AC-DC	Audio Amplifier	Automation	Automotive	Consumer

DC-DC	eMobility	EV-Charging	LED	Lighting

Major home appliance	Motor Control	Multicopter	Onboard	Radar

Sensing	SMPS	Solar	UPS	Wireless charging

Power and Sensing

Selection Guide 2018

infineon

Dear Customer,

The world around us is getting smarter. What was once just fantasy and science fiction is now finding a place in our homes, our offices, and our workplaces. Automotive, home, industrial, and consumer devices are becoming a part of the Internet of Things (IoT) a network of cyber-physical objects that contain embedded electronics to sense, computer actuate, and communicate. New and innovative Human-Machine Interface (HMI) technologies are being developed, and the boundary between devices and the people operating them is becoming blurred.

This incredibly rapid advancement in technology is opening up new opportunities for people in all corners of our world. We are discovering new ways to communicate with the tools that are an indispensable part of our daily lives. Mobile devices with 3D and gesture sensing, high end audio systems with beam-forming microphones, highly efficient wireless charging systems, and innovative power-efficient lighting systems are merging together to shape this technological revolution.

Infineon is a world leader in offering semiconductor solutions that make your life easier, safer, and greener. The Power and Sensing Selection Guide for 2018 opens the door to this better future, providing you with inspiration as you make your products more efficient, cost-effective, and innovative.

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，

我们所处的世界正在变得越来越智能。曾经仅存在于幻想和科幻小说中的事物正出现在我们的家里、办公室和工作场所内。汽车、家居、工业和消费电子设备正在成为物联网 (IoT) 的一部分，这种信息物理对象网络包含嵌入式电子设备，进行传感、计算机启动以及通信。新型的创新人机界面 (HMI) 技术正在开发中，设备与操作人员之间的界限将变得模糊。
科技的迅猛发展正在为世界各地的人们开创新的机遇。我们正在探索新的方法，与日常生活中不可缺少的工具进行交互。具有 3D 和手势感应功能的移动设备、具有波束成形麦克风的高端音频系统、高效无线充电系统以及创新的节能照明系统正在融合，共同形成此次技术革命。
英飞凌是全球领先的半导体解决方案提供商，让您的生活更轻松、更安全、更环保。《2018 年功率和传感选型指南》为这个美好的未来打开了大门，为您提供灵感，让您的产品更高效、更具成本效益和创新性。
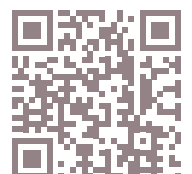
Contents

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

From ordinary speech recognition to contextual awareness

Seamless interaction with smart devices

Infineon offers best-in-class sensors, unique algorithms, and powerful processors that together form the foundation required to create active human machine interfaces that can understand who we are, how we act and what we do in our daily lives.

Sensors allow smart devices to see, hear and understand their surroundings. This contextual awareness sensitivity enables humans to interact with smart devices in a more natural and seamless way than ever before. At Infineon, we are providing the inspiration needed to enhance voice and gesture recognition in innovative human machine user interfaces, making the technological boundary between humans and machines gradually disappear.

1980	2000	2017	2025
Mouse	Touch	Voice	Contextual awareness

We drive contextual awareness within the HMI segments with our best-in-class XENSIV™ sensors – with radar and TOF technologies, pressure sensors and silicon microphones. Together with strong industry partners we develop solutions that make the technology disappear – for your end customers' convenience.

XENSIV™ Fusion

Bringing together Infineon's XENSIV™ sensors with our partners' hardware, we provide the sensor fusion that is key to communication between humans and machines. By fusing radar with silicon microphones, Infineon has achieved the first step towards context awareness. Through sensor fusion, devices are, for the first time, able to do things such as differentiate whether a keyword was spoken by a person in the room or the command came from another source such as a TV or radio.

www.infineon.com/sensors

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 those 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.

Within 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, Nova-lithIC™, 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
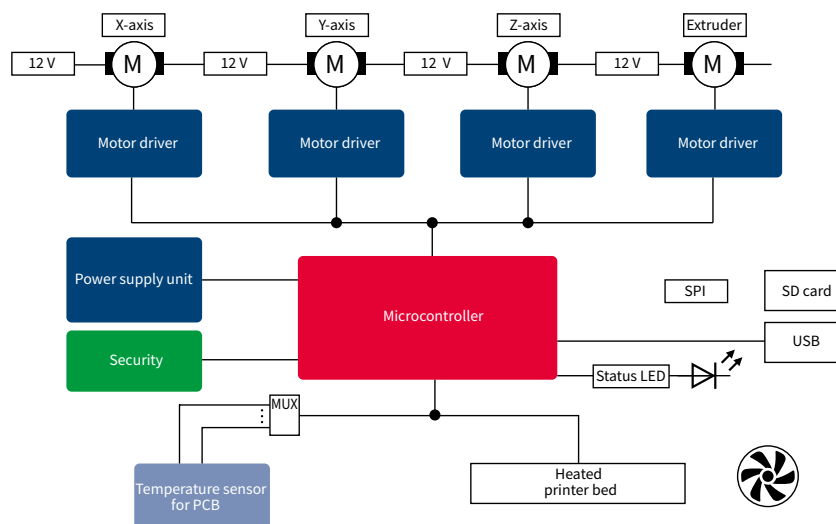
Infineon's product recommendation for 3D printer

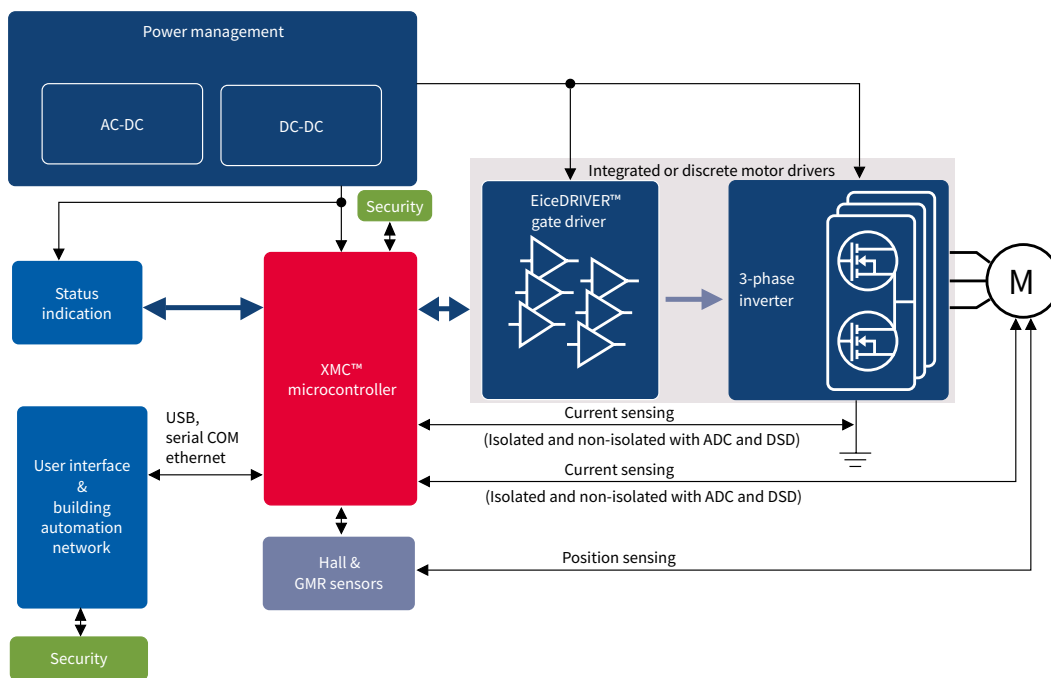| Functional block	Products	Selection/benefit
Motor control	CIPOS™ Nano	High integration
	NovalithIC™	Integrated solution with fast signal processing and short delay times
	Angle sensor	Low power consumption and high accurate angular and linear position detection
	IFX9201	DC motor control for industrial 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
	CoolSiC™ Schottky diodes 650 V G5	Ease-of-use and cost-optimized solution
	EiceDRIVER™ 2EDN gate driver	Fast and robust gate driver
	Low-side gate driver (IRS44273)	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	High efficiency
	EiceDRIVER™ 2EDN gate driver	Fast and robust gate driver
	Low-side gate driver (IRS44273)	Fast and robust gate driver
	High voltage half-bridge and high- and low-side gate driver ICs	Industrial standard rugged gate driver
Main stage: Synchronous rectification	OptiMOS™ 40 V - 60 V	High efficiency
	60 V synchronous rectification MOSFET (IRLR3636)	High efficiency
	EiceDRIVER™ 2EDN gate driver	Fast and robust gate driver
	Low-side gate driver (IRS44273)	Fast and robust gate driver
	High voltage half-bridge and high- and low-side gate driver ICs	Industrial standard rugged 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 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, power supplies and battery management, which help to reduce energy losses in all conditions. This is where Infineon comes into place.

Within 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 updates while our radar solutions cover a 16 times larger area than infrared solutions.

Block diagram

www.infineon.com/automaticopeningsystem

Infineon's product recommendation for automatic opening system

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/6EDL	Industrial standard rugged gate driver
	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
	High voltage half-bridge and high- and low-side gate driver ICs	Industrial standard rugged gate driver
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

Battery powered applications
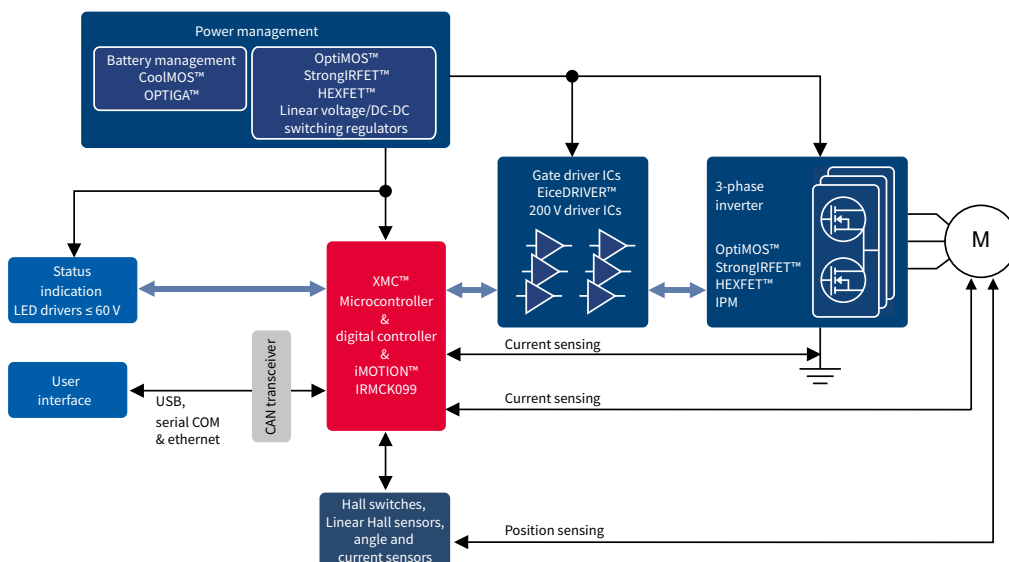## Highest performance in motor control

Based on industry leading technology, highest quality and manufacturing expertise, Infineon provides a variety of innovative power semiconductors which enable designers to develop highly reliable and efficient solutions. Through our comprehensive portfolio we can address a broad range of battery powered motor control applications, such as power tools, forklifts, all kinds of light electric vehicles including e-skateboards, e-scooters, pedelecs, low speed cars and many others. Infineon offers an excellent selection of devices for power management and consumption, as well as voltage regulation – such as power MOSFETs (e.g. CoolMOS™ and OptiMOS™), XMC™ microcontrollers, EiceDRIVER™ gate drivers and more.

Key enabling products are:
› Low voltage power MOSFETs – OptiMOS™ and StrongIRFET™
› Small Signal products
› High voltage power MOSFETs – CoolMOS™
› EiceDRIVER™/Half-bridge and three-phase gate driver ICs
› Magnetic sensors and voltage regulators
› Microcontrollers – XMC™
› Motion control ICs – iMOTION™ IRMCK099
› Authentication IC OPTIGA™ Trust B

Home and professional	Consumer robotics	Light electric vehicle
Power tools, gardening tools, commercial multicopters, cordless home appliance, cordless vacuum cleaners, healthcare equipment	Consumer multicopters, vacuum robots, RC toys, service robotics, household robotics and other consumer robots	eScooter, eBike, electric wheelchair, electric forklift, low speed cars (LSEV), electric motorcycle, other battery vehicles

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

	Consumer robotics	Home and professional	Light electric vehicles
MOSFETs	StrongIRFET™ 20 V-300 V		
	OptiMOS™ 25 V-80 V		OptiMOS™ 80 V-300 V
	CoolMOS™ P7 (standard grade)[1]		CoolMOS™ P7 (industrial grade)[1]
Gate driver ICs	EiceDRIVER™/Half-bridge and three-phase gate driver ICs		
	200 V to 600 V gate driver ICs		
IPM	CIPOS™ Nano		
Microcontrollers	XMC1300/XMC1400		
	iMOTION™	XMC4500/XMC4400	
Microcontroller & driver supply	Linear voltage and DC-DC switching regulators		
CAN transceivers	IFX1050, IFX1051		
Magnetic sensors	Hall and xMR sensors		
Authentication	OPTIGA™ Trust B		

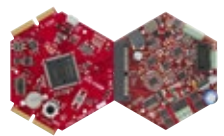| Infineon product offering		Consumer robotics	Home and professional	Light electric vehicles
Supply voltage		12 V-48 V	10.8 V-56 V	24 V-144 V
MOSFET OptiMOS™ StrongIRFET™	Voltage	25 V-100 V	20 V -100 V	60 V-300 V
	Package	SuperSO8/PQFN 3x3/DirectFET™ S/M-Can	SuperSO8/PQFN 3x3/DirectFET™ S/M/L-Can TOLL/TO-220/DPAK/D²PAK	TO-220/DPAK/D²PAK/D²PAK 7pin/TOLL/ DirectFET™ L-Can
HV MOSFETs CoolMOS™ P7	Voltage	600 V – 700 V*	600 V – 700 V*	600 V**
Gate driver ICs		6EDL04N02PR/2EDL05N06PF/IRS2005,7,8 IRS2301/IRS2136/IRS21867/IRS2334	1EDN/2EDN/6EDL04N02PR/2EDL05N06PF IRS2005,7,8 /IRS2301/IRS2136/IRS21867/IRS2334	
IPM – CIPOS™ Nano		IRSM836-0x4MA (x=2,4,8) IRSM808-204MH	IRSM005-800MH IRSM005-301MH	
Authentication IC)		OPTIGA™ Trust B	OPTIGA™ Trust B	OPTIGA™ Trust B
Microcontroller XMC		XMC1100	XMC1300	XMC1300
iMOTION™		IRMCK099M	IRMCK099M	XMC4400/4500
Microcontroller & driver supply		IFX1763/IFX54441/IFX54211/IFX30081/ IFX90121/IFX91041	IFX1763/IFX54441/IFX54211/IFX30081/ IFX90121/IFX91041	IFX1763/IFX54441/IFX54211/IFX30081/ IFX90121/IFX91041
CAN transceivers		IFX1050, IFX1051	IFX1050, IFX1051	IFX1050, IFX1051
Sensors		Hall switches (TLE496X), Angle sensor (TLI5012B), 3D magnetic sensor (TLV493D)	Hall switches (TLE496X), Angle sensor (TLI5012B), 3D magnetic sensor (TLV493D)	Hall switches (TLE496X), Angle sensor (TLE5012B), 3D magnetic sensor (TLV493D)

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)	40 V Medium Can ME/MF DirectFET™ 3-phase BLDC motor drive demo board (DEMO-PTOOL-300W-M)

1) If the necessary package/R_DS(on) combination is not available in the new CoolMOS™ P7 series yet, the previous CoolMOS™ CE and P6 series are the preferred series
* standard grade
** industrial grade

eMobility

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 is 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 DC-charging socket in an electric vehicle. 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
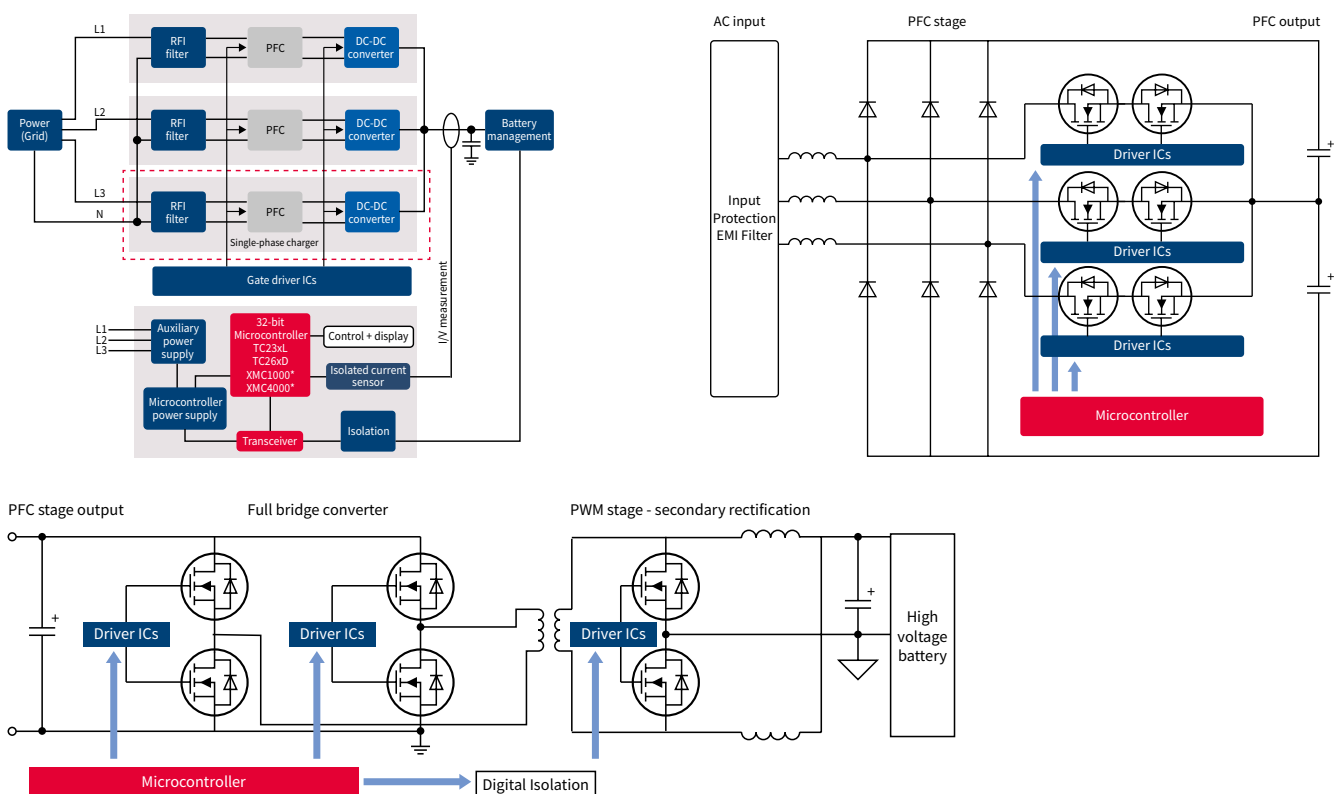
www.infineon.com/emobility

*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, such as 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. For more information about off-board chargers, please refer to page 52 DC EV charging.
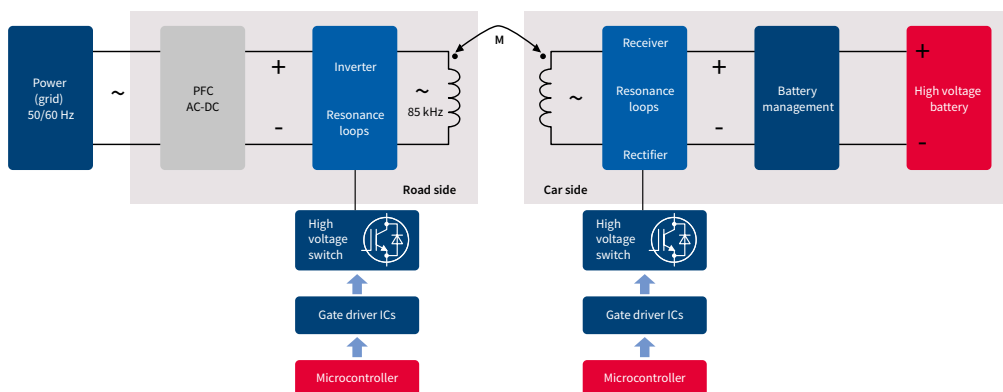
Automotive products for on-board units

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/H5/EH5, IKZxxN65EH5/NH5	TRENCHSTOP™ 5	650 V ultra-fast/fast IGBT with rapid 1 diode
IGWxxN65F5/H5, IGZxxN65H5	TRENCHSTOP™ 5	650 V ultra-fast/fast IGBT
IDWxxG65/120C5(B [3])	CoolSiC™ diode	650 V/1200 V SiC Schottky diode generation 5
IDWDxxG120C5	CoolSiC™ diode	1200 V SiC Schottky diode generation 5 TO-247 2pin
IMW/Z120RxxxM1	CoolSiC™ MOSFET	1200 V SiC MOSFET
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
2EDNxxxxF/R	EiceDRIVER™ 2EDN	2-channel low-side, non-isolated
1EDIxxN12AF	1EDL EiceDRIVER™ Compact	1-channel high-side isolated

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.

www.infineon.com/emobility

1) in development
2) for external chargers
3) „B" in product name refers to common-cathode configuration

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*

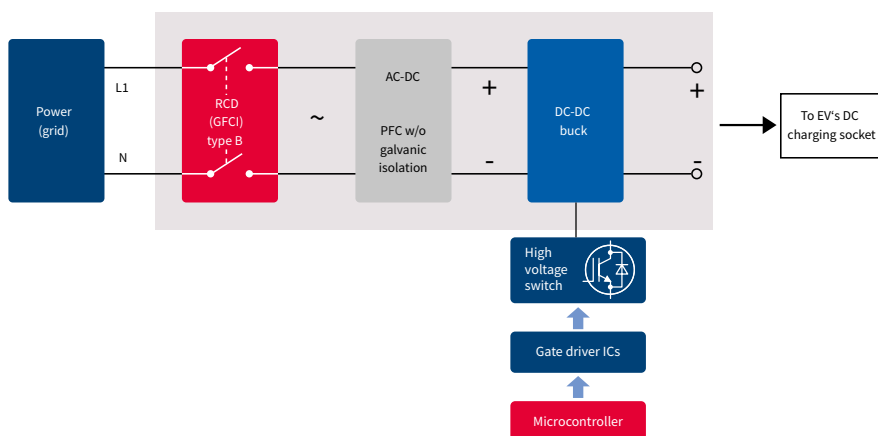| Typical part number	Product family	Description
IKW40N65F5	TRENCHSTOP™ 5	Fast IGBT with rapid 1 Diode, 40 A, TO-247
IGW40N65F5	TRENCHSTOP™ 5	Fast IGBT, single, 40 A, TO-247
IDW40G65C5	CoolSiC™ diode	650 V SiC Schottky diode generation 5, 40 A, TO-247 [2]
XMC4000	XMC™ Microcontroller	32-bit ARM® Cortex® -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. Type-B RCD (GFCI) safety switches are needed 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. The main reason why non-isolated designs are currently not accepted for on-board chargers is because 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

www.infineon.com/emobility

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 lifetime – 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, highlights are our 8-bit XC886CM microcontroller family for the slave blocks and the new 32-bit AURIX™ microcontroller family for the master block, OptiMOS™ low voltage MOSFETs, 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
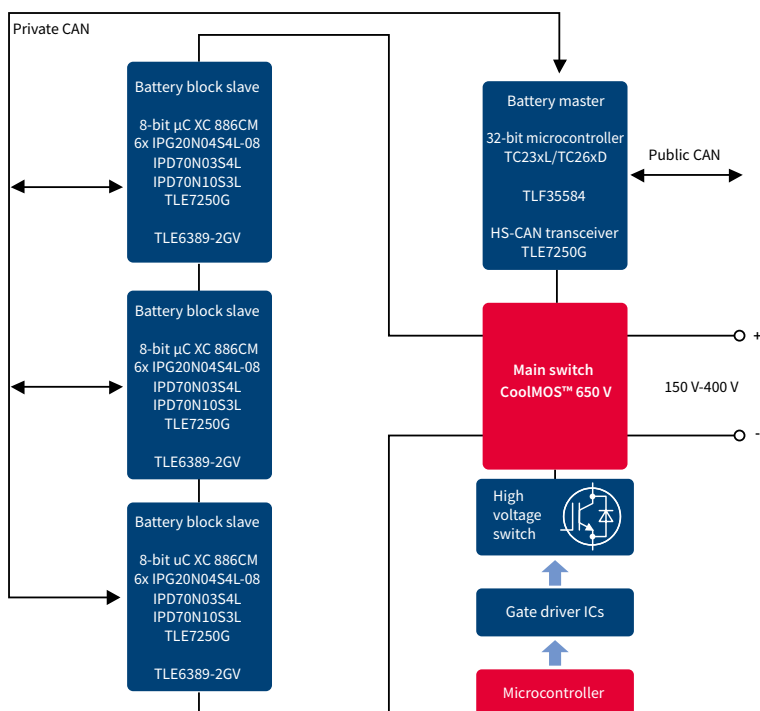
www.infineon.com/emobility

1) in development

Audio Amplifier

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

18
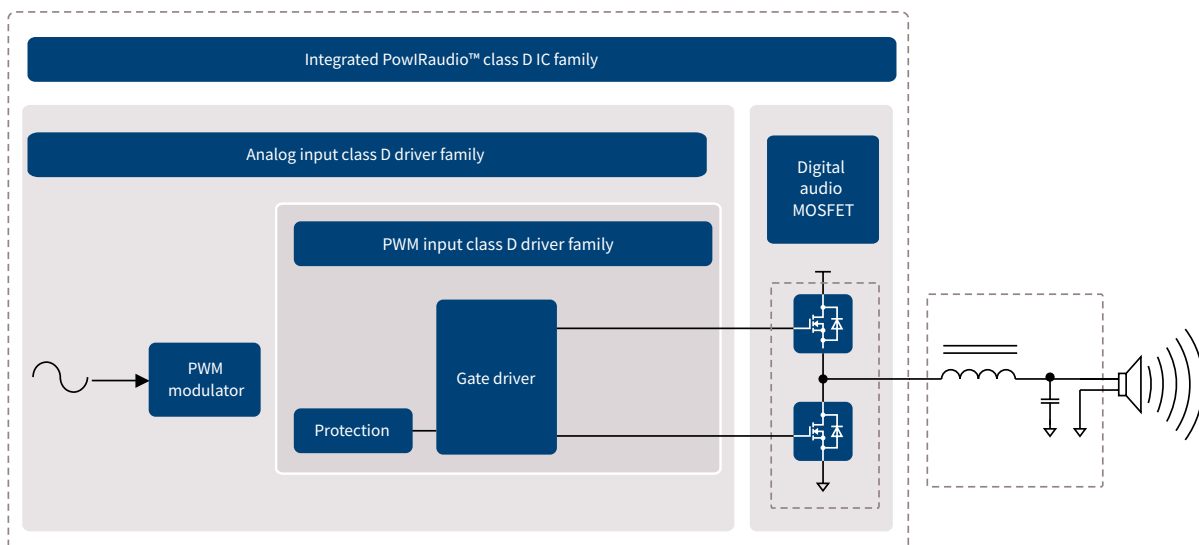
Integrated class D audio modules

Specifications		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

Specifications		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	EVAL_IRAUDAMP23

CoolGaN™ 400 V and 600 V e-mode GaN HEMTs for class D audio product portfolio

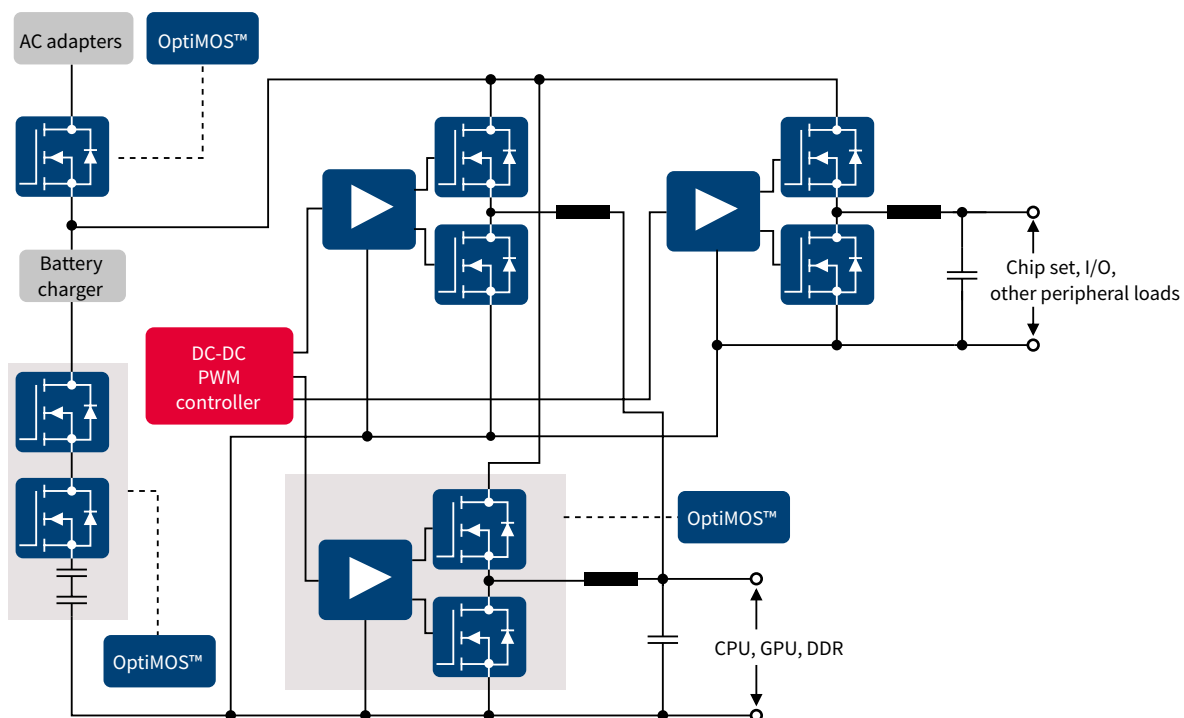|	PG-DSO-20-87	PG-TOLL
P_{max}	Up to 500 W	Up to 200 W
$R_{DS(on) max.}$	70 Ω	70 Ω
Typical part number	IGOT40R070D1 E8220	IGT60R070D1 E8220

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/multi-phase
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

	Server/storage	Powered ICs	Voltage	
Server	Server-Intel/IBM/AMD/ARM Workstation Storage	Server chip set	VCCIO	V_{core}
Storage			VMCP	V_{mem}
Consumer	**High-end consumer**	PC chip set		V_{core}
	High-end desktop Graphic Notebook Industrial PC Gaming			Graphics
Datacom	**Comms**	ASIC ASSP FPGA	FPGAs (~0.5 V – 3.3 V)	Networking SoCs & ASICs, FPGAs
Telecom	**Datacom** Comms core SOHO SAN Edge access / **Telecom** Basestation (macro + distributed)		ASICs (~1.0 V)	Multi-core processors
			ASSPs (~1.0 V)	Ethernet switch ICs

10 A - 30 A
single-phase (multi-rail)

> 30 A
multi-phase/rail

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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.
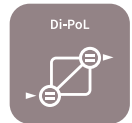
Block diagram
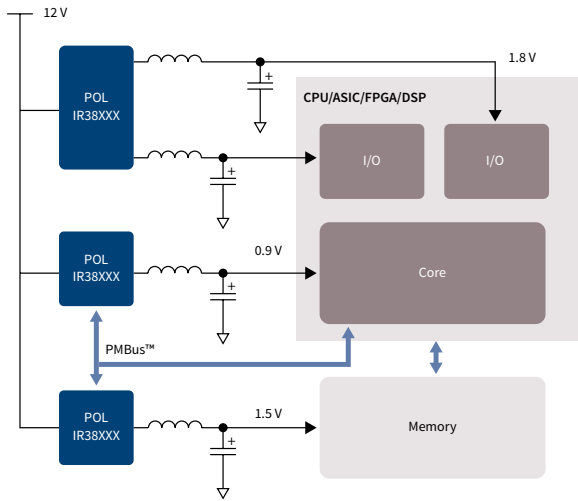
Key features

› 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

DC-DC IPOL portfolio

Digital interface IPOL

I²C PMBus™, telemetry, margin, faults, SVID PVID Digital control/configuration, telemetry and diagnostic					
Part number	Max. current [A]	Package size [mm]	Max. V_{in}	Max. f_{sw}	Distinctive features
IR38064	35	5 x 7	21 V	1500 KHz	PMBus™
IR38063	25	5 x 7	21 V	1500 KHz	
IR38062	15	5 x 7	21 V	1500 KHz	
IR38060	6	5 x 6	21 V	1500 KHz	
IR38163	30	5 x 7	16 V	1500 KHz	OptiMOS™ 5, SVID + PMBus™
IR38165	30	5 x 7	16 V	1500 KHz	OptiMOS™ 5, SVID
IR38363	15	5 x 7	16 V	1500 KHz	OptiMOS™ 5, SVID + PMBus™
IR38365	15	5 x 7	16 V	1500 KHz	OptiMOS™ 5, SVID
IR38263	30	5 x 7	16 V	1500 KHz	OptiMOS™ 5, PVID + PMBus™
IR38265	30	5 x 7	16 V	1500 KHz	OptiMOS™ 5, PVID
IR38164	30	5 x 7	16 V	1500 KHz	OptiMOS™ 5, SVID + PMBus™, enhanced Imon
IRPS5401	4+4+2+2+0.5	7 x 7	14 V	1500 KHz	5 output PMIC, PMBus™

Analog interface IPOL

„Performace" voltage mode PWM Ultra-low jitter and noise, high accuracy and low ripple					
Part number	Max. current [A]	Package size [mm]	Max. V_{in}	Max. f_{sw}	Distinctive features
IR3883	3	3 x 3	14 V	800 KHz	Constant-on-time
IR3823	3	3.5 x 3.5	21 V	1500 KHz	3 soft start
IR3897	4	4 x 5	21 V	1500 KHz	DDR tracking and analog voltage margin/AVSO
IR3898	6	4 x 5	21 V	1500 KHz	
IR3899	9	4 x 5	21 V	1500 KHz	
IR3894	12	5 x 6	21 V	1500 KHz	
IR3895	16	5 x 6	21 V	1500 KHz	
IR3826	23	5 x 6	17 V	1500 KHz	OptiMOS™ 5, 3-level OCP
IR3448	16	5 x 6	21 V	1500 KHz	True differential remote sensing for accuracy and thermally enhanced Cu clip package
IR3847	25	5 x 6	21 V	1500 KHz	
IR3846	35	5 x 7	21 V	1500 KHz	
IR3891	4+4	5 x 6	21 V	1500 KHz	Dual output for density and out-of-phase for less input capacitor
IR3892	6+6	5 x 6	21 V	1500 KHz	

www.infineon.com/dataprocessing

Industrial automation
The smart choice for smart factories

Control level

Cross-application control
XMC™ microcontrollers;
for automation applications

Efficient power management
ISOFACE™; PROFET™; HITFET™
OptiMOS™

| Power supply unit | Digital control uC, DSP, FPGA | Control | Digital output switch | Digital input | Digital output switch |

Security module

CAN/LIN transceiver

Transceiver

ESD/TVS diodes

Protection

Trusted security protection
› OPTIGA™ family for protection of IP, know-how and platform integrity
› M2M SIM and NFC tags for smart assets

Sensor module

Sensor

Sensor

Efficient power management
› MOSFET, smart switches, gate driver ICs
› IGBT power modules, IPMs, for industrial controllers and robots

Cross-application control
› XMC™ microcontrollers;
for automation applications

Security module

Motor control

Valve control

Load control

Motor control

Robot control

Power Bus

Advanced sensing capabilities
› Hall sensors for speed, position, torque and angle measurement
› Radar solutions to scan the robots' environment

Security module

Field level

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

www.infineon.com/welding

*(MMA/TIG < 280 A)
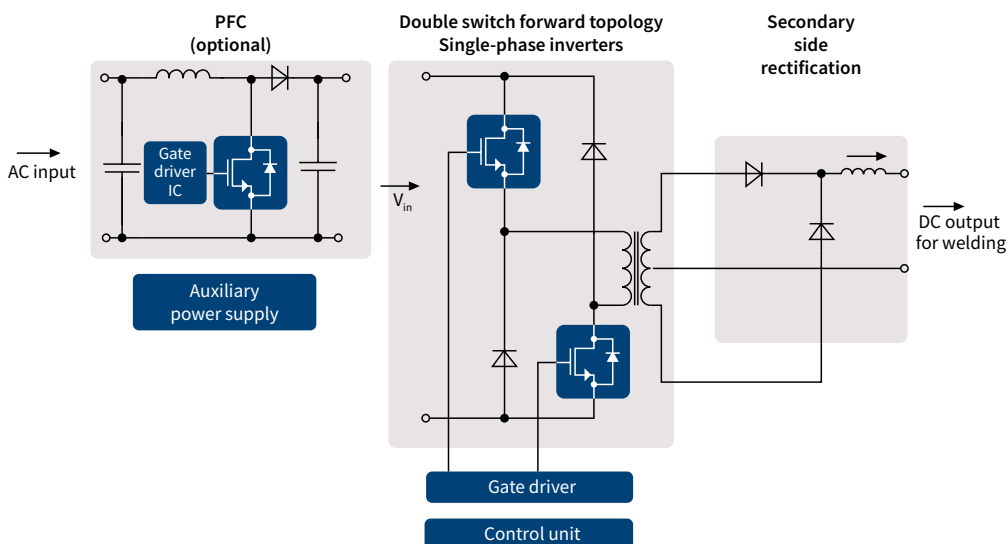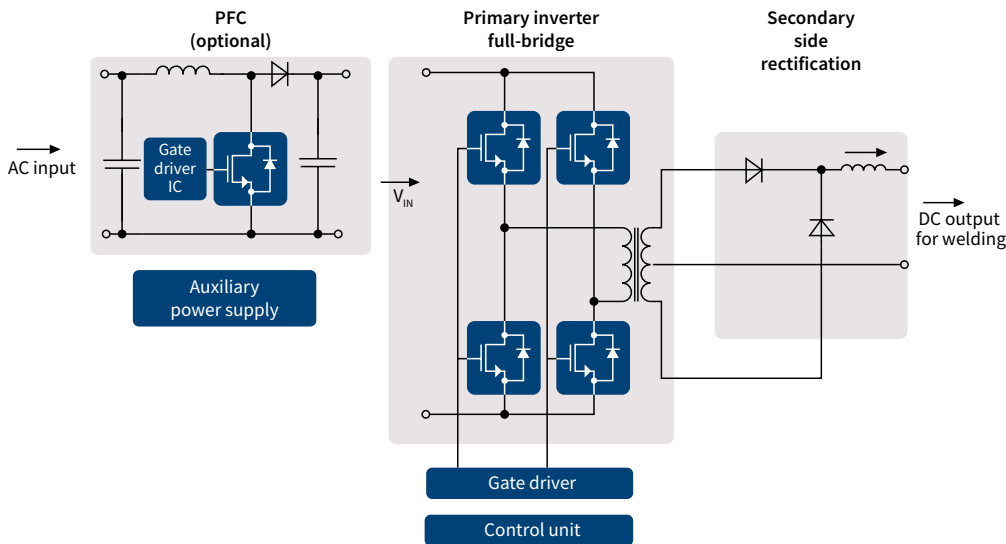
Infineon's product recommendation for industrial welding

Stage		Topology	Voltage class	Technology/product family	Selection/benefit
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
Gate driver ICs		Low-side and half-bridge	25 V/650 V/1200 V	IRS44273L	Rugged and reliable
		Single channel	1200 V	EiceDRIVER™ 1ED Compact/ EiceDRIVER™ Enhanced 1ED020I12-F2	Rugged and reliable
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
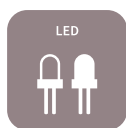
LED lighting
Solutions for cost sensitive applications as well as for smart lighting

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. ICL5102)
  – 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 (i.e. CDM10V)
  – Primary control with wide range input and output voltage range
    enabled by digital LED driver ICs (i.e. XDPL8105)
› Cost effectiveness
  – High voltage SJ 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
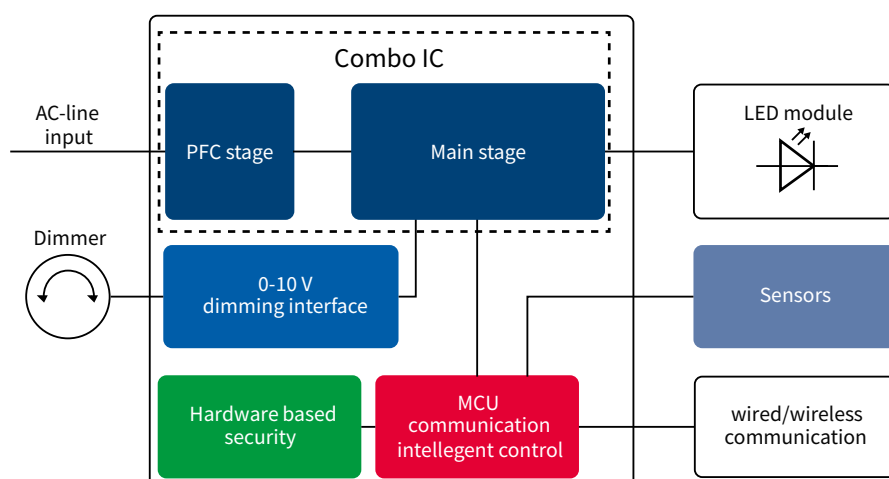
LED drivers

Functional block	Product type	IC product family	MOSFET technology	Voltage class
PFC stage	PFC	IRS2505	CoolMOS™ CE	600 V
		TDA4863	CoolMOS™ P7	600 V/700 V
Combo solutions for PFC and main stage	PFC+LLC (constant current /constant voltage)	ICL5101 ICL5102	CoolMOS™ CE	600 V/650 V
			CoolMOS™ P6	600 V
	PFC + flyback (dual-stage)	XDPL8220 XDPL8221*	CoolMOS™ CE	600 V
			CoolMOS™ P7	800 V/700 V/600 V
	PFC/flyback (single-stage)	XDPL8105	CoolMOS™ P7	800 V
Buck solutions	Buck (single-stage)	ICL8201	CoolMOS™ P7	600 V
	Secondary buck	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
Dimming	0 V-10 V dimming interface IC	CDM10V	-	-
		CDM10VD	-	-
Hardware based security	OPTIGA™	OPTIGA™ Trust	-	-
MCU	XMC™ microcontroller	XMC1100	-	-
Sensors	Radar sensor	BGT24LTR11	-	-

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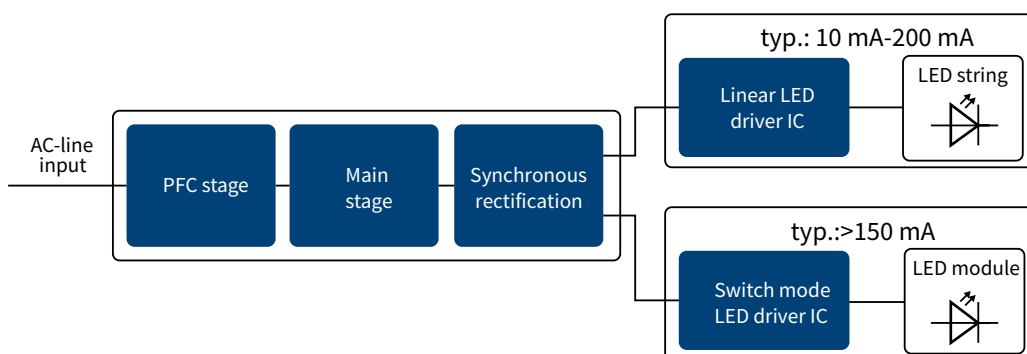
Linear/switch mode LED driver ICs

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

www.infineon.com/lighting

 * coming Q2/2018

** including communication

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 solutions that are developed 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-performance ratio and ease-of-use.

Infineon also offers a range of complementary products, such as low-side gate drivers and high voltage level-shift gate drivers which can be used with the IGBTs, as well as in the central control and power supply subsystems of induction cooking appliances.
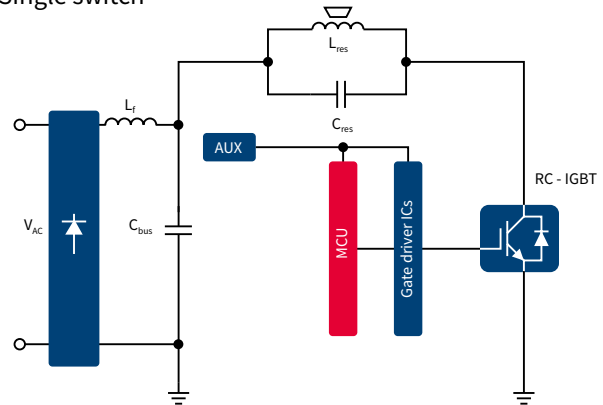
Induction heating inverter (current resonance)

Half-bridge
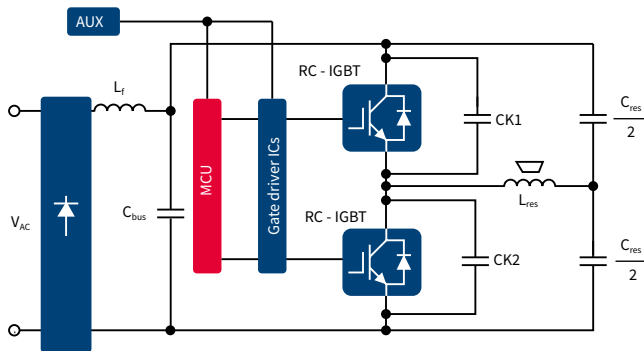
Induction heating inverter (voltage resonance)

Single switch

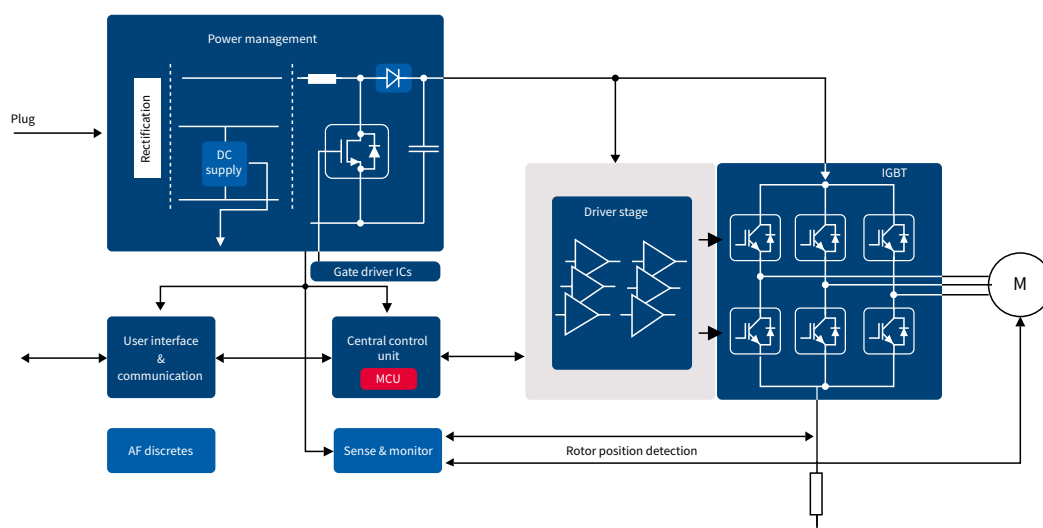| Induction heating	Topology	Voltage class	Technology/product family	Selection/benefit
DC-AC	Series-resonant half-bridge	650 V	RC-H5	Recommendation
	Quasi-resonant single switch	1100 V	RC-H3	Recommendation
	Quasi-resonant single switch	1200 V	RC-H5, RC-E	Recommendation
	Quasi-resonant single switch	1350 V	RC-H5	Recommendation
	Quasi-resonant single switch	1600 V	RC-H2	Recommendation
Gate driver ICs	High-side and low side; half-bridge	600 V/1200 V	2ED2304S06F, 2ED218xS07, IR2213/4	Rugged and reliable
	Single-channel low-side	25 V	IRS44273	Rugged and reliable
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/benefit
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
	IGBT - PFC CCM (low losses - SC)	650 V	TRENCHSTOP™ IGBT6	Recommendation
	MOSFET – PFC CCM	600 V	CoolMOS™ P7	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
	Low-side gate driver ICs	25 V	IRS44273	Rugged and reliable
DC-AC	IGBT – B6-VSI	650 V	TRENCHSTOP™ IGBT6	Efficiency
	IGBT – B6-VSI	600 V	RC-Drives Fast	Recommendation
	MOSFET - B6-VSI	500 V/600 V	CoolMOS™ CE	Cost/performance
	IPM – B6-VSI	600 V	CIPOS™	Recommendation
Gate driver ICs	Driver for 3-phase	600 V	6EDL04I06PT, 6ED003L06-F2	Rugged and reliable
	Driver for half-bridge	600 V	2ED2304S06F	Rugged and reliable
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

Solid state RF powered oven solutions
## Technology improving life quality

Microwave

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 meals, defrost foods, etc. Microwaves have 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 improved. Moving in alignment with the home appliance trend, the solution from Infineon includes a reliable Wi-Fi 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.'

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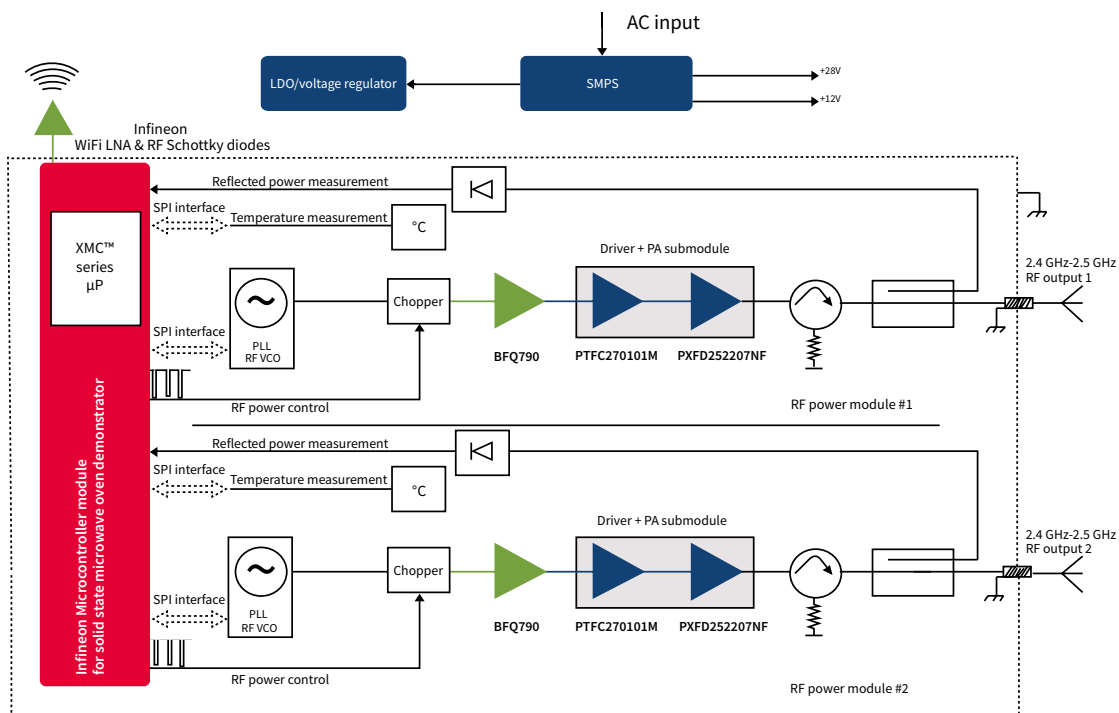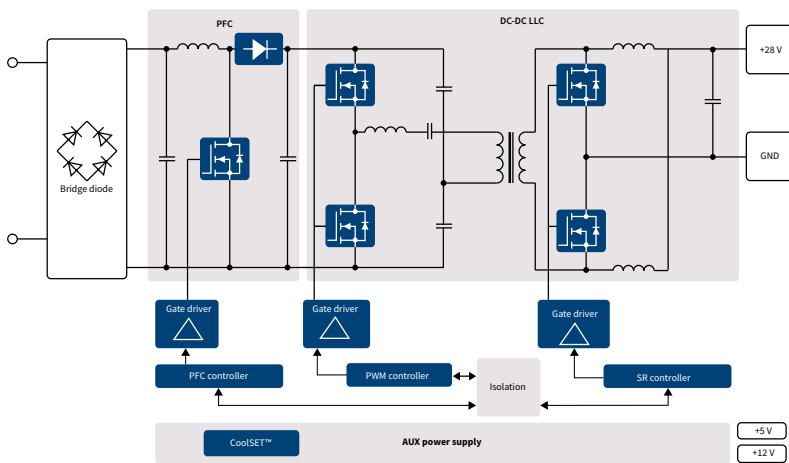
Infineon's highly efficient and cost effective switching power solution enhance the microwave oven performance.

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

Product recommendation

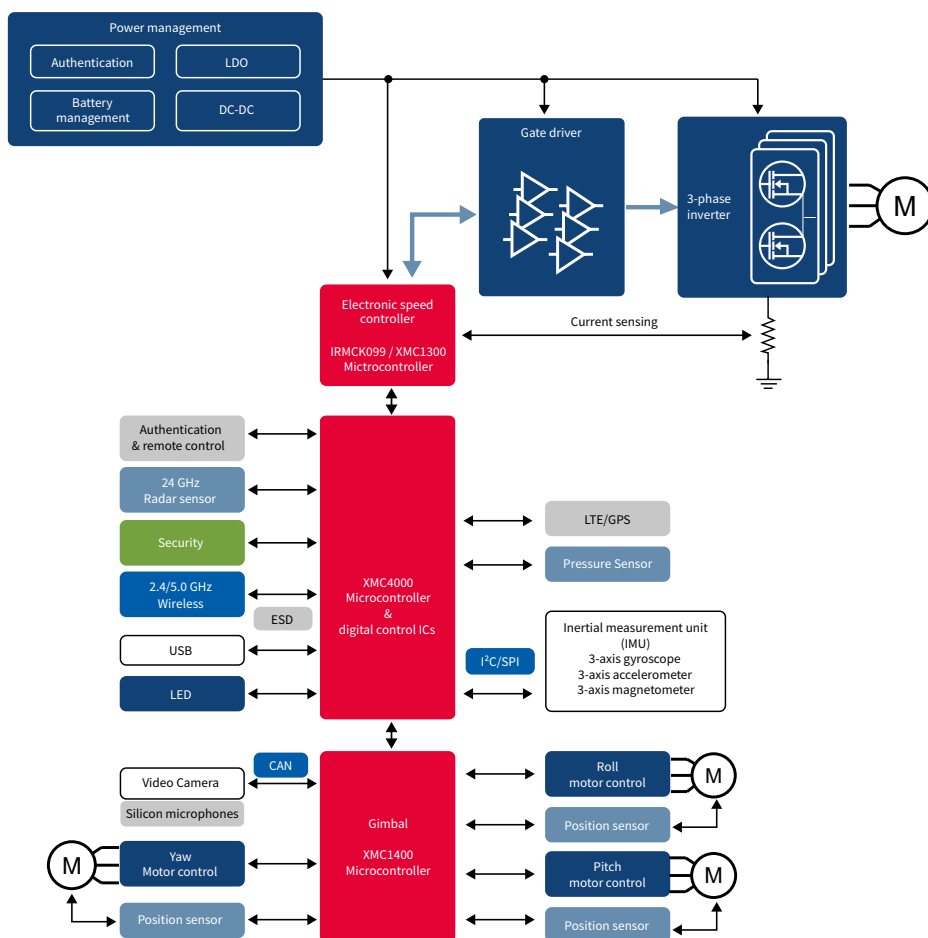| Sub application	Recommendation	Key benefits
Power supply	CoolSET™: ICE2QR1765G, etc.	High integrated AC-DC power controller, low standby, balancing of cost and performance
	PFC controller: ICE3PCS01G	CCM, high power factor, low THD, multi-functional protection
	PFC MOS: IPW60R070P6	CoolMOS™ proven 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
Gate driver ICs	EiceDRIVER™ 1EDN	Rugged and reliable
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
Wi-Fi	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

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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 spectrum 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.

www.infineon.com/multicopter

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	› 24GHz 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

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					ESC		
Microcontrollers	Sensors	DC-DC modules	LDO	Low noise amplifer(LNA)	Microcontrollers	Sensors	Intelligent power modules
› XMC4000 family › XMC1000 family › AURIX™	› Pressure sensor: DPS310 › 24GHz radar sensor: BGT24MTR11, BGT24MTR12 › Current sensor: TLI4970 › ToF imager: IRS1645C	› IFX90121ELV50 › IFX91041EJV33 › IFX91041EJV50	› IFX1117ME › IFX54441EJV › IFX1763XEJV33	› LTE: BGA7H, BGA7M, BGA7L › GPS: BGA524N6, BGA824N6 › Wi-Fi: BFP842ESD, BFR840L3RHESD, BFR843L3, etc.	› XMC1300 family › iMOTION™ IRMCK099 › ePOWER: TLE9879QXA40	› Hall sensor: TLI4961, TLV4961 › Angle sensor: TLI5012B, TLE5009	› IRSM005-800MH › IRSM836-084MA

Security	Accessory authentication	Joystick	Interface protection diodes	LED drivers	MOSFET gate drivers	Dual n-channel power MOSFETs	Low voltage MOSFETs
› OPTIGA™ Trust E SLS32AIA › OPTIGA™ Trust P SLJ52ACA › OPTIGA™ TPM SLB96XX	› OPTIGA™ Trust SLS10ERE › OPTIGA™ Trust B SLE95250	› 3D magnetic sensor: TLV493D	› ESD102 series	› BCR450 › BCR321U › BCR421U	› 6EDL04N02PR › 2EDL05N06PF › IRS2005/7/8 › IRS2301 › IRS2136 › IRS21867 › IRS2334	› IR3742, etc. › BSC0925ND, etc.	› OptiMOS™ 5 series › StrongIRFET™ series

Charger			Battery management		
High voltage MOSFETs	Low voltage MOSFETs	Stand alone PWM controllers	Authentication ICs	Cell balancing	Low voltage MOSFETs
› 600 V–650 V CoolMOS™ CE › 600 V CoolMOS™ P7 (standard grade)	› OptiMOS™ 5 40 V–80 V in TO-220, SuperSO8 › StrongIRFET™ 40 V–75 V	› ICE2QS03G	› OPTIGA™ Trust B SLE95250	› OptiMOS™ 30 V in SSO8, S308, DirectFET™ › StrongIRFET™ 30 V	› OptiMOS™ 5 in SuperSO8, S3O8, DirectFET™ › StrongIRFET™ 40 V-80 V › OptiMOS™ LinearFET

Gimbal control							
Microcontrollers	Angle sensors	LDO	CAN transceivers	Silicon microphones	Low voltage MOSFETs	Dual n-channel power MOSFETs	MOSFET gate drivers
› XMC1400 family	› TLI5012B › TLE5009	› IFX1117ME › IFX54441EJV › IFX1763XEJV33	› HS CAN IFX1050G › IFX1050GVIO	› XENSIV™ IM69D family	› OptiMOS™ 5 25 V-30 V › StrongIRFET™ 25 V–30 V › P-channel MOSFETs	› IRFHM8363TRPBF etc.	› 6EDL04N02PR › 2EDL05N06PF › IRS2005/7/8 › IRS2301 › IRS2136 › IRS21867 › IRS2334

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

Block diagram: TLE987x embedded power IC – cost and space efficient automotive solution
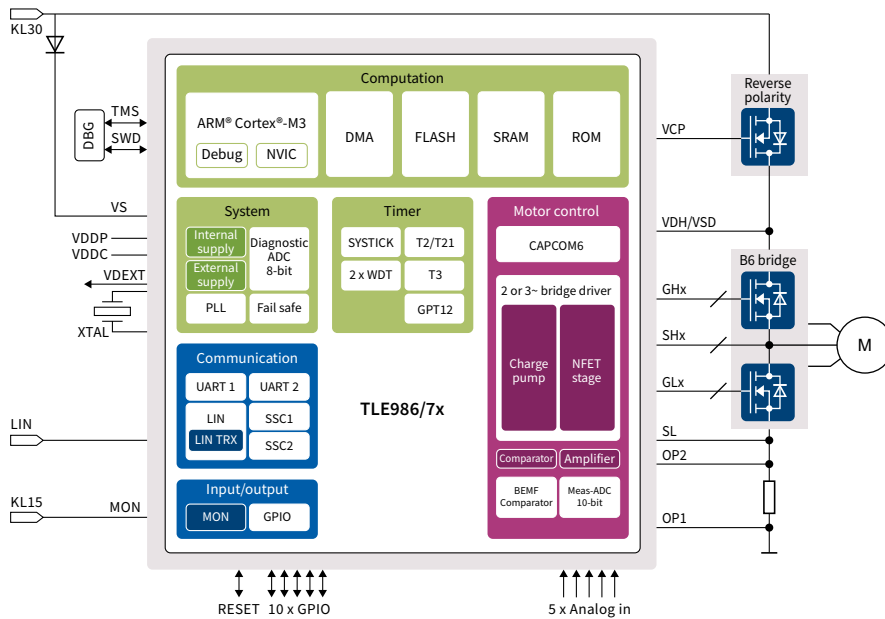
The TLE987x is a single chip 3-phase motor driver that integrates the industry standard ARM® Cortex®-M3 core, six fully integrated n-channel MOSFET drivers, optimized to drive a 3-phase motor via six external power n-channel MOSFETs, a charge pump enabling low voltage operation and programmable current along with current slope control for optimized EMC behavior. Its peripheral set includes a current sense amplifier, a successive approximation ADC synchronized with the capture and compare unit for PWM control and 16-bit timers. Also integrated is a LIN transceiver to enable communication and an on-chip linear voltage regulator to supply external loads.

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Block diagram: Position2Go

New demoboard available – 24GHz radar solutions bring innovation
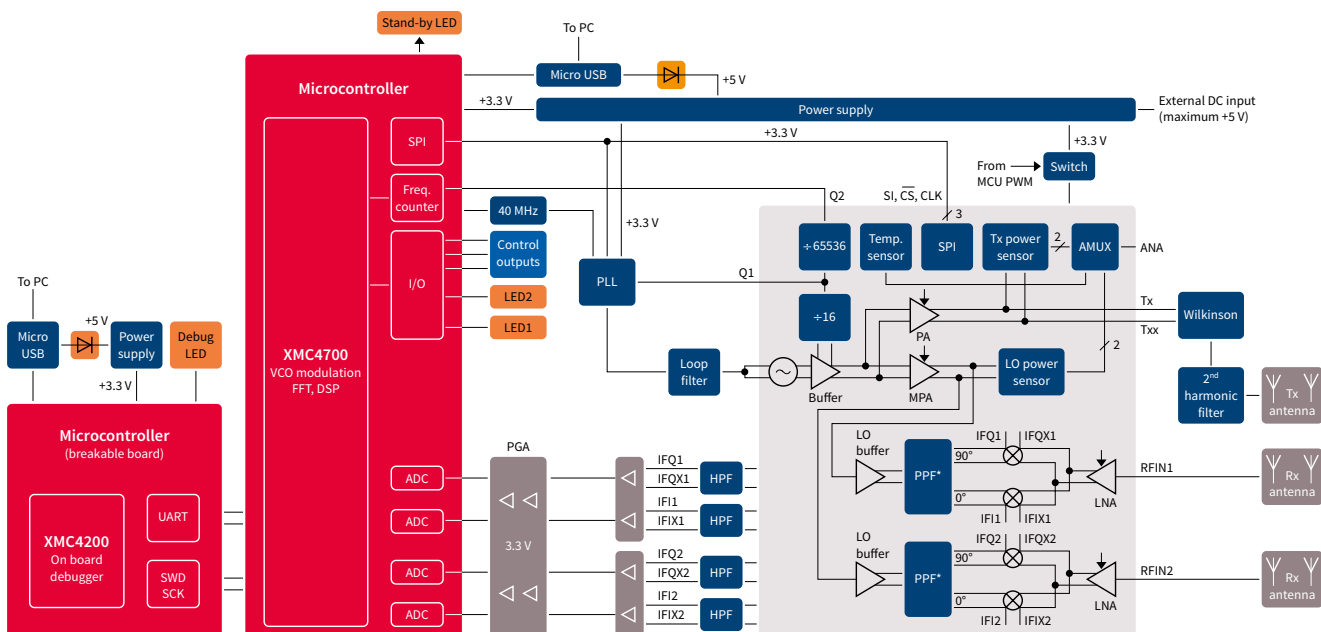
Infineon radar demo board based on the BGT24MTR12– FMCW and Doppler (position of object with distance and angle; speed and direction of movement detection)

› BGT24MTR12
› XMC4700

This development kit allows the user to implement and test several sensing applications at the 24 GHz ISM band such as FMCW distance measurement including angle detection; doppler based movement detection including angle, doppler based direction of movement detection, and doppler based speed measurements of targets.

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SMPS

OPTIGA™ Trust product family
Enabling secured communication for IoT

An increasingly connected world enables 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 systems 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 IoT 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 needs 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, these can be 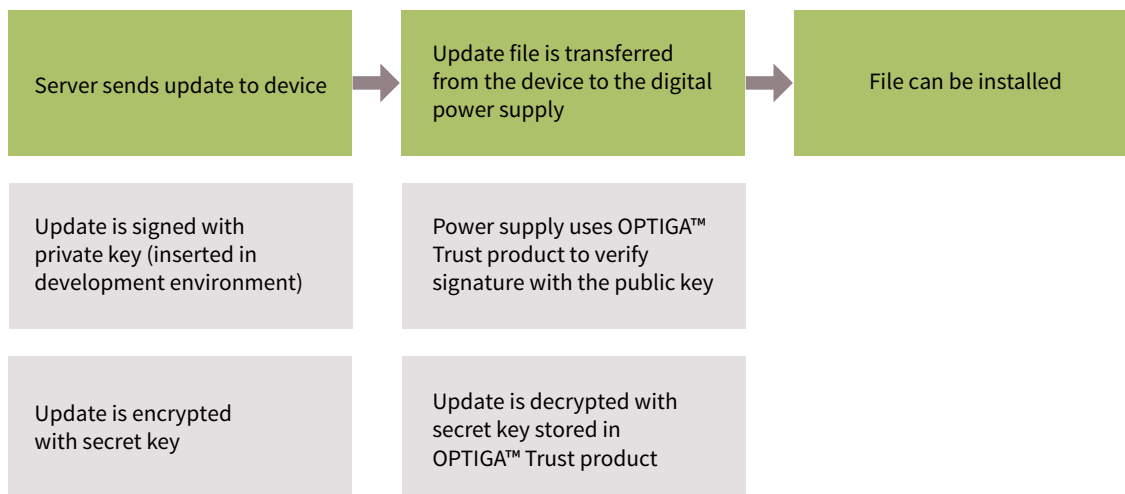sent with a cryptographic signature as encrypted files allowing the receiving system to verify and decrypt the update before installing it. With Infineon's OPTIGA™ Trust product family, the keys used for the signature and encryption are stored in the hardware-based OPTIGA™ security solution, therefore cannot be easily read out or altered.

Application flow for secure software update

Server sends update to device	Update file is transferred from the device to the digital power supply	File can be installed
Update is signed with private key (inserted in development environment)	Power supply uses OPTIGA™ Trust product to verify signature with the public key	
Update is encrypted with secret key	Update is decrypted with secret key stored in OPTIGA™ Trust product	

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

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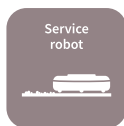
Robotics

Superior solutions for industrial and service robotics

The robotic revolution has started as 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 as 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
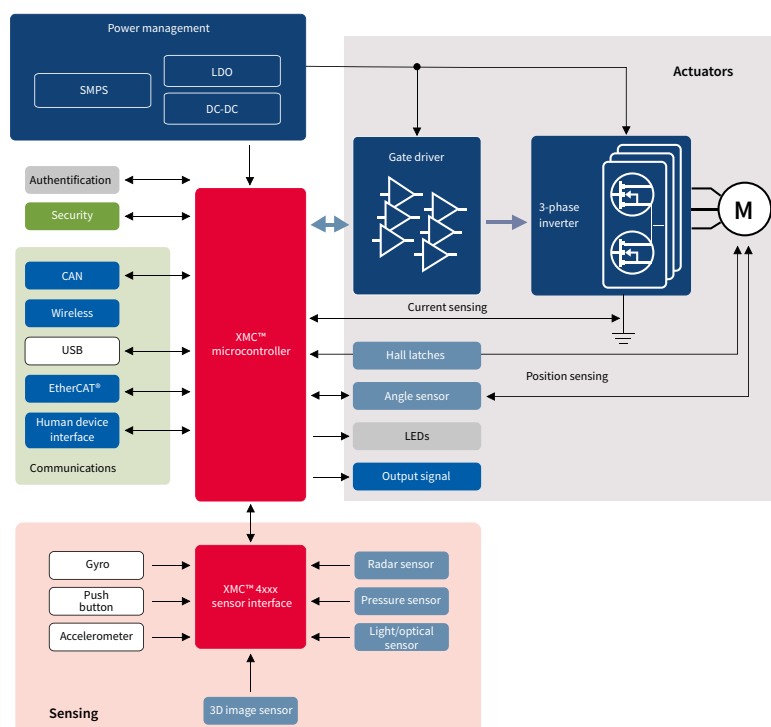
www.infineon.com/industrial-robotics
www.infineon.com/service-robotics

Service robotics – powerful and quiet solutions

Service robotics is another fast growing segment with a 15 percent CAGR within the next 5 years. The key applications are electric vacuum cleaners and lawn mowers. High performance Infineon components such as low $R_{DS(on)}$ MOSFETs, powerful microcontrollers and sensors enable high power density, weight reduction and quietness.

Block diagram – service robotics

AC	→	**Driver** CoolMOS™ CoolSET™ Low side drivers

Battery management

CoolMOS™	OptiMOS™	CoolSET™	XMC™	LDO and DCDC regulators

Battery

Microcontroller
XMC1000
iMOTION™

Gate driver ICs
EiceDRIVER™

Power stage
StrongIRFET™
OptiMOS™
Small Signal MOSFET
Power p-channel MOSFET

Stepper motor
M

Sensors

Current sense

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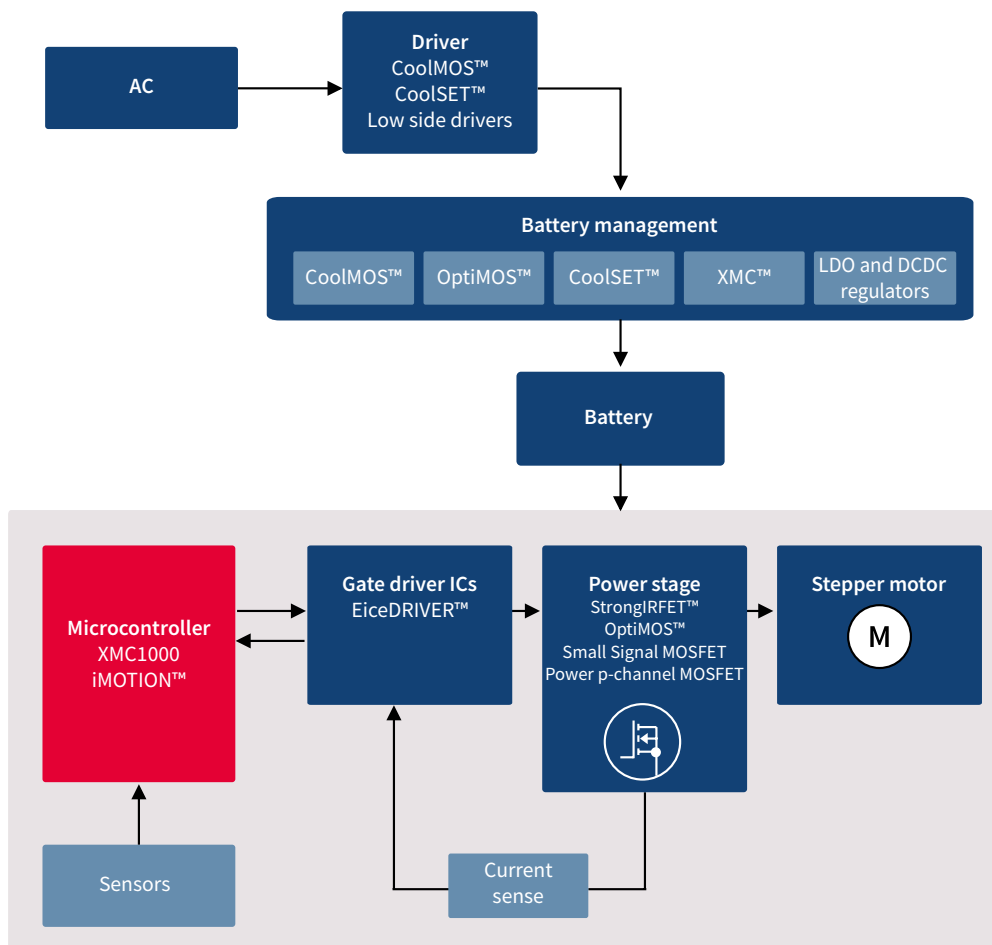
Infineon's product recommendation for robotics

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	Energy efficiency
	LDOs	Small system design
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
	TLE50XX angle sensors – rotor position sensing (FOC, sinusoidal)	Highest accuracy, dual die concept – redundancy in signal generation fulfilling highest safety standards
	TLE496X Hall latches – rotor position sensing (BLDC, prediction for sinusoidal)	Small system design
	TLE499X 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	Highly reliable and robust communication
	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

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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 recently released P7 series, which combine high efficiency and optimized cost with ease-of-use. Infineon developed a family of packages, characterized by having a short lead, IPAK Short Lead with ISO-Standoff and wide creepage that enable our customers cheap and reliable manufacturing specifically for adapters. High power density at low manufacturing cost can be delivered using Infineon's SOT-223 cost effective package which enables SMT manufacturing, while 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.
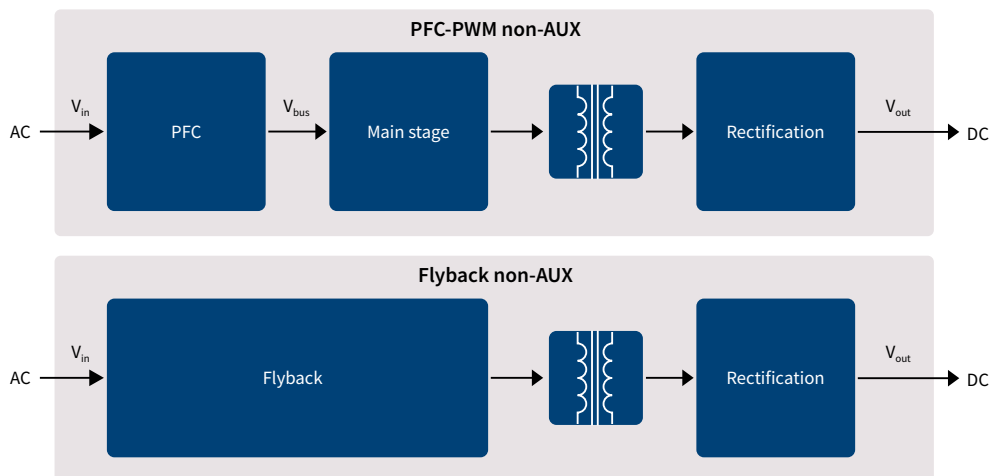
Regional regulations and a general increased sensitivity toward the containment of electronic waste are pointing toward the adoption of universal adapters. The implementations, methodologies and protocols are not yet harmonized, however Infineon is already closely monitoring and partnering with the decision 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	600 V/650 V/700 V/800 V CoolMOS™ CE	› Easy control of switching behavior due to higher $R_{G,int}$ › Better transition losses versus standard MOSFET
	Low voltage MOSFETs	Flyback/auxiliary synchronous rectification	OptiMOS™ 100 V-150 V	› Low conduction losses and reduced overshoot › Logic level can support low voltage gate drive to achieve high efficiency
	Control ICs	QR flyback IC	ICE2QS03G, ICE5QSAG	› High efficiency and low standby power
		FFR flyback IC	IDP2105	› High power density and digital control
PFC	High voltage MOSFETs	DCM PFC	600 V CoolMOS™ P7	› Fast switching speed for improved efficiency › 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
		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 power factor and low THD
Main stage	High voltage MOSFETs	HB LLC	600 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
			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	OptiMOS™ 5 100 V-150 V	› Low conduction losses, reduced overshoot › Logic level switching
	Control ICs	Synchronous rectification	IR1161LTRPBF	› High efficiency › Simple external circuitry

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Block diagram

PFC-PWM non-AUX

AC → V_{in} → PFC → V_{bus} → Main stage → ⧈ → Rectification → V_{out} → DC

Flyback non-AUX

AC → V_{in} → Flyback → ⧈ → Rectification → V_{out} → DC

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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.

To address these requirements, Infineon offers its new CoolMOS™ P7 SJ 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	700 V CoolMOS™ P7 (standard grade)	› Best price competitive CoolMOS™ SJ MOSFET family › Lower switching losses versus standard MOSFET
	Control ICs	QR flyback	ICE5QSAG , ICE5QSAG	› High efficiency and low standby power
		FFR flyback IC	IDP2105	› High power density and ideal for USB-PD
Synchronous rectification	Low voltage MOSFETs	Synchronous rectification	40 V-120 V OptiMOS™ 5 Logic Level	› Low conduction losses and reduced overshoot › Logic level switching › S308/PQFN 3.3x3.3 package available
	Control ICs	Synchronous rectification	IR1161LTRPBF	› High efficiency › Simple external circuitry

Block diagram

www.infineon.com/smps
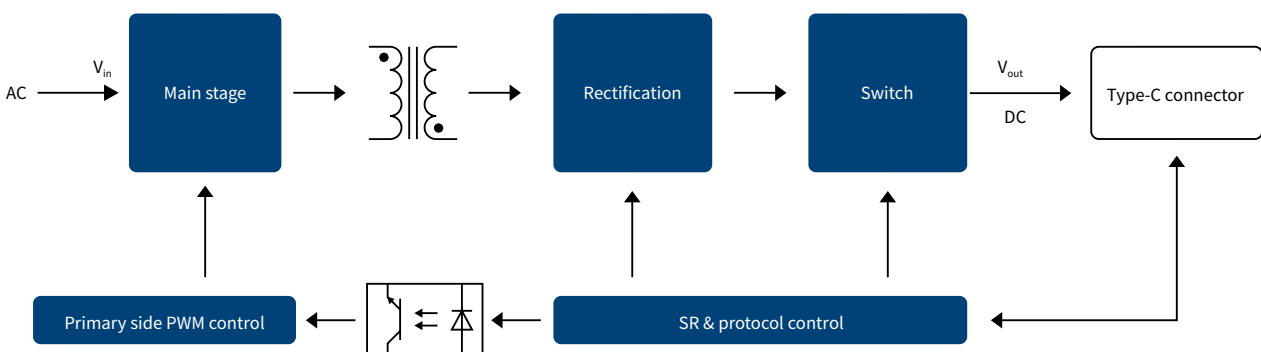
SMPS
More efficient PC power supply

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 having a 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 a 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 approximately 30 to 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, which means R&D engineers can key in the parameters on the 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 THD 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 and low THD
Main stage	Control ICs	HB LLC IC	650 V – ICE1HS01G-1/ ICE2HS01G	› High efficiency and low EMI
Synchronous rectification	Mid. voltage diodes	HB LLC + center-tap	OptiMOS™ 40 V	› Optimized cost/performance and low thermal
			OptiMOS™ 60 V	› Layout tolerance and low thermals

Block diagram

PFC-PWM with AUX and ICs

AC → V_{in} → PFC → V_{bus} → Main stage → [transformer] → Rectification → V_{out} → DC

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LCD TV
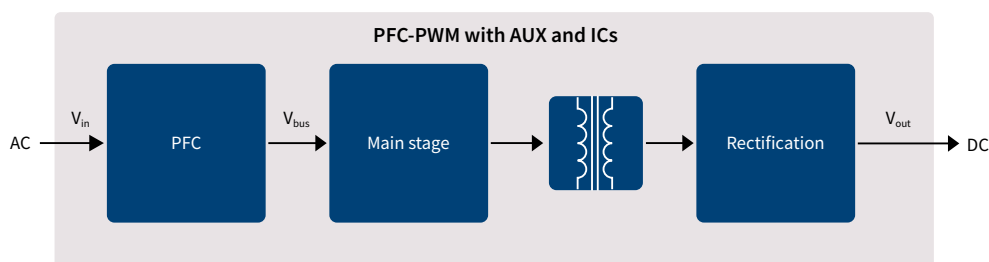
SMPS
TV power supply with lowest power consumption

In addition to their outstanding image quality, new generation TVs gain attention for their user interface, low power consumption and for their slim silhouette. This requires the power supply unit (PSU) to either keep a low profile to maintain the TV's slim appearance and a low thermal dissipation image or to have 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 of that, 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, SOT-223 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 combo non-AUX	High voltage MOSFETs	DCM PFC, HB LLC	600 V CoolMOS™ P7	› Fast switching speed for improved efficiency › 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 CoolMOS™ CE	› Easy control of switching behavior even in non-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 digital 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 digital 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 diode	› Low conduction losses
	Control ICs	CCM PFC IC	ICE3PCS0xG	› High PFC and low THD
Main stage	Control ICs	HB LLC IC	ICE1HS01G-1/ICE2HS01G	› High efficiency and low EMI
Auxiliary power supply	Control ICs	QR/FF flyback CoolSET™	700 V/800 V – 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	700 V CoolMOS™ P7	› Optimized for flyback topologies › Best price competitive CoolMOS™ SJ MOSFET family › Lower switching losses versus standard MOSFET › Controlled dV/dt and di/dt for better EMI

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Non-AUX digital solution for large screen size

```
AC input → PFC → LLC MOS → [transformer] → Rectification → DC output
                ↑          ↑
      PFC + PWM (digital combi) ← [optocoupler] ←
```
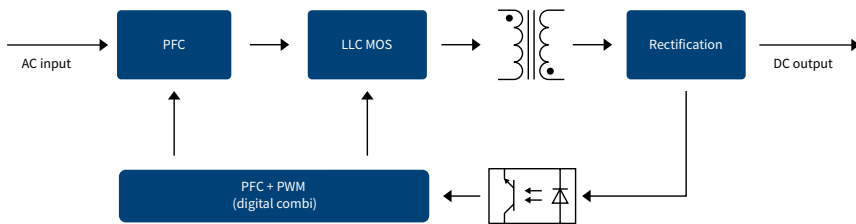
High power solution for larger screen size

```
AC input → PFC → LLC MOS → [transformer] → Rectification → DC output
              ↑          ↑
   CCM PFC controller   LLC controller ← [optocoupler] ←
              ↑          ↑
           AUX/standby →
```
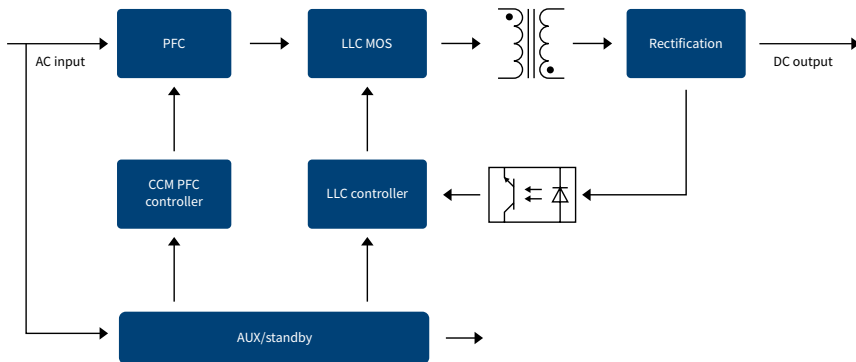
Flyback solution for small screen size

```
AC input → HV MOS → [transformer] → Rectification → DC output
              ↑
            PWM ← [optocoupler] ←
```

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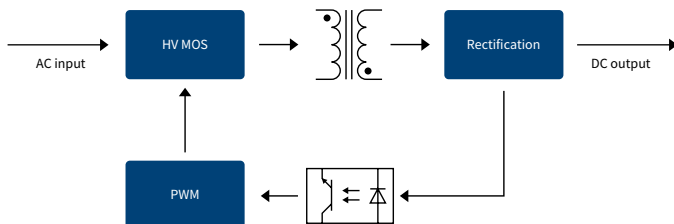
SMPS

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 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	Benefits
Auxiliary power supply	Control ICs	QR/FF flyback CoolSET™	700 V/800 V ICE5QRxx70/80A(Z)(G)	› Low standby power, high efficiency and robustness
Flyback	Control ICs	QR flyback	ICE5QSAG	› High efficiency and 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

Flyback non-AUX

V_{in}

AC → Flyback → ⧖ → Rectification → V_{out} → DC

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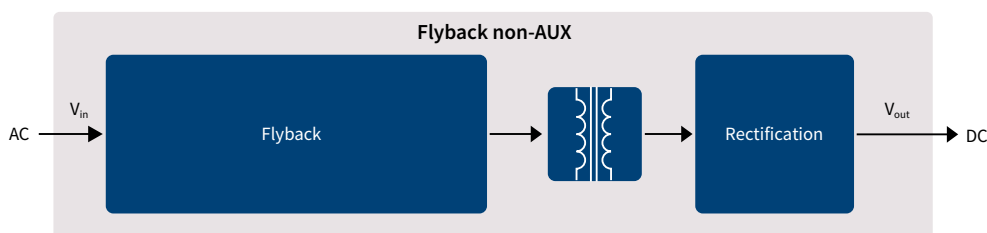
SMPS

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™ Schottky 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	Benefits
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 and 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 and 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 and wide family
Conversion	Microcontrollers	-	XMC4xxx	› Flexibility, HR PWM and digital communication
PFC, PWM/resonant converter, synchronous rectification	Gate driver ICs	-	1EDix EiceDRIVER™	› 100 ns typ. propagation delay time › Functional isolation › Separate source
		-	2EDNx EiceDRIVER™	› 8 V UVLO option › -10 V input robustness › Output robust against reverse current

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SMPS
Full system solution for telecom power supply

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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 CoolSiC™ (Silicon Carbide) diodes. Infineon's high voltage offerings are complemented by the newly introduced high voltage GaN switches named CoolGaN™, enabling highest electrical conversion efficiency at attractive system cost. 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

Functional block	Product category	Topology	Product family	Benefits
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
	High voltage GaN	PFC, totem pole full-bridge	600 V CoolGaN™	› Switching at high frequencies (> Si) › Enables high power desnity
	SiC diodes	CCM/interleaved PFC	650 V CoolSiC™ Schottky diode generation 6	› Low FOM V_F*Q_C
	Control ICs	CCM PFC IC	800 V – ICE3PCS0xG	› High PFC and low THD
DC-DC 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	600 V CoolMOS™ CFD7	› Best-in-class Qrr and t_{rr} level › Significant reduced Q_g › Improved efficiency over previous CoolMOS™ fast body diode series
	Control ICs	HB LLC IC	ICE1HS01G-1 ICE2HS01G	› High efficiency and low EMI
Synchronous rectification	Low voltage MOSFETs	Synchronous rectification MOSFET	OptiMOS™ 80 V-100 V	› 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	5th generation QR/FF flyback CoolSET™	QR 800 V - ICE5QRxx80Ax FF 800 V - ICE5xRxx80AG	› Quasi-resonant switching operation for high efficiency and low EMI signature › Fixed frequency switching operation for ease-of-design – 100 KHz and 125 KHz › Fast and robust start-up with cascode configuration › Robust protection with adjustable line input over-voltage protection, V_{cc} and CS pin short-to-ground protection › Optimized light-load efficiency with selectable burst mode entry/exit profile › Frequency reduction for mid and light load condition to reduce switching losses and increase efficiency › Direct feedback and regulation with integrated error amplifier for non-isolated output › High power delivery of up to 42 W with 800 V heatsink-less SMD package CoolSET™
Housekeeping	Microcontrollers	-	XMC1xxx	› Flexibility, HR PWM, digital communication › ARM® based standard MCU family and wide family
Conversion	Microcontrollers	-	XMC4xxx	› Flexibility, HR PWM, digital communication › ARM® based standard MCU family and wide family
PFC, PWM/resonant converter, synchronous rectification	Gate driver ICs	Single channel non-isolated	1EDN751x EiceDRIVER™	› 8 V UVLO option › (-)10 V input robustness › Output robust against reverse current
		Single channel non-isolated	1EDN7550 EiceDRIVER™	› 8 V UVLO option › (-)10 V input robustness › True differential inputs for >100 VAC ground shift robustness
		Dual channel non-isolated	2EDN7x EiceDRIVER™	› 8 V UVLO option › (-)10 V input robustness › Output robust against reverse current
		Dual channel junction isolated	2EDL811x EiceDRIVER™ (Expected Q2 2018)	› 20 ns typ. propagation delay time › 20V bootstrap capability on high side › (-)7 V input robustness
		Single channel isolated	1EDi Compact EiceDRIVER™	› 100 ns typ. propagation delay time › Functional isolation 1.2 kV Separate source and sync outputs
		Dual channel isolated	2EDFx EiceDRIVER™	› 35 ns typ. propagation delay time › Functional isolation 1.5 kVCMTI > 150 V/ns
		Dual channel isolated	2EDSx EiceDRIVER™	› 35 ns typ. propagation delay time › Reinforced (safe) isolation 6 kV CMTI > 150 V/ns
Or-ing	Low voltage MOSFETs	Or-ing MOSFET	OptiMOS™ 60 V-200 V	› 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	OptiMOS™ 60 V-150 V	
Isolated DC-DC	Low voltage MOSFETs	Primary side PWM MOSFET	OptiMOS™ 60 V-200 V	› Industry's lowest $R_{DS(on)}$ › Highest system efficiency and power density › Outstanding quality and reliability › Reduces the need for a snubber circuit
			StrongIRFET™ 60 V-200 V	
			Small Signal 60 V-200 V	
		Synchronous rectification MOSFET	OptiMOS™ 40 V-100 V	
			StrongIRFET™ 40 V-100 V	
		Or-ing MOSFET	OptiMOS™ 25 V-30 V	
			StrongIRFET™ 25 V-30 V	
Non-isolated POL buck	For more detailed information see chapters DC-DC multiphase enterprise power solution for data processing applications (page 20) and non-isolated DC-DC (page 166)			

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SMPS
Power supplies for off-board DC EV charging stations

EV-Charging

What speaks for off-board DC EV charging?

With the growing number of electric vehicles (EVs), now in some markets viable alternatives to traditional internal combustion engine vehicles, the demand for enhanced power supplies for charging stations increases, too. Currently, all eyes are on China where EVs have gained traction in the rapidly expanding middle class. And also the United States is expected to follow suit soon. However, to truly welcome EVs on a large scale these markets need to provide wide-spread availability of DC charging infrastructure so that drivers can quickly charge their vehicles. DC charging stations are an attractive choice because they offer much faster charging than a standard AC EV charging pile which many EV drivers have at home. Today a DC charging pile with e.g. 120 kW can charge around 80 percent of an EV's battery in just 30 minutes. As charging technologies improve the charging time will drop even further. Consequently, off-board charging is becoming more and more attractive.

Challenges on the horizon

Of course reaching the next level in designing DC EV charging power supplies confronts engineers with many new challenges. For a DC power supply design to be a long term success you must:

› Enhance output power to shorten the charging time
› Improve power density within the set dimensions of the charging station
› Increase efficiency by boosting the load and decreasing power dissipation
› Reduce design cost per watt

Overcoming all of the mentioned issues is possible – with the right partner.

Turn to Infineon for high efficiency and high power density

Off-board charging is becoming more attractive on the market:

AC charging ← ｜ → DC charging

On-board charger

Battery management system
Li-ion battery

DC fast charging station

Every vehicle needs to have its own on-board equipment

Infrastructure investment is shared with hundreds of users

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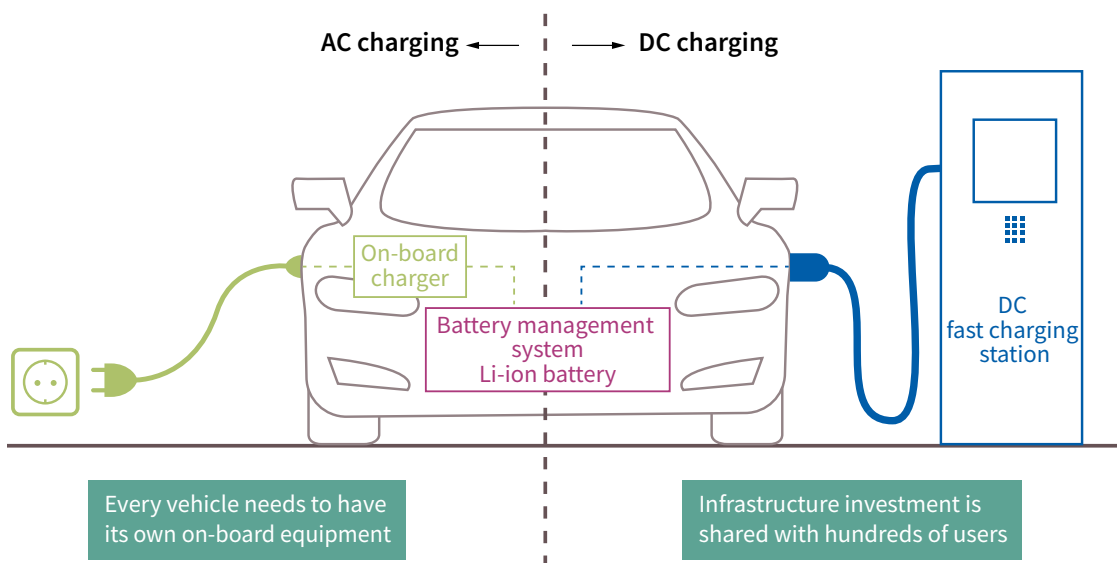
Block diagram: DC EV charging and internal power supply
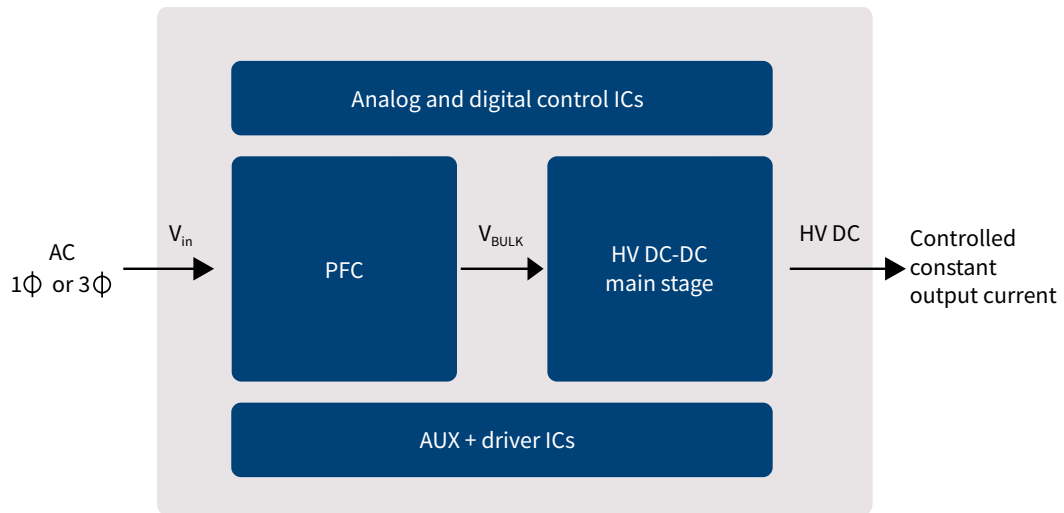
Functional block	Product category	Product family	Product	Additional information
PFC stage (3-phase input Vienna PFC stage)	High voltage MOSFETs	600 V CoolMOS™ P6	IPW60R041P6	600 V, 41 mΩ, TO-247
			IPW60R070P6	600 V, 70 mΩ, TO-247
		650 V CoolMOS™C7	IPW65R019C7	650 V, 19 mΩ, TO-247
		600 V CoolMOS™ C7	IPW60R017C7	600 V, 17 mΩ, TO-247
		600 V CoolMOS™ P7	IPW60R037P7 IPW60R060P7	600 V, 37 mΩ, TO-247 600 V, 60 mΩ, TO-247
HV DC-DC main stage (Soft switching type full-bridge stage)	High voltage MOSFETs	650 V CoolMOS™ CFD2	IPW65R041CFD	650 V, 41 mΩ, TO-247
			IPW65R080CFD	650 V, 80 mΩ, TO-247
		600 V CoolMOS™ CFD7	IPW60R031CFD7	600 V, 31 mΩ, TO-247
			IPW60R040CFD7	600 V, 40 mΩ, TO-247
			IPW60R055CFD7	600 V, 55 mΩ, TO-247
Analog and digital control ICs	Microcontroller	XMC™	XMC1400 family (PFC stage)	ARM® Cortex® M0 based µC
			XMC4000 family (HV DC-DC/PWM stage)	ARM® Cortex® M4F based µC
AUX	AC-DC power conversion	CoolSET™ 5 QR/FF flyback	ICE5QR0680AG	800 V, 42 W, 0.8 mΩ, PG-DSO-12
			ICE5AR0680AG	800 V, 42 W, 0.8 mΩ, PG-DSO-12
Driver ICs (PFC and LLC)	Gate driver ICs for MOSFETs	EiceDRIVER™ 2EDN	2EDN7524F/R	2-channel low-side, non-isolated, 5 A
		EiceDRIVER™ 1EDN	1EDN7x	1-channel low side, non-isolated, 4 A source, 8 A sink
			1EDN7550x	1-channel low-side, non-isolated, true differential inputs
		EiceDRIVER™ 2EDFx	Upcoming	2-channel functional isolated (1.5 kV)
		EiceDRIVER™ 2EDSx	Upcoming	2-channel reinforced (safe) isolated (6 kV)

www.infineon.com/ev-charging

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.
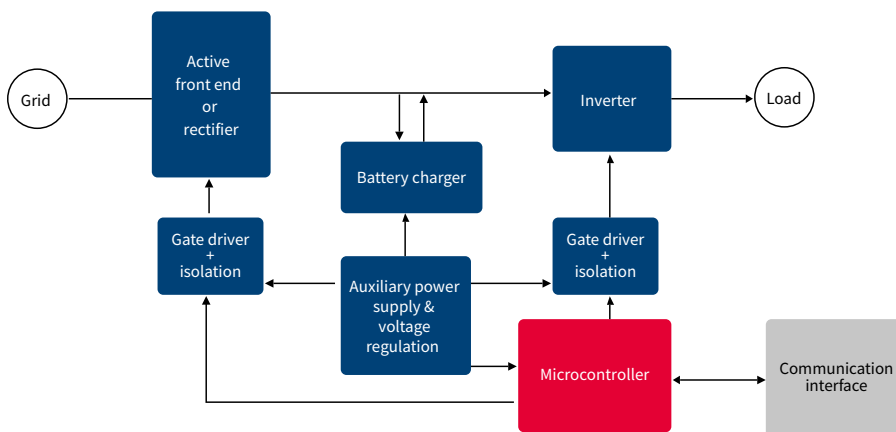
Stage	Topology	Voltage class	Technology	Selection/benefit
Rectifier	3-phase	800 V/1600 V	EasyBRIDGE, EconoBridge™	Recommendation
PFC	Boost PFC	1200 V	TRENCHSTOP™	Ease-of-use
	Boost PFC	1200 V	HighSpeed 3	Efficiency
	Boost PFC	650 V	TRENCHSTOP™ 5 H5	Efficiency
	Boost PFC	650 V	TRENCHSTOP™ 5 S5	Efficiency 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
Gate driver ICs	Single-channel	1200 V	EiceDRIVER™ 1ED Compact	Recommendation
AUX	-	650 V-800 V	CoolSET™	Recommendation

www.infineon.com/ups

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	CoolSiC™ Schottky diode G5/G6	CoolSiC™ Schottky diode G5/G6	CoolMOS™ C7, P7	CoolMOS™ CFD7, P7	CoolMOS™ CFD7, P7	CoolMOS™ CFD7	CoolMOS™ C7, P7
	Low-side	CoolMOS™ C7, P7	CoolMOS™ C7, P7	CoolMOS™ C7, P7	CoolMOS™ CFD7, P7	CoolMOS™ CFD7, P7	CoolMOS™ CFD7	CoolMOS™ C7, P7
Gate driver IC	High-side	n.a.	n.a.	2EDF* / 1EDI	IR(S)21834 IR(S)2183 IR(S)2184	2EDN[1] 1EDN[1] 2EDS*	2EDN[1] 1EDN[1] 2EDS*	2EDN[1] 1EDN[1] 2EDS*
	Low-side	2EDN 1EDN	2EDN 1EDN	2EDN 1EDN				

		EV charging			
		PFC			High voltage DC-DC
Functionality					
Topology		Interleaved boost PFC	Vienna PFC		Phase-shift ZVS full-bridge/LLC
Switching device	High-side	CoolSiC™ Schottky diode G5/G6	CoolMOS™ C7, P7		CoolMOS™ CFD7
	Low-side	CoolMOS™ C7	CoolMOS™ C7, P7		CoolMOS™ CFD7
Gate driver IC	High-side	n.a.	2EDF*	1EDI Compact	2EDN[1] 1EDN[1] 2EDS*
	Low-side	2EDN 1EDN		2EDN 1EDN	

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
* coming Q2/2018

General DC-DC supplies

Synchronous rectification table

	Synchronous rectification		
	Classic		Telco brick 48 V to 12 V
400 V DC-link	Center tapped	Full-bridge	Center tapped SR
Full-bridge			
CoolMOS™ C7[3], P7[4]	n.a.	OptiMOS™ 5	OptiMOS™ 3, 5
CoolMOS™ C7[3], P7[4]	OptiMOS™ 5	OptiMOS™ 5	OptiMOS™ 3, 5
2EDN[1] 1EDN[1] 2EDS*	n.a.	2EDL 2EDF*	n.a.
	2EDN 2 x 1EDN		2EDN

General DC-DC supplies table

General DC-DC supplies			
Without transformer		With transformer	
< 200 W		> 200 W	
Active clamp	Buck	Full-/half-bridge	Push-pull
OptiMOS™ 3, 5; StrongIRFET™			n.a.
OptiMOS™ 3, 5; StrongIRFET™			HEXFET™
n.a.	2EDL	2EDL	n.a.
2EDN 2 x 1EDN			2EDN 2 x 1EDN

Low voltage drives

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™ P7	n.a.
OptiMOS™ 3, 5; StrongIRFET™	OptiMOS™ 3, 5; StrongIRFET™		OptiMOS™ 3, 5; StrongIRFET™	CoolMOS™ P7	CoolMOS™ P7	OptiMOS™ 3, 5; StrongIRFET™
IRS2127(1)	IRS2127(1)	IRS2005 IRS21867 IRS2301 2EDL05N06PF	IRS2127(1)	n.a.	2EDN[1] 1EDN[1] 2EDS*	n.a.
2EDN 1EDN	2EDN 1EDN		2EDN 1EDN	2EDN 1EDN 2EDL05N06PF IRS2005 IRS21867		2EDN 1EDN

XENSIV™ sensors family overview
Inspiring the next step in smart and seamless connectivity

With a proven track record in IoT innovation, we continue to seamlessly and securely connect people and machines. Many IoT trends such as smart devices and wearables, electromobility and connected cars, smart factories and homes, energy intelligence are being driven by technologies that we develop, with our XENSIV™ sensors families being one of the key elements. Today, we are already inspiring the next generation of smart environments – capable of understanding and responding to human communication. Our semiconductors are at the very heart of machine-to-machine (M2M), human-machine interface (HMI), mobile and wireless infrastructure technologies. As the technological boundary between humans and machines gradually disappears, these devices need even more advanced intelligence, enriched with voice assistance capabilities and the latest sensor fusion innovations, not to mention robust security technologies to protect personal data. Sensors and microphones from Infineon are already delivering this intelligent functionality and inspiring the next step in mobile connectivity.
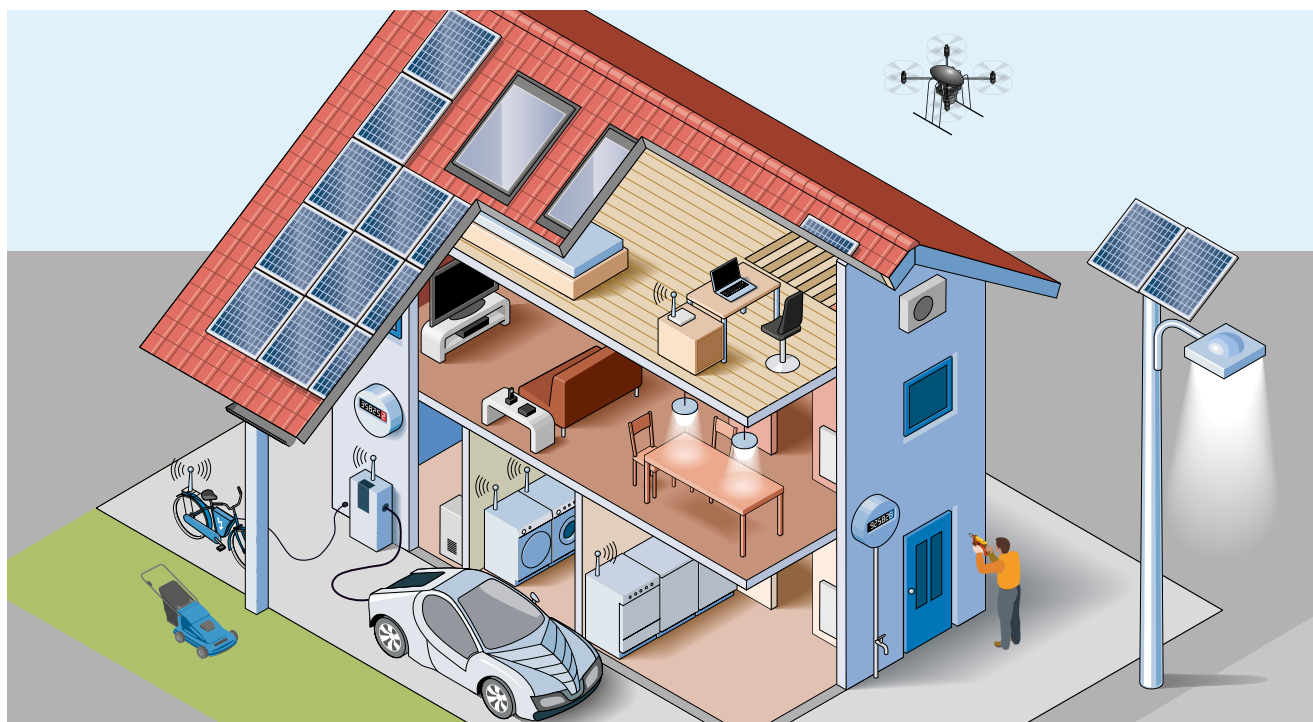
Our increasing range of XENSIV™ sensors families like XENSIV™ radar ICs, XENSIV™ MEMS microphones or environmental sensors as XENSIV™ barometric pressure sensors are beside various magnetic speed, hall and angle sensors supporting industrial and consumer as well as automotive applications.

For a detailed overview please refer to the sensor solution selection guide: www.infineon.com/sensors

www.infineon.com/24GHz
www.infineon.com/pressuresensor
www.infineon.com/microphones

Application overview

XENSIV™ radar ICs

› Presence detection in
lighting and security
› People Tracking and occupancy
detection in IOT/smart home
› Collision avoidance in
multicopter and robotics
› Vital sensing

XENSIV™ MEMS microphones

› Voice user interfaces
› Recording
› Active noise cancellation
› Predictive maintainance
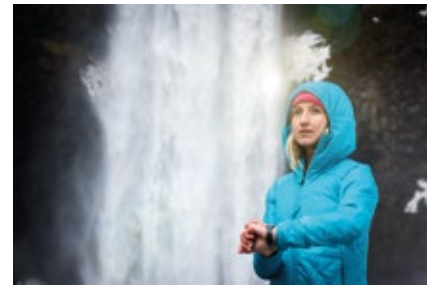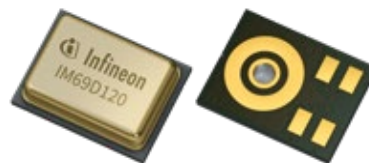
XENSIV™ barometric pressure sensors

› Altitude control
› indoor/outdoor navigation
› Multicopter: air flight control
› Motion, gesture recognition

www.infineon.com/24GHz
www.infineon.com/pressuresensor
www.infineon.com/microphones

Solar
High efficiency designs 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 CoolMOS™ SJ MOSFET, HighSpeed 3 and TRENCHSTOP™ 5, CoolSiC™ Schottky diodes, CoolSiC™ MOSFET, 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	Central inverter 500 kW-5000 kW
MOSFET	OptiMOS™ SuperSO8/DirectFET™ | 75 V-150 V	OptiMOS™ SuperSO8 | 60 V-200 V	OptiMOS™ 150 V-300 V	
		CoolMOS™ D²PAK/ThinPAK | 600 V-800 V	CoolMOS™ TO-247 | 600 V/650 V | 19 mΩ-99 mΩ	
			CoolSiC™ MOSFET TO-247-3/TO-247-4 | 1200 V	
SiC diode		CoolSiC™ Schottky diodes DPAK/TO-220 | 600 V/1200 V D²PAK | 650 V	CoolSiC™ Schottky diodes 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	Primepack; EconoDual3
Gate driver ICs		2EDN EiceDRIVER™	EiceDRIVER™ 1ED Compact EiceDRIVER™ Enhanced 1ED020I12-F2/2ED020I12-F2	EiceDRIVER™ 1ED Compact EiceDRIVER™ Enhanced 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	XMC1xxx ARM® Cortex®-M0
	XMC45xx ARM® Cortex®-M4	XMC45xx ARM® Cortex®-M4	XMC45xx ARM® Cortex®-M4	XMC45xx ARM® Cortex®-M4

Infineon leading products for complete solar system

www.infineon.com/solar
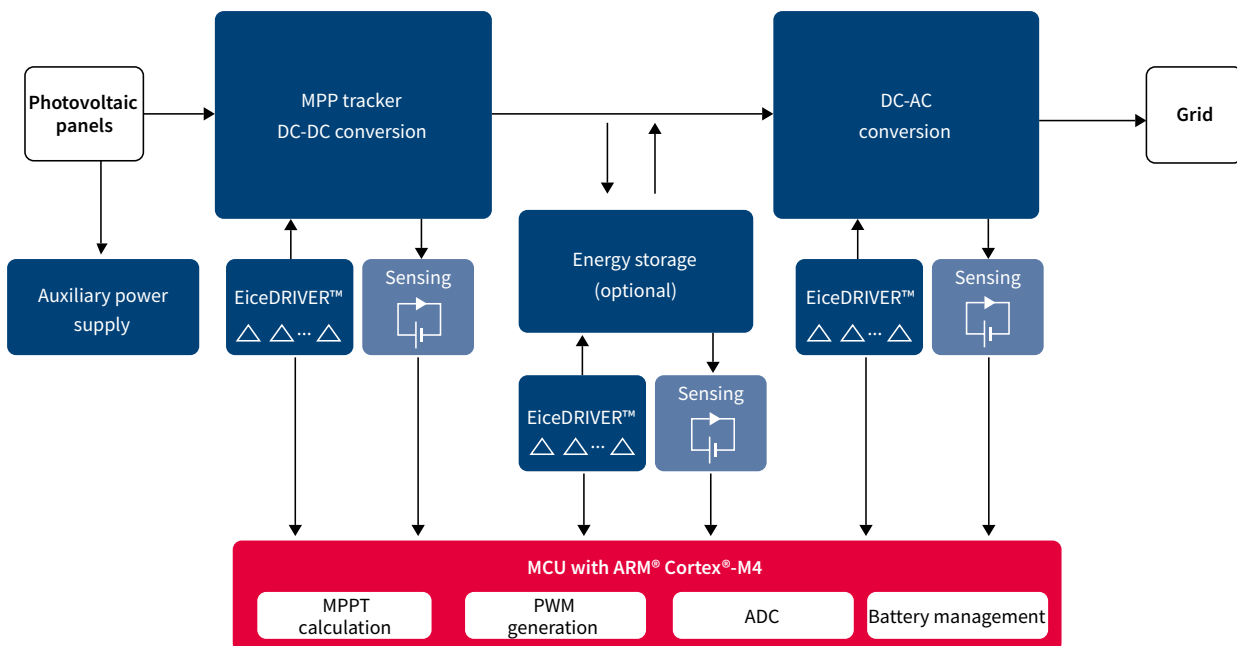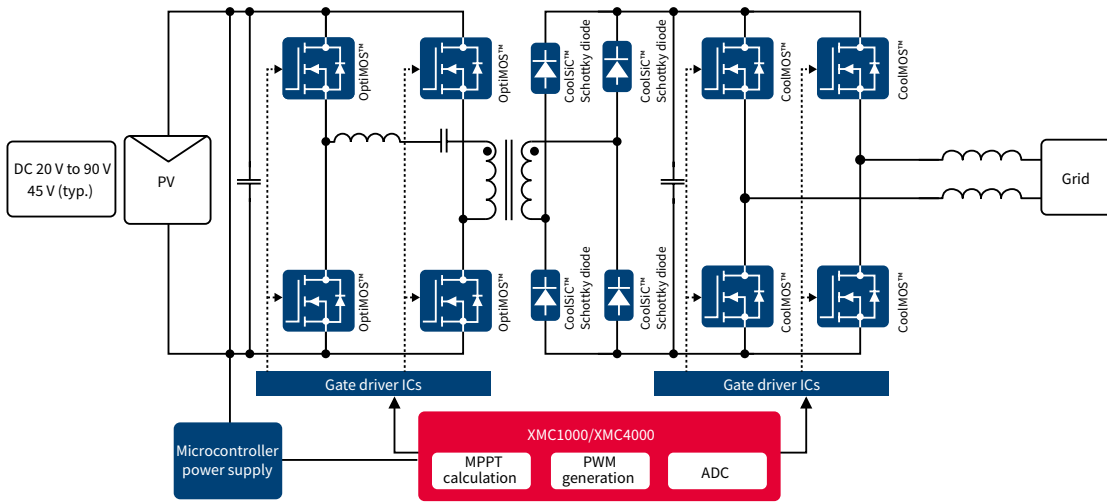
Microinverter

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	IPL60R185P7
			IPL60R125P7
			IPL60R105P7
			IPL60R085P7
			IPL60R065P7
			IPL60R185C7
			IPL60R125C7
			IPL60R104C7
			IPL60R065C7
		650 V	IPL65R195C7
			IPL65R130C7
			IPL65R099C7
			IPL65R070C7

CoolSiC™ Schottky diodes for microinverter

Topology	Package	Voltage class	Part number
Rectifier	TO-252 (DPAK)	1200 V	IDM02G120C5
			IDM05G120C5
			IDM08G120C5
		600 V	IDD05SG60C
	D²PAK	650 V	IDK04G65C5

Functional block	Product category	Product family	Benefits
PFC, PWM/ resonant converter, synchronous rectification	Gate driver ICs	1ED Compact EiceDRIVER™	› 100 ns typ. propagation delay time › Functional isolation › Separate source
		2EDNx EiceDRIVER™	› 8 V UVLO option › (-)10 V input robustness › 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

www.infineon.com/solar
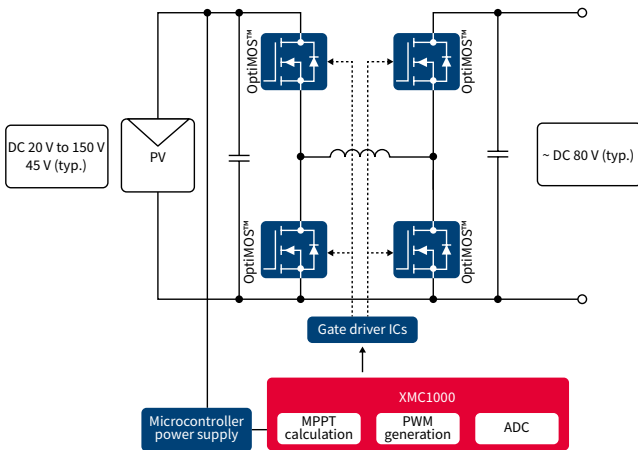
Optimizer

OptiMOS™ MOSFETs for optimizer DC-DC power conversion

Input voltage	Topology	MOSFET breakdown voltage	SuperSO8	S308/PQFN 3.3 x 3.3	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

Single-phase string inverter (non-isolated) – standard solution
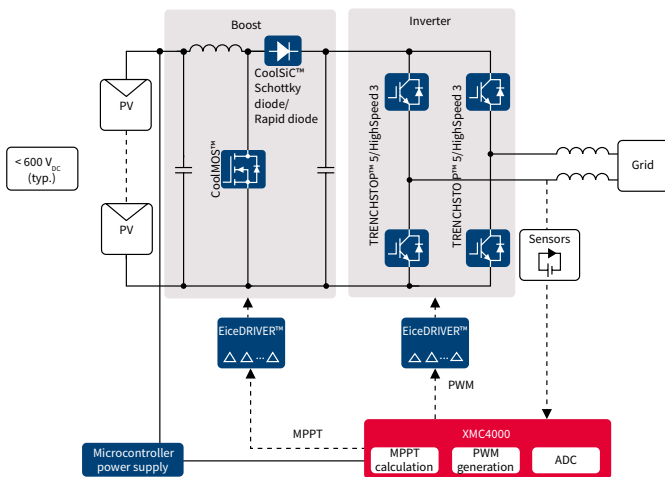
Modules for string inverter

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)	

EiceDRIVER™ for string inverter

EiceDRIVER™ 1EDN/2EDN
› 8 V UVLO option
› (-)10 V input robustness
› Output robust against reverse current

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Single-phase string inverter – multilevel topology
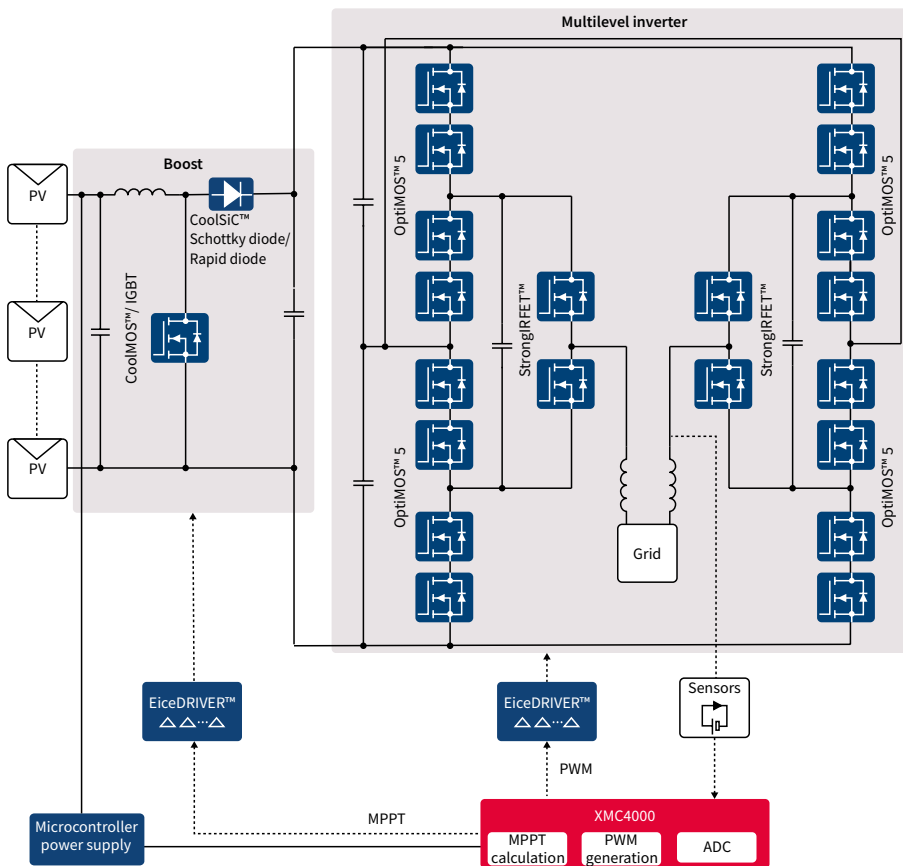
With multilevel inverter four high voltage MOSFETs/IGBTs in H-bridge topology will be replaced with a higher number of lower voltage MOSFETs. Compared to a conventional H-bridge inverter a multilevel inverter, built by lower voltage MOSFETs, offers several advantages:

› With much lower $R_{DS(on)}$ and switching loss parameters, it will significantly reduce conduction and switching losses
› Higher effective output frequency (smaller magnetics) is possible with lower switching losses
› Improved EMC due to reduced switching voltages
› Significant reduction in cooling system, size and weight

Discrete power devices for multilevel string inverter

Topology	MOSFET breakdown voltage [V]	Family	SuperS08	D²PAK	TO-220	TO-247
Three-level PWM floating H-bridge inverter	150	OptiMOS™ 5	BSC093N15NS5 BSC110N15NS5 BSC160N15NS5	IPB044N15N5 IPB048N15N5 IPB060N15N5 IPB073N15N5	IPP051N15N5 IPP076N15N5	–
Three-level PWM floating H-bridge inverter	200, 250, 300	StrongIRFET™	–	–	–	IRF200P222 IRF200P223 IRF250P224 IRF250P225 IRF300P226 IRF300P227

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String inverter (three-phase)

Discrete power devices 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™ P7	IPW60R037P7	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™ P7	IPW60R037P7	600 V
Three-phase	Boost	HighSpeed 3	IKW40N120H3	1200 V
		CoolSiC™ diode	IDW20G120C5B IDW30G120C5B IDW40G120C5B	1200 V
		TRENCHSTOP™ 5 S5	IKW40N65ES5	650 V
		TRENCHSTOP™ 5 L5	IKW30N65EL5	650 V
	Inverter	HighSpeed 3	IKW40N120H3	1200 V
		CoolSiC™ MOSFET	IMW120R045M1 IMZ120R045M1	1200 V

Gate driver ICs for string inverter

Power device	Driving method	Voltage class	Part number
IGBT/SiC MOSFET	Single channel	1200 V	EiceDRIVER™ 1ED Compact EiceDRIVER™ Enhanced 1ED020I12-F2/ 2ED020I12-F2
IGBT/SiC MOSFET	Half-bridge & high- and low-side	1200 V	EiceDRIVER™ Enhanced 2ED020I12-F2/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

For Infineon's extensive module portfolio for string and central inverters, visit:

www.infineon.com/solar

www.infineon.com/igbtmodules1200v

Wireless charging solutions
Highest efficiency for the next level of charging

Over the last years, wireless charging has gained more and more traction in the market and is expected to heavily influence our daily lives in future. Infineon offers a broad portfolio of efficient, high quality products and solutions to serve the key requirements of the dominant market standards: inductive (Qi (WPC)) and resonant (AirFuel). Whether you charge a smartphone (e.g. at home or in the car), a handful of wearables, a power tool, a laptop or a service robot, Infineon's components and solutions help you overcome a wide range of common wireless power transfer challenges for consumer, industrial and automotive wireless charging designs.

Many end markets for wireless battery charging

| Mobile phone | Wearables | Notebook | Tablet | Power Tools | Multicopter | Service robot | Electric Toys | Medical |

Key enabling products for transmitter and adapter

› Low and mid voltage power MOSFETs – OptiMOS™ and StrongIRFET™

› Gate driver ICs – EiceDRIVER™ or OptiMOS™ driver

› Microcontrollers – 32-bit ARM® Cortex®-M XMC™

› P-channel and n-channel Small Signal power MOSFETs

› High voltage power MOSFETs – CoolMOS™

› PWM/flyback controllers and integrated power stage ICs – CoolSET™

› Synchronous rectification ICs and MOSFETs – OptiMOS™

› Gallium Nitride (GaN)- GaN e-mode HEMTs (600 V already available)

System diagram: inductive wireless charging
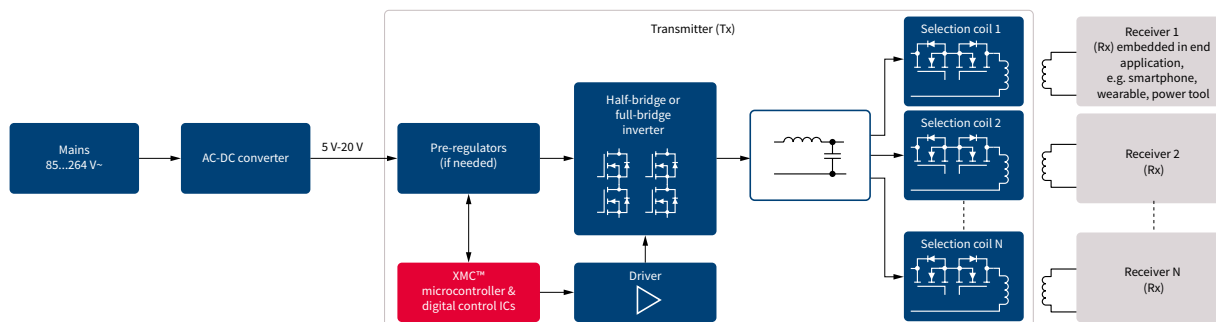
System diagram: resonant wireless charging – class D, full-bridge
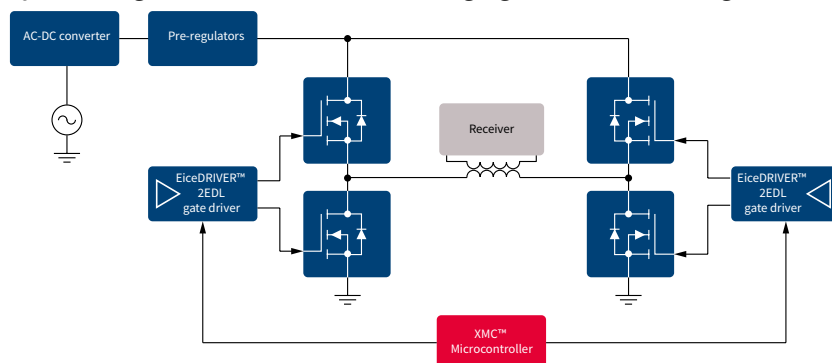
Make use of our evaluation boards for low cost charger and adapter applications (see pages 40 and 42).

www.infineon.com/wirelesscharging

Components for inductive (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 2 x 2 mm packages ready to use. In addition, Infineon's XMC™ 32-bit industrial microcontrollers provide the flexibility to charge "just about anything". Our portfolio supports individual needs by either an ARM® Cortex®-M0 core (XMC1000 family) or a Cortex®-M4 core with a floating point unit (XMC4000 family). We also develop solutions, including software, for selected applications (please check on page 236 for further details).

Inductive (Qi) and low frequency transmitter solutions

Sub-application	Voltage class	Package	Part number	$R_{DS(on)}$ max @ V_{GS} = 4.5 V [mΩ]	Recommendation
Inverter MOSFETs	30 V	Super SO8	BSC0996NS	11.8	Right fit
			BSC0993ND	7	Best performance
		PQFN 3.3 x 3.3	BSZ0589NS	4.4	Best performance
			BSZ0994NS	8.6	Right fit
			BSZ0909NS	15	Right fit
		PQFN 3.3 x 3.3 Dual	BSZ0909ND	25	Best performance
			BSZ0910ND	13	Best performance
		PQFN 2 x 2	IRFHS8342PbF	25	Right fit
			IRLHS6342PbF	15.5	Best performance
Coil selection switch	20 V	PQFN 2 x 2	IRLHS6242PbF	11.7 (=2.5 V drive capable)	Right fit
	25 V				
			IRFHS8242PbF	21	Right fit
	30 V		IRFHS8342PbF	25	Right fit
			IRLHS6342PbF	15.5 (=2.5 V drive capable)	Right fit
		PQFN 3.3 x 3.3	BSZ0994NS	8.6	Best performance
			BSZ0909NS	15	Right fit
Driver IC	PX3517, PX3519 or AURIS2301S				
Microcontroller	XMC1302, XMC14xx, XMC4108 (Software available for selected applications, please check for details on the web)				

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 enabling you to achieve 6.78 MHz inverter designs using robust silicon MOSFET technology. There are even more targeted products in the pipeline and Infineon will soon bring its own GaN technology to 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 very 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. Here again, the XMC™ 32-bit industrial microcontrollers are a great fit to charge "just about anything".

www.infineon.com/wirelesscharging

Transmitter components for A4WP and high switching frequency

Sub-application	Voltage class	Package	Part number	$R_{DS(on)}$ max @ V_{GS} = 4.5 V [mΩ]	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	25	1.8	120	Class D
			BSZ0910ND	13	5.6	230	Class D
		SOT 23	IRLML0030pbf	33	2.75	84	Class D
	40 V	SOT 23	IRLML0040pbf	62	2.8	49	Class D
	60 V	SOT 23	IRLML0060pbf	98	2.6	37	Class D
	80 V	PQFN 2 x 2	IRL80HS120	32	3.5	68	Class D/E
	100 V	PQFN 2 x 2	IRL100HS121	42	2.7	62	Class D/E
	150 V	PQFN 3.3 x 3.3	BSZ900N15NS3	75**	4.1**	46	Class E
			BSZ520N15NS3	42**	7.2**	80	Class E
	200 V		BSZ900N20NS3	78**	7.2**	52	Class E
			BSZ22DN20NS3	200**	3.5**	24	Class E
			BSZ12DN20NS3	111**	5.4**	39	Class E
	250 V		BSZ42DN25NS3	375**	3.6**	21	Class E
Driver ICs	EiceDRIVER™ 2EDL71*						
	EiceDRIVER™ 1EDN and 2EDN						
Microcontroller	XMC1302, XMC14xx, XMC4108 (Software available for selected applications, please check for details on the web)						

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

Wireless in-car charging (automotive)

The next generation of in-cabin wireless charging systems have to meet strict automotive safety, security, environmental and regulatory requirements while still enabling industry-leading charging performance and efficiency. Infineon's AURIX™ microcontroller, voltage regulators, power MOSFET technologies and network ICs will easily support these requirements with a complete charging solution. With 15 W charging that meets existing standards, including fast charge smartphones, the solution easily supports future changes with a software update. A new innovative Foreign Object Detection (FOD) system or our unique improved power drive architecture that provides unparalleled EMI performance are just some benefits to address the design challenges in the automotive wireless charging market. Discover our complete offerings for in-cabin charging on a system level on our webpage - something you will not find just anywhere.

www.infineon.com/wirelesscharging

System diagram: wireless in-car-charging
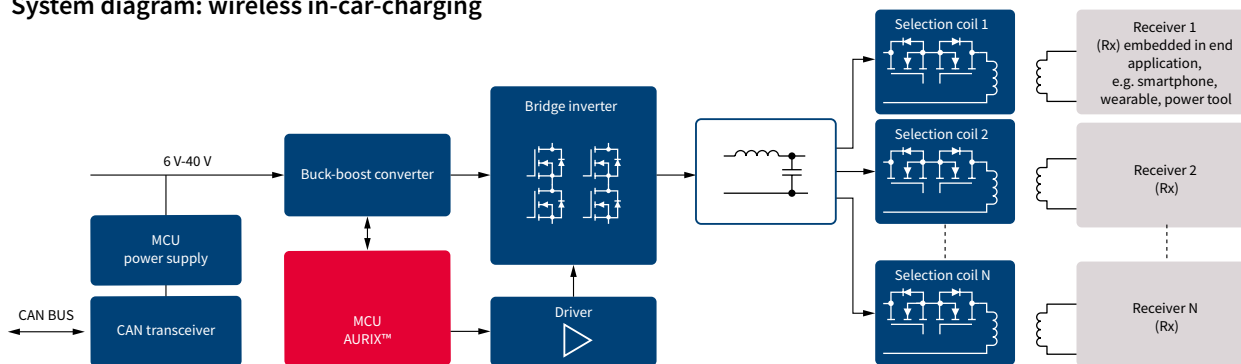
Automotive products for wireless charging	Voltage class	Package	Part number	$R_{DS(on)}$ max @ V_{GS} = 4.5 V [mQ]	Q_G typical [nC]
Inverter automotive grade MOSFETs	40 V	SSO8 5 x 6 Dual	IPG20N04S4-12A	15.5	9
		S3O8 3.3 x 3.3	IPZ40N04S5L-4R8	6.7	11
			IPZ40N04S5L-7R4	10.7	6.5

Automotive products for wireless charging	Voltage class	Package	Part number	$R_{DS(on)}$ max @ V_{GS} = 4.5 V [mQ]	$R_{DS(on)}$ max @ V_{GS} = 10 V [mQ]
Coil selection switch	60 V	TDSON-8	IPG20N06S4L-11A	15.8	11.2
	100 V	5 x 6 SSO8 Dual	IPG20N10S4L-22A	28	22
			IPG20N10S4L-35A	45	35
			IPG16N10S4L-61A	78	61
MCU	AURIX™ SAK-TC212S-4F100N				
Power supply	TLD5190 – buck-boost controller/TLE8366, TLS4120x,TLS203x/TLF35584 – safety MCU supply + CAN supply				
CAN	TLE7250SJ – high performance CAN transceiver				
Drivers	AUIRS2301S				

System solutions for wireless charging

Master your design challenges with Infineon. With our broad range of designs customers have the possibility to make wireless charging available for different kinds of applications. For more information on the availability of our boards please visit us on www.infineon.com/wirelesscharging or get in contact with us via www.infineon.com/support.

Find the right solutions for your wireless charging designs in four steps

Infineon's selection tool for wireless charging designs that allows you to find the right solutions for your designs in just four steps: select the application, power range, standard and the topology you want to apply and get an overview of Infineon's most recommended offerings for your design.

www.infineon.com/wirelesscharging

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.

www.infineon.com/3dprinter
www.infineon.com/audio
www.infineon.com/automaticopeningsystem
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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™	StrongIRFET™
Best-in-class technology	Robust and excellent price/performance ratio
Designed for high performance applications	Designed for industrial applications
Optimized for high switching frequency	Optimized for low switching frequency
Industry's best figure-of-merit	High current carrying capability
High efficiency and power density	Rugged silicon

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

Guidance for applications and voltage classes

OptiMOS™ and StrongIRFET™ portfolio, covering 20 V up to 300 V MOSFETs, can address a broad range of needs from low to high switching frequencies. The tables below provide a guidance overview for the recommended OptiMOS™ or StrongIRFET™ products for each major sub-application and voltage class.

Breakdown voltage

Application	Family	20–30	40	60	75–80	100	135	150	200	250	300
Power Tools	OptiMOS	20–30	40	60	75–80						
	StrongIRFET	20–30	40	60	75–80						
LEV	OptiMOS			60	75–80	100		150	200		
	StrongIRFET			60	75–80	100	135		200		
Multicopter	OptiMOS	20–30	40	60	75–80						
	StrongIRFET	20–30	40	60	75–80						
Battery	OptiMOS	20–30	40	60	75–80						
	StrongIRFET	20–30	40	60	75–80						
Industrial Drives	OptiMOS	20–30	40	60	75–80						
	StrongIRFET	20–30	40	60	75–80						
LSEV	OptiMOS			60	75–80	100		150	200		
	StrongIRFET			60	75–80	100	135		200		
Solar	OptiMOS			60	75–80	100		150			
	StrongIRFET			60	75–80	100					
UPS	OptiMOS	20–30	40	60	75–80	100		150	200	250	300
	StrongIRFET	20–30	40	60	75–80	100		150	200	250	300
Offline	OptiMOS		40	60							
	StrongIRFET		40	60							
Charger	OptiMOS		40	60	75–80	100					
	StrongIRFET		40	60	75–80	100					
Adapter	OptiMOS		40	60	75–80	100					
	StrongIRFET		40	60	75–80	100					
PC Power	OptiMOS		40	60							
	StrongIRFET		40	60							
LCD TV	OptiMOS			60	75–80	100					
	StrongIRFET			60	75–80	100					
Server	OptiMOS		40	60	75–80						
	StrongIRFET		40	60	75–80						
AC-DC	OptiMOS				75–80	100		150	200		
	StrongIRFET				75–80	100					
Telecom	OptiMOS	20–30	40	60	75–80	100		150			
	StrongIRFET	20–30	40	60	75–80	100					

Legend

Family		Breakdown voltage	
OptiMOS™	Recommended	BV_{DSS}	Available
StrongIRFET™	Recommended	BV_{DSS}	Available

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Space saving and high performance packages

	TO-247	TO-220	D²PAK	D²PAK 7pin	TO-Leadless
		Optimized for high power applications and high current capability			
Height [mm]	5.0	4.4	4.4	4.4	2.3
Outline [mm²]	40.15 x 15.9	29.5 x 10.0	15.0 x 10.0	15.0 x 10.0	11.68 x 9.9
Current capability [A]	195.0	195.0	195.0	240.0	300.0
Thermal resistance R_{thJC} [K/W]	2.0	0.5	0.5	0.5	0.4

	SuperSO8	Power Block	PQFN 3.3 x 3.3	PQFN 2 x 2	DirectFET™
	For highest efficiency and power management	Significant design shrink	For highest efficiency and power management	Enables significant space saving	Best thermal behavior in a tiny footprint
Height [mm]	1.0	1.0	1.0	0.9	Small: 0.65 Medium: 0.65 Large: 0.71
Outline [mm²]	5.15 x 6.15	5.0 x 6.0	3.3 x 3.3	2.0 x 2.0	Small: 4.8 x 3.8 Medium: 6.3 x 4.9 Large: 9.1 x 6.98
Current capability [A]	100.0	50.0	40.0	18.5	Small: 75.0 Medium: 180.0 Large: 375.0
Thermal resistance R_{thJC} [K/W]	0.8	1.5	3.2	11.1	0.5

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Discrete and integrated packages

OptiMOS™ and StrongIRFET™ technologies are available in different packages to address the demands for higher current carrying capability and significant space saving.

The broad portfolio enables footprint reduction and boosted current rating as well as optimized thermal performance. While the surface mount leadless devices enable footprint reduction, through hole packages are characterized by a high power rating.

Furthermore, Infineon offers innovative packages such as DirectFET™ and TO-Leadless. DirectFET™ is designed for high frequency applications by offering lowest parasitic resistance. This package is available in three different sizes: small, medium and large. TO-Leadless is optimized to handle currents of up to 300 A, increasing power density with a substantial reduction in footprint.
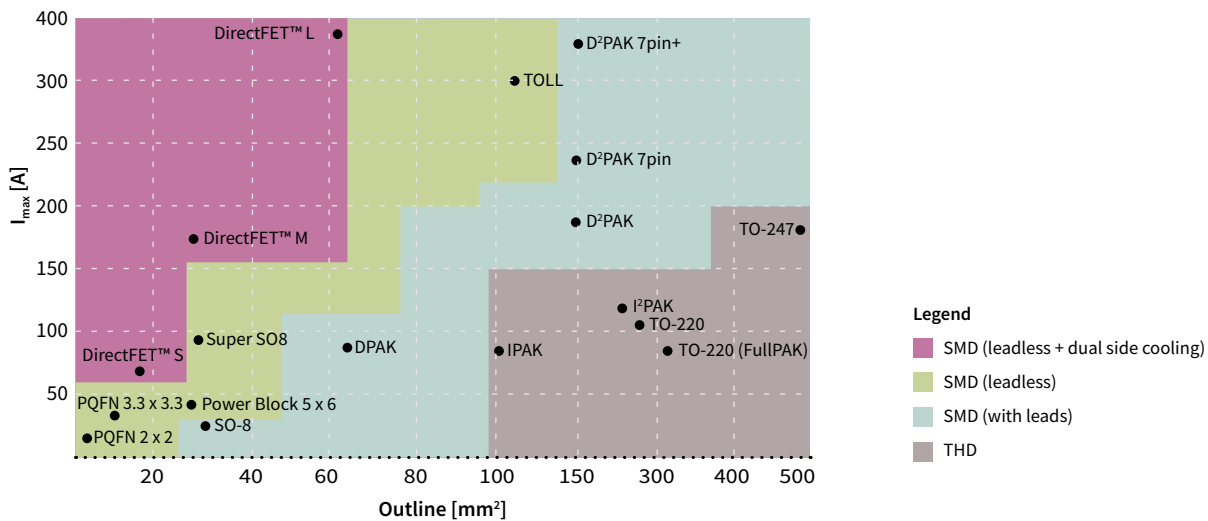
Small signal and Small power MOSFETs
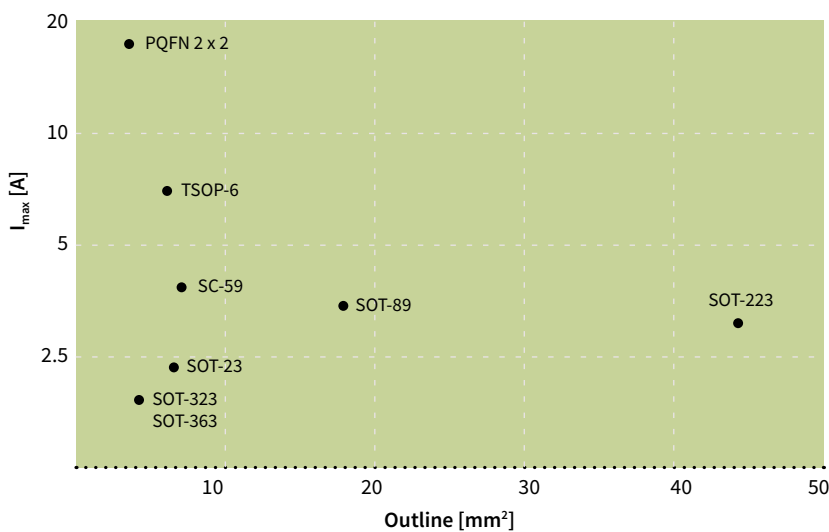
Small signal and Small power MOSFETs are available in eight industry-standard package types ranging from the largest SOT-223 to the smallest PQFN 2 x 2.

Products are offered in single, dual and complementary configurations and are suitable for a wide range of applications including battery protection, LED lighting, low voltage drives and DC-DC converters.

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OptiMOS™ 5 175°C in SuperSO8

Enhanced temperature rating for improved robustness

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

Compared to lower rated devices, the 175°C T_{J_MAX} feature offers either more power at a higher operating junction temperature or longer lifetime at the same operating junction temperature.

The new products are the perfect fit for applications such as server and telecom. The first wave of products offering this enhanced temperature rating includes OptiMOS™ fast diode as well as OptiMOS™ 5 in 30 V, 40 V and 60 V.

T_{J_MAX} =175°C
D_T=25°C
T_{J_OPE}=150°C

T_{J_MAX}=150°C
D_T=25°C
T_{J_OPE}=125°C

www.infineon.com/superso8-175degrees
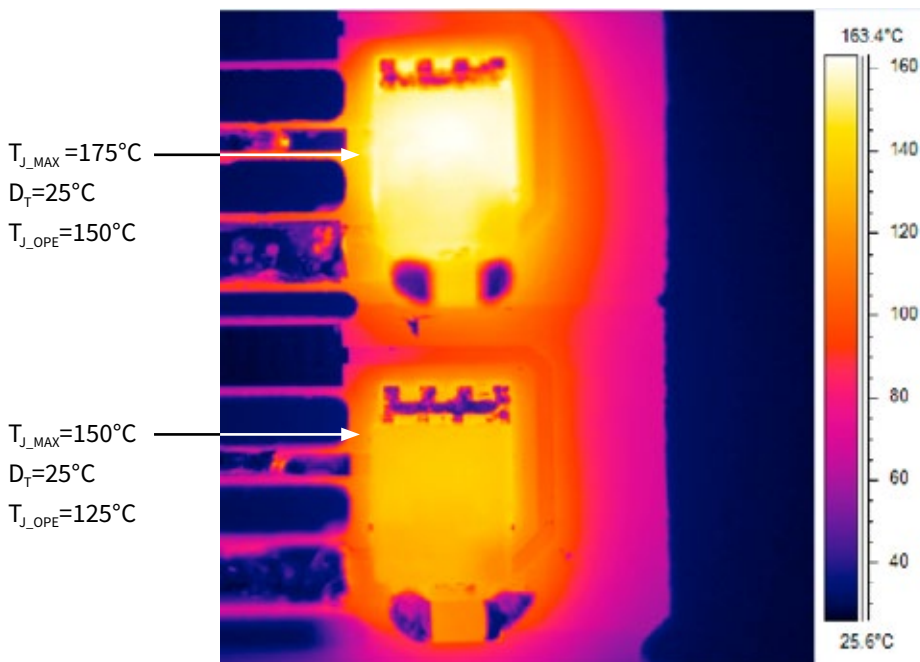
OptiMOS™ Linear FET

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 is currently available in three voltage classes – 100 V, 150 V, and 200 V – in either D²PAK or D²PAK 7pin package.

Safe operating area comparison

Whilst the OptiMOS™ 5 100 V, 1.7 mΩ power MOSFET has a safe operating area of 0.5 A, the OptiMOS™ Linear FET version at the same $R_{DS(on)}$ offers a much wider SOA of 11.5 A (@ 54 V, 10 ms).

OptiMOS™ 5
$R_{DS(on)}$ = 1.7 mΩ
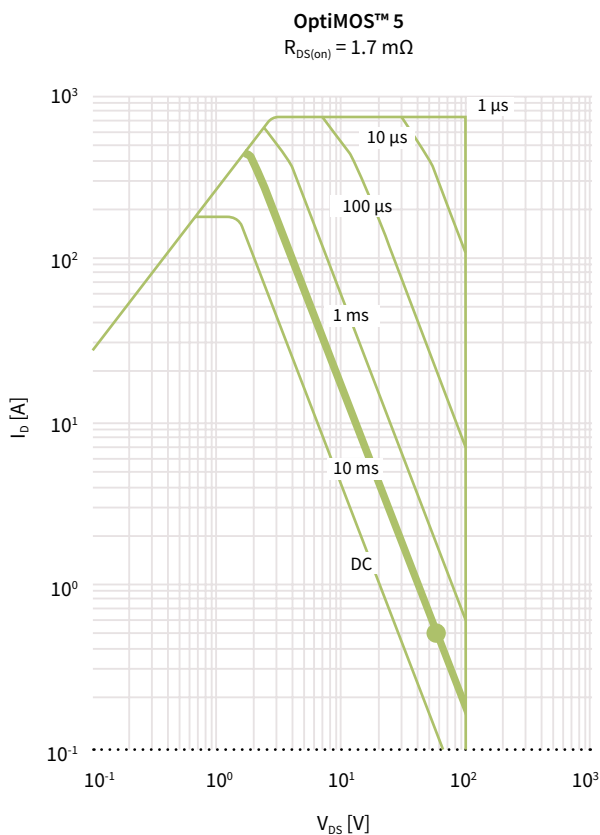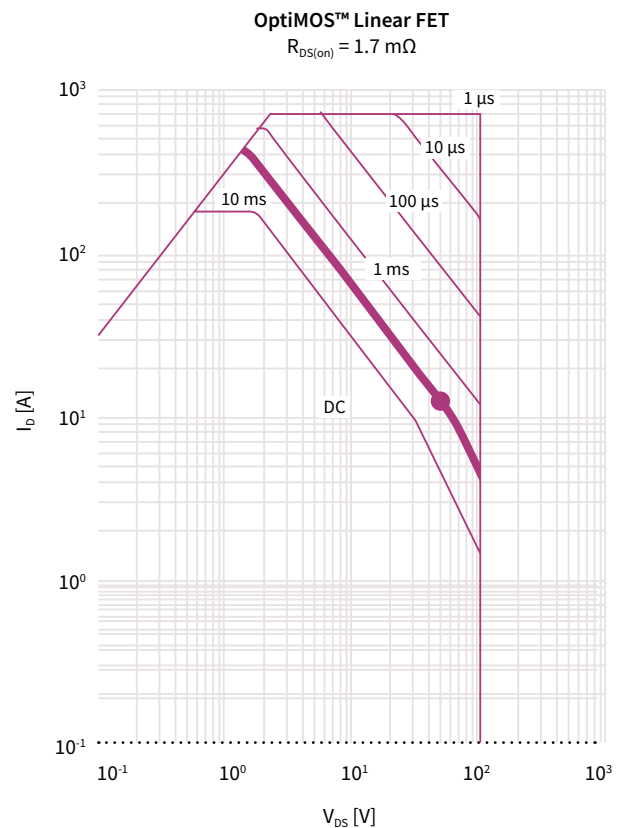
0.5 A @ 54 V
t_{pulse} = 10 ms

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

11.5 A @ 54 V
t_{pulse} = 10 ms

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

Onboard · Mainboard · Notebook · DC-DC · VRD/VRM · LED

$R_{DS(on)}$ 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		
2-4					BSC026N02KS G $R_{DS(on)}$=2.6 mΩ	IRF6201TRPBF $R_{DS(on)}$=2.45 mΩ	
2-4	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	IRF3717 $R_{DS(on)}$=4.4 mΩ	
> 10		IRLHS6242TRPBF $R_{DS(on)}$=11.7 mΩ					IRLML6244[1] *** $R_{DS(on)}$=21 mΩ
> 10		IRLHS6276TRPBF** $R_{DS(on)}$=45.0 mΩ; dual					IRLML6246[1] *** $R_{DS(on)}$=46 mΩ

OptiMOS™ & StrongIRFET™ 25 V logic level

Onboard · Mainboard · Notebook · DC-DC · VRD/VRM · LED · Motor Control

$R_{DS(on)}$ 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		
< 1	BSB008NE2LX $R_{DS(on)}$=0.8 mΩ			BSC009NE2LS5 $R_{DS(on)}$=0.9 mΩ		
< 1				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		
1-2	BSB012NE2LXI** $R_{DS(on)}$=1.2 mΩ		BSZ014NE2LS5IF * *** $R_{DS(on)}$=1.45 mΩ	BSC010NE2LSI** $R_{DS(on)}$=1.05 mΩ		
1-2	IRF6717MTRPBF $R_{DS(on)}$=1.25 mΩ		BSZ017NE2LS5I** $R_{DS(on)}$=1.7 mΩ	BSC014NE2LSI** $R_{DS(on)}$=1.4 mΩ		
1-2	IRF6894MTRPBF** $R_{DS(on)}$=1.3 mΩ		BSZ018NE2LS $R_{DS(on)}$=1.8 mΩ	IRFH5250D $R_{DS(on)}$=1.4 mΩ		
1-2	BSB013NE2LXI** $R_{DS(on)}$=1.3 mΩ		BSZ018NE2LSI** $R_{DS(on)}$=1.8 mΩ	BSC015NE2LS5I** $R_{DS(on)}$=1.5 mΩ		
1-2	IRF6797MTRPBF** $R_{DS(on)}$=1.4 mΩ			BSC018NE2LS $R_{DS(on)}$=1.8 mΩ		
1-2	IRF6716M $R_{DS(on)}$=1.6 mΩ			BSC018NE2LSI** $R_{DS(on)}$=1.8 mΩ		
1-2	IRF6715MTRPBF $R_{DS(on)}$=1.6 mΩ					
1-2	IRF6893MTRPBF** $R_{DS(on)}$=1.6 mΩ					
1-2	IRF6892STRPBF** $R_{DS(on)}$=1.7 mΩ					
1-2	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		
2-4	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	
2-4	BSF035NE2LQ $R_{DS(on)}$=3.5 mΩ		BSZ036NE2LS $R_{DS(on)}$=3.6 mΩ	BSC032NE2LS $R_{DS(on)}$=3.2 mΩ		
2-4	IRF6811STRPBF** $R_{DS(on)}$=3.7 mΩ					
4-10	IRF6802SD $R_{DS(on)}$=4.2 mΩ					
4-10	IRF6710S2TRPBF $R_{DS(on)}$=4.5 mΩ		IRFHM8228TRPBF $R_{DS(on)}$=5.2 mΩ	BSC050NE2LS $R_{DS(on)}$=5.0 mΩ		
4-10	IRF6712STRPBF $R_{DS(on)}$=4.9 mΩ		BSZ060NE2LS $R_{DS(on)}$=6.0 mΩ			
4-10	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

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* 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 5 x 6

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 5 x 6	✓	25	5.9	1.6	7.7	25.0
BSC0911ND	TISON 5 x 6	–	25	4.8	1.7	7.7	25.0
BSC0921NDI	TISON 5 x 6	✓	30	7.0	2.1	5.8	21.0
BSC0923NDI	TISON 5 x 6	✓	30	7.0	3.7	5.2	12.2
BSC0924NDI	TISON 5 x 6	✓	30	7.0	5.2	5.2	8.6
BSC0925ND	TISON 5 x 6	–	30	6.4	6.4	5.2	6.7

OptiMOS™ & StrongIRFET™ 25 V/30 V in Power Block 5 x 6 and 5 x 4

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 5 x 6	✓	25	4.0	1.2	5.6	16.0
BSG0811ND	TISON 5 x 6	–	25	4.0	1.1	5.6	20.0
BSG0813NDI	TISON 5 x 6	✓	25	4.0	1.7	5.6	12.0
IRFH4257DTRPBF	PQFN 5 x 4	✓	25	4.7	1.8	9.7	23.0

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OptiMOS™ & StrongIRFET™ 30 V logic level

Onboard | Mainboard | Notebook | DC-DC | VRD/VRM | Motor Control

$R_{DS(on), max.}$ @ V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D²PAK)	TO-263 (D²PAK 7pin)	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			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			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		IPP055N03L G $R_{DS(on)}$=5.5 mΩ
	IPD075N03L G $R_{DS(on)}$=7.5 mΩ	IPB080N03L G $R_{DS(on)}$=8.0 mΩ		IRL8113PBF $R_{DS(on)}$=6.0 mΩ
	IRLR8729TRPBF $R_{DS(on)}$=8.9 mΩ			IRLB8721PBF $R_{DS(on)}$=8.7 mΩ
	IPD090N03L G $R_{DS(on)}$=9.0 mΩ			
10-25	IPD135N03L G $R_{DS(on)}$=13.5 mΩ			
	IRLR3103 $R_{DS(on)}$=19.0 mΩ			

OptiMOS™ & StrongIRFET™ 30 V logic level

Onboard | Mainboard | Notebook | DC-DC | VRD/VRM | Motor Control

$R_{DS(on), max.}$ @ V_{GS}=10 V [mΩ]	Bare die ($R_{DS(on) typ.}$)	DirectFET™	PQFN 3.3 x 3.3	SuperSO8	TO-Leadless
<1					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** $R_{DS(on)}$=1.5 mΩ	BSC0901NS $R_{DS(on)}$=1.9 mΩ	
		IRF8302MTRPBF** $R_{DS(on)}$=1.8 mΩ	BSZ019N03LS $R_{DS(on)}$=1.9 mΩ	BSC0501NSI** $R_{DS(on)}$=1.9 mΩ	
			BSZ0901NS $R_{DS(on)}$=2.0 mΩ	BSC0901NSI** $R_{DS(on)}$=2.0 mΩ	
	IPC055N03L3*** $R_{DS(on)}$=2.7 mΩ		BSZ0501NSI** $R_{DS(on)}$=2.0 mΩ		

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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	PQFN 2 x 2
< 4				BSC011N03LST $R_{DS(on)}$=1.1 mΩ			
		IRF8304MTRPBF $R_{DS(on)}$=2.2 mΩ	BSZ0901NSI** $R_{DS(on)}$=2.1 mΩ	BSC020N03LS G $R_{DS(on)}$=2.0 mΩ			
	IPC042N03L3*** $R_{DS(on)}$=3.7 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			
	IPC028N03L3 $R_{DS(on)}$=5.0 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			
			BSZ0994NS $R_{DS(on)}$= 7.0mΩ	BSC080N03LS G $R_{DS(on)}$=8.0 mΩ			
			IRFHM831 $R_{DS(on)}$= 7.8 mΩ	IRFH8334TRPBF $R_{DS(on)}$=9.0 mΩ	IRF8721TRPBF $R_{DS(on)}$=8.5 mΩ		
			BSZ088N03LS G $R_{DS(on)}$=8.8 mΩ	BSC090N03LS G $R_{DS(on)}$=9.0 mΩ	IRF8714TRPBF $R_{DS(on)}$=8.7 mΩ		
			IRFHM8334TRPBF $R_{DS(on)}$=9.0 mΩ	BSC0909NS $R_{DS(on)}$=9.2 mΩ			
			BSZ100N03LS G $R_{DS(on)}$=10.0 mΩ				
10-63	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	IRLHS6342*** $R_{DS(on)}$= 16 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	IRFHS8342 $R_{DS(on)}$= 16 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	IRLHS6376*** $R_{DS(on)}$= 63 mΩ; dual
			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 9.5			BSZ0910ND $R_{DS(on)}$=9.5 mΩ; dual				
2 x 15				BSC150N03LD G $R_{DS(on)}$=15.0 mΩ			
2 x 18			BSZ0909ND $R_{DS(on)}$=18 mΩ; dual				

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

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

Onboard · Mainboard · Notebook · DC-DC · VRD/VRM · LED

$R_{DS(on), max.}$ @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		

OptiMOS™ & StrongIRFET™ 40 V normal level

AC-DC · Battery · Consumer · DC-DC · Electric Toys · Industrial Drives · LED · Motor Control · Offline · PC Power · Power Tools · Server · SMPS · Solar · UPS

$R_{DS(on), max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D²PAK)	TO-263 (D²PAK 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 $R_{DS(on)}$=0.9 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	
		IRFS3004 $R_{DS(on)}$=1.75 mΩ	IRFS3004-7P $R_{DS(on)}$=1.25 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	
		IRF1404S $R_{DS(on)}$=4.0 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					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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1) 2.5 V_{GS} capable
*** $R_{DS(on)}$ max @ V_{GS}=4.5 V

OptiMOS™ & StrongIRFET™ 40 V logic level

$R_{DS(on), max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D²PAK)	TO-263 (D²PAK 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 $R_{DS(on)}$=1.4 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		BSC010N04LST $R_{DS(on)}$=1.0 mΩ
		IRL40S212 $R_{DS(on)}$=1.9 mΩ		IRL40B212 $R_{DS(on)}$=1.9 mΩ		IRL7472L1TRPBF $R_{DS(on)}$=2.0 mΩ		BSC010N04LSI $R_{DS(on)}$=1.05 mΩ
								BSC014N04LST $R_{DS(on)}$=1.4 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	IRL1404S $R_{DS(on)}$=4.0 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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OptiMOS™ & StrongIRFET™ 60 V normal level

$R_{DS(on), max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D²PAK)	TO-263 (D²PAK 7pin)	TO-262 (I²PAK)	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	IRFS7534TRLPBF $R_{DS(on)}$=2.4 mΩ	IRFS3006TRL7PP $R_{DS(on)}$=2.1 mΩ		IPP020N06N [2] $R_{DS(on)}$=2.0 mΩ		
		IRFS3006 $R_{DS(on)}$=2.5 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 G [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	IRFS3206 $R_{DS(on)}$=3.0 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		
		IRFS3306 $R_{DS(on)}$=4.2 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	IRF1018ES $R_{DS(on)}$=8.4 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		IRFS3806 $R_{DS(on)}$=15.8 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	IPT012N06N 2) $R_{DS(on)}$=1.2 mΩ
				BSC014N06NST 2) $R_{DS(on)}$=1.45 mΩ	
				BSC016N06NST 2) $R_{DS(on)}$=1.6 mΩ	
				BSC016N06NS 2) $R_{DS(on)}$=1.6 mΩ	
				BSC019N06NS 2) $R_{DS(on)}$=1.9 mΩ	
2-4		IRF7748L1TRPBF $R_{DS(on)}$=2.2 mΩ		BSC028N06NS 2) $R_{DS(on)}$=2.8 mΩ	
				BSC028N06NST 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		IRF6648 $R_{DS(on)}$=7.0 mΩ	BSZ042N06NS 2) $R_{DS(on)}$=4.2 mΩ	IRLH5036TRPBF $R_{DS(on)}$=4.4 mΩ	
		IRF6674 $R_{DS(on)}$=11.0 mΩ		IRFH7545TRPBF $R_{DS(on)}$=5.2 mΩ	
			BSZ068N06NS 2) $R_{DS(on)}$=6.8 mΩ	BSC066N06NS 2) $R_{DS(on)}$=6.6 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	
				BSC097N06NST 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 (D²PAK)	TO-263 (D²PAK 7pin)	TO-262 (I²PAK)	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				
		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 $R_{DS(on)}$=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 G $R_{DS(on)}$=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	BSC065N06LS5 $R_{DS(on)}$=6.5 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	BSC094N06LS5 $R_{DS(on)}$=9.4 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 $R_{DS(on)}$=19.0 mΩ					IRLML0060 $R_{DS(on)}$=92 mΩ
										IRLML2060 $R_{DS(on)}$=480 mΩ

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

OptiMOS™ & StrongIRFET™ 75 V normal level

$R_{DS(on), max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D²PAK)	TO-263 (D²PAK 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 (D²PAK)	TO-263 (D²PAK 7pin)	TO-262 (I²PAK)	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							
		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	IPT029N08N5 $R_{DS(on)}$=2.9 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 $R_{DS(on)}$=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					BSZ084N08NS5 $R_{DS(on)}$=8.4 mΩ	BSC072N08NS5 $R_{DS(on)}$=7.2 mΩ	
>10								IRL80HS120 $R_{DS(on)}$=32.0 mΩ	BSB104N08NP3 $R_{DS(on)}$=10.4 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

20 V–400 V MOSFETs

OptiMOS™ & StrongIRFET™ 100 V normal level

$R_{DS(on), max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D²PAK)	TO-263 (D²PAK 7pin)	TO-262 (I²PAK)	TO-220	TO-220 FullPAK	TO-247
1-2		IPB020N10N5 $R_{DS(on)}$=2.0 mΩ	IPB017N10N5 $R_{DS(on)}$=1.7 mΩ				
		IPB020N10N5LF $R_{DS(on)}$=2.0 mΩ	IPB017N10N5LF $R_{DS(on)}$=1.7 mΩ				
2-4		IPB027N10N3 G $R_{DS(on)}$=2.7 mΩ	IPB024N10N5 $R_{DS(on)}$=2.4 mΩ		IPP023N10N5 $R_{DS(on)}$=2.3 mΩ		IRFP4468PBF $R_{DS(on)}$=2.6 mΩ
		IPB027N10N5 $R_{DS(on)}$=2.7 mΩ	IPB025N10N3 G $R_{DS(on)}$=2.5 mΩ	IPI030N10N3 G $R_{DS(on)}$=3.0 mΩ	IPP030N10N3 G $R_{DS(on)}$=3.0 mΩ	IPA030N10N3 G $R_{DS(on)}$=3.0 mΩ	
		IPB033N10N5LF $R_{DS(on)}$=3.3 mΩ	IPB032N10N5 $R_{DS(on)}$=3.2 mΩ		IPP030N10N5 $R_{DS(on)}$=3.0 mΩ		
			IPB039N10N3 G $R_{DS(on)}$=3.9 mΩ		IPP039N10N5 $R_{DS(on)}$=3.9 mΩ		
4-10	IPD050N10N5 $R_{DS(on)}$=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 $R_{DS(on)}$=8.3 mΩ	IRFP4310ZPBF $R_{DS(on)}$=6.0 mΩ
		IPB065N10N3 G $R_{DS(on)}$=6.5 mΩ			IRFB4310ZPBF $R_{DS(on)}$=6.0 mΩ	IPA086N10N3 G $R_{DS(on)}$=8.6 mΩ	
		IRFS4310ZTRLPBF $R_{DS(on)}$=7.0 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 $R_{DS(on)}$=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	IPD122N10N3 G $R_{DS(on)}$=12.2 mΩ						
	IPD12CN10N G $R_{DS(on)}$=12.4 mΩ	IPB123N10N3 G $R_{DS(on)}$=12.3 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			
	IPD25CN10N G $R_{DS(on)}$=25.0 mΩ						
>25	IPD33CN10N G $R_{DS(on)}$=33.0 mΩ						
	IPD78CN10N G $R_{DS(on)}$=78.0 mΩ						

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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 IPC313N10N3R $R_{DS(on)}$=1.9 mΩ					IPT015N10N5 $R_{DS(on)}$=1.5 mΩ IPT020N10N3 $R_{DS(on)}$=2.0 mΩ
2-4	IPC26N10NR $R_{DS(on)}$=3.2 mΩ IPC173N10N3 $R_{DS(on)}$=3.6 mΩ	IRF7769L1TRPBF $R_{DS(on)}$=3.5 mΩ		BSC035N10NS5 $R_{DS(on)}$=3.5 mΩ BSC040N10NS5 $R_{DS(on)}$=4.0mΩ		
4-10		IRF100DM116 [3] $R_{DS(on)}$=4.3 mΩ BSB056N10NN3 G $R_{DS(on)}$=5.6 mΩ	BSZ097N10NS5 $R_{DS(on)}$=9.7 mΩ	BSC046N10NS3 G $R_{DS(on)}$=4.6 mΩ BSC060N10NS3 G $R_{DS(on)}$=6.0 mΩ BSC070N10NS3 G $R_{DS(on)}$=7.0 mΩ BSC070N10NS5 $R_{DS(on)}$=7.0 mΩ IRFH5010TRPBF $R_{DS(on)}$=9.0 mΩ BSC098N10NS5 $R_{DS(on)}$=9.8 mΩ		
10-25	IPC045N10N3 $R_{DS(on)}$=15.2 mΩ	BSF134N10NJ3 G [1] $R_{DS(on)}$=13.4 mΩ IRF6662TRPBF $R_{DS(on)}$=22.0 mΩ	BSZ160N10NS3 G $R_{DS(on)}$=16.0 mΩ	BSC109N10NS3 G $R_{DS(on)}$=10.9 mΩ BSC118N10NS G $R_{DS(on)}$=11.8 mΩ IRFH7110TRPBF $R_{DS(on)}$=13.5 mΩ BSC160N10NS3 G $R_{DS(on)}$=16.0 mΩ BSC196N10NS G $R_{DS(on)}$=19.6 mΩ	IRF7853TRPBF $R_{DS(on)}$=18.0 mΩ	
>25		IRF6645TRPBF $R_{DS(on)}$=35.0 mΩ IRF7665S2TRPBF $R_{DS(on)}$=62.0 mΩ	BSZ440N10NS3 G $R_{DS(on)}$=44.0 mΩ	BSC252N10NSF G $R_{DS(on)}$=25.2 mΩ BSC440N10NS3 G $R_{DS(on)}$=44.0 mΩ		
2 x 75				BSC750N10ND G $R_{DS(on)}$=75.0 mΩ; dual		
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 (D²PAK)	TO-263 (D²PAK 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						
4-10		IRLS4030TRLPBF $R_{DS(on)}$=4.3 mΩ		IRLB4030PBF $R_{DS(on)}$=4.3 mΩ				BSZ096N10LS5 $R_{DS(on)}$=9.6 mΩ	
10-25	IRLR3110ZTRPBF $R_{DS(on)}$=14.0 mΩ			IPP12CN10L G $R_{DS(on)}$=12.0 mΩ	IPC045N10L3 [2] $R_{DS(on)}$= 16.0 mΩ		BSC123N10LS G $R_{DS(on)}$=12.3 mΩ	BSZ146N10LS5 $R_{DS(on)}$=14.6 mΩ BSZ150N10LS3 $R_{DS(on)}$=15.0 mΩ	
>25					IPC020N10L3 [2] $R_{DS(on)}$=42.0 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) $R_{DS(on)}$ typ. specified @ 4.5 V
3) In development

OptiMOS™ & StrongIRFET™ 120 V normal level

$R_{DS(on), max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D²PAK)	TO-263 (D²PAK 7pin)	TO-262 (I²PAK)	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			
				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				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

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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	TO-Leadless
4-10	IPC302N15N3 $R_{DS(on)}$=4.9 mΩ			BSC093N15NS5 $R_{DS(on)}$=9.3 mΩ	IPT059N15N3 $R_{DS(on)}$ = 5.9 mΩ
	IPC300N15N3R $R_{DS(on)}$=4.9 mΩ				
10-25		IRF7779L2TRPBF [5] $R_{DS(on)}$=11.0 mΩ		BSC110N15NS5 $R_{DS(on)}$=11.0 mΩ	
		IRF150DM115 [3] $R_{DS(on)}$=11.4 mΩ		BSC160N15NS5 $R_{DS(on)}$=16.0 mΩ	
	BSB165N15NZ3 G $R_{DS(on)}$=16.5 mΩ			BSC190N15NS3 G $R_{DS(on)}$=19.0 mΩ	
>25		BSB280N15NZ3 G $R_{DS(on)}$=28.0 mΩ	BSZ300N15NS5 $R_{DS(on)}$=30.0 mΩ	BSC360N15NS3 G $R_{DS(on)}$=36.0 mΩ	
		IRF6643TRPBF $R_{DS(on)}$=34.5 mΩ	BSZ520N15NS3 G $R_{DS(on)}$=52.0 mΩ	BSC520N15NS3 G $R_{DS(on)}$=52.0 mΩ	
		IRF6775MTRPBF $R_{DS(on)}$=56.0 mΩ	BSZ900N15NS3 G $R_{DS(on)}$=90.0 mΩ		

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

$R_{DS(on), max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D²PAK)	TO-263 (D²PAK 7pin)	TO-251/ TO-251 Short Lead (IPAK/IPAK Short Lead)	TO-262 (I²PAK)	TO-220	TO-220 FullPAK	TO-247
4-10		IPB048N15N5 $R_{DS(on)}$=4.8 mΩ	IPB044N15N5 $R_{DS(on)}$=4.4 mΩ		IPI051N15N5 $R_{DS(on)}$=5.1 mΩ	IPP051N15N5 [2] $R_{DS(on)}$=5.1 mΩ		
		IPB048N15N5LF $R_{DS(on)}$=4.8 mΩ	IRF135SA204 [5] $R_{DS(on)}$=5.9 mΩ					
		IPB072N15N3 G $R_{DS(on)}$=7.2 mΩ	IPB060N15N5 $R_{DS(on)}$=6.0 mΩ		IPI075N15N3 G $R_{DS(on)}$=7.5 mΩ	IPP075N15N3 G $R_{DS(on)}$=7.5 mΩ		IRFP4568PBF $R_{DS(on)}$=5.9 mΩ
		IPB073N15N5 $R_{DS(on)}$=7.3 mΩ	IPB065N15N3 G $R_{DS(on)}$=6.5 mΩ		IPI076N15N5 $R_{DS(on)}$=7.6 mΩ	IPP076N15N5 $R_{DS(on)}$=7.6 mΩ	IPA075N15N3 G $R_{DS(on)}$=7.5 mΩ	
		IPB083N15N5LF $R_{DS(on)}$=8.3 mΩ						
		IRF135S203 [5] $R_{DS(on)}$=8.4 mΩ				IRF135B203 [5] $R_{DS(on)}$=8.4 mΩ		
10-25		IPB108N15N3 G $R_{DS(on)}$=10.8 mΩ	IRFS4115TRL7PP $R_{DS(on)}$=11.8 mΩ		IPI111N15N3 G $R_{DS(on)}$=11.1 mΩ	IPP111N15N3 G $R_{DS(on)}$=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 $R_{DS(on)}$=20.0 mΩ	IPB200N15N3 G $R_{DS(on)}$=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 $R_{DS(on)}$=53.0 mΩ	IPB530N15N3 G $R_{DS(on)}$=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™ 200 V normal level

$R_{DS(on), max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D²PAK)	TO-262 (I²PAK)	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			
		IPB110N20N3LF $R_{DS(on)}$=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		IRFB5620PBF $R_{DS(on)}$=72.5 mΩ	
		IRFS4020TRLPBF $R_{DS(on)}$=105.0 mΩ		IRFB4020PBF $R_{DS(on)}$=100.0 mΩ	
				IRF200B211 $R_{DS(on)}$=170.0 mΩ	

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	TO-247
4-10	IPC300N20N3 $R_{DS(on)}$=9.2 mΩ						IRF200P222 $R_{DS(on)}$= 6.6 mΩ
	IPC302N20N3 $R_{DS(on)}$=9.2 mΩ						
>25	IPC302N20NFD $R_{DS(on)}$= 9.4 mΩ			BSC320N20NS3 G $R_{DS(on)}$=32.0 mΩ		IPT111N20NFD $R_{DS(on)}$=11.1 mΩ	IRF200P223 $R_{DS(on)}$= 11.5 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			

www.infineon.com/powermosfet-120V-300V

4) Part qualified according to AEC Q101

OptiMOS™ & StrongIRFET™ 250 V normal level

$R_{DS(on), max.}$ @V_{GS}=10 V [mΩ]	TO-252 (DPAK)	TO-263 (D²PAK)	TO-262 (I²PAK)	TO-220	TO-247	Bare die ($R_{DS(on)\ typ.}$)	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			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 (D²PAK)	TO-220	TO-247	SuperSO8
0-25			IRF300P226 $R_{DS(on)}$=19.0 mΩ	
>25	IPB407N30N $R_{DS(on)}$=40.7 mΩ	IPP410N30N $R_{DS(on)}$=41.0 mΩ	IRFP4868PBF $R_{DS(on)}$=32.0 mΩ	
			IRF300P227 $R_{DS(on)}$=40.0 mΩ	
		IRFB4137PBF $R_{DS(on)}$=69.0 mΩ	IRFP4137PBF $R_{DS(on)}$=69.0 mΩ	BSC13DN30NSFD $R_{DS(on)}$=130.0 mΩ

www.infineon.com/powermosfet-120V-300V

Small Signal p-channel

Voltage [V]		SOT-223	TSOP-6	SOT-89	SC59	SOT-23	SOT-323	SOT-363	PQFN 2 x 2
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 33 mΩ, -6.3 A, LL			BSS308PE 80 mΩ, -2.1 A, LL, ESD		BSD314SPE 140 mΩ, -1.5 A, LL, ESD	IRFHS9301* 37 mΩ, -6.0 A, LL
			IRFTS9342TRPBF* 40 mΩ, -5.8 A, LL			BSS314PE 140 mΩ, -1.5 A, LL, ESD			
			BSL307SP 43 mΩ, -5.5 A, LL			BSS315P 150 mΩ, -1.5 A, LL			IRFHS9351* 170 mΩ, -2.3 A, LL
			BSL305SPE 45 mΩ, -5.5 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			IRLML2244*[1] 54 mΩ, 4.3 A, LL			
			BSL211SP 67 mΩ, -4.7 A, SLL			IRLML2246*[1] 135 mΩ, 2.6 A, LL	BSS209PW 550 mΩ, -0.58 A, SLL	BSV236SP 175 mΩ, -1.5 A, SLL	IRLHS2242*[1] 31 mΩ, -7.2 A, SLL
						BSS215P 150 mΩ, -1.5 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		BSL308C N: 57 mΩ, 2.3 A, LL P: 80 mΩ, -2.0 A, LL					
			BSL316C N: 160 mΩ, 1.4 A, LL P: 150 mΩ, -1.5 A, LL					

www.infineon.com/smallsignal

All products are qualified to Automotive AEC Q101 (except the parts marked with *)

1) $R_{DS(on)}$ 4.5 V rated

Small Signal n-channel

Applications: Automotive · Consumer · DC-DC · eMobility · Industrial Drives · Motor Control · Notebook · Onboard · Telecom

Voltage [V]		SOT-223	TSOP-6	SOT-89	SC59	SOT-23	SOT-323	SOT-363	PQFN 2 x 2
N-channel	20		BSL802SN 22 mΩ, 7.5 A, ULL		BSR802N 23 mΩ, 3.7 A, ULL	IRLML6244* 1) 21 mΩ, 6.3 A, LL			IRLHS6242* 1) 11.7 mΩ, 10.0 A, SLL
			BSL202SN 22 mΩ, 7.5 A, SLL		BSR202N 21 mΩ, 3.8 A, SLL	IRLML6246* 1) 46 mΩ, 4.1 A, LL			IRLHS6276* 1) 45 mΩ, 4.5 A, SLL
			BSL205N 50 mΩ, 2.5 A, SLL, dual			BSS205N 50 mΩ, 2.5 A, SLL		BSD214SN 140 mΩ, 1.5 A, SLL	
						BSS806NE 57 mΩ, 2.3 A, ULL, ESD		BSD816SN 160 mΩ, 1.4 A, ULL	
			BSL207N 70 mΩ, 2.1 A, SLL, dual			BSS806N 57 mΩ, 2.3 A, ULL	BSS214NW 140 mΩ, 1.5 A, SLL	BSD235N 350 mΩ, 0.95 A, SLL, dual	
			BSL214N 140 mΩ, 1.5 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	
	25					IRFML8244* 24 mΩ, 5.8 A, NL			
	30		IRLTS6342* 1) 17.5 mΩ, 8.3 A, LL		BSR302N 23 mΩ, 3.7 A, LL	IRLML0030* 27 mΩ, 5.3 A, LL		BSD316SN 160 mΩ, 1.4A, LL	IRLHS6342* 1) 15.5 mΩ, 8.7 A, SLL
			IRFTS8342* 19 mΩ. 8.2 A, NL			IRLML6344* 1) 29 mΩ, 5.0 A, LL			IRLHS6376* 1) 63 mΩ, 3.6 A, SLL
			BSL302SN 25 mΩ, 7.1 A, LL			BSS306N 57 mΩ, 2.3 A, LL			
			BSL306N 57 mΩ, 2.3 A, LL, dual			IRLML6346* 1) 63 mΩ, 3.4 A, LL			
						IRLML2030* 100 mΩ, 1.4 A, LL			
						BSS316N 160 mΩ, 1.4 A, LL			
	55					BSS670S2L 650 mΩ, 0.54 A, LL	BSS340NW 400 mΩ, 0.88 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	IRLML0060* 92 mΩ, 2.7 A, LL	BSS138W 3.5 Ω, 0.28 A, LL	2N7002DW 3 Ω, 0.3 A, LL, dual	IRL60HS118* 17 mΩ, 18.5 A, LL
		BSP320S 120 mΩ, 2.9 A, NL				IRLML2060* 480 mΩ, 1.2 A, LL	SN7002W 5 Ω, 0.23 A, LL		
		BSP295 300 mΩ, 1.8 A, LL				BSS138N 3.5 Ω, 0.23 A, LL			
						BSS7728N 5 Ω, 0.2 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						
	80								IRL80HS120* 32 mΩ, 12.5 A, LL
	100	BSP372N 230 mΩ, 1.8 A, LL	BSL372SN 220 mΩ, 2.0 A, LL			IRLML0100* 220 mΩ, 1.6 A, LL			IRL100HS121* 42 mΩ, 11.0 A, LL
		BSP373N 240 mΩ, 1.8 A, NL	BSL373SN 230 mΩ, 2.0 A, NL			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			
						BSS169 12 Ω, 0.09 A, depl.			
	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	BSP298 3 Ω, 0.5 A, NL							
		BSP179 24 Ω, 0.04 A, depl.							
		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) (except the parts marked with *)
1) $R_{DS(on)}$ specified at 4.5 V

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		
					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		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		
							IRF9388TRPBF $R_{DS(on)}$=11.9 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		
							IRF9392TRPBF $R_{DS(on)}$= 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	SPP08P06P H* $R_{DS(on)}$=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				
		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 (D²PAK)	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™

| BSC | 014 | N | 03 | L | (S) | (X) | (E) | (G) |

RoHS compliant

Features
F = Fast switching
R = Integrated gate
   resistor
E = ESD protection
A = Qualified according to AEC Q101

Package type
BSB = DirectFET™
   (M Can)
BSC = SuperSO8
BSF = DirectFET™
   (S Can)
BSK = PQFN 2 x 2
BSO = SO-8
BSZ = PQFN 3.3 x 3.3
IPA = FullPAK
SPB/IPB = D^2PAK
IPC = Chip product
SPD/IPD = DPAK
IPI = I^2PAK
SPP/IPP = TO-220
IPS = IPAK Short Leads
IPT = TO-Leadless

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

$R_{DS(on)}$ [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 mm^2 multiplied by 10

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

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

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

| BSC | 0901 | N | X | (I) |

I = Monolithically
   integrated
   Schottky-like diode

Package type

Consecutive number
without any correlation
to product specification

D = Dual
E = ESD
S = Single

Channels
N = N-channel
P = P-channel

Small Signal

BSX	■ ■ ■	J$_1$	Y	J$_2$	Z

"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)

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

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

Additional features
E = ESD protected MOSFET

StrongIRFET™ (from May 2015 onwards)

IR	F	135	SA	204

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^{2}PAK
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

3 sequential digits
3 digits issued sequentially

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

www.infineon.com/baredie

www.infineon.com/optimos-latest-packages

www.infineon.com/optimos-strongirfet-family-selection

Evaluationboards and simulation models

www.infineon.com/to-leadless-evaluationboard

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Videos

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Info | Document | Evaluation Board | Simulation | Play

CoolMOS™ SJ MOSFETs and CoolGaN™ HEMTs

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.

CoolMOS™ superjunction MOSFET for low power SMPS (<150 W)

Not for new design	Active	Active and preferred
		900 V C3
	800 V CE	800 V P7 [1]
	800 V C3	
600/650 V C6/E6	650/700 V CE	700 V P7 [1]
500/600/650 V C3	600 V CE	600 V P7
	600 V P6	
		500 V CE

→ Time →

CoolMOS™ superjunction MOSFET for high power SMPS (>150 W), automotive and CoolGaN™

Not for new design	Active	Active and preferred
		600 V CoolGaN™
		600/650 V G7
500/600 V CP		600/650 V C7
600/650 V C6/E6	600 V P6	600 V P7
500/600/650 V C3	650 V CFD2	600 V CFD7
600 V CFD		600 V CPA
		650 V CFDA

→ Time →

1) Optimized for flyback topologies

■ Price-performance ■ Highest performance ■ Fast recovery diode ■ Automotive

In low power SMPS, high voltage superjunction MOSFETs address applications, such as smartphone/tablet chargers, notebook adapters, LED lighting, as well as audio and TV power supplies. Increasingly, customers replace standard MOSFETs by superjunction MOSFETs to benefit from higher efficiency and less power consumption for the end users. CoolMOS™ P7 sets a new benchmark by offering high performance and competitive price all at once.

Also for high power applications such as server, telecom, PC power, solar, UPS or industrial, Infineon's latest CoolMOS™ 7 superjunction MOSFET series with C7, G7, CFD7 and P7 product families offer what you need - from highest efficiency to best price performance. Infineon now also starts to complement the portfolio with first CoolGaN™ e-mode GaN HEMTs products to further optimize efficiency and system cost.

Infineon's CoolMOS™ superjunction MOSFET offering is complemented by the automotive qualified series 600 V CPA, 650 V CFDA and 800 V C3A. Combining the broad experience from the industrial series, excellent performance and outstanding quality standards well beyond AEC Q101, these series are first choice, if you plan to grab share in the rapidly growing on-board charger and DC-DC converter markets.

www.infineon.com/coolmos
www.infineon.com/gan

600 V CoolMOS™ P7 SJ MOSFET

Perfect combination between high efficiency and ease-of-use

The 600 V CoolMOS™ P7 is a general purpose series, targeting a broad variety of applications, ranging from low power SMPS up to the highest power levels. In the low power arena it is the successor of the 600 V CoolMOS™ CE, and for high power SPMS applications it is the replacement for the 600 V CoolMOS™ P6, which makes it the perfect choice for applications such as server, telecom, PC, solar, ligthing, adapters and TV.

The 600 V CoolMOS™ P7 is Infineon's most well balanced CoolMOS™ technology in terms of combining ease-of-use and excellent efficiency performance. Compared to its predecessors, it offers highest efficiency and improved power density due to the significantly reduced Q_G and E_{oss} levels, as well as optimized $R_{DS(on)}$. The carefully selected integrated gate resistors enable very low ringing tendency and, due to its outstanding robustness of body diode against hard commutation, it is suitable for hard, as well as soft switching topologies, like LLC. In addition, the feature of an excellent ESD capabilty helps to improve the quality in manufacturing. The 600 V CoolMOS™ P7 offers a wide range of $R_{DS(on)}$/package combinations, including THD, as well as SMD devices, at an $R_{DS(on)}$ granularity from 24 mΩ to 600 mΩ and comes along with the most competitive price/performance ratio of all 600 V CoolMOS™ offerings.
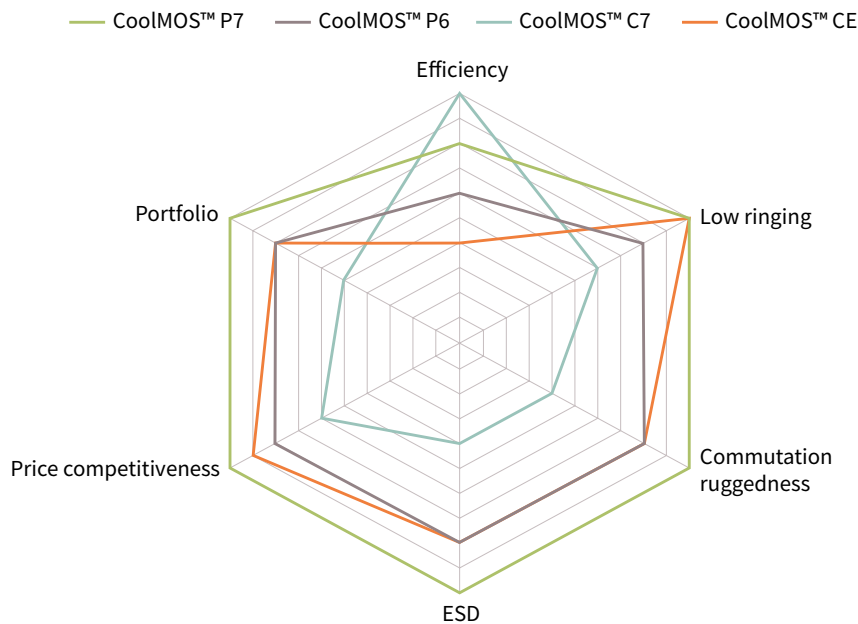
Key features

› 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
› Large portfolio with granular $R_{DS(on)}$ selection qualified for a variety of industrial and consumer applications

Key benefits

› Ease-of-use and fast design-in through low ringing tendency and usage across PFC and PWM stages
› Improved efficiency and 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

www.infineon.com/600V-p7

700 V CoolMOS™ P7 SJ MOSFET

Our answer for flyback topologies

The 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. 700 V CoolMOS™ P7 achieves outstanding efficiency gains of up to 4 percent and a decrease in device temperature of up to 16 percent compared to competition. In contrast with the previous 650 V CoolMOS™ C6 technology, 700 V CoolMOS™ P7 offers 2.4 percent gain in efficiency and 12K lower device temperature, measured at a flyback based charger application, operated at 140 kHz switching speed.

Relative efficiency
@ 230 V_{AC}; T_{amb}=25°C

Relative temperature
@ 230 V_{AC}; T_{amb}=25°C, 30 min burn-in

- CoolMOS™ P7   CoolMOS™ C6
- Competitor 1   Competitor 2

Gate threshold voltage and tolerance
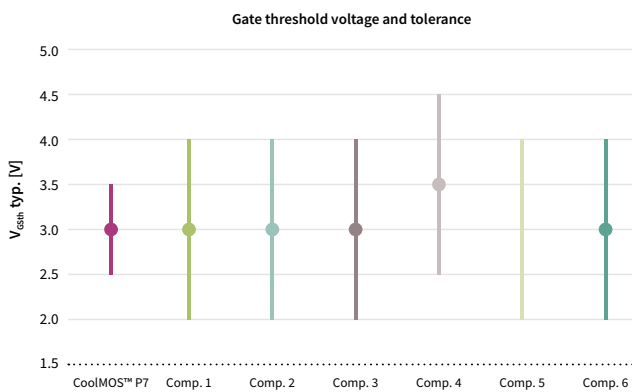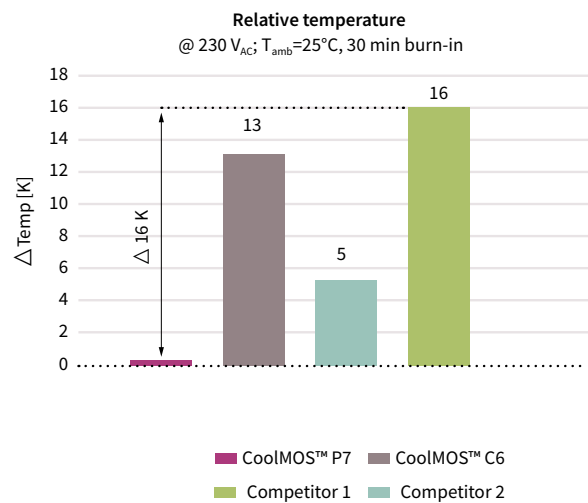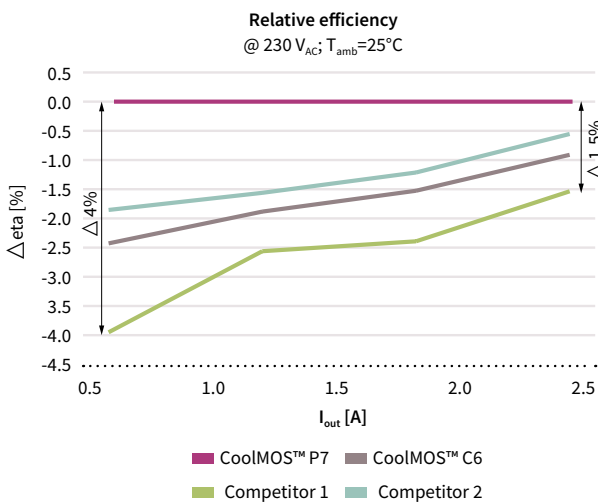
Keeping the ease-of-use in mind, Infineon kept an eye on launching the technology with a low $V_{GS(th)}$ of 3 V and a very narrow tolerance of ±0.5 V. This makes the P7 easy to design-in and enables the usage of lower gate source voltage, which makes it easy to drive and leads to less idle losses. To 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
› 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
› 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
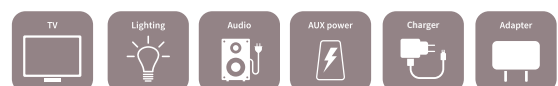
800 V CoolMOS™ P7 SJ MOSFET

A benchmark in efficiency and thermal performance

With the 800 V CoolMOS™ P7 series, Infineon sets a 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 consumer SMPS applications. In addition, it is also suitable for PFC stages within consumer, as well as solar applications, fully covering the market needs in terms of its price/performance ratio.

The technology offers fully optimized key parameters to deliver best-in-class efficiency as well as thermal performance. As demonstrated at a 80 W LED driver, bought on the market, the >45 percent reduction in E_{oss} and C_{oss} as well as the significant improvement in C_{iss} and Q_G, compared to competitor technologies, lead to 0.5 percent higher efficiency at light load which helps to reduce standby power at the end application. At full load the observed improvement is up to 0.3 percent higher efficiency and 6°C lower device temperature.

Plug and play in an 80 W LED driver from market

800 V CoolMOS™ exceptional EMI performance
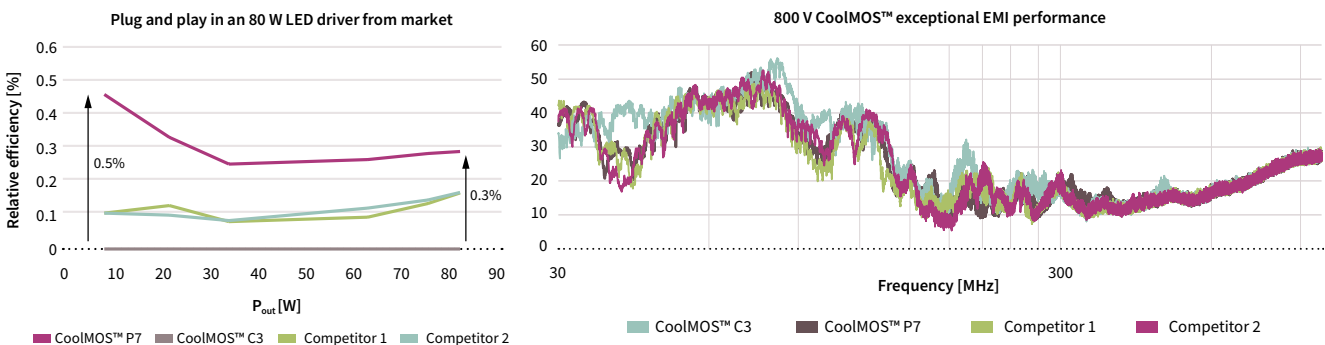
EMI is a system level topic, and the optimization needs to be done on system level only. Nevertheless, a pure plug and play measurement at an Infineon 45 W adapter reveals that 800 V CoolMOS™ P7 shows similar EMI performance compared to Infineon's previous technologies but also when compared to competitors' technologies.

Compared to competition, the 800 V CoolMOS™ P7 technology allows to integrate much lower $R_{DS(on)}$ values into small packages, such as a DPAK. This finally enables high power density designs at highly competitive price levels.

Overview of lowest DPAK $R_{DS(on)}$ for 800 V superjunction MOSFET
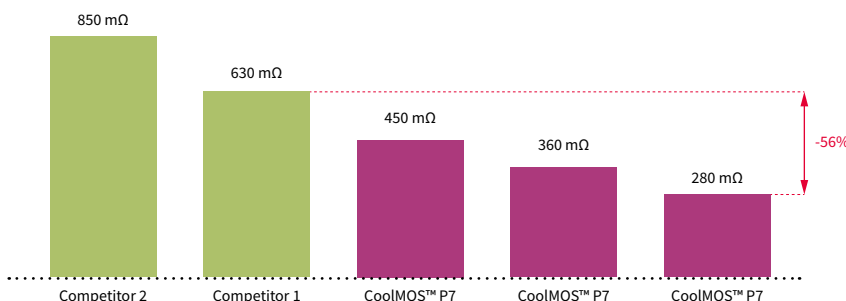
CoolMOS™ P7 sets a new benchmark in best-in-class DPAK $R_{DS(on)}$

Customer benefits:
› High power density
› Lower BOM cost
› Less production cost

The complete P7 platform has been developed with an integrated Zener diode that is used as an ESD protection mechanism, which increases the overall device ruggedness up to HBM class 2 level.

www.infineon.com/800V-p7

600 V CoolMOS™ CFD7 SJ MOSFET

Infineon's answer to resonant switching high power applications

The 600 V CoolMOS™ CFD7 is Infineon's latest high voltage superjunction MOSFET series with an integrated fast body diode. It is the ideal choice for resonant topologies, such as LLC and ZVS PSFB, and targets the high SMPS market.

As a result of significantly reduced gate charge (Q_G), improved turn-off behavior, a reverse recovery charge (Q_{rr}) of up to 69 percent lower compared to the competition, as well as the lowest reverse recovery time (t_{rr}) in the market, it combines highest efficiency and best-in-class reliability in soft switching applications, whilst not sacrificing the easy implementation in the design-in process.

In addition to that, the 600 V CoolMOS™ CFD7 enables higher power density solutions by offering best-in-class $R_{DS(on)}$ package combinations in through-hole devices, as well as in surface-mount devices. In ThinPAK 8x8 and TO-220 with CoolMOS™ CFD7 a $R_{DS(on)}$ of around 30 percent below the next best competitor offering can be achieved. All this together makes CoolMOS™ CFD7 the perfect fit for server and telecom applications, and it is also suitable for EV charging stations.

Q_{rr} comparison of 170 mΩ CFD vs. 190 mΩ range competition*

*Comparison based on datasheet values

Efficiency comparison of CFD7 vs. CFD2 and competition in 2 kW ZVS

| IPW60R070CFD7 | IPW65R080CFD | Competitor A |
| Competitor B | Competitor C | Competitor D |
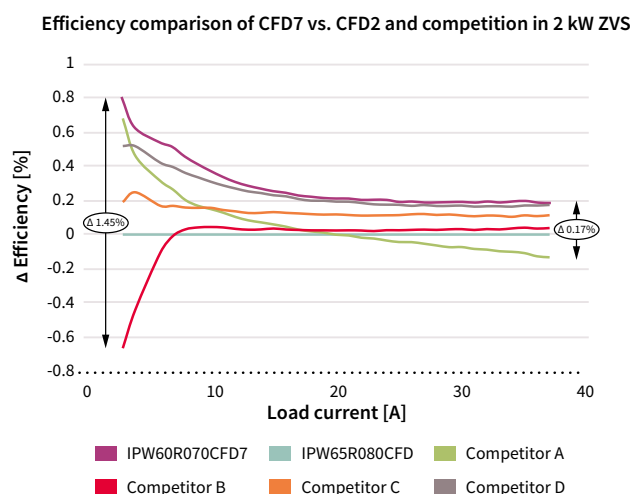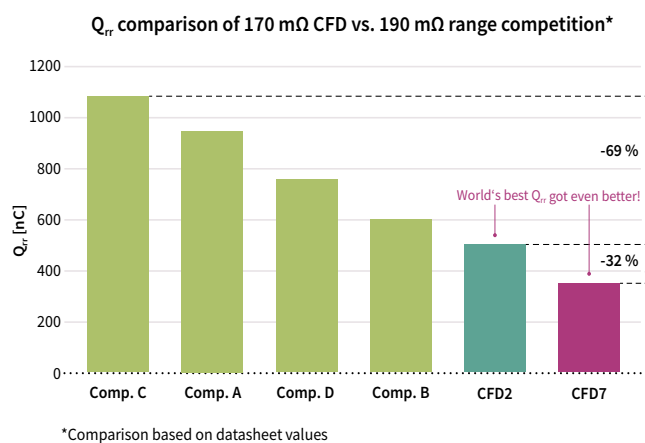
Key features
› Ultra-fast body diode
› Best-in-class reverse recovery charge (Q_{rr})
› Improved reverse diode dv/dt and dif/dt ruggedness
› Lowest figure-of-merit $R_{DS(on)}$ x Q_G x E_{oss}
› Best-in-class $R_{DS(on)}$/packages combinations

Key benefits
› Best-in-class hard commutation ruggedness
› Highest reliability for resonant topologies
› Highest efficiency with outstanding ease-of-use/ performance trade-off
› Enabling increased power density solutions

www.infineon.com/cfd7

600 V and 650 V CoolMOS™ C7 and C7 Gold (G7) SJ MOSFET
Infineon's highest efficiency superjunction MOSFET series

The 600 V and 650V CoolMOS™ C7 and C7 Gold (G7) superjunction MOSFET series are designed to achieve record level efficiency performance – they offer substantial efficiency benefits over the whole load range in hard switching applications compared to previous series and competition. This is achieved by minimizing switching losses via ultra-low levels of E_{oss} (approximately 50 percent reduction compared to the CoolMOS™ CP), reduced Q_G and a careful balance of other relevant product key parameters. The low E_{oss} and Q_G also enable operation at higher switching frequency and related size-reduction of the circuit magnetics.

Reduction of E_{oss}

This together with several best-in-class $R_{DS(on)}$ offerings in established packages makes the CoolMOS™ C7 and C7 Gold series a key enabler for the highest power density. While the 650V CoolMOS™ C7 and (C7 Gold) G7 superjunction MOSFET series are solely designed for hard switching applications such as PFC, the 600 V version is also well suited for high-end LLC stages due to its rugged body diode that withstands slew rates up to 20 V/ns. The product portfolio contains TO-247 4pin, ThinPAK 8x8 and TO-Leadless packages which come with additional Kelvin source contacts enabling further efficiency advantages over the classical 3pin approach.

Key features of CoolMOS™ C7 and C7 Gold (G7)
› Reduced switching loss parameters such as Q_G, C_{oss}, enabling higher switching frequency
› 50 percent E_{oss} reduction compared to older CoolMOS™ CP
› Suitable for hard switching topologies (650 V and 600 V)
› Suitable for high-end resonant (600 V only) topologies
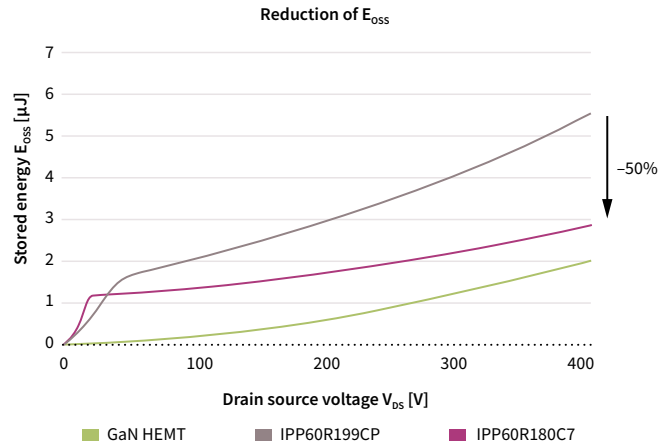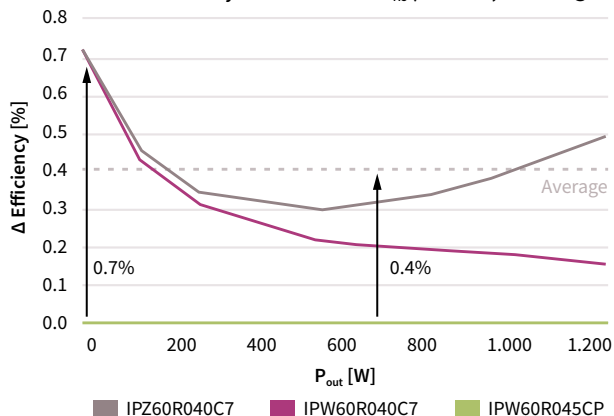
Key benefits of CoolMOS™ C7 and C7 Gold (G7)
› Increased efficiency in hard switching topologies such as PFC and TTF
› Reduced size and cost of magnetic components by increased switching frequency (e.g. 65 kHz -130 kHz)
› Increased power density by smaller packages for same $R_{DS(on)}$
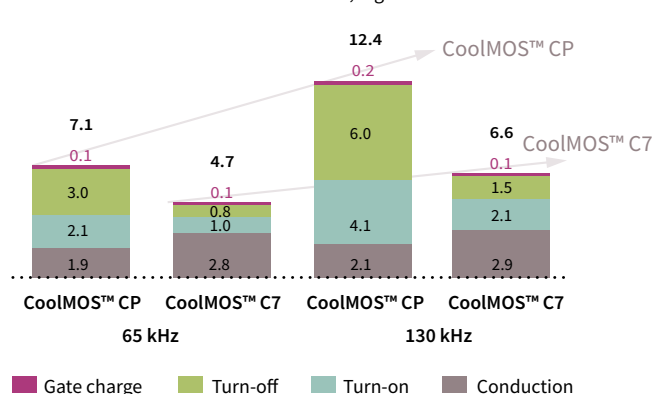
www.infineon.com/600V-c7
www.infineon.com/650V-c7
www.infineon.com/c7-gold-toll

600 V and 650 V CoolMOS™ C7 Gold SJ MOSFET in TO-Leadless package (G7) – High power goes SMD

Combining an improved 600 V resp. 650 V CoolMOS™ C7 technology (C7 Gold), low parasitic package inductance and a 4pin Kelvin source option with the outstanding thermal performance of the TOLL package, Infineon for the first time enables an SMD solution for mid to high power SMPS designs.

Key features of G7 technology in TOLL package

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

Key benefits of G7 technology in TOLL package

› Improved efficiency performance
› Improved power density
› Can be used in higher current applications
› Improved ease-of-use
› Highest quality
› Improved manufacturing

www.infineon.com/c7-gold-toll

CoolMOS™ CE SJ MOSFET

High voltage superjunction MOSFETs for consumer

CoolMOS™ CE is a product family launched by Infineon to address consumer and lighting applications. It offers benefits in efficiency and thermal behavior versus standard MOSFETs and has been optimized for ease-of-use and cost competitiveness, while at the same time delivering the right fit performance and excellent Infineon quality.

Application example: 10 W and 15 W smartphone charger

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

CoolMOS™ CE meets the standard efficiency requirements in charger application
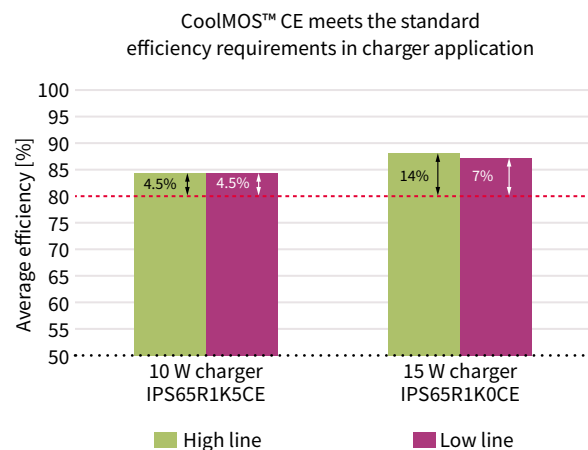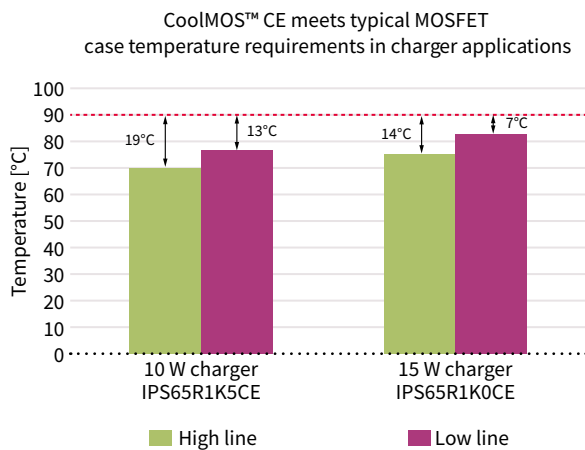
CoolMOS™ CE case temperature:
the maximum MOSFET case temperature is required to be below 90°C. CoolMOS™ CE meets this requirement and offers enough margin required for design-in flexibility.

CoolMOS™ CE efficiency performance:
CoolMOS™ CE meets the 80 percent standard efficiency requirement and offers enough margin required for design-in flexibility.

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
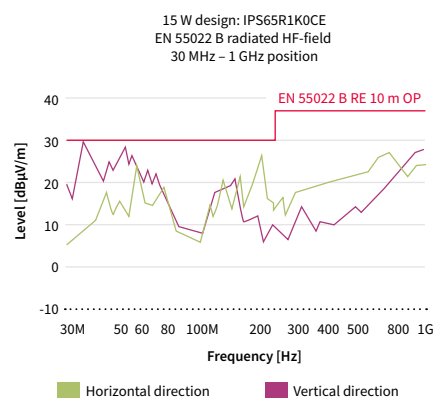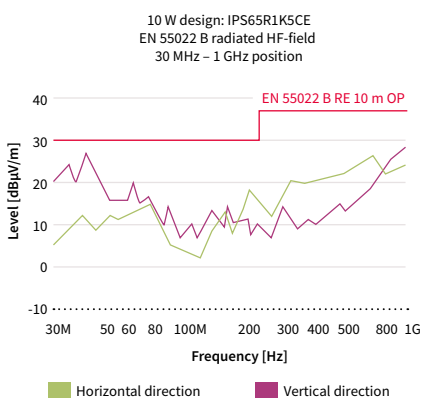
The performance of CoolMOS™ CE in the 10 W and 15 W design demonstrates that the series meets common EMI requirements for charger applications and thus, is also offering design-in flexibility.

CoolMOS™ CE customer benefits	
Product portfolio	We offer a broad portfolio covering five voltage classes in both through-hole and SMD packages
Capacity	We own the world largest capacity for power devices, with three dedicated frontends and four backends
Quality	Our field failure rates are as low as 0.1 DPM
Design-in support	We have a large field application engineering team to provide professional and flexible support for your design

www.infineon.com/ce

CoolMOS™ SJ MOSFET high power package innovations

Space saving and high performance packages

TO-247 4pin with asymmetric leads

For highest efficiency and controllability in high power SMPS markets

The TO-247 4pin package with asymmetric leads is an optimized version of the standard TO-247 4pin and enables highest efficiency and controllability in the high power SMPS market. The fourth pin acts as a Kelvin source. The main current of the switch is placed outside of the gate loop and the feedback is eliminated. This leads to less switching losses, especially at high currents. Secondly, the EMI will be reduced due to cleaner waveforms. In addition, the asymmetric leads further improve the ease-of-use in the design-in process. Compared to the standard TO-247 4pin the distance between the critical pins has been increased to enable simplified wave soldering and reduced board yield loss.

ThinPAK 8x8

Enabling significant space savings

With very small footprint of only 64 mm² (vs. 150 mm² for the D²PAK) and a very low profile with only 1 mm height (vs. 4.4 mm for the D²PAK) the ThinPAK 8x8 leadless SMD package for high voltage MOSFETs is a first choice to decrease system size in power-density driven designs. Low parasitic inductance and a separate 4pin Kelvin source connection offer best efficiency and ease-of-use. The package is RoHS compliant with Halogen free mold compound.

TO-Leadless

Optimized for high power applications

Combined with the latest CoolMOS™ C7 Gold (G7) technology, the TO-Leadless (TOLL) package is Infineon's flagship SMD package for high power/high current SMD solutions. Compared to D²PAK 7pin, TO-Leadless shows a 30 percent reduction in footprint, yet offers improved thermal performance. This and the 50 percent height reduction result in a significant advantage whenever highest power density is demanded. Equipped with 4pin Kelvin source connection and low parasitic inductances the package offers best efficiency and ease of use. The package is MSL1 compliant and reflow solderable.

www.infineon.com/thinpak8x8
www.infineon.com/toll

CoolMOS™ SJ MOSFET low power package innovations

Addressing today's consumer needs

Cost-effective drop-in replacement for DPAK

Solution for higher assembly yield in charger applications

Solution for height reduction in adapters and chargers

Improved creepage distance for open frame power supplies

SOT-223

The SOT-223 package without middle pin is a cost-effective alternative to DPAK, addressing the need for cost reductions in price sensitive applications. It offers a smaller footprint, while still being pin-to-pin compatible with DPAK, thus, allowing a drop-in replacement for DPAK and second sourcing. Moreover, SOT-223 achieves comparable thermal performance to DPAK and enables customers to achieve improved form factors or space savings in designs with low power dissipation.

IPAK Short Lead with ISO Standoff

With a well-defined mold feature at the bottom of the package body, the package allows to fully insert the MOSFET into the PCB, while preserving a well-defined isolation distance of 0.3 mm between PCB and package body. This way, the residues between these two can be effectively removed after cleaning, improving yield and reducing cost. It also helps to increase the effective creepage distance between the legs. The optimized leg width and length makes this package more suitable for chargers.

TO-220 FullPAK Narrow Lead

Infineon's TO-220 FullPAK Narrow Lead addresses customer needs with regards to height reduction requirements in adapter and charger applications. By offering an optimized standoff width and height and improved creepage distance, the package can be fully inserted into the PCB without any production concerns and, therefore, is especially suitable for slim and semi-slim adapter solutions.

TO-220 FullPAK Wide Creepage

This package solution has an increased creepage distance between the pins to 4.25 mm compared to 2.54 mm of a TO-220 FullPAK package. It targets open frame power supplies such as TV sets and PC power, where dust can enter the case through air vents. Dust particles can reduce the effective creepage between pins over time, which may lead to high voltage arcing. The package meets the requirements of open frame power supplies without any additional measures. Thus, it reduces system cost by offering an alternative to frequently used approaches to increase creepage distance.

www.infineon.com/sot-223
www.infineon.com/ipak-sl-isostandoff

www.infineon.com/to220-fp-narrowlead
www.infineon.com/to220-fp-widecreepage

CoolMOS™ SJ MOSFET for automotive

600 V CoolMOS™ CPA and 650 V CoolMOS™ CFDA – on the fast lane in automotive applications

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.

Product series	Key features	Applications	Quality
600 V CoolMOS™ CPA	**Best choice for demanding hard switching applications** › Lowest $R_{DS(on)}$ per package › Lowest gate charge value Q_G	› Hard switching topologies › PFC boost stages in on-board charger › Active clamp or two transistor forward in DC-DC converter	**Quality level well beyond the formal requirements of the AEC Q101 standard through** › Special screening measures in front end, back end › Mission-profile based qualification procedures
650 V CoolMOS™ CFDA	**Easy implementation of layout and design** › Integrated fast body diode › 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}	› Resonant switching topologies › DC-DC stage of OBC › LLC or full-bridge ZVS in DC-DC converter › HID lamp	

CoolMOS™ SJ MOSFET 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™ superjunction 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 of 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

+254%

1.000 cycles — AEC Q101
1.270 cycles — Customer mission profile
2.540 cycles — Infineon automotive robustness validation
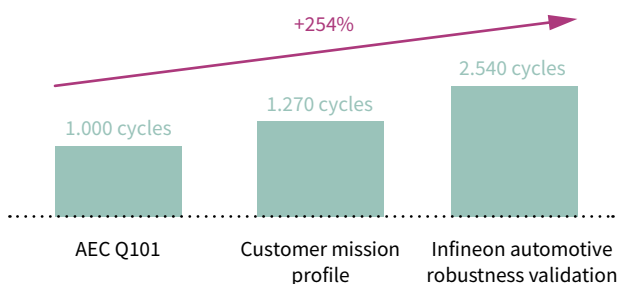
www.infineon.com/cfda
www.infineon.com/coolmos-automotive

CoolMOS™ SJ MOSFET 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 are 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**
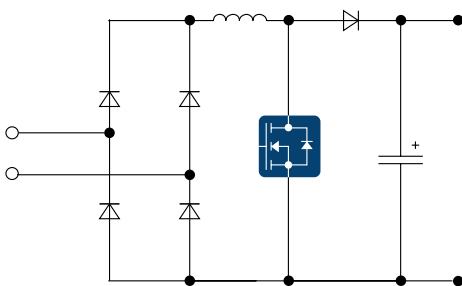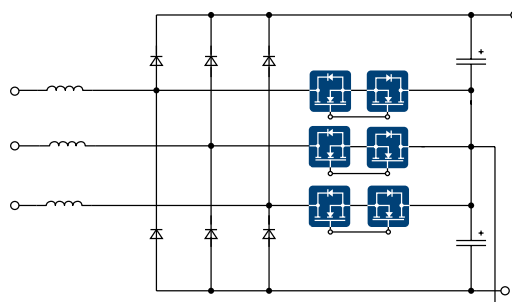
While for the lower power OBC solutions classic PFC approaches are the well-established approaches in the market, the Vienna Rectifier is the optimal solution for the higher power levels. As a true 3-phase topology, it delivers full power if attached to a 3-phase input but is flexible enough to run on 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. With CoolMOS™ you are ready to grab your share in the emerging high-power on board charger markets!

www.infineon.com/coolmos-automotive

CoolGaN™ 600 V e-mode GaN HEMTs

The highest efficiency and power density with reduced system costs

The enhancement mode (e-mode) concept offers fast turn-on and turn-off speed as well as a better path towards integration either on a chip or package level. CoolGaN™ enables simpler and more cost effective half-bridge topologies. Enhancement mode is more suitable for multi-chip integration. As enhancement mode based solutions reach maturity, ease-of-use and solution costs will make them the more prominent solution. The 600 V CoolGaN™ series is realized according to a specific, GaN-tailored qualification process which goes well beyond the standards for silicon power devices. 600 V CoolGaN™ is tailored for telecom, datacom and server SMPS, telecom rectifiers, mobile chargers as well as most of other industrial and consumer applications. It is the most robust and performing concept in the market. The CoolGaN™ portfolio is built around high performing SMD packages to fully exploit the benefits of GaN.

CoolGaN™ for PFC

CoolGaN™ enables the adoption of simpler half-bridge topologies (including elimination of the lossy input bridge rectifier). What results is the choice between either slightly improved efficiency with significant BOM cost savings or record efficiency (>99 percent) for a slight BOM premium

CoolGaN™ for resonant topologies

In resonant applications, 10x lower Q_{oss} and Q_G enables high frequency operations (>1 MHz) at the highest efficiency levels

› Linear output capacitance leads to 8 to 10 times lower dead-time
› Devices can be easily paralleled
› Power density can be pushed even further by optimizing the cooling approach
› CoolGaN™ enables to push the efficiency forward thus enabling further gain in power density e.g. in low power chargers

The highest quality

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

› Infineon qualifies GaN devices well beyond the standards
› 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 the next level of wide-bandgap quality

| Application profile | QRP – quality requirement profile | Degradation models | Rel. investigation at development phase |

Qualification plan

Released product

Efficiency versus load (f_{sw} = 65 kHz)*

99.18   99.33 99.33 99.31 99.25 99.17 99.07 99.00 98.90
98.75

IGO60R070D1

MEASURED VALUES
All available boards within +/- 0.1%

FLAT EFFICIENCY
> 99 % over wide load range

Efficiency [%] — Output power [W]

* No external power supplies – everything included.
V_{in} = 230 V_{AC}, V_{out} = 390 V_{DC}, $t_{ambient}$ = 25 °C

FB totempole

400 V
Q1
Q3
L1
AC IN
Q2
Q4
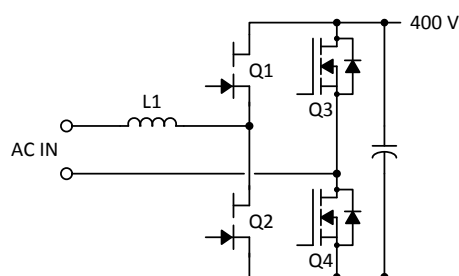
› 2x 70 mΩ CoolGaN™ in DSO-20 BSC
› 2x 33 mΩ CoolMOS™
   (2x 1EDI for GaN)
   (2x driver IC for CoolMOS™)

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Charger   Telecom   Server   Datacom

500 V-900 V MOSFETs

900 V CoolMOS™ C3 — ACTIVE & PREFERRED

Lighting | Server | Telecom | Consumer | Adapter

$R_{DS(on)}$ [mΩ]	TO-220	TO-262 (I²PAK)	TO-263 (D²PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)
120					IPW90R120C3	
340	IPP90R340C3	IPI90R340C3	IPB90R340C3	IPA90R340C3	IPW90R340C3	
500		IPI90R500C3		IPA90R500C3	IPW90R500C3	
800	IPP90R800C3			IPA90R800C3		
1000	IPP90R1K0C3			IPA90R1K0C3		
1200	IPP90R1K2C3	IPI90R1K2C3		IPA90R1K2C3		IPD90R1K2C3

800 V CoolMOS™ P7 — ACTIVE & PREFERRED

Adapter | LED | Audio | SMPS | AUX power

$R_{DS(on)}$ [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
280	IPP80R280P7	IPA80R280P7	IPW80R280P7	IPD80R280P7				IPAN80R280P7
360	IPP80R360P7	IPA80R360P7	IPW80R360P7	IPD80R360P7				IPAN80R360P7
450	IPP80R450P7	IPA80R450P7		IPD80R450P7				IPAN80R450P7
600	IPP80R600P7	IPA80R600P7		IPD80R600P7	IPU80R600P7	IPS80R600P7	IPN80R600P7	
750	IPP80R750P7	IPA80R750P7		IPD80R750P7	IPU80R750P7	IPS80R750P7	IPN80R750P7	
900/950	IPP80R900P7	IPA80R900P7		IPD80R900P7	IPU80R900P7	IPS80R900P7	IPN80R950P7	
1200	IPP80R1K2P7	IPA80R1K2P7		IPD80R1K2P7	IPU80R1K2P7	IPS80R1K2P7	IPN80R1K2P7	
1400	IPP80R1K4P7	IPA80R1K4P7		IPD80R1K4P7	IPU80R1K4P7	IPS80R1K4P7	IPN80R1K4P7	
2000				IPD80R2K0P7	IPU80R2K0P7	IPS80R2K0P7	IPN80R2K0P7	
2400				IPD80R2K4P7	IPU80R2K4P7	IPS80R2K4P7	IPN80R2K4P7	
3300				IPD80R3K3P7	IPU80R3K3P7		IPN80R3K3P7	
4500				IPD80R4K5P7	IPU80R4K5P7		IPN80R4K5P7	

800 V CoolMOS™ CE

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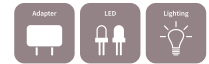
$R_{DS(on)}$ [mΩ]	TO-220	TO-220 FullPAK	TO-247	TO-252 (DPAK)	TO-251 (IPAK)	TO-251 (IPAK Short Lead)
310		IPA80R310CE				
460		IPA80R460CE				
650		IPA80R650CE				
1000		IPA80R1K0CE		IPD80R1K0CE	IPU80R1K0CE	
1400		IPA80R1K4CE		IPD80R1K4CE		
2800				IPD80R2K8CE		

800 V CoolMOS™ C3

Adapter | Lighting | Solar | Consumer | Server | Telecom

$R_{DS(on)}$ [mΩ]	TO-220	TO-262 (I²PAK)	TO-263 (D²PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)
85					SPW55N80C3	
290	SPP17N80C3		SPB17N80C3	SPA17N80C3	SPW17N80C3	
450	SPP11N80C3			SPA11N80C3	SPW11N80C3	
650	SPP08N80C3			SPA08N80C3		
900	SPP06N80C3			SPA06N80C3		SPD06N80C3
1300	SPP04N80C3			SPA04N80C3		SPD04N80C3
2700				SPA02N80C3		SPD02N80C3

700 V CoolMOS™ P7 — ACTIVE & PREFERRED

Charger | Adapter | LCD TV | Lighting | Audio | AUX power

$R_{DS(on)}$ [mΩ]	TO -220	TO – 262 (I²PAK)	TO-251 (IPAK Short Lead)	TO-220 FullPAK	TO-247	TO-252 (DPAK)	TO-220 FullPAK narrow lead	TO-251 (IPAK Short Lead w/ ISO Standoff)	SOT-223
360			IPS70R360P7S	IPA70R360P7S		IPD70R360P7S	IPAN70R360P7S	IPSA70R360P7S	IPN70R360P7S
450				IPA70R450P7S			IPAN70R450P7S	IPSA70R450P7S	IPN70R450P7S
600			IPS70R600P7S	IPA70R600P7S		IPD70R600P7S	IPAN70R600P7S	IPSA70R600P7S	IPN70R600P7S
750				IPA70R750P7S			IPAN70R750P7S	IPSA70R750P7S	IPN70R750P7S
900			IPS70R900P7S	IPA70R900P7S		IPD70R900P7S	IPAN70R900P7S	IPSA70R900P7S	IPN70R900P7S
1200								IPSA70R1K2P7S	IPN70R1K2P7S
1400			IPS70R1K4P7S			IPD70R1K4P7S		IPSA70R1K4P7S	IPN70R1K4P7S
2000								IPSA70R2K0P7S	IPN70R2K0P7S

700 V CoolMOS™ CE

Adapter | LED | Charger
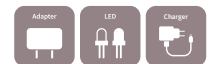
$R_{DS(on)}$ [mΩ]	TO-220	TO-220 FullPAK Wide Creepage	TO-262 (I²PAK)	TO-251 (IPAK Short Lead with ISO Standoff)	TO-252 (DPAK)	TO-251 (IPAK)	TO-251 (IPAK Short Lead)	SOT-223
600		IPAW70R600CE		IPSA70R600CE	IPD70R600CE			
950		IPAW70R950CE	IPI70R950CE	IPSA70R950CE	IPD70R950CE		IPS70R950CE	
1000								IPN70R1K0CE
1400				IPSA70R1K4CE	IPD70R1K4CE		IPS70R1K4CE	
1500								IPN70R1K5CE
2000				IPSA70R2K0CE	IPD70R2K0CE		IPS70R2K0CE	
2100								IPN70R2K1CE

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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 (D²PAK)	TO-220 FullPAK	TO-247	TO-247 4pin	TO-252 (DPAK)	ThinPAK 8x8
19				IPW65R019C7	IPZ65R019C7		
45	IPP65R045C7	IPB65R045C7	IPA65R045C7	IPW65R045C7	IPZ65R045C7		
65	IPP65R065C7	IPB65R065C7	IPA65R065C7	IPW65R065C7	IPZ65R065C7		
70							IPL65R070C7
95	IPP65R095C7	IPB65R095C7	IPA65R095C7	IPW65R095C7	IPZ65R095C7		
99							IPL65R099C7
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

$R_{DS(on)}$ [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			IPN65R1K5CE	

650 V CoolMOS™ CFD2

$R_{DS(on)}$ [mΩ]	TO-220	TO-262 (I²PAK)	TO-263 (D²PAK)	TO-220 FullPAK	TO-247	TO-252 (DPAK)	ThinPAK 8x8
41					IPW65R041CFD		
80					IPW65R080CFD		
110	IPP65R110CFD		IPB65R110CFD	IPA65R110CFD	IPW65R110CFD		
150	IPP65R150CFD	IPI65R150CFD	IPB65R150CFD	IPA65R150CFD	IPW65R150CFD		
165							IPL65R165CFD
190	IPP65R190CFD	IPI65R190CFD	IPB65R190CFD	IPA65R190CFD	IPW65R190CFD		
210							IPL65R210CFD
310	IPP65R310CFD	IPI65R310CFD	IPB65R310CFD	IPA65R310CFD			
340							IPL65R340CFD
420	IPP65R420CFD			IPA65R420CFD	IPW65R420CFD	IPD65R420CFD	
460							IPL65R460CFD
660				IPA65R660CFD		IPD65R660CFD	
950						IPD65R950CFD	
1400						IPD65R1K4CFD	

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600 V CoolMOS™ P7   ACTIVE & PREFERRED
Industrial grade

$R_{DS(on)}$ [mΩ]	TO -220	TO-220 FullPAK	TO-247	TO-247 4pin asymmetric leads	TO-252 (DPAK)	TO-220 FullPAK Wide Creepage	ThinPAK 8x8	D²PAK
37			IPW60R037P7	IPZA60R037P7				
60	IPP60R060P7	IPA60R060P7	IPW60R060P7	IPZA60R060P7				IPB60R060P7
65							IPL60R065P7	
80	IPP60R080P7	IPA60R080P7	IPW60R080P7	IPZA60R080P7			IPL60R085P7	IPB60R080P7
99	IPP60R099P7	IPA60R099P7	IPW60R099P7	IPZA60R099P7				IPB60R099P7
105							IPL60R105P7	
120	IPP60R120P7	IPA60R120P7	IPW60R120P7	IPZA60R120P7				IPB60R120P7
125							IPL60R125P7	
180	IPP60R180P7	IPA60R180P7	IPW60R180P7	IPZA60R180P7	IPD60R180P7			IPB60R180P7
185							IPL60R185P7	
280	IPP60R280P7	IPA60R280P7			IPD60R280P7			IPB60R280P7
285							IPL60R285P7	
360	IPP60R360P7	IPA60R360P7			IPD60R360P7			IPB60R360P7
365							IPL60R365P7	
600	IPP60R600P7	IPA60R600P7			IPD60R600P7			

600 V CoolMOS™ P7   ACTIVE & PREFERRED
Standard grade

$R_{DS(on)}$ [mΩ]	TO -220	TO-220 FullPAK	TO-247	TO-247 4pin	TO-252 (DPAK)	TO-220 FullPAK Wide Creepage	ThinPAK 8x8	SOT-223
180		IPA60R180P7S			IPD60R180P7S	IPAW60R180P7S		
280		IPA60R280P7S			IPD60R280P7S	IPAW60R280P7S		
360		IPA60R360P7S			IPD60R360P7S	IPAW60R360P7S		IPN60R360P7S
600		IPA60R600P7S			IPD60R600P7S	IPAW60R600P7S		IPN60R600P7S

600 V CoolMOS™ CFD7   ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-263 (D²PAK)	TO-220 FullPAK	TO-247	TO-247 4pin	TO-252 (DPAK)	ThinPAK 8x8
31				IPW60R31CFD7			
40				IPW60R40CFD7			
55				IPW60R55CFD7			
70	IPP60R70CFD7			IPW60R70CFD7			
75							IPL60R75CFD7
90	IPP60R90CFD7			IPW60R90CFD7			
125	IPP60R125CFD7		IPA60R125CFD7	IPW60R125CFD7			
170	IPP60R170CFD7		IPA60R170CFD7	IPW60R170CFD7		IPD60R170CFD7	
185							IPL60R185CFD7
280	IPP60R280CFD7		IPA60R280CFD7			IPD60R280CFD7	

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

$R_{DS(on)}$ [mΩ]	TO -220	TO-Leadless (TOLL)	TO-220 FullPAK	TO-247	TO-252 (Quadruple DPAK)	TO-247 4 pin	TO-252 (Double DPAK)	ThinPAK 8x8
28		IPT60R028G7			IPDQ60R028G7*			
50		IPT60R050G7			IPDQ60R050G7*		IPDD60R050G7*	
80		IPT60R080G7			IPDQ60R080G7*		IPDD60R080G7*	
102		IPT60R102G7			IPDQ60R102G7*		IPDD60R102G7*	
125		IPT60R125G7					IPDD60R125G7*	
150		IPT60R150G7					IPDD60R150G7*	
190							IPDD60R190G7*	

600 V CoolMOS™ C7   ACTIVE & PREFERRED

$R_{DS(on)}$ [mΩ]	TO-220	TO-263 (D²PAK)	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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*coming soon

500 V-900 V MOSFETs

600 V CoolMOS™ P6

$R_{DS(on)}$ [mΩ]	TO-220	TO-263 (D²PAK)	TO-220 FullPAK	TO-247	TO-247 4pin	TO-252 (DPAK)	ThinPAK 5x6	ThinPAK 8x8
41				IPW60R041P6				
70				IPW60R070P6	IPZ60R070P6			
99	IPP60R099P6		IPA60R099P6	IPW60R099P6	IPZ60R099P6			
125	IPP60R125P6		IPA60R125P6	IPW60R125P6				
160	IPP60R160P6	IPB60R160P6	IPA60R160P6	IPW60R160P6				
180								IPL60R180P6
190	IPP60R190P6		IPA60R190P6	IPW60R190P6				
210								IPL60R210P6
230		IPB60R230P6	IPA60R230P6					
255								
280	IPP60R280P6	IPB60R280P6	IPA60R280P6	IPW60R280P6				
330/360		IPB60R330P6					IPL60R360P6S	
380			IPA60R380P6			IPD60R380P6		
600		IPB60R600P6	IPA60R600P6			IPD60R600P6		
650							IPL60R650P6S	

600 V CoolMOS™ CE

$R_{DS(on)}$ [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				IPD60R800CE		IPS60R800CE		IPAN60R800CE
1000	IPA60R1K0CE			IPD60R1K0CE	IPU60R1K0CE	IPS60R1K0CE	IPN60R1K0CE	
1500	IPA60R1K5CE			IPD60R1K5CE	IPU60R1K5CE	IPS60R1K5CE	IPN60R1K5CE	
2100				IPD60R2K1CE	IPU60R2K1CE	IPS60R2K1CE	IPN60R2K1CE	
3400				IPD60R3K4CE		IPS60R3K4CE	IPN60R3K4CE	

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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-220 FullPAK Narrow Lead
190	IPP50R190CE	IPA50R190CE						
280	IPP50R280CE	IPA50R280CE		IPD50R280CE				
380	IPP50R380CE	IPA50R380CE		IPD50R380CE				
500		IPA50R500CE		IPD50R500CE				IPAN50R500CE
650				IPD50R650CE			IPN50R650CE	
800		IPA50R800CE		IPD50R800CE			IPN50R800CE	
950		IPA50R950CE		IPD50R950CE			IPN50R950CE	
1400				IPD50R1K4CE			IPN50R1K4CE	
2000				IPD50R2K0CE			IPN50R2K0CE	
3000				IPD50R3K0CE			IPN50R3K0CE	

500 V CoolMOS™ CP

R$_{DS(on)}$ [mΩ]	TO-220	TO-220 FullPAK	TO-247	TO-252 (DPAK)	TO-262 (I²PAK)	TO-263 (D²PAK)	TO-251 (IPAK Short Lead)
140	IPP50R140CP	IPA50R140CP	IPW50R140CP			IPB50R140CP	
199	IPP50R199CP	IPA50R199CP				IPB50R199CP	
250	IPP50R250CP	IPA50R250CP	IPW50R250CP				
299	IPP50R299CP						
350	IPP50R350CP	IPA50R350CP			IPI50R350CP		
399	IPP50R399CP			IPD50R399CP	IPI50R399CP		
520	IPP50R520CP			IPD50R520CP			IPS50R520CP

600 V CoolGaN™ **

R$_{DS(on)}$ [mΩ]	DSO-20-85	DSO-20-87	HSOF-8-3 (TOLL)	DFN 8 x 8
70	IGO60R070D1	IGOT60R070D1	IGT60R070D1	IGLD60R070D1
190			IGT60R070D1S*	IGLD60R190D1

All parts are industrial grade qualified
*Standard grade
** Full production Q4/2018

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500 V–900 V MOSFETs

CoolMOS™ SJ MOSFET 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	99	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	99	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	99	31	93	-20 … 20	60	0.5	TO-247
IPI60R099CPA	99	31	93	-20 … 20	60	0.5	TO-262

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

SOT-223

Voltage [V]	Series	R$_{DS(on)}$ [mΩ]								
		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	P7						360	600			
	CE									1000/1500	2100/3400
650	CE									1500	
700	P7						360	450/600	700	900/1200/1400	2000
	CE									1000/1500/2100	
800	P7								650/750	950/1200/1400	2000/2400/3300/4500

TO-247

Voltage [V]	Series	R$_{DS(on)}$ [mΩ]								
		0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	CP			140		250					
600	P7	37	60/80	99/120	180						
	C7	17/40	60	99/120	180						
	P6	41	70	99/125	160/190	280					
	CFD7	31/40/55	70	90/125	170						
	CPA	45	75	99							
650	C7	19/45	65	95/125	190						
	CFD2	41	80	110	150/190			420			
	CFDA	48	80	110	150/190						
800	P7					280	360				
	C3		85			290		450			
900	C3			120			340	500			

TO-247 4pin

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

TO-247 4pin asymmetric leads

Voltage [V]	Series	R$_{DS(on)}$ [mΩ]								
		0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
600	P7	37	60/80	99/120	180						

IPAK

Voltage [V]	Series	R$_{DS(on)}$ [mΩ]								
		0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
600	CE									1000/1500	2100
800	P7							600	750	900/1200/1400	2000/2400 3300/4500
	CE									1000	

ACTIVE & PREFERRED

www.infineon.com/coolmos-latest-packages

IPAK Short Lead

Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
							$R_{DS(on)}$ [mΩ]				
500	CP							520			
600	CE						400	460	650/800	1000/1500	2100/3400
650	CE						400		650	1000	
700	P7						360/600			900/1400	
700	CE									950/1400	2000
800	P7						600	750		900/1200/1400	2000/2400

IPAK Short Lead with ISO Standoff

Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
							$R_{DS(on)}$ [mΩ]				
700	P7						300	450/600	750	900/1200/1400	2000
700	CE							600		950/1400	2000

DPAK

Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
							$R_{DS(on)}$ [mΩ]				
500	CE					280	380	500	650/800	950/1400	2000/3000
500	CP						399	520			
600	P7				180	280	360	600			
600	C7				180						
600	CE						400	460	650/800	1000/1500	2100/3400
600	P6						380	600			
600	CFD7				170	280					
650	C7				190	225					
650	CE						400		650	1000/1500	
650	CFD2							420	660	950/1400	
650	CFDA							420	660		
700	P7						360	600		900/1400	
700	CE							600		950/1400	2000
800	P7					280	360	450/600	750	900/1200/1400	2000/2400 3300/4500
800	C3									900/1300	2700
800	CE									1000/1400	2800
900	C3									1200	

I²PAK

Voltage [V]	Series	0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
							$R_{DS(on)}$ [mΩ]				
500	CP						350/399				
600	CPA			99							
650	CFD2				150/199		310				
700	CE									950	
900	C3						340	500		1200	

ACTIVE & PREFERRED

www.infineon.com/coolmos-latest-packages

D²PAK

Voltage [V]	Series	R_DS(on) [mΩ]									
		0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	CP			140	199						
600	C7	40	60	99/120	180						
	P6				160	230/280	330	600			
	P7		60/80	99/120	180	280	360				
	CPA			99	199	299					
650	C7	45	65	95/125	190	225					
	CFD2			110	150/190		310				
	CFDA			110	150/190		310		660		
800	C3					290					
900	C3						340				

DDPAK

Voltage [V]	Series	R_DS(on) [mΩ]									
		0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
600	G7	50	80	102/125	150/190						

QDPAK

Voltage [V]	Series	R_DS(on) [mΩ]									
		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							

TO-220 FullPAK

Voltage [V]	Series	R_DS(on) [mΩ]									
		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	800	950	
	CP			140	199	250	350				
600	P7		60/80	99/120	180	280	360	600			
	C7		60	99/120	180						
	CE						400	460	650	1000/1500	
	CFD7			125	170	280					
	P6			99/125	160/190	230/280	380	600			
650	C7	45	65	95/125	190	225					
	CE						400		650	1000/1500	
	CFD2			110	150/190		310	420	660		
700	P7						360	450/600	750	900	
800	P7					280	360	450/600	750	900/1200/1400	
	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

Voltage [V]	Series	R_DS(on) [mΩ]									
		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		
700	P7						360	450/600	750	900	
800	P7					280	360	450			

TO-Leadless

Voltage [V]	Series	R_DS(on) group [mΩ]									
		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						

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500 V-900 V MOSFETs

TO-220

Voltage [V]	Series	$R_{DS(on)}$ [mΩ]									
		0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
500	CE				190	280	380				
	CP			140	199	250/299	350/399	520			
600	P7		60/80	99/120	180	280	360	600			
	C7	40	60	99/120	180						
	P6			99/125	160/190	280					
	CFD7		70	90/125	170	280					
	CPA			99							
650	C7	45	65	95/125	190	225					
	CFD2			110	150/190		310	420			
	CFDA			110	150/190		310		660		
800	P7					280	360	450/600	750	900/1200/1400	
	C3					290		450	650	900/1300	
900	C3						340		800	1000/1200	

TO-220 FullPAK Wide Creepage

Voltage [V]	Series	$R_{DS(on)}$ [mΩ]									
		0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
600	P7				180	280	360	600			
	CE				190	280	380	600			
700	CE							600		950	

ThinPAK 5 x 6

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

ThinPAK 8 x 8

Voltage [V]	Series	$R_{DS(on)}$ [mΩ]									
		0-59	60-89	90-149	150-199	200-299	300-400	401-600	601-899	900-1500	>1500
600	P7		65/85	105/125	185	285	365				
	C7		65	104/125	185						
	CFD7		75		185						
	P6				180	210					
650	C7		70	99/130	195	230					
	CFD2				165	210	340	460			

ACTIVE & PREFERRED

www.infineon.com/coolmos-latest-packages

Naming system

Power MOSFETs (naming system until 2005)

| S | P | P | 20 | N | 60 | C | 3 |

Company
S = Formerly Siemens

Device
P = Power MOSFET

Package type
A = TO-220 FullPAK
B = TO-263 (D²PAK)
D = TO-252 (DPAK)
I = TO-262 (I²PAK)
N = SOT-223
P = TO-220
U = TO-251 (IPAK)
W = TO-247
Z = TO-247 4pin

Specifications
C3 = CoolMOS™ C3
S5 = CoolMOS™ S5

Breakdown voltage
Divided by 10 (60x10 = 600 V)

Technology
N = N-channel transistors

Continuous drain current
(@ T_C = 25°C) [A]
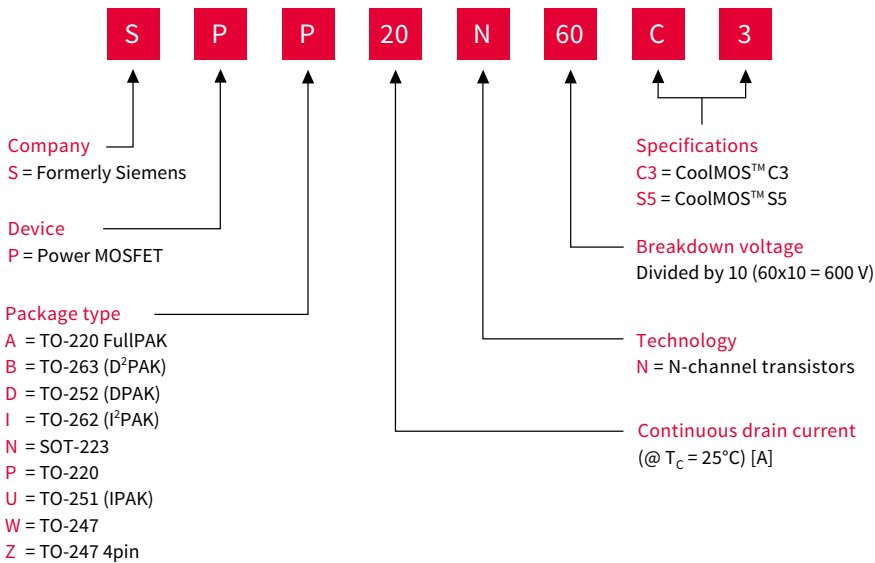
Power MOSFETs (naming system from October 2015 onwards)

| I | P | DD | 80 | R | 190 | P7 | ☐ |

Company
I = Infineon

Device
P = Power MOSFET

Package type (max. 2 digits)
A = TO-220 FullPAK
B = TO-263 (D²PAK)
C = Bare die
D = TO-252 (DPAK)
I = TO-262 (I²PAK)
L = ThinPAK 8x8
N = SOT-223
P = TO-220
S = TO-251 (IPAK Short Lead)
U = TO-251 (IPAK Long Lead)
W = TO-247
Z = TO-247 4pin
T = TO-Leadless
DD = TO-252 (Double DPAK)
AW = TO-220 (Wide Creepage)
AN = TO-220 (Narrow Lead)
LS = ThinPAK 5x6
LK = ThinPAK 5x6 Kelvin source
DQ = TO-252 (Quadruple DPAK)
SA = TO-251 (IPAK Short Lead with ISO Standoff)
ZA = TO-247 4pin asymmetric

Reliability grade
blank = Industrial
A = Automotive
S = Standard

Series name (2-4 digits)
In this case CoolMOS™ P7
(max. digits e.g. CFD7)

$R_{DS(on)}$ [mΩ]

R = $R_{DS(on)}$
As a seperator between voltage und $R_{DS(on)}$

Breakdown voltage
Divided by 10 (80x10 = 800 V)

500 V-900 V MOSFETs

Automotive MOSFETs

I	P	P	60	R	099	C	P	A

Company
I = Infineon

Device
P = Power MOSFET

Package type
B = PG-TO-263 (D²PAK)
I = PG-TO-262 (I²PAK)
P = PG-TO-220

Automotive

Series name
CoolMOS™ CP and CoolMOS™ CFD

$R_{DS(on)}$ [mΩ]

R = $R_{DS(on)}$

Breakdown voltage
Divided by 10 (60x10 = 600 V)

CoolGaN™

I	G	T	60	R	070	D	1	

Company
I = Infineon

Technology
G = GaN

Package type
LD = DFN 8 x 8-LSON
T = TOLL
O = DSO20-BSC
OT = DSO20-TSC

Voltage
Divided by 10 (60x10 = 600 V)

Reliability grade
blank = Industrial
A = Automotive
S = Standard

Generation
1 = 1st generation

Product type
D = Discrete
S = System

$R_{DS(on)}$ [mΩ]

R = $R_{DS(on)}$

Infineon support for high voltage MOSFETs

Useful links and helpful information

Further information, datasheets and documents

www.infineon.com/coolmos

www.infineon.com/coolmos-latest-packages

www.infineon.com/coolmos-automotive

www.infineon.com/gan

Evaluationboards and simulation models

www.infineon.com/coolmos-boards

www.infineon.com/powermosfet-simulationmodels

Videos

www.infineon.com/mediacenter

| Info | Document | Evaluation Board | Simulation | Play |
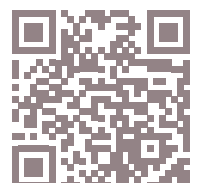
Silicon Carbide

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 and the revolutionary CoolSiC™ MOSFET is now also 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
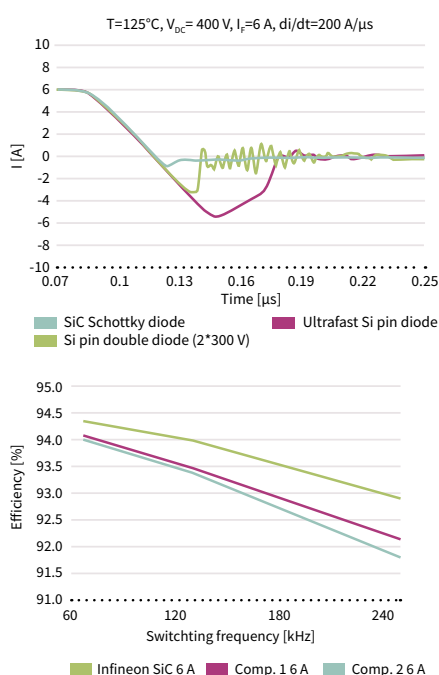> Low turn-off losses
> Reduction of CoolMOS™ or IGBT turn-on loss
> Switching losses independent from load current, switching speed and temperature

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
> EV charging
> Energy storage
> PC power
> Motor drives
> Lighting

T=125°C, V_{DC}= 400 V, I_F=6 A, di/dt=200 A/µs

SiC Schottky diode
Ultrafast Si pin diode
Si pin double diode (2*300 V)

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.

Infineon SiC 6 A
Comp. 1 6 A
Comp. 2 6 A

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.

CoolSiC™ Schottky diodes 650 V

## CoolSiC™ Schottky diodes 650 V G6

The new CoolSiC™ Schottky diode 650 V G6 product family is built over the strong characteristics of the previous generation G5, fully leveraging technology and process innovation to propose the best efficiency and price/performance products to date.

The established CoolSiC™ Schottky diodes G5 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.
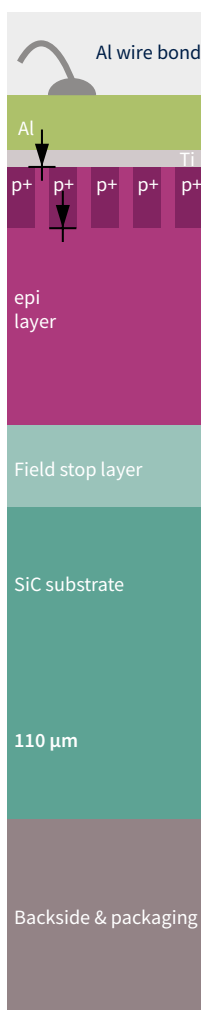
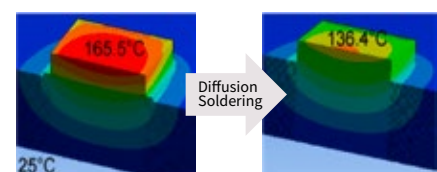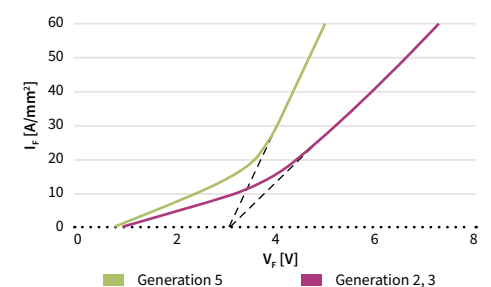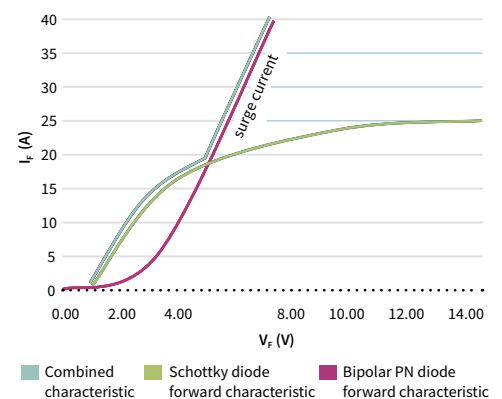### Junction: merged PN structure
On the junction level, it has an optimized merged PN structure. Compared to competitors, Infineon's SiC diode has additional P doped area, together with the N doped EPI layer, it forms a PN junction diode. Thus it is a combination of Schottky diode and PN Junction diode. 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.


Combined characteristic · Schottky diode forward characteristic · Bipolar PN diode forward characteristic

Generation 5 · Generation 2, 3

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

www.infineon.com/sic

On the top of these technologies, the CoolSiC™ Schottky diodes G6 product family introduces a novel and proprietary Schottky metal system. This contributes to lower the V_F (forward voltage) to levels difficult to match by competition, determining a measurable decrease of the conduction losses.
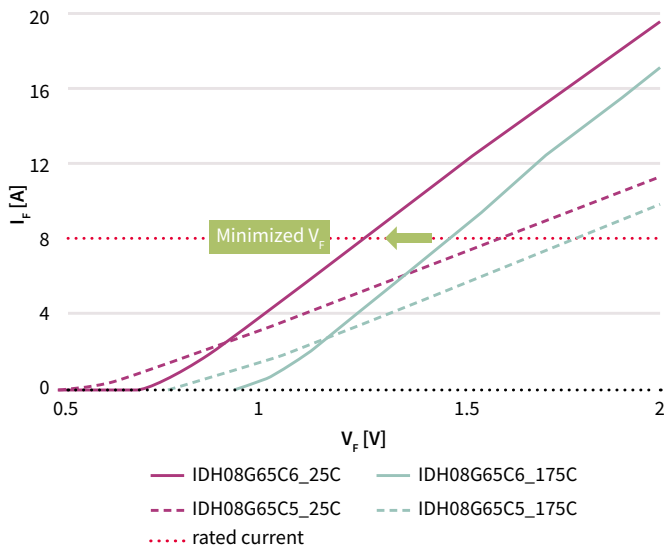
Infineon's CoolSiC™ Schottky diodes offer the optimum efficiency and ruggedness. Lower V_F means lower conduction loss and lower Q_c means lower switching loss. Q_c x V_F is the figure of merit for efficiency and a comparison indicates that the latest generation 6 boasts the lowest Q_c x V_F on the market. Infineon's CoolSiC™ Schottky diodes offer 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.

Efficiency comparison
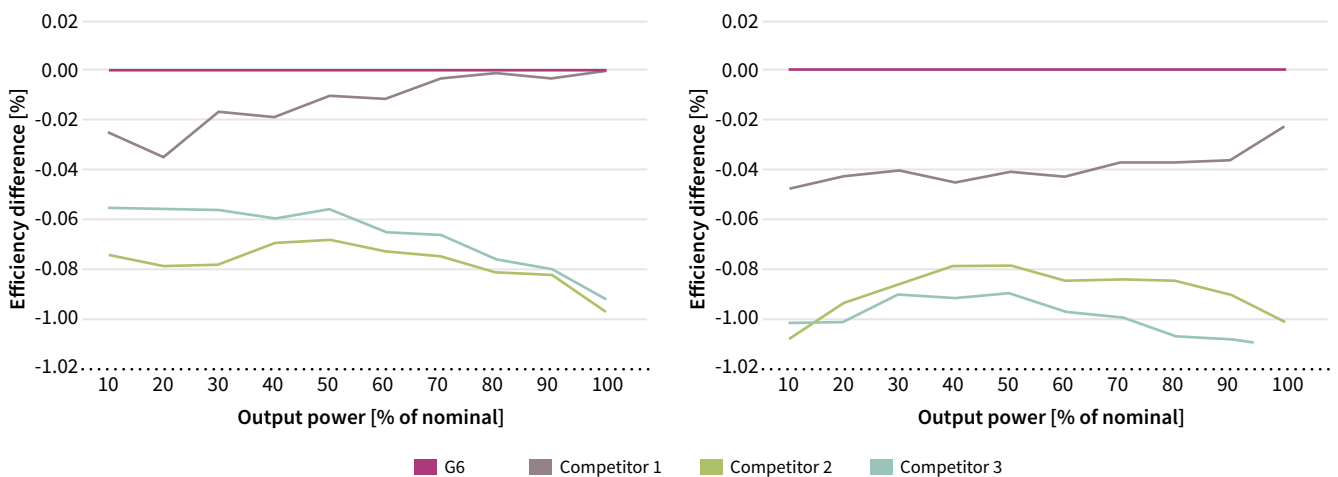
In terms of efficiency, the 8 A G6 device has been tested in CCM PFC. The maximum output power is 3.5 kW. The left figure shows the relative efficiency at 65 KHz, while the right figure shows the relative efficiency at 130 kHz. This shows that Infineon's CoolSiC™ Schottky diode G6 delivers better efficiency over the full load range, keeping this advantage at 130 kHz, therefore meeting the needs of those designers who want to increase the switching frequencies in their designs to attain more power density.

www.infineon.com/coolsic-g6

The best price performance

CoolSiC™ Schottky diodes G6 are the outcome of Infineon's continuous technological and process improvements, enabling the design and development of SiC, getting more price competitive and increasing performance across generations. As a result, G6 is Infineon's best price/performance CoolSiC™ Schottky diode generation, offering the best efficiency per dollar. In addition, Infineon offers the peace of mind of dealing with an industry leader. Customers can leverage the Infineon acknowledged quality and proven supply chain reliability. They can benefit from "one-stop-shop" advantages and maximize system performance, combining CoolSiC™ Schottky diodes with the superjunction MOSFETs of the CoolMOS™ 7 family such as 600 V C7, 650 V C7, 600 V G7, 650 V G7 and 600 V P7.

Price

G2*

G3

G5

G6

* G2 is discontinued

Performance (efficiency, density)

www.infineon.com/coolsic-g6
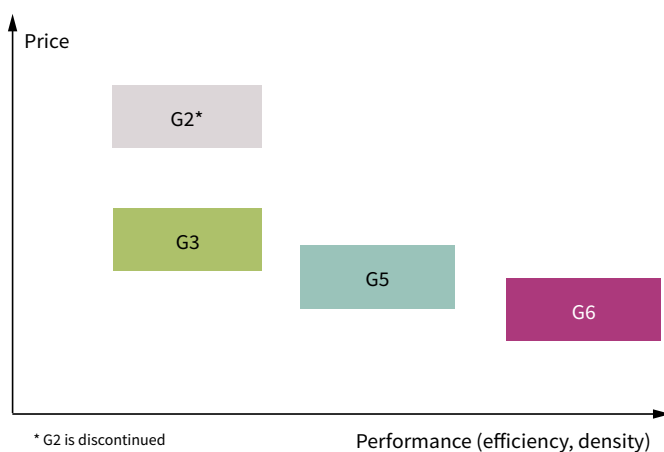
CoolSiC™ Schottky diodes 1200 V

New level of system efficiency and reliability

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 CoolSiC™ Schottky diodes 1200 V G5 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 CoolSiC™ diodes generation 5 in combination with Infineon's 1200 V HighSpeed 3 IGBT, designers can achieve outstanding system level performance and reliability.
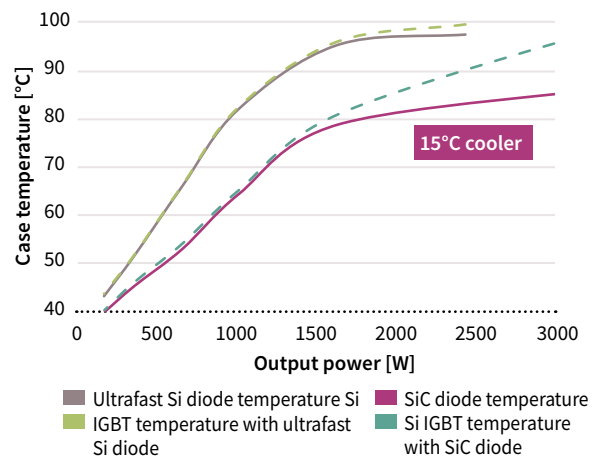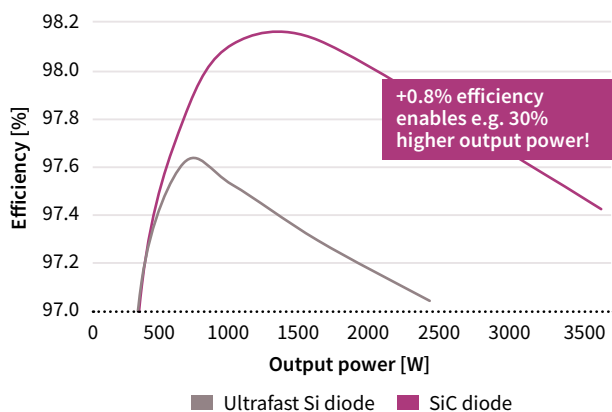
Key features generation 5

› 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

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

1200 V Si IGBT + SiC diode or ultrafast Si diode in a boost stage topology, f_{sw} = 20 kHz

+0.8% efficiency enables e.g. 30% higher output power!

Ultrafast Si diode   SiC diode

15°C cooler

Ultrafast Si diode temperature Si
IGBT temperature with ultrafast
Si diode

SiC diode temperature
Si IGBT temperature
with SiC diode

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

Inverter function	SiC diode	IGBT	IGBT driver	Microcontroller
Boost	IDH08G120C5	IKW15N120H3	1ED020I12-F2	XMC4000
Boost	IDH10G120C5	IKW25N120H3	1ED020I12-F2	XMC4000
Boost	IDW10G120C5B	IKW40N120H3	1ED020I12-F2	XMC4000

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 low switching losses with 1200 V switches, very low 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 with high performance and high reliability. CoolSiC™ MOSFET first products are targeted for photovoltaic inverters, battery charging and energy storage.

CoolSiC™ MOSFET features
> Very low switching losses with temperature independent
> Very low reverse recovery losses of body diode
> Fully controllable dv/dt
> Threshold-free on-state characteristic compared to IGBT
> IGBT-compatible driving voltage (15 V for turn-on)
> Benchmark gate threshold voltage, $V_{GS(th)}$=4.5 V

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

CoolSiC™ Schottky diodes 650 V G6   ACTIVE & PREFERRED

I_F [A]	TO-220 R2L	TO-247 Dual Die	TO-247	D²PAK R2L	ThinPAK 8x8
4	IDH04G65C6				
6	IDH06G65C6				
8	IDH08G65C6				
10	IDH10G65C6				
12	IDH12G65C6				
16	IDH16G65C6				
20	IDH20G65C6				

CoolSiC™ Schottky diodes 650 V G5   ACTIVE

I_F [A]	TO-220 R2L	TO-247 Dual Die	TO-247	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

CoolSiC™ Schottky diodes 650 V G3 `ACTIVE`

I_F [A]	TO-220 R2L	TO-247 Dual Die	TO-247	DPAK R2L	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		

CoolSiC™ Schottky diodes 1200 V G5 `ACTIVE & PREFERRED`

I_F [A]	TO-220 R2L	TO-247 Dual Die	TO-247	TO-247 R2L	DPAK R2L
2	IDH02G120C5				IDM02G120C5
5	IDH05G120C5				IDM02G120C5
8	IDH08G120C5				IDM08G120C5
10	IDH10G120C5	IDW10G120C5B		IDWD10G120C5*	IDM10G120C5
15/16	IDH16G120C5	IDW15G120C5B		IDWD15G120C5*	
20	IDH20G120C5	IDW20G120C5B		IDWD20G120C5*	
30		IDW30G120C5B		IDWD30G120C5*	
40		IDW40G120C5B		IDWD40G120C5*	

„B" in product name refers to common-cathode configuration

www.infineon.com/sic

* coming 2018

Naming system

CoolSiC™ Schottky diodes G2 and G3

I	D	H	X	S	G	X	C

Company
I = Infineon

Device
D = Diode

Package Type
D = DPAK
H = TO-220 R2L
B = D²PAK
D = DPAK = TO-220
V = TO-220 FullPAK
W = TO-247

Continuous forward current
[A]

Technology
S = SiC diode

G = Low thermal resistance
(diffusion soldering)

Breakdown voltage
60 = 600 V
120 = 1200 V

Specifications
C = Surge current stable

CoolSiC™ Schottky diodes G5 and G6

I	D	WD	X	G	X	C	5	B

Company
I = Infineon

Device
D = Diode

Package type
H = TO-220 R2L
W = TO-247
K = D²PAK R2L
L = ThinPAK 8x8
M = DPAK R2L
WD = TO-247 R2L

Continuous forward current
[A]

G = Low thermal resistance

Breakdown voltage
65 = 650 V
120 = 1200 V

Specifications
C = Surge current stable

Series name
5 = Generation 5
6 = Generation 6

B = Common-cathode configuration

www.infineon.com/sic

CoolSiC™ MOSFET

I	M	W	120	R	45	M1	

Company
I = Infineon

Device
M = MOSFET

Package Type
W = TO-247
Z = TO-247 4pin

Breakdown voltage
Divided by 10
120 = 1200 V

Reliable grade
blank = Industrial
A = Automotive
S = Standard

Series name (2 digits)
M1 = Generation 1

$R_{DS(on)}$ [mΩ]

$R = R_{DS(on)}$
As a separator between
voltage und $R_{DS(on)}$

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.

Emitter controlled diodes	Rapid 1	Rapid 2	SiC
0 Hz	18 kHz	40 kHz	100 kHz	>100 kHz
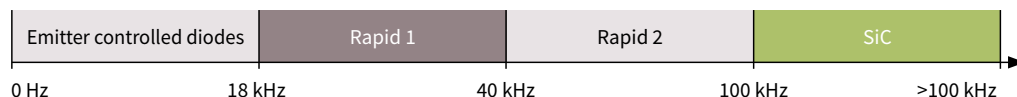
The rapid 1 diode family

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

V_F - Q_{rr} trade-off, rapid 1 diF/dt = 1000 A/us, rapid 2 diF/dt = 300 A/us
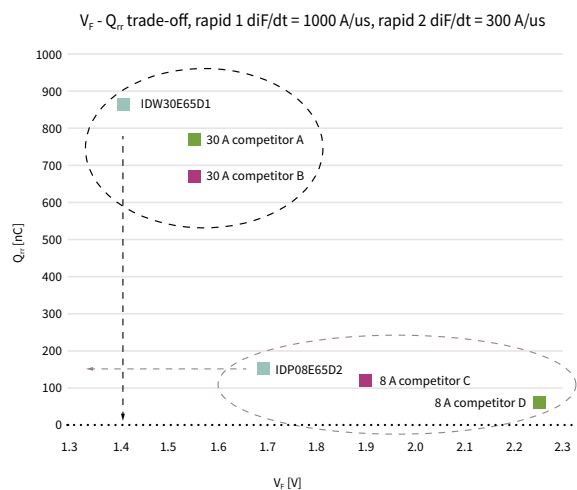
www.infineon.com/rapiddiodes
www.infineon.com/ultrasoftdiodes

Rapid 1 diodes
650 V product family

Aircon | Home Appliance | UPS | Welding

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	TO-247 Advanced Isolation Halogen-Free
8	IDP08E65D1					
15	IDP15E65D1					
20		IDV20E65D1				
30	IDP30E65D1			IDW30E65D1	IDW30C65D1	
40				IDW40E65D1		IDFW40E65D1E
60					IDW60C65D1	
75					IDW75D65D1	
80					IDW80C65D1	

Rapid 2 diodes
650 V product family

Server | Telecom | Server | AC-DC | UPS | Welding

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

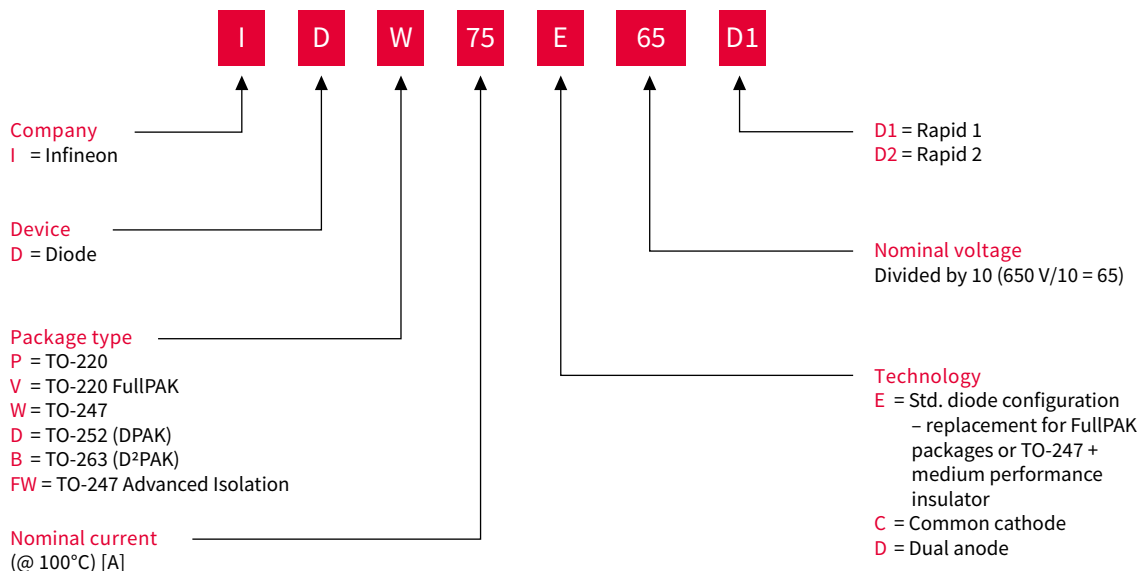www.infineon.com/rapiddiodes

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 (D²PAK) 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

I	D	W	75	E	65	D1

Company
I = Infineon

Device
D = Diode

Package type
P = TO-220
V = TO-220 FullPAK
W = TO-247
D = TO-252 (DPAK)
B = TO-263 (D²PAK)
FW = TO-247 Advanced Isolation

Nominal current
(@ 100°C) [A]

Technology
E = Std. diode configuration – replacement for FullPAK packages or TO-247 + medium performance insulator
C = Common cathode
D = Dual anode

Nominal voltage
Divided by 10 (650 V/10 = 65)

D1 = Rapid 1
D2 = Rapid 2

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 |
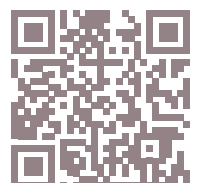
Discrete IGBTs

Market leadership through groundbreaking innovation and application focus

Resolute to achieve the highest standards in performance and quality, Infineon offers comprehensive application-specific discrete IGBTs.

Overview of discrete IGBTs

Product portfolio

	TO-252 (DPAK)	TO-263 (D²PAK)	TO-220	TO-220 FullPAK	TO-247	TO-247 4pin	TO-247PLUS	TO-247PLUS 4pin
Package options								
Voltage class	600 V, 650 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
TRENCHSTOP™ IGBT6 650 V	Home Appliance, Sewing machine

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

Discrete IGBTs

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 reduced system cost.

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.

	TRENCHSTOP™ RC-E (resonant switching)	
TRENCHSTOP™ 2 (hard switching)		
	HighSpeed 3 H3 (hard switching)	
	TRENCHSTOP™ R3/R5 (resonant switching)	

| 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 kHz |
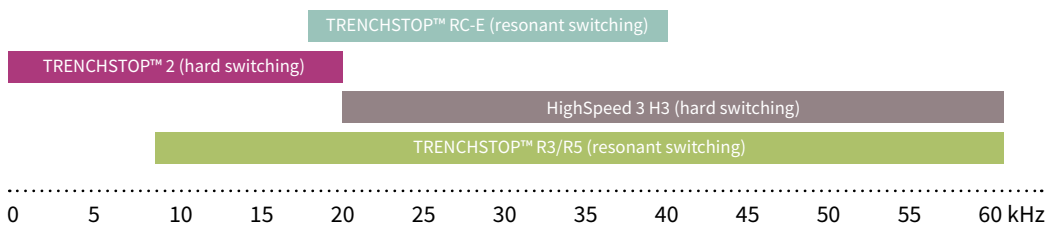
RC-H5	World famous TRENCHSTOP™ RC-H products High performance and low losses	Induction cooking Resonant switching Medium to high frequency converters
RC-E	New TRENCHSTOP™ RC-E Price versus performance leader	Induction cooking Resonant switching Low to medium power cookers
TRENCHSTOP™ 2	Best-in-class 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 tailless/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

TRENCHSTOP™ IGBT6
650 V trench and field-stop IGBT for low power motor drives

Motor drives up to 1 kW are used in a wide variety of applications from home appliance fans and compressors to commercial sewing machines and pumps. The market for these products demands longer lifetimes, high reliability and high efficiency. Therefore, these compact motors require power electronics with the lowest losses and best thermal performance.

The TRENCHSTOP™ IGBT6 family of discrete devices has been designed to meet these specific requirements of motor drives. It has been optimized for the lowest switching losses, which is particularly important in systems with higher switching frequencies up to 30 kHz. Additionally the IGBTs are co-packed with the soft, fast recovery rapid 1 anti-parallel diodes for the lowest total losses.

With a higher blocking voltage at 650 V, and short circuit rating, TRENCHSTOP™ IGBT6 is a key contributor to robust motor designs.

The devices are offered in TO-220 FullPAK packages for the required isolation, as well as DPAK for a more compact surface mount solution.

› Optimized for small drives requiring best-in-class efficiency
› Up to 20 percent reduction in total losses
› Lowest switching losses for better heat management and easier design-in

Power losses [W]
550 W @ T_A = 25°C, 10 kHz, same dv/dt

Legend:
$P_{cnd(s)}$ [W] $P_{on(s)}$ [W] $P_{off(s)}$ [W] $P_{cnd(d)}$ [W] $P_{rec(d)}$ [W]
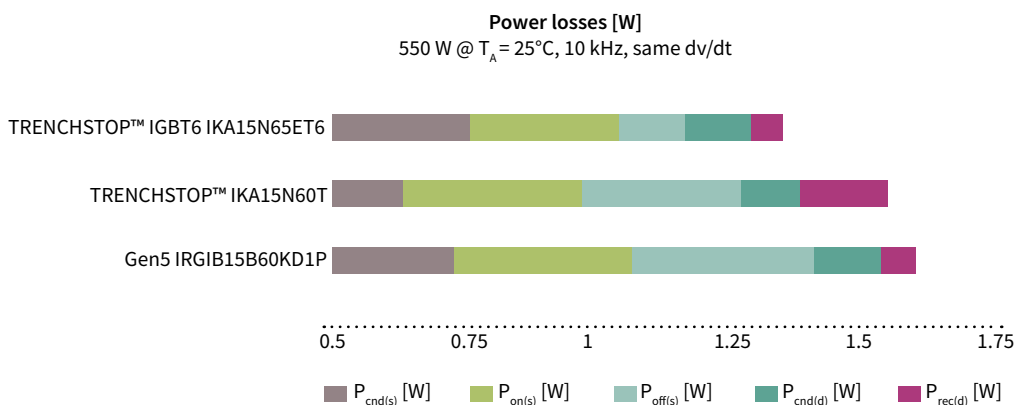
Key features
› Lowest $V_{CE(sat)}$ and V_F
› 650 V blocking voltage
› 3 µsec short-circuit protection capability
› Optimized for switching frequencies from 8–30 kHz

Key benefits
› Good thermal performance, especially at higher frequencies
› Low losses to meet energy efficiency requirements
› Increased design margin and reliability
› Leading price/performance

www.infineon.com/igbt6

Discrete IGBTs

TRENCHSTOP™ advanced isolation
Fully isolated TO-247 package with industry leading IGBTs

TRENCHSTOP™ advanced isolation solution breaks the limits reached by traditional packaging and isolation techniques. This new isolated package enables the highest power density, the best performance and the lowest cooling effort thanks to an effective and reliable thermal path from the IGBT die to the heatsink.

In addition to providing 100 percent electrical isolation, TRENCHSTOP™ advanced isolation also eliminates the need for thermal grease or thermal interface sheets. The new package delivers at least 35 percent lower thermal resistivity, helping designers to increase power density, as well as lower system complexity and assembling costs.
This new package solution allows industrial and home appliance designs to fully utilize the high performance of TRENCHSTOP™ IGBTs with no compromises for isolation and cooling.

Key features
› 2500 V_{RMS} electrical isolation, 50/60 Hz, t = 1 min
› 100 percent tested isolated mounting surface
› Lowest $R_{th(j-h)}$
› Low coupling capacitance, 38 pF
› No need for isolation film or thermal interface material

Key benefits
› Up to 35 percent reduction in assembly time reduces manufacturing cost
› Increased power density
› Improved reliability from higher yield and no isolation film misalignment
› Less EMI filter design effort
› Decreased heatsink size

Thermal resistivity of package and isolation types

TO-247 FullPAK

TO-247 with isolation film[1]

Advanced isolation

50% lower

35% lower

$R_{th(j-h)}$
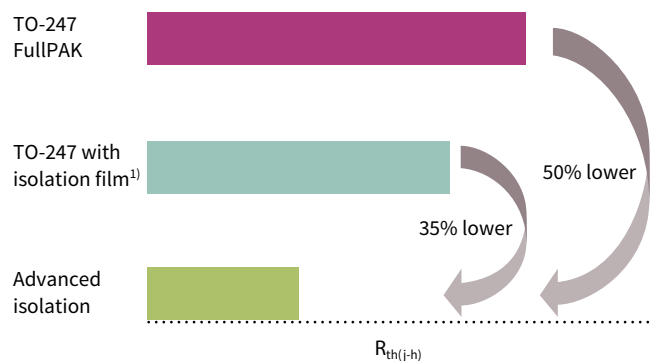
1) Isolation material: standard polyimide based reinforced carrier insulator film with 152 μm thickness, 1.3 W/mK thermal conductivity

TRENCHSTOP™ advanced isolation offers a broad portfolio for specific application needs

Technology	Version and package	Part number	Equivalent current rating @ 65°C [A]	$R_{th(j-h)}$ [K/W]	V_{CEsat} [V] @ T_{vj} = 25°C
TRENCHSTOP™ HighSpeed 3	Price/performance advanced isolation TO-247[1]	IKFW40N60DH3E	44	1.35	2.30
		IKFW50N60DH3E	60	1.15	2.20
		IKFW60N60DH3E	74	1.06	2.20
	Best-in-class advanced isolation TO-247[2]	IKFW50N60DH3	60	1.03	1.85
		IKFW60N60EH3	63	0.91	1.85
		IKFW90N60EH3	95	0.84	1.85
TRENCHSTOP™	Best-in-class advanced isolation TO-247	IKFW50N60ET	64	0.91	1.50
		IKFW75N60ET	95	0.84	1.50
Technology	Version and package	Part number	Equivalent current rating @ 65°C [A]	$R_{th(j-h)}$ [K/W]	V_f [V]
Rapid 1 diode	Price/performance advanced isolation TO-247	IDFW40E65D1E	35	1.92	1.70

1) Optimized to replace FullPAK packages or systems including TO-247 with medium performance insulator, standard polyimide based reinforced carrier insulator with 152 μm thickness, 0.9 W/mK thermal conductivity.
2) Optimized to replace systems using TO-247 with high performance insulator, standard polyimide based reinforced carrier insulator with 152 μm thickness, 1.3 W/mK thermal conductivity.

www.infineon.com/advanced-isolation

TRENCHSTOP™ 5 selection tree

650 V

No — **Free wheeling diode (FWD)** — Yes

50 Hz-20 kHz low speed	30 kHz-120 kHz high speed	50 Hz-20 kHz low speed	> 20 kHz-60 kHz high speed	10 kHz-40 kHz high speed	30 kHz-100 kHz high speed	60 kHz-120 kHz ultra-high speed
Low V$_{CE(sat)}$ TRENCHSTOP™ 5 (L5)	TRENCHSTOP™ 5 (H5/F5/S5)	Low V$_{CE(sat)}$ TRENCHSTOP™ 5 (L5)	RC TRENCHSTOP™ 5 (WR5)	„Soft" TRENCHSTOP™ 5 (S5)	TRENCHSTOP™ 5 (H5)	TRENCHSTOP™ 5 (F5)

Corresponding best fit IGBT | | **Corresponding best fit IGBT** | | | | |

IGW30N65L5	IGP20N65H5/F5	IKW30N65EL5	IKW30N65WR5	IKW30N65ES5	IKP08N65H5	IKP08N65F5
	IGP30N65H5/F5	IKW30N65NL5	IKW40N65WR5	IKW40N65ES5	IKP15N65H5	IKP15N65F5
	IGP40N65H5/F5	IKW75N65EL5	IKW50N65WR5	IKW50N65ES5	IKP20N65H5	IKP20N65F5
		IKZ75N65EL5		IKW75N65ES5	IKP30N65H5	IKP30N65F5
	IGW30N65H5/F5				IKP40N65H5	IKP40N65F5
	IGW40N65H5/F5					
	IGW50N65H5/F5				IKA08N65H5	IKA08N65F5
					IKA15N65H5	IKA15N65F5
	IGZ50N65H5					
	IGZ75N65H5				IKW30N65H5	IKW30N65F5
	IGZ100N65H5				IKW40N65H5	IKW40N65F5
					IKW50N65H5	IKW50N65F5
	IGB15N65S5				IKW50N65EH5	
	IGB20N65S5				IKW75N65EH5	
	IGB50N65S5			**NEW!**		
	IGB50N65H5				IKZ50N65EH5	
				IKZ50N65ES5	IKZ50N65NH5	
				IKZ75N65ES5	IKZ75N65EH5	
					IKZ75N65NH5	
					IKB15N65EH5	
				NEW!	IKB20N65EH5	
					IKB30N65EH5	
				IKB30N65ES5	IKB40N65EH5	IKB40N65EF5
				IKB40N65ES5		

IGBT selection tree

	IGBT
Soft	Diode commutation

Frequency range

8 kHz – 60 kHz RC series (monolythic)	2 kHz – 30 kHz		
	RC-drives (monolythic)	TRENCHSTOP™ Performance	TRENCHSTOP™ IGBT6 NEW!

Voltage range

600 V, 650 V, 1100 V, 1200 V, 1350 V, 1600 V	600 V	600 V, 1200 V	650 V

Part number

IHpccNvvvR2 IHpccNvvvR3 IHpccN60R/RF IHpccNvvvR5 IHpccNvvvE1 NEW!	IKpccN60R IKpccN60RF	IKpccN60T IKpccN60dTP IKpccT120… IGpccN60T IGpccN60TP IGpccT120 IGpccN120T2	IKpccN65dT6

Applications

Induction cooking **Microwave** **Multifunction printers** **Half-bridge resonant** **(Current resonance < 650 V)** **Single switch** **(Voltage resonance > 650 V)**	Conduction loss optimized **Solar inverter** **Asymmetrical bridge** Symmetrical full-bridge 3-level type I or 3-level type II converter **Motor control** Three-phase inverter Full-bridge inverter **Uninterruptable power supply** UPS bridge 3-level type II converter **Major home appliances** Symmetrical full-bridge

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™ 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 (D²PAK) Halogen-Free	TO-220 Halogen-Free	TO-247 Advanced Isolation 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	IKD06N65ET6	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					IKFW50N60ET		IKW50N60T IKW50N60DTP NEW!	
	75					IKFW75N60ET		IKW75N60T	
	100								IKQ100N60T
	120								IKQ120N60T

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

TRENCHSTOP™ IGBT6
650 V product family

Continuous collector current @ T_c=100°C [A]	TO-251 (IPAK)	TO-252 (DPAK) Halogen-Free	TO-263 (D²PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I²PAK) Halogen-Free	TO-220 FullPAK Halogen-Free	TO-247
6		IKD06N65ET6					
8						IKA08N65ET6*	
10						IKA10N65ET6*	
15						IKA15N65ET6*	

* Limited by maximum junction temperature. Applicable for TO-220 standard package.

TRENCHSTOP™
1200 V product family

Continuous collector current @ T_c=100°C [A]		TO-252 (DPAK) Halogen-Free	TO-263 (D²PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I²PAK) Halogen-Free	TO-220 FullPAK	TO-247 Halogen-Free TRENCHSTOP™	TO-247 Halogen-Free TRENCHSTOP™ 2	TO-247PLUS 3pin Halogen-Free 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	IKQ40N120CT2
	50								IKQ50N120CT2
	75								IKQ75N120CT2

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

Induction cooking series
650 V, 1100 V, 1200 V, 1350 V and 1600 V product families

Induction

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

Telecom Welding Solar UPS SMPS Server

	Continuous collector current @ T$_c$=100°C [A]	TO-251 (IPAK)	TO-252 (DPAK)	TO-263 (D²PAK)	TO-220	TO-247 Advanced Isolation	TO-220 FullPAK	TO-247
			Halogen-Free	Halogen-Free	Halogen-Free	Halogen-Free	Halogen-Free	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					IKFW40N60DH3E		IKW40N60H3
	50					IKFW50N60DH3E IKFW50N60DH3		IKW50N60H3
	60					IKFW60N60DH3E IKFW60N60EH3		IKW60N60H3
	75							IKW75N60H3
	90					IKFW90N60EH3		

HighSpeed 3
1200 V product family

Telecom Welding Solar UPS SMPS Server

	Continuous collector current @ T$_c$=100°C [A]	TO-263 (D²PAK)	TO-220	TO-262 (I²PAK)	TO-220 FullPAK	TO-247	TO-247PLUS 3pin	TO-247PLUS 4pin
		Halogen-Free	Halogen-Free	Halogen-Free	Halogen-Free	Halogen-Free	Halogen-Free	Halogen-Free
IGBT	15					IGW15N120H3		
	25					IGW25N120H3		
	40					IGW40N120H3		
DuoPack	15					IKW15N120H3		
	25					IKW25N120H3		
	40					IKW40N120H3	IKQ40N120CH3	IKY40N120CH3
	50						IKQ50N120CH3	IKY50N120CH3
	75						IKQ75N120CH3	IKY75N120CH3

www.infineon.com/rch5

www.infineon.com/rc-e

www.infineon.com/highspeed3

TRENCHSTOP™ 5 F5, H5 and S5
650 V product family

Continuous collector current @Tc=100°C [A]		TO-251 (IPAK)	TO-252 (DPAK)	TO-263 (D²PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I²PAK) Halogen-Free	TO-220 FullPAK Halogen-Free	TO-247 Halogen-Free	TO-247 4pin Halogen-Free
IGBT	20			IGB20N65S5	IGP20N65F5/H5				
	30			IGB30N65S5	IGP30N65F5/H5				
	40				IGP40N65F5/H5			IGW40N65F5/H5	
	50			IGB50N60H5/S5				IGW50N65F5/H5	IGZ50N65H5
	75							IGW75N65H5	IGZ75N65H5
	100								IGZ100N65H5
DuoPack	8				IKP08N65F5/H5	IKA08N65F5/H5			
	15		IKB15N65EH5	IKP15N65F5/H5		IKA15N65F5/H5			
	20		IKB20N65EH5	IKP20N65H5/F5					
	30		IKB30N65EH5/S5	IKP30N65H5/F5				IKW30N65H5	
	40		IKB40N65ES5/H5/F5	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

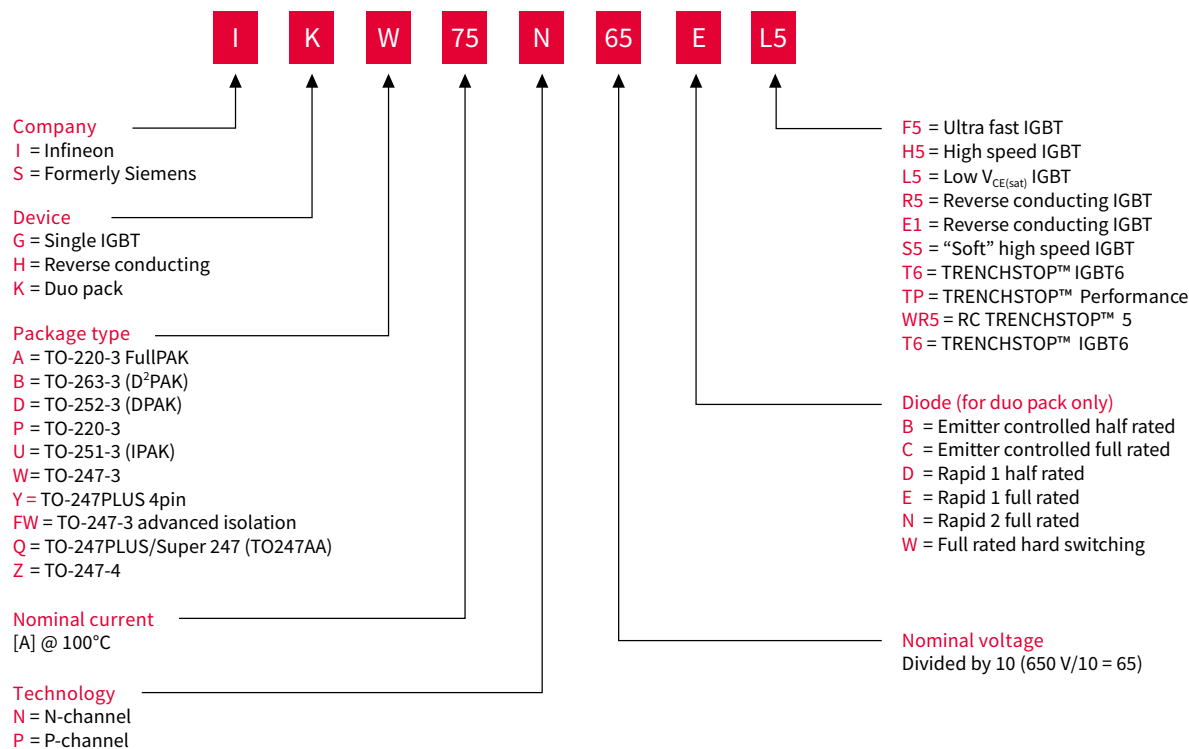| Continuous collector current @Tc=100°C [A]		TO-251 (IPAK)	TO-252 (DPAK)	TO-263 (D²PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I²PAK) Halogen-Free	TO-220 FullPAK Halogen-Free	TO-247 Halogen-Free	TO-247 4pin Halogen-Free
IGBT	30							IGW30N65L5	
DuoPack	30							IKW30N65EL5 IKW30N65NL5	
	75							IKW75N65EL5	IKZ75N75EL5

TRENCHSTOP™ 5 WR5
650 V product family

Continuous collector current @Tc=100°C [A]		TO-251 (IPAK)	TO-252 (DPAK)	TO-263 (D²PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I²PAK) 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 @Tc=100°C [A]		TO-251	TO-252 (DPAK)	TO-263 (D²PAK) Halogen-Free	TO-220 Halogen-Free	TO-262 (I²PAK) 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

Discrete IGBTs

Naming system

IGBT (products launched after 03/2013)

I	K	W	75	N	65	E	L5

Company
I = Infineon
S = Formerly Siemens

Device
G = Single IGBT
H = Reverse conducting
K = Duo pack

Package type
A = TO-220-3 FullPAK
B = TO-263-3 (D^{2}PAK)
D = TO-252-3 (DPAK)
P = TO-220-3
U = TO-251-3 (IPAK)
W = TO-247-3
Y = TO-247PLUS 4pin
FW = TO-247-3 advanced isolation
Q = TO-247PLUS/Super 247 (TO247AA)
Z = TO-247-4

Nominal current
[A] @ 100°C

Technology
N = N-channel
P = P-channel

F5 = Ultra fast IGBT
H5 = High speed IGBT
L5 = Low $V_{CE(sat)}$ IGBT
R5 = Reverse conducting IGBT
E1 = Reverse conducting IGBT
S5 = "Soft" high speed IGBT
T6 = TRENCHSTOP™ IGBT6
TP = TRENCHSTOP™ Performance
WR5 = RC TRENCHSTOP™ 5
T6 = TRENCHSTOP™ IGBT6

Diode (for duo pack only)
B = Emitter controlled half rated
C = Emitter controlled full rated
D = Rapid 1 half rated
E = Rapid 1 full rated
N = Rapid 2 full rated
W = Full rated hard switching

Nominal voltage
Divided by 10 (650 V/10 = 65)

IGBT (products launched before 03/2013)

I	K	W	40	N	120	H	3

Company
I = Infineon
S = Formerly Siemens

Device
K = IGBT + diode (normal drives)
H = Optimized for soft
      switching applications
      (e.g. induction heating)
G = Single IGBT
D = Diode

Package type
A = TO-220 FullPAK
B = TO-263 (D^{2}PAK)
D = TO-252 (DPAK)
P = TO-220
U = TO-251 (IPAK)
W = TO-247

Generation
– = Fast IGBT (~20 kHz)
H$_X$ = HighSpeed generation (600 V - 1200 V)
T$_X$ = TRENCHSTOP™ generation (600 V IGBT 3) (1200 V IGBT 4)
R$_X$ = Reverse conducting
RF = Reverse conducting fast
F = HighSpeed FAST 5
R$_X$ = Rapid diode generation

Nominal voltage
Divided by 10 (1200 V/10 = 120)

Technology
N = N-channel
T = TRENCHSTOP™
E = Emitter-controlled diodes (for diode only)

Nominal current
(@ 100°C) [A]

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

www.infineon.com/discrete-automotive-igbt

www.infineon.com/latest-discrete-packages

Evaluationboards and simulation models

www.infineon.com/eval-TO-247-4pin

www.infineon.com/igbtdiscrete-simulationmodels

Videos

www.infineon.com/mediacenter

Info

Document

Evaluation
Board

Simulation

Play
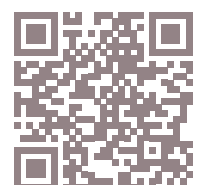
Power management ICs

Technology leadership in power supply

AC-DC power management ICs

PFC controller	PWM controller

CCM PFC (Continuous conduction mode)	**Stand-alone PWM**	**Fixed frequency CoolSET™**
Fixed frequency ICE2PCS02G (65 kHz) ICE2PCS03G (100 kHz) **Adjustable frequency** ICE2PCS01G (50 kHz - 250 kHz) ICE2PCS05G (20 kHz - 250 kHz) ICE3PCS01G (OVP+brown out) ICE3PCS02G (OVP) ICE3PCS03G (Brown out)	**Fixed frequency (FF)** ICE5GSAG (125 Khz) ICE5ASAG (100 Khz) ICE3AS03LJG (100 kHz) ICE3BS03LJG (65 kHz) **Quasi-resonant (QR)** ICE5QSAG ICE2QS02G ICE2QS03G **Half-bridge (HB) LLC resonant** ICE1HS01G-1 ICE2HS01G	**650 V F3/F3R CoolSET™** ICE3A/BRxx65J(Z)/(G) ICE3RBRxx65J ICE3RBRxx65JG **700 V Gen5 CoolSET™** ICE5AR4770AG ICE5AR4770BZS **800 V F3R CoolSET™** ICE5A/GRxx80AG ICE5ARxx80BZS ICE3A/BRxx80JZ ICE3ARxx80CJZ ICE3ARxx80VJZ ICE3ARxx80JG

CrCM PFC (Critical conduction mode)	**Combi (PFC+PWM)**	**Quasi-resonant CoolSET™**
TDA4862G TDA4863G TDA4863-2G IRS2505LPBF	**CrCM + LLC** XDP™ SMPS IDP2308 (DSO-14) XDP™ SMPS IDP2303 (DSO-16) XDP™ SMPS IDP2303A (DSO-16)	**650 V CoolSET™** ICE2QRxx65(Z)/(G) **700 V CoolSET™** ICE5QRxx70AZ/G **800 V CoolSET™** ICE2QRxx80Z/G ICE5QRxx80AZ/G

Power factor correction and combo controller

Critical conduction mode PFC ICs

TDA4862G
TDA4863G
TDA4863-2G
IRS2505LPBF
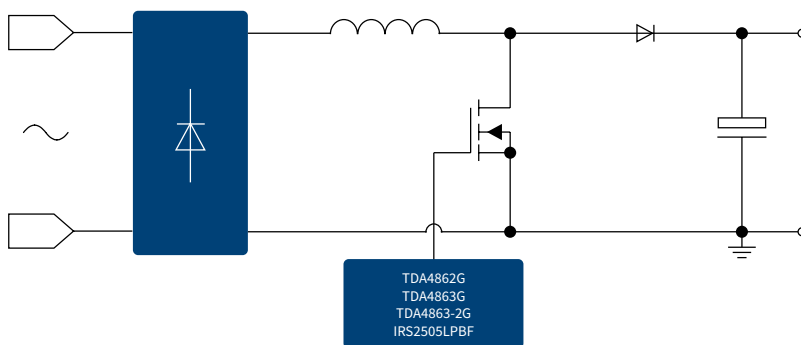
TDA4862G

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 power factor 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
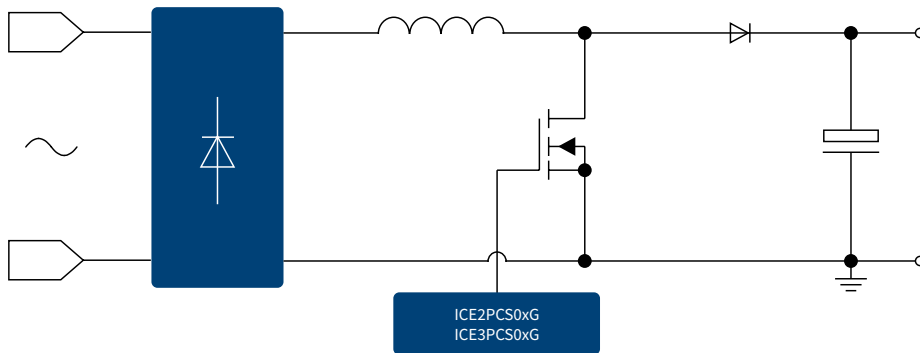
ICE2PCS0xG
ICE3PCS0xG

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	
ICE2PCS02G	65 kHz	2.0 A	DSO-8
ICE2PCS03G	100 kHz	2.0 A	
ICE2PCS05G	20 kHz-250 kHz	2.0 A	

www.infineon.com/acdc

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

3rd generation continuous conduction mode (CCM) power factor correction IC product portfolio

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

PFC CCM IC 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	–				✓

Power ICs

www.infineon.com/acdc

Resonant LLC half-bridge controller IC

LLC resonant (No SR)

ICE1HS01G-1
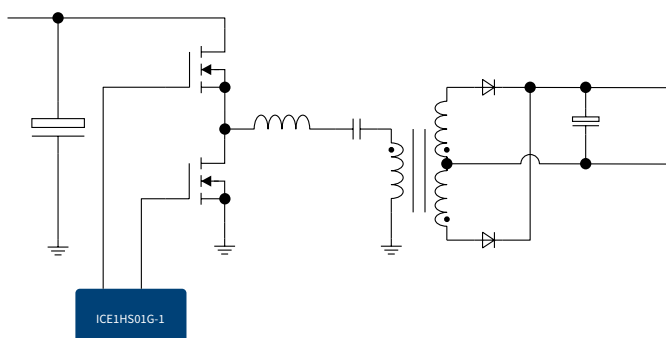
› Novel and simple design (12 components + HB driver)
› Minimum operating frequency is adjustable externally
› Burst mode operation for output voltage regulation during no load and/or bus over-voltage
› Multiple protections in case fault
› Input voltage sense for brown out protection
› Open loop/over 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

ICE2HSO1G
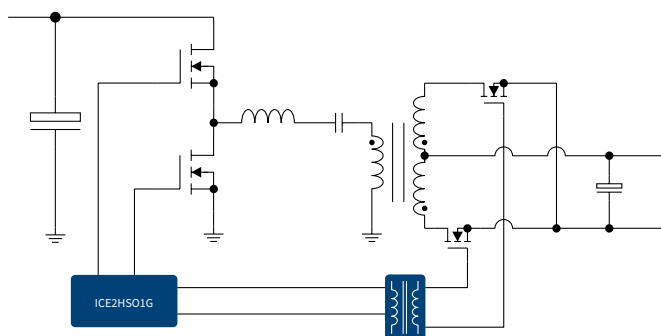
› Novel LLC/SR operation mode and controlled by primary side controller
› Multiple protections for SR operation
› Tight tolerance control
› Accurate setting of switching frequency and dead time
› Simple system design
› Optimized system efficiency
› Multiple Converter protections: OTP, OLP, OCP, latch-off 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.

Power ICs

www.infineon.com/acdc

Climate saver 80 PLUS® and 80 PLUS® Bronze
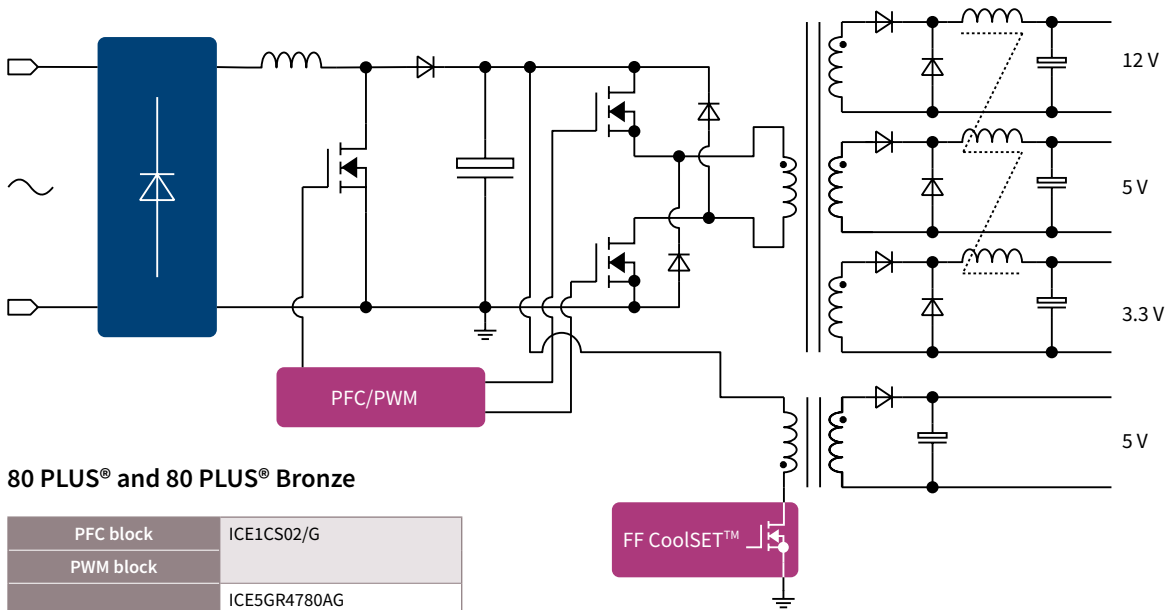
80 PLUS® and 80 PLUS® Bronze

PFC block	ICE1CS02/G
PWM block	
Standby block FF CoolSET™	ICE5GR4780AG
	ICE5GR2280AG
	ICE5GR1680AG
	ICE3AR1080JG
	ICE5AR0680AG

Climate saver 80 PLUS® Silver
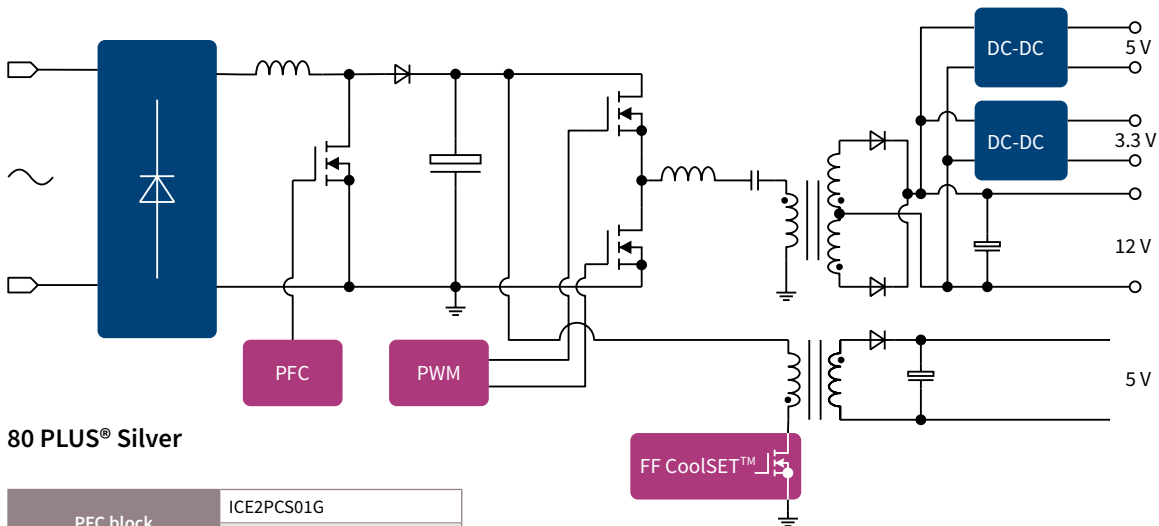
80 PLUS® Silver

PFC block	ICE2PCS01G
	ICE2PCS02G
PWM block	ICE1HS01G-1
Standby block FF CoolSET™	ICE5GR4780AG
	ICE5GR2280AG
	ICE5GR1680AG
	ICE3AR1080JG
	ICE5AR0680AG

Climate saver 80 PLUS® Gold

Climate saver 80 PLUS® Platinum

Certification for Infineon's PC power reference design
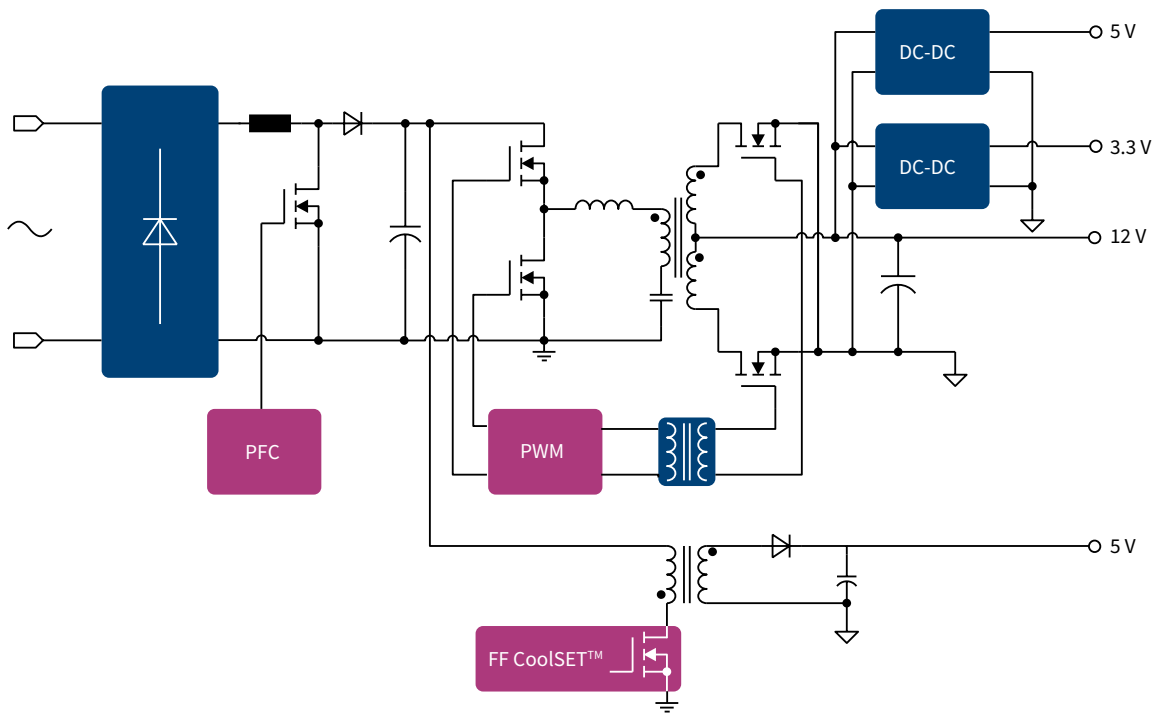
80 PLUS® Gold

	ICE3PCS01G
PFC block	ICE3PCS02G
	ICE3PCS03G
PWM block	ICE2HS01G
	ICE5GR4780AG
Standby block FF CoolSET™	ICE5GR2280AG
	ICE5GR1680AG
	ICE3AR1080JG
	ICE5AR0680AG

80 PLUS® Platinum

Certification for Infineon's PC power reference design

	ICE3PCS01G
PFC block	ICE3PCS02G
	ICE3PCS03G
PWM block	ICE2HS01G
	ICE5QR4780AZ
	ICE2QR4780G
Standby block QR CoolSET™	ICE5QR2280AZ
	ICE2QR2280G-1
	ICE5QR1680AG
	ICE2QR1080G
	ICE5QR0680AG

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

Power ICs

Isolated AC-DC

5th generation quasi-resonant PWM IC and CoolSET™ features
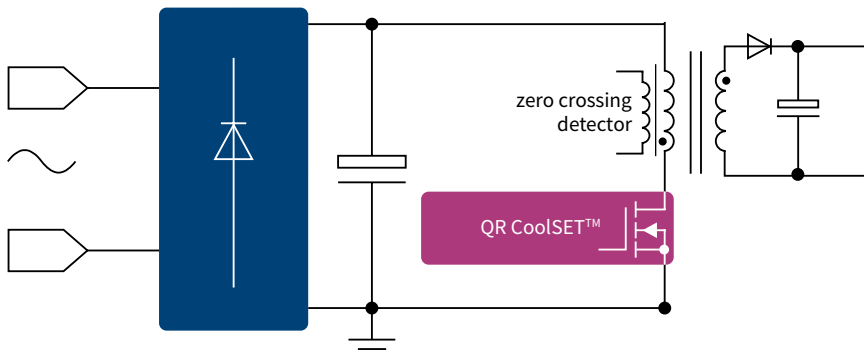
› Integrated CoolMOS™ in both 700 V and 800 V MOSFET with cascode configuration
› Digital frequency reduction with reducing load
› Novel quasi-resonant to minimize the spread of switching frequency between low and high line AC input
› Selectable active burst mode entry/exit profile
› Auto restart mode 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 quasi-resonant CoolSET™

Output power[1) 85 V_{AC}~300 V_{AC} T_a=50°C		15 W	22 W	27 W	32 W	41 W~42 W
$R_{DS(on)}$ max		5.18 Ω	2.35 Ω	1.75 Ω	1.25 Ω	0.80 Ω
700 V	DIP-7	ICE5QR4770AZ	ICE5QR2270AZ		ICE5QR1070AZ	
	DSO-12	ICE5QR4770AG				
800 V	DIP-7	ICE5QR4780AZ	ICE5QR2280AZ			ICE5QR0680AZ
	DSO-12			ICE5QR1680AG		ICE5QR0680AG

2nd Generation quasi-resonant 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	38 W~42 W
$R_{DS(on)}$ max		5.44 Ω ~ 5.18 Ω	2.62 Ω	1.96 Ω	1.11 Ω	0.75 Ω~0.71 Ω
650 V	DIP-7	ICE2QR4765Z		ICE2QR1765Z		ICE2QR0665Z
	DIP-8	ICE2QR4765		ICE2QR1765		ICE2QR0665
	DSO-12	ICE2QR4765G		ICE2QR1765G		ICE2QR0665G
800 V	DIP-7	ICE2QR4780Z	ICE2QR2280Z			ICE2QR0680Z
	DSO-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

5th generation fixed frequency PWM IC and CoolSET™ features
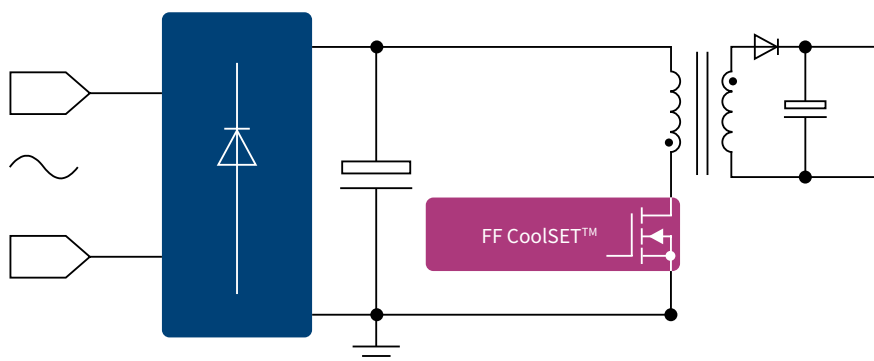
> Integrated CoolMOS™ in both 700 V and 800 V MOSFET
> Cascode configuration for brown in protection, fast and robust start-up
> Available in both 100 kHz and 125 kHz fixed switching frequency
> Frequency reduction in tandem with load reduction to increase efficiency

> Selectable active burst mode entry/exit profile to optimize standby power and ability to disable
> Support CCM flyback operation with in-build slope compensation
> Integrated error amplifier for direct feedback (e.g. non-isolated flyback)
> Adjustable line input over voltage protection (only ICE5xRxxxxAG)

> V_{cc} and CS pin short to ground protection
> Auto restart protection mode to minimize interruption to operation
> DSO-8 package (standalone controller), DIP-7 and DSO-12 package for CoolSET™

Halogen-Free   RoHS

Power ICs

5th generation fixed frequency CoolSET™

Output power[1] 85 V_{AC}~300 V_{AC} T_a=50°C		15 W	23 W	27 W	40 W
$R_{DS(on)}$ max		5.18 Ω	2.35 Ω	1.75 Ω	0.80 Ω
700 V	DIP-7	ICE5AR4770BZS			
	DSO-12	ICE5AR4770AG			
800 V	DIP-7	ICE5AR4780BZS			ICE5AR0680BZS
	DSO-12	ICE5GR4780AG	ICE5GR2280AG	ICE5GR1680AG	ICE5AR0680AG

3rd generation fixed frequency CoolSET™

Output power[1] 85 V_{AC}~300 V_{AC} T_a=50°C		10~15 W	19~21 W	23~26 W	30~34 W	37~41 W
$R_{DS(on)}$ max		11.1 ~ 5.44 Ω	3.42 ~ 2.62 Ω	1.96 ~ 1.71 Ω	1.11 ~ 1.05 Ω	0.75 ~ 0.71 Ω
650 V	DIP-7	ICE3RBR4765JZ		ICE3RBR1765JZ		ICE3RBR0665JZ
	DIP-8	ICE3BR4765J	ICE3A1065ELJ	ICE3BR1765J	ICE3A2065ELJ	ICE3BR0665J
	DSO-12	ICE3RBR4765JG		ICE3RBR1765JG		ICE3RBR0665JG
800 V	DIP-7	ICE3AR4780JZ	ICE3AR2280JZ	ICE3AR1580VJZ	ICE3AR1080VJZ	ICE3AR0680JZ
		ICE3AR4780VJZ	ICE3BR2280JZ			ICE3BR0680JZ
		ICE3AR4780CJZ	ICE3AR2280VJZ			ICE3AR0680VJZ
		ICE3AR10080CJZ	ICE3AR2280CJZ			
	DSO-12	ICE3AR4780JG	ICE3AR2280JG		ICE3AR1080JG	

www.infineon.com/coolset

1) Calculated DCM maximum output power in an open-frame design based on Ta=50° C and T_j=125°C without copper area as heatsink

Fixed frequency PWM IC

FF PWM IC	5th generation		3rd generation	
	ICE5ASAG	ICE5GSAG	ICE3AS03LJG	ICE3BS03LJG
Package	DSO–8		DSO–8	
Switching frequency	100 Khz	125 Khz	100 Khz	65 Khz
Operating temperature	-40°C ~ 129°C		-25°C ~ 130°C	
Start-up cell	Cascode		✓	
V_{cc} on/off threshold	16 V/10 V		18 V/10.5 V	
Soft start time	12 ms		10 ms	20 ms
Frequency jittering	✓		✓	
Modulated gate drive	✓		✓	
Active burst mode	✓ (3 level selectable)		✓	
Slope compensation for CCM	✓		–	
Frequency reduction	✓		–	
Integrated error amplifier for direct feedback	✓		–	
Adjustable line Input overvoltage protection	✓ with auto restart		–	
Adjustable brown in protection	✓ with auto restart		–	
CS pin short-to-ground protection	✓ with auto restart		–	
V_{cc} pin short-to-ground protection	✓ (no start–up)		–	
V_{cc} under voltage protection	✓ with auto restart		✓ with auto restart	
V_{cc} over voltage protection	✓ with auto restart		✓ with latch–up	
Overload /open loop protection	✓ with auto restart		✓ with auto restart	
Over temperature protection	✓ with auto restart and hysteresis		✓ with latch–up	
External blanking time extension	–		✓ with auto restart	
External protection enable pin	–		✓ with latch–up	

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	✓ active burst mode in QR switching 2-level selectable burst mode entry/exit level	–	✓ 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	✓ with auto restart	✓ with latch	✓ with auto restart
Adjustable output overvoltage protection	✓ with auto restart	✓ with latch	✓ 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	✓		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	✓ with latch		✓ with auto restart
V_{cc} over/undervoltage protection	✓ with auto restart		✓ with auto restart
Overload/open loop protection	✓ with auto restart		✓ with auto restart
Over temperature protection	✓ with auto restart		✓ (Auto restart with hysteresis)
Adjustable line input overvoltage protection	–		✓ with auto restart
Brown out	–		✓ with auto restart
CS pin short to ground	–		✓ with auto restart
V_{cc} pin short to ground	–		✓ (No start-up)
Package	DIP-7 DIP-8 DSO-12	DIP-7 DSO-12	DIP-7 DSO-12

www.infineon.com/coolset

Fixed frequency CoolSET™

	700 V CoolSET™	650 V CoolSET™		
	Gen5 ICE5ARxx70AG(BZS)	Gen3 ICE3Axx65ELJ	Gen3R ICE3BRxx65J	Gen3R ICE3RBRxx65JZ(G)
Package	DIP-7, DSO-12	DIP-8		DIP-7, DSO-12
Output power range	15 W	19 W~34 W	15 W~41 W	14 W~39 W
Operating temperature range	-40°C ~ 129°C	-25°C ~ 130°C		-40°C ~ 130°C
Switching frequency	100 kHz	100 kHz	65 kHz	65 kHz
Frequency reduction	✓	–		
Integrated error amplifier	✓	–		
Slope compensation for CCM mode	✓	–		
V_{cc} on/off threshold	16 V/10 V	18 V/10.5 V		
Soft start time	12 ms	20 ms		
Active burst mode selection	3 level	1 level		
CS pin short-to-ground protection	Auto restart	–		
V_{cc} pin short-to-ground protection	No start-up	–		
V_{cc} over voltage protection	Auto restart	Latch	Auto restart	
Over temperature protection	Auto restart with hysteresis	Latch	Auto restart	
External protection enable pin	-	Latch	Auto restart	
Adjustable brown in/out protection	Brown IN only	–		
Adjustable line input over voltage protection	Only ICE5ARxx70AG	–		
Fast AC reset	–			
Product available	ICE5AR4770AG ICE5AR4770BZS	ICE3A1065ELJ ICE3A2065ELJ	ICE3BR4765J ICE3BR1765J ICE3BR0665J	ICE3RBR4765JZ ICE3RBR1765JZ ICE3RBR0665JZ ICE3RBR4765JG ICE3RBR1765JG ICE3RBR0665JG

www.infineon.com/coolset

1) Calculated 85 V_{AC}~300 V_{AC} DCM maximum output power in an open-frame design based on T_a=50°C and T_j=125°C without copper area as heatsink

800 V CoolSET™					
Gen3R ICE3A(B)Rxx80JZ	Gen3R ICE3ARxx80CJZ	Gen3R ICE3ARxx80JG	Gen3R ICE3ARxx80VJZ	Gen5 ICE5ARxx80AG(BZS)	Gen5 ICE5GRxx80AG
DIP–7		DSO–12	DIP–7	DIP–7, DSO–12	DSO–12
10 W~40 W	11 W~23 W	14 W~30 W	15 W~39 W	15 W~40 W	15 W~27 W
−25°C ~ 130°C		−40°C ~ 130°C		−40°C ~ 129°C	
100 kHz/65 kHz	100 kHz	100 kHz		100 kHz	125 kHz
–				✓	
–				✓	
–	✓	–		✓	
17 V/10.5 V				16 V/10 V	
10 ms				12 ms	
4 level	3 level	4 level		3 level	
–				Auto restart	
–				No start–up	
Auto restart					
Auto restart with hysteresis					
Auto restart	Latch	Auto restart	–		
Auto restart			–	Brown IN only	
–			Auto restart	Only ICE5ARxx80AG	Auto restart
–	✓	–			
ICE3AR10080JZ ICE3AR4780JZ ICE3AR2280JZ ICE3AR0680JZ ICE3BR2280JZ ICE3BR0680JZ	ICE3AR10080CJZ ICE3AR4780CJZ ICE3AR2280CJZ	ICE3AR4780JG ICE3AR2280JG ICE3AR1080JG	ICE3AR4780VJZ ICE3AR2280VJZ ICE3AR1580VJZ ICE3AR1080VJZ ICE3AR0680VJZ	ICE5AR0680AG ICE5AR4780BZS ICE5AR0680BZS	ICE5GR4780AG ICE5GR2280AG ICE5GR1680AG

Power ICs

XDP™ SMPS

IDP2303/8 and IDP2303A – digital multi-mode PFC+LLC combo controller

The IDP2303, IDP2303A and IDP2308 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

Product	Target application	Major difference	Package
IDP2303	TV embedded PSU	2nd redundant PFC output over voltage protection	DSO-16
IDP2308			DSO-14 (with enhanced HV creepage distance)
IDP2303A	Adapter, general SMPS	Constant output voltage	DSO-16

IDP2303A - power adapter
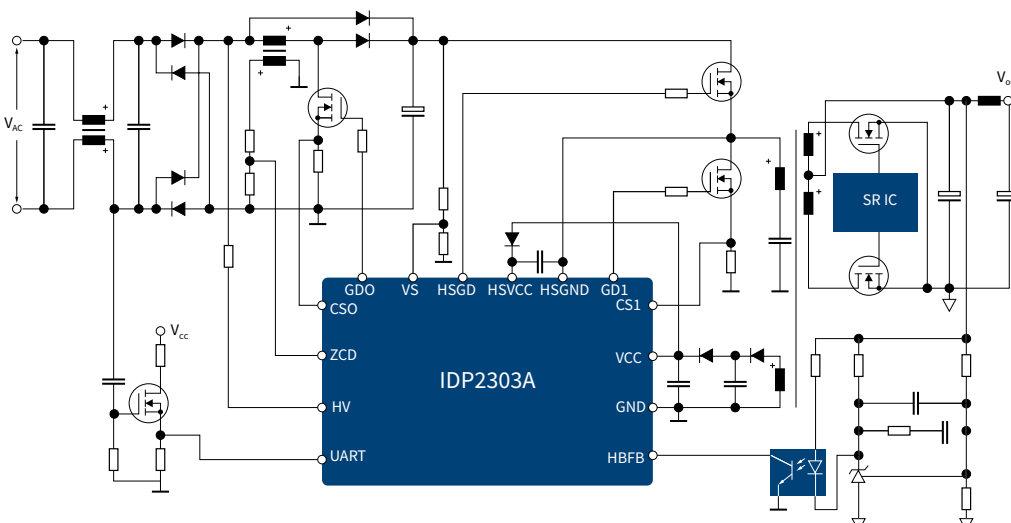
IDP2303/8– embedded PSU

Target applications

› LCD TV power supply
› General SMPS
› Power adapter

www.infineon.com/xdp-smps

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.
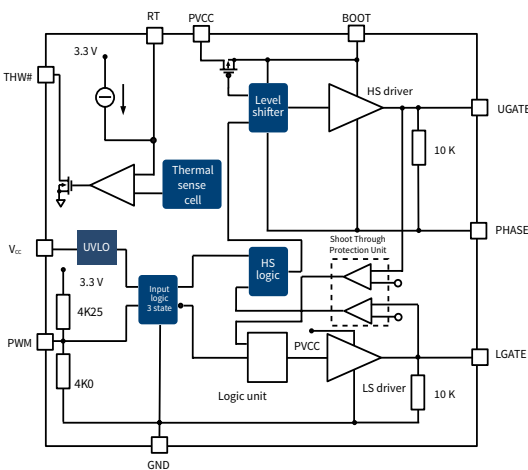
PX3519 features a gate disable pin (EN) for low power consumption.
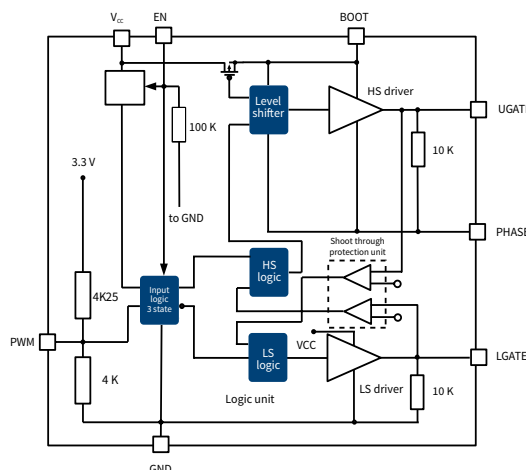
Gate driver	PX3517	PX3519
Package	3 x 3 mm TDSON-10	3 x 3 mm VDSON-8
RoHS compliant	✓	✓
Max. junction temperature	-40°C to 125°C	-40°C to 125°C
Supply voltage and driving voltage, V_{cc}	+4.5 V to 8 V	+4.5 V to 8 V
Boot to GND	30	30
PWM inputs	Tri-state compatibility	Tri-state compatibility
Quiescent 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
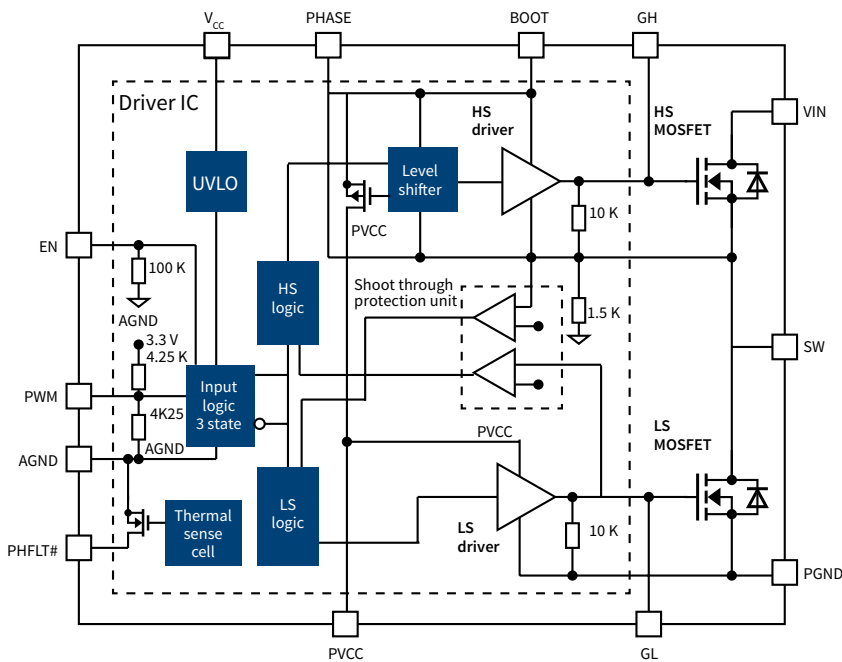
	TDA21231
Input voltage range	4.5 V to 16 V
Peak efficiency	> 95%
Heavy load efficiency @ 40 A	> 95%
PWM interface	3.3 V
Max. average load current	55 A
Temperature monitor and OTP	Thermal warning
RoHS compliant	✓

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 lay-out, 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 6.0 x 6.0 x 0.9 mm³ 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 (6 x 6) 0.4 mm pitch	48-lead (6 x 6) 0.4 mm pitch	40-lead (5 x 5) 0.4 mm pitch	40-lead (5 x 5) 0.4 mm pitch	40-lead (5 x 5) 0.4 mm pitch	48-lead (6 x 6) 0.4 mm pitch	48-lead (6 x 6) 0.4 mm pitch	40-lead (5 x 5) 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

Power ICs

Typical multiphase application circuit
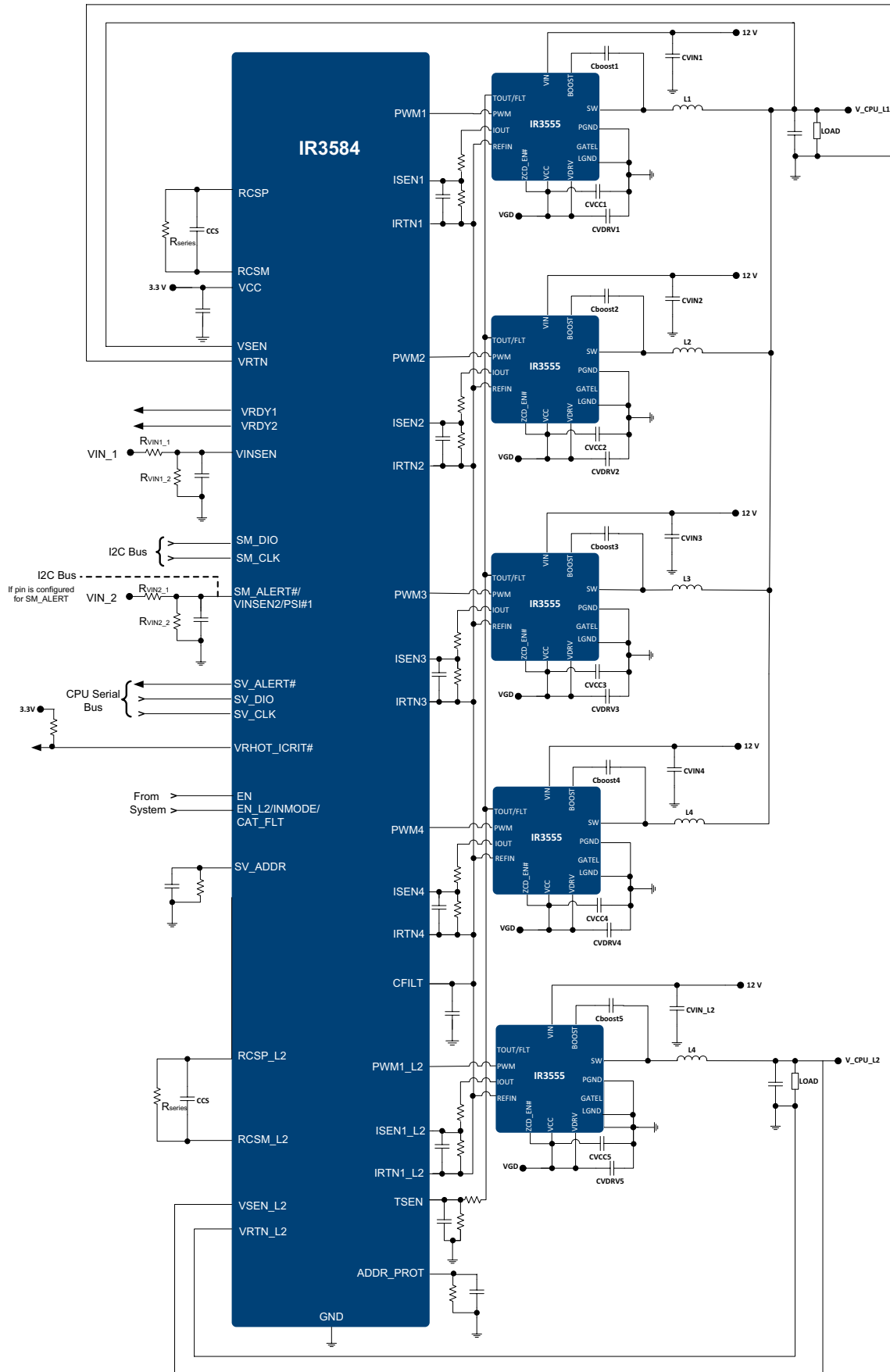
LED driver ICs for general lighting

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.
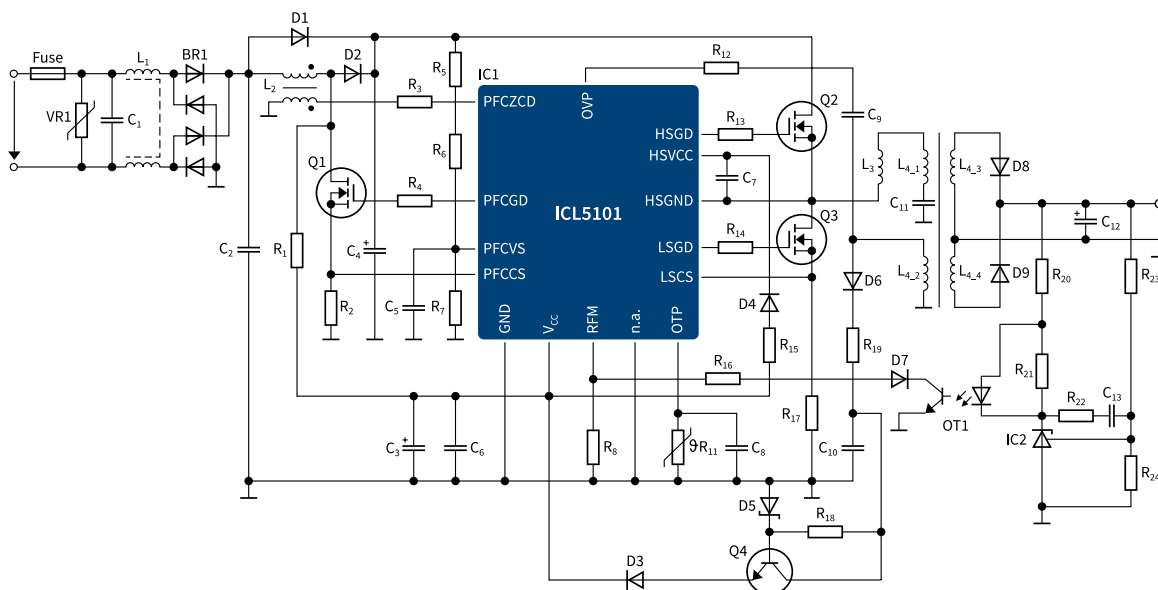
ICL5101– resonant controller with PFC for LED driver

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 percent for operation without audible noise
› High-power quality with PF > 0.96, THD < 10 percent
› Highest efficiency of up to 95 percent due to resonant topology

› Allows secondary-side IC dimming down to 1 percent
› 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

Order information for ICL5101

Type	Description	Ordering code
ICL5101	Resonant controller with PFC	SP001213622
EVALLEDICL5101E1	PFC/LLC evaluation board 110 W	SP001296078

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 percent, 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 percent 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
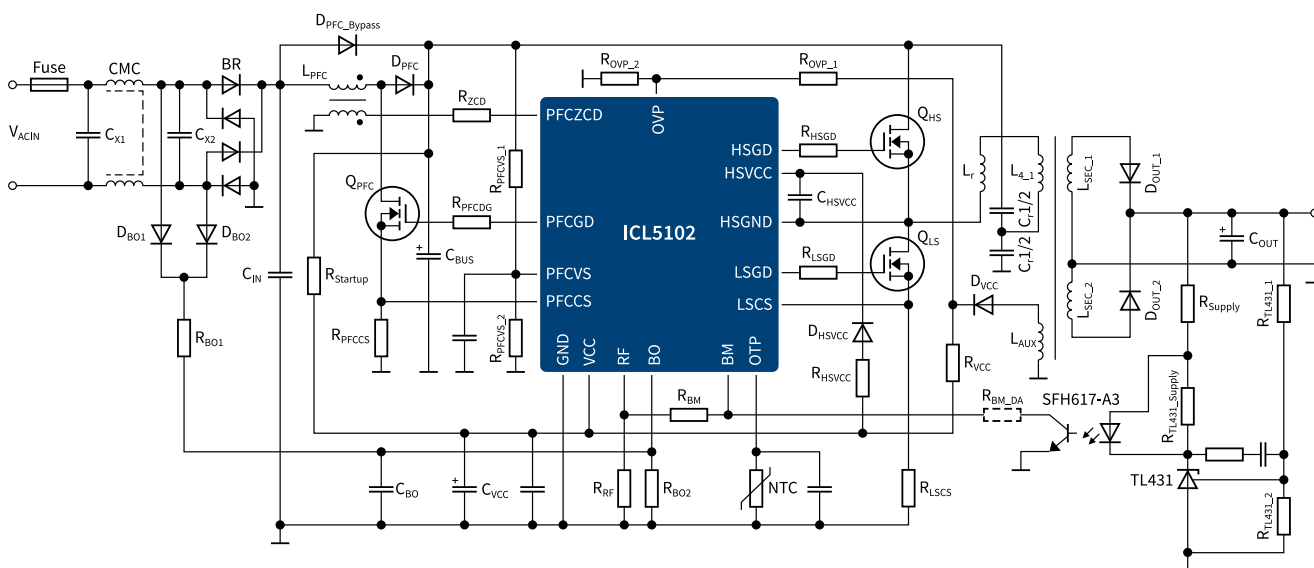
Order information for ICL5102

Type	Description	Ordering code
ICL5102	PFC and resonant controller for LCC and LLC	SP001609012
EVAL-ICL5102-U130W-CC	PFC/LLC-CC constant current evaluation board 130 W LED driver	SP001667160

Power ICs

www.infineon.com/icl5102

XDP™ LED

The digital IC family XDP™ 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 allows to reduce the 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 and 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 percent

› Configurable output current with no BOM change
› Efficiency 91 percent
› High power quality, typical power factor 0.99 and THD <10 percent
› Integrated 600 V startup cell
› Internal temperature guard with adaptive thermal management
› All relevant error conditions are monitored and protected

Typical application schematic
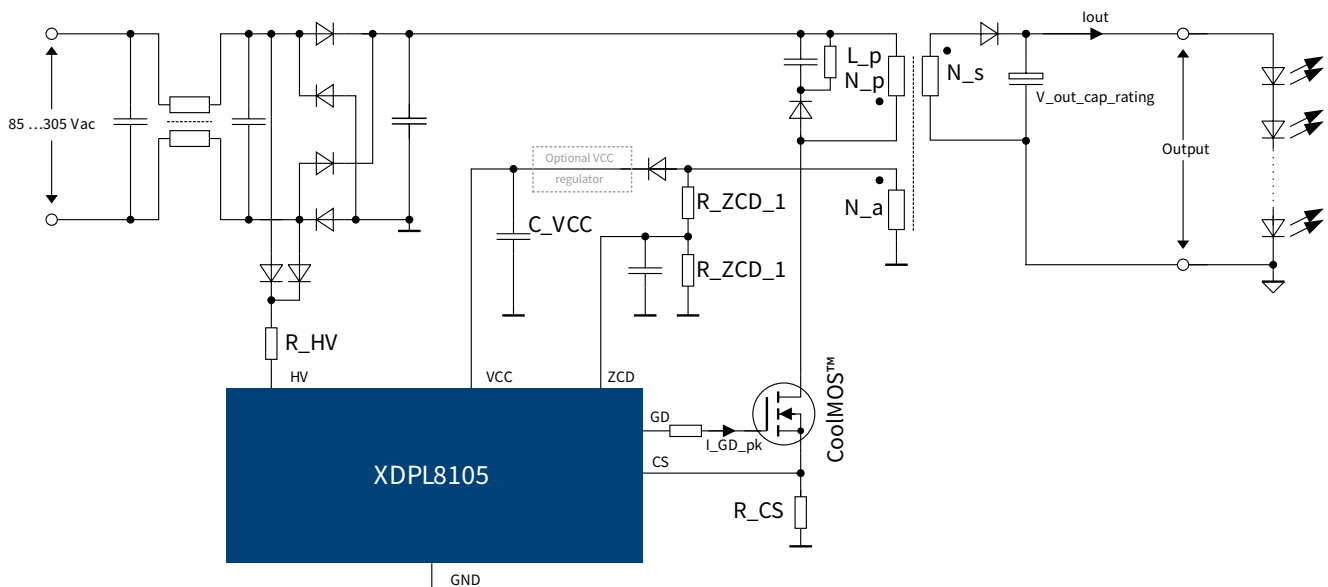
Order information for XDPL8105

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

www.infineon.com/xdpl8105

XDPL8210 – Digital flyback constant current controller IC for LED driver with 1 percent dimming

The XDPL8210 is a digital single-stage flyback controller with power factor correction (PFC) for constant output current. The IC is available in a DSO-8 package and supports a wide feature set with a minimum number of external components. The possibility to tune operational parameters and protection modes helps to ease and speed up the design phase. Additionally this reduces the number of hardware variants. Accurate primary side output current regulation saves the parts for secondary side feedback circuitry.

Wide input voltage range from 90 V_{AC} to 305 V_{AC}

Excellent power factor and THD

› PF>0.9 and THD<15 percent over the whole input voltage range down to one third of the nominal load

› Meets IEC61000-3-2 class C requirements

Protections

› Accurate AC input under-/overvoltage protection with configurable threshold and hysteresis

› Reliable output and V_{CC} under-/overvoltage protection with configurable limits and hysteresis

› Primary side overcurrent protection (protection for transformer shorts or a broken current sense line)

› Over temperature protection

› For most of the protections the reaction can be configured (off, fast auto restart, auto restart or latch mode)

Exceptional low stand-by power consumption

› 35 W reference board consumes <100 mW at 277 V_{AC} and open load

Multi-mode operation

› XDPL8210 supports quasi-resonant, discontinuous conduction and an advanced burst mode

› The controller automatically selects the optimal mode, appropriate to the actual load and input voltage combination

Typical application schematic
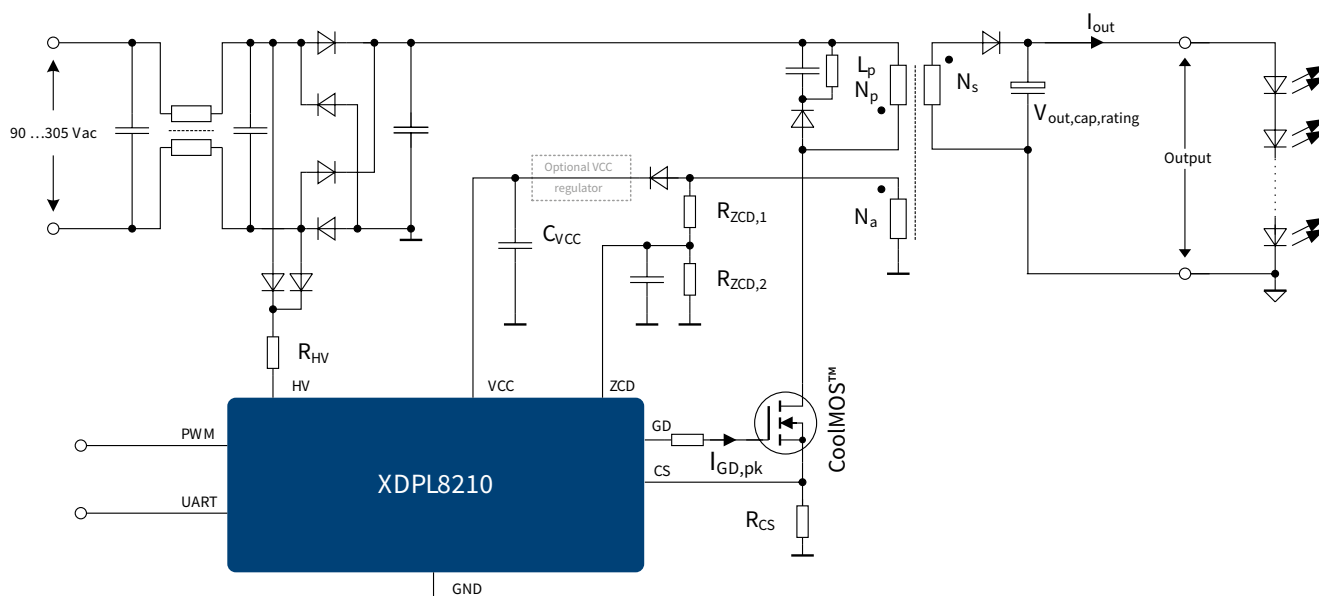
Order information for XDPL8210

Type	Description	Ordering code
XDPL81210	Digital flyback constant current controller IC	SP001643692
REF-XDPL8210-U35W	35 W reference design with CDM10V isolated 0 V-10 V dimming interface	SP001886070

www.infineon.com/xdpl8210

New XDPL8218 – High power factor constant voltage flyback IC

LEDs need a constant current (CC) for safe operation. To improve the performance – especially low flicker - there is a need for a 2-stage architecture with a primary stage constant voltage (CV) circuit. A buck regulator or LDO on secondary side enable high performance LED drivers. Also LED drivers with multiple channels utilize the topology primary side constant voltage output plus secondary side regulators. One requirement for lighting appliances is a high power factor and little harmonics (THD). XDPL8218 provides a constant voltage output with a high power factor.

Wide input voltage range
› Supports extended voltage range from 90 V_{AC} to 305 V_{AC} plus tolerance

Excellent power factor and THD
› PF>0.9 and THD<15 percent over the whole input voltage range down to one third of the nominal load
› Meets IEC61000-3-2 class C requirements

Protections
› Accurate AC input under-/overvoltage protection with configurable threshold and hysteresis
› Reliable output and V_{CC} under-/overvoltage protection with configurable limits and hysteresis
› Primary side overcurrent protection (protection for transformer shorts or a broken current sense line)
› Over temperature protection
› For most of the protections the reaction can be configured (off, fast auto restart, auto restart or latch mode)

Exceptional low stand-by power consumption
› 40 W reference board consumes <100 mW at 277 V_{AC} at open load

Multi-mode operation
› XDPL8218 supports quasi-resonant, discontinuous conduction and an advanced burst mode
› XDPL8218 automatically selects the optimal mode appropriate to the actual load and input voltage combination

Typical application schematic
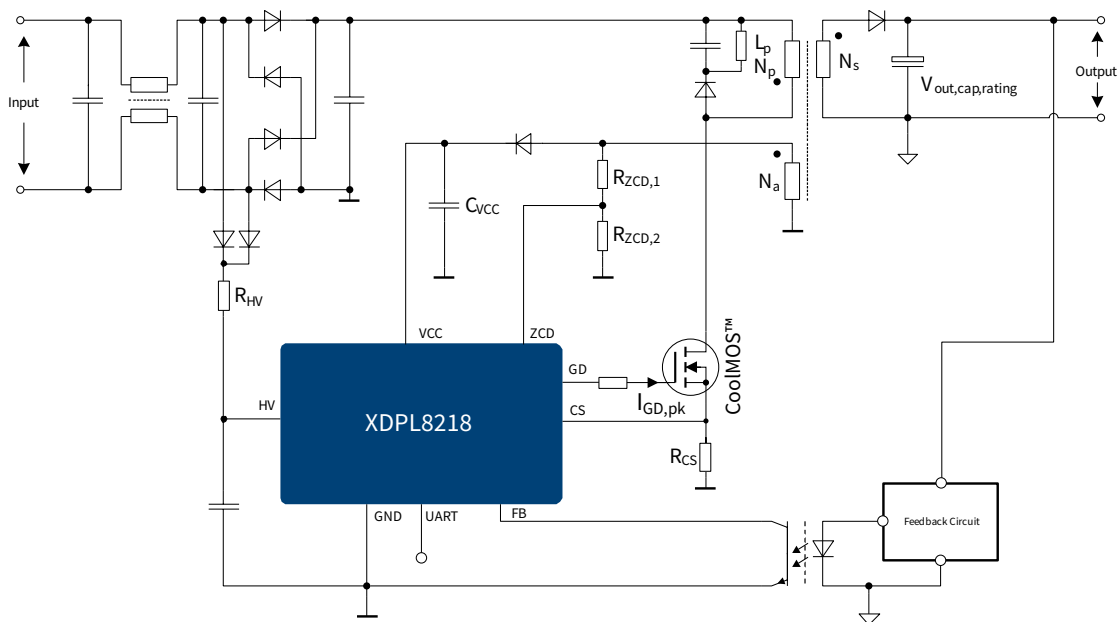
Order information for XDPL8218*

Type	Description	Ordering code
XDPL8218	Digital flyback CV-output controller IC	SP001707258
REF-XDPL8218-U40W	40W reference board with replaceable feedback circuit	SP001710980

www.infineon.com/xdpl8218

* coming Q2/2018

XDPL8220 - Digital dual stage multi-mode flyback controller for CC, CV, LP

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 advanced control algorithms provide the possibility to realize lighting Electronic Control Gear (ECG) for constant current or constant voltage mode with 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.

Typical application schematic
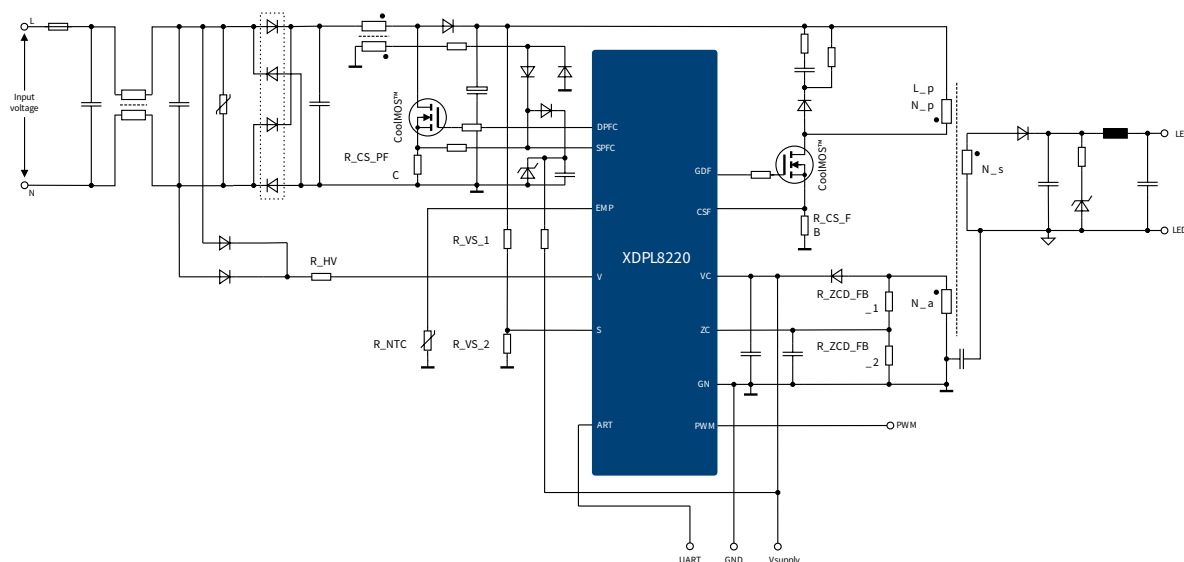
Order information for XDPL8220

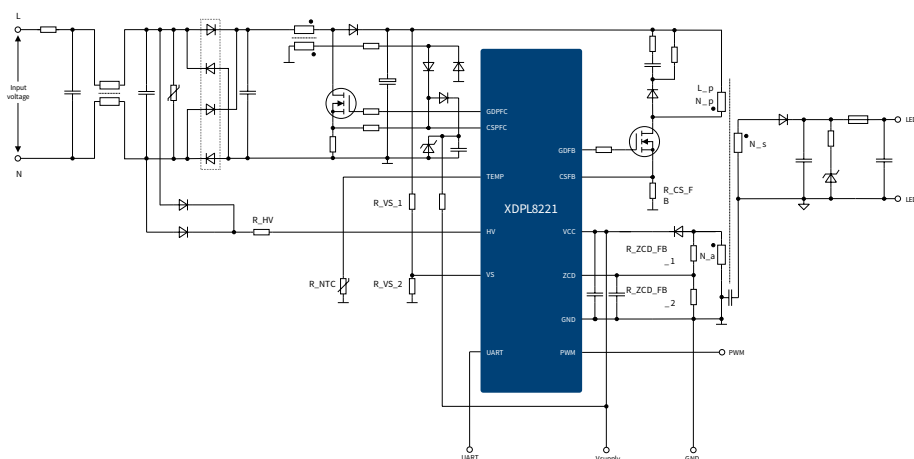| Type	Description	Ordering code
XDPL8220	Digital dual stage multi-mode flyback Controller for CC, CV, LP	SP001398160
REF-XDPL8220-U30W	30 W reference board with CDM10V isolated 0 V-10 V dimming interface	SP001630060
REF-XDPL8220-U50W	50 W reference board with CDM10V isolated 0 V-10 V dimming interface	SP001630066
REF-XDPL8220-U100W	100 W reference board with CDM10V isolated 0 V-10 V dimming interface	SP001630068

www.infineon.com/xdpl8220

New XDPL8221 - Digital dual stage multi-mode flyback controller for CC, CV, LP and 1 percent dimming and serial Interface

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

› **Flicker free dimming down to 1 percent:** The two-stage PFC and flyback architecture combined with digital control loops inside the XDPL8221 shift automatically and flicker free between the optimal operating mode (quasi-resonant, discontinuous or advanced burst). This engine enables dimming down to 1 percent of the target current over a wide operating range.

› **Ready for the upcoming communication needs:** The XDPL8221 comes with a serial interface to communicate with external microcontrollers that implement high-level control features or a communication protocol wired or wireless. The commands of a microcontroller changes the setting or provides information of the operating status of the XDPL8221.

› **Flexibility saves efforts and cost:** The digital core of the XDPL8221 enables a variety of systems based on the same hardware. 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 the tuning of operating constraints.

› **No low frequency flicker:** The modern two stage architecture offered by the XDPL8221 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 100 mW, the XDPL8221 significantly reduces the open load power consumption, while still reacting to external events or user requests.

› **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 XDPL8221 enables an increase of the feature set without external parts.

Typical application schematic

Order information for XDPL8221*

Type	Description	Ordering code
XDPL8221	Digital dual stage multi-mode flyback Controller for CC, CV, LP with 1 percent dimming	SP001684238
REF-XDPL8221-U50W	50 W reference board with CDM10V isolated 0 V-10 V dimming interface	SP00xxxxxxx
REF-XDPL8221-U100W	100 W reference board with CDM10V isolated 0 V-10 V dimming interface	SP00xxxxxxxxx

www.infineon.com/xdpl8221

* coming Q2/2018

Linear current regulators

BCR401W/BCR402W/BCR401U/BCR402U/BCR405U/BCR430U

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 100 mA (adjustable by external resistor)
› Supply voltage up to 18 V (BCR401W, BCR402W) and up to 40 V (BCR401U, BCR402U, BCR405U, BCR430U)
› 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-100 mA)

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	40	10.0	65	PWM by ext. transistor	SC74	750
BCR401W	LED drivers for low-power LEDs	Linear	1.2	18	10.0	60	PWM by ext. transistor	SOT343	500
BCR402U	LED drivers for low-power LEDs	Linear	1.4	40	20.0	65	PWM by ext. transistor	SC74	750
BCR402W	LED drivers for low-power LEDs	Linear	1.4	18	20.0	60	PWM by ext. transistor	SOT343	500
BCR405U	LED drivers for low-power LEDs	Linear	1.4	40	50.0	65	PWM by ext. transistor	SC74	750
BCR430U NEW	LED driver for low-power LEDs	Linear	6	42	Defined by R_{set}	100	PWM by ext. transistor	SOT23	600

NEW: Ultra low voltage drop version BCR430U with only 135 mV at 50 mA

LED current versus voltage drop (V_s = 24 V)
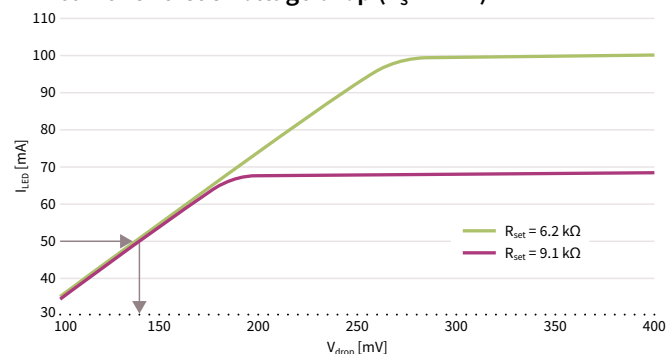
The voltage drop at the integrated LED driver stage can go down to 135 mV at 50 mA and less improving the overall system efficiency and providing extra voltage headroom to compensate for tolerances of LED forward voltage or supply voltage. With the BCR430U, additional LEDs can be added to lighting designs without changing the supply voltage.

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

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	24	250	300	No	SC74	1000
BCR321U	LED drivers for mid-power LEDs	Linear	1.4	24	250	300	Digital input	SC74	1000
BCR420U	LED drivers for mid-power LEDs	Linear	1.4	40	150	200	No	SC74	1000
BCR421U	LED drivers for mid-power LEDs	Linear	1.4	40	150	200	Digital input	SC74	1000
BCR450	LED controller	Linear	3.0	27	70	ext. switch	Digital input	SC74	500

www.infineon.com/bcr
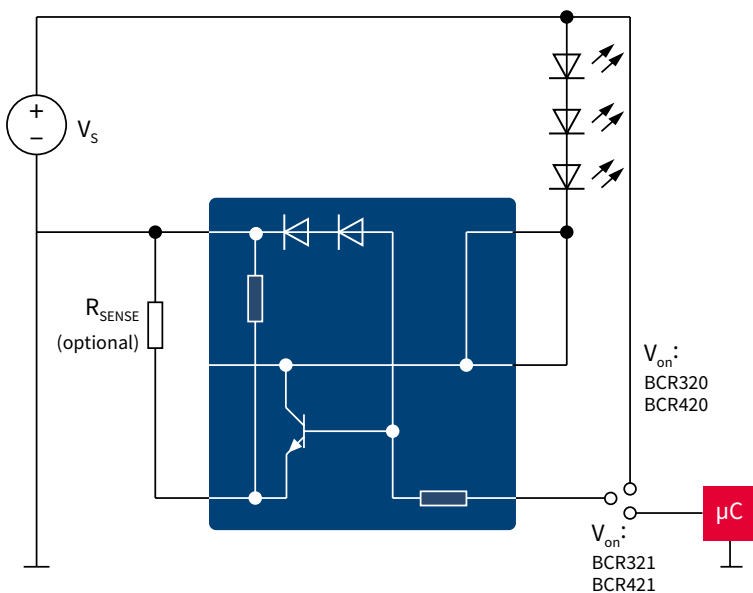
DC-DC switch mode LED driver ICs

ILD1151/ILD4001/ILD4035/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 up to 60 V
› Scalability in output current from 150 mA up to multiple amperes
› Alternative dimming concepts: digital or analog
› Superior adjustable over temperature protection for ILD6150 and ILD6070

› Overvoltage and overcurrent protection
› Smart thermal protection for ILD6070, ILD6150, ILD4035 and ILD4001 contributing to longer LED lifetime
› ILD1151 supports boost, buck-boost and SEPIC topologies

Type	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
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 temperature 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
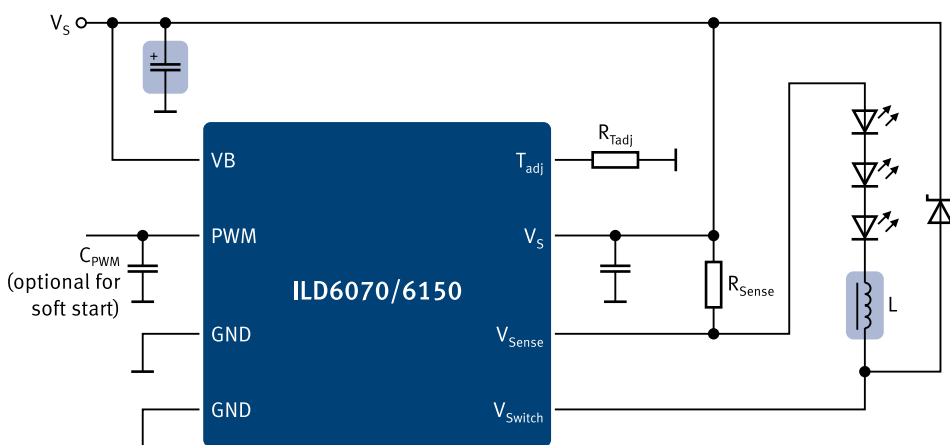
CDM10V and CDM10VD – most flexible dimming interface ICs for 0–10 V
Infineon's fully integrated dimming solutions

Infineon's CDM10V and CDM10VD are the industry's first single-chip lighting interface ICs. They are capable of transforming an analog 0–10 V input into a PWM or dimming input signal, required by a lighting controller IC. CDM10V and CDM10VD devices are dedicated for commercial and industrial LED lighting applications. The compact and highly integrated devices allow designers to replace up to 25 discrete components, used in conventional 0–10 V dimming schemes, with a single device. Supplied in an ultra-miniature 6-pin SOT package, the CDM10Vx and CDM10VDx perfectly match small PCBs with high component densities.

Key features
> Active dimming (0–10 V) and passive dimming (resistor)
> Embedded digital signal processing which maintains
> minimum variations from device to device
> PWM input
> One-time configurable device: CDM10V and pre-configured devices with various feature sets

Key benefits
> Single-device solution leading to low BOM and PCB savings
> Dimming ICs in small SOT-23 package for high power density designs
> Granular portfolio for highest flexibility and easy design-in
> Wide input V_{cc} range 11–25 V, extended range down to 6 V for CDM10V
> Attractive pricing and faster time-to-market

Product type	I_{out} [mA]	Min. duty cycle [%]	PWM output frequency [kHz]	Dimmer/Resistor Bias Current [µA]	Dimm-to-Off	OPN	SP number
CDM10V	5	1/2/**5**/10	0.2/0.5/**1**/2	50/100/**200**/500	**Disabled**/enabled	CDM10VXTSA1	SP001424754
CDM10V-2	5	n.a.	1	200	Enabled	CDM10V2XTSA1	SP001684884
CDM10V-3	5	1	1	200	Disabled	CDM10V3XTSA1	SP001715882
CDM10V-4	5	n.a.	2	100	Enabled	CDM10V4XTSA1	SP001727960
CDM10VD	5	5	1	120	Enabled	CDM10VDXTSA1	SP001619792
CDM10VD-2	5	10	1	120	Enabled	CDM10V2DXTSA1	SP001619794
CDM10VD-3	1	5	1	120	Enabled	CDM10V3DXTSA1	SP001619796
CDM10VD-4	1	10	1	120	Enabled	CDM10V4DXTSA1	SP001630006

Board name	Description	SP number
COOLDIM_PRG_BOARD	Configuration board for CDM10V only	SP001493166
REF-XDPL8220-U30W	30 W two stage PFC FB digital power, efficient and flicker free reference design with CDM10V	SP001630060
REF-XDPL8105-CDM10V	40 W single stage PFC FB digital power reference design with CDM10V	SP001649474

Typical application schematic using CDM10V
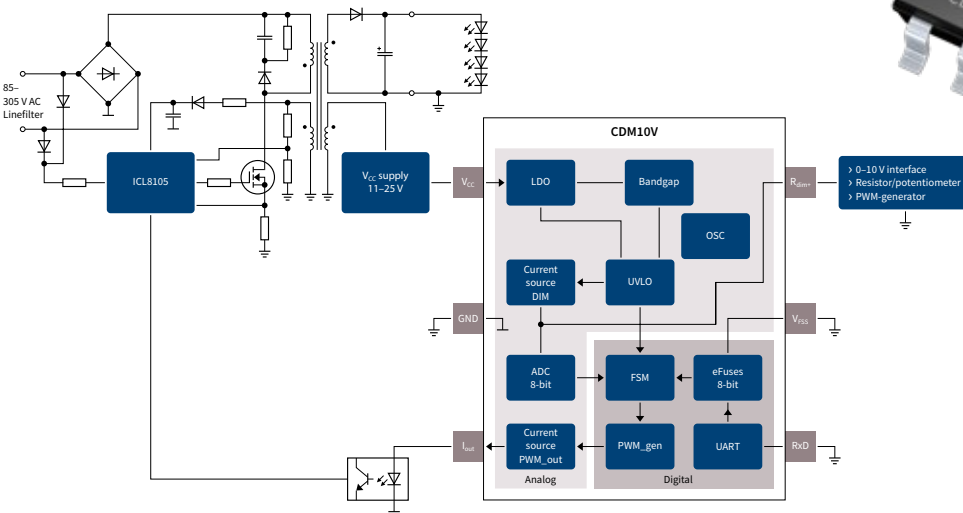
www.infineon.com/cdm10v

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
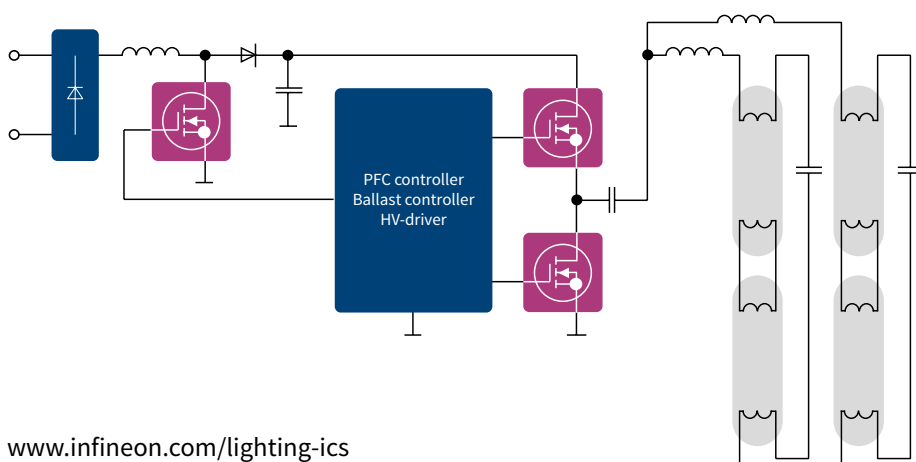
www.infineon.com/lighting-ics

Integrated point-of-load converters
Digital interface IPOL voltage regulators

The digital interface IPOL devices are easy-to-use, fully integrated and highly efficient DC-DC regulator offering I$_2$C/PMBus™, parallel VID, Intel SVID. The on-board PWM controller and MOSFETs make the family a space efficient solution, providing accurate power delivery for low output voltage and high current applications. The IR3806x family of PMBus™ enabled IR MOSFET™ IPOL based SupIRBuck™ voltage regulators offers:

› Compactness of integrated controller, driver and MOSFETs
› High performance analog voltage mode engine
› Flexibility of a rich PMBus™ interface

The IR381(2/3)6x family features OptiMOS™ 5 for the highest efficiency and adds Intel SVID support (IR381(/3)6x) for Intel based systems or parallel VID (IR3826x) for voltage scaling or 8 programmable output voltages booting options to avoid programming at start up. Pin compatible options with and without PMBus™ are available to allow the flexibility of using PMBus™ only during evaluation or easily upgrade a system to PMBus™ without re-layout.

Main features
› PMBus™ revision 1.2 compliant
› ≥ 66 PMBus™ commands
› Wide input voltage range and single 5 V – 16 V input operations
› Differential remote sense
› Ultra-low jitter voltage mode eingine
› Operation temp: -40° to 125° C

Main benefits
› Only single chip solution with extensive PMBus™, parallel VID, Intel SVID support allows 50 percent space saving versus external power competition
› Intel SVID support for Intel-based systems
› Parallel VID or PMBus™ for voltage setting and margining
› Telemetry status via digital bus
› Remote monitoring and update
› Parameter changes by register
› Flexible sequencing
› High accuracy low ripple
› Integrated sequencing, margin, current and voltage monitoring

Analog IPOL voltage regulators

High efficiency and accuracy: Our 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. Wide operating temperature from -40° to 125°C.

Main benefits
› Enhanced voltage mode PWM devices offer high accuracy, ultra-low ripple and noise and higher control bandwidth for less capacitors
› Scalable solutions from 3 A to 35 A
› For designs requiring high density, low cost and easy design, the family includes a 3 A device with enhanced stability constant-on-time engine that does not require external compensation enabling easy designs and fast time-to-market

Integrated POL portfolio

PQFN 5 x 7 mm ~20 – 35 A
PQFN 5 x 6 mm ~6 – 25 A
PQFN 4 x 5 mm ~2 – 10 A
PQFN 3.5 x 3.5 mm / PQFN 3 x 3 mm ~1 – 3 A
1 A — 35 A I$_{out}$

www.infineon.com/ipol
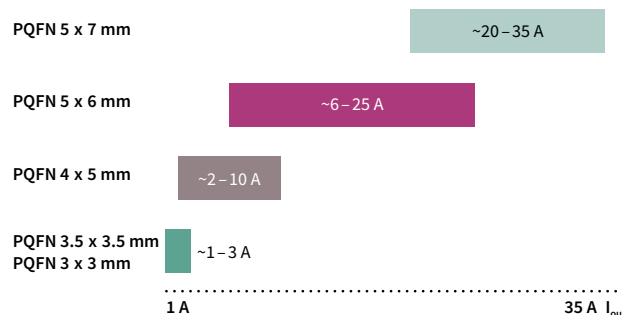
DC-DC IPOL portfolio

Digital interface

I²C PMBus™, telemetry, margin, faults, SVID PVID Digital control/configuration, telemetry and diagnostic					
Part number	Max. current [A]	Package size [mm]	Max. V_{in}	Max. f_{sw}	Distinctive features
IR38064	35	5 x 7	21 V	1500 KHz	PMBus™
IR38063	25	5 x 7	21 V	1500 KHz	
IR38062	15	5 x 7	21 V	1500 KHz	
IR38060	6	5 x 6	21 V	1500 KHz	
IR38163	30	5 x 7	16 V	1500 KHz	OptiMOS™ 5, SVID + PMBus™
IR38165	30	5 x 7	16 V	1500 KHz	OptiMOS™ 5, SVID
IR38363	15	5 x 7	16 V	1500 KHz	OptiMOS™ 5, SVID + PMBus™
IR38365	15	5 x 7	16 V	1500 KHz	OptiMOS™ 5, SVID
IR38263	30	5 x 7	16 V	1500 KHz	OptiMOS™ 5, PVID + PMBus™
IR38265	30	5 x 7	16 V	1500 KHz	OptiMOS™ 5, PVID
IR38164	30	5 x 7	16 V	1500 KHz	OptiMOS™ 5, SVID + PMBus™, enhanced Imon
IRPS5401	4+4+2+2+0.5	7 x 7	14 V	1500 KHz	5 output PMIC, PMBus™

Analog interface

„Performace" voltage mode PWM Ultra-low jitter and noise, high accuracy and low ripple					
Part number	Max. current [A]	Package size [mm]	Max. V_{in}	Max. f_{sw}	Distinctive features
IR3883	3	3 x 3	14 V	800 KHz	Constant-on-time
IR3823	3	3.5 x 3.5	21 V	1500 KHz	3 soft start
IR3897	4	4 x 5	21 V	1500 KHz	DDR tracking and analog voltage margin/AVSO
IR3898	6	4 x 5	21 V	1500 KHz	
IR3899	9	4 x 5	21 V	1500 KHz	
IR3894	12	5 x 6	21 V	1500 KHz	
IR3895	16	5 x 6	21 V	1500 KHz	
IR3826	23	5 x 6	17 V	1500 KHz	OptiMOS™ 5, 3-level OCP
IR3448	16	5 x 6	21 V	1500 KHz	True differential remote sensing for accuracy and thermally enhanced Cu clip package
IR3847	25	5 x 6	21 V	1500 KHz	
IR3846	35	5 x 7	21 V	1500 KHz	
IR3891	4+4	5 x 6	21 V	1500 KHz	Dual output for density and out-of-phase for less input capacitor
IR3892	6+6	5 x 6	21 V	1500 KHz	

Point-of-load products – how to choose

DC-DC products
1 A to 35 A

Analog (VM) IR MOSFET™ IPOL	PMBus™ digital IR MOSFET™ IPOL	Constant on-time IR MOSFET™ IPOL
Flexibility/low jitter IR389x/IR384x: 3 A-35 A	Digital interface IR3806x: 6 A-35 A	Easy/light-load efficiency IR3883: 3 A **NEW!**
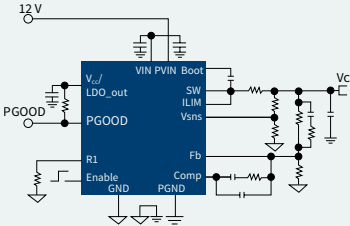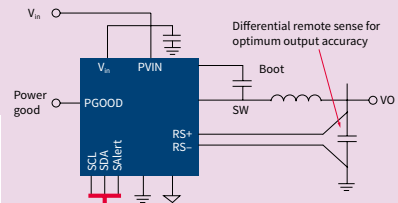
Programmable
› F_{sw}
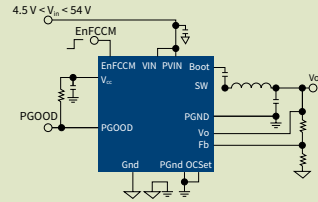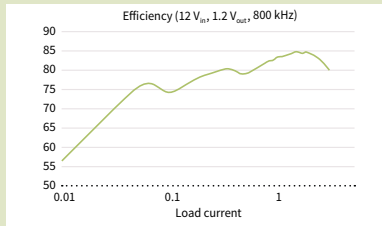› Transient
› Tracking
› Remote sense

› Telemetry
› Margining

Differential remote sense for optimum output accuracy

Digital mode: I2C/PMBus™ interface

PMBus™ IC capabilities

Inventory	Device ID
Configuration	On/off configuration fault/warnings
Control	Sequencing delay/ramp fault response
Telemetry	V_{out}, I_{out}, power temperature, peak values
Status	Comms, data, temps

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

Efficiency (12 V_{in}, 1.2 V_{out}, 800 kHz)

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 2 Mbit/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
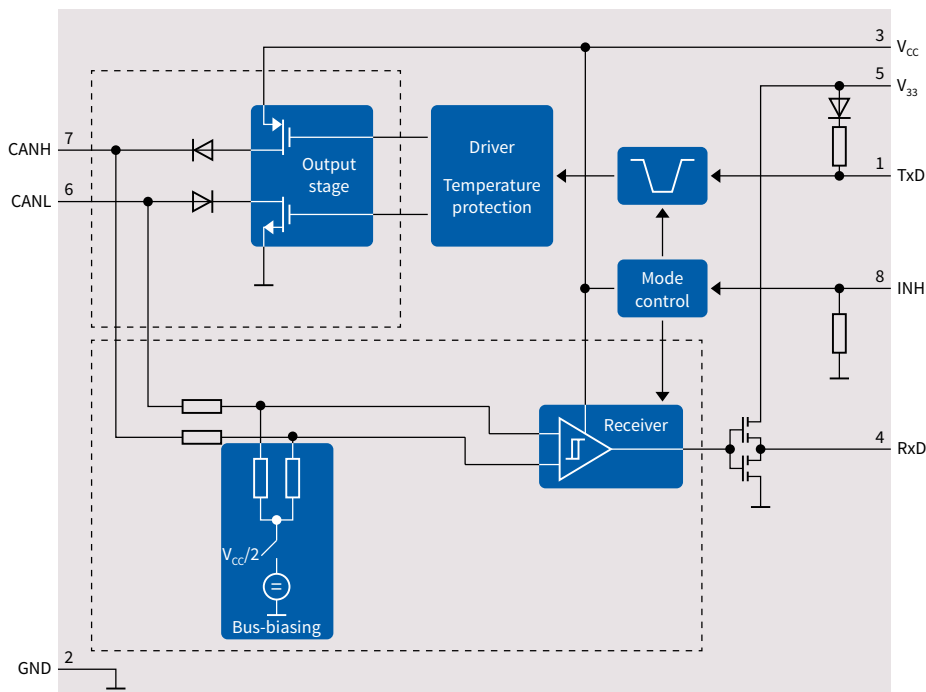
Voltage regulators
Energy-efficient voltage regulators and trackers

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

Power ICs

Block diagram IFX91041

Industrial DC-DC buck regulators (selection tree)

www.infineon.com/industrial-dcdc-converters

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
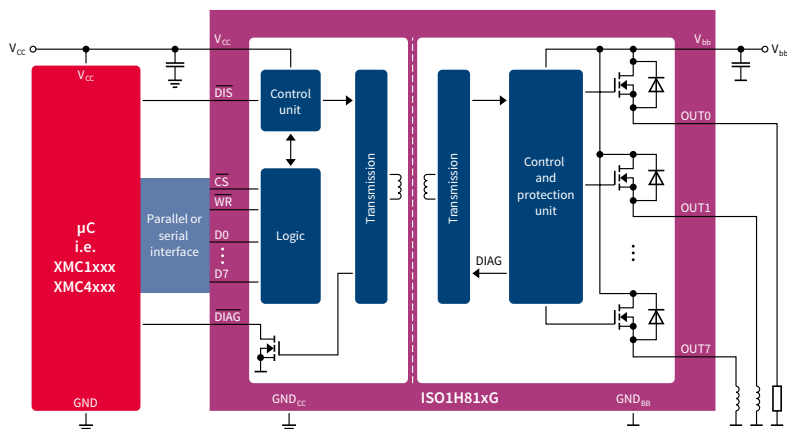
Product overview		ISO1H801G	ISO1H811G	ISO1H812G	ISO1H815G	ISO1H816G
Switch	V_{bb} operational range: 11 V to 35 V	✓	✓	✓	✓	✓
	Max. continuous load current per channel	0.6 A	0.6 A	0.6 A	1.2 A	1.2 A
	Load current increase by using outputs in parallel	✓	✓	✓	✓	✓
	Inductive clamping energy per channel: 1 Joule	✓	✓	✓	✓	✓
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
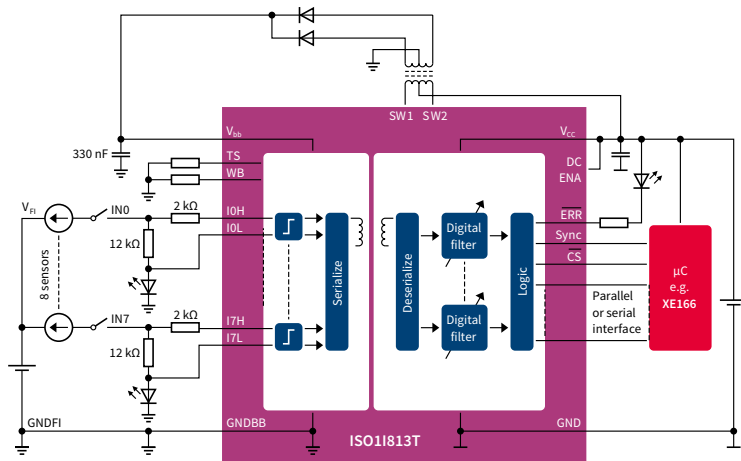
XMC4800 Automation Board V2

The Automation Board utilizes Infineon's industry leading
XMC™ ARM® Cortex®-M4 microcontroller in combination with Infineon
supply, interface, communication and safety products.

› Complete automation kit gateway
› Combined MCU with EtherCAT® slave application
› Isolated interfaces w/ diagnose
› Ethernet connectivity with software examples available
› 24 V supply
› CAN connectivity
› Full software DAVE™ examples

Ordering code: SP001632038

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

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
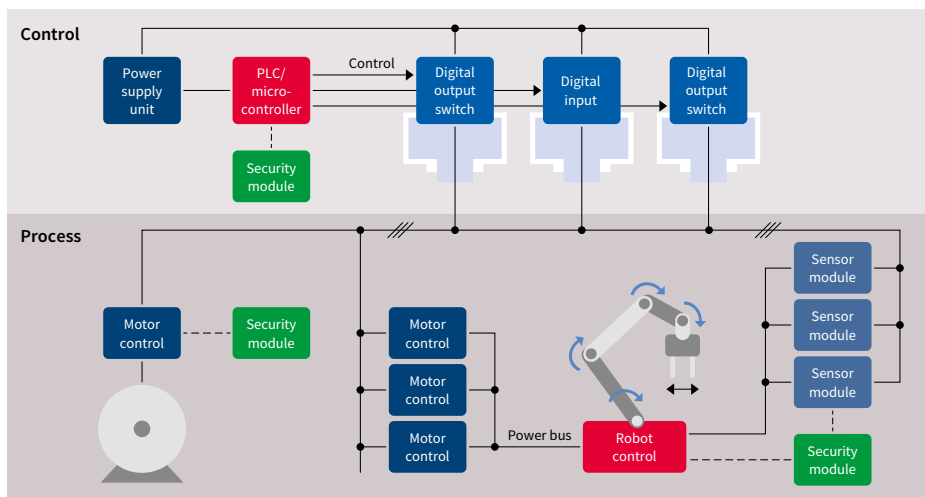
System benefits
› Right fit for digital output switches, motor or robot control, protected switching of decentralized loads like sensors or auxiliary supply
› Suitable for all types of complex loads including high inductances (high EAS)
› Outstanding robustness & reliability as required by industrial 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/industrial-profet

PLC – Programmable Logic Controller digital output modules
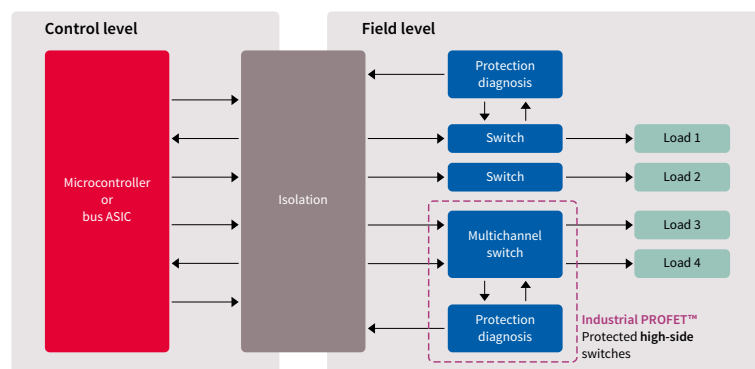
System benefits

> 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

www.infineon.com/industrial-profet

Additional evaluation boards:

> ITS42008, Order: DEMOBOARDITS42008TOBO1
> ITS42K5D-LD-F, Order: DEMOBOARDITS42K5DTOBO1

Power ICs

HITFET™

Protected low-side switches

HITFET™ stands for highly integrated temperature protected MOSFET. These well-established low-side switches offer a compelling feature set with protection against over temperature, short circuit and overload conditions as well as ESD robustness. The HITFET™+ family is the new generation based on a new technology, enabling a significant shrink compared to the existing HITFET™ portfolio (up to 50 percent shrink). This new generation consists of standard and fully featured protected low-side switches (35 mΩ to 125 mΩ) in the TO252-3 and TDSO-8 packages. HITFET™ and HITFET™+ devices address a wide range of applications including resistive, inductive and resistive loads.

Key features
› Low-side switches with integrated protection features
› Scalable in $R_{DS(on)}$ ranges from 490 mΩ down to 11 mΩ
› Adjustable slew rate control (BTFxxx)
› Thermal shutdown with auto-restart or latch behavior
› Status feedback via
  – Increased input current (HITFET™ 2nd gen.)
  – Digital read out via SRP (BTF3050TE)
  – Via STATUS pin (BTF3xxxEJ)

Key applications
› Industrial automation (see page 192)
› Programmable logic controller (PLC) (see page 193)
› Digital I/O modules
› Building and home management
› All kind of solenoid or valve driving
› Power modules
› Solar power inverters

Key benefits
› High design flexibility with scalable $R_{DS(on)}$ and package
› Driving applications with high switching speed requirements up to 25 kHz (e.g. valve, solenoid)
› Easy to design-in
› Choice of packages to match individual application needs

Application diagramm example for HITFET™+
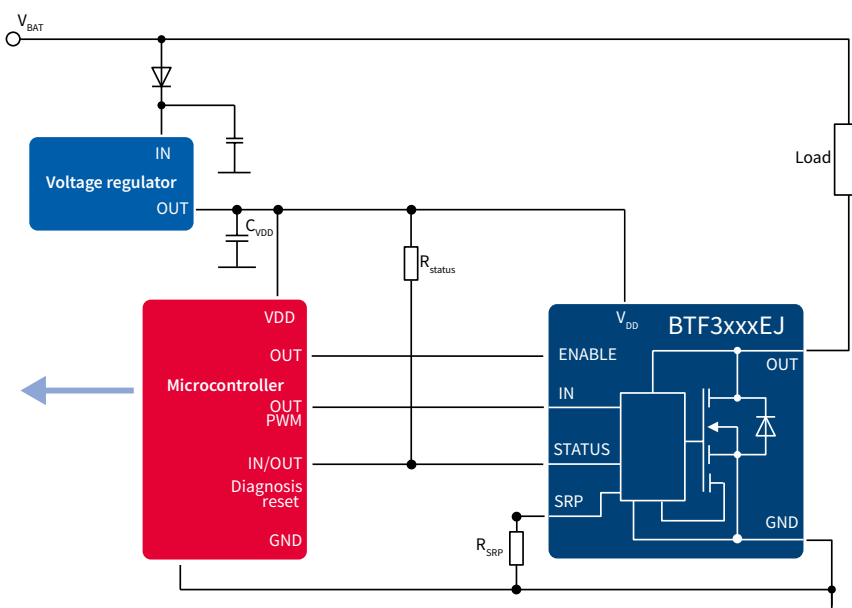
www.infineon.com/hitfet

Product type	Product family	Channels	$R_{DS(on)}$ @25°C [mW]	Nominal load current [A]	EAS [mJ]	Operating voltage range [V]	$IL_{(SD)}$ (typ) [A]	$IL_{(LIM)}$ (typ) [A]	$I_{L(LIM)\_TRIGGER}$ (typ) [A]	Diagnosis	Package
BTS3011TE	HITFET+	1	10.7	10	300 @ 5A	up to 28	-	35	70	STATUS pin	TO252-5 (DPAK 5-leg)
BTS3035EJ	HITFET+	1	28	5.00	105 @ 5 A	up to 31	–	20.00	–	STATUS pin	TDSO-8
BTS3035TF	HITFET+	1	30	5.00	106 @ 5 A	up to 31	–	20.00	–	–	TO252-3 (DPAK 3-leg)
BTF3035EJ*	HITFET+	1	28	5.00	95 @ 5 A	up to 32	–	14.00	41.00	STATUS pin	TDSO-8
BTF3050TE	HITFET+	1	40	3.00	120 @ 3 A	up to 28	–	8.00	30.00	through SRP pin	TO252-5 (DPAK 5-leg)
BTS3050EJ	HITFET+	1	40	4.00	62 @ 3 A	up to 31	–	15.00	–	STATUS pin	TDSO-8
BTS3050TF	HITFET+	1	44	4.00	64 @ 4 A	up to 31	–	15.00	–	–	TO252-3 (DPAK 3-leg)
BTF3050EJ*	HITFET+	1	40	4.00	62 @ 4 A	up to 32	–	10.00	29.00	STATUS pin	TDSO-8
BTS3060TF	HITFET+	1	50	3.00	55 @ 3 A	up to 35	–	10.50	–	–	TO252-3 (DPAK 3-leg)
BTS3080EJ	HITFET+	1	64	3.00	35 @ 3 A	up to 31	–	10.00	–	STATUS pin	TDSO-8
BTS3080TF	HITFET+	1	69	3.00	38 @ 3 A	up to 31	–	10.00	–	–	TO252-3 (DPAK 3-leg)
BTF3080EJ*	HITFET+	1	64	3.00	33 @ 3 A	up to 32	–	7.00	18.00	STATUS pin	TDSO-8
BTS3125EJ	HITFET+	1	100	2.00	30 @ 2 A	up to 31	–	7.00	–	STATUS pin	TDSO-8
BTS3125TF	HITFET+	1	108	2.00	24 @ 2 A	up to 31	–	7.00	–	–	TO252-3 (DPAK 3-leg)
BTF3125EJ*	HITFET+	1	100	2.00	23 @ 2 A	up to 32	–	5.00	12.00	STATUS pin	TDSO-8
BTS3018TC	HITFET	1	14	6.00	1900	up to 36	–	30.00	–	through input pin	TO263-3-2 (TO220-3 (SMD))
BTS141TC	HITFET	1	25	5.10	4000	up to 36	–	25.00	–	through input pin	TO263-3-2 (TO220-3 (SMD))
BTS3028SDL	HITFET	1	28	5.00	350	up to 36	–	18.00	–	through input pin	TO252-3 (DPAK 3-leg)
BTS3028SDR	HITFET	1	28	5.00	350	up to 36	–	18.00	–	through input pin	TO252-3 (DPAK 3-leg)
BTS133TC	HITFET	1	40	3.80	2000	up to 36	–	21.00	–	through input pin	TO263-3-2 (TO220-3 (SMD))
BTS3046SDL	HITFET	1	46	3.60	140	up to 36	–	10.00	–	through input pin	TO252-3 (DPAK 3-leg)
BTS3046SDR	HITFET	1	46	3.60	140	up to 36	–	10.00	–	through input pin	TO252-3 (DPAK 3-leg)
BTS117TC	HITFET	1	80	3.50	1000	up to 36	–	7.00	–	through input pin	TO263-3-2 (TO220-3 (SMD))
BTS3104SDL	HITFET	1	104	2.00	50	up to 36	–	6.00	–	through input pin	TO252-3 (DPAK 3-leg)
BTS3104SDR	HITFET	1	104	2.00	50	up to 36	–	6.00	–	through input pin	TO252-3 (DPAK 3-leg)
AUIPS2041L	HITFET	1	100	1.40	-	up to 35	5.00	–	–	–	SOT-223
AUIPS2051L	HITFET	1	250	0.90	-	up to 35	1.80	–	–	–	SOT-223
AUIPS2052G	HITFET	2	250	0.90	-	up to 35	1.80	–	–	–	SO-8 (DSO-8)
BTS3408G	HITFET	2	480	0.55	800	up to 36	–	1.00	–	through input pin	DSO-8
BSP75N	HITFET	1	490	0.70	550	up to 36	–	1.00	–	through input pin	SOT-223

Low-side switch shield with BTF3050TE

The low-side switch shield from Infineon consists out of three BTF3050TE low-side switches of the HITFET™+ family providing three independent power channels that can be controlled via the input pins. The shield is compatible with microcontroller boards using the Arduino form factor, for example the corresponding ARM® powered XMC™ microcontroller kits from Infineon and supports fast and easy prototyping of applications with BTF3050TE.

Key features
› PWM up to 14 kHz (10 percent duty cycle)
› Driver circuit with logic level inputs
› Fault feedback
› Protection e.g. against overtemperature and overcurrent
› Able to switch all kinds of resistive, inductive and capacitive loads

Operating conditions
› Nominal voltage range 8 V – 18 V
› Nominal current 3 A (typ.) DC
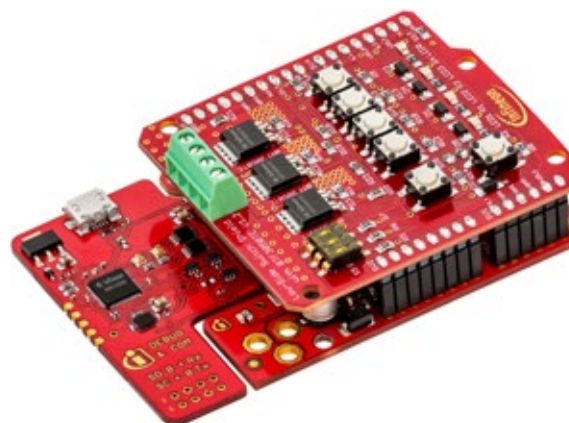
www.infineon.com/hitfet

www.infineon.com/shields-for-arduino

* Available in Q2 2018

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
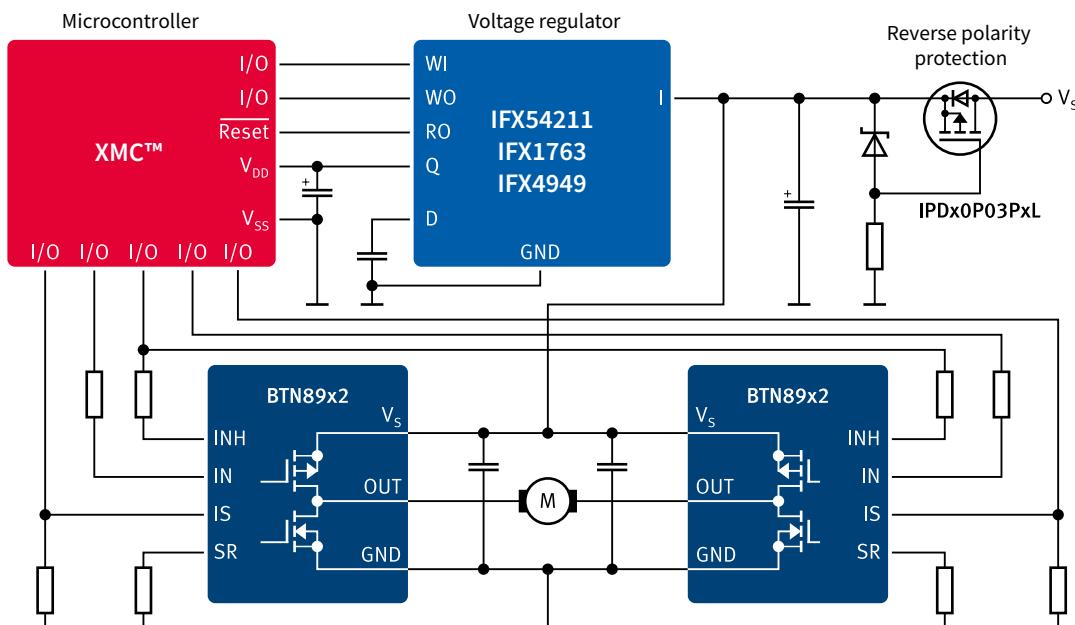
www.infineon.com/novalithic

CS = Current sense   OC = Overcurrent   OT = Overtemperature

Integrated multi half-bridge driver ICs

The TLE94xyz are protected half-bridge drivers designed for 12 V motion control applications such as small DC motors for heating, ventilation and air conditioning (HVAC), as well as automotive mirror adjustment and fold. The family offers 3-, 4-, 6-, 8-, 10-, and 12-fold integrated half-bridge driver. All devices can drive DC motor loads up to 0.9 A per output in cascaded or parallel operation. They provide diagnosis of short circuit, open load, power supply failure and over temperature for each half-bridge to ensure safe operation in HVAC or other systems. The TLE94xyz offers enhanced EMC performance, which in combination with the low quiescent current and a small package makes the product attractive for a wide range of 12 V automotive and industrial applications.

Key features and benefits

› 3-, 4-, 6-, 8-, 10-, 12-half-bridges with integrated output stages and PWM
› 16-bit SPI or direct inputs for control and diagnosis
› Voltage supply range: 5.5 V– 20 V
› Adjustable open load threshold for two outputs
› Variable driving schemes for up to 11 motors
› OUT 1 and 2 optimized for driving
› HS loads (e.g. LED)

Key applications

› 12 V automotive and industrial applications
› Flap motors in HVAC systems
› Mirror adjustment and fold
› Small DC motors (≤ 0.9 A/output)
› Bi-stable relays

Block diagram TLE94112EL
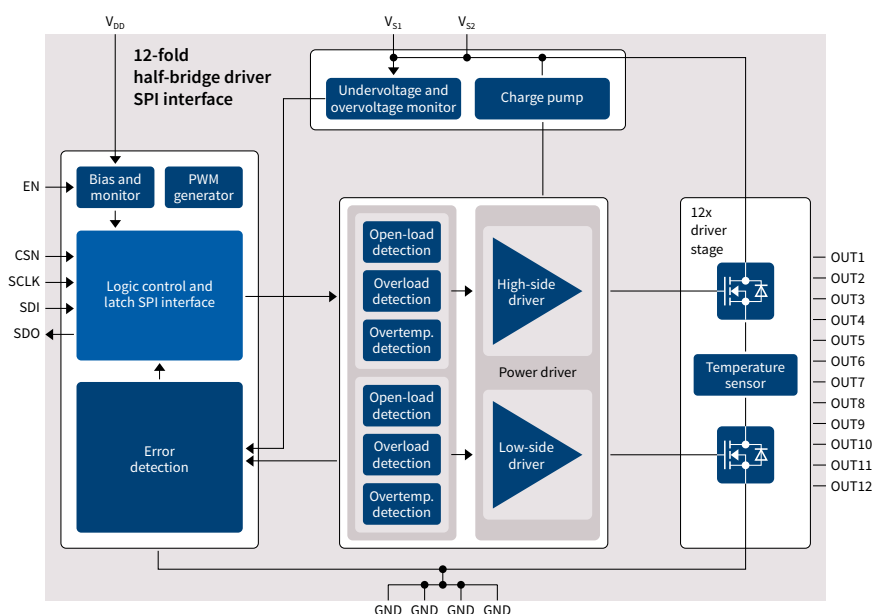
Product table

Product name	Config.	$I_{L(NOM)}$ [A]	$I_{L(lim)}$ [A]	I_q [µA]	$V_{S(OP)}$ [V]	Protection	Diagnostic interface	Highlights	$V_{CE(sat)}/R_{DS(on)}$	Package
TLE94003EP [1]	3 x half-bridge	3 x 0.30	3 x 0.90	0.6	5.5…20	OC, OT, VS, UV/OV	Error flag	TLE94xyz family concept + small package	850 mΩ/switch	TSDSO-14-EP
TLE94103EP [1]	3 x half-bridge	3 x 0.30	3 x 0.90	0.6	5.5…20	OC, OT, OL, VS, UV/OV	16-bit SPI	TLE94xyz family concept + small package	850 mΩ/switch	TSDSO-14-EP
TLE94004EP [1]	4 x half-bridge	4 x 0.30	4 x 0.90	0.6	5.5…20	OC, OT, VS, UV/OV	Error flag	TLE94xyz family concept + small package	850 mΩ/switch	TSDSO-14-EP
TLE94104EP [1]	4 x half-bridge	4 x 0.30	4 x 0.90	0.6	5.5…20	OC, OT, OL, VS, UV/OV	16-bit SPI	TLE94xyz family concept + small package	850 mΩ/switch	TSDSO-14-EP
TLE94106EL	6 x half-bridge	6 x 0.30	6 x 0.90	0.6	5.5…20	OC, OT, OL, VS, UV/OV	16-bit SPI	TLE94xyz family concept + backwards compatible to TLE84106EL	850 mΩ/switch	SSOP-24
TLE94108EL	8 x half-bridge	8 x 0.30	8 x 0.90	0.6	5.5…20	OC, OT, OL, VS, UV/OV	16-bit SPI	TLE94xyz family concept	850 mΩ/switch	SSOP-24
TLE94110EL	10 x half-bridge	10 x 0.30	10 x 0.90	0.6	5.5…20	OC, OT, OL, VS, UV/OV	16-bit SPI	TLE94xyz family concept + backwards compatible to TLE84106EL	850 mΩ/switch	SSOP-24
TLE94112EL	12 x half-bridge	12 x 0.30	12 x 0.90	0.6	5.5…20	OC, OT, OL, VS, UV/OV	16-bit SPI	TLE94xyz family concept + 12 outputs in one package	850 mΩ/switch	SSOP-24

www.infineon.com/dc-motor-bridges

1) coming in Q1/2018

Power ICs

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
› 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

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

DC motor control with half-bridge BTN8982

DC motor control with multi half-bridge TLE94112EL

Infineon shields for Arduino are compatible with microcontroller boards using the Arduino form factor, e.g. Infineon's XMC™ microcontroller kits.

DC motor shield with TLE94112EL for Arduino

The DC motor shield is a small evaluation board equipped with TLE94112EL for use with Arduino. The TLE94112EL is capable to drive up to 6 small DC motors in parallel mode or up to 11 DC motors in cascaded mode. All outputs can drive up to 0.9 A. The outputs can be used stand-alone or combined to increase driving capability up to 3.6 A.

Features
› Driver with 12 half-bridge outputs to drive DC motors, resistive or inductive loads
› Driver is protected against over-temperature, overcurrent, overvoltage, undervoltage and enables diagnosis of overcurrent, overvoltage, undervoltage
› SPI interface with zero clock diagnosis
› Enhanced EMC performance
› Integrated PWM generator with 3 different frequencies (80 Hz, 100 Hz, 200 Hz)

Target applications
› Multi-motor applications
› DC motors and voltage controlled bipolar stepper motors
› Toys
› HVAC systems

www.infineon.com/shields-for-arduino
www.infineon.com/makers

Integrated H-bridges

IFX9201SG and IFX9202ED* are general purpose 6 A H-bridges 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-bridges switch 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 (IFX9201SG) and PG-DSO-36-72 (IFX9202ED) packages
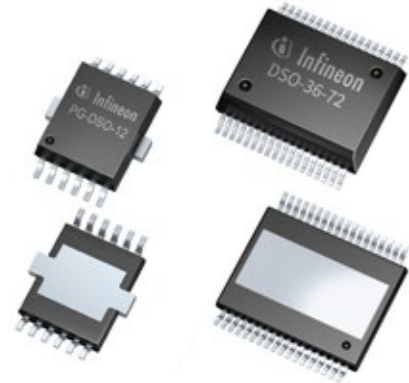
Product summary

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	10	70	7	PG-DSO-12 (power)	2
IFX9202ED*	5.0..36	6	10	70	7	PG-DSO-36 (dual gauge)	1

* IFX9202ED is a dual h-bridge with two independent h-bridges in one package

Applications examples

Application example H-bridge with SPI interface

Application example H-bridge with error flag
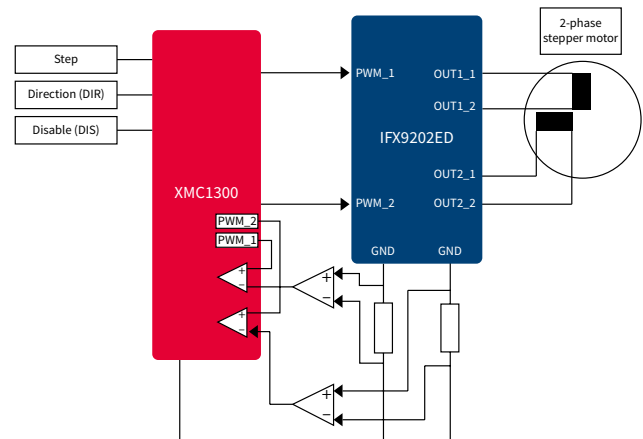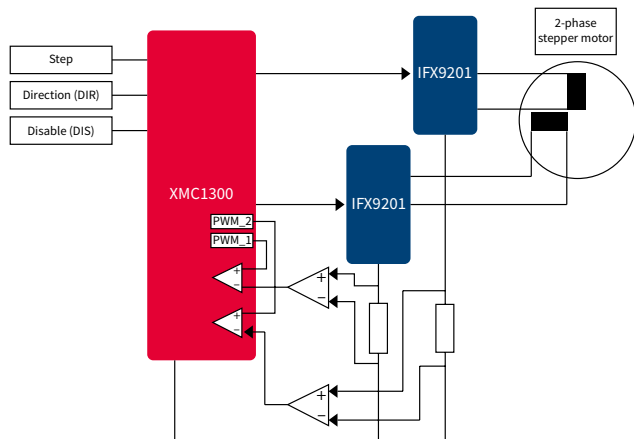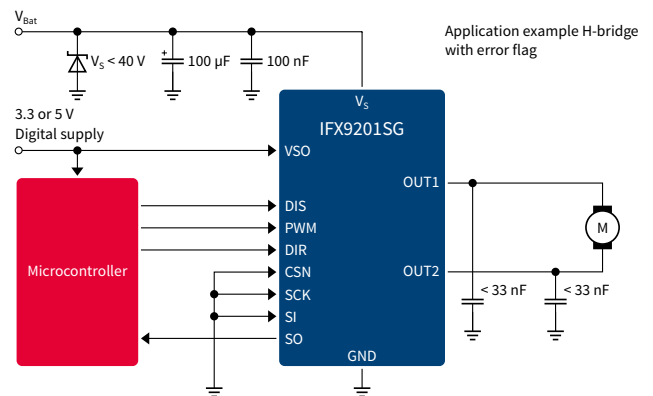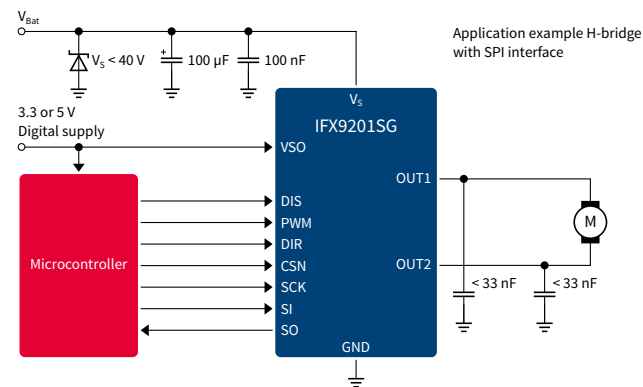
www.infineon.com/dc-motor-bridges

H-bridge Kit 2Go with IFX9201SG

The H-bridge Kit 2GO is a ready to use evaluation kit. It is fully populated with all electronic components equipped with the H-bridge IFX9201 combined with XMC1100 microcontroller based on ARM® Cortex®-M0 CPU. Realize your own DC motor control. It is designed for the control of DC motors or other inductive loads up to 6 A or up to 36 V of supply.

Target applications
› DC motor control for industrial applications
› Home and building automation
› Power tools battery management
› Industrial robotic applications
› Electric toys applications

Stepper motor control shield with IFX9201SG and XMC1300 for Arduino

The stepper motor control shield from Infineon Technologies is one of the first high current stepper motor control boards being compatible to Arduino as well as to Infineon's XMC1100 boot kit. The stepper motor control shield is capable to drive the two coils in a stepper motors featuring dual-half bridge configuration. The implemented integrated IFX9201 half-bridges can be controlled by a STEP-signal via the STEP pin. Interfacing to a microcontroller is made easy by the integrated XMC1300 microcontroller that holds the peripherals to allow high-speed current control. Microstepping of the stepper motor can be achieved using the internal comparators, operational amplifiers are installed to adapt the motor current sense signal to the microcontroller's input levels.

Features
› Compatible with microcontroller boards using the
› Arduino form factor, e.g. Infineon's XMCTM 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

Benefits
› Fast and inexpensive prototyping of stepper motor control
› Simple testing of microstepping algorithms
› Diagnose pin to allow hardware feedback during development
› Overtemperature shut down with latch behavior and undervoltage shut down of the power section

Target applications
› Stepper motors up to 5 A phase current
› 24 V nominal input voltage for the power stage
› Average motor current 3 A without additional cooling effort, 5 A possible with proper cooling

www.infineon.com/h-bridge-kit-2go
www.infineon.com/IFX9201SG-stepper-motor-shield
www.infineon.com/makers
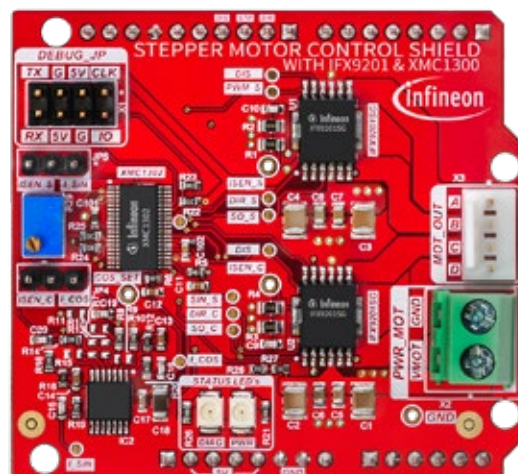
Stepper drivers

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

Power ICs

www.infineon.com/dc-motor-bridges

CIPOS™ IPM family

Control Integrated Power System (CIPOS™) Intelligent Power Modules (IPM)

Depending on the level of integration and power to be handled, Infineon offers a variety of IPMs, with different semiconductors in different packages and different voltage and current classes. These IPMs are separated into Compact, Standard and Performance families.

The CIPOS™ IPMs are families of highly integrated, compact power modules designed to drive motors in applications ranging from home appliances, to fans, pumps and general purpose drives.

Infineon's energy-efficient IPMs integrate the latest power semiconductor and control IC technology leveraging Infineon's advanced IGBTs, MOSFETs, next-generation gate driver ICs and state-of-the-art thermo-mechanical technology.

Product lineup

CIPOS™ Mini
36 x 21 x 3.1 mm

CIPOS™ Micro
29 x 12 x 3.1 mm

CIPOS™ Nano
12 x 12 x 0.9 mm
8 x 9 x 0.9 mm
7 x 8 x 0.9 mm

MOSFET: 40/100/250/500 V PQFN packages Half-bridge and 3-phase inverters	MOSFET: 250/500 V IGBT: 600 V DIP23 and SOP23 packages Inverter	IGBT: 600 V 4 A to 30 A MDIP-24 Fullpack and MDIP-21/24 DCB packages Inverter, SRM, PFC
Compact IPM	**Standard IPM**	**Performance IPM**

Motor current

0.1 A$_{rms}$ ———————————————————————→ 20 A$_{rms}$

Key benefits

› Shorter time-to-market
› Increased reliability
› Reduced system design complexity
› Improved manufacturability
› Reduced PCB board space

Block diagram for CIPOS™

www.infineon.com/ipm
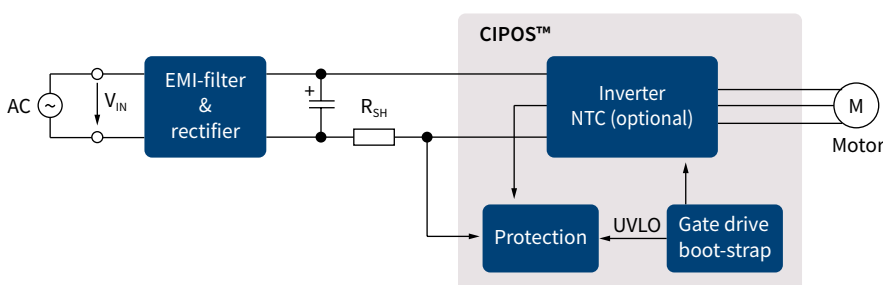
CIPOS™ Nano

3-phase or half-bridge driver with MOSFETs

CIPOS™ Nano is a family of highly integrated, ultra-compact power modules for high efficiency appliance and light industrial applications, including rectifier, converter, inverter in power management circuits and motor drives for hair dryer, air purifier, ceiling fan, circulation pump and ventilators. By utilizing an innovative packaging solution, the CIPOSTM Nano family delivers a new benchmark in device size, offering up to a 60 percent smaller footprint than existing 3-phase motor control power IPMs.

CIPOS™ Nano products comprise of a series of fully integrated 3-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.

Key features

› Smallest IPMs on the market
› Integrated gate driver IC and bootstrap functionality
› Suitable for sinusoidal or trapezoidal modulation
› Low $R_{DS(on)}$ Trench FREDFET
› Under-voltage lockout for all channels
› Matched propagation delay for all channels
› Optimized dV/dt for loss and EMI trade offs
› 3.3 V input logic compatible
› Active high HIN and LIN
› Isolation 1500 VRMS, 1 minute

PQFN 12 x 12
12 x 12 x 0.9 mm

PQFN 8 x 9
8 x 9 x 0.9 mm

PQFN 7 x 8
7 x 8 x 0.9 mm

Key benefits

› Cost savings from smaller footprint
   and reduced PCB space
› Easy implementation of 2 or 3-phase
   motor drives with half-bridge IPMs
› IPMs distribute heat dissipation
   and enable elimination of heat sink
› Same PCB footprint to address multiple
   application markets (100 V_{AC} - 230 V_{AC})

Major applications

Small Home Appliance | Hair Dryer | Air Purifier | Ceiling Fan

Motor drivers | Battery management | Water pump | CPAP

www.infineon.com/ipm

CIPOS™ Micro

Solution for low power motor drive applications

CIPOS™ Micro is a family of compact IPMs 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 ICs tuned to achieve optimal balance between EMI and switching losses. CIPOS™ Micro family offers DC current ratings ranging up to 6 A to drive motors up to 100 W without heatsink and up to 300 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 thermistor for temperature feedback available
› Various lead forms available including through-hole and surface mounted

SOP23
29 x 12 x 3.1 mm

DIP23
29 x 12 x 3.1 mm

Key benefits

› Ease-of-design and short time-to-market
› Compact package with three lead form options 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 possible

Major applications

Fridge
Aircon
Washing machine
Laundry dryer
Vacuum cleaner
Fans
Dishwasher
Drives
Pumps

www.infineon.com/ipm

CIPOS™ Mini

Broad range of applications from PFC to inverter

CIPOS™ Mini modules integrate various power and control components to increase reliability, and to optimize PCB size and system costs. This simplifies the power design and reduces significantly time-to-market.

CIPOS™ Mini modules are designed to control AC motors in variable speed drives for applications from 4 A up to 30 A such as air conditioning, washing machines, refrigerators, V_{AC}uum 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 Infineon SOI gate driver IC 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
› Optimized for home appliances and motor drives
› Rugged SOI gate driver IC technology
› Advanced protection features
› UL1577 certified

Key benefits

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

MDIP-24 Fullpack
36 x 21 x 3.1 mm

MDIP-24/21 DCB
36 x 21 x 3.1 mm

Major applications

| Fridge | Aircon | Washing machine | Dishwasher |
| Laundry dryer | Vacuum cleaner | Drives | |

Power ICs

www.infineon.com/ipm
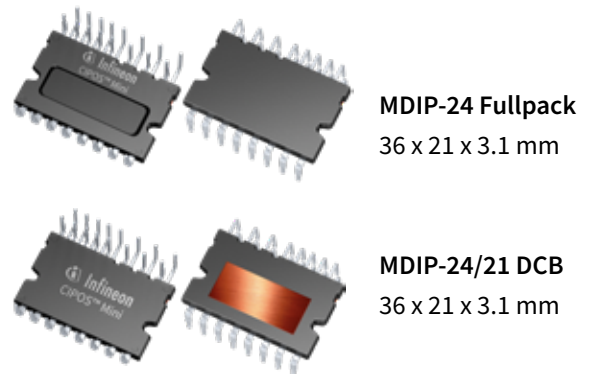
IPM lineup

Family	Package dimensions [mm]	Motor I_{rms} range	Topology	Lineup	Product PN
CIPOS™ Nano	PQFN 12 x 12 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 IRSM836-035MB
	PQFN 8 x 9 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 IRSM808-105MH IRSM807-045MH
	PQFN 7 x 8 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
iMOTION™ Smart	PQFN 12 x 12 12 x 12 x 0.9	0.2 A_{rms} - 0.5 A_{rms}	Fully integrated 3-phase inverter (Power stage + gate driver + controller)	500 V MOSFET 1.7 Ω, 2.2 Ω, 4.0 Ω, 6.0 Ω	IRDM983-025MB IRDM982-035MB IMM001T-0x5M
CIPOS™ Micro	DIP23 and SOP23 29 x 12 x 3.1	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 6 A	IRSM5y6-076zA
CIPOS™ Mini	MDIP-24 Fullpack 36 x 21 x 3.1	Up to 13 A_{rms}	3-phase inverter	600 V IGBT 4 A/6 A/10 A/15 A/20 A/30 A	IGCM04F(G)60yA IGCM06F(G)60yA IGCM10F60yA IGCM15F60yA IGCM20F60yA IKCM10L60yA IKCM15L(F)60yA IKCM20L60yA IKCM30F60yA
				600 V IGBT 10 A/15 A	IKCM10H60yA IKCM15H60yA
			2-phase inverter	650 V CoolMOS™ 0.31 Ω	IM512-L6A
			3-phase inverter	650 V CoolMOS™ 0.31 Ω	IM513-L6A
	MDIP-24/21 DCB 36 x 21 x 3.1	Up to 16 A_{rms}	2-phase interleaved PFC	650 V IGBT 20/30 A	IFCM20T65GD IFCM30T65GD
		Up to 24 A_{rms}	3-phase interleaved PFC	650 V IGBT 20/30 A	IFCM20U65GD IFCM30U65GD
		Up to 10 A_{rms}	3-phase inverter + PFC	600 V IGBT 10/15 A	IFCM10S60GD IFCM10P60GD IFCM15S60GD IFCM15P60GD
		Up to 20 A_{rms}	3-phase inverter	600 V IGBT 15/20/30 A	IKCM15L60yD IKCM20L60yD IKCM30F60yD
		Up to 10 A_{rms}	2-phase asymmetric inverter for SRM	600 V IGBT 15/20 A	IKCM15R60GD IKCM20R60GD

www.infineon.com/ipm

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

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

www.infineon.com/digital-controller

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Videos and eLearnings

www.infineon.com/mediacenter

Info	Document	Evaluation Board	Tools	Simulation	Play

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
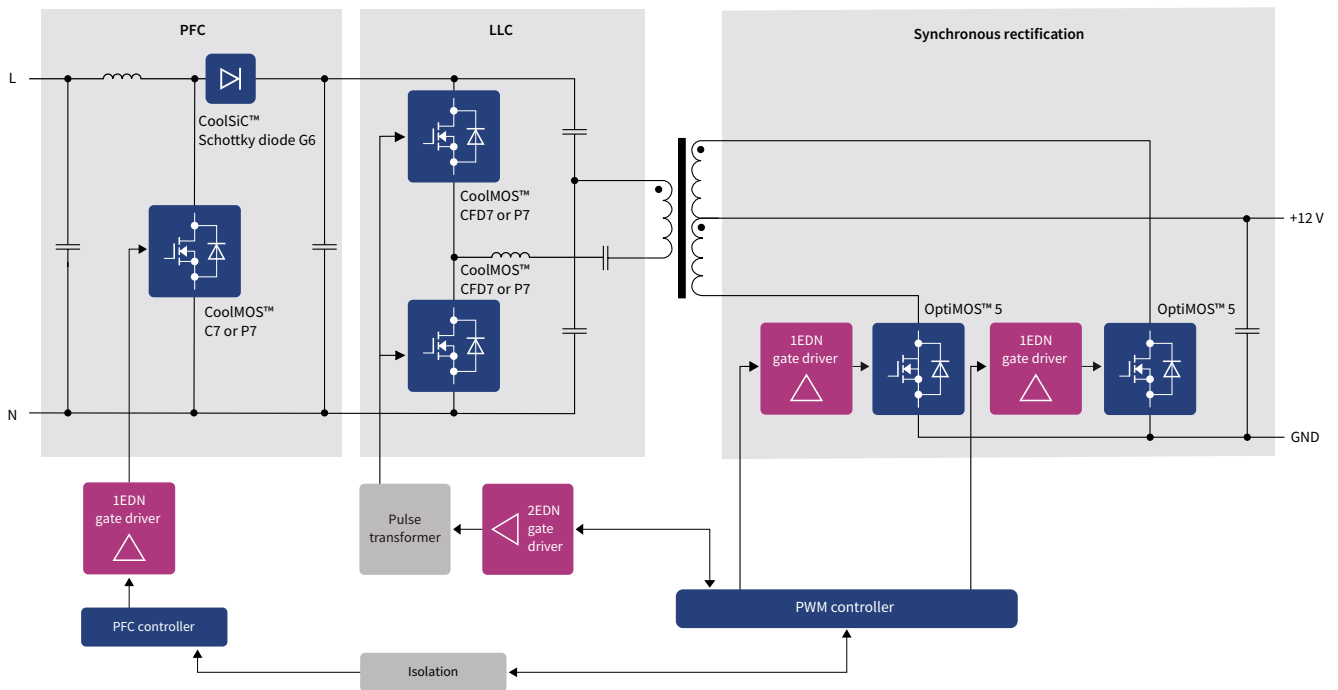
Product portfolio

Package		UVLO	Product name	Orderable part number	Pinout
SOT-23 6pin		4 V	1EDN7511B	1EDN7511BXUSA1	VDD 1 — 6 IN+ / OUT_SRC 2 — 1EDN — 5 IN- / OUT_SNK 3 — 4 GND
		8 V	1EDN8511B	1EDN8511BXUSA1	
SOT-23 5pin		4 V	1EDN7512B	1EDN7512BXTSA1	VDD 1 — 5 OUT / GND 2 — 1EDN / IN+ 3 — 4 IN-
WSON 6pin		4 V	1EDN7512G	1EDN7512GXTMA1	IN- 1 — 6 IN+ / GND 2 — 1EDN — 5 OUT / GND 3 — 4 VDD

www.infineon.com/1edn

2EDN MOSFET EiceDRIVER™ family

Rugged, cool and fast, 2-channel low-side 4 A/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 4 A/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

www.infineon.com/2edn

Application overview 800 W 130 kHz switched mode power supply
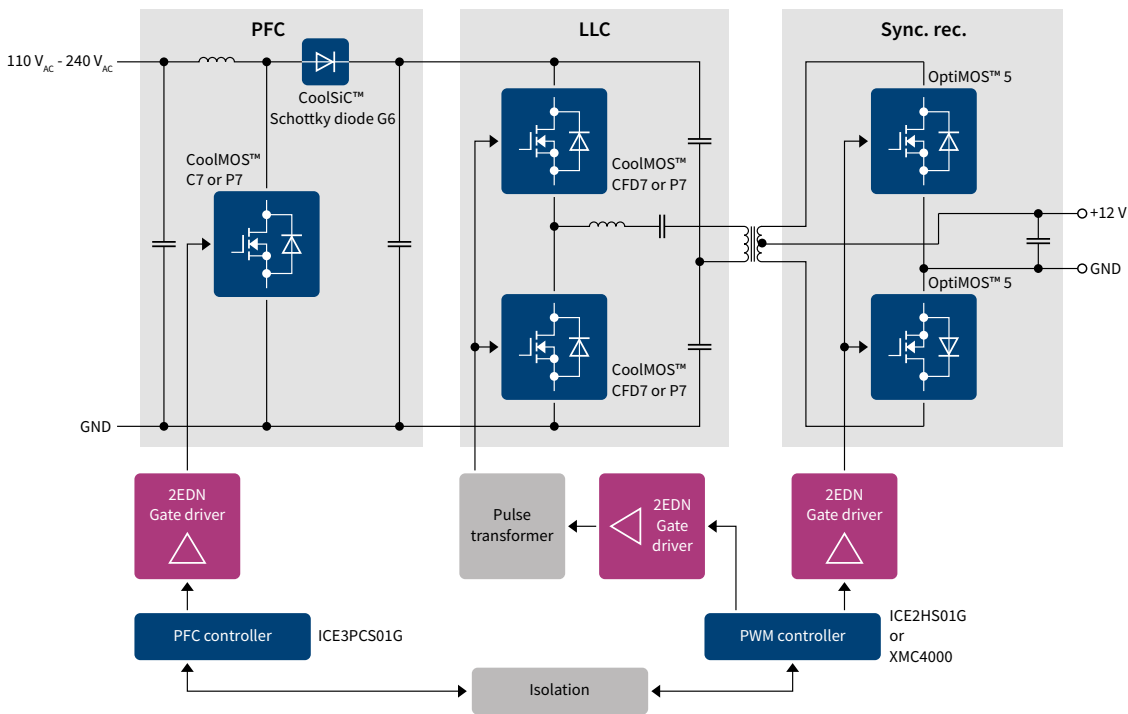
Product portfolio

Package		UVLO	Inputs	Product name	Orderable part number
DSO 8pin		4 V	Direct	2EDN7524F	2EDN7524FXTMA1
			Inverted	2EDN7523F	2EDN7523FXTMA1
			Direct	2EDN7424F	2EDN7424FXTMA1
		8 V	Direct	2EDN8524F	2EDN8524FXTMA1
			Inverted	2EDN8523F	2EDN8523FXTMA1
TSSOP 8pin		4 V	Direct	2EDN7524R	2EDN7524RXUMA1
			Inverted	2EDN7523R	2EDN7523RXUMA1
			Direct	2EDN7424R	2EDN7424RXUMA1
		8 V	Direct	2EDN8524R	2EDN8524RXUMA1
			Inverted	2EDN8523R	2EDN8523RXUMA1
WSON 8pin		4 V	Direct	2EDN7524G	2EDN7524GXTMA1
			Inverted	2EDN7523G	2EDN7523GXTMA1

Industry standard pinout configuration

www.infineon.com/2edn
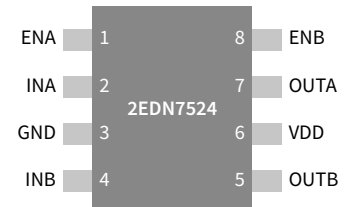
The slew-rate control EiceDRIVER™ with reinforced isolation

1200 V single-channel isolated driver family with dynamic slew-rate control

ED-S
Safe

The new SRC EiceDRIVER™ family, which includes 1EDS20I12SV, 1EDU20I12SV, and 1EDI20I12SV, is addressing the latest generation of highly efficient low-EMI electric drive systems, with lower EMI and improved efficiency. Based on the Infineon coreless transformer technology, it is the first high voltage isolated gate driver on the market with dynamic slew-rate control (SRC), which allows on-the-fly dV/dt control of electric drives through precise gate current control, providing the best trade-off between minimum power dissipation and minimum EMI depending on operating conditions. To turn on the IGBT, the driver works as an adjustable current source in conjunction with an external PMOS transistor and a sense resistor. To turn off the IGBT, the driver uses a 2 A MOSFET output stage. Several important and advanced protection functions are integrated. The driver 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 level and normal driver 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 1EDx20I12SV family is tailored for industrial drive applications such as those using 1200 V power modules for current up to 900 A like the EconoDUAL™ 3. The "S" version 1EDS20I12SV provides reinforced galvanic isolation certification according to both VDE 0884-10 (V_{IORM}=1420 V) and UL 1577 (V_{ISO}=5000 V). The "U" version 1EDU20I12SV is UL 1577 certified only, with a V_{ISO} rating of 5000 V for 1 minute. The "I" version 1EDI20I12SV provides functional isolation. The driver meets today's long-term stability requirements for industrial applications. It is offered in a DSO-36 package with a package width of 300 mil. It is RoHS compliant, green, and halogen-free.

Key features
› 1200 V single-channel IGBT driver
› Precise dynamic gate current control
› Unique: selective short circuit protection for
   3-level inverters
› Overcurrent protection for sense IGBTs and
   conventional IGBTs
› DESAT, soft turn-off, two-level turn-off
› Drive power modules up to 900 A

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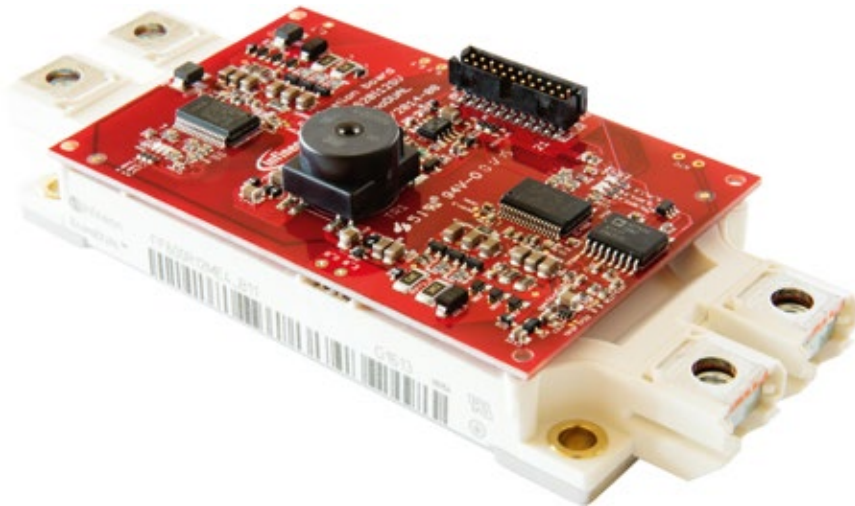› AC and brushless DC motor drives
› High-voltage DC-DC converters
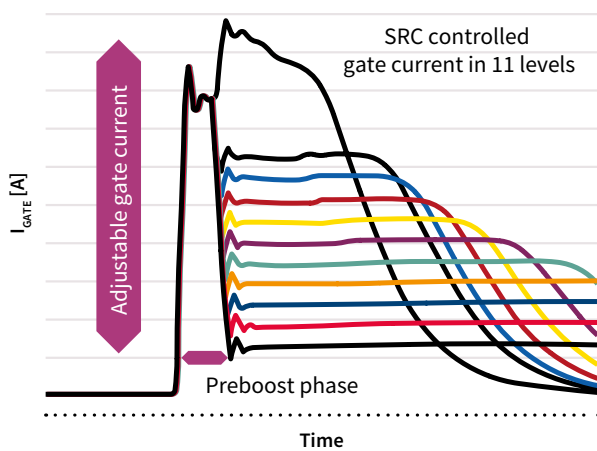› UPS systems
› Servo drives

Simplified application diagram
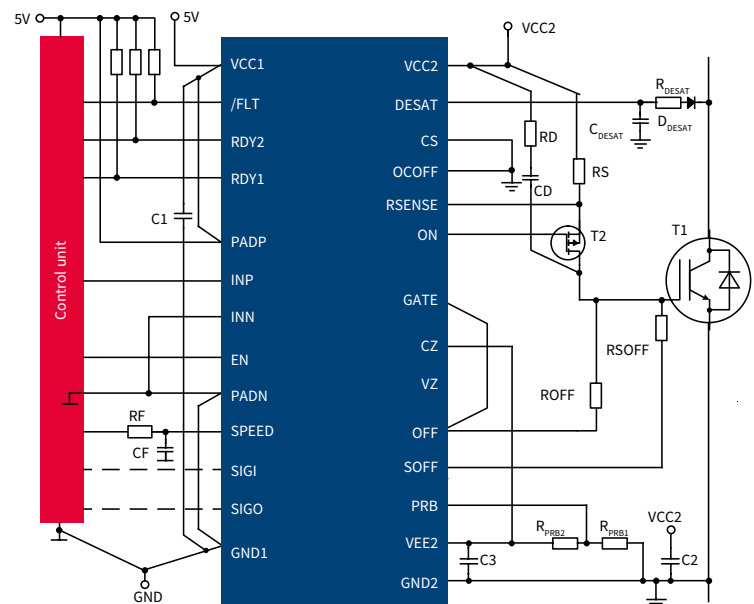
www.infineon.com/SRC

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

Feature – real-time gate current control

SRC controlled gate current in 11 levels

I_{GATE} [A]

Adjustable gate current

Preboost phase

Time

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

dV/dt [kV/µs]

Adjustable dV/dt range

■ Minimum speed
■ Maximum speed

$dV/dt = f(I_C, 25°C, V_{SPEED})$

I_C [A]
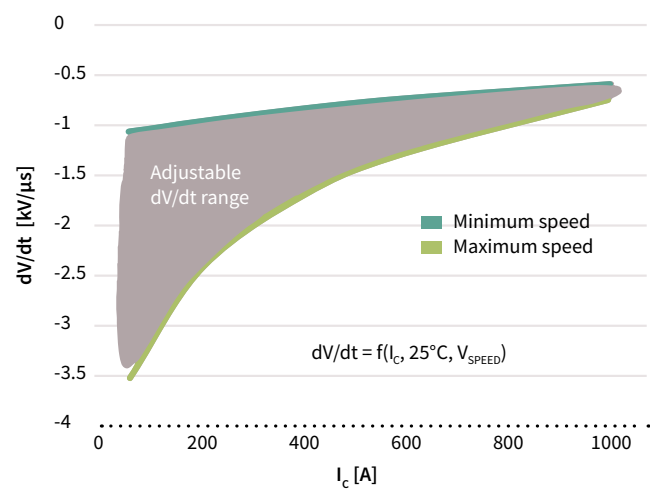
Benefits

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

RoHS

Drives UPS HVDC

Gate driver ICs

EiceDRIVER™ 1ED Compact gate driver IC family

1200 V galvanically isolated single-channel gate driver ICs

ED-C
Compact

Infineon's new EiceDRIVER™ 1EDC Compact 300 mil family is recognized under UL 1577 with an insulation test voltage of V_{ISO} = 2500 V(rms) for 1 min. The functional isolated EiceDRIVER™ 1EDI Compact 150 mil and 300 mil families are also available. The EiceDRIVER™ 1ED Compact family is the perfect driver for superjunction MOSFETs such as CoolMOS™, IGBTs, silicon carbide (SiC) MOSFETs such as CoolSiC™, and IGBT modules.
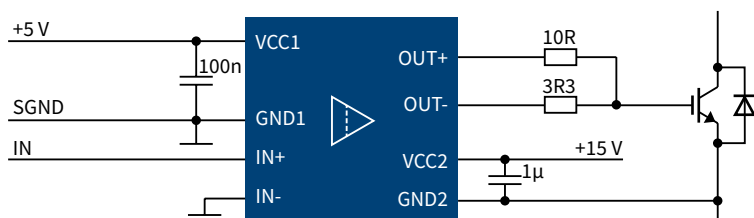
Product features

› Provide DSO-8 300 mil wide body package with 7.6 mm creepage distance
› Up to 10 A typical peak rail-to-rail output
› Suitable for operation at high ambient temperature
› Separate source and sink outputs or active miller clamp
› More than 100 kV/µs CMTI
› Optimized pin out for low inductance power supply

1EDI Compact 150 mil		1EDI60I12AF	1EDI40I12AF	1EDI20I12AF	1EDI05I12AF	1EDI60N12AF	1EDI20N12AF	1EDI30I12MF	1EDI20I12MF	1EDI10I12MF
1EDI Compact 300 mil		1EDI60I12AH	1EDI40I12AH	1EDI20I12AH	1EDI05I12AH	1EDI60H12AH	1EDI20H12AH	1EDI30I12MH	1EDI20I12MH	1EDI10I12MH
1EDC Compact 300 mil		1EDC60I12AH	1EDC40I12AH	1EDC20I12AH	1EDC05I12AH	1EDC60H12AH	1EDC20H12AH	1EDC30I12MH	1EDC20I12MH	1EDC10I12MH
Typ. output current [A]		10/-9.4	7.5/-6.8	4/-3.5	1.3/-0.9	10/-9.4	4/-3.5	5.9/-6.2	4.4/-4.1	2.2/-2.3
Output configuration		Separate sink/ source outputs	Separate sink/ source outputs	Separate sink/ source outputs	Separate sink/ source outputs	Separate sink/ source outputs	Separate sink/ source outputs	Active Miller clamp	Active Miller clamp	Active Miller clamp
Typ. propagation delay [ns]		300	300	300	300	125	125	300	300	300
UVLO	Input [V]	2.85/2.75	2.85/2.75	2.85/2.75	2.85/2.75	2.85/2.75	2.85/2.75	2.85/2.75	2.85/2.75	2.85/2.75
	Output [V]	12/11.1	12/11.1	12/11.1	12/11.1	12/11.1 (H) 9.1/8.5 (N)	12/11.1 (H) 9.1/8.5 (N)	11.9/11	11.9/11	11.9/11

CAV | Drives | Solar | Industrial automation | EV charger | Traction | Industrial robotics | LV-drives | UPS

Simplified application diagram

www.infineon.com/gatedriver
www.infineon.com/1EDcompact

EiceDRIVER™ Enhanced gate driver IC family

1200 V galvanically isolated enhanced gate driver ICs

ED-E
Enhanced

The EiceDRIVER™ 1ED Enhanced gate driver ICs are galvanic isolated single channel IGBT and SiC MOSFET drivers in DSO-16 package that provide output current capabilities of typically 2 A. The precision DESAT function for IGBT is also an excellent solution for SiC MOSFET short-circuit protection.

All logic pins are 5 V CMOS compatible. 2ED020I12-F2 is the dual-channel version of 1ED020I12-F2 in DSO-36 package. 2ED020I12-FI is a high voltage, high speed power MOSFET and IGBT driver with interlocking high and low side referenced outputs.

Product features
› Available in wide body package with 7.6 mm creepage distance
› Suitable for operation at high ambient temperature
› Active miller clamp
› Short circuit clamping and active shutdown
› ≥ 100 kV/µs CMTI
› Precision DESAT protection

EiceDRIVER™ Enhanced		1ED020I12-F2	2ED020I12-F2	1ED020I12-FT	1ED020I12-B2	1ED020I12-BT	2ED020I12-FI
Configuration		Single	Dual	Single	Single	Single	Half Bridge
Package (all 300 mil)		DSO-16	DSO-36	DSO-16	DSO-16	DSO-16	DSO-18
Galvanic isolation		Functional	Functional	Functional	Basic (VDE 0884-10)	Basic (VDE 0884-10)	Functional on High Side
Protection function		DESAT, UVLO	DESAT, UVLO	DESAT, UVLO, two-level turn-off	DESAT, UVLO	DESAT, UVLO, two-level turn-off	UVLO, OPAMP, comparator
UVLO	Input [V]	4.1/3.8	4.1/3.8	4.1/3.8	4.1/3.8	4.1/3.8	12/11
	Output [V]	12/11	12/11	12/11	12/11	12/11	12/11
DESAT charge current [µA]		500	500	500	500	500	–
Bipolar output supply		✓	✓	✓	✓	✓	–
Active miller clamp		✓	✓	✓	✓	✓	–
Inverting and non-inverting inputs		✓	✓	✓	✓	✓	–
Combinable enable/shutdown and fault feedback signals		✓	✓	✓	✓	✓	–
TLSET		–	–	✓	–	✓	–
Typical propagation delay [ns]		170	170	170 + TLTOff	170	170 + TLTOff	85
Isolation definitions							
Functional isolation		Isolation between conductive parts which is necessary only for the proper functioning of the equipment.					
Basic isolation (VDE 0884-10)		Isolation applied to live parts to provide basic protection against electric shock.					

Simplified application diagram
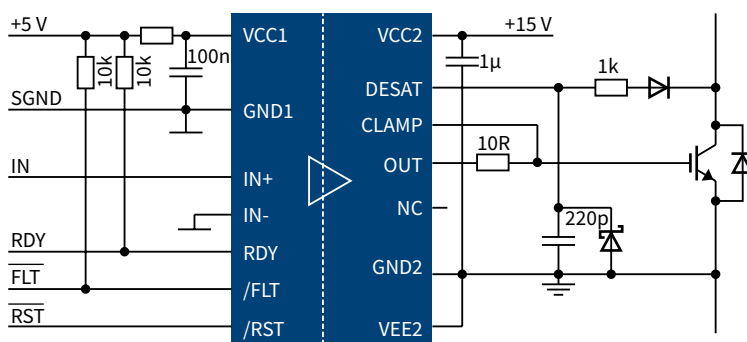
www.infineon.com/gatedriver
www.infineon.com/1EDcompact

Gate driver ICs

IRS2890DS

## New 600 V half-bridge gate driver with overcurrent protection

The new IRS2890DS half-bridge gate driver provides typical 0.22 A source and 0.48 A sink currents in a 14-lead SOIC package for IGBT and MOSFETs. The IRS2890DS integrates over current protection, fault reporting and bootstrap FET.

Product features
› Advanced input filter › Deadtime and cross-conduction prevention logic
› Fully operational to +600 V off-set voltage › Logic operational for VS of -8 V › Operational for transient negative VS -50 V with a 50 ns pulse width
› Integrated bootstrap FET › Integrated comparator (with 0.5 V ± 5 % Reference) for overcurrent protection › Fault and enable multifunction pin

Product benefits
› Reliable switching › Protection under abnormal operation
› Improved reliability › High power capability
› Easy-to-use, straight-forward design › Fast time-to-market › BOM savings

Motor Control Drives Aircon Washing machine Fridge Dishwasher

Typical block diagram
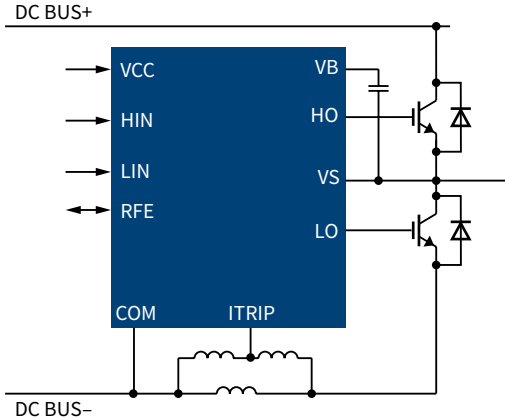
2ED2304S06F

The 2ED2304S06F is a high voltage, high speed power MOSFET and IGBT half bridge driver. Based on the proven Infineon SOI-technology there is an excellent ruggedness and noise immunity. No parasitic thysistor structures are present in the device. Hence, no parasitic latch up may occur at all temperature and voltage conditions. Additionally, the offline online clamping function provides an inherent protection of the parasitic turn-on by floating gate conditions.

Product features

› Floating channel designed for bootstrap operation
› Thin-film-SOI-technology
› Fully operational to 650 V
› Integrated ultra-fast bootstrap diode
› Short propagation delay and delay matching (20 ns, maximum)
› Tolerant to negative transient voltage up to -50 V (pulse width is up 500 ns) given by SOI-technology
› dV/dt immune ±50 V
› Gate drive supply range from 10 to 20 V
› Undervoltage lockout for both channels
› 3.3 V, 5 V and 15 V input logic compatible
› Schmitt trigger inputs with hysteresis and pull down
› Output source/sink current capability +0.36 A/-0.7 A
› RoHS compliant

Typical applications

› Motor drives
› Solar inverter and UPS drives
› General purpose inverter drives
› Half-bridge and full-bridge converters in offline AC-DC
› Power supplies for telecom and lighting

Typical block diagram

www.infineon.com/gatedriver
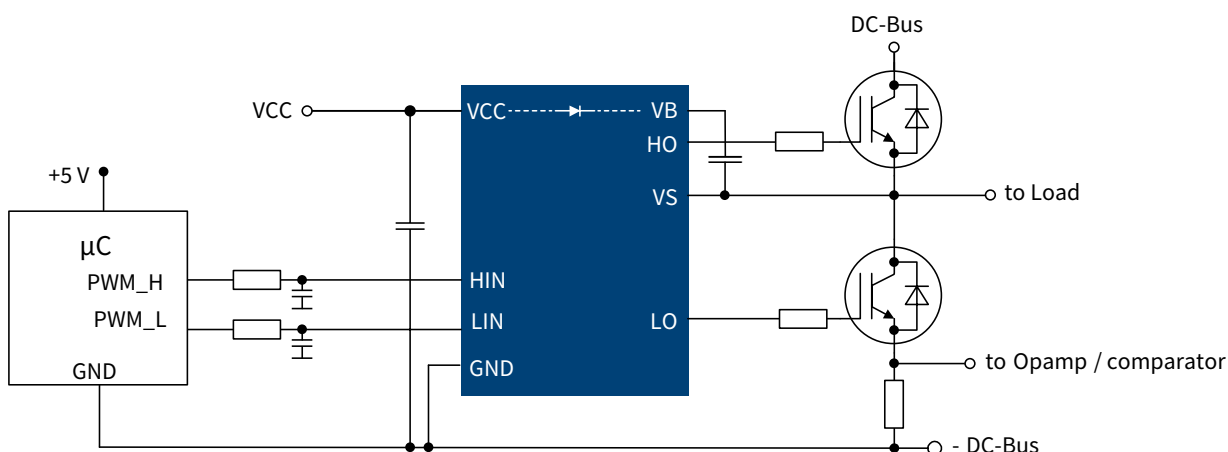
IRS200x 200 V IC family

New half-bridge and high- and low-side gate driver ICs

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 new IRS200x family consists of four devices with a typical output sink current of 600 mA and typical output source current of 290 mA. These 200 V devices are 3.3 V, 5 V, and 15 V logic compatible and have Vs operational logic of -8 V. The IRS2008 and IRS2007 include integrated dead-time and shoot-through protection and all IRS200x devices include under-voltage lockout (UVLO) protection. Additionally, the IRS2008 includes a shutdown input pin. These 200 V devices also feature low quiescent currents.

All three parts are offered in an eight-pin SOIC package or (for IRS2005) in a small form-factor fourteen-pin 4x4 mm MLPQ package. With various logic input options and standard pin-out configurations, these 200 V devices are easy to design-in for fast time-to-market

Applications
› Appliance motor drives
› Servo drives
› Micro inverter drives
› General purpose three phase inverters
› E-bike
› Drones

Product features	Benefits
› 290 mA/600 mA typical source/sink current › 70 ns/35 ns typical turn-on rise and turn-off fall time › Less than 60 ns delay matching time	› Fast and reliable switching
› Under-voltage lockout (UVLO) protection › Deadtime and cross-conduction prevention logic	› 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

www.infineon.com/200vHVIC

Motor Control   Power Tools   Home & garden   LEV

Typical connection diagram (IRS2008)

Up to 200 V
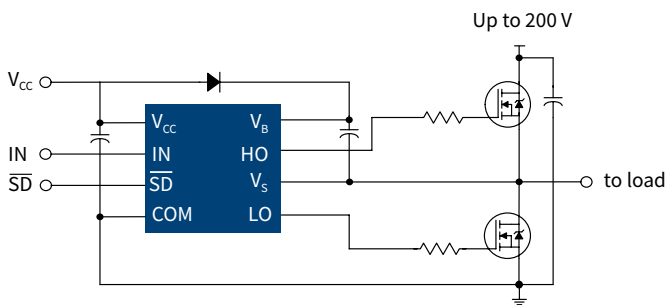
Pin configurations
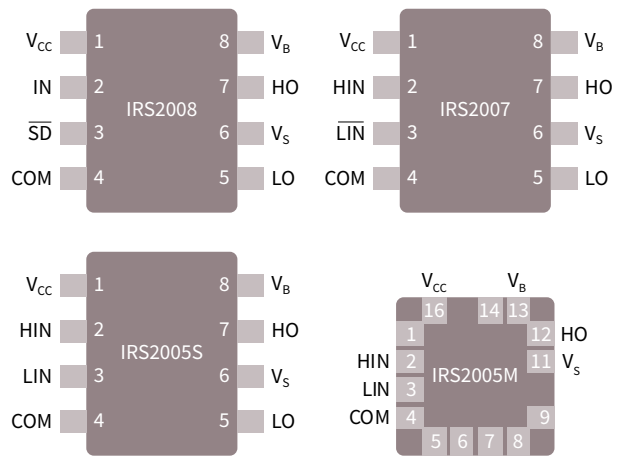
Typical connection diagram (IRS2007)

Up to 200 V
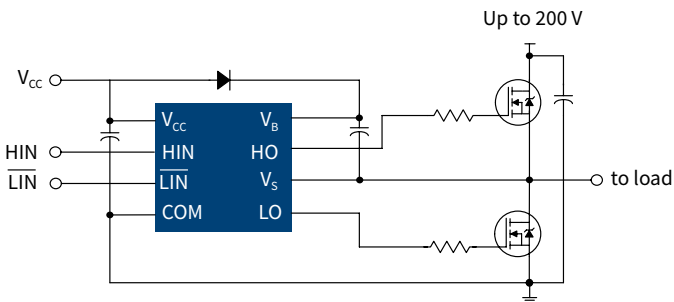
Typical connection diagram (IRS2005)

Up to 200 V
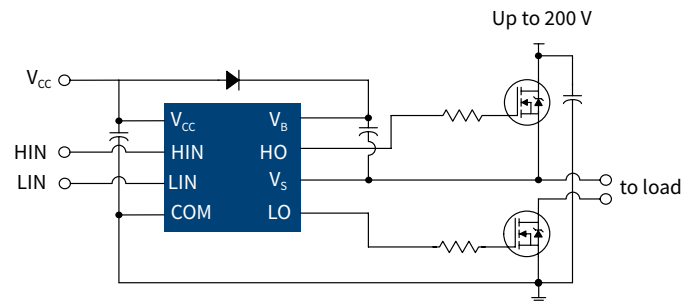
Product portfolio

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, $\overline{SD}$	+8.9/-8.2	8-lead SOIC	2
IRS2007S	200	2	290/600	520	160	150	HIN, $\overline{LIN}$	+8.9/-8.2	8-lead SOIC	2
IRS2005S	200	2	290/600	–	160	150	HIN, LIN	+8.9/-8.2	8-lead SOIC	2
IRS2005M	200	2	290/600	–	160	150	HIN, LIN	+8.9/-8.2	14-lead 4x4 MLPQ	2

IRS2005 replaces IRS2001 (IRS2001 is not recommended for new designs)
IRS2007 can replace IRS2003
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 500 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 opamp for current measurement or over-current detection
Current sense	Dedicated input detects over-current events
Dedicated JFET control	Optimized to drive SiC JFET
Desaturation protection	Protects the switch (IGBT) at short circuit
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
High-voltage start-up	Provides easy and fast circuit start-up while enabling low circuit standby losses
Integrated bootstrap diode	Integrated bootstrap reduces BOM
Over temperature shutdown	Internal over temperature protection circuit protects the IC against excessive power loss and overheating
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
Self-oscillating	Integrated front end oscillator
Separate pin for logic ground	Dedicated pin or logic ground for improved noise immunity
Separate sink/source outputs	Simplifies gate resistor selection, reduces BOM, and improves dV/dt control
Shoot-through protection	Functionality such as deadtime and interlock
Shutdown	Dedicated pin disables the IC outputs
Soft over-current shutdown	Dedicated pin turns off the desaturated transistor, preventing over-voltages
Two-level turn-off	Lowers VCE 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 (SOI)
› (3) Level-shifting junction-isolation technology (JI)
› (4) Non-isolated technology (N-ISO)

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 (SOI) technology is an advanced technique for MOS/CMOS fabrication. In Infineon SOI technology, 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 (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 (N-ISO) 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.

www.infineon.com/gatedriver
www.infineon.com/gdfinder

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.

Half-bridge

Applications: Aircon · Home Appliance · Induction · Drives · Motor Control · Power Tools · Solar · Telecom

Voltage class [V]	I_{o+}/I_{o-} typ [mA]	Typ. UVLO on/off [V]	Typ. prop delay: off/on [ns]	Base PN	Technology	Comparator	Current amplifier	Desaturation protection	Enable	Fault reporting	Integrated bootstrap diode	Over-current protection	Programmable dead time	Programmable shutdown	Self-oscillating	Separate pin for logic ground	Shoot-through protection	Shutdown	Soft over-current shutdown	DSO-8	DSO-14	DSO-18	DIP-8	DIP-14	SSOP-24	VQFN-14	CHIP
1200	1500/2500	12.2/11.2	85/85	2ED020I12-FI	CT	✓	✓										✓	✓						✓			
	2000/3000	10.2/9.3	440/440	IR2214	JI			✓		✓							✓	✓	✓							✓	
700	78/169	8.9/8.2	220/220	IR7304	JI													✓		✓							
	1900/2300	8.9/8.2	270/680	IR7184	JI												✓	✓		✓							
	2500/2500	9.1/8.2	200/200	2ED2183S07**	SOI						✓	✓					✓	✓		✓	✓						✓
	2500/2500	9.1/8.2	200/200	2ED2184S07**	SOI						✓	✓					✓	✓		✓	✓						✓
650	1500/2500	13.5/0	85/85	2ED020I06-FI	CT												✓	✓							✓		
	360/700	9.1/8.3	310/300	2ED2304S06F*	SOI						✓	✓				✓		✓		✓							✓
600	78/169	8.9/8.2	220/220	IR2304	JI													✓		✓						✓	
		8.9/8.2		IR25601	JI													✓		✓							
	180/260	9/8	na	IR21531	JI								✓		✓		✓	✓		✓						✓	✓
		9/8		IR21531D	JI						✓		✓		✓		✓	✓								✓	
		9/8		IR25603	JI								✓		✓		✓	✓		✓						✓	
		11/9		IRS2153(1)D	JI						✓		✓		✓		✓	✓		✓						✓	✓
	200/350	8.9/8.2	200/220	IR2108	JI													✓		✓			✓				
		8.9/8.2		IR21084	JI							✓				✓	✓						✓		✓		
		8.9/8.2		IR2308	JI													✓		✓			✓				
		8.9/8.2		IR25606	JI													✓		✓							
		8.9/8.2	200/750	IR2109	JI												✓	✓		✓							
		8.9/8.2		IR21091	JI							✓					✓	✓		✓							
		8.9/8.2		IR21094	JI							✓				✓	✓	✓					✓			✓	
		4.1/3.8		IR2302	JI												✓	✓		✓							
	210/360	8.9/8.2	150/680	IR2103	JI												✓	✓		✓						✓	
		8.9/8.2		IR2104	JI												✓	✓		✓						✓	
		8.9/8.2		IR25602	JI												✓	✓		✓							
	220/480	8.9/7.7	500/500	IRS2890D*	JI				✓	✓	✓							✓					✓				
	250/500	8.6/8.2	150/750	IR2111	JI												✓	✓		✓			✓				
	290/600	8.9/8.2	150/150	IRS2304	JI													✓		✓							✓
		8.9/8.2	150/680	IRS2103	JI												✓	✓		✓							✓
		8.9/8.2		IRS2104	JI												✓	✓		✓							✓
		8.6/8.2	150/750	IRS2111	JI												✓	✓		✓							✓
		8.9/8.2	200/220	IRS2108	JI													✓		✓							✓
		8.9/8.2		IRS2308	JI													✓		✓							✓
		8.9/8.2		IRS21084	JI							✓				✓	✓						✓		✓		
		8.9/8.2	200/750	IRS2109	JI												✓	✓		✓							✓
		8.9/8.2		IRS21091	JI							✓					✓			✓							
		8.9/8.2		IRS21094	JI							✓				✓	✓	✓					✓			✓	
	360/700	9.1/8.3	300/310	2EDL05N06P	SOI						✓						✓			✓	✓						
		12.5/11.6	400/420	2EDL05I06P	SOI						✓						✓			✓	✓						
	1900/2300	8.9/8.2	220/180	IRS2183	JI												✓			✓			✓				✓
		8.9/8.2		IR2183	JI												✓			✓			✓				
		8.9/8.2		IR(S)21834	JI							✓				✓	✓						✓		✓		
		8.9/8.2	270/680	IRS2184	JI											✓	✓	✓		✓			✓				✓
		8.9/8.2		IR2184	JI												✓	✓		✓			✓				
		8.9/8.2		IR21844	JI							✓				✓	✓	✓					✓		✓		
		8.9/8.2		IRS21844	JI							✓				✓	✓	✓					✓		✓	✓	
	2000/3000	10.2/9.3	440/440	IR2114	JI			✓		✓							✓	✓	✓						✓		
	2300/2800	9.1/8.3	300/310	2EDL23N06P	SOI			✓	✓	✓	✓						✓	✓			✓						
		12.5/11.6	400/420	2EDL23I06P	SOI			✓	✓	✓	✓						✓	✓			✓						
200	290/600	8.9/8.2	150/160	IRS2007*1)	JI												✓										
	130/270		150/680	IRS2003	JI												✓			✓						✓	
	290/600			IRS2008*2)	JI												✓	✓									
	130/270			IRS2004	JI												✓	✓		✓						✓	✓

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1) IRS2007 replaces IRS2003   * New
2) IRS2008 replaces IRS2004   ** Coming soon
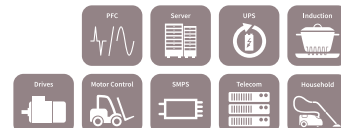
Three-phase

Applications: Aircon, Home Appliance, Induction, Drives, Motor Control, Power Tools, Solar, Telecom

Voltage class [V]	I_{O+}/I_{O-} typ [mA]	Typ. UVLO on/off [V]	Typ. prop delay: off/on [ns]	Base PN	Technology	Current amplifier	Desaturation protection	Enable	Fault reporting	Integrated bootstrap diode	Output for brake chopper	Over-current protection	Programmable dead time	Separate pin for logic ground	Shoot-through protection	Shutdown	DSO-20 WB	DSO-24	DSO-28 WB	DIP-28	LCC-32	MQFP-64	TSSOP-28	VQFN-28	VQFN-34	CHIP
1200	250/500	8.6/8.2	700/750	IR2233	JI	✓			✓			✓		✓		✓			✓	✓	✓					✓
		10.4/9.4		IR2235	JI	✓			✓			✓		✓		✓			✓	✓	✓					
	350/540	11.2/10.2	550/550	IR2238	JI		✓		✓		✓	✓		✓		✓						✓				
	350/650	11.4/10.4	600/600	6ED2230S12**	SOI			✓	✓	✓		✓	✓	✓	✓	✓			✓							✓
600	165/375	11.7/9.8	490/530	6ED003L06-F2	SOI			✓	✓			✓		✓					✓							✓
		11.7/9.8		6EDL04I06(N,P)	SOI			✓	✓	✓		✓		✓					✓							✓
		9/8.1	530/530	6EDL04N06P	SOI			✓	✓	✓		✓		✓					✓							✓
	200/350	8.9/8.2	400/425	IR2136	JI			✓	✓			✓		✓					✓	✓	✓					✓
		11.1/10.9		IR21363	JI			✓	✓			✓		✓					✓				✓			✓
		11.1/10.9		IR21365	JI			✓	✓			✓		✓					✓							
		8.9/8.2		IR21368	JI			✓	✓			✓		✓					✓							✓
		10.4/9.4	530/500	IR21364	JI			✓	✓			✓		✓					✓							✓
		11.1/10.9	530/530	IRS2334	JI												✓							✓		
		8.9/8.2		IRS2336	JI			✓	✓			✓		✓					✓		✓					
		8.9/8.2		IRS2336D	JI			✓	✓	✓		✓		✓					✓		✓			✓		✓
		8.9/8.2		IRS23364D	JI			✓	✓	✓		✓		✓					✓		✓					✓
		8.9/8.2		IRS23365D	JI			✓	✓	✓		✓		✓											✓	
	250/500	9/8.7	425/675	IR213(0,2)	JI	✓			✓			✓		✓					✓	✓	✓					✓
		8.7/8.3	600/1300	IR2131	JI				✓			✓		✓		✓			✓	✓	✓					
		8.6/8.2	700/750	IR2133	JI	✓			✓			✓		✓		✓			✓	✓	✓					
		10.4/9.4		IR2135	JI	✓			✓			✓		✓		✓			✓		✓					✓
200	165/375	11.7/9.8	490/530	6ED003L02-F2	SOI			✓	✓			✓		✓										✓		
		9/8.1	530/530	6EDL04N02P	SOI			✓	✓	✓		✓		✓										✓		

** Coming soon

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Single high-side

Applications: Aircon · Induction · Drives · Motor Control · Solar · Telecom · UPS · Welding

Voltage class [V]	Io+/Io- typ [mA]	Typ. UVLO on/off [V]	Typ. prop delay: off/on [ns]	Base PN	Technology	Active Miller clamp	Current sense	Dedicated control for JFET	Desaturation protection	Enable	Error reporting with shutdown	Fault reporting	Fault reset	Over-current protection	Separate pin for logic ground	Separate sink/source outputs	Soft over-current shutdown	Two-level turn-off	DSO-8	DSO-8 300mil	DSO-16 WB	DSO-19	DSO-36	DIP-8	SOT23-6	CHIP
												Features										Packages				
1200	1300/900	12/11.1	300/300	1EDI05I12A	CT										✓	✓			✓	✓						
				1EDC05I12A*	CT										✓	✓				✓						
	2000/2000	12/11	165/170	1ED020I12-(B,F)2	CT	✓		✓				✓	✓		✓						✓					
			1750/1750	1ED020I12-(B,F)T	CT	✓		✓				✓	✓		✓		✓				✓					
	2200/2300	12/11.1	300/300	1EDI10I12M	CT	✓									✓				✓	✓						
				1EDC10I12M*	CT	✓									✓					✓						
	4000/3500	9.1/8.5	120/115	1EDI20N12A	CT										✓	✓			✓							
		12/11.1	125/120	1EDI20H12A	CT										✓	✓				✓						
				1EDC20H12A*	CT										✓	✓				✓						
			300/300	1EDI20I12A	CT										✓	✓			✓	✓						
				1EDC20I12A*	CT										✓	✓				✓						
	4400/4100			1EDI20I12M	CT	✓									✓				✓	✓						
				1EDC20I12M*	CT	✓									✓					✓						
	4000/4000	16.9/16.4	80/80	1EDI30J12C	CT		✓		✓														✓			
	5900/6200	12/11.1	300/300	1EDI30I12M	CT	✓									✓				✓	✓						
				1EDC30I12M*	CT	✓									✓					✓						
	7500/6800			1EDI40I12A	CT										✓	✓			✓	✓						
				1EDC40I12A*	CT										✓	✓				✓						
	SRC/2000	11.9/11	460/460	1ED(I,U,S)20I12SV**	CT			✓	✓		✓			✓	✓		✓	✓				✓				
	10000/9400	12/11.1	125/120	1EDI60H12A	CT										✓	✓			✓	✓						
				1EDC60H12A*	CT																					
			300/300	1EDI60I12A	CT										✓	✓			✓	✓						
				1EDC60I12A*	CT																					
600	160/240	9/8	215/140	IRS25752	JI																				✓	
	250/500	8.6/8.2	105/125	IR2117	JI														✓						✓	✓
				IR2118	JI														✓						✓	
		10.3/9	150/200	IR2127	JI		✓					✓	✓						✓						✓	✓
		7.2/6.8		IR21271	JI		✓					✓	✓						✓						✓	
		10.3/9		IR2128	JI		✓					✓	✓						✓						✓	✓
	290/600	8.6/8.2	105/125	IRS211(7,8)	JI														✓						✓	✓
		10.3/9	150/150	IRS2127	JI	✓						✓	✓						✓						✓	✓
		7.2/6.8		IRS21271	JI	✓		✓				✓	✓						✓						✓	
500	1600/3300	9.2/8.3	200/170	IR2125	JI		✓				✓	✓		✓									✓		✓	
200	160/240	9/8	215/140	IRS20752	JI																				✓	
100				IRS10752	JI																				✓	

SRC = Turn on slew rate control
* New
** Coming soon

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Gate driver ICs

223

Dual high-side

Voltage class [V]	I_{o+}/I_{o-} typ [mA]	Typ. UVLO on/off [V]	Typ. prop delay: off/on [ns]	Base PN	Technology	Desaturation protection	Fault reporting	Fault reset	Separate pin for logic ground	DSO-36
						Features				**Package**
1200	2000/2000	12/11	165/170	2ED020I12-F2	CT	✓	✓	✓	✓	✓

High-side and low-side

Voltage class [V]	I_{o+}/I_{o-} typ [mA]	Typ. UVLO on/off [V]	Typ. prop delay: off/on [ns]	Base PN	Technology	Under voltage lockout	Integrated bootstrap diode	Separate pin for logic ground	Shutdown	DSO-8	DSO-14	DSO-16 WB	DSO-16NB	DIP-8	DIP-14	VQFN-14	LGA-13	CHIP
						Features				**Packages**								
6000	4000/8000	8.0/7.0	35	2EDS8255H	CT	✓							✓					
6000	4000/8000	8.0/7.0	35	2EDS8265H	CT	✓							✓					
6000	1000/2000	8.0/7.0	35	2EDS8155H	CT	✓							✓					
6000	1000/2000	8.0/7.0	35	2EDS8165H	CT	✓							✓					
1500	4000/8000	4.2/3.9	35	2EDF7275F	CT	✓							✓					
1500	4000/8000	4.2/3.9	35	2EDF7275K	CT	✓											✓	
1500	4000/8000	4.2/3.9	35	2EDF7235K	CT	✓											✓	
1200	2000/2500	10.2/9.3	225/280	IR2213	JI	✓		✓	✓			✓			✓			✓
700	220/350	8.9/8.2	200/220	IR7106	JI	✓				✓								
	290/700	9.1/8.2	200/200	2ED2106S07**	SOI	✓	✓			✓	✓							✓
600	200/350	8.9/8.2	200/220	IR2106	JI	✓				✓				✓				
		8.9/8.2		IR21064	JI	✓		✓			✓			✓				
		4.1/3.8		IR2301	JI	✓				✓				✓				
		8.9/8.2		IR25604	JI	✓				✓								
		4.1/3.8		IRS2301	JI	✓				✓								
	210/360	8.9/8.2	150/160	IR2101	JI	✓				✓				✓			✓
		8.9/8.2		IR2102	JI	✓				✓				✓			
	250/500	8.6/8.2	105/125	IR2112	JI	✓			✓		✓			✓			
	290/600	8.6/8.2	130/135	IRS2112	JI	✓		✓	✓		✓			✓			✓
		8.9/8.2	150/160	IRS2101	JI	✓				✓				✓			✓
		8.9/8.2	200/220	IRS2106	JI	✓				✓				✓			✓
		8.9/8.2		IRS21064	JI	✓		✓			✓			✓			
	360/700	12.5/11.6	400/420	2EDL05I06BF	SOI	✓	✓			✓							
	1900/2300	8.9/8.2	220/180	IRS2181	JI	✓				✓				✓			✓
		8.9/8.2		IR2181	JI	✓				✓				✓			
		8.9/8.2		IR21814	JI	✓		✓			✓			✓			
		8.9/8.2		IRS21814	JI	✓		✓			✓			✓	✓		
	2500/2500	8.6/8.2	94/120	IR2113	JI	✓		✓	✓		✓			✓			✓
		8.6/8.2		IR25607	JI	✓		✓	✓		✓						
		8.5/8.2	120/130	IRS2113	JI	✓		✓	✓		✓			✓	✓		✓
	4000/4000	8.9/8.2	170/170	IRS2186	JI	✓				✓				✓			✓
		8.9/8.2		IRS21864	JI	✓		✓			✓			✓			
		6/5.5		IRS21867	JI	✓				✓							
500	2500/2500	8.6/8.2	94/120	IR2110	JI	✓		✓	✓		✓			✓			
		8.5/8.2	120/130	IRS2110	JI	✓		✓	✓		✓			✓			✓
200	290/600	8.9/8.2	150/160	IRS2005*	JI	✓				✓					✓		
	1000/1000	9/8.2	60/60	IRS2011	JI	✓				✓				✓			✓
		9/8.2	75/80	IR2011	JI	✓				✓				✓			
	3000/3000	8.6/8.2	65/95	IR2010	JI	✓		✓	✓		✓			✓			

* New
** Coming soon

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Single low-side

Voltage class [V]	I_{o+}/I_{o-} typ [mA]	Typ. UVLO on/osff [V]	Typ. prop delay: off/on [ns]	Base PN	Technology	Current sense	Enable	Error reporting with shutdown	Fault reporting	Over-current protection	Separate sink/source outputs	DIP-8	SOT23-5	SOT23-6	WSON-6
						Features						Packages			
25	300/550	5/4.15	50/50	IR44252	N-ISO								✓		
	1500/1500	10,2/9,2	50/50	IRS44273	N-ISO								✓		
	1700/1500	5/4.15	50/50	IR44272	N-ISO	✓							✓		
		5/4.15		IR44273	N-ISO								✓		
20	4000/8000	4.2/3.9	19/19	1EDN7511B	N-ISO	✓				✓				✓	
	8/7			1EDN8511B	N-ISO	✓				✓				✓	
		4.2/3.9		1EDN7512	N-ISO	✓								✓	✓
5	1600/3300	8,9/8	200/150	IR2121	N-ISO	✓		✓	✓	✓		✓			

Dual low-side

Voltage class [V]	I_{o+}/I_{o-} typ [mA]	Typ. UVLO on/off [V]	Typ. prop delay: off/on [ns]	Base PN	Technology	Enable	DSO-8	DIP-8	WSON-8	TSSOP-8
						Features	Package			
25	2300/3300	-	50/50	IRS4426	N-ISO		✓			
		10.2/9.2		IRS44262	N-ISO		✓			
		-		IRS4427	N-ISO		✓	✓		
			65/85	IR25600	N-ISO		✓	✓		
				IR442(6,7)	N-ISO		✓	✓		
20	5000/5000	4.2/3.9	19/19	2EDN752(3,4)	N-ISO	✓	✓		✓	✓
		8/7		2EDN852(3,4)	N-ISO	✓	✓		✓	✓

Related IC: current sense

Voltage class [V]	Base PN	Technology	Current sense	Over-current protection	Separate pin for logic ground	DSO-8	DSO-16 WB	DIP-8	SOT23-5
			Features			Package			
1200	IR2277(1)	JI	✓	✓	✓		✓		
600	IR2172	JI		✓		✓		✓	
	IR2175	JI	✓	✓		✓		✓	
	IR2177(1)	JI	✓	✓	✓		✓		
	IR25750	JI		✓					✓

Related IC: high voltage start-up IC

Voltage class [V]	Base PN	Technology	Enable	High voltage start-up	Over temperature shutdown	SOT23-5
						Package
480	IRS25751	N-ISO	✓	✓	✓	✓

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Gate driver ICs

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/gdfinder
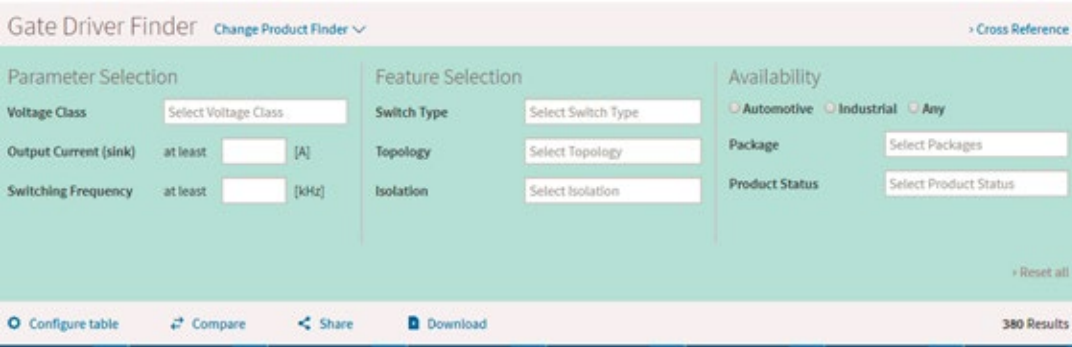
For recommended gate drivers by application, visit www.infineon.com/gdapplication to download the PDF version of the gate driver application matrix handout.

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www.infineon.com/gdfinder

Infineon support for gate driver ICs

Useful links and helpful information

Further information, datasheets and documents

www.infineon.com/gatedriver

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Info

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iMOTION™

Flexible and scalable platform for motor control solutions

iMOTION™ products are highly integrated devices used to control variable speed drives. By integrating both the required hardware and algorithms to perform control of Permanent Magnet Synchronous Motors (PMSM) they provide the shortest time-to-market for inverterized motor systems at the lowest system and development cost.

Observed market trends

› Energy efficiency regulations drive inverterization rate
› Shorter design cycles are driven by reduced product life cycles
› Focus on key differentiators drives trend to outsourcing
› Increased price pressure requires system cost reduction

Key benefits

› Easy to use – no special motor control know-how required
› High performance and energy optimized solution
› Reduced cost of ownership due to R&D and BOM savings
› Fastest time-to-market

Our markets

Home Appliance | Aircon | Fans | Pumps | Motor Control | Cooling compressors

iMOTION™ product offering

iMOTION™ controller		iMOTION™ Smart IPM

iMOTION™
ARM® Cortex®-M0 (optional) | Motion Control Engine (MCE)
› MCE supervision › Motor control
› Sensors › PFC control
› Safety functions › Protection
› Communication

Gate driver — 3-phase inverter — M

iMOTION™
Motion Control Engine (MCE)
› Motor control
› PFC control
› Protection
› Communication

Gate driver — 3-phase inverter — M

Motion Control Engine (MCE) built-in sinusoidal FOC algorithm allows smooth operation at wide speed ranges	**MCE + additional MCU** customer specific application code can be added	**Full inverter system** in one small package, e.g. up to 60 W in PQFN 12 x 12 mm²
IRMCK099/IMC100T	IRMCF100/IMC300A	IRDM983/IMM001T/IMM100

iMOTION™ ecosystem

PC tools and evaluation kits available to configure, test and fine tune the drive inverter.

MCEWizard
SW tool to generate initial drive control parameters

MCEProgrammer
SW tool to program MCE parameter sets

MCEDesigner
SW tool to test, monitor and fine-tune the motor drive – including trace features for live monitoring the drive status

iMOTION™ Link/MCETOOLV2
HW interfaces to the iMOTION™ devices
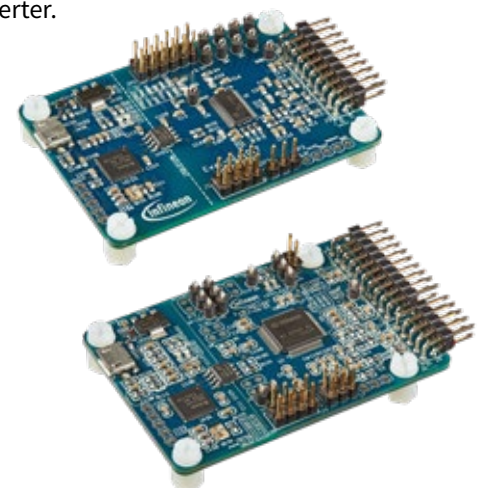
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iMOTION™ Modular Application Design Kit

Infineon's motor control evaluation platform

The iMOTION™ Modular Application Design Kit (MADK) evaluation platform covers motor drive applications up to 1 kW. The platform offers a modular and scalable system solution with different control board options and a wide range of power boards. While the M1 platform provides control of a Permanent Magnet Synchronous Motor (PMSM), the M3 platform also integrates the power factor correction (PFC) implemented as a boost or totem pole PFC.

Using the iMOTION™ MADK standardized 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 the maximum flexibility and scalability during evaluation and development phase at affordable cost.

Get a motor running in less than 1 hour!

Motor control boards		Wide range of power boards	
EVAL-M1-101T IMC101T-T038 Control card		**EVAL-M1-36-84A** CIPOS™ Nano-power board IRSM836-084MA ~110 V/80 W	
EVAL-M1-099M IRMCK099 Control card		**EVAL-M1-36-45A** CIPOS™ Nano-power board IRSM836-045 A ~220 V/80 W	
EVAL-M1-183 IRMCF183 Control card		**EVAL-M1-05F310** CIPOS™ Nano-power board IRSM005-310MH -100 V/300 W	
EVAL-M1-1302 XMC1302 MCU control card		**EVAL-M1-CM610N3** CIPOS™-Mini power board IKCM10H60GA ~220 V/750 W	
Motor + PFC control boards		Power boards with PFC	
EVAL-M3-102T IMC102T-F064 Control card		**EVAL-M3-CM615PN** CIPOS™ mini with boost PFC IFCM15S60GD ~220 V/800 W	
EVAL-M3-188 IRMCF188 Control card		**EVAL-M3-CM615TN** CIPOS™ mini with totem pole PFC IKCM15H60GA ~220 V/800 W	

M1 / M3 (left column labels)
M1 / M3 (right column labels)

www.infineon.com/iMOTION
www.infineon.com/MADK

Drives Pumps Fans Multicopter Motor Control

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			**XMC4500** UPS, solar three-level inverter LQFP-100, -144/LFBGA-144 up to 125°C	**XMC4700** Industrial drives LQFP-100, -144/LFBGA-196 up to 125°C	**XMC4800, XMC4300** EtherCAT®, Multi CAN 6 nodes, industrial drives LQFP-100, -144/LFBGA-196 up to 125°C
	XMC4100 Basic control & connectivity VQFN-48/LQFP-64 up to 125°C		**XMC4200** Server power supplies, 150 ps HRPWM LQFP-64, -100 up to 125°C	**XMC4500, XMC4400** Industrial drives, hall & encoder I/F, ΔΣ demodulator LQFP-64, -100, 144/ LFBGA-144 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		**XMC1400** Flicker-free dimming, SMPS control, dual channel, connectivity VQFN-40, -64/LQFP-64 up to 105°C	**XMC1400** SMPS control, dual channel, connectivity VQFN-40, -64/LQFP-64 up to 105°C	**XMC1400** Motor control, hall & encoder I/F, co-processor VQFN-40, -64/LQFP-64 up to 105°C	**XMC1400** Multi CAN 2 nodes VQFN-48, -64/LQFP-64 up to 105°C
	XMC1100 Basic control & connectivity TSSOP-16, 38/VQFN-24, -40 up to 105°C	**XMC1200, XMC1300** Flicker-free dimming, SMPS control, connectivity TSSOP-16, 28, 38/VQFN-24, -40 up to 105°C	**XMC1300** Basic SMPS control TSSOP-16, 38/VQFN-24, -40 up to 105°C	**XMC1300** Motor control, hall & encoder I/F, co-processor TSSOP-16, 38/VQFN-24, -40 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
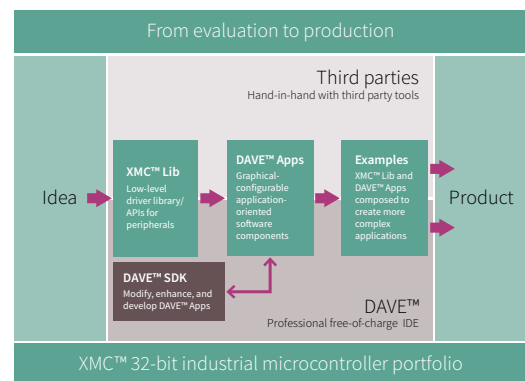
In addition to a rich third party ecosystem and enablement land-
scape, which support the entire development cycle from evalua-
tion to production.
For more www.infineon.com/xmc-ecosystem

From evaluation to production

Third parties
Hand-in-hand with third party tools

Idea

XMC™ Lib
Low-level
driver library/
APIs for
peripherals

DAVE™ Apps
Graphical-
configurable
application-
oriented
software
components

Examples
XMC™ Lib and
DAVE™ Apps
composed to
create more
complex
applications

Product

DAVE™ SDK
Modify, enhance, and
develop DAVE™ Apps

DAVE™
Professional free-of-charge IDE

XMC™ 32-bit industrial microcontroller portfolio

Microcontrollers

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).

ARM® Cortex®-M0	Co-processor	Clocks		Memory		Analog			Timer/PWM				Connectivity		Package
		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															

ARM® Cortex®-M0	Frequency [MHz]	Memory		Analog			Timer/PWM					Connectivity					Package
				ADC1 2-bit/S&H	Number of channels	DAC1 2-bit	CCU4 (4ch)	CCU8 (4ch)	HRPWM (150 ps)	POSIF	Σ 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		

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800 W PFC CCM with XMC1300
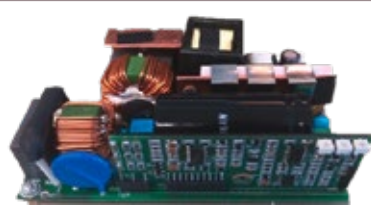
The 800 W PFC CCM evaluation board demonstrates the design and practical results of an 800 W 130 kHz platinum server PFC demo board based on Infineon devices, in terms of power semiconductors, non-isolated gate drivers, analog and digital controllers for the PFC converter as well as flyback controller 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
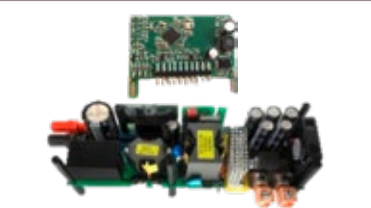
600 W LLC digital control evaluation board shows how to design the half-bridge LLC stage of a server SMPS with the target to meet 80+ Titanium standard efficiency requirements. On this purpose the latest CoolMOS™ technologies, 600 V CoolMOS™ C7 or P6 power MOSFET have been applied on the primary side, and OptiMOS™ low voltage power MOSFET in SuperSO8 BSC010N04LS, in the synchronous rectification secondary stage in combination with QR Cool-SET™ 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

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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

BLUE WIND | hitex DEVELOPMENT TOOLS | ETAS | escrypt Embedded Security & by ETAS | HIGHTEC | NEUTRONICS SOLUTIONS | G-Pulse | ULMA Embedded Solutions | MIXED MODE

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.
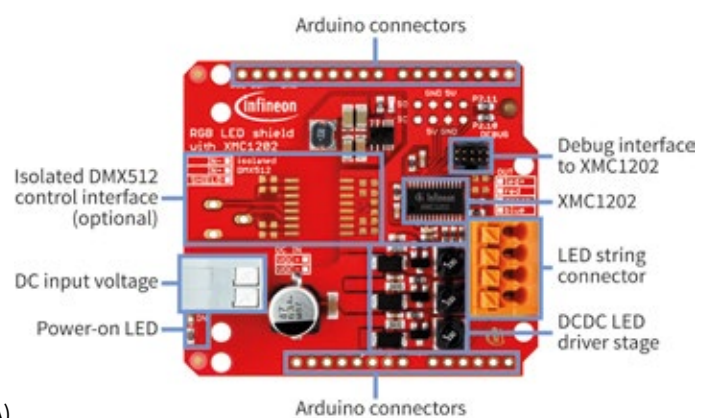
www.infineon.com/shields-for-arduino

Microcontrollers

XMC4800 automation board V2 – explore XMC4800 microcontroller based on ARM® Cortex®-M4
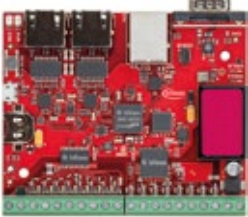
The XMC4800 automation board V2 utilizes Infineon's industry leading XMC™ ARM® Cortex®-M4 microcontroller in combination with Infineon supply, interface, communication and safety products. The XMC4800 automation board V2 is designed to evaluate the capabilities of the XMC4800 microcontroller especially in EtherCAT® slave applications and can be used with a wide range of development tools including Infineon's free of charge Eclipse based IDE, DAVE™.

Key features
› XMC4800-E196 MCU based on ARM® Cortex®-M4 at 144 MHz
› EtherCAT® slave controller, 2 MB flash and 352 KB RAM
› OPTIGA™ Trust E embedded security solution (CC EAL6+)
› Real time clock crystal
› SPI FRAM (64 kB non-volatile memory)
› EtherCAT® slave node (2 EtherCAT® PHY and RJ45 Jacks)
› 24 V ISOFACE™ 8-channel inputs and 8-channel outputs CAN transceiver
› CAN transceiver

Customer benefits
› Complete Automation kit gateway
› Combined MCU with EtherCAT slave application
› Isolated interfaces w/ diagnose
› Ethernet connectivity with soft ware examples available
› 24 V Supply
› CAN connectivity
› Full soft ware DAVE™ examples

XMC4800 automation board V2	Type	Description	Ordering code
	KIT_XMC48_AUT_BASE_V2	The XMC4800 Automation Board V2 utilizes Infineon's industry leading XMC ARM® Cortex®-M4 microcontroller in combination with Infineon supply, interface/communication and safety products.	KITXMC48AUTBASEV2TOBO1
	XMC4800-E196K2048	ARM® Cortex®-M4 microcontroller	XMC4800E196K2048AAXQMA1
	ISO2H823V2.5	24 V 8-channel isolated output	ISO2H823V25XUMA1
	ISO1I813T	24 V 8-channel isolated input	ISO1I813TXUMA1
	SLS 32AIA020A4 USON10	OPTIGA™ Trust E – embedded security solution	SLS32AIA020A4USON10XTMA2
	TLE6250GV33	Infineon CAN transceiver	TLE6250GV33XUMA1
	IFX54441LDV	Infineon voltage regulator	IFX54441LDVXUMA1

XMC™ wireless power controller – enabling wireless charging transmitter applications

Infineon's XMC™ wireless power controller, based on the ARM® Cortex®-M0 core, provides a powerful and cost-effective platform for high performance, smart and safe wireless charging applications. The XMC™ wireless power controller helps the next-generation wireless charging systems to meet strict safety, environmental and regulatory requirements, while still enabling industry-leading charging performance and efficiency. This controller works seamlessly with Infineon's power devices in a scalable architecture to provide a complete charging solution for everything from a fast charge smartphone, to a 20 W robot, or a 60 W drone and beyond.

Key features
› Supports inductive and resonant charging methods
› Power levels up to 60 W
› Multiple industry standard and custom charging profiles using the same hardware architecture
› Single and multi-coil transmitters
› Half- and full-bridge support
› Variable and fixed frequency transmitter types
› Buck and boost topologies
› Integrated FLASH for parameter storage
› Voltage supply 1.8- 5.5 V
› Space saving PG-VQFN-40 package

Customer benefits
› Supports 15 W charging and existing standards, including fast charging of smartphones
› Full power 15 W without exotic thermal management
› Achieves charging rates equivalent to wired charging
› Supports custom charging profiles and industry standards on the same hardware
› Foreign object detection (FOD) with improved accuracy quality-factor monitoring
› Foreign object detection capability can be extended beyond existing standards to improve detection
› Supports custom coils, and greater than three coils

www.infineon.com/automationkit   www.infineon.com/wirelesscharging

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 SIL 3
› 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

	TQFP-80	TQFP-100	LQFP-144 TQFP-144	LQFP-176	LFBGA-292	BGA-416	LFBGA-516
9x series up to 8 MB Max. SRAM 2.75 MB triple-core					TC297	TC298	TC299
7x series up to 4 MB Max. SRAM 472 KB triple-core				TC275	TC277		
6x series up to 2.5 MB Max. SRAM 752 KB dual-core			TC264	TC265	TC267		
3x series up to 2 MB Max. SRAM 708 KB lockstep-core		TC233	TC234		TC237		
2x series up to 1 MB Max. SRAM 96 KB lockstep-core	TC222	TC223	TC224				
1x series up to 512 KB Max. SRAM 56 KB lockstep-core	TC212	TC213	TC214				

↕ Upgrade/downgrade with pin-compatible packages

www.infineon.com/aurix

Microcontrollers

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

www.infineon.com/aurix

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

GUI

Pinning data

Driver config. data

OS config. data

Generation of configuration files

Driver files + OS

Various configuration .c and .h files

Selected drivers source files

OS source files
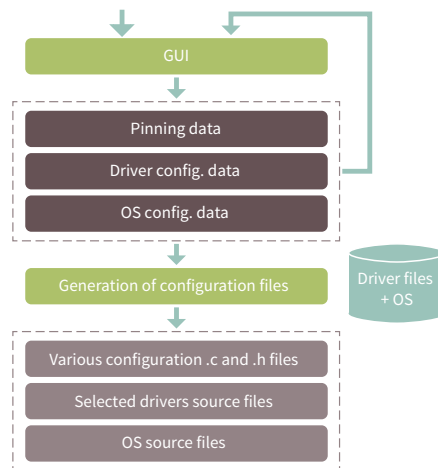
Free TriCore™ entry tool chain

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

AVL | BLUE WIND | CΣi COLORADO ENGINEERING, INC. | escrypt Embedded Security II by ETAS | ETAS | D3 Engineering Define | Design | Deploy | G-Pulse the G-Watchdog Company | MecTronik | MIXED MODE | NEUTRON CONTROLS

RDM GROUP | RDM AUTOMOTIVE RDM MEDITEC RDM TELEMATICS | hitex DEVELOPMENT TOOLS | ULMA Embedded Solutions | HIGHTEC | intecs Solutions the Brainware company | SSt SEASIDETECH | FROBAS | driveXpert ... perfect drive | EWD

For information about our partners and preferred design houses please visit: www.infineon.com/pdh

www.infineon.com/aurix

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

Info	Document	Evaluation Board	Tools	Play
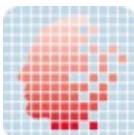
XENSIV™ MEMS microphone
Time to debottleneck your audio chain

The popularity of voice user interfaces and the usage of audio recording to share information and experiences are increasing dramatically. However, the performance of microphones often limits the potential of today's cutting-edge devices. Not anymore!

Infineon XENSIV™ MEMS microphones introduce a new performance class for digital MEMS microphones that overcomes existing audio chain limitations. IM69D130 is designed for applications where low self-noise (high SNR), wide dynamic range, low distortions and a high acoustic overload point are required.

Don't miss a single thing!
With XENSIV™ MEMS microphones, you can create a new user experience benchmark in audio recording.

Talk to tomorrow and be heard!
With XENSIV™ MEMS microphones, you can define the benchmark in speech recognition for a new user experience.
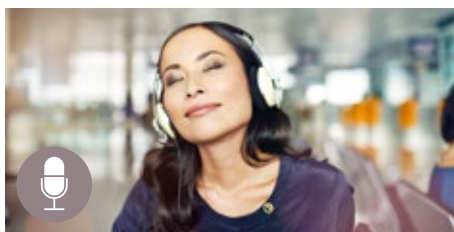
Hear nothing but your favorite beats!
With XENSIV™ MEMS microphones, you can create headsets offering users a benchmark noise cancellation experience.

Features
› 69 dB(A) signal-to-noise ratio
› Below 1 percent distortions at 128dBSPL (130dBSPL AOP)
› Digital (PDM) interface with 6 µs group delay at 1 kHz
› Tight sensitivity (-36 ±1 dB) and phase (± 2deg) tolerances
› 28 Hz low frequency roll-off

Benefits
› High fidelity and far field audio recording
› Matched, noise and distortion free audio signals for advanced audio processing
› Ultra-low group delay for latency-critical applications
› No analog components required

www.infineon.com/microphones

Infineon's dual backplate MEMS technology is based on a miniaturized symmetrical microphone design, similar as utilized in studio condenser microphones, and results in high linearity of the output signal within a dynamic range of 105 dB. The microphone noise floor is at 25 dB[A] (69 dB[A] SNR) and distortion does not exceed 1 percent even at sound pressure levels of 128 dB SPL (AOP 130 dB SPL). The flat frequency response (28 Hz low-frequency roll-off) and tight manufacturing tolerance result in close phase matching of the microphones, which is important for multi-microphone (array) applications.

3.00

1.20

4.00

Data   Clock

V_{DD} Select

Ground

Acoustic port
Ø 0.60

All dimensions in mm
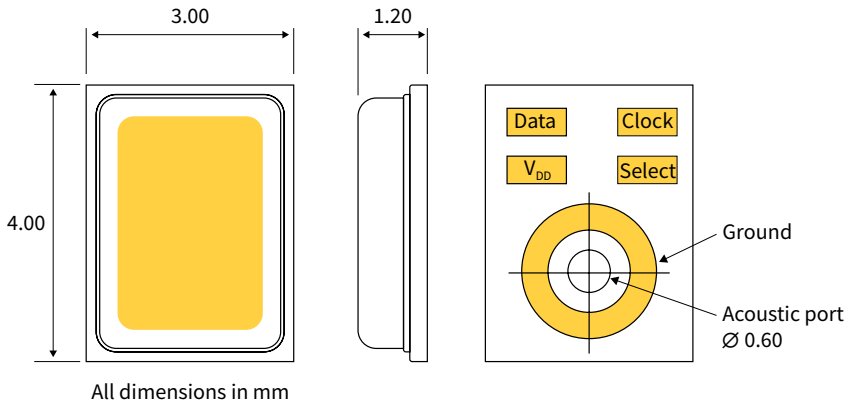
Typical applications

› High quality audio capturing: e.g. cameras, camcorders, conference systems
› Voice user interface: e.g. smart speaker, home automation and IoT devices
› Active noise cancellation: headphones and earphones
› Audio pattern detection: predictive maintenance, security or safety applications

Devices with voice user interface			Audio
TV, laptop and set top box	Digital voice assistance and robots	Smart home appliances	
+ Highest beam-forming precision	+ Best speech recognition	+ Extended voice pick-up distance	+ Best audio quality
Conference	Security	Headsets	Industry 4.0
+ Ultra clear voice pick-up	+ Sensitive to softest audio signals	+ Best noise attenuation	+ Smallest pattern deviation detection

www.infineon.com/microphones

Sensors

Infineon's digital barometric pressure sensor
For mobile and wearable devices

Infineon's digital barometric pressure sensor family are the best choice for mobile and wearable devices enabling navigation experience, activity level monitoring, gesture recognition or weather monitoring. DPS310 and DPS422 are miniaturized digital barometric air pressure sensors based on capacitive technology which guarantees high precision during temperature changes. Both devices offer dual function pressure and temperature sensors and operate at low power consumption. The DPS310 is offering high accuracy pressure level providing ultra-high precision up to 5 cm and ±0.6 hPa relative accuracy.

The DPS422 is a monolithic chip solution having ultra-small critical area. The sensor offers robustness against environments with a high level of accuracy in temperature like ±0.4°C. The sensor'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. Both sensors have FIFO that can store the latest 32 measurements. DPS422 has enhanced FIFO features including adjustable watermark. 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 product features	DPS310	DPS422
Operating pressure range	300…1200 hPa	
Operating temperature range	-40 …85°C	
Pressure level precision	< 0.5 Pa	0.5 Pa
Temperature accuracy	0.5°C	< 0.4°C
Pressure temperature sensitivity	0.5 Pa/K	
Measurement time, low power mode	3 ms	
Average current consumption, low power mode, 1 Hz	3 µA	
Standby current	< 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	8 pins LGA: 2.0 x 2.5 x 1.0 mm	8 pins WLGA: 2.0 x 2.5 x 0.73 mm

www.infineon.com/pressuresensor

Functional block diagram
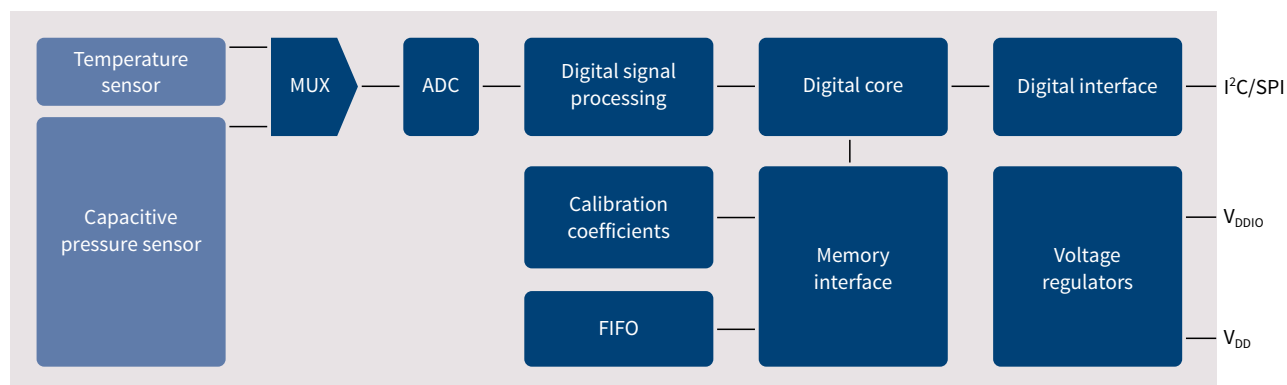
Application circuit example (in I²C configuration)
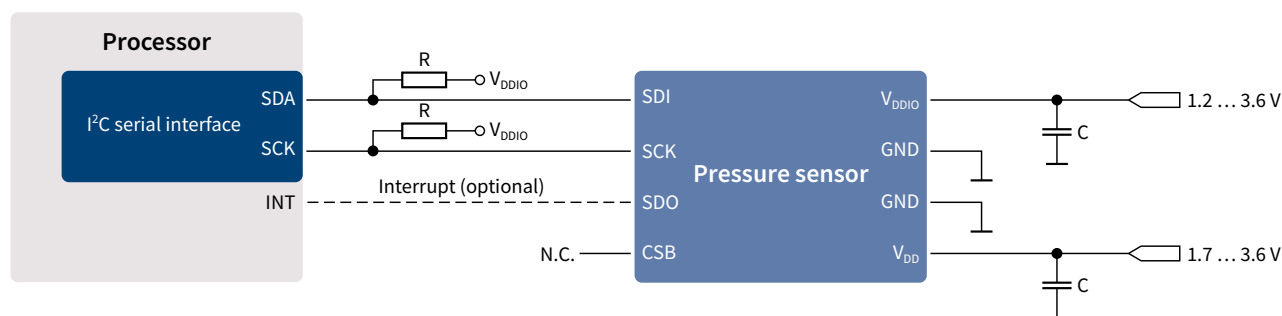
Pin configuration (top view)

Vent hole
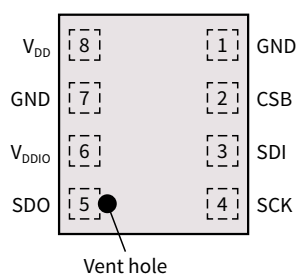
Pin	Name	Function
1	GND	Ground
2	CSB	Chip select
3	SDI	Serial data in/out
4	SCK	Serial clock
5	SDO	Serial data out
6	V_{DDIO}	Digital interface supply
7	GND	Ground
8	V_{DD}	Analog supply

DPS310 package drawing

DPS422 package drawing

www.infineon.com/pressuresensor

24GHz radar sensor

Infineon offers a wide portfolio of mmWave radar sensors to address different customer requirements. The BGT24M/L family is the largest and highest integrated 24GHz radar transceiver family currently on 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.

Utilizing our strong network of partners, the radar portfolio is extended to include a range of easy-to-integrate modules which each contain an Infineon 24GHz MMIC.

Infineon's radar offerings

Infineon MMIC	Evaluation and demo boards	Radar modules
BGT24M/L family	Supporting testing and development	Turnkey modules and design support

www.infineon.com/24GHz

Infineon BGT24M/L family of MMIC chips

The Infineon range of 24GHz industrial radar chips provide four configurations of transmit and receiver channels ensuring there is a chip to support your specific application. From basic applications such as motion detection in security systems which only require one transmit and one receive channel, through to more complex applications like 3D positioning which require two or more receive channels, our range of radar chips support all of your requirements.

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 ±100 km/h

BGT24MTR11	BGT24MR2	BGT24MTR12	BGT24LTR11
› Transceiver 1Tx+1Rx/ IQ differential › 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 › VCO integrated, SPI › Power/temp sensor	› 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 BGT24LTR11N16 key features

› 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
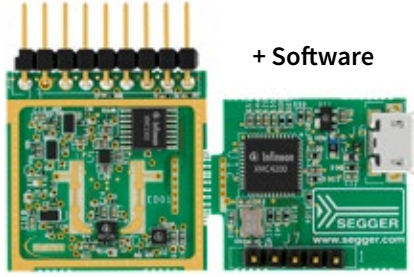
Block diagram
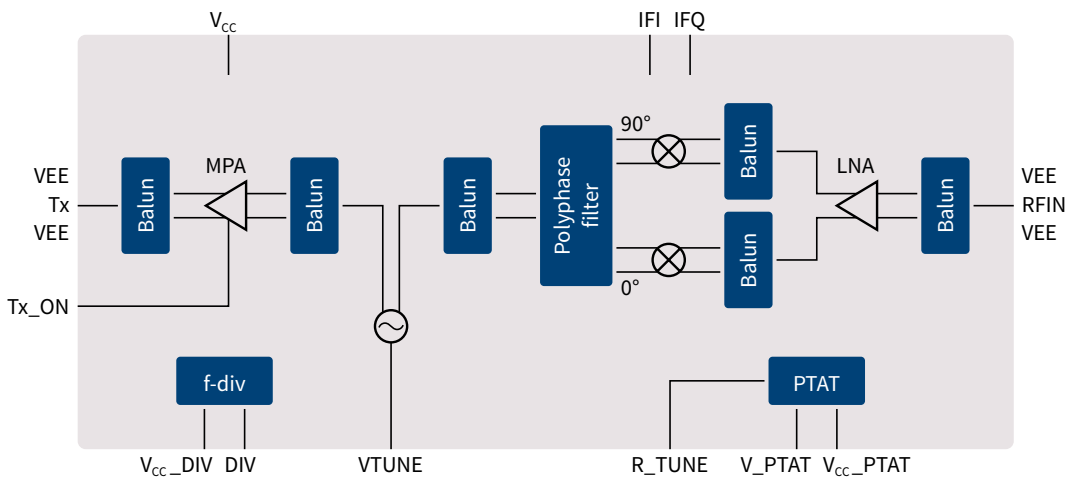
For similar level of information on the other MMIC listed above, please visit:
www.infineon.com/24GHz

24GHz evaluation and demo boards
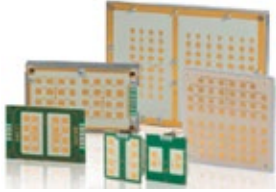
Our range of 24GHz evaluation and demo boards continues to expand to support the needs of our customers and the increasing number of innovative ways radar is being incorporated into new applications.

Features	Infineon development kit	Benefits

Features
› Three 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

Sense2GOL (BGT24LTR11 + XMC1300)	Distance2Go (BGT24MTR11 + XMC4200)	Position2Go (BGT24MTR12 + XMC4700)
› Capability to detect motion, speed and direction of movement (approaching or retreating) Precise measurement of object detection compared to PIR › Operates in harsh environments and detects through non-metallic materials › Low power mode for enhanced battery life › One of the world's smallest complete radar + MCU development kit › BGT24LTR11 – 24GHz highly integrated RF MMIC › XMC1300 ARM® Cortex®-M0 –32-bit industrial microcontroller › Debug over cortex 10 pin debug connector › Integrated multiple element patch antennas	› Capability to detect distance of multiple targets › Capability to detect motion, speed and direction of movement (approaching or retreating) › Operates in harsh environments and detects through non-metallic materials › BGT24MTR11 – 24GHz highly integrated RF MMIC › XMC4200 ARM® Cortex®-M4 –32-bit industrial microcontroller › Debug over cortex 10 pin debug connector › Integrated multiple element patch antennas	› Capability to detect position of multiple targets › Capability to detect distance of multiple targets › Capability to detect motion, speed and direction of movement (approaching or retreating) › Operates in harsh environments and detects through non-metallic materials › BGT24MTR12 – 24GHz highly integrated RF MMIC › XMC4700 ARM® Cortex®-M4 –32-bit industrial microcontroller › Debug over cortex 10 pin debug connector › Integrated multiple element patch antennas
Main applications › Security › Lighting control › Automatic door opener › Vital sensing	**Main applications** › Drone: soft landing/obstacle avoidance › Smart toilets › Tank level sensing › Intelligent switches	**Main applications** › Drone/robots: obstacle avoidance › Security › People tracking (IoT, smart home) › Vital sensing
Board dimensions › 25 mm x 25 mm (pictured with the Segger Debugger break-off board for reprogramming)	**Board dimensions** › Board 36 mm x 45 mm	**Board dimensions** › Board 50 mm x 45 mm
Kit contents › User's manual › SW GUI to operate kit › Schematic and bill-of-materials of module	**Kit contents** › User's manual › SW GUI to operate kit › FMCW FW and SW [1] › Doppler FW and SW [1] › Schematic and bill-of-materials of module	**Kit contents** › User's manual › SW GUI to operate kit › FMCW FW and SW › Doppler FW and SW › Schematic and bill-of-materials of module

www.infineon.com/24GHz

1) Usage of the FMCW and/or Doppler FW and SW requires agreeing to Infineon's user's agreement and licensing terms.

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	Partner modules using Infineon chips	Benefits

› Complete module, including radar MMIC, antenna options, MCU signal processing options, and SW options (Doppler, FSK and FMCW versions available)

Module (RF module; RF module + MCU including SW)

› 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.

Lighting

Security

Touch free switches

Door automation

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

Sensors

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
› Reduced implementation effort, PCB space and cost
› Small package size and weight for SMD mounting
› CSA component acceptance

Block diagram TLI4970
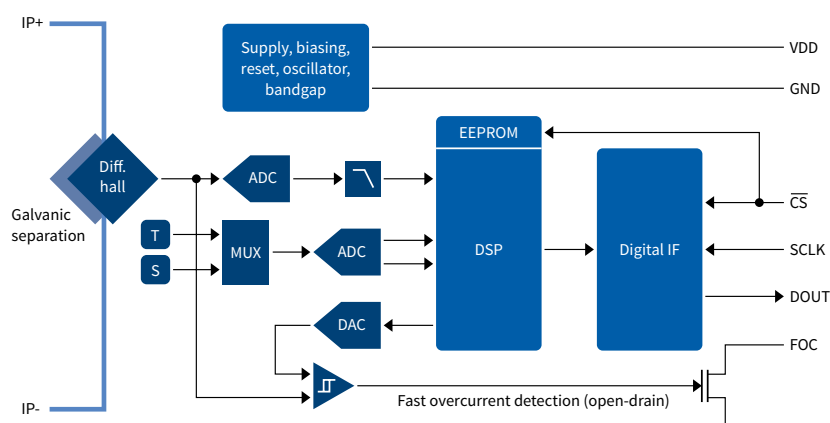
Product summary

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 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.
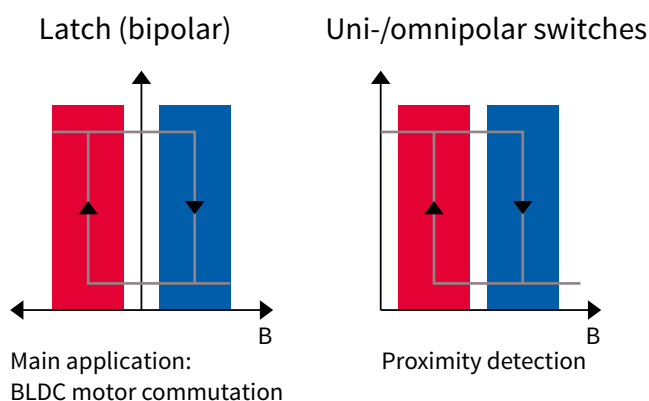
Key features

> 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)

Uni-/omnipolar switches

B

B

Main application:
BLDC motor commutation

Proximity detection

Sales code	Package	Product description	Potential applications
TLx4961	PG-SOT23, PG-SSO-3-2, PG-TO92S	Latch	Index counting systems, BLDC motor commutation
TLx4964	PG-SOT23, PG-SSO-3-2, PG-TO92S	Unipolar	Position sensing
TLx4968	PG-SOT23, PG-SSO-3-2, PG-TO92S	Bipolar	Index counting systems, BLDC motor commutation

www.infineon.com/Hall-switches

Sensors

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.

The linear Hall sensor TLE4997 provides a ratio metric analog output voltage, which is ideally suited to Analog-to-Digital (A/D) conversion with the supply voltage as a reference. The digital signal processing using a 16-bit DSP architecture and digital temperature compensation guarantees excellent stability over a long period of time and temperature range. The minimum overall resolution is 12 bits. The digital linear Hall sensor TLE4998 is available in three protocol options: Puls Width Modulation (PWM), SENT (Single Edge Nibble Transmission, SAE J2716) protocol and SPC (Short PWM Code). The SPC protocol allows transmissions initiated by the ECU. The output stage is an open-drain driver pulling the output pin to low only. Therefore, the high level needs to be obtained by an external pull-up resistor. This output type has the advantage that the receiver may use an even lower supply voltage (e.g. 3.3 V). In this case the pull-up resistor must be connected to the given receiver supply.

Key features
› Single supply voltage 4.5 V-5.5 V
› Temperature range -40°C … +150°C
› Linear ratiometric output between ±50 mT and ± 200mT 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
› 12-bit/16-bit resolution (internal 20-bit digital signal processing)
› Analog and digital interfaces
› Single and dual die products
› Leaded and SMD packages PG-SSO-3, PG-SSO-4, PG-TDSO-8

Key benefits
› Highly accurate contactless position sensing
› In-system calibration possible
› Flexible system implementation

Type	Qualification	Linear magnetic range	Resolution	IDD	Output	Package	Temperature range	Ordering code
TLE4997E2	AECQ-100	±50 mT/±100 mT/±200 mT	12-bit	3-10 mA	Ratiometric analog	SSO-3	-40°C – 150°C	SP000235288
TLE497A8 TLE4997A8D	AECQ-100	±50 mT/±100 mT/±200 mT	16-bit	3-10 mA	Ratiometric analog	TDSO-8	-40°C – 150°C	SP000902756 SP000902760
TLE4998x3 TLE4998x4	AECQ-100	±50 mT/±100 mT/±200 mT	16-bit	30-10 mA	Digital protocol PWM, SENT, SPC	SSO-3 SSO-4	-40°C – 150°C	SP000412104 (P) SP000412108 (S) SP000476468 (C) SP000412106 (P) SP000412110 (S) SP000440972 (C)
TLE4998x8 TLE4998x8D	AECQ-100	±50 mT/±100 mT/±200 mT	16-bit	30-10 mA	Digital protocol PWM, SENT, SPC	TDSO-8	-40°C – 125°C	SP000902780 (S) SP000902772 (P) SP000902764 (C) SP000902776 (P) SP000902784 (S) SP000802768 (C)

www.infineon.com/magnetic-sensors

PRO
SIL

Two sensors in one SMD package

The new SMD package (TDSO) includes two independent sensors with separate power supply and separate signal outputs. Due to special mounting technology, Infineon is able to keep dual-sensor package size very small to enable compact PCB layouts and small magnet sizes. Infineon offers a wide range of Hall sensors In the TDSO package. The two sensors in one package offer sensor redundancy in one package. Sensor redundancy is especially interesting for new generation EPS steering systems with increased ISO 26262 requirements and other safety critical applications. All sensors are automotive qualified. Most products are also available as single-sensor solution with only one sensor.

Features
› Two sensors in one package
› Separate power supply and signal output AEC-Q100 qualified
› Temperature range front -40 to +125°C
› Outstanding quality
› Single-sensor versions available
› 16-pin and 8-pin versions available
› ISO 26262 ready

Automotive applications
› Steering torque systems
› Pedal position
› Any other safety critical application

Linear Halls

Product	Interface	Dual-/single-sensor available	Package
TLE4997A8D	Analog	yes/yes	TDSO-8
TLE4998P8D	PWM	yes/yes	TDSO-8
TLE4998S8D	SENT	yes/yes	TDSO-8
TLE4998C8D	SPC	yes/yes	TDSO-8

Sensors

www.infineon.com/linear-hall

iGMR angle sensors
Compact designs in small outline packages

254

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 (single die) – PG-DSO-8 package
› Temperature range -40°C ... +125°C (dual die) – PG-TDOS16 package

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
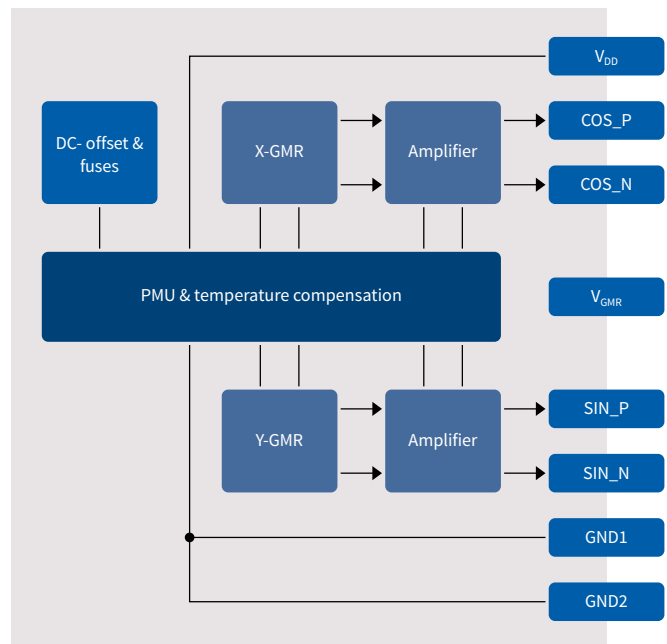
Benefits TLI5012B/TLE5012B

› 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
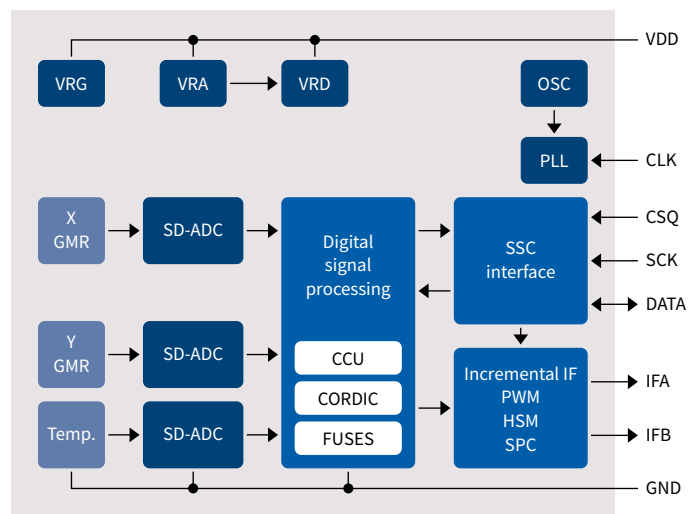
Sensors

3D magnetic sensor

TLV493D-A1B6, TLI493D-A2B6, TLE493D-W2B6 A0 – for consumer, industrial and automotive market

The 493D- sensor family realizes accurate 3D magnetic sensing with extremely low power consumption in a tiny 6 pin package. Capable of detecting the magnetic field in the x, y, and z-direction, the sensor is ideally suited for the measurement of linear, rotational or 3 dimensional movements. The sensors provide with the I^2C protocol a standard 2-wire digital PC interface, which enables high speed bi-directional communication between the sensor and the micro-controller. The product family includes consumer, industrial and automotive qualified products.

With focus to the simplest human machine interface, the TLE493D family focusses on all kind of control elements. The sensors are available or planned as consumer, industry and automotive grade derivatives. Featuring contactless position sensing and high temperature stability of the magnetic threshold, this system concept keeps getting smaller, more accurate and more robust. Typical examples are anti-tempering circuits in e-meters for the consumer range applications and joystick positioning sensing targeting industrial needs. Within the automotive area the focus is the range of control elements like simple human machine interfaces, e.g. detent switches or knobs, direction indicators as well as gear position sensors.

The key benefit is the replacement of mechanical or optical solutions by more reliable systems that are also ready for functional safety support.In keeping with the highest quality standards and environmental regulations, the sensor is RoHs compliant, AEC-Q100 qualified. The TLE493D-W2B6 version is prepared to support system developments in accordance to functional safety standard ISO26262.
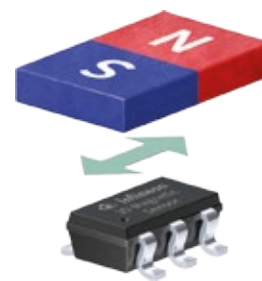
Key applications
› Anti-tampering for e-meters
› Joystick e.g. finger, thumb and gaming paddles
› Control elements e.g. white goods, multifunction knob
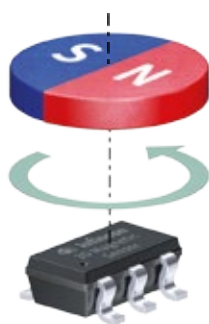
Rotation movement 3D movement Linear movement

www.infineon.com/3dmagnetic

Key features TLV493D – A1B6

- › 3D magnetic sensing
- › Integrated temperature sensing
- › Low current consumption - 0.007 µA in power-down mode
- › 7 nA in power-down mode
- › 10 µA in ultra-low power mode
- › 2.9 V to 3.5 V operating supply voltage
- › Digital output via a 2-wire standard I²C interface
- › Bx, Bz and Bz linear field measurement ±100mT to ±160 mT
- › 12-bit data resolution for each measurement direction

- › Various resolution options from 67 µT/LSB to 134 µT
- › Operating temperature range up to -40°C to 125°C
- › JESD47 qualified

Additional features TLI493D-A2B6 and TLE493D-A2B6

- › Enhanced µC compatibility
- › Sensor address read back
- › Two selectable sensor ranges

- › Higher update frequency allows for an application field that requires faster update speed
- › Operating temperature range:
  - – TLI: -40°C to 105°C
  - – TLE: -40°C to 125°C

Additional features TLE493D-W2B6

- › Wake up by magnetic field exceeding programmable threshold
- › Angular mode for 2D operation

Type	Qualification	Linear magnetic range	Resolution	IDD	Update rate	Temperature range	Ordering code
TLV493D-A1B6	JESD47	± 130 mT (typ)	98 µT /LSB	7 nA - 3.7 mA	10 Hz - 3.3 KHz	-40°C to 125°C	SP001286056
TLI493D-A2B6	JESD47	± 160 mT (min)	134 µT /LSB (67 µT/LSB)*	7 nA - 3.3 mA	0.04 Hz - 7.8 KHz	-40°C to 105°C	Coming soon
TLE493D-W2B6 A0…A3	AECQ-100	± 160 mT (min)	134 µT /LSB (67 µT/LSB)*	7 nA - 3.3 mA	0.04 Hz - 7.8 KHz	-40°C to 125°C	SP001605334 SP001605340 SP001605344 SP001605348
TLE493D-A1B6	AECQ-100	± 60 mT	130 µT/LSB	7 nA - 3.3 mA	0.04 Hz - 7.8 KHz	-40°C to 125°C	SP001368598
TLE493D-A2B6	AECQ-100	± 160 mT(100 mT)	130 µT/LSB (65 µT/LSB)*	7 nA - 3.3 mA	6 Hz - 7.8 KHz	-40°C to 125°C	SP001689848

* Half-range mode

www.infineon.com/3dmagnetic

Sensors

2GO evaluation kits

Smallest, fully featured sensor 2GO evaluation kits for current and 3D magnetic sensors, joystick adapter and rotation knob for the 3D magnetic sensor 2GO

Infineon's sensor 2GO kits are new budget-priced evaluation boards that are already equipped with a sensor combined with an ARM® Cortex®-M0 CPU. The sensor 2GO kits provide a complete set of on-board devices, including an on-board debugger. Build your own application and gadget with the sensor 2GO kits. Our 2GO kits are ready-to-use plug-and-play boards.

Benefits
› Plug-and-measure evaluation board
› First measurements possible within minutes
› Mechanical adapter (joystick/rotation knob) available for quick evaluation

3D magnetic sensor 2GO features
› TLV493D-A1 B6 (three-dimen-sional magnetic sensor)
› 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

Current sensor 2GO features
› TLI4970- D050T4 (current sensor with digital interface)
› XMC1100 (ARM® Cortex®-M0 based)
› On-board J-link lite debugger (realized with XMC4200 microcontroller)
› Power over USB (micro USB), [SD and reverse current protection
› GUI for free download

Joystick adapter for the
3D magnetic sensor 2GO features
› In addition to the 3D magnetic sensor 2GO evaluation kit, Infineon also offers the new joystick adapter, which can be easily mounted on the evaluation board
  – Easy mounting on the 3D magnetic sensor 2GO
  – First magnetic Joystick measurements within minutes
› The user manual in the download area precisely explains usage, mounting and functionality

Rotation knob for the
3D magnetic sensor 2GO features
› Rotate and push button control element
› Simulates rotational and angle sensing movements
› The user manual in the download area precisely explains usage, mounting and functionality

www.infineon.com/sensors2go

Infineon support for sensors

Useful links and helpful information

Further information, datasheets and documents

www.infineon.com/sensors

www.infineon.com/microphones

www.infineon.com/magnetic-sensors

www.infineon.com/current-sensor

www.infineon.com/hall-switches

www.infineon.com/angle-sensors

www.infineon.com/3dmagnetic

www.infineon.com/pressuresensor

www.infineon.com/24GHz

Evaluationboards and simulation models

www.infineon.com/sensors2go

Videos & eLearnings

www.infineon.com/sensor-mediacenter

www.infineon.com/sensor-eLearnings

Info	Document	Evaluation Board	Tools	Play

Packages

Surface mount device technology

Package	Pins	Dimensions (L x W x H)
DPAK (TO-252-2)	2	9.9 x 6.5 x 2.3
DPAK (TO-252)	3	9.9 x 6.5 x 2.3
Reverse DPAK (Rev. TO-252)	3	9.7 x 6.6 x 2.34
DPAK 5pin (TO-252)	5	9.9 x 6.5 x 2.3
HDSOP-10-1	10	20.96 x 6.5 x 2.3
HDSOP-22-1	22	20.96 x 15.0 x 2.3
D²PAK (TO-263)	3	15.0 x 10.0 x 4.4
D²PAK (TO-263-2)	2	15.0 x 10.0 x 4.4
D²PAK 7pin (TO-263)	7	15.0 x 10.0 x 4.4
TO-Leadless (TOLL)	8	11.68 x 9.9 x 2.3
SC59	3	3.0 x 2.8 x 1.1
SOT-23	3	2.9 x 2.4 x 1.0
SOT-89	3	4.5 x 4.0 x 1.5
SOT-223	4	6.5 x 7.0 x 1.6
SOT-323	3	2.0 x 2.1 x 0.9
SOT-363	6	2.0 x 2.1 x 0.9
TSOP-6	6	2.9 x 2.5 x 1.1
PQFN 2x2	6	2.0 x 2.0 x 0.9
PQFN 2x2 dual	6	2.0 x 2.0 x 0.9
PQFN 3.3x3.3	8	3.3 x 3.3 x 1.0
SuperSO8	8	5.15 x 6.15 x 1.0
SuperSO8 dual	8	5.15 x 6.15 x 1.0
SuperSO8 fused leads	8	5.15 x 6.15 x 1.0
TDSON-8-47	8	5.15 x 6.15 x 1.0
TDSON-10-2	10	3.0 x 3.0 x 0.9
TDSON-10-7	10	3.0 x 3.0 x 0.9
TSDSON-8-25 fused leads	8	3.3 x 3.3 x 1.0
TISON-8	8	7.0 x 7.0 x 1.0
TISON-8 (power stage 5x6)	8	5.0 x 6.0 x 1.0
TISON-8-4 (Power Block)	8	5.0 x 6.0 x 1.0
TSON-8-1	8	3.0 x 3.0 x 1.0
TSON-8-3	8	5.0 x 6.0 x 1.0
TSON-8 ThinPAK 5x6	8	5.0 x 5.0 x 1.0
TSON-10	10	3.3 x 3.3 x 1.0
VSON-4 ThinPAK 8x8	4	8.0 x 8.0 x 1.0
VDSON-8	8	4.0 x 4.0 x 0.9
WSON-10	10	4.0 x 4.0 x 0.8
DirectFET™ Small Can	V	4.8 x 3.8 x 0.65
DirectFET™ Medium Can	V	6.3 x 4.9 x 0.65
DirectFET™ Large Can	V	9.1 x 6.98 x 0.71
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.

RoHS

IQFN-27-2		IQFN-30 (DrMOS 4 x 4)		IQFN-31 (DrMOS 5 x 5)		IQFN-36		IQFN-39		IQFN-40	
27	3.3 x 6.0 x 0.9	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

SO-8/SO-8 dual		SO-16/12		SO-14		SO-16		SO-18		DSO-12	
8	5.0 x 6.0 x 1.75	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)

DSO-24		SSOP-24		TDSO-16		SO-19		SO-20		DSO-28	
24	10.5 x 15.6 x 2.65 (max)	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

SO-36		TSSOP-28		TSSOP-48		LFBGA-516-5		LFBGA-292-6		BGA-416-26	
36	15.9 x 11.0 x 3.5	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

LQFP-176-22		LQFP-144-22		TQFP-144-27		TQFP-100-23		TQFP-80-7		Package (JEITA-code)	
176	26.7 x 26.7 x 2.1	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	

All products are RoHS Compliant.

RoHS

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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-247-3-AI		**TO-247 4pin**		**DIP-7**		**DIP-8**		**DIP-14**		**DIP-20**	
3	41.3 x 10.9 x 5.18	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
Super220		**Super247**		**SSO-3-9**		**SSO-3-10**		**SSO-4-1**		**TO92S-3-1**	
3	28.25 x 10.5 x 4.5	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
TO92S-3-2		**Package (JEITA-code)**									
3	4.0 x 1.52 x 3.15	X	L x W x H								

|
pin-count
V = Variable number of pins

All dimensions in mm

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Useful links and helpful information

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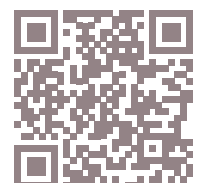
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