



**THE DATASHEET OF  
MAC97A6,412**



## 1. General description

Planar passivated very sensitive gate four quadrant triac in a SOT54 plastic package intended to be interfaced directly to microcontrollers, logic integrated circuits and other low power gate trigger circuits.

## 2. Features and benefits

- Direct interfacing to logic level ICs
- Direct interfacing to low power gate drivers and microcontrollers
- High blocking voltage capability
- Planar passivated for voltage ruggedness and reliability
- Triggering in all four quadrants
- Very sensitive gate

## 3. Applications

- General purpose low power phase control
- General purpose low power switching
- Solid-state relay

## 4. Quick reference data

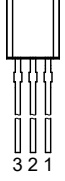

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DRM}$	repetitive peak off-state voltage		-	-	400	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{lead} \leq 50\text{ °C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	-	-	0.6	A
$I_{TSM}$	non-repetitive peak on-state current	full sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>	-	-	8	A
		full sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 16.7\text{ ms}$	-	-	8.8	A
$T_j$	junction temperature		-	-	125	°C
<b>Static characteristics</b>						
$I_{GT}$	gate trigger current	$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G+; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>	-	1	5	mA
		$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G-; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>	-	2	5	mA
		$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G-; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>	-	2	5	mA

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G+; $T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 7</a>	-	4	7	mA
$I_H$	holding current	$V_D = 12\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 9</a>	-	1	10	mA
$V_T$	on-state voltage	$I_T = 0.85\text{ A}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 10</a>	-	1.4	1.9	V
<b>Dynamic characteristics</b>						
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 268\text{ V}$ ; $T_j = 110\text{ }^\circ\text{C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit; <a href="#">Fig. 12</a>	30	45	-	V/ $\mu\text{s}$
$dV_{com}/dt$	rate of change of commutating voltage	$V_D = 400\text{ V}$ ; $T_j = 50\text{ }^\circ\text{C}$ ; $dI_{com}/dt = 0.3\text{ A/ms}$ ; $I_T = 0.84\text{ A}$ ; gate open circuit	-	5	-	V/ $\mu\text{s}$

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	T2	main terminal 2	 <p>TO-92 (SOT54)</p>	 <p>sym051</p>
2	G	gate		
3	T1	main terminal 1		

## 6. Ordering information

Table 3. Ordering information

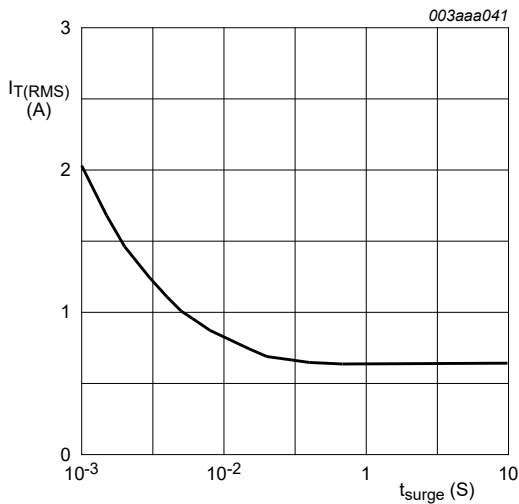
Type number	Package		
	Name	Description	Version
MAC97A6	TO-92	plastic single-ended leaded (through hole) package; 3 leads	SOT54

## 7. Limiting values

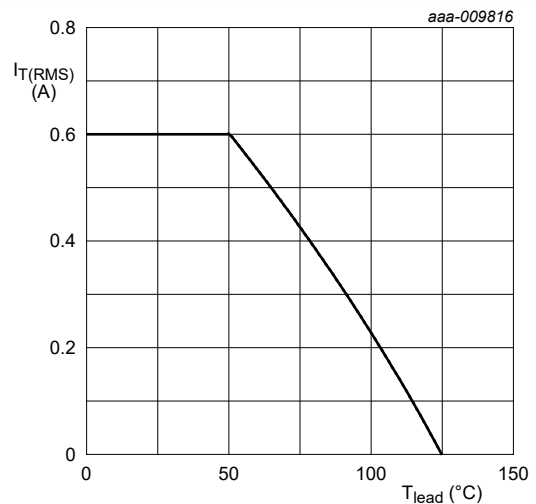
**Table 4. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DRM}$	repetitive peak off-state voltage		-	400	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{lead} \leq 50\text{ °C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	-	0.6	A
$I_{TSM}$	non-repetitive peak on-state current	full sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>	-	8	A
		full sine wave; $T_{j(init)} = 25\text{ °C}$ ; $t_p = 16.7\text{ ms}$	-	8.8	A
$I^2t$	$I^2t$ for fusing	$t_p = 10\text{ ms}$ ; SIN	-	0.32	A <sup>2</sup> s
$di_T/dt$	rate of rise of on-state current	$I_G = 20\text{ mA}$ ; T2+ G+	-	50	A/ $\mu$ s
		$I_G = 20\text{ mA}$ ; T2+ G-	-	50	A/ $\mu$ s
		$I_G = 20\text{ mA}$ ; T2- G-	-	50	A/ $\mu$ s
		$I_G = 20\text{ mA}$ ; T2- G+	-	10	A/ $\mu$ s
$I_{GM}$	peak gate current		-	1	A
$P_{GM}$	peak gate power		-	5	W
$P_{G(AV)}$	average gate power	over any 20 ms period	-	0.1	W
$T_{stg}$	storage temperature		-40	150	°C
$T_j$	junction temperature		-	125	°C



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



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

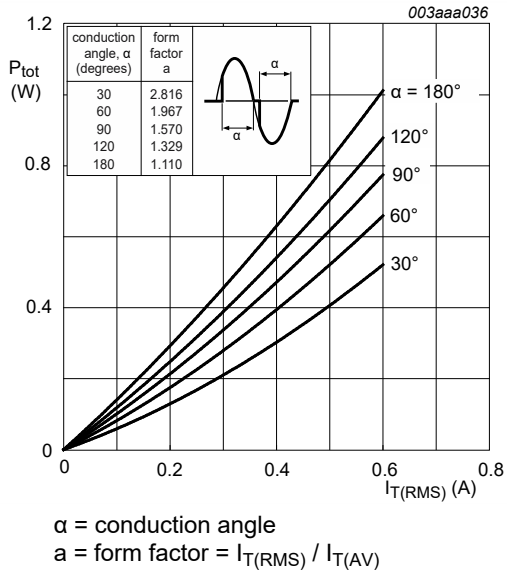


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

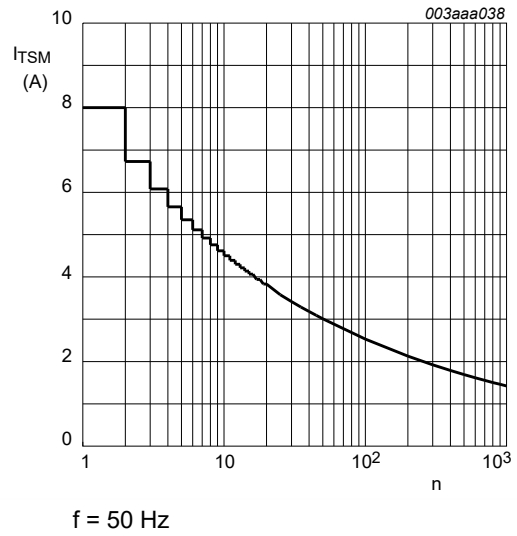


Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values

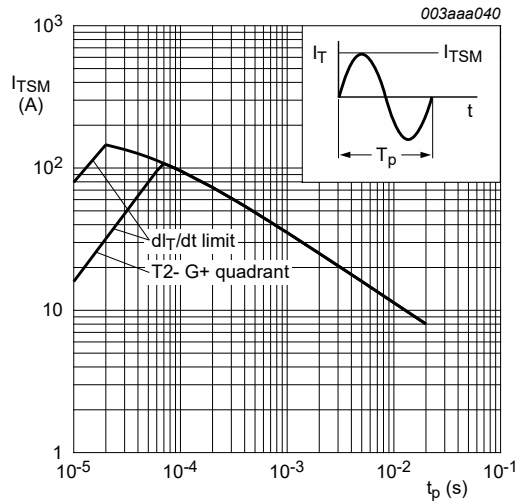


Fig. 5. Non-repetitive peak on-state current as a function of pulse width; maximum values

## 8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
R <sub>th(j-lead)</sub>	thermal resistance from junction to lead	full cycle; <a href="#">Fig. 6</a>	-	-	60	K/W
		half cycle	-	-	80	K/W
R <sub>th(j-a)</sub>	thermal resistance from junction to ambient free air	printed circuit board mounted: lead length = 4 mm	-	150	-	K/W

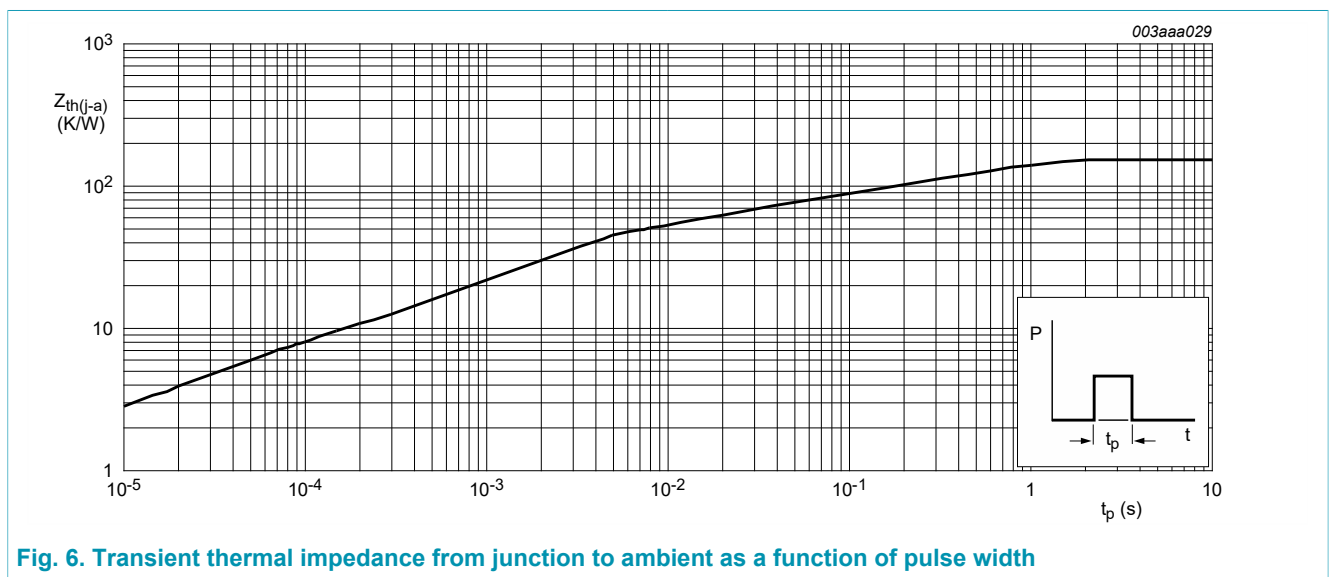


Fig. 6. Transient thermal impedance from junction to ambient as a function of pulse width

## 9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$I_{GT}$	gate trigger current	$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G+; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>	-	1	5	mA
		$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2+ G-; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>	-	2	5	mA
		$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G-; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>	-	2	5	mA
		$V_D = 12\text{ V}$ ; $I_T = 0.1\text{ A}$ ; T2- G+; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 7</a>	-	4	7	mA
$I_L$	latching current	$V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2+ G+; $T_j = 25\text{ °C}$	-	1	10	mA
		$V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2+ G-; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 8</a>	-	5	10	mA
		$V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2- G-; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 8</a>	-	1	10	mA
		$V_D = 12\text{ V}$ ; $I_G = 0.1\text{ A}$ ; T2- G+; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 8</a>	-	2	10	mA
$I_H$	holding current	$V_D = 12\text{ V}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 9</a>	-	1	10	mA
$V_T$	on-state voltage	$I_T = 0.85\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 10</a>	-	1.4	1.9	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>	-	0.9	1.5	V
		$V_D = 400\text{ V}$ ; $I_T = 0.1\text{ A}$ ; $T_j = 110\text{ °C}$ ; <a href="#">Fig. 11</a>	0.1	0.7	-	V
$I_D$	off-state current	$V_D = 400\text{ V}$ ; $T_j = 110\text{ °C}$	-	3	100	$\mu\text{A}$
<b>Dynamic characteristics</b>						
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 268\text{ V}$ ; $T_j = 110\text{ °C}$ ; ( $V_{DM} = 67\%$ of $V_{DRM}$ ); exponential waveform; gate open circuit; <a href="#">Fig. 12</a>	30	45	-	$\text{V}/\mu\text{s}$
$dV_{com}/dt$	rate of change of commutating voltage	$V_D = 400\text{ V}$ ; $T_j = 50\text{ °C}$ ; $dI_{com}/dt = 0.3\text{ A/ms}$ ; $I_T = 0.84\text{ A}$ ; gate open circuit	-	5	-	$\text{V}/\mu\text{s}$
$t_{gt}$	gate-controlled turn-on time	$I_{TM} = 1\text{ A}$ ; $V_D = 400\text{ V}$ ; $I_G = 25\text{ mA}$ ; $dI_G/dt = 5\text{ A}/\mu\text{s}$	-	2	-	$\mu\text{s}$

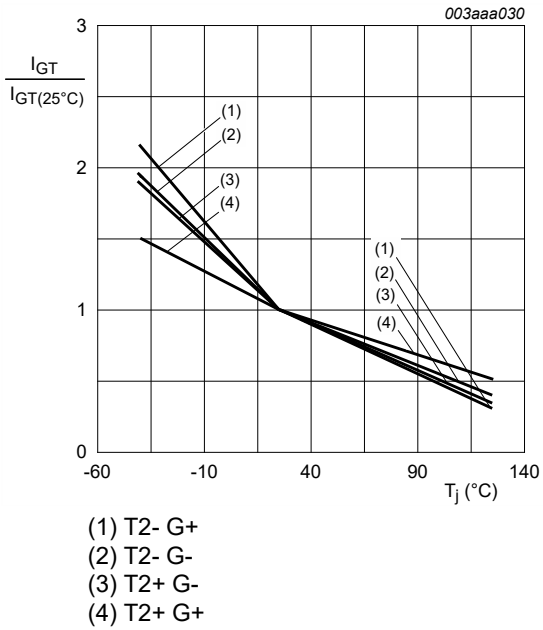


Fig. 7. Normalized gate trigger current as a function of junction temperature

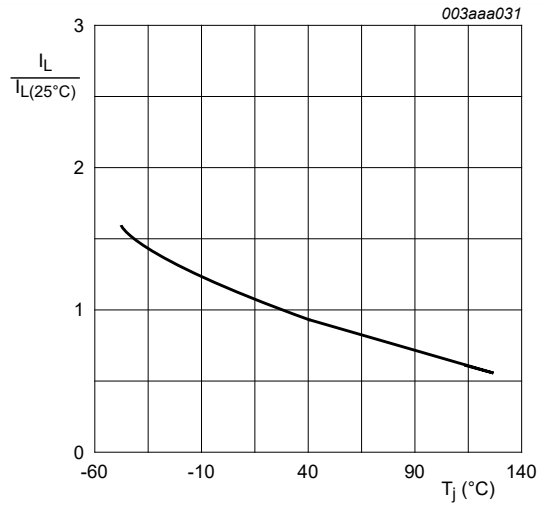


Fig. 8. Normalized latching current as a function of junction temperature

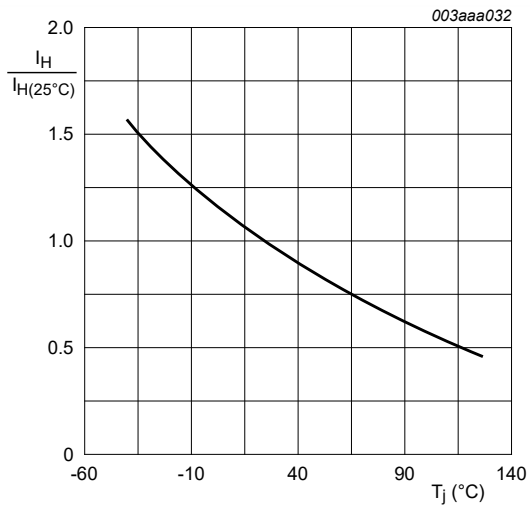
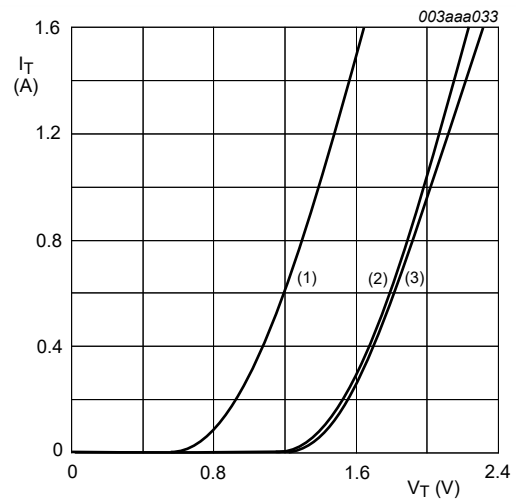


Fig. 9. Normalized holding current as a function of junction temperature



$V_o = 1.45 \text{ V}; R_s = 0.1875 \Omega$

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

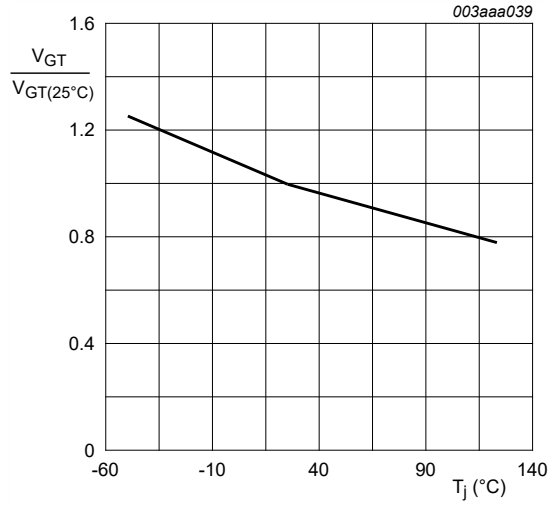


Fig. 11. Normalized gate trigger voltage as a function of junction temperature

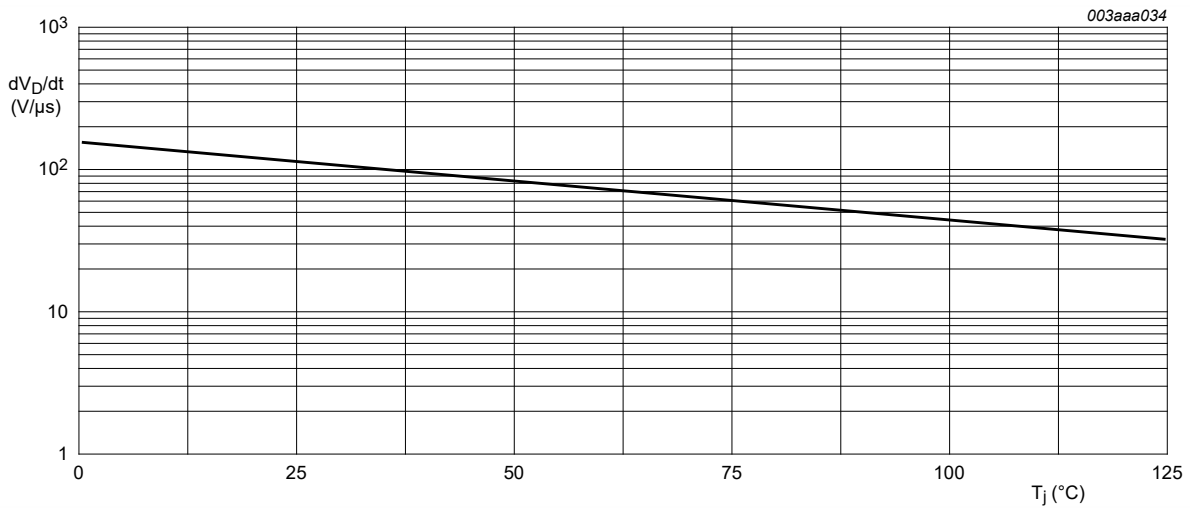


Fig. 12. Critical rate of rise of off-state voltage as a function of junction temperature; typical values

### 10. Package outline

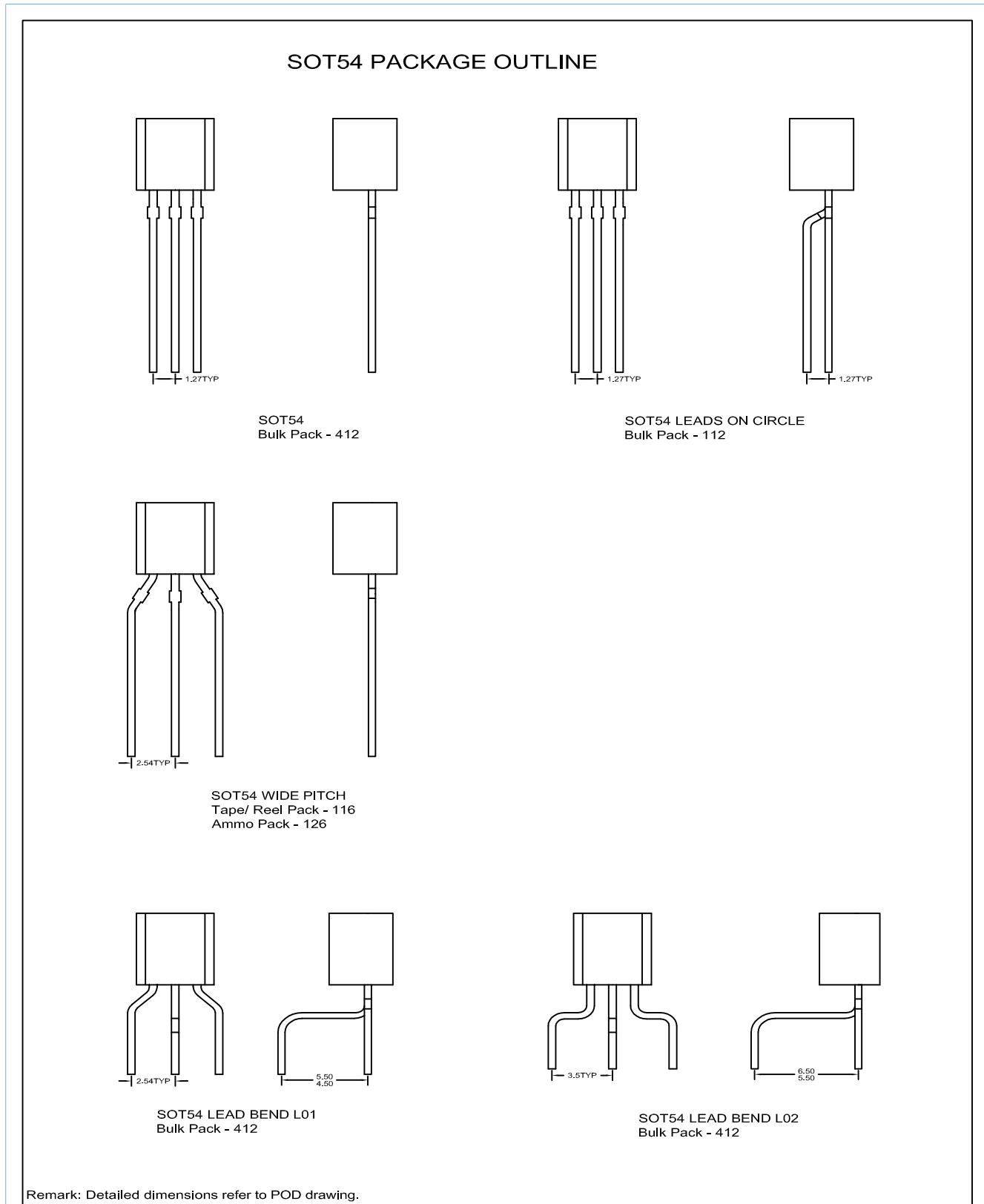


Fig. 13. Package outline TO-92 (SOT54)

# 11. Legal information

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Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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