



# STQ1NK80ZR-AP - STN1NK80Z STD1NK80Z - STD1NK80Z-1

N-CHANNEL 800V - 13  $\Omega$  - 1 A TO-92 /SOT-223/DPAK/IPAK  
Zener - Protected SuperMESH™ MOSFET

**Table 1: General Features**

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>w</sub>
STQ1NK80ZR-AP	800 V	< 16 $\Omega$	0.3 A	3 W
STN1NK80Z	800 V	< 16 $\Omega$	0.25A	2.5 W
STD1NK80Z	800 V	< 16 $\Omega$	1.0 A	45 W
STD1NK80Z-1	800 V	< 16 $\Omega$	1.0 A	45 W

- TYPICAL R<sub>DS(on)</sub> = 13 $\Omega$
- EXTREMELY HIGH dv/dt CAPABILITY
- ESD IMPROVED CAPABILITY
- 100% AVALANCHE TESTED
- NEW HIGH VOLTAGE BENCHMARK
- GATE CHARGE MINIMIZED

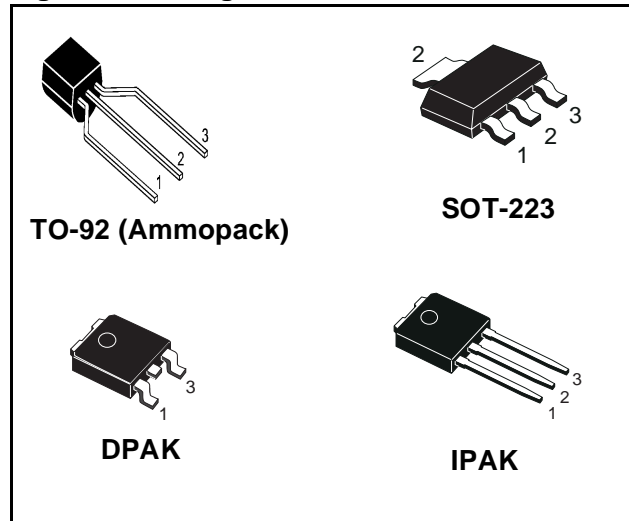
## DESCRIPTION

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.

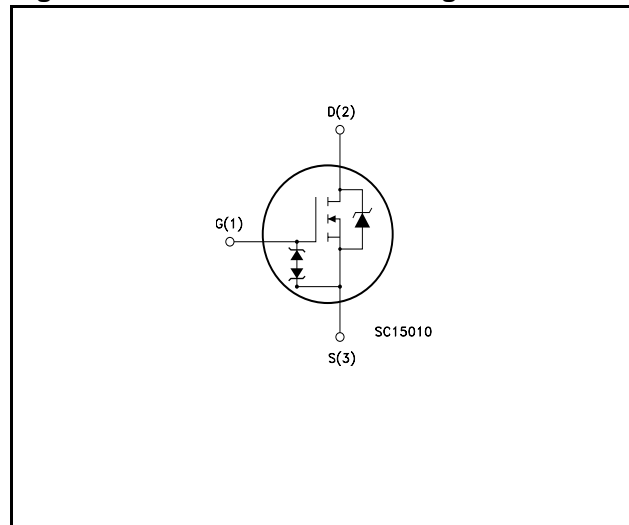
## APPLICATIONS

- AC ADAPTORS AND BATTERY CHARGERS
- SWITCH MODE POWER SUPPLIES (SMPS)

**Figure 1: Package**



**Figure 2: Internal Schematic Diagram**



**Table 2: Order Codes**

SALES TYPE	MARKING	PACKAGE	PACKAGING
STQ1NK80ZR-AP	Q1NK80ZR	TO-92	AMMOPAK
STN1NK80Z	N1NK80Z	SOT-223	TAPE & REEL
STD1NK80ZT4	D1NK80Z	DPAK	TAPE & REEL
STD1NK80Z-1	D1NK80Z	IPAK	TUBE

**Table 3: Absolute Maximum ratings**

Symbol	Parameter	Value			Unit
		TO-92	SOT-223	DPAK/IPAK	
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	800			V
V <sub>DGR</sub>	Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)	800			V
V <sub>GS</sub>	Gate- source Voltage	± 30			V
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 25°C	0.3	0.25	1.0	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	0.19	0.16	0.63	A
I <sub>DM</sub> (●)	Drain Current (pulsed)	5			A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 25°C	3	2.5	45	W
	Derating Factor	0.025	0.02	0.36	W/°C
V <sub>ESD(G-S)</sub>	Gate source ESD (HBM-C= 100pF, R= 1.5KΩ)	1000			V
dv/dt (1)	Peak Diode Recovery voltage slope	4.5			V/ns
T <sub>j</sub> T <sub>stg</sub>	Operating Junction Temperature Storage Temperature	-55 to 150			°C

(●) Pulse width limited by safe operating area  
 (1) I<sub>SD</sub> ≤ 1 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ 640

**Table 4: Thermal Data**

		TO-92	SOT-223	DPAK/IPAK	Unit
R <sub>thj-case</sub>	Thermal Resistance Junction-case Max	--	--	2.78	°C/W
R <sub>thj-amb</sub> (#)	Thermal Resistance Junction-ambient Max	120	50	100	°C/W
R <sub>thj-lead</sub>	Thermal Resistance Junction-lead Max	40	--	--	°C/W
T <sub>l</sub>	Maximum Lead Temperature For Soldering Purpose	260	--	300	°C

(#) When mounted on 1inch<sup>2</sup> FR-4 BOARD, 2 oz Cu

**Table 5: Avalanche Characteristics**

Symbol	Parameter	Max Value	Unit
I <sub>AR</sub>	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T <sub>j</sub> max)	1	A
E <sub>AS</sub>	Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V)	50	mJ

**Table 6: GATE-SOURCE ZENER DIODE**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
BV <sub>GSO</sub>	Gate-Source Breakdown Voltage	I <sub>gs</sub> =± 1mA (Open Drain)	30			V

**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.



**ELECTRICAL CHARACTERISTICS** ( $T_{CASE} = 25^{\circ}C$  UNLESS OTHERWISE SPECIFIED)

**Table 7: On/Off**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 1 \text{ mA}, V_{GS} = 0$	800			V
$I_{DSS}$	Zero Gate Voltage Drain Current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}, T_C = 125^{\circ}C$			1 50	$\mu A$ $\mu A$
$I_{GSS}$	Gate-body Leakage Current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20V$			$\pm 10$	$\mu A$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 50 \mu A$	3	3.75	4.5	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10V, I_D = 0.5 \text{ A}$		13	16	$\Omega$

**Table 8: Dynamic**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs}$ (1)	Forward Transconductance	$V_{DS} = 15 \text{ V}, I_D = 0.5 \text{ A}$		0.8		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GS} = 0$		160 26 6.7		pF pF pF
$C_{oss \text{ eq.}}$ (3)	Equivalent Output Capacitance	$V_{GS} = 0V, V_{DS} = 0V \text{ to } 640V$		9.5		pF
$t_{d(on)}$ $t_r$ $t_{d(off)}$ $t_f$	Turn-on Delay Time Rise Time Turn-off Delay Time Fall Time	$V_{DD} = 400 \text{ V}, I_D = 0.5 \text{ A}$ $R_G = 4.7\Omega, V_{GS} = 10 \text{ V}$ (see Figure 21)		8 30 22 55		ns ns ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 640V, I_D = 1.0 \text{ A},$ $V_{GS} = 10V$ (see Figure 24)		7.7 1.4 4.5		nC nC nC

**Table 9: Source Drain Diode**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}$ (2)	Source-drain Current Source-drain Current (pulsed)				1.0 5	A A
$V_{SD}$ (1)	Forward On Voltage	$I_{SD} = 1.0 \text{ A}, V_{GS} = 0$			1.6	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 1.0 \text{ A}, di/dt = 100 \text{ A}/\mu s$ $V_{DD} = 50 \text{ V}, T_j = 25^{\circ}C$ (see Figure 22)		365 802 4.4		ns nC A
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 1.0 \text{ A}, di/dt = 100 \text{ A}/\mu s$ $V_{DD} = 50 \text{ V}, T_j = 150^{\circ}C$ (see Figure 22)		388 802.7 4.6		ns nC A

Note: 1. Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5 %.

2. Pulse width limited by safe operating area.

3.  $C_{oss \text{ eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

Figure 3: Safe Operating Area for SOT-223

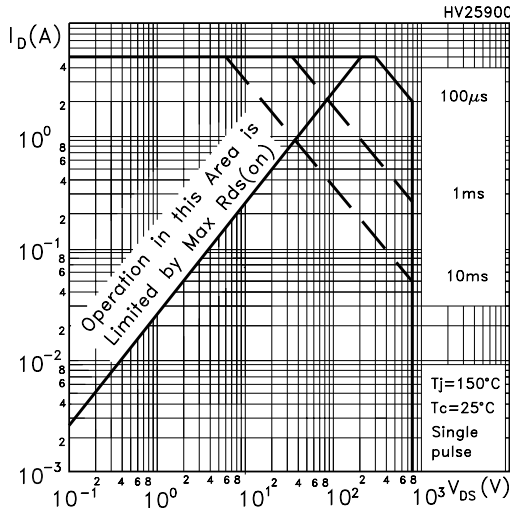


Figure 4: Safe Operating Area for TO-92

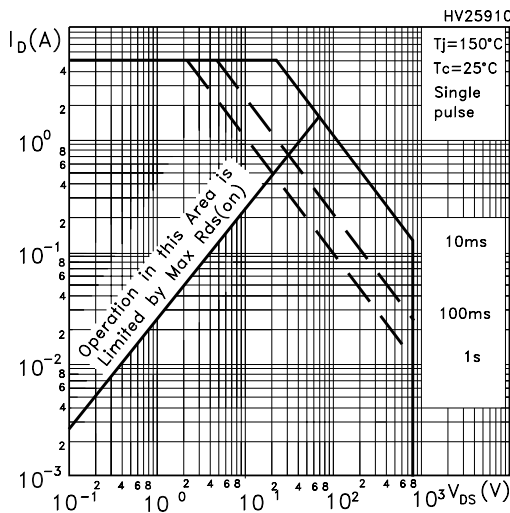


Figure 5: Safe Operating Area for IPAK-DPAK

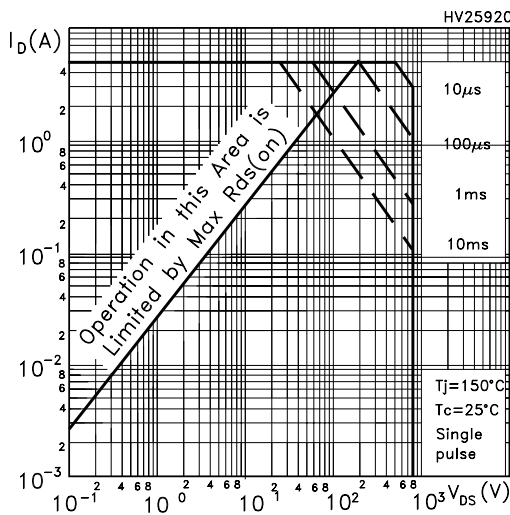


Figure 6: Thermal Impedance for SOT-223

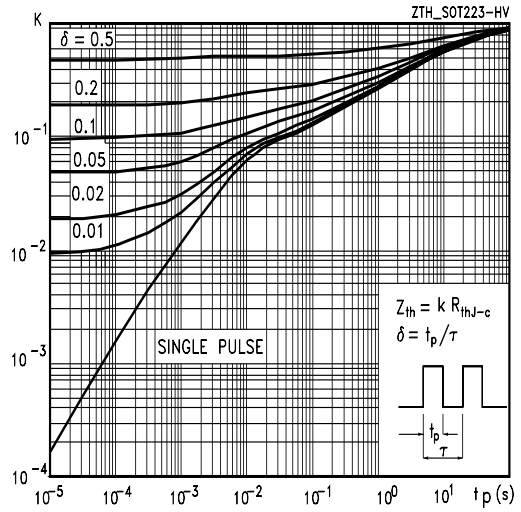


Figure 7: Thermal Impedance for TO-92

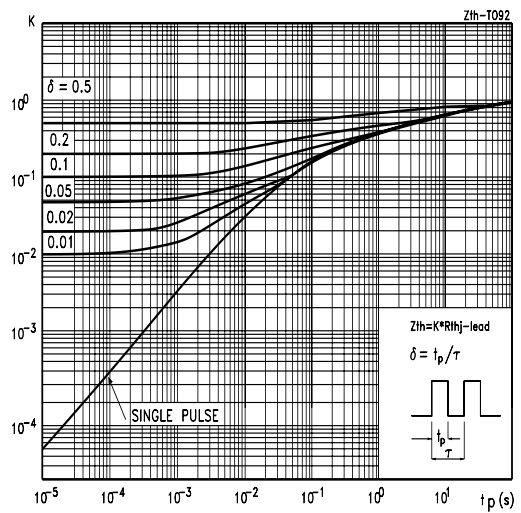


Figure 8: Thermal Impedance for DPAK-IPAK

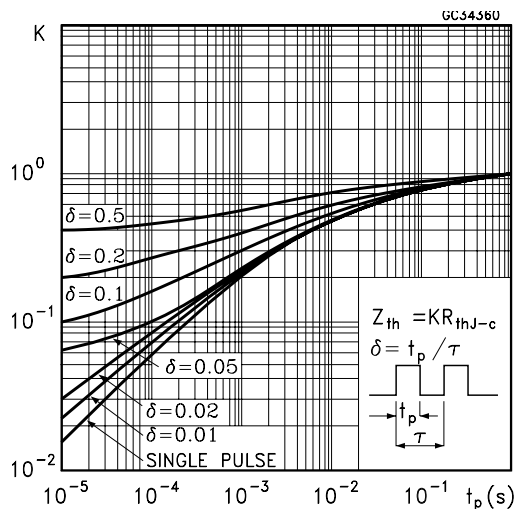


Figure 9: Output Characteristics

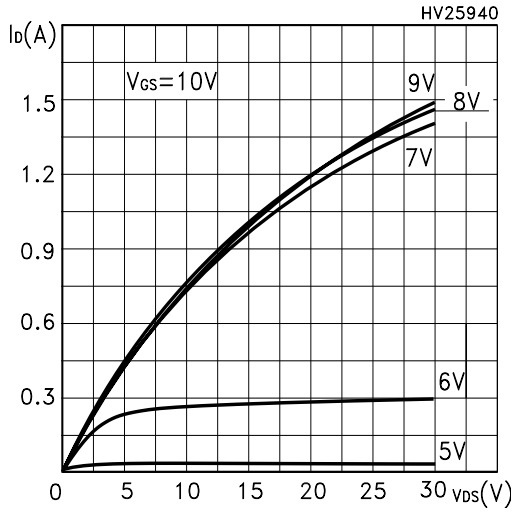


Figure 10: Transconductance

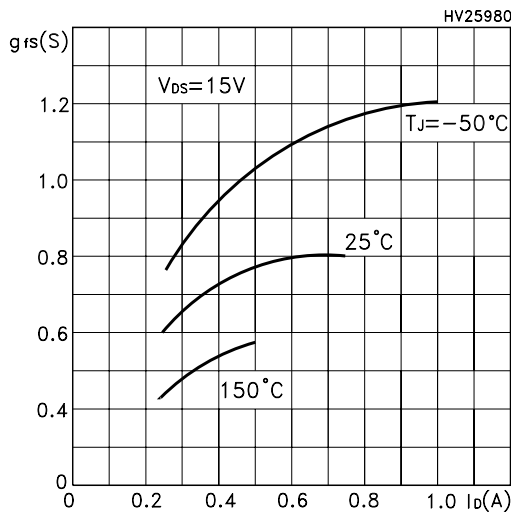


Figure 11: Gate Charge vs Gate-source Voltage

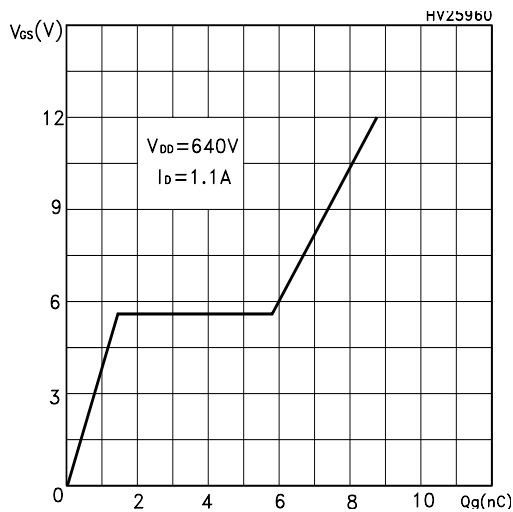


Figure 12: Transfer Characteristics

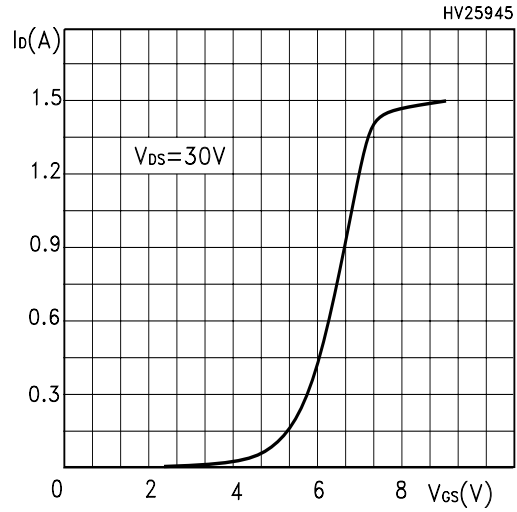


Figure 13: Static Drain-source On Resistance

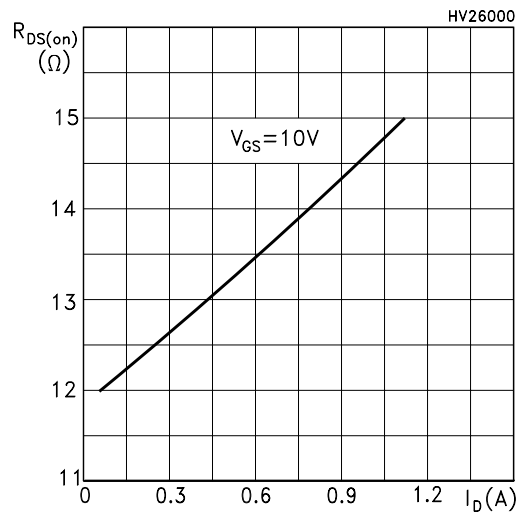


Figure 14: Capacitance Variations

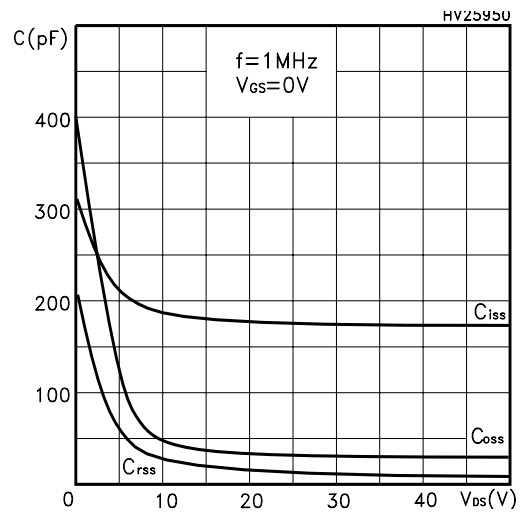


Figure 15: Normalized Gate Threshold Voltage vs Temperature

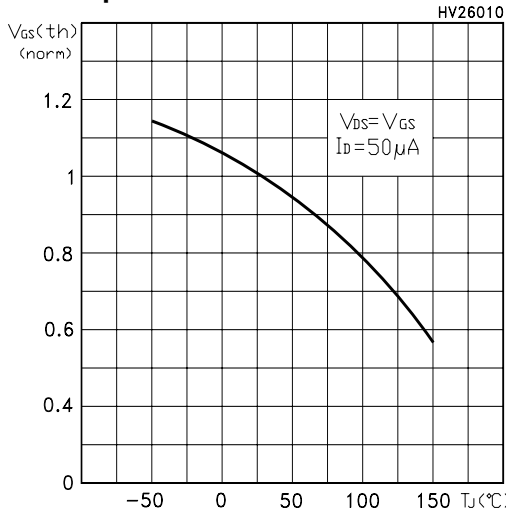


Figure 18: Normalized On Resistance vs Temperature

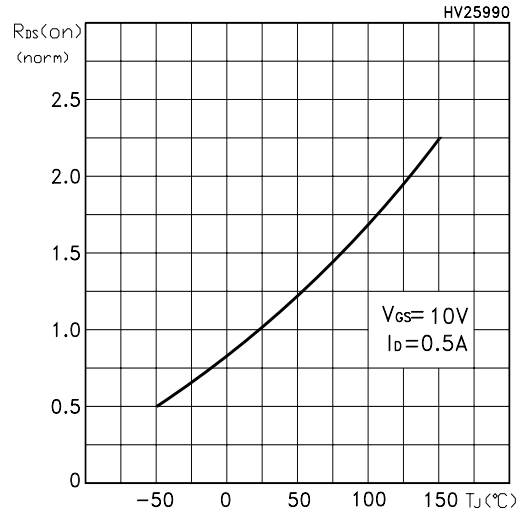


Figure 16: Source-Drain Diode Forward Characteristics

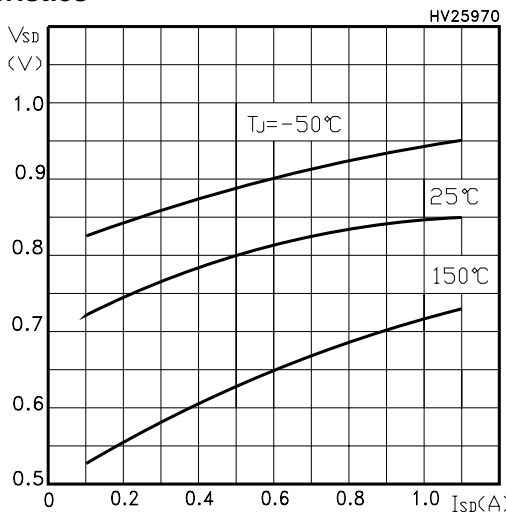


Figure 19: Normalized BVdss vs Temperature

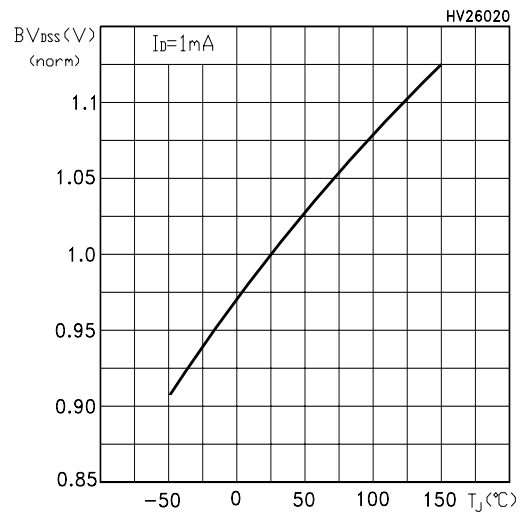


Figure 17: Avalanche Energy vs Starting Tj

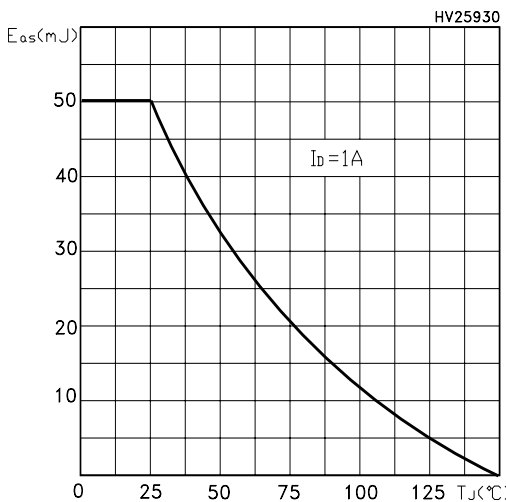


Figure 20: Unclamped Inductive Load Test Circuit

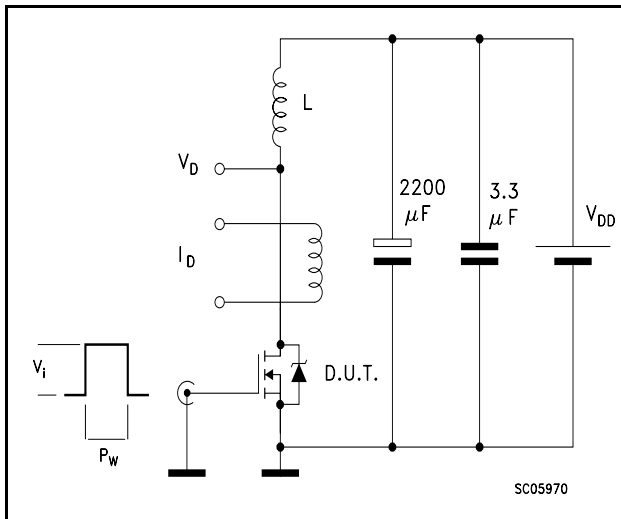


Figure 21: Switching Times Test Circuit For Resistive Load

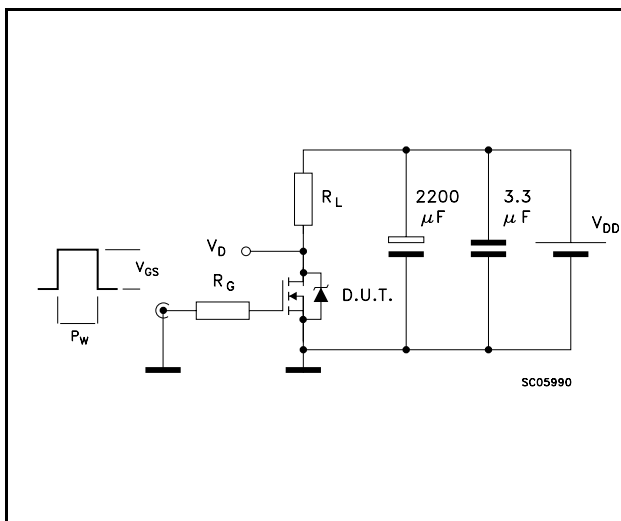


Figure 22: Test Circuit For Inductive Load Switching and Diode Recovery Times

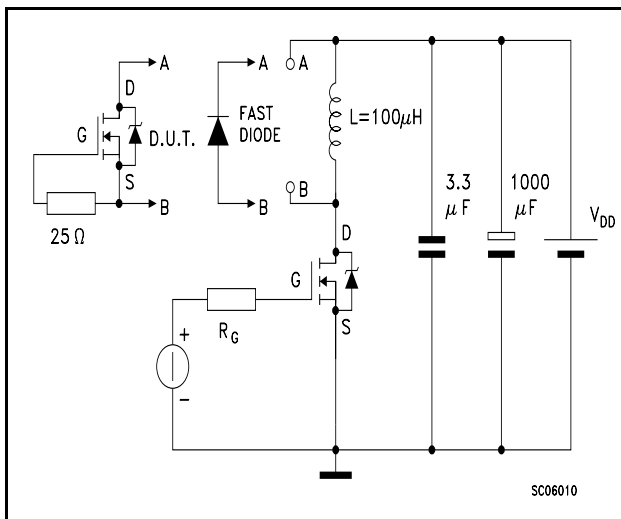


Figure 23: Unclamped Inductive Wavform

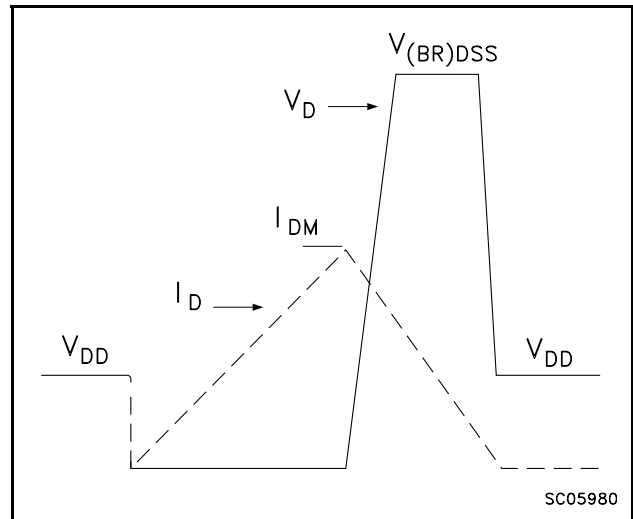
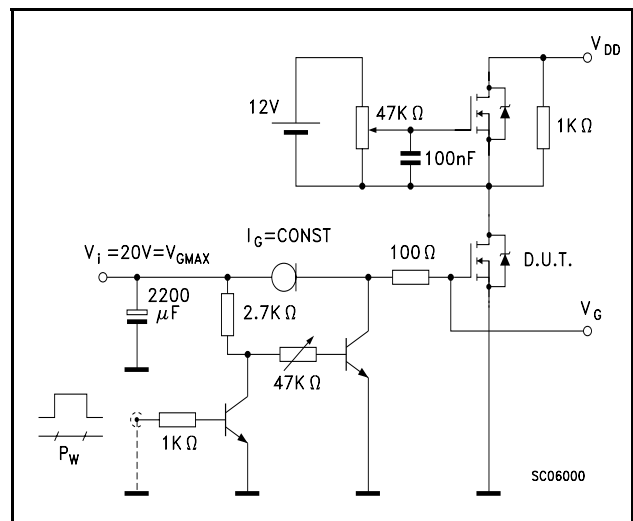


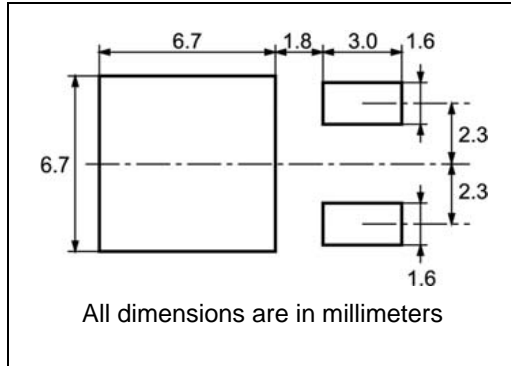
Figure 24: Gate Charge Test Circuit



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](http://www.st.com)



**DPAK FOOTPRINT**



**TAPE AND REEL SHIPMENT**

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

G measured at hub

**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	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

**TAPE MECHANICAL DATA**

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	6.8	7	0.267	0.275
B0	10.4	10.6	0.409	0.417
B1		12.1		0.476
D	1.5	1.6	0.059	0.063
D1	1.5		0.059	
E	1.65	1.85	0.065	0.073
F	7.4	7.6	0.291	0.299
K0	2.55	2.75	0.100	0.108
P0	3.9	4.1	0.153	0.161
P1	7.9	8.1	0.311	0.319
P2	1.9	2.1	0.075	0.082
R	40		1.574	
W	15.7	16.3	0.618	0.641

**BASE QTY** 2500      **BULK QTY** 2500

10 pitches cumulative tolerance on tape +/- 0.2 mm

User Direction of Feed

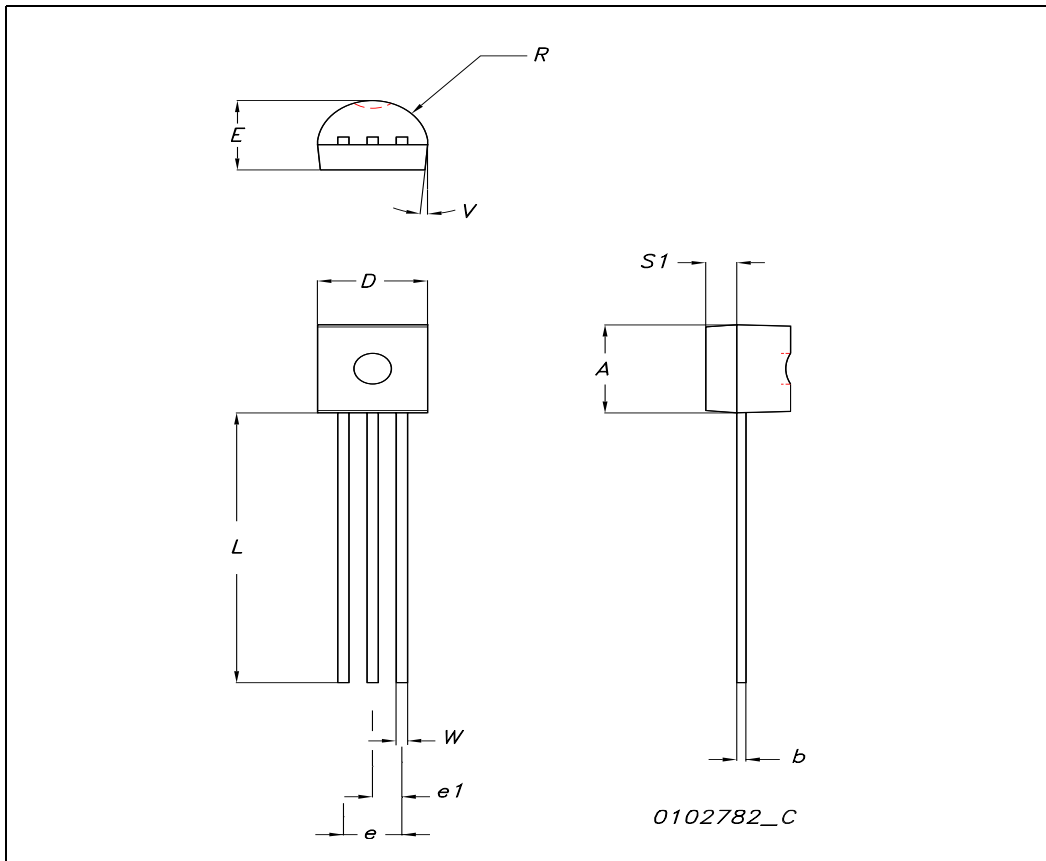
TRL

FEED DIRECTION

Bending radius R min.

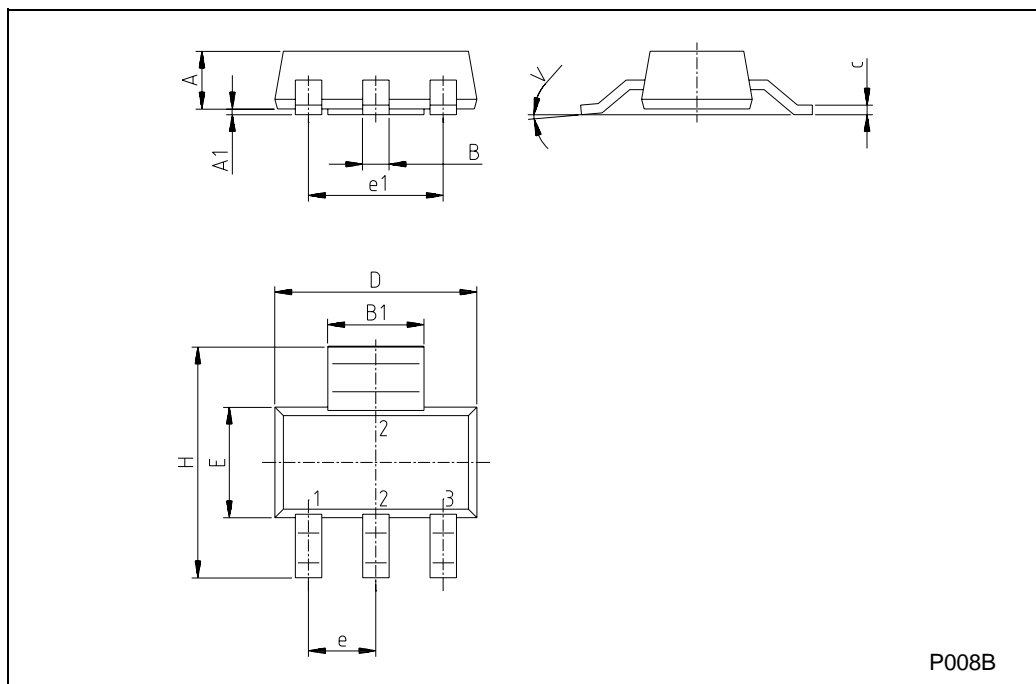
**TO-92 MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.32		4.95	0.170		0.194
b	0.36		0.51	0.014		0.020
D	4.45		4.95	0.175		0.194
E	3.30		3.94	0.130		0.155
e	2.41		2.67	0.094		0.105
e1	1.14		1.40	0.044		0.055
L	12.70		15.49	0.50		0.610
R	2.16		2.41	0.085		0.094
S1	0.92		1.52	0.036		0.060
W	0.41		0.56	0.016		0.022
V		5°			5°	



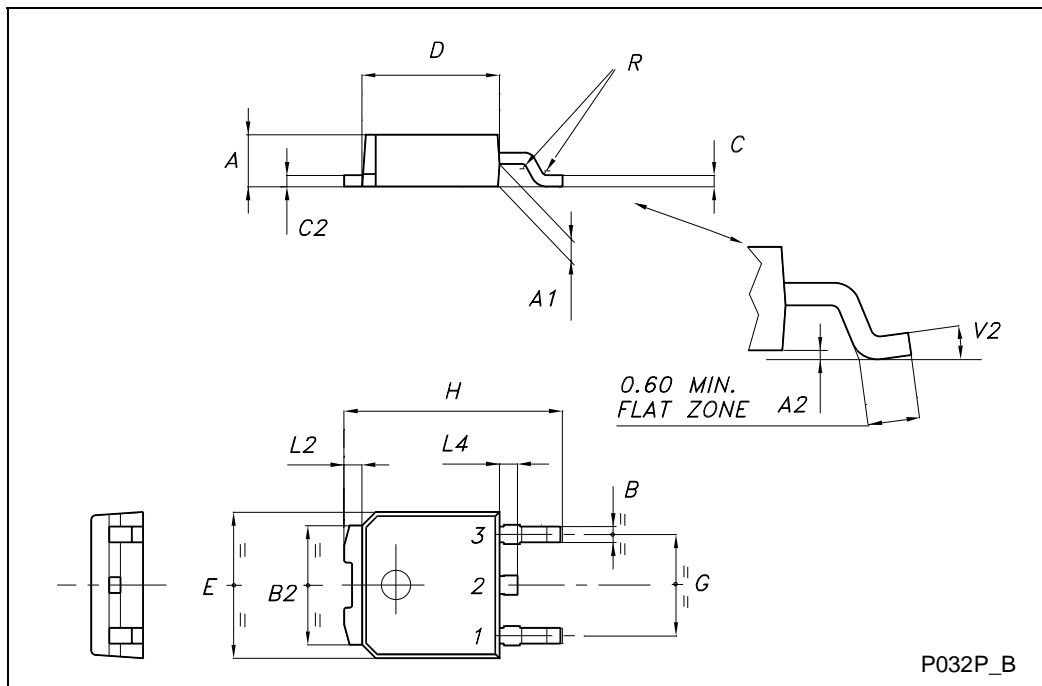
SOT-223 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.80			0.071
B	0.60	0.70	0.80	0.024	0.027	0.031
B1	2.90	3.00	3.10	0.114	0.118	0.122
c	0.24	0.26	0.32	0.009	0.010	0.013
D	6.30	6.50	6.70	0.248	0.256	0.264
e		2.30			0.090	
e1		4.60			0.181	
E	3.30	3.50	3.70	0.130	0.138	0.146
H	6.70	7.00	7.30	0.264	0.276	0.287
V			10°			10°
A1		0.02				



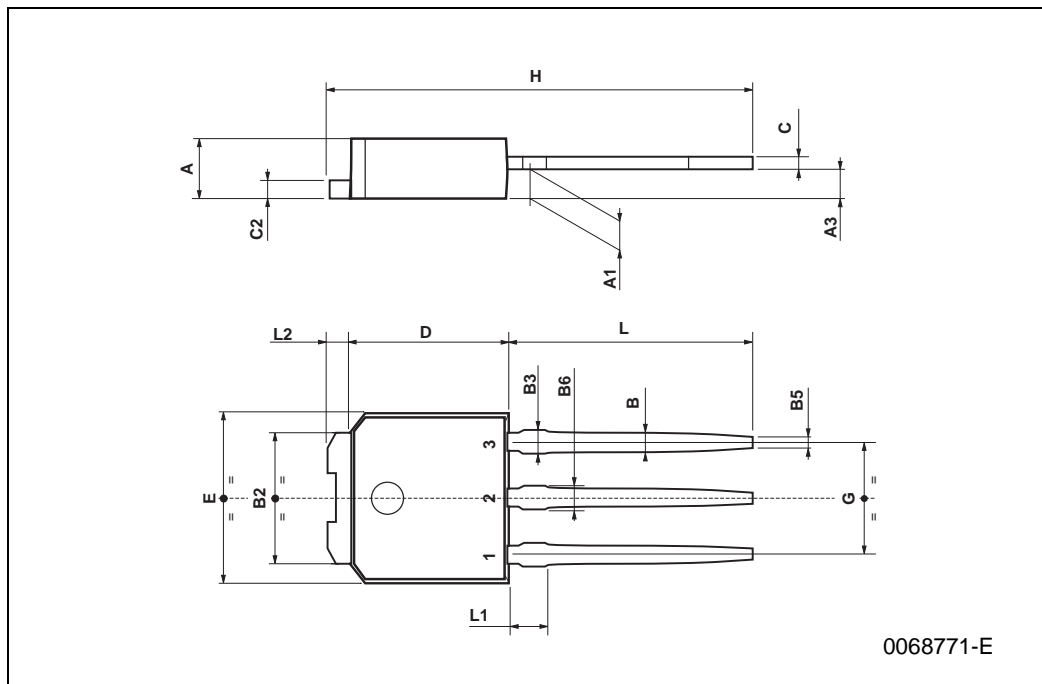
TO-252 (DPAK) MECHANICAL DATA

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-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



**Table 10: Revision History**

<b>Date</b>	<b>Revision</b>	<b>Description of Changes</b>
08-Jun-2005	1	First Release
06-Sep-2005	2	Inserted Ecopack indication
16-Jan-2006	3	Corrected value on Table 3

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