ABSOLUTE RATINGS (limiting values)

Symbol	Parameter			Value	Unit
V_{DRM} / V_{RRM}	Repetitive peak off-state voltage		Tj = 125 °C	500	V
$I_{T(RMS)}$	RMS on-state current full cycle sine wave 50 to 60 Hz	per switch	Tamb = 110 °C	0.2	A
		total array	Tamb = 90 °C	0.4	A
I_{TSM}	Non repetitive surge peak on-state current Tj initial = 25°C, full cycle sine wave		F =50 Hz	5	A
			F =60 Hz	5.5	A
dI/dt	Critical rate of repetitive rise of on-state current I_G = 20mA (tr = 100ns)		F =120 Hz	20	A/µs
V_{PP}	Non repetitive line peak pulse voltage		note 1	2	kV
Tstg	Storage temperature range			- 40 to + 150	°C
Tj	Operating junction temperature range			- 30 to + 125	°C
Tl	Maximum lead temperature for soldering during 10s			260	°C

Note 1: according to test described by IEC61000-4-5 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 (tp = 20µs)	1	A
V_{GM}	Peak positive gate voltage (respect to the pin COM)	5	V

THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
Rth (j-a)	Junction to ambient	90	°C/W

ELECTRICAL CHARACTERISTICS PER SWITCH

For either positive or negative polarity of pin OUT1, OUT2, OUT3, OUT4 voltage respect to pin COM voltage.

Symbol	Test conditions			Values	Unit
I_{GT}	V_D = 12V R_L = 140Ω	Tj=25°C	MAX.	10	mA
V_{GT}	V_D = 12V R_L = 140Ω	Tj=25°C	MAX.	1	V
V_{GD}	V_{OUT} = V_{DRM} R_L = 3.3kΩ	Tj=125°C	MIN.	0.15	V
I_H	I_{OUT} = 100mA gate open	Tj=25°C	TYP.	25	mA
			MAX.	60	mA
I_L	I_G = 20mA	Tj=25°C	TYP.	30	mA
			MAX.	65	mA
V_{TM}	I_{OUT} = 0.3A tp = 500µs	Tj=25°C	MAX.	1.1	V
I_{DRM} I_{RRM}	V_{OUT} = V_{DRM} V_{OUT} = V_{RRM}	Tj=25°C	MAX.	2	µA
		Tj=125°C	MAX.	200	µA
dV/dt	V_{OUT} = 400V gate open	Tj=110°C	MIN.	500	V/µs
(dI/dt)c	(dV/dt)c = 10V/µs	Tj=110°C	MIN.	0.1	A/ms
V_{CL}	I_{CL} = 1mA tp = 1ms	Tj=25°C	TYP.	600	V

AC LINE SWITCH BASIC APPLICATION

The ACS402 device is well adapted to washing machines, dishwashers, tumble driers, refrigerators, water heaters and cookware. 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 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 the 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 device are required between the gates and common terminals.

In appliance systems, this ACS™ switch intends to drive low power load in full cycle ON / OFF mode. The turn off commutation characteristics of these loads can be classified in 3 groups as shown in Table 1.

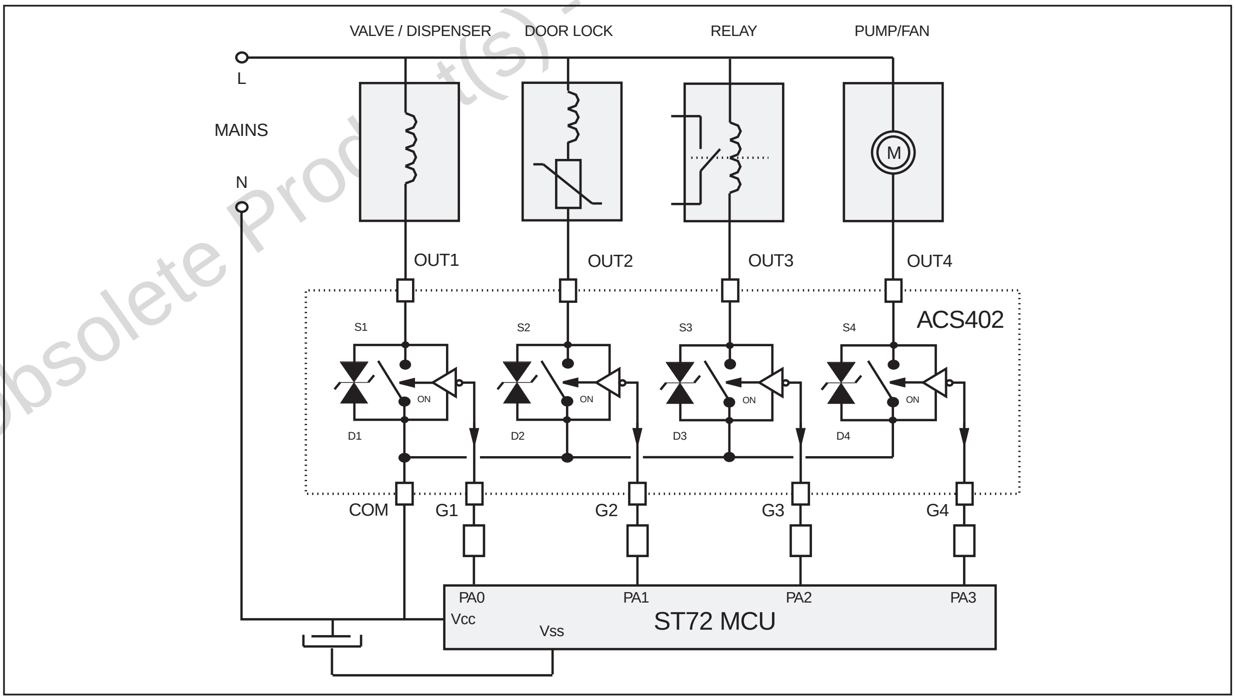
Thanks to its thermal and turn-off commutation performance, each switch of the ACS402 is able to drive an inductive or resistive load up to 0.2 A with no additional turn-off snubber.

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

LOAD	POWER (VA)	POWER FACTOR	RMS LOAD CURRENT (A)	$(dI_{OUT}/dt)c$ (A/ms)	$(dV_{OUT}/dt)c$ (V/µs)
Door lock Bulb Lamp	< 40	1	< 0.2	< 0.1	< 0.15
Relay Valve Dispenser Micro-motor Solenoid	< 20	> 0.7	< 0.1	< 0.05	< 2
Pump Fan	< 40	> 0.2	< 0.2	< 0.1	< 10

(*): Measured with an ACS402 switch

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 section that is especially designed for that purpose.

Fig 1: Turn-off operation of the ACS402 switch with an electro valve: waveform of the gate current I_G, pin OUT current I_{OUT} & voltage V_{OUT}.

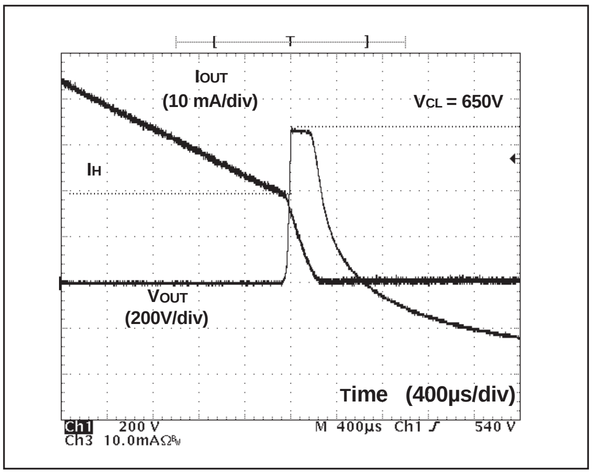
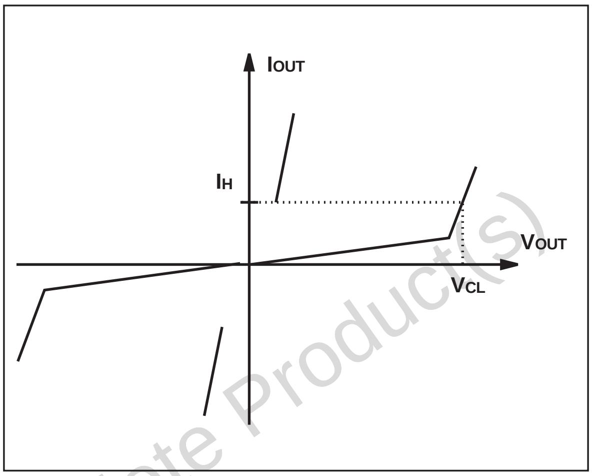


Fig 2: ACS402 switch static characteristic.



AC LINE TRANSIENT VOLTAGE RUGGEDNESS

Each ACS402 switch is able to safely withstand the AC line transient voltages either by clamping the low energy spikes or by breaking over under high energy shocks.

The test circuit in 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 in 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 = 150Ω, L = 5µH, V_{PP} = 2kV.

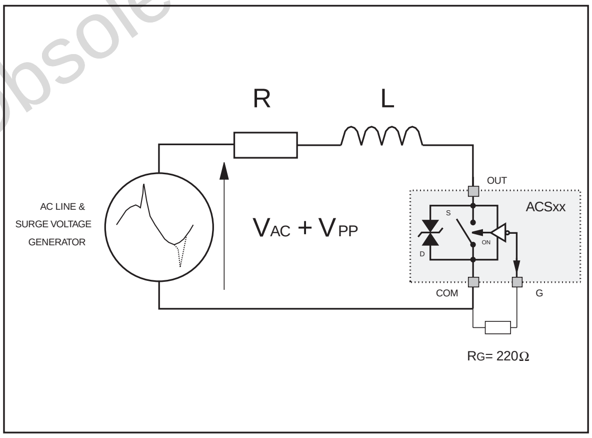


Fig 4: Current and voltage of the ACS™ during IEC61000-4-5 standard test with a 150Ω - 10µH load & V_{PP} = 2kV.

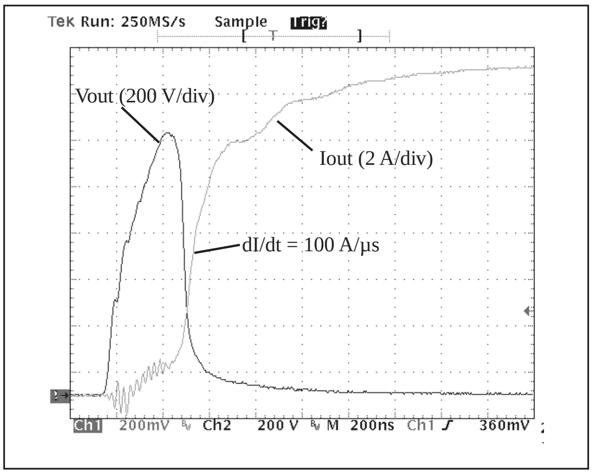


Fig. 5: Maximum power dissipation versus RMS on-state current (per switch).

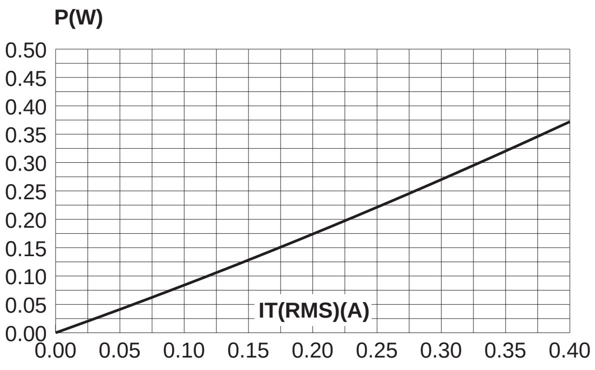


Fig. 6: RMS on-state current versus ambient temperature.

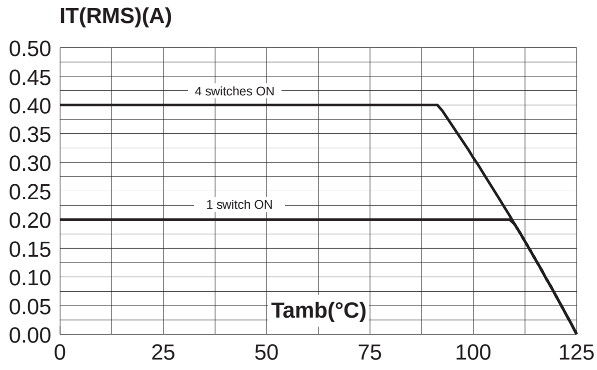


Fig. 7: Relative variation of thermal impedance junction to ambient versus pulse duration (device mounted on printed circuit board FR4, e(Cu) = 35µm)

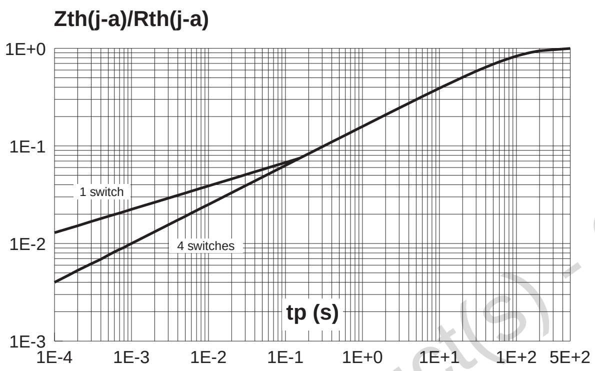


Fig. 8: Relative variation of gate trigger current versus junction temperature.

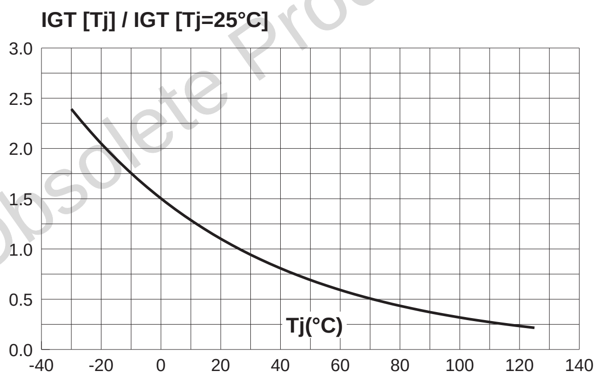


Fig. 9: Relative variation of holding and latching current versus junction temperature.

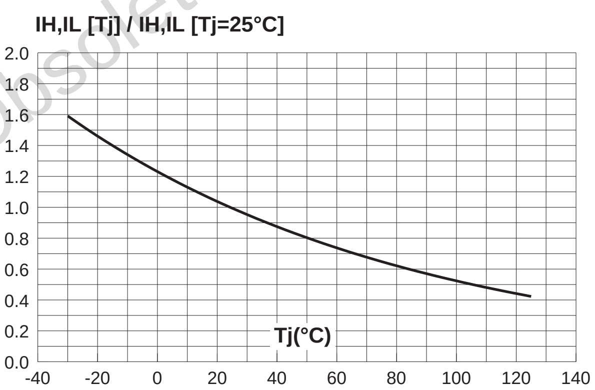


Fig. 10: Surge peak on-state current versus number of cycles.

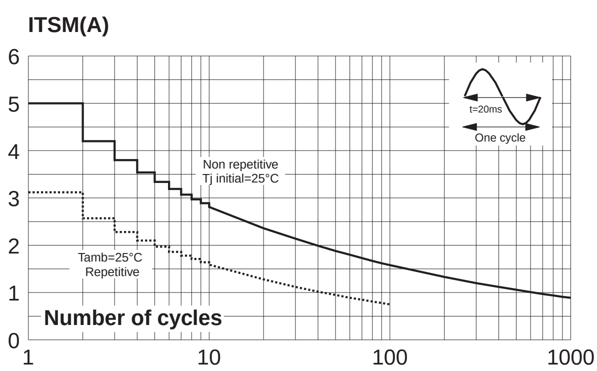


Fig. 11: Non-repetitive surge peak on-state current for a sinusoidal pulse with width tp < 10ms, and corresponding value of I^2t.

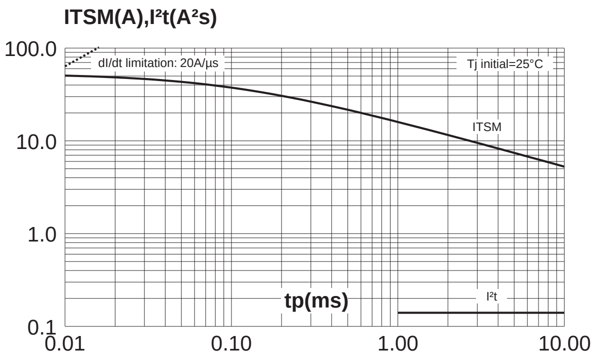


Fig. 12: On-state characteristics (maximum values).

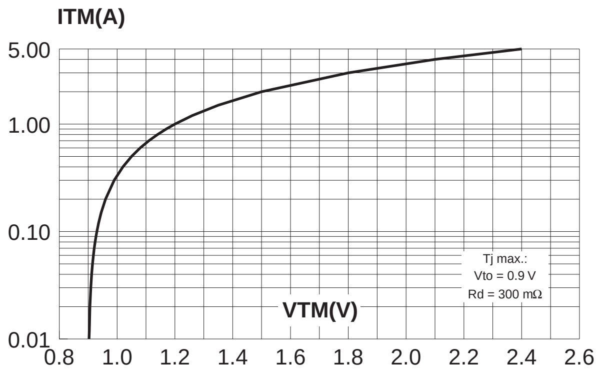
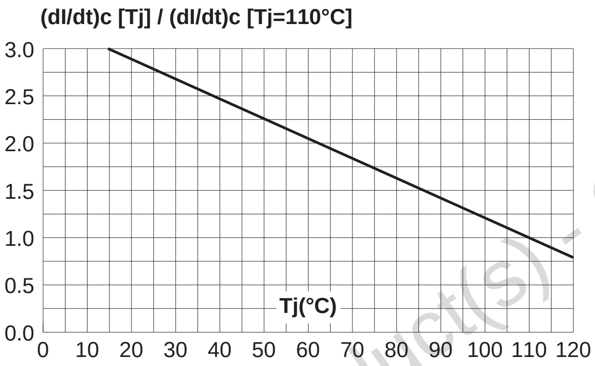
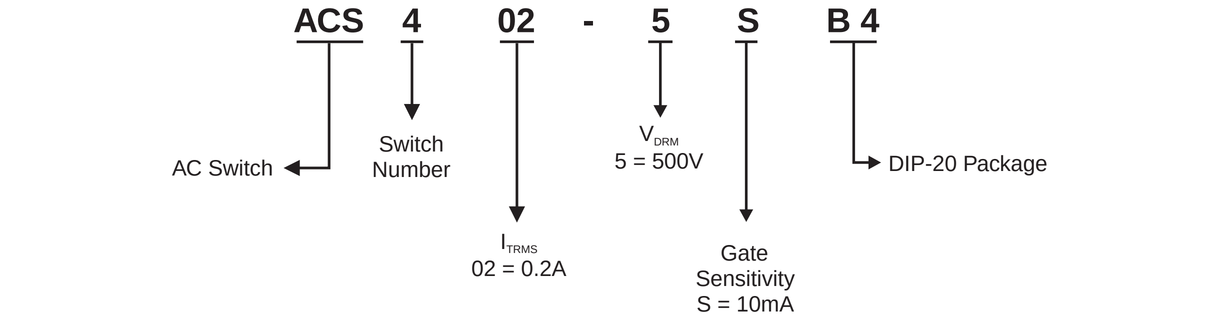


Fig. 13: Relative variation of critical (dI/dt)c versus junction temperature.

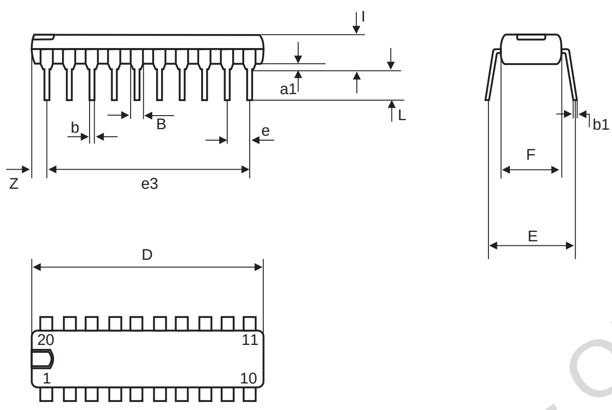


ORDERING INFORMATION



PACKAGE MECHANICAL DATA

DIP-20



REF.	DIMENSIONS					
	Millimetres			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.508			0.020		
B	1.39		1.65	0.055		0.065
b		0.45			0.018	
b1		0.25			0.010	
D			25.4			1.000
E		8.5			0.335	
e		2.54			0.100	
e3		22.86			0.900	
F			7.1			0.279
I			3.93			0.155
L		3.3			0.130	
Z			1.34			0.053

OTHER INFORMATION

Ordering type	Marking	Package	Weight	Base qty	Delivery mode
ACS402-5SB4	ACS4025	DIP-20	1.4 g.	19	Tube

- Epoxy meets UL94,V0

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