

BT138 series D and E

12 A four-quadrant triacs, sensitive gate
Rev. 02 — 12 March 2008

Product data sheet

Product profile

1.1 General description

Passivated sensitive gate triac in a SOT78 plastic package.

1.2 Features

- Very sensitive gate
- Direct interfacing to logic level ICs
- Gate triggering in four quadrants
- Direct interfacing to low power gate drive circuits

1.3 Applications

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

1.4 Quick reference data

- $V_{DRM} \le 600 \text{ V (BT138-600D)}$
- V_{DRM} ≤ 600 V (BT138-600E)
- V_{DRM} ≤ 800 V (BT138-800E)
- $I_{GT} \le 5 \text{ mA (BT138-600D)}$
- $I_{GT} \le 10 \text{ mA (BT138-600E)}$
- $I_{GT} \le 10 \text{ mA (BT138-800E)}$
- $I_{T(RMS)} \le 12 A$
- $I_{TSM} \le 95 \text{ A (t = 20 ms)}$
- $I_{GT} \le 10 \text{ mA } (T2-G+) \text{ (BT138-600D)}$
- $I_{GT} \le 25 \text{ mA } (T2-G+) \text{ (BT138-600E)}$
- $I_{GT} \le 25 \text{ mA } (T2-G+) (BT138-800E)$



2. Pinning information

Table 1. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	main terminal 1 (T1)		N.I.
2	main terminal 2 (T2)	mb	T2—T1
3	gate (G)		Sym051
mb	mounting base; main terminal 2 (T2)		
		SOT78 (TO-220AB)	

3. Ordering information

Table 2. Ordering information

Type number	Package	Package					
	Name	Description	Version				
BT138-600D	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead					
BT138-600E		TO-220AB					
BT138-800E							

4. Limiting values

Table 3. Limiting values

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

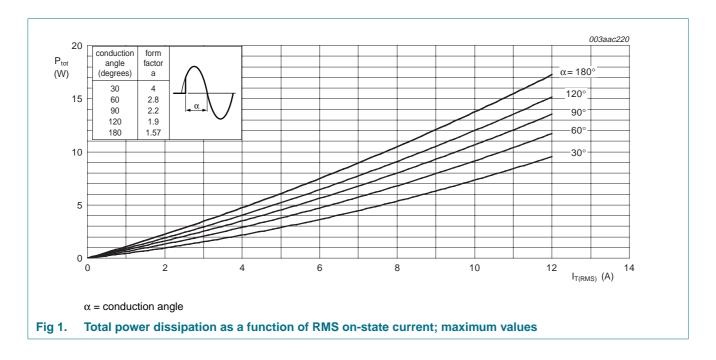
Symbol	Parameter	Conditions	Min	Max	Unit
V_{DRM}	repetitive peak off-state voltage				
		BT138-600D	<u>[1]</u> _	600	V
		BT138-600E	<u>[1]</u> _	600	V
		BT138-800E	-	800	V
I _{T(RMS)}	RMS on-state current	full sine wave; $T_{mb} \le 99 ^{\circ}\text{C}$; see Figure 4 and 5	-	12	Α
I _{TSM}	non-repetitive peak on-state current	full sine wave; $T_j = 25$ °C prior to surge; see Figure 2 and 3			
		t = 20 ms	-	95	Α
		t = 16.7 ms	-	105	Α
l ² t	I ² t for fusing	t _p = 10 ms	-	45	A ² s

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Table 3. Limiting values ...continued
In accordance with the Absolute Maximum Rating System (IEC 60134).

$\begin{array}{c} dl_{T}/dt \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	Symbol	Parameter	Conditions	Min	Max	Unit
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	dl _T /dt rate of rise of on-state of	rate of rise of on-state current	• • • • • • • • • • • • • • • • • • • •			
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			T2+ G+	-	50	A/μs
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			T2+ G-	-	50	A/μs
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			T2- G-	-	50	A/μs
P_{GM} peak gate power - 5 $P_{G(AV)}$ average gate power over any 20 ms period - 0.5 T_{stg} storage temperature -40 +150			T2- G+	-	10	A/μs
$P_{G(AV)}$ average gate power over any 20 ms period - 0.5 T_{stg} storage temperature -40 +150	I _{GM}	peak gate current		-	2	Α
T _{stg} storage temperature -40 +150	P_GM	peak gate power		-	5	W
	$P_{G(AV)}$	average gate power	over any 20 ms period	-	0.5	W
T _i junction temperature - 125	T _{stg}	storage temperature		-40	+150	°C
	Tj	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.



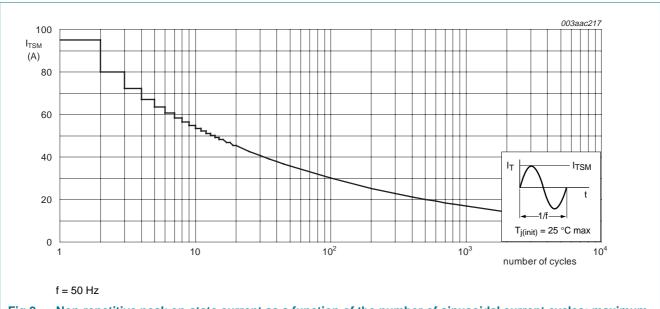
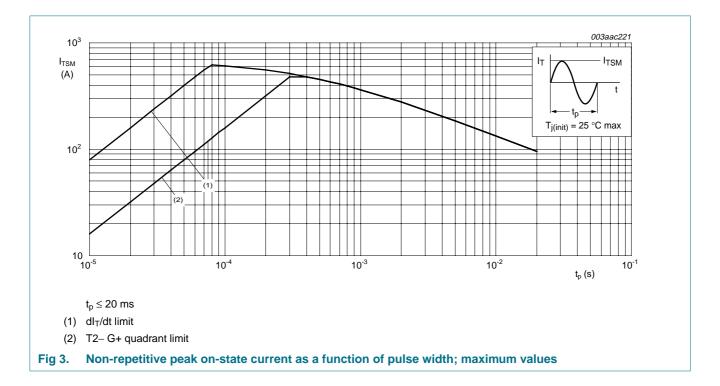
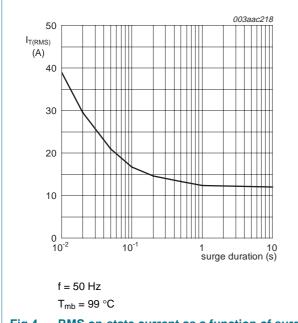


Fig 2. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values





It(RMS)
(A)

10

5

0
-50
0
50
100
T_{mb} (°C)

15

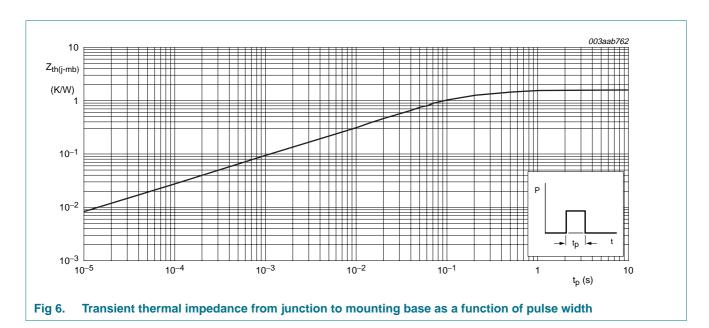
Fig 4. RMS on-state current as a function of surge duration; maximum values

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

5. Thermal characteristics

Table 4. Thermal characteristics

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	full cycle; see Figure 6	-	-	1.5	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	full cycle; in free air	-	60	-	K/W



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6. Static characteristics

Table 5. Static characteristics

 $T_i = 25 \,^{\circ}C$ unless otherwise specified.

Symbol	Parameter	Conditions	BT138	BT138-600D			BT138-600E BT138-800E		
			Min	Тур	Max	Min	Тур	Max	
I _{GT} gate trigger current		$V_D = 12 \text{ V}; I_T = 0.1 \text{ A};$ see Figure 8	'		'		'	'	'
		T2+ G+	-	1.3	5	-	2.5	10	mΑ
		T2+ G-	-	2.8	5	-	4.0	10	mΑ
		T2- G-	-	3.2	5	-	5.0	10	mΑ
		T2- G+	-	5.5	10	-	11	25	mΑ
I _L latching current		$V_D = 12 \text{ V}; I_G = 0.1 \text{ A};$ see Figure 10							
		T2+ G+	-	-	15	-	-	30	mA
		T2+ G-	-	-	20	-	-	40	mA
		T2- G-	-	-	15	-	-	30	mA
		T2- G+	-	-	20	-	-	40	mA
I _H	holding current	$V_D = 12 \text{ V}; I_G = 0.1 \text{ A};$ see Figure 11	-	-	10	-	-	30	mA
V_{T}	on-state voltage	I _T = 15 A; see Figure 9	-	1.4	1.65	-	1.4	1.65	V
V_{GT}	gate trigger voltage	$I_T = 0.1 \text{ A}$; see Figure 7							
		V _D = 12 V;	-	0.7	1.5	-	0.7	1.5	V
		$V_D = V_{DRM}$; $T_j = 125 ^{\circ}C$	0.25	0.4	-	0.25	0.4	-	V
I _D	off-state current	$V_D = V_{DRM(max)};$ $T_j = 125 ^{\circ}C$	-	0.1	0.5	-	0.1	0.5	mA

7. Dynamic characteristics

Table 6. Dynamic characteristics

Symbol Parameter Condition		Conditions	BT138-600D			BT138-600E BT138-800E			Unit
			Min	Тур	Max	Min	Тур	Max	
dV _D /dt	rate of rise of off-state voltage	$\begin{split} &V_{DM} = 0.67 \times V_{DRM(max)}; \\ &exponential \ waveform; \\ &gate \ open \ circuit; \\ &T_j = 110 \ ^{\circ}C \end{split}$	-	50	-	-	150	-	V/μs
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	-	μs

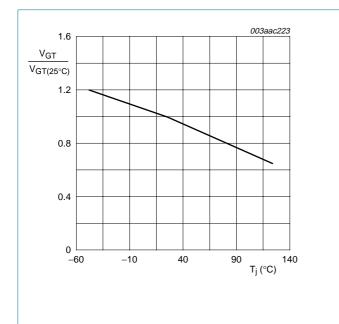
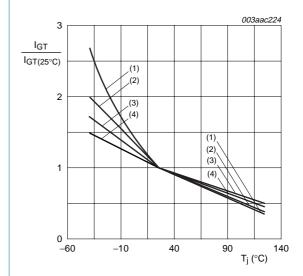
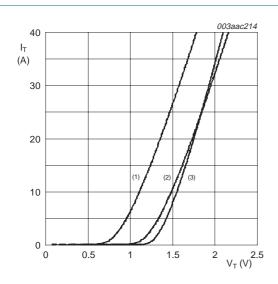


Fig 7. Normalized gate trigger voltage as a function of junction temperature



- (1) T2-G+
- (2) T2-G-
- (3) T2+ G-
- (4) T2+ G+

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



 $V_0 = 1.175 \text{ V}$

 $R_s = 0.032 \Omega$

(1) $T_i = 125$ °C; typical values

(2) $T_i = 125 \,^{\circ}C$; maximum values

(3) $T_j = 25$ °C; maximum values

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

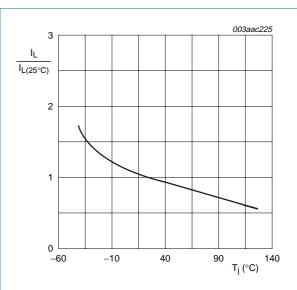


Fig 10. Normalized latching current as a function of junction temperature

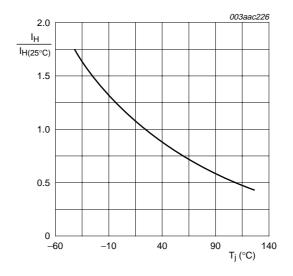


Fig 11. Normalized holding current as a function of junction temperature

Package outline

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

SOT78

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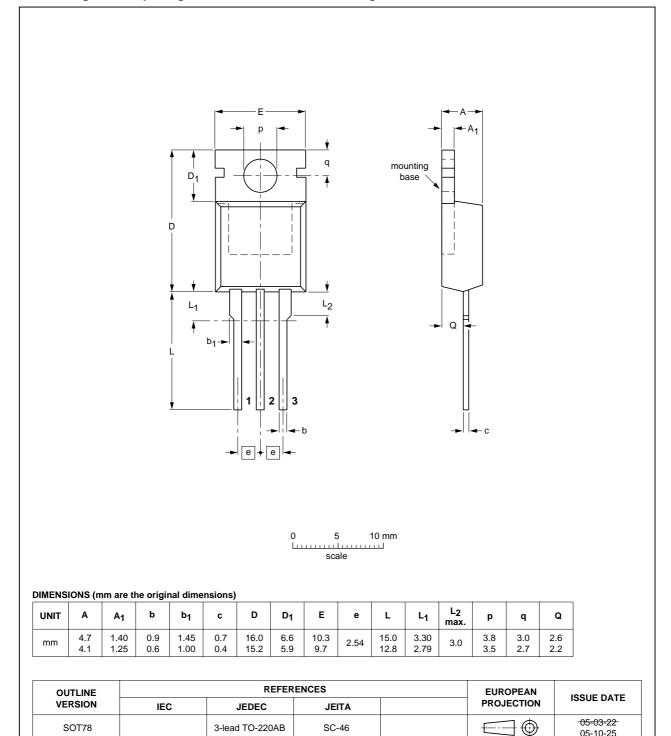


Fig 12. Package outline SOT78 (TO-220AB)

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9. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes	
BT138_SER_D_E_2	20080312	Product data sheet	-	BT138_SERIES_E_1	
Modifications:	 The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. 				
	 Legal texts 	have been adapted to the n	ew company name whe	re appropriate.	
	 BT138-600I 	O product added			
BT138_SERIES_E_1	19970901	Product data sheet	-	-	

BT138 series D and E

12 A four-quadrant triacs, sensitive gate

10. Legal information

10.1 Data sheet status

Document status[1][2]	Product status[3]	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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BT138 series D and E

12 A four-quadrant triacs, sensitive gate

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