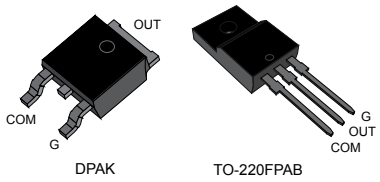
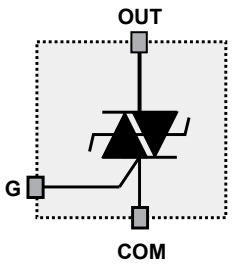
ACST2

Datasheet

2 A - 800 V overvoltage protected AC switch



DPAK TO-220FPAB



Features

- Triac with overvoltage crowbar technology
- High noise immunity: static dV/dt > 500 V/µs
- TO-220FPAB insulated package:
  - complies with UL standards (File ref : E81734)
  - insulation voltage: 2000 V_{RMS}
- Benefits:
  - Enables equipment to meet IEC 61000-4-5
  - High off-state reliability with planar technology
  - Needs no external overvoltage protection
  - Reduces the power passive component count
  - Interfaces directly with the micro-controller
  - High immunity against fast transients described in IEC 61000-4-4 standards

Applications

- AC mains static switching in appliance and industrial control systems
- Driving low power highly inductive loads like solenoid, pump, fan, and micro-motor

Product status link
ACST2

Product summary	
$I_{T(RMS)}$	2 A
V_{DRM}/V_{RRM}	800 V
I_{GT}	10 mA

Description

The ACST2 series belongs to the ACS / ACST power switch family. This high performance device is suited 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 still shows a high electrical noise immunity complying with IEC standards such as IEC 61000-4-4 (fast transient burst test).

1 Characteristics

Table 1. Absolute ratings (limiting values)

Symbol	Parameter			Value	Unit
$I_{T(RMS)}$	On-state rms 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 T_j initial = 25 °C, (full cycle sine wave)	f = 50 Hz	t_p = 20 ms	8.0	A
		f = 60 Hz	t_p = 16.7 ms	8.4	
I^2t	I^2t for fuse selection		t_p = 10 ms	0.5	A^2s
dI/dt	Critical rate of rise on-state current I_G = 2 x I_{GT}, tr ≤ 100 ns	f = 120 Hz	T_j = 125 °C	50	A/µs
V_{PP}(1)	Non repetitive line peak pulse voltage(1)		T_j = 25 °C	2	kV
$P_{G(AV)}$	Average gate power dissipation		T_j = 125 °C	0.1	W
P_{GM}	Peak gate power dissipation (t_p = 20 µs)		T_j = 125 °C	10	W
I_{GM}	Peak gate current (t_p = 20 µs)		T_j = 125 °C	1.6	A
T_{stg}	Storage temperature range			-40 to +150	°C
T_j	Operating junction temperature range			-40 to +125	°C
T_L	Lead temperature for soldering during 10 s (at 3 mm from plastic case)			260	°C
V_{ins}	Insulation rms voltage (60 seconds)			2000	V

1. *according to test described by standard IEC 61000-4-5, see Figure 16 for conditions*

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}			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		Min.	850	V

1. *Minimum I_{GT} is guaranteed at 5% of I_{GT} max*
2. *For both polarities of OUT pin referenced to COM pin*

Table 3. Static characteristics

Symbol	Test conditions			Value	Unit
V_{TM} (1)	I_{OUT} = 2.8 A, t_p = 500 µs	T_j = 25 °C	Max.	2	V
V_{T0} (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}	V_{OUT} = V_{DRM}/ V_{RRM}	T_j = 25 °C	Max.	10	µA
I_{RRM}		T_j = 125 °C		0.5	mA

1. *For both polarities of OUT pin referenced to COM pin*

Table 4. Thermal characteristics

Symbol	Parameter		Value	Unit
$R_{th(j-c)}$	Junction to case for full cycle sine wave conduction	DPAK	4.5	°C/W
		TO-220FPAB	7	
$R_{th(j-a)}$	Junction to ambient	TO-220FPAB	60	
	Junction to ambient, S_{CU} (1) = 0.5 cm²	DPAK	70	

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

1.1 Characteristics (curves)

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

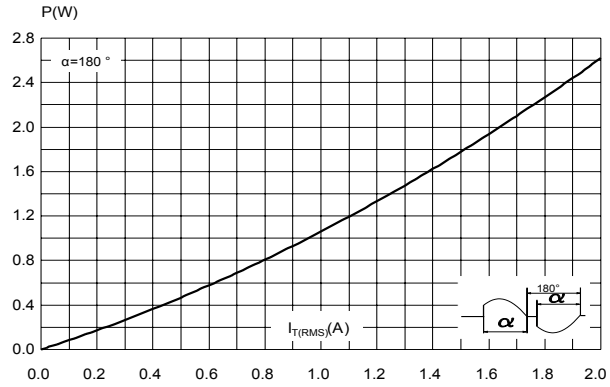


Figure 2. On-state RMS current versus case temperature

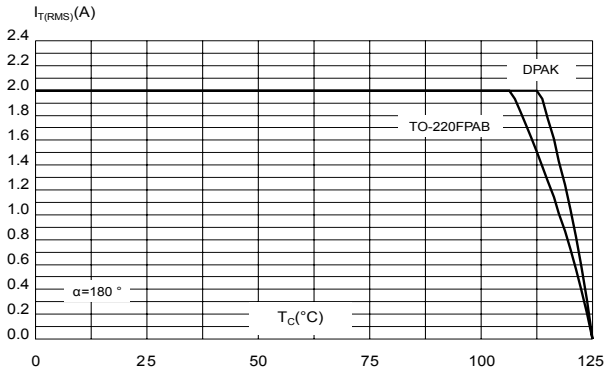


Figure 3. On-state RMS current versus ambient temperature

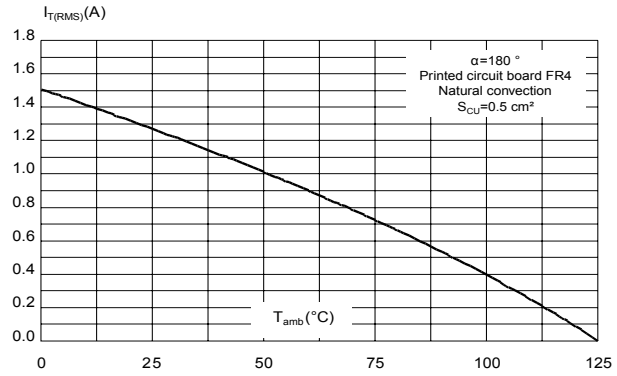


Figure 4. Relative variation of thermal impedance junction to case versus pulse duration (TO-220FPAB)

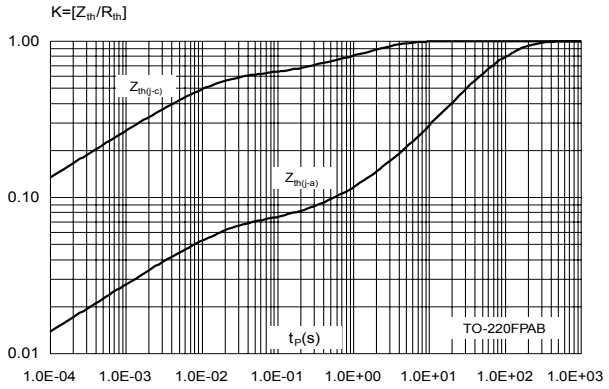


Figure 5. Relative variation of thermal impedance junction to case versus pulse duration (DPAK)

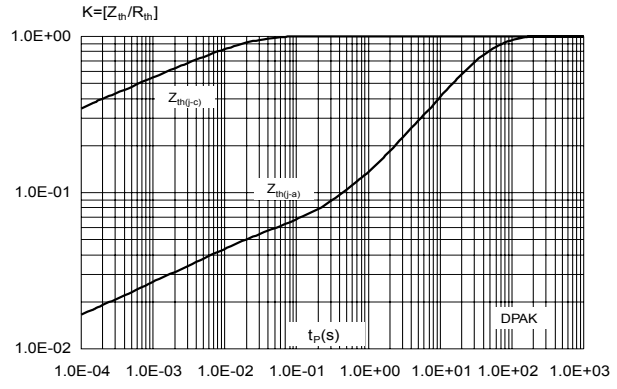


Figure 6. Relative variation of gate trigger, holding and latching current versus junction temperature (typical value)

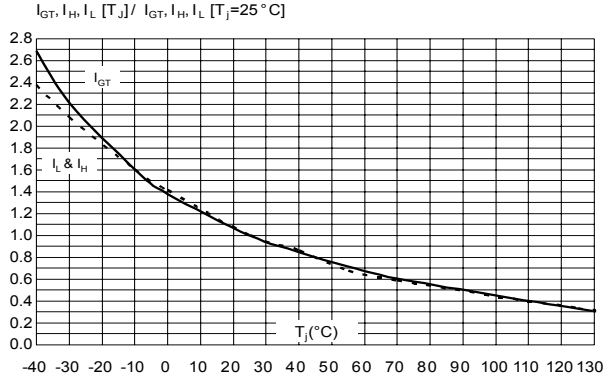


Figure 7. Relative variation of static dV/dt versus junction temperature

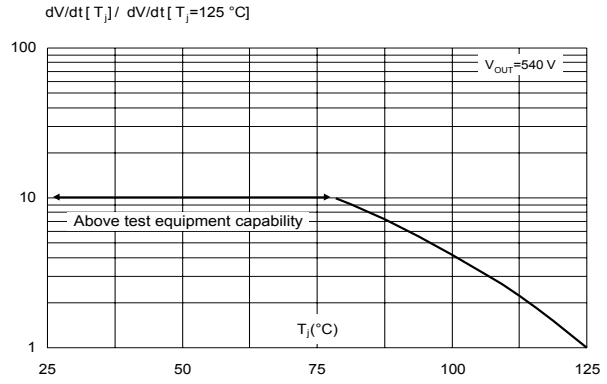


Figure 8. Relative variation of critical rate of decrease of main current versus reapplied dV/dt (typical values)

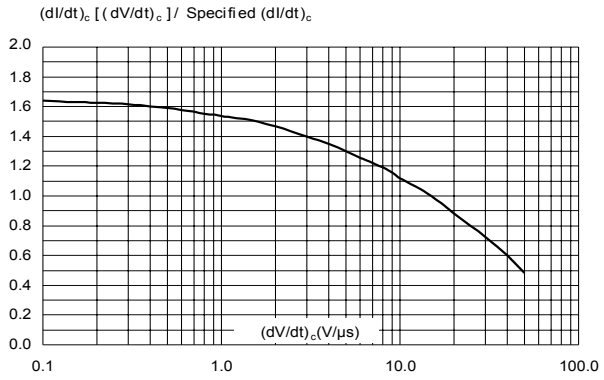


Figure 9. Relative variation of critical rate of decrease of main current versus junction temperature

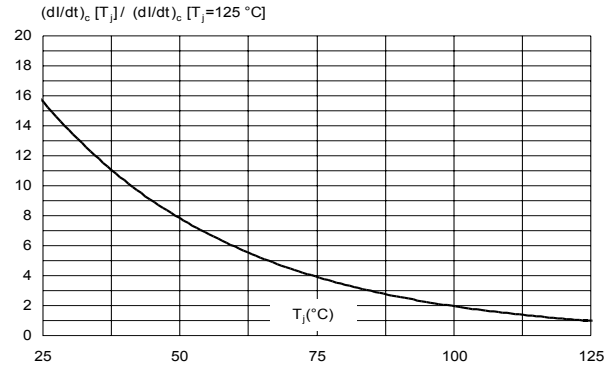


Figure 10. Surge peak on-state current versus number of cycles

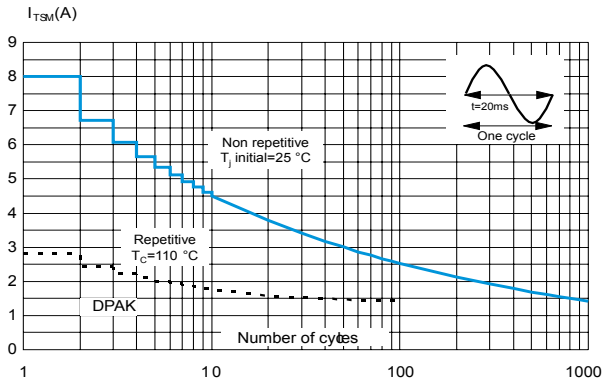


Figure 11. Non repetitive surge peak on-state current for a sinusoidal pulse with width tp < 10 ms and corresponding value

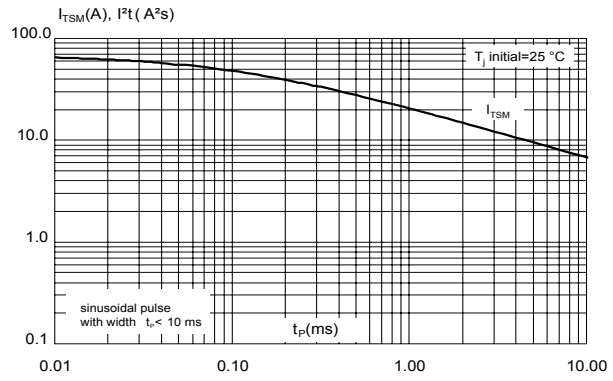


Figure 12. On-state characteristics (maximum values)

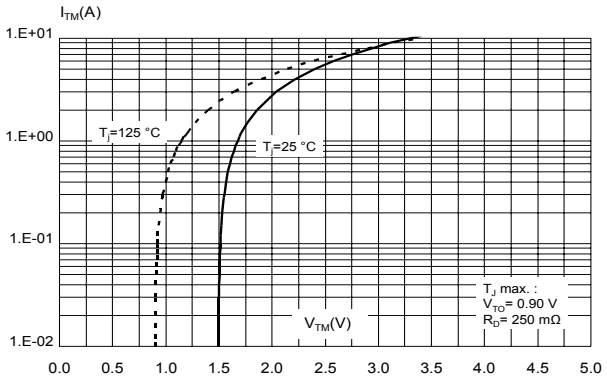


Figure 13. Thermal resistance junction to ambient versus copper surface under tab (typical values)

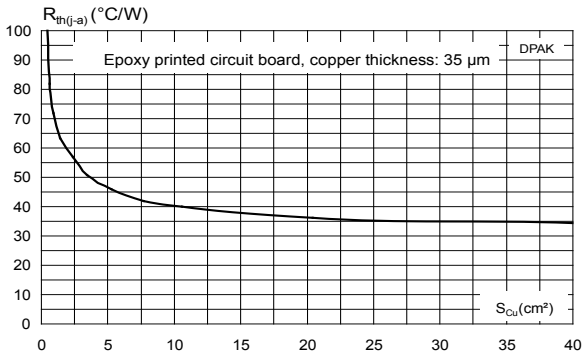
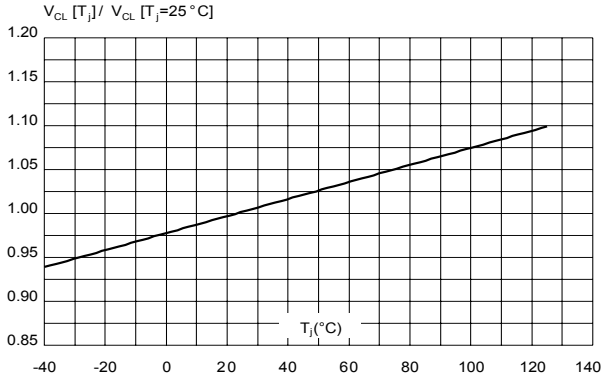


Figure 14. Relative variation of clamping voltage V_{CL} versus junction temperature

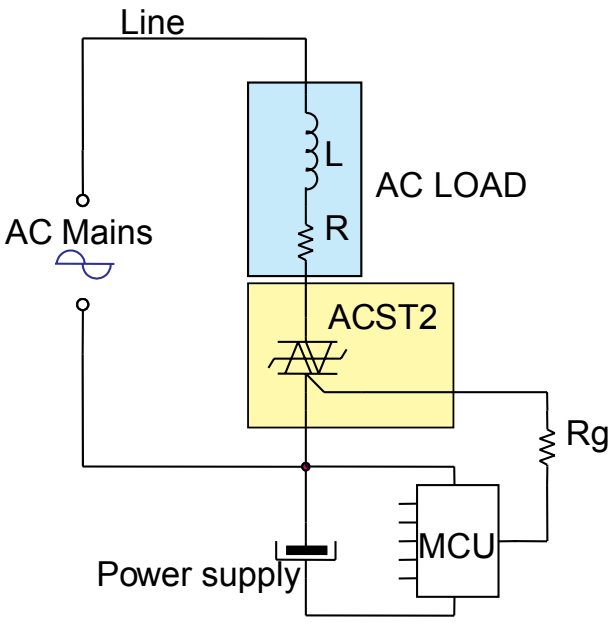


2 Application information

2.1 Typical application descriptions

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. AC induction motor control – typical diagram



2.2 AC line transient voltage ruggedness

In comparison with standard Triacs, which are not robust against surge voltage, the ACST2 is self-protected against over-voltage, specified by the new parameter V_{CL}. In addition, the ACST2 is a sensitive device (I_{GT} = 10 mA), but provides a high noise immunity level against fast transients. The ACST2 switch can safely withstand AC line transient voltages either by clamping the low energy spikes, such as inductive spikes at switch off, or by switching to the on state (for less than 10 ms) to dissipate higher energy shocks through the load. This safety feature works even with high turn-on current ramp up.

The test circuit of Figure 16 represents the ACST2 application, and is used to stress the ACST switch according to the IEC 61000-4-5 standard conditions. With the additional effect of the load which is limiting the current, the ACST switch withstands the voltage spikes up to 2 kV on top of the peak line voltage. The protection is based on an overvoltage crowbar technology. The ACST2 folds back safely to the on state as shown in Figure 17. The ACST2 recovers its blocking voltage capability after the surge and the next zero current crossing. Such a non repetitive test can be done at least 10 times on each AC line voltage polarity.

Figure 16. Overvoltage ruggedness test circuit for resistive and inductive loads for IEC 61000-4-5 standards

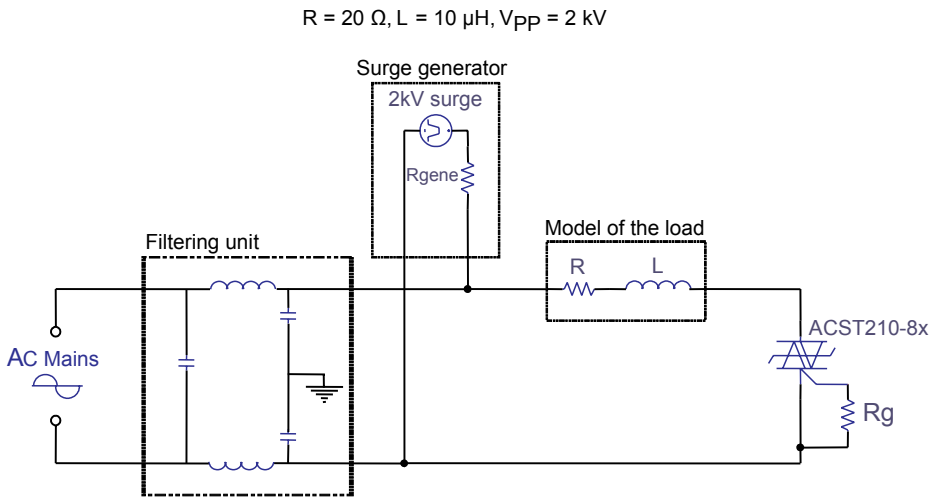
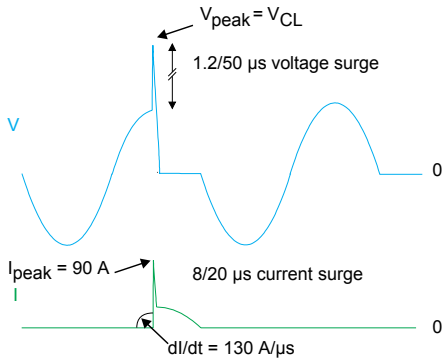


Figure 17. Typical voltage and current waveforms across the ACST4 during IEC 61000-4-5 standard test



3 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

3.1 TO-220FPAB package information

- Epoxy meets UL94, V0
- Recommended torque: 0.4 to 0.6 N·m

Figure 18. TO-220FPAB package outline

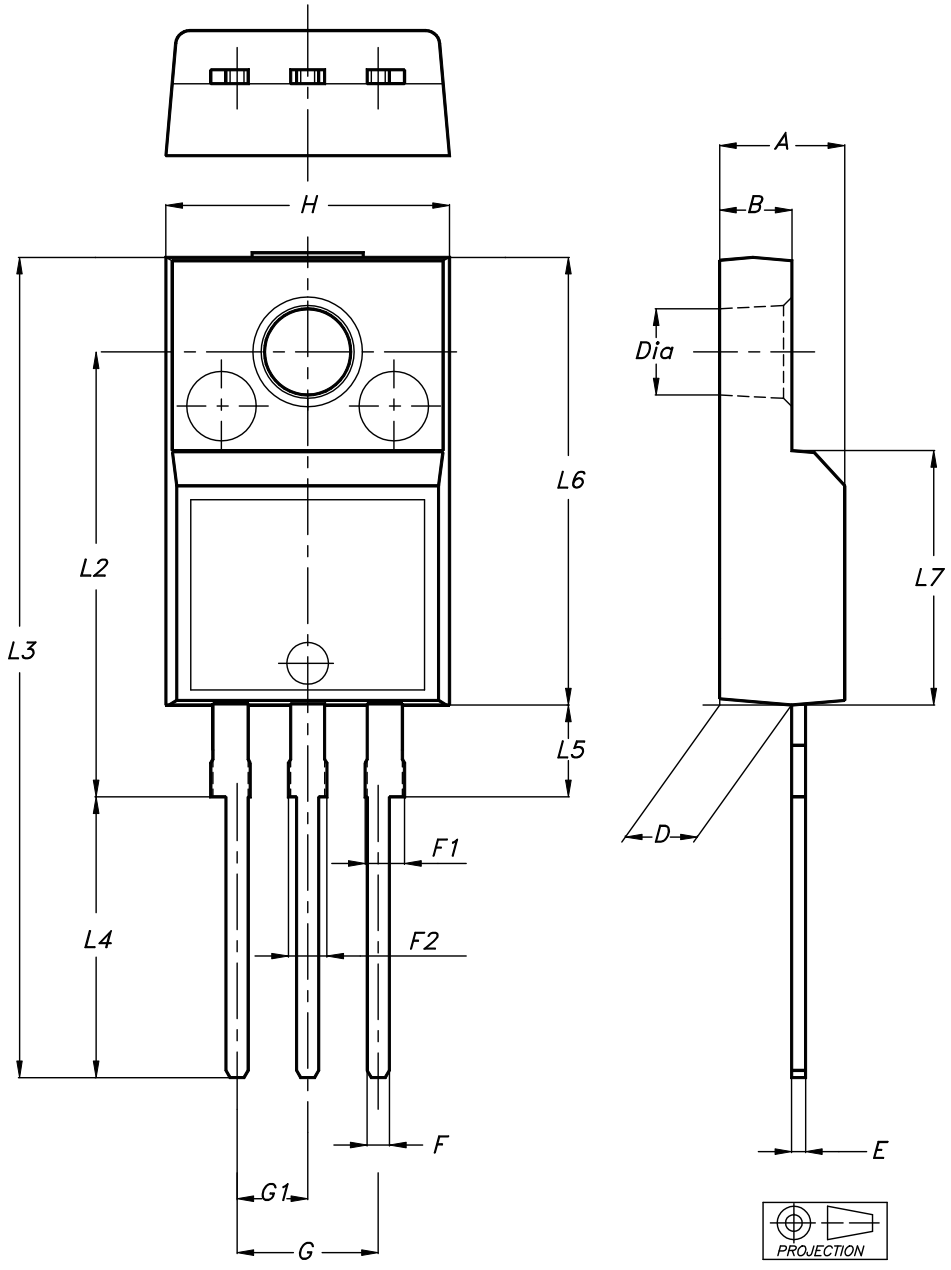


Table 5. **TO-220FPAB package mechanical data**

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.1739	0.1818
B	2.5	2.7	0.0988	0.1067
D	2.50	2.75	0.0988	0.1087
E	0.45	0.70	0.0178	0.0277
F	0.75	1.0	0.0296	0.0395
F1	1.15	1.70	0.0455	0.0672
F2	1.15	1.70	0.0455	0.0672
G	4.95	5.20	0.1957	0.2055
G1	2.40	2.70	0.0949	0.1067
H	10.00	10.40	0.3953	0.4111
L2	16.00 typ.		0.6324 typ.	
L3	28.60	30.60	1.1304	1.2095
L4	9.80	10.6	0.3874	0.4190
L5	2.90	3.60	0.1146	0.1423
L6	15.90	16.40	0.6285	0.6482
L7	9.00	9.30	0.3557	0.3676
Dia	3.0	3.20	0.1186	0.1265

3.2 DPAK package information

- Molding compounded resin is halogen free and meets UL94 flammability standard, level V0
- Lead-free package leads plating

Figure 19. DPAK package outline

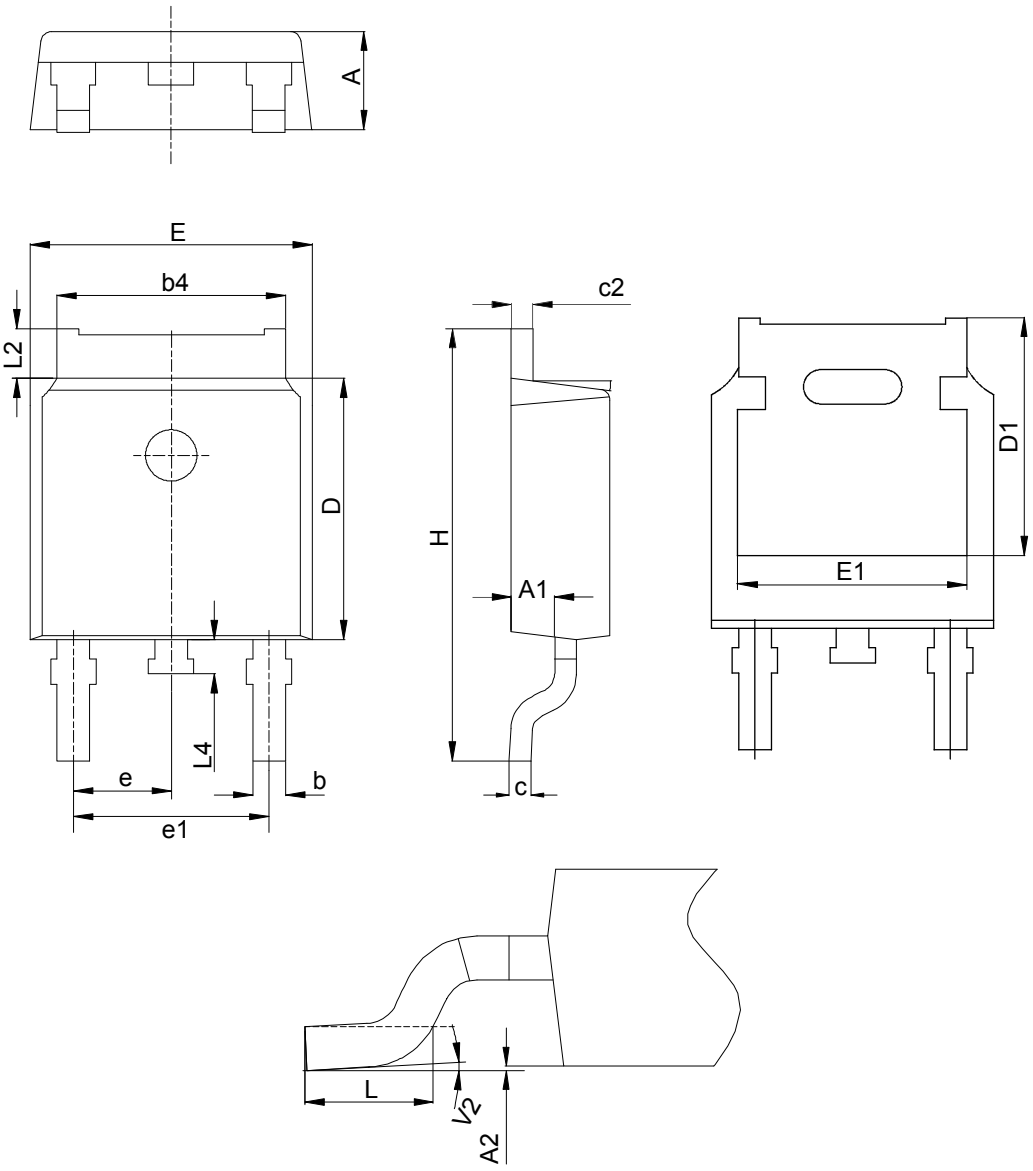


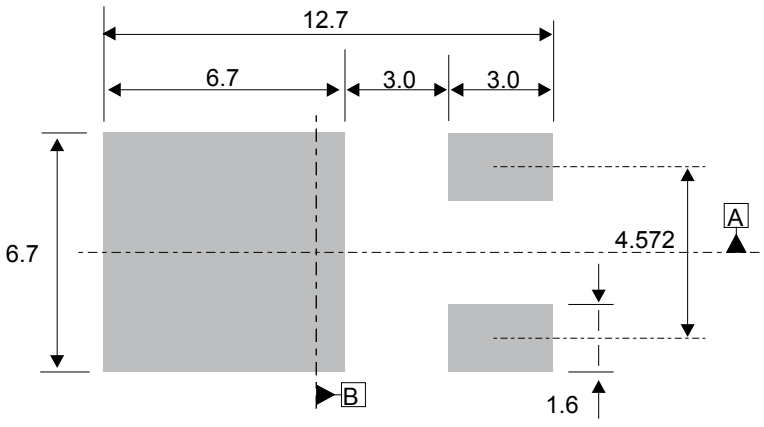
Table 6. DPAK package mechanical data

Ref.	Dimensions					
	Millimeters			Inches[1]		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.18		2.40	0.0858		0.0945
A1	0.90		1.10	0.0354		0.0433
A2	0.03		0.23	0.0012		0.0091
b	0.64		0.90	0.0252		0.354
b4	4.95		5.46	0.1949		0.2150
c	0.46		0.61	0.0181		0.0240
c2	0.46		0.60	0.0181		0.0236
D	5.97		6.22	0.2350		0.2449
D1	4.95		5.60	0.1949		0.2205
E	6.35		6.73	0.2500		0.2650
E1	4.32		5.50	0.1701		0.2165
e		2.286			0.0900	
e1	4.40		4.70	0.1732		0.1850
H	9.35		10.40	0.3681		0.4094
L	1.00		1.78	0.0394		0.0701
L2			1.27			0.0500
L4	0.60		1.02	0.0236		0.0402
V2[2]	-8°		+8°	-8°		+8°

1. *Dimensions in inches are given for reference only*
2. *Degree*

Note: This package drawing may slightly differ from the physical package. However, all the specified dimensions are guaranteed.

Figure 20. DPAK recommended footprint (dimensions are in mm)



4 Ordering information

Figure 21. **Ordering information scheme**

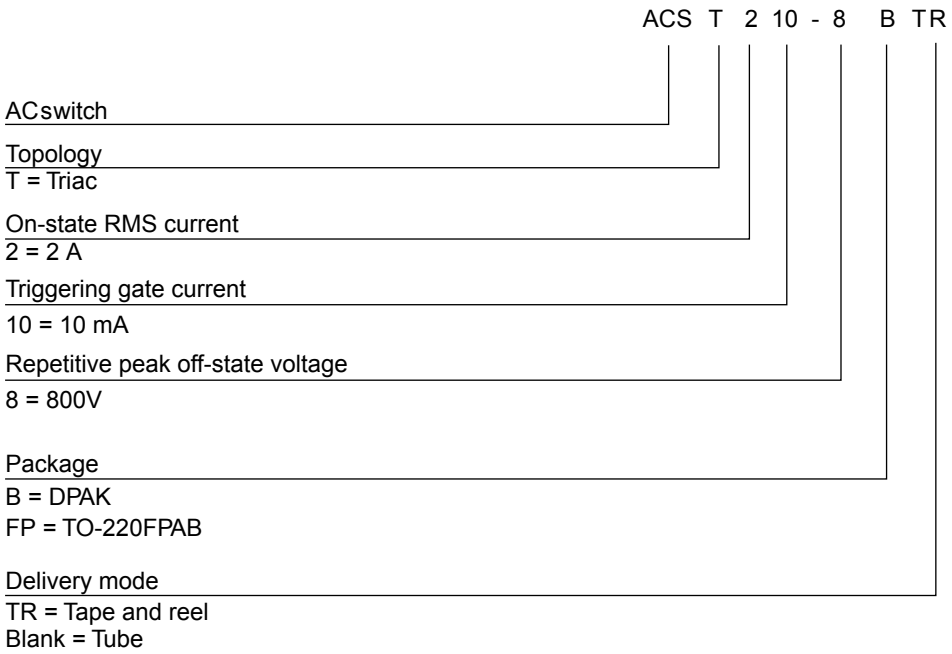


Table 7. **Ordering information**

Order code	Marking	Package	Weight	Base qty.	Packing mode
ACST210-8B	ACST2108	DPAK	0.3 g	50	Tube
ACST210-8BTR		DPAK		2500	Tape and reel
ACST210-8FP		TO-220FPAB	2.4 g	50	Tube

Revision history

Table 8. **Document revision history**

Date	Version	Changes
01-Mar-2007	1	Initial release.
13-Apr-2010	2	Updated ECOPACK statement. Reformatted for consistency with other datasheets in this product class.
01-Jul-2010	3	Updated Figure 22.
24-May-2014	4	Updated DPAK package information and reformatted to current standard.
14-Jun-2017	5	Updated features in cover page and Table 2. Updated Figure 8, Figure 9, Figure 10, Figure 14 and Section 3. Minor text changes.
19-Dec-2019	6	Update DPAK package information.

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