

## General Description

The series of devices use advanced trench gate super junction technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.

## Features

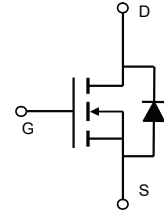
- Optimized body diode reverse recovery performance
- Low on-resistance and low conduction losses
- Small package
- Ultra Low Gate Charge cause lower driving requirements
- 100% Avalanche Tested
- ROHS compliant

## Application

- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)
- LLC Half-bridge



TO-263



Schematic

| Parameter                                                             | Symbol          | Q1       | Q2    | Unit          |
|-----------------------------------------------------------------------|-----------------|----------|-------|---------------|
| Drain-Source Voltage ( $V_{GS}=0V$ )                                  | $V_{DS}$        | 650      |       | V             |
| Gate-Source Voltage ( $V_{DS}=0V$ ), AC ( $f>1$ Hz)                   | $V_{GS}$        | $\pm 40$ |       | V             |
| Gate-Source Voltage ( $V_{DS}=0V$ )                                   | $V_{GS}$        | $\pm 30$ |       | V             |
| Continuous Drain Current at $T_C=25^\circ C$                          | $I_{D(DC)}$     | 21       | 21*   | A             |
| Continuous Drain Current at $T_C=100^\circ C$                         | $I_{D(DC)}$     | 13.2     | 13.2* | A             |
| Pulsed drain current (Note 1)                                         | $I_{DM(pluse)}$ | 84       | 84*   | A             |
| Maximum Power Dissipation( $T_C=25^\circ C$ )                         | $P_D$           | 188      | 33.8  | W             |
| Derate above $25^\circ C$                                             |                 | 1.5      | 0.27  | W/ $^\circ C$ |
| Single pulse avalanche energy (Note 2)                                | EAS             | 441      |       | mJ            |
| Avalanche current(Note 1)                                             | $I_{AR}$        | 10.5     |       | A             |
| Repetitive Avalanche energy , $t_{AR}$ limited by $T_{Jmax}$ (Note 1) | $E_{AR}$        | 0.7      |       | mJ            |

| Parameter                                                | Symbol         | Q1         | Q2 | Unit |
|----------------------------------------------------------|----------------|------------|----|------|
| Drain Source voltage slope, $V_{DS} \leq 480V$ ,         | $dv/dt$        | 50         |    | V/ns |
| Reverse diode $dv/dt$ , $V_{DS} \leq 480V, I_{SD} < I_D$ | $dv/dt$        | 50         |    | V/ns |
| Operating Junction and Storage Temperature Range         | $T_J, T_{STG}$ | -55...+150 |    | °C   |

\* limited by maximum junction temperature

**Table 2. Thermal Characteristic**

| Parameter                                         | Symbol     | Q1   | Q2   | Unit  |
|---------------------------------------------------|------------|------|------|-------|
| Thermal Resistance, Junction-to-Case (Maximum)    | $R_{thJC}$ | 0.66 | 3.69 | °C /W |
| Thermal Resistance, Junction-to-Ambient (Maximum) | $R_{thJA}$ | 62.5 | 80   | °C /W |

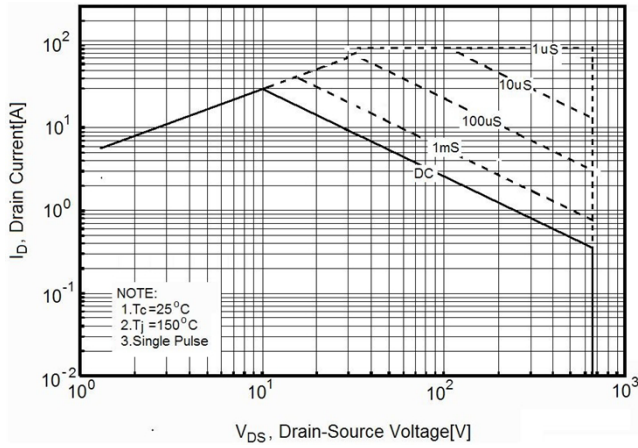
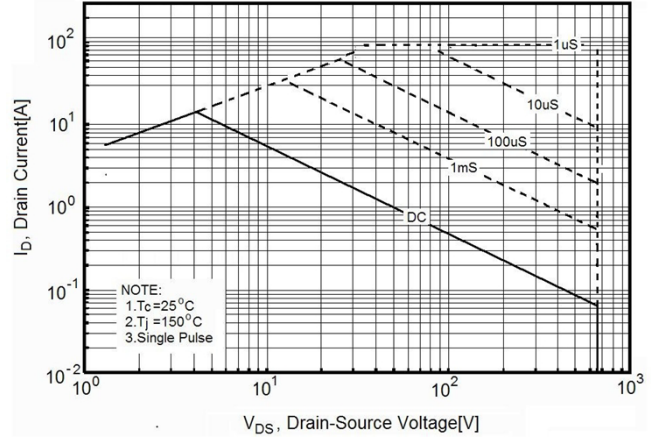
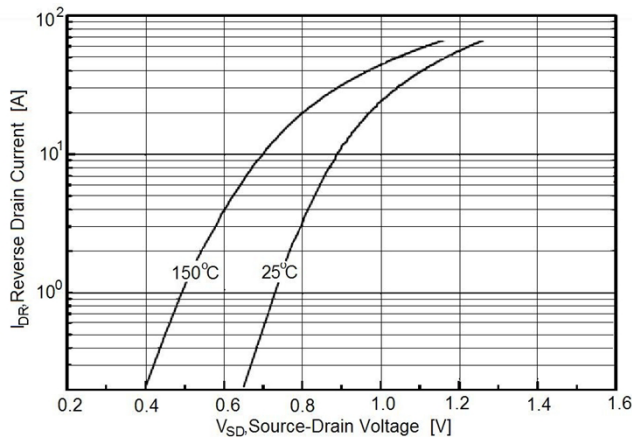
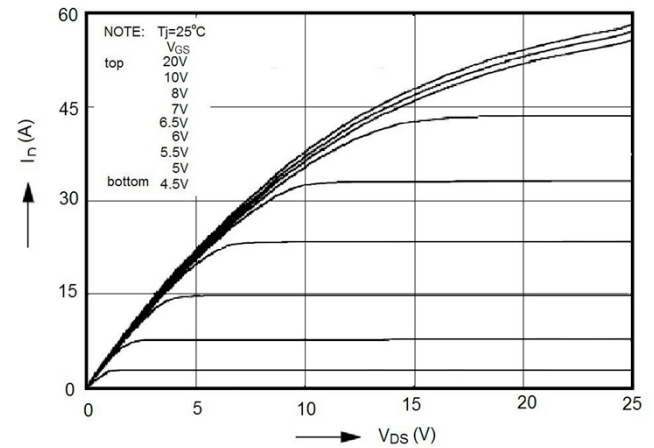
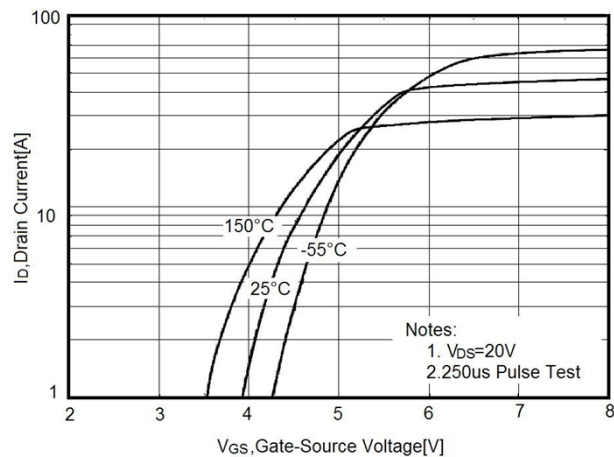
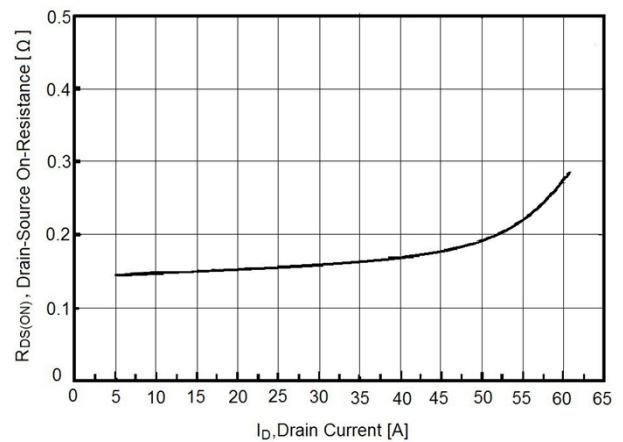
**Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)**

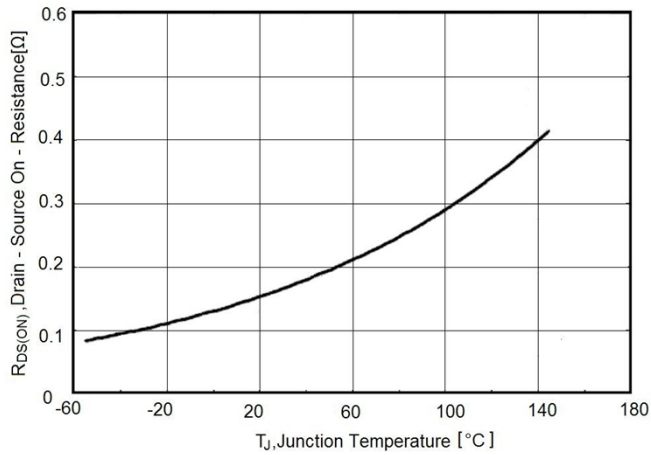
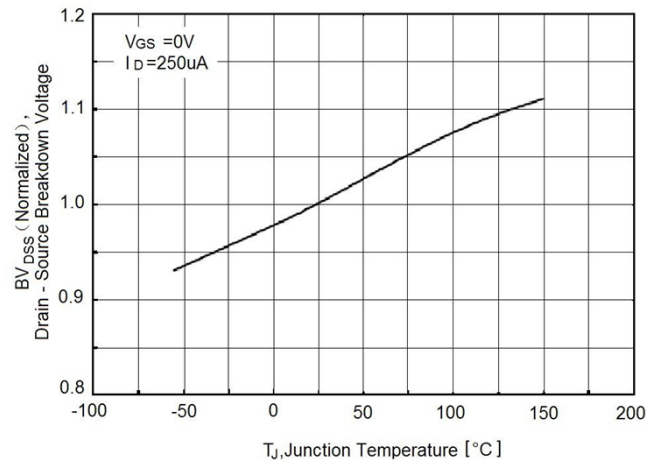
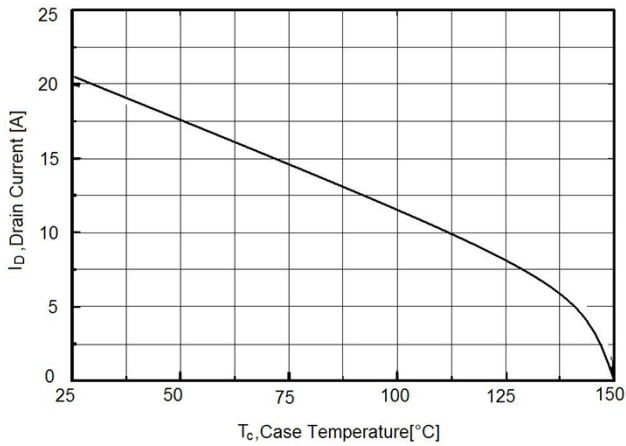
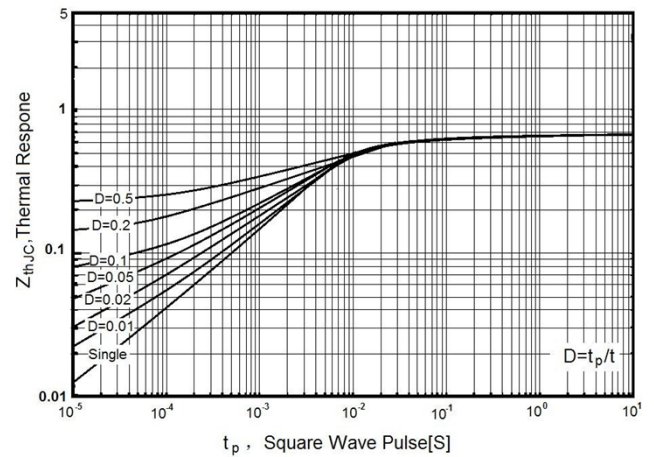
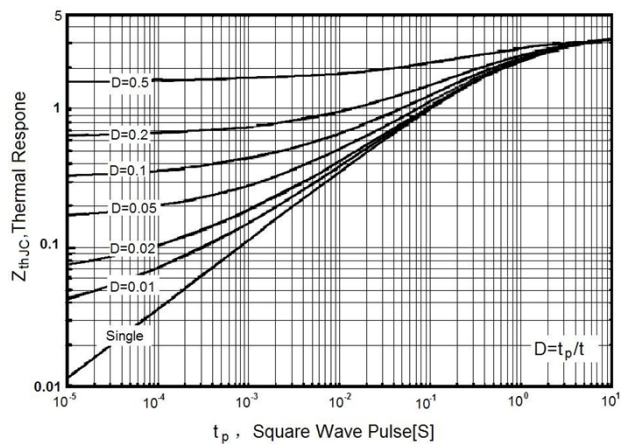
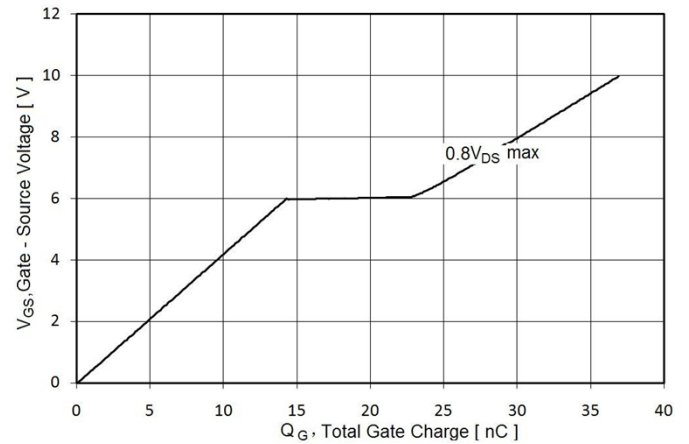
| Parameter                                    | Symbol              | Condition                                                                               | Min | Typ  | Max  | Unit |
|----------------------------------------------|---------------------|-----------------------------------------------------------------------------------------|-----|------|------|------|
| On/off states                                |                     |                                                                                         |     |      |      |      |
| Drain-Source Breakdown Voltage               | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                                              | 650 |      |      | V    |
| Zero Gate Voltage Drain Current(Tc=25℃)      | I <sub>DSS</sub>    | V <sub>DS</sub> =650V, V <sub>GS</sub> =0V                                              |     |      | 2    | μA   |
| Zero Gate Voltage Drain Current(Tc=125℃)     | I <sub>DSS</sub>    | V <sub>DS</sub> =650V, V <sub>GS</sub> =0V                                              |     |      | 100  | μA   |
| Gate-Body Leakage Current                    | I <sub>GSS</sub>    | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                                              |     |      | ±100 | nA   |
| Gate Threshold Voltage                       | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                | 3   | 3.5  | 4    | V    |
| Drain-Source On-State Resistance             | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =10.5A                                             |     | 180  | 215  | mΩ   |
| Dynamic Characteristics                      |                     |                                                                                         |     |      |      |      |
| Input Capacitance                            | C <sub>iss</sub>    | V <sub>DS</sub> =50V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                  |     | 2250 |      | PF   |
| Output Capacitance                           | C <sub>oss</sub>    |                                                                                         |     | 83   |      | PF   |
| Effective output capacitance, energy related | C <sub>o(er)</sub>  | V <sub>GS</sub> =0 V, V <sub>DS</sub> =0...480 V                                        |     | 48   |      | pF   |
| Effective output capacitance, time related   | C <sub>o(tr)</sub>  | ID=constant, V <sub>GS</sub> =0 V<br>V <sub>DS</sub> =0...480V                          |     | 200  |      | pF   |
| Total Gate Charge                            | Q <sub>g</sub>      | V <sub>DS</sub> =480V, I <sub>D</sub> =21A,<br>V <sub>GS</sub> =10V                     |     | 36   |      | nC   |
| Gate-Source Charge                           | Q <sub>gs</sub>     |                                                                                         |     | 14   |      | nC   |
| Gate-Drain Charge                            | Q <sub>gd</sub>     |                                                                                         |     | 8.5  |      | nC   |
| Switching times                              |                     |                                                                                         |     |      |      |      |
| Turn-on Delay Time                           | t <sub>d(on)</sub>  | V <sub>DD</sub> =380V, I <sub>D</sub> =11A,<br>R <sub>G</sub> =4Ω, V <sub>GS</sub> =10V |     | 11   |      | nS   |
| Turn-on Rise Time                            | t <sub>r</sub>      |                                                                                         |     | 6    |      | nS   |
| Turn-Off Delay Time                          | t <sub>d(off)</sub> |                                                                                         |     | 61   |      | nS   |
| Turn-Off Fall Time                           | t <sub>f</sub>      |                                                                                         |     | 4.5  |      | nS   |
| Source- Drain Diode Characteristics          |                     |                                                                                         |     |      |      |      |
| Source-drain current(Body Diode)             | I <sub>SD</sub>     | T <sub>C</sub> =25℃                                                                     |     |      | 21   | A    |
| Pulsed Source-drain current(Body Diode)      | I <sub>SDM</sub>    |                                                                                         |     |      | 84   | A    |
| Forward on voltage                           | V <sub>SD</sub>     | T <sub>J</sub> =25℃, I <sub>SD</sub> =21A, V <sub>GS</sub> =0V                          |     | 0.9  | 1.3  | V    |
| Reverse Recovery Time                        | t <sub>rr</sub>     | T <sub>J</sub> =25℃, I <sub>F</sub> =11A, di/dt=100A/μs                                 |     | 160  |      | nS   |
| Reverse Recovery Charge                      | Q <sub>rr</sub>     |                                                                                         |     | 1.4  |      | uC   |
| Peak Reverse Recovery Current                | I <sub>rrm</sub>    |                                                                                         |     | 17   |      | A    |

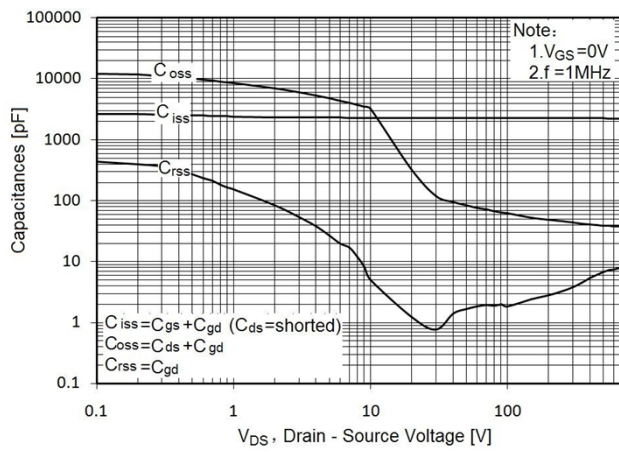
Notes 1. Repetitive Rating: Pulse width limited by maximum junction temperature

2.  $T_J=25^\circ C, V_{DD}=50V, V_G=10V, R_G=25\Omega$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

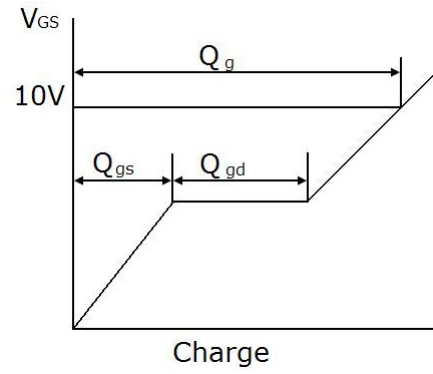
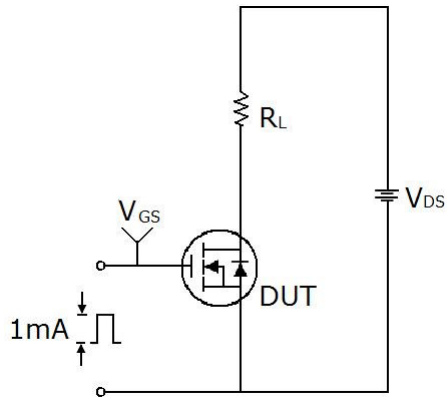
**Figure1. Safe operating area for TO-220/TO-263**

**Figure2. Safe operating area for TO-220F**

**Figure3. Source-Drain Diode Forward Voltage**

**Figure4. Output characteristics**

**Figure5. Transfer characteristics**

**Figure6. Static drain-source on resistance**


**Figure7.  $R_{DS(on)}$  vs Junction Temperature**

**Figure8.  $BV_{DSS}$  vs Junction Temperature**

**Figure9. Maximum  $I_D$  vs Junction Temperature**

**Figure10. Transient Thermal Impedance for TO-220**

**Figure11. Transient Thermal Impedance for TO-220F**

**Figure12. Gate charge waveforms**


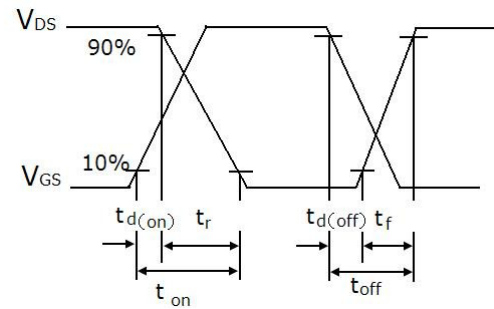
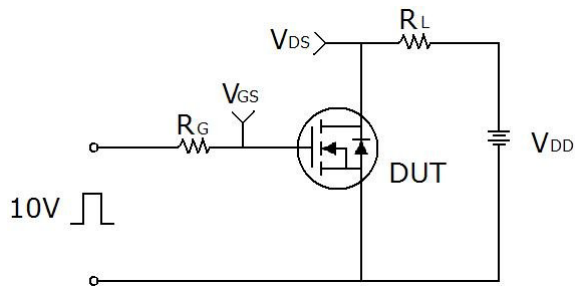
**Figure13. Capacitance**


## Test circuit

### 1) Gate charge test circuit & Waveform



### 2) Switch Time Test Circuit:



### 3) Unclamped Inductive Switching Test Circuit & Waveforms

