

# 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

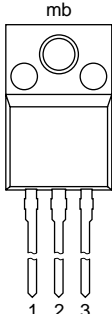

- General purpose switching and phase control
- 230 V lamp dimmers

### 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).

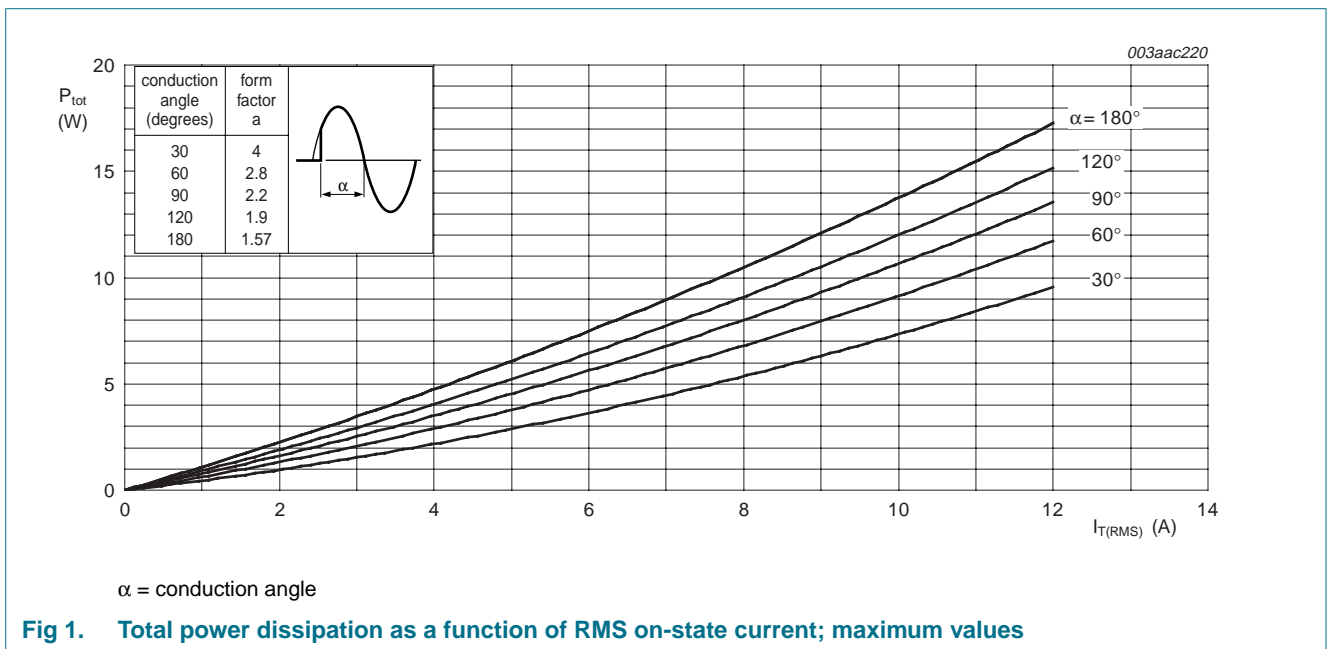
Symbol	Parameter	Conditions	Min	Max	Unit	
$V_{DRM}$	repetitive peak off-state voltage	BT138X-600D	[1]	-	600	V
		BT138X-600E	[1]	-	600	V
		BT138X-800E	-	-	800	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_h \leq 56\text{ °C}$ ; see <a href="#">Figure 4</a> and <a href="#">5</a>	-	12	A	
$I_{TSM}$	non-repetitive peak on-state current	full sine wave; $T_j = 25\text{ °C}$ 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/ $\mu\text{s}$	

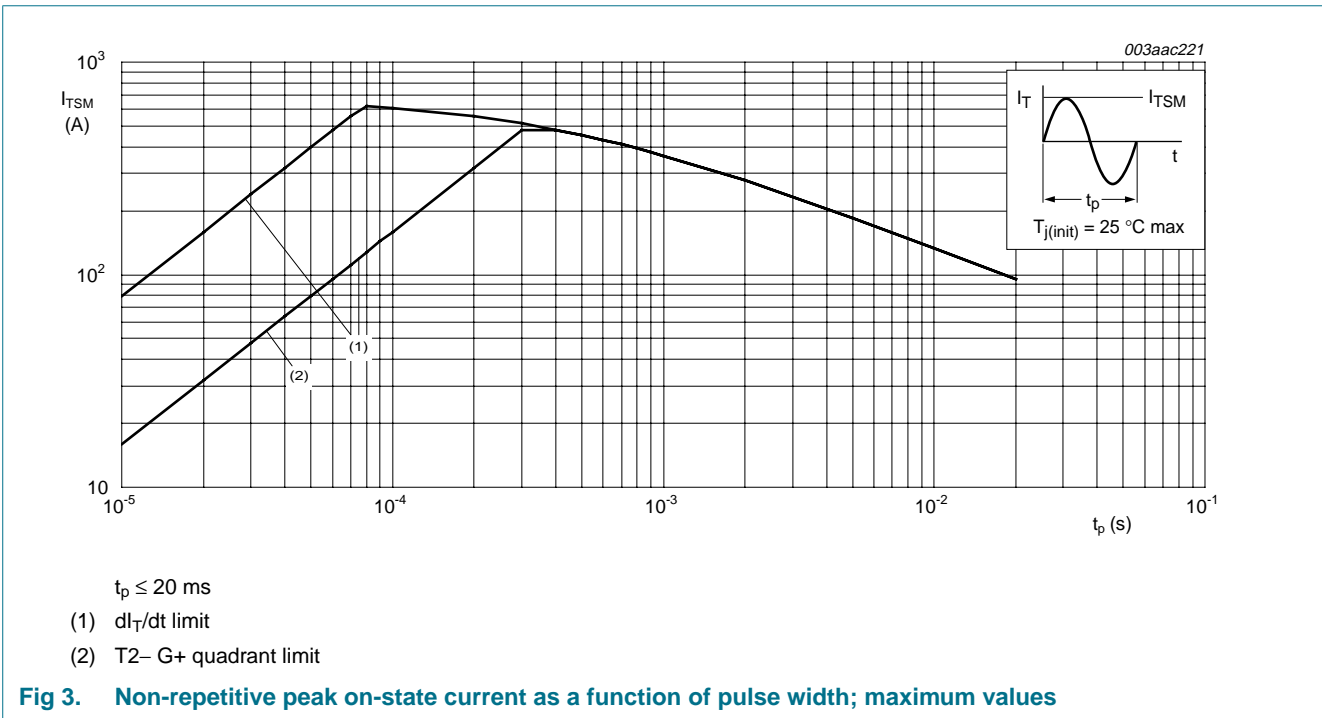
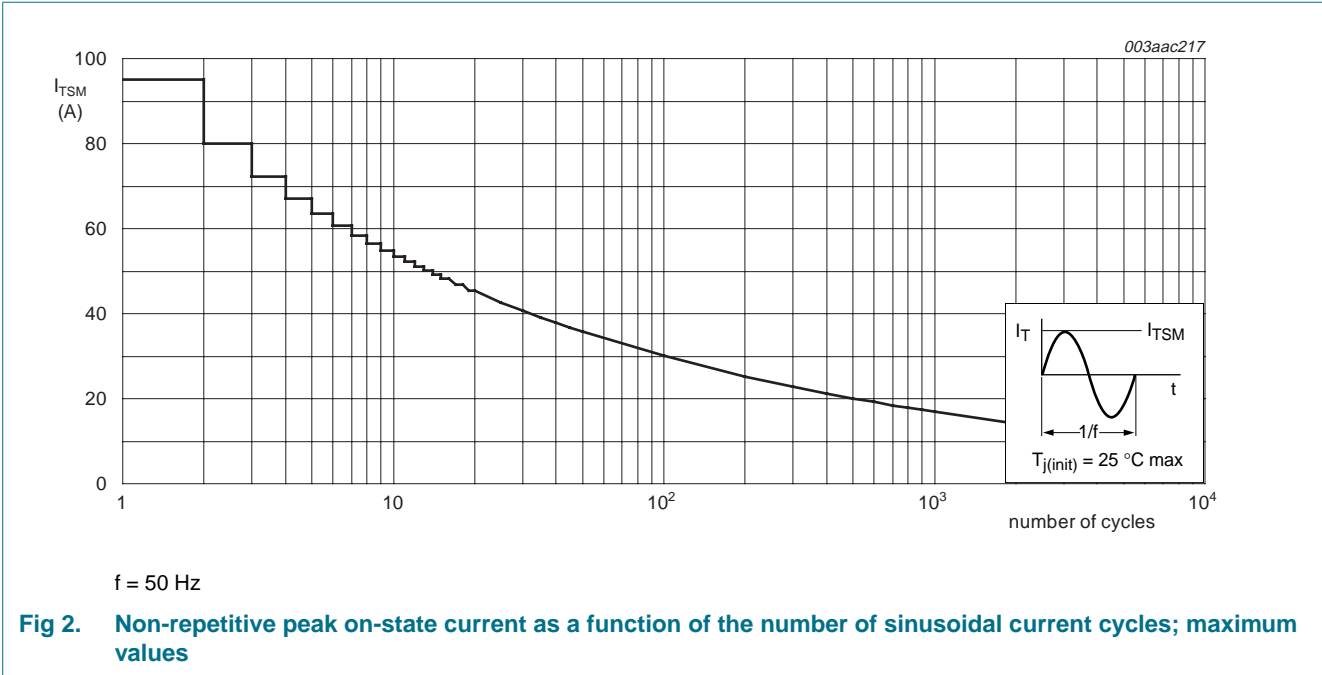
**Table 3. Limiting values ...continued**

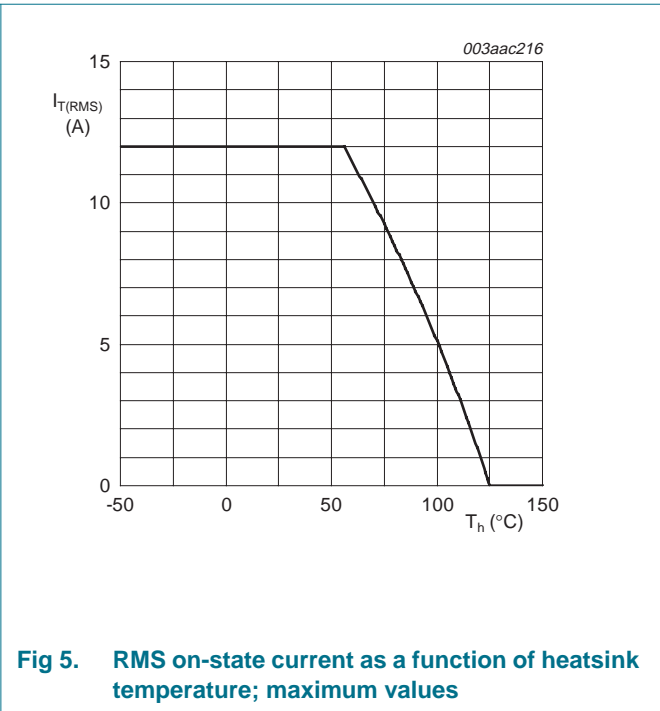
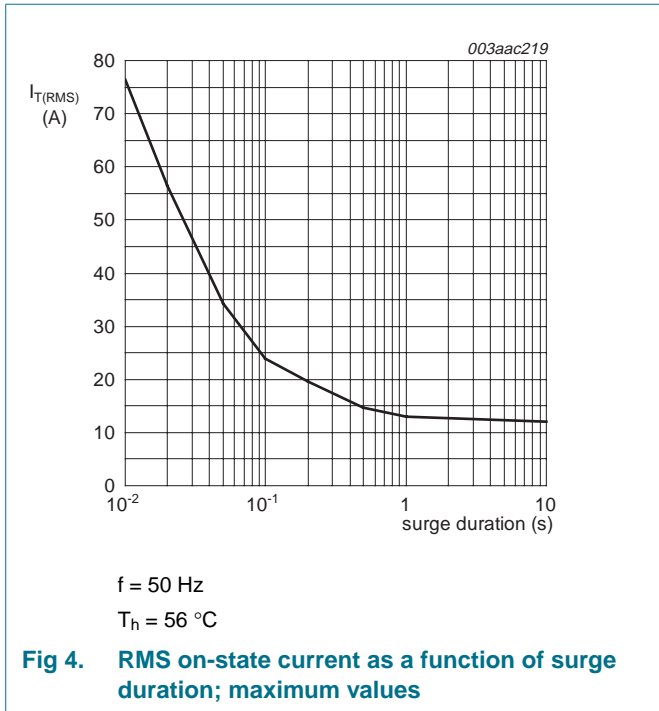
In accordance with the Absolute Maximum Rating System (IEC 60134).

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.



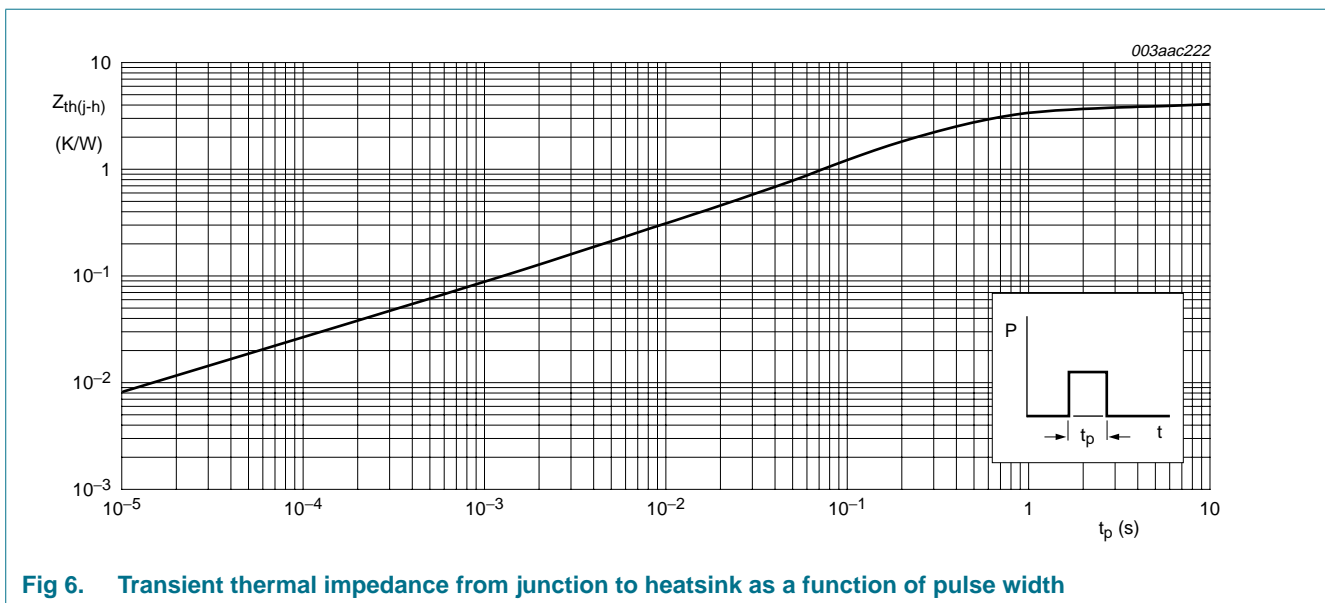




## 5. Thermal characteristics

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**

$T_h = 25\text{ }^\circ\text{C}$  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**

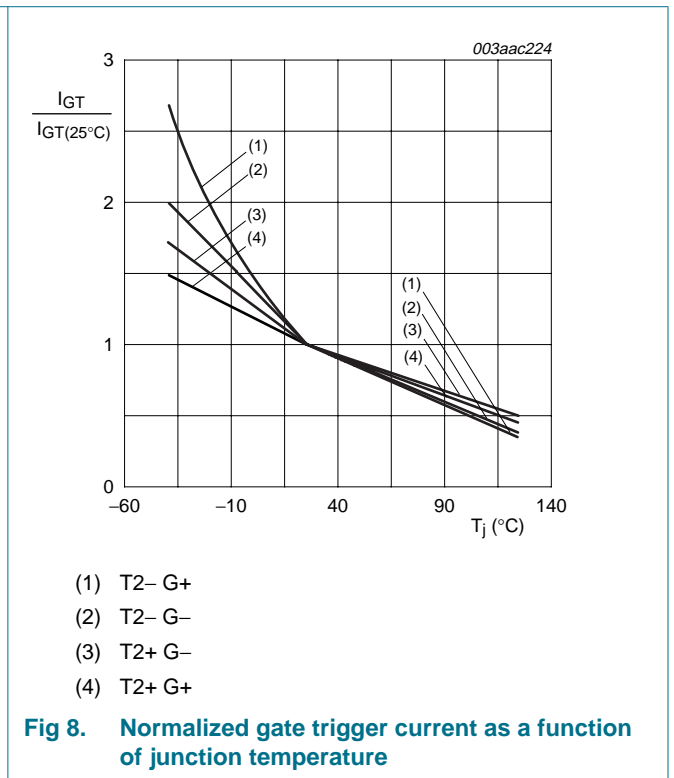
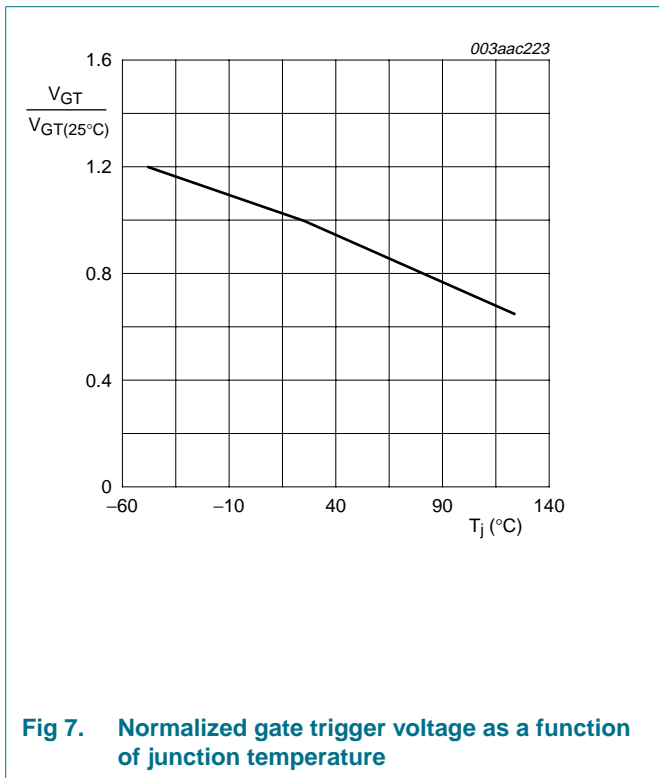
$T_j = 25\text{ }^\circ\text{C}$  unless otherwise specified.

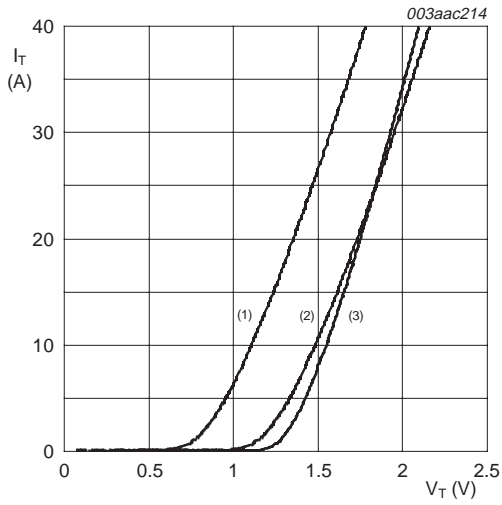
Symbol	Parameter	Conditions	BT138X-600D			BT138X-600E BT138X-800E			Unit
			Min	Typ	Max	Min	Typ	Max	
$I_{\text{GT}}$	gate trigger current	$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; see <a href="#">Figure 8</a>							
		T2+ G+	-	1.3	5	-	2.5	10	mA
		T2+ G-	-	2.8	5	-	4.0	10	mA
		T2- G-	-	3.2	5	-	5.0	10	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
		$V_D = V_{\text{DRM}}$ ; $T_j = 125\text{ }^\circ\text{C}$	0.25	0.4	-	0.25	0.4	-	V
$I_D$	off-state current	$V_D = V_{\text{DRM(max)}}$ ; $T_j = 125\text{ }^\circ\text{C}$	-	0.1	0.5	-	0.1	0.5	mA

8. Dynamic characteristics

Table 7. Dynamic characteristics

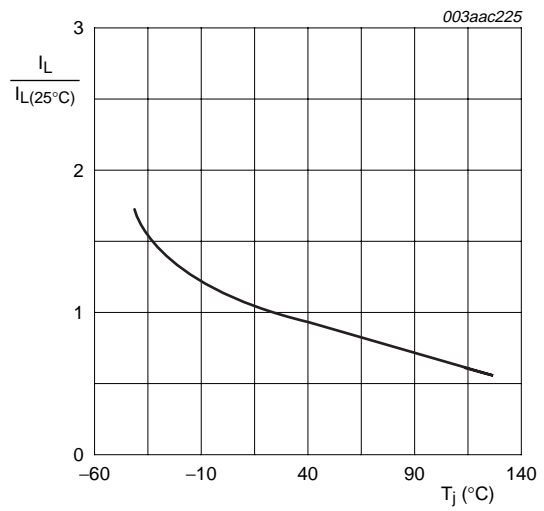
Symbol	Parameter	Conditions	BT138X-600D			BT138X-600E BT138X-800E			Unit
			Min	Typ	Max	Min	Typ	Max	
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 0.67 \times V_{DRM(max)}$ ; exponential waveform; gate open circuit; $T_j = 125\text{ }^\circ\text{C}$	-	50	-	-	150	-	V/ $\mu\text{s}$
$t_{gt}$	gate-controlled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



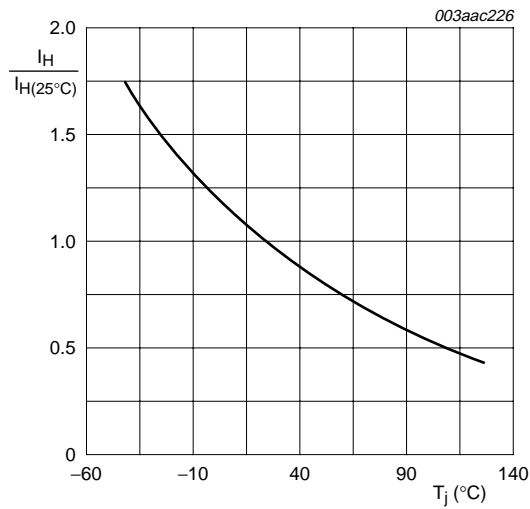


$V_o = 1.175 \text{ V}$   
 $R_s = 0.032 \text{ } \Omega$   
 (1)  $T_j = 125 \text{ } ^\circ\text{C}$ ; typical values  
 (2)  $T_j = 125 \text{ } ^\circ\text{C}$ ; maximum values  
 (3)  $T_j = 25 \text{ } ^\circ\text{C}$ ; maximum values

**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

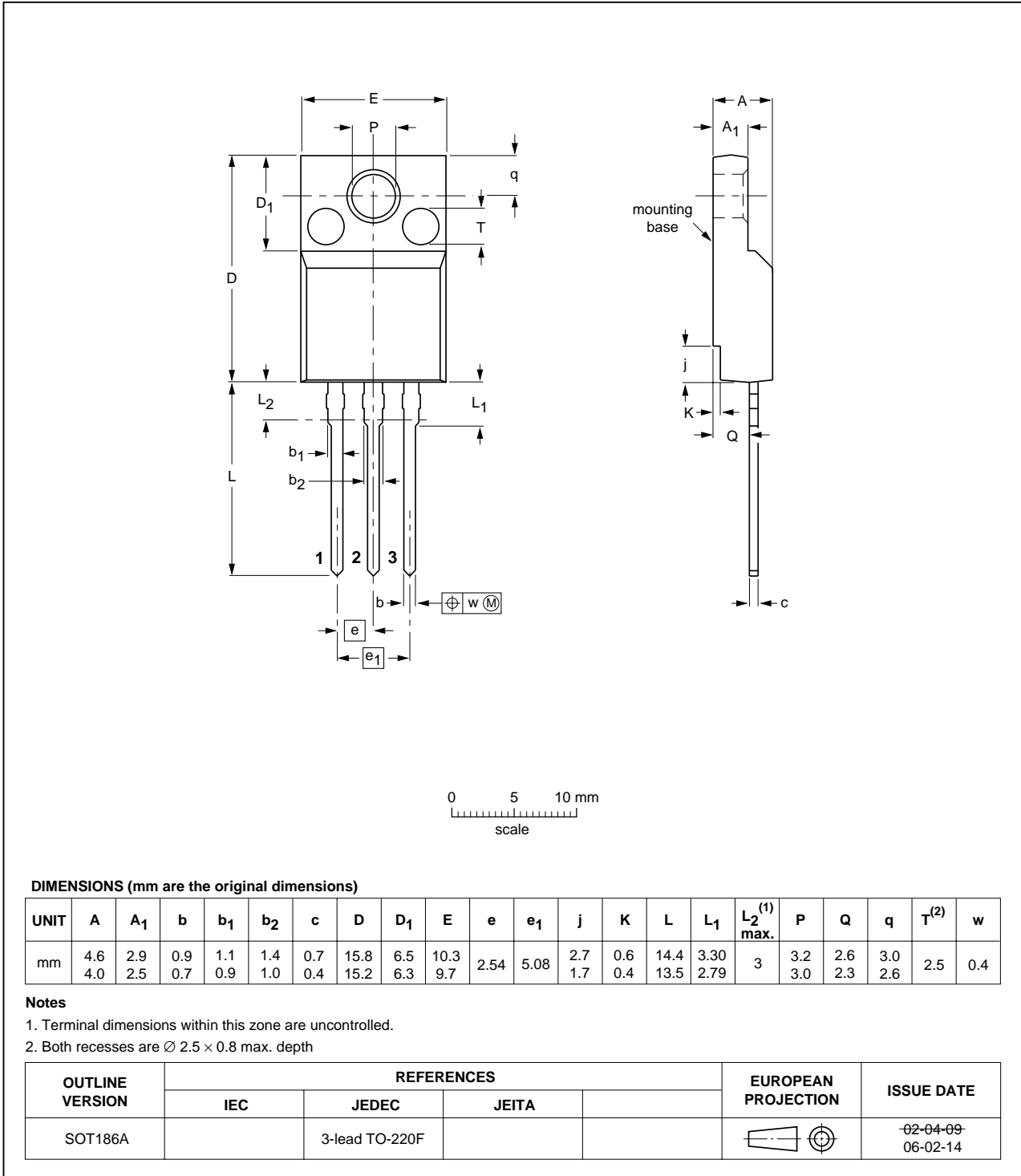


Fig 12. Package outline SOT186A (TO-220F)

## 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".

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