



# STD2NK100Z STP2NK100Z - STU2NK100Z

N-channel 1000 V, 6.25  $\Omega$ , 1.85 A, TO-220, DPAK, IPAK  
Zener-protected SuperMESH™ Power MOSFET

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on) max</sub>	I <sub>D</sub>	P <sub>TOT</sub>
STD2NK100Z	1000 V	< 8.5 $\Omega$	1.85 A	70 W
STP2NK100Z	1000 V	< 8.5 $\Omega$	1.85 A	70 W
STU2NK100Z	1000 V	< 8.5 $\Omega$	1.85 A	70 W

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

## Application

- Switching applications

## 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, specialties is taken to ensure a very good dv/dt capability for the most demanding application. Such series complements ST full range of high voltage Power MOSFETs.

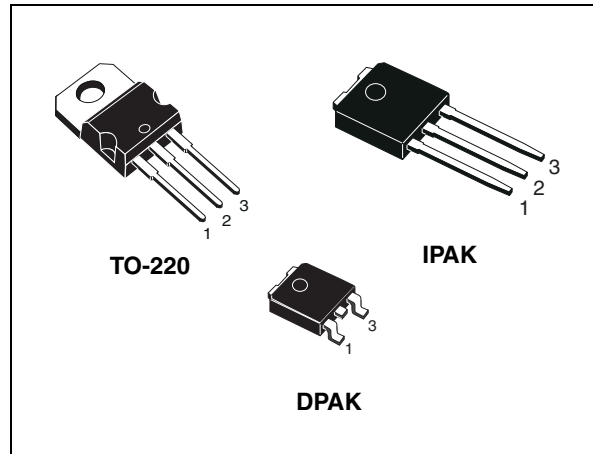


Figure 1. Internal schematic diagram

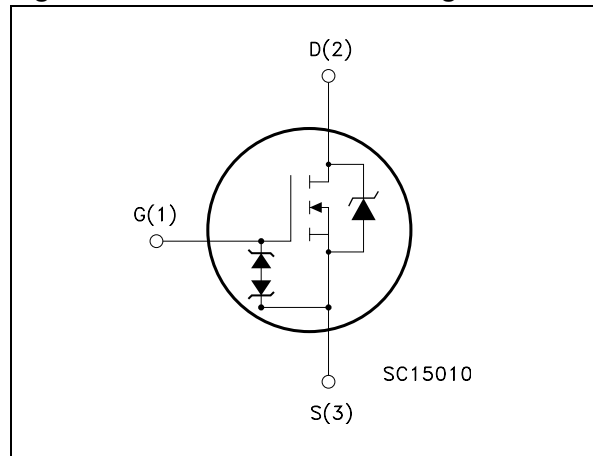


Table 1. Device summary

Order codes	Marking	Package	Packaging
STD2NK100Z	2NK100Z	DPAK	Tape and reel
STP2NK100Z	2NK100Z	TO-220	Tube
STU2NK100Z	2NK100Z	IPAK	Tube

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	1000	V
$V_{GS}$	Gate-source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	1.85	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	1.16	A
$I_{DM}^{(1)}$	Drain current (pulsed)	7.4	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	70	W
	Derating factor	0.56	W/ $^\circ\text{C}$
$V_{ESD(G-S)}$	G-S ESD (HBM C=100 pF, R=1.5 k $\Omega$ )	3000	V
$dv/dt^{(2)}$	Peak diode recovery voltage slope	2.5	V/ns
$T_j$ $T_{stg}$	Operating junction temperature Storage temperature	-55 to 150	$^\circ\text{C}$

1. Pulse width limited by safe operating area
2.  $I_{SD} \leq 1.85\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$

**Table 3. Thermal data**

Symbol	Parameter	Value			Unit
		TO-220	IPAK	DPAK	
$R_{thj-case}$	Thermal resistance junction-case max	1.79			$^\circ\text{C}/\text{W}$
$R_{thj-pcb}$	Thermal resistance junction-pcb minimum footprint	--	--	50	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-amb max	62.5	100		$^\circ\text{C}/\text{W}$
$T_l$	Maximum lead temperature for soldering purpose	300			$^\circ\text{C}$

**Table 4. Avalanche data**

Symbol	Parameter	Value	Unit
$I_{AR}^{(1)}$	Avalanche current, repetitive or not-repetitive	1.85	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	170	mJ

1. Pulse width limited by  $T_{jmax}$
2. Starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$

## 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	$I_D = 1 \text{ mA}, V_{GS} = 0$	1000			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 ( $V_{DS} = 0$ )	$V_{GS} = \pm 30 \text{ V}$			$\pm 10$	$\mu A$
$V_{GS(th)}$	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	$V_{GS} = 10 \text{ V}, I_D = 0.9 \text{ A}$		6.25	8.5	$\Omega$

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15 \text{ V}, I_D = 0.9 \text{ A}$		2.4		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GS} = 0$		499 53 9		pF pF pF
$C_{oss \text{ eq.}}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0, V_{DS} = 0 \text{ to } 800 \text{ V}$		28		pF
$R_G$	Gate input resistance	$f = 1 \text{ MHz}, \text{ open drain}$		6.6		$\Omega$
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 800 \text{ V}, I_D = 1.85 \text{ A}$ $V_{GS} = 10 \text{ V}$ <i>(see Figure 17)</i>		16 3 9		nC nC nC

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

2.  $C_{oss \text{ eq.}}$  is defined as 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	$V_{DD}= 500\text{ V}$ , $I_D= 0.9\text{ A}$ , $R_G=4.7\ \Omega$ , $V_{GS}=10\text{ V}$ <i>(see Figure 16)</i>		7.2		ns
$t_r$	Rise time			6.5		ns
$t_{d(off)}$	Turn-off delay time			41.5		ns
$t_f$	Fall time			32.5		ns

**Table 8. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current				1.85	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				7.4	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}= 1.85\text{ A}$ , $V_{GS}=0$			1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD}= 1.85\text{ A}$ , $di/dt= 100\text{ A}/\mu\text{s}$ , $V_{DD}= 60\text{ V}$ <i>(see Figure 21)</i>		476		ns
$Q_{rr}$	Reverse recovery charge			1.6		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			6.9		A
$t_{rr}$	Reverse recovery time	$I_{SD}= 1.85\text{ A}$ , $di/dt= 100\text{ A}/\mu\text{s}$ , $V_{DD}= 60\text{ V}$ , $T_J=150\text{ }^\circ\text{C}$ <i>(see Figure 21)</i>		532		ns
$Q_{rr}$	Reverse recovery charge			1.9		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			88		A

1. Pulse width limited by package
2. Pulsed: pulse duration = 300 $\mu\text{s}$ , duty cycle 1.5%

**Table 9. 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

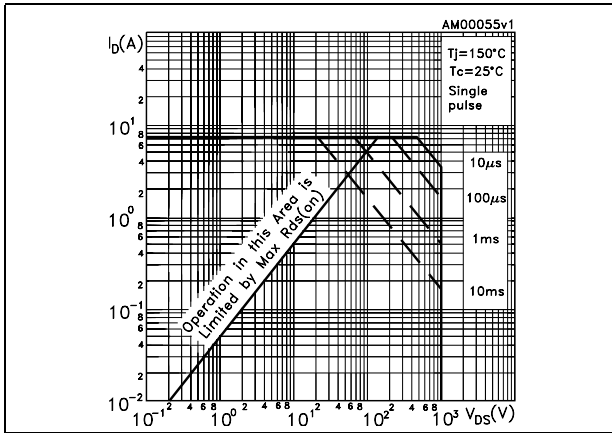


Figure 3. Thermal impedance for TO-220

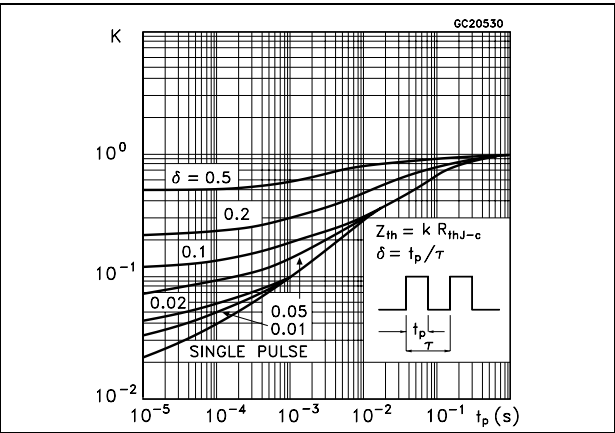


Figure 4. Safe operating area for DPAK, IPAK

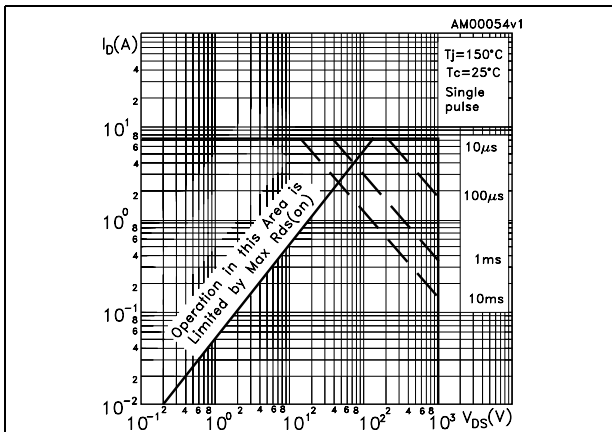


Figure 5. Thermal impedance for DPAK, IPAK

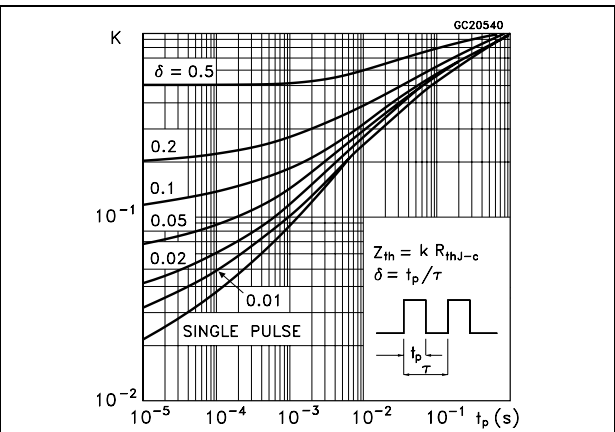


Figure 6. Output characteristics

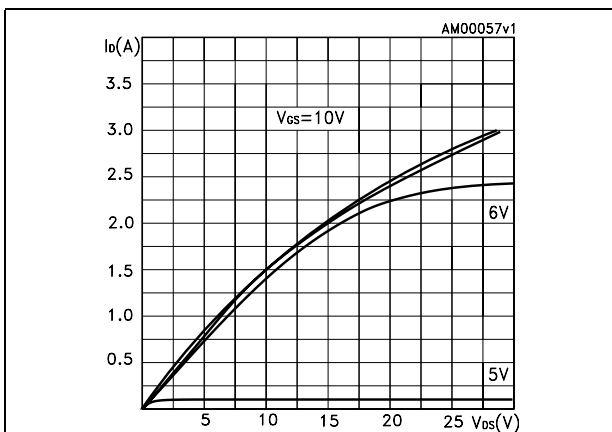


Figure 7. Transfer characteristics

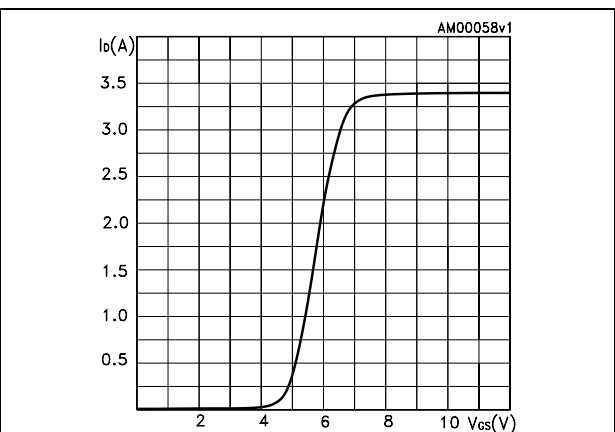


Figure 8. Normalized  $B_{VDSS}$  vs temperature

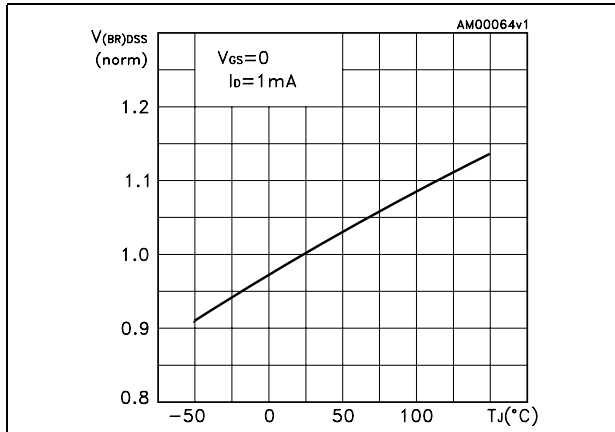


Figure 9. Static drain-source on resistance

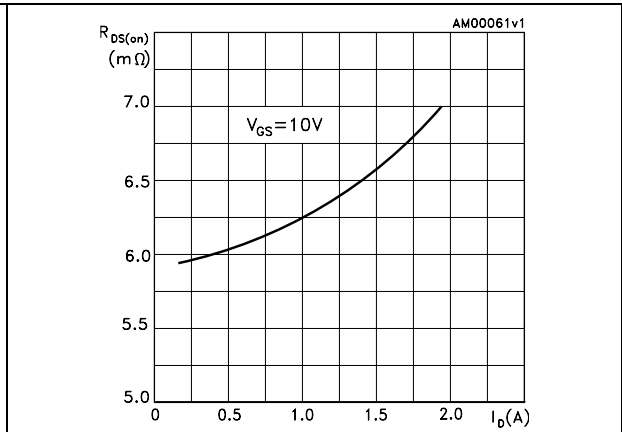


Figure 10. Gate charge vs gate-source voltage

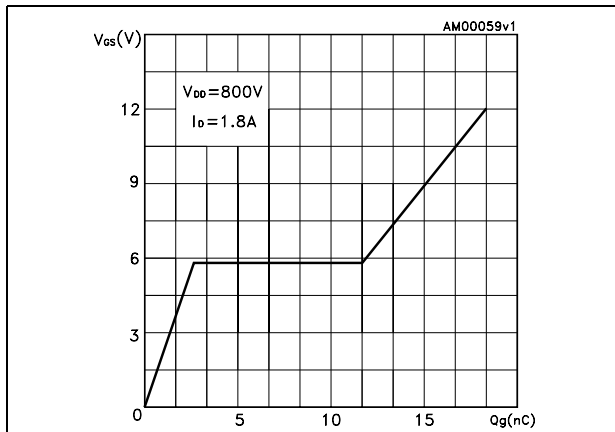


Figure 11. Capacitance variations

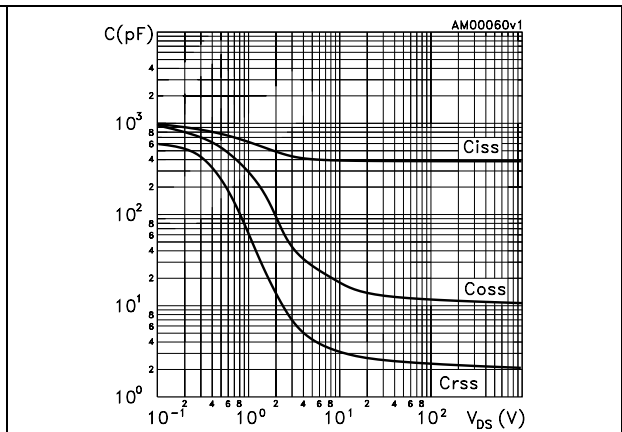


Figure 12. Normalized gate threshold voltage vs temperature

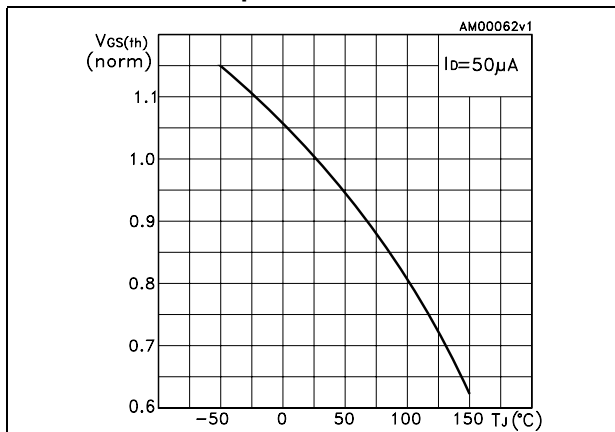


Figure 13. Normalized on resistance vs temperature

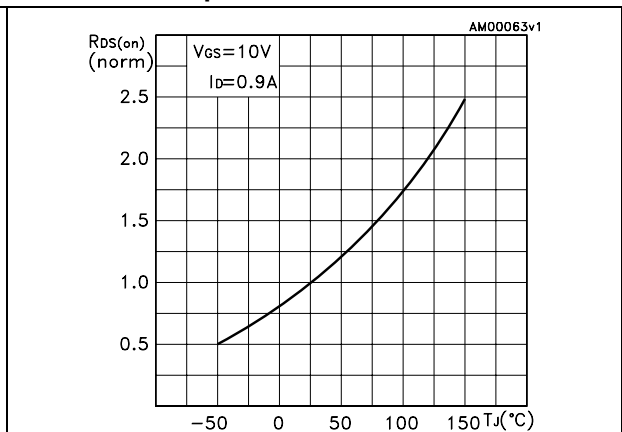


Figure 14. Source-drain diode forward characteristics

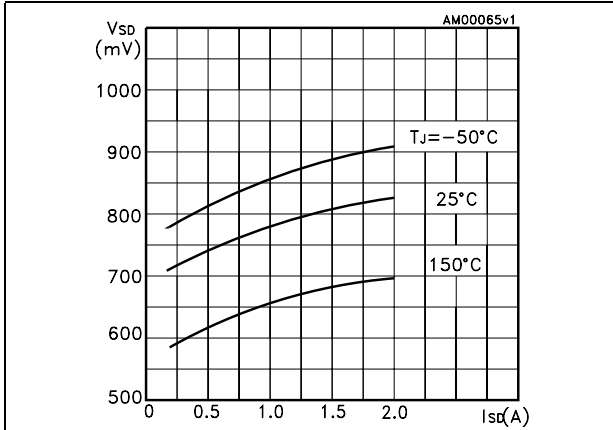
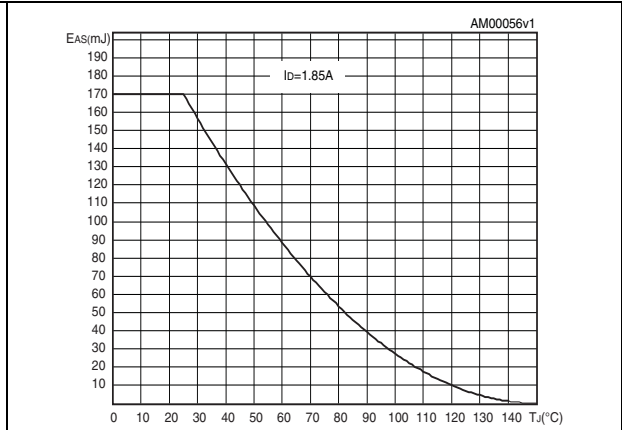


Figure 15. Maximum avalanche energy vs temperature





### 3 Test circuits

Figure 16. Switching times test circuit for resistive load

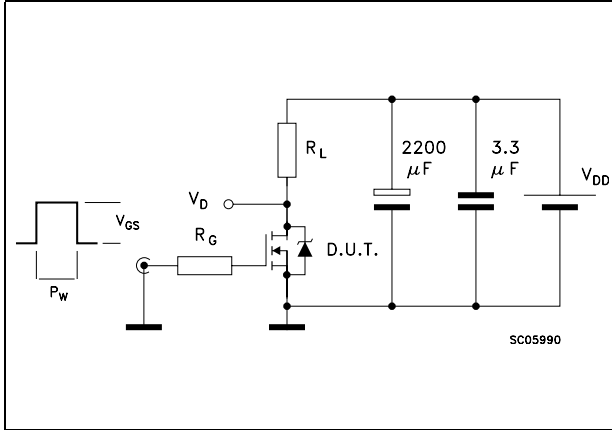


Figure 17. Gate charge test circuit

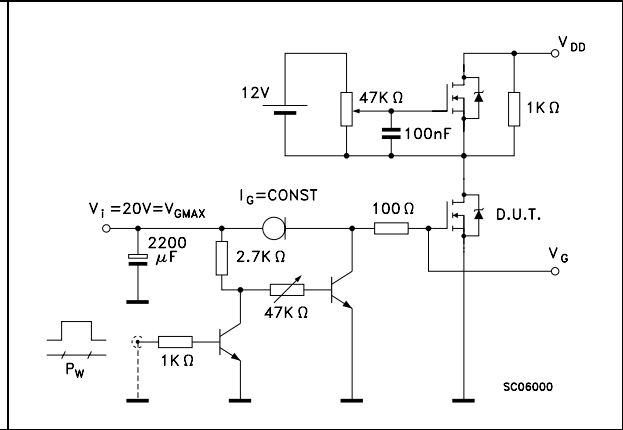


Figure 18. Test circuit for inductive load switching and diode recovery times

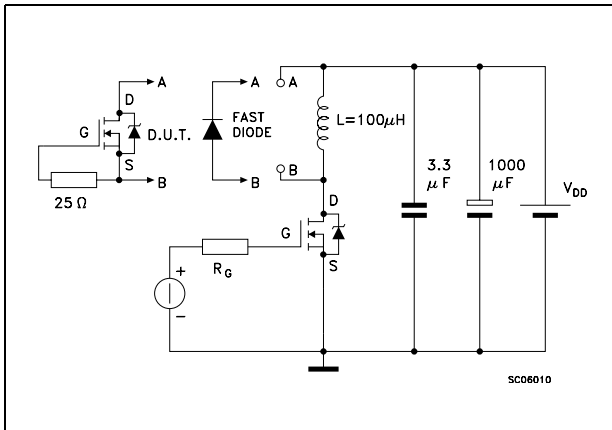


Figure 19. Unclamped inductive load test circuit

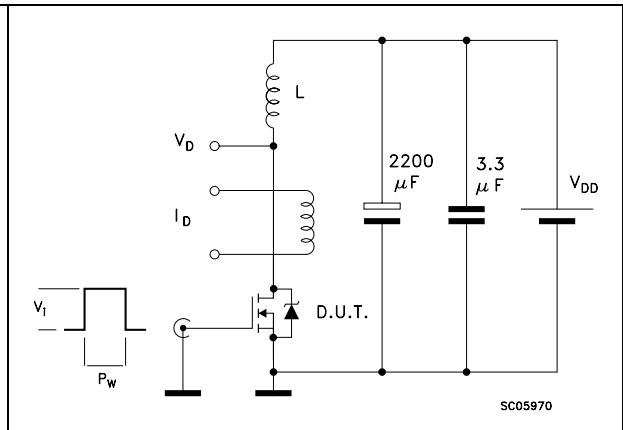


Figure 20. Unclamped inductive waveform

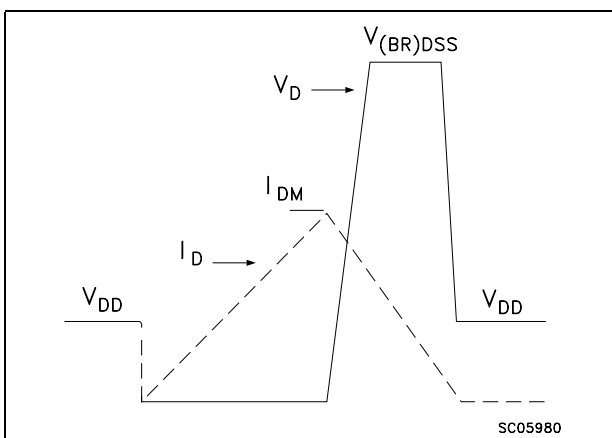
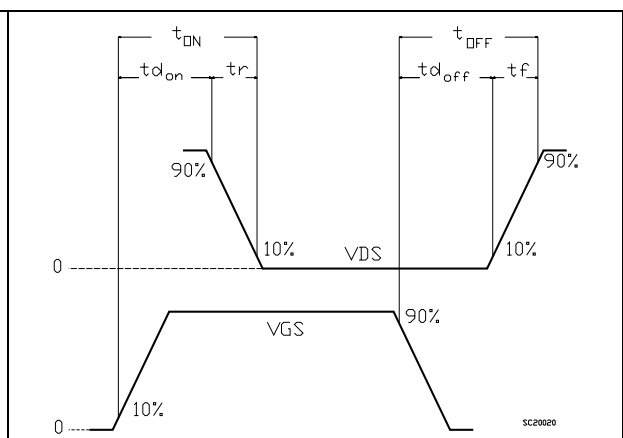


Figure 21. Switching time waveform

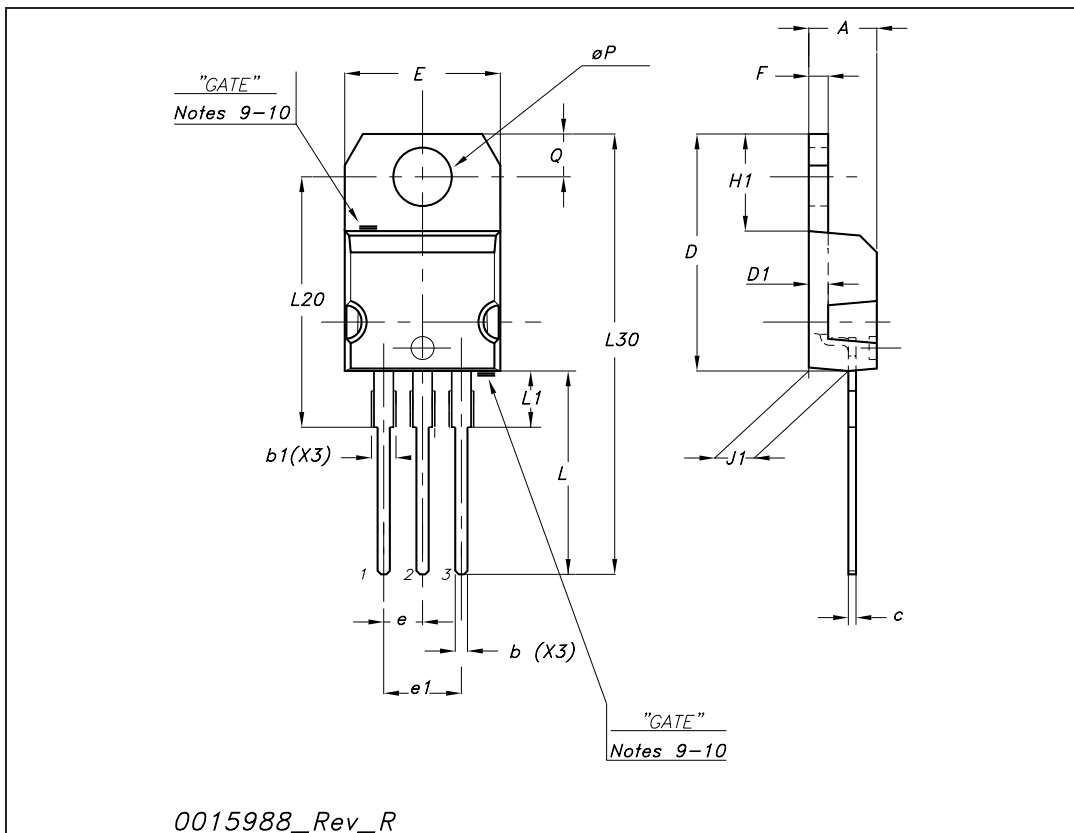


## 4 Package mechanical data

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)

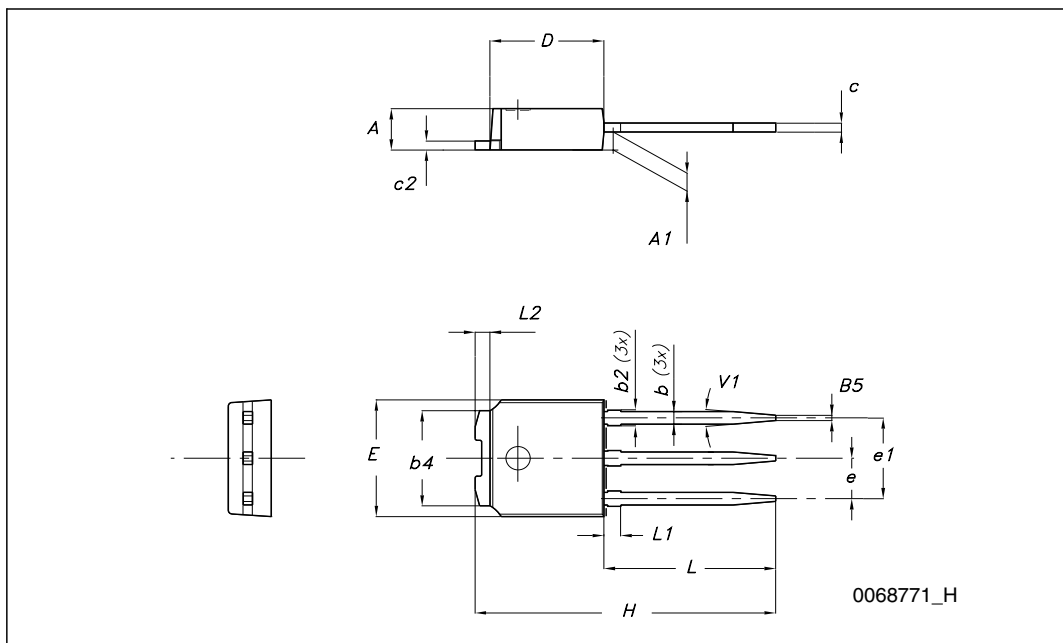
TO-220 mechanical data

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	0.48		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



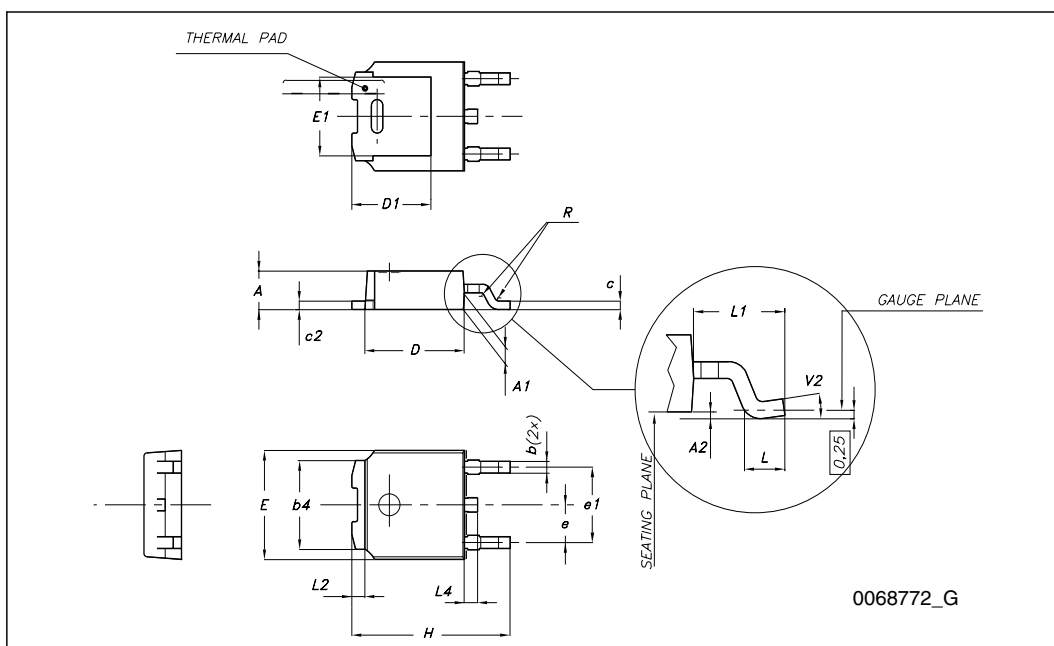
**TO-251 (IPAK) mechanical data**

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
(L1)	0.80		1.20
L2		0.80	
V1		10°	



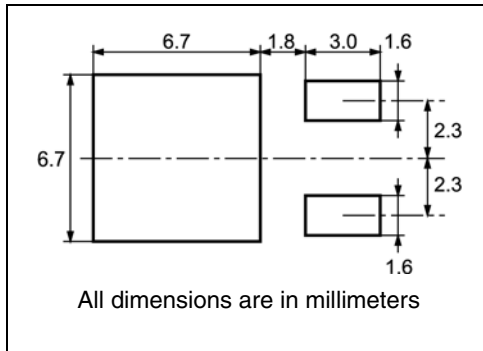
**TO-252 (DPAK) mechanical data**

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°



# 5 Packaging mechanical data

## DPAK FOOTPRINT



## TAPE AND REEL SHIPMENT

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

## 6 Revision history

**Table 10. Document revision history**

Date	Revision	Changes
24-Oct-2007	1	First release
18-Jun-2008	2	– Inserted new package, mechanical data IPAK – Document status promoted from preliminary data to datasheet.

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