ASD
(Application Specific Devices)

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 COM COM 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-220AB package

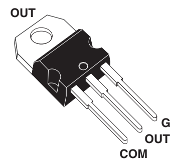
BENEFITS

- Enables equipment to meet IEC61000-4-5 standards
- High off-state reliability with planar technology
- Needs no external overvoltage protection
- Direct interface with the microcontroller
- Reduces the power component count

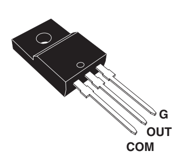
DESCRIPTION

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.

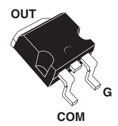
This ACST switch embeds a triac structure with a high voltage clamping device to absorb the inductive turn-off energy and withstand line transients such as those described in the IEC61000-4-5 standards.



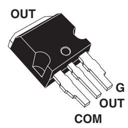
TO-220AB
ACST6-7ST



TO-220FPAB
ACST6-7SFP



D^2PAK
ACST6-7SG



I^2PAK
ACST6-7SR

Table 1: Order Codes

Part Numbers	Marking
ACST6-7ST	ACST67S
ACST6-7SFP	
ACST6-7SG	
ACST6-7SR	

Figure 1: Functional Diagram

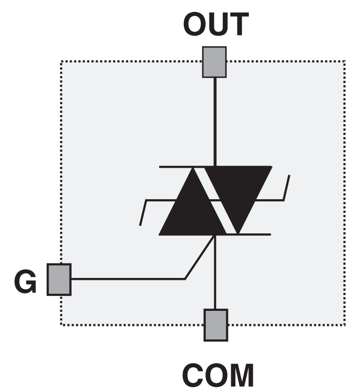


Table 2: Absolute Ratings (limiting values)

Symbol	Parameter		Value	Unit
V_{DRM}/ V_{RRM}	Repetitive peak off-state voltage	T_j = 125 °C	700	V
$I_{T(RMS)}$	RMS on-state current full cycle sine wave 50 to 60 Hz, no heat sink	T_{amb} = 40 °C	1.5	A
	RMS on-state current full cycle sine wave 50 to 60 Hz, TO-220AB package	T_{case} = 105 °C	6	A
I_{TSM}	Non repetitive surge peak on-state current T_j initial = 25 °C, full cycle sine wave	t_p = 20ms	45	A
		t_p = 16.7ms	50	A
I^2t	Thermal constraint for fuse selection	t_p = 10ms	11	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 (see note 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 10s		260	°C

Note 1: according to test described by IEC61000-4-5 standard and figure 3.

Table 3: Gate Characteristics (maximum values)

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

Table 4: Thermal Resistances

Symbol	Parameter	Value	Unit
$Rt_{h(j-a)}$	Junction to ambient TO-220AB / TO-220FPAB	60	°C/W
$R_{th(j-a)}$	Junction to ambient I^2PAK	65	
$R_{th(j-a)}$	Junction to ambient D^2PAK soldered on 1 cm^2 copper pad	45	
$Rt_{h(j-c)}$	Junction to case for full cycle sine wave conduction (TO-220AB)	2.5	°C/W
$R_{th(j-c)}$	Junction to case for full cycle sine wave conduction (TO-220FPAB)	3.5	

Table 5: 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_{T0}	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

Table 6: Electrical Characteristics

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

Symbol	Test conditions			Value	Unit
I_{GT}	V_{OUT} = 12V (DC) R_L = 33Ω	T_j = 25°C	MAX.	10	mA
V_{GT}	V_{OUT} = 12V (DC) R_L = 33Ω	T_j = 25°C	MAX.	1.5	V
V_{GD}	V_{OUT} = V_{DRM} R_L = 3.3Ω	T_j = 125°C	MIN.	0.2	V
I_H	I_{OUT} = 100mA Gate open	T_j = 25°C	MAX.	25	mA
I_L	I_G = 20mA	T_j = 25°C	MAX.	50	mA
V_{TM}	I_{OUT} = 2.1A t_p = 380µs	T_j = 25°C	MAX.	1.4	V
V_{TM}	I_{OUT} = 8.5A t_p = 380µs	T_j = 25°C	MAX.	1.7	V
V_{T0}		T_j = 125°C	MAX.	0.9	V
R_d		T_j = 125°C	MAX.	80	mΩ
I_{DRM} I_{RRM}	V_{OUT} = V_{DRM} V_{OUT} = V_{RRM}	T_j = 25°C	MAX.	20	µA
		T_j = 125°C	MAX.	500	µA
dV/dt	V_{OUT} = 600V gate open	T_j = 125°C	MIN.	200	V/µs
(dI/dt)c	(dI/dt)c = 15V/µs	T_j = 125°C	MIN.	3	A/ms
(dI/dt)c	(dI/dt)c = 15V/µs I_{OUT} < 0 Rgk = 150Ω	T_j = 125°C	MIN.	3.5	A/ms
V_{CL}	I_{CL} = 1mA t_p = 1ms	T_j = 25°C	TYP.	1100	V

AC LINE SWITCH BASIC APPLICATION

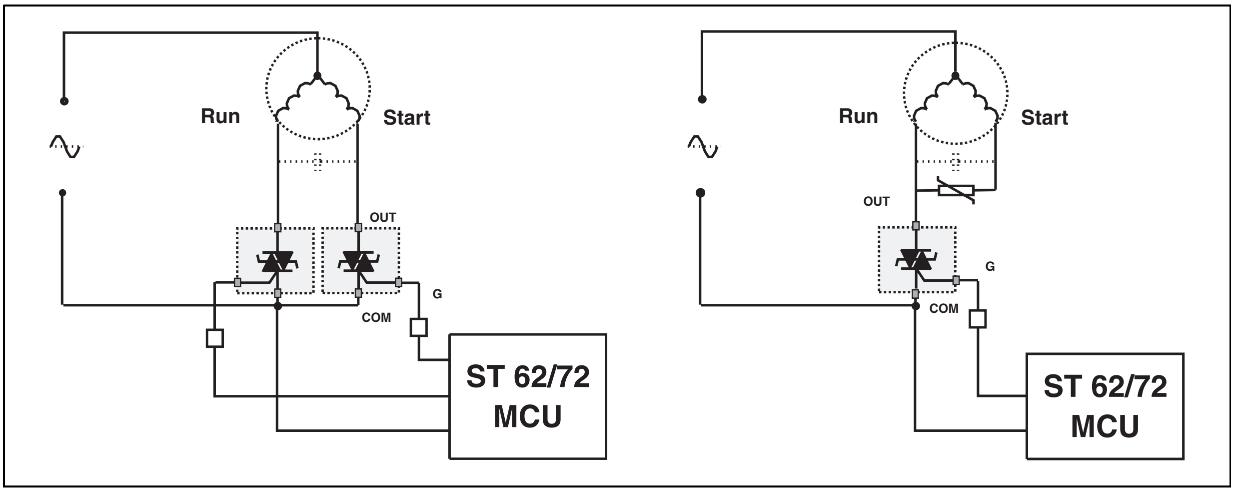
The ACST6-7S device is especially designed to drive medium power induction motors in refrigerators, dish washers, and tumble dryers.

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.

Figure 2: 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 3 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.

Figure 3: Overvoltage ruggedness test circuit for resistive and inductive loads according to IEC61000-4-5 standard R = 10Ω, L = 5µH & V_{PP} = 2kV

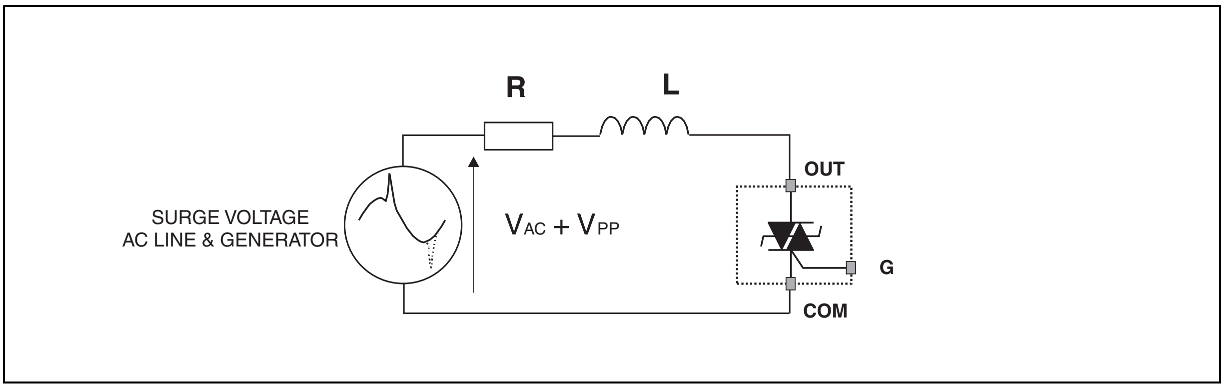


Figure 4: Maximum power dissipation versus RMS on-state current (full cycle)

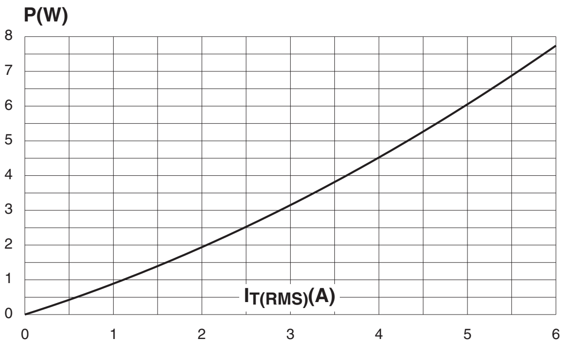


Figure 5: RMS on-state current versus case temperature (full cycle)

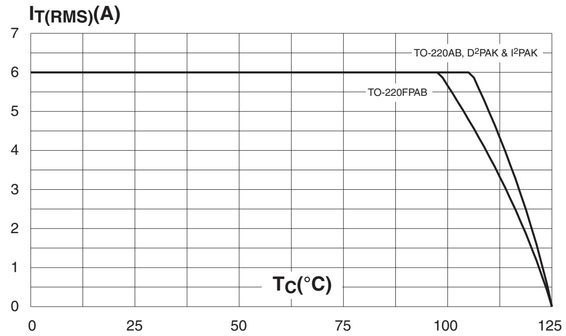


Figure 6: RMS on-state current versus ambient temperature (printed circuit board FR4, copper thickness: 35µm), full cycle

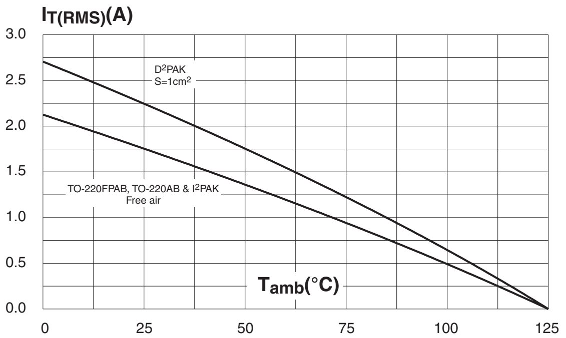


Figure 7: Relative variation of thermal impedance versus pulse duration

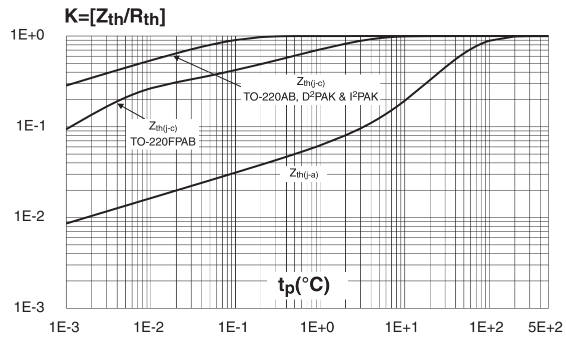


Figure 8: On-state characteristics (maximum values)

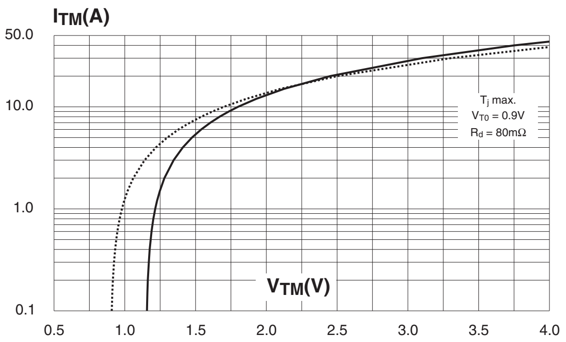


Figure 9: Surge peak on-state current versus number of cycles

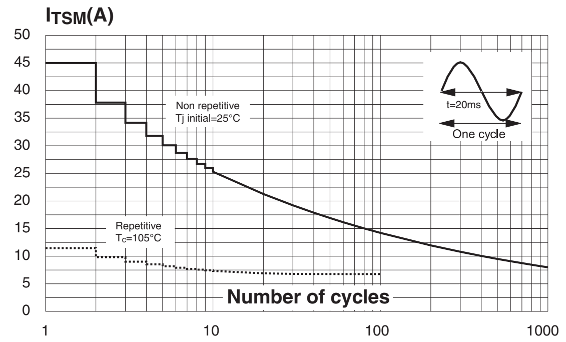


Figure 10: Non repetitive surge peak on-state current for a sinusoidal pulse with width tp < 10ms, and corresponding value of I^2t

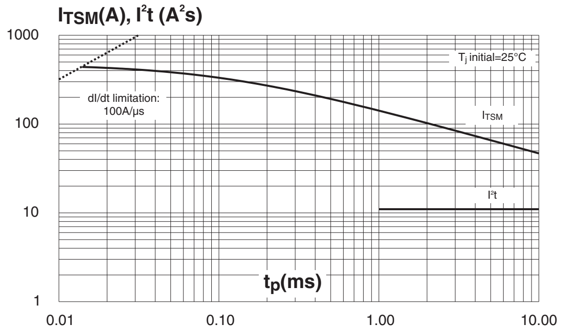


Figure 11: Relative variation of gate trigger current, holding current and latching current versus junction temperature (typical values)

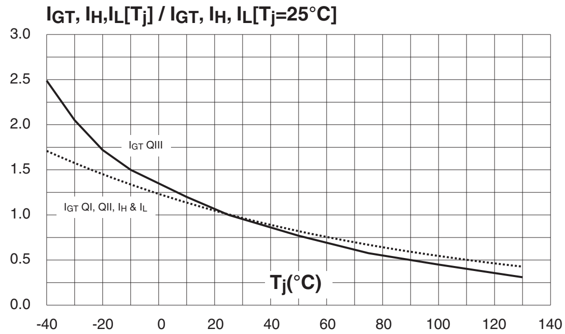


Figure 12: Relative variation of critical rate of decrease of main current versus reapplied (dV/dt)c (typical values)

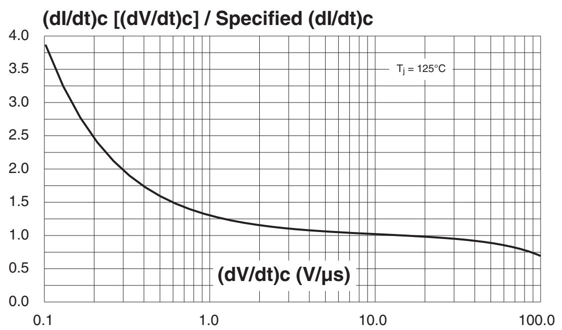


Figure 13: Relative variation of critical rate of decrease of main current versus junction temperature

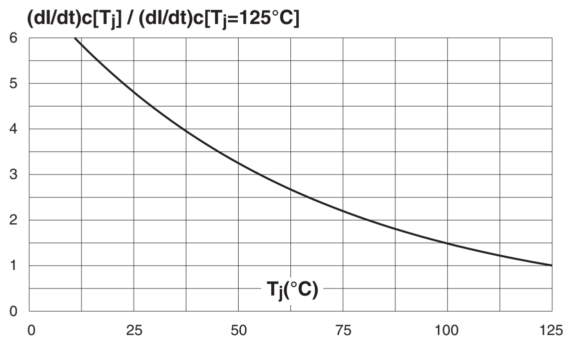


Figure 14: Relative variation of dV/dt immunity versus junction temperature for different values of gate to com resistance (gate open is the reference value)

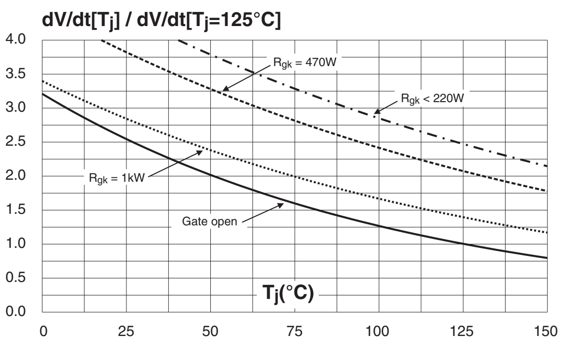


Figure 15: Thermal resistance junction to ambient versus copper surface under tab (printed circuit board FR4, copper thickness: 35µm) (D^2PAK)

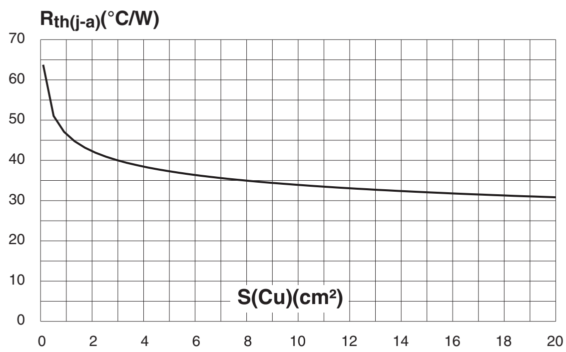
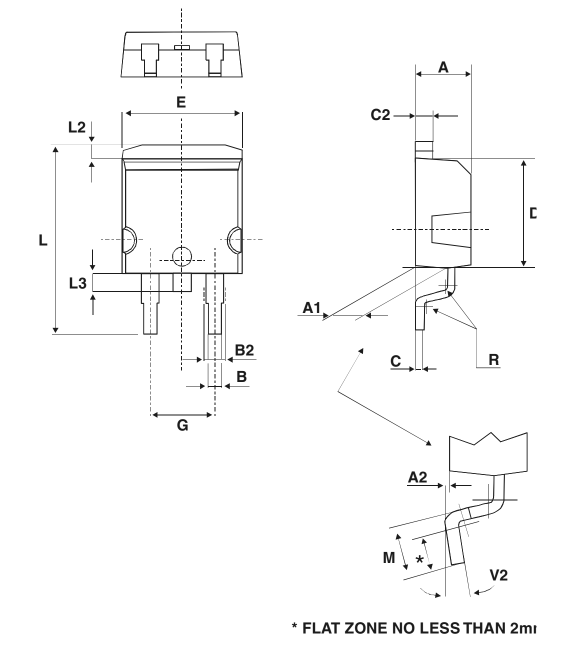


Figure 16: Ordering Information Scheme

ACS T 6 - 7 S T

- **AC Switch**
- **Topology**
  T = Triac
- **RMS on-state current**
  6 = 6A
- **Repetitive peak off-state voltage**
  7 = 700V
- **Triggering gate current**
  S = 10mA
- **Package**
  FP = TO-220FPAB
  T = TO-220AB
  G = D^2PAK
  R = I^2PAK

Figure 17: D^2PAK Package Mechanical Data



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°

Figure 18: Foot Print Dimensions (in millimeters)

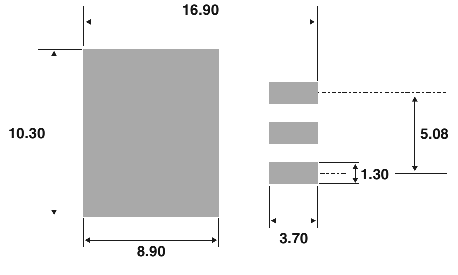
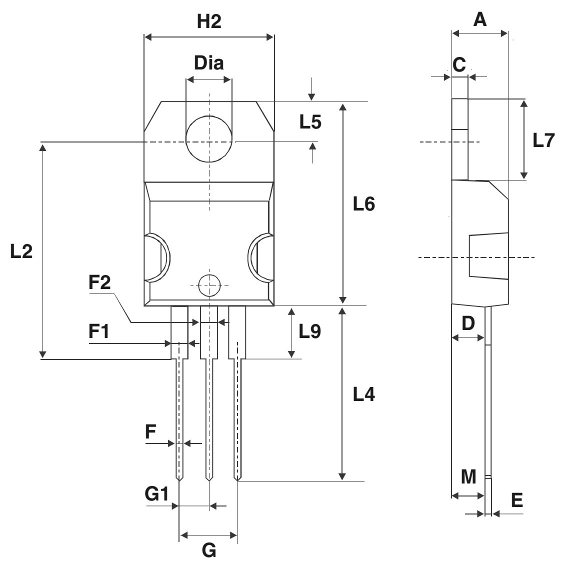
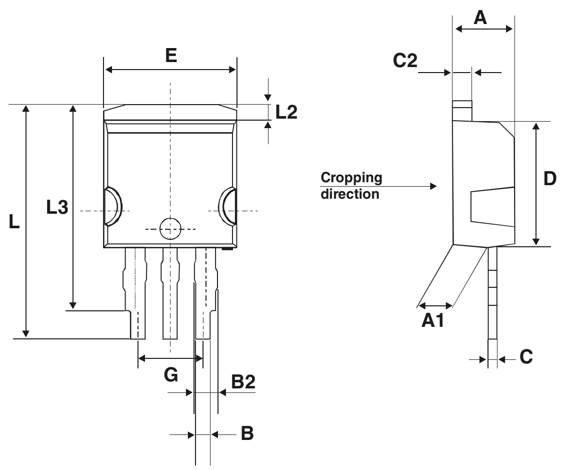


Figure 19: TO-220AB Package Mechanical Data



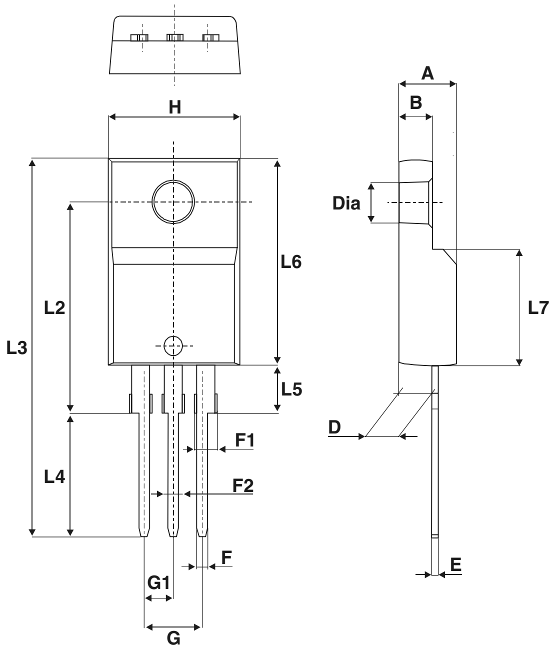
REF.	DIMENSIONS			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
C	1.23	1.32	0.048	0.051
D	2.40	2.72	0.094	0.107
E	0.49	0.70	0.019	0.027
F	0.61	0.88	0.024	0.034
F1	1.14	1.70	0.044	0.066
F2	1.14	1.70	0.044	0.066
G	4.95	5.15	0.194	0.202
G1	2.40	2.70	0.094	0.106
H2	10	10.40	0.393	0.409
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

Figure 20: I^2PAK Package Mechanical Data



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	0.027	0.037
B2	1.14	1.7	0.045	0.067
C	0.45	0.60	0.018	0.024
C2	1.23	1.36	0.048	0.053
D	8.95	9.35	0.352	0.368
E	10.0	10.4	0.394	0.409
G	4.88	5.28	0.192	0.208
L	16.7	17.5	0.657	0.689
L2	1.27	1.40	0.050	0.055
L3	13.82	14.42	0.544	0.568

Figure 21: TO-220FPAB Package Mechanical Data



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
Dia.	3.00	3.20	0.118	0.126

Table 7: Ordering 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	1.5 g	50	Tube

- Epoxy meets UL94,V0

Table 8: Revision History

Date	Revision	Description of Changes
Jan-2002	7F	Last issue.
09-May-2005	8	Layout update. No content change.