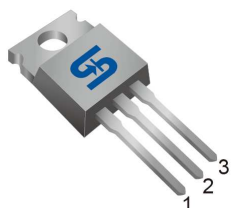
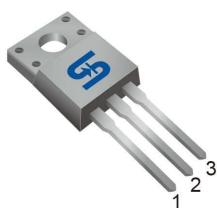




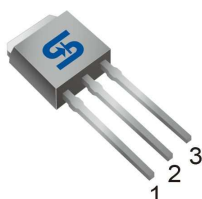
TO-220



ITO-220



TO-251 (IPAK)



TO-252 (DPAK)



Pin Definition:

1. Gate
2. Drain
3. Source

PRODUCT SUMMARY

| V_{DS} (V) | $R_{DS(on)}$ (Ω) | I_D (A) |
|--------------|---------------------------|-----------|
| 600 | 2.5 @ $V_{GS}=10V$ | 4 |

General Description

The TSM4NB60 N-Channel Power MOSFET is produced by new advance planar process. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode.

Features

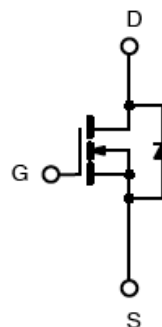
- Low $R_{DS(ON)}$ 2.2 Ω (Typ.)
- Low gate charge typical @ 14.5nC (Typ.)
- Low C_{rss} typical @ 7.0pF (Typ.)
- 100% Avalanche Tested

Ordering Information

| Part No. | Package | Packing |
|----------------|---------|--------------------|
| TSM4NB60CH C5G | TO-251 | 75pcs / Tube |
| TSM4NB60CP ROG | TO-252 | 2.5Kpcs / 13" Reel |
| TSM4NB60CZ C0 | TO-220 | 50pcs / Tube |
| TSM4NB60CI C0G | ITO-220 | 50pcs / Tube |

Note: "G" denotes for Halogen Free

Block Diagram



N-Channel MOSFET

Absolute Maximum Rating ($T_a = 25^\circ C$ unless otherwise noted)

| Parameter | Symbol | Limit | | | Unit |
|--|-----------|---------------------|---------|--------|------------|
| | | IPAK/DPAK | ITO-220 | TO-220 | |
| Drain-Source Voltage | V_{DS} | 600 | | | V |
| Gate-Source Voltage | V_{GS} | ± 30 | | | V |
| Continuous Drain Current | I_D | $T_C = 25^\circ C$ | | | A |
| | | $T_C = 100^\circ C$ | | | A |
| Pulsed Drain Current * | I_{DM} | 16 | | | A |
| Single Pulse Avalanche Energy (Note 2) | E_{AS} | 70 | | | mJ |
| Avalanche Current (Repetitive) (Note 1) | I_{AR} | 4 | | | A |
| Repetitive Avalanche Energy (Note 1) | E_{AR} | 5 | | | mJ |
| Peak Diode Recovery dv/dt (Note 3) | dv/dt | 4.5 | | | V/ns |
| Total Power Dissipation @ $T_C = 25^\circ C$ | P_{TOT} | 50 | 25 | 70 | W |
| Operating Junction Temperature | T_J | 150 | | | $^\circ C$ |
| Storage Temperature Range | T_{STG} | -55 to +150 | | | $^\circ C$ |

Note: Limited by maximum junction temperature

Thermal Performance

| Parameter | Symbol | Limit | | | Unit |
|--|----------------|-----------|---------|--------|----------------------|
| | | IPAK/DPAK | ITO-220 | TO-220 | |
| Thermal Resistance - Junction to Case | $R\theta_{JC}$ | 2.5 | 5 | 1.78 | $^{\circ}\text{C/W}$ |
| Thermal Resistance - Junction to Ambient | $R\theta_{JA}$ | 83 | 62.5 | 62.5 | $^{\circ}\text{C/W}$ |

Electrical Specifications (Ta = 25°C unless otherwise noted)

| Parameter | Conditions | Symbol | Min | Typ | Max | Unit |
|--|--|--------------|-----|------|-----------|---------------|
| Static | | | | | | |
| Drain-Source Breakdown Voltage | $V_{GS} = 0V, I_D = 250\mu\text{A}$ | BV_{DSS} | 600 | -- | -- | V |
| Drain-Source On-State Resistance | $V_{GS} = 10V, I_D = 2A$ | $R_{DS(ON)}$ | -- | 2.2 | 2.5 | Ω |
| Gate Threshold Voltage | $V_{DS} = V_{GS}, I_D = 250\mu\text{A}$ | $V_{GS(TH)}$ | 2.5 | 3.5 | 4.5 | V |
| Zero Gate Voltage Drain Current | $V_{DS} = 600V, V_{GS} = 0V$ | I_{DSS} | -- | -- | 1 | μA |
| Gate Body Leakage | $V_{GS} = \pm 30V, V_{DS} = 0V$ | I_{GSS} | -- | -- | ± 100 | nA |
| Forward Transfer Conductance | $V_{DS} = 40V, I_D = 2A$ | g_{fs} | -- | 2.6 | -- | S |
| Dynamic | | | | | | |
| Total Gate Charge | $V_{DS} = 480V, I_D = 4A,$ $V_{GS} = 10V$ (Note 4,5) | Q_g | -- | 14.5 | -- | nC |
| Gate-Source Charge | | Q_{gs} | -- | 3.4 | -- | |
| Gate-Drain Charge | | Q_{gd} | -- | 7 | -- | |
| Input Capacitance | $V_{DS} = 25V, V_{GS} = 0V,$ $f = 1.0\text{MHz}$ | C_{iss} | -- | 500 | -- | pF |
| Output Capacitance | | C_{oss} | -- | 53.2 | -- | |
| Reverse Transfer Capacitance | | C_{rss} | -- | 7 | -- | |
| Switching | | | | | | |
| Turn-On Delay Time | $V_{GS} = 10V, I_D = 4A,$ $V_{DD} = 300V, R_G = 25\Omega$ (Note 4,5) | $t_{d(on)}$ | -- | 11 | -- | nS |
| Turn-On Rise Time | | t_r | -- | 20 | -- | |
| Turn-Off Delay Time | | $t_{d(off)}$ | -- | 30 | -- | |
| Turn-Off Fall Time | | t_f | -- | 19 | -- | |
| Source-Drain Diode Ratings and Characteristic | | | | | | |
| Source Current | Integral reverse diode in the MOSFET | I_S | -- | -- | 4 | A |
| Source Current (Pulse) | | I_{SM} | -- | -- | 16 | A |
| Diode Forward Voltage | $I_S = 4A, V_{GS} = 0V$ | V_{SD} | -- | -- | 1.13 | V |
| Reverse Recovery Time | $V_{GS} = 0V, I_S = 4A,$ $di/dt = 100\text{A}/\mu\text{s}$ | t_{fr} | -- | 522 | -- | nS |
| Reverse Recovery Charge | | Q_{fr} | -- | 1.6 | -- | μC |

Note 1: Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature

Note 2: $V_{DD} = 50V, I_{AS} = 4A, L = 8\text{mH}, R_G = 25\Omega$, Starting $T_J = 25^{\circ}\text{C}$

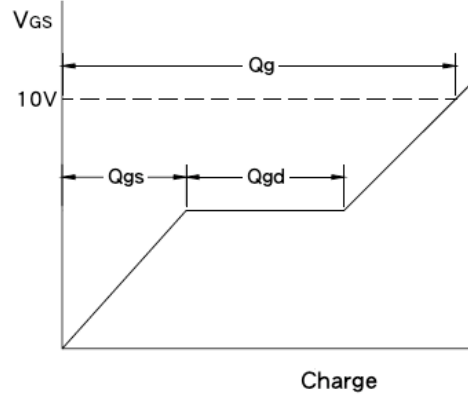
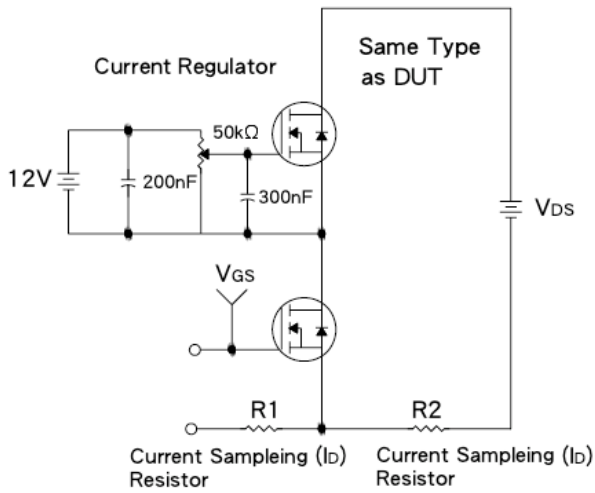
Note 3: $I_{SD} \leq 4A, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^{\circ}\text{C}$

Note 4: Pulse test: pulse width $\leq 300\mu\text{s}$, duty cycle $\leq 2\%$

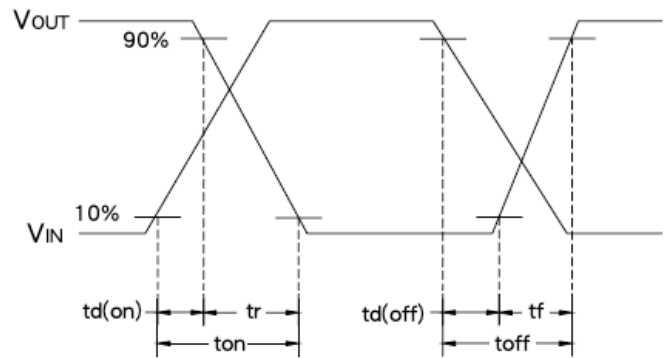
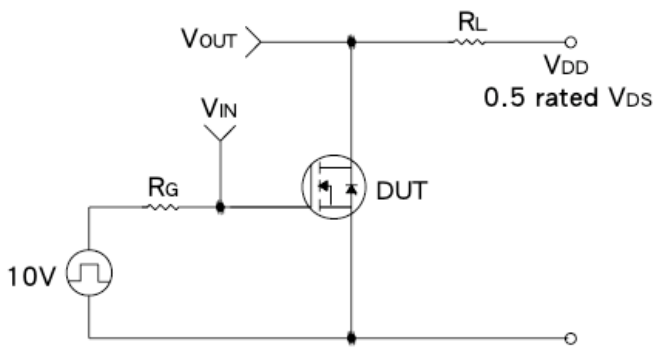
Note 5: Essentially Independent of Operating Temperature



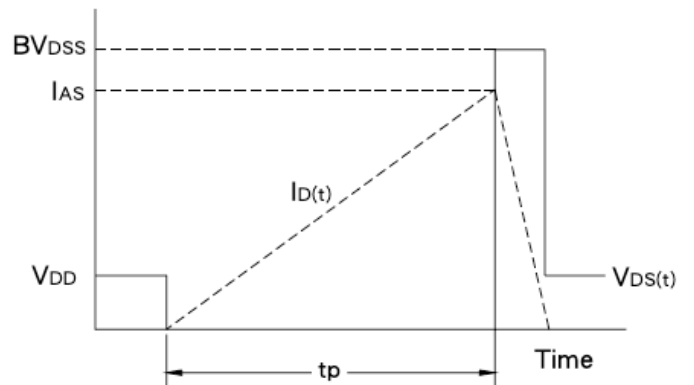
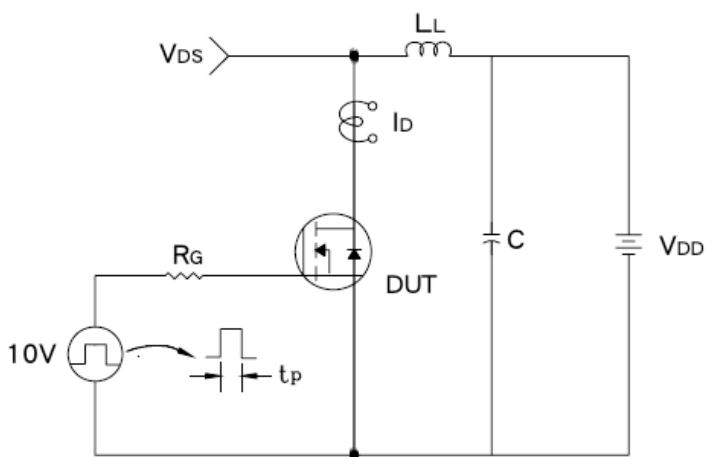
Gate Charge Test Circuit & Waveform



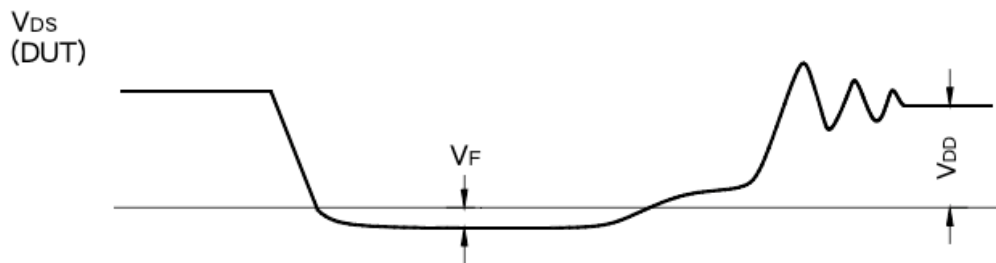
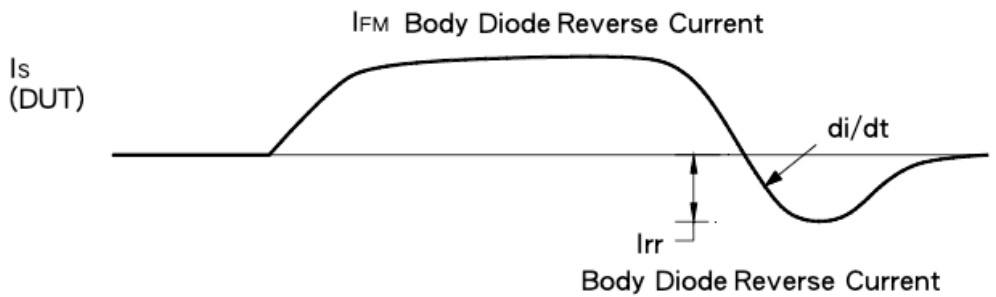
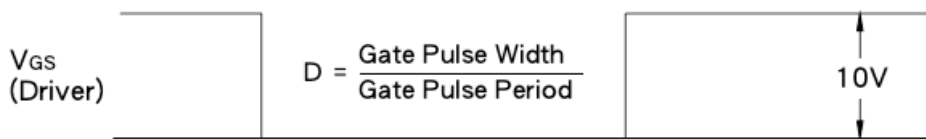
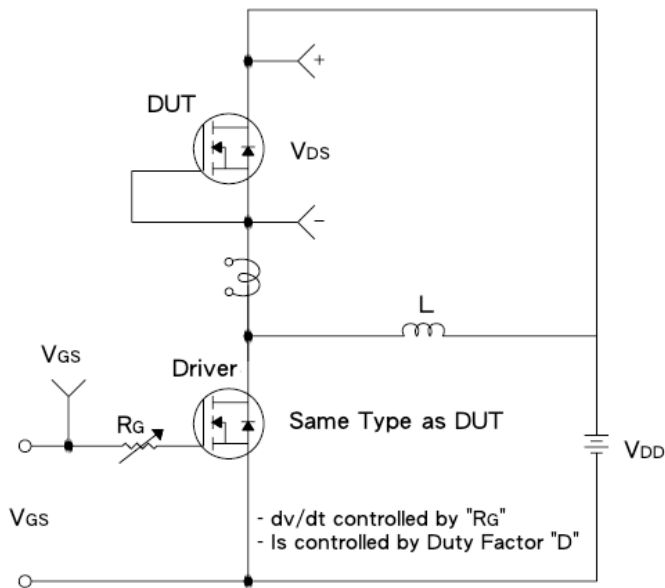
Resistive Switching Test Circuit & Waveform



E_{AS} Test Circuit & Waveform



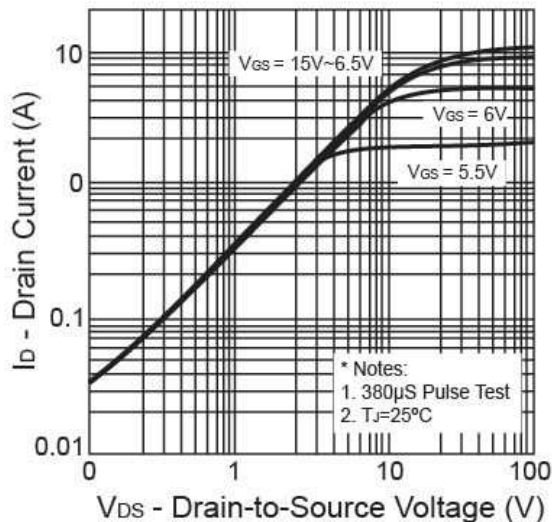
Diode Reverse Recovery Time Test Circuit & Waveform



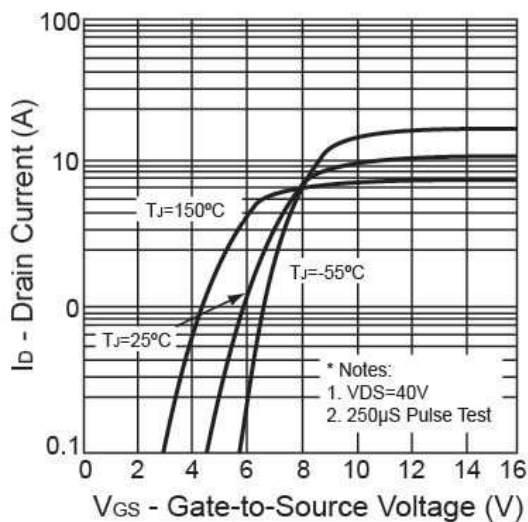


Electrical Characteristics Curve ($T_a = 25^\circ\text{C}$, unless otherwise noted)

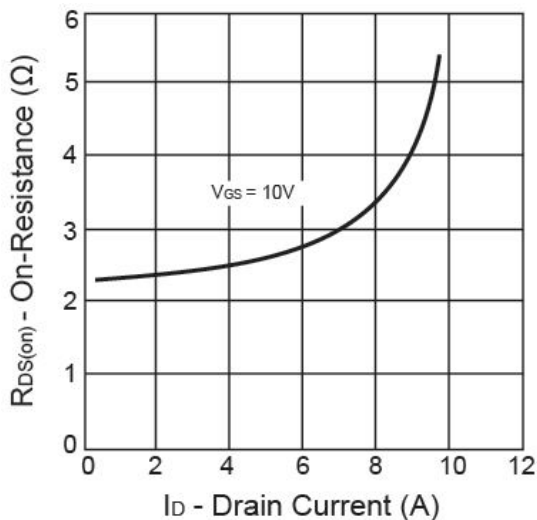
Output Characteristics



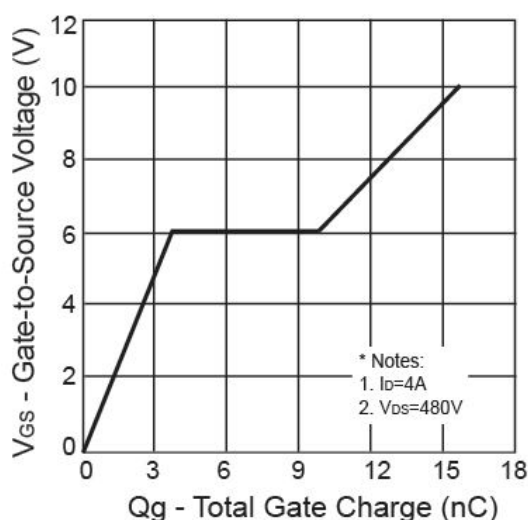
Transfer Characteristics



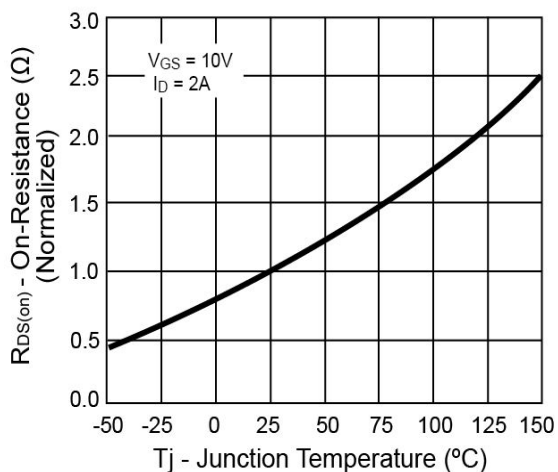
On-Resistance vs. Drain Current



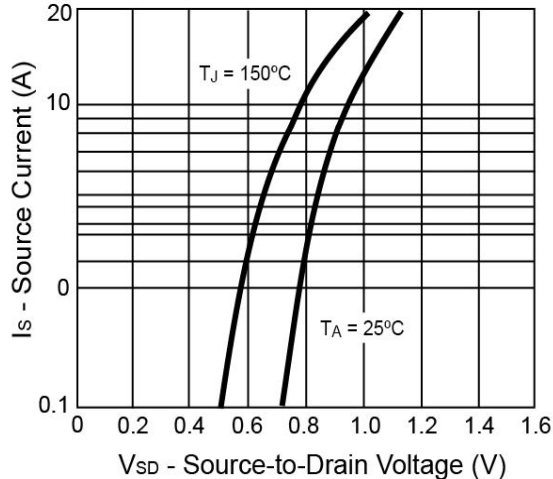
Gate Charge



On-Resistance vs. Junction Temperature

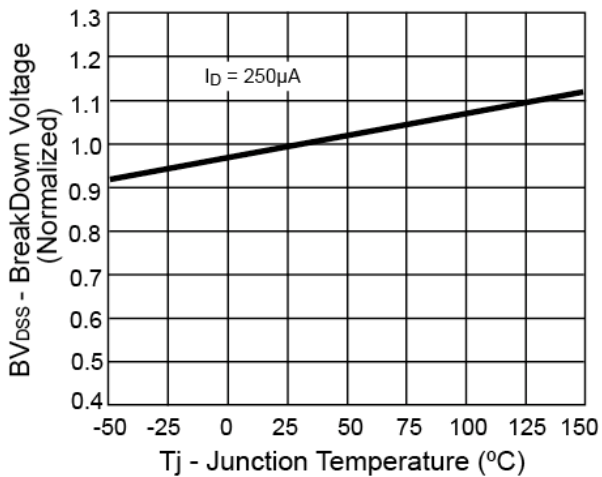


Source-Drain Diode Forward Voltage

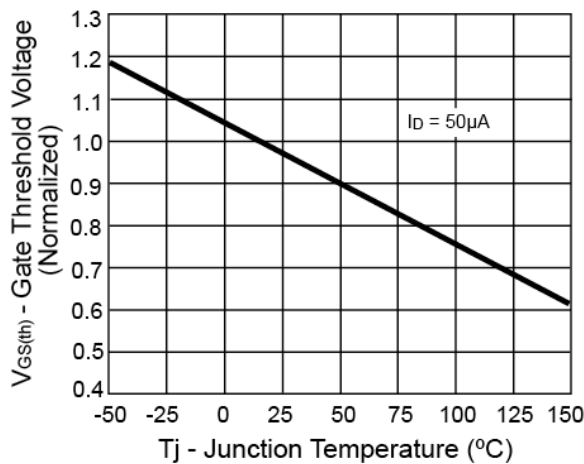


Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)

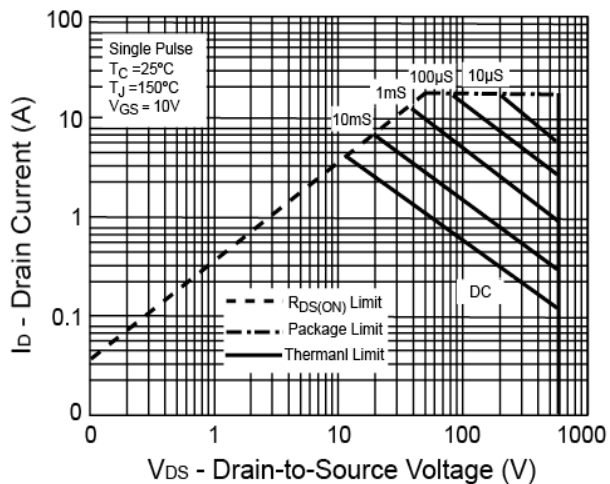
Breakdown Voltage vs. Temperature



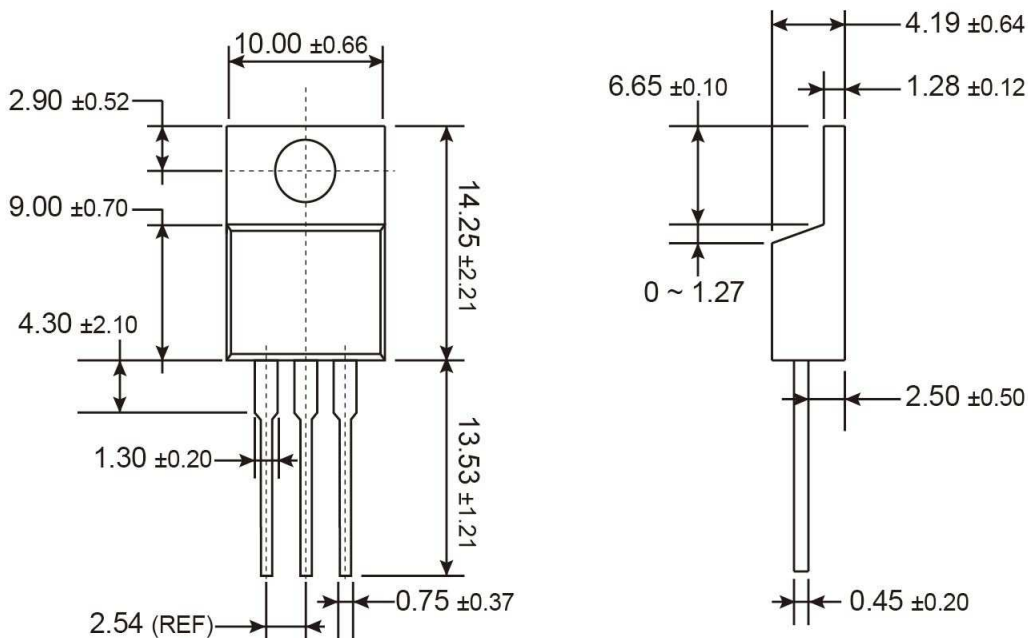
Threshold Voltage vs. Temperature



Maximum Safe Operating Area

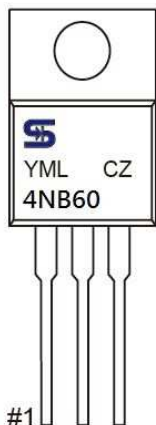


TO-220 Mechanical Drawing



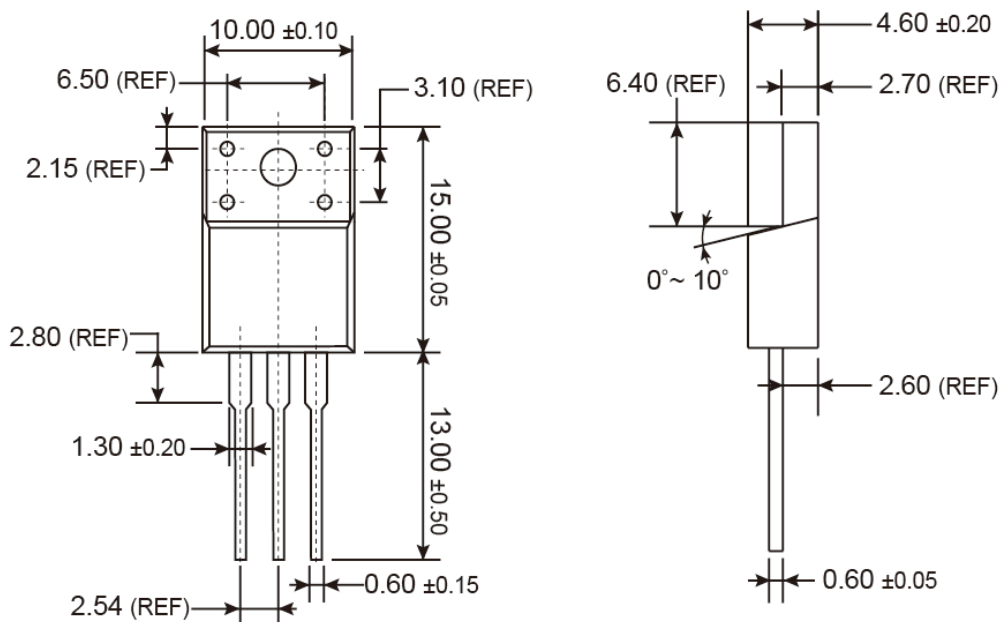
Unit: Millimeters

Marking Diagram



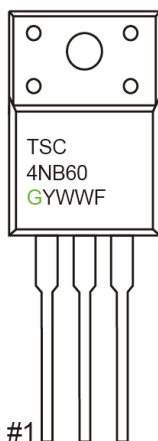
- Y** = Year Code
- M** = Month Code
(**A**=Jan, **B**=Feb, **C**=Mar, **D**=Apr, **E**=May, **F**=Jun, **G**=Jul, **H**=Aug, **I**=Sep, **J**=Oct, **K**=Nov, **L**=Dec)
- L** = Lot Code

ITO-220 Mechanical Drawing



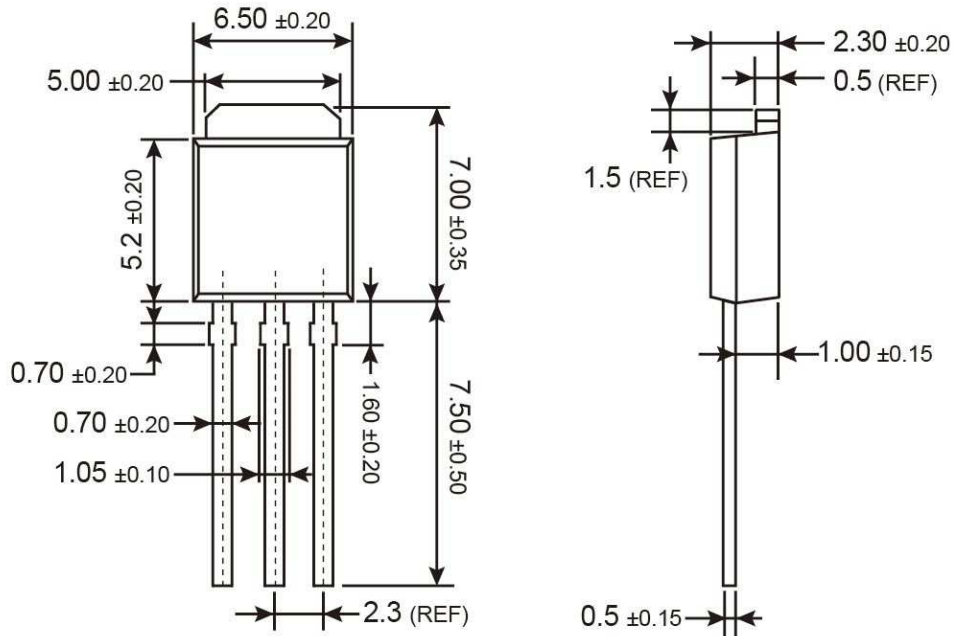
Unit: Millimeters

Marking Diagram



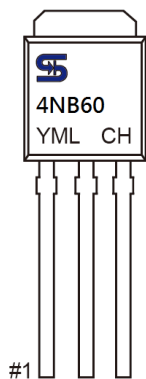
- Y** = Year Code
- M** = Month Code for Halogen Free Product
(**O**=Jan, **P**=Feb, **Q**=Mar, **R**=Apr, **S**=May, **T**=Jun, **U**=Jul, **V**=Aug, **W**=Sep, **X**=Oct, **Y**=Nov, **Z**=Dec)
- L** = Lot Code

TO-251 Mechanical Drawing



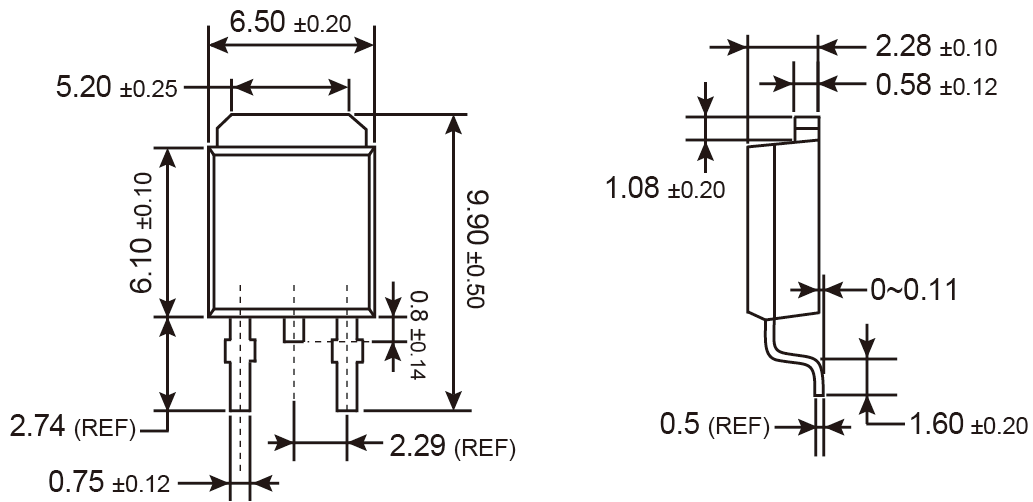
Unit: Millimeters

Marking Diagram



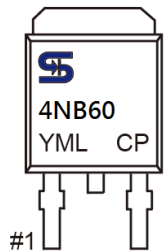
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- L** = Lot Code

TO-252 Mechanical Drawing



Unit: Millimeters

Marking Diagram



- Y** = Year Code
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