



STD45NF75

N-channel 75 V, 0.018 Ω , 40 A DPAK
STripFET™ II Power MOSFET

Features

Type	V _{DSS}	R _{DS(on)} max	I _D
STD45NF75	75 V	< 0.024 Ω	40 A ⁽¹⁾

1. Current limited by package

- 100% avalanche tested
- Gate charge minimized

Application

- Switching applications

Description

This Power MOSFET is the latest development of STMicroelectronics's 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.

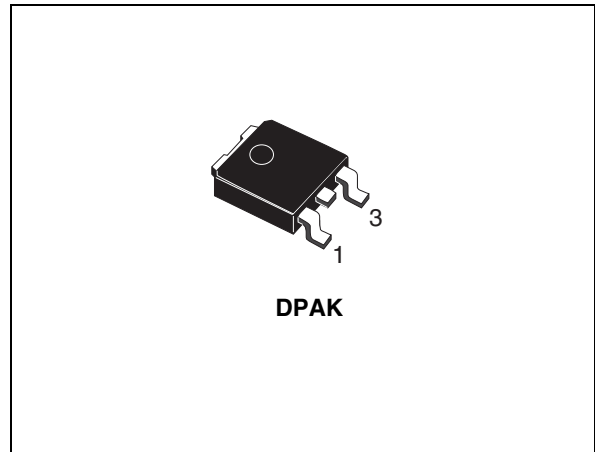


Figure 1. Internal schematic diagram

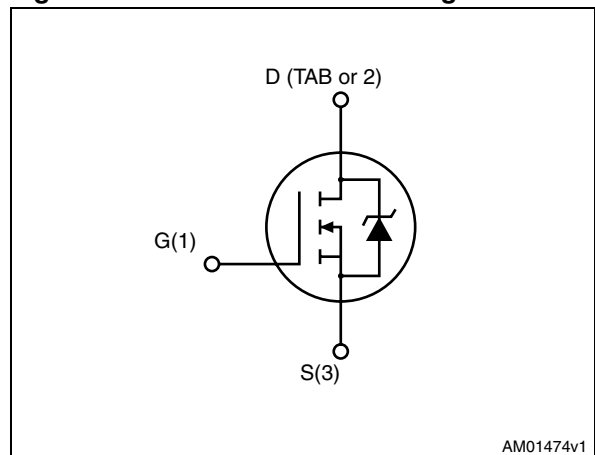


Table 1. Device summary

Order code	Marking	Package	Packaging
STD45NF75T4	D45NF75	DPAK	Tape and reel

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1 Electrical ratings

Table 2. 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	± 20	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	40	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	30	A
$I_{DM}^{(2)}$	Drain current (pulsed)	160	A
P_{tot}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	125	W
	Derating factor	0.83	W/ $^\circ\text{C}$
$dv/dt^{(3)}$	Peak diode recovery voltage slope	20	V/ns
$E_{AS}^{(4)}$	Single pulse avalanche energy	500	mJ
T_{stg}	Storage temperature	-55 to 175	$^\circ\text{C}$
T_j	Max. operating junction temperature		

1. Current limited by package
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq 40\text{ A}$, $di/dt \leq 800\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$
4. Starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = 20\text{ A}$, $V_{DD} = 40\text{ V}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	1.2	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}$	Thermal resistance junction-pcb max	see Figure 16. and Figure 17.	$^\circ\text{C}/\text{W}$
T_J	Maximum lead temperature for soldering purpose ⁽¹⁾	260	$^\circ\text{C}$

1. for 10 sec. 1.6 mm from case

2 Electrical characteristics

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

Table 4. 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 ($V_{GS} = 0$)	$V_{DS} = \text{max rating}$ $V_{DS} = \text{max rating},$ $T_C = 125\text{ °C}$			1 10	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			± 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	$V_{GS} = 10\text{ V}, I_D = 20\text{ A}$		0.018	0.024	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 25\text{ V}, I_D = 20\text{ A}$	-	50		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0$	-	1760 360 140		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	$V_{DD} = 37\text{ V}, I_D = 20\text{ A}$ $R_G = 4.7\ \Omega, V_{GS} = 10\text{ V}$ (see Figure 20)	-	15 40 55 12		ns ns ns ns
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 60\text{ V}, I_D = 40\text{ A},$ $V_{GS} = 10\text{ V}, R_G = 4.7\ \Omega$ (see Figure 21)	-	60 13 23	80	nC nC nC

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

Table 6. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} $I_{SDM}^{(1)}$	Source-drain current Source-drain current (pulsed)		-		40 160	A A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 40\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD} = 40\text{ A}$, $V_{DD} = 30\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 22)	-	120 410 7.5		ns nC A

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

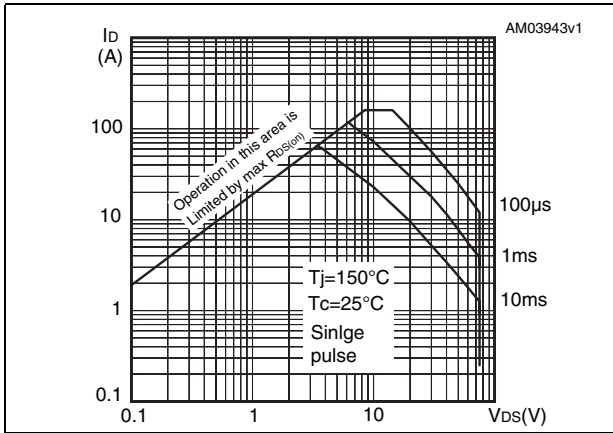


Figure 3. Thermal impedance

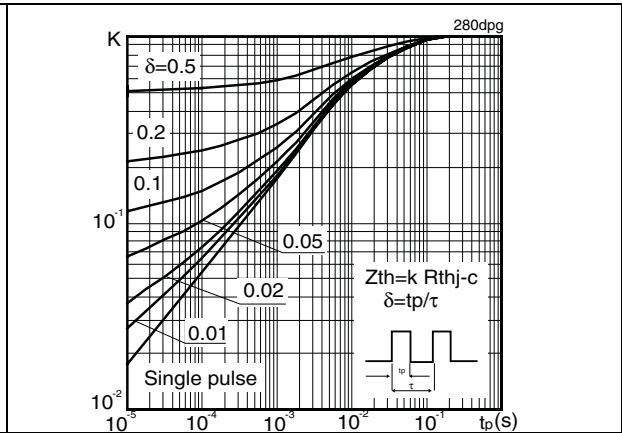


Figure 4. Output characteristics

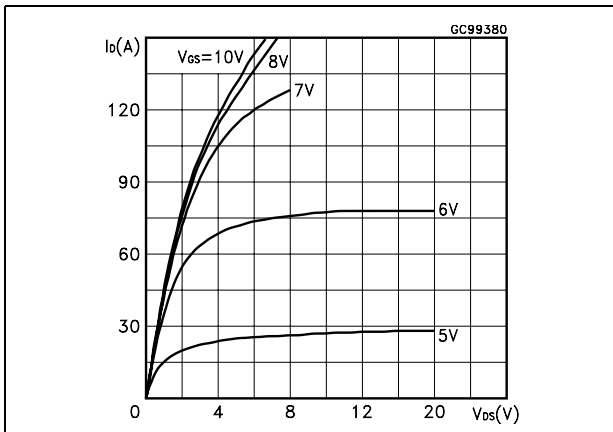


Figure 5. Transfer characteristics

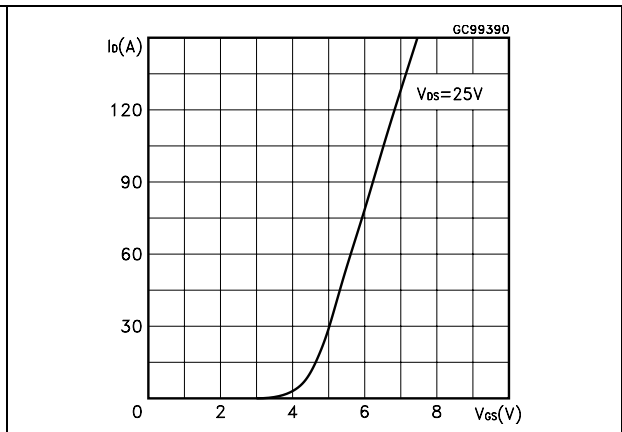


Figure 6. Transconductance

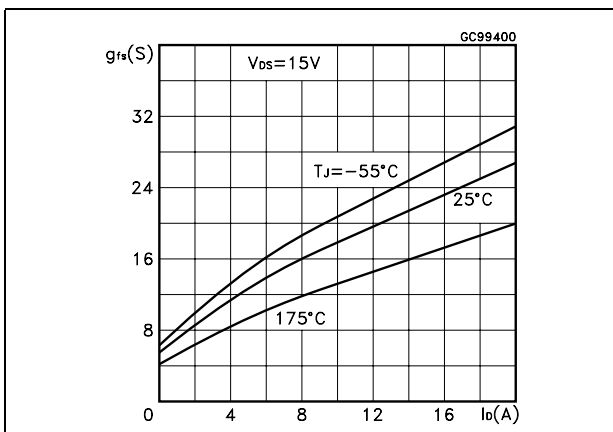


Figure 7. Static drain-source on resistance

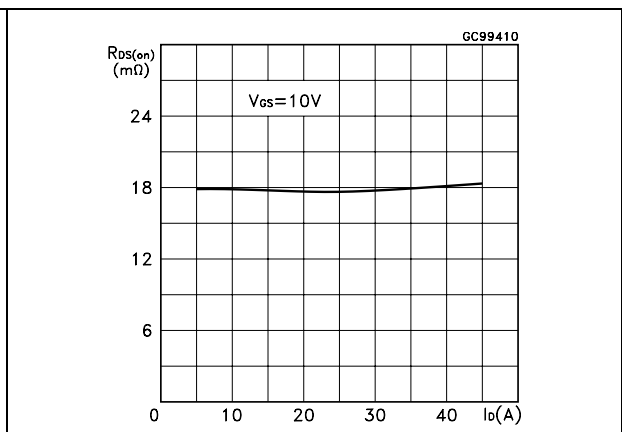


Figure 8. Gate charge vs. gate-source voltage

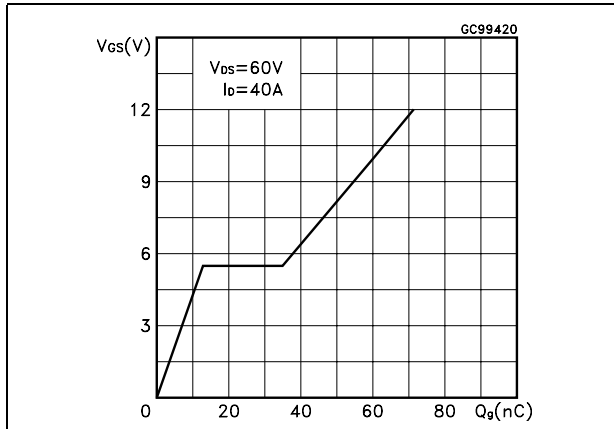


Figure 9. Capacitance variations

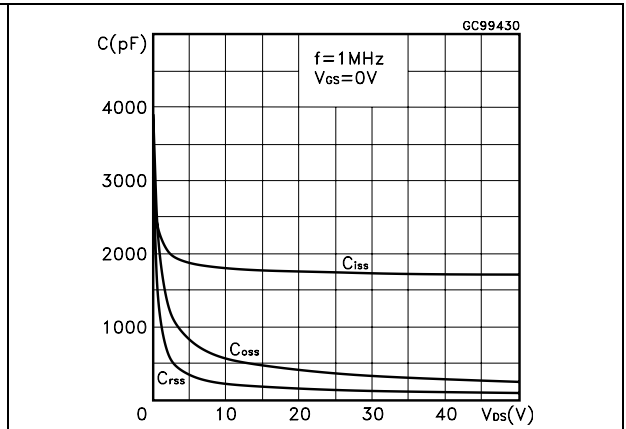


Figure 10. Normalized gate threshold voltage vs. temperature

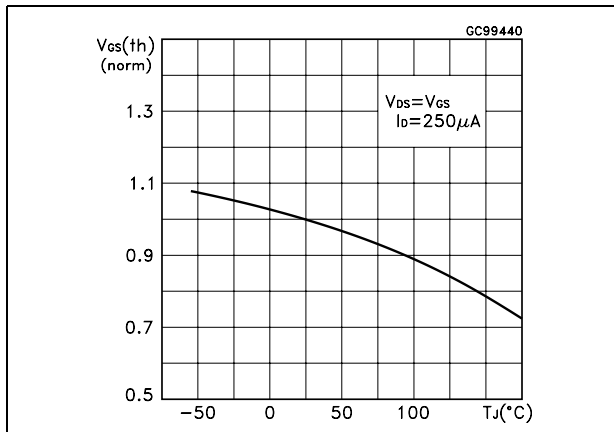


Figure 11. Normalized on resistance vs. temperature

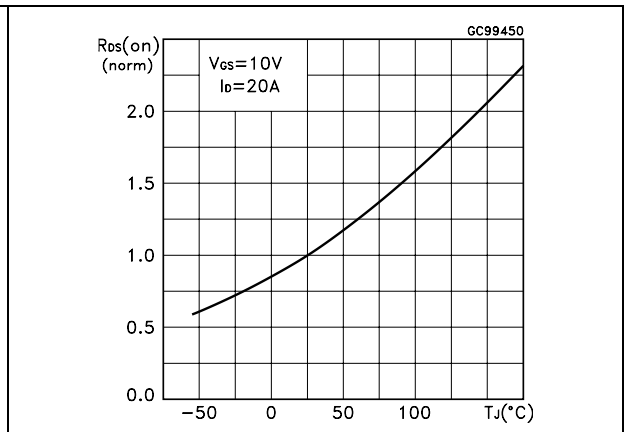


Figure 12. Source-drain diode forward characteristics

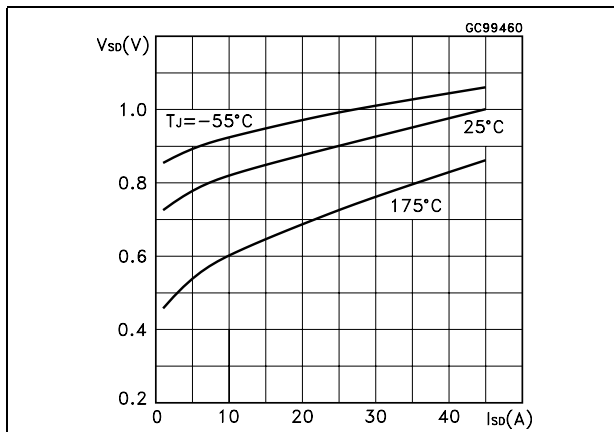


Figure 13. Normalized breakdown voltage vs. temperature

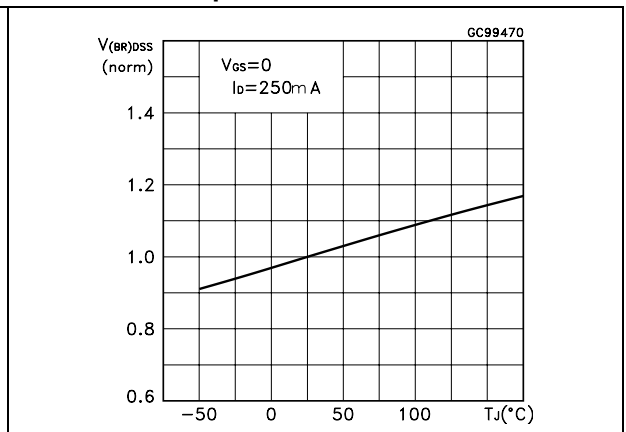


Figure 14. Power derating vs. Tj

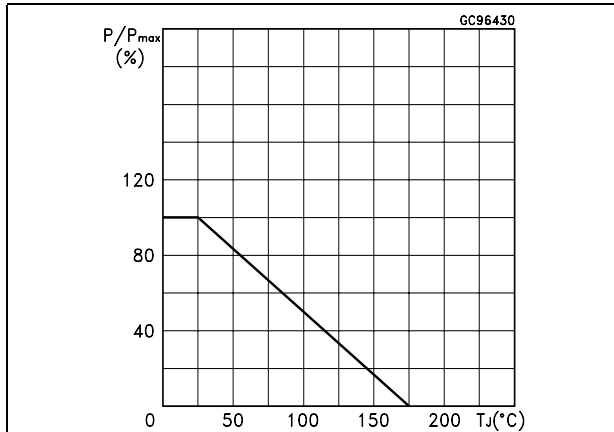


Figure 15. Max Id current vs. Tc

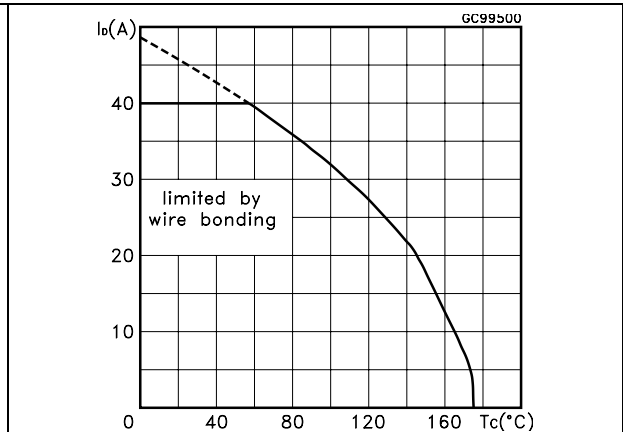


Figure 16. Thermal resistance Rthj-a vs. pcb copper area

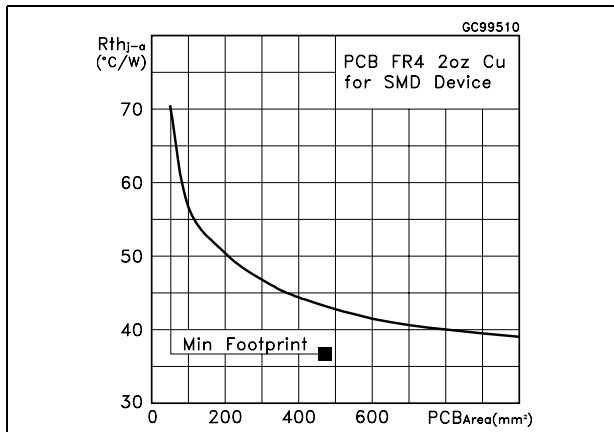


Figure 17. Max power dissipation vs. pcb copper area

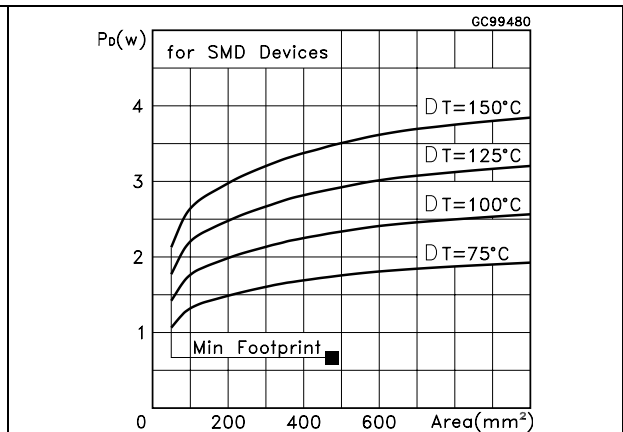
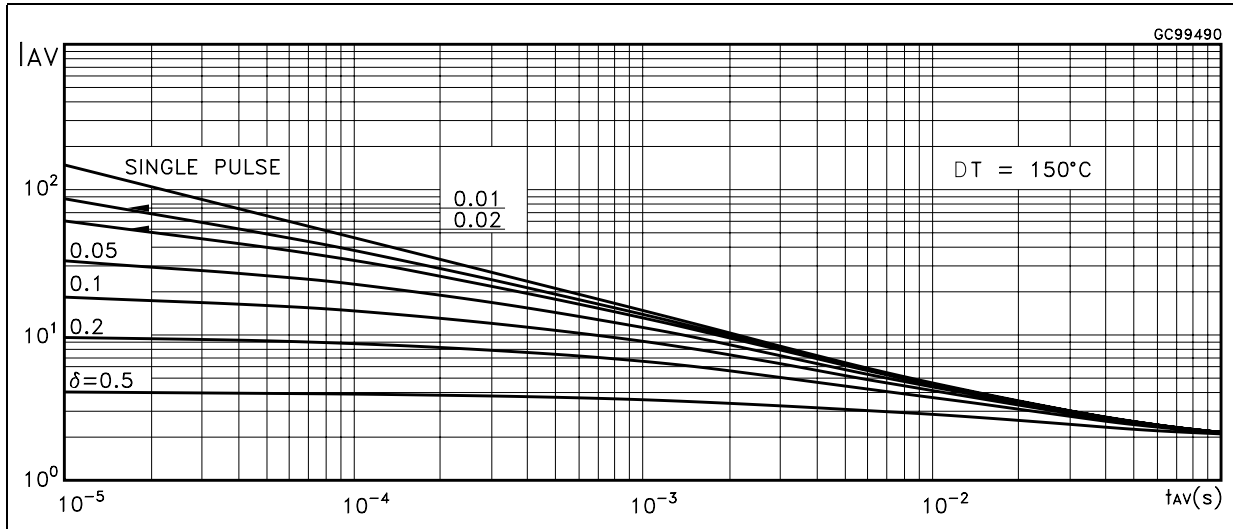


Figure 18. Allowable I_{AV} vs. time in avalanche



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 de rate above 25 °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:

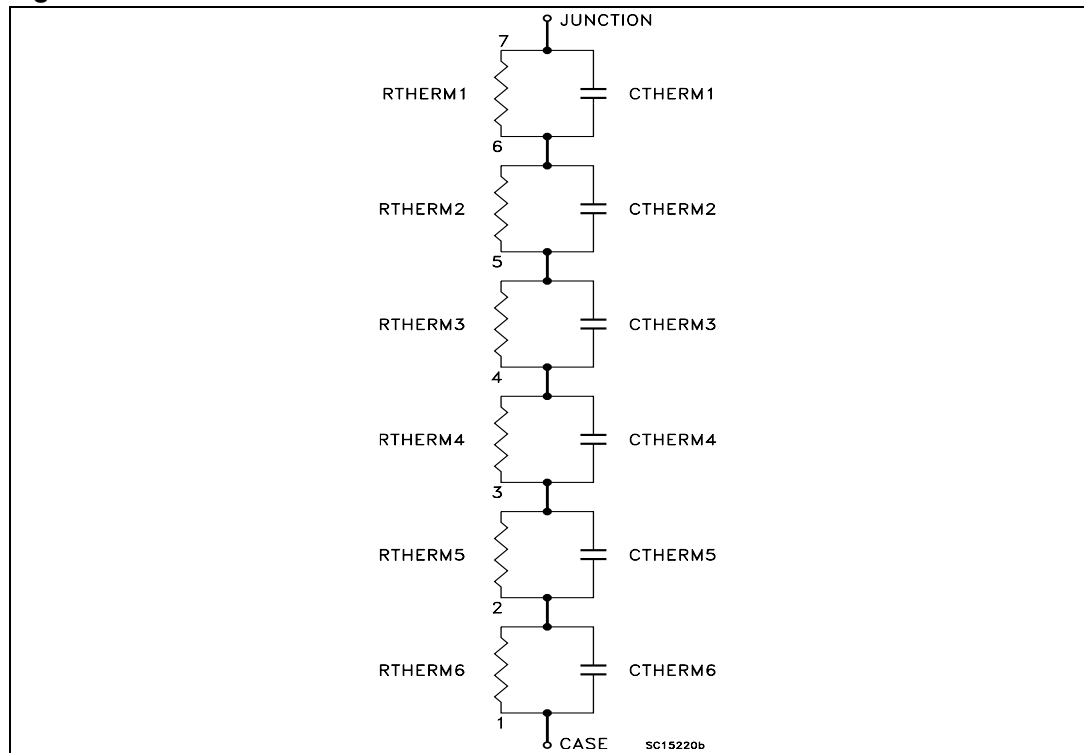
$Z_{th} = K * R_{th}$ is the value coming from normalized thermal response at fixed pulse width equal to T_{AV} .

3 Spice thermal model

Table 7. Spice parameter

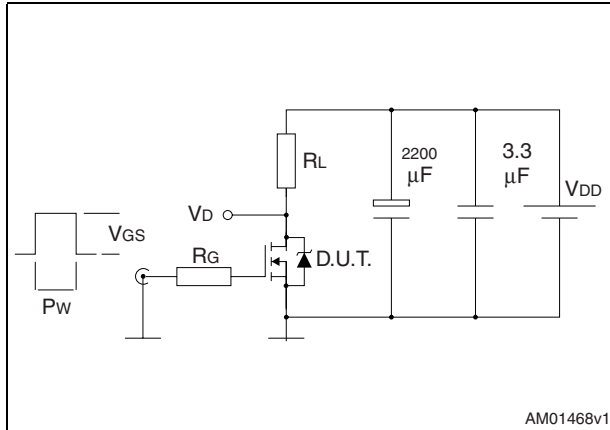
Parameter	Node	Value
CTHERM1	7 - 6	$6 * 10^{-4}$
CTHERM2	6 - 5	$8 * 10^{-3}$
CTHERM3	5 - 4	$2 * 10^{-2}$
CTHERM4	4 - 3	$6 * 10^{-2}$
CTHERM5	3 - 2	$9.65 * 10^{-2}$
CTHERM6	2 - 1	$6 * 10^{-1}$
R THERM1	7 - 6	0.045
R THERM2	6 - 5	0.105
R THERM3	5 - 4	0.150
R THERM4	4 - 3	0.225
R THERM5	3 - 2	0.375
R THERM6	2 - 1	0.600

Figure 19. Thermal network



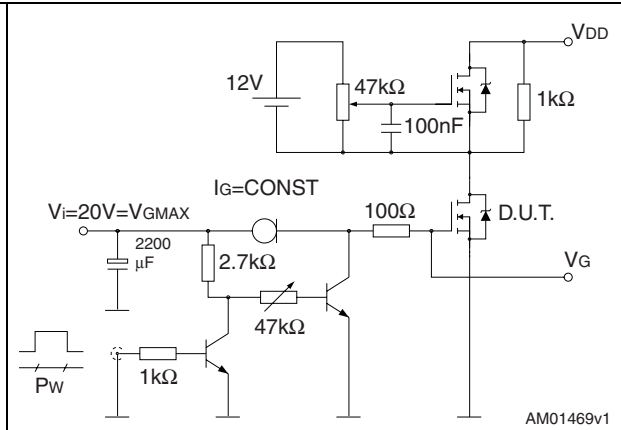
4 Test circuits

Figure 20. Switching times test circuit for resistive load



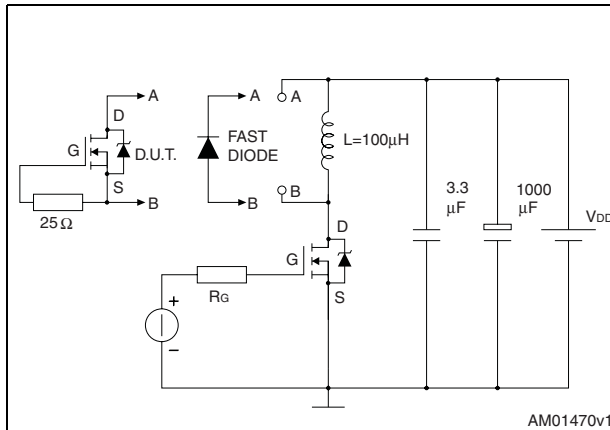
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Figure 21. Gate charge test circuit



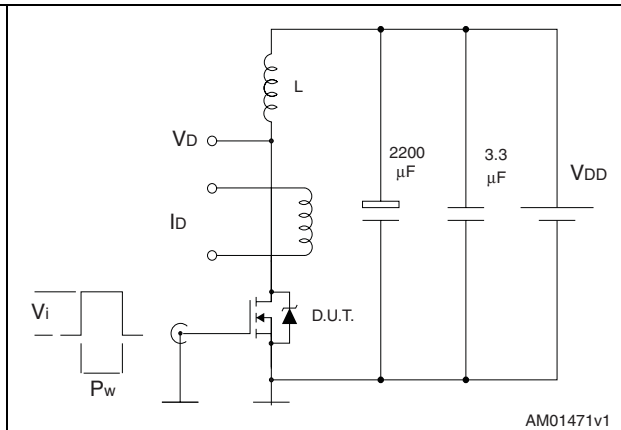
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Figure 22. Test circuit for inductive load switching and diode recovery times



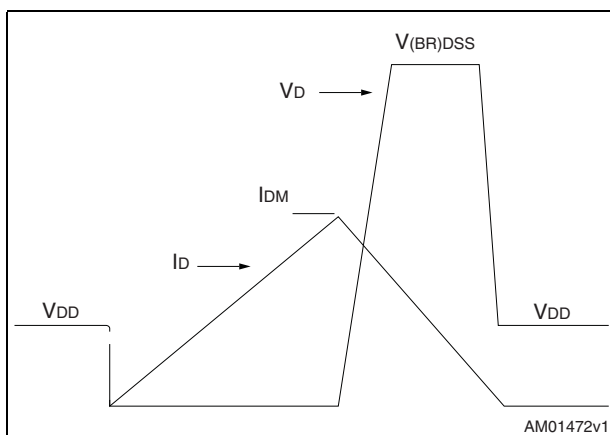
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Figure 23. Unclamped inductive load test circuit



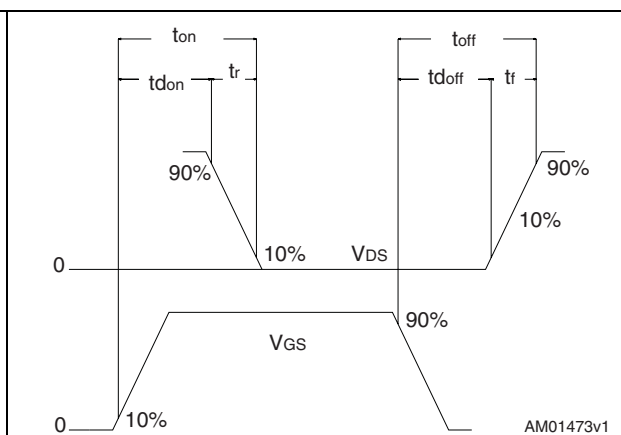
AM01471v1

Figure 24. Unclamped inductive waveform



AM01472v1

Figure 25. Switching time waveform



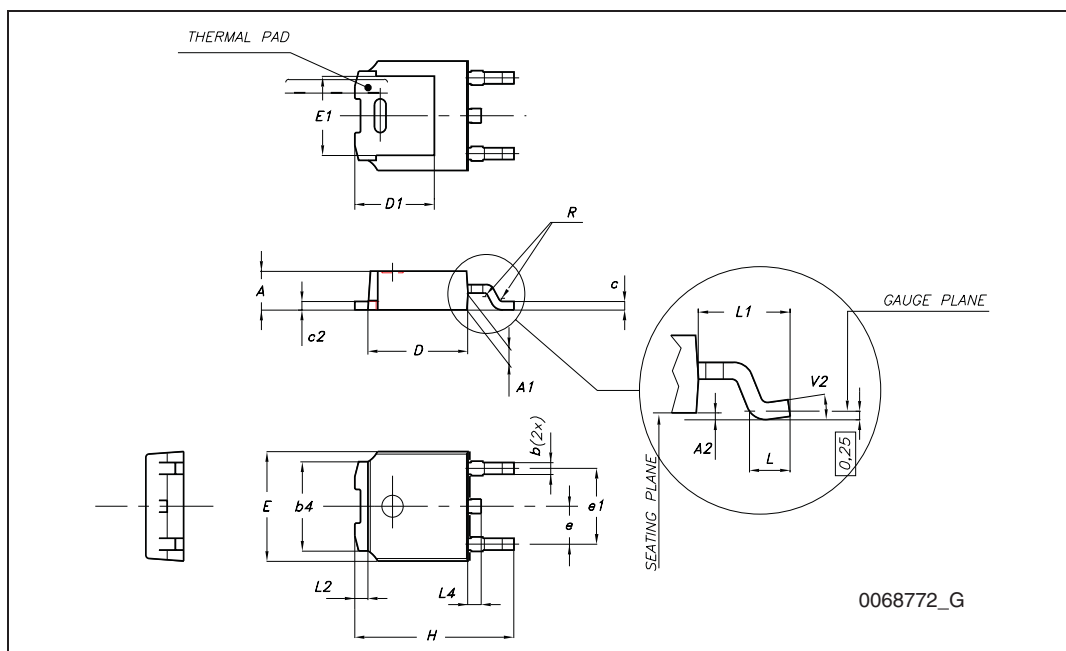
AM01473v1

5 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

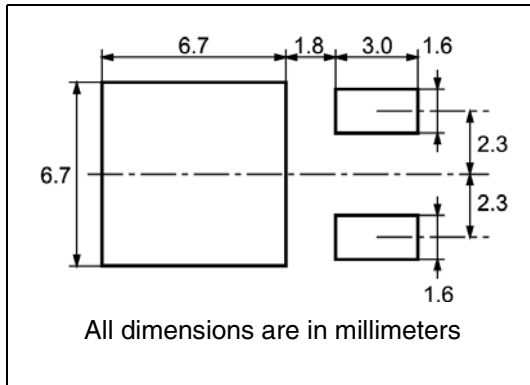
TO-252 (DPAK) mechanical data

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°



6 Packing mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 25mm min. width

G measured at hub

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	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	6.8	7	0.267	0.275
B0	10.4	10.6	0.409	0.417
B1		12.1		0.476
D	1.5	1.6	0.059	0.063
D1	1.5		0.059	
E	1.65	1.85	0.065	0.073
F	7.4	7.6	0.291	0.299
K0	2.55	2.75	0.100	0.108
P0	3.9	4.1	0.153	0.161
P1	7.9	8.1	0.311	0.319
P2	1.9	2.1	0.075	0.082
R	40		1.574	
W	15.7	16.3	0.618	0.641

For machine ref. only including draft and radii concentric around B0

10 pitches cumulative tolerance on tape +/- 0.2 mm

User Direction of Feed

Center line of cavity

FEED DIRECTION

Bending radius R min.

7 Revision history

Table 8. Document revision history

Date	Revision	Changes
22-Jun-2004	1	Preliminary version
09-Sep-2004	2	Complete version
11-Jul-2006	3	New template, no content change
20-Feb-2007	4	Typo mistake on page 1
20-May-2009	5	Figure 2 and Figure 3 have been updated

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