

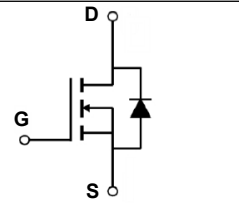
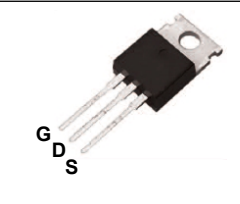
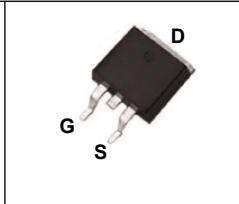
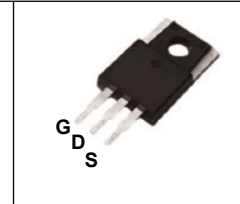
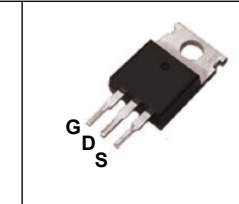
Features

- $V_{DS}=70V, I_D=90A$
 $R_{ds(on)}(typ)=6m\Omega @ V_{gs}=10V$
- 100% Avalanche Tested
- 100% Rg Tested
- Lead-Free (RoHS Compliant)

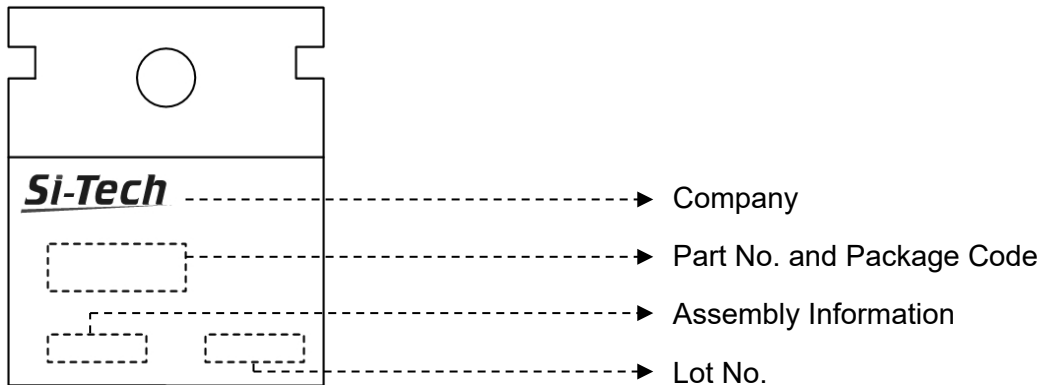
Applications

- DC Motor Control
- DC-DC Converters
- BMS
- SMPS
- Automotive Environment

Internal Circuit and Pin Description

| | | | | |
|---|---|---|--|---|
|  |  |  |  |  |
| Package | TO-220 | TO-263 | TO-220N | TO-220P |
| Package Code | R | S | RN | RP |

Package Marking



Absolute Maximum Ratings ($T_C=25^{\circ}C$ unless otherwise noted)

| Symbol | Parameter | Value | Units |
|-----------|---|-------------|----------------|
| V_{DSS} | Drain-Source Voltage | 70 | V |
| I_D | Continuous Drain Current ($T_C=25^{\circ}C$) | 90 | A |
| | Continuous Drain Current ($T_C=100^{\circ}C$) | 57 | A |
| I_{DM} | Pulsed Drain Current (Note 1) | 360 | A |
| V_{GS} | Gate-Source Voltage | ± 25 | V |
| E_{AS} | Single Pulsed Avalanche Energy (Note 2) | 289 | mJ |
| P_D | Maximum Power Dissipation ($T_C=25^{\circ}C$) | 127 | W |
| | Derating Factor above $25^{\circ}C$ | 1.02 | W/ $^{\circ}C$ |
| T_J | Operating Junction Temperature Range | -55 to +150 | $^{\circ}C$ |
| T_{STG} | Storage Temperature Range | -55 to +150 | $^{\circ}C$ |

Thermal Characteristics

| Symbol | Parameter | Value | Units |
|---------------|--------------------------------------|-------|---------------|
| $R_{th\ j-c}$ | Thermal Resistance, Junction to case | 0.98 | $^{\circ}C/W$ |

Electrical Characteristics ($T_c=25^{\circ}C$ unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|--------------|----------------------------------|--------------------------------|------|------|------|-----------|
| BV_{DSS} | Drain-Source Breakdown Voltage | $V_{GS}=0V, I_D=250\mu A$ | 70 | - | - | V |
| I_{DSS} | Drain-Source Leakage Current | $V_{DS}=66.5V, V_{GS}=0V$ | - | - | 1 | μA |
| I_{GSS} | Gate Leakage Current, Forward | $V_{GS}=25V, V_{DS}=0V$ | - | - | 100 | nA |
| | Gate Leakage Current, Reverse | $V_{GS}=-25V, V_{DS}=0V$ | - | - | -100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}=V_{DS}, I_D=250\mu A$ | 2.4 | 3 | 3.6 | V |
| $R_{DS(on)}$ | Drain-Source On-State Resistance | $V_{GS}=10V, I_D=40A$ | 4.8 | 6 | 7.2 | $m\Omega$ |
| Q_g | Total Gate Charge | $V_{DD}=48V$ | - | 92 | - | nC |
| Q_{gs} | Gate-Source Charge | $V_{GS}=10V$ | - | 22 | - | nC |
| Q_{gd} | Gate-Drain Charge | $I_D=50A$ (Note 3) | - | 23 | - | nC |
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD}=37.5V, V_{GS}=10V$ | - | 22 | - | ns |
| t_r | Turn-on Rise Time | $I_D=45A, R_G=4.7\Omega$ | - | 12 | - | ns |
| $t_{d(off)}$ | Turn-off Delay Time | $T_c=25^{\circ}C$ | - | 28 | - | ns |
| t_f | Turn-off Fall Time | (Note 3) | - | 34 | - | ns |
| R_g | Gate Resistance | $V_{DS}=0V, V_{GS}=0V, f=1MHz$ | - | 0.9 | - | Ω |
| C_{iss} | Input Capacitance | $V_{DS}=25V$ | - | 4713 | - | pF |
| C_{oss} | Output Capacitance | $V_{GS}=0V$ | - | 410 | - | pF |
| C_{rss} | Reverse Transfer Capacitance | $f = 1MHz$ | - | 330 | - | pF |

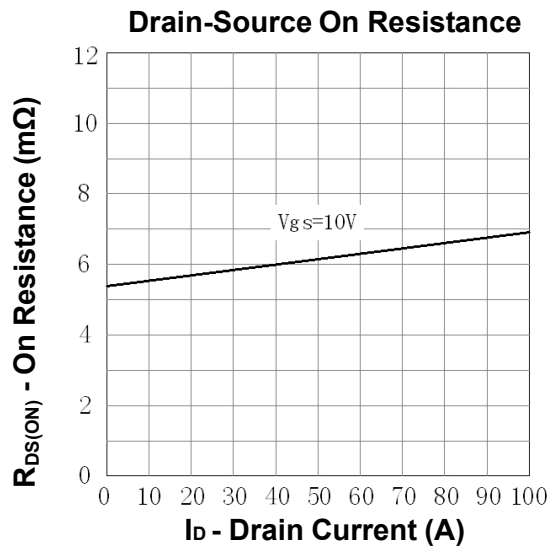
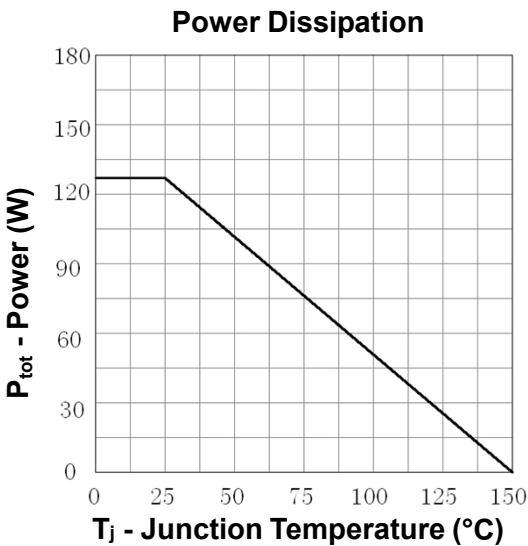
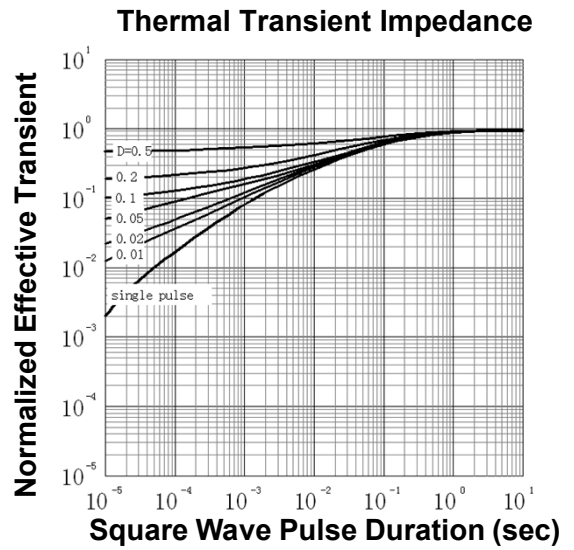
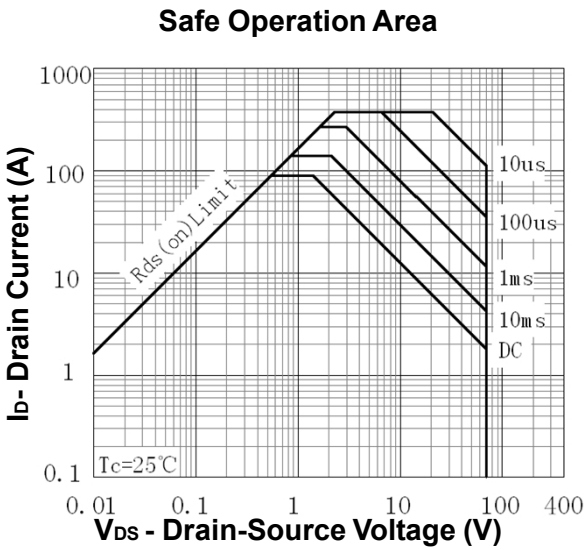
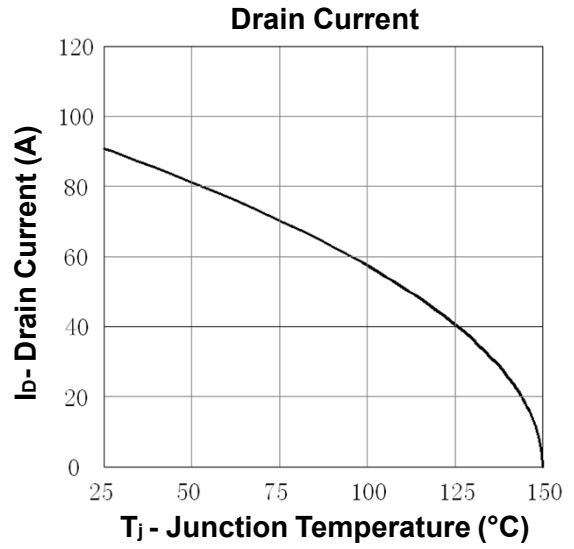
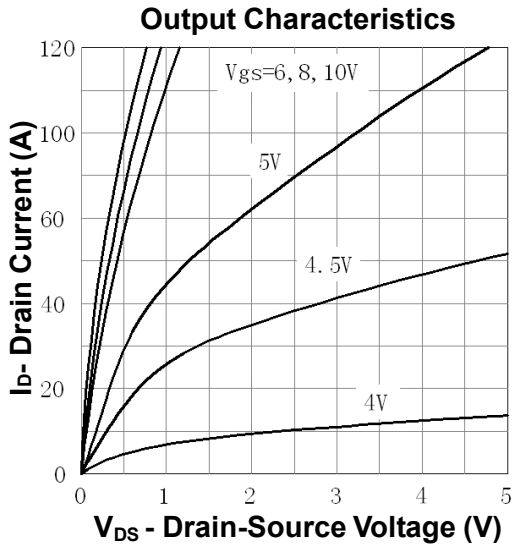
Source-Drain Diode Characteristics ($T_c=25^{\circ}C$ unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|----------|--|------------------------|------|------|------|-------|
| I_S | Continuous Source Diode Forward Current | | - | - | 90 | A |
| I_{SM} | Pulsed Source Diode Forward Current (Note 1) | | - | - | 360 | A |
| V_{SD} | Forward On Voltage | $V_{GS}=0V, I_S=45A$ | - | 0.89 | 1 | V |
| t_{rr} | Reverse Recovery Time | $V_{GS}=0V, I_S=45A$ | - | 50 | - | ns |
| Q_{rr} | Reverse Recovery Charge | $dI_F/dt = 100A/\mu s$ | - | 90 | - | nC |

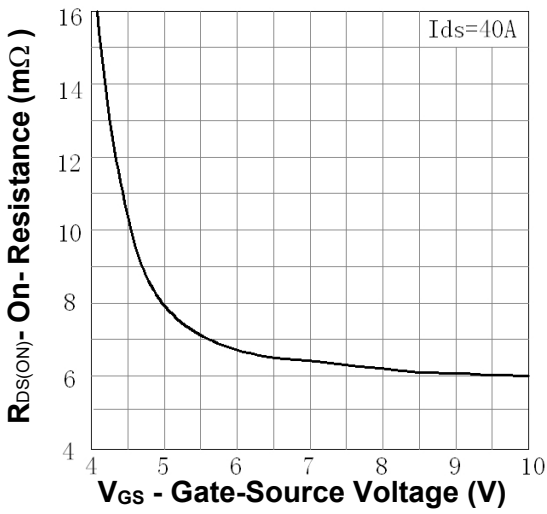
Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $L=0.5mH, V_{DD}=64V, R_G=25\Omega$, Starting $T_J=25^{\circ}C$
3. Pulse Width $\leq 300\mu s$; Duty Cycle $\leq 2\%$

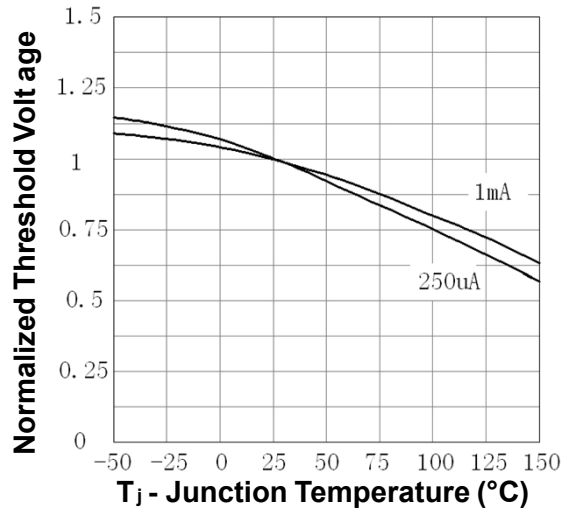
Typical Characteristics



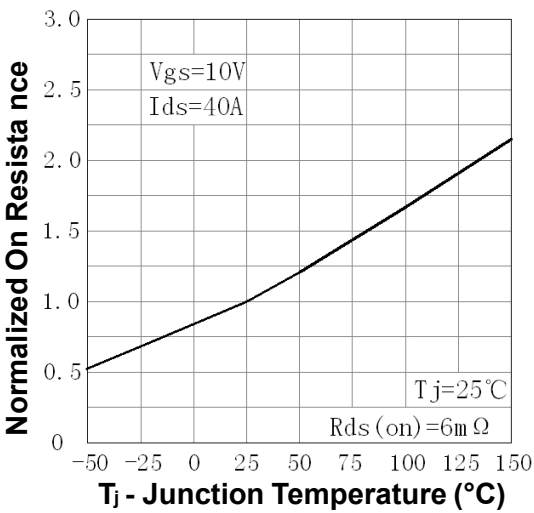
Drain-Source On Resistance



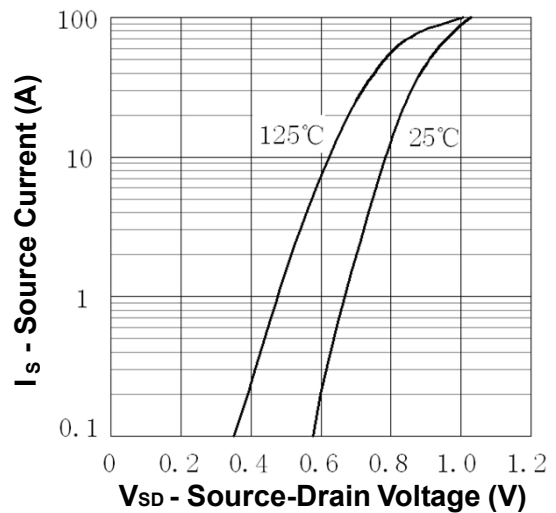
Gate Threshold Voltage



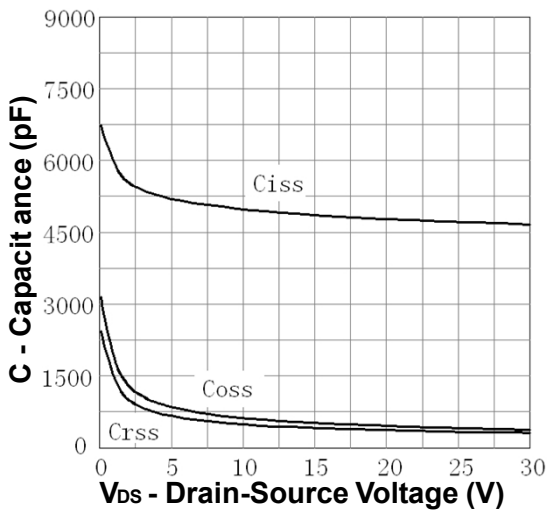
Drain-Source On Resistance



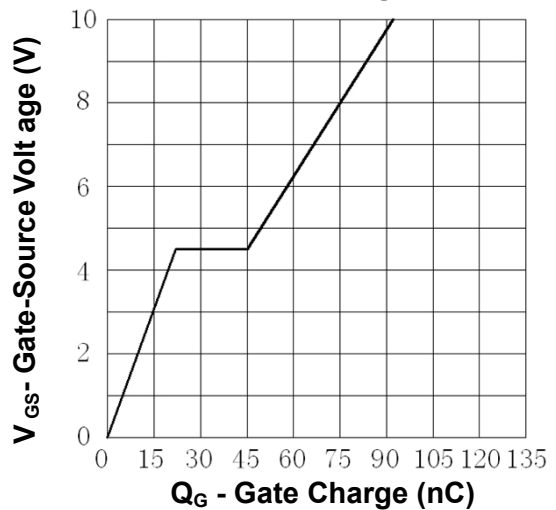
Source-Drain Diode Forward



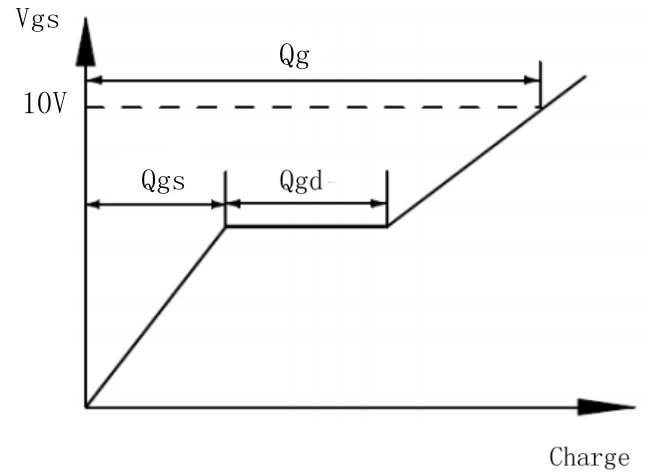
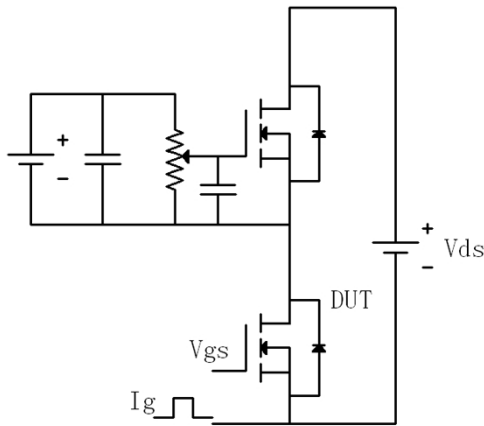
Capacitance



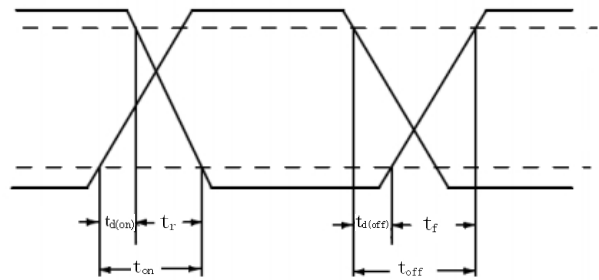
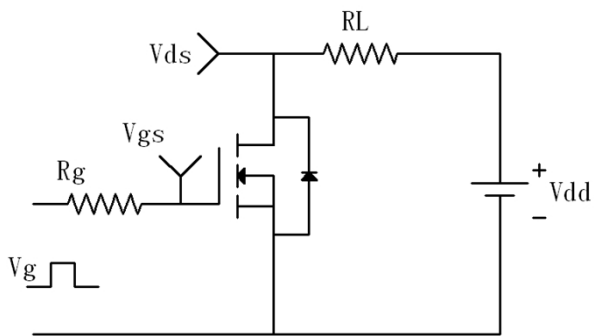
Gate Charge



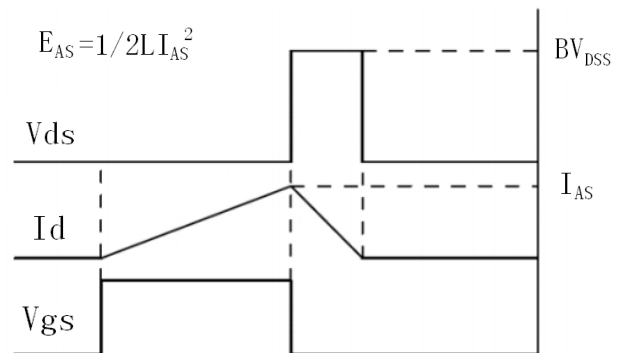
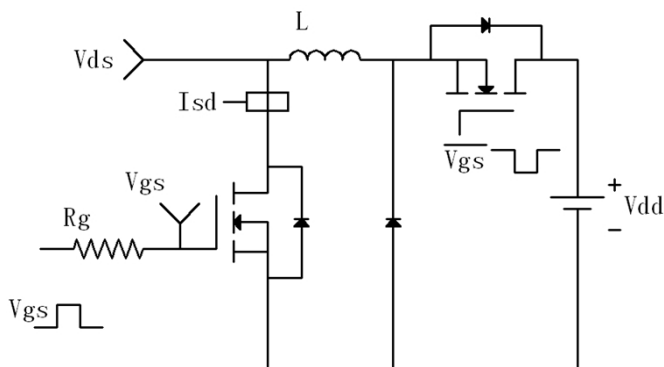
Gate Charge Test Circuit and Waveforms



Switching Time Test Circuit & Waveforms

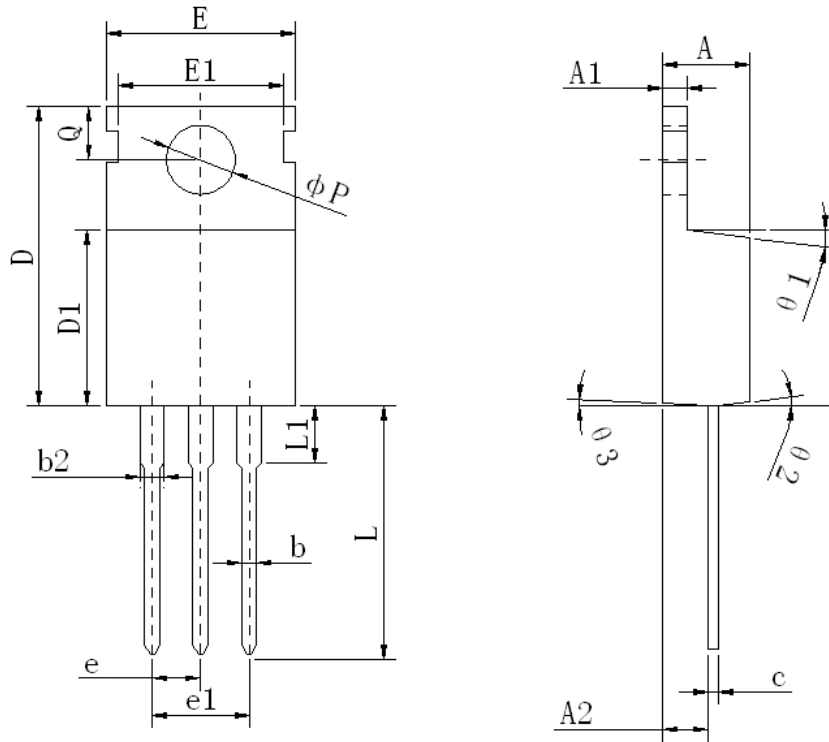


Avalanche Test Circuit & Waveforms



Package Outline

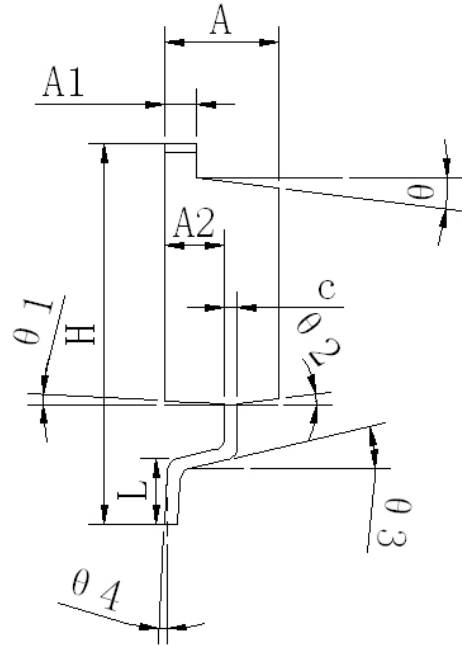
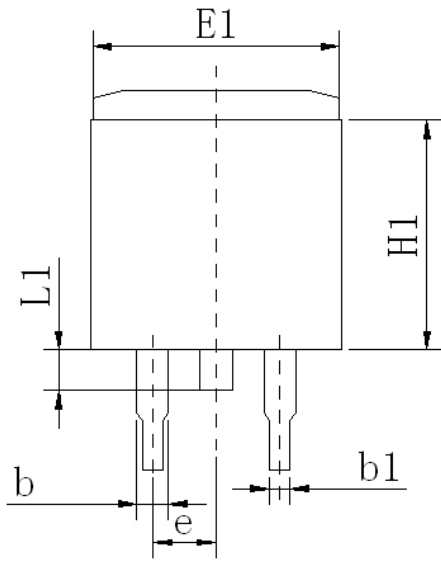
TO220



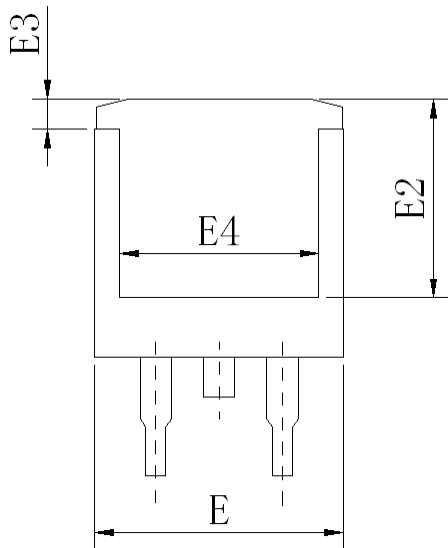
UNIT:mm

| SYMBOL | MIN | NOM | MAX |
|--------|----------|-------|-------|
| A | 4.47 | 4.57 | 4.67 |
| A1 | 1.27 | 1.30 | 1.33 |
| A2 | 2.35 | 2.40 | 2.45 |
| b | 0.76 | 0.80 | 0.89 |
| b2 | 1.23 | 1.27 | 1.38 |
| c | 0.47 | 0.50 | 0.53 |
| D | 15.60 | 15.70 | 15.80 |
| D1 | 9.10 | 9.20 | 9.30 |
| E | 9.70 | 9.90 | 10.10 |
| E1 | - | 8.70 | - |
| e | 2.54 BSC | | |
| e1 | 5.08 BSC | | |
| L | 12.83 | 13.00 | 13.17 |
| L1 | 3.00 | 3.10 | 3.20 |
| P | 3.57 | 3.60 | 3.63 |
| Q | 2.75 | 2.80 | 2.85 |
| θ1 | 5° | 7° | 9° |
| θ2 | 1° | 3° | 5° |
| θ3 | 1° | 3° | 5° |

TO263



UNIT:mm



| SYMBOL | MIN | NOM | MAX |
|------------|----------|-------|-------|
| A | 4.47 | 4.57 | 4.67 |
| A1 | 1.25 | 1.30 | 1.35 |
| A2 | 2.34 | 2.40 | 2.46 |
| b | 1.22 | 1.27 | 1.32 |
| b1 | 0.75 | 0.80 | 0.85 |
| c | 0.45 | 0.50 | 0.55 |
| E | 9.90 | 10.00 | 10.10 |
| E1 | 9.78 | 9.88 | 9.98 |
| E2 | 7.95 | 8.00 | 8.05 |
| E3 | 1.10 | 1.20 | 1.30 |
| E4 | 7.95 | 8.00 | 8.05 |
| e | 2.54 BSC | | |
| H | 15.00 | 15.20 | 15.40 |
| H1 | 10.30 | 10.40 | 10.50 |
| L | 2.20 | 2.40 | 2.60 |
| L1 | 1.50 | 1.60 | 1.70 |
| θ | 5° | 7° | 9° |
| θ_1 | 1° | 3° | 5° |
| θ_2 | 5° | 7° | 9° |
| θ_3 | 11° | 13° | 15° |
| θ_4 | 0° | 2° | 5° |