



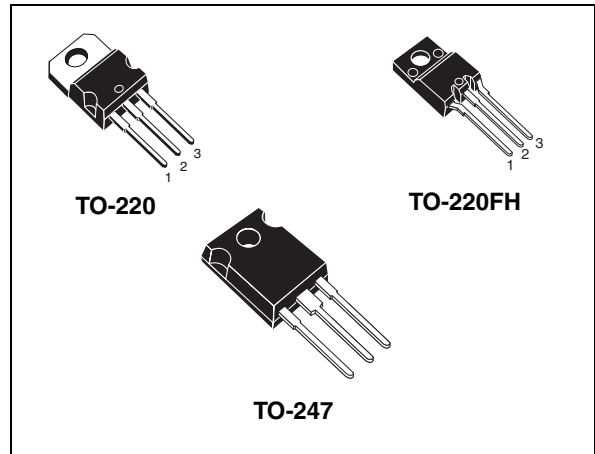
# STFV3N150 STP3N150 - STW3N150

N-channel 1500V - 6Ω - 2.5A - TO-220 - TO-220FH - TO-247  
Very high voltage PowerMESH™ Power MOSFET

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>w</sub>
STP3N150	1500V	< 9Ω	2.5A	140W
STFV3N150	1500V	< 9Ω	2.5A	30W
STW3N150	1500V	< 9Ω	2.5A	140W

- 100% avalanche tested
- Avalanche ruggedness
- Gate charge minimized
- Very low intrinsic capacitances
- High speed switching



## Description

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

## Application

- Switching applications

Figure 1. Internal schematic diagram

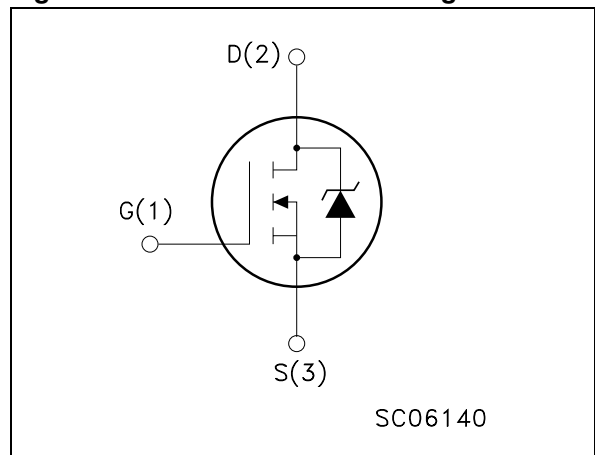


Table 1. Device summary

Oder code	Marking	Package	Packaging
STP3N150	3N150	TO-220	Tube
STFV3N150	3N150	TO-220FH	Tube
STW3N150	3N150	TO-247	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220/TO-247	TO-220FH	
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	1500		V
$V_{GS}$	Gate- source voltage	$\pm 30$		V
$I_D$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	2.5	2.5 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	1.6	1.6 <sup>(1)</sup>	A
$I_{DM}^{(2)}$	Drain current (pulsed)	10	10 <sup>(1)</sup>	A
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	140	30	W
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t=1\text{s}; T_C=25^\circ\text{C}$ )	--	2500	V
	Derating factor	1.12	0.24	W/ $^\circ\text{C}$
$T_j$ $T_{stg}$	Operating junction temperature Storage temperature	-50 to 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	Unit
$R_{thj-case}$	Thermal resistance junction-case Max	0.89		4.17	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	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 $T_j = 25^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{V}$ )	450	mJ

## 2 Electrical characteristics

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

**Table 5. On /off states**

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

**Table 6. Dynamic**

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

1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

2.  $C_{\text{oss eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{\text{oss}}$  when  $V_{\text{DS}}$  increases from 0 to 80%  $V_{\text{DSS}}$

**Table 7. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 750V$ , $I_D = 1.25A$ , $R_G = 4.7\Omega$ , $V_{GS} = 10V$ (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	$I_{SD} = 2.5A$ , $V_{GS} = 0$			1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 2.5A$ , $di/dt = 100A/\mu s$ $V_{DD} = 60V$ $T_j = 25^\circ C$ (see Figure 20)		410		ns
$Q_{rr}$	Reverse recovery charge			2.4		$\mu C$
$I_{RRM}$	Reverse recovery current			11.7		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 2.5A$ , $di/dt = 100A/\mu s$ $V_{DD} = 60V$ $T_j = 150^\circ C$ (see Figure 20)		540		ns
$Q_{rr}$	Reverse recovery charge			3.3		$\mu C$
$I_{RRM}$	Reverse recovery current			12.3		A

1. Pulse width limited by safe operating area

2. Pulsed: pulse duration = 300 $\mu s$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220

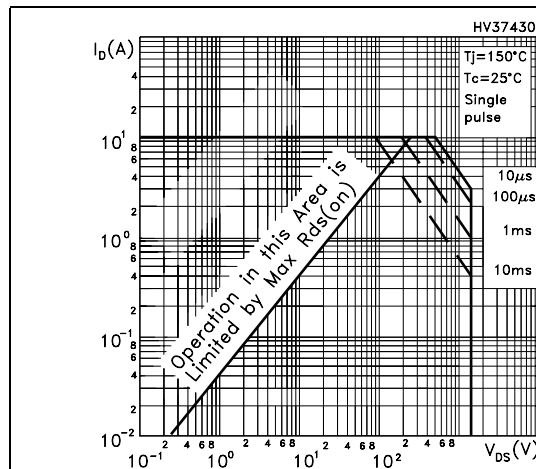


Figure 3. Thermal impedance for TO-220

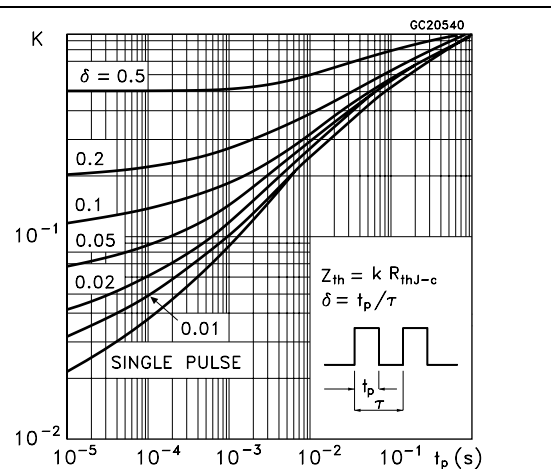


Figure 4. Safe operating area for TO-220FH

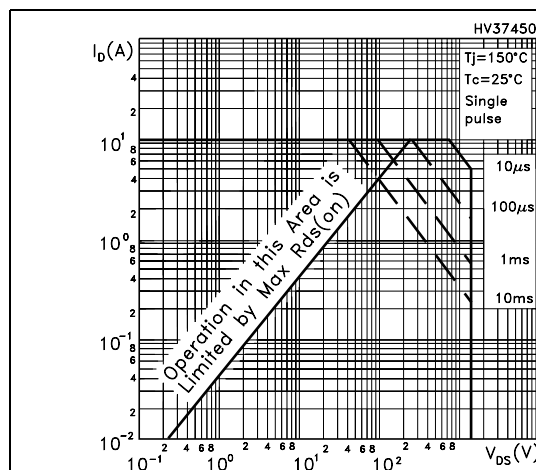


Figure 5. Thermal impedance for TO-220FH

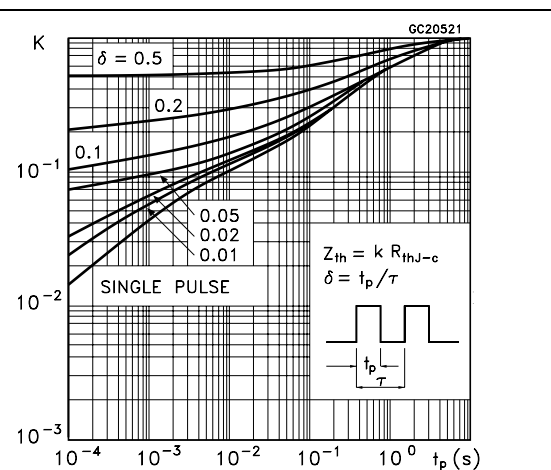


Figure 6. Safe operating area for TO-247

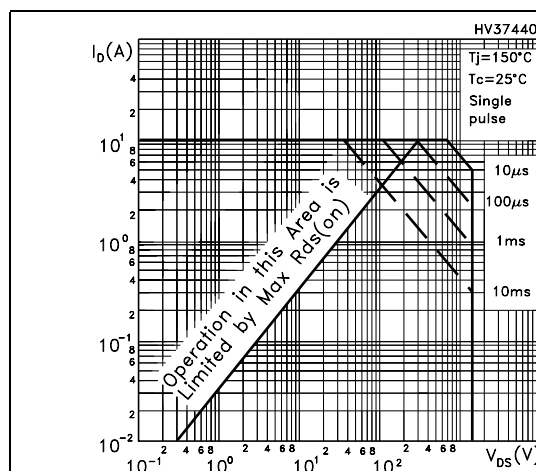


Figure 7. Thermal impedance for TO-247

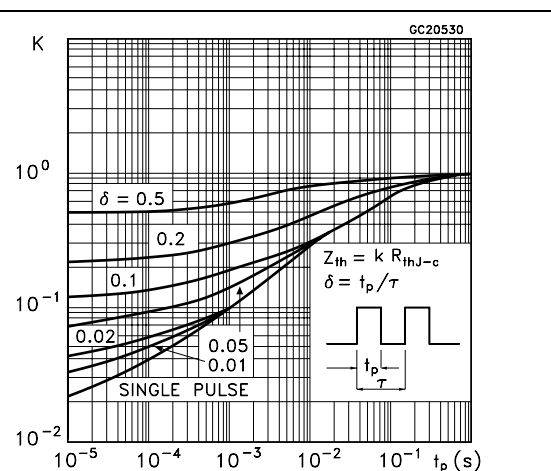


Figure 8. Output characteristics

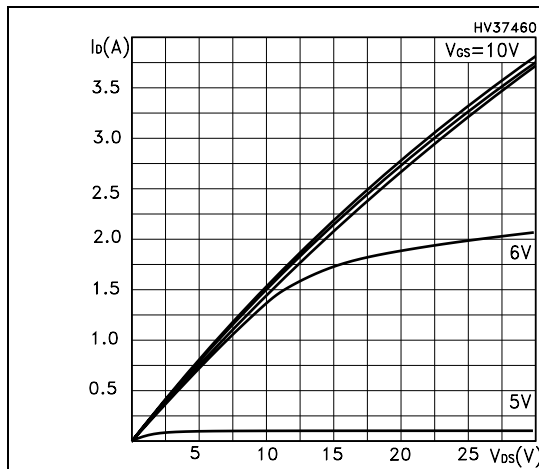


Figure 9. Transfer characteristics

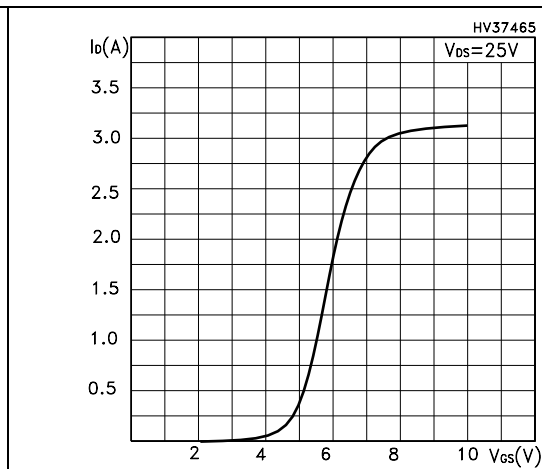
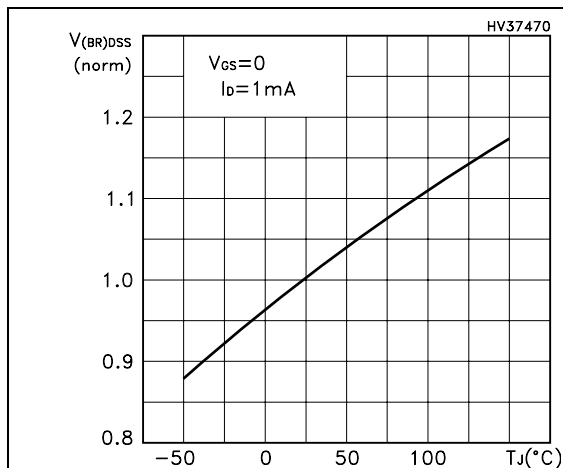
Figure 10. Normalized  $BV_{DSS}$  vs. temperature

Figure 11. Static drain-source on resistance

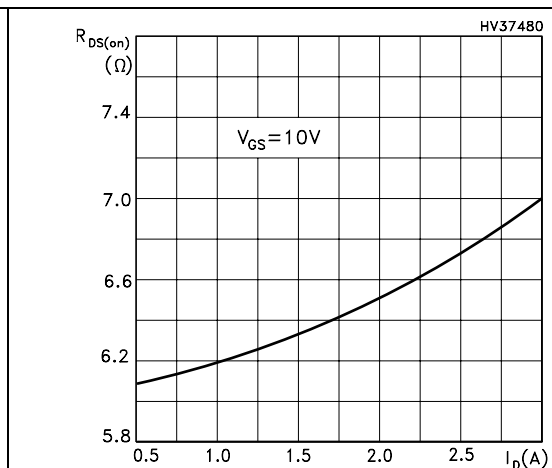


Figure 12. Gate charge vs. gate-source voltage

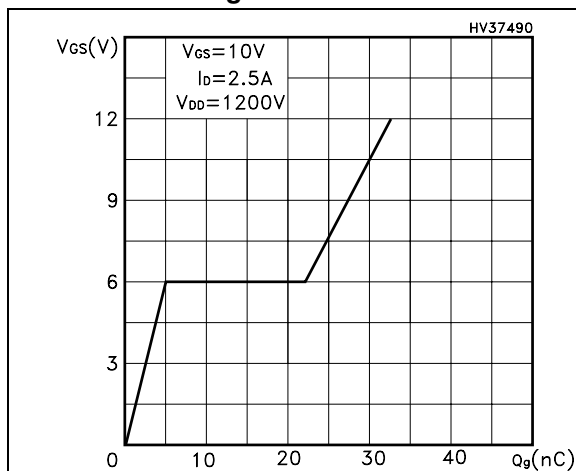


Figure 13. Capacitance variations

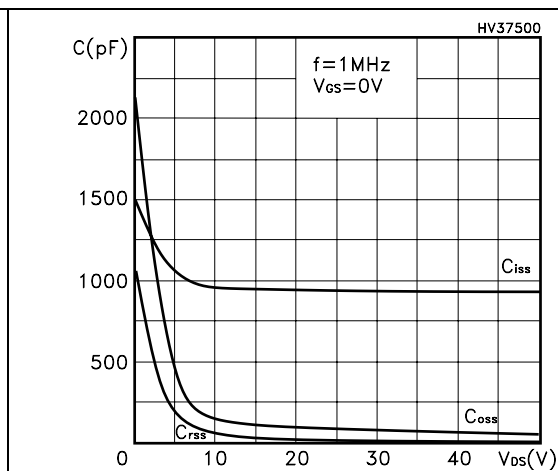


Figure 14. Normalized gate threshold voltage vs. temperature

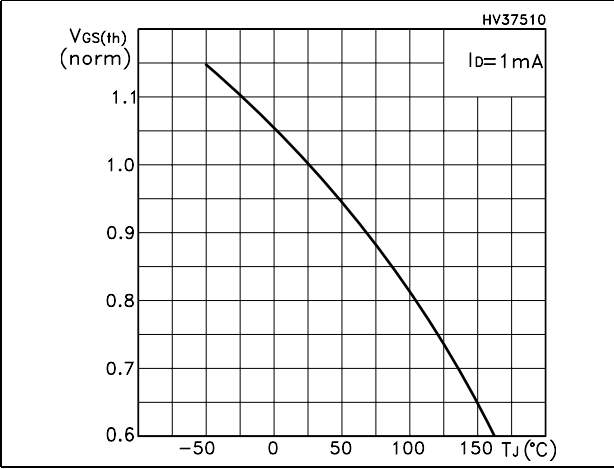


Figure 15. Normalized on resistance vs. temperature

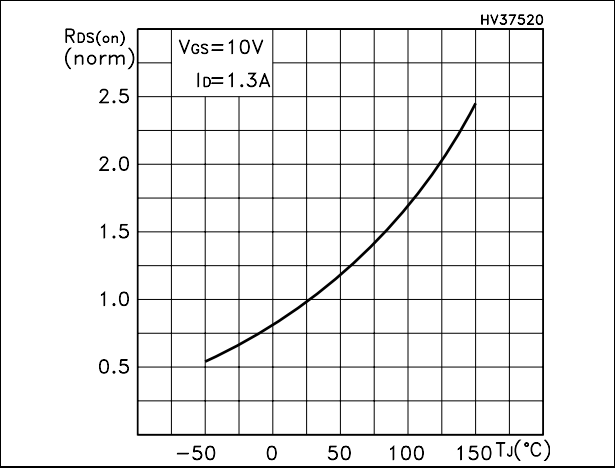


Figure 16. Source-drain diode forward characteristics

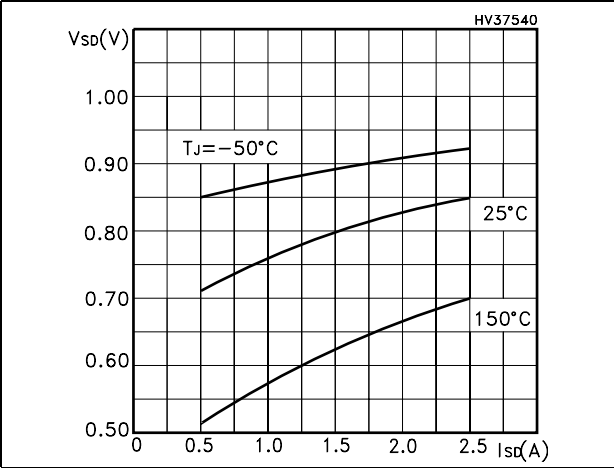
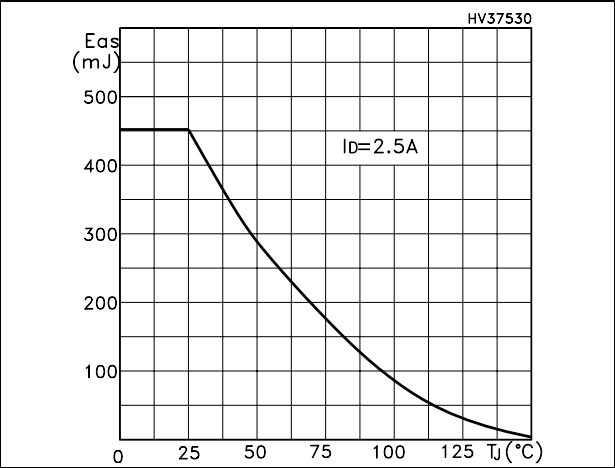


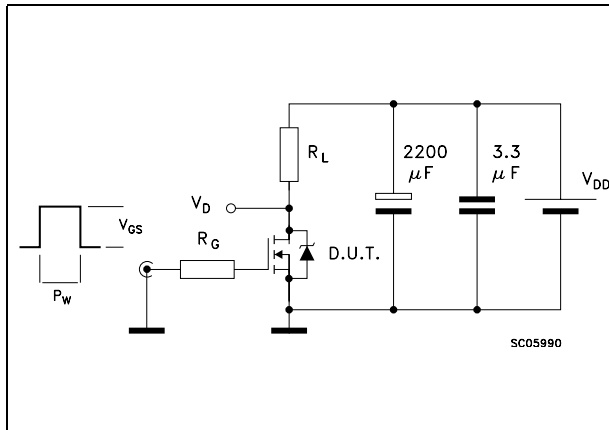
Figure 17. Maximum avalanche energy vs  $T_J$



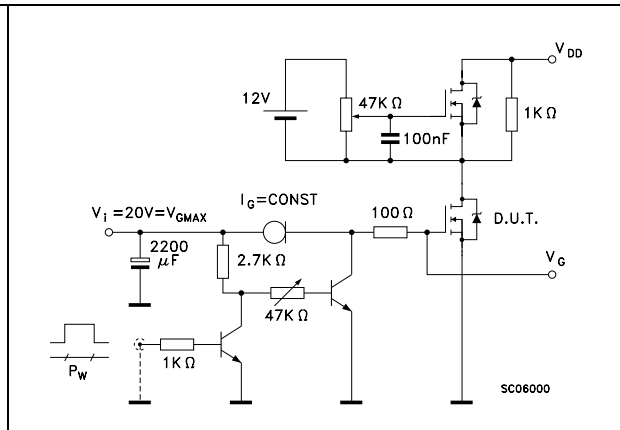


### 3 Test circuits

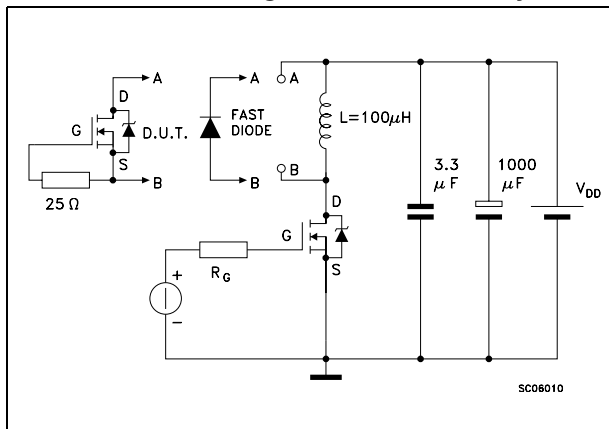
**Figure 18. Switching times test circuit for resistive load**



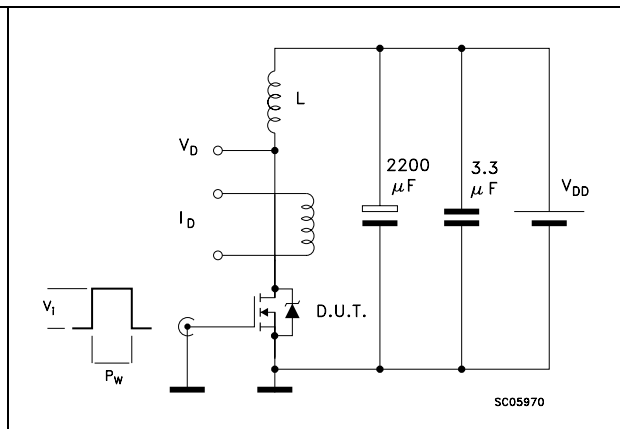
**Figure 19. Gate charge test circuit**



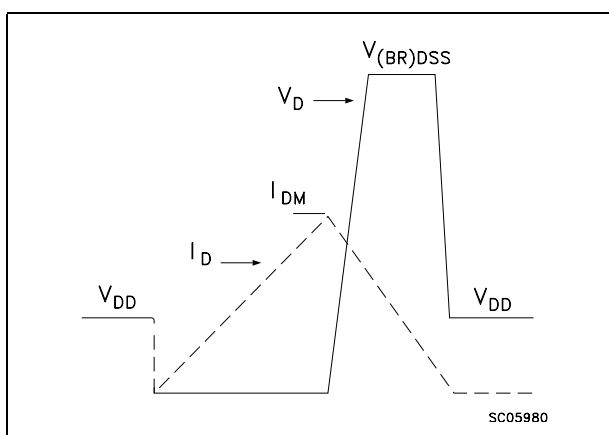
**Figure 20. Test circuit for inductive load switching and diode recovery times**



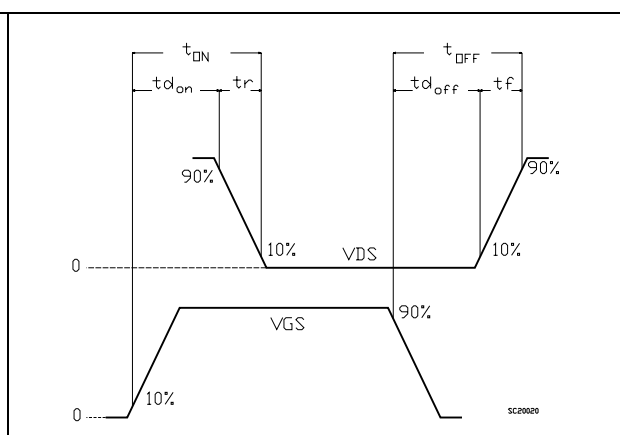
**Figure 21. Unclamped Inductive load test circuit**



**Figure 22. Unclamped inductive waveform**



**Figure 23. Switching time waveform**

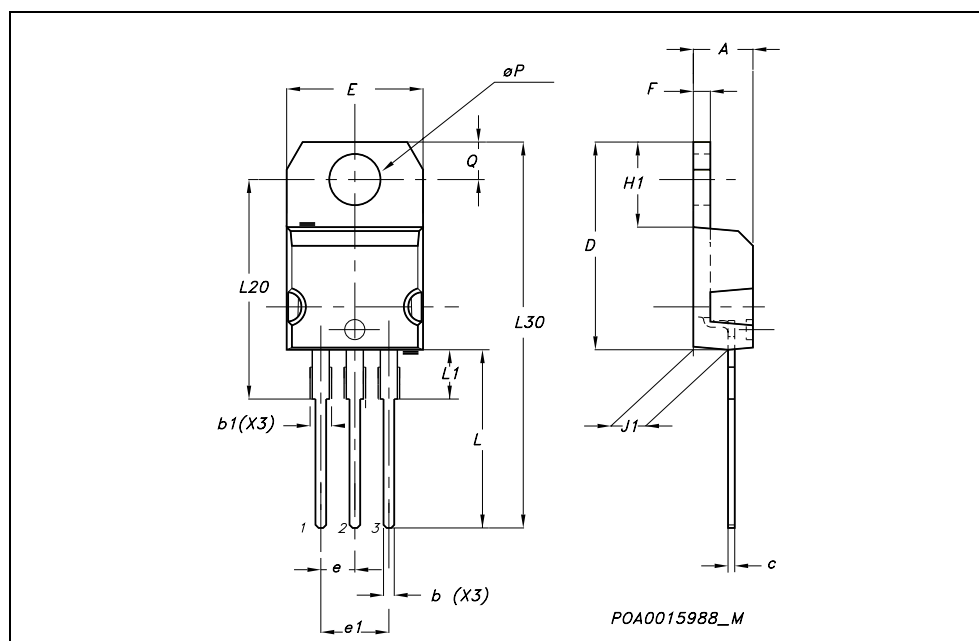


## 4 Package mechanical data

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](http://www.st.com)

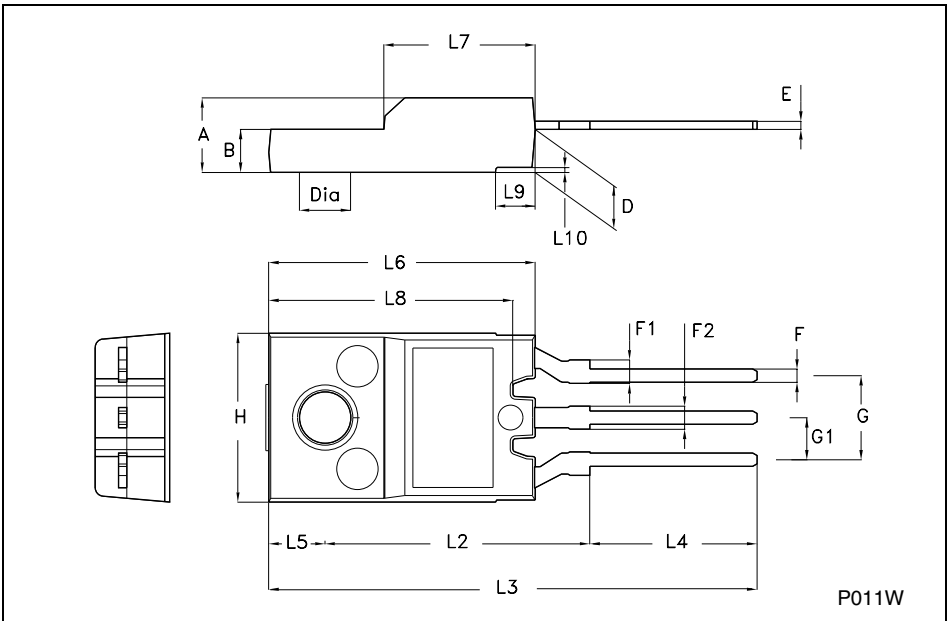
## TO-220 MECHANICAL DATA

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	1.15		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



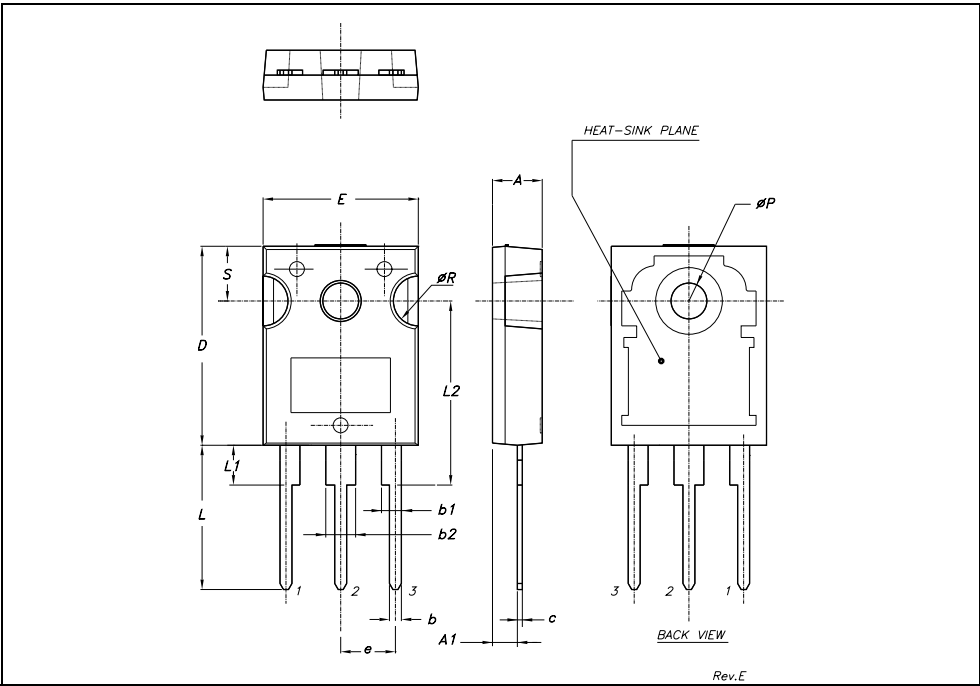
TO-220FH (Fully plastic High voltage) MECHANICAL DATA

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-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 9. Revision history**

Date	Revision	Changes
12-Jan-2007	1	First release
17-Apr-2007	2	Added new value on <a href="#">Table 6</a> .
14-May-2007	3	The document has been reformatted
27-Jul-2007	4	$R_{DS(on)}$ value changed, updated <a href="#">Figure 15</a>

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