

# BUJ103AD

Silicon diffused power transistor

Rev. 01 — 14 December 2004

Product data sheet

## 1. Product profile

### 1.1 General description

High-voltage, high-speed planar-passivated NPN power switching transistor in a SOT428 (D-PAK) surface mounted package.

### 1.2 Features

- Low thermal resistance
- Fast switching

### 1.3 Applications

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

### 1.4 Quick reference data

- $V_{CESM} \leq 700$  V
- $I_C \leq 4$  A
- $P_{tot} \leq 80$  W
- $h_{FEsat} = 12.5$  (typ)

## 2. Pinning information

Table 1: Pinning

Pin	Description	Simplified outline	Symbol
1	base	<p>SOT428 (D-PAK)</p>	<p>sym056</p>
2	collector <a href="#">[1]</a>		
3	emitter		
mb	mounting base; connected to collector		

[1] It is not possible to make a connection to pin 2 of the SOT428 (D-PAK) package.

### 3. Ordering information

**Table 2: Ordering information**

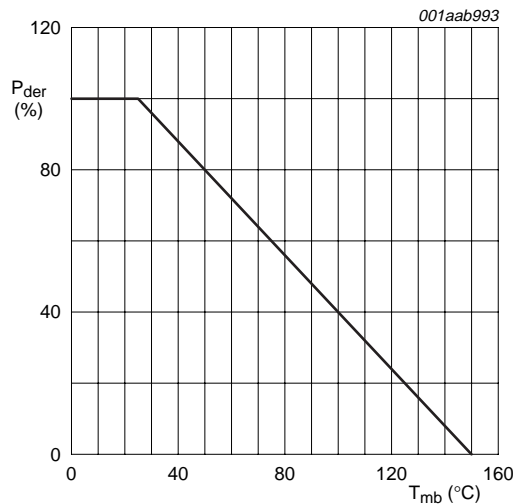
Type number	Package		Version
	Name	Description	
BUJ103AD	D-PAK	plastic single-ended surface mounted package; 3 leads (one lead cropped)	SOT428

### 4. Limiting values

**Table 3: Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CESM}$	peak collector-emitter voltage	$V_{BE} = 0\text{ V}$	-	700	V
$V_{CBO}$	collector-base voltage	open emitter	-	700	V
$V_{CEO}$	collector-emitter voltage	open base	-	400	V
$I_C$	collector current (DC)		-	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	$T_{mb} \leq 25\text{ °C}$ ; see <a href="#">Figure 1</a>	-	80	W
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature		-	150	°C



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

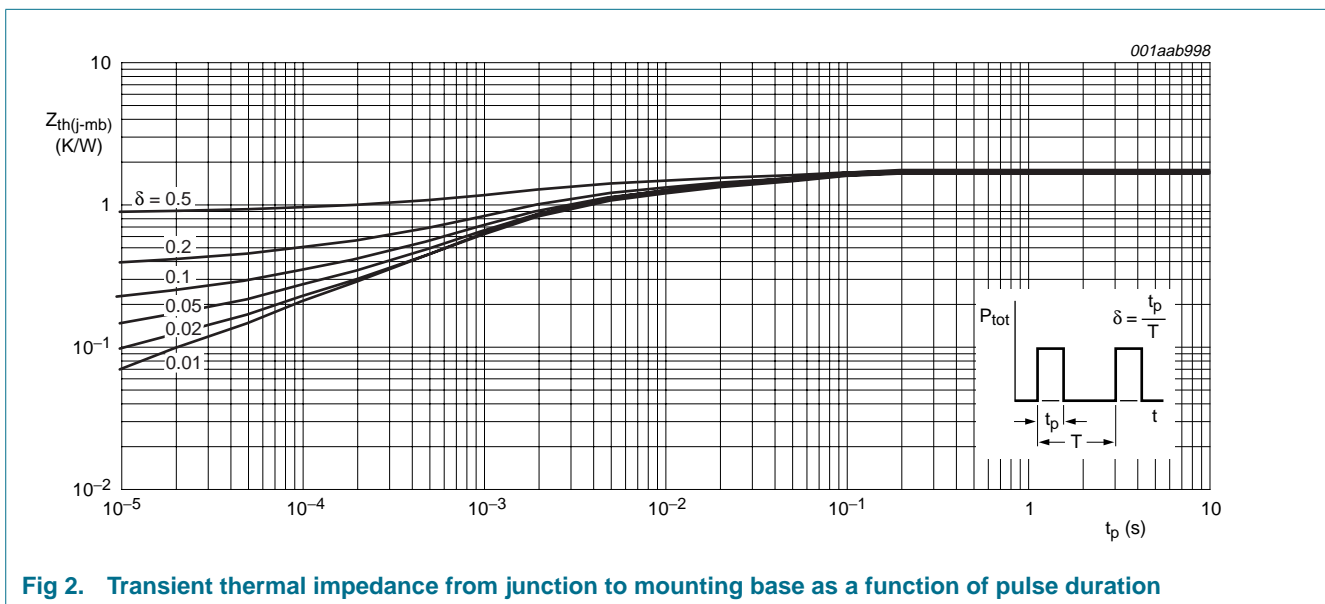
**Fig 1. Normalized total power dissipation as a function of mounting base temperature**

## 5. Thermal characteristics

**Table 4: Thermal characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	see <a href="#">Figure 2</a>	-	-	1.56	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient		[1]	75	-	K/W

[1] Device mounted on a printed-circuit board; minimum footprint.



**Fig 2. Transient thermal impedance from junction to mounting base as a function of pulse duration**

## 6. Characteristics

**Table 5: Characteristics**

$T_{mb} = 25\text{ }^\circ\text{C}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$I_{CES}$	collector-emitter cut-off current	$V_{BE} = 0\text{ V}; V_{CE} = V_{CESMmax}$	[1]	-	1.0	mA
		$V_{BE} = 0\text{ V}; V_{CE} = V_{CESMmax}; T_j = 125\text{ }^\circ\text{C}$	[1]	-	2.0	mA
$I_{CBO}$	collector-base cut-off current	$V_{BE} = 0\text{ V}; V_{CE} = V_{CESMmax}$	[1]	-	1.0	mA
$I_{CEO}$	collector-emitter cut-off current	$V_{CEO} = V_{CEOMmax} = 400\text{ V}$	[1]	-	0.1	mA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 7\text{ V}; I_C = 0\text{ A}$	-	-	0.1	mA
$V_{CE0sus}$	collector-emitter sustaining voltage	$I_B = 0\text{ A}; I_C = 10\text{ mA}; L = 25\text{ mH}$ ; see <a href="#">Figure 3</a> and <a href="#">4</a>	400	-	-	V
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 3.0\text{ A}; I_B = 0.6\text{ A}$ ; see <a href="#">Figure 10</a>	-	0.25	1.0	V
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 3.0\text{ A}; I_B = 0.6\text{ A}$ ; see <a href="#">Figure 11</a>	-	0.97	1.5	V
$h_{FE}$	DC current gain	$I_C = 1\text{ mA}; V_{CE} = 5\text{ V}$ ; see <a href="#">Figure 9</a>	10	17	32	
		$I_C = 500\text{ mA}; V_{CE} = 5\text{ V}$	13	22	32	

**Table 5: Characteristics ...continued**  
 $T_{mb} = 25\text{ }^\circ\text{C}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$h_{FEsat}$	DC saturation current gain	$I_C = 2.0\text{ A}$ ; $V_{CE} = 5\text{ V}$	11	16	22	
		$I_C = 3.0\text{ A}$ ; $V_{CE} = 5\text{ V}$	-	12.5	-	

**Dynamic characteristics**

Switching times (resistive load); see [Figure 5](#) and [6](#)

$t_{on}$	turn-on time	$I_{Con} = 2.5\text{ A}$ ; $I_{Bon} = -I_{Boff} = 0.5\text{ A}$ ; $R_L = 75\text{ }\Omega$	-	0.52	0.6	$\mu\text{s}$
$t_{stg}$	storage time		-	2.7	3.3	$\mu\text{s}$
$t_f$	fall time		-	0.3	0.35	$\mu\text{s}$

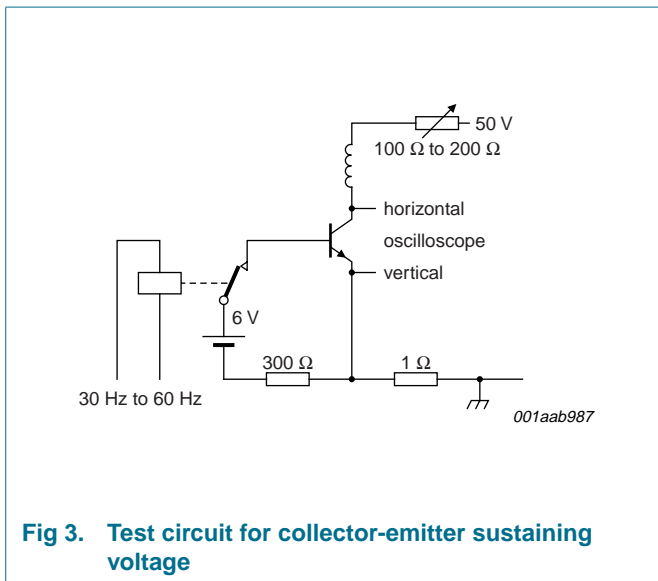
Switching times (inductive load); see [Figure 7](#) and [8](#)

$t_{stg}$	storage time	$I_{Con} = 2\text{ A}$ ; $I_{Bon} = 0.4\text{ A}$ ; $L_B = 1\text{ }\mu\text{H}$ ; $V_{BB} = -5\text{ V}$	-	1.2	1.4	$\mu\text{s}$
$t_f$	fall time		-	30	60	ns

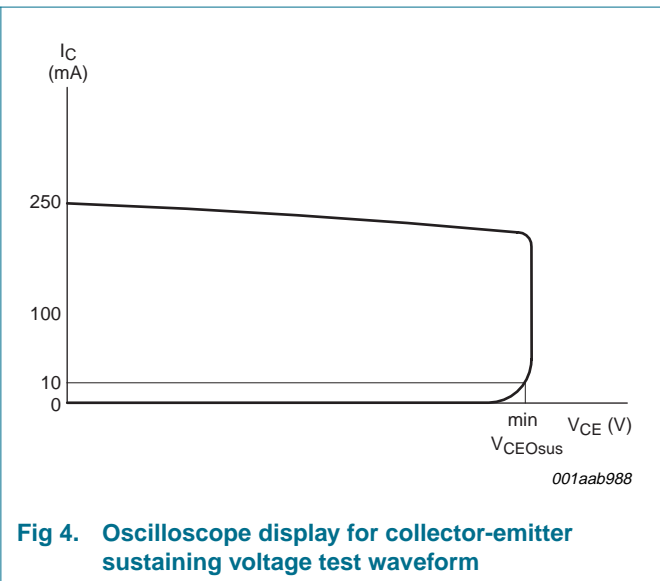
Switching times (inductive load); see [Figure 7](#) and [8](#)

$t_{stg}$	storage time	$I_{Con} = 2\text{ A}$ ; $I_{Bon} = 0.4\text{ A}$ ; $L_B = 1\text{ }\mu\text{H}$ ; $V_{BB} = -5\text{ V}$ ; $T_j = 100\text{ }^\circ\text{C}$	-	-	1.8	$\mu\text{s}$
$t_f$	fall time		-	-	120	ns

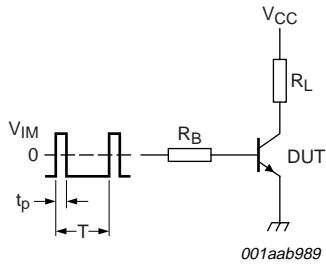
[1] Measured with half sine-wave voltage (curve tracer).



**Fig 3. Test circuit for collector-emitter sustaining voltage**

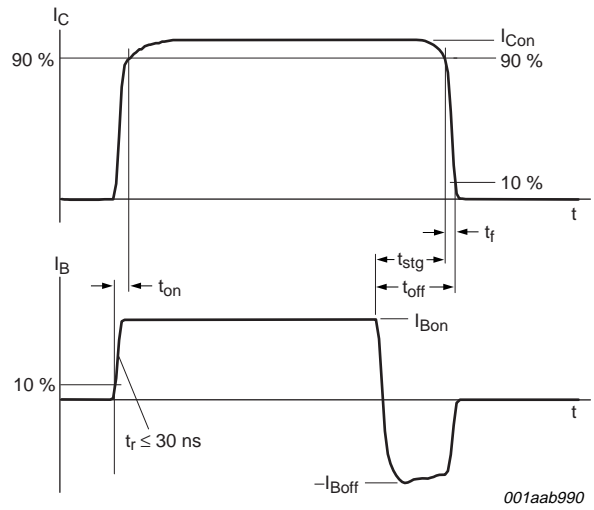


**Fig 4. Oscilloscope display for collector-emitter sustaining voltage test waveform**

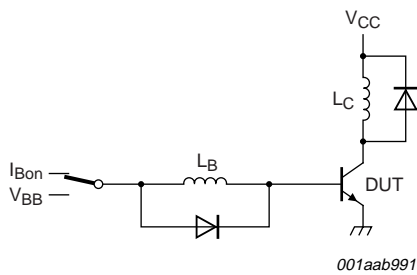


$V_{IM} = -6\text{ V to }+8\text{ V}$ ;  $V_{CC} = 250\text{ V}$ ;  $t_p = 20\text{ }\mu\text{s}$ ;  
 $\delta = t_p/T = 0.01$ .  
 $R_B$  and  $R_L$  calculated from  $I_{Con}$  and  $I_{Bon}$  requirements.

**Fig 5. Test circuit for resistive load switching**

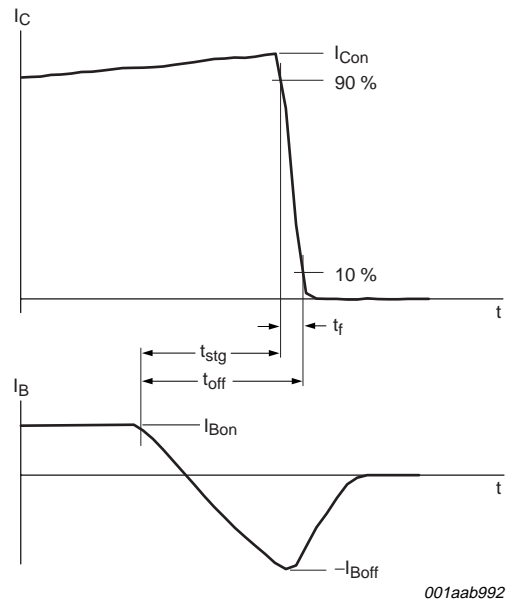


**Fig 6. Switching times waveforms for resistive load**

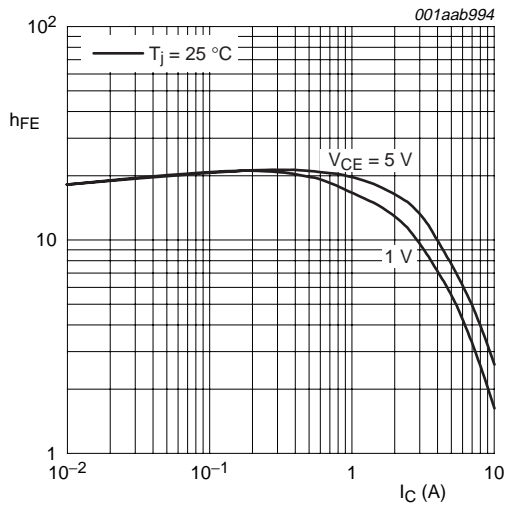


$V_{CC} = 300\text{ V}$ ;  $V_{BB} = -5\text{ V}$ ;  $L_C = 200\text{ }\mu\text{H}$ ;  $L_B = 1\text{ }\mu\text{H}$ .

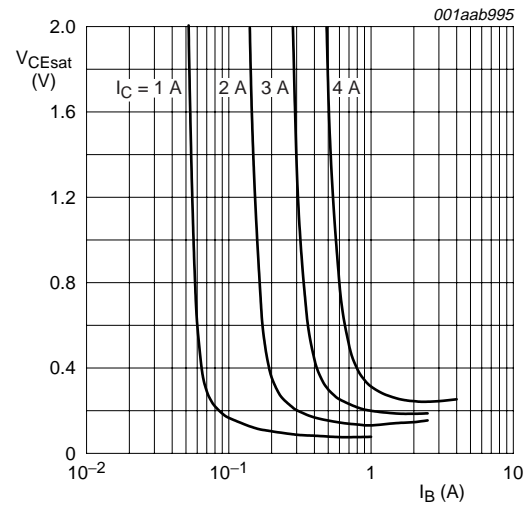
**Fig 7. Test circuit for inductive load switching**



**Fig 8. Switching times waveforms for inductive load**

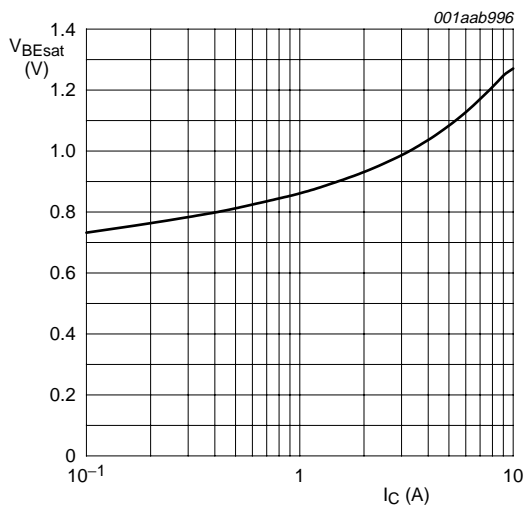


**Fig 9. DC current gain as a function of collector current; typical values**



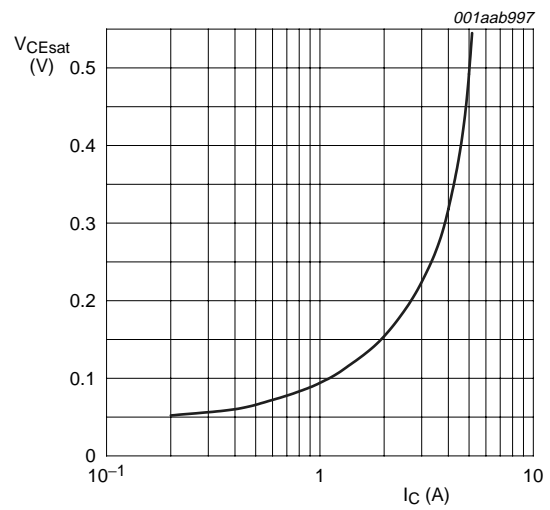
$T_j = 25\text{ }^\circ\text{C}$ .

**Fig 10. Collector-emitter saturation voltage as a function of base current; typical values**



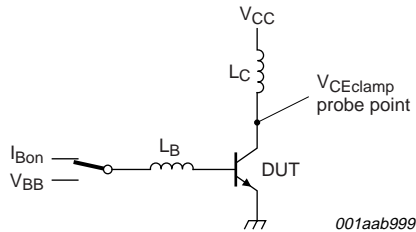
$I_C/I_B = 4$ .

**Fig 11. Base-emitter saturation voltage as a function of collector current; typical values**



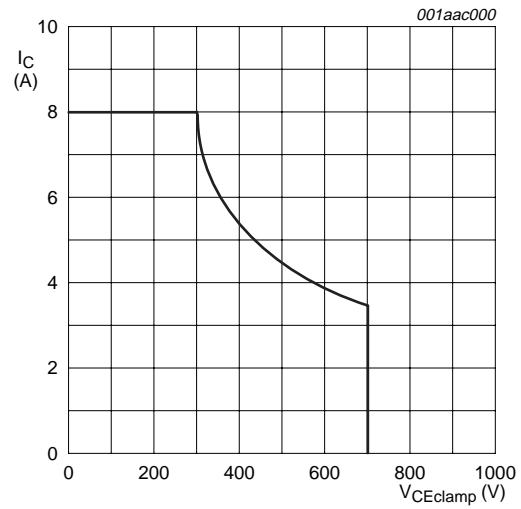
$I_C/I_B = 4$ .

**Fig 12. Collector-emitter saturation voltage as a function of collector current; typical values**



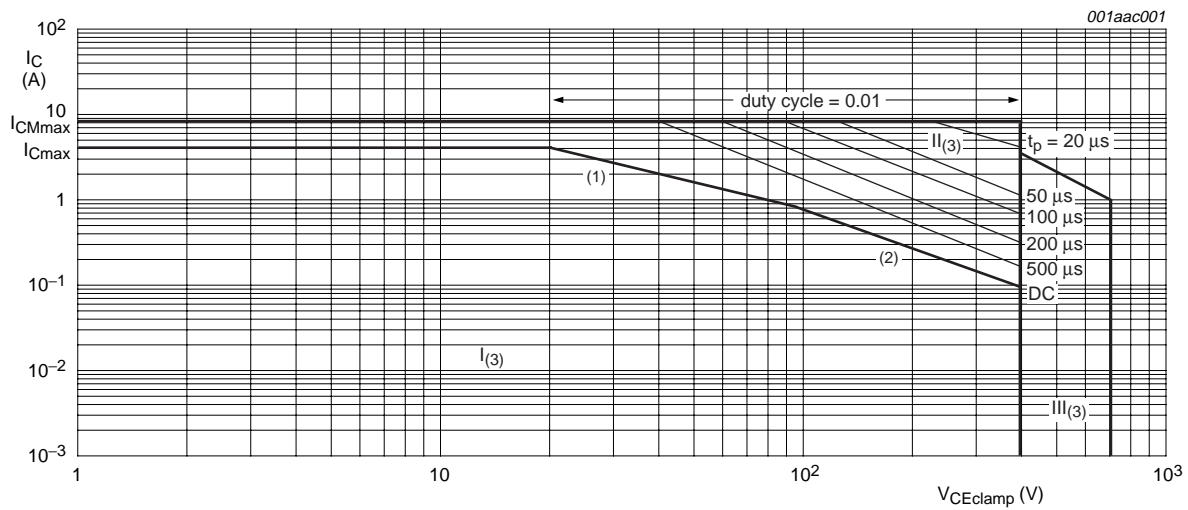
$V_{CEclamp} \leq 1000 \text{ V}$ ;  $V_{CC} = 150 \text{ V}$ ;  $V_{BB} = -5 \text{ V}$ ;  
 $L_B = 1 \mu\text{H}$ ;  $L_C = 200 \mu\text{H}$ .

**Fig 13. Test circuit for reverse bias safe operating area**



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

**Fig 14. Reverse bias safe operating area**



$T_{mb} \leq 25 \text{ }^\circ\text{C}$ ; Mounted with heatsink compound and  $30 \pm 5 \text{ Newton}$  force on the center of the envelope.

- (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  $t_p \leq 0.6 \mu\text{s}$ .

**Fig 15. Forward bias safe operating area**

## 7. Package information

Epoxy meets requirements of UL94 V-0 at  $\frac{1}{8}$  inch.

**8. Package outline**

Plastic single-ended surface mounted package (D-PAK); 3 leads (one lead cropped)

SOT428

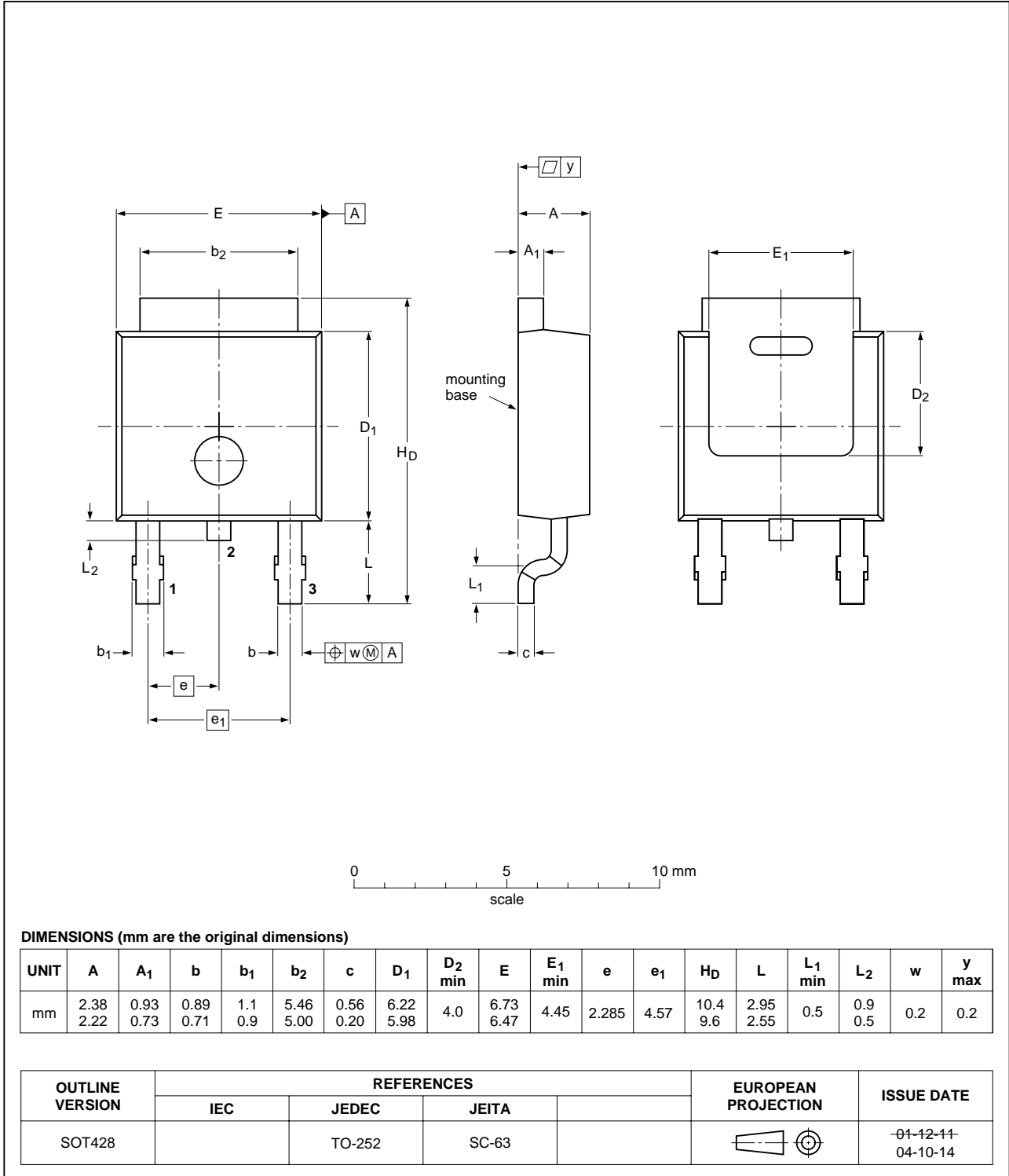
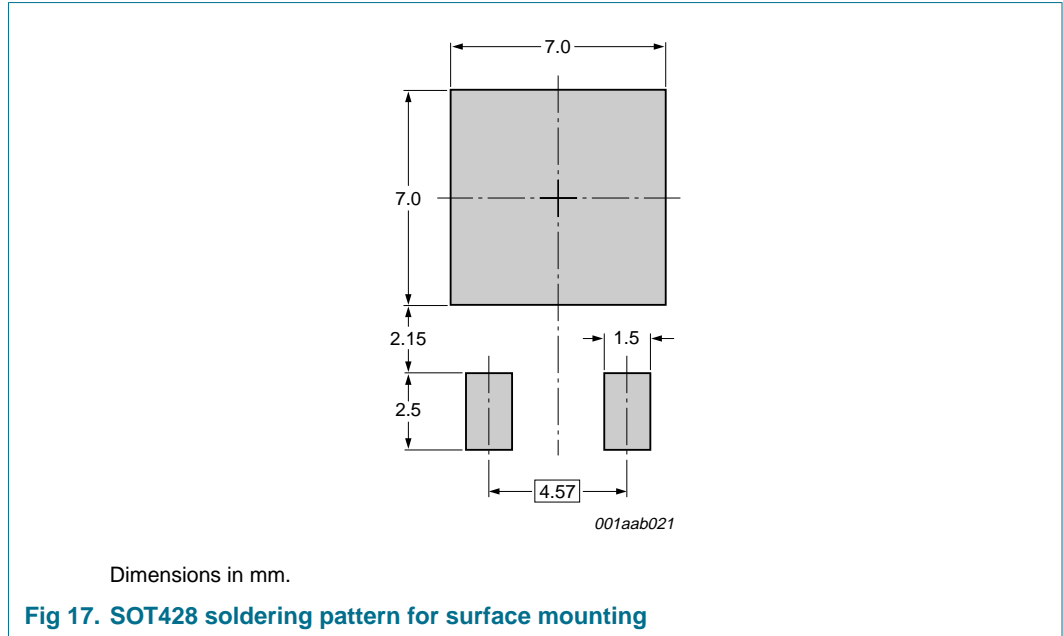


Fig 16. Package outline SOT428 (SC-63)



## 9. Mounting





## 10. Revision history

Table 6: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
BUJ103AD_1	20041214	Product data sheet	-	9397 750 14195	-

## 11. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2]</sup> <sup>[3]</sup>	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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