

# BT139X series

## Triacs

Rev. 05 — 20 January 2005

Product data sheet

## 1. Product profile

### 1.1 General description

Passivated triacs in a SOT186A full pack plastic package intended for use in applications requiring high bidirectional transient and blocking voltage capability.

### 1.2 Features

- High thermal cycling performance
- Isolated mounting base

### 1.3 Applications

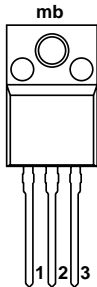
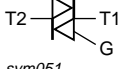
- Motor control
- Industrial and domestic lighting, heating and static switching

### 1.4 Quick reference data

- $V_{\text{DRM}} \leq 600 \text{ V}$  (BT139X-600)
- $V_{\text{DRM}} \leq 600 \text{ V}$  (BT139X-600F)
- $V_{\text{DRM}} \leq 600 \text{ V}$  (BT139X-600G)
- $V_{\text{DRM}} \leq 800 \text{ V}$  (BT139X-800)
- $I_{\text{T(RMS)}} \leq 16 \text{ A}$
- $I_{\text{GT}} \leq 25 \text{ mA}$  (BT139X-F)
- $I_{\text{GT}} \leq 35 \text{ mA}$  (BT139X)
- $I_{\text{GT}} \leq 50 \text{ mA}$  (BT139X-G)

## 2. Pinning information

Table 1: Pinning

Pin	Description	Simplified outline	Symbol
1	main terminal 1		 <i>sym051</i>
2	main terminal 2		
3	gate		
mb	mounting base; isolated		

SOT186A (TO-220F)

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### 3. Ordering information

**Table 2: Ordering information**

Type number	Package		
	Name	Description	Version
BT139X-600	TO-220F	plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3 lead TO-220 'full pack'	SOT186A
BT139X-600F			
BT139X-600G			
BT139X-800			

### 4. Limiting values

**Table 3: Limiting values**

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

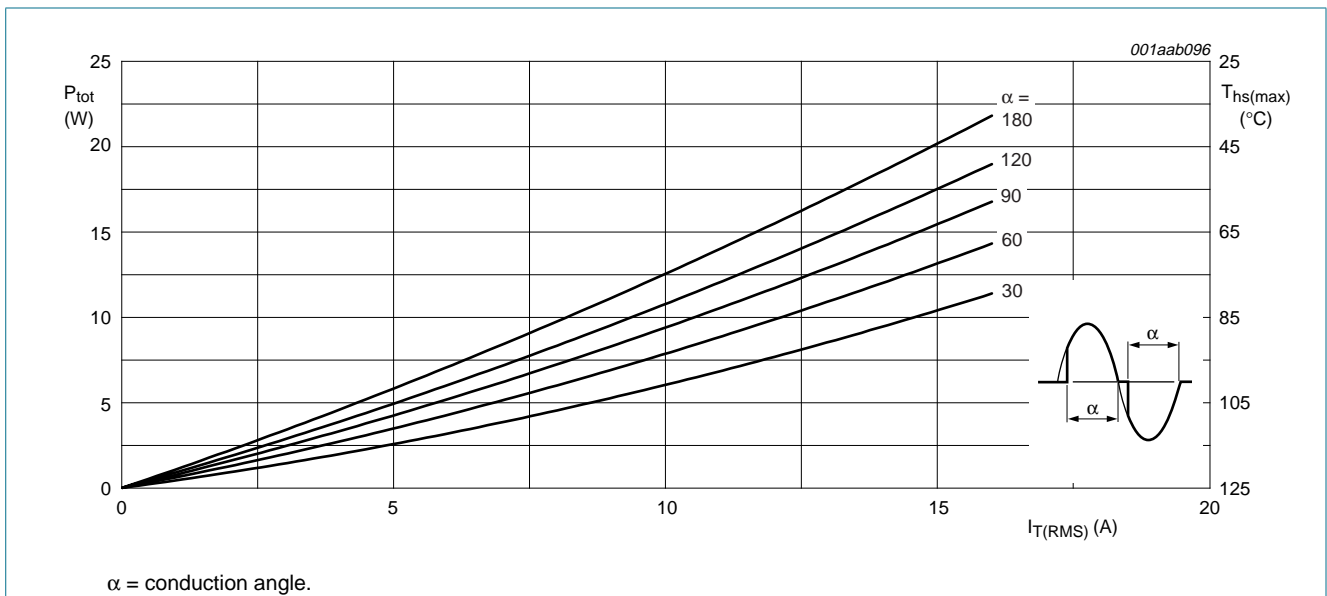
Symbol	Parameter	Conditions	Min	Max	Unit	
$V_{\text{DRM}}$	repetitive peak off-state voltage					
		BT139X-600 series	[1]	-	600	V
		BT139X-800		-	800	V
$I_{\text{T(RMS)}}$	RMS on-state current	full sine wave; $T_{\text{hs}} \leq 38\text{ °C}$ ; <a href="#">Figure 4</a> and <a href="#">Figure 5</a>	-	16	A	
$I_{\text{TSM}}$	non-repetitive peak on-state current	full sine wave; $T_{\text{j}} = 25\text{ °C}$ 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	A <sup>2</sup> s	
$di_{\text{T}}/dt_{\text{t}}$	repetitive rate of rise of on-state current after triggering	$I_{\text{TM}} = 20\text{ A}$ ; $I_{\text{G}} = 0.2\text{ A}$ ; $di_{\text{G}}/dt = 0.2\text{ A}/\mu\text{s}$				
		T2+ G+	-	50	A/ $\mu\text{s}$	
		T2+ G-	-	50	A/ $\mu\text{s}$	
		T2- G-	-	50	A/ $\mu\text{s}$	
		T2- G+	-	10	A/ $\mu\text{s}$	
$I_{\text{GM}}$	peak gate current		-	2	A	
$V_{\text{GM}}$	peak gate voltage		-	5	V	
$P_{\text{GM}}$	peak gate power		-	5	W	
$P_{\text{G(AV)}}$	average gate power	over any 20 ms period	-	0.5	W	
$T_{\text{stg}}$	storage temperature		-40	+150	°C	
$T_{\text{j}}$	junction temperature		-	125	°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/ $\mu\text{s}$ .

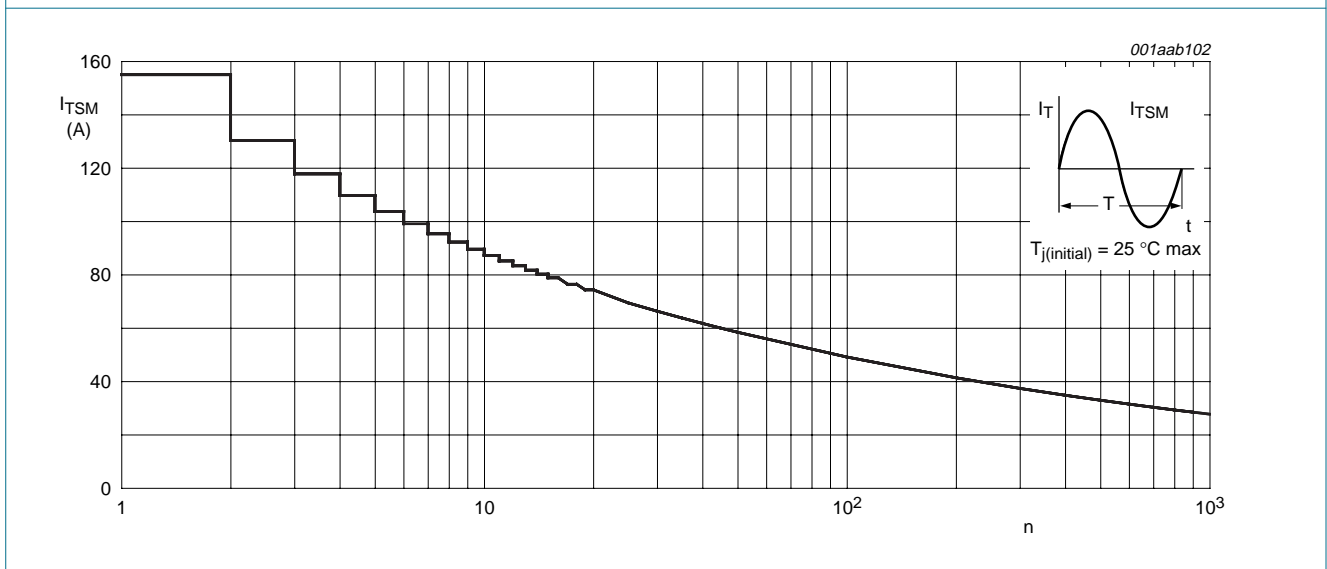
**Table 4: Isolation limiting values and characteristic**

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

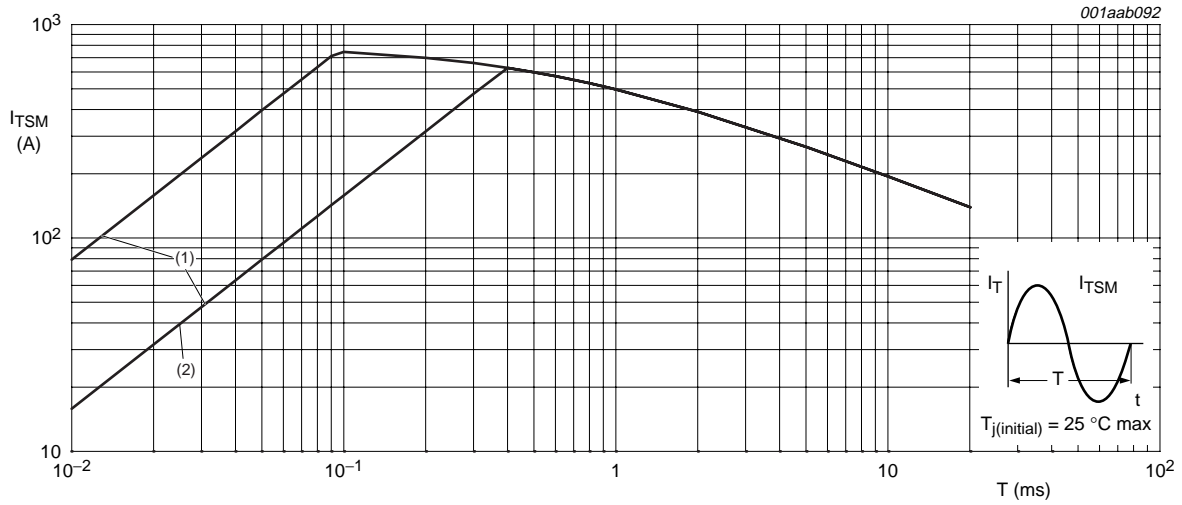
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{isol}$	RMS value isolation voltage from all three terminals to external heatsink	$f = 50$ to $60$ Hz; sinusoidal waveform; R.H. $\leq 65\%$ ; clean and dust free	-	-	2500	V
$C_{isol}$	capacitance from pin 2 to external heatsink	$f = 1$ MHz	-	10	-	pF



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



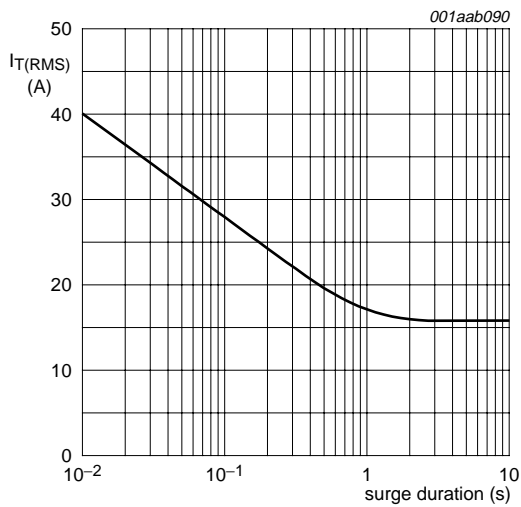
**Fig 2. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values**



$t_p \leq 20\text{ ms.}$

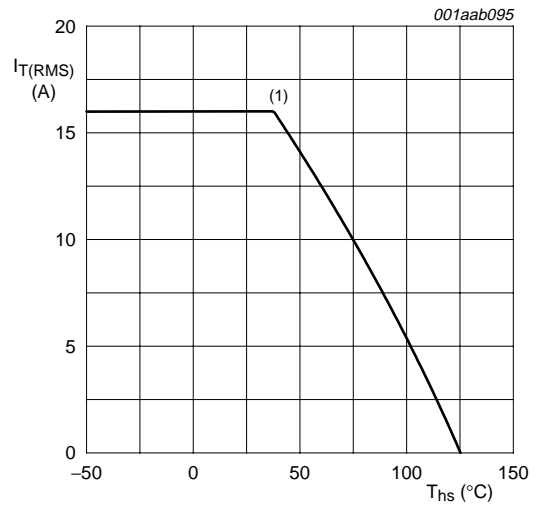
- (1)  $di_T/dt$  limit.
- (2) T2- G+ quadrant.

**Fig 3. Non-repetitive peak on-state current as a function of pulse width; maximum values**



$f = 50\text{ Hz; } T_{hs} \leq 38\text{ }^{\circ}\text{C.}$

**Fig 4. RMS on-state current as a function of surge duration; maximum values**



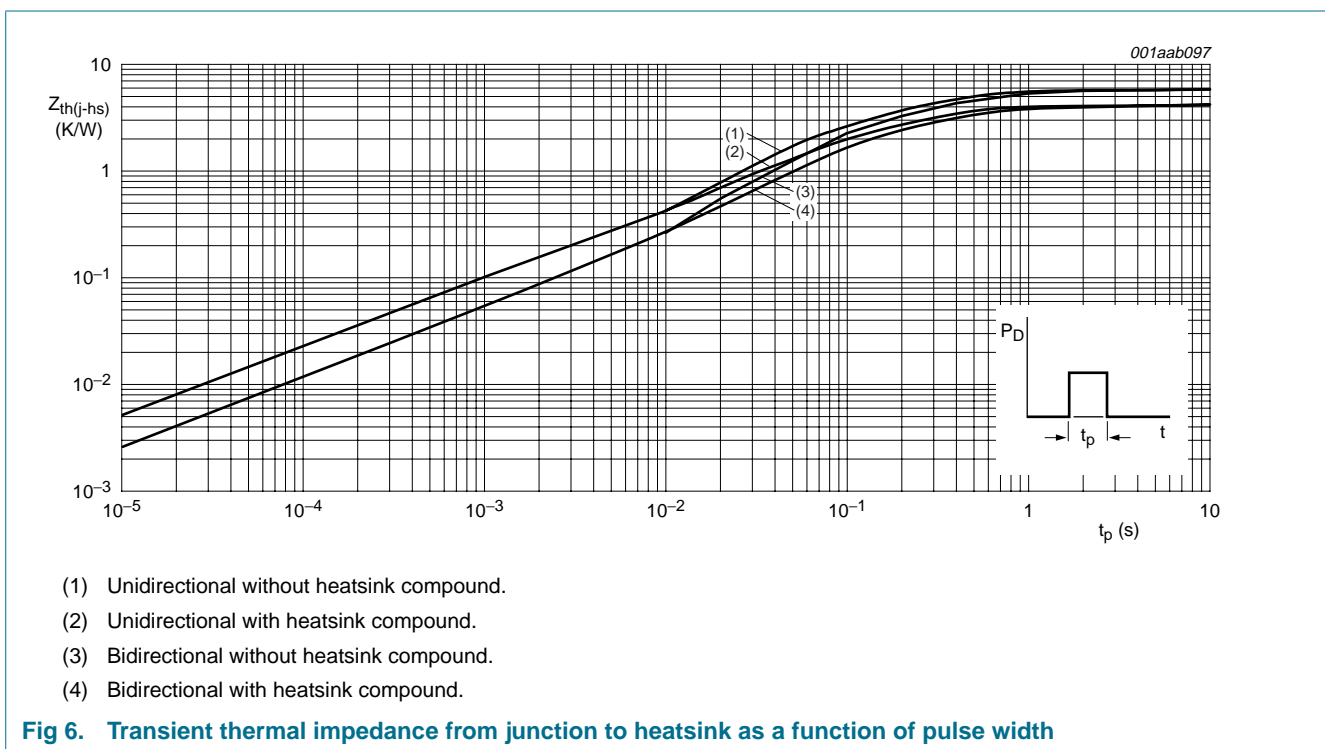
(1)  $T_{hs} = 38\text{ }^{\circ}\text{C.}$

**Fig 5. RMS on-state current as a function of heatsink temperature; maximum values**

## 5. Thermal characteristics

**Table 5: Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Max	Unit
$R_{th(j-hs)}$	thermal resistance junction to heatsink	full or half cycle with heatsink compound; <a href="#">Figure 6</a>	-	4	K/W
		full or half cycle without heatsink compound; <a href="#">Figure 6</a>	-	5.5	K/W
$R_{th(j-a)}$	thermal resistance junction to ambient	in free air	55	-	K/W



## 6. Static characteristics

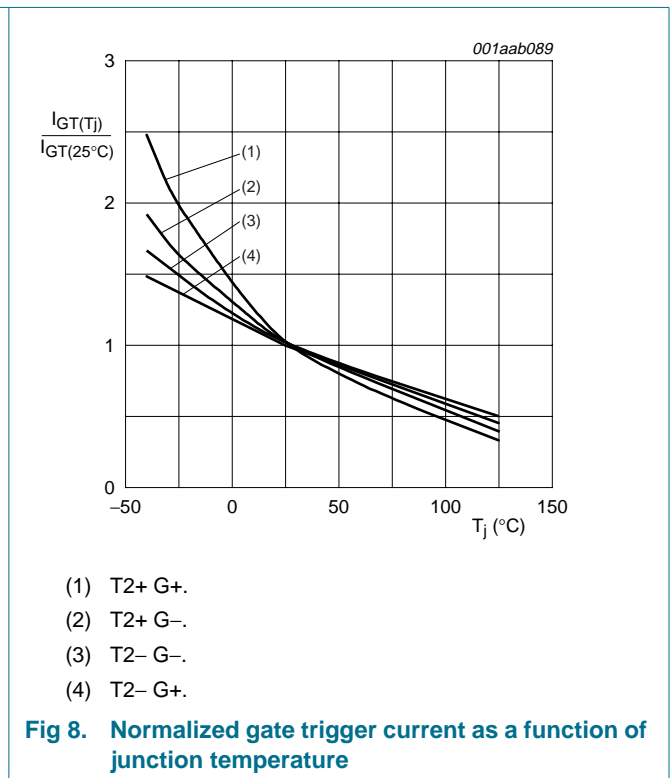
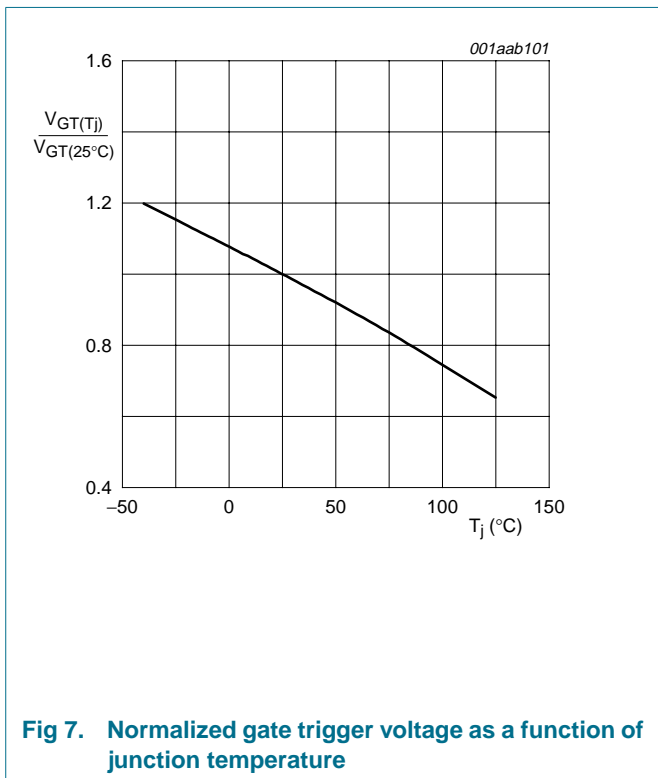
**Table 6: Static characteristics**
*T<sub>j</sub> = 25 °C unless otherwise specified.*

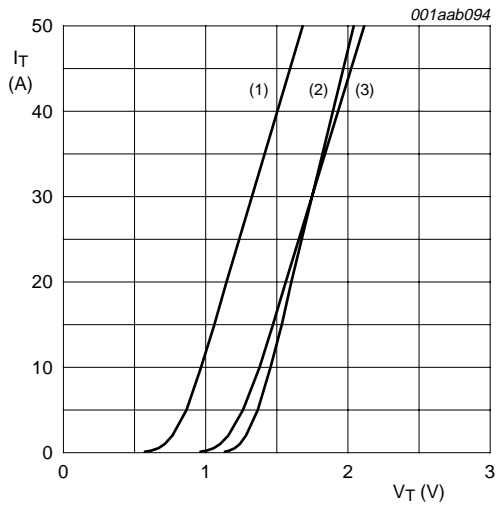
Symbol	Parameter	Conditions	BT139X			BT139X-F			BT139X-G			Unit
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I <sub>GT</sub>	gate trigger current	V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; <a href="#">Figure 8</a>										
		T2+ G+	-	5	35	-	5	25	-	5	50	mA
		T2+ G-	-	8	35	-	8	25	-	8	50	mA
		T2- G-	-	10	35	-	10	25	-	10	50	mA
		T2- G+	-	22	70	-	22	70	-	22	100	mA
I <sub>L</sub>	latching current	V <sub>D</sub> = 12 V; I <sub>GT</sub> = 0.1 A; <a href="#">Figure 10</a>										
		T2+ G+	-	7	40	-	7	40	-	7	60	mA
		T2+ G-	-	20	60	-	20	60	-	20	90	mA
		T2- G-	-	8	40	-	8	40	-	8	60	mA
		T2- G+	-	10	60	-	10	60	-	10	90	mA
I <sub>H</sub>	holding current	V <sub>D</sub> = 12 V; I <sub>GT</sub> = 0.1 A; <a href="#">Figure 11</a>	-	6	45	-	6	45	-	6	60	mA
V <sub>T</sub>	on-state voltage	I <sub>T</sub> = 20 A; <a href="#">Figure 9</a>	-	1.2	1.6	-	1.2	1.6	-	1.2	1.6	V
V <sub>GT</sub>	gate trigger voltage	V <sub>D</sub> = 12 V; I <sub>T</sub> = 0.1 A; <a href="#">Figure 7</a>	-	0.7	1.5	-	0.7	1.5	-	0.7	1.5	V
		V <sub>D</sub> = 400 V; I <sub>T</sub> = 0.1 A; T <sub>j</sub> = 125 °C	0.25	0.4	-	0.25	0.4	-	0.25	0.4	-	V
I <sub>D</sub>	off-state leakage current	V <sub>D</sub> = V <sub>DRM(max)</sub> ; T <sub>j</sub> = 125 °C	-	0.1	0.5	-	0.1	0.5	-	0.1	0.5	mA

## 7. Dynamic characteristics

Table 7: Dynamic characteristics

Symbol	Parameter	Conditions	BT139X			BT139X-F			BT139X-G			Unit
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$dV_D/dt$	critical rate of rise of off-state voltage	$V_{DM} = 67\% V_{DRM(max)}$ ; $T_j = 125\text{ }^\circ\text{C}$ ; exponential waveform; gate open circuit	200	250	-	50	250	-	200	250	-	V/ $\mu\text{s}$
$dV_{com}/dt$	critical rate of change of commutating voltage	$V_{DM} = 400\text{ V}$ ; $T_j = 95\text{ }^\circ\text{C}$ ; $I_{T(RMS)} = 16\text{ A}$ ; $dI_{com}/dt = 7.2\text{ A/ms}$ ; gate open circuit; <a href="#">Figure 12</a>	10	20	-	-	20	-	10	20	-	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	-	-	2	-	-	2	-	$\mu\text{s}$



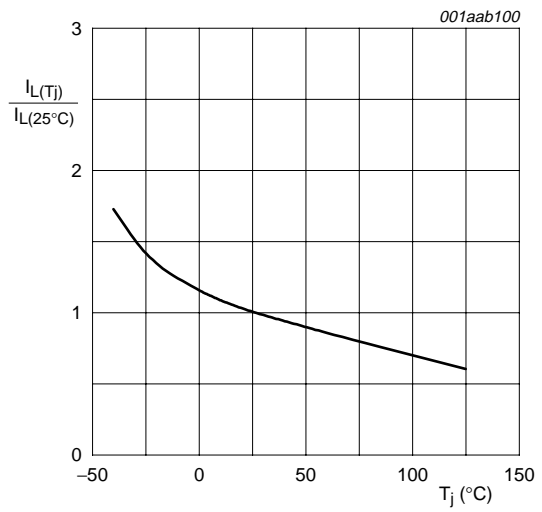


$V_O = 1.195 \text{ V.}$

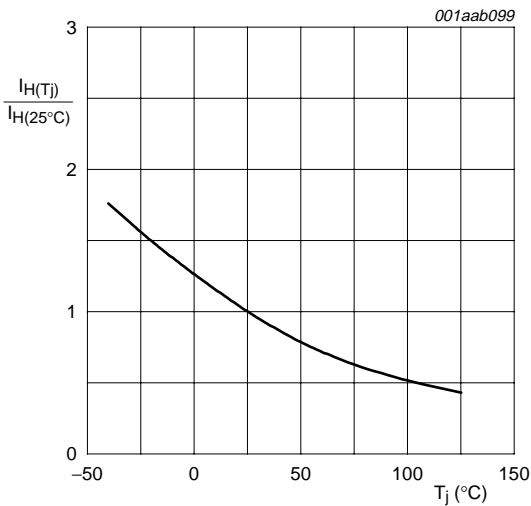
$R_S = 0.018 \Omega.$

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

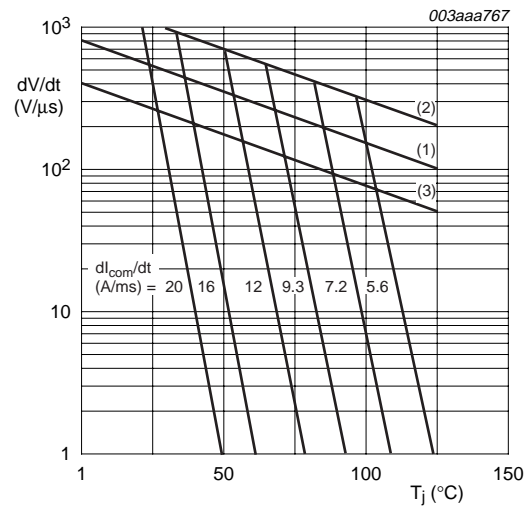
**Fig 9. On-state current as a function of on-state voltage; typical values**



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



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



The triac should commute when  $dI_T/dt$  is below the value on the appropriate curve for pre-commutation  $dI_T/dt$ .

- (1) BT139X-600; BT139X-800.
- (2) BT139X-600G.
- (3) BT139X-600F.

**Fig 12. Critical rate of change of commutating voltage as a function of junction temperature; minimum values**



8. Package outline

Plastic single-ended package; isolated heatsink mounted;  
1 mounting hole; 3 lead TO-220 'full pack'

SOT186A

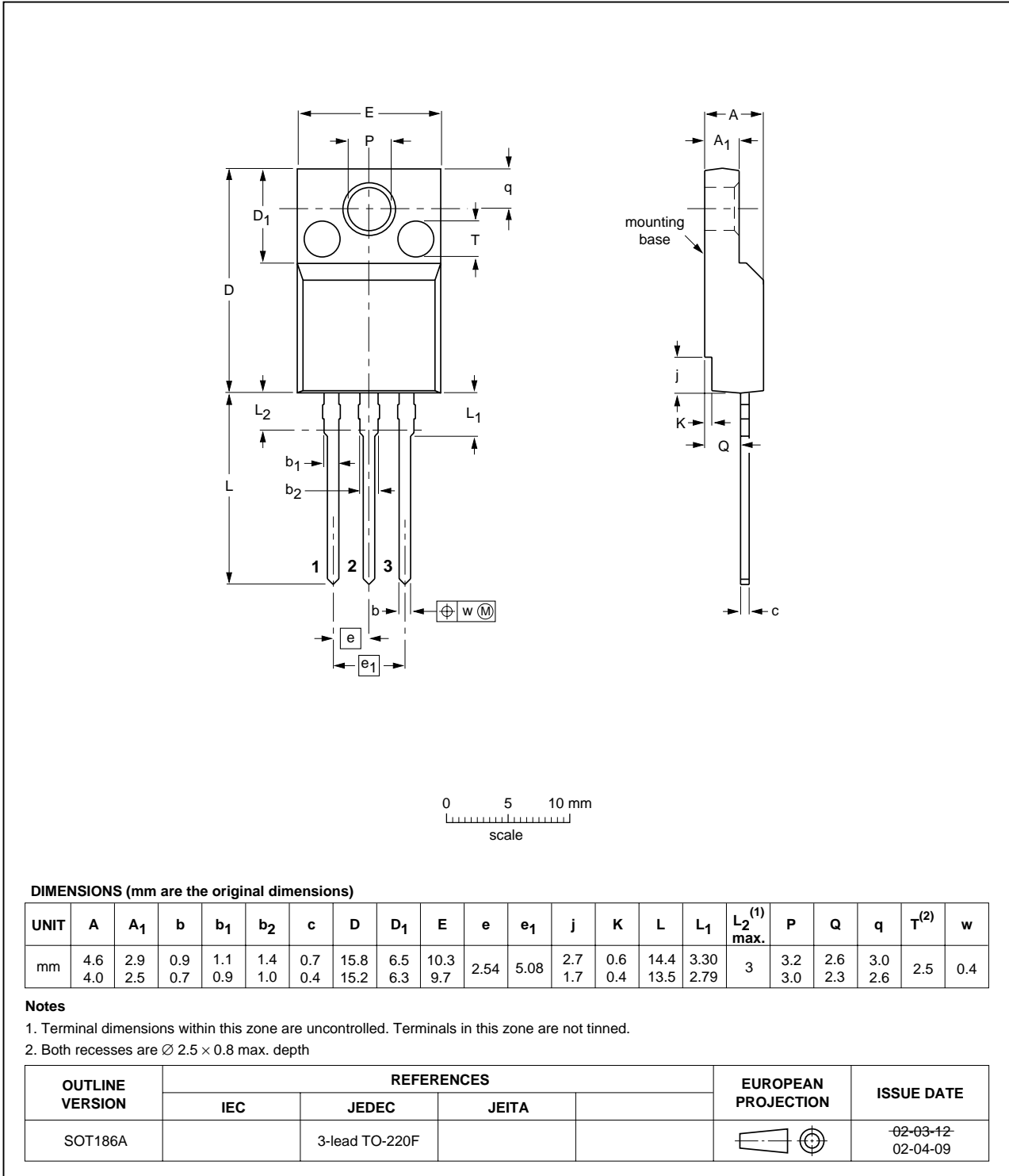


Fig 13. Package outline SOT186A (TO-220F)

## 9. Revision history

**Table 8: Revision history**

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
BT139X_SERIES_5	20050120	Product data sheet	-	9397 750 14038	BT139X_SERIES_4
Modifications:	<ul style="list-style-type: none"> <li>• Correction to headings of <a href="#">Table 6</a> and <a href="#">Table 7</a></li> <li>• <math>I_{GT}</math> data added to <a href="#">Section 1.4 "Quick reference data"</a></li> <li>• <a href="#">Figure 12</a> updated</li> </ul>				
BT139X_SERIES_4	20040712	Product data sheet	-	9397 750 13363	BT139X_SERIES_3
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>				
BT139X_SERIES_3	20030401	Product specification	-	-	BT139X_SERIES_2
BT139X_SERIES_2	20011001	Product specification	-	-	BT139X_SERIES_1
BT139X_SERIES_1	19970901	Product specification	-	-	-

## 10. 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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**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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Date of release: 20 January 2005  
Document number: 9397 750 14038

Published in The Netherlands