

# 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

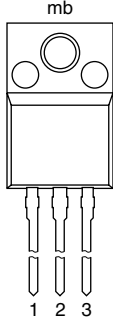
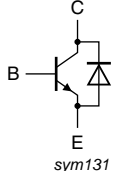
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_C$	collector current	see <a href="#">Figure 1</a> ; see <a href="#">Figure 2</a> ; DC; see <a href="#">Figure 4</a>	-	-	4	A
$P_{tot}$	total power dissipation	$T_h \leq 25\text{ °C}$ ; see <a href="#">Figure 3</a>	-	-	26	W
$V_{CESM}$	collector-emitter peak voltage	$V_{BE} = 0\text{ V}$	-	-	850	V
<b>Static characteristics</b>						
$h_{FE}$	DC current gain	$I_C = 500\text{ mA}$ ; $V_{CE} = 5\text{ V}$ ; see <a href="#">Figure 11</a> ; $T_h = 25\text{ °C}$	13	21	32	
		$V_{CE} = 5\text{ V}$ ; $I_C = 3\text{ A}$ ; see <a href="#">Figure 11</a> ; $T_h = 25\text{ °C}$	-	12.5	-	
$V_{CEOsus}$	collector-emitter sustaining voltage	$I_B = 0\text{ A}$ ; $L_C = 25\text{ mH}$ ; $I_C = 10\text{ mA}$ ; see <a href="#">Figure 6</a> ; see <a href="#">Figure 7</a>	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	$V_{BE} = 0\text{ V}$	-	850	V
$V_{CBO}$	collector-base voltage	$I_E = 0\text{ A}$	-	850	V
$V_{CEO}$	collector-emitter voltage	$I_B = 0\text{ A}$	-	425	V
$I_C$	collector current	DC; see <a href="#">Figure 1</a> ; see <a href="#">Figure 2</a> ; see <a href="#">Figure 4</a>	-	4	A
$I_{CM}$	peak collector current	see <a href="#">Figure 1</a> ; see <a href="#">Figure 2</a> ; see <a href="#">Figure 4</a>	-	8	A
$I_B$	base current	DC	-	2	A
$I_{BM}$	peak base current		-	4	A
$P_{tot}$	total power dissipation	$T_h \leq 25\text{ °C}$ ; see <a href="#">Figure 3</a>	-	26	W
$T_{stg}$	storage temperature		-65	150	°C
$T_j$	junction temperature		-	150	°C

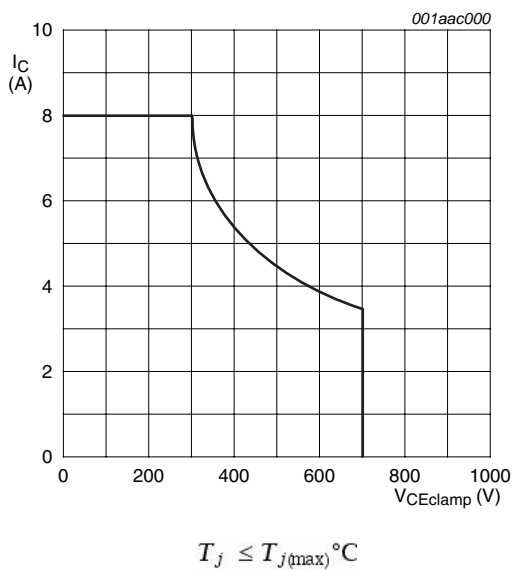
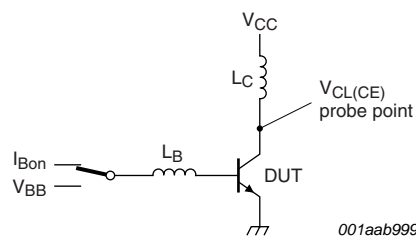
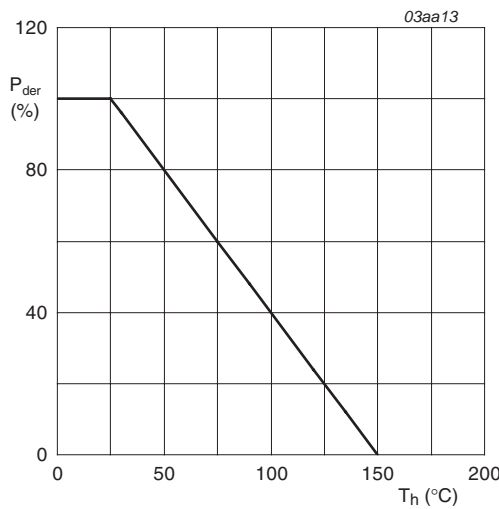


Fig 1. Reverse bias safe operating area



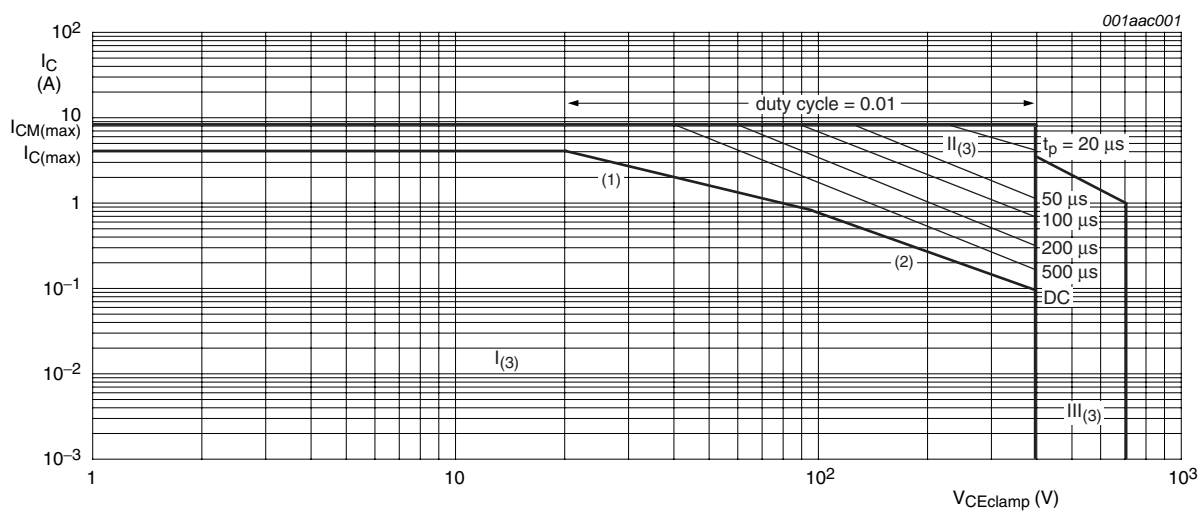
$V_{CL(CE)} \leq 1000 \text{ V}; V_{CC} = 150 \text{ V}; V_{BB} = -5 \text{ V};$   
 $L_B = 1 \mu\text{H}; L_C = 200 \mu\text{H}$

Fig 2. Test circuit for reverse bias safe operating area



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

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



- 1)  $P_{\text{tot}}$  maximum and  $P_{\text{tot}}$  peak maximum lines
- 2) Second breakdown limits
- 3) I = Region of permissible DC operation  
II = Extension for repetitive pulse operation  
III = Extension during turn-on in single transistor converters  
provided that  $R_{\text{BE}} \leq 100 \Omega$  and  $t_p \leq 0.6 \mu\text{s}$

**Fig 4. Forward bias safe operating area for  $T_{mb} \leq 25\text{ }^{\circ}\text{C}$**

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 <a href="#">Figure 5</a>	-	-	4.8	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	55	-	K/W

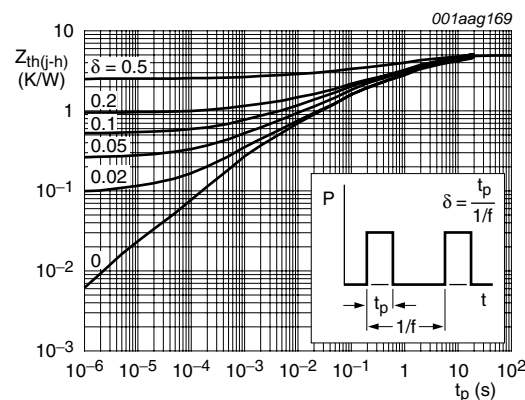


Fig 5. Transient thermal impedance from junction to heatsink as a function of pulse duration

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 <sub>h</sub> = 25 °C; from all terminals to external heatsink; clean and dust free	-	-	2500	V
$C_{isol}$	isolation capacitance	T <sub>h</sub> = 25 °C; f = 1 MHz; from collector to external heatsink	-	10	-	pF

## 7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
I <sub>CES</sub>	collector-emitter cut-off current	V <sub>BE</sub> = 0 V; V <sub>CE</sub> = 850 V; T <sub>j</sub> = 125 °C	[1]	-	2	mA
		V <sub>BE</sub> = 0 V; V <sub>CE</sub> = 850 V; T <sub>j</sub> = 25 °C	[1]	-	1	mA
I <sub>CBO</sub>	collector-base cut-off current	V <sub>CB</sub> = 850 V; I <sub>E</sub> = 0 A	[1]	-	1	mA
I <sub>CEO</sub>	collector-emitter cut-off current	V <sub>CE</sub> = 425 V; I <sub>B</sub> = 0 A	[1]	-	0.1	mA
I <sub>EBO</sub>	emitter-base cut-off current	V <sub>EB</sub> = 7 V; I <sub>C</sub> = 0 A	-	-	10	mA
V <sub>CEOsus</sub>	collector-emitter sustaining voltage	I <sub>B</sub> = 0 A; I <sub>C</sub> = 10 mA; L <sub>C</sub> = 25 mH; see <a href="#">Figure 6</a> ; see <a href="#">Figure 7</a>	400	450	-	V
V <sub>CEsat</sub>	collector-emitter saturation voltage	I <sub>C</sub> = 3 A; I <sub>B</sub> = 0.6 A; see <a href="#">Figure 8</a> ; see <a href="#">Figure 9</a>	-	0.29	1	V
V <sub>BEsat</sub>	base-emitter saturation voltage	I <sub>C</sub> = 3 A; I <sub>B</sub> = 0.6 A; see <a href="#">Figure 10</a>	-	0.99	1.5	V
V <sub>F</sub>	forward voltage	I <sub>F</sub> = 2 A; T <sub>j</sub> = 25 °C	-	1.04	1.5	V
h <sub>FE</sub>	DC current gain	I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 5 V; T <sub>h</sub> = 25 °C; see <a href="#">Figure 11</a>	10	15	32	
		I <sub>C</sub> = 500 mA; V <sub>CE</sub> = 5 V; T <sub>h</sub> = 25 °C; see <a href="#">Figure 11</a>	13	21	32	
		I <sub>C</sub> = 2 A; V <sub>CE</sub> = 5 V; T <sub>h</sub> = 25 °C; see <a href="#">Figure 11</a>	11	16	22	
		I <sub>C</sub> = 3 A; V <sub>CE</sub> = 5 V; T <sub>h</sub> = 25 °C; see <a href="#">Figure 11</a>	-	12.5	-	
Dynamic characteristics						
t <sub>on</sub>	turn-on time	I <sub>C</sub> = 2.5 A; I <sub>Bon</sub> = 0.5 A; I <sub>Boff</sub> = -0.5 A; R <sub>L</sub> = 75 Ω; T <sub>j</sub> = 25 °C; resistive load; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	0.52	0.6	μs
t <sub>s</sub>	storage time	I <sub>C</sub> = 2.5 A; I <sub>Bon</sub> = 0.5 A; I <sub>Boff</sub> = -0.5 A; R <sub>L</sub> = 75 Ω; T <sub>j</sub> = 25 °C; resistive load; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	2.7	3.3	μs
		I <sub>C</sub> = 2 A; I <sub>Bon</sub> = 0.4 A; V <sub>BB</sub> = -5 V; L <sub>B</sub> = 1 μH; T <sub>j</sub> = 25 °C; inductive load; see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>	-	1.2	1.4	μs
		I <sub>C</sub> = 2 A; I <sub>Bon</sub> = 0.4 A; V <sub>BB</sub> = -5 V; L <sub>B</sub> = 1 μH; T <sub>j</sub> = 100 °C; inductive load; see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>	-	-	1.8	μs
t <sub>f</sub>	fall time	I <sub>C</sub> = 2.5 A; I <sub>Bon</sub> = 0.5 A; I <sub>Boff</sub> = -0.5 A; R <sub>L</sub> = 75 Ω; T <sub>j</sub> = 25 °C; resistive load; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	0.3	0.35	μs
		I <sub>C</sub> = 2 A; I <sub>Bon</sub> = 0.4 A; V <sub>BB</sub> = -5 V; L <sub>B</sub> = 1 μH; T <sub>j</sub> = 100 °C; inductive load; see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>	-	-	0.12	μs
		I <sub>C</sub> = 2 A; I <sub>Bon</sub> = 0.4 A; V <sub>BB</sub> = -5 V; L <sub>B</sub> = 1 μH; T <sub>j</sub> = 25 °C; inductive load; see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>	-	0.03	0.06	μs

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

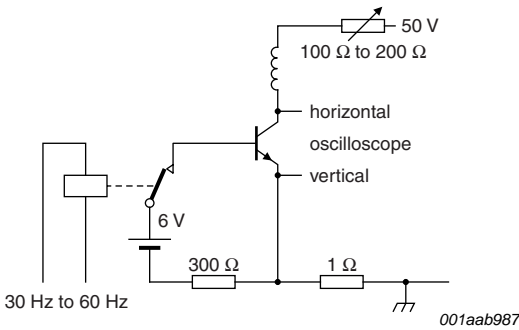


Fig 6. Test circuit for collector-emitter sustaining voltage

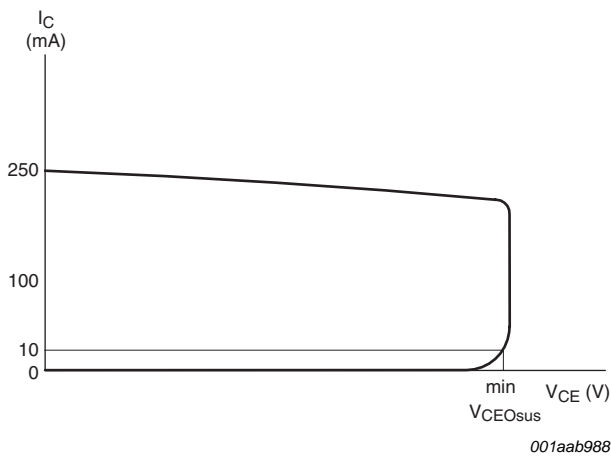


Fig 7. Oscilloscope display for collector-emitter sustaining voltage test waveform

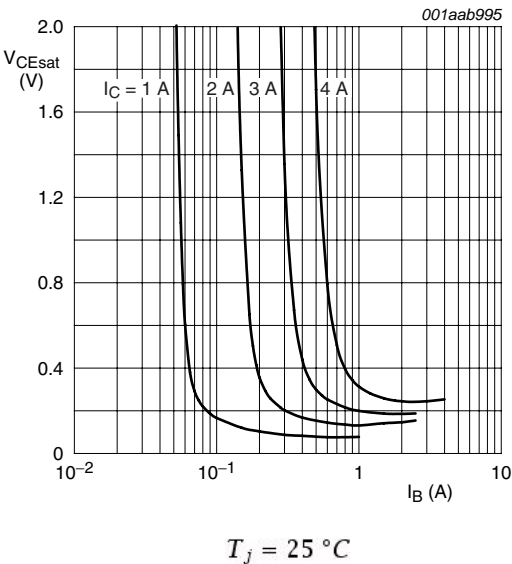


Fig 8. Collector-emitter saturation voltage as a function of base current; typical values

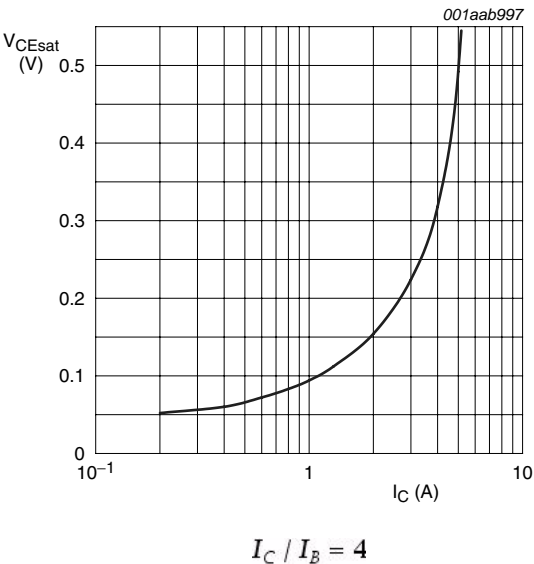


Fig 9. Collector-emitter saturation voltage as a function of collector current; typical values

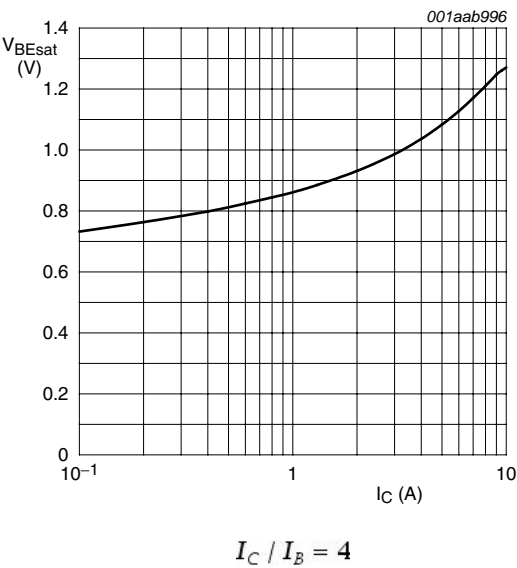


Fig 10. Base-emitter saturation voltage as a function of collector current; typical values

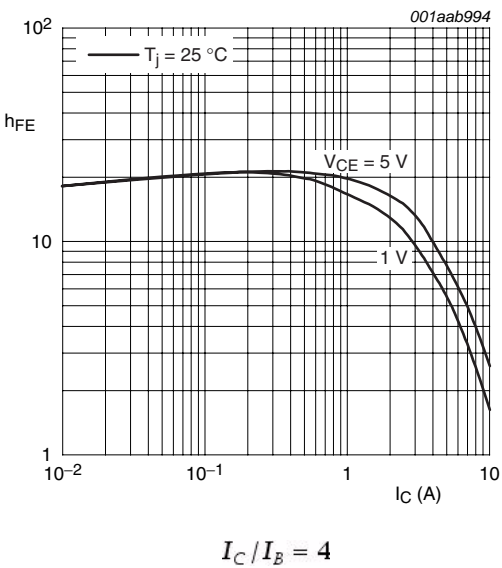
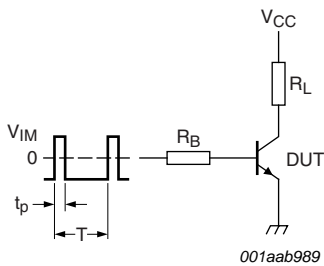


Fig 11. DC current gain as a function of collector current; typical values



$V_{IM} = -6\text{ to }+8\text{ V}$ ;  $V_{CC} = 250\text{ V}$ ;  $t_p = 20\text{ }\mu\text{s}$ ;  $\delta = \frac{t_p}{T} = 0.01$   
 $R_B$  and  $R_L$  calculated from  $I_{Con}$  and  $I_{Bon}$  requirements.

Fig 12. Test circuit for resistive load switching

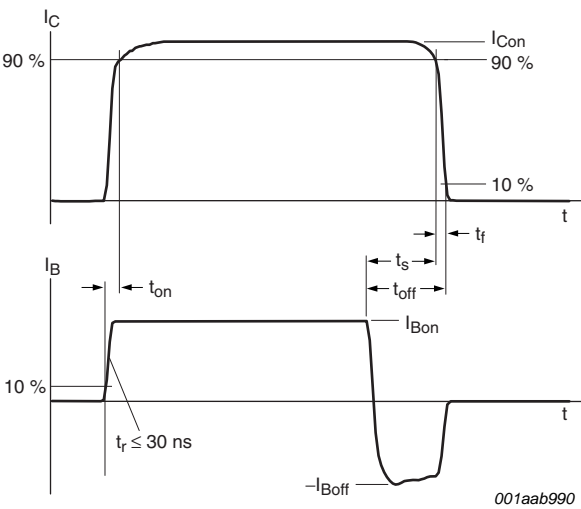
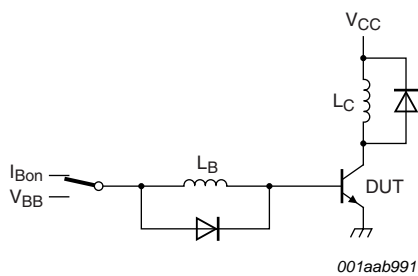


Fig 13. Switching times waveforms for resistive load





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

Fig 14. Test circuit for inductive load switching

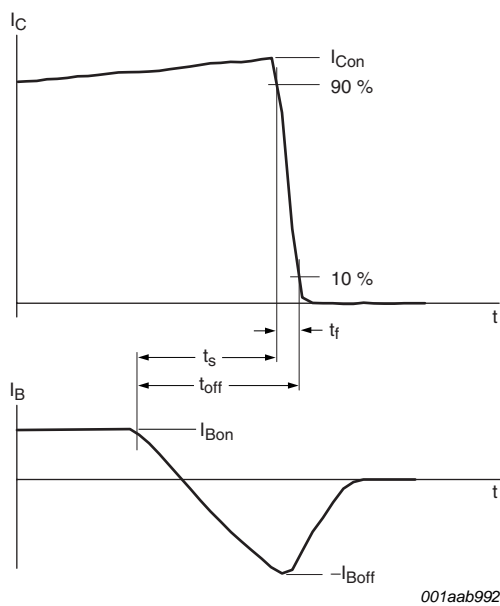


Fig 15. Switching times waveforms for inductive load

8. Package outline

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

SOT186A

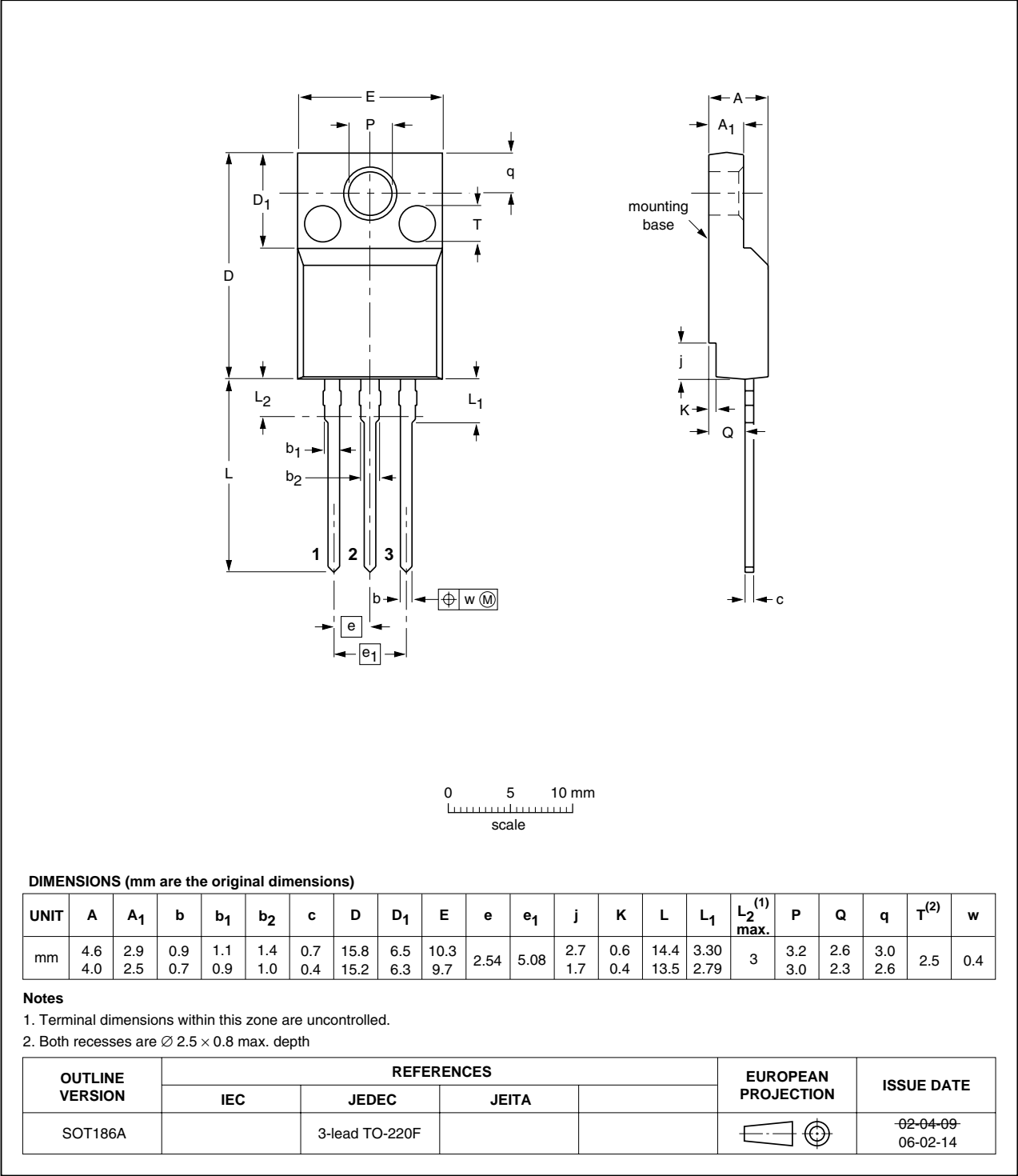


Fig 16. Package outline SOT186A (TO-220F)

## 9. Revision history

Table 8. Revision history

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

## 10. Legal information

### 10.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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.

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

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## 12. Contents

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<b>1</b>	<b>Product profile</b> . . . . .	<b>1</b>
1.1	General description . . . . .	1
1.2	Features and benefits . . . . .	1
1.3	Applications . . . . .	1
1.4	Quick reference data . . . . .	1
<b>2</b>	<b>Pinning information</b> . . . . .	<b>2</b>
<b>3</b>	<b>Ordering information</b> . . . . .	<b>2</b>
<b>4</b>	<b>Limiting values</b> . . . . .	<b>2</b>
<b>5</b>	<b>Thermal characteristics</b> . . . . .	<b>5</b>
<b>6</b>	<b>Isolation characteristics</b> . . . . .	<b>5</b>
<b>7</b>	<b>Characteristics</b> . . . . .	<b>6</b>
<b>8</b>	<b>Package outline</b> . . . . .	<b>10</b>
<b>9</b>	<b>Revision history</b> . . . . .	<b>11</b>
<b>10</b>	<b>Legal information</b> . . . . .	<b>12</b>
10.1	Data sheet status . . . . .	12
10.2	Definitions . . . . .	12
10.3	Disclaimers . . . . .	12
10.4	Trademarks . . . . .	13
<b>11</b>	<b>Contact information</b> . . . . .	<b>13</b>

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