



ACS108-5Sx

ASD™ AC Switch Family

AC LINE SWITCH

MAIN APPLICATIONS

- AC Line switch for appliance control systems
- Drive of low power high inductive or resistive loads like:
 - solenoid, relay, valve, dispenser
 - micro-motor
 - door lock
 - low power lamp bulb
 - pump
 - fan

FEATURES

- $V_{DRM} / V_{RRM} = 500V$
- Avalanche controlled device
- $I_{T(RMS)} = 0.8 A$
- Gate triggering current : $I_{GT} < 10 mA$
- Switch integrated driver
- Drive reference COM connected to the SOT223 tab

BENEFITS

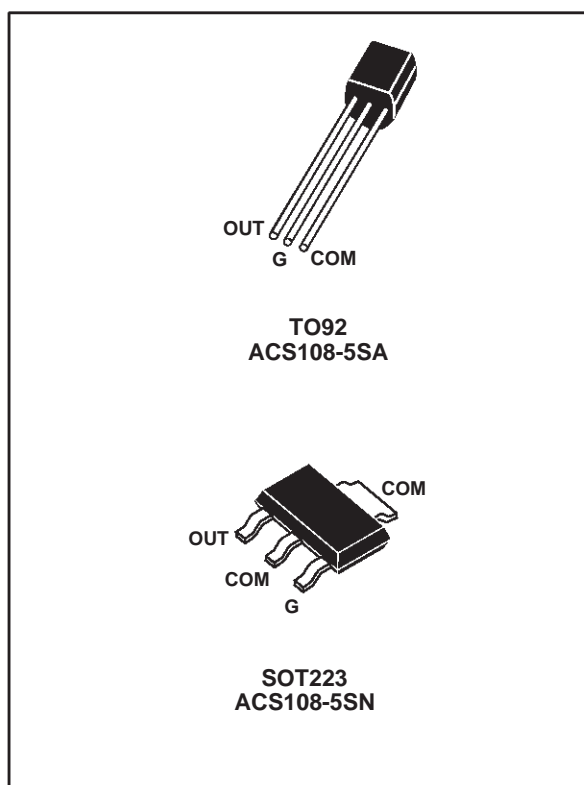
- Needs no more external protection snubber & varistor.
- Enables the equipment to meet IEC1000-4-5 standard.
- Allows straightforward connection of several SOT223 devices on the same cooling pad.
- Reduces the switch component count by up to 80%.
- Interfaces directly with the microcontroller.
- Eliminates any stressing gate kick back on the microcontroller.

DESCRIPTION

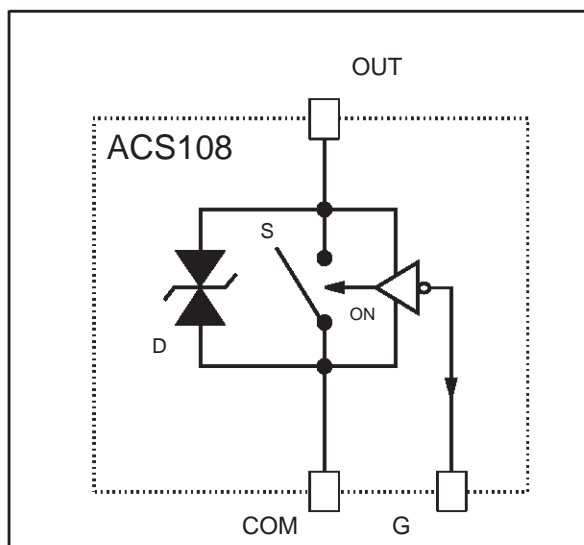
The ACS108 belongs to the AC line switches built around the ASD™ concept. This high performance full planar technology device is able to control an 0.8 A load.

The 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.

Note: For further technical information, please refer to the Application note AN1172.



FUNCTIONAL DIAGRAM



ACS108-5Sx

ABSOLUTE RATINGS (limiting values)

Symbol	Parameter		Value	Unit	
V_{DRM} V_{RRM}	Repetitive peak off-state voltage		$T_j = 25\text{ °C}$	500	V
$I_{T(RMS)}$	RMS on-state current full cycle sine wave 50 to 60 Hz	TO92	$T_{lead} = 60\text{ °C}$	0.8	A
		TO92	$T_{amb} = 60\text{ °C}$	0.3	A
		SOT223	$T_{amb} = 55\text{ °C}$	0.8	A
I_{TSM}	Non repetitive surge peak on-state current T_j initial = 25 °C , full cycle sine wave	$F = 50\text{ Hz}$		7.3	A
		$F = 60\text{ Hz}$		8	A
di/dt	Critical rate of rise of on-state current $I_G = 20\text{ mA}$ with $t_r = 100\text{ ns}$		Repetitive $F = 120\text{ Hz}$	20	A/ μs
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			0 to + 110	$^{\circ}\text{C}$
T_I	Maximum lead temperature for soldering during 10s			260	$^{\circ}\text{C}$

note 1 : according to test described by IEC 1000-4-5 standard & 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	TO92	150	$^{\circ}\text{C/W}$
		SOT223 (*)	60	$^{\circ}\text{C/W}$
$R_{th(j-l)}$	Junction to lead for full AC line cycle conduction	TO92	60	$^{\circ}\text{C/W}$
$R_{th(j-t)}$	Junction to tab for full AC line cycle conduction	SOT223	25	$^{\circ}\text{C/W}$

(*) : with 5 cm^2 copper ($e=35\mu\text{m}$) surface under tab

ELECTRICAL CHARACTERISTICS

For either positive or negative polarity of pin OUT voltage respect to pin COM voltage

Symbol	Test Conditions	Values	Unit	
I_{GT}	$V_{OUT}=12\text{ V}$ (DC) $R_L=140\Omega$	$T_j=25\text{ °C}$ MAX	10	mA
V_{GT}	$V_{OUT}=12\text{ V}$ (DC) $R_L=140\Omega$	$T_j=25\text{ °C}$ MAX	1	V
V_{GD}	$V_{OUT}=V_{DRM}$ $R_L=3.3\text{ k}\Omega$	$T_j=110\text{ °C}$ MIN	0.2	V
I_H	$I_{OUT}= 100\text{ mA}$ gate open	$T_j=25\text{ °C}$ TYP	25	mA
		MAX	60	mA
I_L	$I_G= 20\text{ mA}$	$T_j=25\text{ °C}$ TYP	30	mA
		MAX	65	mA
V_{TM}	$I_{OUT} = 1.1\text{ A}$ $t_p=380\mu\text{s}$	$T_j=25\text{ °C}$ MAX	1.3	V
I_{DRM} I_{RRM}	$V_{OUT} = V_{DRM}$ $V_{OUT} = V_{RRM}$	$T_j=25\text{ °C}$ MAX	2	μA
		$T_j=110\text{ °C}$ MAX	50	μA
dV/dt	$V_{OUT}=400\text{ V}$ gate open	$T_j=110\text{ °C}$ MIN	500	V/ μs
$(di/dt)_c$	$(dV_{OUT}/dt)_c=10\text{ V}/\mu\text{s}$	$T_j=110\text{ °C}$ MIN	0.1	A/ms
V_{CL}	$I_{CL} = 1\text{ mA}$ $t_p=1\text{ ms}$	$T_j=25\text{ °C}$ TYP	600	V

AC LINE SWITCH BASIC APPLICATION

The ACS108 device is well adapted to washing machine, dishwasher, tumble drier, refrigerator, water heater and cookware. It has been designed especially to switch ON and OFF low power loads such as solenoid, valve, relay, micro-motor, fan, pump, door lock and low wattage lamp bulb.

Pin COM: Common drive reference to connect to the power line neutral

Pin G: Switch Gate input to connect to the digital controller

Pin OUT: Switch Output to connect to the Load

The 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. Note that no protection device (zener or capacitor) should be added between gates and common terminals.

The SOT223 version allows several ACS108 devices to be connected on the same cooling PCB pad which is the COM pin : this cooling pad can be then reduced, and the printed circuit layout is simplified.

In appliances systems, the ACS108 switch intends to drive low power load in full cycle ON / OFF mode. When the gate signal is removed, the load is switched off after a delay time that is equal to one half line cycle or one full line cycle depending on the load drive strategy.

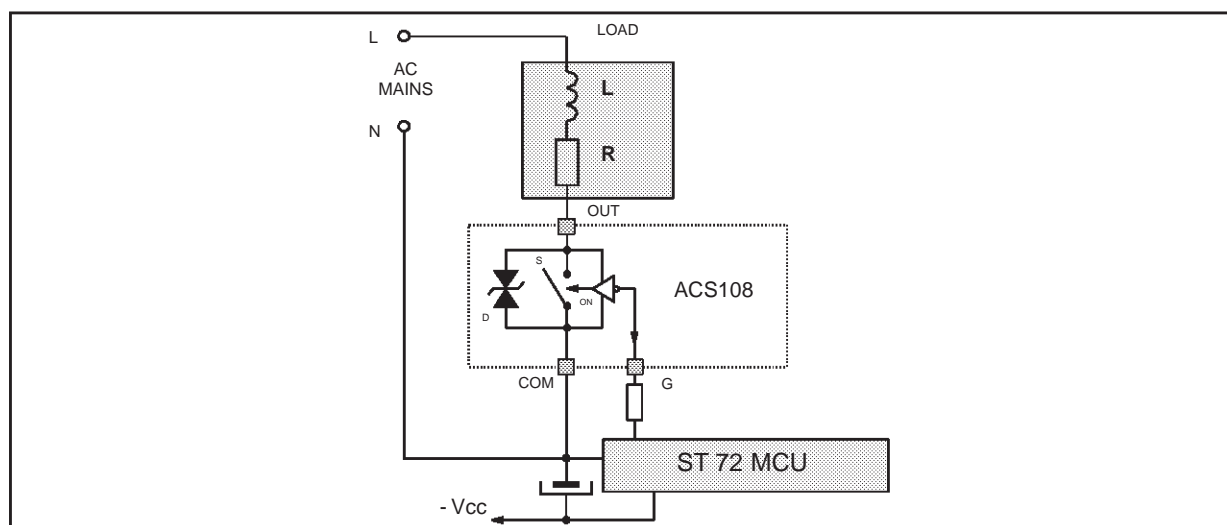
The turn off commutation characteristics of these loads can be classified in 3 groups as shown in table 1.

Thanks to its thermal and turn off commutation performances, the ACS108 switch is able to drive with no additional turn off snubber, a resistive or inductive load up to 0.2 A (when this load has to switch off within one half AC line cycle), an inductive load up to 0.6 A or a resistive load up to 0.8 A (when this load has to switch off within one full AC line cycle).

Table 1: Load grouping versus their turn off commutation requirement (230V AC applications).

LOAD	IRMS (A)	POWER FACTOR	(di/dt)c (A/ms)	(dV/dt)c (V/μs)	TURN-OFF DELAY (ms)
Door Lock Lamp	< 0.3	1	0.15	0.15	<10
	< 0.8	1	0.4	0.15	< 20
Relay Valve Dispenser Micro-motor	< 0.1	> 0.7	< 0.05	< 5	< 10
Pump Fan	< 0.2	> 0.2	< 0.1	< 10	< 10
	< 0.6	> 0.2	< 0.3	< 10	< 20

TYPICAL APPLICATION DIAGRAM



ACS108-5Sx

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 section that is especially designed for that purpose.

Fig 1: Turn-off operation of the ACS108 switch with an electro valve: waveform of the gate current I_G , pin OUT current I_{OUT} & voltage V_{OUT} .

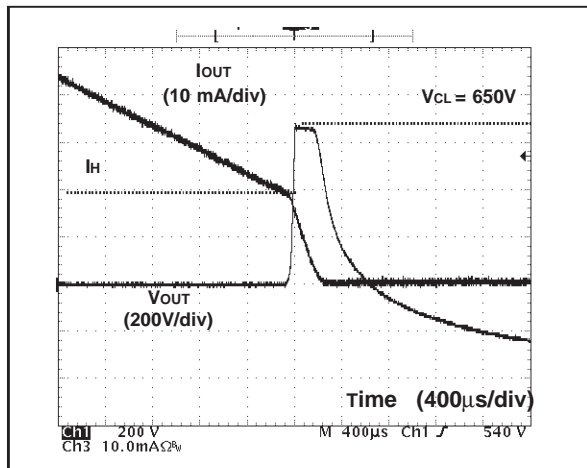
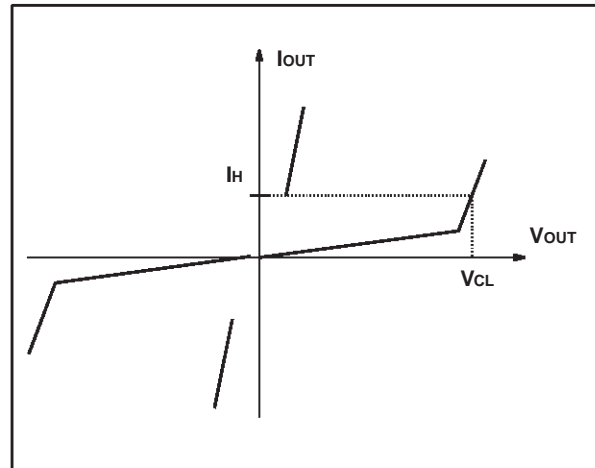


Fig 2: ACS108 switch static characteristic.



AC LINE TRANSIENT VOLTAGE RUGGEDNESS

The ACS108 switch is able to sustain safely the AC line transient voltages either by clamping the low energy spikes or by breaking over under high energy shocks, even with high turn-on current rises.

The test circuit of the figure 4 is representative of the final ACS™ application and is also used to stress the ACS™ switch according to the IEC1000-4-5 standard conditions. Thanks to the load, the ACS™ switch sustains 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 IEC 1000-4-5 standard.

$R = 150\Omega$, $L = 5\mu\text{H}$, $V_{PP} = 2\text{kV}$.

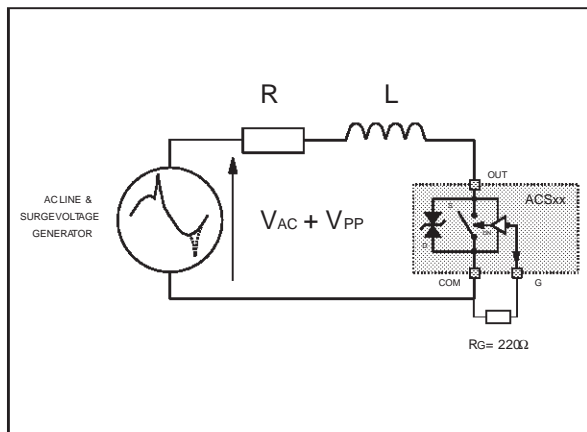


Fig 4: Current and voltage of the ACS™ during IEC 1000-4-5 standard test with a $220\Omega - 10\mu\text{H}$ load & $V_{PP} = 2\text{kV}$.

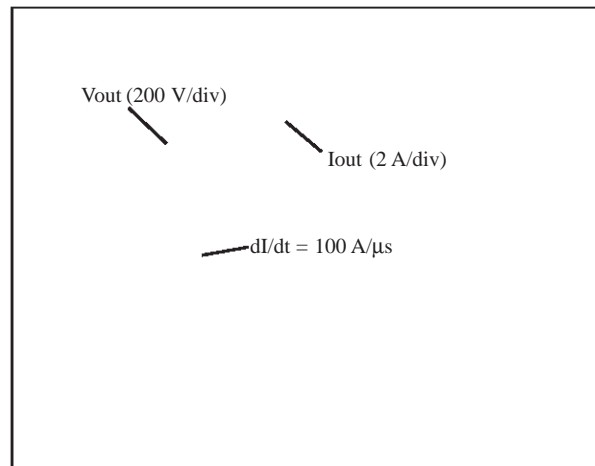


Fig 5: Relative variation of gate trigger current versus junction temperature

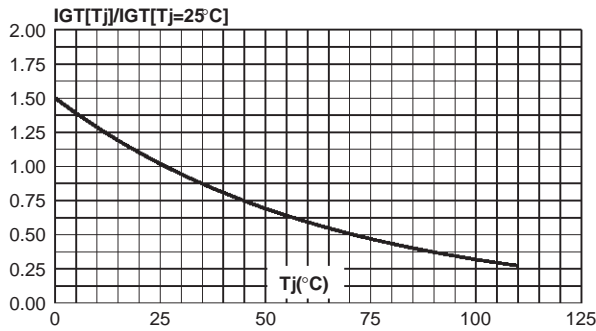


Fig 6: Relative variation of holding & latching currents versus junction temperature

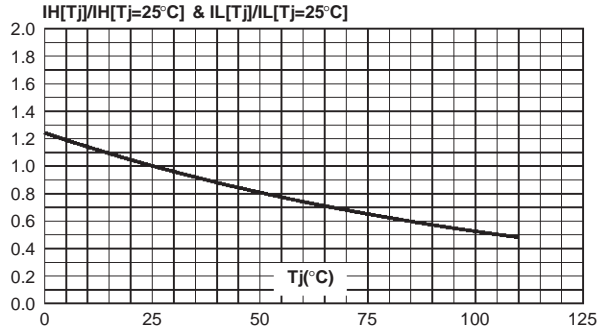


Fig 7: On state characteristics @Tj max
 $V_{TO} = 0.90\text{ V}$ & $R_T = 0.3\ \Omega$ (maximum values)
 $P_{on} = V_{TO} \cdot 2 \cdot \sqrt{2} \cdot I_{T(RMS)} / \Pi + R_T \times I_{T(RMS)}^2$

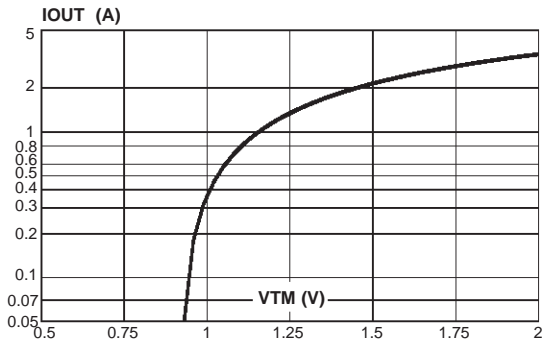


Fig 8: Maximum RMS switch current versus ambient temperature on inductive load (PF>0.1) and a low repetitive rate (F < 1 Hz)
 (*): with 5cm² copper (e=35µm) surface under tab

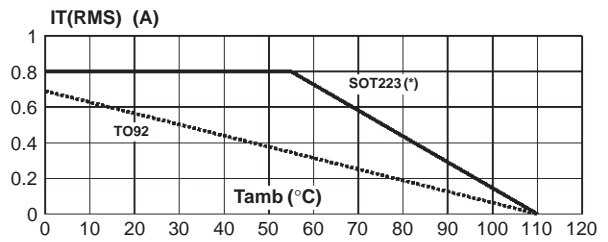


Fig 9-1: Relative variation of the junction to ambient thermal impedance versus conducting pulse duration for the SOT223
 Standard foot print with 35µm copper layout thickness.

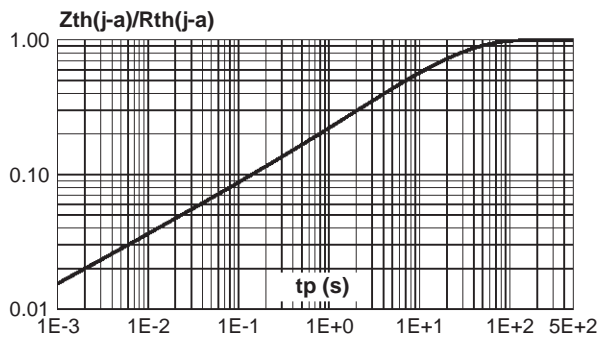
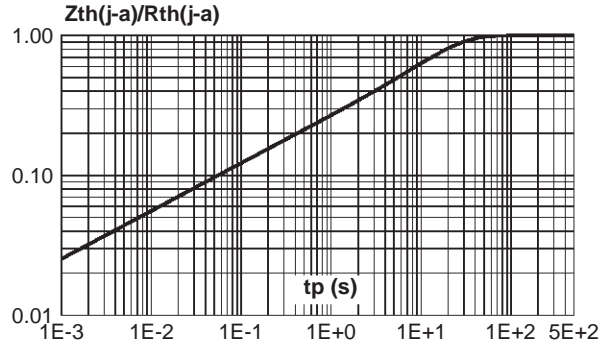
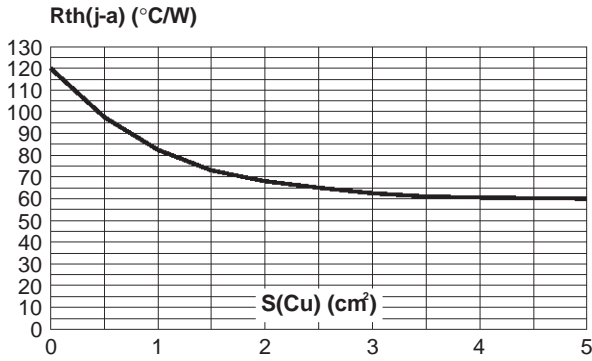


Fig 9-2: Relative variation of the junction to ambient thermal impedance versus conducting pulse duration for the TO92.

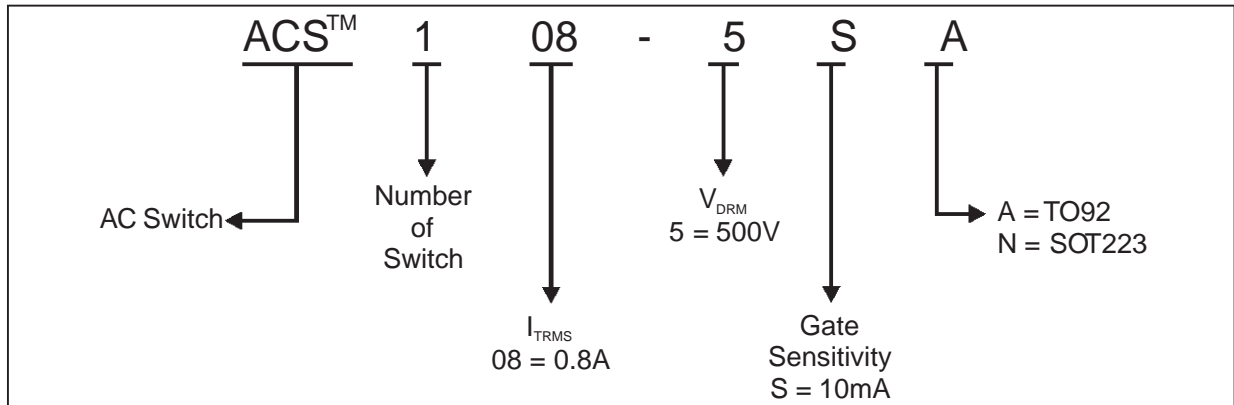


ACS108-5Sx

Fig. 10: SOT223 thermal resistance junction to ambient versus copper surface under tab (Epoxy printed circuit board FR4, copper thickness: 35µm)



ORDERING INFORMATION



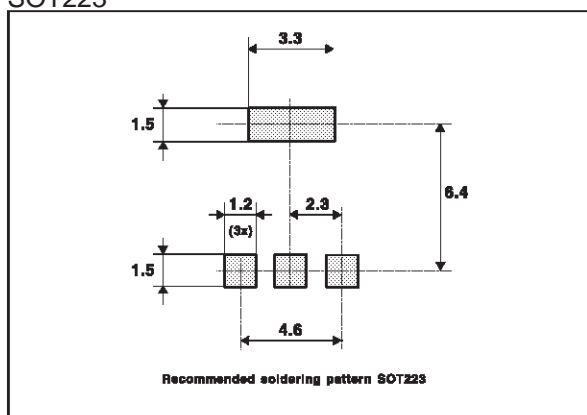
PACKAGE MECHANICAL DATA

SOT223

REF.	DIMENSIONS					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.80			0.071
A1		0.02			0.001	
B	0.60	0.70	0.80	0.024	0.027	0.031
B1	2.90	3.00	3.10	0.114	0.118	0.122
c	0.24	0.26	0.32	0.009	0.010	0.013
D	6.30	6.50	6.70	0.248	0.256	0.264
e		2.3			0.090	
e1		4.6			0.181	
E	3.30	3.50	3.70	0.130	0.138	0.146
H	6.70	7.00	7.30	0.264	0.276	0.287
V	10° max					

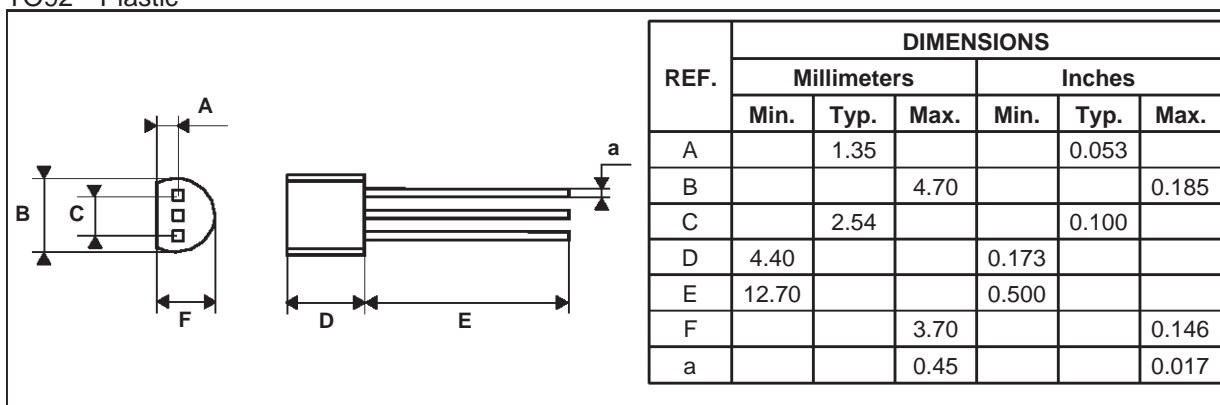
PACKAGE MECHANICAL DATA

SOT223



PACKAGE MECHANICAL DATA

TO92 Plastic



Ordering type	Marking	Package	Weight	Base qty	Delivery mode
ACS108-5SA	ACS08/5S	TO92	0.2g	2500	Bulk
ACS108-5SN	ACS/085S	SOT223	0.123g	1000	Tape & reel

TM: ASD and ACS are trademarks of STMicroelectronics .

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied.

STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a registered trademark of STMicroelectronics

© 1999 STMicroelectronics - Printed in Italy - All rights reserved.

STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - China - Finland - France - Germany - Hong Kong - India - Italy - Japan - Malaysia
Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - U.S.A.

<http://www.st.com>