



# STFW3N150 STP3N150, STW3N150

N-channel 1500 V, 6  $\Omega$ , 2.5 A, PowerMESH™ Power MOSFET  
in TO-220, TO-247, TO-3PF

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STFW3N150	1500 V	< 9 $\Omega$	2.5 A	63 W
STP3N150	1500 V	< 9 $\Omega$	2.5 A	140 W
STW3N150	1500 V	< 9 $\Omega$	2.5 A	140 W

- 100% avalanche tested
- Intrinsic capacitances and Q<sub>g</sub> minimized
- High speed switching
- Fully isolated TO-3PF plastic package
- Creepage distance path is 5.4 mm (typ.) for TO-3PF

## 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<sub>DS(on)</sub> per area, unrivalled gate charge and switching characteristics.

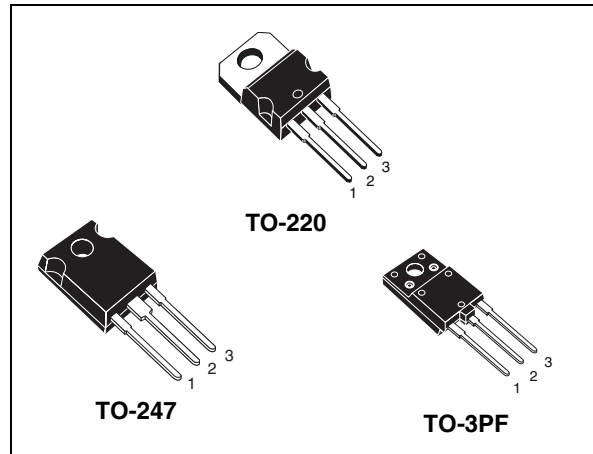


Figure 1. Internal schematic diagram

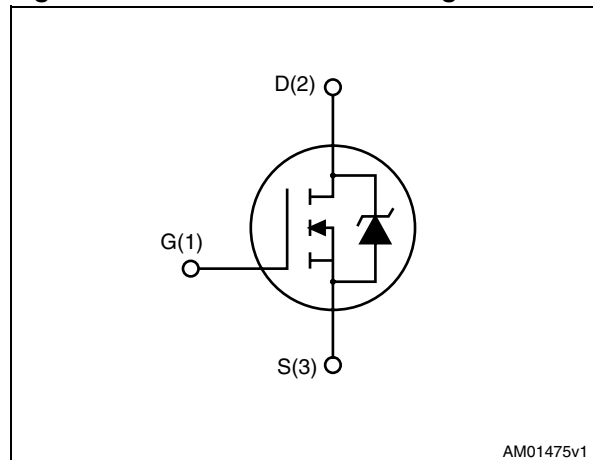


Table 1. Device summary

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

## Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220,TO-247	TO-3PF	
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	1500		V
$V_{GS}$	Gate-source voltage	$\pm 30$		V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	2.5	2.5 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	1.6	1.6 <sup>(1)</sup>	A
$I_{DM}^{(1)}$	Drain current (pulsed)	10	10 <sup>(1)</sup>	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	140	63	W
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t=1\text{ s}; T_C=25\text{ }^\circ\text{C}$ )		3500	V
	Derating factor	1.12	0.5	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. Pulse width limited by safe operating area

**Table 3. Thermal data**

Symbol	Parameter	TO-220	TO-247	TO-3PF	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.89		2	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5	50	50	$^\circ\text{C}/\text{W}$
$T_j$	Maximum lead temperature for soldering purpose	300			$^\circ\text{C}$

**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
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$I_{\text{D}} = 1\text{ mA}$ , $V_{\text{GS}} = 0$	1500			V
$I_{\text{DSS}}$	Zero gate voltage drain current ( $V_{\text{GS}} = 0$ )	$V_{\text{DS}} = \text{Max rating}$ $V_{\text{DS}} = \text{Max rating}$ , $T_{\text{C}} = 125\text{ °C}$			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	$V_{\text{DS}} = V_{\text{GS}}$ , $I_{\text{D}} = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{\text{DS(on)}}$	Static drain-source on resistance	$V_{\text{GS}} = 10\text{ V}$ , $I_{\text{D}} = 1.3\text{ A}$		6	9	$\Omega$

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{\text{fs}}^{(1)}$	Forward transconductance	$V_{\text{DS}} = 30\text{ V}$ , $I_{\text{D}} = 1.3\text{ A}$	-	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	$V_{\text{DS}} = 0$ to $1200\text{ V}$ , $V_{\text{GS}} = 0$	-	100	-	pF
$R_{\text{g}}$	Gate input resistance	$f = 1\text{ MHz}$ Gate DC Bias = 0 Test signal level = 20 mV open drain	-	4	-	$\Omega$
$Q_{\text{g}}$ $Q_{\text{GS}}$ $Q_{\text{GD}}$	Total gate charge Gate-source charge Gate-drain charge	$V_{\text{DD}} = 1200\text{ V}$ , $I_{\text{D}} = 2.5\text{ A}$ , $V_{\text{GS}} = 10\text{ V}$ (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	$V_{DD} = 750\text{ V}$ , $I_D = 1.25\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (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		$\mu\text{C}$
$I_{RRM}$	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		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	12.3		A

1. Pulse width limited by safe operating area

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-3PF

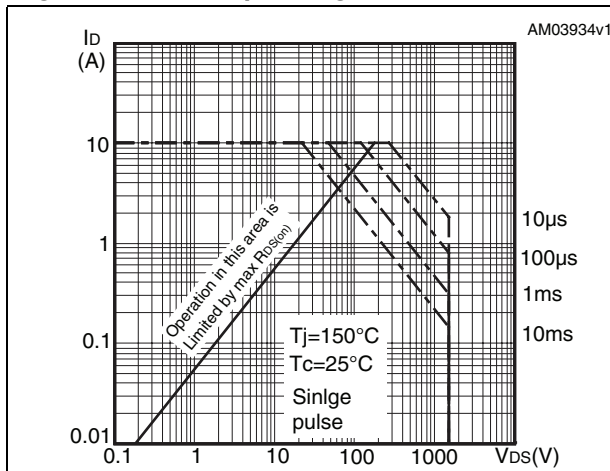


Figure 3. Thermal impedance for TO-3PF

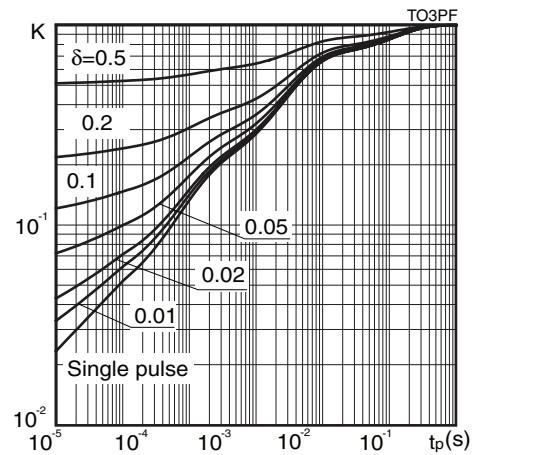


Figure 4. Safe operating area for TO-220

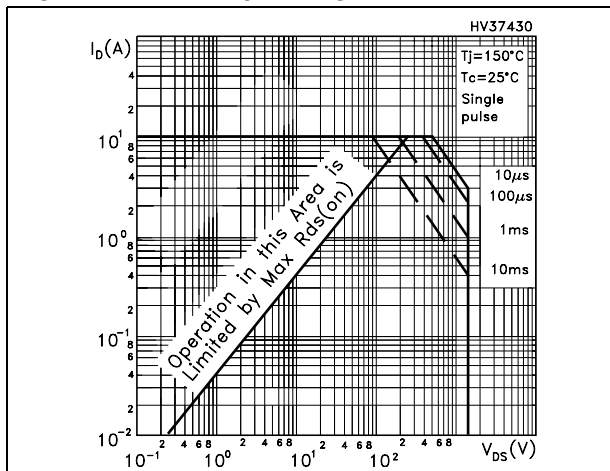


Figure 5. Thermal impedance for TO-220

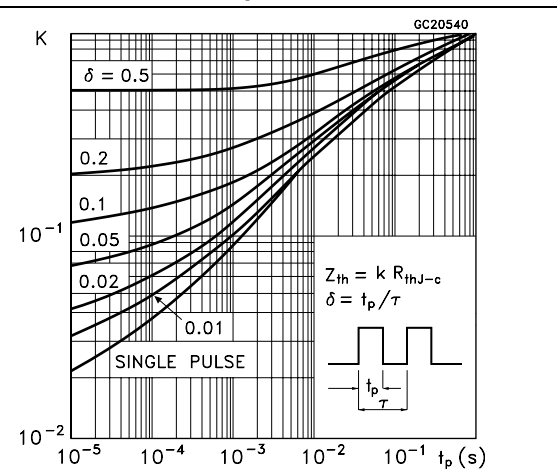


Figure 6. Safe operating area for TO-247

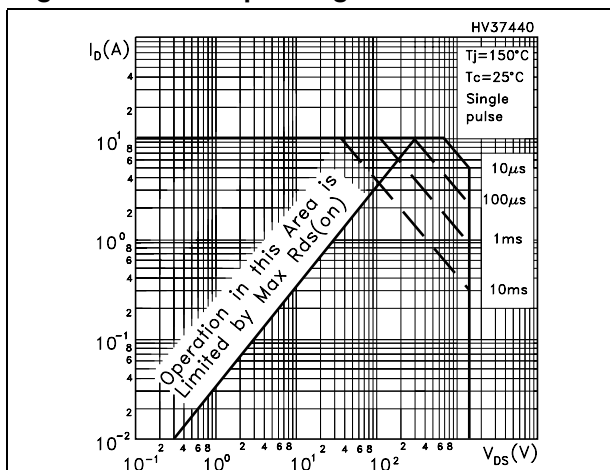


Figure 7. Thermal impedance for TO-247

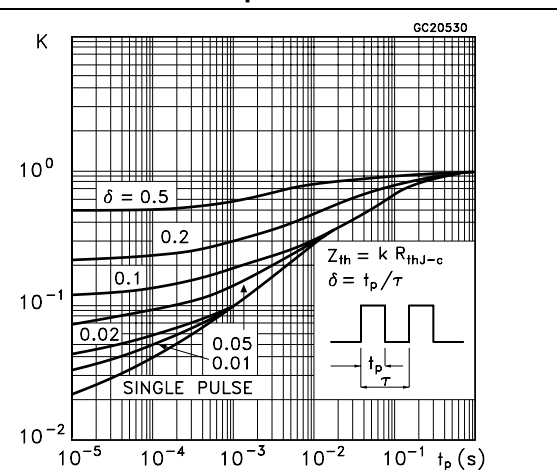


Figure 8. Output characteristics

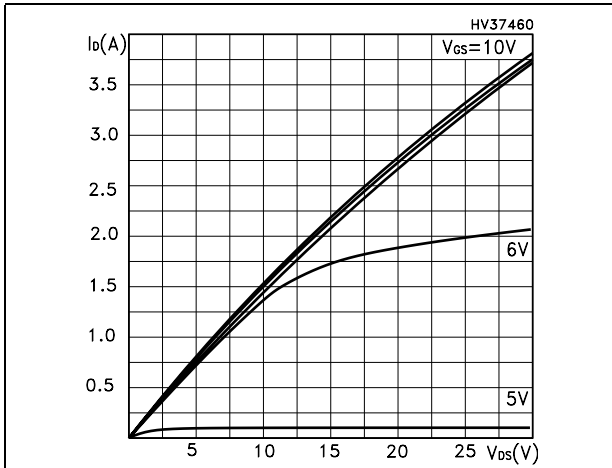


Figure 9. Transfer characteristics

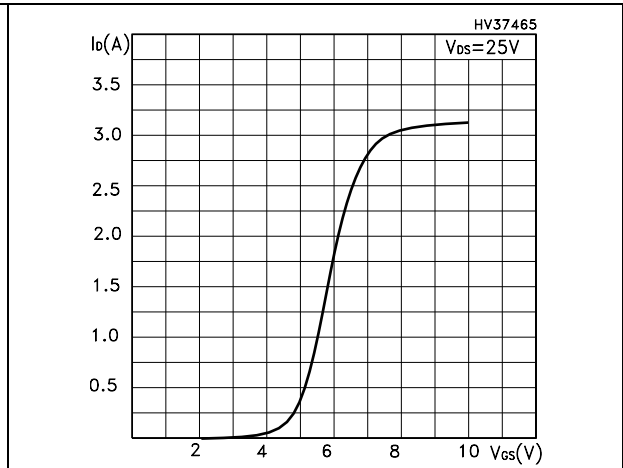


Figure 10. Normalized  $BV_{DSS}$  vs. temperature

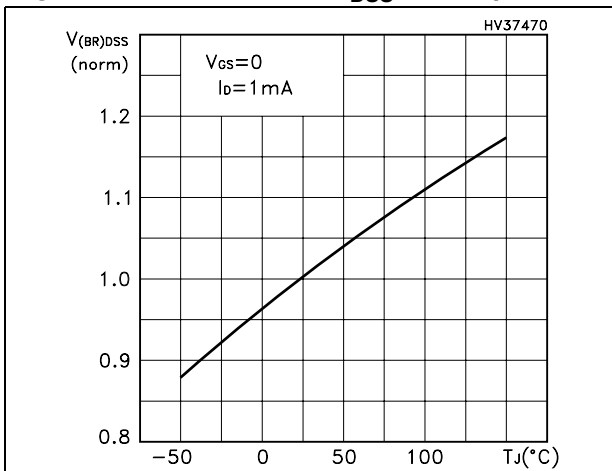


Figure 11. Static drain-source on resistance

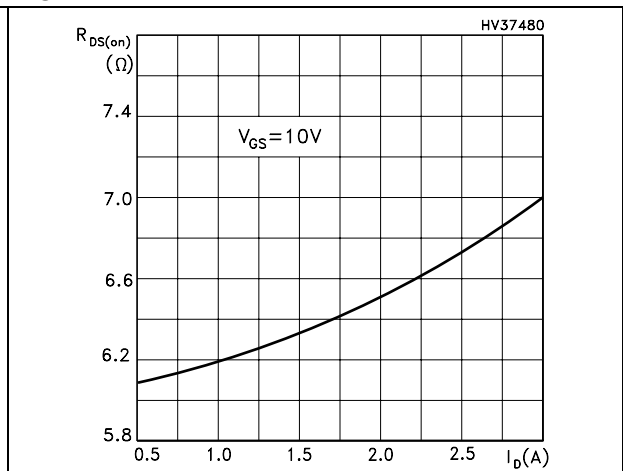


Figure 12. Gate charge vs. gate-source voltage

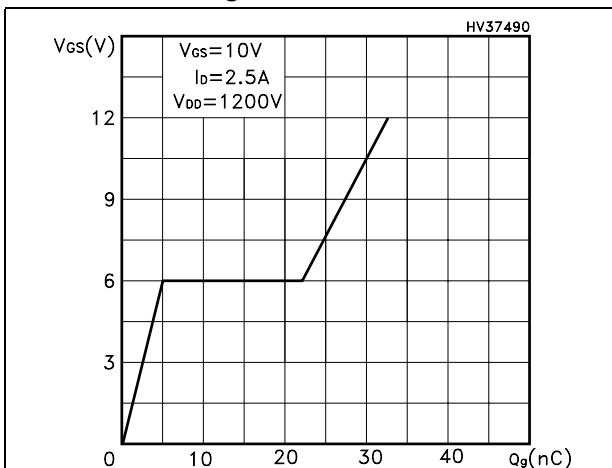


Figure 13. Capacitance variations

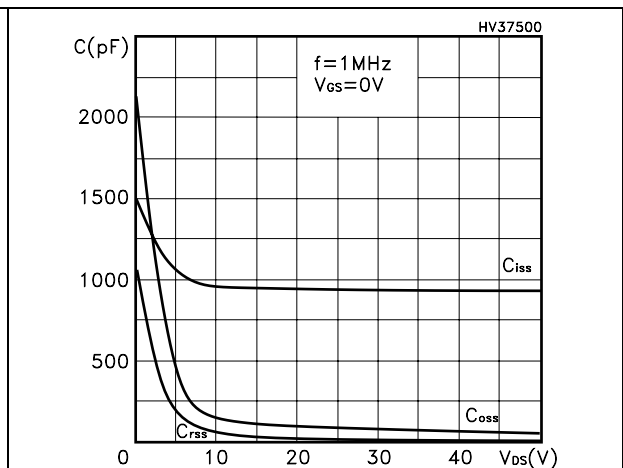


Figure 14. Normalized gate threshold voltage vs. temperature

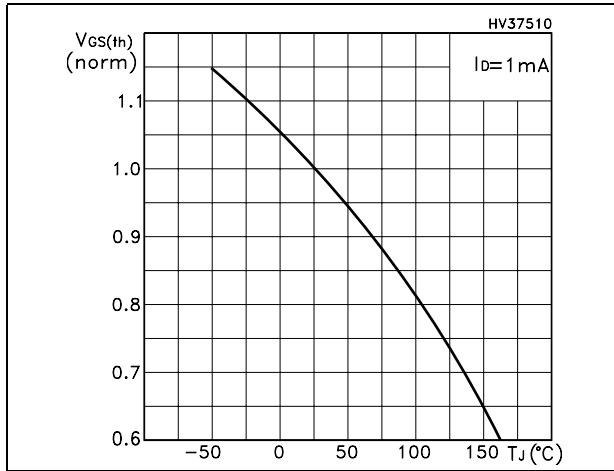


Figure 15. Normalized on resistance vs. temperature

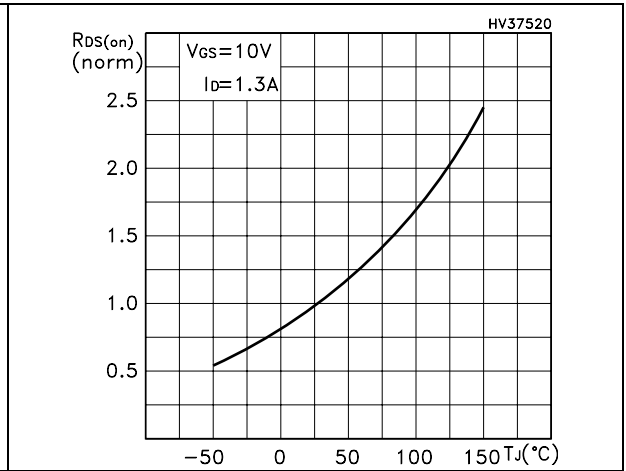


Figure 16. Source-drain diode forward characteristics

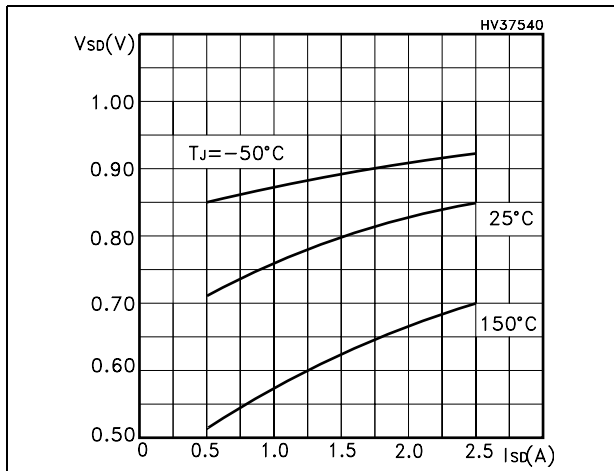
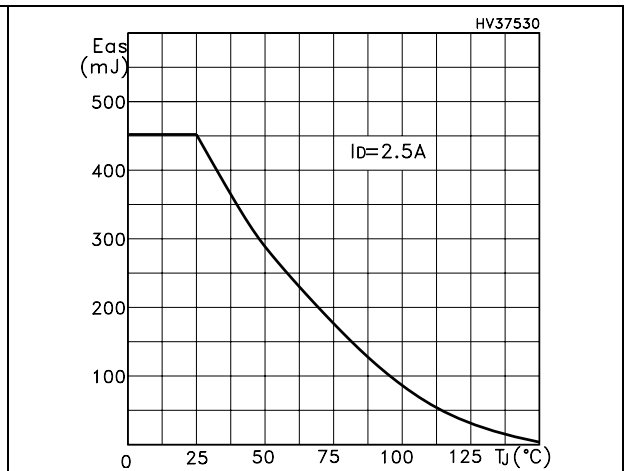
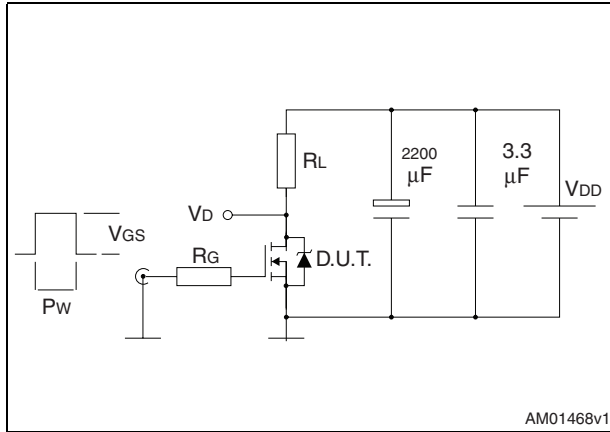


Figure 17. Maximum avalanche energy vs Tj



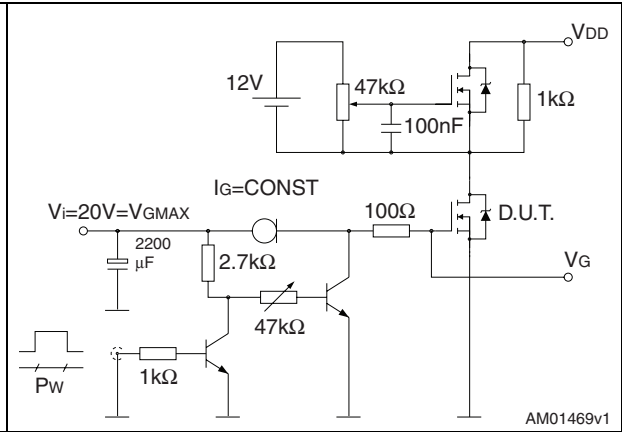
### 3 Test circuits

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



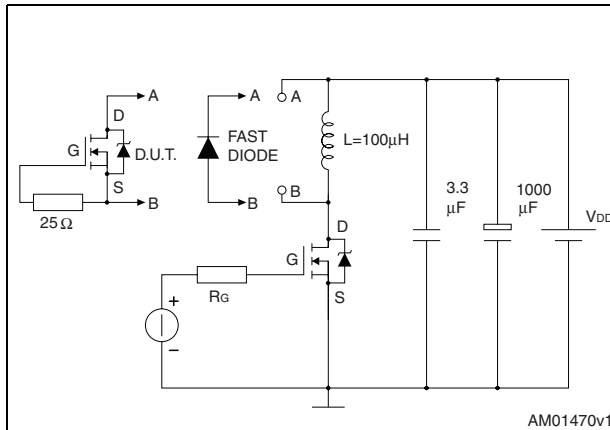
AM01468v1

**Figure 19. Gate charge test circuit**



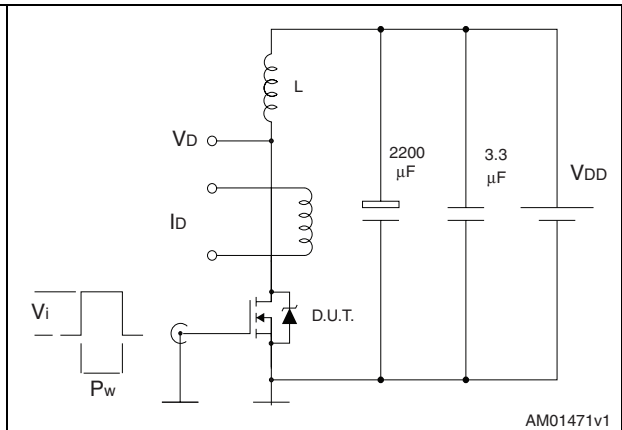
AM01469v1

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



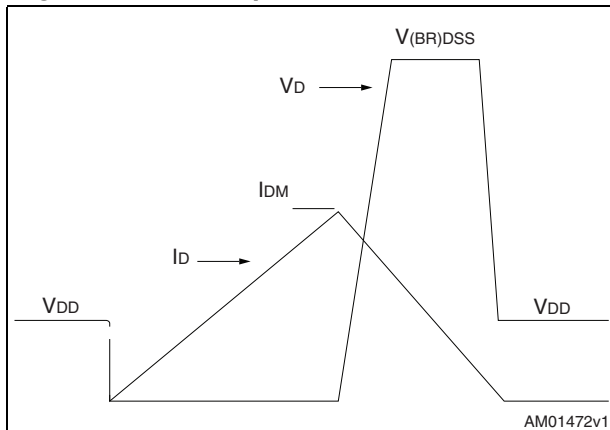
AM01470v1

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



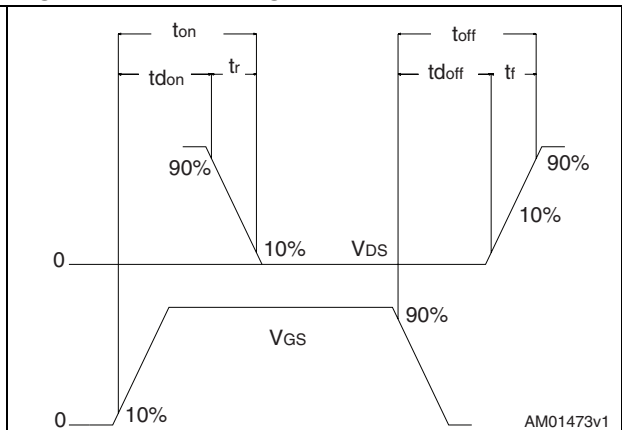
AM01471v1

**Figure 22. Unclamped inductive waveform**



AM01472v1

**Figure 23. Switching time waveform**



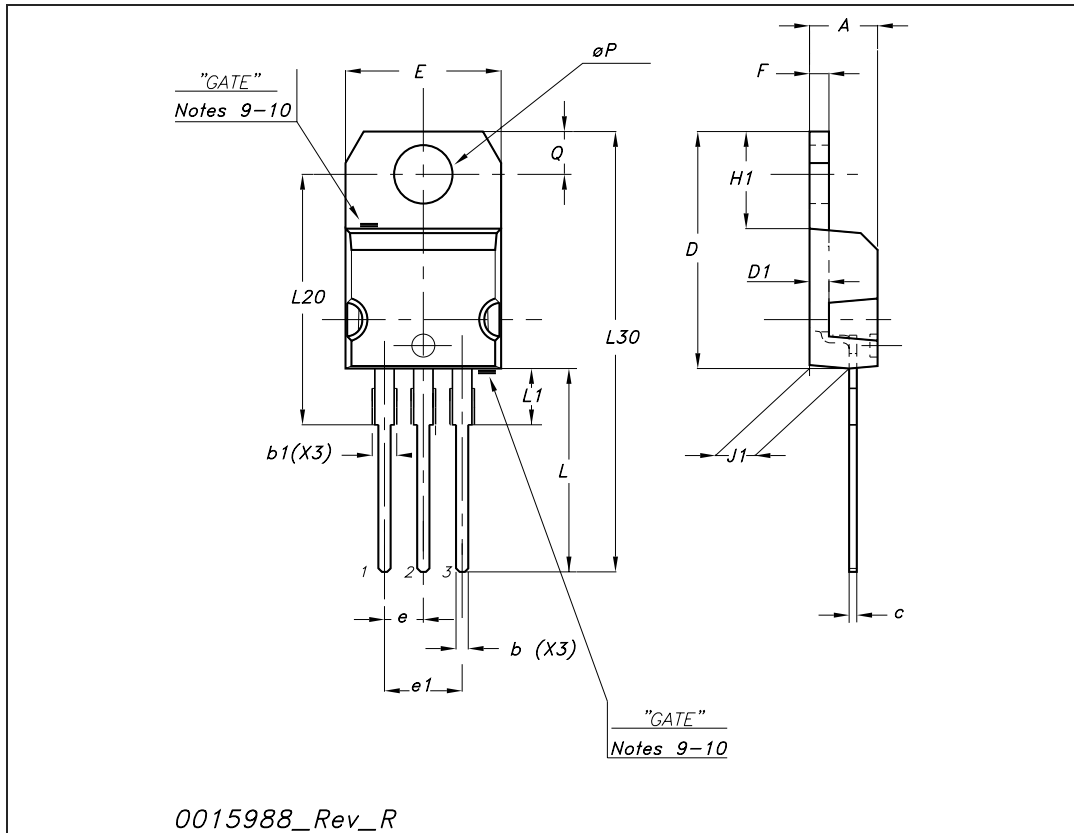
AM01473v1

## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

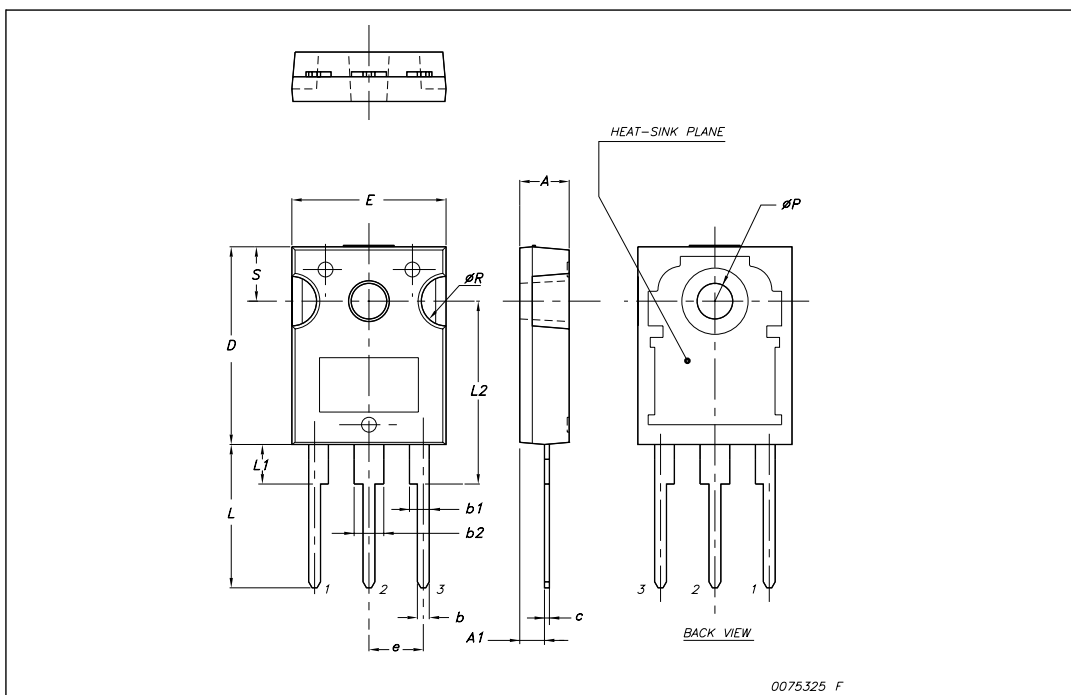
TO-220 mechanical data

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



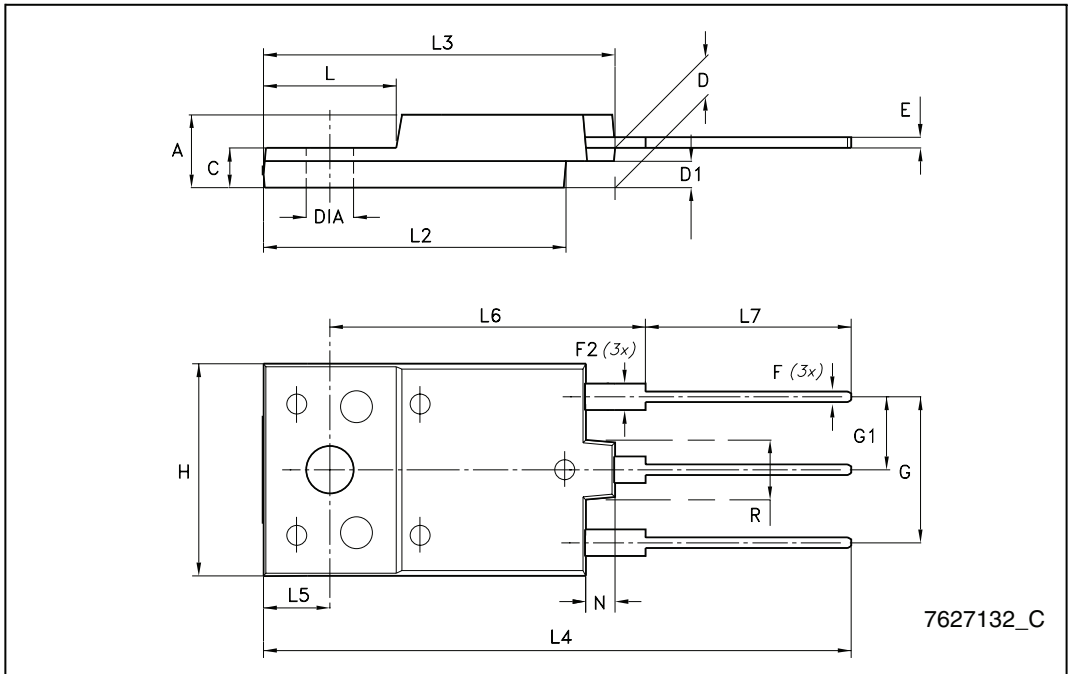
**TO-247 Mechanical data**

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-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 <a href="#">Table 6</a> .
14-May-2007	3	The document has been reformatted
29-Aug-2007	4	$R_{DS(on)}$ value changed, updated <a href="#">Figure 15</a>
09-Apr-2008	5	Added new package: TO-3PF
13-Feb-2009	6	Added $P_{TOT}$ value for TO-3PF ( <a href="#">Table 2: Absolute maximum ratings</a> )
01-Dec-2009	7	– Document status promoted from preliminary data to datasheet – Removed TO-220FH package and mechanical data
10-Dec-2009	8	Corrected $V_{ISO}$ value in <a href="#">Table 2: Absolute maximum ratings</a>
29-Jun-2010	9	Corrected unit in <a href="#">Table 3</a> .

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