

# BT138X series D and E

12 A four-quadrant triacs, sensitive gate

Rev. 03 — 10 March 2008

Product data sheet

## 1. Product profile

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### 1.1 General description

Passivated sensitive gate triac in a SOT186A full pack plastic package.

### 1.2 Features

- Very sensitive gate
- Direct interfacing to logic level ICs
- Isolated mounting base
- Gate triggering in four quadrants
- Direct interfacing to low power gate drive circuits
- High isolation voltage

### 1.3 Applications

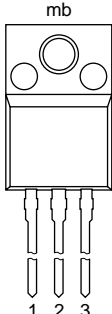

- General purpose switching and phase control
- 230 V lamp dimmers

### 1.4 Quick reference data

- $V_{\text{DRM}} \leq 600 \text{ V}$  (BT138X-600D)
- $V_{\text{DRM}} \leq 600 \text{ V}$  (BT138X-600E)
- $V_{\text{DRM}} \leq 800 \text{ V}$  (BT138X-800E)
- $I_{\text{GT}} \leq 5 \text{ mA}$  (BT138X-600D)
- $I_{\text{GT}} \leq 10 \text{ mA}$  (BT138X-600E)
- $I_{\text{GT}} \leq 10 \text{ mA}$  (BT138X-800E)
- $I_{\text{T(RMS)}} \leq 12 \text{ A}$
- $I_{\text{TSM}} \leq 95 \text{ A}$  ( $t = 20 \text{ ms}$ )
- $I_{\text{GT}} \leq 10 \text{ mA}$  (T2– G+) (BT138X-600D)
- $I_{\text{GT}} \leq 25 \text{ mA}$  (T2– G+) (BT138X-600E)
- $I_{\text{GT}} \leq 25 \text{ mA}$  (T2– G+) (BT138X-800E)

## 2. Pinning information

Table 1. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	main terminal 1 (T1)		
2	main terminal 2 (T2)		
3	gate (G)		
mb	mounting base; isolated		

**SOT186A (TO-220F)**

## 3. Ordering information

Table 2. Ordering information

Type number	Package		Version
	Name	Description	
BT138X-600D	TO-220F	plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 'full pack'	SOT186A
BT138X-600E			
BT138X-800E			

## 4. Limiting values

Table 3. Limiting values

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

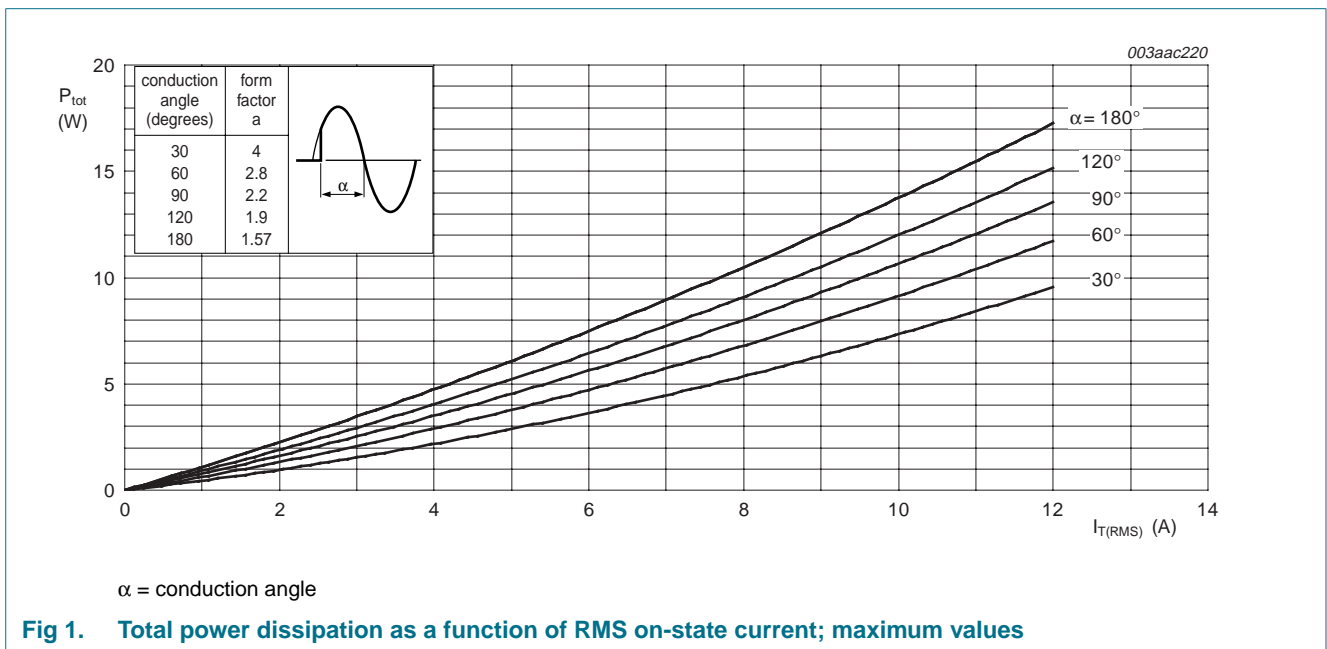
Symbol	Parameter	Conditions	Min	Max	Unit	
$V_{DRM}$	repetitive peak off-state voltage	BT138X-600D	[1]	-	600	V
		BT138X-600E	[1]	-	600	V
		BT138X-800E	-	-	800	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_h \leq 56\text{ }^\circ\text{C}$ ; see <a href="#">Figure 4</a> and <a href="#">5</a>	-	12	A	
$I_{TSM}$	non-repetitive peak on-state current	full sine wave; $T_j = 25\text{ }^\circ\text{C}$ prior to surge; see <a href="#">Figure 2</a> and <a href="#">3</a>	-	-	-	
		$t = 20\text{ ms}$	-	95	A	
		$t = 16.7\text{ ms}$	-	105	A	
$I^2t$	$I^2t$ for fusing	$t_p = 10\text{ ms}$	-	45	A <sup>2</sup> s	
$di_T/dt$	rate of rise of on-state current	$I_{TM} = 20\text{ A}$ ; $I_G = 0.2\text{ A}$ ; $di_G/dt = 0.2\text{ A}/\mu\text{s}$	-	-	-	
		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/ $\mu\text{s}$	

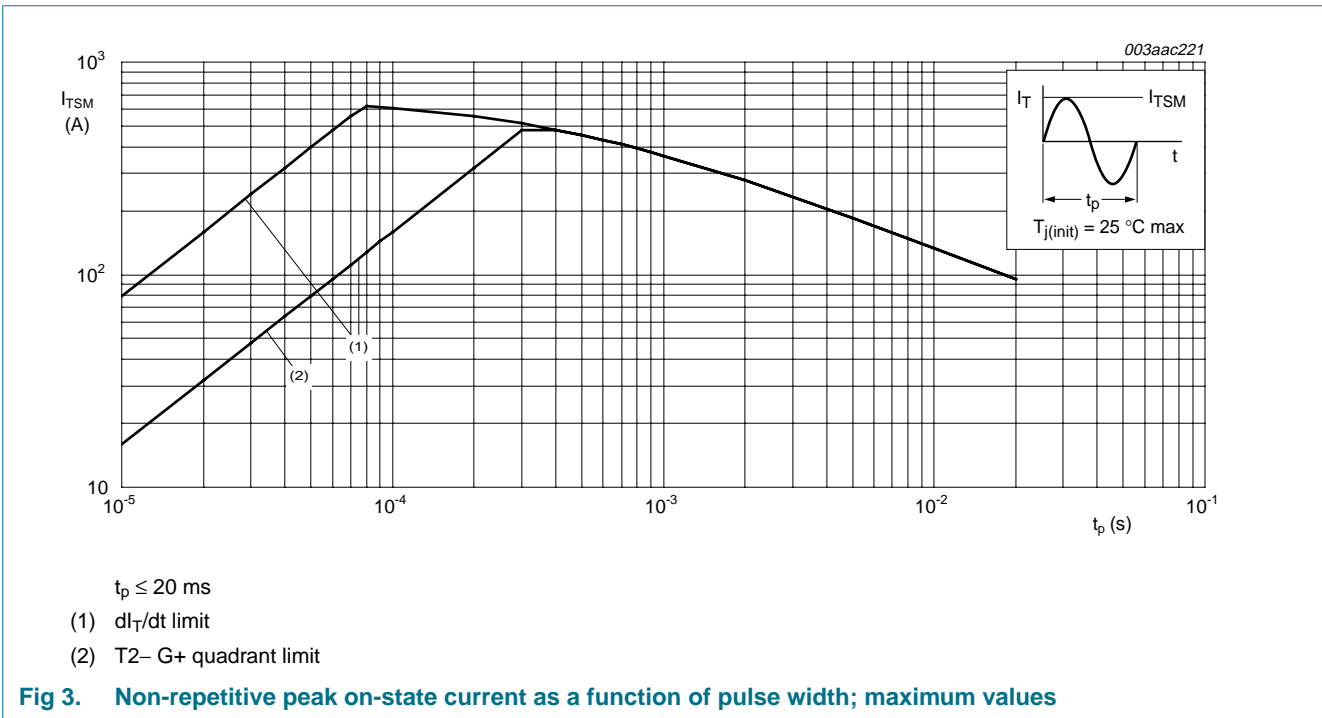
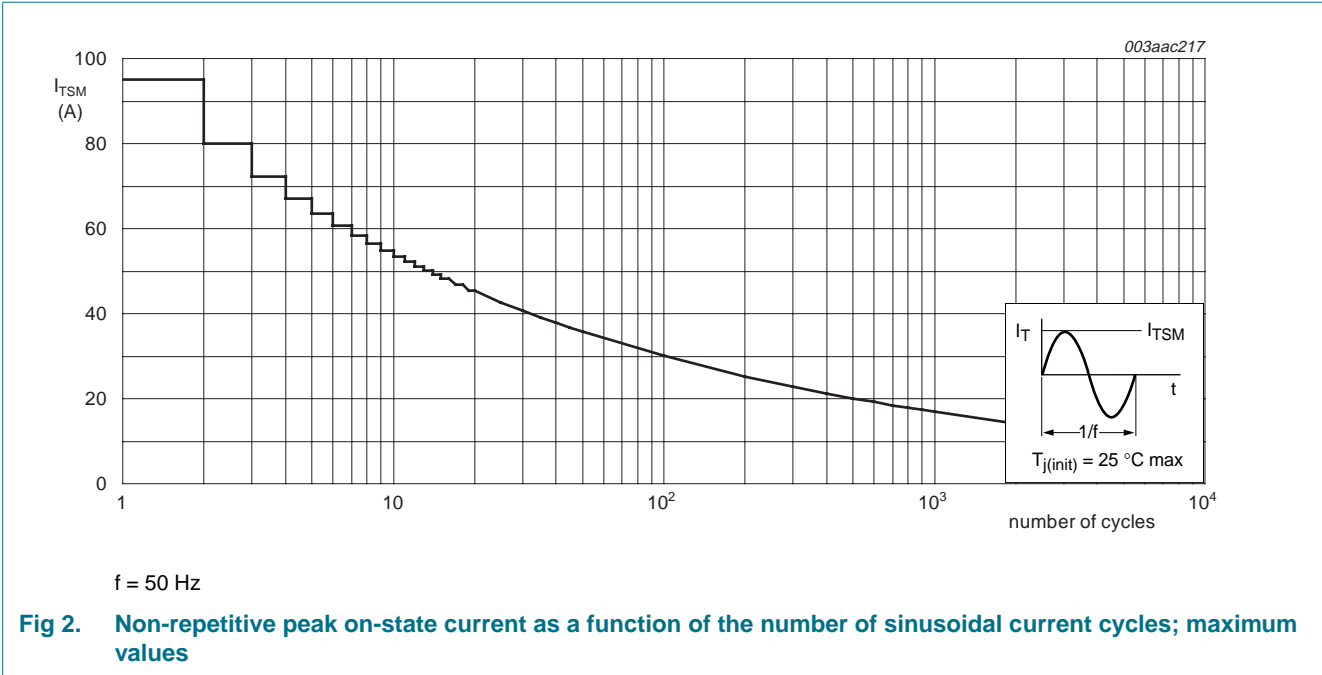
**Table 3. Limiting values ...continued**

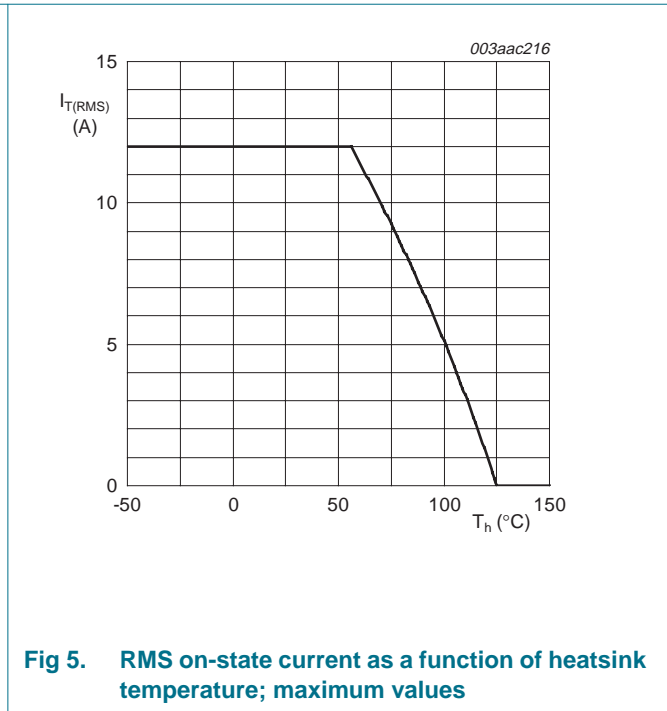
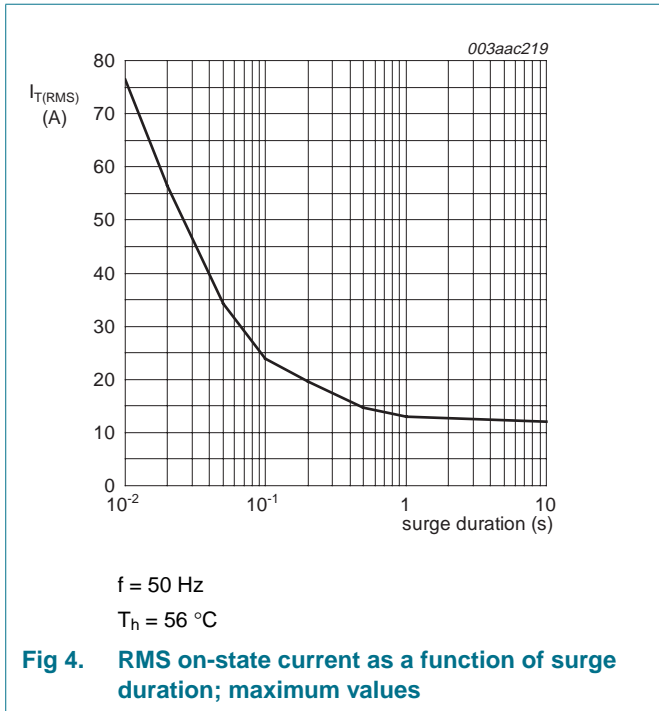
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$I_{GM}$	peak gate current		-	2	A
$P_{GM}$	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	°C
$T_j$	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/μs.



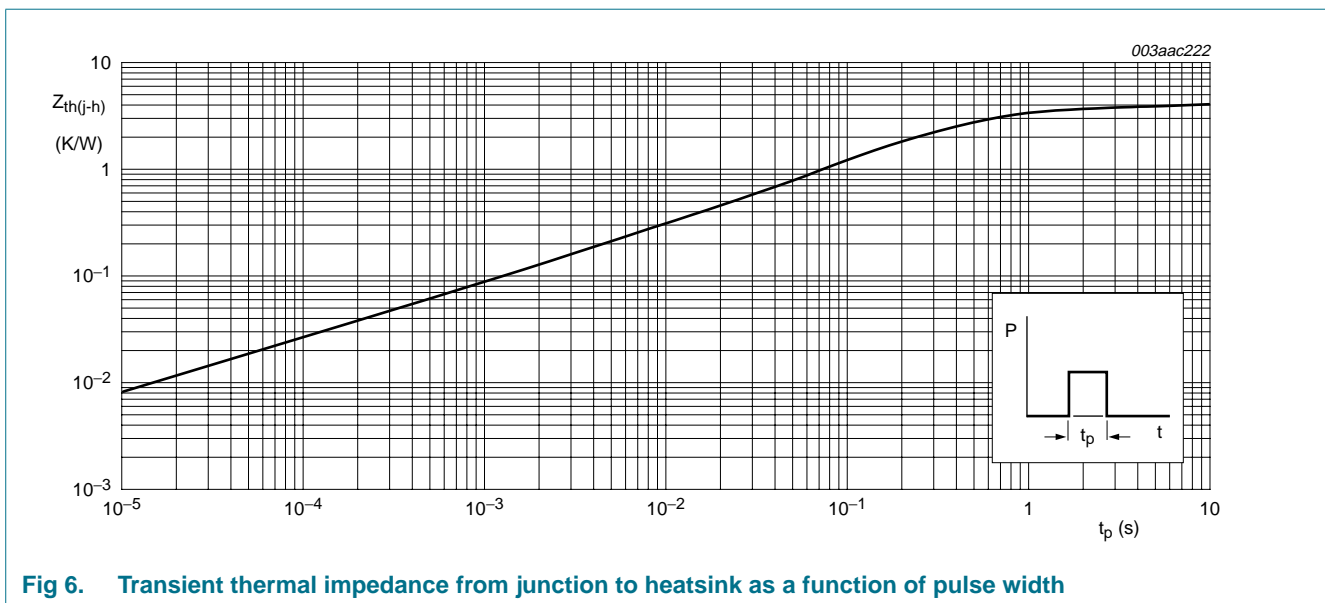




## 5. Thermal characteristics

**Table 4. Thermal characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-h)}$	thermal resistance from junction to heatsink	full cycle; see <a href="#">Figure 6</a>	-	-	4.0	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	full cycle; in free air	-	55	-	K/W



## 6. Isolation characteristics

**Table 5. Isolation limiting values and characteristics**

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

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

## 7. Static characteristics

**Table 6. Static characteristics**

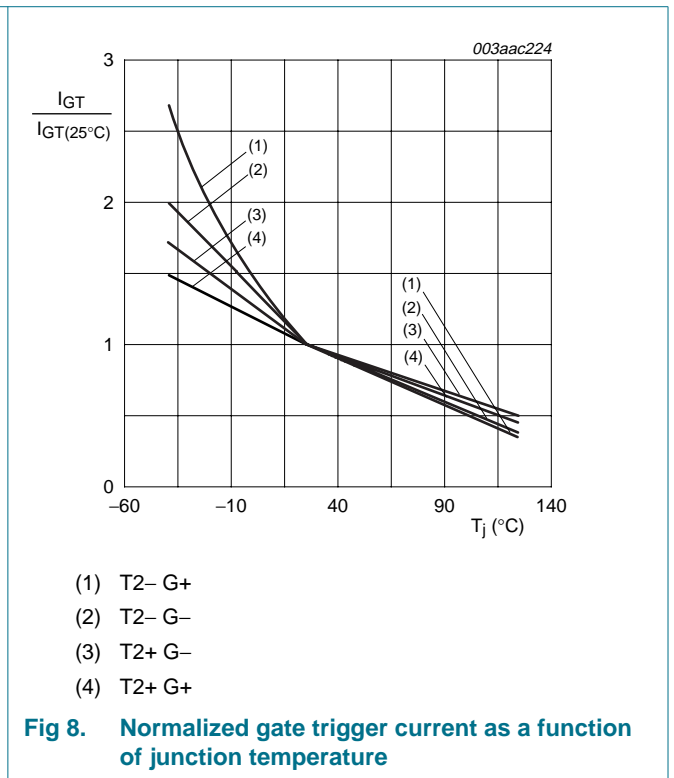
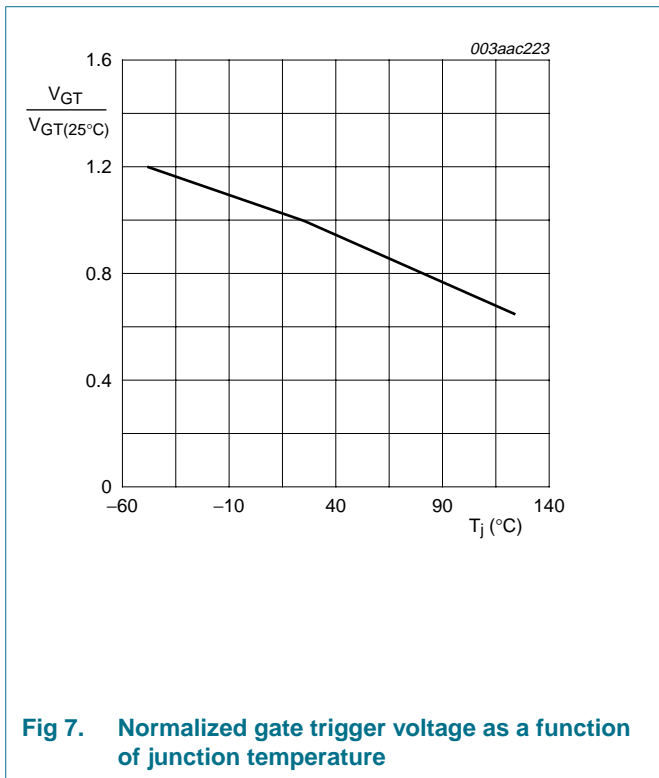
$T_j = 25\text{ °C}$  unless otherwise specified.

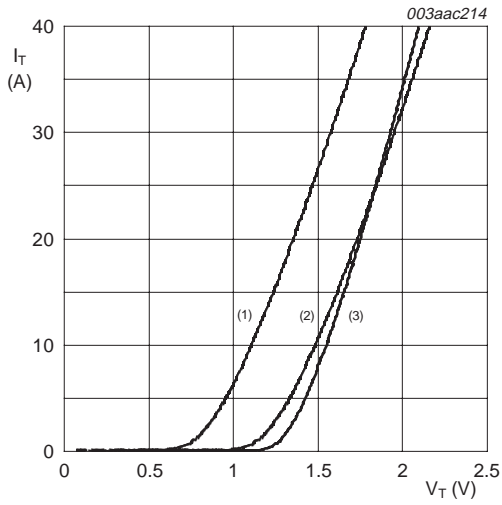
Symbol	Parameter	Conditions	BT138X-600D			BT138X-600E BT138X-800E			Unit		
			Min	Typ	Max	Min	Typ	Max			
$I_{\text{GT}}$	gate trigger current	$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; see <a href="#">Figure 8</a>									
		T2+ G+	-	1.3	5	-	2.5	10	mA		
		T2+ G-	-	2.8	5	-	4.0	10	mA		
		T2- G-	-	3.2	5	-	5.0	10	mA		
$I_L$	latching current	$V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; see <a href="#">Figure 10</a>									
		T2+ G+	-	-	15	-	-	30	mA		
		T2+ G-	-	-	20	-	-	40	mA		
		T2- G-	-	-	15	-	-	30	mA		
$I_H$	holding current	$V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; see <a href="#">Figure 11</a>	-	-	10	-	-	30	mA		
		T2- G+	-	-	20	-	-	40	mA		
		$V_T$	on-state voltage	$I_T = 15\text{ A}$ ; see <a href="#">Figure 9</a>	-	1.4	1.65	-	1.4	1.65	V
		$V_{\text{GT}}$	gate trigger voltage	$I_T = 0.1\text{ A}$ ; see <a href="#">Figure 7</a>							
$V_D = 12\text{ V}$	-			0.7	1.5	-	0.7	1.5	V		
$V_D = V_{\text{DRM}}$ ; $T_j = 125\text{ °C}$	0.25			0.4	-	0.25	0.4	-	V		
$I_D$	off-state current	$V_D = V_{\text{DRM(max)}}$ ; $T_j = 125\text{ °C}$	-	0.1	0.5	-	0.1	0.5	mA		

8. Dynamic characteristics

Table 7. Dynamic characteristics

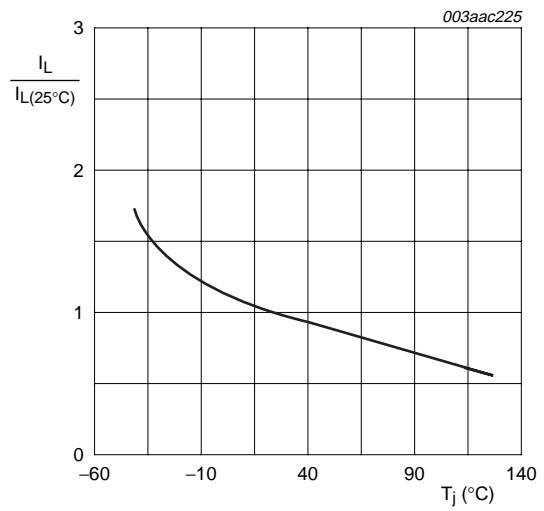
Symbol	Parameter	Conditions	BT138X-600D			BT138X-600E BT138X-800E			Unit
			Min	Typ	Max	Min	Typ	Max	
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 0.67 \times V_{DRM(max)}$ ; exponential waveform; gate open circuit; $T_j = 125\text{ }^\circ\text{C}$	-	50	-	-	150	-	V/ $\mu\text{s}$
$t_{gt}$	gate-controlled turn-on time	$I_{TM} = 16\text{ A}$ ; $V_D = V_{DRM(max)}$ ; $I_G = 0.1\text{ A}$ ; $dI_G/dt = 5\text{ A}/\mu\text{s}$	-	2	-	-	2	-	$\mu\text{s}$



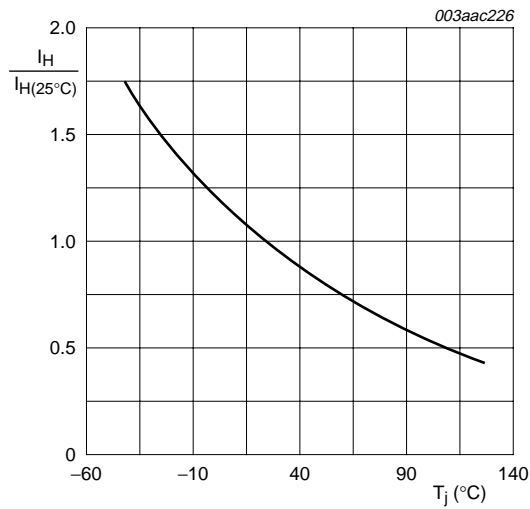


- $V_o = 1.175 \text{ V}$   
 $R_s = 0.032 \text{ } \Omega$
- (1)  $T_j = 125 \text{ } ^\circ\text{C}$ ; typical values
  - (2)  $T_j = 125 \text{ } ^\circ\text{C}$ ; maximum values
  - (3)  $T_j = 25 \text{ } ^\circ\text{C}$ ; maximum values

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



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



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



9. Package outline

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

SOT186A

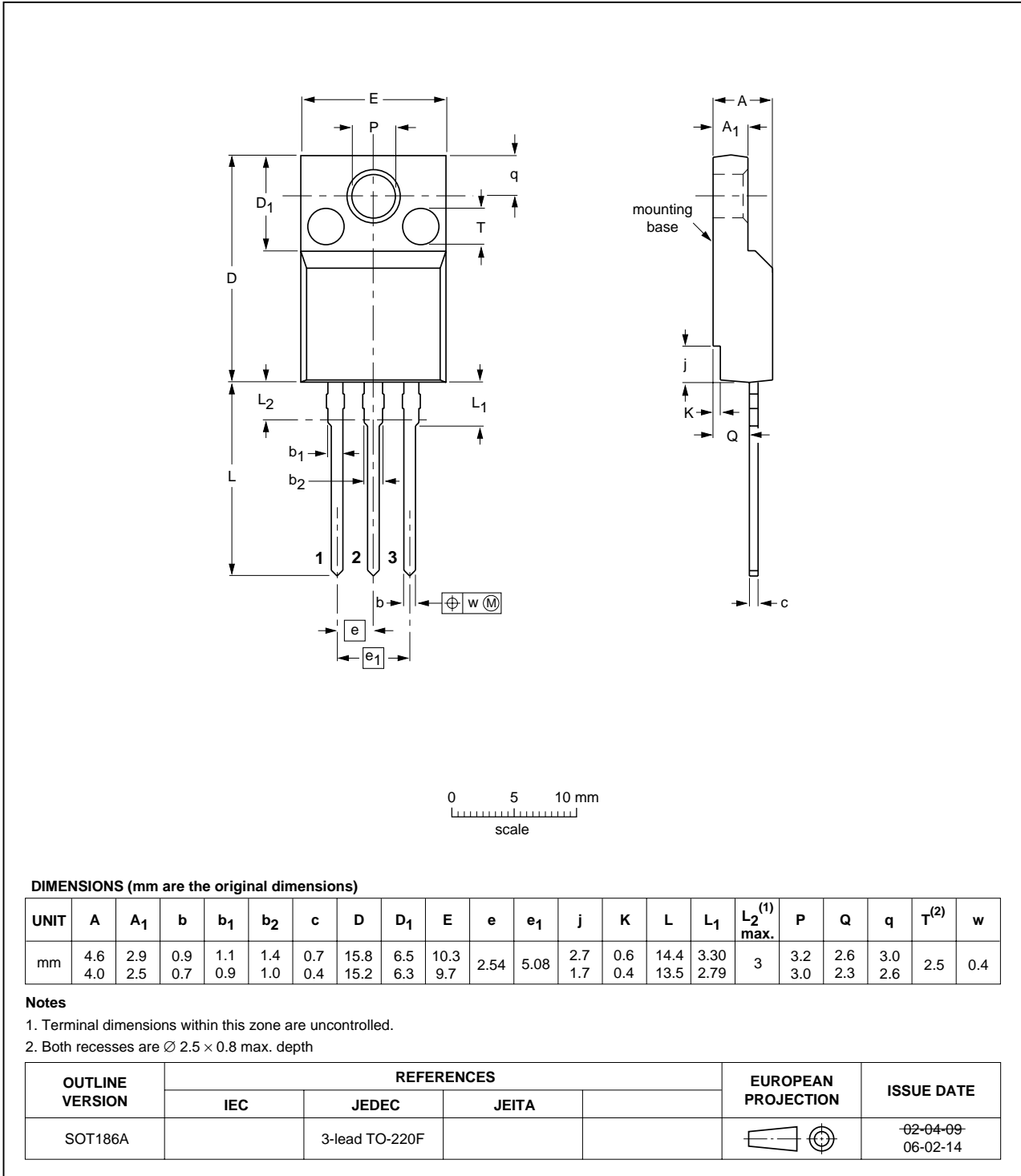


Fig 12. Package outline SOT186A (TO-220F)

## 10. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BT138X_SER_D_E_3	20080310	Product data sheet	-	BT138X_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 identity guidelines of NXP Semiconductors.</li><li>• Legal texts have been adapted to the new company name where appropriate.</li><li>• BT138X-600D product added.</li><li>• <a href="#">Table 7 "Dynamic characteristics"</a>: <math>dV_D/dt</math> updated for BT138X series E.</li></ul>		
BT138X_SERIES_E_2	20010601	Product data sheet	-	BT138X_SERIES_E_1
BT138X_SERIES_E_1	19970901	Product data sheet	-	-

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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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Date of release: 10 March 2008

Document identifier: BT138X\_SER\_D\_E\_3