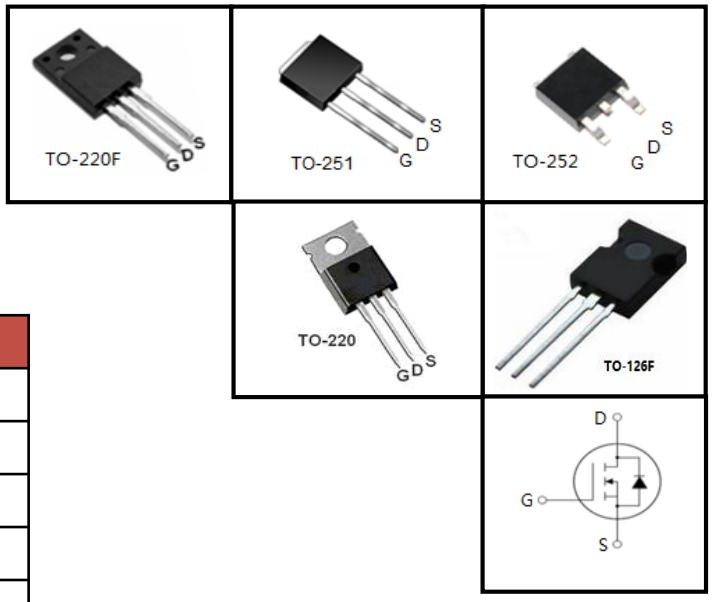
# 600V N-Channel MOSFET

## 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 |
|---|---|---|
| CS2N60F | TO-220F | CS2N60F |
| CS2N60P | TO-220 | CS2N60P |
| CS2N60U | TO-251 | CS2N60U |
| CS2N60D | TO-252 | CS2N60D |
| CS2N60C | TO-126F | CS2N60C |

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

| Parameter | Symbol | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|
| | | TO-220F | TO-126F | TO-220 | TO-251 | TO-252 | |
| Drain-Source Voltage ($V_{GS}$ = 0V) | $V_{DSS}$ | 600 | | | | | V |
| Continuous Drain Current | $I_D$ | 2 | | | | | A |
| Pulsed Drain Current (note1) | $I_{DM}$ | 8 | | | | | A |
| Gate-Source Voltage | $V_{GSS}$ | ±20 | | | | | V |
| Single Pulse Avalanche Energy (note2) | $E_{AS}$ | 28.8 | | | | | mJ |
| Avalanche Current (note1) | $I_{AS}$ | 2.4 | | | | | A |
| Repetitive Avalanche Energy (note1) | $E_{AR}$ | 17.28 | | | | | mJ |
| Power Dissipation ($T_C$ = 25ºC) | $P_D$ | 20 | | 25 | | | W |
| Operating Junction and Storage Temperature Range | $T_J$, $T_{stg}$ | -55~+150 | | | | | ºC |

## Thermal Resistance

| Parameter | Symbol | Value | | | | | Unit |
|---|---|---|---|---|---|---|---|
| | | TO-220F | TO-126F | TO-251 | TO-252 | TO-220 | |
| Thermal Resistance, Junction-to-Case | $R_{thJC}$ | 6.25 | | 5 | | | K/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 | 600 | -- | -- | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 600V, $V_{GS}$ = 0V, $T_J$ = 25ºC | -- | -- | 1 | μA |
| Gate-Source Leakage | $I_{GSS}$ | $V_{GS}$ = ±20V | -- | -- | ±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, $I_D$ = 1.0A | -- | 3.5 | 4.2 | Ω |
| **Dynamic** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0V, $V_{DS}$ = 25V, f = 1.0MHz | -- | 249.5 | -- | pF |
| Output Capacitance | $C_{oss}$ | | -- | 30 | -- | |
| Reverse Transfer Capacitance | $C_{rss}$ | | -- | 4.2 | -- | |
| Total Gate Charge | $Q_g$ | $V_{DD}$ = 480V, $I_D$ = 2.0A, $V_{GS}$ = 10V | -- | 11 | -- | nC |
| Gate-Source Charge | $Q_{gs}$ | | -- | 1.55 | -- | |
| Gate-Drain Charge | $Q_{gd}$ | | -- | 6.15 | -- | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$ = 250V, $I_D$ =2.0A, $R_G$ = 25 Ω | -- | 33.6 | -- | ns |
| Turn-on Rise Time | $t_r$ | | -- | 7.2 | -- | |
| Turn-off Delay Time | $t_{d(off)}$ | | -- | 64 | -- | |
| Turn-off Fall Time | $t_f$ | | -- | 31.2 | -- | |
| **Drain-Source Body Diode Characteristics** | | | | | | |
| Continuous Body Diode Current | $I_S$ | $T_C$ = 25 ºC | -- | -- | 2 | A |
| Pulsed Diode Forward Current | $I_{SM}$ | | -- | -- | 8 | |
| Body Diode Voltage | $V_{SD}$ | $T_J$ = 25ºC, $I_{SD}$ = 2.0A, $V_{GS}$ = 0V | -- | -- | 1.4 | V |
| Reverse Recovery Time | $t_{rr}$ | $V_{GS}$ = 0V,$I_S$ = 2.0A, $di_F/dt$ =100A /μs | -- | 490 | -- | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | -- | 0.6 | -- | μC |

**Notes**

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L = 10.0mH, $V_{DD}$ = 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)**

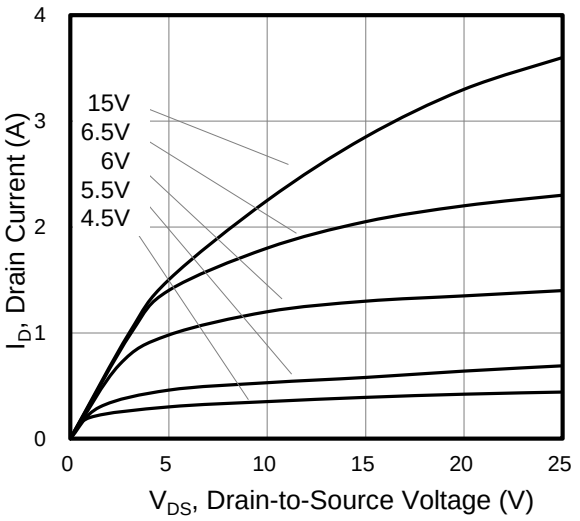



**Figure 2. Body Diode Forward Voltage**

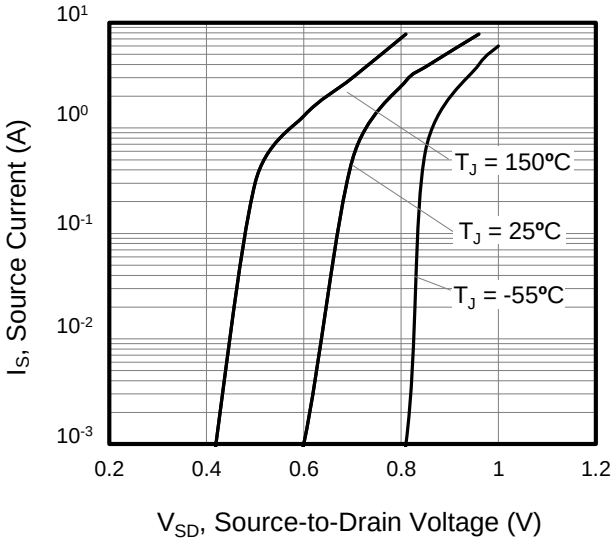



**Figure 3. Drain Current vs. Temperature**

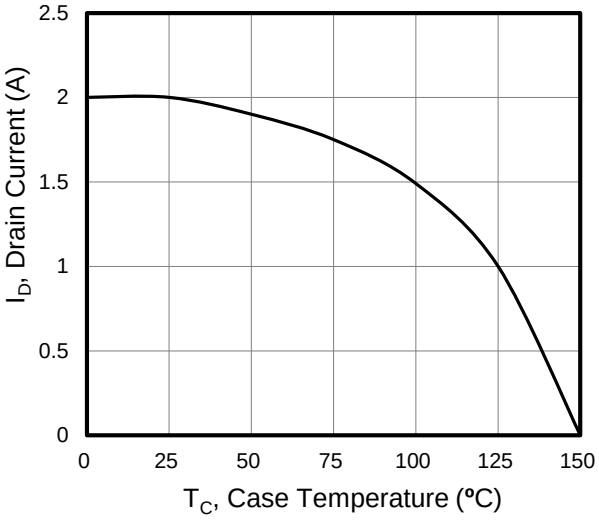



**Figure 4. Power Dissipation vs. Temperature TO-251,TO-252**

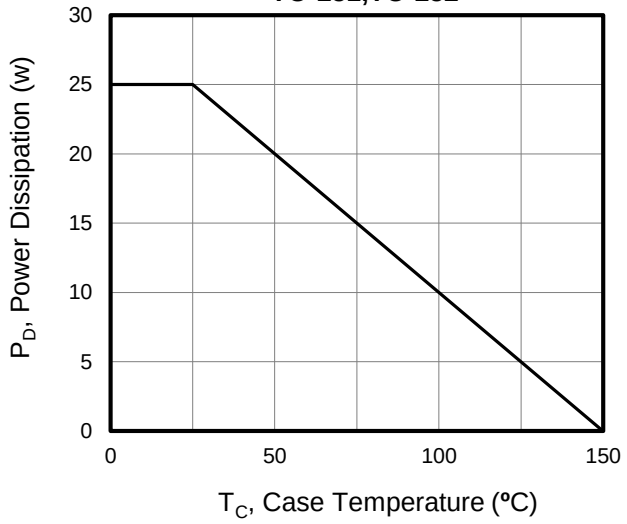



**Figure 5. Transfer Characteristics**

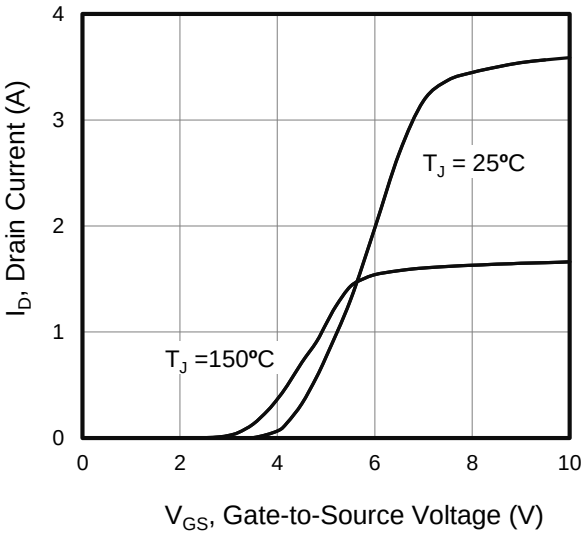
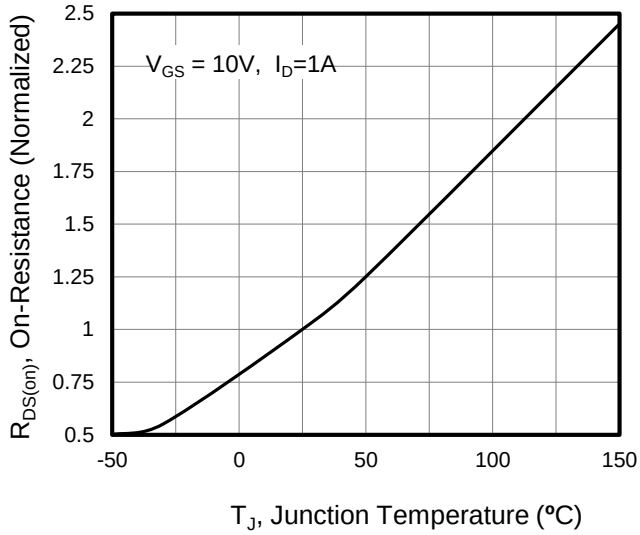



**Figure 6. On-Resistance vs. Temperature**



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

**Figure 7. Capacitance**

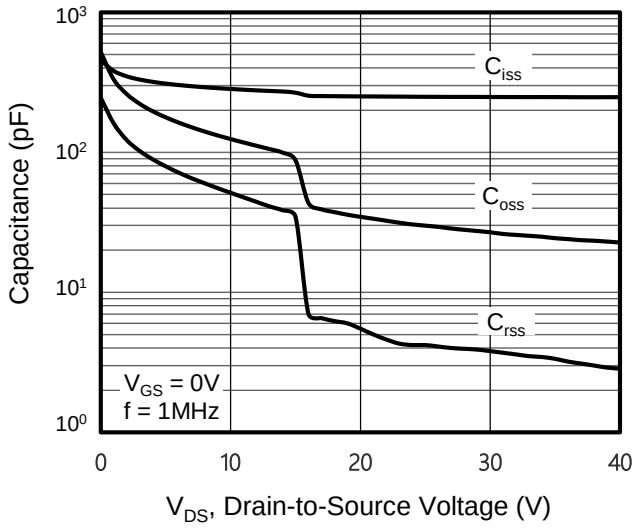



**Figure 8. Gate Charge**

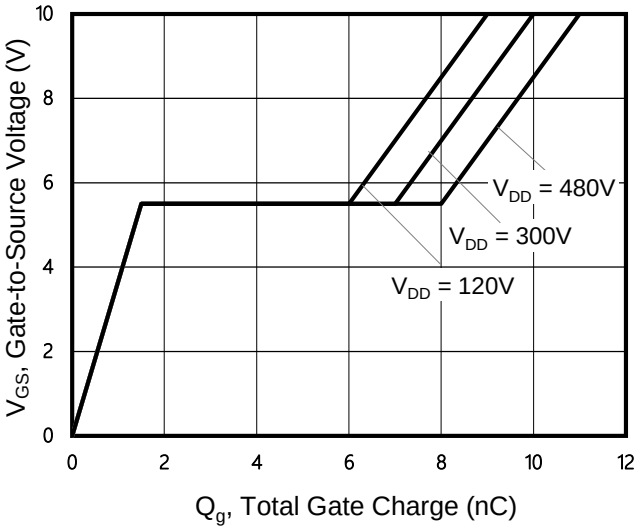



**Figure 9. Transient Thermal Impedance TO-251,TO-252 ,TO-220**

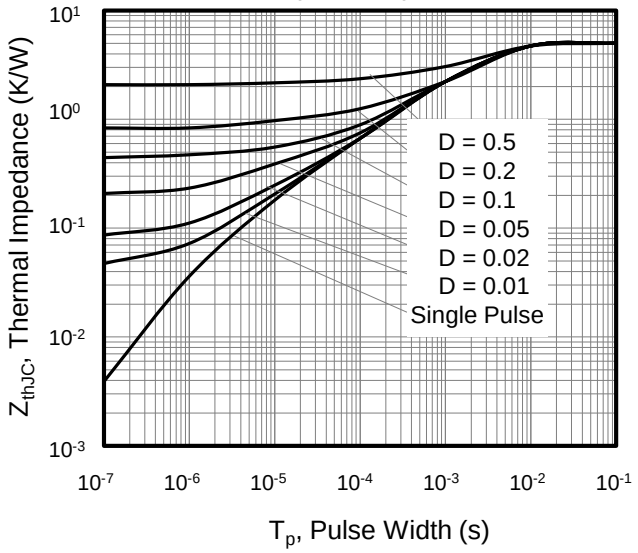



**Figure 10. Transient Thermal Impedance TO-220F ,TO-126F**

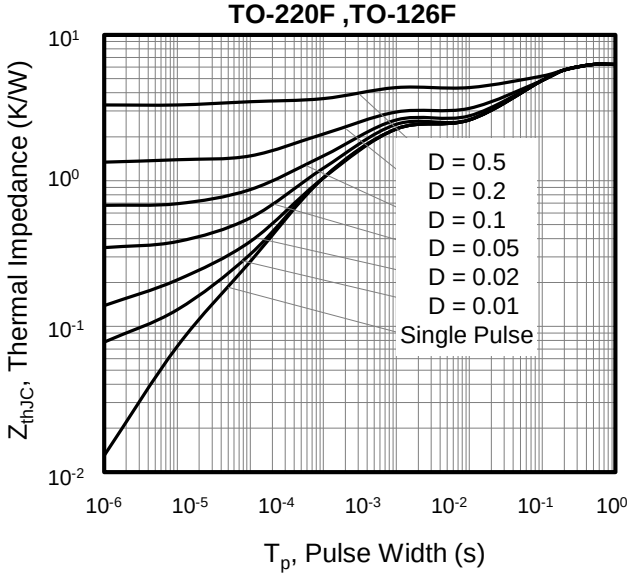


**Figure A：Gate Charge Test Circuit and Waveform**

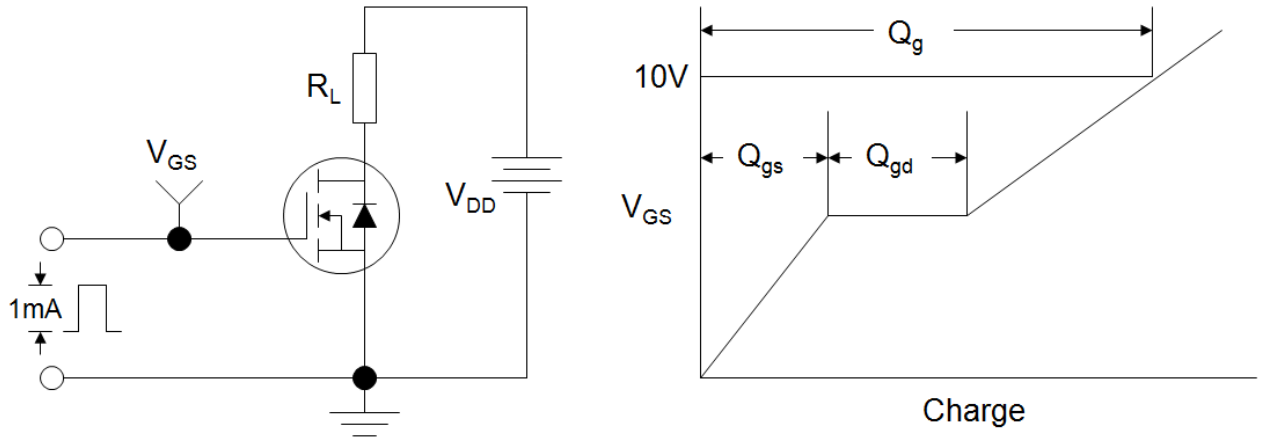



**Figure B：Resistive Switching Test Circuit and Waveform**

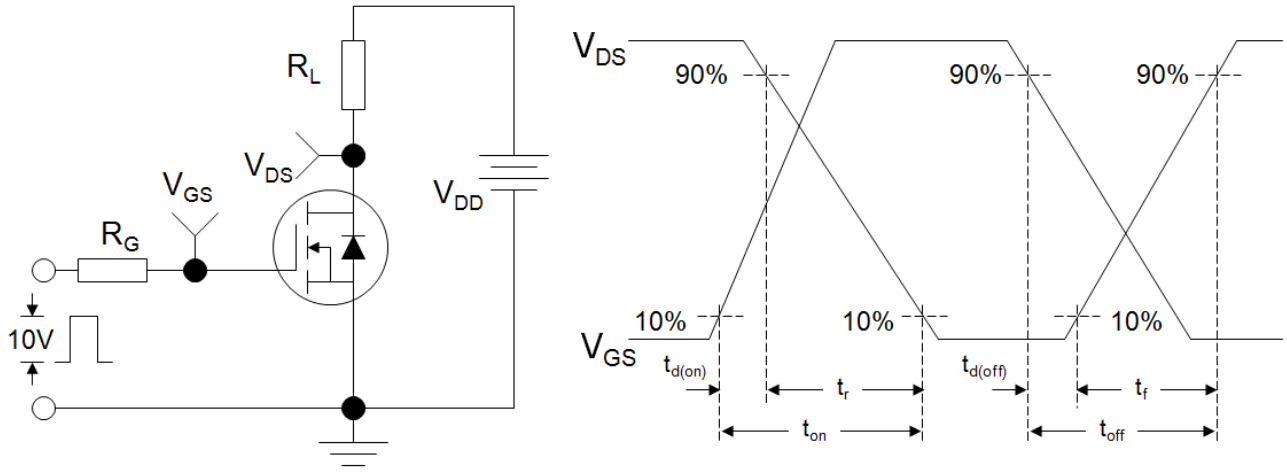
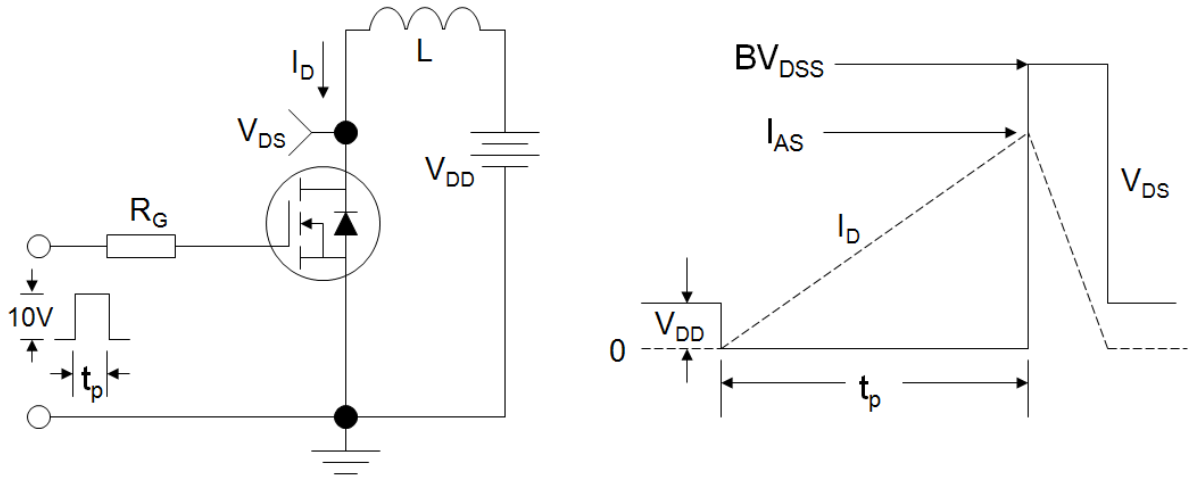
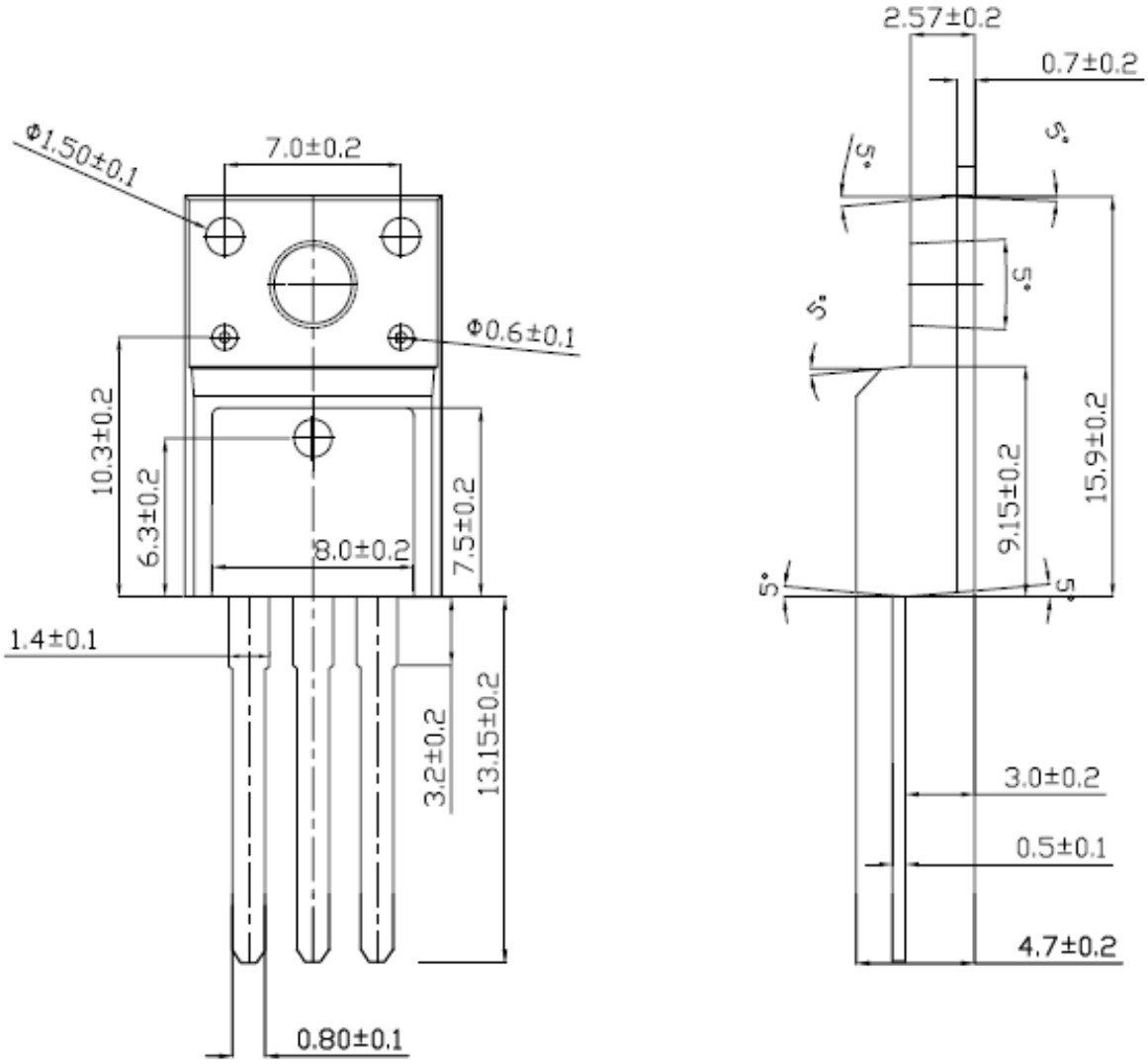


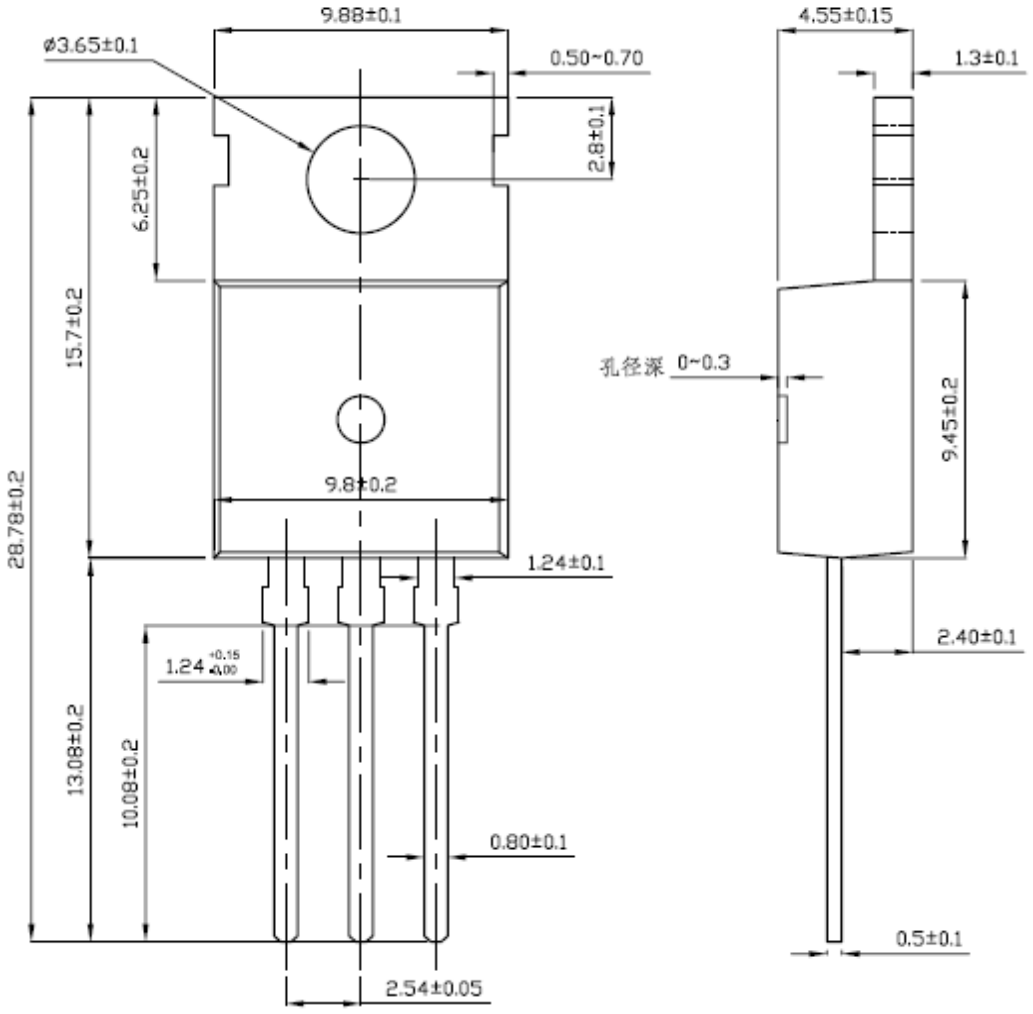

**Figure C：Unclamped Inductive Switching Test Circuit and Waveform**



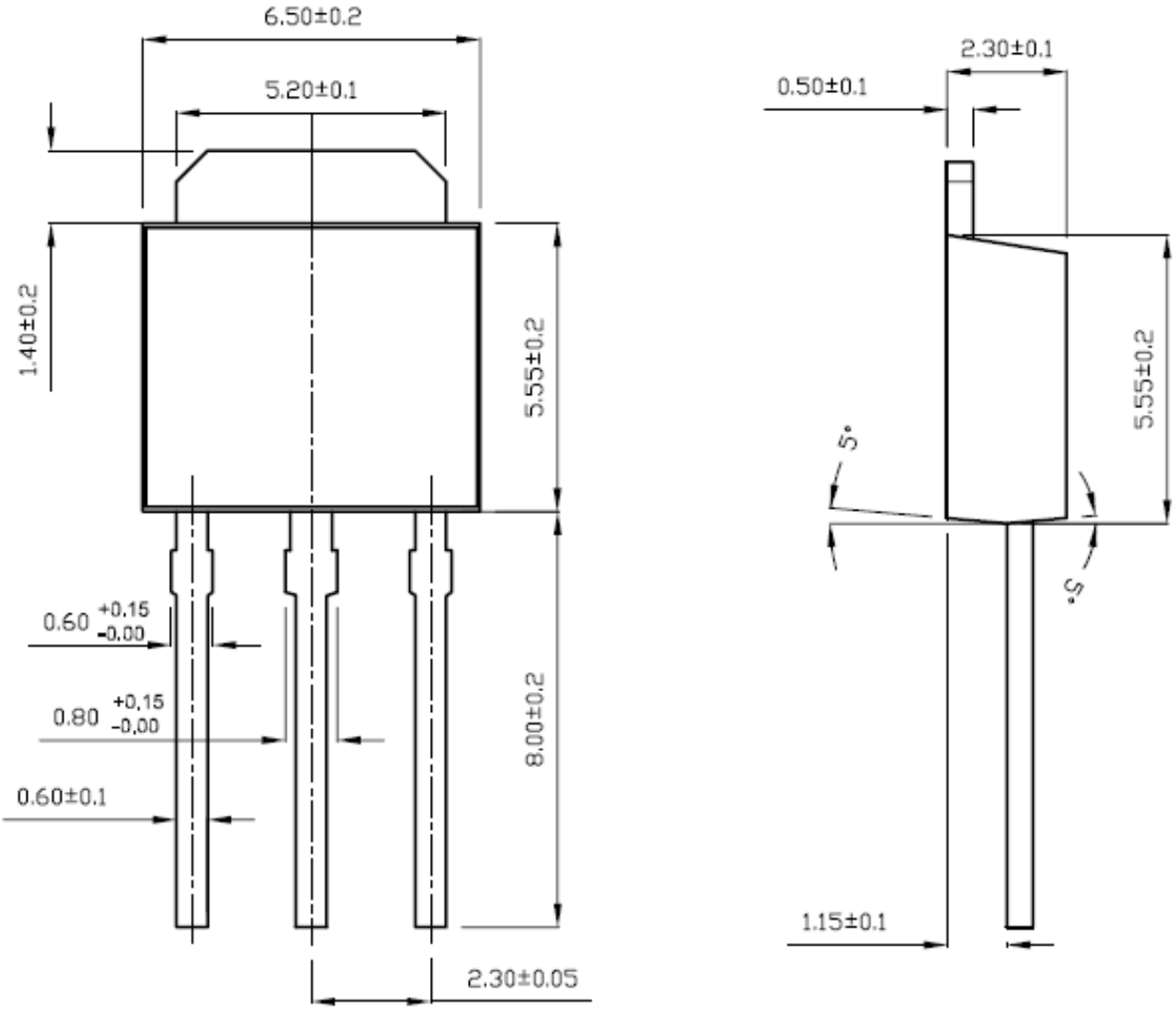
# TO-220F


Φ1.50±0.1
7.0±0.2
Φ0.6±0.1
10.3±0.2
6.3±0.2
8.0±0.2
7.5±0.2
1.4±0.1
3.2±0.2
13.15±0.2
0.80±0.1
2.57±0.2
0.7±0.2
5°
5°
5°
5°
5°
5°
15.9±0.2
9.15±0.2
3.0±0.2
0.5±0.1
4.7±0.2

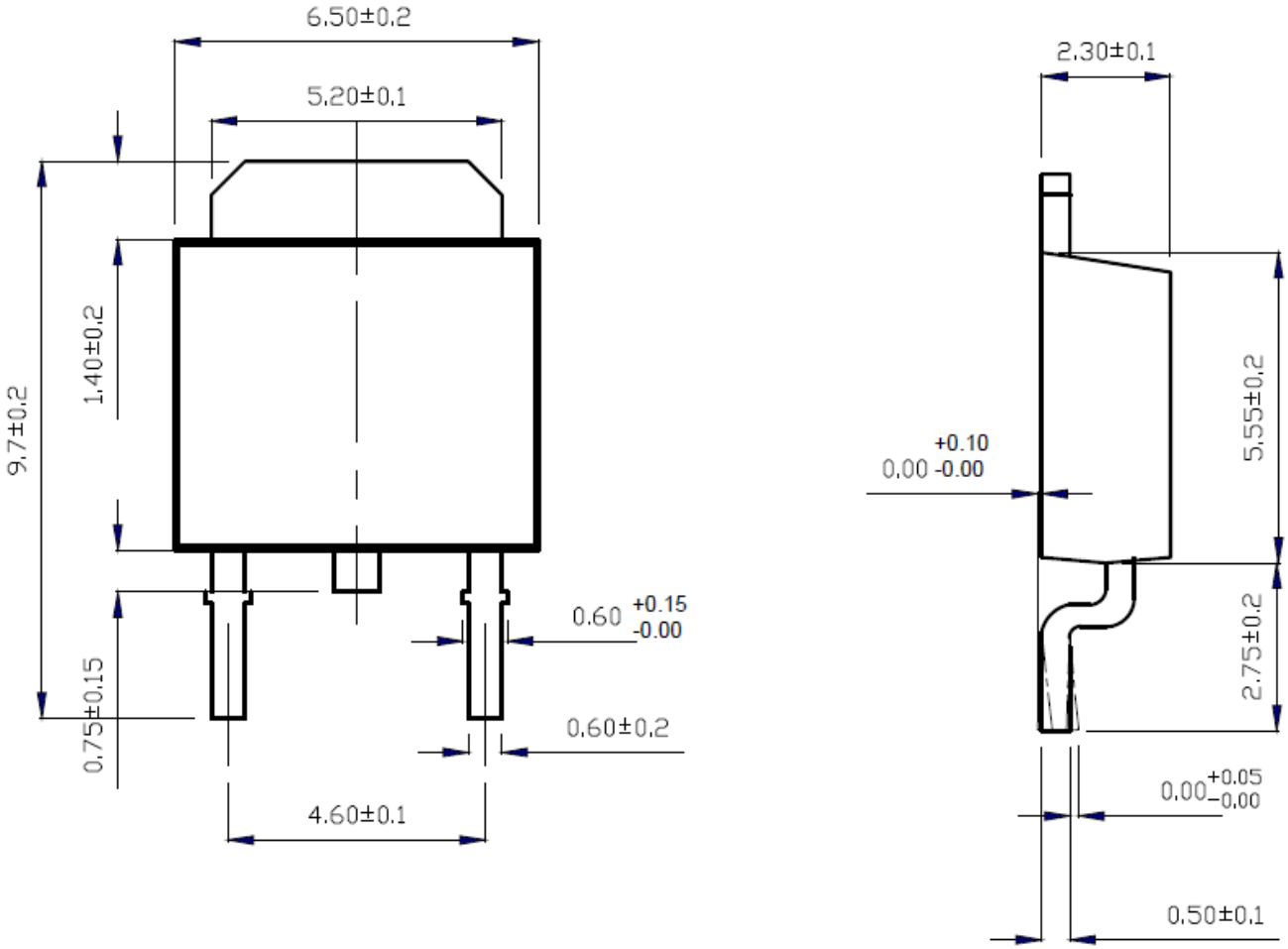
# TO-220


9.88±0.1
ø3.65±0.1
0.50~0.70
2.8±0.1
6.25±0.2
15.7±0.2
28.78±0.2
9.8±0.2
1.24±0.1
1.24 +0.15 -0.00
13.08±0.2
10.08±0.2
0.80±0.1
2.54±0.05
4.55±0.15
1.3±0.1
孔径深 0~0.3
9.45±0.2
2.40±0.1
0.5±0.1

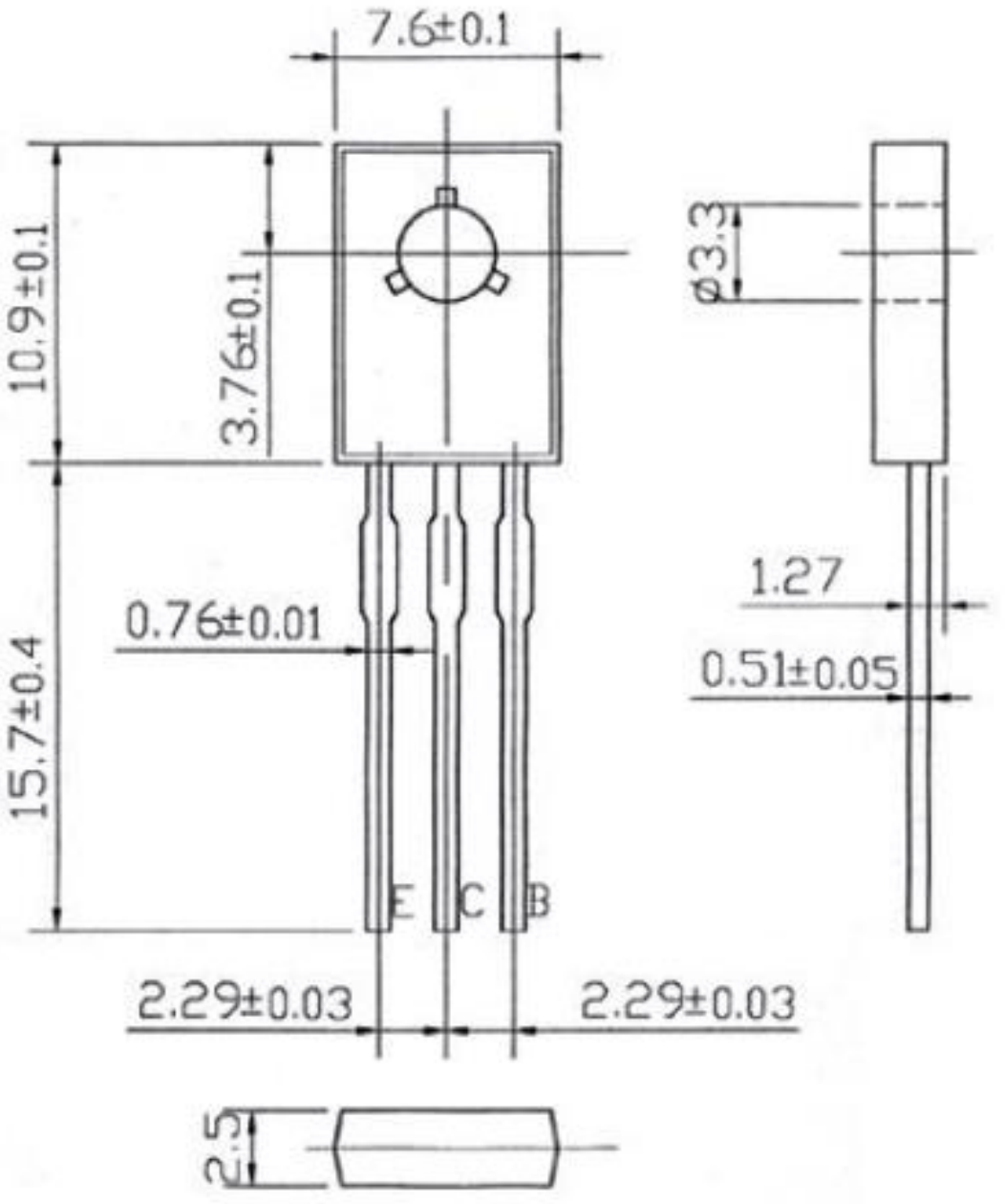
# TO-251


6.50±0.2
5.20±0.1
1.40±0.2
5.55±0.2
0.60 +0.15 -0.00
0.80 +0.15 -0.00
0.60±0.1
8.00±0.2
2.30±0.05
2.30±0.1
0.50±0.1
5°
5°
5.55±0.2
1.15±0.1

# TO-252


6.50±0.2
5.20±0.1
1.40±0.2
9.7±0.2
0.75±0.15
0.60 +0.15 -0.00
0.60±0.2
4.60±0.1
2.30±0.1
+0.10
0.00 -0.00
5.55±0.2
2.75±0.2
0.00 +0.05 -0.00
0.50±0.1

# TO-126F


7.6±0.1
10.9±0.1
3.76±0.1
ø3.3
1.27
0.51±0.05
0.76±0.01
15.7±0.4
E
C
B
2.29±0.03
2.29±0.03
2.5

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