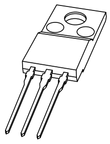


BT139X series

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

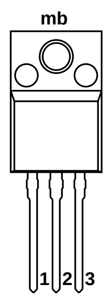
1.4 Quick reference data

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

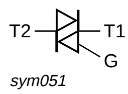
2. Pinning information

Table 1: Pinning

Pin	Description	Simplified outline	Symbol
1	main terminal 1		
2	main terminal 2		
3	gate		
mb	mounting base; isolated		



SOT186A (TO-220F)



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).

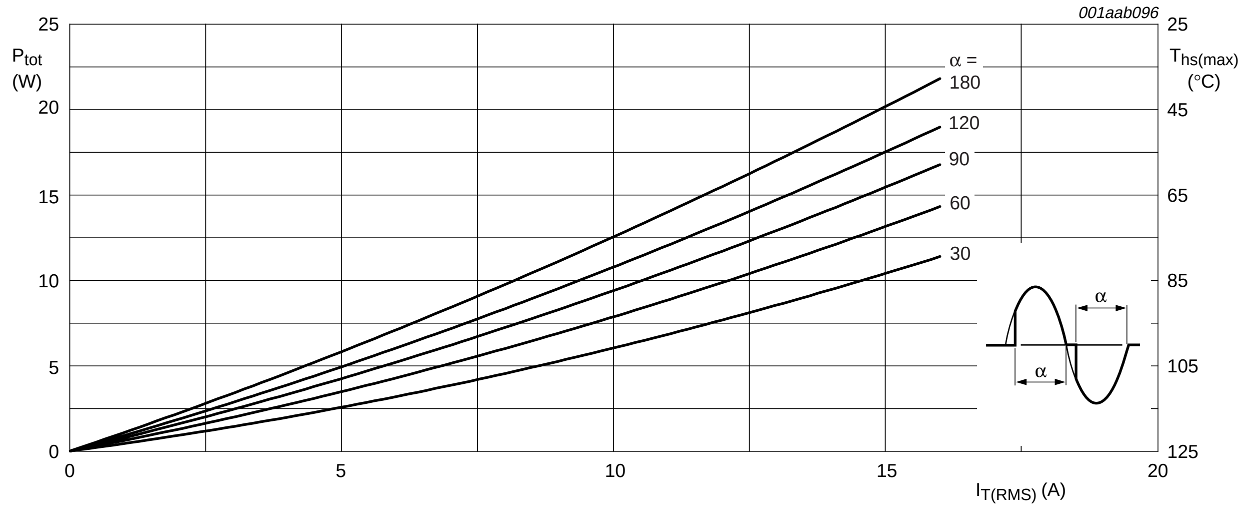
Symbol	Parameter	Conditions	Min	Max	Unit
V_{DRM}	repetitive peak off-state voltage				
	BT139X-600 series	[1]	-	600	V
	BT139X-800		-	800	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{hs} \leq 38$ °C; Figure 4 and Figure 5	-	16	A
I_{TSM}	non-repetitive peak on-state current	full sine wave; $T_j = 25$ °C prior to surge; Figure 2 and Figure 3			
		t = 20 ms	-	155	A
		t = 16.7 ms	-	170	A
I^2t	I^2t for fusing	t = 10 ms	-	120	A^2s
dI_T/d_t	repetitive rate of rise of on-state current after triggering	$I_{TM} = 20$ A; $I_G = 0.2$ A; $dI_G/dt = 0.2$ A/µs			
		T2+ G+	-	50	A/µs
		T2+ G–	-	50	A/µs
		T2– G–	-	50	A/µs
		T2– G+	-	10	A/µs
I_{GM}	peak gate current		-	2	A
V_{GM}	peak gate voltage		-	5	V
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.

Table 4: Isolation limiting values and characteristic

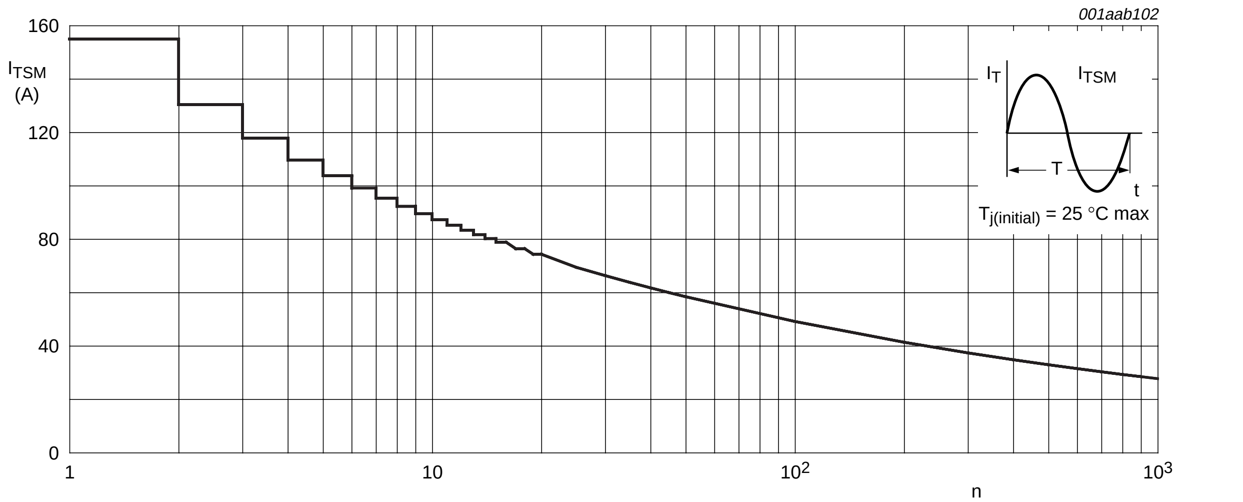
T_{hs} = 25 °C unless otherwise specified.

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. ≤ 65 %; clean and dust free	-	-	2500	V
C_{isol}	capacitance from pin 2 to external heatsink	f = 1 MHz	-	10	-	pF



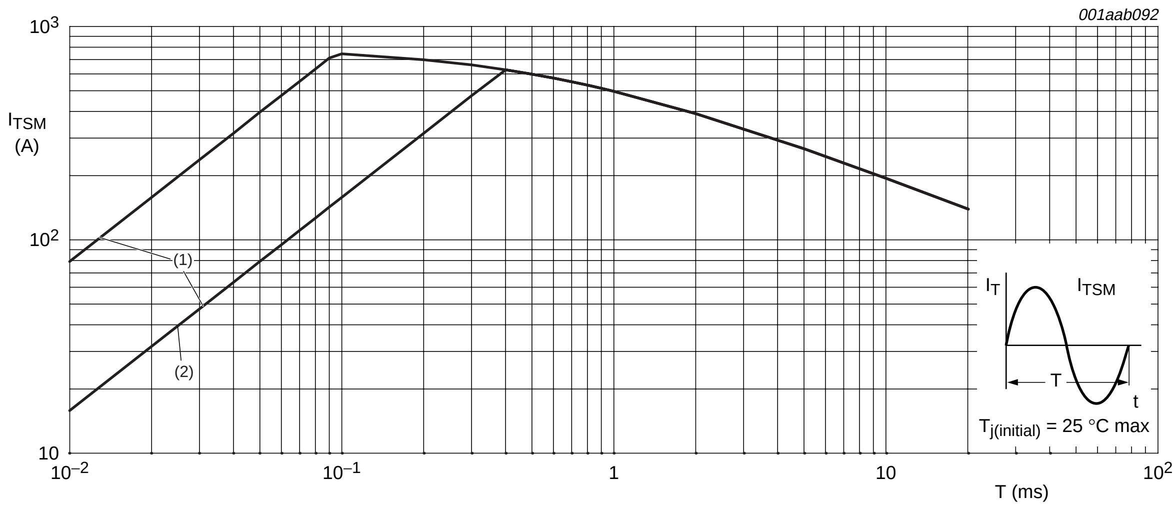
α = conduction angle.

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



f = 50 Hz.

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

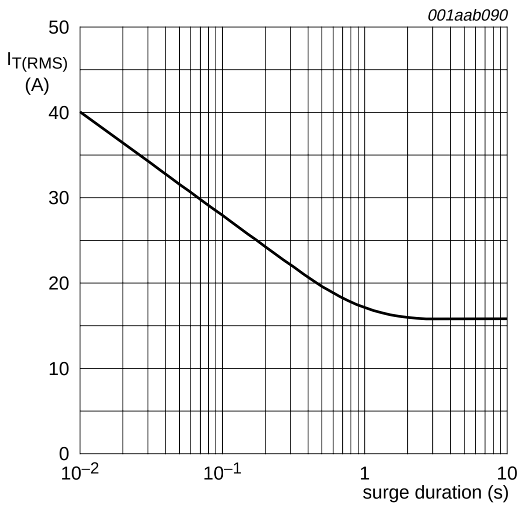


$t_p \leq 20$ ms.

(1) dI_T/dt limit.

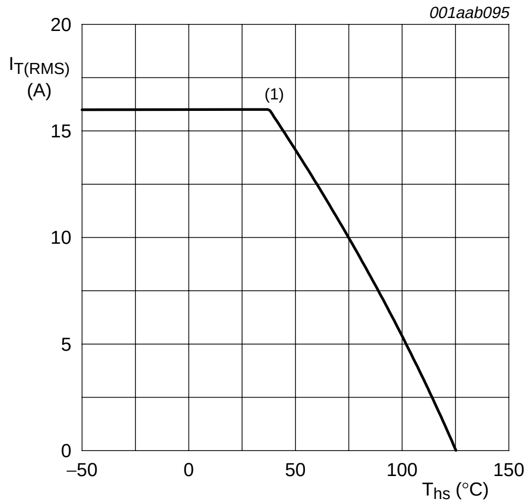
(2) T2– G+ quadrant.

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



f = 50 Hz; $T_{hs} \leq 38$ °C.

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



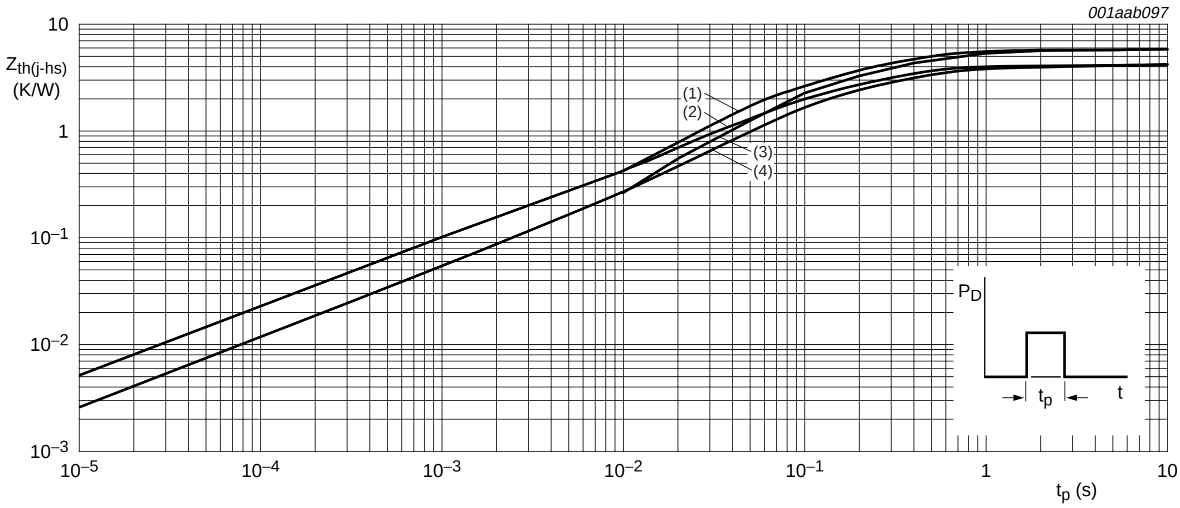
(1) T_{hs} = 38 °C.

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; Figure 6	-	4	K/W
		full or half cycle without heatsink compound; Figure 6	-	5.5	K/W
$R_{th(j-a)}$	thermal resistance junction to ambient	in free air	55	-	K/W



(1) Unidirectional without heatsink compound.

(2) Unidirectional with heatsink compound.

(3) Bidirectional without heatsink compound.

(4) Bidirectional with heatsink compound.

Fig 6. Transient thermal impedance from junction to heatsink as a function of pulse width

6. Static characteristics

Table 6: Static characteristics

T_j = 25 °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 V; I_T = 0.1 A; Figure 8										
		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 V; I_{GT} = 0.1 A; Figure 10										
		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 V; I_{GT} = 0.1 A; Figure 11	-	6	45	-	6	45	-	6	60	mA
V_T	on-state voltage	I_T = 20 A; Figure 9	-	1.2	1.6	-	1.2	1.6	-	1.2	1.6	V
V_{GT}	gate trigger voltage	V_D = 12 V; I_T = 0.1 A; Figure 7	-	0.7	1.5	-	0.7	1.5	-	0.7	1.5	V
		V_D = 400 V; I_T = 0.1 A; T_j = 125 °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 °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 °C; exponential waveform; gate open circuit	200	250	-	50	250	-	200	250	-	V/µs
dV_{com}/dt	critical rate of change of commutating voltage	V_{DM} = 400 V; T_j = 95 °C; $I_{T(RMS)}$ = 16 A; dI_{com}/dt = 7.2 A/ms; gate open circuit; Figure 12	10	20	-	-	20	-	10	20	-	V/µs
t_{gt}	gate controlled turn-on time	I_{TM} = 20 A; $V_D = V_{DRM(max)}$; I_G = 0.1 A; dI_G/dt = 5 A/µs	-	2	-	-	2	-	-	2	-	µs

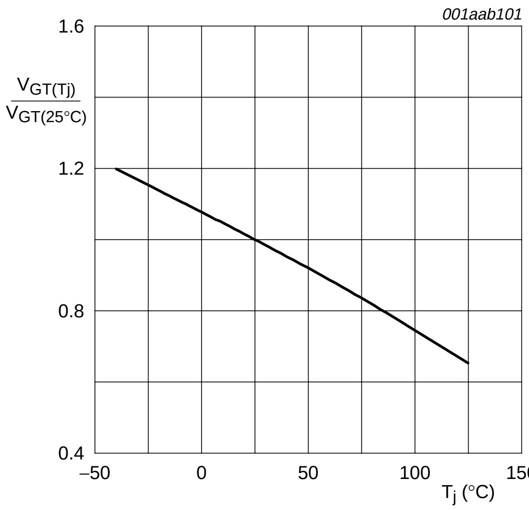
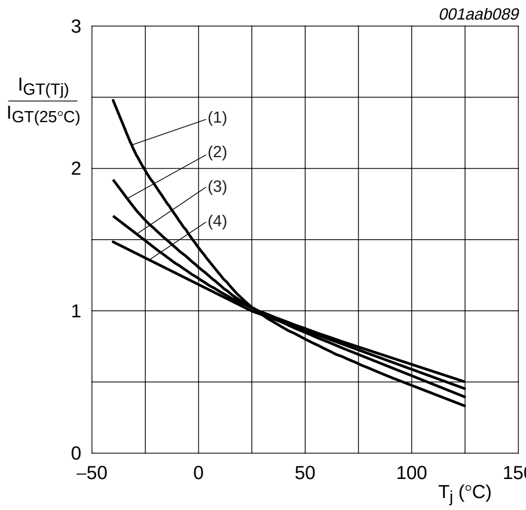
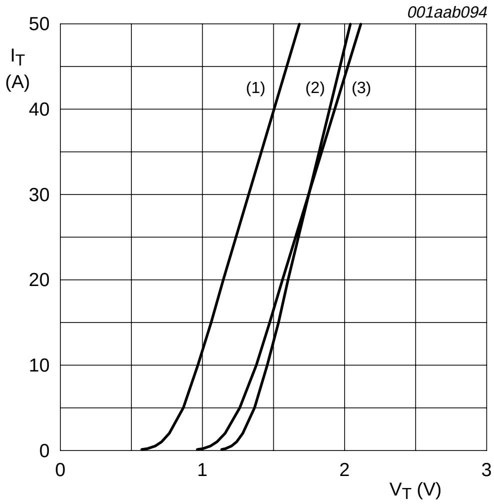


Fig 7. Normalized gate trigger voltage as a function of junction temperature



(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_O = 1.195 V.

R_S = 0.018 Ω.

(1) T_j = 125 °C; typical values.

(2) T_j = 25 °C; maximum values.

(3) T_j = 125 °C; maximum values.

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

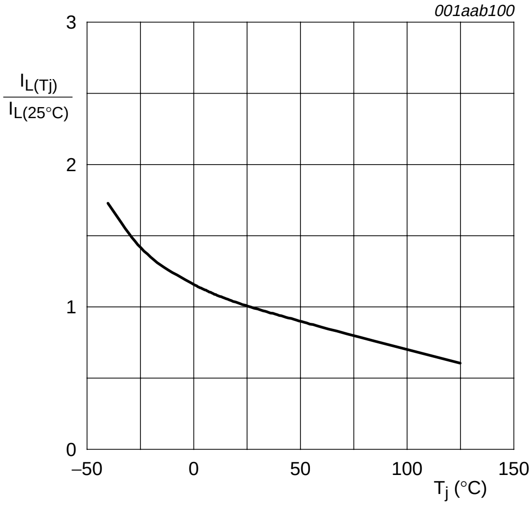


Fig 10. Normalized latching current as a function of junction temperature

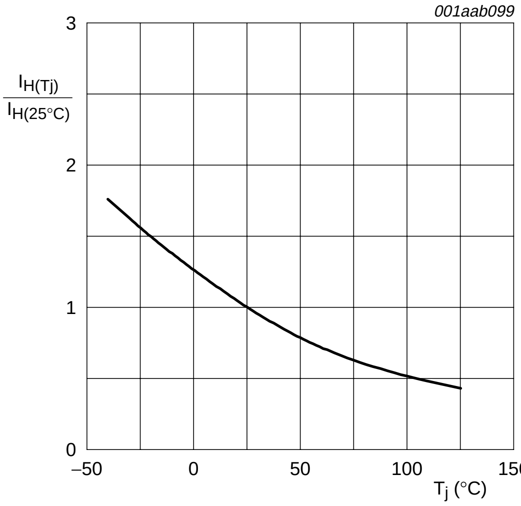
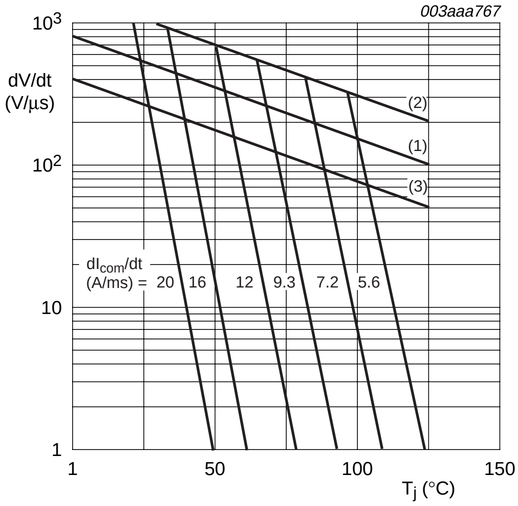


Fig 11. Normalized holding current as a function of junction temperature



The triac should commutate 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.

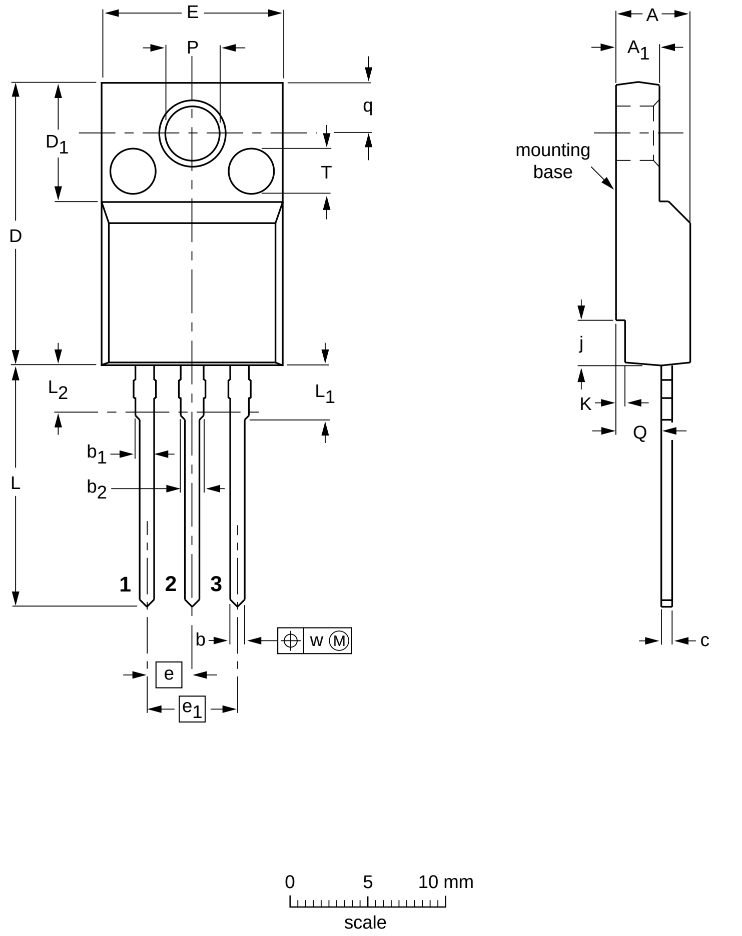
(3) BT139X-600F.

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



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	b_2	c	D	D_1	E	e	e_1	j	K	L	L_1	$L_2^{(1)}$ max.	P	Q	q	$T^{(2)}$	w
mm	4.6 4.0	2.9 2.5	0.9 0.7	1.1 0.9	1.4 1.0	0.7 0.4	15.8 15.2	6.5 6.3	10.3 9.7	2.54	5.08	2.7 1.7	0.6 0.4	14.4 13.5	3.30 2.79	3	3.2 3.0	2.6 2.3	3.0 2.6	2.5	0.4

Notes

1. Terminal dimensions within this zone are uncontrolled. Terminals in this zone are not tinned.
2. Both recesses are ∅ 2.5 × 0.8 max. depth

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT186A		3-lead TO-220F				~~02-03-12~~ 02-04-09

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:	• Correction to headings of Table 6 and Table 7 • I_{GT} data added to Section 1.4 “Quick reference data” • Figure 12 updated				
BT139X_SERIES_4	20040712	Product data sheet	-	9397 750 13363	BT139X_SERIES_3
Modifications:	• The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors.				
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 [1]	Product status [2] [3]	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.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

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[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL http://www.semiconductors.philips.com.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

11. Definitions

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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9397 750 14038

14. Contents

Date of release: 20 January 2005
Document number: 9397 750 14038

Published in The Netherlands