



# STF1N105K3, STFW1N105K3, STP1N105K3

N-channel 1050 V, 8  $\Omega$  typ., 1.4 A SuperMESH3™  
Power MOSFET in TO-220FP, TO-3PF and TO-220 packages

Datasheet — production data

## Features

Order codes	$V_{DS}$	$R_{DS(on)max}$	$I_D$	$P_{TOT}$
STF1N105K3	1050 V	11 $\Omega$	1.4 A	20 W
STFW1N105K3				
STP1N105K3				60 W

- Gate charge minimized
- Extremely large avalanche performance
- 100% avalanche tested
- Very low intrinsic capacitance

## Applications

- Switching applications

## Description

These SuperMESH3™ Power MOSFETs are the result of improvements applied to STMicroelectronics' SuperMESH™ technology, combined with a new optimized vertical structure. These devices boast an extremely low on-resistance, superior dynamic performance and high avalanche capability, rendering them suitable for the most demanding applications.

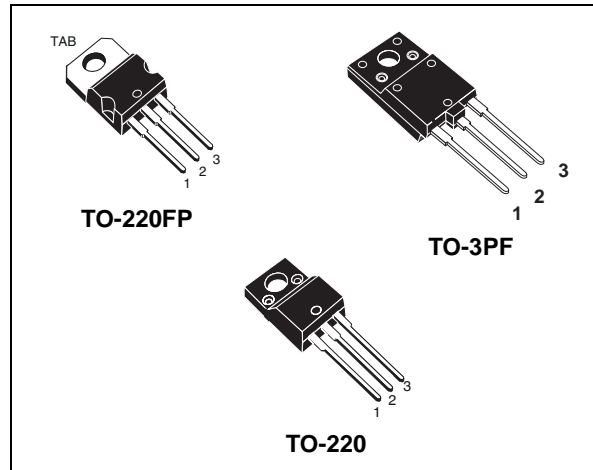
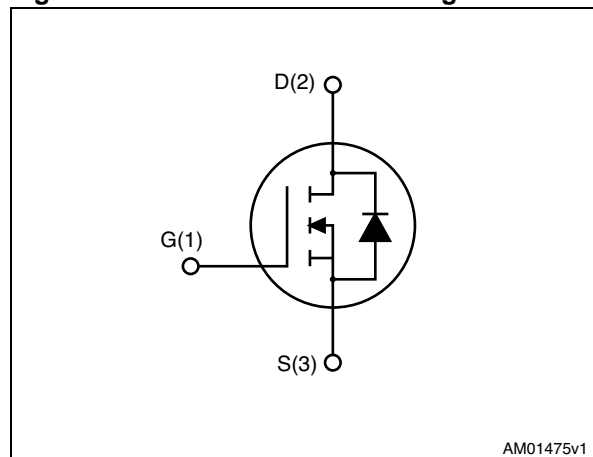


Figure 1. Internal schematic diagram



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Table 1. Device summary

Order codes	Marking	Package	Packaging
STF1N105K3	1N105K3	TO-220FP	Tube
STFW1N105K3		TO-3PF	
STP1N105K3		TO-220	

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value			Unit
		TO-220FP	TO-3PF	TO-220	
$V_{DS}$	Drain source voltage	1050			V
$V_{GS}$	Gate- source voltage	$\pm 30$			V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	1.4 <sup>(1)</sup>		1.4	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	0.9 <sup>(1)</sup>		0.9	A
$I_{DM}^{(2)}$	Drain current (pulsed)	5.6 <sup>(1)</sup>		5.6	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	20		60	W
$I_{AR}$	Max current during repetitive or single pulse avalanche (pulse width limited by $T_{jmax}$ )	1.2			A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	130			mJ
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ ; $T_C = 25\text{ }^\circ\text{C}$ )	2500	3500		V
$dv/dt^{(3)}$	Peak diode recovery voltage slope	6			V/ns
$T_j$ $T_{stg}$	Operating junction temperature Storage temperature	- 55 to 150			$^\circ\text{C}$

- Limited by maximum junction temperature.
- Pulse width limited by safe operating area.
- $I_{SD} \leq 1.4\text{ A}$ ,  $di/dt \leq 100\text{ A}/\mu\text{s}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$ ,  $V_{DS\text{ peak}} \leq V_{(BR)DSS}$ .

**Table 3. Thermal data**

Symbol	Parameter	Value			Unit
		TO-220FP	TO-3PF	TO-220	
Rthj-case	Thermal resistance junction-case max	6.25		2.08	$^\circ\text{C}/\text{W}$
Rthj-amb	Thermal resistance junction-amb max	62.50	50	62.50	$^\circ\text{C}/\text{W}$

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$ , $V_{GS} = 0$	1050			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 1050\text{ V}$ , $V_{DS} = 1050\text{ V}$ , $T_c = 125\text{ °C}$			1 50	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			$\pm 50$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 50\text{ }\mu\text{A}$	2	3	4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 0.6\text{ A}$		8	11	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance			180		pF
$C_{oss}$	Output capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	15	-	pF
$C_{rss}$	Reverse transfer capacitance			1		
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0$ , $V_{DS} = 0\text{ to }840\text{ V}$	-	11	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related			7		
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	18	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 840\text{ V}$ , $I_D = 1.2\text{ A}$		13		nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 10\text{ V}$	-	1.6	-	nC
$Q_{gd}$	Gate-drain charge	(see <a href="#">Figure 18</a> )		8		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 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 525 \text{ V}$ , $I_D = 0.6 \text{ A}$ , $R_G = 4.7 \Omega$ , $V_{GS} = 10 \text{ V}$ (see <a href="#">Figure 20</a> )		6		ns	
$t_r$	Rise time		-	7	-	ns	
$t_{d(off)}$	Turn-off delay time				27		ns
$t_f$	Fall time				50		ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		1.4	mA
$I_{SDM}$	Source-drain current (pulsed)				5.6	A
$V_{SD}^{(1)}$	Forward on voltage	$I_{SD} = 1.2 \text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 1.2 \text{ A}$ , $V_{DD} = 60 \text{ V}$ $di/dt = 100 \text{ A}/\mu\text{s}$ , (see <a href="#">Figure 19</a> )	-		244	ns
$Q_{rr}$	Reverse recovery charge				1	$\mu\text{C}$
$I_{RRM}$	Reverse recovery current				9	A
$t_{rr}$	Reverse recovery time	$I_{SD} = 1.2 \text{ A}$ , $V_{DD} = 60 \text{ V}$ $di/dt = 100 \text{ A}/\mu\text{s}$ , $T_j = 25 \text{ }^\circ\text{C}$ (see <a href="#">Figure 19</a> )	-		330	ns
$Q_{rr}$	Reverse recovery charge				1.3	$\mu\text{C}$
$I_{RRM}$	Reverse recovery current				8	A

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220FP and TO-3PF

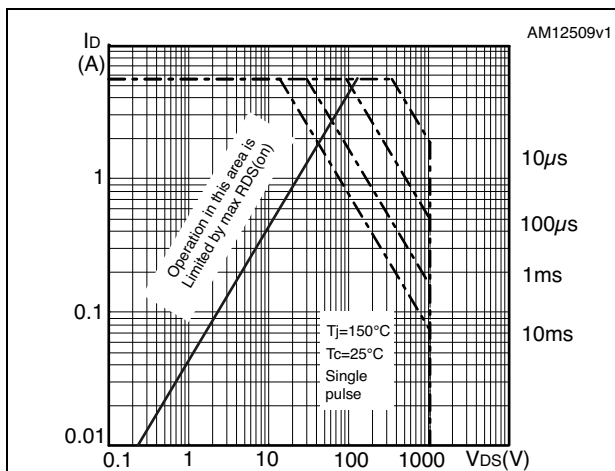


Figure 3. Thermal impedance for TO-220FP and TO-3PF

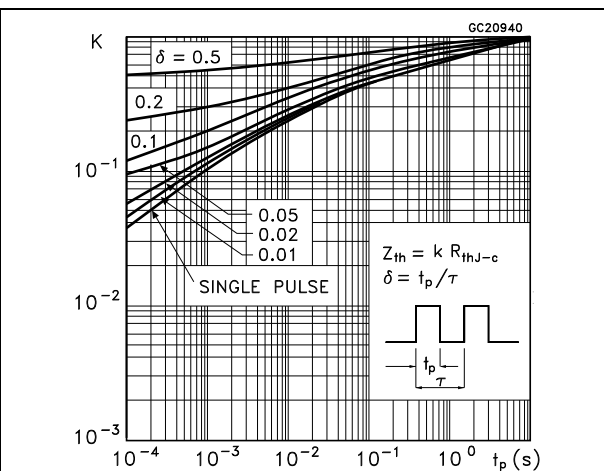


Figure 4. Safe operating area for TO-220

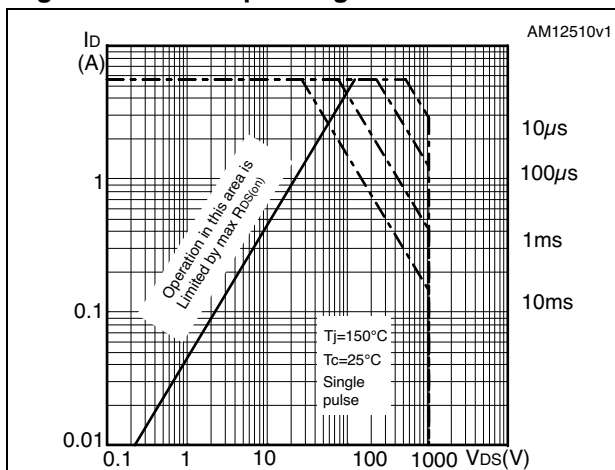


Figure 5. Thermal impedance for TO-220

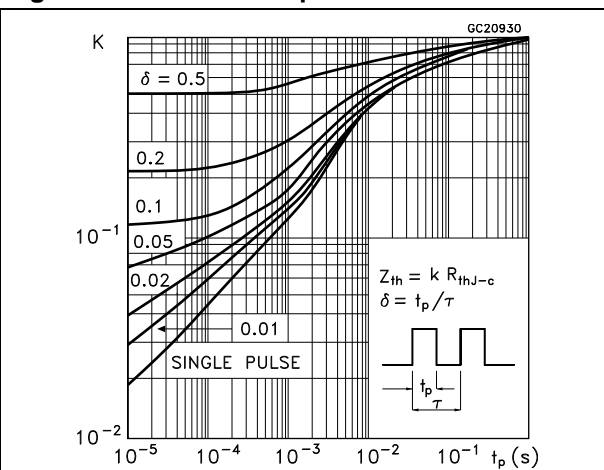


Figure 6. Output characteristics

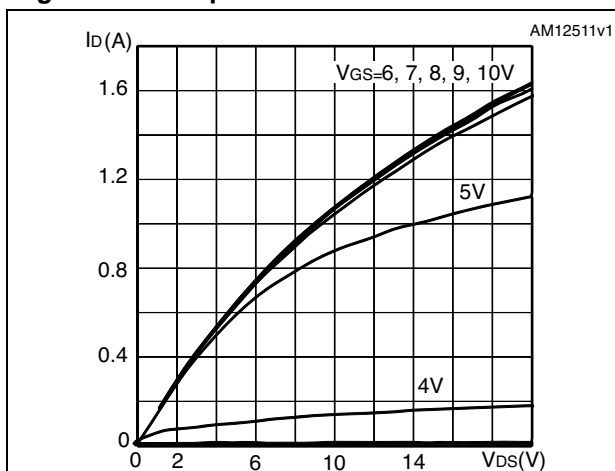


Figure 7. Transfer characteristics

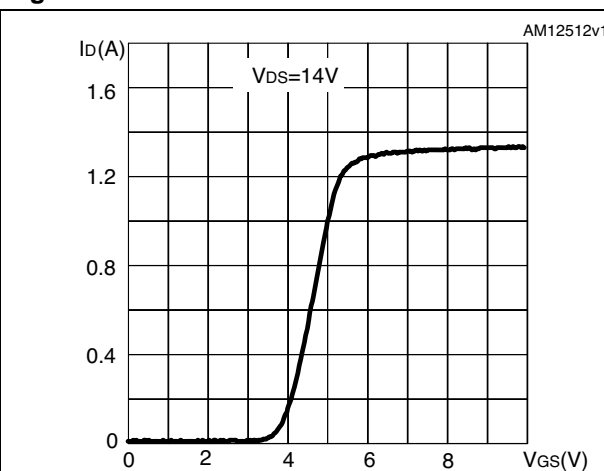


Figure 8. Gate charge vs gate-source voltage Figure 9. Static drain-source on-resistance

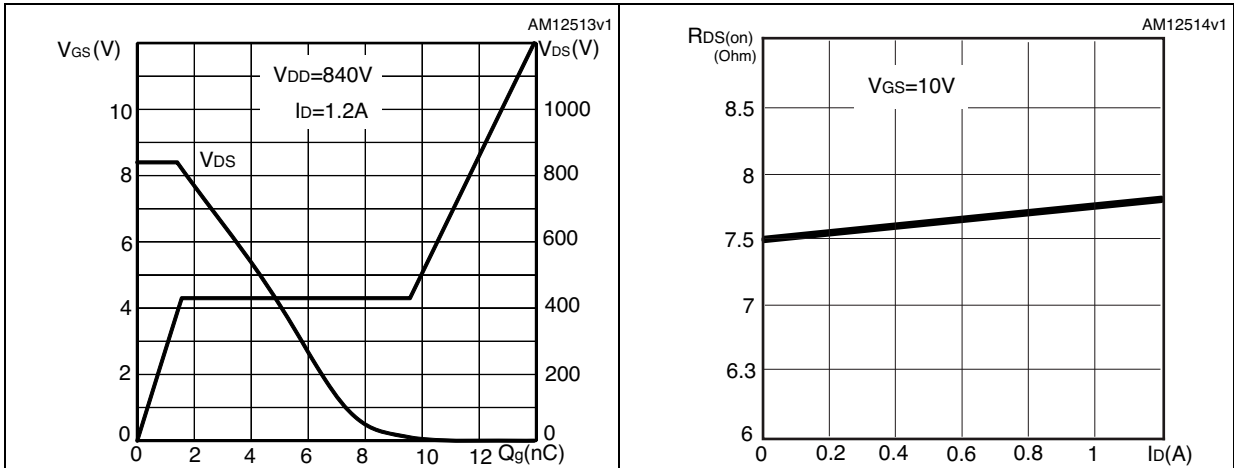


Figure 10. Capacitance variations Figure 11. Output capacitance stored energy

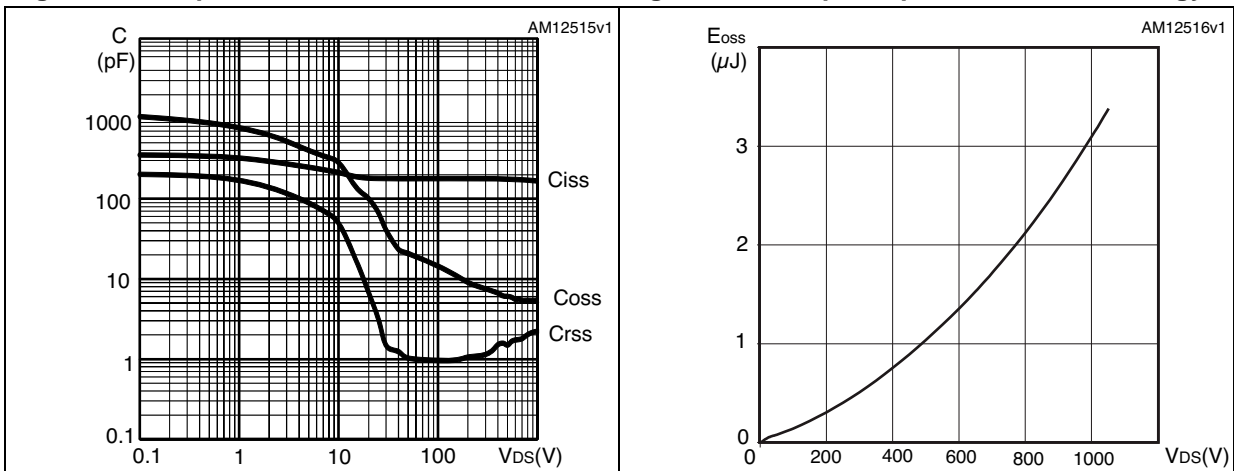


Figure 12. Normalized gate threshold voltage vs temperature Figure 13. Normalized on-resistance vs temperature

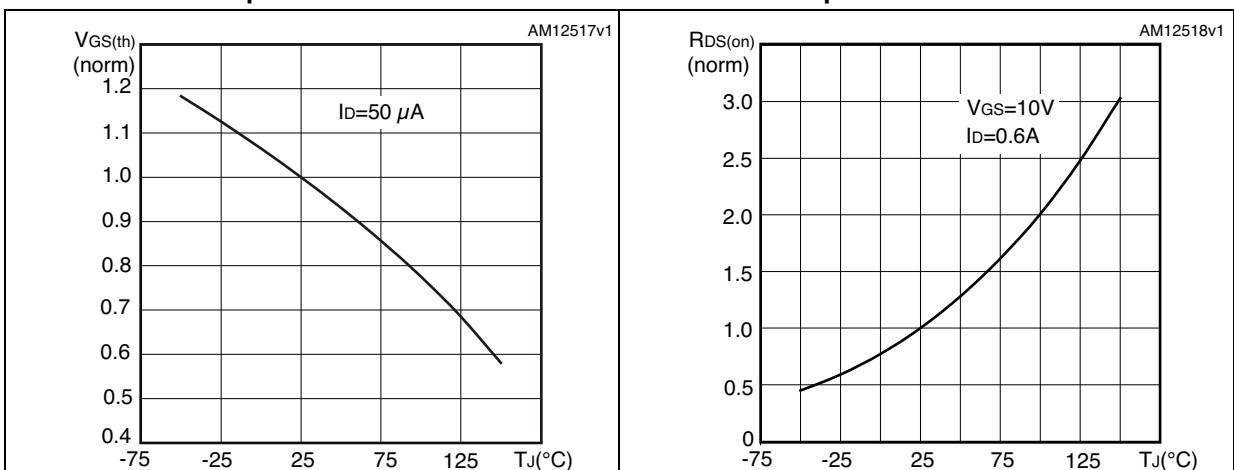


Figure 14. Source-drain diode forward characteristics

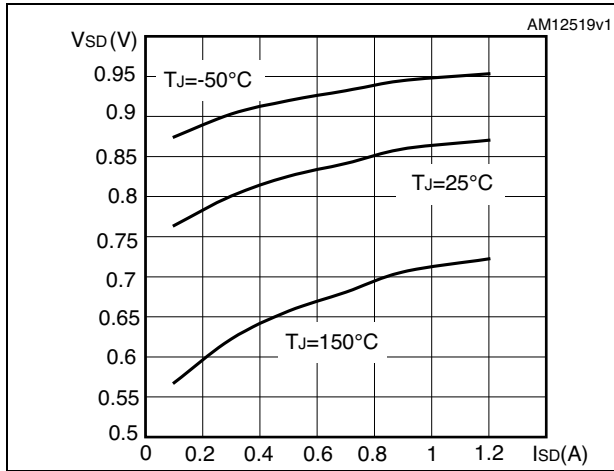


Figure 15. Normalized  $B_{VDSS}$  vs temperature

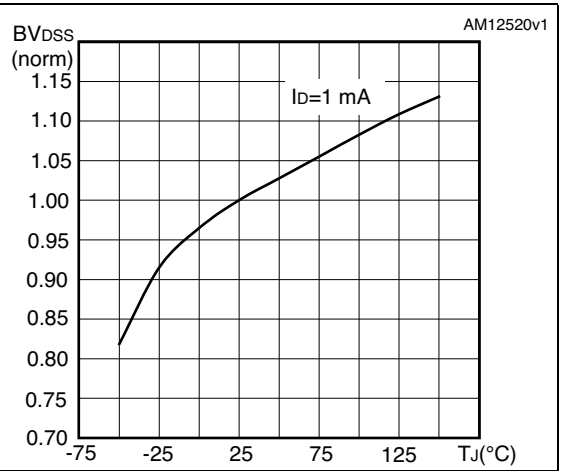
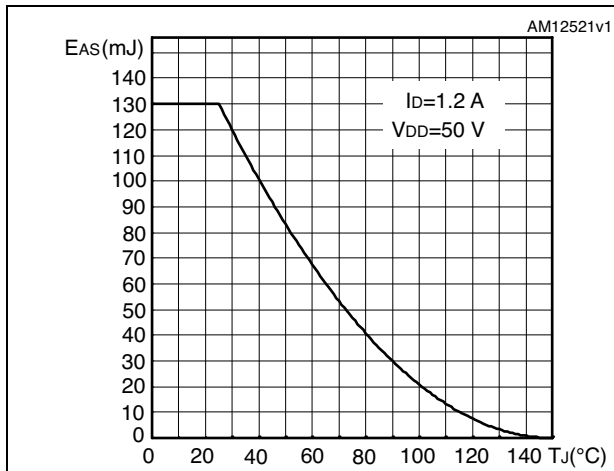


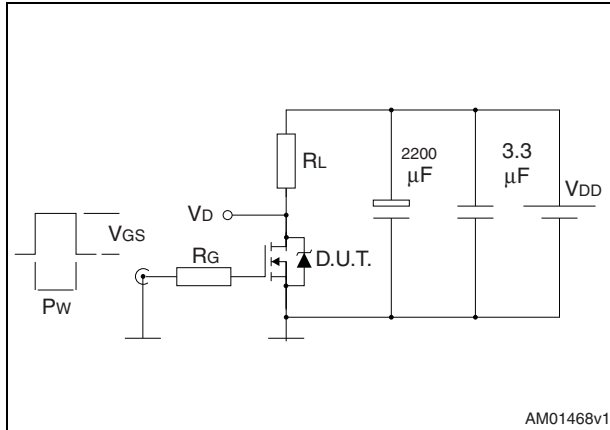
Figure 16. Maximum avalanche energy vs starting TJ





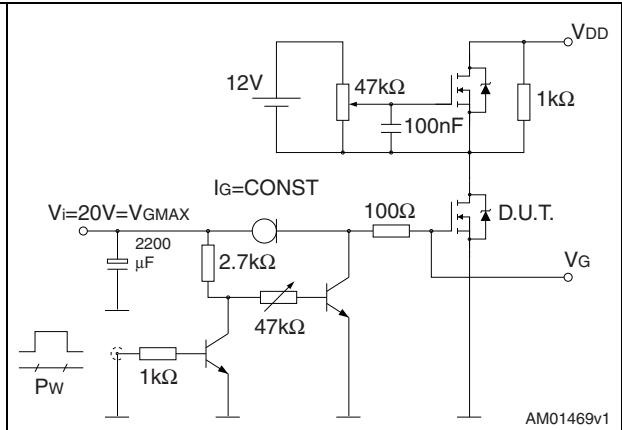
### 3 Test circuits

**Figure 17. Switching times test circuit for resistive load**



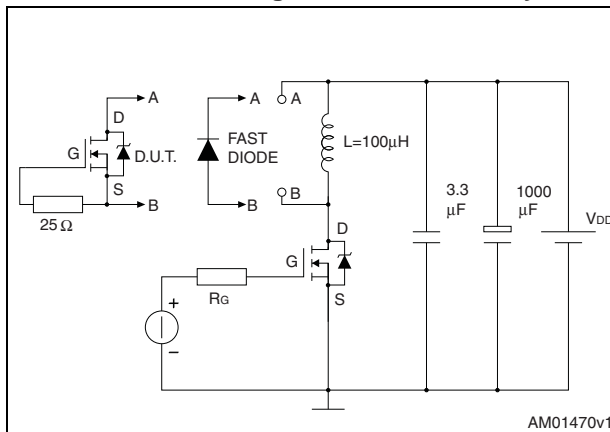
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**Figure 18. Gate charge test circuit**



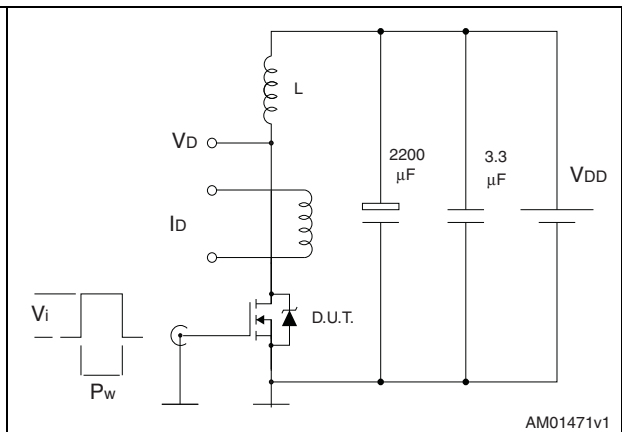
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**Figure 19. Test circuit for inductive load switching and diode recovery times**



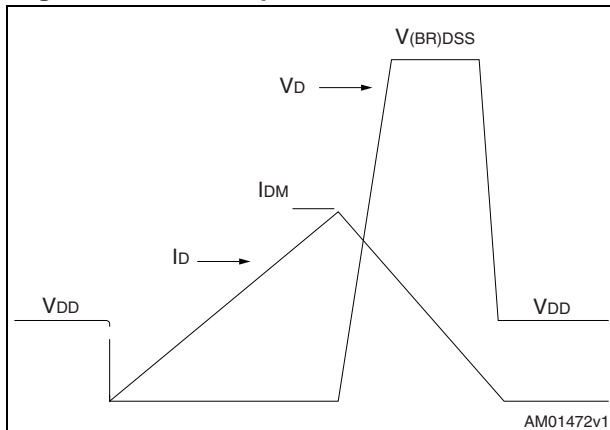
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**Figure 20. Unclamped inductive load test circuit**



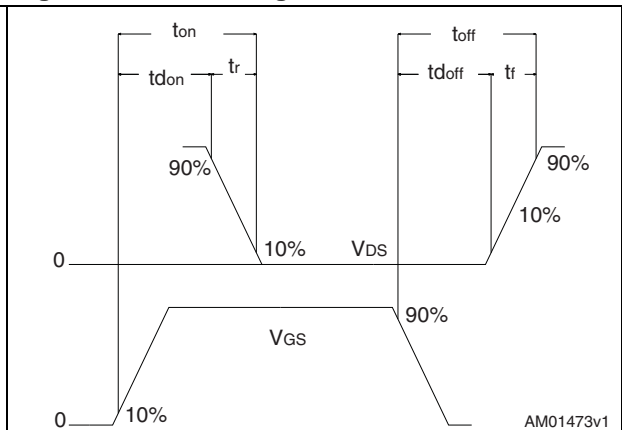
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**Figure 21. Unclamped inductive waveform**



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**Figure 22. Switching time waveform**



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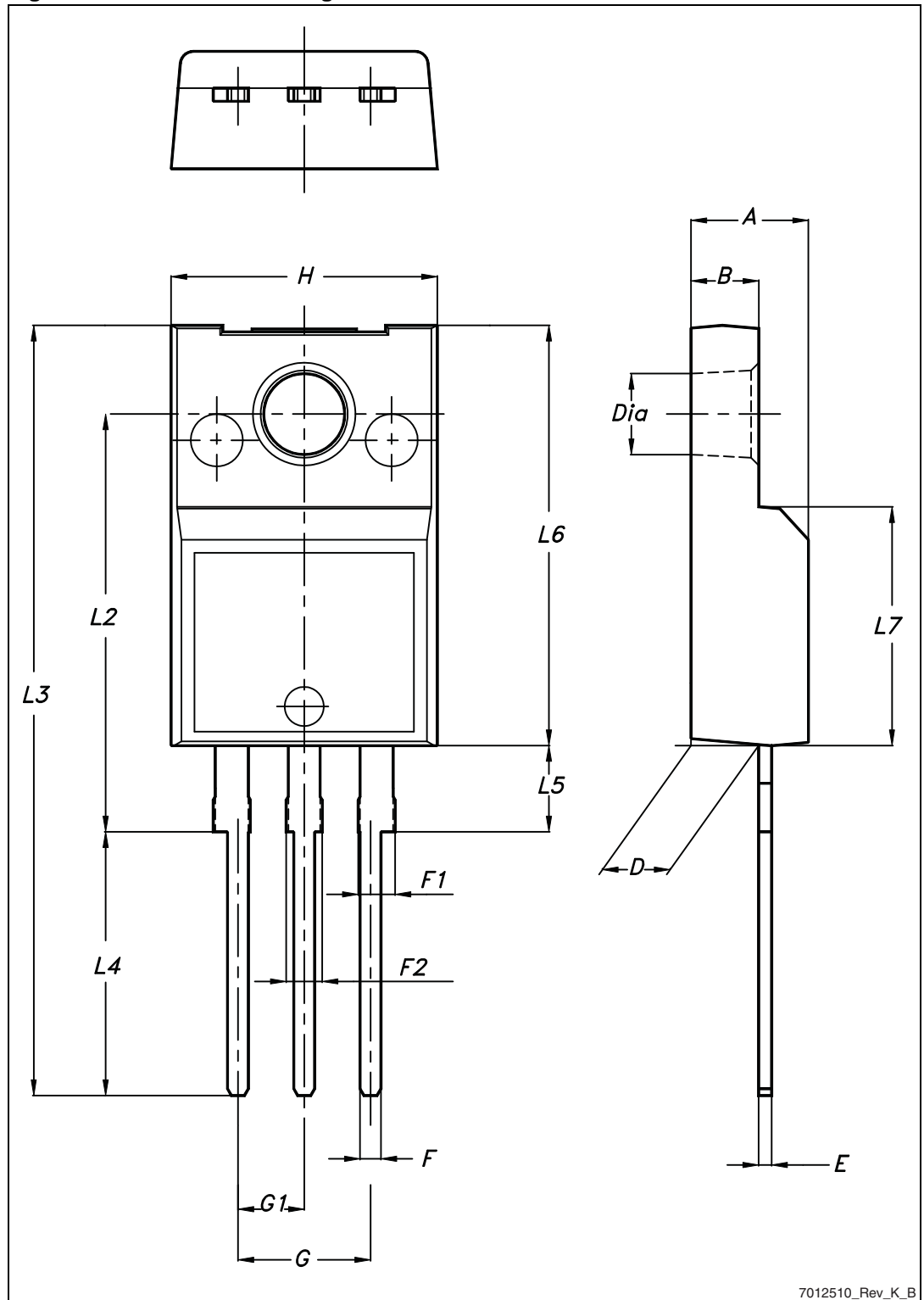
## 4 Package mechanical data

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<sup>®</sup> is an ST trademark.

Table 8. 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 23. TO-220FP drawing



7012510\_Rev\_K\_B

Table 9. 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

Figure 24. TO-3PF drawing

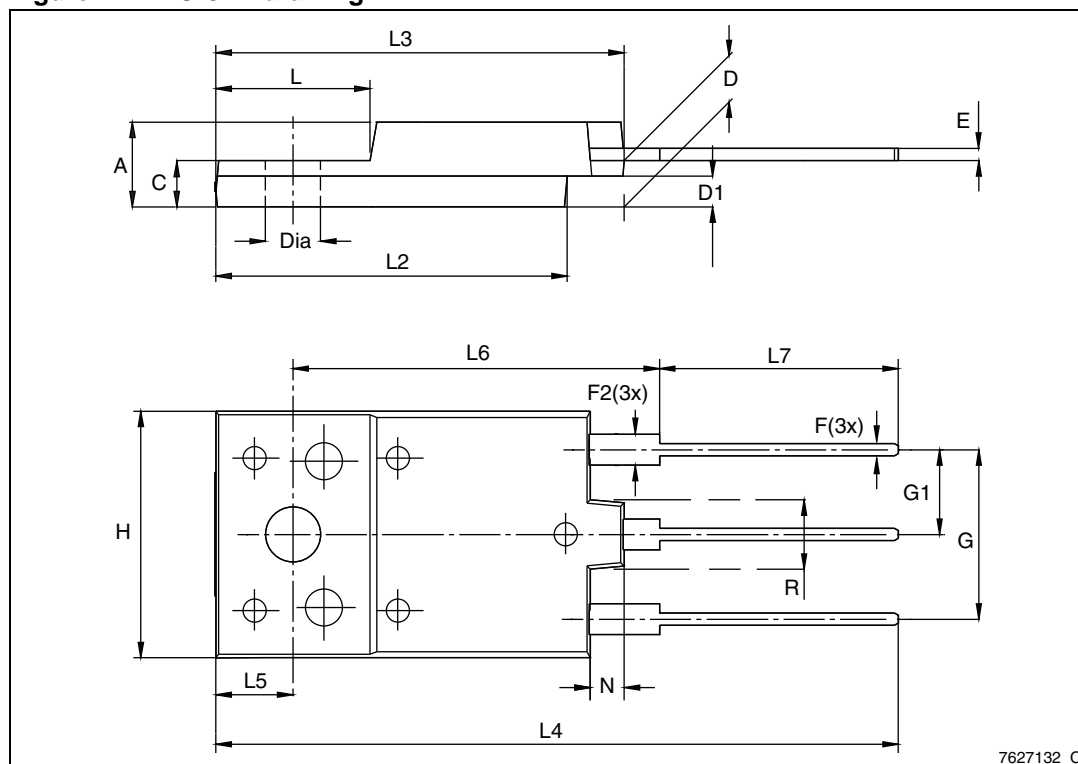
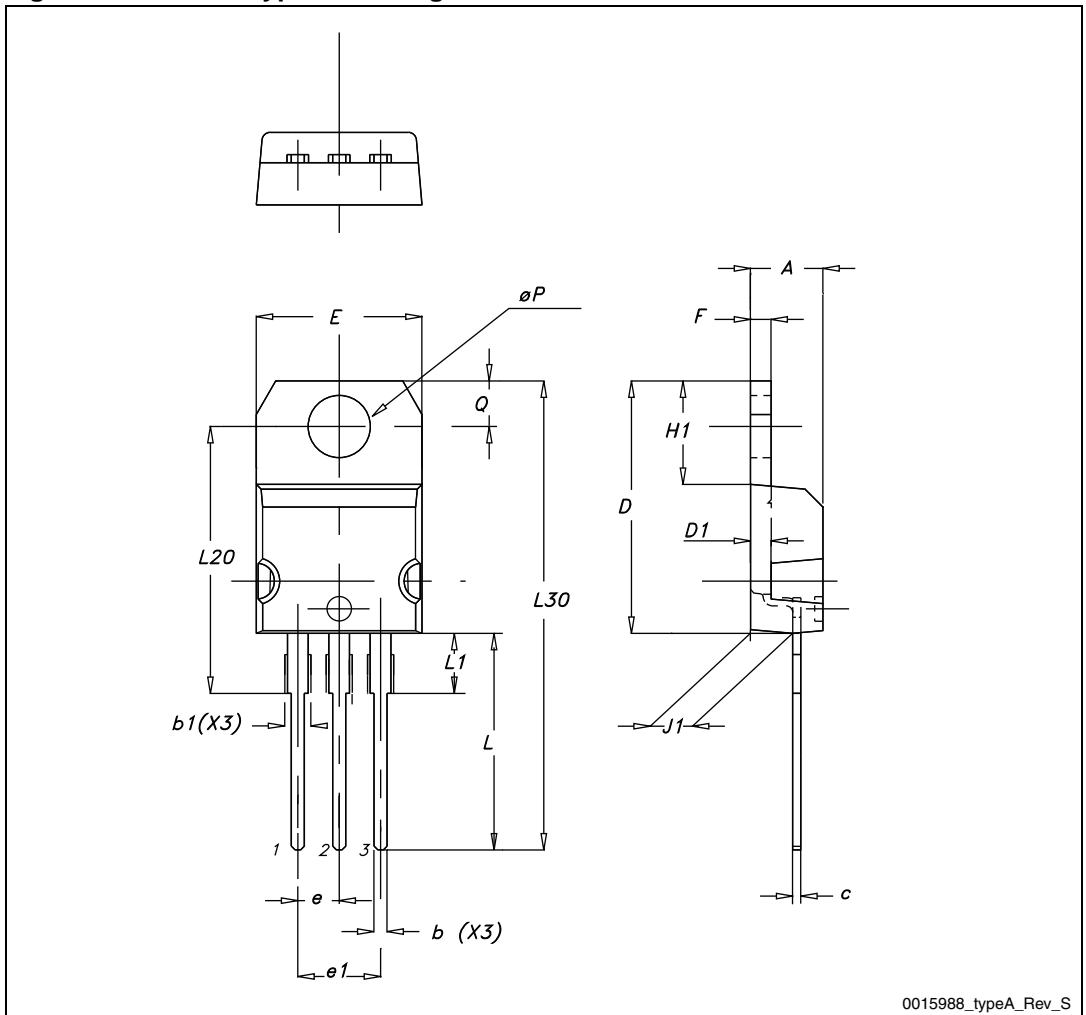


Table 10. TO-220 type A mechanical data

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





## 5 Revision history

Table 11. Document revision history

Date	Revision	Changes
13-Aug-2012	1	First release.
23-Jan-2013	2	Added device in TO-3PF.

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