



## ACST2 Series

### AC Switch family Alternating current switch

#### Main features

Symbol	Value	Unit
$I_{T(RMS)}$	2	A
$V_{DRM}/V_{RRM}$	800	V
$I_{GT}$	10	mA

- Overvoltage crowbar technology
- High noise immunity: static  $dV/dt > 500 \text{ V}/\mu\text{s}$

The ACST2-8SFP in the TO-220FPAB package provides insulation voltage rated at  $1500V_{RMS}$

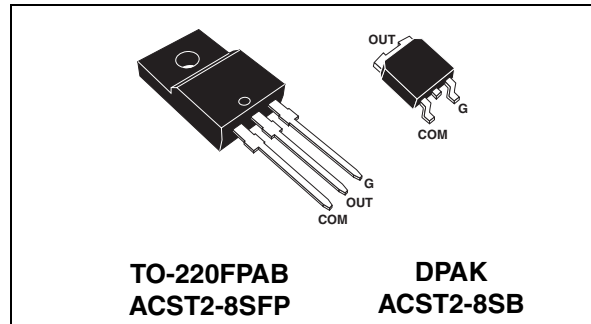
#### Main application

- AC ON/OFF static switching in appliances & industrial control systems
- Drive of low power highly resistive or inductive loads like:
  - solenoid,
  - pump, fan, micro-motor

#### Description

The ACST2 series belongs to the AC power switch family built around the ASD technology. This high performance device is adapted to home appliances or industrial systems and drives loads up to 2 A.

This ACST2 switch embeds a Triac structure with a high voltage clamping device to absorb the inductive turn-off energy and withstand line transients such as those described in the IEC 61000-4-5 standards. The component needs a low gate current to be activated ( $I_{GT} < 10 \text{ mA}$ ) and in the mean time provides a high electrical noise immunity such as those described in the IEC 61000-4-4 standards.



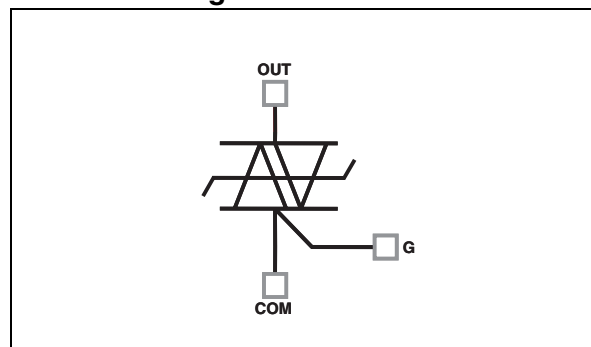
#### Benefits

- Enables equipment to meet IEC 61000-4-5
- High off-state reliability with planar technology
- Needs no external overvoltage protection
- Reduces component count
- Interfaces directly with the micro-controller
- High immunity against fast transients described in IEC 61000-4-4 standards

#### Order code

Part number	Marking
ACST2-8SFP	ACST28S
ACST2-8SB	ACST28S

#### Functional diagram



# 1 Characteristics

**Table 1. Absolute maximum ratings (limiting values)**

Symbol	Parameter		Value	Unit	
$I_{T(RMS)}$	RMS on-state current (full sine wave)	TO-220FPAB	$T_c = 105^\circ C$	2	A
		DPAK	$T_c = 110^\circ C$		
$I_{TSM}$	Non repetitive surge peak on-state current (full cycle sine wave, $T_j$ initial = $25^\circ C$ )	F = 60 Hz	t = 16.7 ms	8.4	A
		F = 50 Hz	t = 20 ms	8.0	
$I^2t$	$I^2t$ Value for fusing	$t_p = 10$ ms		0.5	$A^2s$
di/dt	Critical rate of rise of on-state current $I_G = 2 \times I_{GT}$ , $t_r = 100$ ns	F = 120 Hz	$T_j = 125^\circ C$	50	$A/\mu s$
$V_{PP}^{(1)}$	Non repetitive line peak mains voltage <sup>(1)</sup>		$T_j = 25^\circ C$	2	kV
$P_{G(AV)}$	Average gate power dissipation		$T_j = 125^\circ C$	0.1	W
$P_{GM}$	Peak gate power dissipation ( $t_p = 20 \mu s$ )		$T_j = 125^\circ C$	10	W
$I_{GM}$	Peak gate current ( $t_p = 20 \mu s$ )		$T_j = 125^\circ C$	1.6	A
$T_{stg}$ $T_j$	Storage junction temperature range Operating junction temperature range			-40 to +150 -40 to +125	$^\circ C$
$T_l$	Maximum lead soldering temperature during 10 s (at 3 mm from plastic case)			260	$^\circ C$

1. according to test described by IEC 61000-4-5 standard and [Figure 16](#)

**Table 2. Electrical characteristics ( $T_j = 25^\circ C$ , unless otherwise specified)**

Symbol	Test conditions	Quadrant		Value	Unit
$I_{GT}^{(1)}$	$V_{OUT} = 12 V$ $R_L = 33 \Omega$	I - II - III	MAX	10	mA
$V_{GT}$	$V_{OUT} = 12 V$ $R_L = 33 \Omega$	I - II - III	MAX	1.1	V
$V_{GD}$	$V_{OUT} = V_{DRM}$ $R_L = 3.3 k\Omega$ $T_j = 125^\circ C$	I - II - III	MIN	0.2	V
$I_H^{(2)}$	$I_{OUT} = 100$ mA		MAX	10	mA
$I_L$	$I_G = 1.2 \times I_{GT}$	I - III	MAX	25	mA
		II	MAX	35	
dV/dt <sup>(2)</sup>	$V_{OUT} = 67\% V_{DRM}$ gate open $T_j = 125^\circ C$		MIN	500	$V/\mu s$
(di/dt) <sub>c</sub> <sup>(2)</sup>	$(dV/dt)_c = 15 V/\mu s$ $T_j = 125^\circ C$		MIN	0.5	$A/ms$
$V_{CL}$	$I_{CL} = 0.1$ mA $t_p = 1$ ms $T_j = 25^\circ C$		MIN	850	V

1. minimum  $I_{GT}$  is guaranteed at 5% of  $I_{GT}$  max

2. for both polarity of OUT pin referenced to COM pin

**Table 3. Static electrical characteristics**

Symbol	Test conditions			Value	Unit
$V_{TM}^{(1)}$	$I_{TM} = 2.8 \text{ A } t_p = 500 \mu\text{s}$	$T_j = 25^\circ \text{ C}$	MAX	2	V
$V_{TO}^{(1)}$	Threshold voltage	$T_j = 125^\circ \text{ C}$	MAX	0.9	V
$R_D^{(1)}$	Dynamic resistance	$T_j = 125^\circ \text{ C}$	MAX	250	mΩ
$I_{DRM}$ $I_{RRM}$	$V_{OUT} = V_{DRM} / V_{RRM}$	$T_j = 25^\circ \text{ C}$	MAX	10	μA
		$T_j = 125^\circ \text{ C}$		0.5	mA

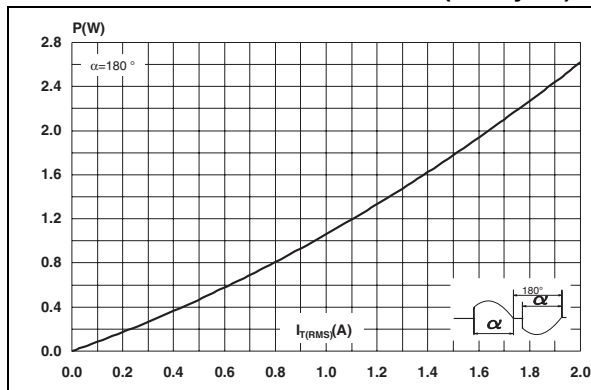
1. for both polarity of OUT pin referenced to COM pin

**Table 4. Thermal resistances**

Symbol	Parameter		Value	Unit
$R_{th(j-c)}$	Junction to case (AC)	DPAK	4.5	° C/W
		TO-220FPAB	7	
$R_{th(j-a)}$	Junction to ambient	TO-220FPAB	60	
		$S_{CU}^{(1)} = 0.5 \text{ cm}^2$ DPAK	70	

1.  $S_{CU}$  = copper surface under tab

**Figure 1. Maximum power dissipation versus RMS on-state current (full cycle)**



**Figure 2. RMS on-state current versus case temperature**

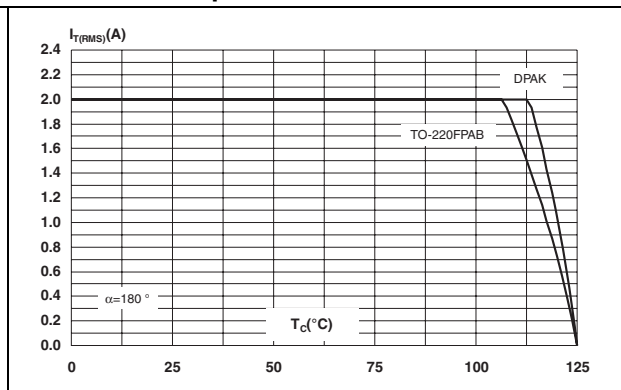


Figure 3. RMS on-state current versus ambient temperature

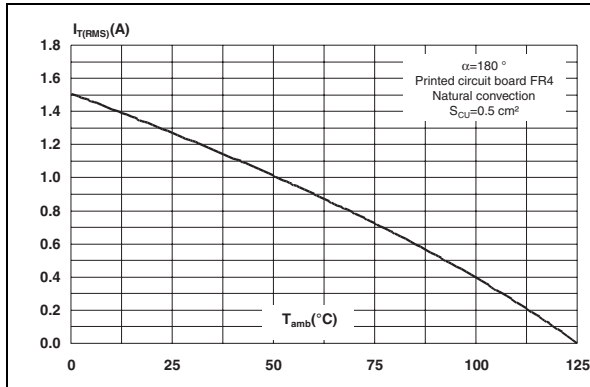


Figure 4. Relative variation of thermal impedance versus pulse duration - TO-220FPAB

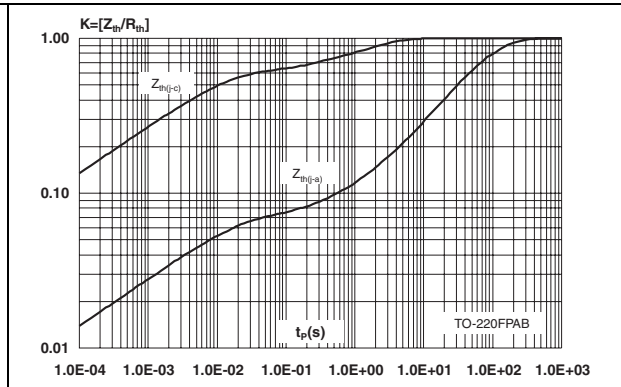


Figure 5. Relative variation of thermal impedance versus pulse duration - DPAK

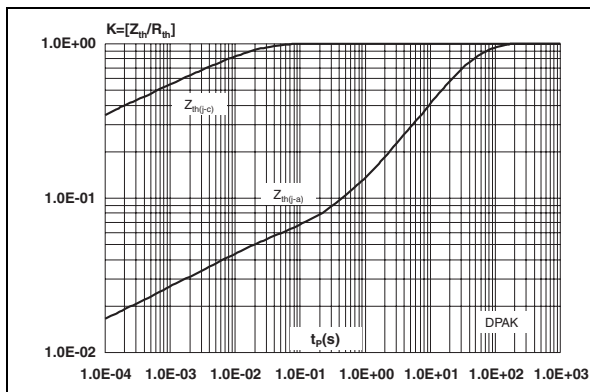


Figure 6. Relative variation of gate trigger current  $I_{GT}$ , holding current  $I_H$  and latching current  $I_L$  versus junction temperature (typical values)

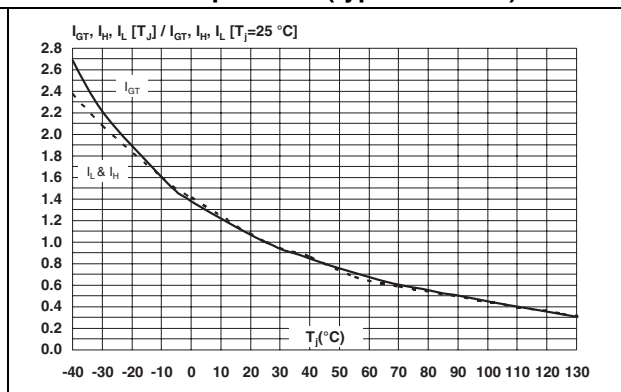


Figure 7. Relative variation of static  $dV/dt$  versus junction temperature

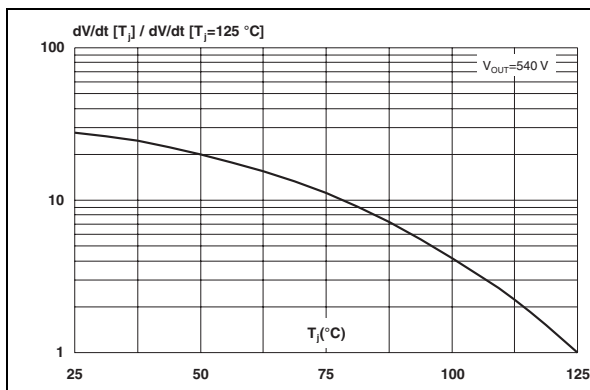
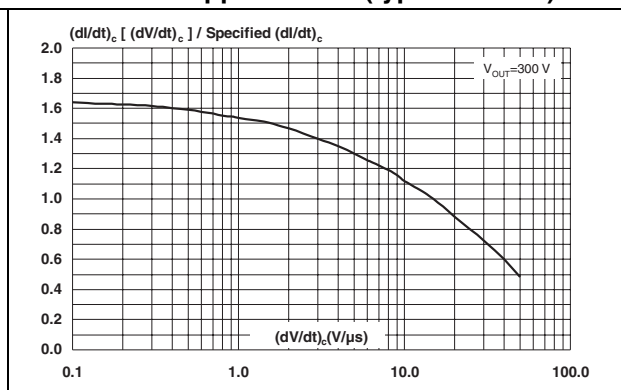
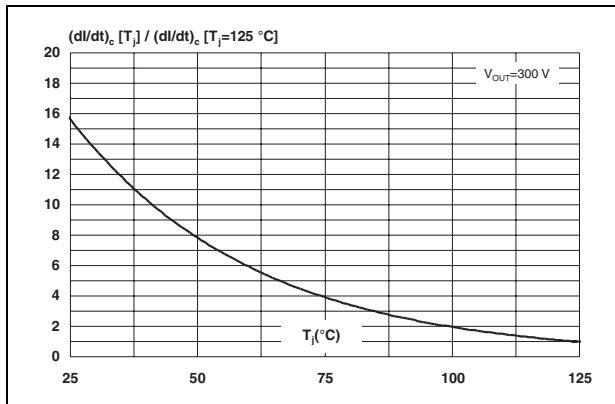


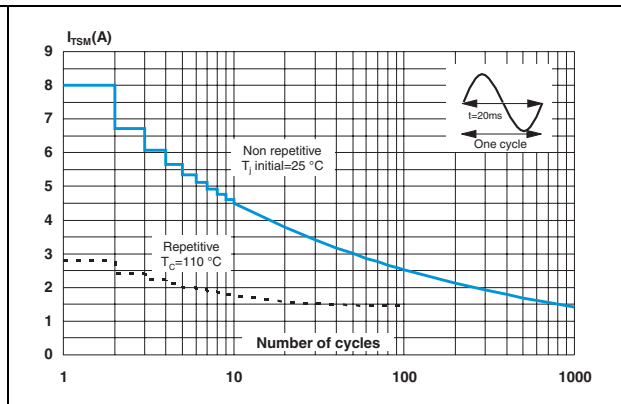
Figure 8. Relative variation of critical rate of decrease of main current versus reapplied  $dV/dt$  (typical values)



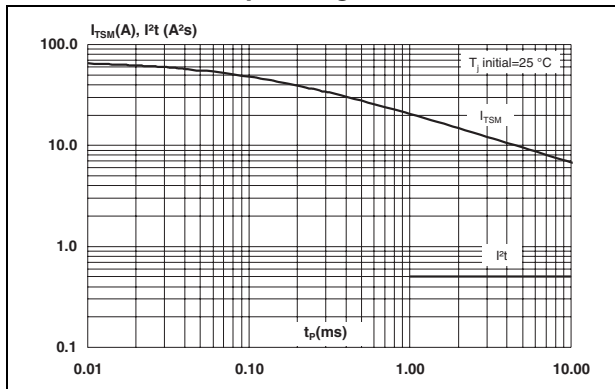
**Figure 9. Relative variation of critical rate of decrease of main current versus junction temperature**



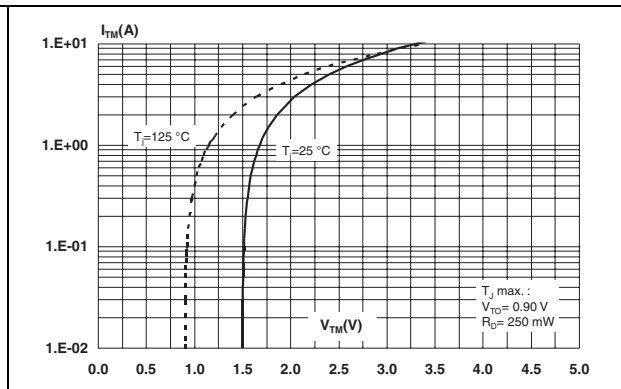
**Figure 10. Surge peak on-state current versus number of cycles**



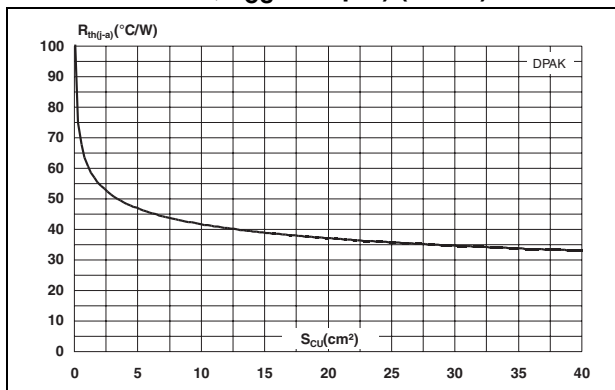
**Figure 11. Non repetitive surge peak on-state current for a sinusoidal pulse with width  $t_p < 10\text{ ms}$ , and corresponding value of  $I^2t$**



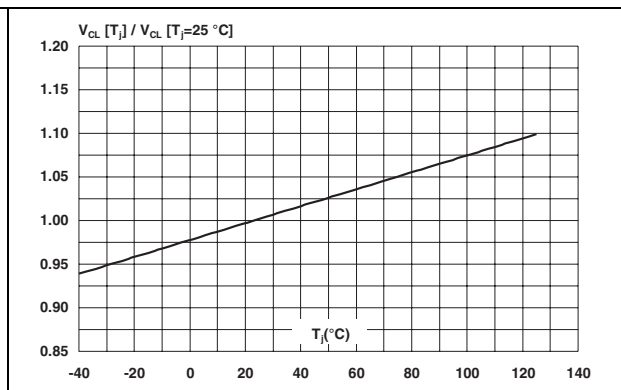
**Figure 12. On-state characteristics (maximum values)**



**Figure 13. Thermal resistance junction to ambient versus copper surface under tab (printed circuit board FR4,  $e_{CU} = 35\text{ }\mu\text{m}$ ) (DPAK)**



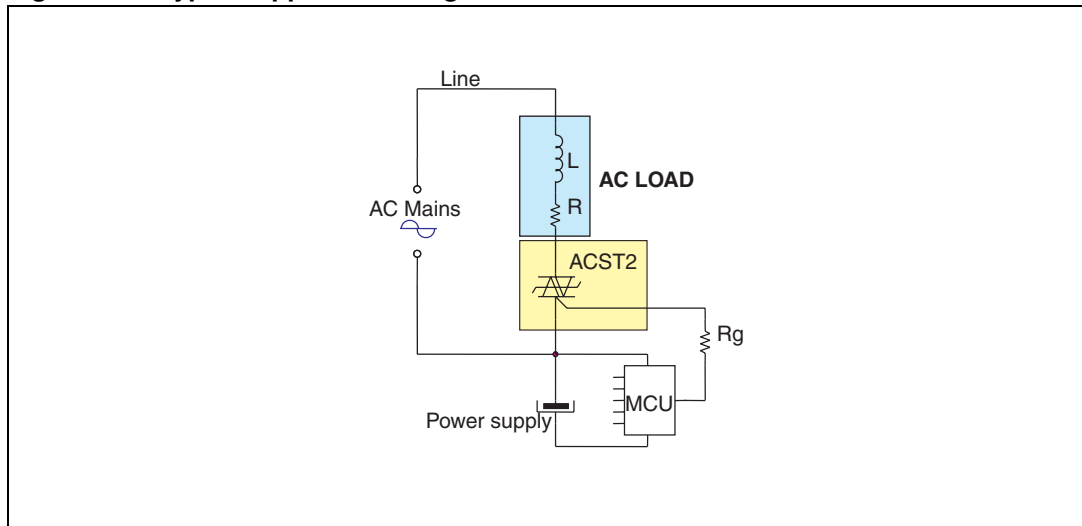
**Figure 14. Relative variation of clamping voltage  $V_{CL}$  versus junction temperature**



## 2 AC line switch basic application

The ACST2 device has been designed to switch on and off highly inductive or resistive loads such as pump, valve, fan, or bulb lamp. Thanks to its high sensitivity ( $I_{GT} \text{ max} = 10 \text{ mA}$ ), the ACST2 can be driven directly by logic level circuits through a resistor as shown on the typical application diagram. Thanks to its thermal and turn-off commutation performances, the ACST2 switch can drive, without any additional snubber, an inductive load up to 2 A.

**Figure 15. Typical application diagram**



### 2.1 Protection against overvoltage: the best choice is ACST

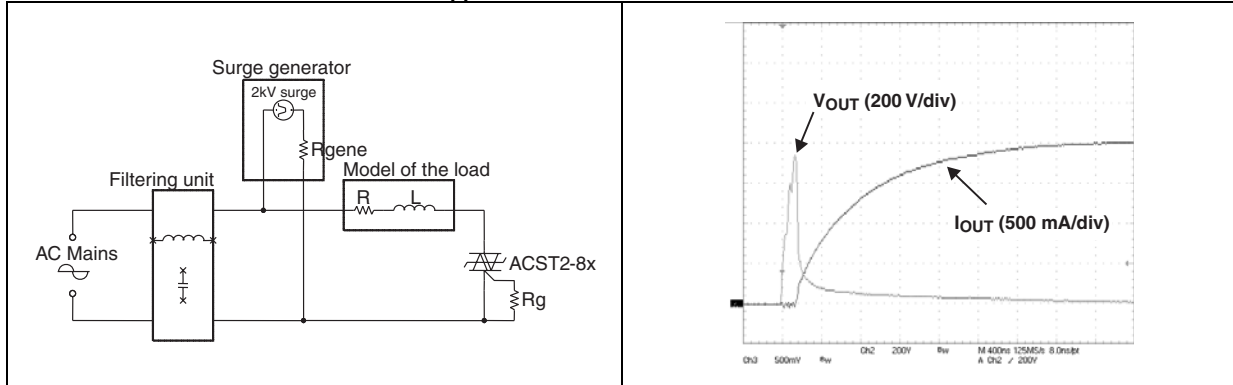
In comparison with standard triacs, which are not robust against surge voltages, the ACST2 is over-voltage self-protected, specified by the new parameter  $V_{CL}$ . In addition, ACST2 is a sensitive device ( $I_{GT} = 10 \text{ mA}$ ), but provides a high noise immunity level against fast transients.

The ACST2 switch is able to sustain safely the AC line transient voltages either by clamping the low energy spikes or by breaking over under high energy shocks, even with fast turn-on current rises.

The test circuit of the [Figure 16](#) is representative of the final ACST2 application, and is also used to stress the ACST switch according to the IEC 61000-4-5 standard conditions. Thanks to the load limiting the current, the ACST switch sustains the voltage spikes up to 2 kV above the peak line voltage. The protection is based on an overvoltage crowbar technology. Actually, the ACST2 will break over safely as shown on [Figure 17](#). The ACST is recovering its blocking voltage capability at the next zero current crossing point. Such non repetitive test can be done 10 times on each AC line voltage polarity.

**Figure 16. Overvoltage ruggedness test circuit** according to IEC 61000-4-5 standards:  
 $R = 200 \Omega$ ,  $L = 10 \mu\text{H}$ ,  $V_{pp} = 2 \text{ kV}$

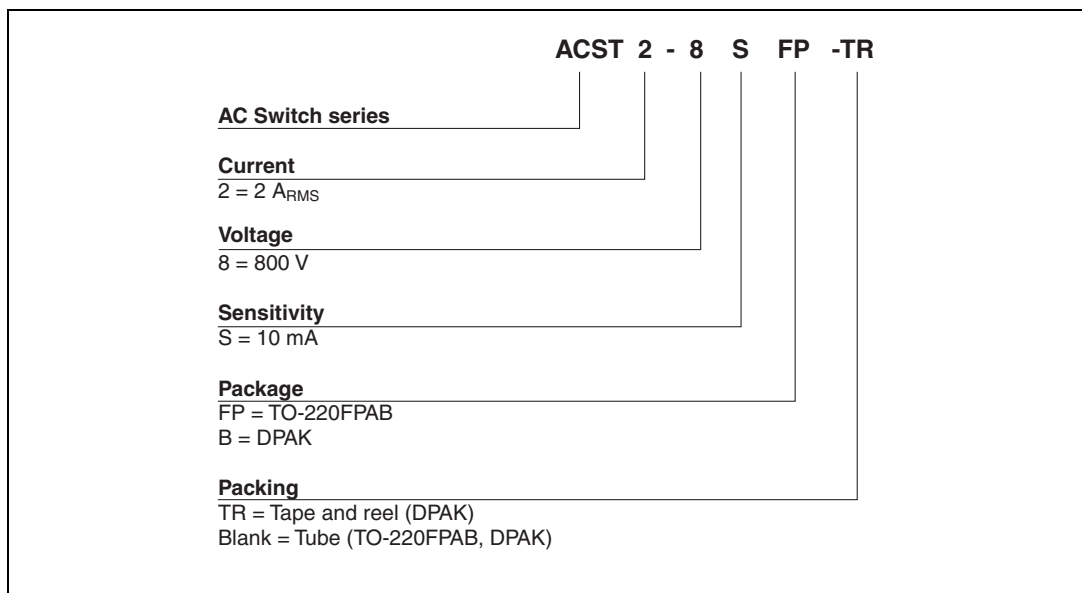
**Figure 17. Typical current and voltage waveforms across the ACST2** during IEC 61000-4-5 standard test



## 2.2 Electrical noise immunity

Even if the ACST2 is a sensitive device ( $I_{GT} = 10 \text{ mA}$ ) and can be controlled directly through a simple resistor by a logic level circuit, it provides a high electrical noise immunity. The intrinsic immunity of the ACST2 is shown by the specified  $dV/dt$  equal to  $500 \text{ V}/\mu\text{s}$  @  $125^\circ \text{ C}$ . This immunity level is 5 to 10 times higher than the immunity provided by an equivalent standard technology triac with the same sensitivity. In other words, ACST2 is sensitive, but has an immunity reaching the one provided by non-sensitive device ( $I_{GT}$  higher than  $35 \text{ mA}$ ).

## 3 Ordering information scheme

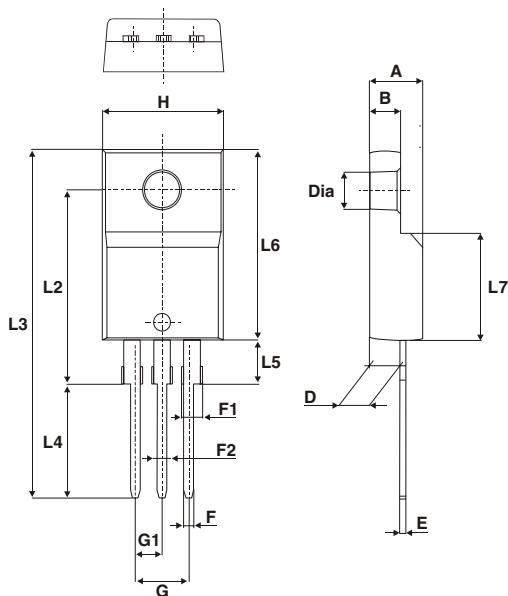


# 4 Package information

- Epoxy meets UL94, V0

**Table 5. TO-220FPAB dimensions**

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.4	4.6	0.173	0.181
B	2.5	2.7	0.098	0.106
D	2.5	2.75	0.098	0.108
E	0.45	0.70	0.018	0.027
F	0.75	1	0.030	0.039
F1	1.15	1.70	0.045	0.067
F2	1.15	1.70	0.045	0.067
G	4.95	5.20	0.195	0.205
G1	2.4	2.7	0.094	0.106
H	10	10.4	0.393	0.409
L2	16 Typ.		0.63 Typ.	
L3	28.6	30.6	1.126	1.205
L4	9.8	10.6	0.386	0.417
L5	2.9	3.6	0.114	0.142
L6	15.9	16.4	0.626	0.646
L7	9.00	9.30	0.354	0.366
Dia.	3.00	3.20	0.118	0.126

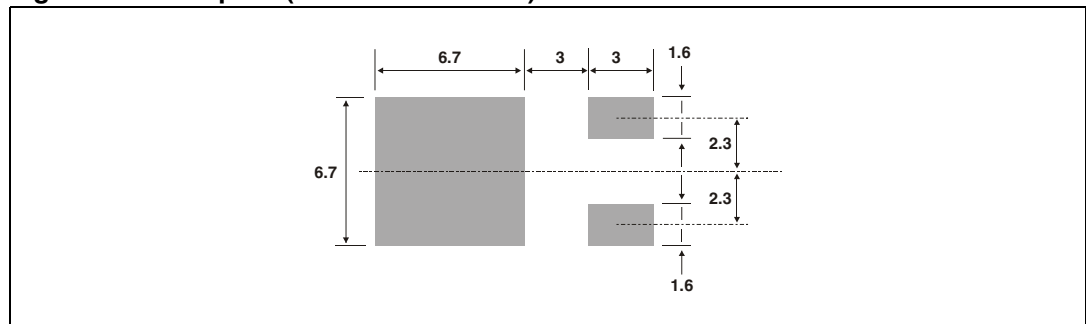




**Table 6. DPAK dimensions**

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	2.20	2.40	0.086	0.094
A1	0.90	1.10	0.035	0.043
A2	0.03	0.23	0.001	0.009
B	0.64	0.90	0.025	0.035
B2	5.20	5.40	0.204	0.212
C	0.45	0.60	0.017	0.023
C2	0.48	0.60	0.018	0.023
D	6.00	6.20	0.236	0.244
E	6.40	6.60	0.251	0.259
G	4.40	4.60	0.173	0.181
H	9.35	10.10	0.368	0.397
L2	0.80 typ.		0.031 typ.	
L4	0.60	1.00	0.023	0.039
V2	0°	8°	0°	8°

**Figure 18. Footprint (dimensions in mm)**



In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com).

## 5 Ordering information

Part number	Marking	Package	Weight	Base Qty	Packing mode
ACST2-8SFP	ACST28S	TO-220FPAB	2.4g	50	Tube
ACST2-8SB	ACST28S	DPAK	0.3g	50	Tube
ACST2-8SB-TR	ACST28S	DPAK	0.3g	2500	Tape and Reel

## 6 Revision history

Date	Revision	Changes
01-Mar-2007	1	Initial release.

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