



# STP120N4F6

N-channel 40 V, 3.8 m $\Omega$ , 80 A, TO-220  
STripFET™ VI DeepGATE™ Power MOSFET

## Features

Order code	V <sub>DSS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STP120N4F6	40 V	4.3 m $\Omega$	80 A <sup>(1)</sup>

1. Current limited by package

- Standard threshold drive
- 100% avalanche tested

## Application

- Switching applications
- Automotive

## Description

This device is a 40 V N-channel STripFET™ VI Power MOSFET based on the 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.

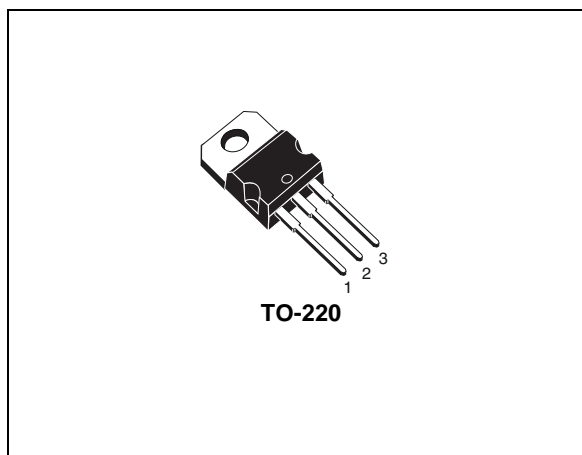


Figure 1. Internal schematic diagram

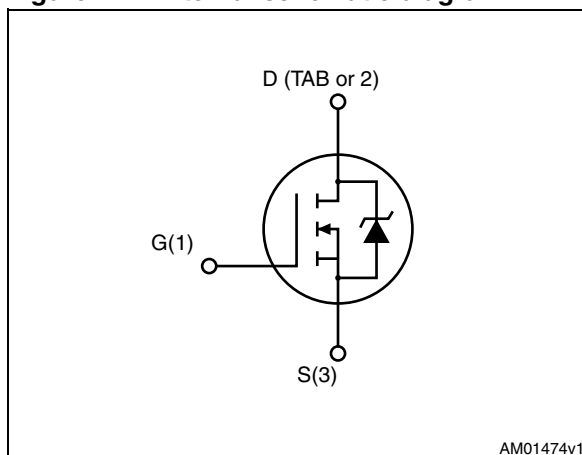


Table 1. Device summary

Order code	Marking	Package	Packaging
STP120N4F6	120N4F6	TO-220	Tube

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	40	V
$V_{GS}$	Gate-source voltage	$\pm 20$	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	80	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	80	A
$I_{DM}^{(2)}$	Drain current (pulsed)	320	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	110	W
$T_{stg}$	Storage temperature	-55 to 175	$^\circ\text{C}$
$T_j$	Operating junction temperature		

1. Current limited by package
2. Pulse width limited by safe operating area

**Table 3. Thermal resistance**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	1.36	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-amb max	62.5	$^\circ\text{C/W}$

**Table 4. Thermal resistance**

Symbol	Parameter	Value	Unit
$I_{AR}^{(1)}$	Avalanche current, repetitive or not-repetitive	40	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	394	mJ

1. Pulse width limited by  $T_j$  max
2. Starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = 40\text{ A}$ ,  $V_{DD} = 25\text{ V}$

## 2 Electrical characteristics

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

**Table 5. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown Voltage	$I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$	40			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 20\text{ V}$ $V_{DS} = 20\text{ V}$ , $T_c = 125\text{ °C}$			1 10	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$	2		4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 40\text{ A}$		3.8	4.3	m $\Omega$

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$		3850		pF
$C_{oss}$	Output capacitance		-	650	-	pF
$C_{rss}$	Reverse transfer capacitance				350	pF
$Q_g$	Total gate charge	$V_{DD} = 20\text{ V}$ , $I_D = 80\text{ A}$		65		nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 10\text{ V}$	-	20	-	nC
$Q_{gd}$	Gate-drain charge	(see Figure 14)		16		nC
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	1.5	-	$\Omega$

**Table 7. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 20\text{ V}$ , $I_D = 40\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ <i>(see Figure 15)</i>	-	20	-	ns
$t_r$	Rise time		-	70	-	ns
$t_{d(off)}$	Turn-off delay time	$V_{DD} = 20\text{ V}$ , $I_D = 40\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ <i>(see Figure 15)</i>	-	40	-	ns
$t_f$	Fall time		-	20	-	ns

**Table 8. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		80	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		320	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 40\text{ A}$ , $V_{GS} = 0$	-		1.1	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 80\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 30\text{ V}$ <i>(see Figure 17)</i>	-	40		ns
$Q_{rr}$	Reverse recovery charge		-	56		nC
$I_{RRM}$	Reverse recovery current		-	2.8		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

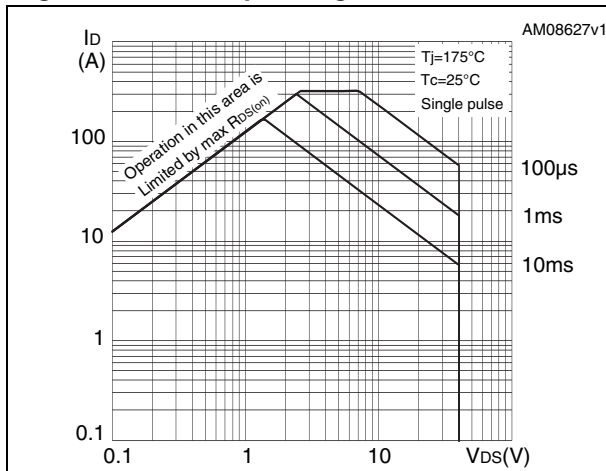


Figure 3. Thermal impedance

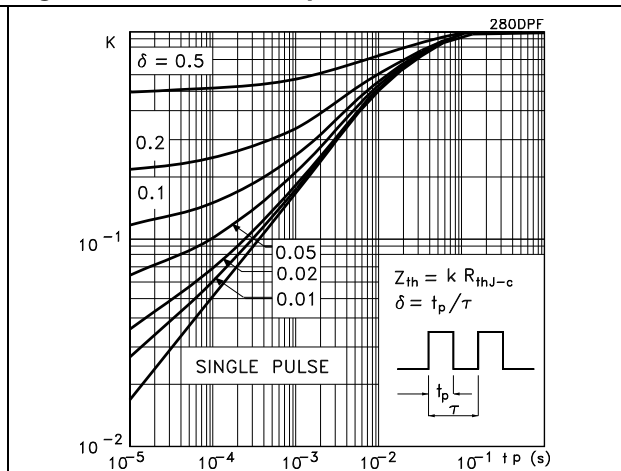


Figure 4. Output characteristics

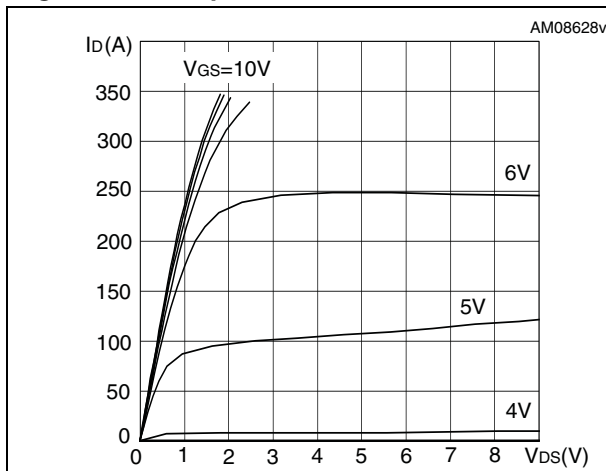


Figure 5. Transfer characteristics

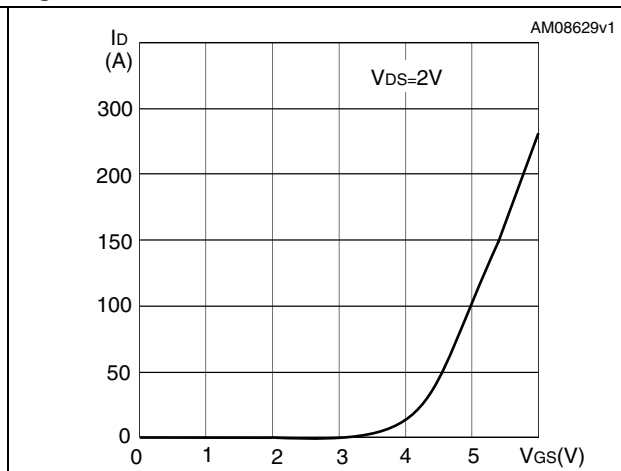


Figure 6. Normalized  $B_{VDSS}$  vs temperature

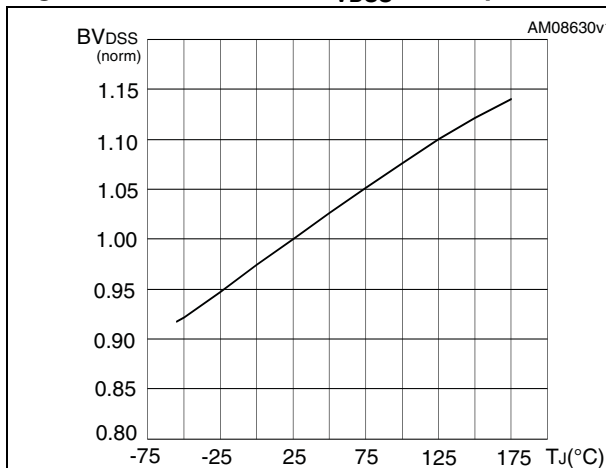


Figure 7. Static drain-source on resistance

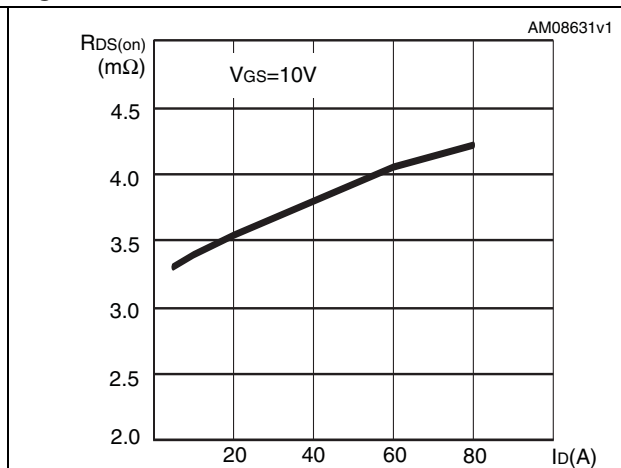


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

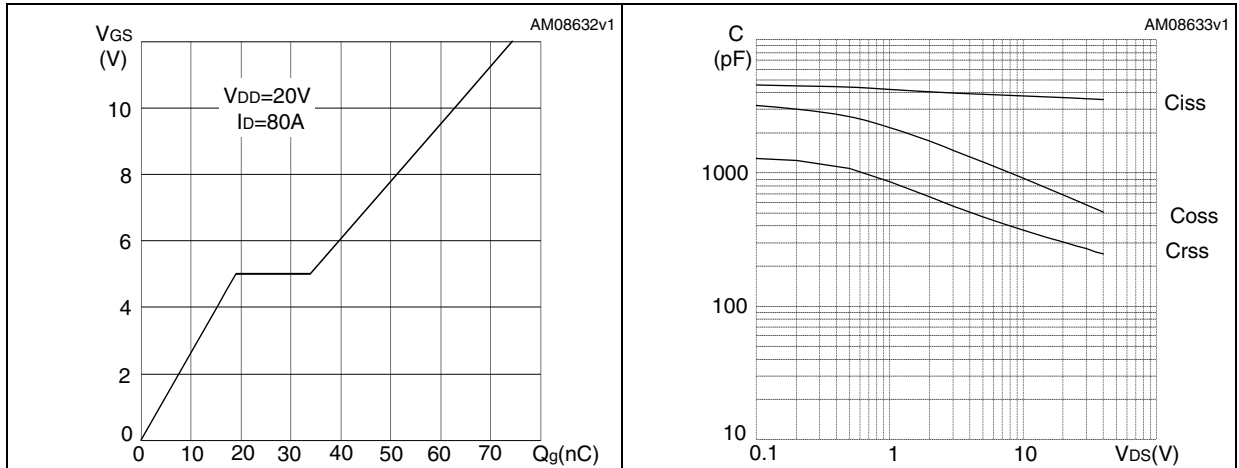


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

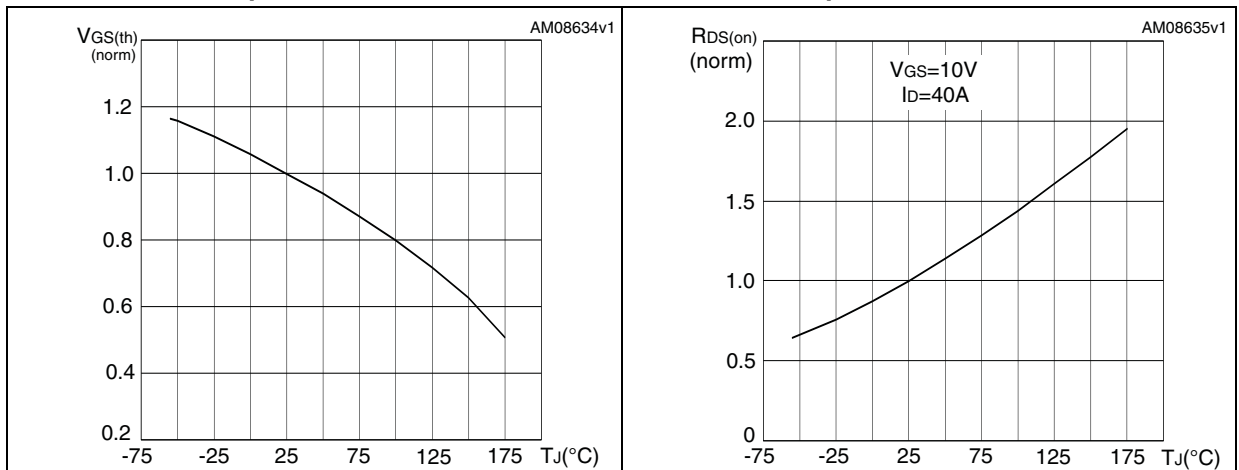
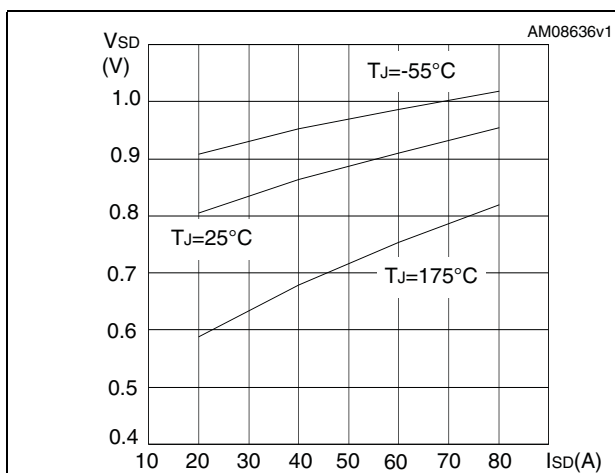


Figure 12. Source-drain diode forward characteristics

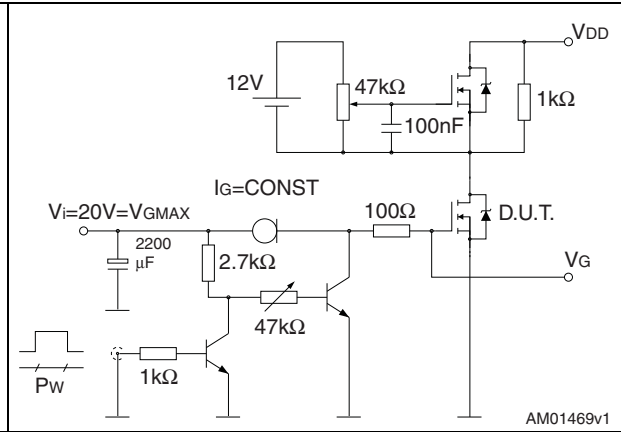


### 3 Test circuits

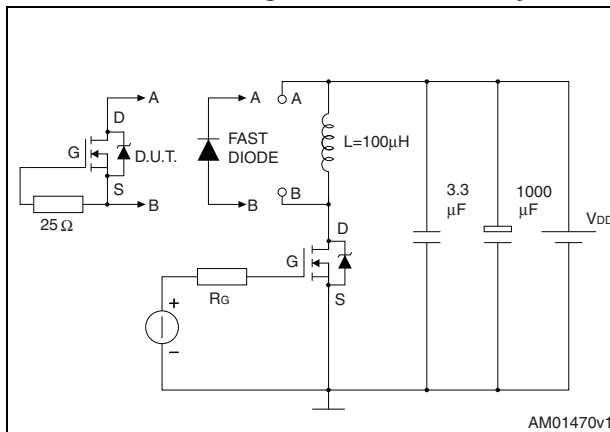
**Figure 13. Switching times test circuit for resistive load**



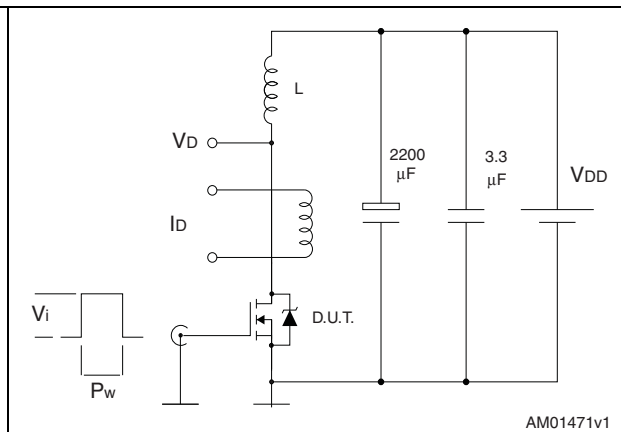
**Figure 14. Gate charge test circuit**



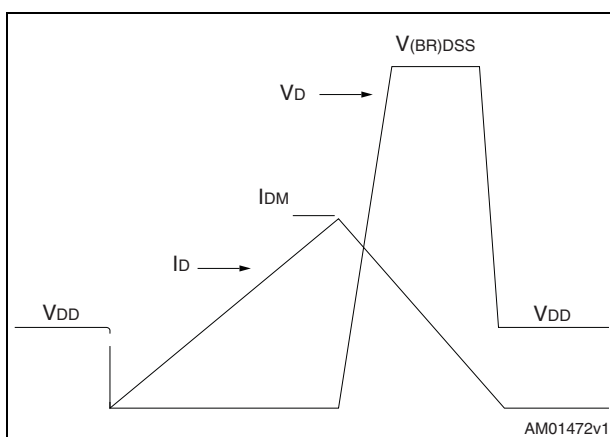
**Figure 15. Test circuit for inductive load switching and diode recovery times**



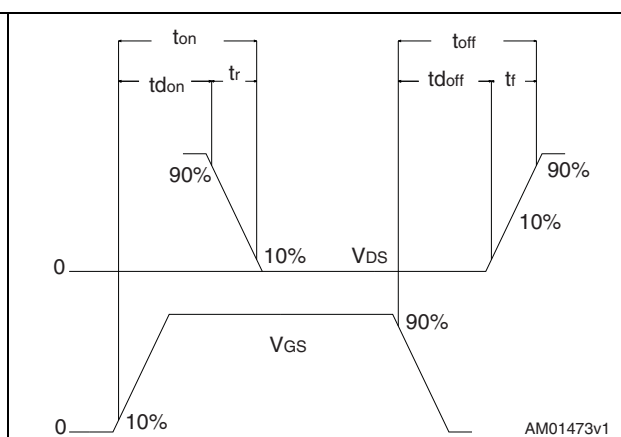
**Figure 16. Unclamped Inductive load test circuit**



**Figure 17. Unclamped inductive waveform**



**Figure 18. Switching time waveform**





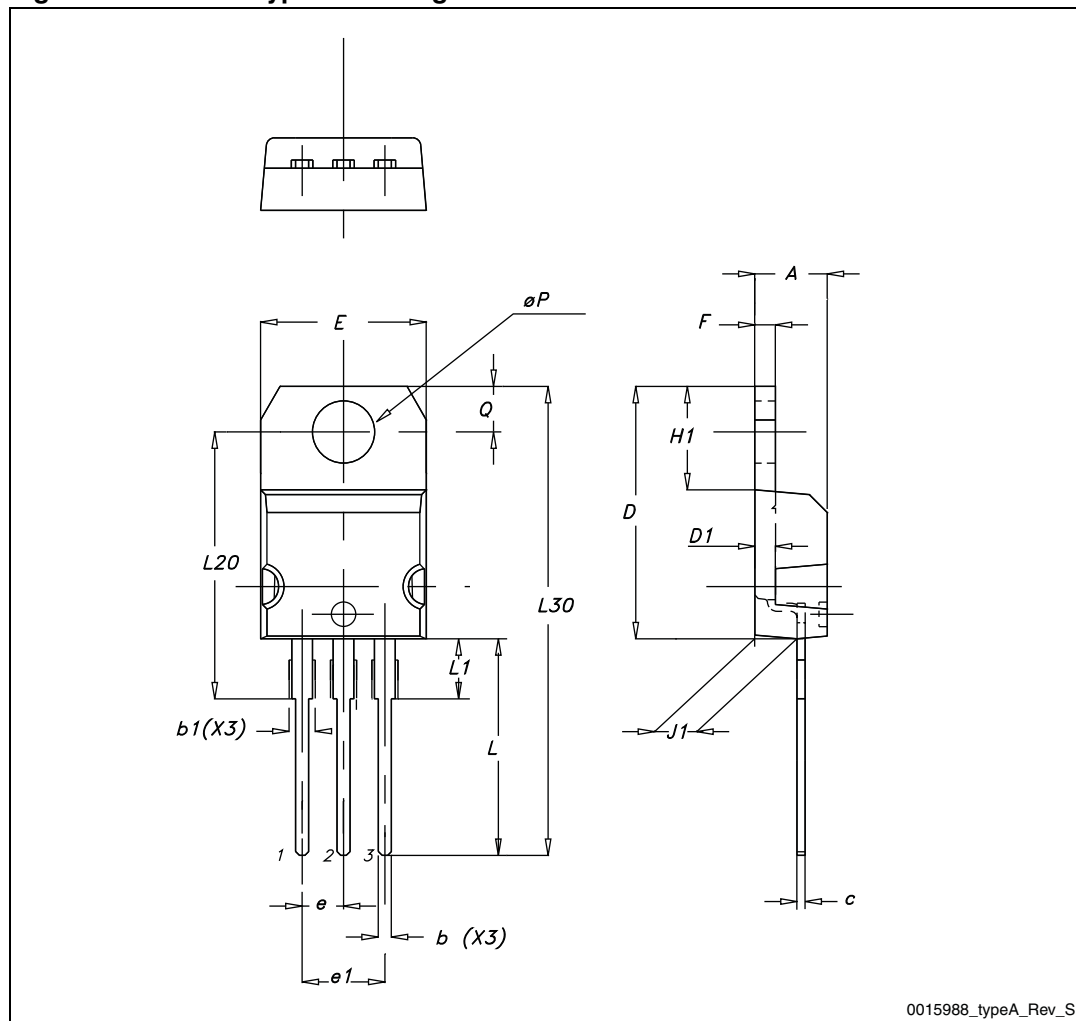
## 4 Package mechanical data

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 products status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

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 19. TO-220 type A drawing



## 5 Revision history

Table 10. Document revision history

Date	Revision	Changes
17-May-2011	1	First release

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