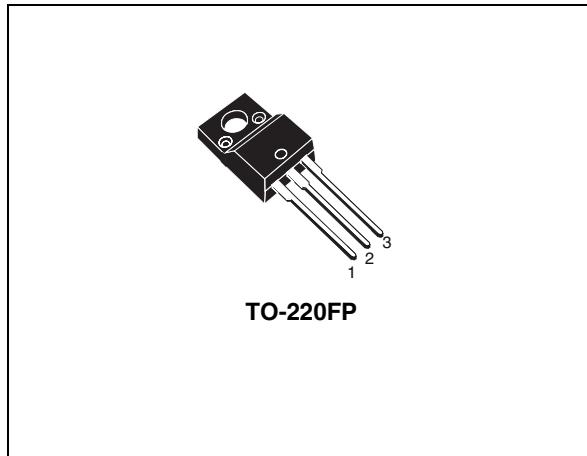


## Features

Type	$V_{DSS}$	$R_{DS(on)}$ max	$I_D$	$P_w$
STF12N50U	500 V	< 0.8 $\Omega$	10 A	30 W

- 100% avalanche tested
- Outstanding dv/dt capability
- Gate charge minimized
- Very low intrinsic capacitance
- Very low  $R_{DS(on)}$
- Extremely low  $t_{rr}$



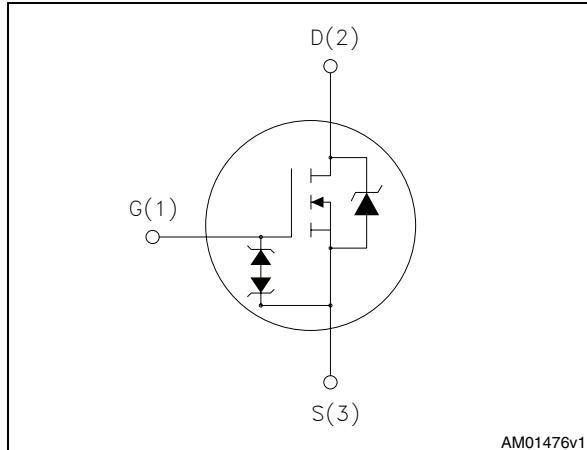
## Application

- Switching applications
  - High voltage inverters specific for LCD TV
  - Lighting full bridge topology
  - Motor control

## Description

The Ultrafast MESH™ series associates all advantages of reduced on-resistance. Zener gate protection and very high dv/dt capability with an extremely enhanced fast body-drain recovery diode.

**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

Order code	Marking	Package	Packaging
STF12N50U	12N50U	TO-220FP	Tube

## Contents

<b>1</b>	<b>Electrical ratings</b>	<b>3</b>
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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	500	V
$V_{GS}$	Gate-source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	10 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	6 <sup>(1)</sup>	A
$I_{DM}^{(2)}$	Drain current (pulsed)	40 <sup>(1)</sup>	A
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	30	W
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)	10	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50$ V)	230	mJ
$dv/dt^{(3)}$	Peak diode recovery voltage slope	20	V/ns
$V_{ESD-(G-S)}$	G-S EDS (HBM C=100 pF; R=1.5 kΩ)	4000	V
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1$ s; $T_C = 25^\circ\text{C}$ )	2500	V
$T_{stg}$	Storage temperature	-55 to 150	°C
$T_j$	Max. operating junction temperature	150	°C

1. Current is limited by wire features.
2. Pulse width limited by safe operating area.
3.  $I_{SD} \leq 10$  A,  $di/dt \leq 400$  A/μs,  $V_{DD} = 80\%$   $V_{(BR)DSS}$ .

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	4.17	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5	°C/W
$T_I$	Maximum lead temperature for soldering purpose	300	°C

## 2 Electrical characteristics

( $T_C = 25^\circ\text{C}$  unless otherwise specified).

**Table 4. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$I_D = 1 \text{ mA}, V_{GS} = 0$	500			V
$I_{\text{DSS}}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, T_C = 125^\circ\text{C}$			10 500	$\mu\text{A}$ $\mu\text{A}$
$I_{\text{GSS}}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20 \text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(\text{th})}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 100 \mu\text{A}$	3	3.75	4.5	V
$R_{\text{DS}(\text{on})}$	Static drain-source on resistance	$V_{GS} = 10 \text{ V}, I_D = 5 \text{ A}$		0.55	0.8	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}$ (1)	Forward transconductance	$V_{DS} = 15 \text{ V}, I_D = 5 \text{ A}$	-	7		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GS} = 0$	-	1219 159 40		pF pF pF
$C_{o(\text{tr})}$	Equivalent capacitance time related	$V_{GS} = 0, V_{DS} = 0 \text{ to } 400 \text{ V}$	-	65		pF
$C_{o(\text{er})}$	Equivalent capacitance energy related		-	48		pF
$R_G$	Intrinsic gate resistance	$f = 1 \text{ MHz open drain}$	-	2		$\Omega$
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 400 \text{ V}, I_D = 10 \text{ A},$ $V_{GS} = 10 \text{ V}$ (see <a href="#">Figure 13</a> )	-	40 7.5 24		nC nC nC

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 250 \text{ V}, I_D = 5 \text{ A}, R_G = 4.7 \Omega, V_{GS} = 10 \text{ V}$ (see <a href="#">Figure 12</a> )	-	19	-	ns
$t_r$	Rise time			17		ns
$t_{d(off)}$	Turn-off-delay time			43	-	ns
$t_f$	Fall time			15		ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}^{(1)}$	Source-drain current		-		10	A
	Source-drain current (pulsed)				40	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 10 \text{ A}, V_{GS} = 0$	-		1.6	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time	$I_{SD} = 10 \text{ A}, dI/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 35 \text{ V}$ (see <a href="#">Figure 17</a> )	-	73		ns
	Reverse recovery charge			182		nC
	Reverse recovery current			5		A
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time	$I_{SD} = 10 \text{ A}, dI/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 35 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$ (see <a href="#">Figure 17</a> )	-	118		ns
	Reverse recovery charge			418		nC
	Reverse recovery current			7		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

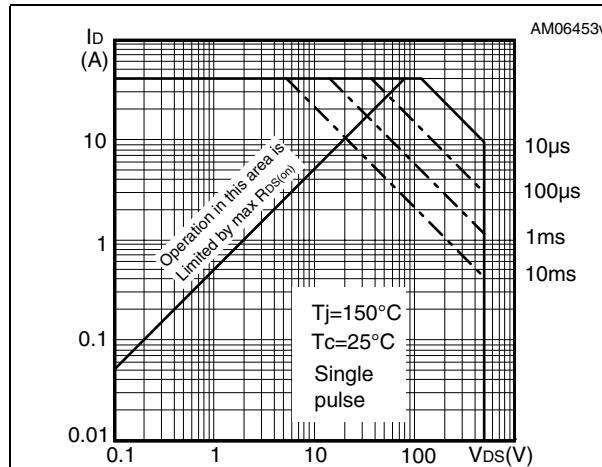


Figure 3. Thermal impedance

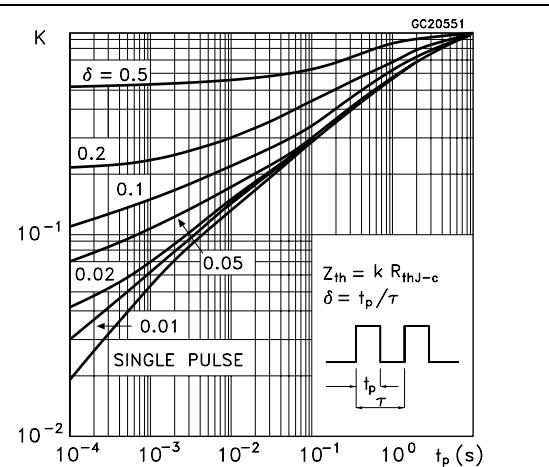


Figure 4. Output characteristics

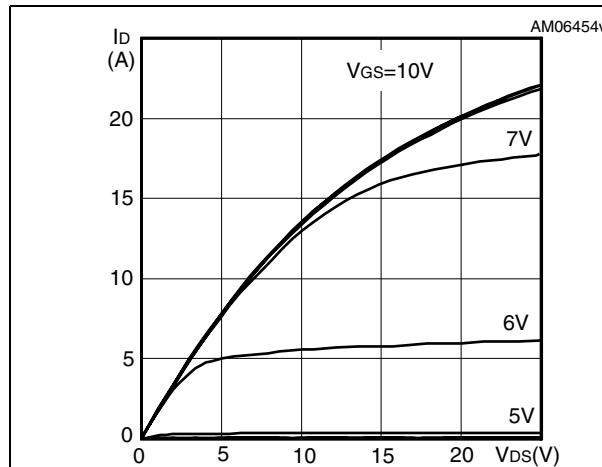


Figure 5. Transfer characteristics

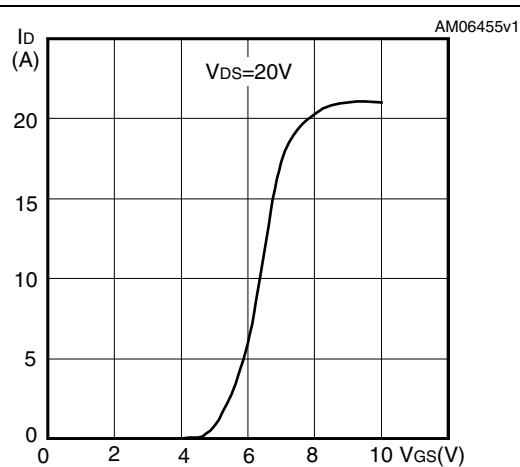
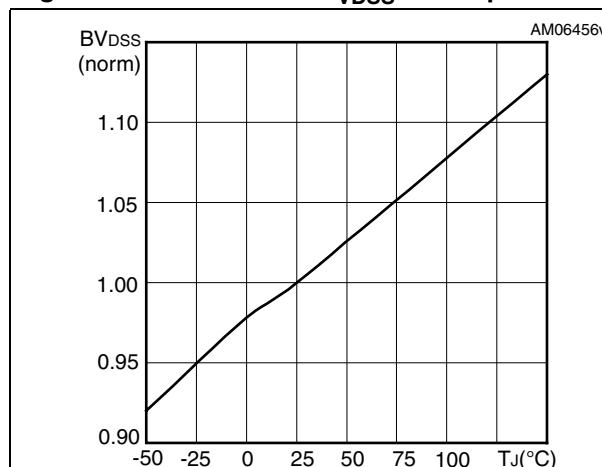
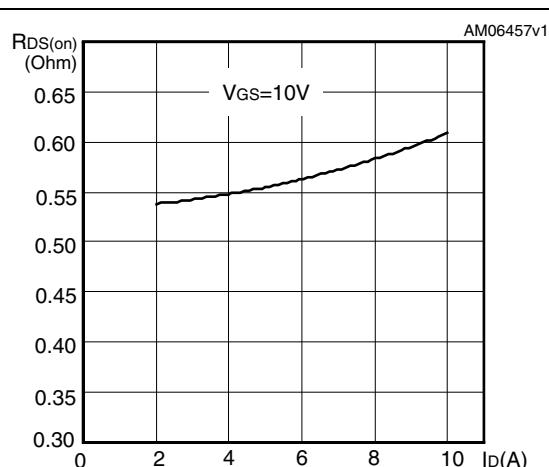
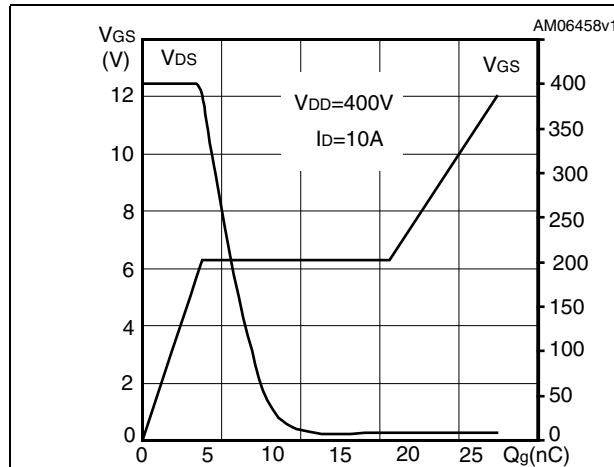
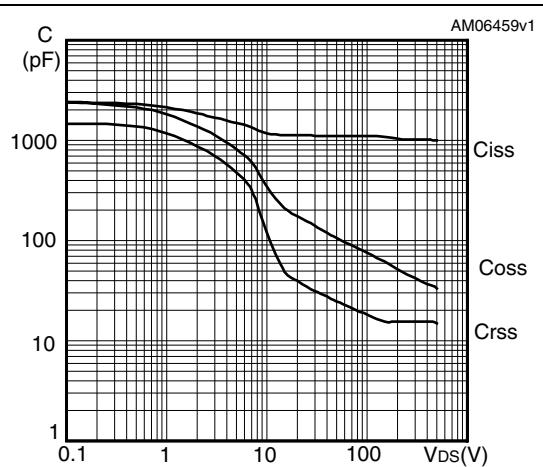
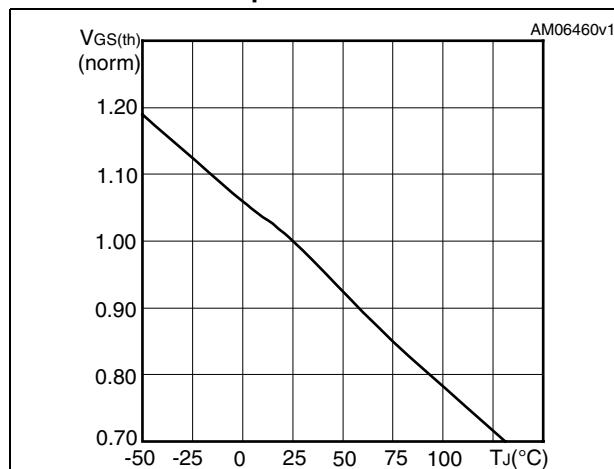
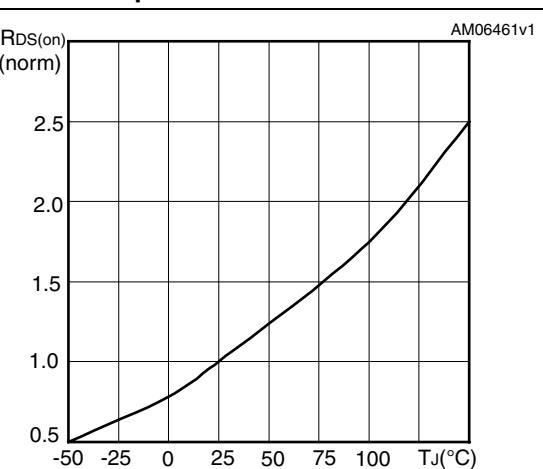
Figure 6. Normalized BV<sub>DS</sub> vs temperature

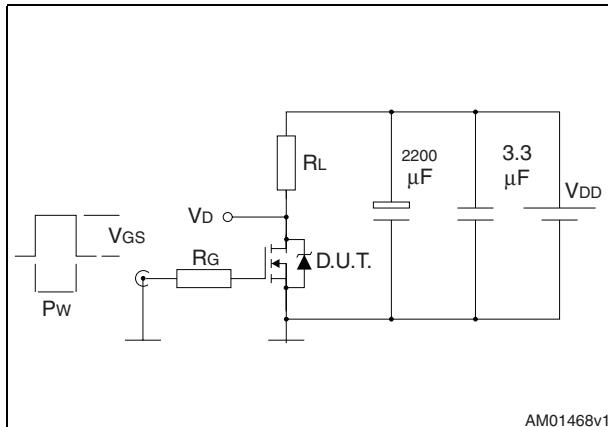
Figure 7. Static drain-source on resistance



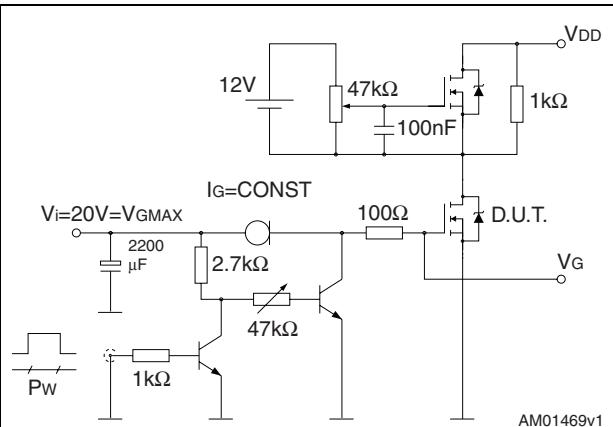
**Figure 8. Gate charge vs gate-source voltage****Figure 9. Capacitance variations****Figure 10. Normalized gate threshold voltage vs temperature****Figure 11. Normalized on resistance vs temperature**

### 3 Test circuits

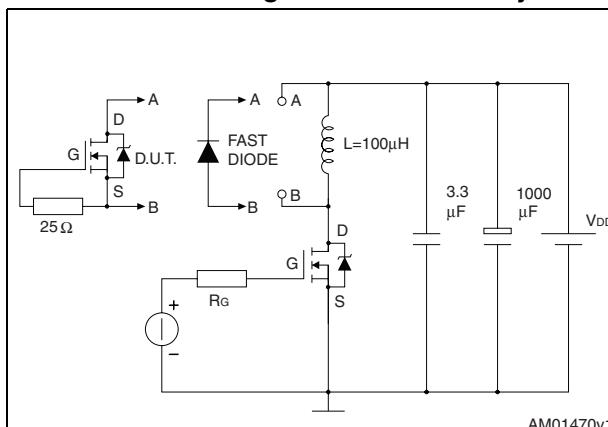
**Figure 12. Switching times test circuit for resistive load**



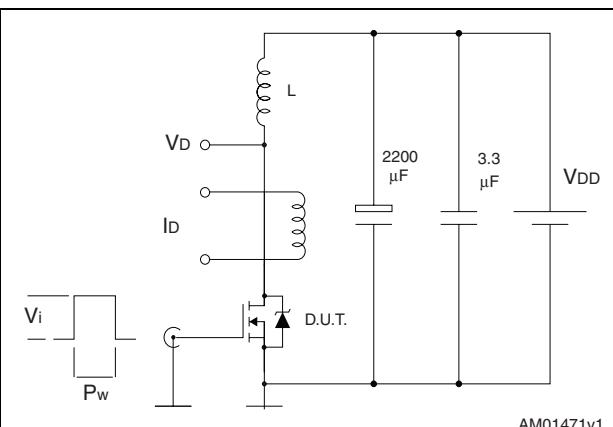
**Figure 13. Gate charge test circuit**



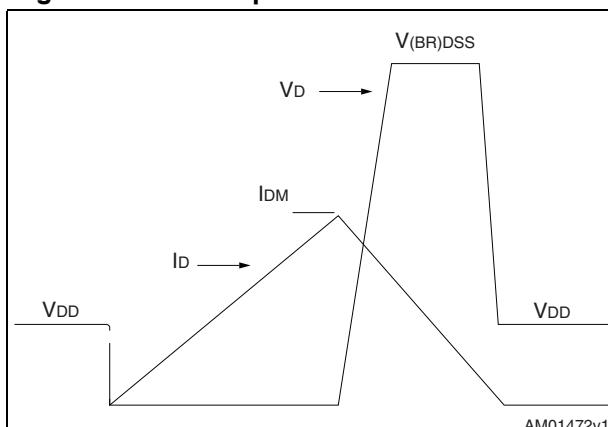
**Figure 14. Test circuit for inductive load switching and diode recovery times**



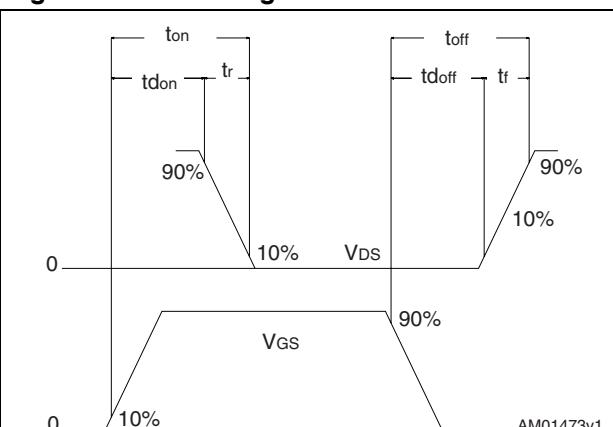
**Figure 15. Unclamped inductive load test circuit**



**Figure 16. Unclamped inductive waveform**



**Figure 17. Switching time waveform**



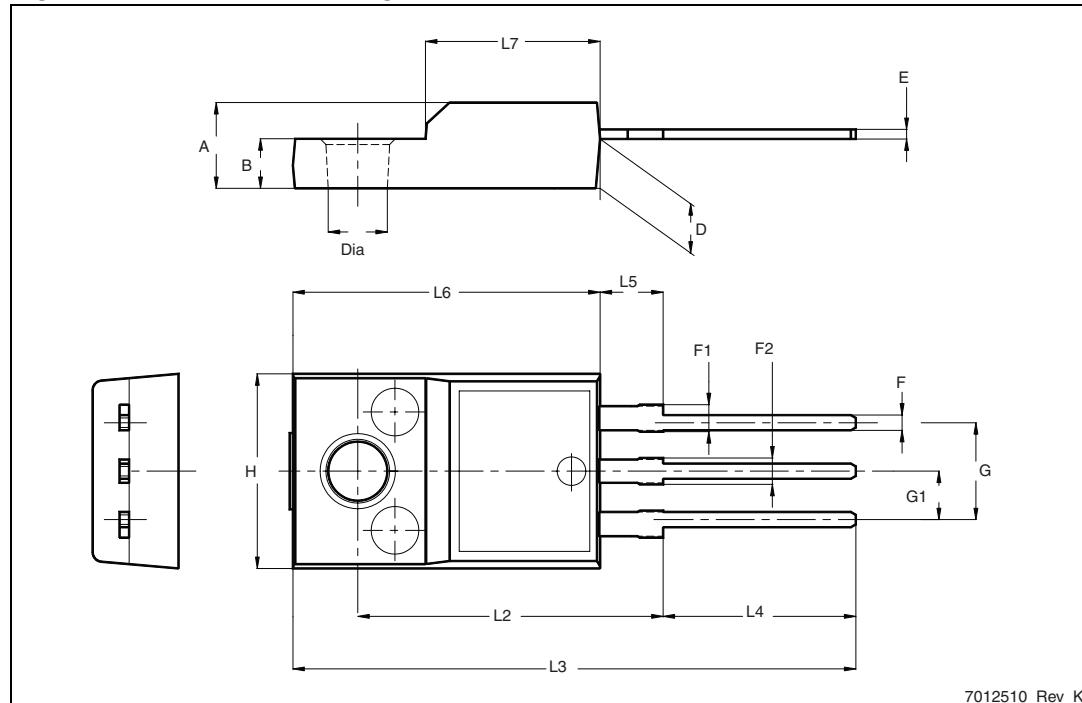
## 4 Package mechanical data

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 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 18. TO-220FP drawing



7012510\_Rev\_K

## 5 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
15-Mar-2010	1	First release.

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