



STB25NM50N/-1 - STF25NM50N STP25NM50N - STW25NM50N

N-channel 500V - 0.11Ω - 22A - TO-220 /FP- I²/D²PAK - TO-247
Second generation MDmesh™ Power MOSFET

General features

Type	V _{DSS} (@T _{jmax})	R _{DS(on)}	I _D
STB25NM50N	550V	<0.140Ω	22A
STB25NM50N-1	550V	<0.140Ω	22A
STF25NM50N	550V	<0.140Ω	22A ⁽¹⁾
STP25NM50N	550V	<0.140Ω	22A
STW25NM50N	550V	<0.140Ω	22A

1. Limited only by maximum temperature allowed

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

Description

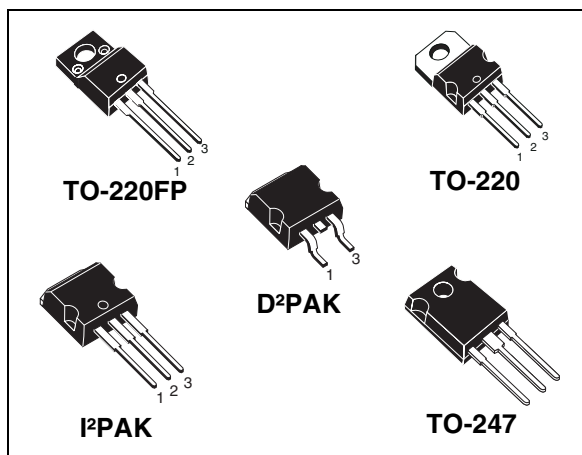
This series of devices is realized with the second generation of MDmesh™ Technology. This revolutionary MOSFET associates a new vertical structure to the Company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency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

Applications

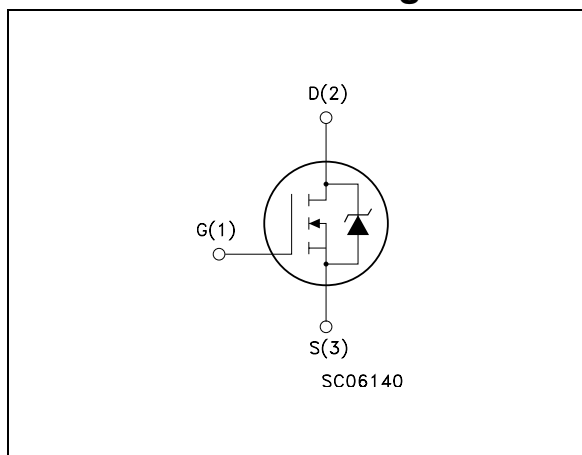
- Switching application

Order codes

Part number	Marking	Package	Packaging
STB25NM50N	B25NM50N	D ² PAK	Tape & reel
STB25NM50N-1	B25NM50N-1	I ² PAK	Tube
STF25NM50N	F25NM50N	TO-220FP	Tube
STP25NM50N	P25NM50N	TO-220	Tube
STW25NM50N	W25NM50N	TO-247	Tube



Internal schematic diagram



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	16
6	Revision history	18

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220 - I ² PAK D ² PAK - TO-247	TO-220FP	
V _{DS}	Drain-source voltage (V _{GS} = 0)	500		V
V _{DGR}	Drain-gate voltage (R _{GS} = 20 kΩ)	500		V
V _{GS}	Gate- source voltage	±25		V
I _D	Drain current (continuous) at T _C = 25°C	22	22 ⁽¹⁾	A
I _D	Drain current (continuous) at T _C = 100°C	14	14 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	88	88 ⁽¹⁾	A
P _{TOT}	Total dissipation at T _C = 25°C	160	40	W
	Derating factor	1.28	0.32	W/°C
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1s; T _C =25°C)	--	2500	V
dv/dt ⁽³⁾	Peak diode recovery voltage slope	15		V/ns
T _{stg}	Storage temperature	-55 to 150		°C
T _j	Max. operating junction temperature	150		°C

- Limited only by maximum temperature allowed
- Pulse width limited by safe operating area
- I_{SD} ≤ 22A, di/dt ≤ 400 A/μs, V_{DD} = 80% V_{(BR)DSS}

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		TO-220 - I ² PAK D ² PAK - TO-247	TO-220FP	
R _{thj-case}	Thermal resistance junction-case Max	0.78	3.1	°C/W
R _{thj-amb}	Thermal resistance junction-ambient Max	62.5		°C/W
T _l	Maximum lead temperature for soldering purpose	300		°C

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _j Max)	10	A
E _{AS}	Single pulse avalanche energy (starting T _j =25°C, I _d =I _{as} , V _{dd} =50V)	350	mJ

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1mA, V_{GS} = 0$	500			V
$dv/dt^{(1)}$	Drain source voltage slope	$V_{DD}=400V, I_D=25A, V_{GS}=10V$		44		V/ns
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, @125^{\circ}C$			1 10	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20V$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10V, I_D = 11A$		0.110	0.140	Ω

1. Characteristic value at turn off on inductive load

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS}=15V, I_D = 11A$		19		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25V, f = 1MHz,$ $V_{GS} = 0$		2565 511 77		pF pF pF
$C_{oss\ eq.}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0V, V_{DS} = 0V \text{ to } 400V$		315		pF
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 400V, I_D = 22A,$ $V_{GS} = 10V,$ <i>(see Figure 18)</i>		84 11 35		nC nC nC
R_g	Gate input resistance	$f=1MHz$ Gate DC Bias=0 Test signal level=20mV open drain		1.6		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_{DS}

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 250V, I_D = 11A$ $R_G = 4.7\Omega, V_{GS} = 10V$ <i>(see Figure 17)</i>		23		ns
t_r	Rise time			23		ns
$t_{d(off)}$	Turn-off delay time				75	ns
t_f	Fall time				22	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current				22	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				88	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 22A, V_{GS} = 0$			1.3	V
t_{rr}	Reverse recovery time	$I_{SD} = 22A, di/dt = 100A/\mu s$ $V_{DD} = 100V, T_j = 25^\circ C$ <i>(see Figure 22)</i>		460		ns
Q_{rr}	Reverse recovery charge			6.9		μC
I_{RRM}	Reverse recovery current			30		A
t_{rr}	Reverse recovery time	$I_{SD} = 22A, di/dt = 100A/\mu s$ $V_{DD} = 100V, T_j = 150^\circ C$ <i>(see Figure 22)</i>		532		ns
Q_{rr}	Reverse recovery charge			8.25		μC
I_{RRM}	Reverse recovery current			31		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 / D²PAK / I²PAK

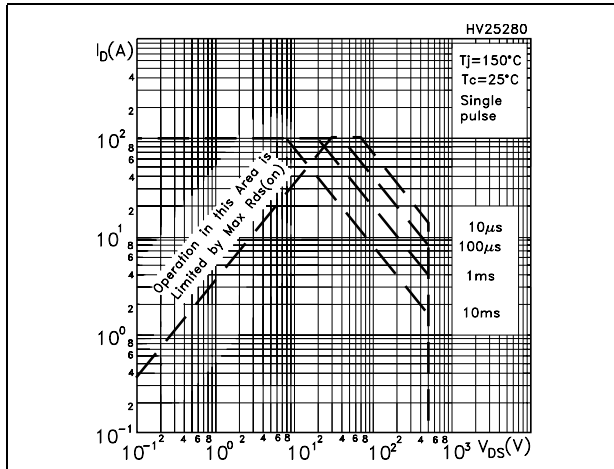


Figure 2. Thermal impedance for TO-220 / D²PAK / I²PAK

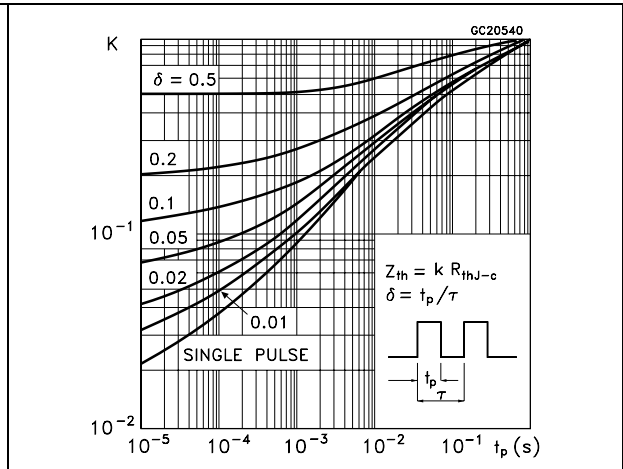


Figure 3. Safe operating area for TO-220FP

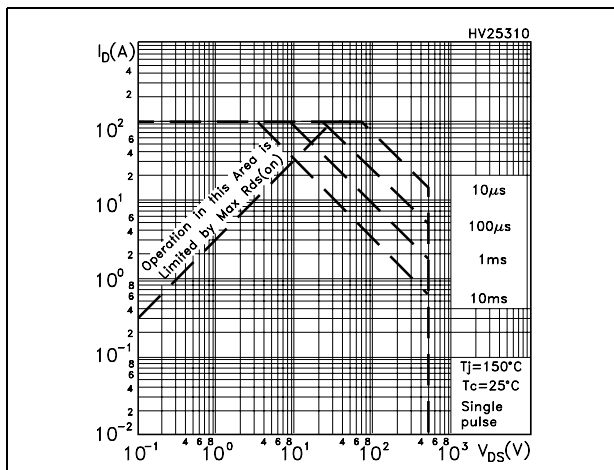


Figure 4. Thermal impedance for TO-220FP

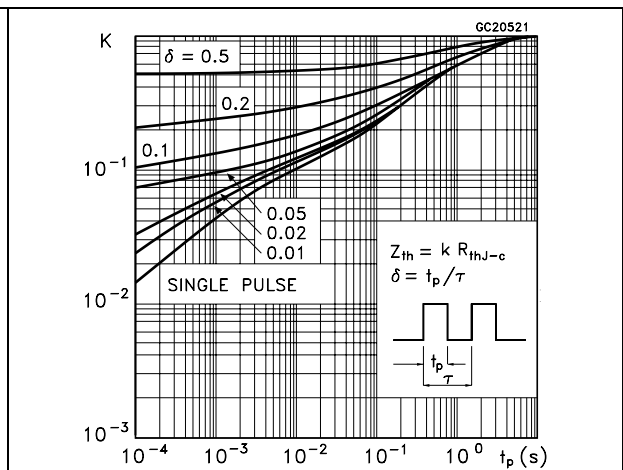


Figure 5. Safe operating area for TO-247

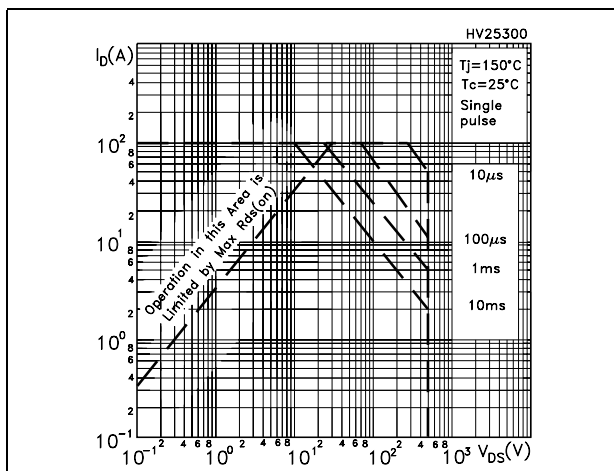


Figure 6. Thermal impedance for TO-247

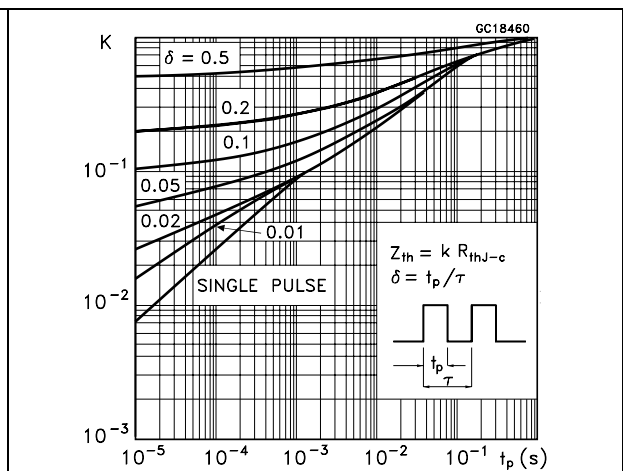


Figure 7. Output characteristics

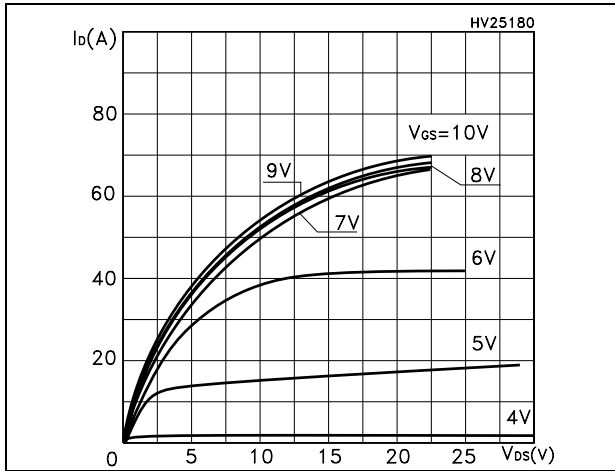


Figure 8. Transfer characteristics

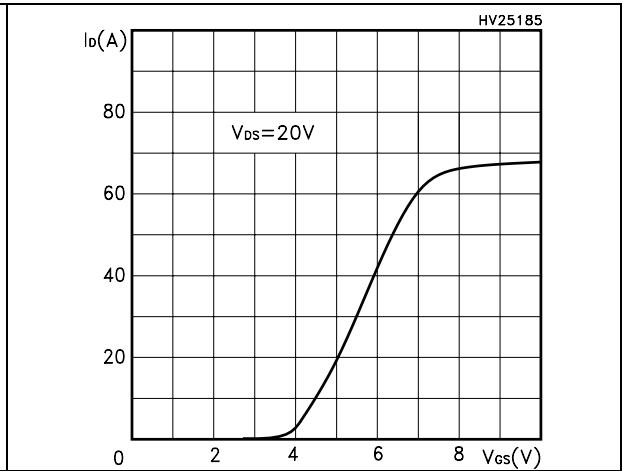


Figure 9. Transconductance

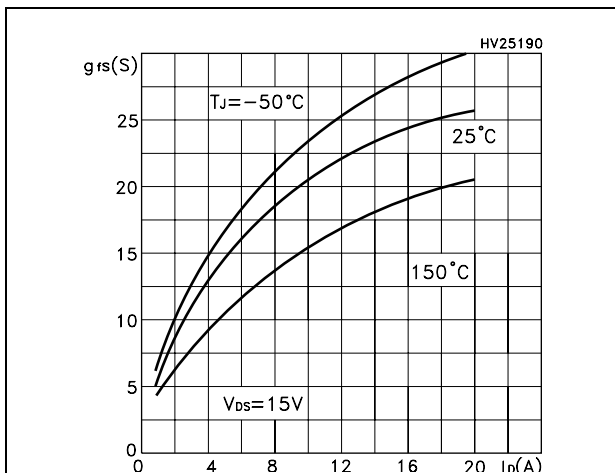


Figure 10. Static drain-source on resistance

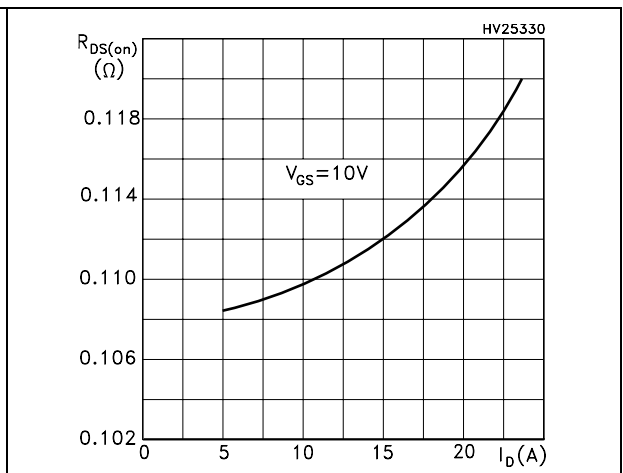


Figure 11. Gate charge vs gate-source voltage Figure 12. Capacitance variations

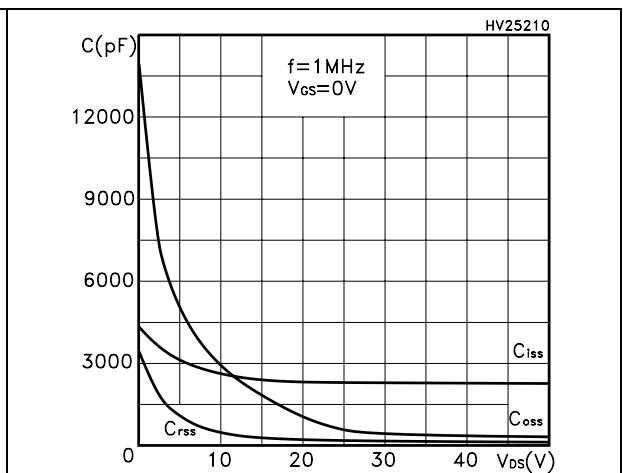
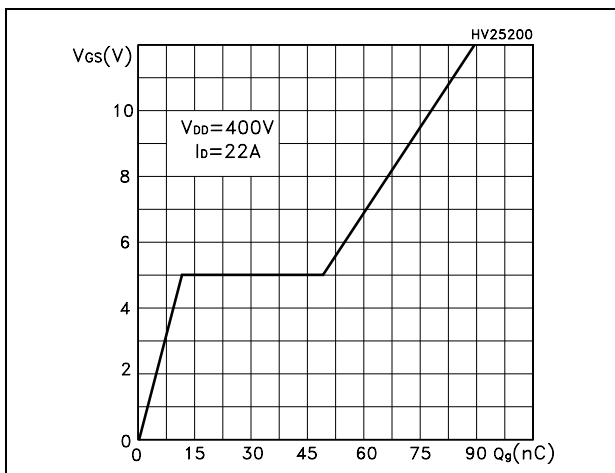


Figure 13. Normalized gate threshold voltage vs temperature

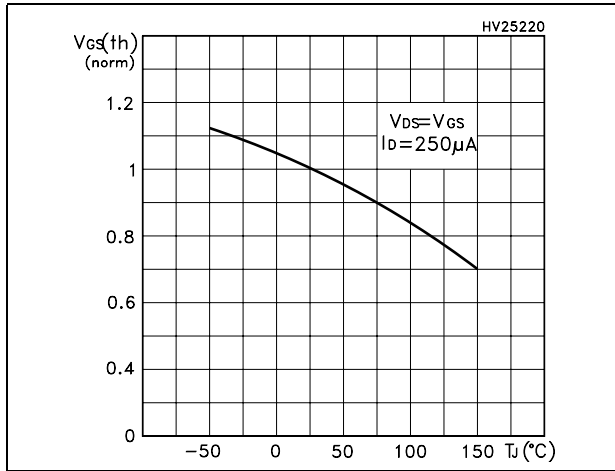


Figure 14. Normalized on resistance vs temperature

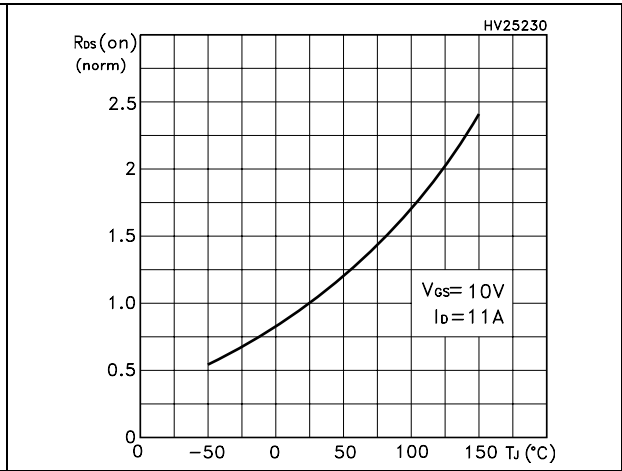


Figure 15. Source-drain diode forward characteristics

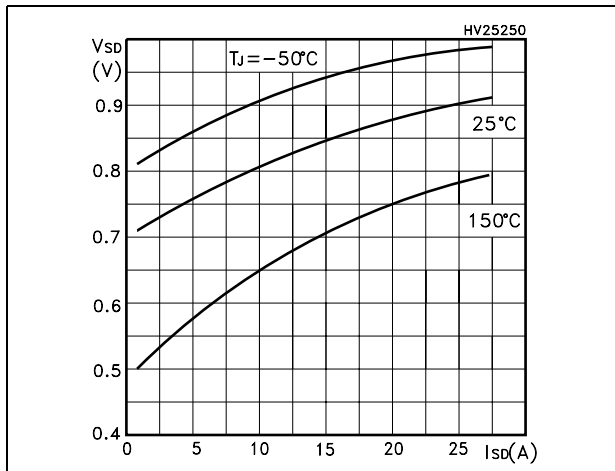
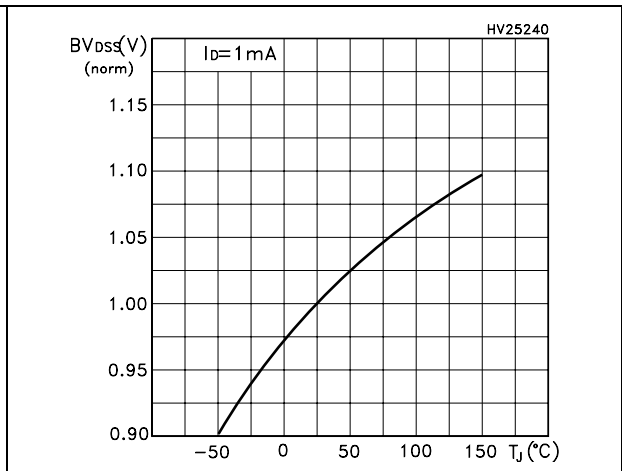


Figure 16. Normalized B_{VDSS} vs temperature



3 Test circuit

Figure 17. Switching times test circuit for resistive load



Figure 18. Gate charge test circuit

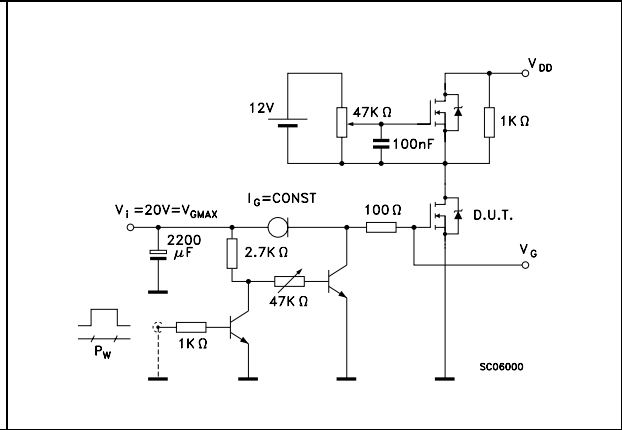


Figure 19. Test circuit for inductive load switching and diode recovery times



Figure 20. Unclamped Inductive load test circuit

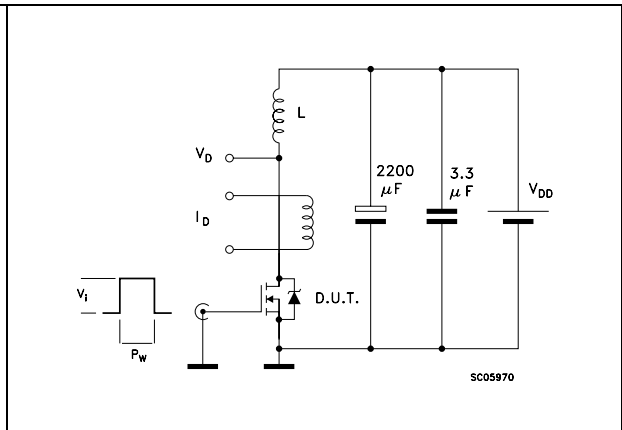


Figure 21. Unclamped inductive waveform

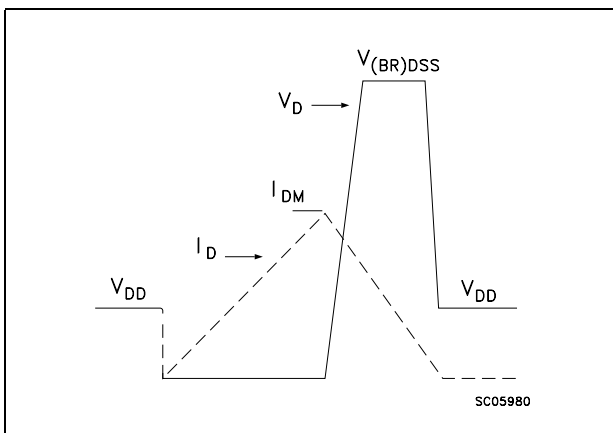
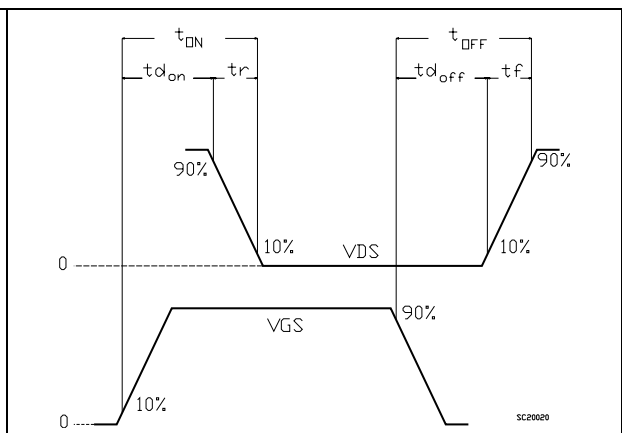


Figure 22. Switching time waveform

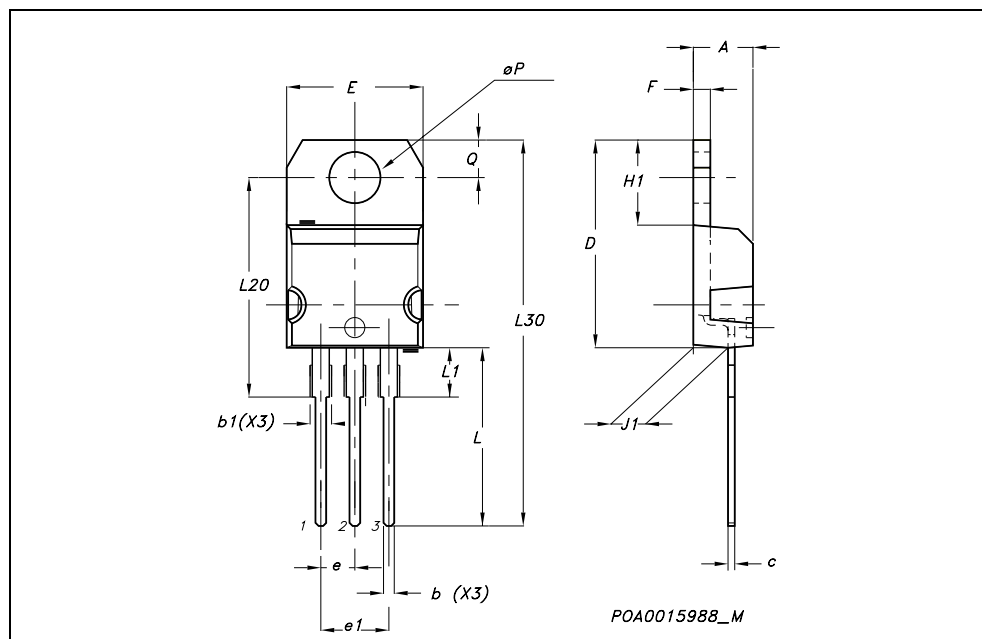


4 Package mechanical data

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

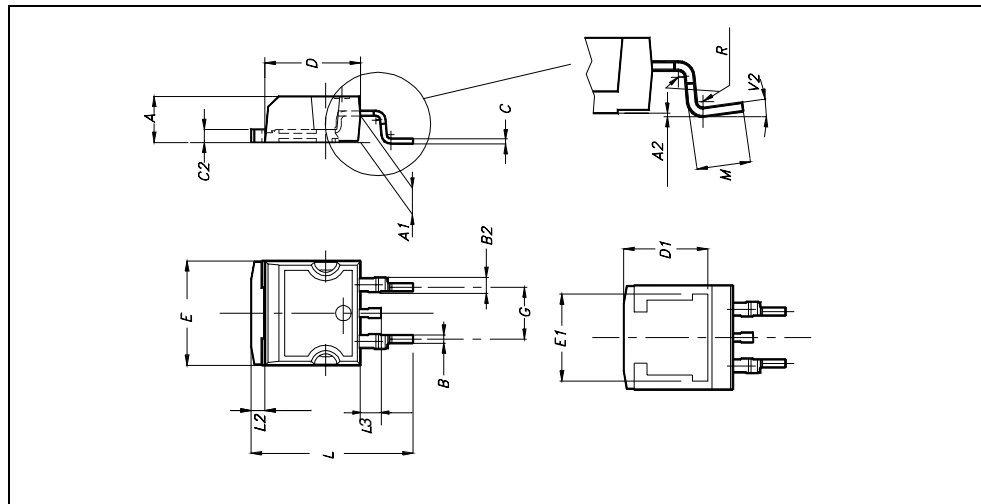
TO-220 MECHANICAL DATA

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



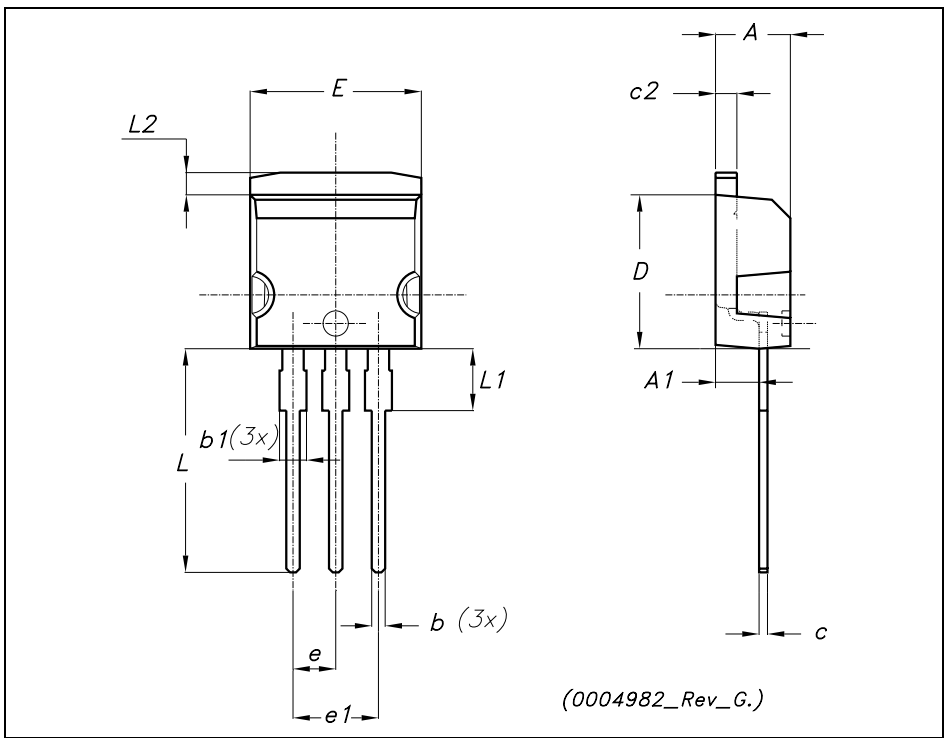
D²PAK MECHANICAL DATA

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°			



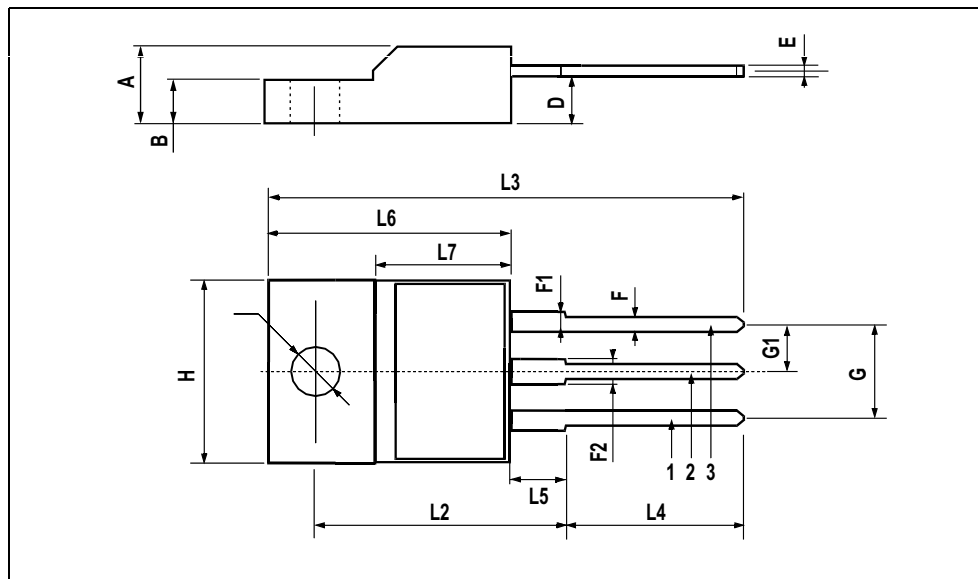
TO-262 (I²PAK) MECHANICAL DATA

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



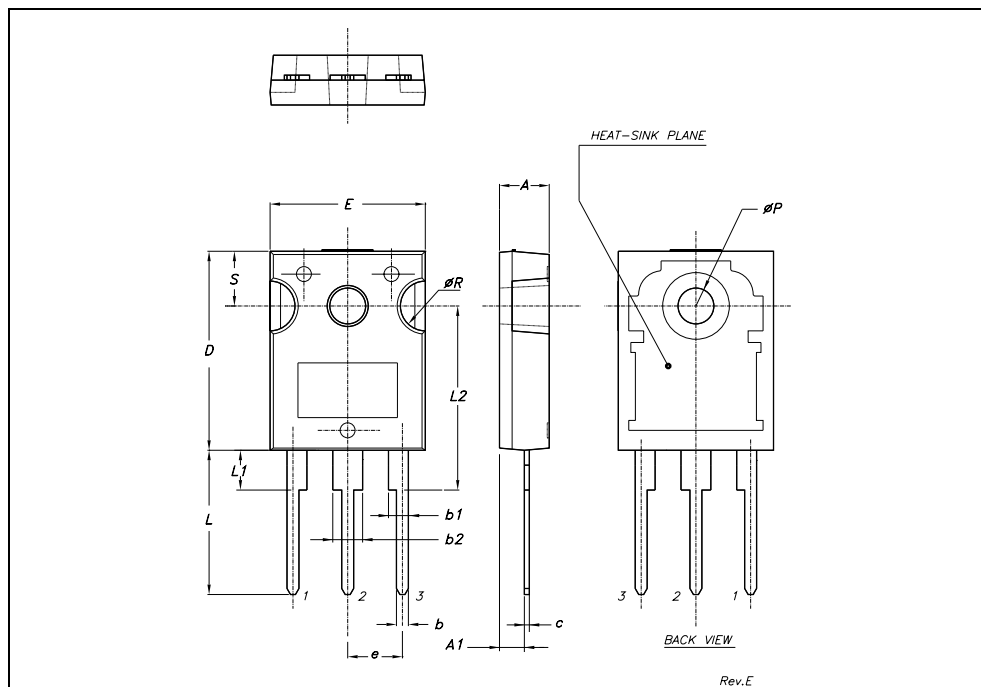
TO-220FP MECHANICAL DATA

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



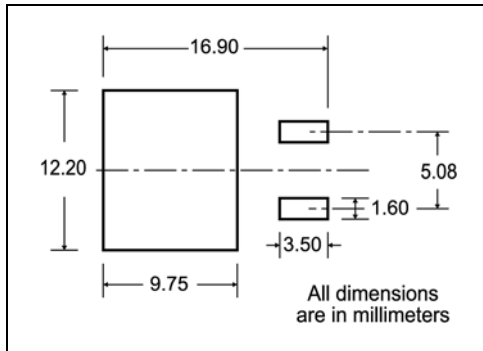
TO-247 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.85		5.15	0.19		0.20
A1	2.20		2.60	0.086		0.102
b	1.0		1.40	0.039		0.055
b1	2.0		2.40	0.079		0.094
b2	3.0		3.40	0.118		0.134
c	0.40		0.80	0.015		0.03
D	19.85		20.15	0.781		0.793
E	15.45		15.75	0.608		0.620
e		5.45			0.214	
L	14.20		14.80	0.560		0.582
L1	3.70		4.30	0.14		0.17
L2		18.50			0.728	
øP	3.55		3.65	0.140		0.143
øR	4.50		5.50	0.177		0.216
S		5.50			0.216	



5 Packaging mechanical data

D²PAK 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

Center line of cavity

User Direction of Feed

FEED DIRECTION

TRL

Bending radius

R min.

* on sales type

6 Revision history

Table 8. Revision history

Date	Revision	Changes
30-Nov-2004	1	First release.
08-Mar-2005	2	Inserted curves
22-Mar-2005	3	Modified title
13-Apr-2005	4	Modified some values
28-Apr-2005	5	Modified some values on Table 7
16-May-2005	6	Modified values on Table 6
17-Jun-2005	7	Inserted new row on Table 5
07-Sep-2005	8	Inserted ecopack indication
05-Oct-2005	9	Modified curves Figure 7 , Figure 8
09-Nov-2005	10	Modified Figure 10
14-Nov-2006	11	New template, new value on Absolute maximum ratings
19-Jan-2007	12	Typo mistake on Table 6

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