STP6NK70Z
STF6NK70Z - STW6NK70Z

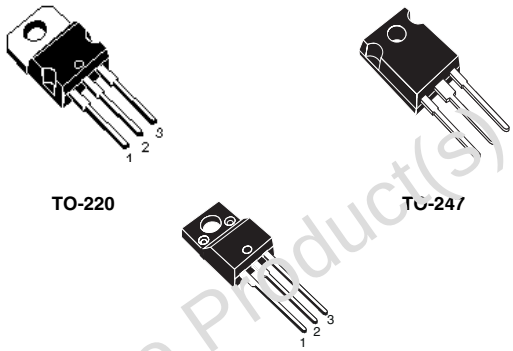
N-channel 700V - 1.5Ω - 5A - TO-220/TO-220FP Zener-protected SuperMESH™ Power MOSFET

General features

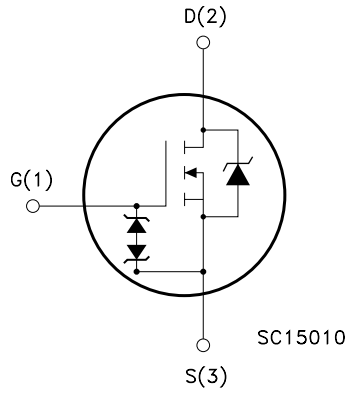
Type	V_{DSS} (@Tjmax)	$R_{DS(on)}$	I_D
STP6NK70Z	700 V	< 1.8 Ω	5 A
STF6NK70Z	700 V	<1.8 Ω	5 A(1)
STW6NK70Z	700 V	< 1.8 Ω	5 A

1. Limited only by maximum temperature allowed

- Extremely high dv/dt capability
- Improved esd capability
- 100% avalanche rated
- Gate charge minimized
- Very low intrinsic capacitances
- Very good manufacturing repeatibility



Internal schematic diagram



Description

The SuperMESH™ series is obtained through an extreme optimization of ST's well established stripbased 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

Order codes

Part number	Marking	Package	Packaging
STP6NK70Z	P6NK70Z	TO-220	Tube
STF6NK70Z	F6NK70Z	TO-220FP	Tube
STW6NK70Z	W5NK90Z	TO-247	Tube

Obsolete Product(s) - Obsolete Product(s)

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1.1 Protection features of gate-to-source zener diodes 4

2 Electrical characteristics 5
2.1 Electrical characteristics (curves) 7

3 Test circuit 10

4 Package mechanical data 11

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Obsolete Product(s) - Obsolete Product(s)

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220/TO-247	TO-220FP	
V_{DS}	Drain-source voltage (V_{GS} = 0)	700		V
V_{GS}	Gate-source voltage	± 30		V
I_D	Drain current (continuous) at T_C = 25°C	5	5 (2)	A
I_D	Drain current (continuous) at T_C=100°C	3.15	3.15 (2)	A
I_{DM} (1)	Drain current (pulsed)	20	20 (2)	A
P_{TOT}	Total dissipation at T_C = 25°C	110	30	W
	Derating factor	0.87	0.24	W/°C
$V_{ESD\ (G-S)}$	Gate source ESD (HBM-C=100pF, R=1.5KΩ)	4000		V
dv/dt(3)	Peak diode recovery voltage slope	4.5		V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1s; Tc= 25°C)	-	2500	V
T_J T_{stg}	Operating junction temperature Storage temperature	-55 to 150		°C

1. Pulse width limited by safe operation area
2. Limited only by maximum temperature allowed
3. $I_{SD} \leq 5$ A, di/dt ≤100A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		TO-220/TO-247	TO-220FP	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	1.14	4.2	°C/W
$R_{thj\text{-}a}$	Thermal resistance junction-ambient max	62.5		°C/W
T_l	Maximum lead temperature for soldering purpose	300		°C

Obsolete Product(s) - Obsolete Product(s)

Table 3. Avalanche characteristics

Symbol	Parameter	Max Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by Tj Max)	5	A
E_{AS}	Single pulse avalanche energy (starting Tj=25°C, Id=Iar, Vdd=50V)	200	mJ

Table 4. Gate-source zener diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
BV_{GSO}	Gate-Source breakdown voltage	Igs=±1mA (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.

Obsolete Product(s) - Obsolete Product(s)

2 Electrical characteristics

(T_{CASE}=25°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} = Max rating, V_{DS} = Max rating, Tc=125°C			1 50	µA µA
I_{GSS}	Gate body leakage current (V_{GS} = 0)	V_{GS} = ± 20V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 100µA	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 2.5 A		1.5	1.8	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward transconductance	V_{DS} = 15V, I_D = 2.5A		4.4		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} =25V, f=1 MHz, V_{GS}=0		930 105 22		pF pF pF
C_{osseq} (2).	Equivalent output capacitance	V_{GS}=0, V_{DS} =0V to 560V		70		pF
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on delay time Rise time Off-voltage rise time Fall time	V_{DD}=350 V, I_D= 2.5 A, R_G=4.7Ω, V_{GS}=10V (see *Figure 18*)		17 18 45 30		ns ns ns ns
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD}=560V, I_D = 5A V_{GS} =10V (see *Figure 19*)		34 6.5 17	47	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} increases from 0 to 80% V_{DSS}

Obsolete Product(s) - Obsolete Product(s)

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current				5	A
I_{SDM}(1)	Source-drain current (pulsed)				20	A
V_{SD}(2)	Forward on voltage	I_{SD} = 5 A, V_{GS}=0			1.6	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 5 A, di/dt = 100 A/µs V_{DD} = 35 V (see *Figure 20*)		432 2.37 11		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 5 A, di/dt = 100 A/µs V_{DD} = 35 V, Tj = 150 °C (see *Figure 20*)		588 3.38 11.5		ns µC A

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

Obsolete Product(s) - Obsolete Product(s)

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

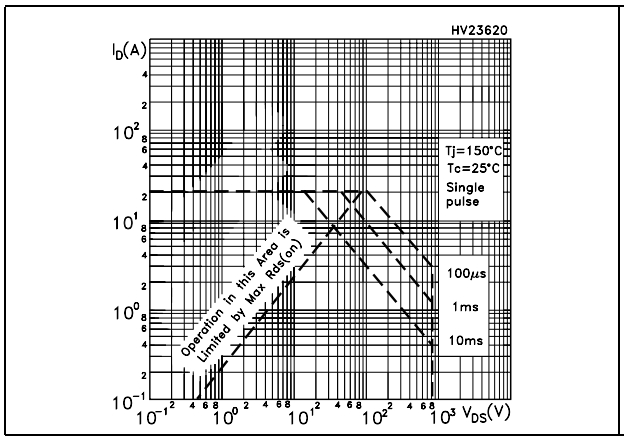


Figure 2. Thermal impedance

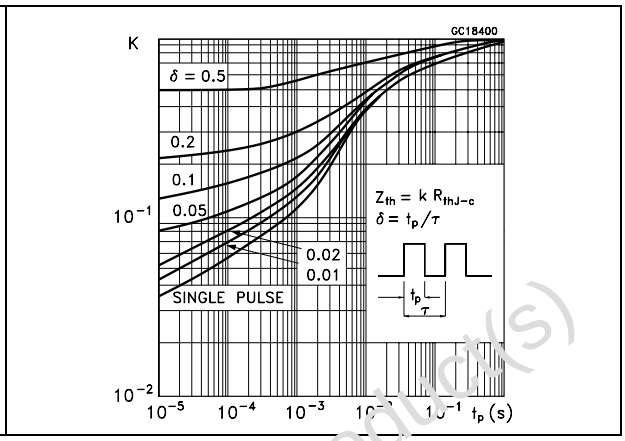


Figure 3. Safe operating area for TO-220FP

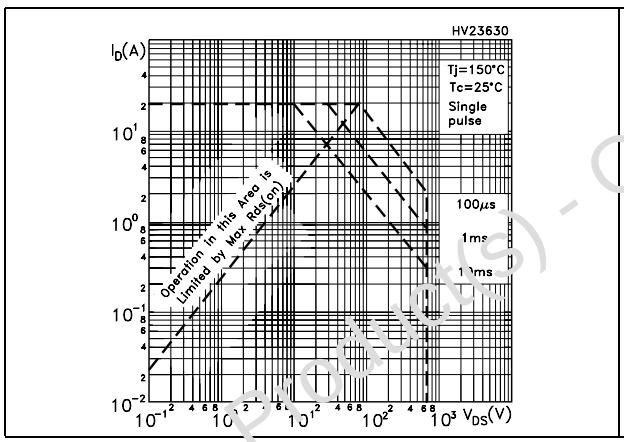


Figure 4. Thermal impedance for TO-220FP

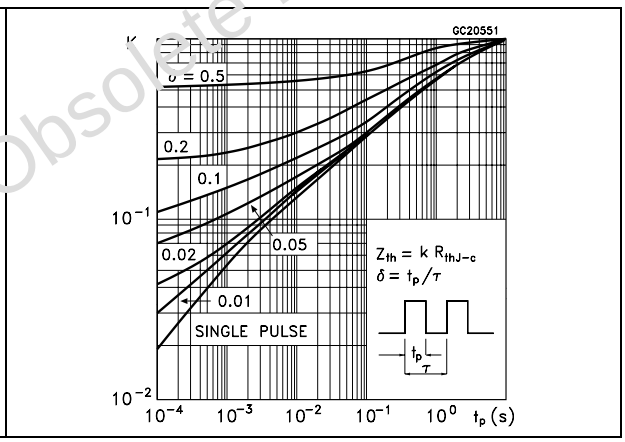


Figure 5. Safe operating area for TO-247

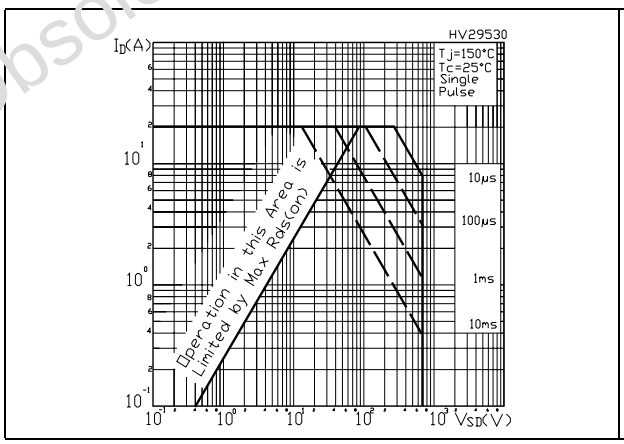
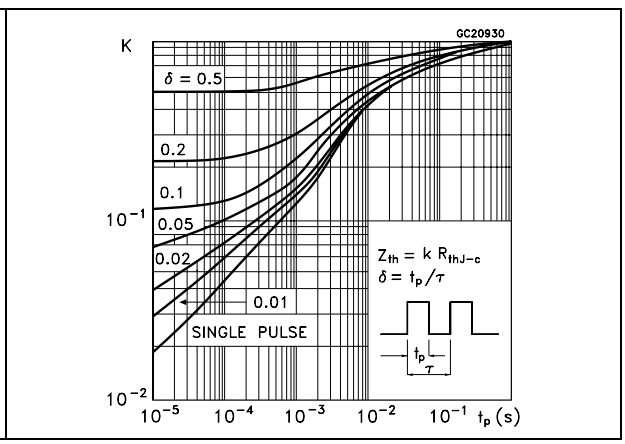


Figure 6. Thermal impedance for TO-247



Obsolete Product(s) - Obsolete Product(s)

Figure 7. Output characteristics

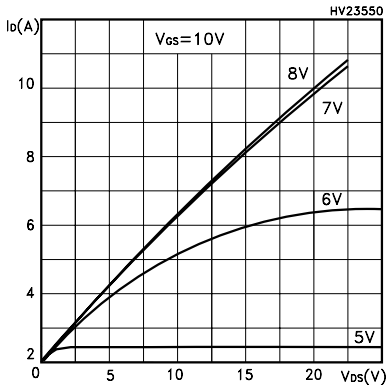


Figure 8. Transfer characteristics

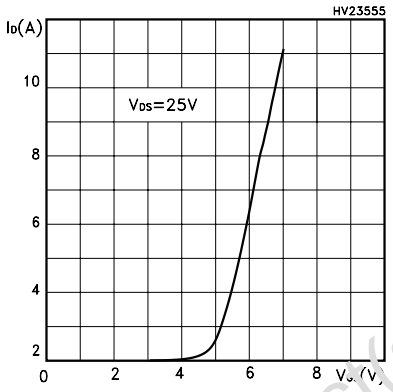


Figure 9. Transconductance

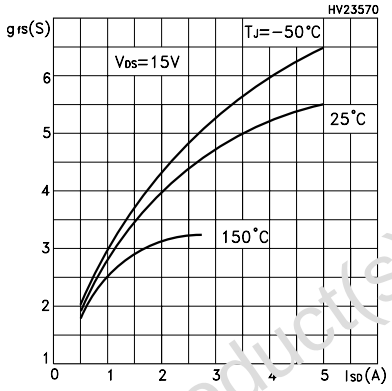


Figure 10. Static drain-source on resistance

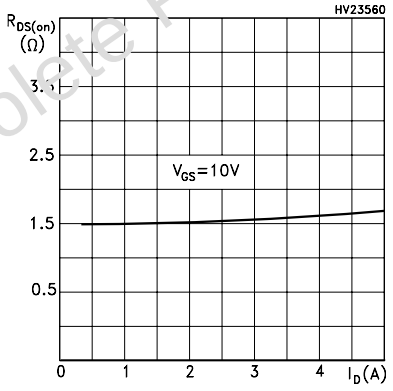


Figure 11. Gate charge vs gate-source voltage

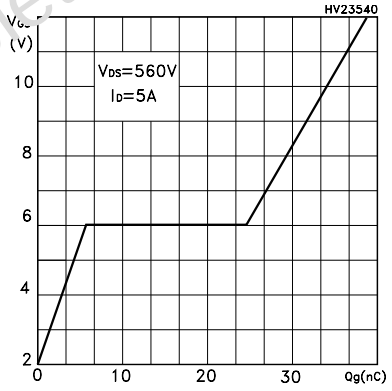
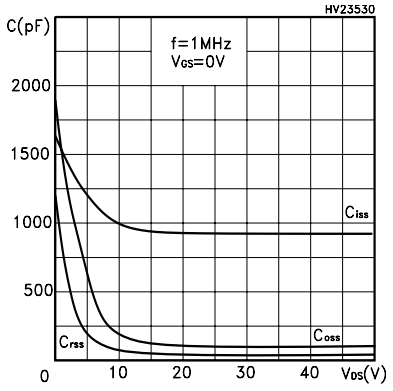


Figure 12. Capacitance variations



Obsolete Product(s) - Obsolete Product(s)

Figure 13. Source-drain diode forward characteristics

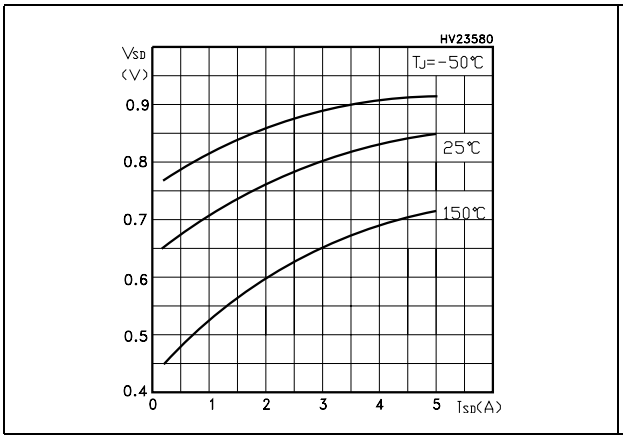


Figure 14. Normalizzed BVdss vs temperature

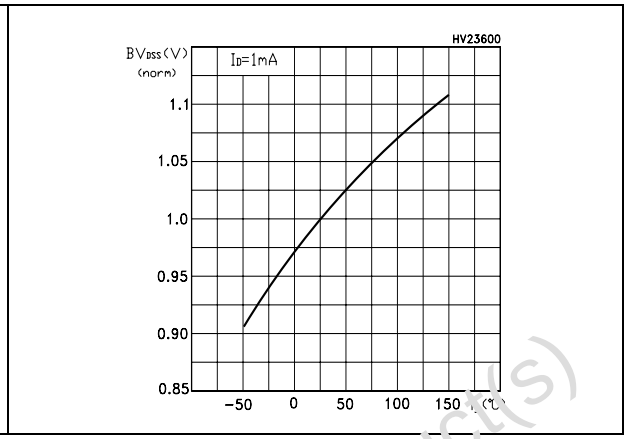
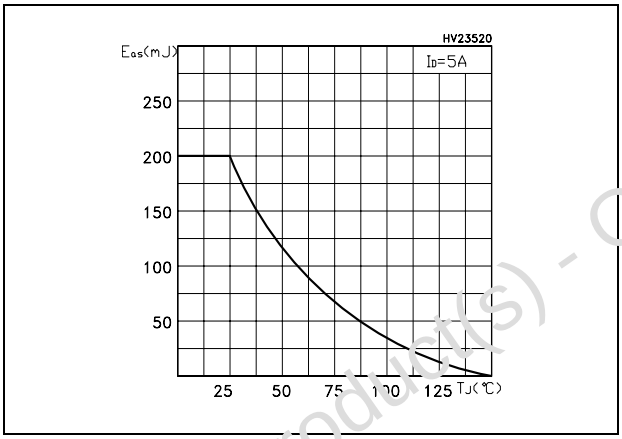


Figure 15. Avalanche Energy vs starting Tj



Obsolete Product(s) - Obsolete Product(s)

3 Test circuit

Figure 16. Unclamped inductive load test circuit

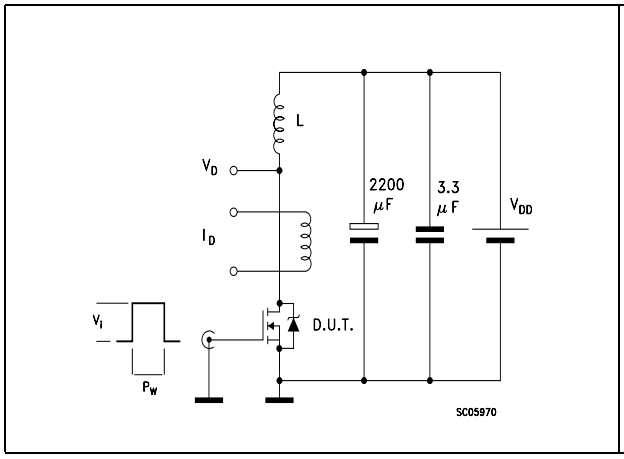


Figure 17. Unclamped inductive wafeform

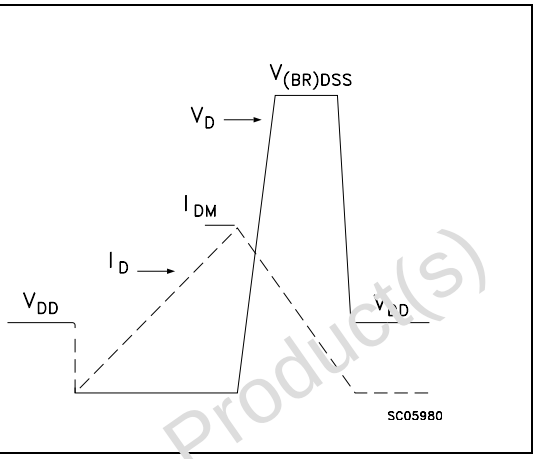


Figure 18. Switching times test circuit for resistive load

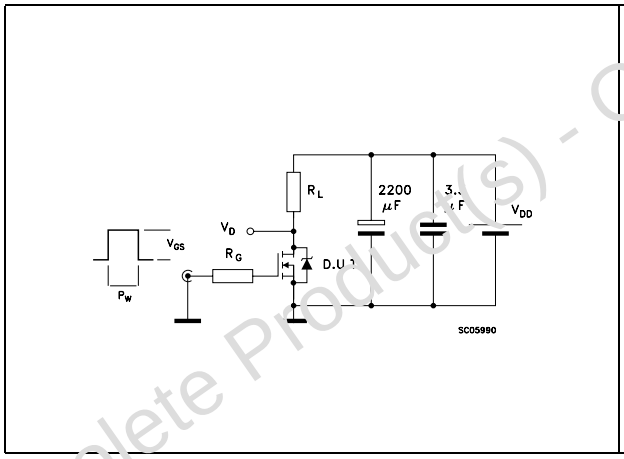


Figure 19. Gate charge test circuit

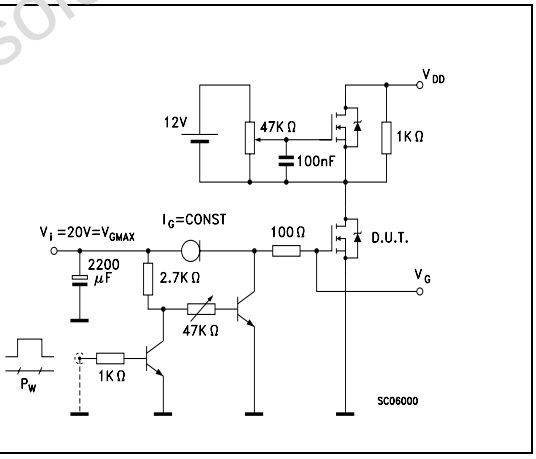
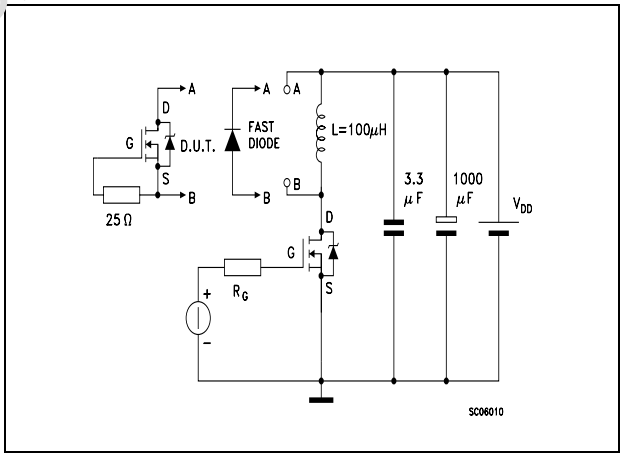


Figure 20. Test circuit for inductive load switching and diode recovery times



Obsolete Product(s) - Obsolete Product(s)

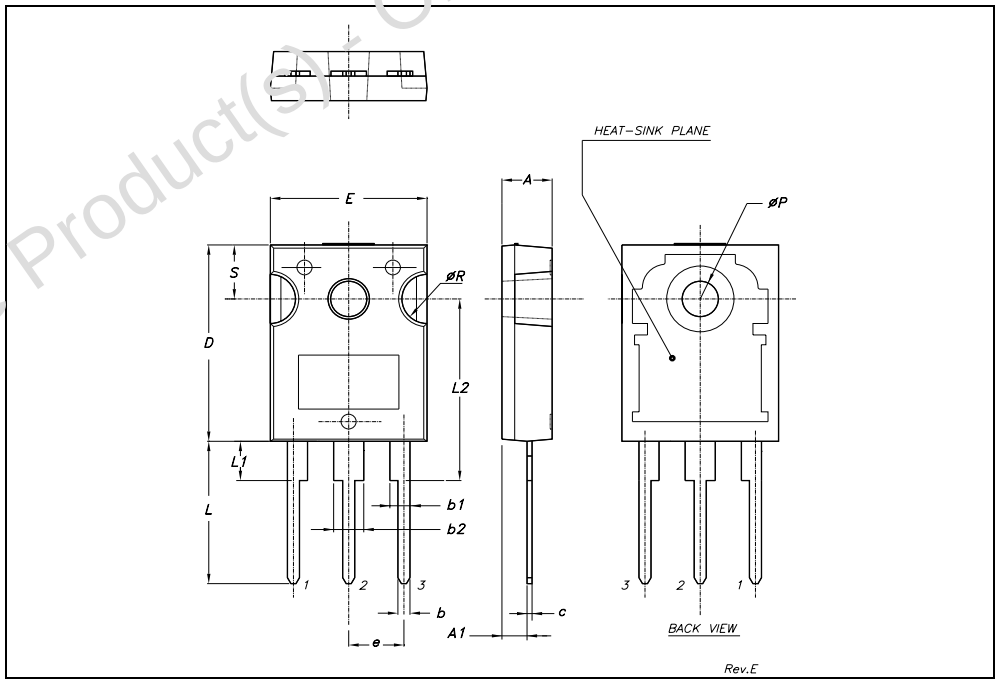
4 Package mechanical data

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

Obsolete Product(s) - Obsolete Product(s)

TO-247 MECHANICAL DATA

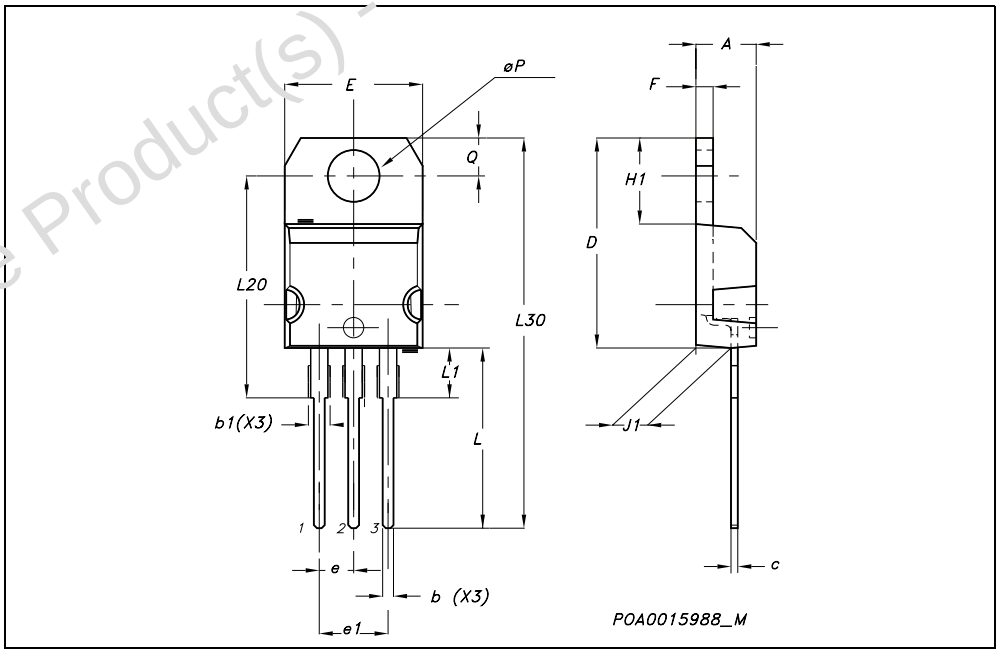
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.85		5.15	0.19		0.20
A1	2.20		2.60	0.086		0.102
b	1.0		1.40	0.039		0.055
b1	2.0		2.40	0.079		0.094
b2	3.0		3.40	0.118		0.134
c	0.40		0.80	0.015		0.03
D	19.85		20.15	0.781		0.793
E	15.45		15.75	0.608		0.620
e		5.45			0.214	
L	14.20		14.80	0.56		0.582
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	



Obsolete Product(s) - Obsolete Product(s)

TO-220 MECHANICAL DATA

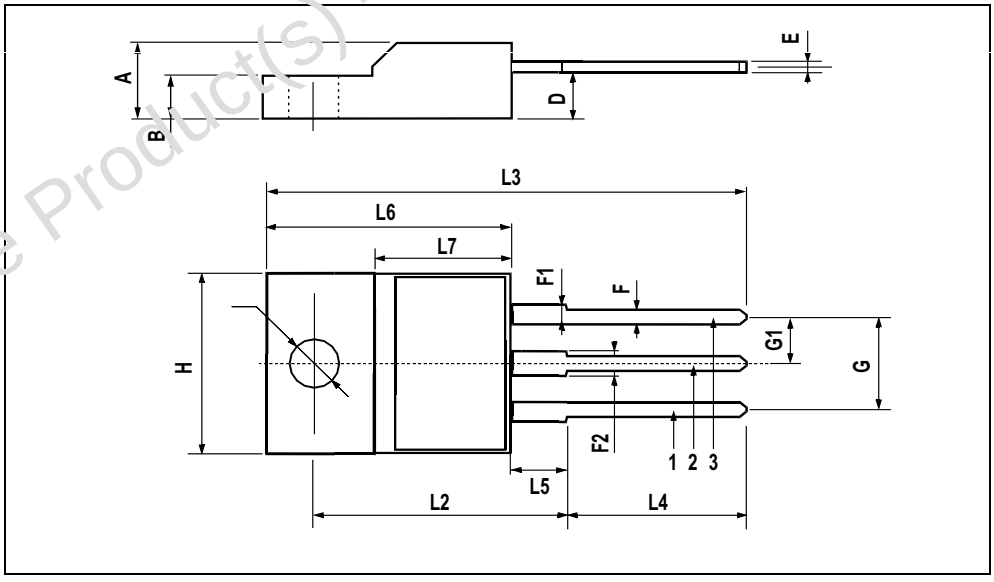
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244		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	
øP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



Obsolete Product(s) - Obsolete Product(s)

TO-220FP MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	0.385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126



Obsolete Product(s) - Obsolete Product(s)

5 Revision history

Table 8. Revision history

Date	Revision	Changes
12-Nov-2004	1	First release
08-Sep-2004	2	Complete version with curves
06-Sep-2005	3	Inserted Ecopack indication
16-Aug-2006	4	New template, no content change

Obsolete Product(s) - Obsolete Product(s)

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