## N Channel MOSFET

Lead Free Package and Finish

### Applications:

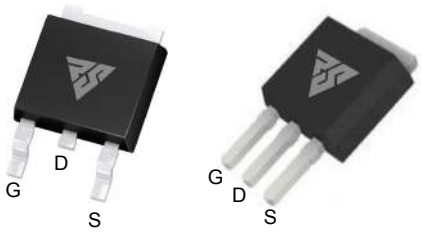
- Adapter & Charger
- AC-DC Switching Power Supply
- LED driving power
- PC Power Supply

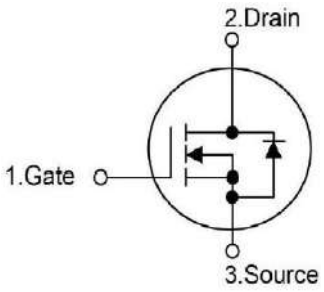
| $I_D$ | $R_{DS(ON)}$(Typ.) | $V_{DSS}$ |
|---|---|---|
| 4A | 2.0Ω | 650V |

### Features:

- 100% avalanche tested
- Ultra low gate Charge
- Low Cress
- Fast switching capability
- RoHS Compliant

TO-252 TO-251




Not to Scale

### Ordering Information

| Part Number | Package | Marking |
|---|---|---|
| RS4N65D | TO-252 | RS4N65D |
| RS4N65MD | TO-251 | RS4N65MD |

### Absolute Maximun Ratings Tc=25℃ unless otherwise specified

| Symbol | Parameter | RS4N65D | Units |
|---|---|---|---|
| $V_{DSS}$ | Drain-to-Source Voltage (Note*1) | 650 | V |
| $I_D$ | Continuous Drain Current | 4 | A |
| $I_D$@ 100 ℃ | Continuous Drain Current | 2.5 | |
| $I_{DM}$ | Pulsed Drain Current (Note*2) | 16 | |
| $P_D$ | Power Dissipation | 38 | W |
| | Derating Factor above 25℃ | 0.3 | W/℃ |
| $V_{GS}$ | Gate-to-Source Voltage | ±30 | V |
| $E_{AS}$ | Single Pulse Avalanche Engergy L=29mH IAS=4A VDD=50V RG=25Ω TJ=25℃ | 290 | mJ |
| $T_L$ | Maximum Temperature for Soldering | 300 | ℃ |
| $T_{PKG}$ | Leads at 0.063in(1.6mm)from Case for 10 seconds<br>Package Body for 10 seconds | 260 | |
| $T_J$ and $T_{STG}$ | Operating Junction and Storage Temperature Range | -55 to 150 | |

*Drain Current Limited by Maximum Junction Temperature

Caution:Stresses greater than those listed in the"Absolute Maximum Ratings"Table may cause permanent damage to the device.

### Thermal Resistance

| Symbol | Parameter | RS4N65D | Units | Test Conditions |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | 2.06 | ℃/W | Drain lead soldered to water cooled heatsink,$P_D$ adjusted for a peak junction temperature of +150℃. |
| $R_{\theta JA}$ | Junction-to-Ambient | 62.7 | | 1 cubic foot chamber,free air. |

**OFF Characteristics** TJ=25℃ unless otherwise specified

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-to-source Breakdown Voltage | 650 | -- | -- | V | $V_{GS}$=0V,$I_D$=250μA |
| $I_{DSS}$ | Drain-to-Source Leakage Current | -- | -- | 1.0 | μA | $V_{DS}$=650V,$V_{GS}$=0V |
| $I_{GSS}$ | Gate-to-Source Forward Leakage | -- | -- | 100 | nA | $V_{GS}$=+30V $V_{DS}$=0V |
| | Gate-to-Source Reverse Leakage | -- | -- | -100 | | $V_{GS}$=-30V $V_{DS}$=0V |

**ON Characteristics TJ=25℃ unless otherwise specified**

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | -- | 2.0 | 2.5 | Ω | $V_{GS}$=10V,$I_D$=2A |
| $V_{GS(TH)}$ | Gate Threshold Voltage | 2.0 | -- | 4.0 | V | $V_{GS}$=$V_{DS}$,$I_D$=250μA |

**Resistive Switching Characteristics** Essentially independent of operating temperature

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $t_{d(ON)}$ | Turn-on Delay Time | -- | 16.4 | -- | nS | $V_{DS}$=325V<br>$I_D$=4A<br>$R_G$=10Ω<br>(Note:3,4) |
| $t_{rise}$ | Rise Time | -- | 19.4 | -- | | |
| $t_{d(OFF)}$ | Turn-OFF Delay Time | -- | 50.3 | -- | | |
| $t_{fall}$ | Fall Time | -- | 21.2 | | | |

**Dynamic Characteristics** Essentially independent of operating temperature

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input Capacitance | -- | 608.8 | -- | pF | $V_{GS}$=0V<br>$V_{DS}$=25V<br>f=1.0MHz |
| $C_{oss}$ | Output Capacitance | -- | 53.6 | -- | | |
| $C_{rss}$ | Reverse Transfer Capacitance | -- | 3.3 | -- | | |
| $Q_g$ | Total Gate Charge | -- | 11.7 | -- | nC | $V_{DS}$=520V<br>$I_D$=4A<br>$V_{GS}$=10V (Note:3,4) |
| $Q_{gs}$ | Gate-to-Source Charge | -- | 2.6 | -- | | |
| $Q_{gd}$ | Gate-to-Drain("Miller"）Charge | -- | 4.4 | -- | | |

## Source-Drain Diode Characteristics

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current | -- | -- | 4 | A | Integral pn-diode in MOSFET |
| $I_{SM}$ | Maximum Pulsed Current | -- | -- | 16 | A | |
| $V_{SD}$ | Diode Forward Voltage | -- | -- | 1.5 | V | IS=4A,VGS=0V |
| $t_{rr}$ | Reverse Recovery Time | -- | 209 | -- | nS | VGS=0V IS=4A,di/dt=100A/μs |
| $Q_{rr}$ | Reverse Recovery Charge | -- | 1.2 | -- | μC | |

**Notes:**

*1.TJ=±25℃ to +150℃.
*2.Repetitive rating;pulse width limited by maximum junction temperature.
*3.Pulse width≤300μs;duty cycle ≤2%.
*4.Basically not affected by temperature.

## Typical Feature curve

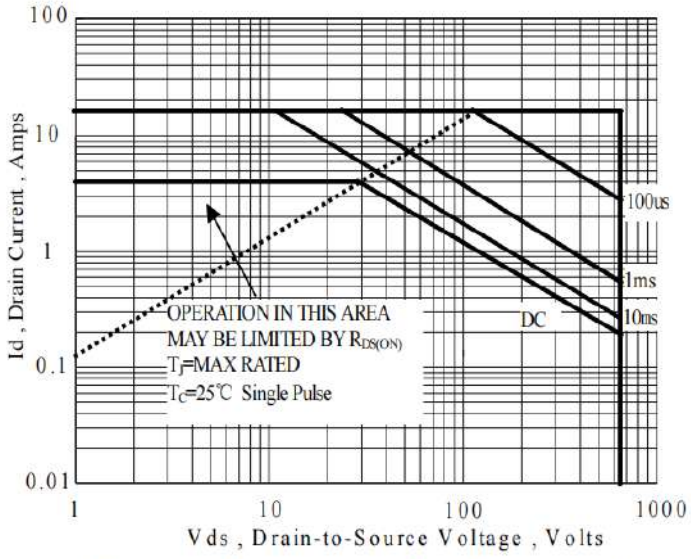



Figure 1 Maximum Forward Bias Safe Operating Area

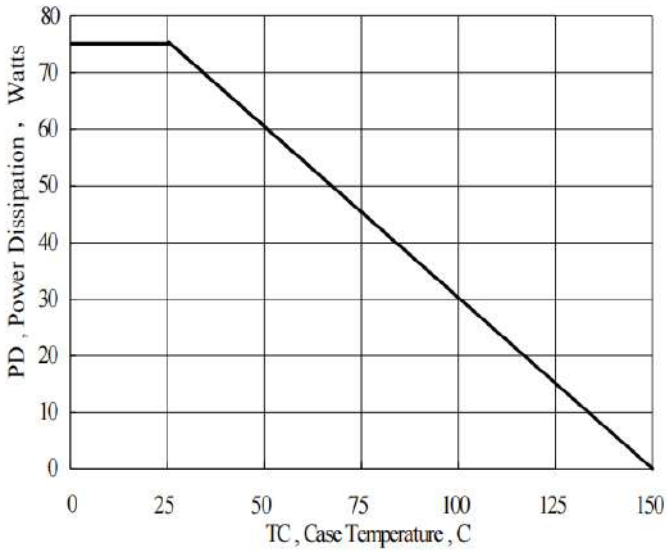



Figure 2 Maximum Power Dissipation vs Case Temperature

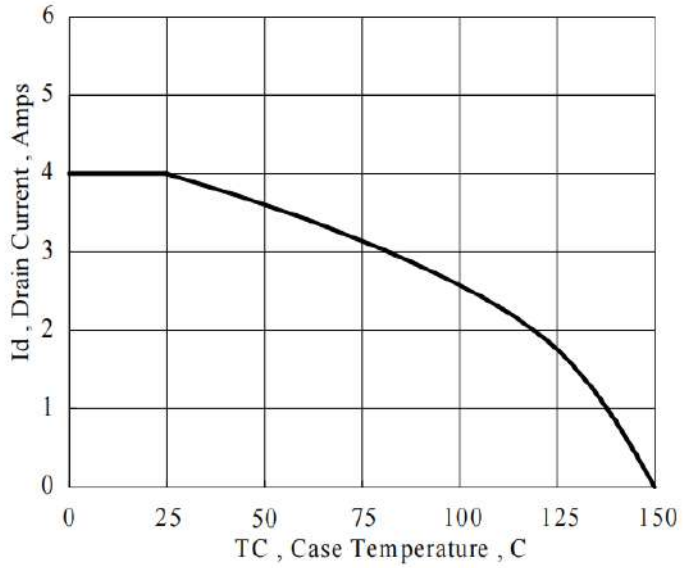



Figure 3 Maximum Continuous Drain Current vs Case Temperature

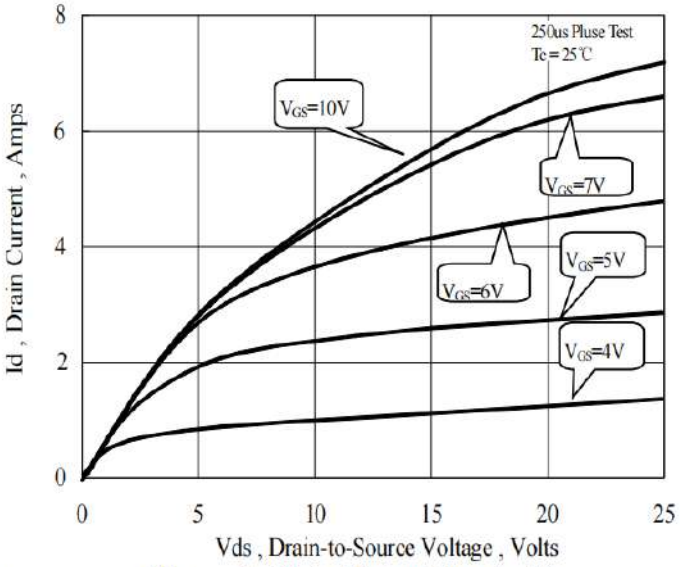



Figure 4 Typical Output Characteristics

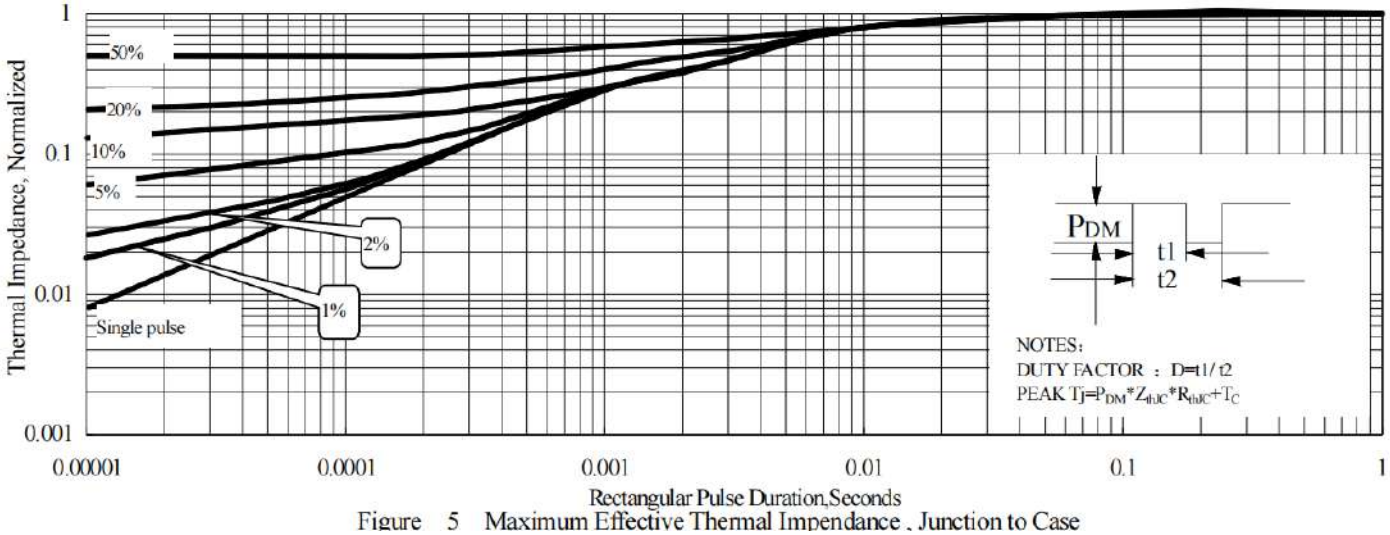



Figure 5 Maximum Effective Thermal Impendance , Junction to Case

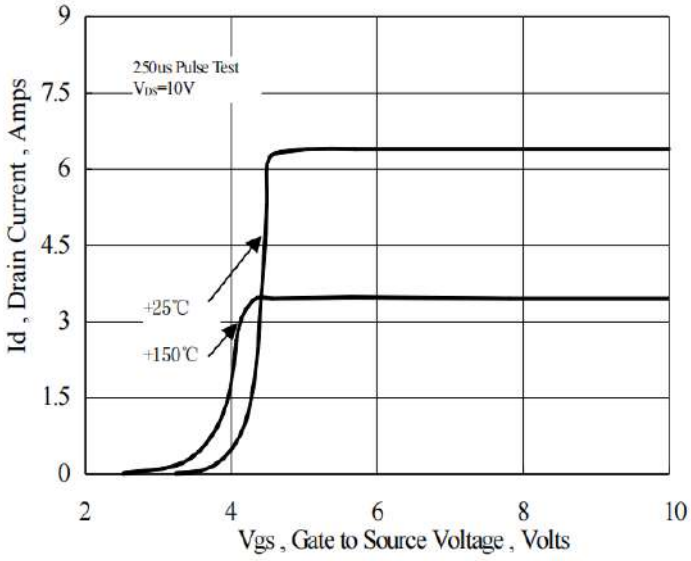



Figure 6 Typical Transfer Characteristics

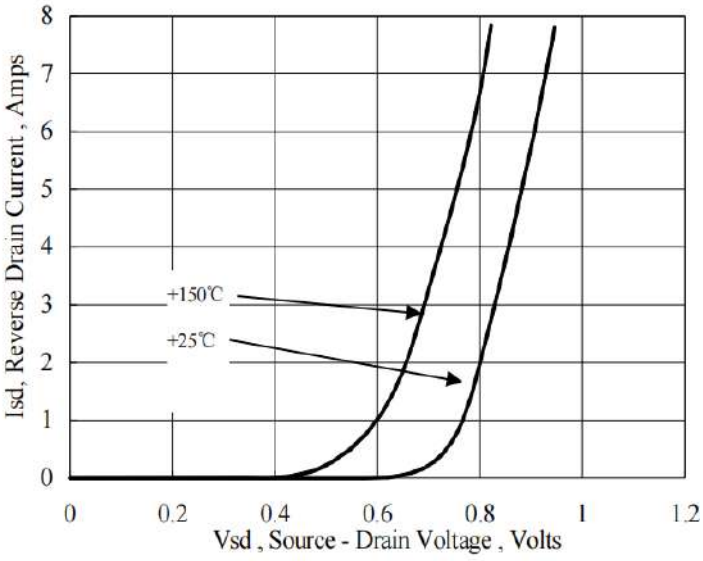



Figure 7 Typical Body Diode Transfer Characteristics

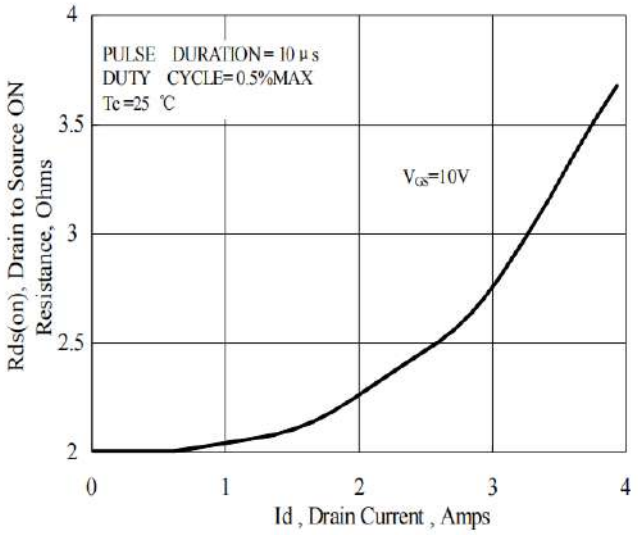



Figure 8 Typical Drain to Source ON Resistance vs Drain Current

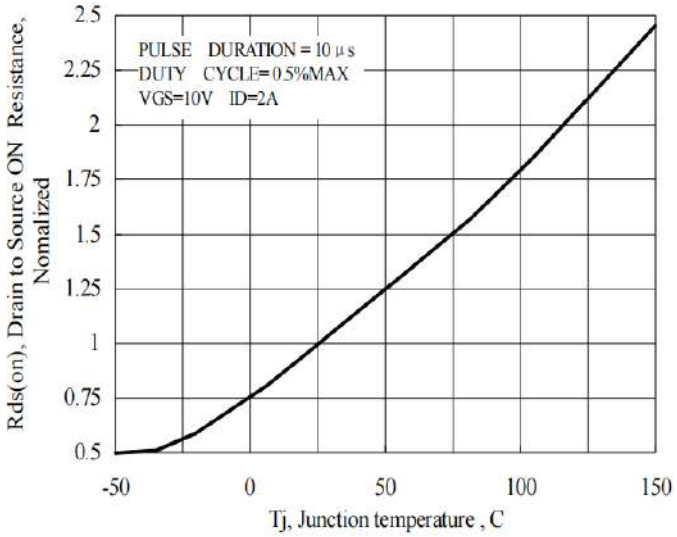



Figure 9 Typical Drian to Source on Resistance vs Junction Temperature

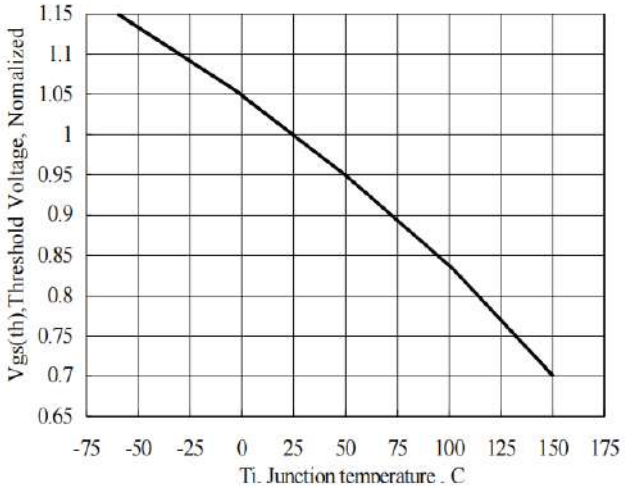



Figure 10 Typical Theshold Voltage vs Junction Temperature

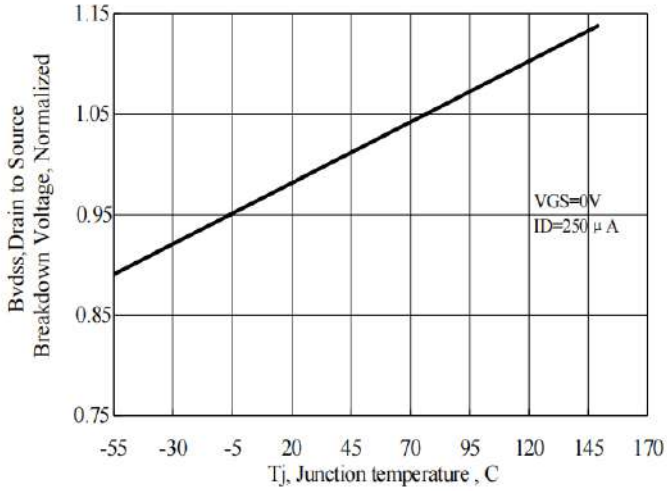



Figure 11 Typical Breakdown Voltage vs Junction Temperature

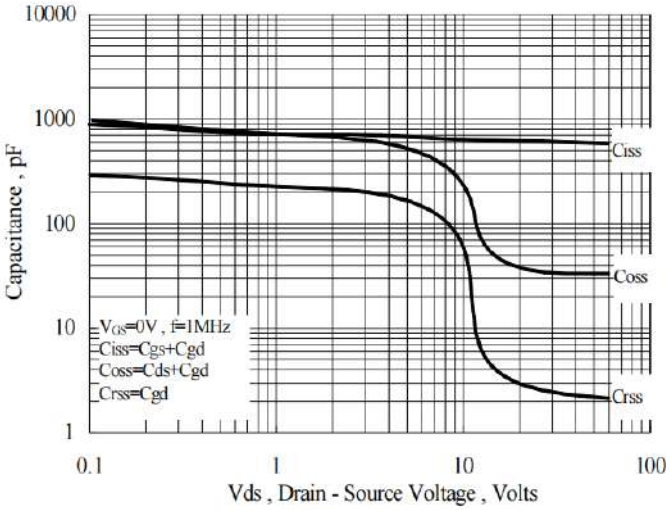



Figure 12 Typical Capacitance vs Drain to Source Voltage

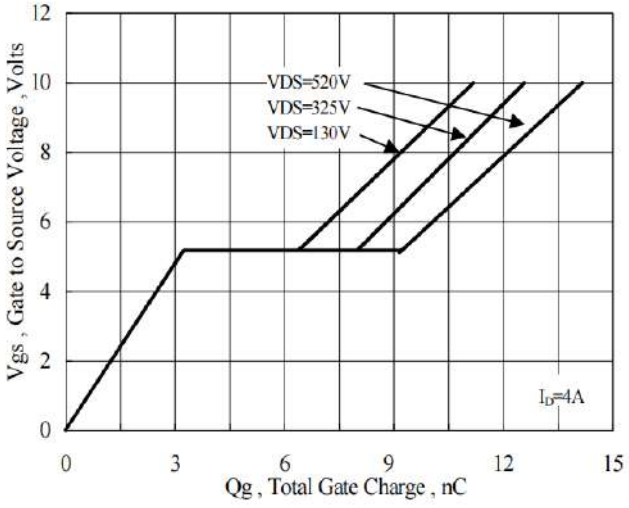



Figure 13 Typical Gate Charge vs Gate to Source Voltage

## Test Circuits and Waveforms

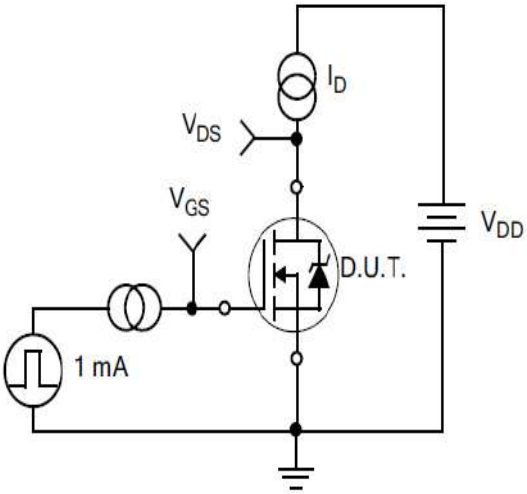



Figure11.
Gate Charge Test Circuit

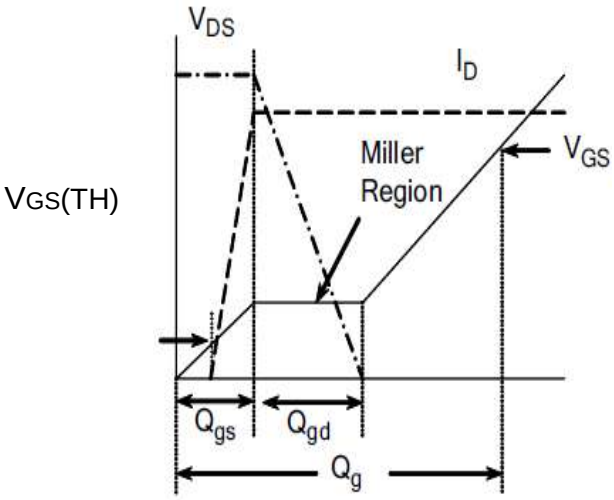



Figure12.
Gate Charge Waveform

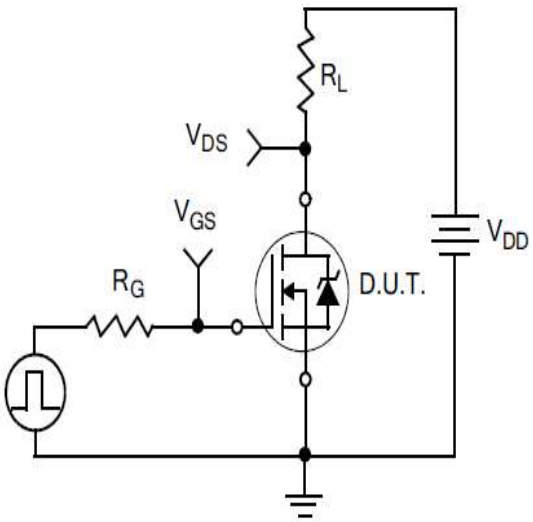



Figure13.
Resistive Switching Test Circuit

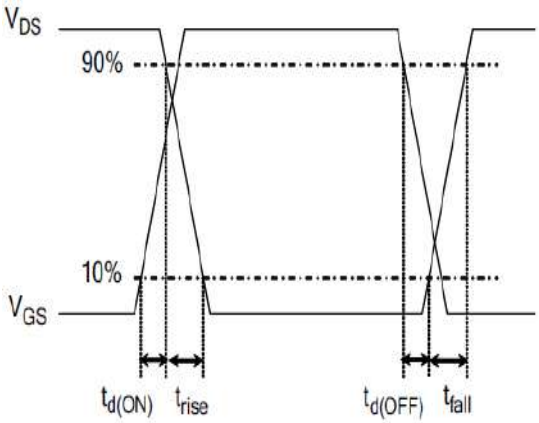



Figure14.
Resistive Switching Waveforms

**Test Circuits and Waveforms**

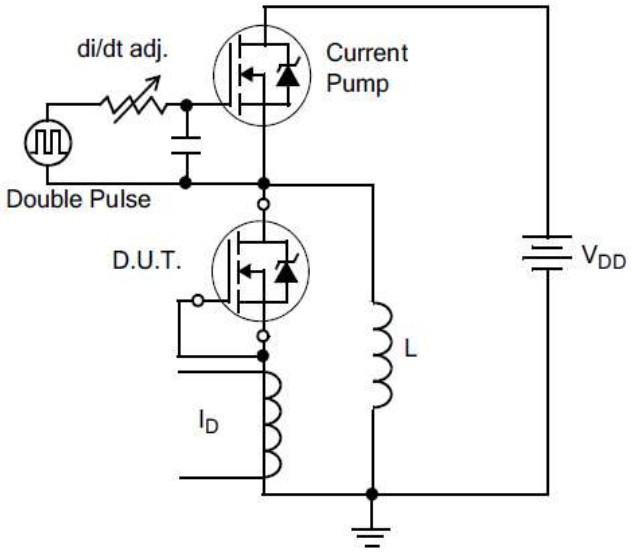



Figure15.Diode Reverse Recovery Test Circuit

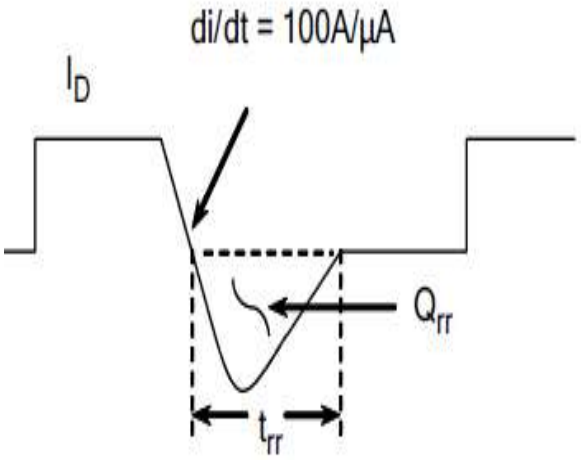



Figure16.Diode Reverse Recovery Waveform

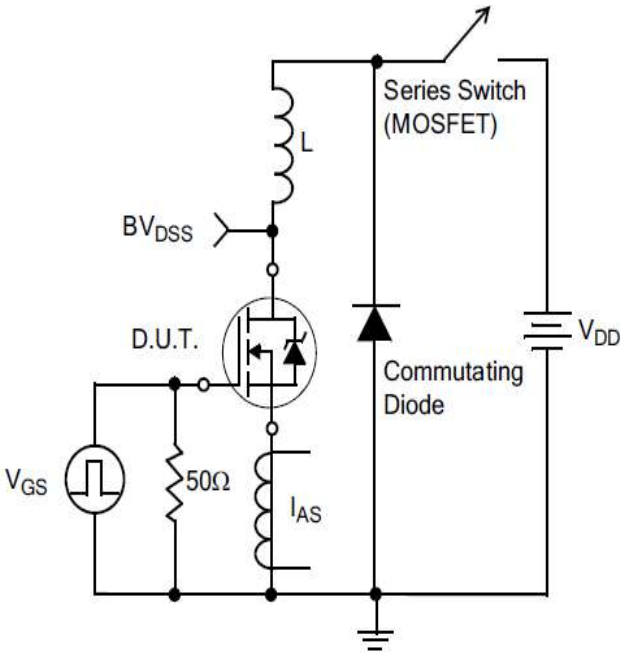
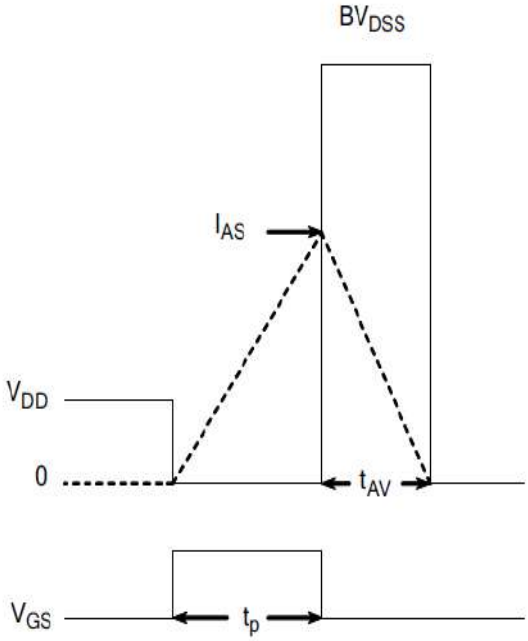



Figure17.Unclamped Inductive Switching Test Circuit



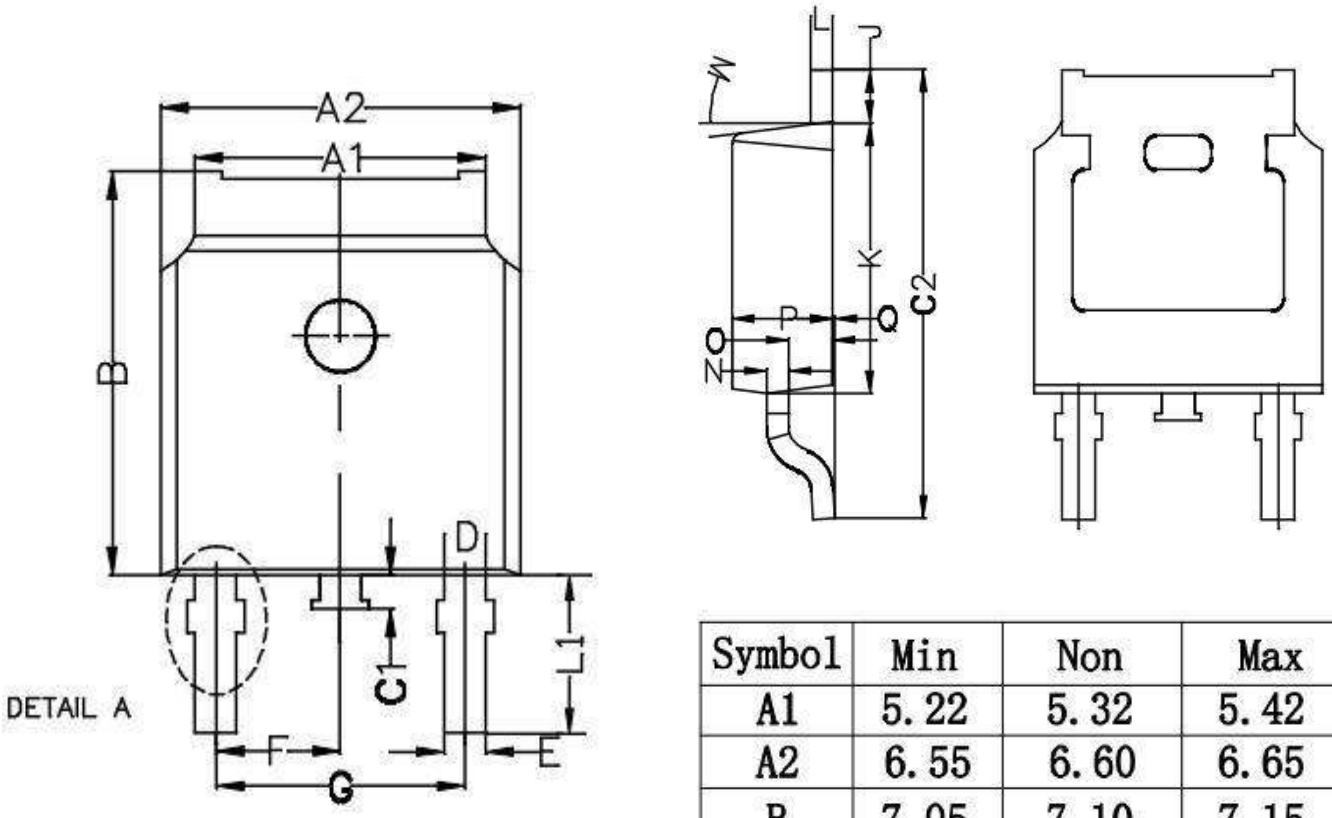

$$E_{AS}=\frac{I_{AS}^2 L}{2}$$

Figure18.Unclamped Inductive Switching Waveforms

## Package outline drawing

TO-252

Unit:mm

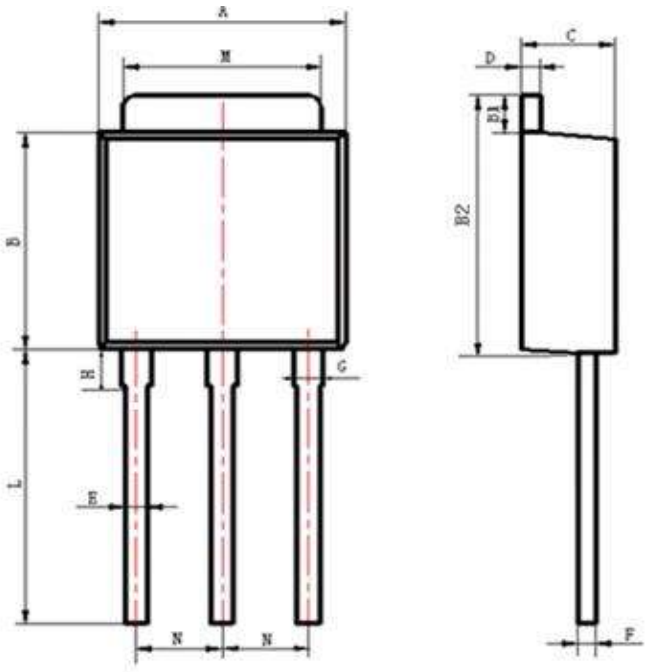



| Symbol | Min | Non | Max |
|---|---|---|---|
| A1 | 5.22 | 5.32 | 5.42 |
| A2 | 6.55 | 6.60 | 6.65 |
| B | 7.05 | 7.10 | 7.15 |
| C1 | 0.70 | 0.80 | 0.90 |
| C2 | 9.70 | 9.90 | 10.10 |
| D | 1.00 REF. | | |
| E | 0.76 REF. | | |
| F | 2.286 REF. | | |
| G | 4.572 REF. | | |
| J | 0.95 | 1.00 | 1.05 |
| K | 6.05 | 6.10 | 6.15 |
| L | 0.508 REF. | | |
| L1 | 2.65 | 2.80 | 2.95 |
| M | 7° REF. | | |
| N | 0.508 REF. | | |
| O | 0.96 | 1.01 | 1.06 |
| P | 2.25 | 2.30 | 2.35 |
| Q | 0.00 | 0.05 | 0.10 |

## Package outline drawing

Unit:mm

TO-251




| Items | Values(mm) | |
|---|---|---|
| | MIN | MAX |
| A | 6.30 | 6.90 |
| B | 5.20 | 6.30 |
| B1 | 0.70 | 1.30 |
| B2 | 6.80 | 7.40 |
| C | 2.10 | 2.50 |
| D | 0.30 | 0.60 |
| E | 0.50 | 0.86 |
| F | 0.30 | 0.60 |
| G | 0.70 | 1.00 |
| H | 1.40 | 2.40 |
| L* | 9.00 | 9.80 |
| M | 5.10 | 5.50 |
| N | 2.09 | 2.49 |

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