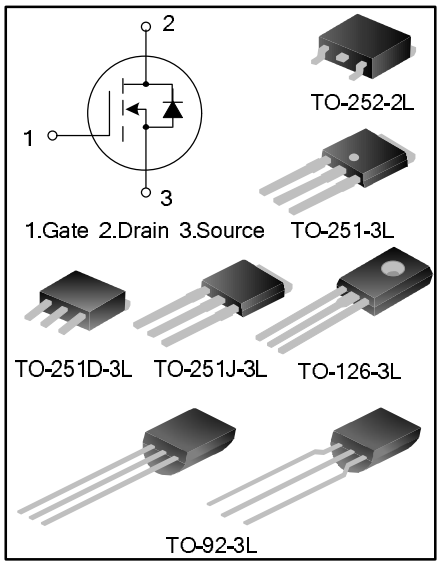
## 1A, 600V N-CHANNEL MOSFET

### GENERAL DESCRIPTION

This power mosfet is an N-channel enhancement mode power MOS field effect transistor which is produced using Hi-semicon proprietary F-Cell™ structure VDMOS technology. The improved planar stripe cell and the improved guard ring terminal have been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode.

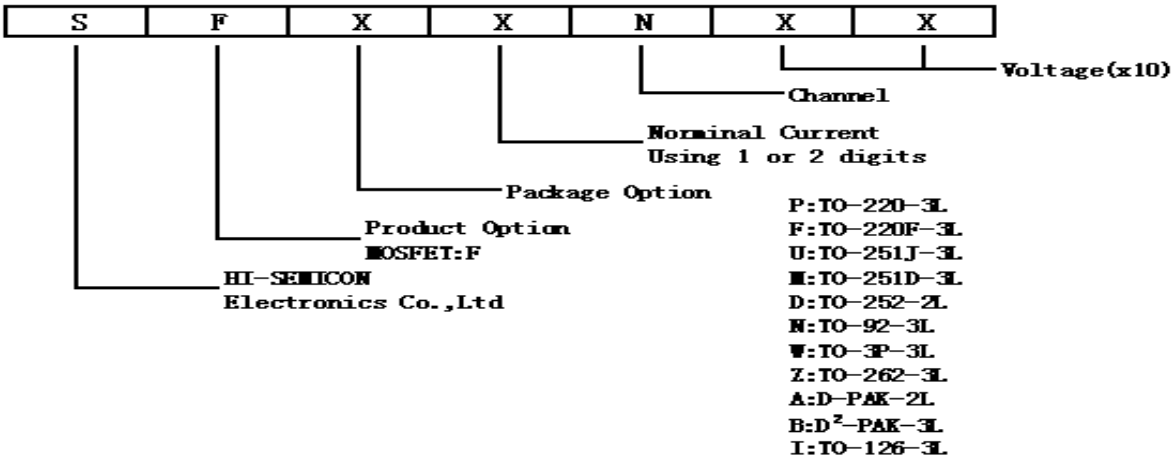
These devices are widely used in AC-DC power suppliers, DC-DC converters and H-bridge PWM motor drivers.




### FEATURES

- 1A,600V,$R_{DS(on)}$ (typ.) =8.2Ω@$V_{GS}$=10V
- Low gate charge
- Low Crss
- Fast switching
- Improved dv/dt capability

### NOMENCLATURE




### ORDERING INFORMATION

| Part No. | Package | Marking | Material | Packing |
|---|---|---|---|---|
| SFM1N60 | TO-251D-3L | SFM1N60 | Pb free | Tube |
| SFU1N60 | TO-251J-3L | SFU1N60 | Pb free | Tube |
| SFI1N60 | TO-126-3L | SFI1N60 | Pb free | Bulk |
| SFN1N60 | TO-92-3L | SFN1N60 | Pb free | Bulk |
| SFN1N60TR | TO-92-3L | SFN1N60 | Pb free | AMMO |
| SFD1N60 | TO-252-2L | SFD1N60 | Pb free | Tape & Reel |

## ABSOLUTE MAXIMUM RATINGS **(Tc=25°C unless otherwise noted)**

| Characteristics | | Symbol | Rating | | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | SFN1N60 | SFM/D1N60 | SFU1N60 | SFI1N60 | |
| Drain-Source Voltage | | $V_{DS}$ | 600 | | | | V |
| Gate-Source Voltage | | $V_{GS}$ | ±30 | | | | V |
| Drain Current | $T_C$=25°C | $I_D$ | 1.0 | | | | A |
| | $T_C$=100°C | | 0.63 | | | | |
| Drain Current Pulsed | | $I_{DM}$ | 1.5 | 4.0 | | | A |
| Power Dissipation($T_C$=25°C) | | $P_D$ | 9 | 28 | 29 | 25 | W |
| -Derate above 25°C | | | 0.07 | 0.22 | 0.23 | 0.20 | W/°C |
| Single Pulsed Avalanche Energy (Note 1) | | $E_{AS}$ | 52 | | | | mJ |
| Operation Junction Temperature Range | | $T_J$ | -55～+150 | | | | °C |
| Storage Temperature Range | | $T_{stg}$ | -55～+150 | | | | °C |

## THERMAL CHARACTERISTICS

| Characteristics | Symbol | Rating | | | | Unit |
|---|---|---|---|---|---|---|
| | | SFN1N60 | SFM/D1N60 | SFU1N60 | SFI1N60 | |
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 13.89 | 4.46 | 4.31 | 5 | °C/W |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 120 | 110 | 110 | 62.5 | °C/W |

## ELECTRICAL CHARACTERISTICS **(Tc=25°C unless otherwise noted)**

| Characteristics | Symbol | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Drain -Source Breakdown Voltage | $B_{VDSS}$ | $V_{GS}$=0V, $I_D$=250μA | 600 | -- | -- | V |
| Drain-Source Leakage Current | $I_{DSS}$ | $V_{DS}$=600V, $V_{GS}$=0V | -- | -- | 1.0 | μA |
| Gate-Source Leakage Current | $I_{GSS}$ | $V_{GS}$=±30V, $V_{DS}$=0V | -- | -- | ±100 | nA |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{GS}$=$V_{DS}$, $I_D$=250μA | 2.0 | -- | 4.0 | V |
| Static Drain- Source On State Resistance | $R_{DS(on)}$ | $V_{GS}$=10V, $I_D$=0.5 A | -- | 8.2 | 11 | Ω |
| Input Capacitance | $C_{iss}$ | $V_{DS}$=25V,$V_{GS}$=0V, f=1.0MHZ | -- | 120.3 | -- | pF |
| Output Capacitance | $C_{oss}$ | | -- | 19.0 | -- | |
| Reverse Transfer Capacitance | $C_{rss}$ | | -- | 0.8 | -- | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$=300V,$I_D$=1.0A, $R_G$=25Ω (Note 2,3) | -- | 6.47 | -- | ns |
| Turn-on Rise Time | $t_r$ | | -- | 13.27 | -- | |
| Turn-off Delay Time | $t_{d(off)}$ | | -- | 7.73 | -- | |
| Turn-off Fall Time | $t_f$ | | -- | 15.87 | -- | |
| Total Gate Charge | $Q_g$ | $V_{DS}$=480V,$I_D$=1.0A, $V_{GS}$=10V (Note 2,3) | -- | 3.45 | -- | nC |
| Gate-Source Charge | $Q_{gs}$ | | -- | 1.10 | -- | |
| Gate-Drain Charge | $Q_{gd}$ | | -- | 1.39 | -- | |

## SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

| Characteristics | Symbol | Test conditions | Min. | Typ. | Max. | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | | SFN1N60 | Others | |
| Continuous Source Current | $I_S$ | Integral Reverse P-N Junction Diode in the MOSFET | -- | -- | 1.0 | | A |
| Pulsed Source Current | $I_{SM}$ | | -- | -- | 1.5 | 4.0 | |
| Diode Forward Voltage | $V_{SD}$ | $I_S$=1.0A, $V_{GS}$=0V | -- | -- | 1.5 | | V |
| Reverse Recovery Time | $T_{rr}$ | $I_S$=1.0A, $V_{GS}$=0V, dIF/dt=100A/μS(Note 2) | -- | 246.08 | -- | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | -- | 0.53 | -- | | μC |

**Notes:**

1. L=30mH，$I_{AS}$=1.74A, $V_{DD}$=85V, $R_G$=25Ω,starting $T_J$=25°C;
2. Pulse Test: Pulse width ≤300μs,Duty cycle≤2%;
3. Essentially independent of operating temperature.

## TYPICAL CHARACTERISTICS

Figure 1. On-Region Characteristics

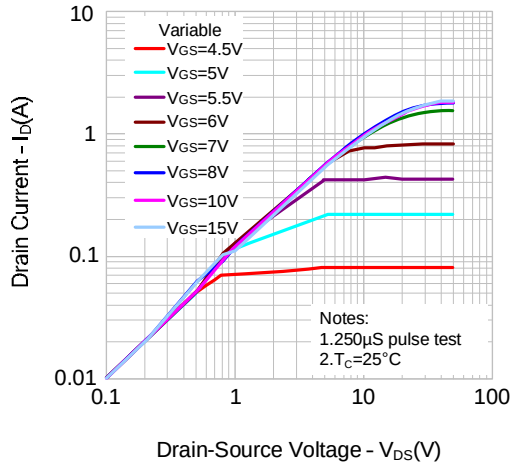



Figure 2. Transfer Characteristics

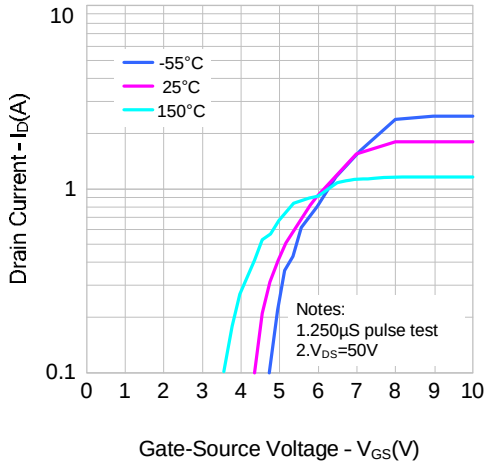



Figure 3. On-Resitance Variation vs. Drain Current and Gate Voltage

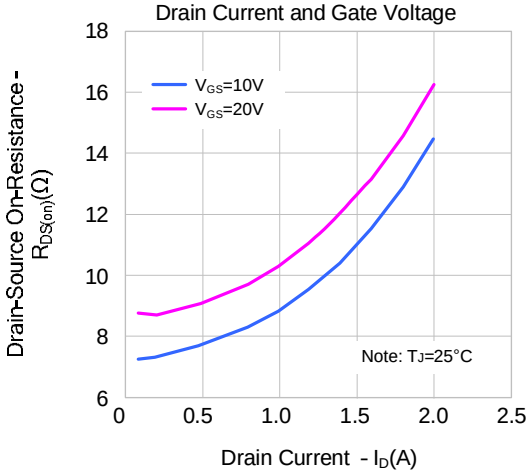
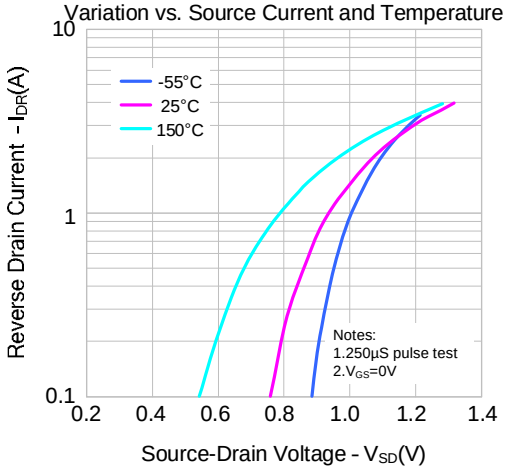



Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature



## TYPICAL CHARACTERISTICS（continued）

Figure 5. Capacitance Characteristics

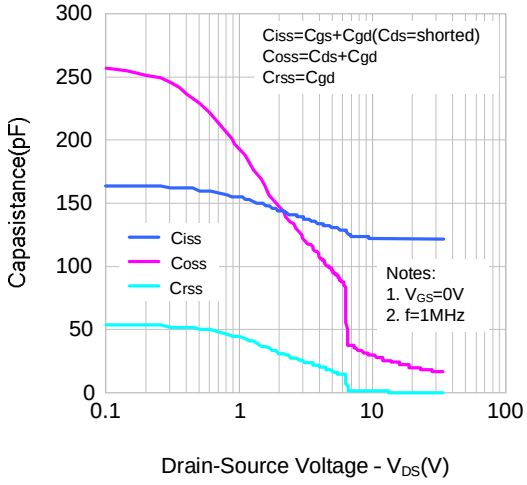



Figure 6. Gate Charge Characteristics

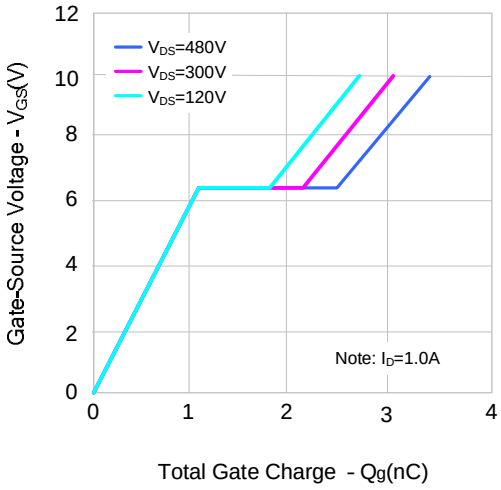



Figure 7. Breakdown Voltage Variation vs. Temperature

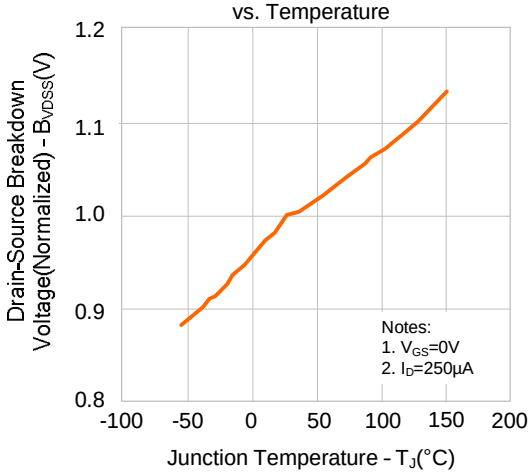



Figure 8. On-resistance Variation vs. Temperature

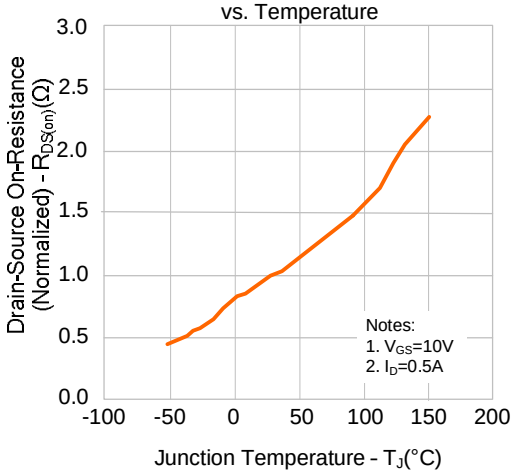



Figure 9-1. Max. Safe Operating Area(SFN1N60)

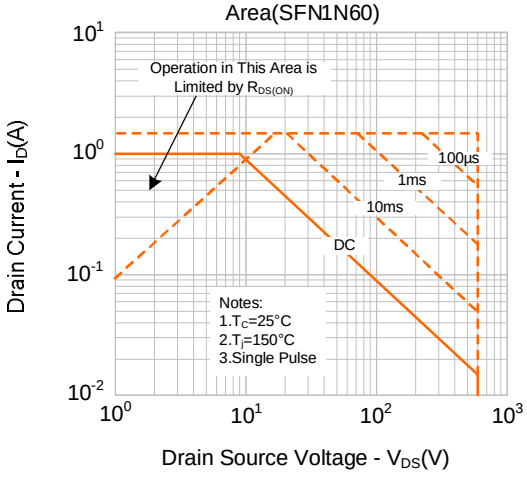
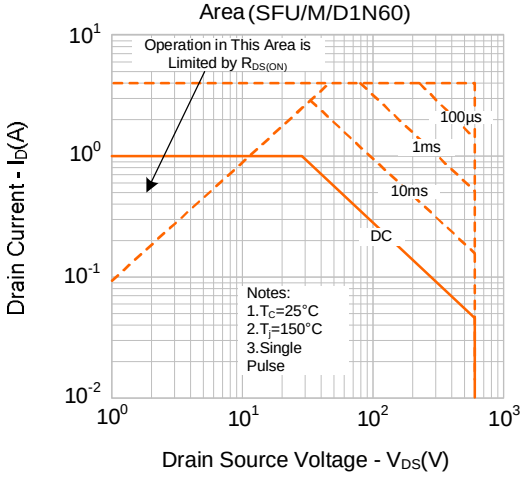



Figure 9-2. Max. Safe Operating Area (SFU/M/D1N60)



TYPICAL CHARACTERISTICS（continued）

Figure 9-3. Max. Safe Operating Area(SFU1N60）

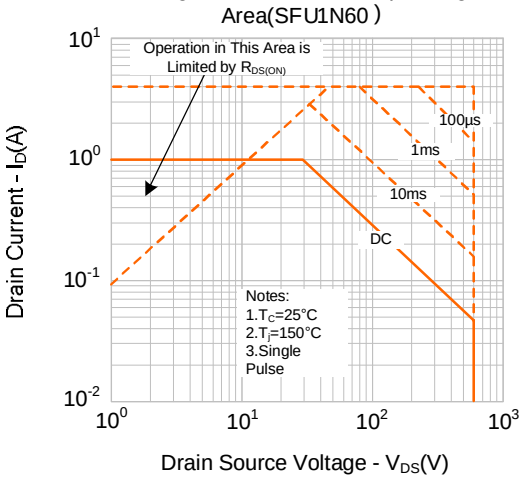



Figure 9-4. Max. Safe Operating Area(SFI1N60）

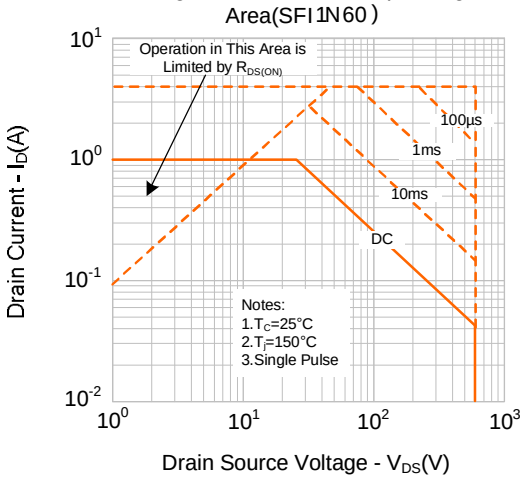
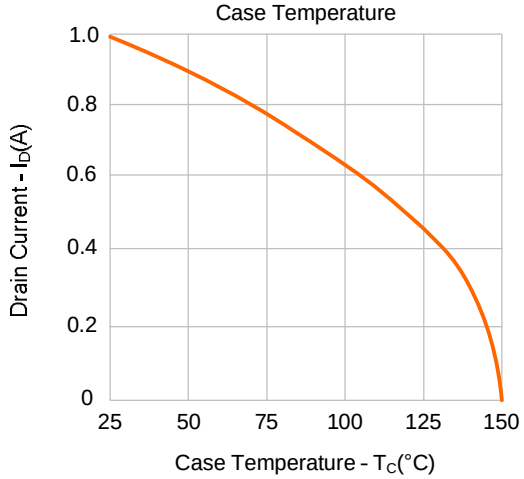
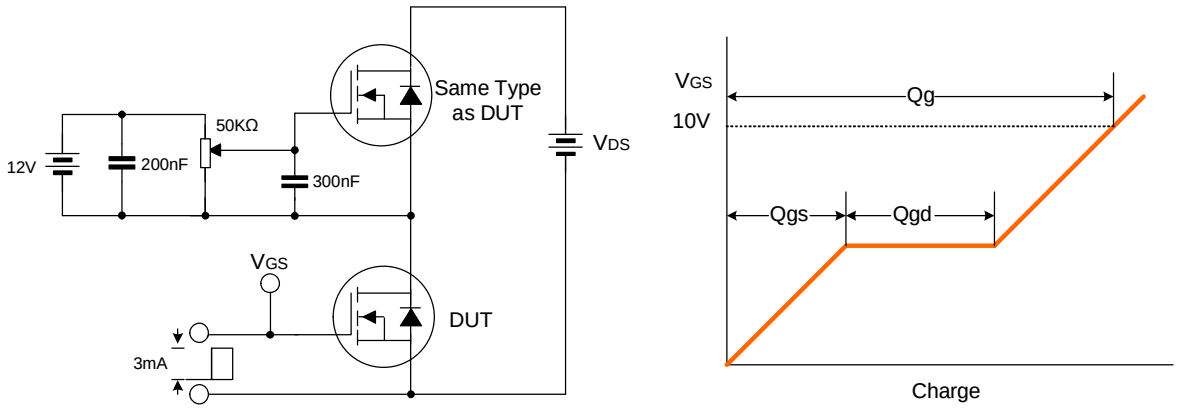



Figure 10. Maximum Drain Current vs. Case Temperature

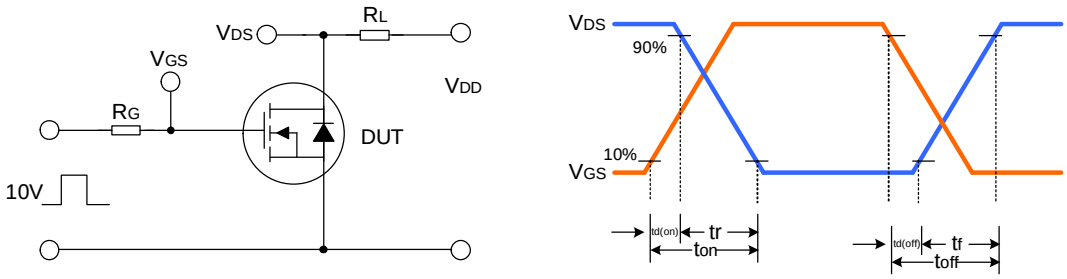


## TYPICAL TEST CIRCUIT

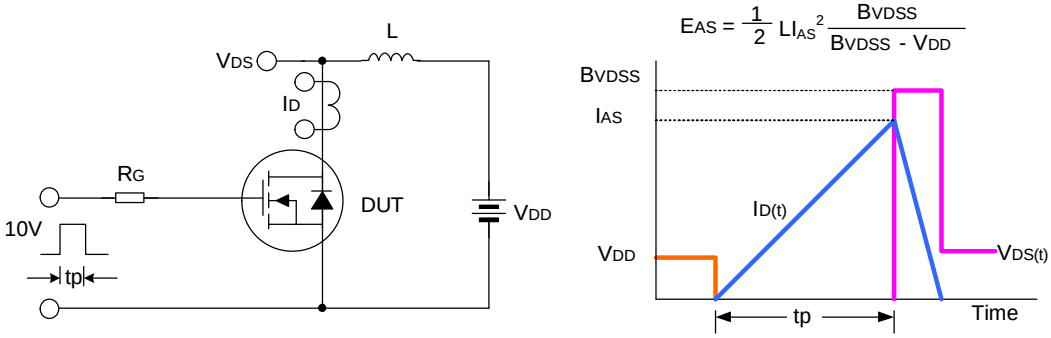
Gate Charge Test Circuit & Waveform




Resistive Switching Test Circuit & Waveform

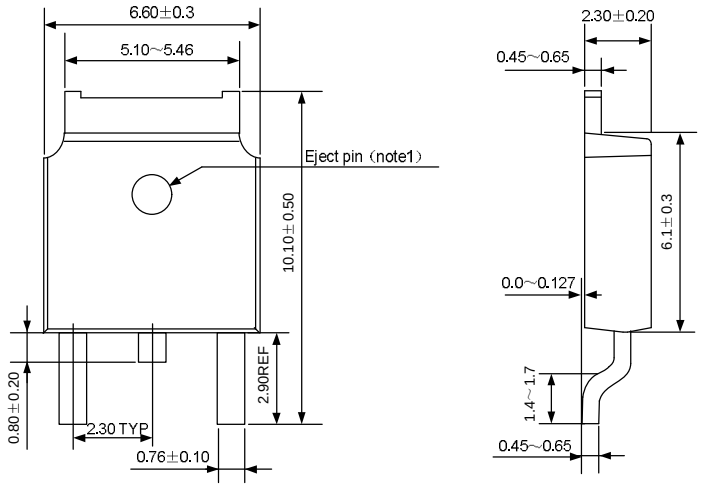



Unclamped Inductive Switching Test Circuit & Waveform



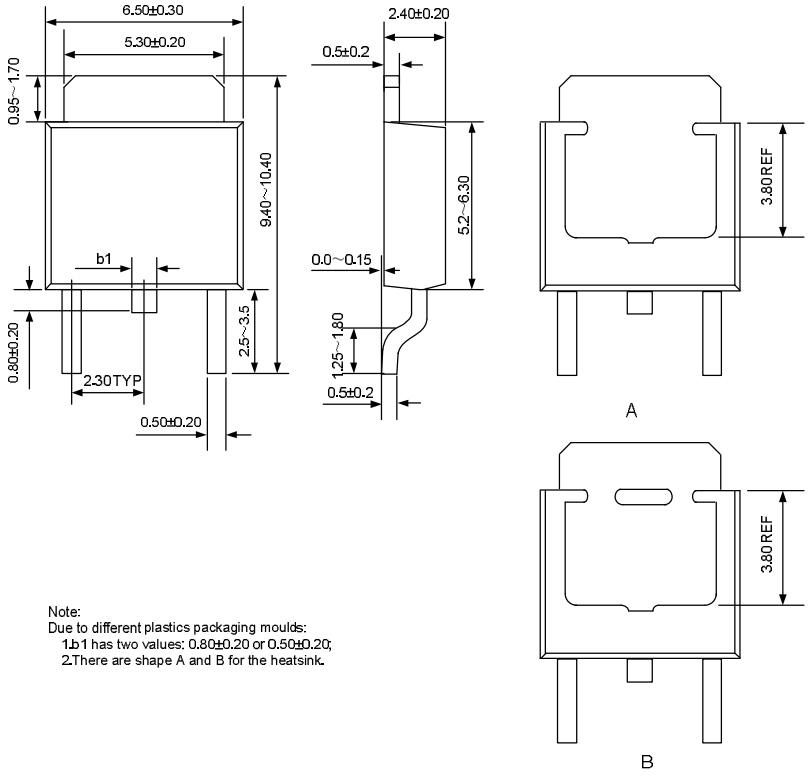
PACKAGE OUTLINE

TO-252-2L(1) UNIT: mm




NOTE1‖ There are two conditions for this position:has an eject pin or has no eject pin.

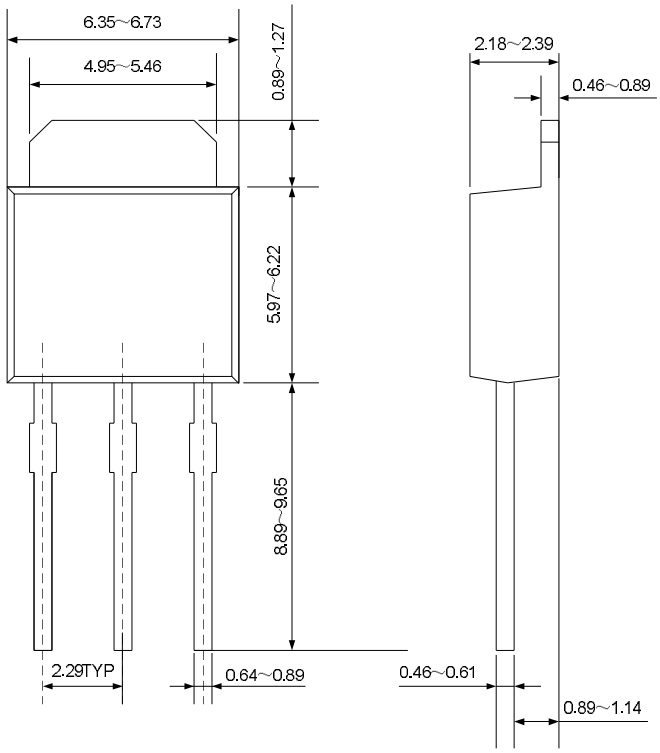
TO-252-2L(2) UNIT: mm



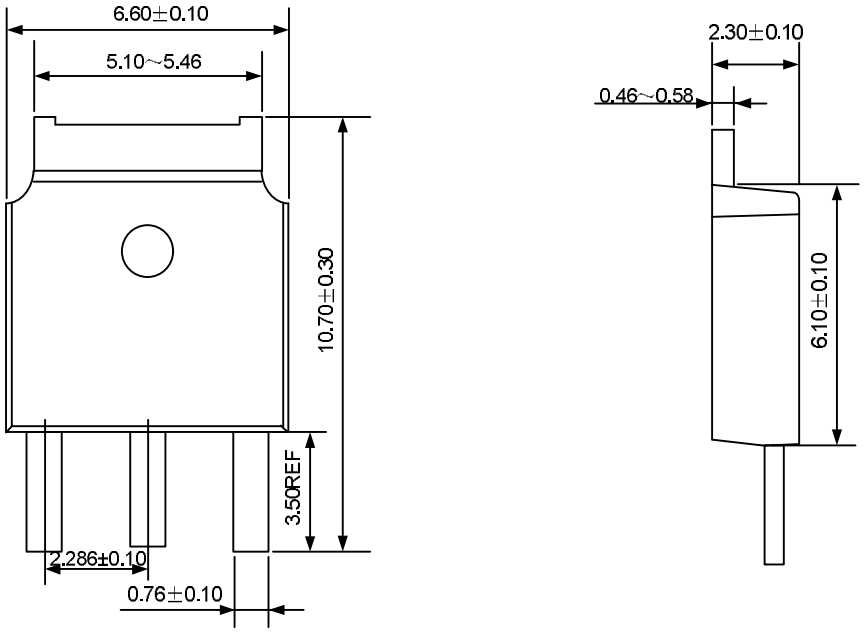

Note:
Due to different plastics packaging moulds:
1.b1 has two values: 0.80±0.20 or 0.50±0.20;
2.There are shape A and B for the heatsink.

PACKAGE OUTLINE (continued)

TO-251J-3L UNIT: mm

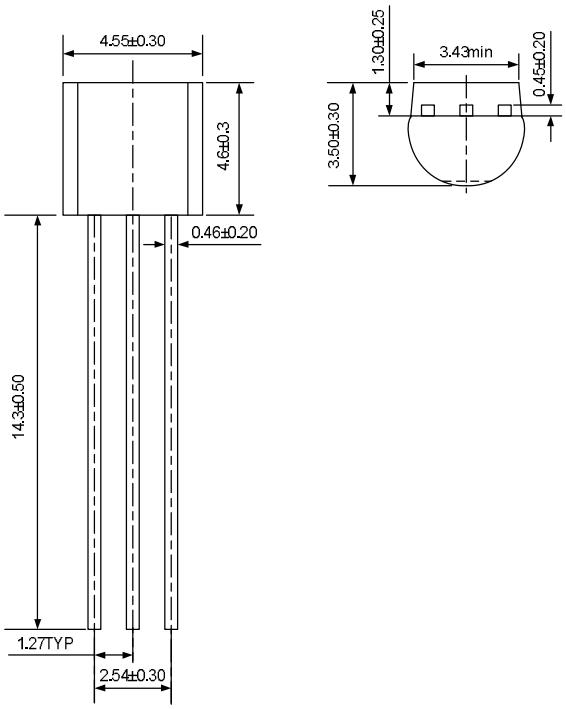



TO-251D-3L UNIT: mm

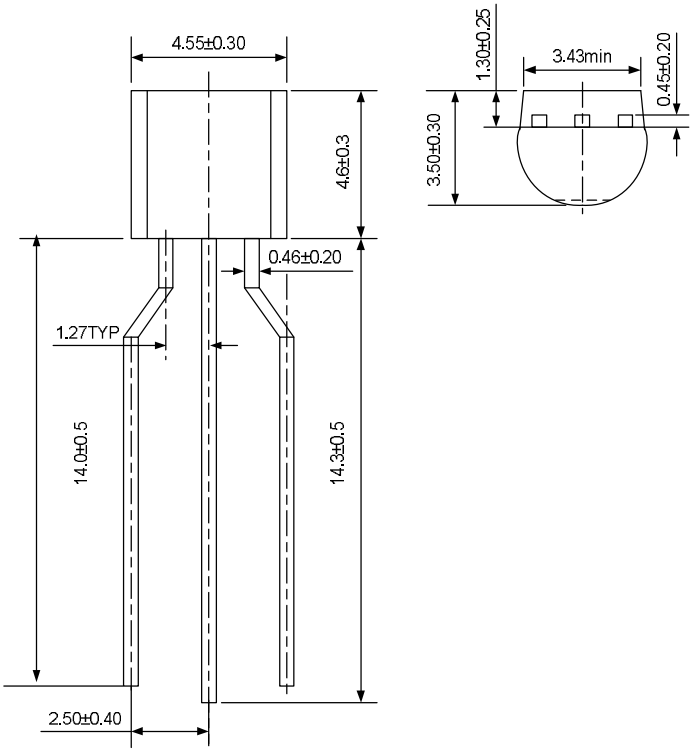


PACKAGE OUTLINE (continued)

TO-92-3L(1) UNIT: mm

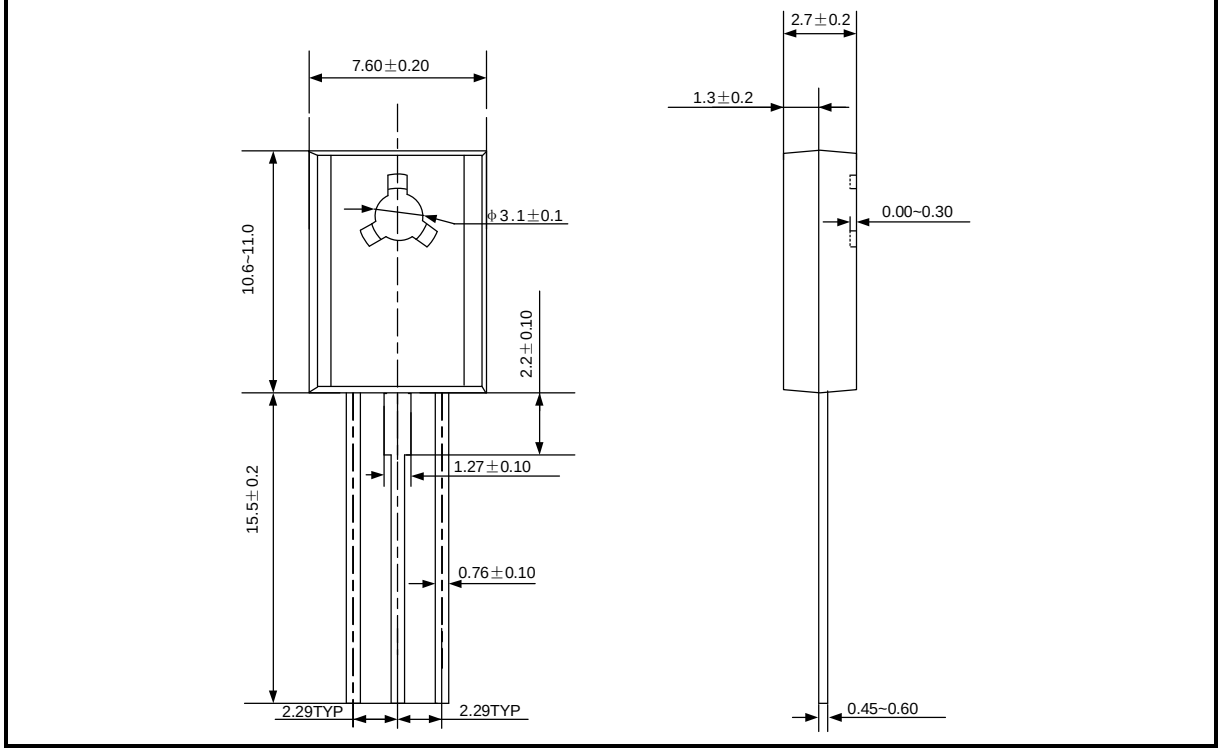



TO-92-3L(2) UNIT: mm



PACKAGE OUTLINE (continued)

TO-126-3L UNIT: mm

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