TAIWAN SEMICONDUCTOR

RoHS COMPLIANCE

TSM4N60

600V N-Channel Power MOSFET

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	2

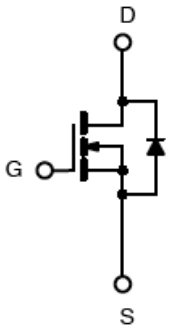
General Description

The TSM4N60 is produced using advanced planar stripe, DMOS technology. This latest technology has been especially designed to minimize on-state resistance, have a high rugged avalanche characteristics. There devices are well suited for high efficiency switch mode power supplies, active power factor correction, electronic lamp ballasts base on half bridge topology.

Features

- Robust high voltage termination
- Avalanche energy specified
- Diode is characterized for use in bridge circuits
- Source to Drain diode recovery time comparable to a discrete fast recovery diode.

Block Diagram



N-Channel MOSFET

Ordering Information

Part No.	Package	Packing
TSM4N60CZ C0	TO-220	50pcs / Tube
TSM4N60CZ C0G	TO-220	50pcs / Tube
TSM4N60CI C0	ITO-220	50pcs / Tube
TSM4N60CI C0G	ITO-220	50pcs / Tube
TSM4N60CH C5	TO-251	75pcs / Tube
TSM4N60CH C5G	TO-251	75pcs / Tube
TSM4N60CP RO	TO-252	2.5Kpcs / 13” Reel
TSM4N60CP ROG	TO-252	2.5Kpcs / 13” Reel

Note: “G” denotes for Halogen Free

Absolute Maximum Rating (Ta = 25°C unless otherwise noted)

Parameter		Symbol	Limit	Unit
Drain-Source Voltage		V_{DS}	600	V
Gate-Source Voltage		V_{GS}	±30	V
Continuous Drain Current		I_D	4	A
Pulsed Drain Current		I_{DM}	16	A
Single Pulse Drain to Source Avalanche Energy (note c)		EAS	120	mJ
Avalanche Current, Repetitive or Not-Repetitive (note d)		IAR	10	mJ
Peak Diode Recovery dv/dt (note e)		dv/dt	4.5	V/ns
Total Power Dissipation @T_C = 25°C	TO-220 / TO-251 / TO-252	P_{TOT}	70	W
	ITO-220		25	
Operating Junction Temperature		T_J	+150	°C
Operating Junction and Storage Temperature Range		T_J, T_{STG}	-55 to +150	°C

TSM4N60

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Thermal Performance

Parameter		Symbol	Limit	Unit
Thermal Resistance Junction to Case	TO-220 / TO-251 / TO-252	$R\Theta_{JC}$	1.78	°C/W
	ITO-220		5	
Thermal Resistance Junction to Ambient	TO-220 / ITO-220	$R\Theta_{JA}$	62.5	°C/W
	TO-251 / TO-252		100	

Notes: Surface mounted on FR4 board t ≤ 10sec

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

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 250uA	BV_{DSS}	600	--	--	V
Zero Gate Voltage Drain Current	V_{DS} = 600V, V_{GS} = 0V	I_{DSS}	--	--	10	uA
Gate Body Leakage	V_{GS} = ±30V, V_{DS} = 0V	I_{GSS}	--	--	±100	nA
On Characteristics						
Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250uA	$V_{GS(TH)}$	2.0	--	4.0	V
Drain-Source On-State Resistance	V_{GS} = 10V, I_D = 2A	$R_{DS(ON)}$	--	2	2.5	Ω
Dynamic Characteristics						
Total Gate Charge	V_{DS} = 480V, I_D = 4A, V_{GS} = 10V	Q_g	--	15	20	nC
Gate-Source Charge		Q_{gs}	--	2.8	--	
Gate-Drain Charge		Q_{gd}	--	6.2	--	
Input Capacitance	V_{DS} = 25V, V_{GS} = 0V, f = 1.0MHz	C_{iss}	--	545	710	pF
Output Capacitance		C_{oss}	--	60	80	
Reverse Transfer Capacitance		C_{rss}	--	8	11	
Turn-On Delay Time	V_{GS} = 10V, I_D = 4A, V_{DD} = 300V, R_G = 25Ω	$t_{d(on)}$	--	10	30	nS
Turn-On Rise Time		t_r	--	35	80	
Turn-Off Delay Time		$t_{d(off)}$	--	45	100	
Turn-Off Fall Time		t_f	--	40	90	
Source-Drain Diode Ratings and Characteristics						
Continuous Source Current	Integral Reverse p-n Junction Diode in the MOSFET	I_S	--	--	4	A
Pulse Source Current		I_{SM}	--	--	16	
Diode Forward Voltage	I_S = 4A, V_{GS} = 0V	V_{SD}	--	--	1.4	V
Reverse Recovery Time	I_S = 4A, V_{GS} = 0V dI$_F$/dt=100A/us	t_{rr}	--	300	--	nS
Reverse Recovery Charge		Q_{rr}	--	2.2	--	uC

Notes:

a. Pulse test: pulse width <=300uS, duty cycle <=2%

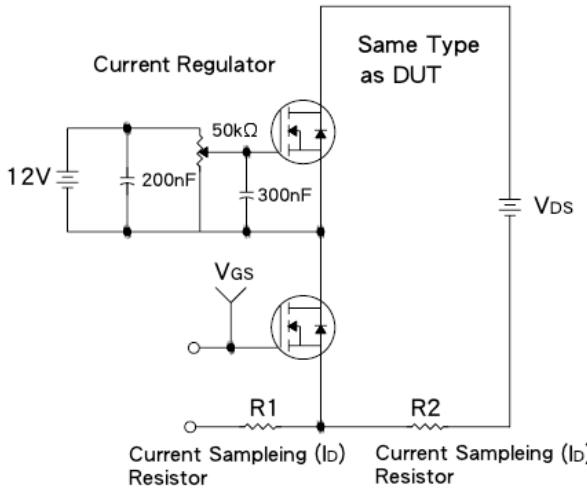
b. Essentially Independent of Operating Temperature.

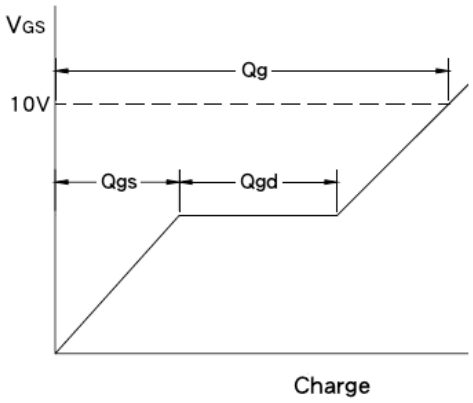
c. V_{DD} = 50V, I_{AS}=4A, L=27.5mH, R_G=25Ω, Starting T_J = 25°C

d. Pulse width limited by junction temperature

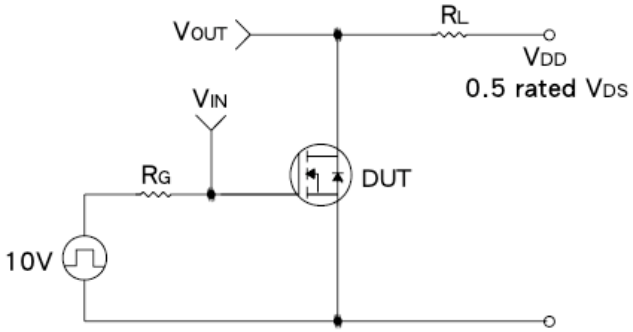
e. I_{SD} ≤ 4A, di/dt ≤ 200A/us, V_{DD} ≤ B_{VDSS}) Starting T_J=25ºC

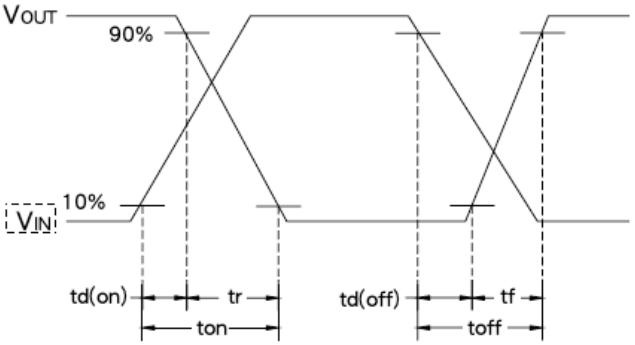
Gate Charge Test Circuit & Waveform



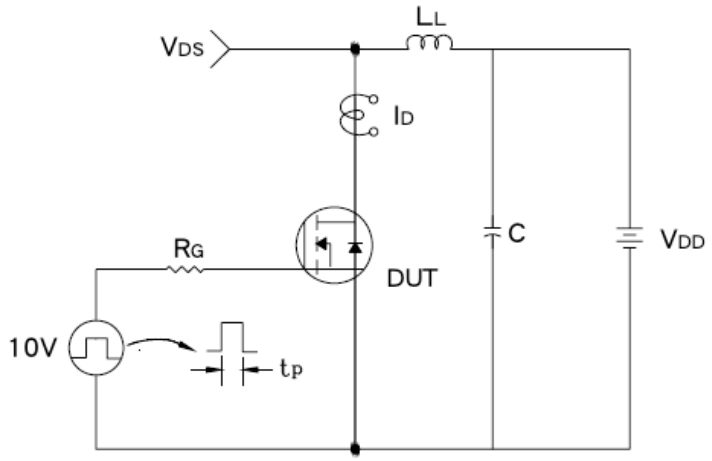


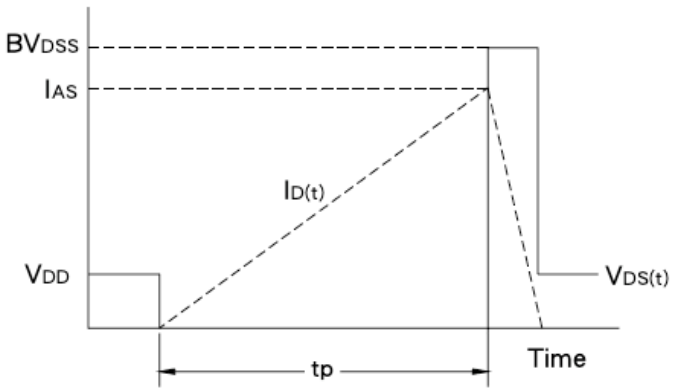
Resistive Switching Test Circuit & Waveform



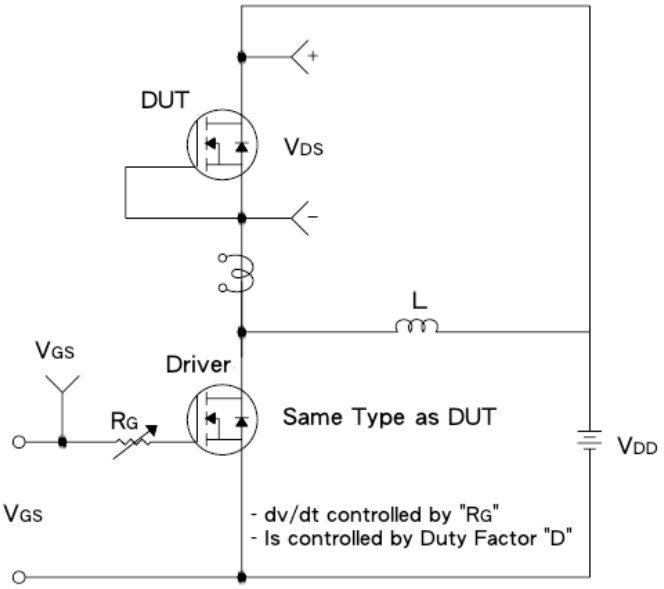


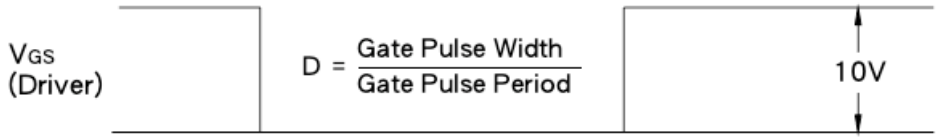
E_{AS} Test Circuit & Waveform

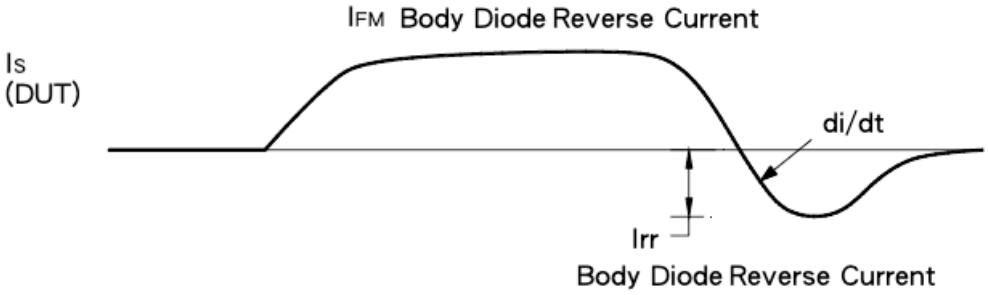


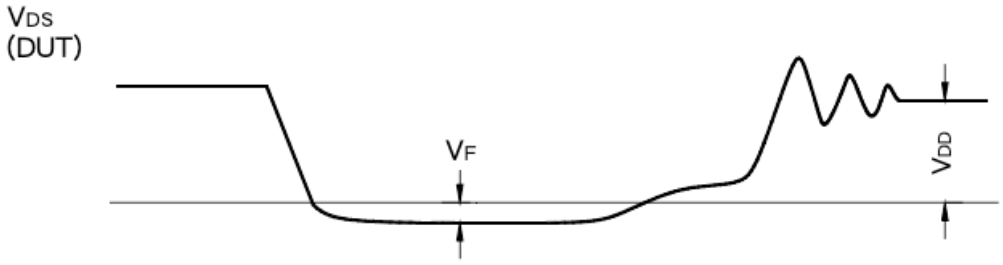


Diode Reverse Recovery Time Test Circuit & Waveform



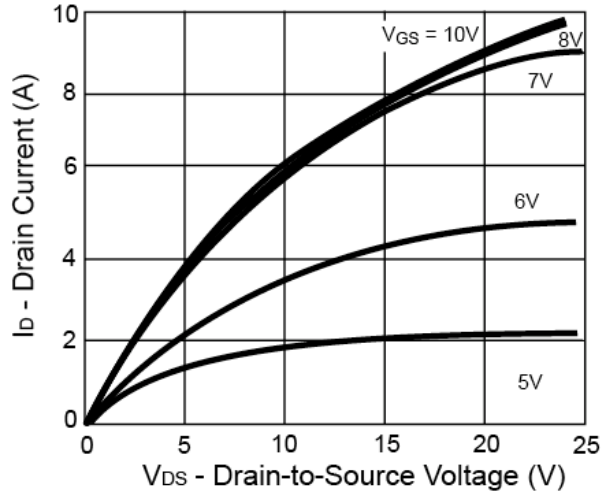




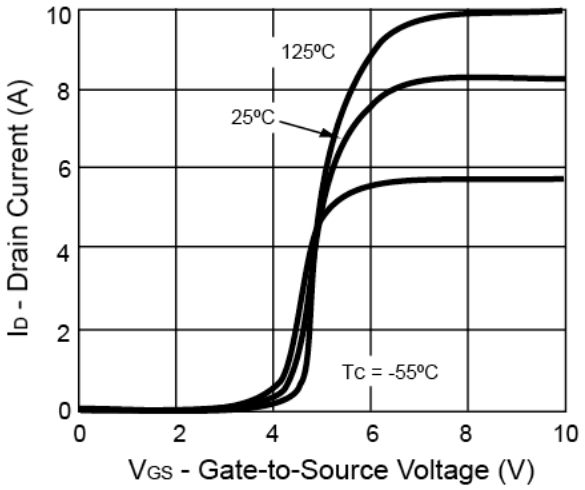


Electrical Characteristics Curve (Ta = 25ºC, unless otherwise noted)

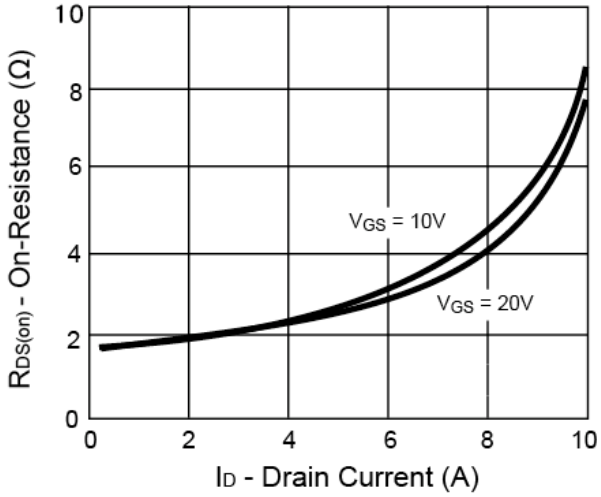
Output Characteristics



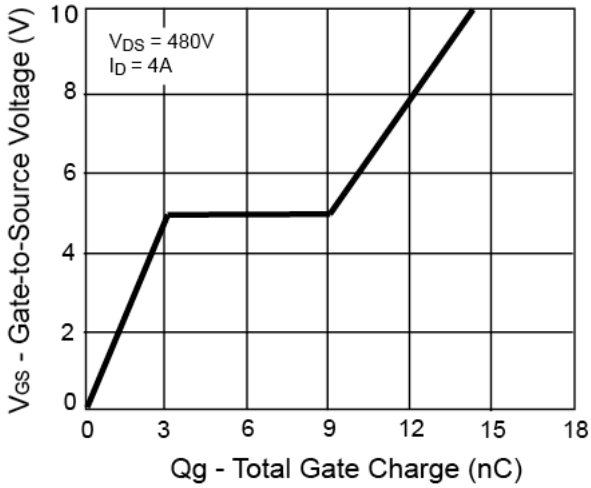
Transfer Characteristics



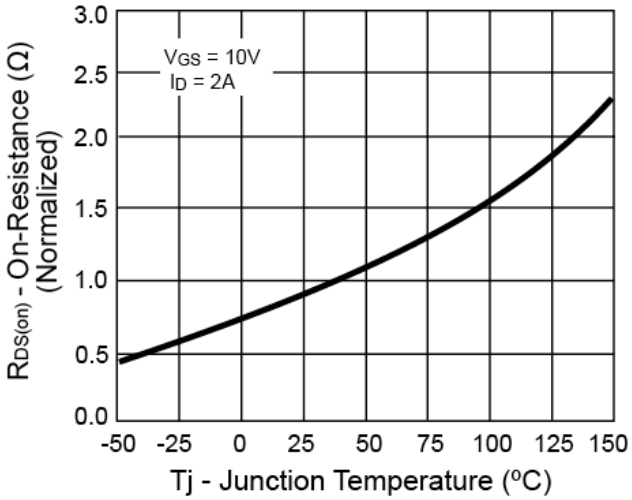
On-Resistance vs. Drain Current



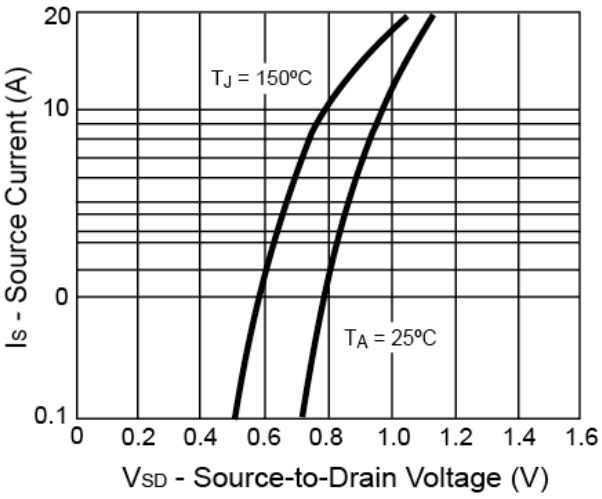
Gate Charge



On-Resistance vs. Junction Temperature



Source-Drain Diode Forward Voltage



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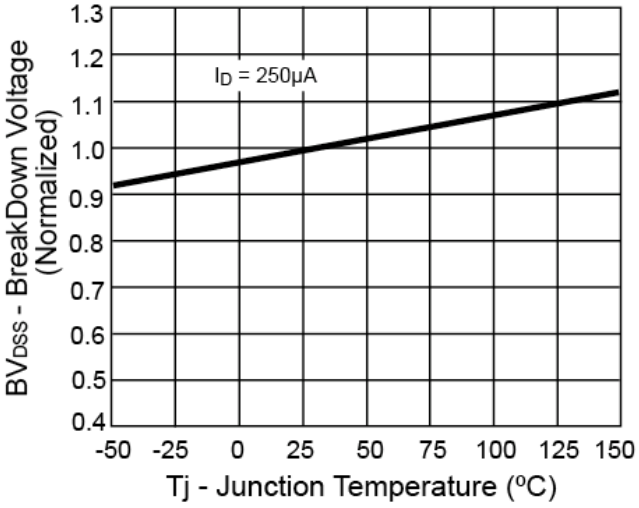
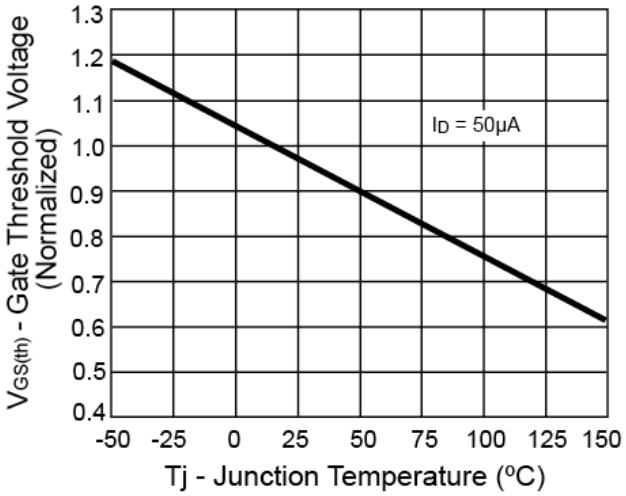
Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)

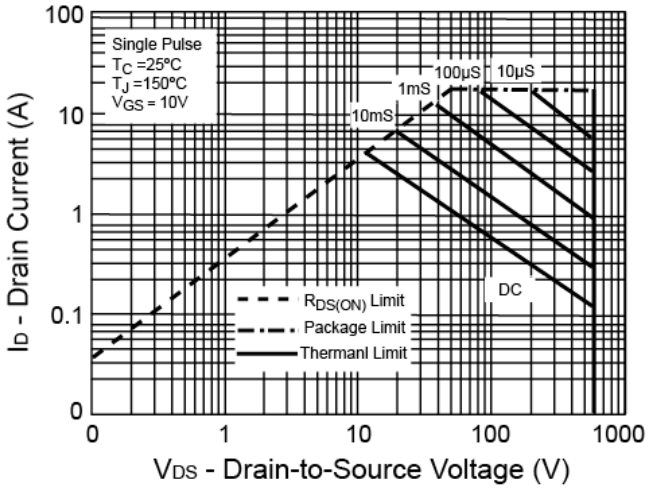
Breakdown Voltage vs. Temperature



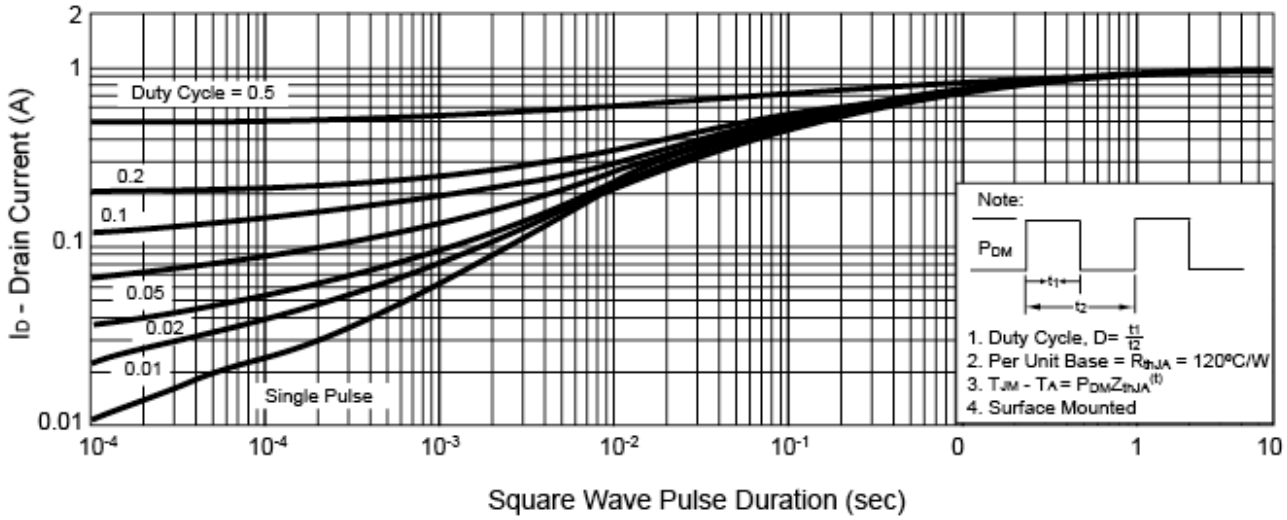
Threshold Voltage vs. Temperature



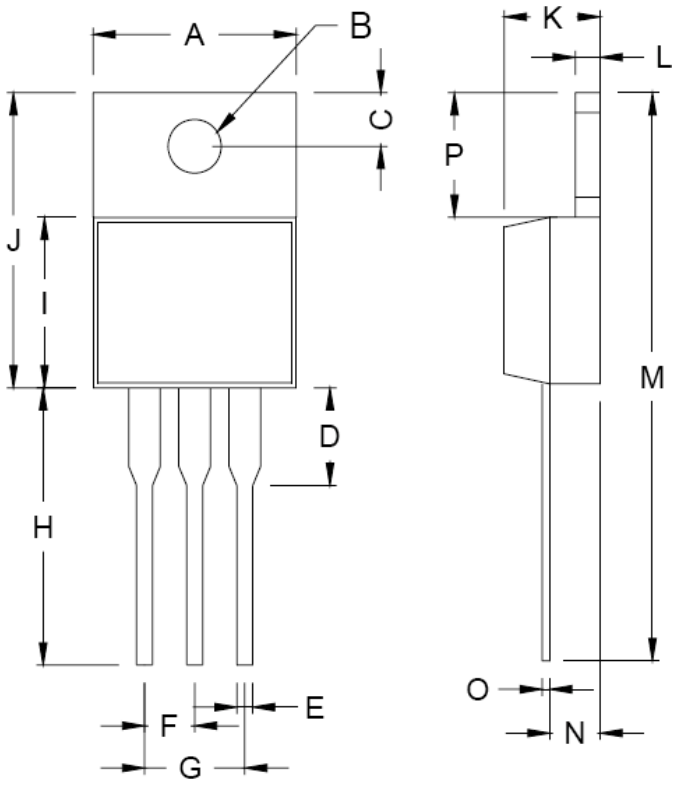
Maximum Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Ambient

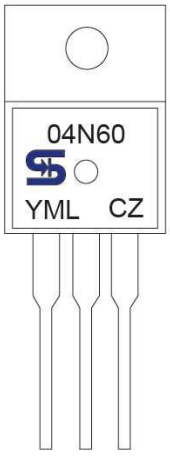


TO-220 Mechanical Drawing



TO-220 DIMENSION				
DIM	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
I	8.382	9.017	0.330	0.355
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



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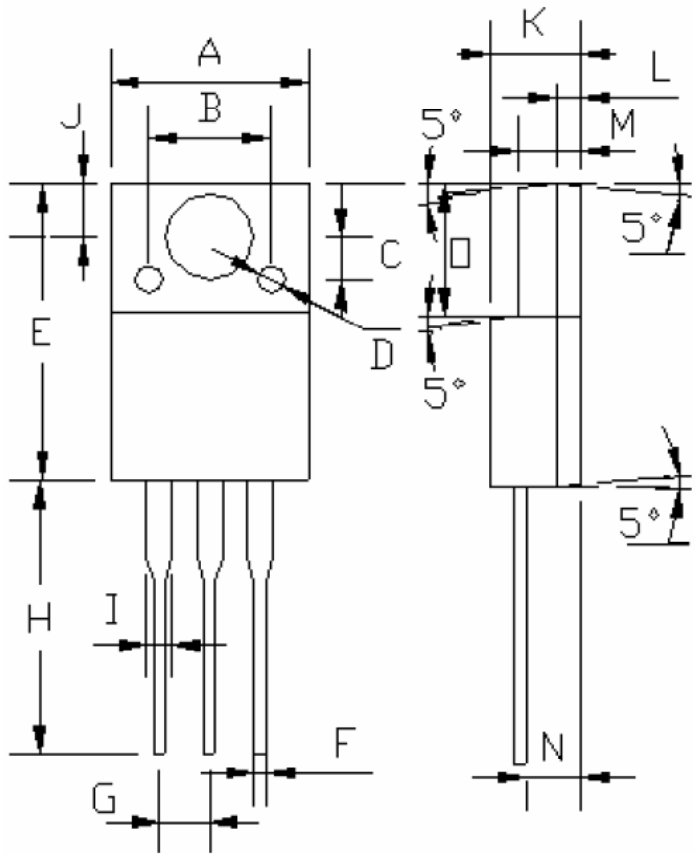
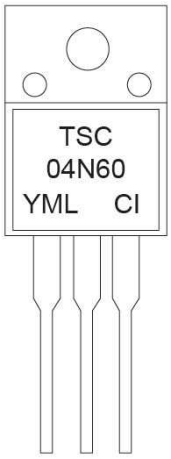
ITO-220 Mechanical Drawing



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	ϕ 1.40 (typ.)		ϕ 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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TSM4N60

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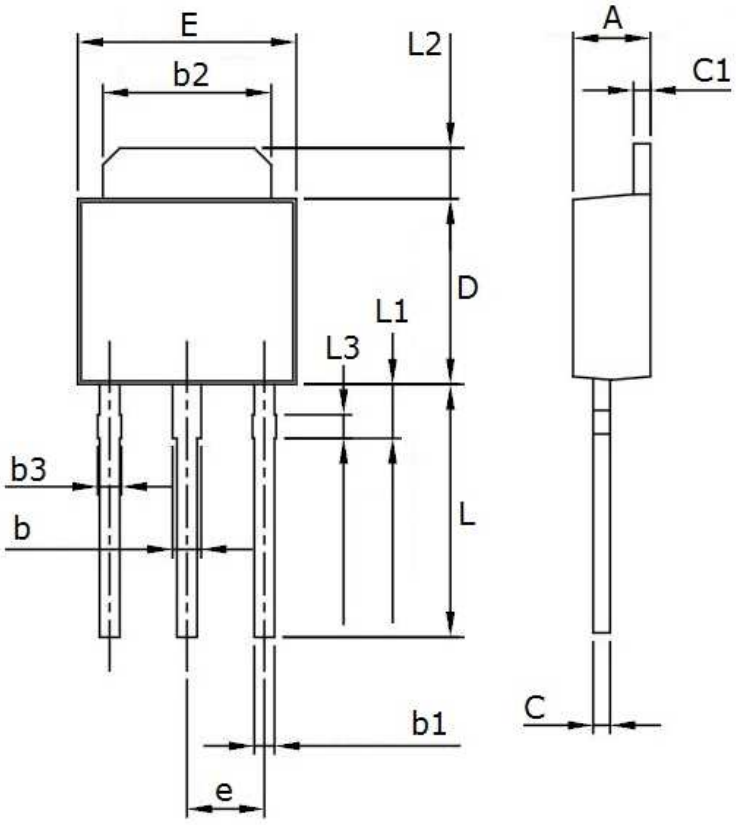
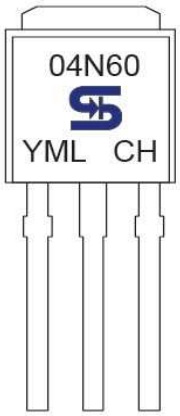
TO-251 Mechanical Drawing



TO-251 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.10	2.50	0.083	0.098
b	0.65	1.05	0.026	0.041
b1	0.58	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



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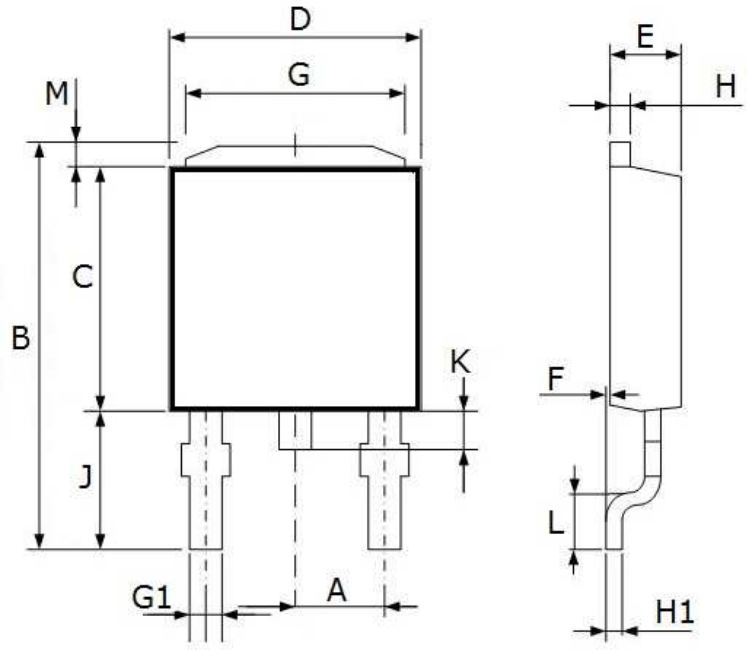
TO-252 Mechanical Drawing



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

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