

## N-Channel Power MOSFET

600V, 4.0A, 2.5Ω

### FEATURES

- 100% Avalanche Tested
- Pb-free plating
- Compliant to RoHS Directive 2011/65/EU and in accordance to WEE 2002/96/EC
- Halogen-free according to IEC 61249-2-21 definition

### KEY PERFORMANCE PARAMETERS

PARAMETER	VALUE	UNIT
$V_{DS}$	600	V
$R_{DS(on)}$ (max)	2.5	Ω
$Q_g$	14.5	nC

### APPLICATION

- Power Supply
- Lighting



**Notes:** MSL 3 (Moisture Sensitivity Level) for TO-252 (DPAK) per J-STD-020

### ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C unless otherwise noted)

PARAMETER	SYMBOL	IPAK/DPAK	ITO-220	TO-220	UNIT
Drain-Source Voltage	$V_{DS}$		600		V
Gate-Source Voltage	$V_{GS}$		±30		V
Continuous Drain Current (Note 1)	$I_D$		$T_C = 25^\circ\text{C}$	4.0	A
			$T_C = 100^\circ\text{C}$	2.4	
Pulsed Drain Current (Note 2)	$I_{DM}$		16		A
Total Power Dissipation @ T <sub>C</sub> = 25°C	$P_{TOT}$	50	25	70	W
Single Pulsed Avalanche Energy (Note 3)	$E_{AS}$		70		mJ
Single Pulsed Avalanche Current (Note 3)	$I_{AS}$		4		A
Repetitive Avalanche Energy (Note 2)	$E_{AR}$		5		mJ
Peak Diode Recovery (Note 4)	dV/dt		4.5		V/ns
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>		- 55 to +150		°C

### THERMAL PERFORMANCE

PARAMETER	SYMBOL	IPAK/DPAK	ITO-220	TO-220	UNIT
Junction to Case Thermal Resistance	$R_{\theta JC}$	2.5	5	1.78	°C/W
Junction to Ambient Thermal Resistance	$R_{\theta JA}$	83	62.5	62.5	°C/W

**Notes:**  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistances. The case thermal reference is defined at the solder mounting surface of the drain pins.  $R_{\theta JA}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.  $R_{\theta JA}$  shown below for single device operation on FR-4 PCB in still air.

<b>ELECTRICAL SPECIFICATIONS</b> ( $T_A = 25^\circ\text{C}$ unless otherwise noted)						
PARAMETER	CONDITIONS	SYMBOL	MIN	TYP	MAX	UNIT
<b>Static</b> (Note 5)						
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A$	$BV_{DSS}$	600	--	--	V
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	$V_{GS(TH)}$	2.5	3.5	4.5	V
Gate Body Leakage	$V_{GS} = \pm 30V, V_{DS} = 0V$	$I_{GSS}$	--	--	$\pm 100$	nA
Zero Gate Voltage Drain Current	$V_{DS} = 600V, V_{GS} = 0V$	$I_{DSS}$	--	--	1	$\mu A$
Drain-Source On-State Resistance	$V_{GS} = 10V, I_D = 2.0A$	$R_{DS(on)}$	--	2.2	2.5	$\Omega$
Forward Transfer Conductance	$V_{DS} = 40V, I_D = 2A$	$g_{fs}$	--	2.6	--	S
<b>Dynamic</b> (Note 6)						
Total Gate Charge	$V_{DS} = 480V, I_D = 4.0A,$ $V_{GS} = 10V$	$Q_g$	--	14.5	--	nC
Gate-Source Charge		$Q_{gs}$	--	3.4	--	
Gate-Drain Charge		$Q_{gd}$	--	7	--	
Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V,$ $f = 1.0MHz$	$C_{iss}$	--	500	--	pF
Output Capacitance		$C_{oss}$	--	53.2	--	
Reverse Transfer Capacitance		$C_{rss}$	--	7	--	
<b>Switching</b> (Note 7)						
Turn-On Delay Time	$V_{DD} = 500V,$ $R_{G(on)} = 25\Omega,$ $I_D = 4.0A, V_{GS} = 10V,$	$t_{d(on)}$	--	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</b> (Note 5)						
Forward On Voltage	$I_S = 4.0A, V_{GS} = 0V$	$V_{SD}$	--	--	1.13	V
Reverse Recovery Time	$V_{GS} = 0V, I_S = 2A$	$t_{rr}$	--	522	--	ns
Reverse Recovery Charge	$di_F/dt = 100A/\mu s$	$Q_{rr}$	--	1.6	--	$\mu C$
Source Current	Integral reverse diode	$I_S$	--	--	4	A
Source Current (Pulse)	in the MOSFET	$I_{SM}$	--	--	16	A

**Notes:**

1. Current limited by package.
2. Pulse width limited by the maximum junction temperature.
3.  $L = 8mH, I_{AS} = 4.0A, V_{DD} = 50V, R_G = 25\Omega,$  Starting  $T_J = 25^\circ\text{C}.$   
100% Eas Test Condition:  $L = 8mH, I_{AS} = 2A, V_{DD} = 50V, R_G = 25\Omega,$  Starting  $T_J = 25^\circ\text{C}.$
4.  $I_{SD} \leq 4A, di/dt \leq 200A/\mu s, V_{DD} \leq BV_{DSS},$  Starting  $T_J = 25^\circ\text{C}.$
5. Pulse test:  $PW \leq 300\mu s,$  duty cycle  $\leq 2\%.$
6. For DESIGN AID ONLY, not subject to production testing.
7. Switching time is essentially independent of operating temperature.

**ORDERING INFORMATION**

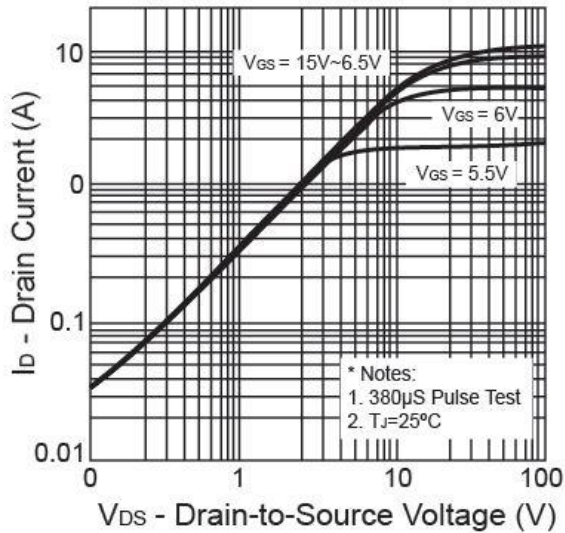
<b>PART NO.</b>	<b>PACKAGE</b>	<b>PACKING</b>
TSM4NB60CZ C0G	TO-220	50pcs / Tube
TSM4NB60CI C0G	ITO-220	50pcs / Tube
TSM4NB60CH C5G	TO-251 (IPAK)	75pcs / Tube
TSM4NB60CH X0G	TO-251S (IPAK SL)	75pcs / Tube
TSM4NB60CP ROG	TO-252 (DPAK)	2,500pcs / 13" Reel

**TSM4NB60CZ C0G**  
**Not Recommended**

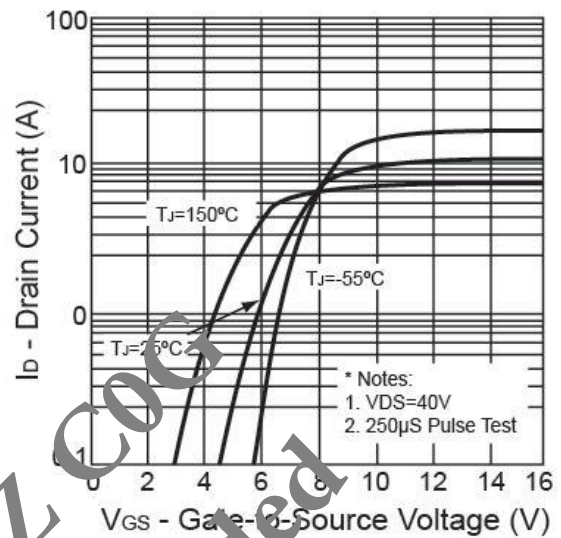
**CHARACTERISTICS CURVES**

( $T_C = 25^\circ\text{C}$  unless otherwise noted)

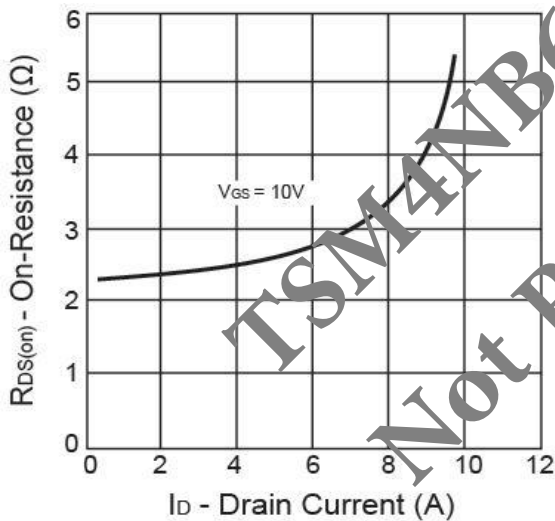
**Output Characteristics**



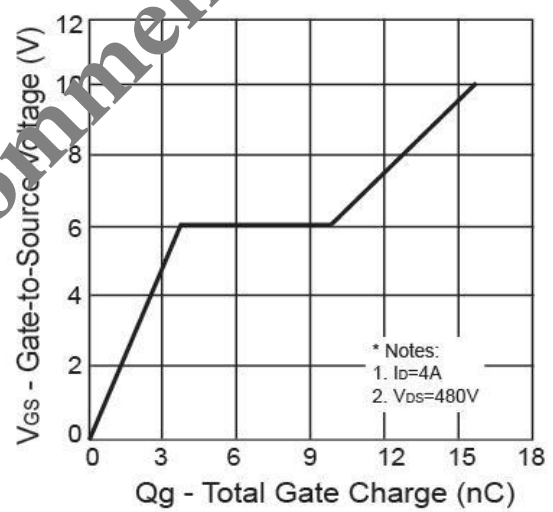
**Transfer Characteristics**



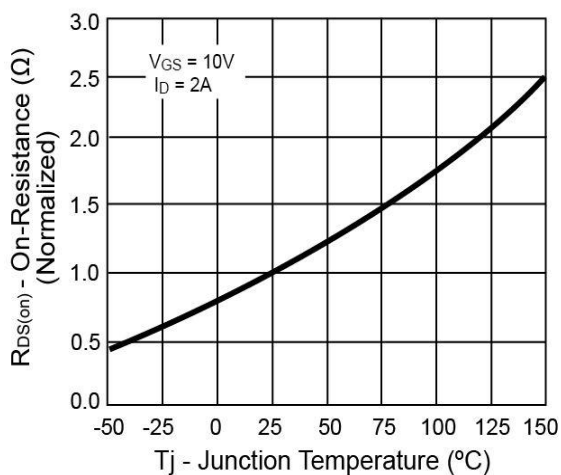
**On-Resistance vs. Drain Current**



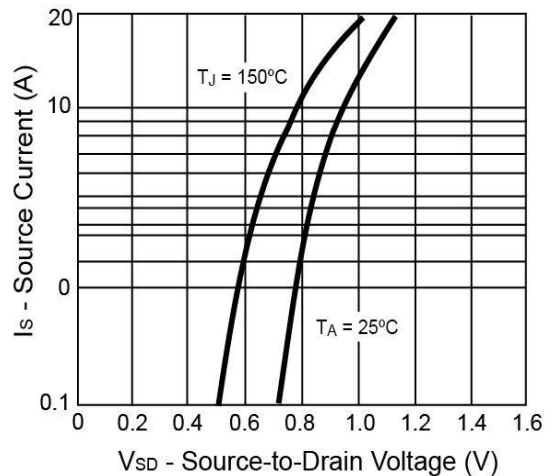
**Gate Charge**



**On-Resistance vs. Junction Temperature**



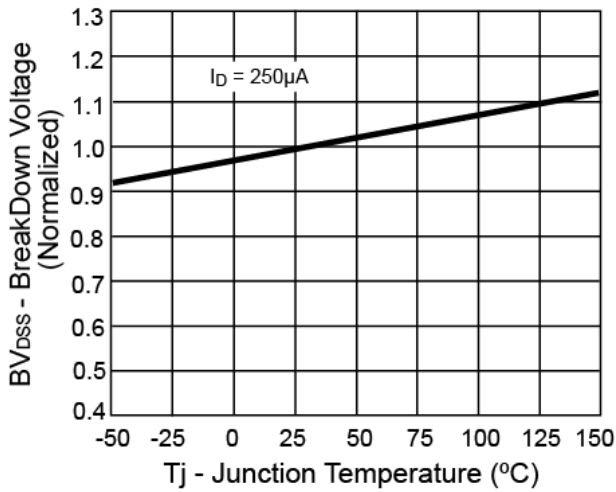
**Source-Drain Diode Forward Voltage**



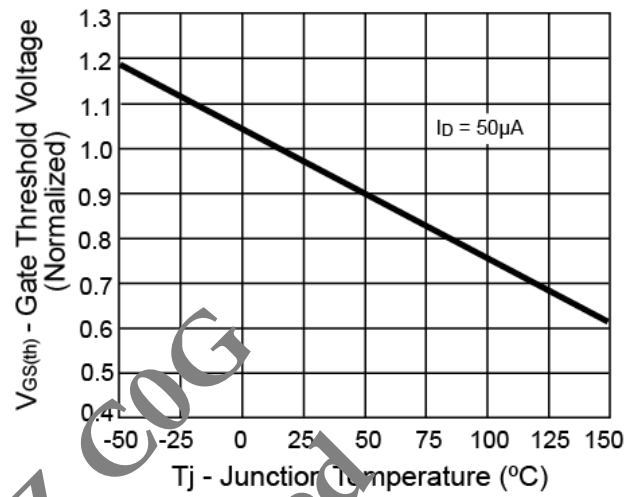
**CHARACTERISTICS CURVES**

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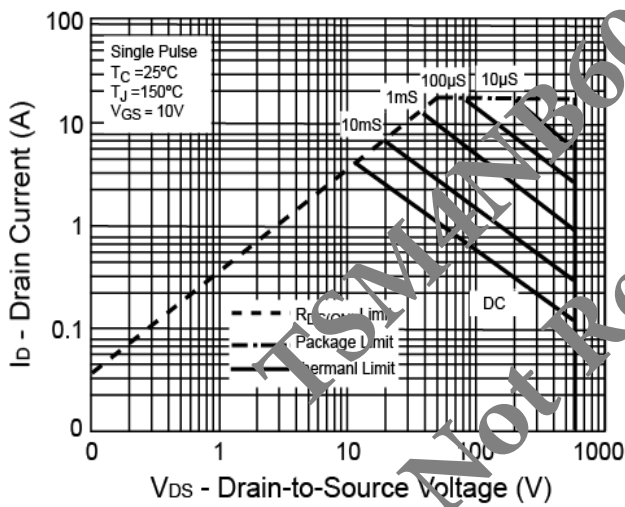
**Breakdown Voltage vs. Temperature**



**Threshold Voltage vs. Temperature**



**Maximum Safe Operating Area**

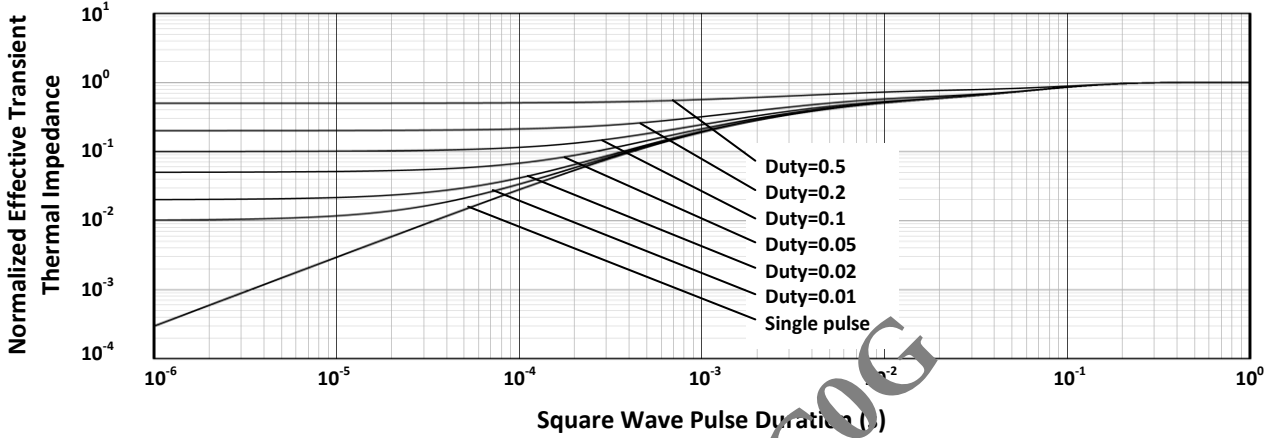


TSM4NB60CZ COG Not Recommended

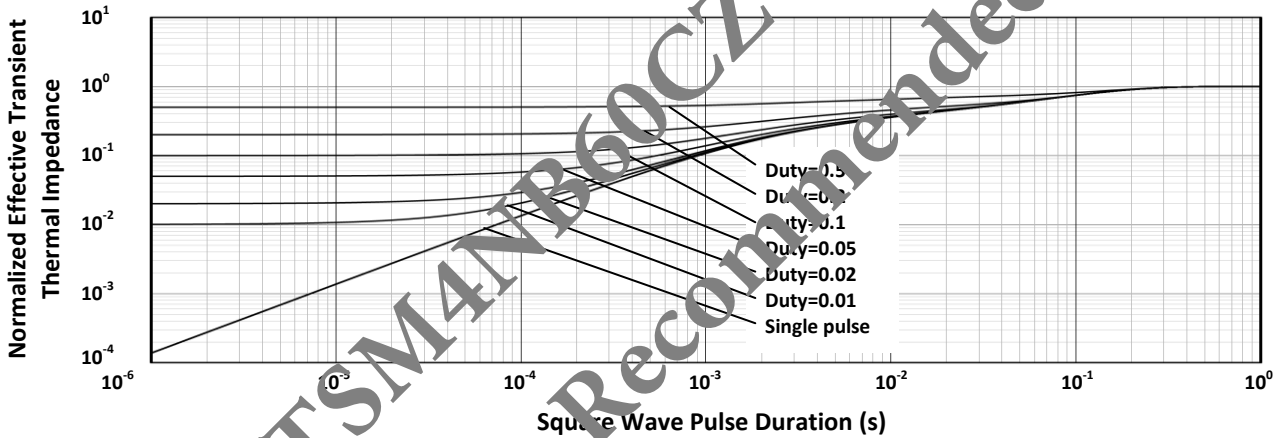
**ELECTRICAL CHARACTERISTICS CURVES**

( $T_C = 25^\circ\text{C}$  unless otherwise noted)

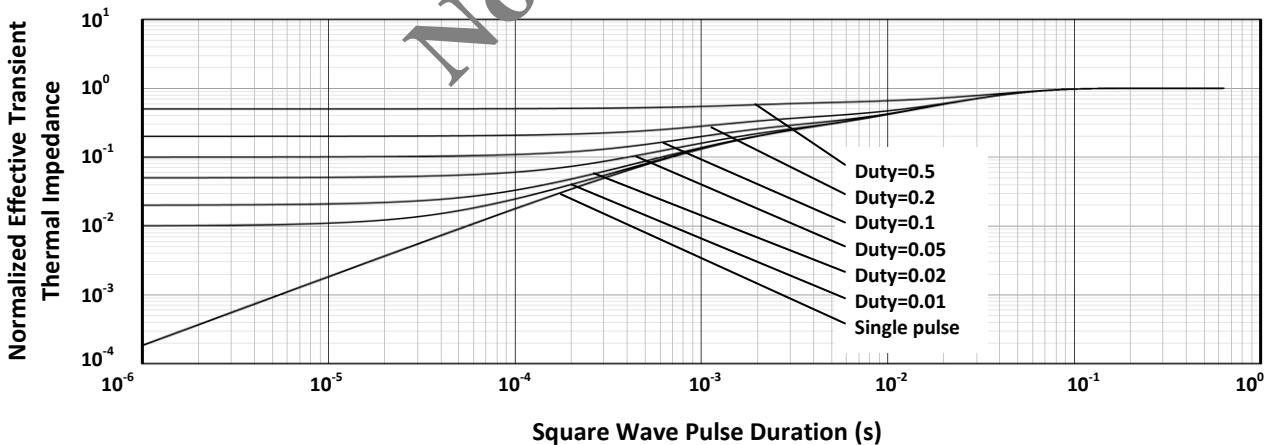
**Normalized Thermal Transient Impedance, Junction-to-Case (TO-220)**



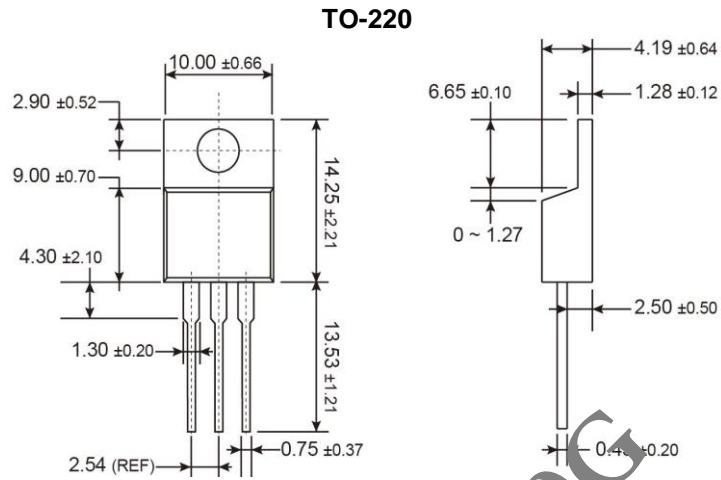
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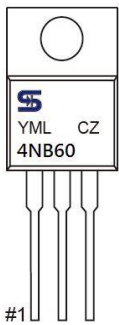
**Normalized Thermal Transient Impedance, Junction-to-Case (DPAK/IPAK)**



**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)



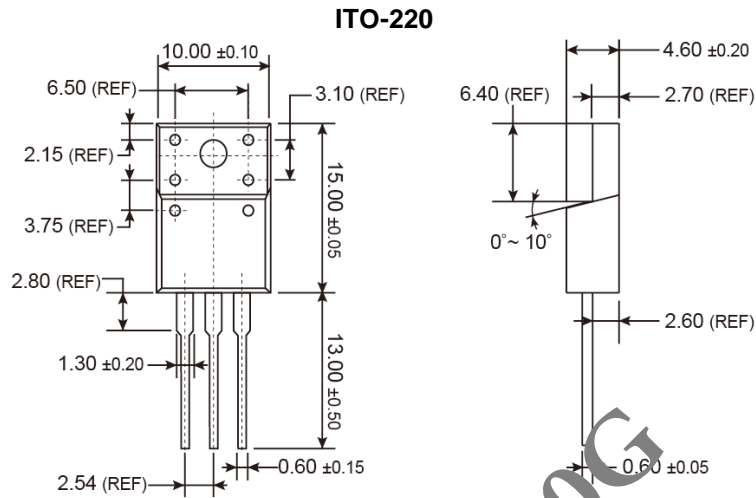
**MARKING DIAGRAM**



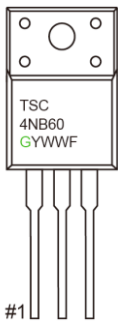
- Y** = Year Code
- M** = Month Code for Halogen Free Product
  - O** =Jan    **P** =Feb    **Q** =Mar    **R** =Apr
  - S** =May    **T** =Jun    **U** =Jul    **V** =Aug
  - W** =Sep    **X** =Oct    **Y** =Nov    **Z** =Dec
- L** = Lot Code (1~9, A~Z)

TSM4NB60CZ COG  
Not Recommended

**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)



**MARKING DIAGRAM**

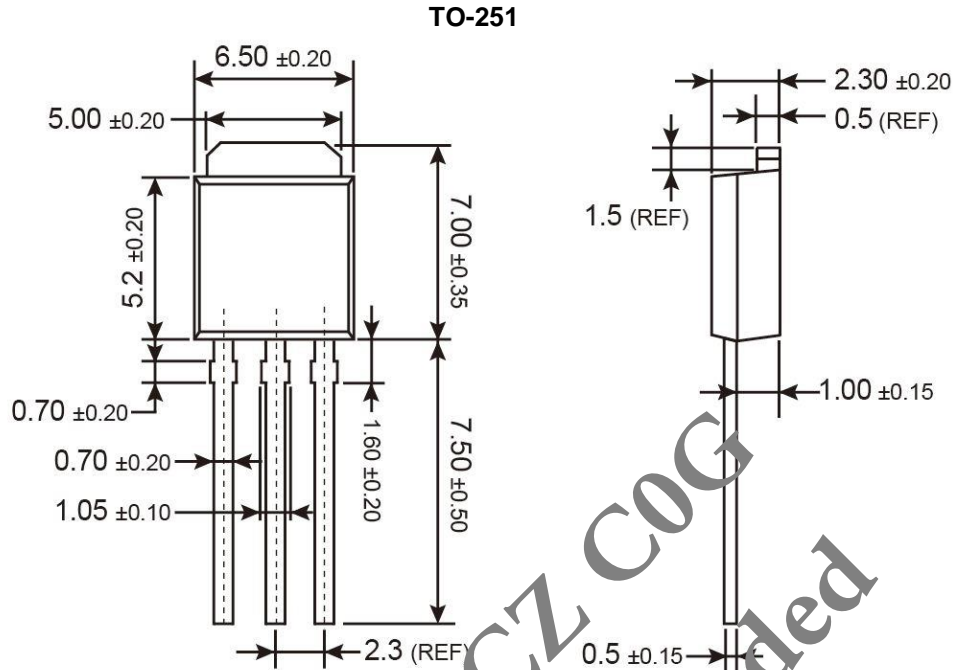


- G** = Halogen Free
- Y** = Year Code
- WW** = Week Code (01~52)
- F** = Factory Code

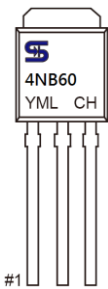
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**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)



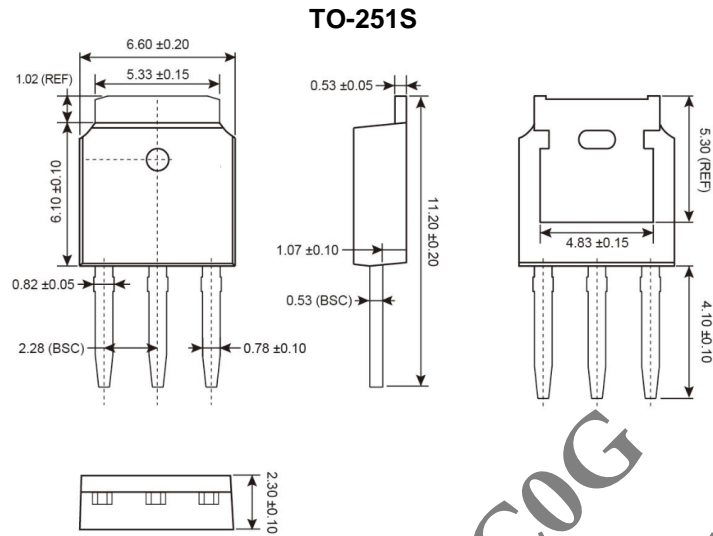
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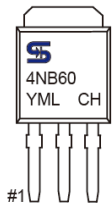
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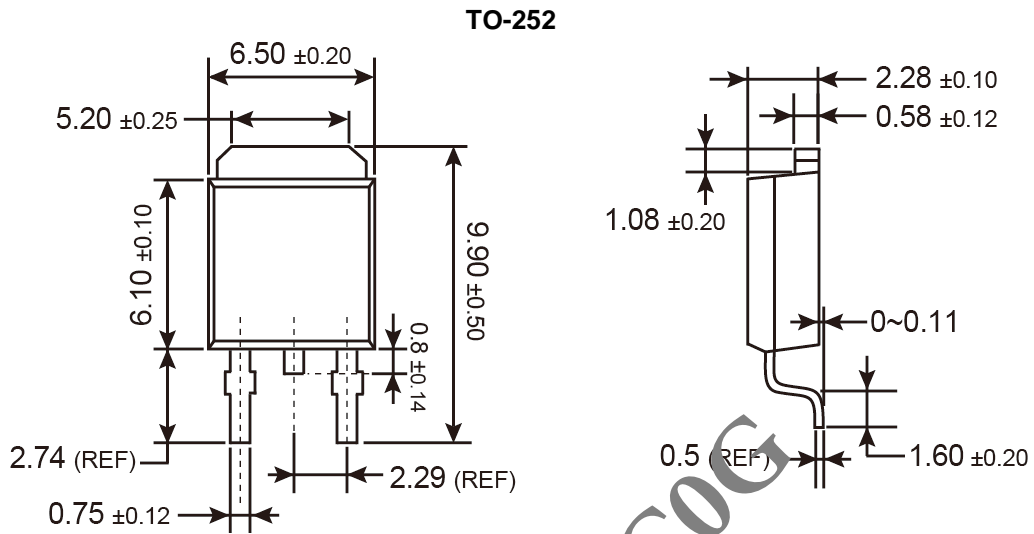
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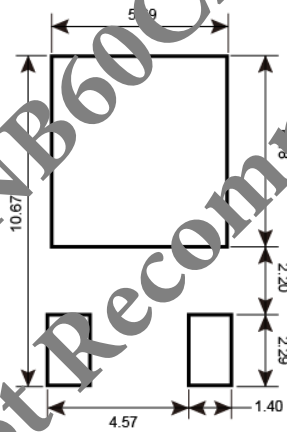
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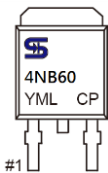
**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)



**SUGGESTED PAD LAYOUT** (Unit: Millimeters)



**MARKING DIAGRAM**



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**TSM4NB60CZ COG**  
**Not Recommended**

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