

## 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

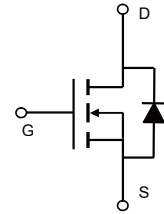
- Optimized body diode reverse recovery performance
- Low on-resistance and low conduction losses
- Small package
- Ultra Low Gate Charge cause lower driving requirements
- 100% Avalanche Tested
- ROHS compliant

## Application

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



TO-220F



Schematic

| Parameter                                                        | Symbol                 | Value      | Unit                |
|------------------------------------------------------------------|------------------------|------------|---------------------|
| Drain-Source Voltage ( $V_{GS}=0V$ )                             | $V_{DS}$               | 650        | V                   |
| Gate-Source Voltage ( $V_{DS}=0V$ ) AC ( $f>1\text{ Hz}$ )       | $V_{GS}$               | $\pm 30$   | V                   |
| Gate-Source Voltage ( $V_{DS}=0V$ ) DC                           | $V_{GS}$               | $\pm 20$   | V                   |
| Continuous Drain Current at $T_c=25^\circ\text{C}$               | $I_{D(DC)}$            | 7.5        | A                   |
| Continuous Drain Current at $T_c=100^\circ\text{C}$              | $I_{D(DC)}$            | 5.25       | A                   |
| Pulsed drain current (Note 1)                                    | $I_{DM(\text{pluse})}$ | 22.5       | A                   |
| Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )              | $P_D$                  | 31.4       | W                   |
| Derate above $25^\circ\text{C}$                                  |                        | 0.21       | W/ $^\circ\text{C}$ |
| Avalanche current(Note 1)                                        | $I_{AS}$               | 2          | A                   |
| Drain Source voltage slope, $V_{DS} \leq 480\text{ V}$ ,         | $dv/dt$                | 50         | V/ns                |
| Reverse diode $dv/dt$ , $V_{DS} \leq 480\text{ V}, I_{SD} < I_D$ | $dv/dt$                | 15         | V/ns                |
| Operating Junction and Storage Temperature Range                 | $T_J, T_{STG}$         | -55...+175 | $^\circ\text{C}$    |

\* limited by maximum junction temperature

**Table 2. Thermal Characteristic**

| Parameter                                         | Symbol     | Value | Unit                        |
|---------------------------------------------------|------------|-------|-----------------------------|
| Thermal Resistance, Junction-to-Case (Maximum)    | $R_{thJC}$ | 4.77  | $^{\circ}\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Ambient (Maximum) | $R_{thJA}$ | 62    | $^{\circ}\text{C}/\text{W}$ |

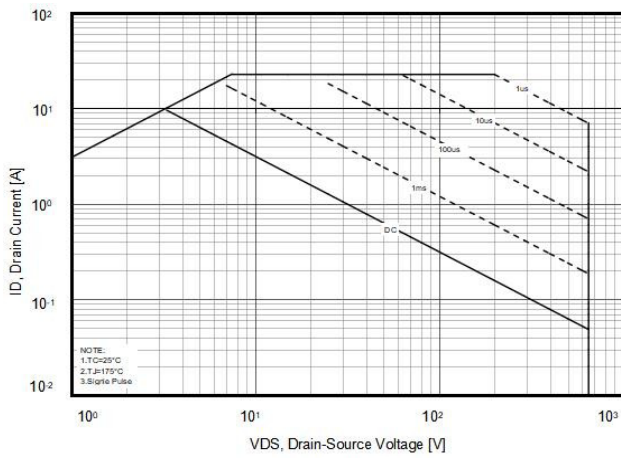
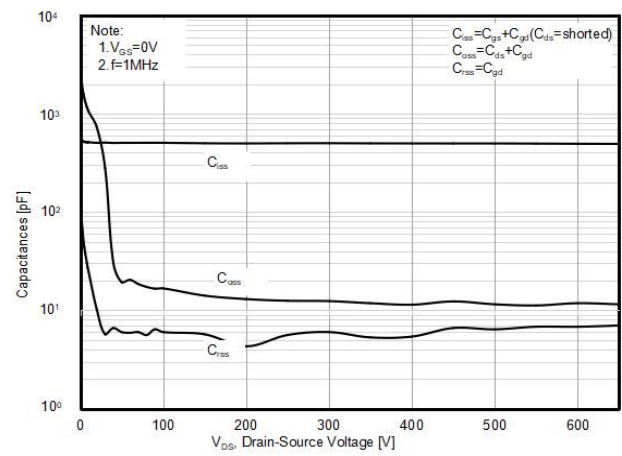
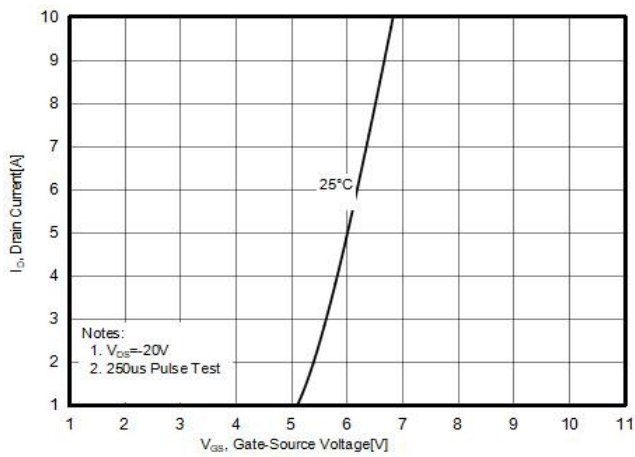
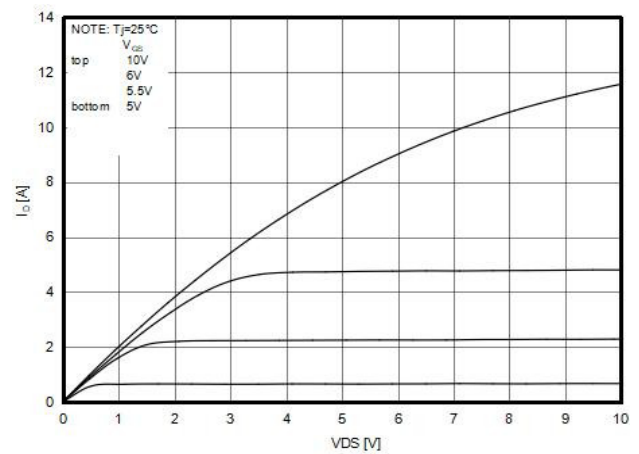
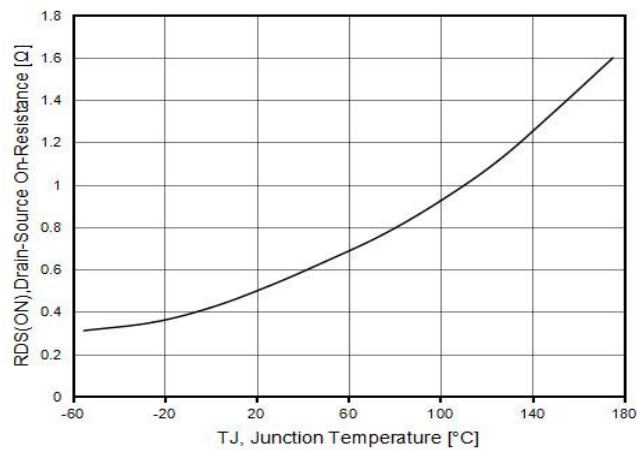
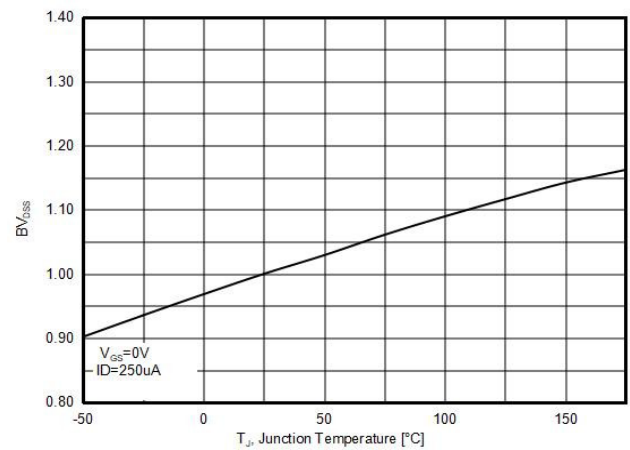
**Table 3. Electrical Characteristics ( $T_J=25^{\circ}\text{C}$  unless otherwise noted)**

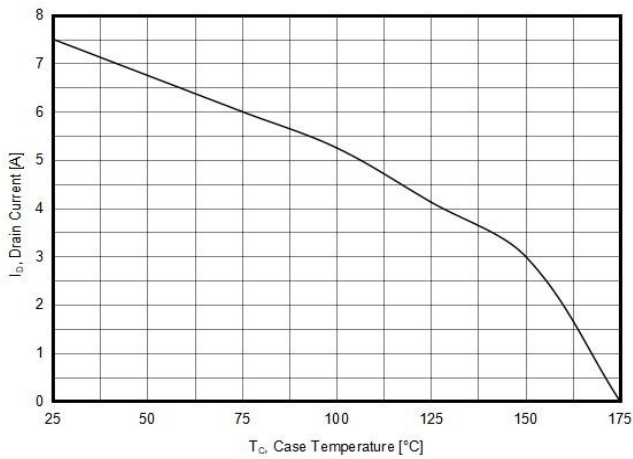
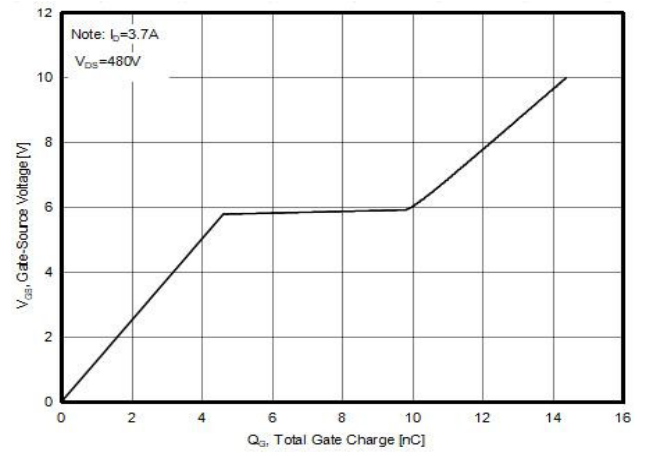
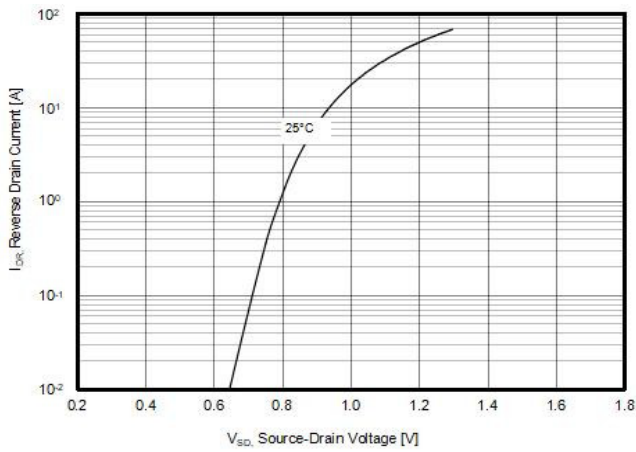
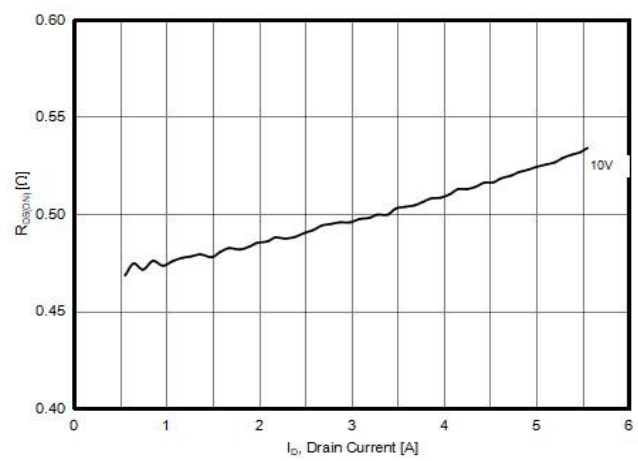
| Parameter                                | Symbol              | Condition                                                                                  | Min | Typ  | Max  | Unit |
|------------------------------------------|---------------------|--------------------------------------------------------------------------------------------|-----|------|------|------|
| 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                                                 |     |      | 1    | 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                                                 |     |      | ±200 | 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> =3.7A                                                 |     | 520  | 580  | mΩ   |
| Dynamic Characteristics                  |                     |                                                                                            |     |      |      |      |
| Input Capacitance                        | C <sub>iss</sub>    | V <sub>DS</sub> =50V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                     |     | 505  | 700  | pF   |
| Output Capacitance                       | C <sub>oss</sub>    |                                                                                            |     | 19.3 |      | pF   |
| Reverse Transfer Capacitance             | C <sub>rss</sub>    |                                                                                            |     | 6.0  |      | pF   |
| Total Gate Charge                        | Q <sub>g</sub>      | V <sub>DS</sub> =480V, I <sub>D</sub> =3.7A,<br>V <sub>GS</sub> =10V                       |     | 14.4 |      | nC   |
| Gate-Source Charge                       | Q <sub>gs</sub>     |                                                                                            |     | 4.6  |      | nC   |
| Gate-Drain Charge                        | Q <sub>gd</sub>     |                                                                                            |     | 5.1  |      | nC   |
| Gate plateau voltage                     | V <sub>gp</sub>     |                                                                                            |     | 5.8  |      | V    |
| Intrinsic gate resistance                | R <sub>G</sub>      | f = 1 MHz open drain                                                                       |     | 35   |      | Ω    |
| Switching times                          |                     |                                                                                            |     |      |      |      |
| Turn-on Delay Time                       | t <sub>d(on)</sub>  | V <sub>DD</sub> =480V, I <sub>D</sub> =3.7A,<br>R <sub>G</sub> =1.7Ω, V <sub>GS</sub> =10V |     | 9    |      | nS   |
| Turn-on Rise Time                        | t <sub>r</sub>      |                                                                                            |     | 6    |      | nS   |
| Turn-Off Delay Time                      | t <sub>d(off)</sub> |                                                                                            |     | 54   |      | nS   |
| Turn-Off Fall Time                       | t <sub>f</sub>      |                                                                                            |     | 7    |      | nS   |
| Source- Drain Diode Characteristics      |                     |                                                                                            |     |      |      |      |
| Source-drain current(Body Diode)         | I <sub>SD</sub>     | T <sub>c</sub> =25℃                                                                        |     |      | 7.5  | A    |
| Pulsed Source-drain current(Body Diode)  | I <sub>SDM</sub>    |                                                                                            |     |      | 22.5 | A    |
| Forward On Voltage                       | V <sub>SD</sub>     | T <sub>j</sub> =25℃, I <sub>SD</sub> =7.5A, V <sub>GS</sub> =0V                            |     | 0.9  | 1.2  | V    |
| Reverse Recovery Time                    | t <sub>rr</sub>     | T <sub>j</sub> =25℃, I <sub>F</sub> =3.7A,<br>di/dt=100A/μs                                |     | 188  |      | nS   |
| Reverse Recovery Charge                  | Q <sub>rr</sub>     |                                                                                            |     | 1.32 |      | uC   |
| Peak Reverse Recovery Current            | I <sub>rrm</sub>    |                                                                                            |     | 14   |      | A    |

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

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

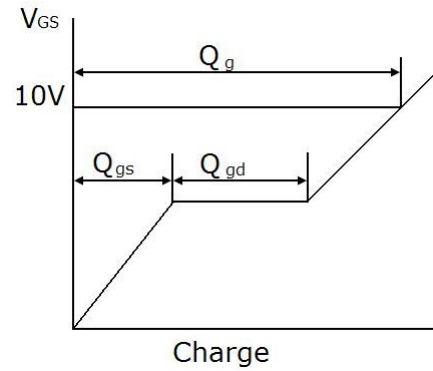
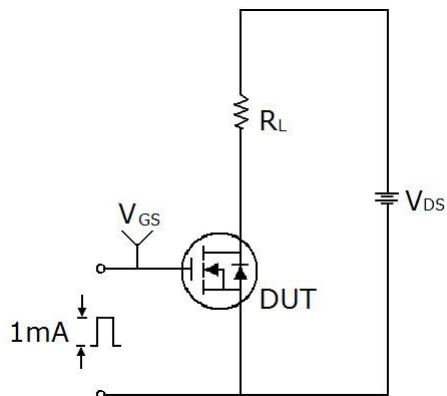
## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

**Figure1. Safe operating area**

**Figure2. Capacitance**

**Figure3. Transfer characteristics**

**Figure4. Output characteristics**

**Figure5.  $R_{DS(ON)}$  vs Junction Temperature**

**Figure6.  $BV_{DSS}$  vs Junction Temperature**


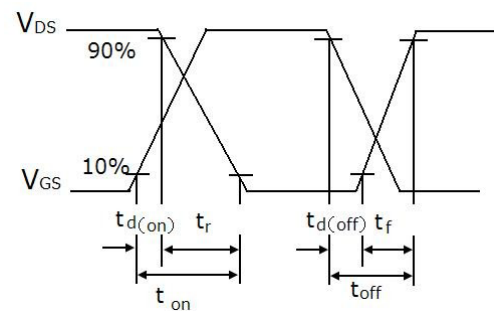
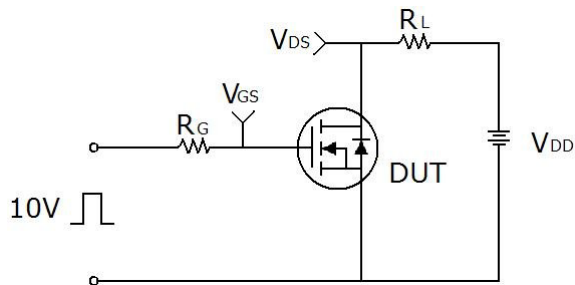
**Figure7. Maximum  $I_D$  vs Junction Temperature**

**Figure8. Gate charge waveforms**

**Figure9. Source-Drain Diode Forward Voltage**

**Figure10. Static drain-source on resistance**


## Test circuit

### 1) Gate charge test circuit & Waveform



### 2) Switch Time Test Circuit:



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

