

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.

2. Features and benefits

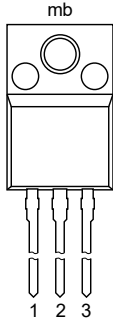
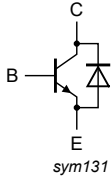
- Fast switching
- High voltage capability
- Integrated anti-parallel E-C diode
- Isolated package
- Very low switching and conduction losses

3. Applications

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

4. Pinning information

Table 1. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 <p>mb</p> <p>1 2 3</p> <p>TO-220F (SOT186A)</p>	 <p>C</p> <p>B</p> <p>E</p> <p>sym131</p>
2	C	collector		
3	E	emitter		
mb	n.c.	mounting base; isolated		

5. Ordering information

Table 2. 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

6. Limiting values

Table 3. 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; Fig. 1; Fig. 2; Fig. 3	-	4	A
I_{CM}	peak collector current	Fig. 1; Fig. 2; Fig. 3	-	8	A
I_B	base current	DC	-	2	A
I_{BM}	peak base current		-	4	A
P_{tot}	total power dissipation	$T_h \leq 25\text{ °C}$; Fig. 4	-	26	W
T_{stg}	storage temperature		-65	150	°C
T_j	junction temperature		-	150	°C

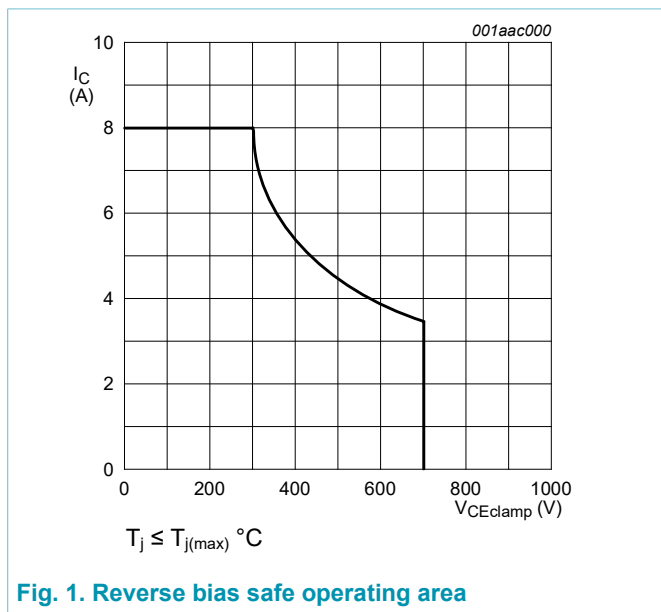
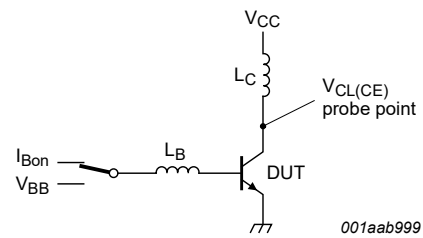
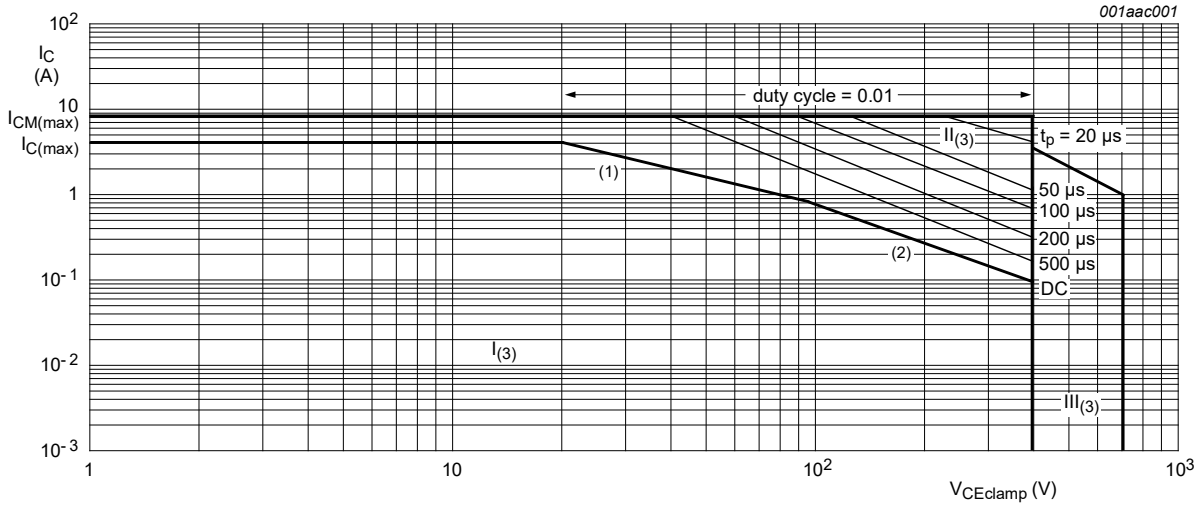


Fig. 1. Reverse bias safe operating area



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

Fig. 2. Test circuit for reverse bias safe operating area



- 1) Ptot maximum and Ptot 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 $T_{mb} \leq 25 \text{ }^\circ\text{C}$

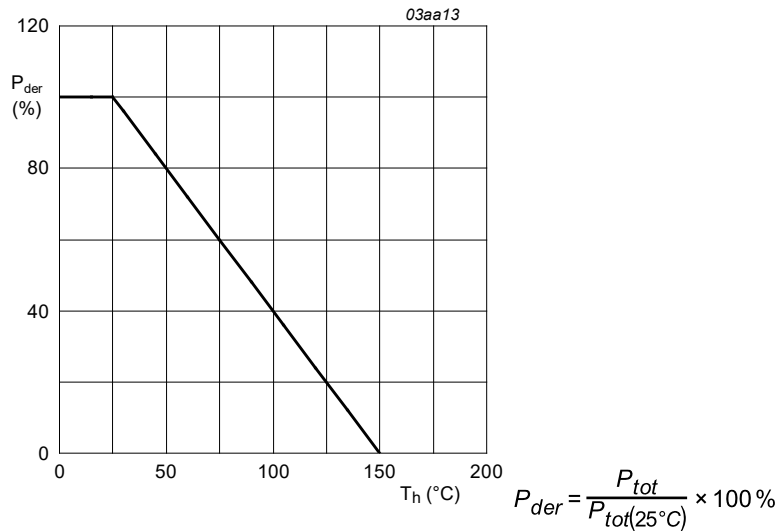


Fig. 4. Normalized total power dissipation as a function of heatsink temperature

7. Thermal characteristics

Table 4. Thermal characteristics

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

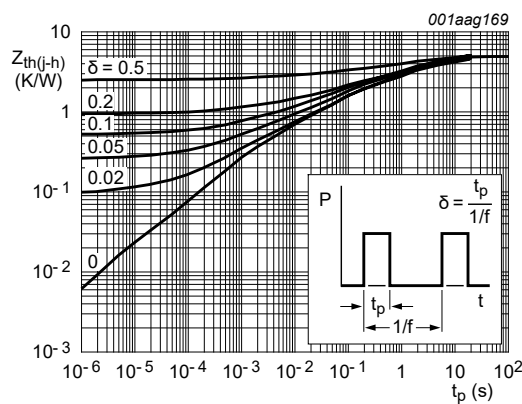


Fig. 5. Transient thermal impedance from junction to heatsink as a function of pulse duration

8. Isolation characteristics

Table 5. 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	$T_h = 25 \text{ }^\circ\text{C}$; $f = 1 \text{ MHz}$; from collector to external heatsink	-	10	-	pF

9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
I_{CES}	collector-emitter cut-off current (base shorted)	$V_{BE} = 0\text{ V}; V_{CE} = 850\text{ V}; T_j = 125\text{ }^\circ\text{C}$	[1]	-	-	2	mA
		$V_{BE} = 0\text{ V}; V_{CE} = 850\text{ V}; T_j = 25\text{ }^\circ\text{C}$	[1]	-	-	1	mA
I_{CBO}	collector-base cut-off current (emitter open)	$V_{CB} = 850\text{ V}; I_E = 0\text{ A}$	[1]	-	-	1	mA
I_{CEO}	collector-emitter cut-off current (base open)	$V_{CE} = 425\text{ V}; I_B = 0\text{ A}$	[1]	-	-	0.1	mA
I_{EBO}	emitter-base cut-off current (collector open)	$V_{EB} = 7\text{ V}; I_C = 0\text{ A}$		-	-	10	mA
V_{CE0sus}	collector-emitter sustaining voltage (base open)	$I_B = 0\text{ A}; I_C = 10\text{ mA}; L_C = 25\text{ mH};$ Fig. 6 ; Fig. 7		400	450	-	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 3\text{ A}; I_B = 0.6\text{ A};$ Fig. 8 ; Fig. 9		-	0.29	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 3\text{ A}; I_B = 0.6\text{ A};$ Fig. 10		-	0.99	1.5	V
V_F	forward voltage	$I_F = 2\text{ A}; T_j = 25\text{ }^\circ\text{C}$		-	1.04	1.5	V
h_{FE}	DC current gain	$I_C = 1\text{ mA}; V_{CE} = 5\text{ V}; T_h = 25\text{ }^\circ\text{C};$ Fig. 11		10	15	32	
		$I_C = 500\text{ mA}; V_{CE} = 5\text{ V}; T_h = 25\text{ }^\circ\text{C};$ Fig. 11		13	21	32	
		$I_C = 2\text{ A}; V_{CE} = 5\text{ V}; T_h = 25\text{ }^\circ\text{C};$ Fig. 11		11	16	22	
		$I_C = 3\text{ A}; V_{CE} = 5\text{ V}; T_h = 25\text{ }^\circ\text{C};$ Fig. 11		-	12.5	-	
Dynamic characteristics							
t_{on}	turn-on time	$I_C = 2.5\text{ A}; I_{Bon} = 0.5\text{ A}; I_{Boff} = -0.5\text{ A};$ $R_L = 75\text{ }\Omega; T_j = 25\text{ }^\circ\text{C};$ resistive load; Fig. 12 ; Fig. 13		-	0.52	0.6	μs
t_s	storage time	$I_C = 2\text{ A}; I_{Bon} = 0.4\text{ A}; V_{BB} = -5\text{ V};$ $L_B = 1\text{ }\mu\text{H}; T_j = 25\text{ }^\circ\text{C};$ inductive load; Fig. 14 ; Fig. 15		-	2.7	3.3	μs
		$I_C = 2\text{ A}; I_{Bon} = 0.4\text{ A}; V_{BB} = -5\text{ V};$ $L_B = 1\text{ }\mu\text{H}; T_j = 100\text{ }^\circ\text{C};$ inductive load; Fig. 14 ; Fig. 15		-	1.2	1.4	μs
		$I_C = 2\text{ A}; I_{Bon} = 0.4\text{ A}; V_{BB} = -5\text{ V};$ $L_B = 1\text{ }\mu\text{H}; T_j = 100\text{ }^\circ\text{C};$ inductive load; Fig. 14 ; Fig. 15		-	-	1.8	μs
t_f	fall time	$I_C = 2.5\text{ A}; I_{Bon} = 0.5\text{ A}; I_{Boff} = -0.5\text{ A};$ $R_L = 75\text{ }\Omega;$ resistive load; Fig. 12 ; Fig. 13		-	0.3	0.35	μs
		$I_C = 2\text{ A}; I_{Bon} = 0.4\text{ A}; V_{BB} = -5\text{ V};$ $L_B = 1\text{ }\mu\text{H};$ inductive load; Fig. 14 ; Fig. 15		-	-	0.12	μs
				-	0.03	0.06	μs

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

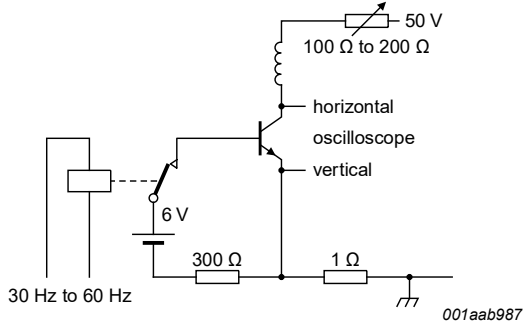


Fig. 6. Test circuit for collector-emitter sustaining voltage

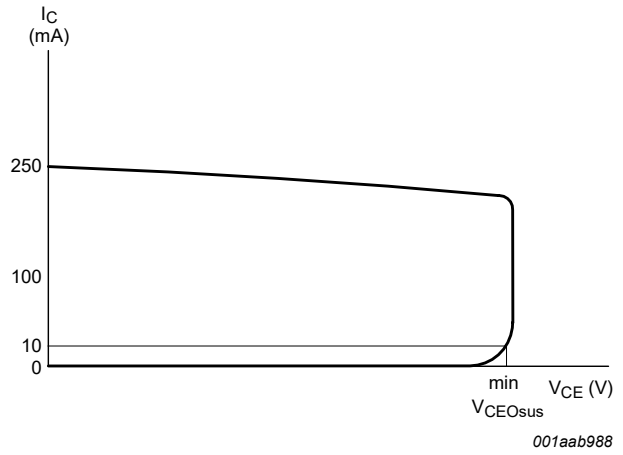


Fig. 7. Oscilloscope display for collector-emitter sustaining voltage test waveform

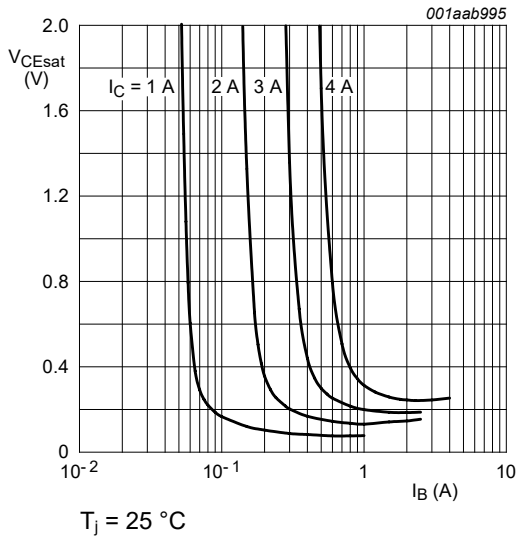


Fig. 8. Collector-emitter saturation voltage as a function of base current; typical values

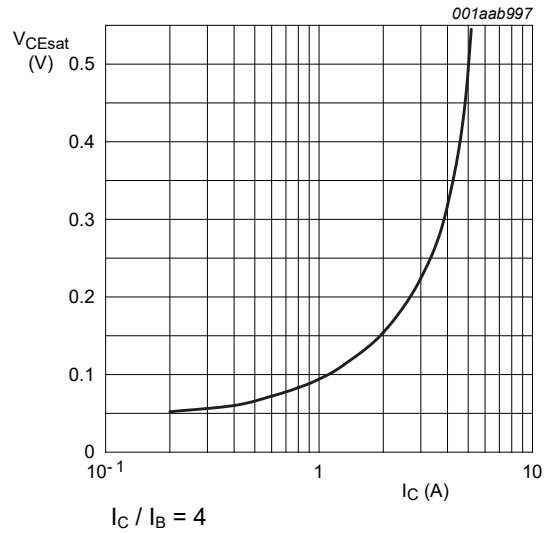


Fig. 9. Collector-emitter saturation voltage as a function of collector current; typical values

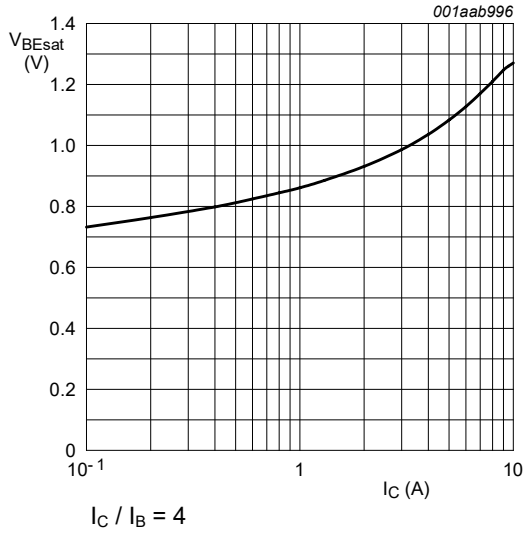


Fig. 10. Base-emitter saturation voltage as a function of collector current; typical values

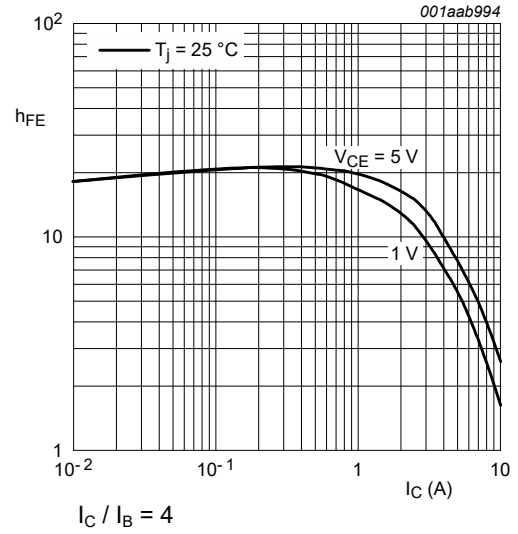
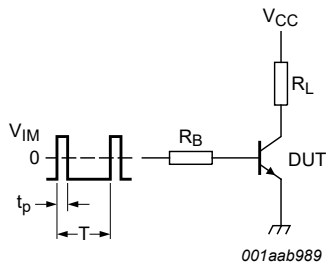


Fig. 11. DC current gain as a function of collector current; typical values



$V_{IM} = -6$ to $+8$ V; $V_{CC} = 250$ V; $t_p = 20$ μ 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

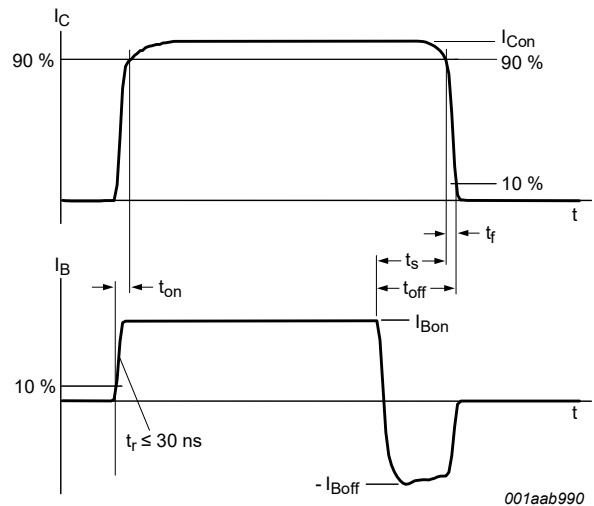
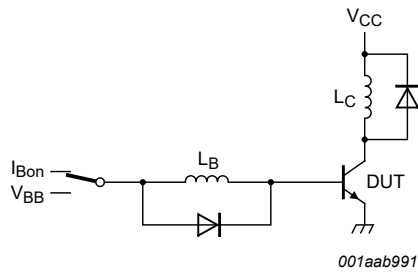


Fig. 13. Switching times waveforms for resistive load



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

Fig. 14. Test circuit for inductive load switching

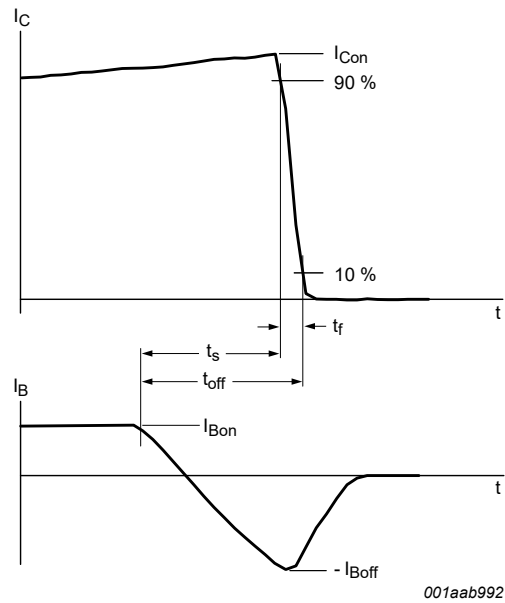


Fig. 15. Switching times waveforms for inductive load

10. Package outline

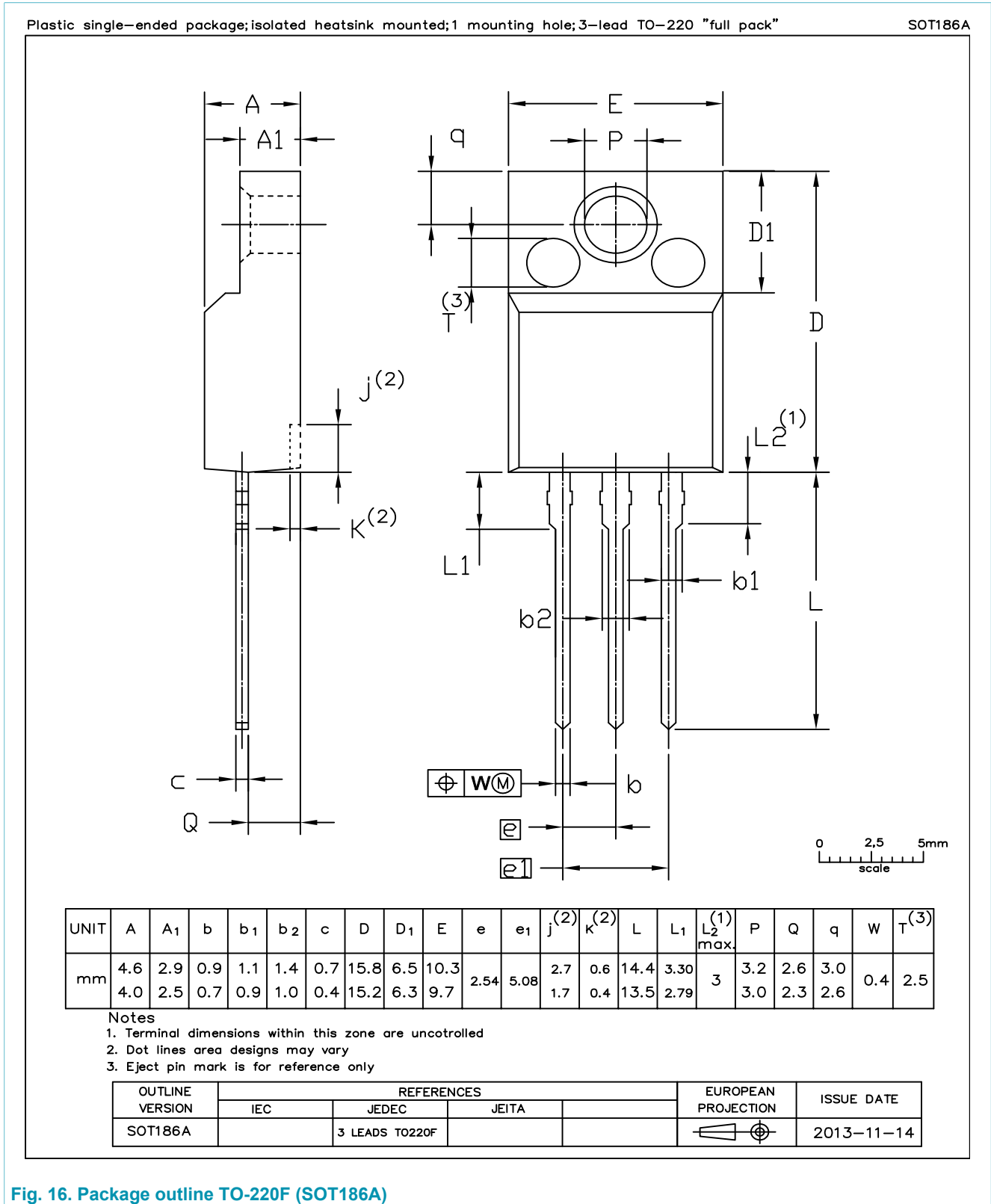


Fig. 16. Package outline TO-220F (SOT186A)

11. Legal information

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Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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Product [short] data sheet	Production	This document contains the product specification.

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