



STP2NK90Z - STD2NK90Z STD2NK90Z-1

N-channel 900V - 5Ω - 2.1A - TO-220 /DPAK/IPAK
Zener-Protected SuperMESH™ MOSFET

General features

Type	V _{DSS} (@T _{Jmax})	R _{DS(on)}	I _D	P _W
STD2NK90Z	900V	<6.5Ω	2.1A	70W
STD2NK90Z-1	900V	<6.5Ω	2.1A	70W
STP2NK90Z	900V	<6.5Ω	2.1A	70W

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

Description

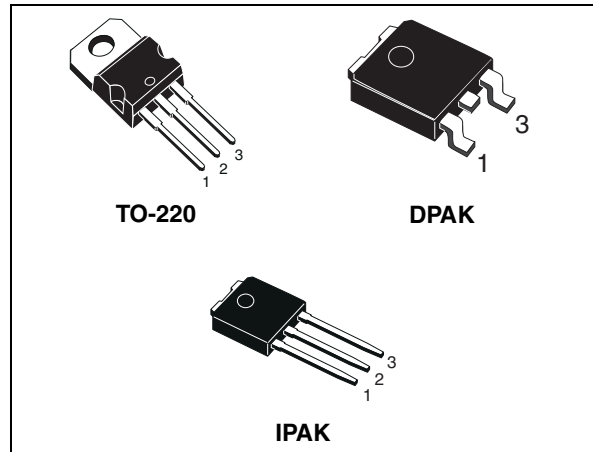
The SuperMESH™ series is obtained through an extreme optimization of ST's well established stripbased PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements ST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

Applications

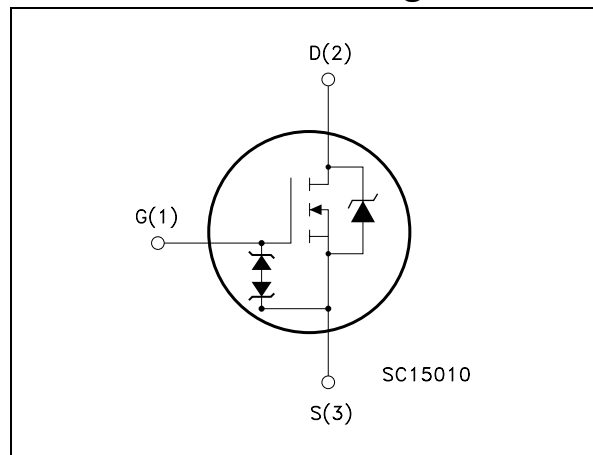
- Switching application

Order codes

Part number	Marking	Package	Packaging
STD2NK90ZT4	D2NK90Z	DPAK	Tape & reel
STD2NK90Z-1	D2NK90Z	IPAK	Tube
STP2NK90Z	P2NK90Z	TO-220	Tube



Internal schematic diagram



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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		STP2NK90Z	STD2NK90Z STD2NK90Z-1	
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	900		V
V_{DGR}	Drain-gate voltage ($R_{GS} = 20\text{ k}\Omega$)	900		V
V_{GS}	Gate- source Voltage	± 30		V
I_D	Drain current (continuous) at $T_C = 25^\circ\text{C}$	2.1		A
I_D	Drain current (continuous) at $T_C = 100^\circ\text{C}$	1.3		A
$I_{DM}^{(1)}$	Drain current (pulsed)	8.4		A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	70		W
	Derating factor	0.56		W/ $^\circ\text{C}$
$V_{ESD(G-S)}$	Gate source ESD(HBM-C=100pF, R=1.5K Ω)	2000		V
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5		V/ns
T_j	Operating junction temperature	-55 to 150		$^\circ\text{C}$
T_{stg}	Storage temperature	-55 to 150		$^\circ\text{C}$

1. Pulse width limited by safe operating area

2. $I_{SD} \leq 1\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
Rthj-case	Thermal resistance junction-case max	1.78	$^\circ\text{C}/\text{W}$
Rthj-amb	Thermal resistance junction-ambient max	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_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	2.1	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	150	mJ

Table 4. Gate-source zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
BV _{GSO}	Gate-source breakdown voltage	I _{gs} =± 1mA (open drain)	30			V

1.1 Protection features of gate-to-source zener diodes

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 Electrical characteristics

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

Table 5. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown Voltage	$I_D = 1 \text{ mA}$, $V_{GS} = 0$	900			V
I_{DSS}	Zero gate voltage Drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}$, $T_C = 125^{\circ}\text{C}$			1 50	μA μA
I_{GSS}	Gate-body Leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20 \text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 50 \mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10 \text{ V}$, $I_D = 1.05 \text{ A}$		5	6.5	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15 \text{ V}$, $I_D = 1.05 \text{ A}$		2.3		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25 \text{ V}$, $f = 1 \text{ MHz}$, $V_{GS} = 0$		485 50 10		pF pF pF
$C_{oss \text{ eq}}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0 \text{ V}$, $V_{DS} = 0 \text{ to } 720 \text{ V}$		24		pF
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 720 \text{ V}$, $I_D = 2 \text{ A}$, $V_{GS} = 10 \text{ V}$ (see Figure 22)		19.5 3.4 10.8	27	nC nC nC

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. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 450 \text{ V}$, $I_D = 1 \text{ A}$, $R_G = 4.7 \Omega$, $V_{GS} = 10 \text{ V}$ (see Figure 19)		21		ns
t_r	Rise time			11		ns
$t_{d(off)}$	Turn-off delay time			43		ns
t_f	Fall time			40		ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current				2.1	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				8.4	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 2.1 \text{ A}$, $V_{GS} = 0$			1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 2 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 50\text{V}$ (see Figure 20)		415		ns
Q_{rr}	Reverse recovery charge			1.5		μC
I_{RRM}	Reverse recovery current			7.2		A
t_{rr}	Reverse recovery time	$I_{SD} = 2 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 50\text{V}$, $T_j = 150^\circ\text{C}$ (see Figure 20)		515		ns
Q_{rr}	Reverse recovery charge			1.9		μC
I_{RRM}	Reverse recovery current			7.5		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

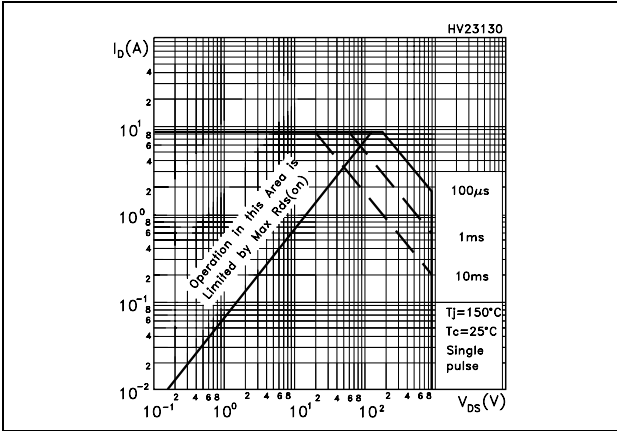


Figure 2. Thermal impedance for TO-220/ DPAK/ D²PAK

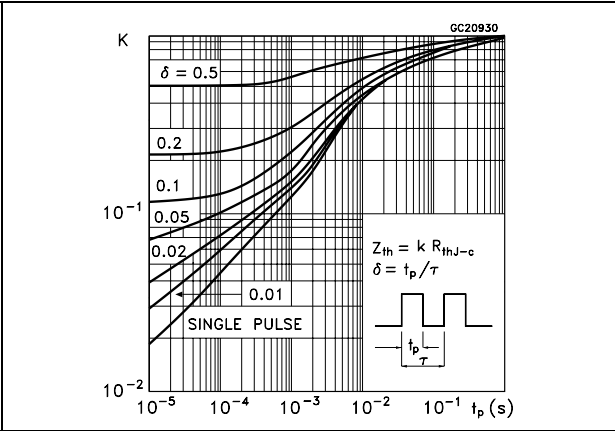


Figure 3. Safe operating area for TO-220FP

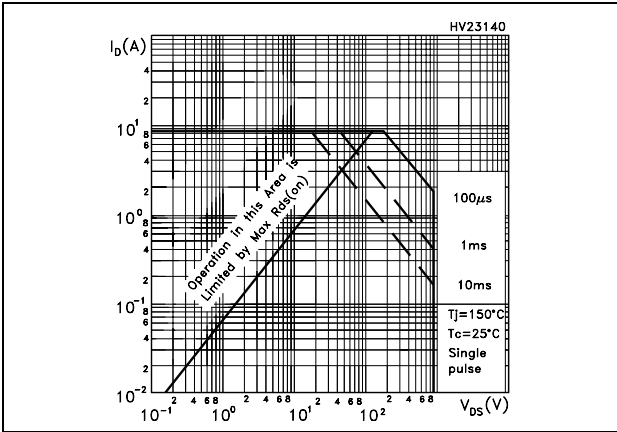


Figure 4. Thermal impedance for TO-220FP

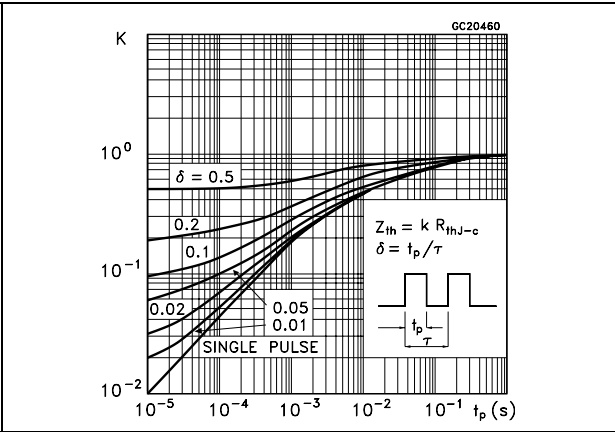


Figure 5. Output characteristics

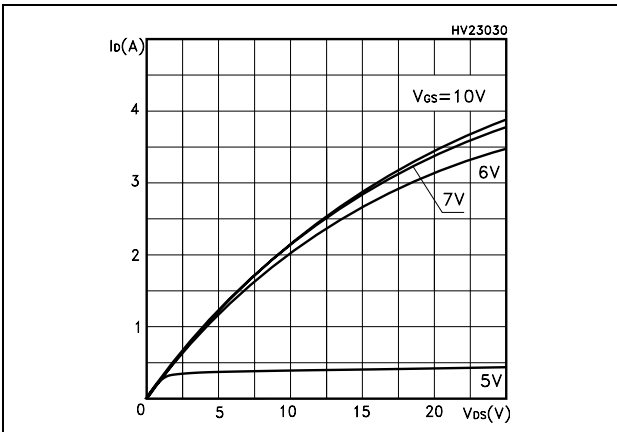


Figure 6. Transfer characteristics

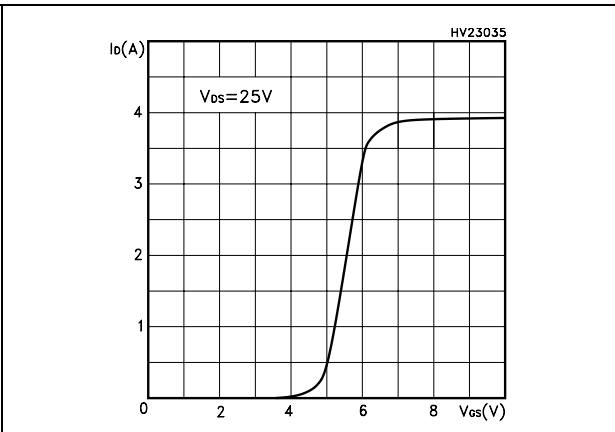


Figure 7. Transconductance

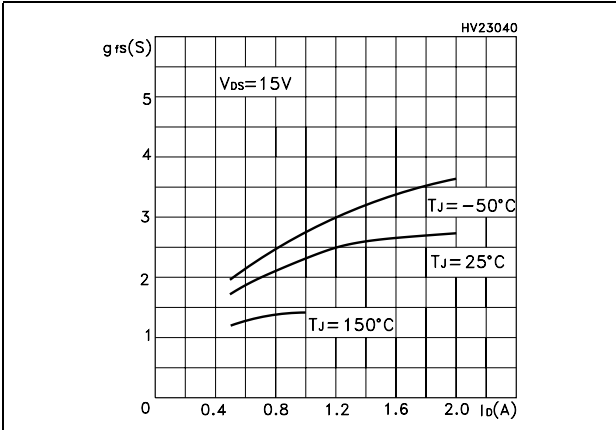


Figure 8. Static drain-source on resistance

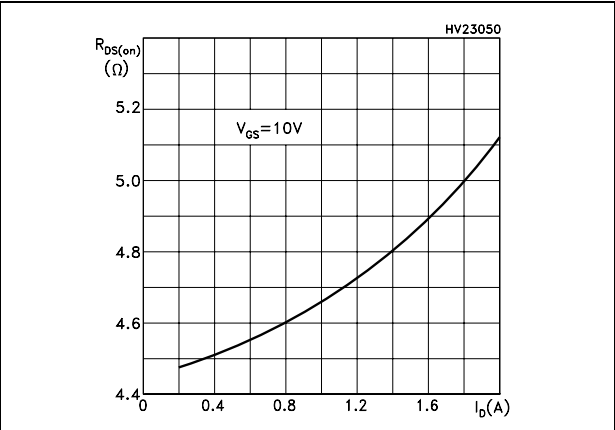


Figure 9. Gate charge vs gate-source voltage

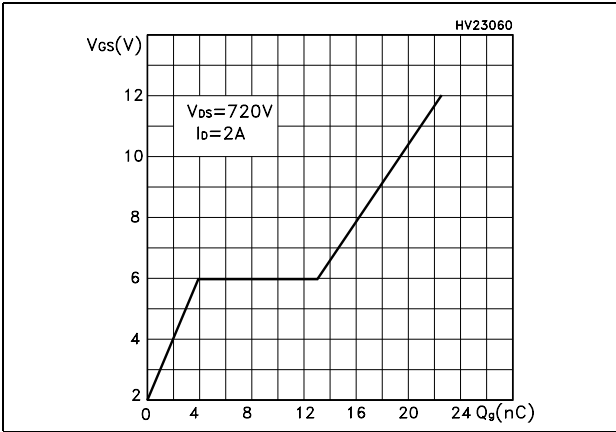


Figure 10. Capacitance variations

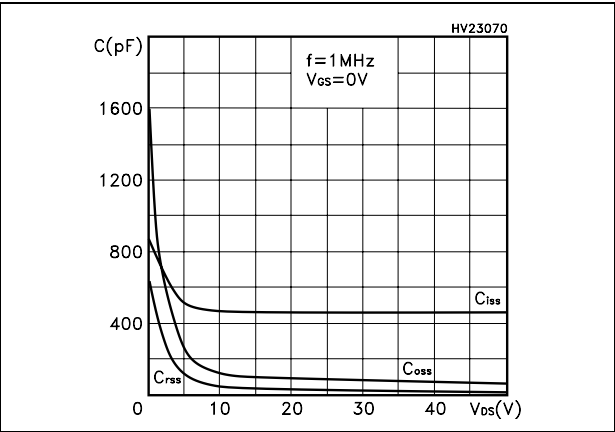


Figure 11. Normalized gate threshold voltage vs temperature

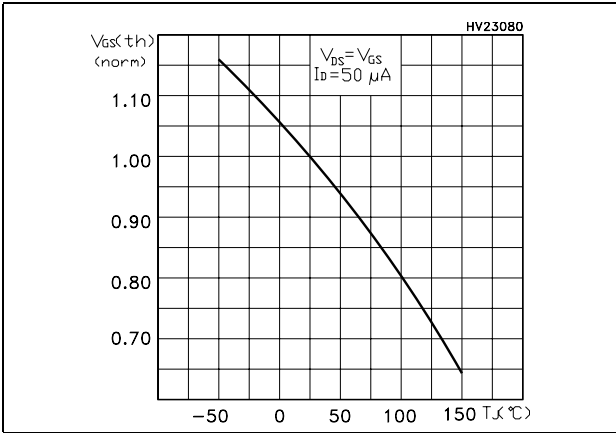


Figure 12. Normalized on resistance vs temperature

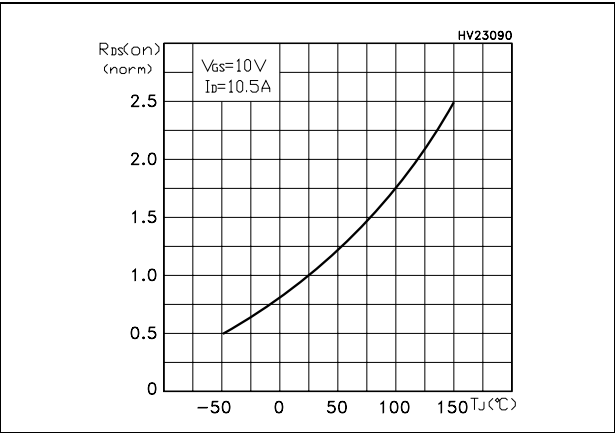


Figure 13. Source-drain diode forward characteristics

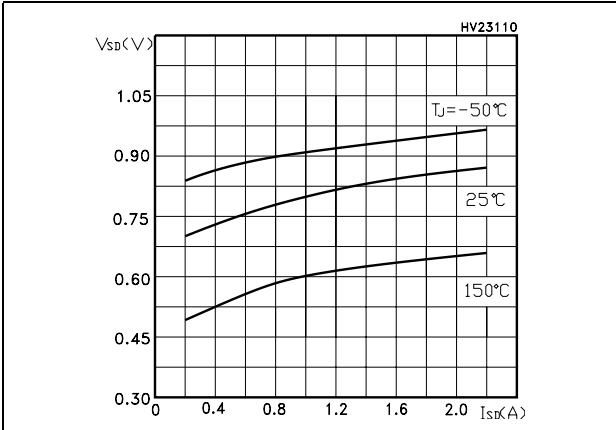


Figure 14. Normalized B_{VDSS} vs temperature

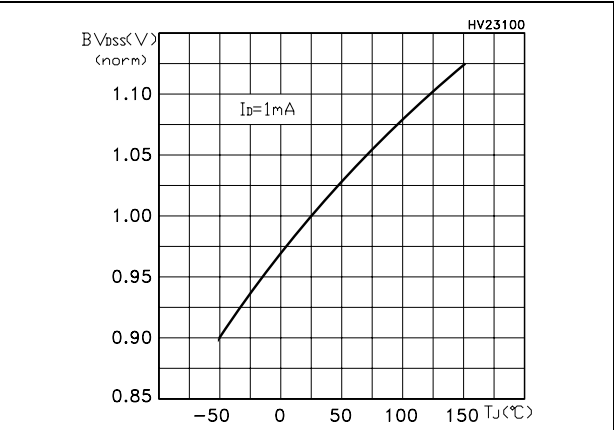
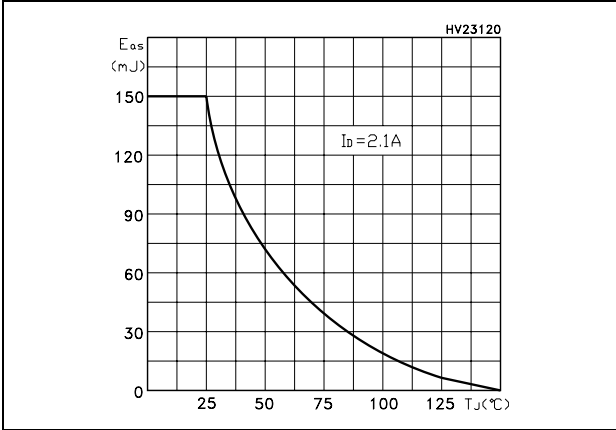


Figure 15. Maximum avalanche energy vs temperature



3 Test circuit

Figure 16. Switching times test circuit for resistive load

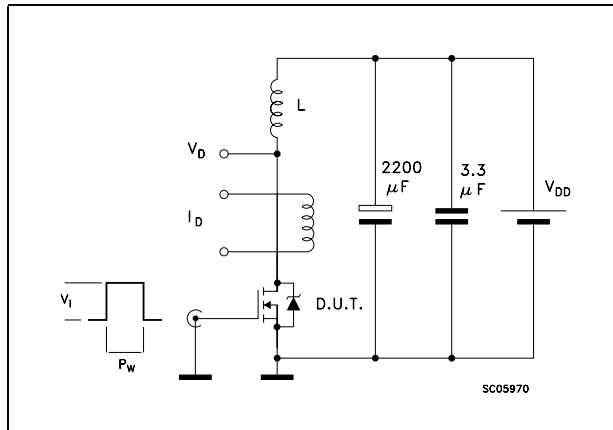


Figure 17. Gate charge test circuit

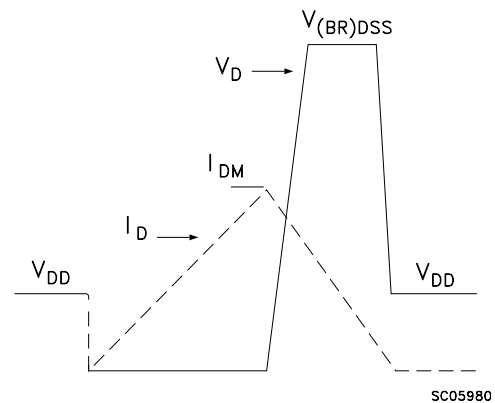


Figure 18. Test circuit for inductive load switching and diode recovery times

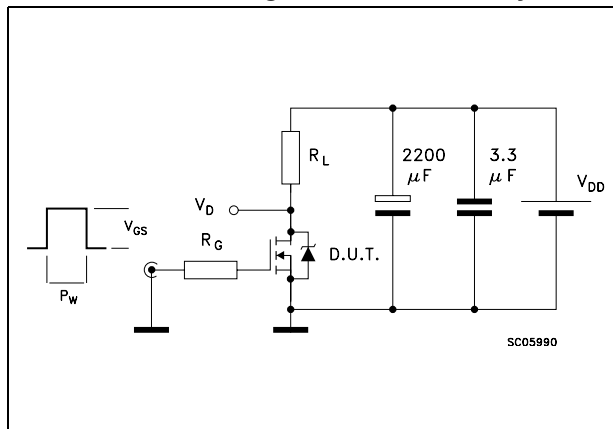


Figure 19. Unclamped Inductive load test circuit

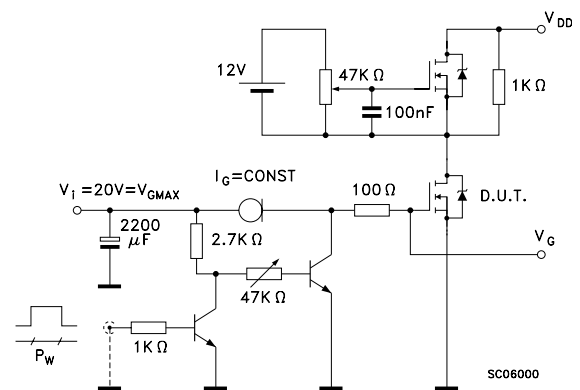
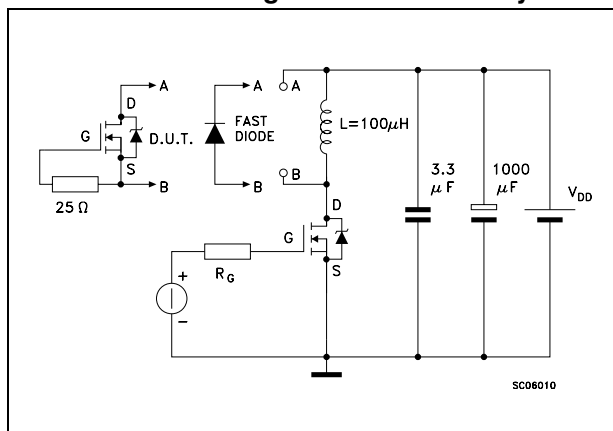


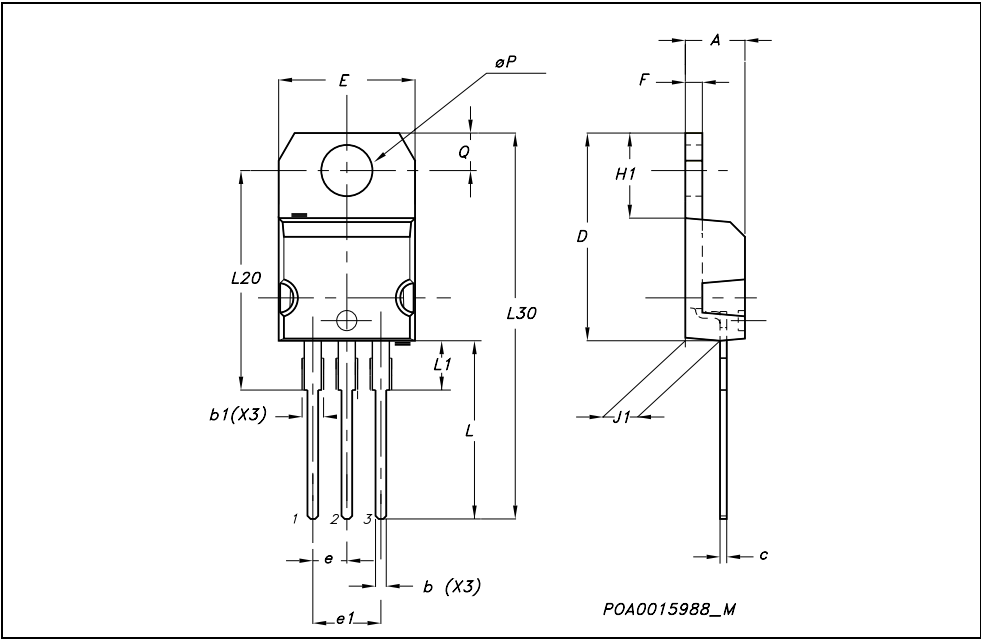
Figure 20. Test circuit for inductive load switching and diode recovery times



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	1.15		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-251 (IPAK) MECHANICAL DATA						
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	15.9		16.3	0.626		0.641
L	9		9.4	0.354		0.370
L1	0.8		1.2	0.031		0.047
L2		0.8	1		0.031	0.039

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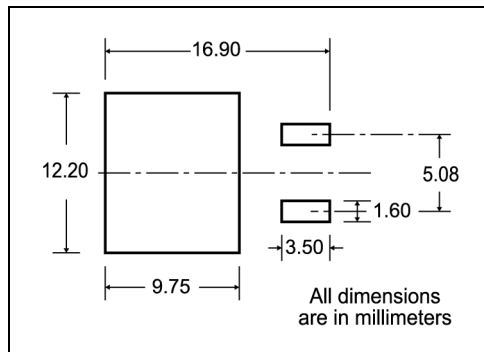
DPAK MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.9	0.025		0.035
b4	5.2		5.4	0.204		0.212
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
D1		5.1			0.200	
E	6.4		6.6	0.252		0.260
E1		4.7			0.185	
e		2.28			0.090	
e1	4.4		4.6	0.173		0.181
H	9.35		10.1	0.368		0.397
L	1			0.039		
(L1)		2.8			0.110	
L2		0.8			0.031	
L4	0.6		1	0.023		0.039
R		0.2			0.008	
V2	0°		8°	0°		8°

The mechanical drawing illustrates the DPAK package geometry. It includes a top view showing dimensions E, b4, L2, L4, H, e, e1, and b(2x). A side view shows dimensions A, c2, D, A1, R, and c. A detail view of the lead shows dimensions A2, L, (L1), V2, and a gauge plane at 0.25. A thermal pad is also indicated on the top view.

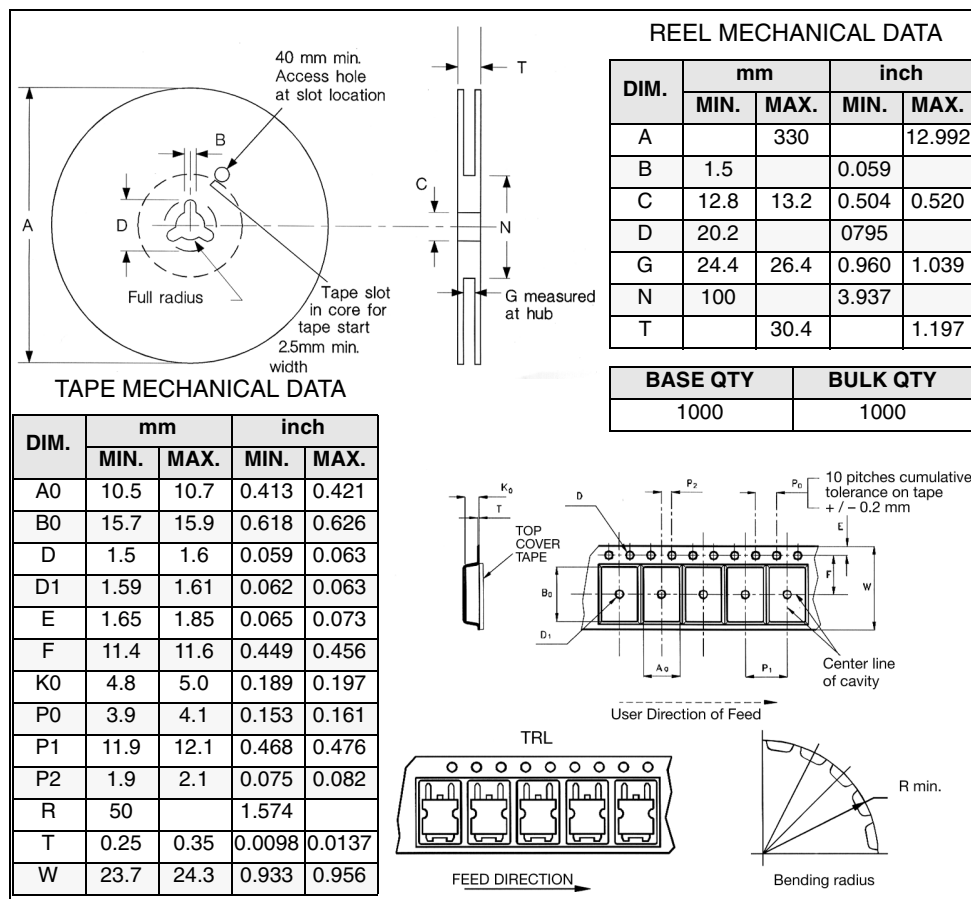
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5 Packing mechanical data

D²PAK FOOTPRINT

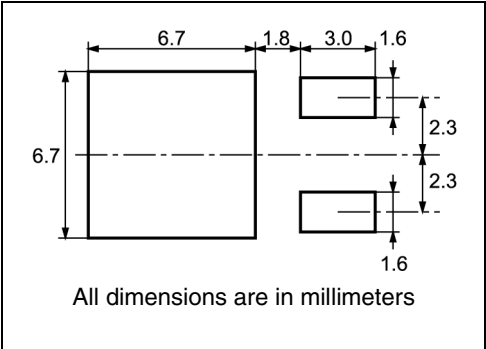


TAPE AND REEL SHIPMENT

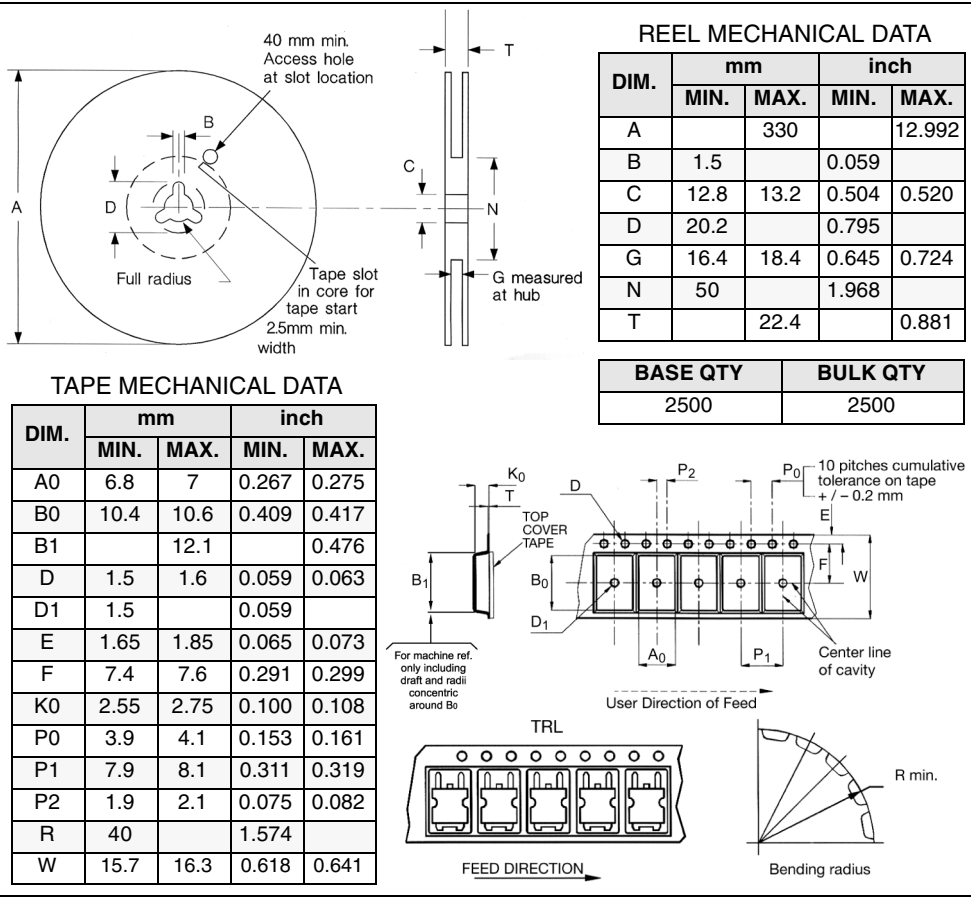


* on sales type

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT



6 Revision history

Table 9. Revision history

Date	Revision	Changes
06-Oct-2004	1	First version
08-Sep-2005	2	Complete version
05-Mar-2006	3	Inserted Ecopack indication
27-Jul-2006	4	New template, no content change

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