



STFV3N150 - STFW3N150 STP3N150 - STW3N150

N-channel 1500 V - 6 Ω - 2.5 A - PowerMESH™ Power MOSFET
TO-220 - TO-220FH - TO-247 - TO-3PF

Features

Type	V _{DSS}	R _{DS(on)} max	I _D	P _w
STFV3N150	1500 V	< 9 Ω	2.5 A	30 W
STFW3N150 ⁽¹⁾	1500 V	< 9 Ω	2.5 A	TBD
STP3N150	1500 V	< 9 Ω	2.5 A	140 W
STW3N150	1500 V	< 9 Ω	2.5 A	140 W

1. All data which refers solely to the TO-3PF package is preliminary

- 100% avalanche tested
- Intrinsic capacitances and Q_g minimized
- High speed switching
- Fully isolated TO-3PF and TO-220FH plastic packages
- Creepage distance path is 5.4 mm (typ.) for TO-3PF
- Creepage distance path is > 4 mm for TO-220FH

Application

- Switching applications

Description

Using the well consolidated high voltage MESH OVERLAY™ process, STMicroelectronics has designed an advanced family of very high voltage Power MOSFETs with outstanding performances. The strengthened layout coupled with the company's proprietary edge termination structure, gives the lowest R_{DS(on)} per area, unrivalled gate charge and switching characteristics.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STFV3N150	3N150	TO-220FH	Tube
STFW3N150	3N150	TO-3PF	Tube
STP3N150	3N150	TO-220	Tube
STW3N150	3N150	TO-247	Tube

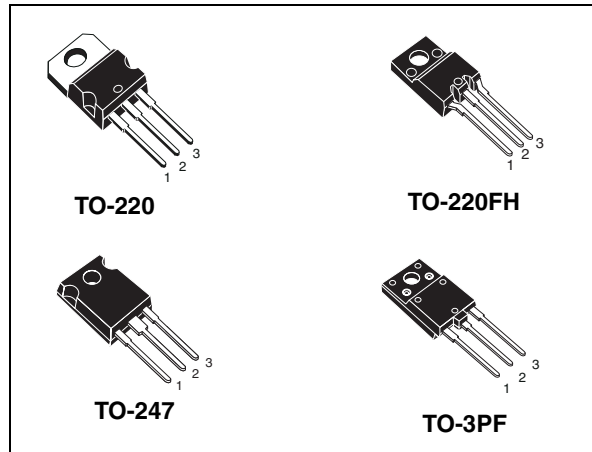
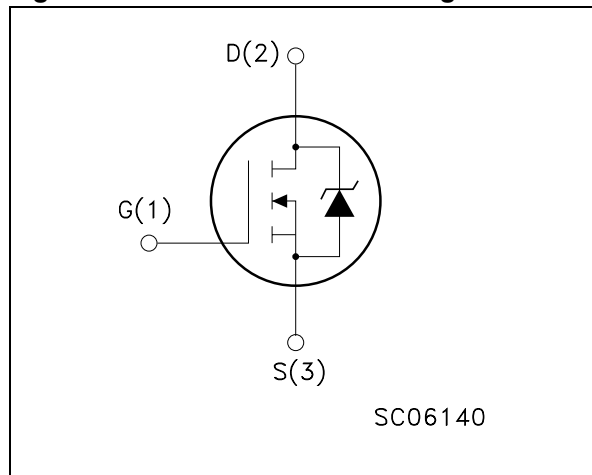


Figure 1. Internal schematic diagram



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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220/TO-247	TO-220FH	TO-3PF	
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	1500			V
V_{GS}	Gate- source voltage	± 30			V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	2.5	2.5 ⁽¹⁾	2.5 ⁽¹⁾	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	1.6	1.6 ⁽¹⁾	1.6 ⁽¹⁾	A
I_{DM} ⁽²⁾	Drain current (pulsed)	10	10 ⁽¹⁾	10 ⁽¹⁾	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	140	30	TBD	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink ($t=1\text{ s}; T_C=25\text{ }^\circ\text{C}$)	--	2500	TBD	V
	Derating factor	1.12	0.24	TBD	W/ $^\circ\text{C}$
T_{stg}	Storage temperature	-50 to 150			$^\circ\text{C}$
T_j	Max. operating junction temperature	150			$^\circ\text{C}$

1. Limited by maximum temperature allowed
2. Pulse width limited by safe operating area

Table 3. Thermal data

Symbol	Parameter	TO-220	TO-247	TO-220FH	TO-3PF	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.89		4.17	TBD	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5	50	62.5		$^\circ\text{C}/\text{W}$
T_j	Maximum lead temperature for soldering purpose	300				$^\circ\text{C}/\text{W}$

Table 4. Avalanche characteristics

Symbol	Parameter	Max value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	2.5	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	450	mJ

2 Electrical characteristics

($T_{\text{case}} = 25\text{ °C}$ unless otherwise specified)

Table 5. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0$	1500			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$, $T_C = 125\text{ °C}$			10 500	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 30\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$, $I_D = 1.3\text{ A}$		6	9	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 30\text{ V}$, $I_D = 1.3\text{ A}$		2.6		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$		939 102 13.2		pF pF pF
$C_{oss\text{ eq.}}^{(2)}$	Equivalent output capacitance	$V_{DS} = 0$ to 1200 V , $V_{GS} = 0$		100		pF
R_g	Gate input resistance	$f = 1\text{ MHz}$ Gate DC Bias = 0 Test signal level = 20 mV open drain		4		Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 1200\text{ V}$, $I_D = 2.5\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 19)		29.3 4.6 17		nC nC nC

1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5%
2. $C_{oss\text{ eq.}}$ 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. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 750\text{ V}$, $I_D = 1.25\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 18)		24		ns
t_r	Rise time			47		ns
$t_{d(off)}$	Turn-off-delay time			45		ns
t_f	Fall time			61		ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
I_{SD}	Source-drain current				2.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				10	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 2.5\text{ A}$, $V_{GS} = 0$			1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 2.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 20)		410		ns
Q_{rr}	Reverse recovery charge			2.4		μC
I_{RRM}	Reverse recovery current			11.7		A
t_{rr}	Reverse recovery time	$I_{SD} = 2.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 20)		540		ns
Q_{rr}	Reverse recovery charge			3.3		μC
I_{RRM}	Reverse recovery current			12.3		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 2. Safe operating area for TO-220

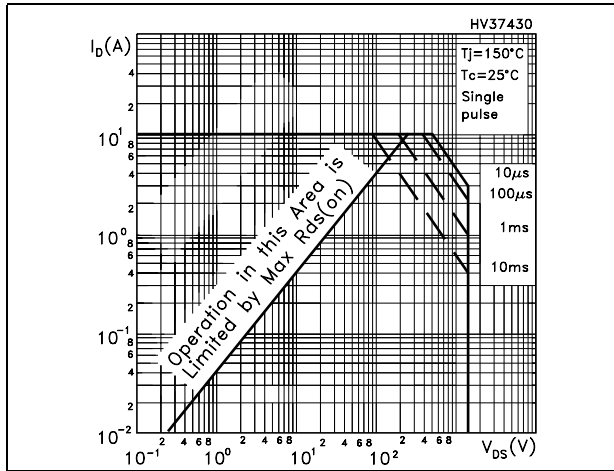


Figure 3. Thermal impedance for TO-220

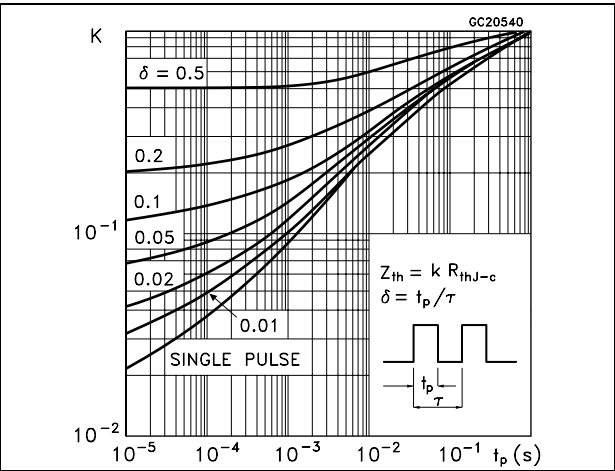


Figure 4. Safe operating area for TO-220FH

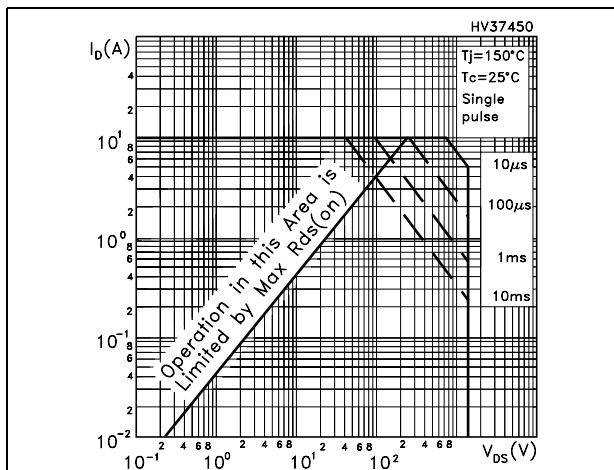


Figure 5. Thermal impedance for TO-220FH

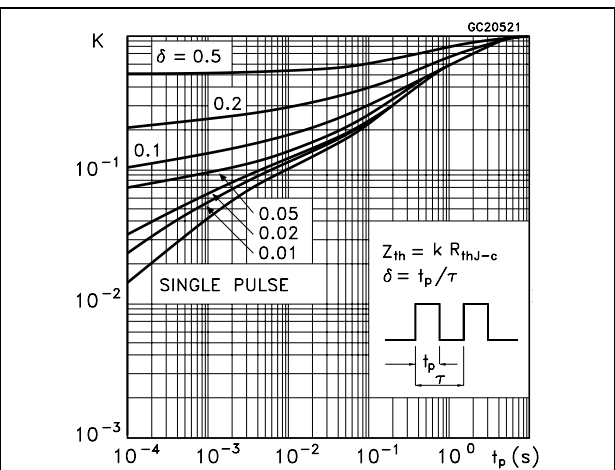


Figure 6. Safe operating area for TO-247

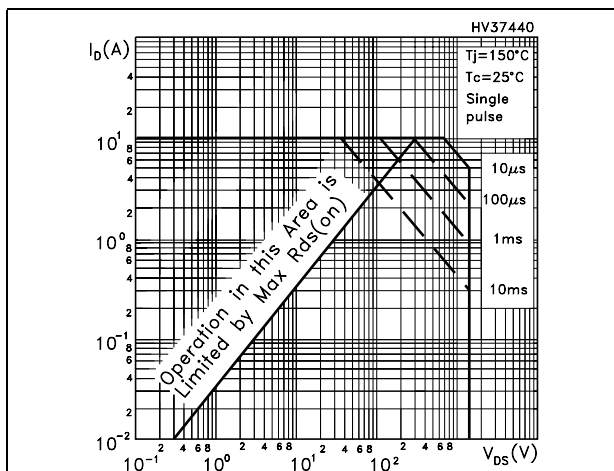


Figure 7. Thermal impedance for TO-247

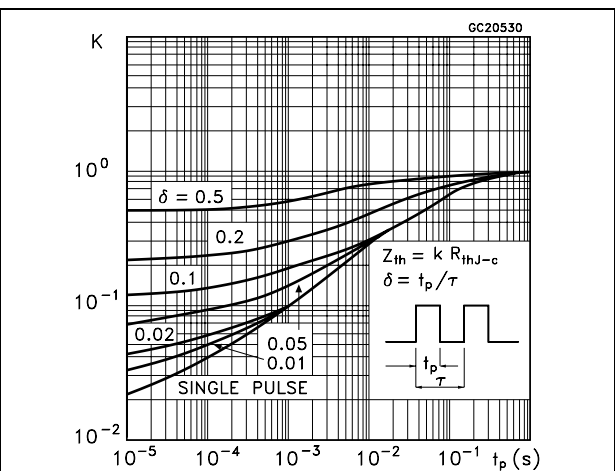


Figure 8. Output characteristics

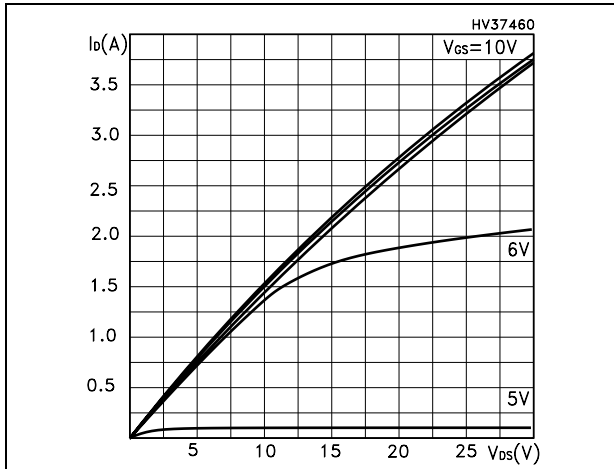


Figure 9. Transfer characteristics

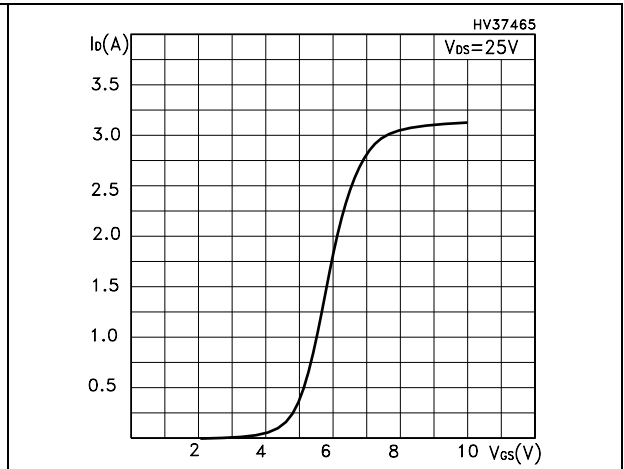


Figure 10. Normalized BV_{DSS} vs. temperature Figure 11. Static drain-source on resistance

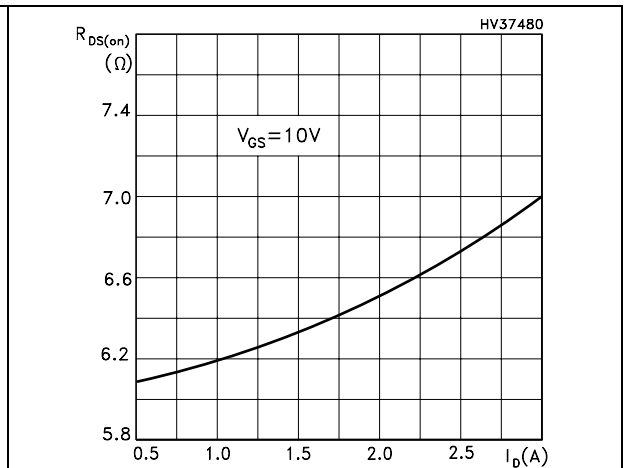
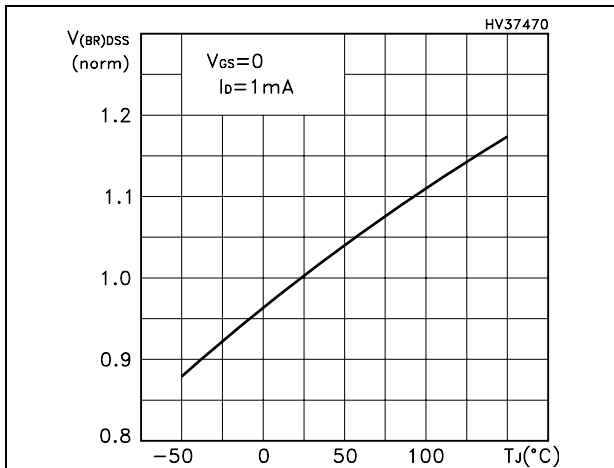


Figure 12. Gate charge vs. gate-source voltage

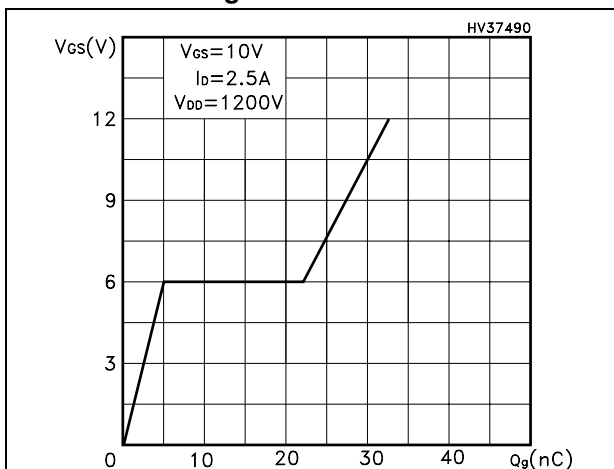


Figure 13. Capacitance variations

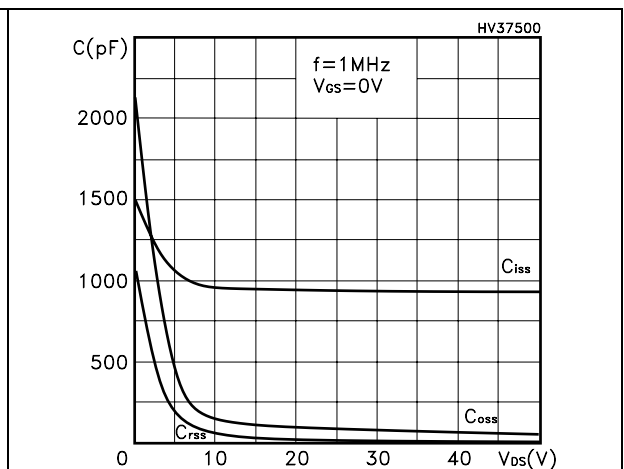


Figure 14. Normalized gate threshold voltage vs. temperature

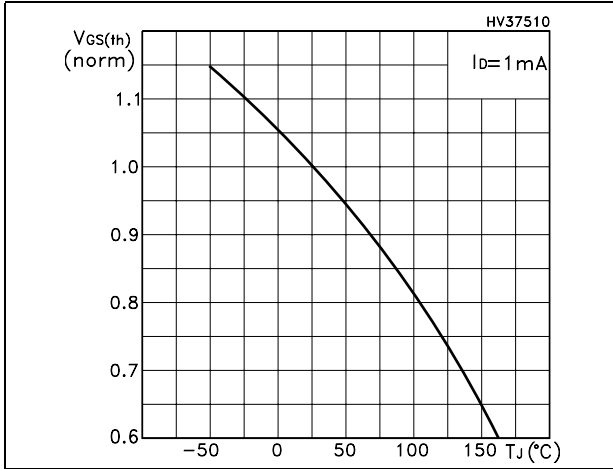


Figure 15. Normalized on resistance vs. temperature

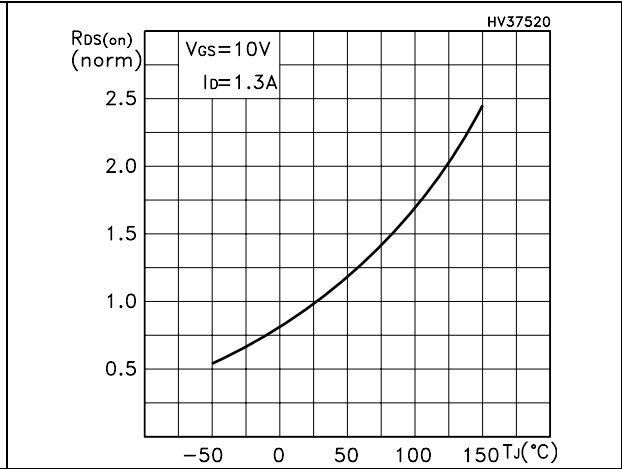


Figure 16. Source-drain diode forward characteristics

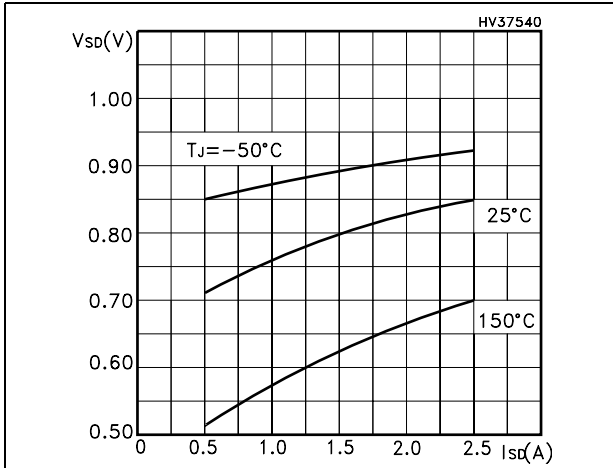
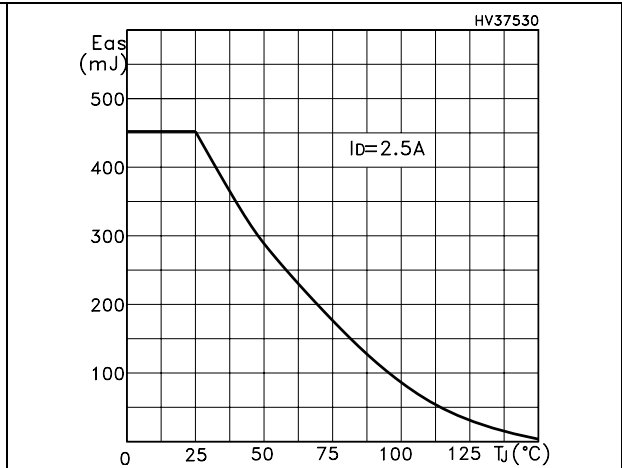


Figure 17. Maximum avalanche energy vs Tj



3 Test circuits

Figure 18. Switching times test circuit for resistive load

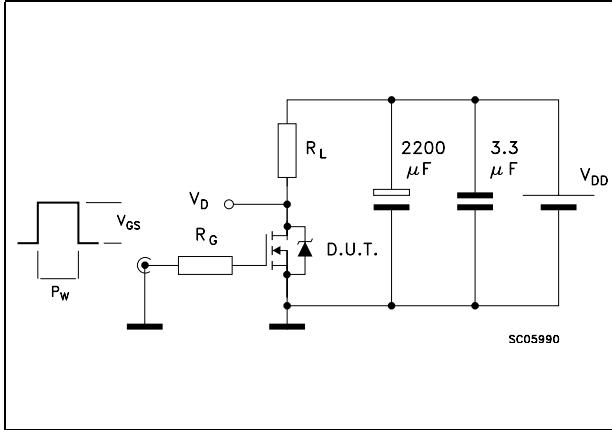


Figure 19. Gate charge test circuit

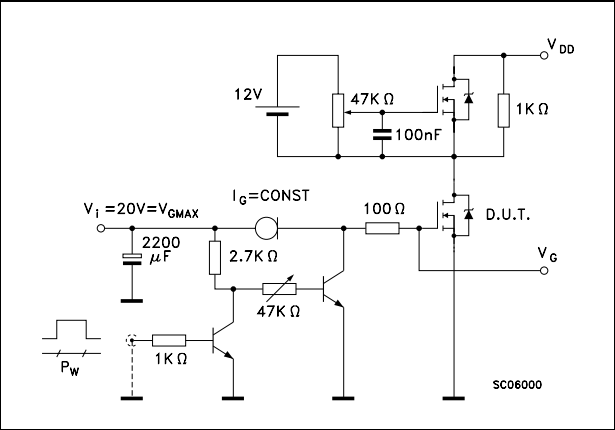


Figure 20. Test circuit for inductive load switching and diode recovery times

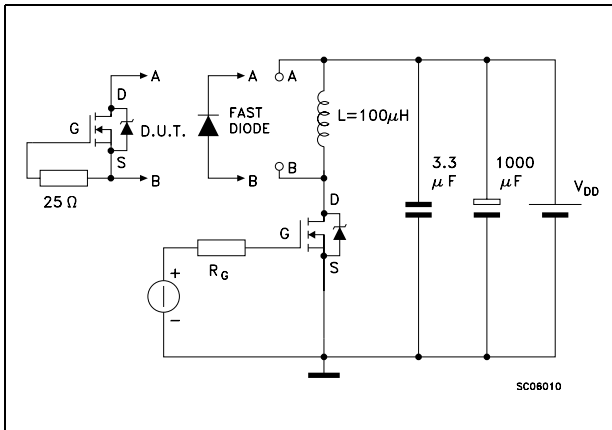


Figure 21. Unclamped inductive load test circuit

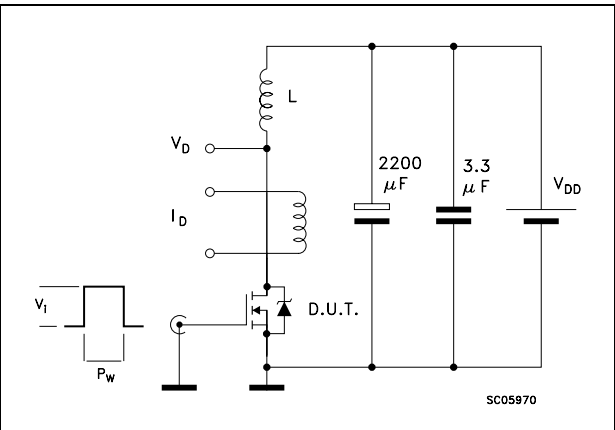


Figure 22. Unclamped inductive waveform

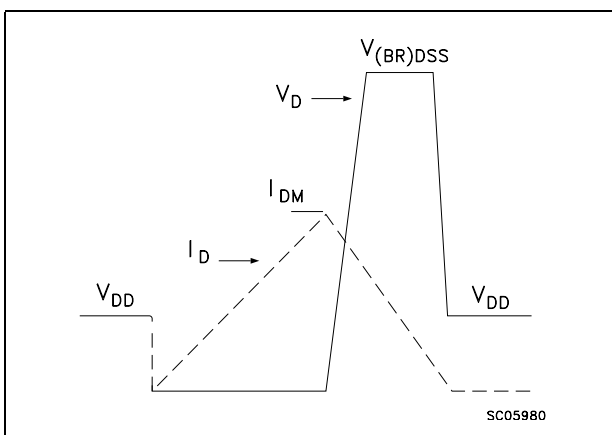
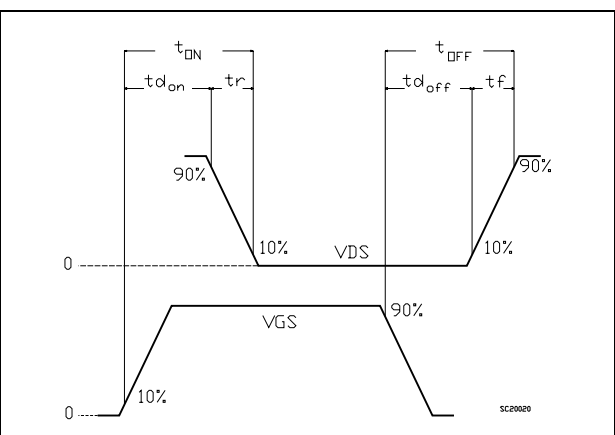


Figure 23. Switching time waveform

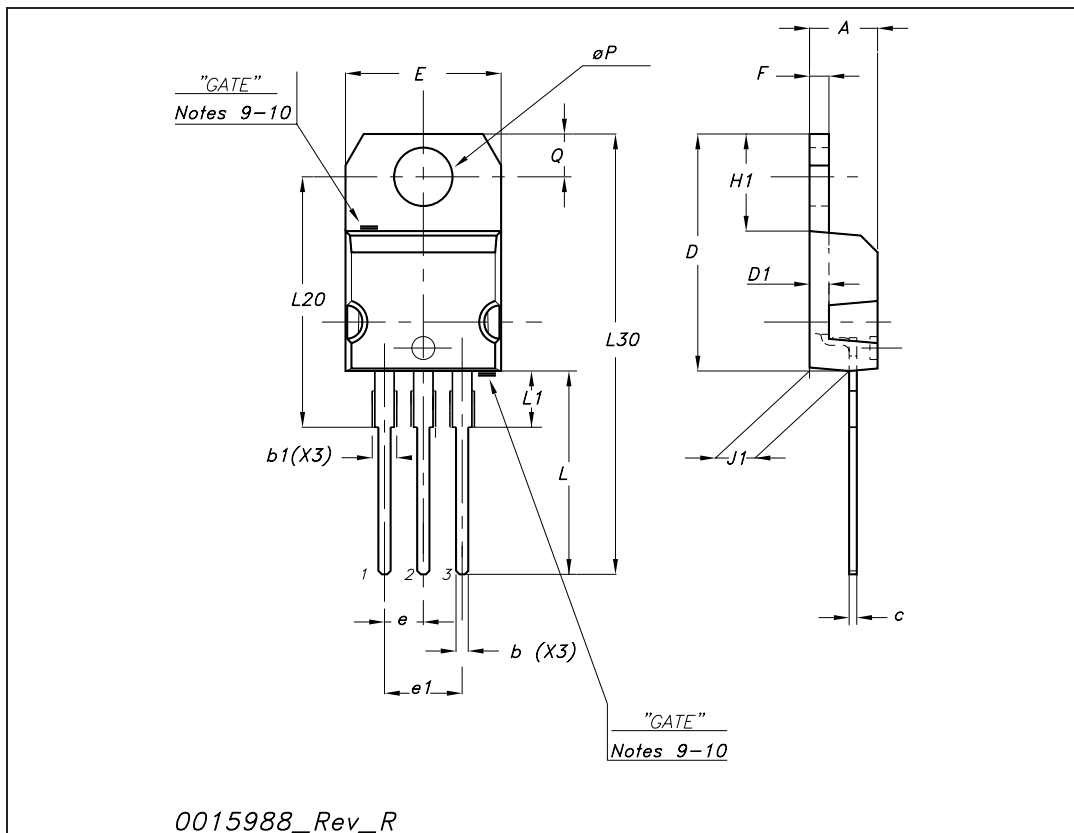


4 Package mechanical data

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

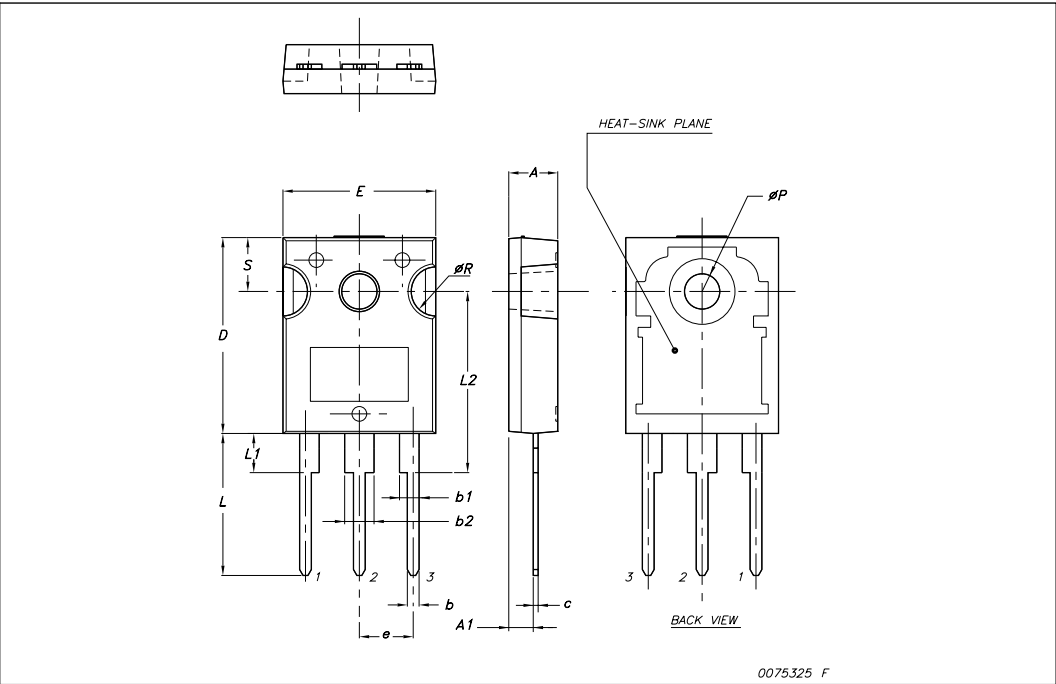
TO-220 mechanical data

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



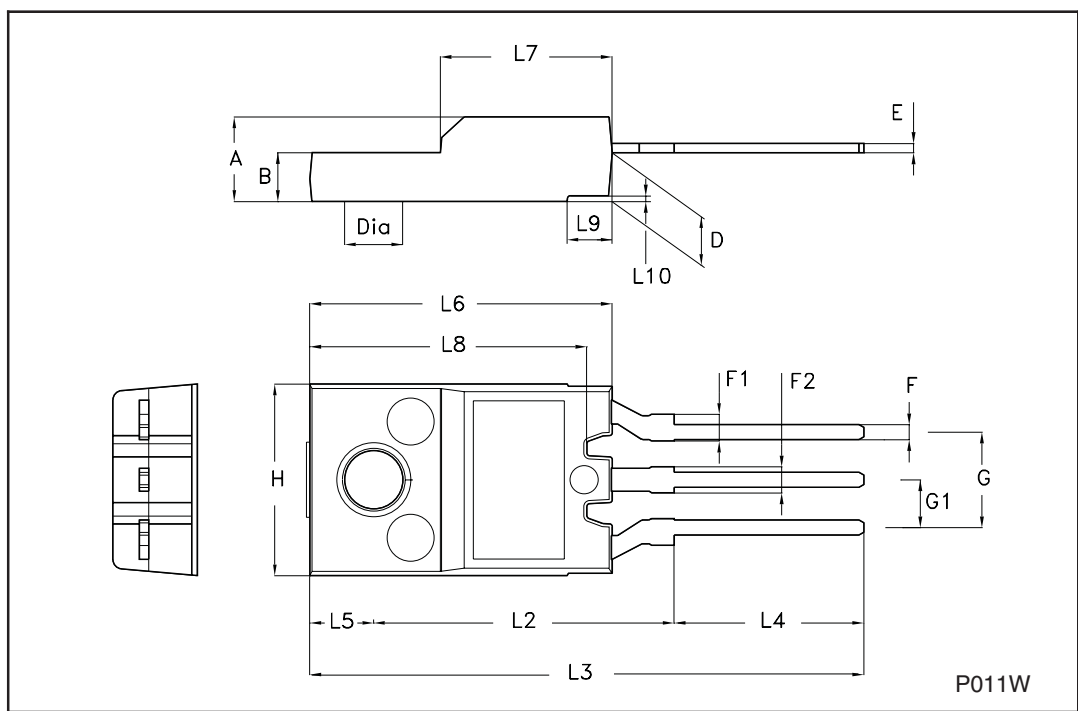
TO-247 Mechanical data

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	



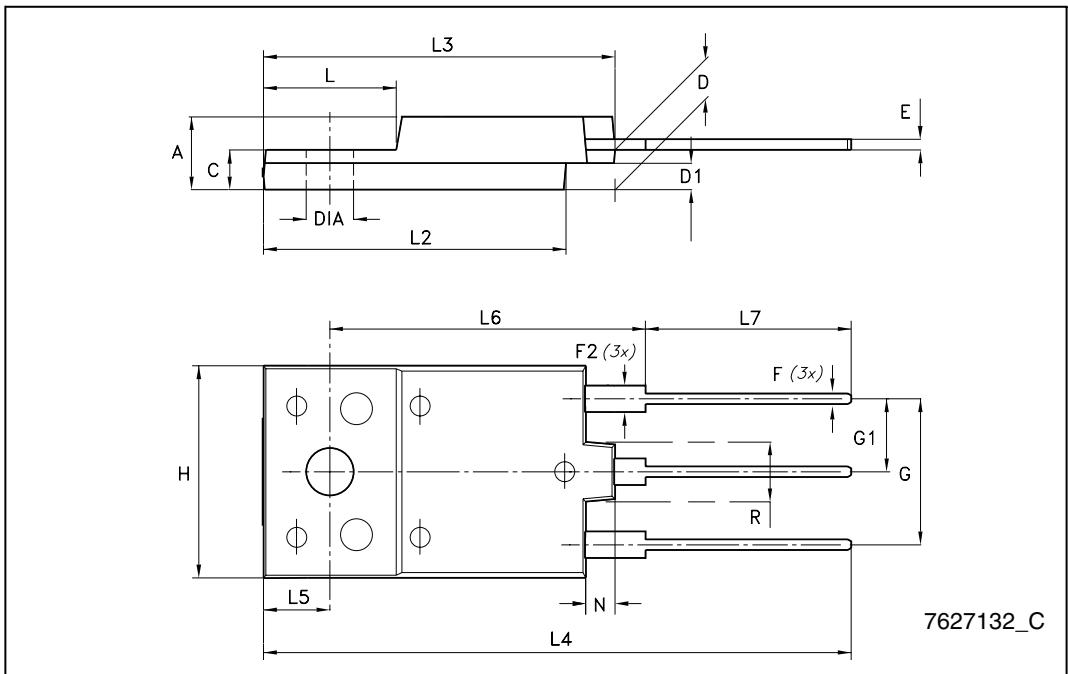
TO-220FH (Fully plastic High voltage) MECHANICAL DATA

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	1.3		1.8	0.051		0.070
F2	1.3		1.8	0.051		0.070
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		3.4			0.134	
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
L8	14.5		15	0.570		0.590
L9		2.4			0.094	



TO-3PF mechanical data

DIM.	mm.		
	min.	typ	max.
A	5.30		5.70
C	2.80		3.20
D	3.10		3.50
D1	1.80		2.20
E	0.80		1.10
F	0.65		0.95
F2	1.80		2.20
G	10.30		11.50
G1		5.45	
H	15.30		15.70
L	9.80	10	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.20		44.40
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
12-Jan-2007	1	First release
17-Apr-2007	2	Added new value on Table 6 .
14-May-2007	3	The document has been reformatted
29-Aug-2007	4	$R_{DS(on)}$ value changed, updated Figure 15
09-Apr-2008	5	Added new package: TO-3PF

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