

1. General description

High voltage, high speed planar passivated NPN power switching transistor in a SOT186A (TO-220F) "full pack" plastic package.

2. Features and benefits

- Fast switching
- Isolated package
- Low thermal resistance
- 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

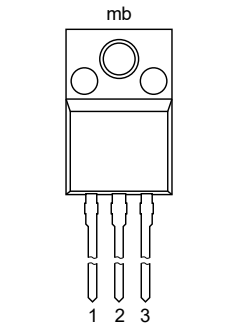
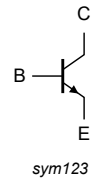
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CM}	peak collector current	Fig. 1 ; Fig. 2 ; Fig. 3	-	-	8	A
P_{tot}	total power dissipation	$T_h \leq 25\text{ °C}$; Fig. 4	-	-	26	W
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0\text{ V}$	-	-	1050	V
Static characteristics						
h_{FE}	DC current gain	$I_C = 0.1\text{ A}$; $V_{CE} = 5\text{ V}$; $T_h = 25\text{ °C}$; Fig. 11	48	66	100	
		$I_C = 0.8\text{ A}$; $V_{CE} = 3\text{ V}$; $T_h = 25\text{ °C}$; Fig. 12	25	42	50	

5. Pinning information

Table 2. Pinning information

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

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUJ302AX	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_{CESM}	collector-emitter peak voltage	$V_{BE} = 0\text{ V}$	-	1050	V
V_{CEO}	collector-emitter voltage	$I_B = 0\text{ A}$	-	400	V
V_{EBO}	emitter-base voltage	$I_C = 0\text{ A}; I_E = 2\text{ A}; t_p < 10\text{ ms}$	-	24	V
I_C	collector current	Fig. 1 ; Fig. 2 ; Fig. 3	-	4	A
I_{CM}	peak collector current		-	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

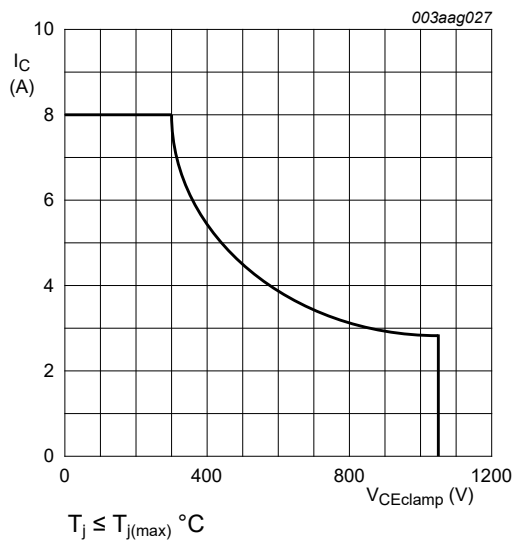
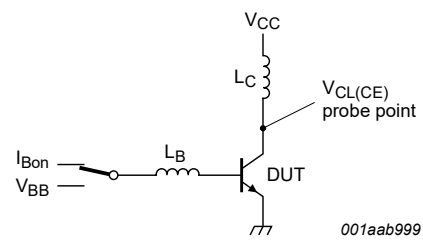
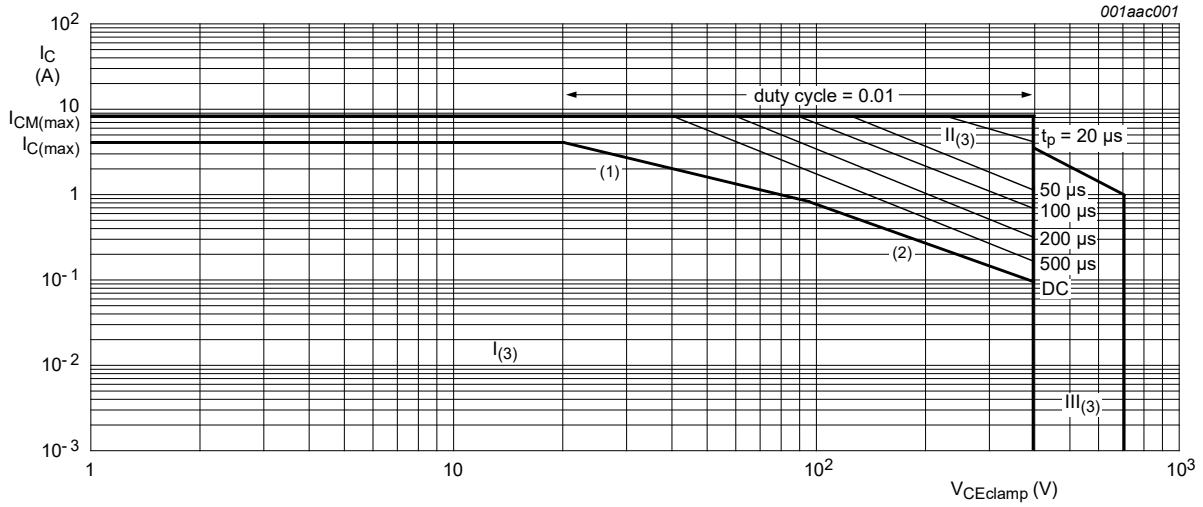


Fig. 1. Reverse bias safe operating area



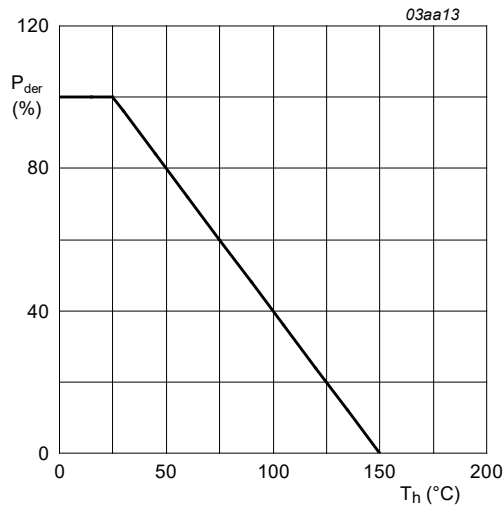
$V_{CL(CE)} \leq 1000\text{ V}; V_{CC} = 150\text{ V}; V_{BB} = -5\text{ V};$
 $L_B = 1\text{ }\mu\text{H}; L_C = 200\text{ }\mu\text{H}$

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



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



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

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

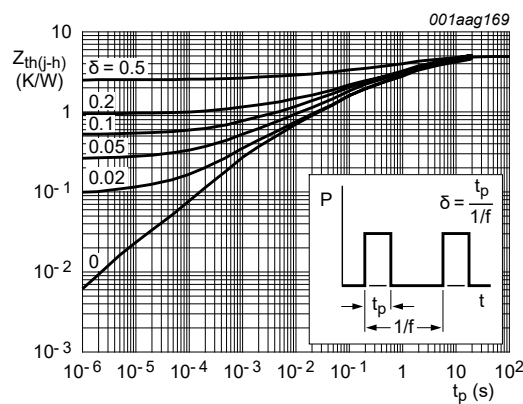


Fig. 5. Transient thermal impedance from junction to heatsink as a function of pulse duration

9. 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 %; $T_h = 25\text{ °C}$; from all terminals to external heatsink; clean and dust free	-	-	2500	V
C_{isol}	isolation capacitance	from collector to external heatsink; f = 1 MHz; $T_h = 25\text{ °C}$	-	10	-	pF

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
I_{CES}	collector-emitter cut-off current (base shorted)	$V_{BE} = 0\text{ V}; V_{CE} = 1050\text{ V}; T_J = 25\text{ }^\circ\text{C}$	-	0.2	10	μA
I_{CEO}	collector-emitter cut-off current (base open)	$V_{CE} = 400\text{ V}; I_B = 0\text{ A}; T_h = 25\text{ }^\circ\text{C}$	-	10	250	μA
$V_{(BR)EBO}$	emitter-base breakdown voltage (collector open)	$I_B = 1\text{ mA}; I_C = 0\text{ A}; T_h = 25\text{ }^\circ\text{C}$	15	19	-	V
V_{CEOsus}	collector-emitter sustaining voltage (base open)	$I_B = 0\text{ A}; I_C = 10\text{ mA}; L_C = 25\text{ mH}; T_h = 25\text{ }^\circ\text{C};$ Fig. 6 ; Fig. 7	400	470	-	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 1\text{ A}; I_B = 0.2\text{ A}; T_h = 25\text{ }^\circ\text{C};$ Fig. 8 ; Fig. 9	-	0.15	0.5	V
		$I_C = 3.5\text{ A}; I_B = 1\text{ A}; T_h = 25\text{ }^\circ\text{C};$ Fig. 8 ; Fig. 9	-	0.6	1.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 3.5\text{ A}; I_B = 1\text{ A}; T_h = 25\text{ }^\circ\text{C};$ Fig. 10	-	1.1	1.5	V
h_{FE}	DC current gain	$I_C = 0.1\text{ A}; V_{CE} = 5\text{ V}; T_h = 25\text{ }^\circ\text{C};$ Fig. 11	48	66	100	
		$I_C = 0.8\text{ A}; V_{CE} = 3\text{ V}; T_h = 25\text{ }^\circ\text{C};$ Fig. 12	25	42	50	
Dynamic characteristics						
t_s	storage time	$I_C = 2.5\text{ A}; I_{B(on)} = 0.5\text{ A}; I_{B(off)} = -0.5\text{ A}; R_L = 60\text{ }\Omega; V_{BB} = -5\text{ V}; T_h = 25\text{ }^\circ\text{C};$ resistive load; $t_p = 300\text{ }\mu\text{s};$ Fig. 13 ; Fig. 14	-	-	3.5	μs
t_f	fall time		-	-	500	ns

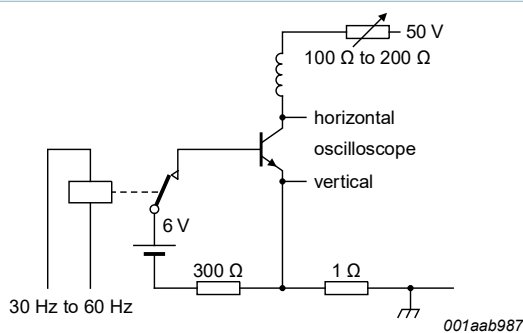


Fig. 6. Test circuit for collector-emitter sustaining voltage

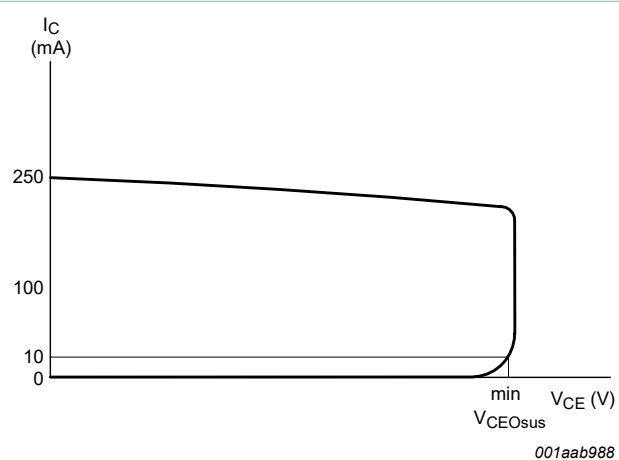


Fig. 7. Oscilloscope display for collector-emitter sustaining voltage test waveform

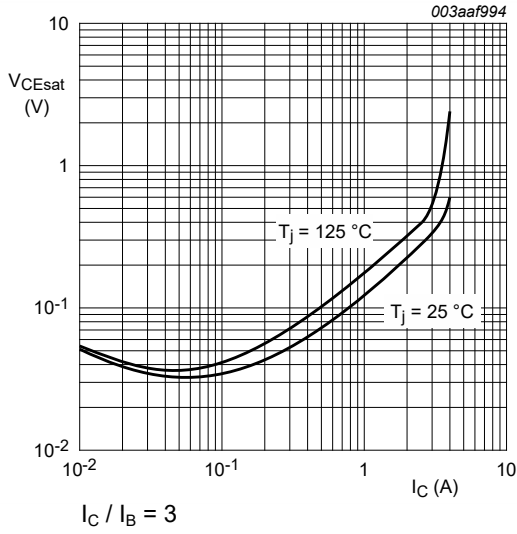


Fig. 8. Collector-emitter saturation voltage as a function of collector current; typical values

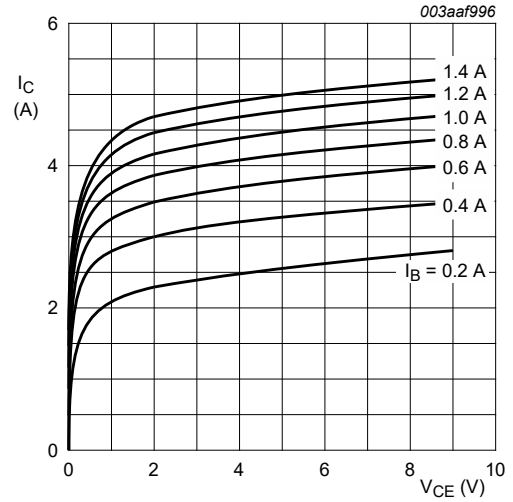


Fig. 9. Collector current as a function of collector-emitter voltage; typical values

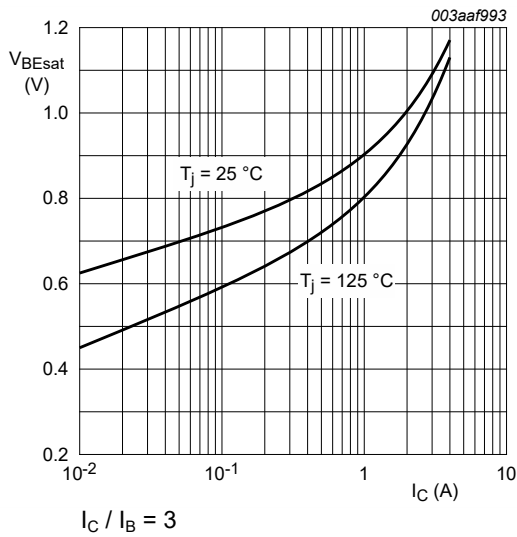


Fig. 10. Base-emitter saturation voltage as a function of collector current; typical values

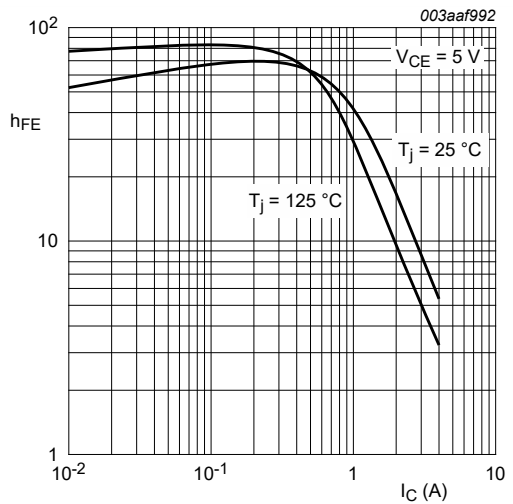


Fig. 11. DC current gain as a function of collector current; typical values

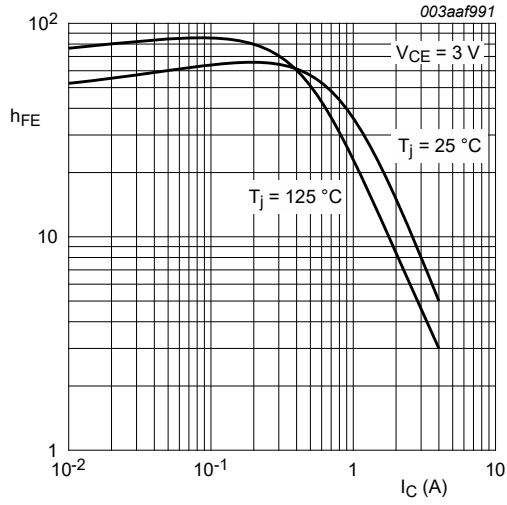
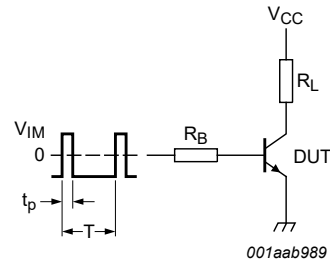


Fig. 12. DC current gain as a function of collector current; typical values



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

Fig. 13. Test circuit for resistive load switching

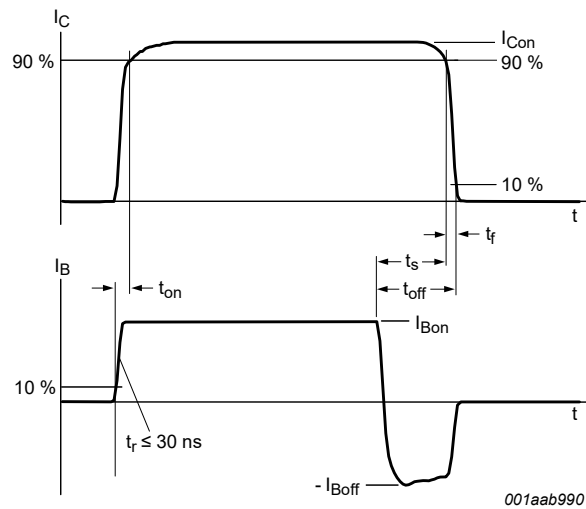


Fig. 14. Switching times waveforms for resistive load

11. Package outline

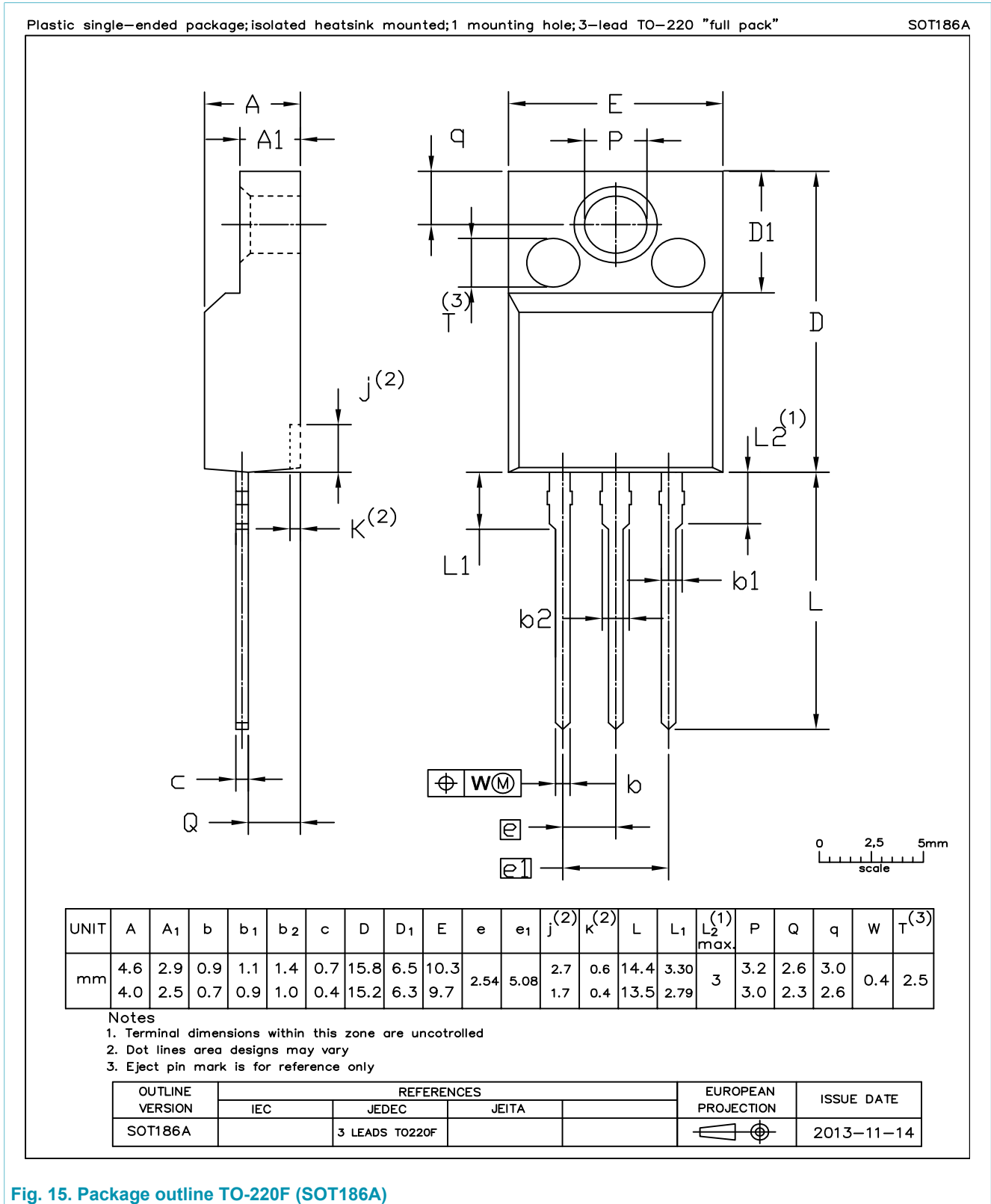


Fig. 15. Package outline TO-220F (SOT186A)

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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