BUJD203AD

NPN power transistor with integrated diode

Rev. 01 — 27 September 2010 Product data sheet

1. Product profile

1.1 General description

High voltage, high speed, planar passivated NPN power switching transistor with integrated anti-parallel E-C diode in a SOT428 (DPAK) surface-mountable plastic package.

1.2 Features and benefits

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

1.3 Applications

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

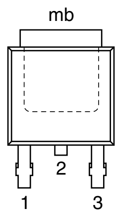
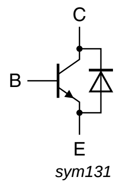
1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_C	collector current	see Figure 1; see Figure 2; DC; see Figure 4	-	-	4	A
P_{tot}	total power dissipation	see Figure 3; $T_{mb} \leq 25$ °C	-	-	80	W
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$ V	-	-	850	V
Static characteristics						
h_{FE}	DC current gain	$I_C = 500$ mA; $V_{CE} = 5$ V; see Figure 12; $T_{mb} = 25$ °C	13	21	32	
		$V_{CE} = 5$ V; $I_C = 3$ A; $T_{mb} = 25$ °C; see Figure 12	-	12.5	-	
V_{CEOsus}	collector-emitter sustaining voltage	$I_B = 0$ A; $L_C = 25$ mH; $I_C = 10$ mA; see Figure 7; see Figure 8	400	450	-	V

2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 **SOT428 (DPAK)**	
2	C	collector[1]		
3	E	emitter		
mb	C	mounting base; connected to collector		

[1] it is not possible to make a connection to pin 2 of the SOT428 (DPAK) package

3. Ordering information

Table 3. Ordering information

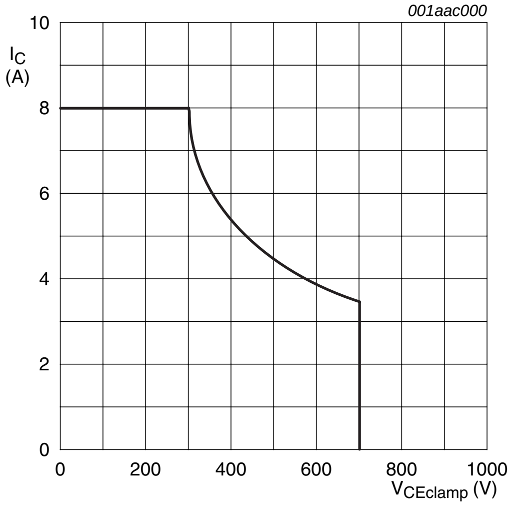
Type number	Package		
	Name	Description	Version
BUJD203AD	DPAK	plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped)	SOT428

4. Limiting values

Table 4. Limiting values

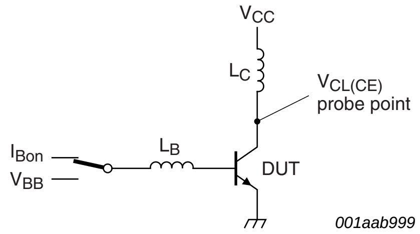
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CESM}	collector-emitter peak voltage	V_{BE} = 0 V	-	850	V
V_{CBO}	collector-base voltage	I_E = 0 A	-	850	V
V_{CEO}	collector-emitter voltage	I_B = 0 A	-	425	V
I_C	collector current	DC; see Figure 1; see Figure 2; see Figure 4	-	4	A
I_{CM}	peak collector current	see Figure 1; see Figure 2; see Figure 4	-	8	A
I_B	base current	DC	-	2	A
I_{BM}	peak base current		-	4	A
P_{tot}	total power dissipation	T_{mb} ≤ 25 °C; see Figure 3	-	80	W
T_{stg}	storage temperature		-65	150	°C
T_j	junction temperature		-	150	°C



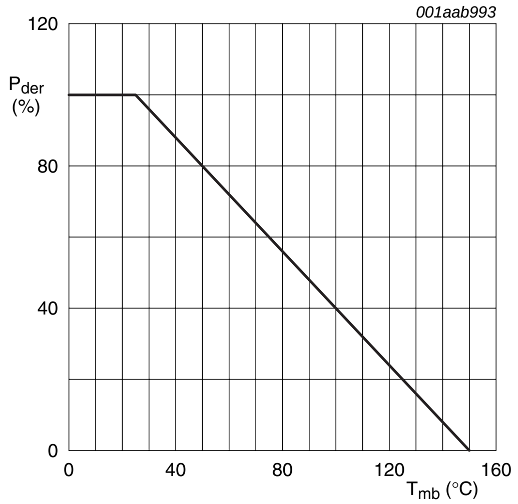
$$T_j \leq T_{j(max)} °C$$

Fig 1. Reverse bias safe operating area



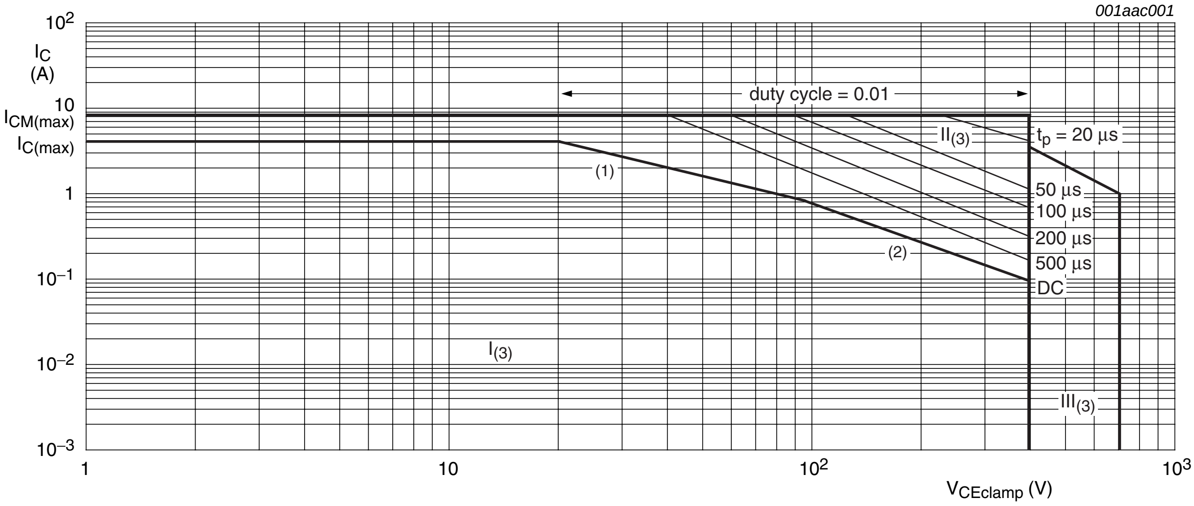
$$V_{CL(CE)} \leq 1000\ V; V_{CC} = 150\ V; V_{BB} = -5\ V;$$
$$L_B = 1\ \mu H; L_C = 200\ \mu H$$

Fig 2. Test circuit for reverse bias safe operating area



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

Fig 3. Normalized total power dissipation as a function of mounting base temperature



1) P_{tot} maximum and P_{tot} peak maximum lines

2) Second breakdown limits

3) I = Region of permissable 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 $t_p \leq 0.6$ µs

Fig 4. Forward bias safe operating area for $T_{mb} \leq 25$ °C

5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	see Figure 6	-	-	1.56	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	printed-circuit-board mounted; minimum footprint; see Figure 5	-	75	-	K/W

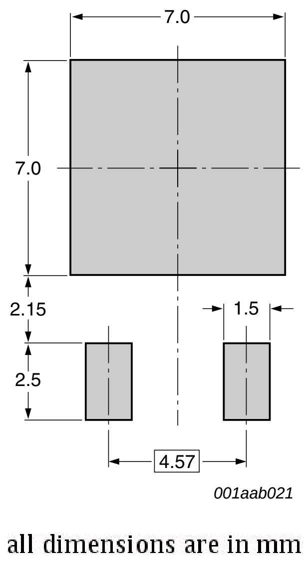


Fig 5. Minimum footprint SOT428

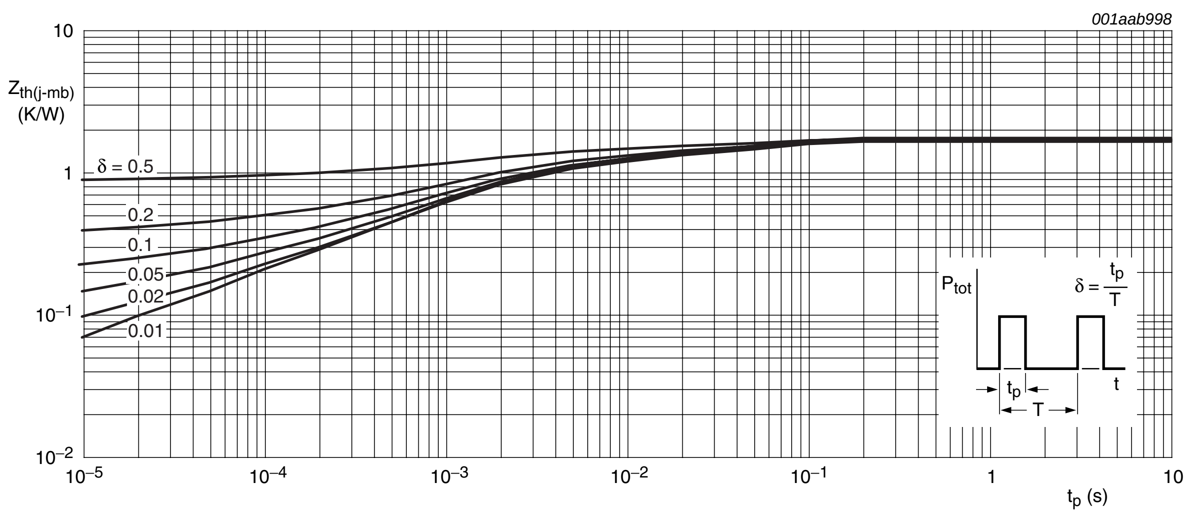


Fig 6. Transient thermal impedance from junction to mounting base as a function of pulse width

6. Characteristics

Table 6. Characteristics

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

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

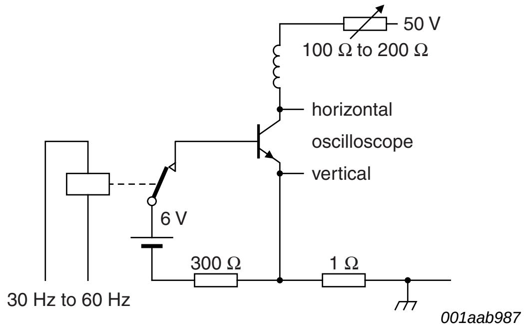


Fig 7. Test circuit for collector-emitter sustaining voltage

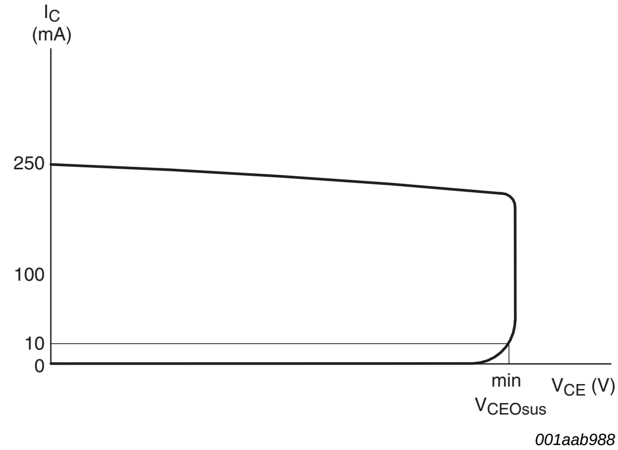
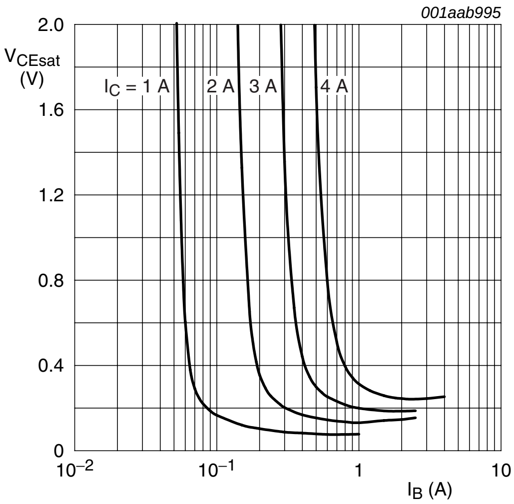
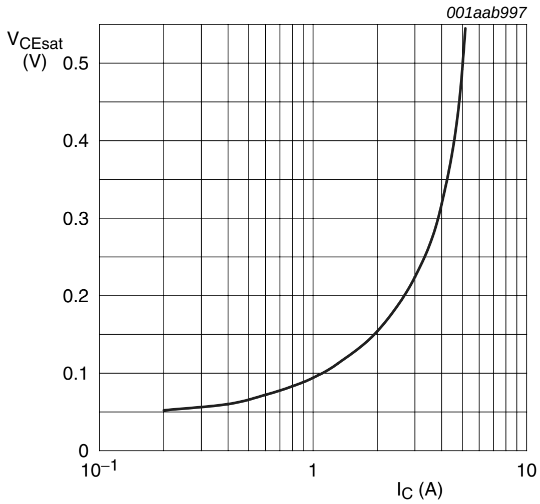


Fig 8. Oscilloscope display for collector-emitter sustaining voltage test waveform



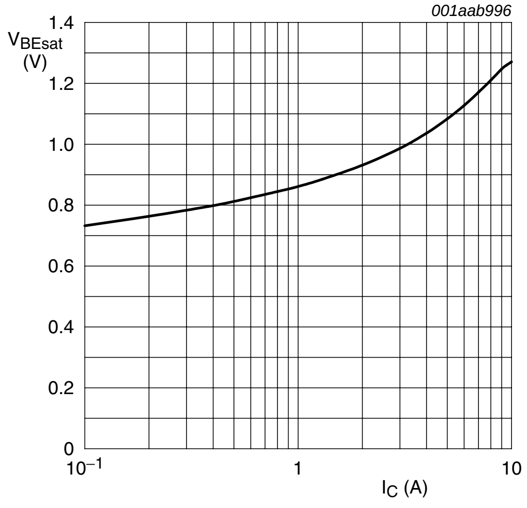
$T_j = 25\,°C$

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



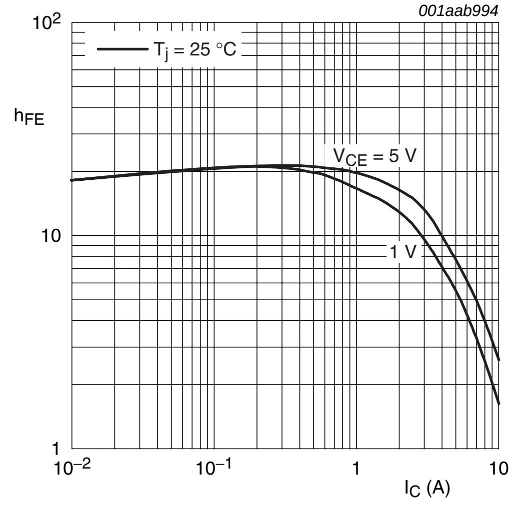
$I_C / I_B = 4$

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



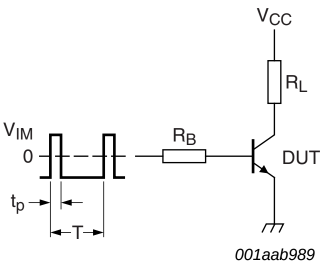
$I_C / I_B = 4$

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



$I_C / I_B = 4$

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



$V_{IM} = -6$ to $+8\ V$; $V_{CC} = 250\ V$; $t_p = 20\ \mu s$; $\delta = \frac{t_p}{T} = 0.01$

R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

Fig 13. Test circuit for resistive load switching

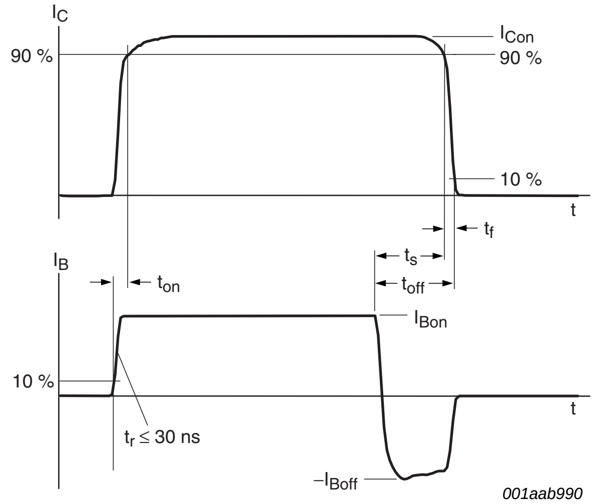
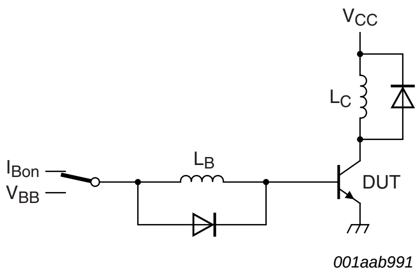


Fig 14. Switching times waveforms for resistive load



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

Fig 15. Test circuit for inductive load switching

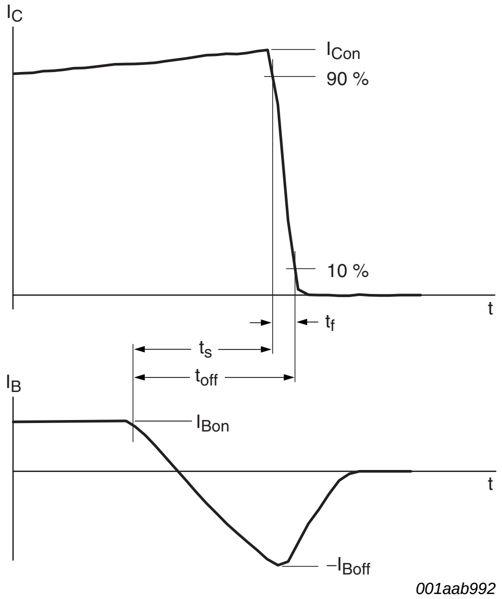
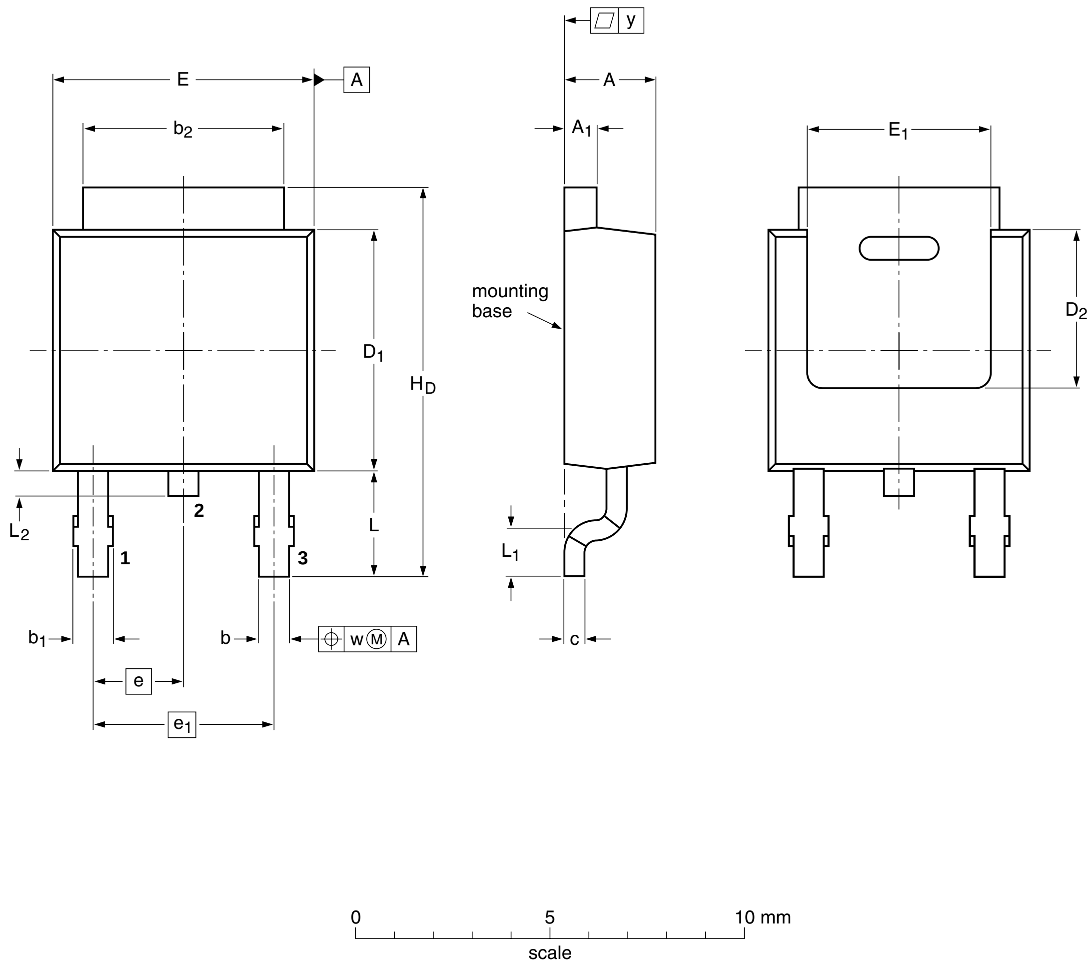


Fig 16. Switching times waveforms for inductive load

7. Package outline

Plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped) **SOT428**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	b_2	c	D_1	D_2 min	E	E_1 min	e	e_1	H_D	L	L_1 min	L_2	w	y max
mm	2.38 2.22	0.93 0.46	0.89 0.71	1.1 0.9	5.46 5.00	0.56 0.20	6.22 5.98	4.0	6.73 6.47	4.45	2.285	4.57	10.4 9.6	2.95 2.55	0.5	0.9 0.5	0.2	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT428		TO-252	SC-63			~~06-02-14~~ 06-03-16

Fig 17. Package outline SOT428 (DPAK)

8. Soldering

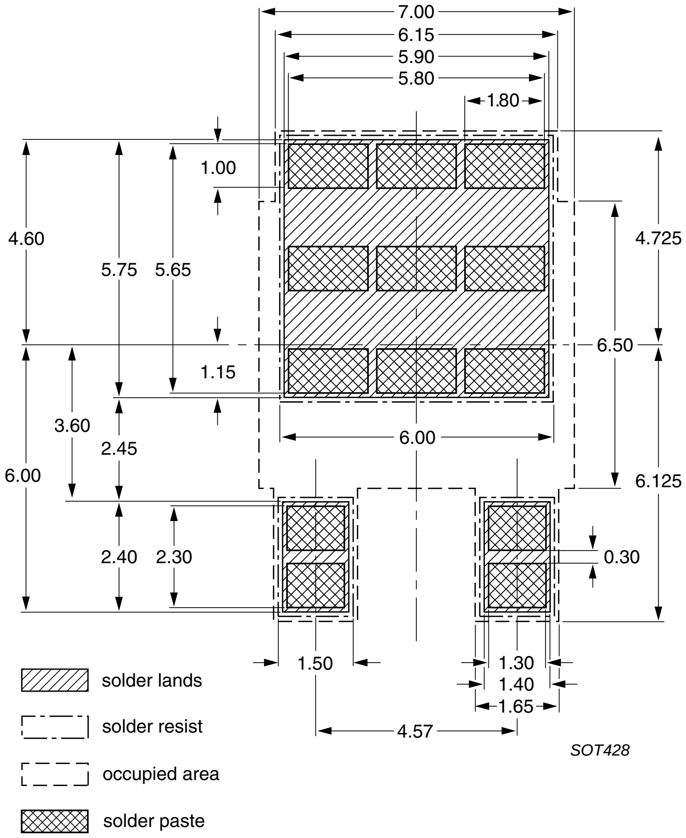


Fig 18. Reflow soldering footprint for SOT428 (DPAK)

9. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUJD203AD v.1	20100927	Product data sheet	-	-

10. Legal information

10.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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12. Contents

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