



# STD8NM60ND, STF8NM60ND STP8NM60ND, STU8NM60ND

N-channel 600 V, 0.59  $\Omega$  , 7 A, FDmesh™ II Power MOSFET  
TO-220, TO-220FP, IPAK, DPAK

## Features

Type	V <sub>DSS</sub> (@T <sub>jmax</sub> )	R <sub>DS(on)</sub> max	I <sub>D</sub>
STD8NM60ND	650 V	< 0.70 $\Omega$	7 A
STF8NM60ND	650 V	< 0.70 $\Omega$	7 A
STP8NM60ND	650 V	< 0.70 $\Omega$	7 A <sup>(1)</sup>
STU8NM60ND	650 V	< 0.70 $\Omega$	7 A

1. Limited only by maximum temperature allowed

- The worldwide best R<sub>DS(on)</sub>\* area amongst the fast recovery diode devices
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- Extremely high dv/dt and avalanche capabilities

## Application

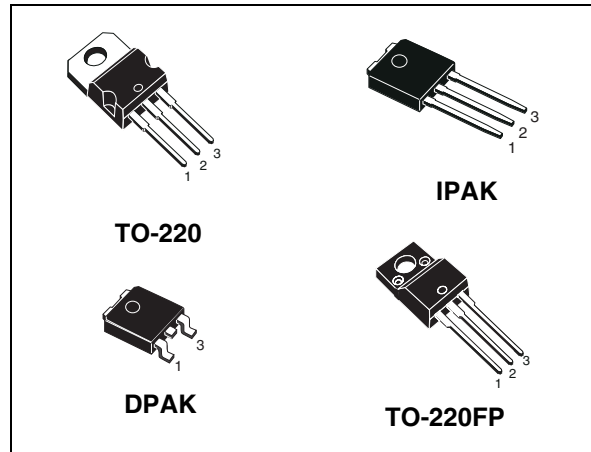
- Switching applications

## Description

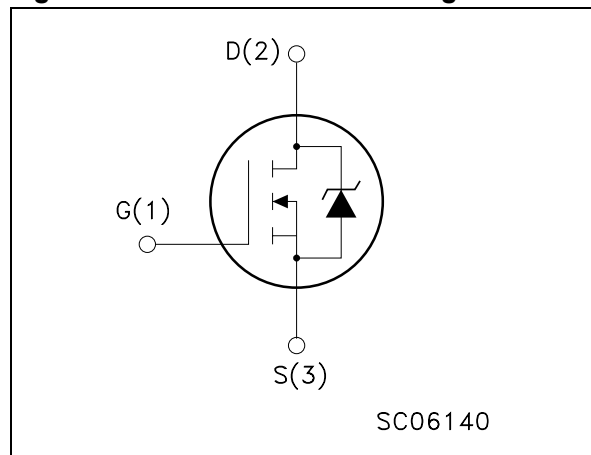
The FDmesh™ II series belongs to the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout and associates all advantages of reduced on-resistance and fast switching with an intrinsic fast-recovery body diode. Strongly recommended for bridge topologies, in ZVS phase-shift converters.

**Table 1. Device summary**

Order codes	Marking	Package	Packaging
STD8NM60ND	8NM60ND	DPAK	Tape and reel
STF8NM60ND	8NM60ND	TO-220FP	Tube
STP8NM60ND	8NM60ND	TO-220	Tube
STU8NM60ND	8NM60ND	IPAK	Tube



**Figure 1. Internal schematic diagram**



# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value			Unit
		TO-220	DPAK	IPAK	
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	600			V
$V_{GS}$	Gate-source voltage	$\pm 30$			V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	77		(1)	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	4.4		4.4 (1)	A
$I_{DM}^{(2)}$	Drain current (pulsed)	28		28 (1)	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	70		25	W
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}; T_C = 25\text{ }^\circ\text{C}$ )			2500	V
$dv/dt^{(3)}$	Peak diode recovery voltage slope	40			V/ns
$T_{stg}$	Storage temperature	-55 to 150			$^\circ\text{C}$
$T_j$	Max. operating junction temperature	150			$^\circ\text{C}$

1. Limited only by maximum temperature allowed
2. Pulse width limited by safe operating area
3.  $I_{SD} \leq 7\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$

**Table 3. Thermal data**

Symbol	Parameter	Value			Unit	
		TO-220	DPAK	IPAK		TO-220FP
$R_{thj-case}$	Thermal resistance junction-case	1.79		5	$^\circ\text{C}/\text{W}$	
$R_{thj-amb}$	Thermal resistance junction-amb	62.5		100	62.5	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}$	Thermal resistance junction-pcb		50			$^\circ\text{C}/\text{W}$
$T_l$	Maximum lead temperature for soldering purpose	300			$^\circ\text{C}$	

**Table 4. Avalanche characteristics**

Symbol	Parameter	Max value	Unit
$I_{AS}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)	2.5	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AS}$ , $V_{DD} = 50\text{ V}$ )	200	mJ

## 2 Electrical characteristics

(T<sub>CASE</sub> = 25 °C unless otherwise specified)

**Table 5. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source breakdown voltage	I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0	600			V
dv/dt <sup>(1)</sup>	Drain-source voltage slope	V <sub>DD</sub> = 480 V, I <sub>D</sub> = 7 A, V <sub>GS</sub> = 10 V	45			V/ns
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			1 100	μA μA
I <sub>GSS</sub>	Gate body leakage current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ±20 V			±100	nA
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> = 10V, I <sub>D</sub> = 3.5 A		0.59	0.70	Ω

1. Characteristics value at turn off on inductive load

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g <sub>fs</sub> <sup>(1)</sup>	Forward transconductance	V <sub>DS</sub> = 15 V, I <sub>D</sub> = 5 A		7.5		S
C <sub>iss</sub> C <sub>oss</sub> C <sub>rss</sub>	Input capacitance Output capacitance Reverse transfer capacitance	V <sub>DS</sub> = 50 V, f = 1 MHz, V <sub>GS</sub> = 0		560 37 4		pF pF pF
C <sub>oss eq.</sub> <sup>(2)</sup>	Equivalent output capacitance	V <sub>GS</sub> = 0, V <sub>DS</sub> = 0 to 480 V		90		pF
R <sub>G</sub>	Gate input resistance	f = 1 MHz Gate DC Bias = 0 Test Signal Level = 20 mV Open Drain		6		Ω
Q <sub>g</sub> Q <sub>gs</sub> Q <sub>gd</sub>	Total gate charge Gate-source charge Gate-drain charge	V <sub>DD</sub> = 480 V, I <sub>D</sub> = 7 A V <sub>GS</sub> = 10 V <i>Figure 19</i>		22 4 13		nC nC nC

1. Pulsed: pulse duration = 300μs, 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>

**Table 7. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$ , $I_D = 7\text{ A}$ ,		9		ns
$t_r$	Rise time	$R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$		22		ns
$t_{d(off)}$	Turn-off delay time	<a href="#">Figure 18</a> ,		37		ns
$t_f$	Fall time	<a href="#">Figure 23</a>		22		ns

**Table 8. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current				7	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				28	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 7\text{ A}$ , $V_{GS} = 0$			1.3	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 7\text{ A}$ , $di/dt = 100$		120		ns
$Q_{rr}$	Reverse recovery charge	$A/\mu s$ , $V_{DD} = 30\text{ V}$ ,		0.49		$\mu C$
$I_{RRM}$	Reverse recovery current	<a href="#">Figure 20</a>		8		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 7\text{ A}$ ,		170		ns
$Q_{rr}$	Reverse recovery charge	$di/dt = 100\text{ A}/\mu s$ ,		0.75		$\mu C$
$I_{RRM}$	Reverse recovery current	$V_{DD} = 30\text{ V}$ , $T_j = 150^\circ C$		9		A

1. Pulse width limited by safe operating area

2. Pulsed: pulse duration = 300  $\mu s$ , duty cycle 1.5%

## 2.1 Electrical characteristics

Figure 2. Safe operating area for TO-220

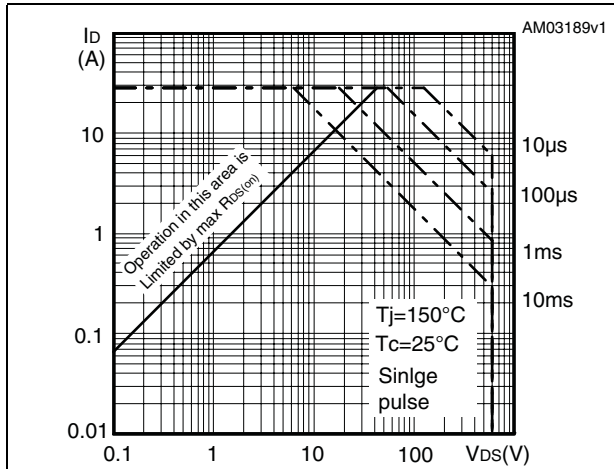


Figure 3. Thermal impedance for TO-220

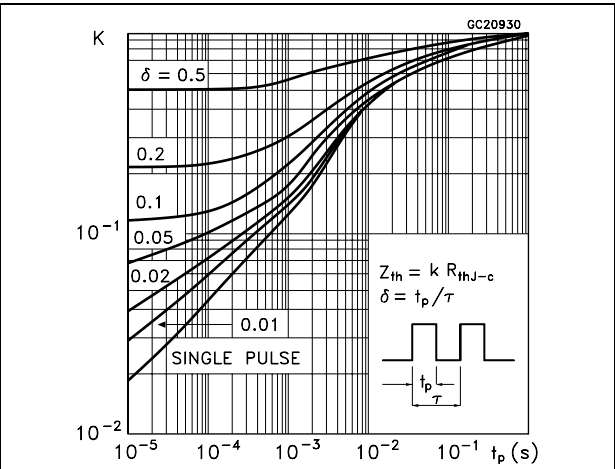


Figure 4. Safe operating area for DPAK, IPAK

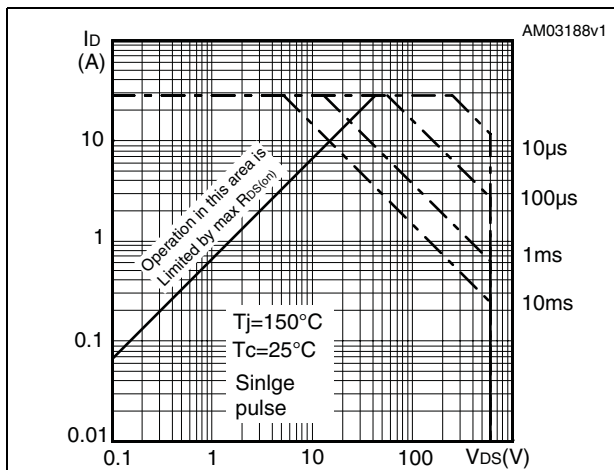


Figure 5. Thermal impedance for DPAK, IPAK

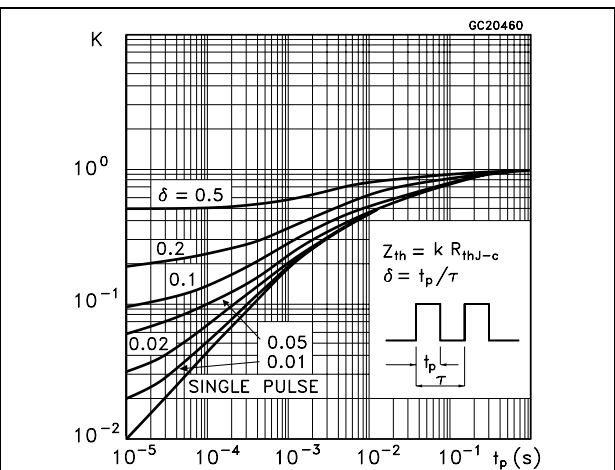


Figure 6. Safe operating area for TO-220FP

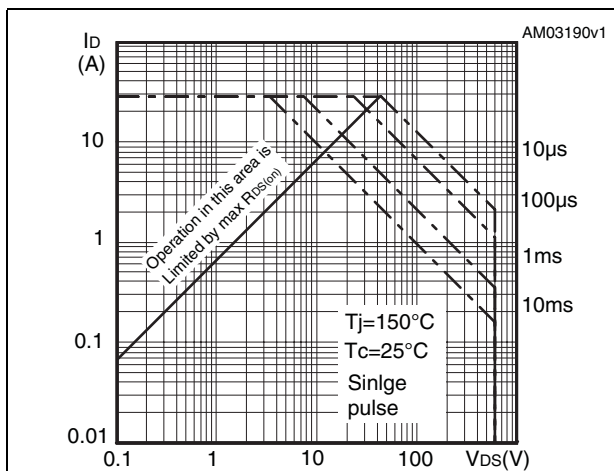


Figure 7. Thermal impedance for TO-220FP

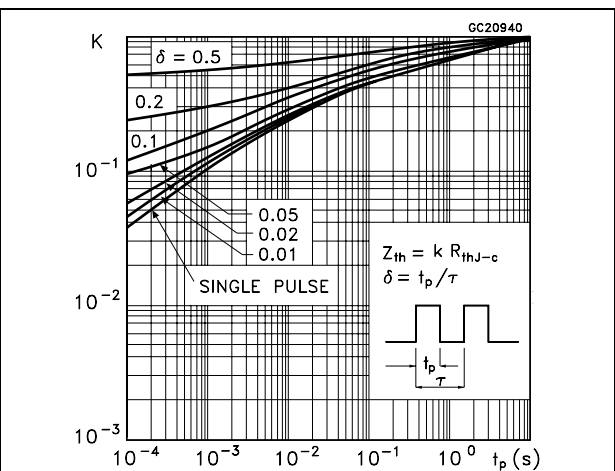


Figure 8. Output characteristics

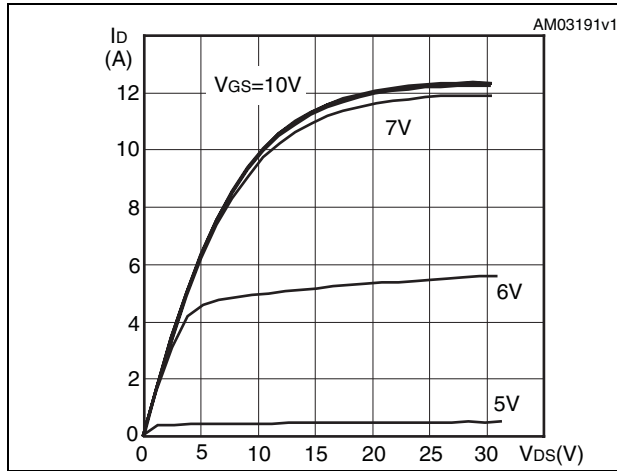


Figure 9. Transfer characteristics

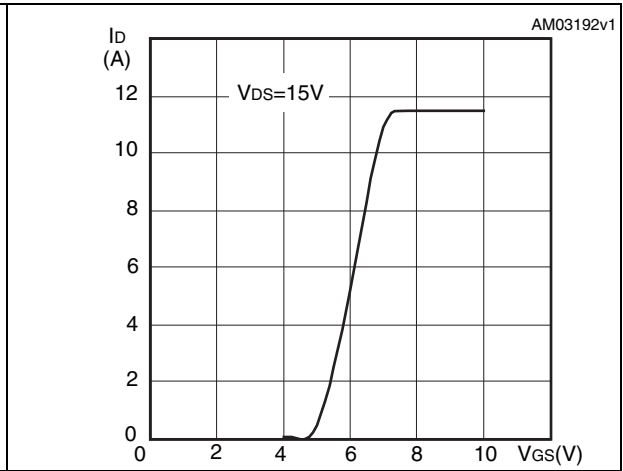


Figure 10. Transconductance

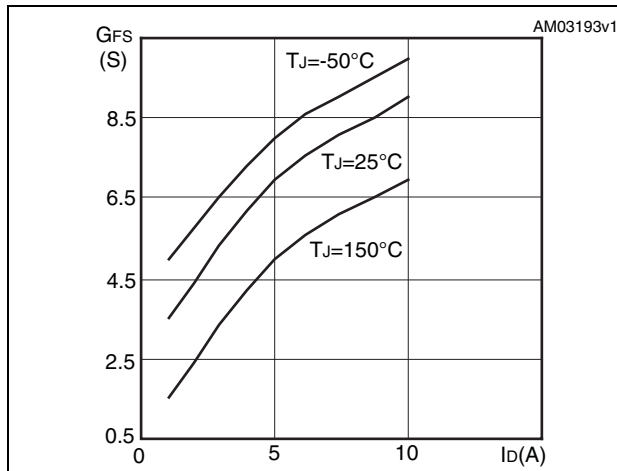


Figure 11. Static-drain source on resistance

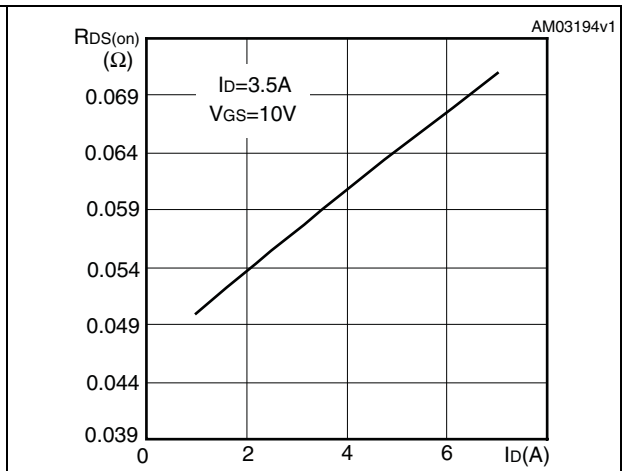


Figure 12. Gate charge vs gate-source voltage Figure 13. Capacitance variations

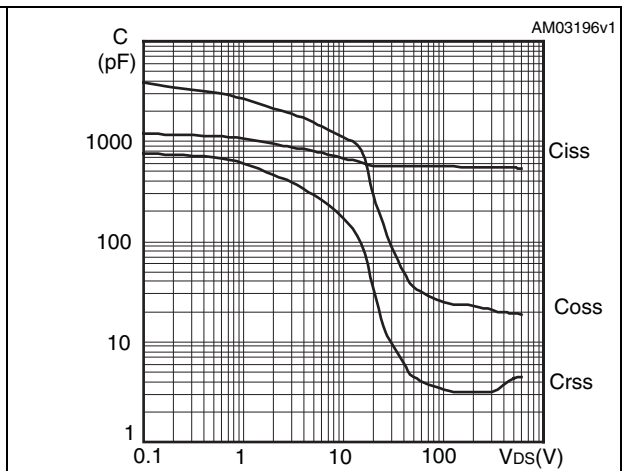
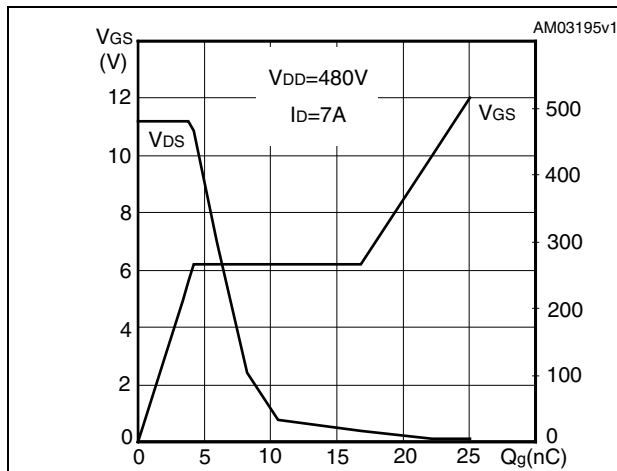


Figure 14. Normalized gate threshold voltage vs temperature

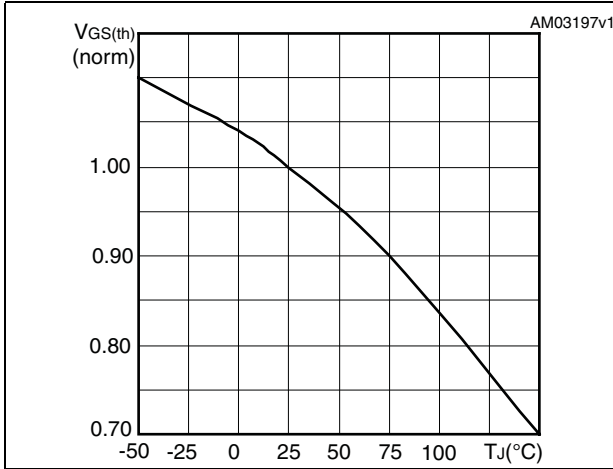


Figure 15. Normalized on resistance vs temperature

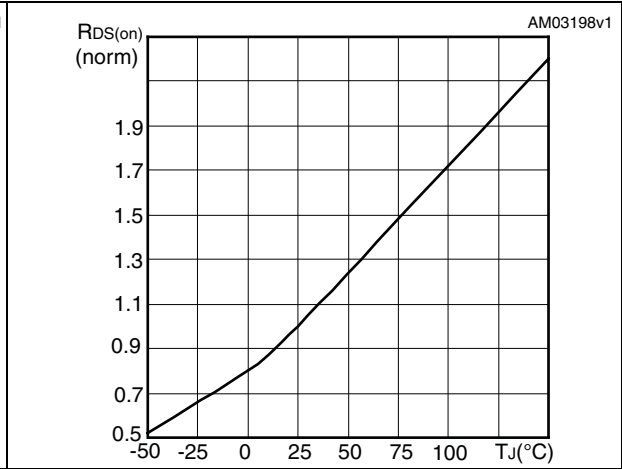


Figure 16. Source-drain diode forward characteristics

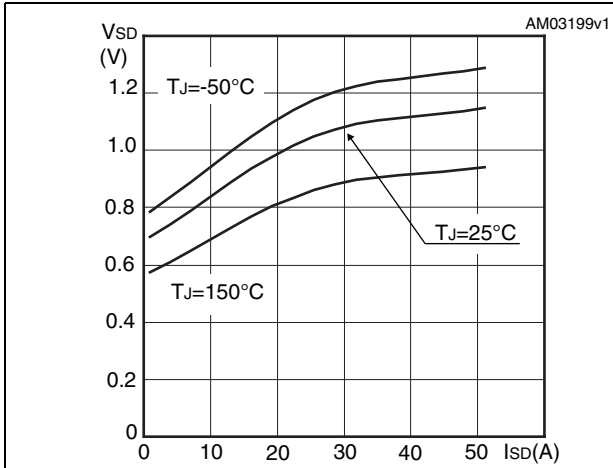
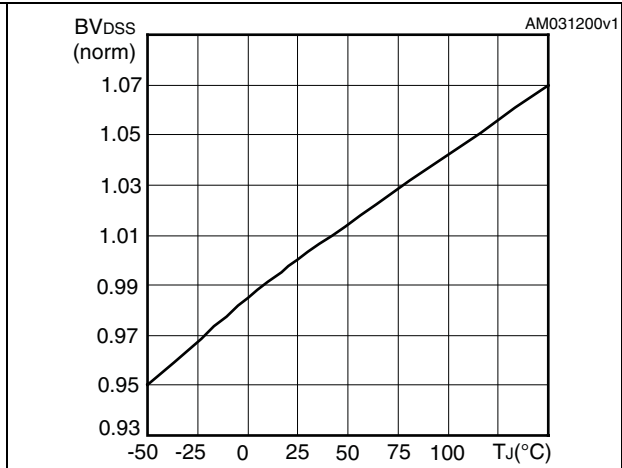


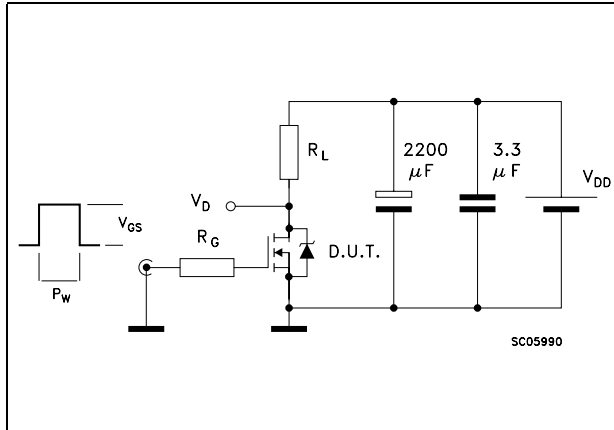
Figure 17. Normalized BV<sub>DSS</sub> vs temperature



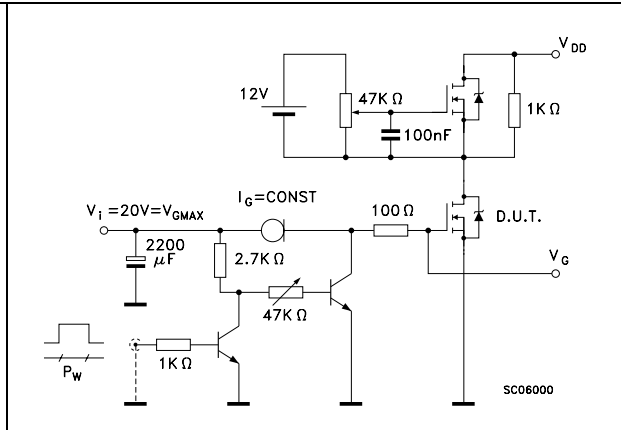


### 3 Test circuits

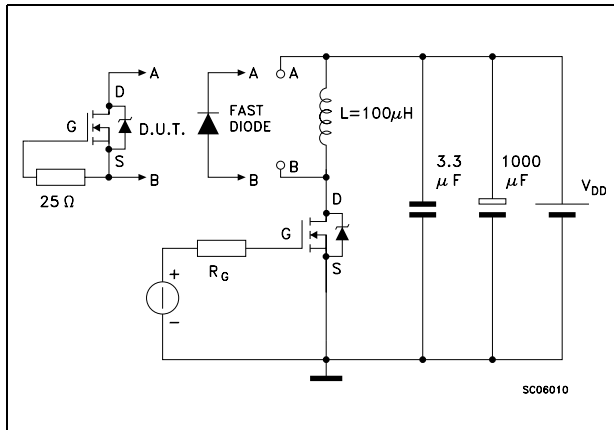
**Figure 18. Switching times test circuit for resistive load**



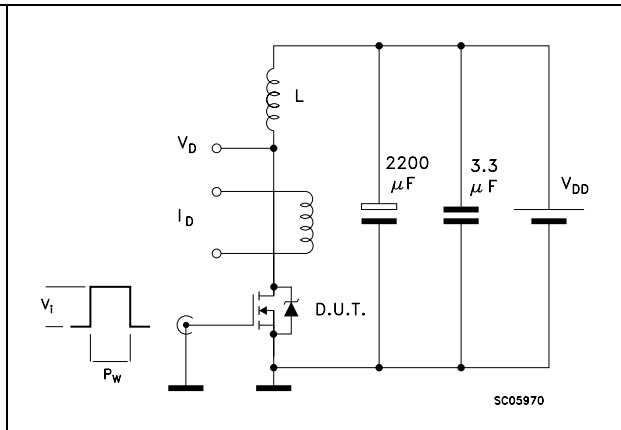
**Figure 19. Gate charge test circuit**



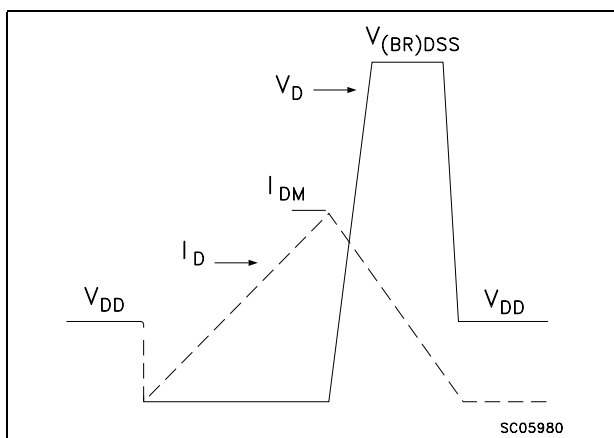
**Figure 20. Test circuit for inductive load switching and diode recovery times**



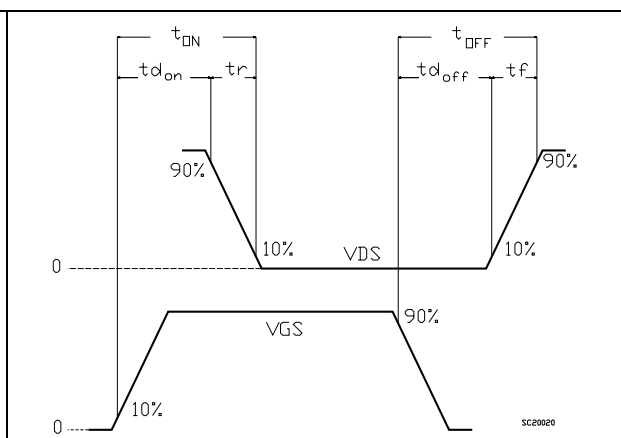
**Figure 21. Unclamped inductive load test circuit**



**Figure 22. Unclamped inductive waveform**



**Figure 23. Switching time waveform**

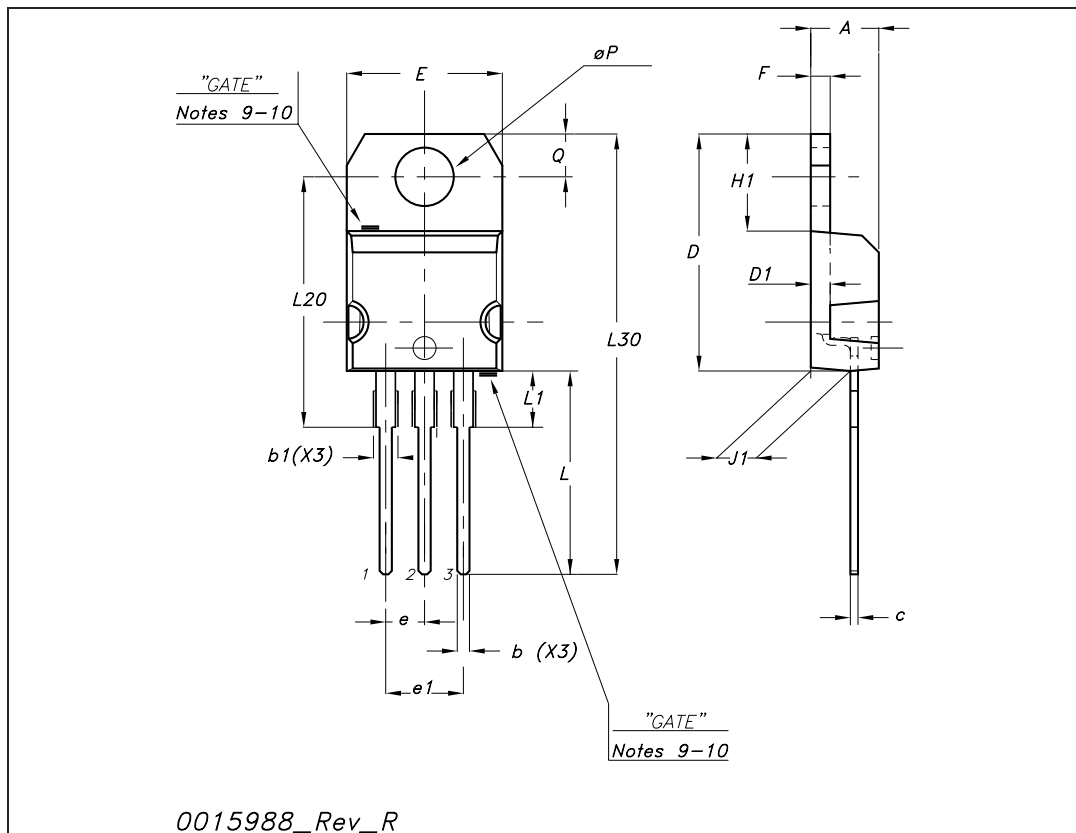


## 4 Package mechanical data

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](http://www.st.com). ECOPACK® is an ST trademark.

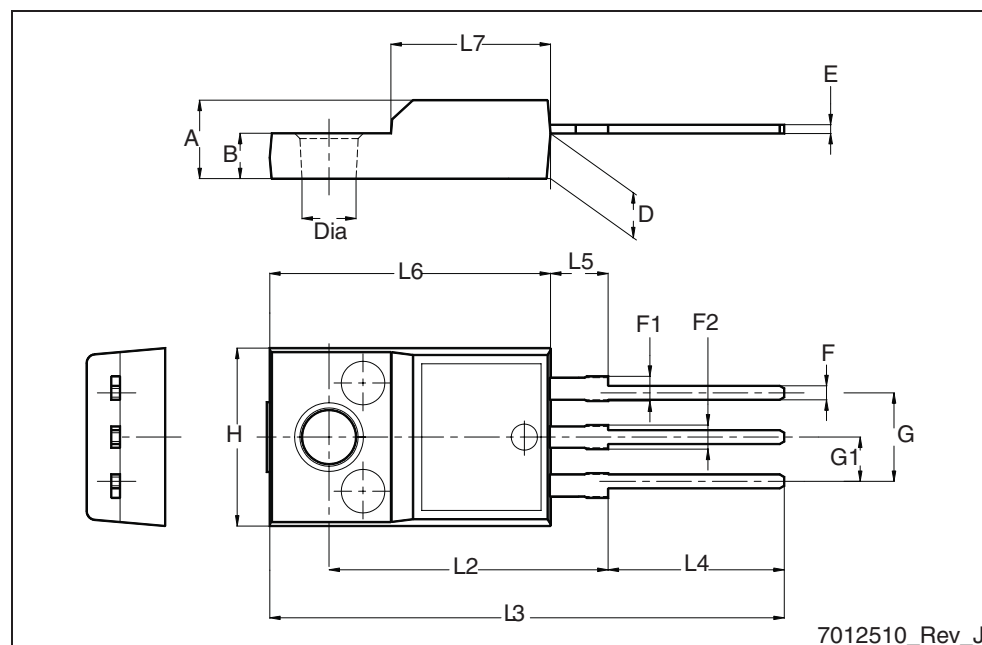
TO-220 mechanical data

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	1.14		1.70	0.044		0.066
c0	.48		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
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
F1	.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L1	3		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L302		8.90			1.137	
∅P	3.75		3.85	0.147		0.151
Q2	.65		2.95	0.104		0.116



TO-220FP mechanical data

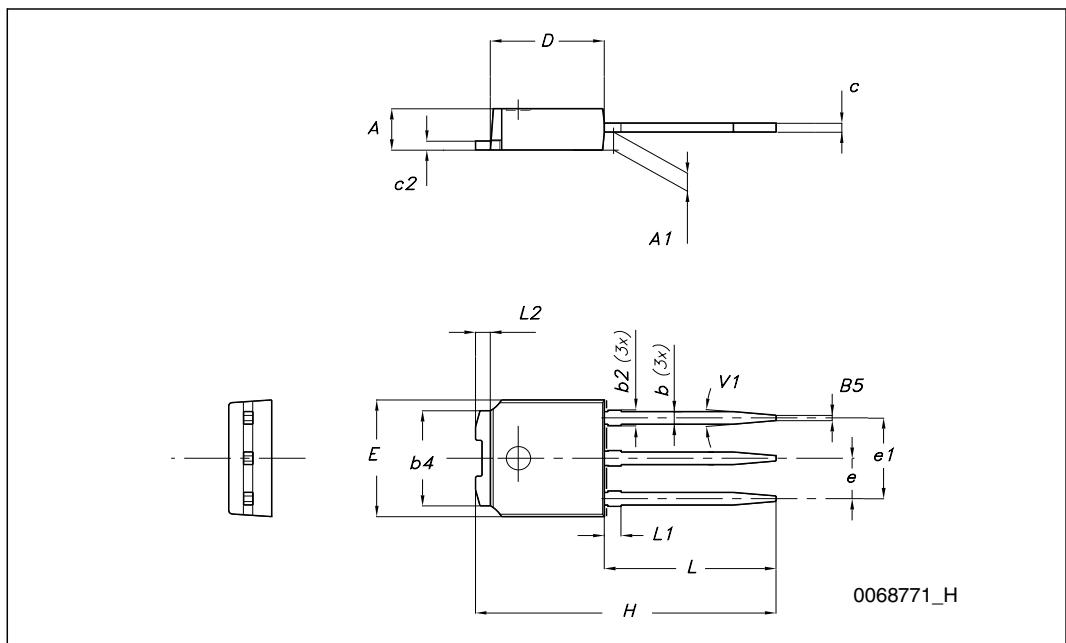
Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.5
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2



7012510\_Rev\_J

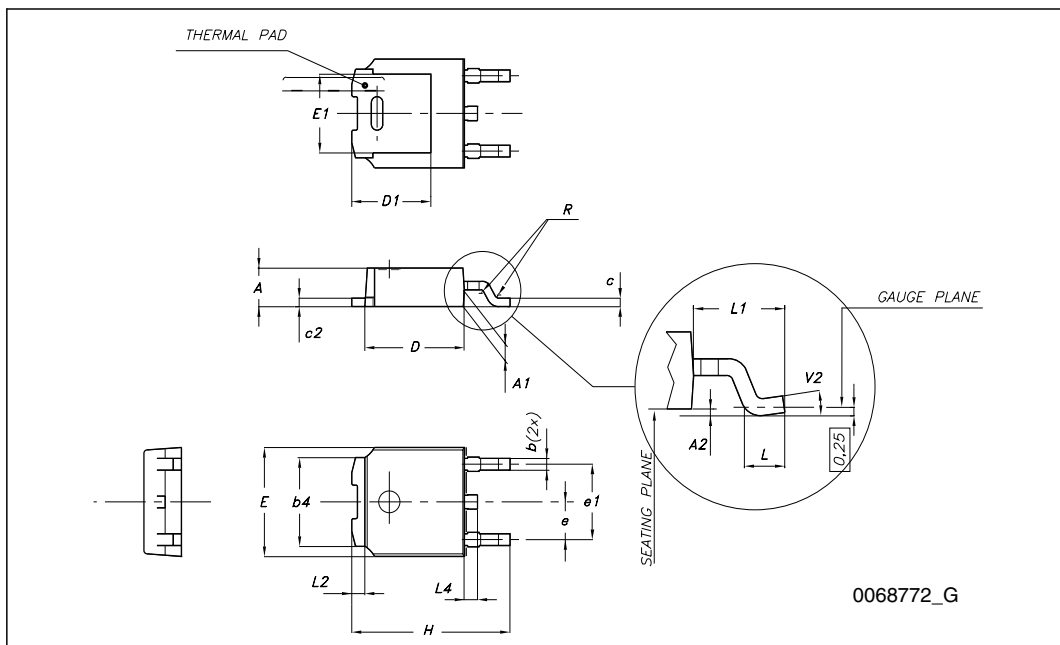
## TO-251 (IPAK) mechanical data

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.901		.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e2		.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
(L1)	0.801		.20
L2		0.80	
V1		10°	



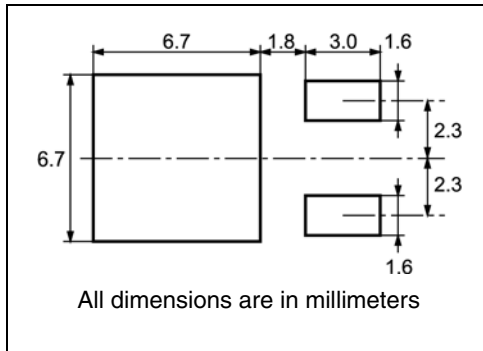
**TO-252 (DPAK) mechanical data**

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.901		.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	
e2		.28	
e1	4.40		4.60
H	9.35		10.10
L1		2.80	
L2		0.80	
L4	0.60		1
R0		.20	
V2	0°		8°



# 5 Packaging 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 2.5mm min. width

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

BASE QTY	BULK QTY
2500	2500

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

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

## 6 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
09-Feb-2009	1	First release



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