Power MOSFET and IGBT · Overview Brochure

Power Semiconductors

Efficient devices for a Green World

Renesas Electronics
www.renesas.eu

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Renesas Power Semiconductors

Renesas understands the performance requirements of power semiconductors, for today and the future, taking advantage of renewable energy resources and also reducing power demands for consumer and industrial applications, achieving increased efficiency.

Renesas is a leading manufacturer of power semiconductors, merging the technology legacy of our founding companies Hitachi, Mitsubishi and NEC. This pool of knowledge enables us to offer high performance devices across the entire voltage range, from V_{DSS} = 20 V to 1500 V for Power MOSFET and Vces = 600 V to 1350 V for IGBT.

The key benefits include:

- Outstanding characteristics enabling highest efficiency circuit design based on exclusively owned technology, in-house IP and continuous new developments
- Huge variety of packages for SMD and THD, allowing optimized circuit layouts
- Complete control covering the entire manufacturing chain, from design to production processes to QA, leading to excellent logistics support including long term product availability
- Full service customer support infrastructure

Power MOSFET

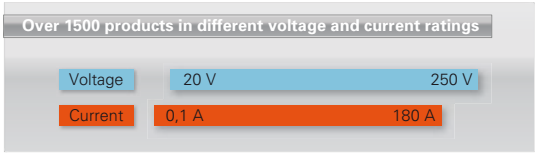
Low voltage	V_{DSS} <=250V
Medium voltage	250 V < V_{DSS} <=700 V
High voltage	700 V < V_{DSS} <=1500 V
IGBT	Vces = 600 V, 1100 V, 1200 V, 1350 V

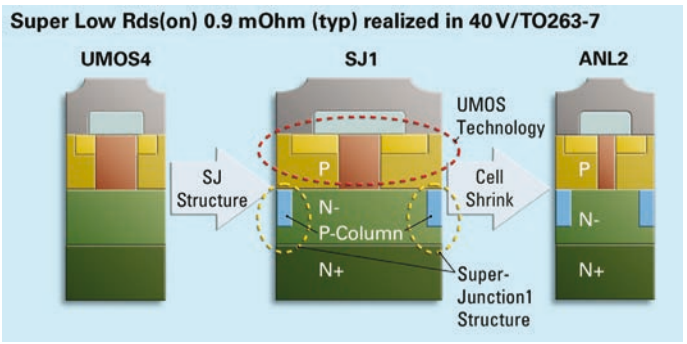
Applications (typ.)	Requirements	Solution	Product range
Low voltage PSU, battery charger, small motor control, LED lighting	Low static and switching losses, low thermal resistance	Low Rds(on), low gate charge, UMOS tech, high performance packages	Low voltage NP, uPA, RJK, ..series
Motor control inverter, consumer and industrial PSU, power conversion, solar inv., welding	Low static and switching losses, high robustness, high switching speed	Low Rds(on), low gate charge, including Super junction tech.	Medium voltage RJK, SJ, 2SK, .. series
Motor control inverter, power conversion, PSU renewable energy	Low Rds(on), high reliability, low thermal resistance	Low Rds(on), low gate charge, no secondary breakdown	High voltage, 2SK series

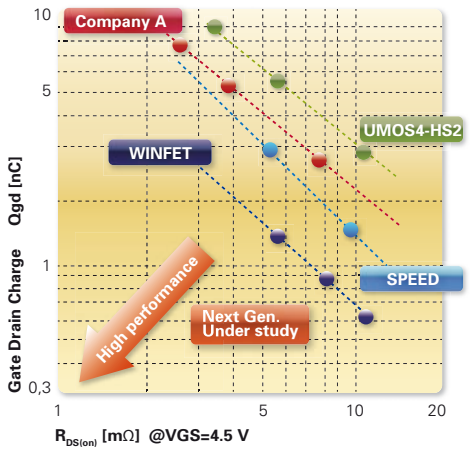
Efficient power designs

Low Voltage Power MOSFET V_{DSS} <= 250 V

- Wide range of voltage classes and current ratings
- N-, P-channel, dual and complementary devices
- Low Rds(on), low gate charge through proprietary IP such as UMOS & ANLx technology
- Variety of standard and high performance packages, e.g. HVSON-8, Mini HVSON8, LFPAK. Offering upgrade option to change eg. from SOP-8 to LFPAK
- Automotive qualification available on selected devices



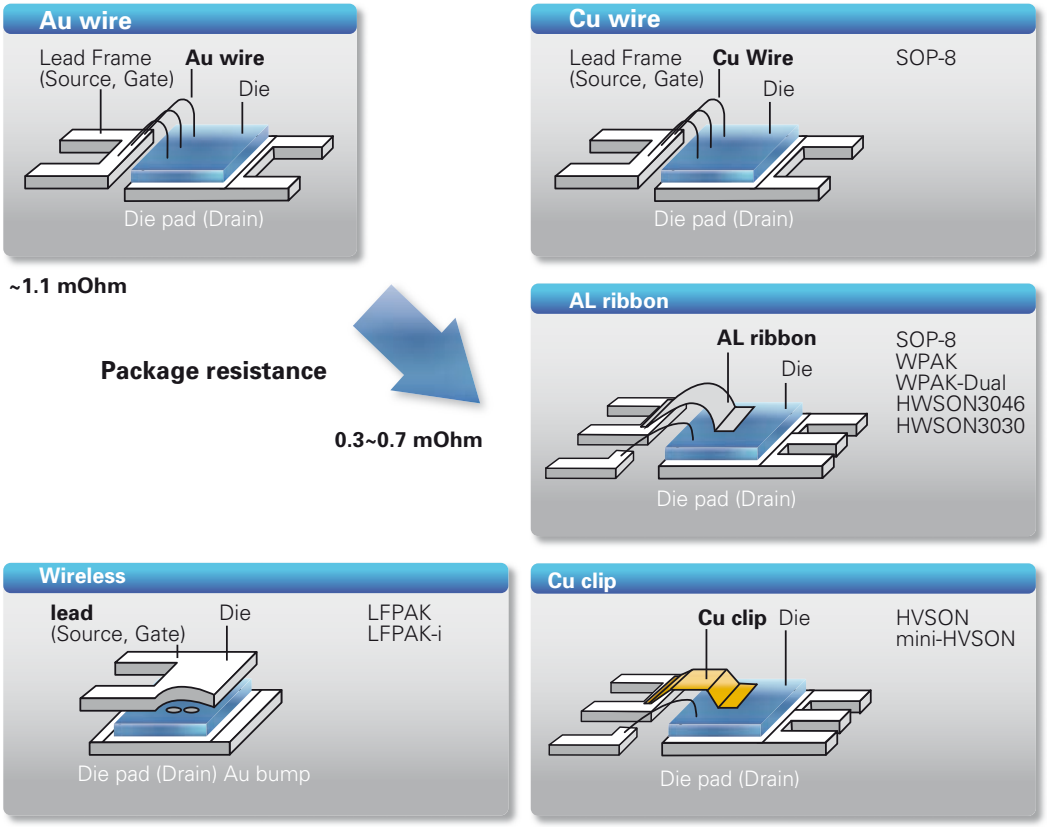




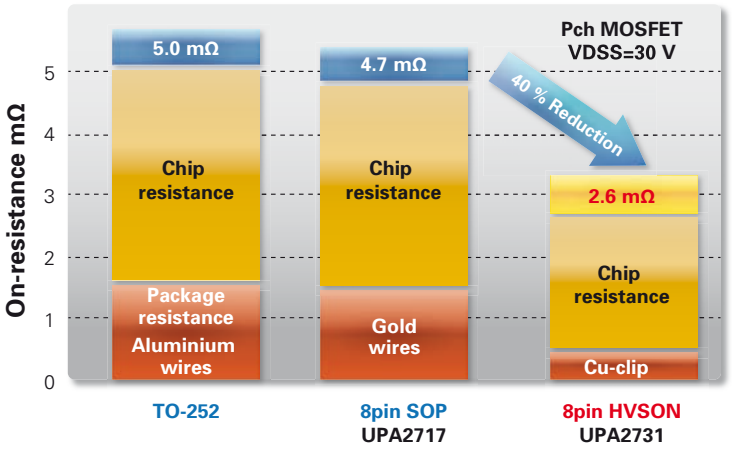
Low RDSon Qgd achieving low switching loss

Minimized Package resistance

Low package resistance -> Reduction of conduction loss



Advanced Assembly Technology



Low Voltage Power MOSFET V_{DSS} <= 250V

High performance packages

> Small outlines,

> low package resistance

Applied mounting and material technologies lead to outstanding performance

Package examples Power MOSFET and IGBT

Dimensions in mm

Power MOSFET

Medium Voltage Power MOSFET
250 V < VDSS <= 700 V

Increasing requirements in the range around VDSS = 600 V are covered by a large variety of products

- Wide range of voltage and current ratings
- THD and SMD package variety
- Excellent efficiency through low R_{DS}(on) and small gate drain charge Qgd

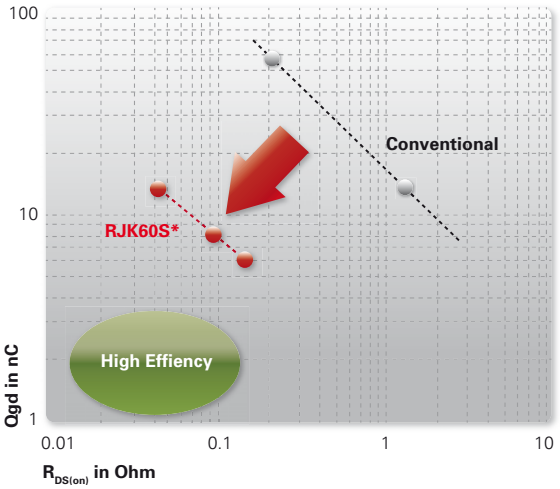
New high performance product family:
Super Junction technology for 600 V

- Outstanding low R_{DS}(on) for low static losses down to 0.045 Ohm
- Extremely low gate charge for high switching speeds
- SMD and THD packages available

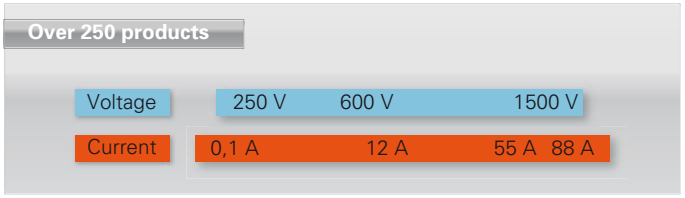
The ideal choice for power supply, welding, lighting, motor control and renewable energy applications.

Super Junction
VDSS = 600 V

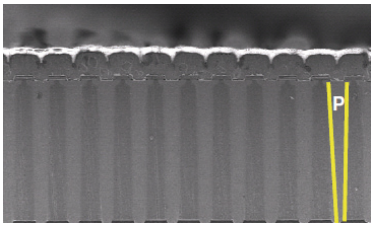
Outstanding performance in comparison to conventional design.



Medium and high Voltage Power MOSFET Overview



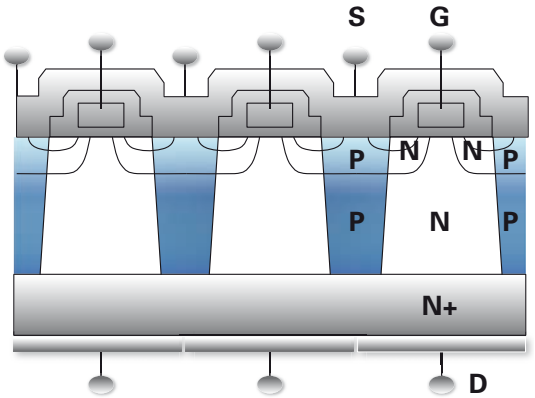
Applied Deep trench structure for Super Junction



High Voltage Power MOSFET
700V <= VDSS <= 1500 V

Renesas offers an attractive line up of discrete Power MOSFETs up to 1500 V. Along with increased efficiency requirements, several applications are moving from the "classic" range of 600 V to the high voltage area. Renesas can cover this with ideal products in several voltage classes: 900 V, 1000 V, 1500 V. Highest reliability and long term support gives the designer the right choice for leading-edge solutions.

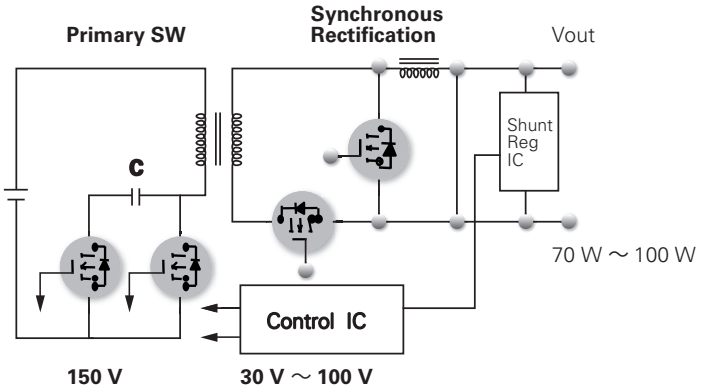
Super Junction cross section



Application examples:

Brick converter, low voltage Power MOSFET

Active Clamp Circuit topology

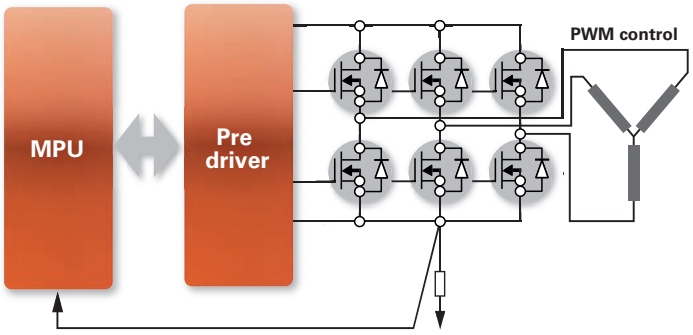


Advantages

- Compact design through high performance packages
- Minimum static and switching power losses through excellent R_{DS}(on) and Qgd values

Motor drive

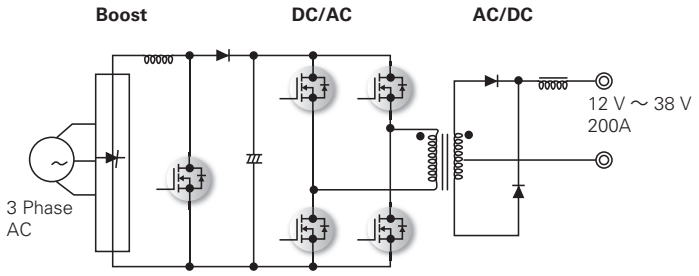
3 phase brushless motor-drive for Power tool



Advantages

High power density through high performance chip / package combination achieving minimum power losses and small footprint.

Welding (frequency 100 kHz)



Advantages

High speed, minimum losses and robust design achieved by Super Junction technology.

IGBT

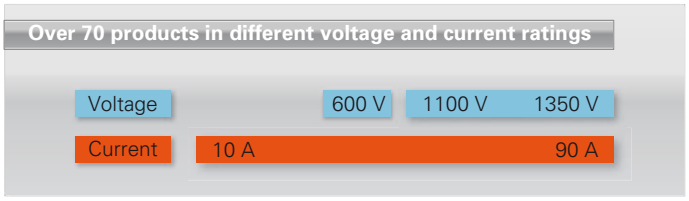
Renesas has a long experience in succesfully designing IGBTs for various applications. This results in up to 70% global market share in specific application areas. These strengths are based on Renesas original technology, which has then been further developed and optimized for European customer requirements, for example in application areas such as inverters for motor control, renewable energy and induction heating

Product highlights:

- Full range within 600 V class, high voltage devices up to 1350 V, Easy to identify the best fitting product for an individual application*
- Extremely low Vce(sat) for high efficiency and low static losses
- Reliability through high short circuit capability up to 10µs, depending on product series* Gate emitter voltage rating +/- 30 V
- Integrated fast recovery diode (FRD)** for compact design
- SMD and THD packages, isolated and non isolated for full design flexibility

* Differrent product series offering application optimized characteristics
**The majority of IGBT devices include a fast recovery diode (FRD) inside the same package for easy design, space and cost saving. Selected versions are also available without integrated FRD in order to further customize the characteristic within the circuitry.

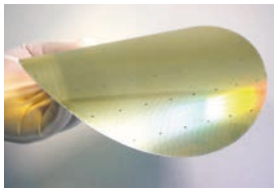
IGBT Product Range



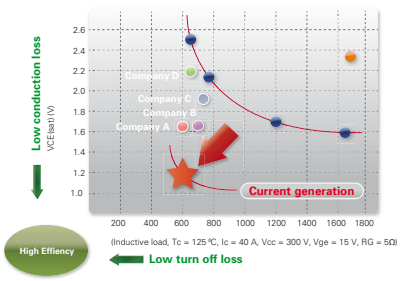
Applications	Requirements	Solution	Product series
IH Kitchen Appliances	High Output, Low Loss, All Metal	High-Speed Trench IGBTs Composite Products with FRD applying HiGT***	F/BF/CF/ DF-series
Inverter, solar inverter, welding	High-Frequency Operation, High Short Circuit Tolerance	HIGT*** with High Short Circuit Tolerance Composite Products with High-Speed FRD	D/M/A8/CV/ CD/CM-series
PFC Circuits	Large Current, High Effiency	Ultra-High-Speed IGBTs Composite Products with High-Speed FRD	608-series

***HiGT: High conductivity IGBT
Renesas Original Technology enables improvement of tradeoff between Vce(sat) vs. tail power loss.

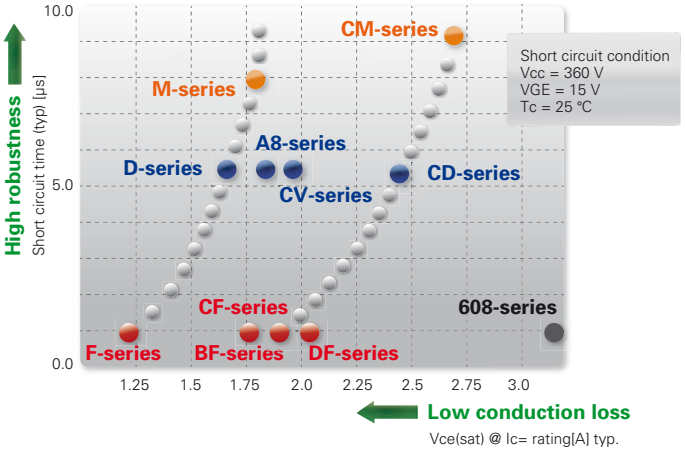
IGBT technology



Applied thin wafer technology for low Vce(sat) resulting in lowest static losses



tsc vs. Vce(sat) for IGBT
Application optimized characteristics



Application-optimized product families

Motor control inverter, solar inverter, welding
Product families in different voltage ranges **600 V** (D-, A8- and M-series) and **1200 V** (CV-,CD- and CM-series) offering a large variety. These products are the perfect choice for applications like motor control, solar inverter and welding. Robust characteristics combined with low power losses, are the key advantages of these IGBT product families.

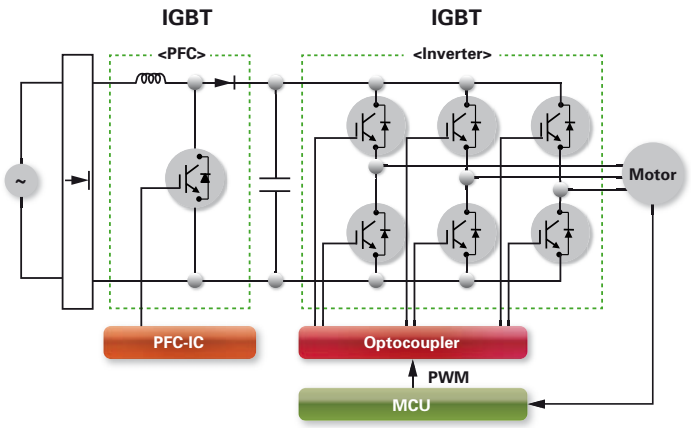
The optimum compromise between **low Vce(sat)** and **short circuit withstand time tsc** can be chosen by selecting

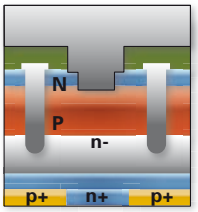
600 V class

- D-series and A8-series offering tsc = 5 µs
- M-series offering tsc = 8 µs

1200 V class

- CV-/CD-series offering tsc = 5 µs
- CM-series offering tsc = 10 µs





IGBT internal structure

Advantages

- High output power with minimum losses through low V_{DE}(sat)
- Robust design through high short circuit capability
- Compact outlines through high current rated devices

Power Supply Unit

The 608-series product family was developed specifically for the requirements of high speed switching PSUs using PFC (Power Factor Correction). Recommended up to 100 kHz, with performing tf (fall time) down to 40ns. The excellent performance of this IGBT product family is the cost down alternative to MOSFET designs.

Induction heating

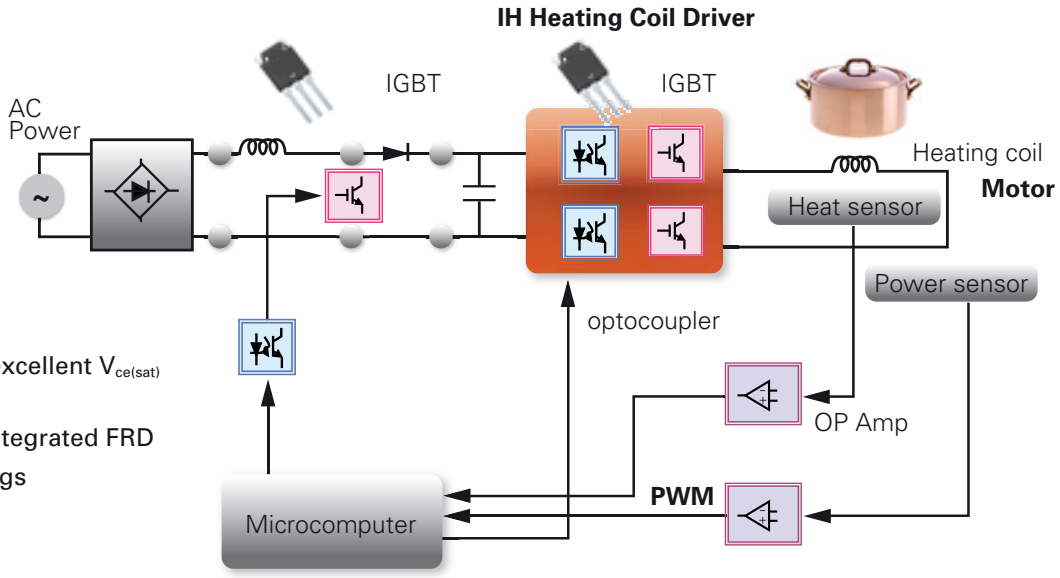
Highly efficient IGBT product family, based on Renesas' own HiGT** technology, achieving extremely low Vce(sat) for outstanding low static losses. Optimized characteristics for this application. Both topologies are supported:

- Series resonant (half bridge) with a variety of 600 V IGBT -> F-series

and

- Quasi resonant (single ended) are available 1100 V/1200 V/1350 V IGBT -> BF-, CF- and DF-series

IH Heating Coil Driver



Advantages

- Low static losses through excellent $V_{ce(sat)}$ characteristics
- Compact design through integrated FRD
- Wide range of current ratings

Power Semiconductor – support infrastructure

Internet

http://www.renesas.eu/products/discrete/index.jsp

Catalog, line up information

General Catalog, "Discrete":
http://documentation.renesas.com/doc/products/transistor/r07cs0003ej0200_discrete.pdf

Line up catalog "Status List", full list of products and production status, updated quarterly
http://documentation.renesas.com/doc/products/transistor/r07cl0001ej0600_transistor.pdf

Application flyers eg.
http://documentation.renesas.com/doc/products/assp/r30ca0003xj0200_po-supply_je.pdf

Data, product selection

Cross reference search on internet:
http://resource.renesas.com/AandP/crossreference/

Online parametric search,
selection by parameters (e.g. voltage, current, $R_{DS(on)}$/$V_{ce(sat)}$,..)
http://www.renesas.eu/

Simulation, design support

http://www.renesas.com/products/analog_and_power/peer/support_tools.jsp

Including:
"Virtual Lab" design tool support for sync buck converter application
http://www.renesas.eu/products/discrete/vp/index.jsp

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