

POWER MANAGEMENT PRODUCT SELECTION GUIDE



Volume 3

International
IOR Rectifier

THE POWER MANAGEMENT LEADER

THE POWER MANAGEMENT LEADER: International Rectifier is a pioneer and world leader in advanced power management technology, from digital, analog and mixed signal ICs to advanced circuit devices, power systems, and components.

Technological breakthroughs from IR are setting the pace for innovation in the electronics we all rely upon each day. Inside our factories and automobiles, at our homes and offices, and orbiting our world, IR's power management technology is enabling today's leading-edge computers, appliances, lighting, automobiles, satellites, and defense systems and creating a pathway to tomorrow's advancements.

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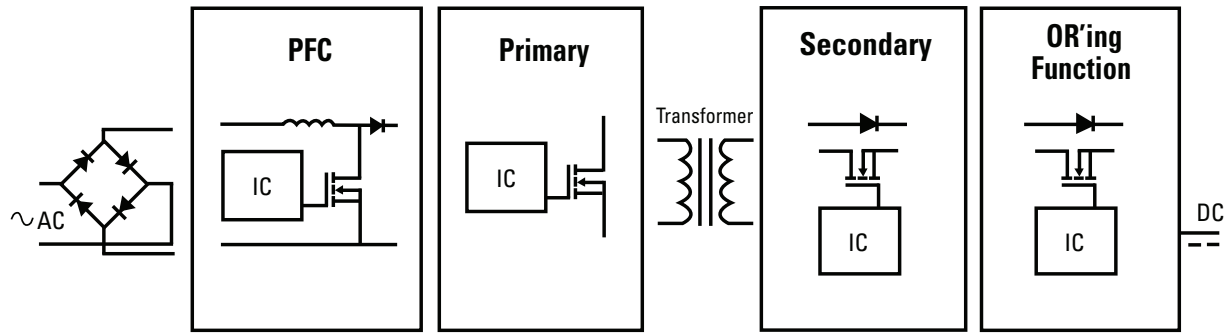
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TYPICAL APPLICATIONS



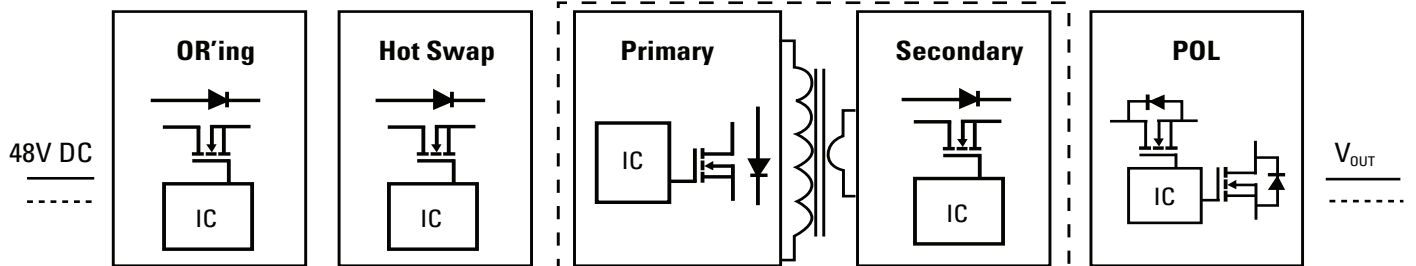
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DC-DC SYSTEMS

ISOLATED DC-DC

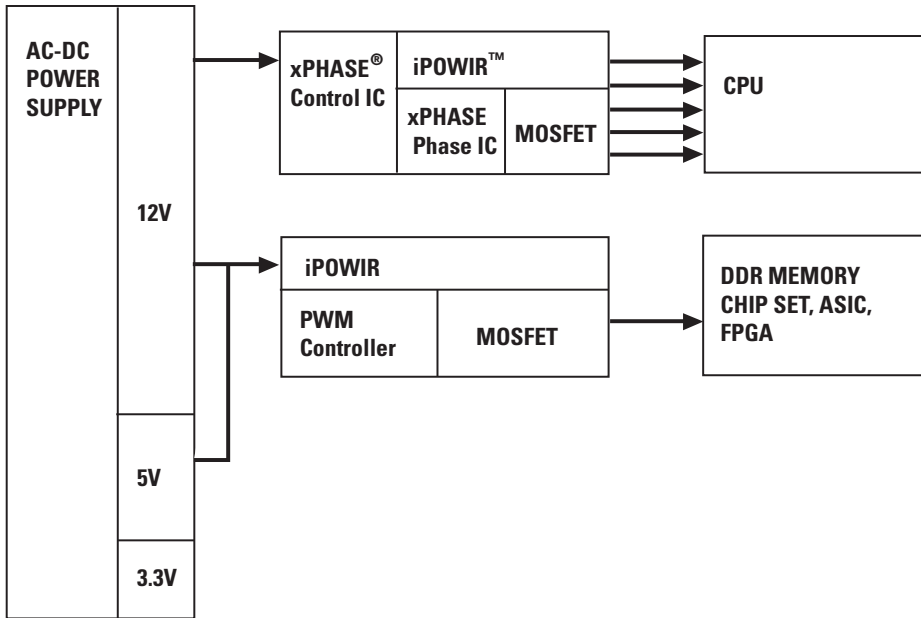


- 12V**
- 5V**
- 3.3V**

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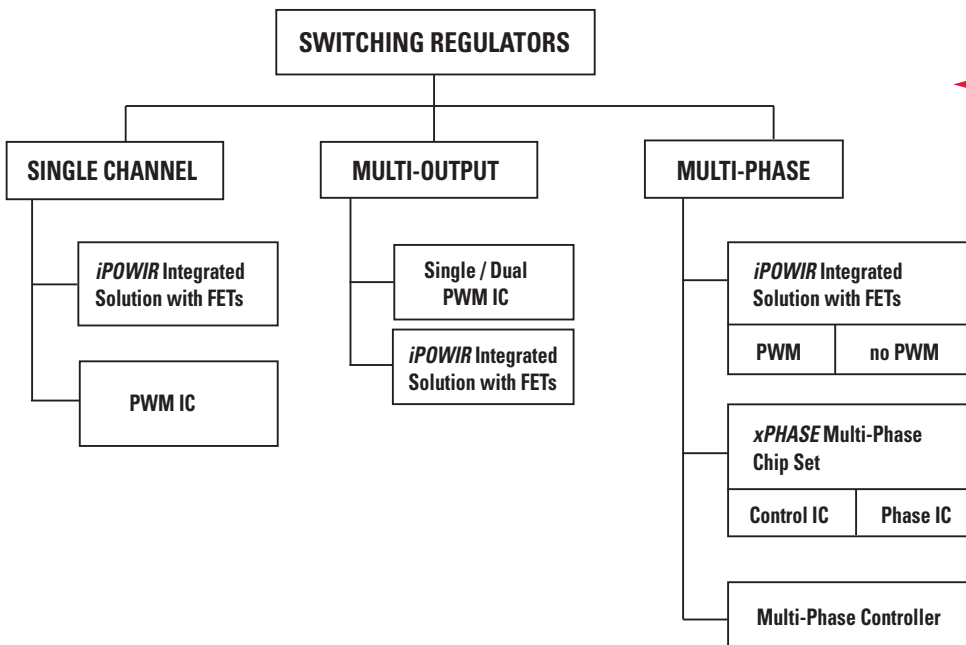
TYPICAL APPLICATIONS | DC-DC Systems

DC-DC APPLICATIONS FOR NON-ISOLATED SWITCHING REGULATORS



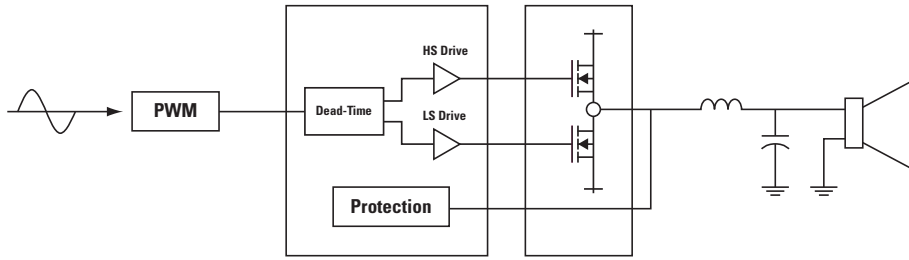
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DC-DC NON-ISOLATED IC SWITCHING REGULATORS FAMILY



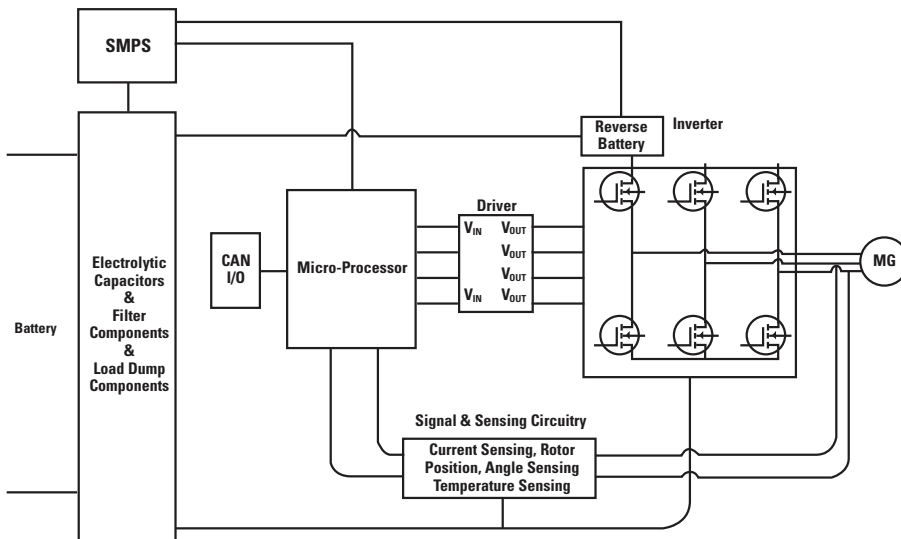
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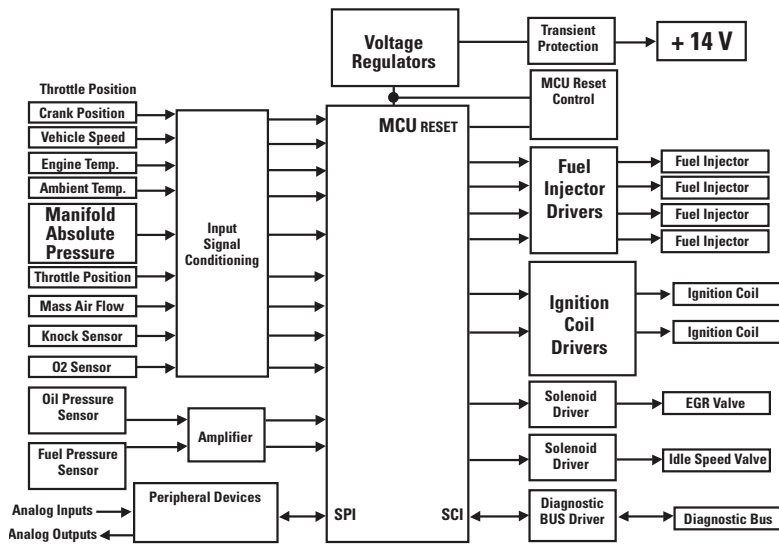
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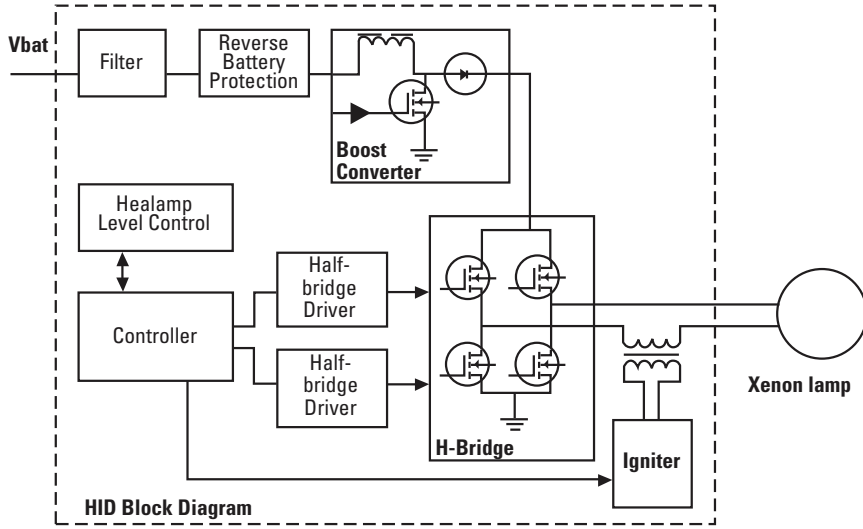
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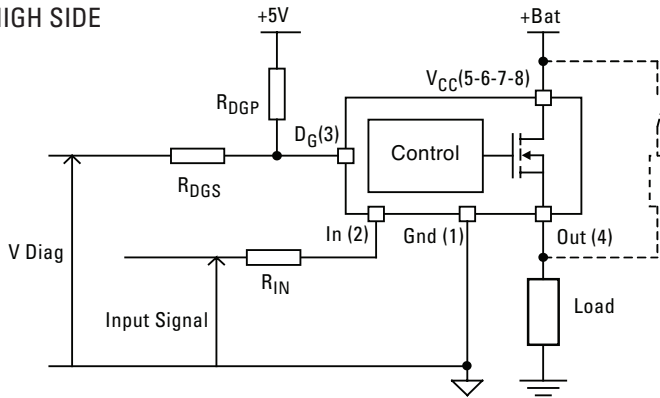
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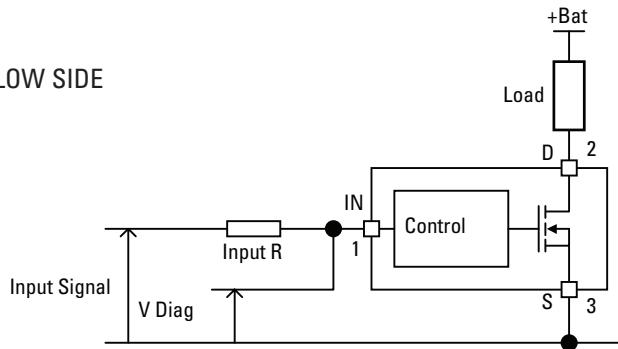
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HIGH SIDE

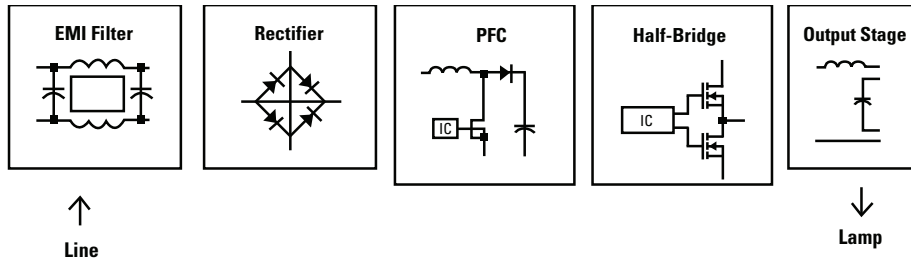


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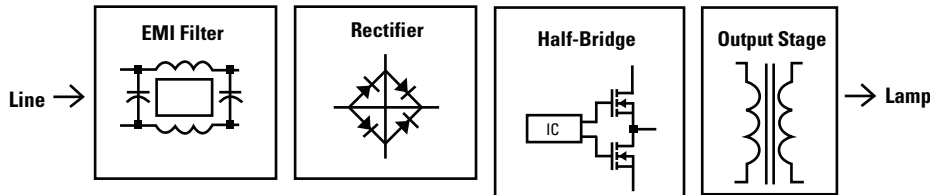


LINEAR FLUORESCENT BALLAST CONFIGURATION



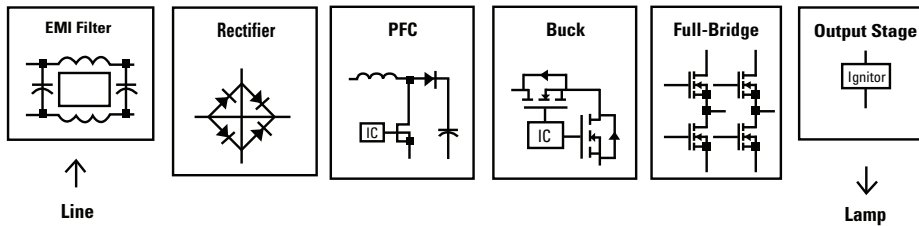
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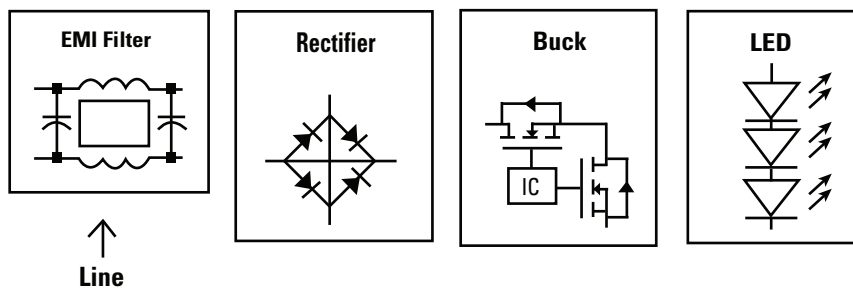
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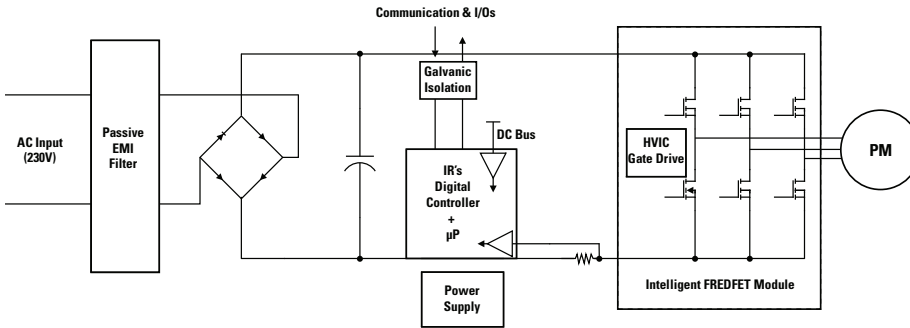
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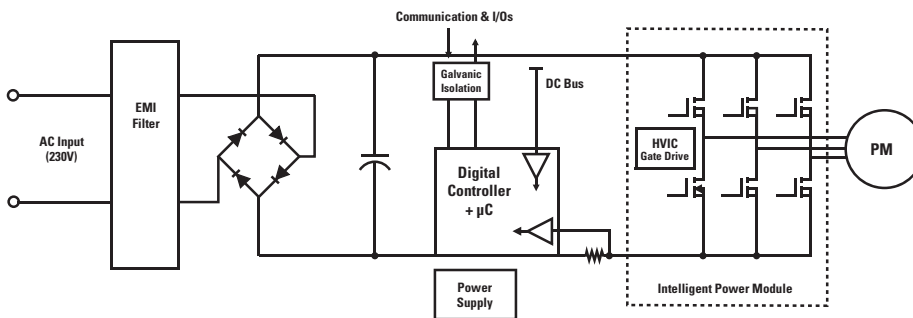
TYPICAL APPLICATIONS | Motor Control

MOTION CONTROL INTEGRATED DESIGN PLATFORM



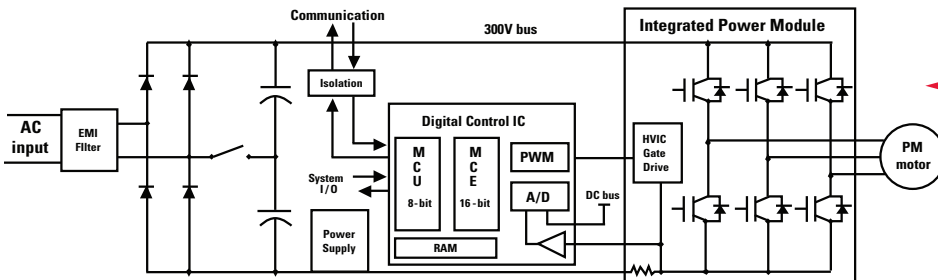
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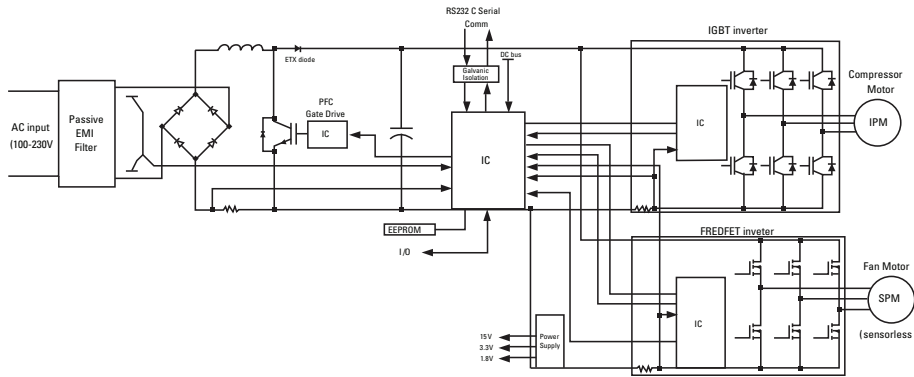
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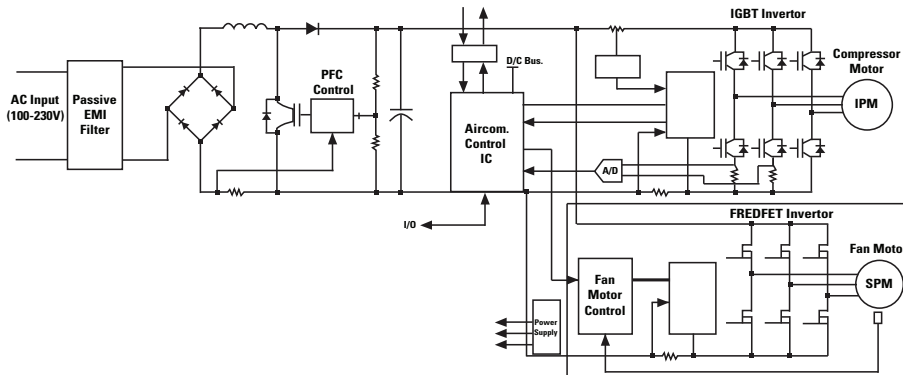
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AIR CONDITIONING — INTEGRATED DESIGN PLATFORM



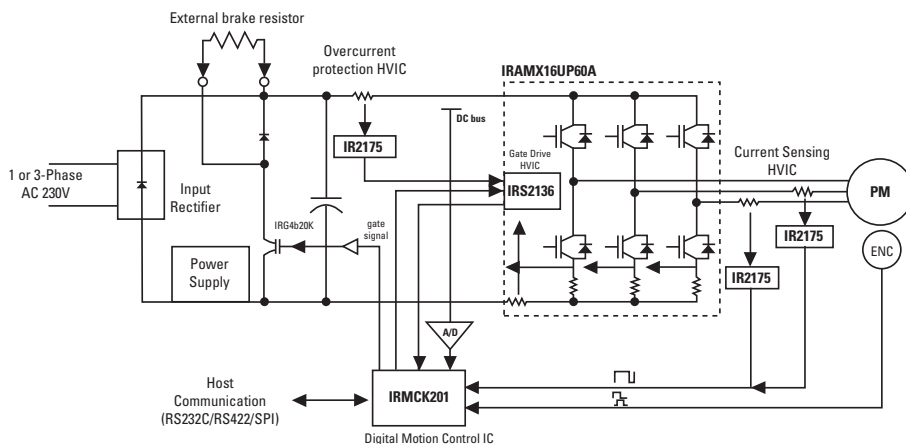
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AC MOTOR



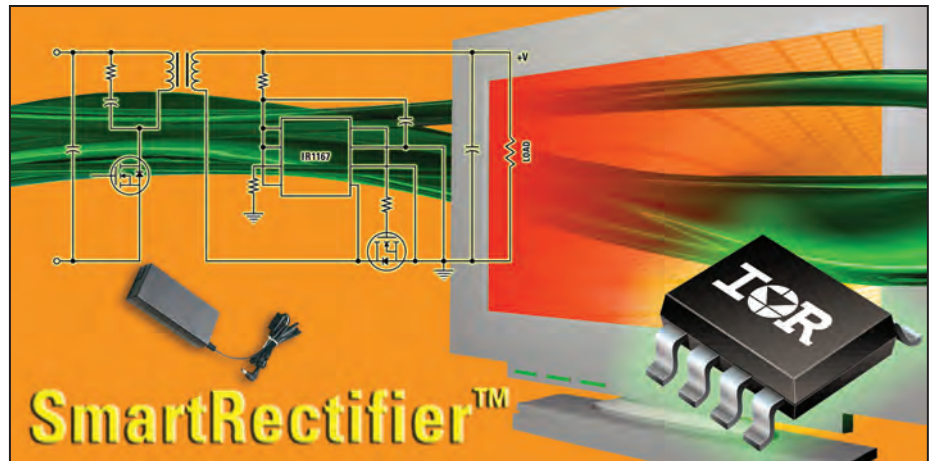
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PRODUCT FAMILIES



The IR Advantage

- Simple, powerful solution
- Enables
 - Higher efficiency
 - Higher Power density
 - Faster time to market
- Complies with CEC 80plus and 1W standby requirements
- Proprietary voltage level detection and 200V HVIC technology
- Direct connection and drive to all 30-200V MOSFETs
- Fast, powerful (7A), accurate, high efficiency operation up to 500kHz
- Independent from primary side
- Operates in all modes
- In 120W laptop adaptor, enables
 - 1% efficiency increase
 - 10°C lower temperature
 - 75% fewer SR components
 - 20% lower SR system cost
- Enables 'no heatsink' SR designs



SmartRectifier™ IR1166/67: Simple, High Efficiency Sync Rec

For designers of high power flyback and resonant half-bridge converters for laptops, mini-PCs, LCD and PDP TVs and games, the SmartRectifier™ offers a simple, high efficiency solution for secondary synchronous rectification (SR) in all operational modes and application conditions.

The IR1166/67 is a secondary control IC with built-in 7A gate drive. Operating independently from the primary side, it uses a proprietary voltage level detection technique to minimize wasteful secondary reactive currents to maximize secondary efficiency.

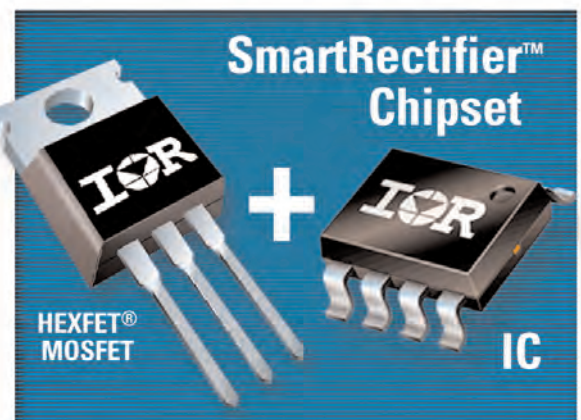
The proprietary 200V HVIC technology allows direct sensing and control of IR's world-class range of Standard- or Logic-Level, 30-200V HEXFET MOSFETs.

Specifications

Part #	Package	V _{CC}	V _{FET}	Sw Freq. Max	Gate Drive +/-	V _{GATE Clamp}	Sleep Current Max	RoHS
IR1166SPbF	SO-8	20	<= 200	500	+1/-3.5	10.7	200	✓
IR1167ASPbF	SO-8	20	<= 200	500	+2 / -7	10.7	200	✓
IR1167BPbF						14.5		

Part #	B _{Vdss}	R _{DS(on)}	Package
IRFB3206PbF	60V	3.0mΩ	TO-220
IRFB3306PbF	60V	4.2mΩ	TO-220
IRF7855PbF	60V	9.4mΩ	SO-8
IRFB3207ZPbF	75V	4.1mΩ	TO-220
IRFB3077PbF	75V	3.3mΩ	TO-220
IRF7854PbF	80V	13.4mΩ	SO-8
IRFB4110PbF	100V	4.5mΩ	TO-220
IRFB4310ZPbF	100V	6.0mΩ	TO-220
IRF7853PbF	100V	18.0mΩ	SO-8
IRFB4321PbF	150V	15.0mΩ	TO-220
IRFB4227PbF	200V	24.0mΩ	TO-220

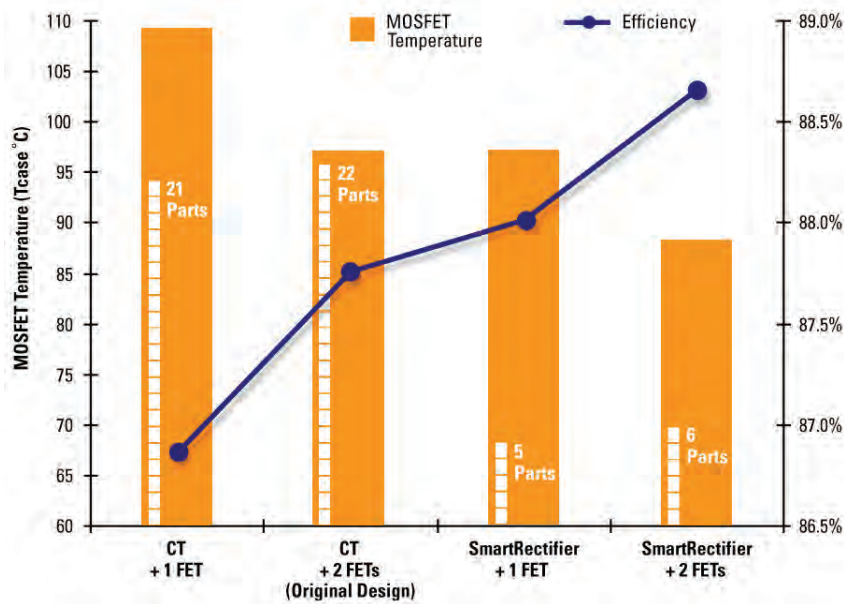
See www.irf.com for full MOSFET selection



IR1166/67 can be used with IR's HEXFET® Power MOSFETs to provide the ultimate Smart Rectifier chipset solutions.

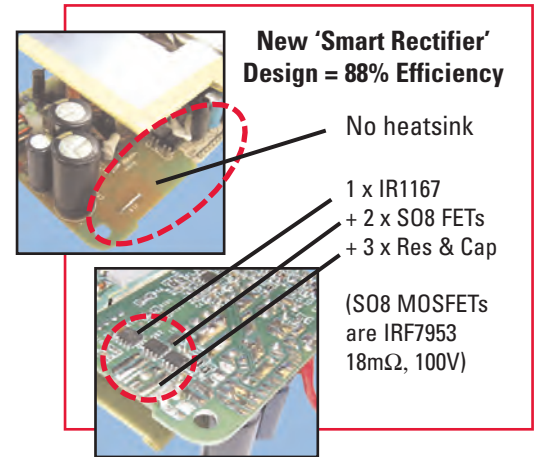
Old Current Transformer vs. New SmartRectifier™

120W Laptop Adaptor
(VOUT=19.5V, IOOUT=6.15A, Full Load, 110VACIN, TAMB=45°C)

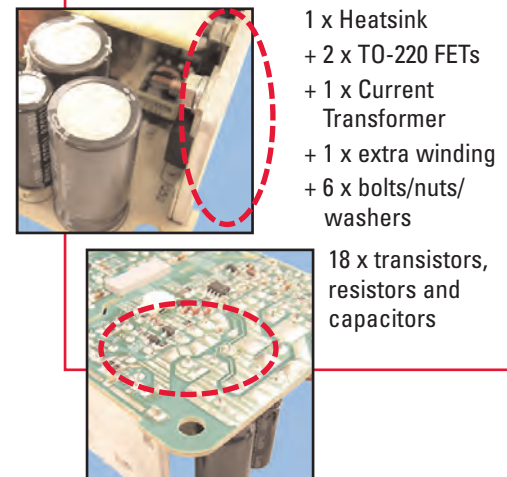


APPLICATION EXAMPLE:

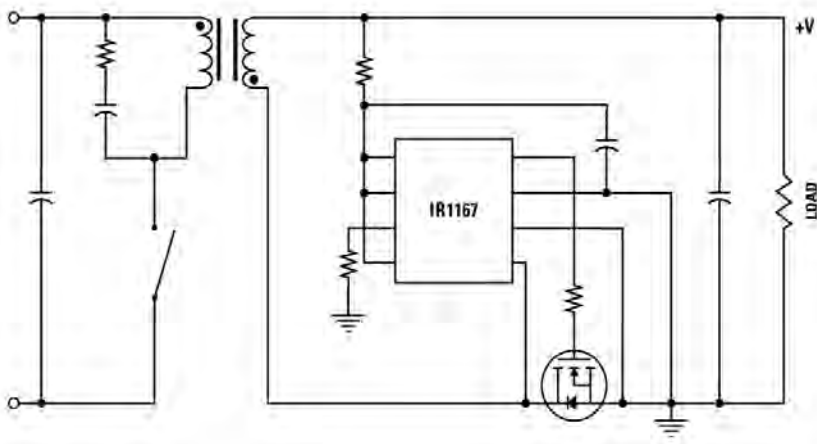
120W laptop adaptor (16.5V, 6.15A)
'No heatsink' redesign



Original 'CT' Design = 87% Efficiency



Flyback Example



- 120W laptop adaptor (19.5V, 6.15A) with current transformer (CT) and TO-220 SR FETs.
- SmartRectifier shows 1% efficiency improvement .
- 10°C lower FET temperature with same heatsinking.
- Allows reduction in SR FETs to allow system cost reductions.

- No manual assembly
- Less space needed ... can redesign to increase power density!

The IR Advantage

- Small, easy, powerful solution
- Enables high power density
- Fast time to market
- Enables compliance with PFC (THD) regulations for Japan, Europe, and China
- Enables compliance with energy standards (1W, Blue Angel, Energy Star)
- No AC line voltage sense required
- 0.999 power factor
- Programmable, fixed switching frequency, 50kHz to 200kHz
- Fast, powerful 1.5A peak gate drive
- Peak current mode control
- Dedicated OVP with soft start, brownout and output undervoltage protection
- Cycle by cycle peak current limit system protection
- For high power systems (>200W)
 - 40% fewer resistors and capacitors
 - Eliminates a current transformer
 - 50% smaller PCB area for the PFC control section
- For lower power systems (<250W)
 - Reduced peak currents
 - 40% reduction in EMI filter cost
 - >16% smaller PCB
 - >10% higher power density



The μ PFC™ Family of Controller ICs Alters Traditional Thinking About PFC Solutions

The IR1150 uses a new, patented "One-Cycle Control (OCC), integrator with reset" technique to deliver the high performance of Continuous Conduction Mode (CCM) PFC with the simplicity and low component count of Discontinuous Current Mode (DCM).

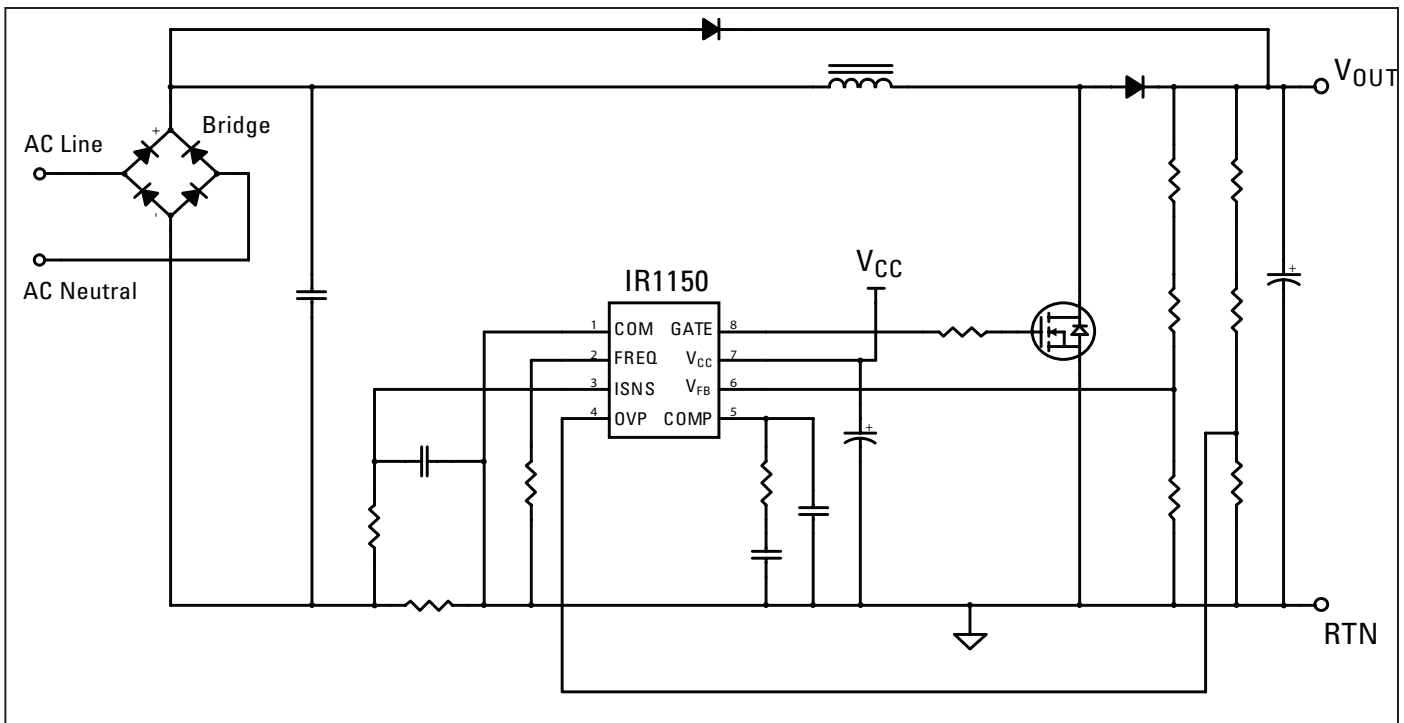
OCC does not have the traditional analog multiplier, AC line sensing or fixed oscillator ramp. In OCC the output of the error amplifier is integrated over each clock cycle to generate a variable-slope ramp. This variable ramp is compared with the error voltage and subtracted from the current sense signal to generate the PWM gate drive.

The IR1150 responds to changes in output voltage in just "one cycle" of the internal clock giving excellent response.

High Power (>200W) Systems

High power applications (>200W) need CCM PFC to have high efficiency and small system sizes. However, traditional CCM multiplier-based solutions are complex, require many design stages and have a high component count, making CCM solutions very expensive.

Part Number	Package	V _{CC} (V)	I _O +/- (A)	Frequency (kHz)	T _{amb} (°C)	Environment	RoHS
IR1150STR	SO-8	13-22	1.5	50-200	0 to +70	Consumer	-
IR1150ISTR	SO-8	13-22	1.5	50-200	-25 to +85	Industrial	-
IR1150STRPbF	SO-8	13-22	1.5	50-200	0 to +70	Consumer	Lead Free
IR1150ISTRPbF	SO-8	13-22	1.5	50-200	-25 to +85	Industrial	Lead Free



In a typical 1kW SMPS, the new OCC solution has 40% fewer resistors and capacitors, removes a current transformer and has a 50% smaller PCB area for the PFC control section. In addition, the IR1150 has a dedicated Over Voltage Protection (OVP) pin to give greater protection for high power systems.

Low Power (<250W) Systems

Lower power applications (<250W) traditionally use DCM systems for simplicity and low system cost. However, as system power increases to 100W and above – e.g. for high end laptop or LCD TV adaptors - DCM systems are large due to high peak currents and EMI filter requirements. OCC operates in CCM mode with reduced peak currents and a 43% reduction in EMI filter needs. This translates into a 16% reduction in PCB and an increase in power density of 10% for a typical 120W laptop adaptor.

Governmental and Energy Standards Compliance

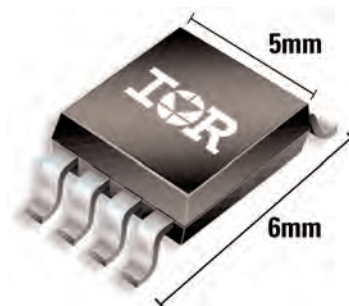
The IR1150 includes features such as enable, micro-power start-up and “sleep mode” for compliance with energy efficiency standards such as “1W Standby”, Blue Angel and Energy Star.

IR’s OCC method used in the IR1150 is an attractive solution to PFC (THD) legislation such as IEC 1000-3-2 in Europe, JIS C 61000-3-2 in Japan and the China Compulsory Certificate (CCC) for products using more than 75W. PFC is not yet a requirement in the US, however, specifications are being prepared by the IEEE.

Even without the need to meet governmental legislation, PFC solutions using the IR1150 OCC IC offer two more advantages; a) designers can create one design with universal AC input for worldwide use which streamlines manufacturing, inventory and logistics, and b) PFC eliminates AC-line harmonics, reducing the rms current and so allows higher power motors or pumps to be used without tripping domestic circuit breakers.

Applications

- AC-DC SMPS >75W
 - Server SMPS and telecom rectifier
 - Notebook computers, LCD TVs, mini-PC power adaptors
 - Plasma TVs, CRT monitors
 - High-end set-top boxes /PVRs, home theatre systems
 - Office machines such as photocopiers and printers
 - PC silver box power supplies
- Motor Drive / Pumps >75W
 - Washing machines, dishwashers
 - Air conditioners
 - Pools, spas, well pumps



Features

- Integrated analog input
- Integrated self-oscillating PWM modulation
- Programmable bidirectional over-current protection with self-reset control
- Start and stop click noise reduction
- Floating inputs enable easy half-bridge implementation
- Programmable preset deadtime for scalable power design
- High noise immunity
- $\pm 100V$ ratings deliver up to 500W in output power
- PWM frequency up to 800kHz
- 16-pin DIP and SOIC



The IRS2092 is an integrated driver IC featuring protected PWM switching for medium power, high performance Class D audio amplifiers up to 500W in home theatre, home stereo, active speaker, musical instrument, and professional audio applications.

Based upon a half bridge topology, the new audio driver IC integrates four essential functions for Class D design implementation including error amplifier, PWM comparator, gate driver, and robust protection circuitry. As a result, this compact 16-pin IC offers high noise immunity, reduced start and stop click noise, and design scalability, while greatly reducing some of the most complicated and costly design tasks such as overload protection.

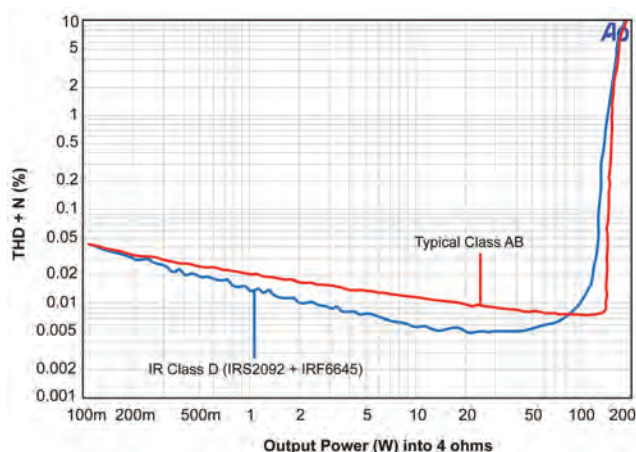
Key IRS2092 features include an analog PWM modulator with frequency up to 800 kHz, programmable bidirectional over-current protection (OCP) with self-reset control, under-voltage lockout protection (UVLO), and programmable preset deadtime for improved THD performance.

Digital Audio MOSFETs

The IRS2092 audio IC may be paired with an extensive range of IR digital audio MOSFETs addressing output power from 50W to 500W. These MOSFETs, have been optimized around parameters critical to audio performance such as efficiency, THD, and EMI. For detailed performance information, please refer to the MOSFET data sheets available online at www.irf.com.

The chipset forms a Class D audio solution that is much smaller than a comparable Class AB design. In a 100W application, for example, the IRS2092 IC and IRF6645 DirectFET[®] MOSFETs reduce board size by 60% and eliminate 20% of the parts from the typical bill of materials.

The IRAUDAMP5 reference design speeds development and evaluation. Based upon the IRS2092 IC and the IRF6645 DirectFET power MOSFETs, the two-channel design is a 120W half-bridge power amplifier which may be scaled for power and number of channels, and requires no heatsink under normal operating conditions. The design offers an efficiency of 96% at 120W in the MOSFET stage, and a THD+N of 0.005% at 60W, four ohms, (both typical).



IC Specifications

Part Number	Offset Voltage	Sink/Source Current	VCC Range (with UVLO)	Min/Max Output Voltage	Selectable Dead Time	Logic Compatible Input
IRS2092(S)PBF	±100V	1.2 / 1.0A	10-18V	10-18V	25 / 45 / 75 / 105ns	3.3 / 5.0V
IRS2011(S)PBF	200V	1 / 1	10-20V	10-20V	—	3.3 / 5.0V
IRS20124SPBF	200V	1.2 / 1.0	10-18V	10-18V	15 / 25 / 35 / 45ns	3.3 / 5.0V
IRS20955SPBF	200V ~ ±100V	1.2 / 1.0A	10-18V	10-18V	15 / 25 / 35 / 45ns	3.3 / 5.0V

Companion Digital Audio MOSFETs

DirectFET®				
Clipping Power	Without Heatsink		With Heatsink	
	4 Ohms	8 Ohms	4 Ohms	8 Ohms
50W - 100W	IRF6645	IRF6665	IRF6665	IRF6665
100W - 120W	IRF6645		IRF6645	IRF6775M
120W - 200W			IRF6645	IRF6775M
200W - 250W			IRF6775M	IRF6785M

IRFx Families			
Clipping power	Package	Load	
		4 Ohms	8 Ohms
50W - 60W	TO-220 Full-Pak 5-Pin	IRFI4024H-117P	IRFI4212H-117P
	TO-220	—	IRFB4212PbF
60W - 100W	TO-220 Full-Pak 5-Pin	IRFI4212H-117P	IRFI4212H-117P
	TO-220	IRFB4212PbF	IRFB4212PbF
100W - 200W	TO-220 Full-Pak 5-Pin	IRFI4212H-117P	IRFI4019H-117P
	TO-220	IRFB4212PbF	IRFB4019PbF
200W - 300W	TO-220 Full-Pak 5-Pin	IRFI4019H-117P	IRFI4020H-117P
	TO-220	IRFB4019PbF	IRFB4020PbF
300W - 500W	TO-220 Full-Pak 5-Pin		
	TO-220	IRFB4227PbF	IRFB4229PbF

CLASS D AUDIO REFERENCE DESIGNS

IRAUDAMP5

Two-channel 120 W Half-bridge Class-D Audio Power Amplifier

- 120W x 2 Channels (THD=1%, 1kHz)
- 0.005% THD+N @ 60W, 4 Ohms
- 170 µV Distortion, IHF-A weighted, AES-17 filter
- 96% Efficiency @ 120W, 4 Ohms, Single Channel Driven, Class-D Stage
- OCP, OVP, UVP, DC protection & OTP
- Self-oscillating half-bridge topology with optional clock synchronization
- Featuring IRS2092S Controller and Gate Driver IC and IRF6645 DirectFET MOSFETs

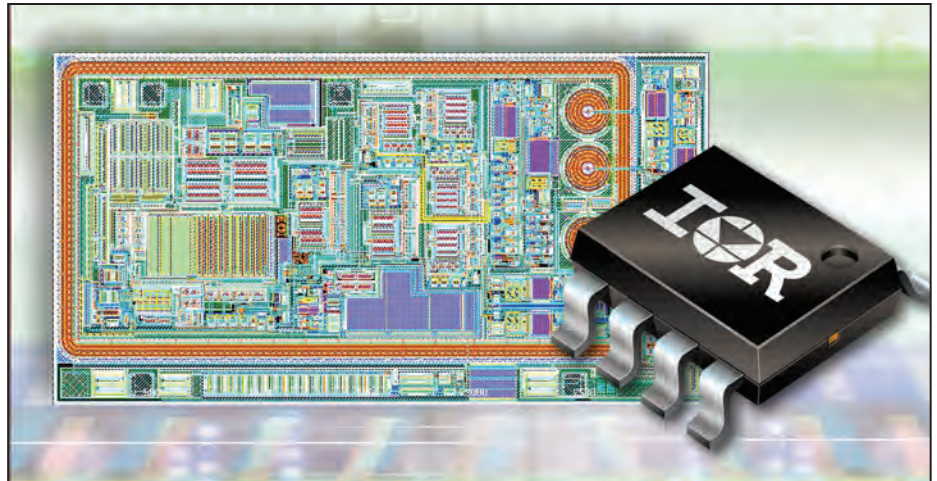
IRAUDAMP4

Two-channel 120 W Half-bridge Class-D Audio Power Amplifier

- 120 W x 2 channels, (THD=1%, 1kHz)
- 0.004% THD+N distortion @ 60W, 4 Ohms
- Residual noise 52 µV, IHF-A weighted, AES-17 filter
- 96% efficiency @ 120W, 4 Ohms, Single Channel Driven, Class-D Stage
- OCP, OVP, UVP, DC protection & OTP
- Self-oscillating half-bridge topology with optional clock synchronization
- Featuring IRS20955S Gate Driver and IRF6645 DirectFET MOSFETs

Features

- Floating channel up to +1200V
- Monolithic integration
- Linear current feedback through shunt resistor
- Direct digital PWM output for easy interface
- Direct analog output for easy interface (IR2177 and IR2277 only)
- Independent fast over-current trip signal
- High common mode noise immunity
- Input over-voltage protection for IGBT short circuit condition
- Open drain outputs

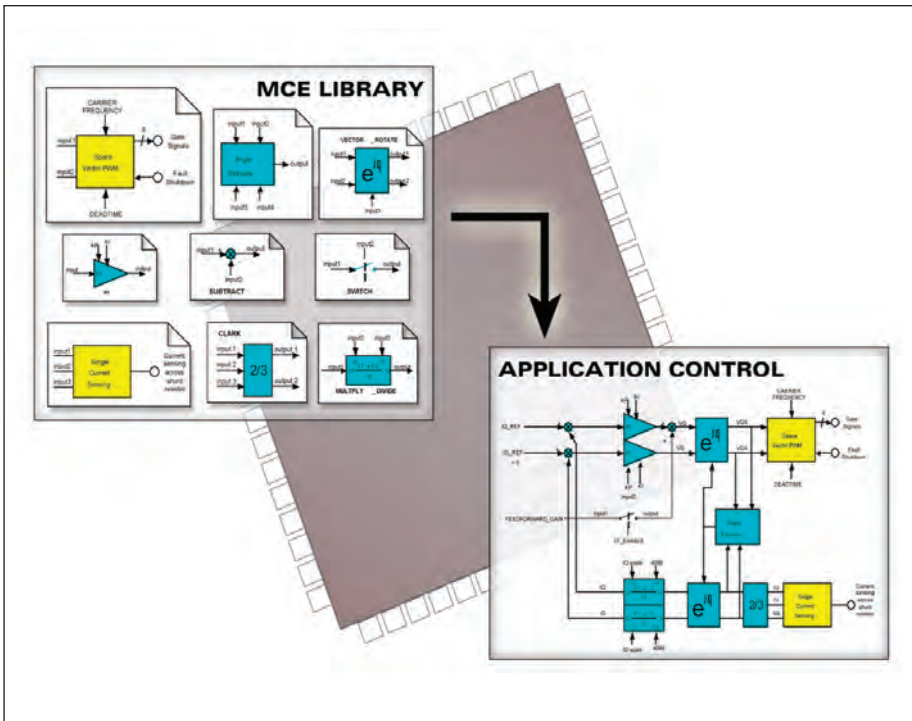


Motion Control Current Sensing ICs

The IR217x/IR227x is a family of monolithic current sensing ICs designed for motor drive applications. The ICs sense the motor phase current through an external shunt resistor, convert the current information from an analog to a digital signal, and transfer the signal to the low-voltage circuitry. IR's proprietary high-voltage isolation technology is implemented to enable the high bandwidth signal processing. The output format is either a discrete PWM to be used when A/D interface is not available, or an accurate analog signal linked to an external voltage reference to simplify signal conditioning in A/D equipped applications. The dedicated over-current trip signal facilitates IGBT short circuit and over-current protection. The open-drain digital outputs of the IR2175, IR2177, IR2277, IR21771, and IR22771 make it easy for any interface from 3.3V to 15V. The self-adaptable analog output of the IR2177 and IR2277 make it easy to interface AD converter with any input range from 3V to 12.5V.

IR's iMOTION™ Integrated Design Platform delivers everything you need to design a complete variable speed motor control subsystem. From the front panel and power entry to the motor terminals, iMOTION brings powerful digital, analog and power silicon together with algorithms, development software and design tools.

Part Number	Package	Offset Voltage	PbF	Analog Output	Digital Output	Overcurrent Output	V _{IN} Range	Duty Cycle		V _{CC} Range
								Min	Max	
IR2175	8-Lead PDIP	600V	Yes	No	Yes	Yes	±260mV	7%	93%	9.5-20V
IR2175S	8-Lead SOIC	600V	Yes	No	Yes	Yes	±260mV	7%	93%	9.5-20V
IR2177S	16-Lead SOIC	600V	Yes	Yes	Yes	Yes	±250mV	10%	30%	8-20V
IR21771S	16-Lead SOIC	600V	Yes	No	Yes	Yes	±250mV	10%	30%	8-20V
IR2277S	16-Lead SOIC	600V	Yes	Yes	Yes	Yes	±250mV	10%	30%	8-20V
IR22771S	16-Lead SOIC	600V	Yes	No	Yes	Yes	±250mV	10%	30%	8-20V



Applications

- In-room and wall air conditioners
- Washing Machines
- Fans and pumps

Features

- Simultaneous sensor-less control for 2 PMSM motors and power factor correction
- Motion Control Engine eliminates control software coding
- Customer application code in co-integrated 60MIPs microcontroller

Advantages

- Simplifies design
- Speeds up development for faster time-to-market
- Eliminates need for external micro controller

IR's iMOTION Integrated Design Platform

IR's iMOTION Integrated Design Platform delivers everything you need to design a complete variable speed motor control subsystem. From the front panel and power entry to the motor terminals, iMOTION brings powerful digital, analog and power silicon together with algorithms, development software and design tools. The latest iMOTION digital control ICs have been designed to include new features such as the microcontroller and embedded Analog Signal Engine™ together with the Motion Control Engine™ to enable simultaneous sensorless control of two Permanent Magnet motors and Power Factor Correction (PFC).

Primary Application	Part Number	Package	Motor Control	Analog	Memory	I/O	Comms
Air Conditioners	IRMCF312	QFP100	2 Motors 1 PFC extra I/O and analog for system functions	12 bit A/D 11 channels POR UVLO Analog watchdog	48kByte Program RAM 8kByte Data RAM	36 dig I/O 1 Capture 4 Timers	RS232 x2 I2C/SPI
Air Conditioners	IRMCF311	QFP64	2 Motors 1 PFC Minimum set of pins for motor control	12 bit A/D 6 channels POR UVLO Analog watchdog	48kByte Program RAM 8kByte Data RAM	20 dig I/O 1 Capture 4 Timers	RS232 x2 I2C/SPI
Washers	IRMCF341	QFP64	1 Motor extra I/O and analog for system functions	12 bit A/D 8 channels POR, UVLO Analog watchdog timer	48kByte Program RAM 8kByte Data RAM	24 dig I/O 1 Capture 4 Timers	RS232 I2C/SPI
Pumps	IRMCF371	QFP48	1 Motor extra I/O, and analog for system functions	12 bit A/D 4 channels POR, UVLO Analog watchdog timer	48kByte Program RAM 8kByte Data RAM	6 digital I/O, 1 capture, 4 timers	RS232 I2C/SPI

HVIC Background Information

- High voltage integrated circuit (HVIC) drivers are driver ICs that receive an input signal from a control IC, amplify this signal, and drive one or more switches (MOSFET or IGBT).
- Many power conditioning applications (e.g. lighting, motor control, etc.) require one or more devices to be switched between high voltage rails. These applications require some form of high voltage level-shifting technology.
- International Rectifier's proprietary high voltage level-shifting technology provides the required level-shifting for these applications in a compact, robust, and cost-effective design.



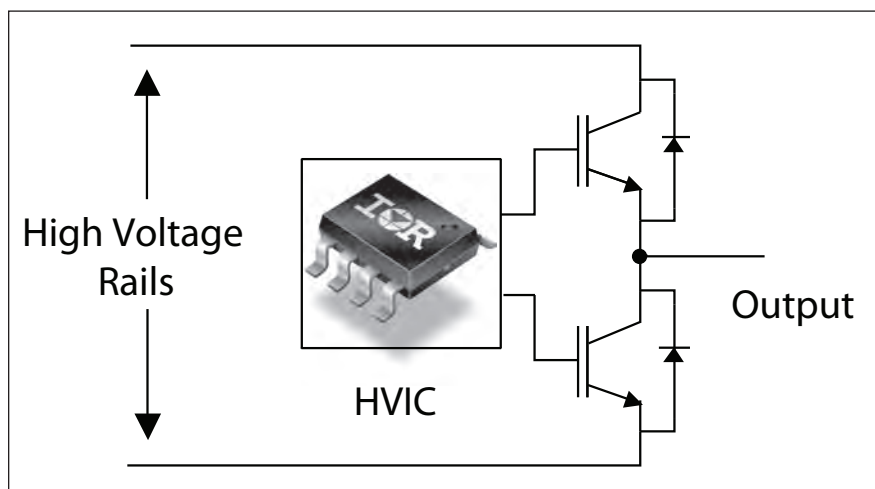
High Voltage Gate Driver ICs (HVICs)

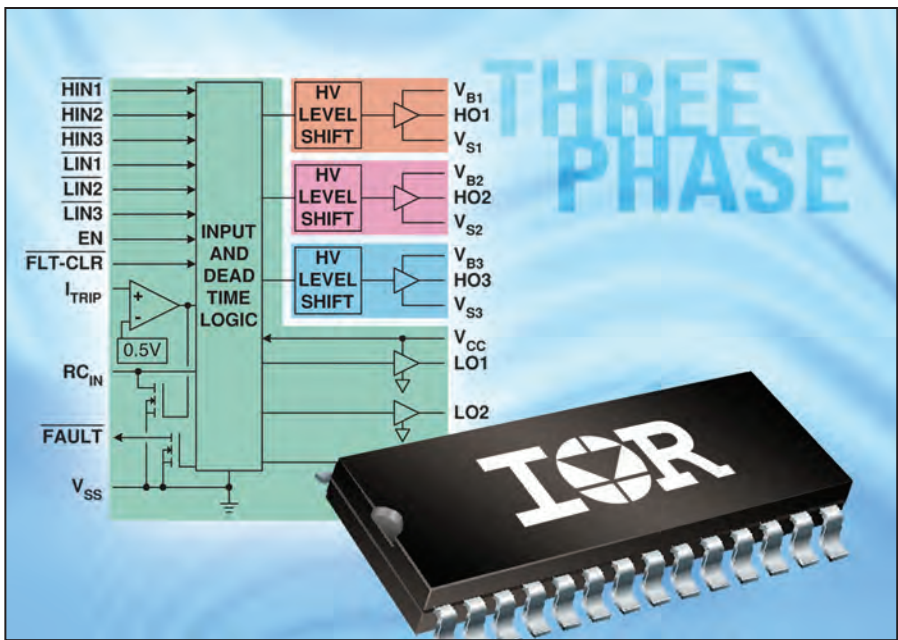
International Rectifier's MOSFET and IGBT gate driver ICs are the simplest, smallest and lowest cost solution to drive MOSFETs or IGBTs up to 1200V in applications up to 12kW, and can save over 30% in part count in a 50% smaller PCB area compared to a discrete opto-coupler or transformer-based solution. With the addition of few external components, IR gate driver ICs provide full driver capability with extremely fast switching speeds, designed-in ruggedness and low-power dissipation.

Gate driver IC's generate the current and voltage necessary to turn MOSFETs or IGBTs on and off from the logic output of a DSP, micro-controller or other logic device. The input is typically a 3.3 volt logic-level signal. All IR gate driver ICs are CMOS compatible, and most are TTL compatible. Output currents are up to 2A.

IR Gate Driver ICs Simplify Design

Driving a MOSFET or IGBT in the high side position of a half-bridge topology or 3-phase inverter leg offers the additional challenge that the gate voltage is referenced to the source rather than to ground. The source voltage is a floating point at up to the maximum bus voltage, or voltage rating of the MOSFET or IGBT, 600V and up for motor drive, lighting or SMPS applications. IR gate drivers use a patented level shifter technology for high voltage applications and offer the only 1200V rating in the industry.





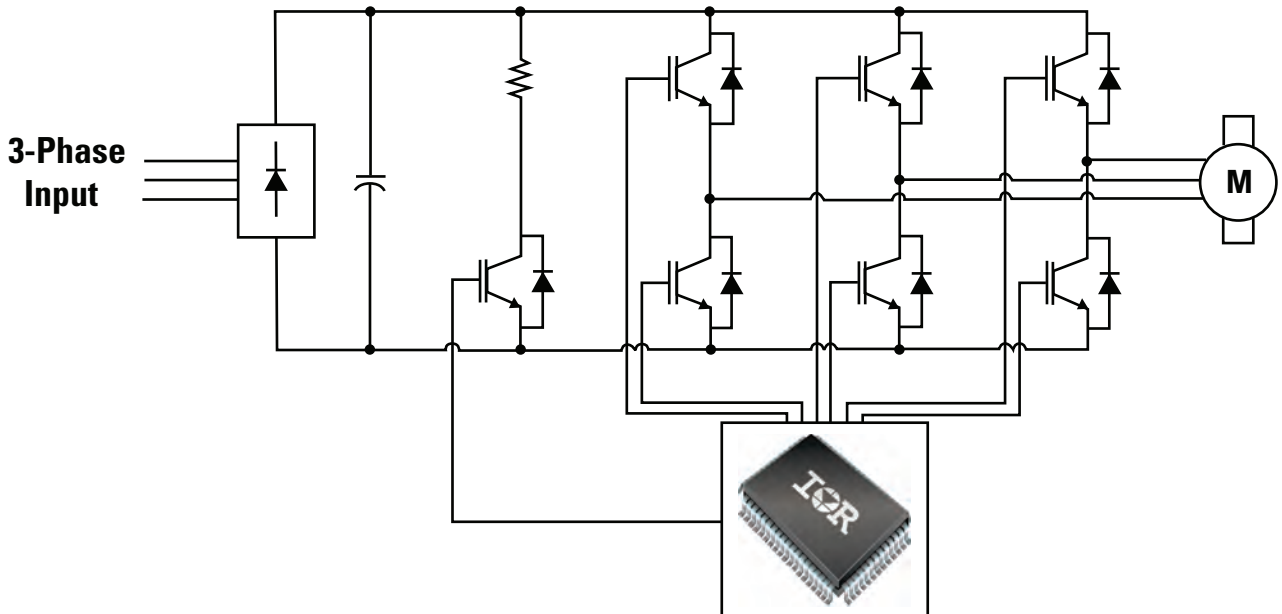
Features at a Glance

- 600V and 1200V gate driver in a single IC for MOSFET and IGBTs
- Multiple configurations
- Single high side
- Half-bridge
- 3 phase inverter driver
- Up to +2.0/-2.0A output source/sink current enables fast switching
- Integrated protection and feedback functions
- Optional deadtime control
- Tolerant to negative voltage transient
- Up to 50V/ns dV/dt immunity
- Optional soft turn-on
- Uses low cost bootstrap power supply
- CMOS and LSTTL input compatible

IR Gate Driver ICs Simplify Design (continued)

These ICs simplify circuit designs by integrating extensive functionality. They use a low cost bootstrap supply, while opto-coupler-based circuits typically require an auxiliary power supply. IR Gate Driver ICs offer optional single input or dual input programmable deadtime control for low-side and high-side drivers as well as for 3-phase drivers to provide design flexibility and minimize cross-conduction.

Typical HVIC application circuit



3-Phase Drivers								
	(units)	IR2130	IR2131	IR2132	IR2133	IR2135	IR2136	IR2136Z
Offset voltage	V	600	600	600	600	600	600	600
General purpose comparator input	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hard shutdown	-	No	No	No	Yes	Yes	No	No
Overcurrent shutdown (ITRIP)	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Input logic for shutdown (SD Pin)	-	No	Yes	No	Yes	Yes	No	No
INPUT LOGIC								
Logic compatibility	V	2.5	2.5	2.5	2.5	2.5	3.3	3.3
HIN, LIN	-	Yes	Yes	Yes	Yes	Yes	Yes	
HIN, LIN	-							Yes
OUTPUT								
V _{out}	V	10-20	10-20	10-20	10-20,12-20	10-20,12-20	10-20	11.5-20
Output high short circuit pulsed current	mA	200	250	200	250	250	200	200
Output low short circuit pulsed current	mA	420	500	420	500	500	350	350
UVLO								
V _{bs} UVLO positive going threshold	V	8.35	8.7	8.35	8.6	10.4	8.9	10.4
V _{bs} UVLO negative going threshold	V	7.95	8.3	7.95	8.2	9.4	8.2	9.4
V _{bs} UVLO hysteresis	V	-	-	-	0.4	1	0.7	1
V _{cc} UVLO positive going threshold	V	9	8.7	9	8.6	10.4	8.9	10.4
V _{cc} UVLO negative going threshold	V	8.7	8.3	8.7	8.2	9.4	8.2	9.4
V _{cc} UVLO lockout hysteresis	V	-	-	-	0.4	1	0.7	1
TIMING								
Turn-on propagation delay	ns	675	1300	675	750	750	425	425
Turn-off propagation delay	ns	425	600	425	700	700	400	400
Shutdown propagation delay (SD Pin)	ns		700		750	750		
Turn-on rise time	ns	80	80	80	90	90	125	125
Turn-off rise time	ns	35	40	35	40	40	50	50
Delay matching, HS & LS turn-on/off (MT)	ns						40	40
Dead-time	ns	2500	700	800	250	250	290	290
Dead-time matching (MDT)	ns						25	25
ITRIP to output shutdown propagation delay	ns	660	700	660	850	850	750	750
ITRIP blanking time	ns	400	400	400	400	400	150	150
ITRIP to (FAULT) propagation delay	ns	590	700	590	650	650	600	600

3-Phase Drivers, cont.								
	(units)	IR21363	IR21365	IR21366	IR21367	IR21368	IR2233	IR2235
Offset voltage	V	600	600	600	600	600	1200	1200
General purpose comparator input	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hard shutdown	-	No	No	No	No	No	Yes	Yes
Overcurrent shutdown (ITRIP)	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Input logic for shutdown (SD Pin)	-	No	No	No	No	No	Yes	Yes
INPUT LOGIC								
Logic compatibility	V	3.3	3.3	3.3	3.3	3.3	2.5	2.5
HIN, LIN	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HIN, LIN	-							
OUTPUT								
V _{out}	V	12-20	12-20	12-20	12-20	10-20	10-20,12-20	10-20,12-20
Output high short circuit pulsed current	mA	200	200	200	200	200	250	250
Output low short circuit pulsed current	mA	350	350	350	350	350	500	500
UVLO								
V _{bs} UVLO positive going threshold	V	11.1	11.1	11.1	11.1	8.9	8.6	10.4
V _{bs} UVLO negative going threshold	V	10.9	10.9	10.9	10.9	8.2	8.2	9.4
V _{bs} UVLO hysteresis	V	0.2	0.2	-	-	-	0.4	1
V _{cc} UVLO positive going threshold	V	11.1	11.1	11.1	11.1	8.9	8.6	10.4
V _{cc} UVLO negative going threshold	V	10.9	10.9	10.9	10.9	8.2	8.2	9.4
V _{cc} UVLO lockout hysteresis	V	0.2	0.2	-	-	-	0.4	1
TIMING								
Turn-on propagation delay	ns	425	425	250	250	425	750	750
Turn-off propagation delay	ns	400	400	180	180	400	700	700
Shutdown propagation delay (SD Pin)	ns						750	750
Turn-on rise time	ns	125	125	125	125	125	90	90
Turn-off rise time	ns	50	50	50	50	50	40	40
Delay matching, HS & LS turn-on/off (MT)	ns	40	40	40	40	40		
Dead-time	ns	290	290	290	290	290	250	250
Dead-time matching (MDT)	ns	25	25	25	25	25		
ITRIP to output shutdown propagation delay	ns	750	750	750	750	750	850	850
ITRIP blanking time	ns	150	150	150	150	150	400	400
ITRIP to (FAULT) propagation delay	ns	600	600	600	600	600	650	650

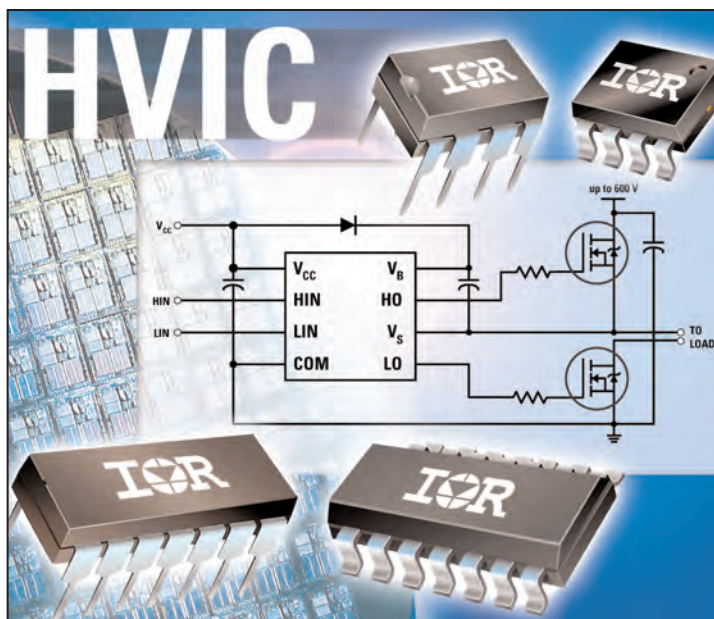
PRODUCT FAMILIES | High Voltage ICs

The IR Advantage

- Dead-time as low as 500ns allows frequency up to 100kHz
- Increases speed range and torque control of motor drives
- Enable rugged gate drive design
- Low power dissipation
- Compared with opto-coupler based solutions:
- 30% fewer parts and 50% smaller PCB
- Doesn't need auxiliary power supply
- 10X faster delay matching ($\pm 50\text{ns}$)
- No degradation of performance over time
- Shorter time to signal over-current $1.5\mu\text{s}$ versus $6\mu\text{s}$
- Reduced EMI and voltage spikes

Applications

- Motor Drive
- Lighting Ballast
- Switched Mode Power Supplies
- Automotive
- Plasma Display Panels



HVICs with advanced over-current detection and protection circuitry

	(units)	Half-Bridge				3-Phase		
		IR2114	IR21141	IR2214	IR22141	IR21381	IR2238	IR22381
Offset voltage		600	600	1200	1200	600	1200	1200
Brake		No	No	No	No	Yes	Yes	Yes
General purpose comparator input		No	No	No	No	No	No	No
Programmable deadtime		No	No	No	No	Yes	Yes	Yes
Desat detection circuit	V	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Active bias (desat)		No	Yes	No	Yes	Yes	No	Yes
Soft shutdown (desat)		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hard shutdown		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Input logic for shutdown (SD Pin)		No	No	No	No	Yes	Yes	Yes
Logic Compatibility		2.5	2.5	2.5	2.5	2.5	2.5	2.5
HIN, LIN	V					Yes	Yes	Yes
HIN, LIN		Yes	Yes	Yes	Yes			
V_{out}	V	10.4-20	10.4-20	10.4-20	10.4-20	12.5-20	12.5-20	12.5-20
Output high short circuit pulsed current	mA	2000	2000	2000	2000	350	350	350
Output low short circuit pulsed current		3000	3000	3000	3000	540	540	540
V_{ds} UVLO positive going threshold	V	10.2	10.2	10.2	10.2	11.2	11.2	11.2
V_{ds} UVLO negative going threshold		9.3	9.3	9.3	9.3	10.2	10.2	10.2
V_{ds} UVLO hysteresis		0.9	0.9	0.9	0.9	1	1	1
V_{cc} UVLO positive going threshold		10.2	10.2	10.2	10.2	11.2	11.2	11.2
V_{cc} UVLO negative going threshold		9.3	9.3	9.3	9.3	10.2	10.2	10.2
V_{cc} UVLO lockout hysteresis		0.9	0.9	0.9	0.9	1	1	1
Turn-on propagation delay		440	440	440	440	550	550	550
Turn-off propagation delay		440	440	440	440	550	550	550
Shutdown propagation delay (SD Pin)						600	600	600
Turn-on rise time	ns	24	24	24	24	80	80	80
Turn-off rise time		7	7	7	7	25	25	25
Dead-time		330	330	330	330	100-5000	100-5000	100-5000
Dead-time matching (MDT)		75 (max)	75 (max)	75 (max)	75 (max)	125 (max)	145 (max)	125 (max)
High desat input threshold voltage	V	8	8	8	8	8	8	8
Low desat input threshold voltage		7	7	7	7	7	7	7
Desat input voltage hysteresis		1	1	1	1	1	1	1
High DSH or DSL input bias current	μA	21	21	21	21	15	15	15
Low DSH or DSL input bias current		-160	-160	-160	-160	-150	0.1	-150
DSH or DSL input bias current			-20		-20	-11.1		-11.1
BR output high short circuit pulsed current	mV					70	70	70
BR output low short circuit pulsed current						125	125	125
BR high level output voltage						6000	300	6000
BR low level output voltage						3000	150	3000

PRODUCT FAMILIES | iPOWIR Multi-Chip Modules



Multi-chip modules, like the iPOWIR™ intelligent scalable building blocks integrate critical power, drive and control silicon, simplify design while raising the efficiency and current density of on-board power converters for the latest generation of low-voltage processors in single- and multiphase topologies. IR's expertise in device matching and "short trace" layout deliver this optimized solution that combines multiple power semiconductors, ICs, and passive components into a single package. The iPOWIR MCMs require less development effort than discrete approaches.

Features at a Glance:

Full-featured: All power semiconductors and analog control & driver IC integrated in one solution to complete a synchronous buck converter

Multiphase: All the power semiconductors and analog driver ICs to complete a power stage for a multiphase buck converter.

iPOWIR™ Benefits

- Reduces part count up to 90%
- Very small form factor: up to 60% smaller than discrete equivalent
- Single-phase single output, dual output and multiphase options
- Internal features minimize layout sensitivity
- Reduced time-to-market
- Guaranteed power loss

Full-Feature Devices Include:

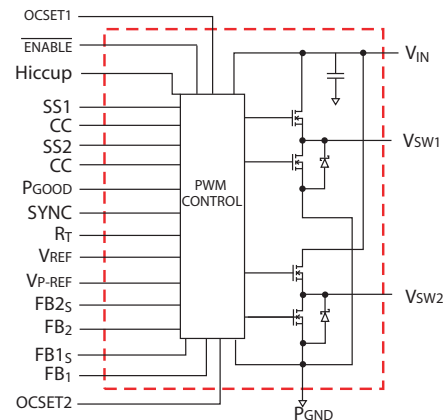
- Over-current hiccup or latch mode
- External synchronization pin
- Independent soft start pins
- Over-voltage protection
- Over-temperature protection

Full-Feature Device Applications:

Non-isolated point-of-load buck converters:

- FPGAs & ASICs with dual logic (core & I/O)
- Peripheral rails in close proximity (low power 15A)
- Single POL (mid power <30A)
- Distributed Power Architecture (DPA) or DC Bus converter 2nd stage POL converters

Simplified Device Diagram



SPECIFICATIONS

Part Number	Package	V _{IN} (min/max)	V _{OUT}	I _{OUT} -Double sided heatsinking	Frequency
iP1201	BGA 9.25 mm x 15.5mm x 2.6 mm	3.14V - 5.5V	0.8V-2.5V for 3.3V _{IN} 0.8V-3.3V for 5V _{IN}	15A dual 30A single	200 - 400kHz
iP1202	BGA 9.25 mm x 15.5mm x 2.6 mm	5.5V - 13.2V	0.8V-5V for 12V _{IN} 0.8V-3.3V for <6V _{IN}	15A dual 30A single	200 - 400kHz
iP1203	LGA 9 mm x 9 mm x 2.3 mm	5.5V - 13.2V	0.8V-8.0V for 12V _{IN}	15A dual	200 - 400kHz
iP1206	LGA 15 mm x 9.25 mm x 1.97 mm	7.5V - 14.5V	0.8V-5.5V for 12V _{IN}	30A dual	200 - 600kHz

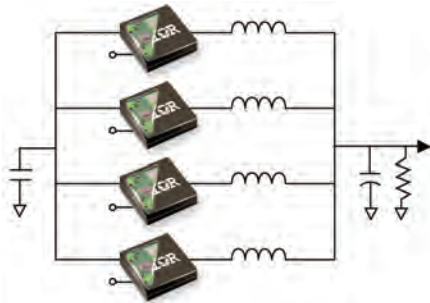
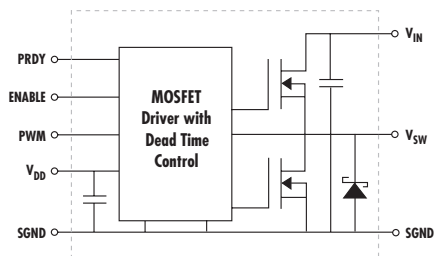
Multiphase Devices Include:

- Up to 40A capability
- 300-1000 kHz frequency
- Up to 92% efficiency

Multiphase Applications:

- High-current multiphase synchronous buck converters to power CPUs in server and desktop computing
- Network processing units (NPUs) and application-specific ICs (ASICs) used in networking, telecom switchers and routers

Multiphase iPOWIR™ Power Stage



The iP200x series family is a functional “building block” for multiphase buck converters which are used to power GHz class CPUs in high-end computing and communications systems. Based on International Rectifier’s *iPOWIR™* technology, the iP200x integrates the power semiconductors, a driver IC and layout-critical passives required for each phase of a multiphase synchronous buck converter into a single package. These products are offered in either ball grid array (BGA) or land grid array (LGA).

GHz class CPUs and high end ASICs require lower voltages, higher currents and faster transient response, all this in reduced solution footprints. By increasing switching frequency, the external passives can be reduced in size and quantity and transient response can be improved. However, increased emphasis on power density and higher operating frequencies can lead to greater layout challenges and higher parasitic losses.

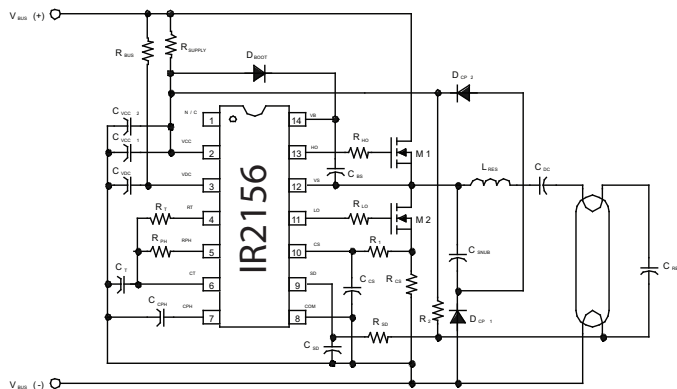
The *iPOWIR* technology platform at International Rectifier capitalizes on proprietary leadless multi-chip packaging, opening the doors to new levels in power density and enabling the performance required by future converters. The *iPOWIR* technology is an example of IR’s power management expertise in all areas and is much more than simply integrating functions. Benchmark power semiconductors are matched with control ICs, optimized packaging and advanced system design. Only when all of these aspects are combined can complete functionality be bundled into a tiny, easy to design solution.

Integration reduces parasitic losses enabling the iP200x to achieve higher efficiency at full-load, while the tiny BGA and LGA packages helps reduce solution footprint. Design time and effort are reduced because one iP200x device replaces up to 10 discrete components per phase, significantly reducing part count. The iP200x requires only a multiphase PWM IC, input and output capacitors and output inductors to enable the design of a fully functional multiphase buck converter.

SPECIFICATIONS

Part Number	Package	V _{IN} (min/max)	V _{DD}	V _{OUT} (min/max)	I _{OUT} (max)	Frequency
iP2001	BGA 11 mm x 11mm x 3 mm	5V - 12V	5V	0.8V-2.5V	20A	250 - 1000kHz
iP2002	BGA 11 mm x 11mm x 2.6 mm	2.5V - 12V	5V	0.8V-5V	30A	250 - 1000kHz
iP2003A	LGA 11 mm x 9 mm x 2.2 mm	3V - 13.2V	5V	0.8V-8.0V	40A	300 - 1000kHz
iP2005A	LGA 7.7 mm x 7.7 mm x 1.7 mm	6.5V - 13.2V	5V	0.8V-5.5V	40A	250 - 1500kHz

PRODUCT FAMILIES | Fluorescent Lighting ICs



Fluorescent Lighting

Fluorescent lighting is used everywhere in our day-to-day lives, from consumer lighting to architectural lighting. High Voltage ICs are an integral part of electronic ballasts, and IR has a product offering to match your requirements.

For example, Fluorescent Ballast ICs feature:

- **Dimming and non-dimming versions**
- **Handle all lamp types**
- **Easy design, minimize component count**

International Rectifier ICs are designed to meet the ballast load requirements for most applications, from real life to abnormal conditions.

IR P/N	Description						
IRS2153D	The IRS2153D is an improved version of the popular IR2153 gate driver IC, and incorporates an internal bootstrap diode as well as a 2V under-voltage lockout hysteresis.						
IR2520D	600V Ballast Controller IC with Adaptive Zero-Voltage Switching, Internal Crest Factor Over-Current Protection and an Integrated Bootstrap Diode in a 8-Pin Dip package.						
IR2156	High voltage half-bridge gate driver with a programmable oscillator and state diagram to form a complete ballast control IC including programmable features and built-in protection.						
IR21571	Fully integrated, fully protected 600V ballast control IC designed to drive fluorescent and HID Lamps.						
IR21592/IR21593	Complete dimming ballast controllers and 600V half-bridge drivers all in one IC.						
IRS2166D	The IRS2166D is an improved version of the IR2166; it's a fully integrated, protected 600V ballast control IC designed to drive fluorescent HID lamps with PFC in a 16-pin package.						
IRS2168D	The IRS2168D is a fully integrated protected 600V ballast control IC designed to drive fluorescent lamps with PFC in 16-Pin package. Designed for universal input and/or multi-lamp ballast applications.						
Programmability	IRS2153D	IR2520D	IR2156	IR21571	IR21592/3	IRS2166D	IRS2168D
Preheat Time	–	Yes	Yes	Yes	Yes	Yes	Yes
Preheat Frequency	–	–	Yes	Yes	–	Yes	Yes
Closed Loop Preheat Current	–	–	–	–	Yes	–	–
Closed Loop Ignition Current	–	–	–	–	–	–	Yes
Run Frequency	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deadtime	–	–	Yes	Yes	–	Yes	–
Features	IRS2153D	IR2520D	IR2156	IR21571	IR21592/3	IRS2166D	IRS2168D
Fixed Deadtime	1.1µs	1.5µs	–	–	1.8/1.0µs	–	1.6µs
Over-current Protection	–	Yes	Yes	Yes	Yes	Yes	Yes
Under-current Protection	–	–	–	Yes	–	–	–
Failure to Strike	–	Yes	Yes	Yes	Yes	Yes	Yes
Open Filament	–	Yes	Yes	Yes	Yes	Yes	Yes
Brownout Protection	–	Yes	Yes	Yes	Yes	Yes	Yes
Thermal Overload Protection	–	–	–	Yes	Yes	–	–
Shutdown Pin	–	–	Yes	Yes	Yes	Yes	Yes
Dimming	–	–	–	–	Yes	–	–
Ignition Detection	–	–	–	–	Yes	–	–
Fault Counter	–	–	–	–	–	–	Yes
End-of-Life Protection	–	–	–	–	–	Yes	Yes
PFC Over-Current	–	–	–	–	–	–	Yes
Integration	IRS2153D	IR2520D	IR2156	IR21571	IR21592/3	IRS2166D	IRS2168D
Bootstrap Diode	Yes	Yes	–	–	–	Yes	Yes
PFC	–	–	–	–	–	Yes	Yes
Current Sensing using VS sensing	–	Yes	–	–	–	–	–
Package	IRS2153D	IR2520D	IR2156	IR21571	IR21592/3	IRS2166D	IRS2168D
DIP & SOIC	8 pin	8 pin	14 pin	16 pin	16 pin	16 pin	16 pin



IRS2540

- 200V half-bridge driver IC
- Micropower startup (<500mA)
- 3% voltage reference
- 140ns deadtime
- 15.6V Zener clamp on Vcc
- Frequency up to 500 kHz
- Auto restart, non latched shutdown
- PWM dimmable

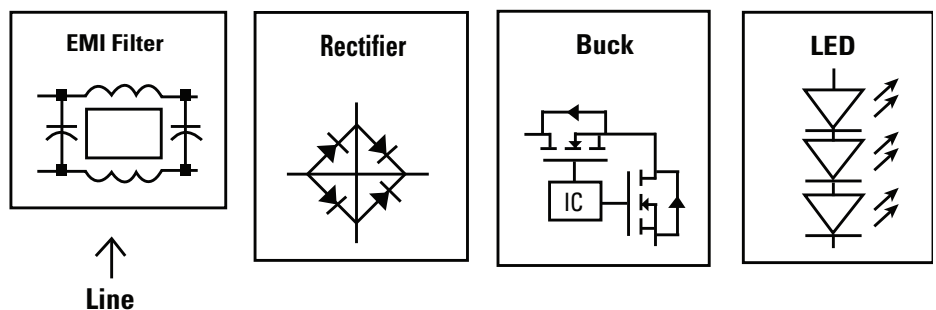
IRS2541

- 600V half-bridge driver IC
- Micropower startup (<500mA)
- 3% voltage reference
- 140ns deadtime
- 15.6V Zener clamp on Vcc
- Frequency up to 500 kHz
- Auto restart, non latched shutdown
- PWM dimmable



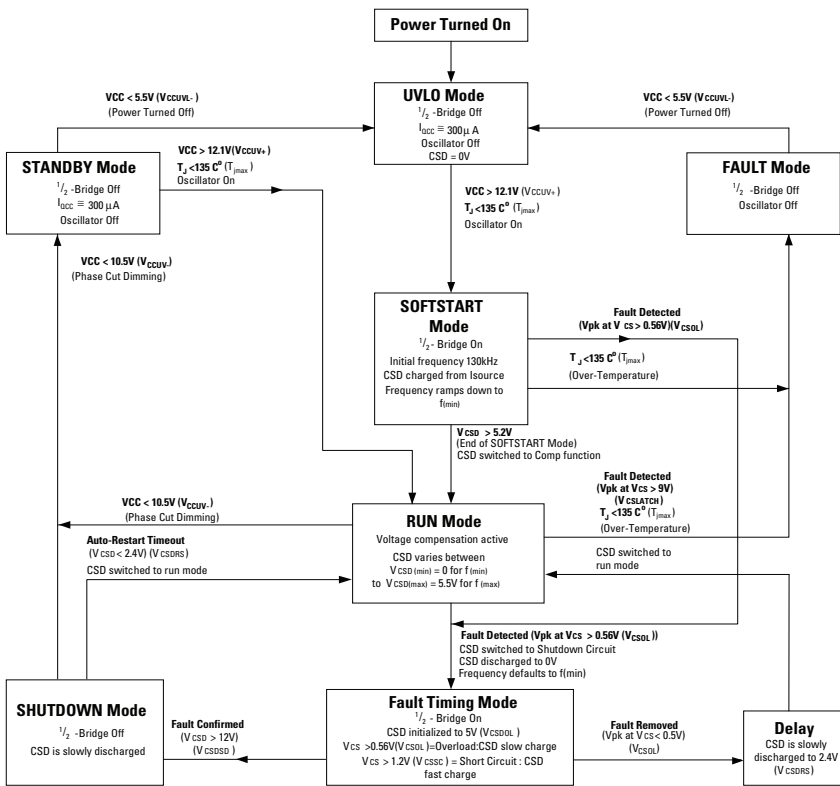
LED Lighting Solution 3

HB-LEDs feature huge longevity, low maintenance requirement, small size, design flexibility, decorative effect capability, safe low DC voltage operation, excellent cold weather performance, lack of mercury, superior color gamut and brightness are making LEDs extremely popular. IR offers dedicated control ICs which can use at best all the LEDs features either in a DC-DC environment or directly off-line. Furthermore IR ICs offers a high degree of integration, minimizing the design time needed and increasing system reliability.



Specifications:

Part Number	Package	Voltage	load current regulation	Micro-power Start-up	Deadtime	Frequency
IRS2540xPbF	DIP8,S08	200	+/-5%	<500 μA	140ns	<500kHz
IRS2541xPbF	DIP8,S08	600	+/-5%	<500 μA	140ns	<500kHz



Features at a Glance

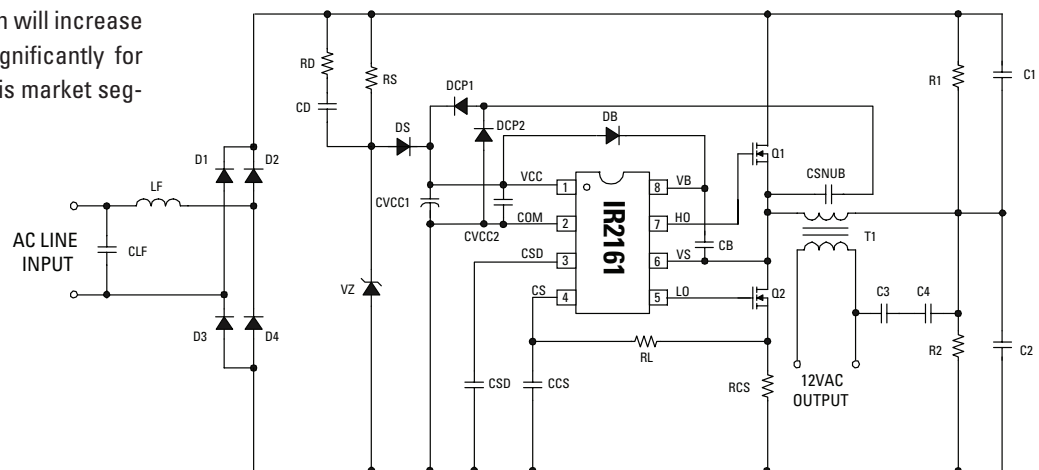
IR2161 Halogen

- Intelligent Half Bridge Driver
- Auto Resetting Short Circuit Protection
- Auto Resetting Overload Protection
- Latching Over-temperature Protection
- Frequency Wobble (for better EMI)
- Micropower Startup ($150\mu A$)
- Phase Cut dimmable for Leading/Trailing Edge
- Output Voltage Shift Comp. (Longer Lamplife)
- Real Soft-start (prevents overdriving the lamp)
- Adaptive Dead Time
- Small 8Pin- DIP/SOIC Package

The World's First Halogen Converter IC

The halogen segment of the market has also been challenging due to the existing self-oscillating solution and the extreme cost pressure. With the right technology, this market can also accept an IC-based solution. This market suffers greatly from reliability and performance issues. Electronic transformers frequently become damaged due to over-load and short-circuit fault conditions. Also, they must be able to dim the halogen lamps smoothly and continuously using a standard phase-cutting triac wall dimmer. The challenge is to provide extensive protection features, lamp voltage regulation and dimming, in a single 8-pin IC. The resulting IR2161 halogen solution is a simple and elegant design that reduces overall component count and delivers a higher performance. The adoption of an IC + MOSFET solution will increase manufacturability and reliability significantly for these products and help to grow this market segment further as well.

Typical Connections



Halogen Lighting ICs

IR P/N	Description
IRS2153D	The IRS2153D is an improved version of the popular IR2153 gate driver IC, and incorporates a internal bootstrap diode as well as a 2V under voltage lockout hysteresis.
IR2161	Halogen Converter Control IC in a 8-lead PDIP package, Features Auto Resetting Short Circuit Protection, Auto Resetting Overload Protection, Overtemperature Protection, Phase Cut Dimmable, Adaptive Deadtime, Output Voltage Shift Compensation and Softstart.

Programmability	IRS2153D	IR2161
Run Frequency	YES	–
Features	IRS2153D	IR2161
Soft Start	–	●
Fixed Deadtime	1.1µs	–
Adaptive Deadtime	–	●
Over-Current Protection	–	●
Adjustable Over-current	–	●
Thermal Overload	–	●
Auto-resetting Short Circuit Protection	–	●
Auto-resetting Overload Protection	–	●
Frequency wobble for better EMI	–	●
Frequency shift Output Voltage Regulation	–	●
Integration	IRS2153D	IR2161
Bootstrap Diode	YES	–
Package	IRS2153D	IR2161
DIP & SOIC	8 pin	8 pin



HID Lighting Solutions

Thanks to key advantages over other light sources (high lumen output, long life, color rendering and “point of light”), HID lamps are gaining in popularity in the industrial world. From few tens of watts for shop lights, to several hundreds of watts for street lighting, IR ICs offer a high degree of integration, minimizing the design time needed and increasing ballast reliability. The traditional industrial topology includes a PFC front-end, a buck converter to regulate the current, and a full-bridge switching a 50% inverting the polarity.

PFC Front End

IR1150: The IR1150 uses a new, patented “One-Cycle Control, integrator with reset technique to deliver the high performance of Continuous Conduction Mode (CCM) PFC with the simplicity and low component count of Discontinuous Current Mode (DCM).

Buck Stage

IRS2117/18: single high-side driver, that allows an easy single drive (1 switch).

IRS21844: thanks to its programmable dead time as well as high current capability (1,5A), the IRS21844 eases the design of a synchronized buck (2 switches) for high power ranges.

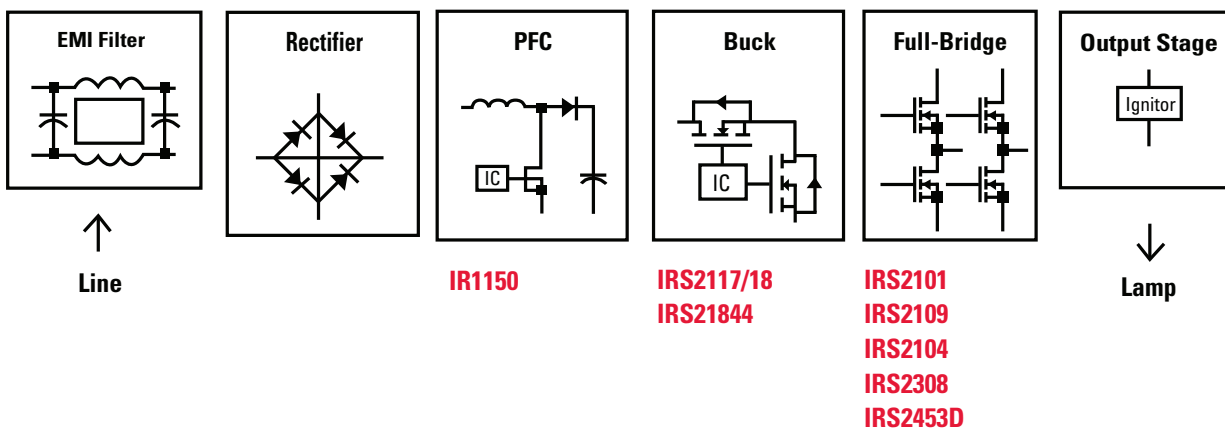
Full-Bridge

IRS2453D: a self-oscillating full-bridge driver with 50% duty cycle, that replaces synchronized IRS2153D.

IRS2101, IRS2109, IRS2104, IRS2308:

If the control circuitry provides the PWM signals, one of IR’s robust high and low side or half-bridge drivers can also be used, depending on drive current capabilities.

LIGHTING HID

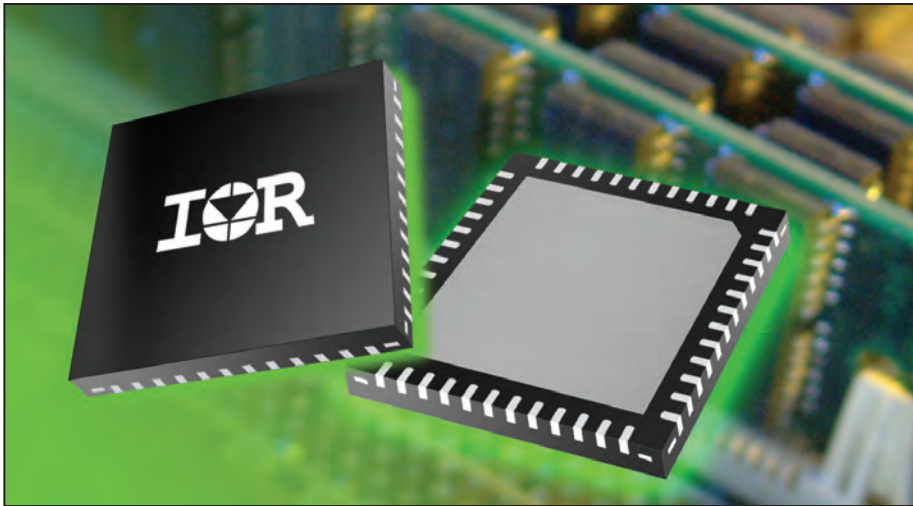


HID Lighting ICs

Buck Stage	Description
IRS2117/18	Single high side driver, that allows an easy single drive (1 switch).
IRS21844	Thanks to its programmable dead time as well as high current capability (1,5A), the IRS21844 eases the design of a synchronized buck (2 switches)

Full Bridge	Description
IRS2453D	A self-oscillating full bridge driver with 50% duty cycle, that replaces 2x IRS2153D: two synchronized half-bridge drivers, used in a full bridge configuration. If the control circuitry provides the PWM signals, one of IR's robust high and low side or half-bridge drivers like IRS2101, IRS2109, IRS2104, IRS2308 can also be used, depending on drive current capabilities as well as topology.

IR P/N	Description - PFC Stage
IR1150	Continuous conduction mode PFC controller
IR P/N	Description - Buck Stage
IRS2117	Single high side driver, 600V - 200 / 400mA
IRS21844	Half-bridge driver, 600V 1.9 / 2.3A
IR P/N	Description - Full Bridge Stage
IRS2453D	Self-oscillating full bridge driver with 50% duty cycle, 600V - 180 / 260mA
IRS2101	High and low side driver, 600V - 130 / 270mA
IRS2308	High and low side driver, 600V - 200 / 350mA
IRS2104	Half-bridge driver - 600V, 130 / 270mA - SD
IRS2109	Half-bridge driver - 600V, 120 / 250mA - SD - VBS UVLO



Exponential growth in the requirements for higher current at lower operating voltages has created a rough road for designers of DC-DC power management systems. International Rectifier has focused the power semiconductor industry's largest R&D effort to implement a roadmap for high performance and cost-effective DC-DC power management. IR's extensive discrete and IC portfolio makes IR the only power semiconductor company with a product for every power management socket on today's computing PCB. IR DC-DC solutions extend to telecom, datacom, networking and peripherals requirements.

Voltage regulators provide clean regulated voltages to various loads such as micro-processors, micro-controllers, memory chips, low-voltage logic circuits and drivers while offering protection and filtering from electrical transients and noise.

Features at a Glance

PWM Controller ICs:

- Single or multiphase topology
- Current sharing for design flexibility (IR3621)
- On-chip MOSFET drivers

The IR Advantage

- One source for voltage regulator ICs and power semiconductors
- Combine with IR HEXFET® power MOSFETs for high-efficiency solution

Applications

- Desktops & servers
- DDR memory
- Networking and telecom
- Consumer electronics
- Graphics cards

DC - DC Switching Regulators

Part Number	Package	V _{CC} (min/max)	V _{OUT} (min)	V _{OUT} (max)	I _{OUT}	Frequency
IR3638S	14-Pin SOIC (NB)	4.0 / 25	*	*	*	Internal 400kHz
IR3629A	12-Lead MLPD	4.0 / 30	*	*	*	Internal 600kHz
IR3628M	12-Lead MLPD	4.0 / 14	0.6	V _{CC} * 0.71	*	Internal 600kHz
IR3624M	10-Lead MLPD	4.0 / 14	0.6	V _{CC} * 0.71	10	Internal 600kHz
IR3637AS	8-Pin SOIC(NB)	4.0 / 25	0.8	V _{CC} * 0.85	15	Internal 600kHz
IR3637S	8-Pin SOIC(NB)	4.0 / 25	0.8	V _{CC} * 0.85	15	Internal 400kHz
IRU3037CF	8-Pin TSSOP	4.0 / 25	1.25	V _{CC} * 0.96	16	200kHz
IR3629	12-Lead MLPD	4.0 / 30	*	*	*	Internal 300kHz
IRU3037CS	8-Pin SOIC(NB)	4.0 / 25	1.25	V _{CC} * 0.96	16	200kHz
IR3651S	14-Pin SOIC (NB)	4.5 / 13.2	*	*	25	programmable to 400kHz
IRU3037ACF	8-Pin TSSOP	4.0 / 25	0.8	V _{CC} * 0.95	15	400kHz
IRU3037ACS	8-Pin SOIC(NB)	4.0 / 25	0.8	V _{CC} * 0.95	15	400kHz
2-Phase, 2-Channel						
IR3621	28-pin TSSOP	4.7 / 16	0.8	V _{CC} * 0.90	60	300kHz
IR3622	32-lead MLPQ	4.5 / 16	0.8	V _{CC} * 0.85	80	600kHz

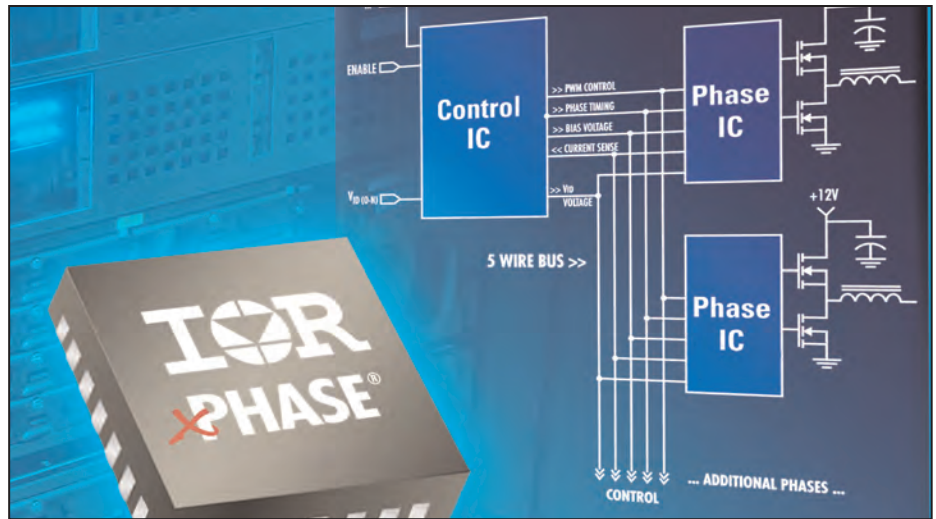
Features at a Glance

Control ICs

- Support both VR11 & 8bit VID and extended VR10 7bit VID Code
- 5-bit AMD Opteron™ compatible VID
- Programmable dynamic VID slew rate
No discharge of output capacitors during dynamic VID step-down (can be disabled)
- Programmable 150kHz to 1MHz oscillator
- Programmable voltage positioning
- Programmable softstart
- Programmable hiccup over-current protection with delay to prevent false triggering
- Simplified powergood provides indication of proper operation and avoids false triggering
- Operates from 12V input.
IR3082A from 9.5V input
- 6.8V/5mA bias regulator provides system reference voltage
- Enables input

Phase ICs

- 2.5A average gate drive current
- Loss-less inductor current sense
- Internal inductor DCR temperature compensation
- Programmable phase delay
- Programmable feed-forward voltage mode PWM Ramp
- 1MHz per-phase operation
- Current sense amplifier drives a single wire average current share bus
- Current share amplifier reduces PWM ramp slope to ensure sharing between phases
- Body braking disables synchronous MOSFET for improved transient response and prevents negative output voltage at converter turn-off
- OVP comparator with 100ns response (not included in IR3088A)
- Phase fault detection (Optiphase™ in IR3087)
- Programmable phase over-temperature detection



The Scalable, Flexible Multiphase Architecture

The XPhase chip set consists of the control IC, containing all the one-per-converter circuitry, and a scalable array of phase converters, each using a single phase IC with all the one-per-phase circuitry.

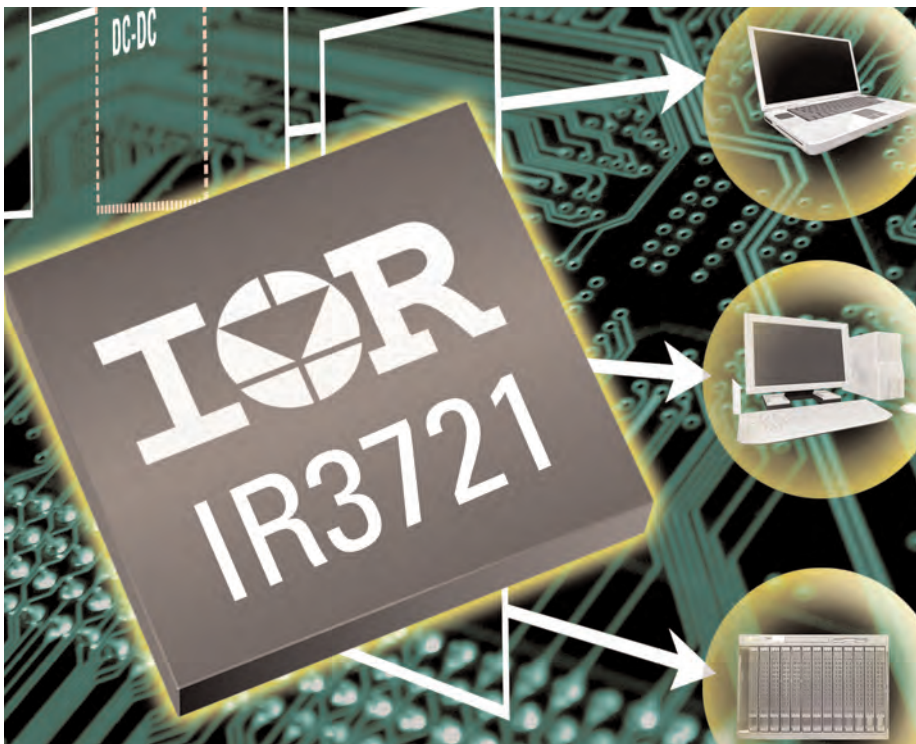
Applications

- Voltage regulators for CPUs in workstations and servers
- High current NPUs in networking equipment

The IR Advantage

- Offers unprecedented flexibility and scalability to support one-to-X phase operation.
- Incorporates unique body braking to achieve dramatic improvements in transient response time while improving efficiency.
- Implements novel control and average output inductor current sensing to accomplish very accurate current sharing with support for 100% duty cycle and over-lapping phases. In addition, it supports single cycle transient response.

Part #	Function	Package	Applications
IR3082	AMD Opteron™ Control IC	20L MLPQ 5x5mm	Controller for AMD Opteron-based servers
IR3082A	9.6V AMD Opteron™ Control IC	20L MLPQ 5x5mm	Controller for AMD Opteron-based servers
IR3510M	HotSwap N+1 Control IC	32L MLPQ 5x5mm	Ideal for powering high availability CPUs and servers in fault tolerant applications where live insertion is required
IR3084A	VR10, VR11 Control IC	28L MLPQ 4x4mm	Control IC for VR10, VR11
IR3084U	VR10, VR11 Control IC	28L MLPQ 4x4mm	Control IC for VR10, VR11 for AMD Opteron
IR3514MPBF	PVID/SVID Control IC	40L MLPQ 6x6mm	AMD Processors with Parallel or Serial VID interface for voltage programming
IR3502M	INTEL® VR11.0, VR11.1 Control IC	32L MLPQ 5X5mm	Intel VR11.0 and VR11.1 based designs
IR3086A	Phase IC with integrated phase fault detect and VR-HOT	20L MLPQ 4x4mm	Phase IC for industrial PCs, workstations and servers
IR3087	Phase IC with integrated VR-HOT and Optiphase™ technology	20L MLPQ 4x4mm	Suitable for applications which require ability to turn off phases for improved light load efficiency
IR3088A	Phase IC with integrated VR-HOT and phase fault defect	20L MLPQ 4x4mm	Suitable for applications requiring output voltages up to 5V
IR3507MPBF	PVID/SVID Phase IC	20L MLPQ 4x4mm	AMD Processors with Parallel or Serial VID interface for voltage programming



Features at a Glance

- Accurate TruePower™ monitor
 - 2.5% static accuracy at 65°C
 - Minimizes dynamic errors
- Minimizes power dissipation
- Versatile
 - Monitors both power or current at DC-DC converter output
 - Single phase or multiphase low voltage buck converters (0.5 – 1.8 V)
 - Inductor DCR or resistive shunt sensing
- Simple add-on to existing converters
- 10 pin 3x3 DFN lead free package
- RoHS compliant

Benefits

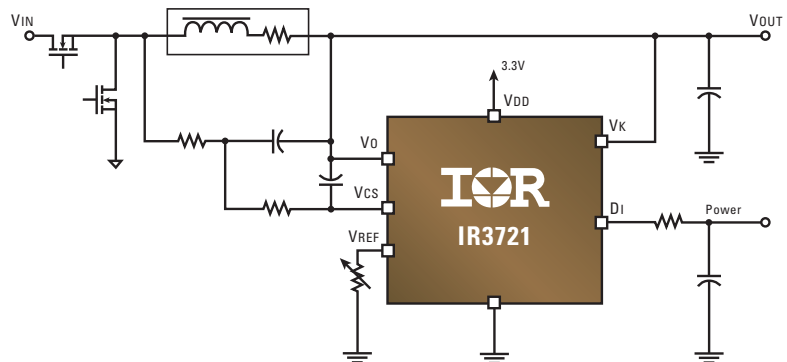
- Accurately reflects dynamic and static power
- Maximizes system performance
 - Within a given power envelope
- Predicts the thermal environment
- Minimizes system power dissipation

Real-time Power Monitoring IC

The IR3721 output power monitor IC for low-voltage DC-DC converters used in notebook, desktop computers, and energy-efficient server applications, utilizes IR’s patent-pending TruePower™ technology to accurately capture highly dynamic power information with 2.5 percent accuracy at 65°C.

The IR3721 measures dynamic power at the output/load side of voltage regulators to deliver a significant improvement in dynamic power measurement accuracy compared to competing power monitor ICs. TruePower™ technology addresses dynamic errors which can account for more than a 30% error in competing solutions which monitor voltage and current separately in dynamic conditions with independent A/D conversion.

The IR3721 power monitor IC monitors the output filter inductor current in a buck or multiphase converter from 0.5 V to 1.8 V and provides the options of using resistive sensing or inductor DCR current sensing with an internal thermal compensation feature to achieve one percent higher efficiency compared to existing solutions while reducing bill of materials and board size requirements.



Specifications

Part Number	Static Accuracy	VK range	VCS range	Bias Supply Voltage	Operating Temperature	Package
IR3721MTRPBF	2.5% @ 65°C	0.5 – 1.8 V	5 mV - 150 mV	+3.3V +/- 5%	0 °C to 125 °C	10 L 3x3 DFN

Features at a Glance

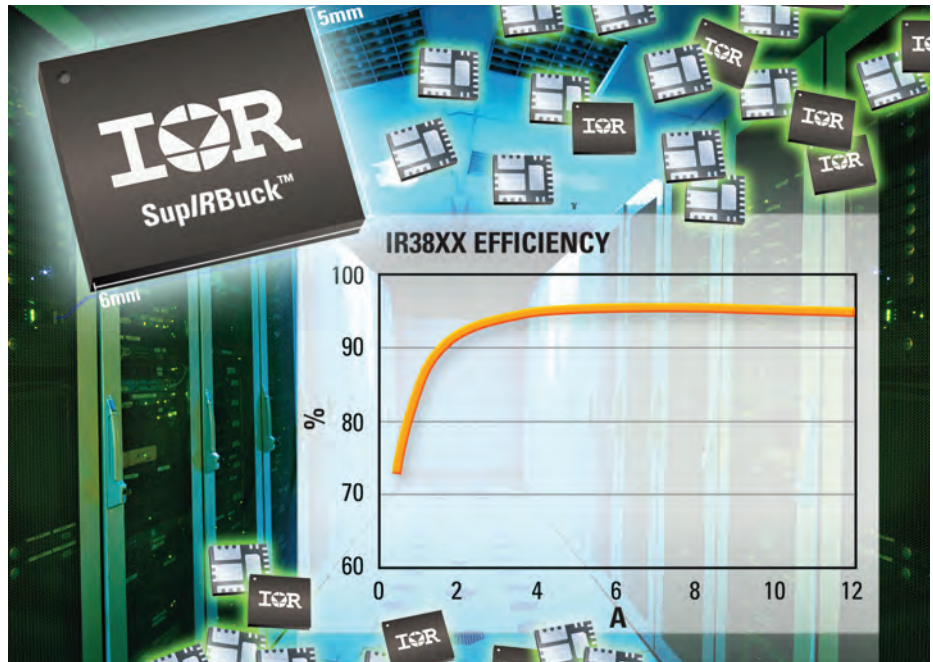
- 600kHz switching frequency
- 4A/7A/12A output options
- Programmable soft start with enable
- Programmable over-current protection
- 0.6V reference voltage with 1.5% accuracy
- 2.5V to 21V conversion Input
- Pre-Bias protection
- 5mm x 6mm Power QFN package

Optional Features

- 300kHz switching frequency
- DDR memory tracking
- Programmable PGOOD

Benefits

- Ease of implementation
- Extremely flexible
- Higher efficiency than monolithic solution
- Much higher density than discrete solution
- Fewer discrete components



Save Energy; Simplify Embedded Power Designs; Shrink Silicon Footprint by 70%

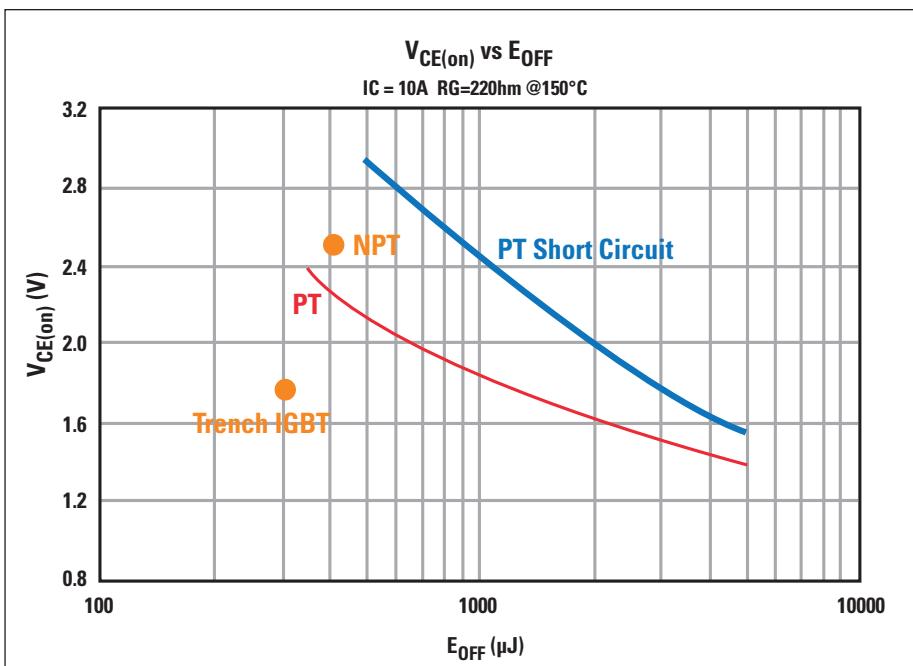
The innovative SupIRBuck family of point-of-load (POL) voltage regulators integrates IR's high performance synchronous buck control ICs and benchmark HEXFET® trench technology MOSFETs in a compact 5mm by 6mm Power QFN package, shrinking the silicon footprint by 70 percent compared to discrete solutions, and offering up to ten percent higher full-load efficiency than competing monolithic ICs.

Designed for 4, 7 and 12 amps of output load current, common features to the SupIRBuck family include wide range input of 2.5V to 21V and output range of 0.6V to 12V, pre-bias start up, fixed 600kHz switching frequency, hiccup current limit, thermal shutdown and precise output voltage regulation. Optional features include 300kHz switching frequency, tracking for DDR memory applications and programmable PGOOD.

The SupIRBuck's thermally enhanced package with slim 0.9mm profile, allows mounting on the back side of the motherboard, making the devices ideally suited for space constrained high-density server applications

Specifications

Part Number	V _{IN} Max/Min	V _{OUT} Max/Min	Max Current	F _{sw}	Package	Features
IR3812MPBF	21 / 2.5	12 / 0.6	4A	600KHz	5mm x 6mm QFN	OCP; OTP; Tracking
IR3822MPBF	21 / 2.5	12 / 0.6	4A	600KHz	5mm x 6mm QFN	OCP; OTP; PGood
IR3822AMPBF	21 / 2.5	12 / 0.6	6A	300KHz	5mm x 6mm QFN	OCP; OTP; PGood
IR3811MPBF	21 / 2.5	12 / 0.6	7A	600KHz	5mm x 6mm QFN	OCP; OTP; Tracking
IR3821MPBF	21 / 2.5	12 / 0.6	7A	600KHz	5mm x 6mm QFN	OCP; OTP; PGood
IR3821AMPBF	21 / 2.5	12 / 0.6	9A	300KHz	5mm x 6mm QFN	OCP; OTP; PGood
IR3810MPBF	21 / 2.5	12 / 0.6	12A	600KHz	5mm x 6mm QFN	OCP; OTP; Tracking
IR3820MPBF	21 / 2.5	12 / 0.6	12A	600KHz	5mm x 6mm QFN	OCP; OTP; PGood
IR3820AMPBF	21 / 2.5	12 / 0.6	14A	300KHz	5mm x 6mm QFN	OCP; OTP; PGood



Benchmark 600V Trench IGBTs

IR's extensive range of highly efficient depletion-stop trench IGBTs are offered in a wide range of configurations.

These Trench IGBTs have lower collector-to-emitter saturation voltage, V_{CE(ON)} and total switching loss, ETS than punch-through (PT) and non-punch-through (NPT) IGBTs.

IR's iMOTION Integrated Design Platform delivers everything you need to design a complete variable speed motor control sub-system. From the front panel and power entry to the motor terminals, iMOTION brings powerful digital, analog and power silicon together with algorithms, development software and design tools

Features at a Glance

- Highly efficient depletion-stop trench IGBTs in range of configurations
- Lower collector-to-emitter saturation voltage, V_{CE(ON)} plus total switching loss, ETS than punch-through (PT) and non-punch-through (NPT) IGBTs

Trench IGBT Co-Pack

Part Number	Package	Circuit	I _C @25°C	I _C @100°C	V _{CE(on)} @25°C
IRGB4056D	TO-220	Co-Pack	24.0A	12.0A	1.85V
IRGB4061D	TO-220	Co-Pack	36.0A	18.0A	1.95V
IRGB4062D	TO-220	Co-Pack	48.0A	24.0A	1.95V
IRGP4062D	TO-247	Co-Pack	48.0A	24.0A	1.95V

NPT IGBT Co-Pack

Part Number	Package	Circuit	I _C @25°C	I _C @100°C	V _{CE(on)} @25°C
IRGR3B60KD2	D-Pak	Co-Pack	7.8A	4.2A	1.9V
IRG*4B60K	TO-220AB, D ² Pak, TO-262	Co-Pack	12A	6.8A	2.1V
IRG*4B60KD1	TO-220 Full-Pak, D ² Pak, TO-262	Co-Pack	12A	6.8A	2.1V
IRG*6B60KD	TO-220AB, D ² Pak, TO-262	Co-Pack	13A	7A	1.8V
IRG*8B60K	TO-220AB, D ² Pak, TO-262	Co-Pack	17A	9A	1.8V
IRG*10B60KD	TO-220AB, D ² Pak, TO-262	Co-Pack	22A	12A	1.8V
IRG*15B60KD	TO-220AB, D ² Pak, TO-262	Co-Pack	31A	15A	1.8V
IRGIB6B60KD	Isolated TO-220 Full-Pak	Co-Pack	9A	6A	1.8V
IRGIB7B60KD	Isolated TO-220 Full-Pak	Co-Pack	12A	8A	1.8V
IRGIB10B60KD1	Isolated TO-220 Full-Pak	Co-Pack	16A	10A	1.7V
IRGIB15B60KD1	Isolated TO-220 Full-Pak	Co-Pack	19A	12A	1.8V

NPT IGBT Discrete

Part Number	Package	Circuit	I _C @25°C	I _C @100°C	V _{CE(on)} @25°C
IRG*6B60K	TO-220AB, D ² Pak, TO-262	Discrete	13A	7A	1.8V
IRG*30B60K	TO-220AB, D ² Pak, TO-262	Discrete	78A	50A	1.95V

* B = TO-220AB, S = D2Pak, SL = TO-262

Features at a Glance

- NPT technology, positive temperature coefficient
- Lower $V_{CE(SAT)}$
- Lower parasitic capacitances
- Minimal tail current
- HEXFRED ultra-fast soft recovery Co-Pack diode
- Tighter distribution of parameters
- Higher reliability

The IR Advantage

- Parallel operation for higher current applications
- Lower conduction losses and switching losses
- Higher switching frequency up to 150kHz

Applications

- Telecom and server SMPS
- PFC and ZVS SMPS circuits
- Uninterruptible power supplies
- Consumer electronics power supplies

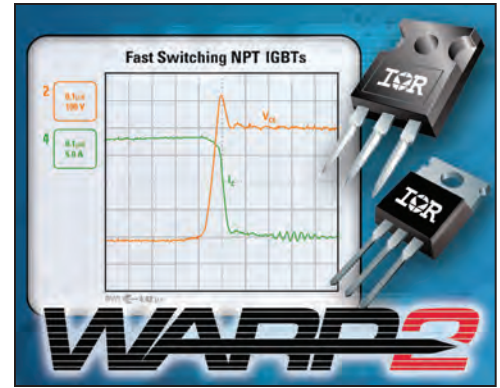
WARP2™ series of Thin Wafer IGBTs for High Frequency SMPS Applications

The WARP2 series of 600V devices (20A, 35A and 50A) in Non Punch Through (NPT) IGBT family are targeted towards high frequency SMPS applications. With a small tail current and a low turn off energy E_{off} , the devices enable the converter to operate up to 150kHz, the range currently dominated by Power MOSFETS.

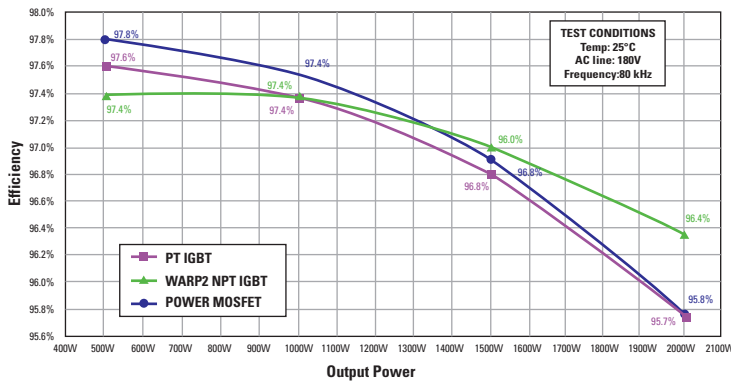
All WARP2 IGBTs are offered with co-pack HEXFRED diodes, which offer excellent reverse recovery characteristics, much better than the integral diodes in a Power MOSFET.

The improvement in switching performance, combined with the positive thermal coefficient characteristics and the lower gate turn-on charge Q_g , allows these devices to operate efficiently up to 150KHz, while offering excellent current sharing properties when operated in parallel, like power MOSFETS. Unlike Power MOSFETS, the conduction losses of these IGBTs remain essentially flat.

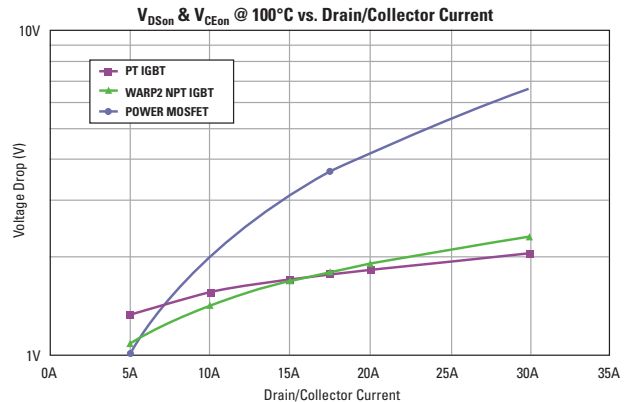
These features make the WARP2 IGBTs an excellent choice. in SMPS applications for medium and large power SMPS designs in Telecom and Computer systems.



System Efficiency Comparison in a 2000W Power Supply



Voltage Drop vs. Current



WARP2 IGBT Part Number	Package	V_{CES}	I_C at 25°C	$V_{CE(on)}$ typ.	Co-Pack Diode	Q_g
IRGP50B60PD1	TO-247	600V	50A	2.0V@33A	15A	205nC
IRGP35B60PD	TO-247	600V	35A	1.85V@22A	15A	160nC
IRGP20B60PD	TO-247	600V	20A	2.05V@13A	8A	68nC
IRGB20B60PD1	TO-220	600V	20A	2.05V@13A	4A	68nC

PRODUCT FAMILIES | Intelligent Power Modules

High voltage power stage delivers dedicated, reliable appliance solution

Integrating industry benchmark three-phase high voltage ICs and rugged trench IGBTs in a sleek and innovative single in-line package (SIP), IR's intelligent power modules (IPMs) deliver a complete power stage solution for today's energy-efficient appliance and light industrial equipment driven by variable speed motors ranging from 400W to 2500W.



The IPMs are an addition to the iMOTION™ family of integrated design platforms from IR. Together with a few external components and our digital controllers, they form a complete motor drive system, greatly accelerating the design path compared to a multi-discrete solution. Built-in over-temperature/over-current protection, along with short-circuit rated IGBTs, an integrated under-voltage lockout function, and built-in temperature monitor provide a high level of protection and fail-safe operation. Other integrated features, such as bootstrap diodes for the highside drive function and the single polarity power supply, simplify overall system design.

Features at a Glance

- Utilizes proprietary three-phase monolithic gate driver IC matched with highly efficient IGBT power switches
- Insulated metal substrate technology for reduced EMI
- Optimized for power up to 2.2kW
- Web-based design tool at www.irf.com/design-center/ipm
- Replaces more than 20 discrete parts to deliver complete power stage solution
- Shrinks board space requirements
- Shortens design time
- Slashes assembly time and cost
- Boosts reliability over discrete designs
- No additional isolation required
- Simplifies procurement and inventory management
- Reference design kit available

Intelligent Power Modules

Part Number	Integrated High Voltage ICs	Current Rating @T _C =25°C	Current Rating @T _C =100°C	Over-Current Trip (typ.)	V (I _{trip})	Package
IRAMS06UP60A	IR21365	6A	3A	User Defined	4.30V	SIP1
IRAMS06UP60B	IR21363	6A	3A	9.8A	0.49V	SIP1
IRAMS10UP60A	IR21365	10A	5A	User Defined	4.30V	SIP1
IRAMS10UP60B	IR21363	10A	5A	14.8A	0.49V	SIP1
IRAMX16UP60A	IR21365	16A	8A	User Defined	4.30V	SIP2
IRAMX16UP60B	IR21363	16A	8A	27.1A	0.49V	SIP2
IRAMX20UP60A	IR21365	20A	10A	User Defined	4.30V	SIP2
IRAMY20UP60B	IR21363	20A	11.5A	28.8A	0.49V	SIP3

MiniSIP Modules

Part Number	Package	Circuit	V _{CES}	I _O @ 25°C	I _O @ 100°C	Switching Frequency	R _{DS(on)}
IR3101	9-lead SIP	Half-Bridge FredFET and Gate Driver IC	500V	2A	1.3A	20	1.0Ω
IR3103	9-lead SIP	Half-Bridge FredFET and Gate Driver IC	500V	0.7A	-	30	2.5Ω

Applications

- Clothes Washers
- In-room and wall air-conditioners
- Compressor drives
- Appliance fans/compressors
- Light industrial drives

Main Configuration

- Open emitter configuration: flexible architecture to configure current sensing feedback resistors. Over-temperature is detected internally and triggers the fault condition.
- Integrated current shunt configuration: a current shunt is included on the negative bus of the inverter. Over-current is detected internally and triggers the fault condition.

The IR Advantage

- Most rugged, efficient and compact switches for the harshest environments.
- Provides charge pump and full switch protection with no additional circuitry.
- Up to 30% smaller PCB area than a discrete charge pump circuit.
- More than 1000 times longer life than electro-mechanical relays due to self protection and absence of wear and tear.
- Up to 20% lower on-resistance than relays reduces heat dissipation and heat sinks.

Features at a Glance

- 40V MOSFET with embedded protection and charge pump in a single package.
- 75V capable technology for 24V battery truck and industrial applications.
- As low as 7mOhms RDS(on) in the D²Pak / TO-220 footprint with current sense feedback.
- Integrated low EMI charge pump allows direct logic input.
- Open-load detection (HSS).
- Diagnostic feedback via the input pin on low side devices.

Protection Features

- Over-current protection
- Shutdown
- Current limiting
- Over-temperature protection
- ESD protection
- Active clamp for inductive loads.

Applications

Ideal replacement for electro-mechanical relays

Automotive

- Transmission Controls
- Junction Boxes
- Electronic Stability Controls
- Anti-lock Brakes, Traction Controls
- Diesel and Gas Direct Injection
- Pump Motors, Radiator Fans
- Head Diesel Glow Plugs
- Lamps

Industrial Automation

- Programmable Logic Controllers (PLC)
- Distributed and Closed-Loop Control Systems
- DC Loads (12VDC and 24VDC) Valves; Solenoids; Heaters
- DC Brushed Motors



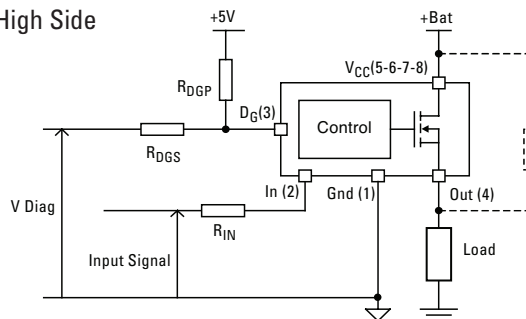
Ultra-Low R_{DS(on)} Self-Protected Intelligent Power Switches

Intelligent Power Switches (IPS) from International Rectifier integrate a low R_{DS(on)} output HEXFET[®] power MOSFET into a single package with protection and control circuits, making them the most rugged, efficient and compact devices available for automotive loads in harsh environments. All devices are qualified to AEC Q100 Qualification standard and devices with “PbF” suffix are RoHs compliant according to the European Union RoHs Directive.

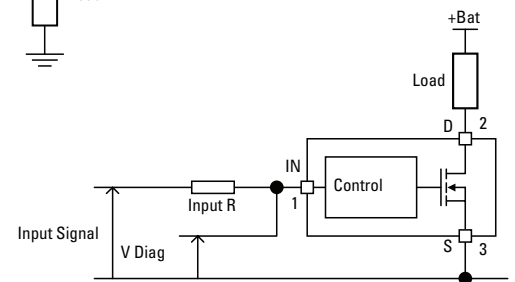
Built-in protection features, like over-temperature, over-current and active inductive energy clamp protect against short circuits, stalled motors and excessive ambient temperature. Designed to safely handle ordinary overload conditions as well as several extraordinary conditions, including loss of ground, load dump and reverse battery, IPS devices eliminate switch failures with the best efficiency and no addition in part count. Over-design for low occurrence fault situations are minimized. The embedded charge pump makes the interface to the micro-controller very simple with full logic-level compatibility.

The double level shifter circuitry that drives the MOSFET in the High-Side Switch (HSS) family provides immunity from large offsets between the logic ground and the load ground and short switching times. Internal slew rate control for turn-on/off and the use of a low noise charge pump means lower EMI, with ground noise generation of less than 10mA.

High Side



Low Side



PRODUCT FAMILIES | Automotive Intelligent Power Switch

P/N	Configuration	Output	R _{DS(ON)} (mΩ)	Over current protection	Over temp protection (Shutdown)	V clamp	Package	
IPS1011PbF	Low side	1	13	85A Shut down	165°C	39V	TO-220	
IPS1011RPbF		1	13	85A Shut down	165°C	39V	D-Pak	
IPS1011SPbF		1	13	85A Shut down	165°C	39V	D ² Pak	
IPS1021PbF		1	25	35A Shut down	165°C	39V	TO-220	
IPS1021RPbF		1	25	35A Shut down	165°C	39V	D-Pak	
IPS1021SPbF		1	25	35A Shut down	165°C	39V	D ² Pak	
IPS1031PbF		1	50	18A Shut down	165°C	39V	TO-220	
IPS1031RPbF		1	50	18A Shut down	165°C	39V	D-Pak	
IPS1031SPbF		1	50	18A Shut down	165°C	39V	D ² Pak	
IPS1041LPBF		1	100	6A Shut down	165°C	39V	SOT-223	
IPS1041RPBF		1	100	6A Shut down	165°C	39V	D-Pak	
IPS1042GPBF		2	100	6A Shut down	165°C	39V	SO-8	
IPS1051LPBF		1	200	3A Shut down	165°C	39V	SOT-223	
IPS1052GPBF		2	200	3A Shut down	165°C	39V	SO-8	
IPS2041LPBF		1	130	5A Shut down	165°C	70V	D-Pak	
IPS2041RPBF		1	130	5A Shut down	165°C	70V	SOT-223	
IPS6011PbF		High side	1	14	60A limit	165°C	39V	TO-220 5P
IPS6011RPbF			1	14	60A limit	165°C	39V	D-Pak 5P
IPS6011SPbF	1		14	60A limit	165°C	39V	D ² Pak 5P	
IPS6021PbF	1		30	32A limit	165°C	39V	TO-220 5P	
IPS6021RPbF	1		30	32A limit	165°C	39V	D-Pak 5P	
IPS6021SPbF	1		30	32A limit	165°C	39V	D ² Pak 5P	
IPS6031PbF	1		55	16A limit	165°C	39V	TO-220 5P	
IPS6031RPbF	1		55	16A limit	165°C	39V	D-Pak 5P	
IPS6031SPbF	1		55	16A limit	165°C	39V	D ² Pak 5P	
IPS6041GPBF	1		130	7A limit	165°C	39V	SO-8	
IPS6041RPBF	1		130	7A limit	165°C	39V	D-Pak 5P	
IPS6041PBF	1		130	7A limit	165°C	39V	TO-220 5P	
IPS6041SPBF	1		130	7A limit	165°C	39V	D ² Pak 5P	
IPS7091GPBF	1		120	5A limit	165°C	70V	SO-8	
IPS7071GPBF	1		120	5A limit	165°C	70V	SO-8	
IPS7091PBF	1		120	5A limit	165°C	70V	TO-220 5P	
IPS7091SPBF	1		120	5A limit	165°C	70V	D ² Pak 5P	
IPS7081RPBF	1		70	6A limit	165°C	70V	D-Pak 5P	
IPS7081PBF	1		70	6A limit	165°C	70V	TO-220 5P	
IPS7081SPBF	1		70	6A limit	165°C	70V	D ² Pak 5P	
IR3316SPBF	High Side with Current Sense	1	7	10 - 90A Programmable shut down	165°C	40V	D ² Pak 5P	
IR3313SPBF		1	7	10 - 90A Programmable shut down	165°C	40V	D ² Pak 5P	
IR3313PBF		1	7	10 - 90A Programmable shut down	165°C	40V	TO-220 5P	
IR3314SPBF		1	12	6 - 58A Programmable shut down	165°C	40V	D ² Pak 5P	
IR3314PBF		1	12	6 - 58A Programmable shut down	165°C	40V	TO-220 5P	
IR3315SPBF		1	20	3 - 30A Programmable shut down	165°C	40V	D ² Pak 5P	
IR3315PBF		1	20	3 - 30A Programmable shut down	165°C	40V	TO-220 5P	

Features at a Glance

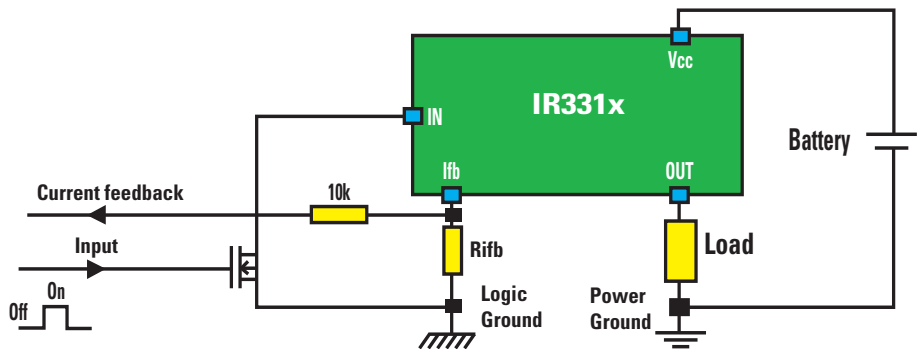
- Integrated charge pump and gate drive for high-side applications
- Load current feedback
- Programmable over-current shutdown
- Over-temperature shutdown
- Active clamp
- Reverse battery protection
- Reverse current capability
- ESD protection

The IR Advantage

- +/- 5% current sense feedback accuracy
- 100 kHz current feedback bandwidth
- Very low $R_{DS(ON)}$ fully protected high-side switch
- Programmable current shutdown
- Simplifies circuits and increases reliability

Applications

- Automotive 14V applications
- Body modules
- Intelligent Glow-plug
- Auxiliary PTC heater
- Engine cooling fan
- Interior fan control



The IR331x family are highly efficient high side power switches that feature integrated programmable over-current protection, over-temperature protection, and active overvoltage clamping. In addition, the IR331x family provides a current feedback output with +/- 5% accuracy over the full operating temperature range (@max. load current) compared to about +/-20% for competitive devices. This accuracy combined with integrated programmable over-current shutdown enables the IR331x switches to protect not only itself but also the load by optimizing the shutdown threshold.

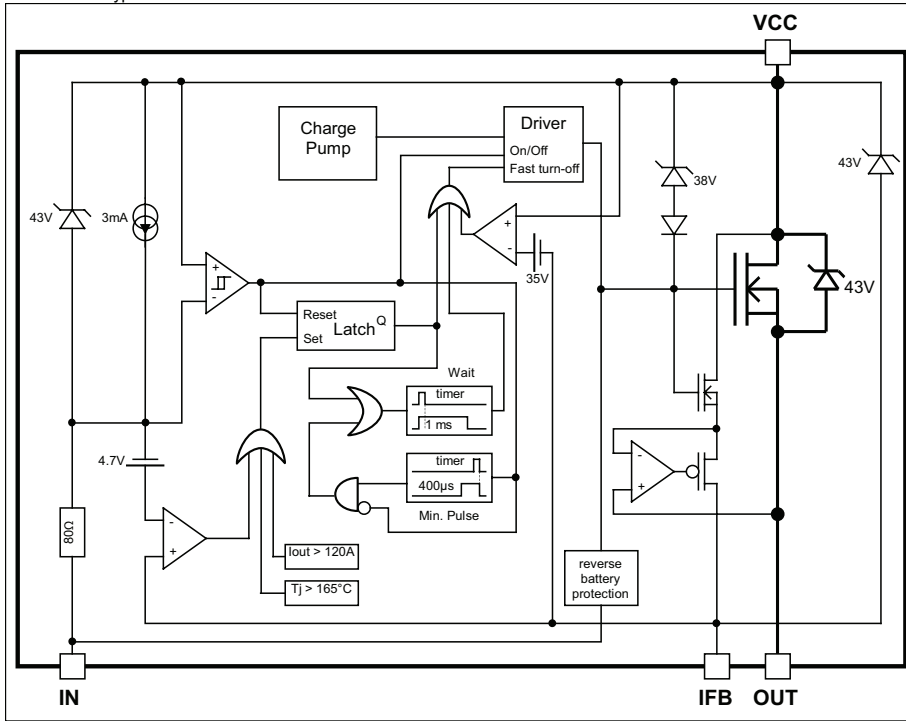
The current feedback feature allows precise current monitoring and control for a very cost effective solution in many applications. With +/- 5% accuracy and 100 kHz bandwidth, the current feedback signal may be used by a standard PWM control IC, ASIC, or microcontroller to implement high-performance functionality from wide bandwidth closed-loop current control of a motor load to basic load fault detection. Implementing current sense functions with the IR331x family eliminates the power loss of a shunt resistor or cost of a Hall sensor.

The IR331x devices are specifically designed for automotive 14V applications where a protection is required in order to prevent the IC and the application from damage in case of short circuits on the line, or by overload. The integrated over-temperature protection and programmable over-current shutdown features save additional fuses and wiring harness, improving the system reliability. Additional integrated features like ESD, reverse battery and active clamp guarantee protection even under harsh automotive operating conditions.



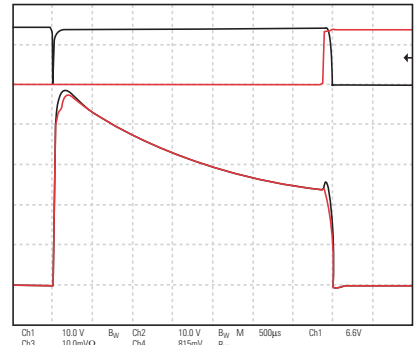
Functional Block Diagram

All values are typical



IR331x Operation

The bottom traces show the load current and the diagnostic current (vertical scale is adjusted to match.)



IR331x Block Diagram

The input signal is referenced to V_{CC} . When the input voltage $V_{CC} - V_{IN}$ exceeds the specified threshold, the output power MOSFET is turned on. When the $V_{CC} - V_{IN}$ is lower than the specified V_{IL} threshold, the output MOSFET is turned off. Any fault will disable the output MOSFET until V_{IN} is cycled off, resetting the fault latch. A current proportional to the power MOSFET current is sourced to the IFB pin and allows easy measurement of the output current. Over current shutdown threshold occurs at $V_{IFB} - V_{IN} > 4V$. Programming the over-current threshold is achieved by choosing R_{IFB} .

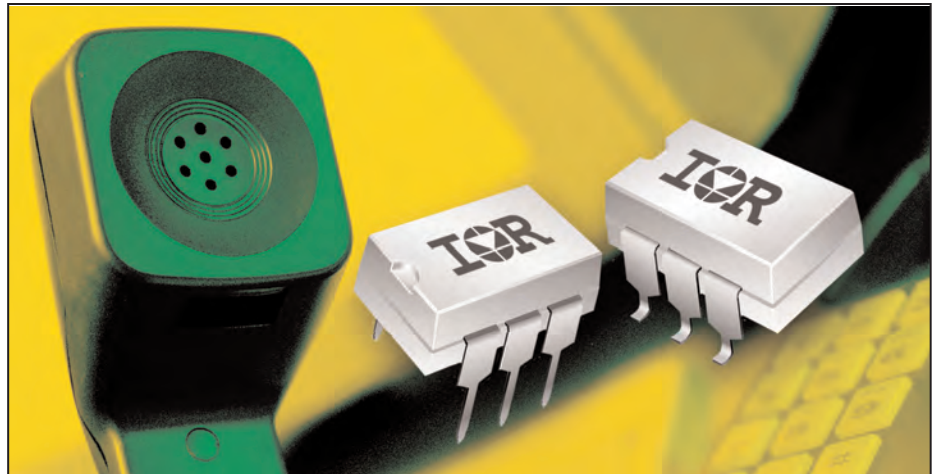
Specifications

Part	Configuration	Output	$R_{ds(ON)}$ (mOhm)	Over current protection	Over Temp Protection Shut Down	V_{clamp}	Package
IR3316SPbF	High Side with Current Sense	1	7	10-90A (Programmable shut down)	145°C	40V	D ² Pak 5P
IR3313SPbF		1	7	10-90A (Programmable shut down)	145°C	40V	D ² Pak 5P
IR3313PbF		1	7	10-90A (Programmable shut down)	145°C	40V	TO-220 5P
IR3314SPbF		1	12	6-58A (Programmable shut down)	145°C	40V	D ² Pak 5P
IR3314PbF		1	12	6-58A (Programmable shut down)	145°C	40V	TO-220 5P
IR3315SPbF		1	20	3-30A (Programmable shut down)	145°C	40V	D ² Pak 5P
IR3315PbF		1	20	3-30A (Programmable shut down)	145°C	40V	TO-220 5P

The IR Advantage

(compared against EMR)

- Miniature size
- No contact bounce
- Long operational life
- High input sensitivity
- High reliability
- Insensitivity to stray electromagnetic fields
- Insensitivity to shock and vibration
- Stable contact resistance over life



International Rectifier Microelectronic Relays

International Rectifier microelectronic relays consist of HEXFET® power MOSFET and IGBT output photovoltaic relays, as well as a line of photovoltaic isolators. The operating parameters of photovoltaic relays are ideal for switching low-level signal loads in instrumentation and data acquisition to medium power loads in industrial controls and process automation, i.e. from microvolts and microamps to 400 volts (AC peak or DC) and up to 6.0 amps of load current at a contact resistance as low as 15 milliohms.

The IR line of specialized telecom relays offers numerous contact configurations, package styles, and functional integration with ringer detection in addition to single-pole contacts and small-profile ThinPak packages compatible with applications in Type II PCMCIA cards. Photovoltaic isolators offer single- and dual-channel, optically isolated outputs that can be used for directly driving the gates of discrete power MOSFETs and/or IGBTs, giving designers the flexibility of creating their own, custom-made solid-state relays capable of controlling loads well over 1,000 volts and 100 amps.

DC Only Load

Name	Package	Circuit	Operating Voltage (+) (V)	Resistance DC (Ohms)	Current DC (mA)	Control Current (mA)	Off-State Resistance (Ohms)	Dielectric Strength (V)	Response Time On (usec)	Response Time Off (usec)	Thermal Offset (V)	PbF Option Available
PVD1352N	mod. 8-pin DIP	1 Form A	100	1.5	550	5	1E+08	4000	150	125	0.2	✓
PVD1352NS	mod. 8-pin SMT	1 Form A	100	1.5	550	5	1E+08	4000	150	125	0.2	✓
PVD1354N	mod. 8-pin DIP	1 Form A	100	1.5	550	5	1E+10	4000	150	125	0.2	✓
PVD1354NS	mod. 8-pin SMT	1 Form A	100	1.5	550	5	1E+10	4000	150	125	0.2	✓
PVD2352N	mod. 8-pin DIP	1 Form A	200	6.0	240	5	1E+08	4000	100	110	0.2	✓
PVD2352NS	mod. 8-pin SMT	1 Form A	200	6	240	5	1E+08	4000	100	110	0.2	✓
PVD3354N	mod. 8-pin DIP	1 Form A	300	6.0	240	5	1E+10	4000	100	110	0.2	✓
PVD3354NS	mod. 8-pin SMT	1 Form A	300	6	240	5	1E+10	4000	100	110	0.2	✓
PVDZ172N	mod. 8-pin DIP	1 Form A	60	0.25	1500	10	1E+08	4000	2000	500		✓
PVDZ172NS	mod. 8-pin SMT	1 Form A	60	0.25	1500	10	1E+08	4000	2000	500		✓

PRODUCT FAMILIES | Micro Electronic Relays

MER: Photovoltaic Relay AC-DC Load

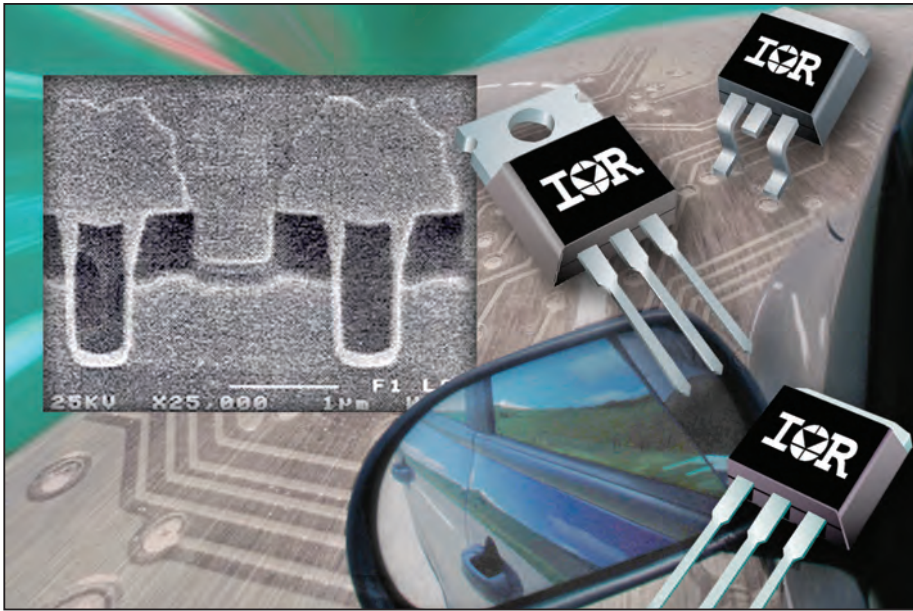
Name	Package	Circuit	Operating Voltage (+) (V)	Operating Voltage (-) (V)	On-State Resistance AC (Ohms)	On-State Resistance DC (Ohms)	Load Current AC (mA)	Load Current DC (mA)	Nominal Control Current (mA)	Off-State Resistance (Ohms)	Dielectric Strength (V)	Response Time On (usec)	Response Time Off (usec)	Thermal Offset (V)	PbF Option Available
PVA1352N	mod. 8-pin DIP	1 Form A	100	100	5		375	375	5	1E+08	4000	150	125	0.2	✓✓
PVA1352NS	mod. 8-pin SMT	1 Form A	100	100	5		375	375	5	1E+08	4000	150	125	0.2	✓✓
PVA1354N	mod. 8-pin DIP	1 Form A	100	100	5		375	375	5	1E+10	4000	150	125	0.2	✓✓
PVA1354NS	mod. 8-pin SMT	1 Form A	100	100	5		375	375	5	1E+10	4000	150	125	0.2	✓✓
PVA2352N	mod. 8-pin DIP	1 Form A	200	200	24		150	150	5	1E+08	4000	100	110	0.2	✓✓
PVA2352NS	mod. 8-pin SMT	1 Form A	200	200	24		150	150	5	1E+08	4000	100	110	0.2	✓✓
PVA3054N	mod. 8-pin DIP	1 Form A	300	300	160		50	50	5	1E+10	4000	60	100	0.2	✓✓
PVA3054NS	mod. 8-pin SMT	1 Form A	300	300	160		50	50	5	1E+10	4000	60	100	0.2	✓✓
PVA3055N	mod. 8-pin DIP	1 Form A	300	300	160		50	50	5	1E+11	4000	60	100	0.2	✓✓
PVA3055NS	mod. 8-pin SMT	1 Form A	300	300	160		50	50	5	1E+11	4000	60	100	0.2	✓✓
PVA3324N	mod. 8-pin DIP	1 Form A	300	300	24		150	150	2	1E+10	4000	100	110	0.2	✓✓
PVA3324NS	mod. 8-pin SMT	1 Form A	300	300	24		150	150	2	1E+10	4000	100	110	0.2	✓✓
PVA3354N	mod. 8-pin DIP	1 Form A	300	300	24		150	150	5	1E+10	4000	100	110	0.2	✓✓
PVA3354NS	mod. 8-pin SMT	1 Form A	300	300	24		150	150	5	1E+10	4000	100	110	0.2	✓✓
PVAZ172N	mod. 8-pin DIP	1 Form A	60	60	0.5		1000	1000	10	1E+08	4000	2000	500		✓✓
PVAZ172NS	mod. 8-pin SMT	1 Form A	60	60	0.5		1000	1000	10	1E+08	4000	2000	500		✓✓
PVG612	6-pin DIP	1 Form A	60	60	0.5	0.15	1000	2000	5	1E+08	4000	2000	500		✓✓
PVG612A	6-pin DIP	1 Form A	60	60	0.1	0.035	2000	4000	5	6E+08	4000	3500	500		✓✓
PVG612AS	6-pin SMT	1 Form A	60	60	0.1	0.035	2000	4000	5	6E+08	4000	3500	500		✓✓
PVG612S	6-pin SMT	1 Form A	60	60	0.5	0.15	1000	2000	5	1E+08	4000	2000	500		✓✓
Name	Package	Circuit	Operating Voltage (+) (V)	Operating Voltage (-) (V)	On-State Resistance AC (Ohms)	On-State Resistance DC (Ohms)	Load Current AC (mA)	Load Current DC (mA)	Nominal Control Current (mA)	Off-State Resistance (Ohms)	Dielectric Strength (V)	Response Time On (usec)	Response Time Off (usec)	Thermal Offset (V)	PbF Option Available
PVG613	6-pin DIP	1 Form A	60	60	0.5	0.25	1	2	5	4.8E+09	4000	2000	500	NA	✓✓
PVG613S	6-pin SMT	1 Form A	60	60	0.5	0.25	1	2	5	4.8E+09	4000	2000	500	NA	✓✓
PVN012	6-pin DIP	1 Form A	20	20	0.1	0.04	2500	4500	3	1.6E+08	4000	5000	500		✓✓
PVN012APBF	6-pin DIP	1 Form A	20	20	0.05	0.015	4000	6000	5		4000	3000	500		✓✓
PVN012ASPBF	6-pin SMT	1 Form A	20	20	0.05	0.015	4000	6000	5		4000	3000	500		✓✓
PVN012S	6-pin SMT	1 Form A	20	20	0.1	0.04	2500	4500	3	1.6E+08	4000	5000	500		✓✓
PVN013	6-pin DIP	1 Form A	20	20	0.1	0.065	2.5	4.5	3	1.6E+09	4000	5000	500	NA	✓✓
PVN013S	6-pin SMT	1 Form A	20	20	0.1	0.065	2.5	4.5	3	1.6E+09	4000	5000	500	NA	✓✓
PV0402AP	Thin-Pak	1 Form A	400	400	22	22	150	150	5	4E+08	3750	1000	500		—
PV0402P	Thin-Pak	1 Form A	400	400	35	35	120	120	3	4E+08	3750	2000	500		—
PVR1300N	16-pin DIP	1 Form A	100	100	5	3	360	420	2.0	10^8	1500	150	125	0.2	✓✓
PVR1301N	16-pin DIP	1 Form A	100	100	5	3	360	420	2.0	10^10	1500	150	125	0.2	✓✓
PVR2300N	16-pin DIP	2 Form A	200	200	24	6	310	310	5	1E+08	1500	150	125	0.2	✓✓
PVR3300N	16-pin DIP	2 Form A	300	300	24	6	310	310	5	1E+08	1500	150	125	0.2	✓✓
PVR3301N	16-pin DIP	2 Form A	300	300	24	6	310	310	5	1E+10	1500	150	125	0.2	✓✓
PVT212	6-pin DIP	1 Form A	150	150	0.75	0.25	550	825	5	1.5E+08	4000	3000	500		✓✓
PVT212S	6-pin SMT	1 Form A	150	150	0.75	0.25	550	825	5	1.5E+08	4000	3000	500		✓✓
PVT312	6-pin DIP	1 Form A	250	250	10	3	190	320	2	2.5E+08	4000	3000	500		✓✓
PVT312L	6-pin DIP	1 Form A	250	250	15	4.25	170	300	2	2.5E+08	4000	3000	500		✓✓
PVT312LS	6-pin SMT	1 Form A	250	250	15	4.25	170	300	2	2.5E+08	4000	3000	500		✓✓
PVT312S	6-pin SMT	1 Form A	250	250	15	4.25	190	320	2	2.5E+08	4000	3000	500		✓✓

MER: Photovoltaic Relay AC-DC Load

Name	Package	Circuit	Operating Voltage (+) (V)	Operating Voltage (-) (V)	On-State Resistance AC (Ohms)	On-State Resistance DC (Ohms)	Load Current AC (mA)	Load Current DC (mA)	Nominal Control Current (mA)	Off-State Resistance (Ohms)	Dielectric Strength (V)	Response Time On (usec)	Response Time Off (usec)	Thermal Offset (V)	PbF Option Available
PVT322	8-pin DIP	2 Form A	250	250	10	10	170	170	2	2.5E+08	4000	3000	500		✓
PVT322A	8-pin DIP	2 Form A	250	250	8	8	170	170	2	2.5E+08	4000	3000	500		✓
PVT322AS	8-pin SMT	2 Form A	250	250	8	8	170	170	2	2.5E+08	4000	3000	500		✓
PVT322S	8-pin SMT	2 Form A	250	250	10	10	170	170	2	2E+08	4000	3000	500		✓
PVT412	6-pin DIP	1 Form A	400	400	27	7	140	210	3	4E+08	4000	2000	500	0.5	✓
PVT412A	6-pin DIP	1 Form A	400	400	6	2	240	360	3	4E+08	4000	3000	500	0.5	✓
PVT412AS	6-pin SMT	1 Form A	400	400	6	2	240	360	3	4E+08	4000	3000	500	0.5	✓
PVT412L	6-pin DIP	1 Form A	400	400	35	9	120	200	3	4E+08	4000	2000	500	0.5	✓
PVT412LS	6-pin SMT	1 Form A	400	400	35	9	120	200	3	4E+08	4000	2000	500	0.5	✓
PVT412S	6-pin SMT	1 Form A	400	400	27	7	140	210	3	4E+08	4000	2000	500		✓
PVT422	8-pin DIP	2 Form A	400	400	35	35	120	120	2	3.2E+08	4000	2000	2000		✓
PVT422P	Thin-Pak	2 Form A	400	400	35	35	120	120	2	3.2E+08	3750	2000	2000		—
PVT422S	8-pin SMT	2 Form A	400	400	35	35	120	230	2	3.2E+08	4000	2000	2000		✓
PVU414	6-pin DIP	1 Form A	400	400	27	7	140	210	3	1E+10	4000	500	200	0.2	✓
PVU414S	6-pin SMT	1 Form A	400	400	27	7	140	210	3	1E+10	4000	500	200	0.2	✓
PVX6012	14-pin DIP	1 Form A	400	400			1	1	5	4E+08	3750	7000	1000		✓
PVY116	4 Lead SOP	1 Form A	40	40	4.4	4.4	250	250	2.0	3.2E+10	1500	500	500		✓
PVY117	4 Lead SOP	1 Form A	40	40	0.95	0.95	470	470	2	4E+10	1500	200	100		✓

MER: Photovoltaic Isolator

Name	Package	Circuit	Number of Outputs	Output Voltage (V)	Short Circuit Current	Nominal Control Current (mA)	PbF Option Available
PVI1050N	8-pin DIP	2 Form A	2	5	5	10	✓
PVI1050NS	8-pin SMT	2 Form A	2	5	5	10	✓
PVI5013R	8-pin DIP	2 Form A	2	5	1	10	✓
PVI5013RS	8-pin SMT	2 Form A	2	3	1	5	✓
PVI5033R	8-pin DIP	2 Form A	2	5	5	5	✓
PVI5033RS	8-pin SMT	2 Form A	2	5	5	5	✓
PVI5050N	mod. 8-pin DIP	1 Form A	1	5	5	10	✓
PVI5050NS	mod. 8-pin SMT	1 Form A	1	5	5	10	✓
PVI5080N	mod. 8-pin DIP	1 Form A	1	5	8	10	✓
PVI5080NS	mod. 8-pin SMT	1 Form A	1	5	8	10	✓



The IR Advantage

Compared to the best competitive Trench devices in the market:

- Lowest $R_{DS(on)}$ per unit area at elevated temperature
- Excellent avalanche capability
- Low gate charge

Applications

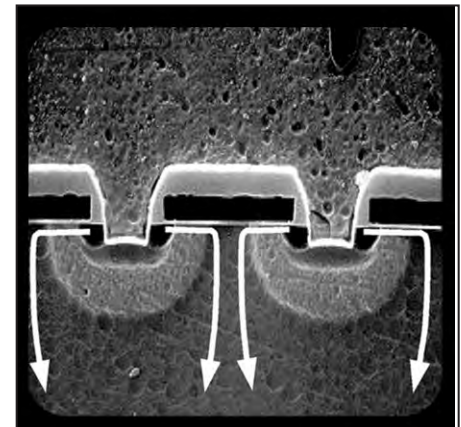
High power applications including:

- Integrated Starter Alternator
- Synchronous Rectifier Alternators
- Electrical Power Steering
- Brush and brushless DC motor control

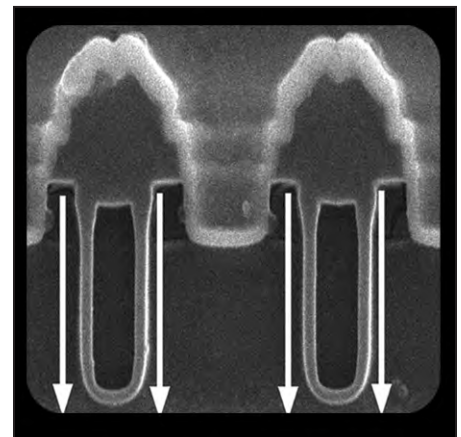
International Rectifier automotive Trench HEXFET® Power MOSFETs feature improved efficiency, switching performance and ruggedness compared to competitive Trench technology. IR Trench process has been uniquely optimized to extend the benefits of Trench technology to the harsh automotive environment without sacrificing the avalanche ruggedness that automotive system designers have come to expect from IR's planar MOSFETs.

With high power automotive applications in mind, IR Trench technology has been optimized for low on-resistance and offers 15% lower $R_{DS(ON)}$ per unit area than best competitive devices and 45% lower than best planar technology.

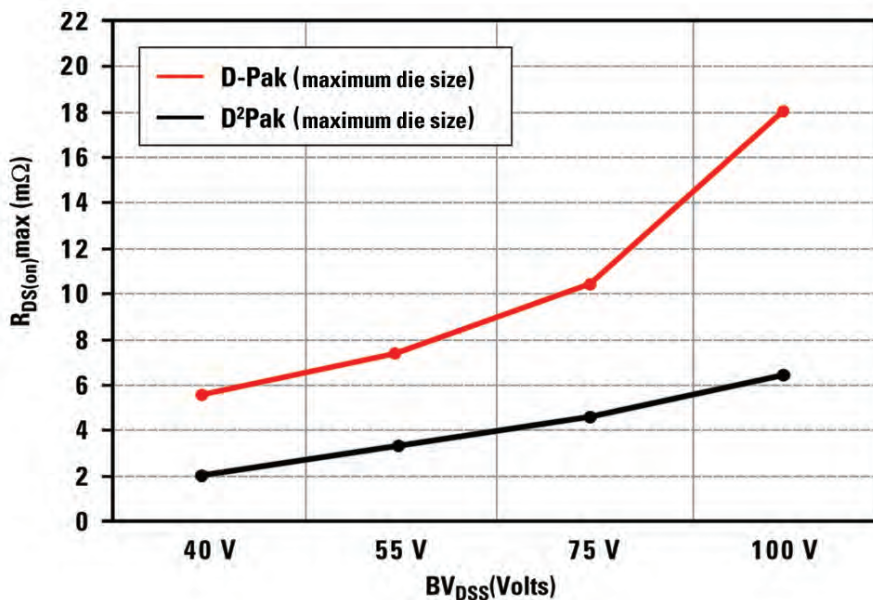
Electron Flow



Planar



Trench



Automotive Trench MOSFETs | PRODUCT FAMILIES

Trench HEXFET® Power MOSFETs *

Part #	Package ⁽⁴⁾	V _{DS} (V)	R _{DS(on)} (mW)	I _D , max (A)	R _{th} (C/W)max	Typ R _{dson} Temp Coeff.
IRF2903Z	D ² Pak	30	2.6	75 ⁽¹⁾	0.51	Std
IRF2804S	D ² Pak	40	2.0	75	0.45	Std
IRF2804S-7P	D ² Pak-7P	40	1.6	160 ⁽¹⁾	0.50	Std
IRF1404ZS	D ² Pak	40	3.7	75	0.65	Std
IRL1404ZS	D ² Pak	40	5.9 ⁽⁵⁾	75	0.65	Logic
IRLR3114ZPBF	DPak	40	6.5	42 ⁽¹⁾	1.05	Logic
IRF4104S	D ² Pak	40	5.5	75	1.05	Std
IRFR4104	DPak	40	5.5	42 ⁽¹⁾	1.05	Std
IRFR3504Z	DPak	40	9.0	42	1.66	Std
IRF1405ZS-7P	D ² Pak-7P	55	4.9	120	0.65	Std
IRF1405ZS	D ² Pak	55	4.9	75	0.65	Std
IRF3805ZS-7P	D ² Pak-7P	55	2.6	160	0.5	Std
IRF3805ZS	D ² Pak	55	3.3	75	0.45	Std
IRF3205ZS	D ² Pak	55	6.5	75	0.67	Std
IRF1010ZS	D ² Pak	55	7.5	75	1.11	Std
IRFR1010Z	DPak	55	8.5	42	1.11	Std
IRFZ48ZS	D ² Pak	55	11.0	61	1.64	Std
IRL3705ZS	D ² Pak	55	12.0	75	1.18	Logic
IRLR3705Z	DPak	55	13.0	42	1.18	Logic
IRFZ46ZS	D ² Pak	55	13.6	51	1.84	Std
IRFR2905Z	DPak	55	14.5	42	1.38	Std
IRFZ44ZS	D ² Pak	55	14.0	51	1.87	Std
IRLR2905Z	DPak	55	22.5	42	1.9	Logic
IRLZ44ZS	D ² Pak	55	22.5	60	1.87	Logic
IRFR4105Z	DPak	55	24.5	30 ⁽¹⁾	3.12	Std
IRFL024Z	SOT-223	55	57.5	5.1	45	Std
IRLL024Z	SOT-223	55	100	16	4.28	Logic
IRLR024Z	DPak	55	100	16	4.28	Logic
IRFR48Z	DPak	55	12	30	1.64	Std
IRFR46Z	DPak	55	14.5	30	1.84	Std
IRLR3915	DPak ⁽³⁾	55	14	30	1.3	Std
IRF3305	TO-220 ^(2,3)	55	8	75	0.45	Std
IRF1010EZS	D ² Pak	60	8.5	75	1.11	Std
IRFZ44VZS	D ² Pak	60	12.0	57	1.64	Std
IRF2907ZS	D ² Pak	75	4.5	75	0.45	Std
IRF2807ZS	D ² Pak	75	9.4	75	0.9	Std
IRFR2307Z	DPak	75	16	42	1.5	Std
IRFR2607Z	DPak	75	22	40	1.9	Std
IRFS3207	D ² Pak	75	4.5	75	0.5	Std
IRF3307	D ² Pak	75	6.3	75	0.6	Std
IRF3507	D ² Pak	75	8.8	75	0.8	Std
IRFR3710Z	DPak	100	18.0	42	1.05	Std
IRF540ZS	D ² Pak	100	26.5	36	1.64	Std
IRFR120Z	DPak	100	190	8.7	4.28	Std
IRFR540Z	DPak	100	27	30	1.64	Std
IRFS4610	D ² Pak	100	14	70	0.8	Std
IRFS4410	D ² Pak	100	10	75	0.6	Std
IRFS4310	D ² Pak	100	7	75	0.5	Std

*Pbf version available. Add Pbf suffix to part number.

1) Package limit on 75A D²Pak, 160A 7-Pin D²Pak, 42A DPak and 30A DPak

2) Planar Technology

3) Designed for applications that require linear gate drive

4) Check availability in other packages such as TO-220, TO-262, I-Pak at auto.irf.com

5) R_{DS(on)} of logic level devices specified at VGS 4.5V



The International Rectifier DirectFET power package

The International Rectifier DirectFET power package is a breakthrough surface-mount power MOSFET packaging technology designed for efficient topside cooling in a SO-8 footprint. In combination with improved bottom-side cooling, the new package can be cooled on both sides to cut part count by up to 60%, and board space by as much as 50% compared to devices in standard or enhanced SO-8 packages. This effectively doubles current density (A/in²) at a lower total system cost. The DirectFET MOSFET family offerings match 20V, 25V and 30V synchronous buck converter MOSFET chipsets, followed by the addition at 30V targeted for high frequency operation. The DirectFET MOSFET family is also available in two different can sizes giving maximum flexibility for all your design needs.



The DirectFET Discovery Center is intended for customers that are looking for a deeper understanding of DirectFET device innovative features as well as examples of applications in which it can be used to boost circuit performances both

from electrical and thermal point of view features. The Discovery Center is organized in the following sections:

- DirectFET MOSFET Overview features a complete and deep description of the package's electrical, mechanical and thermal characteristics.
- Applications features a portfolio of reference and feasible designs using DirectFET MOSFETs.
- Engineering features a production cycle related description of the DirectFET MOSFET's unique properties.
- FAQs features detailed, quick and engineering oriented answers to frequently asked questions.

For more info visit:
www.irf.com/product-info/directfet/dfdsccovery/

Features at a Glance

- RoHs compliant containing no lead or bromide
- Lead free
- 1.4°C/W junction to case thermal resistance (R_{th(J-C)}) enables highly effective top-side cooling
- Less than 1°C/W R_{th(junction-pcb)} in same footprint as SO-8
- Over 90% lower die-free package resistance (DFPR) than SO-8
- 0.7mm profile compared to 1.75mm for SO-8
- Direct chip attach with no wire bonding or lead-frame
- Lower package inductance for higher frequencies
- Compatible with high volume manufacturing equipment and processes

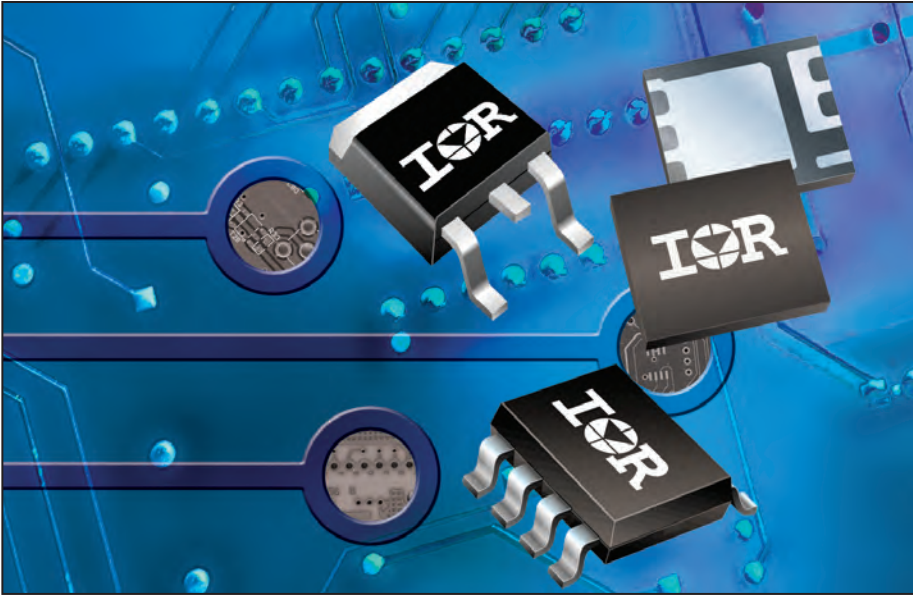
The IR Advantage

- Increases current density by a factor of two
- Cuts MOSFET part count by 60%
- Reduces PCB space by 50%
- Up to 50°C lower operating temperature increases reliability
- Lower total system cost

Applications

- VRM modules for Servers (sync buck)
- Workstations and mainframes (sync rectification, ORing)
- High-performance notebooks (sync buck)
- Advanced telecom and datacom systems (bus converter)
- Radio controlled toys (motor control)
- Battery operated tools (motor control)
- Class D audio (amplifier)

Part Number	BV _{DSS} Max. (V)	Application	R _{DS(on)}				V _{GS} Max. (V)	I _D @ 25°C Case (A)	Q _G Typ. (nC)	Q _{GD} Typ. (nC)	Q _{sw} Typ. (nC)	AN-1035 Layout Code	1" Sq. Rthj-a °C/W	Rthj-c °C/W
			@ 10V Max. (mΩ)	@ 4.5V Max. (mΩ)	@ 10V Typ. (mΩ)	@ 4.5V Typ. (mΩ)								
IRF6609TRPBF	20	Sync FET	2.0	2.6	1.6	2.0	±20	150	46	15	20	MT	45	1.4
IRF6619TRPBF		Sync FET	2.2	3.0	1.65	2.2	±20	150	38	13	17	MX	45	1.4
IRF6620TRPBF		Sync FET	2.7	3.6	2.1	2.8	±20	150	28	8.8	12	MX	45	1.4
IRF6636TRPBF		Sync FET	4.5	6.4	3.2	4.6	±20	81	18	6.1	8	ST	58	3
IRF6623TRPBF		Ctrl FET	5.7	9.7	4.4	7.5	±20	55	11	4.0	5.2	ST	58	3
IRF6633TRPBF		Ctrl FET	5.6	9.4	4.1	7.0	±20	59	11	4.0	5.2	MP	55	3
IRF6610TRPBF		Ctrl FET	6.8	10.7	5.2	8.2	±20	66	11	3.6	4.9	SQ	58	3
IRF6716MTRPBF	25	Sync FET	1.6	2.6	1.2	2.0	±20	180	39	12.0	17.3	MX	35	1.6
IRF6629TRPBF		Sync FET	2.1	2.7	1.6	2.1	±20	180	34	11	15	MX	45	1.2
IRF6628TRPBF		Sync FET	2.5	3.3	1.9	2.5	±20	160	31	12	16	MX	45	1.3
IRF6713STRPBF		Sync/Ctrl	3.0	4.4	2.2	3.4	±20	95	21	6.3	9.0	SQ	58	3.0
IRF6712STRPBF		Ctrl FET	4.9	8.7	3.8	6.7	±20	68	13	4.4	6.1	SQ	58	3.5
IRF6622TRPBF		Ctrl FET	6.3	8.9	4.9	6.8	±20	59	11	3.8	5.4	SQ	58	3.7
IRF6635TRPBF	30	Sync FET	1.8	2.4	1.3	1.8	±20	180	47	17	29	MX	45	1.4
IRF6678TRPBF		Sync FET	2.2	3.0	1.7	2.3	±20	150	43	15	19	MX	45	1.4
IRF6618TRPBF		Sync FET	2.2	3.4	1.7	-	±20	150	43	15	19	MT	45	1.4
IRF6611TRPBF		Sync FET	2.6	3.4	2.0	2.6	±20	150	37	12.5	15.8	MX	32	1.4
IRF6638TRPBF		Sync FET	2.9	3.9	2.2	3.0	±20	140	30	11	14	MX	45	1.4
IRF6612TRPBF		Sync FET	3.3	4.4	2.5	3.4	±20	136	30	10	13	MX	45	1.4
IRF6626TRPBF		Sync/Ctrl	5.4	7.1	4.0	5.2	±20	72	19	6.7	8.3	ST	58	3
IRF6631TRPBF		Ctrl FET	7.8	10.8	6.0	8.3	±20	57	12	4.4	5.5	SQ	58	3
IRF6637TRPBF		Ctrl FET	7.7	10.8	5.7	8.2	±20	52	11	4.0	5.0	MP	55	1.3
IRF6617TRPBF		Ctrl FET	8.1	10.3	6.2	7.9	±20	52	11	4.0	5.0	ST	58	3
IRF6621TRPBF		Ctrl FET	9.1	12.1	7.0	9.3	±20	55	11.7	4.2	5.2	SQ	58	3
IRF6613TRPBF		40	Sync Rect	3.4	4.1	2.6	3.1	±20	150	42	11.5	15.9	MT	45
IRF6616TRPBF	Sync Rect		5.0	6.2	3.7	4.6	±20	106	29	9.4	12	MX	45	1.4
IRF6614TRPBF	Sync Rect		8.3	9.9	5.9	7.1	±20	55	19	6.0	7.4	ST	58	3
DirectFETKY														
IRF6691TRPBF	20	Sync FET	1.8	2.5	1.2	1.8	±12	180	47	15	19	MT	45	1.4
DirectFET Mid Voltage														
IRF6648TRPBF	60	SR / PB	7.0		5.5		±20	86	36	14	17	MN	45	1.4
IRF6646TRPBF	80	SR / PB	9.5		7.6		±20	68	36	12	14	MN	45	1.4
IRF6668TRPBF		SR / PB	15		12		±20	55	22	7.8	9.4	MZ	45	1.4
IRF6644TRPBF	100	SR / PB	13		10		±20	60	35	12	13	MN	45	1.4
IRF6662TRPBF		SR / PB	22		18		±20	47	22	6.8	8.0	MZ	45	1.4
IRF6645TRPBF		SR / PB	35		28		±20	25	14	4.8	5.6	SJ	58	3
IRF6655TRPBF		SR / PB	62		53		±20	19	8.7	2.8	3.4	SH	58	3
IRF6643TRPBF	150	SR / PB	35		29		±20	35	39	11	13	MZ	45	1.4
IRF6775MTRPBF		ClassD	47		56		±20	28	25	6.6	8	MZ	45	1.4
IRF6641TRPBF	200	SR / PB	60		51		±20	26	34	9.5	11	MZ	45	1.4
IRF6785MTRPBF		ClassD	100		85		±20	15	26	6.9	8.2	MZ	45	1.4



Benchmark MOSFETs for DC-DC Buck Converter Applications

International Rectifier offers a family of 30V synchronous buck MOSFETs for DC-DC synchronous point-of-load (POL) converters. The SO-8 synchronous MOSFETs are designed for high density applications requiring small size, high efficiency and improved thermal conduction, making them ideally suited for notebook applications and point-of-load (POL) converters used in servers, as well as advanced telecom and datacom systems.

The new 30V, N-channel devices are offered in standard D-Pak, SO-8 and the newly introduced "Power QFN" packages that are optimized for the high volume production. The power quad flat-pack no-lead (PQFN) packages provide improved thermal performance and flexibility for new designs within a common SO-8 package form factor.

These new MOSFETs offer significant gate oxide improvement over previous generations and provide high performance as part of a system-wide solution to optimize 12VIN / 1-3VOUT DC-DC synchronous buck converter applications. Low RDS(on) and low Qg makes these new parts ideally suited for point-of-load converter applications. The low conduction losses improve full-load efficiency and thermal performance while the low switching losses help to achieve high efficiency even at light loads. The new devices enable a simplified cost-effective migration for existing designs.

MOSFET Features and Benefits:

- RoHS-compliant
- Halogen free
- Ideally suited for POL synchronous buck converter applications
- Very low RDS(on) at 4.5V VGS
- Low conduction losses
- Improved full load efficiency and thermal performance
- High efficiency, even at light loads

Power QFN Features and Benefits:

- Compact 5 x 6 mm² package
- Low thermal resistance
- Large source lead for more reliable soldering
- Pin compatible to SO-8
- Optimized for high volume production

Market/Applications:

- Notebooks
- Point-of-load (POL) converters used in servers
- Advanced telecom and datacom systems

The IR Advantage:

- Benchmark performance standards and manufacturing capabilities
- Widest range of packages up to 250V
- Industry-leading quality

Part Number	Function	Package	VDS (V)	VGS (V)	ID@ TA = 25°C (A)	R _{DS(on)} (mΩ)		VTH (V)	QG (nC)
						VGS = 4.5V	VGS = 10V		
IRF8707PBF	Load Switch	SO-8	30	±20	11	17.5	11.9	>1.35	6.2
IRF8714PBF	Control FET	SO-8	30	±20	14	13.0	8.7	>1.35	8.1
IRF8721PBF	Control FET	SO-8	30	±20	14	12.5	8.5	>1.35	8.3
IRLR8721PBF	Control FET	D-Pak	30	±20	65	11.8	8.4	>1.35	8.5

Part Number	Function	Package	VDS (V)	VGS (V)	ID@ TA = 25°C (A)	R _{DS(on)} (mΩ)		VTH (V)	QG (nC)
						VGS = 4.5V	VGS = 10V		
IRF8736PBF	Sync FET	SO-8	30	±20	18	6.8	4.8	>1.35	17
IRF7862PBF	Sync FET	SO-8	30	±20	21	4.5	3.7	>1.35	30
IRLR8743PBF	Sync FET	D-Pak	30	±20	160	3.9	3.1	>1.35	39

Two new part numbers IRFH7921PBF and IRFH7932PBF are offered in the new Power QFN package. The new PQFN provides designers the flexibility to shrink their form factor while improving performance and reliability. It measures at a compact 5 x 6 mm² and has a large source lead for more reliable soldering. The PQFN offers thermal impedance improvements of up to 30 percent and current rating improvements of up to 15 percent over SO-8 package. With its footprint and height advantage, PQFN fills the gap between SO-8 and DirectFET packages. The new package is optimized for high volume production.

Part Number	Function	Package	VDS (V)	VGS (V)	ID@ TA = 25°C (A)	R _{DS(on)} (mΩ)		VTH (V)	QG (nC)
						VGS = 4.5V	VGS = 10V		
IRFH7921PBF	Control FET	PQFN	30	±20	15	12.5	8.5	>1.35	9.3
IRFH7932PBF	Sync FET	PQFN	30	±20	25	3.9	3.3	>1.35	34



Benchmark MOSFETs for Synchronous Rectification Applications

IR has expanded its range of 60V, 75V, and 100V HEXFET® MOSFETs designed for AC-DC synchronous rectification in servers, laptop adaptors, and desktop power supplies with the introduction of the new IRFB/S/SL3206, IRFB3077, and IRFB4110.

In the ongoing quest to increase the power density and speed of data processing circuits, the need for higher density power supplies continues to grow. The new IRFB/S/SL3206, IRFB3077, and IRFB4110 MOSFETs enable improved power density by lowering RDS(on) by up to 10% compared to previous industry standards and offer superior synchronous rectification performance through improved RDS(on) in AC-DC SMPS applications.

The highly efficient 75V and 100V HEXFET power MOSFETs, in a TO-220 package, enable a part count reduction of 30% or more in secondary synchronous rectification and full-bridge topology power supplies compared to competing devices in the same package.

The 75V MOSFETs are designed to shrink circuit size and increase power density in high power server AC-DC switch-mode power supplies (SMPS) with 12V output or 48V rail ORing circuits. The 100V devices are well suited to high power flyback secondary rectification and offer enhanced primary-side efficiency in high power telecom isolated 48V DC-DC converters. In addition, the new MOSFETs can be used in stepper motor and brushless DC motor drive applications.

Features and Benefits:

- Tailored for synchronous rectification applications
- Enable lower conduction losses for higher efficiency and greater power density
- Available in TO-220, D2PAK, D2PAK-7 and TO-262 packages
- Available lead-free
- Qualified Industrial and moisture sensitivity MSL1

Market/Applications:

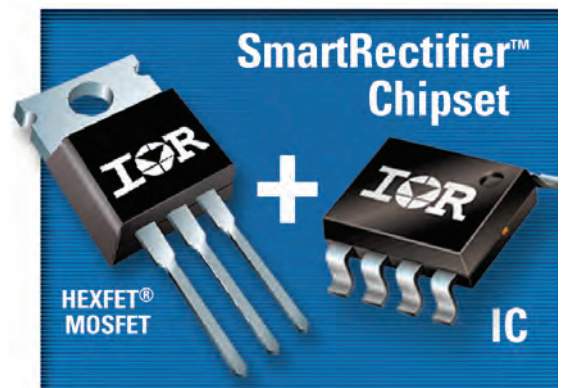
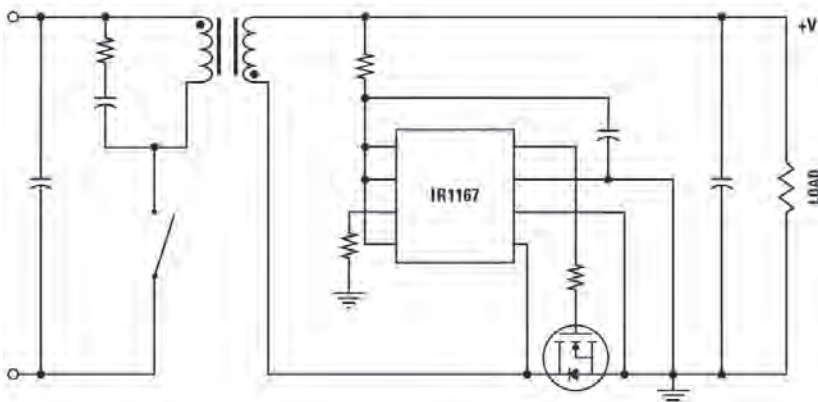
- AC-DC servers, laptop adaptors, and desktop power supplies
- Telecom and server ORing function for 48V rails
- Primary side 24V VIN DC-DC and low voltage motor drive applications

The IR Advantage:

- Industry's Lowest RDS(on)
- Covering 12V – 24V output SMPS power requirements
- Benchmark performance in AC-DC SMPS applications

Part Number	V _{DS} (V)	I _D (A)	R _{DS(on)} @ V _{GS} = 10V (mΩ)	Q _G (nC)	Package
IRF2804PBF	40	270	2.3	160	TO-220
IRF2804SPBF	40	270	2.0	160	D ² Pak
IRF2804S-7PPBF	40	320	1.6	170	D ² Pak-7
IRF3805S-7PPBF	55	240	2.6	130	D ² Pak-7
IRFB3206PBF	60	210	3.0	120	TO-220
IRFS3206PBF	60	210	3.0	120	D ² Pak
IRFB3077PBF	75	210	3.3	160	TO-220
IRFS3207ZPBF	75	170	4.1	120	D ² Pak
IRF2907ZS-7PPBF	75	180	3.8	170	D ² Pak-7
IRFB4110PBF	100	180	4.5	150	TO-220
IRFS4310ZPBF	100	127	6.0	120	D ² Pak
IRFB4321PBF	150	83	15	71	TO-220
IRFS4321PBF	150	83	15	71	D ² Pak
IRFB4227PBF	200	65	24	70	TO-220
IRFS4227PBF	200	62	26	70	D ² Pak
IRFB4332PBF	250	60	33	99	TO-220
IRFS4229PBF	250	45	48	72	D ² Pak

HEXFET[®] MOSFETs can be used with IR's Smart Rectifier to provide the ultimate Smart Rectifier Chipset solutions. SmartRectifier IR1166/67 is a secondary control IC with built in 7A gate drive. Operating independently from the primary side, it uses a proprietary voltage level detection technique to minimize wasteful secondary reactive currents to maximize secondary efficiency. The proprietary 200V HVIC technology allows direct sensing and control of the HEXFET MOSFETs.





Benchmark MOSFETs for Industrial Applications

As the industrial market continues to evolve, so does the need for reliable and rugged switching devices. Large battery driven applications, such as forklifts, uninterruptible power supply (UPS) systems, power tools, electric bikes, and other DC motor driven systems are pushing the limits of efficiency and reliability as the need for more power and extended battery life continues to be a staple of newer designs. The need for rugged and efficient MOSFETs is an integral part of these designs. IR's latest offering of power MOSFETs meets the demands of these applications as they offer the best performing devices in the most reliable package offerings on the market.

The new 7-pin D2PAK, for example, combined with IR's latest silicon technology offers superior $R_{DS(on)}$ and increased power rating compared to standard D2PAK devices. A standard three-lead D2PAK is limited to approximately 100A, depending on lead cross-section and manufacturer's specification method. IR's devices have an enhanced 7-pin lead frame that allows a larger wire bond area, reducing die-free package resistance. Using the D2PAK outline, the 7-pin version can also increase the voltage rating from the standard D2PAK and thus increase the safety margin in specific circuitry and load topologies where a higher voltage rating can handle large transients caused by sudden changes in the load.

The 40V IRF2804S-7PPBF (160A continuous) and the 55V IRF3805S-7PPBF (160A continuous) have an $R_{DS(on)}$ value of $1.6\text{ m}\Omega$ and $2.6\text{ m}\Omega$ respectively. The enhanced current rating allows for a considerable improvement in power density. They are an ideal replacement for multiple D2PAK devices as well as larger through-hole package devices. In addition, repetitive avalanche (EAR) is characterized on the data sheet and guaranteed up to maximum junction temperature (T_{j-max}).

Features and Benefits:

- Low on resistance per silicon area
- Optimized for both fast switching and low gate charge
- Excellent gate, avalanche and dynamic dv/dt ruggedness

Market/Applications:

- DC Motor Drives
- Uninterruptible Power Supplies (UPS)
- DC-DC Converters
- Power Tools
- Electric Bikes

The IR Advantage:

- Best die to footprint ratio
- Industry's lowest $R_{DS(on)}$
- Largest range of packages up to 250V
- Industry-leading quality

7-Pin D²PAK : A Unique Alternative

7-Pin D²PAK advantages over standard D²PAK

- Up to 0.4mΩ less R_{DS(on)}
- Double the current handling capability
- Superior thermal performance



IRF2804SPBF 40V VDS	
Id	R _{DS(on)}
270A	2.0mΩ

IRF2804S-7PPBF 40V VDS	
Id	R _{DS(on)}
320A	1.6mΩ

Part Number	VDS (V)	RDS(on) Max. @VGS=10V (mΩ)	Id (A)	Qg (nC)	Package
IRF2804S-7PPBF	40	1.6	320	170	D ² PAK-7
IRF2804SPBF	40	2.0	270	160	D ² PAK
IRF2804PBF	40	2.3	270	160	T0-220
IRF3805S-7PPBF	55	2.6	240	130	D ² PAK-7
IRFB3206PBF	60	3.0	210	120	T0-220
IRFS3206PBF	60	3.0	210	120	D ² PAK
IRFP3206PBF	60	3.0	210	120	T0-247
IRF1018EPBF	60	8.4	79	69	T0-220
IRF1018ESPBF	60	8.4	79	69	D ² PAK
IRFR1018EPBF	60	8.4	79	69	D-PAK
IRFB3806PBF	60	15.8	43	30	T0-220
IRFS3806PBF	60	15.8	43	30	D ² PAK
IRFR3806PBF	60	15.8	43	30	D-PAK
IRFB3077PBF	75	3.3	210	160	T0-220
IRFP3077PBF	75	3.3	210	160	T0-247
IRF2907ZS-7PPBF	75	3.8	180	170	D ² PAK-7
IRFS3207ZPBF	75	4.1	170	120	D ² PAK
IRFB3607PBF	75	9.0	80	84	T0-220
IRFS3607PBF	75	9.0	80	84	D ² PAK
IRFR3607PBF	75	9.0	80	84	D-PAK
IRFB4110PBF	100	4.5	180	150	T0-220
IRFP4110PBF	100	4.6	168	152	T0-247
IRFS4310ZPBF	100	6.0	127	120	D ² PAK
IRFP4310ZPBF	100	6.0	127	120	T0-247
IRFB4321PBF	150	15	83	71	T0-220
IRFS4321PBF	150	15	83	71	D ² PAK
IRFB4227PBF	200	24	65	70	T0-220
IRFS4227PBF	200	26	62	70	D ² PAK
IRFB4332PBF	250	33	60	99	T0-220
IRFS4229PBF	250	48	45	72	D ² PAK

PRODUCT FAMILIES | Benchmark MOSFETs

PQFN Package, N Channel MOSFETs

Part Number	BV _{DSS} Max. (V)	R _{DS(on)} Max. @ V _{GS} =10V (mΩ)	V _{GS} Max. (V)	I _D @ TA=25°C (A)	Q _g Typ. (nC)	Package
IRFH7932PBF	30V	3.3	± 20	25	34	PQFN
IRFH7921PBF		8.5	± 20	15	9.3	PQFN

These parts are Trench MOSFETs and should be used in switching power supply applications.

SO-8 Package, N Channel MOSFETs

Part Number	BV _{DSS} Max. (V)	R _{DS(on)} Max. @ V _{GS} =10V (mΩ)	V _{GS} Max. (V)	I _D @ TA=25°C (A)	Q _g Typ. (nC)	Package
IRF3717PBF	20	4.4	± 20	20	22	SO-8
IRF7862PBF	30	3.7	± 20	21	30	SO-8
IRF8736PBF		4.8	± 20	18	17	SO-8
IRF8721PBF		8.5	± 20	14	8.3	SO-8
IRF8714PBF		8.7	± 20	14	8.1	SO-8
IRF8707PBF		11.9	± 20	11	6.2	SO-8
IRF7842PBF	40	5.0	± 20	18	33	SO-8
IRF7855PBF	60	9.4	± 20	12	26	SO-8
IRF7854PBF	80	13.4	± 20	10	27	SO-8
IRF7493PBF		15	± 20	9.2	31	SO-8
IRF7853PBF	100	18	± 20	8.3	28	SO-8
IRF7495PBF		22	± 20	7.3	34	SO-8
IRF7494PBF	150	44	± 20	5.2	36	SO-8
IRF7492PBF	200	79	± 20	3.7	39	SO-8

These parts are Trench MOSFETs and should be used in switching power supply applications.

Surface Mount Power Packages, Logic Level, N Channel MOSFETs

Part Number	BV _{DSS} Max. (V)	R _{DS(on)} Max. @ V _{GS} =10V (mW)	I _D @ TA=25°C (A)	Q _g Typ. (nC)	Package
IRLR3717PBF	20V	5.5	120	21	D-Pak
IRLR3715ZPBF		15.5	49	7.2	D-Pak
IRL3715ZSPBF		15.5	50	7.0	D ² Pak
IRLR3714ZPBF		25	37	4.7	D-Pak
IRL3714ZSPBF		26	36	4.8	D ² Pak
IRLR8743PBF	30V	3.9	160	39	D-Pak
IRL7833SPBF		4.5	150	32	D ² Pak
IRL8113SPBF		7.1	105	23	D ² Pak
IRLR8113PBF		7.4	94	22	D-Pak
IRLR8721PBF		11.8	65	8.5	D-Pak
IRLR7807ZPBF		18.2	43	7.0	D-Pak
IRL1404ZSPBF	40V	5.9	200	75	D ² Pak
IRLR3114ZPBF		6.5	130	40	D-Pak
IRLR3705ZPBF	55V	12.0	89	44	D-Pak
IRLR2905ZPBF		22.5	60	23	D-Pak
IRLR024ZPBF		100	16	6.6	D-Pak
IRLR3110ZPBF	100V	16	63	34	D-Pak

These parts are Trench MOSFETs and should be used in switching power supply applications.

Through-Hole Packages, Logic Level, N Channel MOSFETs

Part Number	BV _{DSS} Max. (V)	R _{DS(on)} Max. @ V _{GS} =10V (mW)	I _D @ TA=25°C (A)	Q _g Typ. (nC)	Package
IRL3715ZPBF	20V	15.5	50	7.0	TO-220AB
IRL3714ZPBF		26	36	4.8	TO-220AB
IRL7833PBF	30V	4.5	150	32	TO-220AB
IRL8113PBF		7.1	105	23	TO-220AB
IRL1404ZPBF	40V	5.9	200	75	TO-220AB

These parts are Trench MOSFETs and should be used in switching power supply applications.

PRODUCT FAMILIES | Benchmark MOSFETs

Surface Mount Power Packages, N Channel MOSFETs

Part Number	BV _{DSS} Max. (V)	R _{DS(on)} Max. @ V _{GS} =10V (mW)	I _D @ TA=25°C (A)	Q _g Typ. (nC)	Package
IRFR3711ZPBF	20V	5.7	93	18	D-Pak
IRF3711ZSPBF		6.0	92	16	D ² Pak
IRF3704ZSPBF		7.9	67	8.7	D ² Pak
IRFR3704ZPBF		8.4	60	9.3	D-Pak
IRF1324S-7PPBF	24V	1.0	429	180	D ² Pak 7-pin
IRF2903ZSPBF	30V	2.4	260	160	D ² Pak
IRF3709ZSPBF		6.3	87	17	D ² Pak
IRFR3709ZPBF		6.5	86	17	D-Pak
IRFR3707ZPBF		9.5	58	9.6	D-Pak
IRF3707ZSPBF		9.5	59	9.7	D ² Pak
IRF2804S-7PPBF	40V	1.6	320	170	D ² Pak 7-pin
IRF2804SPBF		2.0	270	160	D ² Pak
IRF1404ZSPBF		3.7	190	100	D ² Pak
IRFR4104PBF		5.5	119	59	D-Pak
IRF4104SPBF		5.5	120	68	D ² Pak
IRFR3504ZPBF		9.0	77	30	D-Pak
IRF3805S-7PPBF	55V	2.6	240	130	D ² Pak 7-pin
IRF3205ZSPBF		6.5	110	76	D ² Pak
IRFR1010ZPBF		7.5	94	63	D-Pak
IRFZ48ZSPBF		11	61	43	D ² Pak
IRFR48ZPBF		11	62	40	D-Pak
IRFZ44ZSPBF		13.9	51	29	D ² Pak
IRFR4105ZPBF		24.5	30	18	D-Pak
IRFS3206PBF	60V	3.0	210	120	D ² Pak
IRFS3306PBF		4.2	160	85	D ² Pak
IRFR1018EPBF		8.4	77	46	D-Pak
IRF1018ESPBF		8.4	77	51	D ² Pak
IRFR3806PBF		16.2	42	22	D-Pak
IRFS3806PBF		16.2	42	22	D ² Pak
IRF2907ZS-7PPBF	75V	3.8	180	170	D ² Pak 7-pin
IRFS3207ZPBF		4.1	170	120	D ² Pak
IRFS3307ZPBF		5.8	120	79	D ² Pak
IRFR3607PBF		9.0	80	51	D-Pak
IRFS3607PBF		9.0	80	51	D ² Pak
IRFR2307ZPBF		16	53	50	D-Pak
IRFR2607ZPBF		22	45	34	D-Pak
IRFS4310ZPBF	100V	6.0	127	120	D ² Pak
IRFS4410ZPBF		9.0	97	83	D ² Pak
IRFS4610PBF		14	73	90	D ² Pak
IRFR3710ZPBF		18	56	69	D-Pak
IRF3710ZSPBF		18	59	82	D ² Pak
IRF540ZSPBF		26.5	36	42	D ² Pak
IRFR120ZPBF		190	8.7	6.9	D-Pak
IRFS4321PBF	150V	15	83	71	D ² Pak
IRFS4227PBF	200V	24	62	70	D ² Pak
IRFS4229PBF	250V	48	45	72	D ² Pak

These parts are Trench MOSFETs and should be used in switching power supply applications.

Through-Hole Packages, N Channel MOSFETs

Part Number	BV _{DSS} Max. (V)	R _{DS(on)} Max. @ V _{GS} =10V (mW)	I _D @ TA=25°C (A)	Q _g Typ. (nC)	Package
IRF3711ZPBF	20	6.0	92	16	TO-220AB
IRF3704ZPBF		7.9	67	8.7	TO-220AB
IRF2903ZPBF	30	2.4	260	160	TO-220AB
IRF3709ZPBF		6.3	87	17	TO-220AB
IRF3707ZPBF		9.5	59	9.7	TO-220AB
IRF2804PBF	40	2.3	270	160	TO-220AB
IRF1404ZPBF		3.7	190	100	TO-220AB
IRF4104PBF		5.5	120	68	TO-220AB
IRF3205ZPBF	55	6.5	110	76	TO-220AB
IRFZ48ZPBF		11	61	43	TO-220AB
IRFZ44ZPBF		13.9	51	29	TO-220AB
IRFB3206PBF	60	3.0	210	120	TO-220AB
IRFP3206PBF		3.0	210	120	TO-247AC
IRFB3306PBF		4.2	160	85	TO-220AB
IRFP3306PBF		4.2	160	85	TO-247AC
IRF1018EPBF		8.4	79	46	TO-220AB
IRFB3806PBF		16.2	43	22	TO-220AB
IRFB3077PBF	75	3.3	210	160	TO-220AB
IRFP3077PBF		3.3	210	160	TO-247AC
IRFB3207ZPBF		4.1	170	120	TO-220AB
IRFP2907ZPBF		4.5	170	180	TO-247AC
IRFB3307ZPBF		5.8	120	79	TO-220AB
IRFB3607PBF		9.0	80	56	TO-220AB
IRFB4110PBF	100	4.5	180	150	TO-220AB
IRFP4110PBF		4.6	168	152	TO-247AC
IRFB4310ZPBF		6.0	127	120	TO-220AB
IRFP4310ZPBF		6.0	127	120	TO-247AC
IRFB4410ZPBF		9.0	97	83	TO-220AB
IRFP4410ZPBF		9.0	97	83	TO-247AC
IRFB4610PBF		14	73	90	TO-220AB
IRF3710ZPBF		18	59	82	TO-220AB
IRF540ZPBF		26.5	36	42	TO-220AB
IRFB4212PBF		72.5	18	15	TO-220AB
IRFB4321PBF	150	15	83	71	TO-220AB
IRFP4321PBF		15.5	78	71	TO-247AC
IRFB4019PBF		95	17	13	TO-220AB
IRFB4227PBF	200	24	65	70	TO-220AB
IRFP4227PBF		25	65	70	TO-247AC
IRFB4020PBF		100	18	18	TO-220AB
IRFP4332PBF	250	33	57	99	TO-247AC
IRFB4332PBF		33	60	99	TO-220AB
IRFP4229PBF		46	44	72	TO-247AC
IRFB4229PBF		46	46	72	TO-220AB

These parts are Trench MOSFETs and should be used in switching power supply applications.

REFERENCE DESIGNS



AC-DC ICs Reference Designs

International Rectifier offers a wide range of reference designs for AC-DC applications. Each reference design kit includes a fully assembled and tested demo board along with applicable datasheets and application notes.

Featured Kits

IRAC1150-D2

One Cycle Control μ PFC Daughter Board

- Featuring IR1150S PFC IC
- Brownout, Over Voltage & Open feedback loop protection
- Universal AC input
- Programmable frequency (50kHz-200kHz)
- Full load start up with no minimum load requirements
- Design a PFC Circuit Online, go to PFC Design Software



IRAC1150-300W

PFC IC for use in continuous conduction mode boost converter applications designed for power factor correction and harmonic current reduction.

- Featuring IR1150S PFC IC
- Universal AC input
- Total Power 300W @ 377V DC
- Frequency 50kHz-300kHz programmable
- Design a PFC Circuit Online, go to PFC Design Software



IRAC1166-100W

+16V Low-side Smart Rectification 100W Flyback

- Wide Input Synchronous Buck Regulator
- Universal AC input
- 16V @ 6.25A during active rectification mode
- Featuring heatsink less secondary



AC-DC ICs Reference Designs

Reference Design	Part Number	Description
IRAC1150-D2	IR1150	One Cycle Control μ PFC Daughter Board
IRAC1150-300W	IR1150	PFC IC for use in continuous conduction mode boost converter applications designed for power factor correction and harmonic current reduction.
IRAC1166-100W	IR1166	Synchronous rectification IC for use in 100W Flyback applications.

Appliance Reference Designs

International Rectifier offers the IRADK31 reference design for Appliance applications. This reference design kit includes a fully assembled and tested demo board along with applicable datasheets and application notes.

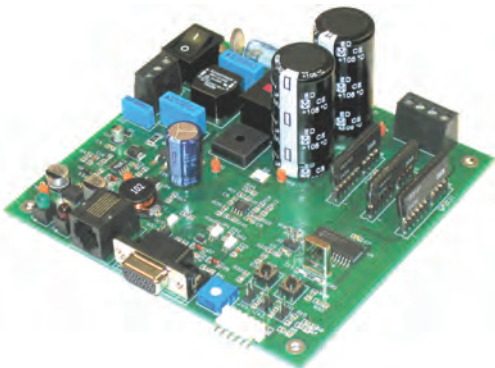


Featured Kits

IRADK-S10UP60

1/2 HP AC motor drive using the IRAMS10UP60B

- Featuring the IRAMS10UP60B Appliance power module
- 3-Phase 115-230V Volts/Hertz ac motor drive
- Opto-isolated RS-232 serial link interface to the GUI software
- GUI displays drive status
 - DC bus voltage
 - Estimated junction temperature
 - Output current
 - Modulation index
- GUI settable parameters
 - PWM frequency
 - Dead time
 - Motor rated voltage and frequency
 - Target speed
 - Current limit



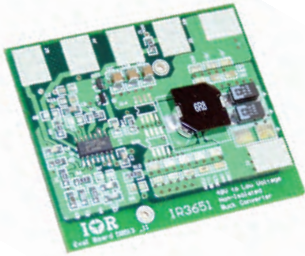
IRADK31

1/4 HP DC brushless motor using IR31xx

- Featuring IR3101 or IR3103
- 3-Phase 115-230V motor drive
- Opto-isolated RS-232 serial link interface to the GUI software.
- GUI Displays driver status, DC-link current, motor speed.
- GUI user settable parameters:
 - Motor operating speed
 - PWM frequency
 - Current Limit.

DC-DC Reference Designs

International Rectifier offers a wide range of reference designs for DC-DC applications. Each reference design kit includes a fully assembled and tested demo board along with applicable datasheets and application notes.



IRDC3651

Wide Input Synchronous Buck Regulator

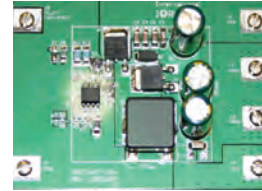
- Ideal for onboard DC-DC applications
- 48 V_{IN}, 3.3 V_{OUT} @ 10A I_{OUT}
- 100 KHz switching frequency
- Footprint compatible with either DirectFETs or SO-8 MOSFETs



IRDC3623

2-Phase Dual Sync Buck with Oscillator Synchronization

- Featuring IR3623M PWM Controller
- iP2003A Power Block
- Pie-bias Startup
- Ideal for high current onboard DC to DC applications
- Programmable switching frequency up to 1.2 MHz
- 12 V_{IN}, 1.8 V_{OUT} @ 60A each



IRPP3637-18A

Synchronous Buck Regulator for onboard DC to DC applications

- Featuring IR3637 PWM Controller
- 12 V_{IN}, 3.3 V_{OUT} @ 18A I_{OUT}
- 600 KHz switching frequency
- Programmable soft start
- Under voltage lockout

DC-DC Reference Designs

Reference Design	Part Number	Description
IRDC3037	IRU3037	8-pin synchronous PWM controller, 200 KHz
IRPP3637-06A	IR3637A	Optimized 6A Powir+ reference design featuring IR3637A synchronous buck controller
IRPP3637-06A	IR3637	Optimized 12A Powir+ reference design featuring IR3637 synchronous buck controller
IRPP3637-06A	IR3637	Optimized 18A Powir+ reference design featuring IR3637 synchronous buck controller
IRPP3624-05A	IR3624	Optimized 5A Powir+ reference design featuring IR3624 synchronous buck controller
IRPP3624-12A	IR3624	Optimized 12A Powir+ reference design featuring IR3624 synchronous buck controller
IRDC3037A	IRU3037A	8-pin synchronous PWM controller, 400 KHz
IRDC3065	IRU3065	Positive to negative voltage converter
IRDC3621	IR3621M	Reference design kit featuring High Performance Dual Synchronous Buck Controller
IRDC3624	IR3624	Reference design kit featuring High Performance Synchronous Buck Controller
IRDC3637	IR3637	Reference design kit featuring High Performance Dual Synchronous Buck Controller
IRDC3651	IR3651PBF	Reference design kit featuring Wide Input Synchronous Buck Regulator
IRDCiP1201-A	iP1201	2-phase, 30A, 3.14-5.5VIN, 0.8-3.3VOUT synchronous buck converter reference design
IRDCiP1202-A	iP1202	2-phase, 30A, 5.5-13.2VIN, 0.8-3.3VOUT synchronous buck converter reference design
IRDCiP1203-A	iP1203	1-phase, 15A, 5.5-13.2VIN, 1.0-3.3VOUT synchronous buck converter reference design
IRDCiP2001-A	iP2001	2-phase, 40A, 5-12VIN, 1-2VOUT multiphase buck converter reference design
IRDCiP2001-B	iP2001	3-phase, 60A, 5-12VIN, 1-2VOUT multiphase buck converter reference design
IRDCiP2001-C	iP2001	4-phase, 80A, 5-12VIN, 1-2VOUT multiphase buck converter reference design
IRDCiP2002-C	iP2002	4-phase, 120A, 6.5-12VIN, 0.8-3.3VOUT multiphase buck converter reference design

Lighting Reference Designs

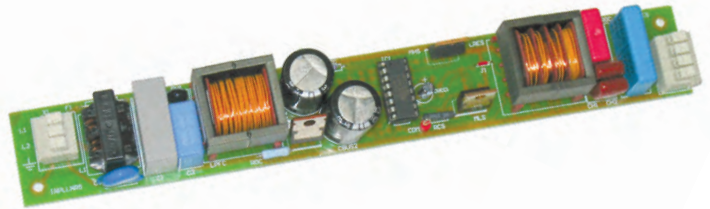
International Rectifier offers a wide range of reference designs for Lighting applications. Each reference design kit includes a fully assembled and tested demo board along with applicable datasheets and application notes.

Featured Kits

IRPLLNR5

Universal Input Linear Fluorescent Ballast for 54W TL5 Lamp

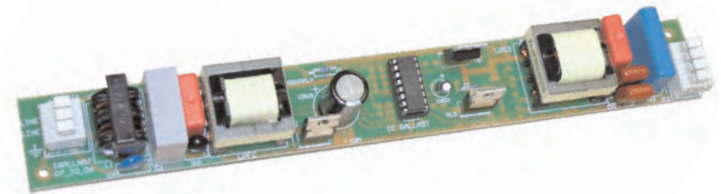
- Using IRS2168D HVIC ballast controller
- High Power Factor/Low THD
- High Frequency Operation
- Lamp Filament Preheating
- Lamp Fault Protection with Auto-Restart
- Low AC Line Protection
- End of Lamp Life Shutdown
- Optimum THD for wide range input voltage



IRPLLNR7

Universal Input Linear Fluorescent Ballast for 35W TL5 Lamp

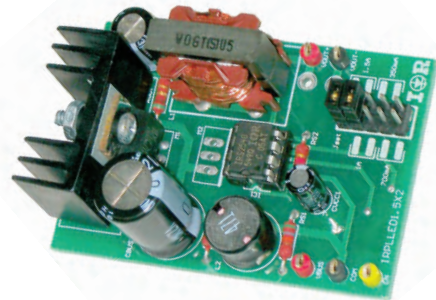
- Using IRS2166D HVIC ballast controller
- High Power Factor/Low THD
- High Frequency Operation
- Lamp Filament Preheating
- Lamp Fault Protection with Auto-Restart
- Low AC Line Protection
- End of Lamp Life Shutdown



IRPLED1

High-voltage DC-DC buck converter for HB-LEDs constant current control

- Featuring IRS2540PbF HVIC LED buck controller
- Time delayed hysteretic regulation
- Continuous load current control
- High Frequency Operation, PWM Dimmable
- Synchronous rectification ,Auto restart, non-latched shutdown



Reference Design	Part Number	Description
IRPLCFL2	IR2156	42W, single, compact fluorescent lighting ballast, IR2156 100/220VAC
IRPLCFL3	IR2156	A ballast that can be dimmed from a domestic (phase cut) dimmer.
IRPLCFL4	IR2156	A 3-Way Dimming CFL Ballast
IRPLCFL6	IR2166	High Power CFL for 60W-12W, 100-250VAC Input
IRPLDIM2U	IR21592	Digital dimming DALI (Digital Addressable Lighting Interface) compliant lighting linear ballast with 1% dimming, IR2159, U.S. version, 120VAC line, 32W/T8 lamp
IRPLHAL01E	IR2161	Halogen Convertor, 220/230VAC Input, 12VAC Output, 100VA Max

Motor Control Reference Designs

International Rectifier offers a number of reference designs for AC Induction or Brushless Motor motion control applications. Each reference design kit includes a fully assembled and tested demo board along with applicable datasheets and application notes.

Featured Kits

IRMD22381Q

A complete AC and brushless motor driver used with a 30A power module

- Featuring IR22381Q Three phase gate driver IC with advanced protection functions
- High Current Gate Driver for AC Induction or Brushless Motors
- Integrated desaturation detection circuit
- 1200V DC-Bus Capability up to 50A
- Compatible with standard ECONO2-6PACK IGBT module (Not included in design kit)



IRMD22141SS

High Current Gate Driver Reference design

- Featuring IR22141SS half bridge gate driver IC
- High Current Gate Driver for AC Induction or Brushless Motors
- Integrated desaturation detection circuit with active bias
- 1200V DC-Bus Capability up to 50A
- Compatible with standard ECONO2-6PACK IGBT module (Not included in design kit)



Reference Design	Part Number	Description
IRMD22381Q	IR22381Q	High Current Gate Driver reference design for AC Induction or brushless motors. Features include Integrated desaturation detection circuit & 1200V DC-Bus Capability up to 50A. Compatible with standard ECONO2-6PACK IGBT module (Not included in design kit)
IRMD2214SS	IR2214SS	High Current Gate Driver reference design for AC Induction or brushless motors. Features include Integrated desaturation detection circuit with active bias & 1200V DC-Bus Capability up to 50A. Compatible with standard ECONO2-6PACK IGBT module (Not included in design kit)
IRMD22141SS	IR22141SS	Complete AC and brushless motor driver used with a 30A power module. Features include Integrated desaturation detection circuit with active bias & 1200V DC-Bus Capability up to 50A. Compatible with standard ECONO2-6PACK IGBT module (Not included in design kit)
IRCS2277S	IR2277S	For 3-phase / 380V motor drives the IRCS2277S is designed to read 3-phase motor currents on top of pin-out compatible gate driver boards. The board can be used for both AC and Brushless motors current sensing by reading the voltage developed on shunt resistors.

RESOURCES

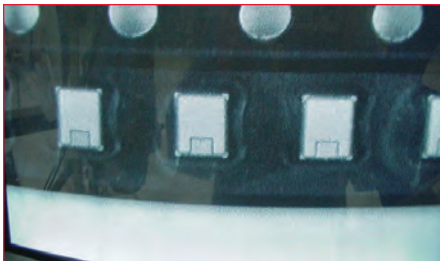


The IR Advantage

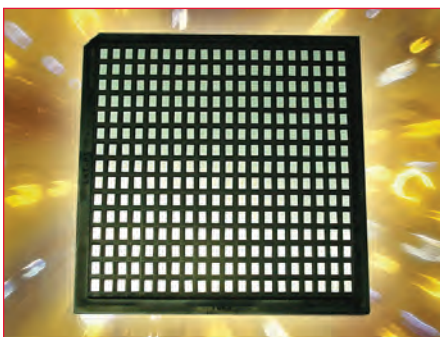
- KGD testing equal to package part testing
- 100% Avalanche capability for more than 75A
- Singulated testing, eliminating lateral current paths
- Accurate testing for $R_{DS(on)}$
- Voltage ratings up to 1200V
- Leakage current testing down to nA range
- Pogo pins provide accurate voltage and resistance readings
- Hybrid modifications enable clean noise environment
- Each die is warranted to be electrically good



KGD package Options



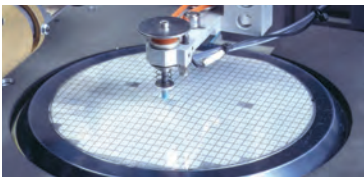
T&R option: T&R dimensions are according to die size.



Chip pack option: Tray packaging option can be either 4" x 4" or 2" x 2" (outside dimensions).

International Rectifier's SureCHIP Program is a process regimen that combines high-volume manufacturing and assembly with precision parametric testing and special packaging to deliver Known Good Die (KGD) power semiconductors. The KGD process provides measurably higher yields and is an economically viable solution in the manufacturing of multi-chip modules (MCMs). As part of the SureCHIP process, individual good die from probed and sawn wafers are transferred to a custom-designed test nest for 100% electrical and visual testing.

SureCHIP power semiconductor die are packaged into tape and reel in a nitrogen atmosphere or into chip trays for shipment. The SureCHIP KGD process is qualified for 100% DC parametric testing. Additionally, avalanche testing on MOSFETs and short circuit testing on IGBTs can be performed.



Individual Die from probed and sawn wafer are transferred to a custom designed test nest for electrical testing

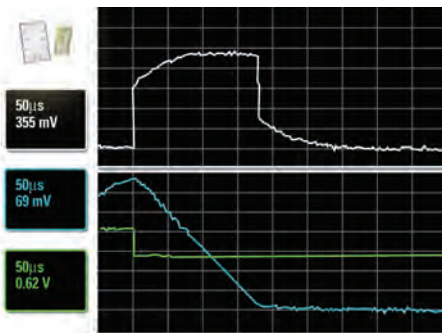


SureCHIP is packaged in tape after passing 100% electrical testing and visual inspection



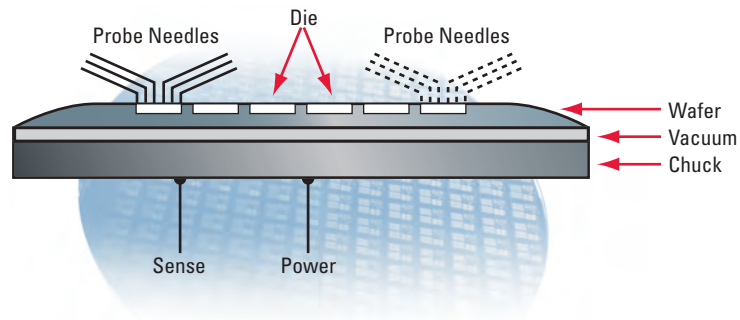
Die is fully tested in the proprietary test nest with the true Kelvin connections to enable measurements at high current

Sample Avalanche Test Results



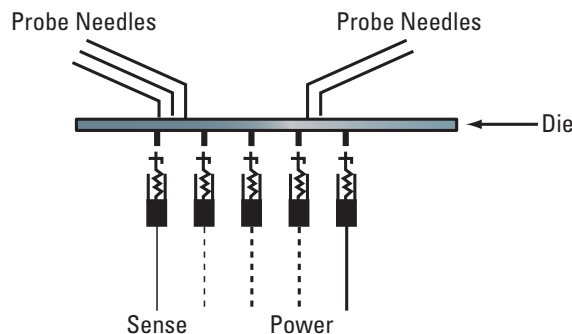
Comparison of Wafer Level Testing of $R_{DS(on)}$ vs. IR's KGD Solution

Wafer Level Testing



1. Multiple contacts between backside of wafer and chuck tester
2. Die to Die interference cannot be isolated
3. $R_{DS(on)}$ accurate down to $20m\Omega$
4. I_{DRAIN} measurements constrained to less than 10A
5. Parallel testing resulting in multiple signal paths that can effect results
6. Key measurements impacted by Kelvin contacts over entire backside of wafer
7. High risk for final application due to dicing operation

IR's KGD Level Testing



1. Pogo pins provide uniform contact
2. Direct contact with isolated Die
3. $R_{DS(on)}$ accurate down to $2.5m\Omega$
4. I_{DRAIN} Measurements possible to greater than 75A
5. Singulated testing, eliminating lateral current paths
6. Hybrid modifications enable cleaner noise environment
7. Kelvin contact fixed to single location for single die
8. Singulated die usually pre-screened for mechanical defects

The myPOWER Advantage

- Eliminates simulation model development by giving access to a fully developed, highly accurate and FREE model
- Eliminates the delay in building breadboards and most breadboarding iterations
- Enables more robust designs optimized for cost and performance
- Saves 1 to 6 months in development time and thousands of dollars in development cost

DESIGN TOOL SELECTIONS



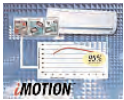
Power Factor Correction

Simple circuit design
Calculate all part values
Reduce PCB space 50%



Point of Load

Simulate iPower circuits
Compare discrete MOSFETs
Calculate efficiency and Tj



Motor Control

Analyze performance
Compare IGBT modules
Calculate efficiency and Tj



Synchronous Rectification

Improve circuit efficiency
Compare MOSFET choices
Calculate all part values



Bus Converter

Multiple Topologies
Compare discrete MOSFETs
Calculate efficiency and Tj



Lighting

Create Schematic and BOM
Display output waveforms
AC or DC input Designs



- Simulate Circuits
- Analyze Waveforms
- Compare MOSFETS
- Calculate Losses

Designing DC-DC converters for advanced NPU or CPU is becoming increasingly complex. Now you have an alternative to starting your new design from scratch.

Try the myPOWER on-line design center: it is one place dedicated to the design of high performance DC-DC converters operating at up to 80A at V_{OUT} as low as 1.1V and at frequencies as high as 1 MHz.

myPOWER gives you a proven design with a complete, costed BOM and a high speed, +/-5% accuracy simulation tool to verify and optimize your circuit. And you can order a customized reference design kit for overnight delivery.



Global Environmental, Health, and Safety Policy

International Rectifier is committed to protecting and preserving the environment in all its business operations and providing a safe and secure workplace. It is our intent to respect the views of our customers, employees, community, and stakeholders as a responsible business dedicated to continual improvement in environmental, health and safety management and the prevention of pollution.

Consistent with our values, principles, and policies, we pledge to:

- Encourage the efficient use of electricity by improving the power conversion process through the development of innovative products.
- Comply with all applicable laws and regulations, and consider any other requirements to which we subscribe.
- Ensure policy performance by stating objectives and setting clear targets for their achievement as part of the Annual Business Planning process.
- Review our EH&S management system to assure its continued applicability and effectiveness through periodic assessments and audits.
- Help conserve natural resources through additional cost-effective reuse, recycling, and reduction efforts in existing and future operations.
- Foster a safe and secure work environment by increasing employee knowledge and awareness of environmental, health and safety best practices.
- Communicate the Policy to all employees, stakeholders, and make it available to the public.

Stewardship

Creating Environmental Value - International Rectifier is dedicated to providing an environmentally sustainable future by creating environmental value through our product designs and reducing our local and global environmental footprint through a management culture that integrates environmental goals into the decision making model

- IR designs and manufactures power management products that save energy, providing leadership to an environmentally sustainable future.
- Reducing our footprint on the local and global environment by having environmental goals as part of our annual business planning process.
- ISO14001 Certifications

Online Self Support

Technical Documents

- Electronics 101 tutorial
- Application notes
- Technical papers
- Design tips
- FAQ's

Design Support

- Software Design Tools
 - MyPower, with two primary sections, MOSFET selector tool & iPowir Sync Buck Simulator
 - HEXRISE Temperature Rise Calculator
 - DirectFET Thermal Rating Calculator
 - Ballast Design Assistant (BDA) software
 - Spice & Saber Models
- Reference design kits
- Design tips

Product Information

- Parametric Search
- Product Line
- New Products
- Cross & Replacement
- Lead Free
- Product Packaging
- Product Literature
- Quality & Reliability
- Samples & Sales



Our Mission as a Global Technical Assistance Center

Our mission as a global Technical Assistance Center is to provide quality prompt solutions to customer inquiries. In addition to self-support material available on our website qualified application engineers are available to address your questions by email/online or by phone. Our global presence allows for a continuous 24 hours operation, enabling us to resolve most inquiries within the first business day.

In line with the rapid expansion of IR's proprietary product line, regular up to date training is provided for the TAC staff to ensure quality of support. Additional technical documentation such as application notes and design tips are generated to further encourage online self-support and to reduce resolution time.

TAC Support Channels

- Direct Customers
- IR Sales Reps
- Internal IR Employees
- Distributors
- FAEs

Types of Technical Inquiries Supported by TAC

- Assistance with Design-In of IR Technologies
- Recommendation of Proprietary Product Solutions
- Identification/Verification of Part numbers
- Applications Assistance
- Trouble shooting customer designs
- Product Selection
- Verification of Product datasheet Parameters
- Cross Reference to Competitor Parts
- Recommendations of Upgrades to Obsolete Parts

Value Added for Our Customers

- Global Real Time Support
 - Online & Email
 - Phone & Fax
- Real time literature Support
- Online Software Design Support
- Technical Training Modules
- Tradeshows



How to find Technical Support on the International Rectifier main webpage:



How to submit a question online:



Using the following interface questions along with related attachments (e.g. schematics) can be submitted. Upon successful submission of a question the system will issue an incident tracking number.



“My Stuff” Tab allows to update or to check the status of an incident. This tab also enables the use to answer update notifications, and edit account profile.



Using the FAQ tab you may view our extended online knowledge base:

Channels of Contact

Online: <http://tac.irf.com>

E-mail: tac@irf.com

Phone Numbers:

North America

Hours: 8:00AM-5:00PM PST

Tel: 310-252-7105

Fax: 310-252-7903

Europe:

Hours: 8:30AM-5:30PM GMT

Tel: ++ 33 164 864 93

Fax: ++33 164 864 970

Asia, China (Shenzhen)

Hours: 9:00AM-6:00PM CST

Tel: ++ 86-755-8329-6861

Fax: ++86-755-8329-6862

Asia, China (Shanghai)

Hours: 9:00AM-6:00PM CST

Tel: ++ 86-21-5877-5606

Fax: ++ 86-21-5877-3880

Asia, Korea (Seoul)

Hours: 9:00AM-6:00PM CST

Tel: ++ 82-255-74332

Germany

Hours: 9:00AM-4:00PM CET

Tel: ++ 49-6102-884-310

Fax: ++ 49-6102-884-433

GLOBAL LOCATIONS

Innovation For Energy Conservation — For over 60 years, IR's industry-leading power management technology has helped transform crude electricity into clean, efficient power. Today, IR strives to conserve the world's dwindling energy reserves by:

- Enabling affordable energy-saving solutions that squeeze more efficiency from everyday electronic products and;
- Tackling tough technology roadblocks by delivering high power density that extends performance of next-generation communications and computing equipment with less wasted energy.



Design Centers*

- 1 El Segundo, CA
- 5 Santa Clara, CA
- 6 Irvine, CA
- 7 Leominster, MA
- 8 North Kingstown, RI
- 9 Durham, NC
- 11 Oxted, UK
- 13 Skovlunde, Denmark
- 14 Provence, France
- 15 Pavia, Italy

Technical Assistance Centers and Service Centers*

- 1 El Segundo, CA
- 12 Reigate, UK
- 16 Neu Isenburg, Germany
- 17 Singapore
- 18 Shenzhen, China
- 19 Shanghai, China
- 20 Tokyo, Japan
- 21 Seoul, Korea
- 23 Paris, France

Manufacturing*

- 1 El Segundo, CA
- 2 Temecula, CA
- 3 Mesa, AZ
- 4 Tijuana, Mexico
- 5 Santa Clara, CA
- 7 Leominster, MA
- 10 Newport, Wales, UK
- 22 St. Paul, MN

* Only major centers are listed.

Facts






- Established in 1947
- Over 5,400 employees world wide
- New York Stock Exchange: IRF
- Operations in 20+ countries
- Holder of over 450 technology patents
- Industry leader in R&D investment

Products

- High performance analog, digital and mixed signal ICs
- Advanced circuit devices
- Power systems
- Benchmark MOSFETs

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Application information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by IR for the use or misuse of such information or for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patents rights or IR or others.

Product Line	Applications	Key Products
 <p>Energy Saving Products</p> <p>Integrated design platforms that enable customers to add energy-conserving features that achieve lower operating energy costs and manufacturing Bill of Material (BOM) costs.</p>	<ul style="list-style-type: none"> • Appliances • Audio • Automotive • Display • Industrial • Lighting 	<ul style="list-style-type: none"> • Digital Control ICs • High-Voltage ICs • IGBTs • IRAM Integrated Power Modules • Intelligent Power Switches • MERs
 <p>Enterprise Power</p> <p>Optimized power management system solutions that deliver benchmark power density, efficiency and performance in enterprise power.</p>	<ul style="list-style-type: none"> • Servers • Storage Networks • Switchers & Routers • Workstations • Notebooks 	<ul style="list-style-type: none"> • DirectFET® • Low-Voltage ICs • SupIRBuck™ • XPhase® • Power Monitor IC
 <p>Power Stage</p> <p>This optimized and versatile functional component combines multiple power semiconductors, ICs, and passive elements into a single thermally enhanced package.</p>	<ul style="list-style-type: none"> • Mobile Computers • Switchers & Routers • Servers • Game Stations 	<ul style="list-style-type: none"> • iP120x • iP200x
 <p>Benchmark MOSFETs</p> <p>IR continues to lead the industry by offering power MOSFETs with the lowest $R_{DS(on)}$ and widest range of packages up to 250V for a diverse range of applications.</p>	<ul style="list-style-type: none"> • Automotive • Computing • Communications • Motor Control 	<ul style="list-style-type: none"> • Trench HEXFET® MOSFETs • Discrete HEXFET® MOSFETs • Dual HEXFET® MOSFETs • FlipFET™ • FETKY® • Hybrid HEXFET® MOSFETs
 <p>Aerospace & Defense</p> <p>Our discrete components, complex hybrid power module assemblies and rugged DC-DC converters utilize leading-edge power technology which, together with demanding environmental specifications help engineers to meet their toughest design challenges.</p>	<ul style="list-style-type: none"> • Space • Military • Aerospace • Rugged Industrial • Medical 	<ul style="list-style-type: none"> • RAD-Hard MOSFETs • Power Modules/Hybrid Solutions • Motor Control Solutions • DC-DC Converters