

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. These devices are well suited for high efficiency switch mode power supplies, active power factor correction, electronic lamp ballasts base on half bridge topology.

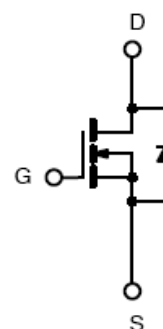
Features

- 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
TSM4N60CI C0	ITO-220	50pcs / Tube
TSM4N60CH C5	TO-251	80pcs / Tube
TSM4N60CP RO	TO-252	2.5Kpcs / 13" Reel

Block Diagram



N-Channel MOSFET

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 (V _{DD} = 50V, I _{AS} =4A, L=27.5mH, R _G =25Ω), Starting T _J = 25°C	EAS	240	mJ
Repetitive Avalanche Energy (Pulse width limited by junction temperature)	EAR	10	mJ
Peak Diode Recovery dv/dt (I _{SD} ≤ 4A, di/dt ≤ 200A/us, V _{DD} ≤ B _{VDS}) Starting T _J =25°C	dv/dt	4.5	V/ns
Maximum Power Dissipation @Ta = 25°C	TO-220 / TO-251 / TO-252	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

Thermal Performance

Parameter	Symbol	Limit	Unit
Thermal Resistance Junction to Case	TO-220 / TO-251 / TO-252	1.78	°C/W
	ITO-220	5	
Thermal Resistance Junction to Ambient	TO-220 / ITO-220	62.5	°C/W
	TO-251 / TO-252	100	

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

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

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A$	BV_{DSS}	600	--	--	V
Breakdown Voltage Temperature Coefficient	$I_D = 250\mu A$ Referenced to 25°C	$\Delta BV_{DSS} / T_J$	--	0.6	--	V/°C
Zero Gate Voltage Drain Current	$V_{DS} = 600V, V_{GS} = 0V$	I_{DSS}	--	--	10	μA
Gate Body Leakage	$V_{GS} = \pm 30V, V_{DS} = 0V$	I_{GSS}	--	--	± 100	nA

On Characteristics

Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	$V_{GS(TH)}$	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

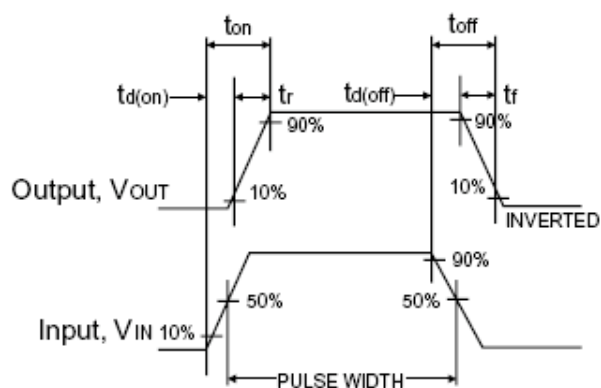
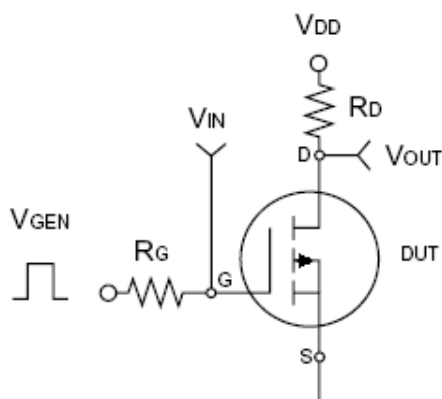
Total Gate Charge	$V_{DS} = 480V, I_D = 4A,$ $V_{GS} = 10V$	Q_g	--	15	20	nC
Gate-Source Charge		Q_{gs}	--	2.8	--	
Gate-Drain Charge		Q_{gd}	--	6.2	--	
Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V,$ $f = 1.0\text{MHz}$	C_{iss}	--	545	710	pF
Output Capacitance		C_{oss}	--	60	80	
Reverse Transfer Capacitance		C_{rss}	--	8	11	
Turn-On Delay Time	$V_{GS} = 10V, I_D = 4A,$ $V_{DD} = 300V, R_G = 25\Omega$	$t_{d(on)}$	--	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	$I_S = 4A, V_{GS} = 0V$	V_{SD}	--	--	1.4	V
Reverse Recovery Time	$I_S = 4A, V_{GS} = 0V$	t_{rr}	--	300	--	nS
Reverse Recovery Charge	$dI_F/dt = 100A/\mu s$	Q_{rr}	--	2.2	--	μC

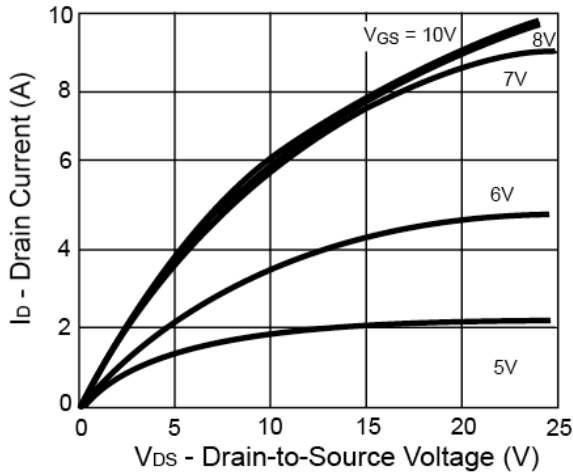
Notes:

- Pulse test: pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$
- Essentially Independent of Operating Temperature.

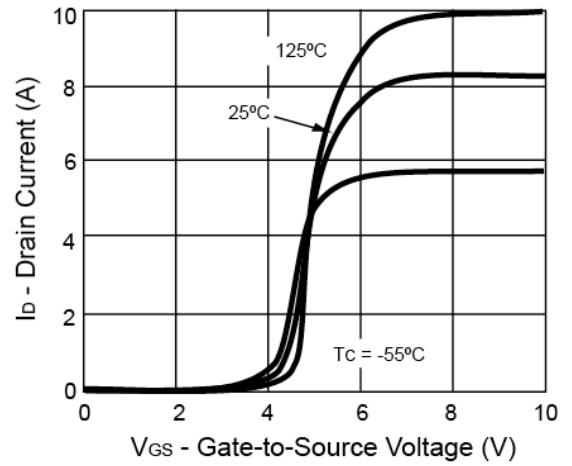


Electrical Characteristics Curve ($T_a = 25^\circ\text{C}$, unless otherwise noted)

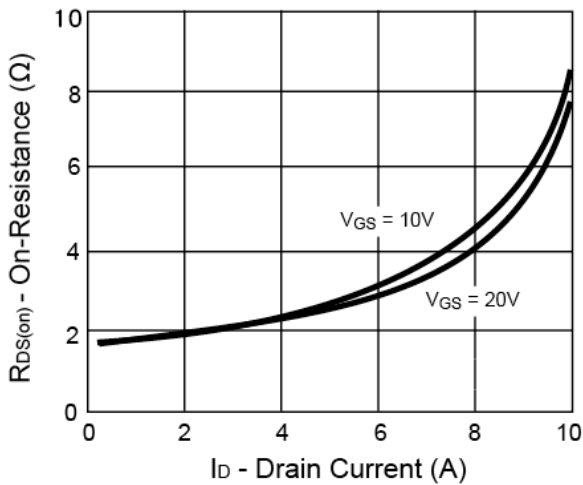
Output Characteristics



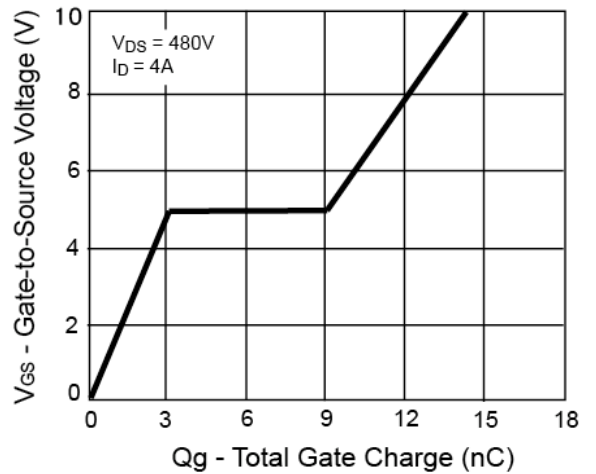
Transfer Characteristics



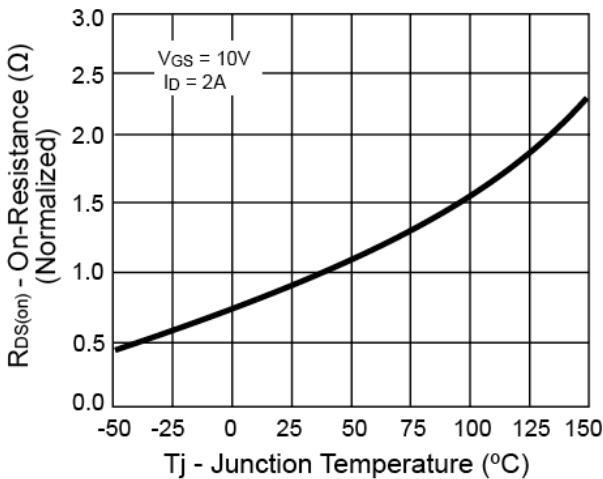
On-Resistance vs. Drain Current



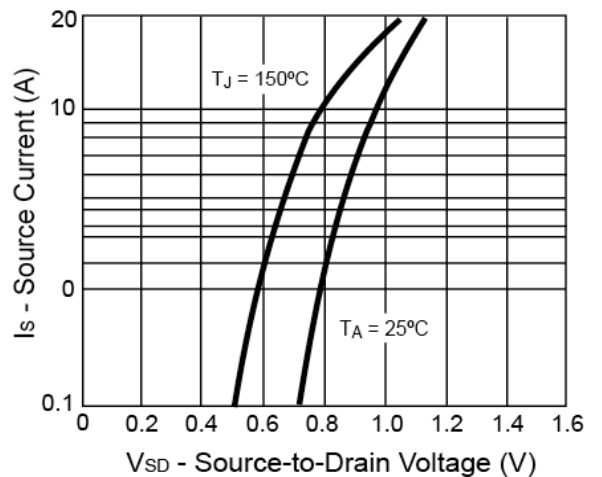
Gate Charge



On-Resistance vs. Junction Temperature

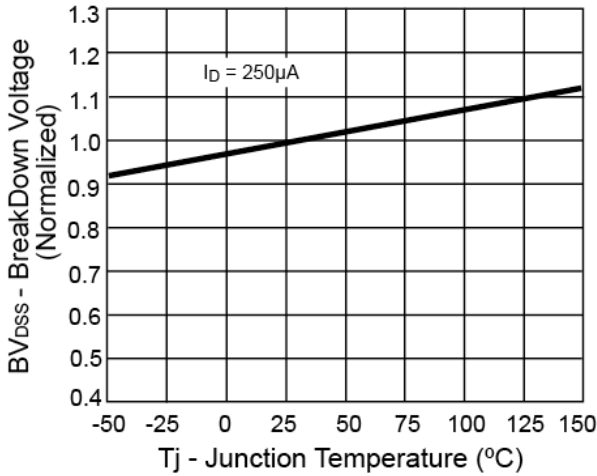


Source-Drain Diode Forward Voltage

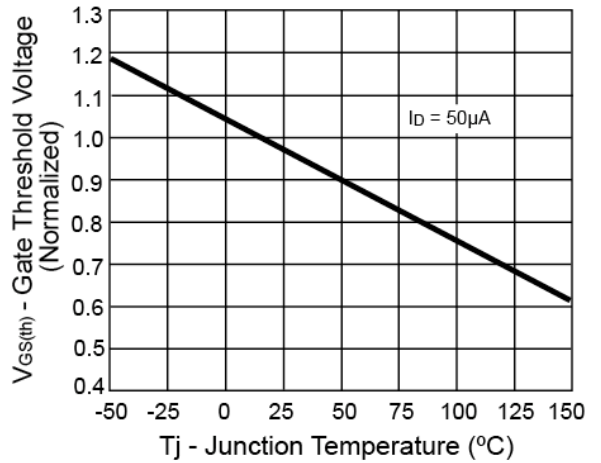


Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)

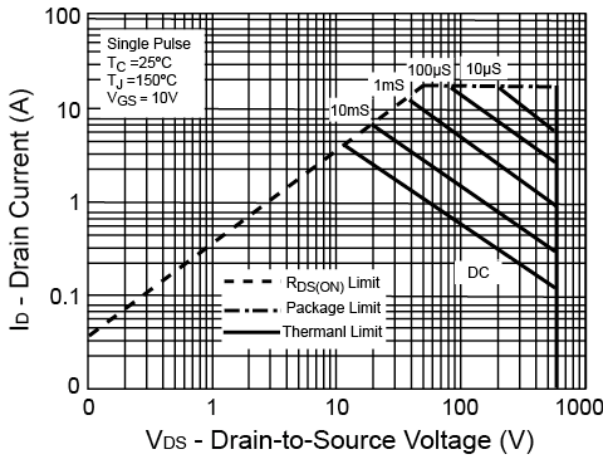
Breakdown Voltage vs. Temperature



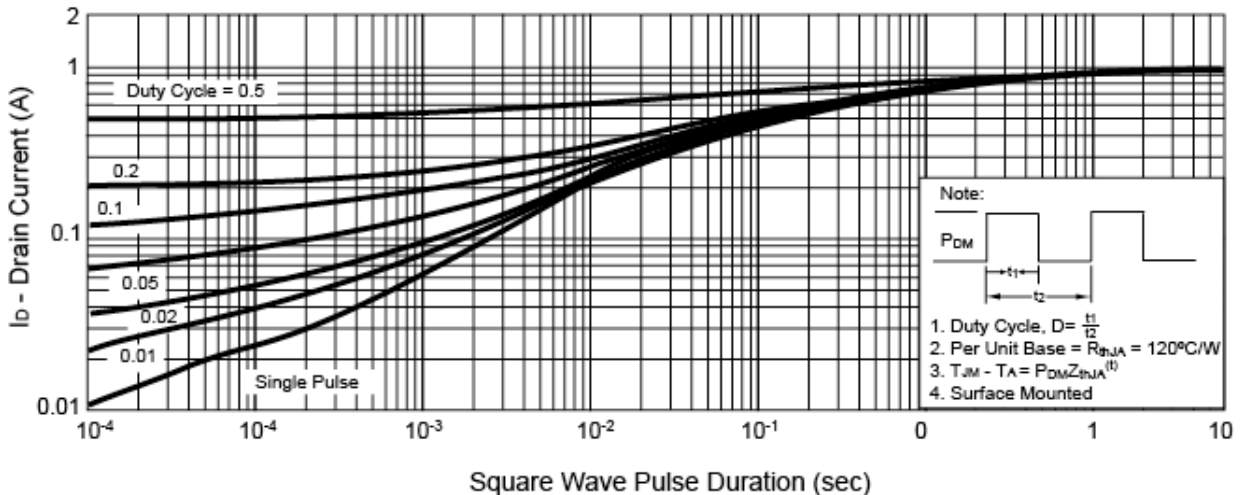
Threshold Voltage vs. Temperature



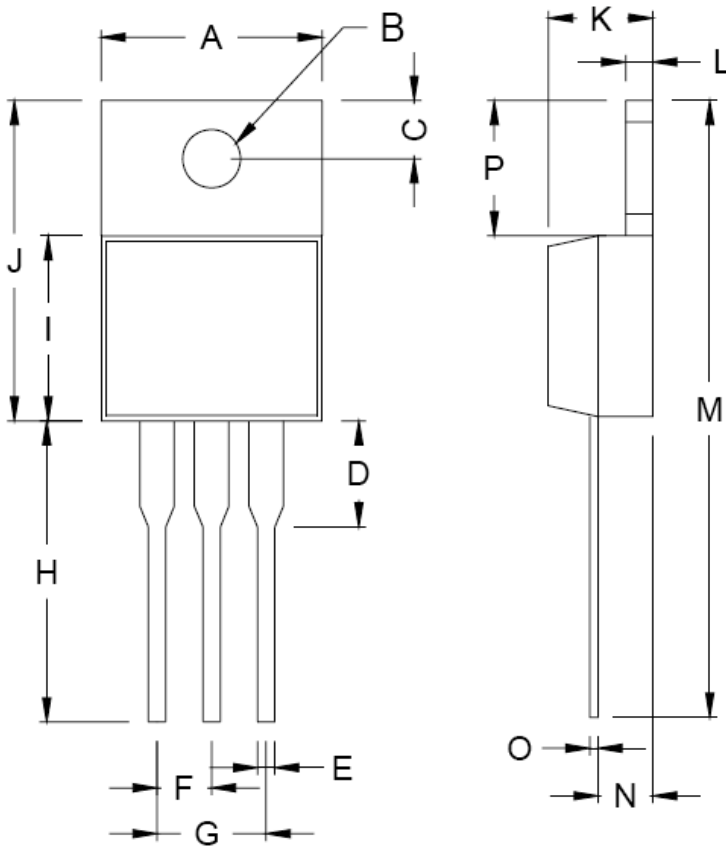
Maximum Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Ambient

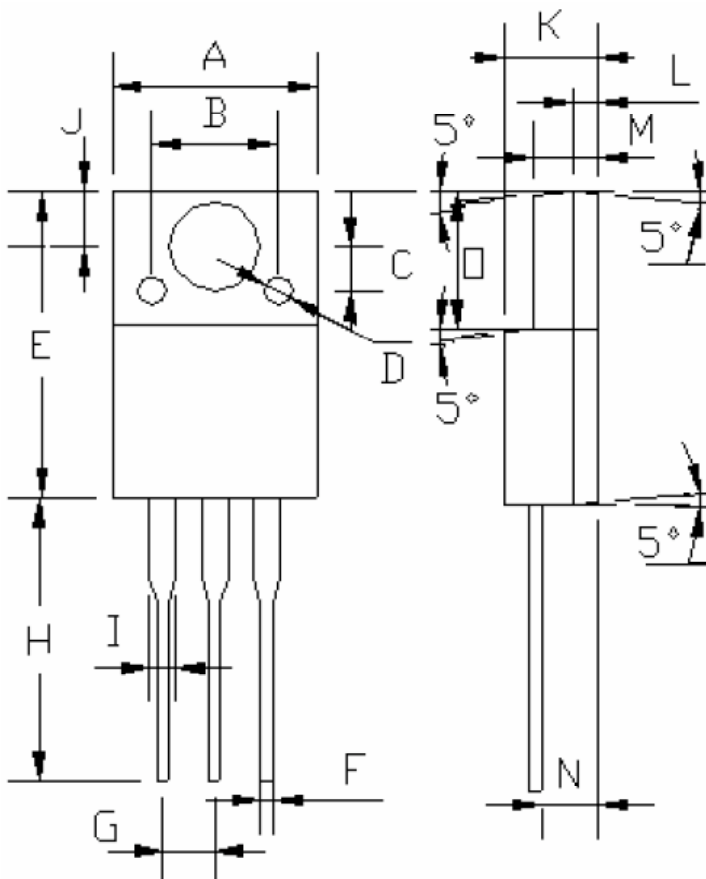


TO-220 Mechanical Drawing



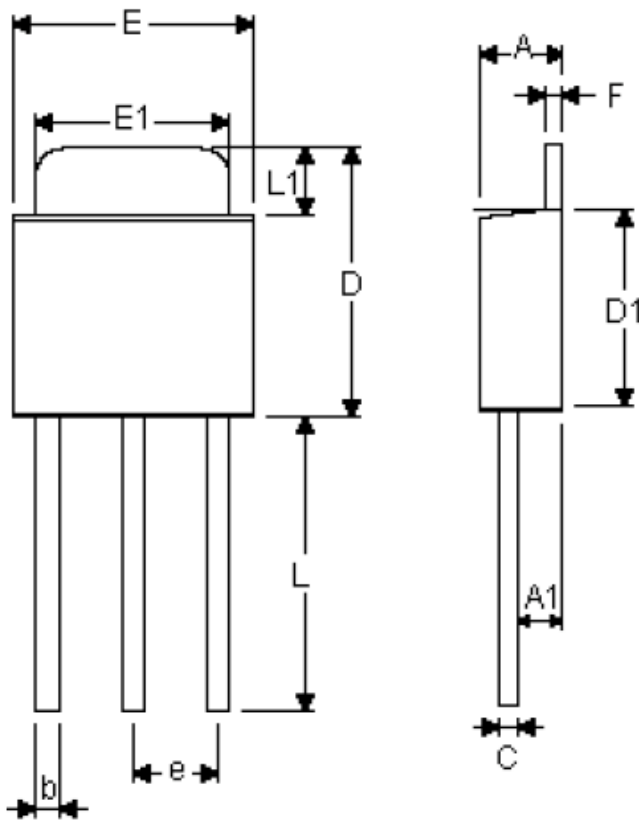
DIM	TO-220 DIMENSION			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.000	10.500	0.394	0.413
B	3.740	3.910	0.147	0.154
C	2.440	2.940	0.096	0.116
D	-	6.350	-	0.250
E	0.381	1.106	0.015	0.040
F	2.345	2.715	0.092	0.058
G	4.690	5.430	0.092	0.107
H	12.700	14.732	0.500	0.581
I	8.382	9.017	0.330	0.355
J	14.224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

ITO-220 Mechanical Drawing



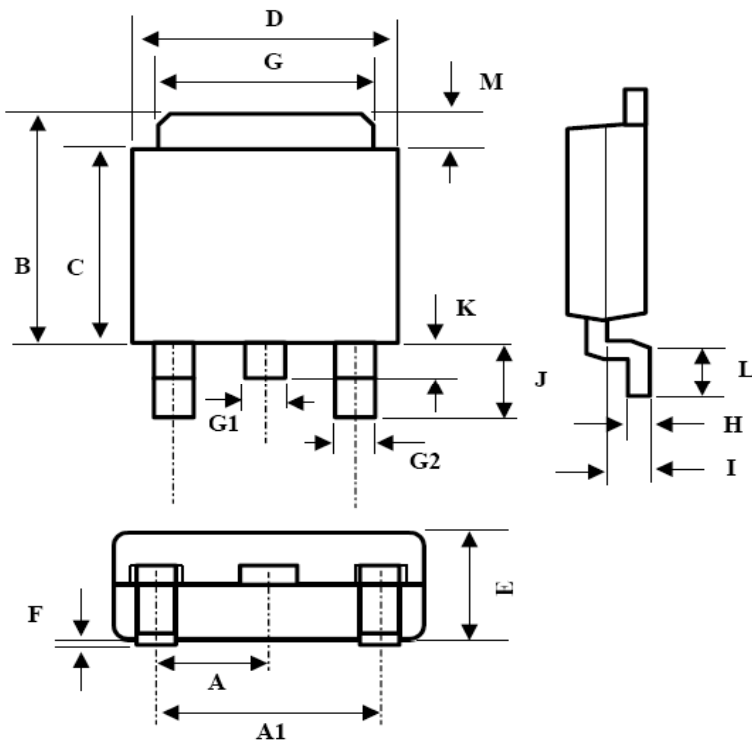
DIM	ITO-220 DIMENSION			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.04	10.07	0.395	0.396
B	6.20 (typ.)		0.244 (typ.)	
C	2.20 (typ.)		0.087 (typ.)	
D	φ 1.40 (typ.)		φ 0.055 (typ.)	
E	15.0	15.20	0.591	0.598
F	0.52	0.54	0.020	0.021
G	2.35	2.73	0.093	0.107
H	13.50	13.55	0.531	0.533
I	1.11	1.49	0.044	0.058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

SOT-251 Mechanical Drawing



DIM	TO-251 DIMENSION			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.20	2.4	0.087	0.095
A1	1.10	1.30	0.043	0.051
b	0.40	0.80	0.016	0.032
C	0.40	0.60	0.016	0.024
D	6.70	7.30	0.264	0.287
D1	5.40	5.65	0.213	0.222
E	6.40	6.65	0.252	0.262
e	2.10	2.50	0.083	0.098
F	0.40	0.60	0.016	0.024
L	7.00	8.00	0.276	0.315
L1	1.60	1.86	0.063	0.073

SOT-252 Mechanical Drawing



DIM	TO-252 DIMENSION			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.3BSC		0.09BSC	
A1	4.6BSC		0.18BSC	
B	6.80	7.20	0.268	0.283
C	5.65	5.90	0.222	0.232
D	6.40	6.65	0.252	0.262
E	2.20	2.40	0.087	0.094
F	0.00	0.20	0.000	0.008
G	5.20	5.40	0.205	0.213
G1	0.75	0.85	0.030	0.033
G2	0.55	0.65	0.022	0.026
H	0.35	0.65	0.014	0.026
I	0.90	1.50	0.035	0.059
J	2.20	2.80	0.087	0.110
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	0.67



TSM4N60

600V N-Channel Power MOSFET

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