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 $V_{oss} = 20\,\text{V}$ to $1500\,\text{V}$ for Power MOSFET and $V_{ces} = 600\,\text{V}$ to $1350\,\text{V}$ 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

<table>
<thead>
<tr>
<th>Voltage Class</th>
<th>$V_{DSS}$ Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low voltage</td>
<td>$&lt; 250,\text{V}$</td>
</tr>
<tr>
<td>Medium voltage</td>
<td>$250,\text{V} &lt; V_{oss} &lt; 700,\text{V}$</td>
</tr>
<tr>
<td>High voltage</td>
<td>$700,\text{V} &lt; V_{oss} &lt; 1500,\text{V}$</td>
</tr>
</tbody>
</table>

#### IGBT

- $V_{ces} = 600\,\text{V}$, $1100\,\text{V}$, $1200\,\text{V}$, $1350\,\text{V}$

### Efficient power designs

#### Low Voltage Power MOSFET $V_{DSS} <= 250\,\text{V}$
- Wide range of voltage classes and current ratings
- N-, P-channel, dual and complementary devices
- Low $R_{ds(on)}$, 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

### Applications (typ.)

- Low voltage PSU, battery charger, small motor control, LED lighting
- Motor control inverter, consumer and industrial PSU, power conversion, solar inv., welding
- Motor control inverter, power conversion, PSU renewable energy

### Requirements

- Low static and switching losses, low thermal resistance
- Low static and switching losses, high robustness, high switching speed
- Low $R_{ds(on)}$, high reliability, low thermal resistance

### Solution

- Low $R_{ds(on)}$, low gate charge, UMOS tech, high performance packages
- Low $R_{ds(on)}$, low gate charge, including Super junction tech.
- Low $R_{ds(on)}$, low gate charge, no secondary breakdown

### Product range

- Low voltage NP, uPA, RJK, series
- Medium voltage RJK, SJ, 2SK, series
- High voltage, 2SK series

---

---
Minimized Package resistance

Low package resistance → Reduction of conduction loss

- 1.1 mOhm

Package resistance

0.3~0.7 mOhm

Advanced Assembly Technology

Low Voltage Power MOSFET $V_{DS} \leq 250V$

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 < $V_{DS}$ <= 700 V

Increasing requirements in the range around $V_{DS} = 600$ 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 $Q_{gd}$

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**

$V_{DS} = 600$ V

Outstanding performance in comparison to conventional design.

---

**Medium and high Voltage Power MOSFET**

Overview

<table>
<thead>
<tr>
<th>Over 250 products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
</tr>
<tr>
<td>Current</td>
</tr>
</tbody>
</table>

**Applied Deep trench structure for Super Junction**

**High Voltage Power MOSFET**

700V <= $V_{DS}$ <= 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

![Diagram of Brick converter](image)

**Advantages**
- Compact design through high performance packages
- Minimum static and switching power losses through excellent $R_{DS(on)}$ and $Q_{gd}$ values

**Motor drive**
3 phase brushless motor-drive for Power tool

![Diagram of Motor drive](image)

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

**Welding (frequency 100 kHz)**

![Diagram of Welding circuit](image)

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

Renesas has a long experience in successfully 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

* Different 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.

Applications
- IH Kitchen Appliances
- Inverter, solar inverter, welding
- PFC Circuits

Requirements
- High Output, Low Loss, All Metal
- High-Frequency Operation, High Short Circuit Tolerance
- Large Current, High Efficiency

Solution
- High-Speed Trench IGBTs Composite Products with FRD applying HiGT***
- HiGT*** with High Short Circuit Tolerance Composite Products with High-Speed FRD
- Ultra-High-Speed IGBTs Composite Products with High-Speed FRD

Product series
- F/BF/CF/DF-series
- D/M/A8/CV/CD/CM-series
- 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

www.renesas.eu
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.

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

Advantages
> Low static losses through excellent Vce(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”:

Line up catalog “Status List”, full list of products and production status, updated quarterly

Application flyers eg.

Data, product selection

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

Online parametric search, selection by parameters (e.g. voltage, current, RDS(on)/VCE(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

Before purchasing or using any Renesas Electronics products listed herein, please refer to the latest product manual and/or data sheet in advance.