



BUJ303AX

NPN power transistor

Rev. 05 — 3 May 2011

Product data sheet

1. Product profile

1.1 General description

High voltage, high speed, planar passivated NPN power switching transistor in a SOT186A (TO220F) "full pack" plastic package.

1.2 Features and benefits

- Fast switching
- Isolated package
- Very high voltage capability
- Very low switching and conduction losses

1.3 Applications

- DC-to-DC converters
- High frequency electronic lighting ballasts
- Inverters
- Motor control systems

1.4 Quick reference data

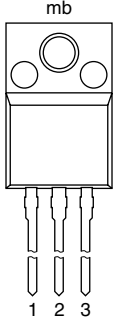
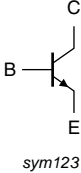
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_C	collector current	see Figure 1 ; see Figure 2 ; see Figure 4	-	-	5	A
P_{tot}	total power dissipation	$T_h \leq 25\text{ °C}$; see Figure 3	-	-	32	W
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0\text{ V}$	-	-	1000	V
Static characteristics						
h_{FE}	DC current gain	$I_C = 5\text{ mA}$; $V_{CE} = 5\text{ V}$; $T_h = 25\text{ °C}$; see Figure 11	10	22	35	
		$I_C = 500\text{ mA}$; $V_{CE} = 5\text{ V}$; $T_h = 25\text{ °C}$; see Figure 11	14	25	35	
Dynamic characteristics						
t_f	fall time	$I_C = 2.5\text{ A}$; $I_{B(on)} = 0.5\text{ A}$; see Figure 14 ; see Figure 15 ; $V_{BB} = -5\text{ V}$; $L_B = 1\text{ }\mu\text{H}$; $T_h = 25\text{ °C}$	-	145	160	ns



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

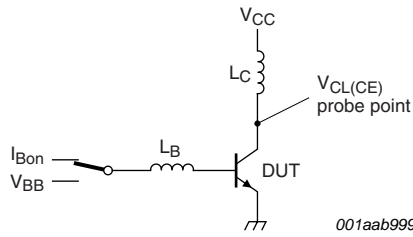
Type number	Package		
	Name	Description	Version
BUJ303AX	TO-220F	plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack"	SOT186A

4. Limiting values

Table 4. Limiting values

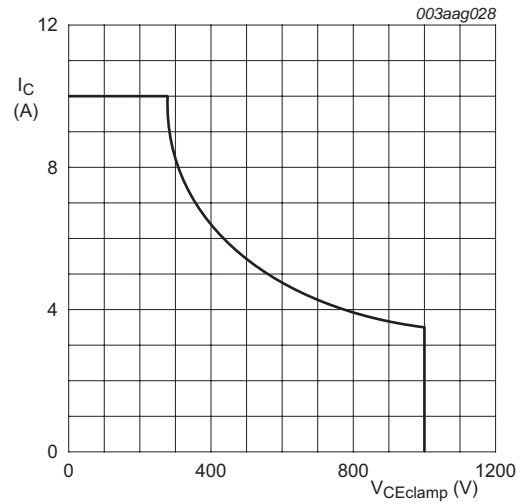
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0\text{ V}$	-	1000	V
V_{CEO}	collector-emitter voltage	$I_B = 0\text{ A}$	-	500	V
I_C	collector current	see Figure 1 ; see Figure 2 ; see Figure 4	-	5	A
I_{CM}	peak collector current		-	10	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 Figure 3	-	32	W
T_{stg}	storage temperature		-65	150	°C
T_j	junction temperature		-	150	°C



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

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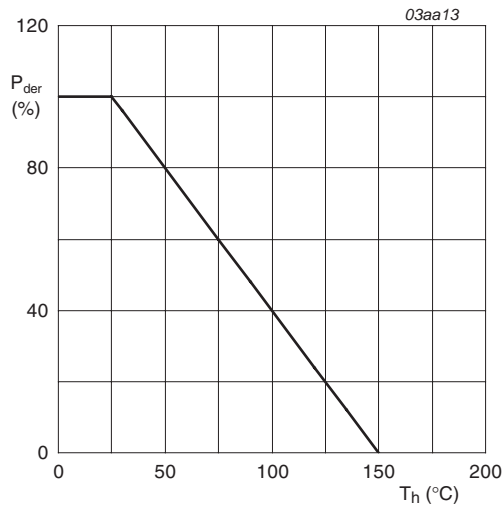


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$T_j \leq T_{j(max)}$

Fig 1. Test circuit for reverse bias safe operating area

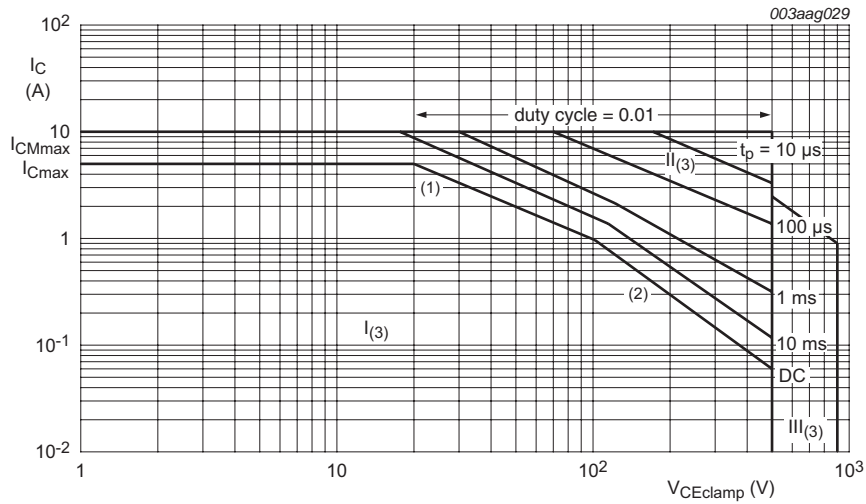
Fig 2. Reverse bias safe operating area



03aa13

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

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



(1) P_{tot} maximum and P_{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_{BE} ≤ 100 Ω and t_p ≤ 0.6 μs.

Fig 4. Forward bias safe operating area for T_{mb} ≤ 25 °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 Figure 5	-	-	3.95	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	55	-	K/W

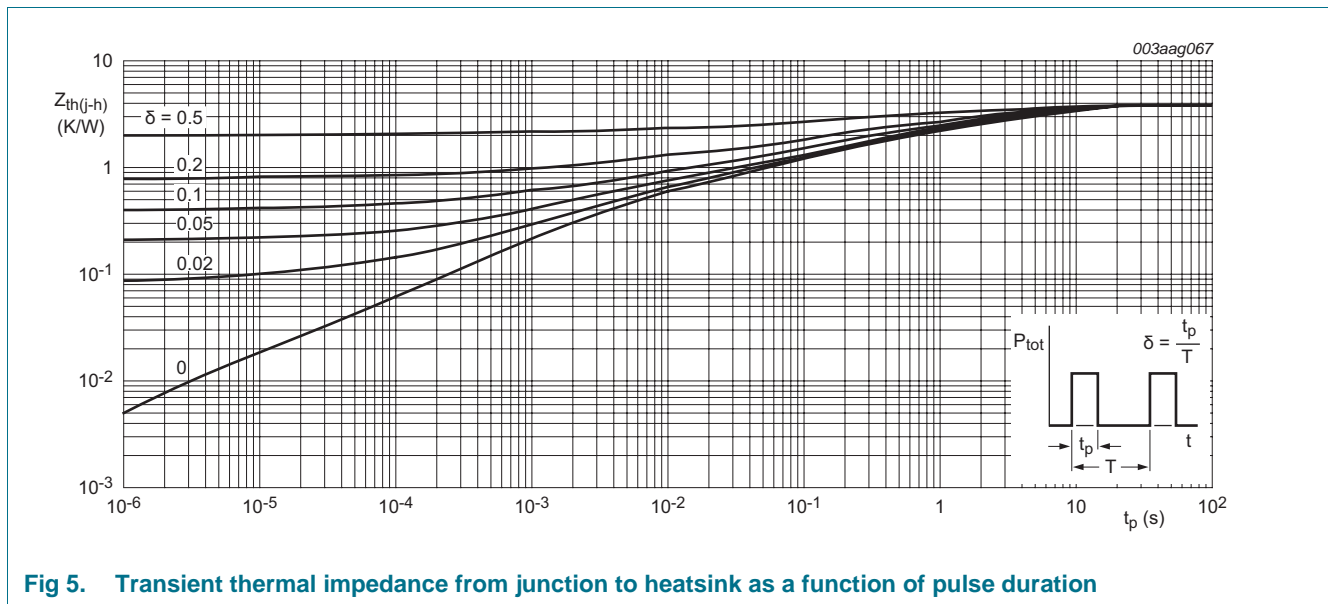


Fig 5. Transient thermal impedance from junction to heatsink as a function of pulse duration

6. Isolation characteristics

Table 6. Isolation characteristics

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

7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
Static characteristics							
I_{CES}	collector-emitter cut-off current	$V_{BE} = 0\text{ V}; V_{CE} = 1000\text{ V}; T_h = 25\text{ }^\circ\text{C}$	[1]	-	-	1	mA
		$V_{BE} = 0\text{ V}; V_{CE} = 1000\text{ V}; T_j = 125\text{ }^\circ\text{C}$	[1]	-	-	2	mA
I_{CBO}	collector-base cut-off current	$V_{CB} = 1000\text{ V}; I_E = 0\text{ A}; T_h = 25\text{ }^\circ\text{C}$	[1]	-	-	1	mA
I_{CEO}	collector-emitter cut-off current	$V_{CE} = 500\text{ V}; I_B = 0\text{ A}; T_h = 25\text{ }^\circ\text{C}$	[1]	-	-	0.1	mA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 9\text{ V}; I_C = 0\text{ A}; T_h = 25\text{ }^\circ\text{C}$	-	-	0.1	mA	
$V_{CEO_{sus}}$	collector-emitter sustaining voltage	$I_B = 0\text{ A}; I_C = 10\text{ mA}; L_C = 25\text{ mH}; T_h = 25\text{ }^\circ\text{C}$; see Figure 6 ; see Figure 7	500	-	-	V	
$V_{CE_{sat}}$	collector-emitter saturation voltage	$I_C = 3\text{ A}; I_B = 0.6\text{ A}; T_h = 25\text{ }^\circ\text{C}$; see Figure 8 ; see Figure 9	-	0.25	1.5	V	
$V_{BE_{sat}}$	base-emitter saturation voltage	$I_C = 3\text{ A}; I_B = 0.6\text{ A}; T_h = 25\text{ }^\circ\text{C}$; see Figure 10	-	0.97	1.3	V	
h_{FE}	DC current gain	$I_C = 5\text{ mA}; V_{CE} = 5\text{ V}; T_h = 25\text{ }^\circ\text{C}$; see Figure 11	10	22	35		
		$I_C = 500\text{ mA}; V_{CE} = 5\text{ V}; T_h = 25\text{ }^\circ\text{C}$; see Figure 11	14	25	35		
$h_{FE_{sat}}$	DC saturation current gain	$I_C = 2.5\text{ A}; V_{CE} = 5\text{ V}; T_h = 25\text{ }^\circ\text{C}$; see Figure 11	10	13.5	17		
		$I_C = 3\text{ A}; V_{CE} = 5\text{ V}; T_h = 25\text{ }^\circ\text{C}$; see Figure 11	-	12	-		
Dynamic characteristics							
t_{on}	turn-on time	$I_C = 2.5\text{ A}; I_{B_{on}} = 0.5\text{ A}; I_{B_{off}} = -0.5\text{ A}; R_L = 75\text{ }\Omega; V_{BB} = -4\text{ V}; T_h = 25\text{ }^\circ\text{C}$; resistive load; see Figure 12 ; see Figure 13	-	0.5	0.7	μs	
t_s	storage time	$I_C = 2.5\text{ A}; I_{B_{on}} = 0.5\text{ A}; V_{BB} = -5\text{ V}; L_B = 1\text{ }\mu\text{H}; T_h = 25\text{ }^\circ\text{C}$; inductive load; see Figure 14 ; see Figure 15	-	1.4	1.6	μs	
		$I_C = 2.5\text{ A}; I_{B_{on}} = 0.5\text{ A}; V_{BB} = -5\text{ V}; L_B = 1\text{ }\mu\text{H}; T_j = 100\text{ }^\circ\text{C}$; inductive load; see Figure 14 ; see Figure 15	-	1.7	1.9	μs	
		$I_C = 2.5\text{ A}; I_{B_{on}} = 0.5\text{ A}; I_{B_{off}} = -0.5\text{ A}; R_L = 75\text{ }\Omega; V_{BB} = -4\text{ V}; T_h = 25\text{ }^\circ\text{C}$; resistive load; see Figure 12 ; see Figure 13	-	0.33	0.45	μs	
t_f	fall time	$I_C = 2.5\text{ A}; I_{B_{on}} = 0.5\text{ A}; V_{BB} = -5\text{ V}; L_B = 1\text{ }\mu\text{H}; T_h = 25\text{ }^\circ\text{C}$; see Figure 14 ; see Figure 15	-	145	160	ns	
		$I_C = 2.5\text{ A}; I_{B_{on}} = 0.5\text{ A}; V_{BB} = -5\text{ V}; L_B = 1\text{ }\mu\text{H}; T_j = 100\text{ }^\circ\text{C}$; inductive load; see Figure 14 ; see Figure 15	-	160	200	ns	
		$I_C = 2.5\text{ A}; I_{B_{on}} = 0.5\text{ A}; I_{B_{off}} = -0.5\text{ A}; R_L = 75\text{ }\Omega; V_{BB} = -4\text{ V}; T_h = 25\text{ }^\circ\text{C}$; resistive load; see Figure 12 ; see Figure 13	-	0.33	0.45	μs	

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

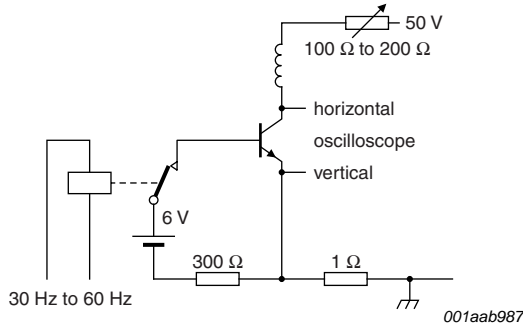


Fig 6. Test circuit for collector-emitter sustaining voltage

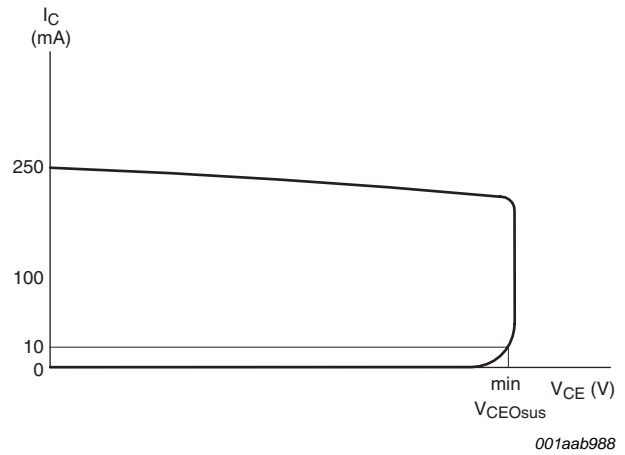


Fig 7. Oscilloscope display for collector-emitter sustaining voltage test waveform

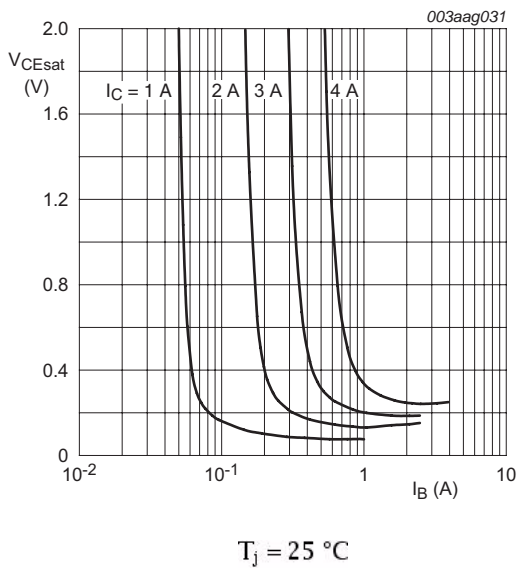


Fig 8. Collector-emitter saturation voltage as a function of base current; typical values

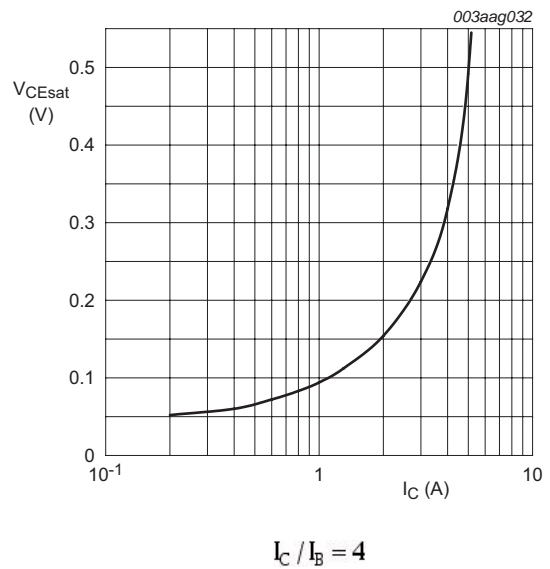
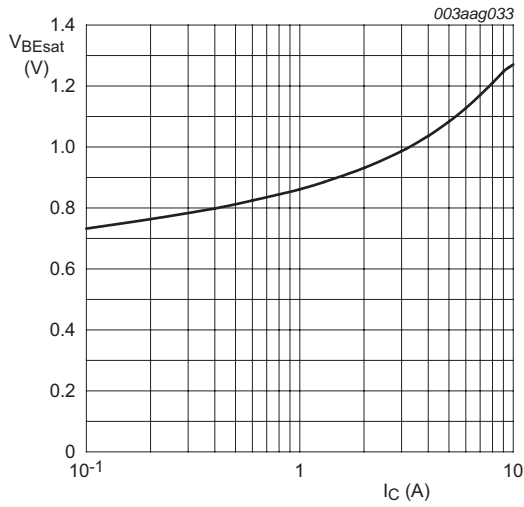
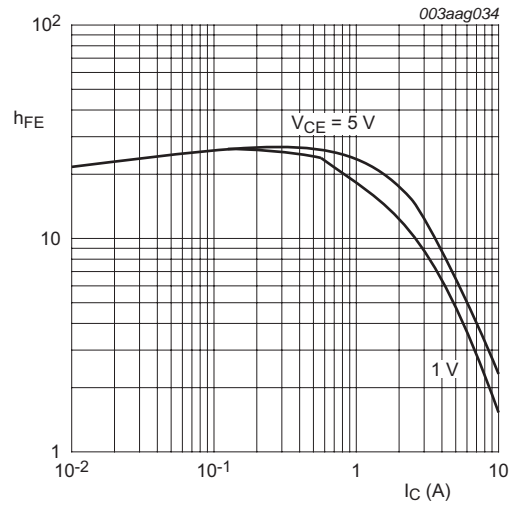


Fig 9. Collector-emitter saturation voltage as a function of collector current; typical values



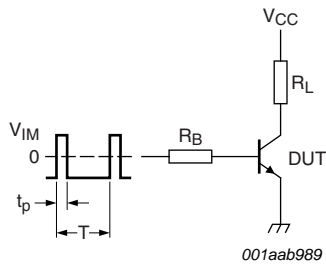
$I_C / I_B = 4$

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



$T_j = 25\text{ }^\circ\text{C}$

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



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

Fig 12. Test circuit for resistive load switching

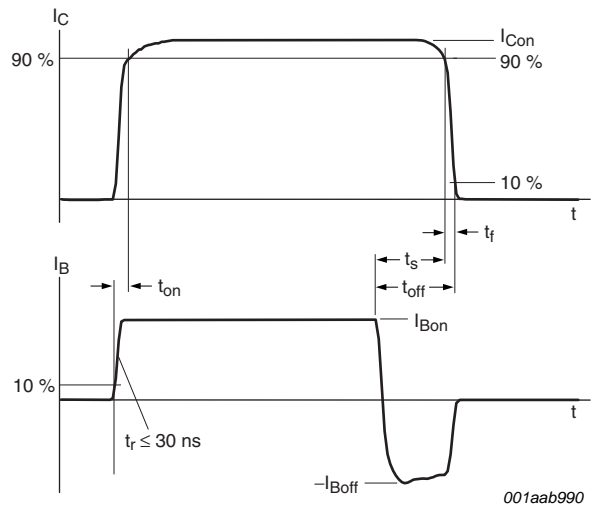
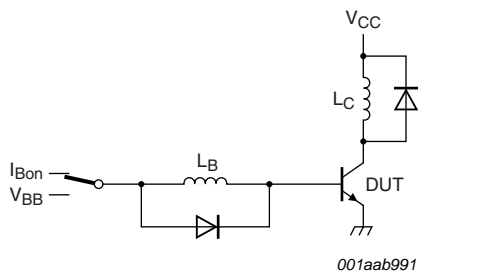


Fig 13. Switching times waveforms for resistive load



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

Fig 14. Test circuit for inductive load switching

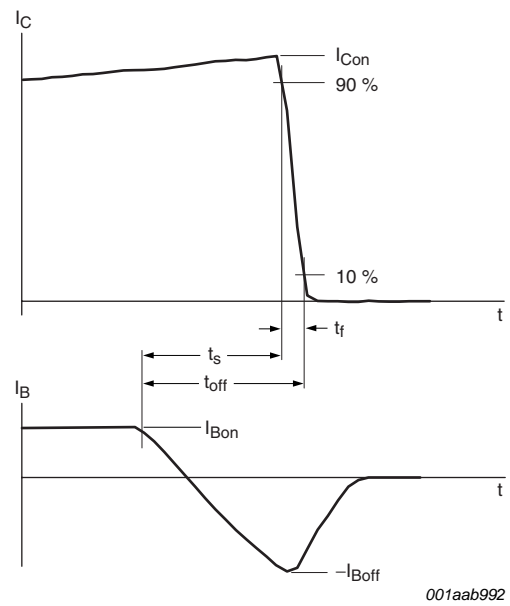


Fig 15. Switching times waveforms for inductive load

8. Package outline

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

SOT186A

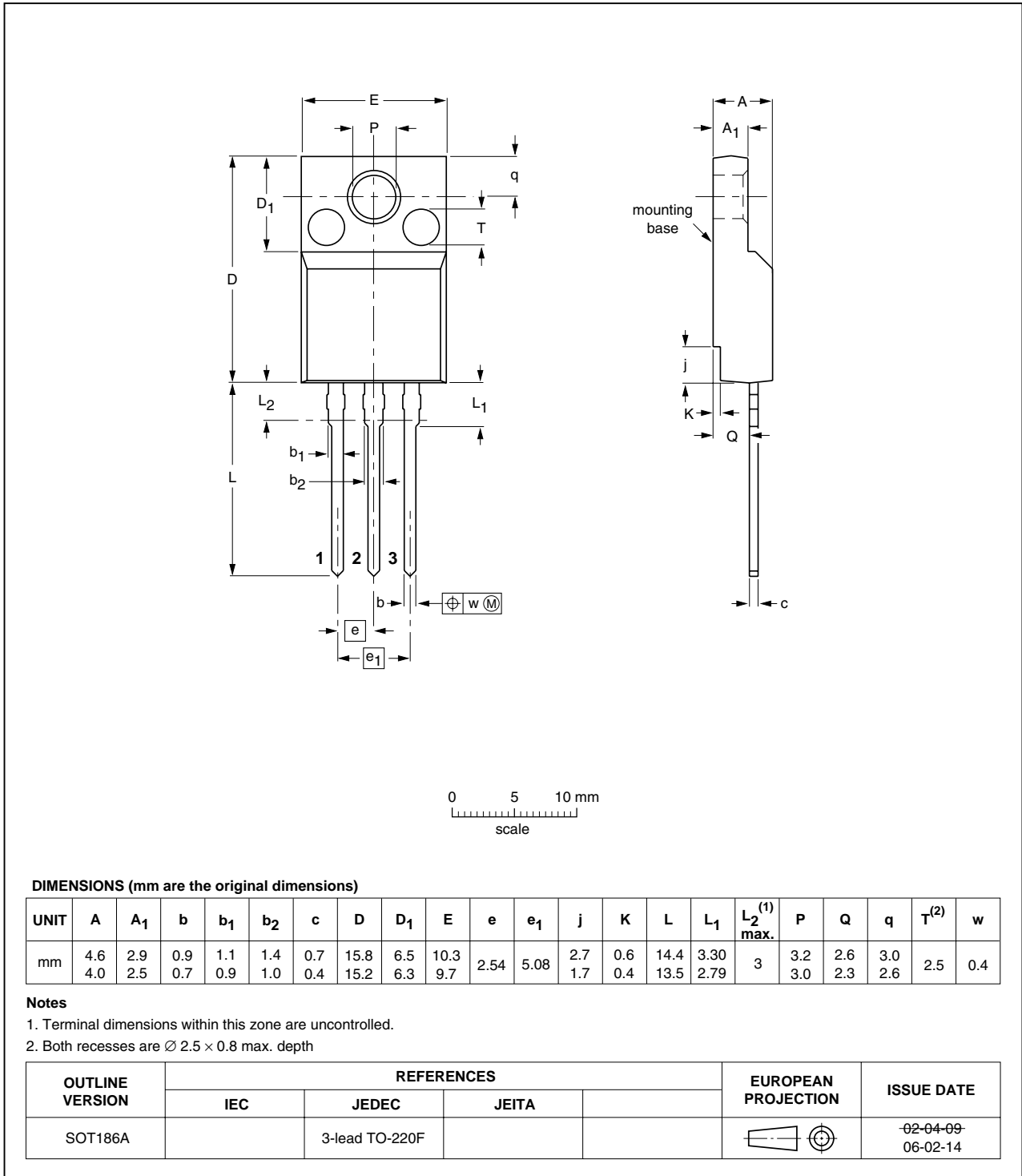


Fig 16. Package outline SOT186A (TO-220F)

9. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUJ303AX v.5	20110503	Product data sheet	-	BUJ303AX v.4
Modifications:	• Various changes to content.			
BUJ303AX v.4	20110415	Product data sheet	-	BUJ303AX v.3

10. Legal information

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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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