

# BT139 series E

Triacs; sensitive gate

Rev. 03 — 23 September 2004

Product data sheet

## 1. Product profile

### 1.1 General description

Passivated, sensitive gate triacs in a SOT78 (TO-220AB) plastic package.

### 1.2 Features

- High sensitivity in all four quadrants.

### 1.3 Applications

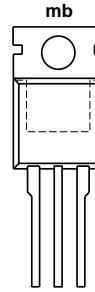
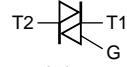
- General purpose bidirectional switching ■ Phase control.

### 1.4 Quick reference data

- |                                     |  |
|-------------------------------------|--|
| ■ $V_{DRM} \leq 600$ V (BT139-600E) | ■ $I_{TSM} \leq 155$ A                         |
| ■ $V_{DRM} \leq 800$ V (BT139-800E) | ■ $I_{GT} \leq 10$ mA (T2+ G+; T2+ G-; T2- G-) |
| ■ $I_{T(RMS)} \leq 16$ A            | ■ $I_{GT} \leq 25$ mA (T2- G+).                |

## 2. Pinning information

Table 1: Pinning

Pin	Description	Simplified outline	Symbol
1	main terminal 1 (T1)		
2	main terminal 2 (T2)		
3	gate (G)		
mb	mounting base, connected to main terminal 2 (T2)	 1 2 3	 sym051

SOT78 (TO-220AB)

**PHILIPS**

### 3. Ordering information

**Table 2:** Ordering information

Type number	Package			Version
	Name	Description		
BT139-600E	SC-46	plastic single-ended package; heatsink mounted; 1 mounting hole;		SOT78
BT139-800E		3-lead TO-220AB		

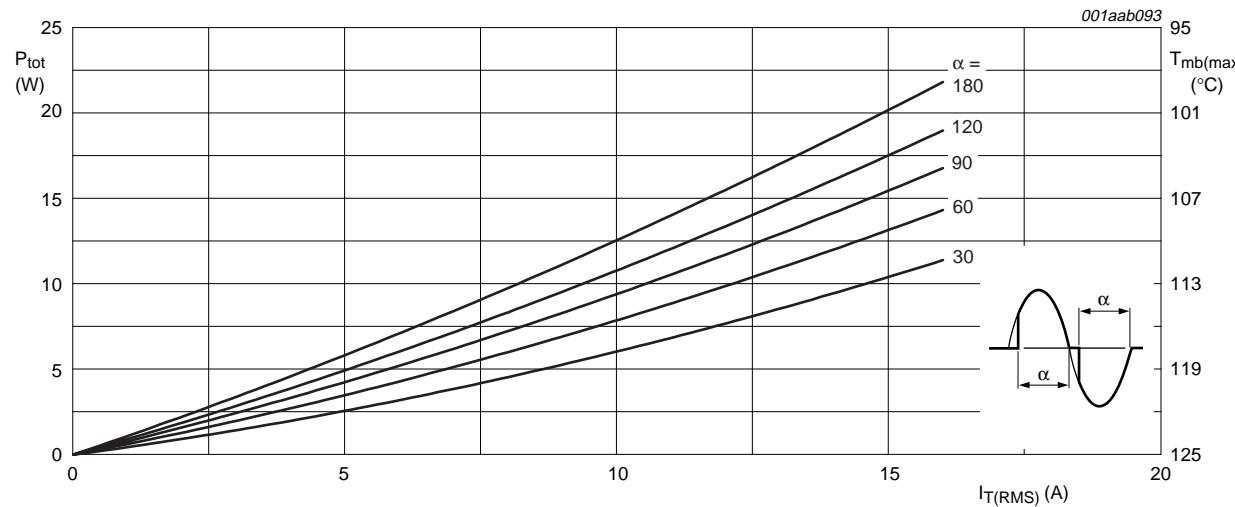
### 4. Limiting values

**Table 3:** Limiting values

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

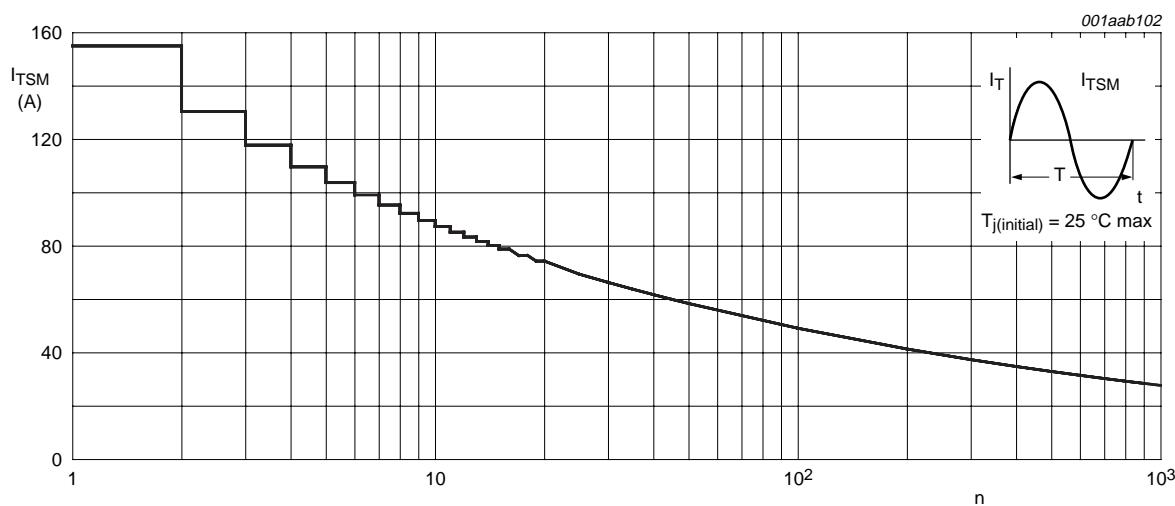
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DRM}$	repetitive peak off-state voltage				
	BT139-600E	[1]	-	600	V
	BT139-800E		-	800	V
$I_{T(RMS)}$	RMS on-state current	full sinewave; $T_{mb} \leq 99^\circ\text{C}$ ; <a href="#">Figure 4</a> and <a href="#">Figure 5</a>	-	16	A
$I_{TSM}$	non-repetitive peak on-state current	full sine wave; $T_j = 25^\circ\text{C}$ prior to surge; <a href="#">Figure 2</a> and <a href="#">Figure 3</a>			
		$t = 20 \text{ ms}$	-	155	A
		$t = 16.7 \text{ ms}$	-	170	A
$I^2t$	$I^2t$ for fusing	$t = 10 \text{ ms}$	-	120	$\text{A}^2\text{s}$
$dI/dt$	repetitive rate of rise of on-state current after triggering	$I_{TM} = 20 \text{ A}; I_G = 0.2 \text{ A};$ $dI/dt = 0.2 \text{ A}/\mu\text{s}$			
		$T2+ G+$	-	50	$\text{A}/\mu\text{s}$
		$T2+ G-$	-	50	$\text{A}/\mu\text{s}$
		$T2- G-$	-	50	$\text{A}/\mu\text{s}$
		$T2- G+$	-	10	$\text{A}/\mu\text{s}$
$I_{GM}$	peak gate current		-	2	A
$V_{GM}$	peak gate voltage		-	5	V
$P_{GM}$	peak gate power		-	5	W
$P_{G(AV)}$	average gate power	over any 20 ms period	-	0.5	W
$T_{stg}$	storage temperature		-40	+150	$^\circ\text{C}$
$T_j$	junction temperature		-	125	$^\circ\text{C}$

[1] Although not recommended, off-state voltages up to 800 V may be applied without damage, but the triac may switch to the on-state. The rate of rise of current should not exceed 15 A/ $\mu\text{s}$ .



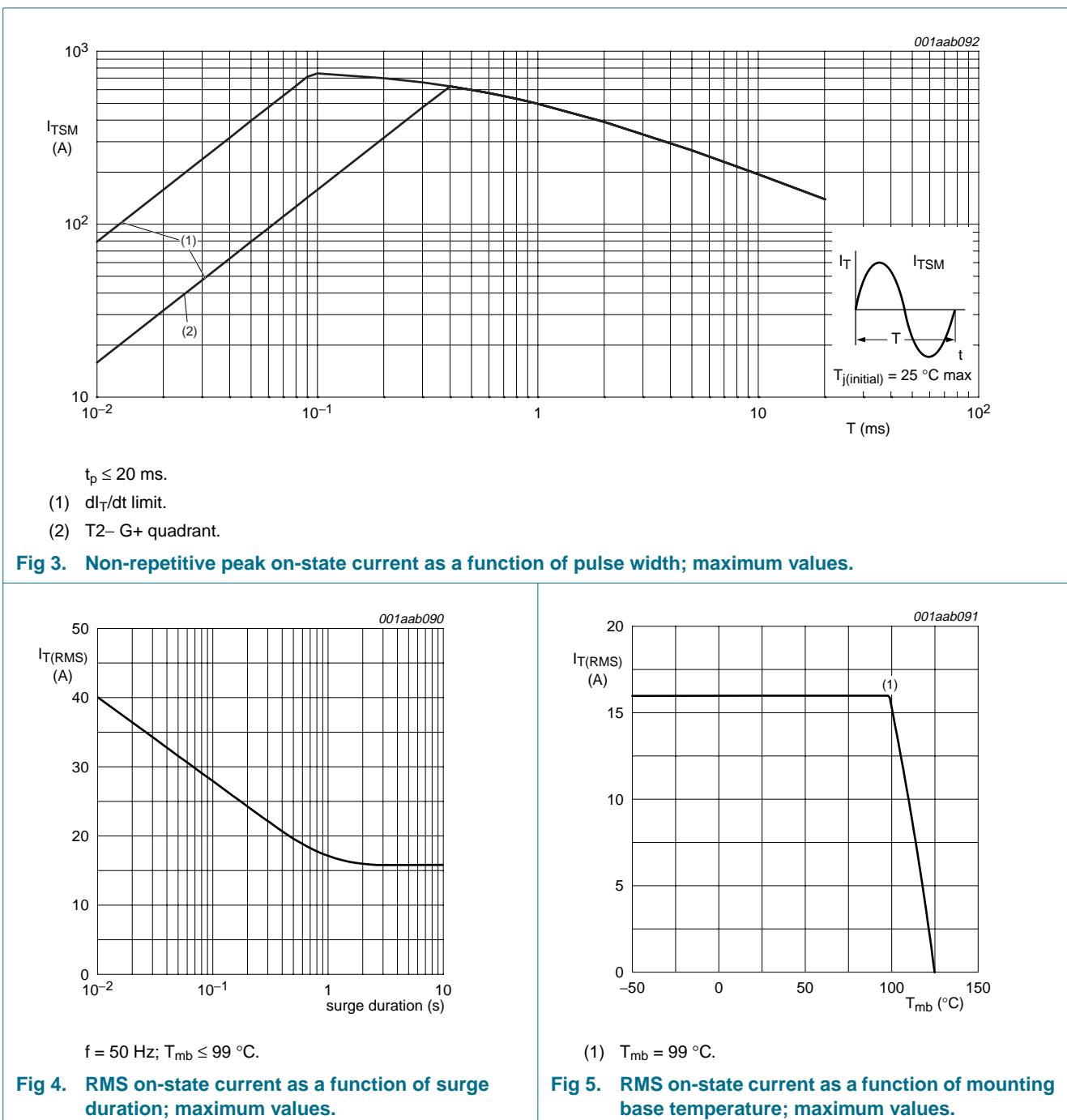
$\alpha$  = conduction angle.

Fig 1. Total power dissipation as a function of RMS on-state current; maximum values.



$f = 50$  Hz.

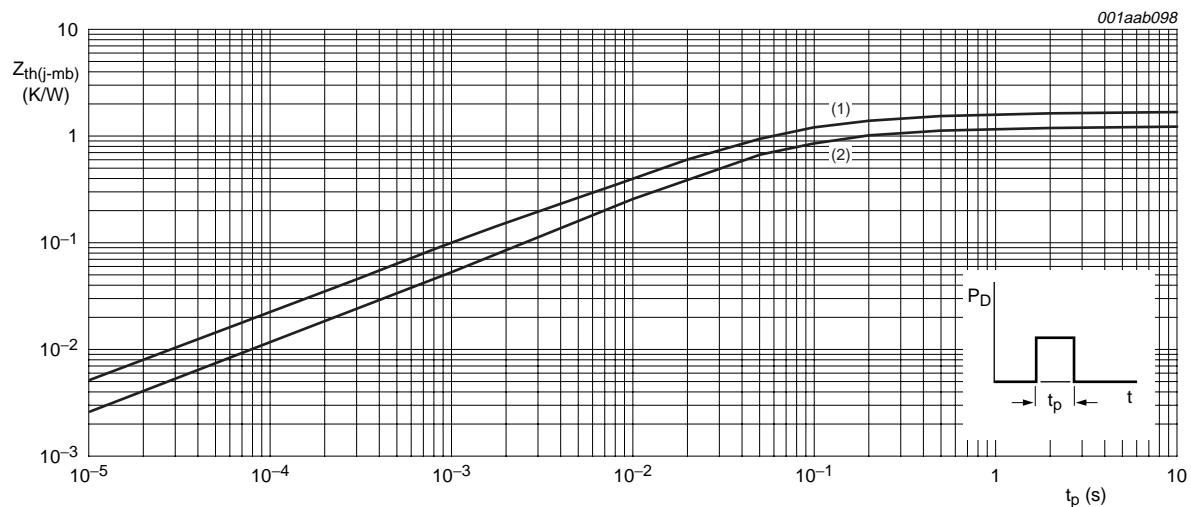
Fig 2. Non-repetitive peak on-state current as a function of the number ( $n$ ) of sinusoidal current cycles; maximum values.



## 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	full cycle; <a href="#">Figure 6</a>	-	-	1.2	K/W
		half cycle; <a href="#">Figure 6</a>	-	-	1.7	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	60	-	K/W



(1) Unidirectional.

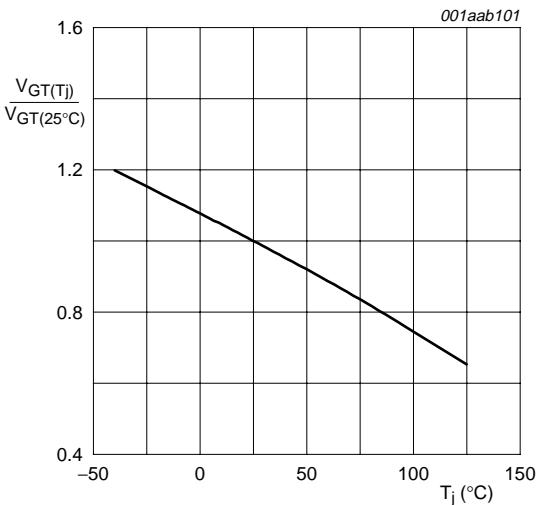
(2) Bidirectional.

**Fig 6. Transient thermal impedance as a function of pulse width.**

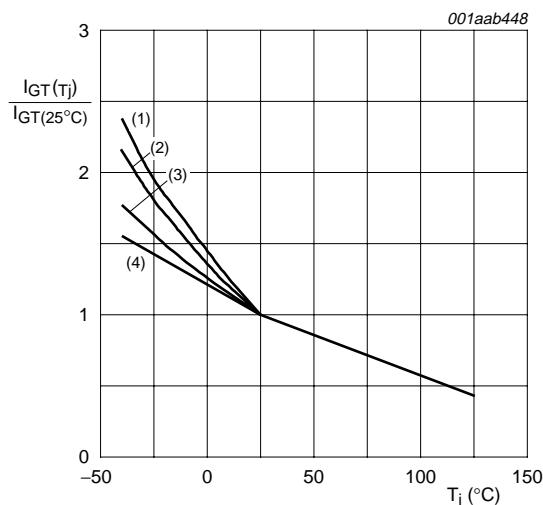
## 6. Characteristics

**Table 5: Characteristics** $T_j = 25^\circ\text{C}$  unless otherwise specified.

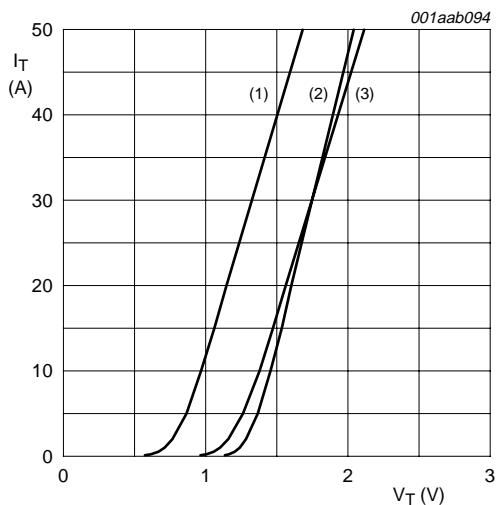
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$I_{GT}$	gate trigger current	$V_D = 12 \text{ V}; I_T = 0.1 \text{ A}$ ; <a href="#">Figure 8</a>				
		T2+ G+	-	2.5	10	mA
		T2+ G-	-	4	10	mA
		T2- G-	-	5	10	mA
		T2- G+	-	11	25	mA
$I_L$	latching current	$V_D = 12 \text{ V}; I_{GT} = 0.1 \text{ A}$ ; <a href="#">Figure 10</a>				
		T2+ G+	-	3.2	30	mA
		T2+ G-	-	16	40	mA
		T2- G-	-	4	30	mA
		T2- G+	-	5.5	40	mA
$I_H$	holding current	$V_D = 12 \text{ V}; I_{GT} = 0.1 \text{ A}$ ; <a href="#">Figure 11</a>	-	4	45	mA
$V_T$	on-state voltage	$I_T = 20 \text{ A}$ ; <a href="#">Figure 9</a>	-	1.2	1.6	V
$V_{GT}$	gate trigger voltage	$V_D = 12 \text{ V}; I_T = 0.1 \text{ A}$ ; <a href="#">Figure 7</a>	-	0.7	1.5	V
		$V_D = 400 \text{ V}; I_T = 0.1 \text{ A}$ ; $T_j = 125^\circ\text{C}$	0.25	0.4	-	V
$I_D$	off-state leakage current	$V_D = V_{DRM(\max)}; T_j = 125^\circ\text{C}$	-	0.1	0.5	mA
<b>Dynamic characteristics</b>						
$dV_D/dt$	critical rate of rise of off-state voltage	$V_{DM} = 67\% V_{DRM(\max)}$ ; $T_j = 125^\circ\text{C}$ ; exponential waveform; gate open circuit	-	50	-	V/ $\mu\text{s}$
$t_{gt}$	gate controlled turn-on time	$I_{TM} = 20 \text{ A}; V_D = V_{DRM(\max)}$ ; $I_G = 0.1 \text{ A}; dI_G/dt = 5 \text{ A}/\mu\text{s}$	-	2	-	$\mu\text{s}$



**Fig 7.** Normalized gate trigger voltage as a function of junction temperature.



**Fig 8.** Normalized gate trigger current as a function of junction temperature.

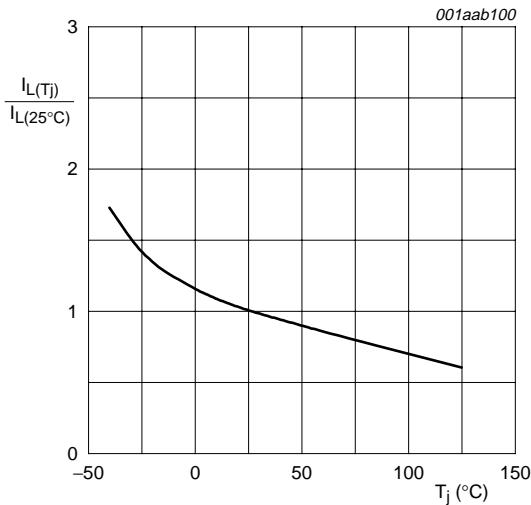


$V_O = 1.195$  V.

$R_s = 0.018$   $\Omega$ .

- (1)  $T_j = 125$   $^{\circ}$ C; typical values.
- (2)  $T_j = 25$   $^{\circ}$ C; maximum values.
- (3)  $T_j = 125$   $^{\circ}$ C; maximum values.

**Fig 9.** On-state current characteristics.



**Fig 10.** Normalized latching current as a function of junction temperature.

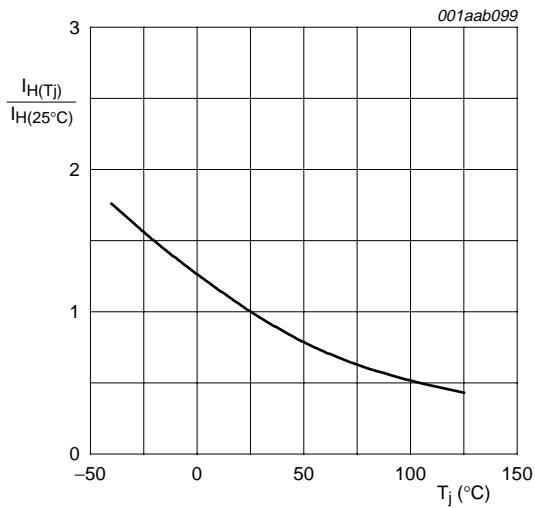


Fig 11. Normalized holding current as a function of junction temperature.

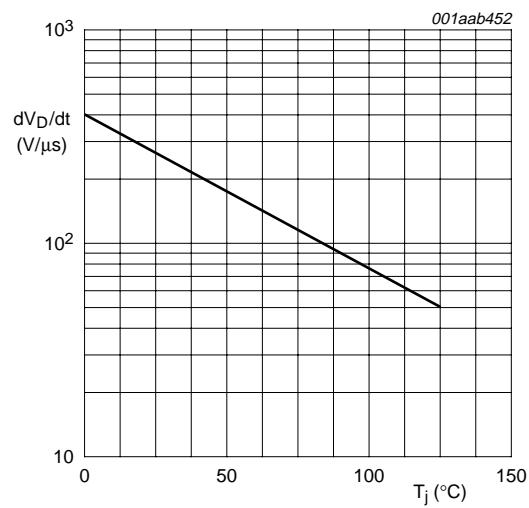
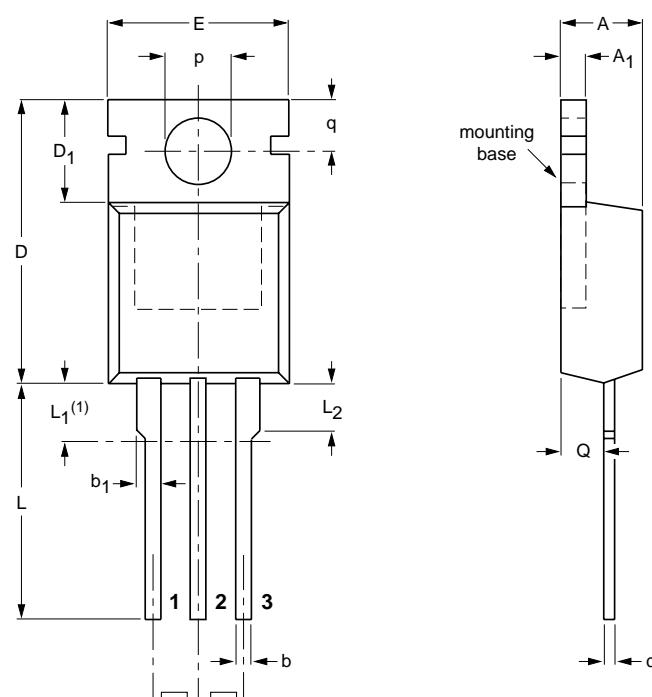


Fig 12. Critical rate of rise of off-state voltage as a function of junction temperature; minimum values.

## 7. Package outline

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

SOT78



0      5      10 mm  
scale

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

UNIT	A	A <sub>1</sub>	b	b <sub>1</sub>	c	D	D <sub>1</sub>	E	e	L	L <sub>1(1)</sub>	L <sub>2</sub> max.	p	q	Q
mm	4.5 4.1	1.39 1.27	0.9	1.3 1.0	0.7 0.4	15.8 15.2	6.4 5.9	10.3 9.7	2.54	15.0 13.5	3.30 2.79	3.0	3.8 3.6	3.0 2.7	2.6 2.2

**Note**

1. Terminals in this zone are not tinned.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78		3-lead TO-220AB	SC-46			-01-02-16 03-01-22

**Fig 13. Package outline; SOT78 (TO-220AB).**



## 8. Revision history

**Table 6: Revision history**

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
BT139_SERIES_E_3	20040923	Product data sheet	-	9397 750 13437	BT139_SERIES_E_2
Modifications:	<ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors.</li></ul>				
BT139_SERIES_E_2	20010701	Product specification	-	-	BT139_SERIES_E_1
BT139_SERIES_E_1	19971001	Product specification	-	-	-



## 9. Data sheet status

Level	Data sheet status [1]	Product status [2][3]	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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**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**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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