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

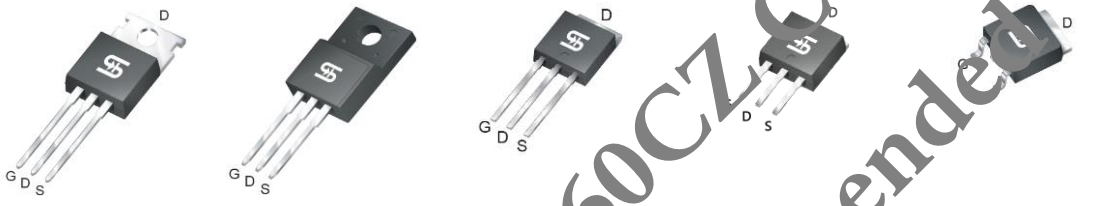
KEY PERFORMANCE PARAMETERS		
PARAMETER	**VALUE**	**UNIT**
V_{DS}	600	V
$R_{DS(on)}$ (max)	2.5	Ω
Q_g	14.5	nC

APPLICATION

- Power Supply
- Lighting

Pb-Free RoHS COMPLIANT HALOGEN FREE

TO-220 **ITO-220** **TO-251 (IPAK)** **TO-251S (IPAK-SL)** **TO-252 (DPAK)**



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

ABSOLUTE MAXIMUM RATINGS (T_A = 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)	T_C = 25°C	I_D	4.0			A
	T_C = 100°C		2.4			
Pulsed Drain Current (Note 2)		I_{DM}	16			A
Total Power Dissipation @ T_C = 25°C		P_{DTOT}	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_J, T_{STG}	- 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.

ELECTRICAL SPECIFICATIONS (T_A = 25°C unless otherwise noted)						
PARAMETER	**CONDITIONS**	**SYMBOL**	**MIN**	**TYP**	**MAX**	**UNIT**
Static (Note 5)						
Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 250μA	BV_{DSS}	600	--	--	V
Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250μA	$V_{GS(TH)}$	2.5	3.5	4.5	V
Gate Body Leakage	V_{GS} = ±30V, V_{DS} = 0V	I_{GSS}	--	--	±100	nA
Zero Gate Voltage Drain Current	V_{DS} = 600V, V_{GS} = 0V	I_{DSS}	--	--	1	μA
Drain-Source On-State Resistance	V_{GS} = 10V, I_D = 2.0A	$R_{DS(on)}$	--	2.2	2.5	Ω
Forward Transfer Conductance	V_{DS} = 40V, I_D = 2A	g_{fs}	--	2.6	--	S
Dynamic (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	--	
Switching (Note 7)						
Turn-On Delay Time	V_{DD} = 300V, R_{GEN} = 25Ω, 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	--	
Source-Drain Diode (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 dI_F/dt = 100A/μs	t_{rr}	--	522	--	ns
Reverse Recovery Charge		Q_{rr}	--	1.6	--	μC
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 = 8mH, I_{AS} = 4.0A, V_{DD} = 50V, R_G = 25Ω, Starting T_J = 25°C.
   100% Eas Test Condition: L = 8mH, I_{AS} = 2A, V_{DD} = 50V, R_G = 25Ω, Starting T_J = 25°C
4. I_{SD} ≤ 4A, dI/dt ≤ 200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C.
5. Pulse test: PW ≤ 300μs, duty cycle ≤ 2%.
6. For DESIGN AID ONLY, not subject to production testing.
7. Switching time is essentially independent of operating temperature.

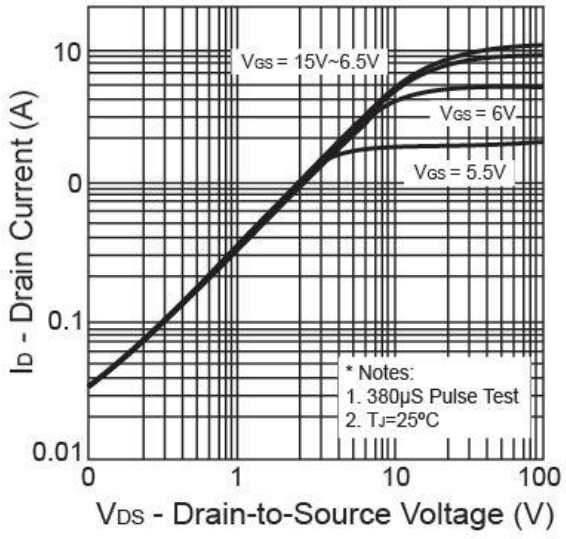
ORDERING INFORMATION

PART NO.	PACKAGE	PACKING
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

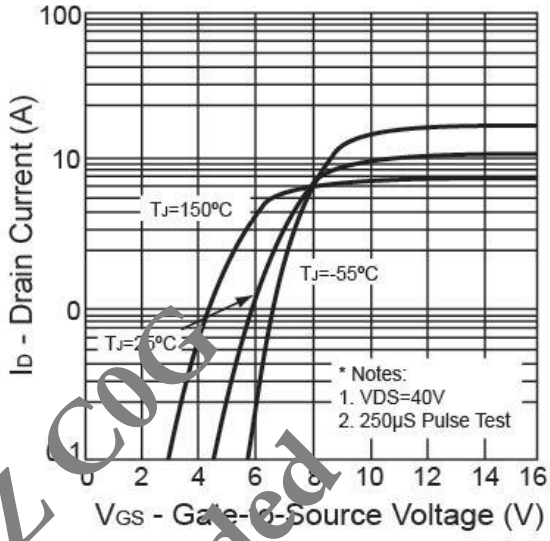
CHARACTERISTICS CURVES

(T_C = 25°C unless otherwise noted)

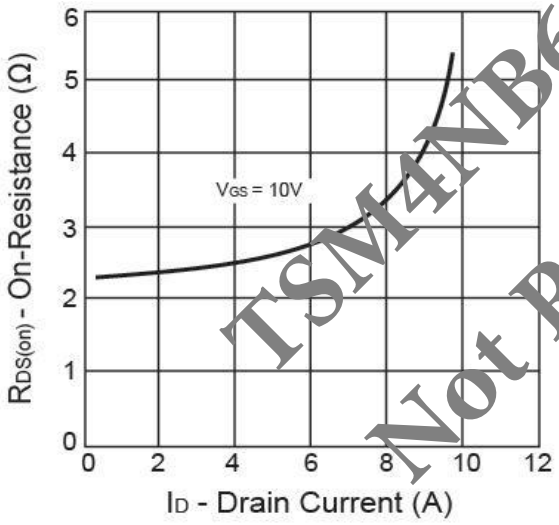
Output Characteristics



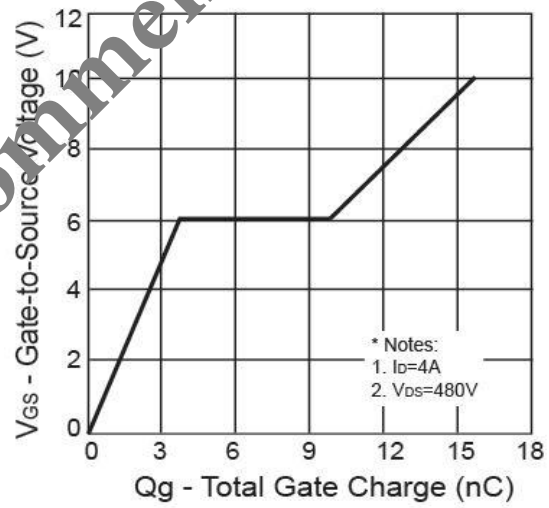
Transfer Characteristics



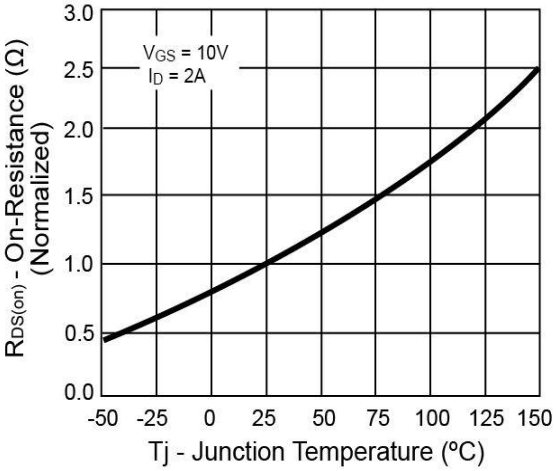
On-Resistance vs. Drain Current



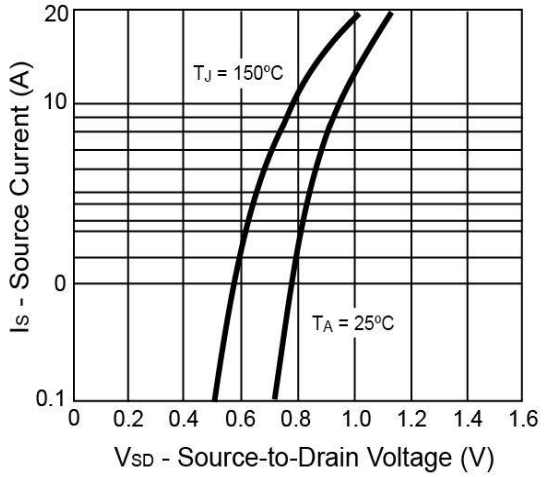
Gate Charge



On-Resistance vs. Junction Temperature



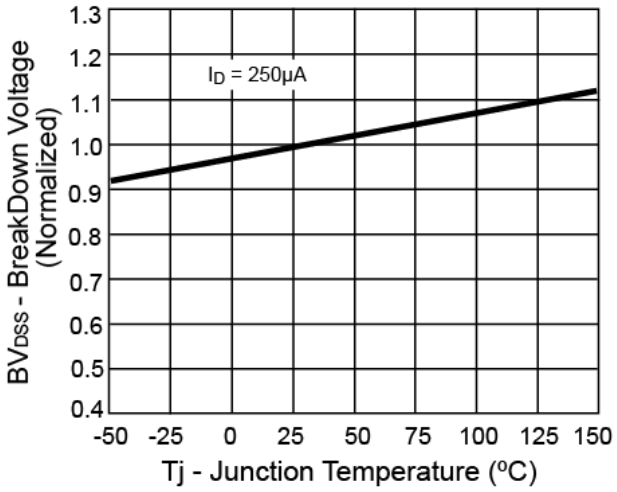
Source-Drain Diode Forward Voltage



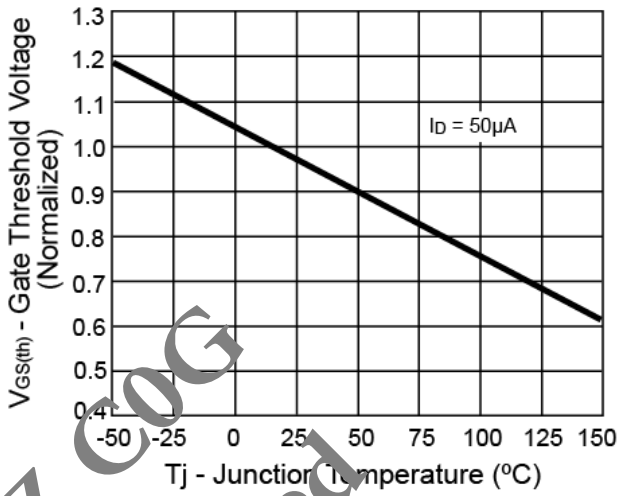
CHARACTERISTICS CURVES

(T_C = 25°C unless otherwise noted)

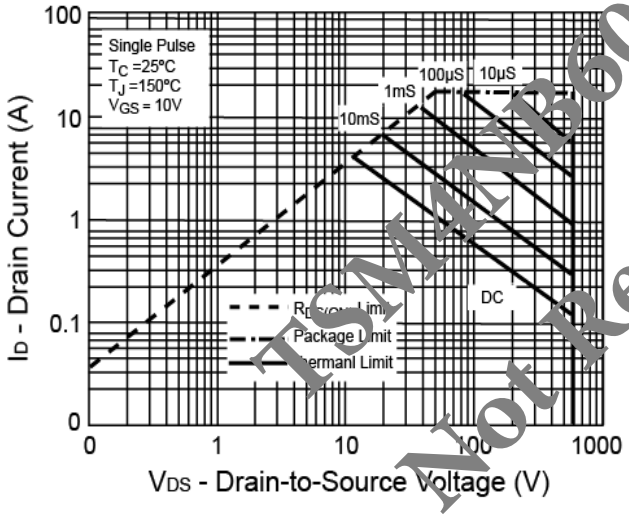
Breakdown Voltage vs. Temperature



Threshold Voltage vs. Temperature



Maximum Safe Operating Area



ELECTRICAL CHARACTERISTICS CURVES

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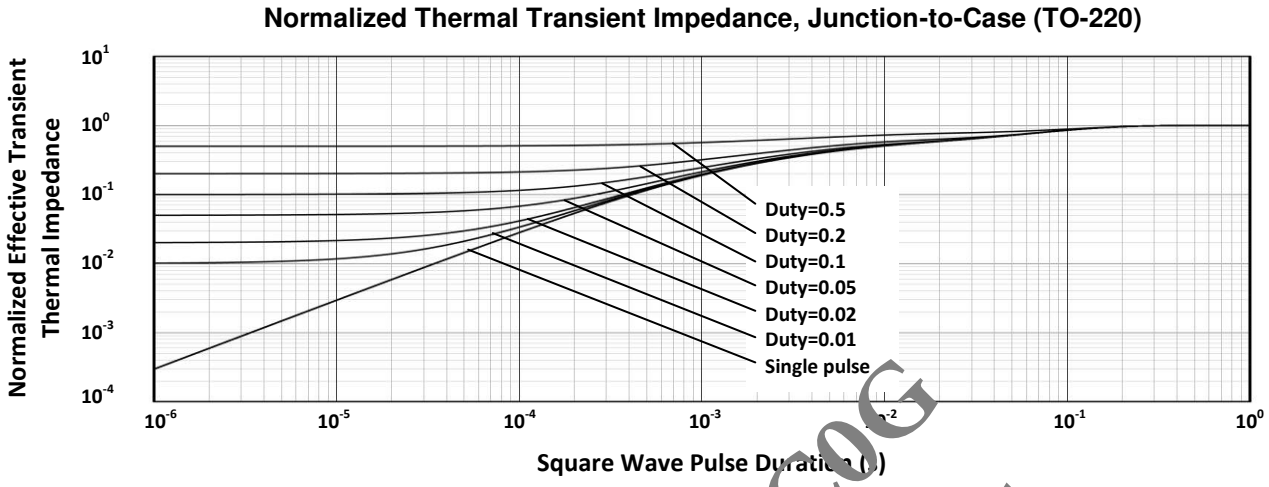
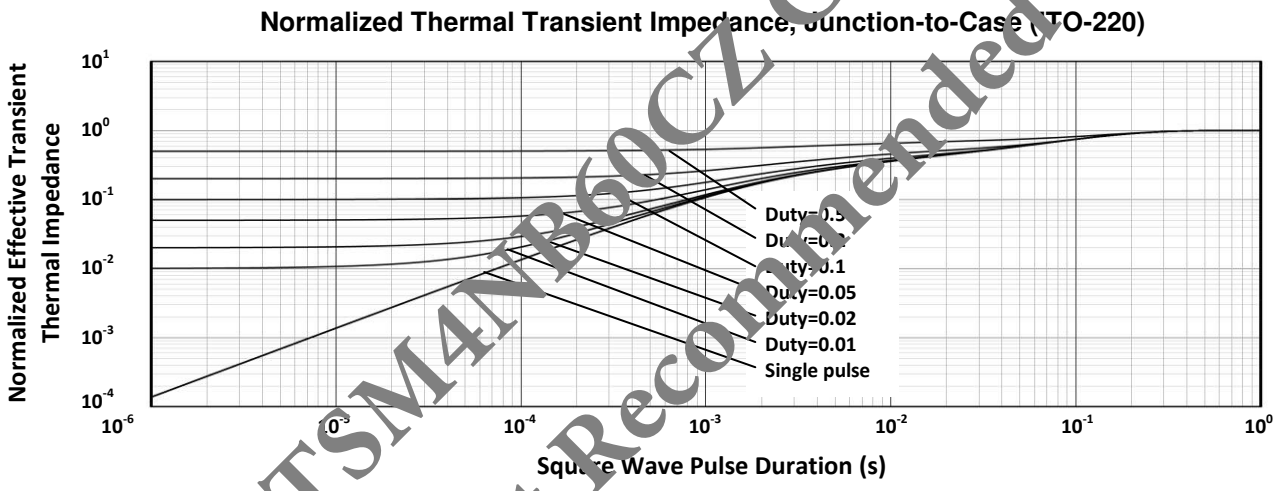
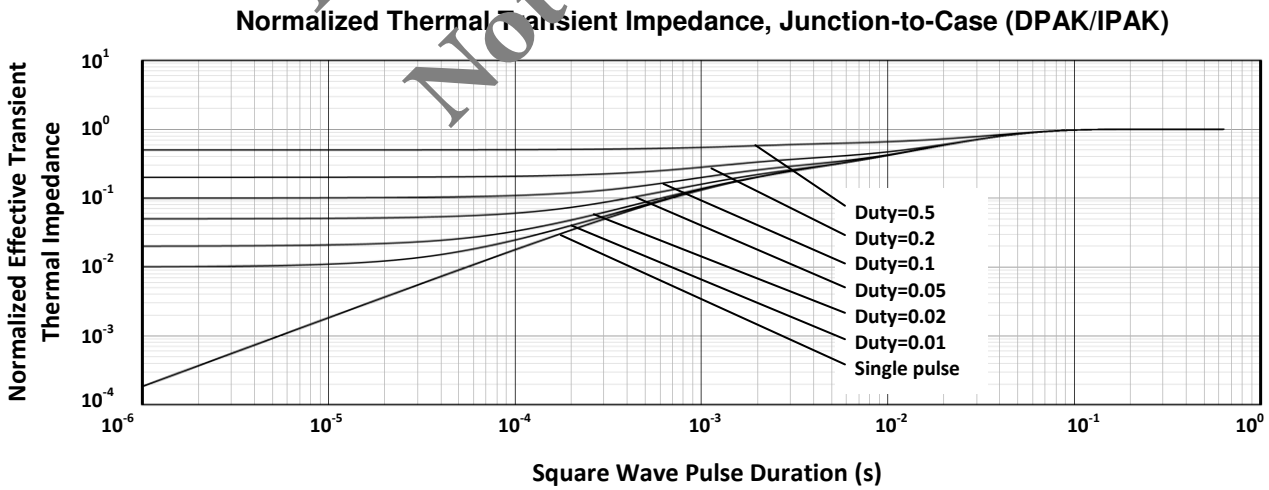
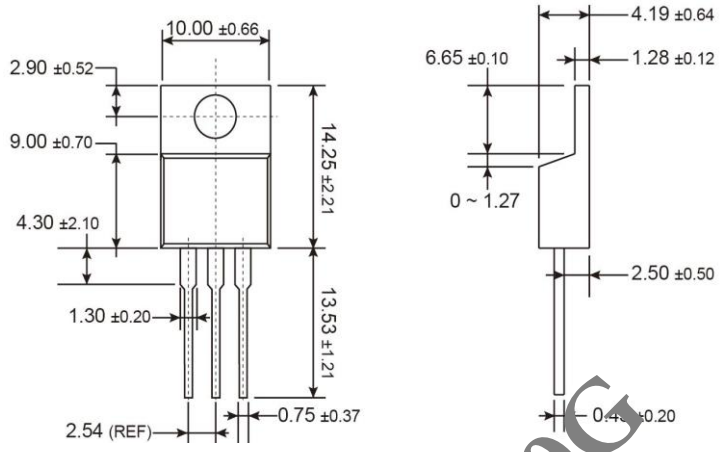




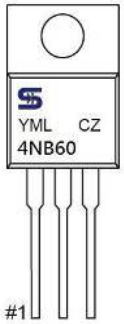


PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

TO-220



MARKING DIAGRAM



Y = Year Code

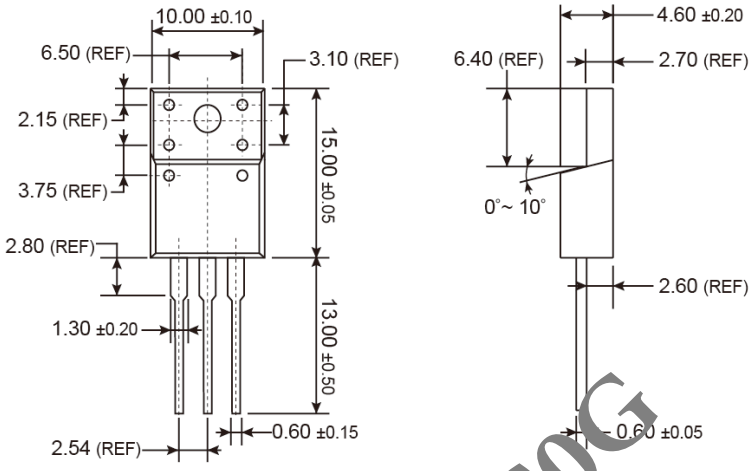
M = Month Code for Halogen Free Product

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)

PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

ITO-220



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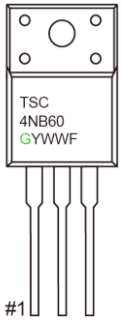
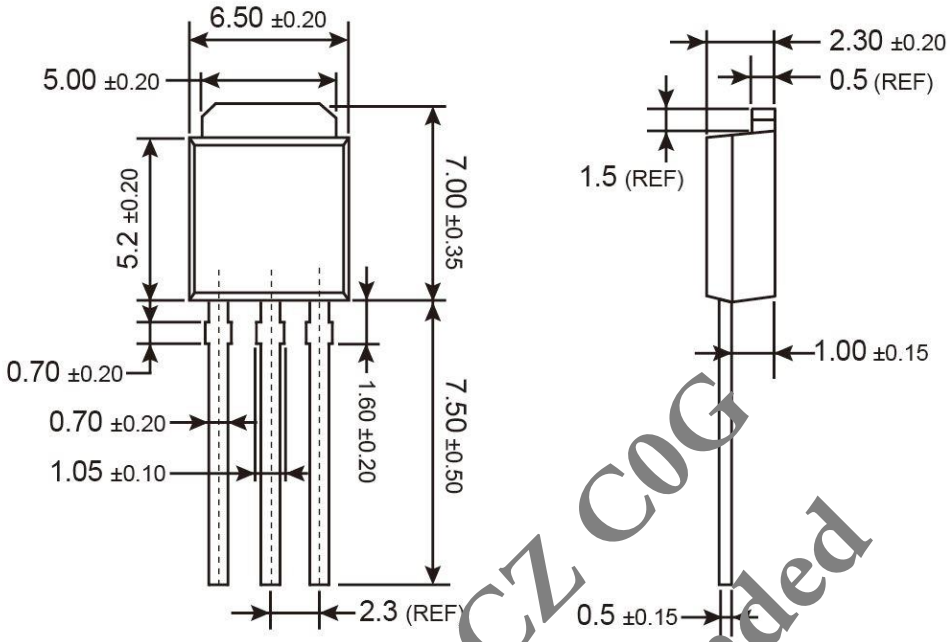


G = Halogen Free
Y = Year Code
WW = Week Code (01~52)
F = Factory Code

PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

TO-251



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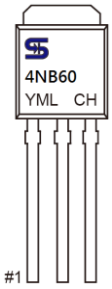

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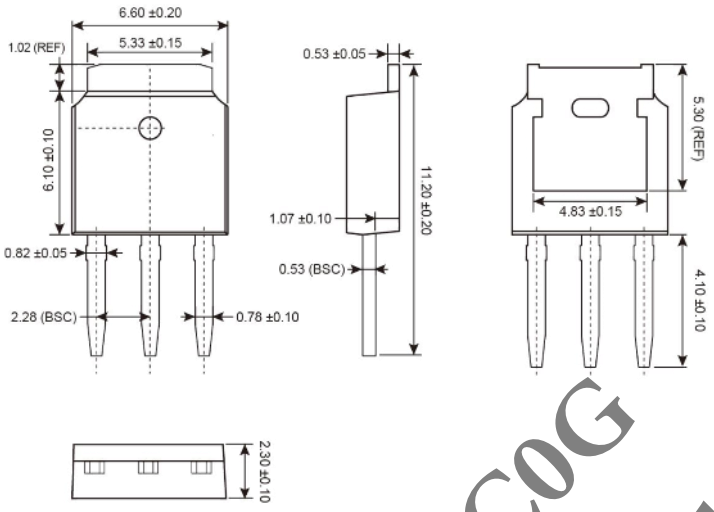
PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

TO-251S



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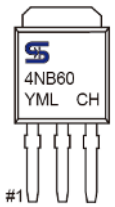

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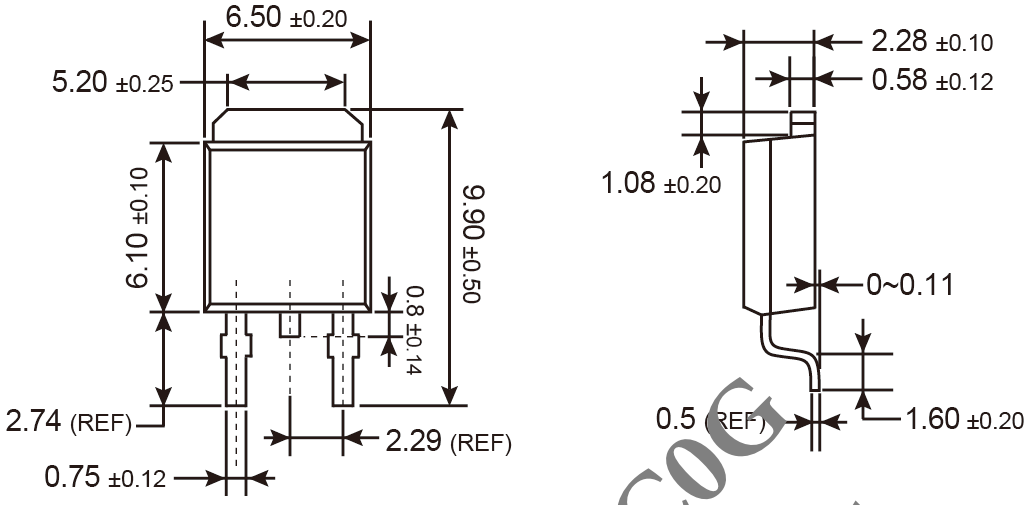
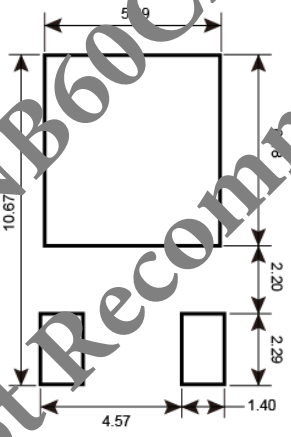
PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

TO-252



SUGGESTED PAD LAYOUT (Unit: Millimeters)



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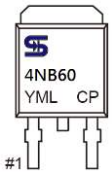

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