



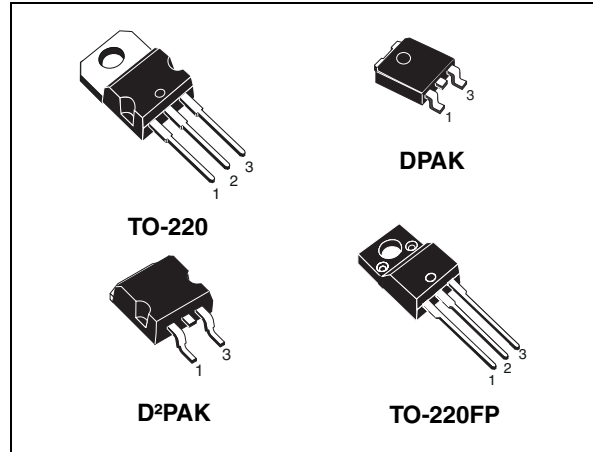
STB12NM50N - STD12NM50N STF12NM50N - STP12NM50N

N-channel 500V - 0.29Ω - 11A - TO-220 /FP- D²PAK - DPAK
Second generation MDmesh™ Power MOSFET

General features

Type	V _{DSS} (@T _{jmax})	R _{DS(on)}	I _D
STB12NM50N	550V	<0.38Ω	11A
STD12NM50N	550V	<0.38Ω	11A
STF12NM50N	550V	<0.38Ω	11A ⁽¹⁾
STP12NM50N	550V	<0.38Ω	11A

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



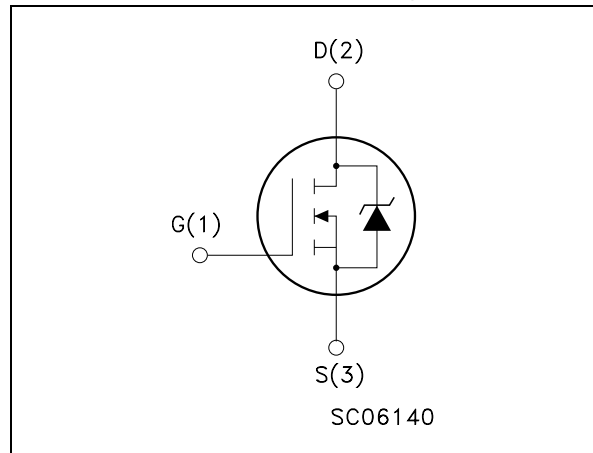
Description

This series of devices is realized with the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters

Applications

- Switching application

Internal schematic diagram



Order codes

Part number	Marking	Package	Packaging
STB12NM50N	B12NM50N	D ² PAK	Tape & reel
STD12NM50N	D12NM50N	DPAK	Tape & reel
STF12NM50N	F12NM50N	TO-220FP	Tube
STP12NM50N	P12NM50N	TO-220	Tube

Contents

1 **Electrical ratings** 3

2 **Electrical characteristics** 4

 2.1 Electrical characteristics (curves) 6

3 **Test circuit** 9

4 **Package mechanical data** 10

5 **Packaging mechanical data** 15

6 **Revision history** 17

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220-D/D ² PAK	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 $T_C = 25^\circ\text{C}$	11	11 ⁽¹⁾	A
I_D	Drain current (continuous) at $T_C = 100^\circ\text{C}$	6.7	6.7 ⁽¹⁾	A
$I_{DM}^{(2)}$	Drain current (pulsed)	44	44 ⁽¹⁾	A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	100	25	W
	Derating factor	0.8	0.2	W/ $^\circ\text{C}$
$dv/dt^{(3)}$	Peak diode recovery voltage slope	15		V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink ($t=1\text{s}; T_C=25^\circ\text{C}$)	--	2500	V
T_J T_{stg}	Operating junction temperature Storage temperature	-55 to 150		$^\circ\text{C}$

1. Limited only by maximum temperature allowed

2. Pulse width limited by safe operating area

3. $I_{SD} \leq 1\text{A}$, $di/dt \leq 400\text{A}/\mu\text{s}$, $V_{DD} = 80\%V_{(BR)DSS}$

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		TO-220 D ² PAK	DPAK	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case max	1.25		5	$^\circ\text{C}/\text{W}$
R_{thj-a}	Thermal resistance junction-ambient max	62.5	100	62.5	$^\circ\text{C}/\text{W}$
T_l	Maximum lead temperature for soldering purpose	300			$^\circ\text{C}$

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J Max)	5	A
E_{AS}	Single pulse avalanche energy (starting $T_J=25^\circ\text{C}$, $I_d=I_{as}$, $V_{dd}=50\text{V}$)	350	mJ

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{mA}$, $V_{GS} = 0$	500			V
$dv/dt^{(1)}$	Peak diode recovery voltage slope	$V_{DD}=400\text{V}$, $I_D=11\text{A}$, $V_{GS}=10\text{V}$	44			V/ns
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}$, $V_{DS} = \text{Max rating} @ 125^{\circ}\text{C}$			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	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{V}$, $I_D = 5.5\text{A}$		0.29	0.38	Ω

1. Characteristic value at turn off inductive load

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS}=15\text{V}$, $I_D = 5.5\text{A}$		8		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS}=25\text{V}$, $f=1\text{MHz}$, $V_{GS}=0$		880 230 30		pF pF pF
$C_{oss\ eq}^{(2)}$	Equivalent output capacitance	$V_{GS}=0$, $V_{DS}=0\text{V}$ to 400V		130		pF
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD}=400\text{V}$, $I_D = 11\text{A}$ $V_{GS}=10\text{V}$ (see Figure 9)		30 6 15		nC nC nC
R_g	Gate input resistance	$f=1\text{MHz}$ Gate DC Bias=0 test signal level=20mV open drain		4.5		Ω

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 6. Switching times

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD}=250\text{ V}$, $I_D=5.5\text{ A}$, $R_G=4.7\Omega$, $V_{GS}=10\text{ V}$ (see Figure 15)		15		ns
t_r	Rise time			15		ns
$t_{d(off)}$	Turn-off delay time			60		ns
t_f	Fall time			14		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current				11	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				44	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=11\text{ A}$, $V_{GS}=0$			1.3	V
t_{rr}	Reverse recovery time	$I_{SD}=11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD}=100\text{ V}$, $T_j=25^\circ\text{C}$		340		ns
Q_{rr}	Reverse recovery charge			3.5		μC
I_{RRM}	Reverse recovery current			20		A
t_{rr}	Reverse recovery time	$I_{SD}=11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD}=100\text{ V}$, $T_j=150^\circ\text{C}$		420		ns
Q_{rr}	Reverse recovery charge			4		μC
I_{RRM}	Reverse recovery current			20		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 1. Safe operating area for TO-220/
DPAK/ D²PAK

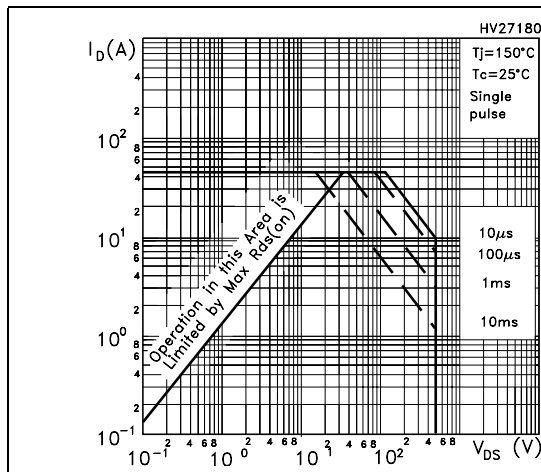


Figure 2. Thermal impedance for TO-220/
DPAK/ D²PAK

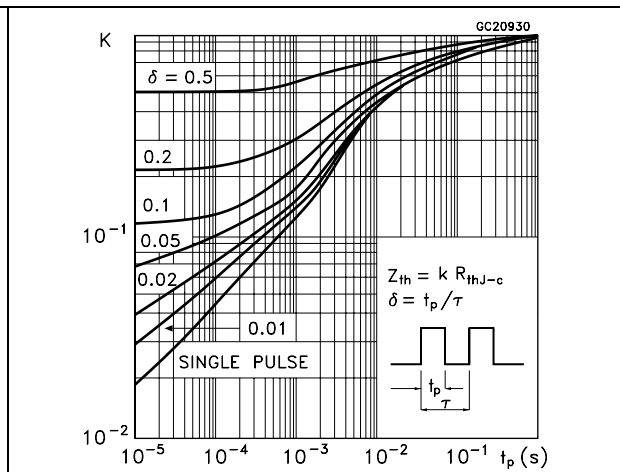


Figure 3. Safe operating area for TO-220FP

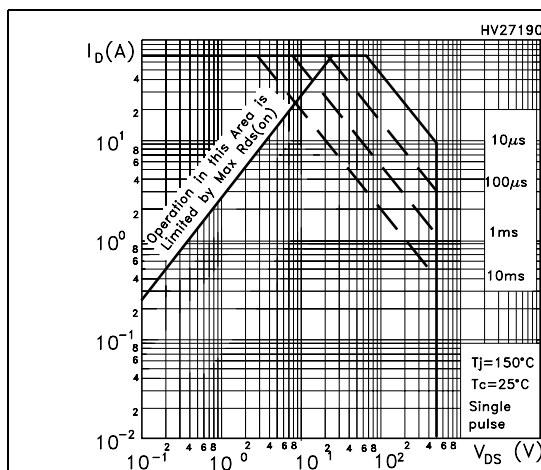


Figure 4. Thermal impedance for TO-220FP

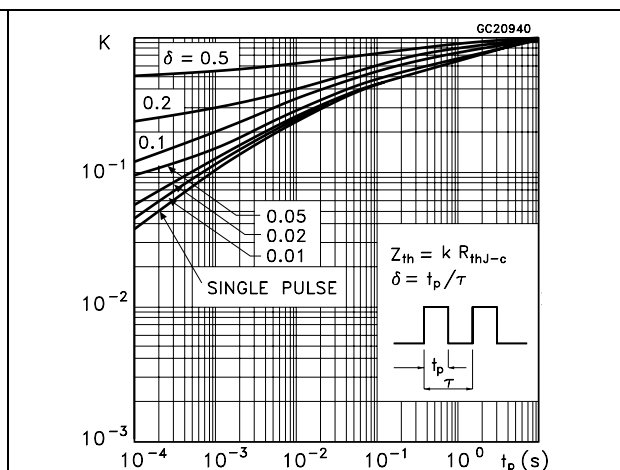


Figure 5. Output characteristics

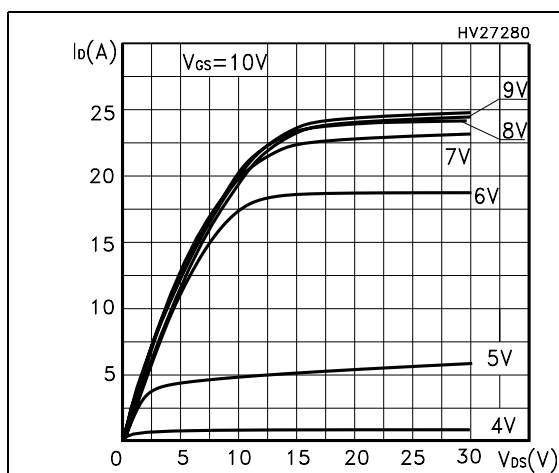


Figure 6. Transfer characteristics

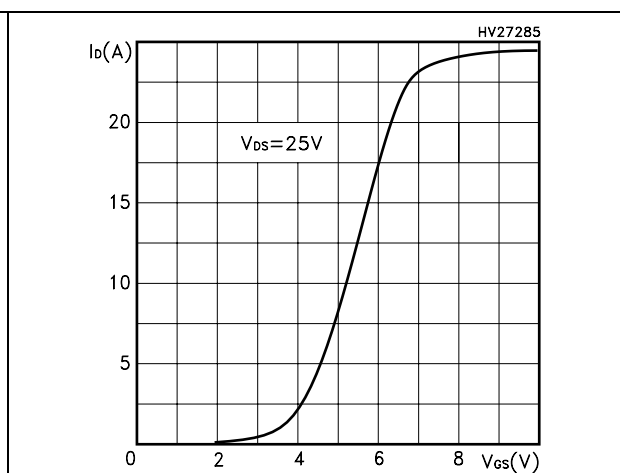


Figure 7. Transconductance

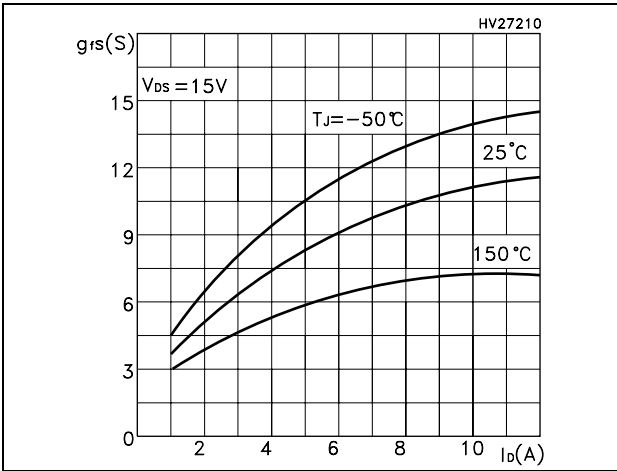


Figure 8. Static drain-source on resistance

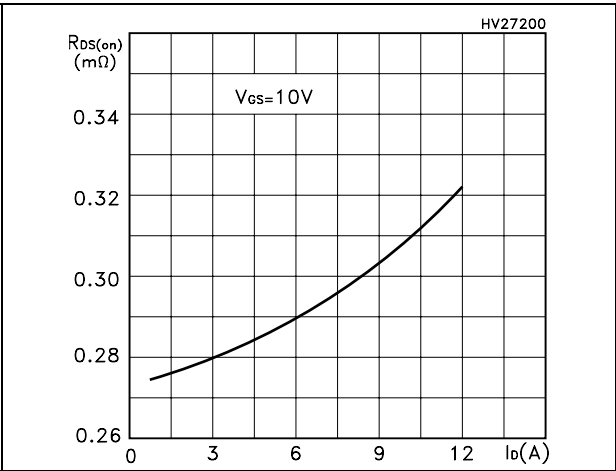


Figure 9. Gate charge vs gate-source voltage

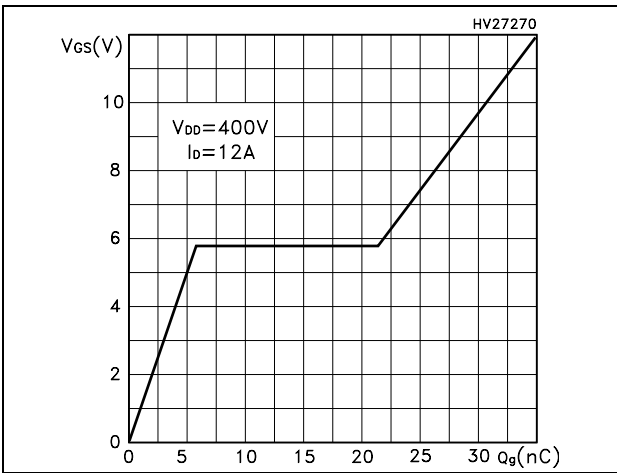


Figure 10. Capacitance variations

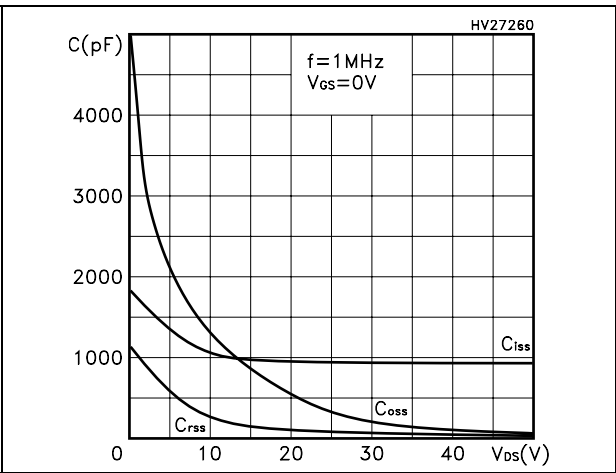


Figure 11. Normalized gate threshold voltage vs temperature

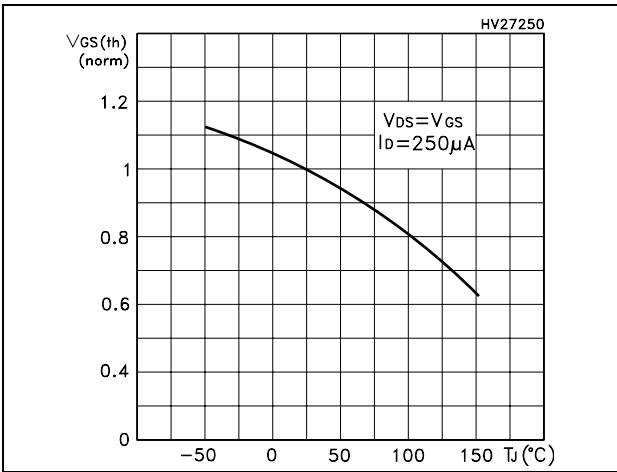


Figure 12. Normalized on resistance vs temperature

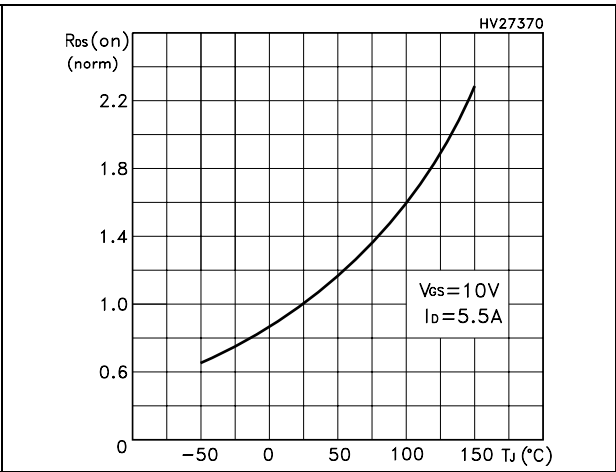


Figure 13. Source-drain diode forward characteristics

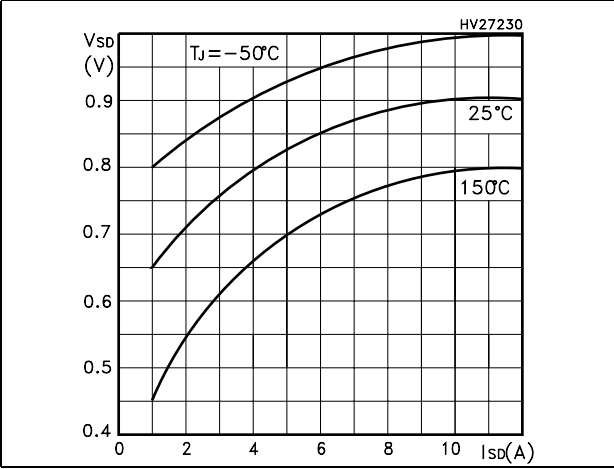
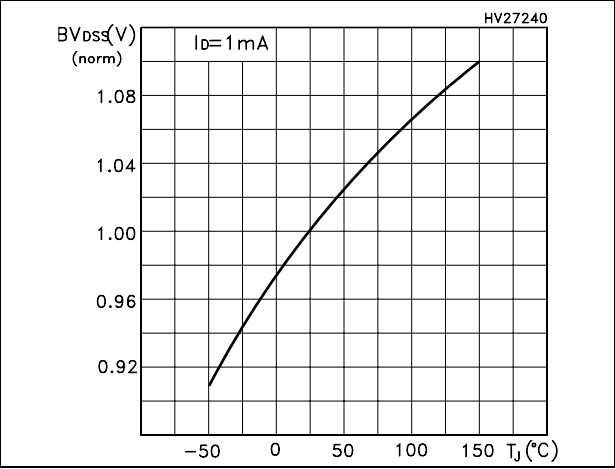


Figure 14. Normalized $B_{V_{DSS}}$ vs temperature



3 Test circuit

Figure 15. Switching times test circuit for resistive load

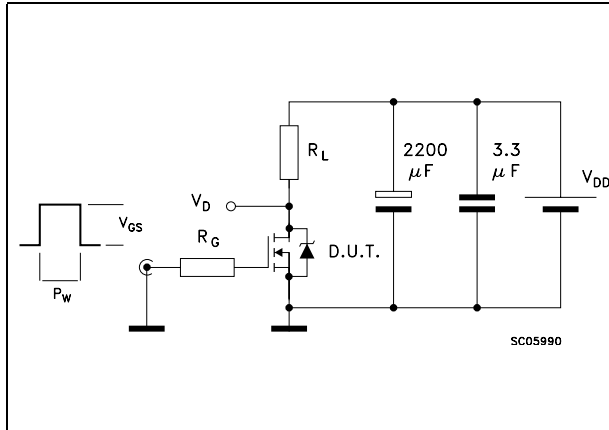


Figure 16. Gate charge test circuit

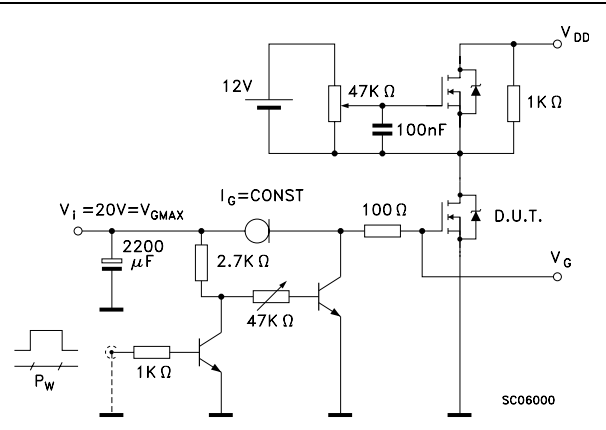


Figure 17. Test circuit for inductive load switching and diode recovery times

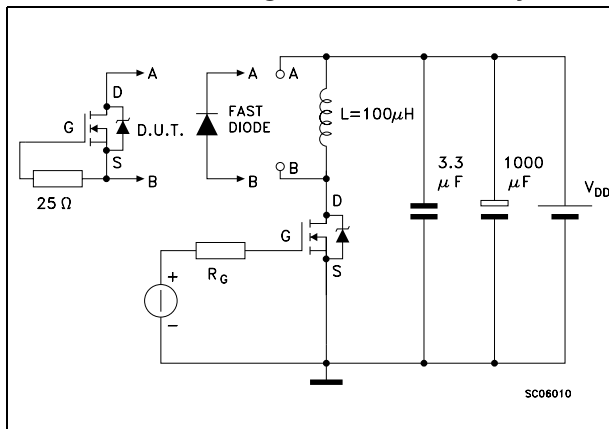


Figure 18. Unclamped Inductive load test circuit

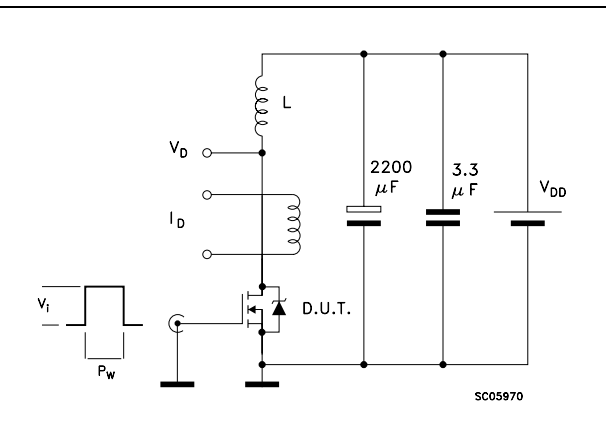


Figure 19. Unclamped inductive waveform

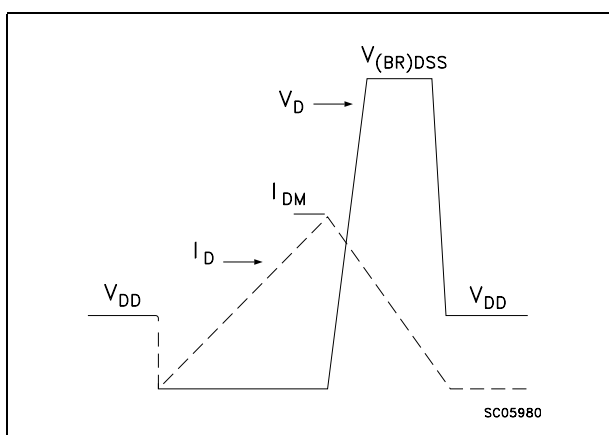
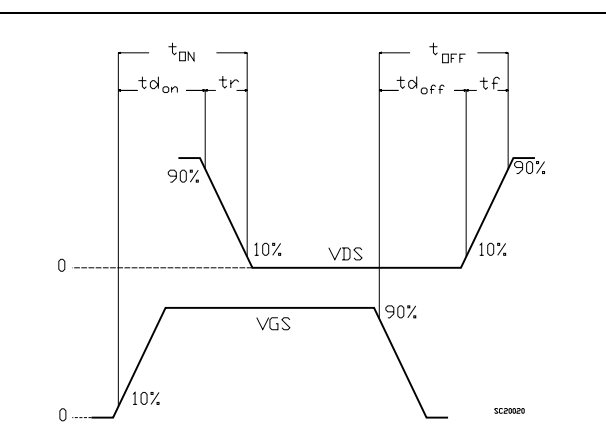


Figure 20. Switching time waveform

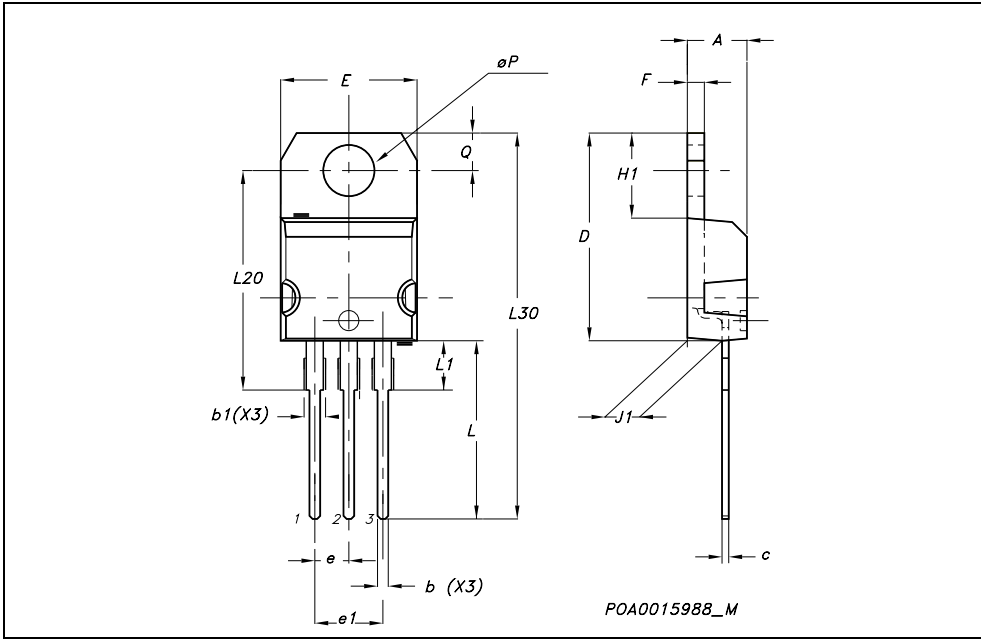


4 Package mechanical data

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

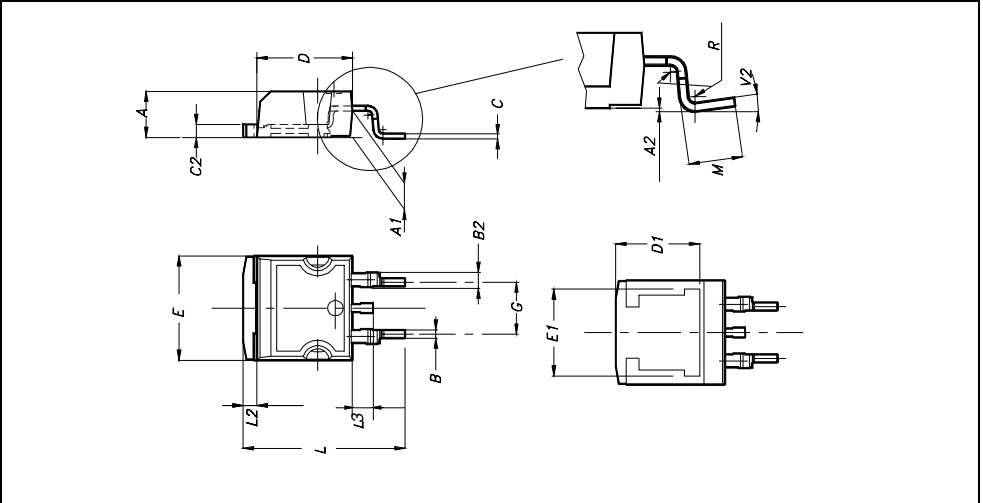
TO-220 MECHANICAL DATA

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



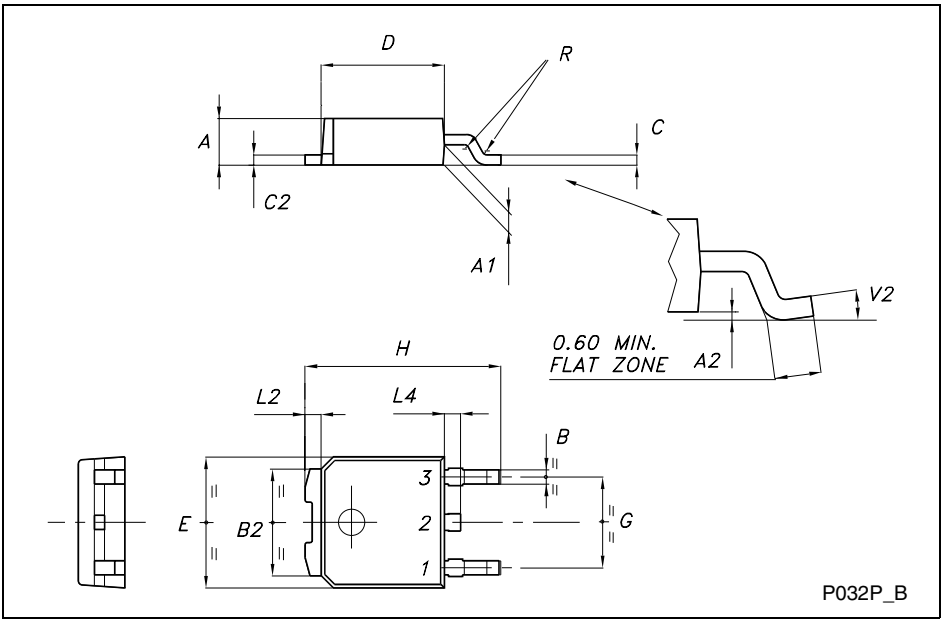
D²PAK MECHANICAL DATA

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°			



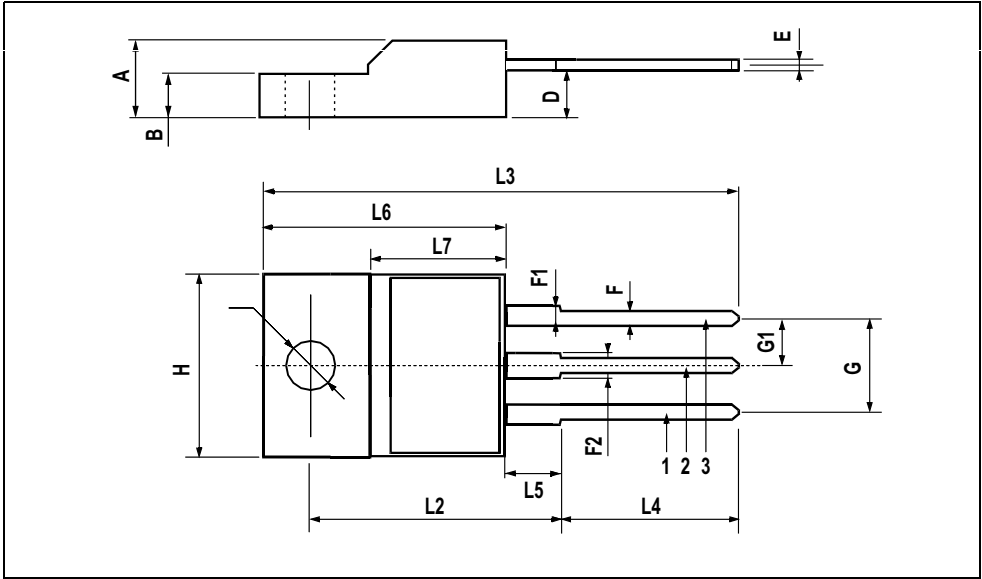
TO-252 (DPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.20		2.40	0.087		0.094
A1	0.90		1.10	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.90	0.025		0.035
B2	5.20		5.40	0.204		0.213
C	0.45		0.60	0.018		0.024
C2	0.48		0.60	0.019		0.024
D	6.00		6.20	0.236		0.244
E	6.40		6.60	0.252		0.260
G	4.40		4.60	0.173		0.181
H	9.35		10.10	0.368		0.398
L2		0.8			0.031	
L4	0.60		1.00	0.024		0.039
V2	0°		8°	0°		0°



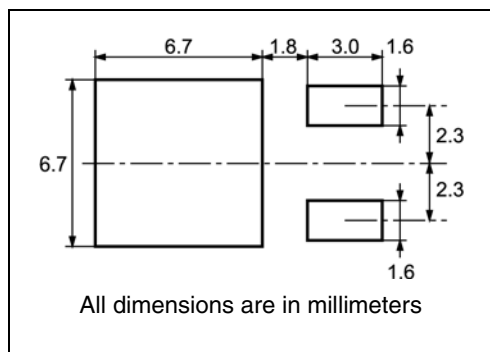
TO-220FP MECHANICAL DATA

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	.0385		0.417
L5	2.9		3.6	0.114		0.141
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

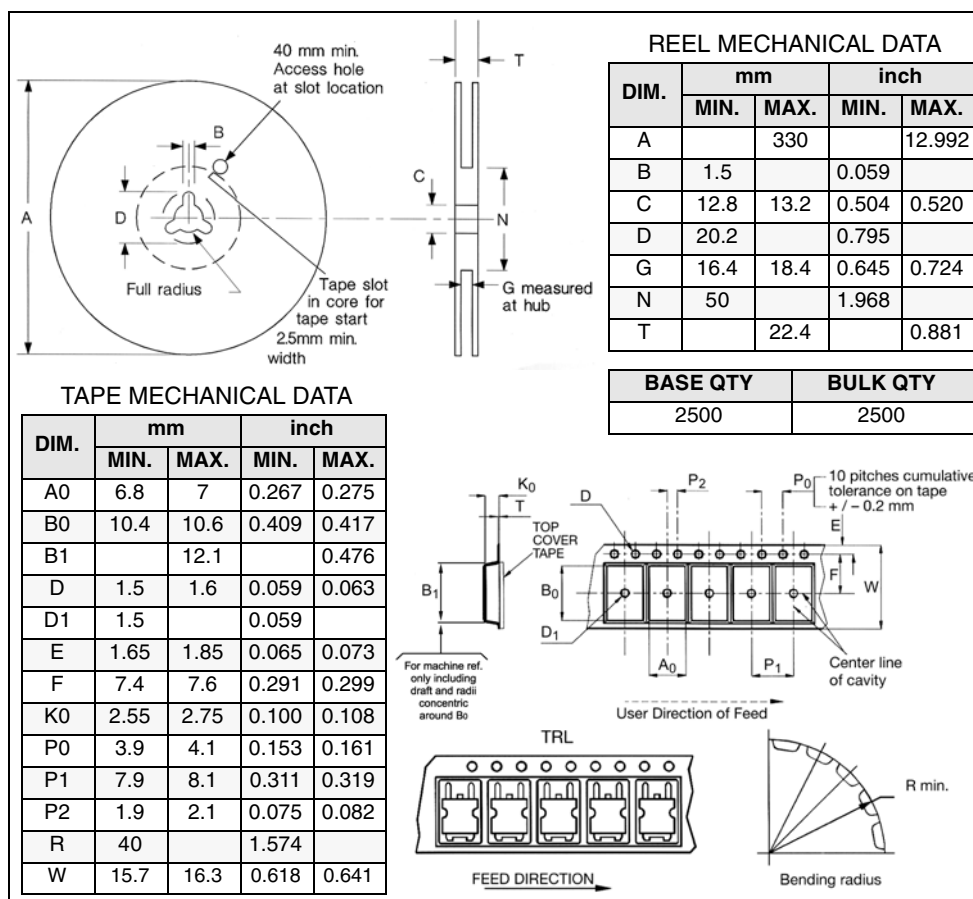


5 Packaging mechanical data

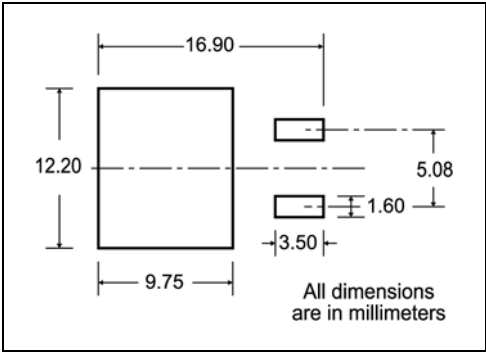
DPAK FOOTPRINT



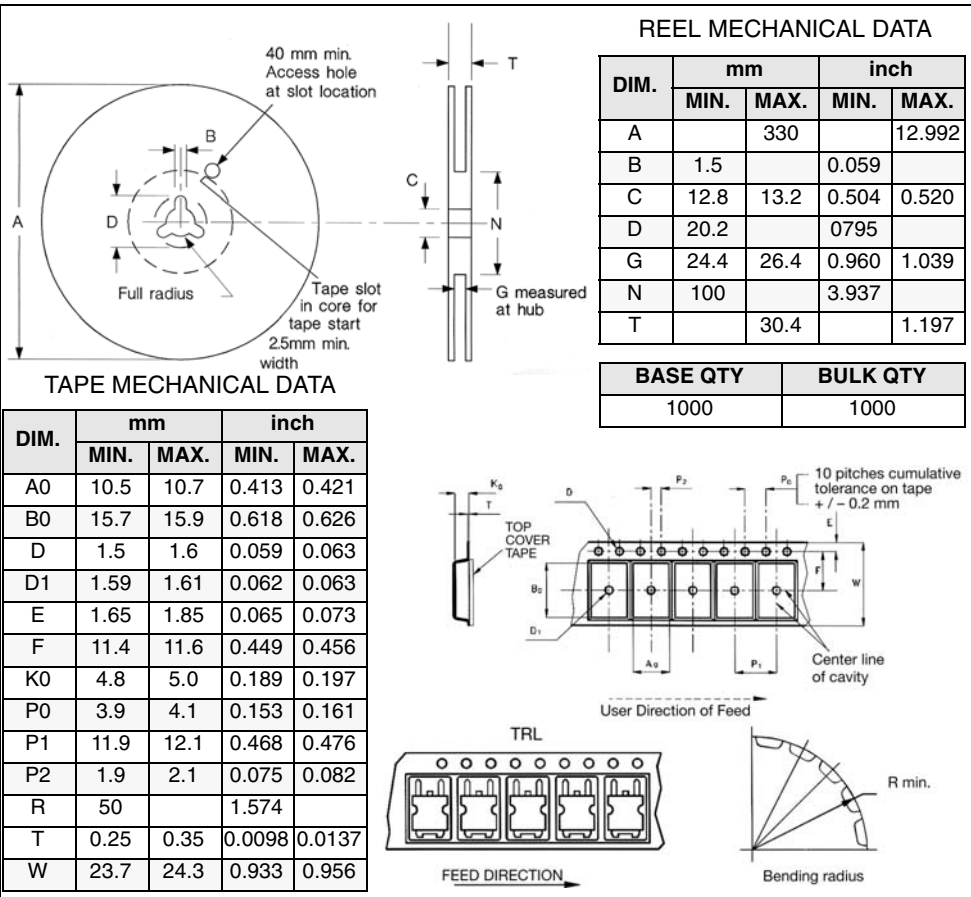
TAPE AND REEL SHIPMENT



D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



* on sales type

6 Revision history

Table 8. Revision history

Date	Revision	Changes
24-May-2005	1	First Release
10-Jun-2005	2	Inserted new row in Table 6.: Switching times
28-Sep-2005	3	Complete version
14-Oct-2005	4	Modified Figure 5 , Figure 8
06-Mar-2006	5	New Stylesheet
29-Mar-2006	6	Modified value on Table 4.
14-Nov-2006	7	New template

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