



STFW3N150 STP3N150, STW3N150

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

Features

Type	V _{DSS}	R _{DS(on)} max.	I _D	P _{TOT}
STFW3N150	1500 V	< 9 Ω	2.5 A	63 W
STP3N150	1500 V	< 9 Ω	2.5 A	140 W
STW3N150	1500 V	< 9 Ω	2.5 A	140 W

- 100% avalanche tested
- Intrinsic capacitances and Q_g 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_{DS(on)} per area, unrivalled gate charge and switching characteristics.

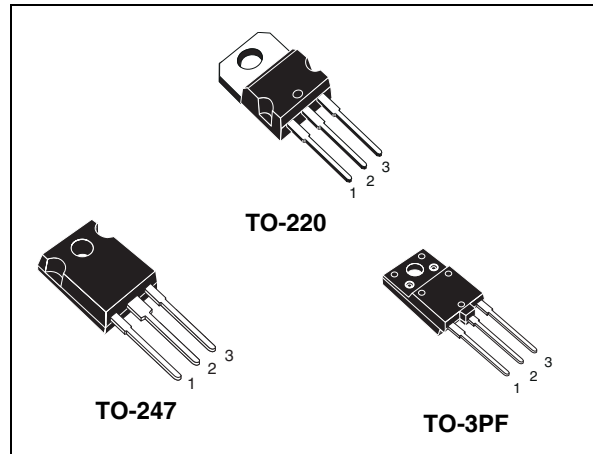


Figure 1. Internal schematic diagram

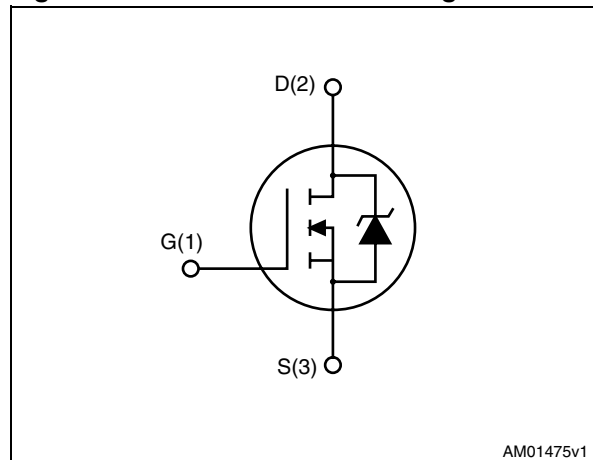


Table 1. Device summary

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

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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	± 30		V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	2.5	2.5 ⁽¹⁾	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	1.6	1.6 ⁽¹⁾	A
$I_{DM}^{(1)}$	Drain current (pulsed)	10	10 ⁽¹⁾	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_{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	μA μA
I_{GSS}	Gate-body leakage current ($V_{\text{DS}} = 0$)	$V_{\text{GS}} = \pm 30\text{ V}$			± 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	Ω

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_{iSS} C_{OSS} C_{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 V , $V_{\text{GS}} = 0$	-	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	$V_{\text{DD}} = 1200\text{ V}$, $I_{\text{D}} = 2.5\text{ A}$, $V_{\text{GS}} = 10\text{ V}$ (see Figure 19)	-	29.3 4.6 17	-	nC nC nC

1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5%

2. $C_{\text{OSS eq.}}$ 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}

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-3PF

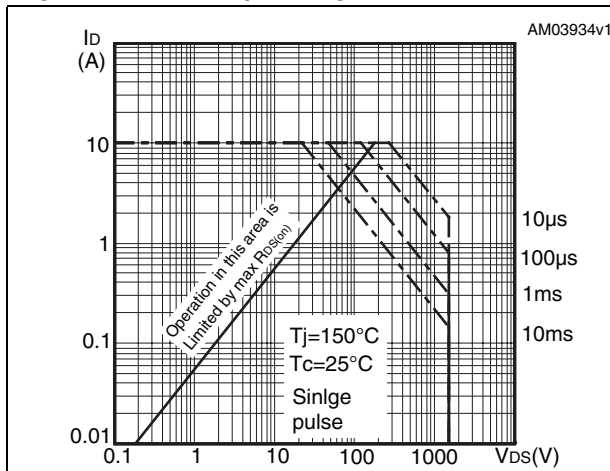


Figure 3. Thermal impedance for TO-3PF

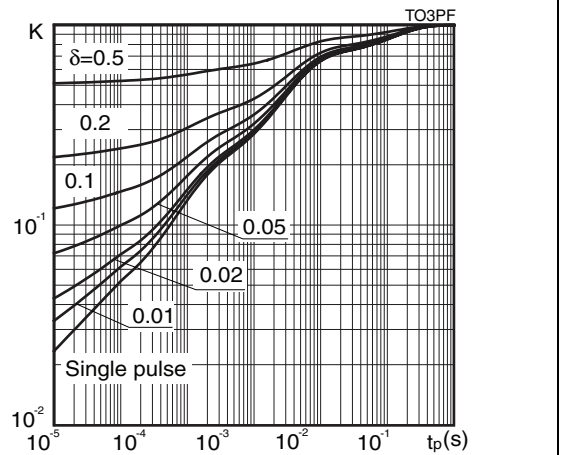


Figure 4. Safe operating area for TO-220

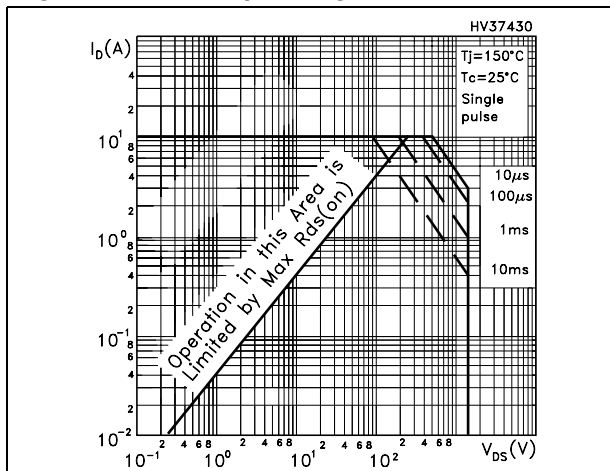


Figure 5. Thermal impedance for TO-220

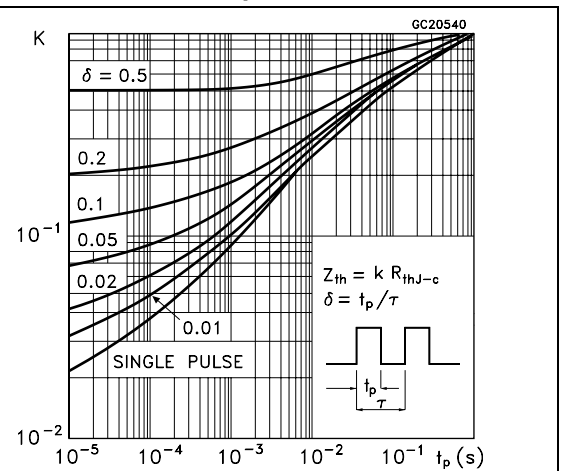


Figure 6. Safe operating area for TO-247

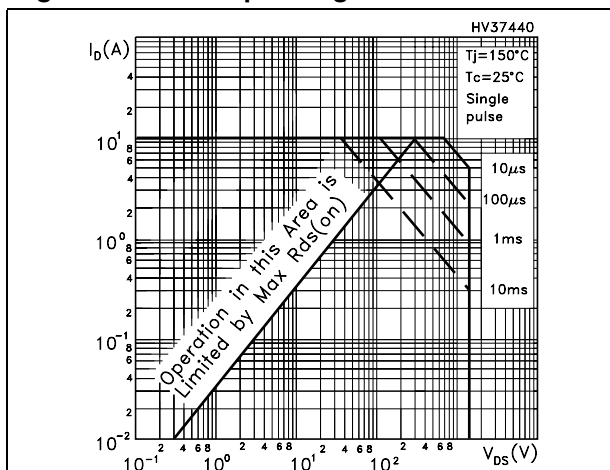


Figure 7. Thermal impedance for TO-247

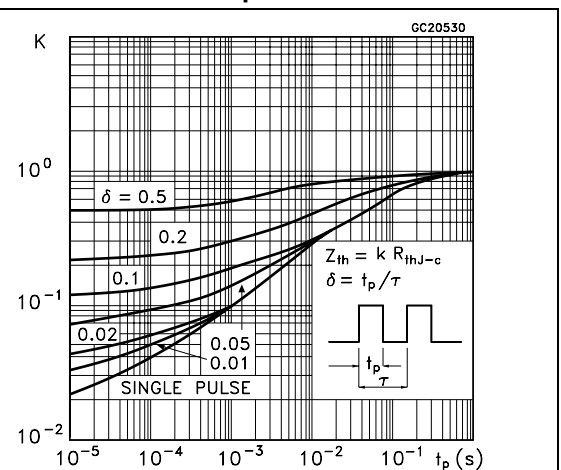


Figure 8. Output characteristics

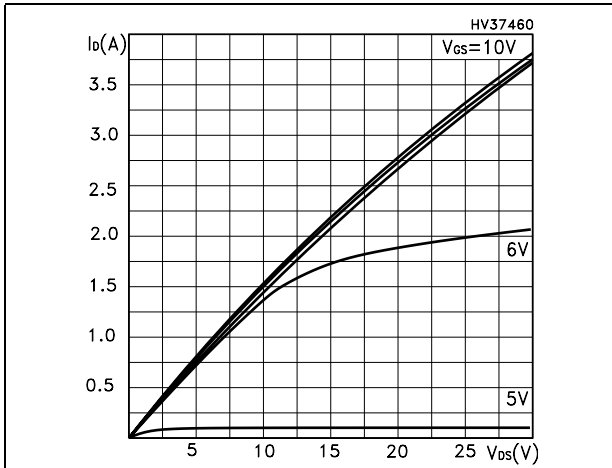


Figure 9. Transfer characteristics

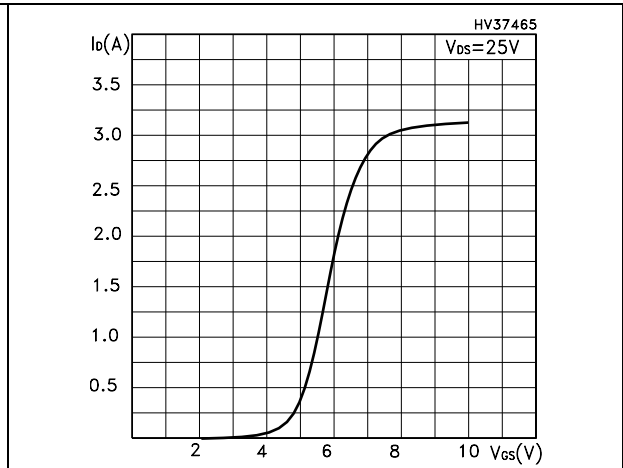


Figure 10. Normalized BV_{DSS} vs. temperature

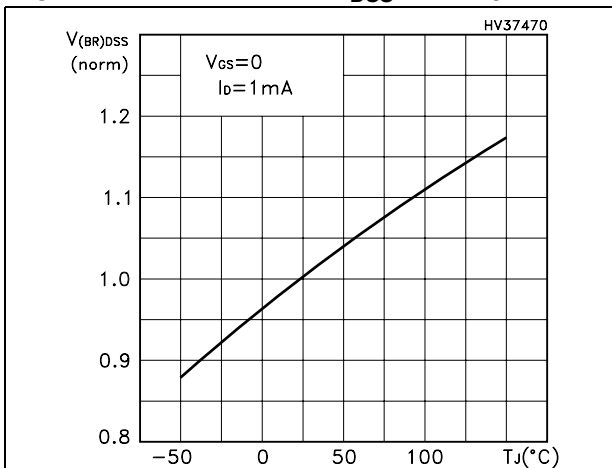


Figure 11. Static drain-source on resistance

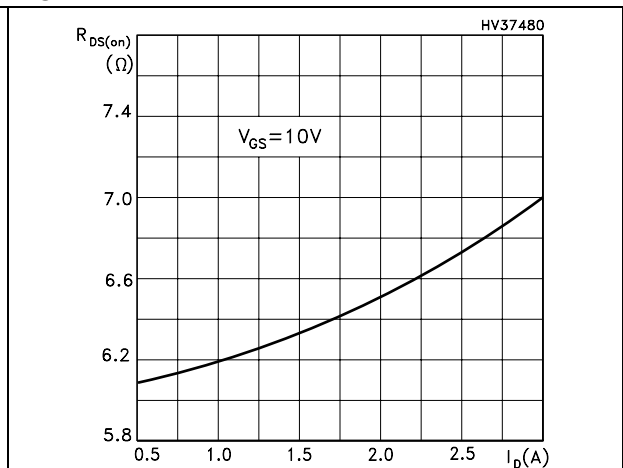


Figure 12. Gate charge vs. gate-source voltage

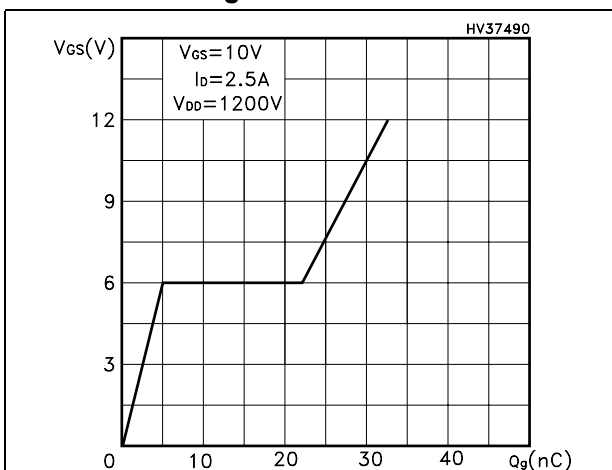


Figure 13. Capacitance variations

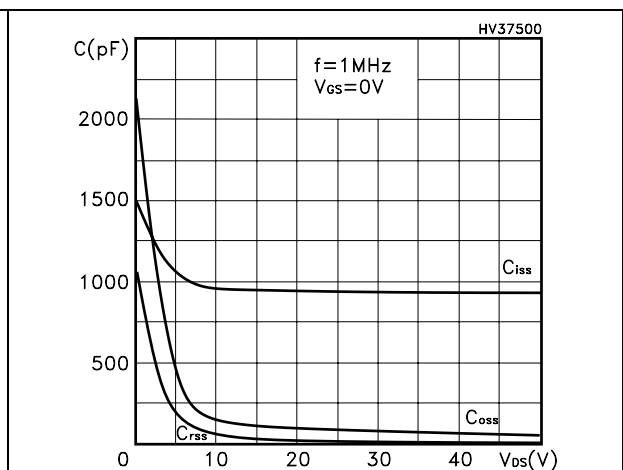


Figure 14. Normalized gate threshold voltage vs. temperature

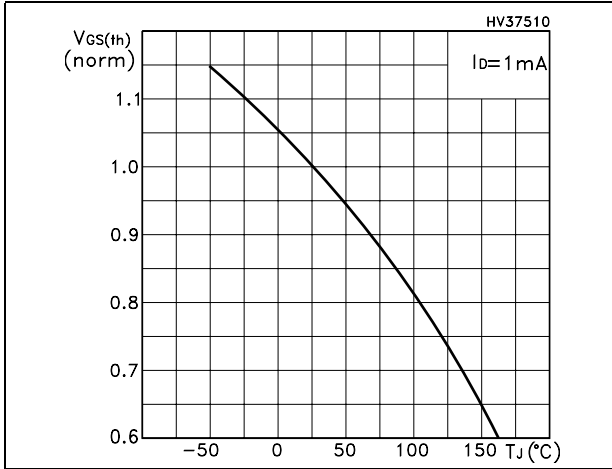


Figure 15. Normalized on resistance vs. temperature

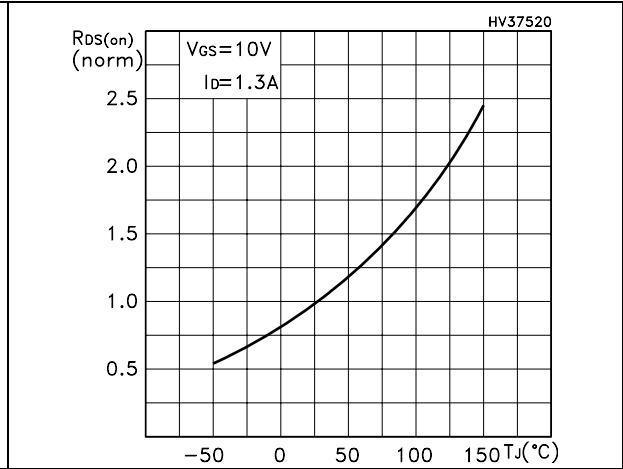


Figure 16. Source-drain diode forward characteristics

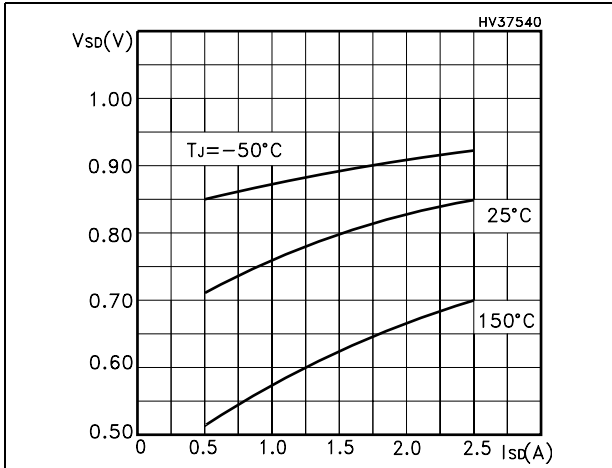
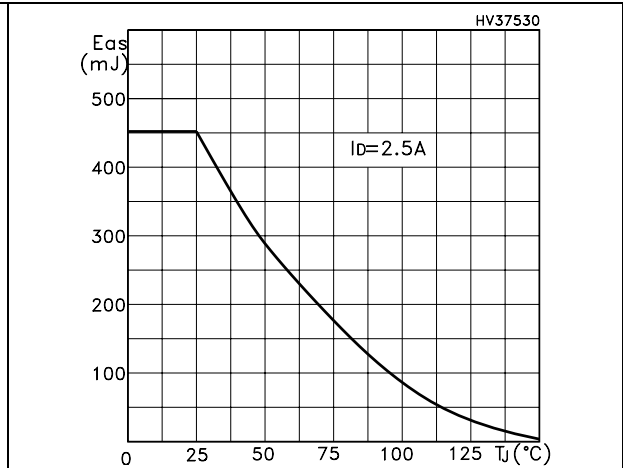


Figure 17. Maximum avalanche energy vs Tj



3 Test circuits

Figure 18. Switching times test circuit for resistive load

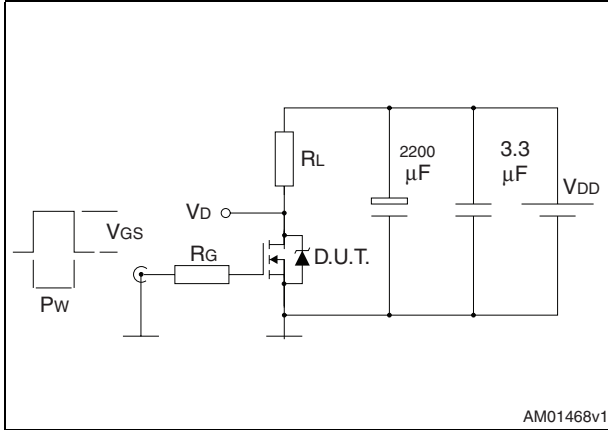


Figure 19. Gate charge test circuit

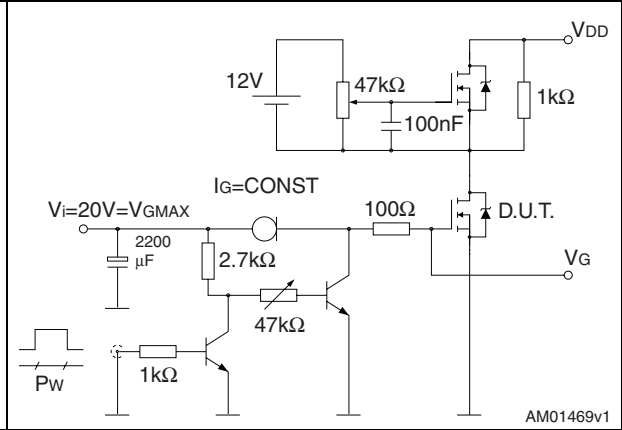


Figure 20. Test circuit for inductive load switching and diode recovery times

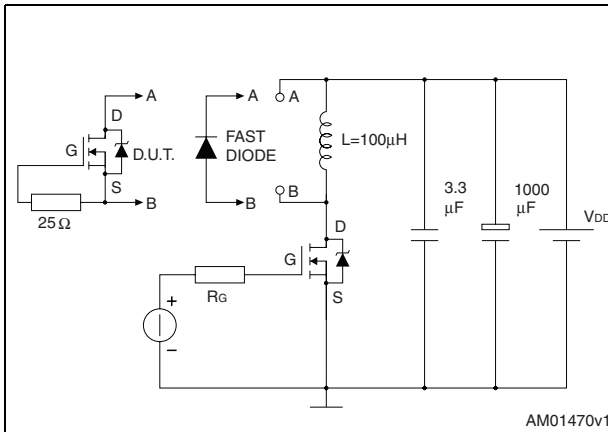


Figure 21. Unclamped inductive load test circuit

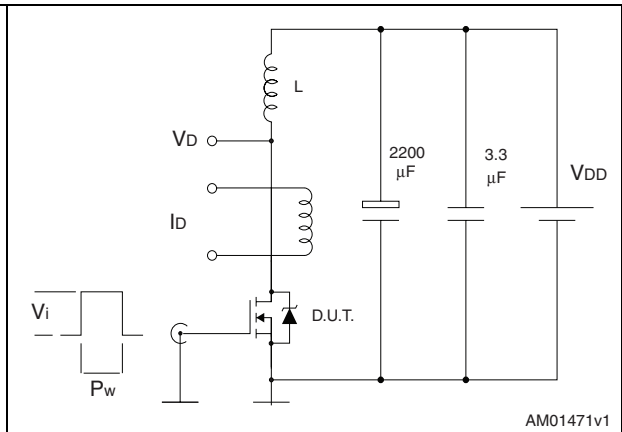


Figure 22. Unclamped inductive waveform

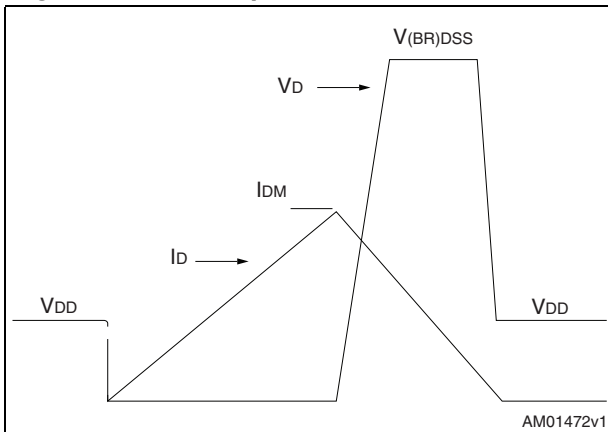
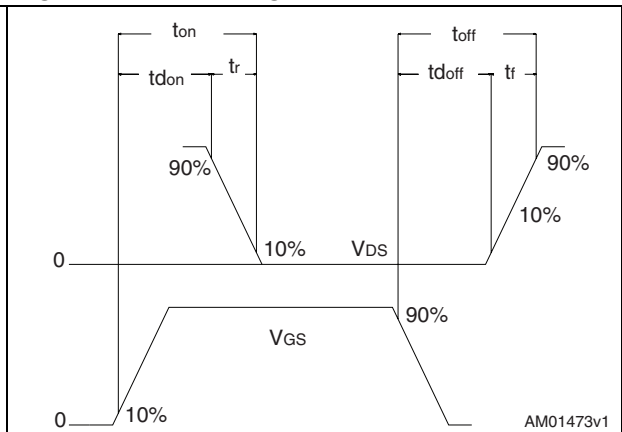


Figure 23. Switching time waveform

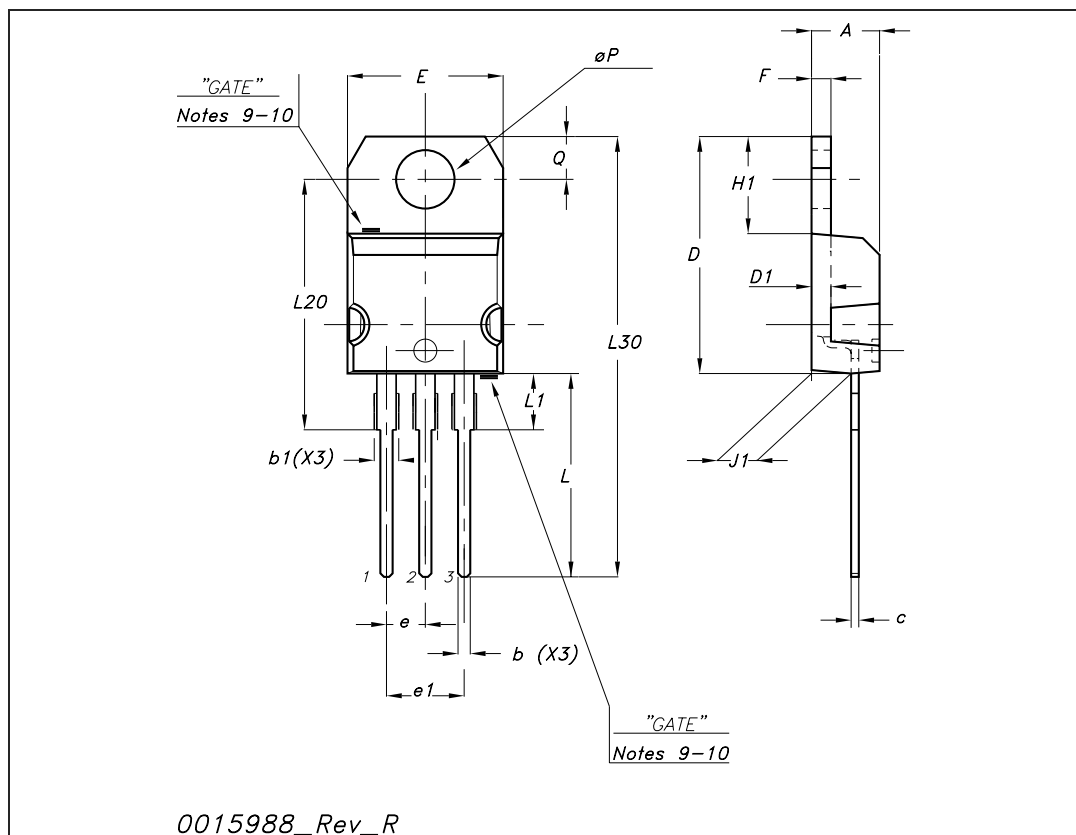


4 Package mechanical data

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

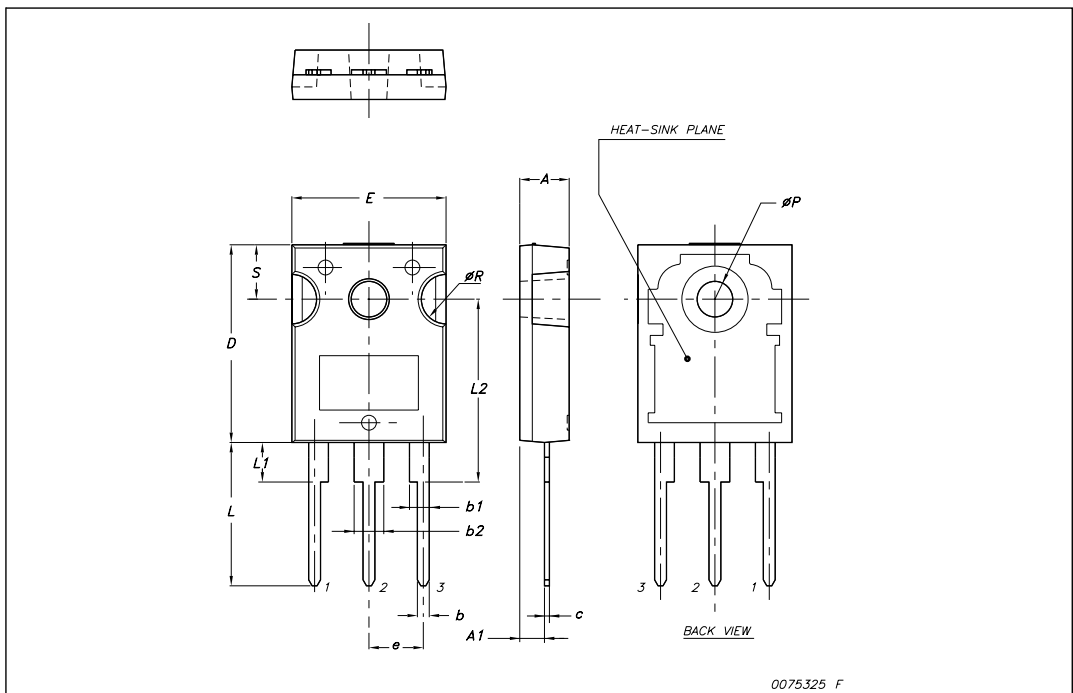
TO-220 mechanical data

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



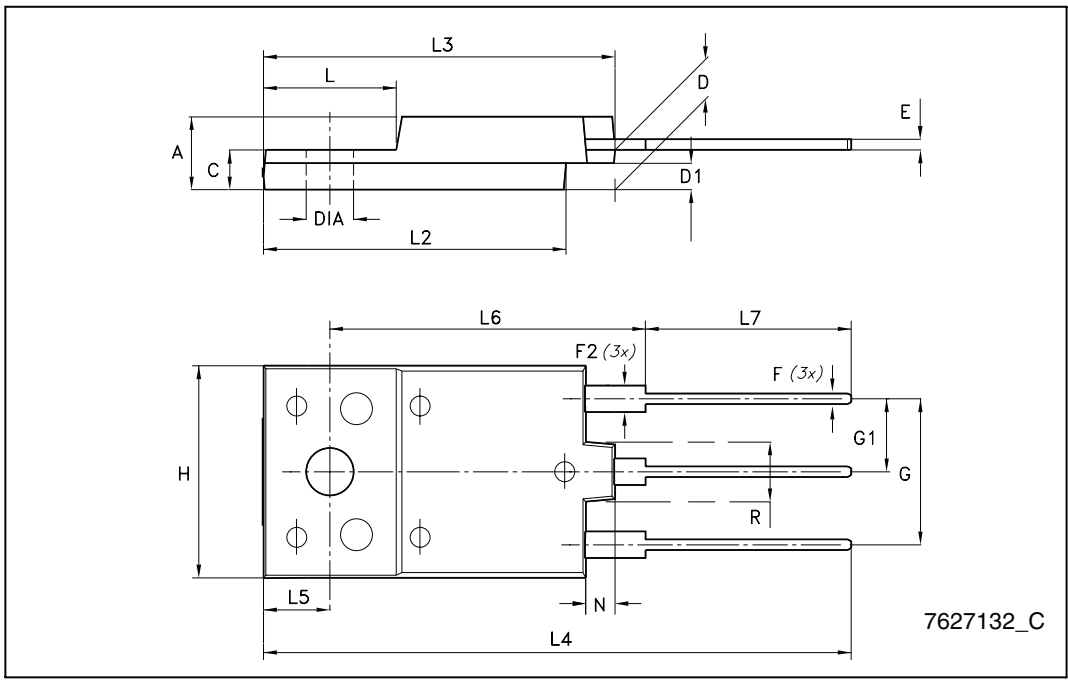
TO-247 Mechanical data

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 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
13-Feb-2009	6	Added P_{TOT} value for TO-3PF (Table 2: Absolute maximum ratings)
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 Table 2: Absolute maximum ratings
29-Jun-2010	9	Corrected unit in Table 3 .

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