



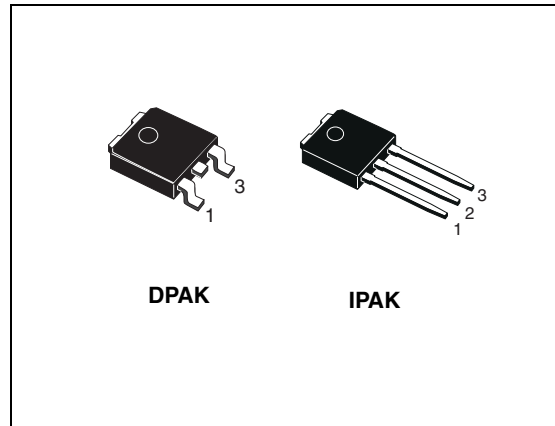
# STD2NK70Z STD2NK70Z-1

N-channel 700V - 6Ω - 1.6 A - DPAK/IPAK  
Zener protected SuperMESH™ Power MOSFET

## General features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>w</sub>
STD2NK70Z	700V	7Ω	1.6A	45W
STD2NK70Z-1	700V	7Ω	1.6A	45W

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



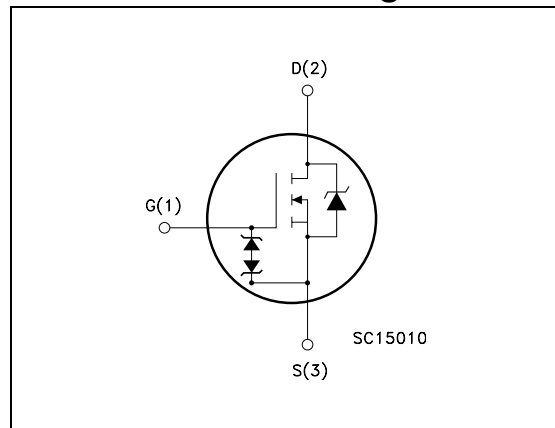
## Description

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 application. Such series complements ST full range of high voltage MOSFETs including revolutionary MDmesh™ products.

## Applications

- Switching application

## Internal schematic diagram



## Order codes

Part number	Marking	Package	Packaging
STD2NK70Z	D2NK70Z	D <sup>2</sup> PAK	Tape & reel
STD2NK70Z-1	D2NK70Z	IPAK	Tube

## Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>3</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>5</b>
	2.1 Electrical characteristics (curves) .....	7
<b>3</b>	<b>Test circuit</b> .....	<b>10</b>
<b>4</b>	<b>Package mechanical data</b> .....	<b>11</b>
<b>5</b>	<b>Packaging mechanical data</b> .....	<b>14</b>
<b>6</b>	<b>Revision history</b> .....	<b>15</b>

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	700	V
$V_{DGR}$	Drain-gate voltage ( $R_{GS} = 20\text{ k}\Omega$ )	700	V
$V_{GS}$	Gate- source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	1.6	A
$I_D$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	1	A
$I_{DM}^{(1)}$	Drain current (pulsed)	6.4	A
$P_{tot}$	Total dissipation at $T_C = 25^\circ\text{C}$	45	W
	Derating factor	0.36	W/ $^\circ\text{C}$
$V_{ESD(G-S)}$	Gate source ESD (HBM-C = 100pF, R = 1.5 K $\Omega$ )	2000	V
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
$T_{stg}$	Storage temperature	55 to 150	$^\circ\text{C}$
$T_j$	Max. operating junction temperature		

1. Pulse width limited by safe operating area.
2.  $I_{SD} \leq 1.6\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$

**Table 2. Thermal data**

$R_{thj-case}$	Thermal resistance junction-case max	2.78	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	100	$^\circ\text{C}/\text{W}$
$T_J$	Maximum lead temperature for soldering purpose	300	$^\circ\text{C}$

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AS}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ Max)	1.6	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j=25^\circ\text{C}$ , $I_d=I_{ar}$ , $V_{dd}=50\text{V}$ )	110	mJ

**Table 4. Gate-source zener diode**

Symbol	Parameter	Test Condition	Min.	Typ.	Max	Unit
$BV_{GSO}$	Gate-source breakdown voltage	$I_{gs} = \pm 1\text{mA}$ (open drain)	30			A

## 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

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

**Table 5. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1mA, V_{GS} = 0$	700			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	$\mu A$ $\mu A$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20V$			$\pm 10$	nA
$V_{GS(th)}$	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	$V_{GS} = 10V, I_D = 0.8A$		6	7	$\Omega$

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15V, I_D = 0.8A$		1.4		S
$C_{iss}$	Input capacitance	$V_{DS} = 25V, f = 1 \text{ MHz},$ $V_{GS} = 0$		280		pF
$C_{oss}$	Output capacitance			35		pF
$C_{rss}$	Reverse transfer capacitance			6.5		pF
$C_{oss \text{ eq}}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0, V_{DS} = 0V \text{ to } 560V$		17		pF
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 350V, I_D = 0.8A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 14)		7		ns
$t_r$	Rise time			17		ns
$t_{d(off)}$	Turn-off delay time			20		ns
$t_f$	Fall time			35		ns
$Q_g$	Total gate charge	$V_{DD} = 560V, I_D = 0.8A$		11.4		nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 10V$		2		nC
$Q_{gd}$	Gate-drain charge	(see Figure 15)		6.8		nC

1. Pulsed: pulse duration=300 $\mu s$ , 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				1.6	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				6.4	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=1.6A, V_{GS}=0$			1.6	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD}=1.6A,$ $di/dt = 100A/\mu s,$ $V_{DD}=50V, T_j=25^\circ C$ (see Figure 16)		334 918 5.5		ns $\mu C$ A
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD}=1.6A,$ $di/dt = 100A/\mu s,$ $V_{DD}= 50V, T_j=150^\circ C$ (see Figure 16)		350 1050 6		ns $\mu C$ A

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

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

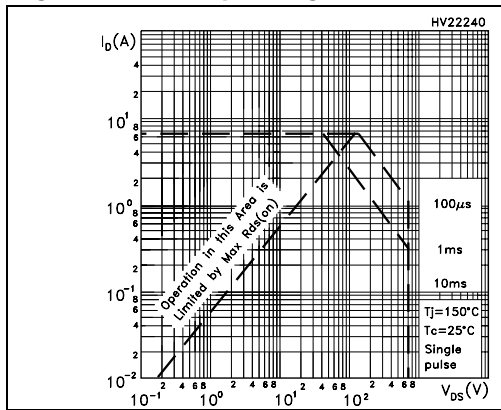


Figure 2. Thermal impedance

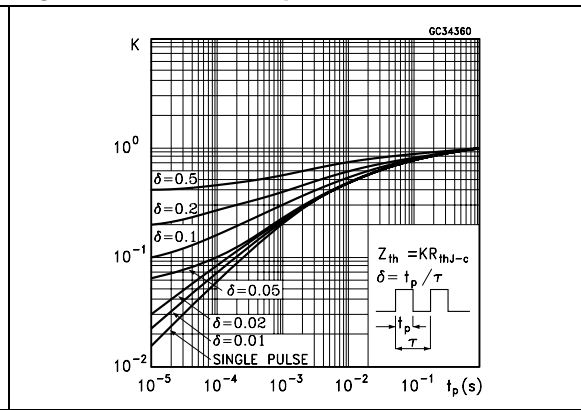


Figure 3. Output characteristics

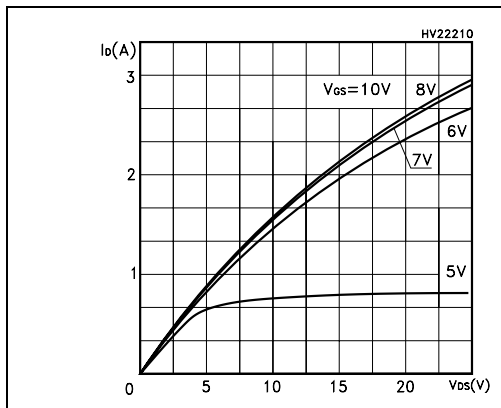


Figure 4. Transfer characteristics

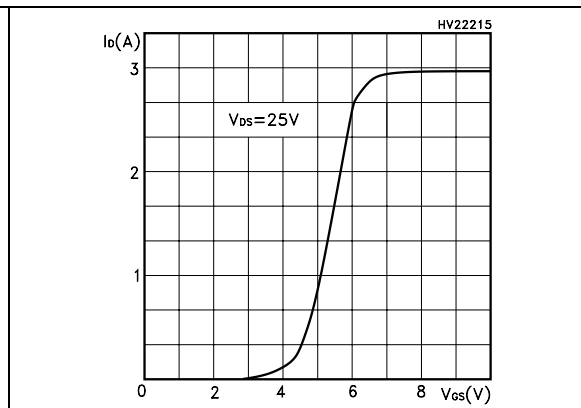


Figure 5. Transconductance

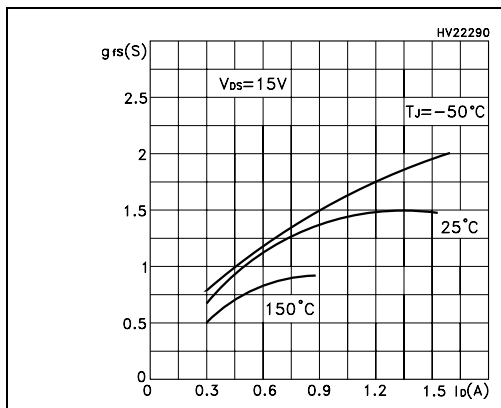


Figure 6. Static drain-source on resistance

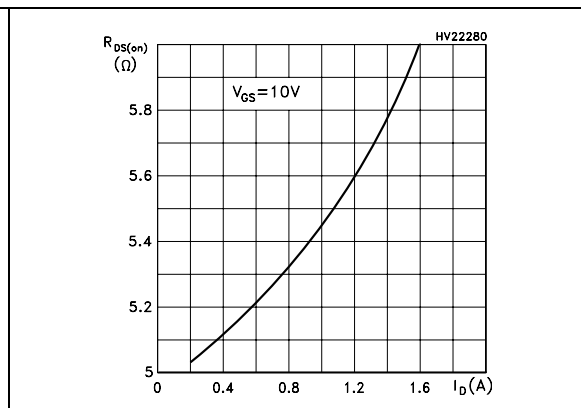


Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

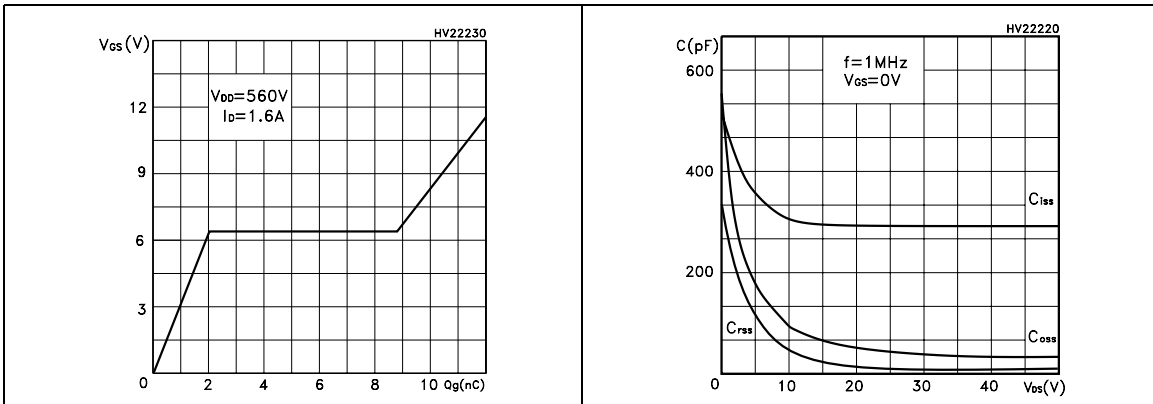


Figure 9. Normalized gate threshold voltage vs temperature Figure 10. Normalized on resistance vs temperature

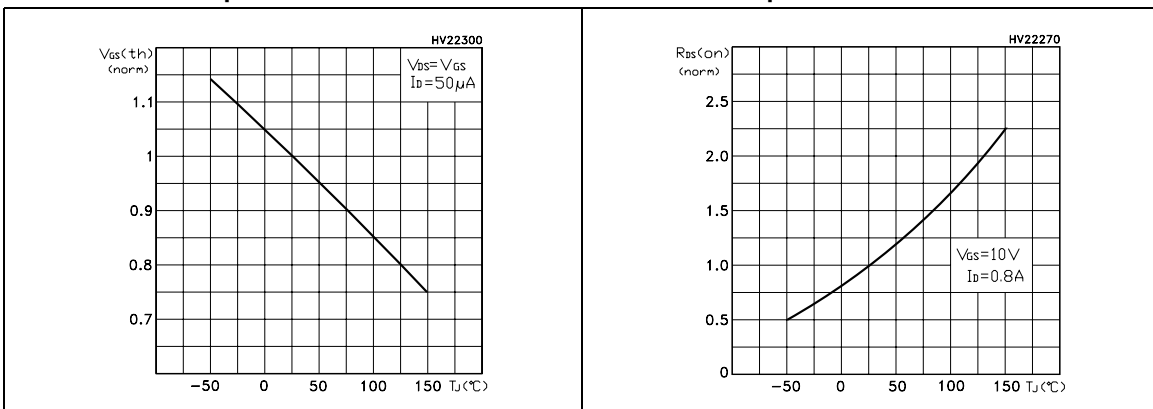


Figure 11. Source-drain diode forward characteristics Figure 12. Normalized  $B_{V_{DSS}}$  vs temperature

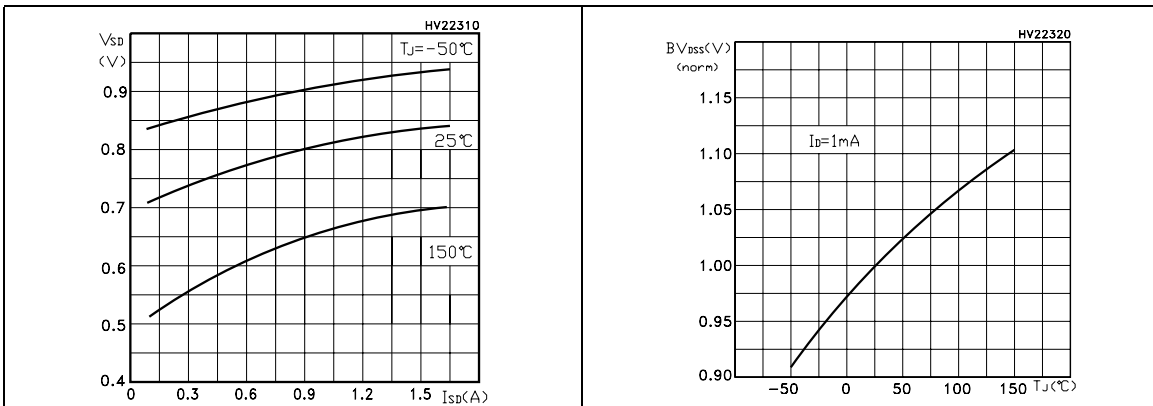
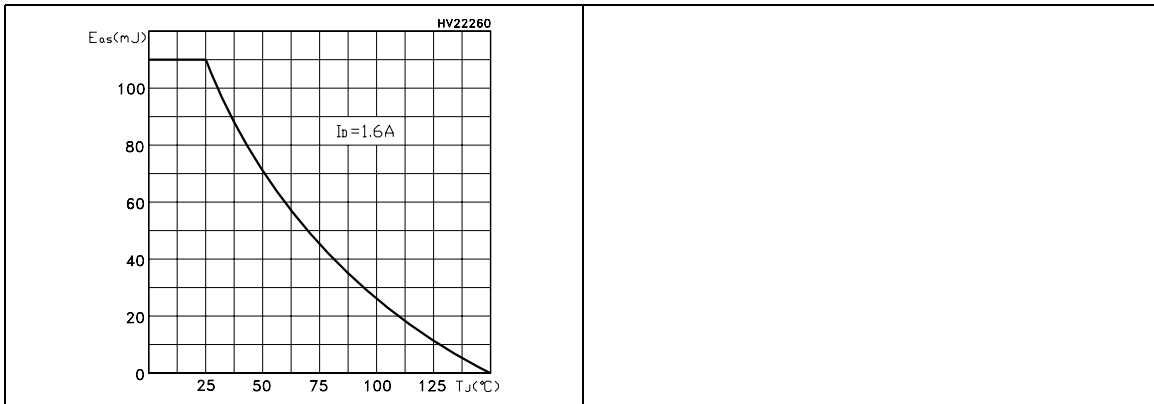




Figure 13. Maximum avalanche energy vs temperature



### 3 Test circuit

Figure 14. Switching times test circuit for resistive load

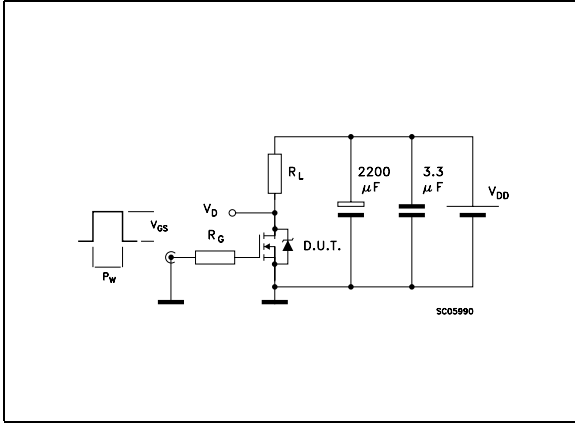


Figure 15. Gate charge test circuit

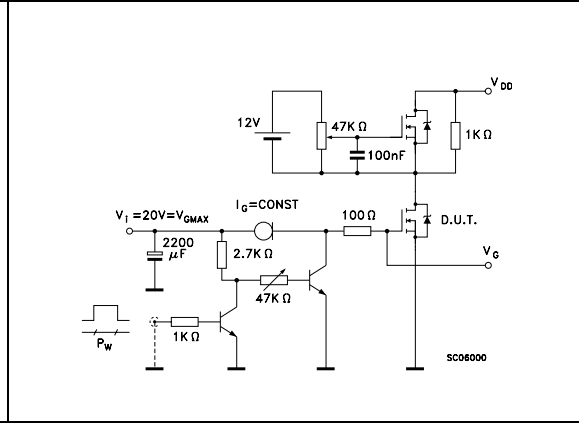


Figure 16. Test circuit for inductive load switching and diode recovery times

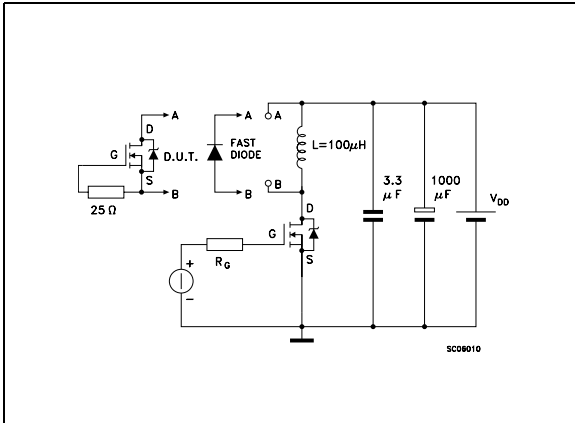


Figure 17. Unclamped Inductive load test circuit

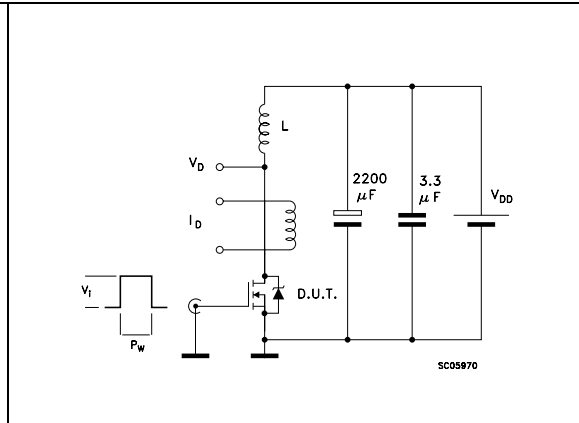


Figure 18. Unclamped inductive waveform

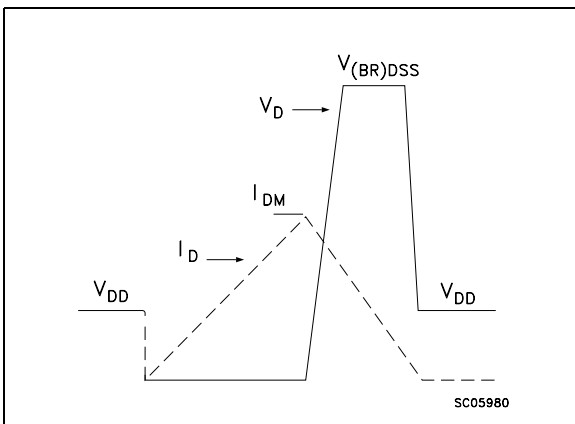
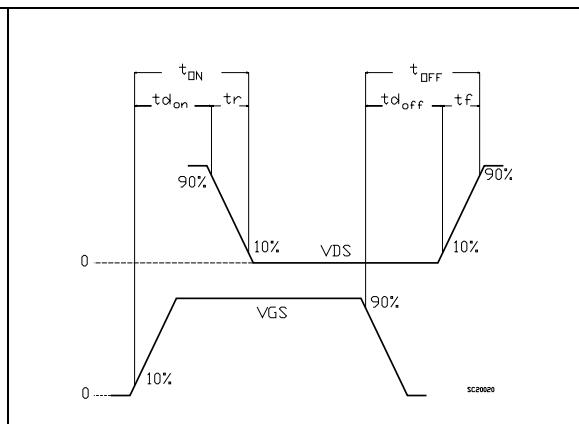


Figure 19. Switching time waveform

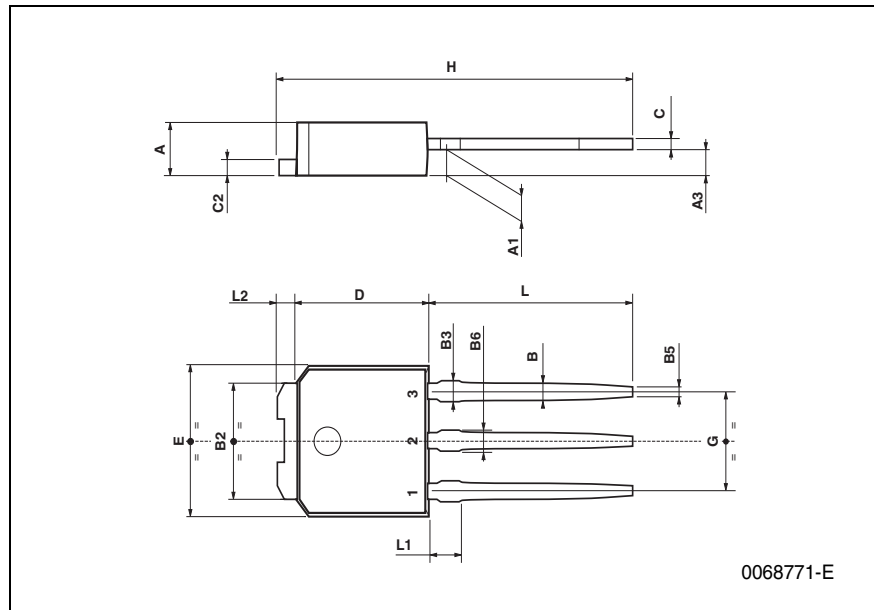


## 4 Package mechanical data

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

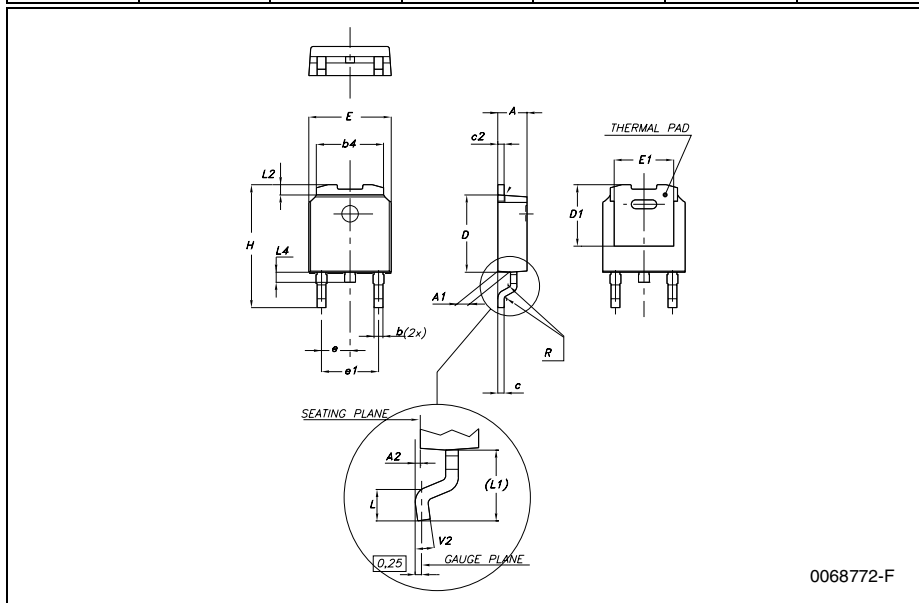
TO-251 (IPAK) MECHANICAL DATA

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



**DPAK MECHANICAL DATA**

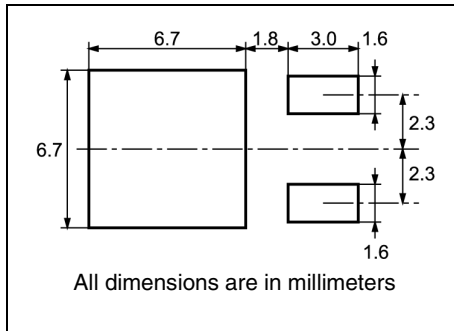
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.9	0.025		0.035
b4	5.2		5.4	0.204		0.212
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
D1		5.1			0.200	
E	6.4		6.6	0.252		0.260
E1		4.7			0.185	
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°



0068772-F

## 5 Packaging mechanical data

### 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

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

BASE QTY	BULK QTY
2500	2500

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

For machine ref. only including draft and radii concentric around B0

10 pitches cumulative tolerance on tape +/- 0.2 mm

User Direction of Feed

FEED DIRECTION

Bending radius R min.

## 6 Revision history

Table 8. Revision history

Date	Revision	Changes
21-Jan-2005	1	First Release
10-Jun-2005	2	Updated <a href="#">Figure 1: Safe operating area</a>
13-Jul-2006	3	New template, no content change

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2006 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

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