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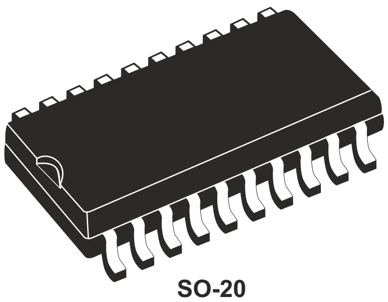
ACS302

3-line overvoltage protected AC switch array

Datasheet - production data



SO-20
ACS302-6T3

Features

- 3-line AC switch array
- Overvoltage protection
- High static immunity and dynamic commutation
- V_{DRM}, V_{RRM} = 600 V
- T_J = 125 °C max.
- I_{GT} < 5 mA

Application

Drive of low power highly inductive or resistive loads like:

- Relay, valve, solenoid
- Dispenser, door lock
- Pump, fan, micro-motor

Table 1. Device summary

Order code	Package	V_{DRM}, V_{RRM}	I_{GT}
ACS302-6T3	SO-20	600 V	5 mA

Description

ACS302 offers 3 AC switches in one single package with 600 V blocking voltage, high commutation and noise immunity - all that is required for inductive load control.

Its high integration allows reduced space consumption of PCB.

ACS302 enables inductive application to be compliant with IEC 61000-4-4 and IEC 61000-4-5.

Figure 1. Pinout

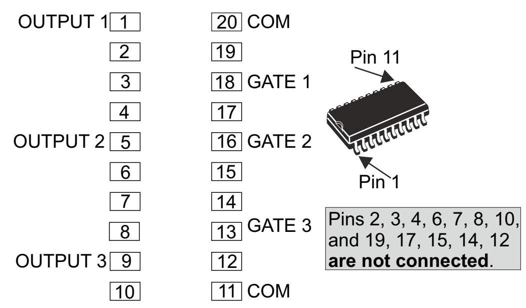
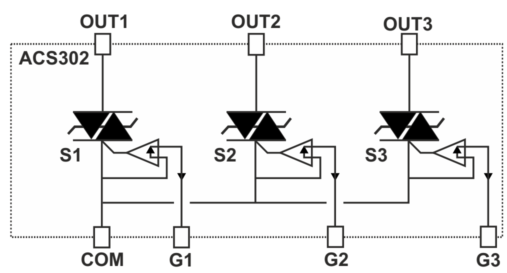


Figure 2. Configuration



ACS is a registered trademark of STMicroelectronics

1 Characteristics

Table 2. Absolute maximum ratings – for one switch and T_J = 25 °C, unless otherwise specified

Symbol	Parameter			Value	Unit
$I_{T(RMS)}$	On-state rms current (180° conduction angle, full sine wave)	1 switch ON	T_a = 110 °C	0.2	A
		2 or 3 switches ON	T_a = 90 °C	0.4	A
I_{TSM}	Non repetitive surge peak on-state current (T_J initial = 25 °C)		t_p =16.7ms	7.6	A
			t_p = 20 ms	7.3	
I^2t	I^2t value for fusing		t_p = 10ms	0.38	A^2s
dI/dt	Critical rate of rise of on-state current $I_G = 2 \times I_{GT}$, $t_r \leq 100$ ns		F = 120 Hz	50	A/µs
V_{DRM}, V_{RRM}	Repetitive peak off-state voltage		T_j = 125 °C	600	V
V_{pp}(1)	Non-repetitive line peak pulse voltage			2	kV
I_{GM}	Peak gate current	T_J = 125 °C	t_p = 20 µs	1	A
P_{GM}	Peak gate power	T_J = 125 °C	t_p = 20 µs	10	W
$P_{G(AV)}$	Average gate power dissipation			0.1	W
T_{stg}	Storage junction temperature range			-40 to +150	°C
T_j	Operating junction temperature range			-40 to +125	°C
T_L	Maximum lead temperature for soldering during 10 s.			260	°C

1. According to test described by IEC 61000-4-5 standard and figure 3

Table 3. Electrical characteristics (for one switch and T_j = 25°C, unless otherwise specified)

Symbol	Test conditions	Quadrants		Value	Unit
I_{GT}	V_{OUT} = 12 V, R_L = 33 Ω	II - III	MIN	0.25	mA
			MAX	5	
V_{GT}	V_{OUT} = 12 V, R_L = 33 Ω		MAX	0.9	V
V_{GD}	$V_{OUT} = V_{DRM}$, R_L = 3.3 kΩ, T_j = 125 °C	II - III	MIN	0.15	V
I_H	I_T = 100 mA, gate open		MAX	20	mA
I_L	$I_G = 1.2\ I_{GT}$	II - III	MAX	25	mA
dV/dt	V_{OUT} = 400 V, gate open	T_j = 125 °C	MIN	300	V/µs
(dI/dt)c	(dV/dt)c = 15 V/µs, turn-off time ≤ 20 ms	T_j = 125 °C	MIN	0.15	A/ms
t_{gt}	I_{TM} = 1 A, V_D = 400 V, I_G = 100 mA, dI_G/dt = 100 mA/µs, R_L = 400 Ω		TYP	2	µs
V_{CL}	I_{CL} = 0.1 mA, t_p = 1 ms		MIN	650	V

Table 4. Static electrical characteristics (for one switch)

Symbol	Test conditions			Value	Unit
V_{TM}	I_{TM} = 0.3 A, t_p = 380 µs	T_j = 25°C	MAX	1.2	V
V_{TO}	Threshold voltage	T_j = 125°C		0.8	V
R_D	Dynamic resistance	T_j = 125°C		500	mΩ
I_{DRM}, I_{RRM}	V_{OUT} = 600 V	T_j = 25°C		2	µA
		T_j = 125°C		200	µA

Table 5. Thermal resistance

Symbol	Parameter	Value	Unit
$R_{th(j-a)}$	Junction to ambient (AC)	80	°C/W

Figure 3. Maximum power dissipation versus rms on-state current (per switch).

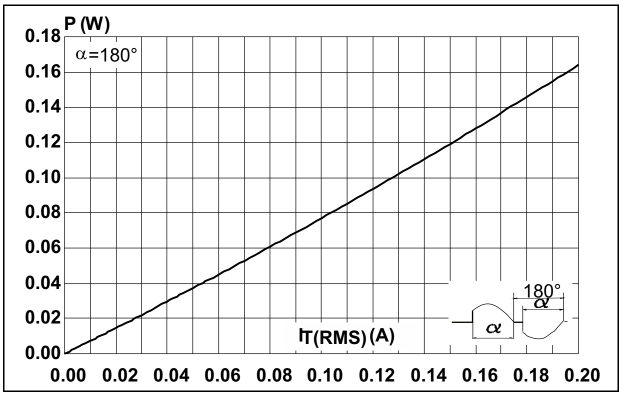


Figure 4. On-state rms current versus ambient temperature (free air convection)

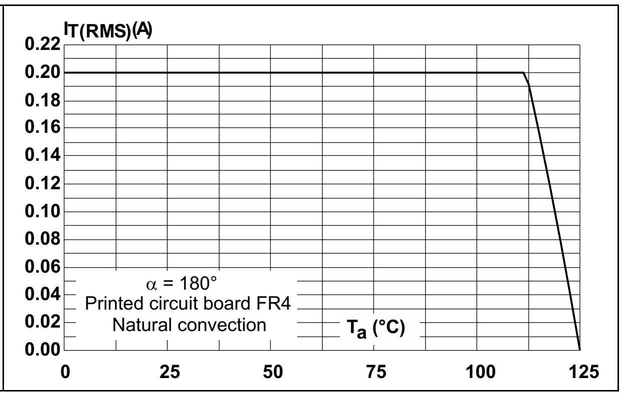


Figure 5. Relative variation of thermal impedance junction to ambient versus pulse duration

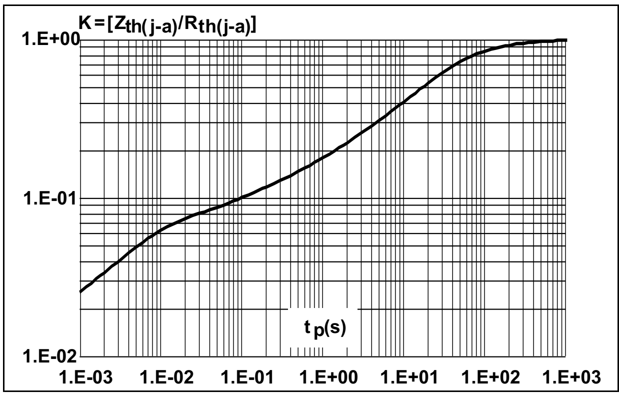


Figure 6. Relative variation of gate triggering current and voltage (I_{GT}, V_{GT}) versus junction temperature (typical values)

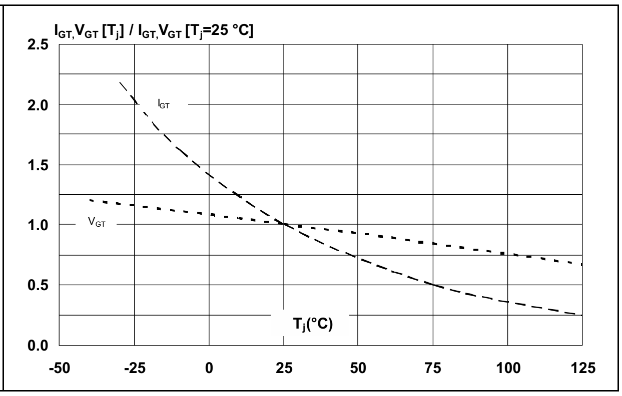


Figure 7. Relative variation of holding current and latching current (I_H, I_L) versus junction temperature (typical values)

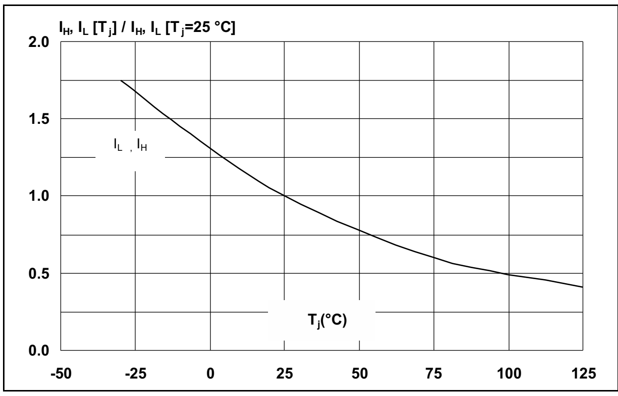


Figure 8. Surge peak on-state current versus number of cycles

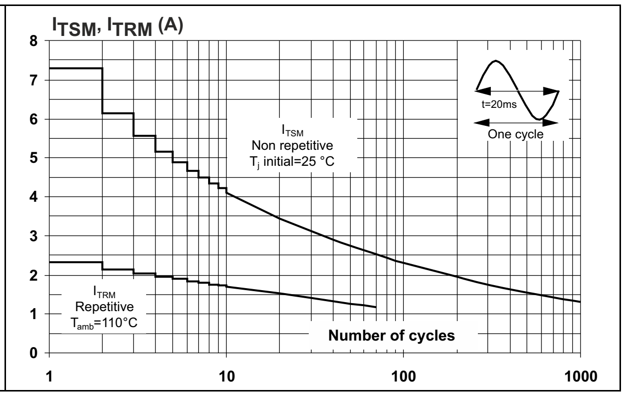


Figure 9. Non-repetitive surge peak on-state current for a sinusoidal pulse with width t_p < 10ms, and corresponding value of I^2t

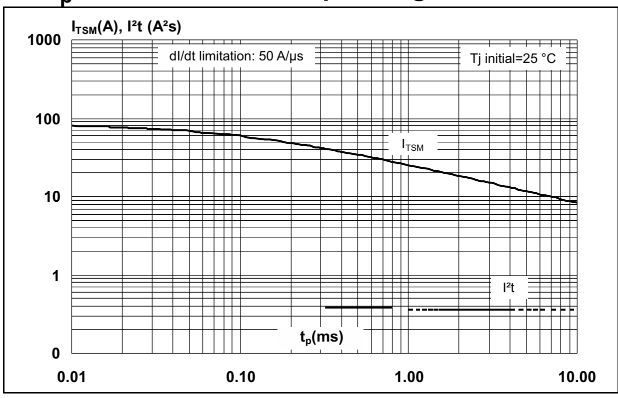


Figure 10. On-state characteristics (maximum values)

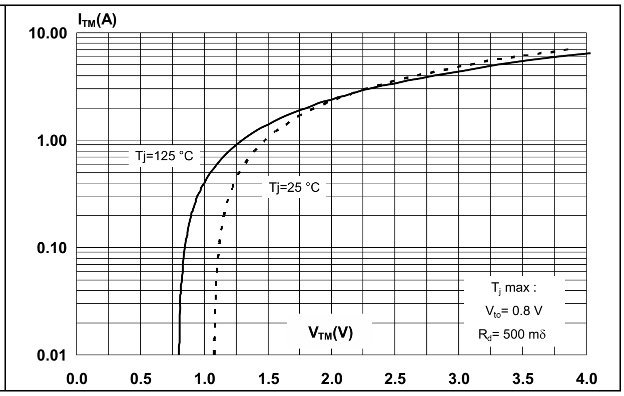


Figure 11. Relative variation of critical rate of decrease of current (dI/dt)c versus junction temperature (typical values)

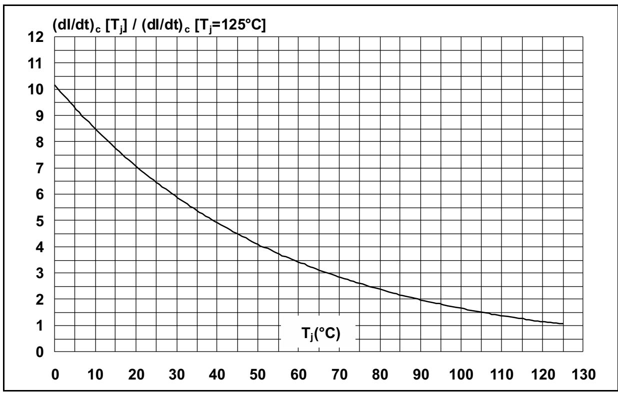


Figure 12. Relative variation of critical rate of decrease of current (dI/dt)c versus dV/dt (typical values)

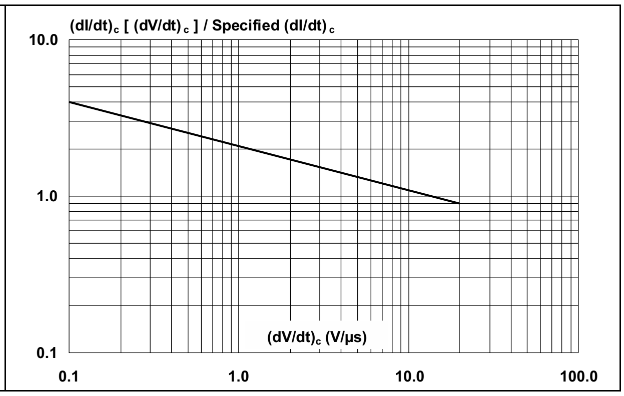


Figure 13. Relative variation of dV/dt immunity versus junction temperature (typical values)

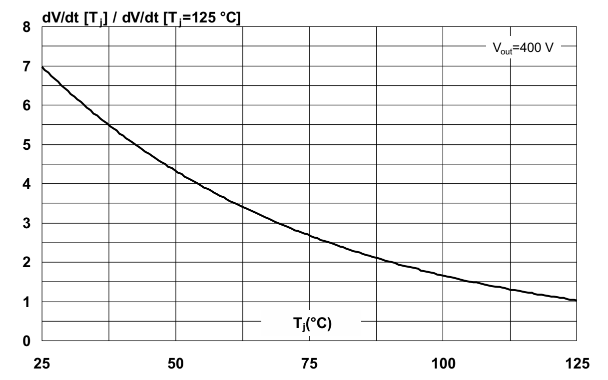


Figure 14. Relative variation of leakage current versus junction temperature (typical values)

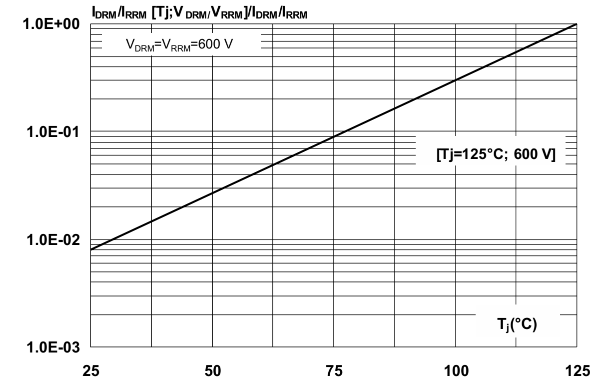
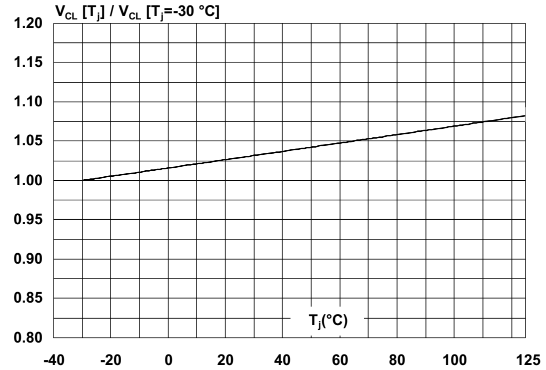


Figure 15. Relative variation of clamping voltage (V_{CL}) versus junction temperature (minimum values)



2 AC line switch basic application

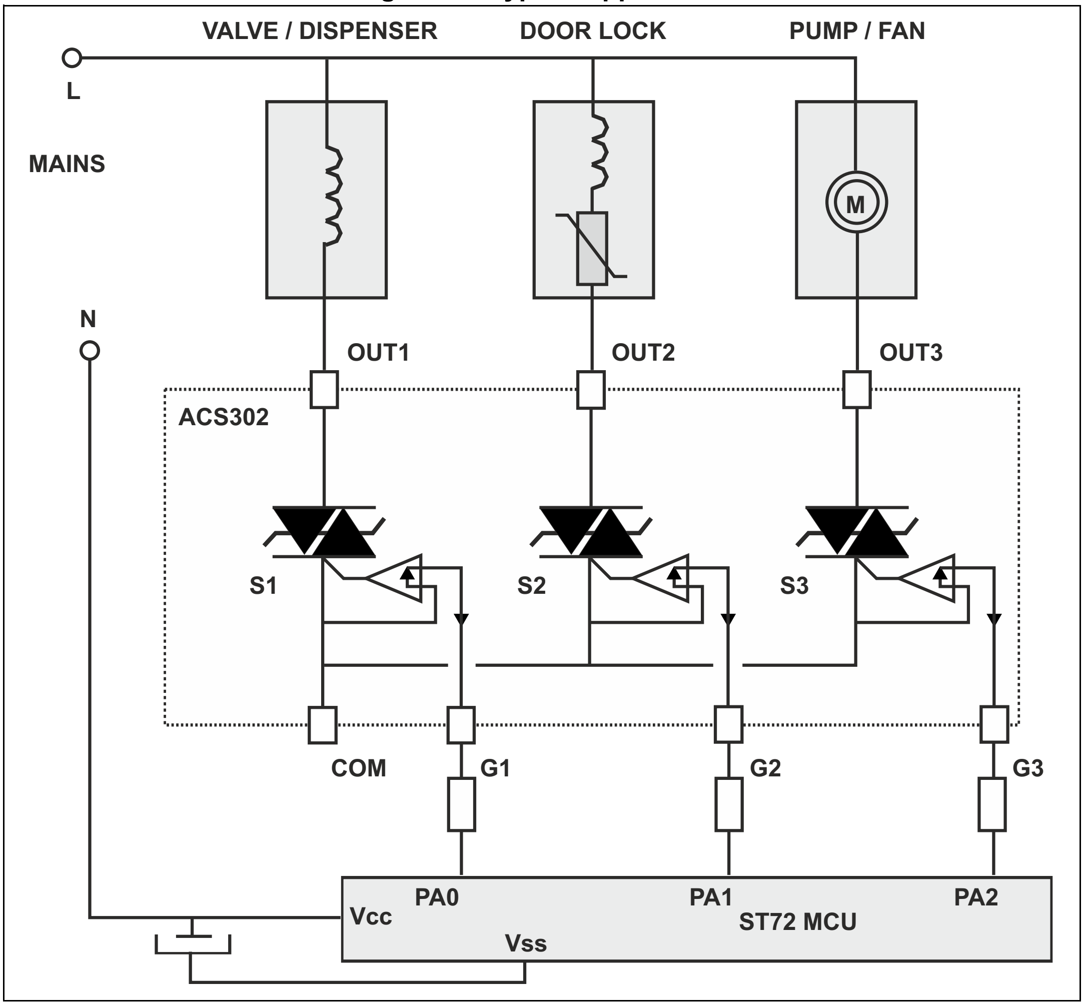
The ACS302 device is well adapted to washing machines, dishwashers, tumble driers, refrigerators, water heaters, and cooking products. It has been designed especially to switch ON and OFF low power loads such as solenoids, valves, relays, micro-motors, pumps, fans, door locks and low power lamps.

- **Pin COM:** Common drive reference, to connect to the power line neutral
- **Pin G:** Switch gate input to connect to the digital controller through a resistor
- **Pin OUT:** Switch output, to connect to the load

Each ACS® is triggered with a negative gate current flowing out of the gate pin G. It can be driven directly by the digital controller through a resistor as shown on the typical application diagram. No protection devices are required between the gates and common terminals.

In appliance systems, this ACS drives slow power loads in full cycle ON / OFF mode. Thanks to its thermal and turn off commutation performances, the ACS302 switch is able to drive three loads up to 0.2 A each such as two water valves and a door lock in a dishwasher, without any additional turn-off snubber.

Figure 16. Typical application



2.1 High Inductive switch-off operation

In *Figure 17*, at the end of the last conduction half-cycle, the load current reaches the holding current level I_H, and the ACS turns off. Because of the inductance L of the load, the current flows through the avalanche diode D 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 depends on the holding current I_H (*Figure 18*) and the inductance (up to 10 H). The energy stored can reach about 20 mJ and is dissipated in the clamping diode section that is especially designed for that purpose.

Figure 17. Turn-off operation of the ACS302 with an electro-valve: waveform of the pin OUT current I_{OUT} and voltage V_{OUT}

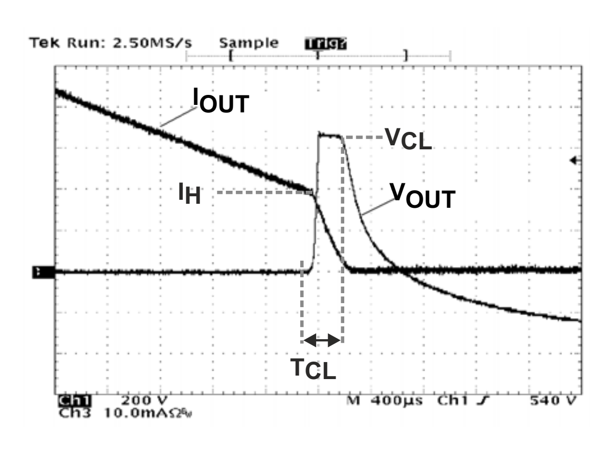
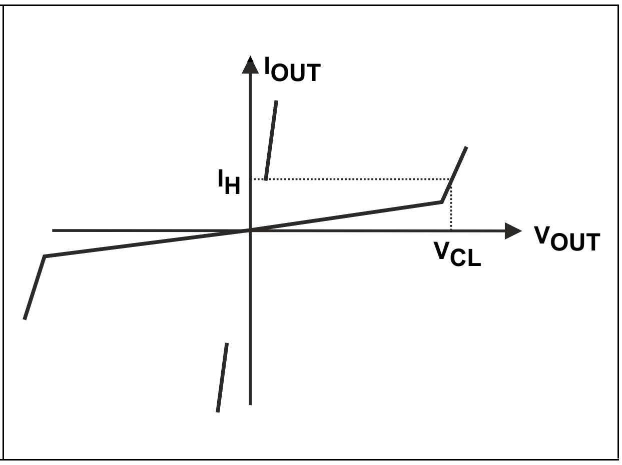


Figure 18. ACS302 switch static characteristic

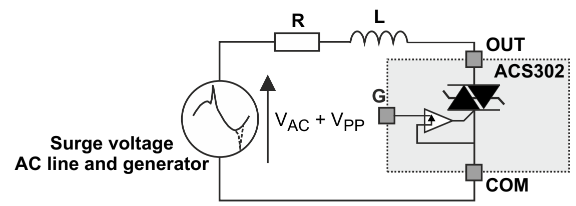


2.2 AC line transient voltage ruggedness

The ACS302 is able to withstand safely the AC line transient voltages either by clamping the low energy spikes or by breaking over under high energy shocks.

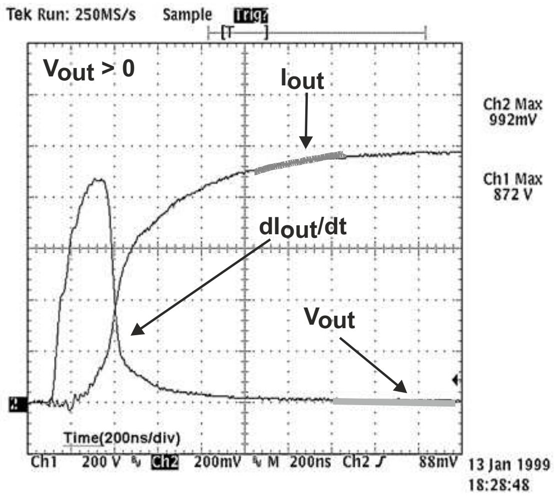
The test circuit shown in *Figure 19* is representative of the final ACS application and is also used to stress the ACS according to the IEC 61000-4-5 standard conditions. Thanks to the load, the ACS withstands the voltage spikes up to 2 kV above the peak line voltage. It will break over safely even on resistive load where the turn on current rise is high as shown in *Figure 20*. Such non repetitive test can be done 10 times on each AC line voltage polarity.

Figure 19. Overvoltage ruggedness test circuit for resistive and inductive loads according to IEC 61000-4-5 standard



R = 150 Ω, L = 5 µH, V_{PP} = 2 kV

Figure 20. Current and voltage of the ACS during IEC 61000-4-5 standard test with R = 150 Ω, L = 5 µH, V_{PP} = 2kV



3 Package information

- Epoxy meets UL94, V0
- Lead-free package

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.

Figure 21. SO-20 dimension definitions

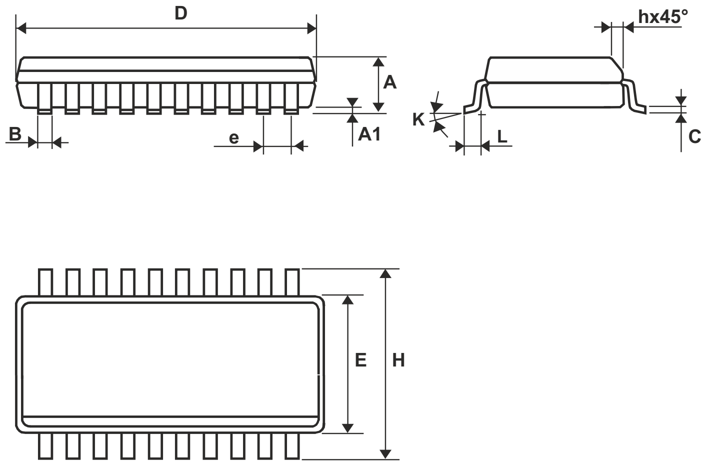
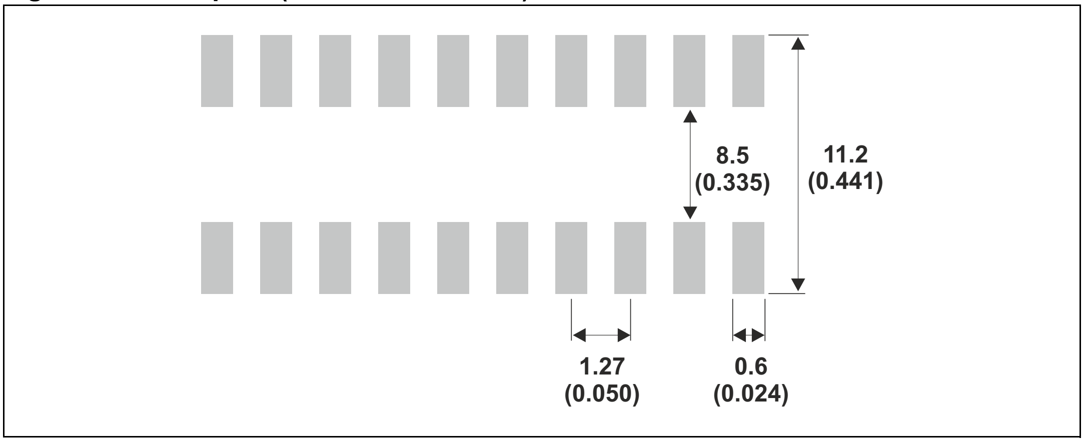


Table 6. SO-20 dimensions

Ref.	dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.35		2.65	0.092		0.104
A1	0.10		0.30	0.004		0.008
B	0.33		0.51	0.013		0.020
C	0.23		0.32	0.009		0.013
D	12.6		13.0	0.484		0.512
E	7.40		7.60	0.291		0.299
e		1.27			0.050	
H	10.0		10.65	0.394		0.419
h	0.25		0.75	0.010		0.029
L	0.40		1.27	0.016		0.050
K	8° (max)					

Figure 22. Footprint (dimensions in mm)



4 Ordering Information

Figure 23. Ordering information scheme

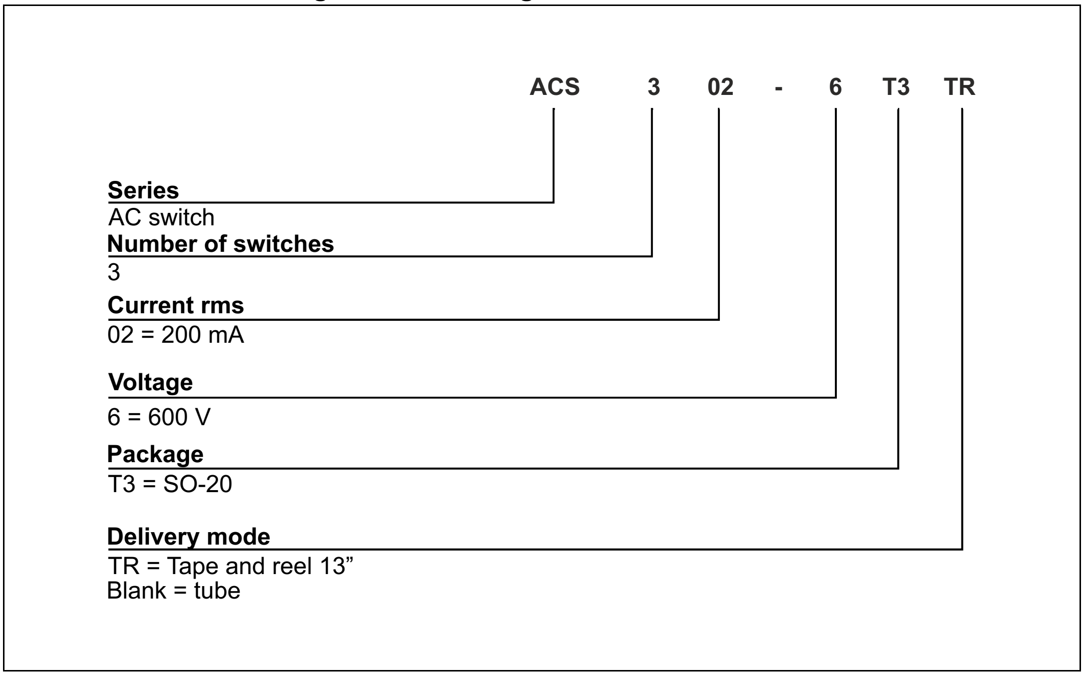


Table 7. Ordering information

Order code	Marking	Package	Weight	Base Qty	Delivery mode
ACS302-6T3-TR	ACS302-6	SO-20	0.55g	1,000	Tape and Reel 13”
ACS302-6T3	ACS302-6	SO-20	0.55g	40	Tube

5 Revision history

Table 8. Document revision history

Date	Revision	Changes
01-Jul-2013	1	First release.

Please Read Carefully: