

## 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

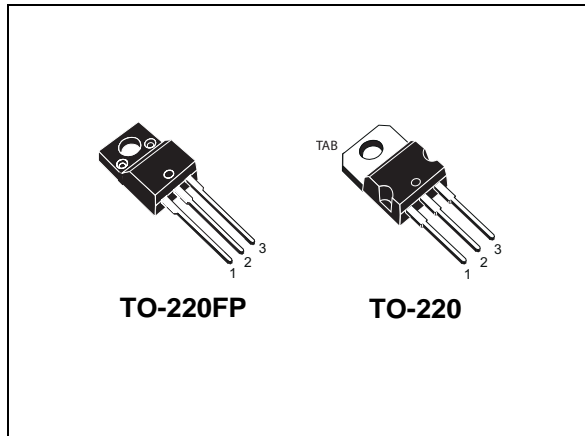
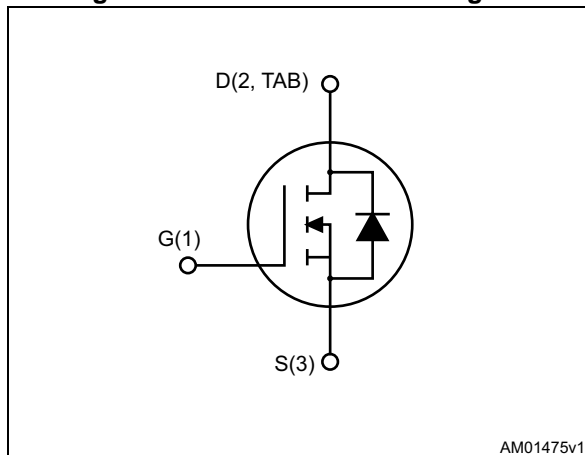


Figure 1. Internal schematic diagram



### 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	

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# 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 $T_C = 25\text{ }^\circ\text{C}$	45	110	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	32	76	A
$I_{DM}^{(2)}$	Drain current (pulsed)	180	415	A
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	30	150	W
$E_{AS}^{(3)}$	Single pulse avalanche energy	490		mJ
$T_J$	Operating junction temperature	-55 to 175		$^\circ\text{C}$
$T_{stg}$	Storage temperature			$^\circ\text{C}$

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

**Table 3. Thermal resistance**

Symbol	Parameter	Value		Unit
		TO-220FP	TO-220	
$R_{thj-case}$	Thermal resistance junction-case	5.00	1.00	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-amb	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 ( $V_{GS}=0$ )	$I_D = 250\ \mu\text{A}$	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	$V_{DD}=50\ \text{V}, I_D = 110\ \text{A}$	-	72	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS}=10\ \text{V}$	-	31	-	nC
$Q_{gd}$	Gate-drain charge	<a href="#">Figure 17</a>	-	16	-	nC

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD}=50\ \text{V}, I_D=55\ \text{A}, R_G=4.7\ \Omega, V_{GS}=10\ \text{V}$ <a href="#">Figure 16</a>	-	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

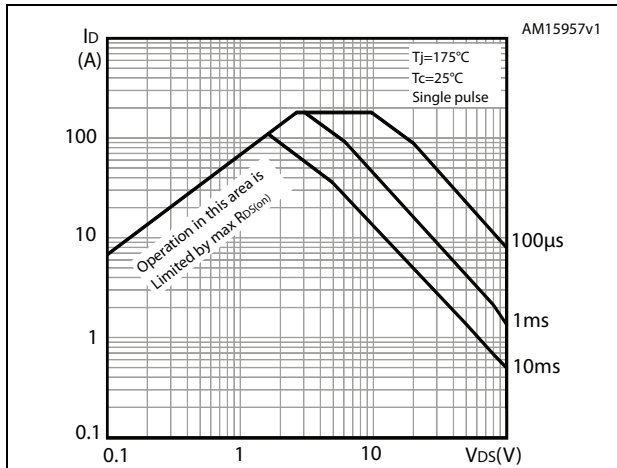


Figure 3. Thermal impedance for TO-220FP

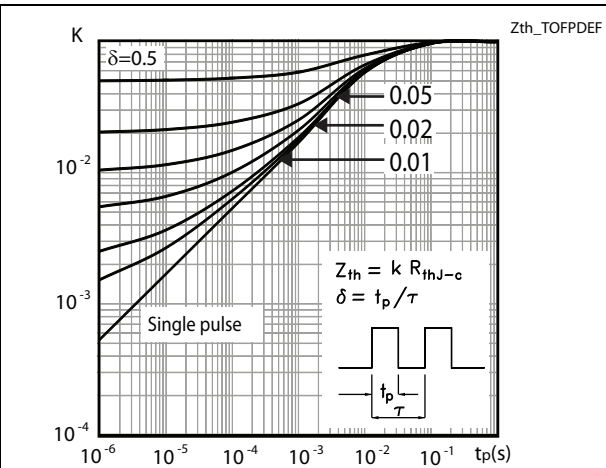


Figure 4. Safe operating area for TO-220

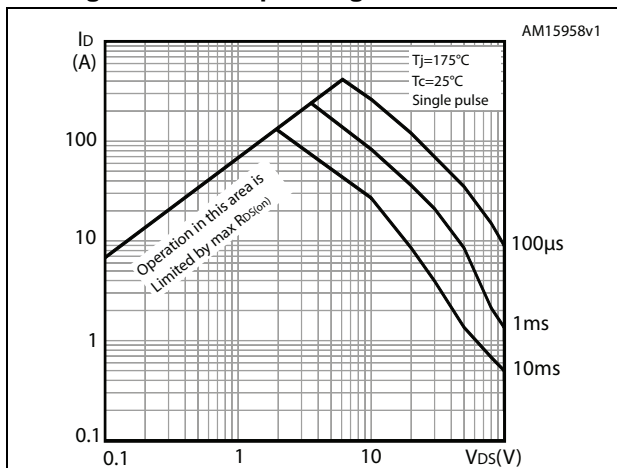


Figure 5. Thermal impedance for TO-220

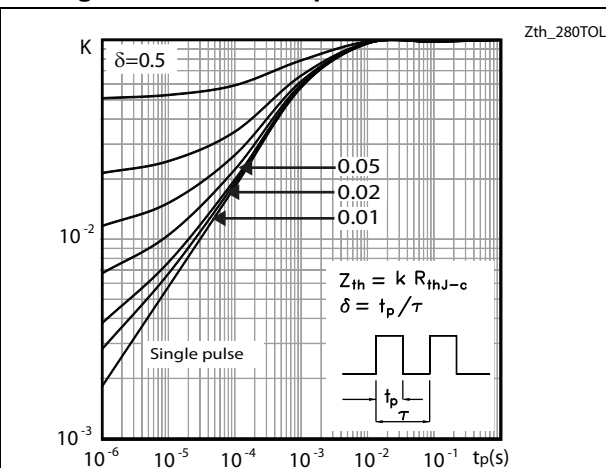


Figure 6. Output characteristics

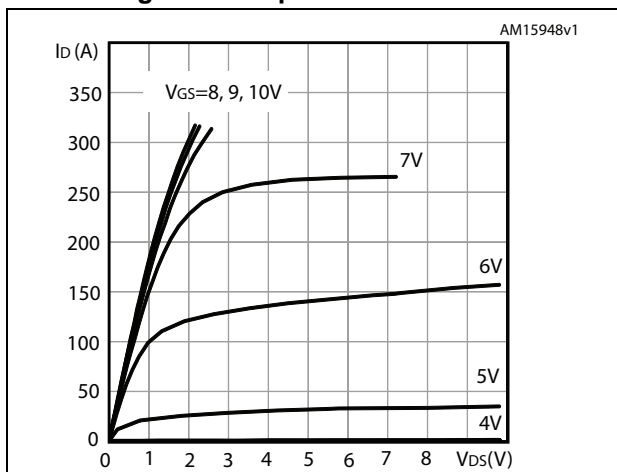


Figure 7. Transfer characteristics

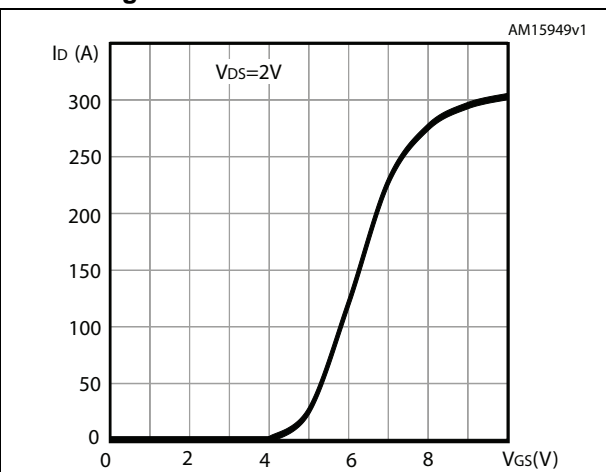


Figure 8. Gate charge vs gate-source voltage

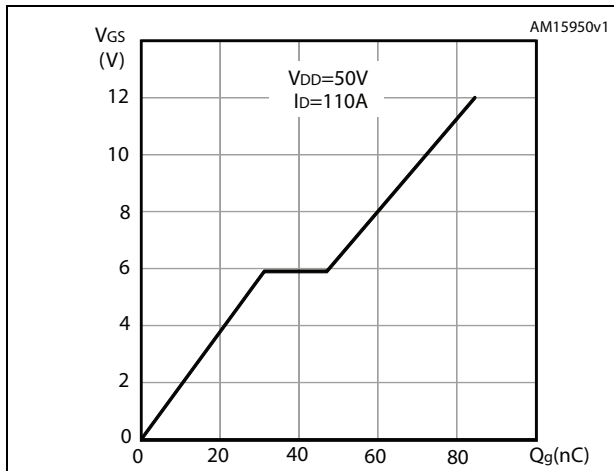


Figure 9. Static drain-source on-resistance for TO-220FP

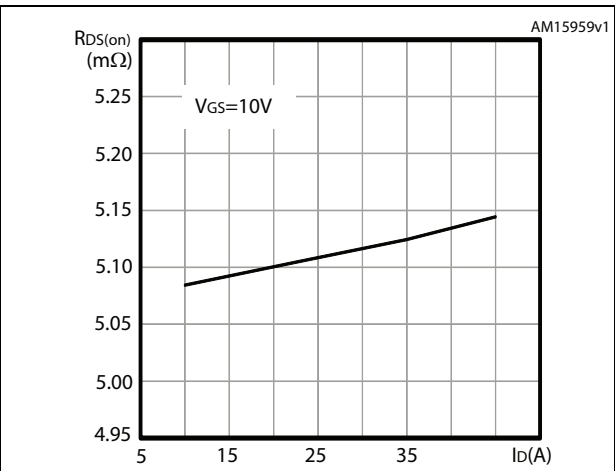


Figure 10. Static drain-source on-resistance for TO-220

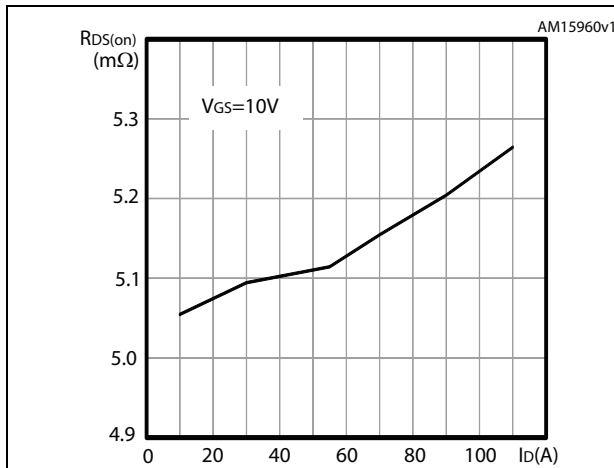


Figure 11. Capacitance variations

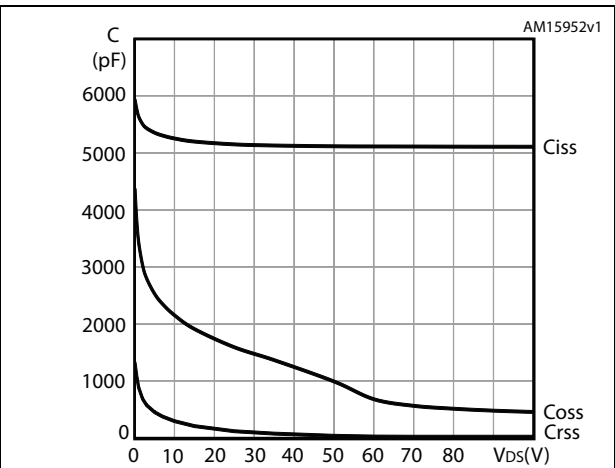


Figure 12. Normalized gate threshold voltage vs temperature

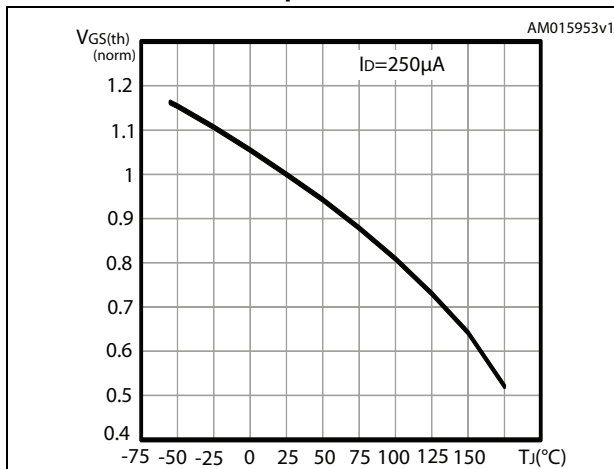


Figure 13. Normalized on-resistance vs temperature

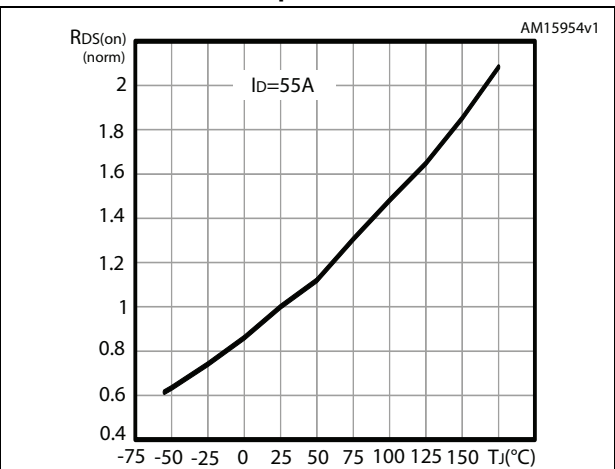


Figure 14. Normalized  $B_{VDSS}$  vs temperature

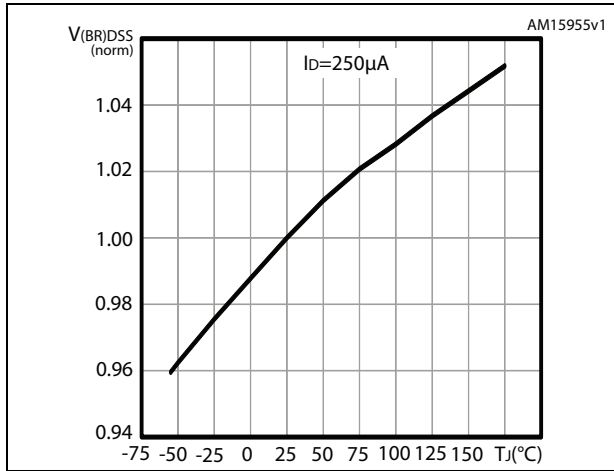
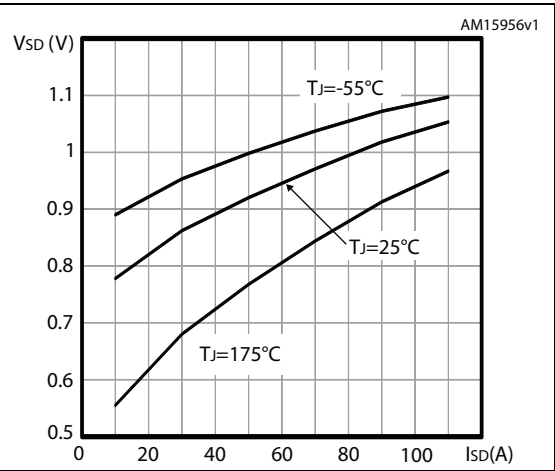


Figure 15. Source-drain diode forward vs temperature





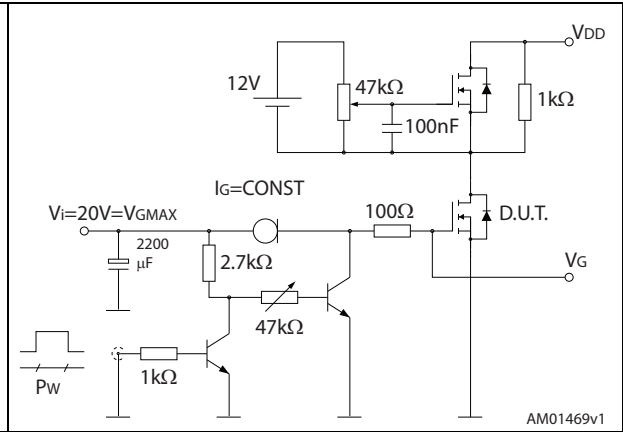
### 3 Test circuits

Figure 16. Switching times test circuit for resistive load



AM01468v1

Figure 17. Gate charge test circuit



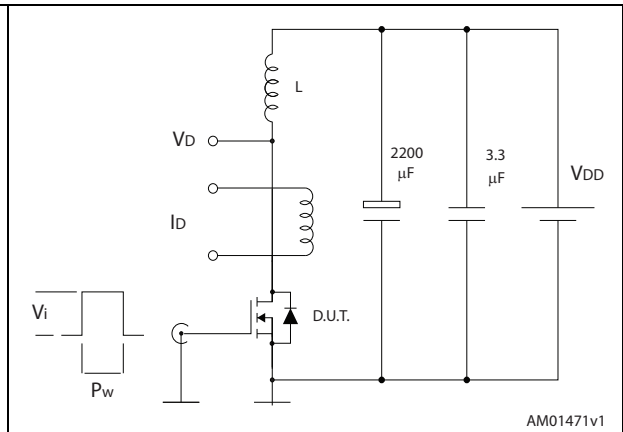
AM01469v1

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



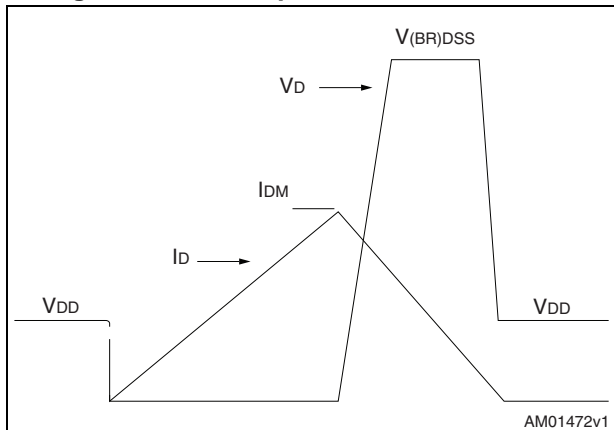
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Figure 19. Unclamped inductive load test circuit



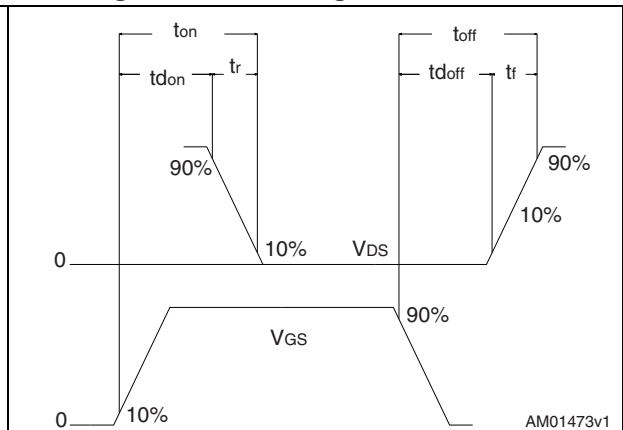
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Figure 20. Unclamped inductive waveform



AM01472v1

Figure 21. Switching time waveform



AM01473v1

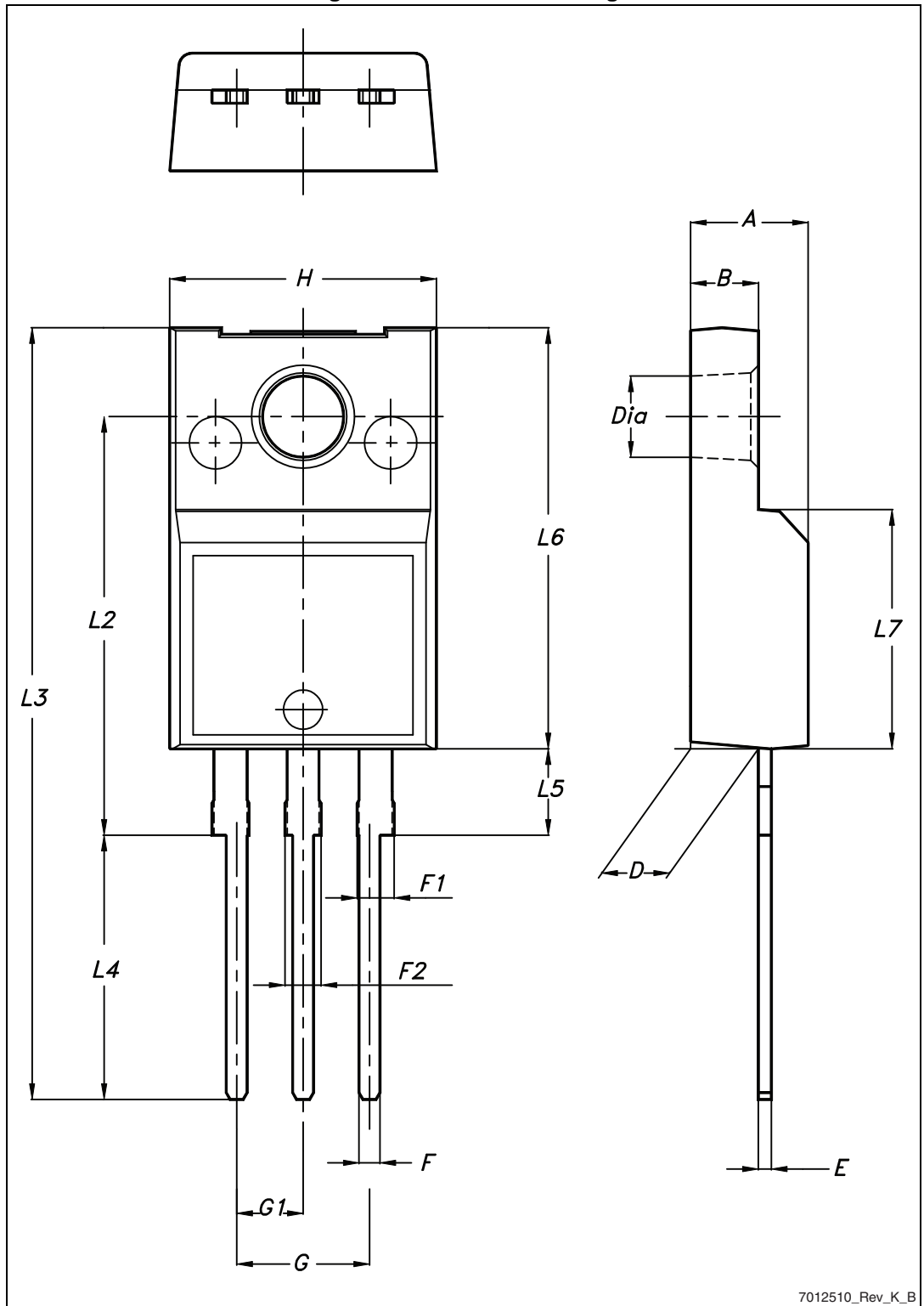
## 4 Package mechanical data

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

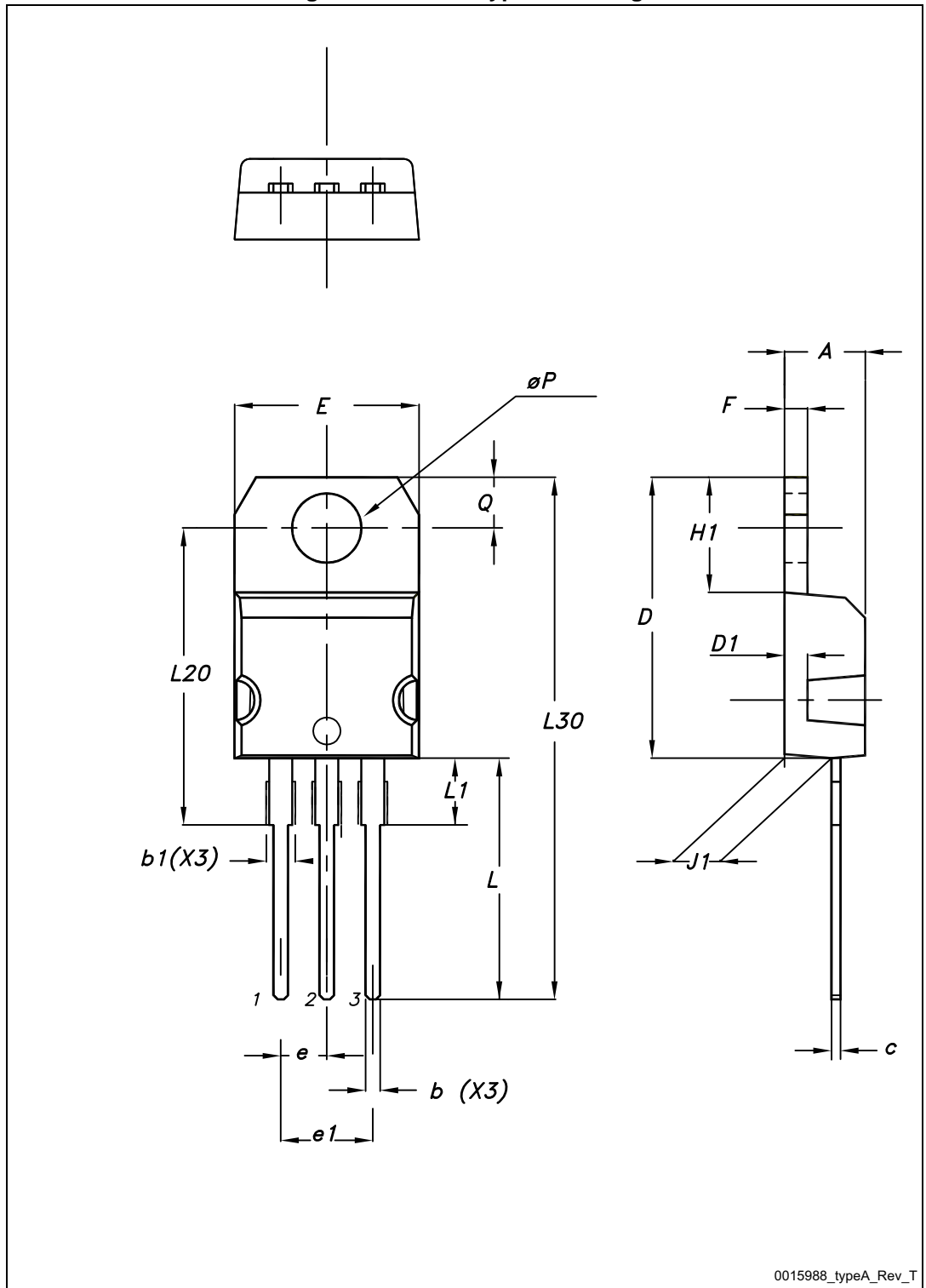


7012510\_Rev\_K\_B

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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