

## 1. General description

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

## 2. Features and benefits

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

## 3. Applications

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

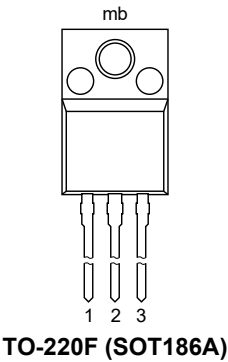
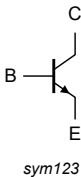
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CM}$	peak collector current	<a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	-	-	10	A
$P_{tot}$	total power dissipation	$T_h \leq 25\text{ °C}$ ; <a href="#">Fig. 4</a>	-	-	32	W
$V_{CESM}$	collector-emitter peak voltage	$V_{BE} = 0\text{ V}$	-	-	1000	V
<b>Static characteristics</b>						
$h_{FE}$	DC current gain	$I_C = 5\text{ mA}$ ; $V_{CE} = 5\text{ V}$ ; $T_h = 25\text{ °C}$ ; <a href="#">Fig. 11</a>	10	22	35	
		$I_C = 500\text{ mA}$ ; $V_{CE} = 5\text{ V}$ ; $T_h = 25\text{ °C}$ ; <a href="#">Fig. 11</a>	14	25	35	

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 <p>TO-220F (SOT186A)</p>	 <p>sym123</p>
2	C	collector		
3	E	emitter		
mb	n.c.	mounting base; isolated		

6. Ordering information

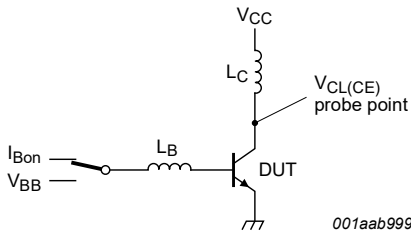
Table 3. Ordering information

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

7. Limiting values

Table 4. Limiting values  
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CESM</sub>	collector-emitter peak voltage	V <sub>BE</sub> = 0 V	-	1000	V
V <sub>CEO</sub>	collector-emitter voltage	I <sub>B</sub> = 0 A	-	500	V
I <sub>C</sub>	collector current	Fig. 1; Fig. 2; Fig. 3	-	5	A
I <sub>CM</sub>	peak collector current		-	10	A
I <sub>B</sub>	base current	DC	-	2	A
I <sub>BM</sub>	peak base current		-	4	A
P <sub>tot</sub>	total power dissipation	T <sub>h</sub> ≤ 25 °C; Fig. 4	-	32	W
T <sub>stg</sub>	storage temperature		-65	150	°C
T <sub>j</sub>	junction temperature		-	150	°C



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

Fig. 1. Test circuit for reverse bias safe operating area

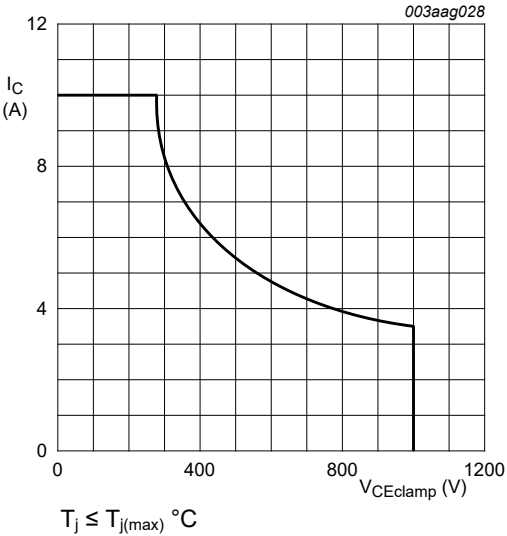
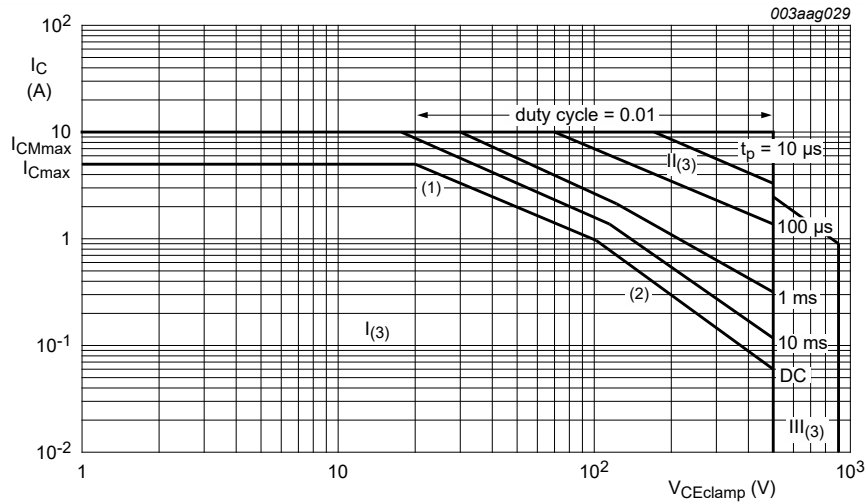


Fig. 2. Reverse bias safe operating area



(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. 3. Forward bias safe operating area for  $T_{mb} \leq 25^\circ C$

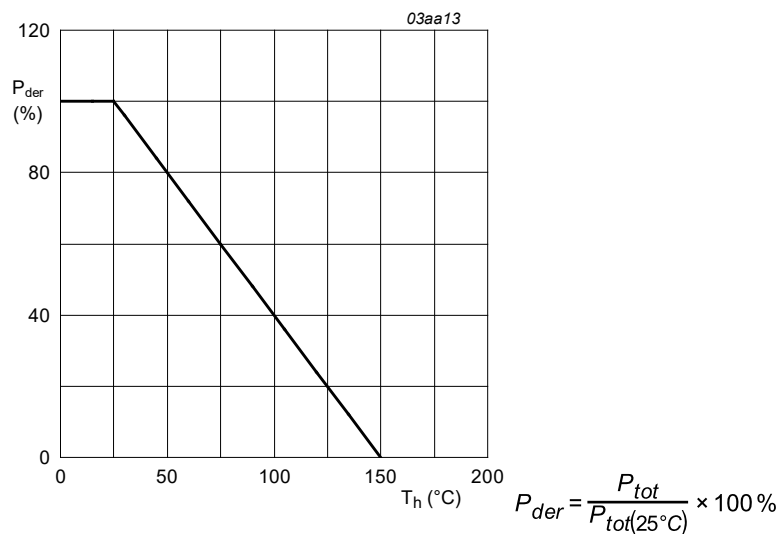


Fig. 4. Normalized total power dissipation as a function of heatsink temperature

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

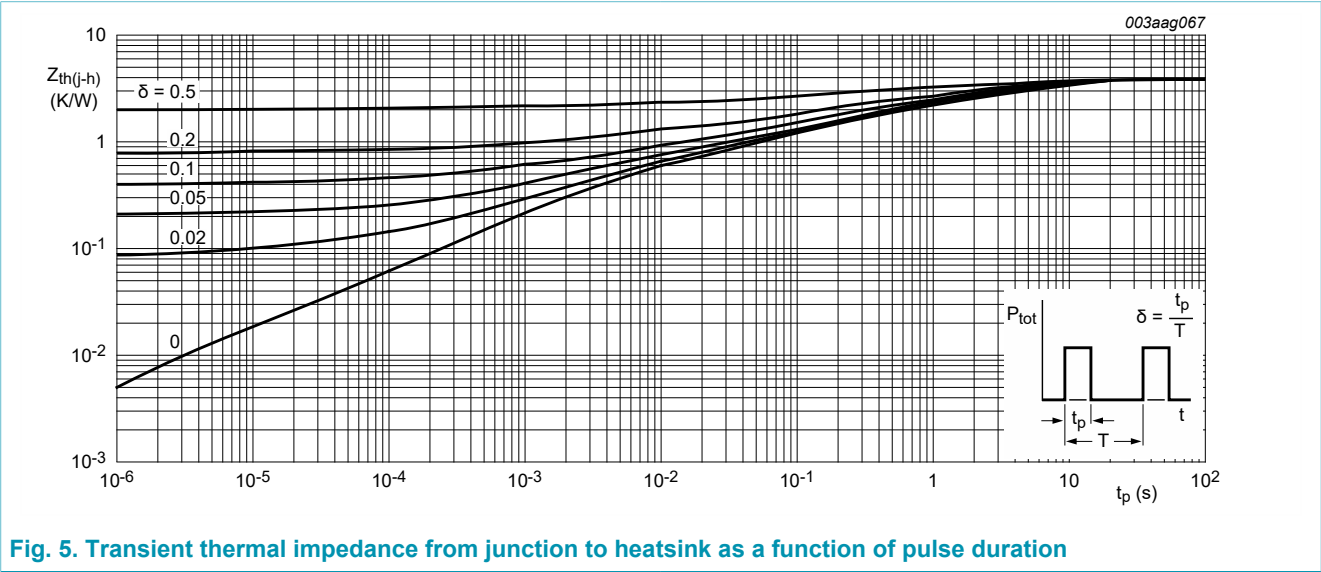


Fig. 5. Transient thermal impedance from junction to heatsink as a function of pulse duration

9. Isolation characteristics

Table 6. Isolation characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{isol(RMS)}$	RMS isolation voltage	$50\text{ Hz} \leq f \leq 60\text{ Hz}$ ; $RH \leq 65\%$ ; $T_h = 25\text{ }^\circ\text{C}$ ; 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

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
I <sub>CES</sub>	collector-emitter cut-off current (base shorted)	V <sub>BE</sub> = 0 V; V <sub>CE</sub> = 1000 V; Measured with half-sine wave voltage (curve tracer)		-	-	1	mA
				-	-	2	mA
I <sub>CBO</sub>	collector-base cut-off current (emitter open)	V <sub>CB</sub> = 1000 V; I <sub>E</sub> = 0 A; T <sub>h</sub> = 25 °C; Measured with half-sine wave voltage (curve tracer)		-	-	1	mA
I <sub>CEO</sub>	collector-emitter cut-off current (base open)	V <sub>CE</sub> = 500 V; I <sub>B</sub> = 0 A; T <sub>h</sub> = 25 °C; Measured with half-sine wave voltage (curve tracer)		-	-	0.1	mA
I <sub>EBO</sub>	emitter-base cut-off current (collector open)	V <sub>EB</sub> = 9 V; I <sub>C</sub> = 0 A; T <sub>h</sub> = 25 °C		-	-	0.1	mA
V <sub>CEOsus</sub>	collector-emitter sustaining voltage (base open)	I <sub>B</sub> = 0 A; I <sub>C</sub> = 100 mA; L <sub>C</sub> = 25 mH; T <sub>h</sub> = 25 °C; <a href="#">Fig. 6</a> ; <a href="#">Fig. 7</a>		500	-	-	V
V <sub>CEsat</sub>	collector-emitter saturation voltage	I <sub>C</sub> = 3 A; I <sub>B</sub> = 0.6 A; T <sub>h</sub> = 25 °C; <a href="#">Fig. 8</a> ; <a href="#">Fig. 9</a>		-	0.35	1.5	V
V <sub>BEsat</sub>	base-emitter saturation voltage	I <sub>C</sub> = 3 A; I <sub>B</sub> = 0.6 A; T <sub>h</sub> = 25 °C; <a href="#">Fig. 10</a>		-	1.01	1.3	V
h <sub>FE</sub>	DC current gain	I <sub>C</sub> = 5 mA; V <sub>CE</sub> = 5 V; T <sub>h</sub> = 25 °C; <a href="#">Fig. 11</a>		10	22	35	
		I <sub>C</sub> = 500 mA; V <sub>CE</sub> = 5 V; T <sub>h</sub> = 25 °C; <a href="#">Fig. 11</a>		14	25	35	
h <sub>FEsat</sub>	DC saturation current gain	I <sub>C</sub> = 2.5 A; V <sub>CE</sub> = 5 V; T <sub>h</sub> = 25 °C; <a href="#">Fig. 11</a>		10	13.5	17	
		I <sub>C</sub> = 3 A; V <sub>CE</sub> = 5 V; T <sub>h</sub> = 25 °C; <a href="#">Fig. 11</a>		-	11	-	
Dynamic characteristics (switching times - resistive load)							
t <sub>s</sub>	turn-off delay 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>h</sub> = 25 °C; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>		-	3.3	4	μs
t <sub>f</sub>	fall time			-	0.33	0.45	μs
Dynamic characteristics (switching times - inductive load)							
t <sub>s</sub>	turn-off delay time	I <sub>C</sub> = 2.5 A; I <sub>Bon</sub> = 0.5 A; V <sub>BB</sub> = -5 V; L <sub>B</sub> = 1 μH; T <sub>h</sub> = 25 °C; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>		-	1.4	1.6	μs
		I <sub>C</sub> = 2.5 A; I <sub>Bon</sub> = 0.5 A; V <sub>BB</sub> = -5 V; L <sub>B</sub> = 1 μH; T <sub>h</sub> = 100 °C; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>		-	1.7	1.9	μs
t <sub>r</sub>	rise time	I <sub>C</sub> = 2.5 A; I <sub>Bon</sub> = 0.5 A; V <sub>BB</sub> = -5 V; L <sub>B</sub> = 1 μH; T <sub>h</sub> = 25 °C; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>		-	145	160	ns
		I <sub>C</sub> = 2.5 A; I <sub>Bon</sub> = 0.5 A; V <sub>BB</sub> = -5 V; L <sub>B</sub> = 1 μH; T <sub>h</sub> = 100 °C; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>		-	160	200	ns

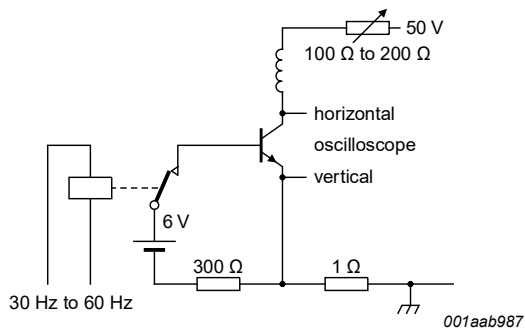


Fig. 6. Test circuit for collector-emitter sustaining voltage

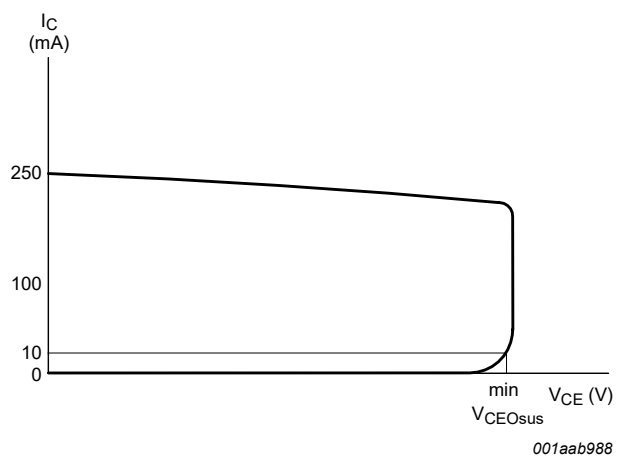


Fig. 7. Oscilloscope display for collector-emitter sustaining voltage test waveform

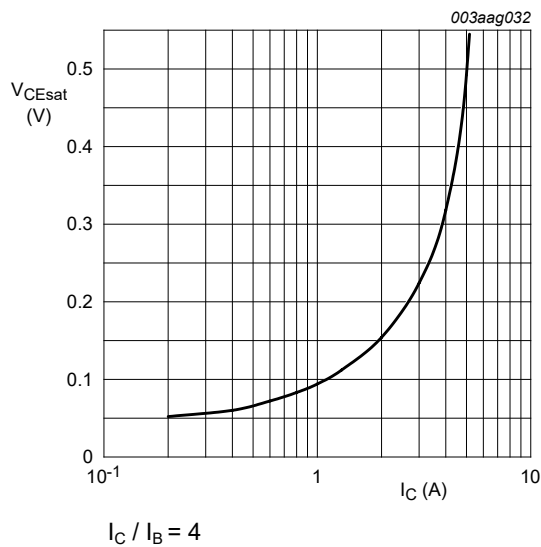


Fig. 8. Collector-emitter saturation voltage as a function of collector current; typical values

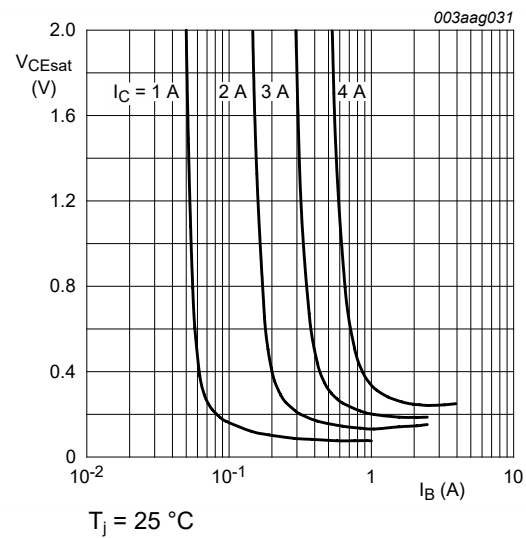


Fig. 9. Collector-emitter saturation voltage as a function of base current; typical values

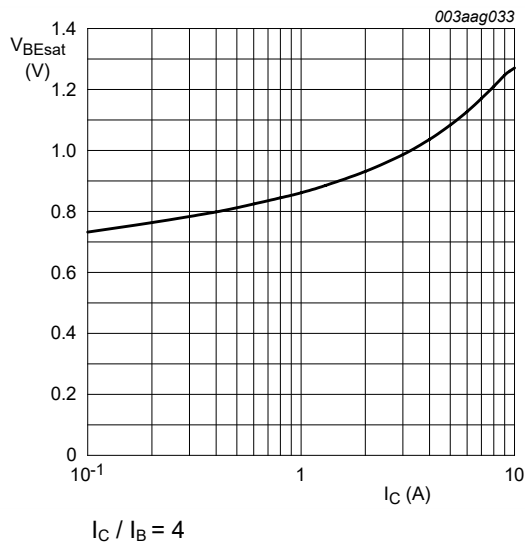


Fig. 10. Base-emitter saturation voltage as a function of collector current; typical values

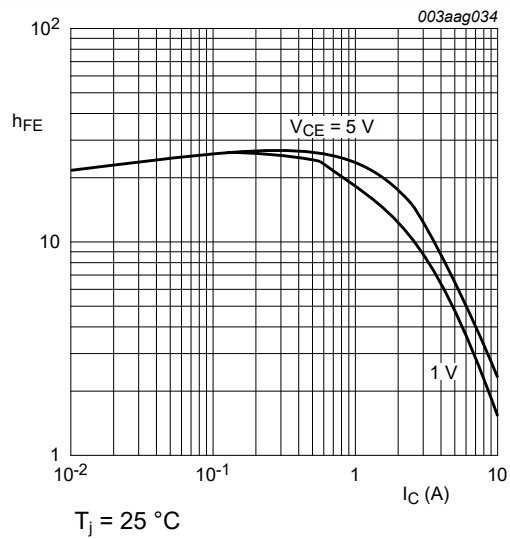
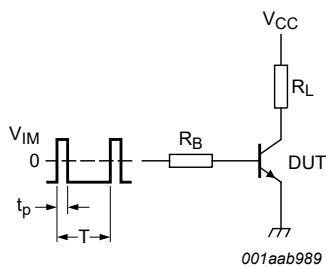


Fig. 11. DC current gain as a function of collector current; typical values



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

Fig. 12. Test circuit for resistive load switching

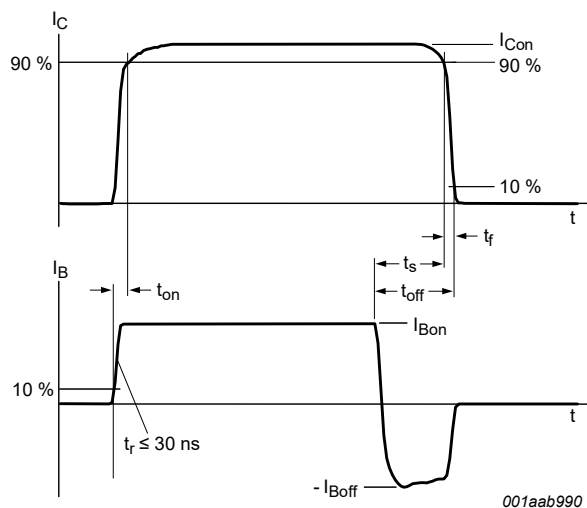
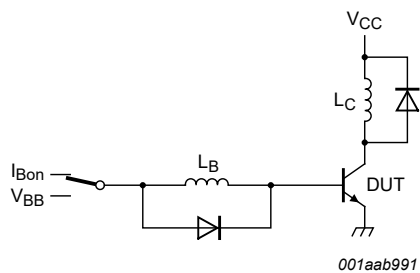


Fig. 13. Switching times waveforms for resistive load



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

Fig. 14. Test circuit for inductive load switching

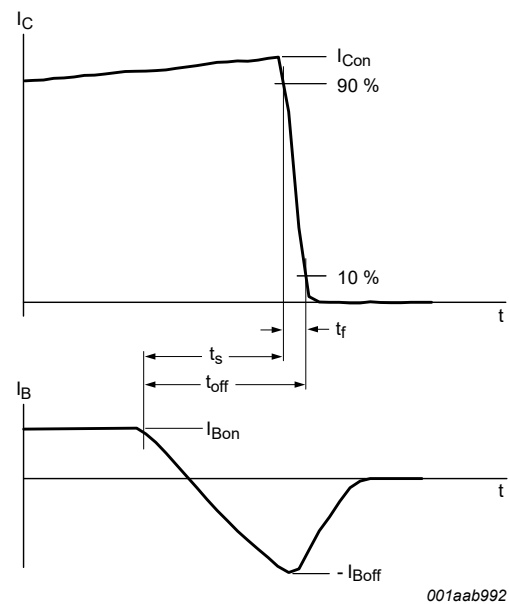


Fig. 15. Switching times waveforms for inductive load

11. Package outline

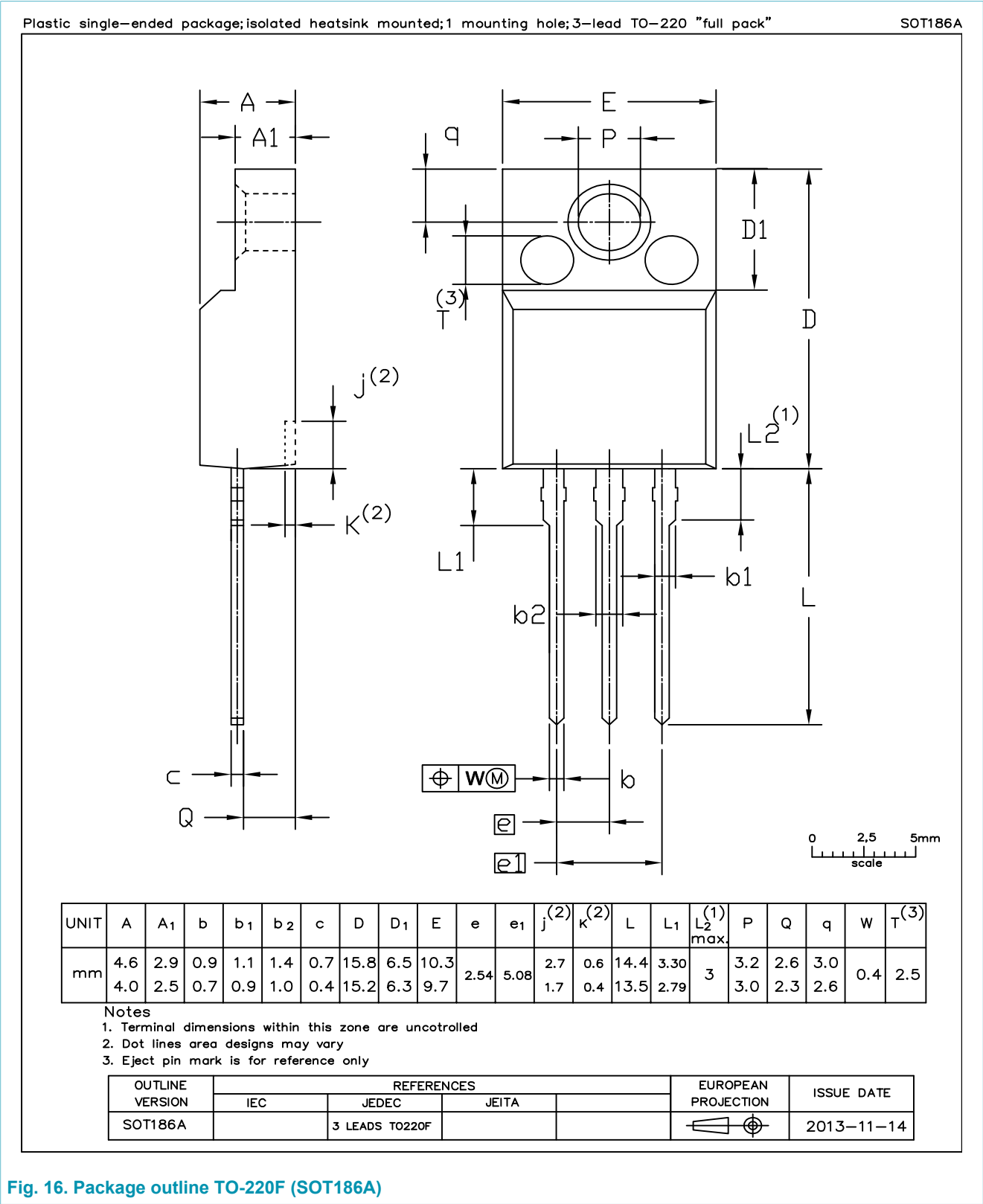


Fig. 16. Package outline TO-220F (SOT186A)

## 12. 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.
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Date of release: 9 October 2018