



IMPORTANT NOTICE

10 December 2015

1. Global joint venture starts operations as WeEn Semiconductors

Dear customer,

As from November 9th, 2015 NXP Semiconductors N.V. and Beijing JianGuang Asset Management Co. Ltd established Bipolar Power joint venture (JV), **WeEn Semiconductors**, which will be used in future Bipolar Power documents together with new contact details.

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Thank you for your cooperation and understanding,

WeEn Semiconductors





BUJ303AX

NPN power transistor

Rev. 6 — 8 February 2012

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

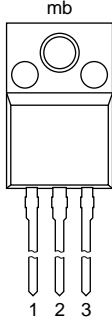
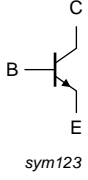
Table 1. Quick reference data

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



2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base		 sym123
2	C	collector		
3	E	emitter		
mb	n.c.	mounting base; isolated		

SOT186A (TO-220F)

3. Ordering information

Table 3. Ordering information

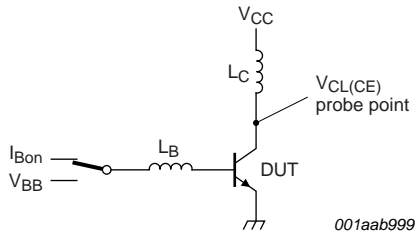
Type number	Package		
	Name	Description	Version
BUJ303AX	TO-220F	plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack"	SOT186A

4. Limiting values

Table 4. Limiting values

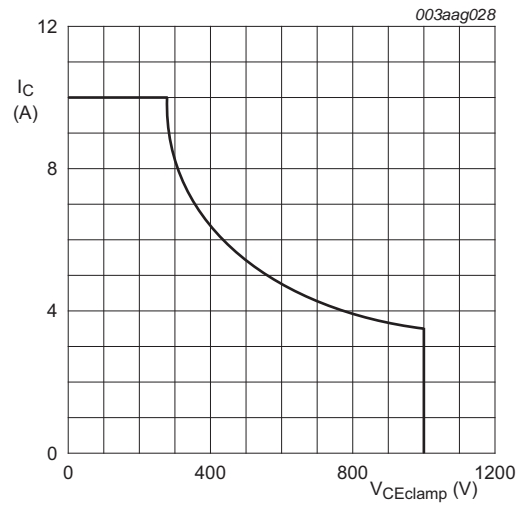
In accordance with the Absolute Maximum Rating System (IEC 60134).

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



$$V_{CL(CE)} \leq 1000 \text{ V}; V_{CC} = 150 \text{ V}; V_{BB} = -5 \text{ V};$$

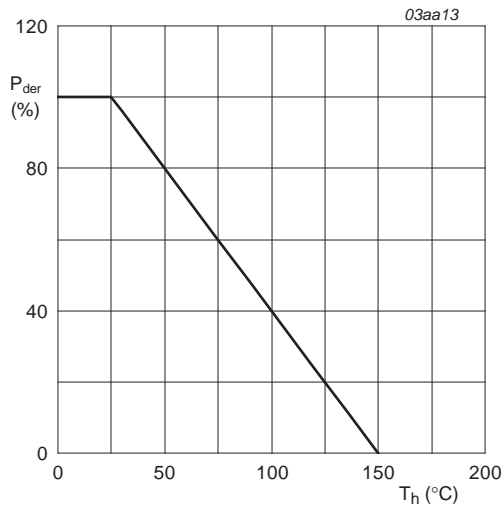
$$L_B = 1 \mu\text{H}; L_C = 200 \mu\text{H}$$



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

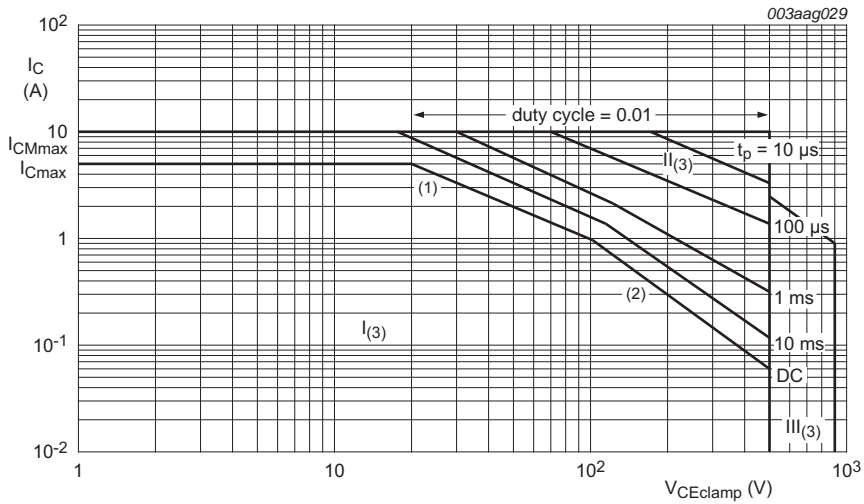
Fig 1. Test circuit for reverse bias safe operating area

Fig 2. Reverse bias safe operating area



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

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 $R_{BE} \leq 100 \Omega$ and $t_p \leq 0.6 \mu s$.

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 Figure 5	-	-	3.95	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	55	-	K/W

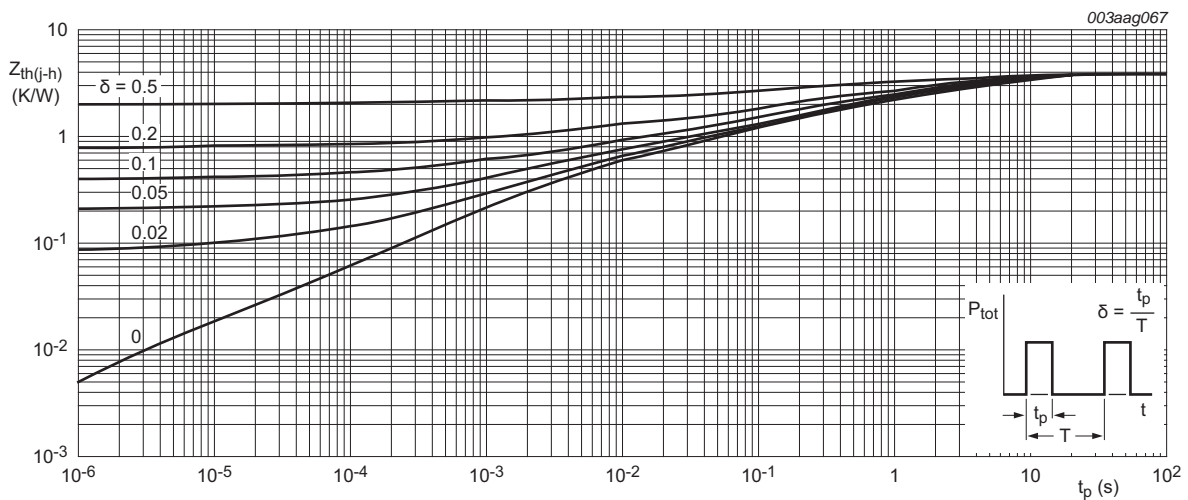


Fig 5. Transient thermal impedance from junction to heatsink as a function of pulse duration

6. Isolation characteristics

Table 6. Isolation characteristics

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

7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
I_{CES}	collector-emitter cut-off current	$V_{\text{BE}} = 0 \text{ V}$; $V_{\text{CE}} = 1000 \text{ V}$; $T_h = 25 \text{ }^\circ\text{C}$; Measured with half-sine wave voltage (curve tracer)	-	-	1	mA
		$V_{\text{BE}} = 0 \text{ V}$; $V_{\text{CE}} = 1000 \text{ V}$; $T_h = 125 \text{ }^\circ\text{C}$; Measured with half-sine wave voltage (curve tracer)	-	-	2	mA
I_{CBO}	collector-base cut-off current	$V_{\text{CB}} = 1000 \text{ V}$; $I_E = 0 \text{ A}$; $T_h = 25 \text{ }^\circ\text{C}$; Measured with half-sine wave voltage (curve tracer)	-	-	1	mA
I_{CEO}	collector-emitter cut-off current	$V_{\text{CE}} = 500 \text{ V}$; $I_B = 0 \text{ A}$; $T_h = 25 \text{ }^\circ\text{C}$; Measured with half-sine wave voltage (curve tracer)	-	-	0.1	mA
I_{EBO}	emitter-base cut-off current	$V_{\text{EB}} = 9 \text{ V}$; $I_C = 0 \text{ A}$; $T_h = 25 \text{ }^\circ\text{C}$	-	-	0.1	mA
V_{CEOsus}	collector-emitter sustaining voltage	$I_B = 0 \text{ A}$; $I_C = 100 \text{ mA}$; $L_C = 25 \text{ mH}$; $T_h = 25 \text{ }^\circ\text{C}$; see Figure 6 ; see Figure 7	500	-	-	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 3.0 \text{ A}$; $I_B = 0.6 \text{ A}$; $T_h = 25 \text{ }^\circ\text{C}$; see Figure 8 ; see Figure 9	-	0.35	1.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 3.0 \text{ A}$; $I_B = 0.6 \text{ A}$; $T_h = 25 \text{ }^\circ\text{C}$; see Figure 10	-	1.01	1.3	V
h_{FE}	DC current gain	$I_C = 5 \text{ mA}$; $V_{\text{CE}} = 5 \text{ V}$; $T_h = 25 \text{ }^\circ\text{C}$; see Figure 11	10	22	35	
		$I_C = 500 \text{ mA}$; $V_{\text{CE}} = 5 \text{ V}$; $T_h = 25 \text{ }^\circ\text{C}$; see Figure 11	14	25	35	
h_{FEsat}	DC saturation current gain	$I_C = 2.5 \text{ A}$; $V_{\text{CE}} = 5 \text{ V}$; $T_h = 25 \text{ }^\circ\text{C}$; see Figure 11	10	13.5	17	
		$I_C = 3.0 \text{ A}$; $V_{\text{CE}} = 5 \text{ V}$; $T_h = 25 \text{ }^\circ\text{C}$; see Figure 11	-	11	-	
Dynamic Characteristics (switching times - resistive load)						
t_s	turn-off delay time	$I_C = 2.5 \text{ A}$; $I_{\text{Bon}} = 0.5 \text{ A}$; $I_{\text{Boff}} = -0.5 \text{ A}$; $R_L = 75 \text{ } \Omega$; $T_h = 25 \text{ }^\circ\text{C}$; see Figure 12 ; see Figure 13	-	3.3	4	μs
t_f	fall time		-	0.33	0.45	μs

Table 7. Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Dynamic Characteristics (switching times - inductive load)						
t_s	turn-off delay 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	-	1.4	1.6	μs
t_s	turn-off delay time	$I_C = 2.5\text{ A}$; $I_{B(on)} = 0.5\text{ A}$; $V_{BB} = -5\text{ V}$; $L_B = 1\text{ }\mu\text{H}$; $T_h = 100\text{ }^\circ\text{C}$; see Figure 14 ; see Figure 15	-	1.7	1.9	μs
t_r	rise 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
		$I_C = 2.5\text{ A}$; $I_{B(on)} = 0.5\text{ A}$; $V_{BB} = -5\text{ V}$; $L_B = 1\text{ }\mu\text{H}$; $T_h = 100\text{ }^\circ\text{C}$; see Figure 14 ; see Figure 15	-	160	200	ns

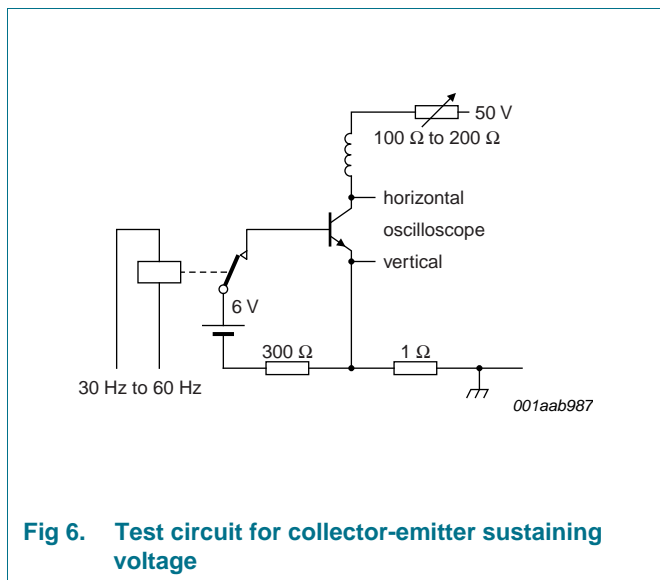


Fig 6. Test circuit for collector-emitter sustaining voltage

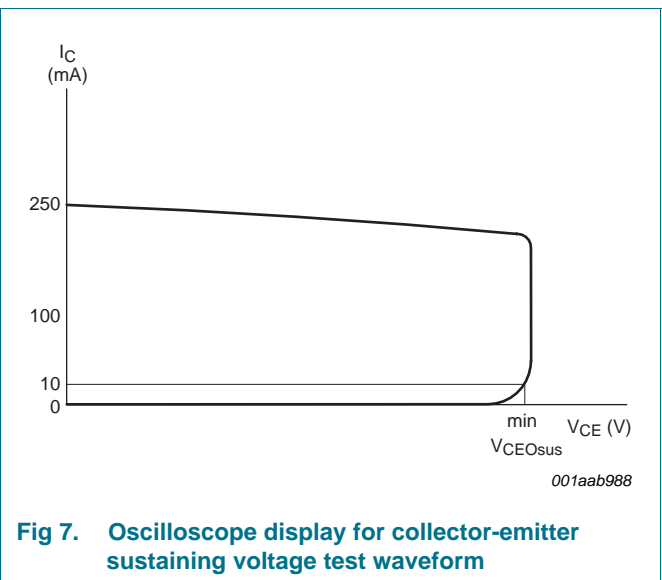
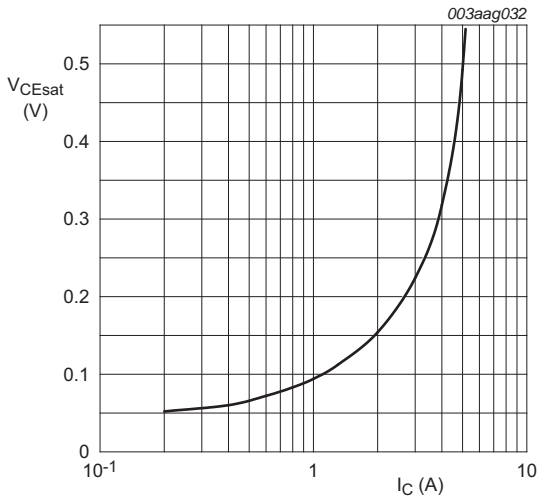
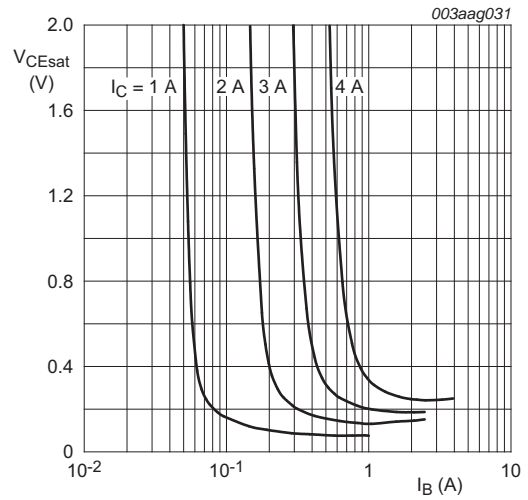


Fig 7. Oscilloscope display for collector-emitter sustaining voltage test waveform



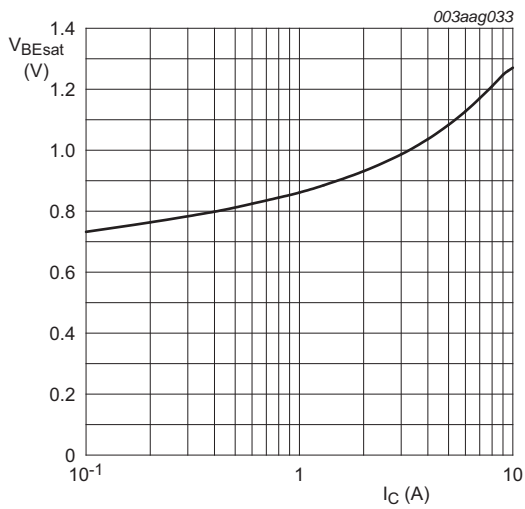
$I_C / I_B = 4$

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



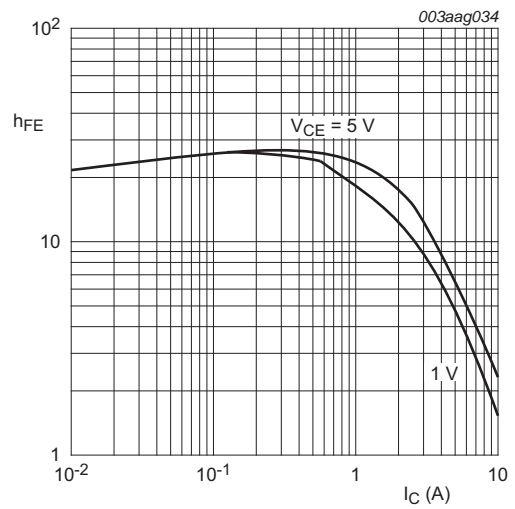
$T_j = 25\text{ }^\circ\text{C}$

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



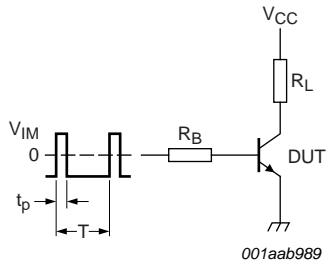
$I_C / I_B = 4$

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



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

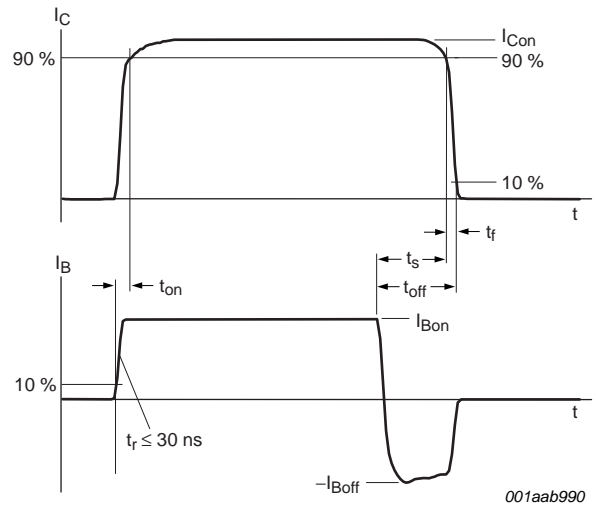
Fig 11. DC current gain as a function of collector current; typical values



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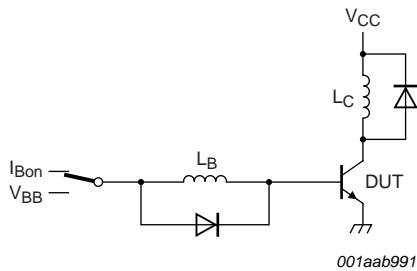
$V_{IM} = -6 \text{ to } +8\text{V}; t_p = 20 \mu\text{s}; \delta = \frac{t_p}{T} = 0.01$
 R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

Fig 12. Test circuit for resistive load switching



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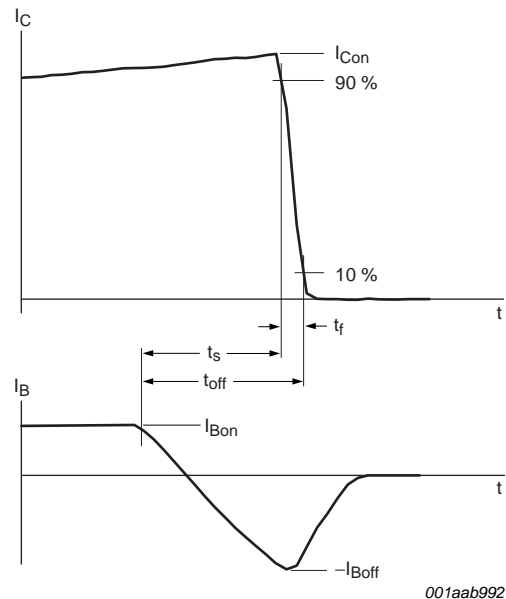
Fig 13. Switching times waveforms for resistive load



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

Fig 14. Test circuit for inductive load switching



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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

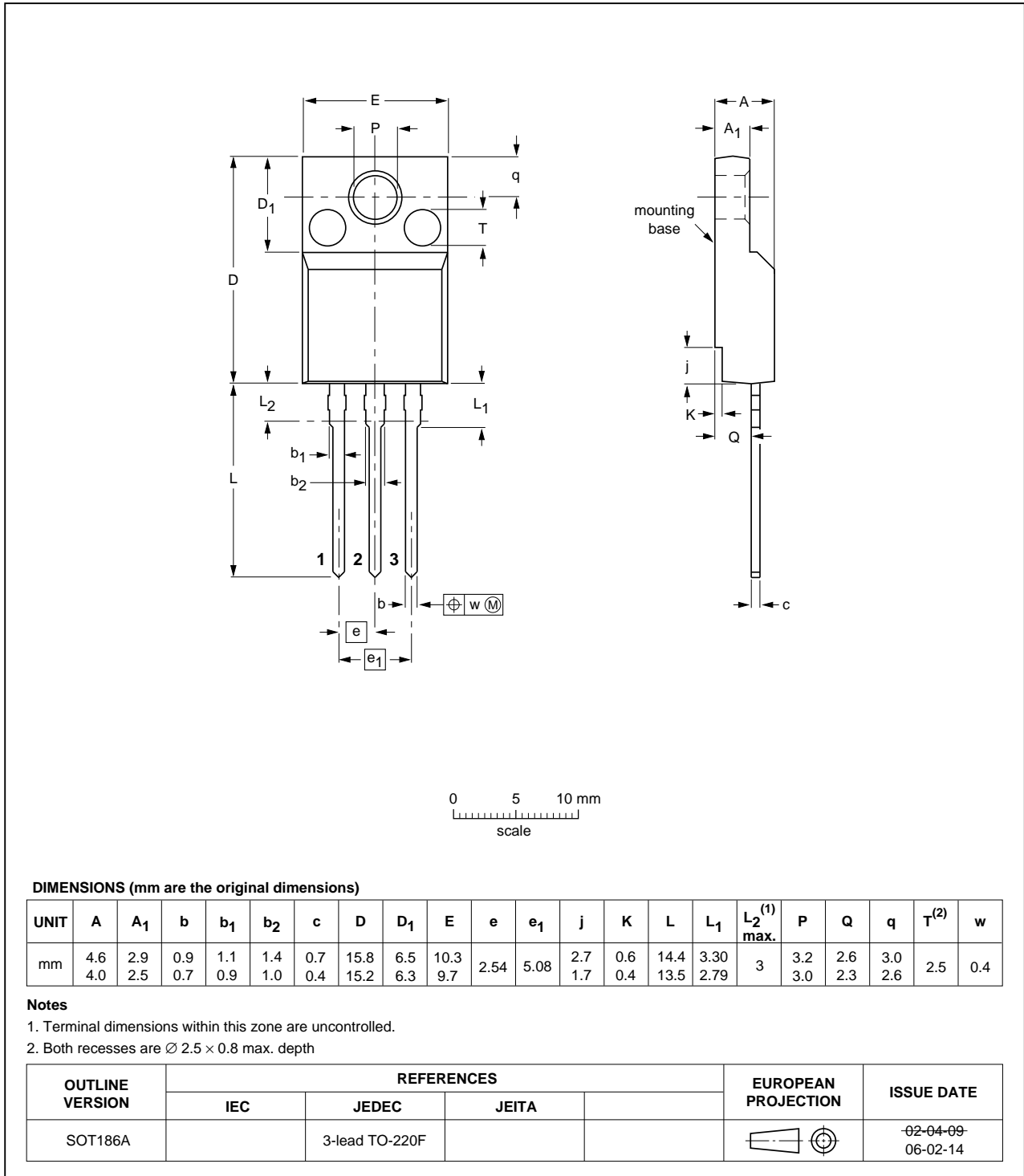


Fig 16. Package outline SOT186A (TO-220F)

9. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUJ303AX v.6	20120208	Product data sheet	-	BUJ303AX v.5
Modifications:	• Various changes to content.			
BUJ303AX v.5	20110503	Product data sheet	-	BUJ303AX v.4

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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