



# 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 <sub>DS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>	P <sub>TOT</sub>
STF1N105K3	1050 V	11 $\Omega$	1.4 A	20 W
STFW1N105K3				60 W
STP1N105K3				

- 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.

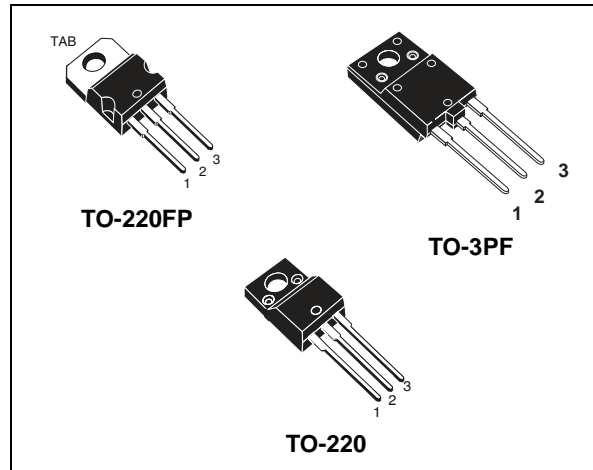


Figure 1. Internal schematic diagram

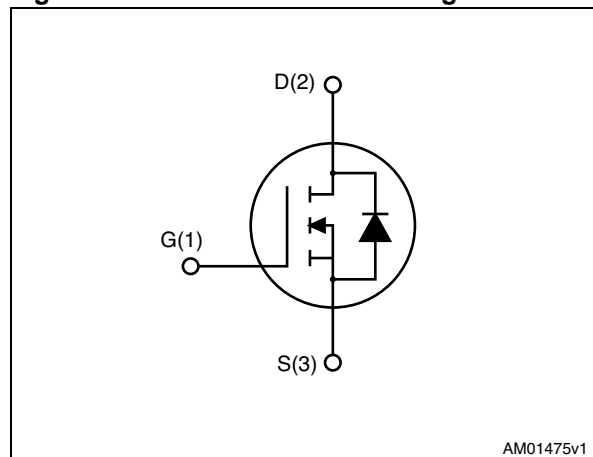


Table 1. Device summary

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

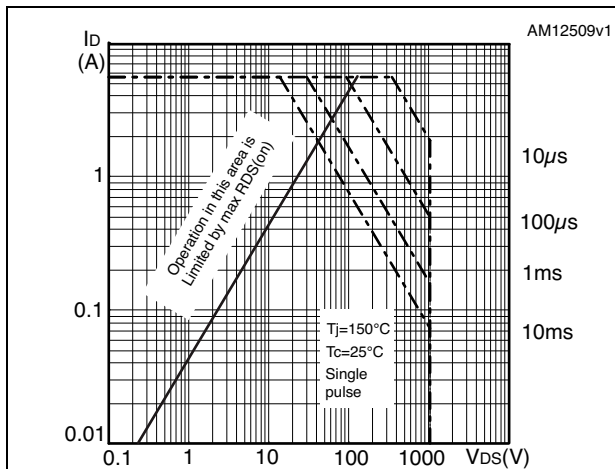


Figure 3. Thermal impedance for TO-220FP and TO-3PF

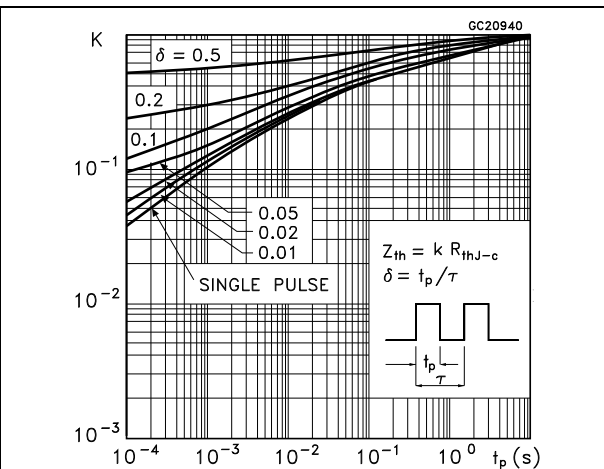


Figure 4. Safe operating area for TO-220

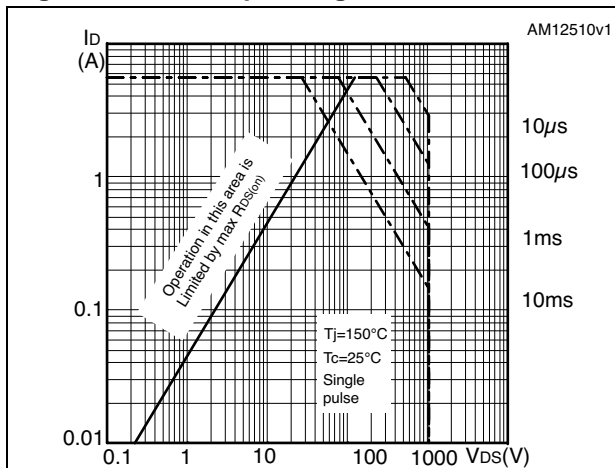


Figure 5. Thermal impedance for TO-220

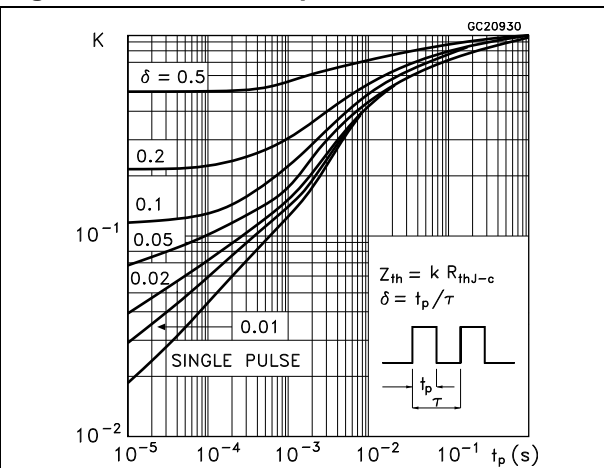


Figure 6. Output characteristics

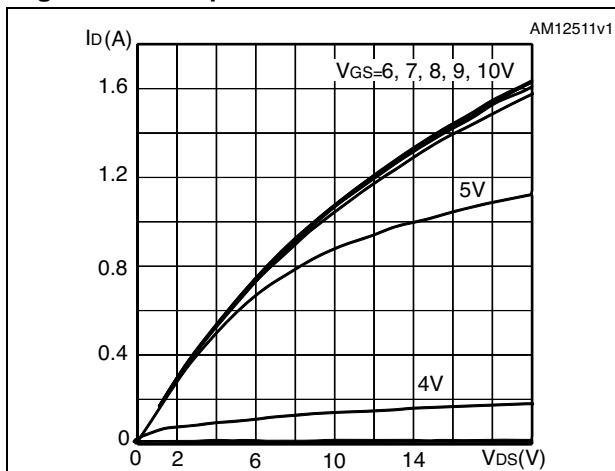


Figure 7. Transfer characteristics

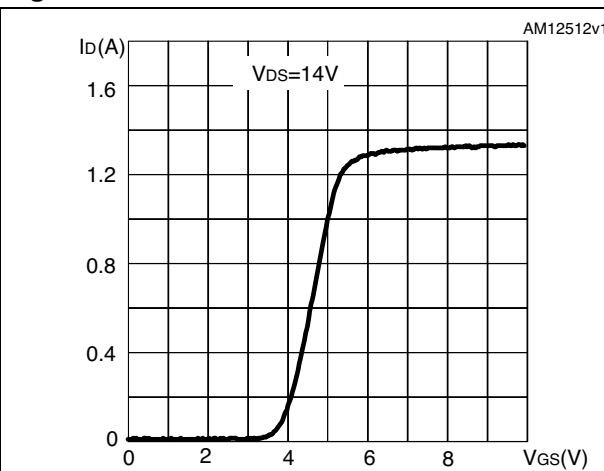


Figure 8. Gate charge vs gate-source voltage Figure 9. Static drain-source on-resistance

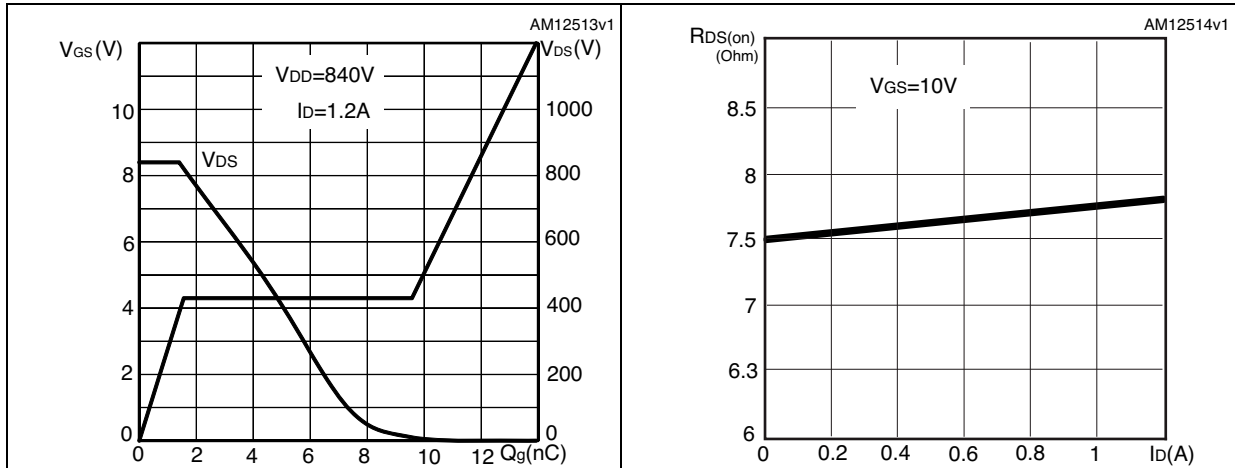


Figure 10. Capacitance variations Figure 11. Output capacitance stored energy

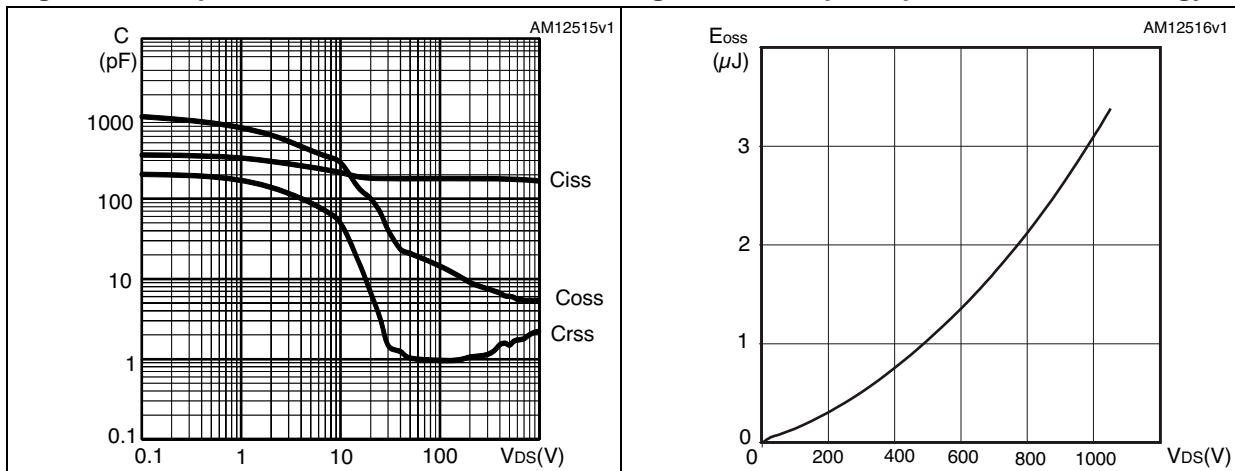


Figure 12. Normalized gate threshold voltage vs temperature Figure 13. Normalized on-resistance vs temperature

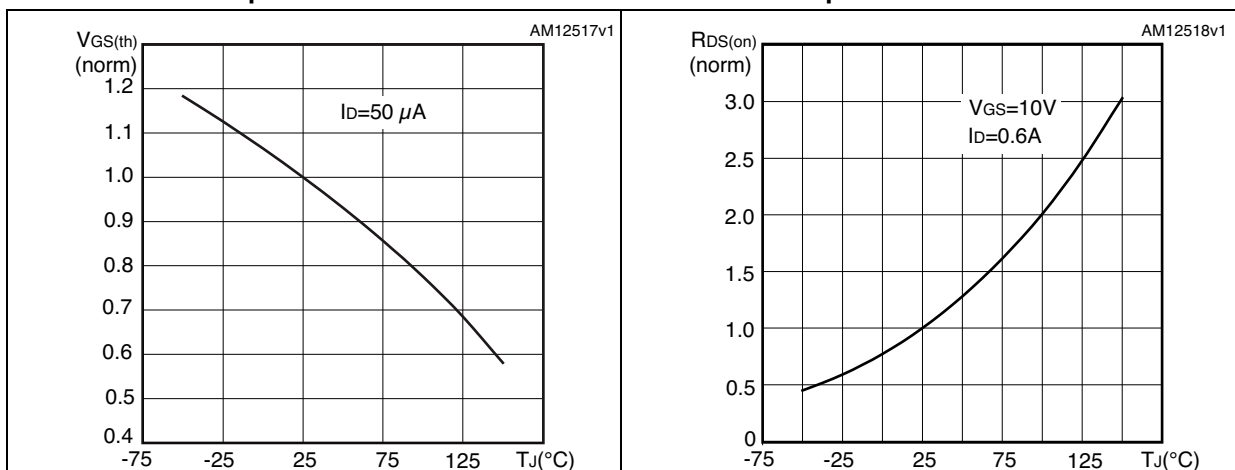


Figure 14. Source-drain diode forward characteristics

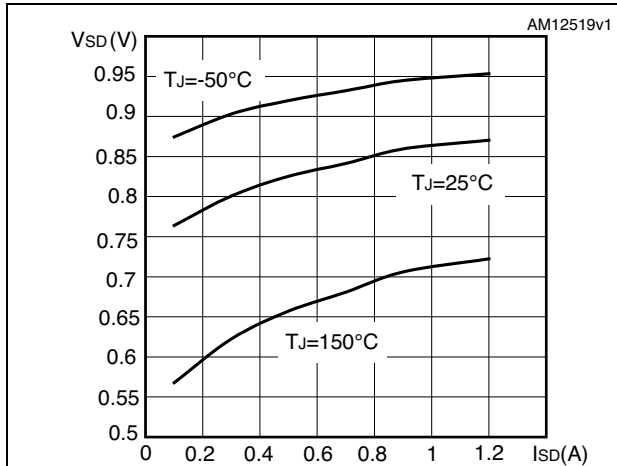


Figure 15. Normalized BV<sub>DSS</sub> vs temperature

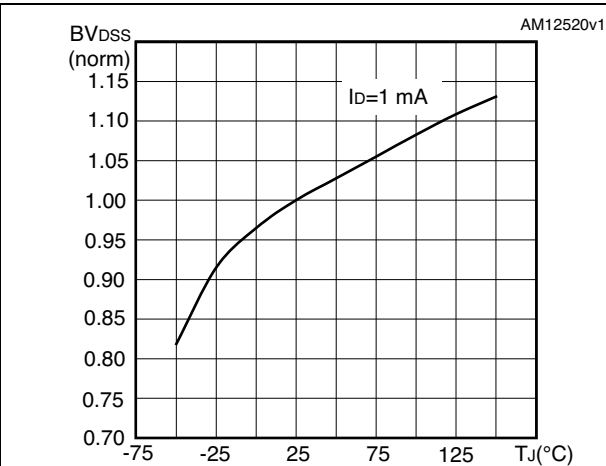
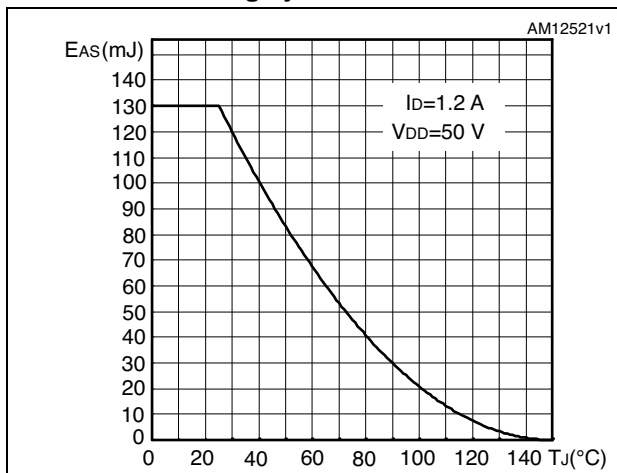


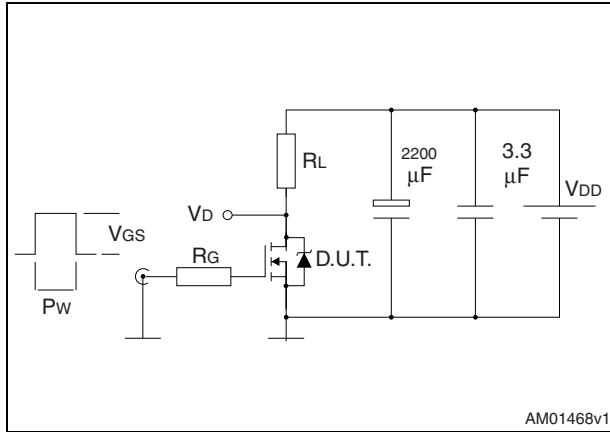
Figure 16. Maximum avalanche energy vs starting TJ



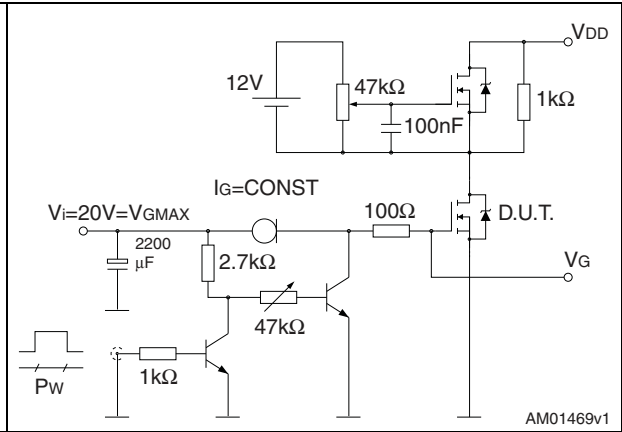


### 3 Test circuits

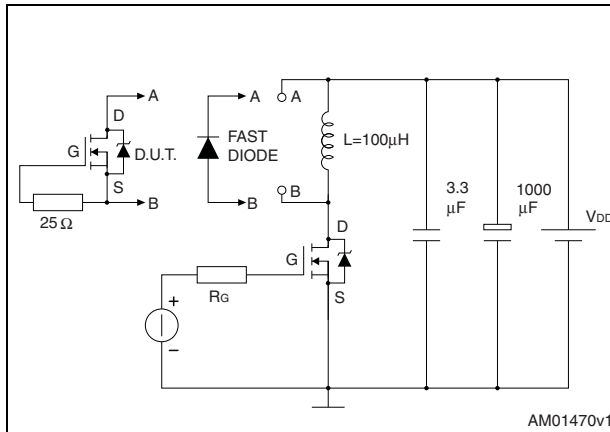
**Figure 17. Switching times test circuit for resistive load**



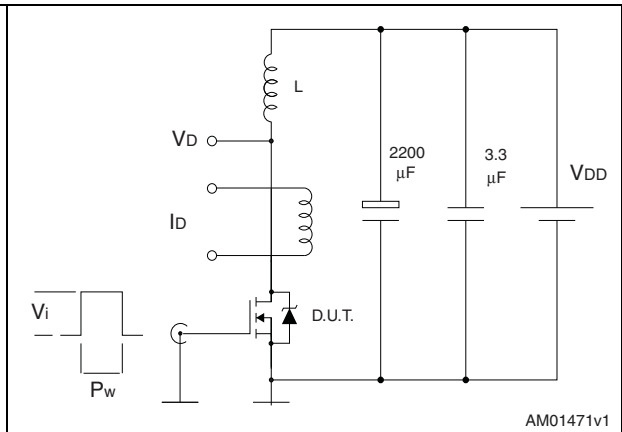
**Figure 18. Gate charge test circuit**



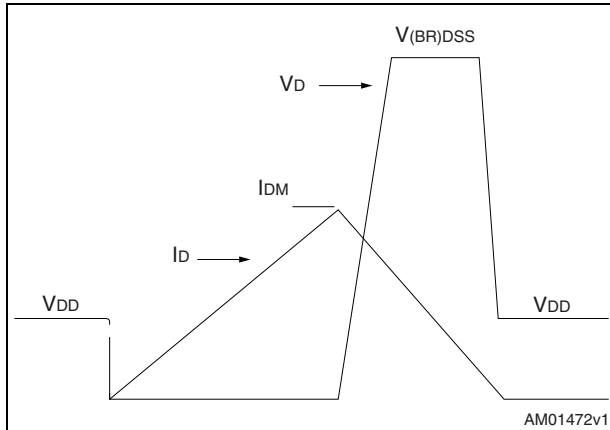
**Figure 19. Test circuit for inductive load switching and diode recovery times**



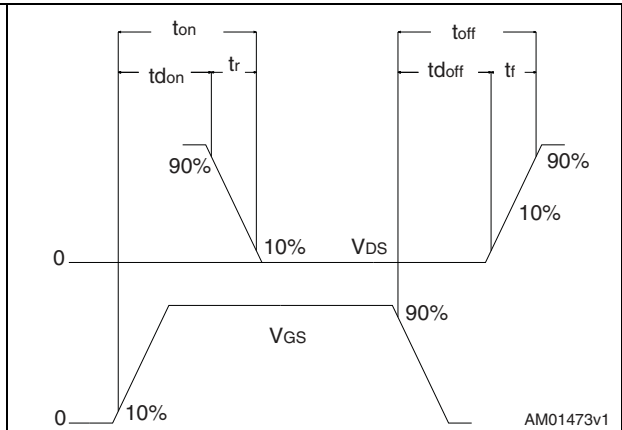
**Figure 20. Unclamped inductive load test circuit**



**Figure 21. Unclamped inductive waveform**



**Figure 22. Switching time waveform**



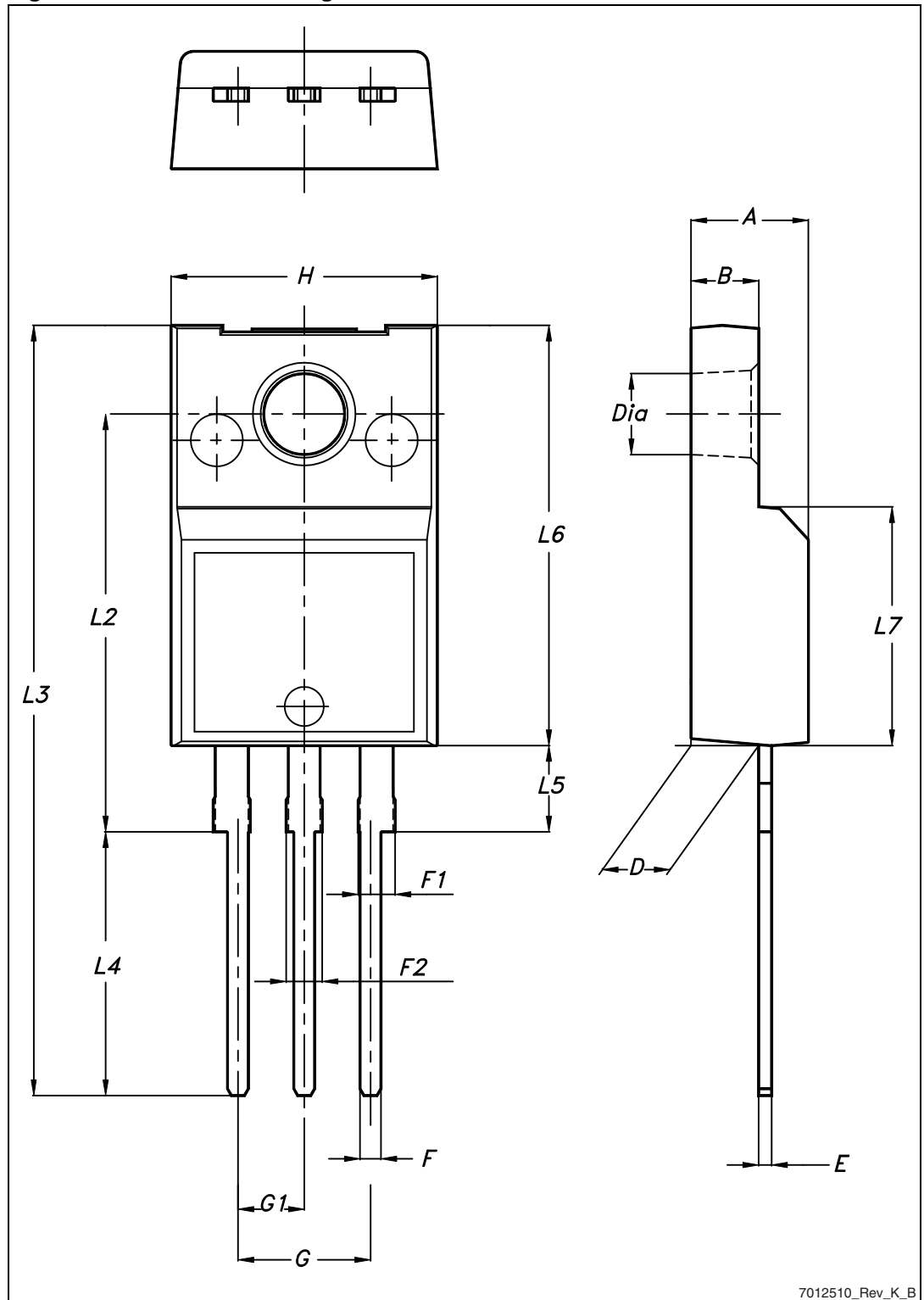
## 4 Package mechanical data

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<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

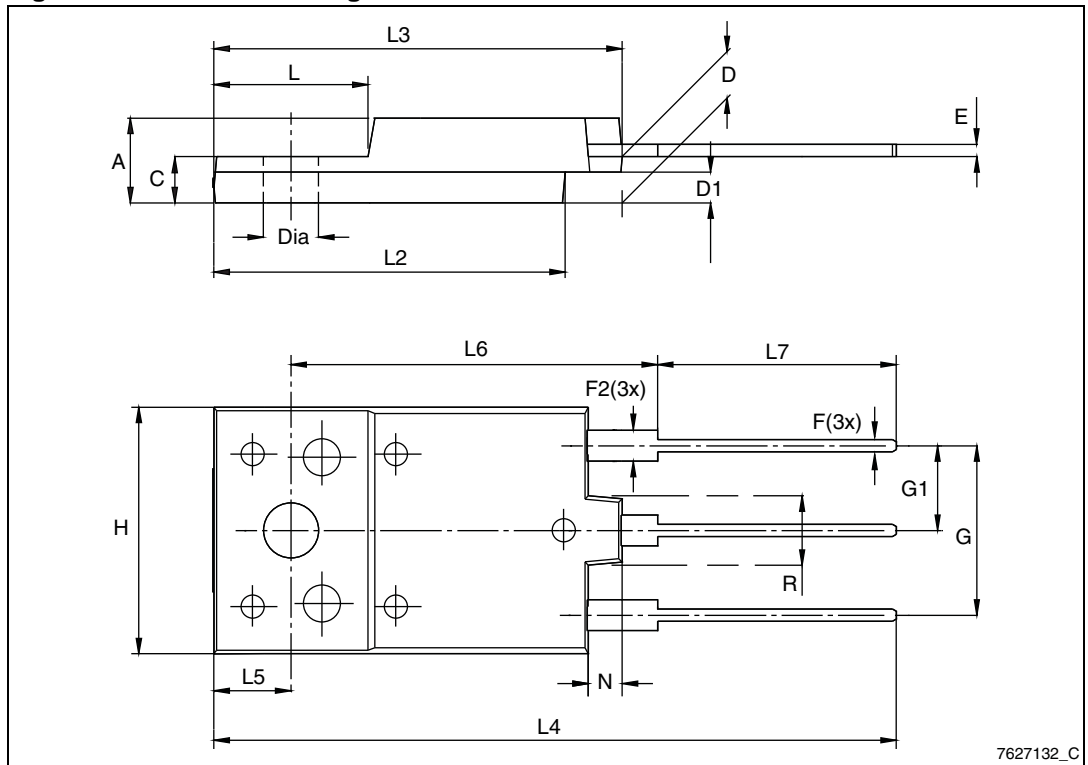


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Table 9. TO-3PF mechanical data

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

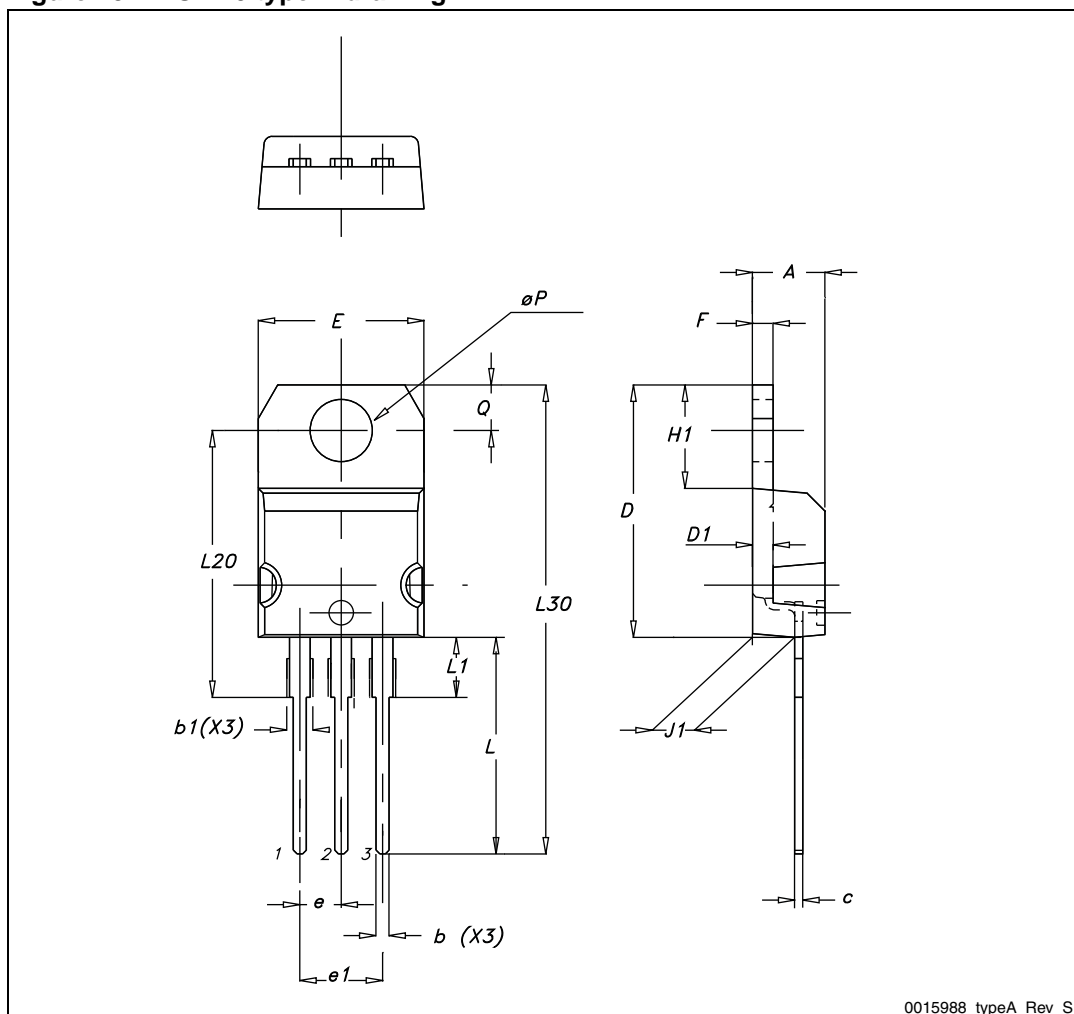


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Table 10. TO-220 type A mechanical data

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	
∅P	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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