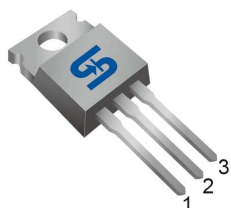
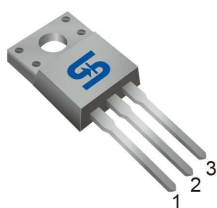




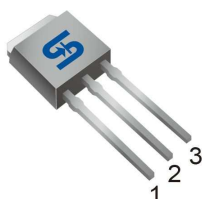
TO-220



ITO-220



TO-251 (IPAK)



TO-252 (DPAK)



Pin Definition:

1. Gate
2. Drain
3. Source

PRODUCT SUMMARY

V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A)
600	2.5 @ $V_{GS}=10V$	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

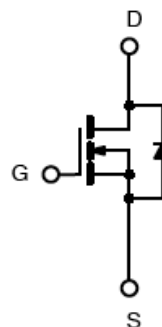
- Low $R_{DS(ON)}$ 2.2 Ω (Typ.)
- Low gate charge typical @ 14.5nC (Typ.)
- Low C_{rss} typical @ 7.0pF (Typ.)
- 100% Avalanche Tested

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 C0	ITO-220	50pcs / Tube

Note: "G" denotes for Halogen Free

Block Diagram



N-Channel MOSFET

Absolute Maximum Rating ($T_a = 25^\circ C$ unless otherwise noted)

Parameter	Symbol	Limit			Unit
		IPAK/DPAK	ITO-220	TO-220	
Drain-Source Voltage	V_{DS}	600			V
Gate-Source Voltage	V_{GS}	± 30			V
Continuous Drain Current	I_D	$T_C = 25^\circ C$			A
		$T_C = 100^\circ C$			A
Pulsed Drain Current *	I_{DM}	16			A
Single Pulse Avalanche Energy (Note 2)	E_{AS}	70			mJ
Avalanche Current (Repetitive) (Note 1)	I_{AR}	4			A
Repetitive Avalanche Energy (Note 1)	E_{AR}	5			mJ
Peak Diode Recovery dv/dt (Note 3)	dv/dt	4.5			V/ns
Total Power Dissipation @ $T_C = 25^\circ C$	P_{TOT}	50	25	70	W
Operating Junction Temperature	T_J	150			$^\circ C$
Storage Temperature Range	T_{STG}	-55 to +150			$^\circ C$

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 $^{\circ}$ C unless otherwise noted)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Static						
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu\text{A}$	BV_{DSS}	600	--	--	V
Drain-Source On-State Resistance	$V_{GS} = 10V, I_D = 2A$	$R_{DS(ON)}$	--	2.2	2.5	Ω
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu\text{A}$	$V_{GS(TH)}$	2.5	3.5	4.5	V
Zero Gate Voltage Drain Current	$V_{DS} = 600V, V_{GS} = 0V$	I_{DSS}	--	--	1	μA
Gate Body Leakage	$V_{GS} = \pm 30V, V_{DS} = 0V$	I_{GSS}	--	--	± 100	nA
Forward Transfer Conductance	$V_{DS} = 40V, I_D = 2A$	g_{fs}	--	2.6	--	S
Dynamic						
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	--	
Switching						
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	--	
Source-Drain Diode Ratings and Characteristic						
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	$V_{GS} = 0V, I_S = 4A,$ $di/dt = 100\text{A}/\mu\text{s}$	t_{fr}	--	522	--	nS
Reverse Recovery Charge		Q_{fr}	--	1.6	--	μC

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 $T_J = 25^{\circ}\text{C}$

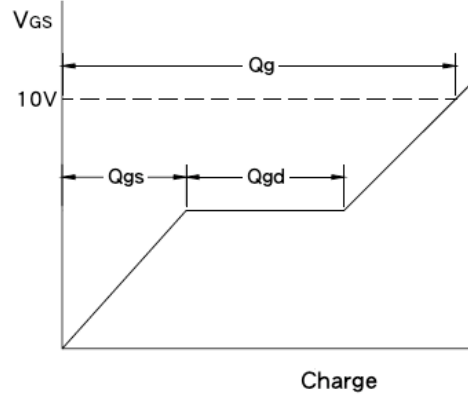
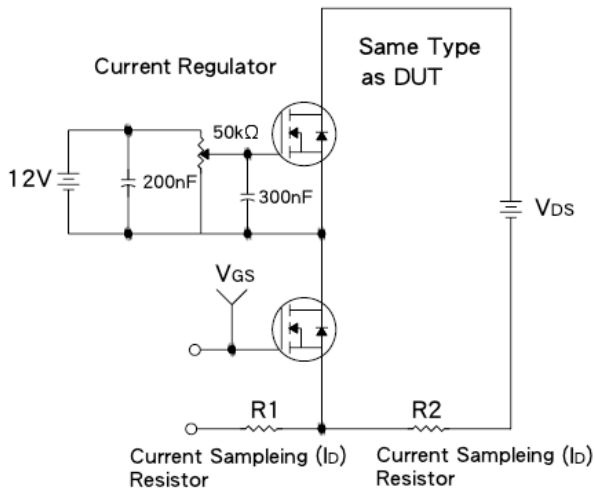
Note 3: $I_{SD} \leq 4A, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^{\circ}\text{C}$

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

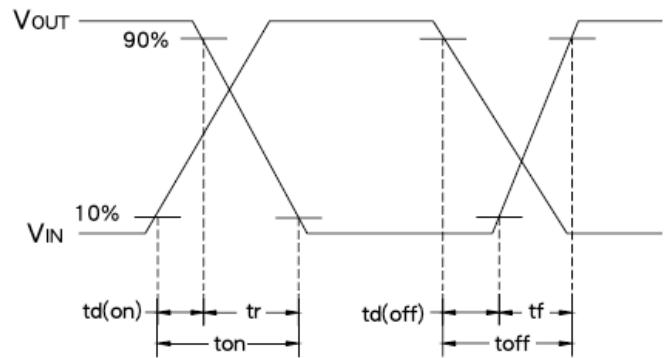
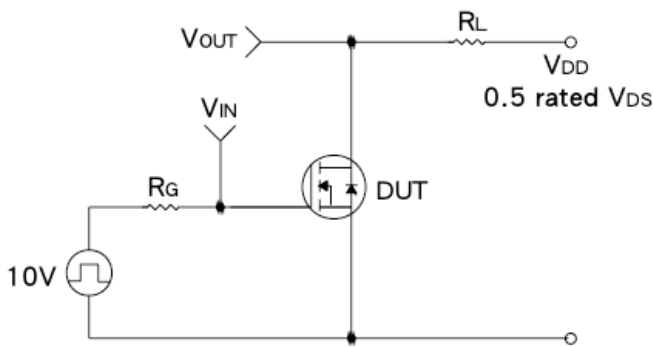
Note 5: Essentially Independent of Operating Temperature



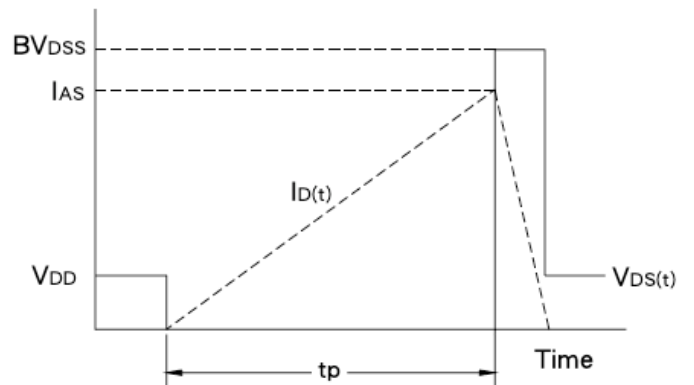
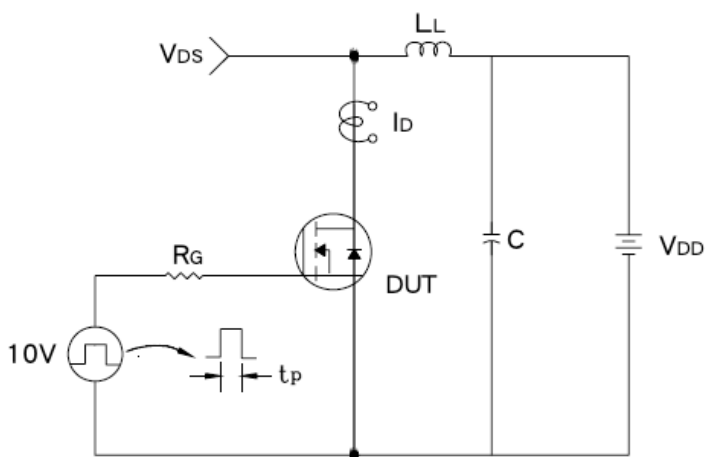
Gate Charge Test Circuit & Waveform



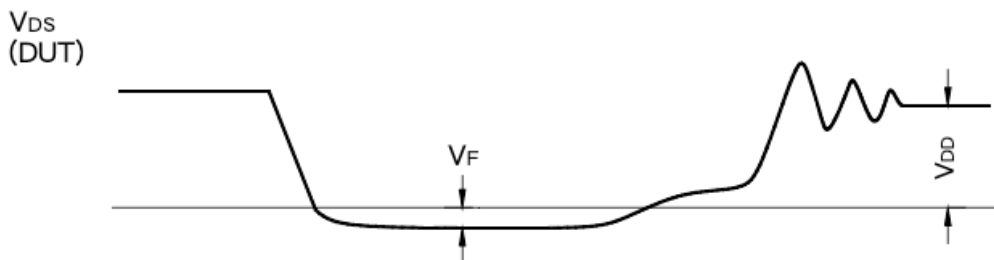
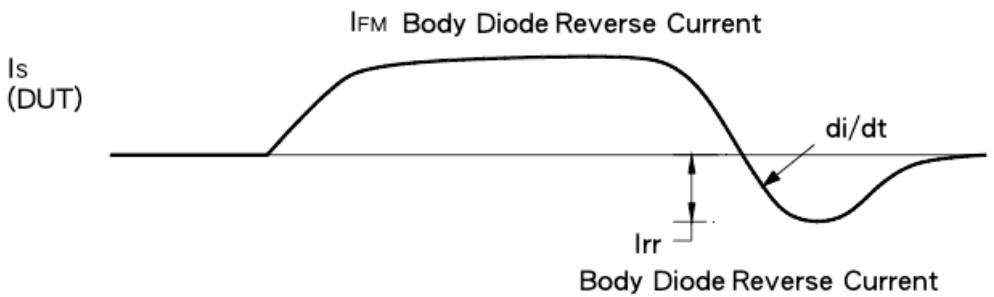
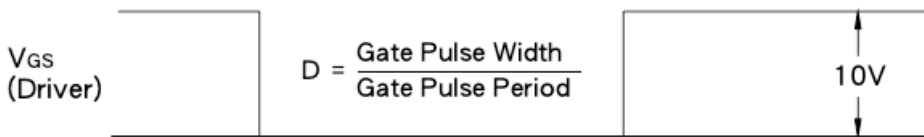
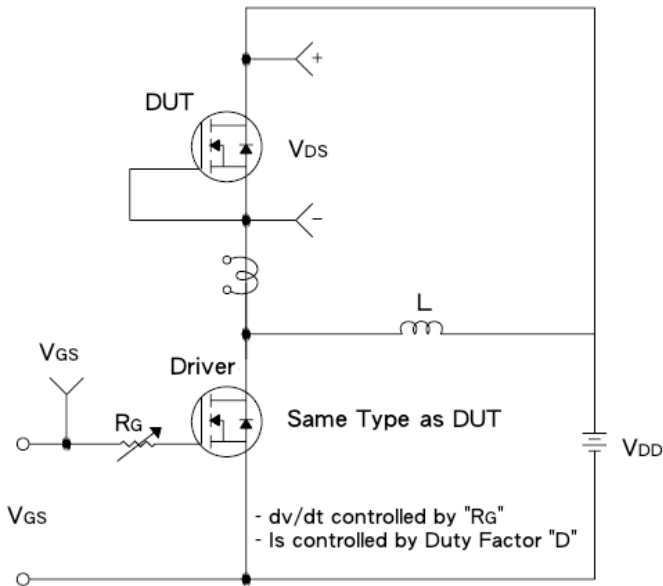
Resistive Switching Test Circuit & Waveform



E_{AS} Test Circuit & Waveform



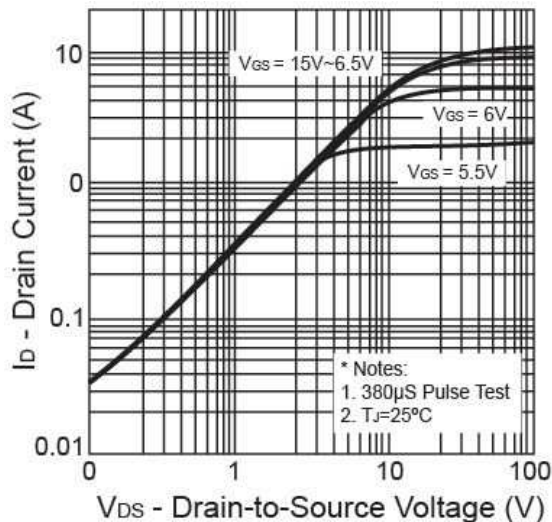
Diode Reverse Recovery Time Test Circuit & Waveform



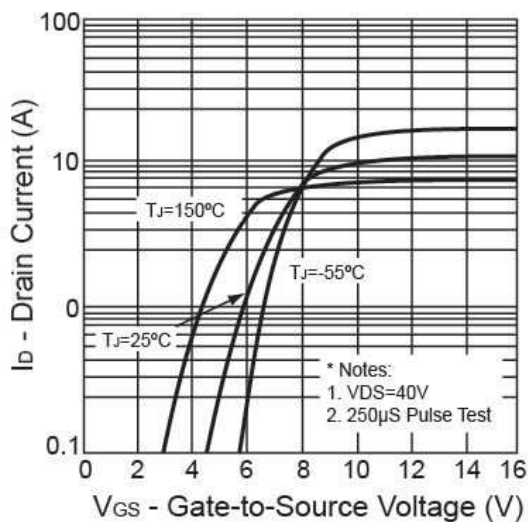


Electrical Characteristics Curve ($T_a = 25^\circ\text{C}$, unless otherwise noted)

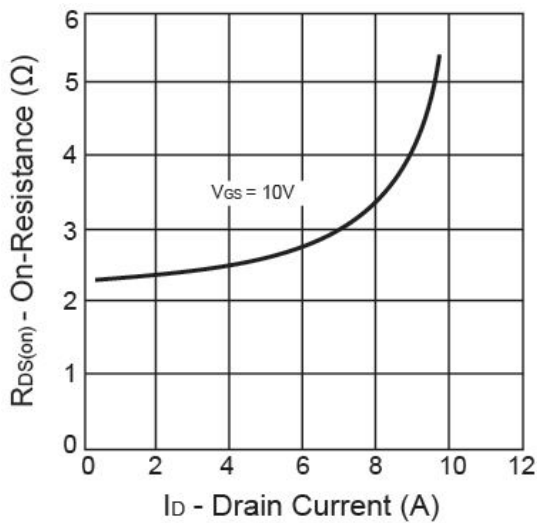
Output Characteristics



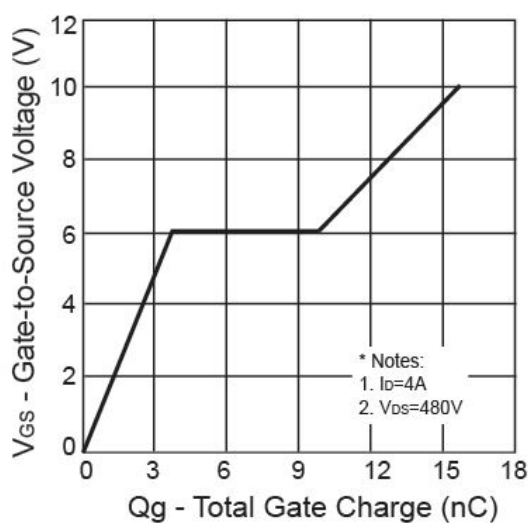
Transfer Characteristics



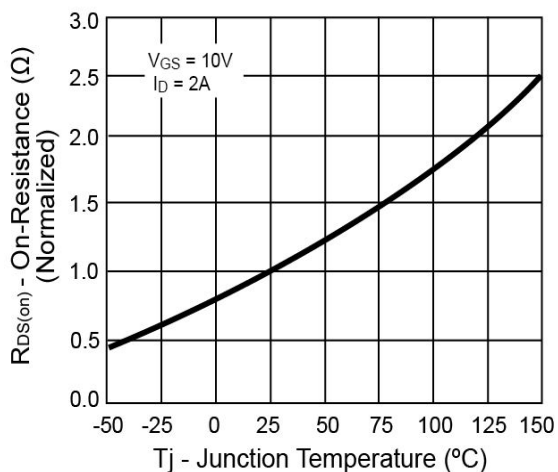
On-Resistance vs. Drain Current



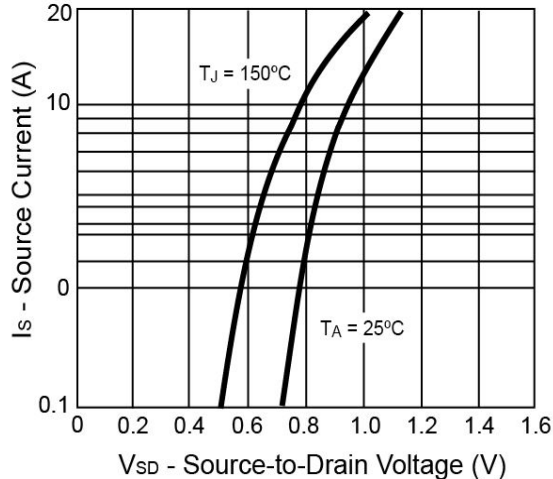
Gate Charge



On-Resistance vs. Junction Temperature

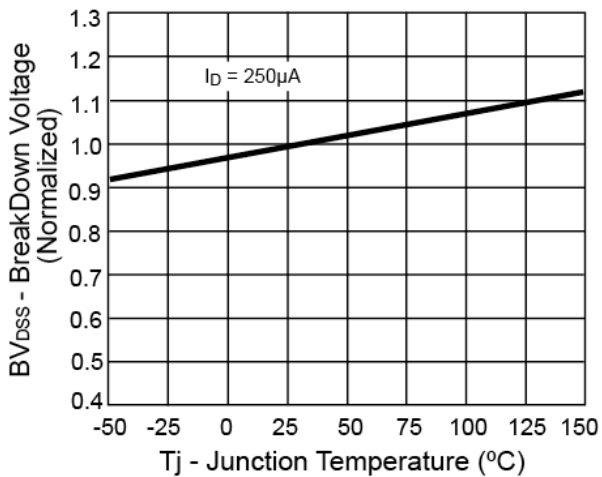


Source-Drain Diode Forward Voltage

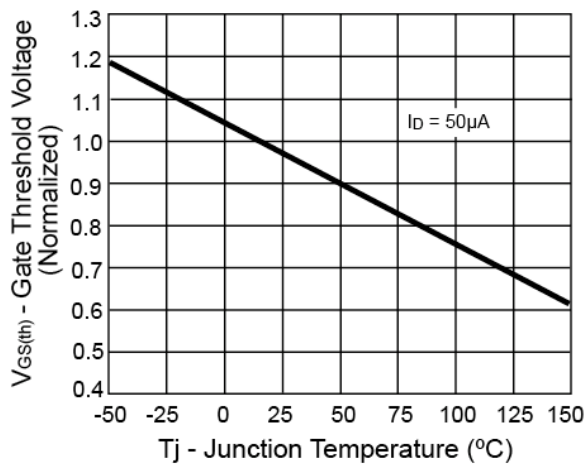


Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)

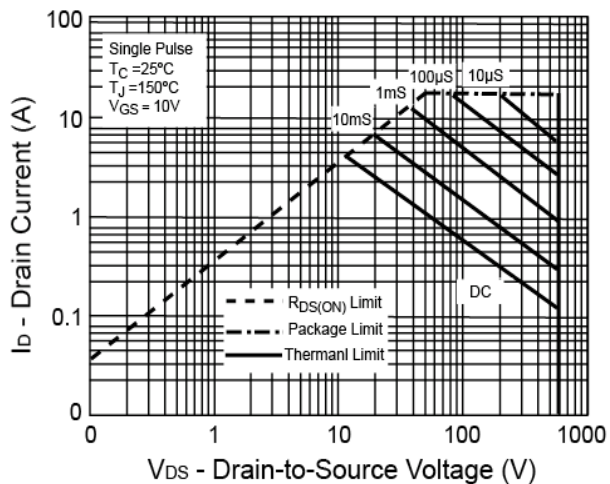
Breakdown Voltage vs. Temperature



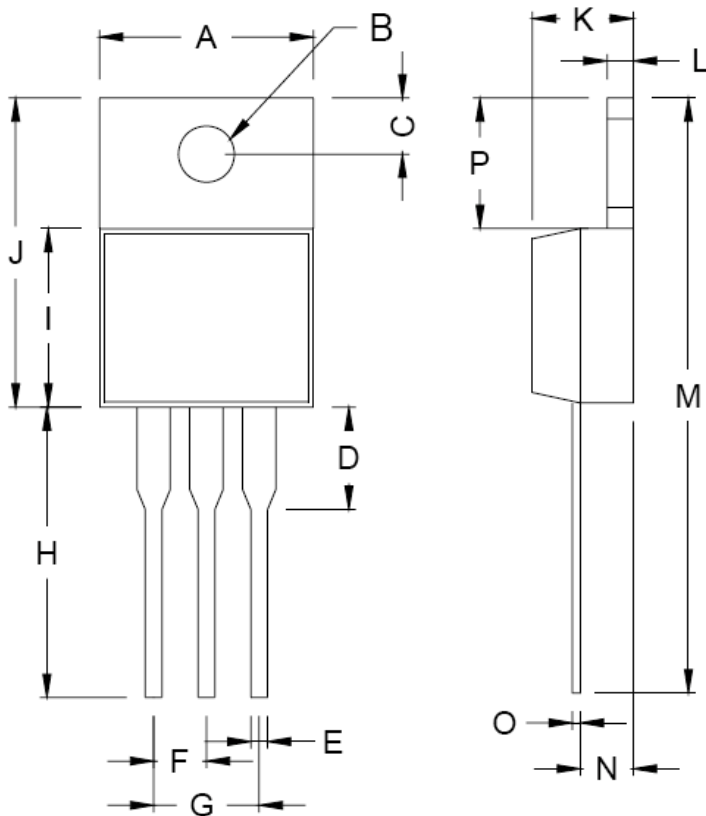
Threshold Voltage vs. Temperature



Maximum Safe Operating Area

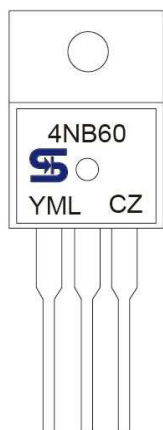


TO-220 Mechanical Drawing



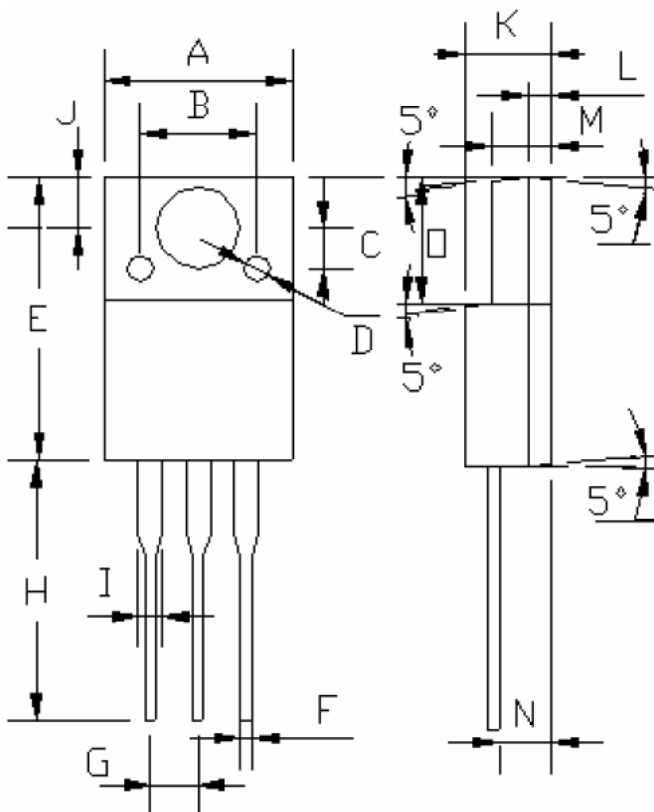
DIM	TO-220 DIMENSION			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.000	10.500	0.394	0.413
B	3.740	3.910	0.147	0.154
C	2.440	2.940	0.096	0.116
D	-	6.350	-	0.250
E	0.381	1.106	0.015	0.040
F	2.345	2.715	0.092	0.058
G	4.690	5.430	0.092	0.107
H	12.700	14.732	0.500	0.581
J	14.224	16.510	0.560	0.650
K	3.556	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



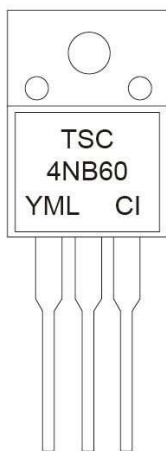
- Y** = Year Code
- M** = Month Code
(**A**=Jan, **B**=Feb, **C**=Mar, **D**=Apr, **E**=May, **F**=Jun, **G**=Jul, **H**=Aug, **I**=Sep, **J**=Oct, **K**=Nov, **L**=Dec)
- L** = Lot Code

ITO-220 Mechanical Drawing



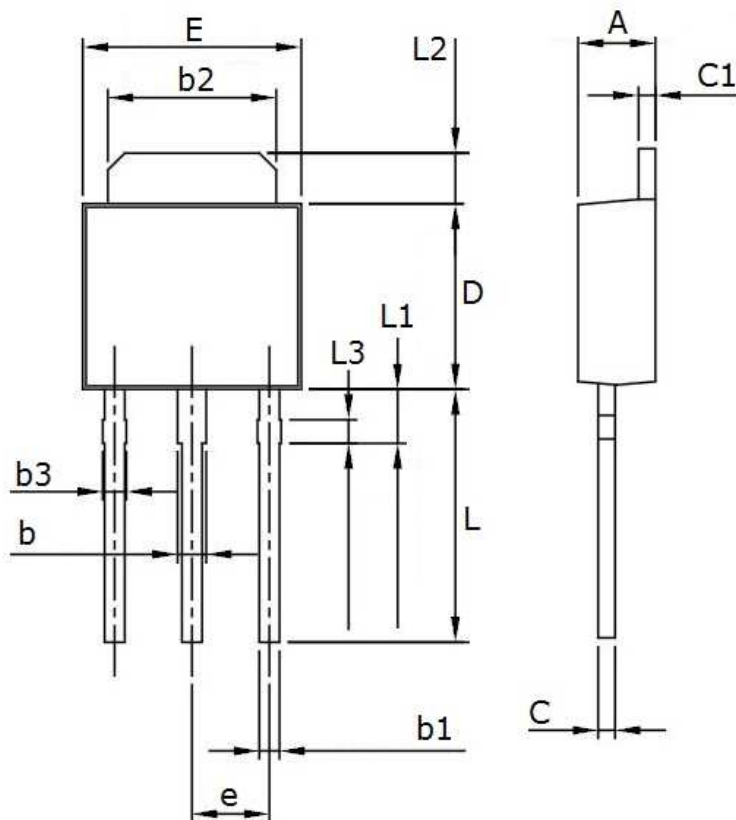
ITO-220 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.04	10.07	0.395	0.396
B	6.20 (typ.)		0.244 (typ.)	
C	2.20 (typ.)		0.087 (typ.)	
D	§ 1.40 (typ.)		§ 0.055 (typ.)	
E	15.0	15.20	0.591	0.598
F	0.52	0.54	0.020	0.021
G	2.35	2.73	0.093	0.107
H	13.50	13.55	0.531	0.533
I	1.11	1.49	0.044	0.058
J	2.60	2.80	0.102	0.110
K	4.49	4.50	0.176	0.177
L	1.15 (typ.)		0.045 (typ.)	
M	3.03	3.05	0.119	0.120
N	2.60	2.80	0.102	0.110
O	6.55	6.65	0.258	0.262

Marking Diagram



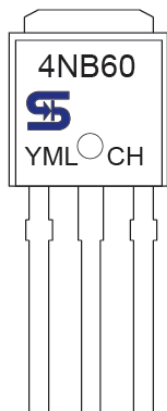
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- L** = Lot Code

TO-251 Mechanical Drawing



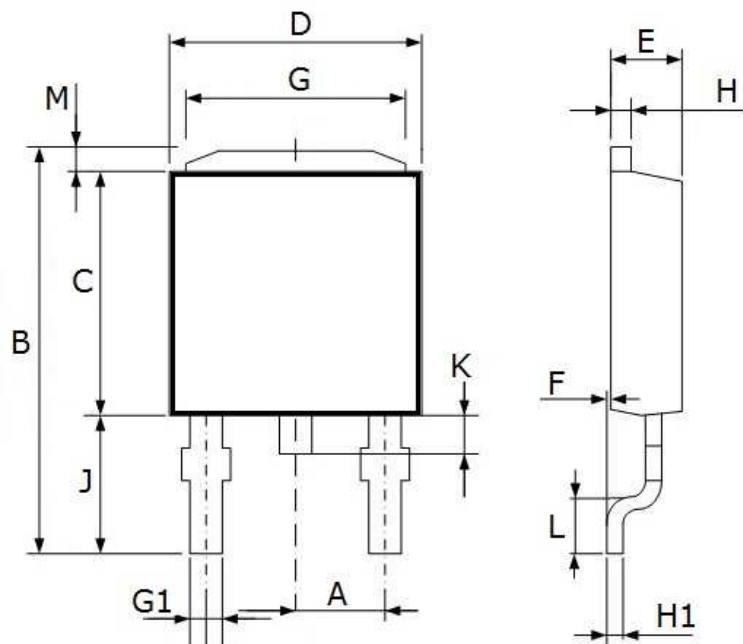
TO-251 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.10	2.50	0.083	0.098
b	0.95	1.15	0.035	0.045
b1	0.40	0.62	0.023	0.024
b2	4.80	5.20	0.189	0.205
b3	0.68	0.72	0.027	0.028
C	0.35	0.65	0.014	0.026
C1	0.40	0.60	0.016	0.024
D	5.30	5.70	0.209	0.224
E	6.30	6.70	0.248	0.264
e	2.30 BSC		0.09 BSC	
L	7.00	8.00	0.276	0.315
L1	1.40	1.80	0.055	0.071
L2	1.30	1.70	0.051	0.067
L3	0.50	0.90	0.020	0.035

Marking Diagram



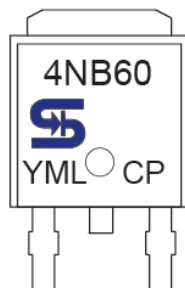
- Y** = Year Code
- M** = Month Code for Halogen Free Product
(O=Jan, P=Feb, Q=Mar, R=Apl, S=May, T=Jun, U=Jul, V=Aug, W=Sep, X=Oct, Y=Nov, Z=Dec)
- L** = Lot Code

TO-252 Mechanical Drawing



TO-252 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.30 BSC		0.090 BSC	
B	10.20	10.80	0.402	0.425
C	5.30	5.70	0.209	0.224
D	6.30	6.70	0.248	0.264
E	2.10	2.50	0.083	0.098
F	0.00	0.20	0.000	0.008
G	4.80	5.20	0.189	0.205
G1	0.40	0.80	0.016	0.031
H	0.40	0.60	0.016	0.024
H1	0.35	0.65	0.014	0.026
J	3.35	3.65	0.132	0.144
K	0.50	1.10	0.020	0.043
L	0.90	1.50	0.035	0.059
M	1.30	1.70	0.051	0.067

Marking Diagram



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

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