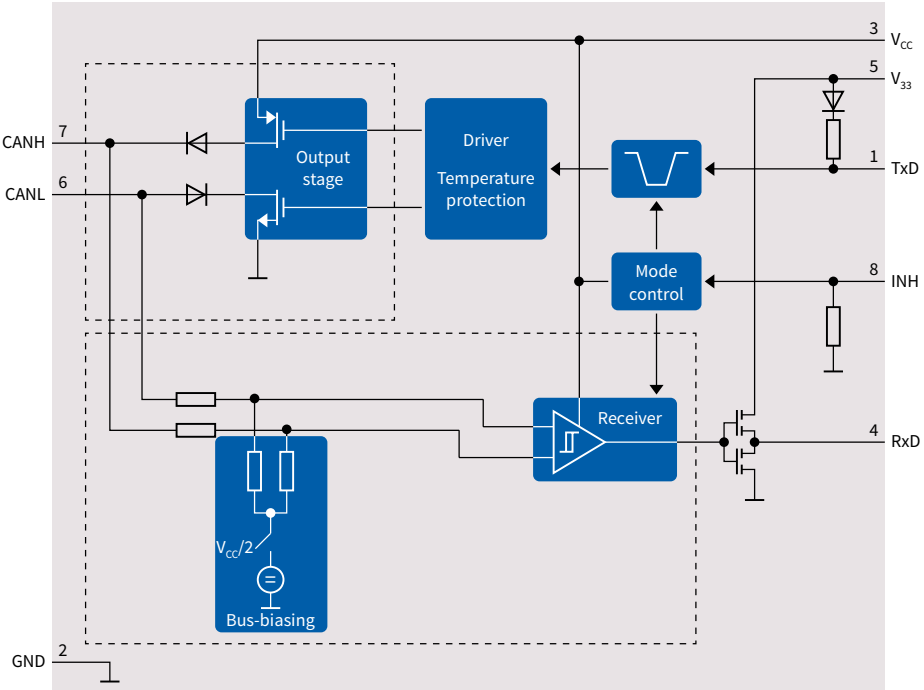
IFX1051 key features

- Fully compatible to ISO 11898-2
- Wide common mode range for EMI
- Very low EME
- Excellent ESD robustness
- Guaranteed loop delay symmetry to support CAN FD data frames up to 2 MBit/s
- VIO input for voltage adaption to the microcontroller supply
- Extended supply range on V_{CC} and VIO supply
- CAN short circuit proof to ground, battery and V_{CC}
- TxD time-out function with very long TxD timeout timing
- Low CAN bus leakage current in power-down state
- Overtemperature protection
- Protected against transients
- Receive-only mode
- Green product (RoHS compliant)
- Two package options: tiny package PG-TSON-8 or standard package PG-DSO-8

IFX1051 key benefits

- Cost efficient replacement to industry market standard device *1051
- High speed communication up to 2 MBit/s
- Wide temperature range

CAN FD IFX1051 block diagramm



www.infineon.com/industrial-transceivers

Voltage regulators

Energy-efficient voltage regulators and trackers

Our linear voltage regulators and trackers help to reduce energy consumption, extending operating time and minimizing operating costs across all kinds of systems. The wide supply voltage range, low quiescent current, rich protective feature set and choice of packages make our devices the perfect fit across a broad application spectrum, apart from automation systems as well for heath care, traffic, power tools, lighting and many other multi-market systems. Our trackers are ideal as additional supplies for off-board loads to increase system reliability.

Key features

- Input voltage up to 60 V
- Output current up to 1.5 A
- Output voltage adjustable or fixed to specific values
- Quiescent current down to 5 µA
- Overload, overtemperature, short-circuit and reverse-polarity protection
- Low current consumption
- Extended temperature range -40°C ... +125°C

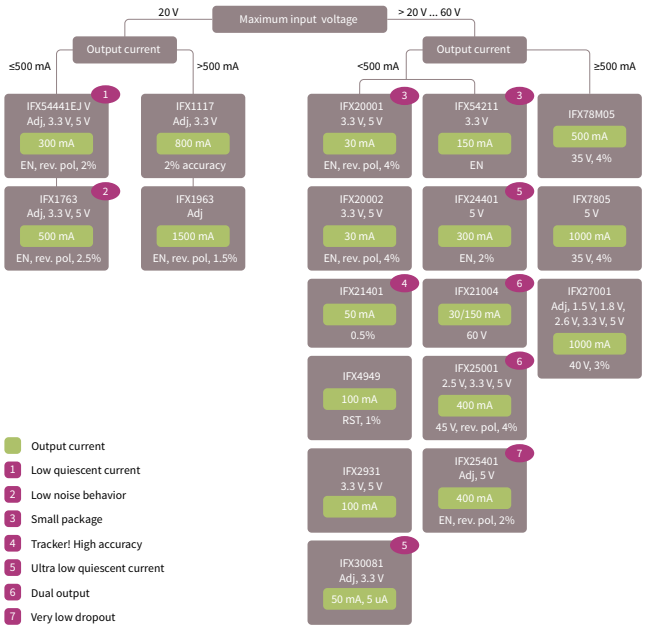
Key benefits

- Pin-to-pin compatibility with industry-standard parts
- Very low dropout voltage
- Trackers for optimized heat distribution and external protection
- Trackers for maximum system cost reduction
- Small robust packages

Infineon microcontroller families and industrial voltage regulators

Microcontroller family	Input voltage [V]	Input current (max.) [mA]	Voltage regulator
XMC1000 family	1.8 … 5.5	<100	IFX54211/IFX2931/IFX4949/IFX25001/IFX544xx/ IFX30081
XMC4000 family	3.3	<500/300	IFX1763/IFX544xx/IFX1117/IFX30081
XC8xx	3.3 … 5.0	200	IFX20001/IFX30081/IFX21401/IFX4949/IFX544xx
XE166/XC2000	1.5 and 3.3 or 5.0	100	IFX25401/IFX24401/IFX2931/IFX4949/IFX1763/IFX54441
TriCore™	1.5 … 3.3	>400	IFX27001/IFX8117/IFX91041/IFX80471/IFX25001/IFX1117

Industrial linear voltage regulator (selection tree)



www.infineon.com/industrial-voltage-regulators

DC-DC converters

Robust range of converters for the widest application spectrum

Our high-efficiency switching regulators and controllers help to reduce energy consumption. In addition to extending the operating time of battery powered systems, they also significantly improve the thermal budget of the application. Overall, this translates into minimal operating costs. For your design flexibility, they are available as adjustable voltage variants as well as with dedicated fixed output voltage values.

Key features

- Input voltage up to 60 V
- Output currents going from 500 mA up to 10 A
- Switching frequencies ranging from 100 kHz to 2.2 MHz
- Shutdown quiescent current down to below 2 µA
- Current limitation and overtemperature protection
- Enable feature

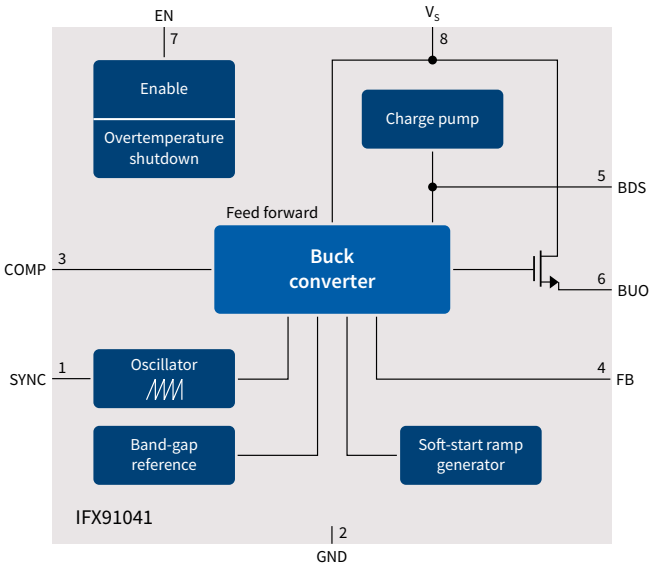
Key benefits

- High-efficiency regulation
- Only a few external components needed for stable regulation
- Perfectly suited for regulation in pre-/post-regulation power supply architectures

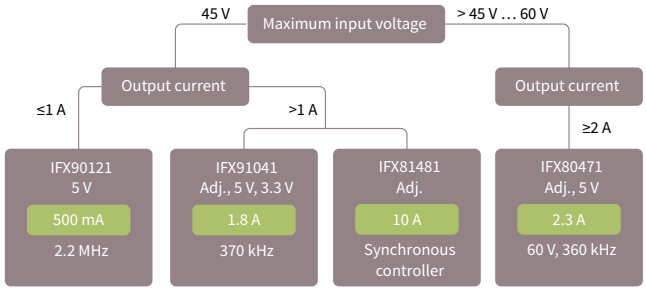
DC-DC converters

Part number	V_Q (multiple)	Output current type	Output current [A]	Product features	Package
IFX81481ELV	Adjustable	Buck controller	10.0	10 A synchronous DC-DC adjustable step down controller; f = 100 kHz-700 kHz, N	PG-SSOP-14
IFX90121EL V50	5.0 V	Buck converter	0.5	V_{in} up to 45 V, 2.2 MHz step-down regulator with low quiescent current	PG-SSOP-14
IFX80471SK V	Adjustable	Buck controller	2.3	V_{in} up to 60 V; V_Q adjustable from 1.25 V up to 15 V; external MOSFET	PG-DSO-14
IFX80471SK V50	5.0 V	Buck controller	2.3	V_{in} up to 60 V; external MOSFET	PG-DSO-14
IFX91041EJV	Adjustable	Buck converter	1.8	V_Q adjustable from 0.6 V up to 16 V; tolerance 2% up to 1000 mA	PG-DSO-8
IFX91041EJ V33	3.3 V	Buck converter	1.8	V_Q fixed to 3.3 V; tolerance 2% up to 1000 mA	PG-DSO-8
IFX91041EJ V50	5.0 V	Buck converter	1.8	V_Q fixed to 5.0 V; tolerance 2% up to 1000 mA	PG-DSO-8

Block diagram IFX91041



Industrial DC-DC buck regulators (selection tree)



www.infineon.com/industrial-dcdc-converters

Industrial PROFET™

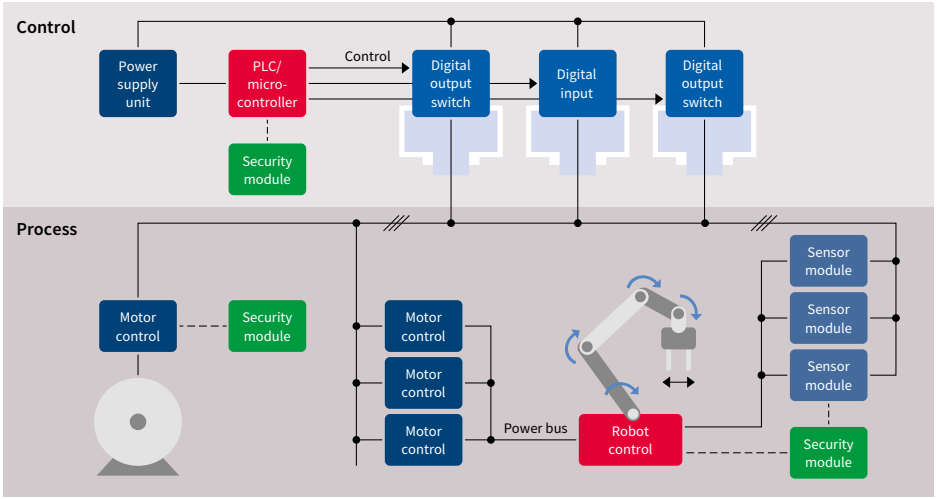
Protected high-side switches

The well-established high-side switch Industrial PROFET™ products were designed for targeting a variety of industrial applications which include all types of resistive, inductive and capacitive loads. Due to their outstanding energy robustness, they are perfectly suitable for switching even higher inductive loads and driving relays. Their main application areas include high-voltage applications (VBAT up to 58 V), high-speed PWM applications (up to 1 kHz) and they are most notably capable of switching higher inductances smoothly. Industrial PROFET™ can be applied to drive any kind of sensor units, indicators, displays, LEDs, relays, valves and magnetic actuators or replace electromechanical relays, fuses and discrete circuits. Industrial PROFET™ are also the perfect match for applications with long wiring or any other kind of inductive loads or applications with space constraints

Key applications

- Industrial automation
- Programmable Logic Controller (PLC)
- Digital I/O modules
- Robotics
- Building and home management
- Solar applications
- Wind energy systems
- Smart grid
- Medical
- E-bikes
- Motor control and drives
- Power supplies

Industrial automation system diagram

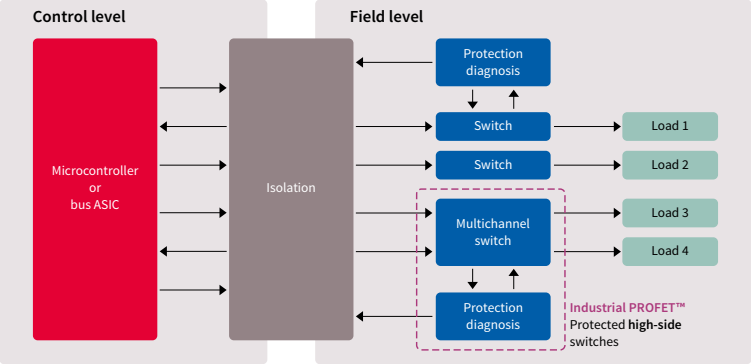


System benefits

- Right fit for digital output switches, motor or robot control, protected switching of decentralized loads like sensors or auxiliary supply
- Suitable for all types of complex loads including high inductances (high EAS)
- Outstanding robustness & reliability as required by industrial mission profiles
- Thermally optimized products with low $R_{DS(on)}$ to deal with the high ambient temperatures and limited or even no cooling
- Diagnosis & protection for safe system operation
- Small & compact design for higher integration and applications with space constraints

www.infineon.com/profet

PLC – Programmable Logic Controller digital output modules



System benefits

- Suitable for all types of complex loads including high inductances (EAS) as PLC manufacturers cannot predict how the end customer will use the digital outputs
- Outstanding robustness & reliability as required by industrial mission profiles
- Thermally optimized products with low $R_{DS(on)}$ to deal with the high ambient temperatures within I/O modules with limited or even no cooling
- Diagnosis & protection for safe system operation
- Small & compact design for higher Integration
- Addressing the I/O modules quasi standard currents 2 A & 0.5 A, but also lower currents as within micro-PLCs

Product	Number of channels	$R_{DS(on)}$ (typ) [mΩ]	Nominal load current [A]	E_{AS} [mJ]	Recommended operating voltage range [V]	$I_{L(SC)}$ (typ) [A]	Diagnosis	Package
ITS4060S-SJ-N	1	50	3.10	900 @ 1.50 A	5.00 … 34.00	17.0	n/a	DSO-8
ISP772T	1	50	2.60	900 @ 1.50 A	5.00 … 34.00	17.0	n/a	DSO-8
ITS428L2	1	60	7.00	190 @ 7.00 A	4.75 … 41.00	22.0	Digital	TO252-5
ITS4100S-SJ-N	1	70	2.40	870 @ 1.00 A	5.00 … 34.00	10.0	n/a	PG-DSO-8
ISP762T	1	70	2.00	870 @ 1.00 A	5.00 … 34.00	10.0	n/a	DSO-8
ITS4200S-ME-O	1	150	1.10	700 @ 0.50 A	11.00 … 45.00	1.4	n/a	SOT223-4
ITS4141N	1	150	1.10	700 @ 0.50 A	12.00 … 45.00	1.4	n/a	SOT223-4
ITS4141D	1	150	1.10	12,000 @ 0.50 A	12.00 … 45.00	1.4	n/a	TO-252-5
ITS4200S-ME-P	1	150	2.20	160 @ 1.00 A	11.00 … 45.00	3.0	n/a	SOT223-4
ITS4142N	1	150	2.20	160 @ 1.00 A	12.00 … 45.00	3.0	n/a	SOT223-4
ITS4200S-ME-N	1	160	1.20	500 @ 0.50 A	5.00 … 34.00	1.5	n/a	DSO-8
ISP452	1	160	1.20	500 @ 0.50 A	5.00 … 34.00	1.5	n/a	SOT223-4
ITS4200S-SJ-D	1	150	1.70	125 @ 1.00 A	6.00 … 52.00	6.5	Digital	DSO-8
ISP752R	1	200	1.70	125 @ 1.00 A	6.00 … 52.00	6.5	Digital	DSO-8
ISP752T	1	200	1.70	125 @ 1.00 A	6.00 … 52.00	6.5	n/a	DSO-8
ITS4300S-SJ-D	1	250	0.80	800 @ 0.30 A	5.00 … 34.00	1.2	Digital	DSO-8
ISP742RI	1	350	0.80	800 @ 0.30 A	5.00 … 34.00	1.2	Digital, inverted	DSO-8
ITS41K0S-ME-N	1	1000	0.55	1000 @ 0.15 A	4.90 … 60.00	0.9	n/a	SOT223-4
ITS4140N	1	1000	0.55	1000 @ 0.15 A	4.90 … 60.00	0.9	n/a	SOT223-4
ITS5215L	2	90	2 x 2.00	178 @ 3.50 A	5.50 … 40.00	15.0	Digital	DSO-12
ITS42K5D-LD-F	2	2500	2 x 0.25	Freewheeling	4.50 … 45.00	0.6	Digital	TSON-10
ITS724G	4	90	4 x 2.00	120 @ 3.30 A	5.50 … 40.00	15.0	Digital	DSO-20
ITS716G	4	140	4 x 1.00	76 @ 2.30 A	5.50 … 40.00	9.0	Digital	DSO-20
ITS711L1	4	200	4 x 1.00	150 @ 1.90 A	5.00 … 35.00	7.5	Digital	DSO-20
ITS42008-SB-D	8	200	8 x 0.60	10,000 @ 625 mA	11.00 … 45.00	3.0	Digital	DSO-36
ITS4880R	8	200	8 x 0.60	10,000 @ 625 mA	11.00 … 45.00	3.0	Digital	DSO-36

Industrial PROFET™ evaluation board plus samples:

- ITS4060S-SJ-N, ITS4100S-SJ-N, ITS4200S-SJ-D,
- ITS4300S-SJ-D, ITS4200S-ME-N, ITS4200S-ME-O,
- ITS4200S-ME-P, ITS41K0S-ME-N

Order: INDPROFETEVALBOARDTOBO1

Additional evaluation boards:

- ITS42008, DEMOBOARDITS42008TOBO1
- ITS42K5D-LD-F, DEMOBOARDITS42K5DTOBO1

www.infineon.com/profet

Half- and H-bridges

Motor control design made easy

Half-bridges

The NovalithIC™ provides a complete, low-ohmic protected half-bridge in a single package (typ. path resistance @ 25°C down to 10 mΩ). It can also be combined with an additional NovalithIC™ to create a half-bridge or three-phase bridge. The NovalithIC™ family has the capability to switch high-frequency PWM while providing overcurrent, overvoltage and overtemperature protection. The NovalithIC™ family offers cost-optimized, scalable solutions for protected high-current PWM motor drives with very restrictive board space. Due to the p-channel high-side switch the need for a charge pump is eliminated thus minimizing EMI.

Basic features
- Low quiescent current
- Capable for high PWM frequency
- Logic level input
- Adjustable slew rate
- Cross-current protection

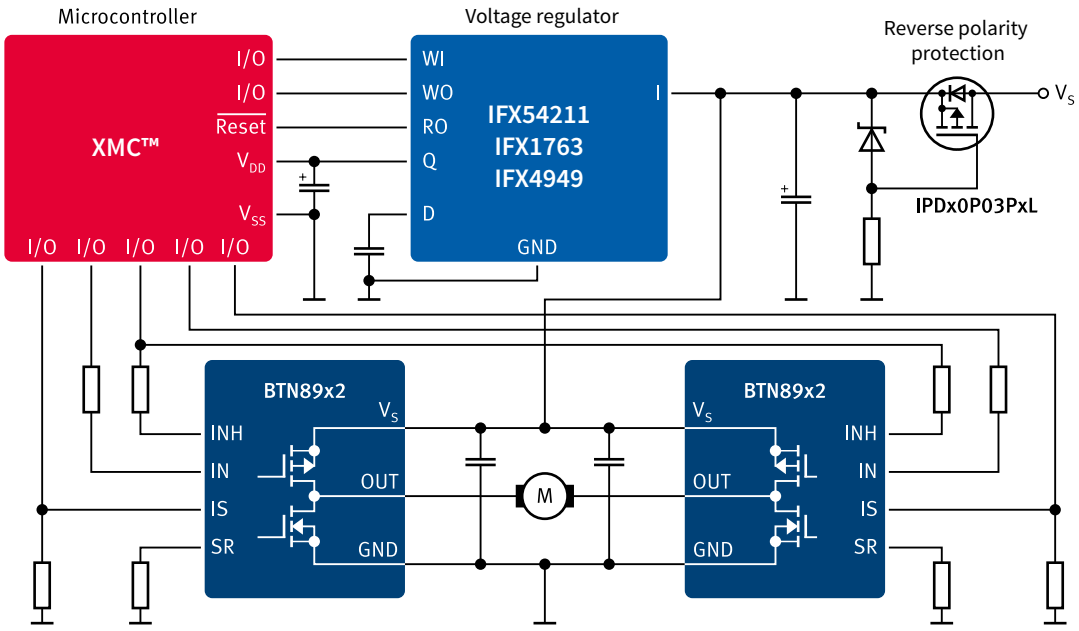
Protection features
- Overtemperature shutdown
- Overvoltage (lockout or smart clamp)
- Undervoltage
- Overcurrent

Diagnostic features
- Overtemperature
- Overvoltage
- Overcurrent
- Current sense and status

NovalithIC™ product overview

Product number	Operating range [V]	$R_{DS(on)}$ path (typ.) [mΩ]	$I_{D(lim)}$ (typ.) [A]	I_q (typ.) [µA]	Switch time (typ.) [µs]	Diagnosis	Protection	Package
BTN8962TA	5.5 ... 40.0	14.2	42	7	0.25	OT, OC, CS	UV, OT, OC	PG-TO-263-7
BTN8982TA	5.5 ... 40.0	10.0	70	7	0.25	OT, OC, CS	UV, OT, OC	PG-TO-263-7

Application example for high-current PWM motor drives



www.infineon.com/novalithic

1) HS switch only
CS = Current sense
OC = Overcurrent
OT = Overtemperature

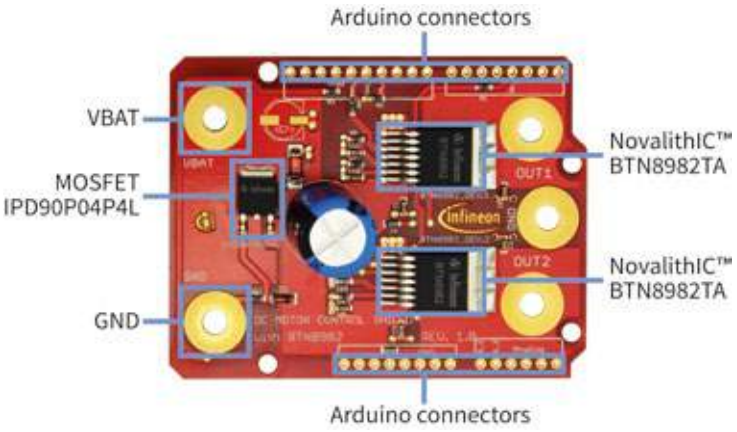
DC motor control shield with BTN8982TA for Arduino

The DC motor control shield is capable of driving two uni-directional DC motors (half-bridge configuration) or one bi-directional DC motor (H-bridge configuration). The implemented half-bridge NovalithIC™ BTN8982TA can be controlled by a PWM via the IN pin. Interfacing to a microcontroller is made easy by the integrated driver IC which features logic level inputs, diagnosis with current sense, slew rate adjustment, dead time generation and protection against overtemperature, undervoltage, overcurrent and short circuit.

Features

- Compatible with microcontroller boards using the Arduino form factor, e.g. Infineon's XMC™ microcontroller kits
- Capable of high frequency PWM, e.g. 30 kHz
- Adjustable slew rates for optimized EMI by changing external resistor
- Driver circuit with logic level inputs
- Diagnosis with current sense

- **Operating conditions**
- Brushed DC motor control up to 250 W continuous load
- 8–18 V nominal input voltage (max. 6–40 V)
- Average motor current 30 A restricted due to PCB (BTN8982TA current limitation @ 55 A min.)



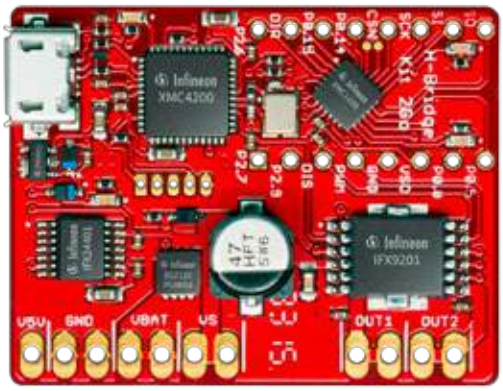
www.infineon.com/shields-for-arduino

H-bridge

IFX9201SG is a general purpose 6 A H-bridge designed for the control of small DC motors and inductive loads. The outputs can be pulse width modulated at frequencies up to 20 kHz – that enables operation above the human sonic range – by means of PWM/DIR control. While the signal at the DIR input defines the direction of the DC motor, the PWM signal controls the duty cycle. For load currents above the current limitation threshold (8 A typ.) the H-bridge switches into chopper current limitation mode.

Key features and benefits

- Up to nominal 36 V supply voltage
- Short circuit, over-temperature protection and under-voltage shutdown
- Detailed SPI diagnosis or simple error flag
- Simple design with few external components
- Small and robust PG-DSO-12-17 package



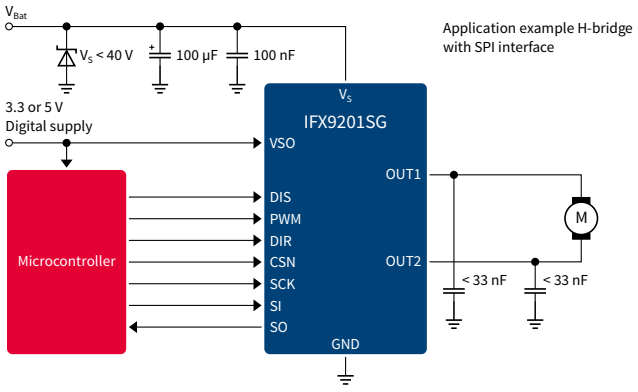
H-bridge kit 2GO with IFX9201

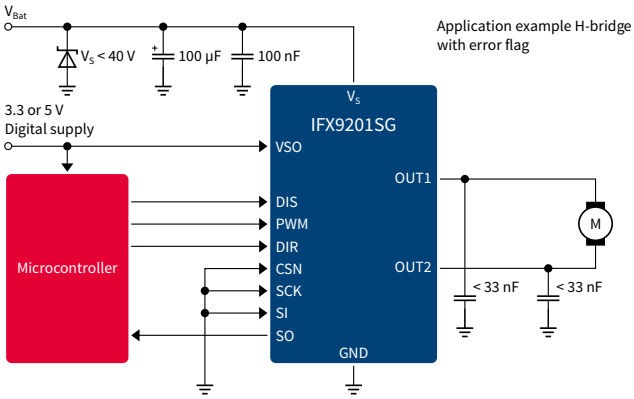
A ready to use evaluation kit. It is fully populated with all electronic components and equipped with the H-bridge IFX9201 combined with an ARM® Cortex®-M0 CPU.

Product summary

Product number	Operating voltage [V]	Current limit (min.) [A]	Quiescent current (typ.) [µA]	Operating range [A]	$R_{DS(on)}$ (typ./switch) [mΩ]	Packages	R_{thJC} (max.) [K/W]
IFX9201SG	5.0...36	6.0	10.0	70	7	PG-DSO-12 (power)	2.0

Block diagram





www.infineon.com/bridges
www.infineon.com/h-bridge-kit-2go

Stepper drivers

Cost-efficient, durable and reliable

The TLE4726G, TCA3727G and TLE8444SL are designed to drive bipolar stepper motors, DC motors and other inductive loads that operate on a constant current. The TLE4726G and TCA3727G have integrated control logic and power output stages for two bipolar windings.

Key features

- Full to half-step operation
- Protected bipolar power stages
- Implemented current control
- Error flag for diagnosis
- Overtemperature protection

Applications

- ATM
- Franking machines
- Vending machine
- Idle speed control
- Printer
- Toys

Stepper drivers product overview

Product number	$I_{L(NOM)}$	$I_{L(lim)}$	I_q [µA]	$V_{S(op)}$	Step operations	Protection	Diagnostic interface	Highlights	Package
TCA3727G	2x0.75	2x1.5	200	5–50	Full to mini-step	OT	–	High operating voltage, low quiescent current with inhibit	PG-DSO-24
TLE4726G	2x0.75	2x1.5	200	5–50	Full to mini-step	OT	–	High operating voltage, low quiescent current with inhibit	PG-DSO-24
TLE8444SL	4x0.50	4x0.90	1	1–18	Full to half-step	SC, OT, OV, UV, OL	Status flag	Open load detection in on-state	SSOP-24-7

CS = Current sense
OC = Overcurrent
OT = Overtemperature
SC = Short circuit
UV = Undervoltage
OL = Open-load

XDP™ digital power

Simplify innovation

Power supply development migrates from analog to digital design to achieve smaller form factors and higher efficiency. Infineon has introduced the category brand XDP™ digital power to include the next generation of ICs, that will highlight Infineon's digital power competence. The digital IC families XDP™ LED and XDP™ SMPS are the first all-in-one package solutions that integrate a digital power controller with key peripherals and simplify your innovations.

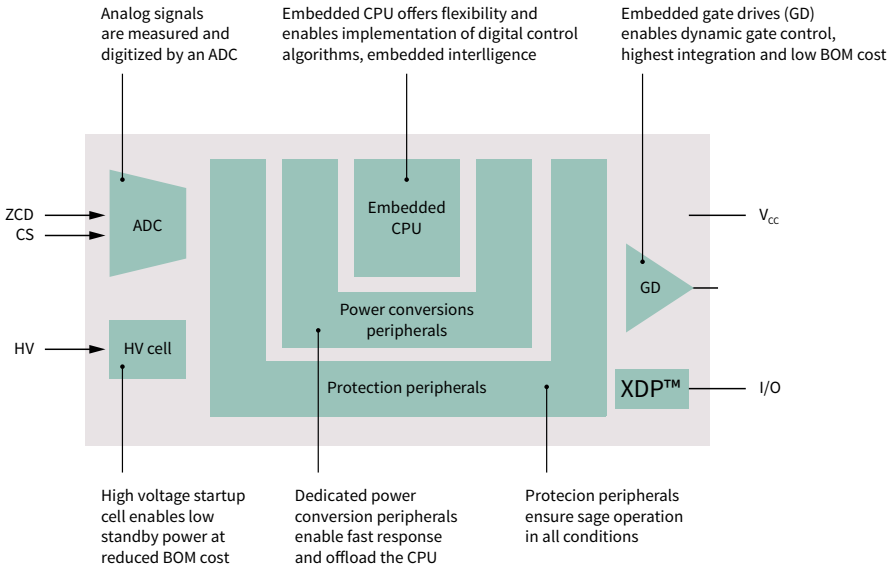
Key benefits of a digital switched mode power supply

- Technical enhancement and cost saving go hand-in-hand
- Firmware gives flexibility over fixed analog design
- Cost saving and faster time to market increase competitiveness

Your advantage

- More flexibility through digital approach
- Simplify the management of product variation
- Shorten development cycles down by 70 percent
- Offer room for customer innovation and own IP
- Advanced energy efficiency
- Reduced system cost and BOM

Software controlled XDP™ digital power system



The value added

For lighting market customers, XDP™ LED helps to cope with the paradigm shift of LED requirements and to solve actual lighting challenges. For power supply customers in the mid-performance sector XDP™ SMPS helps to comply with energy efficiency criteria and provides a much better stand-by management.

www.infineon.com/xdp

.dp Vision

This GUI simplifies your design

.dp Vision is a graphical user interface (GUI) for parameter configuration and programming of Infineon XDP™ digital power ICs for evaluation purposes. With .dp Vision software, parameters of XDP™ products can be easily adapted to application needs, .dp Vision supports the configuration of the following parameters: Hardware configuration, protections, temperature guard, startup and shutdown, control loop, dimming, multimode, enhanced PFC, fine tuning. The XDP™ device will be connected via USA to a computer using the .dp interface generation 2 hardware, which is a galvanic isolated and certified interface board.

Key features

- Set parameter and protection behavior for .dp products
- Test parameters temporarily
- Burn parameters permanently
- Automatic update of firmware on .dp interface gen2
- Online update functionality keeps .dp Vision up to date
- Assistant functionality to guide a user through a typical parametrization flow

Your advantage

- Comfortable parameter setting without changing components on hardware
- Maximum flexibility for adapting application behavior via parameters
- Optimize system performance
- Reduced R&D efforts

Applications

- Generic framework for all .dp digital power devices
- Application add-on packages will add the support of new products to .dp Vision

.dp Vision and .dp Interface board available via www.hitex.com/dp

System requirements

Type	Requirements
Operating system	Windows XP 32-bit/64-bit; Windows 7 32-bit/64-bit; Windows 8 32-bit/64-bit; Windows 8.1 32-bit/64-bit with USB connector
RAM	2 GB
CPU	Intel Celeron 1.1 GHz
Graphics	Integrated graphic card

www.infineon.com/xdp

XDP™ SMPS
IDP2303(A) – digital multi-mode PFC+LLC combo controller

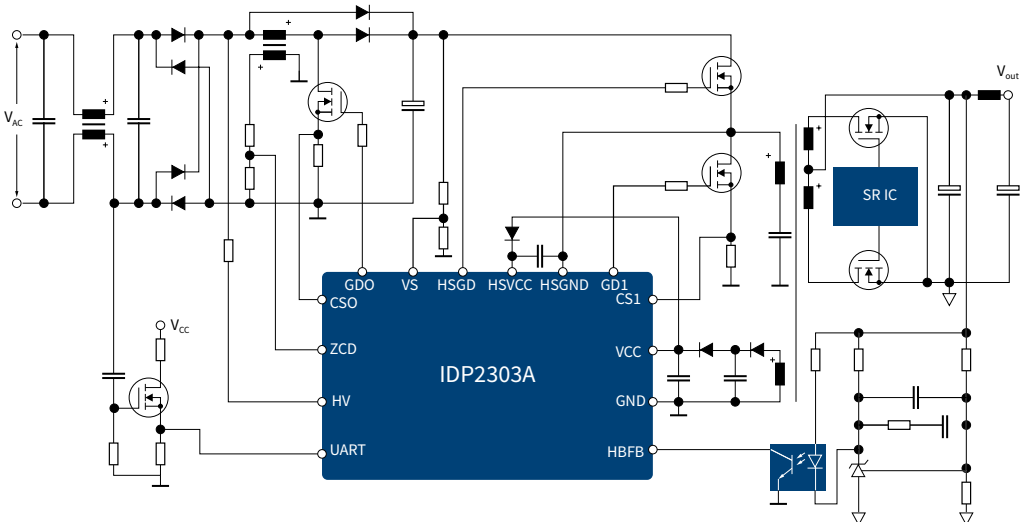
The IDP2303 and IDP2303A are high performance digital combo controllers with integrated drivers and 600 V depletion cell designed for boost PFC and half-bridge LLC targeting switched mode power supplies (SMPS) from 75 W to 300 W.

- Support non-AUX operation with lowest standby performance and startup cell
- Support multi-mode PFC operation for optimized efficiency curve
- Configurable frequency setting for LLC soft-start and normal operation
- Synchronous PFC and LLC burst mode control with soft-start to prevent acoustic noise
- Excellent dynamic response by adaptive LLC burst mode
- Configurable and comprehensive protections for PFC/LLC/IC temp
- IEC62368-1 certified active X-cap discharge function
- Flexible IC parameter setting with digital UART interface supports PSU platform approach

Key benefits

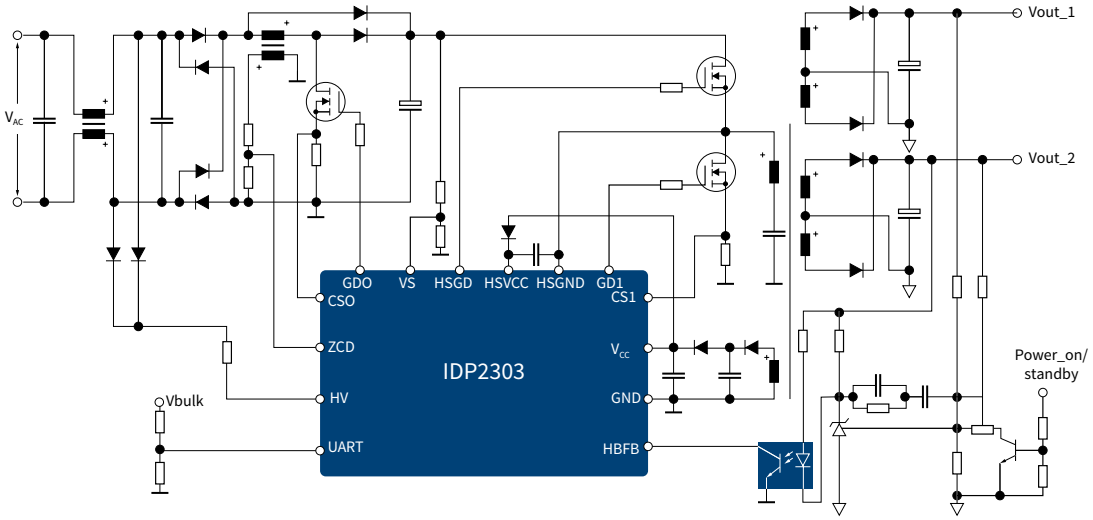
- Low BOM count due to high integration of digital control
- No auxiliary power supply needed
- Easy design of system schematic and PCB layout
- Small form factor design
- Higher system reliability
- Shorter development cycles and higher design and production flexibility

IDP2303A - power adapter



www.infineon.com/idp2303

IDP2303 – embedded PSU



Target applications

- LCD TV power supply
- General SMPS
- Power adapter

www.infineon.com/idp2303

XDP™ LED
XDPL8220 - the simple and innovative entry point to smart lighting

The digital core of the XDPL8220 controller enables a variety of systems based on the same device. Its advanced control algorithms provide the possibility to realize lighting Electronic Control Gear (ECG) for constant current or constant voltage mode in the same circuit. The power limitation mode keeps the light on while it optimally utilizes the components capabilities. The device is adaptable to the target application, by providing a comprehensive parameter set for adjustment of operating constraints.

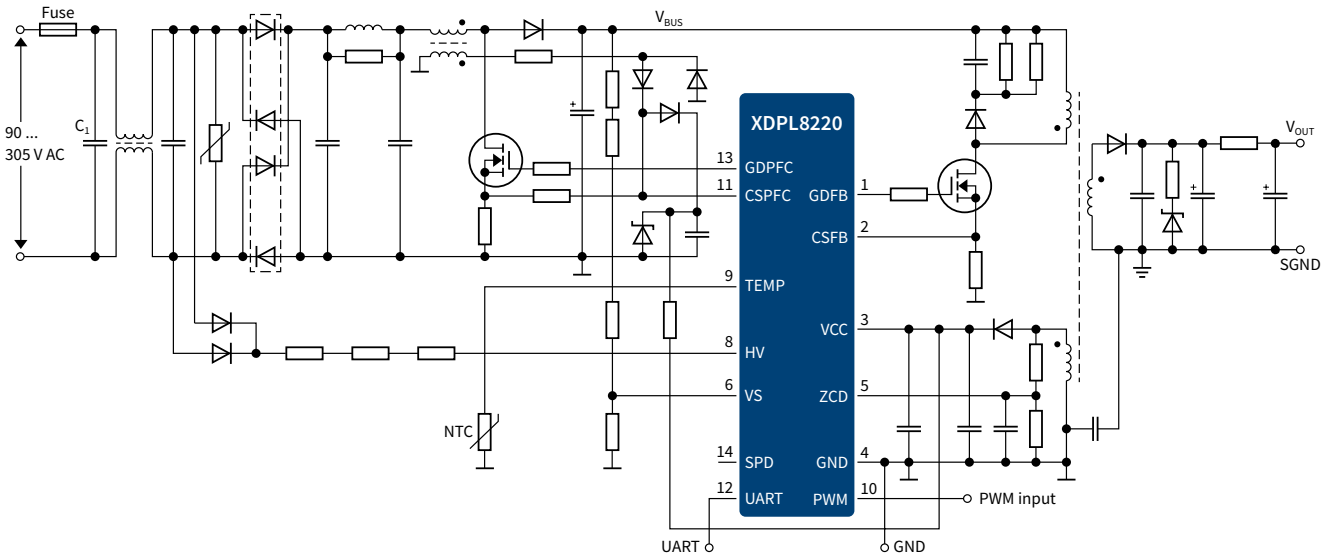
Power conversion with solid performance and more

- Input voltage range 90 V_{AC} –305 V_{AC}
- Efficiency > 90 percent
- Power factor > 0.9
- THD < 15 percent compliant with IEC 61000-3-2 class C
- Device selects optimum between quasi-resonant or discontinuous conduction mode
- Dimming via current amplitude reduction
- Digital parameter setting
- Constant current, constant voltage and limited power modes simultaneously available
- Flicker free dual stage topology
- External temperature sensor
- Stand-by power < 70 mW
- Smooth temperature management
  - All relevant error conditions are monitored and protected under voltage
  - Over voltage
  - Open-load
  - Output shorted

Key benefits

- Flexibility saves efforts and cost
- Essentially no low frequency flicker
- Low stand-by power facilitates permanent operation of the ECG
- Intelligent temperature management protects longevity of luminaries
- Small BOM due to integration and primary side control

Typical application schematic



www.infineon.com/xdpl8220

Infineon support for XDP™ digital power

Simplify innovation

Further information, datasheets and documents

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Intelligent power modules (IPM)

Integrating power electronics and intelligent control

Depending on the level of integration and power to be handled, Infineon offers a wide variety of semiconductors in different packages, voltage and current classes and integrations. CIPOS™ IPMs are highly integrated, compact power modules designed to drive motors in applications ranging from home appliances, fans, pumps to general purpose drives. These energy-efficient intelligent power modules integrate the latest power semiconductor and control ICs technology leveraging Infineon's advanced IGBTs, MOSFETs, next-generation gate driver ICs and state-of-the-art thermo-mechanical technology.

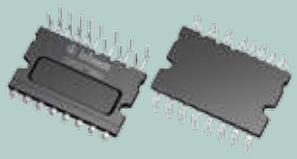
IPM product lineup

Compact IPM lineup

CIPOS™ Nano
3-phase: 1 A-4 A/500 V
2 A-8 A/250 V
Half-bridge:40 V,100 V

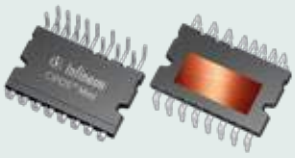
CIPOS™ Micro
MOSFET: 250 V,500 V
IGBT: 600 V

Standard IPM lineup



CIPOS™ Mini
4 A-30 A, 600 V-650 V inverter

Performance IPM lineup



CIPOS™ Mini-DCB
15 A-30 A, 600 V-650 V inverter, PFC, SRM

0.1 A_{rms} — 15 A_{rms}

CIPOS™ IPMs	Applications
Nano	Major home appliance, Fridge, Aircon, Washing machine, Dishwasher, Vacuum cleaner, Fans, Drives
Micro	Major home appliance, Fridge, Aircon, Washing machine, Dishwasher, Fans, Drives
Mini	Major home appliance, Fridge, Washing machine, Laundry dryer, Aircon, Dishwasher, Drives

Key benefits

- Simplified logistics
- Improved manufacturability
- Space saving
- Shorter time-to-market
- Increased reliability
- Reduced system cost

www.infineon.com/ipm

CIPOS™ Nano

Three-phase or half-bridge driver with MOSFETs

The CIPOS™ Nano is a family of highly integrated, ultra-compact, patent pending power modules for high efficiency appliance and light industrial applications, including compressor drives for refrigeration, pumps for heating and water circulation, air-conditioning fans, dishwashers, and automation systems. By utilizing an innovative packaging solution, the CIPOS™ Nano family delivers a new benchmark in device size, offering up to a 60 percent smaller footprint than existing three-phase motor control power ICs. The CIPOS™ Nano family comprises a series of fully integrated three-phase or half-bridge surface-mount motor control circuit solutions. The new alternative approach utilizes PCB copper traces to dissipate heat from the module, providing cost savings through a smaller package design and even eliminating the need for an external heat sink.

CIPOS™ Micro

Solution for low power motor drive applications

The CIPOS™ Micro is a family of compact integrated power modules (IPM) for low power motor drive applications including fans, pumps, air purifiers and refrigerator compressor drives. It offers a cost effective power solution by leveraging industry standard footprints and processes compatible with various PCB substrates. The family features rugged and efficient high voltage FREDFET MOSFETs specifically optimized for variable frequency drives with voltage ratings of 250 V, 500 V and 600 V IGBTs. These devices are paired with the most advanced high voltage driver IC tuned to achieve optimal balance between EMI and switching losses. The CIPOS™ Micro family offers DC current ratings ranging up to 4.6 A to drive motors up to 90 W without heatsink and up to 250 W with heatsink, and are available in both through-hole and surface mount package options.

Key features

- Integrated bootstrap functionality
- Under-voltage lockout for all channels
- Matched propagation delay for all channels
- Optimized dV/dt for loss and EMI trade-off
- Advanced input filter with shoot-through protection
- Separate low-side emitter pins for single or leg-shunt current sensing
- 3.3 V logic compatible
- Up to 1900 V_{RMS}, 1 min isolation (UL certified: File number E252584)
- UL certified NTC for temperature feedback available in CIPOS™ Micro series
- Various lead forms available in CIPOS™ Micro series including through-hole and SMD

Key benefits

- Ease of design and short time-to-market
- Five different compact packages available
- Wide range of current and voltage ratings in the same package
- Wide range of modules for 110 V_{AC} or 230 V_{AC} applications in the same footprint
- Simplified design and manufacturing
- Lower losses than similar modules in the market
- Heat sink-less operation

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CIPOS™ Mini

Intelligent power modules (IPM) 600 V / 4 A–30 A

The energy efficient CIPOS™ Mini module integrates various power and control components to increase reliability, and to optimize PCB size and system costs. This simplifies the power design and reduces significantly the time-to-market.
The CIPOS™ Mini module is designed to control AC motors in variable speed drives for applications from 4 A to up 30 A such as air conditioning, washing machines, refrigerators, vacuum cleaners, compressors and industrial drives up to 3 kW.
The package concept is specially adapted to power applications that need good thermal conduction and electrical isolation, but also EMI-safe control, innovative FAULT indication and overload protection. The feature of Infineon's reverse conducting IGBTs or TRENCHSTOP™ IGBT is used with a new optimized SOI gate driver from Infineon for excellent electrical performance.

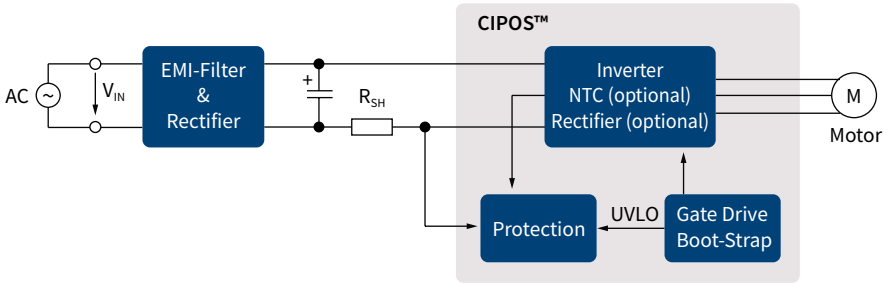
Key features

- Dual-in-line transfer molded package with DCB or Fullpack substrate
- Current rating from 4 A to 30 A, power rating up to 3 kW
- Used for home appliances and motor drivers
- Rugged SOI gate driver technology
- Advanced protection features
- 600 V voltage rating
- UL1577 certified

Key benefits

- High integrations (bootstrap circuit, thermistor) for easy design and saving system space
- Single platform possible from 4 A to 30 A
- Enhanced robustness of the advanced IGBT, gate driver IC technology
- Smaller package and high power density
- Two kinds of substrates provide cost efficient solution for home appliances
- UL certified thermistor

Block diagram for CIPOS™



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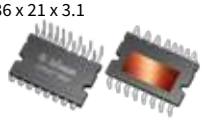
IPM lineup

Family	Package dimensions [mm]	Motor I_{rms} range	Topology	Lineup	Product PN
CIPOS™ Nano	12 x 12 x 0.9 	0.1 A_{rms} - 1.2 A_{rms}	3-phase inverter	250 V MOSFET 0.45 Ω, 1.05 Ω, 2.2 Ω	IRSM836-0x4MA
				500 V MOSFET 1.7 Ω, 2.2 Ω, 4.0 Ω, 6.0 Ω	IRSM836-0x5MA
	8 x 9 x 0.9 	0.4 A_{rms} – 2 A_{rms}	Half-bridge	250 V MOSFET 0.15 Ω	IRSM808-204MH
				500 V MOSFET 0.8 Ω, 1.7 Ω	IRSM807-105MH IRSM807-045MH
	7 x 8 x 0.9 	1 A_{rms} - 10 A_{rms}	Low voltage half-bridge	40 V MOSFET 4.5 mΩ	IRSM005-800MH
				100 V MOSFET 21 mΩ	IRSM005-301MH
Smart	12 x 12 x 0.9 	0.2 A_{rms} - 0.5 A_{rms}	3-phase inverter + controller	500 V MOSFET 1.7 Ω to 6 Ω	IRDM983-025MB IRDM983-035MB* IRDM988-0(1,2,3,4)MB* IRDM932-0(1,2,3)MB*
CIPOS™ Micro	29 x 12 x 2.9 	0.1 A_{rms} - 2.0 A_{rms}	3-phase inverter	250 V MOSFET 0.45 Ω, 1.05 Ω, 2.4 Ω	IRSM5y5-0x4zA
				500 V MOSFET 1.3 Ω, 1.7 Ω, 2.2 Ω, 4.0 Ω, 6.0 Ω	IRSM5y5-0x5zA
				600 V IGBT 4 A	IRSM5y6-076zA
CIPOS™ Mini	36 x 21 x 3.1 	Up to 13 A_{rms}	3-phase inverter	600 V 4 A/6 A/10 A/15 A/20 A/30 A	IGCM04F60yA IGCM06F60yA IKCM10L60yA IKCM15L60yA IKCM20L60yA IKCM30F60yA
				600 V 10 A/15 A(washing machine)	IKCM10H60yA IKCM15H60yA
	36 x 21 x 3.1 	Up to 20 A_{rms}	3-phase inverter	600 V 15/20/30 A	IKCM15L60yD IKCM20L60yD IKCM30F60yD
		Up to 10 A_{rms}	2-phase asymmetric inverter for SRM	600 V 15/20 A	IKCM15R60GD IKCM20R60GD

x = current rating
y = 0 (with thermistor)
Y = 1 (without thermistor)
z = D (through-hole) or P (SMD)
* PN under development

www.infineon.com/ipm

Industrial and general purpose gate driver ICs

The expert's choice

Leveraging the application expertise and advanced technologies of Infineon, the industrial and general purpose gate driver ICs are well suited for many applications such as industrial motor drives, solar inverters, UPS, switch mode power supplies, lighting and major home appliances. Infineon offers a comprehensive portfolio of industrial and general purpose gate driver ICs with a variety of configurations, voltage classes, isolation levels, protection features, and package options. These flexible gate driver ICs are complementary to Infineon IGBTs, MOSFETs, SiC JFET and other power switches in discrete gate drive applications or as part of integrated power modules.

1EDN MOSFET EiceDRIVER™ family

Rugged, cool and fast, 1-channel low-side 4/8 A gate driver ICs

1EDN family overview

1-channel MOSFET gate driver ICs are the crucial link between control ICs and powerful MOSFET and GaN switching devices. Gate driver ICs enable high system level efficiencies, excellent power density and consistent system robustness.

1EDN family: fast, precise, strong and compatible

- Highly efficient SMPS enabled by 5 ns short slew rates and ± 5 ns propagation delay precision for fast MOSFET and GaN switching
- Separate source and sink outputs simplify the application design
- Industry standard packages and pinout ease system design upgrades

1EDN family: the new reference in ruggedness and low power dissipation

- -10 V robustness of control and enable inputs provides crucial safety margin when driving pulse transformers
- 5 A reverse output current robustness eliminates the need for Schottky switching diodes when driving MOSFETs in TO-220 and TO-247 packages
- Cool driver ICs thanks to true rail-to-rail low impedance output stages
- 4 V and 8 V UVLO (Under Voltage Lock Out) options for instant MOSFET protection during start-up and under abnormal conditions

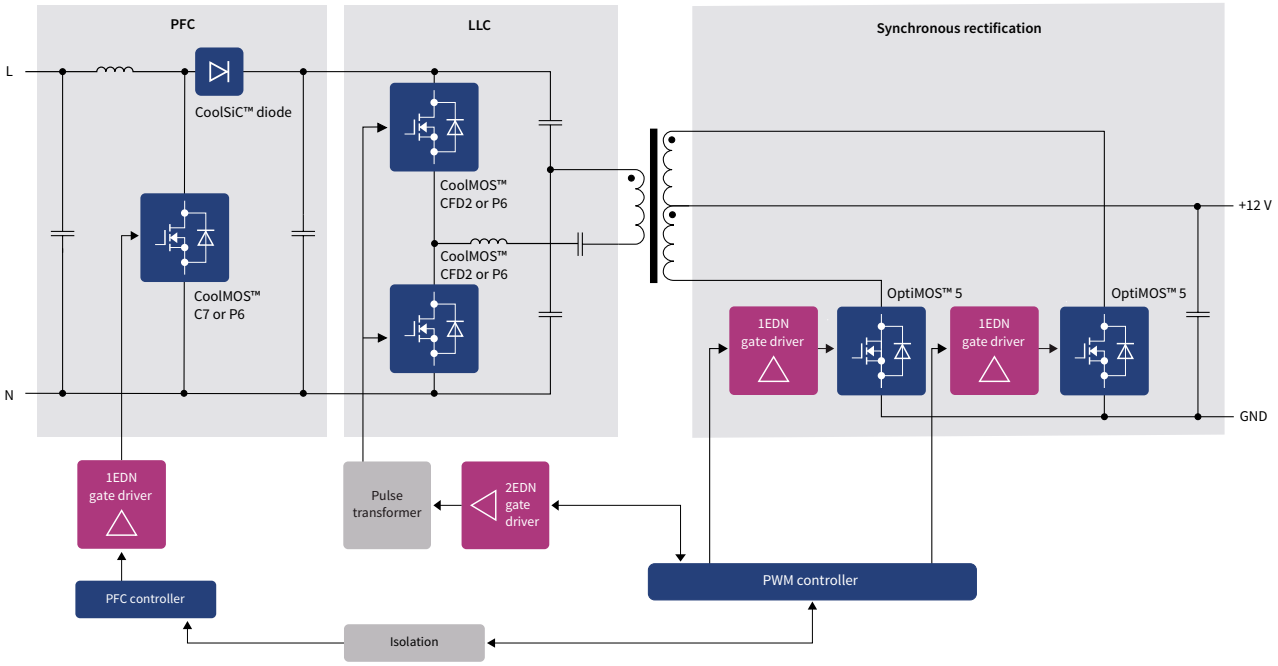
Applications

- PFC
- Synchronous rectification
- DC-DC converters
- Telecom bricks
- Power tools
- Industrial SMPS
- Motor control
- Wireless charging

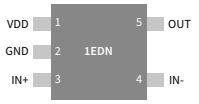
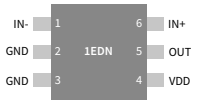
www.infineon.com/1edn

Product features	Product benefits	Application benefits
› 4 A source/8 A sink current › 6 ns rise/5 ns fall times › ± 5 ns propagation delay precision	› Fast Miller plateau transition › Precise timing	› High power efficiency – in hard switching PFC with SiC diode – in half-bridges and synchronous rectifications
› True rail-to-rail low impedance output stages	› Low power dissipation in driver IC	› Cooler driver IC operation › Higher MOSFET drive capability
› 4 V and 8 V UVLO options › 19 ns propagation delay	› Fast and reliable MOSFET turn-off, independent of control IC	› Instant MOSFET protection during start-up and under abnormal operation
› -10 V robustness of inputs	› Increased GND-bounce robustness	› Crucial safety margin to drive pulse transformer
› 5 A reverse output current robustness	› Saves switching diodes	› Increases power density › BOM savings
› Industry standard pinout and packages	› Straight forward design upgrades	› Short time-to-market

Application overview 800 W switched mode power supply



Product portfolio

Package		UVLO	Product name	Orderable part number	Pinout
	SOT-23 6pin	4 V	1EDN7511B	To follow	
		8 V	1EDN8511B	To follow	
	SOT-23 5pin	4 V	1EDN7512B	1EDN7512BXTSA1	
	WSON 6pin	4 V	1EDN7512G	1EDN7512GXTMA1	

www.infineon.com/1edn

2EDN MOSFET EiceDRIVER™ family

Rugged, cool and fast, 2-channel low-side 5 A Driver IC

2EDN family overview

2-channel MOSFET Driver ICs are the crucial link between digital control ICs and powerful MOSFET and GaN switching devices. MOSFET Driver ICs enable high system level efficiencies, excellent power density and consistent system robustness.

2EDN family: fast, precise, strong and compatible

- Highly efficient SMPS enabled by 5 ns short slew rates and 10 ns propagation delay precision for fast MOSFET and GaN switching
- Numerous deployment options due to two 5 A channels. 1 ns channel-to-channel accuracy to use two channels in parallel
- Industry standard packages and pinout ease system design upgrades

2EDN family: the new reference in ruggedness and low power dissipation

- 4 V and 8 V UVLO (Under Voltage Lock Out) options for instant MOSFET protection under abnormal conditions
- -10 V robustness of control and enable inputs provides crucial safety margin when driving pulse transformers or driving MOSFETs in TO-220 and TO-247 packages
- 5 A reverse output current robustness eliminates the need for Schottky switching diodes and reduces bill-of-material
- Cool driver ICs from true rail-to-rail low impedance output stages

Applications

- Server
- Telecom
- DC-DC converters
- Bricks
- Power tools
- Industrial SMPS
- Motor control
- Solar

Product features	Product benefits	Application benefits
5 A souce/sink current 5 ns rise/fall times <10 ns propagation delay precision	Fast Miller plateau transition Precise timing	High power efficiency – in hard switching PFC with SiC diode – in half-bridges and synchronous rectifications
True rail-to-rail low impedance output stages	Low power dissipation in driver IC	Cooler driver IC operation Higher MOSFET drive capability
4 V and 8 V UVLO options 19 ns propagation delay for both control and enable inputs	Fast and reliable MOSFET turn-off, independent of control IC	Instant MOSFET protection under abnormal operation
-10 V robustness of control and enable inputs	Increased GND-bounce robustness	Crucial safety margin to drive pulse transformer
5 A reverse output current robustness	Saves switching diodes	Increases power density BOM savings
2 independent channels Excellent 1 ns channel-to-channel accuracy	Option to increase drive current by truly concurrent switching of 2 channels	One IC covering many applications
Industry standard pinout and packages	Straight forward design upgrades	Short time-to-market

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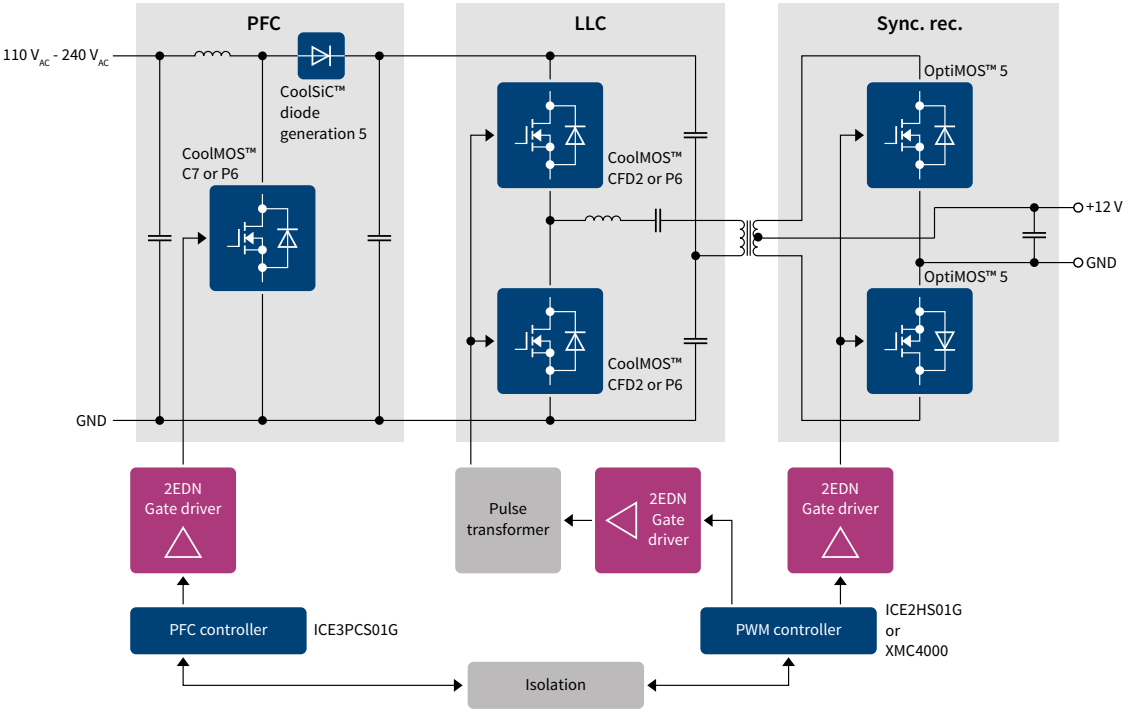
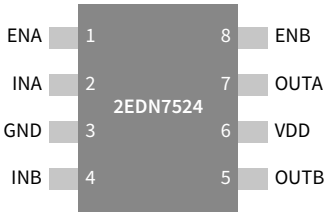
Application overview 800 W 130 kHz switched mode power supply



Product portfolio

Package		UVLO	Inputs	Product name	Orderable part number
	DSO 8pin	4 V	Direct	2EDN7524F	2EDN7524FXTMA1
			Inverted	2EDN7523F	2EDN7523FXTMA1
		8 V	Direct	2EDN8524F	2EDN8524FXTMA1
			Inverted	2EDN8523F	2EDN8523FXTMA1
	TSSOP 8pin	4 V	Direct	2EDN7524R	2EDN7524RXUMA1
			Inverted	2EDN7523R	2EDN7523RXUMA1
		8 V	Direct	2EDN8524R	2EDN8524RXUMA1
			Inverted	2EDN8523R	2EDN8523RXUMA1
	WSON 8pin	4 V	Direct	2EDN7524G	2EDN7524GXTMA1
			Inverted	2EDN7523G	2EDN7523GXTMA1

Industry standard pinout configuration



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1EDS20I12SV EiceDRIVER™ Safe

1200 V single-channel driver IC with reinforced galvanic isolation according to VDE 0884-10

ED-S Safe

The new 1EDS20I12SV EiceDRIVER™ Safe is dedicated to the next generation of high-efficiency and low-EMI electric drive systems. It is tailored for industrial drive applications using 1200 V power modules for currents up to 900 A, such as the EconoDUAL™ 3 (up to 600 A). It is a single-channel IGBT driver IC with reinforced galvanic isolation according to VDE 0884-10 based on our coreless transformer technology.

The 1EDS20I12SV provides a variety of enhanced features. Dynamic slew rate control (SRC) allows dV/dt control in electric drives through precise gate current control. This enables on-the-fly tuning for the best tradeoff between minimum power dissipation and minimum EMI depending on operating conditions such as high and low load. The driver also includes desaturation protection for IGBTs and overcurrent protection for sense IGBTs via the fault status output pin. Two ready state output pins indicate proper driver power supply and normal operation. Two-level turn-off with adjustable timing and voltage protects against excessive overvoltage in case of the IGBT operating at overcurrent or a short circuit.

The 1EDS20I12SV meets today's long-term stability requirements for industrial applications. To turn on the IGBT, the driver works as an adjustable current source in conjunction with an external PMOS transistors and a sense resistor. To turn off the IGBT, the driver uses a 2 A MOSFET output stage.

The driver is offered in a DSO-36 package with a package width of 300mil. It is RoHS-compliant, green, and halogen-free.

Key features

- 1200 V single-channel IGBT driver IC with reinforced galvanic isolation according to VDE 0884-10
- Unique: precise dynamic gate current control
- Unique: selective short circuit protection for 3-level inverters
- Overcurrent protection for sense IGBTs and conventional IGBTs
- Protection: DESAT, soft turn-off and two-level turn-off

Applications

- AC and brushless DC motor drives
- High voltage DC-DC converters
- UPS systems
- Servo drives

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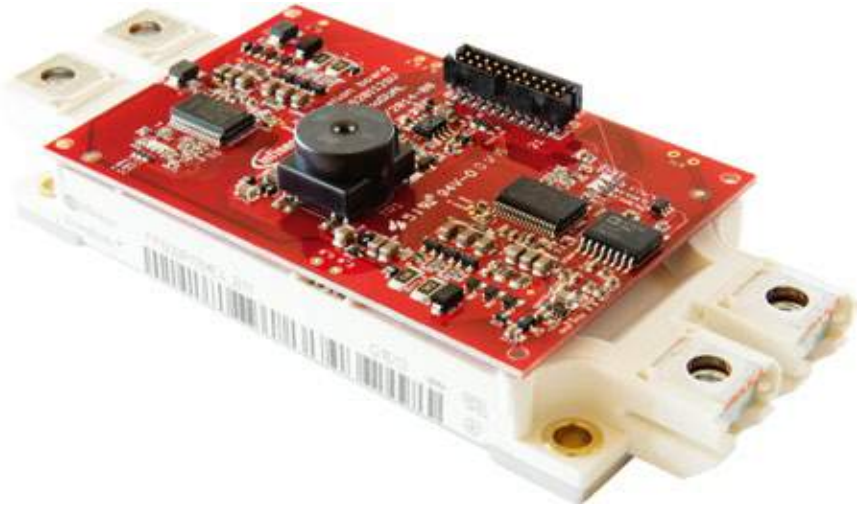
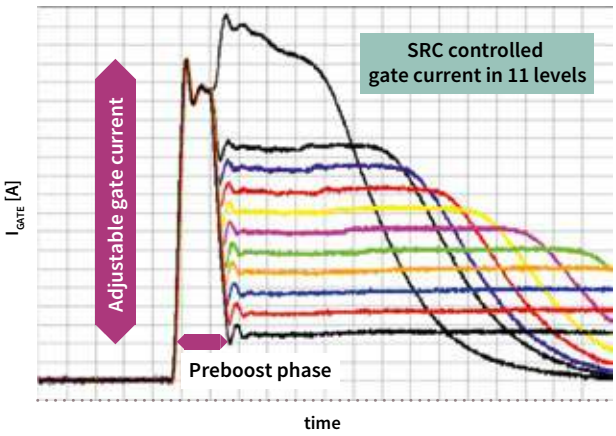
www.infineon.com/eicedriver

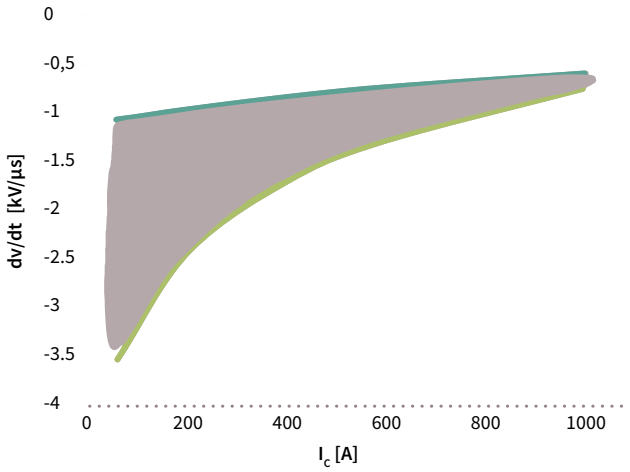
1EDS-SRC driver board with EconoDUAL™ 3 power module



Feature – real-time gate current control



Effect – gate turn-on tunable across a very large dV/dt range:



Benefits

- Low EMI during low load conditions and high efficiency during high load conditions
- Reduction or elimination of dV/dt filter

RoHS

Drives UPS HVDC

www.infineon.com/eicedriver-safe
www.infineon.com/eicedriver

IRS200x 200 V IC family

Now including IRS2008SPBF – Half-bridge driver IC

The 200 V half-bridge and high- and low-side driver IC family is tailored for low voltage (24 V, 36 V, and 48 V) and mid-voltage (60 V, 80 V and 100 V) motor drive applications. The IRS200x family utilizes our advanced high voltage IC process to realize a compact, efficient and robust monolithic construction.

The IRS200x family consists of seven devices with a typical output sink current of 600 mA and typical output source current of 290 mA. The 200 V devices are 3.3 V, 5 V, and 15 V logic compatible. V_{CC} undervoltage lockout (UVLO) protection is a standard feature provided across the family while IRS2008 and IRS2005 also include VBS UVLO protection. Additionally, the IRS2008 has VS operational logic of -8 V. The IRS2008, IRS2004, and IRS2003 include integrated dead-time and shoot-through protection. The 200 V devices feature low quiescent currents. IRS2008 and IRS2004 also features a shutdown input pin.

The 200 V devices are offered in eight-pin SOIC, eight-pin DIP or fourteen-pin 4x4 mm MLPQ packages with various logic input options and standard pin-out configurations for high design flexibility and fast time-to-market.

Applications

- Appliance motor drives
- Servo drives
- Micro inverter drives
- General purpose three phase inverters
- E-bike
- Multicopter

Product features	Benefits
› 290 mA/600 mA typical sink/source current › 70 ns/35 ns typical turn-on rise and turn-off fall time › Less than 60 ns delay matching time	› High power efficiency
› V_{CC} undervoltage lockout (UVLO) protection with additional VBS UVLO for IRS2008 and IRS2005 › Dead time and cross-conduction prevention logic	› Fast and reliable switching › Protection under abnormal operation
› Fully operational to +200 V off-set voltage › Tolerate to negative transient voltage, dV/dt immune	› Increased device reliability
› Low quiescent current	› Low cost bootstrap power supply › BOM savings
› Various input options › Standard pin-out and packages	› Easy to use, straight forward design › Fast time-to-market

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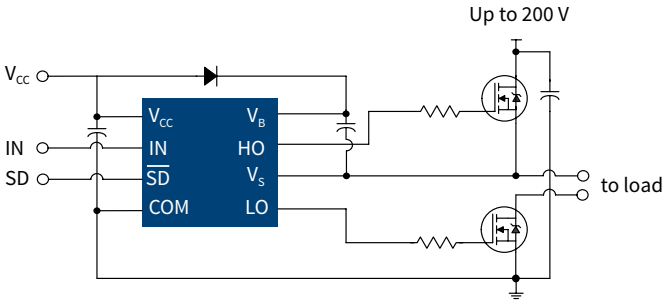
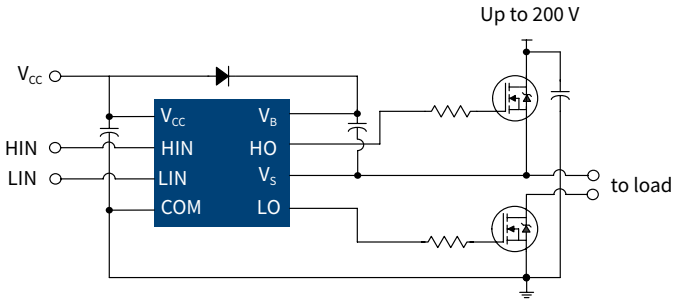
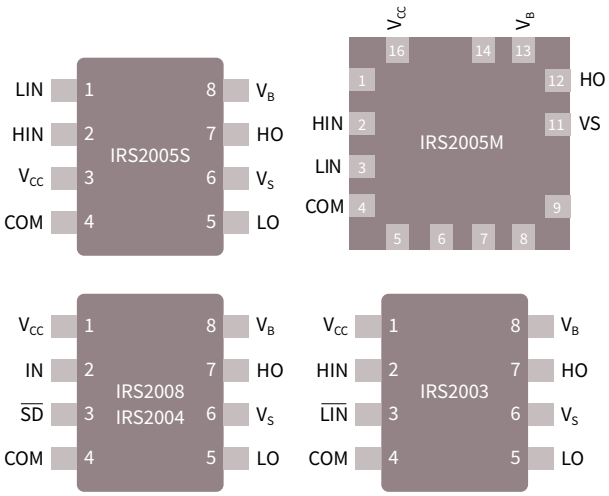
Typical connection diagram IRS2008 and IRS2004



Typical connection diagram IRS2005



Pin configurations



Product portfolio

Part number	Voltage class [V]	Channels	Source/sink current typ. [mA]	Deadtime typ. [ns]	Typ. propagation delay [ns]		Control inputs	UVLO typ. [V]	Package	MSL
					on	off				
IRS2008S	200	2	290/600	520	680	150	IN $\overline{SD}$	8.2-9.7	8-lead SOIC	2
IRS2005S	200	2	290/600	-	160	150	HIN LIN	8.2-9.7	8-lead SOIC	2
IRS2005M	200	2	290/600	-	160	150	HIN LIN	8.2-9.7	14-lead 4x4 MLPQ	2
IRS2004	200	2	290/600	520	680	150	IN $\overline{SD}$	8.2-9.7	8-lead PDIP	-
IRS2004S	200	2	290/600	520	680	150	IN $\overline{SD}$	8.2-9.7	8-lead SOIC	2
IRS2003	200	2	290/600	520	680	150	HIN $\overline{LIN}$	8.2-9.7	8-lead PDIP	-
IRS2003S	200	2	290/600	520	680	150	HIN $\overline{LIN}$	8.2-9.7	8-lead SOIC	2

*IRS2001 is not recommended for new designs, IRS2005 replaces IRS2001 and IRS2008 can replace IRS2004

www.infineon.com/200vHVIC

Industrial and general purpose gate driver ICs

Infineon's gate driver IC solutions are the expert's choice. With more than 200 reliable and efficient gate driver solutions, we provide a comprehensive portfolio for virtually any application. Addressing various application requirements, Infineon delivers solutions with an assortment of gate driver topologies, voltage classes, drive capability, features and package options to optimize performance, minimize size and reduce cost. Some discrete gate driver ICs are also available in bare die. The table below shows additional gate driver IC features available in the current portfolio.

Feature	Benefit
Active miller clamp	Protection against inadvertent dynamic turn-on because of parasitic effects
Brake chopper	Integrated brake IGBT driver with protection
Comparator	General purpose comparator included
Current amplifier	An independent op-amp for current measurement or over current detection
Current sense	Dedicated input detects over current events
Desaturation protection	Protects the switch (IGBT) at short circuit
Dedicated JFET control	Optimized to drive CoolSiC™ (SiC JFET)
Enable	Dedicated pin terminates all outputs
Error reporting with shutdown	Pin indicates fault conditions and programs shutdown time
Fault reporting	Indicates an over current or under voltage shutdown has occurred
Fault reset	Dedicated pin resets the DESAT-FAULT-state of the chip
Integrated bootstrap diode	Integrated bootstrap reduces BOM
Over current protection	Ensures safe application operation in case of over current
Programmable dead time	Dead time is programmable with external resistor for flexible design
Programmable shutdown	A shutdown feature has been designed into a pin
Shoot-through protection	Functionality such as dead time and interlock
Soft over current shutdown	Dedicated pin turns off the desaturated transistor, preventing over voltages
Shutdown	Dedicated pin disables the IC outputs
Separate sink/source outputs	Simplifies gate resistor selection, reduces BOM and improves dV/dt control
Self-oscillating	Integrated front end oscillator
Separate pin for logic ground	Dedicated pin for logic ground
Two-level turn-off	Lowers V_{CE} overshoots at turn-off during short circuits or over current events
Under voltage lockout	Ensures safe application operation by avoiding unexpected driver behavior

Infineon's industrial and general purpose gate driver ICs utilize the following technologies:

- (1) Coreless transformer technology (CT)
- (2) Level-shifting silicon-on-insulator technology (LS-SOI)
- (3) Level-shifting junction-isolation technology (LS-JI)
- (4) Non-isolated technology (NI)

Coreless transformer (CT) technology uses semiconductor manufacturing processes to integrate a transformer consisting of metal spirals and silicon oxide insulation. The transformer is placed on the transmitter chip. Bond wires connect the upper winding with the receiver chip.

Level-shifting silicon-on-insulator (LS-SOI) technology is an advanced technique for MOS/CMOS fabrication. The silicon is separated by a buried silicon dioxide layer. The top layer, which is the silicon film, is used to produce the transistor. The bottom layer is used as the silicon substrate. The buried silicon dioxide provides an insulation barrier between the active layer and silicon substrate. Infineon’s advanced process allows monolithic high voltage and low voltage circuitry construction with additional technology-enhanced features.

Level-shifting junction isolation (LS-JI) technology is a mature MOS/CMOS fabrication technique where silicon is used to produce the transistors. Infineon's proprietary HVIC and latch immune CMOS technologies enable ruggedized monolithic construction. The advanced process allows monolithic high voltage and low voltage circuitry construction with the best price for performance.

Non-isolated (NI) technology refers to gate drivers utilizing low voltage circuitry. Infineon's world-class fabrication techniques enable tiny low side drivers in DSO-8 and SOT-23 packages with high current capabilities.

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Product overview

To ease the selection process, this overview is structured along the configurations of the gate driver ICs, as opposed to by application topology.

Single high-side

Voltage class	I_{o+}/I_{o-} typ [mA]	Typ. prop delay: off/on [ns]	Base PN	Technology	Features														Package							
					Under voltage lockout	Separate pin for logic ground	Separate sink/source outputs	Over current protection	Current sense	Desaturation protection	Soft over current shutdown	Two-level turn-off	Fault reporting	Active miller clamp	Fault reset	Error reporting with shutdown	Enable	Dedicated JFET control	DSO-8	DSO-8 300mil	DSO-16	DSO-16 WB	DSO-19	DSO-36	DIP-8	SOT23-6
1200	1300/900	300/300	1EDI05I12A	CT	✓	✓	✓												✓	✓						
	2000/2000	165/170	1ED020I12-(B,F)2	CT	✓	✓				✓			✓	✓	✓						✓					
		1750/1750	1ED020I12-(B,F)T	CT	✓	✓				✓		✓	✓	✓	✓						✓					
	2200/2300	300/300	1EDI10I12M	CT	✓	✓								✓					✓	✓						
	4000/3500	120/115	1EDI20N12A	CT	✓	✓	✓												✓							
		125/120	1EDI20H12A	CT	✓	✓	✓													✓						
		300/300	1EDI20I12A	CT	✓	✓	✓												✓	✓						
			1EDI20I12M	CT	✓	✓								✓					✓	✓						
	4000/4000	80/80	1EDI30J12CP	CT	✓												✓	✓					✓			
	5900/6200	300/300	1EDI30I12M	CT	✓	✓								✓					✓	✓						
	7500/6800	300/300	1EDI40I12A	CT	✓	✓	✓												✓	✓						
	SRC*/2000	460/460	1EDS20I12SV	CT	✓	✓		✓		✓	✓	✓	✓				✓							✓		
	10000/9400	125/120	1EDI60H12A	CT	✓	✓	✓												✓	✓						
		300/300	1EDI60I12A	CT	✓	✓	✓												✓	✓						
600	160/240	215/140	IRS25752	JI	✓																					✓
	250/500	105/125	IR211(7,8)	JI	✓														✓						✓	
		150/200	IR2127(1)	JI	✓			✓	✓				✓						✓						✓	
			IR2128	JI	✓			✓	✓				✓						✓						✓	
	290/600	105/125	IRS211(7,8)	JI	✓														✓						✓	
		150/150	IRS2127	JI	✓			✓	✓				✓						✓						✓	
			IRS21271	JI	✓			✓	✓	✓			✓						✓						✓	
500	1600/3300	200/170	IR2125	JI	✓			✓	✓				✓			✓						✓			✓	
200	160/240	215/140	IRS20752	JI	✓																					✓
100	160/240	215/140	IRS10752	JI	✓																					✓

*SRC = Turn on slew rate control

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Single low-side

Voltage class	I_{o+}/I_{o-} typ [mA]	Typ. prop delay: off/on [ns]	Base PN	Technology	Features: Under voltage lockout	Separate sink/source outputs	Over current protection	Current sense	Fault reporting	Error reporting with shutdown	Enable	Package: DIP-8	SOT23-5	SOT23-6	WSON-6
25	300/550	50/50	IR44252	NI	✓								✓		
	1500/1500	50/50	IRS44273	NI	✓								✓		
	1700/1500	50/50	IR44272	NI	✓						✓		✓		
			IR44273	NI	✓								✓		
20	4000/8000	19/19	1EDN(7,8)511B	NI	✓	✓					✓			✓	
			1EDN7512	NI	✓						✓			✓	✓
5	1600/3300	200/150	IR2121	NI	✓		✓	✓	✓	✓		✓			

Dual high-side

Voltage class	I_{o+}/I_{o-} typ [mA]	Typ. prop delay: off/on [ns]	Base PN	Technology	Features: Under voltage lockout	Separate pin for logic ground	Desaturation protection	Fault reporting	Fault reset	Package: DSO-36
1200	2000/2000	165/170	2ED020I12-F2	CT	✓	✓	✓	✓	✓	✓

Dual low-side

Voltage class	I_{o+}/I_{o-} typ [mA]	Typ. prop delay: off/on [ns]	Base PN	Technology	Features: Under voltage lockout	Enable	Package: DSO-8	DIP-8	WSON-8	TSaSOP-8
25	2300/3300	50/50	IRS4426	NI			✓			
			IRS44262	NI	✓		✓			
			IRS4427	NI			✓	✓		
			IRS4428	NI			✓			
		65/85	IR25600	NI			✓	✓		
			IR442(6,7)	NI			✓	✓		
20	5000/5000	19/19	2EDN752(3,4)F	NI	✓	✓	✓			
			2EDN752(3,4)G	NI	✓	✓			✓	
			2EDN752(3,4)R	NI	✓	✓				✓
			2EDN852(3,4)F	NI	✓	✓	✓			
			2EDN852(3,4)G	NI	✓	✓			✓	
			2EDN852(3,4)R	NI	✓	✓				✓

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High-side and low-side

Voltage class	I_{o+}/I_{o-} typ [mA]	Typ. prop delay: off/on [ns]	Base PN	Technology	Features: Under voltage lockout	Features: Separate pin for logic ground	Features: Integrated bootstrap diode	Features: Shutdown	Benefits: DSO-8	Benefits: DSO-14	Benefits: DSO-16 WB	Benefits: DIP-8	Benefits: DIP-14	Benefits: VQFN-14
1200	2000/2500	225/280	IR2213	JI	✓	✓		✓			✓		✓	
700	220/350	200/220	IR7106	JI	✓				✓					
600	200/350	200/220	IR2106	JI	✓				✓			✓		
			IR21064	JI	✓	✓				✓			✓	
			IR2301	JI	✓				✓			✓		
			IR25604	JI	✓				✓					
			IRS2301	JI	✓				✓					
	210/360	150/160	IR210(1,2)	JI	✓				✓			✓		
	250/500	105/125	IR2112	JI	✓			✓			✓		✓	
	290/600	130/135	IRS2112	JI	✓	✓		✓			✓		✓	
		150/160	IRS2101	JI	✓				✓			✓		
		200/220	IRS2106	JI	✓				✓			✓		
			IRS21064	JI	✓	✓				✓			✓	
	360/700	400/420	2EDL05I06B	SOI	✓		✓		✓					
	1900/2300	220/180	IR(S)2181	JI	✓				✓			✓		
			IR21814	JI	✓	✓				✓			✓	
			IRS21814	JI	✓	✓				✓			✓	✓
	2500/2500	94/120	IR2113	JI	✓	✓		✓			✓		✓	
			IR25607	JI	✓	✓		✓			✓			
		120/130	IRS2113	JI	✓	✓		✓			✓		✓	✓
	4000/4000	170/170	IRS2186	JI	✓				✓			✓		
			IRS21864	JI	✓	✓				✓			✓	
			IRS21867	JI	✓				✓					
500	2500/2500	94/120	IR2110	JI	✓	✓		✓			✓		✓	
		120/130	IRS2110	JI	✓	✓		✓			✓		✓	
200	290/600	150/160	IRS2005	JI	✓				✓					✓
	1000/1000	60/60	IRS2011	JI	✓				✓			✓		
		75/80	IR2011	JI	✓				✓			✓		
	3000/3000	65/95	IR2010	JI	✓	✓		✓			✓		✓	

Current sense

Voltage class	Base PN	Technology	Features: Separate pin for logic ground	Features: Over current protection	Features: Current sense	Package: DSO-8	Package: DSO-16 WB	Package: DIP-8	Package: SOT23-5
1200	IR2277(1)	JI	✓	✓	✓		✓		
600	IR2172	JI		✓		✓		✓	
	IR2175	JI		✓	✓	✓		✓	
	IR2177(1)	JI	✓	✓	✓		✓		
	IR25750	JI		✓					✓

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Half-bridge

Voltage class	I_{o+}/I_{o-} typ [mA]	Typ. prop delay: off/on [ns]	Base PN	Technology	Features															Package							
					Under voltage lockout	Separate pin for logic ground	Integrated bootstrap diode	Shoot-trough protection	Over current protection	Desaturation protection	Soft over current shutdown	Fault reporting	Current Amplifier	Programmable shutdown	Programmable dead time	Comparator	Shutdown	Enable	Self-oscillating	DSO-8	DSO-14	DSO-18	DIP-8	DIP-14	SSOP-24	VQFN-14
1200	1500/2500	85/85	2ED020I12-FI	CT	✓			✓					✓			✓	✓					✓				
	2000/3000	440/440	IR2214S	JI	✓	✓		✓		✓	✓	✓													✓	
700	78/169	220/220	IR7304	JI	✓			✓												✓						
	1900/2300	270/680	IR7184	JI	✓			✓									✓			✓						
650	1500/2500	85/85	2ED020I06-FI	CT	✓			✓									✓					✓				
600	78/169	220/220	IR2304	JI	✓			✓												✓			✓			
			IR25601	JI	✓			✓												✓						
	180/260	na	IR21531	JI	✓			✓						✓			✓		✓	✓			✓			
			IR21531D	JI	✓		✓	✓						✓			✓		✓				✓			
			IR25603	JI	✓			✓						✓			✓		✓	✓			✓			
			IRS2153(1)D	JI	✓		✓	✓						✓			✓		✓	✓			✓			
	200/350	200/220	IR2108	JI	✓			✓												✓			✓			
			IR21084	JI	✓	✓		✓							✓						✓			✓		
			IR2308	JI	✓			✓												✓			✓			
			IR25606	JI	✓			✓												✓						
		200/750	IR2109	JI	✓			✓									✓			✓			✓			
			IR21091	JI	✓			✓							✓		✓			✓			✓			
			IR21094	JI	✓	✓		✓							✓		✓				✓			✓		
			IR2302	JI	✓			✓									✓			✓			✓			
	210/360	150/680	IR2103	JI	✓			✓												✓			✓			
			IR2104	JI	✓			✓									✓			✓			✓			
			IR25602	JI	✓			✓									✓			✓						
	220/480	500/500	IRS2890	JI	✓		✓	✓	✓			✓									✓					
	250/500	150/750	IR2111	JI	✓			✓												✓			✓			
	290/600	150/150	IRS2304	JI	✓			✓												✓			✓			
		150/680	IRS2103	JI	✓			✓												✓			✓			
			IRS2104	JI	✓			✓									✓			✓			✓			
		150/750	IRS2111	JI	✓			✓												✓			✓			
		200/220	IRS2(1,3)08	JI	✓			✓												✓			✓			
			IRS21084	JI	✓	✓		✓							✓						✓			✓		
		200/750	IRS2109	JI	✓			✓									✓			✓			✓			
			IRS21091	JI	✓			✓							✓					✓			✓			
			IRS21094	JI	✓	✓		✓							✓		✓				✓			✓		
	360/700	300/310	2EDL05N06P	SOI	✓		✓	✓												✓	✓					
		400/420	2EDL05I06P	SOI	✓		✓	✓												✓	✓					
	1900/2300	220/180	IR(S)2183	JI	✓			✓												✓			✓			
			IR(S)21834	JI	✓	✓		✓							✓						✓			✓		
		270/680	IR(S)2184	JI	✓			✓									✓			✓			✓			
			IR21844	JI	✓	✓		✓							✓		✓				✓			✓		
			IRS21844	JI	✓	✓		✓							✓		✓				✓			✓		✓
	2000/3000	440/440	IR2114S	JI	✓	✓		✓		✓	✓	✓													✓	
	2300/2800	300/310	2EDL23N06P	SOI	✓	✓	✓	✓	✓			✓						✓			✓					
		400/420	2EDL23I06P	SOI	✓	✓	✓	✓	✓			✓						✓			✓					
200	290/600	150/680	IRS2007	JI	✓			✓												✓						
			IRS2003	JI				✓												✓			✓			
			IRS2008	JI	✓			✓									✓			✓						
			IRS2004	JI				✓									✓			✓			✓			

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Three-phase

Voltage class	I_{o+}/I_{o-} typ [mA]	Typ. prop delay: off/on [ns]	Base PN	Technology	Features										Package							
					Under voltage lockout	Separate pin for logic ground	Integrated bootstrap diode	Shoot-through protection	Over current protection	Desaturation protection	Current amplifier	Brake chopper	Fault reporting	Shutdown	Enable	DSO-20 WB	DSO-28 WB	DIP-28	LCC-32	MQFP-64	TSSOP-28	VQFN-28	VQFN-34
1200	250/500	700/750	IR223(3,5)	JI	✓	✓		✓	✓		✓		✓	✓			✓	✓	✓				
600	165/375	490/530	6ED003L06-F2	SOI	✓	✓		✓	✓				✓		✓		✓						
			6EDL04I06(N,P)T	SOI	✓	✓	✓	✓	✓				✓		✓		✓						
		530/530	6EDL04N06P	SOI	✓	✓	✓	✓	✓				✓		✓		✓						
	200/350	400/425	IR2136	JI	✓	✓		✓	✓				✓		✓		✓	✓	✓				
			IR21363	JI	✓	✓		✓	✓				✓		✓		✓		✓				
			IR2136(5,8)	JI	✓	✓		✓	✓				✓		✓		✓						
		530/500	IR21364	JI	✓	✓		✓	✓				✓		✓		✓						
		530/530	IRS2334	JI	✓			✓								✓						✓	
			IRS2336	JI	✓	✓		✓	✓				✓		✓		✓		✓				
			IRS2336D	JI	✓	✓	✓	✓	✓				✓		✓		✓		✓			✓	
			IRS23364D	JI	✓	✓	✓	✓	✓				✓		✓		✓		✓				
			IRS23365D	JI	✓	✓	✓	✓	✓				✓		✓								✓
	250/500	425/675	IR213(0,2)	JI	✓	✓		✓	✓		✓		✓				✓	✓	✓				
		600/1300	IR2131	JI	✓	✓		✓	✓				✓	✓			✓	✓	✓				
		700/750	IR2133	JI	✓	✓		✓	✓		✓		✓	✓			✓	✓	✓				
			IR2135	JI	✓	✓		✓	✓		✓		✓	✓			✓		✓				
200	165/375	490/530	6ED003L02-F2	SOI	✓	✓		✓	✓				✓		✓						✓		
		530/530	6EDL04N02P	SOI	✓	✓	✓	✓	✓				✓		✓						✓		
1200	350/540	550/550	IR2238	JI	✓	✓		✓	✓	✓		✓	✓	✓						✓			

Gate driver selection tool

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

Visit the gate driver selection tool by going to www.infineon.com/gatedriver

www.infineon.com/gatedriver
www.infineon.com/eicedriver

iMOTION™

Highly integrated products to control variable speed drives

iMOTION™ ICs integrate all the control and analog interface functions required for sensor less field oriented control (FOC) of PM motors. In addition, they feature Infineon's patented motor control engine (MCE) that eliminates software coding for the motor control algorithm development.

Observed market trends

- Energy regulations higher performance drive inverterization rate
- Shorter product life cycles and larger product portfolios
- Miniaturization of building blocks
- Increased price pressure

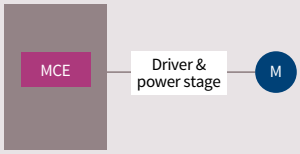
Our markets

Key benefits

- Easy to use – no special motor control know-how required
- High performance and energy optimized solution
- Reduced system cost due to R&D and BOM savings
- Improved time-to-market

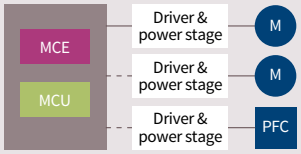
iMOTION™ product offering

Controller



Motion Control Engine (MCE)
built-in sinusoidal FOC algorithm allows smooth operation at wide speed ranges

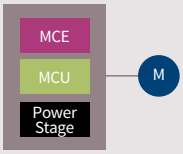
IRMCK099



MCE + additional MCU
allows to add customer specific application code

IRMCX1/IRMCX3/IRMCF588

Smart IPMs



Full inverter system
in one small package, e.g. up to 60 W in PQFN 12x12 mm²

IRDM982/IRDM983/IRDM988

iMOTION™ ecosystem

Specialized tools available to tune, drive and test your application

MCEWizard/TinyWizard
SW tool to generate drive control parameters from motor and hardware specifications

MCEDesigner
SW tool to fine-tune your motor control – with trace features to watch internal variables

MCEProgrammer
Program MCE OTP/SRAM

IRMCK099 evaluation kit

www.infineon.com/imotion

iMOTION™ Modular Application Design Kit

Infineon‘s evaluation platform - get a motor running in less than one hour!

The iMOTION™ Modular Application Design Kit (MADK) evaluation platform covers motor drive applications up to 1 kW. The platform is offering a modular and scalable system solution with different control board options and a range of power boards. Using iMOTION™ MADK standardized M1 platform interface, different control and power boards can be combined in a system that perfectly matches the requirements of the application. This modular approach allows developers a maximum in flexibility and scalability during evaluation and development phase at affordable costs.
The set up of a complete motor drive system is possible in less than one hour!

Further information, datasheets and documents
www.infineon.com/imotion
www.infineon.com/madk

For technical assistance
www.infineon.com/support

MADK applications

XMC™

One microcontroller platform. Countless solutions.

Infineon's XMC™ 32-bit industrial microcontroller portfolio is designed for efficiency and demanding industrial applications.

XMC™ MCU portfolio

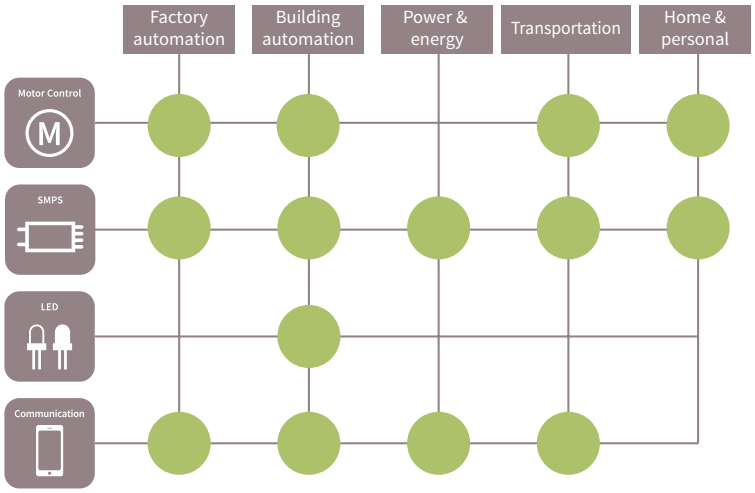
- RAM: 8 kB up to 352 kB
- Flash: 16 kB up to 2 MB
- Accurate analog-mixed signal peripherals
- Fast timer/PMW peripherals
- Rich communication interfaces
- 16pin to 196pin count packages

XMC1000 family

- ARM® Cortex®-M0 up to 48 MHz
- Peripherals up to 96 MHz
- One time Event Request Unit (ERU)
- V_{DD}: 1.8 to 5.5 V
- $T_{Ambient}$: -40°C to 105°C

XMC4000 family

- ARM® Cortex®-M4 up to 144 MHz
- Built in DSP, SFPU
- Peripherals up to 144 MHz
- Event Request Unit (ERU)
- $T_{Ambient}$: -40°C to 125°C



	XMC™ entry	LED lighting	Digital power	Motor control	Industrial I/O
XMC4000 ARM® Cortex® M4F up to 144 MHz core 64 KB-2 MB Flash	**XMC4100** Basic control & connectivity VQFN-48/LQFP-64 up to 125°C		**XMC4500** UPS, solar three-level inverter LQFP-100, -144/LFBGA-144 up to 125°C **XMC4200** Server power supplies, 150 ps HRPWM LQFP-64, -100 up to 125°C	**XMC4700** Industrial drives LQFP-100, -144/LFBGA-196 up to 125°C **XMC4500, XMC4400** Industrial drives, hall & encoder I/F, ΔΣ demodulator LQFP-64, -100, 144/ LFBGA-144 up to 125°C	**XMC4800, XMC4300** EtherCAT®, Multi CAN 6 nodes, industrial drives LQFP-100, -144/LFBGA-196 up to 125°C **XMC4500** Multi CAN 3 nodes, external memory, Ethernet, SD/MMC, industrial drivesLQFP-100, -144/LFBGA-144 up to 125°C
XMC1000 ARM® Cortex® M0 up to 48 MHz core/96 MHz peripheral 8-200 KB Flash	**XMC1100** Basic control & connectivity TSSOP-16, 38/VQFN-24, -40 up to 105°C	**XMC1400** Flicker-free dimming, SMPS control, dual channel, connectivity VQFN-40, -64/LQFP-64 up to 105°C **XMC1200, XMC1300** Flicker-free dimming, SMPS control, connectivity TSSOP-16, 28, 38/VQFN-24, -40 up to 105°C	**XMC1400** SMPS control, dual channel, connectivity VQFN-40, -64/LQFP-64 up to 105°C **XMC1300** Basic SMPS control TSSOP-16, 38/VQFN-24, -40 up to 105°C	**XMC1400** Motor control, hall & encoder I/F, co-processor VQFN-40, -64/LQFP-64 up to 105°C **XMC1300** Motor control, hall & encoder I/F, co-processor TSSOP-16, 38/VQFN-24, -40 up to 105°C	**XMC1400** Multi CAN 2 nodes VQFN-48, -64/LQFP-64 up to 105°C

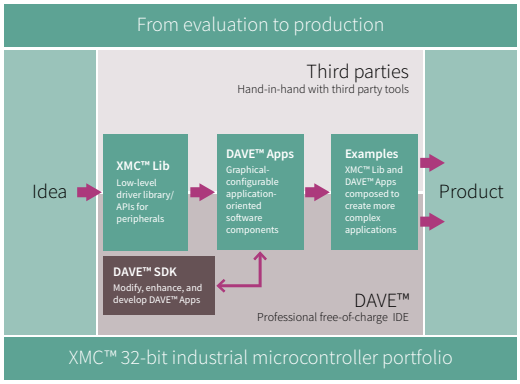
www.infineon.com/xmc

XMC™ ecosystem, enablement and partners

A comprehensive set of tools, products, components, and services are available for fast and efficient design with XMC™ microcontrollers.

Infineon enablement for XMC™ MCUs

- **DAVE™** – www.infineon.com/dave
  Professional and free-of-charge development platform
- **XMC™ library for Embedded Coder®** – www.infineon.com/matlab
  Model-based design from MATLAB® and Simulink® environment, download free-of-charge
- **IEC60730 class B library for XMC™** – www.infineon.com/iec60730
  Free-of-charge available for XMC™ industrial microcontrollers
- **µC/Probe™ XMC™** – www.infineon.com/ucprobexmc
  Free-of-charge version of µC/Probe™ for XMC™ MCUs to build user interfaces for visualizing, observing, and control of the internals of XMC™ MCUs
- **XMC™ Link** – www.infineon.com/xmclink
  Functional isolated debug probe, based on SEGGER J-Link technology



In addition to a rich third party ecosystem and enablement landscape, which support the entire development cycle from evaluation to production.

For more www.infineon.com/xmc-ecosystem

Infineon's XMC™ 32-bit industrial microcontroller portfolio is designed for system cost and efficiency for demanding industrial applications. It comes with the most advanced peripheral set in the industry. Fast and largely autonomous peripherals can be configured to support individual needs.

Highlights include analog-mixed signal, timer/PWM and communication peripherals powered by either an ARM® Cortex®-M0 core (XMC1000 family) or a Cortex®-M4 core with a floating point unit (XMC4000 family).

		Clocks		Memory		Analog			Timer/PWM				Connectivity		Package
ARM® Cortex®-M0	Co-processor	Frequency	Peripherals			ADC1 2-bit/S&H	Number of channels	Analog comparators	CCU4 (4ch)	CCU8 (4ch)	POS IF	BCCU	US IC	CAN 2.0B	
XMC11x	-	32	64	Flash	8-64 kB	1/1	Up to 12	-	1x	-	-	-	2x	-	VQFN 24/40 TSSOP 16/38
				RAM	16 kB										
XMC12x	-	32	64	Flash	16-200 kB	1/2	Up to 12	Up to 3	1x	-	-	1x	2x	-	VQFN 24/40 TSSOP 16/28/38
				RAM	16 kB										
XMC13x	☑	32	64	Flash	8-200 kB	1/2	Up to 12	Up to 3	1x	1x	1x	1x	2x	-	VQFN 24/40 TSSOP 16/38
				RAM	16 kB										
XMC14x	☑	48	96	Flash	32-200 kB	1/2	Up to 12	Up to 4	2x	2x	2x	1x	4x	Up to 2	VQFN 40/48/64 LQFP 64
				RAM	16 kB										
Supply voltage range 1.8 V – 5.5 V															
Temperature range -40°C … 85°C/105°C															

		Memory		Analog			Timer/PWM					Connectivity					Package
ARM® Cortex®-M0	Frequency [MHz]			ADC1 2-bit/S&H	Number of channels	DAC1 2-bit	CCU4 (4ch)	CCU8 (4ch)	HRPWM (150 ps)	POSIF	∑ Demodulator	US IC	CAN 2.0B	USB	Ethernet	EtherCAT®	
XMC41x	80	Flash	64-128 kB	2/2	Up to 9	2 ch	2x	1x	1x	1x	-	4x	Up to 2	-	-	-	VQFN 48 TQFP 64
		RAM	20 kB														
XMC42x	80	Flash	256 kB	2/2	Up to 9	2 ch	2x	1x	4 ch	1x	-	4x	2x	1x	-	-	VQFN 48 TQFP 64
		RAM	40 kB														
XMC43x	144	Flash	256 kB	2/2	Up to 14	2 ch	2x	1x	-	-	-	4x	2x	1x	1x	1x	LQFP 100
		RAM	128 kB														
XMC44x	120	Flash	256-512 kB	4/4	Up to 18	2 ch	4x	2x	4 ch	2x	4ch	4x	2x	1x	1x	-	TQFP 64 LQFP 100
		RAM	80 kB														
XMC45x	120	Flash	512 MB	4/4	Up to 26	2 ch	4x	2x	-	2x	4 ch	4x	Up to 3	1x	1x	-	LQFP 100/144 LFBGA 144
		RAM	128-160 kB														
XMC47x	144	Flash	1.5-2 MB	4/4	Up to 26	2 ch	4x	2x	-	2x	4 ch	6x	6x	1x	1x	-	LQFP 100/144 LFBGA 196
		RAM	276-352 kB														
XMC48x	144	Flash	1-2 MB	4/4	Up to 26	2 ch	4x	2x	-	2x	4 ch	6x	6x	1x	1x	1x	LQFP 100/144 LFBGA 196
		RAM	200-352 kB														
Supply voltage range 3.1-3.6 V																	
Temperature range -40°C … 85°C/125°C																	

www.infineon.com/xmc
www.infineon.com/dave

XMC™ digital power explorer kit

The new digital power explorer kit is designed with the particular goal of making it easy for engineers to take the first steps into digital power control with XMC™ microcontrollers. It showcases both XMC™ families Cortex®-M microcontrollers: XMC4000 and XMC1000, 30 V dual n-channel OptiMOS™ MOSFETs and IRS2011S gate drivers. The kit includes two different control card options, XMC1300 control card (ARM® Cortex®-M0) and XMC4200 control card (ARM® Cortex®-M4F), which allow designers to evaluate both XMC™ microcontroller families and make the right price/performance choice for their application.

Key features

- Synchronous buck converter evaluation kit controlled with XMC4200 or XMC1300 ARM® Cortex®-M MCUs
- On-board resistive load banks
- Featuring BSC0924NDI dual n-channel OptiMOS™ and IRS2011S high and low-side gate driver
- Different control schemes possible
  - Voltage mode control
  - Peak current mode control (with slope compensation)

Customer benefits

- Easy entry in digital power control applications
- Understand the details of voltage/peak current control and how to extract the maximum of XMC™ devices
- DAVE™ v4 APPs for buck converter and much more examples

XMC™ digital power explorer kit	Specification		Infineon components	
	V_{in}	12 V_{DC}	**MCU**	XMC4200 or XMC1300
	V_{out_nom}	3.3 V_{DC}	**MOSFETs**	OptiMOS™ BSC0924NDI
	I_{out}	2 A	**MOSFET HB driver**	IRS2011S
	P_{out}	6 W		

www.infineon.com/xmc

800 W PFC CCM with XMC1300

The 800 W PFC CCM evaluation board demonstrates the design and practical results of an 800 W 130 kHz platinum server PFC demo board based on Infineon devices, in terms of power semiconductors, non-isolated gate drivers, analog and digital controllers for the PFC converter as well as flyback controller for the auxiliary supply. This demo board verifies the performance of the latest 600 V CoolMOS™ C7 MOSFET technology working at 130 kHz in a PFC CCM boost converter along with EiceDRIVER™ ICs and 650 V CoolSiC™ Schottky diode generation 5 using digital control.

Key features

- Classic PFC boost stage digitally controlled with XMC1302 including voltage and current loops
- Protections, including cycle-by-cycle current protection included
- Run time debug with isolated UART to PC interface and PC software

Customer benefits

- High efficient PFC stage with a complete system solution from Infineon
- HW and SW available
- Higher switching frequency permits higher power density

800 W PFC CCM with XMC1300	Specification		Infineon components	
	V_{in}	90-265 V_{AC}	**MCU**	XMC1302 (TSSOP38)
	V_{out_nom}	380 V_{DC}	**MOSFET**	600 V CoolMOS™ C7
	I_{out}	2 A	**MOSFET driver**	2EDN7524F non-isolated
	PWM frequency	130 kHz	**Diode**	650 V CoolSiC™ Schottky diode generation 5
	THD	< 10%	**Auxiliary PSU**	ICE2QR4780Z
	Power factor	> 0.9 from 20% load		
	Efficiency	97% (peak)		

600 W LLC digital control

600 W LLC digital control evaluation board shows how to design the half-bridge LLC stage of a server SMPS with the target to meet 80+ Titanium standard efficiency requirements. On this purpose the latest CoolMOS™ technologies, 600 V CoolMOS™ C7 or P6 power MOSFET have been applied on the primary side, and OptiMOS™ low voltage power MOSFET in SuperSO8 BSC010N04LS, in the synchronous rectification secondary stage in combination with QR CoolSET™ ICE2QR2280Z, hi-low-side driver 2EDL05N06PF, low-side gate driver 2EDN7524F and a XMC4200 microcontroller.

Key features:

- 600 W LLC half-bridge stage with synchronous rectification (SR)
- All controlled with XMC4200 including:
  - Start up (PWM to PFM) and burst mode algorithms
  - Adaptive dead time and capacitive mode detection
  - No hard commutation at any condition

Customer benefits

- Learn LLC topology with a complete system solution from Infineon
  - HW and SW available
- Close to customer solution
  - High efficiency → 97.8%
  - Reliability and power density

600 W LLC digital control	Specification		Infineon components	
	V_{in}	350 V_{DC}-410 V_{DC}	MCU	XMC4200 (VQFN48)
	V_{out_nom}	12 V_{DC}	MOSFET SR	BSC010N04LS
	I_{out}	50 A	HB driver	2EDL05N06PF
	P_{out}	600 W	LLC HB MOSFET	CoolMOS™ IPP60R190P6
	f_{res}	157 kHz	Auxiliary PSU	ICE2QR2280Z

www.infineon.com/xmc

3 kW dual-phase LLC converter using XMC4400

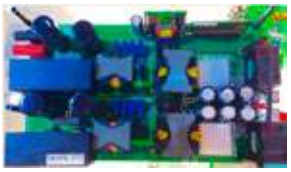
The 3 kW dual-phase LLC demo board is an example of a high efficiency isolated DC-DC converter using state-of-the-art Infineon components, both power devices and controller/driver ICs. The use of an advanced digital control using the XMC4400 microcontroller, together with the latest generation of CoolMOS™ and OptiMOS™ devices, allows to achieve a very flat efficiency curve in the entire load range. The demo board is targeting the HV DC-DC stage of high-end telecom rectifiers.

Key features

- Full digital control by XMC4400 on the secondary side
- Digital current sharing with phase shedding
- Accurate algorithm able to prevent hard commutation and capacitive load mode in LLC operation

Customer benefits

- Full digital control by XMC4400 on the secondary side
- Efficiency peak 98.5% and more than 97.2% in the entire load range.
- Easy monitoring and parameter setting via a graphic user interface.

3 kW dual-phase LLC converter using XMC4400	Specification		Infineon components	
	V_{in}	350 V_{DC}-410 V_{DC}	MCU	XMC4400 (LQFP64)
	V_{out_nom}	54.3 V_{DC}	MOSFETs SR	OptiMOS™ BSC093N15NS5
	I_{out_max}	55 A	Drivers	1EDI60N12AF 2EDN7524R
	P_{out}	3000 W	LLC HB MOSFET	CoolMOS™ P6 IPW60R041P6
	f_{range}	90 kHz-200 kHz	Auxiliary PSU	ICE2QR2280Z
	Peak efficiency	>98.4%		

Preferred design houses

For information about our partners and preferred design houses please visit: www.infineon.com/pdh

RGB LED lighting shield with XMC1202 for Arduino

The RGB LED lighting shield with XMC1202 for Arduino uses a DC-DC buck topology and is able to drive up to 3 LED channels with constant current. The shield itself is powered by a programmable XMC™ 32-bit ARM® MCU with embedded brightness color control unit (BCCU, XMC1200 MCU series), for flicker-free LED dimming and color control.

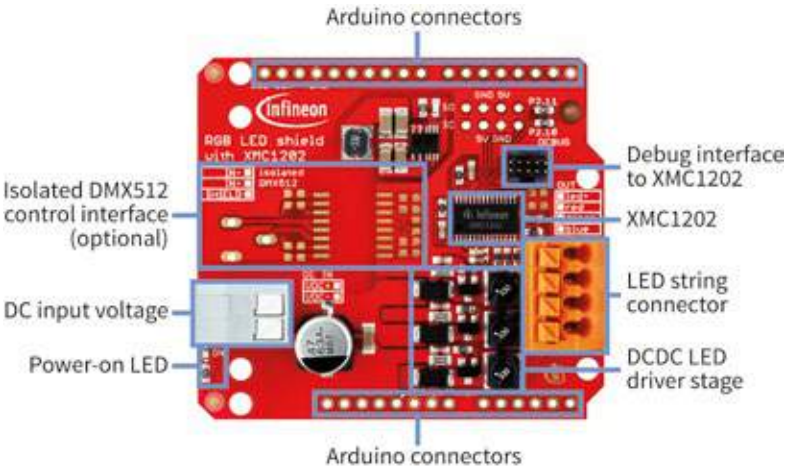
Features

- Compatible with Arduino Uno R3 and XMC1100 boot kit from Infineon
- Easily configurable for various light engines and any input voltage (within operating conditions)
- Wide DC input voltage range
- Simple I2C interface

Operating conditions

- Nominal: 12 V-48 V input voltage (max. 6 V-60 V)
- Average LED current up to 700 mA (max. peak current 1 A)

The Infineon shields mentioned above are hardware compatible with Arduino and Infineon's XMC™ boot and relax kits.



www.infineon.com/shields-for-arduino

AURIX™ – 32-bit microcontrollers

32-bit multicore TriCore™ – safety joins performance

AURIX™ is Infineon's family of microcontrollers serving exactly the needs of industrial applications in terms of performance and safety. Its innovative multi-core architecture, based on up to three independent 32-bit TriCore™ CPUs @ 300 MHz has been designed to meet the highest safety standards while increasing the performance at the same time. Using the AURIX™ scalable platform, developers will be able to implement applications like motor control and drives, PLC or any other automation application. Developments using AURIX™ require less effort to achieve the SIL/ IEC61508 standard based on its innovative safety concept and multiple HW safety features. Furthermore, AURIX™ has enhanced communication capabilities to support communication between CAN, LIN, FlexRay and Ethernet buses.

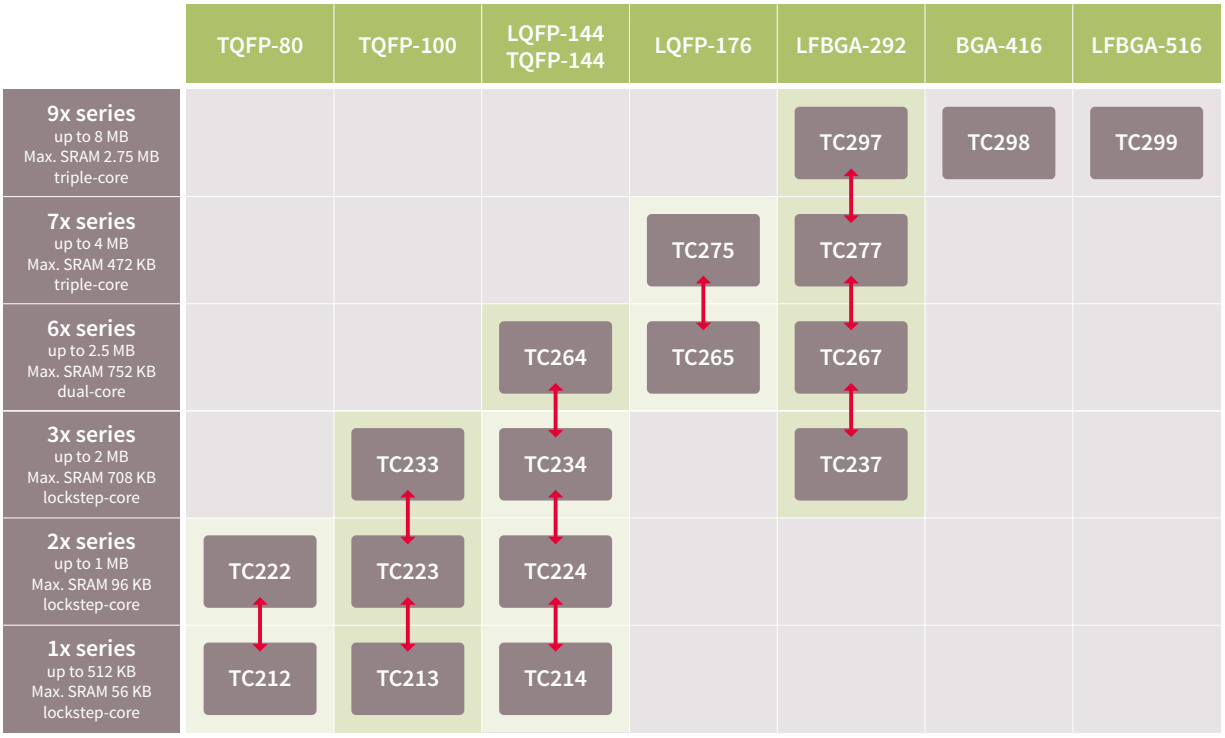
Key features

- TriCore™ with DSP functionality
- Best-in-class real-time performance: triple TriCore™ with up to 300 MHz per core
- Supporting floating point and fix point with all cores
- Up to 2.75 MB of internal RAM, up to 8 MB of flash
- Innovative single supply 5 V or 3.3 V
- IEC61508 conformance to support safety requirements up to SIL3
- Embedded EEPROM
- Advanced communication peripherals: CAN FD, LIN, SPI, FlexRay, Ethernet

Key benefits

- High scalability gives the best cost-performance fit
- High integration leads to significant cost savings
- High integration leads to reduced complexity
- Innovative supply concept leads to best-in-class power consumption

AURIX™ family package scalability



Upgrade/downgrade with pin-compatible packages

www.infineon.com/aurix

AURIX™ microcontroller

Product type	Max. clock frequency [MHz]	Program memory [KByte]	SRAM (incl. cache) [KByte]	Co-processor [1]	Cores/lockstep	Timed I/O	Number of ADC channels	External Bus interface	CAN nodes	Communication interfaces [2]	Temperature ranges [3]	Packages	Additional features/remarks [4]
TC299TX	300	8000	2728	FPU	3/1	263	84/10 DS	yes	6	4xASCLIN, 6xQSPI, 3xMSC, 2xI²C,15xSENT, HSSL, 5xPSI5, 2xFlexRay, Ethernet, CAN FD	K	PG-LFBGA-516	EVR, STBU, HSM
TC299TP	300	8000	728	FPU	3/1	263	84/10 DS	yes	6	4xASCLIN, 6xQSPI, 3xMSC, 2xI²C, 15xSENT, HSSL, 5xPSI5, 2xFlexRay, Ethernet, CAN FD	K	PG-LFBGA-516	EVR, STBU, HSM
TC298TP	300	8000	728	FPU	3/1	232	60/10 DS	yes	6	4xASCLIN, 6xQSPI, 3xMSC, 2xI²C, 15xSENT, HSSL, 5xPSI5, 2xFlexRay, Ethernet, CAN FD	K	PG-LBGA-416	EVR, STBU, HSM
TC297TA	300	8000	2728	FPU, FFT, CIF	3/1	169	60/10 DS	no	6	4xASCLIN, 4xQSPI, 3xMSC, 2xI²C, 15xSENT, HSSL, 5xPSI5, 2xFlexRay, Ethernet, CAN FD	K	PG-LFBGA-292	EVR, STBU, HSM
TC297TX	300	8000	2728	FPU	3/1	263	60/10 DS	no	6	4xASCLIN, 4xQSPI, 3xMSC, 2xI²C, 15xSENT, HSSL, 5xPSI5, 2xFlexRay, Ethernet, CAN FD	K	PG-LFBGA-292	EVR, STBU,HSM
TC297TP	300	8000	728	FPU	3/1	169	60/10 DS	no	6	4xASCLIN, 4xQSPI, 3xMSC, 2xI²C, 15xSENT, HSSL, 5xPSI5, 2xFlexRay, Ethernet, CAN FD	K	PG-LFBGA-292	EVR, STBU, HSM
TC277TP	200	4000	472	FPU	3/2	169	60/6 DS	no	4	4xASCLIN, 4xQSPI, 2xMSC, HSSL, 2xI²C, 10xSENT, 3xPSI5, FlexRay, Ethernet, CAN FD	K	PG-LFBGA-292	EVR, WUT, HSM
TC275TP	200	4000	472	FPU	3/2	112	60/6 DS	no	4	4xASCLIN, 4xQSPI, 2xMSC,HSSL, 2xI²C, 10xSENT, 3xPSI5, FlexRay, Ethernet, CAN FD	K	PG-LQFP-176	EVR, WUT, HSM
TC267D	200	2500	240	FPU	2/1	169	50/3 DS	no	5	4xASCLIN, 4xQSPI, 2xMSC, 2xI²C, 10xSENT, 3xPSI5, HSSL, FlexRay, Ethernet, CAN FD	K	PG-LFBGA-292	EVR, STBU
TC265D	200	2500	240	FPU	2/1	112	50/3 DS	no	5	4xASCLIN, 4xQSPI, 2xMSC, 2xI²C, 10xSENT, HSSL, 3xPSI5, FlexRay, Ethernet, CAN FD	K	PG-LQFP-176	EVR, STBU
TC264DA	200	2500	752	FPU, FFT,CIF	2/1	88	40/3 DS	no	5	4xASCLIN, 4xQSPI, 2xMSC, 2xI²C, 10xSENT, HSSL, 3xPSI5, FlexRay, Ethernet, CAN FD	K	PG-LQFP-144	EVR, STBU
TC264D	200	2500	240	FPU	2/1	88	40/3 DS	no	5	4xASCLIN, 4xQSPI, 2xMSC, 2xI²C, 10xSENT, HSSL, 3xPSI5, FlexRay, Ethernet, CAN FD	K	PG-LQFP-144	EVR, STBU
TC237LP	200	2000	192	FPU	1/1	120	24	no	6	2xASCLIN, 4xQSPI, 4xSENT, FlexRay, CAN FD	K	PG-LFBGA-292	EVR, WUT, HSM
TC234LA	200	2000	704	FPU, FFT	1/1	120	24	no	6	2xASCLIN, 4xQSPI, 4xSENT, FlexRay, Ethernet	K	PG-TQFP-144	EVR, WUT, HSM
TC234LX	200	2000	704	FPU	1/1	120	24	no	6	2xASCLIN, 4xQSPI, 4xSENT, FlexRay, Ethernet	K	PG-TQFP-144	EVR, WUT, HSM
TC234LP	200	2000	192	FPU	1/1	120	24	no	6	2xASCLIN, 4xQSPI, 4xSENT, FlexRay, CAN FD	K	PG-TQFP-144	EVR, WUT, HSM
TC233LP	200	2000	192	FPU	1/1	78	24	no	6	2xASCLIN, 4xQSPI, 4xSENT, FlexRay, CAN FD	K	PG-TQFP-100	EVR, WUT, HSM
TC224L	133	1000	96	FPU	1/1	120	24	no	3	2xASCLIN, 4xQSPI, 4xSENT, CAN FD	K	PG-TQFP-144	EVR, WUT
TC223L	133	1000	96	FPU	1/1	78	24	no	3	2xASCLIN, 4xQSPI, 4xSENT, CAN FD	K	PG-TQFP-100	EVR, WUT
TC222L	133	1000	96	FPU	1/1	59	24	no	3	2xASCLIN, 4xQSPI, 4xSENT, CAN FD	K	PG-TQFP-80	EVR, WUT
TC214L	133	500	96	FPU	1/1	120	14	no	3	2xASCLIN, 4xQSPI, 4xSENT, CAN FD	K	PG-TQFP-144	EVR, WUT
TC213L	133	500	96	FPU	1/1	78	24	no	3	2xASCLIN, 4xQSPI, 4xSENT, CAN FD	K	PG-TQFP-100	EVR, WUT
TC212L	133	500	96	FPU	1/1	59	24	no	3	2xASCLIN, 4xQSPI, 4xSENT, CAN FD	K	PG-TQFP-80	EVR, WUT

[1] CIF = Camera and external ADC Interface, FFT = Fast Fourier Transform Accelerator, FPU = Floating Point Unit, PCP = Peripheral Control Processor
[2] ASC = Asynchronous Serial Channel, ASCLIN = Asyn/Synchronous Local Interconnect Network, HSSL= High Speed serial Link, I2C = Inter-Integrated Circuit, LIN = Local Interconnect Network, MLI = Micro Link Interface, MSC = Micro Second Channel, PSI5 = Peripheral Sensor Interface 5, QSPI = Queued Serial Peripheral Interface, SENT = Single Edge Nibble Transmission, SSC = Synchronous Serial Channel, CAN FD ISO11898-1:2015
[3] Ambient Temperature Range: A = -40°C ... 140°C, B = 0°C ... 70°C, F = -40°C ... 85°C, H = -40°C ... 110°C, K = -40°C ... 125°C, L = -40°C ... 150°C, X = -40°C ... 105°C
[4] EVR = Embedded Voltage Regulator, HSM = Hardware Security Module, STBU = Stand-by Control Unit, WUT = Wake-Up Timer

www.infineon.com/aurix

Expert kits

Infineon TriCore™ family starter kits are powerful evaluation systems that enable evaluation and development well before the target hardware is available. They offer a solid platform for both hardware and software engineers to evaluate and prototype designs that are closely aligned with their final applications.

Our kits include

- Full-featured evaluation board
- USB cable
- Easy connectivity to all peripheral modules
- Extension board
- Development tools for evaluation such as compilers, debuggers and DAVE™
- Technical documentation – user manuals, architecture manuals, application notes, data sheets, board documentation

Further information on TriCore™ starter kits:
http://ehitex.com/starter-kits/for-tricore

Flexible application development platform with TFT-screen for the 32-bit AURIX™ multicore TriCore™ family

To simplify the development of your own application, the kit is supplied with a variety of on-board components including a highly-integrated software development environment that gives you everything you need to compile, debug and flash your AURIX™ multicore application.

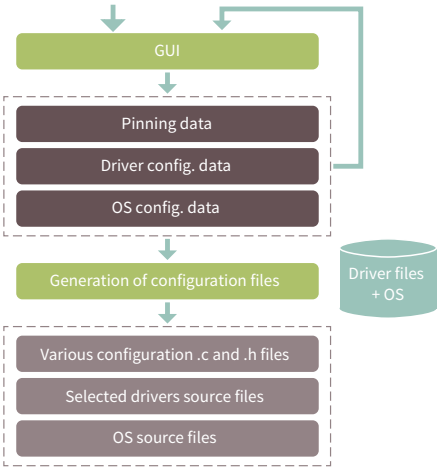
Including

- AURIX™ application board
- 3 V lithium battery
- Link to the free TriCore™ entry tool chain including getting started, first 3 steps to
  - install the tools
  - set up your hardware
  - write, compile and debug your first program

Further information on AURIX™ application kits:
http://ehitex.com/shopware.php/sViewport,search/sSearch,AURIX+application+kit

ACT– AURIX™ configuration tool

ACT is a powerful tool that helps engineers to jump-start programming of Infineon microcontrollers.



Key feature

- Altium TASKING VX TriCore™ Lite Version including build-in
  - AURIX™ pin mapping incl. interactive package view
  - AURIX™ iLLD (low-level driver)
  - AURIX™ OSEK

Free TriCore™ entry tool chain

This free of charge tooling entry tool chain provides all required features to develop and test software for TriCore™ and AURIX™. The tool can be used with all available TriCore™ and AURIX™ starter kit and application boards.

Key features

- Eclipse based IDE
- Project wizard to easy define the project properties for device and board support
- High performance GNU C compiler
- Integrated source level debugger
- On-chip flash programming support

Preferred design houses

For information about our partners and preferred design houses please visit: www.infineon.com/pdh

Infineon support for industrial microcontrollers

One platform, countless solutions

Further information, datasheets and documents

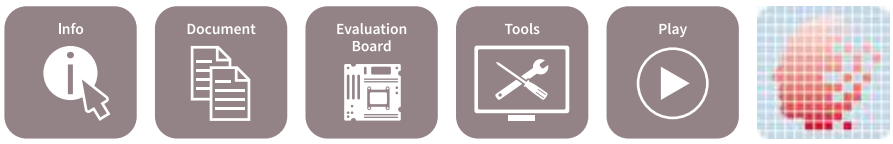
www.infineon.com/xmc
www.infineon.com/xmc1000
www.infineon.com/xmc4000
www.infineon.com/aurix
www.infineon.com/shields-for-arduino

Videos

www.infineon.com/xmc-mediacenter

XMC™ MCUs ecosystem and enablement – kits, board, tools and software

DAVE™ IDE: www.infineon.com/dave
Boards and kits: www.infineon.com/xmc-dev
Ecosystem and tools: www.infineon.com/xmc-ecosystem



Current sensors

The miniaturization advantage

TLI4970 is a high-precision current sensor based on our proven Hall technology. Its coreless concept supports the miniaturization trend defining today's sensor designs. It is a fully digital solution with the added bonus of ease-of-use. There is no need for any external calibration or other parts (such as A/D converters, Op-amps, reference voltage sources), reducing the overall implementation effort, PCB space and cost significantly.
TLI4970 provides superior accuracy compared with existing open- or closed-loop systems with magnetic cores. It has additional functionality such as overcurrent detection and programmable filters, while offering a significantly smaller footprint and lower power consumption. Key applications include AC-DC inverters, DC-DC converters and PFC power supplies and current monitoring.

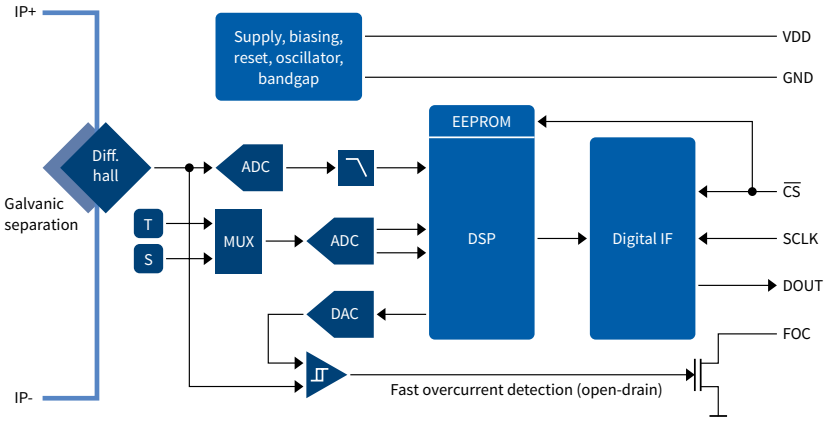
Key features

- AC & DC measurement range up to +/-50 A
- Highly accurate over temperature range and lifetime (max. 1.0% (0 h), 1.6% (over lifetime) of indicated value)
- Low offset error (max. 75 mA over temperature and lifetime)
- High magnetic stray field suppression
- Fast overcurrent detection with configurable threshold
- Galvanic isolation up to 2.5 kV max. rated isolation voltage (UL1577)
- 16-bit digital SPI output (13-bit current value)
- Small 7.0 x 7.0 mm² SMD package

Key benefits

- Plug and play solution – no external calibration needed
- Much smaller footprint than existing solutions
- Reduced implementation effort, PCB space and cost
- Small package size and weight for SMD mounting
- CSA component acceptance

Block diagram TLI4970



Product summary

Product number	Description	Primary current range	Max. accuracy error[1]	Package
TLI4970-D050T4	Qualified according to industrial standards: For use in industrial and consumer applications	50 A	±1.6	PG-TISON-8
TLI4970-D050T5		50 A	±3.5	
TLI4970-D025T4		25 A	±1.6	
TLI4970-D025T5		25 A	±3.5	

www.infineon.com/tli4970

[1] Accuracy error includes temperature and lifetime drifts

Hall-effect switches

The energy-saving option with excellent accuracy and robustness

Our portfolio of hall switches (e.g. TLV496x, TLI496x) comprises unipolar and omnipolar switches, bipolar latches and double hall switches. They are suited to a wide range of applications such as position sensing, index counting, BLDC motor control, etc. These devices show excellent accuracy and robustness against electrical disturbances and are available in a variety of packages.

Key features

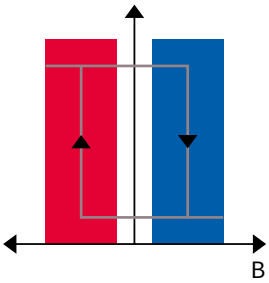
- Operating supply voltage 3 V–32 V
- Reverse polarity protection (-18 V)
- Overvoltage capability up to 42 V without external resistor
- Low current consumption (1.6 mA)
- Active error compensation
- High ESD performance, up to 7 kV HBM
- Small SMD package SOT23
- Leaded package PG-TO92S-3

Key benefits

- Reduction of system power consumption
- Reduced system size
- Removal of protection devices
- Reliable system operation
- Increased motor efficiency
- Broad range of switching thresholds available for all applications
- Special industrial and consumer versions available

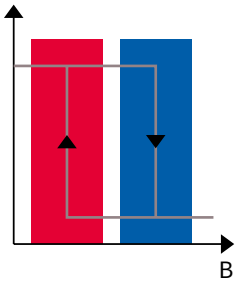
Hall switch types

Latch (bipolar)



Main application:
BLDC motor commutation

Uni-/omnipolar switches



Proximity detection

www.infineon.com/hall-switches

Linear hall sensors

Highly accurate angular and linear position measurement

All products of our linear hall family measure the vertical component of a magnetic field. The output signal is directly proportional to the sensed magnetic field. Building on these principles, our TLE499x family of linear hall ICs has been designed specifically to meet the requirements of highly accurate angular and linear position measurement. They are also suited to current measurement applications.

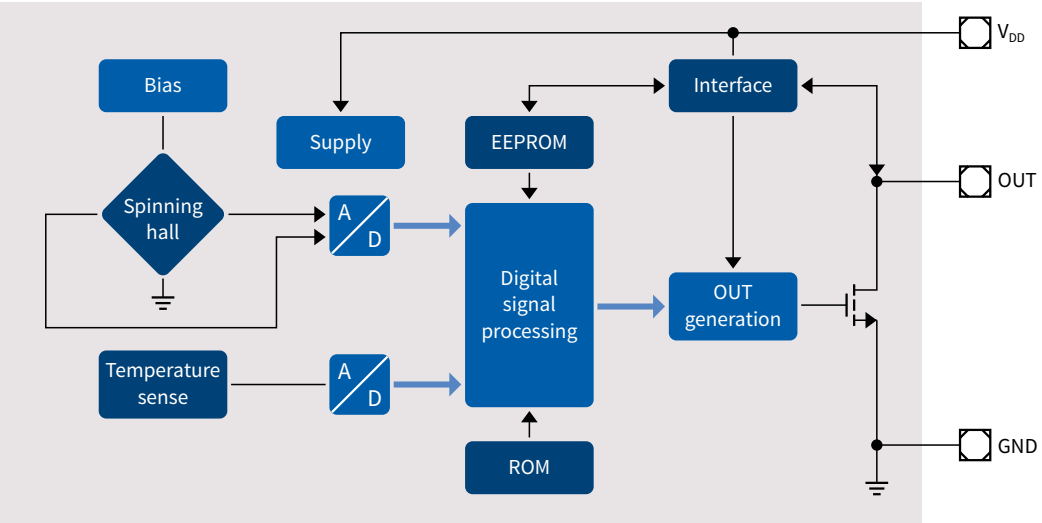
Key features

- Single supply voltage 4.5 V-5.5 V
- Temperature range -40°C ... +150°C
- Linear ratiometric output between -200 mT and +200 mT within three ranges
- Sensitivity offset and clamping programmable
- Digital temperature and stress compensation
- High-voltage capability and reverse polarity protection
- Low drift of output signal over temperature and lifetime
- 20-bit digital signal processing
- Analog and digital interfaces
- Packages PG-SSO-3-10, PG-SSO-4-1

Key benefits

- Highly accurate contactless position sensing
- In-system calibration possible
- Flexible system implementation

Block diagram TLE4998



www.infineon.com/magnetic-sensors

iGMR angle sensors

Compact designs in small outline packages

Our angle sensor family is based on integrated Giant Magneto Resistance (iGMR) technology. These sensors detect the orientation of an applied magnetic field by measuring sine and cosine angle components with monolithically integrated magneto-resistive elements. This allows them to easily determine the absolute orientation of the magnetic field between 0° and 360°. Data processing and communication interfaces are integrated on the same silicon chip as the sensing elements, allowing a compact design using small outline packages. Our angle sensor family offers a broad variety of communication interfaces, as well as different levels of data processing and self-test capabilities. Ideal for functional safety-critical applications, our TLE5309D combines a TLE5009 iGMR with a TLE5109 iAMR chip, whereas the TLE5012BD combines two TLE5012B iGMR in one fully integrated dual-sensor package. Target applications of our iGMR sensors include contactless angle measurement, rotational position measurement and BLDC motor commutation.

Features

- Integrated GMR (iGMR) technology
- 0°–360° angle measurement with sine and cosine bridge
- Supply voltage 3.3 V or 5.0 V
- On-chip temperature compensation of amplitude and offset
- Temperature range -40°C ... +150°C
- PG-DSO-8 package
- New in dual sensor package PG-TDOS16

Product portfolio

Sales number	Description	Interface
TLE5009 E1000	V_{DD}: 3.3 V; static offset compensation	Analog
TLE5009 E1010	V_{DD}: 3.3 V; TCO[1]	Analog
TLE5009 E2000	V_{DD}: 5.0 V; static offset compensation	Analog
TLE5009 E2010	V_{DD}: 5.0 V; TCO[1]	Analog
TLE5012B E1000	V_{DD}: 3.3 V and 5.0 V	SPI[2], IIF[3]
TLE5012B E5000	V_{DD}: 3.3 V and 5.0 V	SPI[2], PWM[4]
TLE5012BD E1200	V_{DD}: 3.3 V and 5.0 V DualDie	SPI[2], IIF[3]
TLE5309D E1211	V_{DD}: 3.3 V (AMR and GMR), TCO[1], DualDie	Analog
TLE5309D E2211	V_{DD}: 5.0 V (AMR and GMR), TCO[1], DualDie	Analog
TLE5309D E5201	V_{DD}: 5.0 V (AMR) and 3.3 V (GMR), DualDie	Analog
TLI5012B E1000	V_{DD}: 3.3 V and 5.0 V	SPI[2], IIF[3]

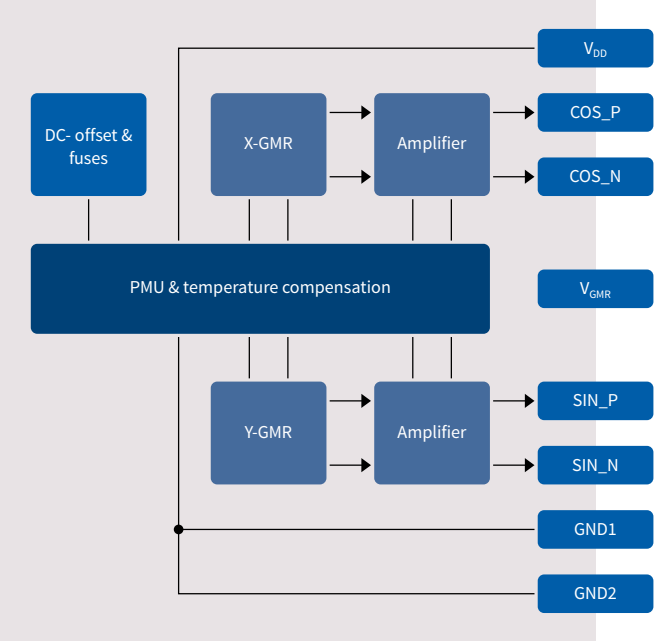
www.infineon.com/angle-sensors

1) TCO = Temperature compensation
2) SPI = Serial peripheral interface
3) IIF = Incremental interface
4) PWM = Pulse width modulation

Benefits TLE5009

- The analog sensor output signals can be directly connected to the analog inputs of a microcontroller
- The output signals are offset- and temperature-compensated
- Output signals can be read as single-ended or differential voltage
- Signal amplitudes are independent from supply voltage variations

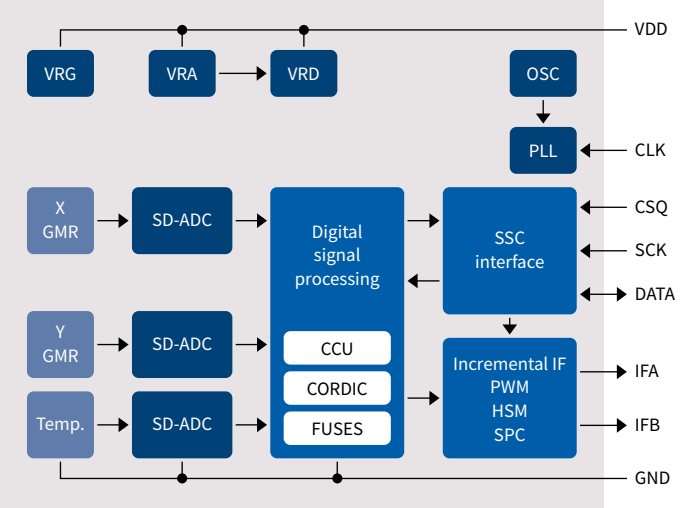
Block diagram TLE5009



Benefits TLI5012B/TLE5012B

- Different digital interfaces available (SPI, PWM, IIF)
- Integrated angle calculation based on sine and cosine values
- Increased accuracy with auto-calibration functionality
- Prediction of output signal to compensate latency
- High-speed angle update rate up to 23.4 kHz

Block diagram TLI5012B/TLE5012B



www.infineon.com/angle-sensors

3D magnetic sensor

TLV493D-A1B6 – low power three access linear hall sensor

The 3D magnetic sensor TLV493D-A1B6 offers accurate three dimensional sensing with extremely low power consumption. Within its small 6pin package the sensor provides direct measurement of the x, y and z magnetic field components, making it ideally suited for the measurement of 3D movement, linear travel and 360° rotation.

By combining 3-axis measurement in a small package, with low power consumption, the TLV493D-A1B6 provides environmental robustness and contactless position sensing durability to applications currently using potentiometers or optical solutions. System size can also be reduced, as magnetic threshold stability over temperature provides a more accurate and robust solution for these systems. The sensor provides a standard 2-wire digital I^2C interface, which enables high speed bi-directional communication between the sensor and microcontroller.

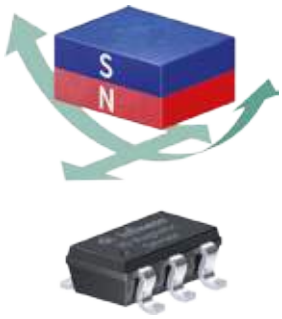
Key applications

- E-meters e.g. anti-tampering
- Joystick e.g. finger, thumb and gaming paddles
- Control elements e.g. white goods, multifunction knob

Key features

- Integrated temperature sensing
- Low current consumption
  - 0.007 µA in power down mode
  - 10 µA in ultra low power mode
- 2.8 V to 3.5 V operating supply voltage
- Digital output via 2-wire standard I^2C interface
- Bx, By and Bz linear field measurement up to ±150 mT
- 12-bit data resolution for each measurement direction
- Resolution 98 µT/LSB
- TSOP6 package

Rotation movement



3D movement

Linear movement

Parameter	Typ.	Unit
Usable magnetic linear range – Bx, By and Bz	±130	mT
Magnetic offset error	±0.2	mT
X to Y static channel matching	±2	%
X/Y to Z static channel matching	±5	%

www.infineon.com/3dmagnetic

3D magnetic sensor 2GO

TLV493D-A1B6 (three dimensional magnetic sensor)

The 3D magnetic sensor 2GO is a new budget-priced evaluation board equipped with a magnetic sensor for three dimensional measurement combined with an ARM® Cortex®-M0 CPU. The 3D magnetic sensor 2GO has a complete set of on-board devices, including an on-board debugger. Build your own application and gadget with the 3D magnetic sensor 2GO.

Current sensor 2GO

TLI4970-D050T4 (current sensor with digital interface)

The current sensor 2GO is a new budget-priced evaluation board equipped with a current sensor combined with an ARM® Cortex®-M0 CPU. The current sensor 2GO has a complete set of on-board devices, including an on-board debugger. Build your own application and gadget with the current sensor 2GO.

Key features sensors kits 2GO

- XMC1100 (ARM® Cortex®-M0 based)
- On-board J-Link Lite Debugger (realized with XMC4200 microcontroller) power over USB (Micro USB)
- ESD and reverse current protection
- GUI for free download

www.infineon.com/sensors2go

DPS310 digital barometric pressure sensor for mobile and wearable devices

The DPS310 is a miniaturized digital barometric air pressure sensor with a high accuracy level and low current consumption. The DPS310 is both a pressure and temperature sensor. The pressure sensor element is based on a capacitive principle which guarantees high precision during temperature changes. The small package makes the DPS310 ideal for mobile applications and wearable devices.

The DPS310's internal signal processor converts the output from the pressure and temperature sensor elements to 24-bit results. Each pressure sensor has been calibrated individually and contains calibration coefficients. The coefficients are used in the application to convert the measurement results to true pressure and temperature values.

The sensor has a FIFO that can store the latest 32 measurements. Since the host processor can remain in a sleep mode for a longer period between readouts, a FIFO can reduce the system power consumption.

Sensor measurements and calibration coefficients are available via the serial I2C/SPI interface.

Typical applications

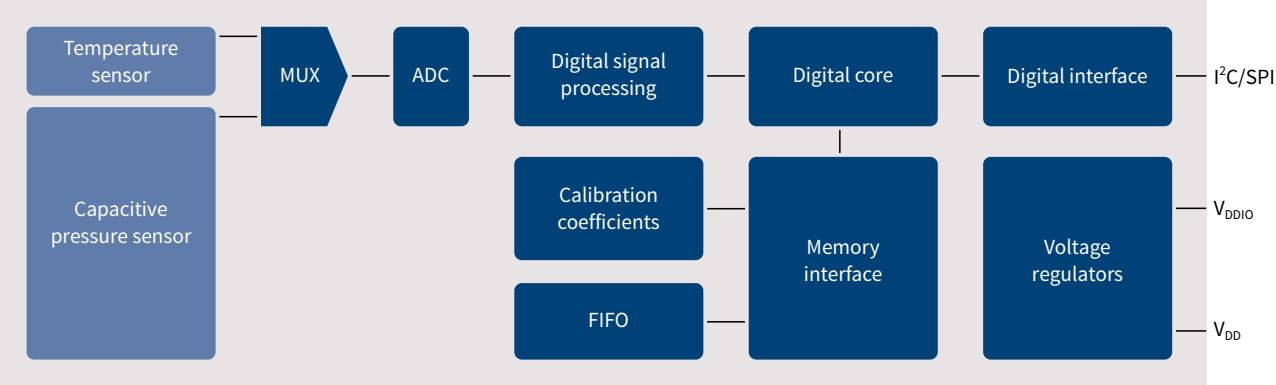
- Indoor navigation
  - Floor detection e.g. in shopping malls and parking garages
- Health and sports
  - Accurate elevation gain and vertical speed
- Outdoor navigation
  - GPS start-up time and accuracy improvement
  - Dead-reckoning e.g. in tunnels
- Local weather station

Key features

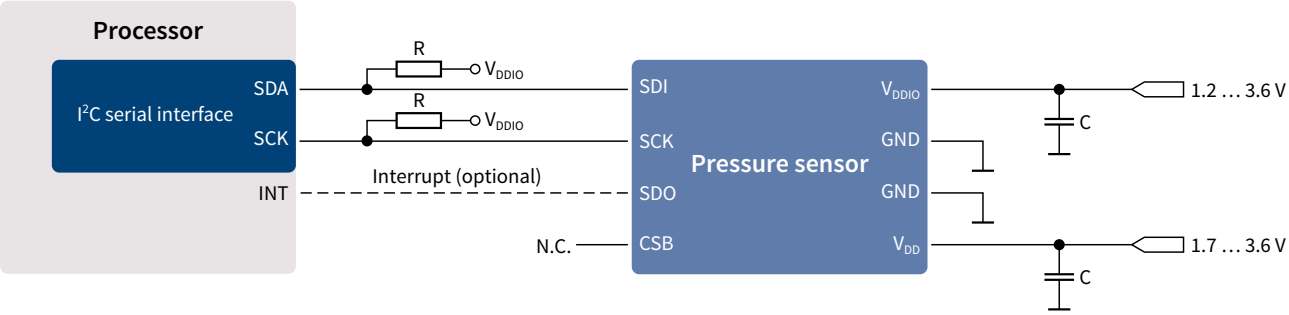
- Operation range
  - Pressure: 300 … 1200 hPa
  - Temperature: -40 … 85°C
- Pressure level precision
  - ±0.005 hPa (or ±5 cm) (high-precision mode)
- Pressure sensor relative accuracy
  - ±0.06 hPa (or ±0.5 m)
- Temperature accuracy
  - ±0.5°C
- Pressure temperature sensitivity
  - < 0.5 Pa/K
- Measurement time
  - Low power mode: 3 ms
- Average current consumption
  - Low power: 3 µA (1 measurement/sec.)
  - Standby: < 1 µA
- Supply voltage
  - V_{DDIO}: 1.2 … 3.6 V
  - V_{DD}: 1.7 … 3.6 V
- Operating modes
  - Command (manual)
  - Background (automatic)
  - Standby
- Interface
  - I2C and SPI (both with optional interrupt)
- Package dimensions
  - 8 pin LGA
  - 2.0 x 2.5 x 1.0 mm

www.infineon.com/pressuresensor

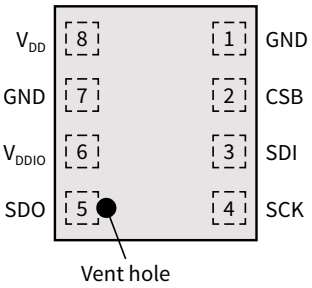
Functional block diagram



Application circuit example (in I2C configuration)



Pin configuration (top view)



Pin	Name	Function
1	GND	Ground
2	CSB	Chip select
3	SDI	Serial data in/out
4	SCK	Serial clock
5	SDO	Serial data out
6	V_{DDIO}	Digital interface supply
7	GND	Ground
8	V_{DD}	Analog supply

www.infineon.com/pressuresensor

24GHz mmWave radar

Industrial

The BGT24M/L family is the largest and highest integrated 24GHz radar transceiver family currently in the market, saving ~30 percent board space compared to discrete line ups. Infineon provides a total of four 24Ghz industrial radar chips, providing a range of different transmitter and receiver channel configurations, supporting different application requirements.

Applications

- Building and smart home (IoT)
- Indoor/outdoor lighting
- Smart street lighting
- UAV/multicopter
- Security
- Robotics

Key benefits

- Direction, proximity and speed detection
- Hidden mounting capability
- Maintains operation through harsh weather conditions
- Motion tracking
- Ghost target suppression
- Target positioning
- Adaptable to different application requirements

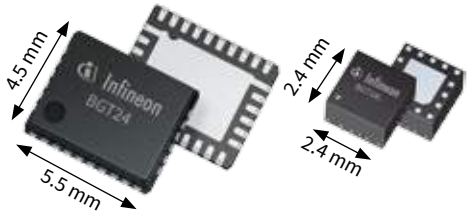
In addition to the Infineon BGT24M/L family of MMIC chips, Infineon provides a continuously expanding range of evaluation and demo boards to support the testing and development of radar in multiple applications. All boards are provided with base level software to support ease-of-use and faster to market integration.

Our 3rd offering comes in the format of radar modules . Through utilising our strong network of partners our radar offering extends to a portfolio of easy to integrate modules containing the Infineon 24Ghz MMIC inside.

IFX MMIC	Evaluation and demo boards	Radar modules
BGT24M/L family	Supporting testing and development	Turnkey modules and design support

Infineon BGT24M/L family of MMIC chips

The Infineon range of 24GHz industrial radar chips provide 4 configurations of transmit and receiver channels ensuring there is a chip to support your specific application. Whether one transmit and one receive channel is enough for applications such as basic motion detection in security, through to more complex speed detection requiring 2 receiver channels, our range supports your needs.

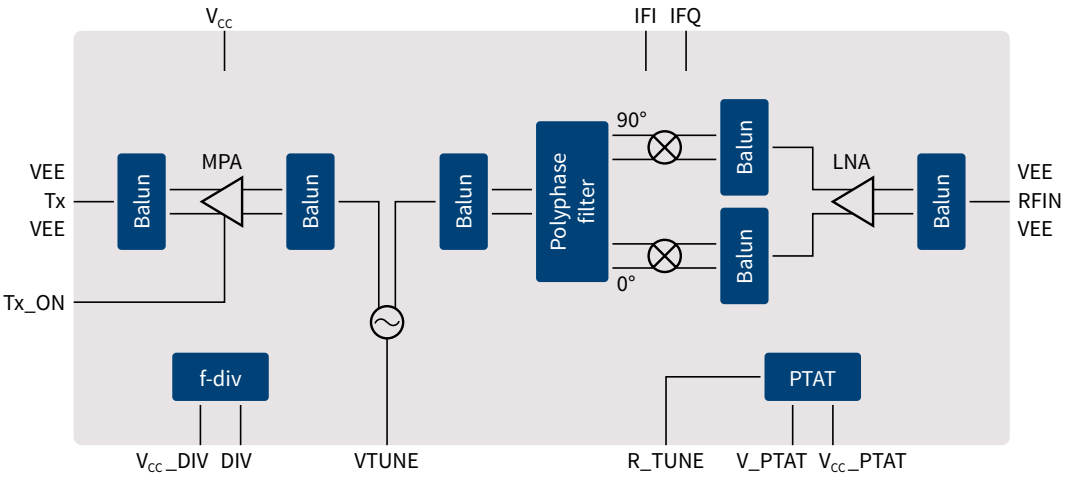
Features	Infineon MMIC	Benefits
› 24GHz ISM band operation for motion, speed, direction movement and distance measurements › 4 MMIC chips available		› Long range distance detection of moving objects up to 30 m › Wide range speed detection up to more than ±100 km/h

BGT24MTR11	BGT24MR2	BGT24MTR12	BGT24LTR11
› Transceiver 1Tx+1Rx/ IQ differential › VCO integrated, SPI › Power/temp sensor › RF_{in} 24.0-26.0 GHz › 500 mW @3.3 V › 4.5 x 5.5 mm -VQFN-32	› Twin receiver 2Rx/ IQ differential › RF_{in} 24.0-26.0 GHz › 300 mW @3.3 V › 4.5 x 5.5 mm -VQFN-32	› Transceiver 1Tx+2Rx / IQ differential › RF_{in} 24.0-26.0 GHz › 700 mW @3.3 V › 4.5 x 5.5 mm -VQFN-32	› Transceiver (1Tx+1Rx) › Single- ended › BITE Tested › RF_{in} 24.0 – 24.25 GHz › 150 mW @3.3 V › 2.4 x 2.4 mm -TSNP-16

The following features and block diagram are for the BGT24LTR11N16.
For similar level of information on the other MMIC listed above, please visit: www.infineon.com/24GHz

- 24GHz transceiver MMIC
- Fully integrated low phase noise V_{CO}
- Built in temperature compensation circuit for VCO stabilization
- Low power consumption
- Fully ESD protected device
- Single ended RF and IF terminals
- 200 GHz bipolar SiGe:C technology b7hf200
- Single supply voltage 3.3 V

Block diagram



www.infineon.com/24GHz

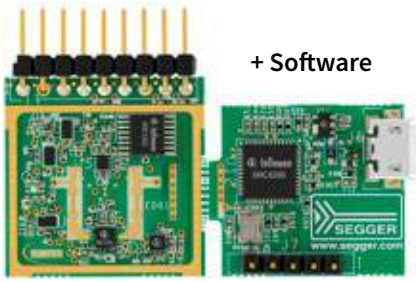
24GHz evaluation and demo boards

Our range of 24GHz evaluation and demo boards continues to expand to support the needs of our customers and the increasing number of innovative ways radar is being incorporated into new applications.

Features

- Four system boards available
- All include 24GHz radar and XMC™ microcontroller
- Kit contains user manual, GUI, MATLAB compiler and Gerber files
- Requires software

Infineon development kit



+ Software

Demokit with SW, reference design

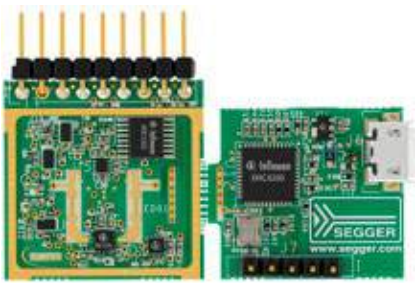
Benefits

- Capability to detect motion, speed and direction of movement (approaching or retreating) distance and angle of arrival based on hardware
- FW/SW available for each radar mode

RFB2412 (BGT24TR12 + XMC4400)	Sense2GO2 (BGT24MTR11 + XMC4200)	Sense2GOL (BGT24LTR11 + XMC1300)
› 1 transmitter + 2 receivers › Motion detection › Doppler radar for speed monitoring › **Software based FMCW for distance measurement of stationary objects - NEW** › **Angle of arrival estimation – NEW** › **FSK for distance and velocity measurements of moving target**	› Starter kit for radar and microcontroller development › 1 transmitter and 1 receiver › Doppler radar for motion detection and speed measurement › Low power mode for enhanced battery life › Industrial standard interfaces via CAN and IOLINK › **Range to 15 m**	› Starter kit for radar as well as Infineon microcontrollers › Low end solution + development kit › 1 transmitter and 1 receiver › Doppler radar for motion detection and speed measurement › Low power mode for enhanced battery life › **One of the world's smallest complete radar + MCU development kit**
Board dimensions 120 mm x 80 mm	**Board dimensions** 36 mm x 40 mm	**Board dimensions** 25 mm x 25 mm (Pictured with the Segger Debugger breakoff board for reprogramming)
		

The following features are representative of the demo board Sense2GoL.
For similar level of information on the other boards available, listed above, please visit: www.infineon.com/24GHz

New – Sense2GoL demo board



Kit contents

- User manual
- Firmware for motion detection
- SW GUI for radar signal observation
- PCB schematic and Gerber files

Features

- BGT24LTR11 – 24 GHz highly integrated low power MMIC
- XMC1302 ARM® Cortex®-M0 – 32-bit industrial microcontroller
- Multiple integrated patch antennas available (default 1x4 with FOV = 28° x 80°)
- Segger debugger breakoff board for reprogramming

www.infineon.com/24GHz

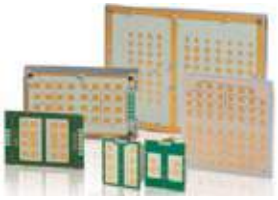
24GHz modules

Partnering with the leading radar solution providers enables Infineon to connect our customers looking for turnkey solutions and design support for a complete range of applications.

Features

- Complete module, including radar MMIC, antenna options, MCU signal processing options, and SW options (Doppler, FSK and FMCW versions available)

Partner modules using Infineon chips



Module (RF module; RF module + MCU including SW)

Benefits

- Ease-of-design
- Turn-key solution for customers with limited radar/RF/SW know-how

By integrating the Infineon 24GHz MMIC chip into their own easy-to-use, and simple to integrate modules we have reduced the complexity and time to market for a range of applications from home automation, multicopter, robotics and street lighting.

New application or simple PIR replacement? Radar has it covered.

Radar used in motion detection applications increases accuracy when compared to passive infrared (PIR) technology allowing a more precise measurement of object detection and providing new capabilities such as the detection of speed and direction of moving objects. Radar is also superior to camera based systems by allowing detection of the objects while keeping identities anonymous.

Visit the link below to view our network of partners who provide modules and design support for all 24GHz industrial applications: www.infineon.com/24GHzpartners

www.infineon.com/24GHz

Infineon support for sensors

Useful links and helpful information

Further information, datasheets and documents

www.infineon.com/magnetic-sensors
www.infineon.com/current-sensor
www.infineon.com/hall-switches
www.infineon.com/angle-sensors
www.infineon.com/3dmagnetic
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Evaluationboards and simulation models

www.infineon.com/sensors2go

Videos & eLearnings

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www.infineon.com/sensor-eLearnings

Info | Document | Evaluation Board | Tools | Play

Packages

Surface mount device technology

DPAK (TO-252-2)		DPAK (TO-252)		Reverse DPAK (Rev. TO-252)		DPAK 5pin (TO-252)		D²PAK (TO-263)		D²PAK (TO-263-2)	
2	9.9 x 6.5 x 2.3	3	9.9 x 6.5 x 2.3	3	9.7 x 6.6 x 2.34	5	9.9 x 6.5 x 2.3	3	15.0 x 10.0 x 4.4	2	15.0 x 10.0 x 4.4
											
D²PAK 7pin (TO-263)		**TO-Leadless (TOLL)**		**SC59**		**SOT-23**		**SOT-89**		**SOT-223**	
7	15.0 x 10.0 x 4.4	8	11.68 x 9.9 x 2.3	3	3.0 x 2.8 x 1.1	3	2.9 x 2.4 x 1.0	3	4.5 x 4.0 x 1.5	4	6.5 x 7.0 x 1.6
											
SOT-323		**SOT-363**		**TSOP-6**		**PQFN 2x2**		**PQFN 2x2 dual**		**PQFN 3.3x3.3**	
3	2.0 x 2.1 x 0.9	6	2.0 x 2.1 x 0.9	6	2.9 x 2.5 x 1.1	6	2.0 x 2.0 x 0.9	6	2.0 x 2.0 x 0.9	8	3.3 x 3.3 x 1.0
											
SuperSO8		**SuperSO8 dual**		**SuperSO8 fused leads**		**TDSON-10-2**		**TDSON-10-7**		**TISON-8**	
8	5.15 x 6.15 x 1.0	8	5.15 x 6.15 x 1.0	8	5.15 x 6.15 x 1.0	10	3.0 x 3.0 x 0.9	10	3.0 x 3.0 x 0.9	8	7.0 x 7.0 x 1.0
											
TISON-8 (power stage 5x6)		**TISON-8-4 (Power Block)**		**TSON-8-1**		**TSON-8 ThinPAK 5x6**		**TSON-10**		**VSON-4 ThinPAK 8x8**	
8	5.0 x 6.0 x 1.0	8	5.0 x 6.0 x 1.0	8	3.0 x 3.0 x 1.0	8	5.0 x 5.0 x 1.0	10	3.3 x 3.3 x 1.0	4	8.0 x 8.0 x 1.0
											
VDSON-8		**WSON-10 (DrMOS 4x4)**		**DirectFET™ Small Can**		**DirectFET™ Medium Can**		**DirectFET™ Large Can**		**Package (JEITA-code)**	
8	4.0 x 4.0 x 0.9	10	4.0 x 4.0 x 0.8	V	4.8 x 3.8 x 0.65	V	6.3 x 4.9 x 0.65	V	9.1 x 6.98 x 0.71	X	L x W x H
										| pin-count V = Variable number of pins All dimensions in mm	

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IQFN-30		IQFN-31 (DrMOS 5x5)		IQFN-36		IQFN-39		IQFN-40		SO-8/SO-8 dual	
30	4.0 x 4.0 x 1.0	31	5.0 x 5.0 x 0.8	36	7.5 x 6.0 x 0.9	39	5.0 x 6.0 x 0.9	40	6.0 x 6.0 x 0.8	8	5.0 x 6.0 x 1.75
											
SO-16/12		**SO-14**		**SO-16**		**SO-18**		**DSO-12**		**DSO-24**	
12	10.0 x 6.0 x 1.75	14	8.75 x 6.0 x 1.75	16	10.0 x 6.0 x 1.75	18	12.8 x 10.3 x 2.65	12	10.3 x 7.8 x 2.6 (max)	24	10.5 x 15.6 x 2.65 (max)
											
SSOP-24		**TDSO-16**		**SO-19**		**SO-20**		**DSO-28**		**SO-36**	
24	6 x 8.65 x 1.75 (max)	16	5.0 x 6.0 x 1.2	19	12.8 x 10.3 x 2.65	20	12.8 x 10.3 x 2.65	28	18.1 x 10.3 x 2.65	36	15.9 x 11.0 x 3.5
											
TSSOP-28		**TSSOP-48**		**LFBGA-516-5**		**LFBGA-292-6**		**BGA-416-26**		**LQFP-176-22**	
28	9.7 x 6.4 x 1.2	48	12.5 x 6.1 x 1.1	516	25.3 x 25.3 x 2.8	292	17.3 x 17.3 x 2.35	416	27.3 x 27.3 x 3.2	176	26.7 x 26.7 x 2.1
											
LQFP-144-22		**TQFP-144-27**		**TQFP-100-23**		**TQFP-80-7**		**Package (JEITA-code)**			
144	22.4 x 22.4 x 2.2	144	18.7 x 18.7 x 1.6	100	14.5 x 14.5 x 1.5	80	12.6 x 12.6 x 1.5	X	L x W x H		
								| pin-count V = Variable number of pins All dimensions in mm			

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Through hole device technology

IPAK (TO-251)		IPAK SL (TO-251 SL)		I²PAK (TO-262)		TO-220 real 2pin		TO-220 2pin		TO-220 3pin	
3	15.5 x 6.5 x 2.3	3	10.7 x 6.5 x 2.3	3	25.1 x 10 x 4.4	2	29.15 x 10.0 x 4.4	2	29.1 x 9.9 x 4.4	3	29.15 x 10.0 x 4.4
											
TO-220 FullPAK		**TO-220 FullPAK Narrow Lead**		**TO-220 FullPAK Wide Creepage**		**TO-220-6-46**		**TO-220-6-47**		**TO-247**	
3	29.6 x 10.5 x 4.7	3	29.6 x 10.5 x 4.7	3	28.85 x 11 x 4.7	6	21.7 x 9.9 x 4.4	6	26.1 x 9.9 x 4.4	3	40.15 x 15.9 x 5.0
											
TO-247 4pin		**DIP-7**		**DIP-8**		**DIP-14**		**DIP-20**		**Super220**	
4	40.15 x 15.9 x 5.0	7	9.52 x 8.9 x 4.37	8	9.52 x 8.9 x 4.37	14	19.5 x 8.9 x 4.37	20	24.6 x 9.9 x 4.2	3	28.25 x 10.5 x 4.5
											
Super247		**SSO-3-9**		**SSO-3-10**		**SSO-4-1**		**TO92S-3-1**		**TO92S-3-2**	
3	34.6 x 15.6 x 5	3	A: 3.71 x 5.34 x 1 B: 2.68 x 5.34 x 1.2	3	4.06 x 1.5 x 4.05	4	5.34 x 1.0 x 3.71	3	4.0 x 1.52 x 3.15	3	4.0 x 1.52 x 3.15
											

Package (JEITA-code)	
X	L x W x H

|
pin-count
V = Variable number of pins

All dimensions in mm

All products are RoHS Compliant.

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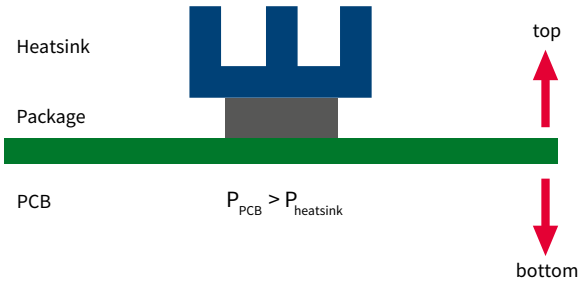
Top and bottom side cooling of SMD devices

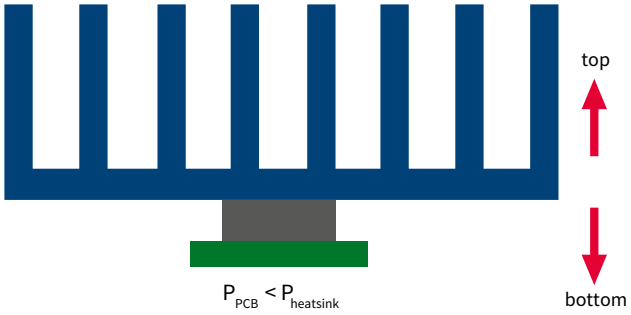
For LV MOSFETs different SMD packages such as SuperSO8 and DirectFET™ are available. If the cooling system is designed for main heatflow to the PCB both packages will show similar thermal performance.
If the main heat flow is to the top side the DirectFET™ is the better choice since the thermal resistance to the top side is lower ($R_{th\_top\_DirectFET™}$ ~ 1 K/W, $R_{th\_top\_SuperSO8}$ ~ 20 K/W).

Bottom side cooling



Thermal performance
DirectFET™ ~ SuperSO8

Top side cooling

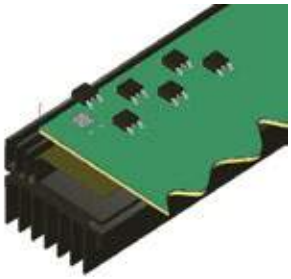


Thermal performance
DirectFET™ > SuperSO8

Example: high performance server
(PCB: 8 layer, 70 µm)

Example: motherboard (PCB 4 layer, 35 µm) with
high performance heatsink

New IGBT technology RCD allows highest power density with small SMD packages



The new IGBT RCD technology in combination with an efficient cooling system allows to use small SMD packages which enable to build compact systems with increased power density. In order to improve the heat dissipation, thermal vias are integrated in the PCB under the device case which results in a low thermal resistance to the opposite side of the PCB. A heatsink complements the cooling system. Isolation to the heatsink is realized with a thermal foil. With this cooling system power dissipation up to 7 to 10 W/IGBT is achievable which corresponds to ~ 2 kW application systems.

www.infineon.com/packages

OptiMOS™ in TO-Leadless

A package optimized for high current applications

TO-Leadless has been designed for high currents up to 300 A. In addition, latest OptiMOS™ Silicon technology in combination with reduced package resistance achieves lowest $R_{DS(on)}$. This enables a reduction in the number of parallel MOSFETs in a forklift application and increases power density.

Further the 60 percent smaller package size enables a very compact design. Compared to D^2PAK 7pin, TO-Leadless shows a substantial reduction in footprint of 30 percent. The 50 percent reduced height offers a significant advantage in applications where compact designs are key, such as rack or blade servers.

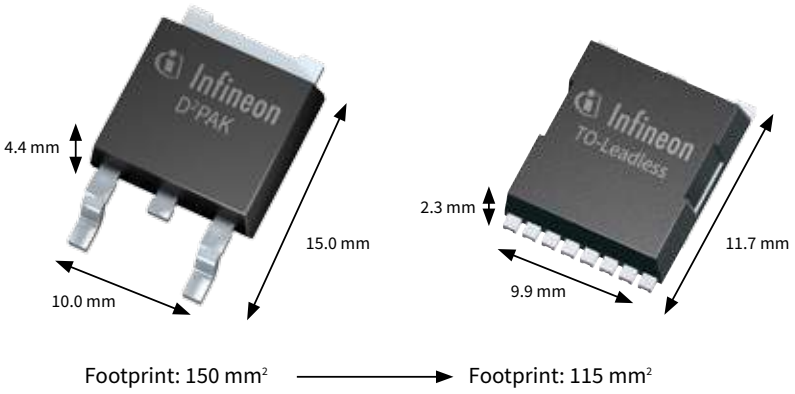
Moreover low package parasitic inductances result in an improved EMI behavior and a 50 percent bigger solder contact area avoids electro migration at high current levels, which results in improved reliability.

Applications

- Forklift
- Light electric vehicles
- Point-of-load (POL)
- Telecom
- eFuse

Features

- Industry‘s lowest $R_{DS(on)}$
- Highest current capability up to 300 A
- Very low package parasitics and inductances
- Less paralleling and cooling required
- Highest system reliability
- System cost reduction
- Enabling very compact design



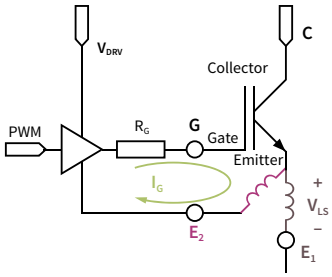
www.infineon.com/toll

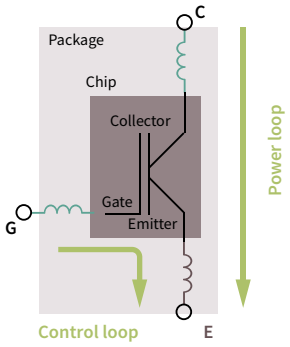
TO-247 4pin full load efficiency for free

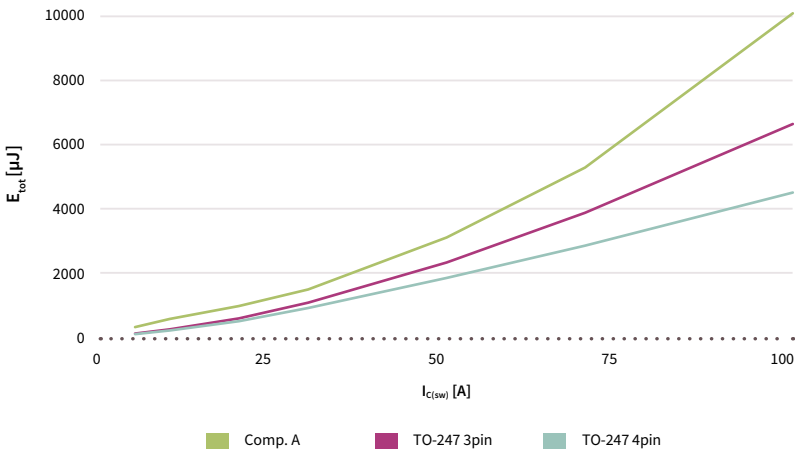
Package for high voltage switches with increased creepage and clearance
Infineon's TO-247 4pin package enables significant efficiency improvement in hard switched topologies and at the same time allows a better control. The fourth pin acts as Kelvin source. The main current of the switch is placed outside of the gate loop and the feedback is eliminated. This leads especially at high currents to less switching losses. Secondly, the EMI will be reduced due to cleaner waveforms.

The benefit will be seen in various hard switching topologies used in AC-DC and DC-AC conversion. The package helps as well in designs where the next current or $R_{DS(on)}$ class with a three pin approach must be chosen in high load operation. This is related to the improved efficiency by 5 to 8 percent at such operation condition.

Benefits
- Full load efficiency
- Improved EMI
- Better gate control
- Increased creepage







Evaluation board available:

EVAL-IGBT-650 V-TO247-4

www.infineon.com/to-247-4

Applications
- UPS
- Solar
- Welding
- Drives
- Aircon/HVAC

TO-247PLUS higher power in the standard footprint

Infineon introduces the new package TO-247PLUS, responding to the market requirement to accommodate ever increasing amounts of silicon in smaller, space saving packages .

Higher current capability – improved thermal behavior
Infineon's new TO-247PLUS has the same outer dimensions as the industry standard TO-247, but due to the absence of the screw hole, allows up to 120 A in 600 V. Also the total backside active thermal pad area has been increased to improve heat dissipation capabilities of the package.

Improved thermal management and creepage distances
Better heat dissipation through lower R_{th} improves thermal management, that means less heat sink and lower cost for the cooling infrastructure.

TO-247PLUS package body has special "plastic trousers", that allow to increase the creepage distance to 4.25 mm – 2 mm bigger compared to the standard TO-247. Special cut-outs of the mold compound at the upper corners, increase creepage path at single clip mounting.

A new bond wiring concept realized in TO-247PLUS allows increase of the DC collector current from 80 A to 160 A (at T_c = 25°C) contributing to the better reliability and longer lifetime of the IGBT.

Features
- Highest current rating co-pack 600 V in 100 A and 120 A
- 35% bigger active thermal pad area for up to 20% lower thermal resistance $R_{th(jh)}$
- Extended creepage distance of 4.25 mm – 2 mm bigger than TO-247

Benefits
- Higher system power density – I_c increase keeping the same system thermal performance
- Lower thermal resistance $R_{th(jh)}$ and improved by ~15% heat dissipation capability of TO-247PLUS versus TO-247
- Higher reliability, extended lifetime of the device

TO-247	Major differences	TO-247PLUS
	› Screw hole vs. no screw hole › Maximum allowable chip area in single die ~70 mm² vs. 120 mm² › Current capability (DuoPAK) 600 V: 75 A vs. 120 A (+60%) › Increased creepage by 52% to 4.25 mm › Bond wire limit increased from 80 A to 160 A › Bigger backside active thermal pad area due to missing hole 140 mm² vs. 190 mm² › 20% lower thermal resistance $R_{th(jh)}$ › 10% – 15% better heat dissipation	

www.infineon.com/to-247plus

Infineon support for packages

Useful links and helpful information

Further information, datasheets and documents

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- India ..... 000 800 4402 951 (English)
- USA ..... 1-866 951 9519 (English/German)
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- Direct access ..... +49 89 234-0 (interconnection fee, German/English)

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