

# BT139X series

## Triacs

Rev. 6 — 1 November 2011

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 and benefits

- High thermal cycling performance
- Isolated mounting base

### 1.3 Applications

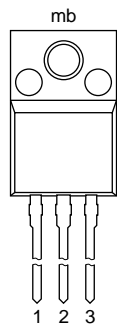
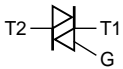
- Motor control
- Industrial and domestic lighting, heating and static switching

### 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		 sym051
2	main terminal 2		
3	gate		
mb	mounting base; isolated		

### 3. Ordering information

Table 2. Ordering information

Type number	Package		Version
	Name	Description	
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).

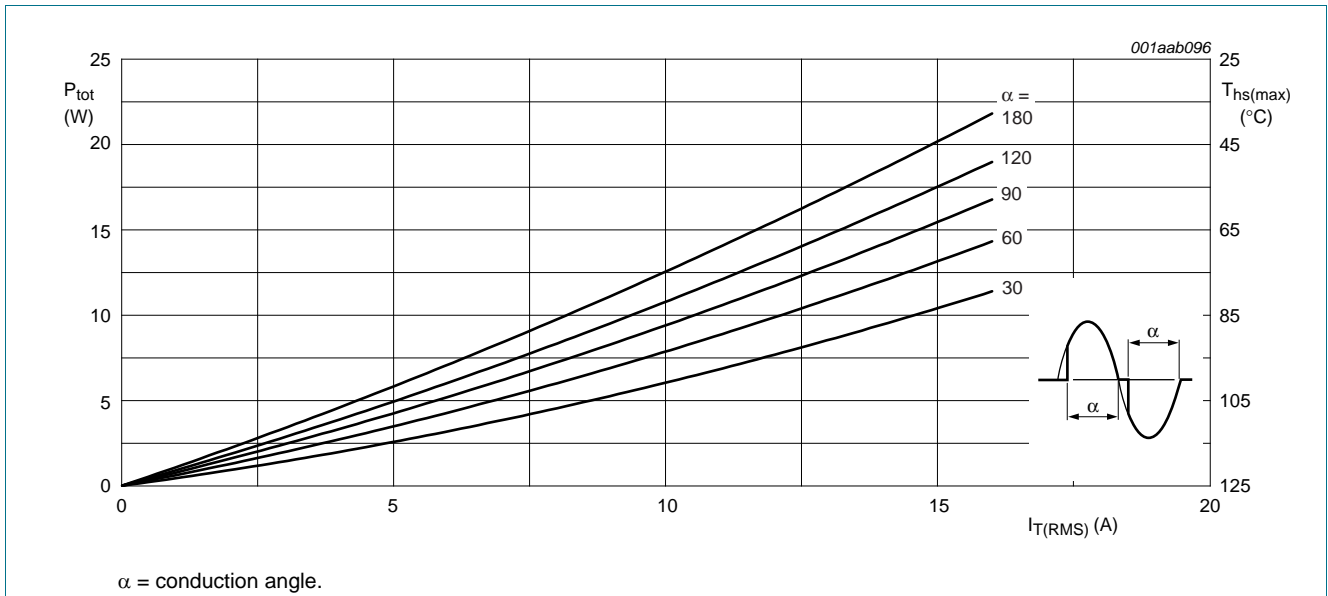
Symbol	Parameter	Conditions	Min	Max	Unit		
$V_{\text{DRM}}$	repetitive peak off-state voltage		[1]	600	V		
				BT139X-600 series	-	800	V
				BT139X-800	-	800	V
$I_{\text{T(RMS)}}$	RMS on-state current	full sine wave; $T_{\text{hs}} \leq 38\text{ °C}$ ; <a href="#">Figure 4</a> and <a href="#">Figure 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>		155	A		
				$t = 20\text{ ms}$	-	170	A
				$t = 16.7\text{ ms}$	-	170	A
$I^2t$	$I^2t$ for fusing	$t = 10\text{ ms}$	-	120	$\text{A}^2\text{s}$		
$di_{\text{T}}/dt$	repetitive rate of rise of on-state current after triggering	$I_{\text{TM}} = 20\text{ A}$ ; $I_{\text{G}} = 0.2\text{ A}$ ; $di_{\text{G}}/dt = 0.2\text{ A}/\mu\text{s}$		50	$\text{A}/\mu\text{s}$		
				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	$\text{A}/\mu\text{s}$
$I_{\text{GM}}$	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	$^{\circ}\text{C}$		
$T_{\text{j}}$	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/ $\mu\text{s}$ .

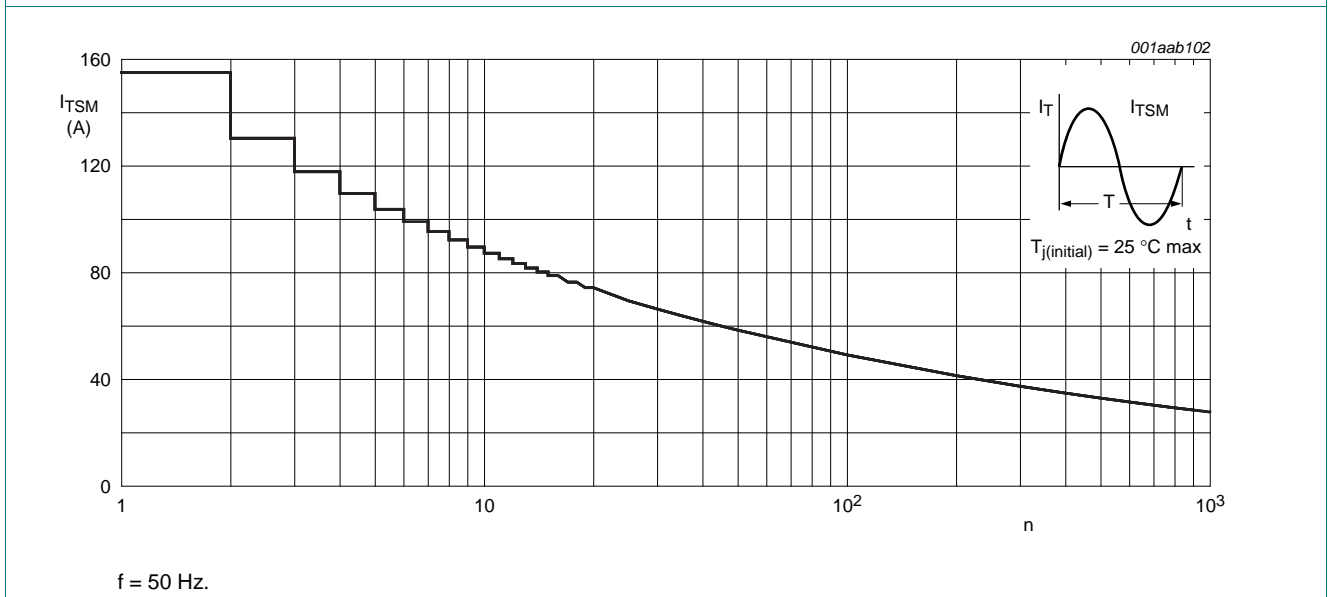
**Table 4. Isolation limiting values and characteristic**

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

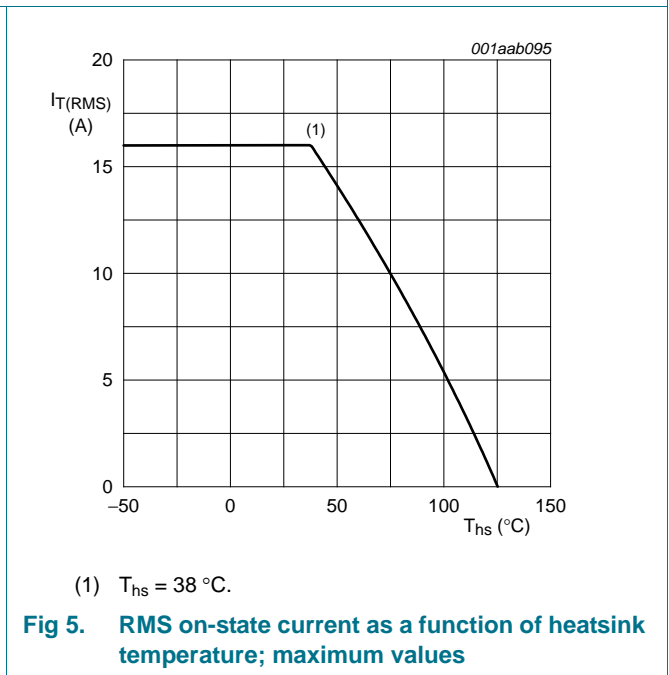
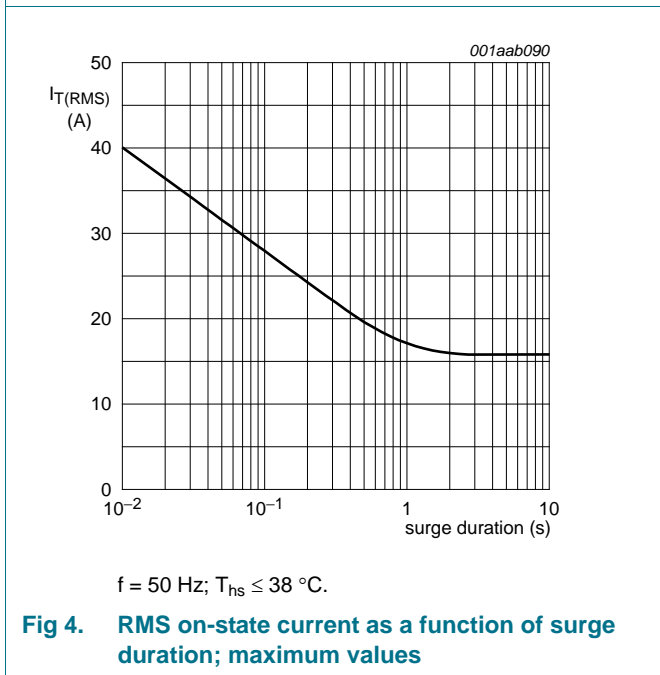
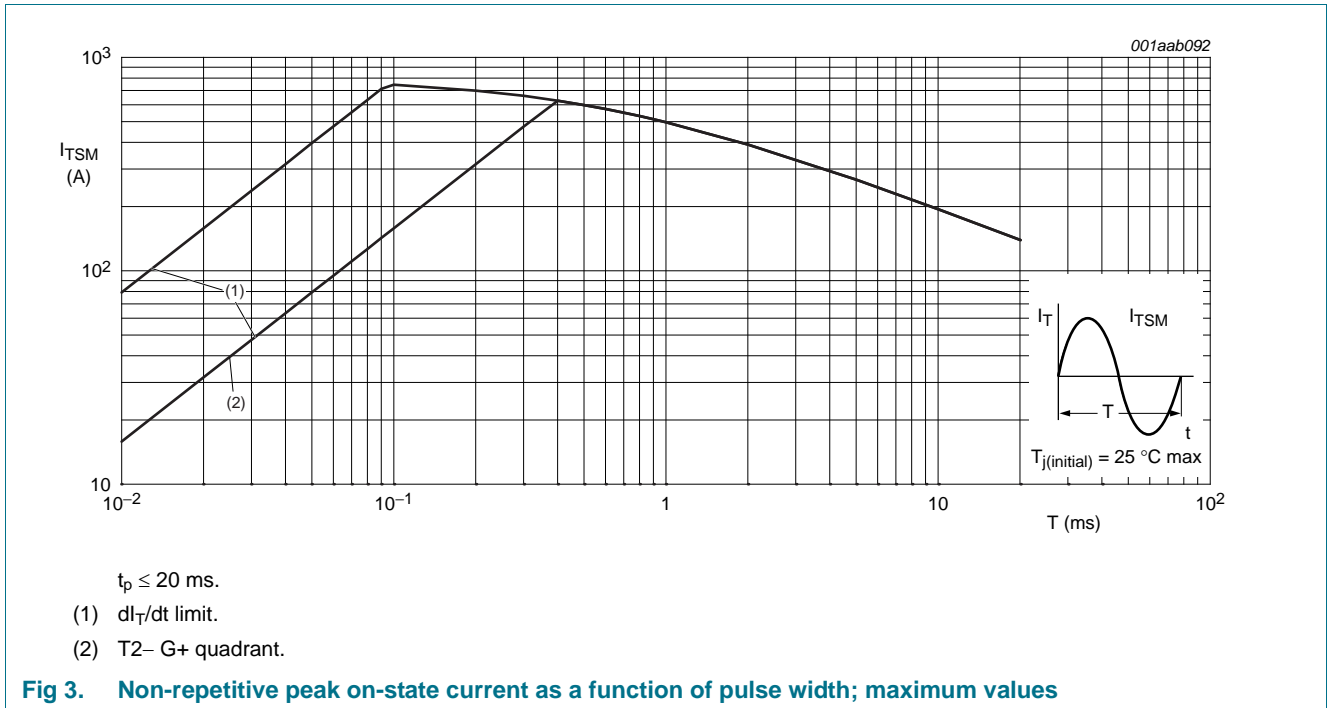
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{isol}$	RMS value isolation voltage from all three terminals to external heatsink	$f = 50$ to $60\text{ Hz}$ ; sinusoidal waveform; R.H. $\leq 65\%$ ; clean and dust free	-	-	2500	V
$C_{isol}$	capacitance from pin 2 to external heatsink	$f = 1\text{ MHz}$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



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



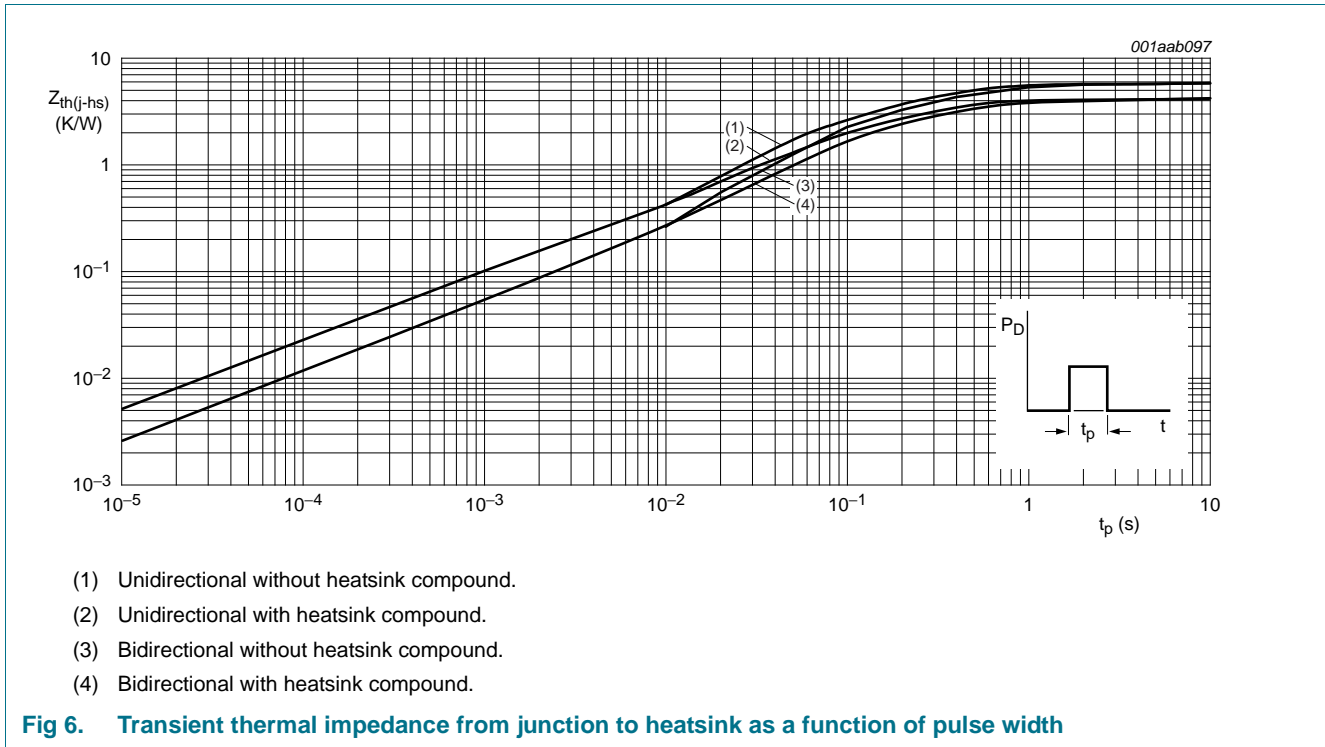
**Fig 2. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values**



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**

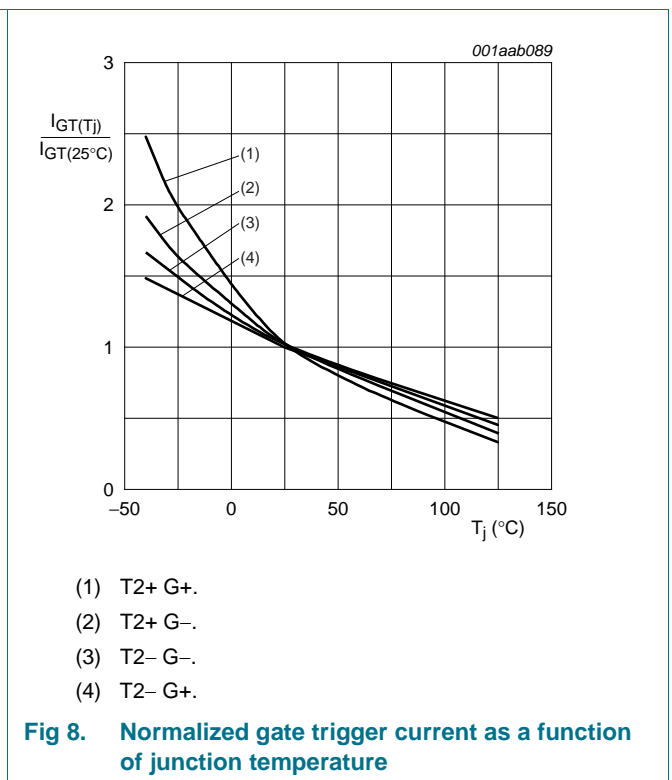
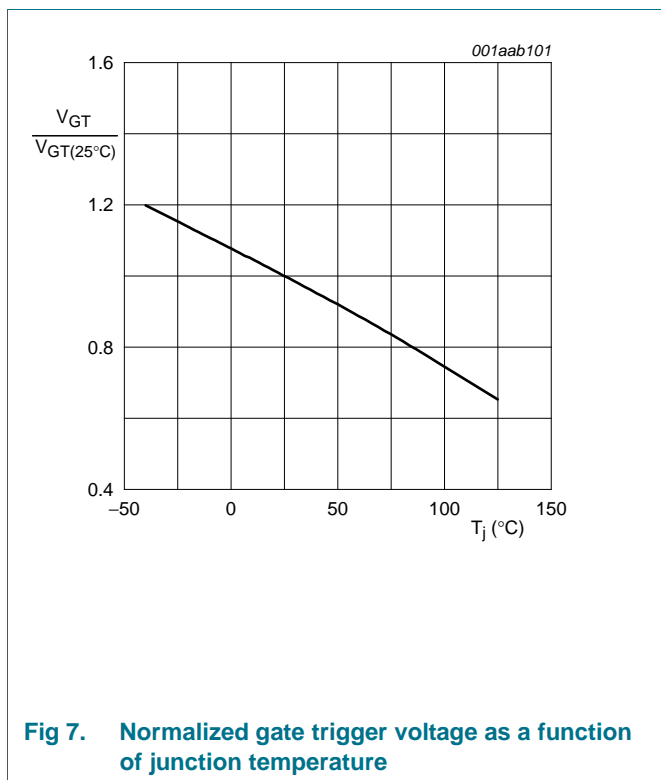
$T_j = 25\text{ °C}$  unless otherwise specified.

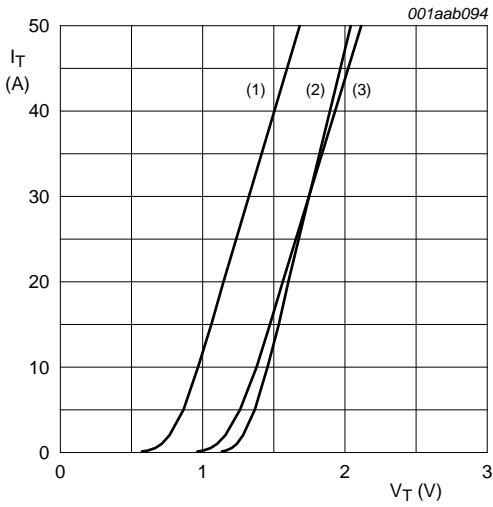
Symbol	Parameter	Conditions	BT139X			BT139X-F			BT139X-G			Unit
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{GT}$	gate trigger current	$V_D = 12\text{ V};$ $I_T = 0.1\text{ A};$ <a href="#">Figure 8</a>										
		T2+ G+	-	5	35	-	5	25	-	5	50	mA
		T2+ G-	-	8	35	-	8	25	-	8	50	mA
		T2- G-	-	10	35	-	10	25	-	10	50	mA
		T2- G+	-	22	70	-	22	70	-	22	100	mA
$I_L$	latching current	$V_D = 12\text{ V};$ $I_{GT} = 0.1\text{ A};$ <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
$I_H$	holding current	$V_D = 12\text{ V};$ $I_{GT} = 0.1\text{ A};$ <a href="#">Figure 11</a>	-	6	45	-	6	45	-	6	60	mA
$V_T$	on-state voltage	$I_T = 20\text{ A};$ <a href="#">Figure 9</a>	-	1.2	1.6	-	1.2	1.6	-	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	-	0.7	1.5	-	0.7	1.5	V
		$V_D = 400\text{ V};$ $I_T = 0.1\text{ A};$ $T_j = 125\text{ °C}$	0.25	0.4	-	0.25	0.4	-	0.25	0.4	-	V
$I_D$	off-state leakage current	$V_D = V_{DRM(max)};$ $T_j = 125\text{ °C}$	-	0.1	0.5	-	0.1	0.5	-	0.1	0.5	mA

## 7. Dynamic characteristics

Table 7. Dynamic characteristics

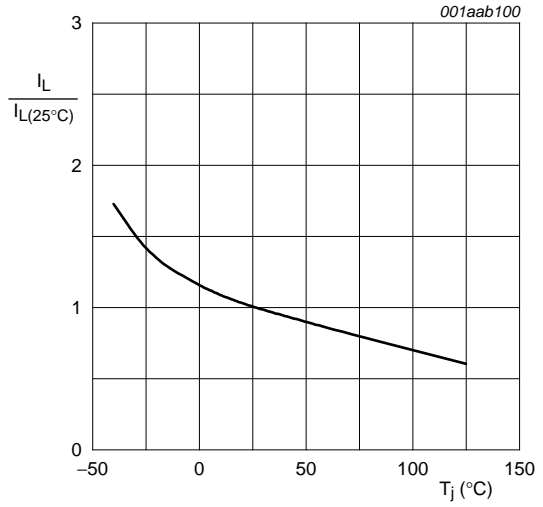
Symbol	Parameter	Conditions	BT139X			BT139X-F			BT139X-G			Unit
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$dV_D/dt$	critical rate of rise of off-state voltage	$V_{DM} = 67\% V_{DRM(max)}$ ; $T_j = 125\text{ }^\circ\text{C}$ ; exponential waveform; gate open circuit	200	250	-	50	250	-	200	250	-	$V/\mu\text{s}$
$dV_{com}/dt$	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	-	$\mu\text{s}$



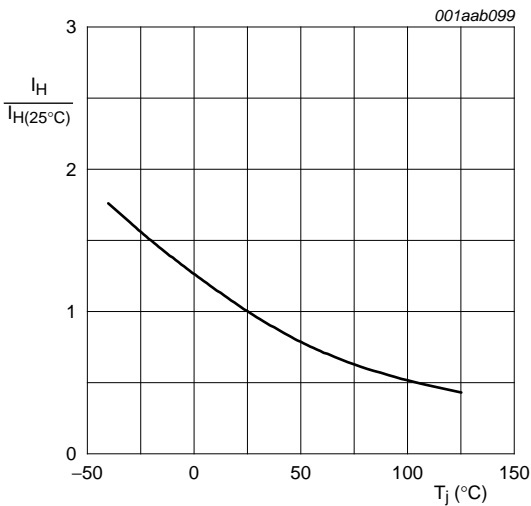


$V_O = 1.195 \text{ V}$ .  
 $R_S = 0.018 \text{ } \Omega$ .  
 (1)  $T_j = 125 \text{ } ^\circ\text{C}$ ; typical values.  
 (2)  $T_j = 25 \text{ } ^\circ\text{C}$ ; maximum values.  
 (3)  $T_j = 125 \text{ } ^\circ\text{C}$ ; maximum values.

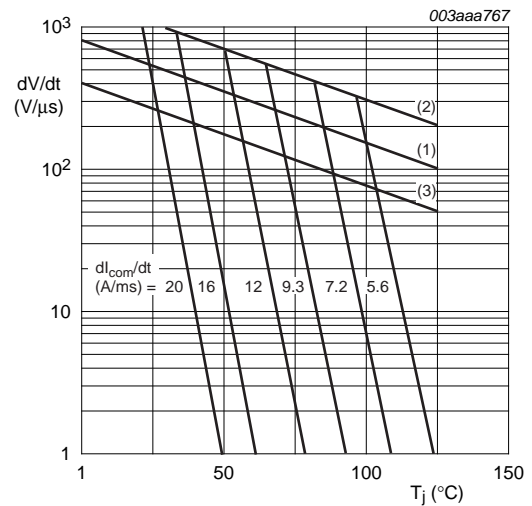
**Fig 9. On-state current as a function of on-state voltage; typical values**



**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

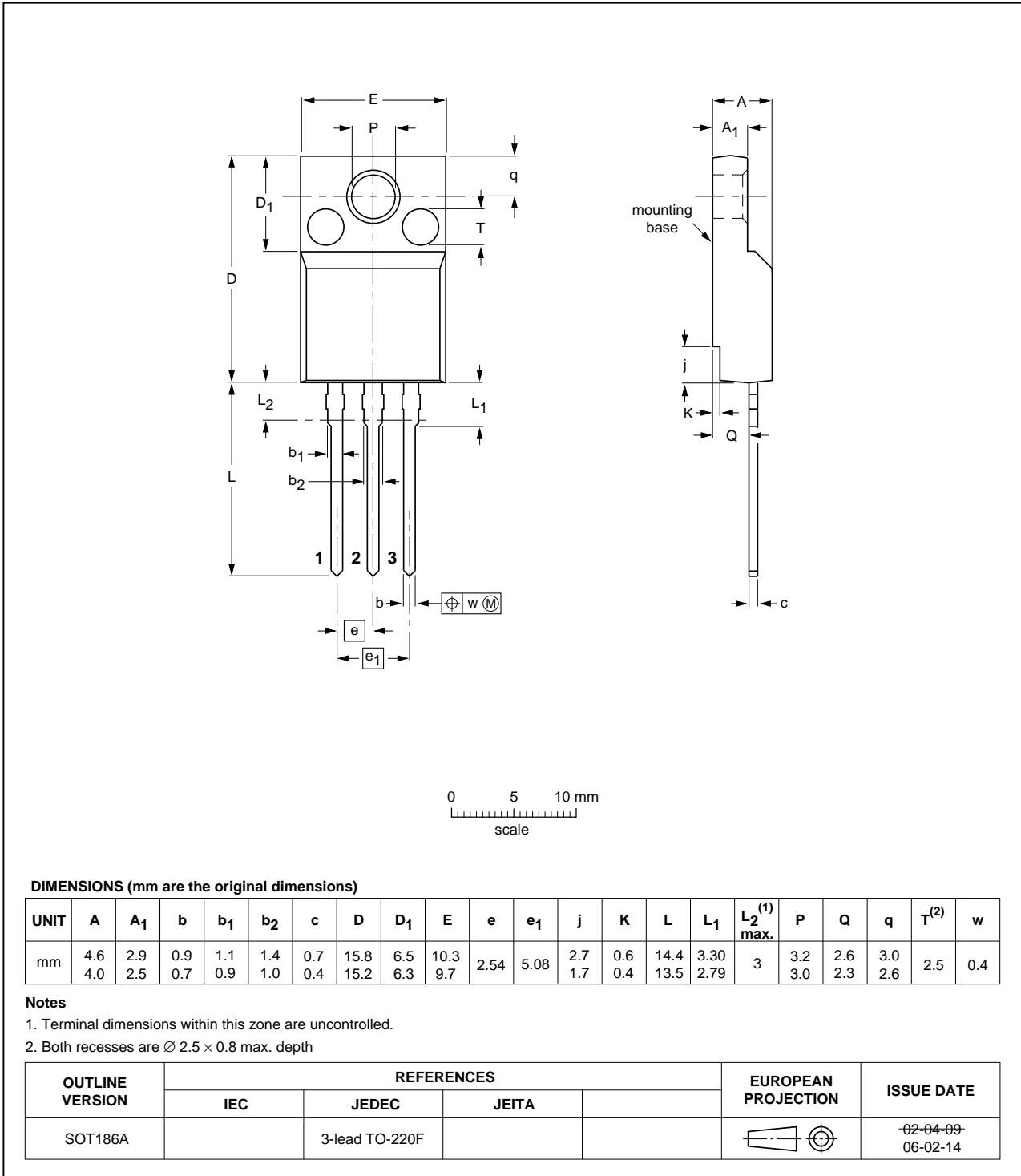


Fig 13. Package outline SOT186A (TO-220F)

## 9. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BT139X_SER v.6	20111101	Product data sheet		BT139X_SERIES v.5
Modifications:				
			<ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>• Legal texts have been adapted to the new company name where appropriate.</li></ul>	
BT139X_SERIES v.5	20050120	Product data sheet		BT139X_SERIES v.4
BT139X_SERIES v.4	20040712	Product data sheet		BT139X_SERIES v.3
BT139X_SERIES v.3	20030401	Product specification		BT139X_SERIES v.2
BT139X_SERIES v.2	20011001	Product specification		BT139X_SERIES v.1
BT139X_SERIES v.1	19970901	Product specification		-

## 10. Legal information

### 10.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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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