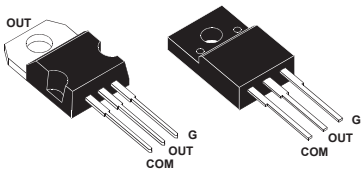
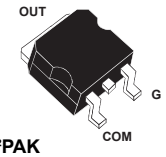
ACST8

Datasheet

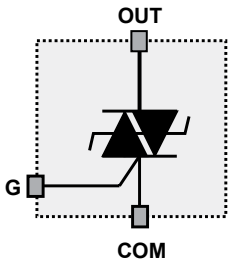
8 A - 800 V overvoltage protected AC switch



TO-220AB TO-220FPAB



D²PAK



Product status link
ACST8

Product summary	
$I_{T(RMS)}$	8 A
V_{DRM}/V_{RRM}	800 V
I_{GT}	30 mA

Features

- Triac with overvoltage protection
- High noise immunity: static dV/dt > 2000 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
  - High immunity against fast transients described in IEC 61000-4-4 standards

Applications

- AC mains static switching in appliance and industrial control systems
- Drive of medium power AC loads such as:
  - Universal drum motor of washing machine
  - Compressor of fridge or air conditioner

Description

The ACST8 series belongs to the ACS/ACST power switch family built around A.S.D. (application specific discrete) technology. This high performance device is suited to home appliances or industrial systems and drives an induction motor up to 8 A.

This ACST8 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.

ACST8 shows a high 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 = 91 °C	8	A
		TO-220AB, D²PAK	T_c = 105 °C		
		D²PAK with 1 cm² copper	T_{amb} = 43 °C	2	
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	80	A
		f = 60 Hz	t_p = 16.7 ms	84	
I^2t	I^2t for fuse selection		t_p = 10 ms	42	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	100	A/µs
V_{PP}[1]	Non repetitive line peak pulse voltage		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 ms)		T_j = 125 °C	10	W
I_{GM}	Peak gate current (t_p = 20 ms)		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) for TO-220FPAB			2000	V

1. *according to test described by standard IEC 61000-4-5 standard and Figure 17*

Table 2. Electrical characteristics per switch

Symbol	Test conditions	Quadrant		Value	Unit
I_{GT} [1]	V_{OUT} = 12 V, R_L = 33 Ω	I - II - III	Max.	30	mA
V_{GT}			Max.	1.0	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} = 500 mA		Max.	30	mA
I_L	I_G = 1.2 x I_{GT}	I - II - III	Max.	50	mA
dV/dt[2]	V_{OUT} = 67% V_{DRM}, gate open, T_j = 125 °C		Min.	2000	V/µs
(dI/dt)c[2]	Without snubber, T_j = 125 °C		Min.	8	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} = 11.3 A, t_p = 500 µs	T_j = 25 °C	Max.	1.5	V
V_{T0} (1)	Threshold voltage	T_j = 125 °C	Max.	0.9	V
R_D (1)	Dynamic resistance	T_j = 125 °C	Max.	50	mΩ
I_{DRM}	V_{OUT} = V_{DRM}/ V_{RRM}	T_j = 25 °C	Max.	20	µA
I_{RRM}		T_j = 125 °C		1	mA

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

Table 4. Thermal characteristics

Symbol	Parameter		Value	Unit
$R_{th(j-a)}$	Junction to ambient	TO-220FPAB, TO-220AB	60	°C/W
	Junction to ambient (soldered on 1cm² copper pad)	D²PAK	45	
$R_{th(j-c)}$	Junction to case (AC)	TO-220FPAB	3.6	
		TO-220AB, D²PAK	2	

1.1 Characteristics (curves)

Figure 1. Maximum power dissipation versus RMS on-state current

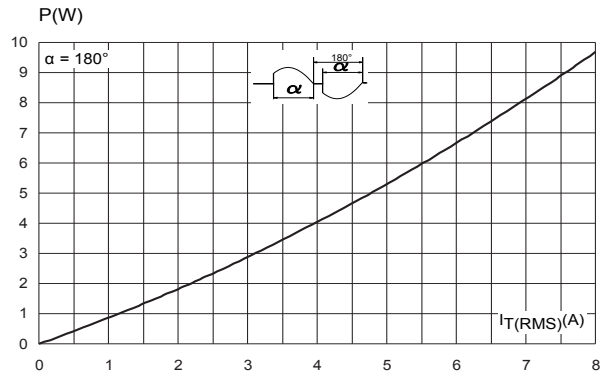


Figure 2. On-state RMS current versus case temperature (full cycle)

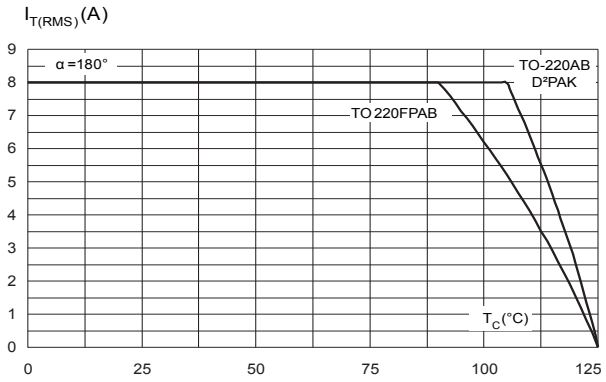


Figure 3. On-state RMS current versus ambient temperature (free air convection, full cycle)

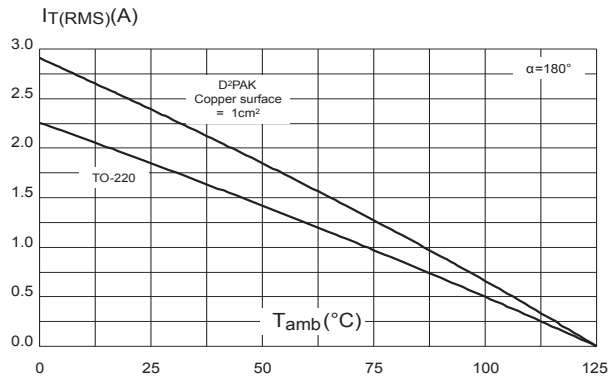


Figure 4. Relative variation of thermal impedance versus pulse duration

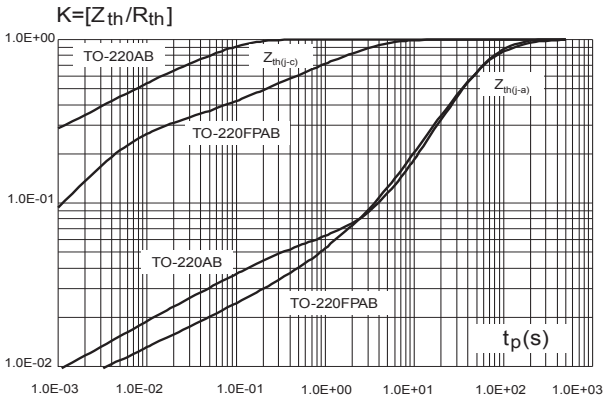


Figure 5. Relative variation of gate trigger current and gate trigger voltage versus junction temperature (typical values)

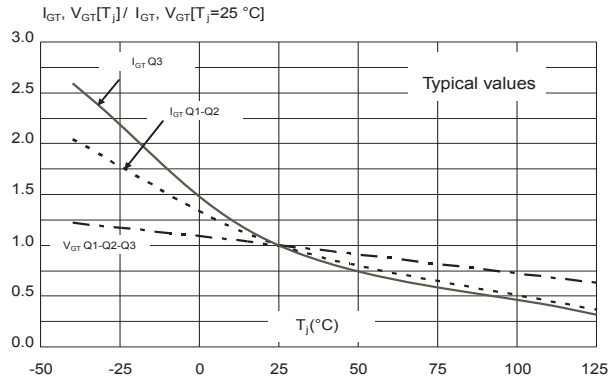


Figure 6. Relative variation of holding current and latching current versus junction temperature (typical values)

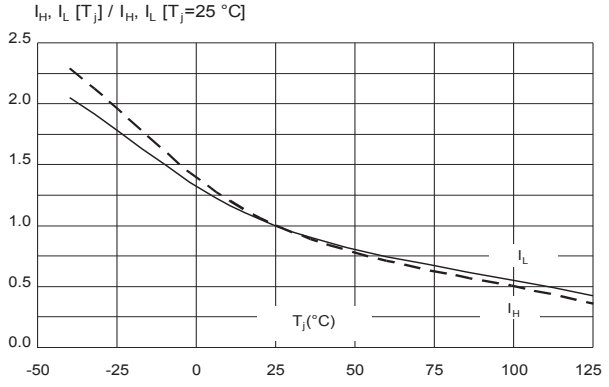


Figure 7. Surge peak on-state current versus number of cycles

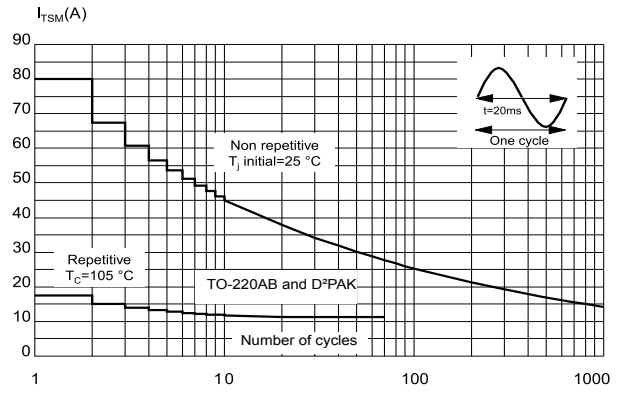


Figure 8. Non repetitive surge peak on-state current for a sinusoidal pulse width

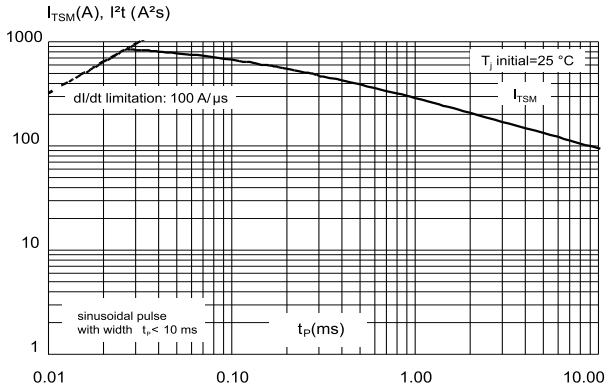


Figure 9. On-state characteristics (maximum values)

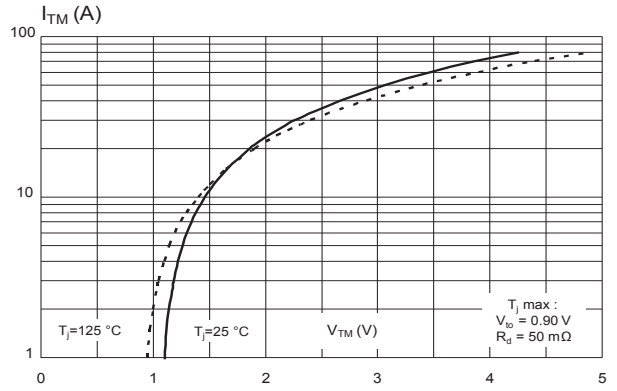


Figure 10. Relative variation of critical rate of decrease of main current (dI/dt)c versus junction temperature

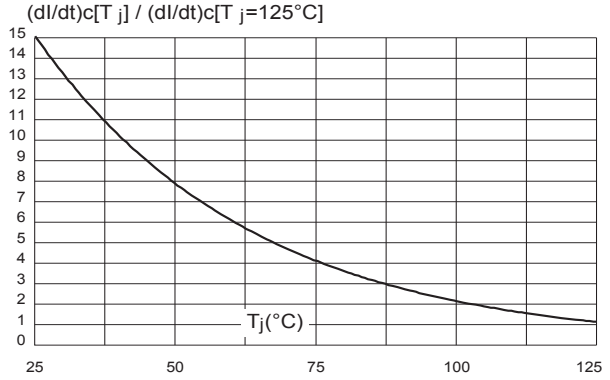


Figure 11. Relative variation of static dV/dt immunity versus junction temperature (gate open)

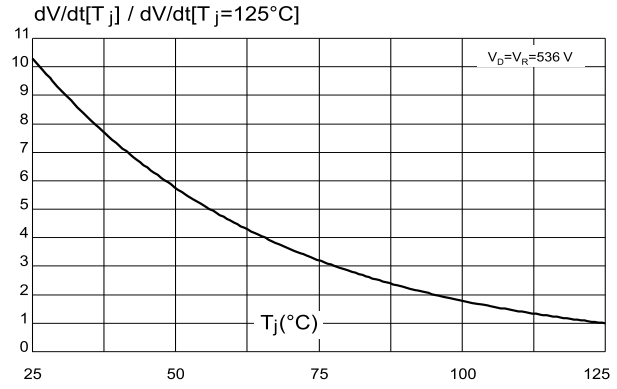


Figure 12. Relative variation of leakage current versus junction temperature

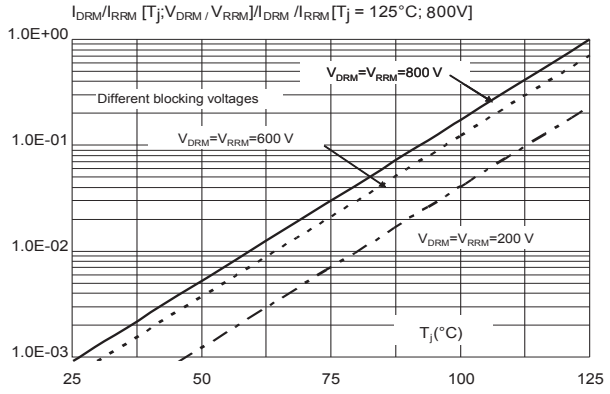


Figure 13. Relative variation of the clamping voltage versus junction temperature (minimum values)

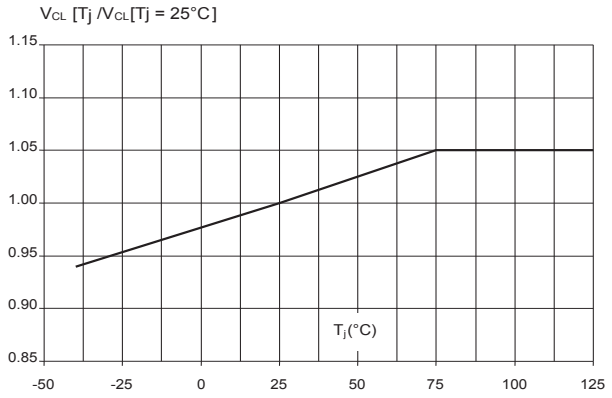
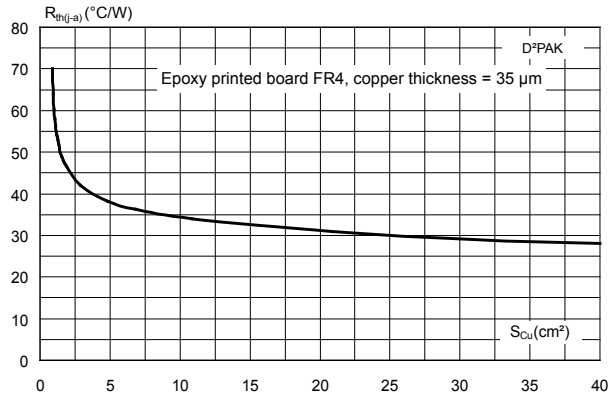


Figure 14. Thermal resistance junction to ambient versus copper surface under tab (typical values)

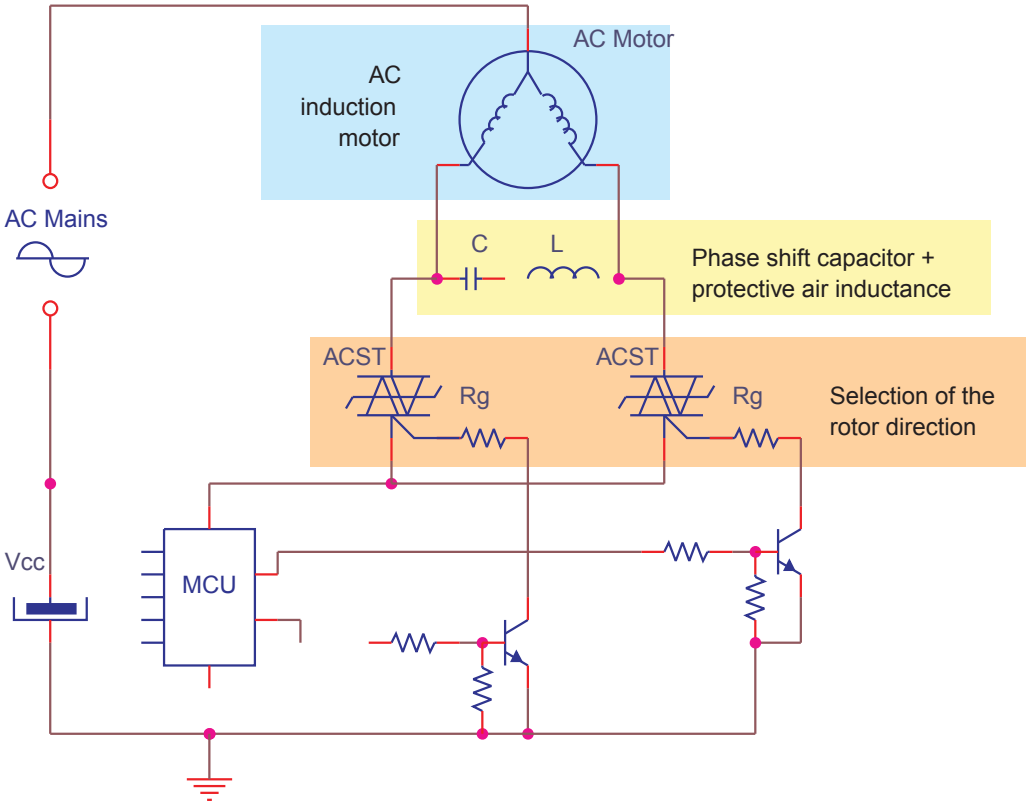


2 Application information

2.1 Typical application descriptions

The ACST8 device has been designed to control medium power load, such as AC motors in home appliances. Thanks to its thermal and turn off commutation performances, the ACST8 switch is able to drive an inductive load up to 8 A with no turn off additional snubber. It also provides high thermal performances in static and transient modes such as high torque operating conditions or inrush current of an AC motor.

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 ACST8 is self-protected against over-voltage, specified by the new parameter V_{CL}. The ACST8 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 17 represents the ACST8 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 ACST8 folds back safely to the on state as shown in Figure 18. The ACST4 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

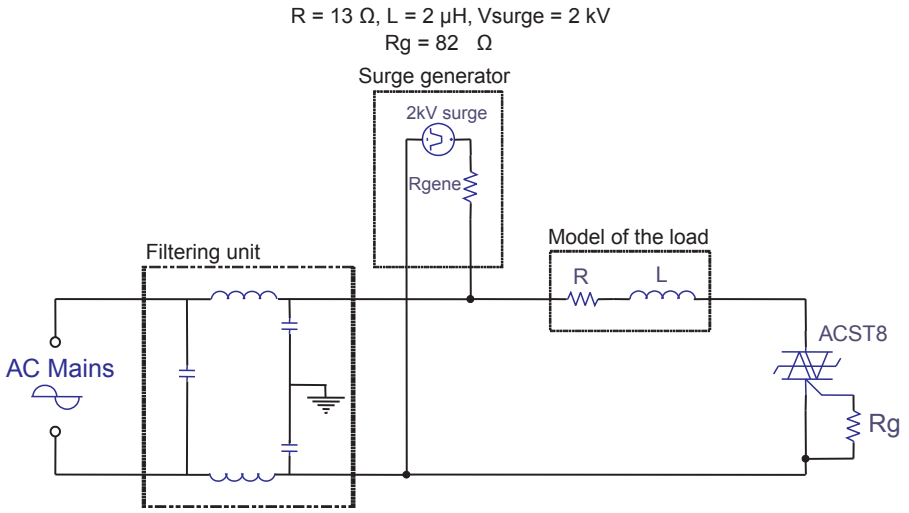
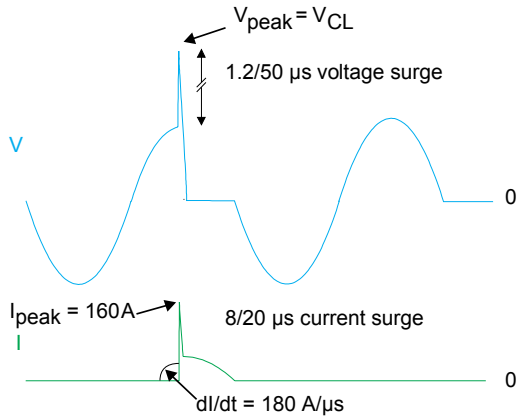


Figure 17. Typical voltage and current waveforms across the ACST8 during IEC 61000-4-5 standard test



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-220AB package information

- Molding compouned resin is halogen free and meets UL94 flammability standard, level V0
- Lead-free package leads plating
- Cooling method: by conduction (C)
- Recommended torque value: 0.55 N·m
- Maximum torque value: 0.70 N·m

Figure 18. TO-220AB package outline

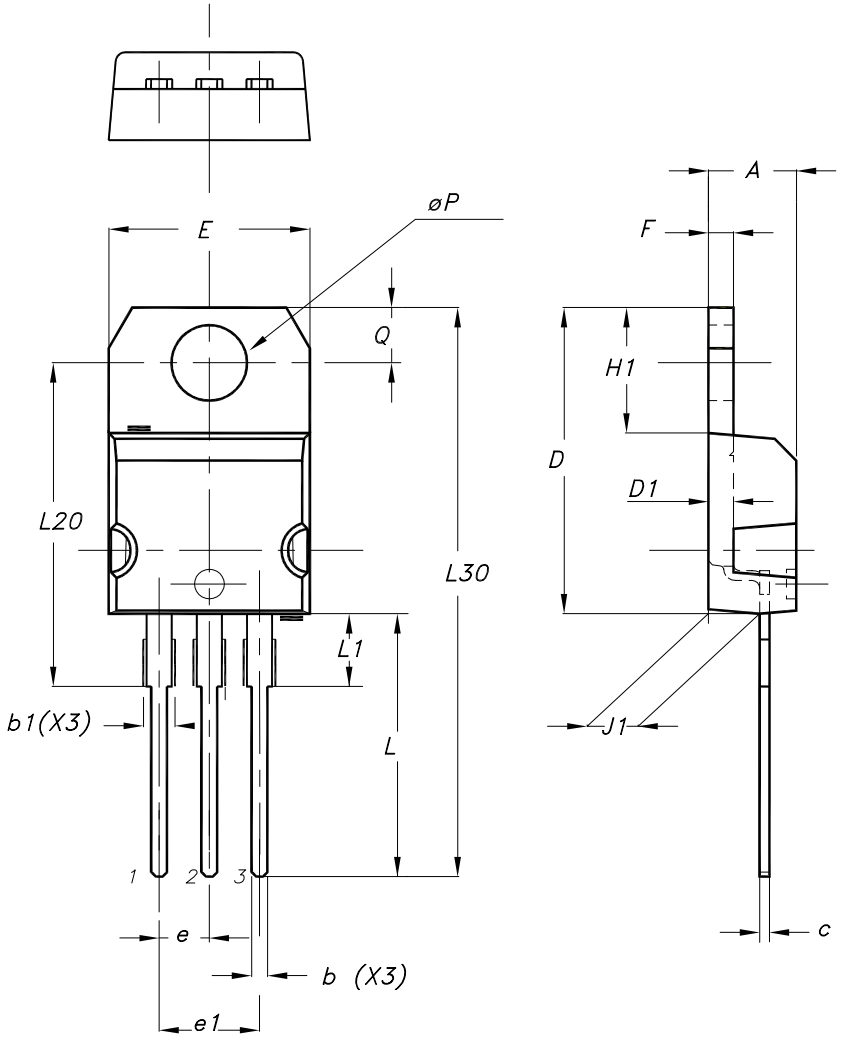


Table 5. **TO-220AB package mechanical data**

Ref.	Dimensions			
	Millimeters		Inches (for reference only)	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.1732	0.1811
b	0.61	0.88	0.0240	0.0346
b1	1.14	1.55	0.0449	0.0610
c	0.48	0.70	0.0189	0.0276
D	15.25	15.75	0.6004	0.6201
D1	1.27 typ.		0.0500 typ.	
E	10.00	10.40	0.3937	0.4094
e	2.40	2.70	0.0945	0.1063
e1	4.95	5.15	0.1949	0.2028
F	1.23	1.32	0.0484	0.0520
H1	6.20	6.60	0.2441	0.2598
J1	2.40	2.72	0.0945	0.1071
L	13.00	14.00	0.5118	0.5512
L1	3.50	3.93	0.1378	0.1547
L20	16.40 typ.		0.6457 typ.	
L30	28.90 typ.		1.1378 typ.	
θP	3.75	3.85	0.1476	0.1516
Q	2.65	2.95	0.1043	0.1161

3.2 TO-220FPAB package information

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

Figure 19. **TO-220FPAB package outline**

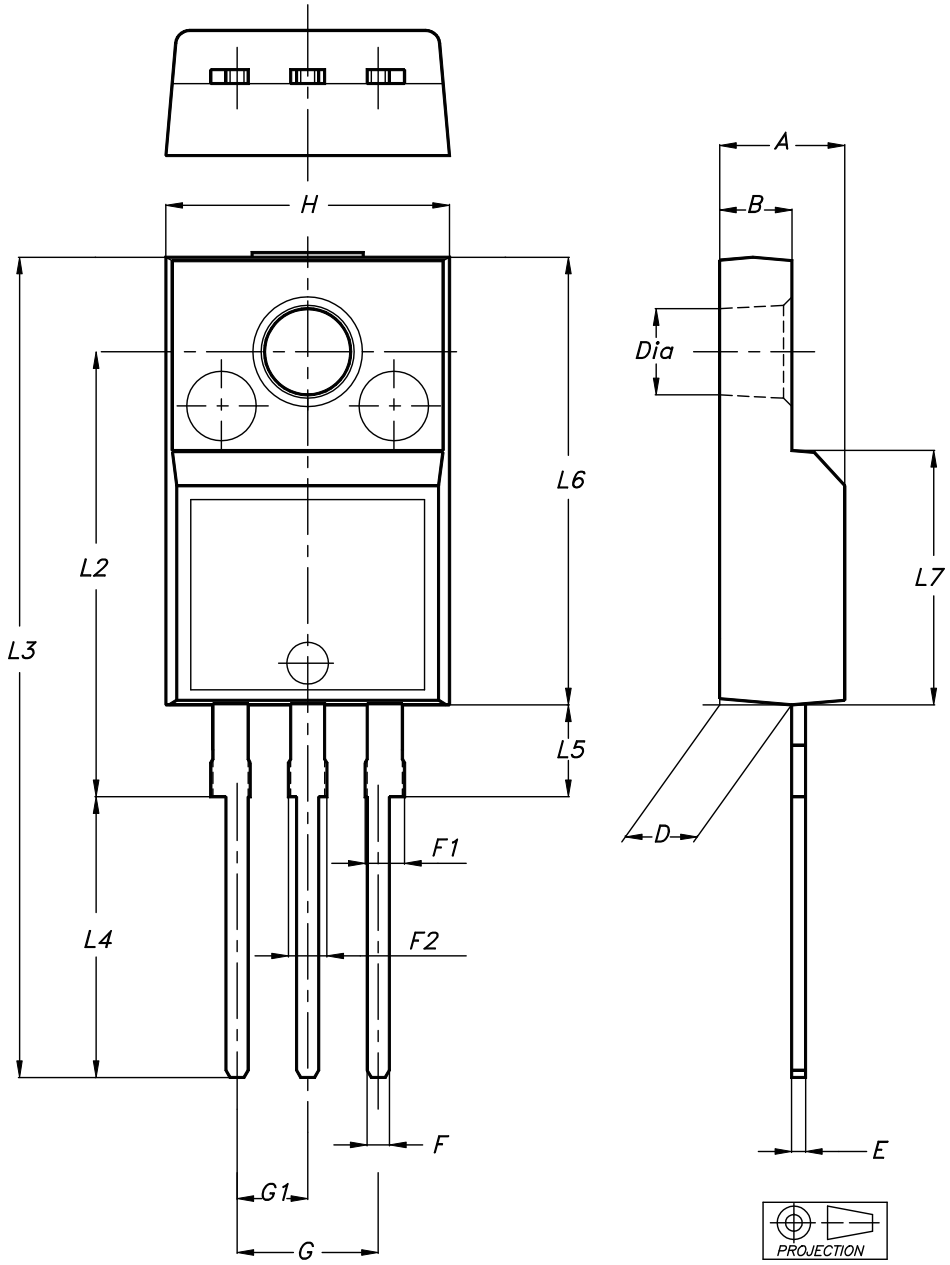


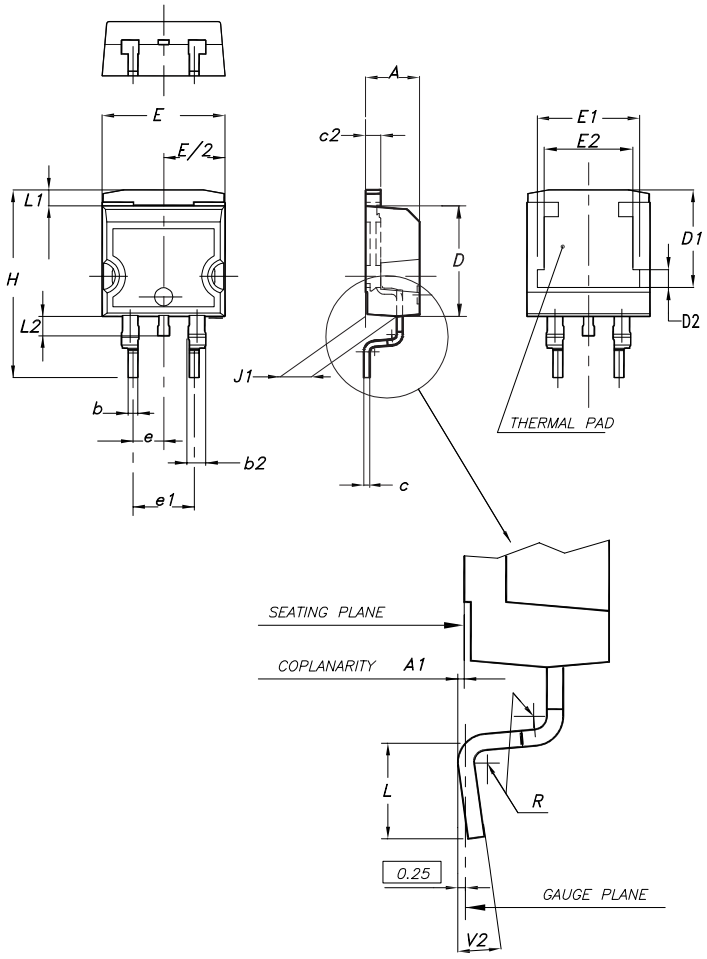
Table 6. **TO-220FPAB package mechanical data**

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

3.3 D²PAK package information

- Epoxy meets UL94, V0.
- Cooling method: by conduction (C)

Figure 20. D²PAK package outline

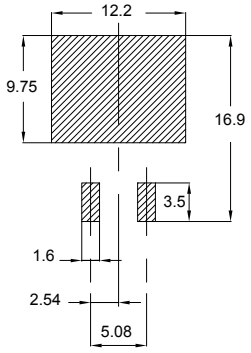


Note: This package drawing may slightly differ from the physical package. However, all the specified dimensions are guaranteed.

Table 7. **D²PAK package mechanical data**

Ref.	Dimensions					
	Millimeters			Inches (for reference only)		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.028		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.018		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50	7.75	8.00	0.295	0.305	0.315
D2	1.10	1.30	1.50	0.043	0.051	0.060
E	10.00		10.40	0.394		0.409
E1	8.30	8.50	8.70	0.335	0.343	0.346
E2	6.85	7.05	7.25	0.266	0.278	0.282
e		2.54			0.100	
e1	4.88		5.28	0.190		0.205
H	15.00		15.85	0.591		0.624
J1	2.49		2.69	0.097		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.049		0.055
L2	1.30		1.75	0.050		0.069
R		0.40			0.015	
V2	0°		8°	0°		8°

Figure 21. **D²PAK recommended footprint (dimensions are in mm)**



4 Ordering information

Figure 22. **Ordering information scheme**

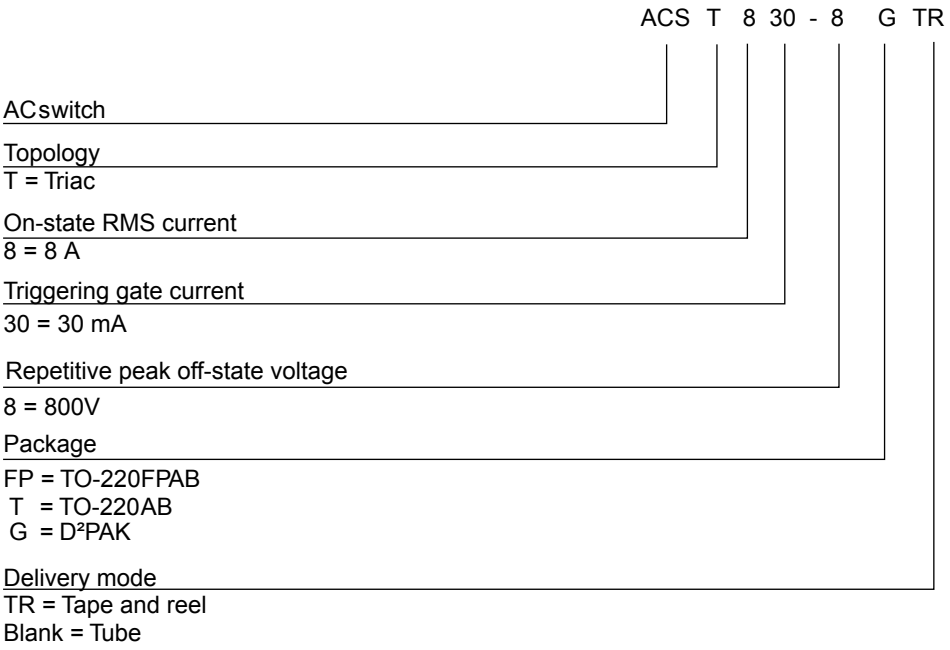


Table 8. **Ordering information**

Order code	Marking	Package	Weight	Base qty.	Packing mode
ACST830-8FP	ACST8308	TO-220FPAB	2.4 g	50	Tube
ACST830-8T		TO-220AB	2.3 g	50	Tube
ACST830-8GTR		D²PAK	1.5 g	1000	Tape and reel

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
Jan-2002	4B	Last update.
08-Nov-2004	5	TO-220AB and D²PAK packages added.
24-Nov-2004	6	Table 6 page 3: I_{GT} parameter added.
18-Dec-2009	7	Added ECOPACK statement. Reformatted for consistency with other datasheets in this product class. Order codes updated.
01-Jul-2010	8	Updated Figure 19.
07-Feb-2011	9	Updated Table 2.
04-Sep-2017	10	Updated features in cover page and Table 2. Updated Section 4: Package information. Minor text changes.
29-Sep-2021	11	Updated D²PAK package information.

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