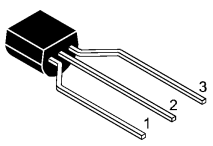
STD1LNK60Z-1
STQ1NK60ZR - STN1NK60Z

N-CHANNEL 600V - 13Ω - 0.8A - TO-92 - IPAK - SOT-223
Zener-Protected SuperMESH™ Power MOSFET

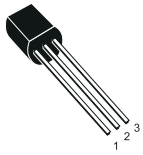
General features

Type	V_{DSS}	$R_{DS(on)}$	I_D	Pw
STD1LNK60Z-1	600V	<15Ω	0.8A	25W
STQ1NK60ZR	600V	<15Ω	0.3A	3W
STN1NK60Z	600V	<15Ω	0.3A	3.3W

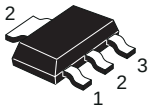
- 100% avalanche tested
- Extremely high dv/dt capability
- Gate charge minimized
- ESD improved capability
- New high voltage benchmark



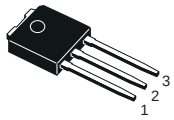
TO-92 (Ammopak)



TO-92



SOT-223

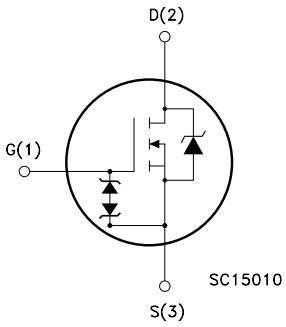


IPAK

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.

Internal schematic diagram



Applications

- Switching application

Order codes

Sales Type	Marking	Package	Packaging
STD1LNK60Z-1	D1LNK60Z	IPAK	TUBE
STQ1NK60ZR	Q1NK60ZR	TO-92	BULK
STQ1NK60ZR-AP	Q1NK60ZR	TO-92	AMMOPAK
STN1NK60Z	1NK60Z	SOT-223	TAPE & REEL

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		IPAK	TO-92	SOT-223	
V_{DS}	Drain-Source Voltage (V_{GS} = 0)	600			V
V_{DGR}	Drain-Gate Voltage (R_{GS} = 20KΩ)	600			V
V_{GS}	Gate-Source Voltage	± 30			V
I_D	Drain Current (continuous) at T_C = 25°C	0.8	0.3	0.3	A
I_D	Drain Current (continuous) at T_C=100°C	0.5	0.189		A
I_{DM}(1)	Drain Current (pulsed)	3.2	1.2		A
P_{TOT}	Total Dissipation at T_C = 25°C	25	3	3.3	W
	Derating Factor	0.24	0.25	0.26	W/°C
$V_{ESD(G-D)}$	Gate source ESD(HBM-C=100pF, R=1.5KΩ)	800			V
dv/dt(2)	Peak Diode Recovery voltage slope	4.5			V/ns
T_J T_{stg}	Operating Junction Temperature Storage Temperature	-55 to 150			°C

1. Pulse width limited by safe operating area
2. I_{SD} ≤0.3A, di/dt ≤200A/µs, V_{DD} =80%$V_{(BR)DSS}$

Table 2. Thermal resistance

Symbol	Parameter	Value			Unit
		IPAK	TO-92	SOT-223	
$R_{thj\text{-}case}$	Thermal resistance junction-case Max	5	--	--	°C/W
$R_{thj\text{-}a}$	Thermal resistance junction-ambient Max	100	120	37.87(1)	°C/W
$R_{thj\text{-}lead}$	Thermal resistance junction-lead Max	--	40	--	°C/W
T_l	Maximum lead temperature for soldering purpose	275	260		°C

1. When mounted on 1 inch² FR-4 board, 2 Oz Cu

Table 3. Avalanche data

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche Curent, Repetitive or Noy-Repetitive (pulse width limited by Tj Max)	0.8	A
E_{AS}	Single pulse avalanche Energy (starting Tj=25°C, Id=Iar, Vdd=50V)	60	mJ

2 Electrical characteristics

(T_{CASE}=25°C unless otherwise specified)

Table 4. On/off states

Symbol	Parameter	Test Condictions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	I_D = 1mA, V_{GS}= 0	600			V
I_{DSS}	Zero Gate Voltage Drain Current (V_{GS} = 0)	V_{DS} = Max Rating, V_{DS} = MaxRating @125°C			1 50	µA µA
I_{GSS}	Gate Body Leakage Current (V_{DS} = 0)	V_{GS} = ±20V			±10	µA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}= V_{GS}, I_D = 50µA	3	3.75	4..5	V
$R_{DS(on)}$	Static Drain-Source On Resistance	V_{GS}= 10V, I_D= 0.4A		13	15	Ω

Table 5. Dynamic

Symbol	Parameter	Test Condictions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	V_{DS} =15V, I_D = 0.4A		0.5		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V_{DS} =25V, f=1 MHz, V_{GS}=0		94 17.6 2.8		pF pF pF
$C_{oss\ eq}$ (2).	Equivalent Output Capacitance	V_{GS}=0, V_{DS} =0V to 480V		11		pF
Q_g Q_{gs} Q_{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	V_{DD}=480V, I_D = 0.8A V_{GS} =10V (see Figure 11)		4.9 1 2.7	6.9	nC nC nC

1. Pulsed: pulse duration=300µs, 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} inceases from 0 to 80% V_{DSS}

Table 6. Switching times

Symbol	Parameter	Test Condictions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on Delay Time Rise Time Turn-off Delay Time Fall Time	V_{DD}=300 V, I_D= 0.4A, R_G=4.7Ω, V_{GS}=10V (see Figure 19)		5.5 5 13 28		ns ns ns ns

Table 7. Source drain diode

Symbol	Parameter	Test Condictions	Min	Typ.	Max	Unit
I_{SD}	Source-drain Current				0.8	A
I_{SDM}(1)	Source-drain Current (pulsed)				2.4	A
V_{SD}(2)	Forward on Voltage	I_{SD}=0.8A, V_{GS}=0			1.6	V
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I_{SD}=0.8A, di/dt = 100A/µs, V_{DD}=20V, Tj=25°C		135 216 3.2		ns nC A
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I_{SD}=0.8A, di/dt = 100A/µs, V_{DD}=20V, Tj=150°C		140 224 3.2		ns nC A

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

Table 8. Gate-source zener diode

Symbol	Parameter	Test Condictions	Min.	Typ.	Max.	Unit
BV_{GSO}(1)	Gate-source Braekdown Voltage	Igs=±1mA (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 1. Safe operating area for IPAK

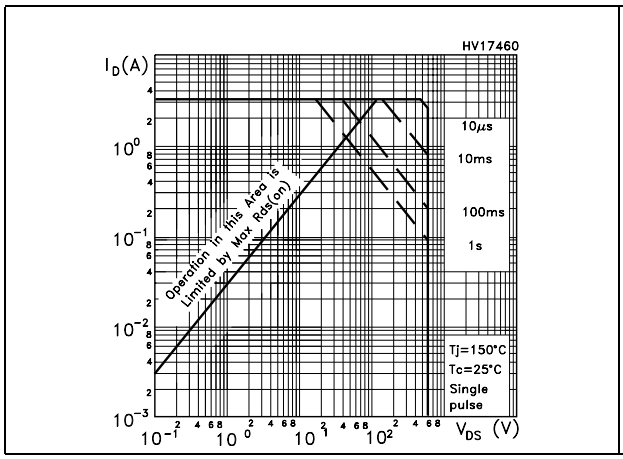


Figure 2. Thermal impedance for IPAK

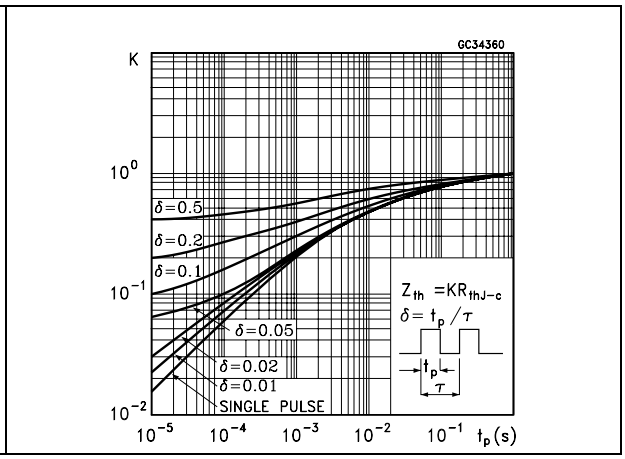


Figure 3. Safe operating area for TO-92

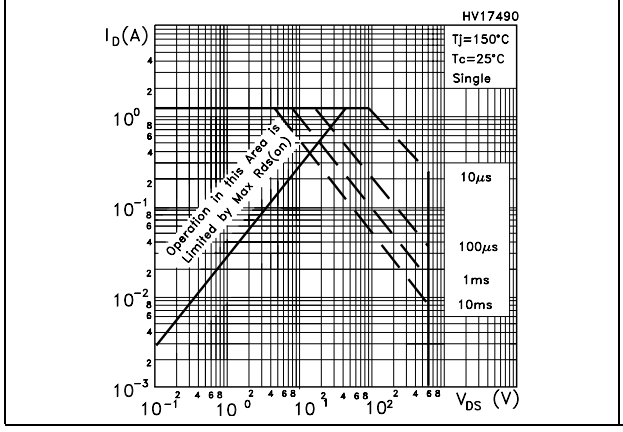


Figure 4. Thermal impedance for TO-92

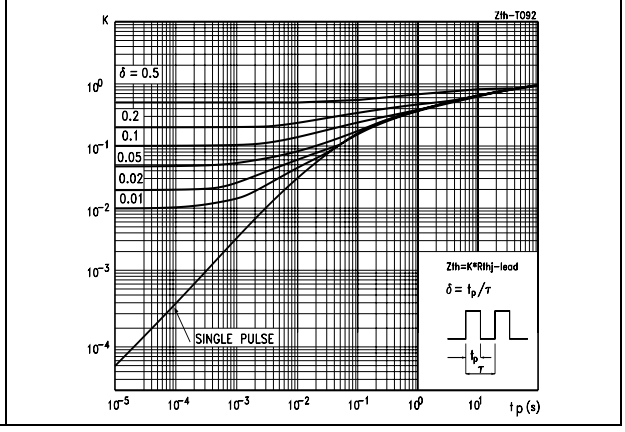


Figure 5. Safe operating area for SOT-223

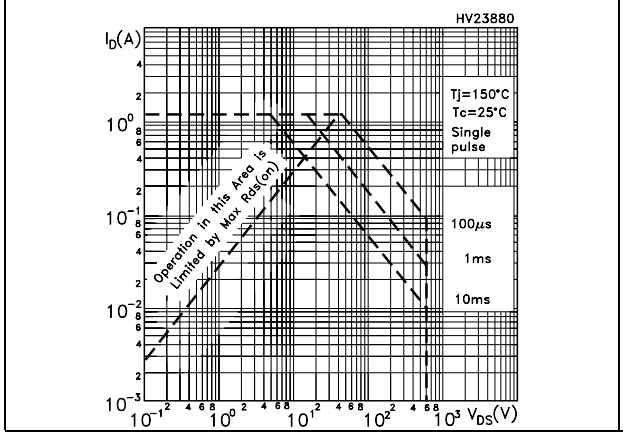


Figure 6. Thermal impedance for SOT-223

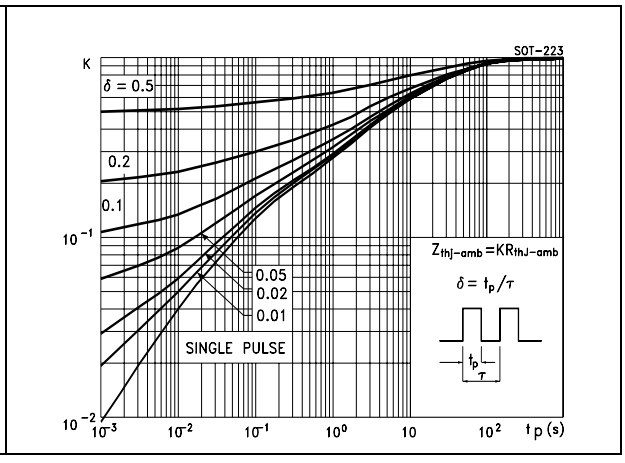


Figure 7. Output characterisics

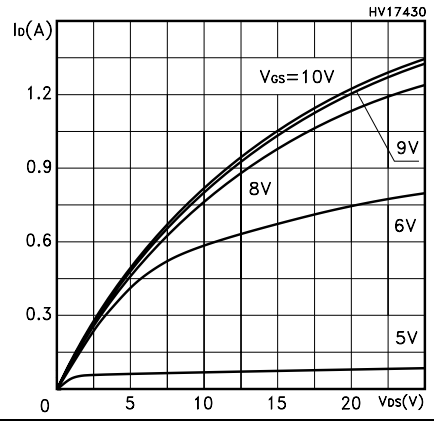


Figure 8. Transfer characteristics

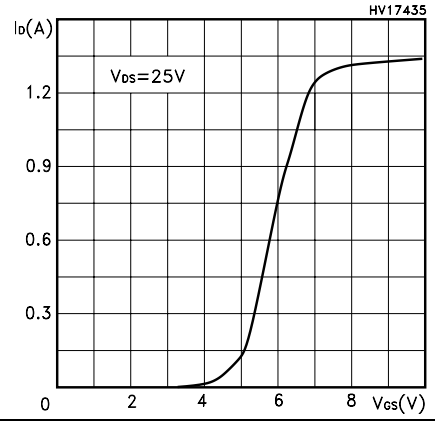


Figure 9. Transconductance

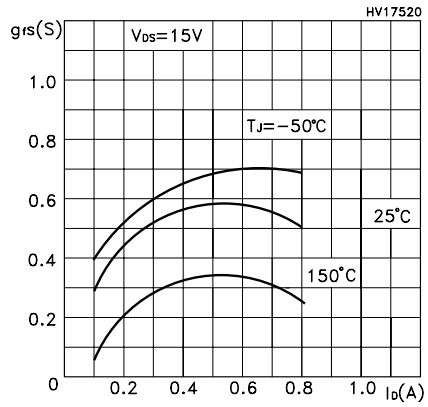


Figure 10. Static drain-source on resistance

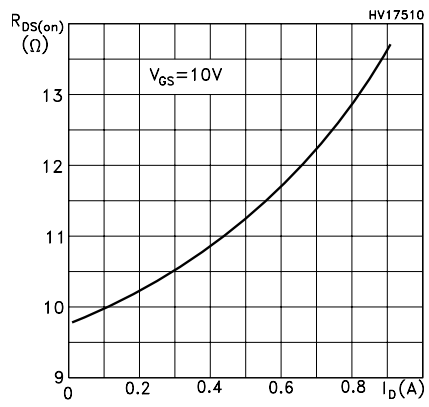


Figure 11. Gate charge vs gate-source voltage

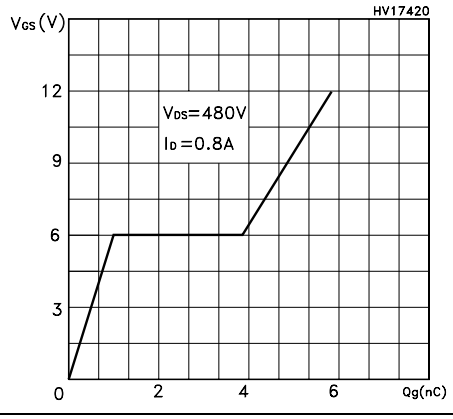


Figure 12. Capacitance variations

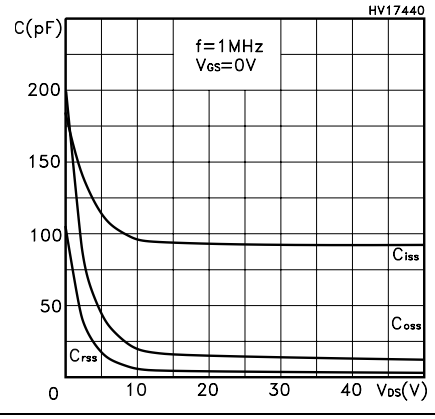


Figure 13. Normalized gate threshold voltage vs temperature

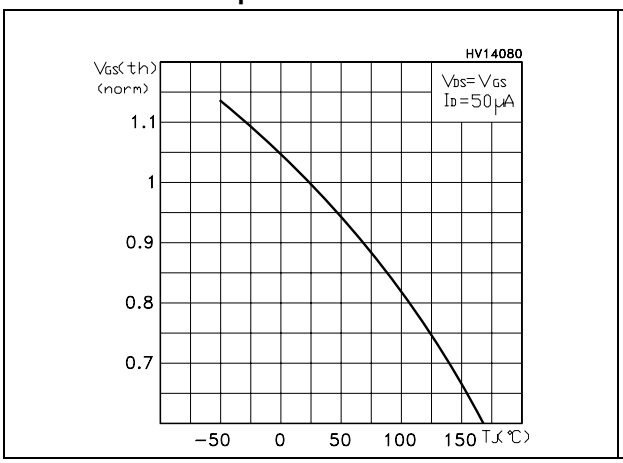


Figure 14. Normalized on resistance vs temperature

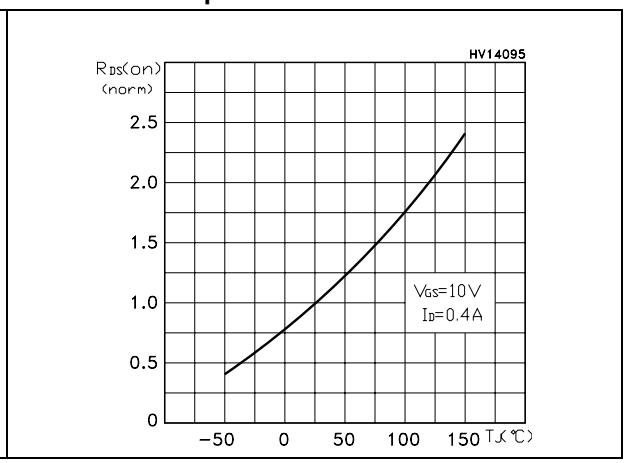


Figure 15. Source-drain diode forward characteristics

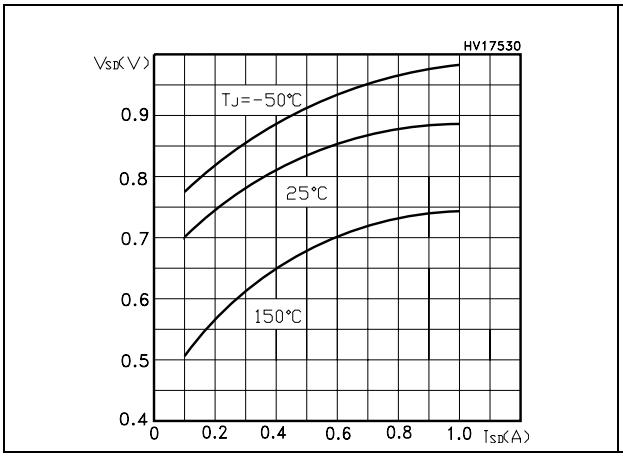


Figure 16. Normalized B_{VDSS} vs temperature

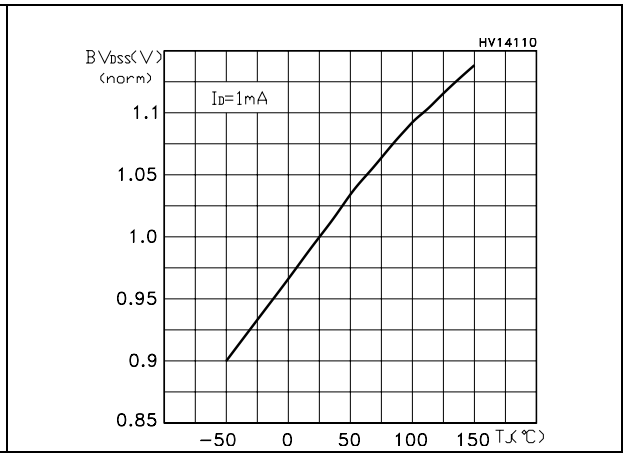


Figure 17. Maximum avalanche energy vs temperature

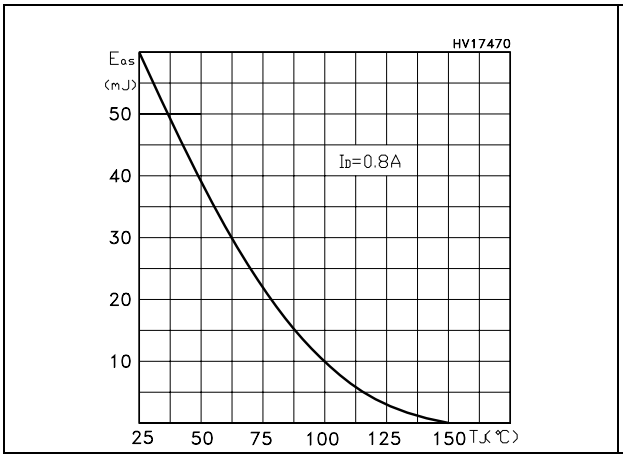
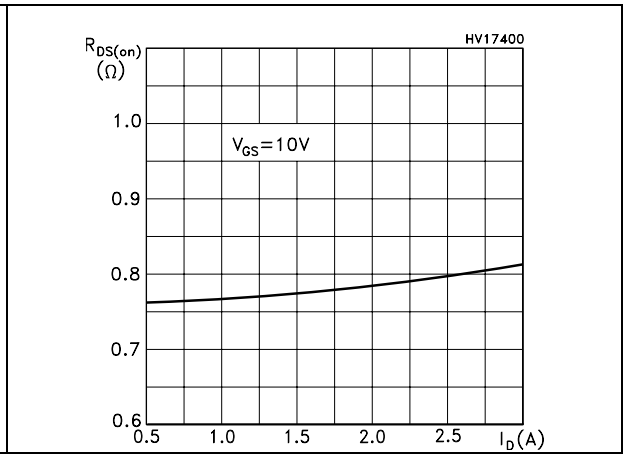


Figure 18. Max Id Current vs Tc



3 Test circuit

Figure 19. Switching times test circuit for resistive load

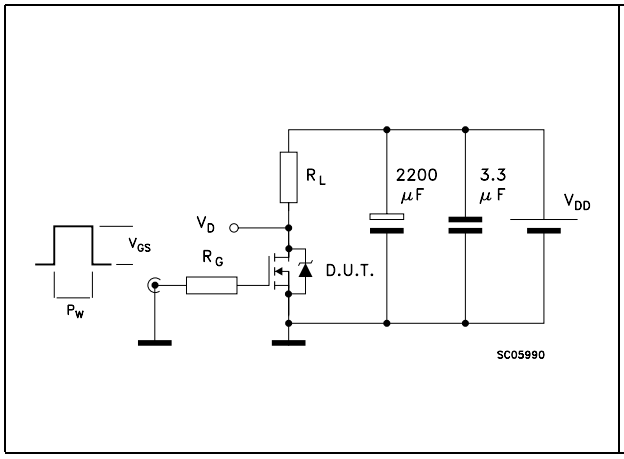


Figure 20. Gate charge test circuit

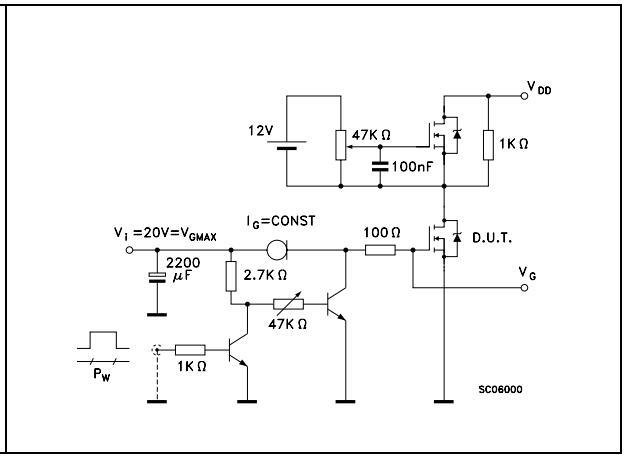


Figure 21. Test circuit for inductive load switching and diode recovery times

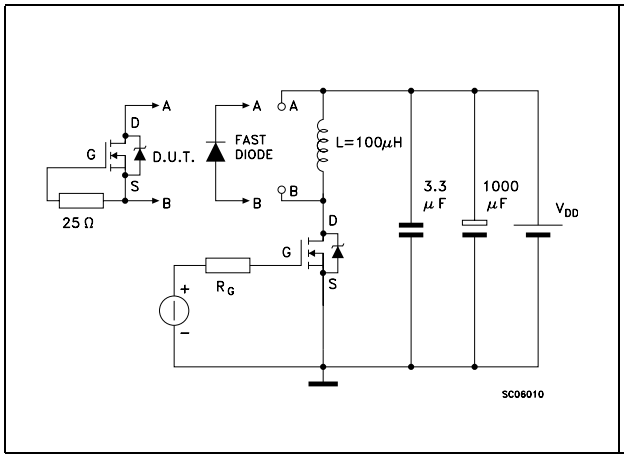


Figure 22. Unclamped Inductive load test circuit

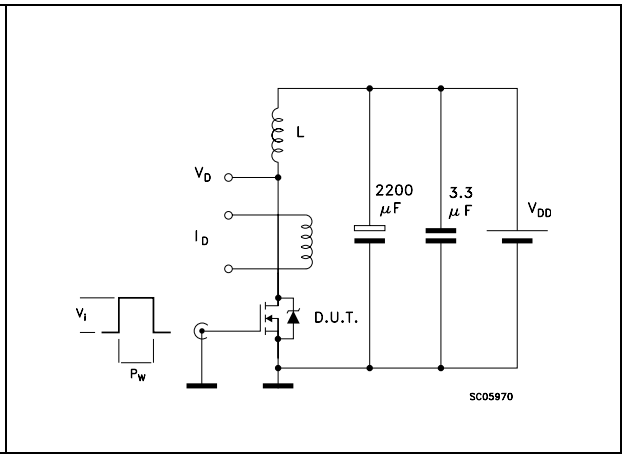


Figure 23. Unclamped inductive waveform

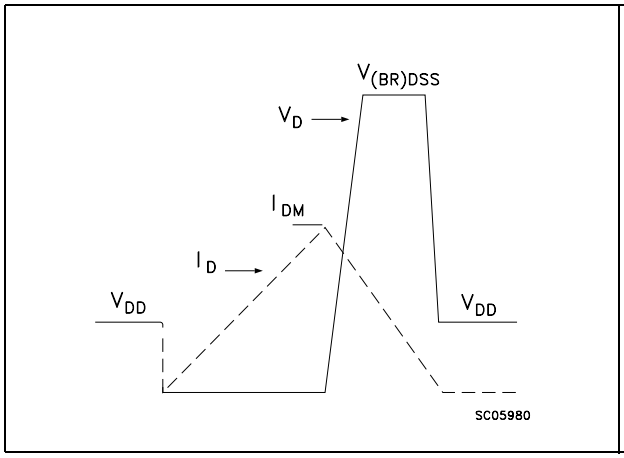
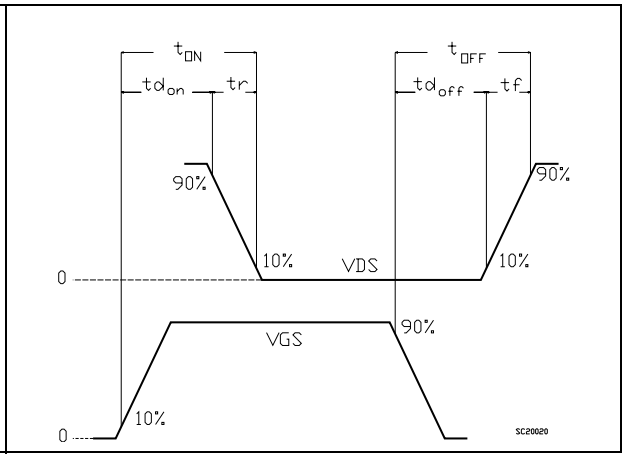


Figure 24. Switching time waveform

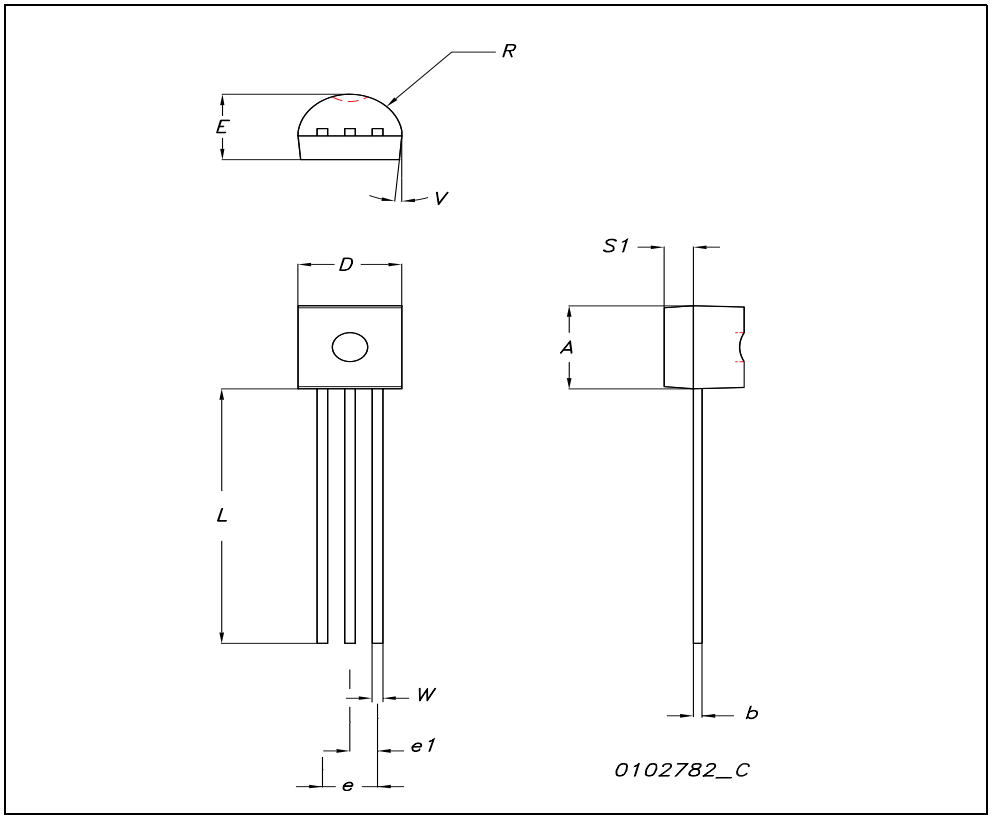


4 Package mechanical data

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

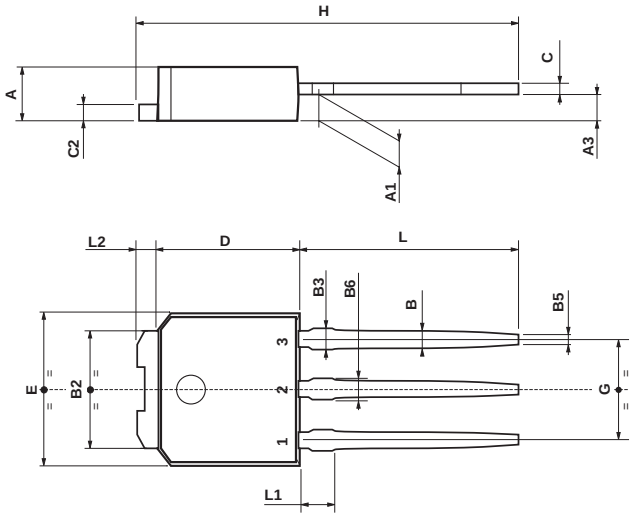
TO-92 MECHANICAL DATA

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°	



TO-251 (IPAK) MECHANICAL DATA

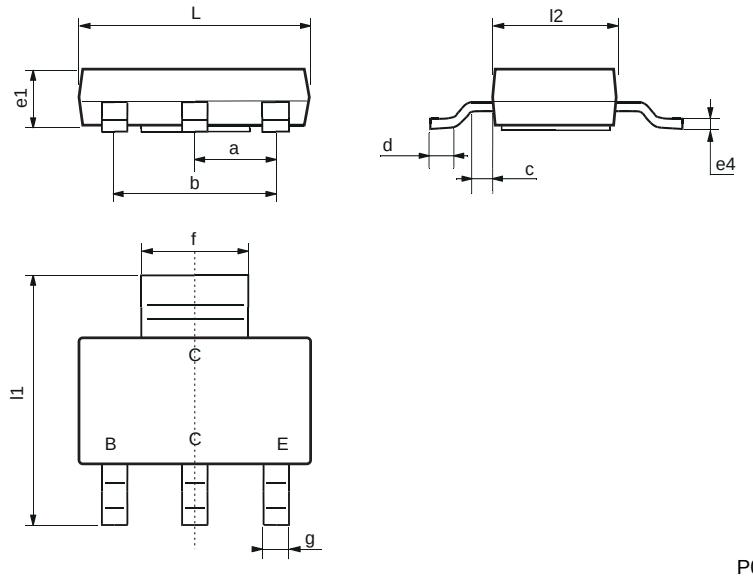
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		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



0068771-E

SOT-223 MECHANICAL DATA

DIM.	mm			mils		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a	2.27	2.3	2.33	89.4	90.6	91.7
b	4.57	4.6	4.63	179.9	181.1	182.3
c	0.2	0.4	0.6	7.9	15.7	23.6
d	0.63	0.65	0.67	24.8	25.6	26.4
e1	1.5	1.6	1.7	59.1	63	66.9
e4			0.32			12.6
f	2.9	3	3.1	114.2	118.1	122.1
g	0.67	0.7	0.73	26.4	27.6	28.7
l1	6.7	7	7.3	263.8	275.6	287.4
l2	3.5	3.5	3.7	137.8	137.8	145.7
L	6.3	6.5	6.7	248	255.9	263.8



P008B

5 Revision history

Table 9. Revision history

Date	Revision	Changes
19-Mar-2003	1	First Release
15-May-2003	2	Removed DPAK
09-Jun-2003	3	Final datasheet
17-Nov-2004	4	Inserted SOT-223
15-Feb-2005	5	Modified *Figure 3.*
07-Sep-2005	6	Inserted ecopak indication
22-Feb-2006	7	New template

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