



STW13NK100Z

N-channel 1000V - 0.56Ω - 13A - TO-247
Zener - Protected SuperMESH™ PowerMOSFET

General features

Type	V _{DSS} (@T _{jmax})	R _{DS(on)}	I _D	P _W
STW13NK100Z	1000 V	< 0.70 Ω	13 A	350W

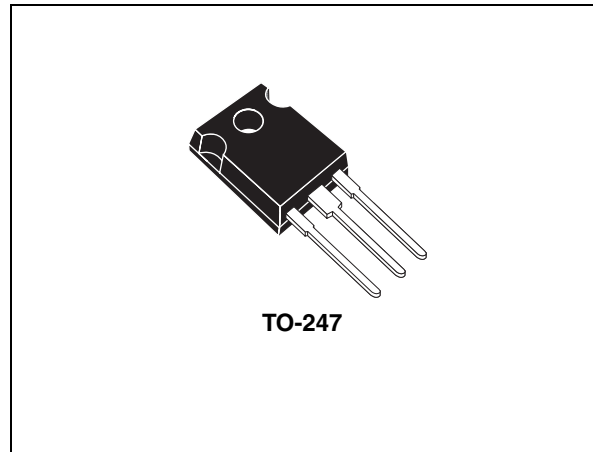
- Extremely high dv/dt capability
- 100% avalanche tested
- Gate charge minimized
- Very low intrinsic capacitances
- Very good manufacturing repeatability

Description

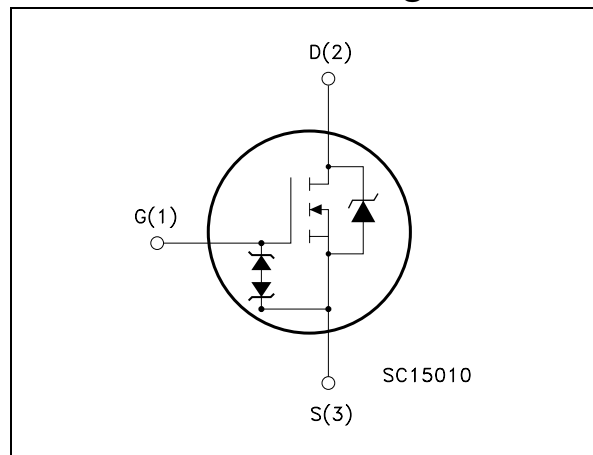
The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements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

Applications

- Switching application



Internal schematic diagram



Order codes

Part number	Marking	Package	Packaging
STW13NK100Z	W13NK100Z	TO-247	Tube

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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	1000	V
V_{DGR}	Drain-gate voltage ($R_{GS} = 20K\Omega$)	1000	V
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current (continuous) at $T_C = 25^\circ C$	13	A
I_D	Drain current (continuous) at $T_C = 100^\circ C$	8.2	A
$I_{DM}^{(1)}$	Drain current (pulsed)	52	A
P_{TOT}	Total dissipation at $T_C = 25^\circ C$	350	W
	Derating Factor	2.7	W/ $^\circ C$
$V_{ESD (G-S)}$	Gate source ESD(HBM-C=100pF, R=1,5K Ω)	6000	V
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4	V/ns
T_J	Operating junction temperature	-55 to 150	$^\circ C$
T_{stg}	Storage temperature		

1. Pulse width limited by safe operating area

2. $I_{SD} \leq 8.3 A$, $di/dt \leq 200 A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq T_{JMAX}$

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case Max	0.36	$^\circ C/W$
R_{thj-a}	Thermal resistance junction-ambient Max	50	$^\circ C/W$
T_l	Maximum lead temperature for soldering purpose	300	$^\circ C$

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J Max)	13	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25^\circ C$, $I_d = I_{AR}$, $V_{DD} = 50V$)	700	mJ

Table 4. Gate-source zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
BV_{GSO}	Gate-source breakdown voltage	$I_{gs}=\pm 1\text{mA}$ (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

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

Table 5. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1mA, V_{GS} = 0$	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 10	μA μA
I_{GSS}	Gate body leakage current ($V_{GS} = 0$)	$V_{GS} = \pm 20V$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 150 \mu A$	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10V, I_D = 6.5 A$		0.56	0.70	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15V, I_D = 6.5 A$		14		S
C_{iss}	Input capacitance	$V_{DS} = 25V, f = 1 \text{ MHz}, V_{GS} = 0$		6000		pF
C_{oss}	Output capacitance			455		pF
C_{rss}	Reverse transfer capacitance			100		pF
$C_{osseq}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0, V_{DS} = 0V \text{ to } 800V$		227		pF
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 500V, I_D = 7A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 16)		45		ns
t_r	Rise time			35		ns
$t_{d(off)}$	Off-voltage rise time			145		ns
t_f	Fall time			45		ns
Q_g	Total gate charge	$V_{DD} = 800V, I_D = 13A$ $V_{GS} = 10V$		190	266	nC
Q_{gs}	Gate-source charge			30		nC
Q_{gd}	Gate-drain charge			100		nC

1. Pulsed: pulse duration=300 μs , 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} 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				13	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				52	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=8.3A, V_{GS}=0$			1.6	V
t_{rr}	Reverse recovery time	$I_{SD}=13 A,$ $di/dt = 100A/\mu s,$ $V_{DD}=100 V, T_j=25^\circ C$ (see Figure 18)		820		ns
Q_{rr}	Reverse recovery charge			12.7		μC
I_{RRM}	Reverse recovery current			31		A
t_{rr}	Reverse recovery time	$I_{SD}=13 A,$ $di/dt = 100A/\mu s,$ $V_{DD}=100V, T_j=150^\circ C$ (see Figure 18)		1050		ns
Q_{rr}	Reverse recovery charge			17.8		μC
I_{RRM}	Reverse recovery current			34		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

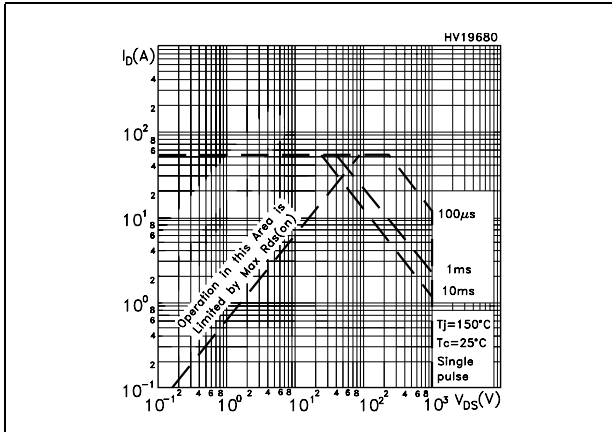


Figure 2. Thermal impedance

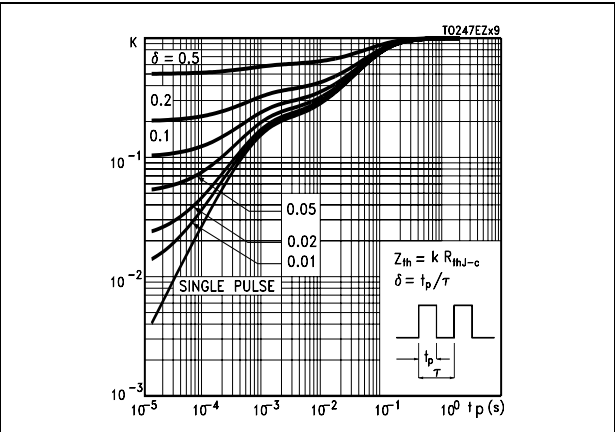


Figure 3. Output characteristics

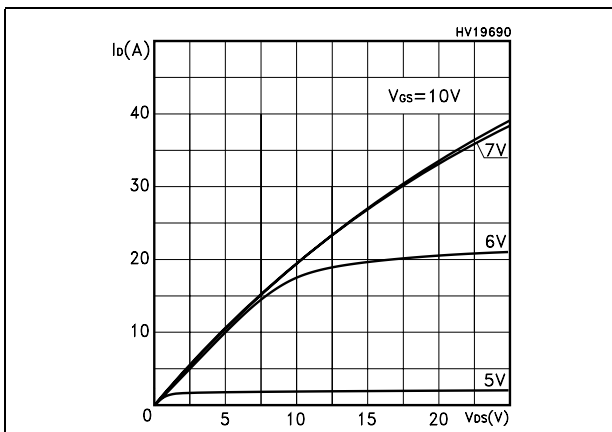


Figure 4. Transfer characteristics

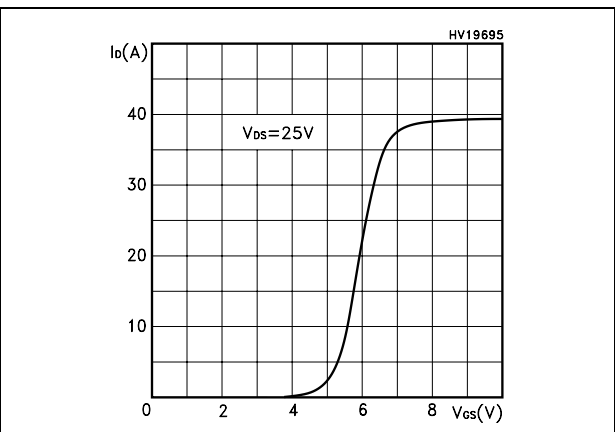


Figure 5. Transconductance

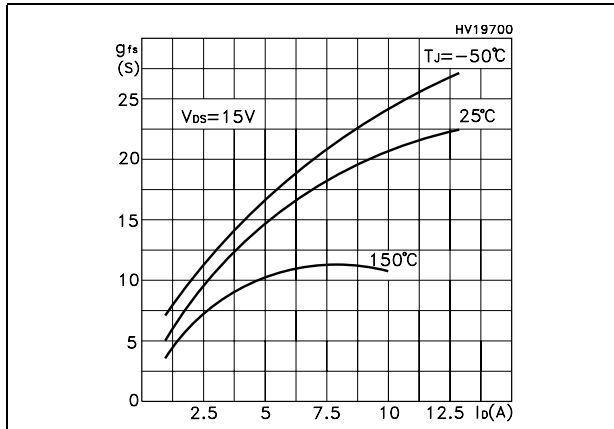


Figure 6. Static drain-source on resistance

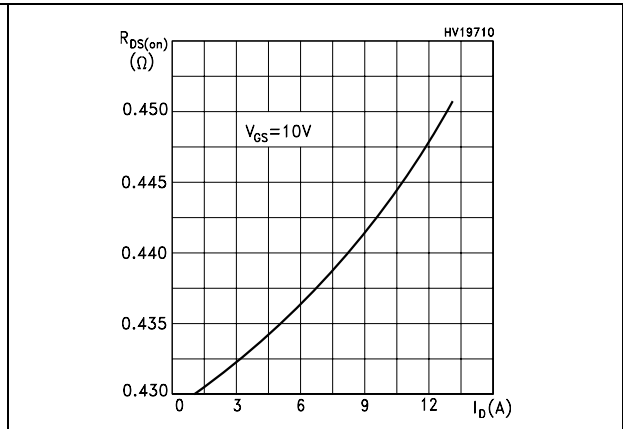


Figure 7. Gate charge vs gate-source voltage

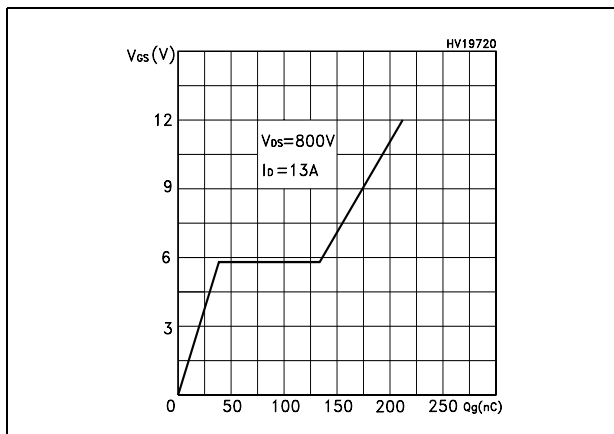


Figure 8. Capacitance variations

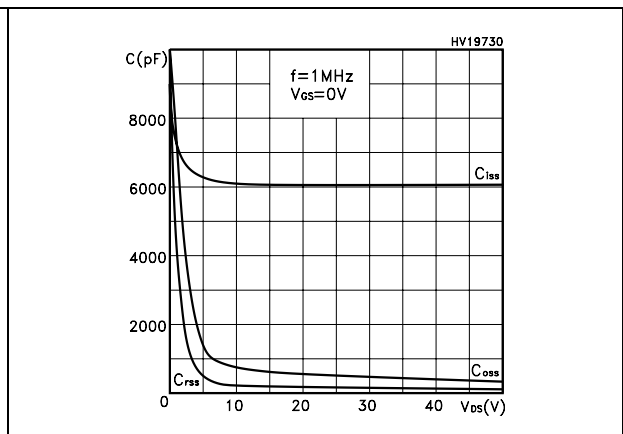


Figure 9. Normalized gate threshold voltage vs temperature

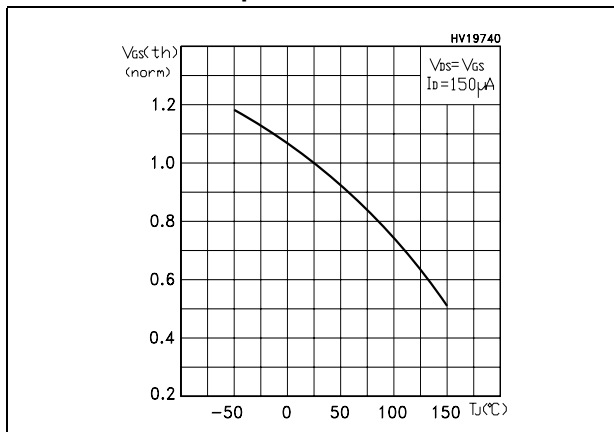


Figure 10. Normalized on resistance vs temperature

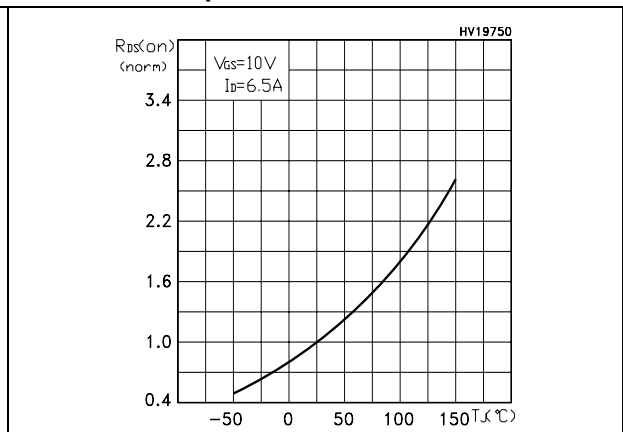


Figure 11. Source-drain diode forward characteristics

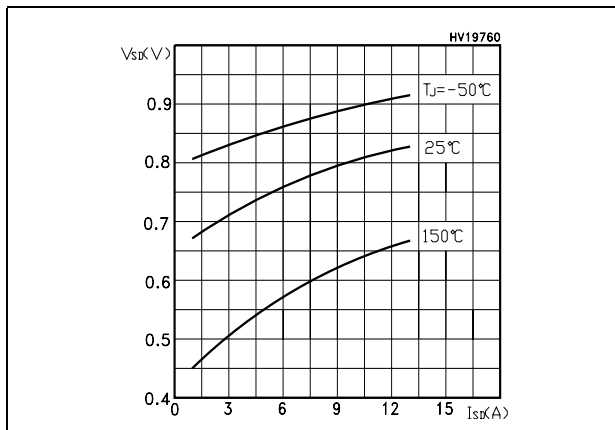


Figure 12. Normalized B_{VDSS} vs temperature

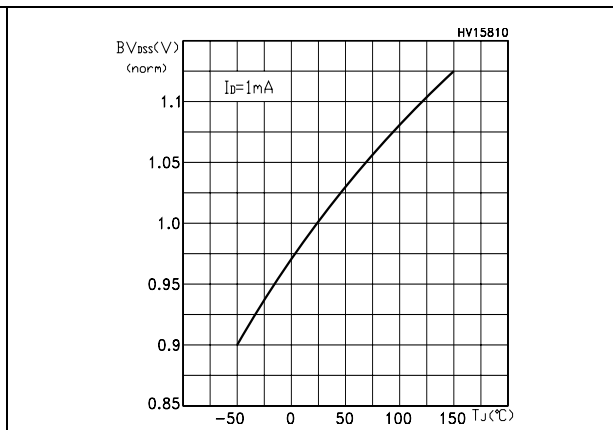
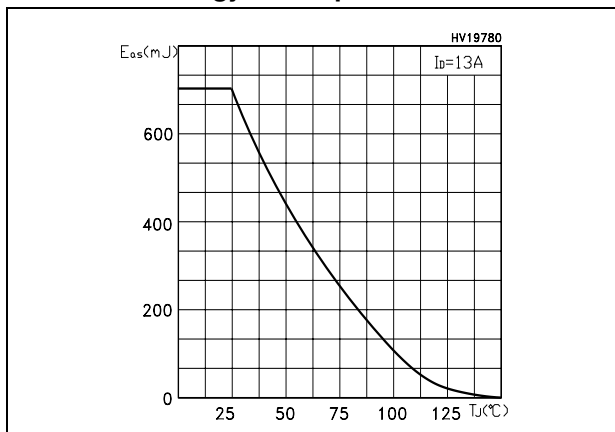


Figure 13. Maximum avalanche energy vs temperature



3 Test circuit

Figure 14. Unclamped Inductive load test circuit

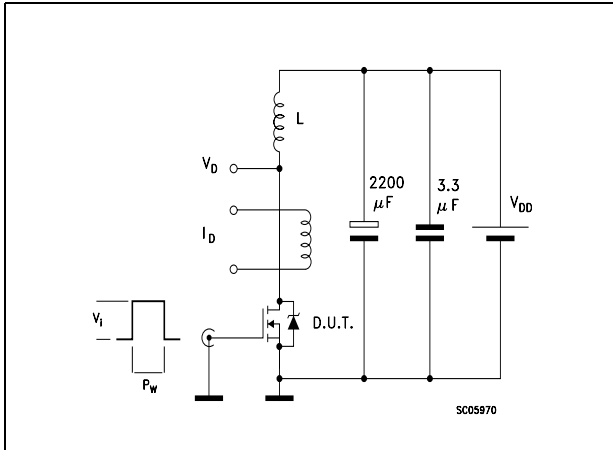


Figure 15. Unclamped Inductive waveform

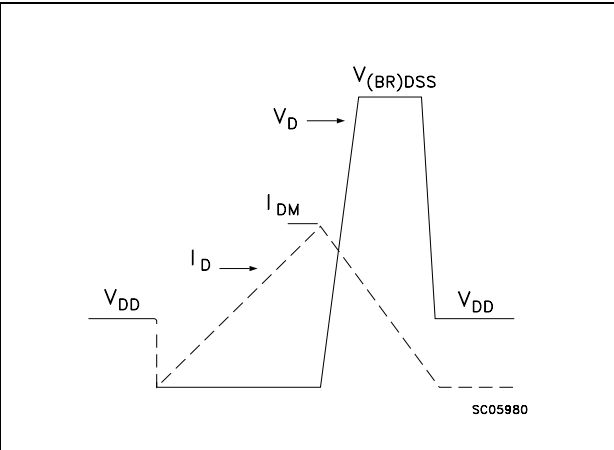


Figure 16. Switching times test circuit for resistive load

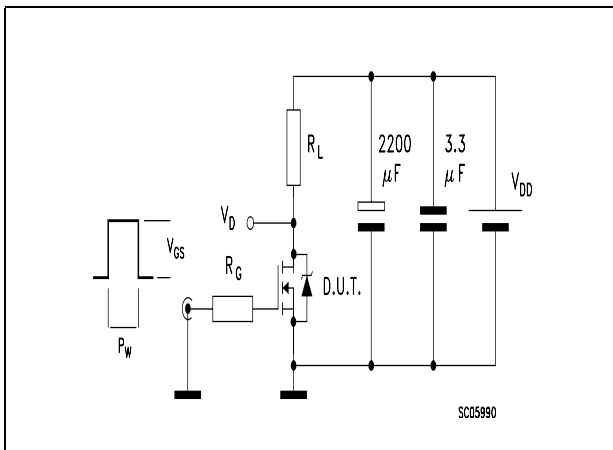


Figure 17. Gate charge test circuit

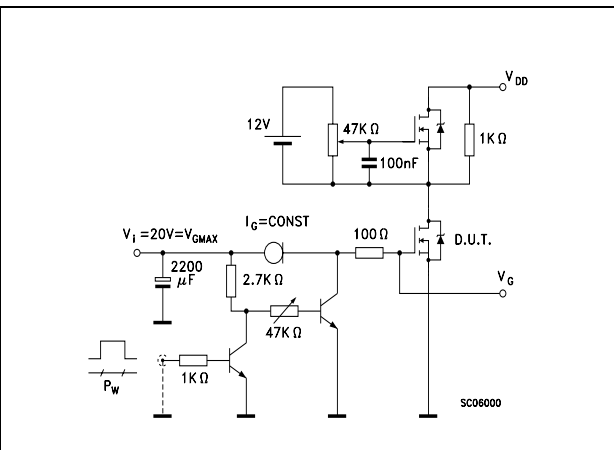
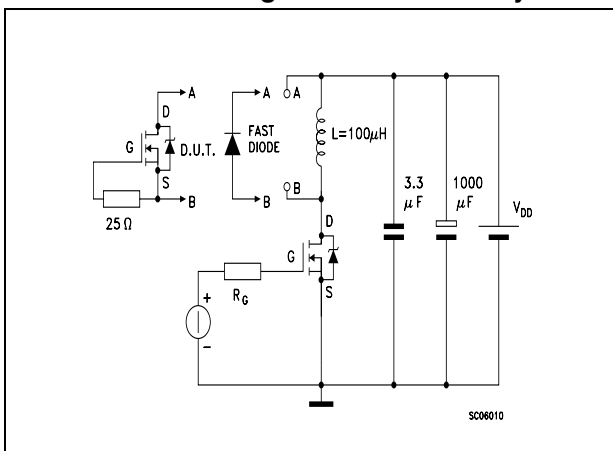


Figure 18. Test circuit for inductive load switching and diode recovery times

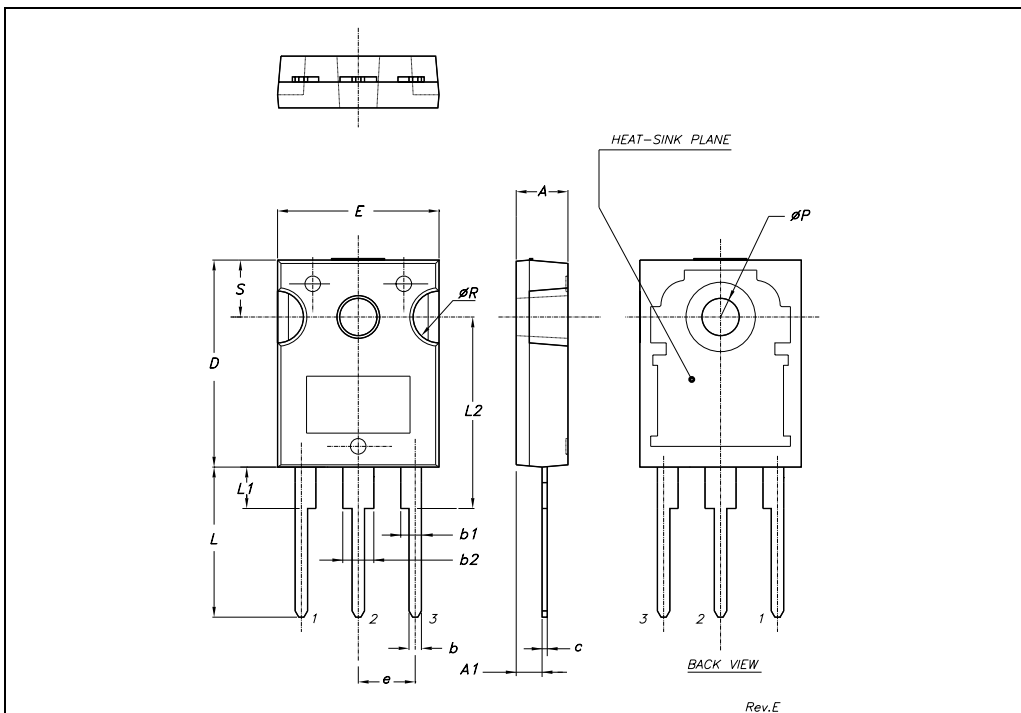


4 Package mechanical data

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-247 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.85		5.15	0.19		0.20
A1	2.20		2.60	0.086		0.102
b	1.0		1.40	0.039		0.055
b1	2.0		2.40	0.079		0.094
b2	3.0		3.40	0.118		0.134
c	0.40		0.80	0.015		0.03
D	19.85		20.15	0.781		0.793
E	15.45		15.75	0.608		0.620
e		5.45			0.214	
L	14.20		14.80	0.560		0.582
L1	3.70		4.30	0.14		0.17
L2		18.50			0.728	
øP	3.55		3.65	0.140		0.143
øR	4.50		5.50	0.177		0.216
S		5.50			0.216	



5 Revision history

Table 8. Revision history

Date	Revision	Changes
22-Jun-2004	1	Target document
09-Sep-2004	2	Preliminary document
28-Jan-2005	3	Complete version with curves
18-Sep-2005	4	<i>Figure 12</i> changed
01-Aug-2006	5	New template, no content change

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