

ACST10

Overvoltage protected AC switch

Features

- Triac with overvoltage crowbar technology
- Low I_{GT} (< 10 mA) or high immunity (I_{GT} < 35 mA) version</p>
- 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
- Need no external over voltage protection
- Reduces the power passive component count
- High immunity against fast transients described in IEC 61000-4-4 standards

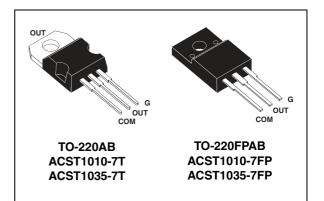
Applications

- 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 ACST10 series belongs to the ACS™/ACST power switch family built with A.S.D.[®] (application specific discrete) technology. This high performance device is suited to home appliances or industrial systems, and drives loads up to 10 A.

This ACST10 switch has a Triac structure and a high voltage clamping device to absorb the inductive turn-off energy and withstand transients such as those described in the IEC 61000-4-5 standard. The ACST1010-7 needs a low gate current to be activated ($I_{GT} < 10$ mA) and still shows a high noise immunity complying with IEC 61000-4-4 standard. The ACST1035-7 offers a high static dV/dt immunity of 2 kV/µs minimum.





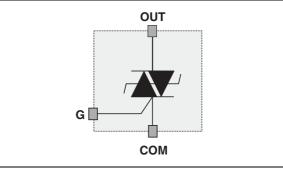


Table 1.Device summary

Symbol	Value	Unit
I _{T(RMS)}	10	А
V _{DRM} /V _{RRM}	700	V
I _{GT}	10 or 35	mA

TM: ACS is a trademark of STMicroelectronics

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

1 Characteristics

Symbol	Parameter			Value	Unit
	On state time surrent (full size ways)	TO-220AB	T _c = 105 °C	10	А
I _{T(RMS)}	On-state rms current (full sine wave)	TO-220FPAB	T _c = 84 °C	10	A
	Non repetitive surge peak on-state current	F = 60 Hz	t _p = 16.7 ms	105	А
ITSM	T_j initial = 25 °C, (full cycle sine wave)	F = 50 Hz	t _p = 20 ms	100	А
l ² t	I ² t for fuse selection		t _p = 10 ms	66	A ² s
dl/dt	Critical rate of rise on-state current $I_G = 2 \times I_{GT}$, (t _r ≤ 100 ns)	E = 120 Hz		100	A/µs
V _{PP}	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 ($t_p = 20 \ \mu s$)	T _j = 125 °C	10	W	
I _{GM}	Peak gate current (t _p = 20 µs)	1.6	А		
T _{stg}	Storage temperature range	-40 to +150	°C		
Тј	Operating junction temperature range	-40 to +125	°C		
Τ _Ι	Maximum lead solder temperature during 10 ms (at 3 mm from case)			260	°C
V _{INS(RMS)}	Insulation rms voltage		T0-220FPAB	1500	V

Table 2. Absolute ratings (limiting values)

1. According to test described in IEC 61000-4-5 standard and Figure 17

Table 3.Electrical characteristics

Table 5.		1131103					
Symbol	Test conditions Quadrant		Ŧ		Va	lue	Unit
Symbol	Test conditions	Quadrant	Тј		ACST1010-7	ACST1035-7	Unit
I _{GT} ⁽¹⁾	V_{OUT} = 12 V, R _L = 33 Ω	- -	25 °C	MAX.	10	35	mA
V _{GT}	V_{OUT} = 12 V, R _L = 33 Ω	- -	25 °C	MAX.	1.0		V
V _{GD}	$V_{OUT} = V_{DRM}, R_L = 3.3 \Omega$ I - II - III		125 °C	MIN.	0.2		V
I _H (2)	I _{OUT} = 500 mA		25 °C	MAX.	30	50	mA
١L	l _G = 1.2 x l _{GT}	- -	25 °C	MAX.	50	70	mA
dV/dt ⁽²⁾	V _{OUT} = 67 % V _{DRM} , gate open		125 °C	MIN.	200	2000	V/µs
(dl/dt)c ⁽²⁾	(dV/dt)c = 15 V/µs	125 °C		MIN.	4.4		A/ms
	Without snubber	125	125 0	IVIIIN.		12	7/115
V _{CL}	$I_{CL} = 0.1 \text{ mA}, t_p = 1 \text{ ms}$		25 °C	MIN.	8	50	V

1. Minimum I_{GT} is guaranteed at 5% of I_{GT} max

2. For both polarities of OUT pin referenced to COM pin



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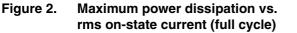
Symbol	Test conditions			Value	Unit
V _{TM} ⁽¹⁾	I _{OUT} = 14.1 A, t _p = 500 μs	T _j = 25 °C	MAX.	1.5	V
V _{T0} ⁽¹⁾	Threshold voltage	T _j = 125 °C	MAX.	0.9	V
R _d ⁽¹⁾	Dynamic resistance	T _j = 125 °C	MAX.	35	mΩ
I _{DRM}		T _j = 25 °C	MAX.	20	μA
$V_{OUT} = V_{DRM} / V_{RRM}$	VOUT - VDRM/ VRRM	T _j = 125 °C	MAX.	1.2	mA

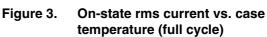
Table 4. Static characteristics

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

Table 5. **Thermal characteristics**

Symbol	Parameter		Value	Unit
Р	Junction to case (AC)	TO-220AB	1.7	°C/W
R _{th(j-c)} Junction t	Sunction to case (AC)	TO-220FPAB	3.5	°C/W
R _{th(j-a)}	Junction to ambient	TO-220AB TO-220FPAB	60	°C/W





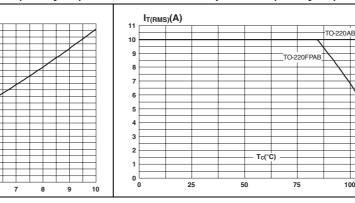
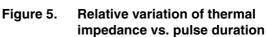


Figure 4. On-state rms current vs. ambient temperature (free air convection full cycle)

I_{T(RMS)}(A)

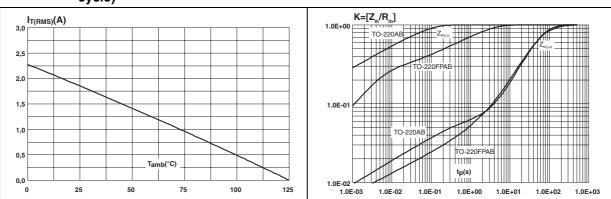
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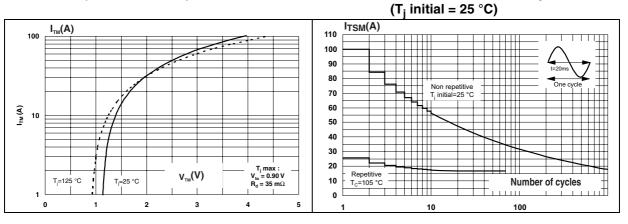


Figure 7.

Figure 8. Non repetitive surge peak on-state Figure 9. current for a sinusoidal pulse and corresponding value of I²t

Relative variation of gate triggering current (I_{GT}) and gate triggering voltage vs. junction temperature

Non repetitive surge peak on-state current vs. number of cycles

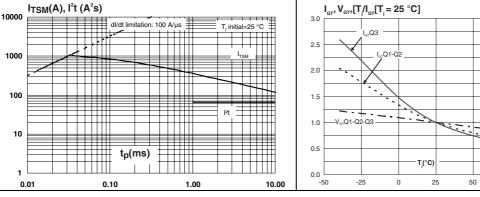


Figure 10. Relative variation of holding (I_H) and latching current (I₁) vs. junction temperature

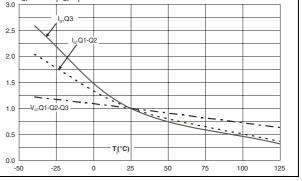


Figure 11. Relative variation of critical rate of decrease of main current (di/dt)c vs. (dV/dt)c

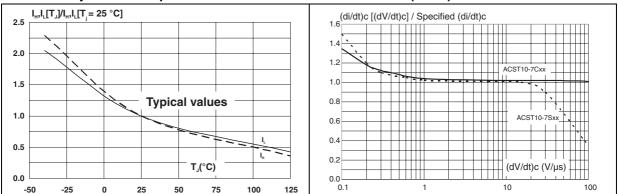




Figure 12. Relative variation of critical rate of Figure 13. Relative variation of static dV/dt vs. decrease of main current (di/dt)c vs. junction temperature

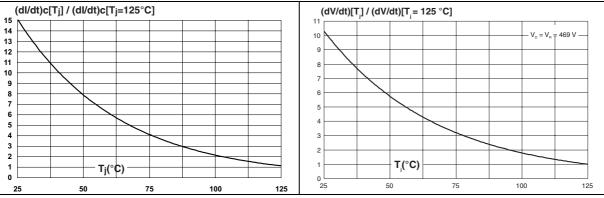
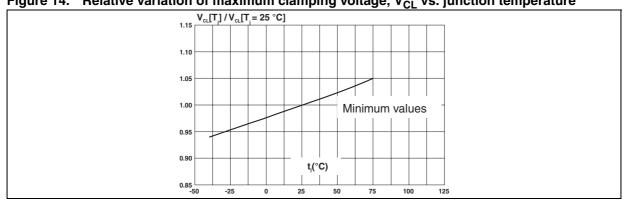


Figure 14. Relative variation of maximum clamping voltage, V_{CL} vs. junction temperature



junction temperature



2 Application information

2.1 Typical application description

The ACST10 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 ACST10 switch is able to drive an inductive load up to 10 A with no turn off additional snubber. It also provides high thermal performances in static and transient modes such as the compressor inrush current or high torque operating conditions of an AC motor. Thanks to its low gate triggering current level, the ACST1010-7 can be driven directly by an MCU through a simple gate resistor as shown *Figure 15*.

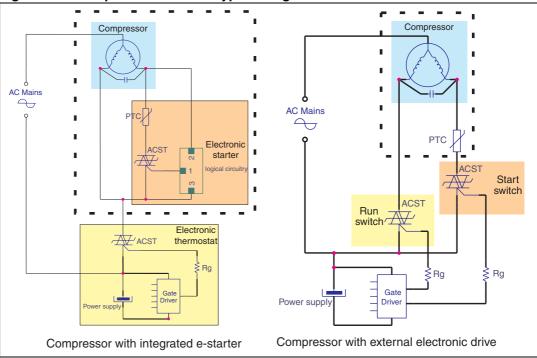


Figure 15. Compressor control – typical diagram



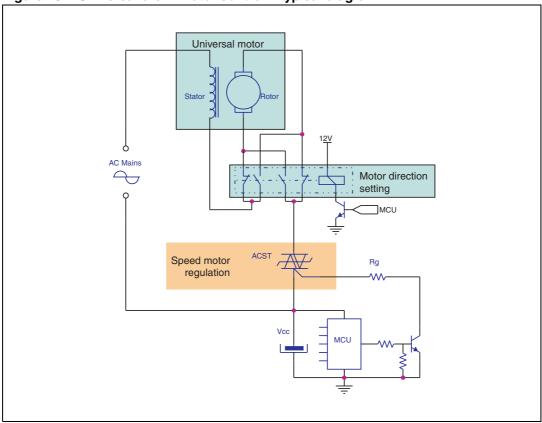


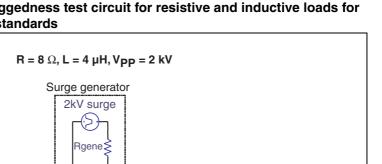
Figure 16. Universal drum motor control – typical diagram

2.2 AC line transient voltage ruggedness

In comparison with standard Triacs, which are not robust against surge voltage, the ACST10 is self-protected against over-voltage, specified by the new parameter V_{CL} . The ACST10 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 ACST10 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 ACST10 folds back safely to the on state as shown in *Figure 18*. The ACST10 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.





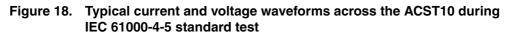
Model of the load

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Figure 17. Overvoltage ruggedness test circuit for resistive and inductive loads for IEC 61000-4-5 standards



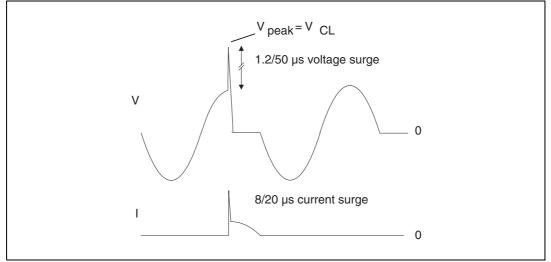
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3 Ordering information scheme

Figure 19	Ordering	information	scheme
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AC switch	
TeTriac	
On-state rms current 10 = 10 A	
Sensitivity	
10 = 10 mA 35 = 35 mA	
Voltage	
7 = 700 V	
Package	
FP = TO-220FPAB T = TO-220AB	

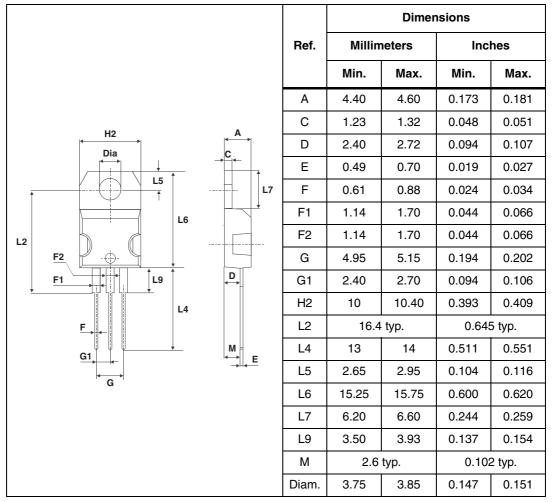


4 Package information

- 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: <u>www.st.com</u>. ECOPACK[®] is an ST trademark.

Table 6. TO-220AB dimensions





			Dimer	nsions	
	Ref.	Millimeters		Inches	
		Min.	Max.	Min.	Max.
	А	4.4	4.6	0.173	0.181
	В	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
Dia	F	0.75	1	0.030	0.039
	F1	1.15	1.50	0.045	0.059
L2 L7	F2	1.15	1.50	0.045	0.059
	G	4.95	5.20	0.195	0.205
	G1	2.4	2.7	0.094	0.106
$\int \int \int \frac{1}{1+\frac{1}{2}} \frac{F_1}{F_1} = \frac{D_2}{2} \frac{1}{2} \frac{F_1}{2} $	Н	10	10.4	0.393	0.409
L4 → ← <u>F2</u>	L2	16 Тур.		0.63 Тур.	
↓ ↓ ↓ ↓ ↓ │ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓	L3	28.6	30.6	1.126	1.205
G1 →⊔←=	L4	9.8	10.6	0.386	0.417
G	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

Table 7. TO-220FPAB dimensions



5 Ordering information

Table 8. Ordering information

Order code	Marking	Package	Weight	Base qty	Packing mode
ACST1010-7T	ACST10107	TO-220AB	2.3 g	50	Tube
ACST1010-7FP	ACSTICIO	TO-220FPAB	2.3 g	50	Tube
ACST1035-7T	ACST10357	TO-220AB	2.3 g	50	Tube
ACST1035-7FP	ACG110357	TO-220FPAB	2.3 g	50	Tube

6 Revision history

Table 9.Document revision history

Date	Revision	Changes
02-Dec-2008	1	First issue
13-Apr-2009	2	Updated ECOPACK statement. Reformatted for consistency with other datasheets in this product class.
01-Jul-2010	3	Updated order code in Table 3.



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