# THE DATASHEET OF

# ACST4-7SB-TR

# ACST4 Series

ASD™
AC Switch Family

AC POWER SWITCH

### MAIN APPLICATIONS

- AC static switching in appliance control systems
- Drive of low power high inductive or resistive loads like
  - spray pump in dishwashers
  - fan in air-conditioners

### FEATURES

- Blocking voltage : $V_{DRM}$ / $V_{RRM}$ = +/-700V
- Avalanche controlled : $V_{CL}$ typ = 1100 V
- Nominal conducting current : $I_{T(RMS)}$ = 4A
- High surge current capability: 30A for 20ms full wave
- Gate triggering current : $I_{GT}$ < 10 mA or 25mA
- Switch integrated driver
- High noise immunity : static dV/dt >500V/µs

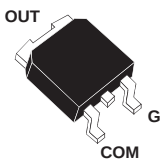
### BENEFITS

- Enables equipment to meet IEC 61000-4-5
- High off-state reliability with planar technology
- No external overvoltage protection needed
- Reduces the power component factor
- Interfaces directly with the microcontroller
- Direct interface with the microcontroller for the ACST4-7S ($I_{GT}$ < 10mA)

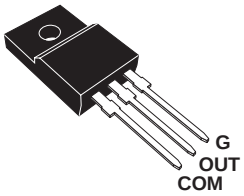
### DESCRIPTION

The ACST4 belongs to the AC power switch family built around the ASD™ technology. This high performance device is adapted to home appliances or inductrial systems and drives loads up to 4 A.

The ACS™ 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.

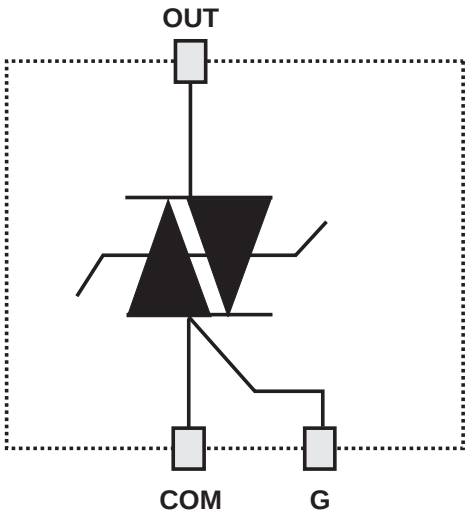



**DPAK**
**ACST4-7SB/CB**




**TO-220FPAB**
**ACST4-7SFP/CFP**

### 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 = 110 °C | 4 | A |
| | | TO-220FPAB | Tc = 100 °C | | |
| $I_{TSM}$ | Non repetitive surge peak on-state current Tj initial = 25°C, full cycle sine wave | | F =50 Hz | 30 | A |
| | | | F =60 Hz | 33 | A |
| $I^2t$ | Fusing capability | | tp = 10ms | 6.4 | $A^2s$ |
| 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 B.

**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 | A |
| $I_{GM}$ | Peak gate current (tp = 20µs) | 1 | 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 |
| Rth (j-l) | Junction to case for full cycle sine wave conduction | DPAK | | 2.6 | °C/W |
| | | TO-220FPAB | | 4.6 | °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 | | | | ACST4-7S | ACST4-7C | Unit |
|---|---|---|---|---|---|---|---|
| $I_{GT}$ | $V_{OUT}$=12V (DC) $R_L$=33Ω | QI - QII - QIII | Tj=25°C | MAX | 10 | 25 | mA |
| $V_{GT}$ | $V_{OUT}$=12V (DC) $R_L$=33Ω | QI - QII - QIII | Tj=25°C | MAX | 1 | 1.1 | V |
| $V_{GD}$ | $V_{OUT}$=$V_{DRM}$ $R_L$=3.3kΩ | | Tj=125°C | MIN | 0.2 | | V |
| $I_H$ | $I_{OUT}$= 100mA gate open | | Tj=25°C | MAX | 20 | 35 | mA |
| $I_L$ | $I_G$= 2 x $I_{Gt}$max | | Tj=25°C | MAX | 40 | 60 | mA |
| $V_{TM}$ | $I_{OUT}$ = 5.6A tp=380µs | | Tj=25°C | MAX | 1.5 | | V |
| $V_{TO}$ | | | Tj=125°C | MAX | 0.90 | | V |
| Rd | | | Tj=125°C | MAX | 100 | | mΩ |
| $I_{DRM}$ / $I_{RRM}$ | $V_{OUT}$ = 700V | | Tj=25°C | MAX | 10 | | µA |
| | | | Tj=125°C | MAX | 500 | | |
| dV/dt | $V_{OUT}$=460V gate open | | Tj=110°C | MIN | 200 | 500 | V/µs |
| (dI/dt)c | (dV/dt)c = 15V/µs | | Tj=125°C | MIN | 2.0 | 2.5 | A/ms |
| $V_{CL}$ | $I_{CL}$ = 1mA tp=1ms | | Tj=25°C | TYP | 1100 | | V |

## AC LINE SWITCH BASIC APPLICATION

The ACST4 device has been designed to switch on & off low power, but highly inductive or resistive loads such as dishwashers spray pumps, and air-conditioners fan.

Pin COM: Common drive reference to connect to the power line neutral

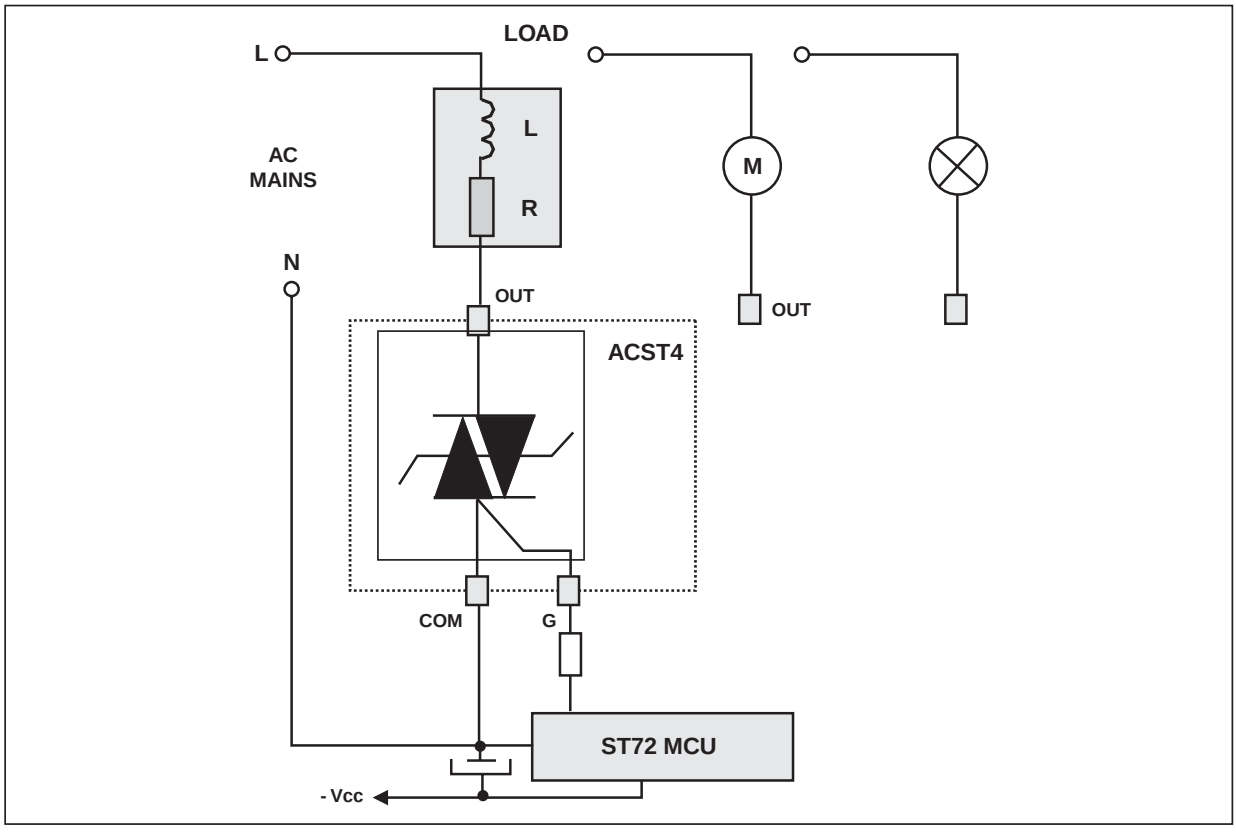
Pin G: Switch Gate input to connect to the digital controller

Pin OUT: Switch Output to connect to the load

ACST4-7S triggering current has to be sunk from the gate pin G. The switch can then be driven directly by logic level circuits through a resistor as shown on the typical application diagram ( Fig A ).

Thanks to its thermal and turn off commutation performances, the ACST4 switch is able to drive with no turn off additional snubber an inductive load up to 4 A.

## TYPICAL APPLICATION DIAGRAM (Fig. A)




## AC LINE TRANSIENT VOLTAGE RUGGEDNESS

The ACST4 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 2 is representative of the final ACST application and is also used to stress the ACST switch according to the IEC 61000-4-5 standard conditions. Thanks to the load, the ACST 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 rate of rise, is as high as shown on figure 3. Such non-repetitive test can be done 10 times on each AC line voltage polarity.

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

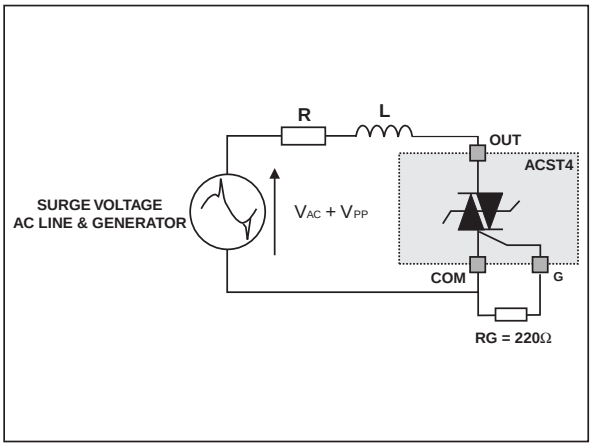



**Fig. C:** Current and Voltage of the ACST4 during IEC61000-4-5 standard test with R, L & $V_{PP}$ .

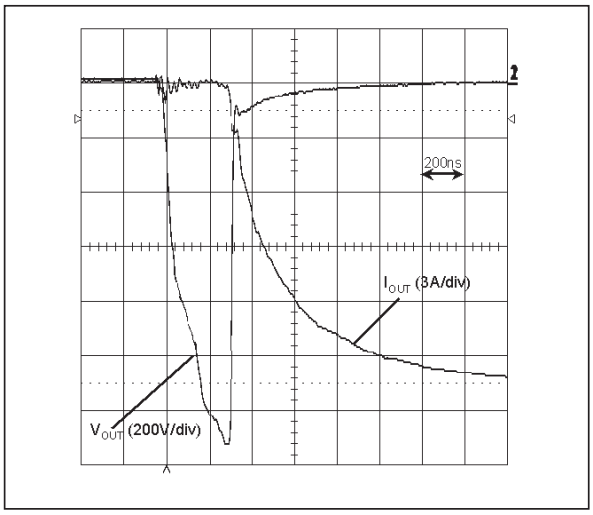



**Fig. 1:** Maximum power dissipation versus RMS on-state current.

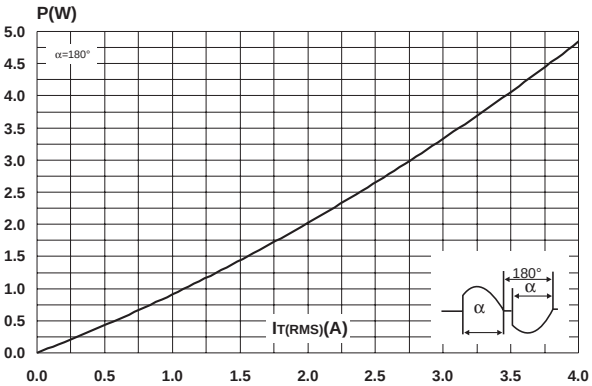



**Fig. 2-1:** RMS on-state current versus case temperature.

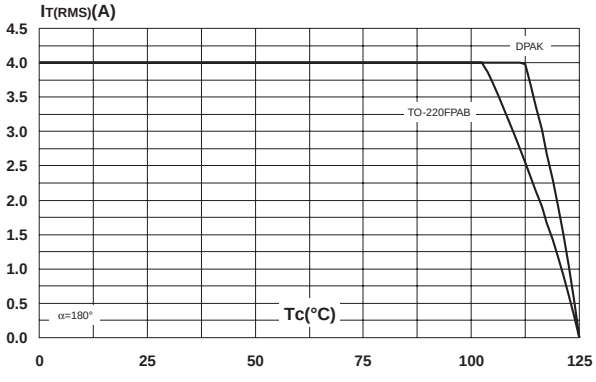


**Fig. 2-2:** RMS on-state current versus ambient temperature.

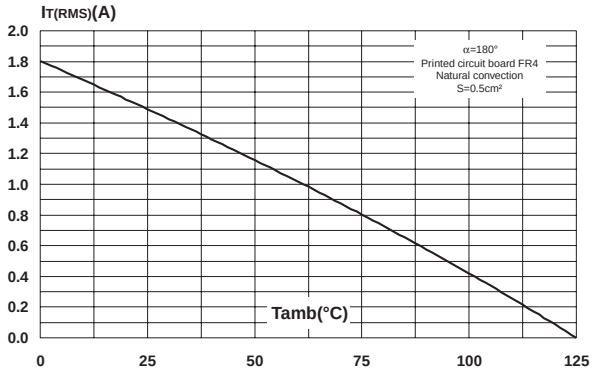



**Fig. 3:** Relative variation of thermal impedance versus pulse duration.

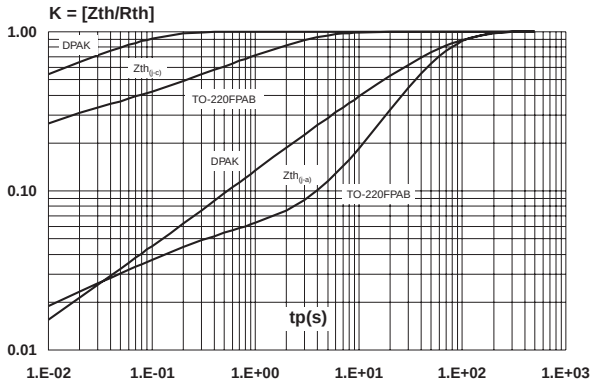



**Fig. 4:** Relative variation of gate trigger current, holding current and latching versus junction temperature (typical values).

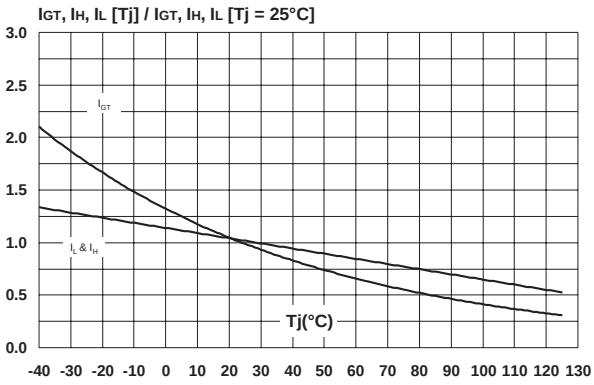



**Fig. 5:** Relative variation of static dV/dt versus junction temperature.

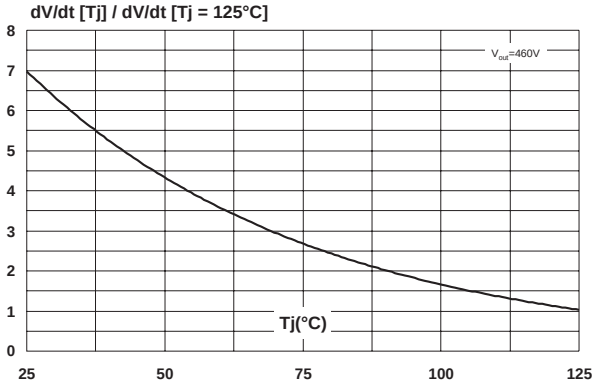



**Fig. 6-1:** Relative variation of critical rate of decrease of main current versus reapplied dV/dt (typical values).

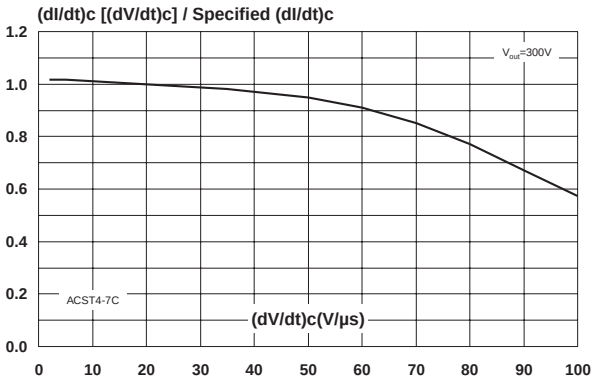



**Fig. 6-2:** Relative variation of critical rate of decrease of main current versus reapplied dV/dt (typical values).

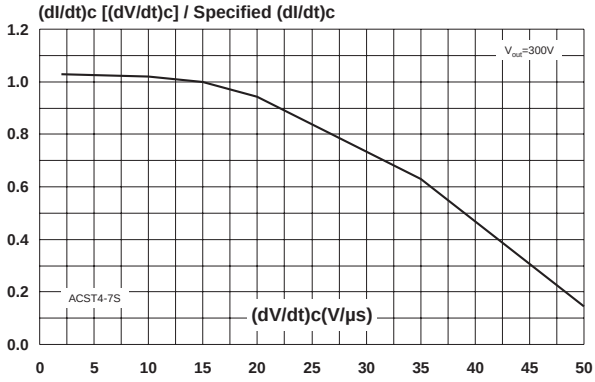


**Fig. 7:** Relative variation of critical rate of decrease of main current versus junction temperature.

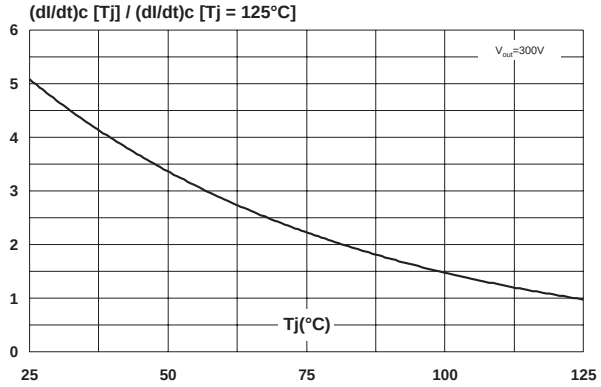



**Fig. 8:** Surge peak on-state current versus number of cycles.

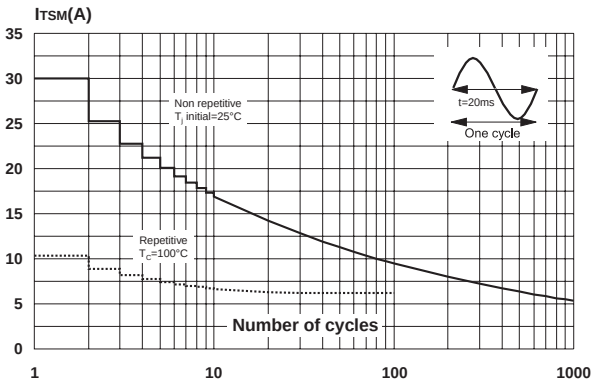



**Fig. 9:** Non repetitive surge peak on-state current for a sinusoidal pulse with width tp < 10ms, and corresponding value of $I^2t$.

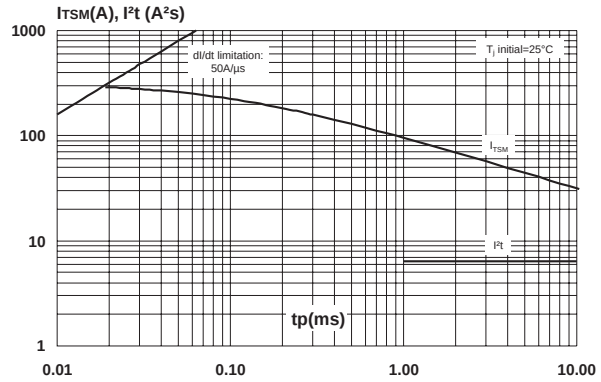



**Fig. 10:** On-state characteristics (maximum values).

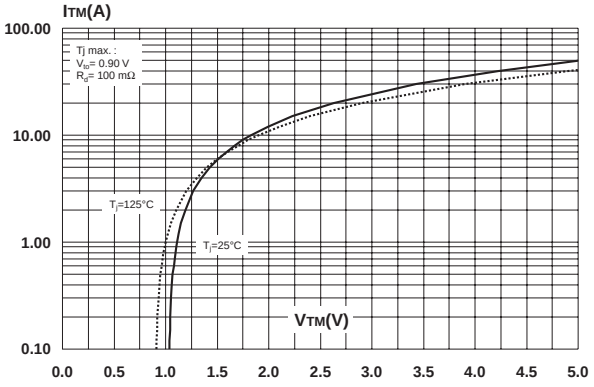
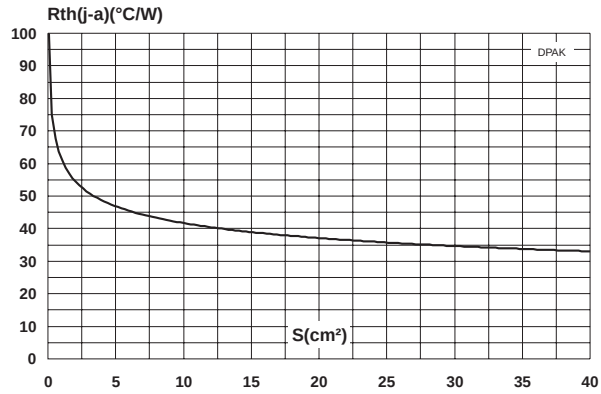
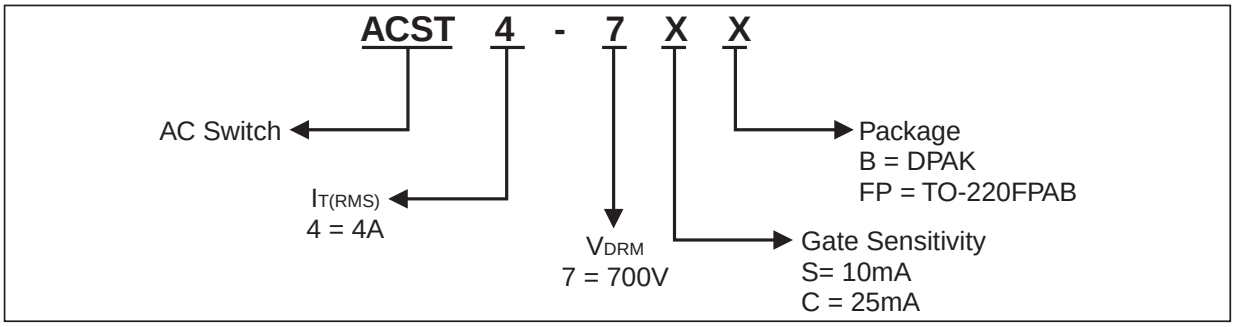



**Fig. 11:** Thermal resistance junction to ambient versus copper surface under tab (printed circuit board FR4, copper thickness: 35µm)

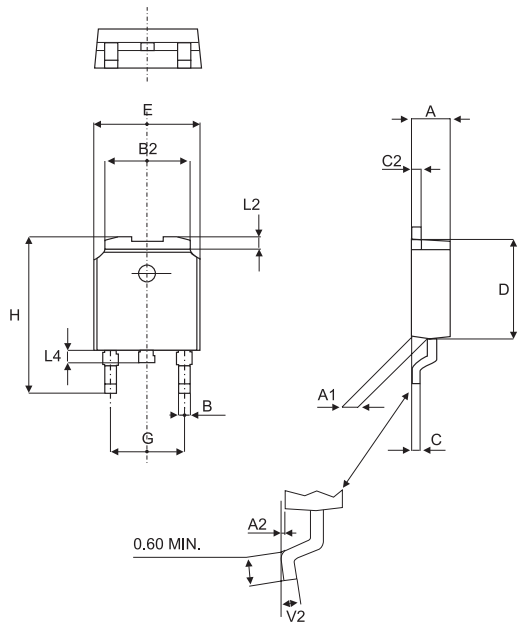


## ORDERING INFORMATION




## PACKAGE OUTLINE MECHANICAL DATA

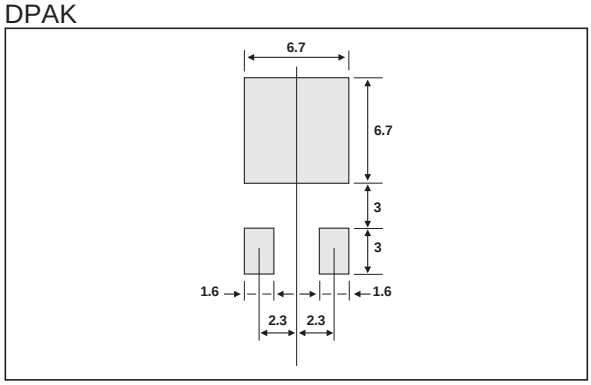
DPAK




| 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° |

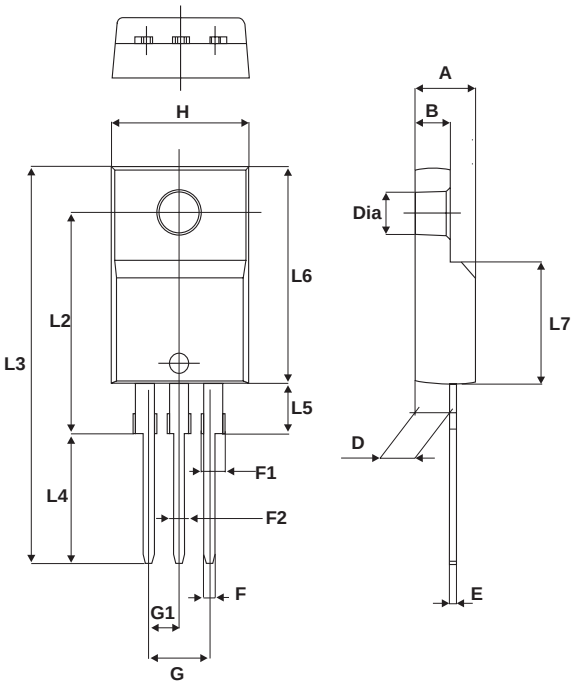
## FOOT PRINT

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 |

## OTHER INFORMATION

| Ordering type | Marking | Package | Weight | Base qty | Delivery mode |
|---|---|---|---|---|---|
| ACST4-7SB | ACST47S | DPAK | 0.3 g | 75 | Tube |
| ACST4-7SB-TR | ACST47S | DPAK | 0.3 g | 2500 | Tape & reel |
| ACST4-7SFP | ACST47S | TO-220FPAB | 2.4 g | 50 | Tube |
| ACST4-7CB | ACST47C | DPAK | 0.3 g | 75 | Tube |
| ACST4-7CB-TR | ACST47C | DPAK | 0.3 g | 2500 | Tape & reel |
| ACST4-7CFP | ACST47C | TO-220FPAB | 2.4 g | 50 | Tube |

- Epoxy meets UL94,V0

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