

## N-channel 100 V, 5.1 mΩ typ., 110 A, STripFET™ VII DeepGATE™ Power MOSFETs in TO-220FP and TO-220 packages

Datasheet - production data

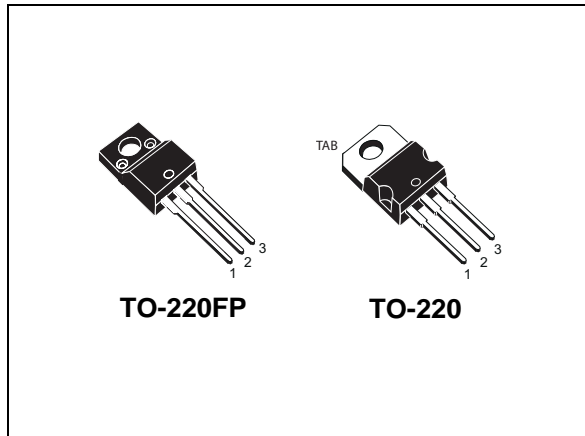
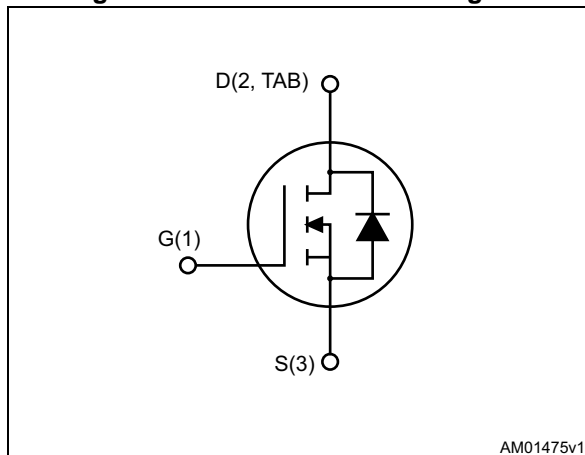


Figure 1. Internal schematic diagram



### Features

Order codes	V <sub>DS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>	P <sub>TOT</sub>
STF110N10F7	100 V	0.007 Ω	45 A	30 W
STP110N10F7			110 A	150 W

- Ultra low on-resistance
- 100% avalanche tested

### Applications

- Switching applications

### Description

These devices utilize the 7<sup>th</sup> generation of design rules of ST's proprietary STripFET™ technology, with a new gate structure. The resulting Power MOSFET exhibits the lowest R<sub>DS(on)</sub> in all packages.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STF110N10F7	110N10F7	TO-220FP	Tube
STP110N10F7		TO-220	

# Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>3</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>4</b>
	2.1 Electrical characteristics (curves) .....	6
<b>3</b>	<b>Test circuits</b> .....	<b>9</b>
<b>4</b>	<b>Package mechanical data</b> .....	<b>10</b>
<b>5</b>	<b>Revision history</b> .....	<b>15</b>

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220FP	TO-220	
$V_{DS}$	Drain-source voltage	100		V
$V_{GS}$	Gate-source voltage	$\pm 20$		V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ °C}$	45	110	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ °C}$	32	76	A
$I_{DM}^{(2)}$	Drain current (pulsed)	180	415	A
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25\text{ °C}$	30	150	W
$E_{AS}^{(3)}$	Single pulse avalanche energy	490		mJ
$T_J$	Operating junction temperature	-55 to 175		°C
$T_{stg}$	Storage temperature			°C

1. This value is rated according to  $R_{thj-c}$ .
2. Limited by safe operating area.
3. Starting  $T_J=25\text{ °C}$ ,  $I_D=18$ ,  $V_{DD}=50\text{ V}$ .

**Table 3. Thermal resistance**

Symbol	Parameter	Value		Unit
		TO-220FP	TO-220	
$R_{thj-case}$	Thermal resistance junction-case	5.00	1.00	°C/W
$R_{thj-amb}$	Thermal resistance junction-amb	62.50		°C/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 ( $V_{GS}=0$ )	$I_D = 250\ \mu\text{A}$	100		-	V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS}=0$ )	$V_{DS} = 100\ \text{V}$			1	$\mu\text{A}$
		$V_{DS} = 100\ \text{V}; T_C=125\text{ °C}$			10	$\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{DS}=0$ )	$V_{GS} = 20\ \text{V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS}=V_{GS}, I_D = 250\ \mu\text{A}$	2.5		4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	For TO-220FP: $V_{GS}=10\ \text{V}, I_D=22.5\ \text{A}$		5.1	7	m $\Omega$
		For TO-220: $V_{GS}=10\ \text{V}, I_D=55\ \text{A}$				

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS}=50\ \text{V}, f=1\ \text{MHz}, V_{GS}=0$	-	5117	-	pF
$C_{oss}$	Output capacitance		-	992	-	pF
$C_{rss}$	Reverse transfer capacitance		-	39	-	pF
$Q_g$	Total gate charge	$V_{DD}=50\ \text{V}, I_D = 110\ \text{A}$ $V_{GS}=10\ \text{V}$ <i>Figure 17</i>	-	72	-	nC
$Q_{gs}$	Gate-source charge		-	31	-	nC
$Q_{gd}$	Gate-drain charge		-	16	-	nC

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD}=50\ \text{V}, I_D=55\ \text{A}, R_G=4.7\ \Omega, V_{GS}=10\ \text{V}$ <i>Figure 16</i>	-	25	-	ns
$t_r$	Rise time		-	36	-	ns
$t_{d(off)}$	Turn-off delay time		-	52	-	ns
$t_f$	Fall time		-	21	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max.	Unit
$I_{SD}$	Source-drain current: For TO-220FP		-		45	A
	For TO-220		-		110	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed): For TO-220FP		-		180	A
	For TO-220		-		415	A
$V_{SD}^{(2)}$	Forward on voltage	For TO-220FP: $I_{SD} = 22.5 \text{ A}, V_{GS} = 0$	-		1.2	V
		For TO-220: $I_{SD} = 55 \text{ A}, V_{GS} = 0$				
$t_{rr}$	Reverse recovery time	$I_{SD} = 110 \text{ A},$ $di/dt = 100 \text{ A}/\mu\text{s},$ $V_{DD} = 80 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$	-	77		ns
$Q_{rr}$	Reverse recovery charge		-	150		nC
$I_{RRM}$	Reverse recovery current		-	4.3		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-220FP

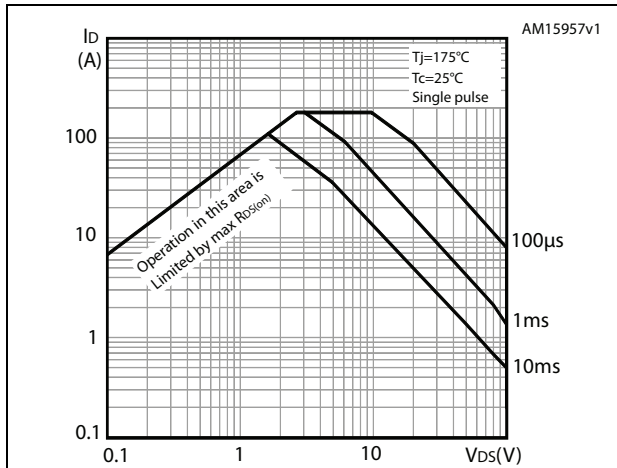


Figure 3. Thermal impedance for TO-220FP

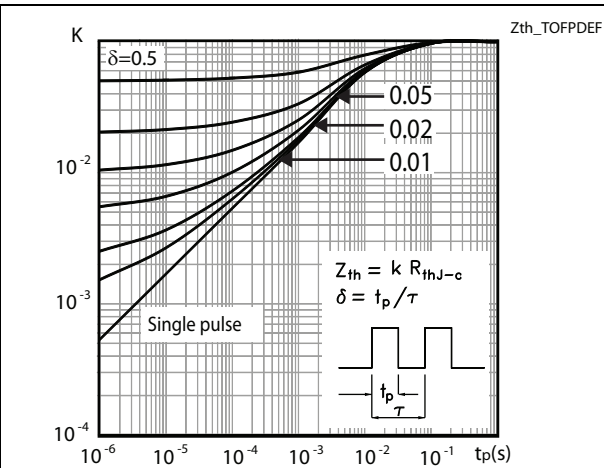


Figure 4. Safe operating area for TO-220

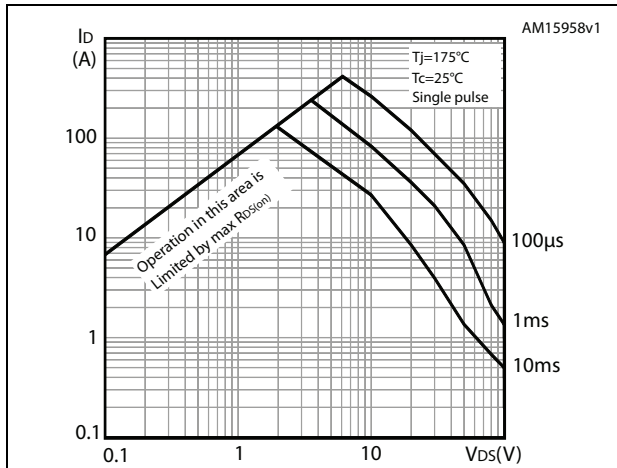


Figure 5. Thermal impedance for TO-220

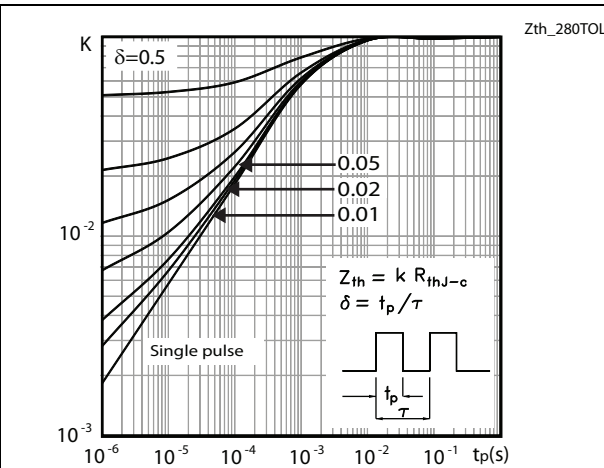


Figure 6. Output characteristics

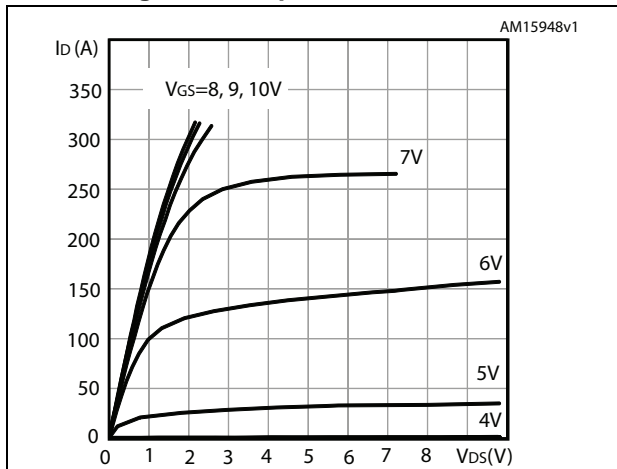


Figure 7. Transfer characteristics

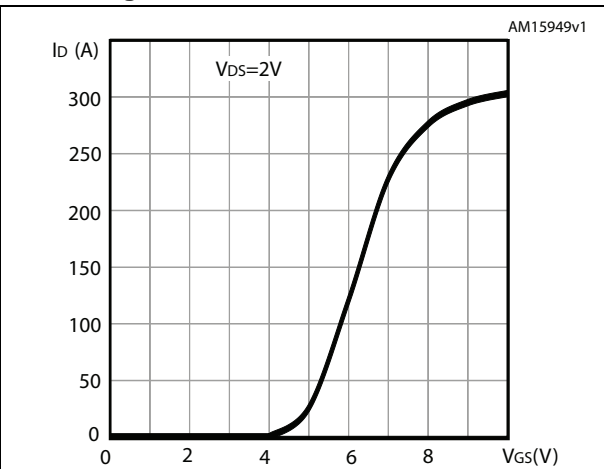


Figure 8. Gate charge vs gate-source voltage

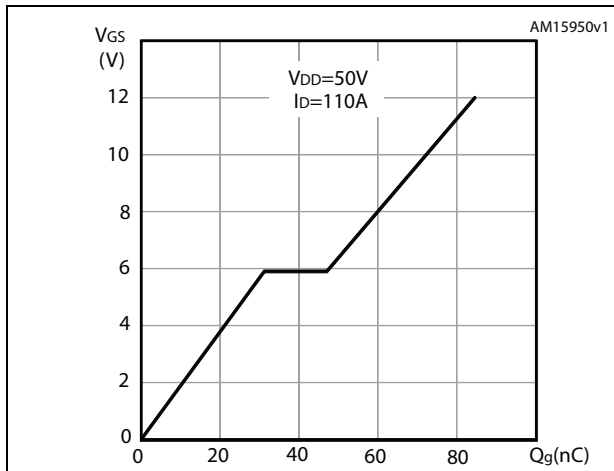


Figure 9. Static drain-source on-resistance for TO-220FP

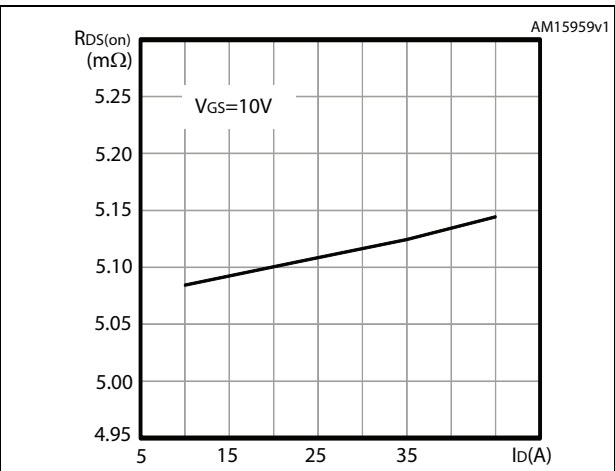


Figure 10. Static drain-source on-resistance for TO-220

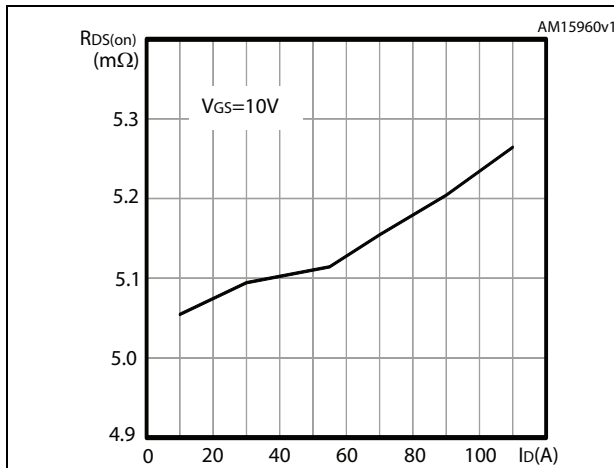


Figure 11. Capacitance variations

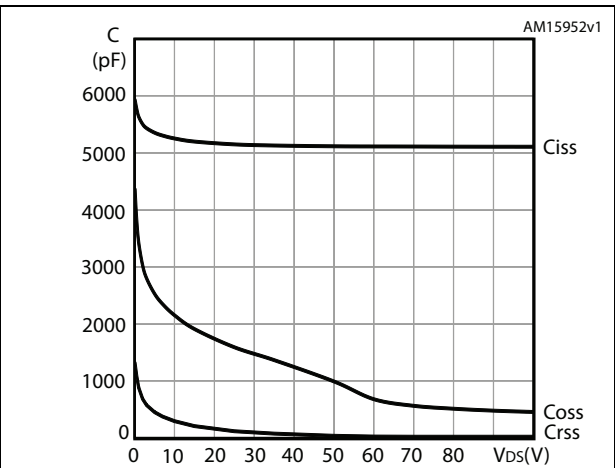


Figure 12. Normalized gate threshold voltage vs temperature

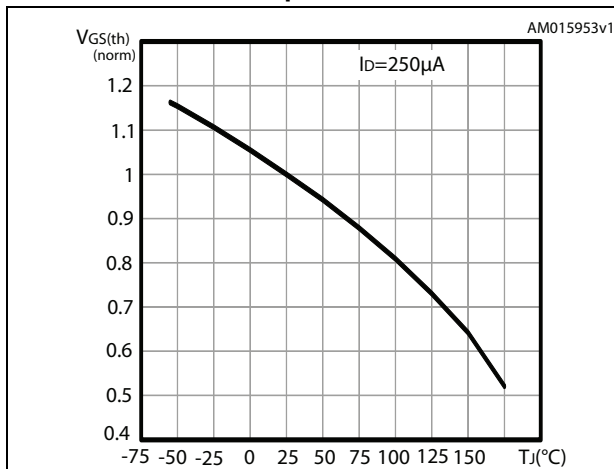


Figure 13. Normalized on-resistance vs temperature

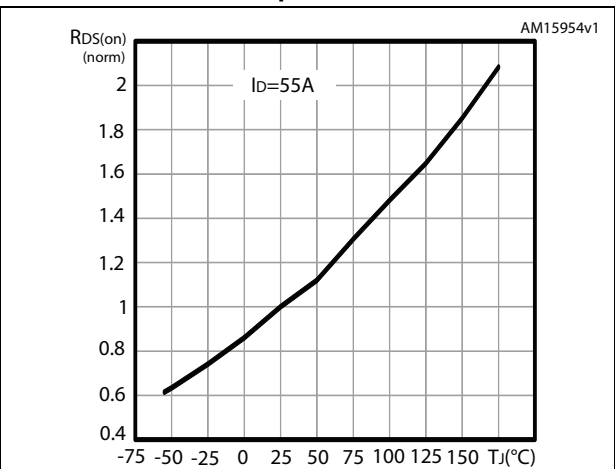


Figure 14. Normalized  $B_{VDSS}$  vs temperature

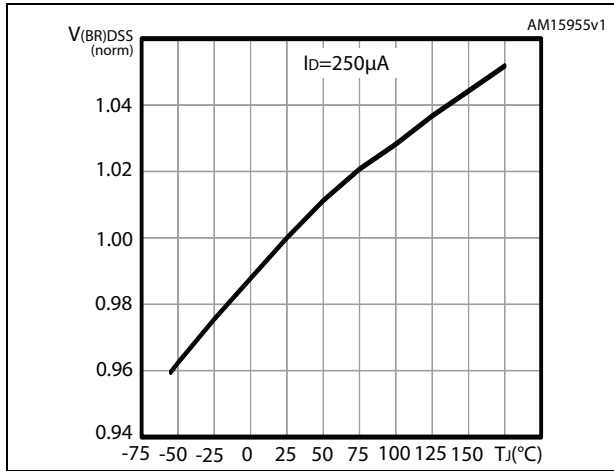
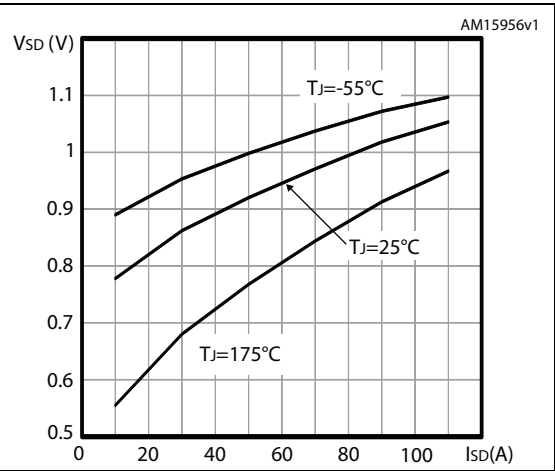


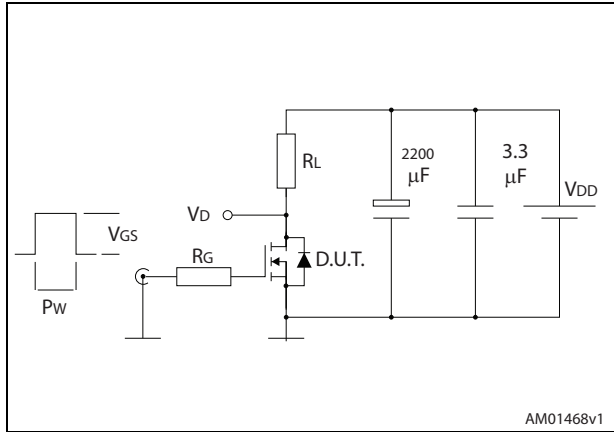
Figure 15. Source-drain diode forward vs temperature





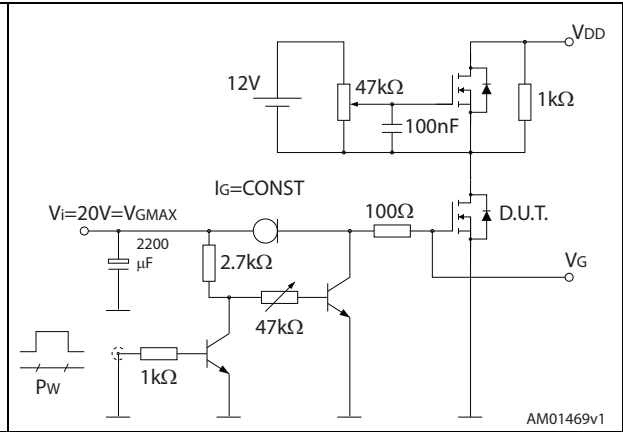
### 3 Test circuits

Figure 16. Switching times test circuit for resistive load



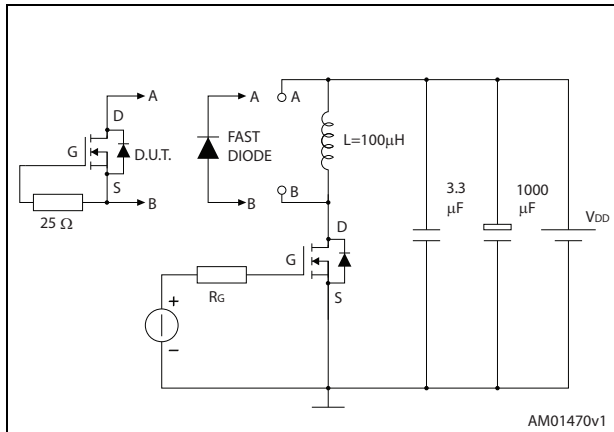
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Figure 17. Gate charge test circuit



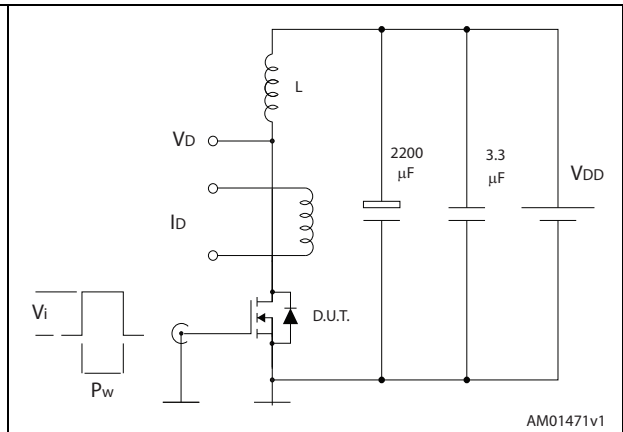
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Figure 18. Test circuit for inductive load switching and diode recovery times



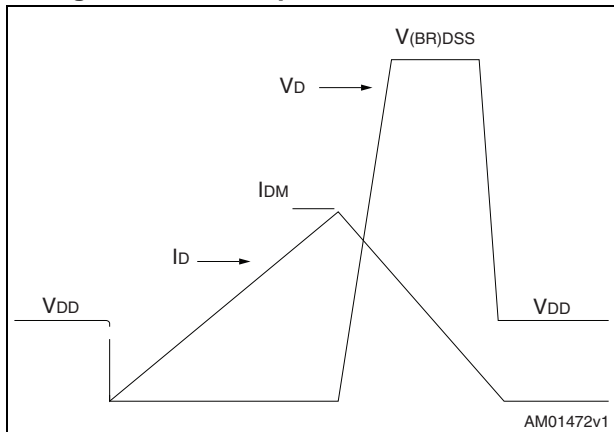
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Figure 19. Unclamped inductive load test circuit



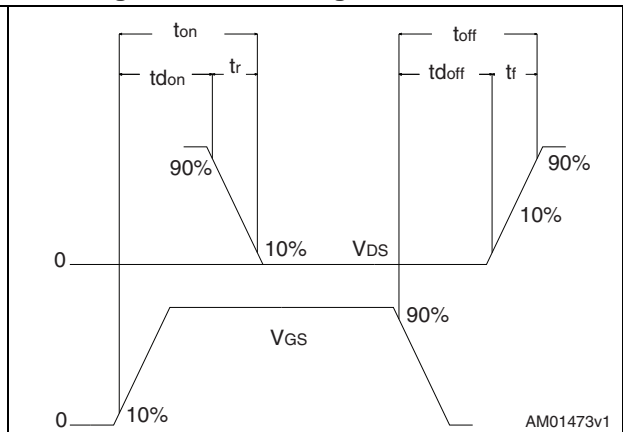
AM01471v1

Figure 20. Unclamped inductive waveform



AM01472v1

Figure 21. Switching time waveform



AM01473v1

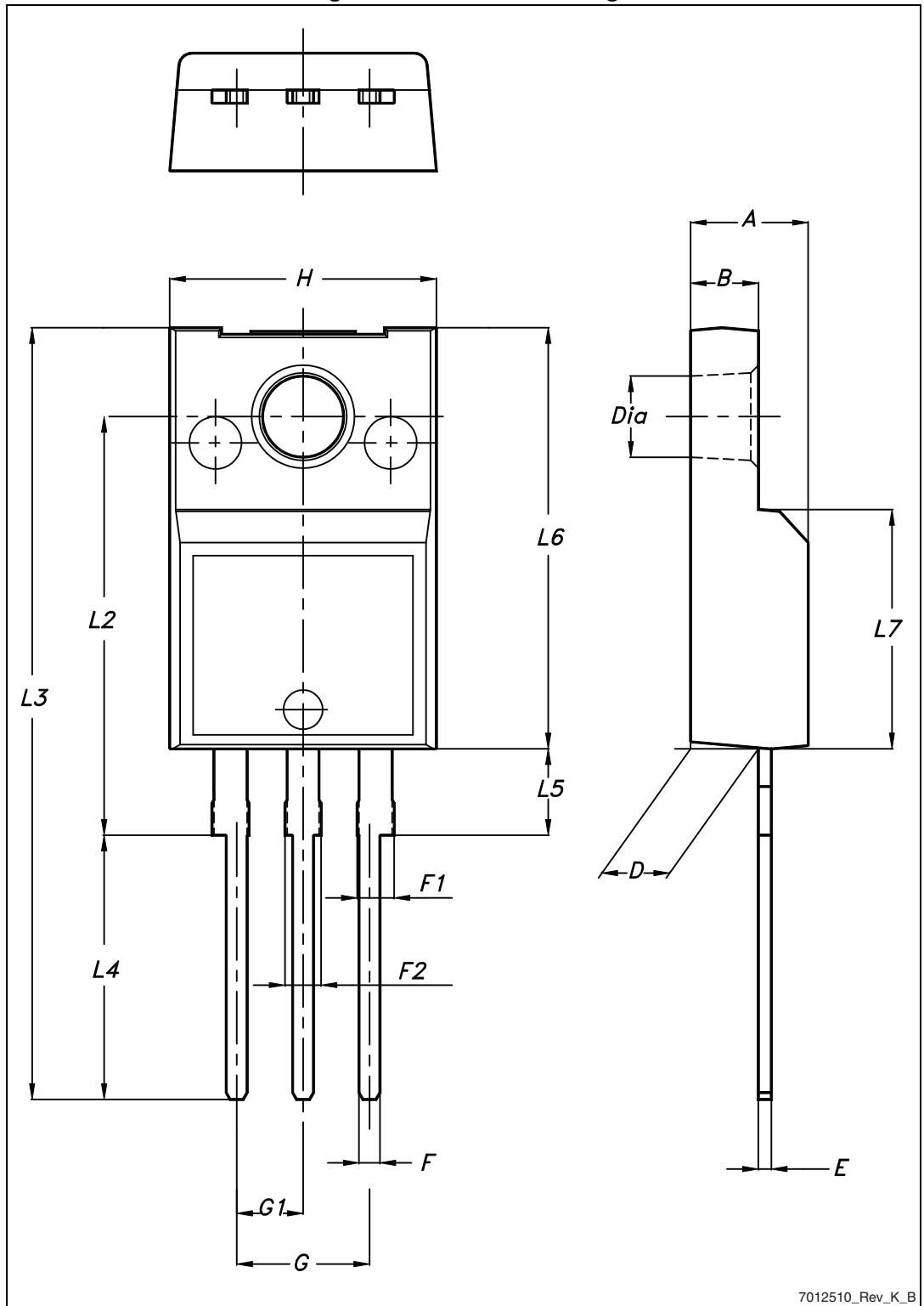
## 4 Package mechanical data

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 22. TO-220FP drawing

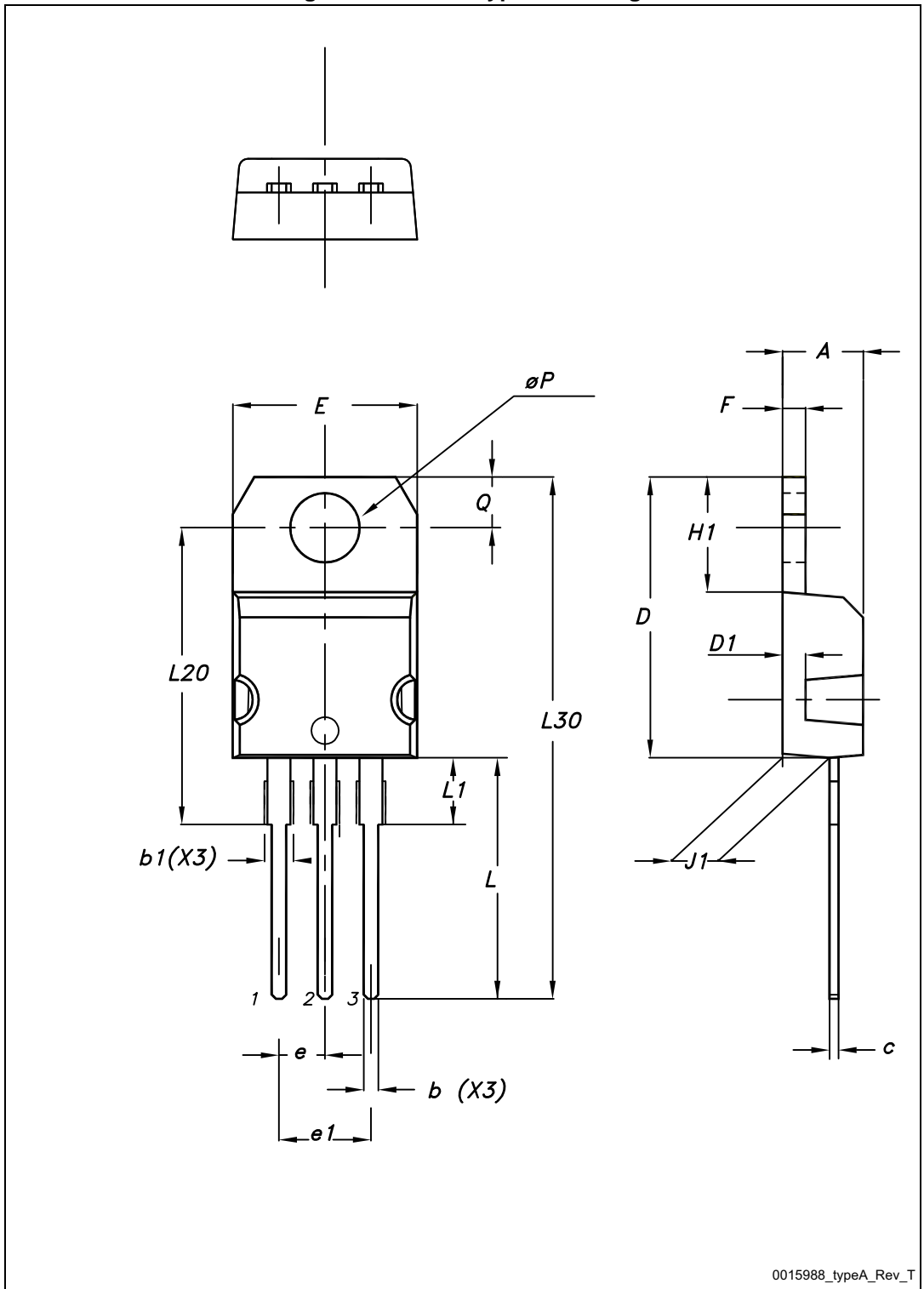


7012510\_Rev\_K\_B

Table 9. 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 23. TO-220 type A drawing



0015988\_typeA\_Rev\_T

## 5 Revision history

**Table 10. Document revision history**

Date	Revision	Changes
03-Dec-2012	1	Initial release.
16-Jul-2013	2	<ul style="list-style-type: none"><li>– Part numbers (STF45N10F7 and STH110N10F7-2) have been moved to two separate datasheets</li><li>– Modified: title, <math>I_{DM}</math> value for TO-220</li><li>– Added: <math>E_{AS}</math></li><li>– Modified: the entire typical values in <a href="#">Table 5</a> and <a href="#">6</a></li><li>– Modified: typical and max values in <a href="#">Table 7</a></li><li>– Modified: <a href="#">Figure 16</a>, <a href="#">17</a>, <a href="#">18</a>, <a href="#">19</a>, <a href="#">Table 9</a> and <a href="#">Figure 23</a></li><li>– Minor text changes</li></ul>

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