

## 1. General description

Planar passivated Silicon Controlled Rectifier (SCR) in a SOT186A (TO-220F) "full pack" plastic package intended for use in applications requiring good bidirectional blocking voltage and high current surge capability with high thermal cycling performance and high junction temperature capability ( $T_{j(max)} = 150\text{ °C}$ ).

## 2. Features and benefits

- High junction operating temperature capability ( $T_{j(max)} = 150\text{ °C}$ )
- Good bidirectional blocking voltage capability
- High current surge capability
- High thermal cycling performance
- Isolated mounting base package
- Planar passivated for voltage ruggedness and reliability

## 3. Applications

- Capacitive Discharge Ignition (CDI)
- Crowbar protection
- Inrush protection
- Motor control
- Voltage regulation
- High junction operating temperature capability ( $T_{j(max)} = 150\text{ °C}$ )

## 4. Quick reference data

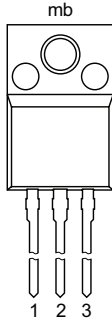

Table 1. Quick reference data

Symbol	Parameter	Conditions	Values	Unit
<b>Absolute maximum rating</b>				
$V_{RRM}$	repetitive peak reverse voltage		650	V
$I_{T(RMS)}$	RMS on-state current	half sine wave; $T_h \leq 94\text{ °C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	12	A
$I_{TSM}$	non-repetitive peak on-state current	half sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 10\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>	120	A
		half sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 8.3\text{ ms}$	132	A
$T_j$	junction temperature		150	°C

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$I_{GT}$	gate trigger current	$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>	-	-	5	mA
$I_H$	holding current	$V_D = 12\text{ V}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 9</a>	-	7	20	mA
$V_T$	on-state voltage	$I_T = 12\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 10</a>	-	1.18	1.54	V
<b>Dynamic characteristics</b>						
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 436\text{ V}$ ; $T_j = 150\text{ °C}$ ; $R_{GK} = 100\ \Omega$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform;	200	1000	-	V/ $\mu$ s

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	K	cathode		
2	A	anode		
3	G	gate		
mb	n.c.	mounting base; isolated		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
BT151X-650LT	TO-220F	plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack"	SOT186A

## 7. Marking

Table 4. Marking codes

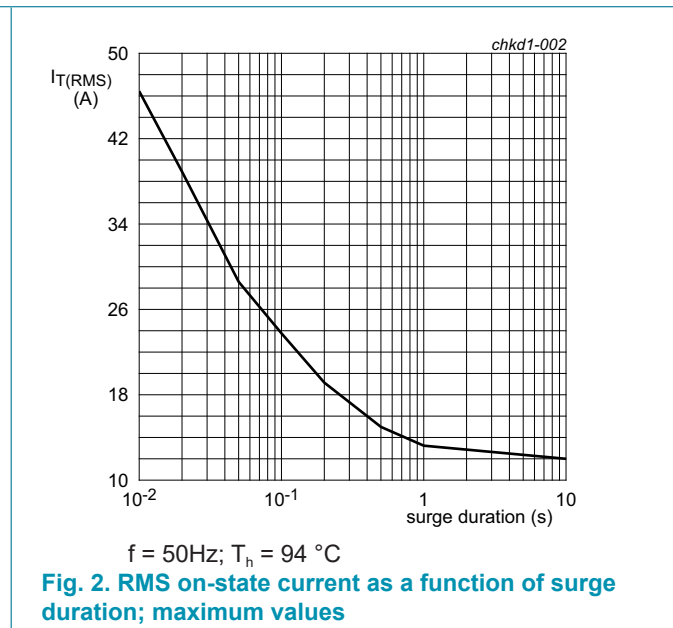
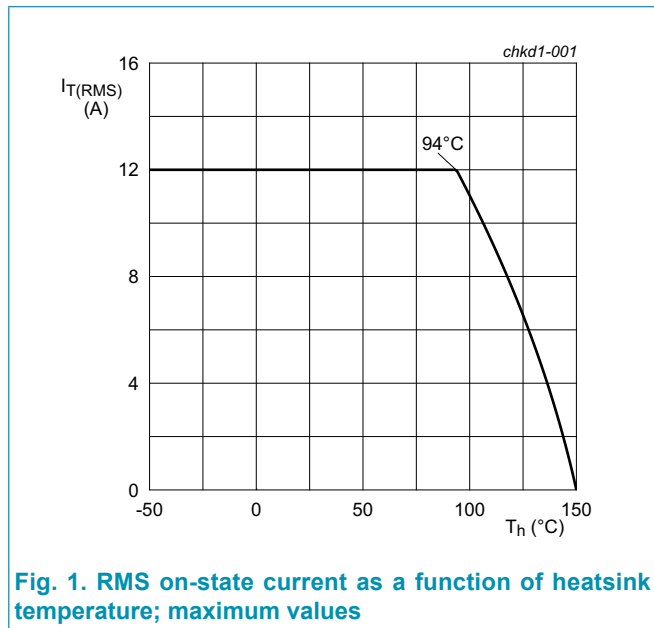
Type number	Marking codes
BT151X-650LT	BT151X-650LT

## 8. Limiting values

**Table 5. Limiting values**

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

Symbol	Parameter	Conditions	Values	Unit
$V_{DRM}$	repetitive peak off-state voltage		650	V
$V_{RRM}$	repetitive peak reverse voltage		650	V
$I_{T(AV)}$	average on-state current	half sine wave; $T_h \leq 94\text{ }^\circ\text{C}$ ;	7.5	A
$I_{T(RMS)}$	RMS on-state current	half sine wave; $T_h \leq 94\text{ }^\circ\text{C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	12	A
$I_{TSM}$	non-repetitive peak on-state current	half sine wave; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$ ; $t_p = 10\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>	120	A
		half sine wave; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$ ; $t_p = 8.3\text{ ms}$	132	A
$I^2t$	$I^2t$ for fusing	$t_p = 10\text{ ms}$ ; sine wave	72	$\text{A}^2\text{s}$
$di_T/dt$	rate of rise of on-state current	$I_G = 10\text{ mA}$	50	$\text{A}/\mu\text{s}$
$I_{GM}$	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 to 150	$^\circ\text{C}$
$T_j$	junction temperature		150	$^\circ\text{C}$



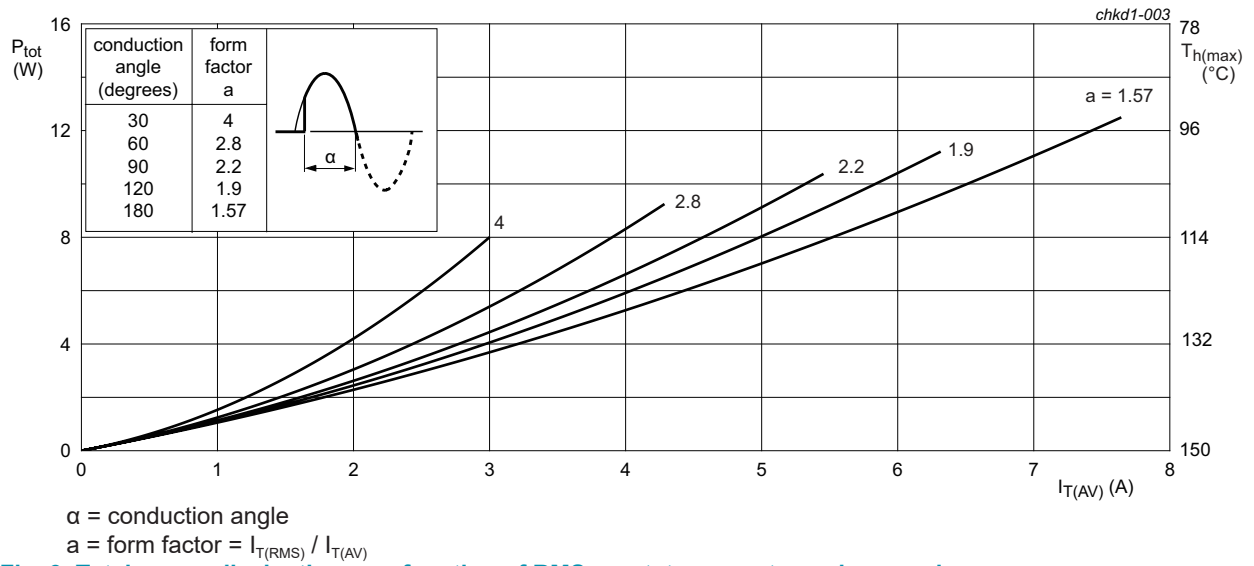


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

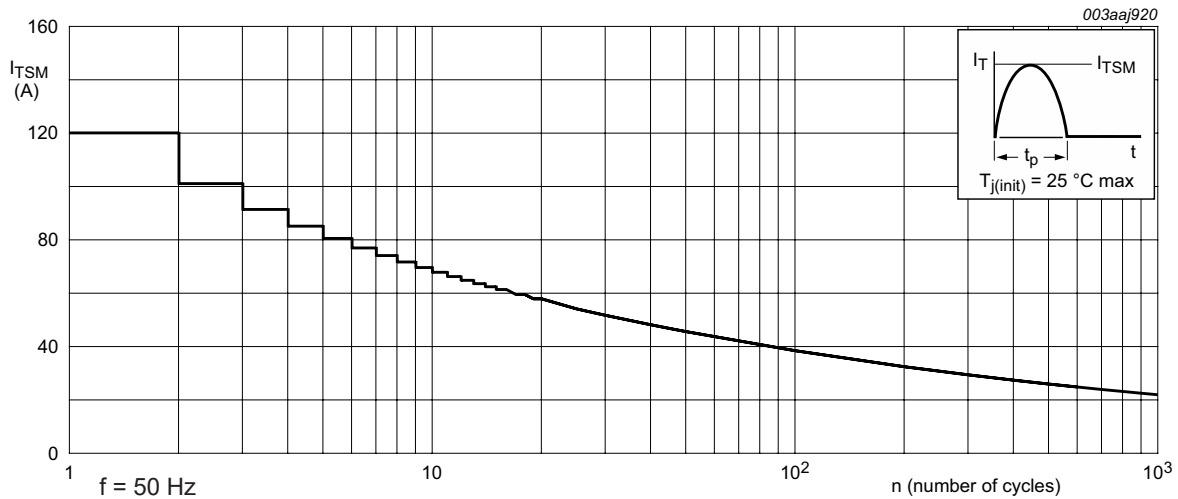


Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values

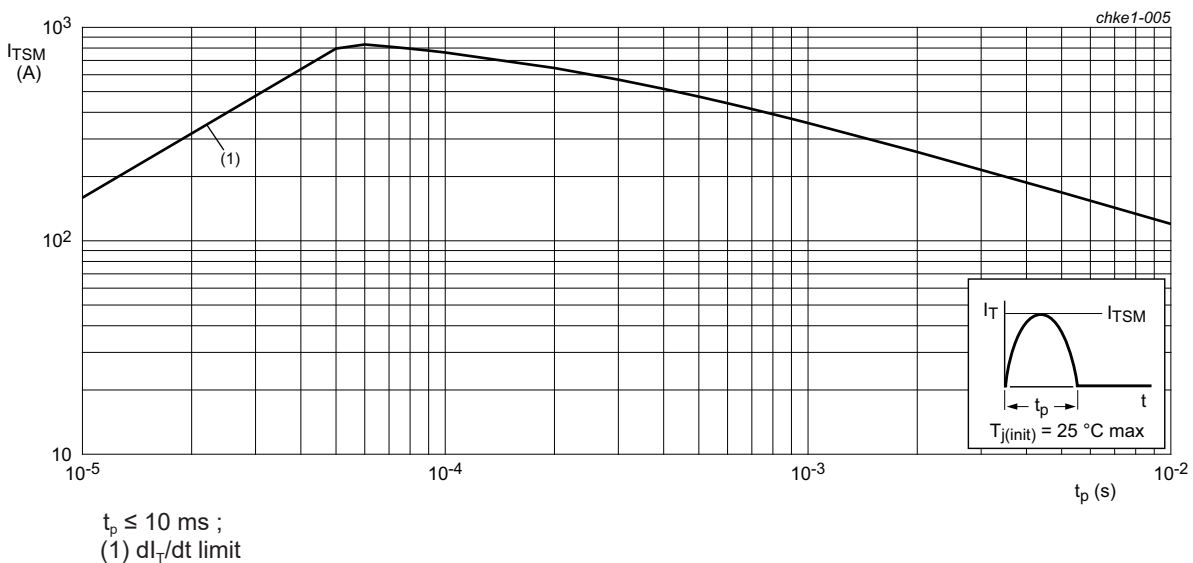


Fig. 5. Total power dissipation as a function of RMS on-state current; maximum values

## 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-h)}$	thermal resistance from junction to heatsink	with heatsink compound; <a href="#">Fig. 6</a>	-	-	4.5	K/W
		without heatsink compound; <a href="#">Fig. 6</a>	-	-	6.5	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient free air	in free air	-	55	-	K/W

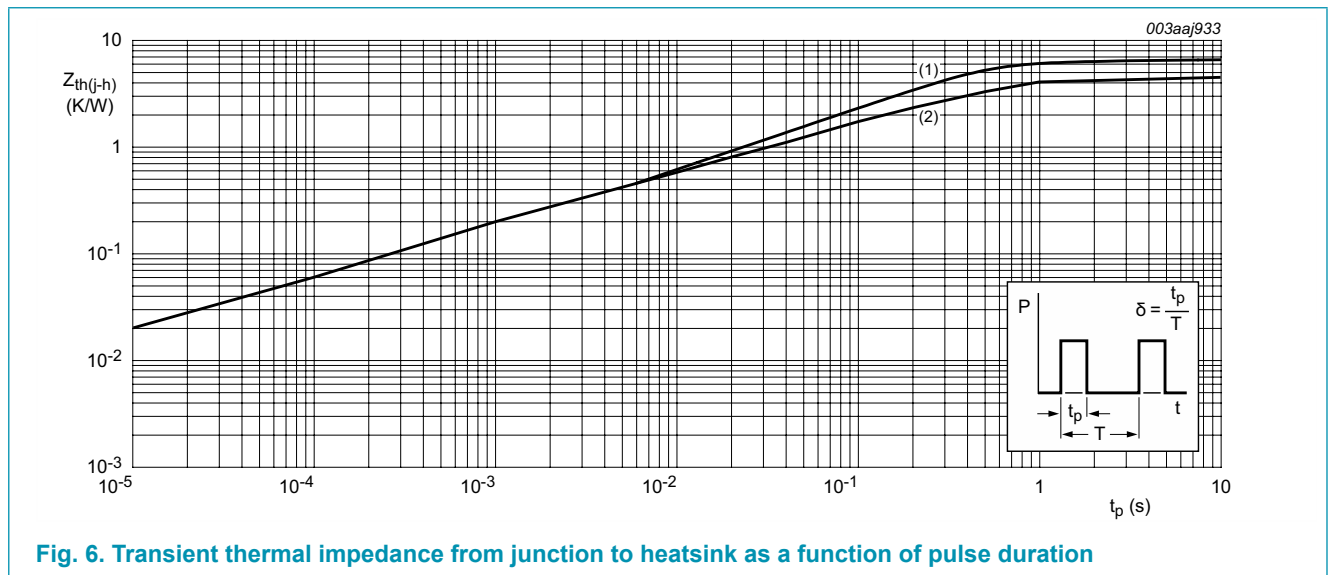


Fig. 6. Transient thermal impedance from junction to heatsink as a function of pulse duration

## 10. Isolation characteristics

Table 7. Isolation characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{isol(RMS)}$	RMS isolation voltage	50 Hz ≤ f ≤ 60 Hz; RH ≤ 65 %; from all pins to external heatsink; sinusoidal waveform; clean and dust free	-	-	2500	V
$C_{isol}$	isolation capacitance	from cathode to external heatsink	-	10	-	PF

## 11. Characteristics

Table 8. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$I_{GT}$	gate trigger current	$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>	-	-	5	mA
$I_L$	latching current	$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 8</a>	-	10	40	mA
$I_H$	holding current	$V_D = 12\text{ V}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 9</a>	-	7	20	mA
$V_T$	on-state voltage	$I_T = 12\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 10</a>	-	1.18	1.54	V
$V_{GT}$	gate trigger voltage	$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 11</a>	-	0.6	1	V
		$V_D = 400\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 150\text{ °C}$ ; <a href="#">Fig. 11</a>	0.2	0.4	-	V
$I_D$	off-state current	$V_D = 650\text{ V}$ ; $T_j = 150\text{ °C}$	-	-	1	mA
$I_R$	reverse current	$V_D = 650\text{ V}$ ; $T_j = 150\text{ °C}$	-	-	1	mA
<b>Dynamic characteristics</b>						
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 436\text{ V}$ ; $T_j = 150\text{ °C}$ ; $R_{GK} = 100\text{ }\Omega$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform;	200	1000	-	V/ $\mu$ s
		$V_{DM} = 436\text{ V}$ ; $T_j = 150\text{ °C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit	50	-	-	V/ $\mu$ s
$t_{gt}$	gate-controlled turn-on time	$I_{TM} = 12\text{ A}$ ; $V_D = 650\text{ V}$ ; $I_G = 10\text{ mA}$ ; ( $dI_G/dt$ ) $_M = 5\text{ A}/\mu\text{s}$ ; $T_j = 25\text{ °C}$	-	2	-	$\mu$ s
$t_q$	commutated turn-off time	$V_{DM} = 436\text{ V}$ ; $T_j = 150\text{ °C}$ ; $I_{TM} = 12\text{ A}$ ; $V_R = 25\text{ V}$ ; $dV_D/dt = 30\text{ V}/\mu\text{s}$ ; ( $dI_T/dt$ ) $_M = 30\text{ A}/\mu\text{s}$ ; $R_{GK(ext)} = 100\text{ }\Omega$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ )	-	70	-	$\mu$ s

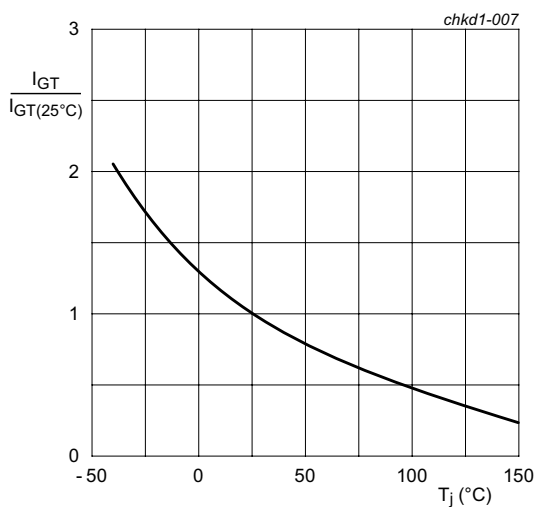


Fig. 7. Normalized gate trigger current as a function of junction temperature

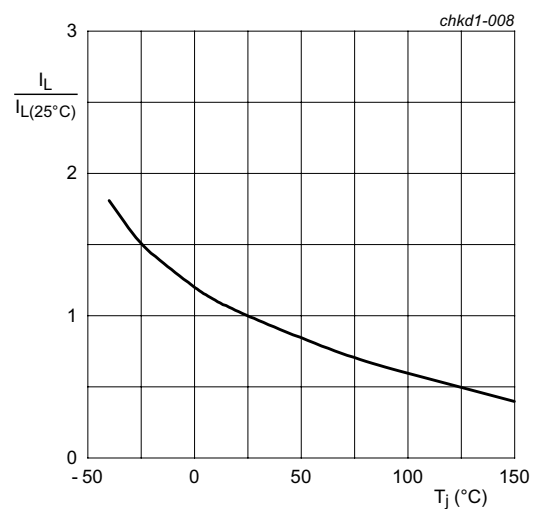


Fig. 8. Normalized latching current as a function of junction temperature

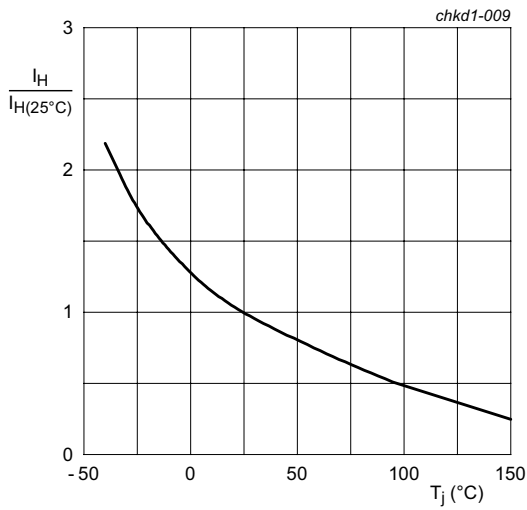
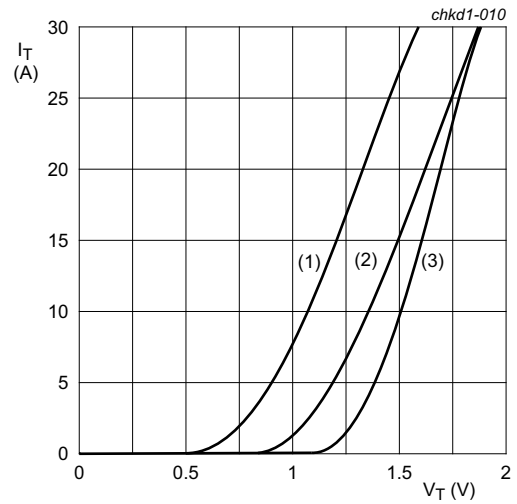


Fig. 9. Normalized holding current as a function of junction temperature



$V_o = 0.967 \text{ V}; R_s = 0.0354 \Omega$   
 (1)  $T_j = 150^\circ\text{C}$ ; typical values  
 (2)  $T_j = 150^\circ\text{C}$ ; maximum values  
 (3)  $T_j = 25^\circ\text{C}$ ; maximum values

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

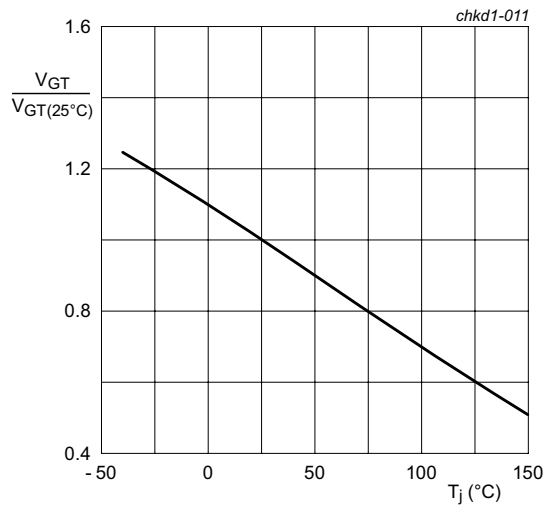
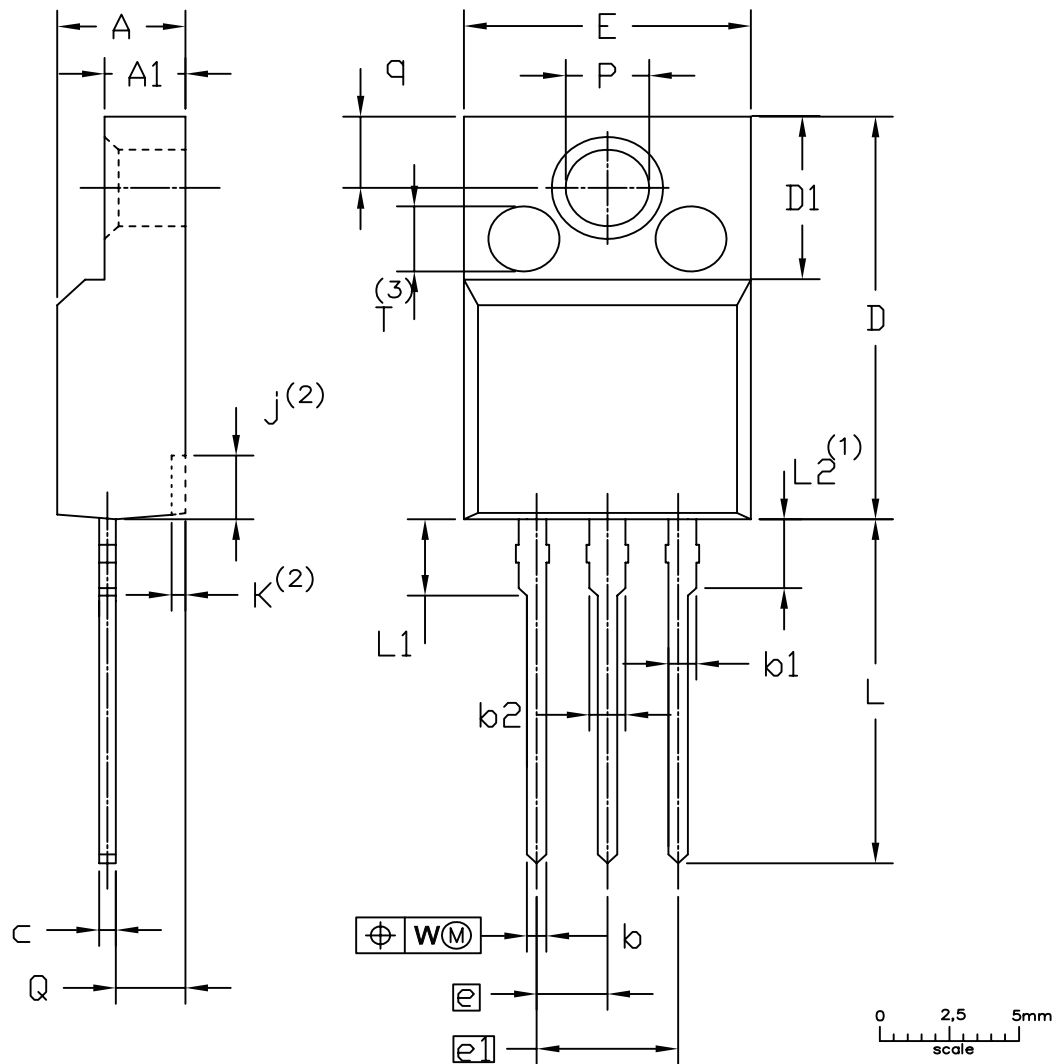


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

### 12. Package outline

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

SOT186A



UNIT	A	A <sub>1</sub>	b	b <sub>1</sub>	b <sub>2</sub>	c	D	D <sub>1</sub>	E	e	e <sub>1</sub>	j <sup>(2)</sup>	k <sup>(2)</sup>	L	L <sub>1</sub>	L <sub>2</sub> <sup>(1)</sup> max.	P	Q	q	W	T <sup>(3)</sup>
mm	4.6	2.9	0.9	1.1	1.4	0.7	15.8	6.5	10.3	2.54	5.08	2.7	0.6	14.4	3.30	3	3.2	2.6	3.0	0.4	2.5
	4.0	2.5	0.7	0.9	1.0	0.4	15.2	6.3	9.7			1.7	0.4	13.5	2.79		3.0	2.3	2.6		

Notes

- Terminal dimensions within this zone are uncontrolled
- Dot lines area designs may vary
- Eject pin mark is for reference only

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA		
SOT186A		3 LEADS TO220F			2013-11-14



## 13. Legal information

### 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.

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Date of release: 28 November 2018

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