BUJD203AX

NPN power transistor with integrated diode

Rev. 01 — 27 September 2010 Product data sheet

1. Product profile

1.1 General description

High voltage, high speed, planar passivated NPN power switching transistor with integrated anti-parallel E-C diode in a SOT186A (TO220F) full pack plastic package.

1.2 Features and benefits

- Fast switching
- High voltage capability
- Integrated anti-parallel E-C diode
- Isolated package
- Very low switching and conduction losses

1.3 Applications

- DC-to-DC converters
- Electronic lighting ballasts
- Inverters
- Motor control systems

1.4 Quick reference data

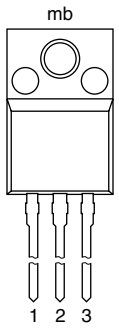
Table 1. Quick reference data

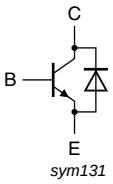
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_C	collector current	see Figure 1; see Figure 2; DC; see Figure 4	-	-	4	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Figure 3	-	-	26	W
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$ V	-	-	850	V
Static characteristics						
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 5$ V; see Figure 11; $T_h = 25$ °C	13	21	32	
		$V_{CE} = 5$ V; $I_C = 3$ A; see Figure 11; $T_h = 25$ °C	-	12.5	-	
V_{CEOsus}	collector-emitter sustaining voltage	$I_B = 0$ A; $L_C = 25$ mH; $I_C = 10$ mA; see Figure 6; see Figure 7	400	450	-	V

2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base		
2	C	collector		
3	E	emitter		
mb	n.c.	mounting base; isolated		





SOT186A (TO-220F)

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUJD203AX	TO-220F	plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack"	SOT186A

4. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CESM}	collector-emitter peak voltage	V_{BE} = 0 V	-	850	V
V_{CBO}	collector-base voltage	I_E = 0 A	-	850	V
V_{CEO}	collector-emitter voltage	I_B = 0 A	-	425	V
I_C	collector current	DC; see Figure 1; see Figure 2; see Figure 4	-	4	A
I_{CM}	peak collector current	see Figure 1; see Figure 2; see Figure 4	-	8	A
I_B	base current	DC	-	2	A
I_{BM}	peak base current		-	4	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Figure 3	-	26	W
T_{stg}	storage temperature		-65	150	°C
T_j	junction temperature		-	150	°C

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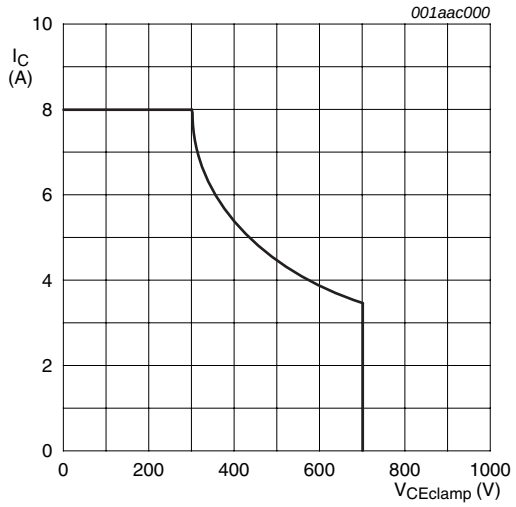
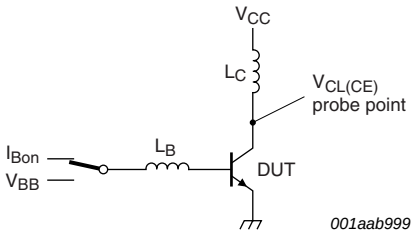


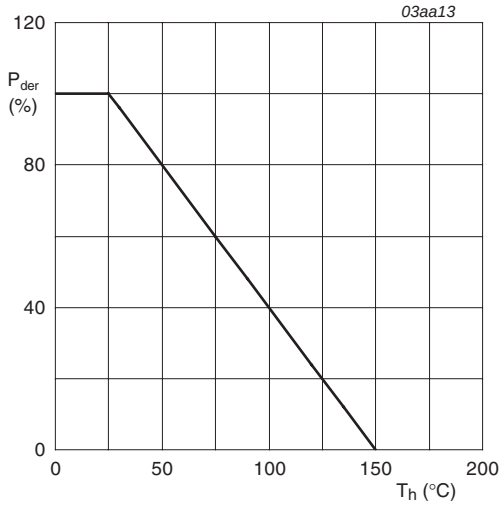
$$T_j \leq T_{j(max)}\,°C$$

Fig 1. Reverse bias safe operating area



$$V_{CL(CE)} \leq 1000\ V; V_{CC} = 150\ V; V_{BB} = -5\ V;$$
$$L_B = 1\,\mu H; L_C = 200\,\mu H$$

Fig 2. Test circuit for reverse bias safe operating area



$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

Fig 3. Normalized total power dissipation as a function of heatsink temperature

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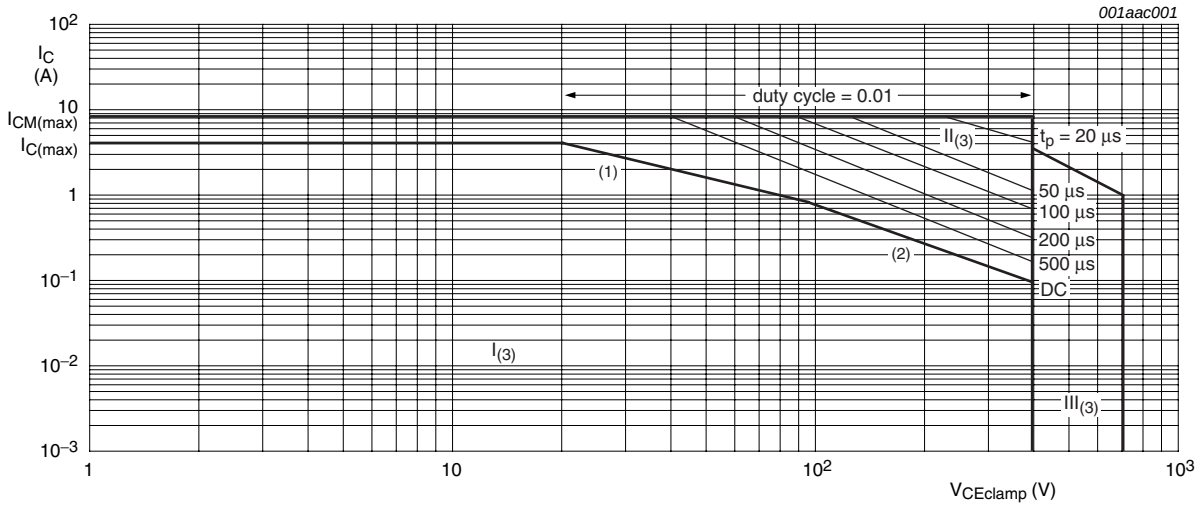

1)P_{tot} maximum and P_{tot} peak maximum lines

2)Second breakdown limits

3) I = Region of permissable DC operation

II = Extension for repetitive pulse operation

III = Extension during turn-on in single transistor converters provided that $R_{BE} \leq 100\ \Omega$ and $t_p \leq 0.6\ \mu s$

Fig 4. Forward bias safe operating area for $T_{mb} \leq 25\ °C$

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5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-h)}$	thermal resistance from junction to heatsink	with heatsink compound; see Figure 5	-	-	4.8	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	55	-	K/W

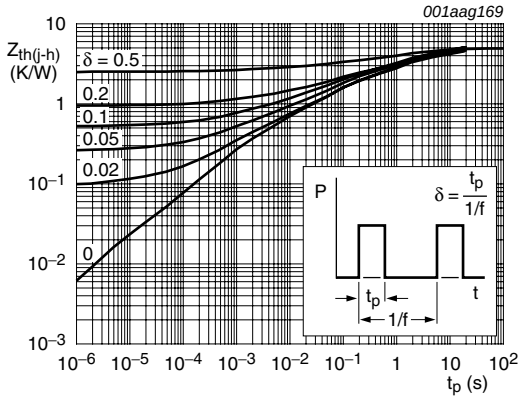

Fig 5. Transient thermal impedance from junction to heatsink as a function of pulse duration

6. Isolation characteristics

Table 6. Isolation characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{isol(RMS)}$	RMS isolation voltage	50 Hz ≤ f ≤ 60 Hz; RH ≤ 65 %; T_h = 25 °C; from all terminals to external heatsink; clean and dust free	-	-	2500	V
C_{isol}	isolation capacitance	T_h = 25 °C; f = 1 MHz; from collector to external heatsink	-	10	-	pF

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7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
I_{CES}	collector-emitter cut-off current	V_{BE} = 0 V; V_{CE} = 850 V; T_j = 125 °C	[1]	-	-	2	mA
		V_{BE} = 0 V; V_{CE} = 850 V; T_j = 25 °C	[1]	-	-	1	mA
I_{CBO}	collector-base cut-off current	V_{CB} = 850 V; I_E = 0 A	[1]	-	-	1	mA
I_{CEO}	collector-emitter cut-off current	V_{CE} = 425 V; I_B = 0 A	[1]	-	-	0.1	mA
I_{EBO}	emitter-base cut-off current	V_{EB} = 7 V; I_C = 0 A		-	-	10	mA
V_{CEOsus}	collector-emitter sustaining voltage	I_B = 0 A; I_C = 10 mA; L_C = 25 mH; see Figure 6; see Figure 7		400	450	-	V
V_{CEsat}	collector-emitter saturation voltage	I_C = 3 A; I_B = 0.6 A; see Figure 8; see Figure 9		-	0.29	1	V
V_{BEsat}	base-emitter saturation voltage	I_C = 3 A; I_B = 0.6 A; see Figure 10		-	0.99	1.5	V
V_F	forward voltage	I_F = 2 A; T_j = 25 °C		-	1.04	1.5	V
h_{FE}	DC current gain	I_C = 1 mA; V_{CE} = 5 V; T_h = 25 °C; see Figure 11		10	15	32	
		I_C = 500 mA; V_{CE} = 5 V; T_h = 25 °C; see Figure 11		13	21	32	
		I_C = 2 A; V_{CE} = 5 V; T_h = 25 °C; see Figure 11		11	16	22	
		I_C = 3 A; V_{CE} = 5 V; T_h = 25 °C; see Figure 11		-	12.5	-	
Dynamic characteristics							
t_{on}	turn-on time	I_C = 2.5 A; I_{Bon} = 0.5 A; I_{Boff} = -0.5 A; R_L = 75 Ω; T_j = 25 °C; resistive load; see Figure 12; see Figure 13		-	0.52	0.6	µs
t_s	storage time	I_C = 2.5 A; I_{Bon} = 0.5 A; I_{Boff} = -0.5 A; R_L = 75 Ω; T_j = 25 °C; resistive load; see Figure 12; see Figure 13		-	2.7	3.3	µs
		I_C = 2 A; I_{Bon} = 0.4 A; V_{BB} = -5 V; L_B = 1 µH; T_j = 25 °C; inductive load; see Figure 14; see Figure 15		-	1.2	1.4	µs
		I_C = 2 A; I_{Bon} = 0.4 A; V_{BB} = -5 V; L_B = 1 µH; T_j = 100 °C; inductive load; see Figure 14; see Figure 15		-	-	1.8	µs
t_f	fall time	I_C = 2.5 A; I_{Bon} = 0.5 A; I_{Boff} = -0.5 A; R_L = 75 Ω; T_j = 25 °C; resistive load; see Figure 12; see Figure 13		-	0.3	0.35	µs
		I_C = 2 A; I_{Bon} = 0.4 A; V_{BB} = -5 V; L_B = 1 µH; T_j = 100 °C; inductive load; see Figure 14; see Figure 15		-	-	0.12	µs
		I_C = 2 A; I_{Bon} = 0.4 A; V_{BB} = -5 V; L_B = 1 µH; T_j = 25 °C; inductive load; see Figure 14; see Figure 15		-	0.03	0.06	µs

[1] Measured with half-sine wave voltage (curve tracer)

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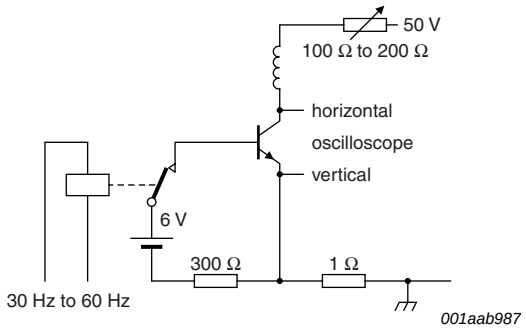


Fig 6. Test circuit for collector-emitter sustaining voltage

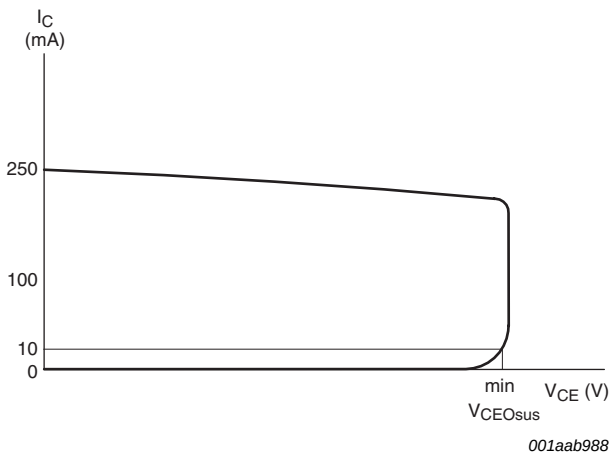
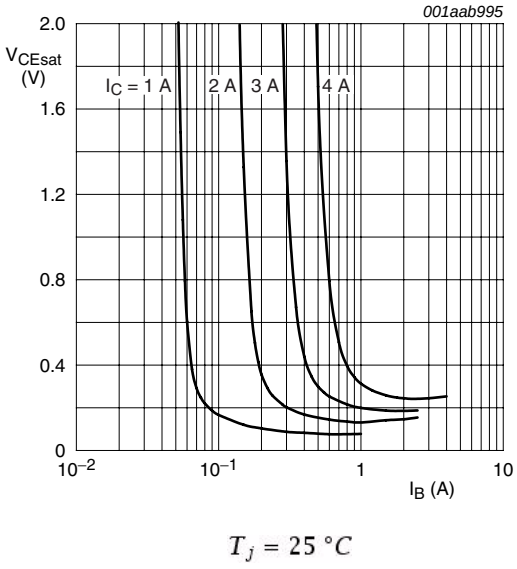
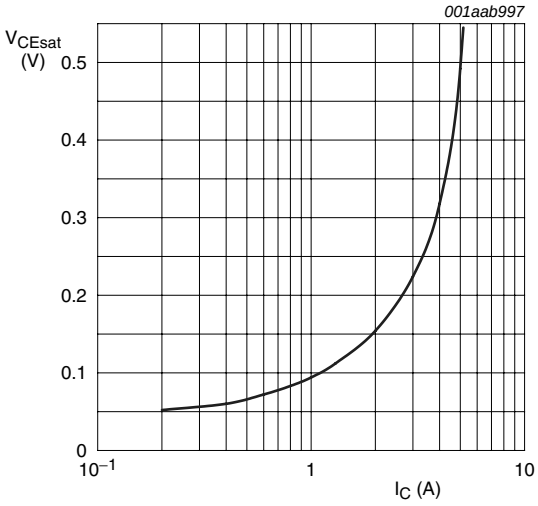


Fig 7. Oscilloscope display for collector-emitter sustaining voltage test waveform



$T_j = 25\ °C$

Fig 8. Collector-emitter saturation voltage as a function of base current; typical values



$I_C / I_B = 4$

Fig 9. Collector-emitter saturation voltage as a function of collector current; typical values

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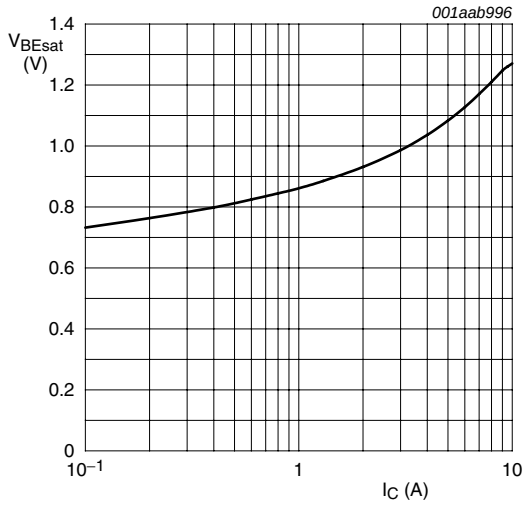
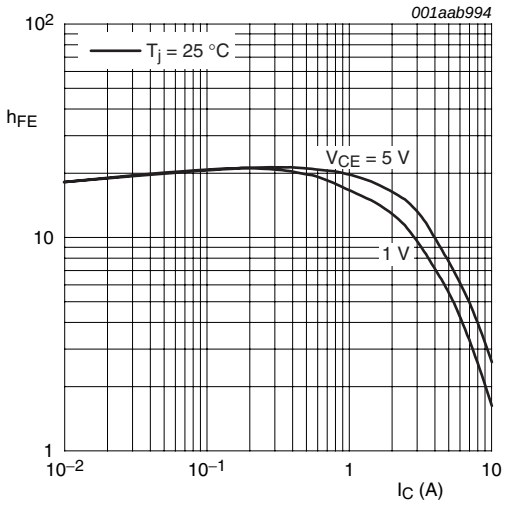


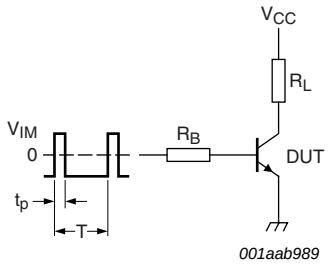
$I_C / I_B = 4$

Fig 10. Base-emitter saturation voltage as a function of collector current; typical values



$I_C / I_B = 4$

Fig 11. DC current gain as a function of collector current; typical values



$V_{IM} = -6$ to $+8\ V$; $V_{CC} = 250\ V$; $t_p = 20\ \mu s$; $\delta = \frac{t_p}{T} = 0.01$

R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

Fig 12. Test circuit for resistive load switching

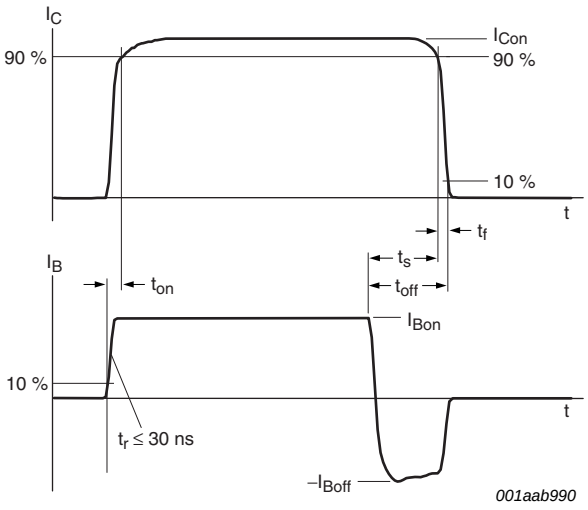


Fig 13. Switching times waveforms for resistive load

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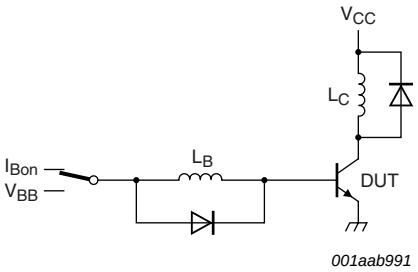

$V_{CC} = 300\ V; V_{BB} = -5\ V; L_C = 200\ \mu H; L_B = 1\ \mu H$

Fig 14. Test circuit for inductive load switching

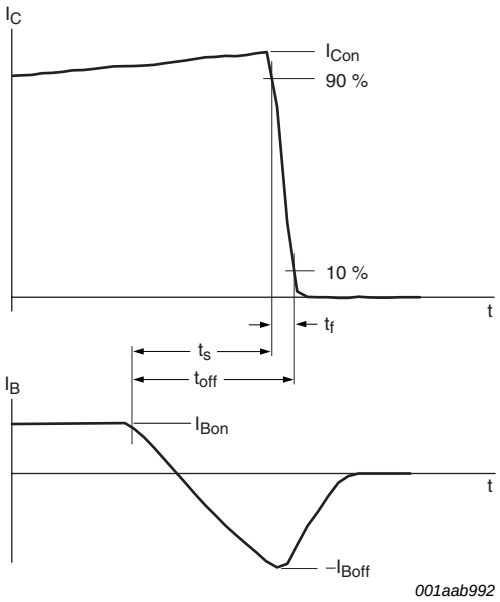

Fig 15. Switching times waveforms for inductive load

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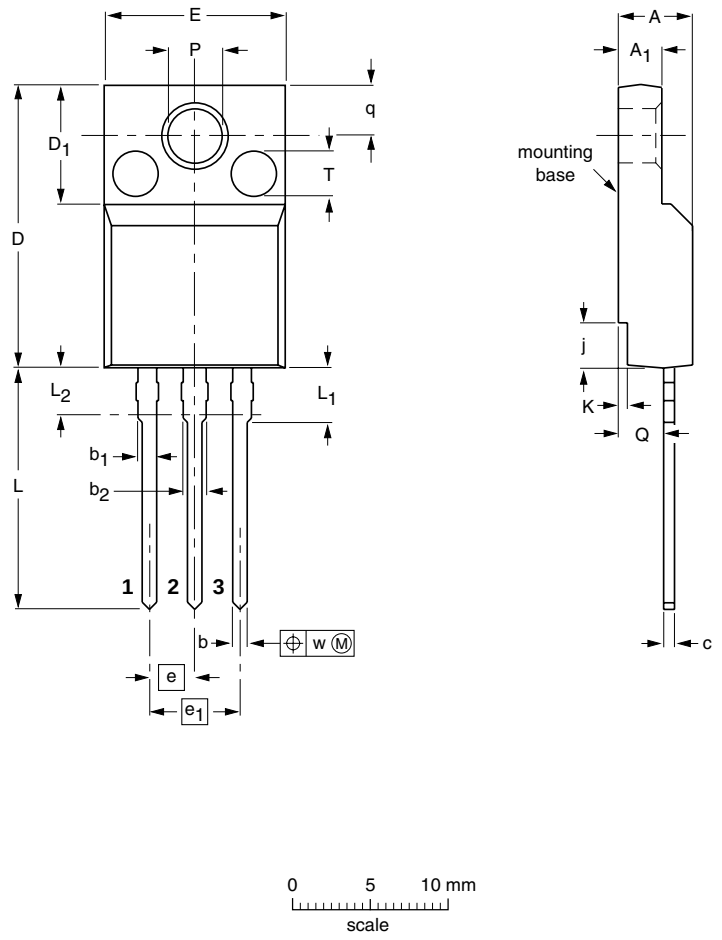
8. Package outline

Plastic single-ended package; isolated heatsink mounted;
1 mounting hole; 3-lead TO-220 'full pack'

SOT186A



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	b_2	c	D	D_1	E	e	e_1	j	K	L	L_1	L_2 (1) max.	P	Q	q	T (2)	w
mm	4.6 4.0	2.9 2.5	0.9 0.7	1.1 0.9	1.4 1.0	0.7 0.4	15.8 15.2	6.5 6.3	10.3 9.7	2.54	5.08	2.7 1.7	0.6 0.4	14.4 13.5	3.30 2.79	3	3.2 3.0	2.6 2.3	3.0 2.6	2.5	0.4

Notes

1. Terminal dimensions within this zone are uncontrolled.
2. Both recesses are ∅ 2.5 × 0.8 max. depth

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT186A		3-lead TO-220F				~~02-04-09~~ 06-02-14

Fig 16. Package outline SOT186A (TO-220F)

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9. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUJD203AX v.1	20100927	Product data sheet	-	-

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10. Legal information

10.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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