



STB12NM50FD - STB12NM50FD-1 STP12NM50FD/FP - STW14NM50FD

N-channel 500V - 0.32Ω - 12A - TO-220/FP - D²/I²PAK - TO-247
FDmesh™ Power MOSFET (with fast diode)

General features

Type	V _{DSS}	R _{DS(on)}	I _D	P _w
STB12NM50FD	500V	<0.4Ω	12A	160W
STB12NM50FD-1	500V	<0.4Ω	12A	160W
STP12NM50FD	500V	<0.4Ω	12A	160W
STP12NM50FD/FP	500V	<0.4Ω	12A	35W
STW14NM50FD	500V	<0.4Ω	12A	160W

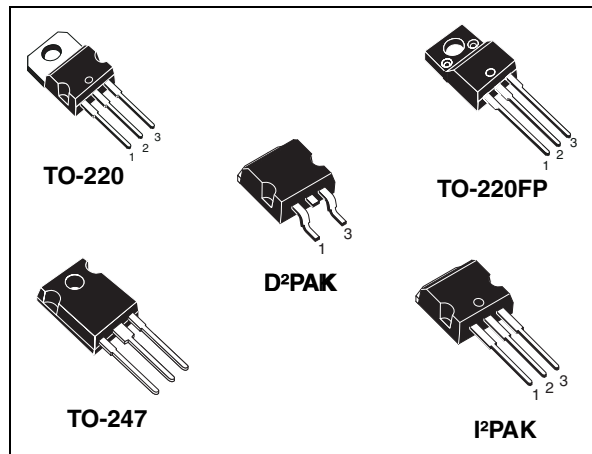
- 100% avalanche tested
- High dv/dt and avalanche capabilities
- Low input capacitance and gate charge
- Low gate input resistance
- Tight process control and high manufacturing yields

Description

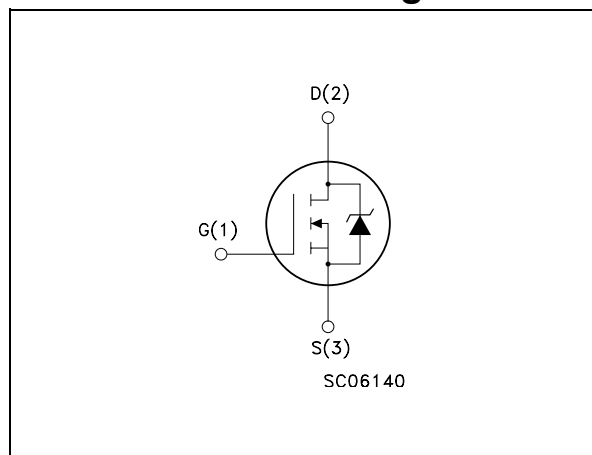
The FDmesh™ associates all advantages of reduced on-resistance and fast switching with an intrinsic fast-recovery body diode. It is therefore strongly recommended for bridge topologies, in particular ZVS phase-shift converters.

Applications

- Switching application



Internal schematic diagram



Order codes

Part number	Marking	Package	Packaging
STB12NM50FD	B12NM50FD	D ² PAK	Tape & reel
STB12NM50FD-1	B12NM50FD	I ² PAK	Tube
STP12NM50FD	P12NM50FD	TO-220	Tube
STP12NM50FD/FP	P12NM50FD/FP	TO-220FP	Tube
STW14NM50FD	W14NM50FD	TO-247	Tube

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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220/ D ² /I ² PAK	TO-220FP	TO-247	
V _{DS}	Drain-source voltage (V _{GS} = 0)	500			V
V _{DGR}	Drain-gate voltage (R _{GS} = 20KΩ)	500			V
V _{GS}	Gate-source voltage	± 30			V
I _D	Drain current (continuous) at T _C = 25°C	12	12 ⁽¹⁾	14	A
I _D	Drain current (continuous) at T _C =100°C	7.5	7.5 ⁽¹⁾	8.8	A
I _{DM} ⁽²⁾	Drain current (pulsed)	48	48 ⁽¹⁾	56	A
P _{TOT}	Total dissipation at T _C = 25°C	160	35	160	W
	Derating factor	1.28	0.28	1.4	W/°C
dv/dt ⁽³⁾	Peak diode recovery voltage slope	20			V/ns
V _{ISO}	Insulation withstand voltage (DC)	--	2500	--	V
T _J T _{stg}	Operating junction temperature Storage temperature	-65 to 150			°C

- Limited only by maximum temperature allowed
- Pulse width limited by safe operating area
- I_{SD} ≤ 2A, di/dt ≤ 400A/μs, V_{DD} = 80%V_{(BR)DSS}

Table 2. Thermal resistance

Symbol	Parameter	Value				Unit
		TO-220 I ² PAK	D ² PAK	TO-220FP	TO-247	
R _{thj-case}	Thermal resistance junction-case Max	0.78		3.57	0.77	°C/W
R _{thj-a}	Thermal resistance junction-ambient Max	62.5	100	62.5		°C/W
T _I	Maximum lead temperature for soldering purpose	300				°C

Table 3. Avalanche data

Symbol	Parameter	Value	Unit
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _J Max)	6	A
E _{AS}	Single pulse avalanche energy (starting T _J =25°C, I _d =I _{ar} , V _{dd} =50V)	400	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
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 ($V_{DS} = 0$)	$V_{GS} = \pm 30V$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10V, I_D = 6A$		0.32	0.4	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15V, I_D = 6A$		9.8		S
C_{iss}	Input capacitance	$V_{DS} = 25V, f = 1 \text{ MHz},$ $V_{GS} = 0$		1000		pF
C_{oss}	Output capacitance			390		pF
C_{rss}	Reverse transfer capacitance			20		pF
Q_g	Total gate charge	$V_{DD} = 400V, I_D = 3A$		12		nC
Q_{gs}	Gate-source charge	$V_{GS} = 10V$		3		nC
Q_{gd}	Gate-drain charge	(see Figure 11)		7		nC
R_G	Gate input resistance	$f = 1 \text{ MHz}$ Gate DC Bias = 0 test signal level = 20mV open drain		2		Ω

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

Table 6. Switching times

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD}=250\text{ V}$, $I_D=6\text{ A}$, $R_G=4.7\Omega$, $V_{GS}=10\text{ V}$ (see Figure 17)		19		ns
t_r	Rise time			10		ns
$t_{r(Voff)}$	Off-voltage rise time	$V_{DD}=400\text{ V}$, $I_D=12\text{ A}$, $R_G=4.7\Omega$, $V_{GS}=10\text{ V}$ (see Figure 17)		39		ns
t_f	Fall time			18		ns
t_c	Cross-over time			29		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current				12	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				48	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=12\text{ A}$, $V_{GS}=0$			1.5	V
t_{rr}	Reverse recovery time	$I_{SD}=12\text{ A}$, $T_j=25^\circ\text{C}$ $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD}=30\text{ V}$, (see Figure 22)		140		ns
Q_{rr}	Reverse recovery charge			800		nC
I_{RRM}	Reverse recovery current			11		A
t_{rr}	Reverse recovery time	$I_{SD}=12\text{ A}$, $T_j=150^\circ\text{C}$ $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD}=30\text{ V}$, (see Figure 22)		252		ns
Q_{rr}	Reverse recovery charge			1890		nC
I_{RRM}	Reverse recovery current			15		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

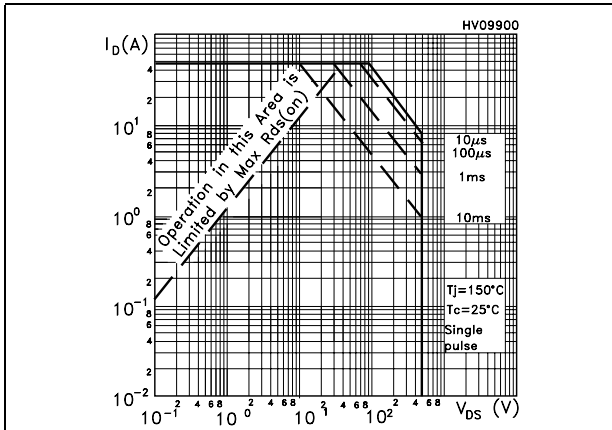


Figure 2. Thermal impedance for TO-220/D²PAK/I²PAK

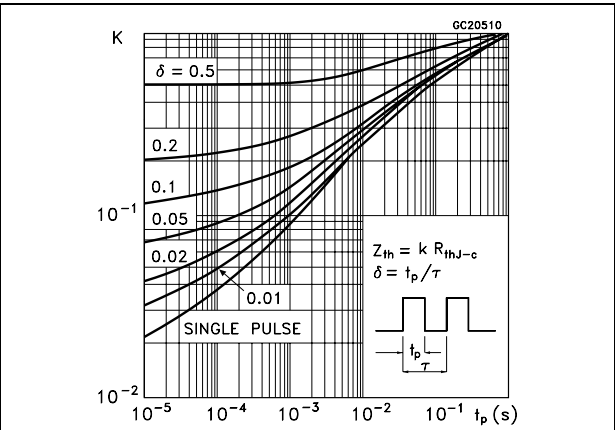


Figure 3. Safe operating area for TO-220FP

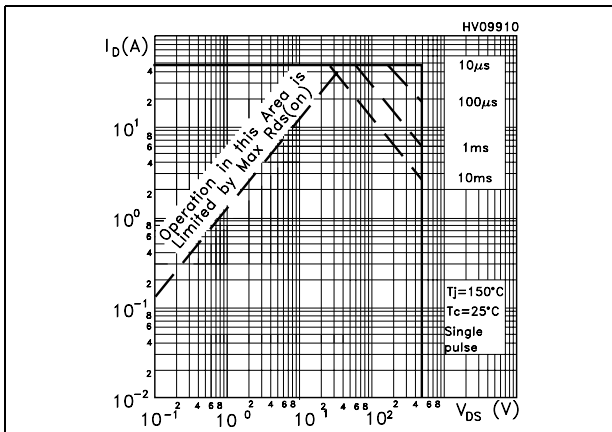


Figure 4. Thermal impedance for TO-220FP

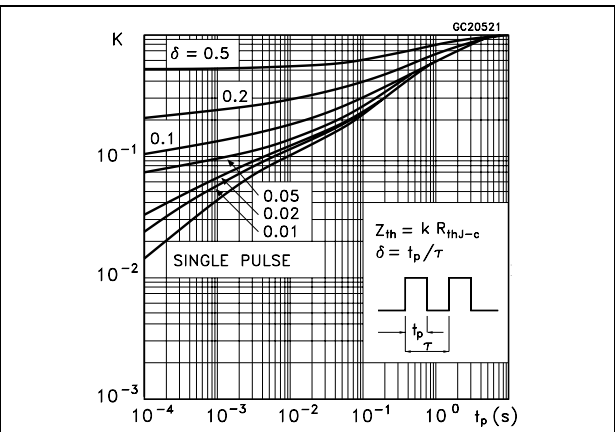


Figure 5. Safe operating area for TO-247

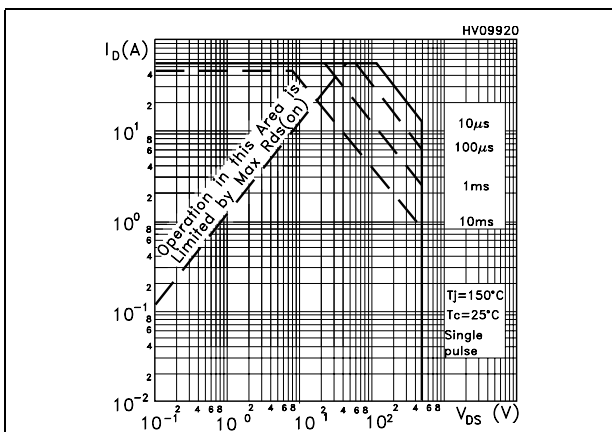


Figure 6. Thermal impedance for TO-247

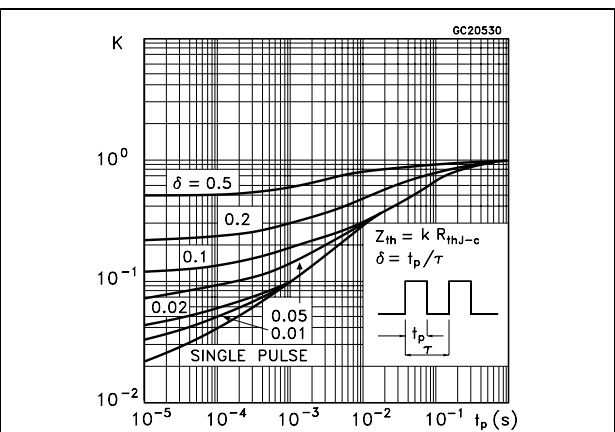


Figure 7. Output characteristics

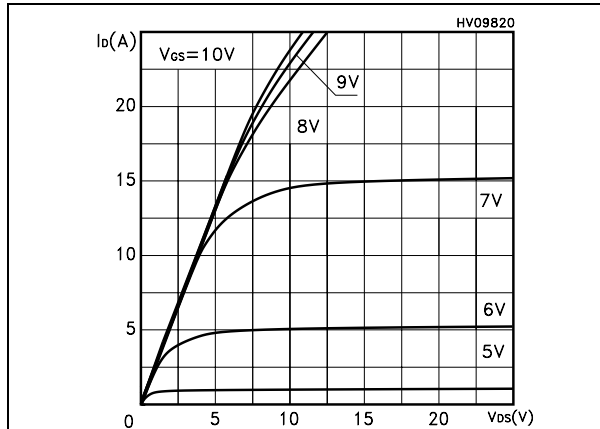


Figure 8. Transfer characteristics

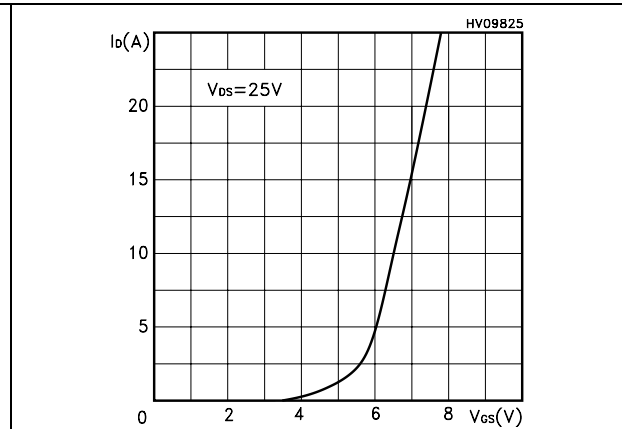


Figure 9. Transconductance

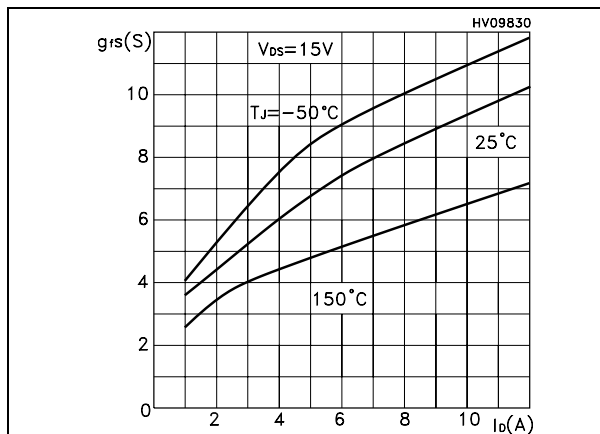


Figure 10. Static drain-source on resistance

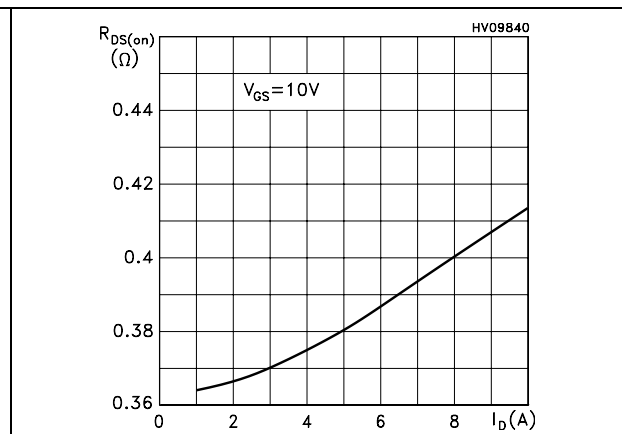


Figure 11. Gate charge vs gate-source voltage Figure 12. Capacitance variations

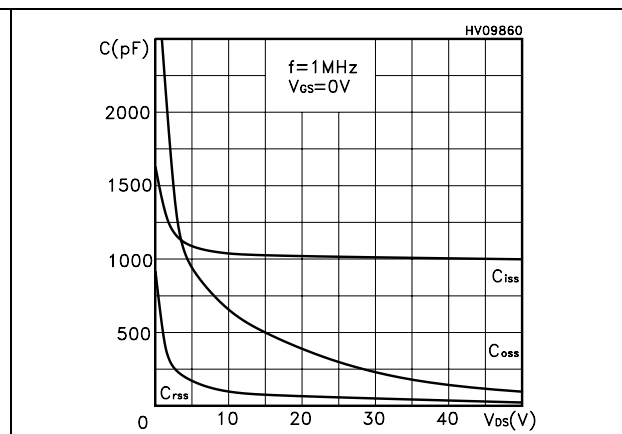
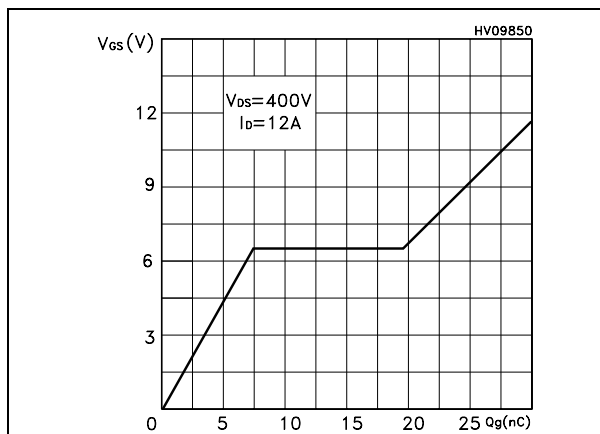


Figure 13. Normalized gate threshold voltage vs temperature

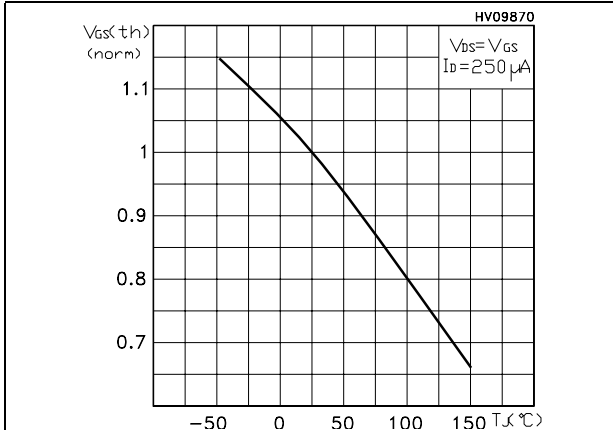


Figure 14. Normalized on resistance vs temperature

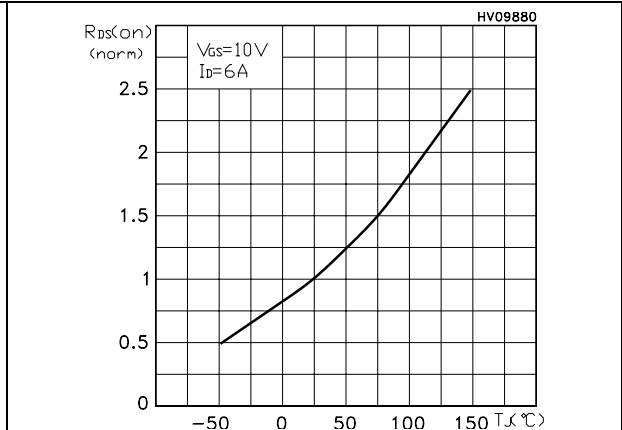


Figure 15. Source-drain diode forward characteristics

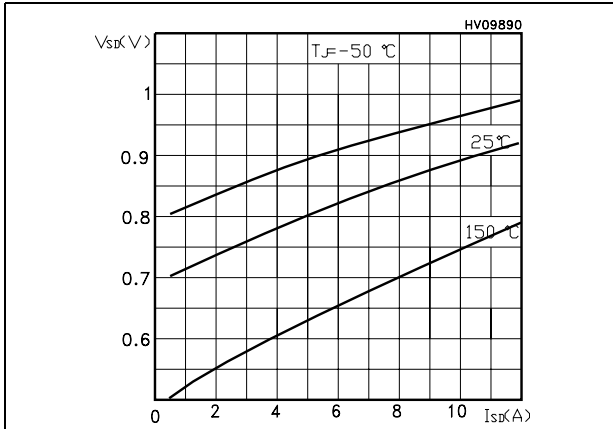
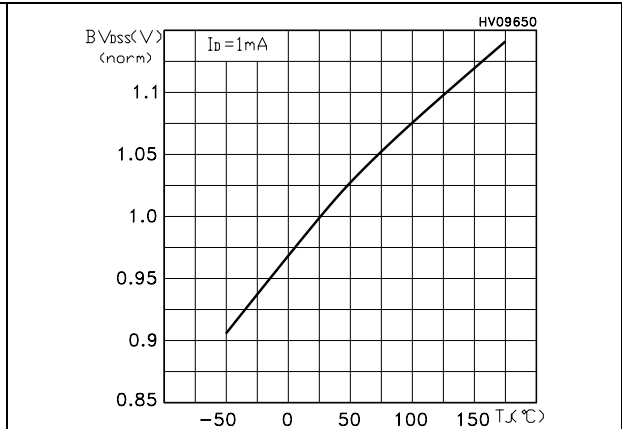


Figure 16. Normalized BV_{DSS} vs temperature



3 Test circuit

Figure 17. Switching times test circuit for resistive load



Figure 18. Gate charge test circuit

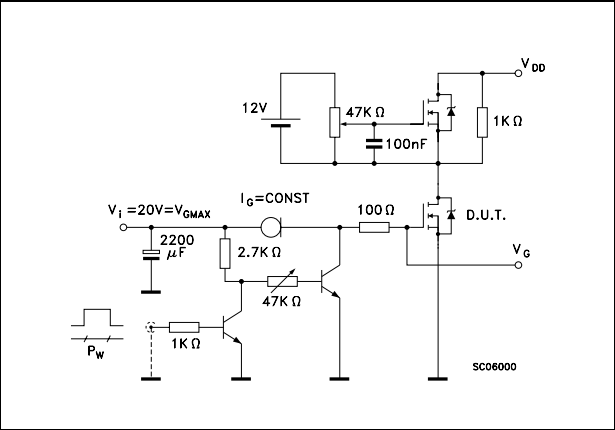


Figure 19. Test circuit for inductive load switching and diode recovery times



Figure 20. Unclamped inductive load test circuit

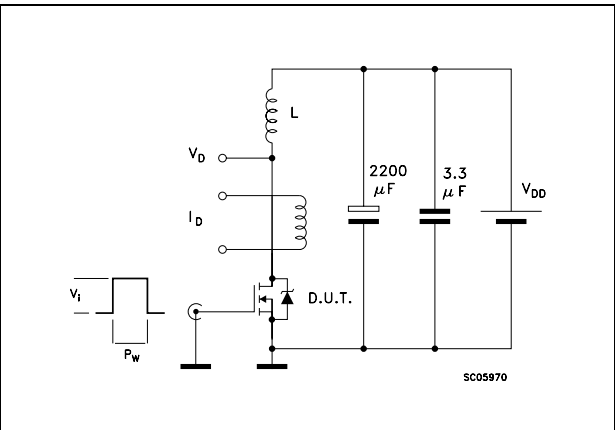
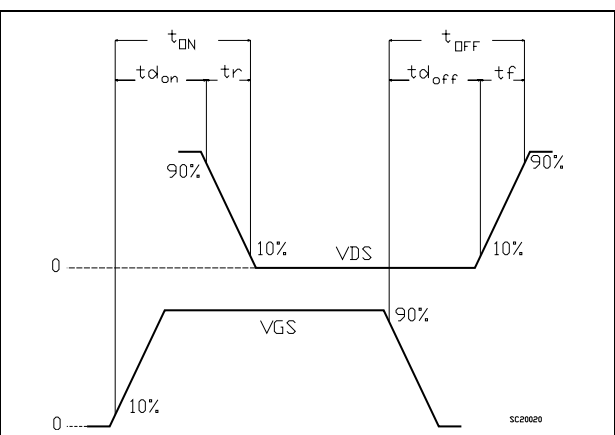


Figure 21. Unclamped inductive waveform



Figure 22. Switching time waveform

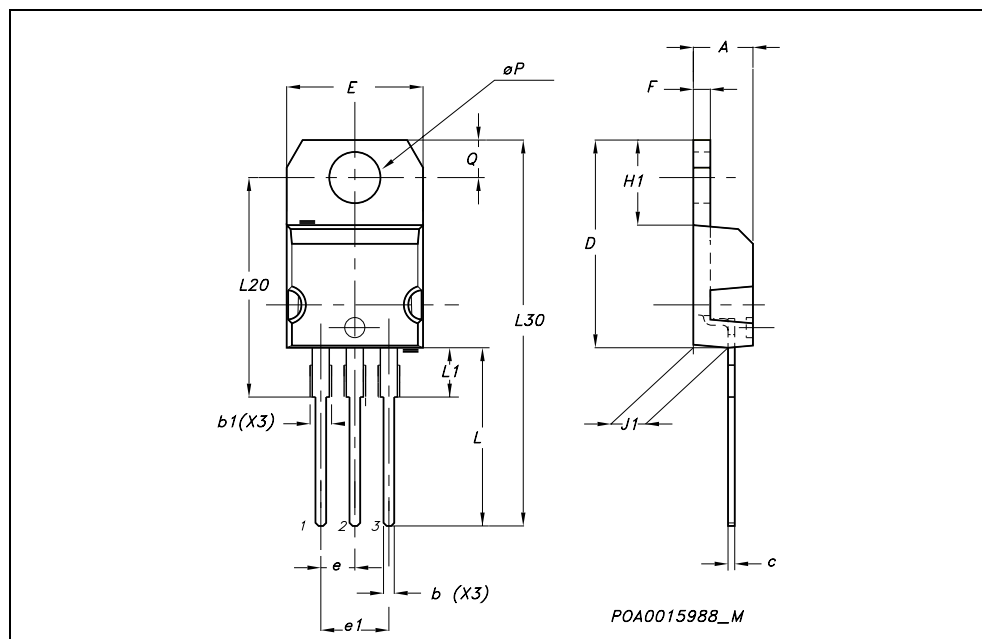


4 Package mechanical data

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

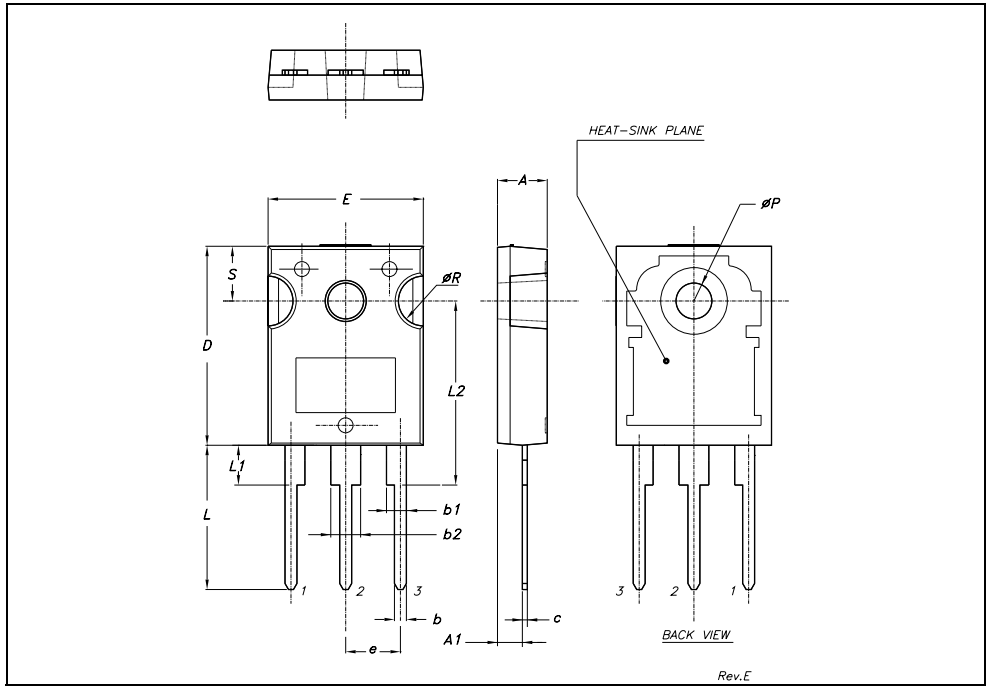
TO-220 MECHANICAL DATA

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



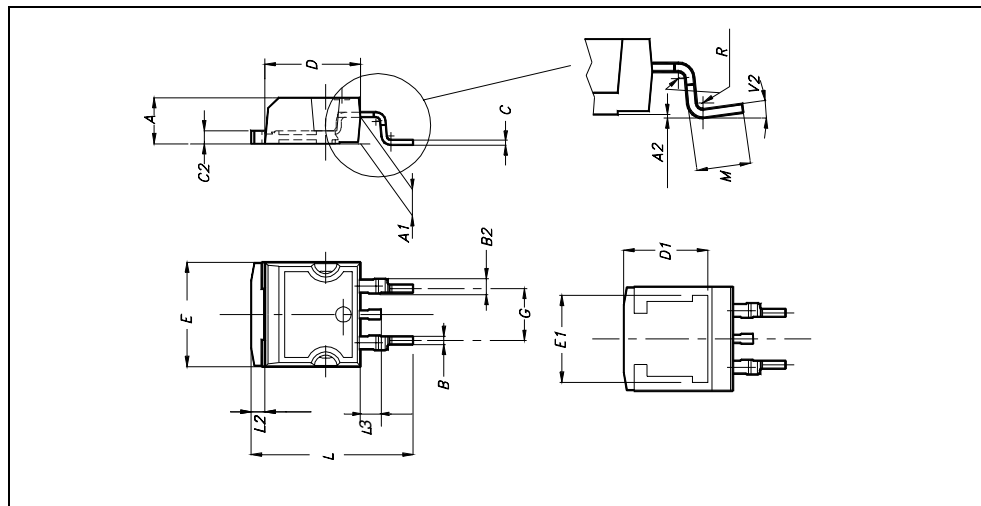
TO-247 MECHANICAL DATA

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	



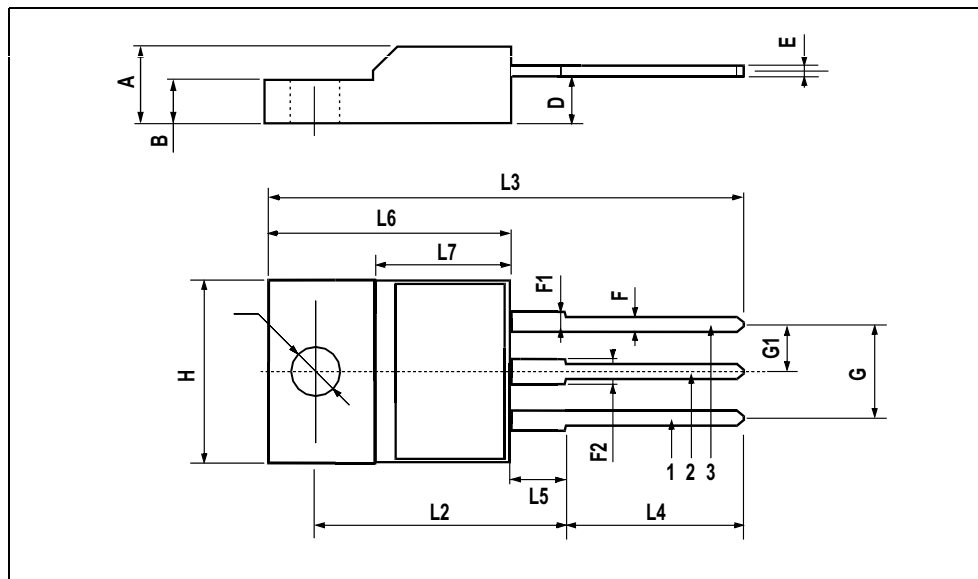
D²PAK MECHANICAL DATA

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°			



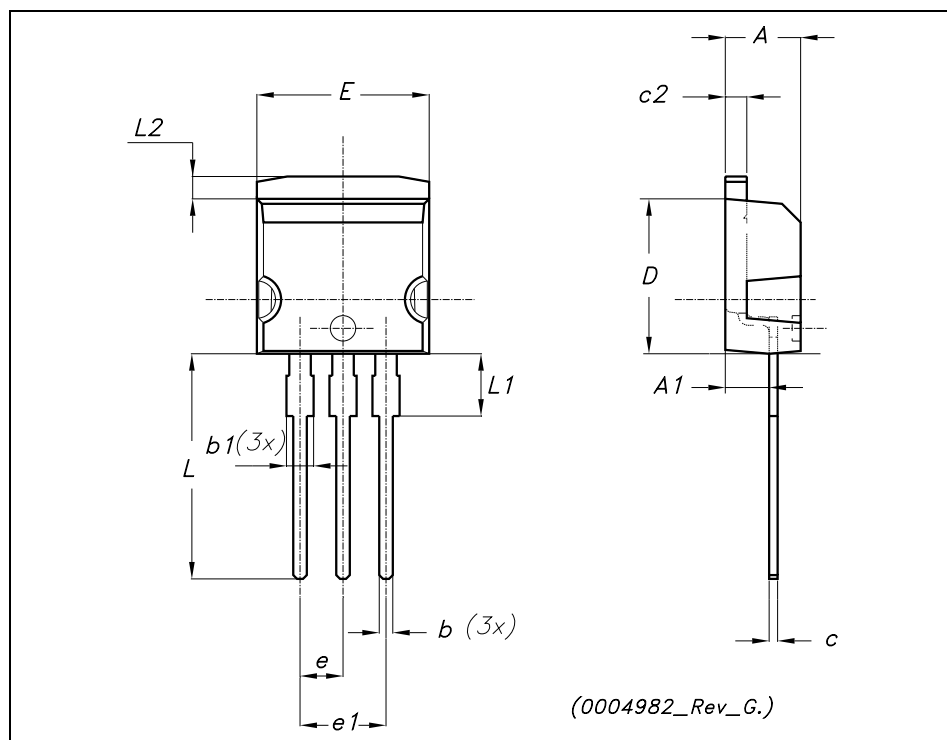
TO-220FP MECHANICAL DATA

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-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



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

* on sales type

6 Revision history

Table 8. Revision history

Date	Revision	Changes
03-May-2006	3	New template

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