

N-channel 60 V, 0.0063 Ω typ., 77 A STripFET™ VI DeepGATE™
 Power MOSFET in a TO-220 package

Datasheet — production data

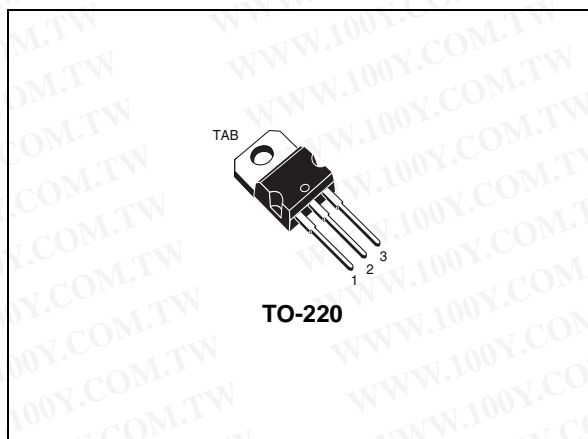
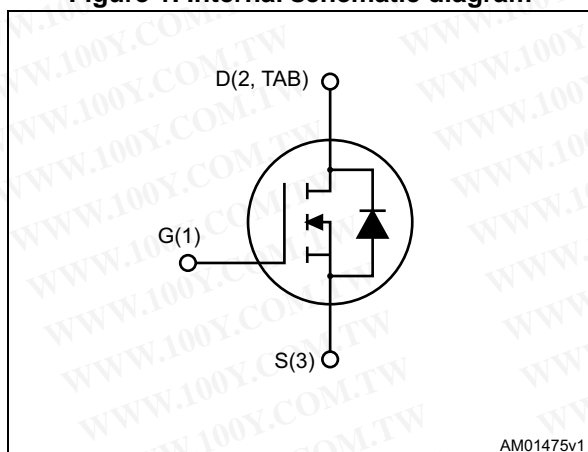


Figure 1. Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max	I _D	P _{TOT}
STP77N6F6	60 V	0.007 Ω	77 A	80 W

- R_{DS(on)} * Q_g industry benchmark
- Extremely low on-resistance R_{DS(on)}
- High avalanche ruggedness
- Low gate drive power losses
- Very low switching gate charge

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using the 6th generation of STripFET™ DeepGATE™ technology, with a new gate structure. The resulting Power MOSFET exhibits the lowest R_{DS(on)} in all packages.

Table 1. Device summary

Order code	Marking	Package	Packaging
STP77N6F6	77N6F6	TO-220	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	60	V
V_{GS}	Gate-source voltage	± 20	V
$I_D^{(1)}$	Drain current (continuous) at $T_c = 25\text{ }^\circ\text{C}$	77	A
$I_D^{(1)}$	Drain current (continuous) at $T_c = 100\text{ }^\circ\text{C}$	55	A
$I_{DM}^{(2)}$	Drain current (pulsed)	308	A
$P_{TOT}^{(1)}$	Total dissipation at $T_c = 25\text{ }^\circ\text{C}$	80	W
T_{JPstg}	Operating junction temperature storage temperature	-55 to 175	$^\circ\text{C}$

1. This value is rated according to R_{thj-c}
2. Pulse width is limited by safe operating area

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thj-c}	Thermal resistance junction-case	1.88	$^\circ\text{C/W}$
$R_{thj-a}^{(1)}$	Thermal resistance junction-ambient	62.5	

1. When mounted on FR-4 board of 1 inch², 2 oz Cu, $t < 10\text{ } \mu\text{s}$

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AV}	Avalanche current, repetitive or not-repetitive (pulse width limited by maximum junction temperature)	38.5	A
E_{AS}	Single pulse avalanche energy ($T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AV}$, $V_{DD} = 43\text{ V}$)	152	mJ

2 Electrical characteristics

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

Table 5. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\ \mu\text{A}$, $V_{GS} = 0$	60			V
I_{DSS}	Zero gate voltage	$V_{DS} = 60\ \text{V}$, $V_{GS} = 0$			10	μA
	Drain current	$V_{DS} = 60\ \text{V}$, $V_{GS} = 0$, $T_J = 125\text{ °C}$			100	μA
I_{GSS}	Gate-body leakage current	$V_{GS} = \pm 20\ \text{V}$, $V_{DS} = 0$			± 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	$V_{GS} = 10\ \text{V}$, $I_D = 38.5\ \text{A}$		0.0063	0.007	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 25\ \text{V}$, $f = 1\ \text{MHz}$, $V_{GS} = 0$	-	4295	-	pF
C_{oss}	Output capacitance		-	292	-	pF
C_{riss}	Reverse transfer capacitance		-	190	-	pF
Q_g	Total gate charge	$V_{DD} = 30\ \text{V}$, $I_D = 77\ \text{A}$, $V_{GS} = 10\ \text{V}$	-	70.5	-	nC
Q_{gs}	Gate-source charge		-	19.7	-	nC
Q_{gd}	Gate-drain charge		-	16.2	-	nC
R_g	Intrinsic gate resistance	$f = 1\ \text{MHz}$ open drain	-	2.2	-	Ω

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 30\ \text{V}$, $I_D = 77\ \text{A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\ \text{V}$	-	22	-	ns
t_r	Rise time		-	42	-	ns
$t_{d(off)}$	Turn-off-delay time		-	73	-	ns
t_f	Fall time		-	16	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		77	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		308	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 77 \text{ A}$, $V_{GS} = 0$	-		1.3	V
t_{rr}	Reverse recovery time	$I_{SD} = 77 \text{ A}$, $V_{DD} = 48 \text{ V}$ $di/dt = 100 \text{ A}/\mu\text{s}$, $T_j = 25 \text{ }^\circ\text{C}$	-	49		ns
Q_{rr}	Reverse recovery charge		-	8.5		nC
I_{RRM}	Reverse recovery current		-	0.3		A

1. Pulse width is limited by safe operating area
2. Pulse test: pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

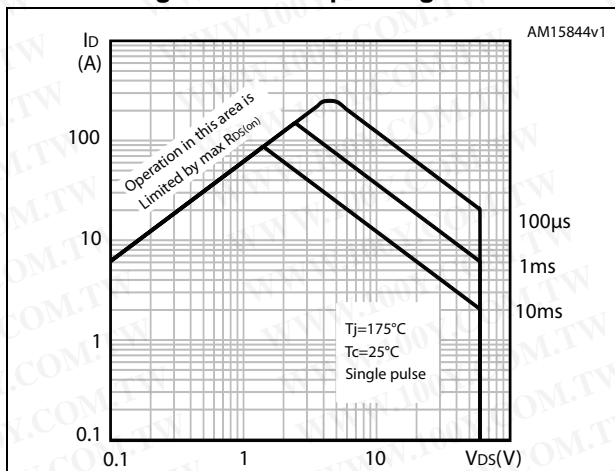


Figure 3. Thermal impedance

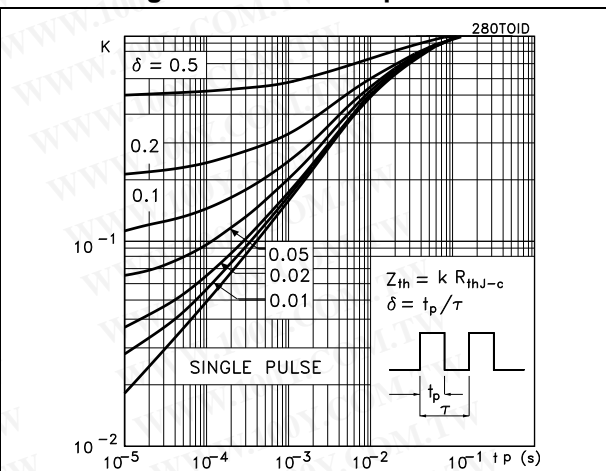


Figure 4. Output characteristics

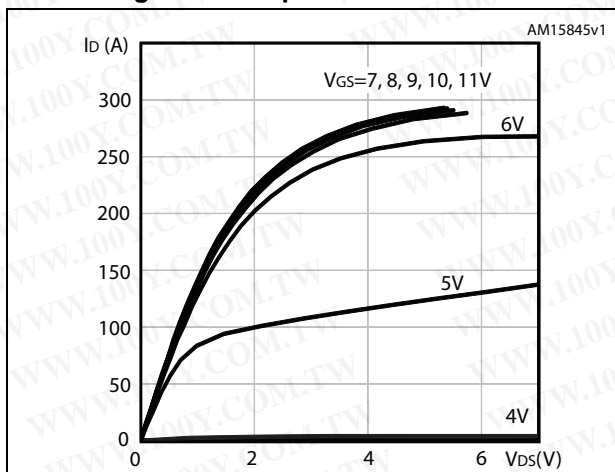


Figure 5. Transfer characteristics

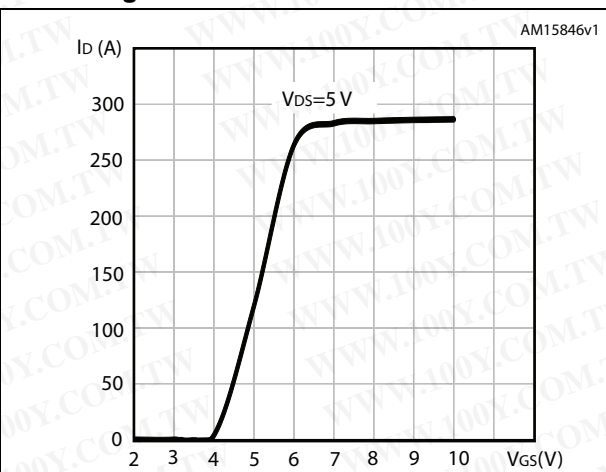


Figure 6. Gate charge vs gate-source voltage

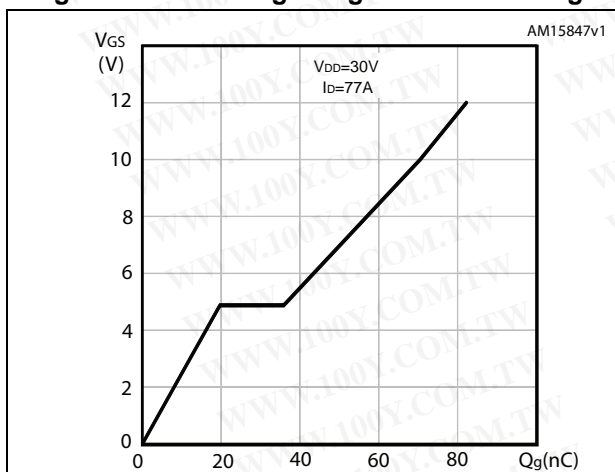


Figure 7. Static drain-source on-resistance

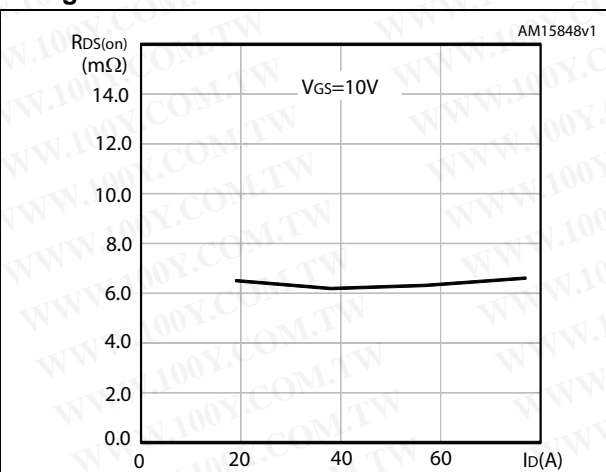


Figure 8. Capacitance variations

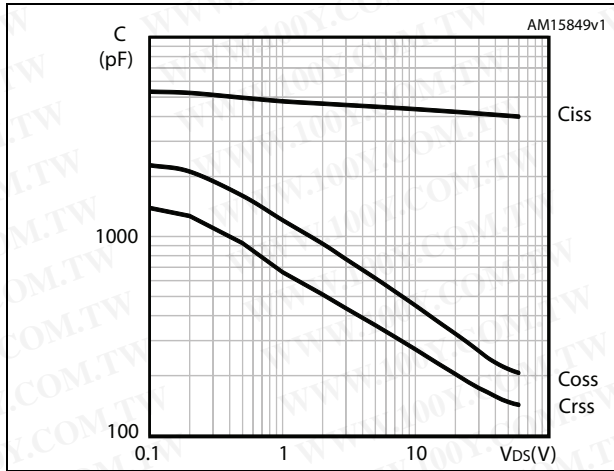


Figure 9. Normalized gate threshold voltage vs. temperature

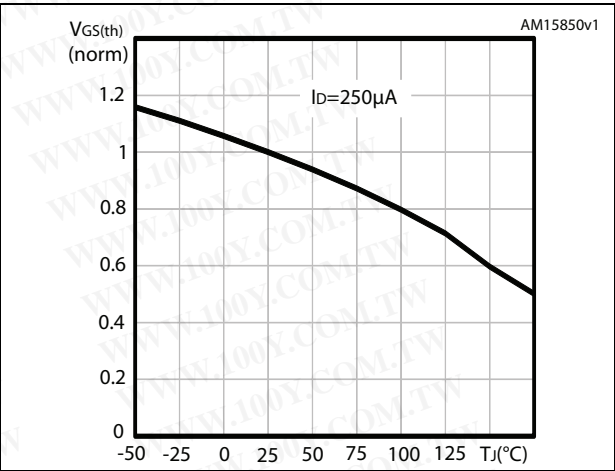


Figure 10. Normalized on-resistance vs. temperature

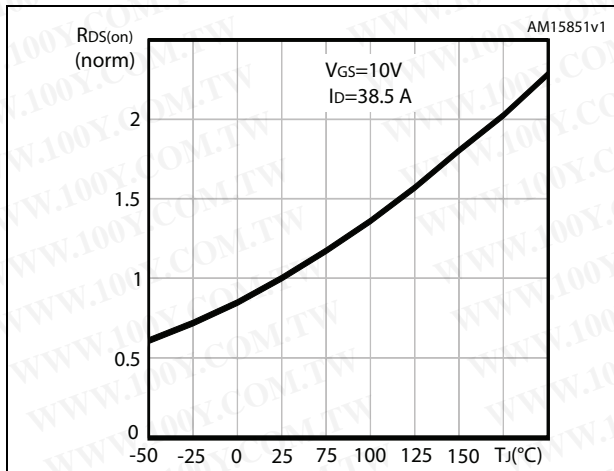


Figure 11. Drain-source diode forward characteristics

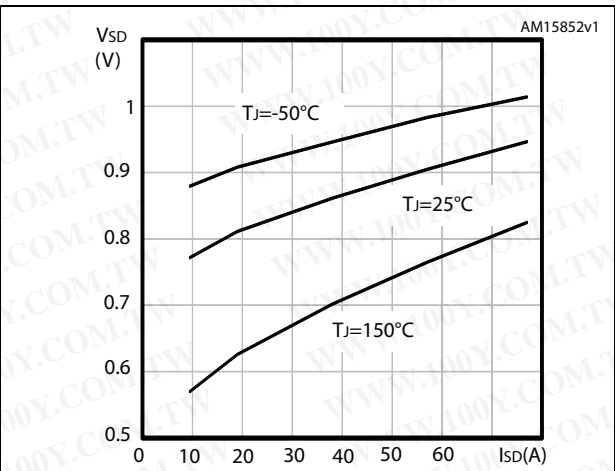
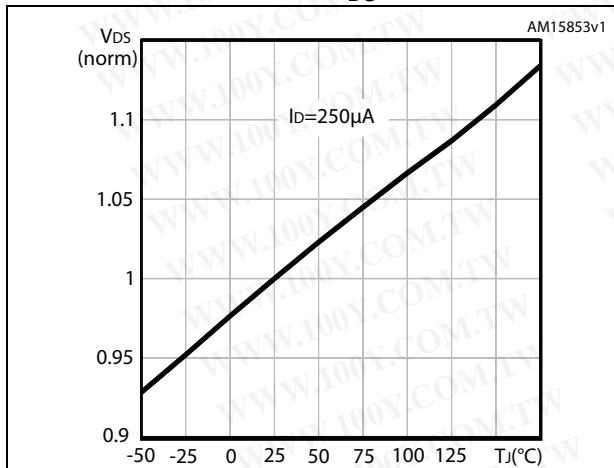


Figure 12. Normalized VDS vs. temperature



3 Test circuits

Figure 13. Switching times test circuit for resistive load

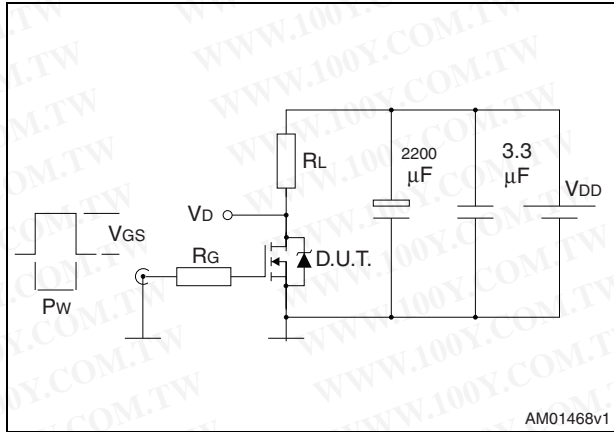


Figure 14. Gate charge test circuit

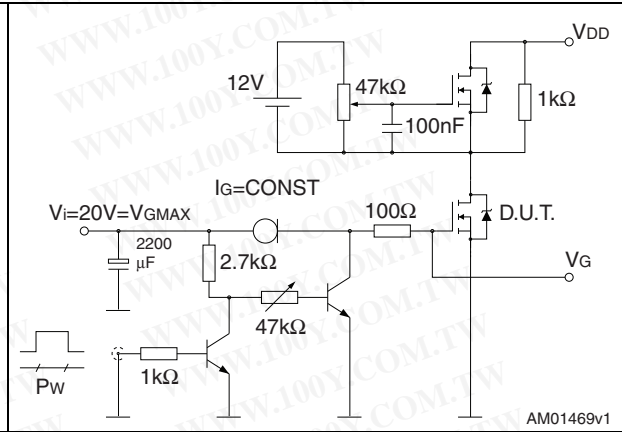


Figure 15. Test circuit for inductive load switching and diode recovery times

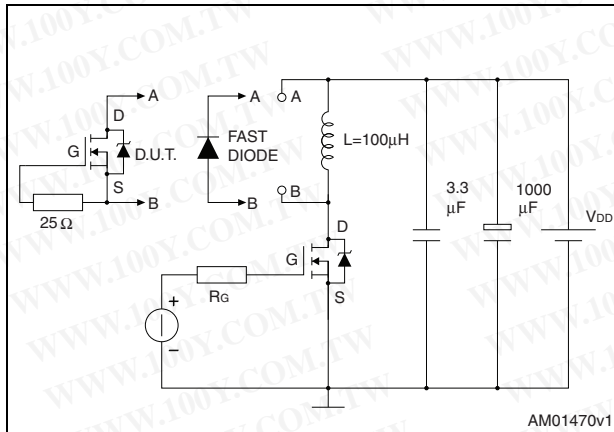


Figure 16. Unclamped inductive load test circuit

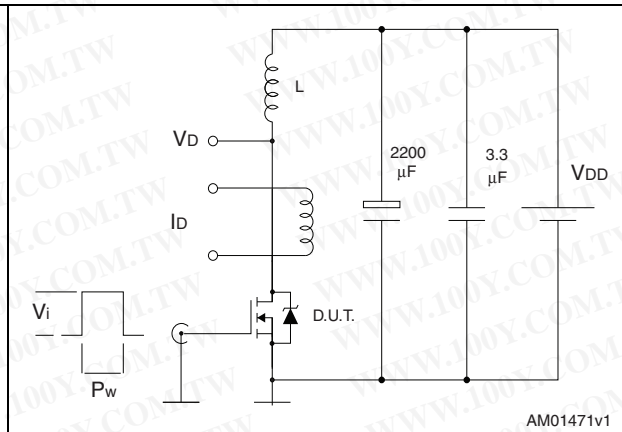


Figure 17. Unclamped inductive waveform

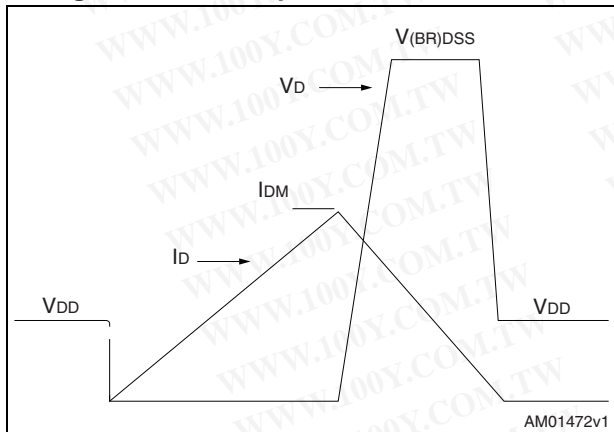
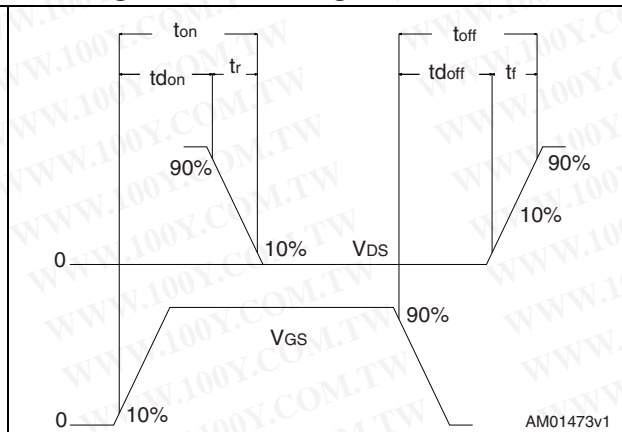


Figure 18. Switching time waveform



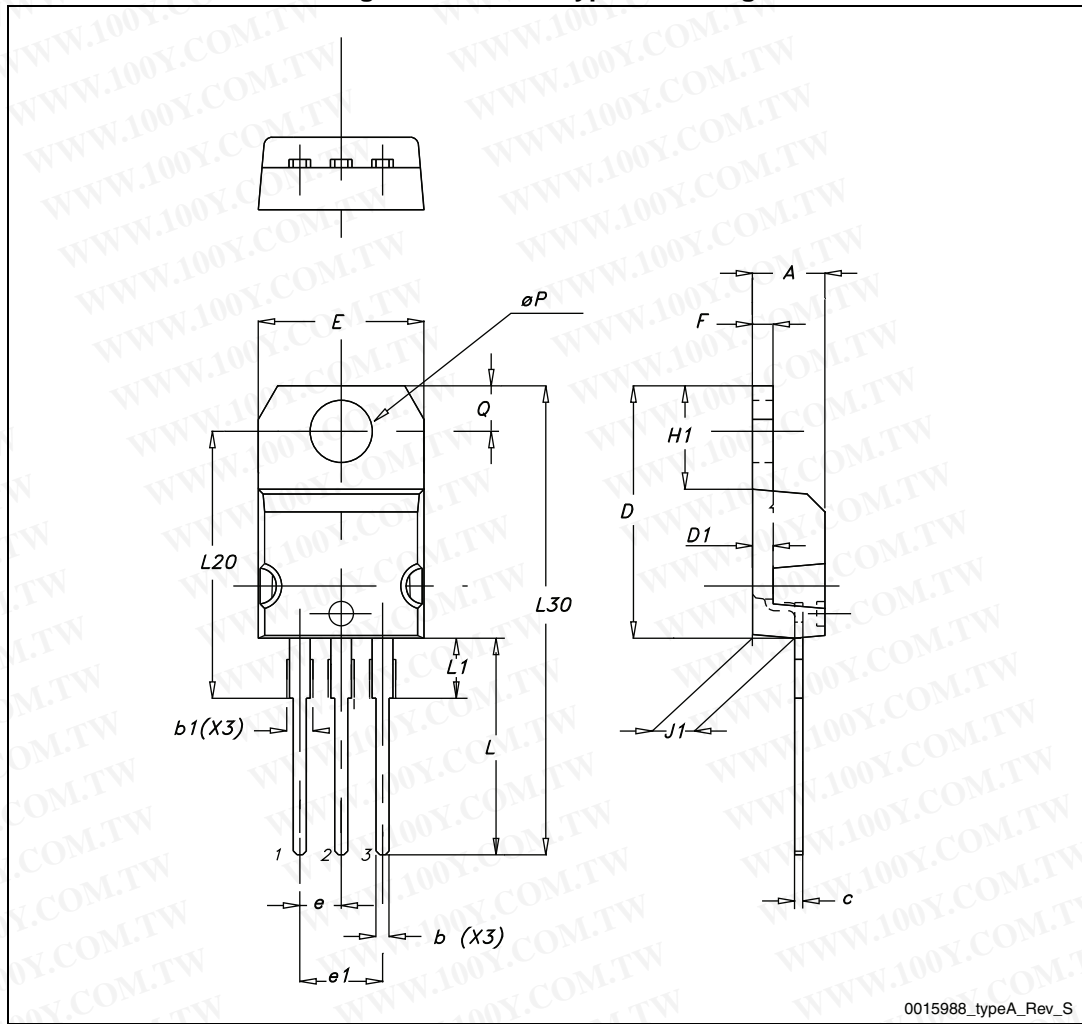
4 Package mechanical data

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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
12-Dec-2012	1	First release.
23-May-2013	2	<ul style="list-style-type: none"> – Updated: values in Table 4, the entire values in Table 6, 7, V_{DD} and T_J values in Table 8, typical values for t_{rr}, Q_{rr}, I_{RRM} in Table 8 – Added: V_{SD} max value in Table 8 – Added: Section 2.1: Electrical characteristics (curves) – Minor text changes

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