BT139-600E

4Q Triac

Rev. 05 — 24 March 2011 **Product data sheet**

1. Product profile

1.1 General description

Planar passivated sensitive gate four quadrant triac in a SOT78 (TO-220AB) plastic package intended for use in applications requiring high bidirectional transient and blocking voltage capability and high thermal cycling performance. Typical applications include motor control, industrial and domestic lighting, heating and static switching. This sensitive gate "series E" triac is intended to be interfaced directly to microcontrollers, logic integrated circuits and other low power gate trigger circuits.

1.2 Features and benefits

- Direct triggering from low power drivers and logic ICs
- High blocking voltage capability
- Planar passivated for voltage ruggedness and reliability
- Sensitive gate
- Triggering in all four quadrants

1.3 Applications

- General purpose motor control
- General purpose switching

1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DRM}	repetitive peak off-state voltage		-	-	600	V
I_{TSM}	non-repetitive peak on-state current	full sine wave; $T_{j(init)}$ = 25 °C; t_p = 20 ms; see Figure 4; see Figure 5	-	-	155	A
$I_{T(RMS)}$	RMS on-state current	full sine wave; T_{mb} ≤ 99 °C; see Figure 1; see Figure 2; see Figure 3	-	-	16	A

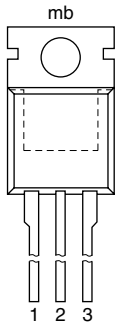
Table 1. Quick reference data *...continued*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
I_{GT}	gate trigger current	V_D = 12 V; I_T = 0.1 A; T2+ G+; T_j = 25 °C; see Figure 7	-	2.5	10	mA
		V_D = 12 V; I_T = 0.1 A; T2+ G-; T_j = 25 °C; see Figure 7	-	4	10	mA
		V_D = 12 V; I_T = 0.1 A; T2- G-; T_j = 25 °C; see Figure 7	-	5	10	mA
		V_D = 12 V; I_T = 0.1 A; T2- G+; T_j = 25 °C; see Figure 7	-	11	25	mA

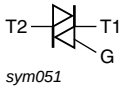
2. Pinning information

Table 2. Pinning information

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



SOT78 (TO-220AB)



3. Ordering information

Table 3. Ordering information

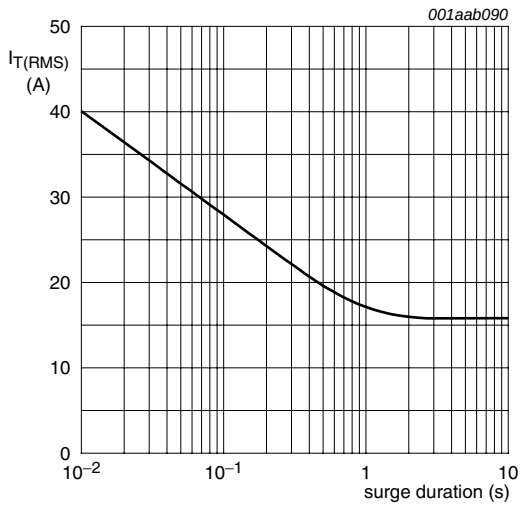
Type number	Package		
	Name	Description	Version
BT139-600E	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78
BT139-600E/DG	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

4. Limiting values

Table 4. Limiting values

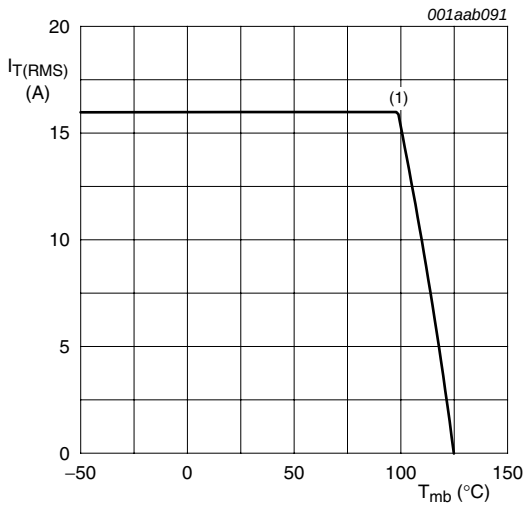
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DRM}	repetitive peak off-state voltage		-	600	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{mb} \leq 99$ °C; see Figure 1; see Figure 2; see Figure 3	-	16	A
I_{TSM}	non-repetitive peak on-state current	full sine wave; $T_{j(init)} = 25$ °C; $t_p = 20$ ms; see Figure 4; see Figure 5	-	155	A
		full sine wave; $T_{j(init)} = 25$ °C; $t_p = 16.7$ ms	-	170	A
I^2t	I^2t for fusing	$t_p = 10$ ms; sine-wave pulse	-	120	A^2s
dI_T/dt	rate of rise of on-state current	$I_T = 20$ A; $I_G = 0.2$ A; $dI_G/dt = 0.2$ A/µs; T2+ G+	-	50	A/µs
		$I_T = 20$ A; $I_G = 0.2$ A; $dI_G/dt = 0.2$ A/µs; T2+ G-	-	50	A/µs
		$I_T = 20$ A; $I_G = 0.2$ A; $dI_G/dt = 0.2$ A/µs; T2- G-	-	50	A/µs
		$I_T = 20$ A; $I_G = 0.2$ A; $dI_G/dt = 0.2$ 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



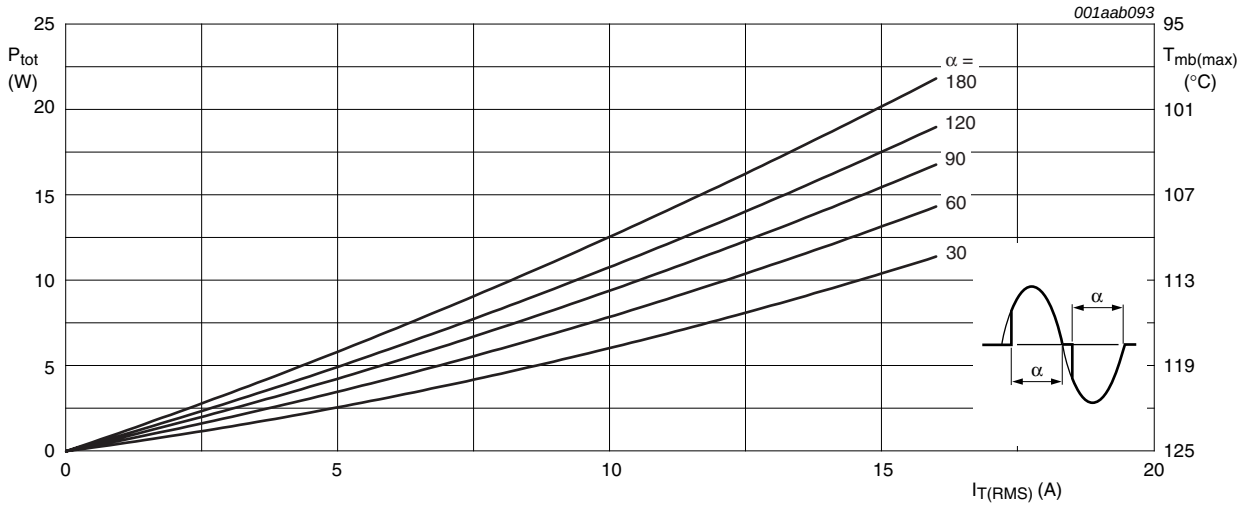
f = 50 Hz
$T_{mb} \leq 99$ °C

Fig 1. RMS on-state current as a function of surge duration; maximum values



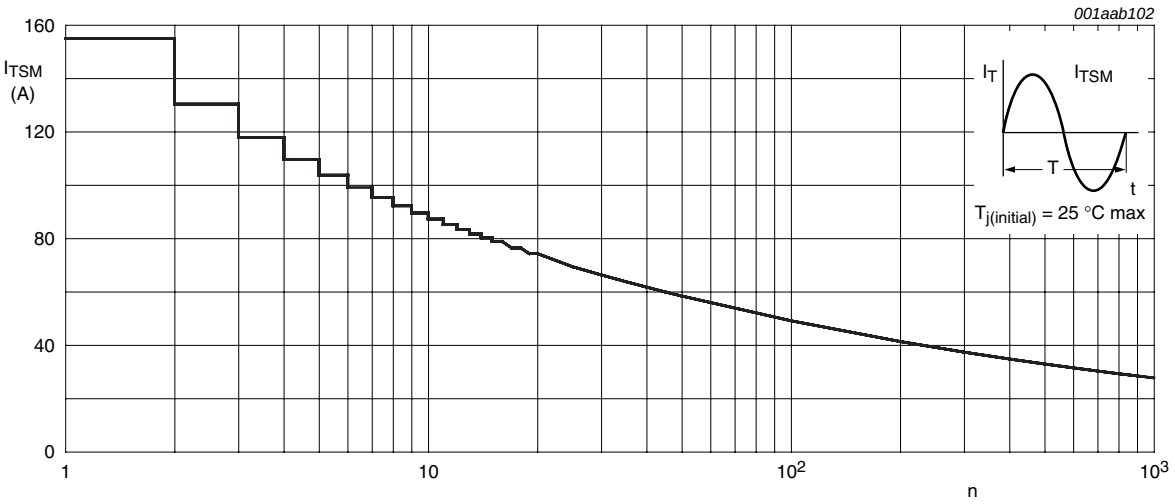
(1) $T_{mb} = 99$ °C

Fig 2. RMS on-state current as a function of mounting base temperature; maximum values



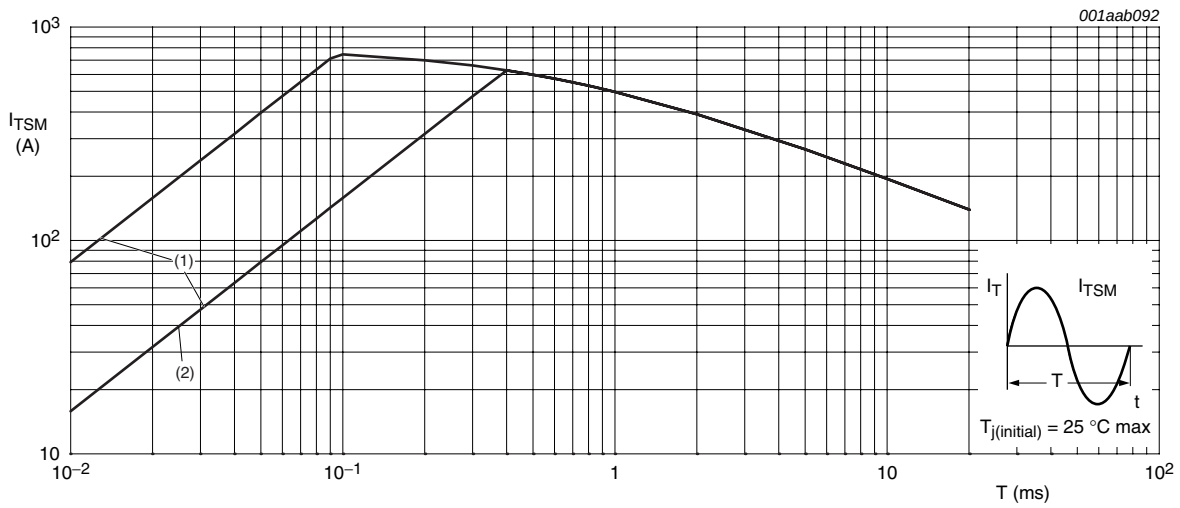
α = conduction angle

Fig 3. Total power dissipation as a function of RMS on-state current; maximum values.



f = 50 Hz; n = number of cycles

Fig 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values



$t_p \leq 20ms$

(1) dI_T / dt limit

(2) T2 − G + quadrant limit

Fig 5. Non-repetitive peak on-state current as a function of pulse width; maximum values

5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	half cycle; see Figure 6	-	-	1.7	K/W
		full cycle; see Figure 6	-	-	1.2	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	60	-	K/W

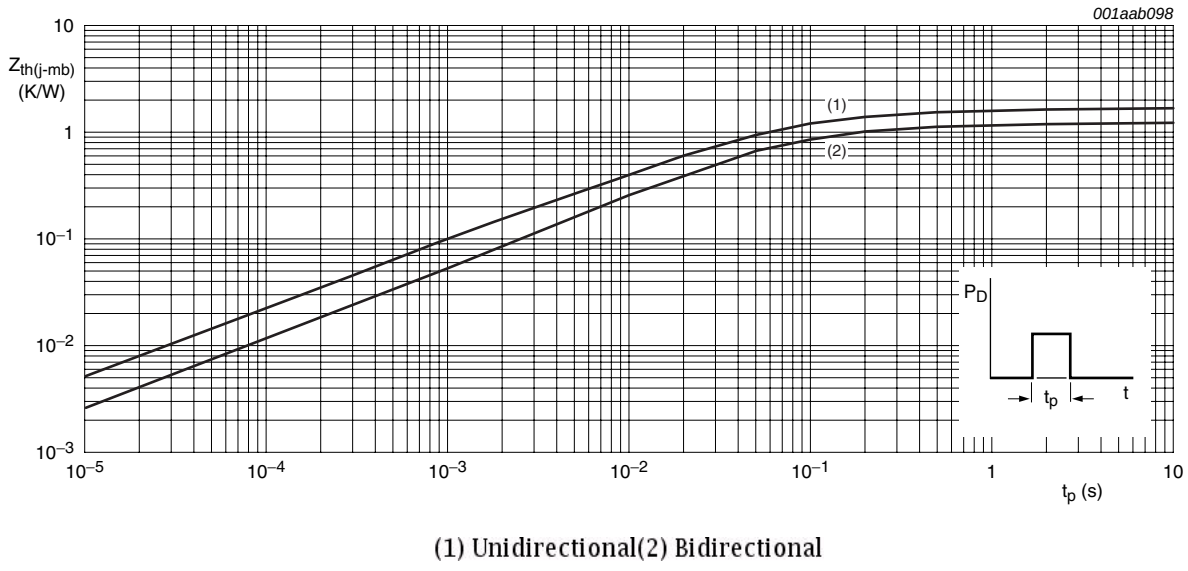
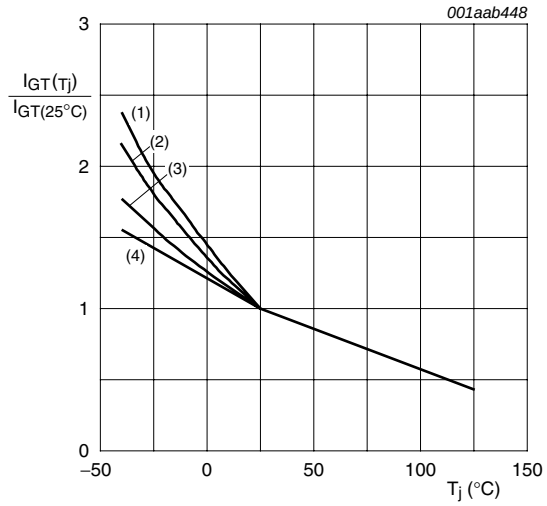


Fig 6. Transient thermal impedance from junction to mounting base as a function of pulse width

6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
I_{GT}	gate trigger current	V_D = 12 V; I_T = 0.1 A; T2+ G+; T_j = 25 °C; see Figure 7	-	2.5	10	mA
		V_D = 12 V; I_T = 0.1 A; T2+ G-; T_j = 25 °C; see Figure 7	-	4	10	mA
		V_D = 12 V; I_T = 0.1 A; T2- G-; T_j = 25 °C; see Figure 7	-	5	10	mA
		V_D = 12 V; I_T = 0.1 A; T2- G+; T_j = 25 °C; see Figure 7	-	11	25	mA
I_L	latching current	V_D = 12 V; I_G = 0.1 A; T2+ G+; T_j = 25 °C; see Figure 8	-	3.2	30	mA
		V_D = 12 V; I_G = 0.1 A; T2+ G-; T_j = 25 °C; see Figure 8	-	16	40	mA
		V_D = 12 V; I_G = 0.1 A; T2- G-; T_j = 25 °C; see Figure 8	-	4	30	mA
		V_D = 12 V; I_G = 0.1 A; T2- G+; T_j = 25 °C; see Figure 8	-	5.5	40	mA
I_H	holding current	V_D = 12 V; T_j = 25 °C; see Figure 9	-	4	45	mA
V_T	on-state voltage	I_T = 20 A; T_j = 25 °C; see Figure 10	-	1.2	1.6	V
V_{GT}	gate trigger voltage	V_D = 12 V; I_T = 0.1 A; T_j = 25 °C; see Figure 11	-	0.7	1.5	V
		V_D = 400 V; I_T = 0.1 A; T_j = 125 °C; see Figure 11	0.25	0.4	-	V
I_D	off-state current	V_D = 600 V; T_j = 125 °C	-	0.1	0.5	mA
Dynamic characteristics						
dV_D/dt	rate of rise of off-state voltage	V_{DM} = 402 V; T_j = 125 °C; exponential waveform; gate open circuit	-	50	-	V/µs
t_{gt}	gate-controlled turn-on time	I_{TM} = 20 A; V_D = 600 V; I_G = 0.1 A; dI_G/dt = 5 A/µs	-	2	-	µs



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

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

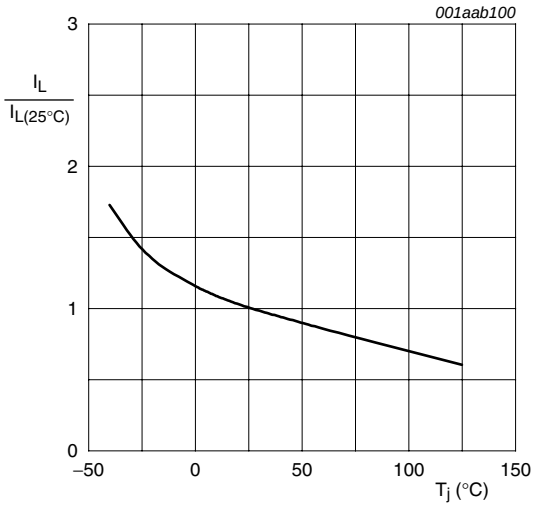


Fig 8. Normalized latching current as a function of junction temperature

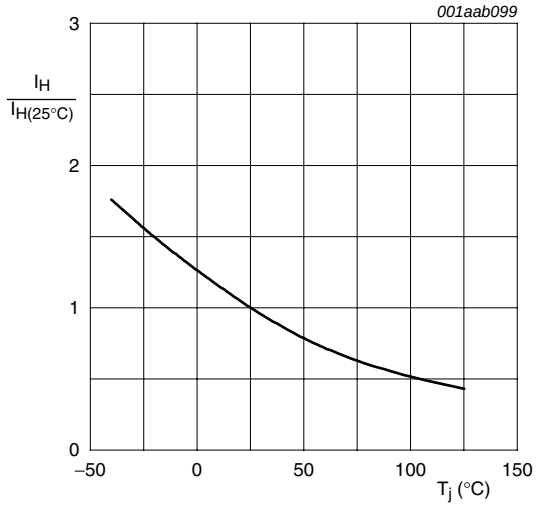
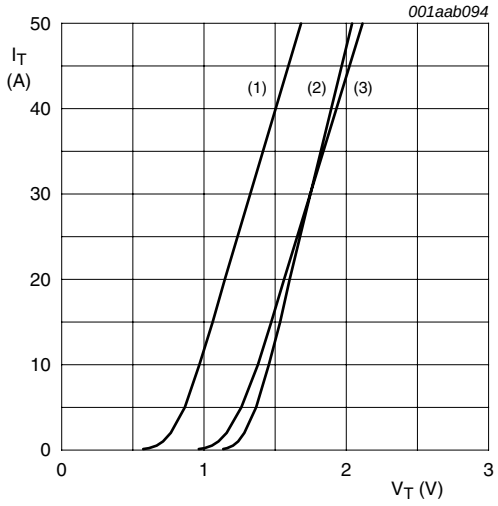


Fig 9. Normalized holding current as a function of junction temperature



$V_o = 1.195\ V$

$R_s = 0.018\ \Omega$

(1) $T_j = 125\ °C$; typical values

(2) $T_j = 25\ °C$; maximum values

(3) $T_j = 125\ °C$; maximum values

Fig 10. On-state current as a function of on-state voltage

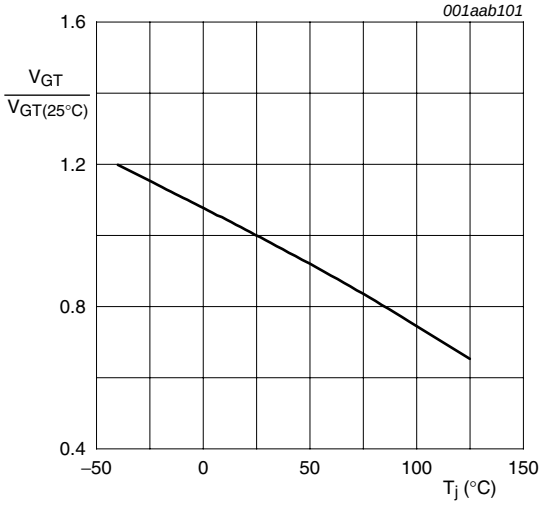
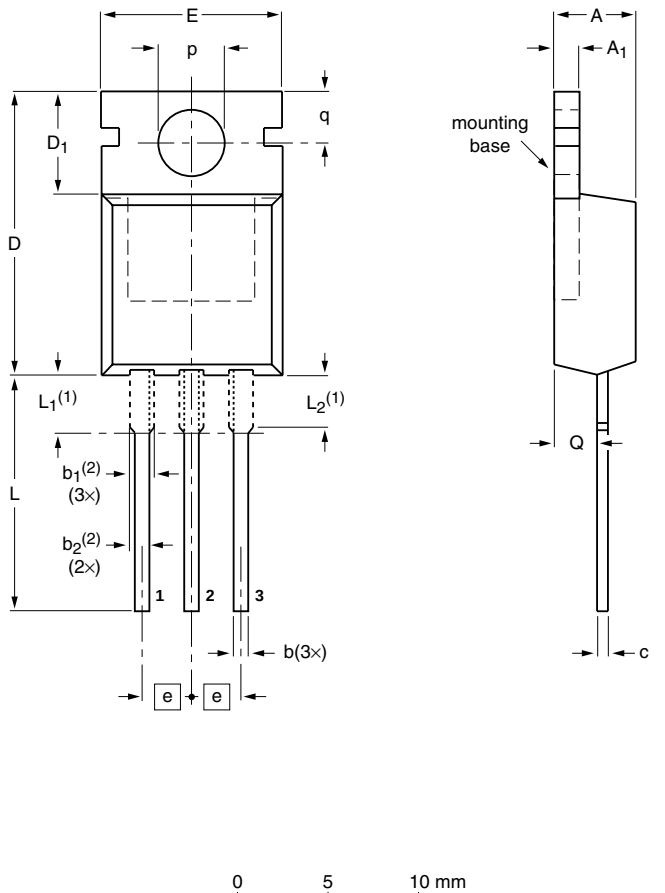


Fig 11. Normalized gate trigger voltage as a function of junction temperature

7. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB **SOT78**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1(2)	b_2(2)	c	D	D_1	E	e	L	L_1(1)	L_2(1) max.	p	q	Q
mm	4.7 4.1	1.40 1.25	0.9 0.6	1.6 1.0	1.3 1.0	0.7 0.4	16.0 15.2	6.6 5.9	10.3 9.7	2.54	15.0 12.8	3.30 2.79	3.0	3.8 3.5	3.0 2.7	2.6 2.2

Notes

1. Lead shoulder designs may vary.
2. Dimension includes excess dambar.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78		3-lead TO-220AB	SC-46			~~08-04-23~~ 08-06-13

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

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BT139-600E v.5	20110324	Product data sheet	-	BT139-600E v.4
Modifications:	• Various changes to content.			
BT139-600E v.4	20110224	Product data sheet	-	BT139_SER_E v.3

9. Legal information

9.1 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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11. Contents

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