



## 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  $1500V_{RMS}$

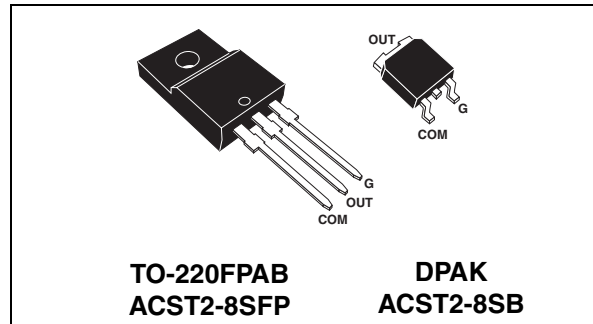
### Main application

- 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.



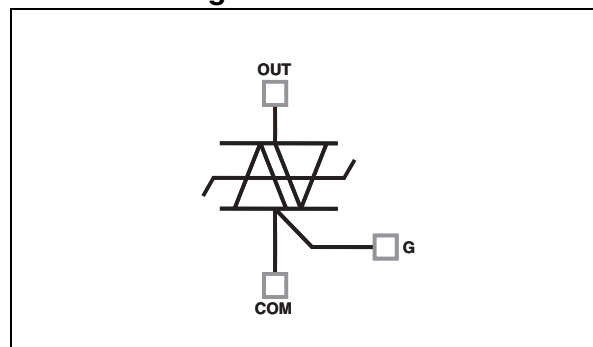
### Benefits

- 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            | $T_C = 105^\circ \text{C}$ | 2                          | A                      |
|                    |                                                                                                         | DPAK                  | $T_C = 110^\circ \text{C}$ |                            |                        |
| $I_{TSM}$          | Non repetitive surge peak on-state current (full cycle sine wave, $T_J$ initial = $25^\circ \text{C}$ ) | 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                                                                                 | $t_p = 10 \text{ ms}$ |                            | 0.5                        | $\text{A}^2\text{s}$   |
| dl/dt              | Critical rate of rise of on-state current<br>$I_G = 2 \times I_{GT}$ , $t_r = 100 \text{ ns}$           | F = 120 Hz            | $T_J = 125^\circ \text{C}$ | 50                         | $\text{A}/\mu\text{s}$ |
| $V_{PP}^{(1)}$     | Non repetitive line peak mains voltage <sup>(1)</sup>                                                   |                       | $T_J = 25^\circ \text{C}$  | 2                          | kV                     |
| $P_{G(AV)}$        | Average gate power dissipation                                                                          |                       | $T_J = 125^\circ \text{C}$ | 0.1                        | W                      |
| $P_{GM}$           | Peak gate power dissipation ( $t_p = 20 \mu\text{s}$ )                                                  |                       | $T_J = 125^\circ \text{C}$ | 10                         | W                      |
| $I_{GM}$           | Peak gate current ( $t_p = 20 \mu\text{s}$ )                                                            |                       | $T_J = 125^\circ \text{C}$ | 1.6                        | A                      |
| $T_{stg}$<br>$T_J$ | Storage junction temperature range<br>Operating junction temperature range                              |                       |                            | -40 to +150<br>-40 to +125 | $^\circ \text{C}$      |
| $T_l$              | Maximum lead soldering temperature during 10 s (at 3 mm from plastic case)                              |                       |                            | 260                        | $^\circ \text{C}$      |

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

**Table 2. Electrical characteristics ( $T_J = 25^\circ \text{C}$ , unless otherwise specified)**

| Symbol                              | Test conditions                                                              | Quadrant     |     | Value | Unit                   |
|-------------------------------------|------------------------------------------------------------------------------|--------------|-----|-------|------------------------|
| $I_{GT}^{(1)}$                      | $V_{OUT} = 12 \text{ V}$ $R_L = 33 \Omega$                                   | I - II - III | MAX | 10    | mA                     |
| $V_{GT}$                            | $V_{OUT} = 12 \text{ V}$ $R_L = 33 \Omega$                                   | I - II - III | MAX | 1.1   | V                      |
| $V_{GD}$                            | $V_{OUT} = V_{DRM}$ $R_L = 3.3 \text{ k}\Omega$ $T_J = 125^\circ \text{C}$   | I - II - III | MIN | 0.2   | V                      |
| $I_H^{(2)}$                         | $I_{OUT} = 100 \text{ mA}$                                                   |              | 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 $T_J = 125^\circ \text{C}$                |              | MIN | 500   | $\text{V}/\mu\text{s}$ |
| (dl/dt) <sub>c</sub> <sup>(2)</sup> | (dV/dt) <sub>c</sub> = $15 \text{ V}/\mu\text{s}$ $T_J = 125^\circ \text{C}$ |              | MIN | 0.5   | $\text{A}/\text{ms}$   |
| $V_{CL}$                            | $I_{CL} = 0.1 \text{ mA}$ $t_p = 1 \text{ ms}$ $T_J = 25^\circ \text{C}$     |              | 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   | m $\Omega$    |
| $I_{DRM}$<br>$I_{RRM}$ | $V_{OUT} = V_{DRM} / V_{RRM}$                    | $T_j = 25^\circ \text{C}$  | MAX | 10    | $\mu\text{A}$ |
|                        |                                                  | $T_j = 125^\circ \text{C}$ |     | 0.5   | mA            |

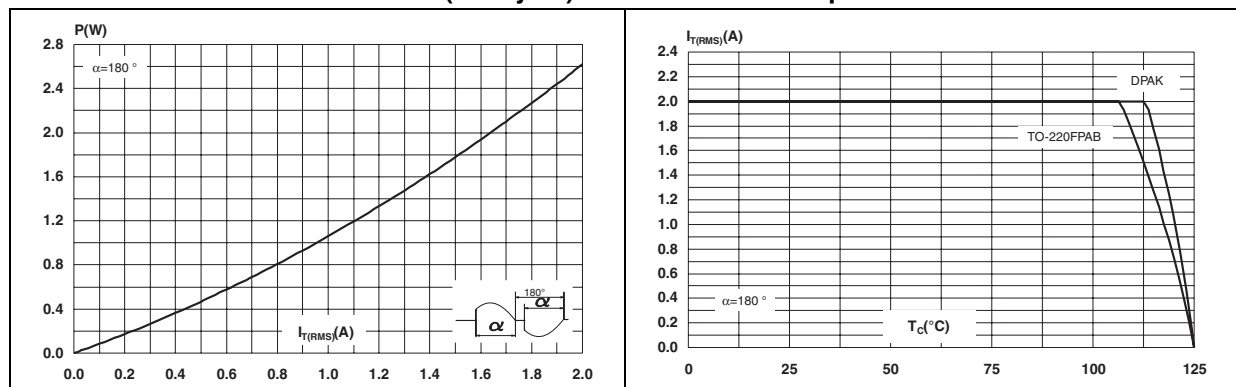
1. for both polarity of OUT pin referenced to COM pin

**Table 4. Thermal resistances**

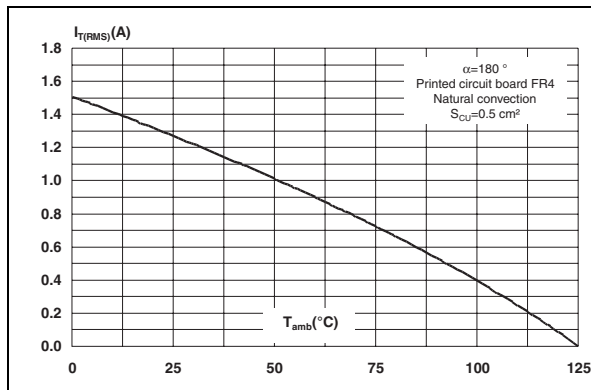
| Symbol        | Parameter             |                                       | Value | Unit                |
|---------------|-----------------------|---------------------------------------|-------|---------------------|
| $R_{th(j-c)}$ | Junction to case (AC) | DAK                               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

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

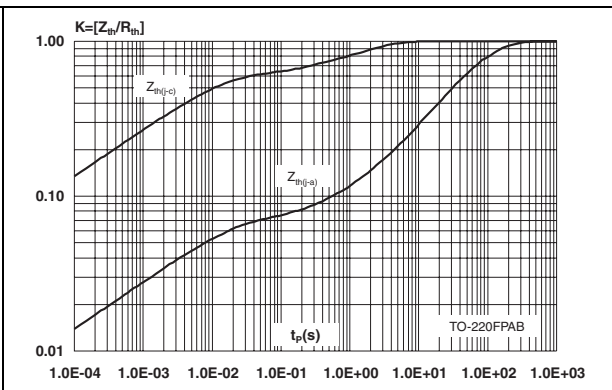
**Figure 1. Maximum power dissipation versus RMS on-state current (full cycle)**      **Figure 2. RMS on-state current versus case temperature**



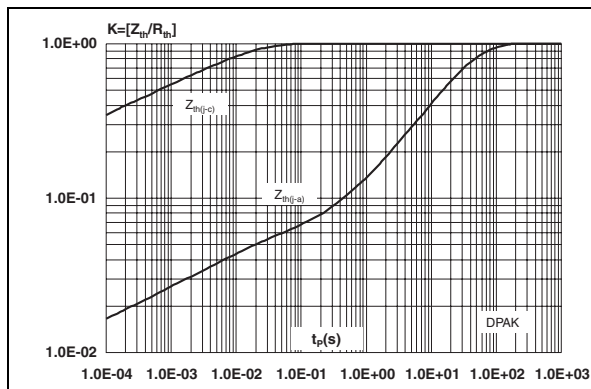
**Figure 3. RMS on-state current versus ambient temperature**



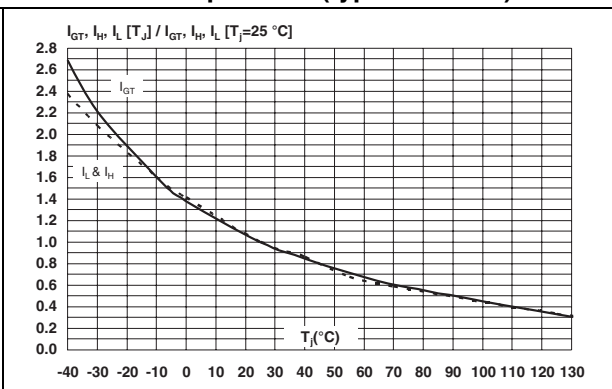
**Figure 4. Relative variation of thermal impedance versus pulse duration - TO-220FPAB**



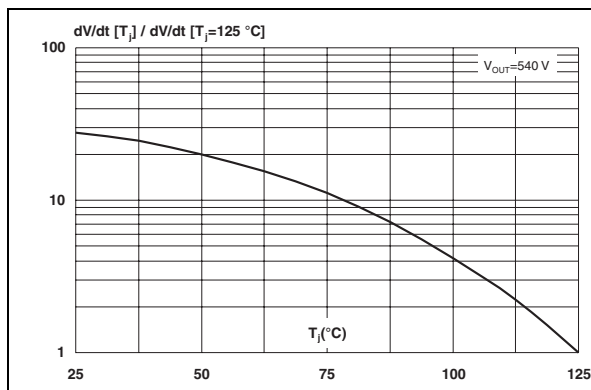
**Figure 5. Relative variation of thermal impedance versus pulse duration - DPAK**



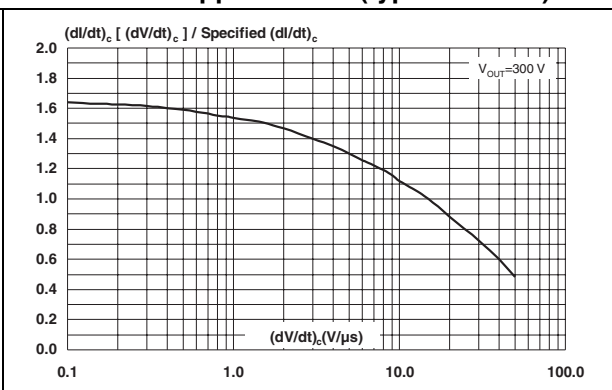
**Figure 6. Relative variation of gate trigger current  $I_{GT}$ , holding current  $I_H$  and latching current  $I_L$  versus junction temperature (typical values)**



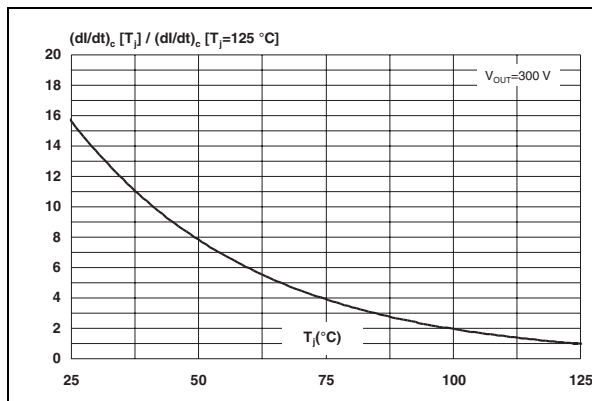
**Figure 7. Relative variation of static  $dV/dt$  versus junction temperature**



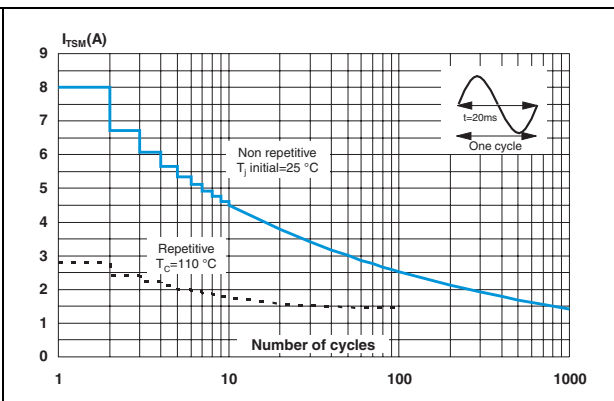
**Figure 8. Relative variation of critical rate of decrease of main current versus reapplied  $dV/dt$  (typical values)**



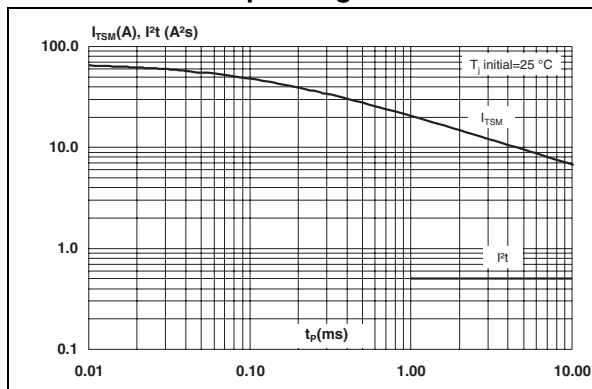
**Figure 9. Relative variation of critical rate of decrease of main current versus junction temperature**



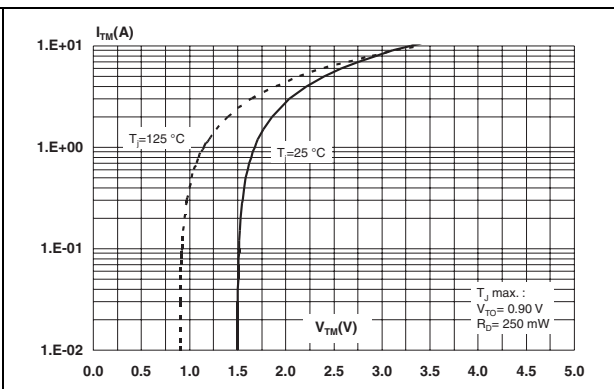
**Figure 10. Surge peak on-state current versus number of cycles**



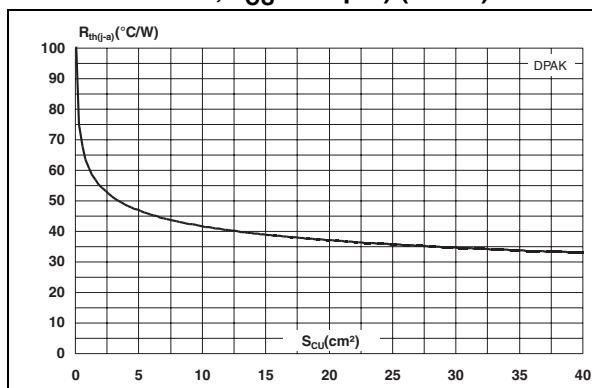
**Figure 11. Non repetitive surge peak on-state current for a sinusoidal pulse with width  $t_p < 10$  ms, and corresponding value of  $I^2t$**



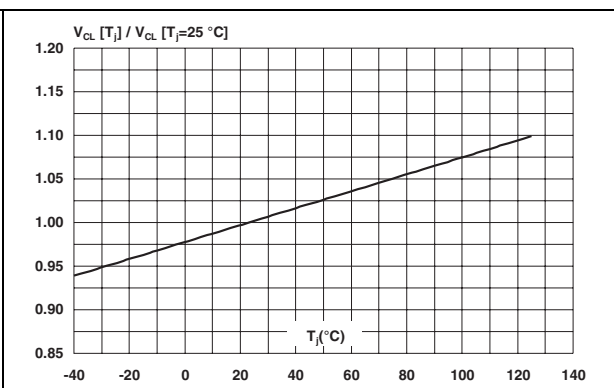
**Figure 12. On-state characteristics (maximum values)**



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



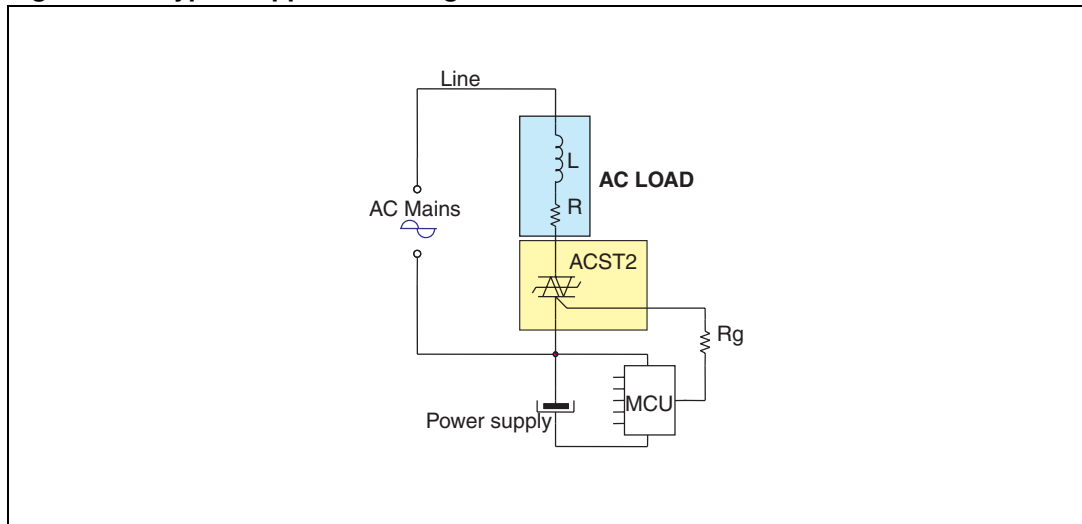
**Figure 14. Relative variation of clamping voltage  $V_{CL}$  versus junction temperature**



## 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**



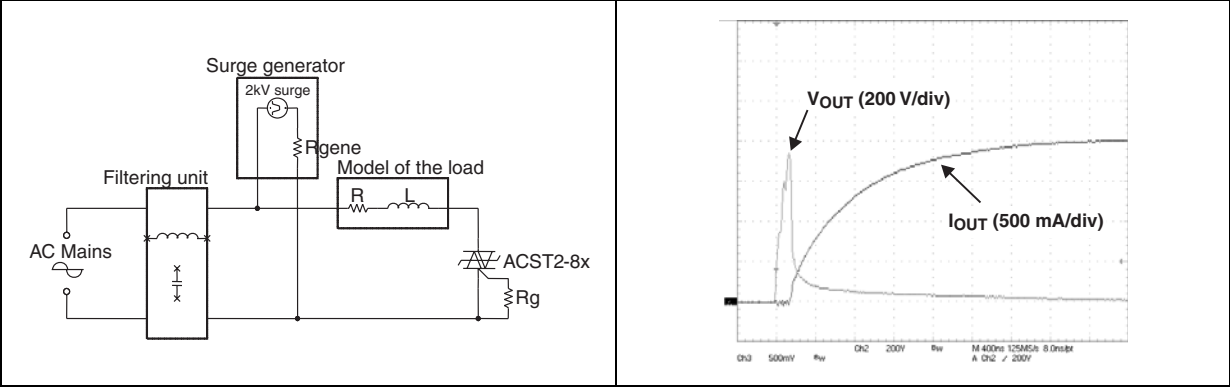
### 2.1 Protection against overvoltage: the best choice is ACST

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.

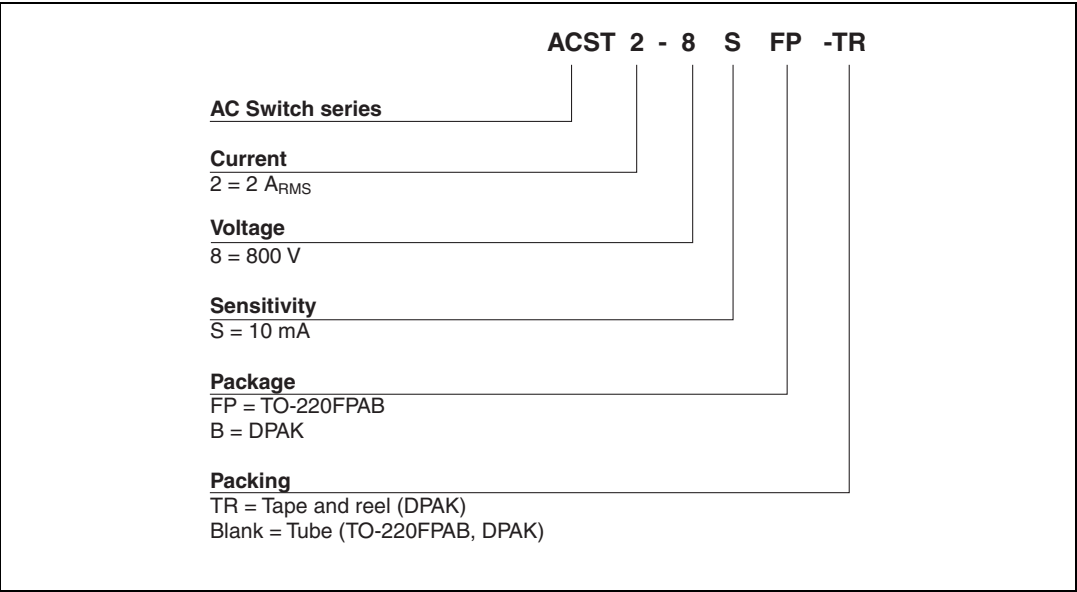
**Figure 16. Overvoltage ruggedness test circuit**  
**Figure 17. Typical current and voltage**  
**for resistive and inductive loads**  
**according to IEC 61000-4-5**  
**standards:**  
**R = 200 Ω, L = 10 μH, V<sub>pp</sub> = 2 kV**



**2.2 Electrical noise immunity**

Even if the ACST2 is a sensitive device ( $I_{GT} = 10\text{ mA}$ ) 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  $500\text{ V}/\mu\text{s}$  @  $125^\circ\text{C}$ . 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 word, 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**

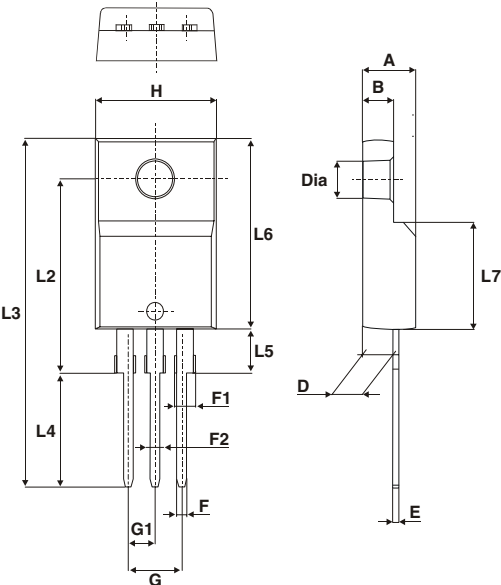


4 Package information

- 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 |

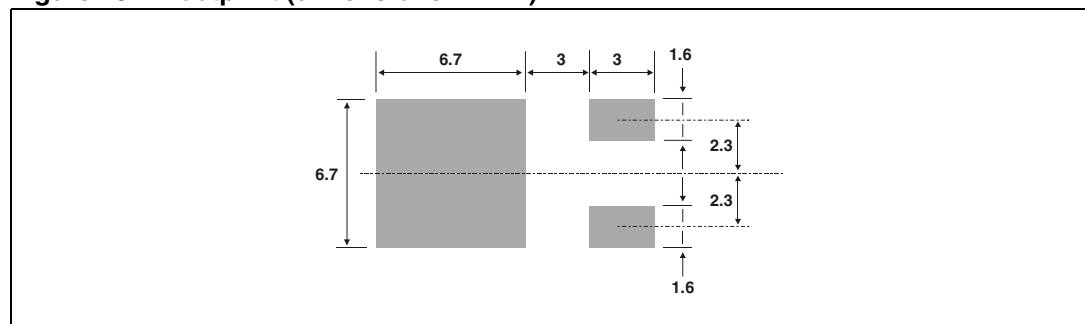


The technical drawing illustrates the TO-220FPAB package in three views: top, side, and a detail of the mounting tab. The top view shows a rectangular body with a central circular feature and four mounting tabs. Dimensions L1 through L7 and H define the overall size and tab lengths. The side view shows the package's profile, with dimensions A, B, D, and E indicating its height and tab thickness. The detail view shows the mounting tab with dimensions F, F1, F2, G, and G1. A diameter dimension (Dia.) is also shown for the central feature.

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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