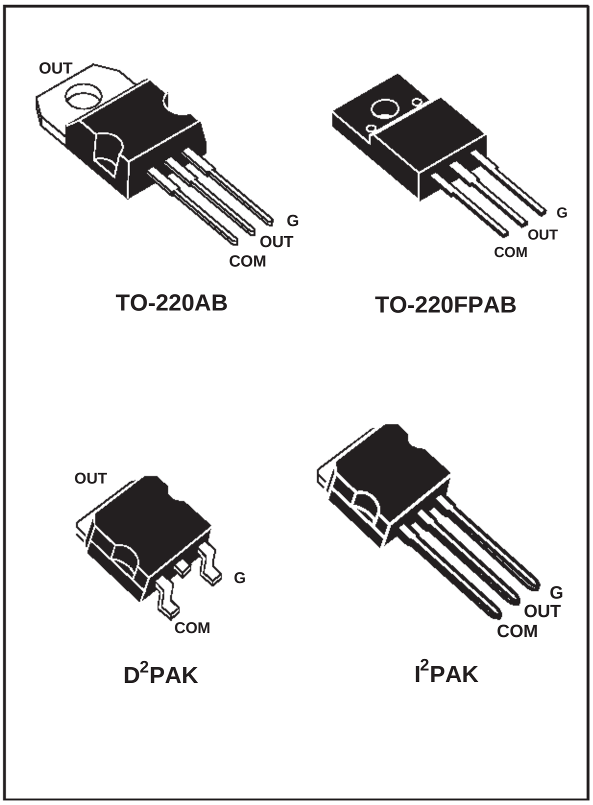
ACST6-7S

ASD™
AC Switch Family

OVER VOLTAGE PROTECTED
AC POWER SWITCH



MAIN APPLICATIONS

- AC static switching in appliance & industrial control systems
- Induction motor drive actuator for:
  - Refrigerator / Freezer compressor
  - Dishwasher spray pump
  - Clothes drier tumble
- Actuator for the thermostat of a refrigerator or freezer

FEATURES

- V_{DRM} / V_{RRM} = +/- 700V
- Avalanche controlled device
- $I_{T(RMS)}$=1.5 A with no heat sink and T_{amb} = 40°C
- $I_{T(RMS)}$ = 6A with T_{CASE} = 105 °C
- High noise immunity: static dV/dt > 200 V/µs
- Gate triggering current : I_{GT} < 10 mA
- Snubberless turn off commutation: (dI/dt)c > 3.5A/ms
- D^2PAK, I^2PAK, TO-220FPAB or TO-220 package

BENEFITS

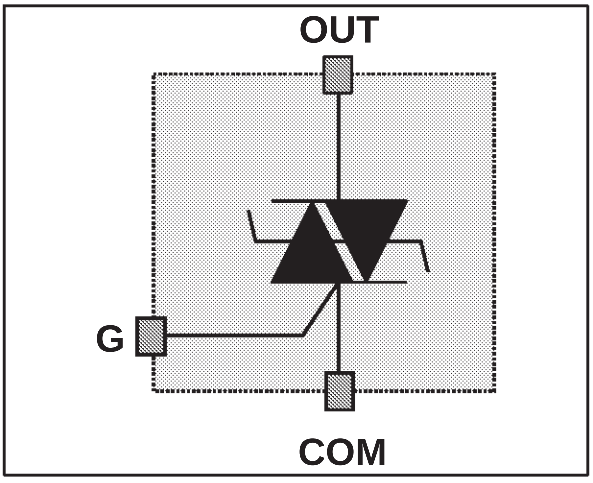
- Enables equipment to meet EN61000-4-5 standards
- High off-state reliability with planar technology
- Needs no external overvoltage protection
- Direct interface with the microcontroller
- Reduces the power component count

DESCRIPTION

The ACST6-7Sx belongs to the AC power switch family built around the ASD technology. This high performance device is adapted to home appliances or industrial systems and drives an induction motor up to 6A.

This ACST switch embeds a triac structure with a high voltage clamping device to absorb the inductive turn-off energy and sustain line transients such as those described in the IEC61000-4-5 standards.

FUNCTIONAL DIAGRAM:



ABSOLUTE RATINGS (limiting values)

Symbol	Parameter		Value	Unit
V_{DRM} / V_{RRM}	Repetitive peak off-state voltage	Tj = 125 °C	700	V
$I_{T(RMS)}$	RMS on-state current full cycle sine wave 50 to 60 Hz, no heat sink	Tamb = 40 °C	1.5	A
	RMS on-state current full cycle sine wave 50 to 60 Hz, TO-220AB package	Tcase= 105 °C	6	A
I_{TSM}	Non repetitive surge peak on-state current Tj initial = 25°C, full cycle sine wave	tp = 20ms	45	A
		tp = 16.7ms	50	A
I^2t	Thermal constraint for fuse selection	tp = 10ms	14	A^2s
dI/dt	Non repetitive on-state current critical rate of rise I_G = 10mA (t_R < 100ns)	Rate period > 1mn	100	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 A.

GATE CHARACTERISTICS (maximum values)

Symbol	Parameter	Value	Unit
$P_{G\ (AV)}$	Average gate power dissipation	0.1	W
P_{GM}	Peak gate power dissipation (tp = 20µs)	10	W
I_{GM}	Peak gate current (tp = 20µs)	1	A

THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
Rth (j-a)	Junction to ambient TO-220AB / TO-220FPAB / I^2PAK	60	°C/W
Rth (j-a)	Junction to ambient D^2PAK soldered on 1cm^2 copper pad	45	°C/W
Rth (j-c)	Junction to case for full cycle sine wave conduction (TO-220AB)	2.5	°C/W
Rth (j-c)	Junction to case for full cycle sine wave conduction (TO-220FPAB)	3.5	°C/W

PARAMETER DESCRIPTION

Parameter Symbol	Parameter description
I_{GT}	Gate triggering current
V_{GT}	Gate triggering voltage
V_{GD}	Non triggering voltage
I_H	Holding current
I_L	Latching current
V_{TM}	On state voltage
V_{TO}	On state characteristic threshold voltage
R_D	On state characteristic dynamic resistance
I_{DRM} / I_{RRM}	Forward or reverse leakage current
dV/dt	Static pin OUT voltage rise
(dI/dt)c	Turn off current rate of decay
V_{CL}	Avalanche voltage at turn off

ELECTRICAL CHARACTERISTICS PER SWITCH

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

Symbol	Test conditions			Values	Unit
I_{GT}	Vout = 12V (DC) $R_L = 33\Omega$	Tj = 25°C	MAX.	10	mA
V_{GT}	Vout = 12V (DC) $R_L = 33\Omega$	Tj = 25°C	MAX.	1.5	V
V_{GD}	$V_{OUT} = V_{DRM}$ $R_L = 3.3k\Omega$	Tj =125°C	MIN.	0.2	V
I_H	I_{OUT} = 100mA Gate open	Tj = 25°C	MAX.	25	mA
I_L	I_G = 20mA	Tj = 25°C	MAX.	50	mA
V_{TM}	I_{OUT} = 2.1A tp = 380µs	Tj = 25°C	MAX.	1.4	V
V_{TM}	I_{OUT} = 8.5A tp = 380µs	Tj = 25°C	MAX.	1.7	V
V_{to}		Tj = 125°C	MAX.	0.9	V
R_D		Tj = 125°C	MAX.	80	mΩ
I_{DRM} I_{RRM}	$V_{OUT} = V_{DRM}$ $V_{OUT} = V_{RRM}$	Tj = 25°C	MAX.	20	µA
		Tj = 125°C	MAX.	500	µA
dV/dt	V_{OUT} = 600V gate open	Tj = 125°C	MIN.	200	V/µs
(dI/dt)c	(dV/dt)c = 15V/µs	Tj = 125°C	MIN.	3	A/ms
(dI/dt)c	(dV/dt)c = 15V/µs Iout < 0 Rgk = 150Ω	Tj = 125°C	MIN.	3.5	A/ms
V_{CL}	I_{CL} = 1mA tp = 1ms	Tj = 25°C	TYP.	1100	V

AC LINE SWITCH BASIC APPLICATION

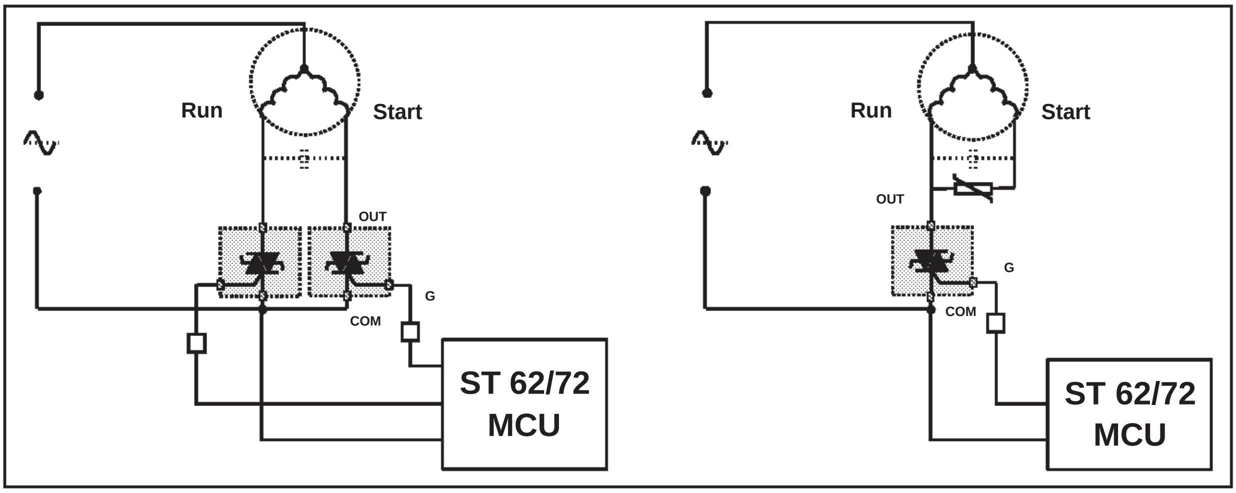
The ACST6-7S device is especially designed to drive medium power induction motors in refrigerators, dish washers, and tumble dryers.

Pin COM : Common drive reference, to be connected to the power line neutral
Pin G : Switch Gate input to be connected to the controller
Pin OUT : Switch Output to be connected to the load

When driven from a low voltage controller, the ACST switch is triggered with a negative gate current flowing out of the gate pin G. It can be directly driven by the controller through a resistor as shown on the typical application diagram. In appliance systems, the ACST6-7S switch intends to drive medium power load in ON / OFF full cycle or phase angle control mode.

Thanks to its thermal and turn-off commutation characteristics, the ACST6-7S switch is able to drive an inductive load up to 6A without a turn-off aid snubber circuit.

TYPICAL APPLICATION DIAGRAM



AC LINE TRANSIENT VOLTAGE RUGGEDNESS

The ACST6-7S 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 A is representative of the ACST application and is used to test the ACST switch according to the IEC61000-4-5 standard conditions. Thanks to the load impedance, the ACST switch withstands voltage spikes up to 2 kV above the peak line voltage by breaking over safely. Such non-repetitive testing can be done 10 times on each AC line voltage polarity.

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

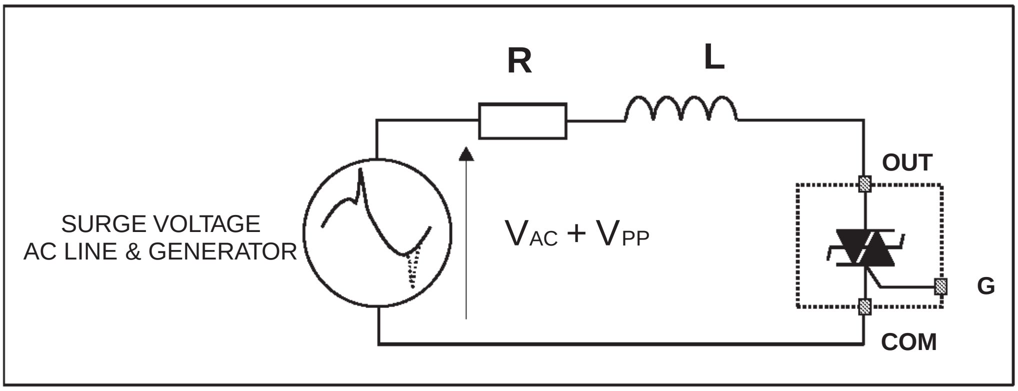


Fig. 1: Maximum power dissipation versus RMS on-state current.

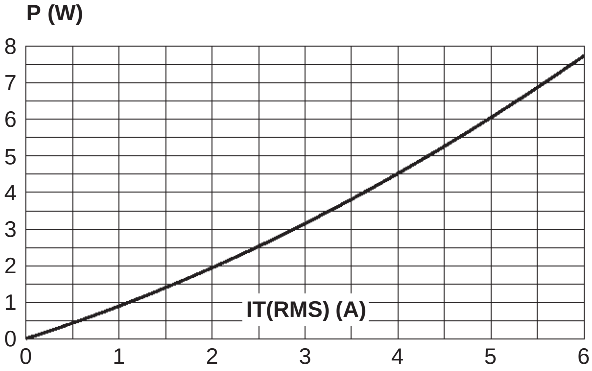


Fig. 2-1: RMS on-state current versus case temperature.

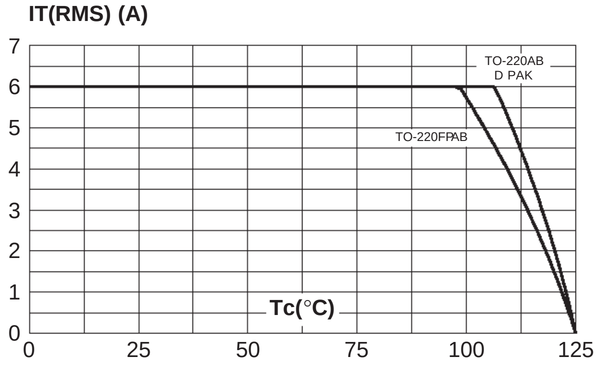


Fig. 2-2: RMS on-state current versus ambient temperature.

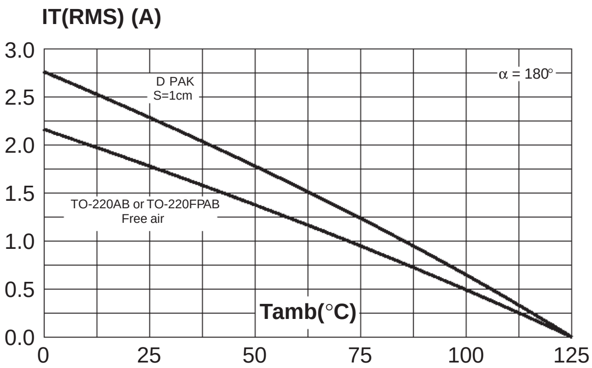


Fig. 3: Relative variation of thermal impedance versus pulse duration.

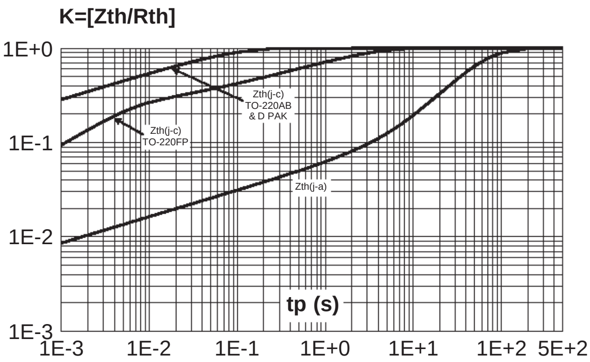


Fig. 4: On-state characteristics (maximum values).

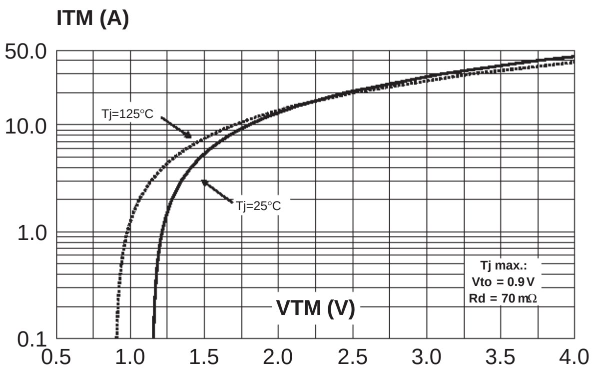


Fig. 5: Surge peak on-state current versus number of cycles.

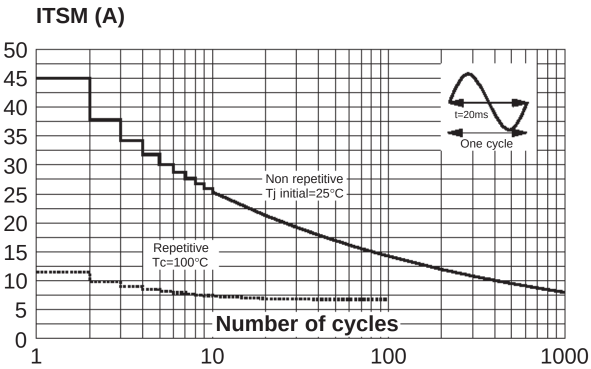


Fig. 6: Non repetitive surge pea on-state current for a sinusoidal pulse with width tp<10ms, and corresponding value of I^2t.

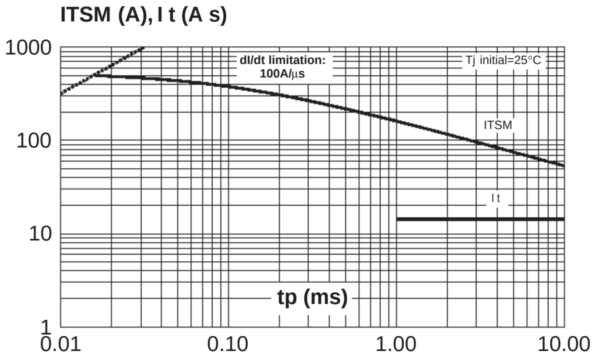


Fig. 7: Relative variation of gate trigger current, holding current and latching current versus junction temperature (typical values).

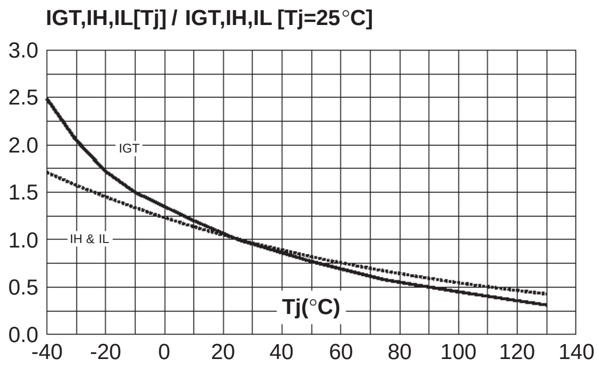


Fig. 8: Relative variation of critical rate of decrease of main current versus reapplied dV/dt (typical values).

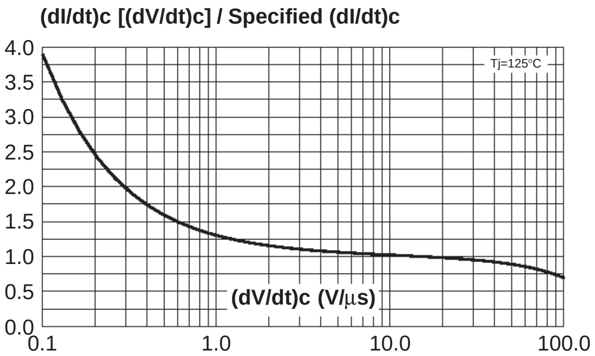


Fig. 9: Relative variation of critical rate of decrease of main current versus junction teperature.

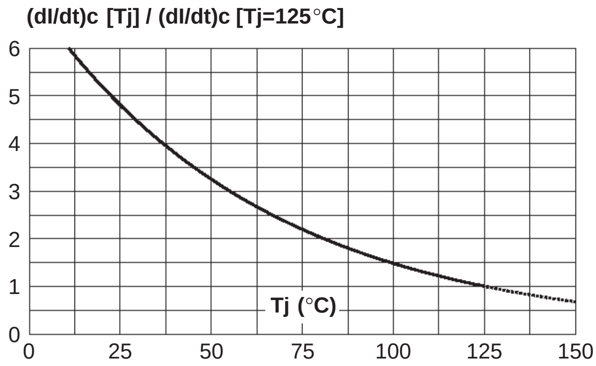


Fig. 10: Relative variation of dV/dt immunity versus junction temperature for different values of gate to com resistance.

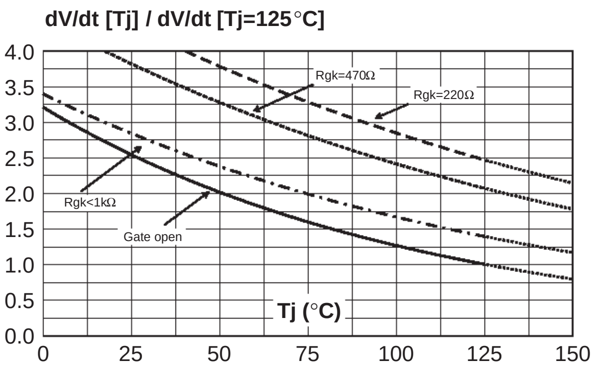
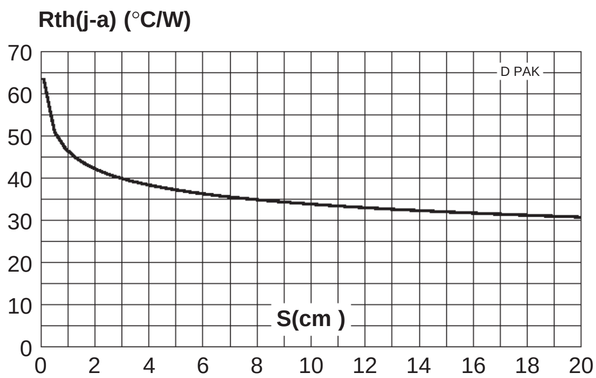
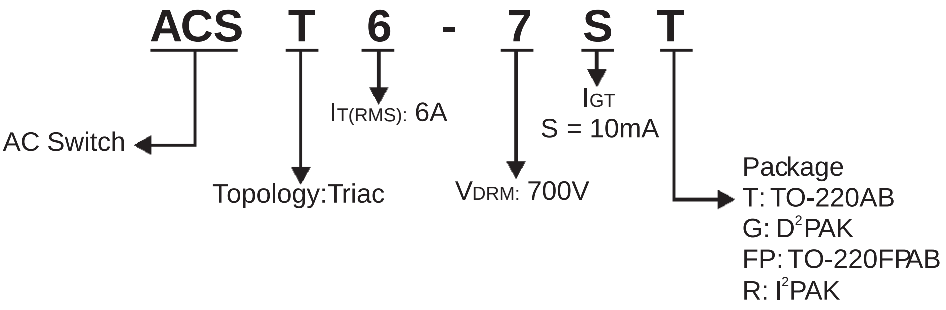


Fig. 11: Thermal resistance junction to ambient versus copper surface under tab (Epoxy printed circuit board FR4, copper thickness: 35µm).

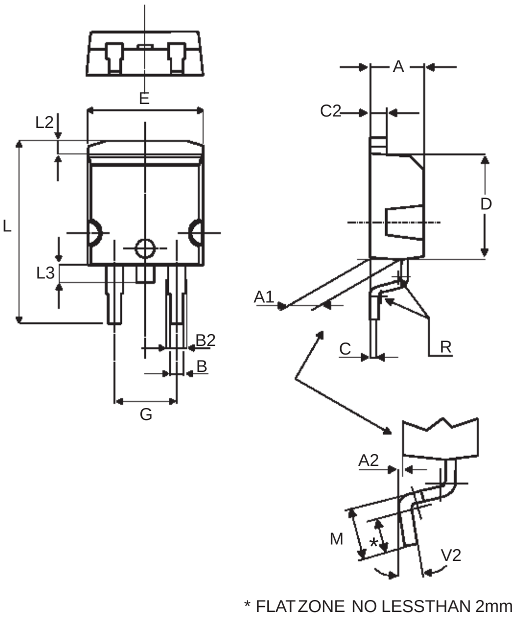


ORDERING INFORMATION



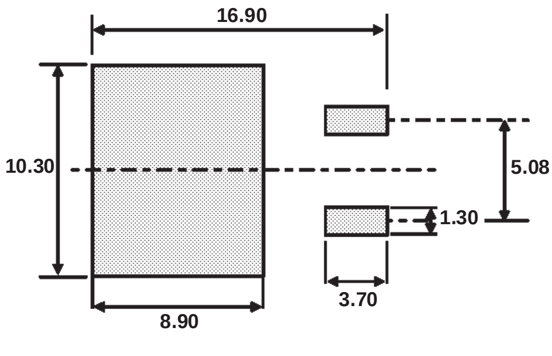
PACKAGE MECHANICAL DATA

D²PAK Plastic



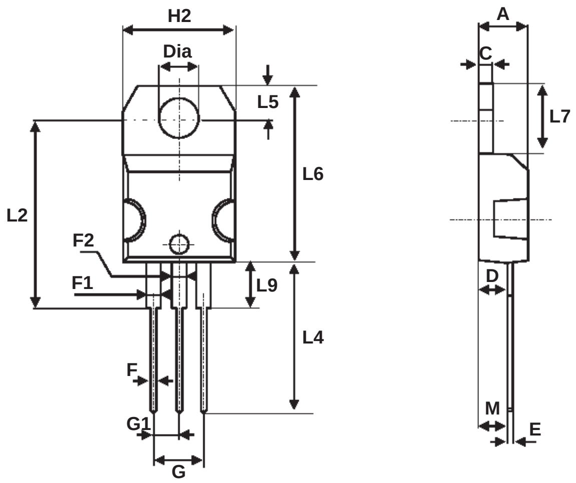
REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
A1	2.49	2.69	0.098	0.106
A2	0.03	0.23	0.001	0.009
B	0.70	0.93	0.027	0.037
B2	1.14	1.70	0.045	0.067
C	0.45	0.60	0.017	0.024
C2	1.23	1.36	0.048	0.054
D	8.95	9.35	0.352	0.368
E	10.00	10.40	0.393	0.409
G	4.88	5.28	0.192	0.208
L	15.00	15.85	0.590	0.624
L2	1.27	1.40	0.050	0.055
L3	1.40	1.75	0.055	0.069
M	2.40	3.20	0.094	0.126
R	0.40 typ.		0.016 typ.	
V2	0°	8°	0°	8°

FOOTPRINT DIMENSIONS (in millimeters)



PACKAGE MECHANICAL DATA

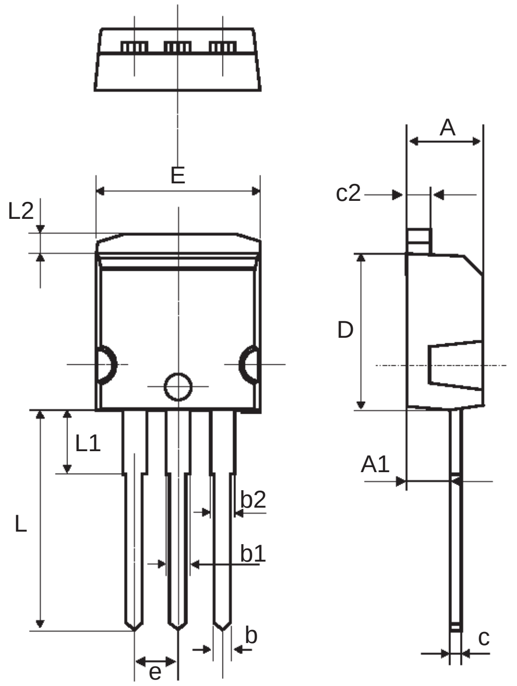
TO-220AB (Plastic)



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

PACKAGE MECHANICAL DATA

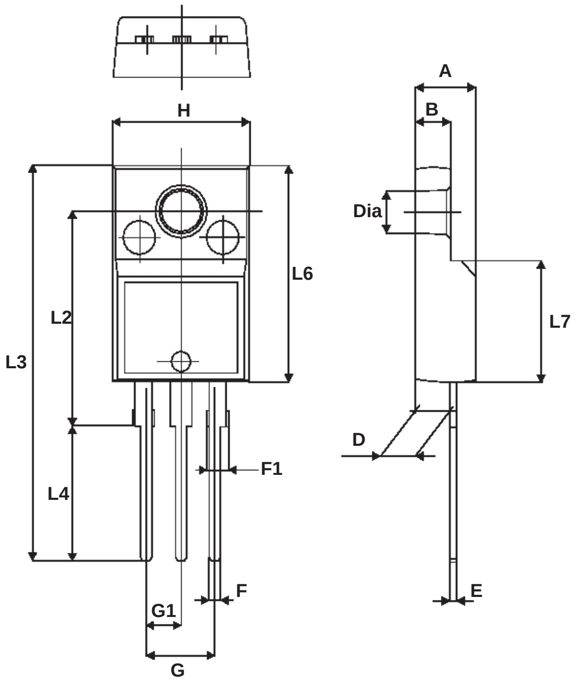
I^2PAK



REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
A1	2.49	2.69	0.098	0.106
b	0.70	0.93	0.028	0.037
b1	1.14	1.17	0.044	0.046
b2	1.14	1.17	0.044	0.046
c	0.45	0.60	0.018	0.024
c2	1.23	1.36	0.048	0.054
D	8.95	9.35	0.352	0.368
e	2.40	2.70	0.094	0.106
E	10.0	10.4	0.394	0.409
L	13.1	13.6	0.516	0.535
L1	3.48	3.78	0.137	0.149
L2	1.27	1.40	0.050	0.055

PACKAGE MECHANICAL DATA

TO-220FPAB (Plastic)



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	0.017	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	0.204
G1	2.40	2.70	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	1.204
L4	9.8	10.6	0.385	0.417
L6	15.9	16.4	0.626	0.645
L7	9.00	9.30	0.354	0.366
Dia.	3	3.20	0.118	0.126

OTHER INFORMATION

Ordering type	Marking	Package	Weight	Base qty	Delivery mode
ACST6-7ST	ACST67S	TO-220AB	2.3 g	50	Tube
ACST6-7SG	ACST67S	D^2PAK	1.5 g	50	Tube
ACST6-7SFP	ACST67S	TO-220FPAB	2.4 g	50	Tube
ACST6-7SR	ACST67S	I^2PAK	1.49 g	50	Tube

- Epoxy meets UL94,V0