

N-CHANNEL 550V @ T_{jmax} -0.30 Ω - 12A TO-220/FP/D²/I²PAK Zener-Protected SuperMESH™ MOSFET

Table 1: General Features

TYPE	V _{DSS} (@T _{jmax})	R _{DS(on)}	I _D
STB12NM50	550 V	< 0.35 Ω	12 A
STB12NM50-1	550 V	< 0.35 Ω	12 A
STP12NM50	550 V	< 0.35 Ω	12 A
STP12NM50FP	550 V	< 0.35 Ω	12 A

- TYPICAL R_{DS(on)} = 0.30 Ω
- HIGH dv/dt AND AVALANCHE CAPABILITIES
- LOW INPUT CAPACITANCE AND GATE CHARGE
- 100% AVALANCHE TESTED
- LOW GATE INPUT RESISTANCE
- TIGHT PROCESS CONTROL AND HIGH MANUFACTURING YIELDS

DESCRIPTION

The MDmesh™ is a new revolutionary MOSFET technology that associates the Multiple Drain process with the Company's PowerMESH™ horizontal layout. The resulting product has an outstanding low on-resistance, impressively high dv/dt and excellent avalanche characteristics. The adoption of the Company's proprietary strip technique yields overall dynamic performance that is significantly better than that of similar competition's products.

APPLICATIONS

The MDmesh™ family is very suitable for increasing power density of high voltage converters allowing system miniaturization and higher efficiencies.

Table 2: Order Codes

SALES TYPE	MARKING	PACKAGE	PACKAGING
STB12NM50T4	B12NM50	D ² PAK	TAPE & REEL
STB12NM50-1	B12NM50	I ² PAK	TUBE
STP12NM50	P12NM50	TO-220	TUBE
STP12NM50FP	P12NM50FP	TO-220FP	TUBE

Figure 1: Package

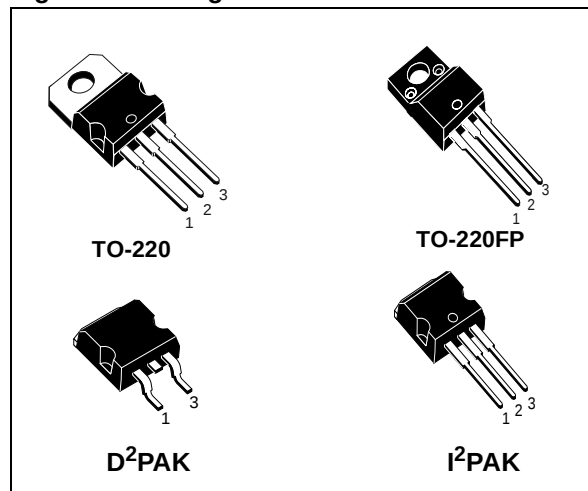


Figure 2: Internal Schematic Diagram

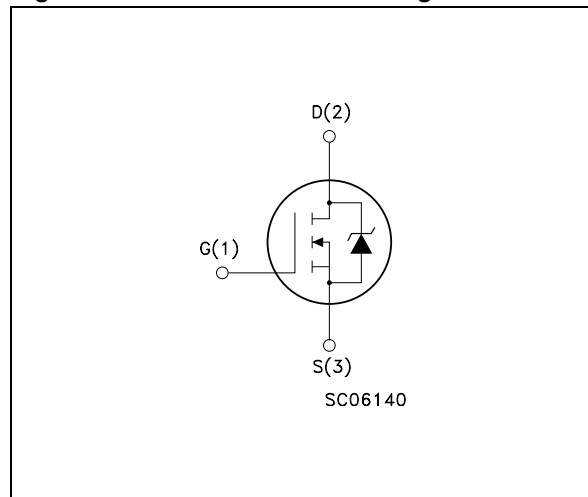


Table 3: Absolute Maximum ratings

Symbol	Parameter	Value		Unit
		STB12NM50 STB12NM50 STP12NM50	STP12NM50FP	
V_{GS}	Gate- source Voltage	± 30		V
I_D	Drain Current (continuous) at $T_C = 25^\circ\text{C}$	12	12 (*)	A
I_D	Drain Current (continuous) at $T_C = 100^\circ\text{C}$	7.5	7.5 (*)	A
$I_{DM}(\bullet)$	Drain Current (pulsed)	48	48 (*)	A
P_{TOT}	Total Dissipation at $T_C = 25^\circ\text{C}$	160	35	W
	Derating Factor	1.28	0.28	W/ $^\circ\text{C}$
V_{ISO}	Insulation Withstand Voltage (DC)	--	2500	V
$dv/dt(1)$	Peak Diode Recovery voltage slope	15		V/ns
T_j T_{stg}	Operating Junction Temperature Storage Temperature	-65 to 150 -65 to 150		$^\circ\text{C}$ $^\circ\text{C}$

($\bullet$) Pulse width limited by safe operating area

(1) $I_{SD} \leq 12\text{A}$, $di/dt \leq 400\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$.

(*) Limited only by maximum temperature allowed

Table 4: Thermal Data

		TO-220/ D ² PAK / I ² PAK	TO-220FP	
Rthj-case	Thermal Resistance Junction-case Max	0.78	3.57	$^\circ\text{C}/\text{W}$
Rthj-amb	Thermal Resistance Junction-ambient Max	62.5		$^\circ\text{C}/\text{W}$
T_I	Maximum Lead Temperature For Soldering Purpose	300		$^\circ\text{C}$

Table 5: Avalanche Characteristics

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max)	6	A
E_{AS}	Single Pulse Avalanche Energy (starting $T_j = 25^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{V}$)	400	mJ

ELECTRICAL CHARACTERISTICS ($T_{CASE} = 25^\circ\text{C}$ UNLESS OTHERWISE SPECIFIED)

Table 6: On /Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 250\text{ }\mu\text{A}$, $V_{GS} = 0$	500			V
I_{DSS}	Zero Gate Voltage Drain Current ($V_{GS} = 0$)	$V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}$, $T_C = 125^\circ\text{C}$			1 10	μA μA
I_{GSS}	Gate-body Leakage Current ($V_{DS} = 0$)	$V_{GS} = \pm 30\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 50\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10\text{ V}$, $I_D = 6\text{ A}$		0.30	0.35	Ω

ELECTRICAL CHARACTERISTICS (CONTINUED)

Table 7: Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	$V_{DS} = 15\text{ V}$, $I_D = 6\text{ A}$		5.5		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$		1000 180 25		pF pF pF
$C_{oss\text{ eq}}$ (3).	Equivalent Output Capacitance	$V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ to }400\text{ V}$		90		pF
$t_{d(on)}$ t_r	Turn-on Delay Time Rise Time	$V_{DD} = 250\text{ V}$, $I_D = 6\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 17)		20 10		ns ns
Q_g Q_{gs} Q_{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 400\text{ V}$, $I_D = 12\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 20)		28 8 18	39	nC nC nC
R_g	Gate Input Resistance	$f = 1\text{ MHz}$ Gate DC Bias = 0 Test Signal Level = 20mV Open Drain		1.6		Ω

Table 8: Source Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM} (2)	Source-drain Current Source-drain Current (pulsed)				12 48	A A
V_{SD} (1)	Forward On Voltage	$I_{SD} = 12\text{ A}$, $V_{GS} = 0$			1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see Figure 18)		270 2.23 16.5		ns μC A
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$, $T_j = 150^\circ\text{C}$ (see Figure 18)		340 3 18		ns μC A

(1) Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %.

(2) Pulse width limited by safe operating area.

(3) $C_{oss\text{ eq}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS} .

**Figure 3: Safe Operating Area For TO-220/
D²PAK/I²PAK**

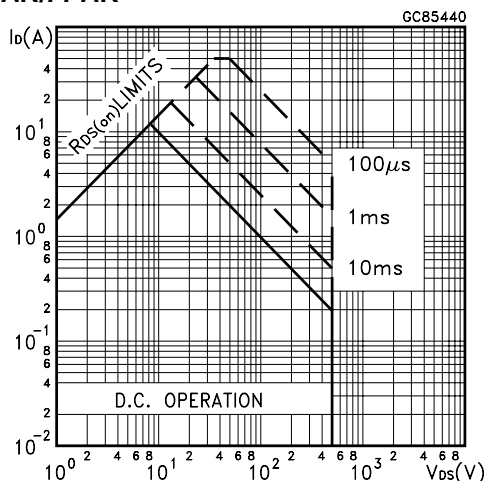


Figure 4: Safe Operating Area For TO-220FP

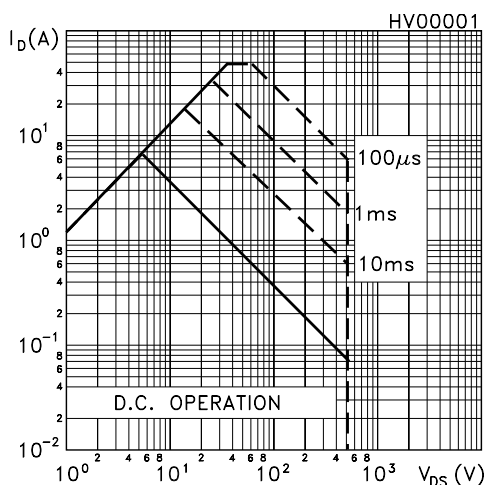
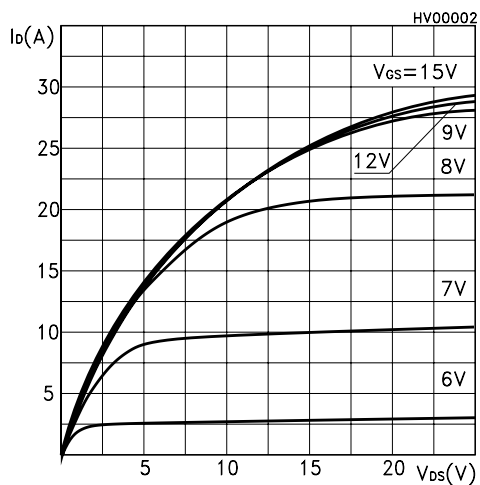


Figure 5: Output Characteristics



**Figure 6: Thermal Impedance TO-220/D²PAK/
I²PAK**

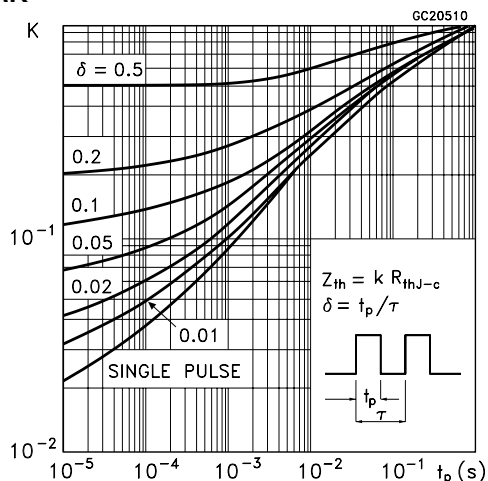


Figure 7: Thermal Impedance For TO-220FP

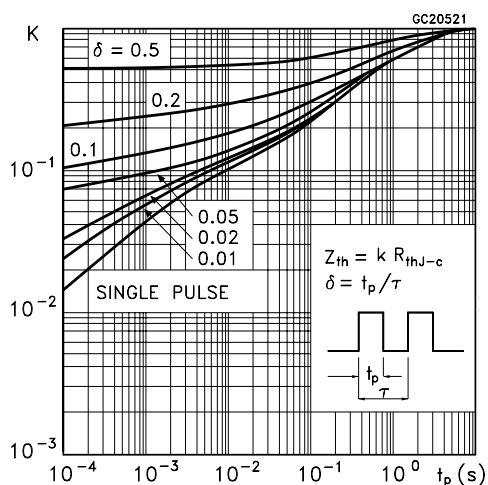


Figure 8: Transfer Characteristics

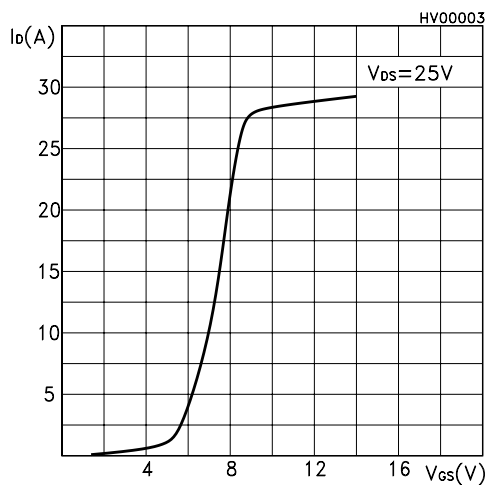


Figure 9: Transconductance

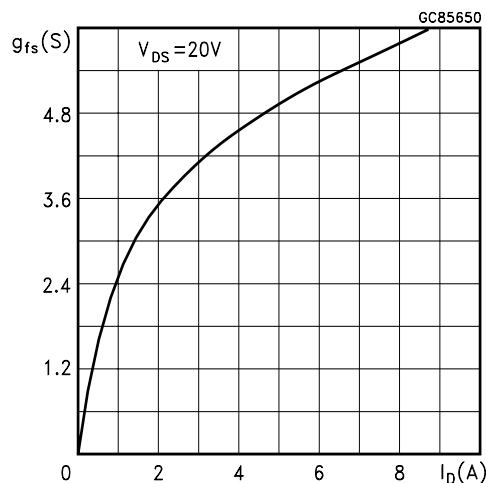


Figure 10: Gate Charge vs Gate-source Voltage

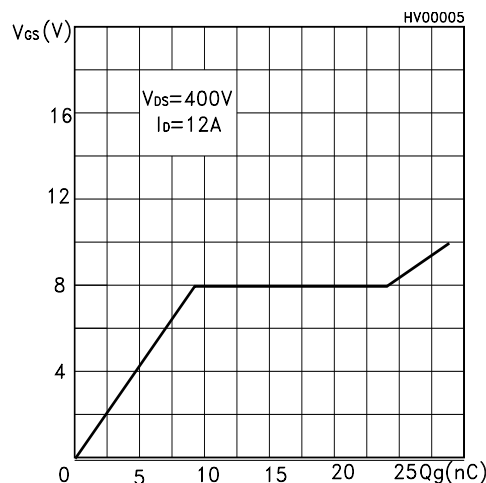


Figure 11: Normalized Gate Threshold Voltage vs Temperature

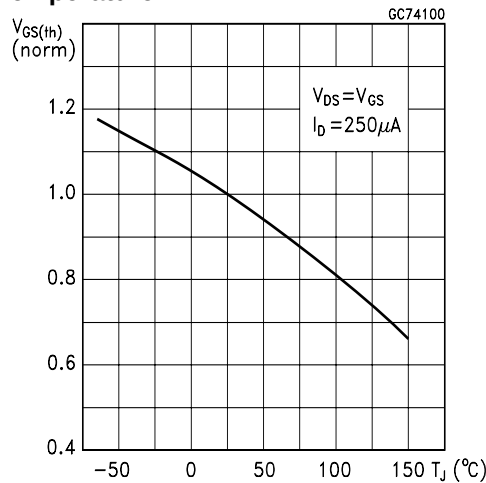


Figure 12: Static Drain-Source On Resistance

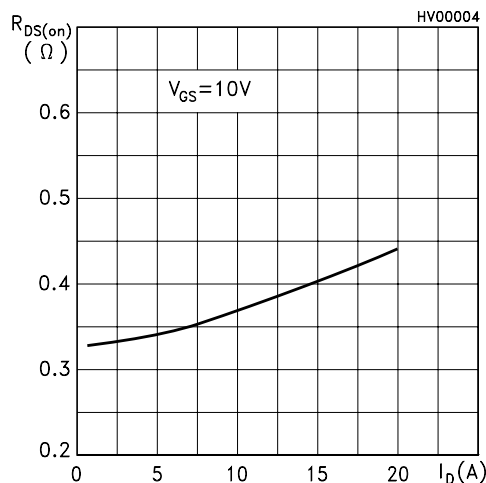


Figure 13: Capacitance Variations

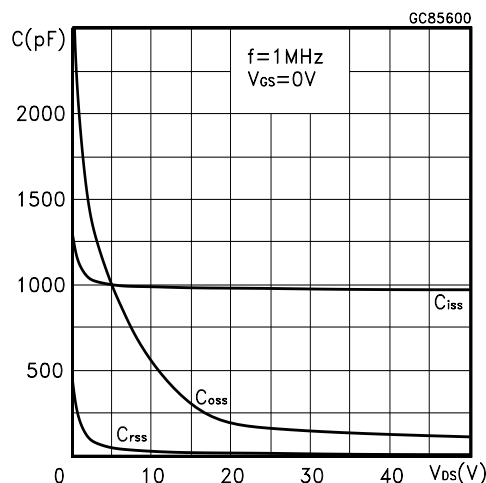


Figure 14: Normalized On Resistance vs Temperature

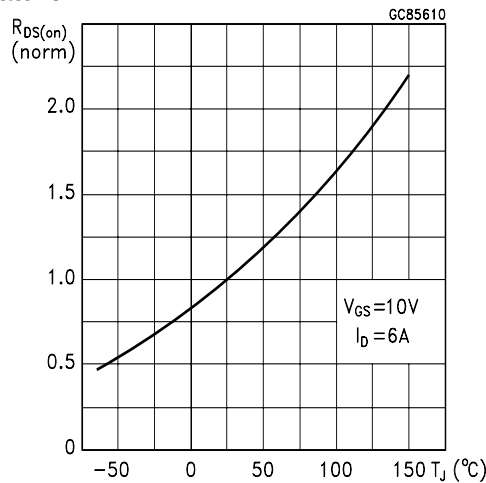


Figure 15: Source-Drain Forward Characteristics

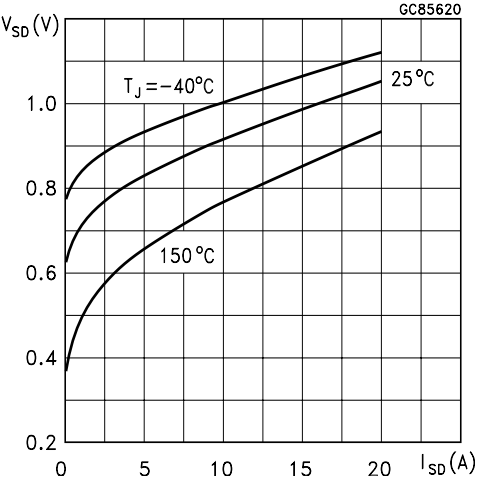


Figure 16: Unclamped Inductive Load Test Circuit

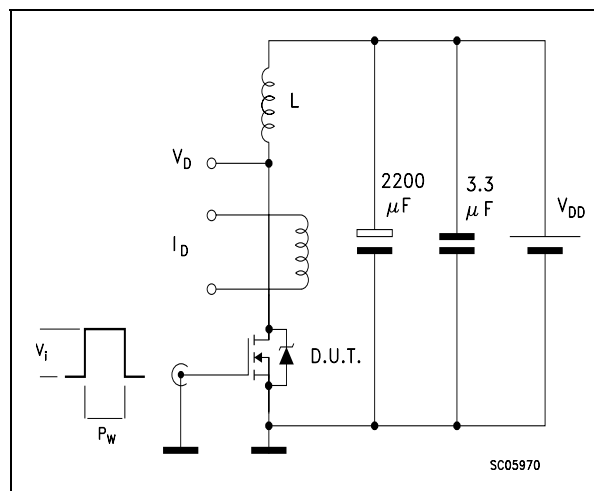


Figure 17: Switching Times Test Circuit For Resistive Load

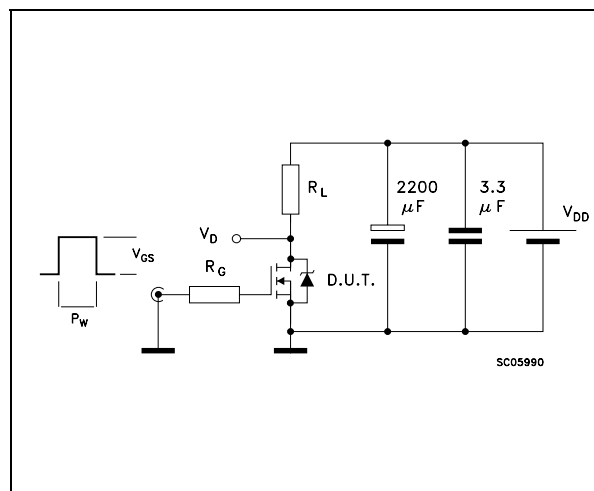


Figure 18: Test Circuit For Inductive Load Switching and Diode Recovery Times

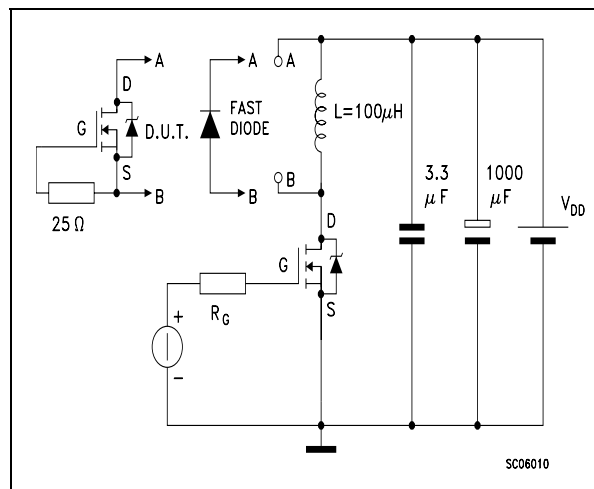


Figure 19: Unclamped Inductive Waform

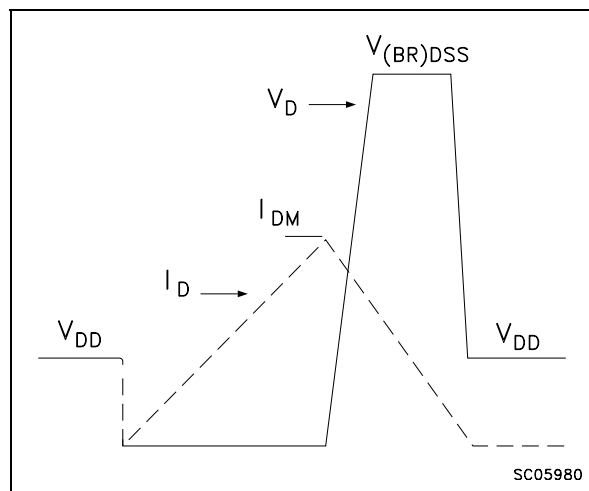
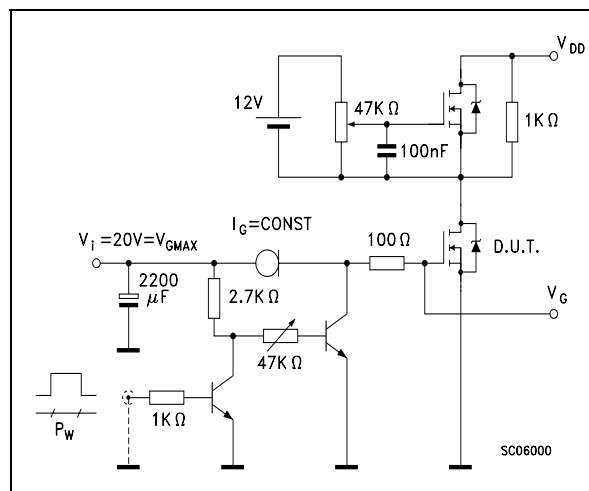
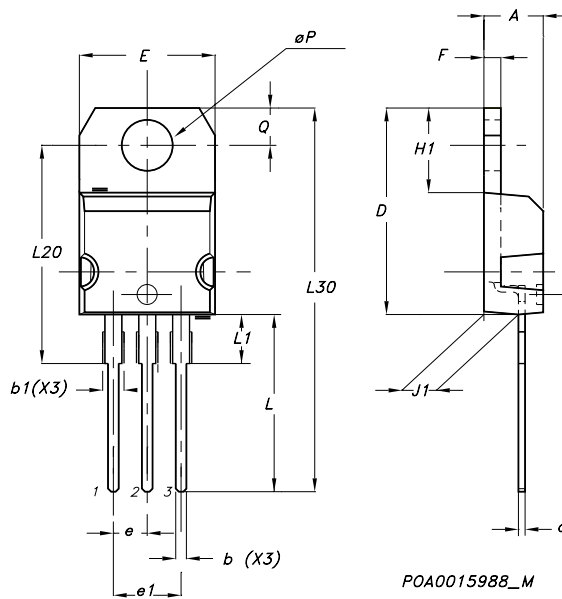


Figure 20: Gate Charge Test Circuit



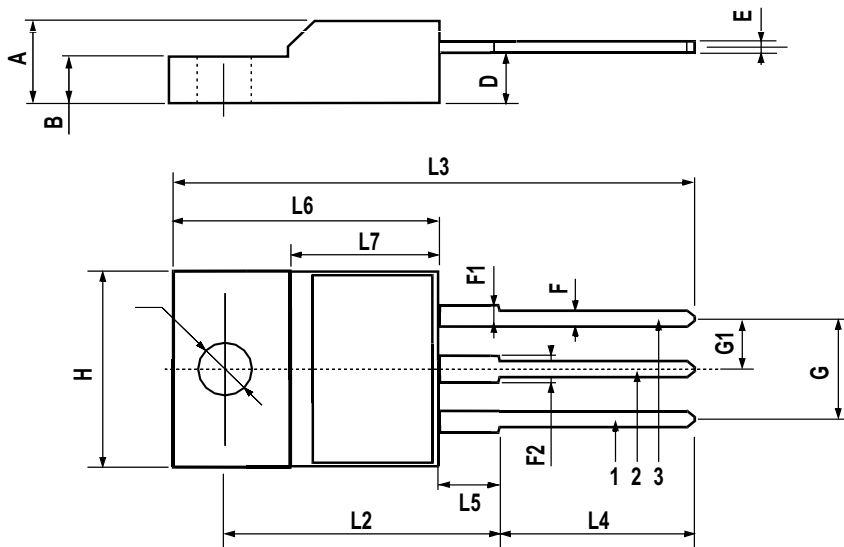
TO-220 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
øP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



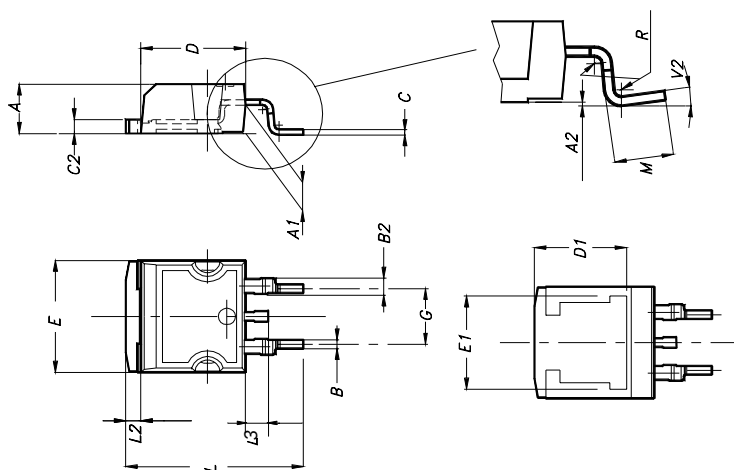
TO-220FP MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	.0385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126



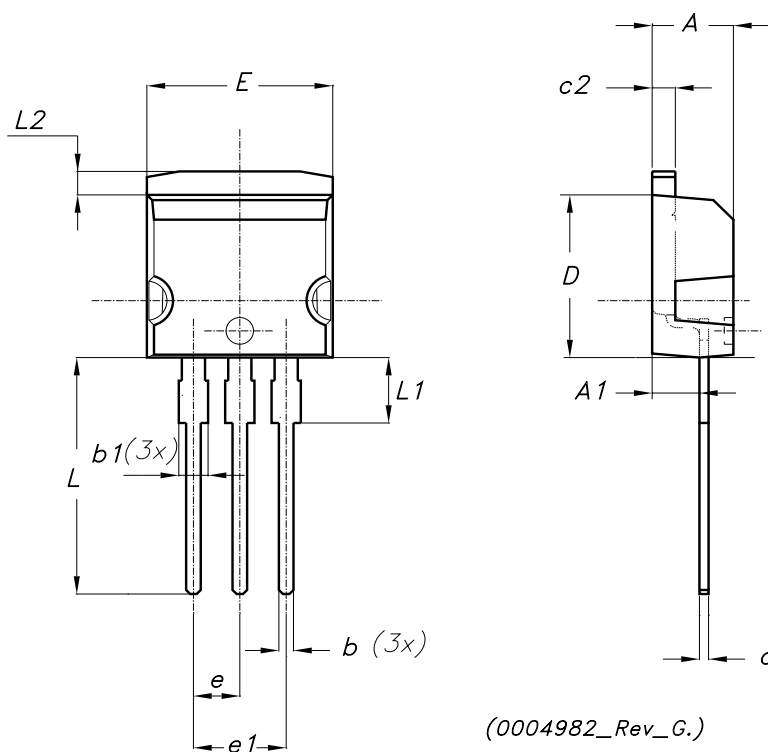
D²PAK MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		4°			

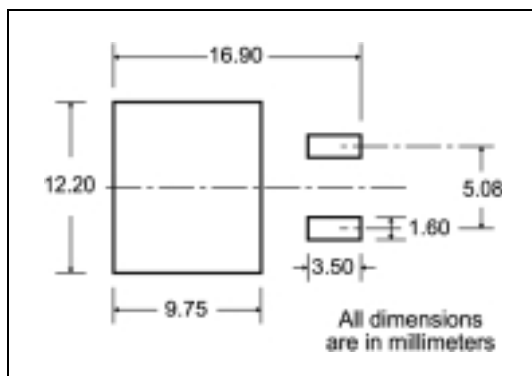


TO-262 (I²PAK) MECHANICAL DATA

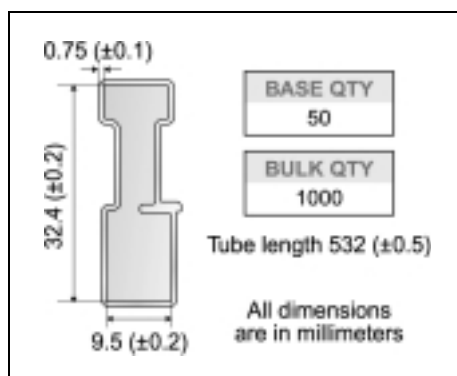
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
A1	2.40		2.72	0.094		0.107
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
c2	1.23		1.32	0.048		0.052
D	8.95		9.35	0.352		0.368
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
E	10		10.40	0.393		0.410
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L2	1.27		1.40	0.050		0.055



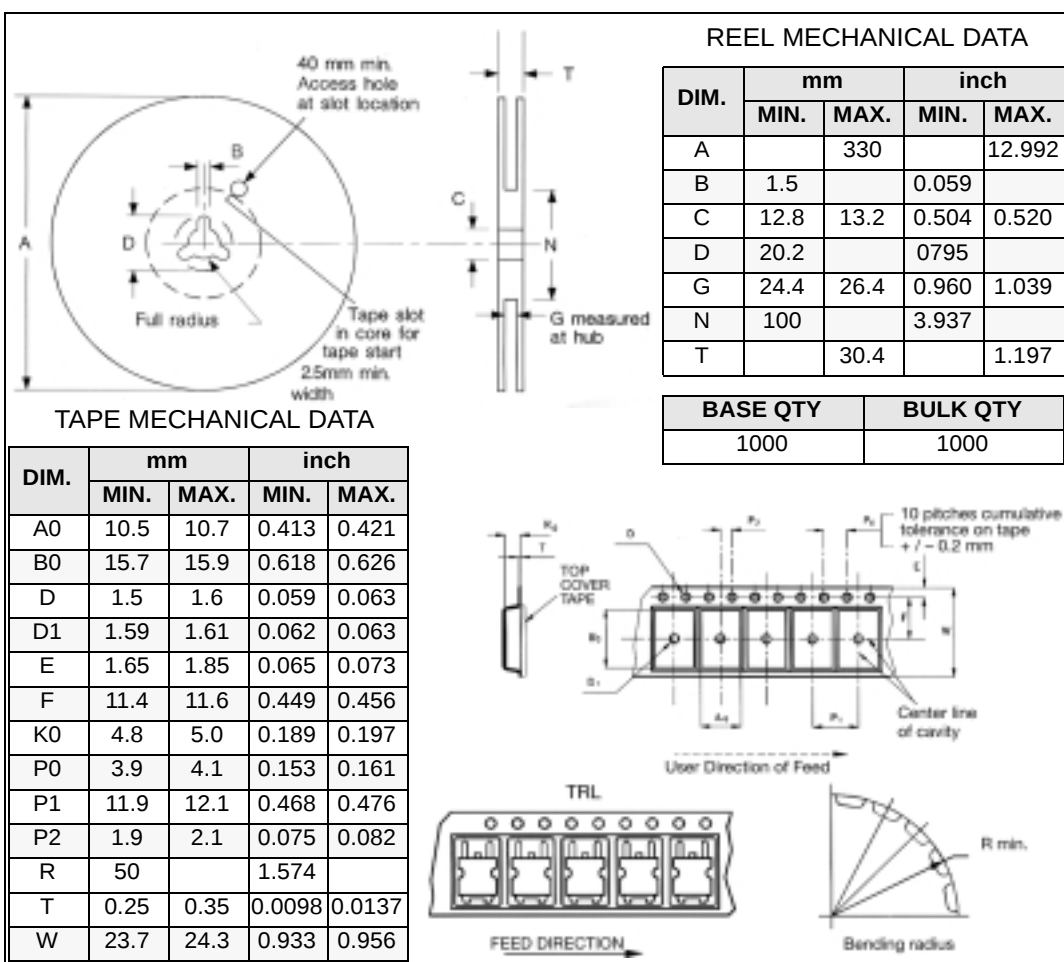
D²PAK FOOTPRINT



TUBE SHIPMENT (no suffix)*



TAPE AND REEL SHIPMENT (suffix "T4")*



* on sales type