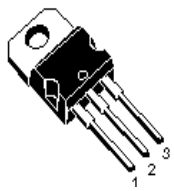
STP3HNK90Z
STF3HNK90Z

N-channel 900V - 0.35Ω - 3A - TO-220 - TO-220FP
Zener-protected SuperMESH™ Power MOSFET

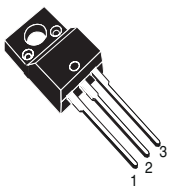
General features

Type	V_{DSS} (@Tjmax)	$R_{DS(on)}$	I_D
STP3HNK90Z	900 V	< 0.42 Ω	3 A
STP3HNK90Z	900 V	< 0.42 Ω	3 A

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



TO-220

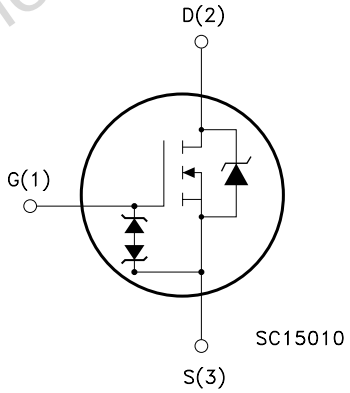


TO-220FP

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

Part number	Marking	Package	Packaging
STP3HNK90Z	P3HNK90Z	TO-220	Tube
STF3HNK90Z	F3HNK90Z	TO-220FP	Tube

Obsolete Product(s) - Obsolete Product(s)

Contents

1 **Electrical ratings** 3
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

5 **Revision history** 14

Obsolete Product(s) - Obsolete Product(s)

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		STP3HNK90Z	STF3HNK90Z	
V_{DS}	Drain-source voltage (V_{GS} = 0)	800		V
V_{DGR}	Drain-gate voltage (R_{GS} = 20KΩ)	800		V
V_{GS}	Gate-source voltage	± 30		V
I_D	Drain current (continuous) at T_C = 25°C	3	3 (1)	A
I_D	Drain current (continuous) at T_C=100°C	1.89	1.89 (1)	A
I_{DM}(2)	Drain current (pulsed)	12	12 (1)	A
P_{TOT}	Total dissipation at T_C = 25°C	90	25	W
	Derating factor	0.72	0.2	W/°C
$V_{ESD(G-S)}$	Gate source ESD(HBM-C=100pF, R=1.5KΩ)	3000		V
dv/dt (3)	Peak diode recovery voltage slope	4.5		V/ns
V_{ISO}	Insulation withstand voltage (DC)	-	2500	V
T_J T_{stg}	Operating junction temperature Storage temperature	-55 to 150		°C

1. Limited only by maximum temperature allowed
2. Pulse width limited by safe operating area
3. I_{SD} ≤3A, di/dt ≤200A/µs, V_{DD} ≤$V_{(BR)DSS}$, T_j ≤T_{JMAX}.

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		TO-220	TO-220FP	
$R_{thj\text{-}case}$	Thermal resistance junction-case Max	1.38	5	°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	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by Tj Max)	3	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	900			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} = ± 30V			±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 = 1.5 A		3.5	4.2	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward transconductance	V_{DS} =15V, I_D = 1.5A		19		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} =25V, f=1 MHz, V_{GS}=0		690 71 14.4		pF pF pF
C_{osseq} (2).	Equivalent output capacitance	V_{GS}=0, V_{DS} =0V to 720V		88		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}=450 V, I_D= 1.5 A, R_G=4.7Ω, V_{GS}=10V (see *Figure 18*)		23 28 42 27		ns ns ns ns
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD}=720V, I_D = 3A V_{GS} =10V		26 5.7 13.9	35	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				3	A
I_{SDM}(1)	Source-drain current (pulsed)				12	A
V_{SD}(2)	Forward on voltage	I_{SD}= 3 A, V_{GS}=0			1.6	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}=3 A, di/dt = 100A/µs, V_{DD}=50V, Tj=25°C (see *Figure 20*)		494 2.4 9.8		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}=3A, di/dt = 100A/µs, V_{DD}=50V, Tj=150°C (see *Figure 20*)		628 3.2 10.2		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 for TO-220

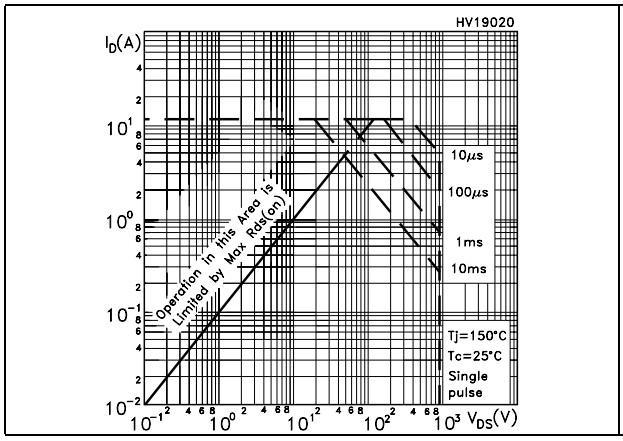


Figure 2. Thermal impedance for TO-220

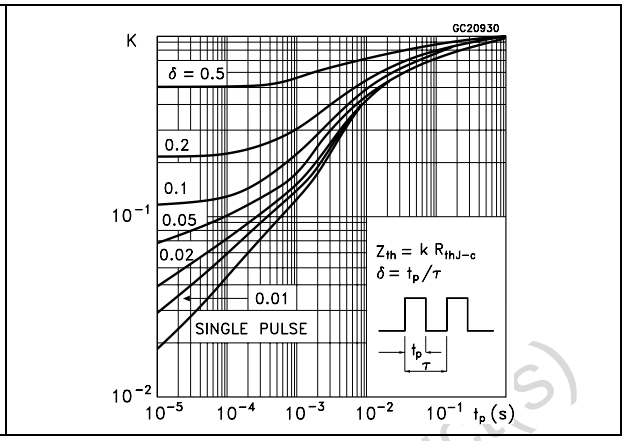


Figure 3. Safe operating area for TO-220FP

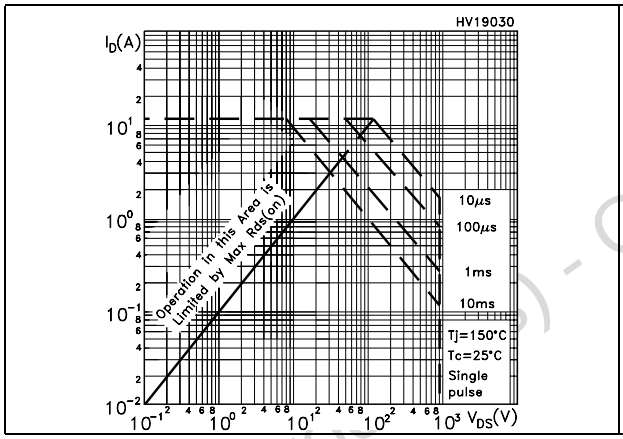


Figure 4. Thermal impedance for TO-220FP

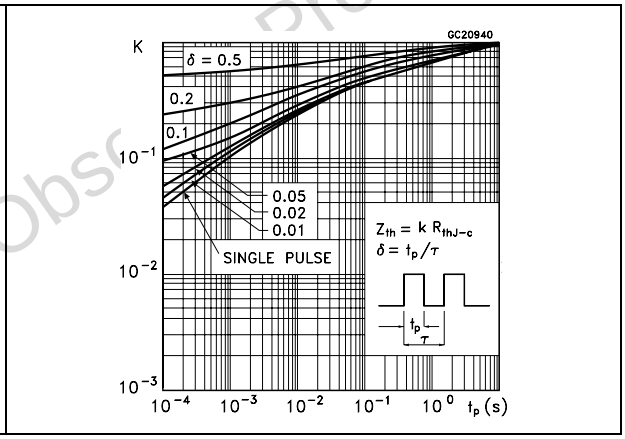


Figure 5. Output characterisics

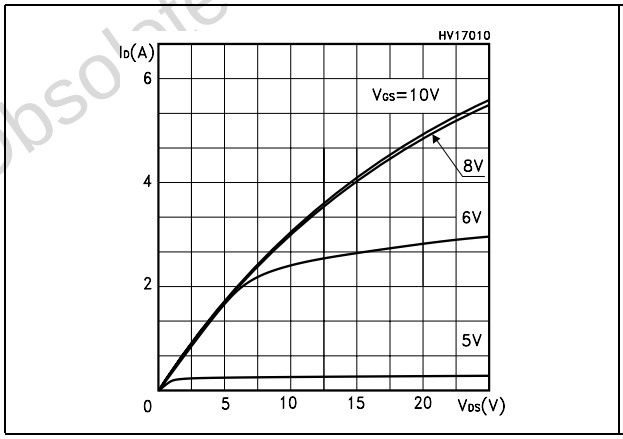
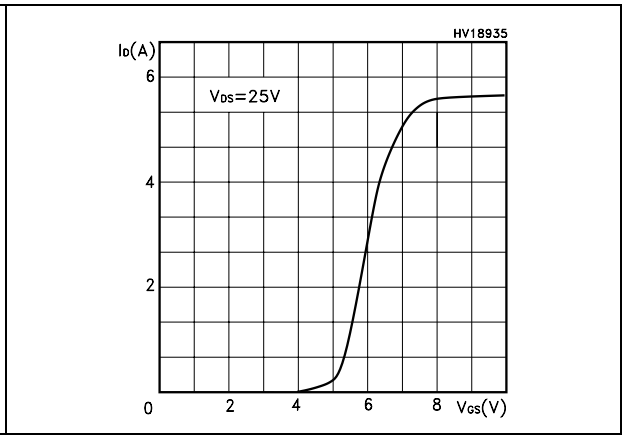


Figure 6. Transfer characteristics



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Figure 7. Transconductance

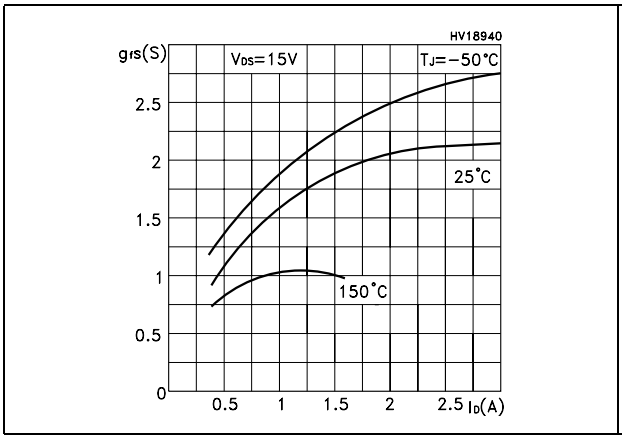


Figure 8. Static drain-source on resistance

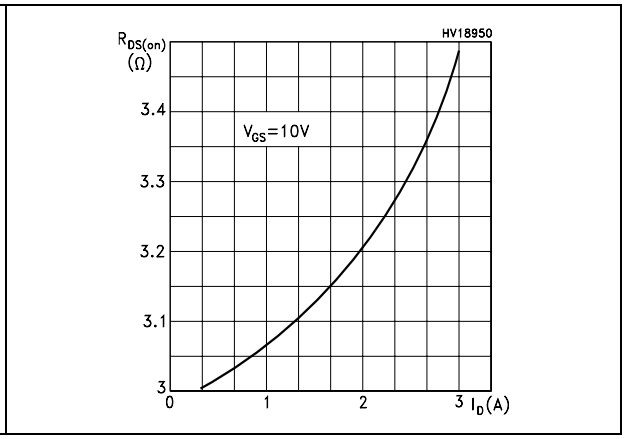


Figure 9. Gate charge vs gate-source voltage

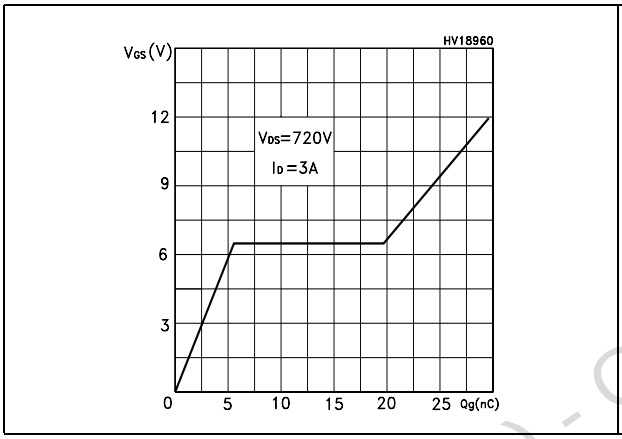


Figure 10. Capacitance variations

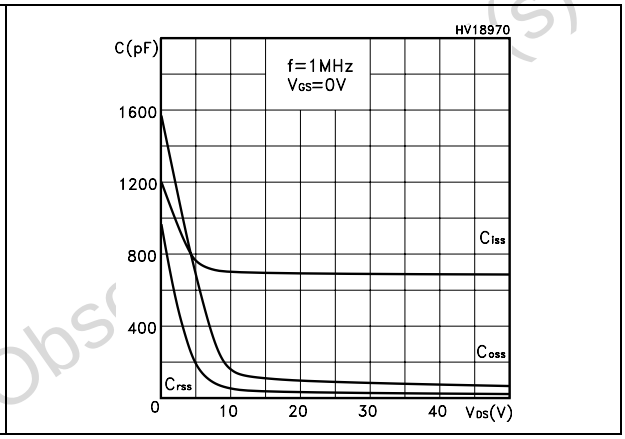


Figure 11. Normalized gate threshold voltage vs temperature

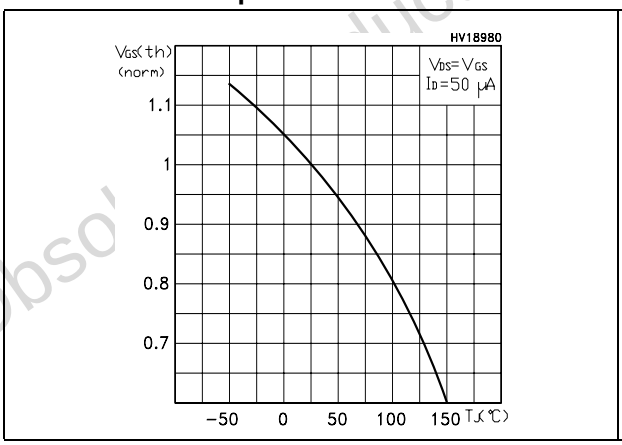
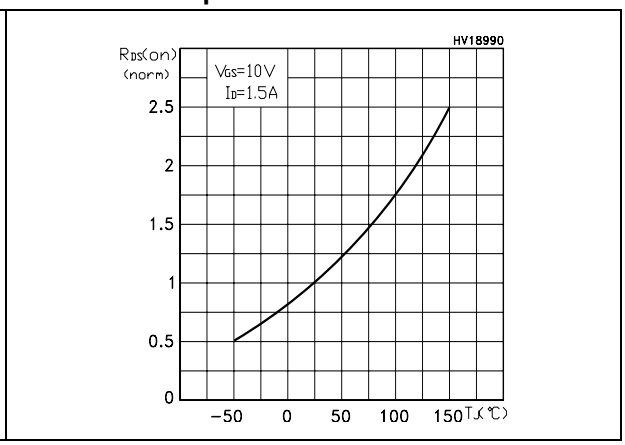


Figure 12. Normalized on resistance vs temperature



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Figure 13. Source-drain diode forward characteristics

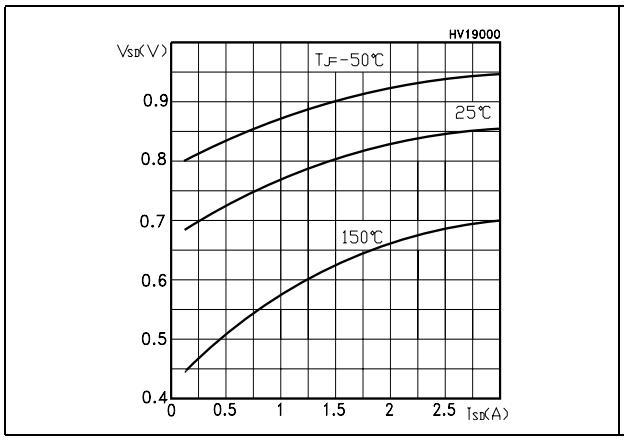


Figure 14. Normalized B_{VDSS} vs temperature

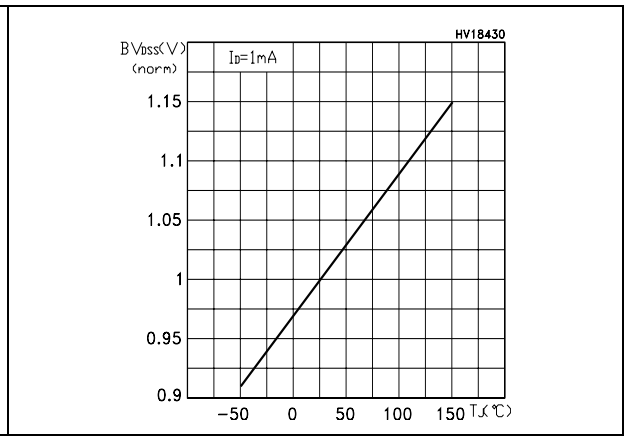
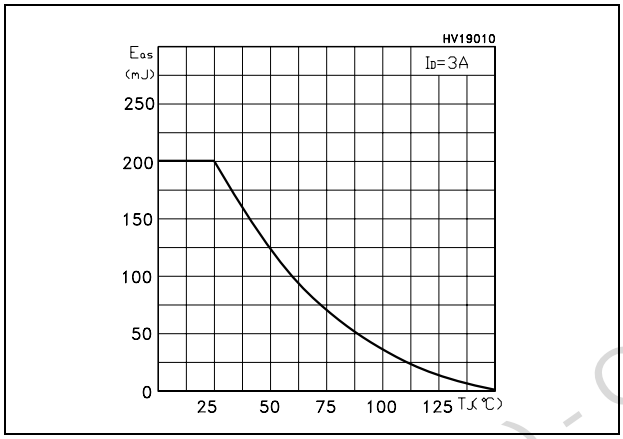


Figure 15. Maximum avalanche energy vs temperature



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3 Test circuit

Figure 16. Unclamped Inductive load test circuit

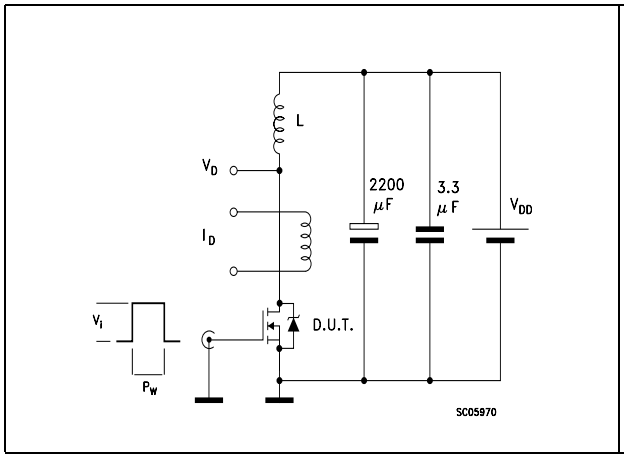


Figure 17. Unclamped Inductive waveform

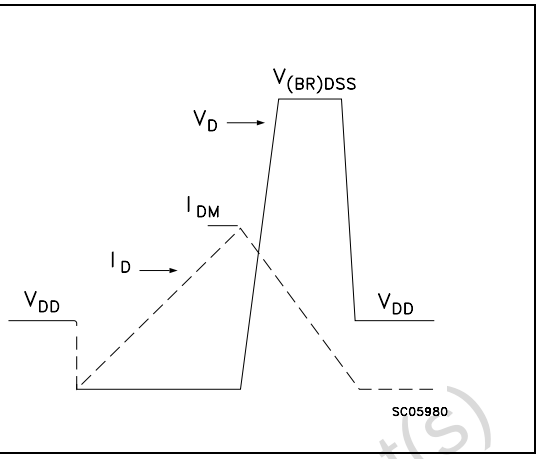


Figure 18. Switching times test circuit for resistive load

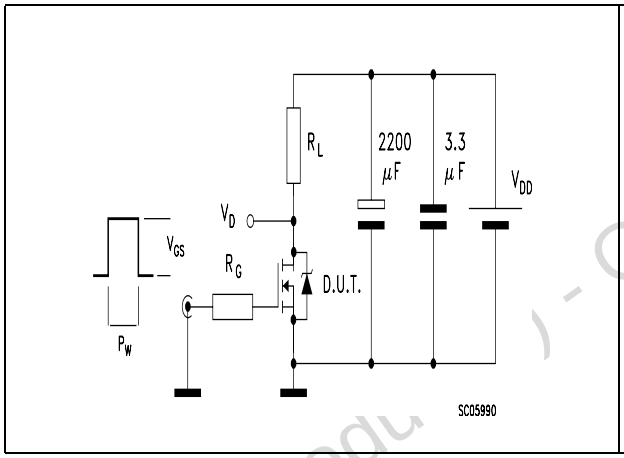


Figure 19. Gate charge test circuit

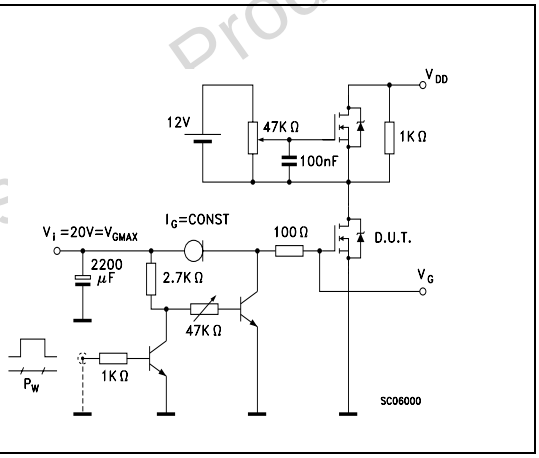
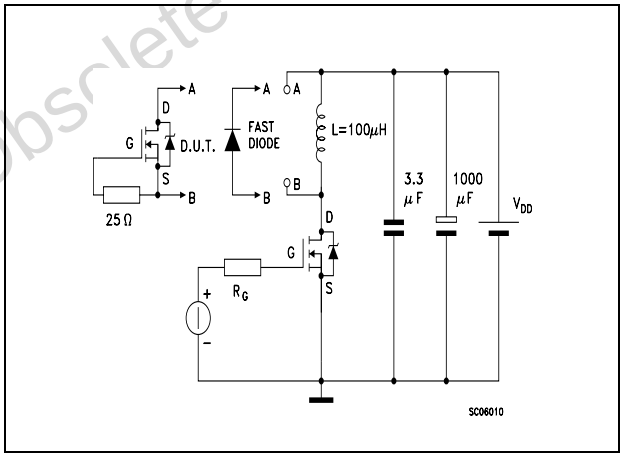


Figure 20. Test circuit for inductive load switching and diode recovery times



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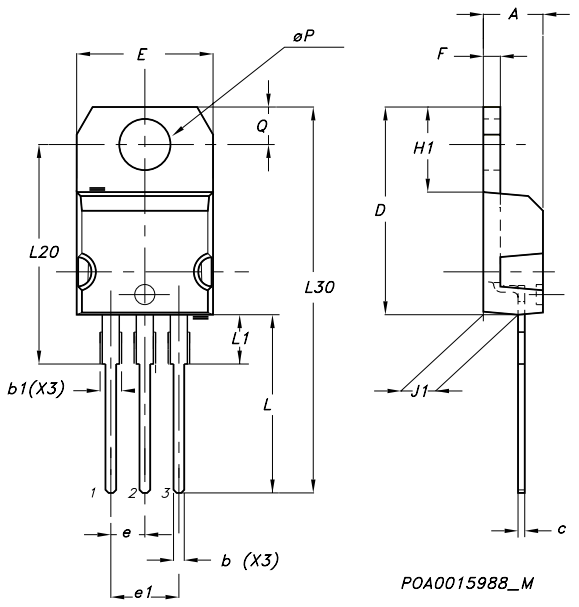
4 Package mechanical data

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-220 MECHANICAL DATA

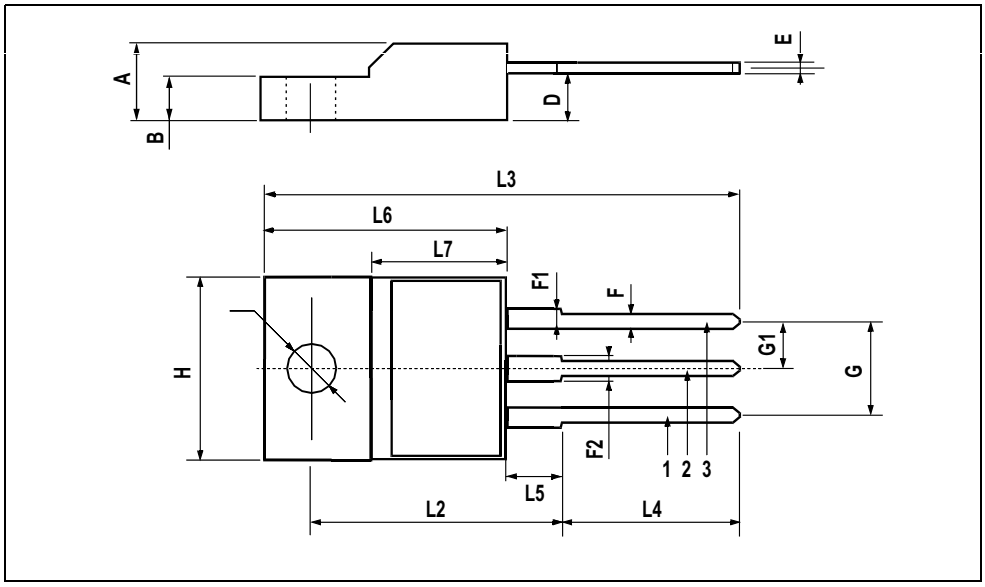
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244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



Obsole

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	.0385		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



Obsole

5 Revision history

Table 8. Revision history

Date	Revision	Changes
09-Sep-2004	2	Complete document
10-Aug-2006	3	New template, no content change

Obsolete Product(s) - Obsolete Product(s)

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