



# STF19NM50N STP19NM50N, STW19NM50N

N-channel 500 V, 0.2  $\Omega$ , 14 A MDmesh™ II Power MOSFET  
in TO-220FP, TO-220 and TO-247

## Features

Type	$V_{DSS}$ @ $T_{Jmax}$	$R_{DS(on)}$ max	$I_D$
STF19NM50N STP19NM50N STW19NM50N	550 V	< 0.25 $\Omega$	14 A

- 100% avalanche tested
- Low input capacitances and gate charge
- Low gate input resistance

## Application

- Switching applications

## Description

This second generation of MDmesh™ technology, applies the benefits of the multiple drain process to STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product offers improved on-resistance, low gate charge, high dv/dt capability and excellent avalanche characteristics.

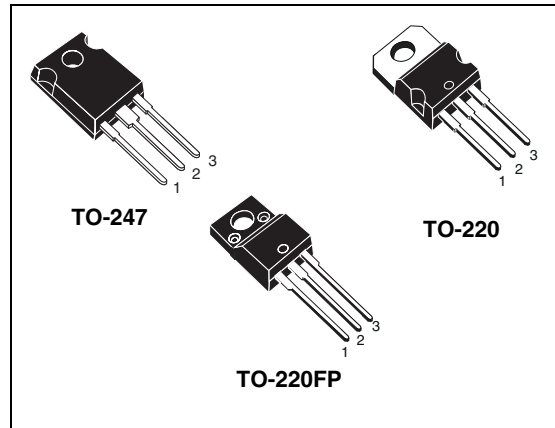


Figure 1. Internal schematic diagram

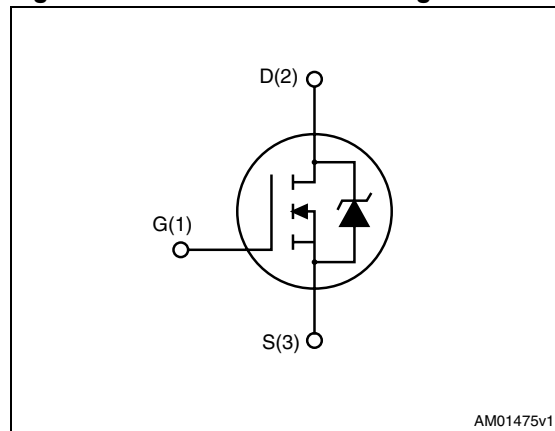


Table 1. Device summary

Order codes	Marking	Package	Packaging
STF19NM50N	19NM50N	TO-220FP	Tube
STP19NM50N		TO-220	
STW19NM50N		TO-247	

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value			Unit
		TO-220	TO-247	TO-220FP	
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	500			V
$V_{GS}$	Gate-source voltage	$\pm 25$			V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	14		14 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	9		9 <sup>(1)</sup>	A
$I_{DM}^{(2)}$	Drain current (pulsed)	56		56 <sup>(1)</sup>	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	110		30	W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	15			V/ns
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ ; $T_C = 25\text{ }^\circ\text{C}$ )	2500			V
$T_{stg}$	Storage temperature	- 55 to 150			$^\circ\text{C}$
$T_j$	Max. operating junction temperature	150			$^\circ\text{C}$

- Limited only by maximum temperature allowed
- Pulse width limited by safe operating area
- $I_{SD} \leq 14\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{Peak} < V_{(BR)DSS}$

**Table 3. Thermal data**

Symbol	Parameter	Value			Unit
		TO-220	TO-247	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case max	1.14		4.17	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5	50	62.5	$^\circ\text{C}/\text{W}$
$T_l$	Maximum lead temperature for soldering purpose	300			$^\circ\text{C}$

**Table 4. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)	7	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	208	mJ

## 2 Electrical characteristics

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

**Table 5. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$ , $V_{GS} = 0$	500			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$ , $T_C = 125\text{ °C}$			1 10	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 25\text{ V}$			10	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 7\text{ A}$		0.2	0.25	$\Omega$

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 50\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	1000	-	pF
$C_{oss}$	Output capacitance			72		pF
$C_{rss}$	Reverse transfer capacitance			3		pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }400\text{ V}$ , $V_{GS} = 0$	-	104	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related			51		pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	4.4	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 400\text{ V}$ , $I_D = 14\text{ A}$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 19</a> )	-	34	-	nC
$Q_{gs}$	Gate-source charge			5		nC
$Q_{gd}$	Gate-drain charge			18		nC

1. Time related is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$
2. Energy related is defined as a constant equivalent capacitance giving the same stored energy 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	$V_{DD} = 250\text{ V}$ , $I_D = 7\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 20</a> )		12		ns	
$t_r$	Rise time		-	16	-	ns	
$t_{d(off)}$	Turn-off-delay time				61		ns
$t_f$	Fall time				17		ns

**Table 8. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		14	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		56	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 14\text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 14\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see <a href="#">Figure 23</a> )	-	296		ns
$Q_{rr}$	Reverse recovery charge		-	3.5		nC
$I_{RRM}$	Reverse recovery current		-	23		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 14\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 23</a> )	-	346		ns
$Q_{rr}$	Reverse recovery charge		-	4		nC
$I_{RRM}$	Reverse recovery current		-	24		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-220

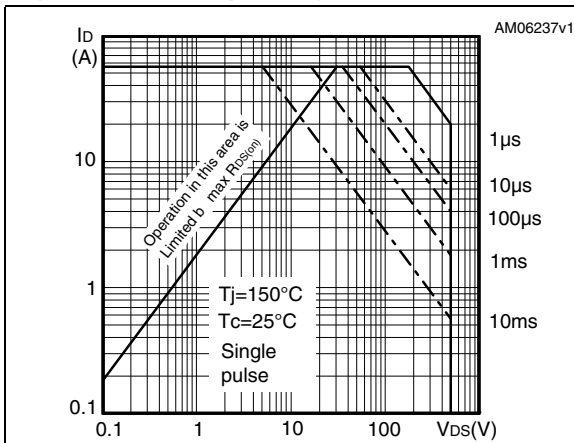


Figure 3. Thermal impedance for TO-220

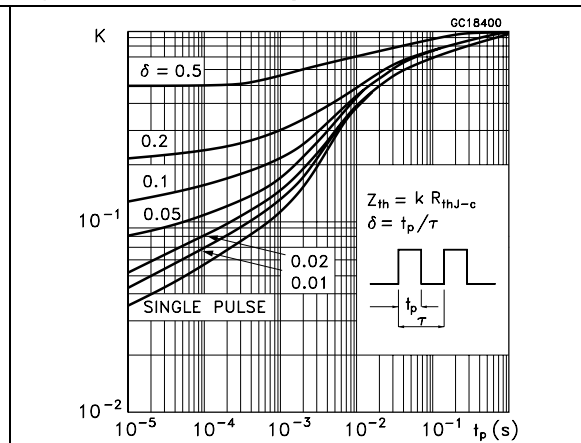


Figure 4. Safe operating area for TO-220FP

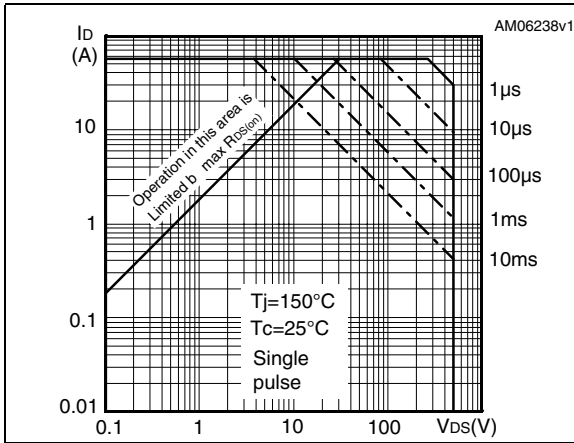


Figure 5. Thermal impedance for TO-220FP

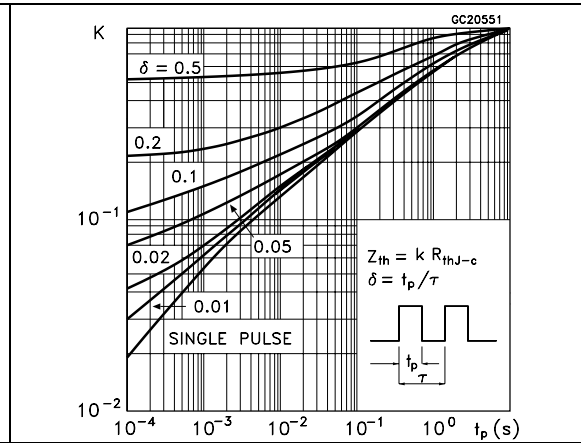


Figure 6. Safe operating area for TO-247

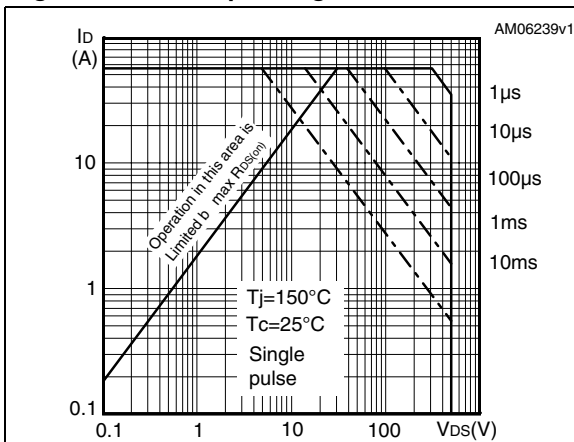


Figure 7. Thermal impedance for TO-247

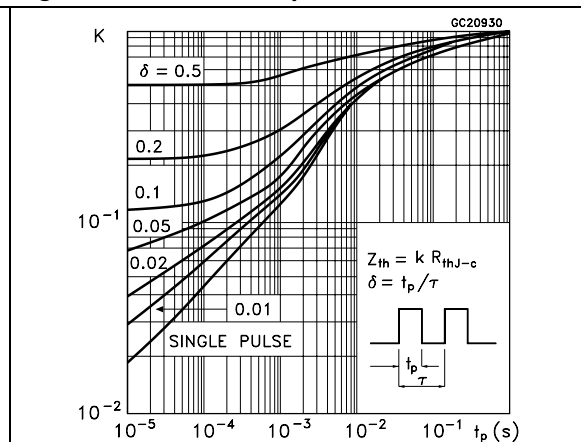


Figure 8. Output characteristics

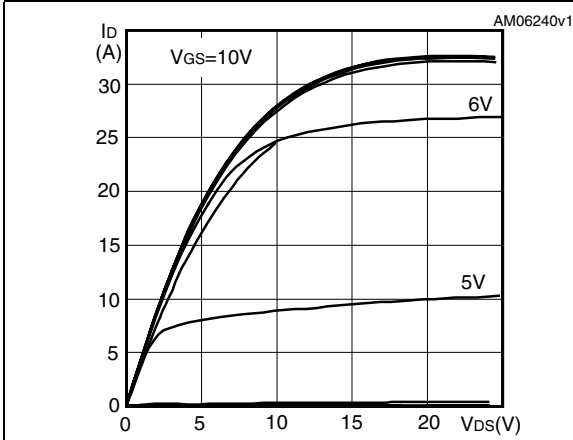


Figure 9. Transfer characteristics

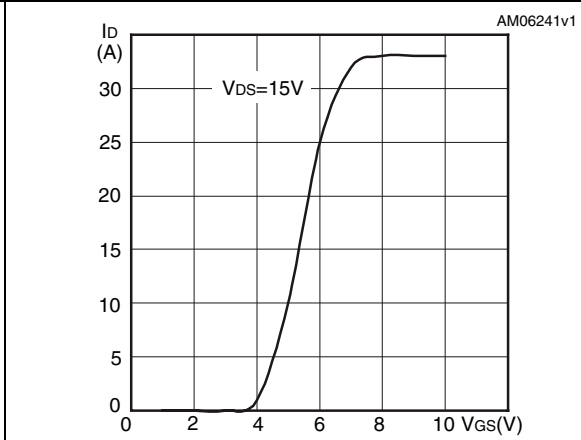


Figure 10. Gate charge vs gate-source voltage Figure 11. Static drain-source on resistance

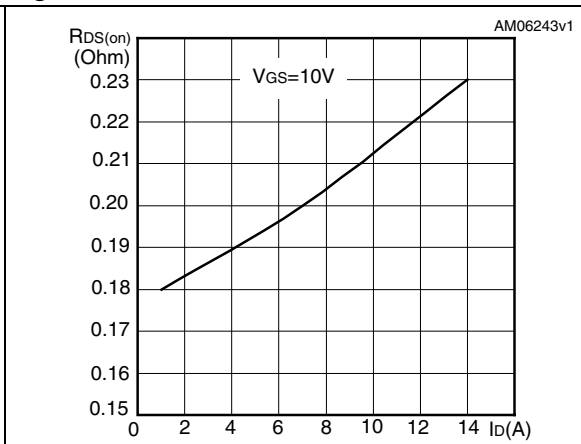
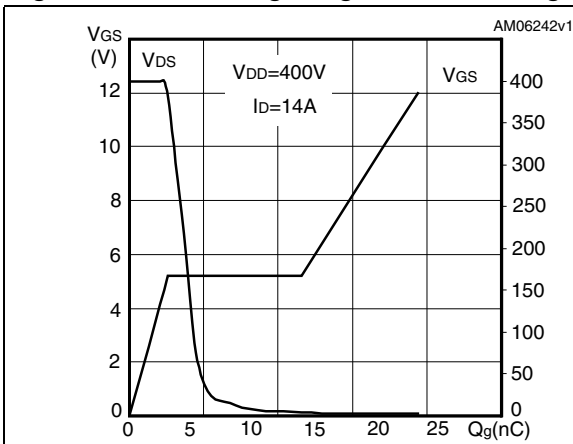


Figure 12. Capacitance variations

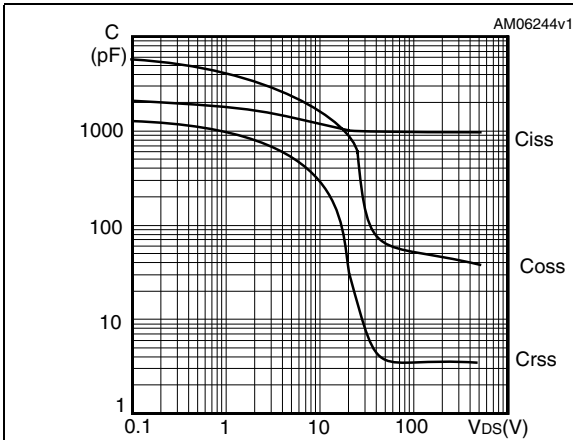


Figure 13. Output capacitance stored energy

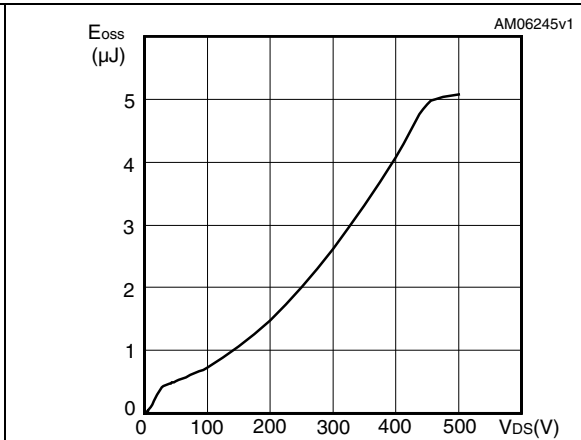


Figure 14. Normalized gate threshold voltage vs temperature

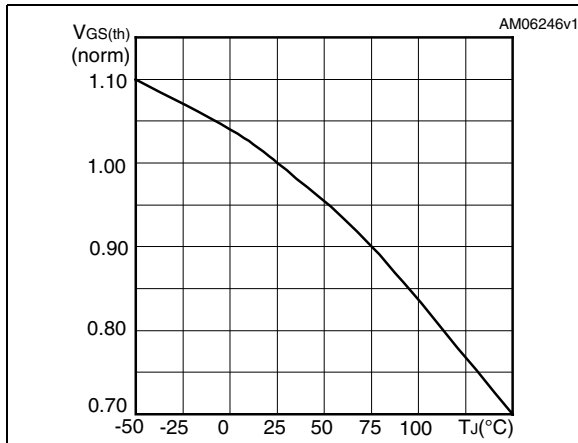


Figure 15. Normalized on resistance vs temperature

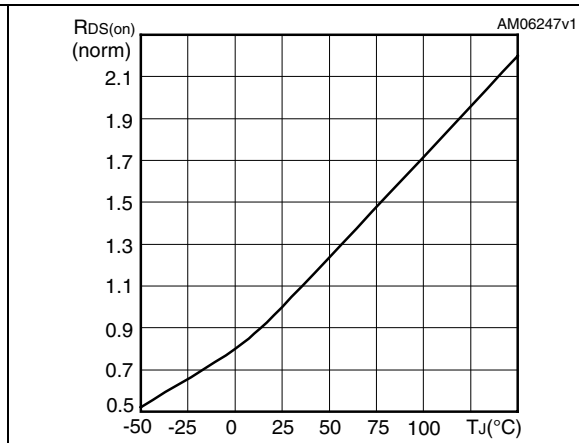


Figure 16. Source-drain diode forward characteristics

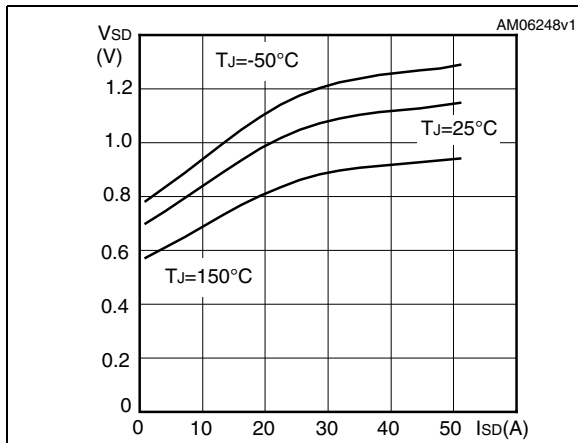
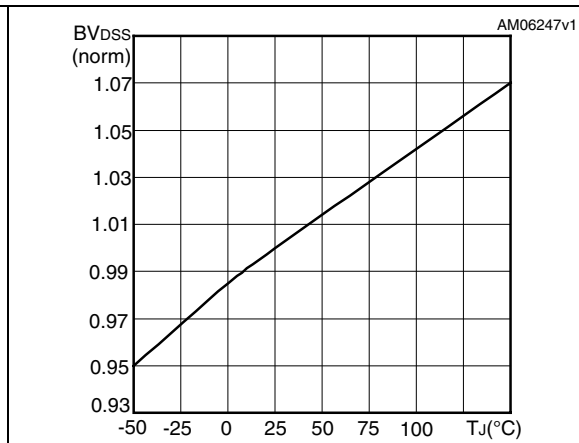


Figure 17. Normalized B<sub>V</sub>DSS vs temperature





### 3 Test circuits

Figure 18. Switching times test circuit for resistive load

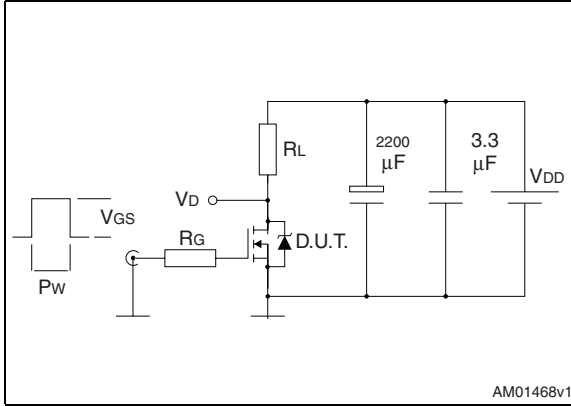


Figure 19. Gate charge test circuit

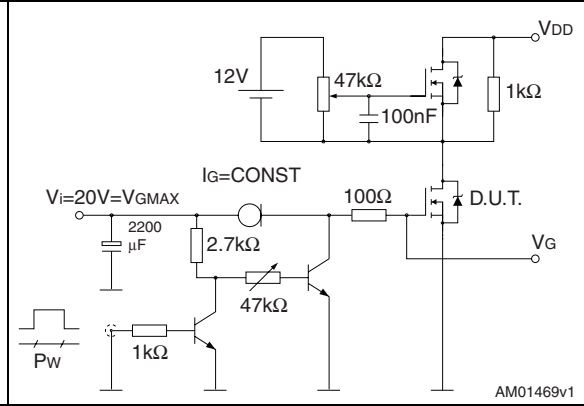


Figure 20. Test circuit for inductive load switching and diode recovery times

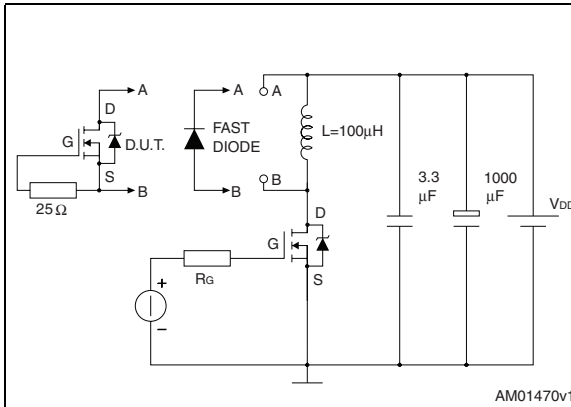


Figure 21. Unclamped inductive load test circuit

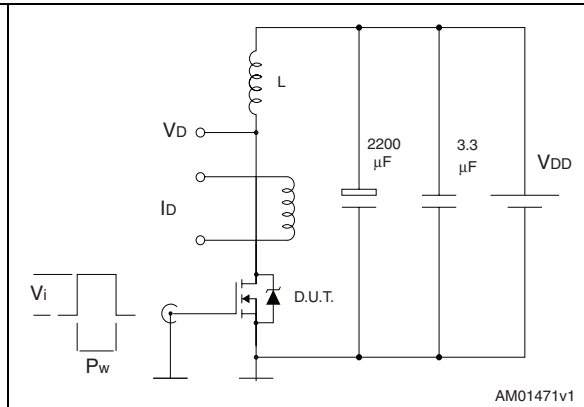


Figure 22. Unclamped inductive waveform

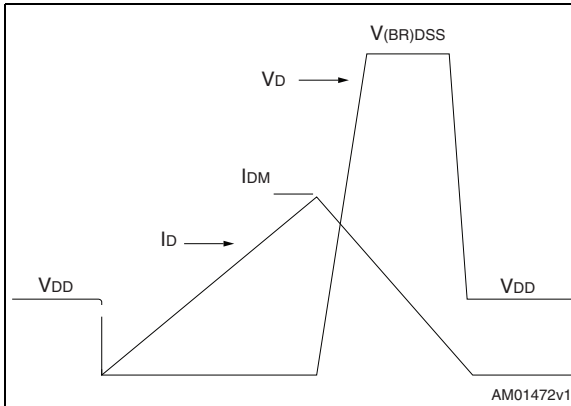
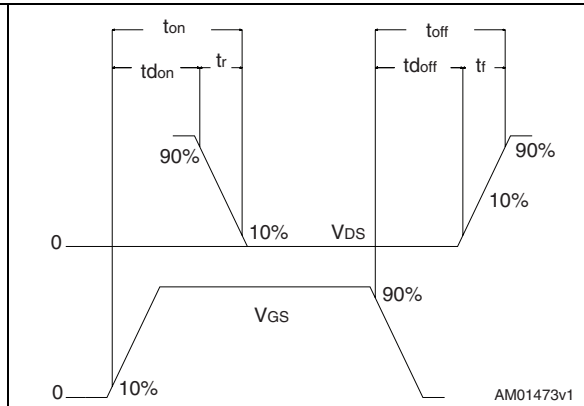


Figure 23. Switching time waveform



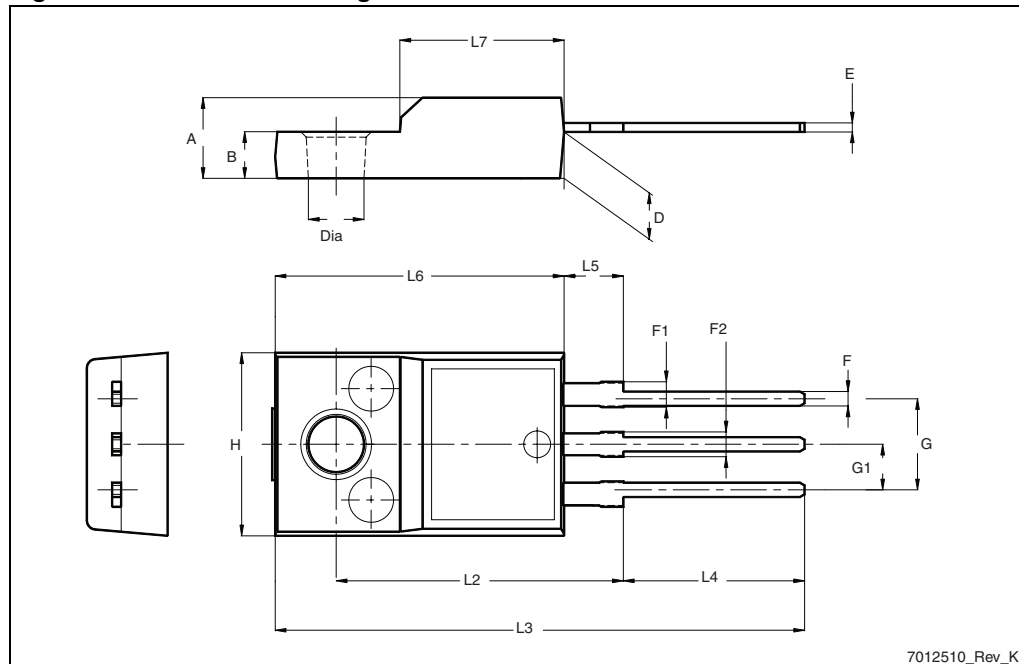
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<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.

Table 9. TO-220FP mechanical data

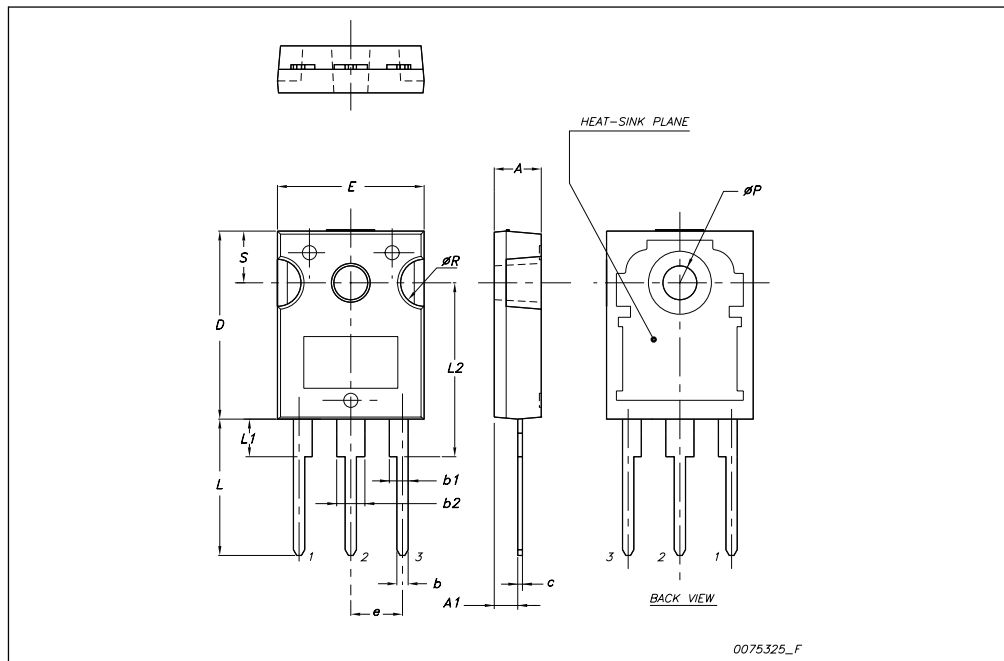
Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 24. TO-220FP drawing



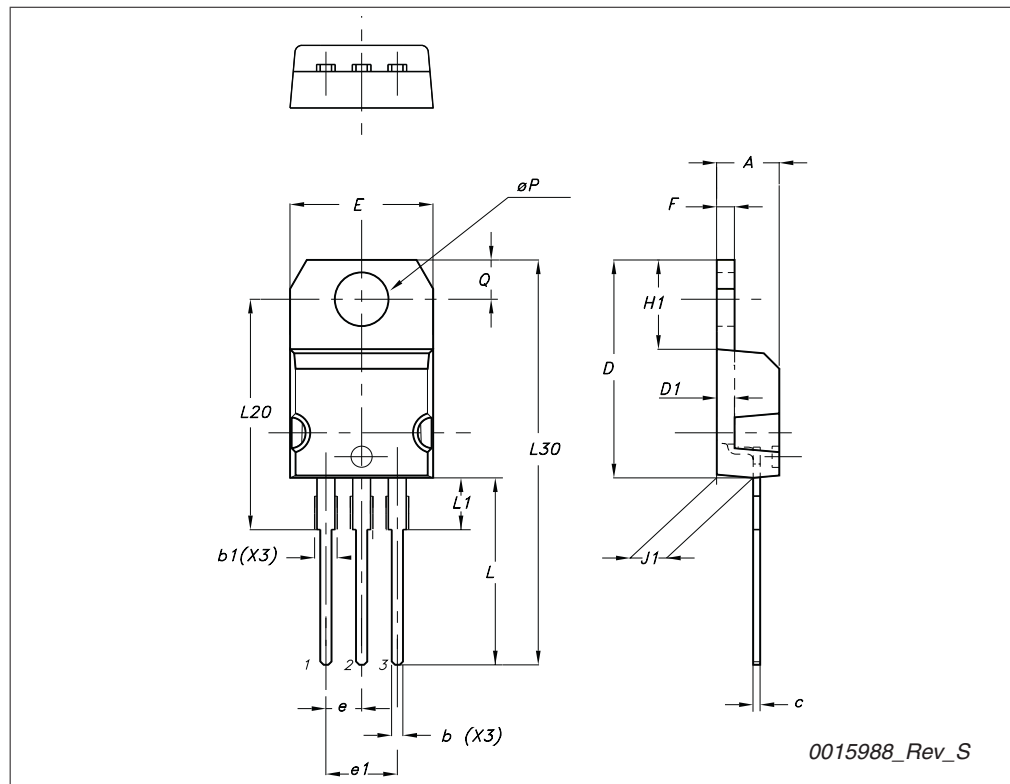
**TO-247 mechanical data**

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-220 type A mechanical data

Dim	mm		
	Min	Typ	Max
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95



## 5 Revision history

Table 10. Document revision history

Date	Revision	Changes
09-Feb-2010	1	First release

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