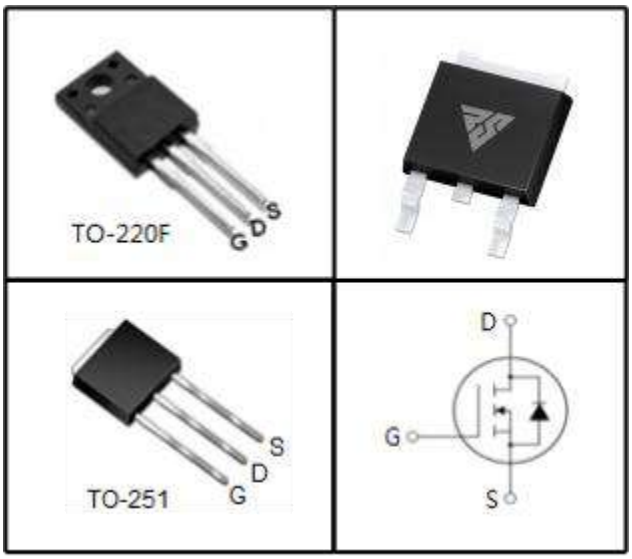
# 500V N-Channel MOSFET

Lead Free Package and Finish

## FEATURES

- Fast switching
- 100% avalanche tested
- Improved dv/dt capability




## APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)

**Device Marking and Package Information**

| Device | Package | Marking |
|---|---|---|
| RS6N50F | TO-220F | RS6N50F |
| RS6N50MD | TO-251 | RS6N50MD |
| RS6N50D | TO-252 | RS6N50D |

**Absolute Maximum Ratings** $T_C$ = 25ºC, unless otherwise noted

| Parameter | Symbol | Value | | | Unit |
|---|---|---|---|---|---|
| | | TO-220F | TO-252 | TO-251 | |
| Drain-Source Voltage ($V_{GS}$ = 0V) | $V_{DSS}$ | 500 | | | V |
| Continuous Drain Current | $I_D$ | 6 | | | A |
| Pulsed Drain Current (note1) | $I_{DM}$ | 24 | | | A |
| Gate-Source Voltage | $V_{GSS}$ | ±30 | | | V |
| Single Pulse Avalanche Energy (note2) | $E_{AS}$ | 80 | | | mJ |
| Avalanche Current (note1) | $I_{AS}$ | 4 | | | A |
| Repetitive Avalanche Energy (note1) | $E_{AR}$ | 48 | | | mJ |
| Power Dissipation ($T_C$ = 25ºC) | $P_D$ | 36 | 75 | | W |
| Operating Junction and Storage Temperature Range | $T_J$, $T_{stg}$ | -55~+150 | | | ºC |

**Thermal Resistance**

| Parameter | Symbol | Value | | | Unit |
|---|---|---|---|---|---|
| | | TO-220F | TO-252 | TO-251 | |
| Thermal Resistance, Junction-to-Case | $R_{thJC}$ | 3.47 | 1.67 | | ºC/W |
| Thermal Resistance, Junction-to-Ambient | $R_{thJA}$ | 62.5 | 60 | | |

**Specifications** $T_J$ = 25ºC, unless otherwise noted

| Parameter | Symbol | Test Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0V, $I_D$ = 250μA | 500 | -- | -- | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 500V, $V_{GS}$ = 0V, $T_J$ = 25ºC | -- | -- | 1 | μA |
| Gate-Source Leakage | $I_{GSS}$ | $V_{GS}$ = ±30V | -- | -- | ±100 | nA |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | 3.0 | -- | 4.0 | V |
| Drain-Source On-Resistance (Note3) | $R_{DS(on)}$ | $V_{GS}$ = 10V, $I_D$ = 3.0A | -- | 1.2 | 1.5 | Ω |
| **Dynamic** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0V, $V_{DS}$ = 25V, f = 1.0MHz | -- | 535 | -- | pF |
| Output Capacitance | $C_{oss}$ | | -- | 63 | -- | |
| Reverse Transfer Capacitance | $C_{rss}$ | | -- | 4.7 | -- | |
| Total Gate Charge | $Q_g$ | $V_{DD}$ = 400V, $I_D$ = 6.0A, $V_{GS}$ = 10V | -- | 14.4 | -- | nC |
| Gate-Source Charge | $Q_{gs}$ | | -- | 2.8 | -- | |
| Gate-Drain Charge | $Q_{gd}$ | | -- | 6.8 | -- | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$ = 250V, $I_D$ =6.0A, $R_G$ = 25 Ω | -- | 36 | -- | ns |
| Turn-on Rise Time | $t_r$ | | -- | 7.8 | -- | |
| Turn-off Delay Time | $t_{d(off)}$ | | -- | 80.5 | -- | |
| Turn-off Fall Time | $t_f$ | | -- | 23.5 | -- | |
| **Drain-Source Body Diode Characteristics** | | | | | | |
| Continuous Body Diode Current | $I_S$ | $T_C$ = 25 °C | -- | -- | 6 | A |
| Pulsed Diode Forward Current | $I_{SM}$ | | -- | -- | 36 | |
| Body Diode Voltage | $V_{SD}$ | $T_J$ = 25ºC, $I_{SD}$ = 3.0A, $V_{GS}$ = 0V | -- | -- | 1.4 | V |
| Reverse Recovery Time | $t_{rr}$ | $V_{GS}$ = 0V,$I_S$ = 6.0A, $di_F/dt$ =100A /μs | -- | 460 | -- | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | -- | 1.313 | -- | μC |

**Notes**

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L=10mH, $V_{DD}$ = 50V, $R_G$ = 25 Ω, Starting $T_J$ = 25 ºC
3. Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 1%

## Typical Characteristics $T_J$ = 25ºC, unless otherwise noted

**Figure 1. Output Characteristics ($T_J$ = 25ºC)**

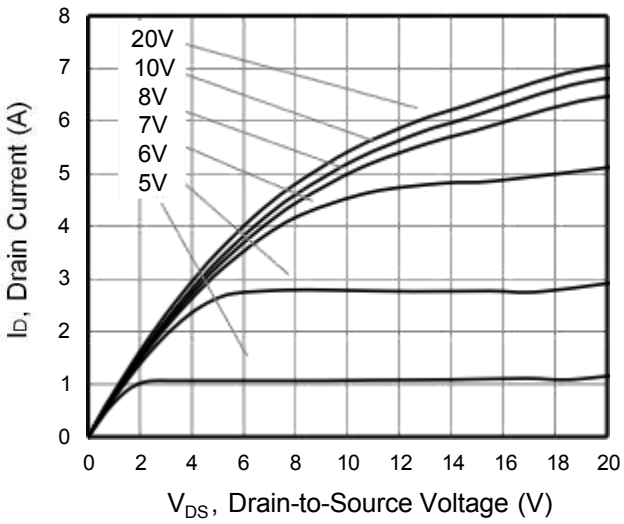



**Figure 2. Body Diode Forward Voltage**

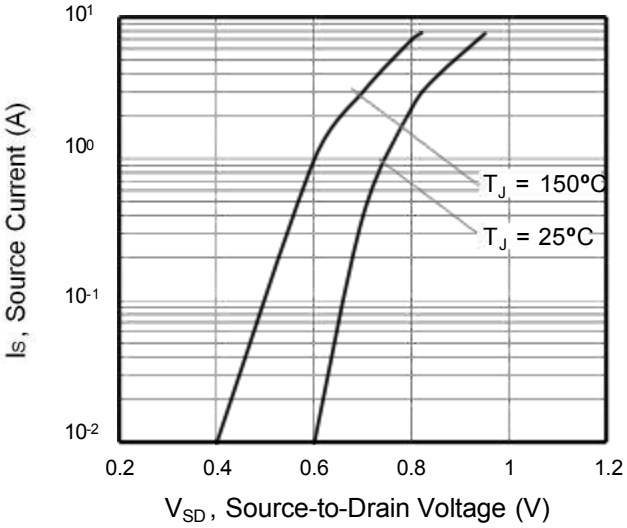



**Figure 3. Drain Current vs. Temperature**

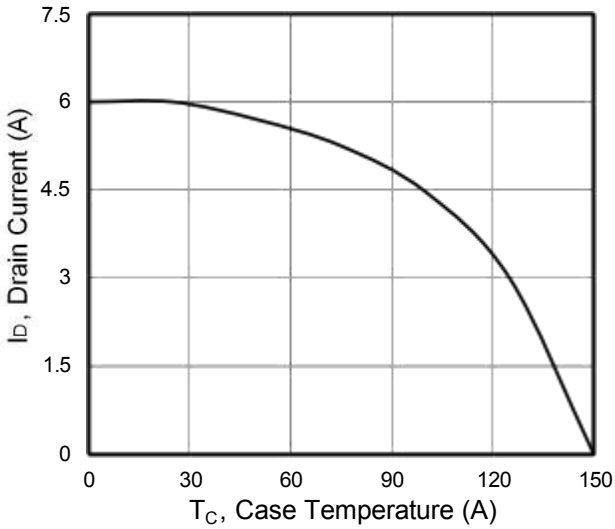



**Figure 4. $BV_{DSS}$ Variation vs. Temperature**

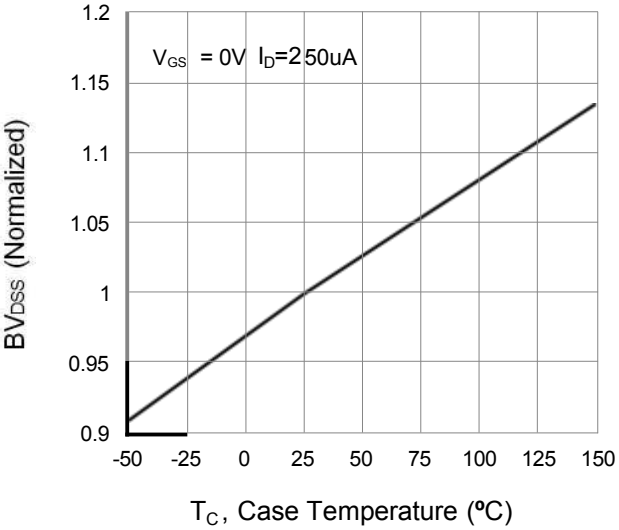



**Figure 5. Transfer Characteristics**

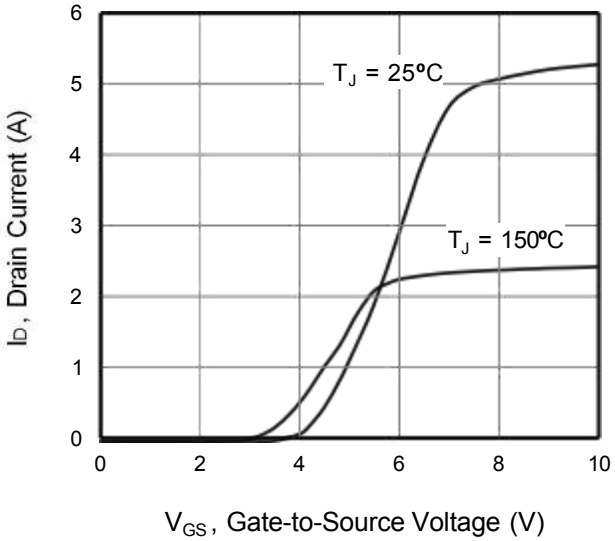
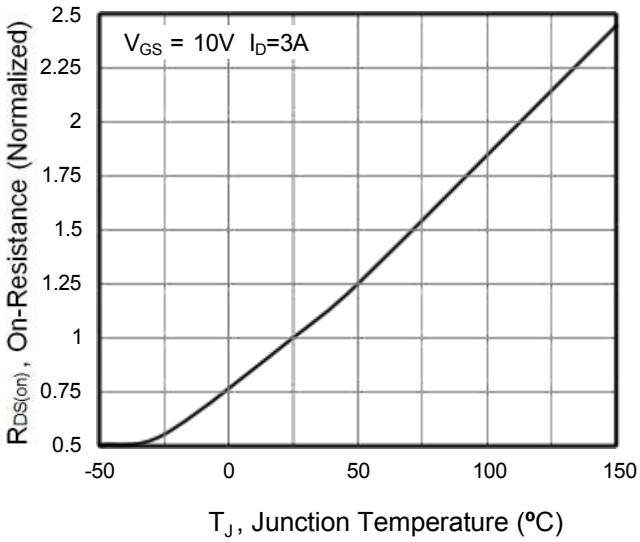



**Figure 6. On-Resistance vs. Temperature**



**Typical Characteristics** $T_J$ = 25ºC, unless otherwise noted

**Figure 7. Capacitance**

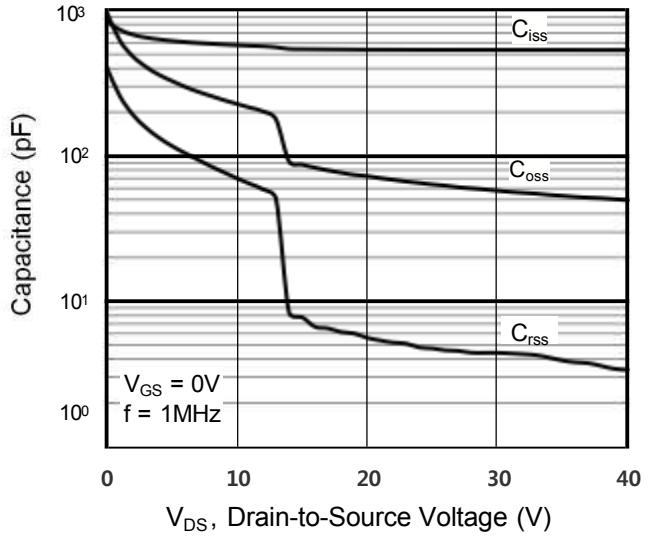



**Figure 8. Gate Charge**

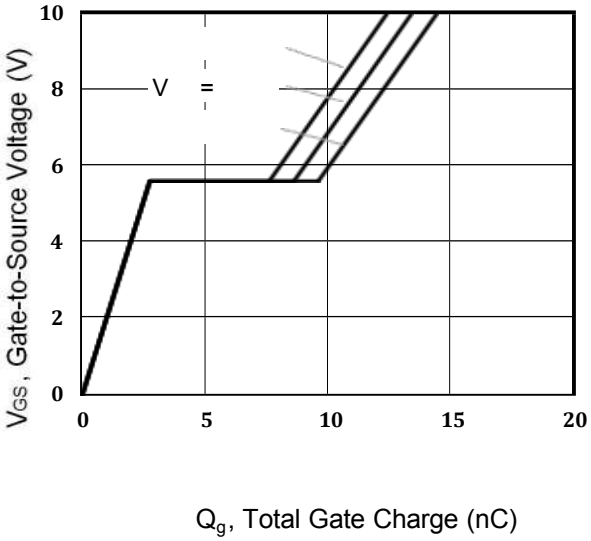



**Figure 9. Transient Thermal Impedance TO-220F**

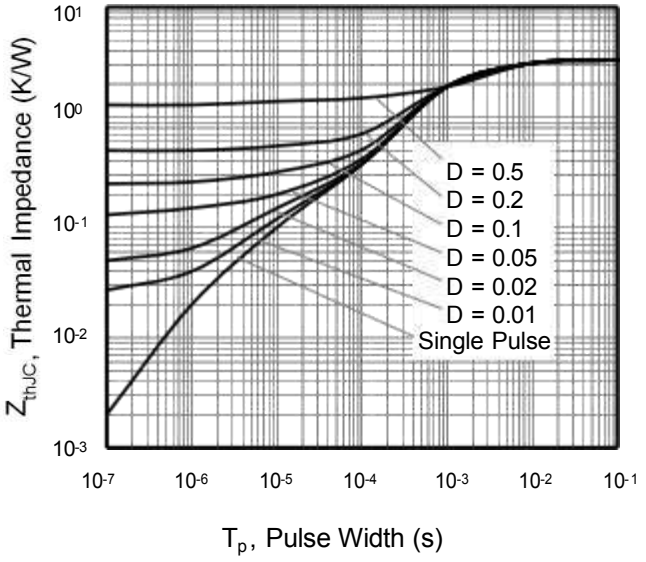



**Figure 10. Transient Thermal Impedance TO-251,TO-252**

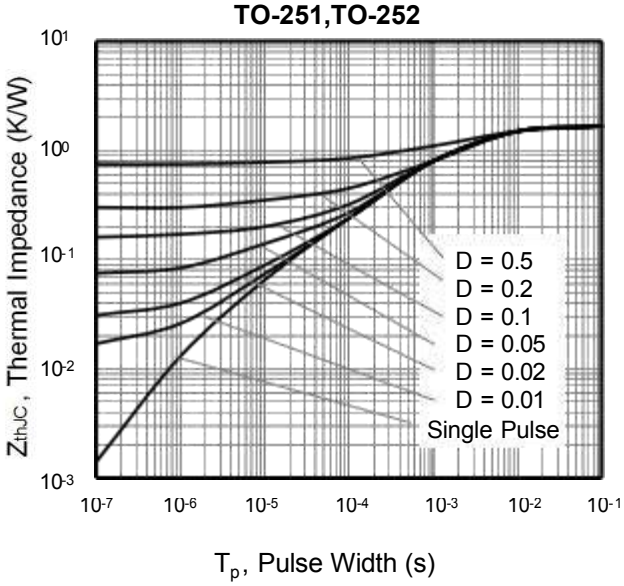


**Figure A：Gate Charge Test Circuit and Waveform**

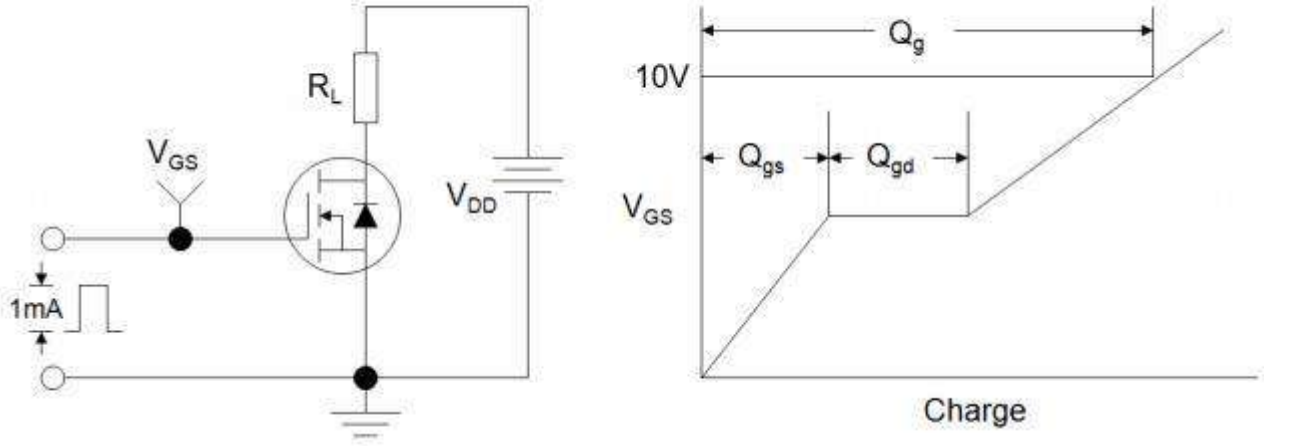



**Figure B：Resistive Switching Test Circuit and Waveform**

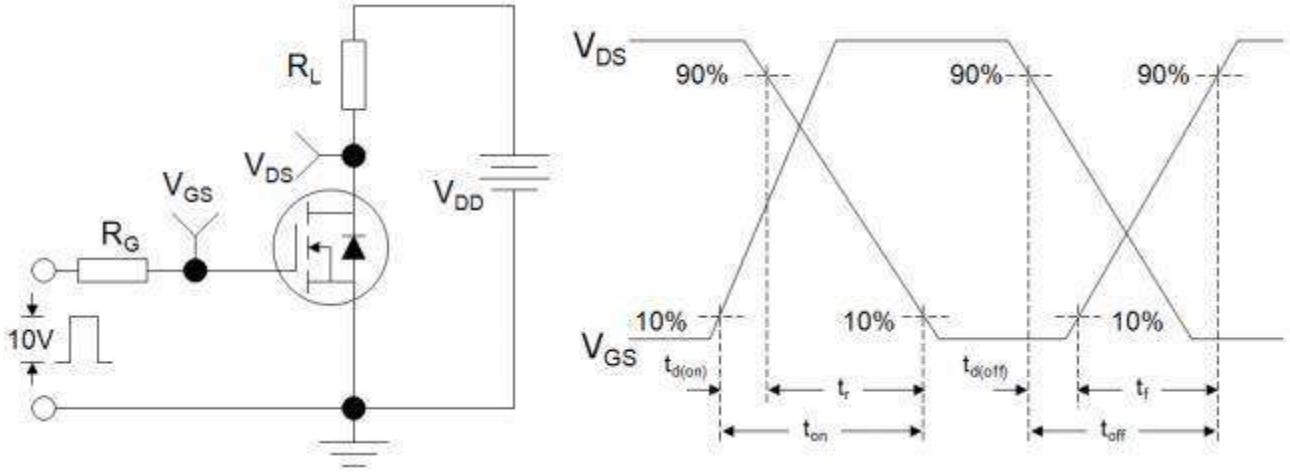
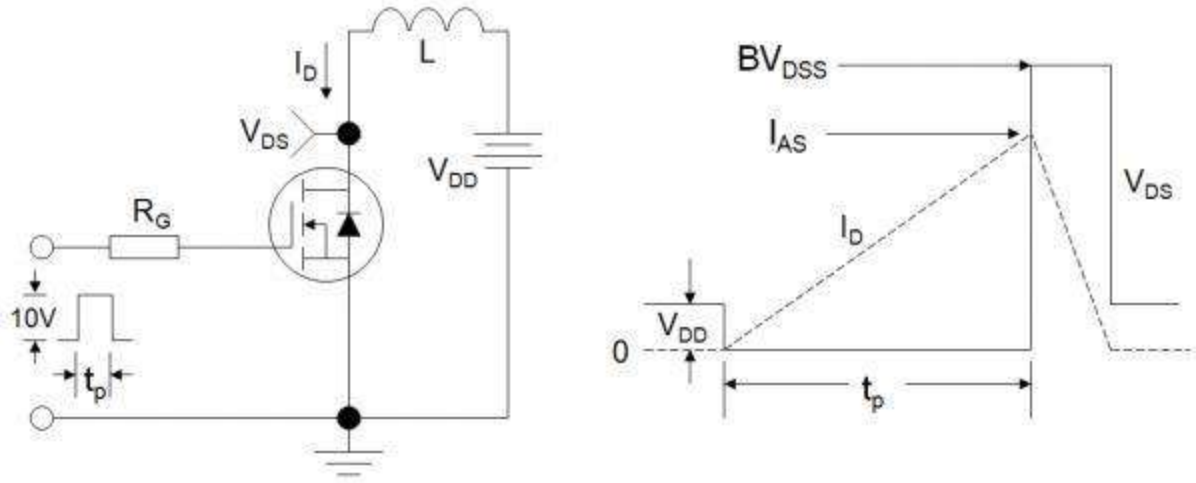
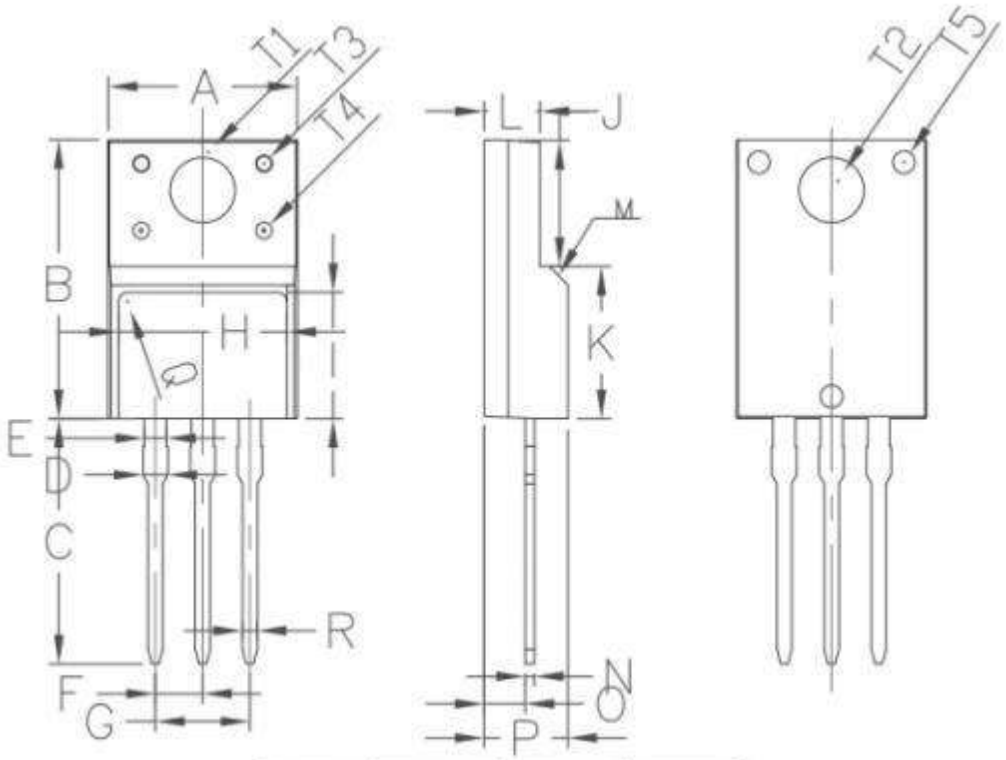



**Figure C：Unclamped Inductive Switching Test Circuit and Waveform**

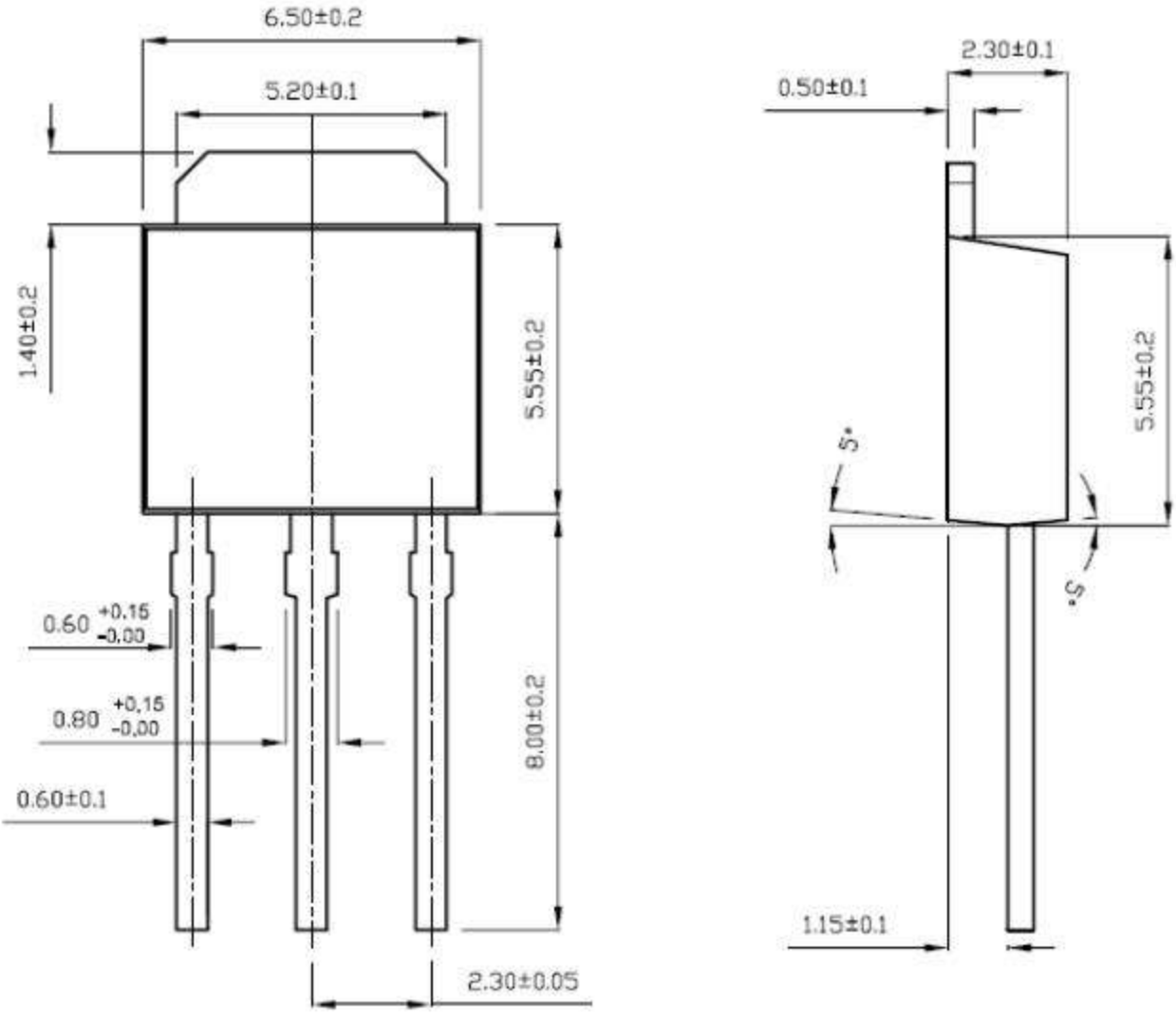


# TO-220F




| Symbol | Min | Non | Max |
|---|---|---|---|
| A | 9.96 | 10.16 | 10.36 |
| B | 15.67 | 15.87 | 16.07 |
| C | 13.14 | 13.34 | 13.54 |
| D | 1.20 | 1.30 | 1.40 |
| E | | 1.20 | |
| F | | 2.54 | |
| G | | 5.08 | |
| H | 7.60 | 7.80 | 8.00 |
| I | 7.10 | 7.30 | 7.50 |
| J | 6.48 | 6.68 | 6.88 |
| K | 8.99 | 9.19 | 9.39 |
| L | 2.34 | 2.54 | 2.74 |
| M | | 45° | |
| N | 0.49 | 0.50 | 0.52 |
| O | 2.15 | 2.35 | 2.55 |
| P | 4.50 | 4.70 | 4.90 |
| Q | | 0.50 | |
| S | 4° | 4.5° | 5° |
| T1 | | 3.45 | |
| T2 | | 3.18 | |
| T3 | | 1.50 | |
| T4 | | 1.20 | |
| T5 | | 1.50 | |
| R | 0.77 | 0.8 | 0.83 |

# TO-251



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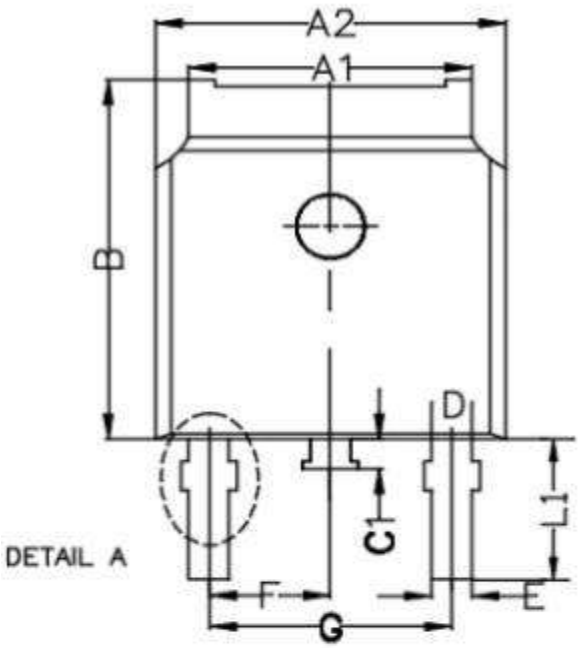


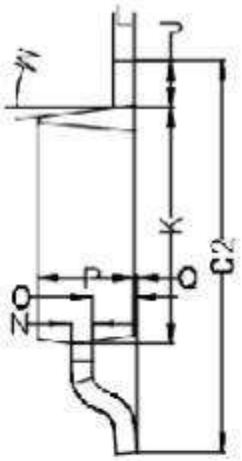


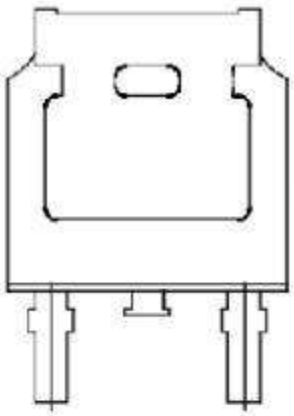

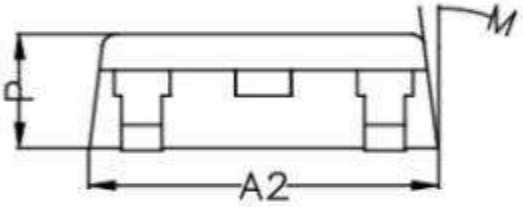


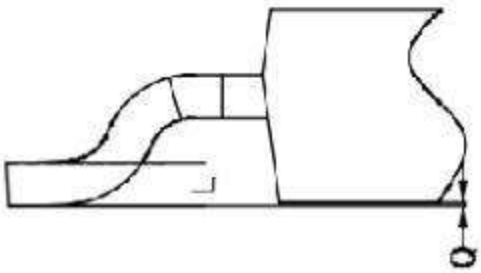


| Symbol | Min | Non | Max |
|---|---|---|---|
| A1 | 5.22 | 5.32 | 5.42 |
| A2 | 6.55 | 6.60 | 6.65 |
| B | 7.05 | 7.10 | 7.15 |
| C1 | 0.70 | 0.80 | 0.90 |
| C2 | 9.70 | 9.90 | 10.10 |
| D | 1.00 REF. | | |
| E | 0.76 REF. | | |
| F | 2.286 REF. | | |
| G | 4.572 REF. | | |
| J | 0.95 | 1.00 | 1.05 |
| 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 |

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