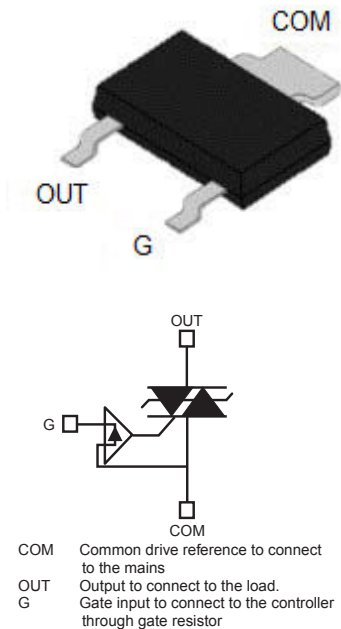


## 0.8 A - 800 V overvoltage protected AC switch (ACS)



### Features

- Enables equipment to meet IEC 61000-4-5 surge with overvoltage crowbar technology
- High noise immunity against static dV/dt and IEC 61000-4-4 burst
- Needs no external protection snubber or varistor
- Reduces component count by up to 80% and interfaces directly with the micro-controller
- High creepage distance for SOT223-2L: 3.8 mm
- Clamping at  $V_{CL}$ , then crowbar action

### Applications

- General purpose AC line load switching
- Driving low power high inductive or resistive loads like:
  - Relay, valve, solenoid, dispenser
  - Pump, fan, low power motor, door lock, air flow dumper
  - Lamp

### Description

The ACS108-8SP belongs to the AC switch range (built with A. S. D. technology). This high performance switch can control a load of up to 0.8 A.

This device switch includes an overvoltage crowbar structure to absorb the inductive turn-off energy, and a gate level shifter driver to separate the digital controller from the main switch. It is triggered with a negative gate current flowing out of the gate pin.

#### Product status link

[ACS108-8SP](#)

#### Product summary

<b>Order code</b>	ACS108-8SP
<b>Package</b>	SOT223-2L
<b><math>I_{T(RMS)}</math></b>	0.8 A
<b><math>V_{DRM}, V_{RRM}</math></b>	800 V
<b><math>I_{GT}</math></b>	10 mA

# 1 Characteristics

**Table 1. Absolute maximum ratings ( $T_{amb} = 25\text{ °C}$ , unless otherwise specified)**

Symbol	Parameter	Value	Unit
$I_{T(RMS)}$	RMS on-state current (180° conduction angle)	$T_{amb} = 76\text{ °C}$ 0.8	A
$I_{TSM}$	Non repetitive surge peak on-state current ( $T_j$ initial = 25 °C)	$t_p = 20\text{ ms}$ 13	A
		$t_p = 16.7\text{ ms}$ 13.7	
$I^2t$	$I^2t$ for fuse selection	$t_p = 10\text{ ms}$ 1.1	A <sup>2</sup> s
$V_{DRM} / V_{RRM}$	Repetitive peak off-state voltage	800	V
$di/dt$	Critical rate of rise of on-state current $I_G = 2 \times I_{GT}$ , $t_r \leq 100\text{ ns}$	$f = 120\text{ Hz}$ , $T_j = 125\text{ °C}$ 100	A/ $\mu$ s
$V_{PP}^{(1)}$	Non repetitive line peak pulse voltage	2	kV
$P_{G(AV)}$	Average gate power dissipation	$T_j = 125\text{ °C}$ 0.1	W
$V_{GM}$	Peak positive gate voltage	$T_j = 125\text{ °C}$ 10	V
$I_{GM}$	Peak gate current	$t_p = 20\text{ }\mu$ s, $T_j = 125\text{ °C}$ 1	A
$T_{stg}$	Storage temperature range	-40 to +150	°C
$T_j$	Operating junction temperature range	-40 to +125	°C
$T_l$	Maximum lead temperature soldering during 10 s	260	°C

1. according to test described by standard IEC 61000-4-5, see Figure 17 for conditions

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

Symbol	Test conditions	Quadrant	Value	Unit
$I_{GT}^{(1)}$	$V_{OUT} = 12\text{ V}$ , $R_L = 33\text{ }\Omega$	II - III	Max. 10	mA
$V_{GT}$			Max. 1.0	
$V_{GD}$	$V_{OUT} = V_{DRM}$ , $R_L = 3.3\text{ k}\Omega$	II - III	Min. 0.15	V
$I_H^{(2)}$	$I_T = 100\text{ mA}$ , gate open		Max. 10	mA
$I_L$	$I_G = 1.2 \times I_{GT}$		Max. 25	mA
$dV/dt^{(2)}$	$V_{OUT} = 402\text{ V}$ , gate open	$T_j = 125\text{ °C}$	Min. 2000	V/ $\mu$ s
	$V_{OUT} = 536\text{ V}$ , gate open		400	
$(di/dt)_c$	Without snubber (15 V/ $\mu$ s), turn-off time $\leq 20\text{ ms}$	$T_j = 125\text{ °C}$	Min. 2	A/ms
$V_{CL}^{(2)}$	$I_{CL} = 0.1\text{ mA}$ , $t_p = 1\text{ ms}$	$T_j = 125\text{ °C}$	Min. 850	V

1. Minimum  $I_{GT}$  is guaranteed at 10% of  $I_{GT}$  max.

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

**Table 3. Static electrical characteristics**

Symbol	Test conditions		Value		Unit
$V_{TM}^{(1)}$	$I_{TM} = 1.1 \text{ A}$ , $t_p = 500 \mu\text{s}$	$T_j = 25 \text{ }^\circ\text{C}$	Max.	1.3	V
$V_{TO}^{(1)}$	Threshold voltage	$T_j = 125 \text{ }^\circ\text{C}$	Max.	0.85	V
$R_D^{(1)}$	Dynamic resistance	$T_j = 125 \text{ }^\circ\text{C}$	Max.	350	m $\Omega$
$I_{DRM}$ $I_{RRM}$	$V_{OUT-COM} = V_{DRM}$ ; $V_{COM-OUT} = V_{RRM}$	$T_j = 25 \text{ }^\circ\text{C}$	Max.	2	$\mu\text{A}$
		$T_j = 125 \text{ }^\circ\text{C}$		0.2	mA

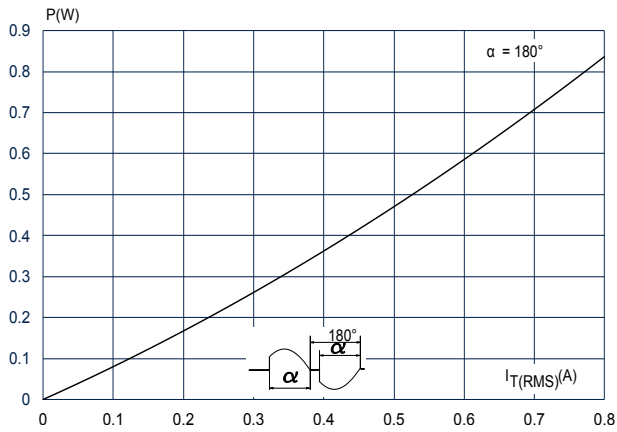
1. For both polarities of OUT pin referenced to COM pin

**Table 4. Thermal characteristics**

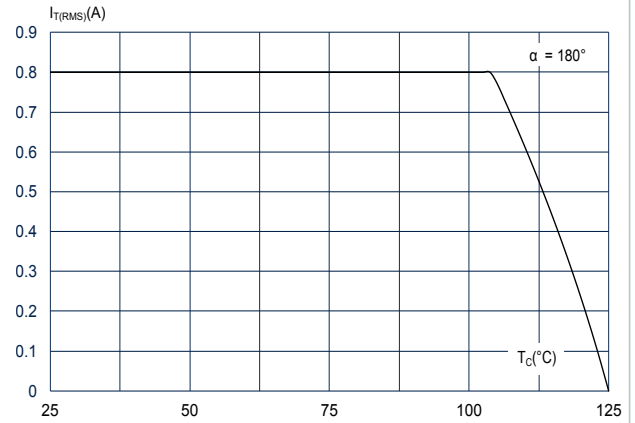
Symbol	Parameter		Value		Unit
$R_{th(j-t)}$	Junction to tab (AC)		Max.	25	$^\circ\text{C/W}$
$R_{th(j-a)}$	Junction to ambient, $S = 5 \text{ cm}^2$		Typ.	60	

## 1.1 Characteristics (curves)

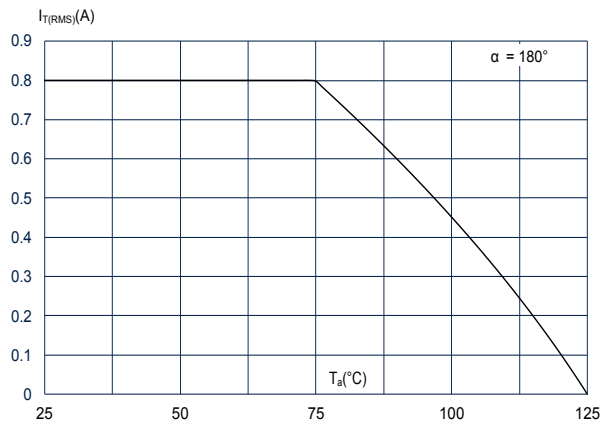
**Figure 1. Maximum power dissipation versus rms on-state current**



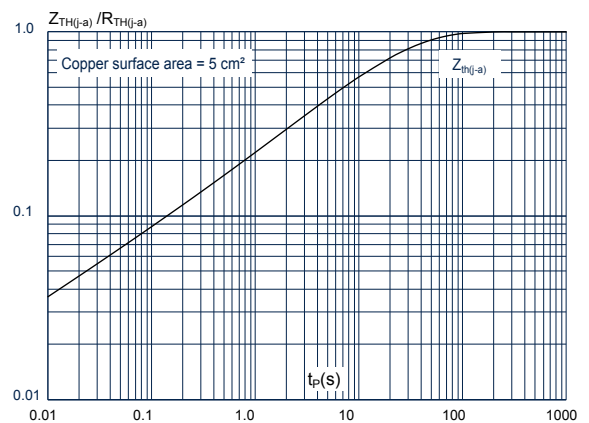
**Figure 2. On-state rms current versus case temperature**



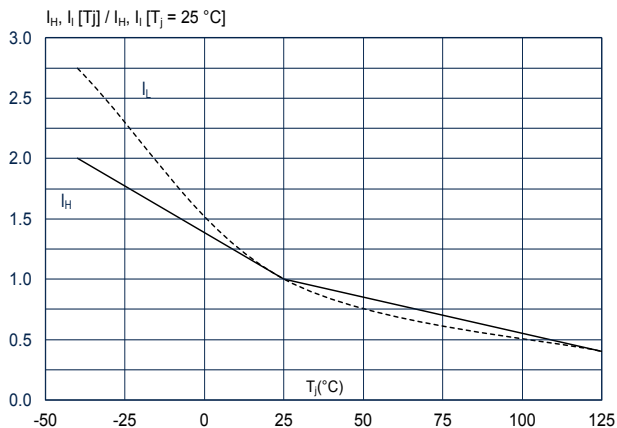
**Figure 3. On-state rms current versus ambient temperature (free air convection)**



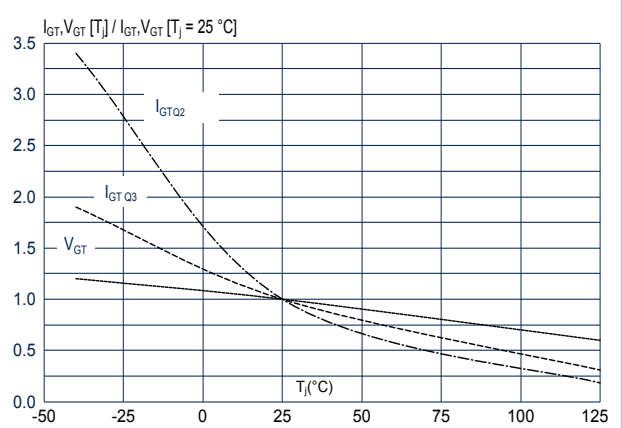
**Figure 4. Relative variation of thermal impedance junction to ambient versus pulse duration**



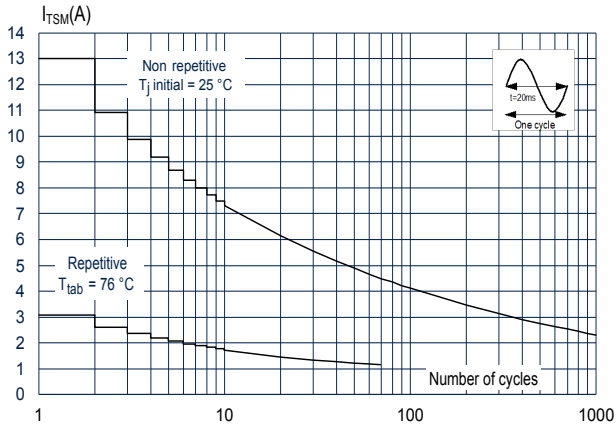
**Figure 5. Relative variation of holding and latching current versus junction temperature**



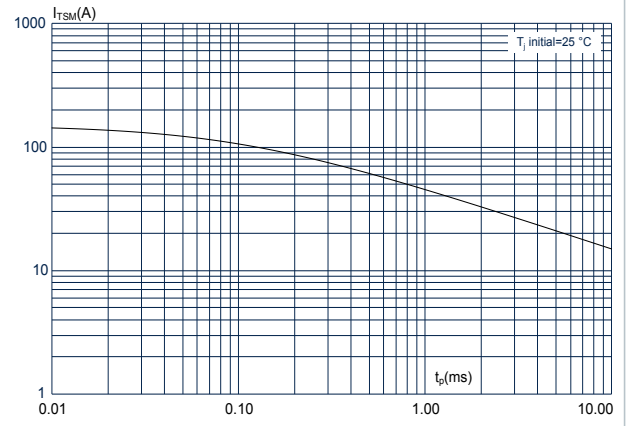
**Figure 6. Relative variation of  $I_{GT}$  and  $V_{GT}$  versus junction temperature**



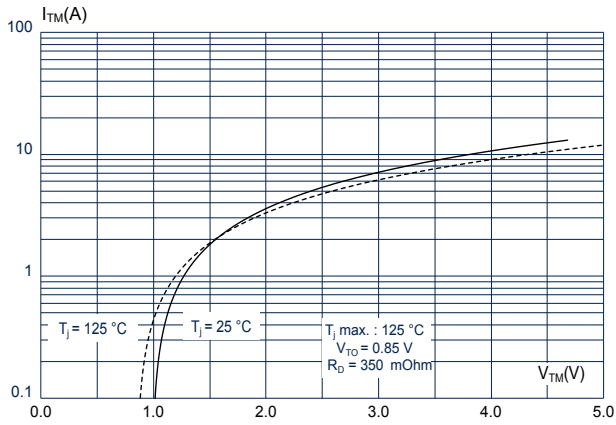
**Figure 7. Surge peak on-state current versus number of cycles**



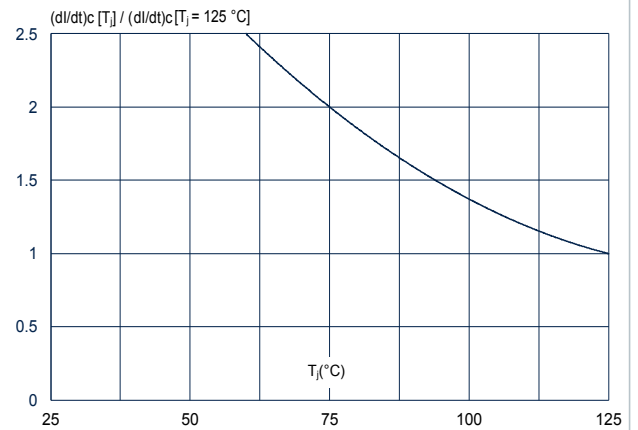
**Figure 8. Non repetitive surge peak on-state current for a sinusoidal pulse**



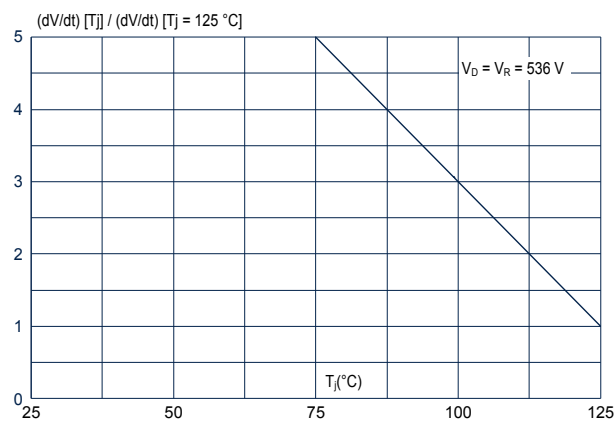
**Figure 9. On-state characteristics (maximum values)**



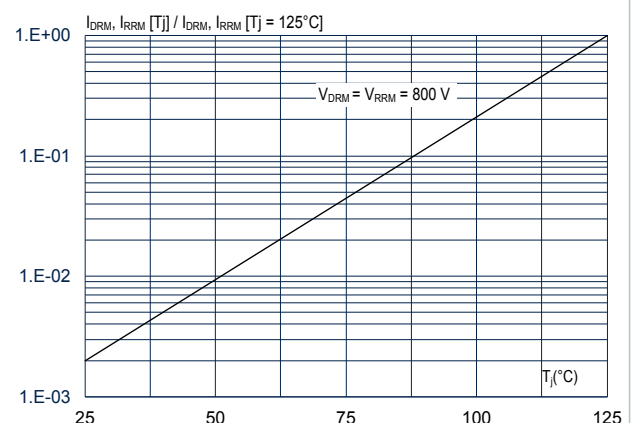
**Figure 10. Relative variation of critical rate of decrease of main current versus junction temperature**



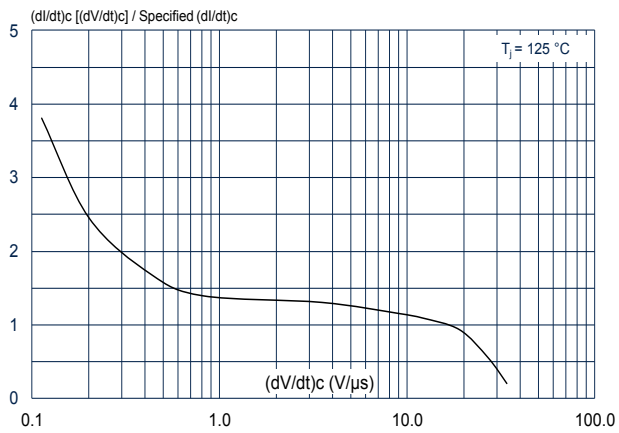
**Figure 11. Relative variation of static dV/dt immunity versus junction temperature**



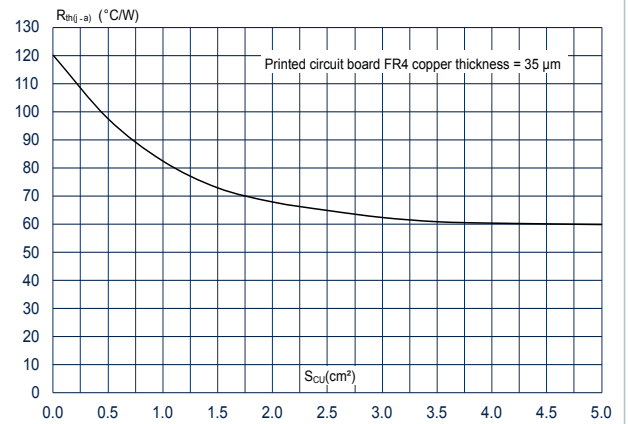
**Figure 12. Relative variation of leakage current versus junction temperature**



**Figure 13. Relative variation of critical rate of decrease of main current (di/dt)<sub>c</sub> versus (dV/dt)<sub>c</sub>**



**Figure 14. Thermal resistance junction to ambient versus copper surface under tab**

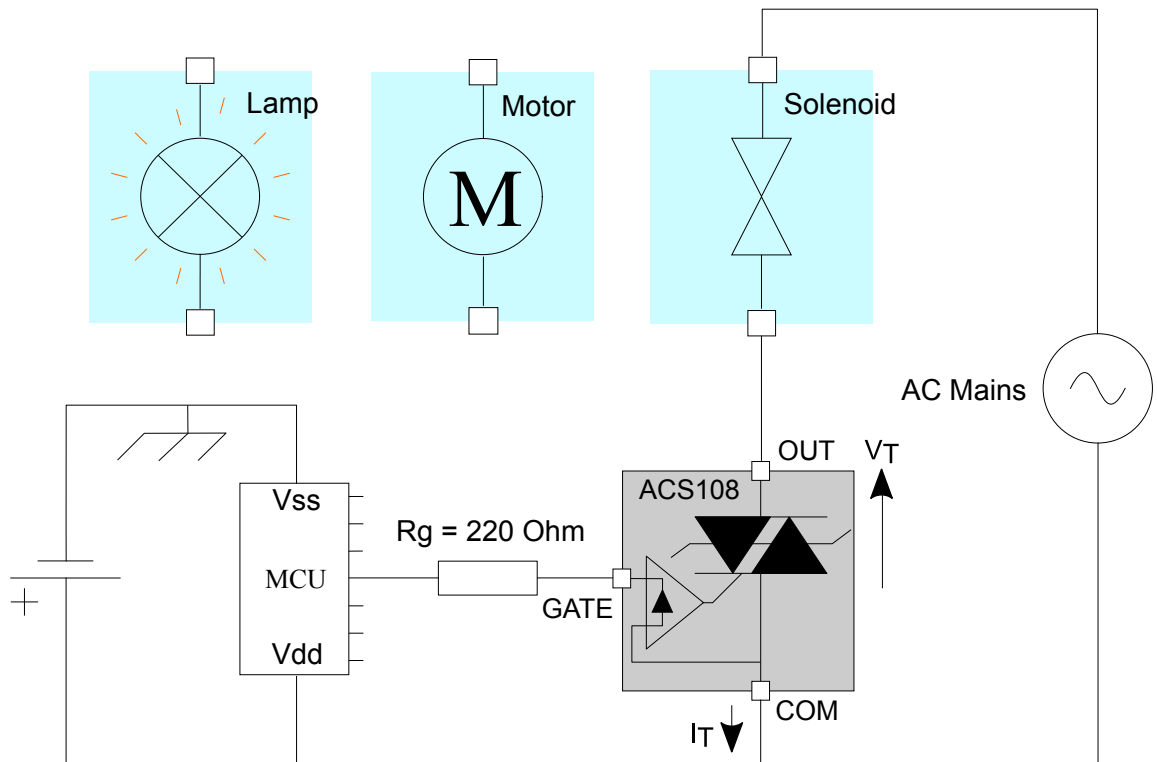


## 2 Alternating current mains switch - basic application

The ACS108 switch is triggered by a negative gate current flowing from the gate pin G. The switch can be driven directly by the digital controller through a resistor as shown in [Figure 15. Typical application schematic](#)

Thanks to its overvoltage protection and turn-off commutation performance, the ACS108 switch can drive a small power high inductive load with neither varistor nor additional turn-off snubber.

Figure 15. Typical application schematic



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

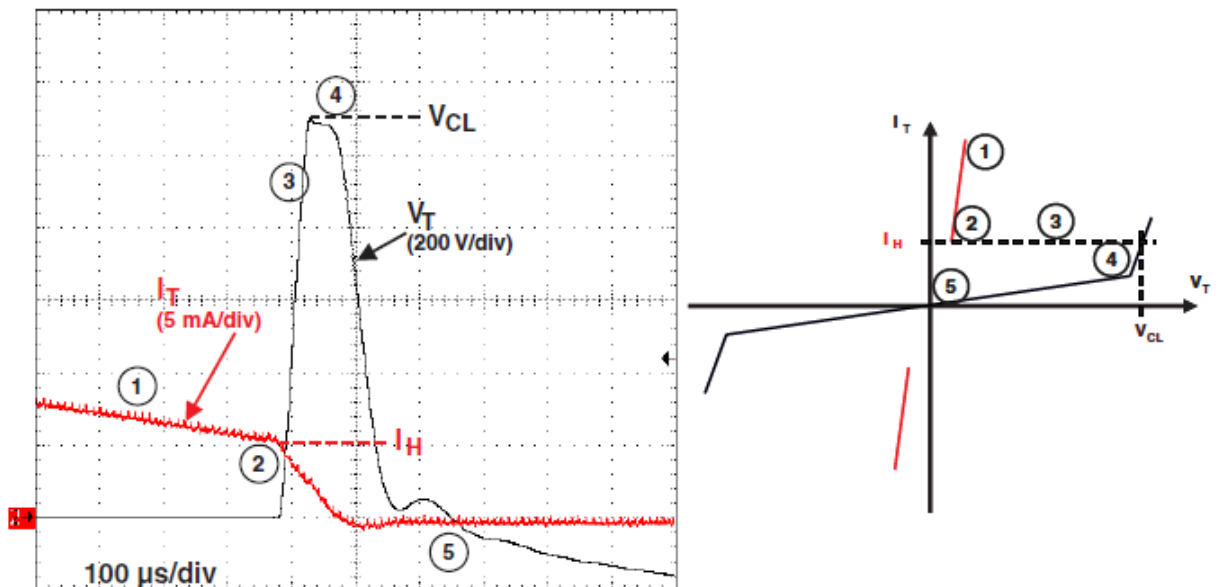
In comparison with standard Triacs the ACS108 is over-voltage self-protected, as specified by the parameter  $V_{CL}$ . This feature is useful in two operating conditions: in case of turn-off of very inductive load, and in case of surge voltage that can occur on the electrical network.

### 2.1.1 High inductive load switch-off: turn-off overvoltage clamping

With high inductive and low rms current loads the rate of decrease of the current is very low. An overvoltage can occur when the gate current is removed and the OUT current is lower than  $I_H$ .

As shown in Figure 16. Switching off of a high inductive load - typical clamping capability of ACS108 ( $T_{amb} = 25^\circ\text{C}$ ), at the end of the last conduction half-cycle, the load current decreases ①. The load current reaches the holding current level  $I_H$  ②, and the ACS turns off ③. The water valve, as an inductive load (up to 15 H), reacts as a current generator and an overvoltage is created, which is clamped by the ACS ④. The current flows through the ACS avalanche and decreases linearly to zero. During this time, the voltage across the switch is limited to the clamping voltage  $V_{CL}$ . The energy stored in the inductance of the load is dissipated in the clamping section that is designed for this purpose. When the energy has been dissipated, the ACS voltage falls back to the mains voltage value (230 V rms, 50 Hz) ⑤.

Figure 16. Switching off of a high inductive load - typical clamping capability of ACS108 ( $T_{amb} = 25^\circ\text{C}$ )



### 2.1.2 Alternating current mains transient voltage ruggedness

The ACS108 switch is able to withstand safely the AC mains transients either by clamping the low energy spikes or by breaking-over when subjected to high energy shocks, even with high turn-on current rises.

The test circuit shown in Figure 17. Overvoltage ruggedness test circuit for resistive and inductive loads,  $T_{amb} = 25^\circ\text{C}$  (conditions equivalent to IEC 61000-4-5 standard) is representative of the final ACS108 application, and is also used to test the AC switch according to the IEC 61000-4-5 standard conditions. Thanks to the load limiting the current, the ACS108 switch withstands the voltage spikes up to 2 kV above the peak mains voltage. The protection is based on an overvoltage crowbar technology. Actually, the ACS108 breaks over safely as shown in Figure 18. Typical current and voltage waveforms across the ACS108 (+2 kV surge, IEC 61000-4-5 standard). The ACS108 recovers its blocking voltage capability after the surge (switch off back at the next zero crossing of the current).

Such non-repetitive tests can be done 10 times on each AC mains voltage polarity.



Figure 17. Overvoltage ruggedness test circuit for resistive and inductive loads,  $T_{amb} = 25\text{ }^{\circ}\text{C}$  (conditions equivalent to IEC 61000-4-5 standard)

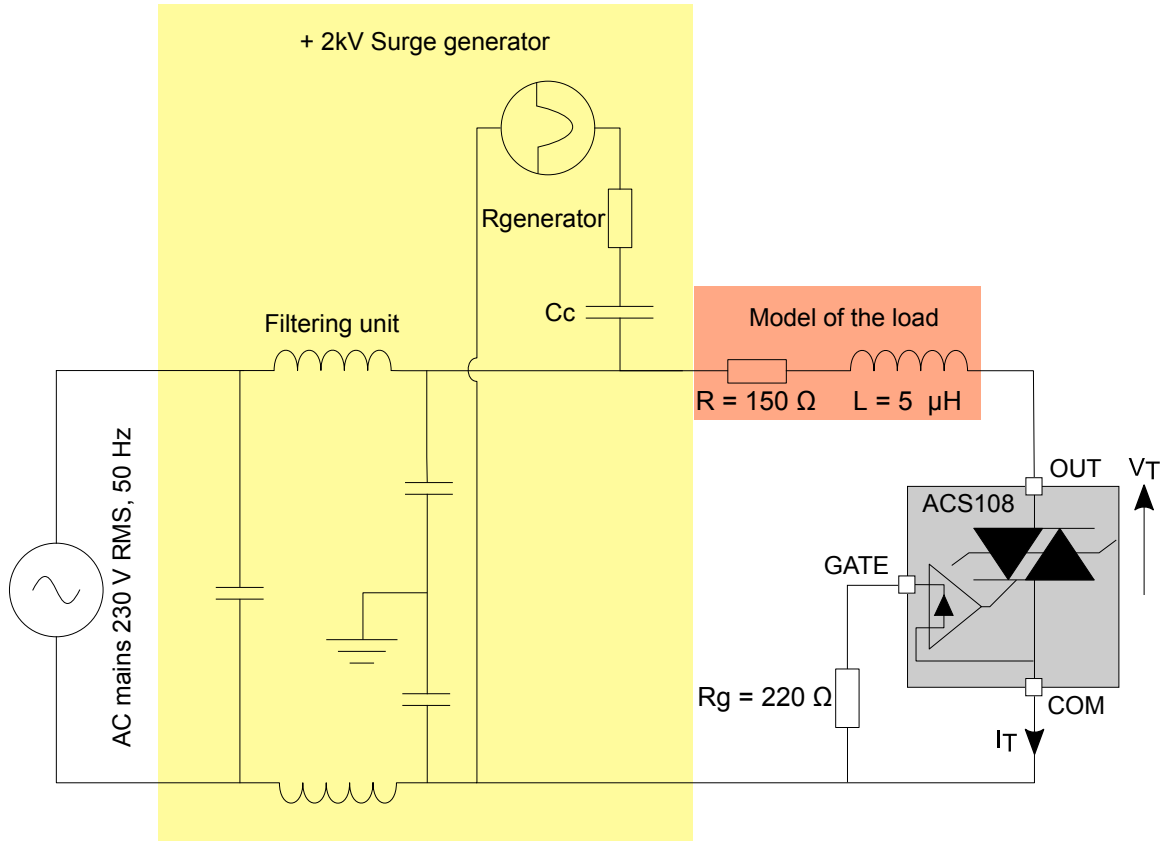
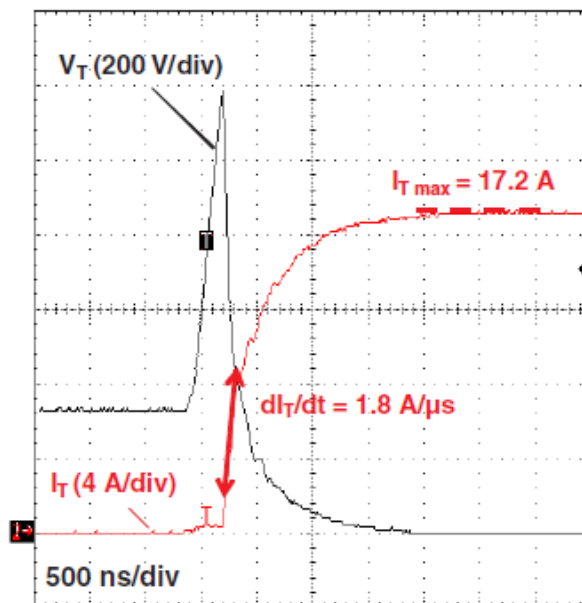


Figure 18. Typical current and voltage waveforms across the ACS108 (+2 kV surge, IEC 61000-4-5 standard)



### 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](http://www.st.com). ECOPACK is an ST trademark.

#### 3.1 SOT223-2L package information

- Epoxy meets UL94, V0
- Lead free plating + halogen-free molding resin

Figure 19. SOT223-2L package outline

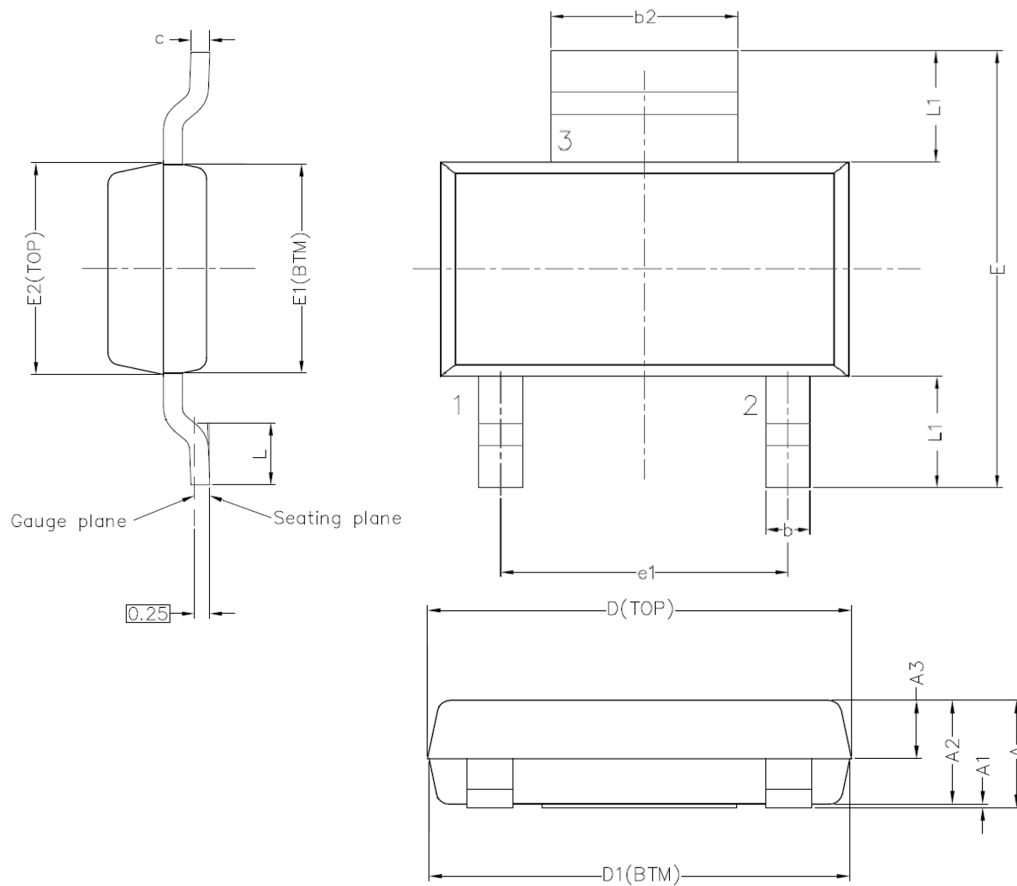
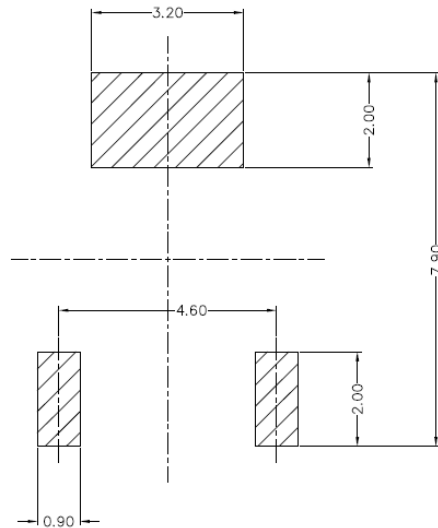


Table 5. SOT223-2L package mechanical data

Ref.	Dimensions		
	Millimeters		
	Min.	Typ.	Max.
A			1.80
A1	0.02		0.10
A2	1.50	1.60	1.70
A3	0.80	0.90	1.00
b	0.67		0.80
b2	2.96		3.09
c	0.30		0.35
D	6.48	6.53	6.58
D1	6.43	6.48	6.53
E	6.80		7.20
E1	3.30	3.38	3.48
E2	3.33	3.43	3.53
e1	4.50	4.60	4.70
L	0.80	1.00	1.20
L1	1.78 Ref		

Figure 20. Recommended footprint (dimensions in mm)



## 4 Ordering information

Figure 21. Ordering information scheme

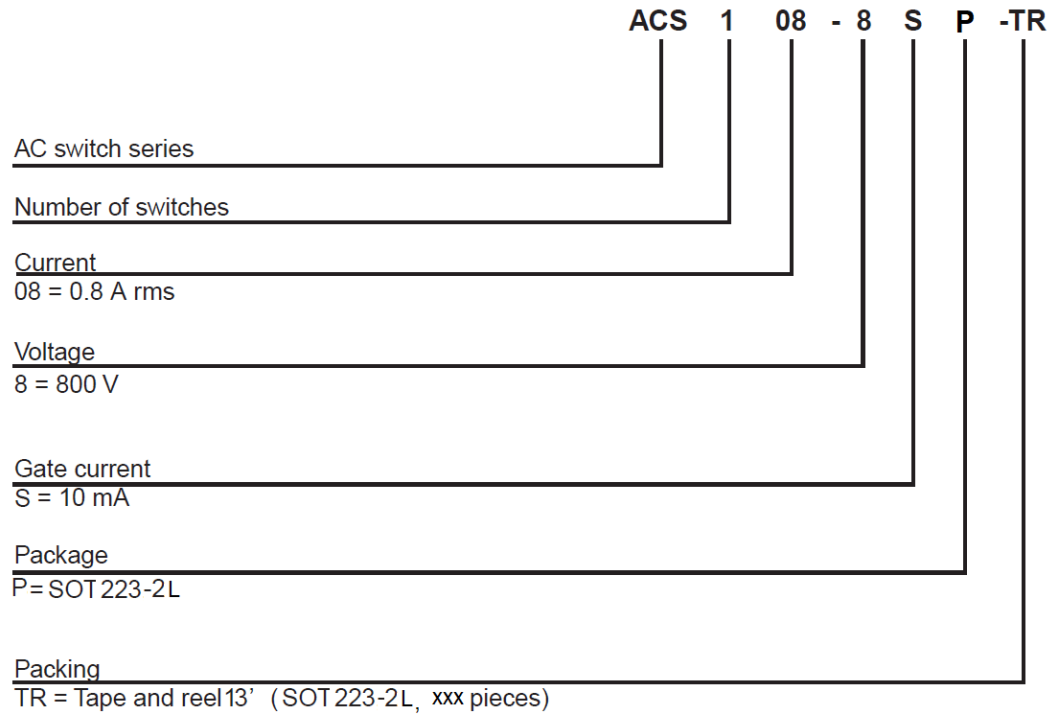


Table 6. Ordering information

Order code	Marking	Package	Weight	Base qty.	Packing mode
ACS108-8SP-TR	ACS 108 8S	SOT-223-2L	110 mg	4000	Tape and reel 13"

## Revision history

**Table 7. Document revision history**

Date	Revision	Changes
28-Jun-2023	1	Initial release.

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