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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China





# ACS302-5T3

## ASD™ AC Switch Family

## THREE LINES AC SWITCH ARRAY

### MAIN APPLICATIONS

- AC on-off static switching in appliance & industrial control systems
- Drive of low power high inductive or resistive loads like:
  - relay, valve, solenoid, dispenser
  - pump, fan, micro-motor
  - low power lamp bulb, door lock

### FEATURES

- THREE HIGH VOLTAGE AC SWITCH ARRAY
- BLOCKING VOLTAGE:  $V_{DRM} / V_{RRM} = 500V$
- CLAMPING VOLTAGE:  $V_{CL} = 600 V$
- NOMINAL CONDUCTING CURRENT PER LINE:  $I_{T(RMS)} = 0.2 A$
- NOMINAL CONDUCTING CURRENT FOR TOTAL ARRAY:  $I_{T(RMS)} = 0.4 A$
- GATE TRIGGERING CURRENT:  $I_{GT} < 5 mA$

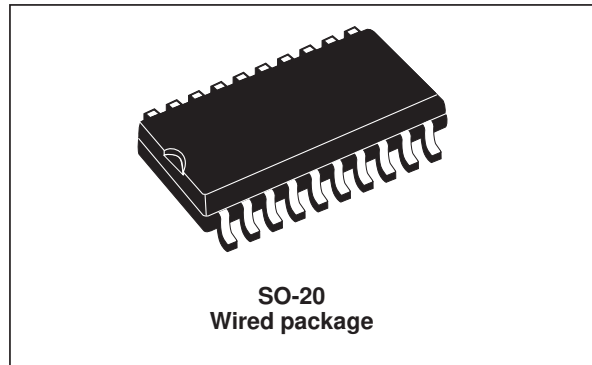
### BENEFITS

- Needs no external overvoltage protection
- Enables equipment to meet IEC61000-4-5 standard
- Interfaces directly with a microcontroller
- Eliminates any stressing gate kick back on the microcontroller
- Array structure: design simplified, increase reliability and space saving aspects
- Mounting in SO-20 package enables the device to meet IEC335-1 standard

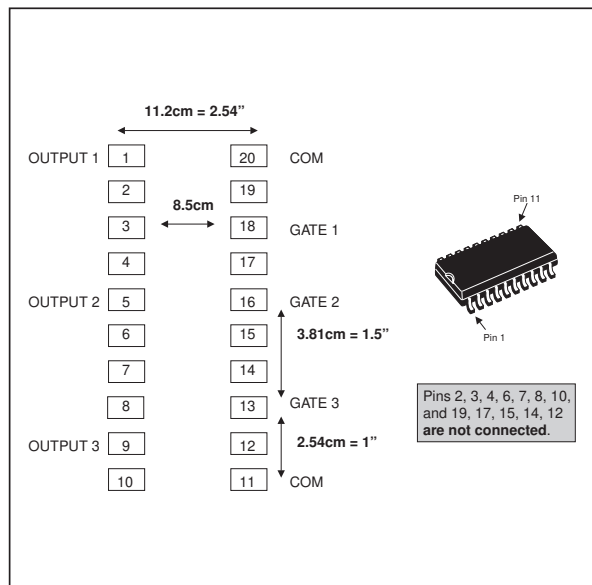
### DESCRIPTION

The ACS302 belongs to the AC line switch family built around the ASD™ concept. This high performance device includes 3 bidirectional AC switches able to control an 0.2A resistive or inductive load device.

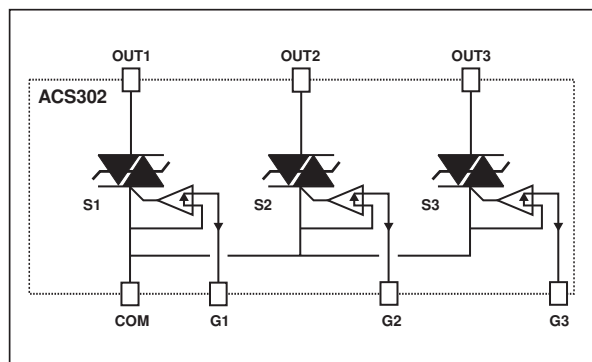
Each ACS™ switch embeds a high voltage clamping structure to absorb the inductive turn off energy and a gate level shifter driver to separate the digital controller from the main switch. It is triggered with a negative gate current flowing out of the gate pin.



### PIN-OUT



### FUNCTIONAL DIAGRAM



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## ACS302-5T3

### ABSOLUTE RATINGS (limiting values)

Symbol	Parameter		Value	Unit
$V_{DRM} / V_{RRM}$	Repetitive peak off-state voltage	$T_j = 125\text{ }^\circ\text{C}$	500	V
$I_{T(RMS)}$	RMS on-state current full cycle sine wave 50 to 60 Hz	$T_{amb} = 110\text{ }^\circ\text{C}$	One switch on = 0.2	A
		$T_{amb} = 90\text{ }^\circ\text{C}$	Array: 0.4	A
$I_{TSM}$	Non repetitive surge peak on-state current $T_j$ initial = $25\text{ }^\circ\text{C}$ , full cycle sine wave	F = 50 Hz	7.3	A
		F = 60 Hz	7.6	A
dI/dt	Critical rate of repetitive rise of on-state current $I_G = 10\text{mA}$ with $t_r = 100\text{ns}$	F = 120 Hz	20	A/ $\mu\text{s}$
$V_{PP}$	Non repetitive line peak pulse voltage	note 1	2	kV
$T_{stg}$	Storage temperature range		- 40 to + 150	$^\circ\text{C}$
$T_j$	Operating junction temperature range		- 30 to + 125	$^\circ\text{C}$
TI	Maximum lead temperature for soldering during 10s		260	$^\circ\text{C}$

Note 1: according to test described by IEC61000-4-5 standard and figure 3.

### SWITCH GATE CHARACTERISTICS (maximum values)

Symbol	Parameter	Value	Unit
$P_{G(AV)}$	Average gate power dissipation	0.1	W
$I_{GM}$	Peak gate current ( $t_p = 20\mu\text{s}$ )	1	A
$V_{GM}$	Peak positive gate voltage (respect to the pin COM)	5	V

### THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
$R_{th(j-a)}$	Junction to ambient	93	$^\circ\text{C/W}$

### ELECTRICAL CHARACTERISTICS

Symbol	Test Conditions		Values	Unit	
$I_{GT}$	$V_{OUT} = 12\text{V}$ $R_L = 140\Omega$	$T_j = 25\text{ }^\circ\text{C}$	MAX	5	mA
$V_{GT}$	$V_{OUT} = 12\text{V}$ $R_L = 140\Omega$	$T_j = 25\text{ }^\circ\text{C}$	MAX	0.9	V
$V_{GD}$	$V_{OUT} = V_{DRM}$ $R_L = 3.3\text{k}\Omega$	$T_j = 125\text{ }^\circ\text{C}$	MIN	0.15	V
$I_H$	$I_{OUT} = 100\text{mA}$ gate open	$T_j = 25\text{ }^\circ\text{C}$	TYP	20	mA
			MAX	45	
$I_L$	$I_G = 10\text{mA}$	$T_j = 25\text{ }^\circ\text{C}$	TYP	25	mA
			MAX	50	
$V_{TM}$	$I_{OUT} = 0.3\text{A}$ $t_p = 380\mu\text{s}$	$T_j = 25\text{ }^\circ\text{C}$	MAX	1.2	V
$I_{DRM}$ $I_{RRM}$	$V_{OUT} = V_{DRM}$ $V_{OUT} = V_{RRM}$	$T_j = 25\text{ }^\circ\text{C}$	MAX	2	$\mu\text{A}$
		$T_j = 125\text{ }^\circ\text{C}$	MAX	200	
dV/dt	$V_{OUT} = 400\text{V}$ gate open	$T_j = 110\text{ }^\circ\text{C}$	MIN	300	V/ $\mu\text{s}$
(dI/dt) <sub>c</sub>	(dV/dt) <sub>c</sub> = 5V/ $\mu\text{s}$ $I_{OUT} > 0$	$T_j = 110\text{ }^\circ\text{C}$	MIN	0.1	A/ms
	(dV/dt) <sub>c</sub> = 10V/ $\mu\text{s}$ $I_{OUT} < 0$	$T_j = 110\text{ }^\circ\text{C}$	MIN	0.15	A/ $\mu\text{s}$
$V_{CL}$	$I_{CL} = 1\text{mA}$ $t_p = 1\text{ms}$	$T_j = 25\text{ }^\circ\text{C}$	TYP	600	V

## ELECTRICAL CHARACTERISTICS

Symbol	Parameter
$I_{GT}$	Triggering gate current
$V_{GT}$	Triggering gate voltage
$V_{GD}$	Non-triggering gate voltage
$I_H$	Holding current
$I_L$	Latching current
$V_{TM}$	Peak on-state voltage drop
$V_{T0}$	On-state threshold voltage
$R_d$	On-state dynamic resistance
$I_{DRM}/I_{RRM}$	Maximum forward or reverse leakage current
$dV/dt$	Critical rate of rise of off-state voltage
$(dV/dt)_C$	Critical rate of decrease of commutating off-state voltage
$(dI/dt)_C$	Critical rate of decrease of commutating on-state current
$V_{CL}$	Clamping voltage
$I_{CL}$	Clamping current

## AC LINE SWITCH BASIC APPLICATION

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

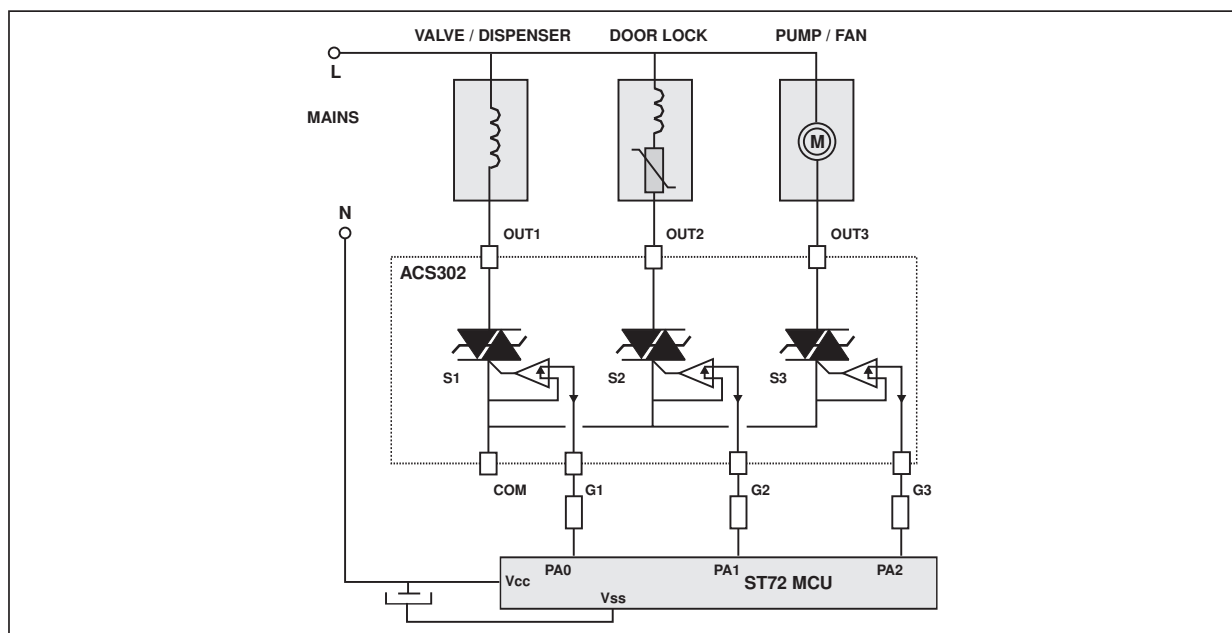
- **Pin COM:** Common drive reference, to connect to the power line neutral
- **Pin G:** Switch Gate input to connect to the digital controller through a resistor
- **Pin OUT:** Switch Output, to connect to the load

Each ACS™ switch 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 appliances systems, this ACS™ switch intends to drive low power loads in full cycle ON / OFF mode.

Thanks to its thermal and turn off commutation performances, the ACS302-5TA switch is able to drive three loads up to 0.2A each, as, for example, two water valves and a door lock in a dishwasher, without any additional turn-off snubber.

## TYPICAL APPLICATION DIAGRAM

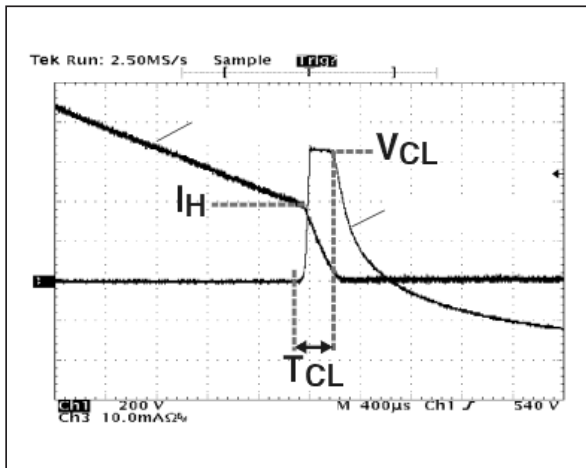


**HIGH INDUCTIVE SWITCH-OFF OPERATION**

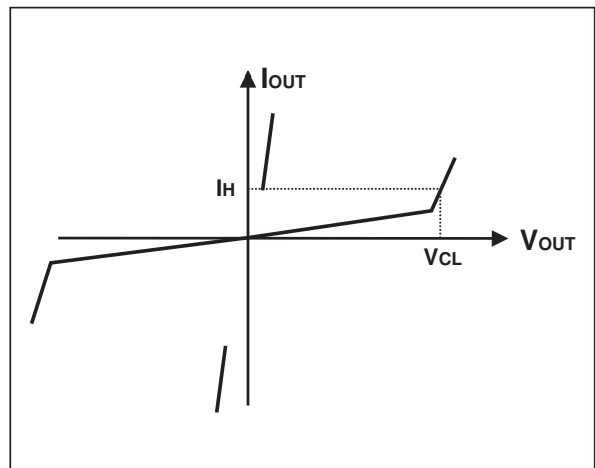
At the end of the last conduction half-cycle, the load current reaches the holding current level  $I_H$ , and the ACS™ switch turns off. Because of the inductance  $L$  of the load, the current flows through the avalanche diode  $D$  and decreases linearly to zero. During this time, the voltage across the switch is limited to the clamping voltage  $V_{CL}$ .

The energy stored in the inductance of the load depends on the holding current  $I_H$  and the inductance (up to 10 H); it can reach about 20 mJ and is dissipated in the clamping diode section that is especially designed for that purpose.

**Fig. 1:** Turn-off operation of the ACS302 switch with an electro valve: waveform of the pin OUT current  $I_{OUT}$  & voltage  $V_{OUT}$ .



**Fig. 2:** ACS302 switch static characteristic.

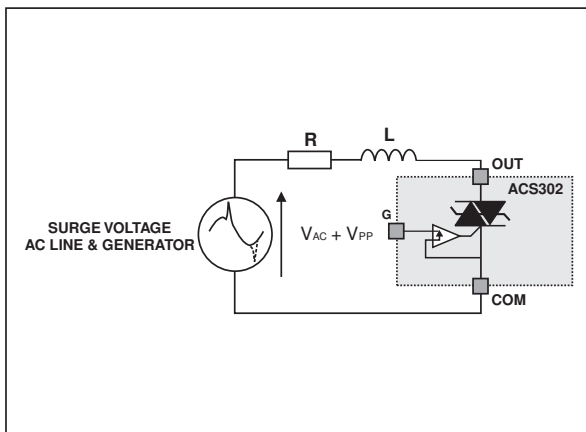


**AC LINE TRANSIENT VOLTAGE RUGGEDNESS**

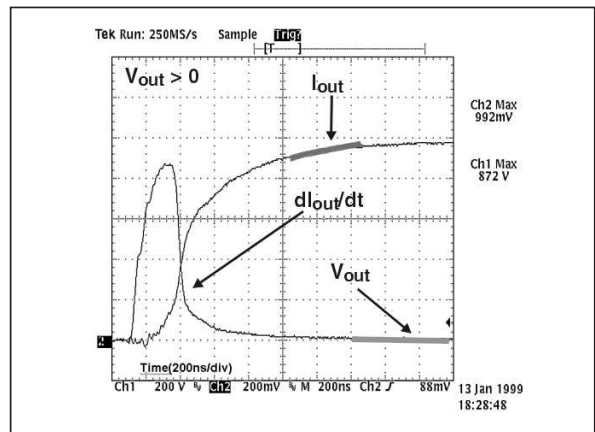
The ACS302 switch is able to withstand safely the AC line transient voltages either by clamping the low energy spikes or by breaking over under high energy shocks.

The test circuit of the figure 3 is representative of the final ACS™ application and is also used to stress the ACS switch according to the IEC61000-4-5 standard conditions. Thanks to the load, the ACS™ switch 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 on figure 4. Such non repetitive test can be done 10 times on each AC line voltage polarity.

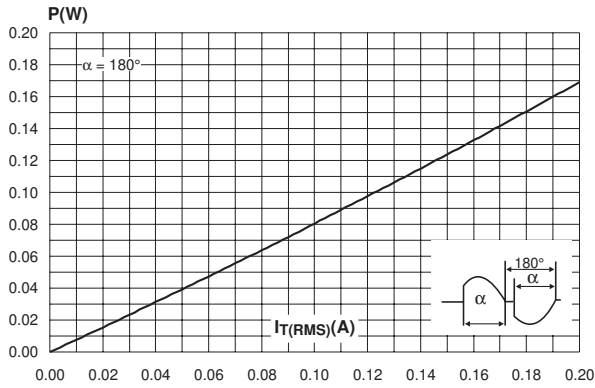
**Fig. 3:** Overvoltage ruggedness test circuit for resistive and inductive loads according to IEC61000-4-5 standard.  $R = 150\Omega$ ,  $L = 5\mu H$ ,  $V_{PP} = 2kV$ .



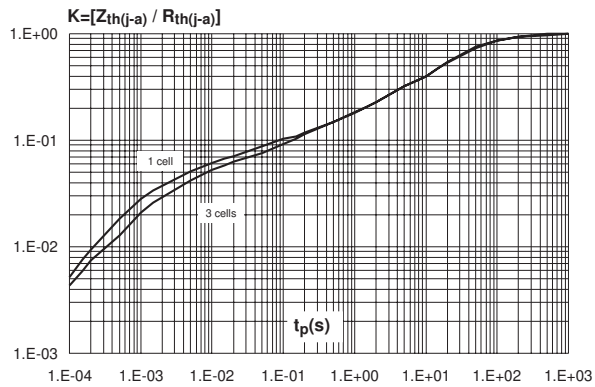
**Fig. 4:** Current and Voltage of the ACS™ during IEC61000-4-5 standard test with  $R = 150\Omega$ ,  $L = 5\mu H$  &  $V_{PP} = 2kV$ .



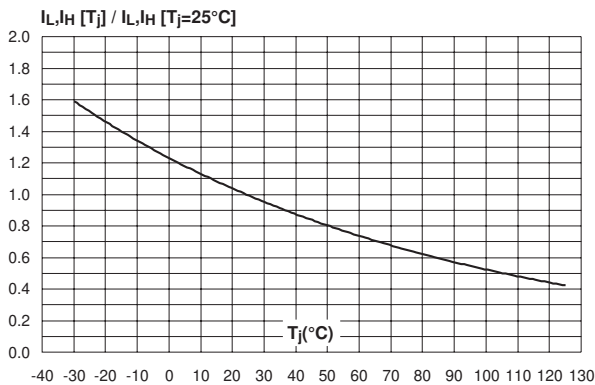
**Fig. 5:** Maximum power dissipation versus RMS on-state current (per switch).



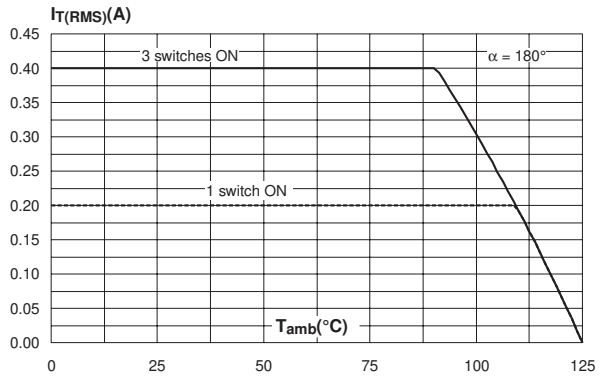
**Fig. 7:** Relative variation of thermal impedance junction to ambient versus pulse duration .



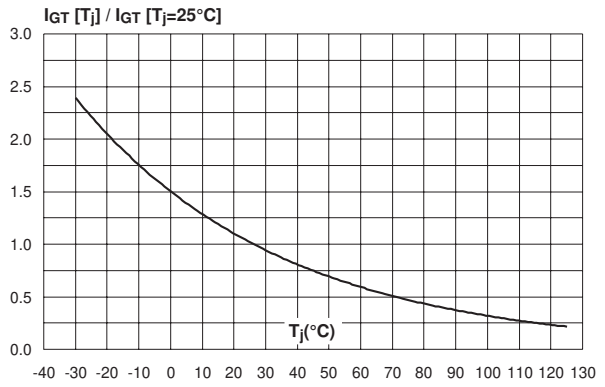
**Fig. 9:** Relative variation of holding and latching current versus junction temperature (typical values).



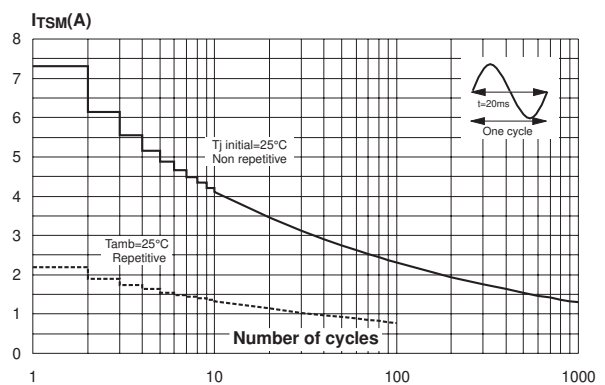
**Fig. 6:** RMS on-state current versus ambient temperature.



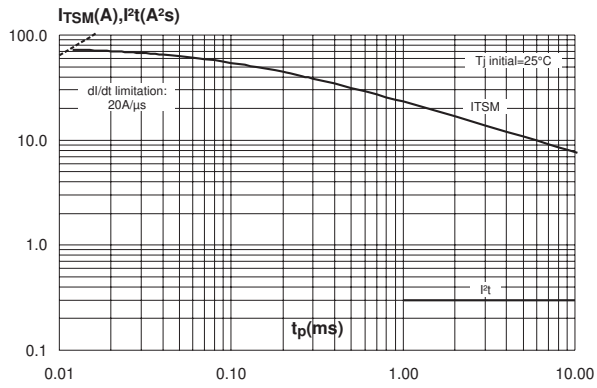
**Fig. 8:** Relative variation of gate trigger current versus junction temperature (typical value).



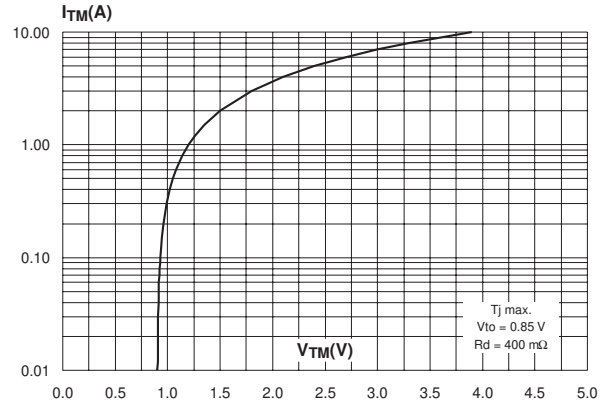
**Fig. 10:** Surge peak on-state current versus number of cycles.



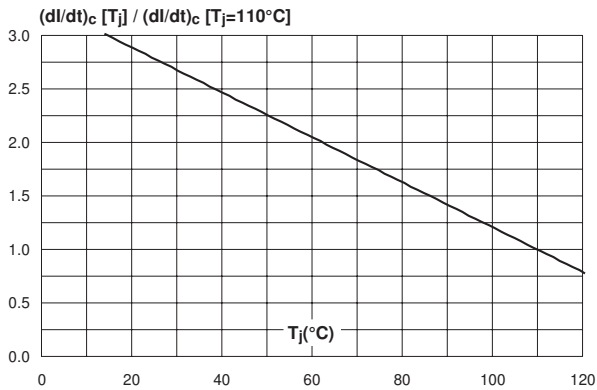
**Fig. 11:** Non-repetitive surge peak on-state current for a sinusoidal pulse with width  $t_p < 10\text{ms}$ , and corresponding value of  $I^2t$ .



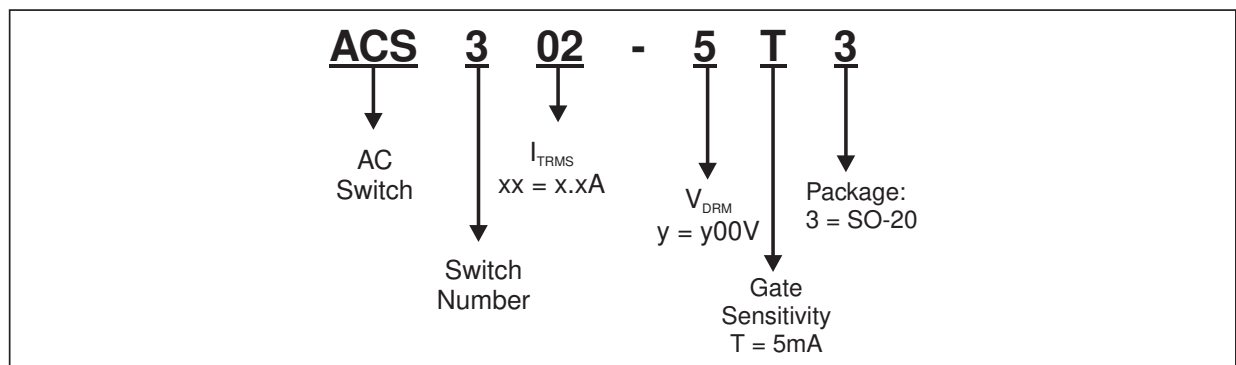
**Fig. 12:** On-state characteristics (maximum values).



**Fig. 13:** Relative variation of critical  $(dI/dt)_c$  versus junction temperature.



**ORDERING INFORMATION**

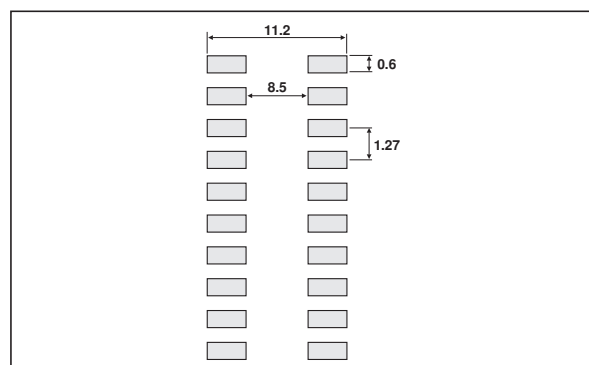


## PACKAGE OUTLINE MECHANICAL DATA

SO-20

REF.	DIMENSIONS					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.35		2.65	0.092		0.104
A1	0.10		0.20	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	0.50		1.27	0.020		0.050
K	8° (max)					

## FOOT PRINT DIMENSIONS (in millimeters)



## OTHER INFORMATION

Ordering type	Marking	Package	Weight	Base qty	Delivery mode
ACS302-5T3	ACS302	SO-20	0.55g	40	Tube

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