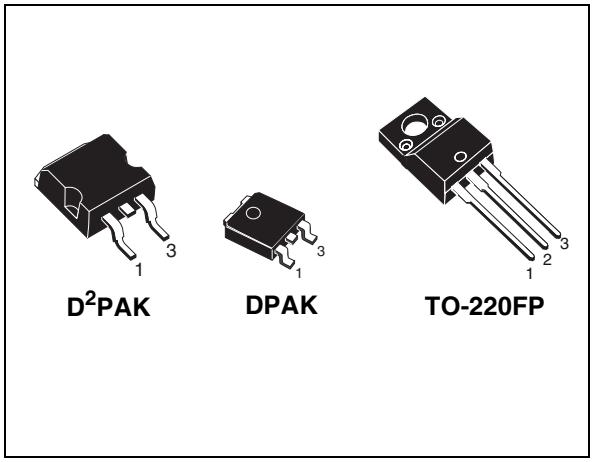
STB12NM50ND
STD12NM50ND, STF12NM50ND

N-channel 500 V, 0.29 Ω, 11 A, FDmesh™ II Power MOSFET (with fast diode) in D^2PAK, DPAK, TO-220FP

Features

Type	V_{DSS} (@Tjmax)	$R_{DS(on)}$ max	I_D
STB12NM50ND	550 V	0.38 Ω	11 A
STD12NM50ND	550 V	0.38 Ω	11 A
STF12NM50ND	550 V	0.38 Ω	11 A

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance



Application

- Switching applications

Description

FDmesh™ technology combines the MDmesh™ features with an intrinsic fast-recovery body diode. The resulting product has reduced on-resistance and fast switching commutations, making it especially suitable for bridge topologies where low t_{rr} is required.

Figure 1. Internal schematic diagram

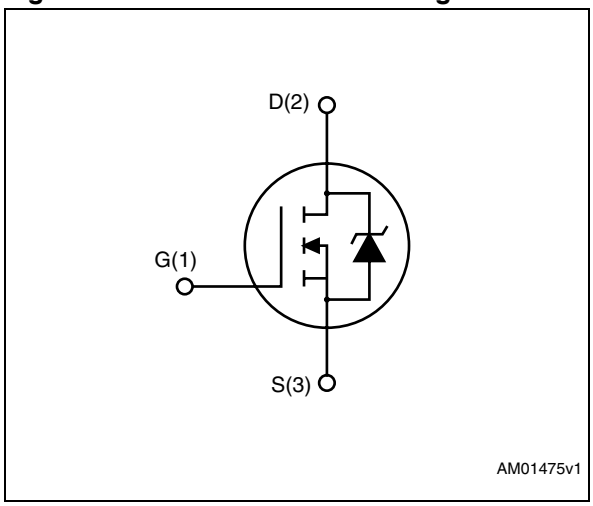


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB12NM50ND	12NM50ND	D^2PAK	Tape and reel
STD12NM50ND	12NM50ND	DPAK	Tape and reel
STF12NM50ND	12NM50ND	TO-220FP	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		D²PAK	DPAK	TO-220FP	
V_{DS}	Drain-source voltage (V_{GS}=0)	500			V
V_{GS}	Gate-source voltage	± 25			V
I_D	Drain current (continuous) at T_C = 25 °C	11		11 (1)	A
I_D	Drain current (continuous) at T_C = 100 °C	6.9		6.9 (1)	A
I_{DM} (2)	Drain current (pulsed)	44		44 (1)	A
P_{TOT}	Total dissipation at T_C = 25 °C	100		25	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s;T_C=25 °C)			2500	V
dv/dt (3)	Peak diode recovery voltage slope	40			V/ns
T_{stg}	Storage temperature	-55 to 150			°C
T_j	Operating junction temperature	150			°C

1. Limited only by maximum temperature allowed
2. Pulse width limited by safe operating area
3. $I_{SD} \leq$ 11 A, di/dt $\leq$ 600 A/µs, V_{DD} = 80% $V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		D²PAK	DPAK	TO-220FP	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	1.25		5	°C/W
$R_{thj\text{-}pcb}$	Thermal resistance junction-pcb max	30	50		°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-amb max			62.5	°C/W
T_l	Maximum lead temperature for soldering purposes	300			°C

Table 4. Avalanche characteristics

Symbol	Parameter	Max value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by Tj max)	5	A
E_{AS}	Single pulse avalanche energy (starting Tj = 25 °C, I_D = I_{AS}, V_{DD} = 50 V)	350	mJ

2 Electrical characteristics

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

Table 5. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	I_D = 1 mA, V_{GS}= 0	500			V
dv/dt(1)	Drain-source voltage slope	V_{DD} = 400 V,I_D = 11 A, V_{GS} = 10 V		44		V/ns
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = Max rating, V_{DS} = Max rating, @125 °C			1 100	µA µA
I_{GSS}	Gate body leakage current (V_{DS} = 0)	V_{GS} = ±20 V			100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS}= V_{GS}, I_D = 250 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS}= 10 V, I_D= 5.5 A		0.29	0.38	Ω

1. Value measured at turn off under inductive load

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs}(1)	Forward transconductance	V_{DS} =15 V, I_D= 5.5 A	-	8	-	S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} = 50 V, f =1 MHz, V_{GS} = 0	-	850 48 5	-	pF pF pF
$C_{oss\ eq.}$(2)	Equivalent output capacitance	V_{GS} = 0, V_{DS} = 0 to 400 V	-	100	-	pF
R_g	Gate input resistance	f=1 MHz Gate DC Bias=0 Test signal level=20 mV open drain	-	4.5	-	Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 400 V, I_D = 11 A V_{GS} = 10 V *Figure 19*	-	30 6 17	-	nC nC nC

1. Pulsed: pulse duration = 300 µs, duty cycle 1.5%
2. $C_{oss\ eq.}$ 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}

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on delay time Rise time Turn-off delay time Fall time	V_{DD} = 250 V, I_D = 5.5 A, R_G = 4.7 Ω, V_{GS} = 10 V *Figure 18*	-	12 15 40 17	-	ns ns ns ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM} (1)	Source-drain current Source-drain current (pulsed)		-		11 44	A A
V_{SD} (2)	Forward on voltage	I_{SD} = 11 A, V_{GS}=0	-		1.6	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 11 A, di/dt =100 A/µs, V_{DD} = 100 V *Figure 20*	-	122 650 11		ns nC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	V_{DD} = 100 V di/dt =100 A/µs, I_{SD} = 11 A Tj = 150 °C, *Figure 20*	-	160 940 12		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 for D²PAK

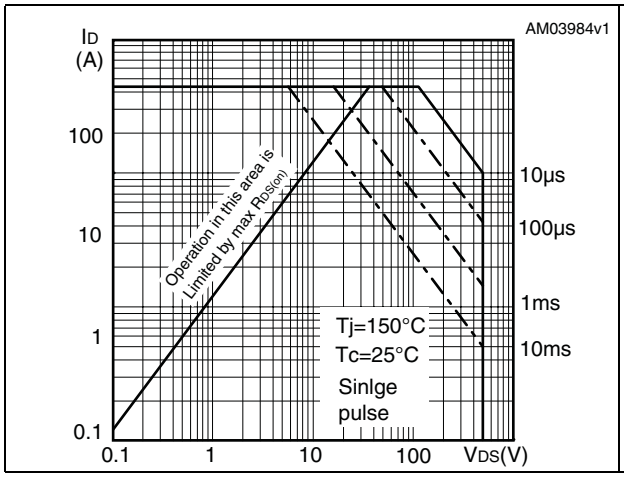


Figure 3. Thermal impedance for D²PAK

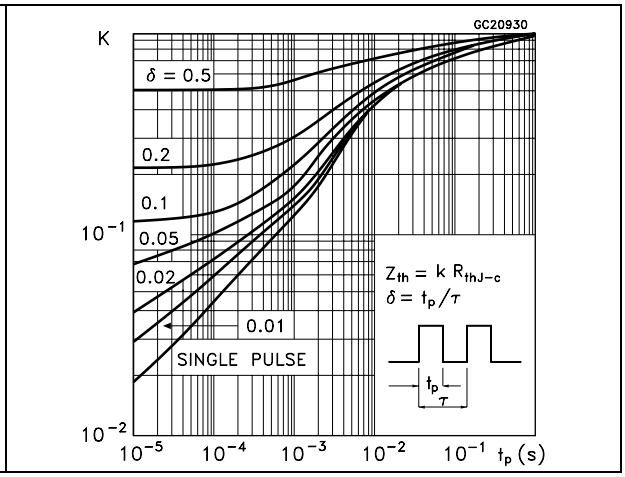


Figure 4. Safe operating area for TO-220FP

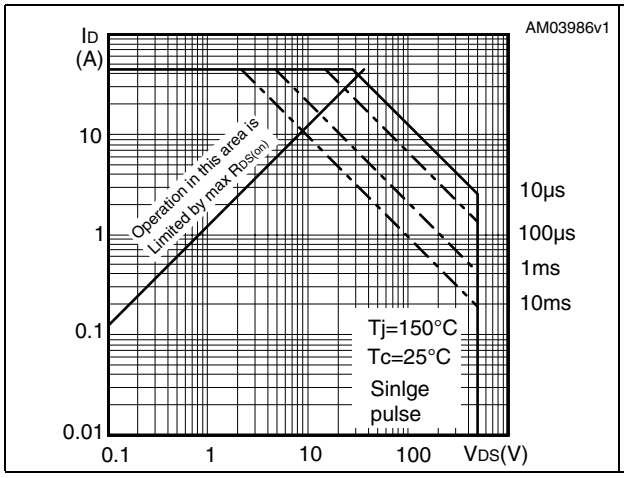


Figure 5. Thermal impedance for TO-220FP

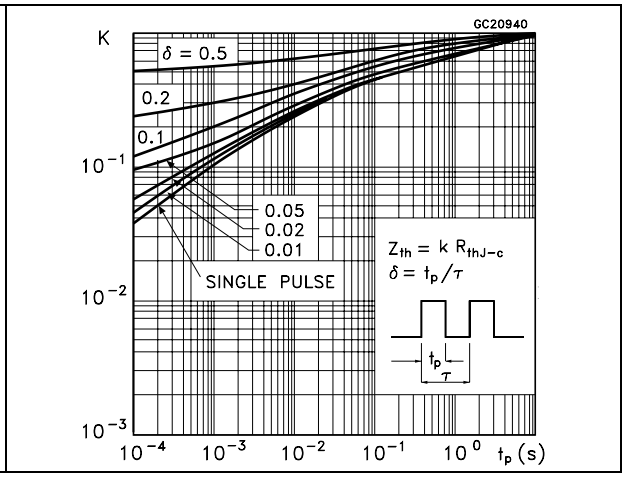


Figure 6. Safe operating area for DPAK

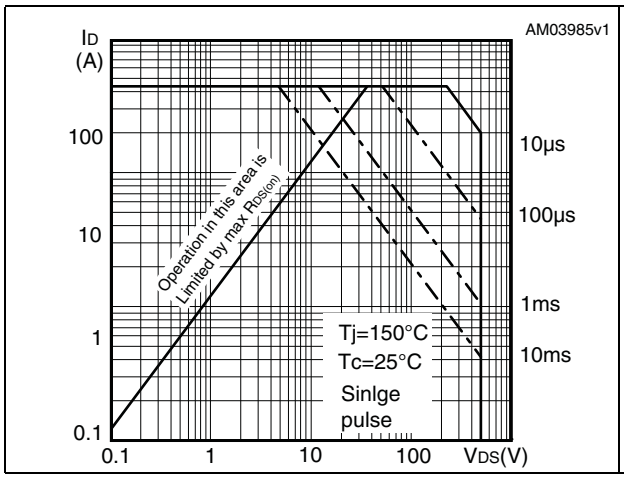


Figure 7. Thermal impedance for DPAK

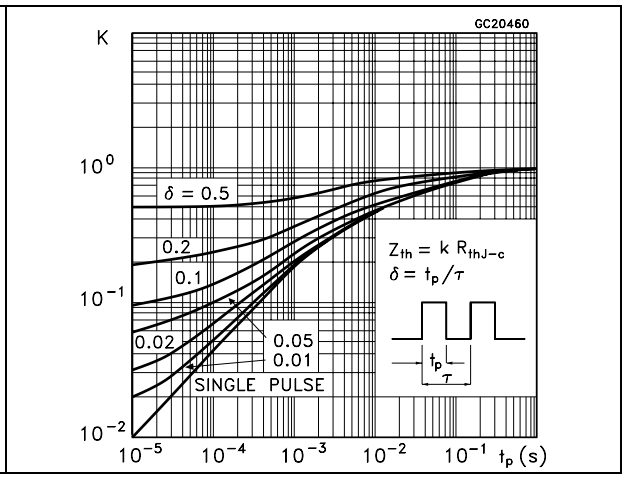


Figure 8. Output characteristics

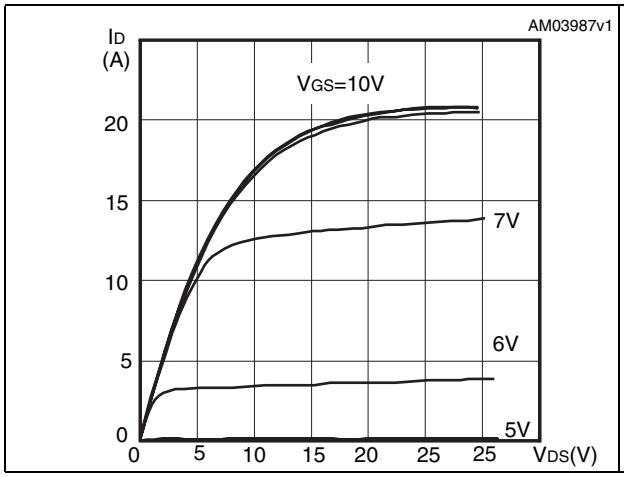


Figure 9. Transfer characteristics

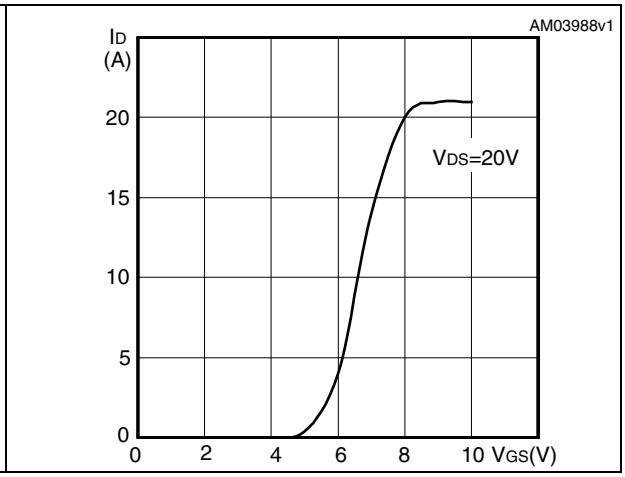


Figure 10. Transconductance

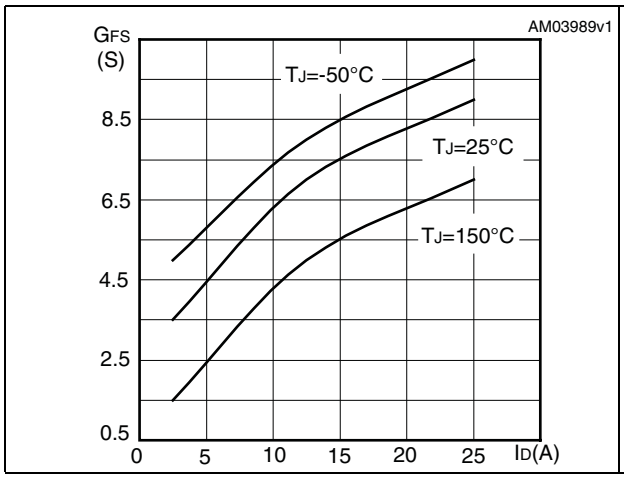


Figure 11. Static drain-source on resistance

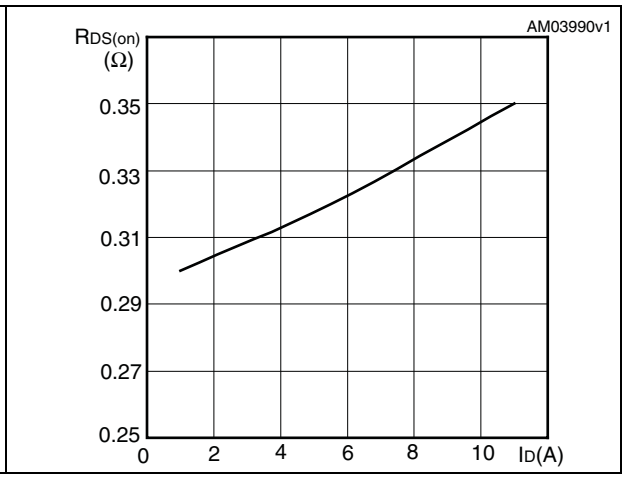


Figure 12. Gate charge vs gate-source voltage

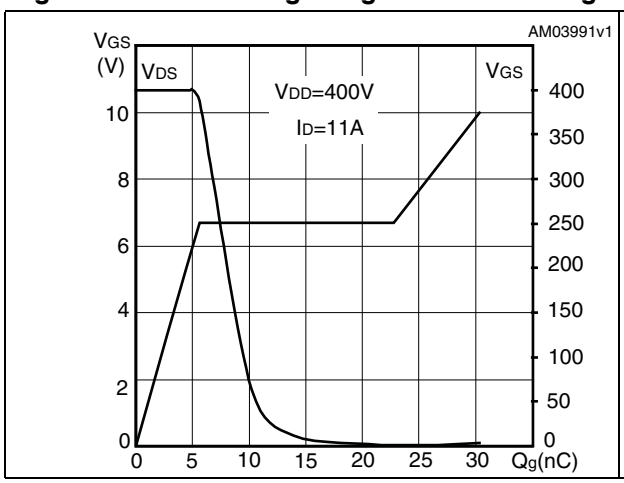


Figure 13. Capacitance variations

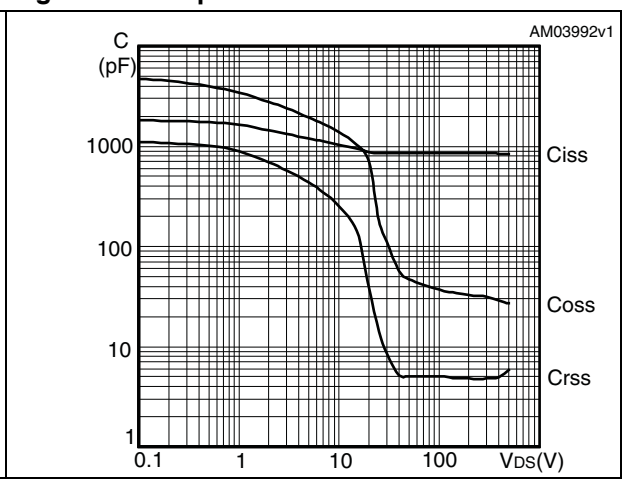


Figure 14. Normalized gate threshold voltage vs temperature

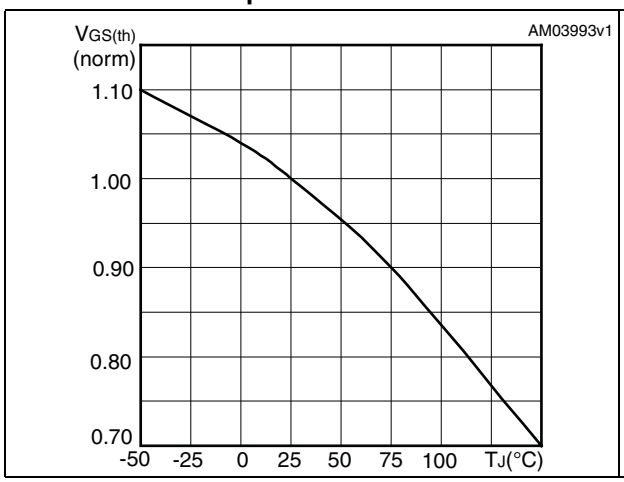


Figure 15. Normalized on resistance vs temperature

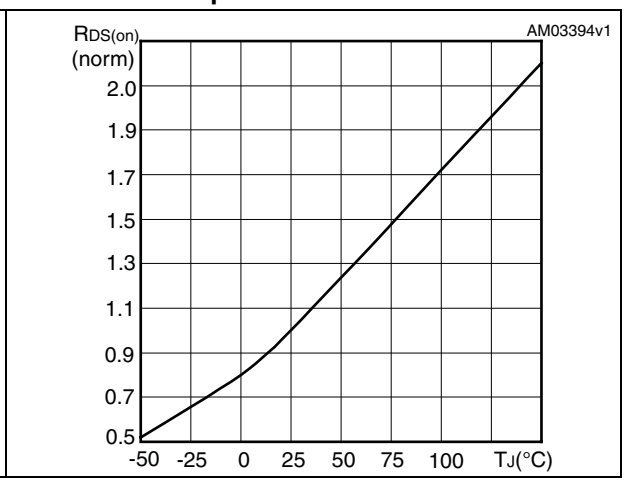


Figure 16. Source-drain diode forward characteristics

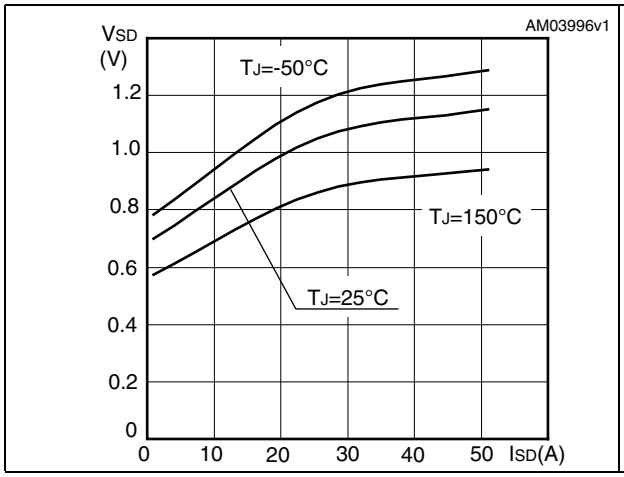
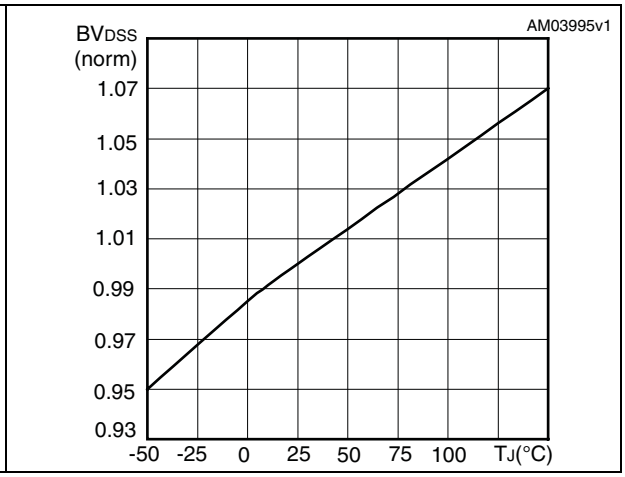


Figure 17. Normalized B_{VDSS} vs temperature



3 Test circuits

Figure 18. Switching times test circuit for resistive load

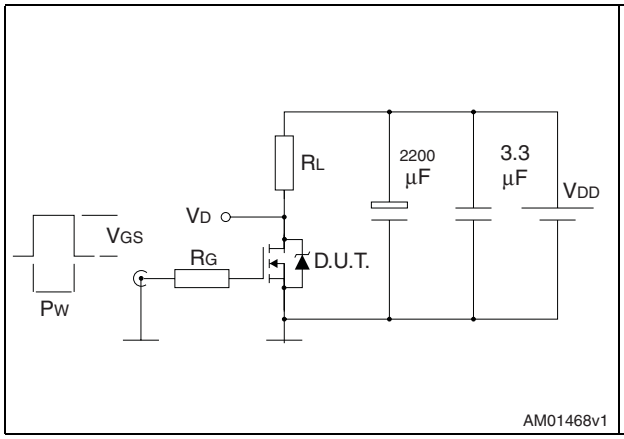


Figure 19. Gate charge test circuit

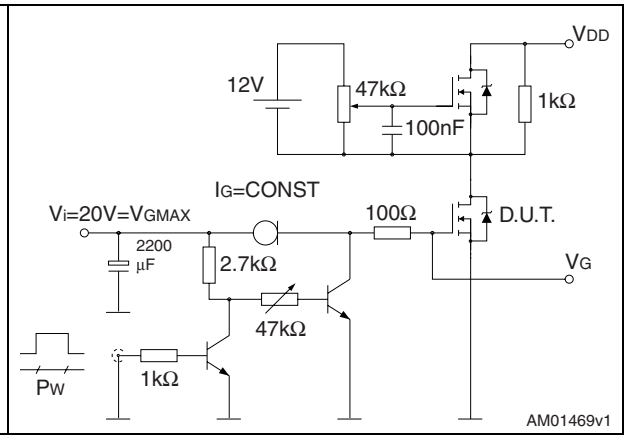


Figure 20. Test circuit for inductive load switching and diode recovery times

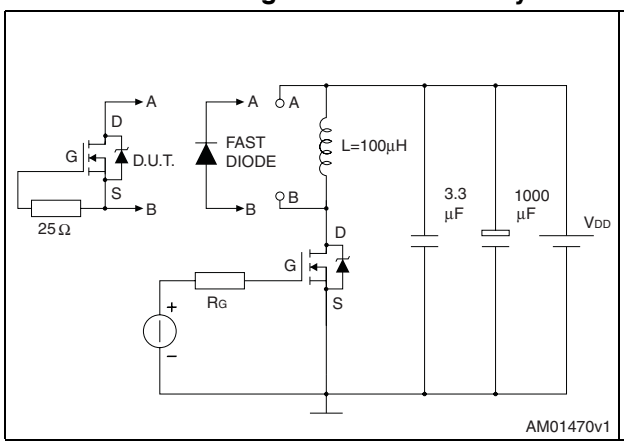


Figure 21. Unclamped inductive load test circuit

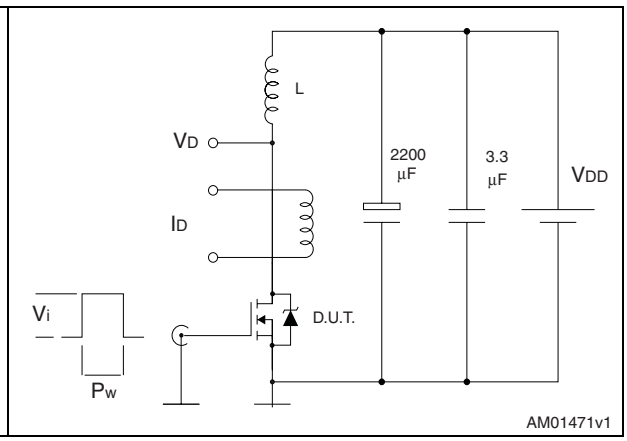


Figure 22. Unclamped inductive waveform

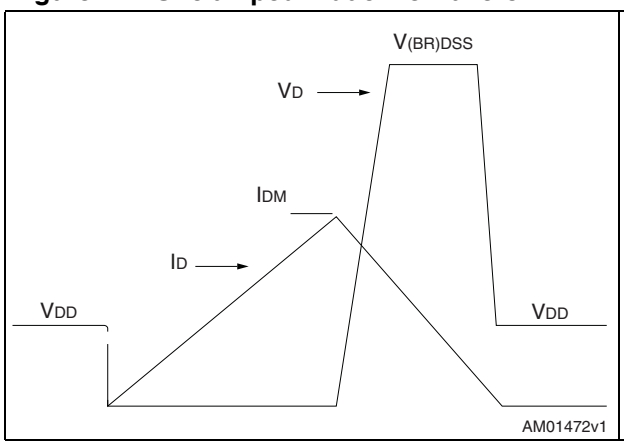
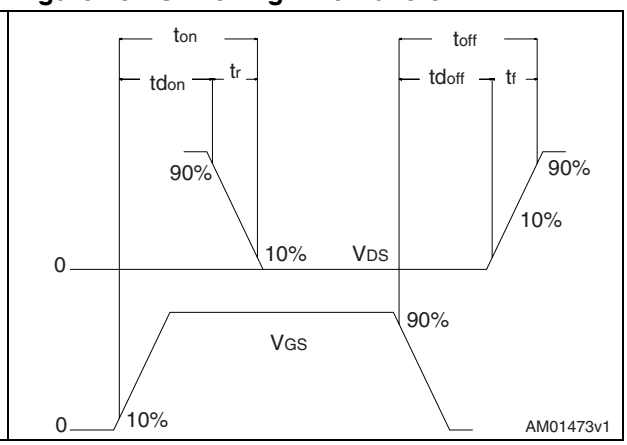


Figure 23. Switching time waveform

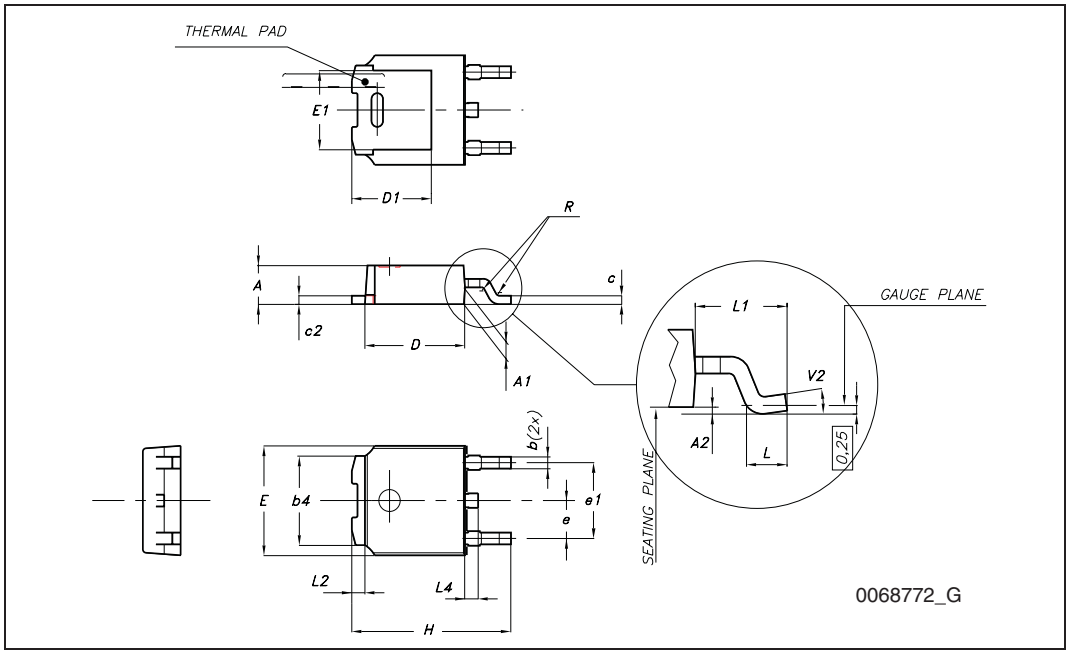


4 Package mechanical data

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. ECOPACK is an ST trademark.

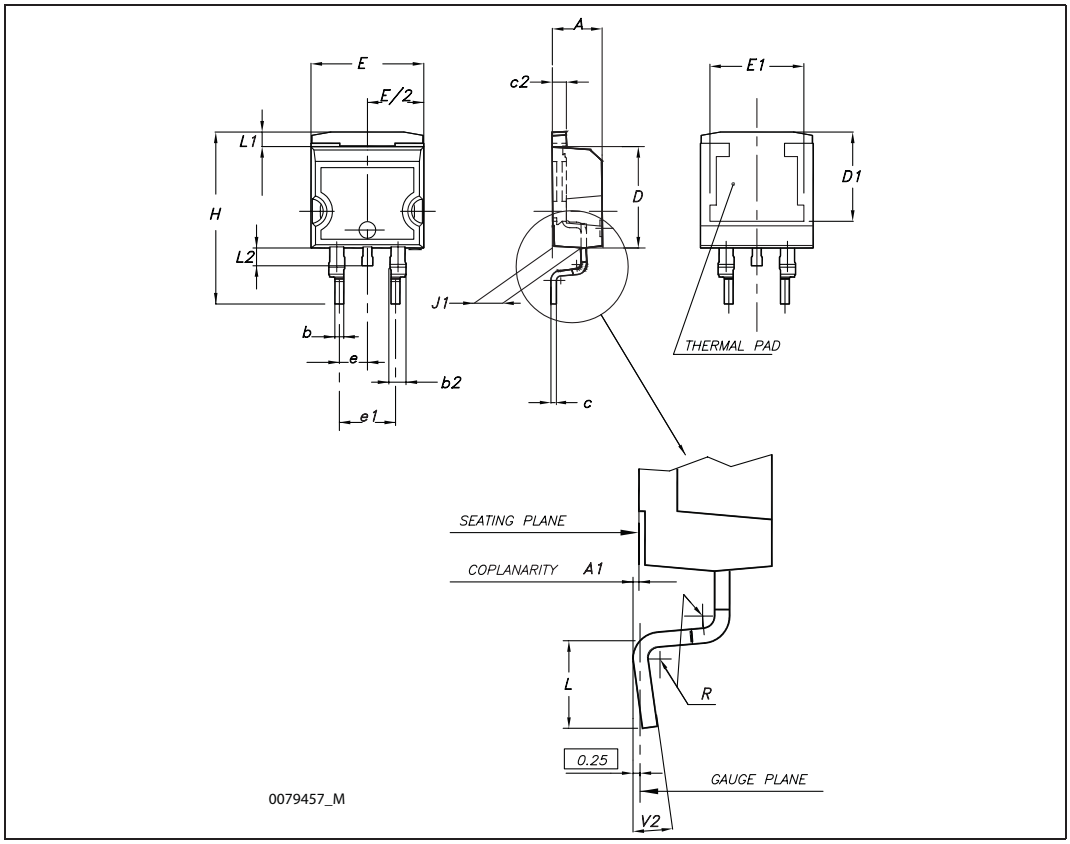
TO-252 (DPAK) mechanical data

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 °



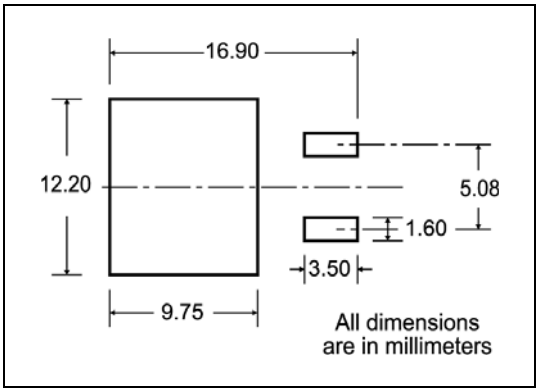
D²PAK (TO-263) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.027		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.017		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50			0.295		
E	10		10.40	0.394		0.409
E1	8.50			0.334		
e		2.54			0.1	
e1	4.88		5.28	0.192		0.208
H	15		15.85	0.590		0.624
J1	2.49		2.69	0.099		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.05		0.055
L2	1.30		1.75	0.051		0.069
R		0.4			0.016	
V2	0°		8°	0°		8°

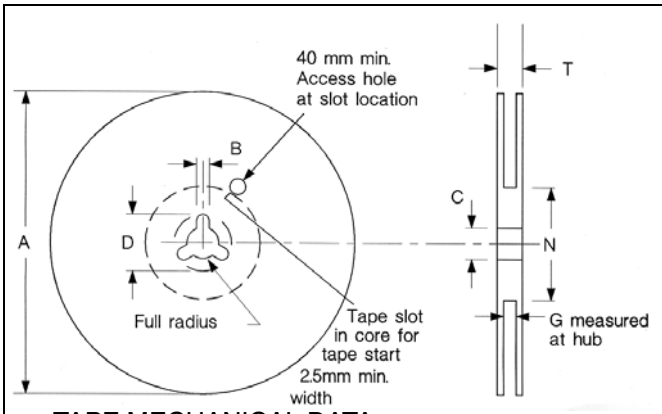


5 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



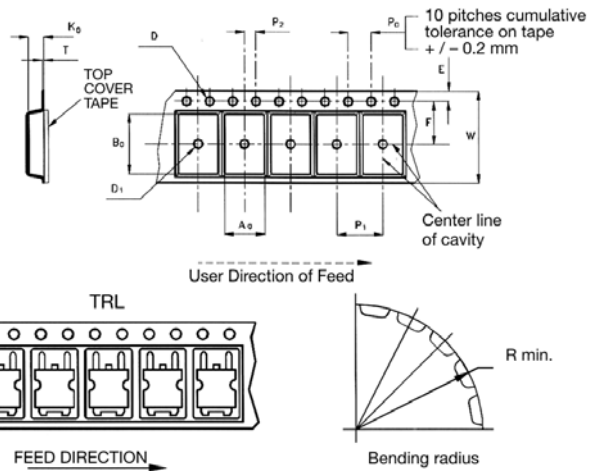
REEL MECHANICAL DATA

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		0795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

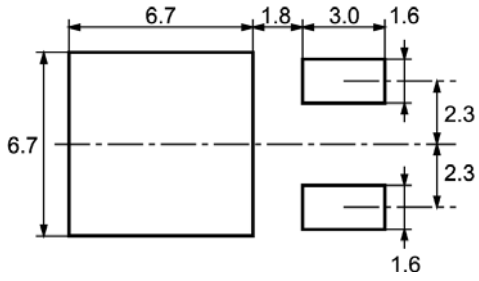
TAPE MECHANICAL DATA

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



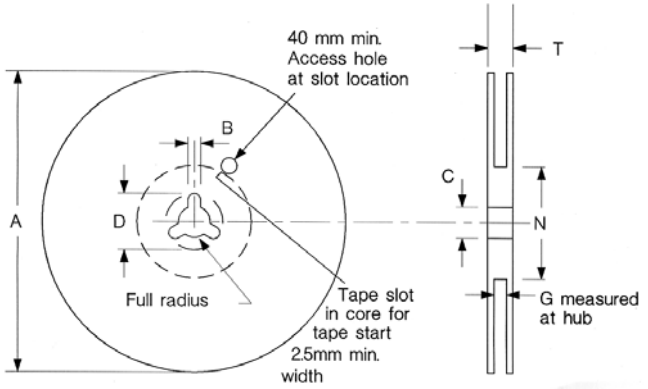
* on sales type

DPAK FOOTPRINT



All dimensions are in millimeters

TAPE AND REEL SHIPMENT



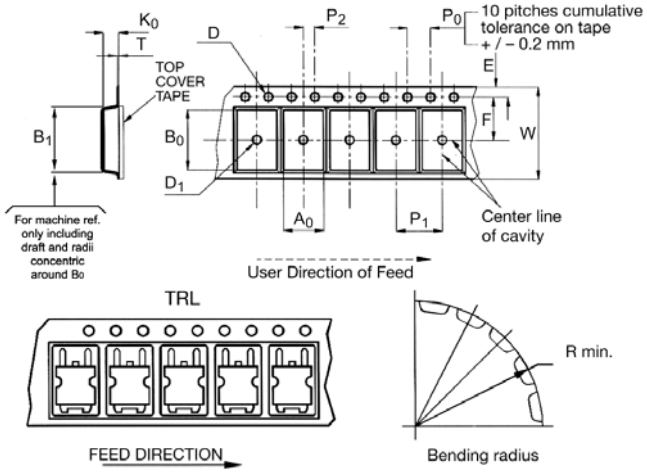
REEL MECHANICAL DATA

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

BASE QTY	BULK QTY
2500	2500

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



6 Revision history

Table 9. Document revision history

Date	Revision	Changes
23-Sep-2008	1	First release
10-Jun-2009	2	Added new package, mechanical data: TO-220FP