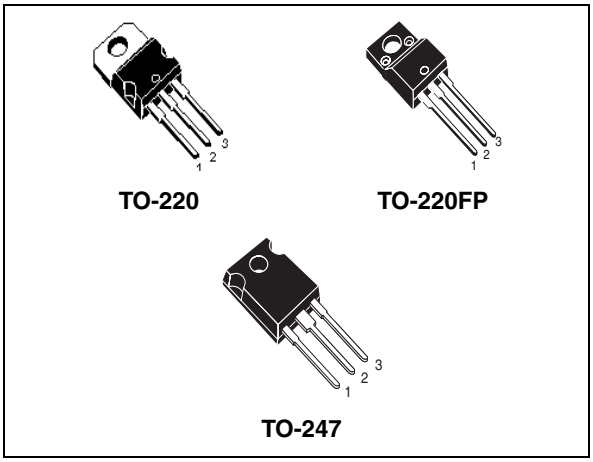
STP5NK100Z, STF5NK100Z
STW5NK100Z

N-channel 1000 V, 2.7 Ω, 3.5 A, TO-220, TO-220FP, TO-247 SuperMESH3™ Power MOSFET

Features

Type	V_{DSS} (@T_{JMAX})	$R_{DS(on)}$max	I_D
STF5NK100Z	1000 V	< 3.7 Ω	3.5 A
STP5NK100Z	1000 V	< 3.7 Ω	3.5 A
STW5NK100Z	1000 V	< 3.7 Ω	3.5 A

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



Applications

- Switching application

Description

The new SuperMESH™ series of Power MOSFETS is the result of further design improvements on ST's well-established strip-based PowerMESH™ layout. In addition to significantly lower on-resistance, the device offers superior dv/dt capability to ensure optimal performance even in the most demanding applications. The SuperMESH™ devices further complement an already broad range of innovative high voltage MOSFETs, which includes the revolutionary MDmesh™ products.

Figure 1. Internal schematic diagram

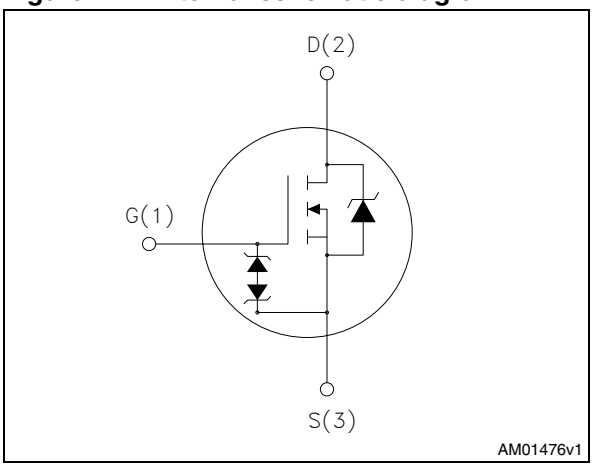


Table 1. Device summary

Order code	Marking	Package	Packaging
STF5NK100Z	F5NK100Z	TO-220FP	Tube
STP5NK100Z	P5NK100Z	TO-220	Tube
STW5NK100Z	W5NK100Z	TO-247	Tube

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Contents

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220, TO-247	TO-220FP	
V_{DS}	Drain-source voltage (V_{GS} = 0)	1000		V
V_{GS}	Gate-source voltage	± 30		V
I_D	Drain current (continuous) at T_C = 25°C	3.5	3.5 (1)	A
I_D	Drain current (continuous) at T_C=100°C	2.2	2.2 (1)	A
I_{DM}(2)	Drain current (pulsed)	14	14 (1)	A
P_{TOT}	Total dissipation at T_C = 25°C	125	30	W
	Derating factor	1	0.24	W/°C
$V_{ESD(G-S)}$	Gate source ESD (HBM-C=100pF, R=1.5 kΩ)	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=1 s; Tc= 25°C)		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. $I_{SD} \leq 3.5$ A, di/dt ≤ 200 A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$.

Table 3. Thermal data

Symbol	Parameter	Value		Unit
		TO-220, TO-247	TO-220FP	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	1	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

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_{JMAX})	3.5	A
E_{AS}	Single pulse avalanche energy (starting T_j=25 °C, Id=Iar, Vdd=50 V)	250	mJ

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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 = 1 mA, V_{GS}= 0	1000			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} = ± 20 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 100 µA	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 1.75 A		2.7	3.7	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward transconductance	V_{DS} =15 V, I_D = 1.75 A	-	4		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} =25 V, f=1 MHz, V_{GS}=0	-	1154 106 21.3		pF pF pF
C_{osseq} (2)	Equivalent output capacitance	V_{GS}=0, V_{DS} =0 V to 800 V	-	46.8		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}=500 V, I_D= 1.75 A, R_G=4.7 Ω, V_{GS}=10 V (see *Figure 21*)	-	22.5 7.7 51.5 19		ns ns ns ns
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD}=800 V, I_D = 3.5 A V_{GS} =10 V (see *Figure 22*)	-	42 7.3 21.7	59	nC nC 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}

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Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		3.5	A
I_{SDM}(1)	Source-drain current (pulsed)		-		14	A
V_{SD}(2)	Forward on voltage	I_{SD}= 3.5 A, V_{GS}=0	-		1.6	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}= 3.5 A, di/dt = 100 A/µs, V_{DD}=30 V (see *Figure 23*)	-	605 3.09 10.5		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}= 3.5 A, di/dt = 100 A/µs, V_{DD}=35 V, T_j=150 °C (see *Figure 23*)	-	742 4.2 11.2		ns µC A

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

Table 8. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
BV_{GSO}	Gate-source breakdown voltage	Igs=± 1 mA (open drain)	30			V

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.

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2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220FP

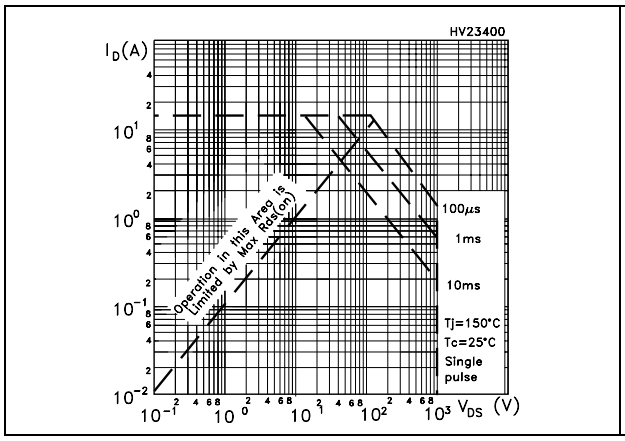

Figure 3. Thermal impedance for TO-220FP

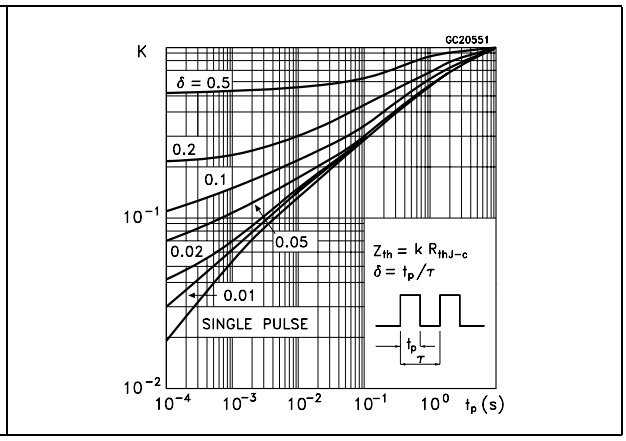

Figure 4. Safe operating area for TO-220

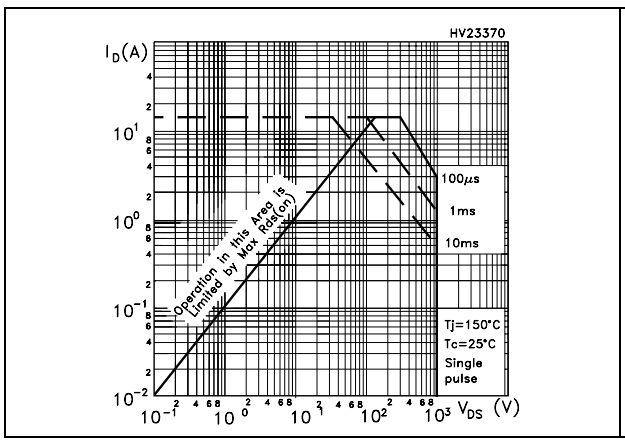

Figure 5. Thermal impedance for TO-220

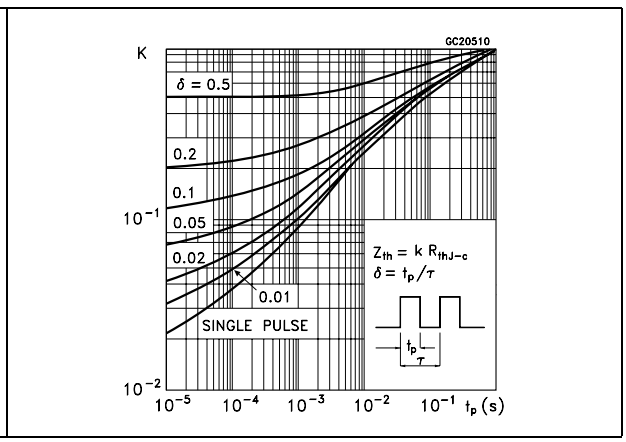

Figure 6. Safe operating area for TO-247

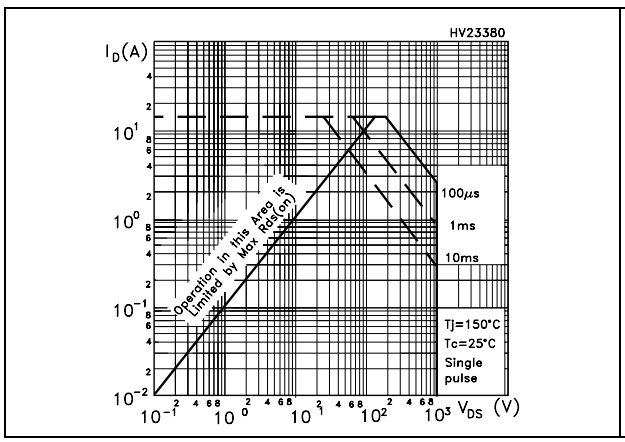

Figure 7. Thermal impedance for TO-247

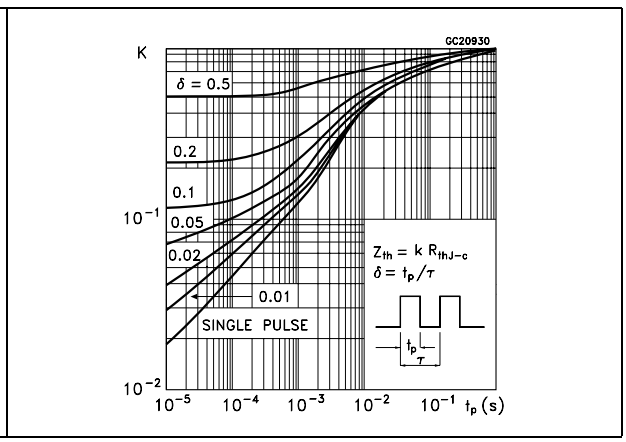

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Figure 8. Output characteristics

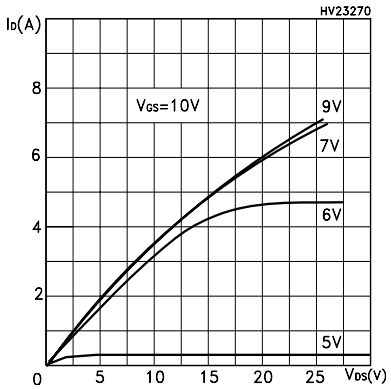

Figure 9. Transfer characteristics

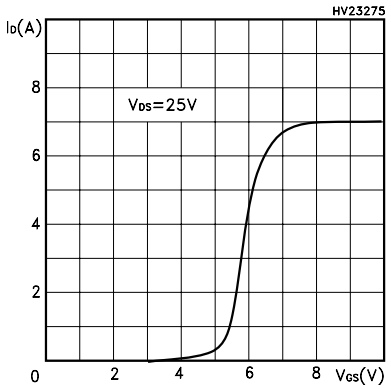

Figure 10. Transconductance

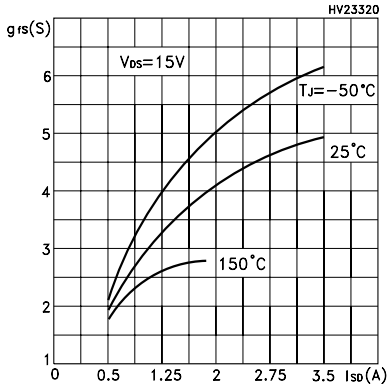

Figure 11. Static drain-source on resistance

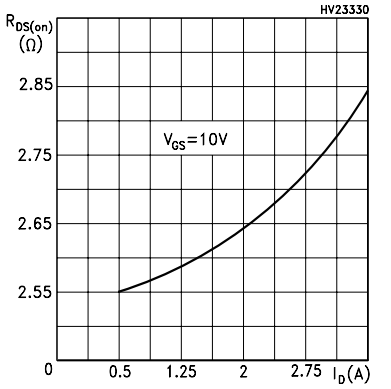

Figure 12. Gate charge vs gate-source voltage

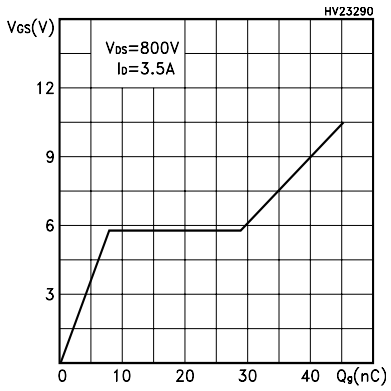

Figure 13. Capacitance variations

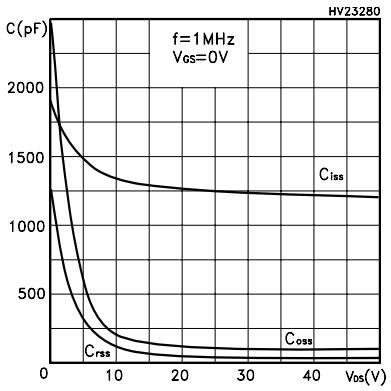

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Figure 14. Normalized gate threshold voltage vs temperature

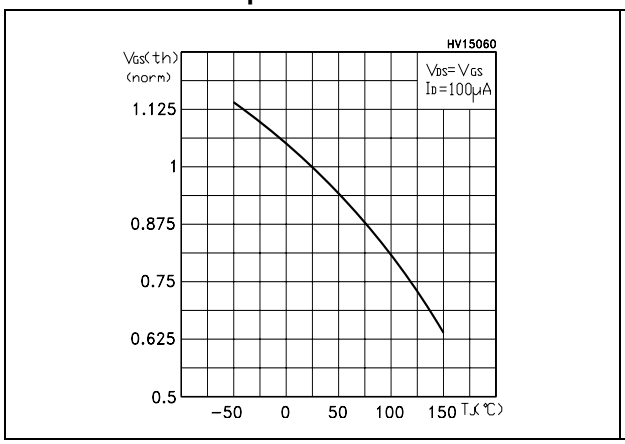


Figure 15. Normalized on resistance vs temperature

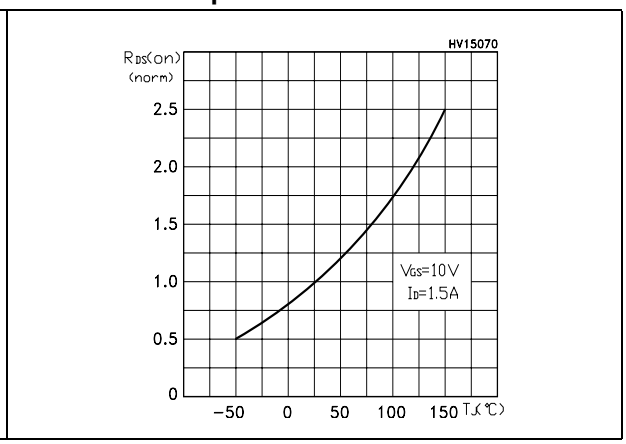


Figure 16. Source-drain diode forward characteristics

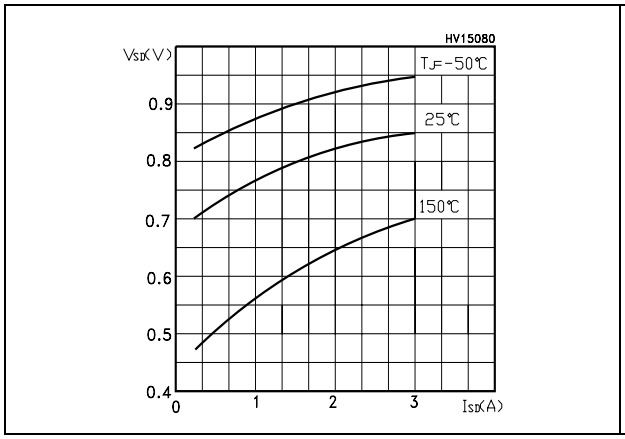


Figure 17. Normalized BVdss vs temperature

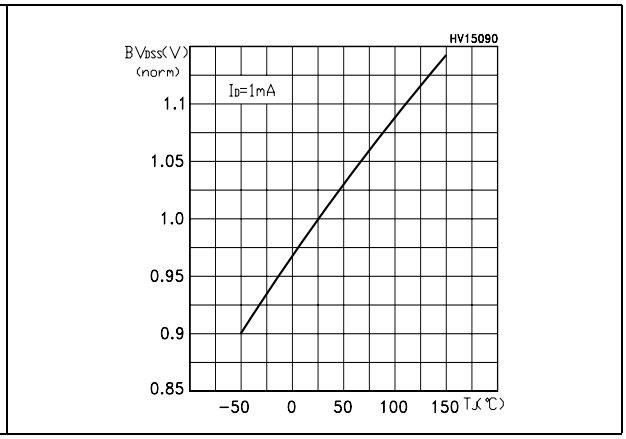
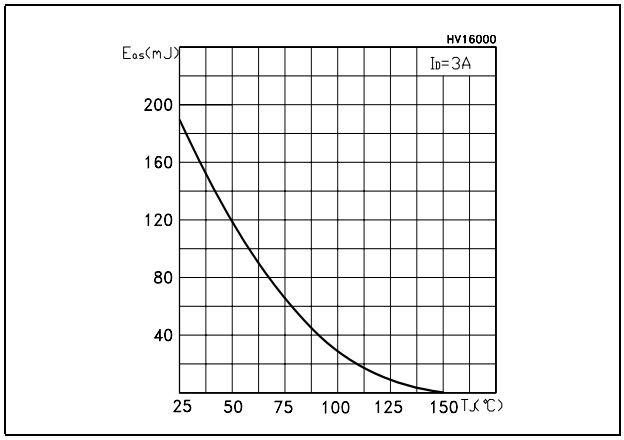


Figure 18. Maximum avalanche energy vs temperature



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3 Test circuits

Figure 19. Unclamped inductive load test circuit

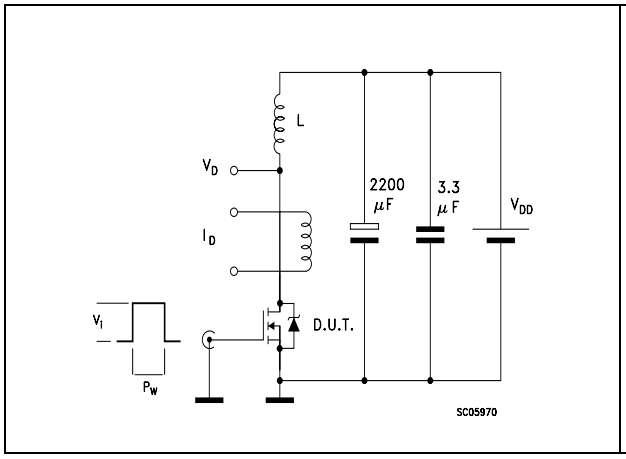


Figure 20. Unclamped inductive waveform

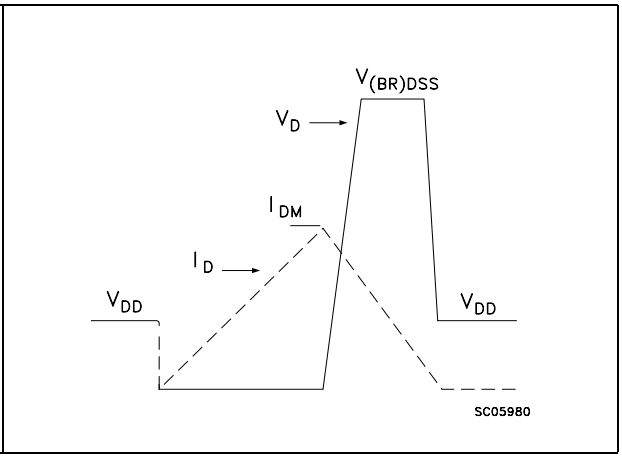


Figure 21. Switching times test circuit for resistive load

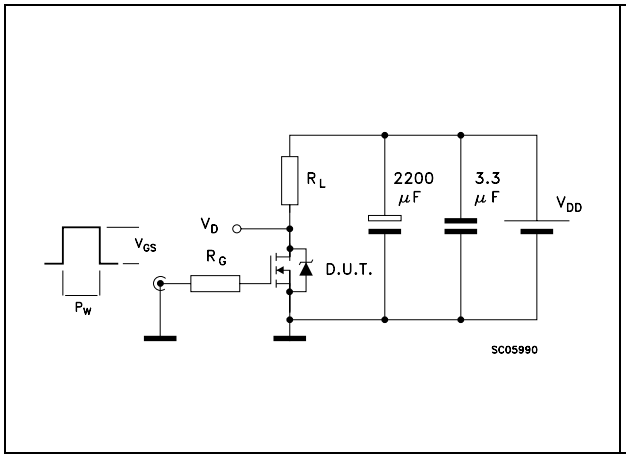


Figure 22. Gate charge test circuit

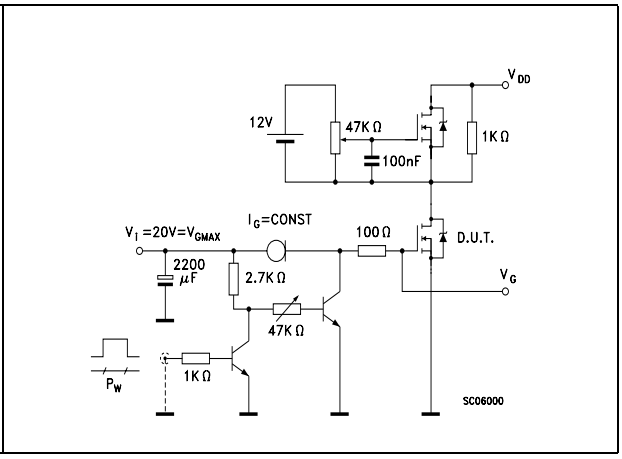
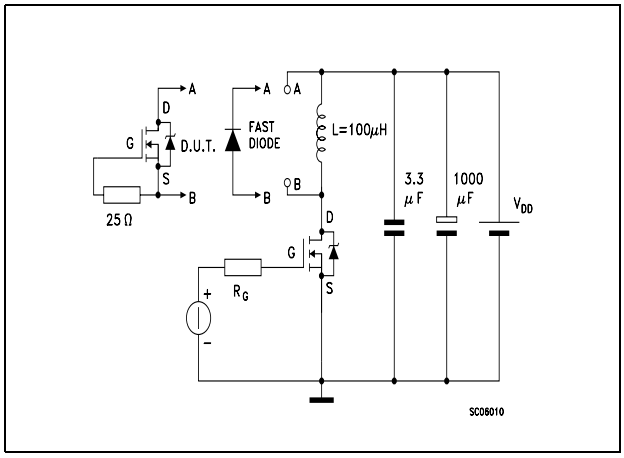


Figure 23. Test circuit for inductive load switching and diode recovery times



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4 Package mechanical data

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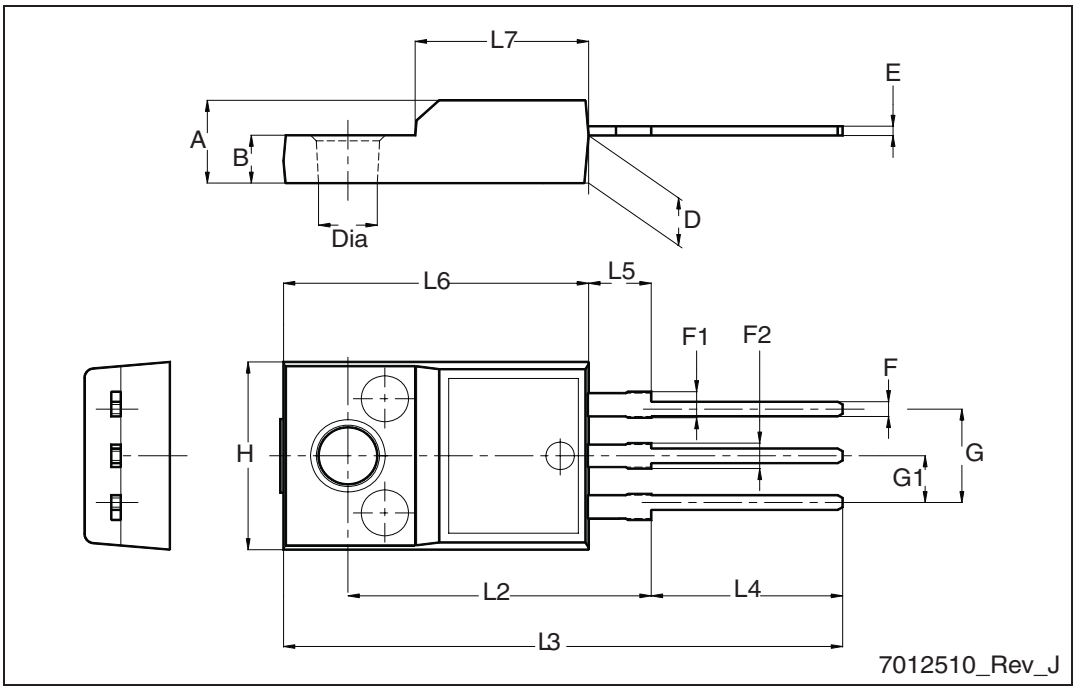
TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.5
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2



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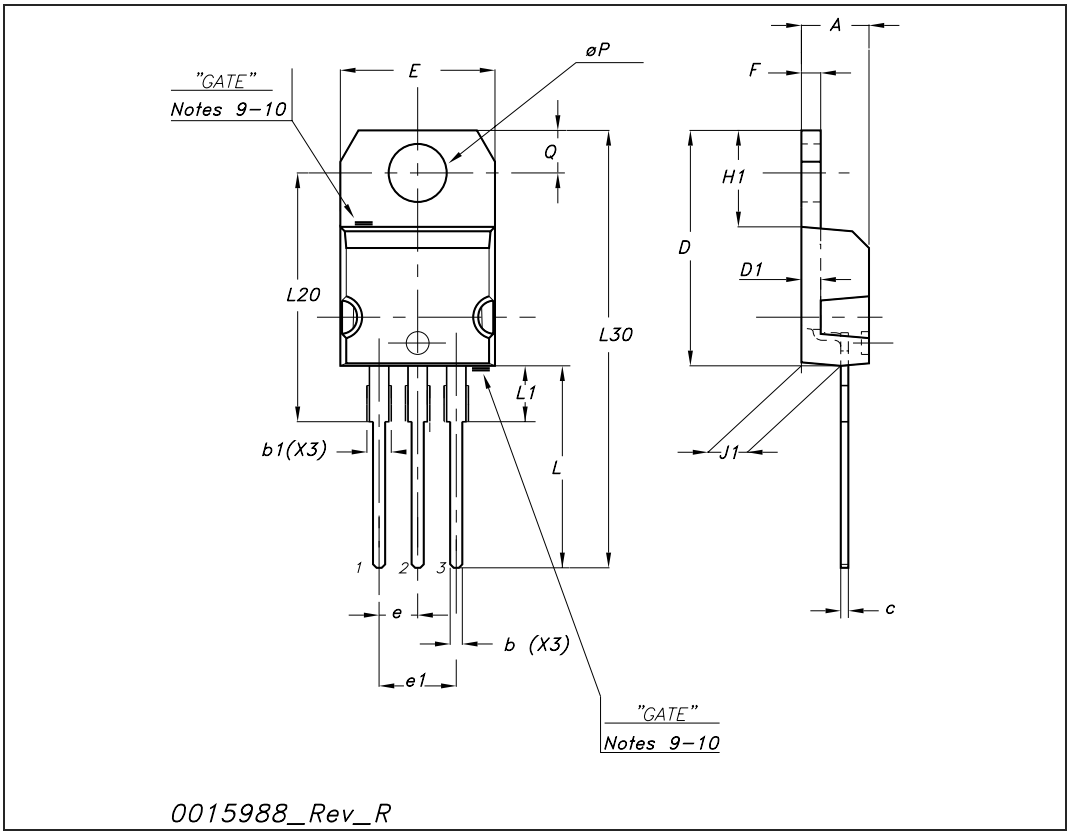
TO-220 mechanical data

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



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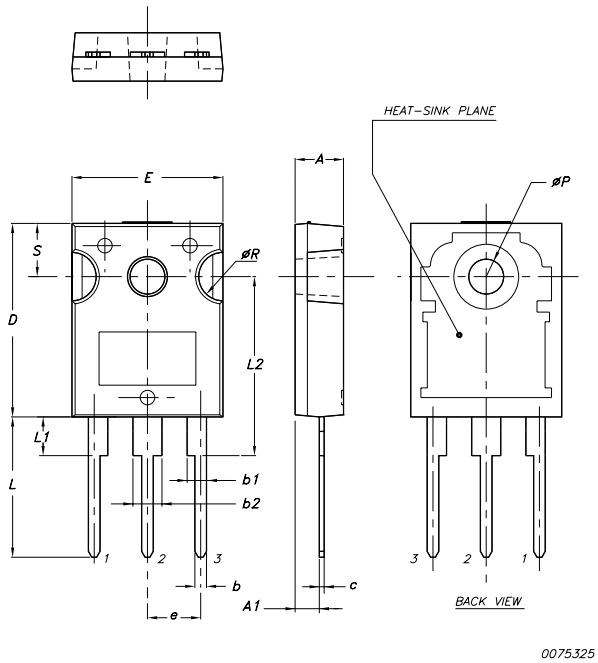
TO-247 Mechanical data

Dim.	mm.		
	Min.	Typ	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
øP	3.55		3.65
øR	4.50		5.50
S		5.50	



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5 Revision history

Table 9. Document revision history

Date	Revision	Changes
12-Oct-2004	1	First release
08-Sep-2005	2	Complete datasheet
16-Dec-2005	3	Inserted ecopack indication
16-Aug-2006	4	New template, no content change
15-May-2009	5	Modified: *Section 2.1: Electrical characteristics (curves)*

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