



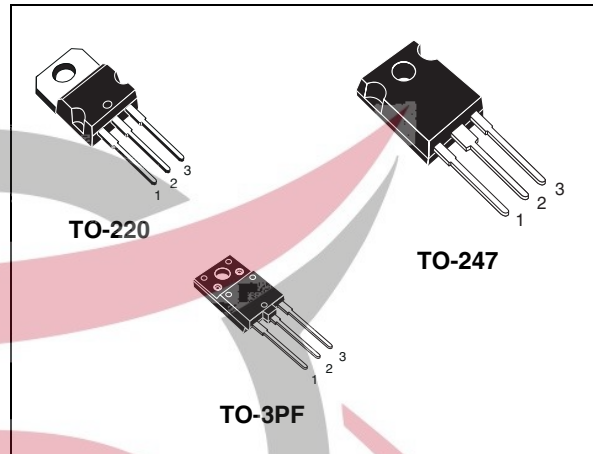
# STFW4N150 STP4N150, STW4N150

N-channel 1500 V, 5  $\Omega$ , 4 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>w</sub>
STFW4N150	1500 V	< 7 $\Omega$	4 A	63 W
STP4N150	1500 V	< 7 $\Omega$	4 A	160 W
STW4N150	1500 V	< 7 $\Omega$	4 A	160 W

- 100% avalanche tested
- Intrinsic capacitances and Q<sub>g</sub> minimized
- High speed switching
- Fully isolated TO-3PF plastic packages
- 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.

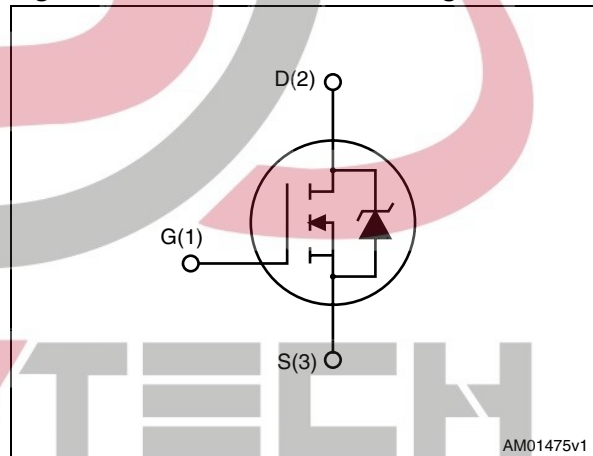


Table 1. Device summary

Order codes	Marking	Package	Packaging
STFW4N150	4N150	TO-3PF	Tube
STP4N150	P4N150	TO-220	Tube
STW4N150	W4N150	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	$\pm 30$			V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	4	4	4 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	2.5	2.5	2.5 <sup>(1)</sup>	A
$I_{DM}$ <sup>(1)</sup>	Drain current (pulsed)	12	12	12 <sup>(1)</sup>	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	160		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
$T_{stg}$	Storage temperature	-55 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	Value			Unit
		TO-220	TO-247	TO-3PF	
$R_{thj-case}$	Thermal resistance junction-case max	0.78		2	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction- ambient max	62.5	50		$^\circ\text{C}/\text{W}$

**Table 4. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)	4	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	350	mJ

## 2 Electrical characteristics

( $T_{CASE} = 25\text{ °C}$  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	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 30\text{ V}$			$\pm 100$	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	$V_{GS} = 10\text{ V}$ , $I_D = 2\text{ A}$		5	7	$\Omega$

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 30\text{ V}$ , $I_D = 2\text{ A}$	-	3.5		S
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	1300		pF
$C_{oss}$	Output capacitance			120		pF
$C_{rss}$	Reverse transfer capacitance			12		pF
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 750\text{ V}$ , $I_D = 2\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ <i>Figure 19</i>	-	35		ns
$T_r$	Rise time			30		ns
$t_{d(off)}$	Turn-off delay time			45		ns
$t_f$	Fall time			45		ns
$Q_g$	Total gate charge	$V_{DD} = 600\text{ V}$ , $I_D = 4\text{ A}$ , $V_{GS} = 10\text{ V}$ <i>Figure 20</i>	-	30	50	nC
$Q_{gs}$	Gate-source charge			10		nC
$Q_{gd}$	Gate-drain charge			9		nC

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

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		4	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		12	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 4 \text{ A}, V_{GS} = 0$	-		2	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 4 \text{ A},$ $di/dt = 100 \text{ A}/\mu\text{s}$	-	510		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 45 \text{ V}$	-	3		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	<i>Figure 21</i>	-	12		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 4 \text{ A},$ $di/dt = 100 \text{ A}/\mu\text{s}$	-	615		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 45 \text{ V}, T_j = 150^\circ\text{C}$	-	4		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	<i>Figure 21</i>	-	12.6		A

1. Pulse width limited by safe operating area
2. Pulsed: pulse duration=300 $\mu\text{s}$ , duty cycle 1.5%



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## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220

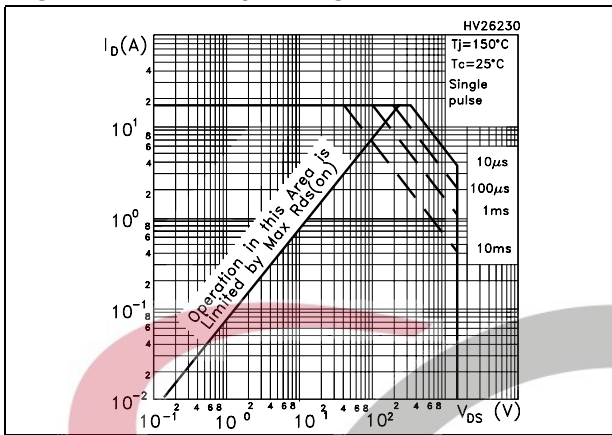


Figure 3. Thermal impedance for TO-220

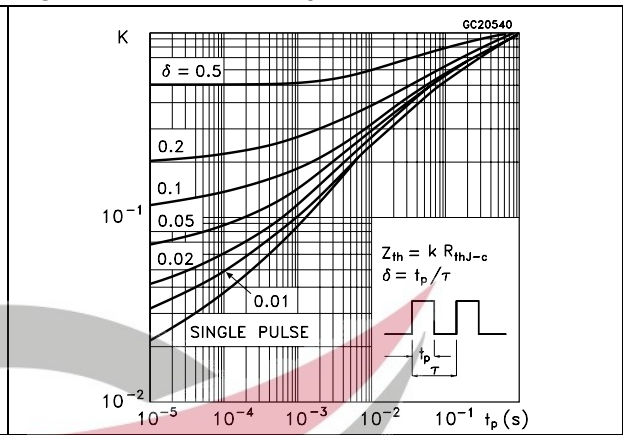


Figure 4. Safe operating area for TO-3PF

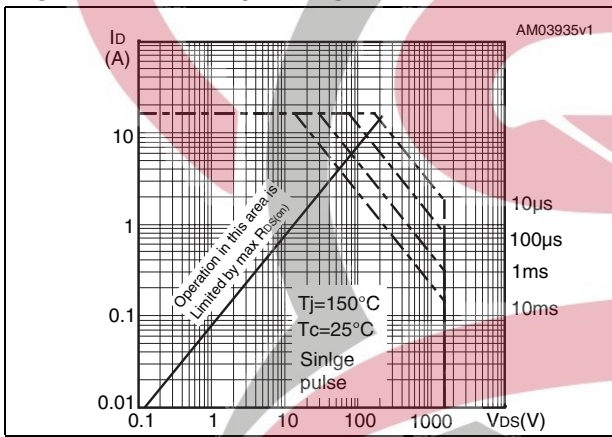


Figure 5. Thermal impedance for TO-3PF

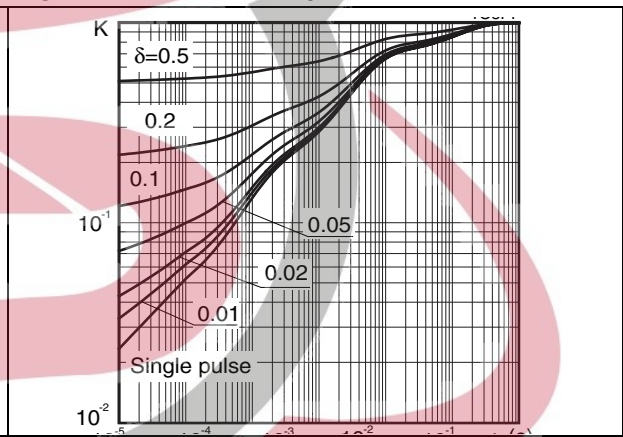


Figure 6. Safe operating area for TO-247

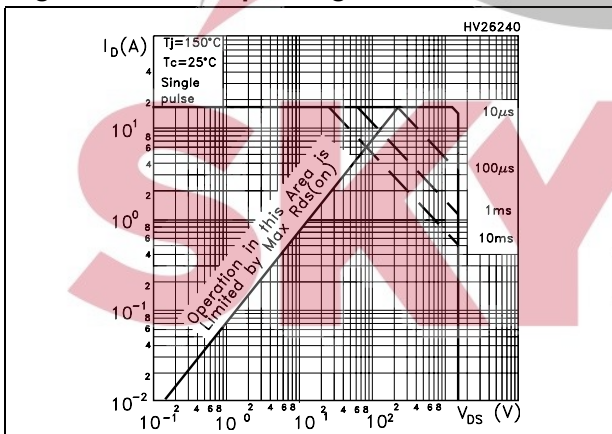


Figure 7. Thermal impedance for TO-247

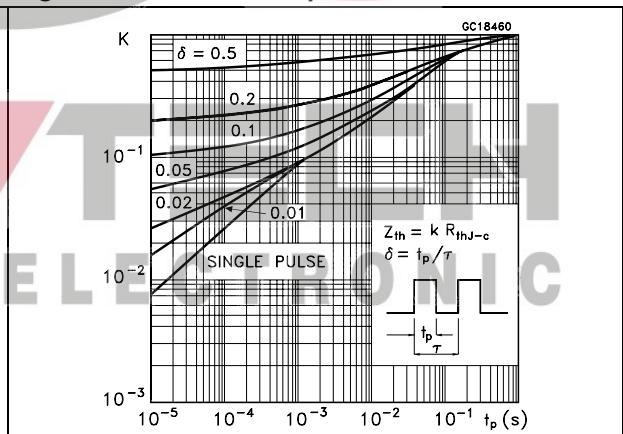


Figure 8. Output characteristics

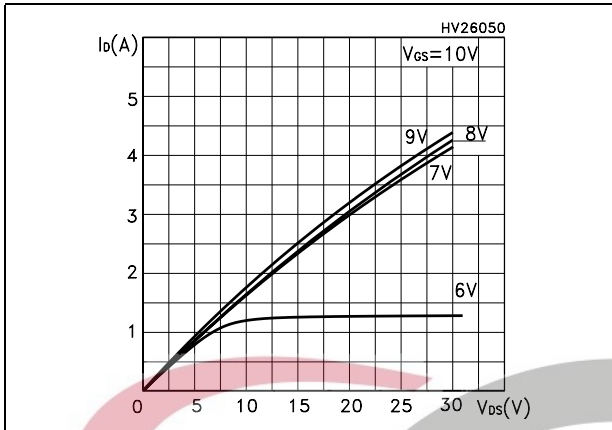


Figure 9. Transfer characteristics

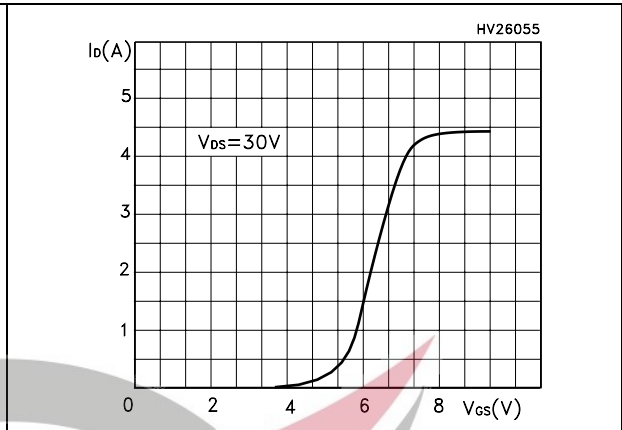


Figure 10. Transconductance

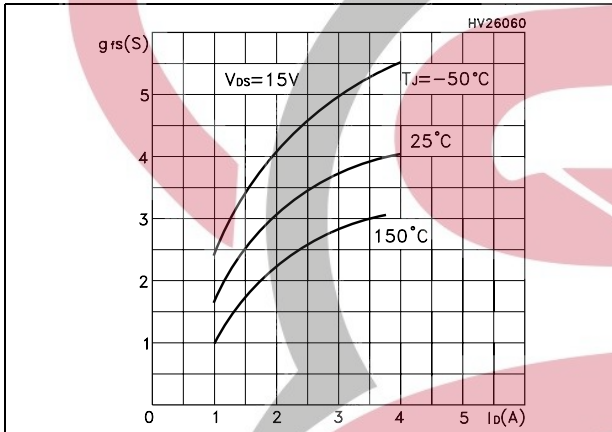


Figure 11. Static drain-source on resistance

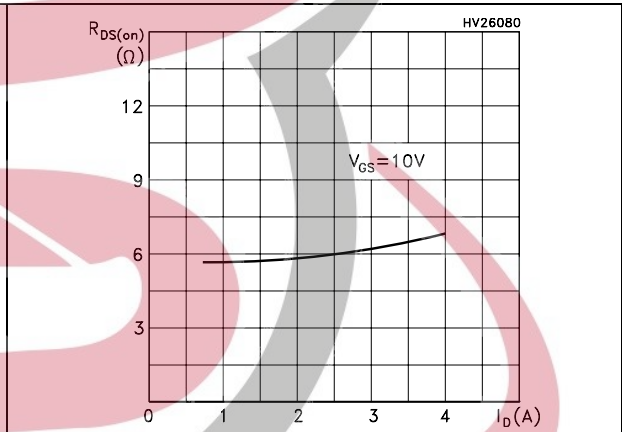


Figure 12. Gate charge vs gate-source voltage

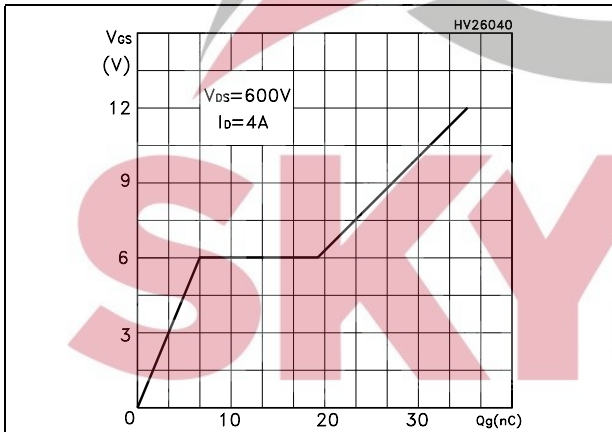


Figure 13. Capacitance variations

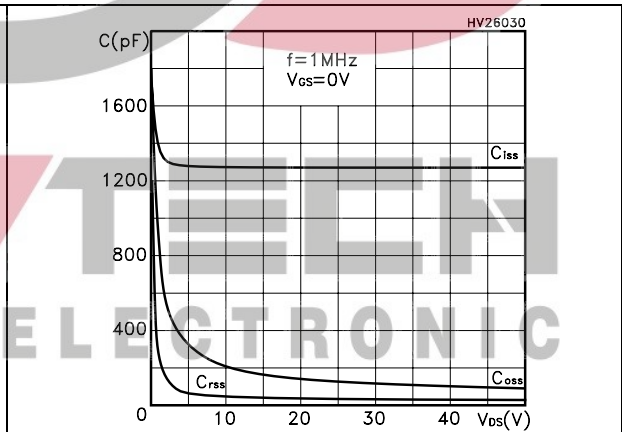


Figure 14. Normalized gate threshold voltage vs temperature

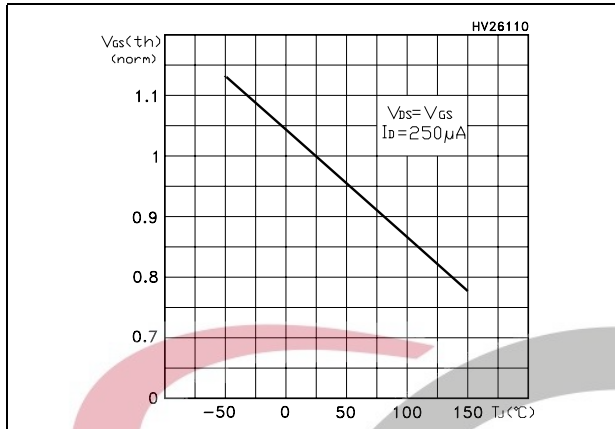


Figure 15. Normalized on resistance vs temperature

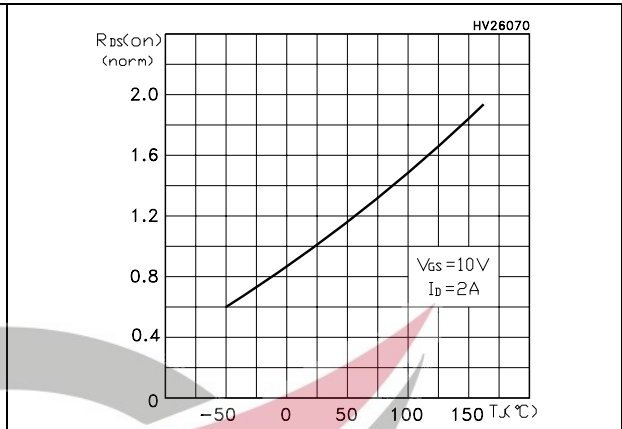


Figure 16. Source-drain diode forward characteristics

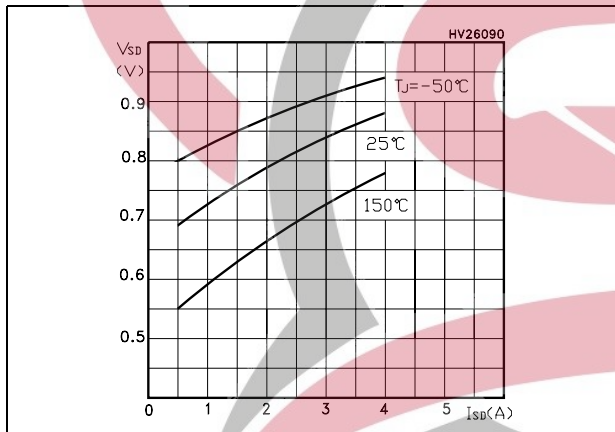


Figure 17. Normalized  $B_{VDSS}$  vs temperature

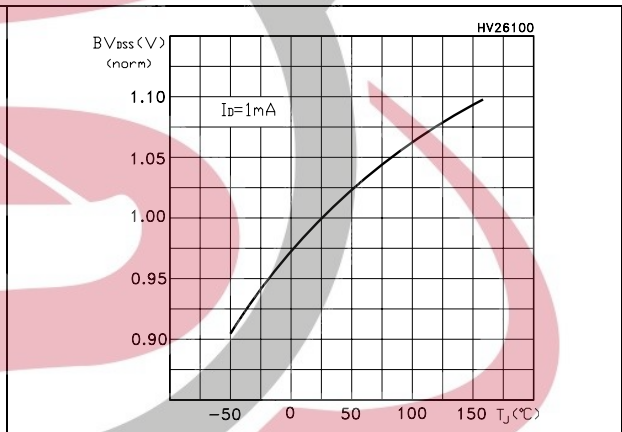
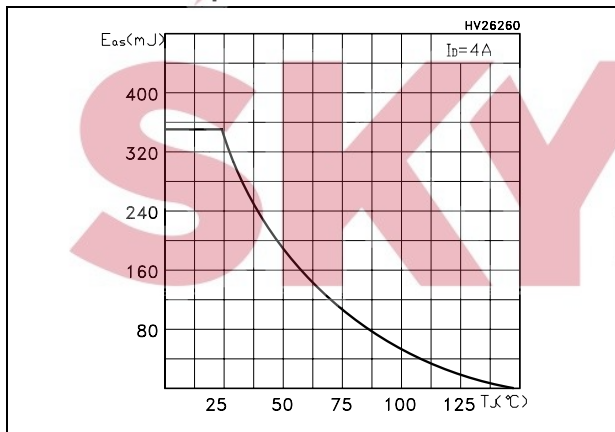


Figure 18. Maximum avalanche energy vs temperature





### 3 Test circuits

Figure 19. Switching times test circuit for resistive load

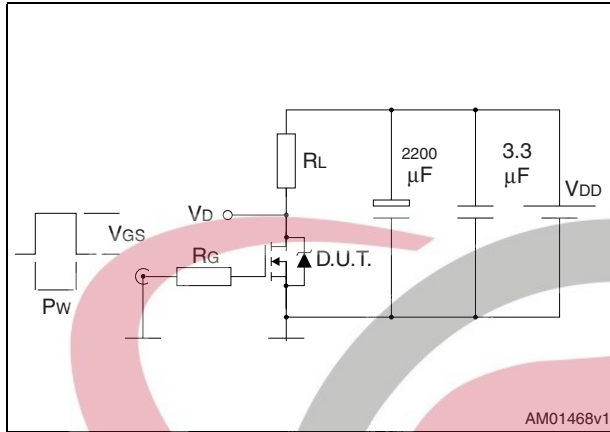


Figure 20. Gate charge test circuit

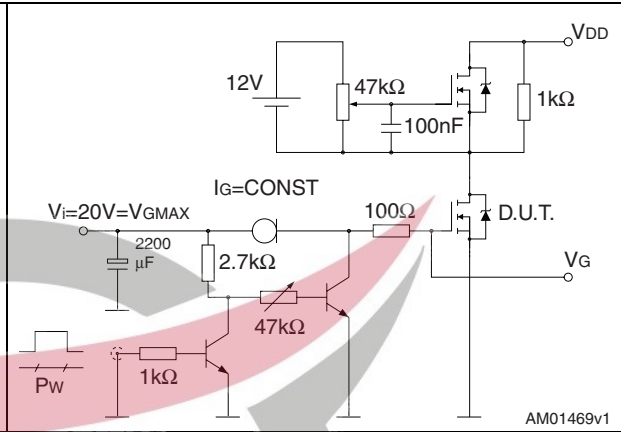


Figure 21. Test circuit for inductive load switching and diode recovery times

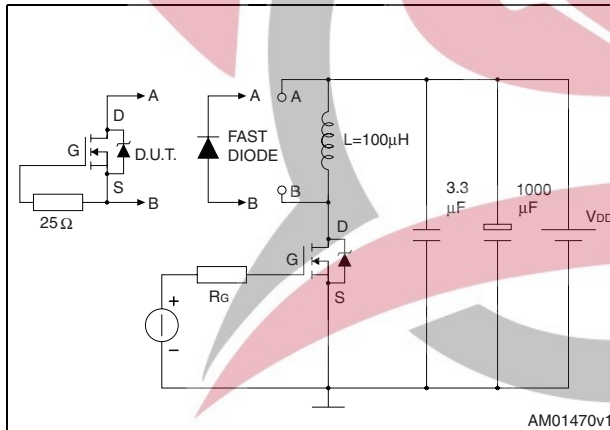


Figure 22. Unclamped inductive load test circuit

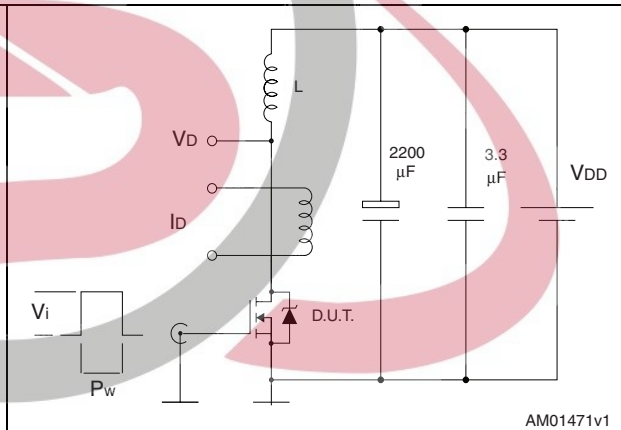


Figure 23. Unclamped inductive waveform

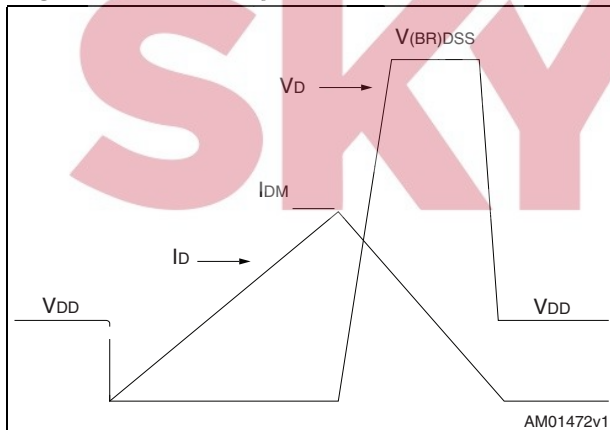
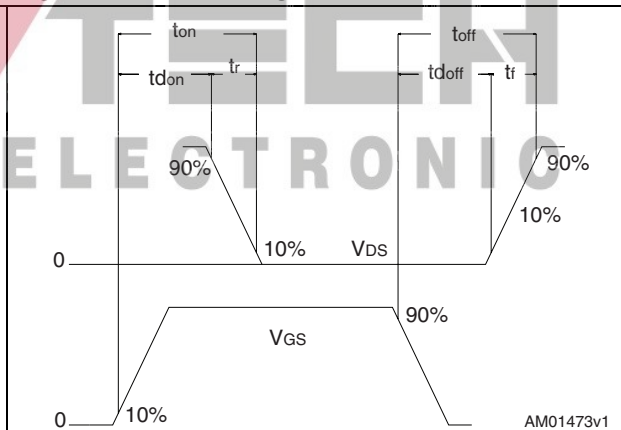


Figure 24. Switching time waveform



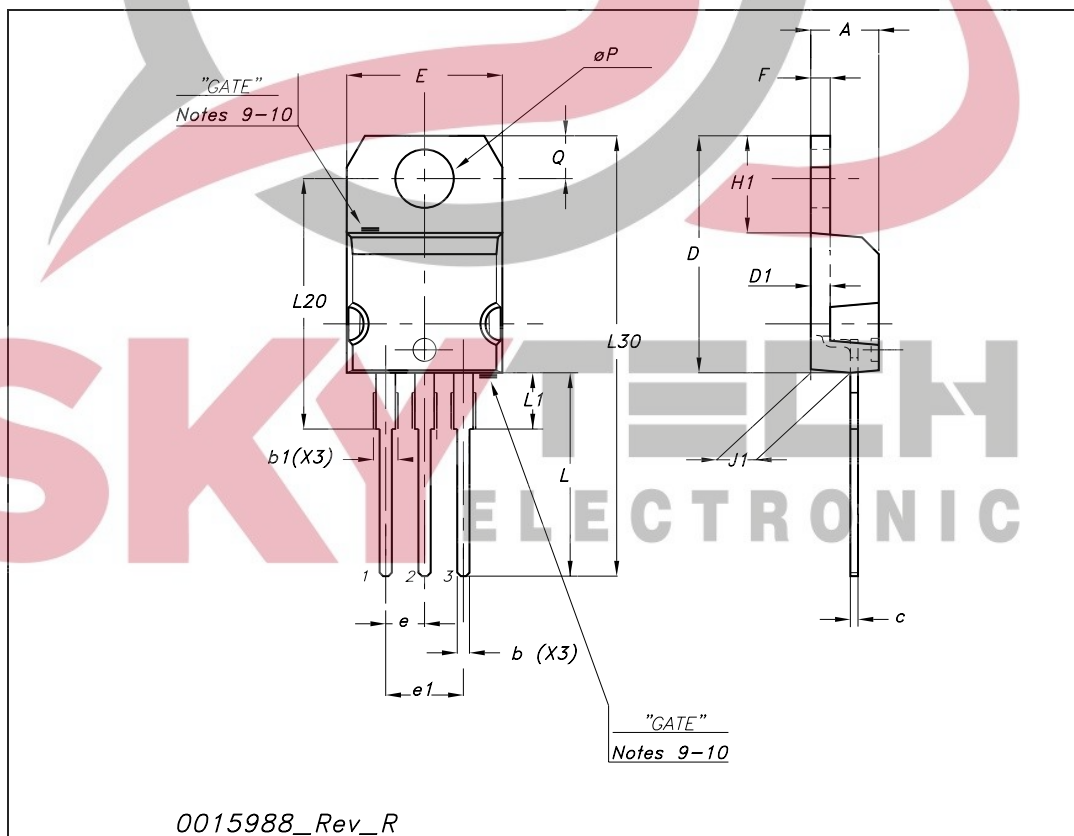
## 4 Package mechanical data

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](http://www.st.com). ECOPACK is an ST trademark.



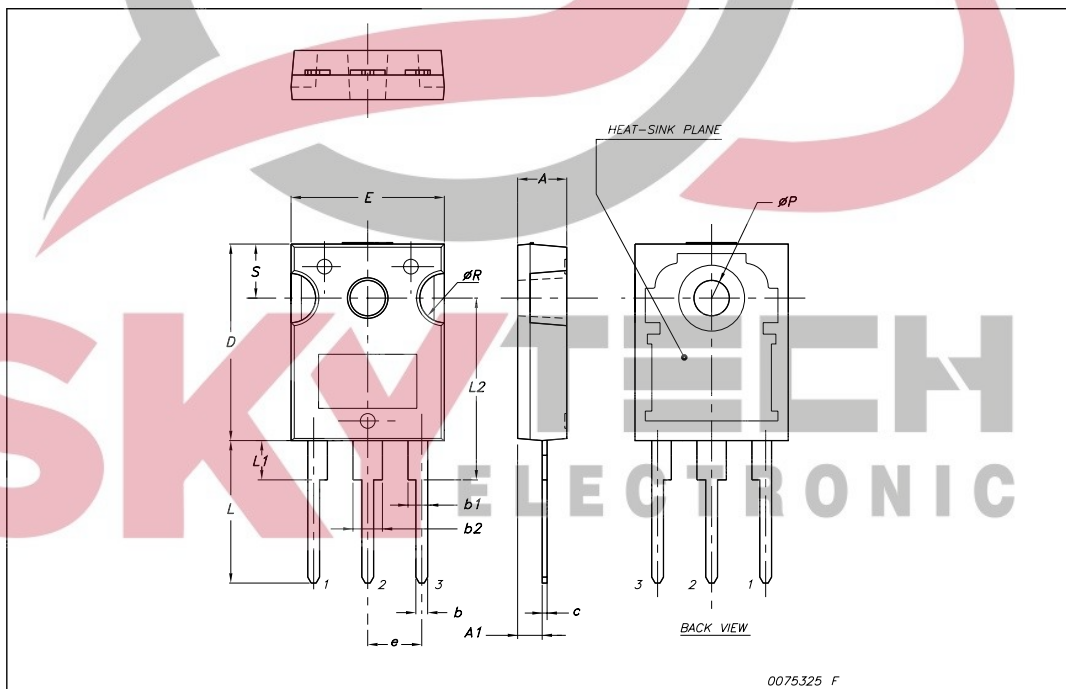
TO-220 mechanical data

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



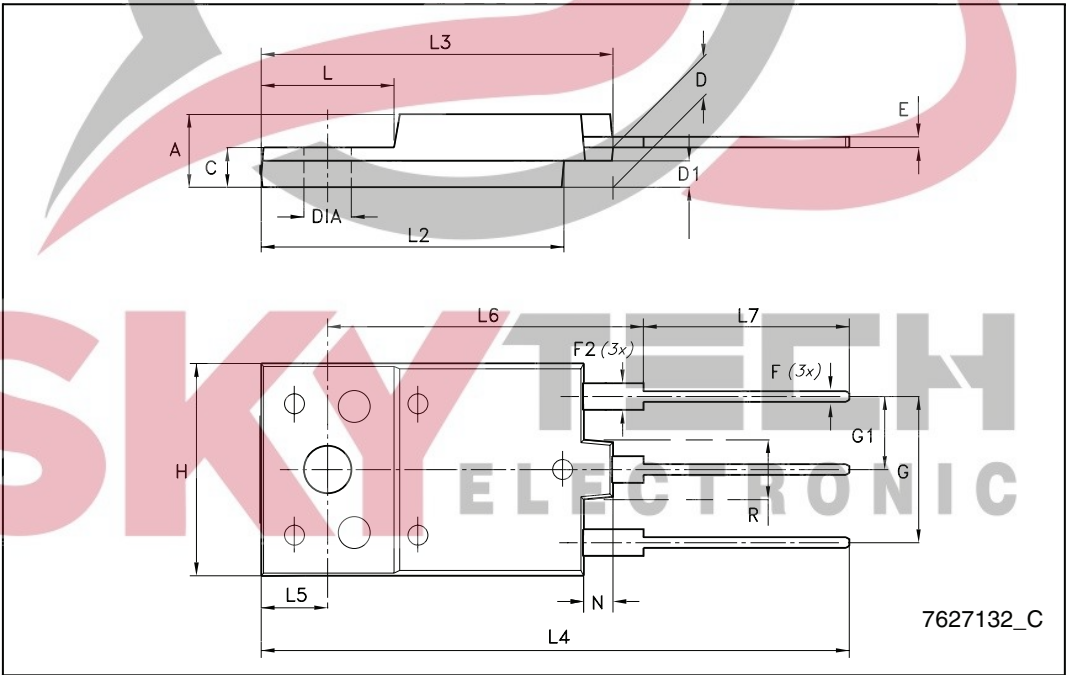
**TO-247 Mechanical data**

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	
∅P	3.55		3.65
∅R	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 8. Document revision history**

Date	Revision	Changes
29-Mar-2005	1	Initial release
07-Jul-2005	2	Removed TO-220FP
07-Oct-2005	3	Document status promoted from preliminary data to datasheet
10-Aug-2006	4	Document reformatted, no content change
06-Nov-2007	5	Updated unit on <a href="#">Table 5: On/off states</a>
09-Apr-2008	6	Added new packages: TO-220FH, TO-3PF
21-Jan-2009	7	Remove package TO-220FH
23-Feb-2009	8	Added $P_{TOT}$ value for TO-3PF $P_{TOT}$ ( <a href="#">Table 2: Absolute maximum ratings</a> )
23-Jul-2009	9	Added new figures: <a href="#">Figure 4: Safe operating area for TO-3PF</a> and <a href="#">Figure 5: Thermal impedance for TO-3PF</a>



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