Sanrise Tech 尚阳通

Datasheet

# 78mΩ, 600V, Super Junction N-Channel Power MOSFET SRC60R078B

## General Description

The Sanrise SRC60R078B is a high voltage power MOSFET, fabricated using advanced super junction technology. The resulting device has extremely low on resistance, low gate charge and fast switching time, making it especially suitable for applications which require superior power density and outstanding efficiency.

The SRC60R078B break down voltage is 600V and it has a high rugged avalanche characteristics. The SRC60R078B is available in TO-263-2，TO-220F and TO-247 packages.

## Features

- Ultra Low $R_{DS(ON)}$ = 78mΩ @ $V_{GS}$ = 10V.
- Ultra Low Gate Charge, Qg=90.3nC typ.
- Intrinsic Fast-Recovery Body Diode
- Fast switching capability
- Robust design with better EAS performance

## Application

- AC/DC Power Supply
- EV Charger
- PC / Sever / Telecom
- Solar Inverter

## Symbol

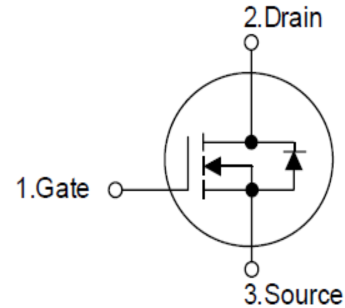



Figure 1 Symbol of SRC60R078B

## Package Type

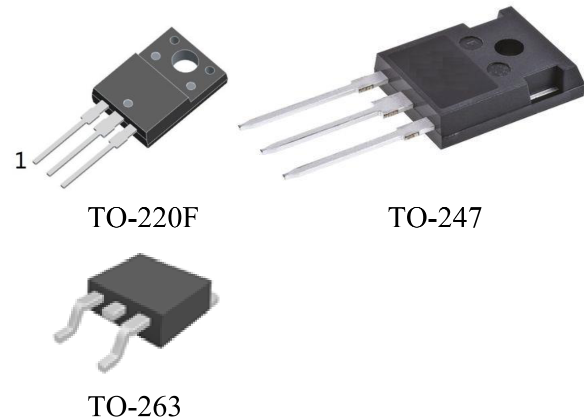
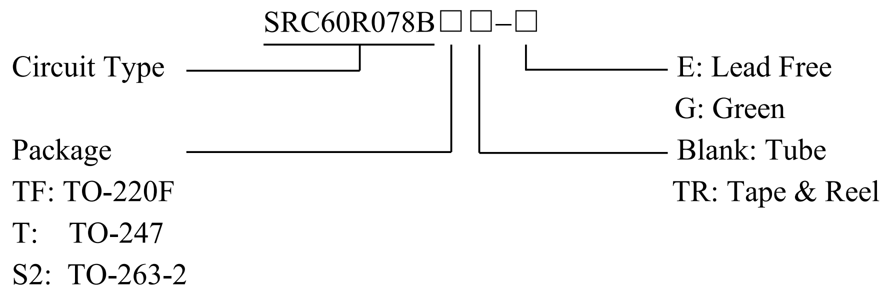



Figure 2 Package Types of SRC60R078B

## Ordering Information




| Package | Part Number | | Marking ID | | Packing Type |
|---|---|---|---|---|---|
| | Lead Free | Green | Lead Free | Green | |
| TO-220F | SRC60R078BTF-E | SRC60R078BTF-G | SRC60R078BTFE | SRC60R078BTFG | Tube |
| TO-247 | SRC60R078BT-E | SRC60R078BT-G | SRC60R078BTE | SRC60R078BTG | Tube |
| TO-263-2 | SRC60R078BS2TR-E | SRC60R078BS2TR-G | SRC60R078BS2E | SRC60R078BS2G | Tape & Reel |

## Absolute Maximum Ratings

| Parameter | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DSS}$ | 600 | V |
| Gate-Source Voltage | | $V_{GSS}$ | ±30 | V |
| Continuous Drain Current | $T_C$=25ºC | $I_D$ | 42 | A |
| | $T_C$=125ºC | | 18.7 | |
| Pulsed Drain Current (Note 2) | | $I_{DM}$ | 126 | A |
| Avalanche Energy, Single Pulse (Note 3) | | $E_{AS}$ | 550 | mJ |
| Avalanche Energy, Repetitive (Note 2) | | $E_{AR}$ | 0.6 | mJ |
| Avalanche Current, Repetitive (Note 2) | | $I_{AR}$ | 4.5 | A |
| Continuous Diode Forward Current | | $I_S$ | 42 | A |
| Diode Pulse Current | | $I_{S.PULSE}$ | 126 | A |
| MOSFET dv/dt Ruggedness, $V_{DS}$<=480V | | dv/dt | 50 | V/ns |
| Reverse Diode dv/dt, $V_{DS}$<=480V, $I_{SD}$<=$I_D$ | | dv/dt | 50 | V/ns |
| Power Dissipation（TO-220F） | | $P_{tot}$ | 35.7 | W |
| Power Dissipation（TO-247） | | $P_{tot}$ | 291 | W |
| Operating Junction Temperature | | $T_J$ | 150 | ºC |
| Storage Temperature | | $T_{STG}$ | -55 to 150 | ºC |
| Lead Temperature (Soldering, 10 sec) | | $T_{LEAD}$ | 260 | ºC |

Note:

1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. Repetitive Rating: Pulse width limited by maximum junction temperature
3. $I_{AS}$ = 4.5A, $V_{DD}$ = 60V, $R_G$ = 25Ω, Starting $T_J$ = 25°C

## Thermal Resistance

| Parameter | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Thermal resistance, Junction-to-Case | TO-220F | $R_{thJC}$ | | | 3.5 | ºC /W |
| | TO-263-2 | | | | 0.43 | |
| | TO-247 | | | | 0.43 | |
| Thermal resistance, Junction-to-Ambient | TO-220F | $R_{thJA}$ | | | 70 | ºC /W |
| | TO-263-2 | | | | 58 | |
| | TO-247 | | | | 58 | |

## Electrical Characteristics

$T_J$ = 25℃, unless otherwise specified.

| Parameter | | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Statistic Characteristics** | | | | | | | |
| Drain-Source Breakdown Voltage | | $BV_{DSS}$ | $V_{GS}$=0V, $I_D$=250uA | 600 | | | V |
| Zero Gate Voltage Drain Current | | $I_{DSS}$ | $V_{DS}$=600V, $V_{GS}$=0V | | | 10 | uA |
| Gate-Body Leakage Current | Forward | $I_{GSSF}$ | $V_{GS}$=30V, $V_{DS}$=0V | | | 100 | nA |
| | Reverse | $I_{GSSR}$ | $V_{GS}$=-30V, $V_{DS}$=0V | | | -100 | nA |
| Gate Threshold Voltage | | $V_{GS(TH)}$ | $V_{DS}$=$V_{GS}$, $I_D$=800uA | 3.0 | 4.0 | 5.0 | V |
| Static Drain-Source On-Resistance | | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=21A | | 70 | 78 | mΩ |
| Gate Resistance | | $R_G$ | f=1MHz, Open Drain | | 0.7 | | Ω |
| **Dynamic Characteristics** | | | | | | | |
| Input Capacitance | | $C_{ISS}$ | $V_{DS}$=50V, $V_{GS}$=0V, f=1MHz | | 3300 | | pF |
| Output Capacitance | | $C_{OSS}$ | | | 136 | | |
| Reverse Transfer Capacitance | | $C_{RSS}$ | | | 2.3 | | |
| Effective output capacitance, energy related NOTE5 | | $C_{O(er)}$ | $V_{GS}$=0V, $V_{DS}$=0…400V | | 98.2 | | pF |
| Effective output capacitance, time related NOTE6 | | $C_{O(tr)}$ | | | 601 | | |
| Turn-on Delay Time | | $t_{d(on)}$ | $V_{DD}$=400V, $I_D$=21A $R_G$=1.8Ω, $V_{GS}$=10V | | 24 | | ns |
| Rise Time | | $t_r$ | | | 38 | | |
| Turn-off Delay Time | | $t_{d(off)}$ | | | 48 | | |
| Fall Time | | $t_f$ | | | 10 | | |
| **Gate Charge Characteristics** | | | | | | | |
| Gate to Source Charge | | $Q_{gs}$ | $V_{DD}$=480V, $I_D$=21A $V_{GS}$=0 to 10V | | 22.9 | | nC |
| Gate to Drain Charge | | $Q_{gd}$ | | | 45.6 | | |
| Gate Charge Total | | $Q_g$ | | | 90.3 | | |
| Gate Plateau Voltage | | $V_{plateau}$ | | | 6.5 | | V |
| **Reverse Diode Characteristics** | | | | | | | |
| Drain-Source Diode Forward Voltage | | $V_{SD}$ | $V_{GS}$=0V, $I_{SD}$=21A | | 0.9 | 1.1 | V |
| Reverse Recovery Time | | $t_{rr}$ | $V_R$=100V, $I_F$=21A $dI_F/dt$=100A/us | | 158 | | ns |
| Reverse Recovery Charge | | $Q_{rr}$ | | | 0.95 | | uC |
| Peak Reverse Recovery Current | | $I_{rrm}$ | | | 12.0 | | A |

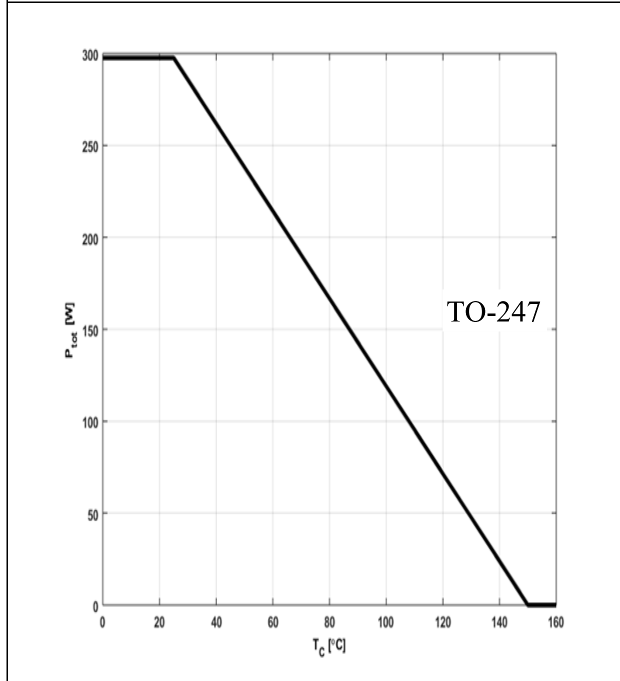
Note:

5. $C_{O(er)}$ is a fixed capacitance that gives the same stored energy as $C_{OSS}$ while $V_{DS}$ is rising from 0 to 480V

6. $C_{O(tr)}$ is a fixed capacitance that gives the same charging time as $C_{OSS}$ while $V_{DS}$ is rising from 0 to 480 V

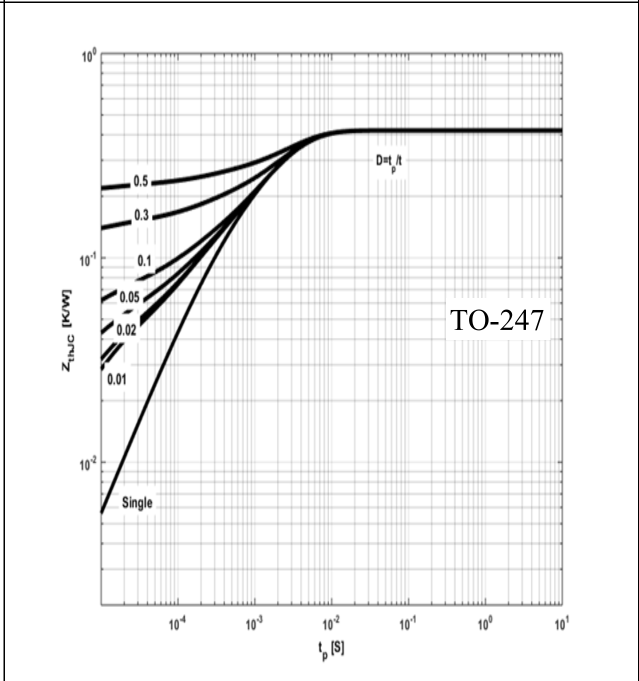
## Typical Performance Characteristics

Figure 3: Power Dissipation



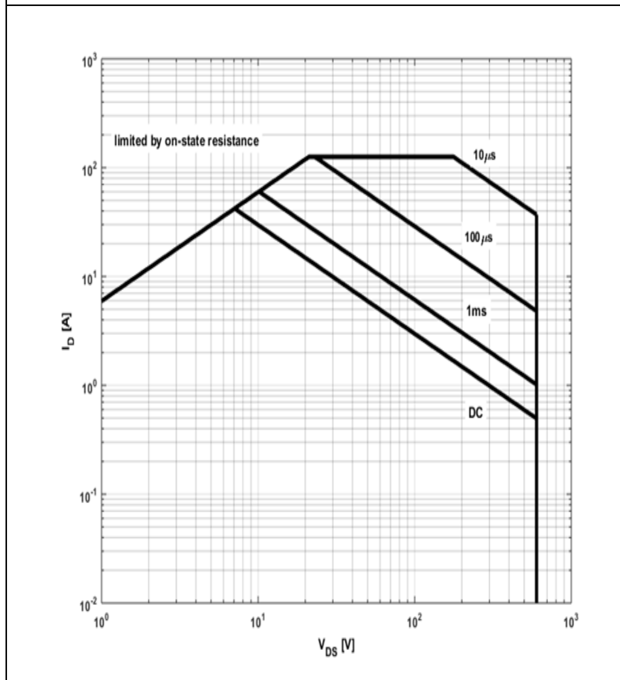

$P_{tot} = f(T_c)$

Figure 4: Max. Transient Thermal Impedance



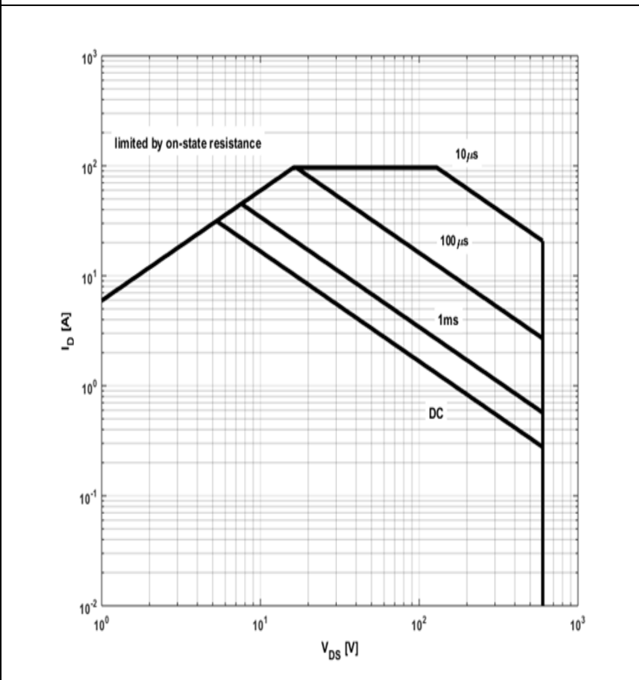

$Z_{(thJC)} = f(t_p)$; parameter: $D = t_p/T$

Figure 5: Safe Operating Area

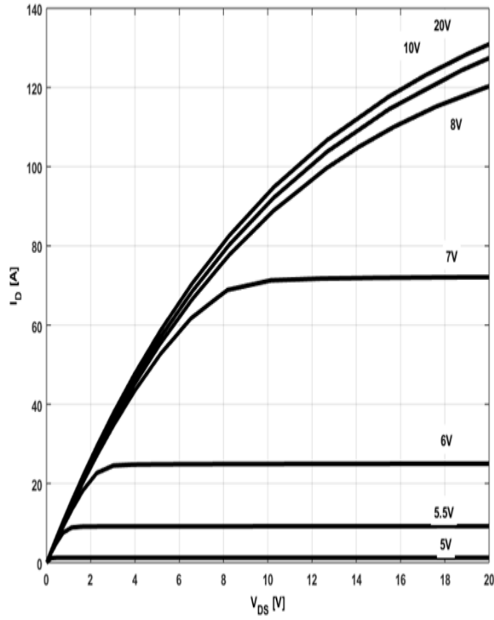
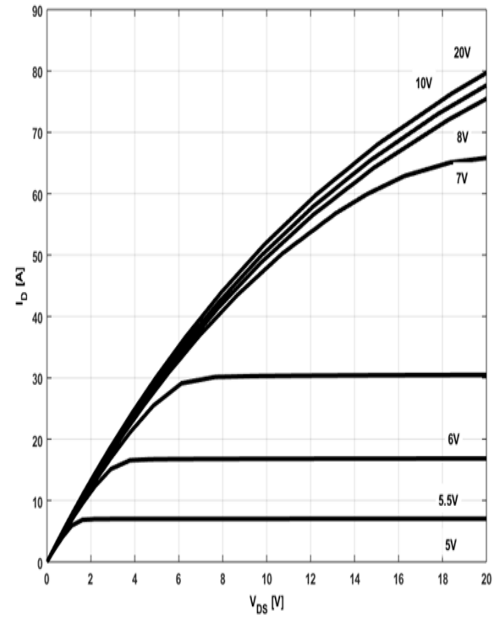


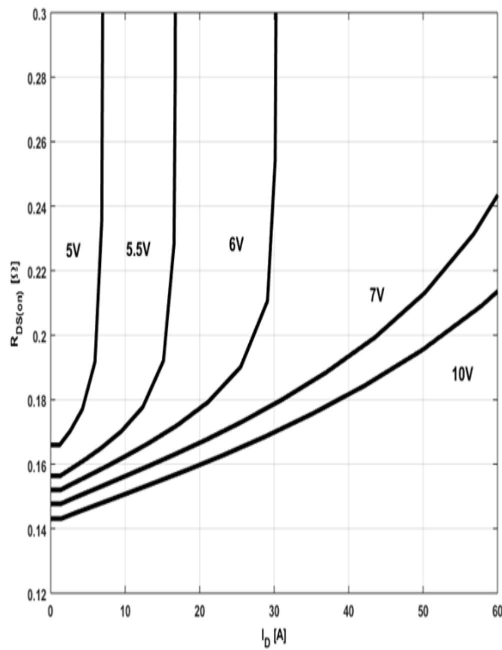
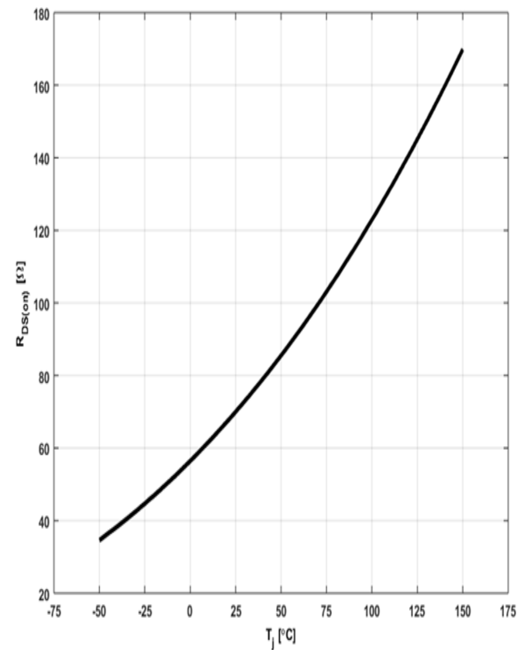

$I_D = f(V_{DS})$; $T_c$= 25ºC; $V_{GS}$>7V; parameter $t_p$

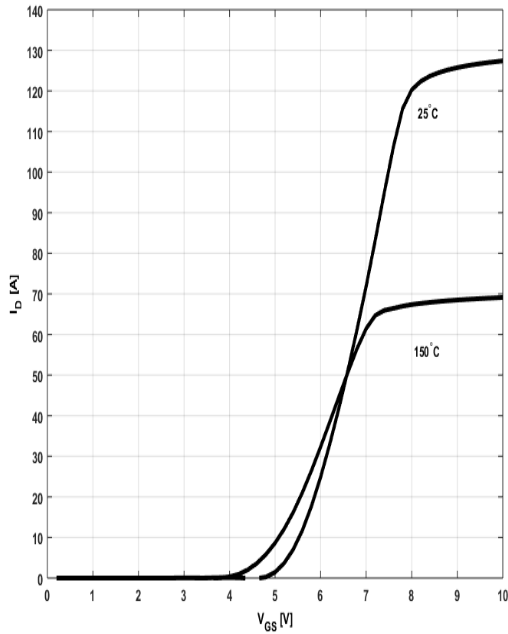
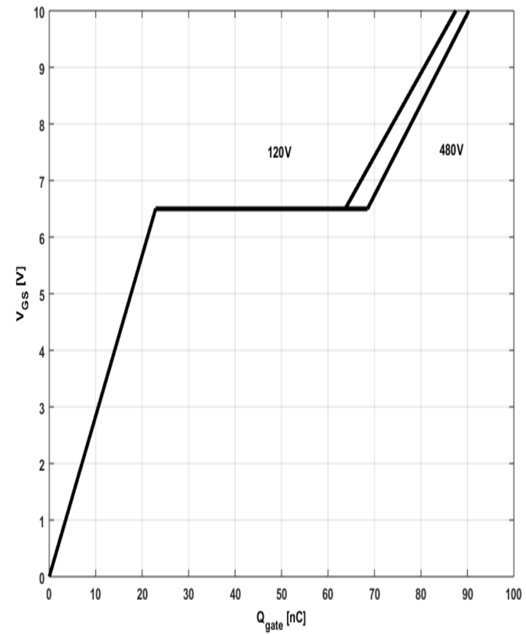
Figure 6: Safe Operating Area

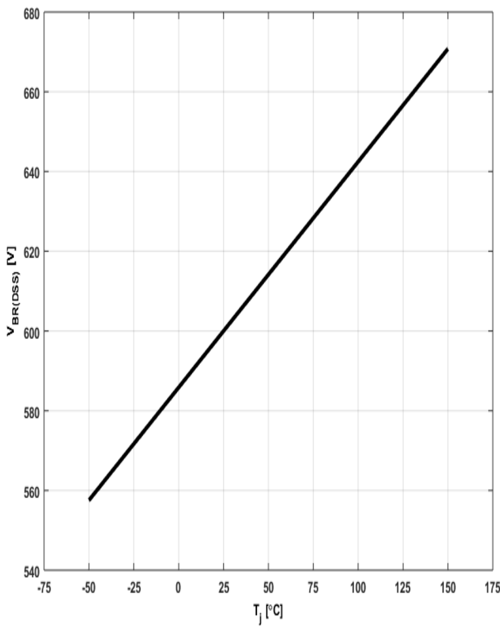
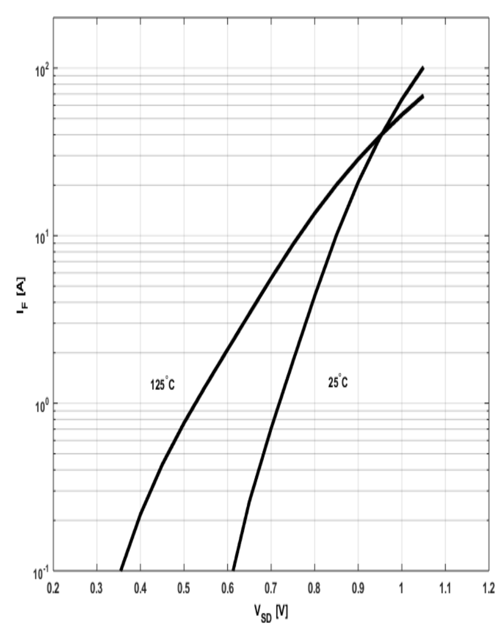


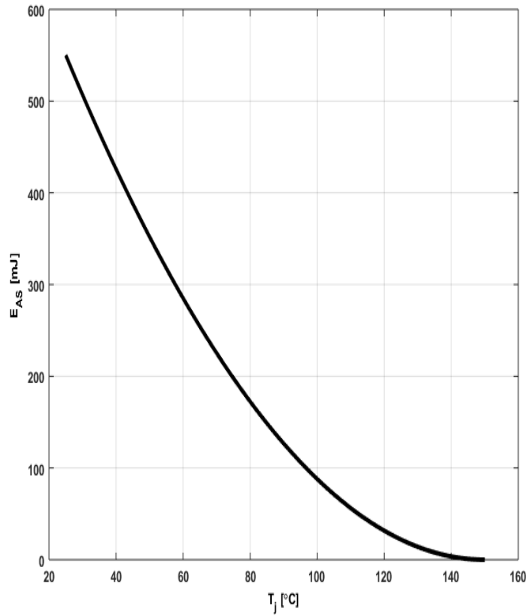
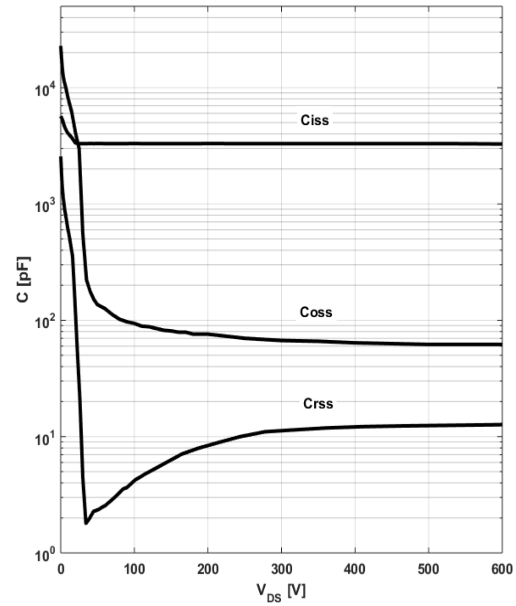

$I_D = f(V_{DS})$; $T_c$= 80ºC; $V_{GS}$>7V; parameter $t_p$

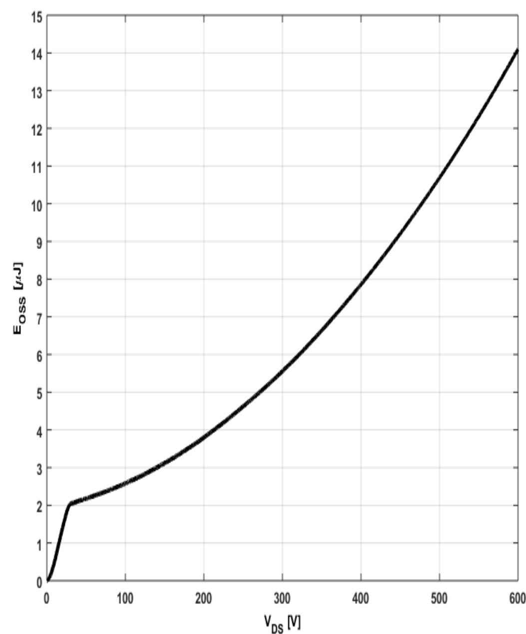
| Figure 7: Typ. Output Characteristics | Figure 8: Typ. Output Characteristics |
|---|---|
|   |   |
| $I_D = f(V_{DS})$; Tj= 25ºC; parameter: $V_{GS}$ | $I_D = f(V_{DS})$; $T_j$= 125ºC; parameter: $V_{GS}$ |

| Figure 9: Typ. Drain-Source On-State Resistance | Figure 10: Typ. Drain-Source On-State Resistance |
|---|---|
|   |   |
| $R_{DS(ON)}$ =f($I_D$); $T_j$=125ºC; parameter: $V_{GS}$ | $R_{DS(ON)}$=f($T_j$); $I_D$=21A; $V_{GS}$=10V |

| Figure 11: Typ. Transfer Characteristics | Figure 12: Typ. Gate Charge |
|---|---|
|   |   |
| $I_D = f(V_{GS})$; $V_{DS} = 20V$ | $V_{GS} = f(Q_{gate})$, $I_D = 21A$ pulsed |

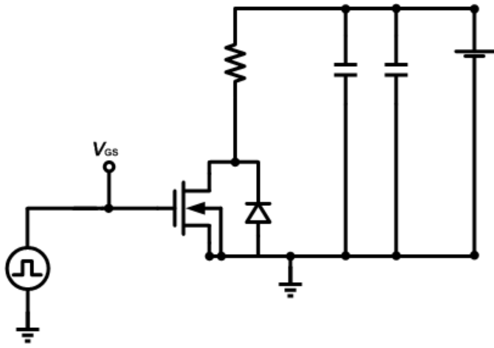
| Figure 13: Drain-Source Breakdown Voltage | Figure 14: Forward Characteristics of Reverse Diode |
|---|---|
|   |   |
| $V_{BR(DSS)} = f(T_j)$; $I_D = 10mA$ | $I_F = f(V_{SD})$; parameter: $T_j$ |

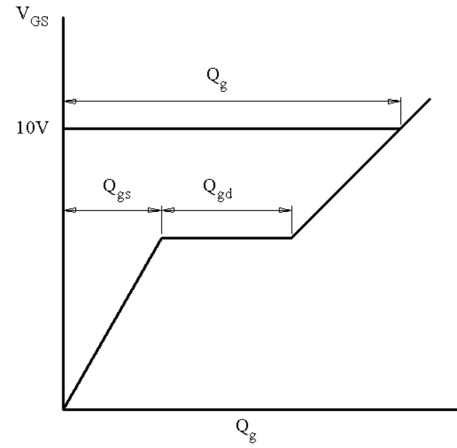
| Figure 15: Avalanche Energy | Figure 16: Typ. Capacitances |
|---|---|
|   |   |
| $E_{AS}$=f($T_j$); $I_D$=4.5A; $V_{DD}$=60V | C=f($V_{DS}$); $V_{GS}$=0; f=1MHz |

| Figure 17: $C_{OSS}$ Stored Energy |
|---|
|   |
| $E_{OSS}$=f($V_{DS}$) |

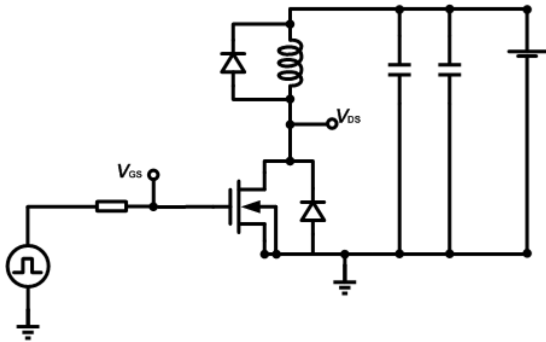
## Test Circuits

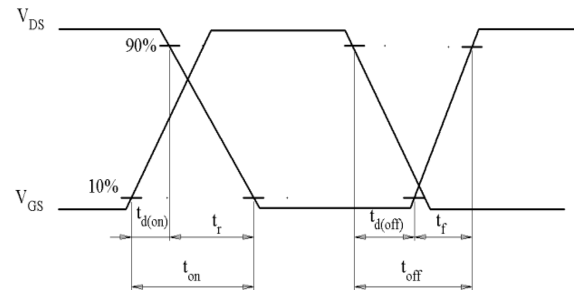
### 1. Gate Charge Test Circuit & Waveform



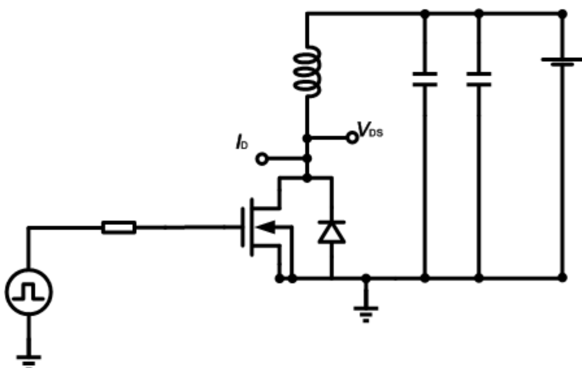



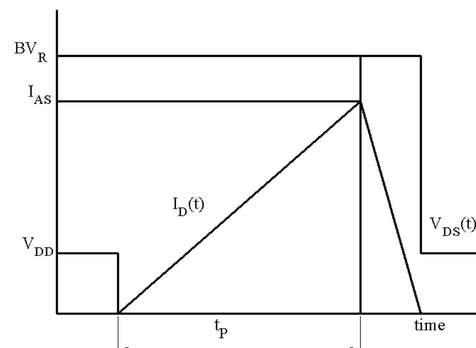

### 2. Switch Time Test Circuit



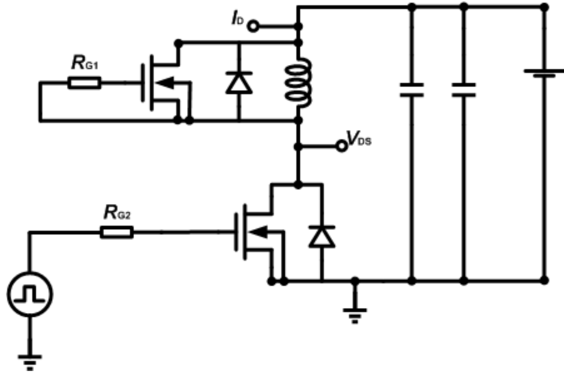



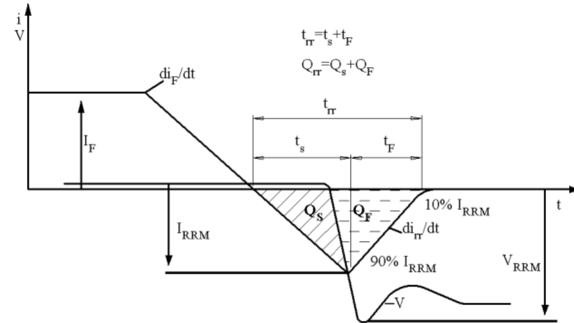

### 3. Unclaimed Inductive Switching Test Circuit & Waveforms



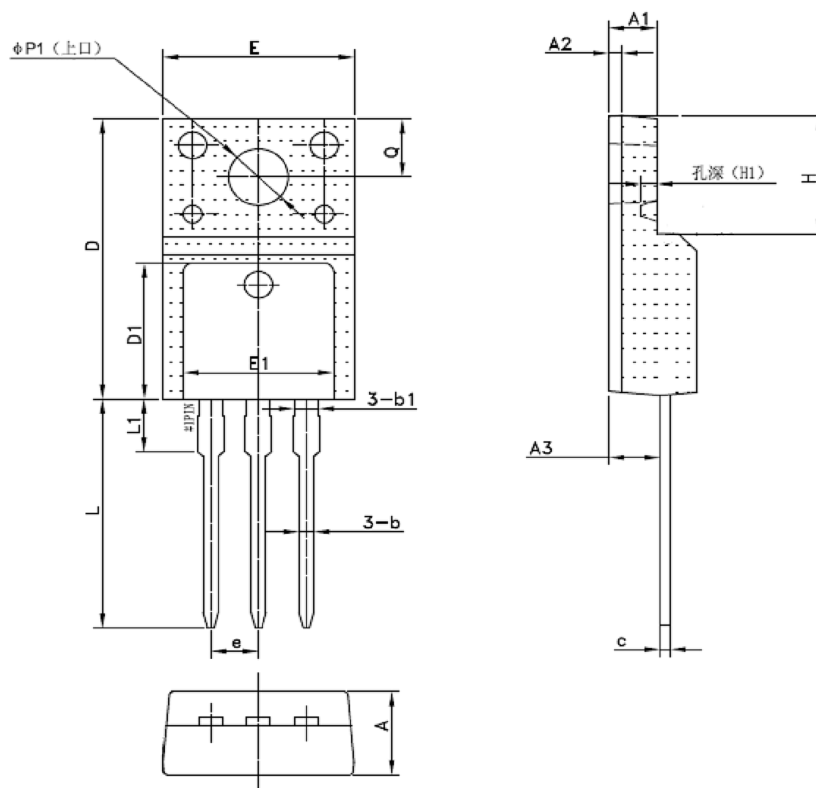
## 4. Test Circuit and Waveform for Diode Characteristics



## Mechanical Dimensions

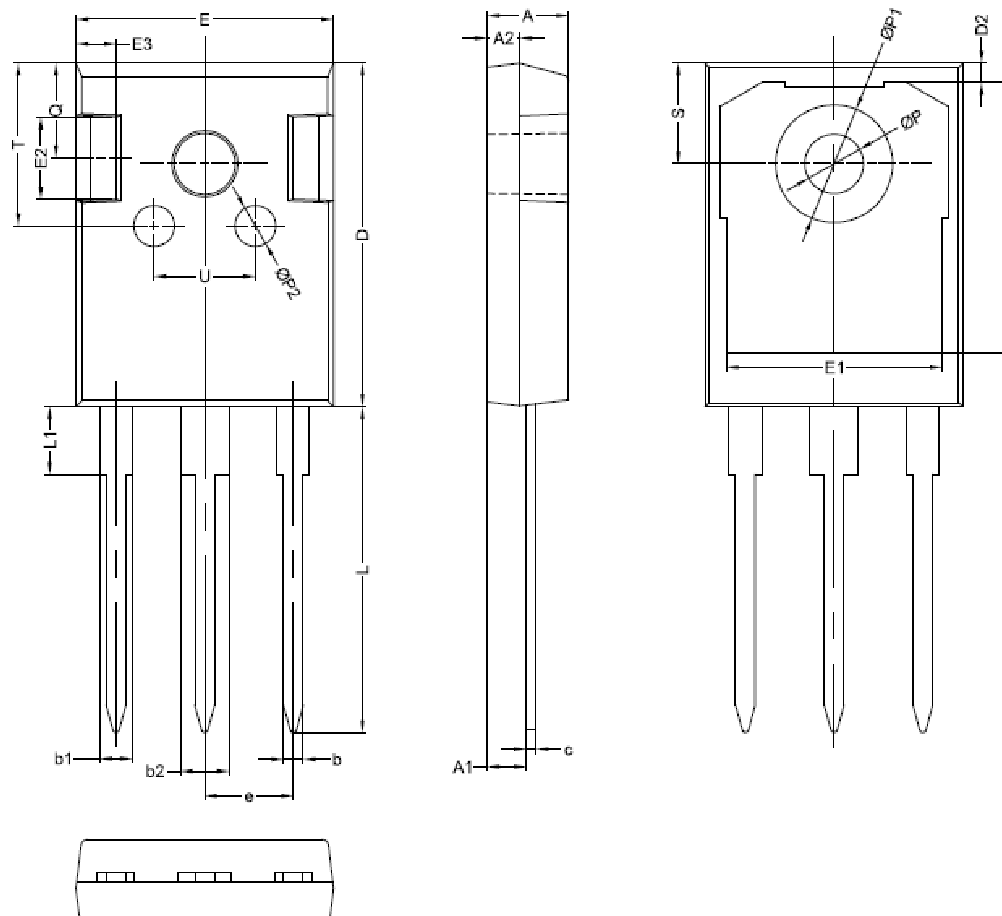
**TO-220F** **Unit: mm**




| Symbol | Dimensions(mm) | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.30 | 4.70 | 4.90 |
| A1 | 2.34 | 2.54 | 2.90 |
| A2 | - | 0.70 | - |
| A3 | 2.56 | 2.76 | 2.96 |
| b | 0.55 | - | 0.95 |
| b1 | - | 1.28 | - |
| c | 0.42 | 0.50 | 0.70 |
| D | 14.70 | - | 16.07 |
| D1 | - | 7.70 | - |
| E | 9.96 | 10.16 | 10.36 |
| E1 | - | 8.00 | - |
| e | 2.54(BSC) | | |
| H | - | 6.70 | - |
| (H1) | - | (0.81) | - |
| L | 12.48 | 12.98 | 13.50 |
| L1 | - | 2.93 | - |
| ΦP1 | - | 3.18 | - |
| Q | 2.90 | 3.30 | 3.50 |

## Mechanical Dimensions (Continued)

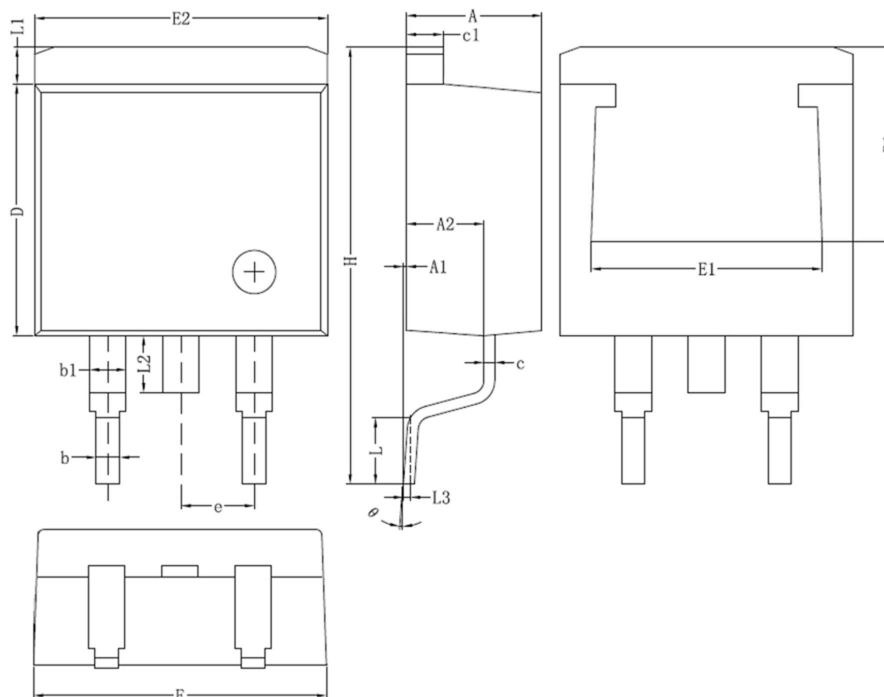
**TO-247** **Unit: mm**




| Symbol | Dimensions(mm) | | | Symbol | Dimensions(mm) | | |
|---|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | Min. | Typ. | Max. |
| A | 4.80 | 5.00 | 5.20 | E2 | - | 5.00 | - |
| A1 | 2.21 | 2.41 | 2.61 | E3 | - | 2.50 | - |
| A2 | 1.90 | 2.00 | 2.10 | e | 5.44(BSC) | | |
| b | 1.10 | 1.20 | 1.35 | L | 19.42 | 19.92 | 20.42 |
| b1 | - | 2.00 | - | L1 | - | 4.13 | - |
| b2 | - | 3.00 | - | P | 3.50 | 3.60 | 3.70 |
| c | 0.55 | 0.60 | 0.75 | P1 | - | - | 7.40 |
| D | 20.80 | 21.00 | 21.20 | P2 | - | 2.50 | - |
| D1 | - | 16.55 | - | Q | - | 5.80 | - |
| D2 | - | 1.20 | - | S | 6.05 | 6.15 | 6.25 |
| E | 15.60 | 15.80 | 16.00 | T | - | 10.00 | - |
| E1 | - | 13.30 | - | U | - | 6.20 | - |

## Mechanical Dimensions

**TO-263-2** **Unit: mm**




| Symbol | Dimensions(mm) | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.30 | 4.60 | 4.85 |
| A1 | 0.00 | 0.10 | 0.25 |
| A2 | 2.59 | 2.69 | 2.89 |
| b | 0.70 | 0.81 | 0.96 |
| b1 | - | 1.27 | - |
| c | 0.36 | 0.40 | 0.61 |
| c1 | 1.15 | 1.27 | 1.40 |
| D | 8.55 | - | 9.40 |
| D1 | 6.40 | - | - |
| E | 9.80 | 10.10 | 10.31 |
| E1 | 7.60 | - | - |
| E2 | 9.80 | 10.00 | 10.20 |
| e | 2.54(BSC) | | |
| H | 14.70 | 15.20 | 16.00 |
| L | 2.00 | 2.30 | 2.84 |
| L1 | 1.00 | 1.27 | 1.40 |
| L2 | - | - | 2.20 |
| L3 | - | 0.25 | - |
| θ | 0° | - | 8° |

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**Main Site:**

**- Headquarter**
Sanrise Technology Limited Company
Rm.601~603, Building B, SDG Information Port, No.2, Kefeng Road, Science & Technology Park, Nanshan District, ShenZhen, P.R.China
Tel: +86-755-22953335
Fax: +86-755-22916878

**- Shanghai Office**
Sanrise Technology Limited Company
Rm.702, Building A, No. 666, Zhangheng Road, Zhangjiang Hi-Tech Park, Shanghai, P.R.China

Tel: +86-21-68825918