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 V/µs

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

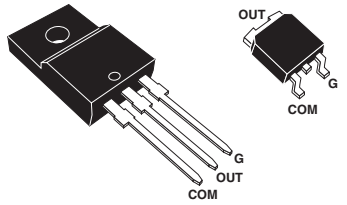
Main application

- 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 mA) and in the mean time provides a high electrical noise immunity such as those described in the IEC 61000-4-4 standards.



TO-220FPAB
ACST2-8SFP

DPAK
ACST2-8SB

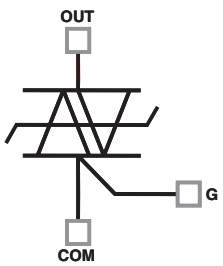
Benefits

- 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° C	2	A
		DPAK	T_c = 110 °C		
I_{TSM}	Non repetitive surge peak on-state current (full cycle sine wave, T_J initial = 25° 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 x I_{GT}, t_r = 100 ns	F = 120 Hz	Tj = 125° C	50	A/µs
V_{PP} (1)	Non repetitive line peak mains voltage (1)		Tj = 25° C	2	kV
$P_{G(AV)}$	Average gate power dissipation		Tj = 125° C	0.1	W
P_{GM}	Peak gate power dissipation (t_p = 20 µs)		Tj = 125° C	10	W
I_{GM}	Peak gate current (t_p = 20 µs)		Tj = 125° C	1.6	A
T_{stg} T_j	Storage junction temperature range Operating junction temperature range			-40 to +150 -40 to +125	° C
T_l	Maximum lead soldering temperature during 10 s (at 3 mm from plastic case)			260	° C

1. according to test described by IEC 61000-4-5 standard and *Figure 16*

Table 2. Electrical characteristics (T_j = 25° C, unless otherwise specified)

Symbol	Test conditions	Quadrant		Value	Unit
I_{GT} (1)	V_{OUT} = 12 V R_L = 33 Ω	I - II - III	MAX	10	mA
V_{GT}	V_{OUT} = 12 V R_L = 33 Ω	I - II - III	MAX	1.1	V
V_{GD}	V_{OUT} = V_{DRM} R_L = 3.3 kΩ T_j = 125° C	I - II - III	MIN	0.2	V
I_H (2)	I_{OUT} = 100 mA		MAX	10	mA
I_L	I_G = 1.2 x I_{GT}	I - III	MAX	25	mA
		II	MAX	35	
dV/dt (2)	V_{OUT} = 67% V_{DRM} gate open T_j = 125° C		MIN	500	V/µs
(dI/dt)c (2)	(dV/dt)c = 15 V/µs T_j = 125° C		MIN	0.5	A/ms
V_{CL}	I_{CL} = 0.1 mA t_p = 1 ms T_j = 25° 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 A t_p = 500 µs	T_j = 25° C	MAX	2	V
V_{TO} (1)	Threshold voltage	T_j = 125° C	MAX	0.9	V
R_D (1)	Dynamic resistance	T_j = 125° C	MAX	250	mΩ
I_{DRM} I_{RRM}	V_{OUT} = V_{DRM} / V_{RRM}	T_j = 25° C	MAX	10	µA
		T_j = 125° 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 cm^2	DPAK	70	

1. S_{CU} = copper surface under tab

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

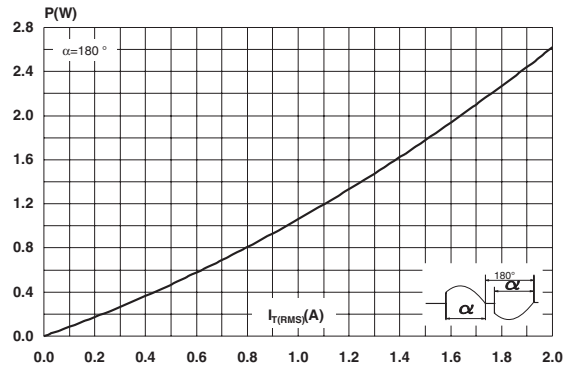


Figure 2. RMS on-state current versus case temperature

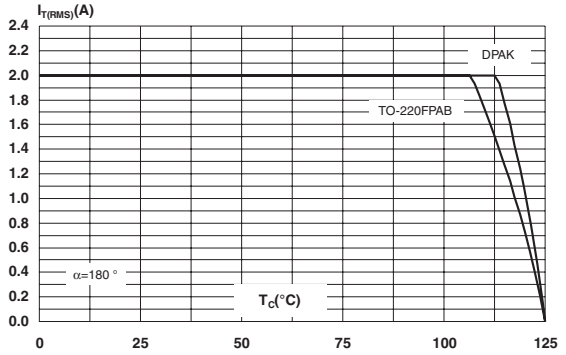


Figure 3. RMS on-state current versus ambient temperature

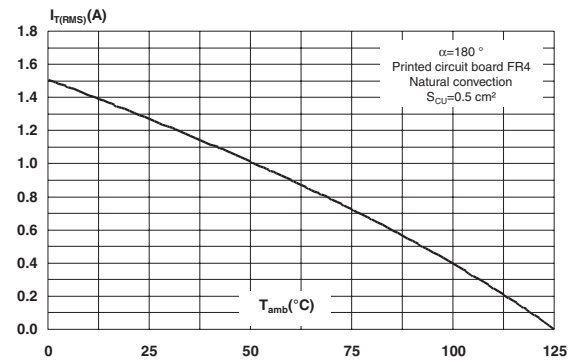


Figure 4. Relative variation of thermal impedance versus pulse duration - TO-220FPAB

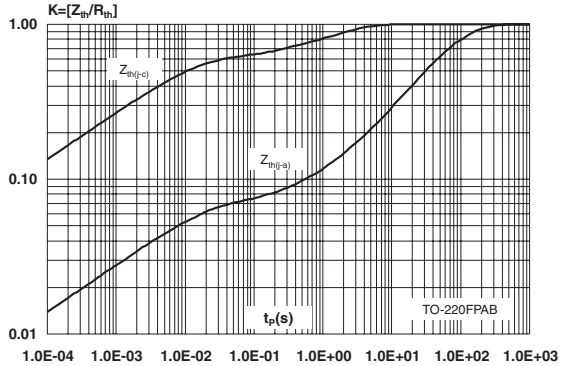


Figure 5. Relative variation of thermal impedance versus pulse duration - DPAK

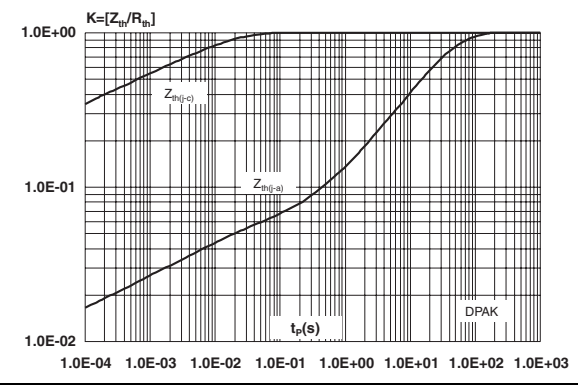


Figure 6. Relative variation of gate trigger current I_{GT}, holding current I_H and latching current I_L versus junction temperature (typical values)

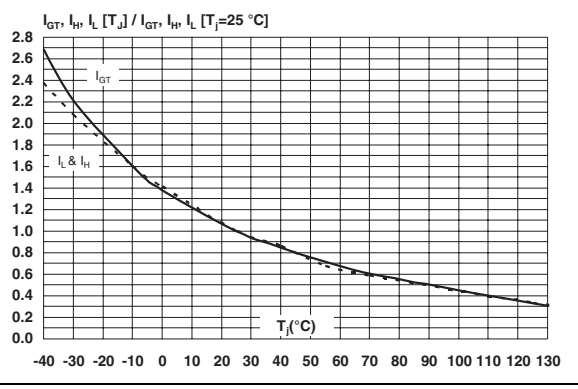


Figure 7. Relative variation of static dV/dt versus junction temperature

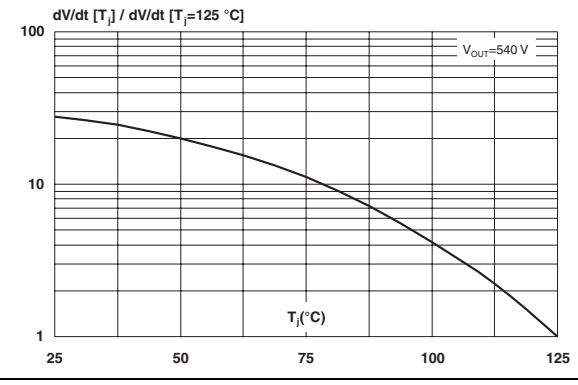


Figure 8. Relative variation of critical rate of decrease of main current versus reapplied dV/dt (typical values)

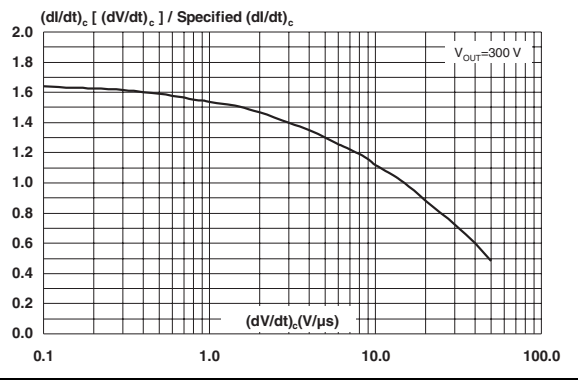


Figure 9. Relative variation of critical rate of decrease of main current versus junction temperature

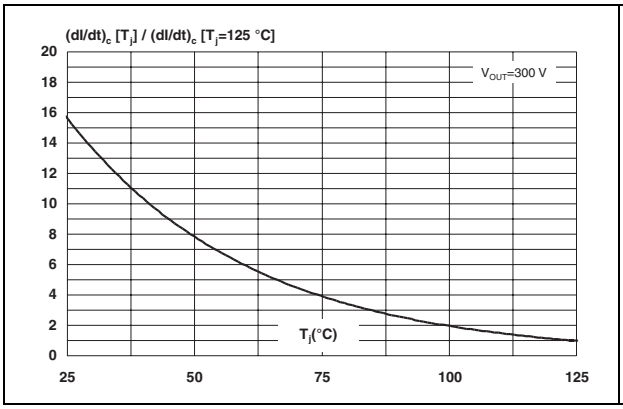


Figure 10. Surge peak on-state current versus number of cycles

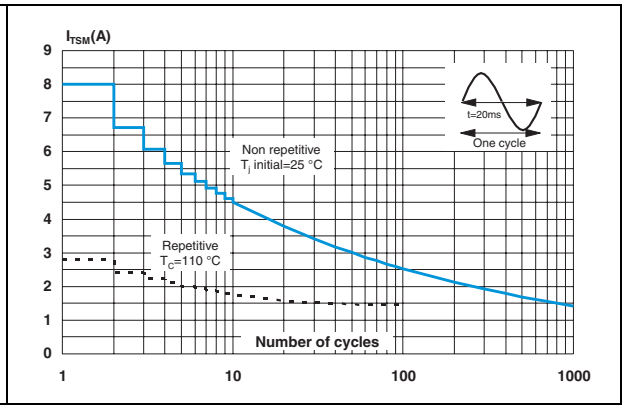


Figure 11. Non repetitive surge peak on-state current for a sinusoidal pulse with width t_P < 10 ms, and corresponding value of I^2t

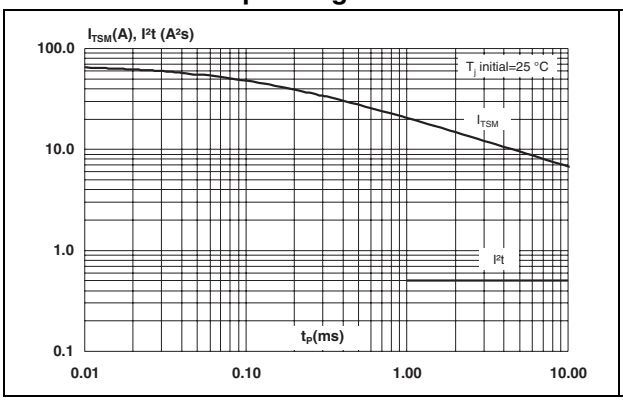


Figure 12. On-state characteristics (maximum values)

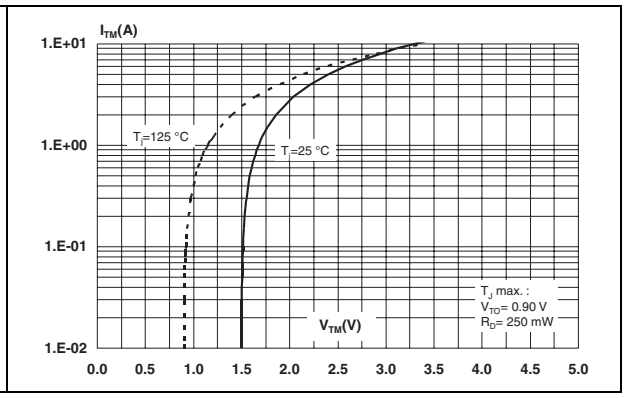


Figure 13. Thermal resistance junction to ambient versus copper surface under tab (printed circuit board FR4, e_{CU} = 35 µm) (DPAK)

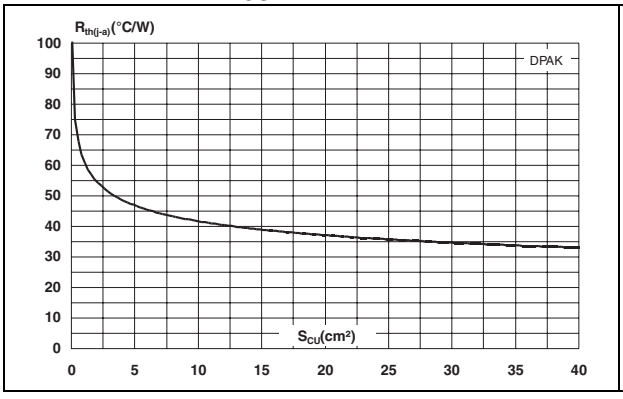
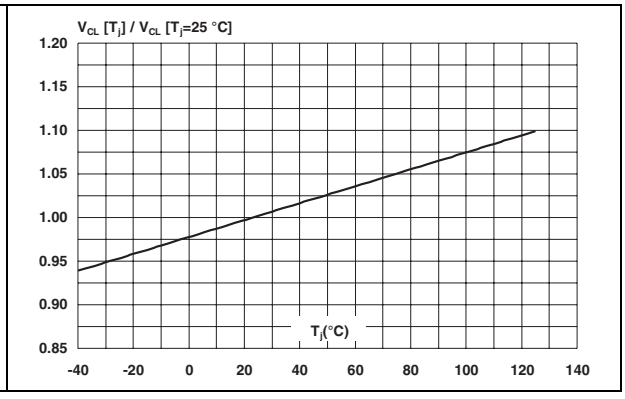


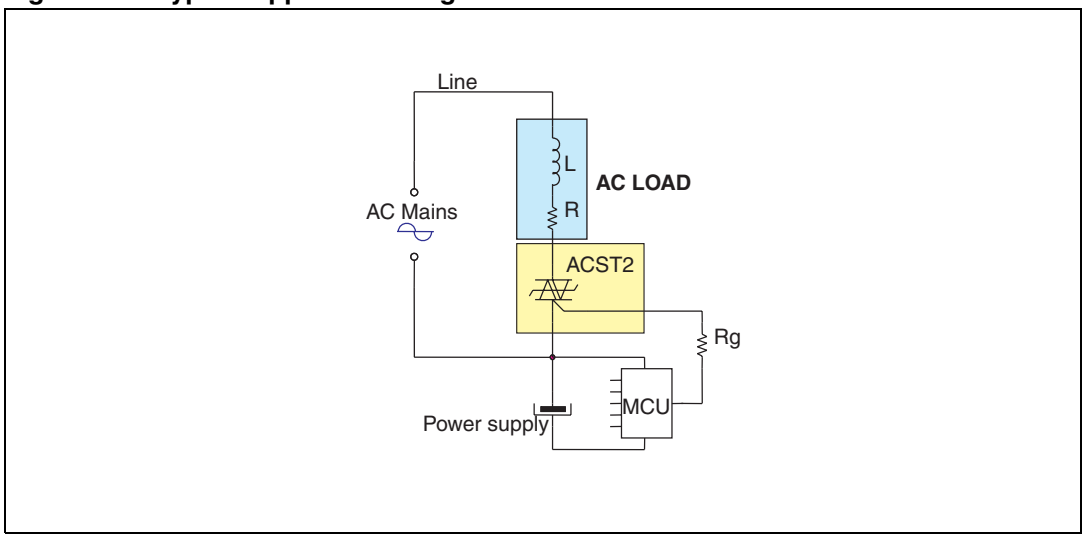
Figure 14. Relative variation of clamping voltage V_{CL} versus junction temperature



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} max = 10 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} = 10mA), 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 for resistive and inductive loads according to IEC 61000-4-5 standards: R = 200 Ω, L = 10 µH, V_{pp} = 2 kV

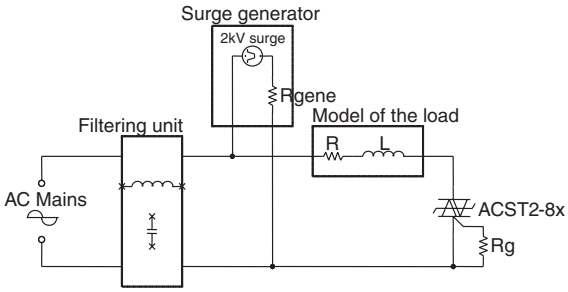
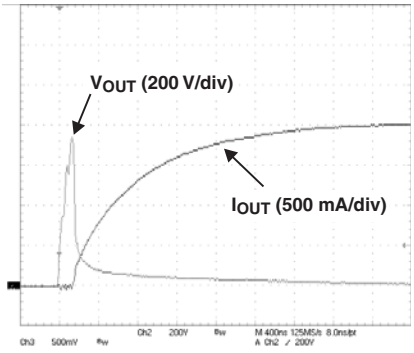


Figure 17. Typical current and voltage waveforms across the ACST2 during IEC 61000-4-5 standard test



2.2 Electrical noise immunity

Even if the ACST2 is a sensitive device (I_{GT} = 10 mA) and can be controlled directly though 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 V/µs @ 125° 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 word, ACST2 is sensitive, but has an immunity reaching the one provided by non-sensitive device (I_{GT} higher than 35 mA).

3 Ordering information scheme

ACST 2 - 8 S FP -TR

AC Switch series

Current
2 = 2 A_{RMS}

Voltage
8 = 800 V

Sensitivity
S = 10 mA

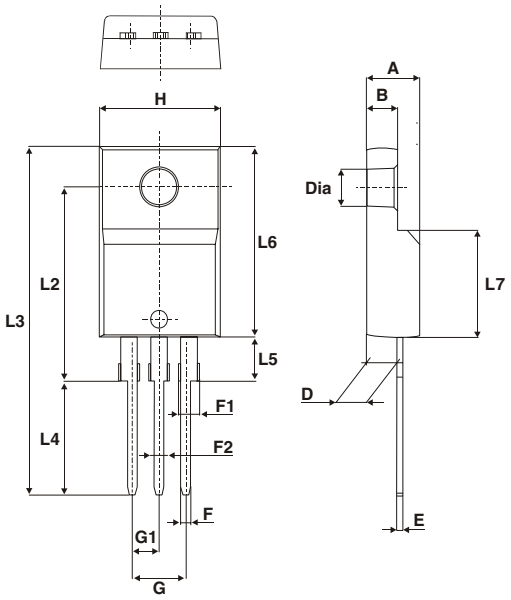
Package
FP = TO-220FPAB
B = DPAK

Packing
TR = Tape and reel (DPAK)
Blank = Tube (TO-220FPAB, DPAK)

4 Package information

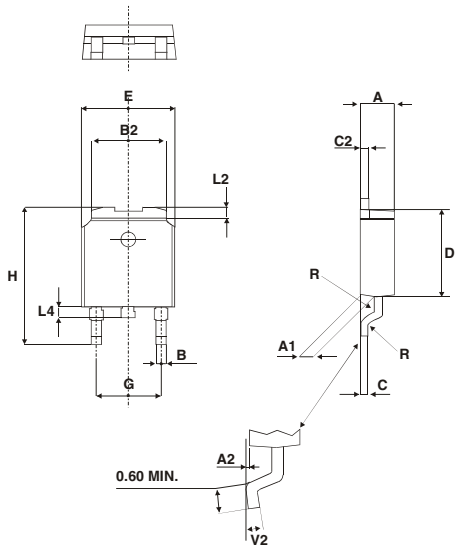
- Epoxy meets UL94, V0

Table 5. TO-220FPAB dimensions



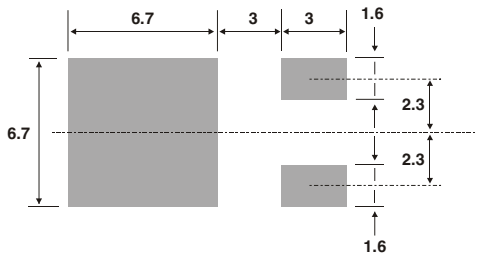
Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.4	4.6	0.173	0.181
B	2.5	2.7	0.098	0.106
D	2.5	2.75	0.098	0.108
E	0.45	0.70	0.018	0.027
F	0.75	1	0.030	0.039
F1	1.15	1.70	0.045	0.067
F2	1.15	1.70	0.045	0.067
G	4.95	5.20	0.195	0.205
G1	2.4	2.7	0.094	0.106
H	10	10.4	0.393	0.409
L2	16 Typ.		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.

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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