COOLiR ADVANTAGES:

- Flexibility and scalability enable customized solutions and platform scalability.
- Cost-effective, high-performance power density.
- Safety-critical, improved reliability.
- Low package and circuit inductance (< 100 µOhm).
- No wirebonds, improved reliability.
- Low resistance, increased power density.
- Synchronous Rectification.
- Power Supply.
- Motor Control.
- Communications.
- Computing.
- Audio.
- Heavy Loads and Actuators.
- Lighting.
- Body Electronics.
- Powertrain/Energy Management Solutions.
- AC and DC Motor Drives.
- SMPS.
- Lighting.
- Industrial.
- Appliances.
- Medical.
- Rugged Industrial.
- Commercial Aviation.
- Space.
- Set-Top Box.
- Game Stations.
- Workstations.
- Switchers & Routers.
- Storage Networks.
- Servers.
- BOM Costs.
- Lower operating energy costs.
- Conserving features that achieve up to 79%.
- Low package and circuit inductance.
- Flexibility and scalability enable customized solutions and platform scalability.

COOLiRılı Advanced Automotive Power Management Solutions

COOLiR2Die and COOLiR2Bridge packaging platforms complement the silicon
International Rectifier's COOLiR silicon and advanced COOLiR2 packaging technology deliver a new market for high-speed gate arrays for hybrid electric vehicle (HEV) to help address the need to reduce the size, weight and system cost to improve the performance and ruggedness of the devices without increasing manufacturing complexity.

COOLiR Die and COOLiR Bridge packaging solutions complement the silicon
by addressing the challenges of HEV design with reduced size, weight and system cost.

International Rectifier

THE POWER MANAGEMENT LEADER
COOLiR™ ADVANTAGES:
• Flexibility and scalability enable customized solutions and platform approach in very compact system designs.
• Combat cooling, improve power density.
• Exceptional, improved reliability.
• Low package and circuit inductance (<100 µOhm).
• Low package and circuit inductance.

COOLiR™: Enhanced design and efficient input switching due to the freedom to mount the device on the backside as well. A “Flipped” (front) packing possibility is integrated into the overall design.

Using the “Flipped” and “up” one side of the coil, a very compact and low-height bridge.

Flexible cooling arrangements including double sided cooling and a “T” Stripes of 120°C max and C3 and C4 FR4 substrates enable to 175°C max.

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COOLiR™ Advanced Automotive Power Management Solutions

If you have a problem with your IGBTs, check out our solutions.

Super Junction MOSFETs have been the choice of switch in high frequency and high voltage applications, until now...

COOLiR™ Gen.1

Super Junction MOSFETs with their superior performance have been the choice of switch in high frequency and high voltage applications, until now.

COOLiR™ Gen.2

Super Junction MOSFETs have been the choice of switch in high frequency and high voltage applications, until now...

A COOLiR™ Solution

VR (V)

Rg = 10 ohm

di/dt 2.6 A/ns

IF

VR

Oscillation-Free, Soft Recovery of COOLiRDiode™ Gen.2

IR's ultrafast switching COOLiRIGBTs Gen1 are tailor-made according to the needs of fast switching, high power HEV/EV applications such as DC-DC converters and battery chargers.

By using our new COOLiR™ Gen.1, International Rectifier has optimized cost and efficiency to simplify the development of automotive high-power applications.

IGBTs offer reduced conduction losses and greater efficiency at higher currents than a MOSFET.

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COOLiRIGBT™ Gen.1 ADVANTAGES:

- Tj Max of 175°C
- Devices optimized for high frequency switching applications
- 600V rated devices with a short-circuit rating of > 5µs
- Switching frequencies up to 200kHz
- Paired with an optimal diode
- VCE(on) typ. of 1.8V
- Large dies offering excellent efficiency at high currents

Tj Max

Manufacturability

Switching Frequency

Losses At High Currents

150˚C

Super Junction MOSFET

Complex

High

High

175˚C

COOLiRIGBT™ Gen1

Simple

High

Low

Switching Frequency (kHz)

1 kHz

100 kHz

1000 kHz

Max Input Current (Amps)

COOLiRIGBT™ Gen1

Tj=175°C

Super Junction MOSFET

Tj=150°C

COOLiRIGBT with Tjmax=175°C offers a maximum current increased by 50% compared to leading SJ MOSFETs on the market.

Super Junction MOSFETs have been the choice of switch in high frequency and high voltage applications, until now...

COOLiRIGBT™ Gen.2

A new trench platform specifically designed for HEV/EV motor drives. This market technology enables low Tjmax, high efficiency, high performance, and outstanding performance at a lower cost.

COOLiR™ Gen.2 ADVANTAGES:

- Very low conduction losses
- Tj max 175°C
- BV of 680V at 25°C
- Tsc of > 6µs at 150°C
- Available as bare die as well as in traditional and performance packages

A COOLiR™ Solution

COOLiRDiode™ Gen.2

The complementary COOLiRDiode was developed specifically for COOLiRIGBT™ Gen.2, offering optimal paralleling with minimal ringing and no oscillation even at low currents.

COOLiRDiode™ Gen.2 ADVANTAGES:

- Tj max 175°C matching IGBT
- BV of 680V at 25°C
- Double sided cooling
- Soft recovery without oscillation
- Low Vf and low Err versions

Battery charger

COOLiRIGBT™ Gen.1

• High efficiency, cost competitive IGBT technology
• IGBT capable of high power and high frequencies
• Optimal diode with low ringing and no oscillation

DC-DC converter

COOLiRIGBT™ Gen.1

• Capable of frequencies up to 200kHz
• Diode with superior trr and no oscillation
• Sparse 1kHz

Main inverter

COOLiR2Bridge™ + COOLiR2Die™

• Flexible cooling configurations (single/double sided) lowering Rth
• High power density
• Superior electrical performance
• Package inductance of < 12nH
• Package resistance < 0.5mOhm
• Elimination of wire bond dramatically improves reliability while reducing cost and size

AC compressor

COOLiRIGBT™ Gen.2

• Superior robustness and reliability
• Cost effective
• Superior efficiency
• Tjmax 175°C
• BV of 680V

• MOSFET RDS(on) stays flat as current increases
• IGBT RCE(on) reduces as current increases

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Super Junction MOSFETs have been the choice of switch in high frequency and high voltage applications, until now...
COOLiR™ Advanced Automotive Power Management Solutions

**COOLiRIGBT™ Gen.1**

- High efficiency, cost competitive IGBT technology
- IGBT capable of high power and high frequencies
- Optimal diode with low ringing and no oscillation

**COOLiR2Bridge™ + COOLiR2Die™**

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**AC COMPRESSOR**

- Superior robustness and reliability
- Cost effective
- Superior efficiency
- Tjmax 175°C
- BV of 680V

**DC-DC CONVERTER**

- IGBTs offer reduced conduction losses and greater efficiency at higher currents than a MOSFET.
- IGBTs with Tjmax=175°C offers a maximum current increased by 50% compared to leading SJMOSFETs on the market.

**SUPER JUNCTION MOSFET**

- MOSFET $R_{DS(on)}$ stays flat as current increases
- IGBT $R_{CE(on)}$ reduces as current increases

**SUPER JUNCTION MOSFET ADVANTAGES:**

- Very low conduction losses
- $T_j$ max 175°C
- $B V$ of 680V at 25°C
- $T_{sc}$ of >6µs at 150°C
- Available as bare die as well as in traditional and performance packages

**COOLiRIGBT™ Gen.2**

- Very high current density with good high power performance
- $R_{CE(on)}$ typ. of 1.8V
- Large dies offering excellent efficiency at high currents
- Switching frequencies up to 200kHz
- Paired with an optimal diode

**COOLiRDiode™ Gen.2**

- Tj max 175°C matching IGBT
- BV of 680V at 25°C
- Double sided cooling
- Soft recovery without oscillation
- Low Vf and low Err versions

**MAIN INVERTER**

- Flexible cooling configurations (single/double sided) lowering Rth
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**BATTERY CHARGER**

- High efficiency, cost competitive IGBT technology
- IGBT capable of high power and high frequencies
- Optimal diode with low ringing and no oscillation

**DC-DC CONVERTER**

- Capable of frequencies up to 200kHz
- Diode with superior trr and no oscillation
- Tjmax 175°C

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Rg = 10 ohm  
di/dt 2.6 A/ns

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IR's ultrafast switching COOLiRIGBTs Gen1 are tailor-made according to the needs of fast switching, high power HEV/EV applications such as DC-DC converters and battery chargers.

By using ultra-fast COOLiRIGBTs International Rectifier has optimized cost and efficiency to simplify the development of automotive high power applications.

IGBTs offer reduced conduction losses and greater efficiency at higher currents than a MOSFET.

COOLiRIGBT™ Gen1 ADVANTAGES:
• Tj Max of 175°C  
• Devices optimized for high frequency switching applications  
• 600V rated devices with a short circuit rating of > 5µs  
• Switching frequencies up to 200kHz  
• Paired with an optimal diode  
• VCE(on) typ. of 1.8V  
• Large dies offering excellent efficiency at high currents

A COOLiR™ Solution

COOLiR™ Gen.1
• High efficiency, cost competitive IGBT technology  
• IGBT capable of high power and high frequencies  
• Optimal diode with low ringing and no oscillation

COOLiRIGBT™ Gen.2
• Very high current driving with good temperature capability  
• Reduced size and weight  
• Tj max 175°C  
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**COOLiR™ Solution**

**Battery Charger**
- High efficiency, cost competitive IGBT technology
- IGBT capable of high power and high frequencies
- Optimal diode with low ringing and no oscillation

**DC-DC Converter**
- Capable of frequencies up to 200kHz
- Diode with superior trr and no oscillation
- Super TOPS

**Main Inverter**
- Flexible cooling configurations (single/double sided) lowering Rth
- High power density
- Superior electrical performance
- Package inductance < 12nH
- Package resistance < 0.5mOhm
- Elimination of wire bond dramatically improves reliability while reducing cost and size

**AC Compressor**
- Superior robustness and reliability
- Cost effective
- Superior efficiency
- Tjmax 175°C
- BV of 680V at 25°C

**COOLiR™ Gen.2**

**Super Junction MOSFET**
- Very low conduction losses
- Tj max 175°C
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**COOLiRDiode™ Gen.2**
- Tj max 175°C matching IGBT
- BV of 680V at 25°C
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- Soft recovery without oscillation
- Low Vf and low Err versions

**A COOLIR™ Solution COOLiRIGBT™ Gen.2**

- A new trench platform specifically designed for HEV/EV motor drive applications. Thin wafer technology enables extra low Tj, achieving high power density with outstanding performance in various areas of automotive power.

**COOLiR™ Gen.2 ADVANTAGES:**
- Very high current density with good thermal performance
- Reduced size and weight
- Cost effective
- Tj max 175°C

**COOLiR™ Gen.2 ADVANTAGES:**
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**COOLiR™ Advanced Automotive Power Management Solutions**

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**MOSFET**
- MOSFET R DS(on) stays flat as current increases
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**Super Junction MOSFET**
- Superior performance and reliability
- Superior efficiency
- Tj Max of 150°C

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| **Enterprise Power** | **Optimized power management system solutions that deliver benchmark power density, efficiency and performance in enterprise power.** | **Servers**<br>**Storage Networks**<br>**Switchers & Routers**<br>**Workstations**<br>**Notebooks**<br>**Game Stations**<br>**Set-Top Box** | **DirectFET® plus**<br>**SuperFET®**<br>**PowRstage®**<br>**CHiL Digital Controllers** |

| **Automotive** | **Automotive grade power management solutions qualified to meet the needs of 12V, 24V and HEV/EV applications with a zero defect goal.** | **AC and DC Motor Drives**<br>**Powertrain / Engine control**<br>**Body Electronics**<br>**Lighting**<br>**Class D Audio**<br>**Heavy Loads and Actuators** | **Automotive Qualified:**<br>**HEXFET® Power MOSFETs**<br>**Intelligent Power Switches**<br>**Driver ICs**<br>**IGBTs**<br>**DirectFET®**<br>**COOLIR™** |

| **Benchmark MOSFETs** | **IR continues to lead the industry by offering power MOSFETs with the lowest R_th and widest range of packages up to 250V for a diverse range of applications.** | **Audio**<br>**Computing**<br>**Communications**<br>**Motor Control**<br>**Power Supply**<br>**Synchronous Rectification** | **Discrete HEXFET® MOSFETs**<br>**Dual HEXFET® MOSFETs**<br>**FETK®**<br>**DirectFET®**<br>**StrongIRFET**<br>**FastIRFET** |

| **HiRel** | **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.** | **Space**<br>**Military**<br>**Commercial Aviation**<br>**Rugged Industrial**<br>**Medical** | **RAD-Hard MOSFETs**<br>**Power Modules/Hybrid Solutions**<br>**Motor Control Solutions**<br>**DC-DC Converters** |

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