



# STF34NM60N STP34NM60N, STW34NM60N

N-channel 600 V, 0.092  $\Omega$ , 29 A MDmesh™ II Power MOSFET  
TO-220, TO-247, TO-220FP

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on) max.</sub>	I <sub>D</sub>	P <sub>TOT</sub>
STF34NM60N	600 V	0.105 $\Omega$	29 A	40 W
STP34NM60N	600 V	0.105 $\Omega$	29 A	210 W
STW34NM60N	600 V	0.105 $\Omega$	29 A	210 W

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

## Application

Switching applications

## Description

These devices are made using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

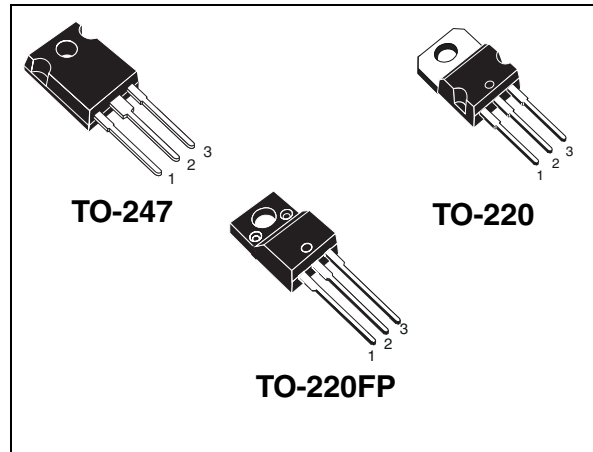


Figure 1. Internal schematic diagram

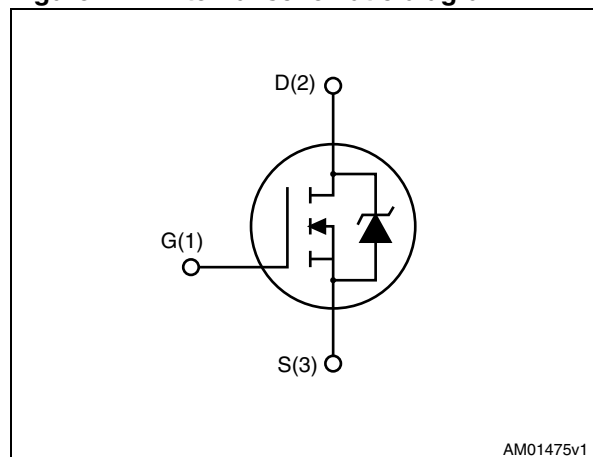


Table 1. Device summary

Order codes	Marking	Package	Packaging
STF34NM60N	34NM60N	TO-220FP	Tube
STP34NM60N		TO-220	
STW34NM60N		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 ( $V_{GS} = 0$ )	600		V
$V_{GS}$	Gate- source voltage	$\pm 25$		V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	29	29 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	18	18	A
$I_{DM}^{(2)}$	Drain current (pulsed)	116	116	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	210	40	W
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_J$ max)	10.5		A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	345		mJ
$dv/dt^{(3)}$	Peak diode recovery voltage slope	15		V/ns
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ ; $T_C = 25\text{ }^\circ\text{C}$ )	1200		V
$T_{stg}$	Storage temperature	- 55 to 150		$^\circ\text{C}$
$T_J$	Max. operating junction temperature	150		

- Limited only by maximum temperature allowed.
- Pulse width limited by safe operating area.
- $I_{SD} \leq 29\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS\text{ peak}} \leq V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$

**Table 3. Thermal data**

Symbol	Parameter	TO-220	TO-247	TO-220FP	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.60		3.13	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5	50	62.5	$^\circ\text{C}/\text{W}$
$T_l$	Maximum lead temperature for soldering purpose	300			$^\circ\text{C}$

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$ , $V_{GS} = 0$	600			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating @ } 125\text{ °C}$			1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 25\text{ V}$			100	nA
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}$ , $I_D = 14.5\text{ A}$		0.092	0.105	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	2722	-	pF
$C_{oss}$	Output capacitance			173		pF
$C_{rss}$	Reverse transfer capacitance			1.75		pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0$ , $V_{DS} = 0\text{ to }480\text{ V}$	-	458	-	pF
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$ , $I_D = 14.5\text{ A}$ $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 23</a> ), (see <a href="#">Figure 18</a> )	-	17	-	ns
$t_r$	Rise time			34		ns
$t_{d(off)}$	Turn-off delay time			106		ns
$t_f$	Fall time			67		ns
$Q_g$	Total gate charge	$V_{DD} = 480\text{ V}$ , $I_D = 29\text{ A}$ , $V_{GS} = 10\text{ V}$ , (see <a href="#">Figure 19</a> )	-	83.6	-	nC
$Q_{gs}$	Gate-source charge			14		nC
$Q_{gd}$	Gate-drain charge			45		nC
$R_g$	Gate input resistance	f=1MHz Gate DC Bias=0 Test signal level=20 mV Open drain	-	2.9	-	$\Omega$

1.  $C_{oss\text{ eq.}}$  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 6. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		29	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		116	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 29\text{ A}, V_{GS} = 0$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 29\text{ A}, V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ (see <a href="#">Figure 20</a> )	-	408		ns
$Q_{rr}$	Reverse recovery charge			8		nC
$I_{RRM}$	Reverse recovery current			39		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 29\text{ A}, V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ , $T_J = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 20</a> )	-	480		ns
$Q_{rr}$	Reverse recovery charge			10		nC
$I_{RRM}$	Reverse recovery current			42		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

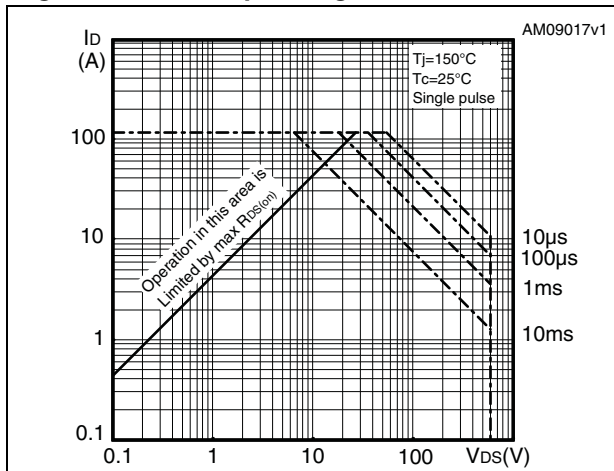


Figure 3. Thermal impedance for TO-220

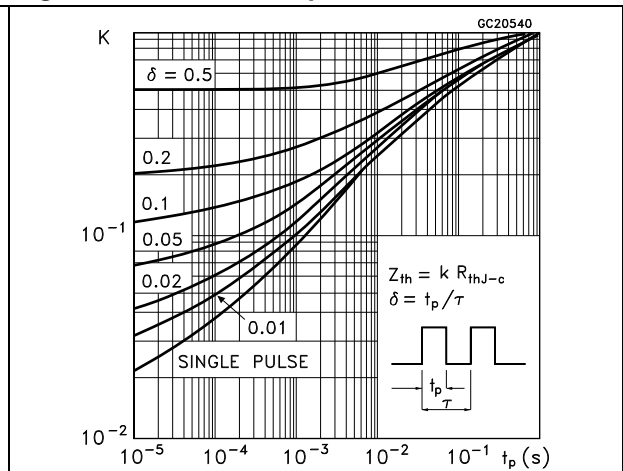


Figure 4. Safe operating area for TO-220FP

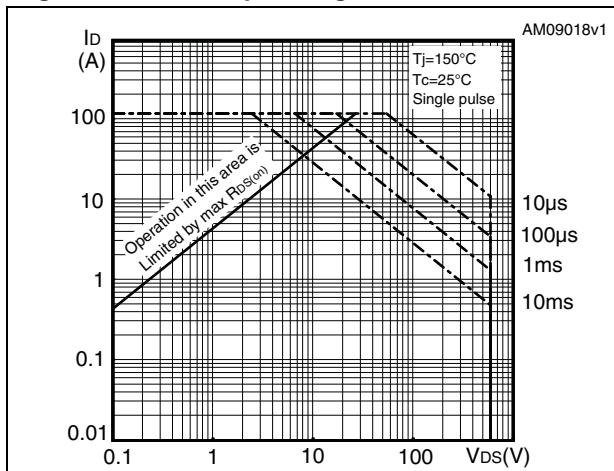


Figure 5. Thermal impedance for TO-220FP

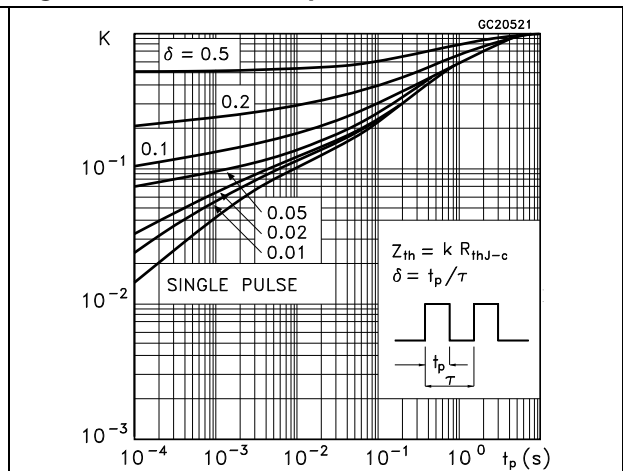


Figure 6. Safe operating area for TO-247

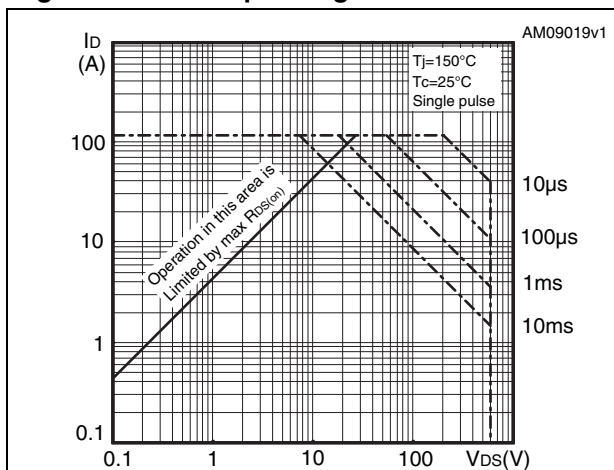


Figure 7. Thermal impedance for TO-247

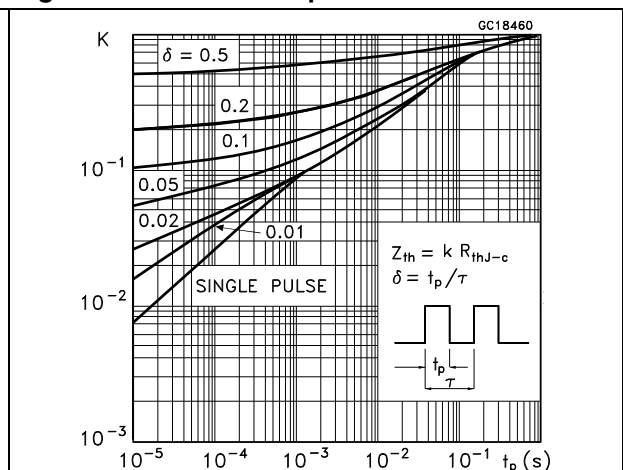


Figure 8. Output characteristics

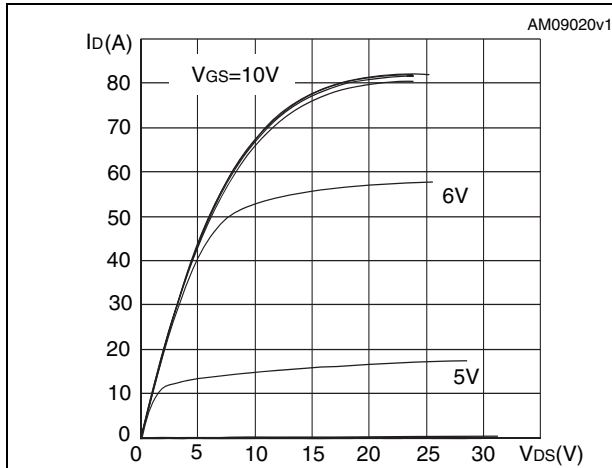


Figure 9. Transfer characteristics

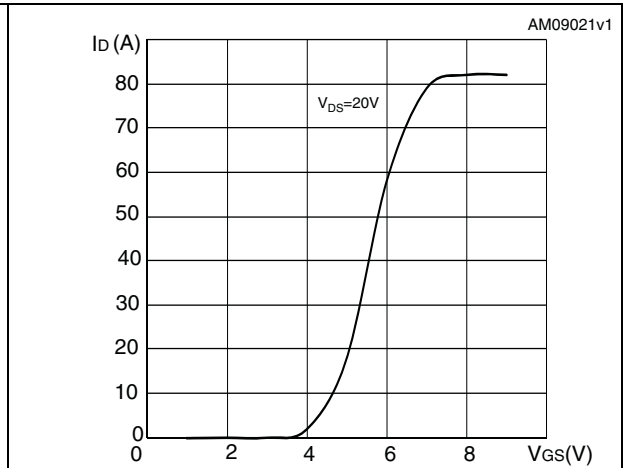


Figure 10. Gate charge vs gate-source voltage

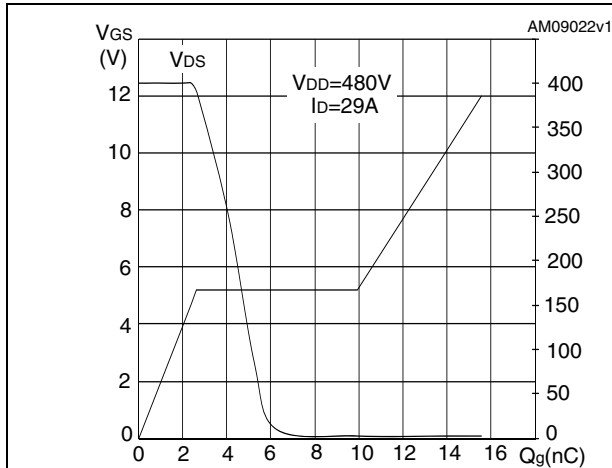


Figure 11. Static drain-source on resistance

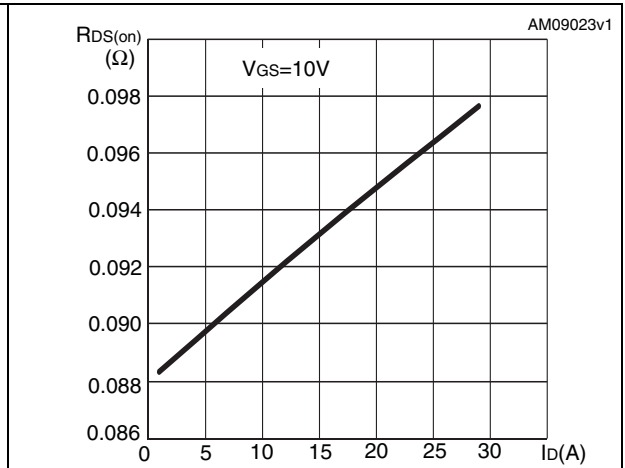


Figure 12. Capacitance variations

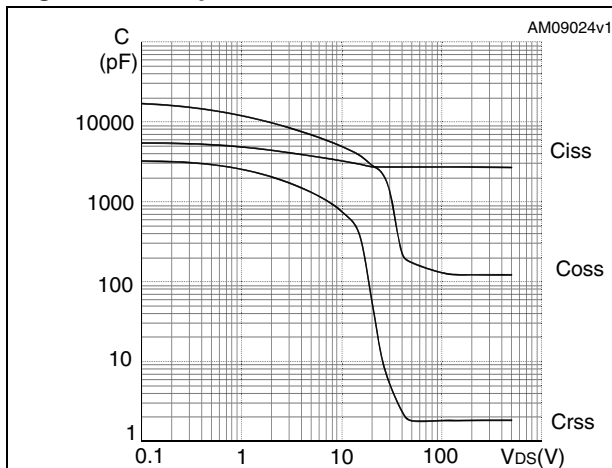


Figure 13. Output capacitance stored energy

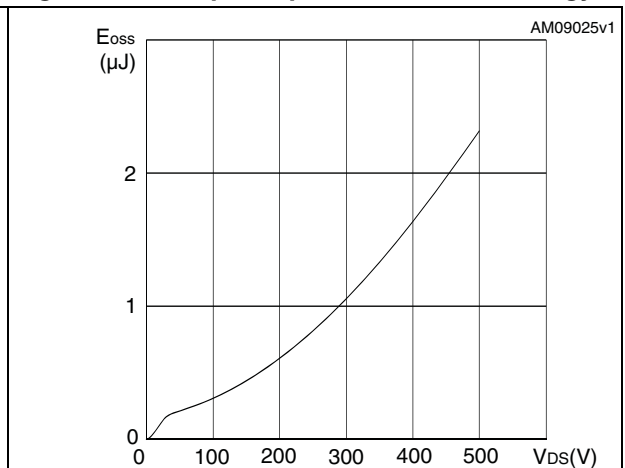


Figure 14. Normalized gate threshold voltage vs temperature

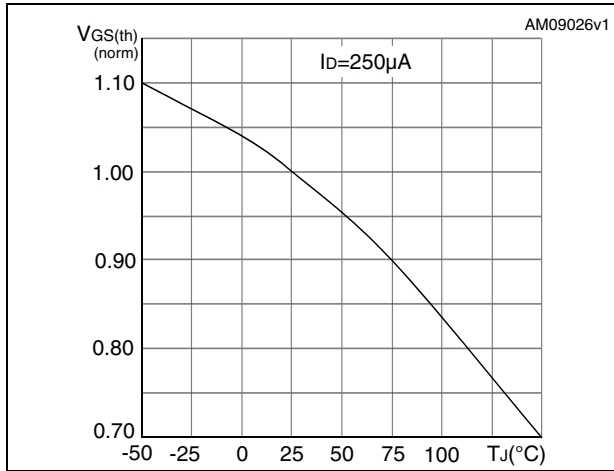


Figure 15. Normalized on resistance vs temperature

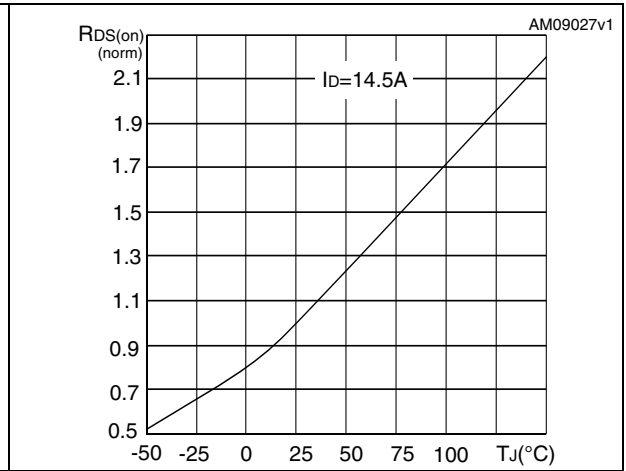


Figure 16. Normalized  $B_{VDSS}$  vs temperature

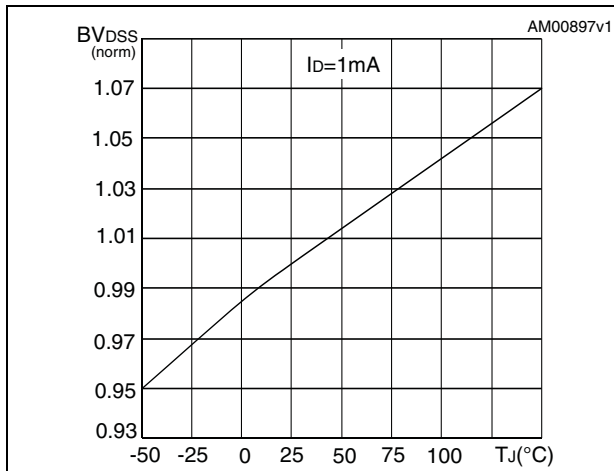
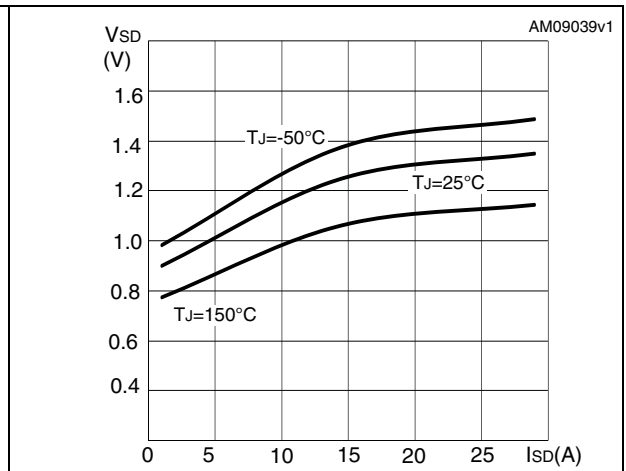
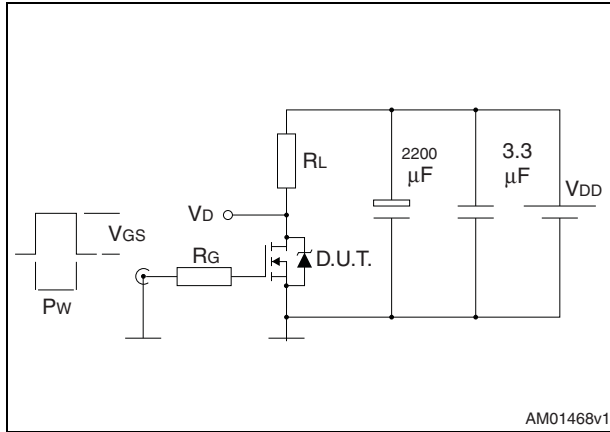


Figure 17. Source-drain diode forward characteristics

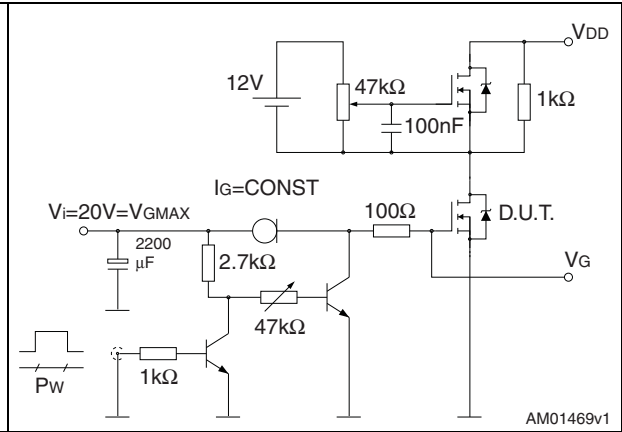


### 3 Test circuits

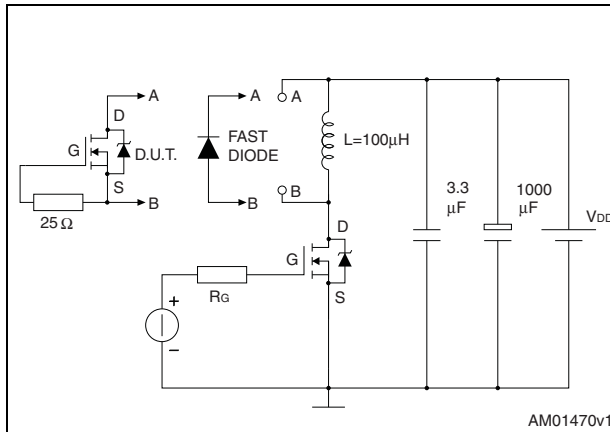
**Figure 18. Switching times test circuit for resistive load**



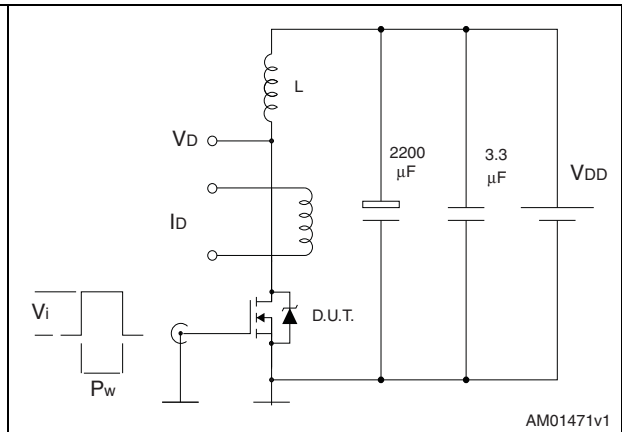
**Figure 19. Gate charge test circuit**



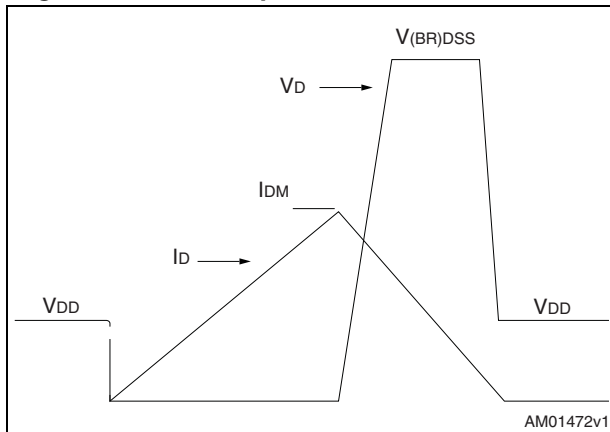
**Figure 20. Test circuit for inductive load switching and diode recovery times**



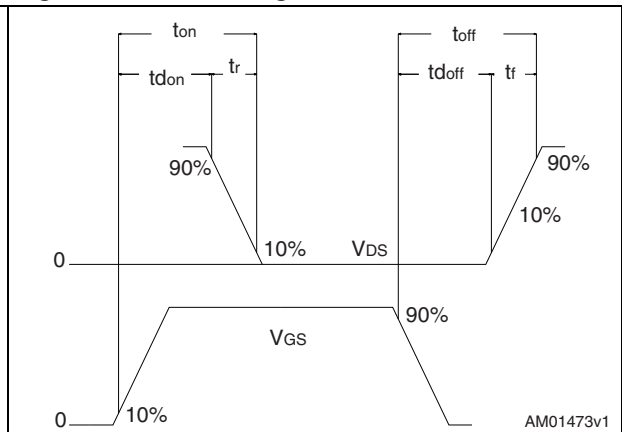
**Figure 21. Unclamped inductive load test circuit**



**Figure 22. Unclamped inductive waveform**



**Figure 23. Switching time waveform**



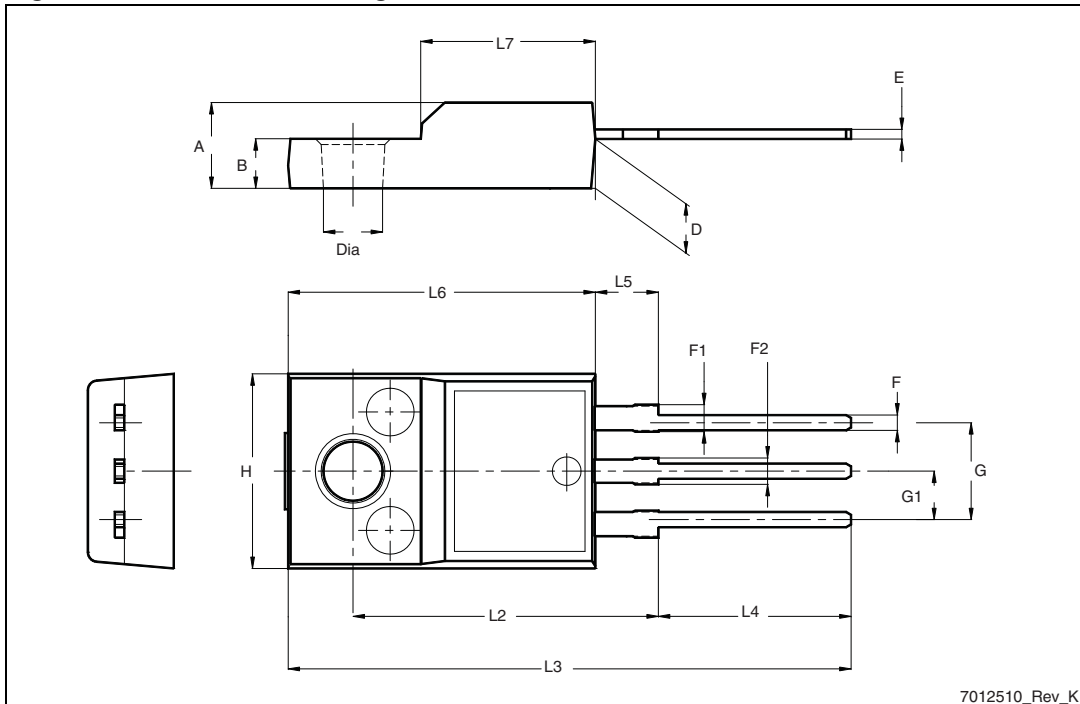
## 4 Package mechanical data

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

Table 7. 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



7012510\_Rev\_K

Table 8. 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	
ØP	3.75		3.85
Q	2.65		2.95

Figure 25. TO-220 type A drawing

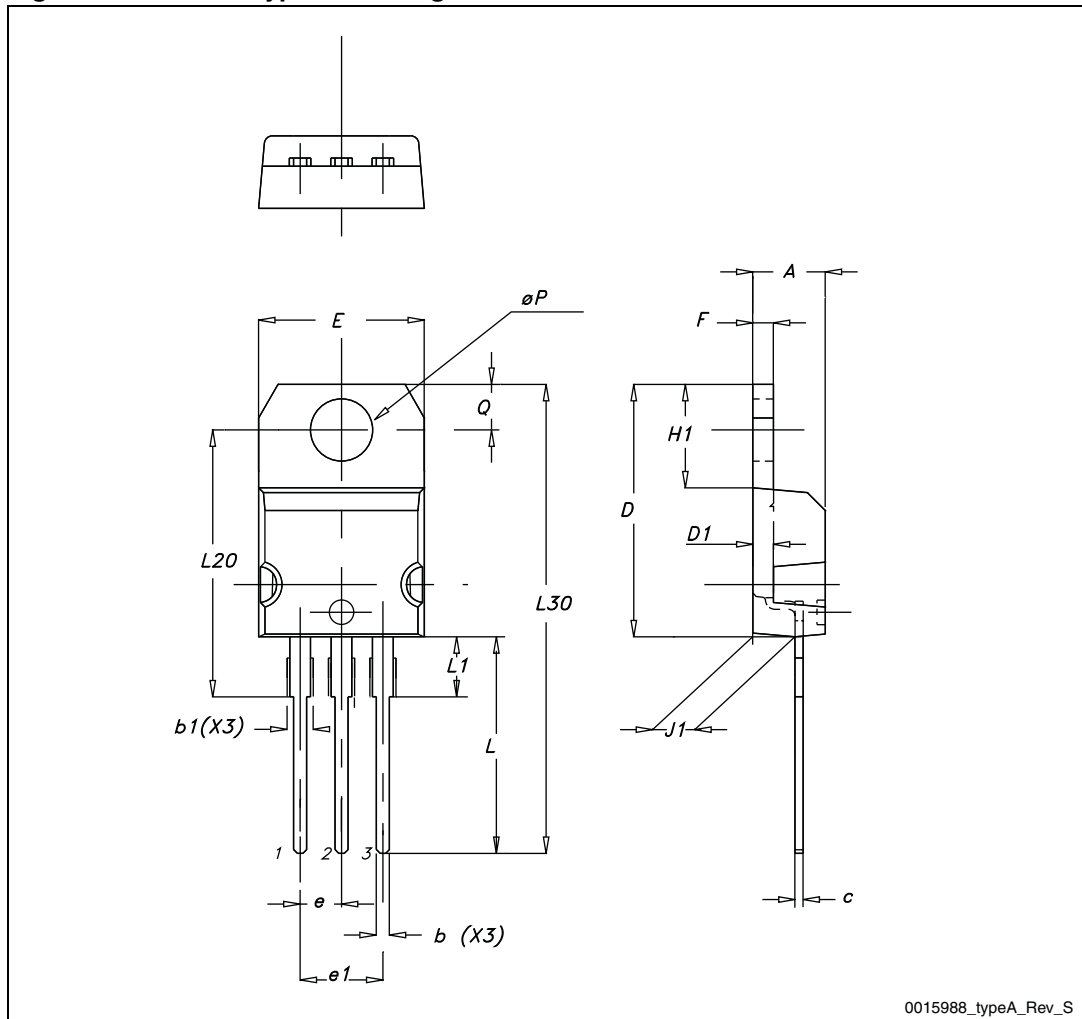
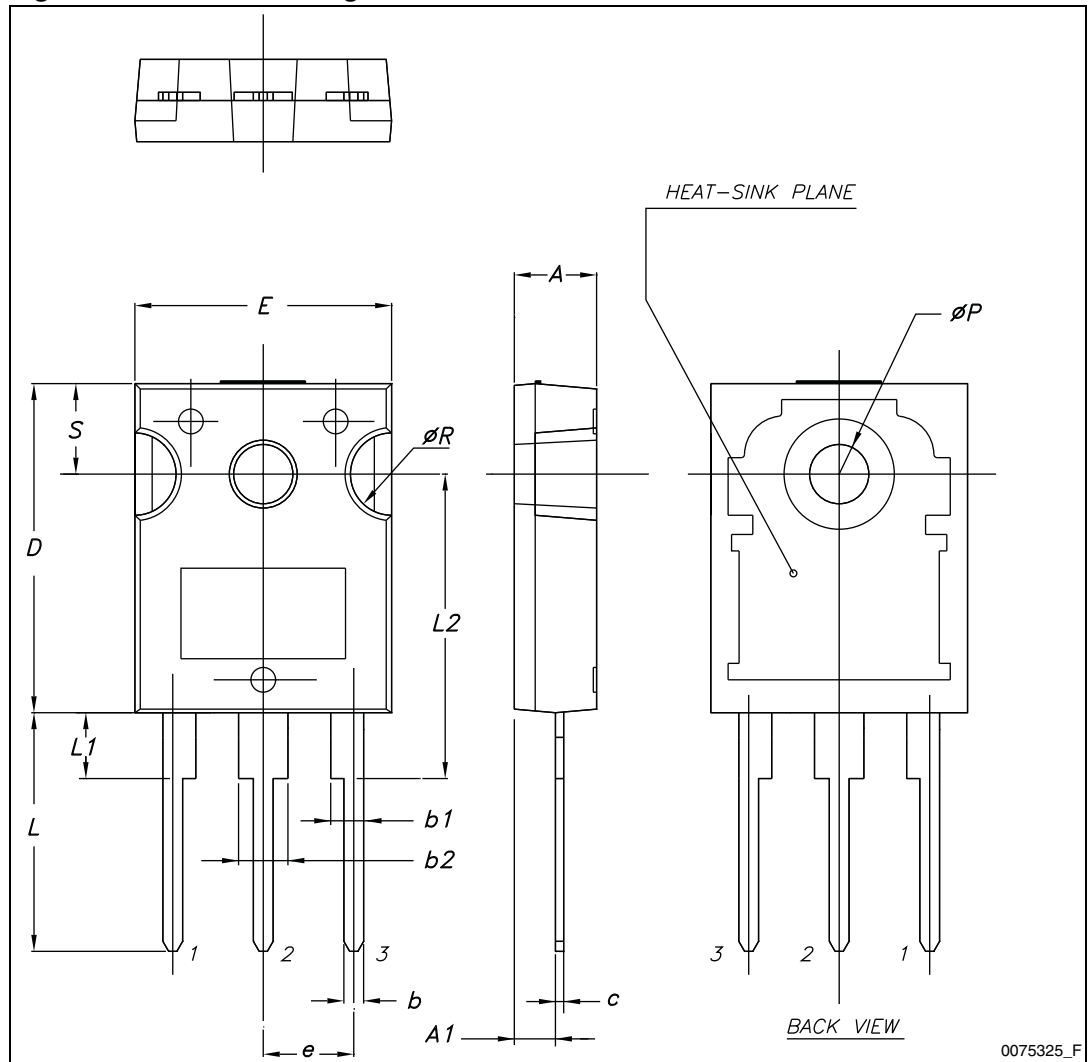


Table 9. TO-247 mechanical data

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	

Figure 26. TO-247 drawing



0075325\_F

## 5 Revision history

**Table 10. Document revision history**

Date	Revision	Changes
05-Aug-2010	1	Initial release.
02-Sep-2010	2	Updated title on cover page and <a href="#">Table 4: On/off states</a> .
08-Mar-2011	3	Document status promoted from preliminary data to datasheet.

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