



# STP140NF75 STB140NF75 - STB140NF75-1

N-channel 75V - 0.0065Ω - 120A - D<sup>2</sup>PAK/I<sup>2</sup>PAK/TO-220  
STripFET™ III Power MOSFET

## General features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STB140NF75	75V	<0.0075Ω	120A <sup>(1)</sup>
STB140NF75-1	75V	<0.0075Ω	120A <sup>(1)</sup>
STP140NF75	75V	<0.0075Ω	120A <sup>(1)</sup>

1. Current limited by package

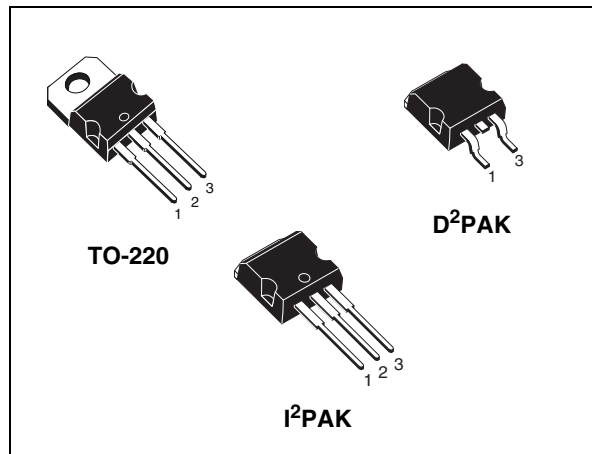
- 100% avalanche tested

## Description

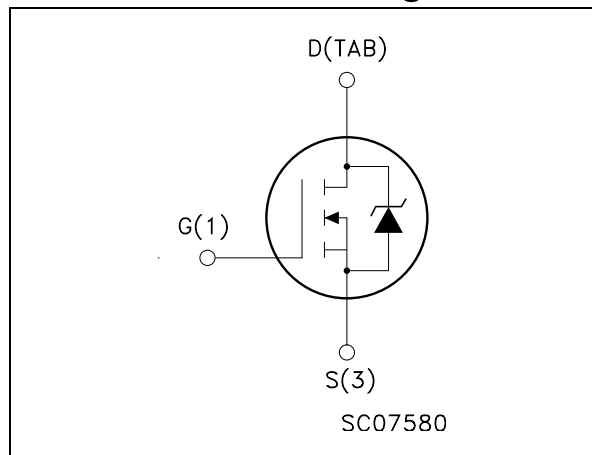
This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

## Applications

- Switching application



## Internal schematic diagram



## Order codes

Part number	Marking	Package	Packaging
STB140NF75T4	B140NF75	D <sup>2</sup> PAK	Tape & reel
STB140NF75-1	B140NF75	I <sup>2</sup> PAK	Tube
STP140NF75	P140NF75	TO-220	Tube

## Contents

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	75	V
$V_{DGR}$	Drain-gate voltage ( $R_{GS} = 20\text{ k}\Omega$ )	75	V
$V_{GS}$	Gate- source voltage	$\pm 20$	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	120	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	100	A
$I_{DM}^{(2)}$	Drain current (pulsed)	480	A
$P_{tot}$	Total dissipation at $T_C = 25^\circ\text{C}$	310	W
	Derating Factor	2.08	W/°C
$dv/dt^{(3)}$	Peak diode recovery voltage slope	10	V/ns
$E_{AS}^{(4)}$	Single pulse avalanche energy	750	mJ
$T_{stg}$	Storage temperature	-55 to 175	°C
$T_j$	Max. operating junction temperature		

1. Value limited by wire bonding
2. Pulse width limited by safe operating area.
3.  $I_{SD} \leq 20\text{A}$ ,  $di/dt \leq 400\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$
4. Starting  $T_j = 25^\circ\text{C}$ ,  $I_D = 60\text{A}$ ,  $V_{DD} = 30\text{V}$

**Table 2. Thermal data**

Rthj-case	Thermal resistance junction-case max	0.48	°C/W
Rthj-amb	Thermal resistance junction-ambient max	62.5	°C/W
$T_J$	Maximum lead temperature for soldering purpose <sup>(1)</sup>	300	°C

1. for 10 sec. 1.6mm from case

## 2 Electrical characteristics

( $T_{CASE}=25^{\circ}\text{C}$  unless otherwise specified)

**Table 3. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\mu\text{A}$ , $V_{GS} = 0$	75			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{max ratings}$ $V_{DS} = \text{max ratings}$ , $T_C = 125^{\circ}\text{C}$			1 10	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\mu\text{A}$	2		4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{V}$ , $I_D = 70\text{A}$		0.0065	0.0075	$\Omega$

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15\text{V}$ , $I_D = 70\text{A}$		160		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$ , $V_{GS} = 0$		5000 960 310		pF pF pF
$t_{d(on)}$ $t_r$ $t_{d(off)}$ $t_f$	Turn-on delay time Rise time Turn-off delay time Fall time	$V_{DD} = 38\text{V}$ , $I_D = 70\text{A}$ $R_G = 4.7\Omega$ , $V_{GS} = 10\text{V}$ (see <a href="#">Figure 19</a> )		30 140 130 90		ns ns ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 60\text{V}$ , $I_D = 120\text{A}$ , $V_{GS} = 10\text{V}$ (see <a href="#">Figure 20</a> )		160 28 70	218	nC nC nC

1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

**Table 5. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}^{(1)}$	Source-drain current Source-drain current (pulsed)				120 480	A A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 120A, V_{GS} = 0$			1.5	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD} = 120A,$ $di/dt = 100A/\mu s,$ $V_{DD} = 35V, T_j = 150^\circ C$ (see <a href="#">Figure 21</a> )		115 450 8		ns nC A

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

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

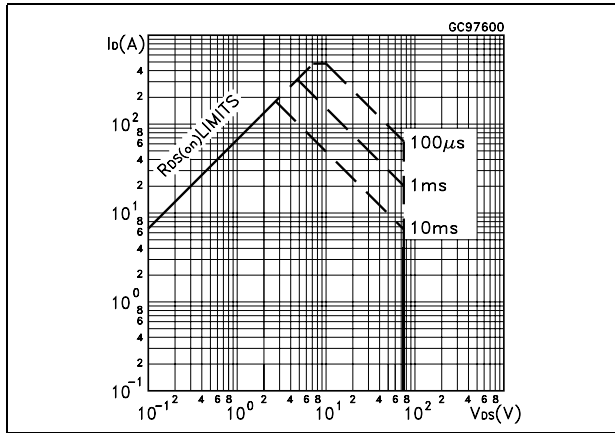


Figure 2. Thermal impedance

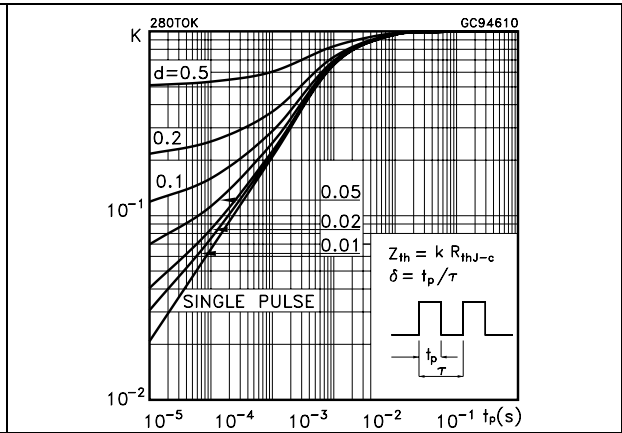


Figure 3. Output characteristics

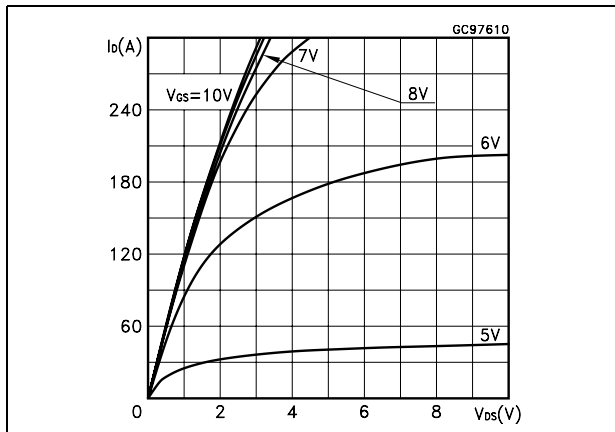


Figure 4. Transfer characteristics

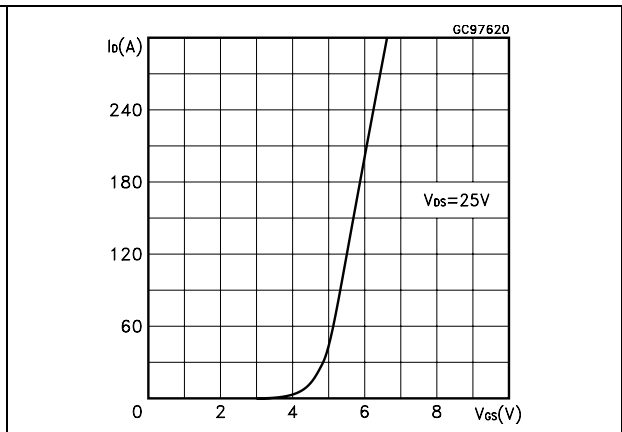


Figure 5. Transconductance

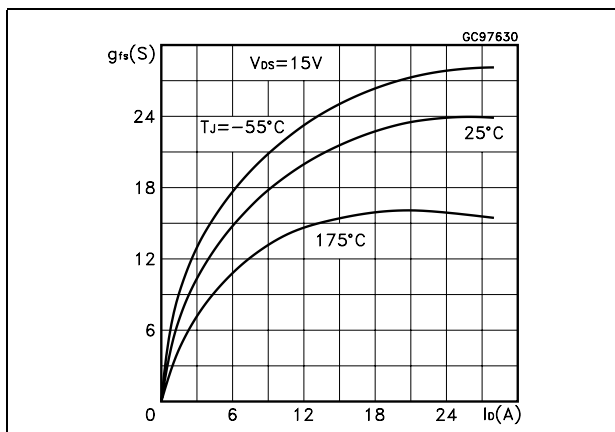


Figure 6. Static drain-source on resistance

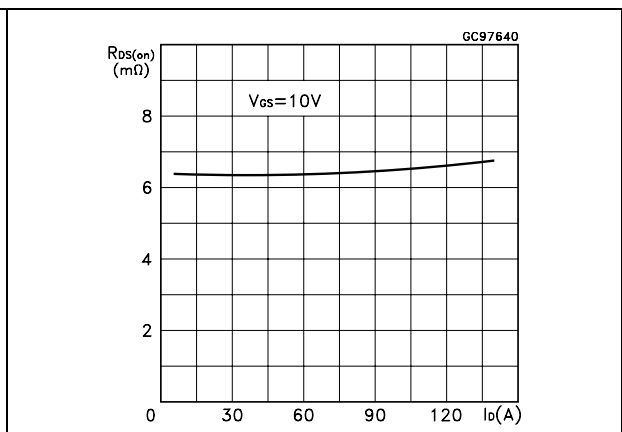


Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

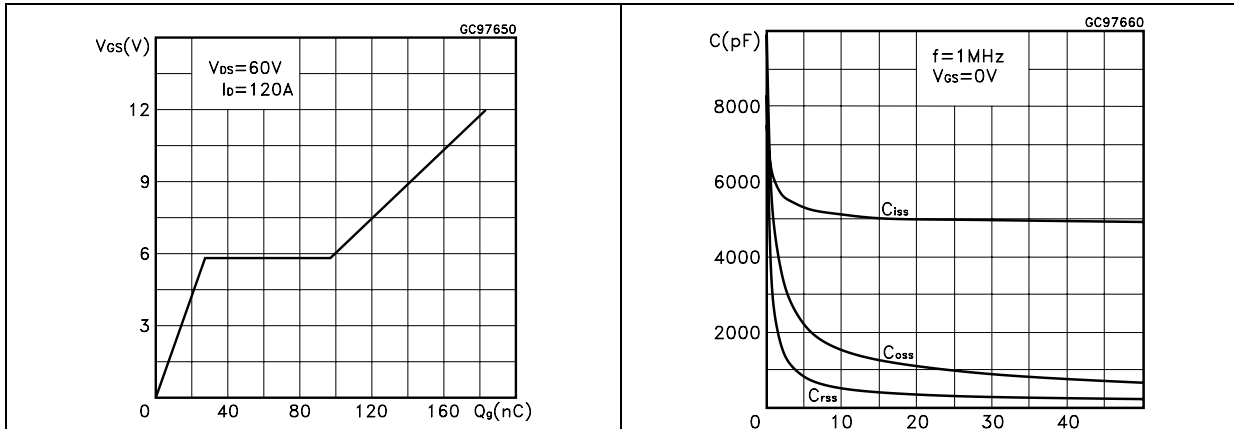


Figure 9. Normalized gate threshold voltage vs temperature Figure 10. Normalized on resistance vs temperature

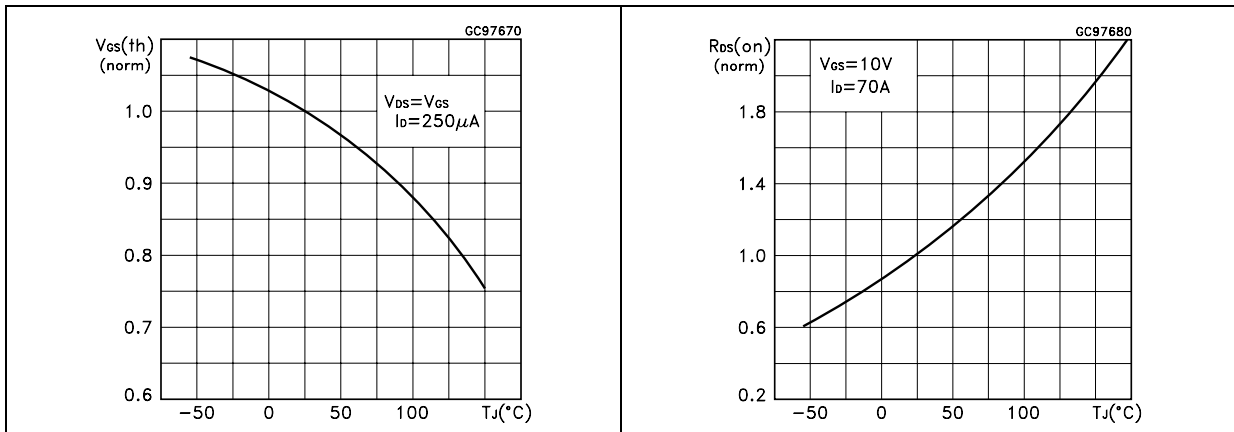


Figure 11. Source-drain diode forward characteristics Figure 12. Normalized  $B_{V_{DS}}$  vs temperature

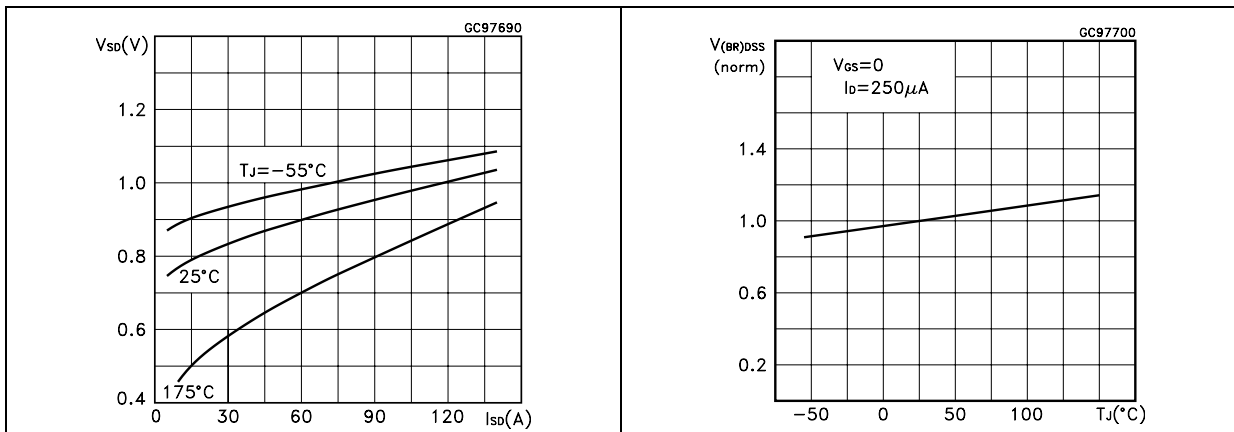


Figure 13. Power derating vs Tc

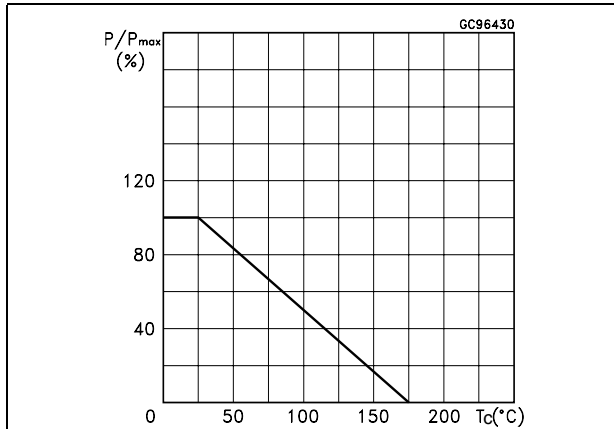


Figure 14. Max I<sub>D</sub> current vs Tc

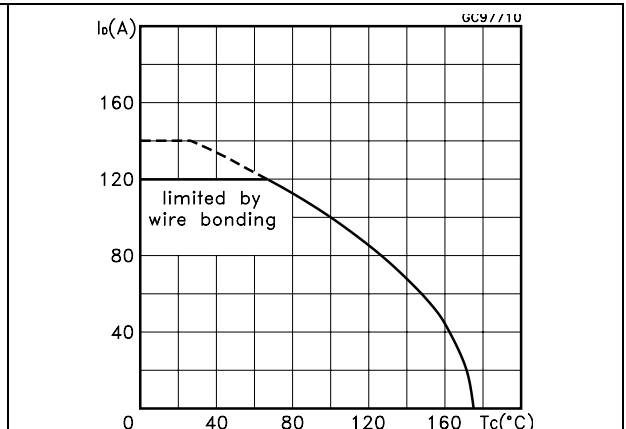


Figure 15. Thermal resistance R<sub>thj-a</sub> vs PCB copper area

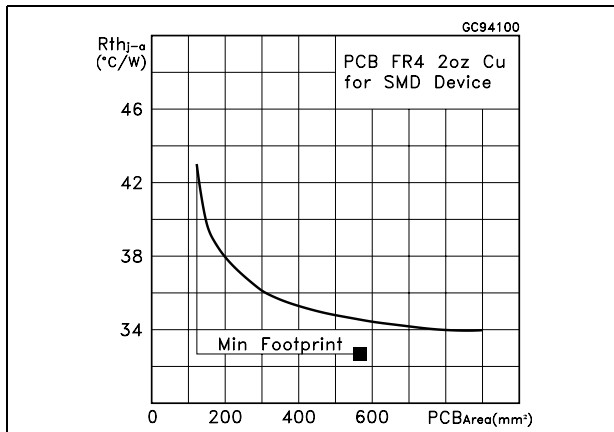


Figure 16. Max power dissipation vs PCB copper area

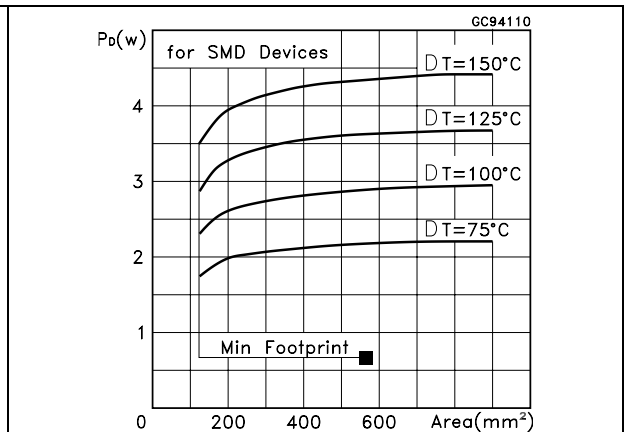
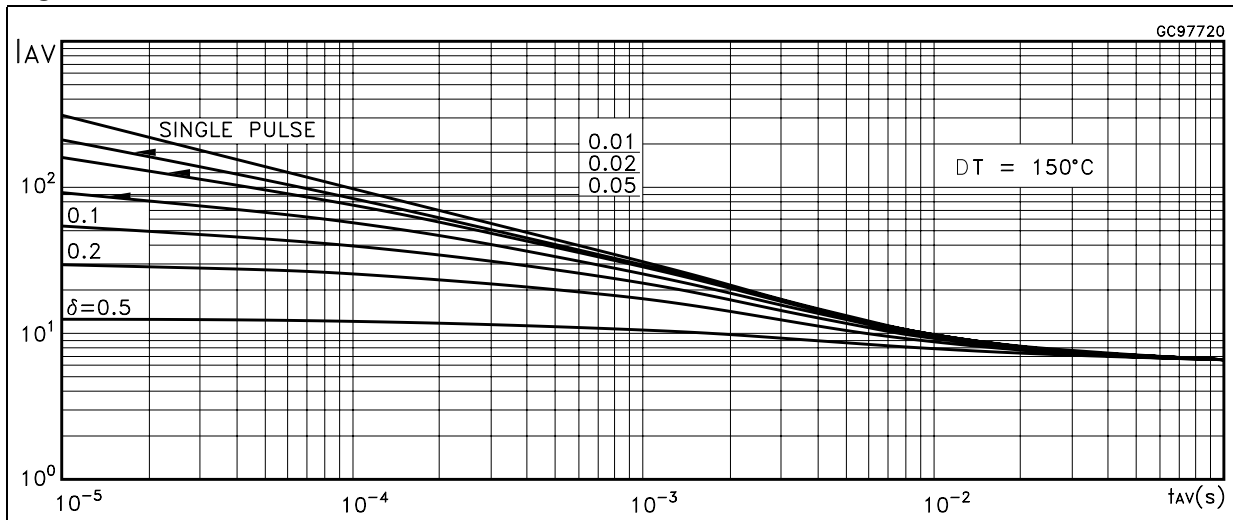




Figure 17. Allowable I<sub>AV</sub> vs time in avalanche



The previous curve gives the safe operating area for unclamped inductive loads, single pulse or repetitive, under the following conditions:

$$P_{D(AVE)} = 0.5 * (1.3 * B_{VDSS} * I_{AV})$$

$$E_{AS(AR)} = P_{D(AVE)} * t_{AV}$$

Where:

$I_{AV}$  is the allowable current in avalanche

$P_{D(AVE)}$  is the average power dissipation in avalanche (single pulse)

$t_{AV}$  is the time in avalanche

To derate above  $25^\circ C$ , at fixed  $I_{AV}$ , the following equation must be applied:

$$I_{AV} = 2 * (T_{jmax} - T_{CASE}) / (1.3 * B_{VDSS} * Z_{th})$$

Where:

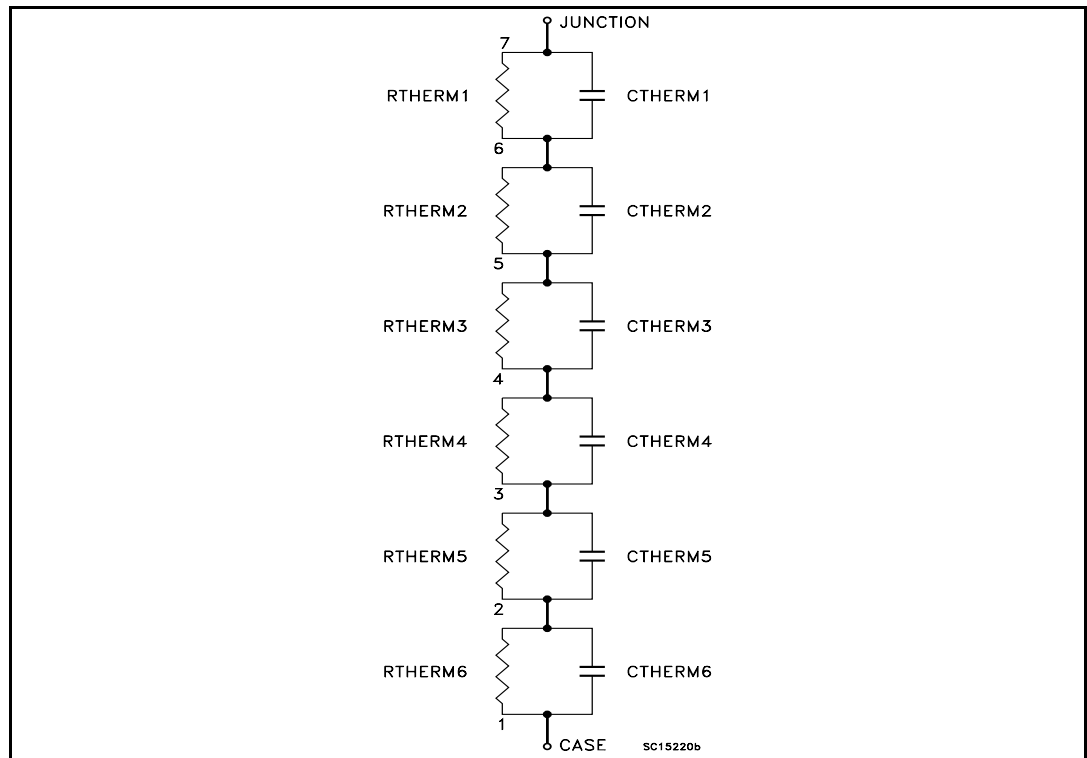
$Z_{th} = K * R_{th}$  is the value coming from normalized thermal response at fixed pulse width equal to  $T_{AV}$ .

### 3 Spice thermal model

**Table 6. Parameters**

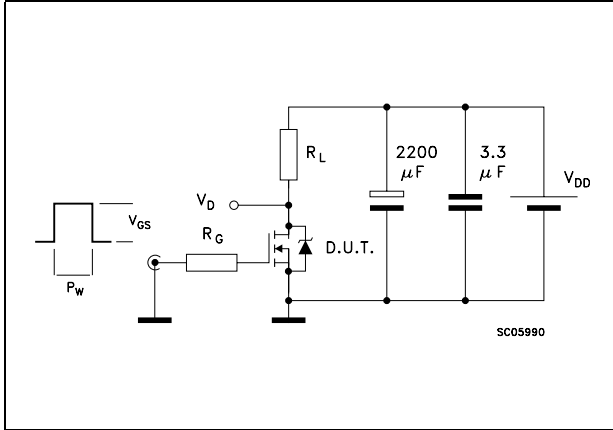
Parameter	Node	Value
CTHERM1	7 - 6	$1.49 * 10^{-3}$
CTHERM2	6 - 5	$3.50 * 10^{-2}$
CTHERM3	5 - 4	$5.94 * 10^{-2}$
CTHERM4	4 - 3	$9.74 * 10^{-2}$
CTHERM5	3 - 2	$8.86 * 10^{-2}$
CTHERM6	2 - 1	$8.27 * 10^{-1}$
RTHERM1	7 - 6	0.0384
RTHERM2	6 - 5	0.0624
RTHERM3	5 - 4	0.072
RTHERM4	4 - 3	0.0912
RTHERM5	3 - 2	0.1008
RTHERM6	2 - 1	0.1152

**Figure 18. Scheme**

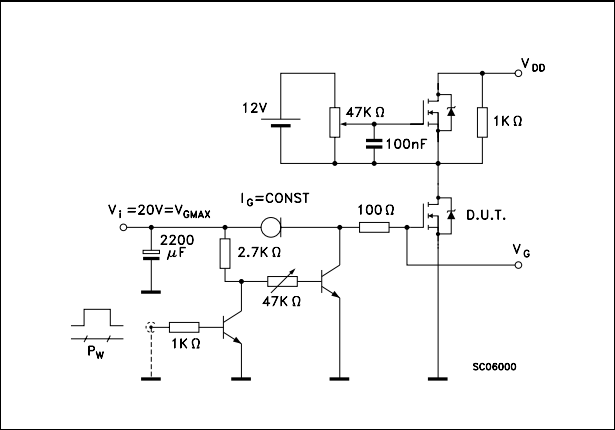


# 4 Test circuit

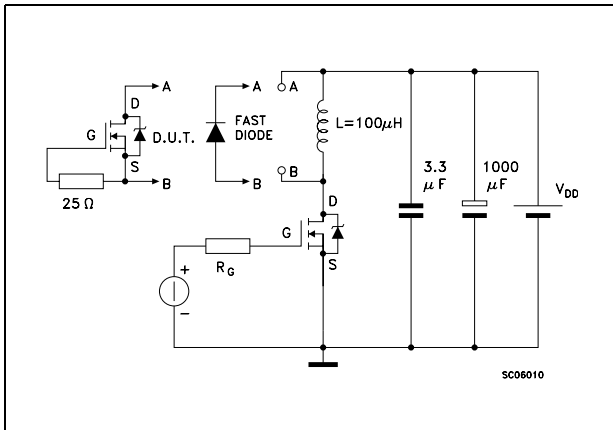
**Figure 19. Switching times test circuit for resistive load**



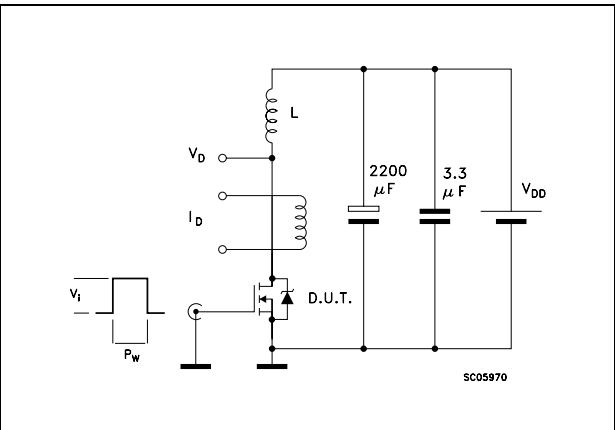
**Figure 20. Gate charge test circuit**



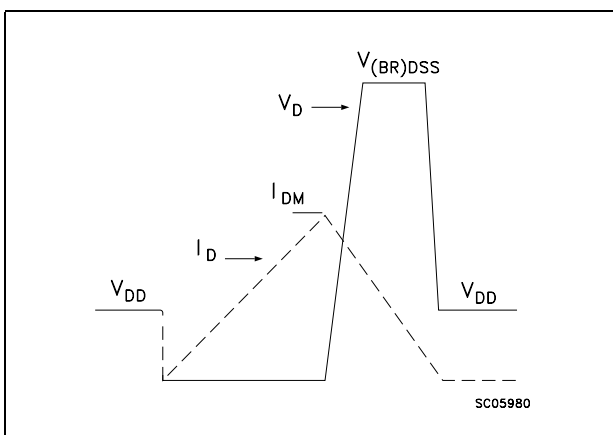
**Figure 21. Test circuit for inductive load switching and diode recovery times**



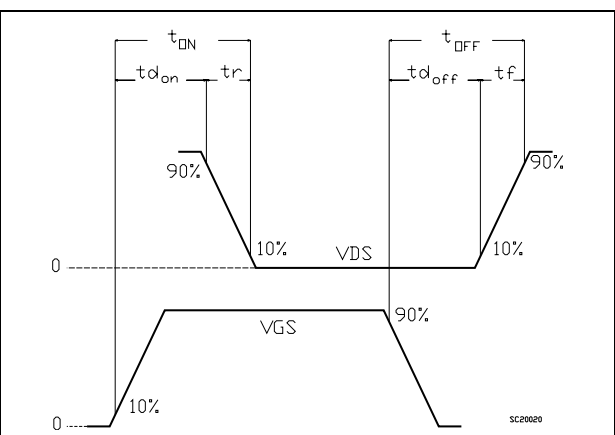
**Figure 22. Unclamped Inductive load test circuit**



**Figure 23. Unclamped inductive waveform**



**Figure 24. Switching time waveform**

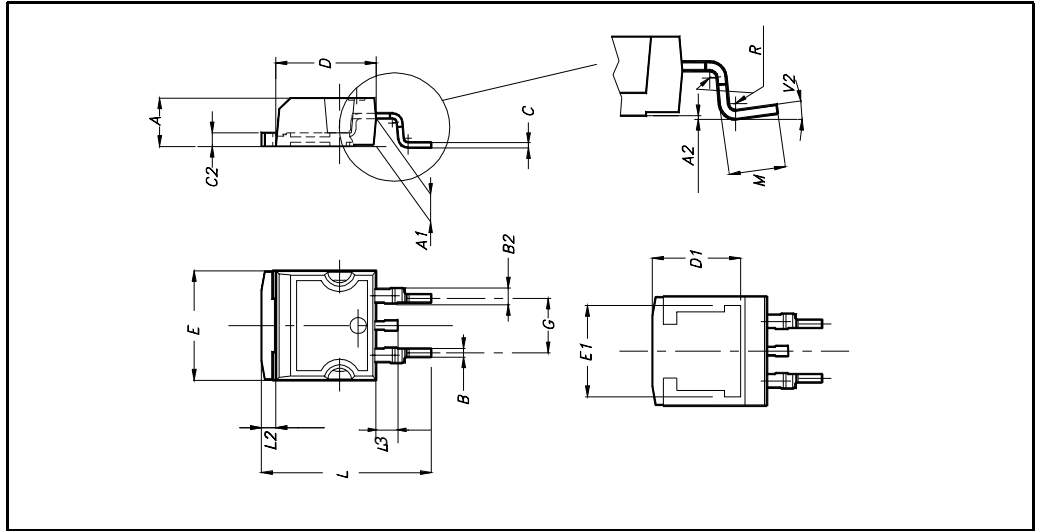


## 5 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)

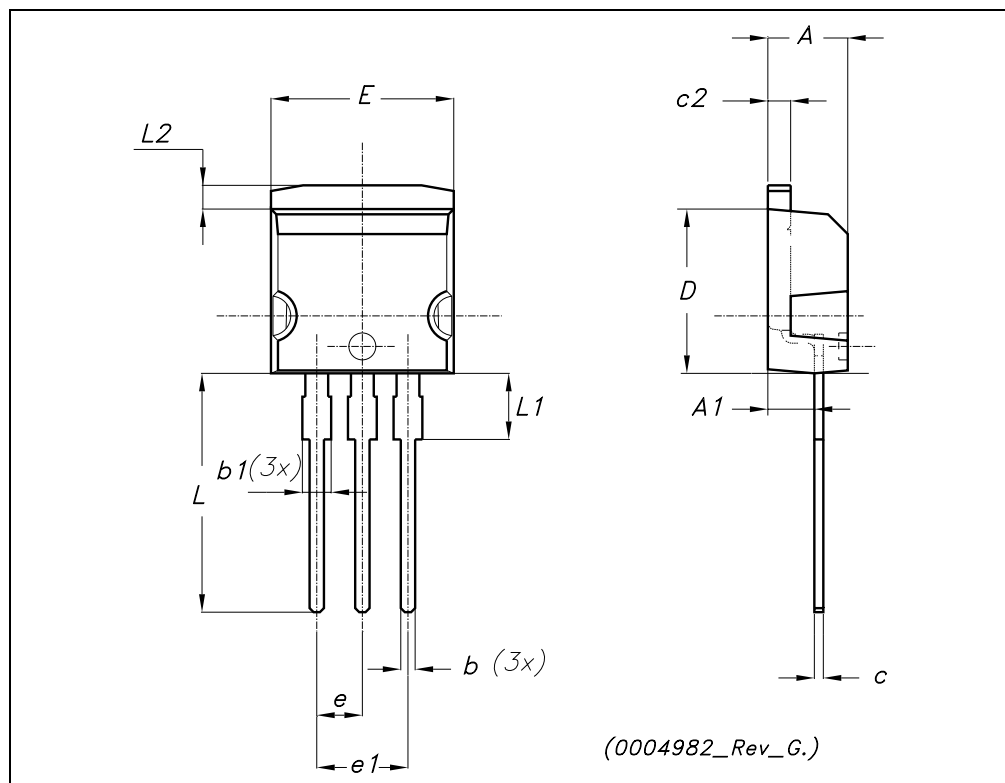
**D<sup>2</sup>PAK MECHANICAL DATA**

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
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°			



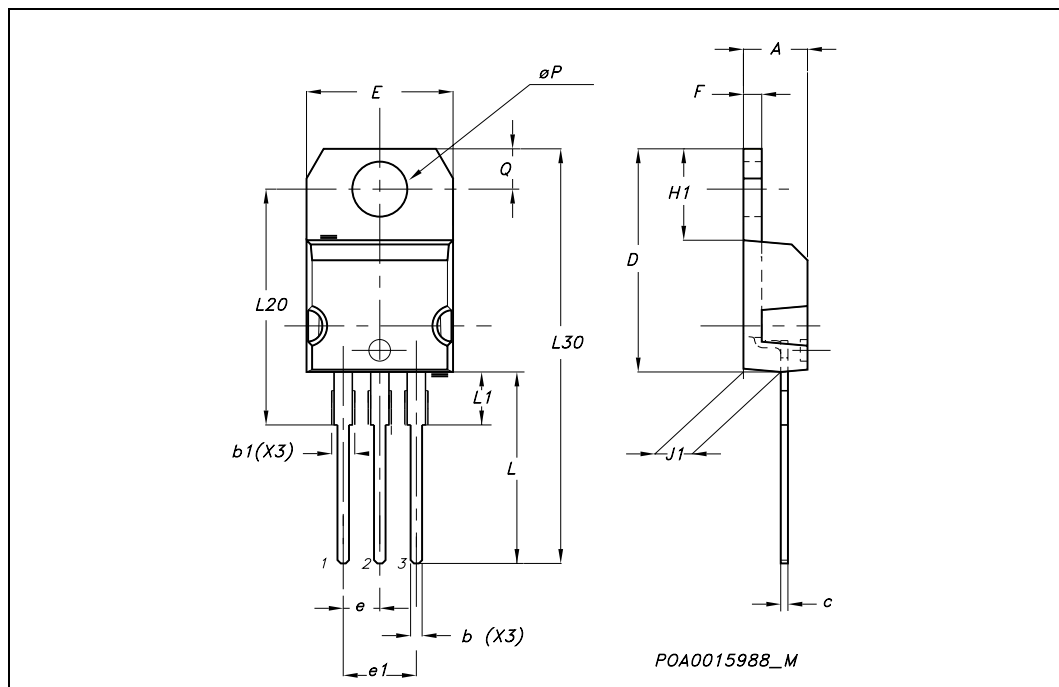
**TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA**

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



**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



## 6 Packaging mechanical data

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



### TAPE AND REEL SHIPMENT

**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

10 pitches cumulative tolerance on tape +/- 0.2 mm

FEED DIRECTION

Bending radius R min.

\* on sales type



## 7 Revision history

Table 7. Revision history

Date	Revision	Changes
21-Jun-2004	2	Preliminary datasheet
19-Jun-2006	3	New template, content change
28-Jun-2006	4	Graphical updates, <a href="#">Figure 10</a> and <a href="#">Figure 13</a>

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