

# **NXP ACTT2S-800E Thyristor datasheet**

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AC Thyristor Triac power switch in a SOT428 (DPAK) surface mountable plastic package with self-protective clamping capabilities against low and high energy transients.

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# ACTT2S-800E

## AC Thyristor Triac power switch

17 March 2014

Product data sheet

### 1. General description

AC Thyristor Triac power switch in a SOT428 (DPAK) surface mountable plastic package with self-protective clamping capabilities against low and high energy transients.

### 2. Features and benefits

- Clamping structure ensuring safe high over-voltage withstand capability
- Direct interfacing with low power drivers and microcontrollers
- Full cycle AC conduction
- Over-voltage withstand capability to IEC 61000-4-5
- Pin compatible with standard triacs
- Planar passivated for voltage ruggedness and reliability
- Protective self turn-on capability for high energy transients
- Safe clamping capability for low energy over-voltage transients
- Sensitive gate for easy logic level triggering
- Surface mountable package
- Triggering in three quadrants only
- Very high immunity to false turn-on by  $dV/dt$

### 3. Applications

- AC fan, pump and compressor controls
- Highly inductive, resistive and safety loads
- Large and small appliances (White Goods)
- Reversing induction motor controls

### 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DRM}$	repetitive peak off-state voltage		-	-	800	V
$I_{TSM}$	non-repetitive peak on-state current	full sine wave; $T_{j(init)} = 25\text{ }^{\circ}\text{C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>	-	-	14	A
$T_j$	junction temperature		-	-	125	$^{\circ}\text{C}$
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{mb} \leq 115\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	-	-	2	A



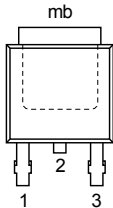
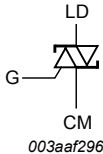
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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>PP</sub>	peak pulse voltage	T <sub>J</sub> = 25 °C; non-repetitive, off-state; <a href="#">Fig. 6</a>	-	-	2	kV
<b>Static characteristics</b>						
I <sub>GT</sub>	gate trigger current	V <sub>D</sub> = 12 V; I <sub>T</sub> = 100 mA; LD+ G+; T <sub>J</sub> = 25 °C; <a href="#">Fig. 8</a>	-	-	10	mA
		V <sub>D</sub> = 12 V; I <sub>T</sub> = 100 mA; LD+ G-; T <sub>J</sub> = 25 °C; <a href="#">Fig. 8</a>	-	-	10	mA
		V <sub>D</sub> = 12 V; I <sub>T</sub> = 100 mA; LD- G-; T <sub>J</sub> = 25 °C; <a href="#">Fig. 8</a>	-	-	10	mA
V <sub>CL</sub>	clamping voltage	I <sub>CL</sub> = 0.1 mA; t <sub>p</sub> = 1 ms; T <sub>J</sub> = 25 °C	850	-	-	V
<b>Dynamic characteristics</b>						
dV <sub>D</sub> /dt	rate of rise of off-state voltage	V <sub>DM</sub> = 536 V; T <sub>J</sub> = 125 °C; (V <sub>DM</sub> = 67% of V <sub>DRM</sub> ); exponential waveform; gate open circuit; <a href="#">Fig. 13</a>	500	-	-	V/μs
di <sub>com</sub> /dt	rate of change of commutating current	V <sub>D</sub> = 400 V; T <sub>J</sub> = 125 °C; I <sub>T(RMS)</sub> = 2 A; dV <sub>com</sub> /dt = 10 V/μs; gate open circuit; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	3	-	-	A/ms

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	CM	common	 <p style="text-align: center;"><b>DPAK (SOT428)</b></p>	 <p style="text-align: center;">003aaf296</p>
2	LD	load		
3	G	gate		
mb	LD	mounting base; load		

## 6. Ordering information

Table 3. Ordering information

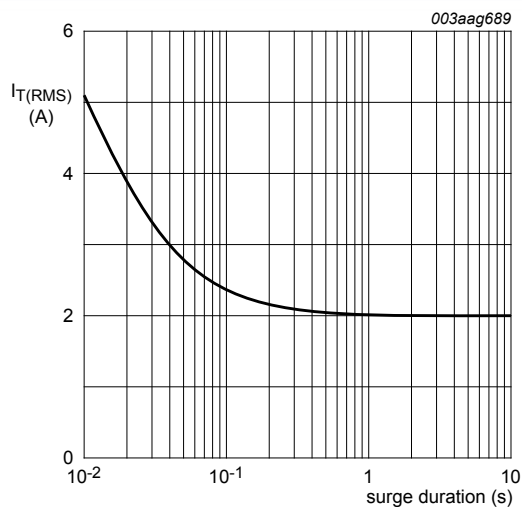
Type number	Package		
	Name	Description	Version
ACTT2S-800E	DPAK	plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped)	SOT428

## 7. Limiting values

**Table 4. Limiting values**

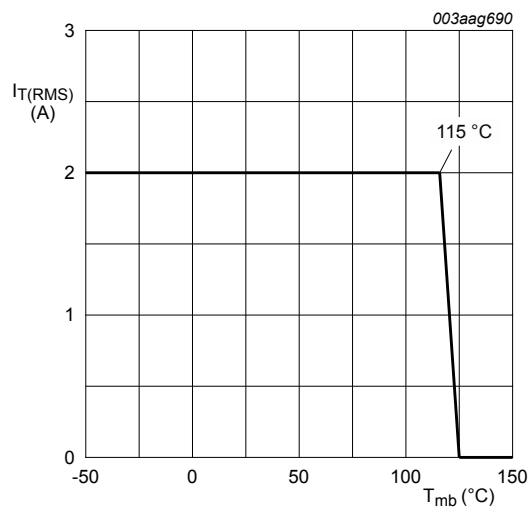
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DRM}$	repetitive peak off-state voltage		-	800	V
$I_{T(RMS)}$	RMS on-state current	full sine wave; $T_{mb} \leq 115\text{ }^\circ\text{C}$ ; <a href="#">Fig. 1</a> ; <a href="#">Fig. 2</a> ; <a href="#">Fig. 3</a>	-	2	A
$I_{TSM}$	non-repetitive peak on-state current	full sine wave; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$ ; $t_p = 16.7\text{ ms}$	-	15.4	A
		full sine wave; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$ ; $t_p = 20\text{ ms}$ ; <a href="#">Fig. 4</a> ; <a href="#">Fig. 5</a>	-	14	A
$I^2t$	$I^2t$ for fusing	$t_p = 10\text{ ms}$ ; sine-wave pulse	-	0.98	$\text{A}^2\text{s}$
$di_T/dt$	rate of rise of on-state current	$I_T = 3\text{ A}$ ; $I_G = 0.2\text{ A}$ ; $di_G/dt = 0.2\text{ A}/\mu\text{s}$	-	100	$\text{A}/\mu\text{s}$
$I_{GM}$	peak gate current	$t = 20\text{ }\mu\text{s}$	-	2	A
$P_{GM}$	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	$^\circ\text{C}$
$T_j$	junction temperature		-	125	$^\circ\text{C}$
$V_{PP}$	peak pulse voltage	$T_j = 25\text{ }^\circ\text{C}$ ; non-repetitive, off-state; <a href="#">Fig. 6</a>	-	2	kV



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

$f = 50\text{ Hz}$ ;  $T_{mb} = 115\text{ }^\circ\text{C}$



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

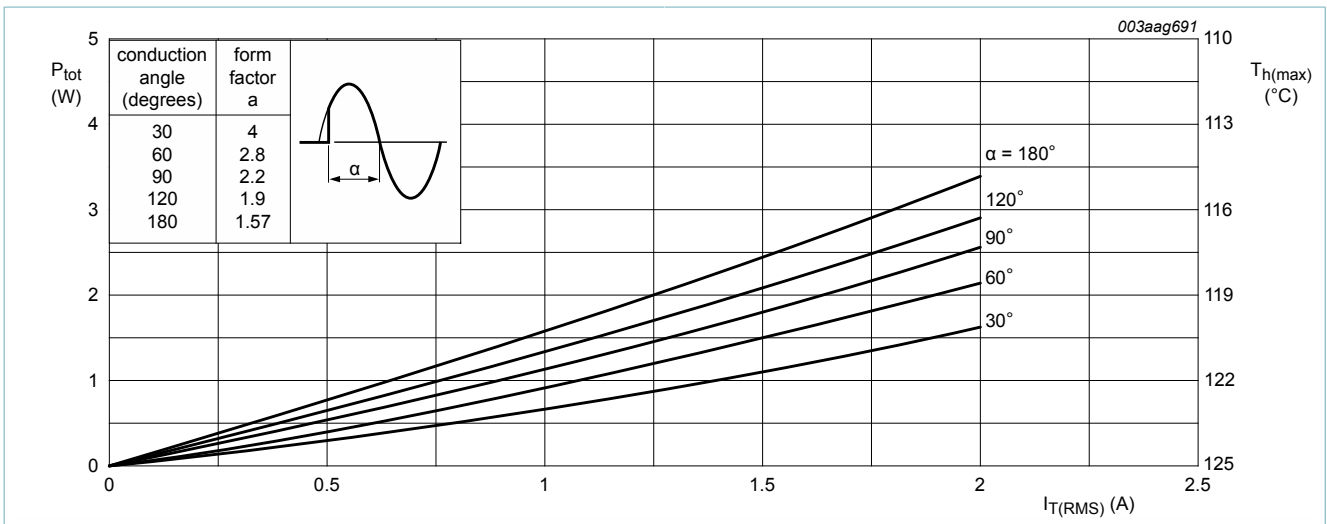


Fig. 3. Total power dissipation as a function of RMS on-state current; maximum values

$\alpha = \text{conduction angle}$   
 $a = \text{form factor} = I_{T(RMS)} / I_{T(AV)}$

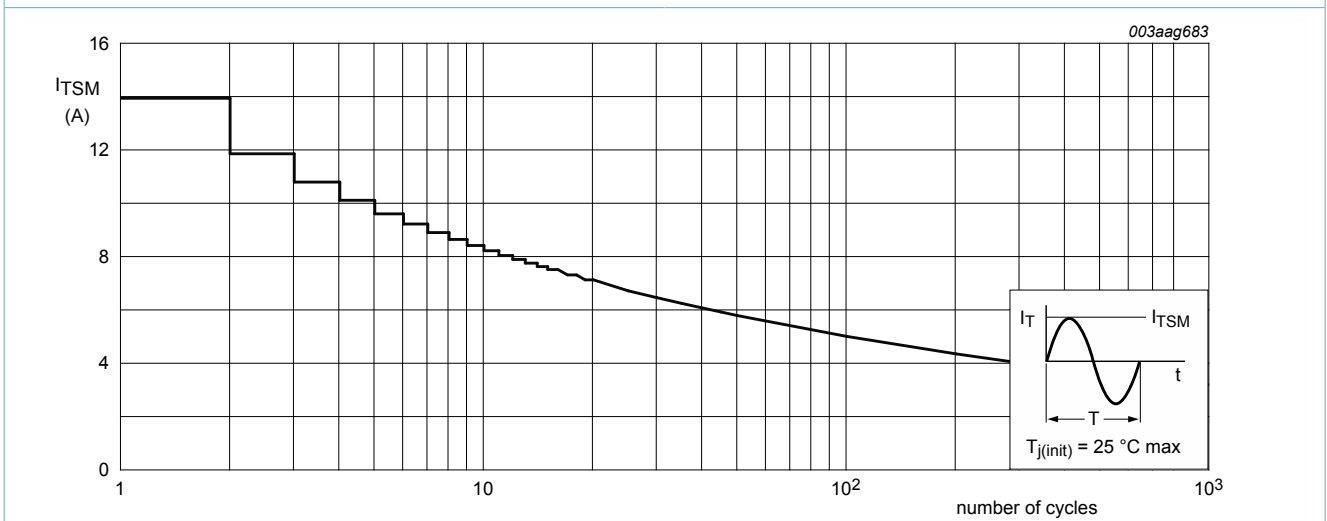


Fig. 4. Non-repetitive peak on-state current as a function of the number of sinusoidal current cycles; maximum values

$f = 50 \text{ Hz}$

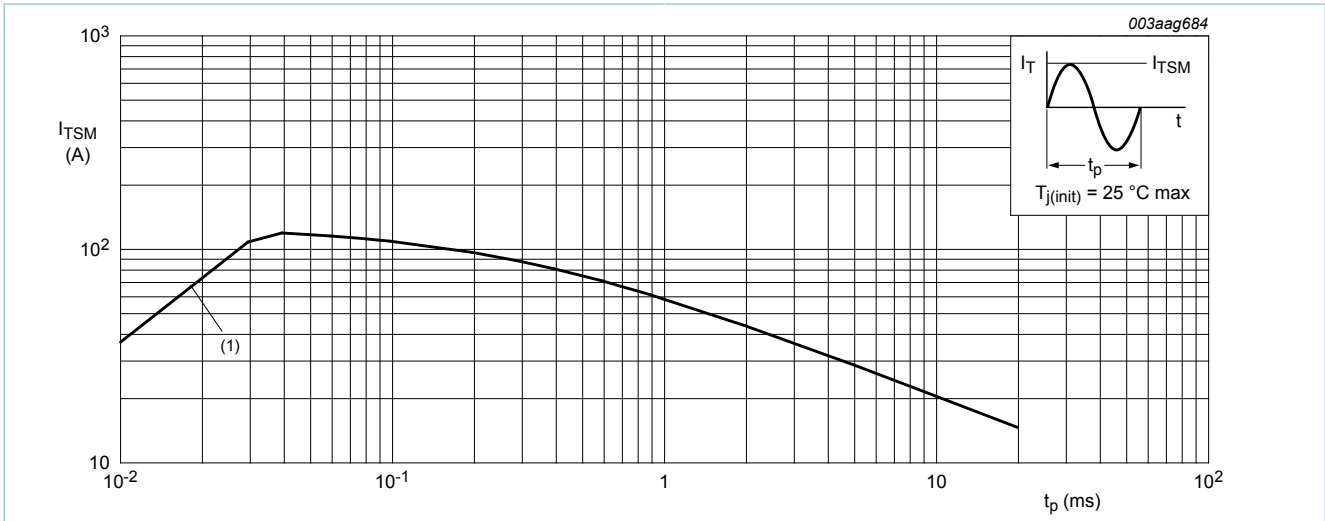


Fig. 5. Non-repetitive peak on-state current as a function of pulse width; maximum values

$t_p \leq 20 \text{ ms}$ ; (1)  $dI_T / dt$  limit

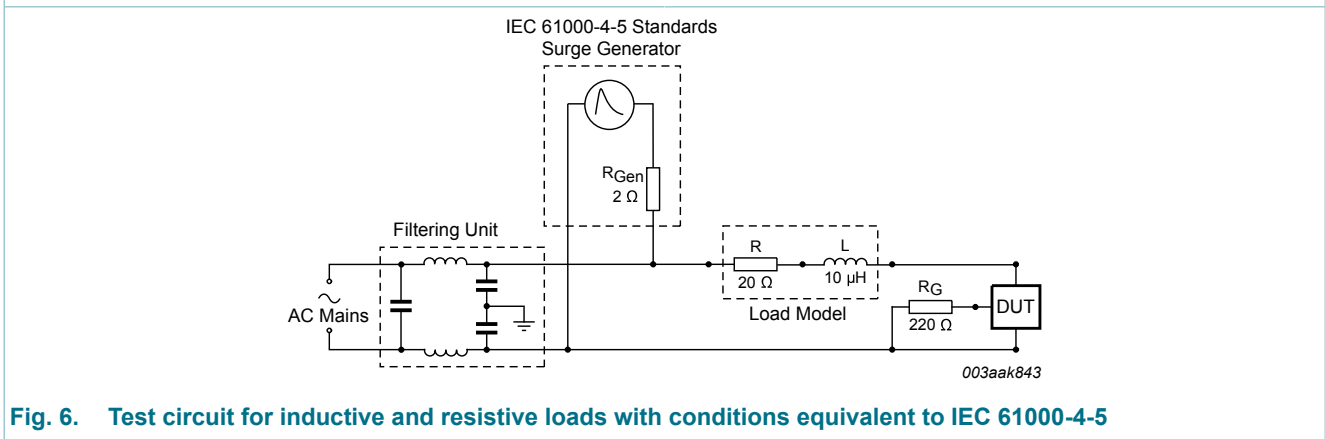
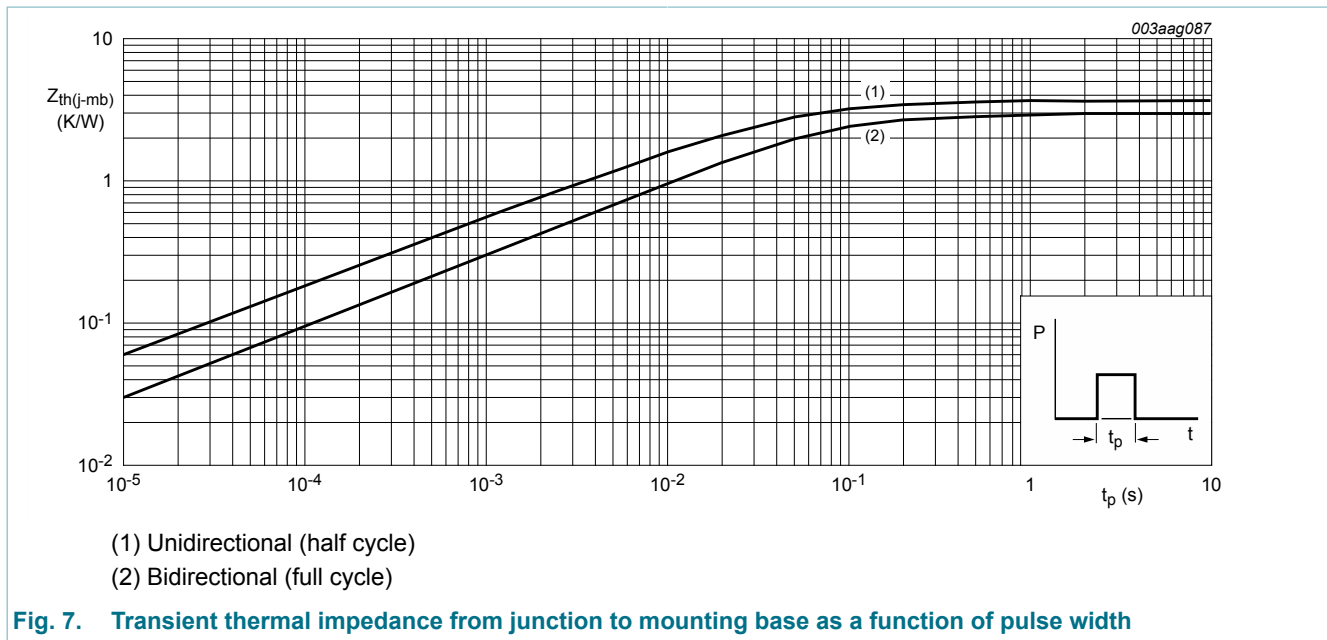


Fig. 6. Test circuit for inductive and resistive loads with conditions equivalent to IEC 61000-4-5

## 8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	full cycle; Fig. 7	-	-	3	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	printed circuit board (FR4) mounted	-	75	-	K/W

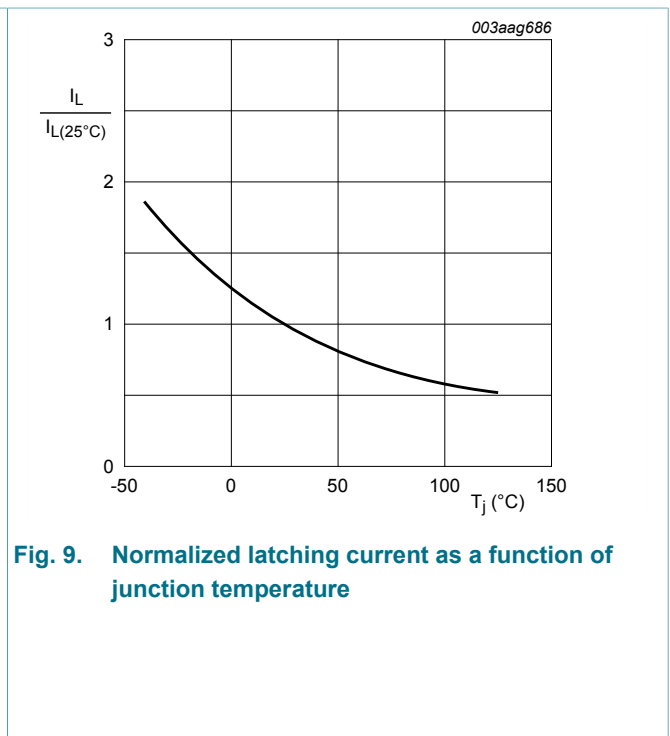
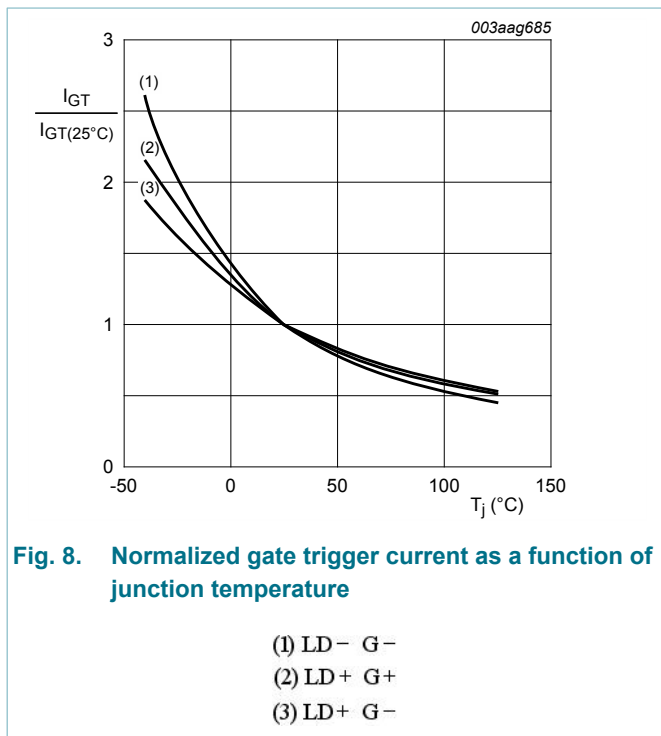


## 9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
I <sub>GT</sub>	gate trigger current	V <sub>D</sub> = 12 V; I <sub>T</sub> = 100 mA; LD+ G+; T <sub>j</sub> = 25 °C; <a href="#">Fig. 8</a>	-	-	10	mA
		V <sub>D</sub> = 12 V; I <sub>T</sub> = 100 mA; LD+ G-; T <sub>j</sub> = 25 °C; <a href="#">Fig. 8</a>	-	-	10	mA
		V <sub>D</sub> = 12 V; I <sub>T</sub> = 100 mA; LD- G-; T <sub>j</sub> = 25 °C; <a href="#">Fig. 8</a>	-	-	10	mA
I <sub>L</sub>	latching current	V <sub>D</sub> = 12 V; I <sub>G</sub> = 100 mA; LD+ G+; T <sub>j</sub> = 25 °C; <a href="#">Fig. 9</a>	-	-	25	mA
		V <sub>D</sub> = 12 V; I <sub>G</sub> = 100 mA; LD+ G-; T <sub>j</sub> = 25 °C; <a href="#">Fig. 9</a>	-	-	30	mA
		V <sub>D</sub> = 12 V; I <sub>G</sub> = 100 mA; LD- G-; T <sub>j</sub> = 25 °C; <a href="#">Fig. 9</a>	-	-	25	mA
I <sub>H</sub>	holding current	V <sub>D</sub> = 12 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 10</a>	-	-	25	mA
V <sub>T</sub>	on-state voltage	I <sub>T</sub> = 3 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 11</a>	-	-	2	V
V <sub>GT</sub>	gate trigger voltage	V <sub>D</sub> = 12 V; I <sub>T</sub> = 100 mA; T <sub>j</sub> = 25 °C; <a href="#">Fig. 12</a>	-	0.8	1	V
		V <sub>D</sub> = 400 V; I <sub>T</sub> = 100 mA; T <sub>j</sub> = 125 °C; <a href="#">Fig. 12</a>	0.2	0.45	-	V
I <sub>D</sub>	off-state current	V <sub>D</sub> = 800 V; T <sub>j</sub> = 25 °C	-	-	10	μA

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		$V_D = 800\text{ V}; T_j = 125\text{ }^\circ\text{C}$	-	-	0.5	mA
$V_{CL}$	clamping voltage	$I_{CL} = 0.1\text{ mA}; t_p = 1\text{ ms}; T_j = 25\text{ }^\circ\text{C}$	850	-	-	V
<b>Dynamic characteristics</b>						
$dV_D/dt$	rate of rise of off-state voltage	$V_{DM} = 536\text{ V}; T_j = 125\text{ }^\circ\text{C}; (V_{DM} = 67\% \text{ of } V_{DRM});$ exponential waveform; gate open circuit; <a href="#">Fig. 13</a>	500	-	-	V/ $\mu$ s
$dI_{com}/dt$	rate of change of commutating current	$V_D = 400\text{ V}; T_j = 125\text{ }^\circ\text{C}; I_{T(RMS)} = 2\text{ A};$ $dV_{com}/dt = 10\text{ V}/\mu\text{s};$ gate open circuit; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	3	-	-	A/ms





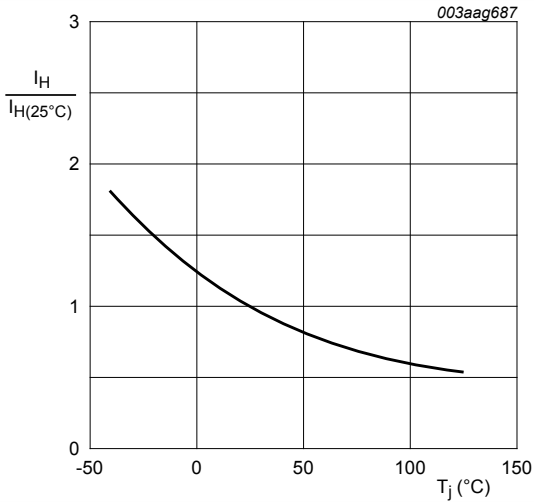


Fig. 10. Normalized holding current as a function of junction temperature

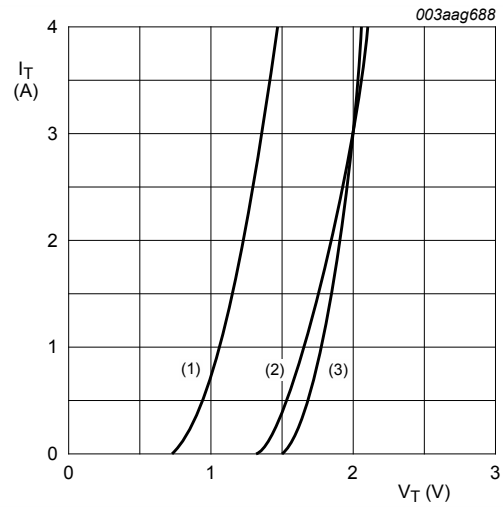


Fig. 11. On-state current as a function of on-state voltage

$V_O = 1.612 \text{ V}; R_S = 0.120 \Omega;$   
 (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

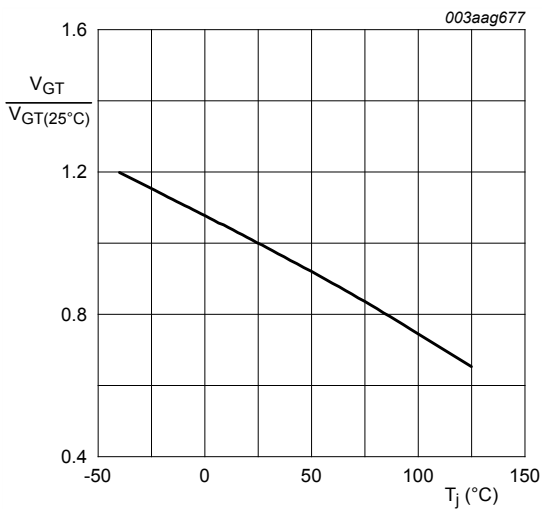


Fig. 12. Normalized gate trigger voltage as a function of junction temperature

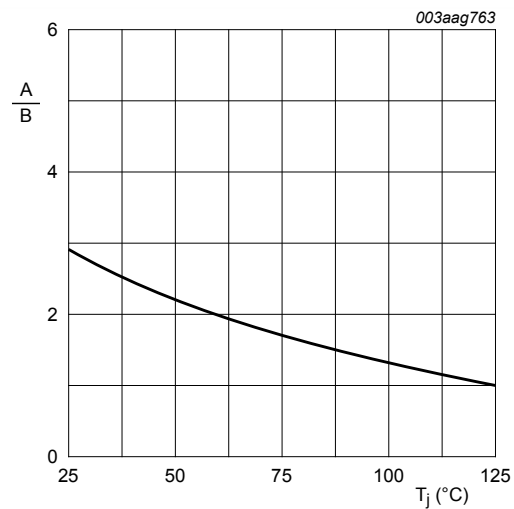
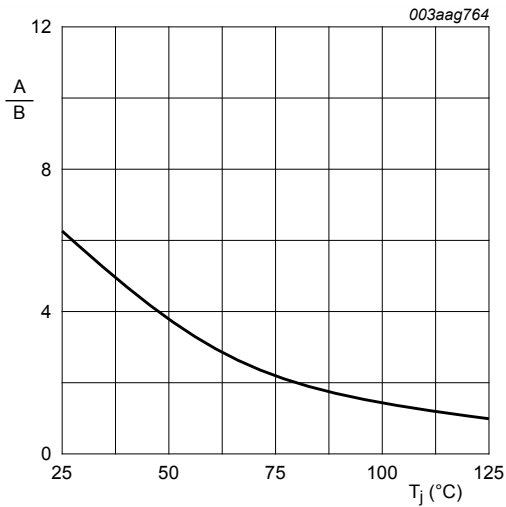


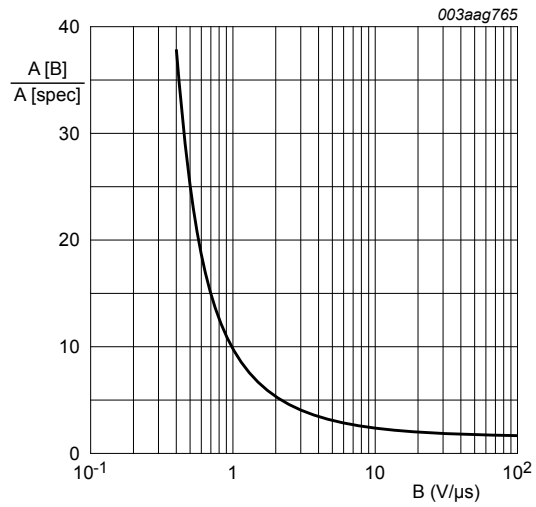
Fig. 13. Normalized rate of rise of off-state voltage as a function of junction temperature

A is  $dV_D/dt$  at condition  $T_j \text{ }^\circ\text{C}$   
 B is  $dV_D/dt$  at condition  $T_j 125 \text{ }^\circ\text{C}$



**Fig. 14. Normalized critical rate of rise of commutating current as a function of junction temperature**

A is  $dI_{com}/dt$  at condition  $T_j$  °C  
 B is  $dI_{com}/dt$  at condition  $T_j$  125 °C  
 $V_D = 400$  V



**Fig. 15. Normalized critical rate of change of commutating current as a function of critical rate of change of commutating voltage; minimum values**

A[B] is  $dI_{com}/dt$  at condition B,  $dV_{com}/dt$   
 A[spec] is the specified data sheet value of  $dI_{com}/dt$   
 turn-off time less than 20 ms

### 10. Package outline

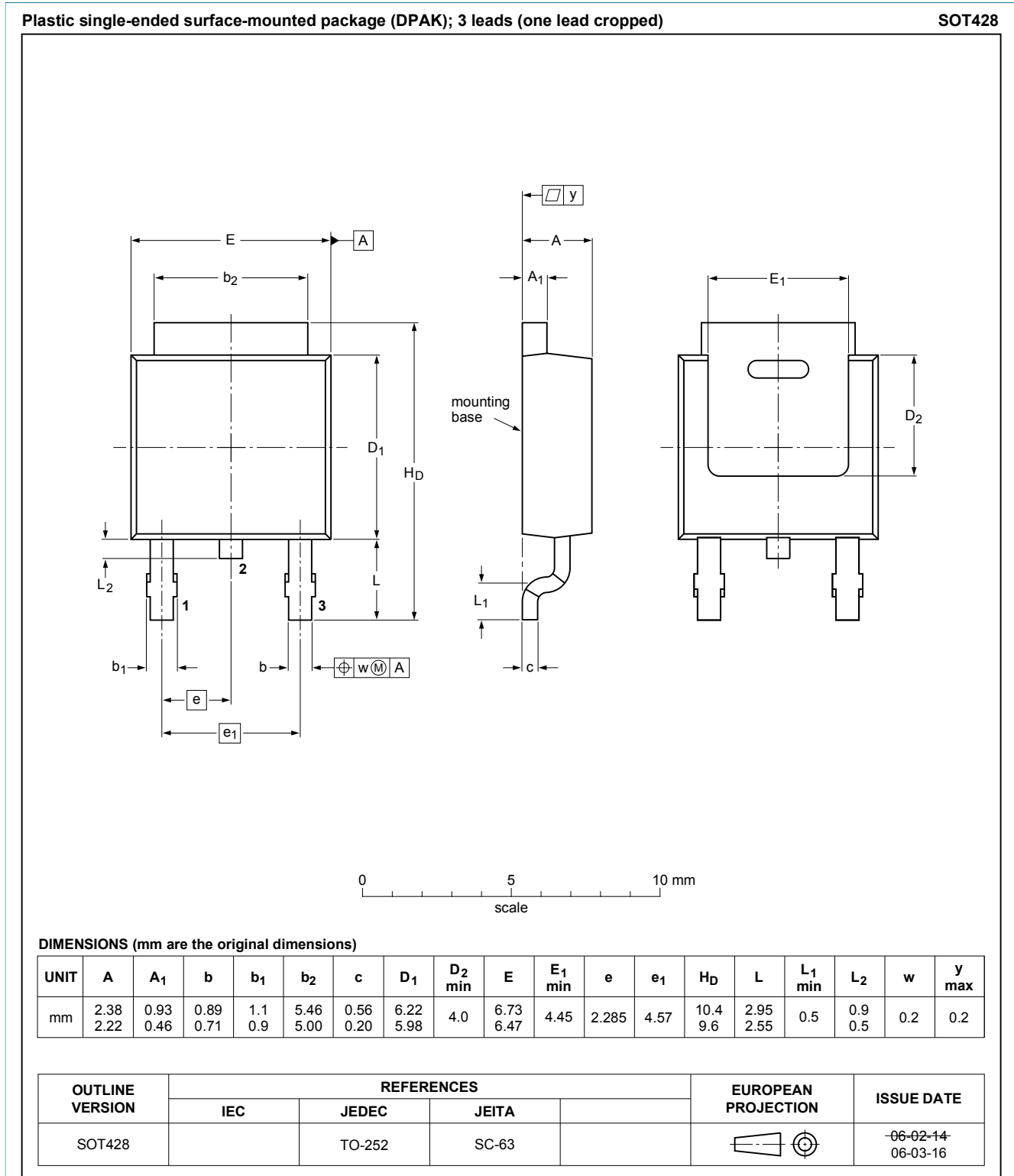


Fig. 16. Package outline DPAK (SOT428)

## 11. Soldering

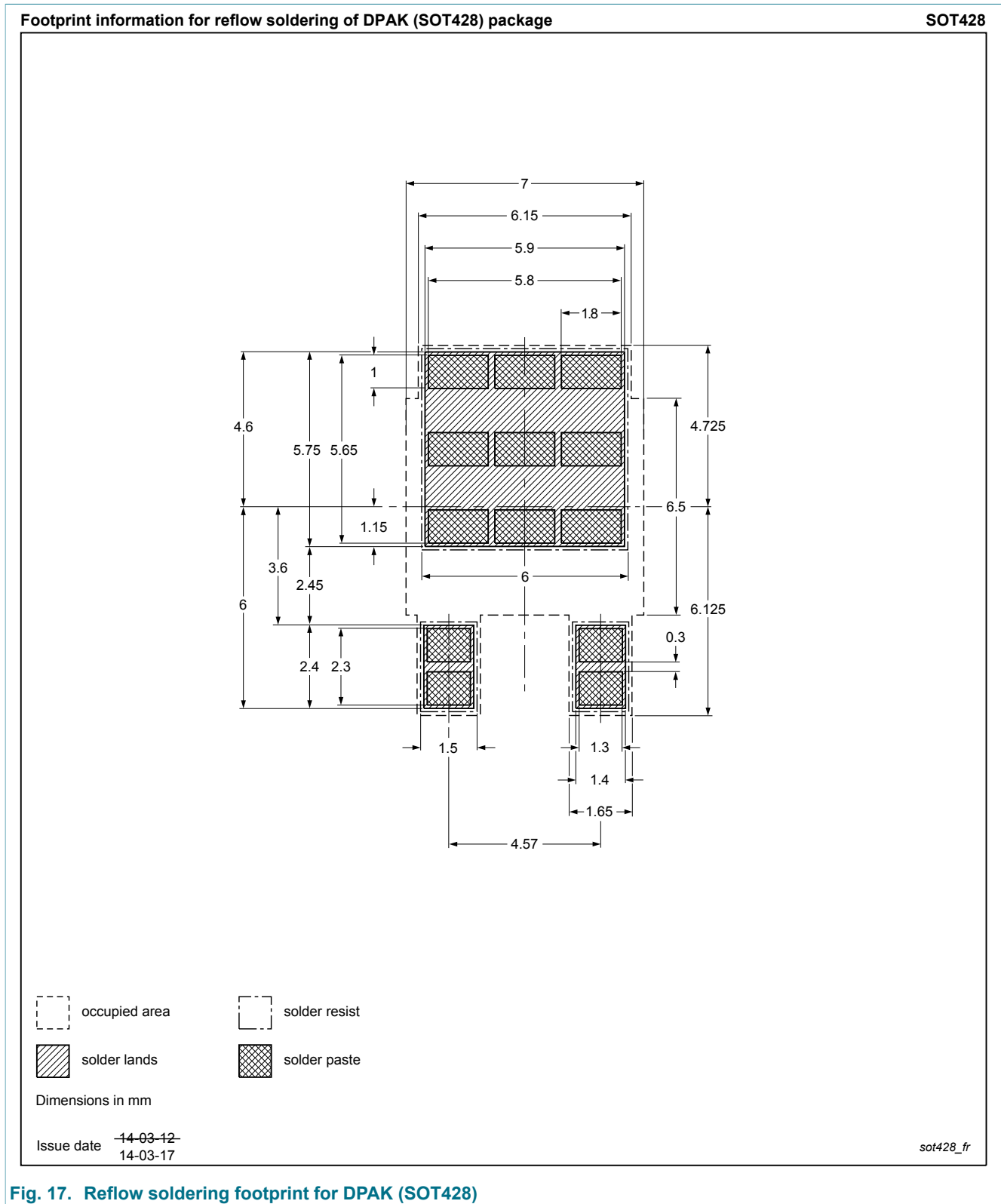


Fig. 17. Reflow soldering footprint for DPAK (SOT428)

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### 13. Contents

1	General description .....	1
2	Features and benefits .....	1
3	Applications .....	1
4	Quick reference data .....	1
5	Pinning information .....	2
6	Ordering information .....	2
7	Limiting values .....	3
8	Thermal characteristics .....	5
9	Characteristics .....	6
10	Package outline .....	10
11	Soldering .....	11
12	Legal information .....	12
12.1	Data sheet status .....	12
12.2	Definitions .....	12
12.3	Disclaimers .....	12
12.4	Trademarks .....	13

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