

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

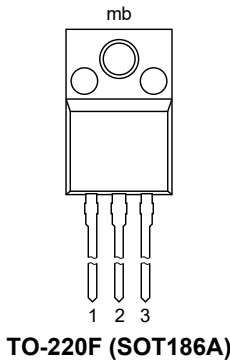
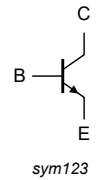
4. Quick reference data

Table 1. Quick reference data

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

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 <p>mb</p> <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

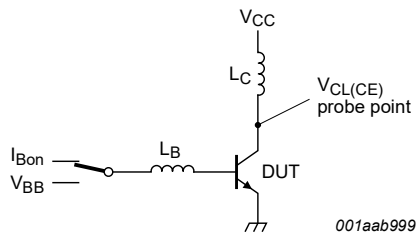
Type number	Package		
	Name	Description	Version
BUJ303AX	TO-220F	plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack"	SOT186A

7. Limiting values

Table 4. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{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	Fig. 1 ; Fig. 2 ; Fig. 3	-	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	$T_h \leq 25\text{ °C}$; Fig. 4	-	32	W
T_{stg}	storage temperature		-65	150	°C
T_j	junction temperature		-	150	°C



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

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

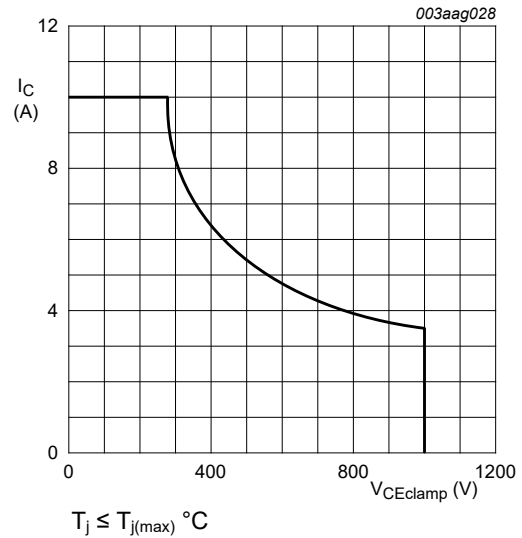
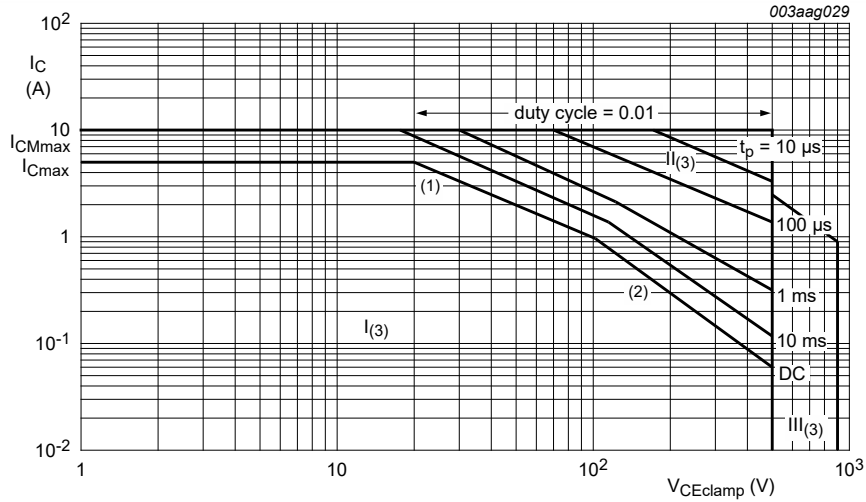


Fig. 2. Reverse bias safe operating area



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

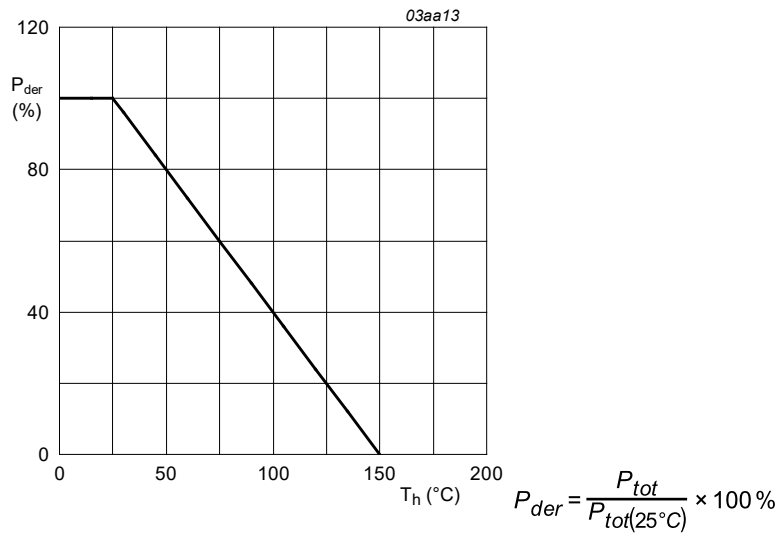


Fig. 4. Normalized total power dissipation as a function of heatsink temperature

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

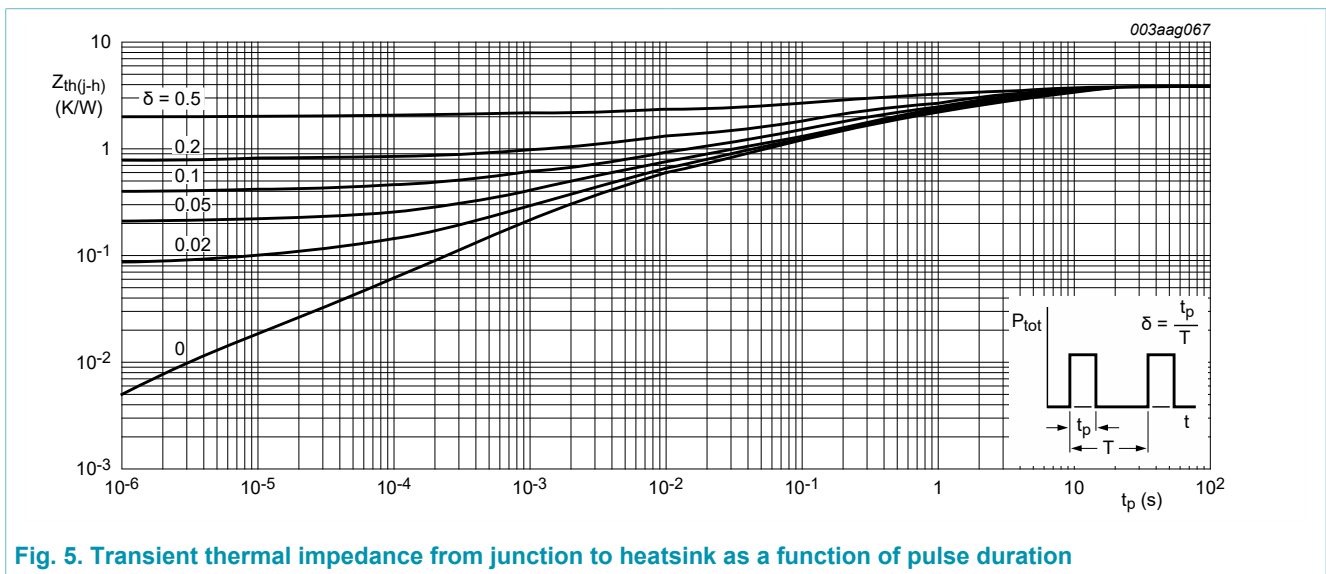


Fig. 5. Transient thermal impedance from junction to heatsink as a function of pulse duration

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_{CES}	collector-emitter cut-off current (base shorted)	$V_{BE} = 0\text{ V}$; $V_{CE} = 1000\text{ V}$; Measured with half-sine wave voltage (curve tracer)	-	-	1	mA
			-	-	2	mA
I_{CBO}	collector-base cut-off current (emitter open)	$V_{CB} = 1000\text{ V}$; $I_E = 0\text{ A}$; $T_h = 25\text{ °C}$; Measured with half-sine wave voltage (curve tracer)	-	-	1	mA
I_{CEO}	collector-emitter cut-off current (base open)	$V_{CE} = 500\text{ V}$; $I_B = 0\text{ A}$; $T_h = 25\text{ °C}$; Measured with half-sine wave voltage (curve tracer)	-	-	0.1	mA
I_{EBO}	emitter-base cut-off current (collector open)	$V_{EB} = 9\text{ V}$; $I_C = 0\text{ A}$; $T_h = 25\text{ °C}$	-	-	0.1	mA
V_{CEOsus}	collector-emitter sustaining voltage (base open)	$I_B = 0\text{ A}$; $I_C = 100\text{ mA}$; $L_C = 25\text{ mH}$; $T_h = 25\text{ °C}$; Fig. 6 ; Fig. 7	500	-	-	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 3\text{ A}$; $I_B = 0.6\text{ A}$; $T_h = 25\text{ °C}$; Fig. 8 ; Fig. 9	-	0.35	1.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 3\text{ A}$; $I_B = 0.6\text{ A}$; $T_h = 25\text{ °C}$; Fig. 10	-	1.01	1.3	V
h_{FE}	DC current gain	$I_C = 5\text{ mA}$; $V_{CE} = 5\text{ V}$; $T_h = 25\text{ °C}$; Fig. 11	10	22	35	
		$I_C = 500\text{ mA}$; $V_{CE} = 5\text{ V}$; $T_h = 25\text{ °C}$; Fig. 11	14	25	35	
h_{FEsat}	DC saturation current gain	$I_C = 2.5\text{ A}$; $V_{CE} = 5\text{ V}$; $T_h = 25\text{ °C}$; Fig. 11	10	13.5	17	
		$I_C = 3\text{ A}$; $V_{CE} = 5\text{ V}$; $T_h = 25\text{ °C}$; Fig. 11	-	11	-	
Dynamic characteristics (switching times - resistive load)						
t_s	turn-off delay time	$I_C = 2.5\text{ A}$; $I_{B(on)} = 0.5\text{ A}$; $I_{B(off)} = -0.5\text{ A}$; $R_L = 75\text{ }\Omega$; $T_h = 25\text{ °C}$; Fig. 12 ; Fig. 13	-	3.3	4	μs
t_f	fall time		-	0.33	0.45	μs
Dynamic characteristics (switching times - inductive load)						
t_s	turn-off delay time	$I_C = 2.5\text{ A}$; $I_{B(on)} = 0.5\text{ A}$; $V_{BB} = -5\text{ V}$; $L_B = 1\text{ }\mu\text{H}$; $T_h = 25\text{ °C}$; Fig. 14 ; Fig. 15	-	1.4	1.6	μs
		$I_C = 2.5\text{ A}$; $I_{B(on)} = 0.5\text{ A}$; $V_{BB} = -5\text{ V}$; $L_B = 1\text{ }\mu\text{H}$; $T_h = 100\text{ °C}$; Fig. 14 ; Fig. 15	-	1.7	1.9	μs
t_r	rise time	$I_C = 2.5\text{ A}$; $I_{B(on)} = 0.5\text{ A}$; $V_{BB} = -5\text{ V}$; $L_B = 1\text{ }\mu\text{H}$; $T_h = 25\text{ °C}$; Fig. 14 ; Fig. 15	-	145	160	ns
		$I_C = 2.5\text{ A}$; $I_{B(on)} = 0.5\text{ A}$; $V_{BB} = -5\text{ V}$; $L_B = 1\text{ }\mu\text{H}$; $T_h = 100\text{ °C}$; Fig. 14 ; Fig. 15	-	160	200	ns

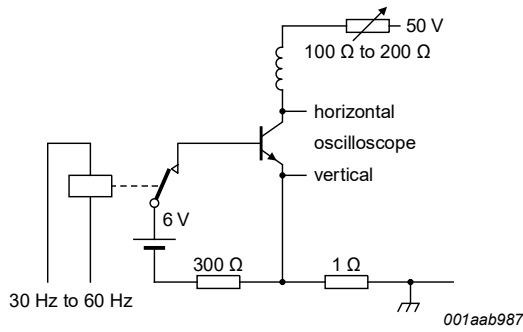


Fig. 6. Test circuit for collector-emitter sustaining voltage

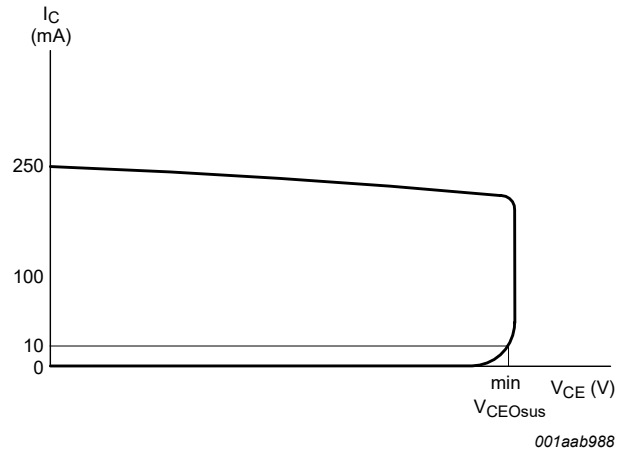


Fig. 7. Oscilloscope display for collector-emitter sustaining voltage test waveform

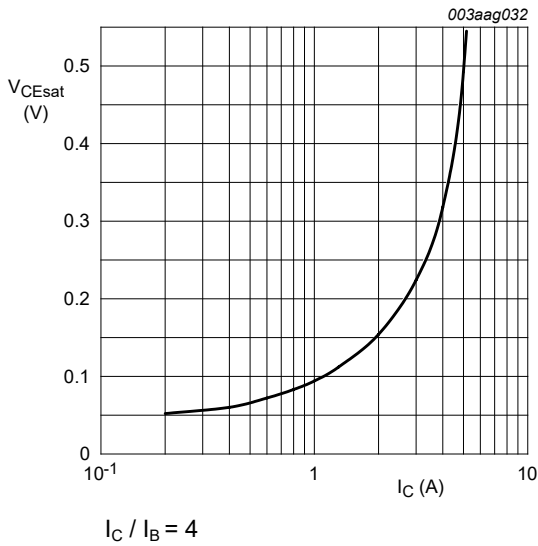


Fig. 8. Collector-emitter saturation voltage as a function of collector current; typical values

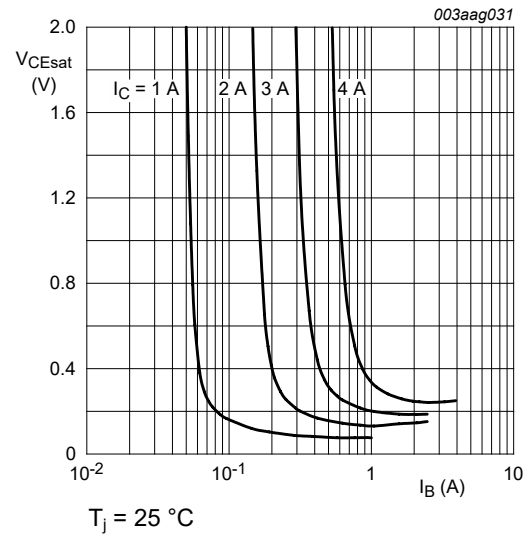


Fig. 9. Collector-emitter saturation voltage as a function of base current; typical values

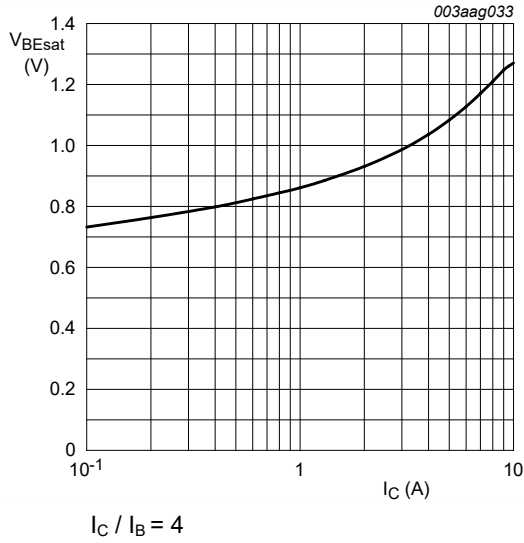


Fig. 10. Base-emitter saturation voltage as a function of collector current; typical values

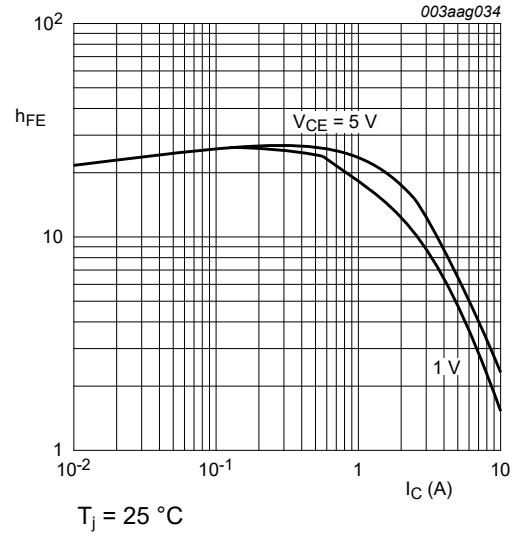
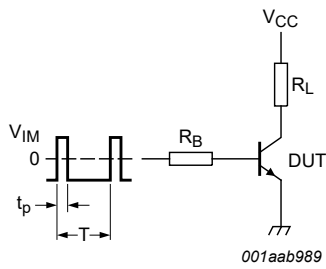


Fig. 11. DC current gain as a function of collector current; typical values



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

Fig. 12. Test circuit for resistive load switching

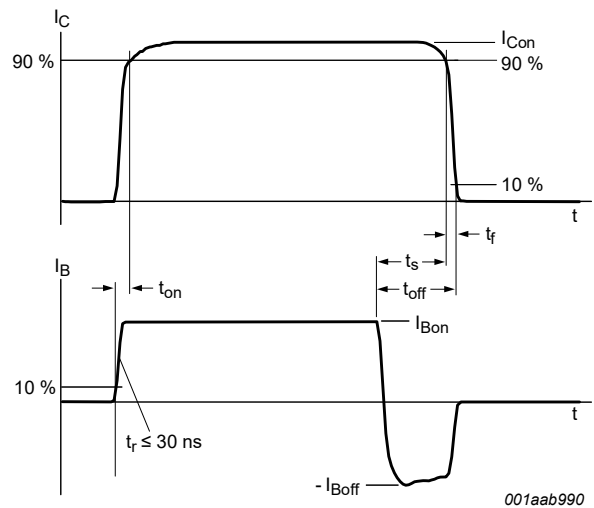
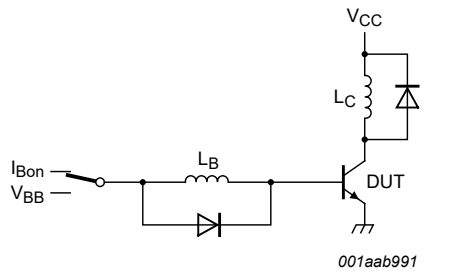


Fig. 13. Switching times waveforms for resistive load



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

Fig. 14. Test circuit for inductive load switching

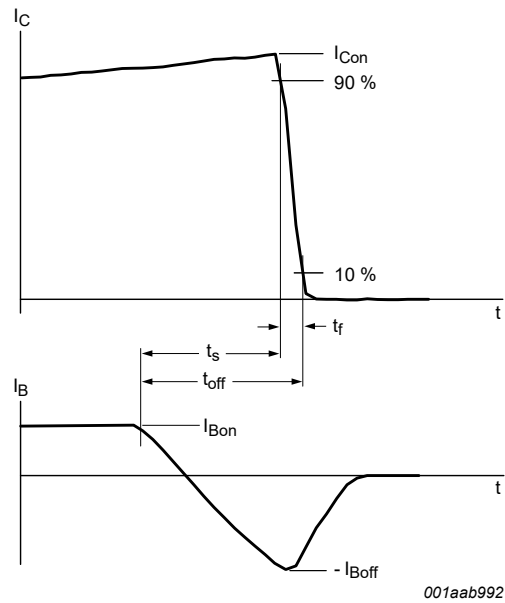


Fig. 15. Switching times waveforms for inductive load

11. Package outline

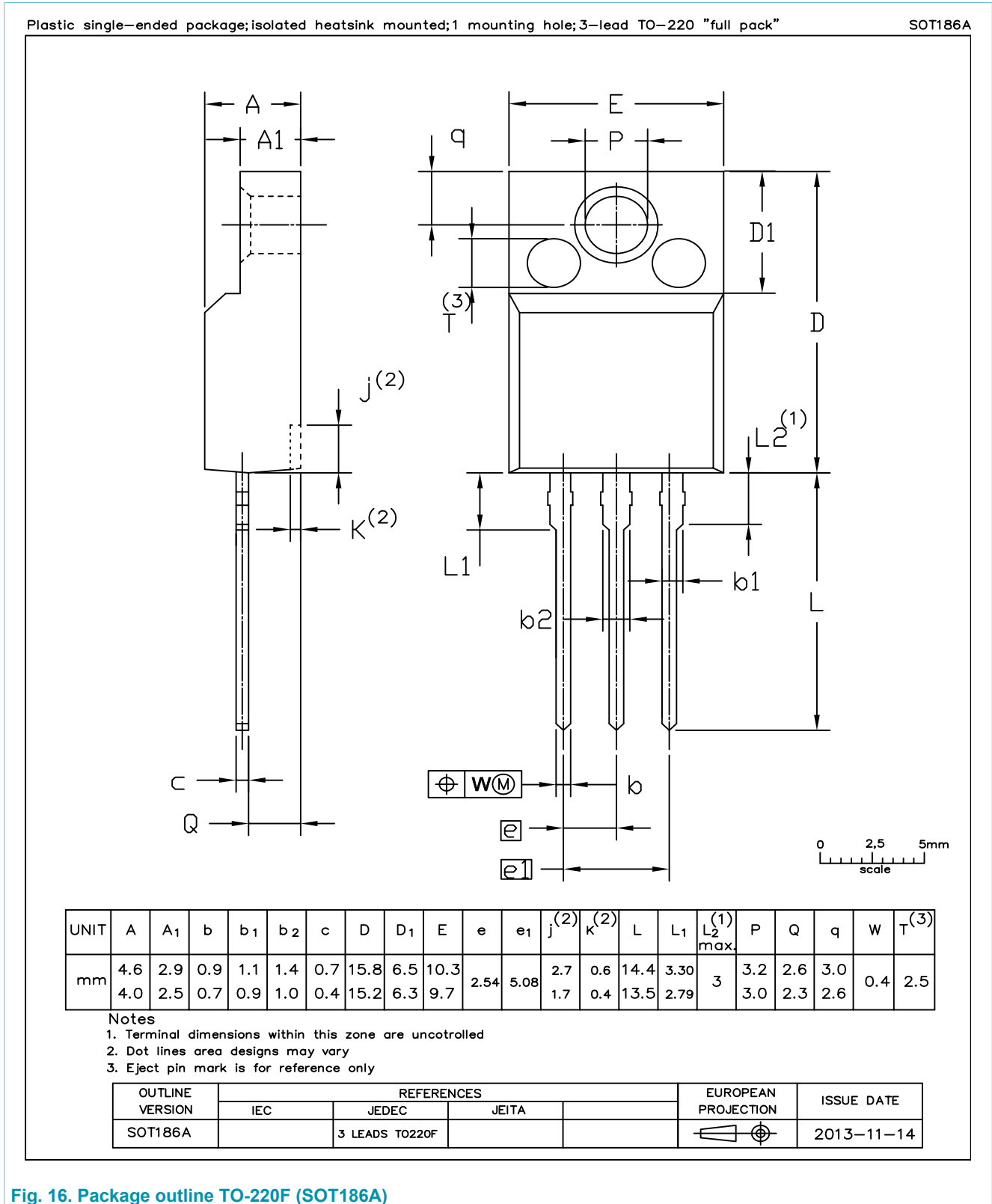


Fig. 16. Package outline TO-220F (SOT186A)

12. 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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