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ACST8

Overvoltage protected AC switch

Features

- Triac with overvoltage protection
- High noise immunity: static dV/dt > 2000 V/µs
- TO-220FPAB insulated package: 1500 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 motor of washing machine drum
  - Compressor for 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 device 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).

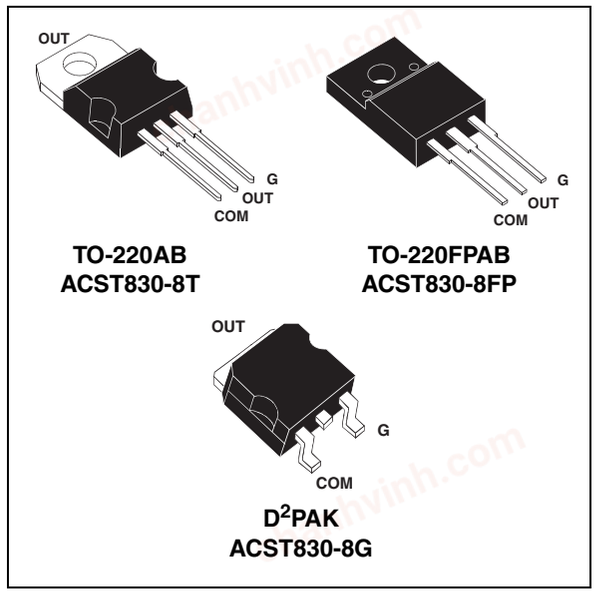


Figure 1. Functional diagram

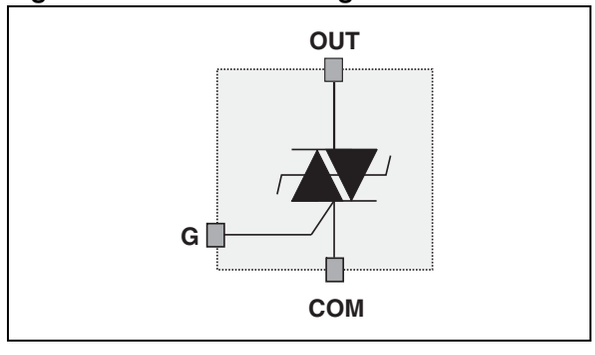


Table 1. Device summary

Symbol	Value	Unit
$I_{T(RMS)}$	8	A
V_{DRM}/V_{RRM}	800	V
I_{GT}	30	mA

TM: ACS is a trademark of STMicroelectronics.
®: A.S.D. is a registered trademark of STMicroelectronics

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1 Characteristics

Table 2. Absolute ratings (limiting values)

Symbol	Parameter			Value	Unit
$I_{T(RMS)}$	On-state rms current (full sine wave)	TO-220FPAB	T_{case} = 91 °C	8	A
		TO-220AB / D^2PAK	T_{case} = 105 °C		
		D^2PAK with 1 cm2 Cu	T_{amb} = 43 °C	2	A
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	A
I^2t	Thermal constraint for fuse selection		t_p = 10 ms	42	A^2s
dI/dt	Critical rate of rise on-state current I_G = 2 x $I_{GT,}$ ($t_r \leq$ 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	Maximum lead soldering temperature during 10 s			260	°C
$V_{INS(RMS)}$	Insulation rms voltage	TO-220FPAB		1500	V

1. According to test described in IEC 61000-4-5 standard and *Figure 18.*

Table 3. Electrical characteristics per switch

Symbol	Test conditions	Quadrant	T_j		Value	Unit
I_{GT}(1)	V_{OUT} = 12 V, R_L = 33 Ω	I - II - III	25 °C	Max	30	mA
V_{GT}	V_{OUT} = 12V, R_L = 33 Ω	I - II - III	25 °C	Max	1.0	V
V_{GD}	V_{OUT} = V_{DRM}, R_L = 3.3 kΩ	I - II - III	125 °C	Min	0.2	V
I_H(2)	I_{OUT} = 500 mA		25 °C	Max	30	mA
I_L	I_G = 1.2 x I_{GT}	I - II - III	25 °C	Max	50	mA
dV/dt(2)	V_{OUT} = 67% V_{DRM}, gate open		125 °C	Min	2000	V/µs
(dI/dt)c(2)	Without snubber		125 °C	Min	8	A/ms
V_{CL}	I_{CL} = 0.1 mA, t_p = 1 ms		25 °C	Min	850	V

1. Minimum I_{GT} is guaranteed at 5% of $I_{GT(Max)}$
2. For either positive or negative polarity of OUT pin with reference to COM pin

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Table 4. Static characteristics

Symbol	Test conditions			Value	Unit
V_{TM}	I_{TM} = 11.3 A t_p = 500 µs	Tj = 25 °C	Max	1.5	V
V_{TO}	Threshold voltage	Tj = 125 °C	Max	0.9	V
R_D	Dynamic resistance	Tj = 125 °C	Max	50	mΩ
I_{DRM} I_{RRM}	V_{OUT} = V_{DRM} / V_{RRM}	Tj = 25 °C	Max	20	µA
		Tj = 125 °C		1	mA

Table 5. Thermal resistances

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

Figure 2. Maximum power dissipation versus on-state rms current

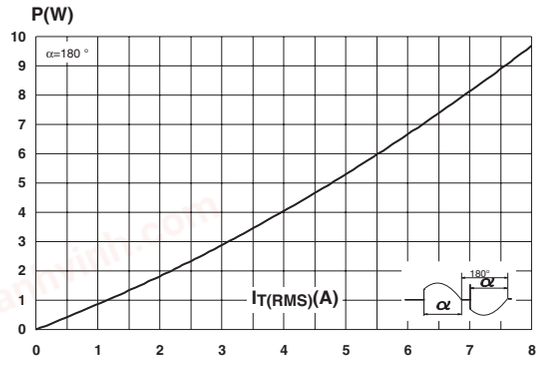
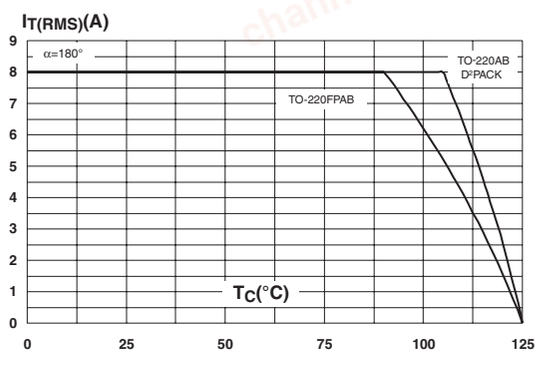


Figure 3. On-state rms current versus case temperature (full cycle)



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Figure 4. On-state rms current versus ambient temperature (free air convection, fulle cycle)

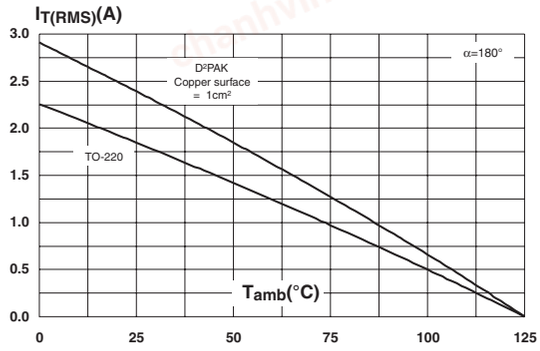


Figure 5. Relative variation of thermal impedance versus pulse duration

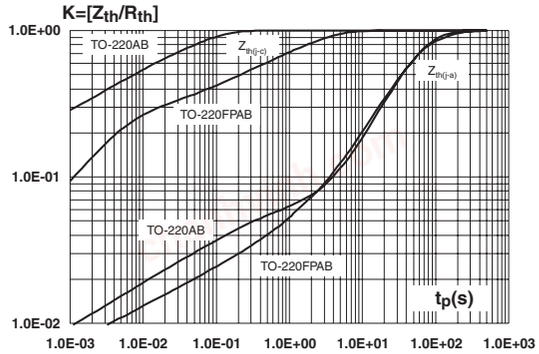


Figure 6. Relative variation of gate trigger current (I_{GT}) and voltage (V_{GT}) versus junction temperature

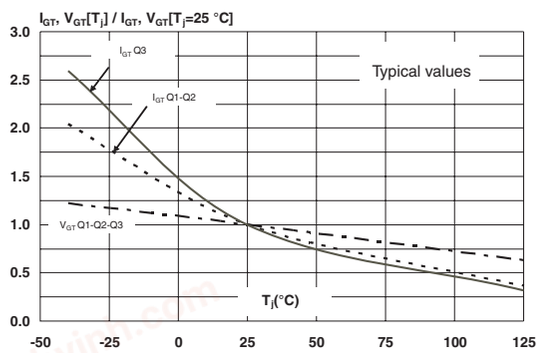


Figure 7. Relative variation of holding current (I_H) and latching current (I_L) versus junction temperature

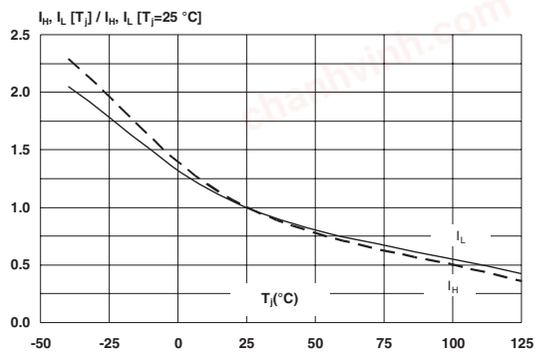


Figure 8. Surge peak on-state current versus number of cycles

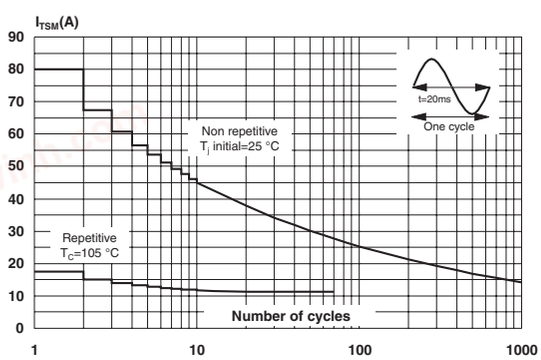
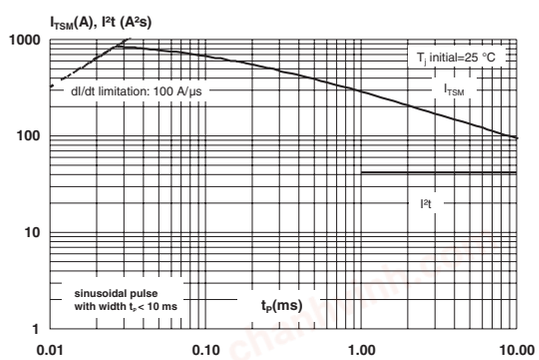


Figure 9. Non repetitive surge peak on-state current and corresponding value of I^2t versus sinusoidal pulse width



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Figure 10. On-state characteristics (maximum values)

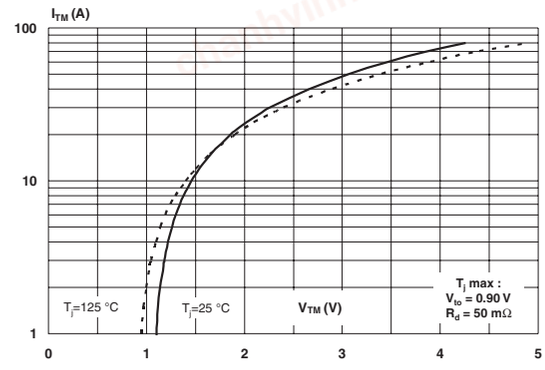


Figure 11. Relative variation of critical rate of decrease of main current $(dI/dt)_c$ versus junction temperature

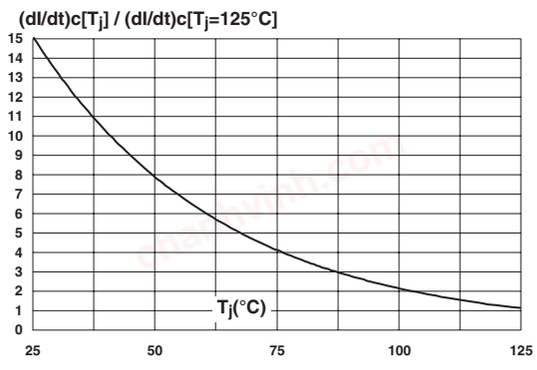


Figure 12. Relative variation of static dV/dt immunity versus junction temperature (gate open)

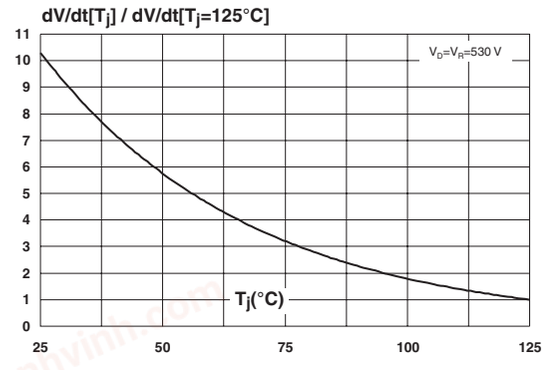


Figure 13. Relative variation of leakage current versus junction temperature

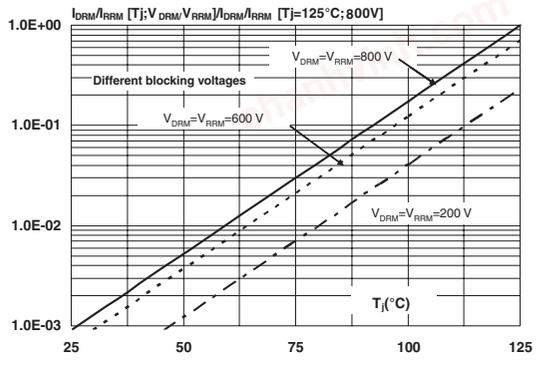


Figure 14. Relative variation of clamping voltage (V_{CL}) versus junction temperature (minimum values)

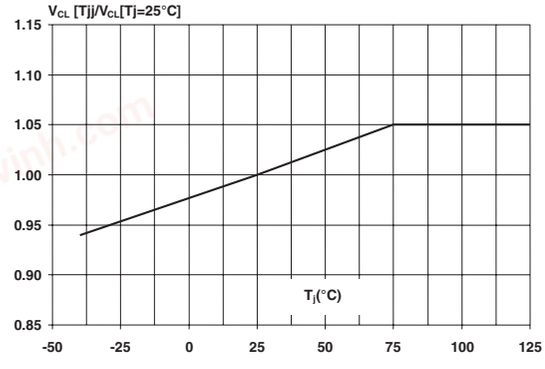
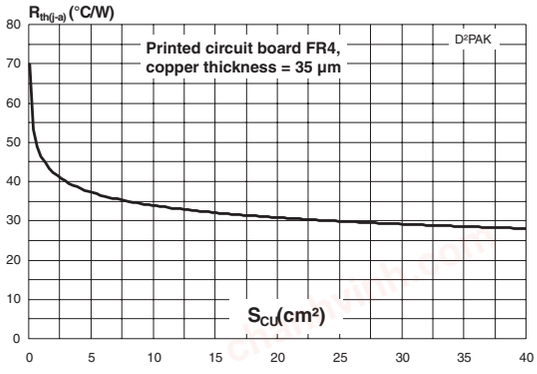


Figure 15. Thermal resistance junction to ambient versus copper surface under tab



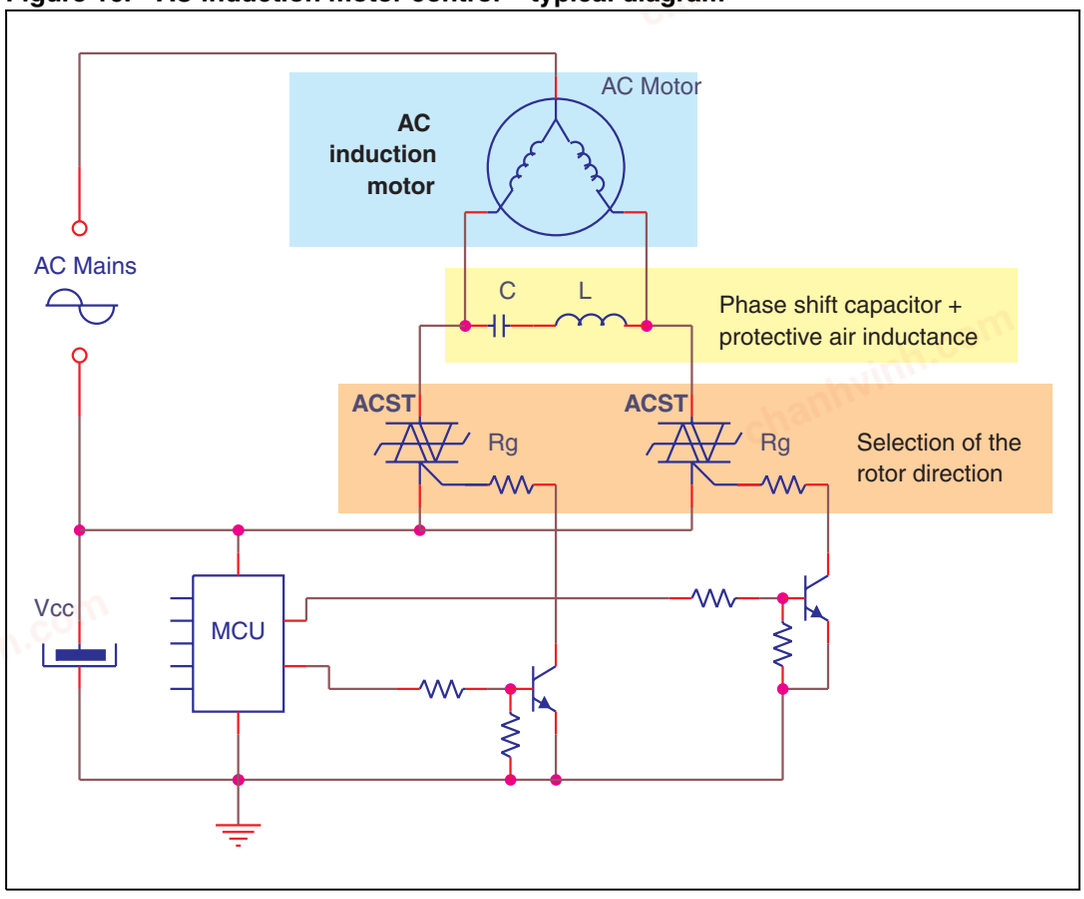
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2 Application information

2.1 Typical application description

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 16. AC induction motor control – typical diagram



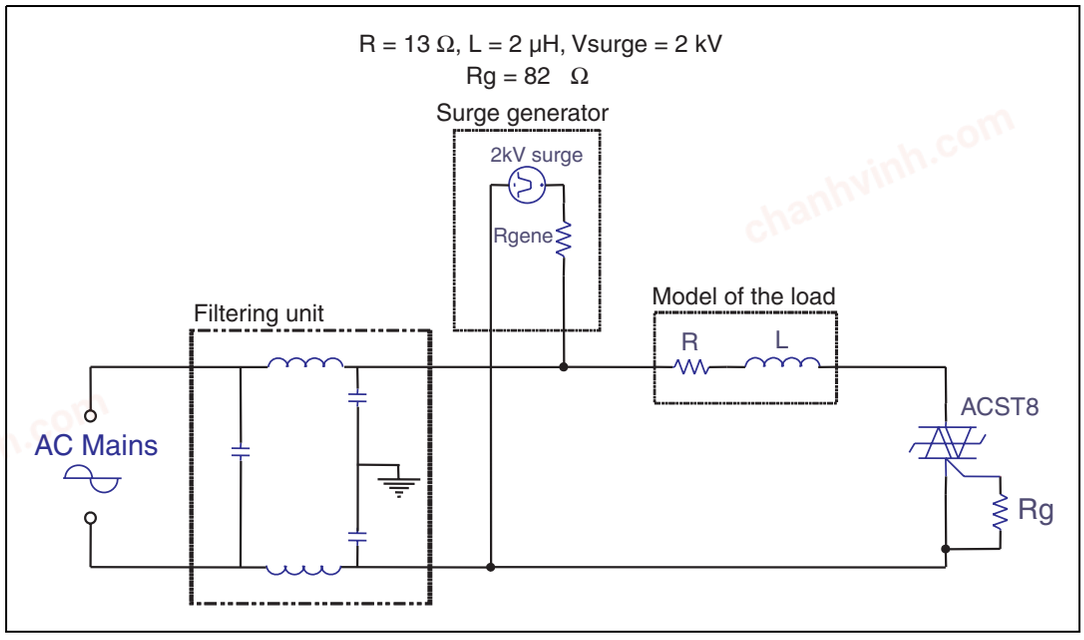
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2.2 AC line transient voltage ruggedness

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.

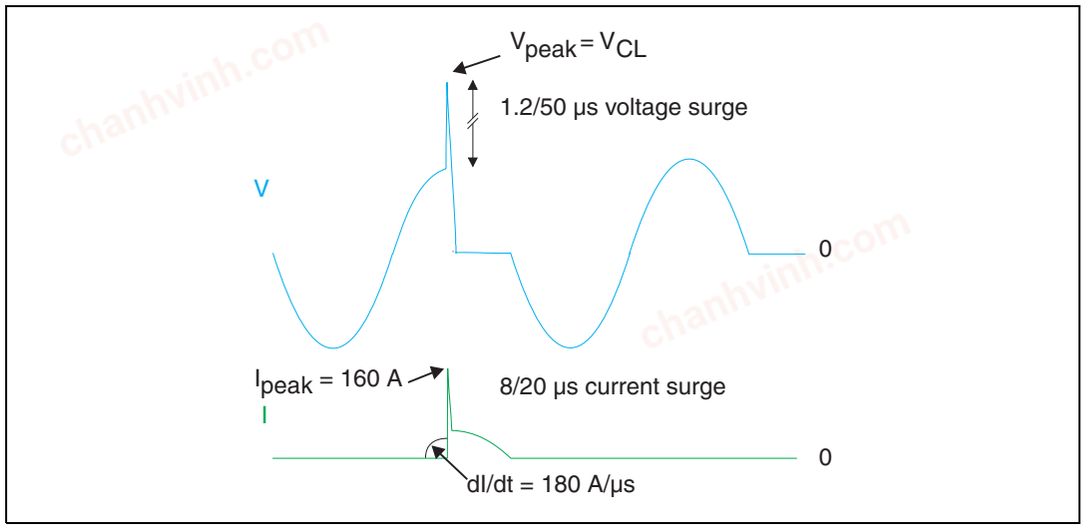
The test circuit of *Figure 17* represents the ACST8 application, and is used to stress the ACST switch according to the IEC 61000-4-5 standard conditions. With the additional effect of the load which is limiting the current, the ACST switch withstands the voltage spikes up to 2 kV on top of the peak 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 ACST8 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 17. Overvoltage ruggedness test circuit for resistive and inductive loads for IEC 61000-4-5 standards



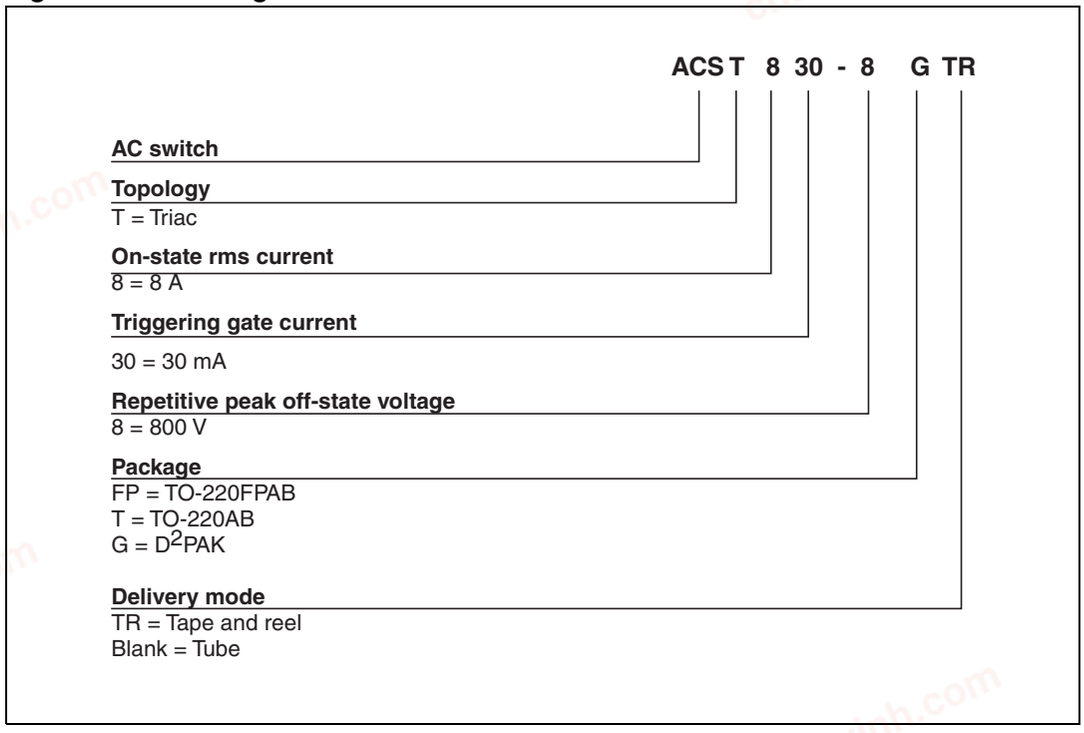
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Figure 18. Typical current and voltage waveforms across the ACST8 during IEC 61000-4-5 standard test



3 Ordering information scheme

Figure 19. Ordering information scheme



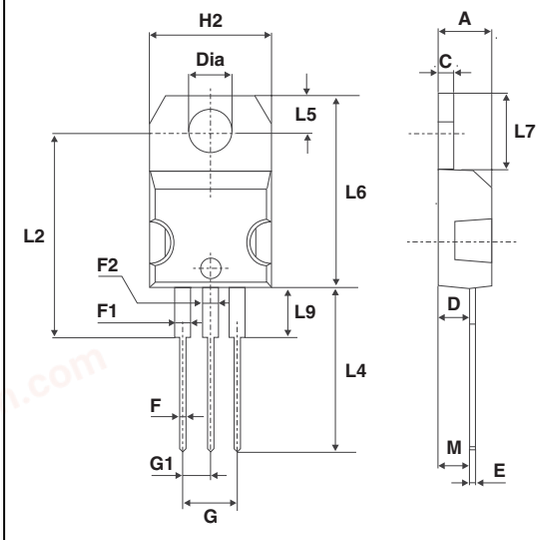
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4 Package information

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

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.

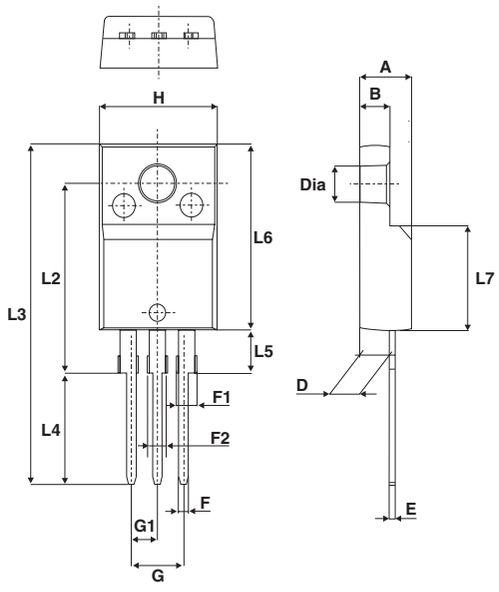
Table 6. TO-220AB dimensions



Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
C	1.23	1.32	0.048	0.051
D	2.40	2.72	0.094	0.107
E	0.49	0.70	0.019	0.027
F	0.61	0.88	0.024	0.034
F1	1.14	1.70	0.044	0.066
F2	1.14	1.70	0.044	0.066
G	4.95	5.15	0.194	0.202
G1	2.40	2.70	0.094	0.106
H2	10	10.40	0.393	0.409
L2	16.4 typ.		0.645 typ.	
L4	13	14	0.511	0.551
L5	2.65	2.95	0.104	0.116
L6	15.25	15.75	0.600	0.620
L7	6.20	6.60	0.244	0.259
L9	3.50	3.93	0.137	0.154
M	2.6 typ.		0.102 typ.	
Diam.	3.75	3.85	0.147	0.151

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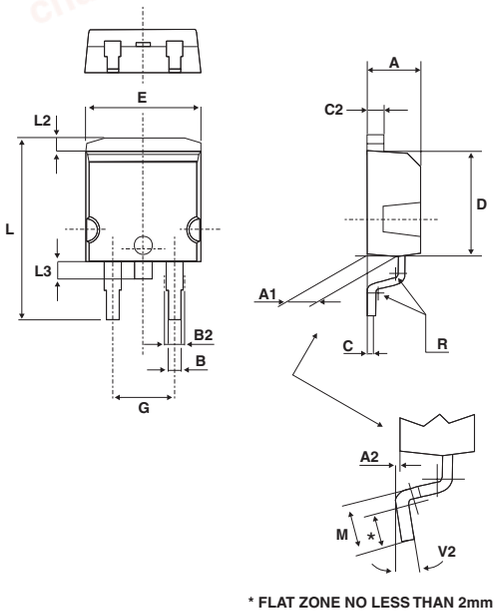
Table 7. TO-220FPAB dimensions



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
Diam.	3.00	3.20	0.118	0.126

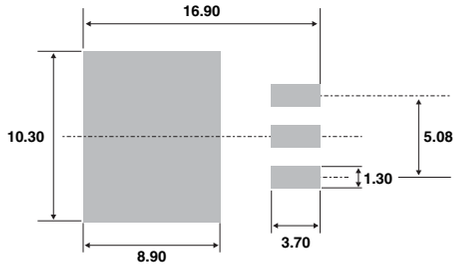
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Table 8. D²PAK dimensions



Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
A1	2.49	2.69	0.098	0.106
A2	0.03	0.23	0.001	0.009
B	0.70	0.93	0.027	0.037
B2	1.14	1.70	0.045	0.067
C	0.45	0.60	0.017	0.024
C2	1.23	1.36	0.048	0.054
D	8.95	9.35	0.352	0.368
E	10.00	10.40	0.393	0.409
G	4.88	5.28	0.192	0.208
L	15.00	15.85	0.590	0.624
L2	1.27	1.40	0.050	0.055
L3	1.40	1.75	0.055	0.069
M	2.40	3.20	0.094	0.126
R	0.40 typ.		0.016 typ.	
V2	0°	8°	0°	8°

Figure 20. Footprint (dimensions in mm)



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5 Ordering information

Table 9. 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		D^2PAK	1.5 g	500	Tape and reel

6 Revision history

Table 10. Document revision history

Date	Revision	Changes
Jan-2002	4B	Last update.
08-Nov-2004	5	TO-220AB and D^2PAK 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.*

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