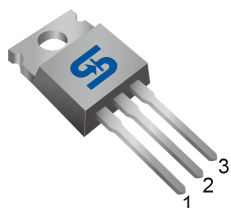
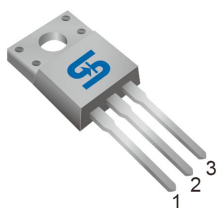




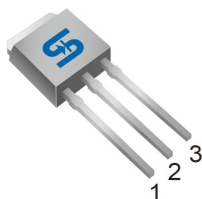
TO-220



ITO-220



TO-251 (IPAK)



TO-252 (DPAK)



**Pin Definition:**

1. Gate
2. Drain
3. Source

**PRODUCT SUMMARY**

V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A)
600	2.5 @ V <sub>GS</sub> =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**

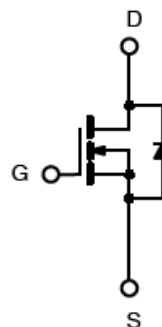
- Low R<sub>DS(ON)</sub> 2.2Ω (Typ.)
- Low gate charge typical @ 14.5nC (Typ.)
- Low Crss typical @ 7pF (Typ.)
- 100% Avalanche Tested

**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 Ratings** (T<sub>A</sub>=25°C unless otherwise noted)

Parameter	Symbol	Limit			Unit
		IPAK/DPAK	ITO-220	TO-220	
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>	4			A
		2.4			A
Pulsed Drain Current *	I <sub>DM</sub>	16			A
Single Pulse Avalanche Energy (Note 2)	E <sub>AS</sub>	70			mJ
Avalanche Current (Repetitive) (Note 1)	I <sub>AR</sub>	4			A
Repetitive Avalanche Energy (Note 1)	E <sub>AR</sub>	5			mJ
Peak Diode Recovery dv/dt (Note 3)	dv/dt	4.5			V/ns
Total Power Dissipation @ T <sub>C</sub> =25°C	P <sub>TOT</sub>	50	25	70	W
Operating Junction Temperature	T <sub>J</sub>	150			°C
Storage Temperature Range	T <sub>STG</sub>	-55 to +150			°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
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A$	$BV_{DSS}$	600	--	--	V
Drain-Source On-State Resistance	$V_{GS} = 10V, I_D = 2A$	$R_{DS(ON)}$	--	2.2	2.5	$\Omega$
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	$V_{GS(TH)}$	2.5	3.5	4.5	V
Zero Gate Voltage Drain Current	$V_{DS} = 600V, V_{GS} = 0V$	$I_{DSS}$	--	--	1	$\mu A$
Gate Body Leakage	$V_{GS} = \pm 30V, V_{DS} = 0V$	$I_{GSS}$	--	--	$\pm 100$	nA
Forward Transfer Conductance	$V_{DS} = 40V, I_D = 2A$	$g_{fs}$	--	2.6	--	S
<b>Dynamic</b>						
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	--	
<b>Switching</b>						
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	--	
<b>Source-Drain Diode Ratings and Characteristic</b>						
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	$V_{GS} = 0V, I_S = 4A,$ $di/dt = 100A/\mu s$	$t_{rr}$	--	522	--	ns
Reverse Recovery Charge		$Q_{rr}$	--	1.6	--	$\mu C$

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

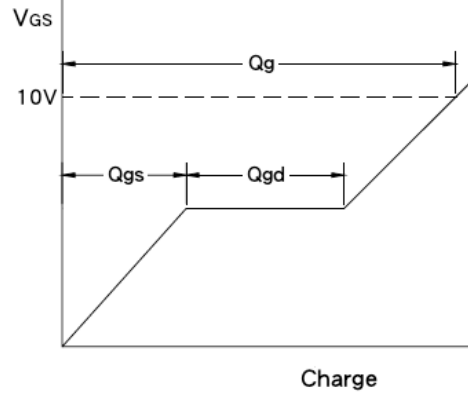
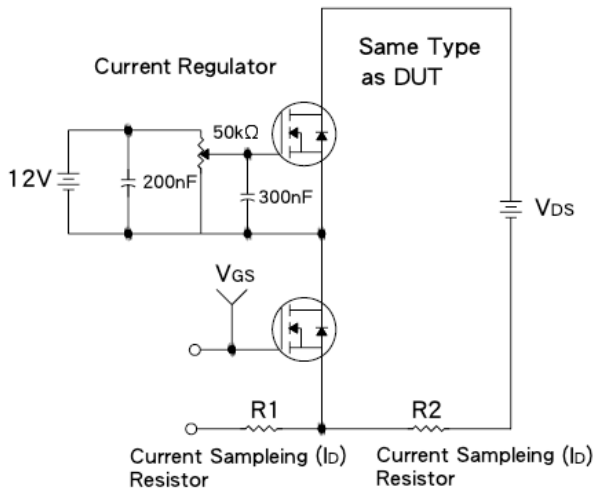
**Note 2:**  $V_{DD} = 50V, I_{AS} = 4A, L = 8\text{mH}, R_G = 25\Omega$ , Starting  $T_J = 25^{\circ}\text{C}$

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

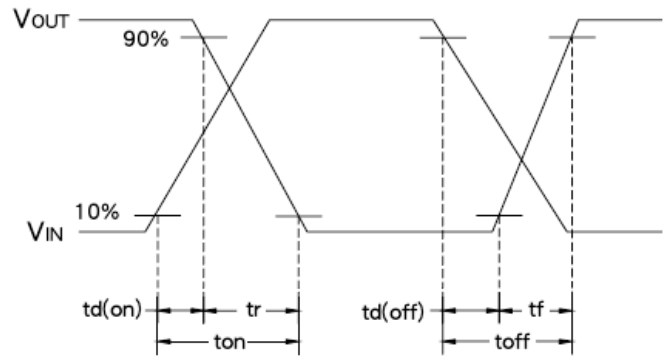
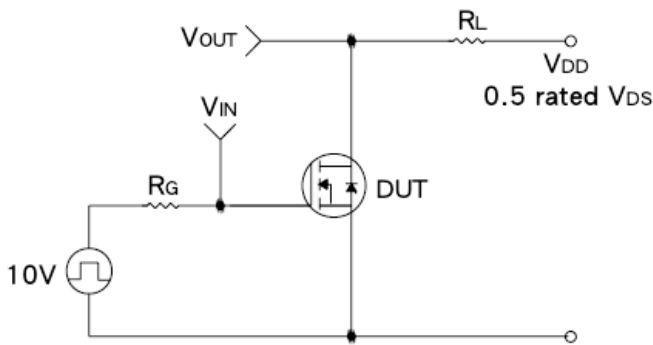
**Note 4:** Pulse test: pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$

**Note 5:** Essentially Independent of Operating Temperature

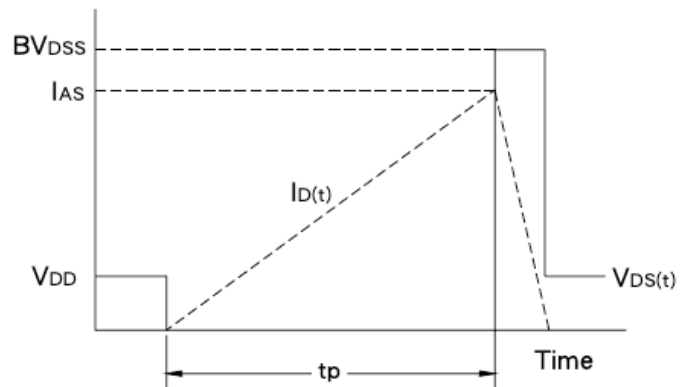
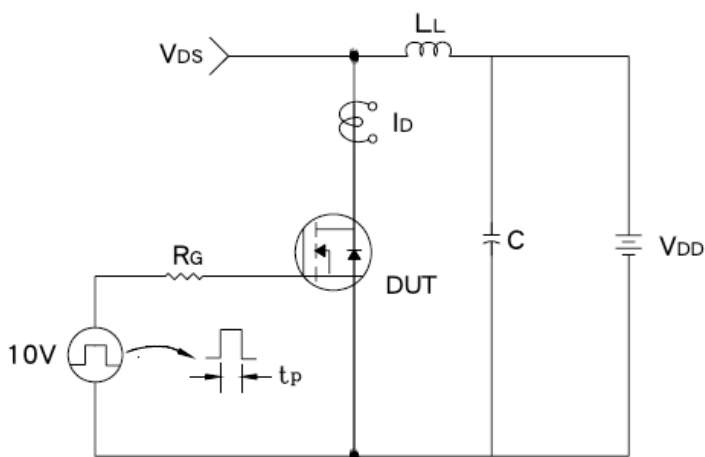
### Gate Charge Test Circuit & Waveform



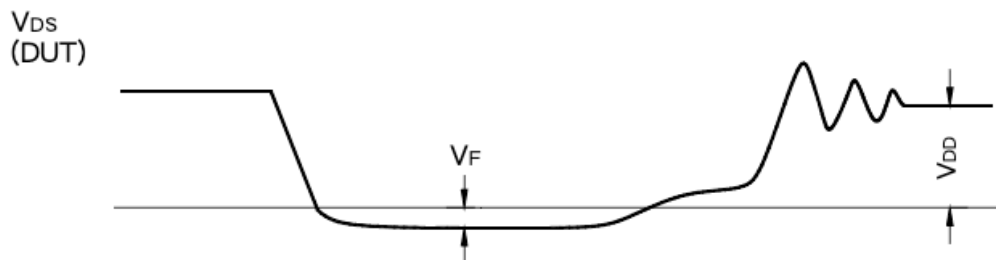
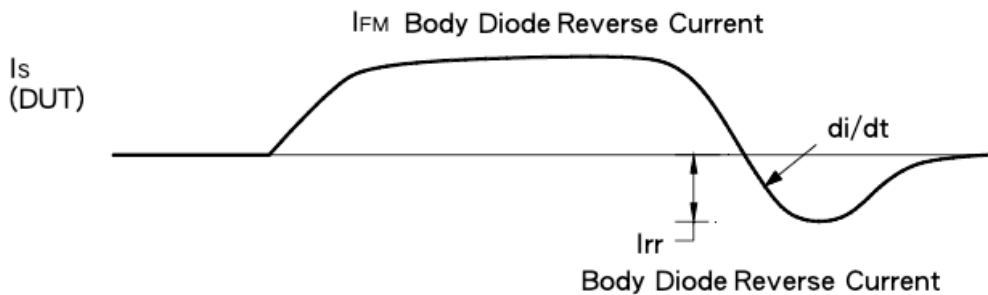
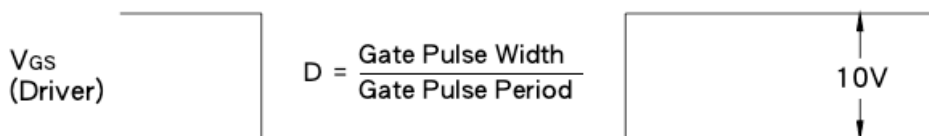
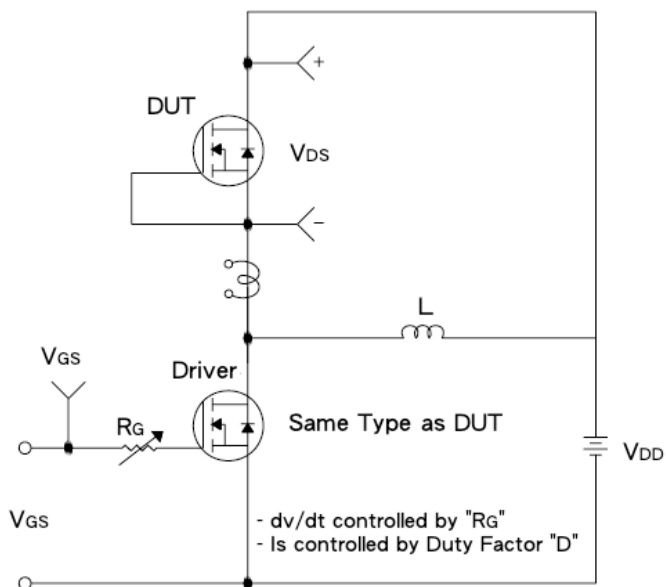
### Resistive Switching Test Circuit & Waveform



### E<sub>AS</sub> Test Circuit & Waveform

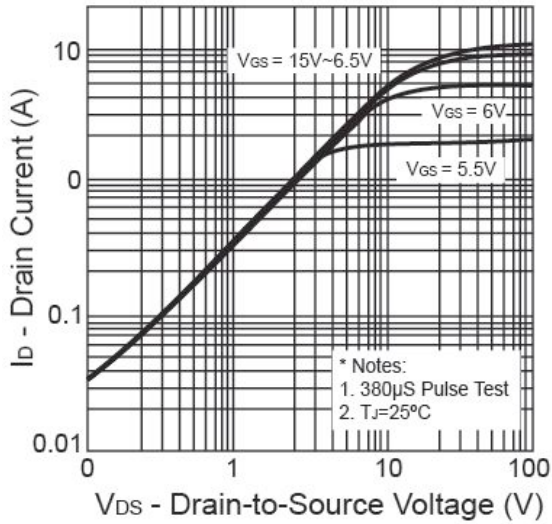


**Diode Reverse Recovery Time Test Circuit & Waveform**

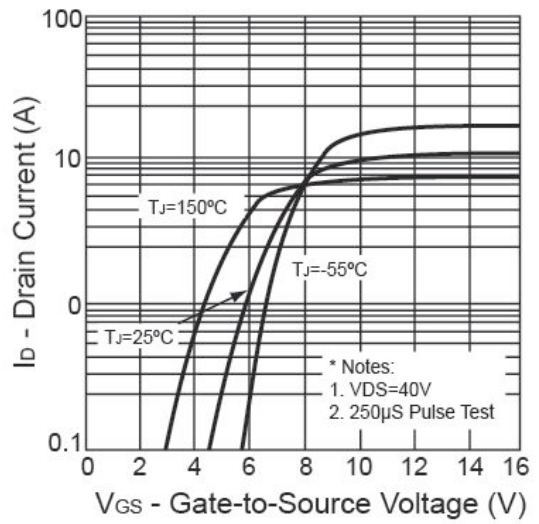


**Electrical Characteristics Curve** (Ta = 25°C, unless otherwise noted)

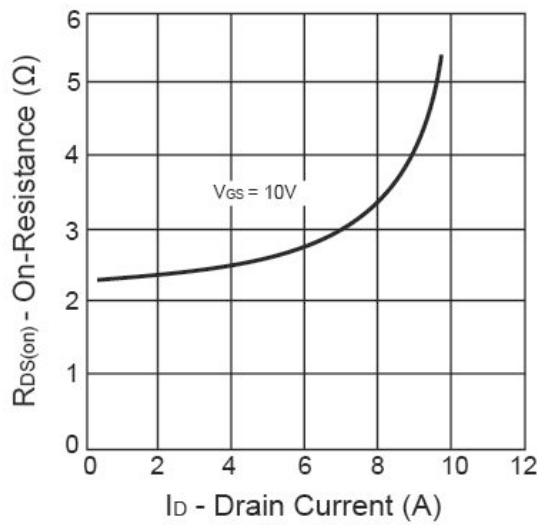
**Output Characteristics**



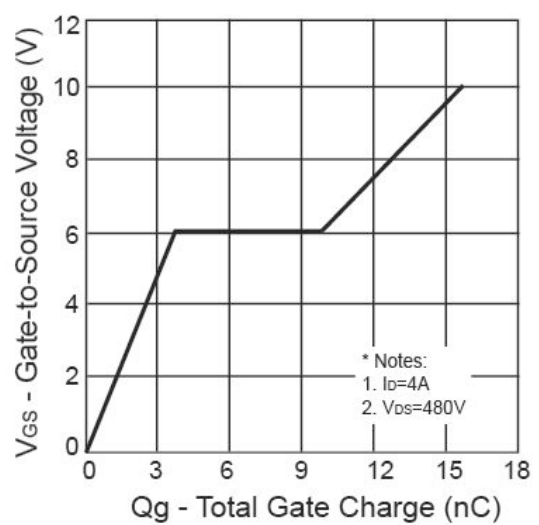
**Transfer Characteristics**



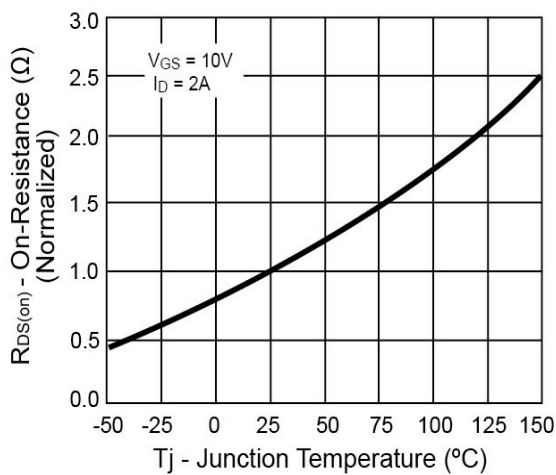
**On-Resistance vs. Drain Current**



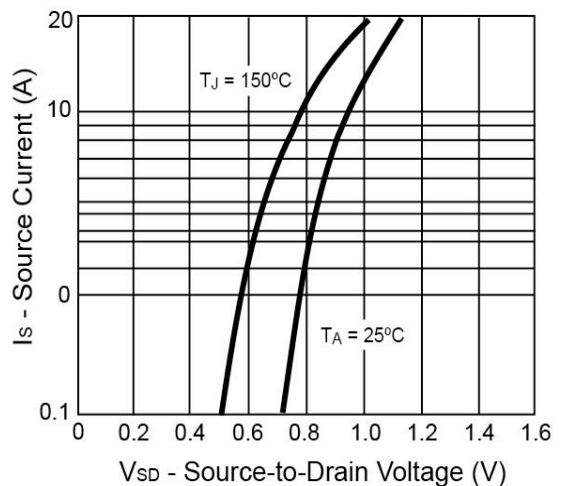
**Gate Charge**



**On-Resistance vs. Junction Temperature**

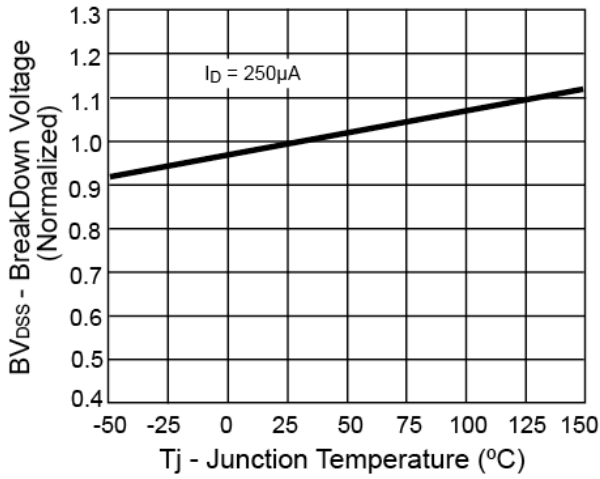


**Source-Drain Diode Forward Voltage**

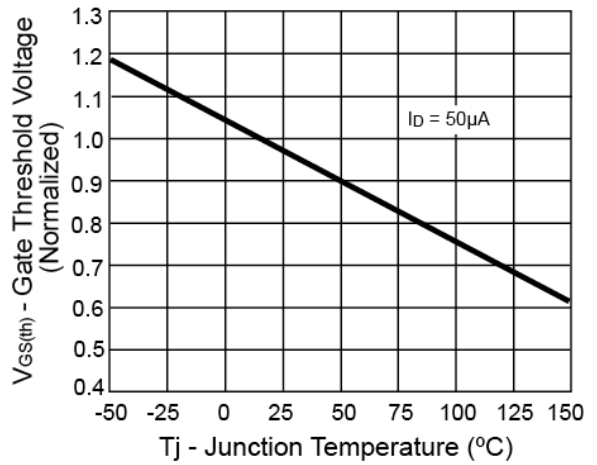


**Electrical Characteristics Curve** (Ta = 25°C, unless otherwise noted)

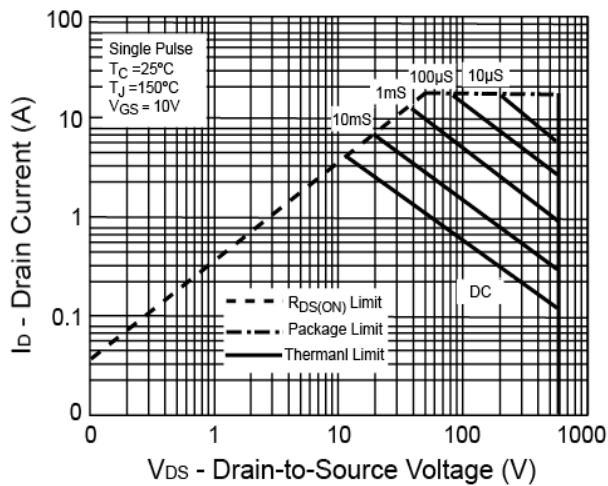
**Breakdown Voltage vs. Temperature**



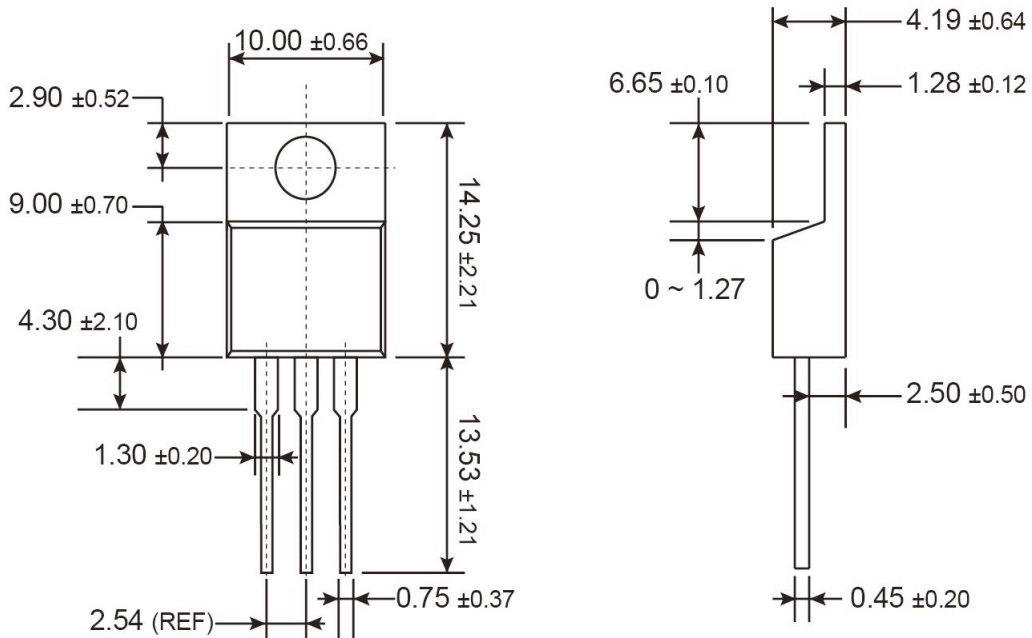
**Threshold Voltage vs. Temperature**



**Maximum Safe Operating Area**

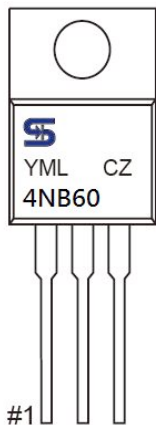


**TO-220 Mechanical Drawing**



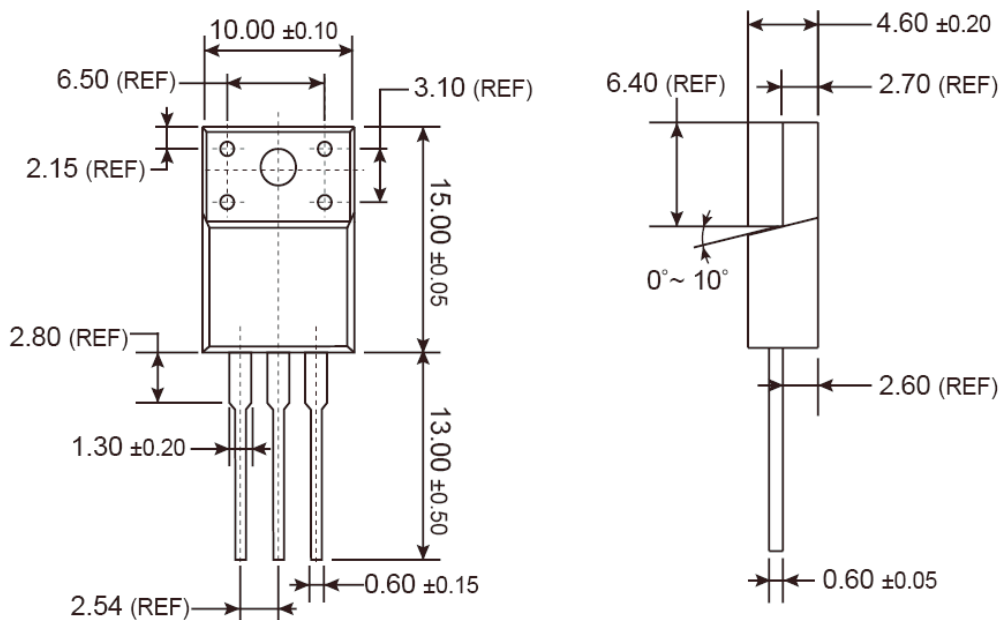
Unit: Millimeters

**Marking Diagram**



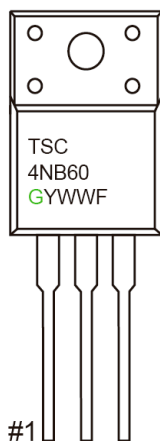
- Y** = Year Code
- M** = Month Code  
(**A**=Jan, **B**=Feb, **C**=Mar, **D**=Apr, **E**=May, **F**=Jun, **G**=Jul, **H**=Aug, **I**=Sep, **J**=Oct, **K**=Nov, **L**=Dec)
- L** = Lot Code

**ITO-220 Mechanical Drawing**



Unit: Millimeters

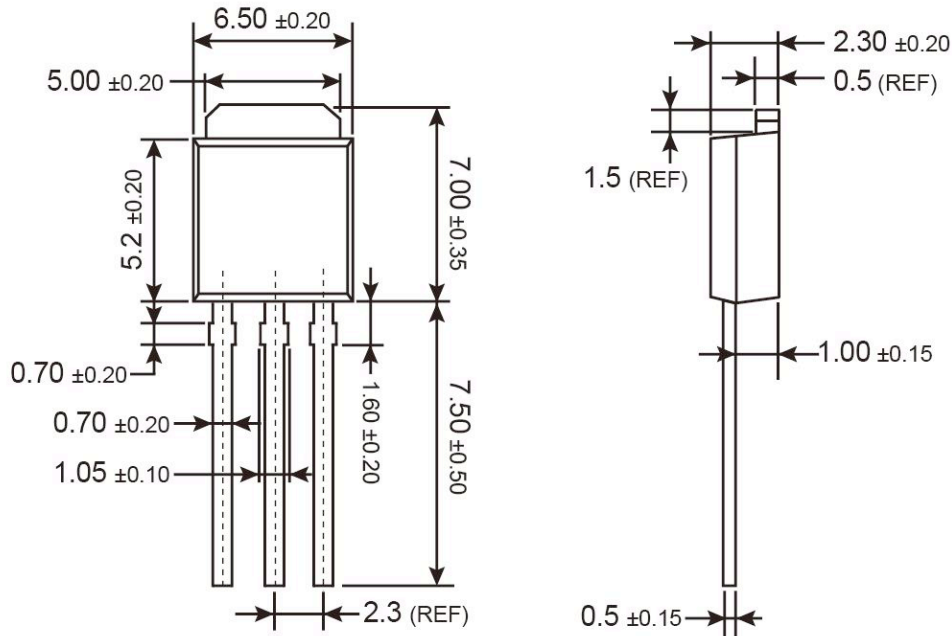
**Marking Diagram**



- G** = Halogen Free Product
- Y** = Year Code
- WW** = Week Code (01~52)
- F** = Factory Code

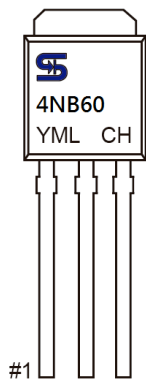


**TO-251 Mechanical Drawing**



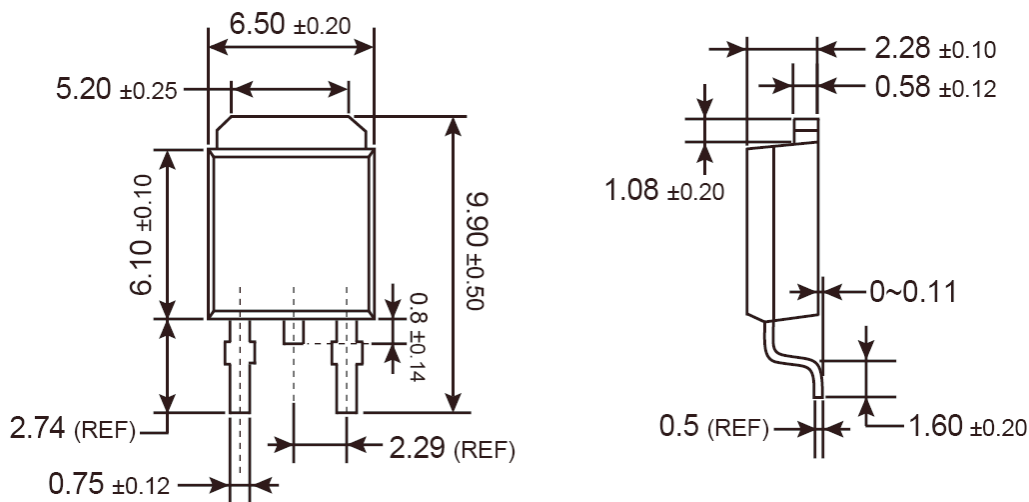
Unit: Millimeters

**Marking Diagram**



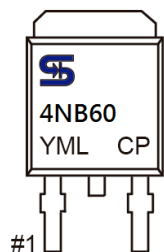
- Y** = Year Code
- M** = Month Code for Halogen Free Product  
(**O**=Jan, **P**=Feb, **Q**=Mar, **R**=Apr, **S**=May, **T**=Jun, **U**=Jul, **V**=Aug, **W**=Sep, **X**=Oct, **Y**=Nov, **Z**=Dec)
- L** = Lot Code

**TO-252 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

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