

## 1. General description

High voltage, high speed planar passivated NPN power switching transistor in a SOT78 (TO-220AB) plastic package.

## 2. Features and benefits

- Fast switching
- 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

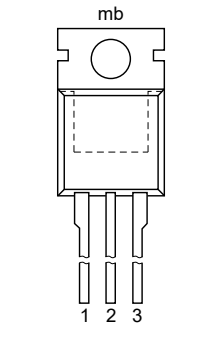
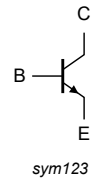
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CM}$	peak collector current	<a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	-	-	10	A
$P_{tot}$	total power dissipation	$T_{mb} \leq 25\text{ °C}$ ; <a href="#">Fig. 4</a>	-	-	100	W
$V_{CESM}$	collector-emitter peak voltage	$V_{BE} = 0\text{ V}$	-	-	1000	V
<b>Static characteristics</b>						
$h_{FE}$	DC current gain	$I_C = 5\text{ mA}$ ; $V_{CE} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 11</a>	10	22	35	
		$I_C = 500\text{ mA}$ ; $V_{CE} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 11</a>	14	25	35	

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	B	base	 <p>TO-220AB (SOT78)</p>	 <p>sym123</p>
2	C	collector		
3	E	emitter		
mb	C	mounting base; connected to collector		

## 6. Ordering information

Table 3. Ordering information

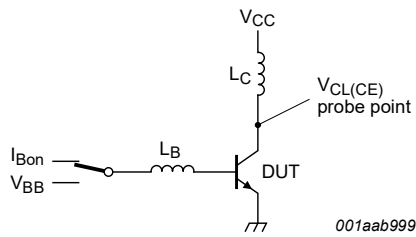
Type number	Package		
	Name	Description	Version
BUJ303A	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

## 7. Limiting values

**Table 4. Limiting values**

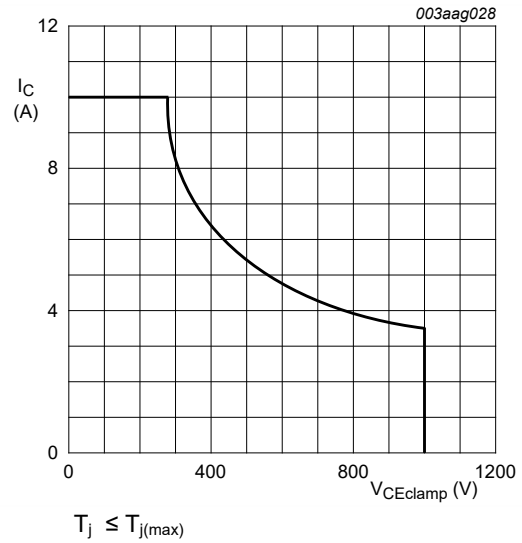
In accordance with the Absolute Maximum Rating System (IEC 60134).

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	<a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	-	5	A
$I_{CM}$	peak collector current		-	10	A
$I_B$	base current		-	2	A
$I_{BM}$	peak base current		-	4	A
$P_{tot}$	total power dissipation	$T_{mb} \leq 25\text{ °C}$ ; <a href="#">Fig. 4</a>	-	100	W
$T_{stg}$	storage temperature		-65	150	°C
$T_j$	junction temperature		-	150	°C

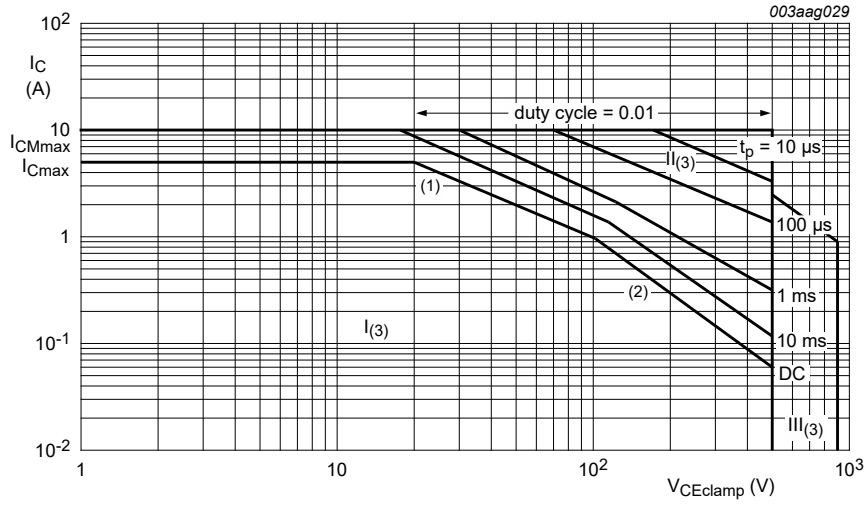


$V_{CEclamp} \leq 1000\text{ V}$ ;  $V_{CC} = 150\text{ V}$ ;  $V_{BB} = -5\text{ V}$ ;  
 $L_B = 1\text{ }\mu\text{H}$ ;  $L_C = 200\text{ }\mu\text{H}$ .

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

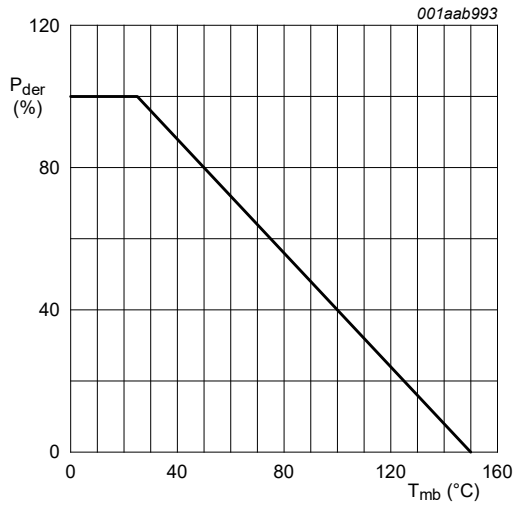


**Fig. 2. Reverse bias safe operating area**



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



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

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

### 8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	<a href="#">Fig. 5</a>	-	-	1.25	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient free air	in free air	-	60	-	K/W

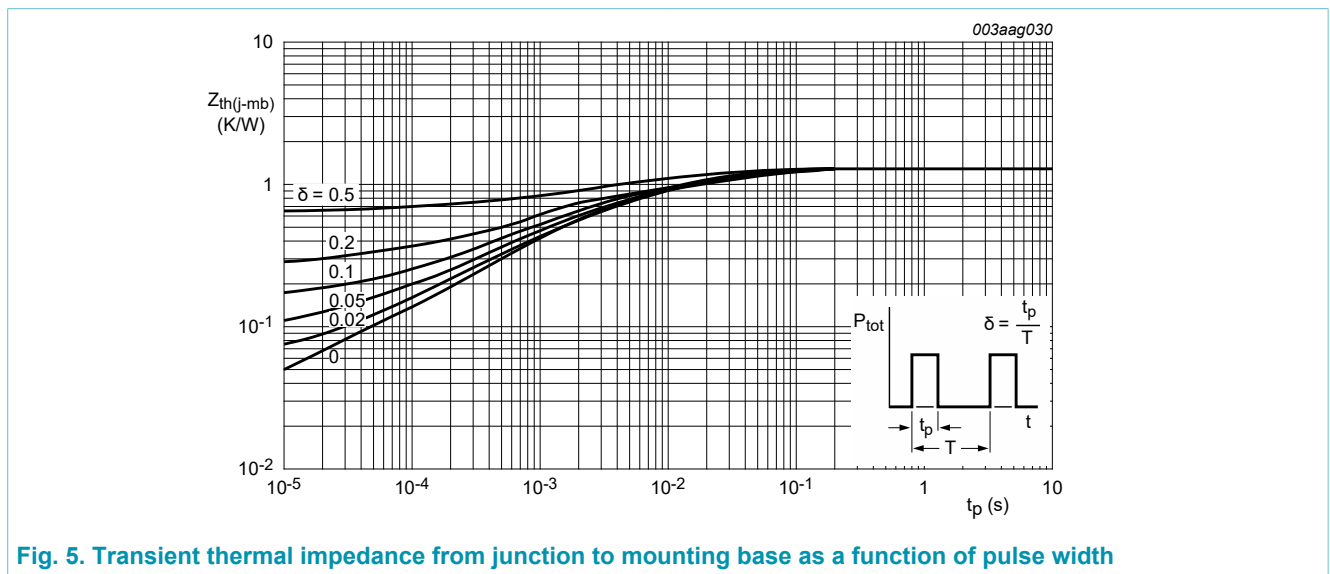


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse width

## 9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$I_{CES}$	collector-emitter cut-off current (base shorted)	$V_{BE} = 0\text{ V}$ ; $V_{CE} = 1000\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; Measured with half-sine wave voltage (curve tracer)	-	-	1	mA
		$V_{BE} = 0\text{ V}$ ; $V_{CE} = 1000\text{ V}$ ; $T_{mb} = 125\text{ °C}$ ; Measured with half-sine wave voltage (curve tracer)	-	-	2	mA
$I_{CBO}$	collector-base cut-off current (emitter open)	$V_{CB} = 1000\text{ V}$ ; $I_E = 0\text{ A}$ ; $T_{mb} = 25\text{ °C}$ ; Measured with half-sine wave voltage (curve tracer)	-	-	1	mA
$I_{CEO}$	collector-emitter cut-off current (base open)	$V_{CE} = 500\text{ V}$ ; $I_B = 0\text{ A}$ ; $T_{mb} = 25\text{ °C}$ ; Measured with half-sine wave voltage (curve tracer)	-	-	0.1	mA
$I_{EBO}$	emitter-base cut-off current (collector open)	$V_{EB} = 9\text{ V}$ ; $I_C = 0\text{ A}$ ; $T_{mb} = 25\text{ °C}$	-	-	0.1	mA
$V_{CEO_{sus}}$	collector-emitter sustaining voltage (base open)	$I_B = 0\text{ A}$ ; $I_C = 100\text{ mA}$ ; $L_C = 25\text{ mH}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 6</a> ; <a href="#">Fig. 7</a>	500	-	-	V
$V_{CE_{sat}}$	collector-emitter saturation voltage	$I_C = 3\text{ A}$ ; $I_B = 0.6\text{ A}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 8</a> ; <a href="#">Fig. 9</a>	-	0.35	1.5	V
$V_{BE_{sat}}$	base-emitter saturation voltage	$I_C = 3\text{ A}$ ; $I_B = 0.6\text{ A}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 10</a>	-	1.01	1.3	V
$h_{FE}$	DC current gain	$I_C = 5\text{ mA}$ ; $V_{CE} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 11</a>	10	22	35	
		$I_C = 500\text{ mA}$ ; $V_{CE} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 11</a>	14	25	35	
$h_{FE_{sat}}$	DC saturation current gain	$I_C = 2.5\text{ A}$ ; $V_{CE} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 11</a>	10	13.5	17	
		$I_C = 3\text{ A}$ ; $V_{CE} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 11</a>	-	11	-	
<b>Dynamic characteristics (switching times - resistive load)</b>						
$t_s$	storage time	$I_C = 2.5\text{ A}$ ; $I_{B_{on}} = 0.5\text{ A}$ ; $I_{B_{off}} = -0.5\text{ A}$ ; $R_L = 75\text{ }\Omega$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	3.3	4	$\mu\text{s}$
$t_f$	fall time		-	0.33	0.45	$\mu\text{s}$
<b>Dynamic characteristics (switching times - inductive load)</b>						
$t_s$	storage time	$I_C = 2.5\text{ A}$ ; $I_{B_{on}} = 0.5\text{ A}$ ; $V_{BB} = -5\text{ V}$ ; $L_B = 1\text{ }\mu\text{H}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	-	1.4	1.6	$\mu\text{s}$
		$I_C = 2.5\text{ A}$ ; $I_{B_{on}} = 0.5\text{ A}$ ; $V_{BB} = -5\text{ V}$ ; $L_B = 1\text{ }\mu\text{H}$ ; $T_j = 100\text{ °C}$ ; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	-	1.7	1.9	$\mu\text{s}$
$t_f$	fall time	$I_C = 2.5\text{ A}$ ; $I_{B_{on}} = 0.5\text{ A}$ ; $V_{BB} = -5\text{ V}$ ; $L_B = 1\text{ }\mu\text{H}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	-	145	160	ns
		$I_C = 2.5\text{ A}$ ; $I_{B_{on}} = 0.5\text{ A}$ ; $V_{BB} = -5\text{ V}$ ; $L_B = 1\text{ }\mu\text{H}$ ; $T_j = 100\text{ °C}$ ; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	-	160	200	ns

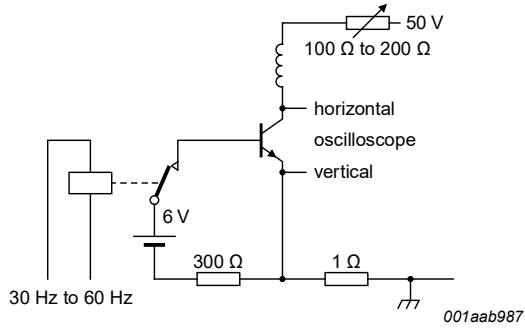


Fig. 6. Test circuit for collector-emitter sustaining voltage

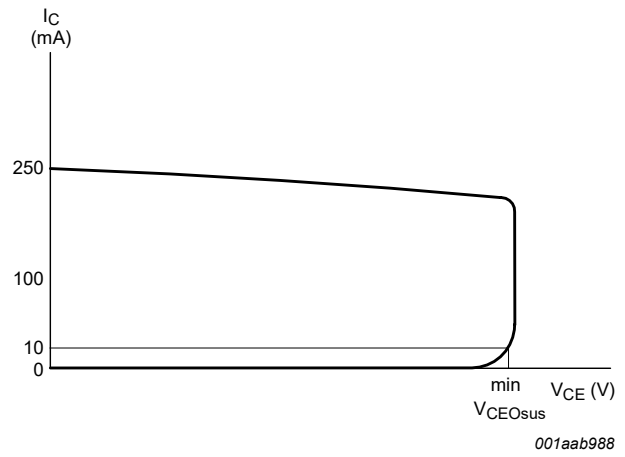


Fig. 7. Oscilloscope display for collector-emitter sustaining voltage test waveform

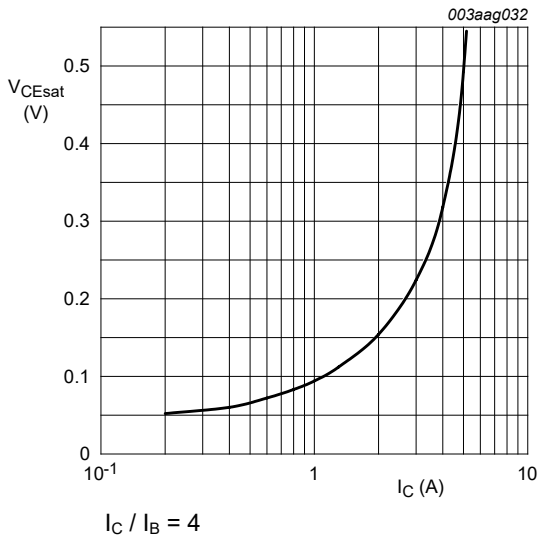


Fig. 8. Collector-emitter saturation voltage as a function of collector current; typical values

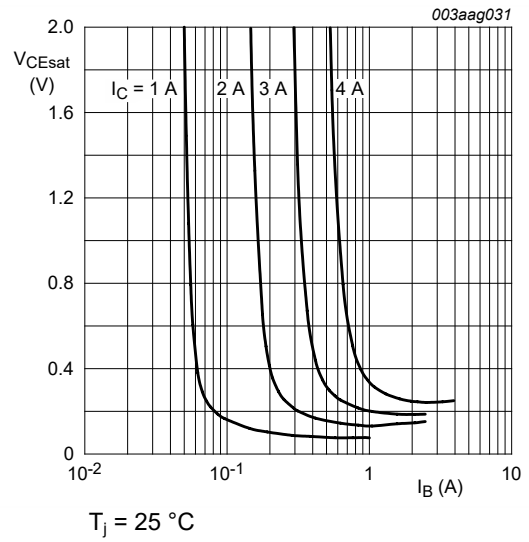


Fig. 9. Collector-emitter saturation voltage as a function of base current; typical values

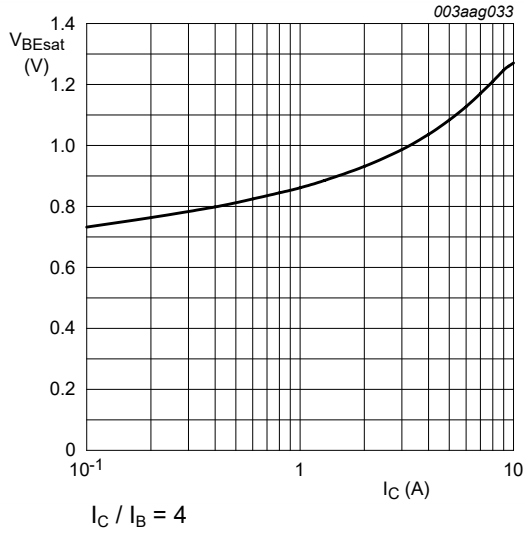


Fig. 10. Base-emitter saturation voltage as a function of collector current; typical values

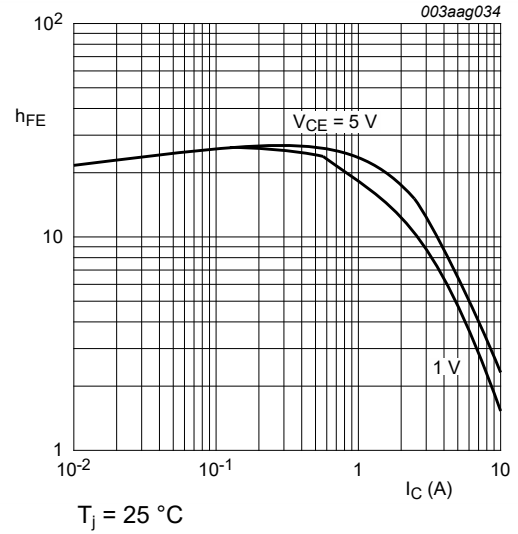
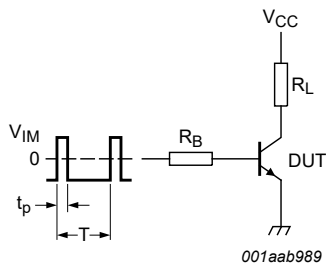


Fig. 11. DC current gain as a function of collector current; typical values



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

Fig. 12. Test circuit for resistive load switching

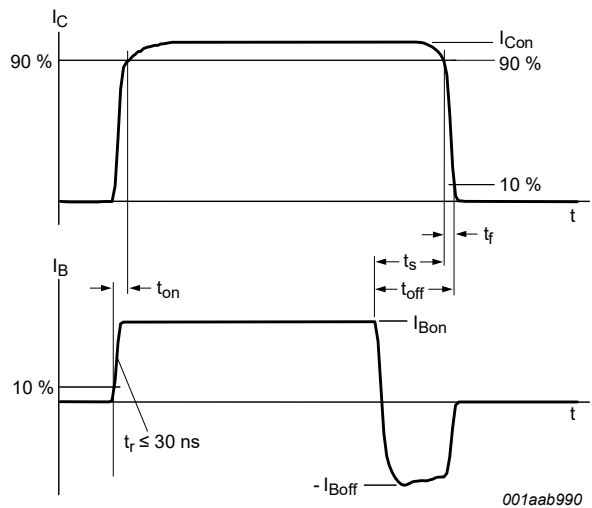
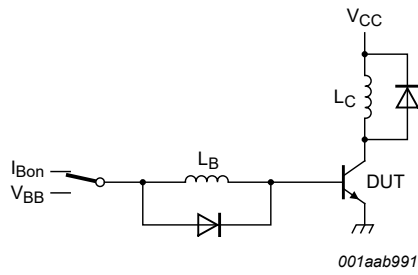


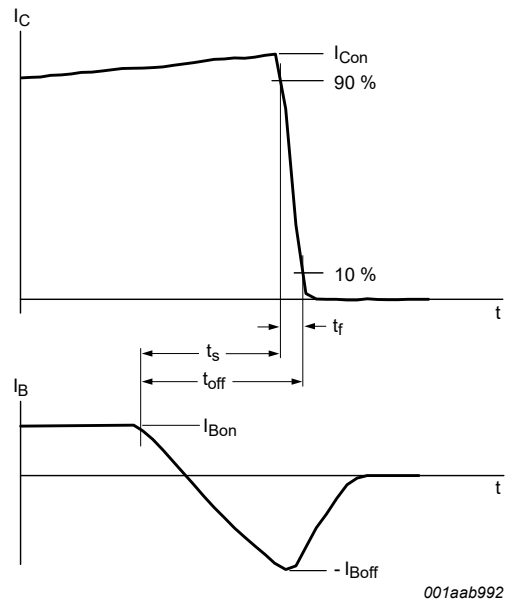
Fig. 13. Switching times waveforms for resistive load





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

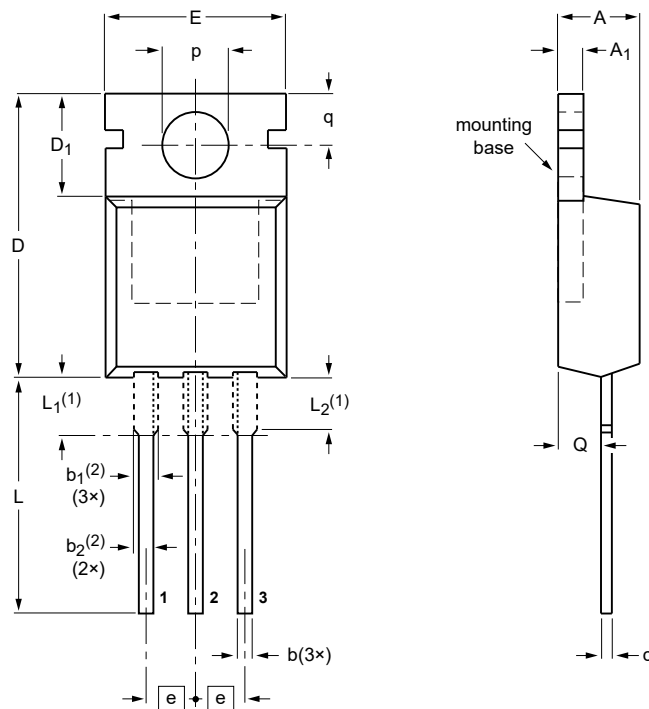
**Fig. 14. Test circuit for inductive load switching**



**Fig. 15. Switching times waveforms for inductive load**

### 10. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB SOT78



**DIMENSIONS** (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	b	b <sub>1</sub> (2)	b <sub>2</sub> (2)	c	D	D <sub>1</sub>	E	e	L	L <sub>1</sub> (1)	L <sub>2</sub> (1) max.	p	q	Q
mm	4.7 4.1	1.40 1.25	0.9 0.6	1.6 1.0	1.3 1.0	0.7 0.4	16.0 15.2	6.6 5.9	10.3 9.7	2.54	15.0 12.8	3.30 2.79	3.0	3.8 3.5	3.0 2.7	2.6 2.2

**Notes**

1. Lead shoulder designs may vary.
2. Dimension includes excess dambar.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78		3-lead TO-220AB	SC-46			08-04-23 08-06-13

Fig. 16. Package outline TO-220AB (SOT78)

## 11. Legal information

### 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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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Date of release: 12 October 2018

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