

## N-Channel Power MOSFET

600V, 4.0A, 2.5Ω

### FEATURES

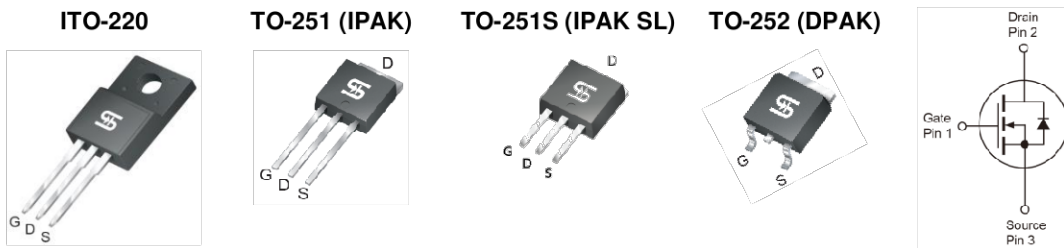
- 100% Avalanche Tested
- Pb-free plating
- Compliant to RoHS Directive 2011/65/EU and in accordance to WEE 2002/96/EC
- Halogen-free according to IEC 61249-2-21 definition

### 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 (D-PAK) per J-STD-020

### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

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

### THERMAL PERFORMANCE

PARAMETER	SYMBOL	IPAK/DPAK	ITO-220	UNIT
Junction to Case Thermal Resistance	$R_{\theta JC}$	2.5	5	°C/W
Junction to Ambient Thermal Resistance	$R_{\theta JA}$	83	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.  $R_{\theta JC}$  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	$V_{GS} = 0\text{V}, I_D = 250\mu\text{A}$	$BV_{DSS}$	600	--	--	V
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu\text{A}$	$V_{GS(TH)}$	2.5	3.5	4.5	V
Gate Body Leakage	$V_{GS} = \pm 30\text{V}, V_{DS} = 0\text{V}$	$I_{GSS}$	--	--	$\pm 100$	nA
Zero Gate Voltage Drain Current	$V_{DS} = 600\text{V}, V_{GS} = 0\text{V}$	$I_{DSS}$	--	--	1	$\mu\text{A}$
Drain-Source On-State Resistance	$V_{GS} = 10\text{V}, I_D = 2.0\text{A}$	$R_{DS(on)}$	--	2.2	2.5	$\Omega$
Forward Transfer Conductance	$V_{DS} = 40\text{V}, I_D = 2\text{A}$	$g_{fs}$	--	2.6	--	S
<b>Dynamic</b> (Note 6)						
Total Gate Charge	$V_{DS} = 480\text{V}, I_D = 4.0\text{A},$ $V_{GS} = 10\text{V}$	$Q_g$	--	14.5	--	nC
Gate-Source Charge		$Q_{gs}$	--	3.4	--	
Gate-Drain Charge		$Q_{gd}$	--	7	--	
Input Capacitance	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V},$ $f = 1.0\text{MHz}$	$C_{iss}$	--	500	--	pF
Output Capacitance		$C_{oss}$	--	53.2	--	
Reverse Transfer Capacitance		$C_{rss}$	--	7	--	
<b>Switching</b> (Note 7)						
Turn-On Delay Time	$V_{DD} = 300\text{V},$ $R_{GEN} = 25\Omega,$ $I_D = 4.0\text{A}, V_{GS} = 10\text{V},$	$t_{d(on)}$	--	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	$I_S = 4.0\text{A}, V_{GS} = 0\text{V}$	$V_{SD}$	--	--	1.13	V
Reverse Recovery Time	$V_{GS} = 0\text{V}, I_S = 2\text{A}$ $dI_F/dt = 100\text{A}/\mu\text{s}$	$t_{rr}$	--	522	--	ns
Reverse Recovery Charge		$Q_{rr}$	--	1.6	--	$\mu\text{C}$
Source Current	Integral reverse diode in the MOSFET	$I_S$	--	--	4	A
Source Current (Pulse)		$I_{SM}$	--	--	16	A

**Notes:**

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

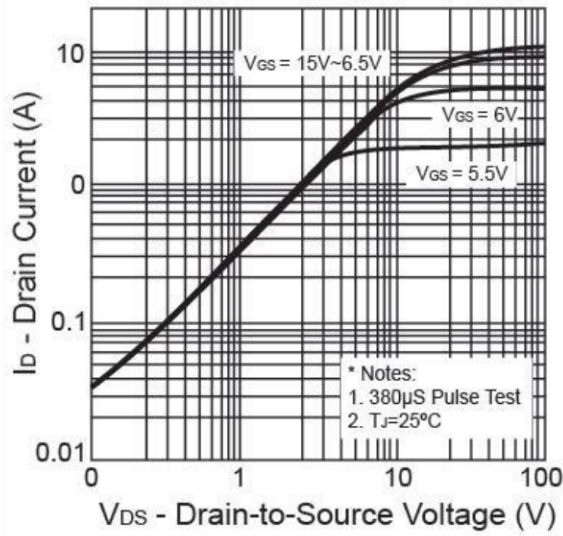
**ORDERING INFORMATION**

<b>ORDERING CODE</b>	<b>PACKAGE</b>	<b>PACKING</b>
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

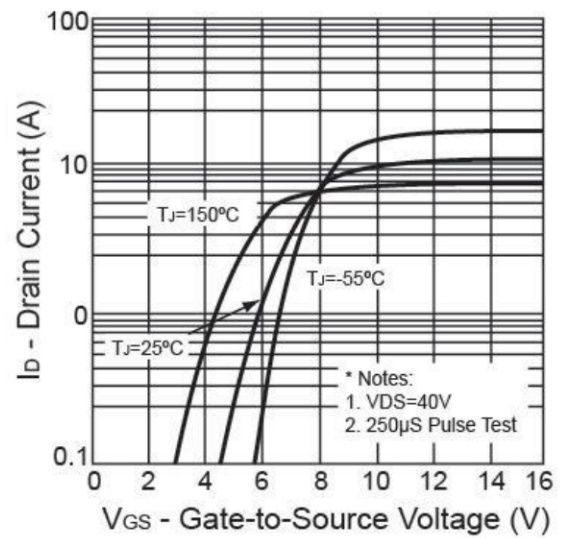
**CHARACTERISTICS CURVES**

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

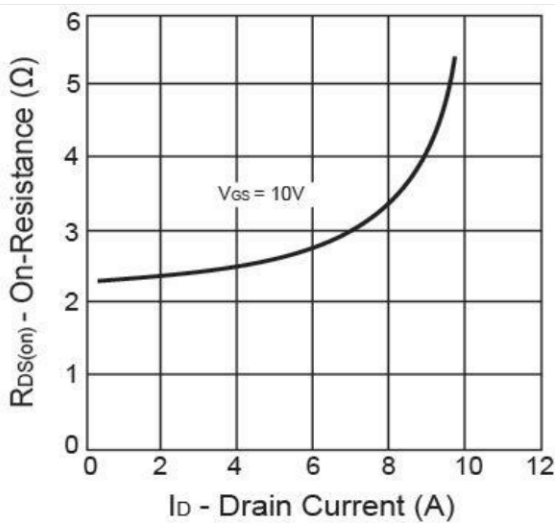
**Output Characteristics**



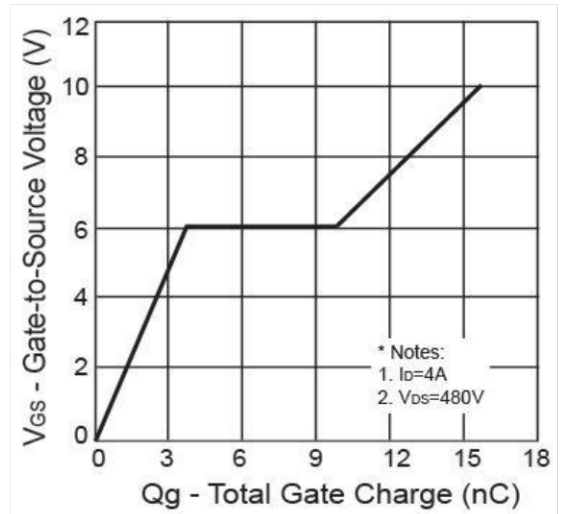
**Transfer Characteristics**



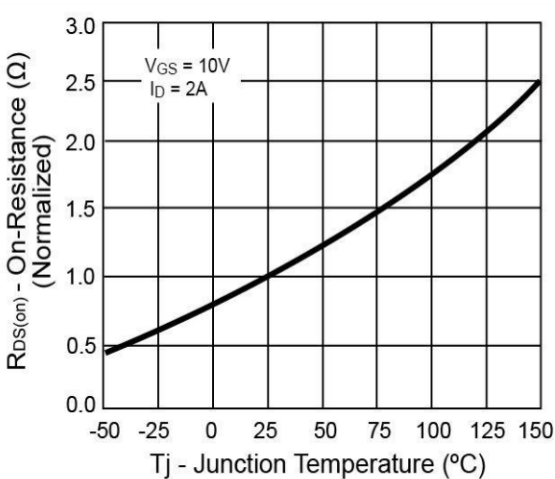
**On-Resistance vs. Drain Current**



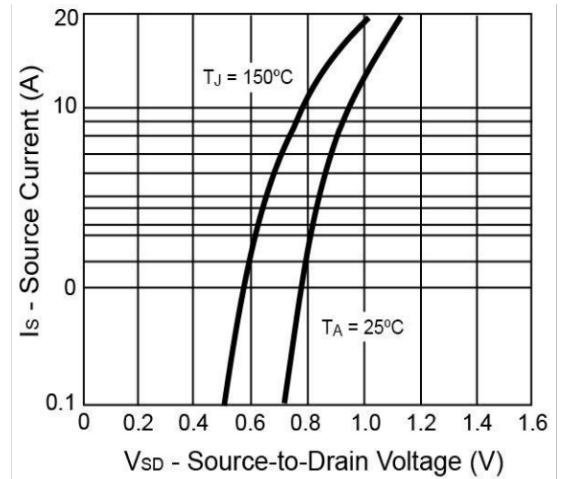
**Gate Charge**



**On-Resistance vs. Junction Temperature**



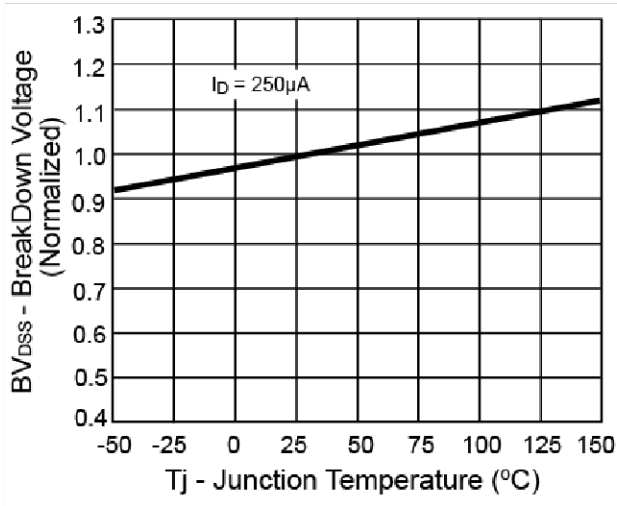
**Source-Drain Diode Forward Voltage**



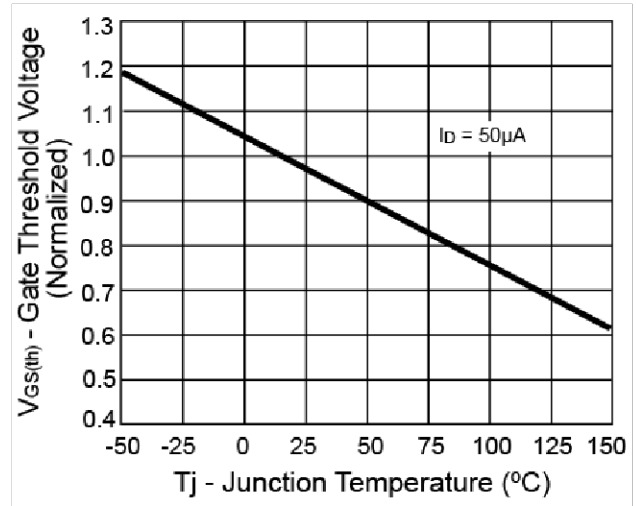
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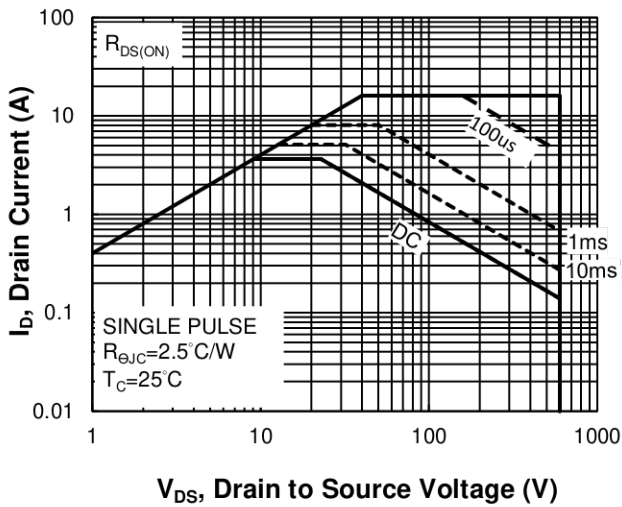
**Breakdown Voltage vs. Temperature**



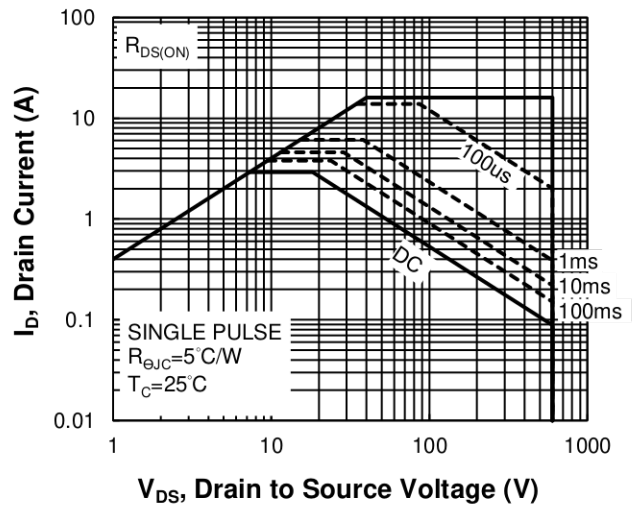
**Threshold Voltage vs. Temperature**



**Maximum Safe Operating Area (IPAK/DPAK)**

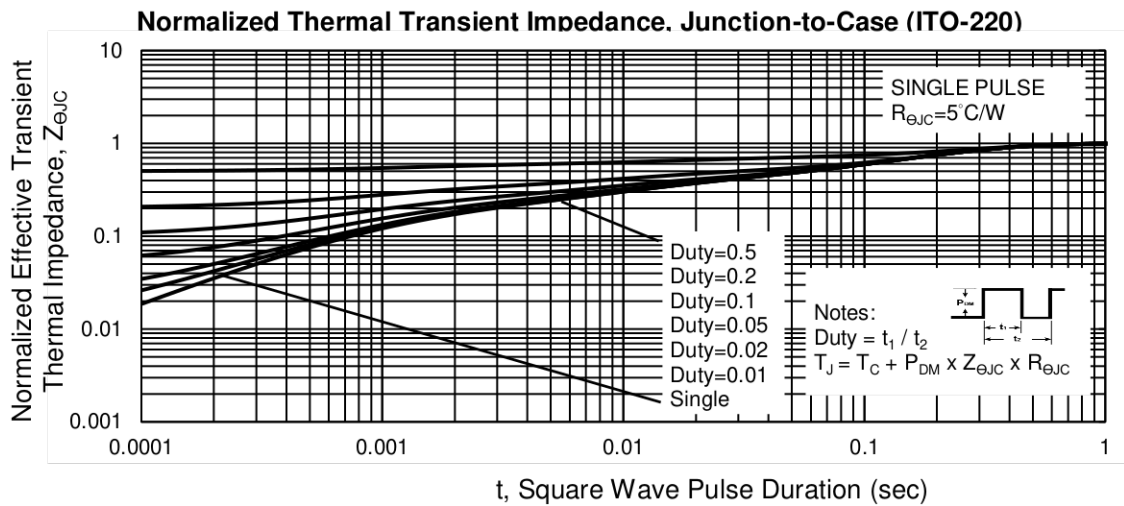
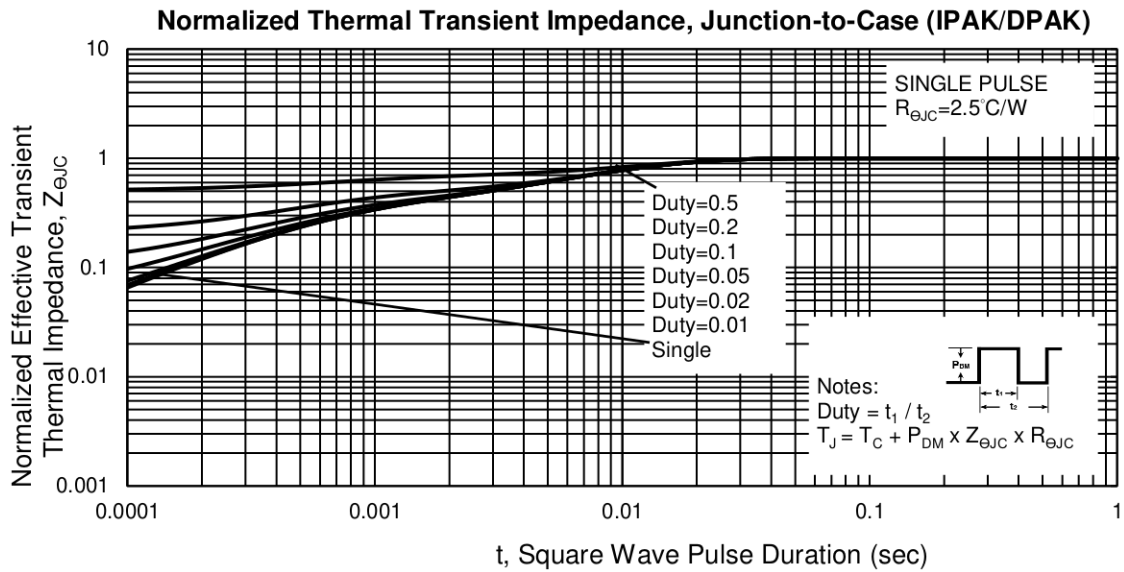


**Maximum Safe Operating Area (ITO-220)**

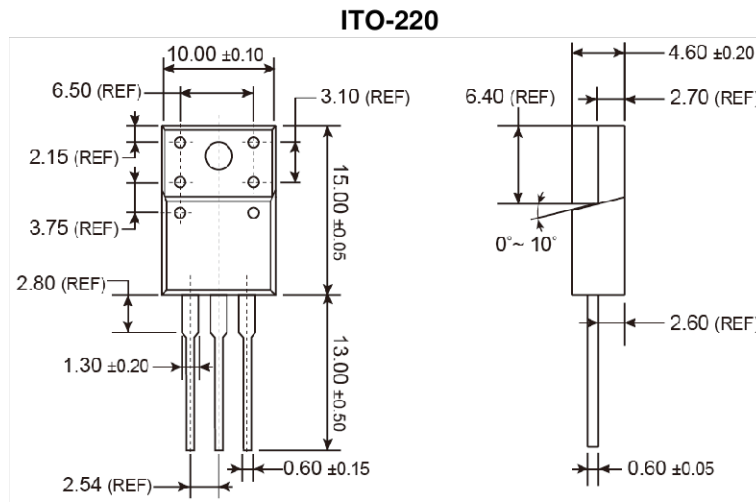


**ELECTRICAL CHARACTERISTICS CURVES**

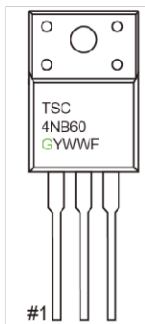
( $T_C = 25^\circ\text{C}$  unless otherwise noted)



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

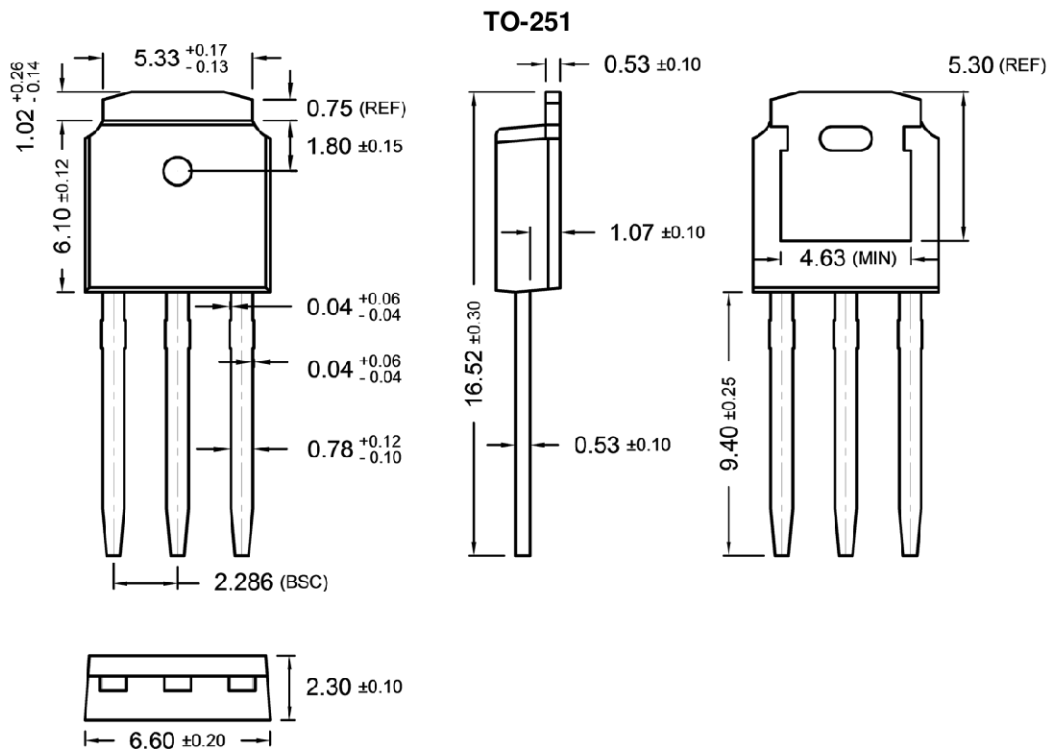


**MARKING DIAGRAM**

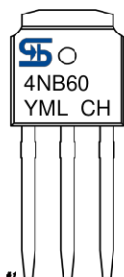


- G** = Halogen Free
- Y** = Year Code
- WW** = Week Code (01~52)
- F** = Factory Code

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



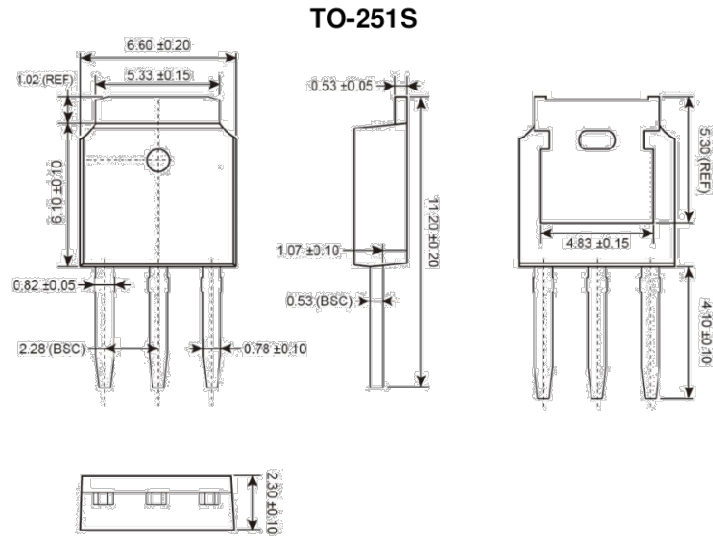
**MARKING DIAGRAM**



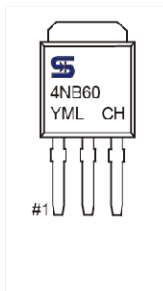
- Y** = Year Code
- M** = Month Code for Halogen Free Product
  - O** =Jan    **P** =Feb    **Q** =Mar    **R** =Apr
  - S** =May    **T** =Jun    **U** =Jul    **V** =Aug
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- L** = Lot Code (1~9, A~Z)



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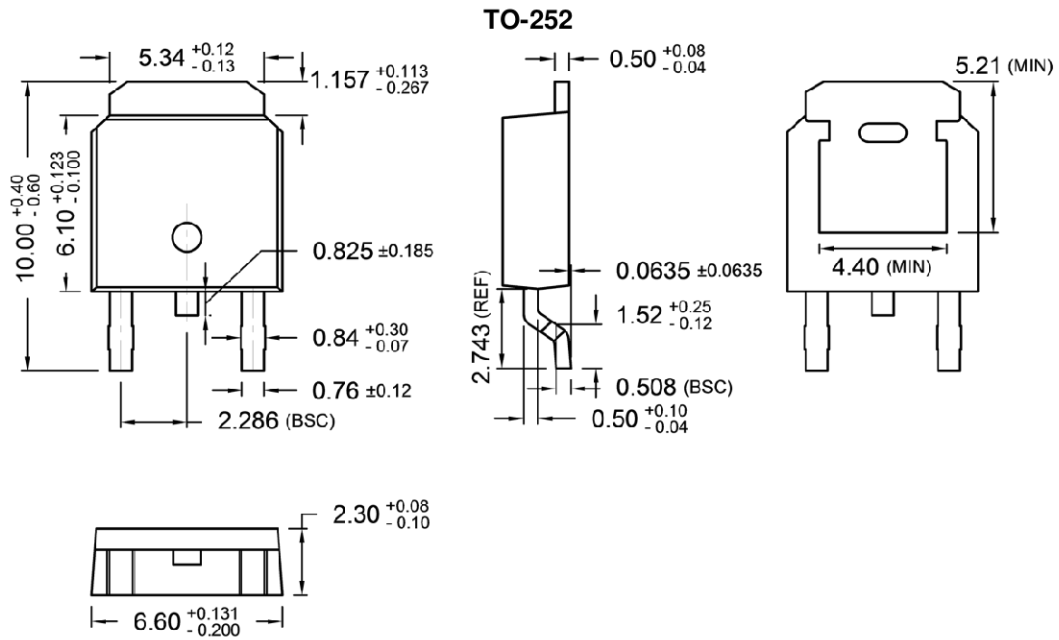


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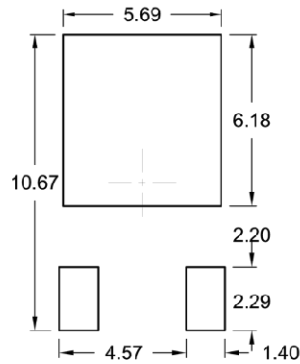


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**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)



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



**MARKING DIAGRAM**



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