

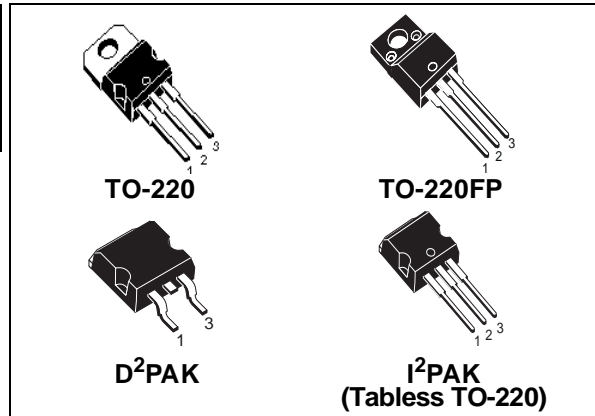


# STP12NM50 - STP12NM50FP STB12NM50 - STB12NM50-1

N-CHANNEL 500V - 0.30Ω - 12A TO-220/FP/D<sup>2</sup>PAK/I<sup>2</sup>PAK  
MDmesh™ Power MOSFET

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STP12NM50/FP	500V	<0.35Ω	12 A
STB12NM50	500V	<0.35Ω	12 A
STB12NM50-1	500V	<0.35Ω	12 A

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

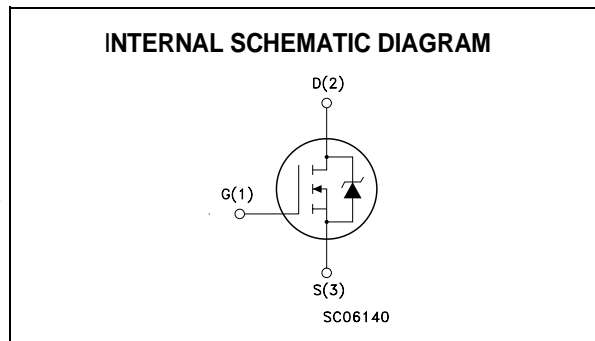


## DESCRIPTION

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.



## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		STP(B)12NM50(-1)	STP12NM50FP	
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	500		V
V <sub>DGR</sub>	Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)	500		V
V <sub>GS</sub>	Gate- source Voltage	±30		V
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 25°C	12	12(*)	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	7.5	7.5(*)	A
I <sub>DM</sub> (●)	Drain Current (pulsed)	48	48(*)	A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 25°C	160	35	W
	Derating Factor	1.28	0.28	W/°C
dv/dt(1)	Peak Diode Recovery voltage slope	15		V/ns
V <sub>ISO</sub>	Insulation Withstand Voltage (DC)	--	2500	V
T <sub>stg</sub>	Storage Temperature	-65 to 150		°C
T <sub>j</sub>	Max. Operating Junction Temperature	150		°C

(●) Pulse width limited by safe operating area  
October 2002

(1) I<sub>SD</sub> ≤ 12 A, di/dt ≤ 400 A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.  
(\*) Limited only by maximum temperature allowed

## STP12NM50 - STP12NM50FP - STB12NM50 - STB12NM50-1

### THERMAL DATA

		TO-220 /D <sup>2</sup> PAK/ I <sup>2</sup> PAK	TO-220FP	
Rthj-case	Thermal Resistance Junction-case Max	0.78	3.57	°C/W
Rthj-amb T <sub>I</sub>	Thermal Resistance Junction-ambient Max Maximum Lead Temperature For Soldering Purpose	62.5 300		°C/W °C

### AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
I <sub>AR</sub>	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T <sub>j</sub> max)	6	A
E <sub>AS</sub>	Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V)	400	mJ

### ELECTRICAL CHARACTERISTICS (T<sub>CASE</sub> = 25 °C UNLESS OTHERWISE SPECIFIED) OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source Breakdown Voltage	I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0	500			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0)	V <sub>DS</sub> = Max Rating V <sub>DS</sub> = Max Rating, T <sub>C</sub> = 125 °C			1 10	μA μA
I <sub>GSS</sub>	Gate-body Leakage Current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ±30V			±100	nA

### ON (1)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	3	4	5	V
R <sub>DS(on)</sub>	Static Drain-source On Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 6 A		0.30	0.35	Ω

### DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g <sub>fs</sub> (1)	Forward Transconductance	V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub> , I <sub>D</sub> = 6A		5.2		S
C <sub>iSS</sub>	Input Capacitance	V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0		1000		pF
C <sub>oSS</sub>	Output Capacitance			180		pF
C <sub>rSS</sub>	Reverse Transfer Capacitance			25		pF
C <sub>oSS eq.</sub> (2)	Equivalent Output Capacitance	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 400V		90		pF
R <sub>g</sub>	Gate Input Resistance	f=1 MHz Gate DC Bias=0 Test Signal Level=20mV Open Drain		1.6		Ω

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

2. C<sub>oSS eq.</sub> is defined as a constant equivalent capacitance giving the same charging time as C<sub>oSS</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>.

## STP12NM50 - STP12NM50FP - STB12NM50 - STB12NM50-1

### ELECTRICAL CHARACTERISTICS (CONTINUED)

#### SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{DD} = 250\text{ V}$ , $I_D = 6\text{ A}$		20		ns
$t_r$	Rise Time	$R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$ (see test circuit, Figure 3)		10		ns
$Q_g$	Total Gate Charge	$V_{DD} = 400\text{ V}$ , $I_D = 12\text{ A}$ , $V_{GS} = 10\text{ V}$		28		nC
$Q_{gs}$	Gate-Source Charge			8		nC
$Q_{gd}$	Gate-Drain Charge			15		nC

#### SWITCHING OFF

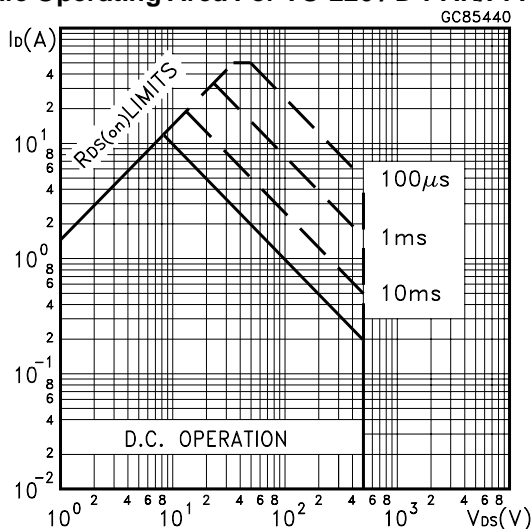
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$	Off-voltage Rise Time	$V_{DD} = 400\text{ V}$ , $I_D = 12\text{ A}$ , $R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$ (see test circuit, Figure 5)		19		ns
$t_f$	Fall Time			8		ns
$t_c$	Cross-over Time			18		ns

#### SOURCE DRAIN DIODE

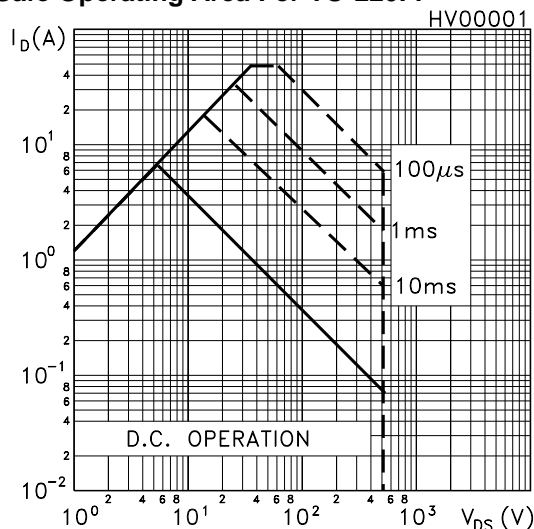
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain Current				12	A
$I_{SDM(2)}$	Source-drain Current (pulsed)				48	A
$V_{SD(1)}$	Forward On Voltage	$I_{SD} = 12\text{ A}$ , $V_{GS} = 0$			1.5	V
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 12\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 100\text{ V}$ , $T_j = 25^\circ\text{C}$ (see test circuit, Figure 5)		270		ns
$Q_{rr}$	Reverse Recovery Charge			2.23		$\mu\text{C}$
$I_{RRM}$	Reverse Recovery Current			16.5		A
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 12\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 100\text{ V}$ , $T_j = 150^\circ\text{C}$ (see test circuit, Figure 5)		340		ns
$Q_{rr}$	Reverse Recovery Charge			3		$\mu\text{C}$
$I_{RRM}$	Reverse Recovery Current			18		A

Note: 1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.  
2. Pulse width limited by safe operating area.

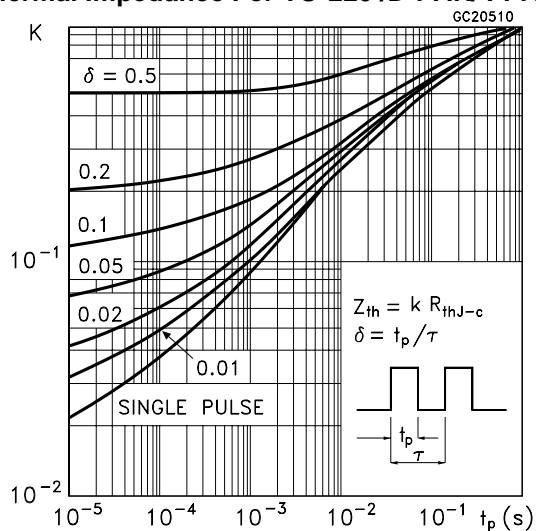
Safe Operating Area For TO-220 / D<sup>2</sup>PAK / I<sup>2</sup>PAK



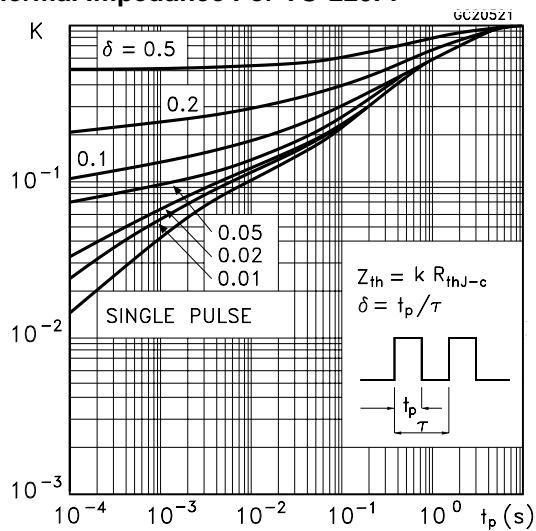
Safe Operating Area For TO-220FP



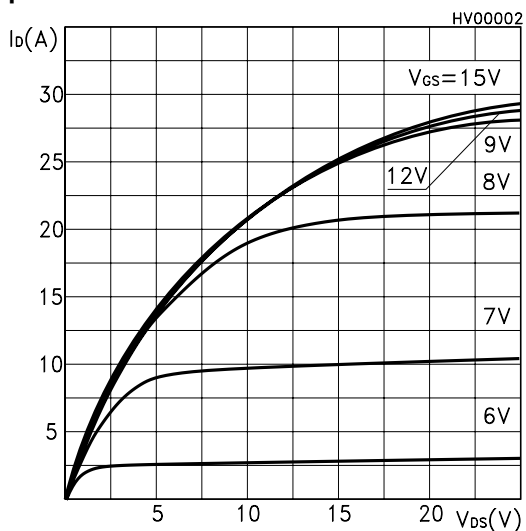
Thermal Impedance For TO-220 /D<sup>2</sup>PAK/ I<sup>2</sup>PAK



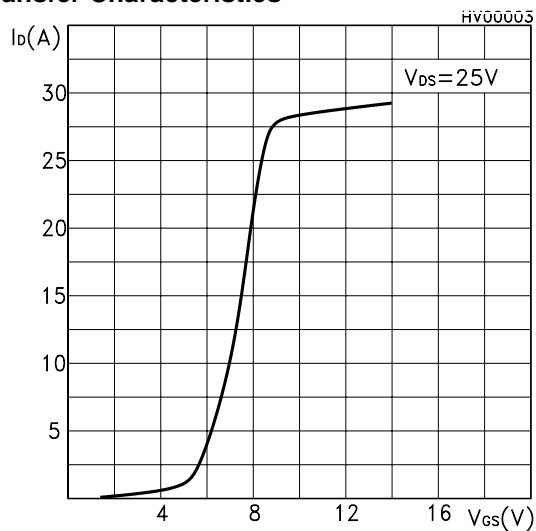
Thermal Impedance For TO-220FP



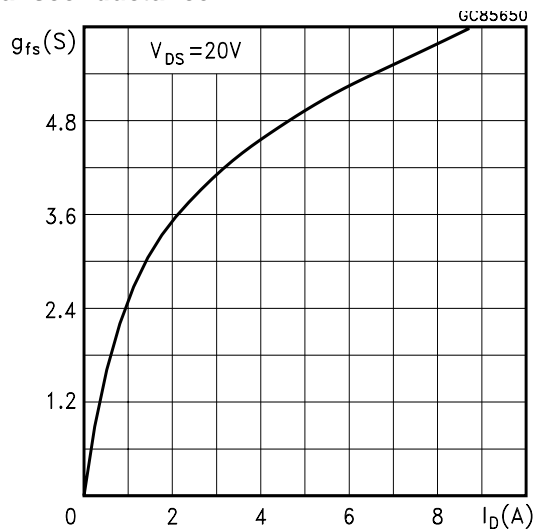
Output Characteristics



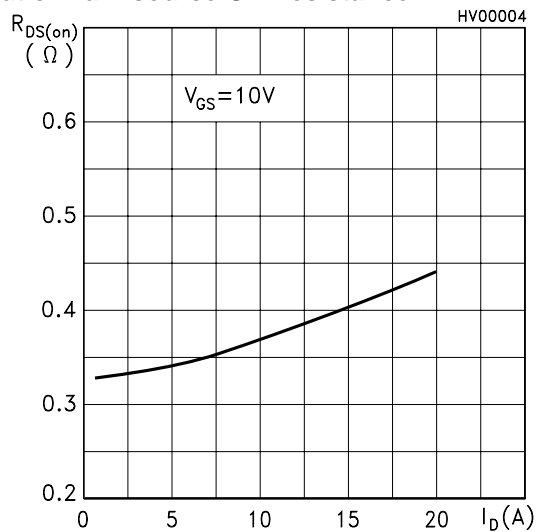
Transfer Characteristics



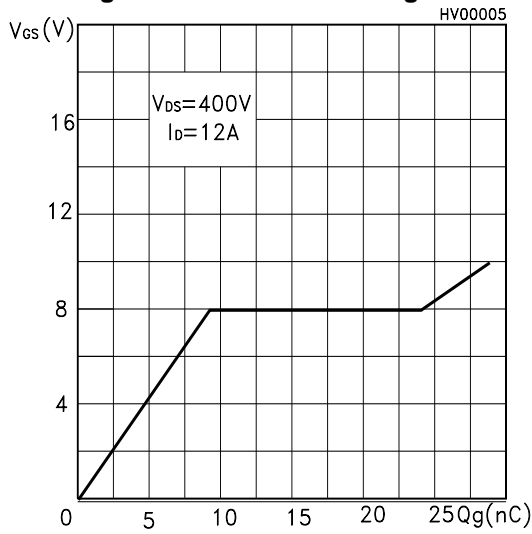
Transconductance



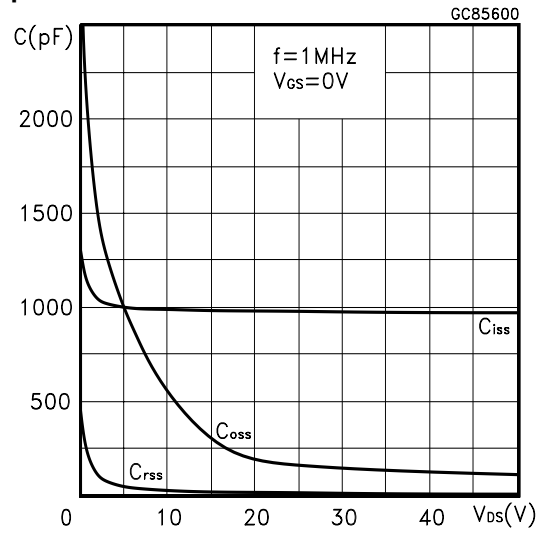
Static Drain-source On Resistance



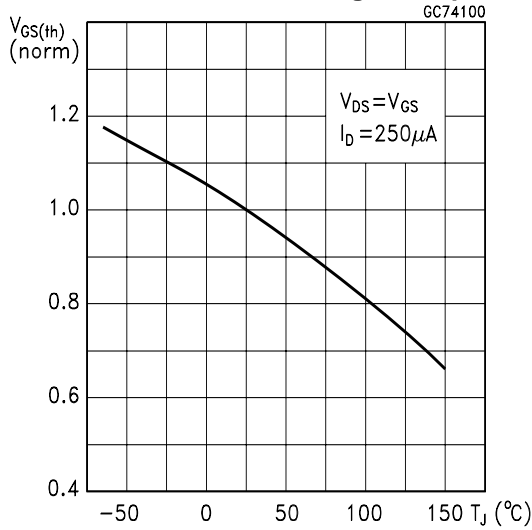
**Gate Charge vs Gate-source Voltage**



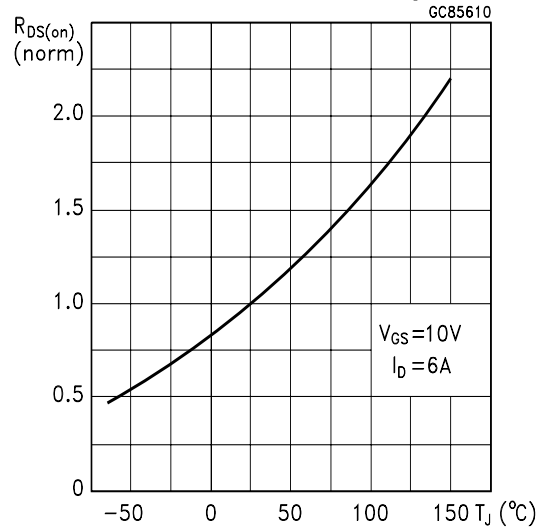
**Capacitance Variations**



**Normalized Gate Threshold Voltage vs Temperature**



**Normalized On Resistance vs Temperature**



**Source-drain Diode Forward Characteristics**

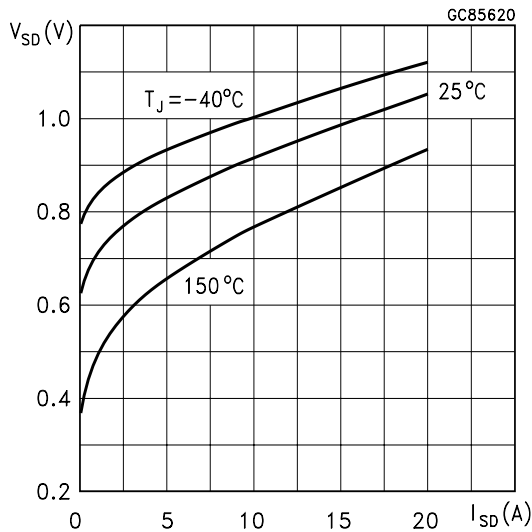


Fig. 1: Unclamped Inductive Load Test Circuit

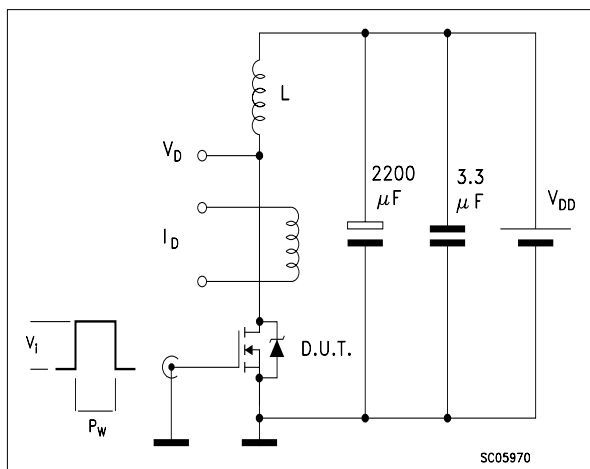


Fig. 2: Unclamped Inductive Waveform

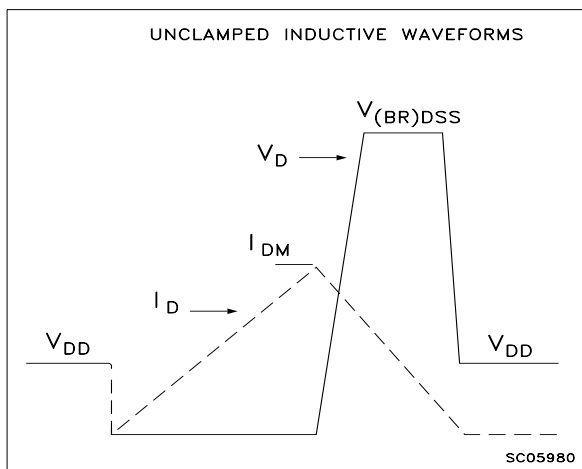


Fig. 3: Switching Times Test Circuits For Resistive Load

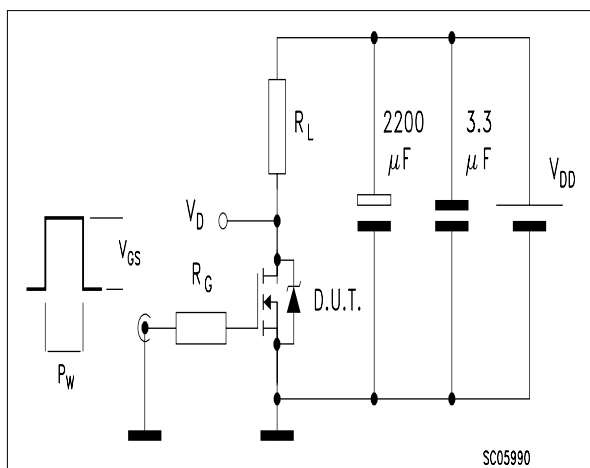
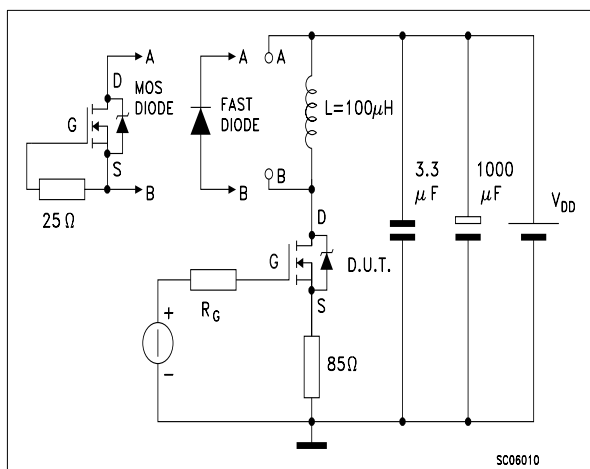


Fig. 4: Gate Charge test Circuit

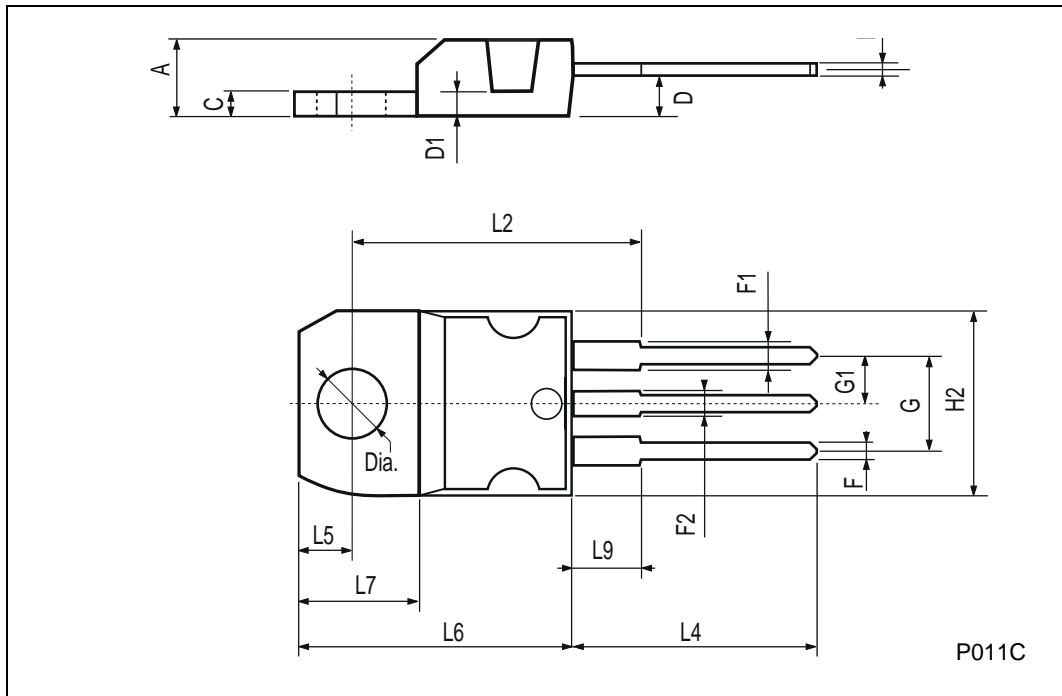


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



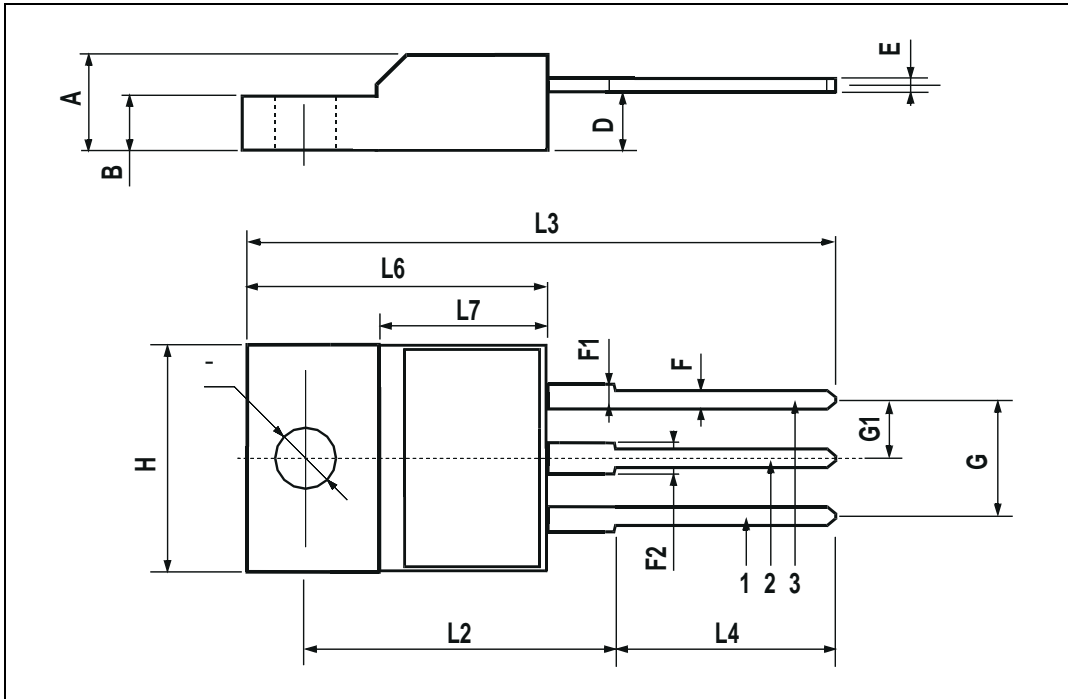
TO-220 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137		0.154
DIA.	3.75		3.85	0.147		0.151



**TO-220FP MECHANICAL DATA**

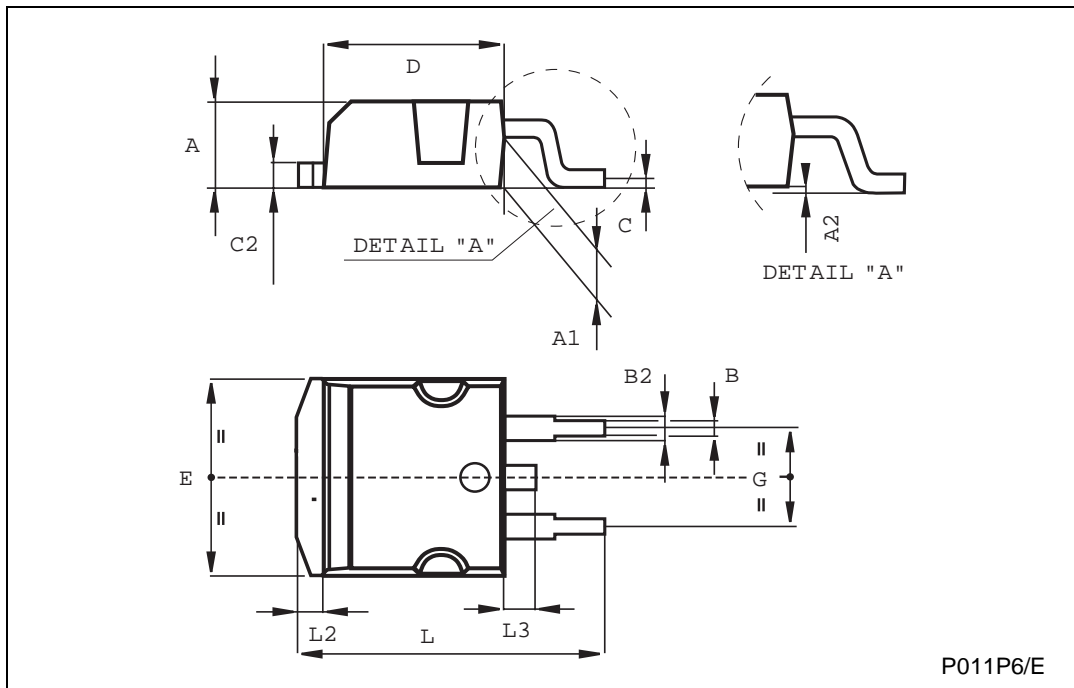
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	0.385		0.417
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





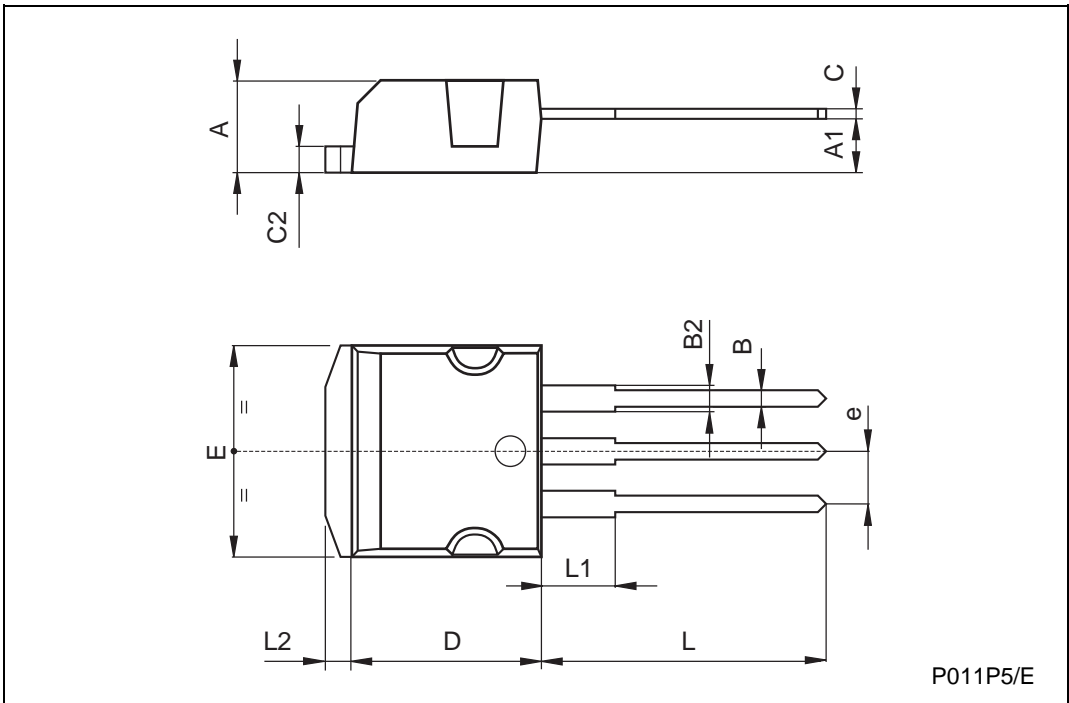
TO-263 (D<sup>2</sup>PAK) MECHANICAL DATA

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
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	1.21		1.36	0.047		0.053
D	8.95		9.35	0.352		0.368
E	10		10.4	0.393		0.409
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.624
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068

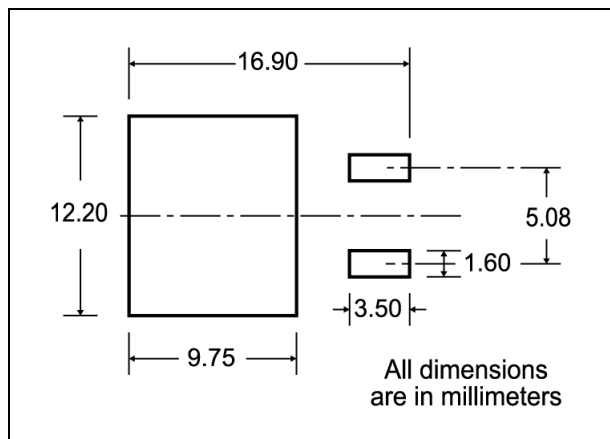


**TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA**

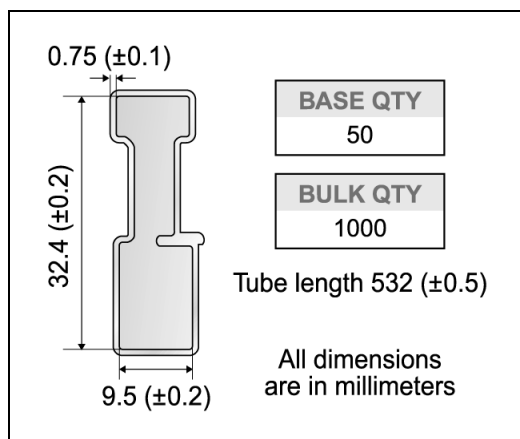
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
e	2.4		2.7	0.094		0.106
E	10		10.4	0.393		0.409
L	13.1		13.6	0.515		0.531
L1	3.48		3.78	0.137		0.149
L2	1.27		1.4	0.050		0.055



### D<sup>2</sup>PAK FOOTPRINT



### TUBE SHIPMENT (no suffix)\*



### TAPE AND REEL SHIPMENT (suffix "T4")\*

Diagram showing the tape mechanical data. It includes a circular reel core with a diameter of A, a central hub with diameter D, and a tape slot with width T. The distance from the center of the core to the center of the tape slot is B. The distance from the center of the core to the center of the hub is C. The distance from the center of the core to the center of the tape slot is D. The distance from the center of the core to the center of the hub is N. The distance from the center of the core to the center of the tape slot is G, measured at the hub. The tape slot in the core for tape start has a width of 2.5 mm min. A 40 mm min. access hole is located at the slot location. The full radius of the core is also indicated.

**TAPE MECHANICAL DATA**

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	10.5	10.7	0.413	0.421
B0	15.7	15.9	0.618	0.626
D	1.5	1.6	0.059	0.063
D1	1.59	1.61	0.062	0.063
E	1.65	1.85	0.065	0.073
F	11.4	11.6	0.449	0.456
K0	4.8	5.0	0.189	0.197
P0	3.9	4.1	0.153	0.161
P1	11.9	12.1	0.468	0.476
P2	1.9	2.1	0.075	0.082
R	50		1.574	
T	0.25	0.35	0.0098	0.0137
W	23.7	24.3	0.933	0.956

**REEL MECHANICAL DATA**

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

Diagram showing the reel mechanical data. It includes a cross-section of the reel with dimensions K<sub>0</sub>, T, D, P<sub>2</sub>, P<sub>0</sub>, E, F, W, B<sub>0</sub>, D<sub>1</sub>, A<sub>0</sub>, P<sub>1</sub>, and Center line of cavity. The top cover tape is shown with a thickness of T. The distance from the center of the core to the center of the tape slot is B. The distance from the center of the core to the center of the hub is C. The distance from the center of the core to the center of the tape slot is D. The distance from the center of the core to the center of the hub is N. The distance from the center of the core to the center of the tape slot is G, measured at the hub. The tape slot in the core for tape start has a width of 2.5 mm min. A 40 mm min. access hole is located at the slot location. The full radius of the core is also indicated.

10 pitches cumulative tolerance on tape +/- 0.2 mm

User Direction of Feed

FEED DIRECTION

Bending radius R min.

\* on sales type

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