ACS120-7SB/SFP/ST

AC LINE SWITCH

MAIN APPLICATIONS

- AC static switching in appliance control systems
- Drive of low power high inductive or resistive loads like
  - relay, valve, solenoid, dispenser
  - pump, fan, micro-motor
  - defrost heater

FEATURES

- Blocking voltage : V_{DRM} / V_{RRM} = +/-700V
- Avalanche controlled : V_{CL} typ = 1100 V
- Nominal conducting current : $I_{T(RMS)}$ = 2A
- Gate triggering current : I_{GT} < 10 mA
- Switch integrated driver
- High noise immunity : static dV/dt >500V/µs

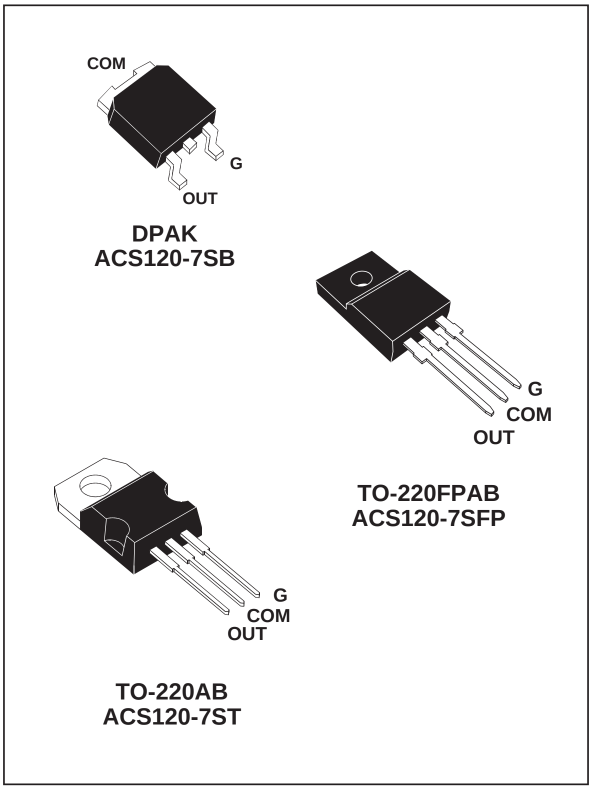
BENEFITS

- Needs no more external protection snubber or varistor
- Enables equipment to meet IEC 61000-4-5
- Reduces component count up to 80 %
- Interfaces directly with the microcontroller
- Eliminates any gate kick back on the microcontroller
- Allows straightforward connection of several ACS™ on same cooling pad.

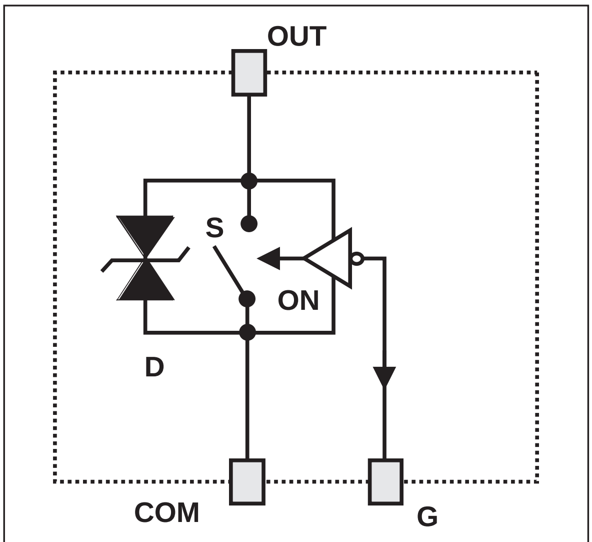
DESCRIPTION

The ACS120 belongs to the AC line switch family built around the ASD™ concept. This high performance switch circuit is able to control a load up to 2 A.

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.



FUNCTIONAL DIAGRAM



ABSOLUTE RATINGS (limiting values)

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

Symbol	Parameter			Value	Unit
V_{DRM} / V_{RRM}	Repetitive peak off-state voltage		Tj = -10 °C	700	V
$I_{T(RMS)}$	RMS on-state current full cycle sine wave 50 to 60 Hz	DPAK	Tc = 115 °C	2	A
		TO-220FPAB	Tc = °C		
		TO-220AB	Tc = 115 °C		
I_{TSM}	Non repetitive surge peak on-state current Tj initial = 25°C, full cycle sine wave		F =50 Hz	20	A
			F =60 Hz	11	A
I^2t	Fusing capability		tp = 10ms	2.2	A²s
dI/dt	Repetitive on-state current critical rate of rise I_G = 10mA (tr < 100ns)	Tj = 125°C	F = 120 Hz	50	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 soldering temperature during 10s			260	°C

Note 1: according to test described by IEC61000-4-5 standard & Figure 3.

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 (in respect to pin COM)	5	V

THERMAL RESISTANCES

Symbol	Parameter			Value	Unit
Rth (j-a)	Junction to ambient	S = 0.5cm²	DPAK	70	°C/W
		TO-220FPAB		60	°C/W
		TO-220AB		60	°C/W
Rth (j-l)	Junction to tab/lead for full cycle sine wave conduction	DPAK		2.6	°C/W
		TO-220FPAB		3.5	°C/W
		TO-220AB		2.6	°C/W

S = Copper surface under Tab

PARAMETER DESCRIPTION

Parameter Symbol	Parameter description
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_{TO}	On state threshold voltage
Rd	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 rise 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

ELECTRICAL CHARACTERISTICS

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

Symbol	Test Conditions				Values	Unit
I_{GT}	V_{OUT}=12V (DC) R_L=140Ω	QII - QIII	Tj=25°C	MAX	10	mA
V_{GT}	V_{OUT}=12V (DC) R_L=140Ω	QII - QIII	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	MAX	45	mA
I_L	I_G= 20mA		Tj=25°C	MAX	65	mA
V_{TM}	I_{OUT} = 2.8A tp=380µs		Tj=25°C	MAX	1.3	V
V_{TO}			Tj=125°C	MAX	0.85	V
Rd			Tj=125°C	MAX	200	mΩ
I_{DRM} / I_{RRM}	V_{OUT} = 700V		Tj=25°C	MAX	2	µA
			Tj=125°C	MAX	200	
dV/dt	V_{OUT}=460V gate open		Tj=110°C	MIN	500	V/µs
(dI/dt)c	(dV/dt)c = 20V/µs		Tj=125°C	MIN	1	A/ms
V_{CL}	I_{CL} = 1mA tp=1ms		Tj=25°C	TYP	1100	V

AC LINE SWITCH BASIC APPLICATION

The ACS120 device is well adapted to Washing machine, dishwasher, tumble drier, refrigerator, air-conditioning systems, and cookware. It has been designed especially to switch on & off low power loads such as solenoid, valve, relay, dispenser, micro-motor, pump, fan and defrost heaters.

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

This 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.

Thanks to its thermal and turn off commutation performances, the ACS120 switch is able to drive with no turn off additional snubber an inductive load up to 2 A.

TYPICAL APPLICATION DIAGRAM

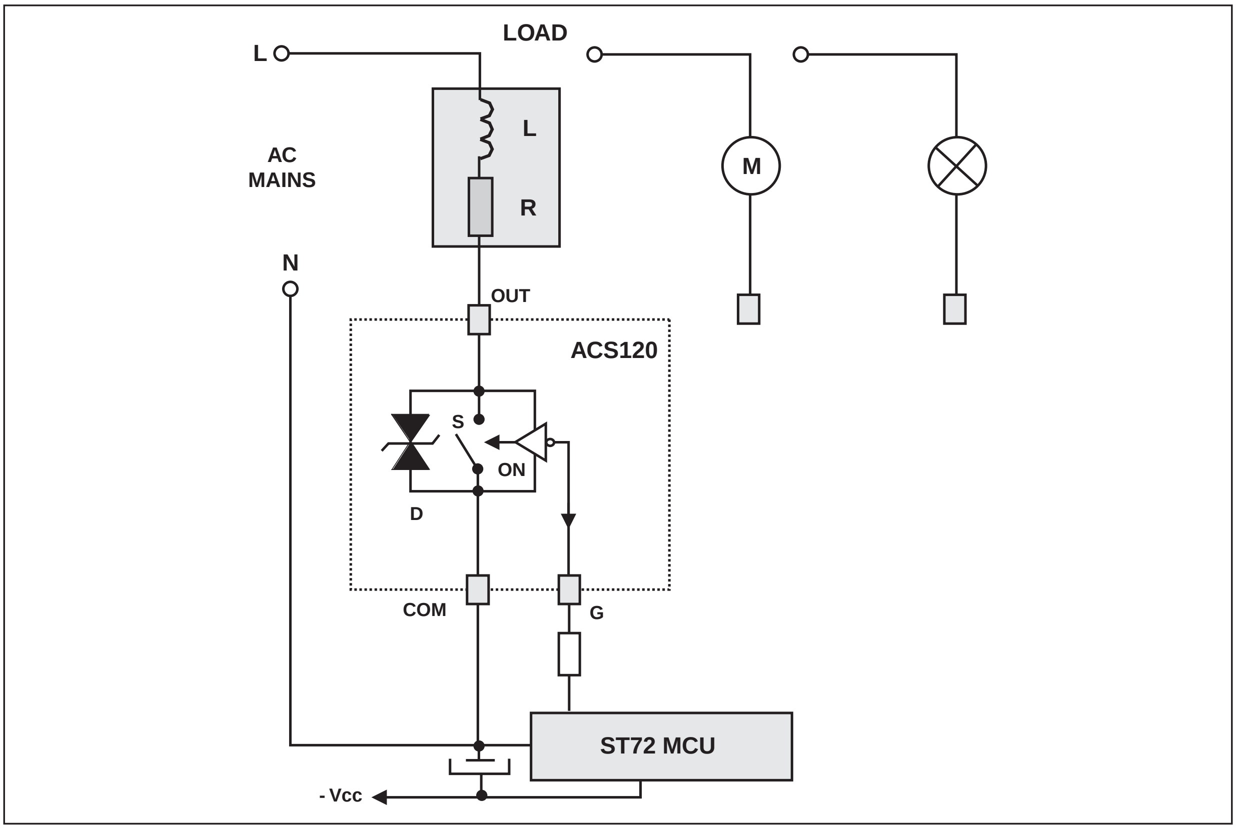


Fig. A: Turn-off operation of the ACS120 switch with an electro-valve: waveform of the pin OUT current I_{OUT} and voltage V_{OUT}.

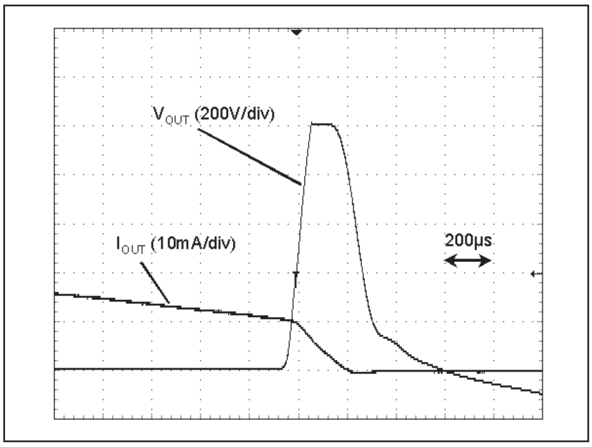
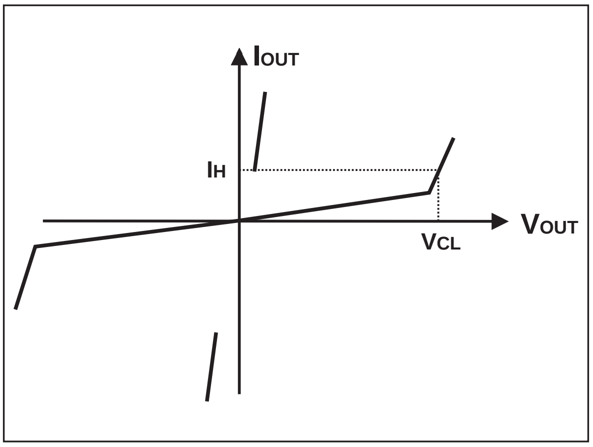


Fig. B: ACS120 switch static characteristic.



AC LINE TRANSIENT VOLTAGE RUGGEDNESS

The ACS120 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 C is representative of the final ACS application and is also used to stress the ACS switch according to the IEC 61000-4-5 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 D. Such non repetitive test can be done 10 times on each AC line voltage polarity.

Fig. C: Overvoltage ruggedness test circuit for resistive and inductive loads according to IEC61000-4-5 standards.
R = 150Ω, L = 10µH, V_{PP} = 2kV.

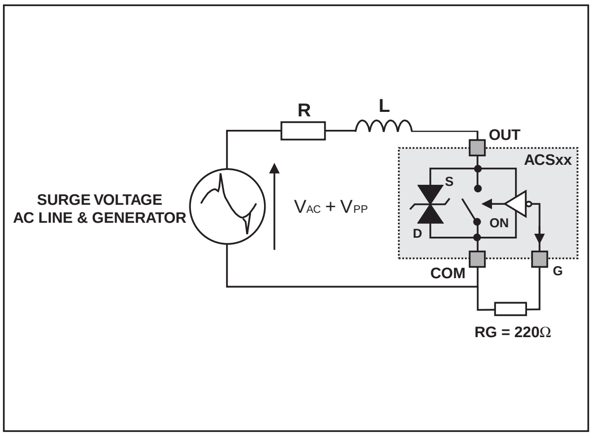
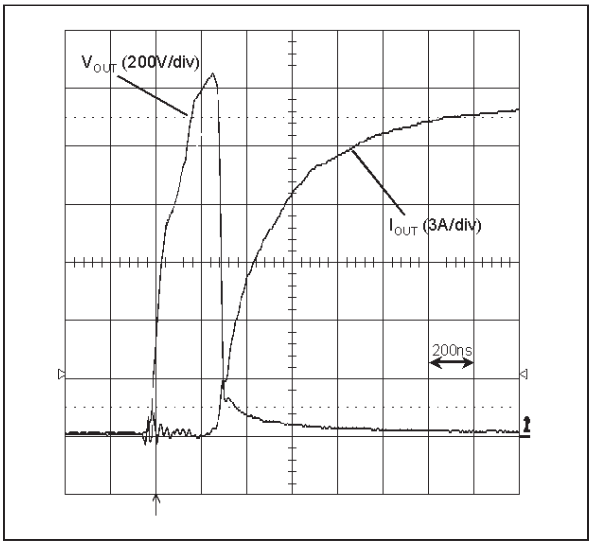


Fig. D: Current and Voltage of the ACS120 during IEC61000-4-5 standard test with R, L & V_{PP} .



OTHER FIGURES

Maximum power dissipation vs RMS on state current.
RMS on-state current vs ambient temperature, case temperature
Relative variation of thermal impedance junction to ambient vs pulse duration and package
Relative variation of gate trigger current vs junction temperature
Relative variation of holding, latching and gate current vs junction
Relative variation of dV/dt vs Tj
Relative variation of $(dV/dt)_c$ vs $(di/dt)_c$
Surge peak on-state current vs number of cycles
Non repetitive surge peak on-state current for a sinusoidal pulse with tp<10ms, and corresponding of I²t.
On-state characteristics (maximal values)
Thermal resistance junction to ambient vs copper surface under tab (DPAK)
Relative variation of critical (di/dt)c vs junction temperature

Fig. 1: Maximum power dissipation versus RMS on-state current.

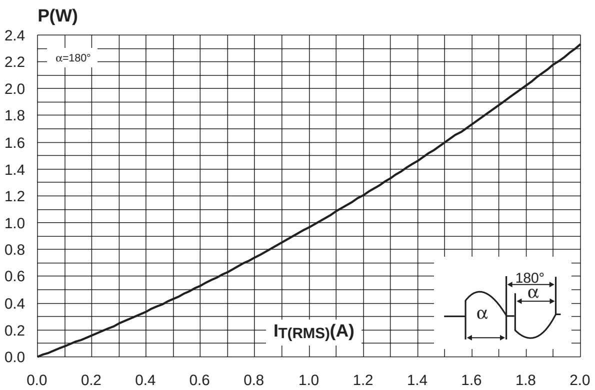


Fig. 2-1: RMS on-state current versus case temperature.

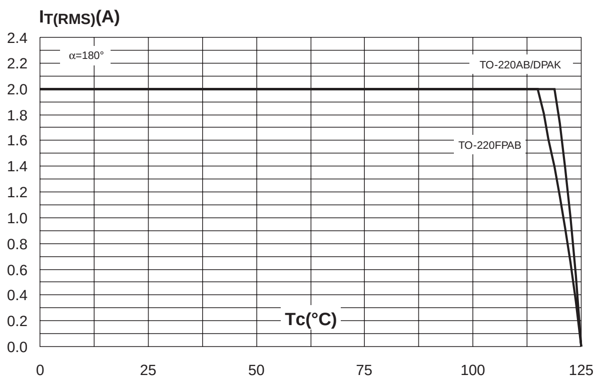


Fig. 2-2: RMS on-state current versus ambient temperature.

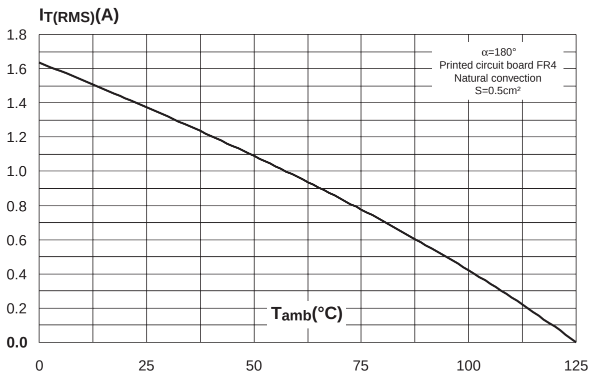


Fig. 3: Relative variation of thermal impedance versus pulse duration.

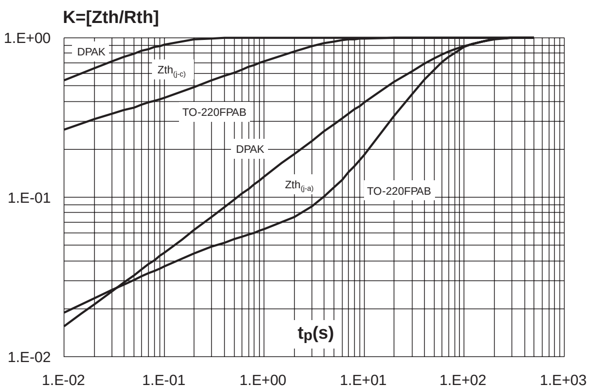


Fig. 4: Relative variation of gate trigger current, holding current and latching versus junction temperature (typical values).

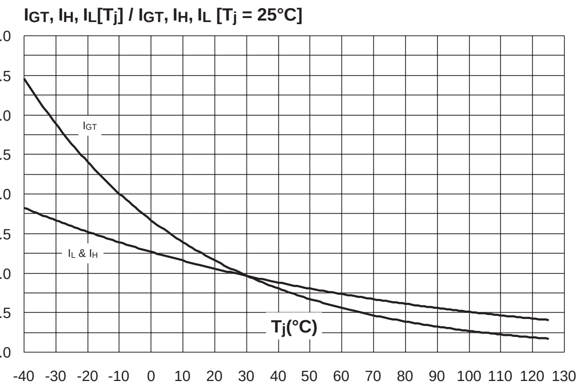


Fig. 5: Relative variation of static dV/dt versus junction temperature.

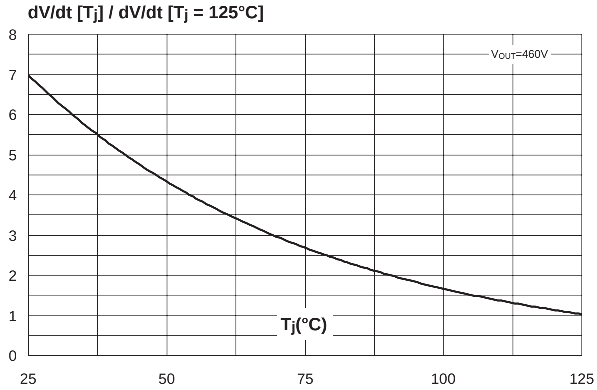


Fig. 6: Relative variation of critical rate of decrease of main current versus reapplied dV/dt (typical values).

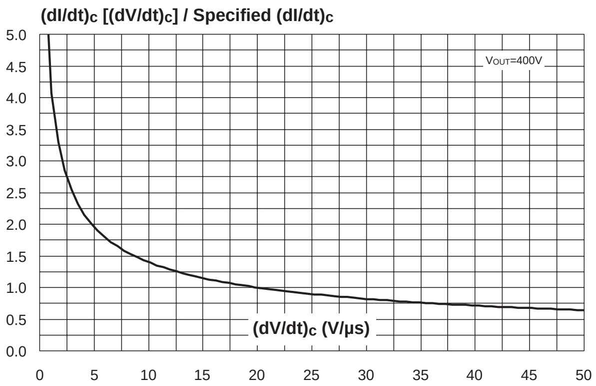


Fig. 7: Relative variation of critical rate of decrease of main current versus junction temperature.

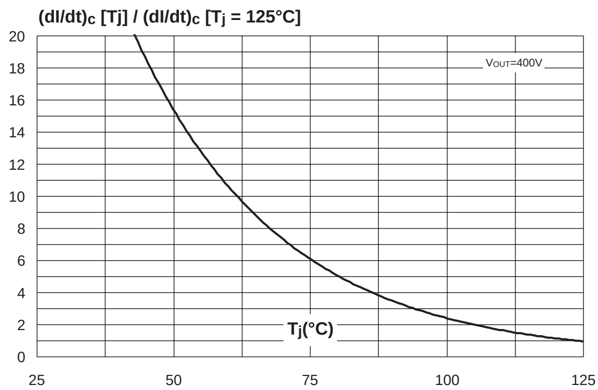


Fig. 8: Surge peak on-state current versus number of cycles.

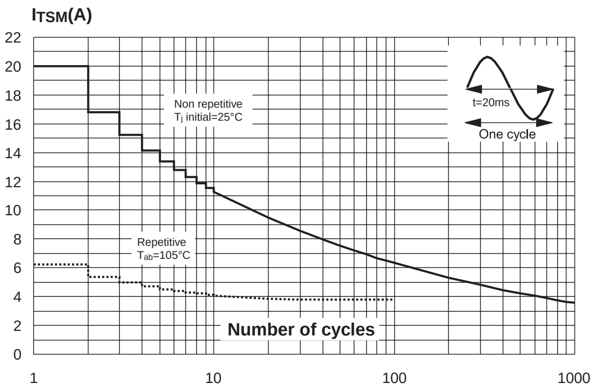


Fig. 9: Non repetitive surge peak on-state current for a sinusoidal pulse with width tp < 10ms, and corresponding value of I²t.

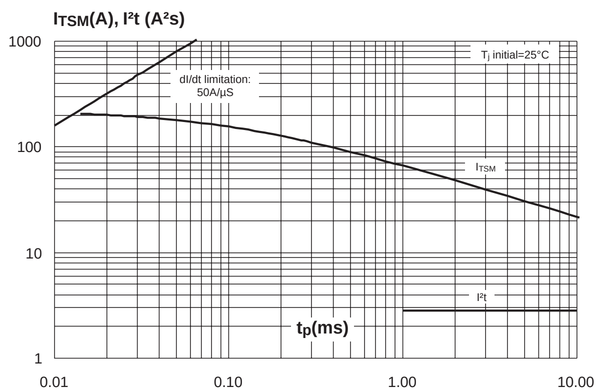


Fig. 10: On-state characteristics (maximum values).

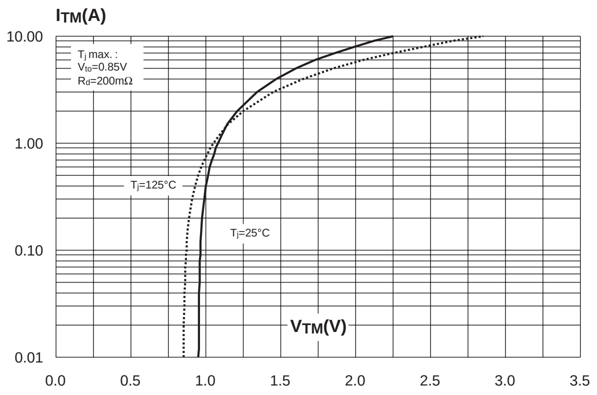
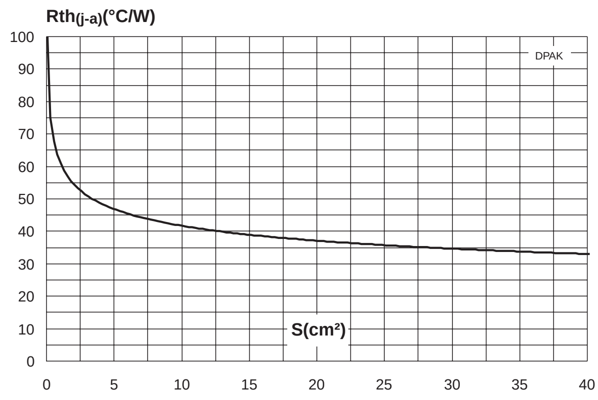
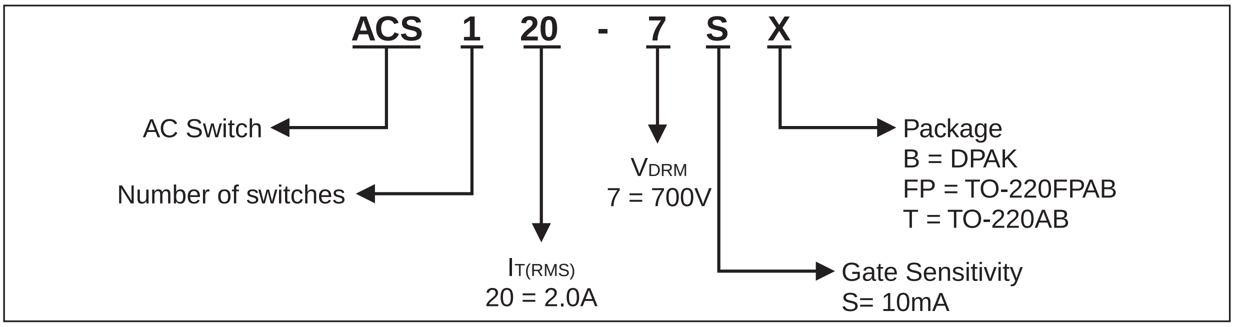


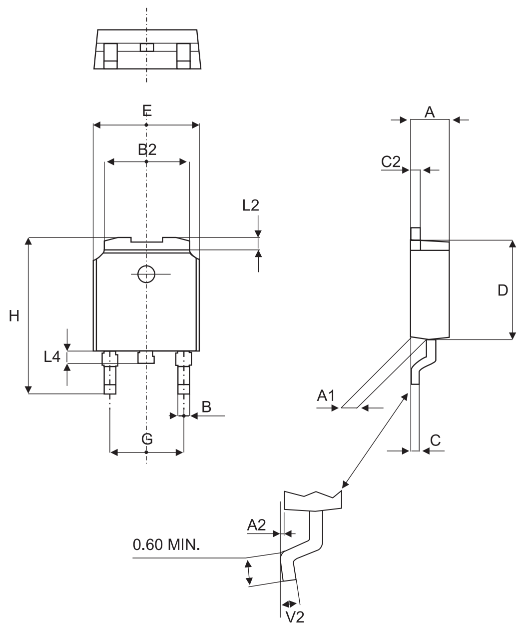
Fig. 11: Thermal resistance junction to ambient versus copper surface under tab (printed circuit board FR4, copper thickness: 35µm)



ORDERING INFORMATION

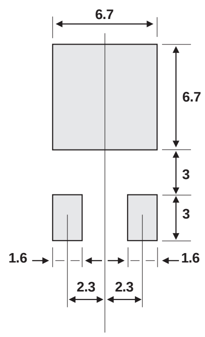


PACKAGE OUTLINE MECHANICAL DATA
DPAK

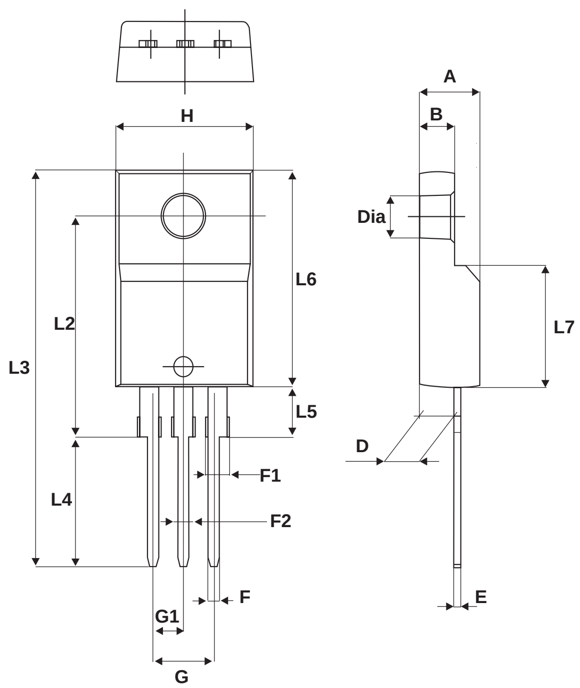


REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max	Min.	Max.
A	2.20	2.40	0.086	0.094
A1	0.90	1.10	0.035	0.043
A2	0.03	0.23	0.001	0.009
B	0.64	0.90	0.025	0.035
B2	5.20	5.40	0.204	0.212
C	0.45	0.60	0.017	0.023
C2	0.48	0.60	0.018	0.023
D	6.00	6.20	0.236	0.244
E	6.40	6.60	0.251	0.259
G	4.40	4.60	0.173	0.181
H	9.35	10.10	0.368	0.397
L2	0.80 typ.		0.031 typ.	
L4	0.60	1.00	0.023	0.039
V2	0°	8°	0°	8°

FOOT PRINT
DPAK



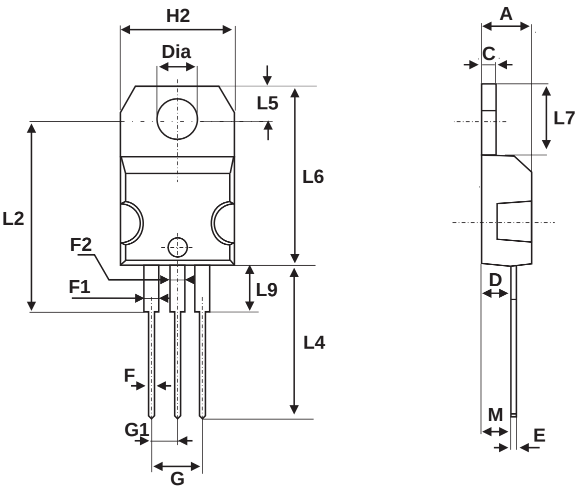
PACKAGE OUTLINE MECHANICAL DATA
TO-220FPAB



REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.4	4.6	0.173	0.181
B	2.5	2.7	0.098	0.106
D	2.5	2.75	0.098	0.108
E	0.45	0.70	0.018	0.027
F	0.75	1	0.030	0.039
F1	1.15	1.70	0.045	0.067
F2	1.15	1.70	0.045	0.067
G	4.95	5.20	0.195	0.205
G1	2.4	2.7	0.094	0.106
H	10	10.4	0.393	0.409
L2	16 Typ.		0.63 Typ.	
L3	28.6	30.6	1.126	1.205
L4	9.8	10.6	0.386	0.417
L5	2.9	3.6	0.114	0.142
L6	15.9	16.4	0.626	0.646
L7	9.00	9.30	0.354	0.366

PACKAGE OUTLINE MECHANICAL DATA

TO-220AB



REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
C	1.23	1.32	0.048	0.051
D	2.40	2.72	0.094	0.107
E	0.49	0.70	0.019	0.027
F	0.61	0.88	0.024	0.034
F1	1.14	1.70	0.044	0.066
F2	1.14	1.70	0.044	0.066
G	4.95	5.15	0.194	0.202
G1	2.40	2.70	0.094	0.106
H2	10	10.40	0.393	0.409
L2	16.4 typ.		0.645 typ.	
L4	13	14	0.511	0.551
L5	2.65	2.95	0.104	0.116
L6	15.25	15.75	0.600	0.620
L7	6.20	6.60	0.244	0.259
L9	3.50	3.93	0.137	0.154
M	2.6 typ.		0.102 typ.	
Diam.	3.75	3.85	0.147	0.151

OTHER INFORMATION

Ordering type	Marking	Package	Weight	Base qty	Delivery mode
ACS120-7SB	ACS1207S	DPAK	0.3 g	75	Tube
ACS120-7SB-TR	ACS1207S	DPAK	0.3 g	2500	Tape & reel
ACS120-7SFP	ACS1207S	TO-220FPAB	2.4 g	50	Tube
ACS120-7ST	ACS1207S	TO-220AB	2.3 g	250	Bulk

- Epoxy meets UL94,V0