



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

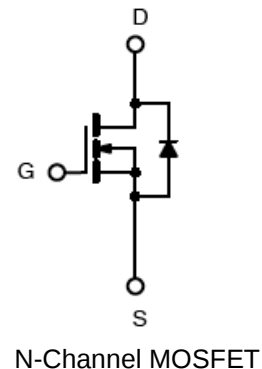
- Robust high voltage termination
- Avalanche energy specified
- Diode is characterized for use in bridge circuits
- Source to Drain diode recovery time comparable to a discrete fast recovery diode.

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

Block Diagram



N-Channel MOSFET

Absolute Maximum Rating ($T_a = 25^\circ\text{C}$ 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 @ $T_c = 25^\circ\text{C}$	TO-220 / TO-251 / TO-252	70	W
	ITO-220	25	
Operating Junction Temperature	T_J	+150	$^\circ\text{C}$
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 to +150	$^\circ\text{C}$

Thermal Performance

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

Notes: Surface mounted on FR4 board $t \leq 10\text{sec}$

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

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	$V_{GS} = 0\text{V}$, $I_D = 250\mu\text{A}$	BV_{DSS}	600	--	--	V
Zero Gate Voltage Drain Current	$V_{DS} = 600\text{V}$, $V_{GS} = 0\text{V}$	I_{DSS}	--	--	10	μA
Gate Body Leakage	$V_{GS} = \pm 30\text{V}$, $V_{DS} = 0\text{V}$	I_{GSS}	--	--	± 100	nA
On Characteristics						
Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250\mu\text{A}$	$V_{GS(TH)}$	2.0	--	4.0	V
Drain-Source On-State Resistance	$V_{GS} = 10\text{V}$, $I_D = 2\text{A}$	$R_{DS(ON)}$	--	2	2.5	Ω
Dynamic Characteristics						
Total Gate Charge	$V_{DS} = 480\text{V}$, $I_D = 4\text{A}$, $V_{GS} = 10\text{V}$	Q_g	--	15	20	nC
Gate-Source Charge		Q_{gs}	--	2.8	--	
Gate-Drain Charge		Q_{gd}	--	6.2	--	
Input Capacitance	$V_{DS} = 25\text{V}$, $V_{GS} = 0\text{V}$, $f = 1.0\text{MHz}$	C_{iss}	--	545	710	pF
Output Capacitance		C_{oss}	--	60	80	
Reverse Transfer Capacitance		C_{rss}	--	8	11	
Turn-On Delay Time	$V_{GS} = 10\text{V}$, $I_D = 4\text{A}$, $V_{DD} = 300\text{V}$, $R_G = 25\Omega$	$t_{d(on)}$	--	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	

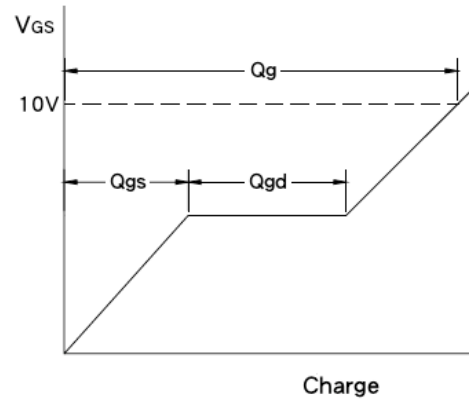
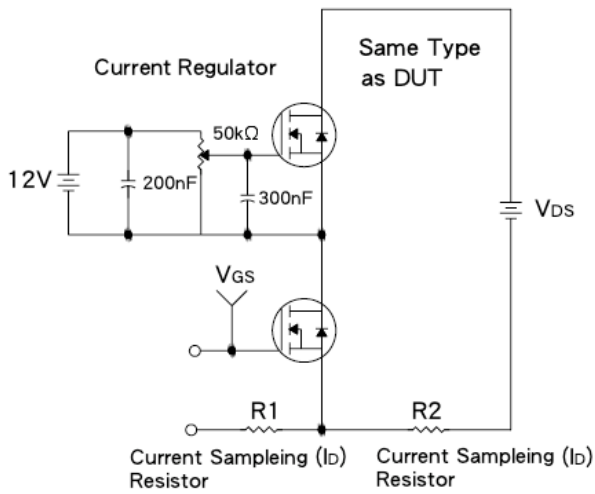
Source-Drain Diode Ratings and Characteristics

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	$I_S = 4\text{A}$, $V_{GS} = 0\text{V}$	V_{SD}	--	--	1.4	V
Reverse Recovery Time	$I_S = 4\text{A}$, $V_{GS} = 0\text{V}$	t_{rr}	--	300	--	nS
Reverse Recovery Charge	$di/dt = 100\text{A/us}$	Q_{rr}	--	2.2	--	μC

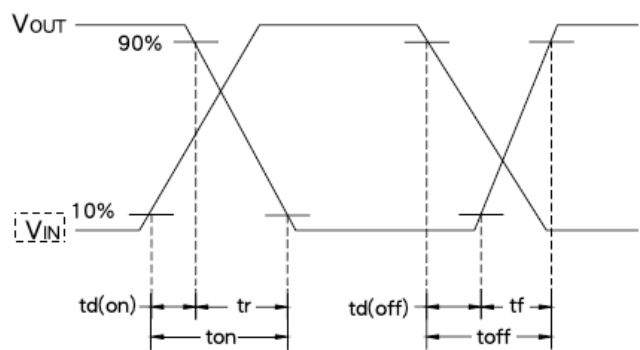
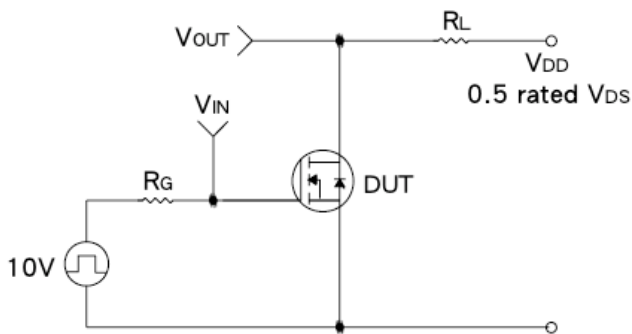
Notes:

- Pulse test: pulse width $\leq 300\mu\text{s}$, duty cycle $\leq 2\%$
- Essentially Independent of Operating Temperature.
- $V_{DD} = 50\text{V}$, $I_{AS} = 4\text{A}$, $L = 27.5\text{mH}$, $R_G = 25\Omega$, Starting $T_J = 25^{\circ}\text{C}$
- Pulse width limited by junction temperature
- $I_{SD} \leq 4\text{A}$, $di/dt \leq 200\text{A/us}$, $V_{DD} \leq B_{VDSS}$ Starting $T_J = 25^{\circ}\text{C}$

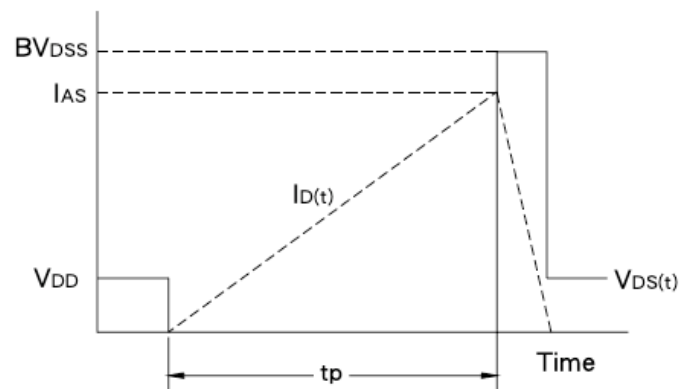
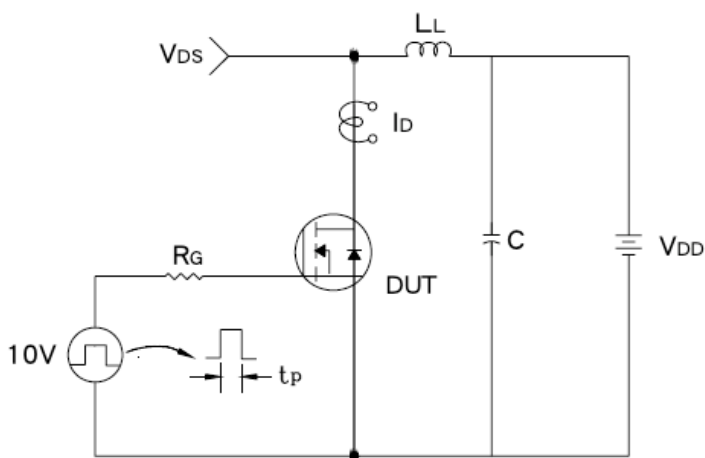
Gate Charge Test Circuit & Waveform



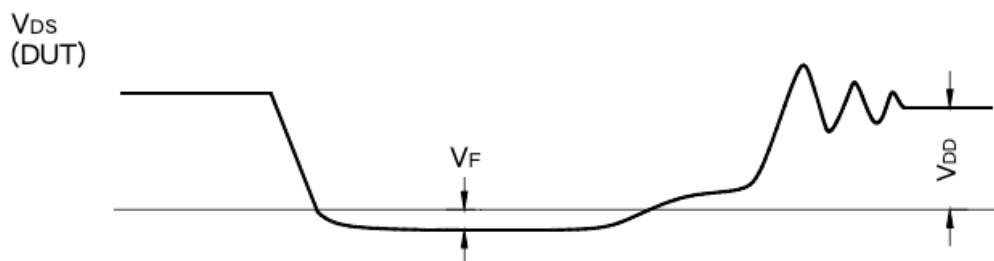
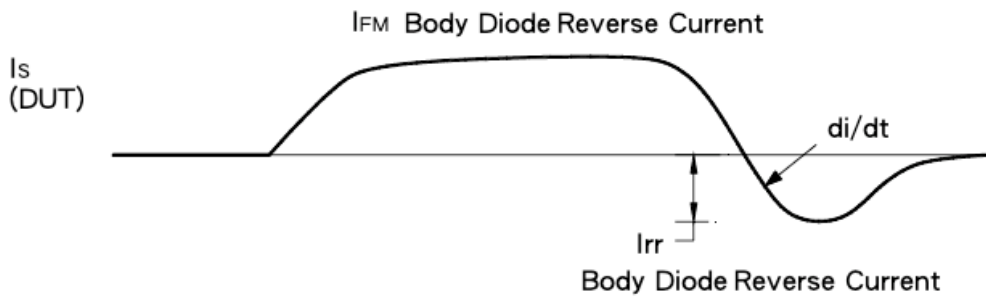
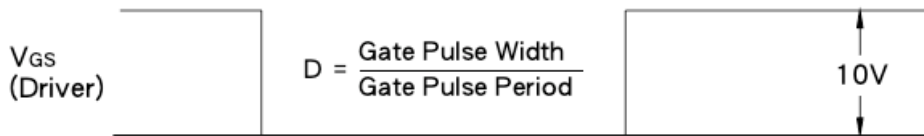
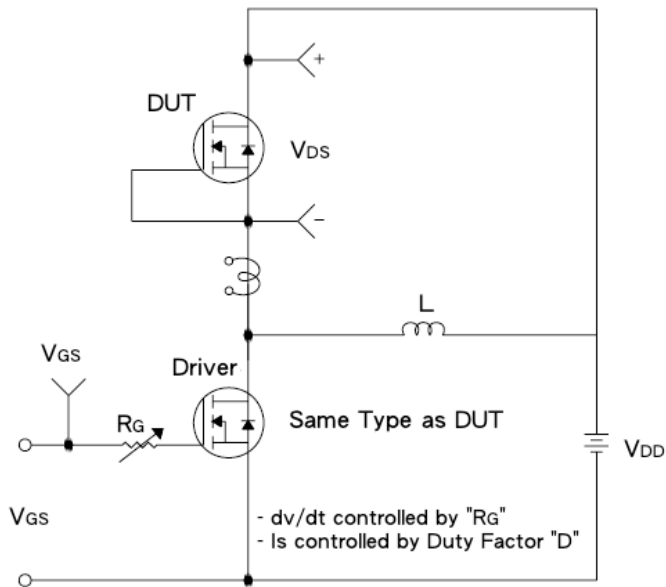
Resistive Switching Test Circuit & Waveform



E_{AS} Test Circuit & Waveform

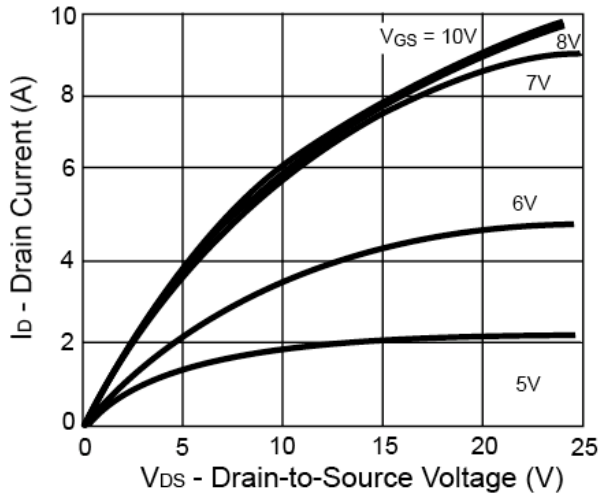


Diode Reverse Recovery Time Test Circuit & Waveform

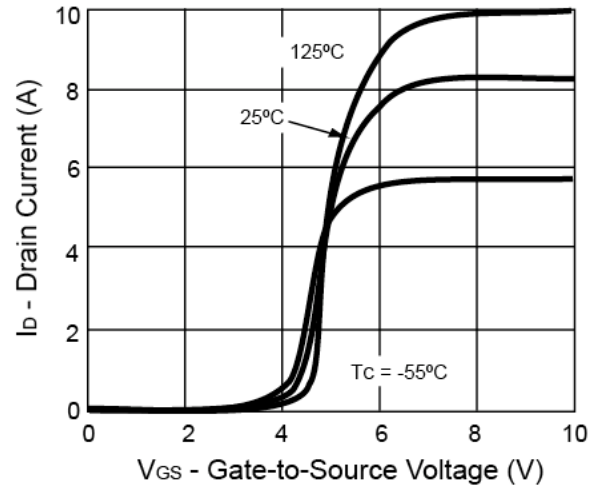


Electrical Characteristics Curve ($T_a = 25^\circ\text{C}$, unless otherwise noted)

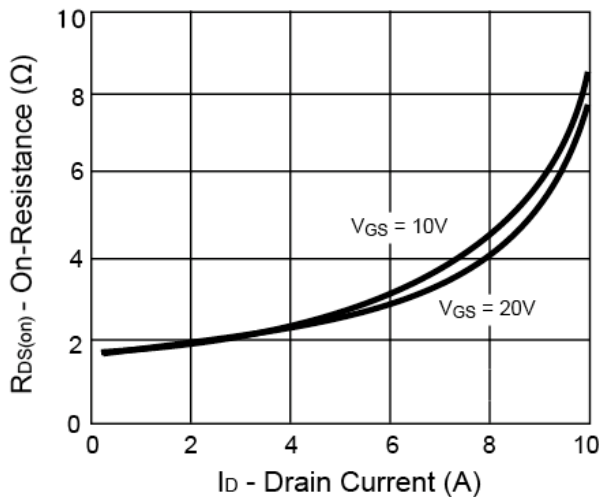
Output Characteristics



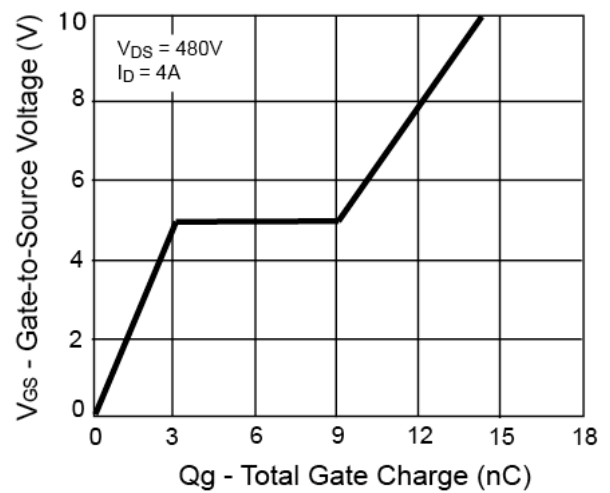
Transfer Characteristics



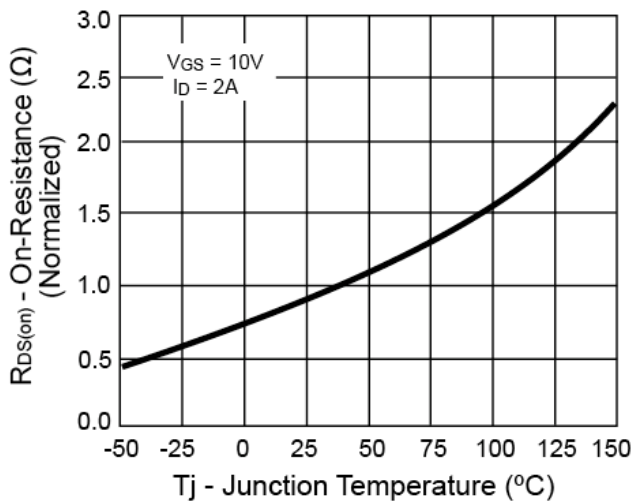
On-Resistance vs. Drain Current



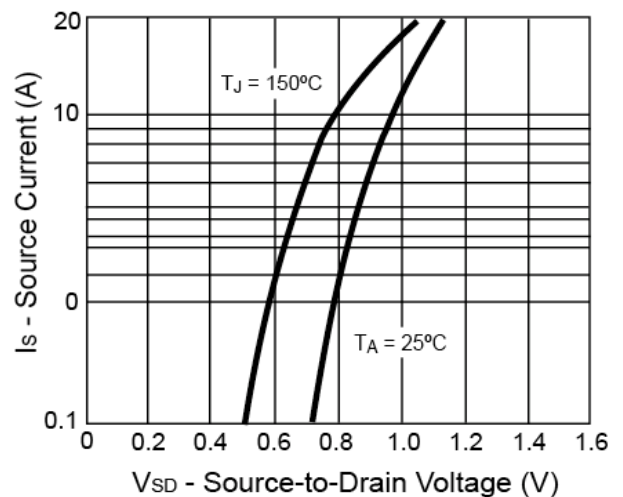
Gate Charge



On-Resistance vs. Junction Temperature

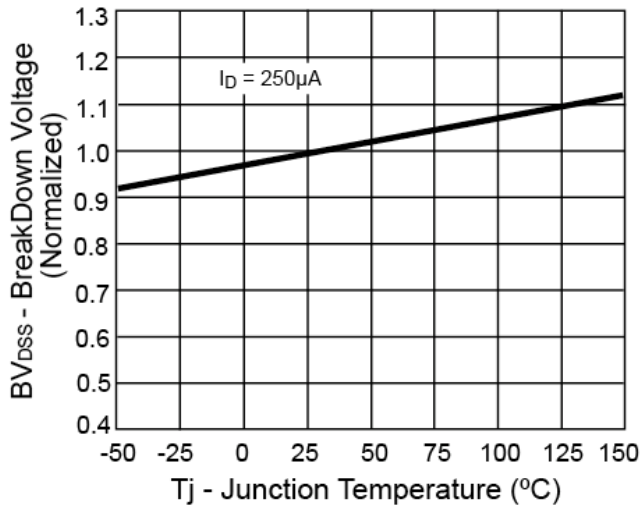


Source-Drain Diode Forward Voltage

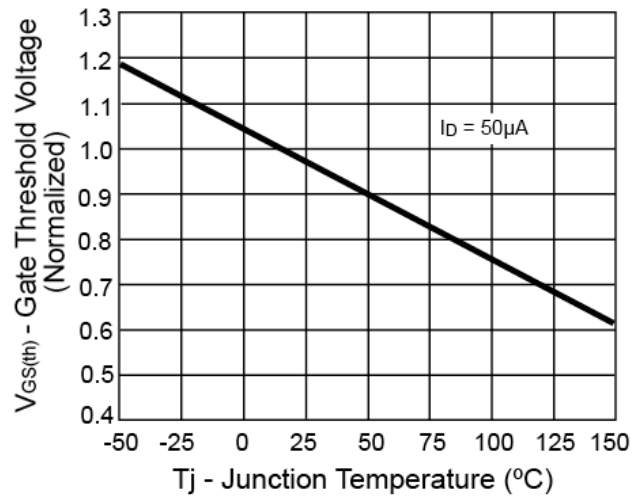


Electrical Characteristics Curve ($T_a = 25^\circ\text{C}$, unless otherwise noted)

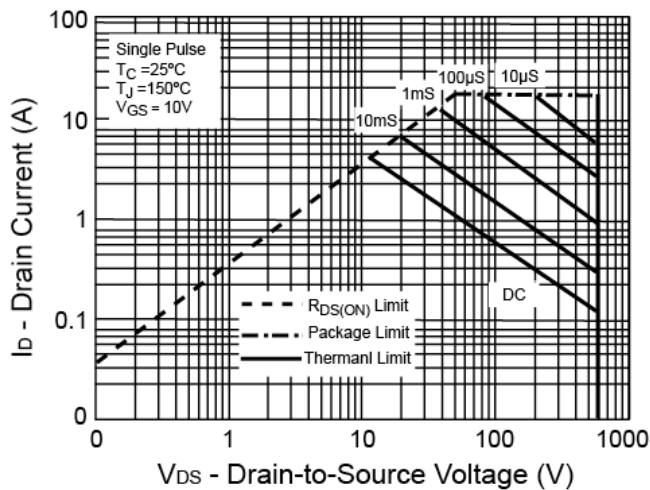
Breakdown Voltage vs. Temperature



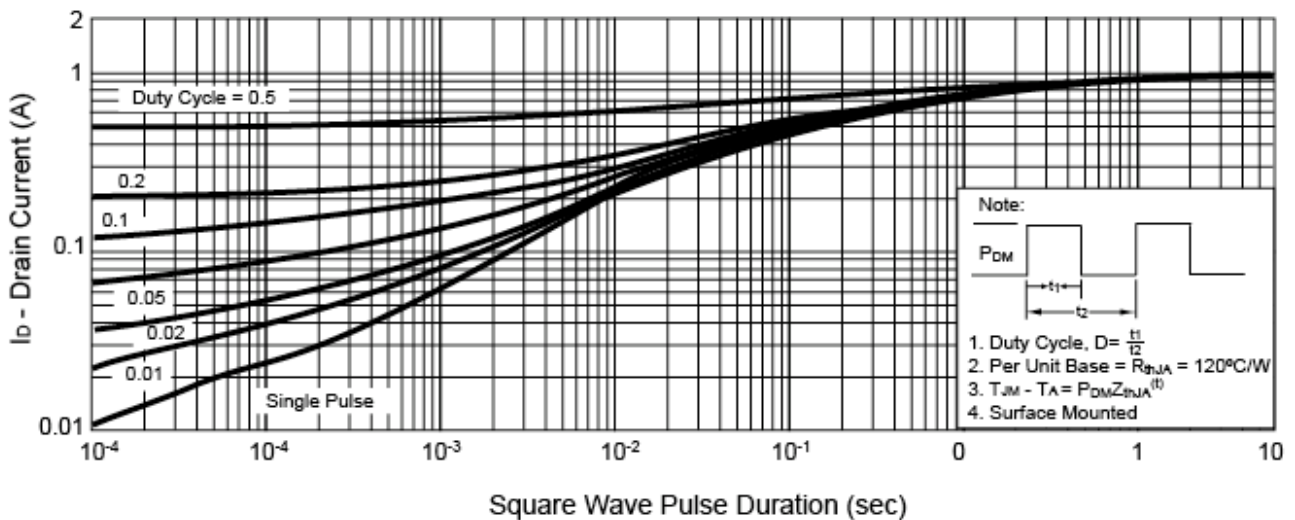
Threshold Voltage vs. Temperature



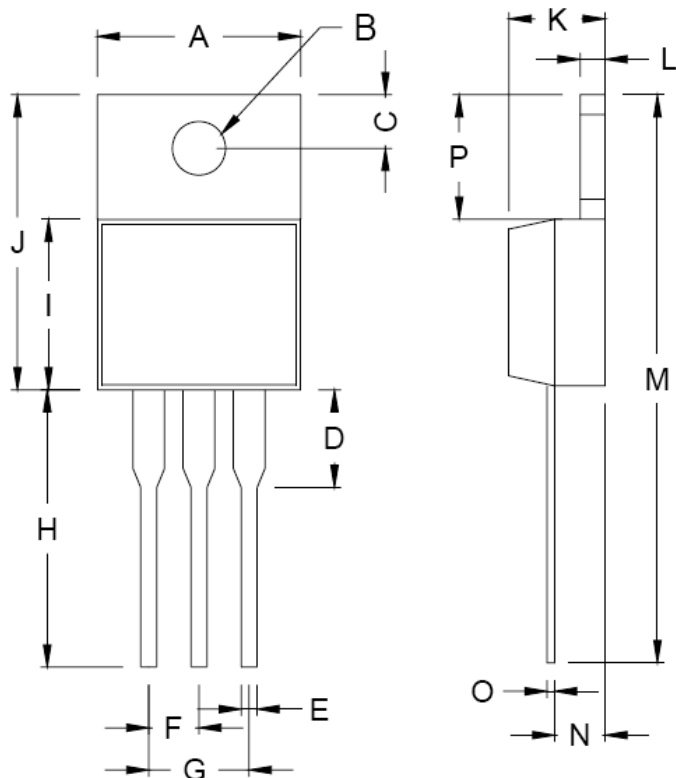
Maximum Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Ambient

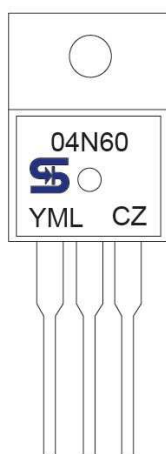


TO-220 Mechanical Drawing



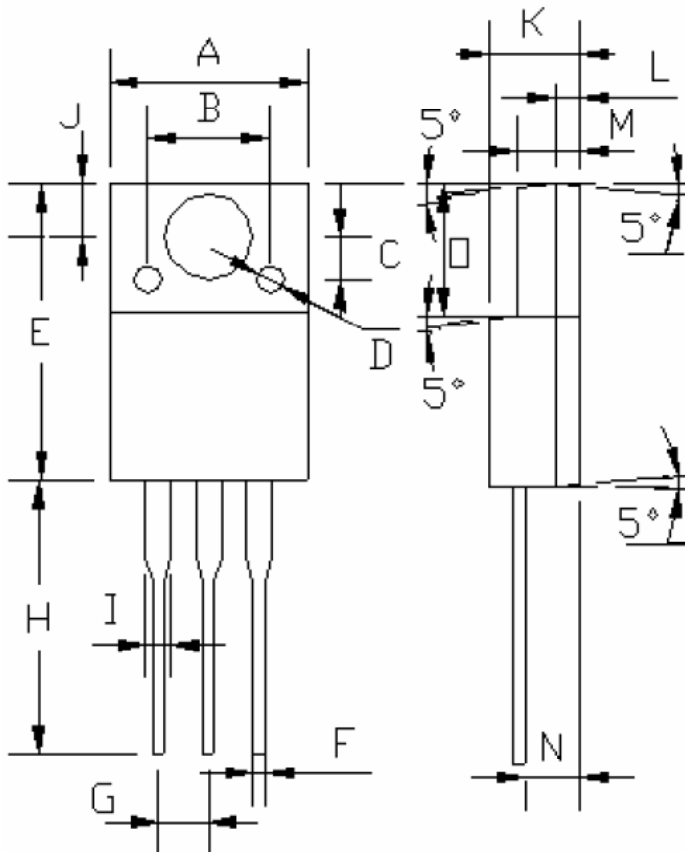
TO-220 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.000	10.500	0.394	0.413
B	3.740	3.910	0.147	0.154
C	2.440	2.940	0.096	0.116
D	-	6.350	-	0.250
E	0.381	1.106	0.015	0.040
F	2.345	2.715	0.092	0.058
G	4.690	5.430	0.092	0.107
H	12.700	14.732	0.500	0.581
I	8.382	9.017	0.330	0.355
J	14.224	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



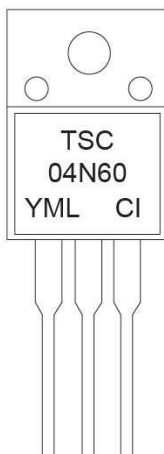
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ITO-220 Mechanical Drawing



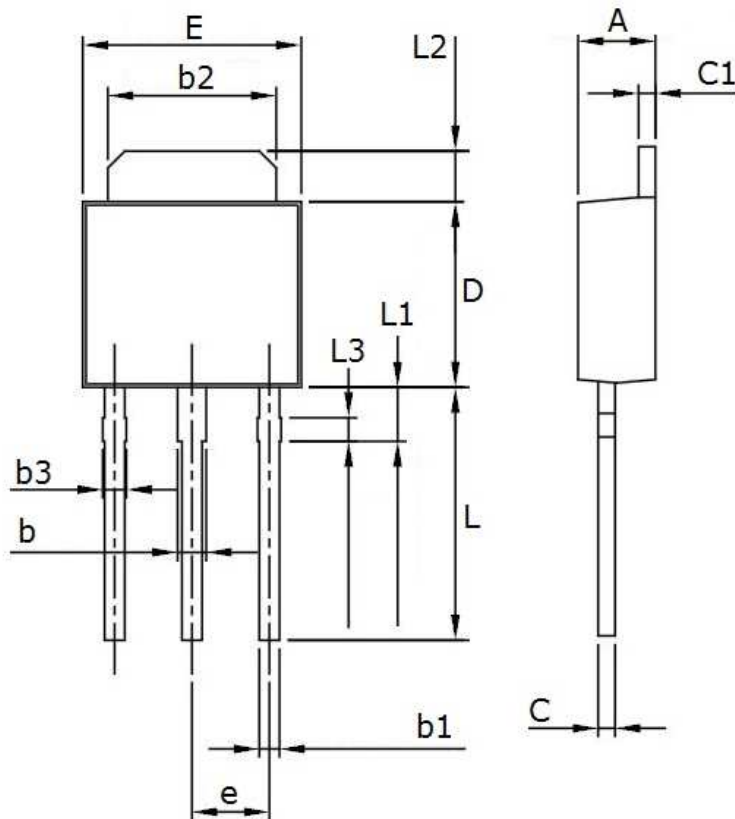
ITO-220 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.04	10.07	0.395	0.396
B	6.20 (typ.)		0.244 (typ.)	
C	2.20 (typ.)		0.087 (typ.)	
D	§ 1.40 (typ.)		§ 0.055 (typ.)	
E	15.0	15.20	0.591	0.598
F	0.52	0.54	0.020	0.021
G	2.35	2.73	0.093	0.107
H	13.50	13.55	0.531	0.533
I	1.11	1.49	0.044	0.058
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



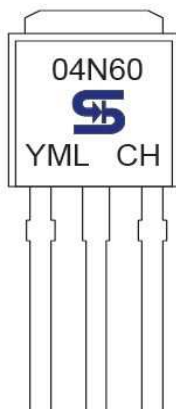
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TO-251 Mechanical Drawing



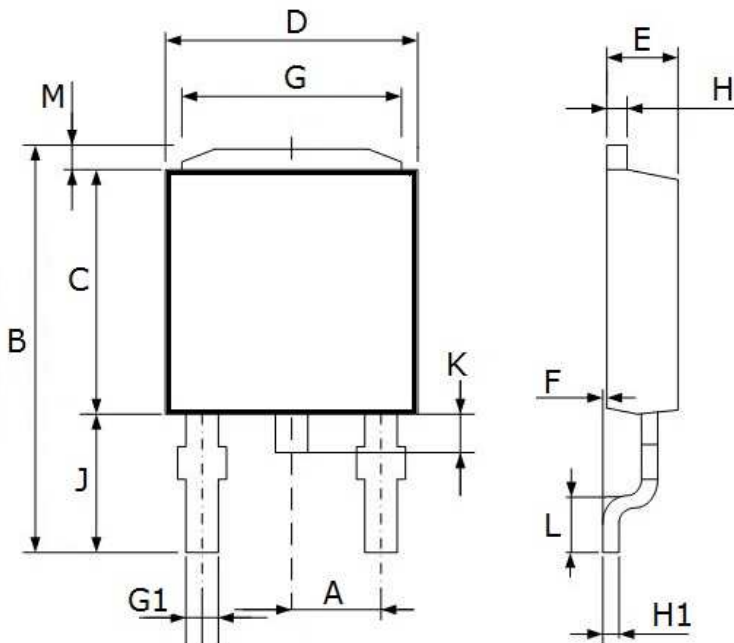
TO-251 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.10	2.50	0.083	0.098
b	0.65	1.05	0.026	0.041
b1	0.58	0.62	0.023	0.024
b2	4.80	5.20	0.189	0.205
b3	0.68	0.72	0.027	0.028
C	0.35	0.65	0.014	0.026
C1	0.40	0.60	0.016	0.024
D	5.30	5.70	0.209	0.224
E	6.30	6.70	0.248	0.264
e	2.30 BSC		0.09 BSC	
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



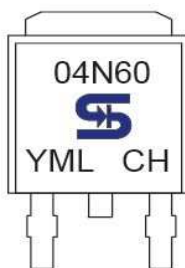
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TO-252 Mechanical Drawing



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

Marking Diagram



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