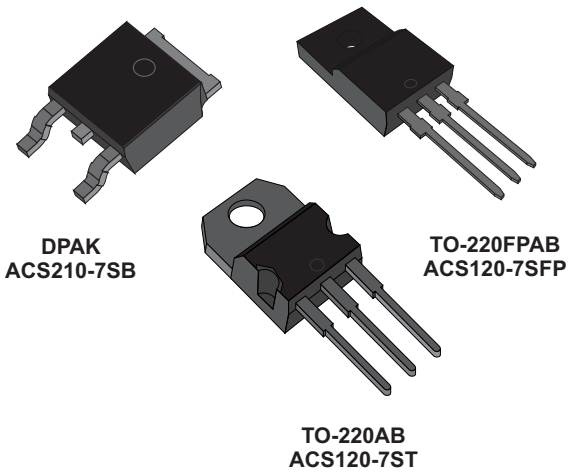
ACS120

AC line switch

Datasheet - production data



Features

- Blocking voltage: V_{DRM} / V_{RRM} = +/- 700 V
- Avalanche controlled: V_{CL} typ. = 1100 V
- Nominal conducting current: $I_{T(RMS)}$ = 2A
- Gate triggering current: I_{GT} < 10mA
- Switch integrated driver
- High noise immunity: static dV/dt > 500 V/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 micro controller
- Eliminates any gate kick back on the micro-controller
- Allows straightforward connection of several AC switches on same cooling pad.

Applications

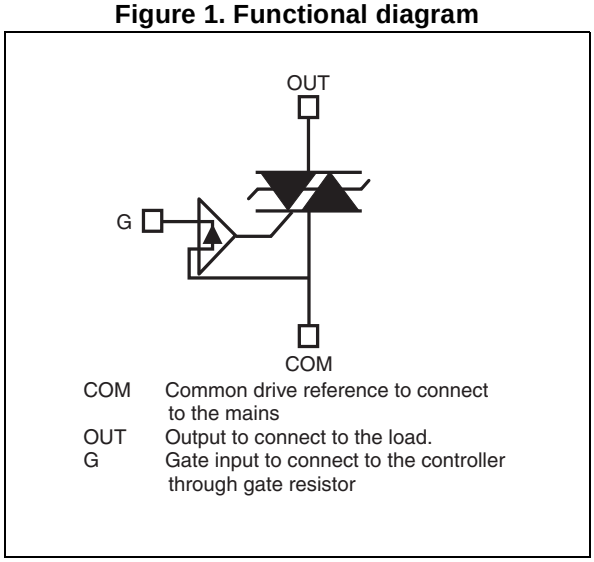
- AC static switching in appliance control systems
- Drive of low power high inductive or resistive loads like:
  - relay, valve, solenoid, dispenser
  - pump, fan, micro-motor
  - defrost heater

Description

The ACS120 belongs to the AC line switch family. This high performance switch circuit is able to control a load of up to 2 A.

The AC 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.

Figure 1. Functional diagram



1 Characteristics

Table 1. 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			700	V
$I_{T(RMS)}$	On-state rms current full cycle sine wave 50 to 60 Hz	DPAK	T_c = 119 °C	2	A
		TO-220FPAB	T_c = 117 °C		
		TO-220AB	T_c = 119 °C		
I_{TSM}	Non repetitive surge peak on-state current T_j initial = 25 °C, full cycle sine wave		F = 50 Hz	20	A
			F = 60 Hz	21	A
I^2t	Fusing capability		t_p = 10 ms	2.6	A^2s
dI/dt	Repetitive on-state current critical rate of rise I_G = 10 mA (t_r < 100 ns)	T_j = 125 °C	F = 120 Hz	50	A/µs
V_{PP}	Non repetitive line peak pulse voltage(1)			2	kV
T_{stg}	Storage temperature range			- 40 to + 150	°C
T_j	Operating junction temperature range			- 30 to + 125	°C
T_l	Maximum lead soldering temperature during 10 s			260	°C

1. According to test described by IEC 61000-4-5 standard and *Figure 5*

Table 2. 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 µs)	1	A
V_{GM}	Peak positive gate voltage (in respect to pin COM)	5	V

Table 3. Thermal resistances

Symbol	Parameter			Value	Unit
$R_{th\ (j-a)}$	Junction to ambient	S = 0.5 cm^2(1)	DPAK	70	°C/W
		TO-220FPAB		60	°C/W
		TO-220AB		60	°C/W
$R_{th\ (j-c)}$	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

1. S = Copper surface under tab

Table 4. 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
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 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

Table 5. Electrical characteristics

Symbol	Test conditions				Values	Unit
I_{GT}	V_{OUT} = 12V (DC), R_L = 140 Ω	QII -QIII	T_j = 25°C	MAX	10	mA
V_{GT}	V_{OUT} = 12V (DC), R_L = 140 Ω	QII -QIII	T_j = 25 °C	MAX	1	V
V_{GD}	V_{OUT} = V_{DRM}, R_L = 3.3 kΩ		T_j = 125 °C	MIN	0.15	V
I_H	I_{OUT} = 100 mA gate open		T_j = 25 °C	MAX	45	mA
I_L	I_G = 20 mA		T_j = 25 °C	MAX	65	mA
V_{TM}	I_{OUT} = 2.8 A, t_p = 380 µs		T_j = 25 °C	MAX	1.3	V
V_{TO}			T_j = 125 °C	MAX	0.85	V
R_d			T_j = 125 °C	MAX	200	mΩ
I_{DRM} /I_{RRM}	V_{OUT} = 700 V		T_j = 25 °C	MAX	2	µA
			T_j = 125 °C	MAX	200	
dV/dt	V_{OUT} = 460 V gate open		T_j = 110 °C	MIN	500	V/µs
(dI/dt)c	(dV/dt)c = 20 V/µs		T_j = 125 °C	MIN	1	A/ms
V_{CL}	I_{CL} = 1 mA, t_p = 1 ms		T_j = 25 °C	TYP	1100	V

Figure 2. Maximum power dissipation versus rms on-state current

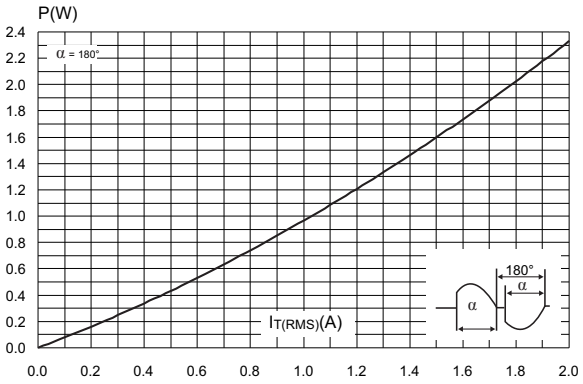


Figure 3. On-state rms current versus ambient temperature

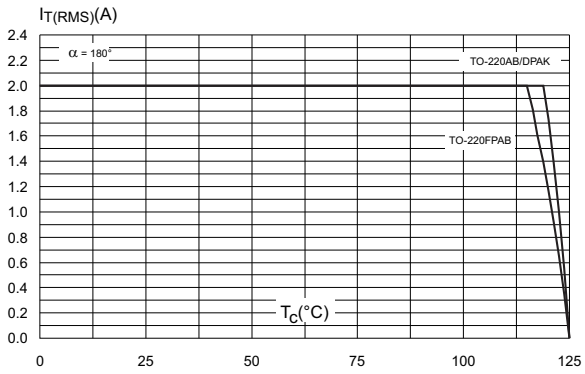


Figure 4. On-state rms current versus ambient temperature

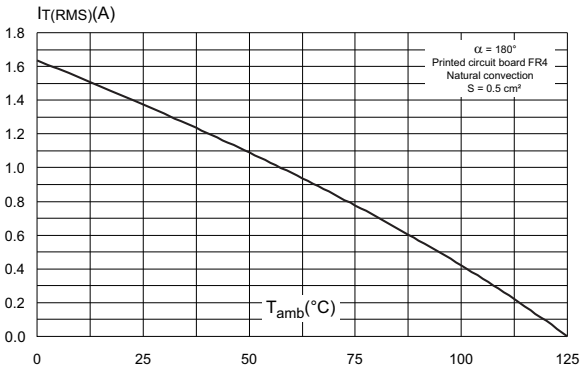


Figure 5. Relative variation of thermal impedance versus pulse duration

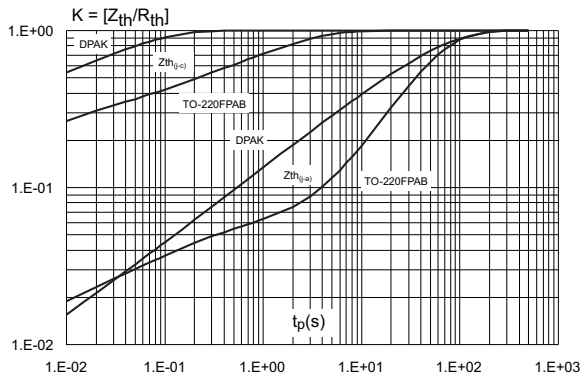


Figure 6. Relative variation of gate trigger, holding and latching versus current junction temperature

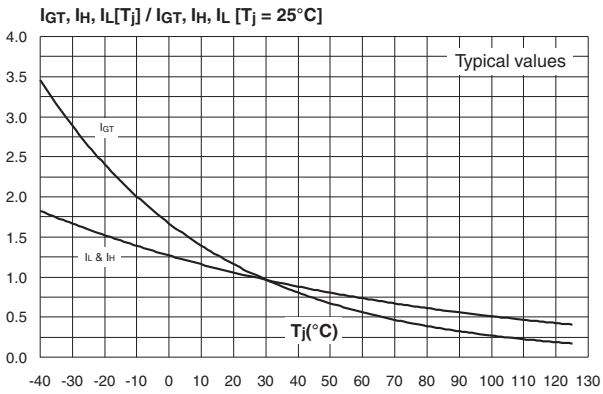


Figure 7. Relative variation of static dV/dt versus junction temperature

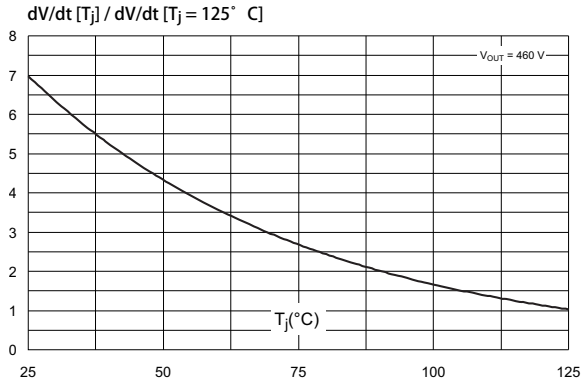


Figure 8. Relative variation of critical rate of decrease of main current versus reapplied dV/dt (typical values)

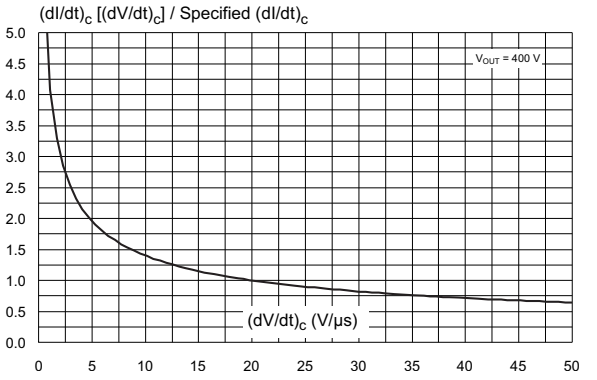


Figure 9. Relative variation of critical rate of decrease of main current versus junction temperature

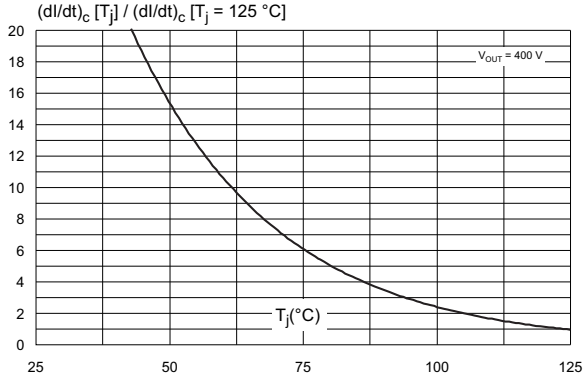


Figure 10. Surge peak on-state current versus number of cycles

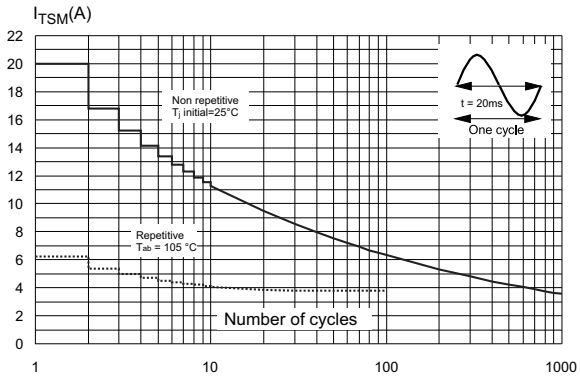


Figure 11. Non repetitive surge peak on-state currentand corresponding value of I^2t

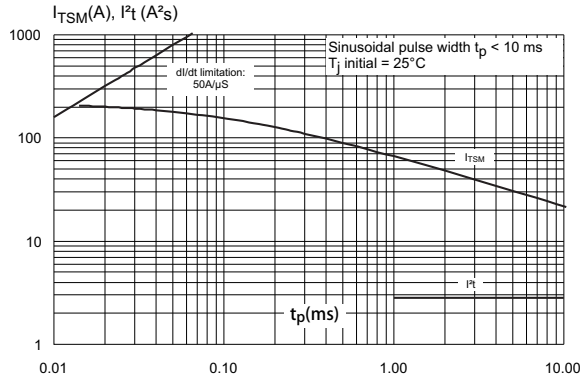


Figure 12. On-state characteristics (maximum values)

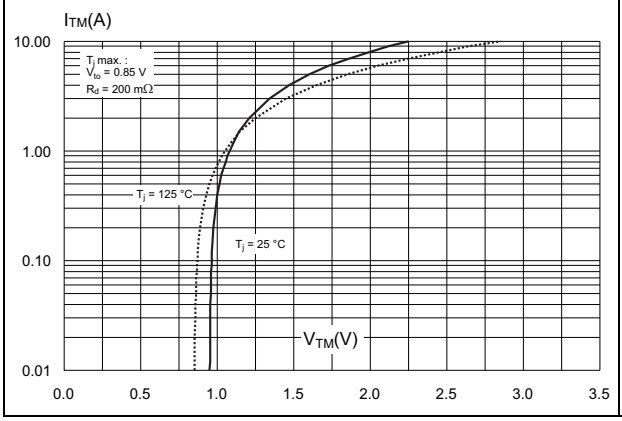
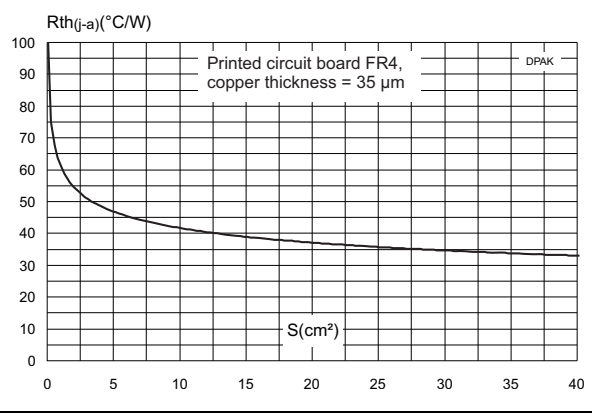


Figure 13. Thermal resistance junction to ambient versus copper surface under tab



2 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 and off low power loads such as solenoid, valve, relay, dispenser, micro-motor, pump, fan and defrost heaters.

This AC switch is triggered by a negative gate current flowing out of the gate pin G. It can be driven directly by the digital MCU through a resistor as shown on the typical application diagram.

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

Figure 14. Typical application diagram

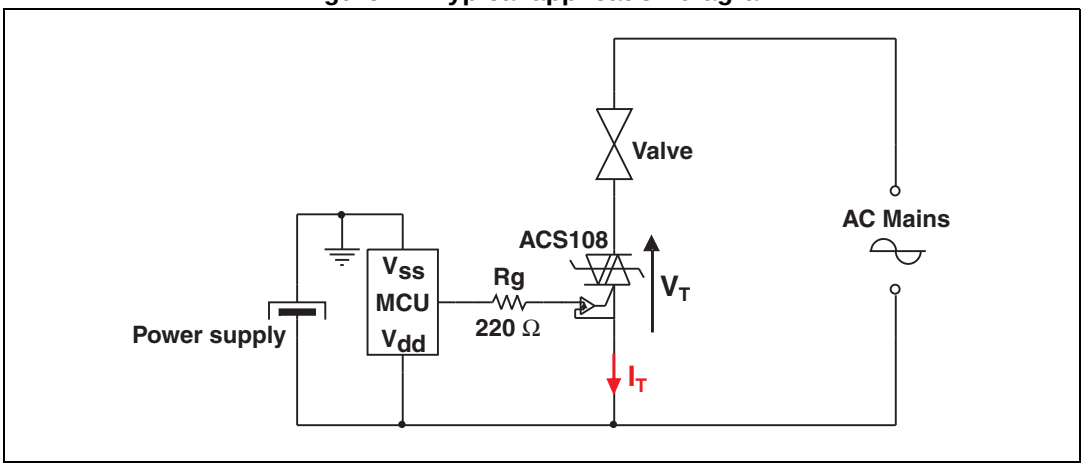


Figure 15. Turn-off operation of the ACS120 switch with an electro-valve

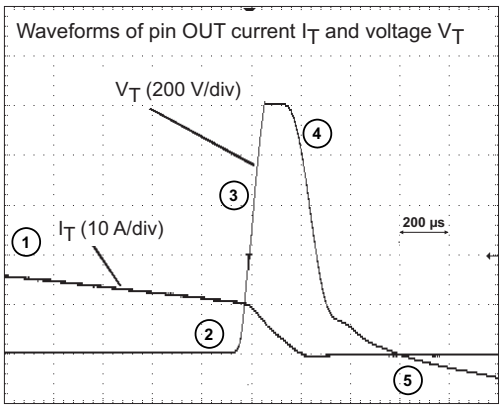


Figure 16. ACS120 switch static characteristic

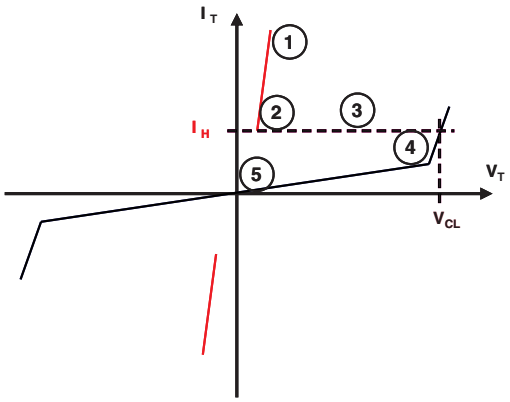


Figure 17. Overvoltage ruggedness test circuit for resistive and inductive loads

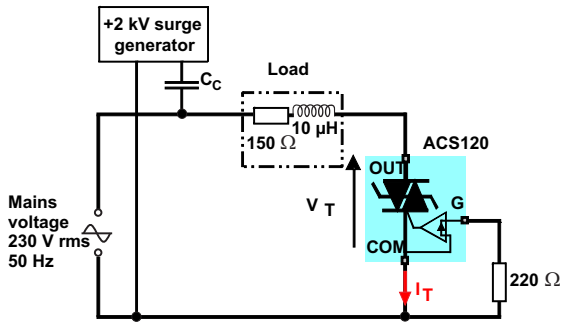
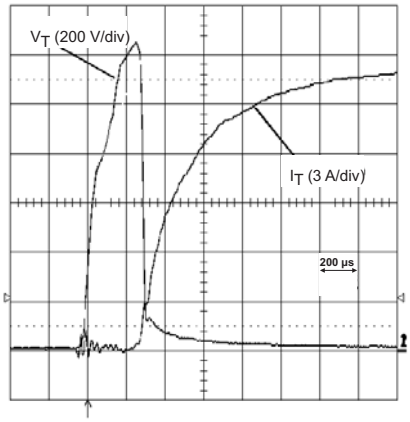


Figure 18. Current and Voltage of the ACS120 during IEC 61000-4-5 standard test with R, L and V_{PP}.



3 Package information

- Epoxy meets UL94, V0
- Lead-free package
- Recommended torque: 0.4 to 0.6 N·m

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 19. TO-220FPAB dimension definitions

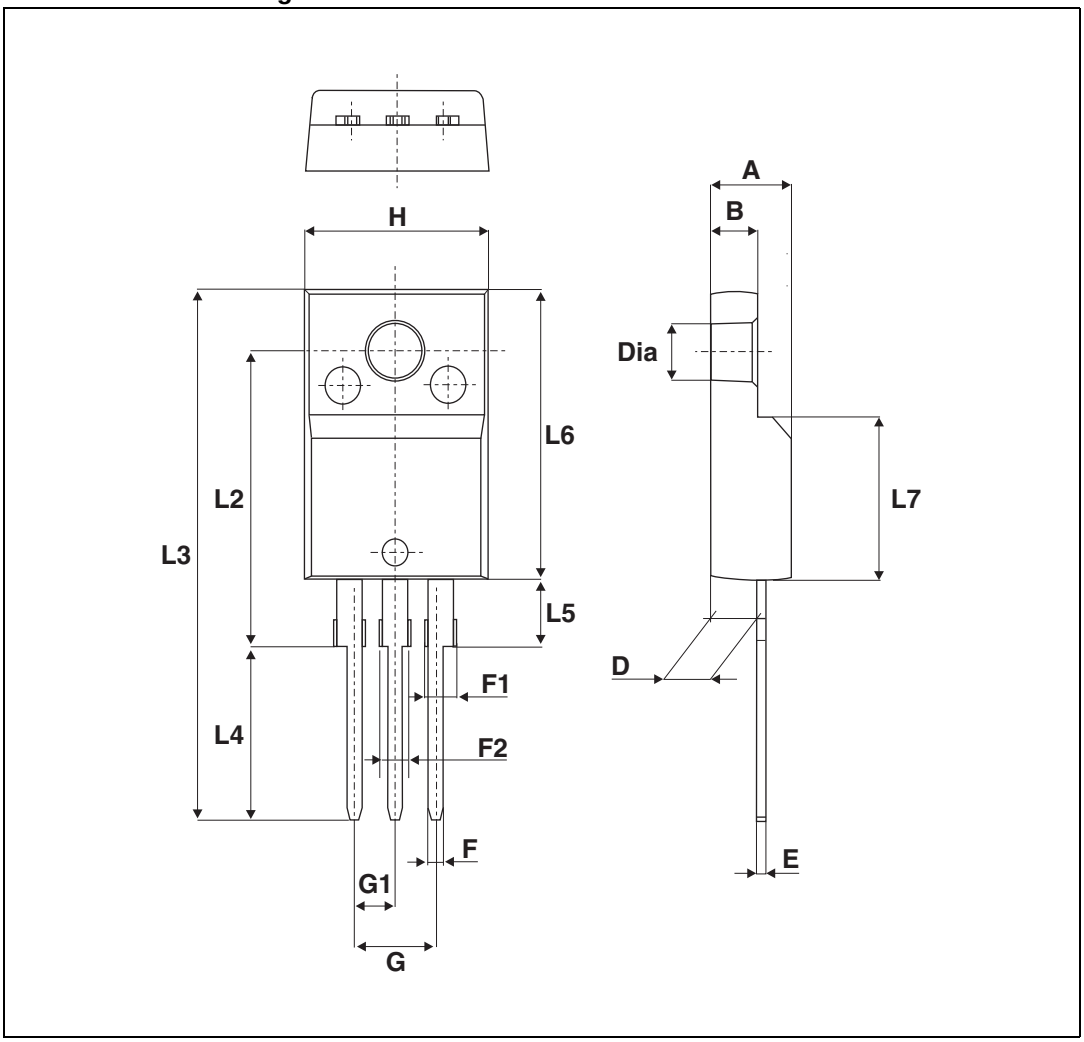
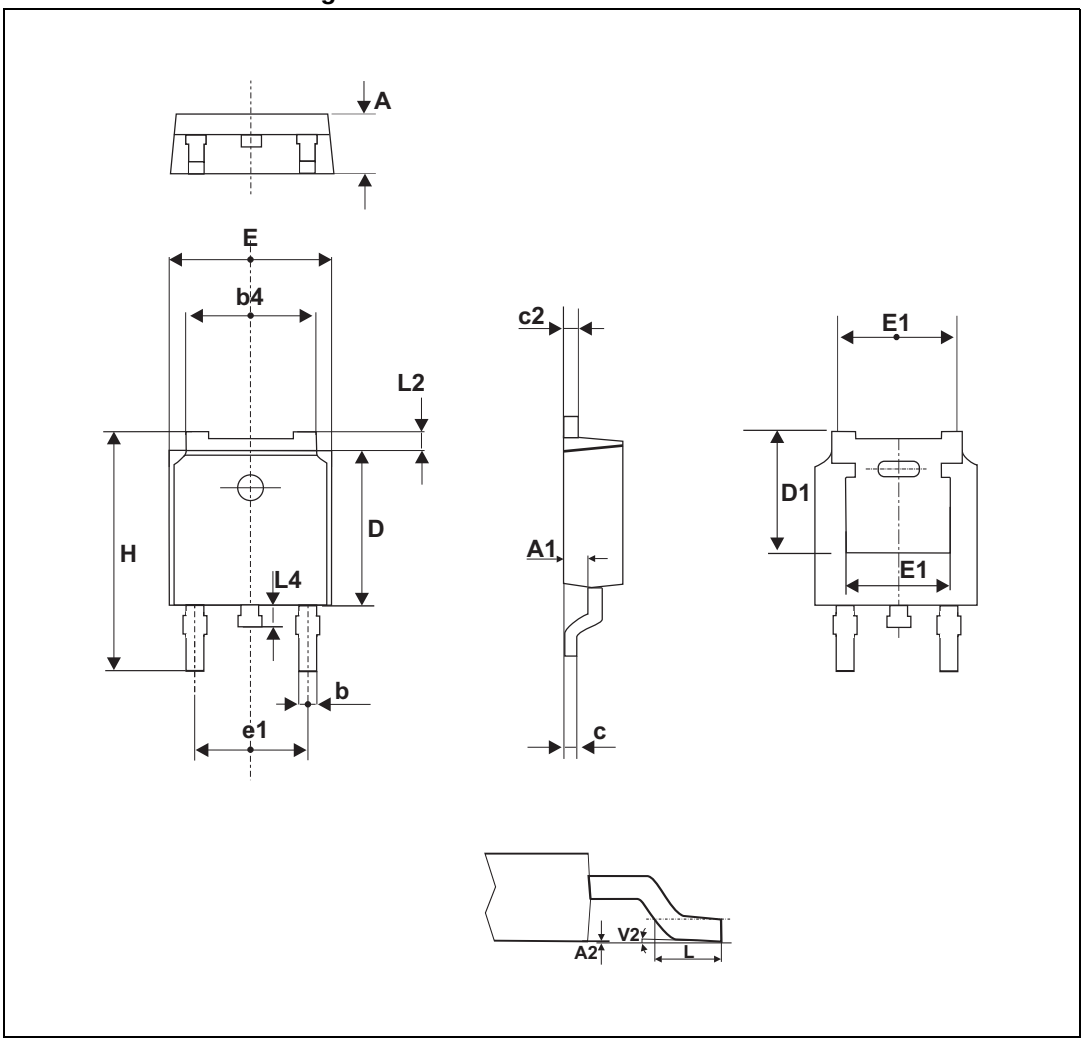


Table 6. TO-220FPAB dimension values

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	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			0.63	
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
Dia.	3.00		3.20	0.118		0.126

Figure 20. DPAK dimension definitions



Note: This package drawing may slightly differ from the physical package. However, all the specified dimensions are guaranteed.

Table 7. DPAK dimension values

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.18		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
b4	4.95		5.46	0.195		0.215
c	0.46		0.61	0.018		0.024
c2	0.46		0.60	0.018		0.023
D	5.97		6.22	0.235		0.244
D1	5.10			0.201		
E	6.35		6.73	0.250		0.264
E1		4.32			0.170	
e1	4.40		4.70	0.173		0.185
H	9.35		10.40	0.368		0.409
L	1.00		1.78	0.039		0.070
L2			1.27			0.05
L4	0.60		1.02	0.023		0.040
V2	0°		8°	0°		8°

Figure 21. Footprint (dimensions in mm)

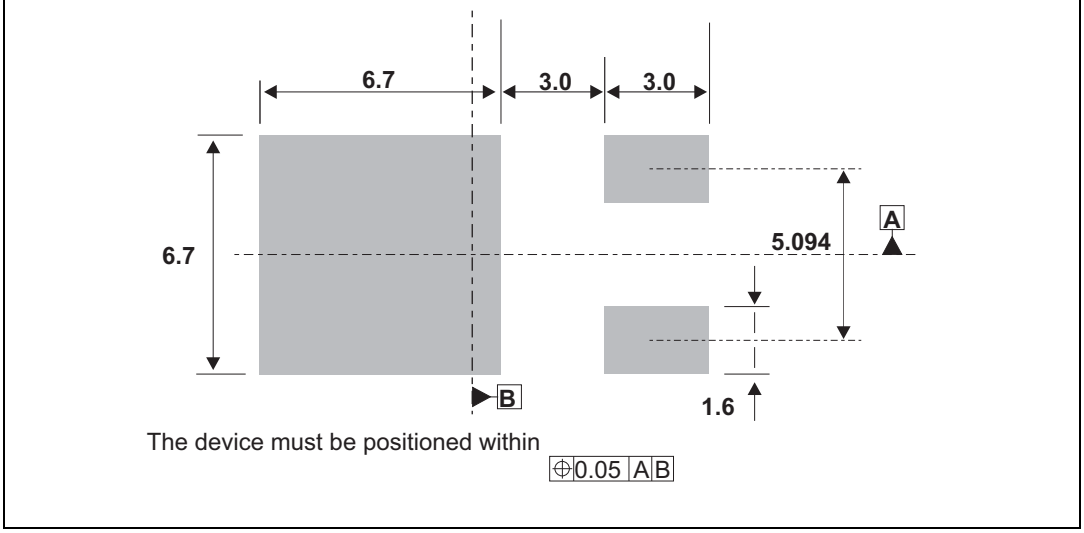
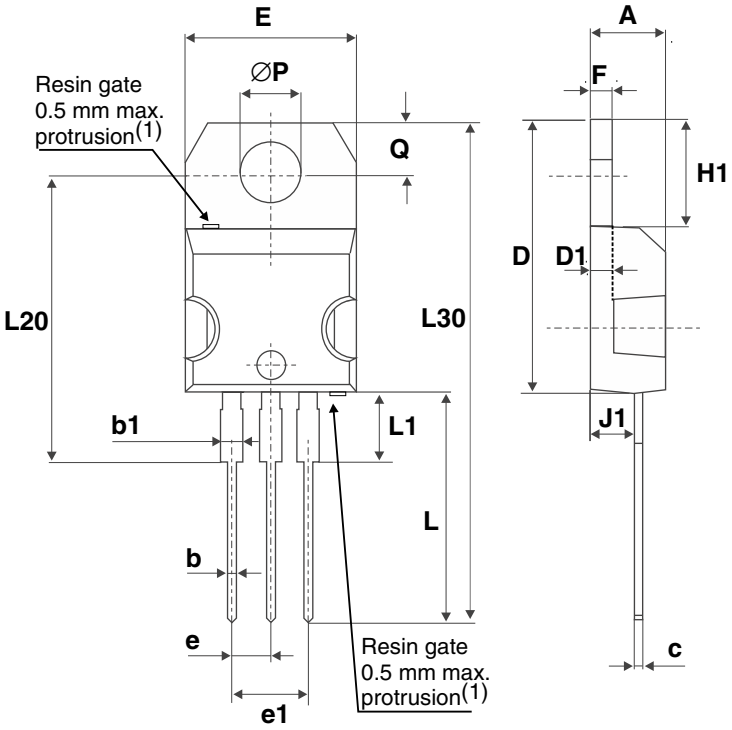


Figure 22. TO-220AB dimension definitions



(1) Resin gate position accepted in each of the two position shown as well as the symmetrical opposites

Table 8. TO-220AB dimension values

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.17	0.18
b	0.61	0.88	0.024	0.035
b1	1.14	1.70	0.045	0.067
c	0.48	0.70	0.019	0.027
D	15.25	15.75	0.60	0.62
D1	1.27 typ.		0.05 typ.	
E	10	10.40	0.39	0.41
e	2.40	2.70	0.094	0.106
e1	4.95	5.15	0.19	0.20
F	1.23	1.32	0.048	0.052
H1	6.20	6.60	0.24	0.26
J1	2.40	2.72	0.094	0.107
L	13	14	0.51	0.55
L1	3.50	3.93	0.137	0.154
L20	16.40 typ.		0.64 typ.	
L30	28.90 typ.		1.13 typ.	
∅P	3.75	3.85	0.147	0.151
Q	2.65	2.95	0.104	0.116

4 Ordering information

Figure 23. Ordering information scheme

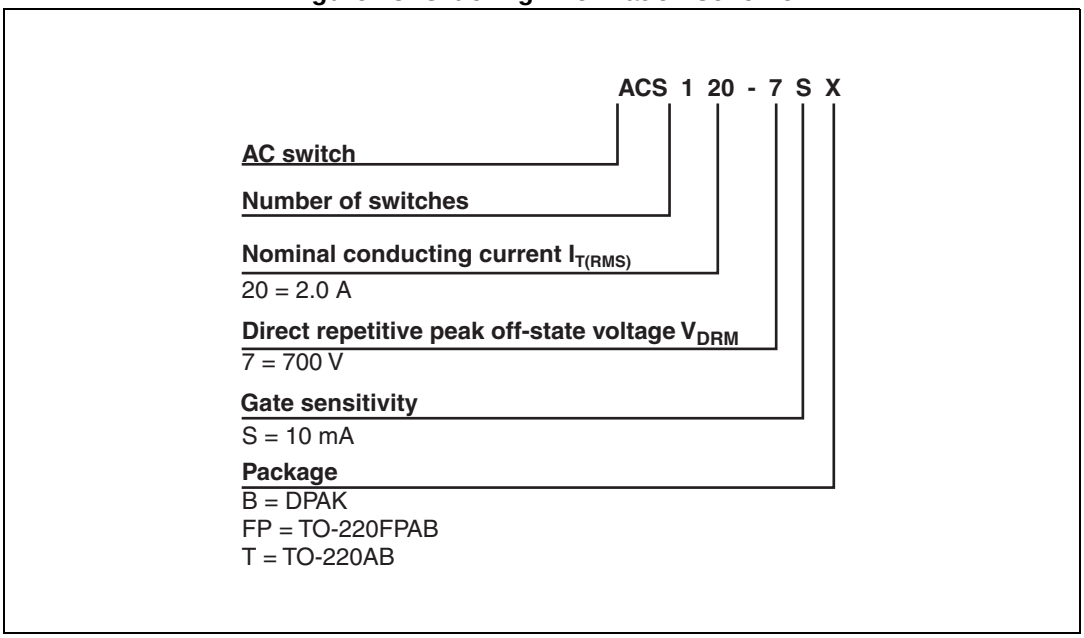


Table 9. Ordering information

Order code	Marking	Package	Weight	Base Qty	Packing mode
ACS120-7SB	ACS1207S	DPAK	0.3 g	75	Tube
ACS120-7SB-TR	ACS1207S	DPAK	0.3 g	2500	Tape and reel
ACS120-7SFP	ACS1207S	TO-220FPAB	2.4 g	50	Tube
ACS120-7ST	ACS1207S	TO-220AB	2.3 g	250	Bulk

5 Revision history

Table 10. Document revision history

Date	Revision	Changes
Apr-2004	1	Previous release.
28-Jan-2011	2	Added ECOPACK statement. Updated T_c values in *Table 1*.
28-May-2014	3	Updated DPAK package information and reformatted to current standard.

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