
**Pin Definition:**

1. Gate
2. Drain
3. Source

**PRODUCT SUMMARY**

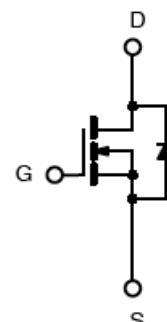
| <b>V<sub>DS</sub> (V)</b> | <b>R<sub>DS(on)</sub>(Ω)</b> | <b>I<sub>D</sub> (A)</b> |
|---------------------------|------------------------------|--------------------------|
| 600                       | 5 @ V <sub>GS</sub> = 10V    | 1                        |

**General Description**

The TSM2N60 is used an advanced termination scheme to provide enhanced voltage-blocking capability without degrading performance over time. In addition, this advanced MOSFET is designed to withstand high energy in avalanche and commutation modes. The new energy efficient design also offers a drain- to-source diode with a fast recovery time. Designed for high voltage, high speed switching applications in power supplies, converters and PWM motor controls, these devices are particularly well suited for bridge circuits where diode speed and commutating safe operating areas are critical and offer additional and safety margin against unexpected voltage transients.

**Features**

- Robust high voltage termination
- Avalanche energy specified
- Diode is characterized for use in bridge circuits
- Source to Drain diode recovery time comparable to a discrete fast recovery diode.

**Block Diagram**

**N-Channel MOSFET**
**Ordering Information**

| <b>Part No.</b> | <b>Package</b> | <b>Packing</b>    |
|-----------------|----------------|-------------------|
| TSM2N60CP RO    | TO-252         | 2.5Kpcs/ 13" Reel |
| TSM2N60CP ROG   | TO-252         | 2.5Kpcs/ 13" Reel |
| TSM2N60CH C5    | TO-251         | 75pcs / Tube      |
| TSM2N60CH C5G   | TO-251         | 75pcs / Tube      |
| TSM2N60CZ C0    | TO-220         | 50pcs / Tube      |

**Note:** "G" denotes for Halogen Free

**Absolute Maximum Rating (Ta = 25°C unless otherwise noted)**

| <b>Parameter</b>   | <b>Symbol</b>                     | <b>Limit</b> | <b>Unit</b> |
|--|-----------------------------------|--------------|-------------|
| Drain-Source Voltage   | V <sub>DS</sub>                   | 600          | V           |
| Gate-Source Voltage  | V <sub>GS</sub>                   | ±30          | V           |
| Continuous Drain Current   | I <sub>D</sub>                    | 2            | A           |
| Pulsed Drain Current   | I <sub>DM</sub>                   | 9            | A           |
| Continuous Source Current (Diode Conduction) <sup>a,b</sup>  | I <sub>S</sub>                    | 1            | A           |
| Single Pulse Drain to Source Avalanche Energy<br>(V <sub>DD</sub> = 50V, I <sub>AS</sub> =1.8A, L=68mH, R <sub>G</sub> =25Ω) | EAS                               | 120          | mJ          |
| Maximum Power Dissipation @ T <sub>c</sub> = 25°C  | P <sub>DTOT</sub>                 | 70           | W           |
|  |                                   | 70           |             |
| Operating Junction Temperature   | T <sub>J</sub>                    | +150         | °C          |
| Operating Junction and Storage Temperature Range   | T <sub>J</sub> , T <sub>STG</sub> | -55 to +150  | °C          |

**Thermal Performance**

| Parameter                                | Symbol         | Limit | Unit                        |
|--|----------------|-------|-----------------------------|
| Thermal Resistance - Junction to Case    | $R\theta_{JC}$ | 2.87  | $^{\circ}\text{C}/\text{W}$ |
| TO-220                                   |                | 2.32  |                             |
| Thermal Resistance - Junction to Ambient | $R\theta_{JA}$ | 110   | $^{\circ}\text{C}/\text{W}$ |
| TO-220                                   |                | 62.5  |                             |

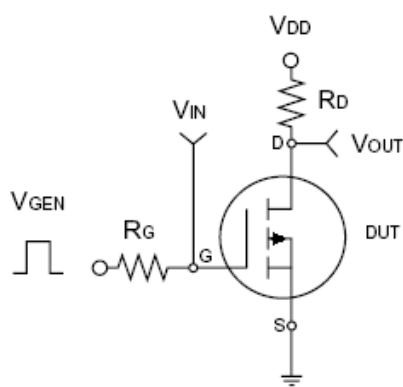
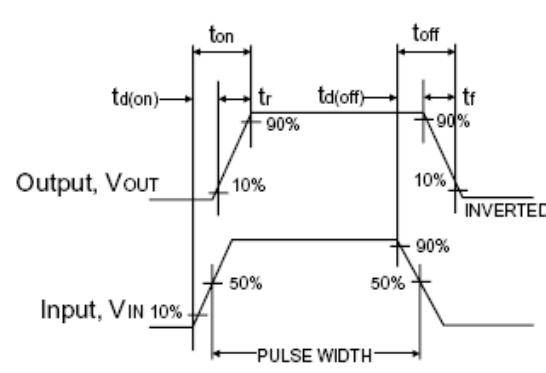
Notes: Surface mounted on FR4 board  $t \leq 10\text{sec}$

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

| Parameter                        | Conditions   | Symbol              | Min | Typ | Max       | Unit          |
|----------------------------------|--|---------------------|-----|-----|-----------|---------------|
| <b>Static</b>                    |  |                     |     |     |           |               |
| Drain-Source Breakdown Voltage   | $V_{GS} = 0\text{V}$ , $I_D = 250\mu\text{A}$  | $BV_{DSS}$          | 600 | --  | --        | V             |
| Drain-Source On-State Resistance | $V_{GS} = 10\text{V}$ , $I_D = 1\text{A}$  | $R_{DS(\text{ON})}$ | --  | --  | 5         | $\Omega$      |
| Gate Threshold Voltage           | $V_{DS} = V_{GS}$ , $I_D = 250\mu\text{A}$   | $V_{GS(\text{TH})}$ | 2.0 | --  | 4.0       | V             |
| Zero Gate Voltage Drain Current  | $V_{DS} = 600\text{V}$ , $V_{GS} = 0\text{V}$  | $I_{DSS}$           | --  | --  | 10        | $\mu\text{A}$ |
| Gate Body Leakage                | $V_{GS} = \pm 20\text{V}$ , $V_{DS} = 0\text{V}$   | $I_{GSS}$           | --  | --  | $\pm 100$ | nA            |
| Forward Transconductance         | $V_{DS} = 40\text{V}$ , $I_D = 1\text{A}$  | $g_{fs}$            | --  | 5   | --        | S             |
| Diode Forward Voltage            | $I_S = 2\text{A}$ , $V_{GS} = 0\text{V}$   | $V_{SD}$            | --  | --  | 1.6       | V             |
| <b>Dynamic<sup>b</sup></b>       |  |                     |     |     |           |               |
| Total Gate Charge                | $V_{DS} = 400\text{V}$ , $I_D = 2\text{A}$ ,<br>$V_{GS} = 10\text{V}$                    | $Q_g$               | --  | 13  | 22        | nC            |
| Gate-Source Charge               |  | $Q_{gs}$            | --  | 2   | --        |               |
| Gate-Drain Charge                |  | $Q_{gd}$            | --  | 6   | --        |               |
| Input Capacitance                | $V_{DS} = 25\text{V}$ , $V_{GS} = 0\text{V}$ ,<br>$f = 1.0\text{MHz}$                    | $C_{iss}$           | --  | 435 | --        | pF            |
| Output Capacitance               |  | $C_{oss}$           | --  | 56  | --        |               |
| Reverse Transfer Capacitance     |  | $C_{rss}$           | --  | 9.2 | --        |               |
| <b>Switching<sup>c</sup></b>     |  |                     |     |     |           |               |
| Turn-On Delay Time               | $V_{GS} = 10\text{V}$ , $I_D = 2\text{A}$ ,<br>$V_{DD} = 300\text{V}$ , $R_G = 18\Omega$ | $t_{d(on)}$         | --  | 12  | --        | nS            |
| Turn-On Rise Time                |  | $t_r$               | --  | 21  | --        |               |
| Turn-Off Delay Time              |  | $t_{d(off)}$        | --  | 30  | --        |               |
| Turn-Off Fall Time               |  | $t_f$               | --  | 24  | --        |               |

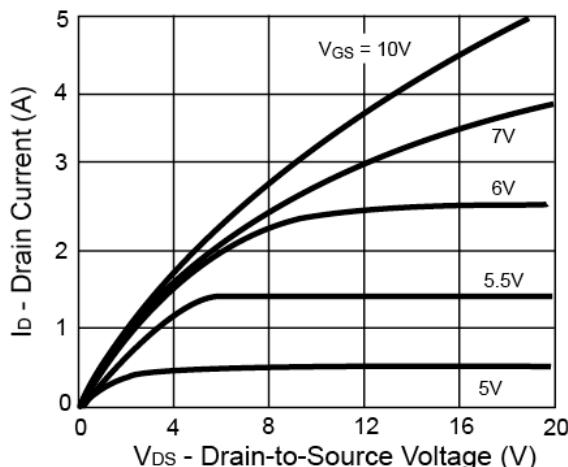
**Notes:**

- Pulse test: pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$
- For design reference only, not subject to production testing.
- Switching time is essentially independent of operating temperature.

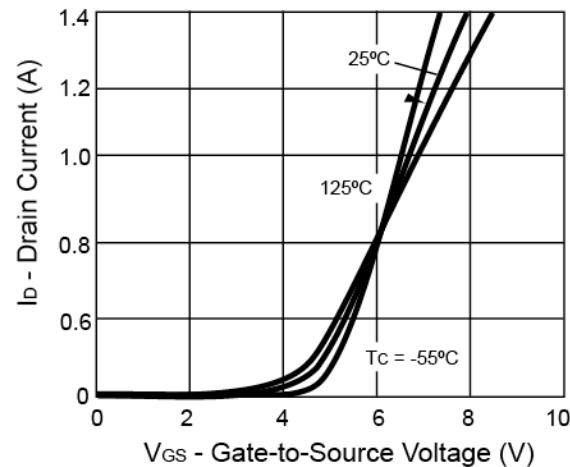

**Switching Test Circuit**

**Switching Waveforms**

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

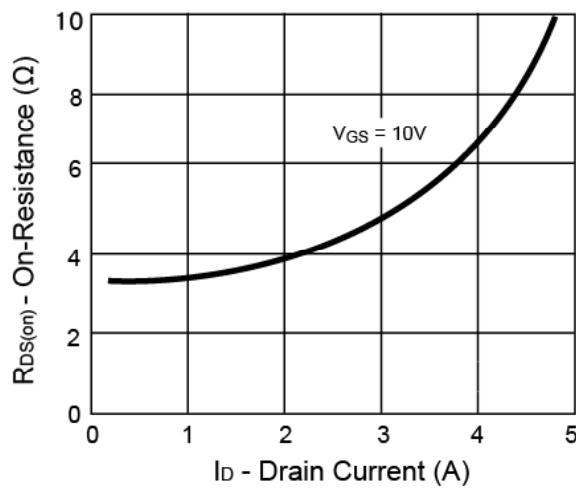
**Output Characteristics**



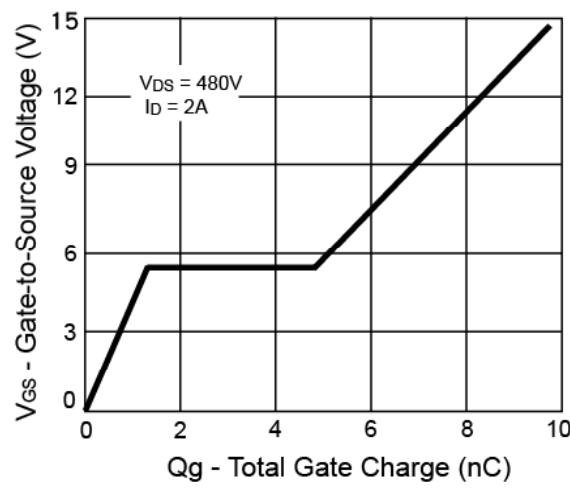
**Transfer Characteristics**



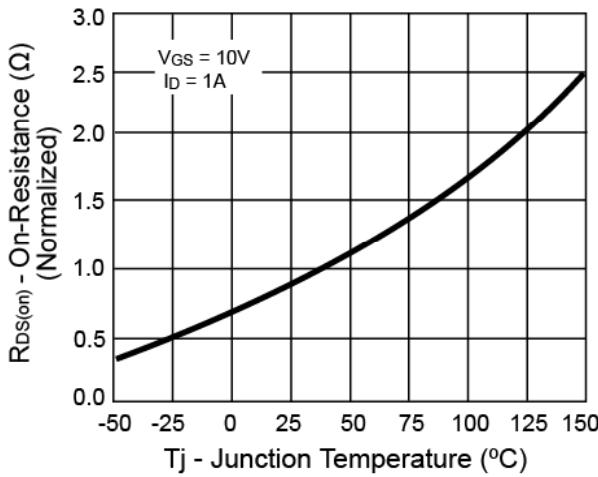
**On-Resistance vs. Drain Current**



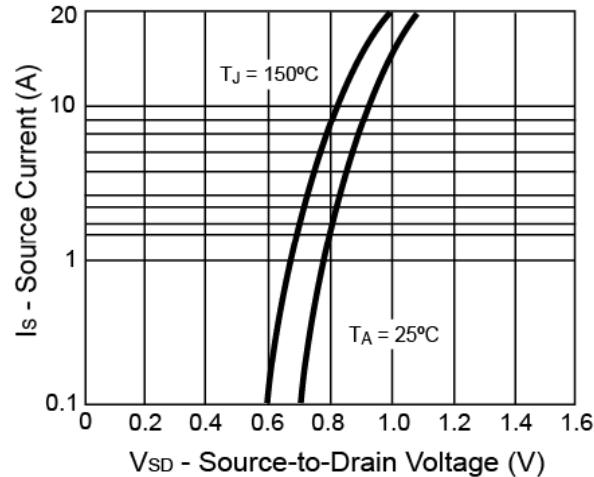
**Gate Charge**



**On-Resistance vs. Junction Temperature**

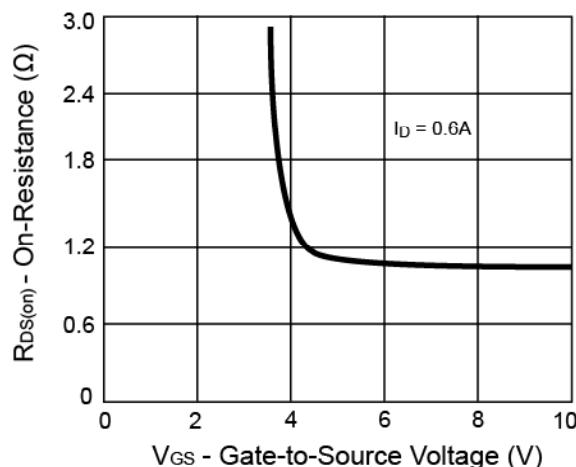


**Source-Drain Diode Forward Voltage**

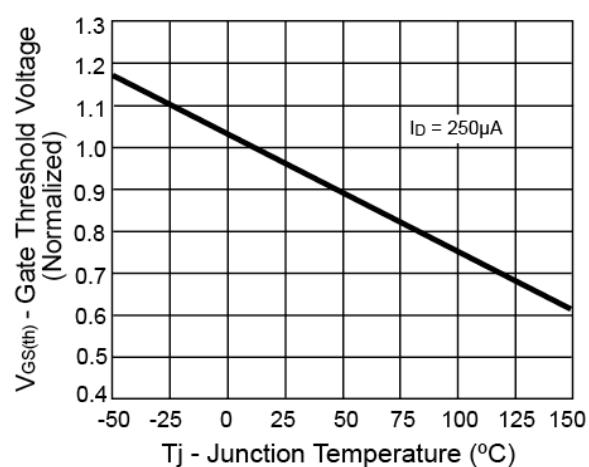


**Electrical Characteristics Curve** ( $T_a = 25^\circ\text{C}$ , unless otherwise noted)

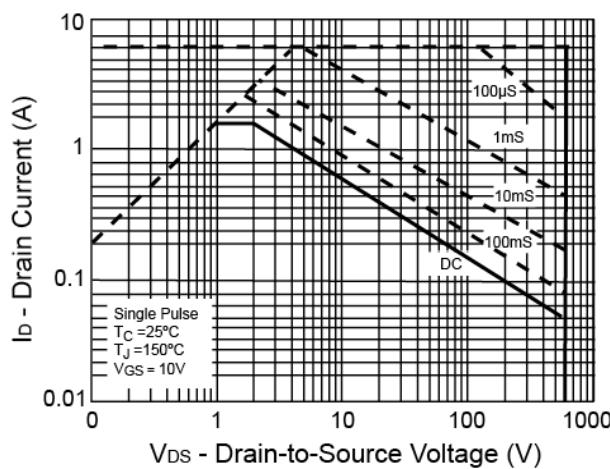
**On-Resistance vs. Gate-Source Voltage**



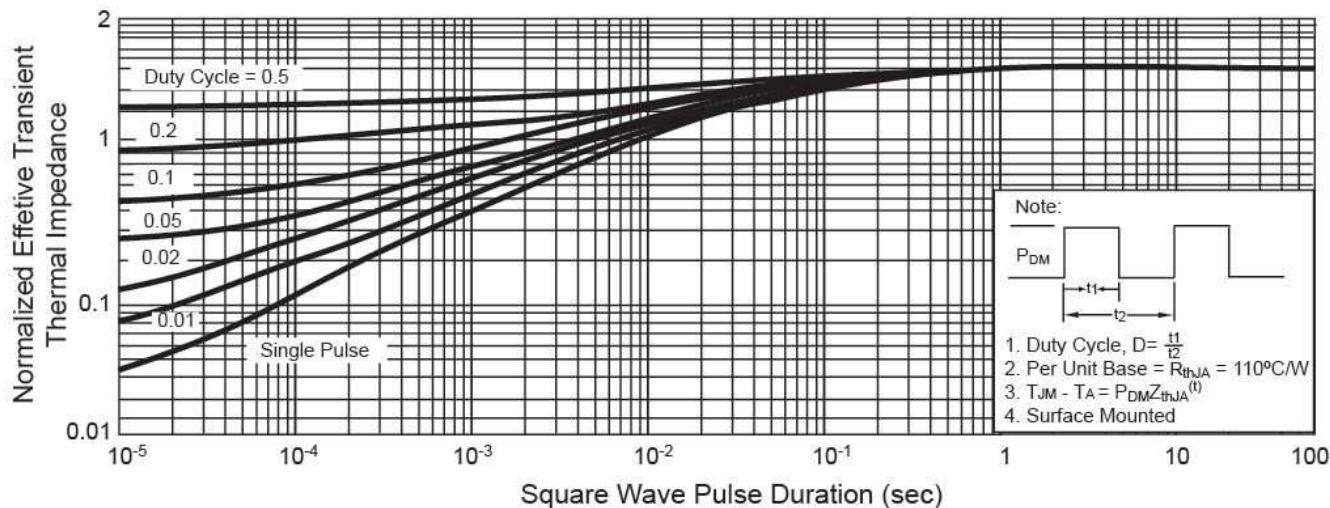
**Threshold Voltage**



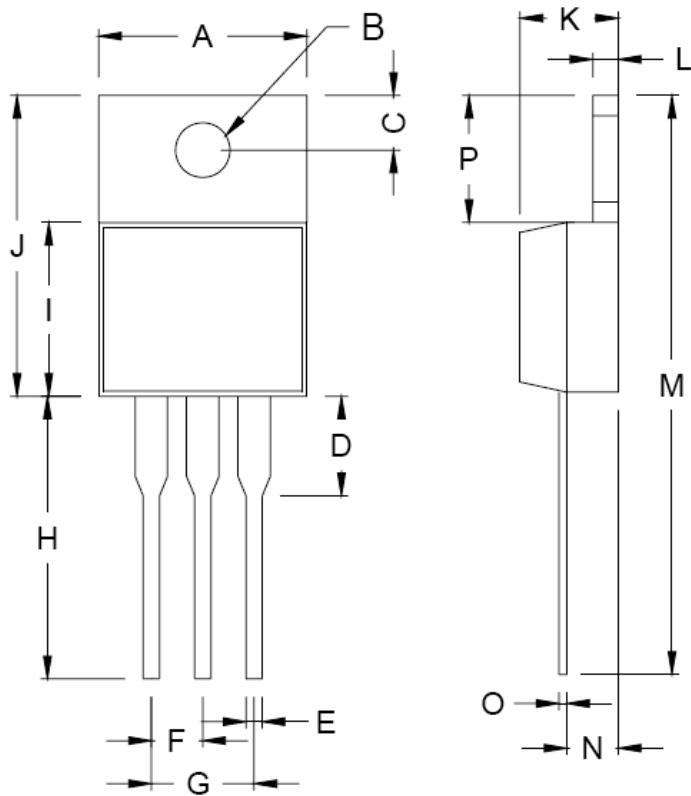
**Maximum Safe Operating Area**



**Normalized Thermal Transient Impedance, Junction-to-Ambient**

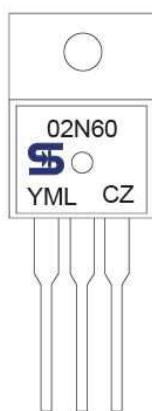


## TO-220 Mechanical Drawing



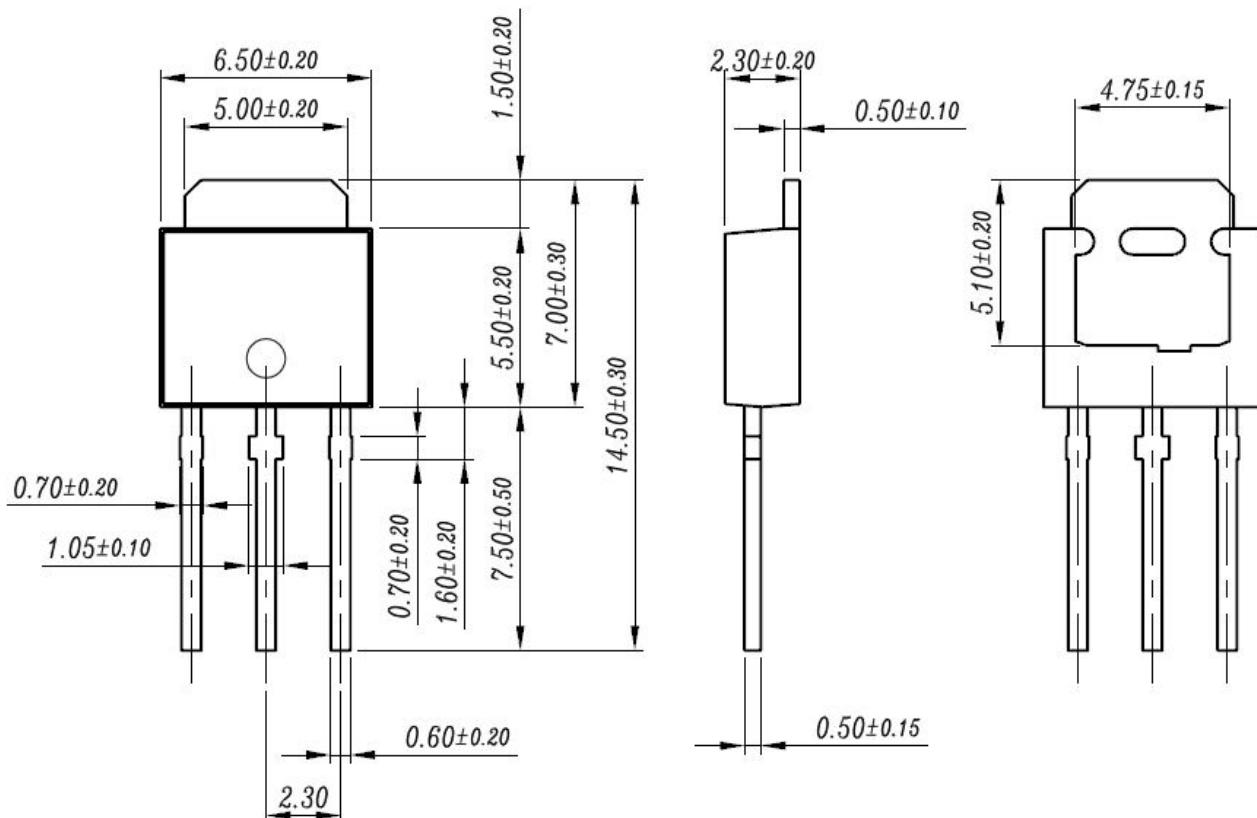
| TO-220 DIMENSION |             |        |        |       |
|------------------|-------------|--------|--------|-------|
| DIM              | MILLIMETERS |        | INCHES |       |
|                  | MIN         | MAX    | MIN    | MAX   |
| A                | 10.000      | 10.500 | 0.394  | 0.413 |
| B                | 3.740       | 3.910  | 0.147  | 0.154 |
| C                | 2.440       | 2.940  | 0.096  | 0.116 |
| D                | -           | 6.350  | -      | 0.250 |
| E                | 0.381       | 1.106  | 0.015  | 0.040 |
| F                | 2.345       | 2.715  | 0.092  | 0.058 |
| G                | 4.690       | 5.430  | 0.092  | 0.107 |
| H                | 12.700      | 14.732 | 0.500  | 0.581 |
| J                | 14.224      | 16.510 | 0.560  | 0.650 |
| K                | 3.556       | 4.826  | 0.140  | 0.190 |
| L                | 0.508       | 1.397  | 0.020  | 0.055 |
| M                | 27.700      | 29.620 | 1.060  | 1.230 |
| N                | 2.032       | 2.921  | 0.080  | 0.115 |
| O                | 0.255       | 0.610  | 0.010  | 0.024 |
| P                | 5.842       | 6.858  | 0.230  | 0.270 |

## Marking Diagram



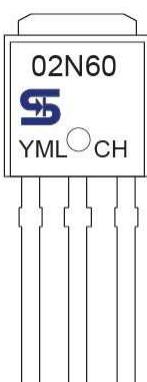
**Y** = Year Code  
**M** = Month Code  
 (A=Jan, B=Feb, C=Mar, D=Apl, E=May, F=Jun, G=Jul, H=Aug,  
 I=Sep, J=Oct, K=Nov, L=Dec)  
**L** = Lot Code

## TO-251 Mechanical Drawing



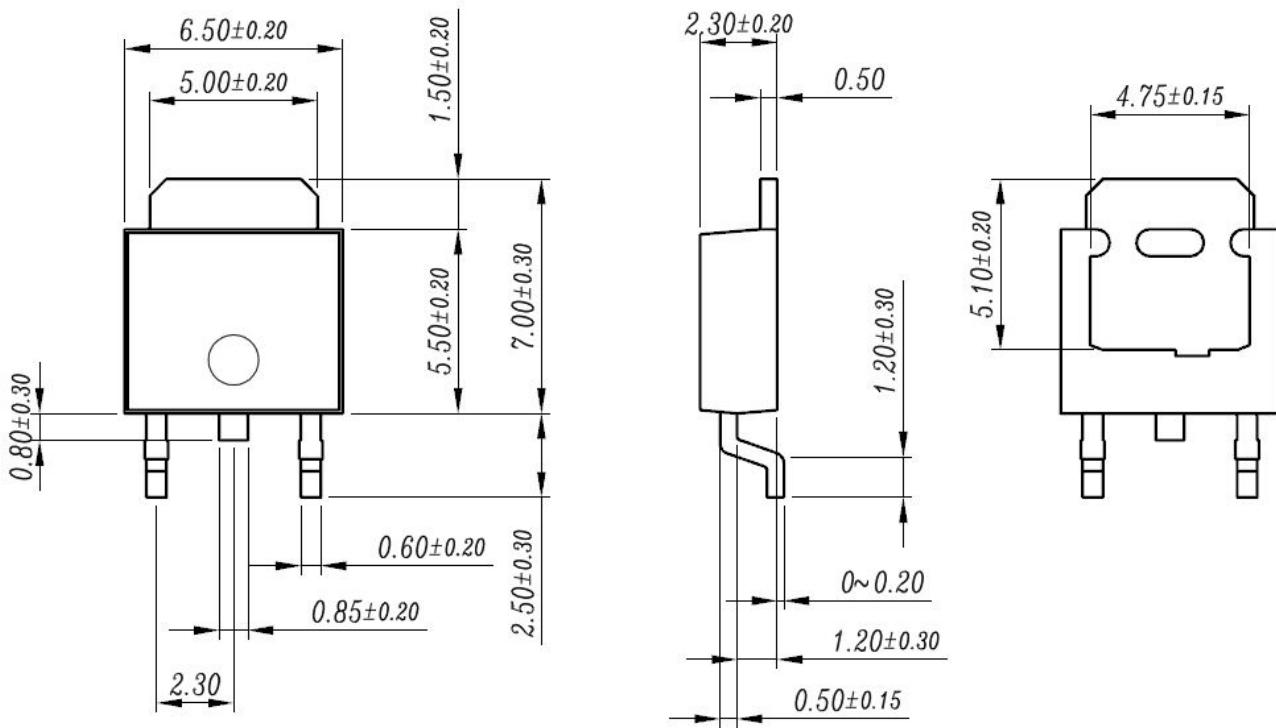
Unit: Millimeters

## Marking Diagram



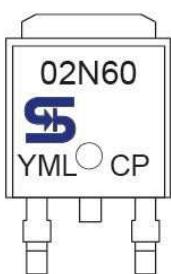
- Y** = Year Code
- M** = Month Code
  - (**A**=Jan, **B**=Feb, **C**=Mar, **D**=Apr, **E**=May, **F**=Jun, **G**=Jul, **H**=Aug, **I**=Sep, **J**=Oct, **K**=Nov, **L**=Dec)
- = Month Code for Halogen Free Product
  - (**O**=Jan, **P**=Feb, **Q**=Mar, **R**=Apr, **S**=May, **T**=Jun, **U**=Jul, **V**=Aug, **W**=Sep, **X**=Oct, **Y**=Nov, **Z**=Dec)
- L** = Lot Code

### TO-252 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)
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- L** = Lot Code

Pb

RoHS  
COMPLIANCE

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