



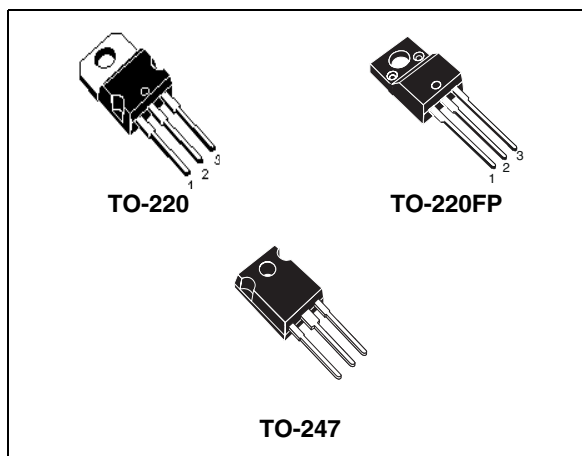
STP8NK80Z - STP8NK80ZFP STW8NK80Z

N-channel 800V - 1.3Ω - 6.2A - TO-220 /TO-220FP/TO-247
Zener-protected SuperMESH™ Power MOSFET

Features

Type	V _{DSS}	R _{DS(on)}	I _D
STP8NK80Z	800 V	< 1.5 Ω	6.2 A
STP8NK80ZFP	800 V	< 1.5 Ω	6.2 A
STW8NK80Z	800 V	< 1.5 Ω	6.2 A

- Extremely high dv/dt capability
- 100% avalanche tested
- Gate charge minimized
- Very low intrinsic capacitances
- Very good manufacturing repeatability



Description

The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements ST full range of high voltage MOSFETs including revolutionary MDmesh™ products.

Application

- Switching applications

Figure 1. Internal schematic diagram

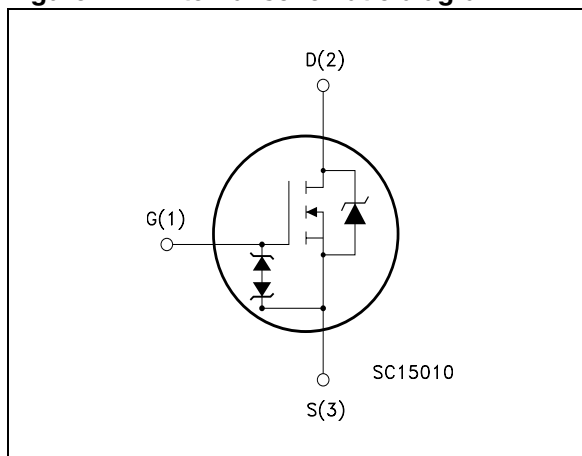


Table 1. Device summary

Order codes	Marking	Package	Packaging
STP8NK80Z	P8NK80Z	TO-220	Tube
STP8NK80ZFP	P8NK80ZFP	TO-220FP	Tube
STW8NK80Z	W8NK80Z	TO-247	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	Revision history	14

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220 - TO-247	TO-220FP	
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	800		V
V_{GS}	Gate- source voltage	± 30		V
I_D	Drain current (continuous) at $T_C = 25^\circ\text{C}$	6.2	6.2 ⁽¹⁾	A
I_D	Drain current (continuous) at $T_C = 100^\circ\text{C}$	3.9	3.9 ⁽¹⁾	A
$I_{DM}^{(2)}$	Drain current (pulsed)	24.8	24.8 ⁽¹⁾	A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	140	30	W
	Derating factor	1.12	0.24	W/ $^\circ\text{C}$
$V_{ESD(G-S)}$	Gate source ESD(HBM-C=100pF, R=1.5K Ω)	4000		V
$dv/dt^{(3)}$	Peak diode recovery voltage slope	4.5		V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1s; $T_C = 25^\circ\text{C}$)	-	2500	V
T_j T_{stg}	Max 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. $I_{SD} \leq 6.2$ A, $di/dt \leq 200$ A/ μs , $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$.

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		TO-220	TO-220FP	TO-247	
$R_{thj-case}$	Thermal resistance junction-case max	0.89	4.2	0.89	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5		50	$^\circ\text{C}/\text{W}$
T_l	Maximum lead temperature for soldering purpose	300			$^\circ\text{C}$

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j Max)	6.2	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$, $I_d = I_{AR}$, $V_{dd} = 50\text{V}$)	300	mJ

2 Electrical characteristics

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

Table 5. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown voltage	$I_D = 1mA, V_{GS} = 0$	800			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 50	μA μA
I_{GSS}	Gate-body leakage Current ($V_{DS} = 0$)	$V_{GS} = \pm 20 V$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 100 \mu A$	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10 V, I_D = 3.1 A$		1.3	1.5	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15V, I_D = 3.1 A$		5.2		S
C_{iss}	Input capacitance	$V_{DS} = 25 V, f = 1 \text{ MHz},$ $V_{GS} = 0$		1320		pF
C_{oss}	Output capacitance			143		pF
C_{rss}	Reverse transfer capacitance			27		pF
$C_{oss \text{ eq.}}^{(2)}$	Equivalent output capacitance	$V_{DS} = 0V, V_{DS} = 0V \text{ to } 640V$		58		pF
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400 V, I_D = 3.1 A,$ $R_G = 4.7 \Omega, V_{GS} = 10 V$ (see Figure 21)		17		ns
t_r	Rise time			30		ns
$t_{r(off)}$	Turn-off delay time			48		ns
t_f	Fall time			28		ns
Q_g	Total gate charge	$V_{DD} = 640 V, I_D = 6.2 A,$ $V_{GS} = 10 V$		46		nC
Q_{gs}	Gate-source charge			8.5		nC
Q_{gd}	Gate-drain charge			25		nC
$t_{r(Voff)}$	Off-voltage rise time	$V_{DD} = 640 V, I_D = 6.2 A,$ $R_G = 4.7 \Omega, V_{GS} = 10 V$ (see Figure 23)		9		ns
t_f	Fall time			9		ns
t_c	Cross-over time			18		ns

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

2. $C_{oss \text{ eq.}}$ 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. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current				6.2	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				24.8	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 6.2 \text{ A}, V_{GS} = 0$			1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 6.2 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$		460		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 50 \text{ V}, T_j = 150^\circ\text{C}$		2990		nC
I_{RRM}	Reverse recovery current	(see Figure 23)		13		A

1. Pulsed: pulse duration=300 μs , duty cycle 1.5%
2. Pulse width limited by safe operating area

Table 8. Gate-source zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$BV_{GSO}^{(1)}$	Gate-source breakdown voltage	$I_{gs} = \pm 1 \text{ mA}$ (Open Drain)	30			V

1. The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220

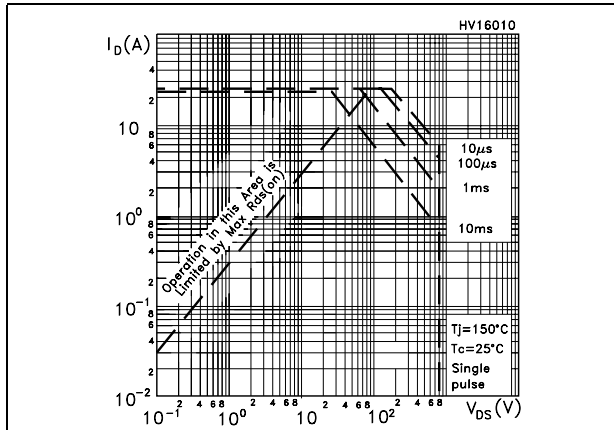


Figure 3. Thermal impedance for TO-220

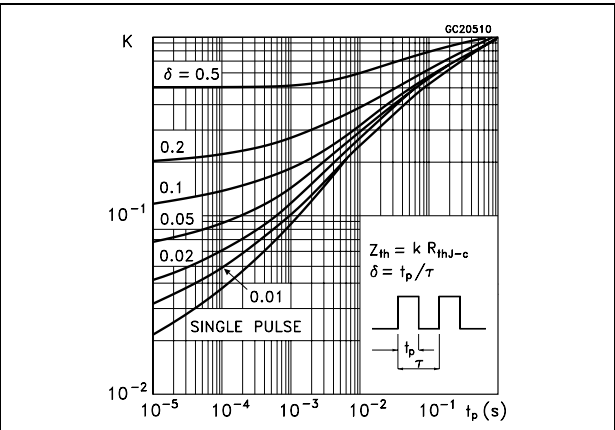


Figure 4. Safe operating area for TO-220FP

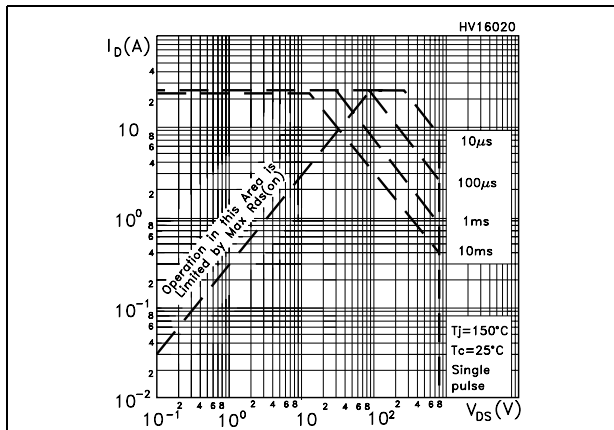


Figure 5. Thermal impedance for TO-220FP

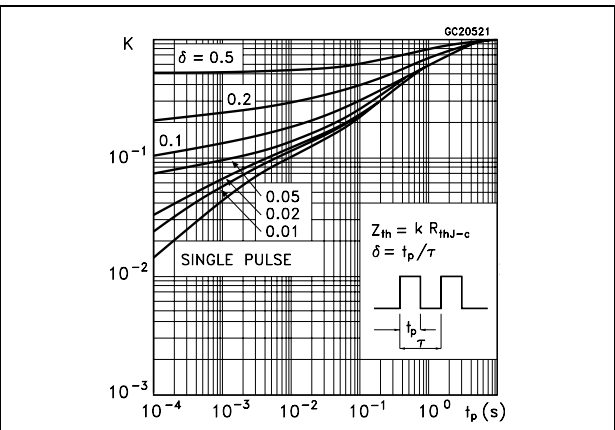


Figure 6. Safe operating area for TO-247

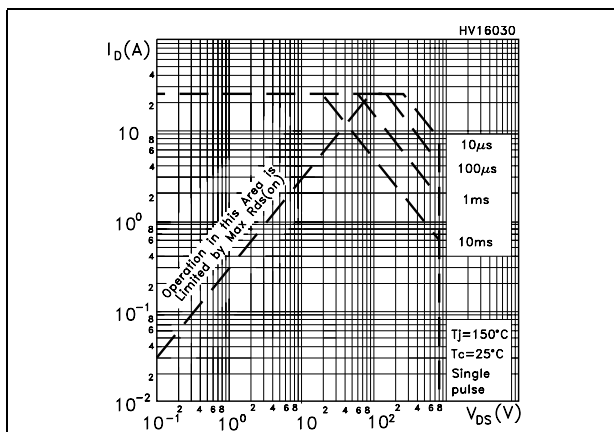


Figure 7. Thermal impedance for TO-247

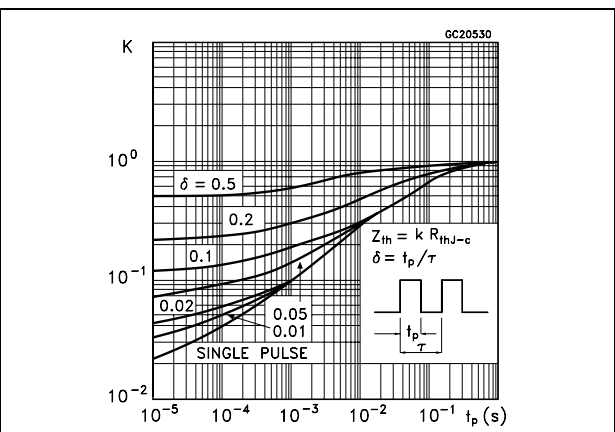


Figure 8. Output characteristics

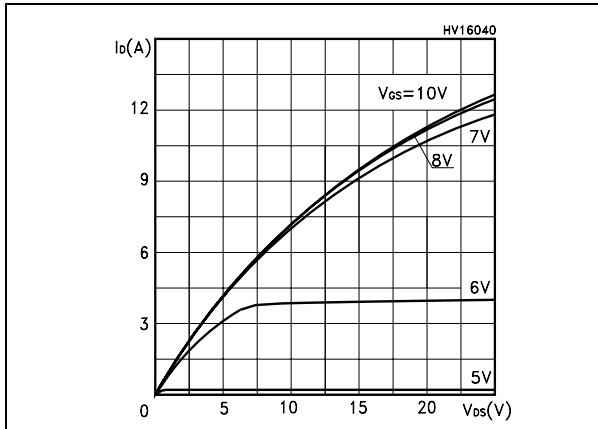


Figure 9. Transfer characteristics

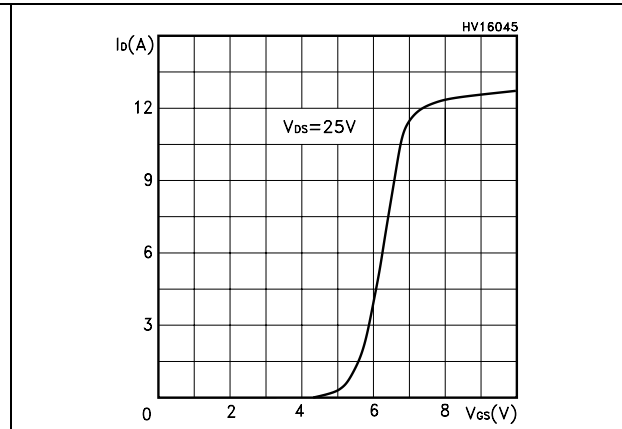


Figure 10. Transconductance

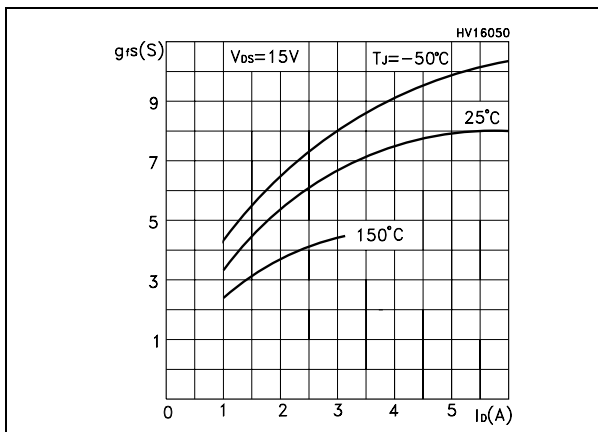


Figure 11. Static drain-source on resistance

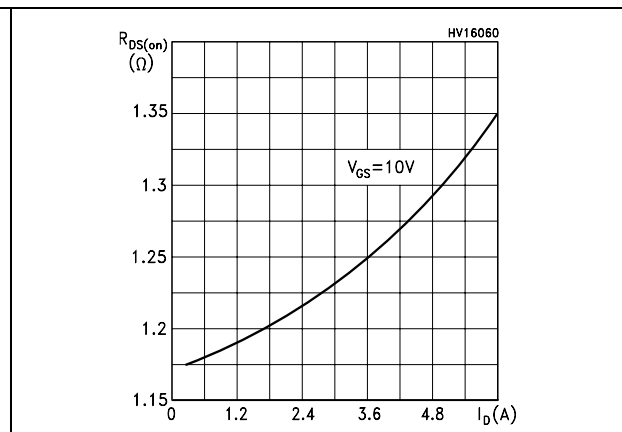


Figure 12. Gate charge vs gate-source voltage

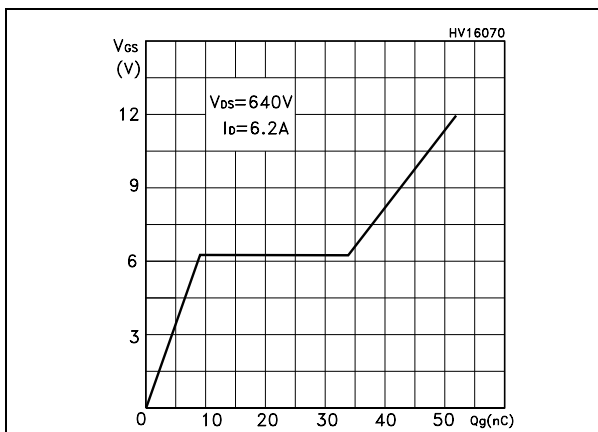


Figure 13. Capacitance variations

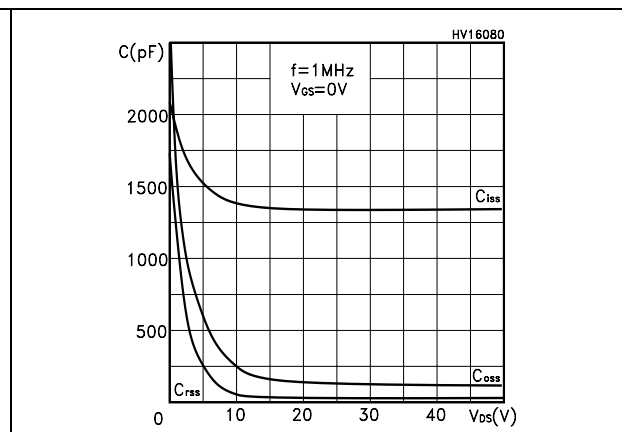


Figure 14. Normalized gate threshold voltage vs temperature

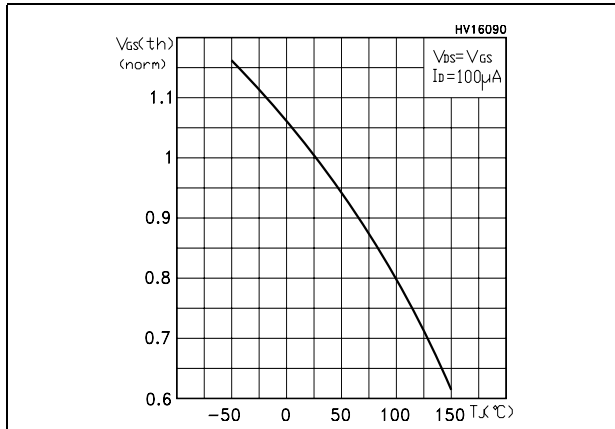


Figure 15. Normalized on resistance vs temperature

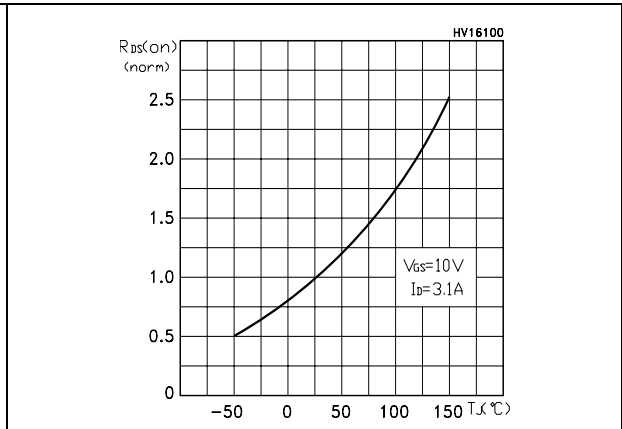


Figure 16. Source-drain diode forward characteristic

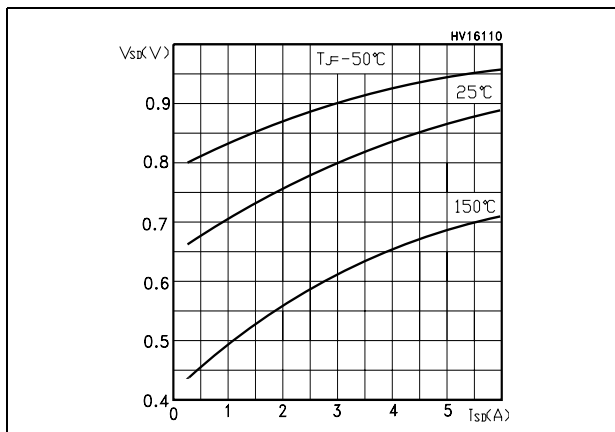


Figure 17. Normalized B_{VDS} vs temperature

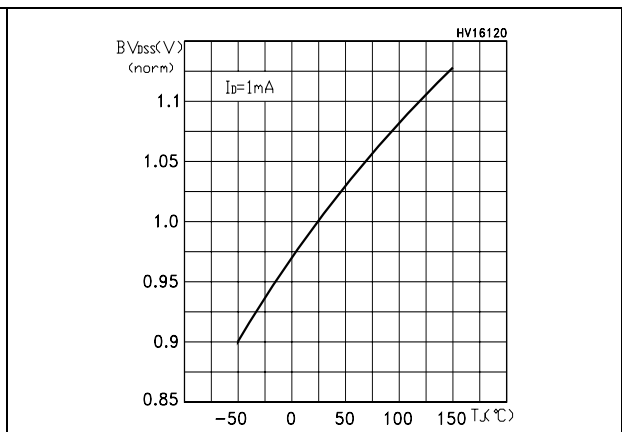
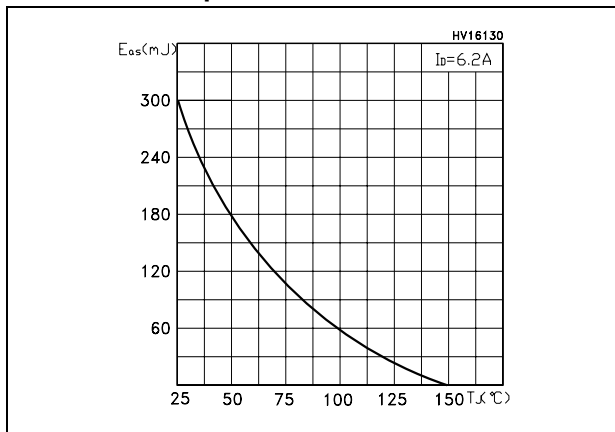


Figure 18. Maximum avalanche energy vs temperature



3 Test circuit

Figure 19. Unclamped inductive load test circuit

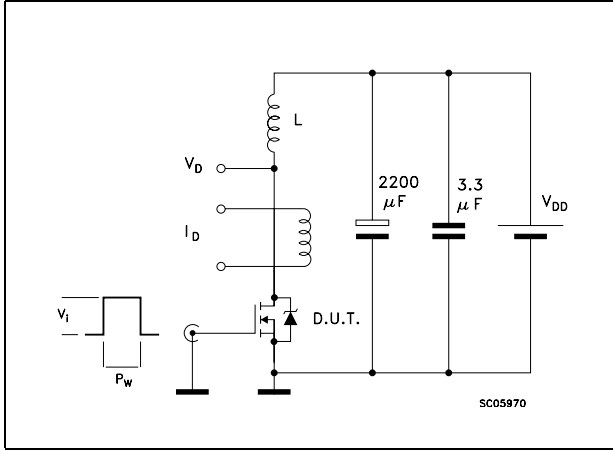


Figure 20. Unclamped inductive waveform

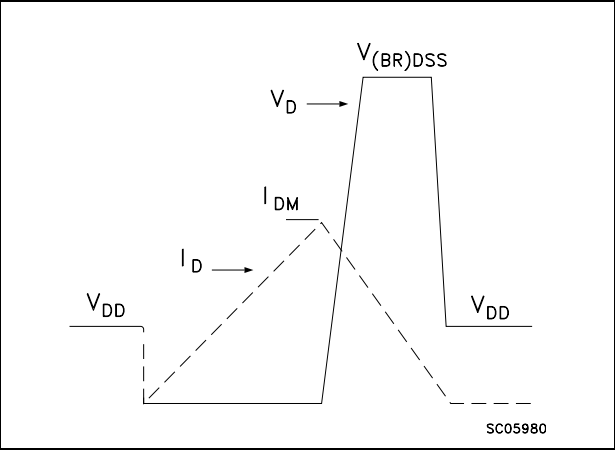


Figure 21. Switching times test circuit for resistive load

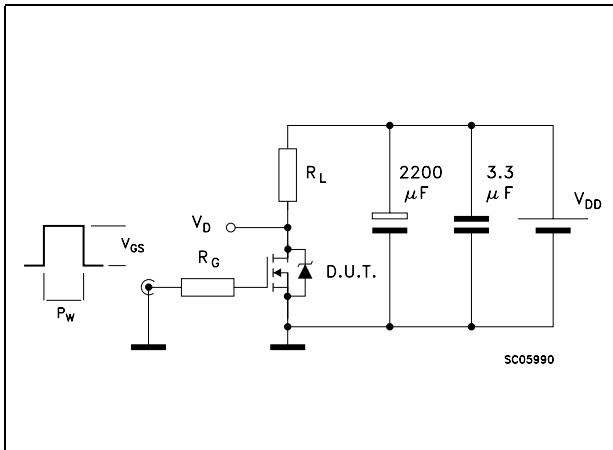


Figure 22. Gate charge test circuit

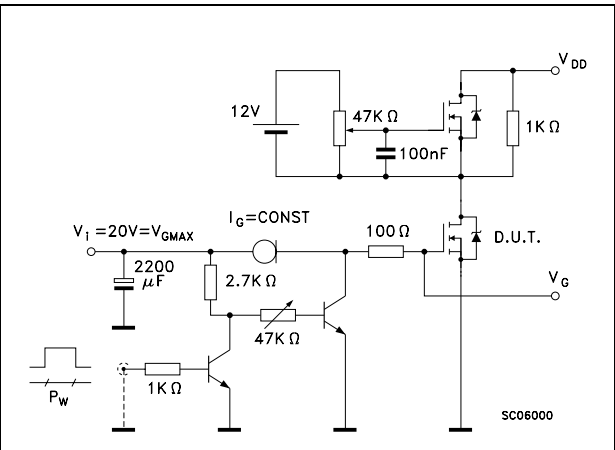
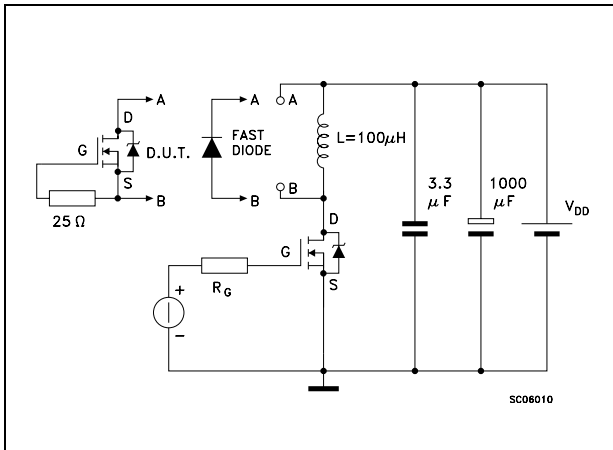


Figure 23. Test circuit for inductive load switching and diode recovery times

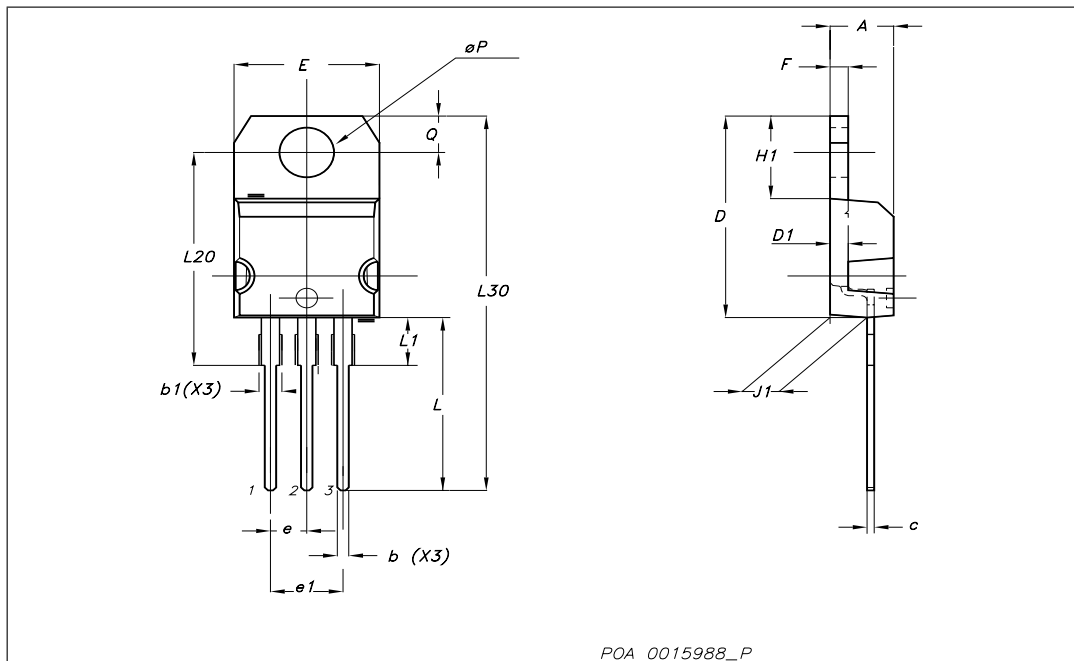


4 Package mechanical data

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

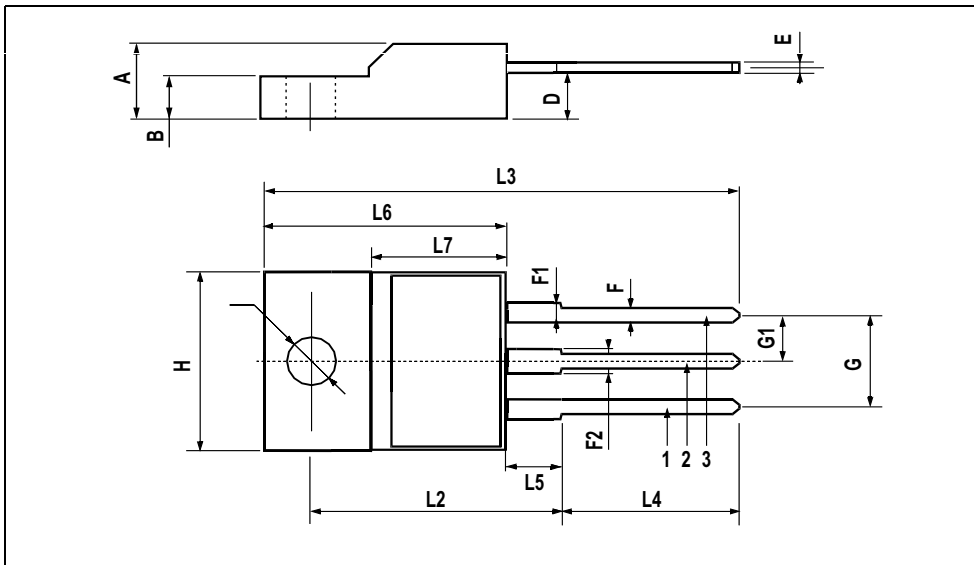
TO-220 mechanical data

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	1.14		1.70	0.044		0.066
c	0.49		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
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
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	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



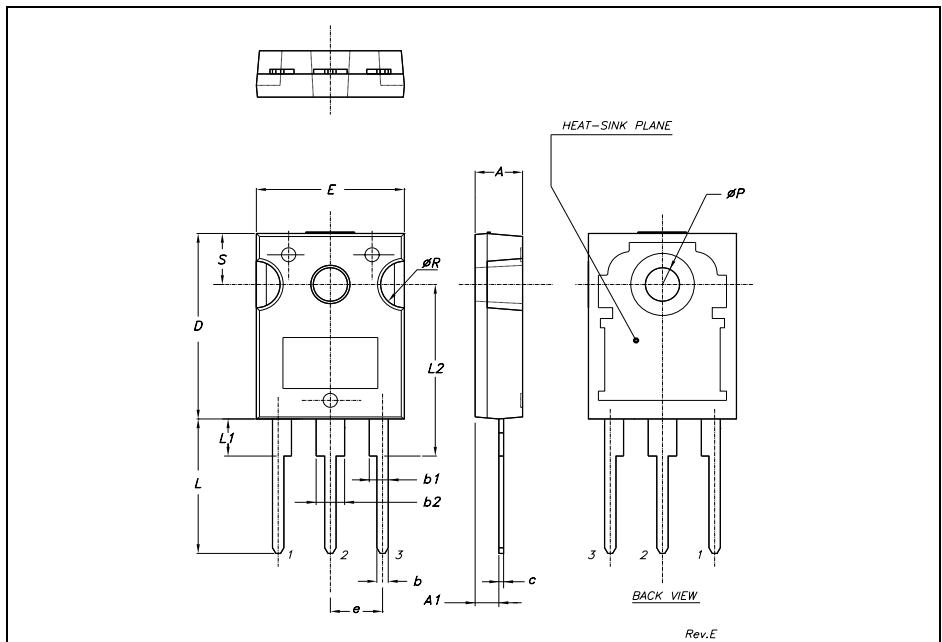
TO-220FP MECHANICAL DATA

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 Revision history

Table 9. Revision history

Date	Revision	Changes
09-Sep-2004	2	Complete version
17-Aug-2006	3	New template, no content change
20-Apr-2007	4	Typo errors on Table 6
02-Jul-2007	5	Table 2 has been updated

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