

Overvoltage protected AC switch

Datasheet - production data

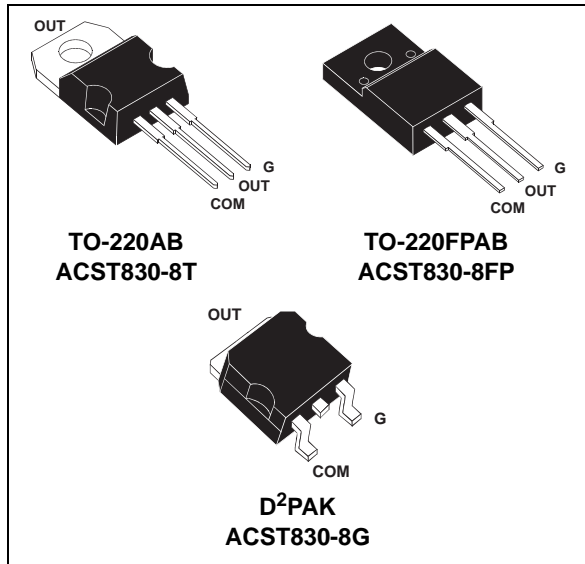
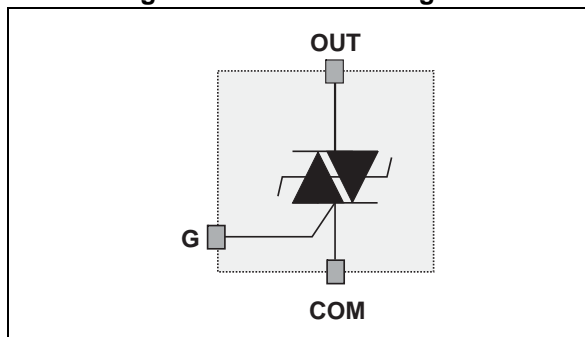


Figure 1. Functional diagram



Features

- Triac with overvoltage protection
- High noise immunity: static $dV/dt > 2000 \text{ V}/\mu\text{s}$
- TO-220FPAB insulated package:
 - complies with UL standards (file ref: E81734)
 - insulation voltage: $2000 \text{ V}_{\text{RMS}}$

Benefits

- Enables equipment to meet IEC 61000-4-5

- High off-state reliability with planar technology
- Needs no external overvoltage protection
- Reduces the power passive component count
- High immunity against fast transients described in IEC 61000-4-4 standards

Applications

- AC mains static switching in appliance and industrial control systems
- Drive of medium power AC loads such as:
 - Universal motor of washing machine drum
 - Compressor for fridge or air conditioner

Description

The ACST8 series belongs to the ACS/ACST power switch family built around A.S.D. (application specific discrete) technology. This high performance device is suited to home appliances or industrial systems and drives an induction motor up to 8 A.

This ACST8 device 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 IEC 61000-4-5 standards.

ACST8 shows a high noise immunity complying with IEC standards such as IEC 61000-4-4 (fast transient burst test).

Table 1. Device summary

| Symbol | Value | Unit |
|---------------------------------|-------|------|
| $I_{\text{T(RMS)}}$ | 8 | A |
| $V_{\text{DRM}}/V_{\text{RRM}}$ | 800 | V |
| I_{GT} | 30 | mA |

1 Characteristics

Table 2. Absolute ratings (limiting values)

| Symbol | Parameter | | Value | Unit | |
|----------------|--|--|----------------------------|---------------|------------------|
| $I_{T(RMS)}$ | On-state rms current (full sine wave) | TO-220FPAB | $T_{case} = 91\text{ °C}$ | 8 | A |
| | | TO-220AB / D ² PAK | $T_{case} = 105\text{ °C}$ | | |
| | | D ² PAK with 1 cm ² Cu | $T_{amb} = 43\text{ °C}$ | 2 | A |
| I_{TSM} | Non repetitive surge peak on-state current T_j initial = 25 °C, full cycle sine wave | F = 50 Hz | $t_p = 20\text{ ms}$ | 80 | A |
| | | F = 60 Hz | $t_p = 16.7\text{ ms}$ | 84 | A |
| I^2t | Thermal constraint for fuse selection | | $t_p = 10\text{ ms}$ | 42 | A ² s |
| dI/dt | Critical rate of rise on-state current $I_G = 2 \times I_{GT}$, ($t_r \leq 100\text{ ns}$) | F = 120 Hz | $T_j = 125\text{ °C}$ | 100 | A/ μ s |
| $V_{PP}^{(1)}$ | Non repetitive line peak pulse voltage | | $T_j = 25\text{ °C}$ | 2 | kV |
| $P_{G(AV)}$ | Average gate power dissipation | | $T_j = 125\text{ °C}$ | 0.1 | W |
| P_{GM} | Peak gate power dissipation ($t_p = 20\text{ ms}$) | | $T_j = 125\text{ °C}$ | 10 | W |
| I_{GM} | Peak gate current ($t_p = 20\text{ ms}$) | | $T_j = 125\text{ °C}$ | 1.6 | A |
| T_{stg} | Storage temperature range | | | - 40 to + 150 | °C |
| T_j | Operating junction temperature range | | | - 40 to + 125 | °C |
| T_l | Maximum lead soldering temperature during 10 s | | | 260 | °C |
| $V_{INS(RMS)}$ | Insulation RMS voltage (60 seconds) | TO-220FPAB | | 2000 | V |

1. According to test described in IEC 61000-4-5 standard and [Figure 17](#).

Table 3. Electrical characteristics per switch

| Symbol | Test conditions | Quadrant | T_j | | Value | Unit |
|-------------------|--|--------------|--------|-----|-------|------------|
| $I_{GT}^{(1)}$ | $V_{OUT} = 12\text{ V}$, $R_L = 33\ \Omega$ | I - II - III | 25 °C | Max | 30 | mA |
| V_{GT} | $V_{OUT} = 12\text{ V}$, $R_L = 33\ \Omega$ | I - II - III | 25 °C | Max | 1.0 | V |
| V_{GD} | $V_{OUT} = V_{DRM}$, $R_L = 3.3\text{ k}\Omega$ | I - II - III | 125 °C | Min | 0.2 | V |
| $I_H^{(2)}$ | $I_{OUT} = 500\text{ mA}$ | | 25 °C | Max | 30 | mA |
| I_L | $I_G = 1.2 \times I_{GT}$ | I - II - III | 25 °C | Max | 50 | mA |
| $dV/dt^{(2)}$ | $V_{OUT} = 67\% V_{DRM}$, gate open | | 125 °C | Min | 2000 | V/ μ s |
| $(dI/dt)_C^{(2)}$ | Without snubber | | 125 °C | Min | 8 | A/ms |
| V_{CL} | $I_{CL} = 0.1\text{ mA}$, $t_p = 1\text{ ms}$ | | 25 °C | Min | 850 | V |

1. Minimum I_{GT} is guaranteed at 5% of $I_{GT(Max)}$
2. For either positive or negative polarity of OUT pin with reference to COM pin

Table 4. Static characteristics

| Symbol | Test conditions | | | Value | Unit |
|------------------------|---|------------------------------------|-----|-------|---------------|
| V_{TM} | $I_{TM} = 11.3 \text{ A}$ $t_p = 500 \mu\text{s}$ | $T_j = 25 \text{ }^\circ\text{C}$ | Max | 1.5 | V |
| V_{TO} | Threshold voltage | $T_j = 125 \text{ }^\circ\text{C}$ | Max | 0.9 | V |
| R_D | Dynamic resistance | $T_j = 125 \text{ }^\circ\text{C}$ | Max | 50 | m Ω |
| I_{DRM} I_{RRM} | $V_{OUT} = V_{DRM} / V_{RRM}$ | $T_j = 25 \text{ }^\circ\text{C}$ | Max | 20 | μA |
| | | $T_j = 125 \text{ }^\circ\text{C}$ | | 1 | mA |

Table 5. Thermal resistances

| Symbol | Parameter | | Value | Unit |
|---------------|--|------------------------------|-------|--------------------|
| $R_{th(j-a)}$ | Junction to ambient | TO-220FPAB TO-220AB | 60 | $^\circ\text{C/W}$ |
| | Junction to ambient (soldered on 1 cm ² copper pad) | D ² PAK | 45 | |
| $R_{th(j-c)}$ | Junction to case (AC) | TO-220FPAB | 3.6 | |
| | | TO-220AB, D ² PAK | 2 | |

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

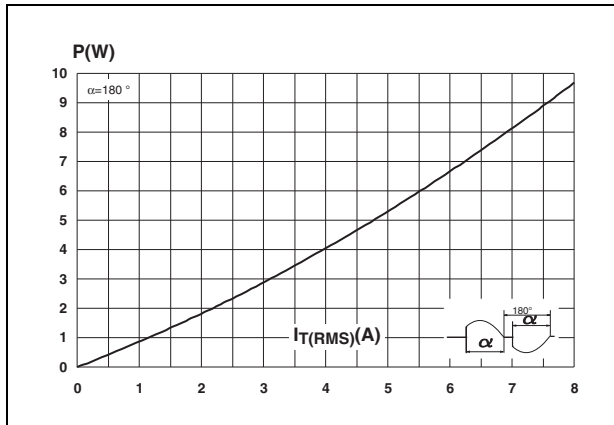


Figure 3. On-state RMS current versus case temperature (full cycle)

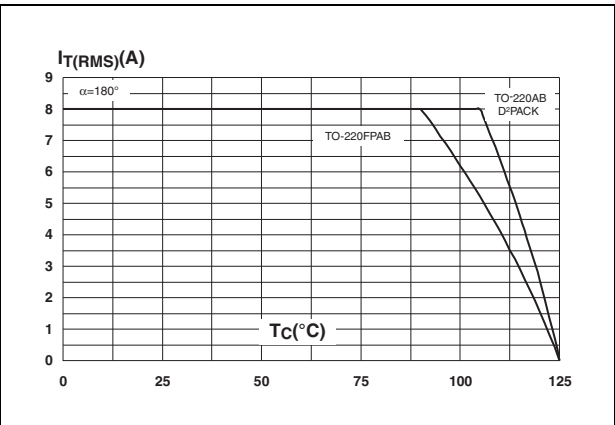


Figure 4. On-state RMS current versus ambient temperature (free air convection, full cycle)

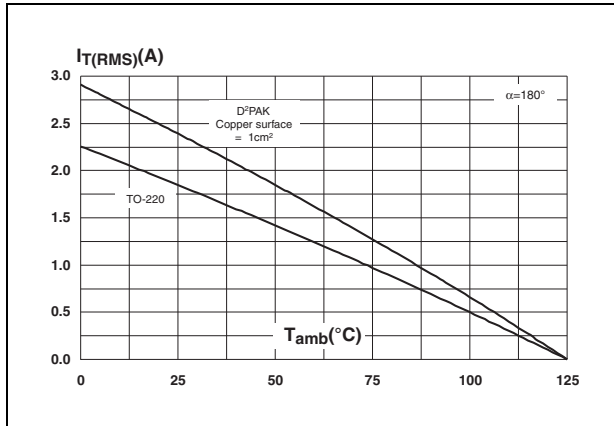


Figure 5. Relative variation of thermal impedance versus pulse duration

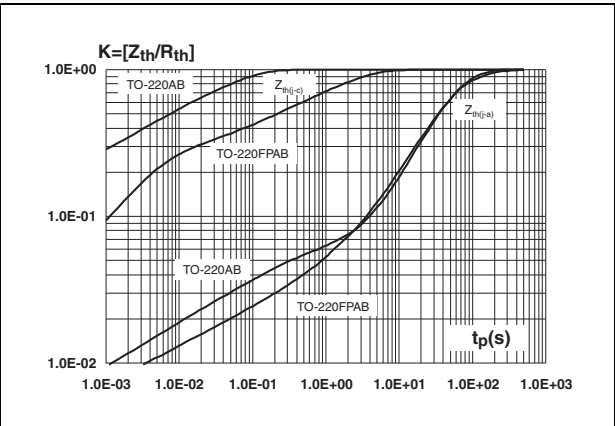


Figure 6. Relative variation of gate trigger current (IGT) and voltage (VGT) versus junction temperature

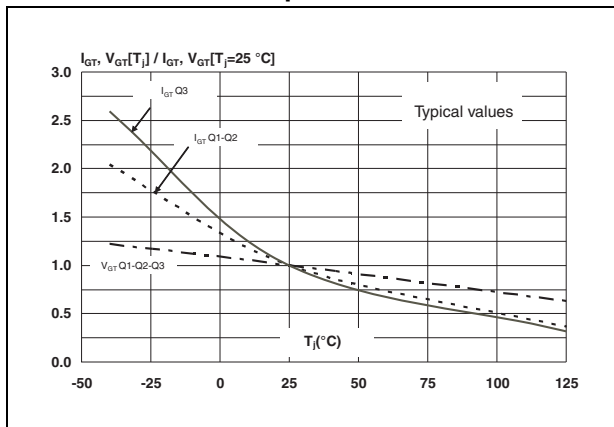


Figure 7. Relative variation of holding current (IH) and latching current (IL) versus junction temperature

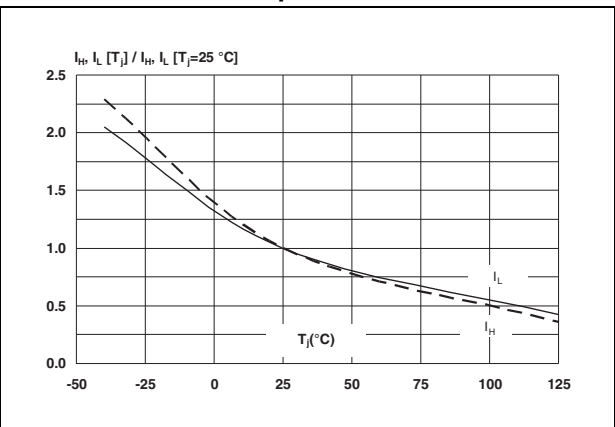


Figure 8. Surge peak on-state current versus number of cycles

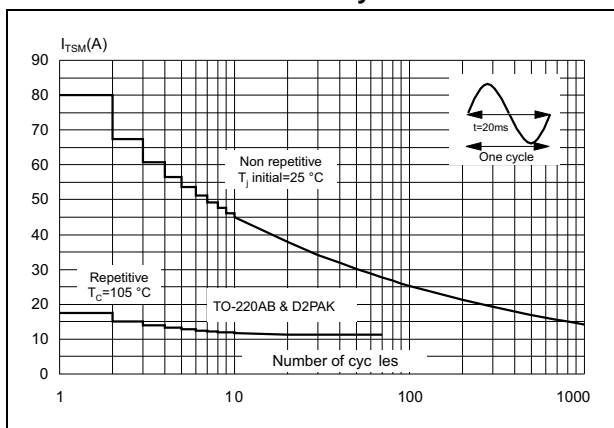


Figure 9. Non repetitive surge peak on-state current versus sinusoidal pulse width

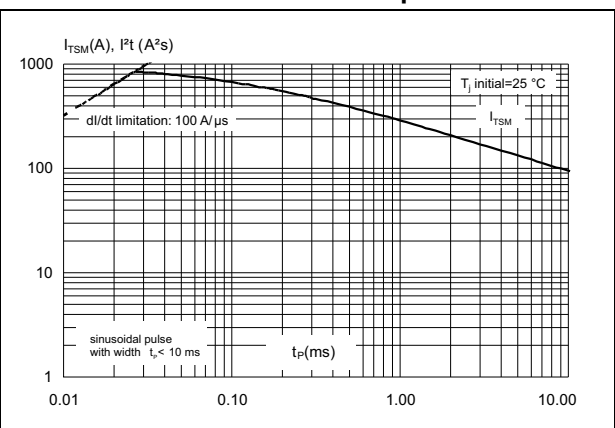


Figure 10. On-state characteristics (maximum values)

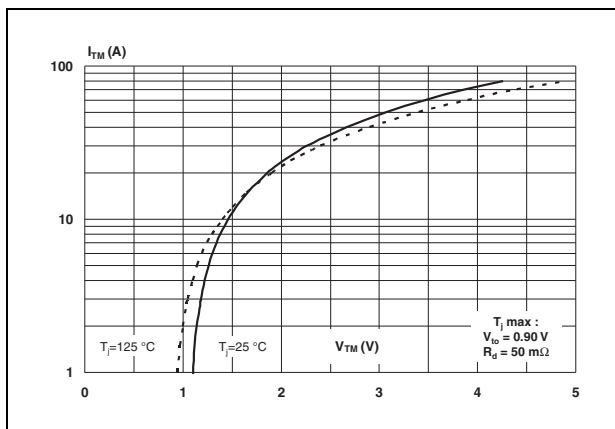


Figure 11. Relative variation of critical rate of decrease of main current $(di/dt)_c$ versus junction temperature

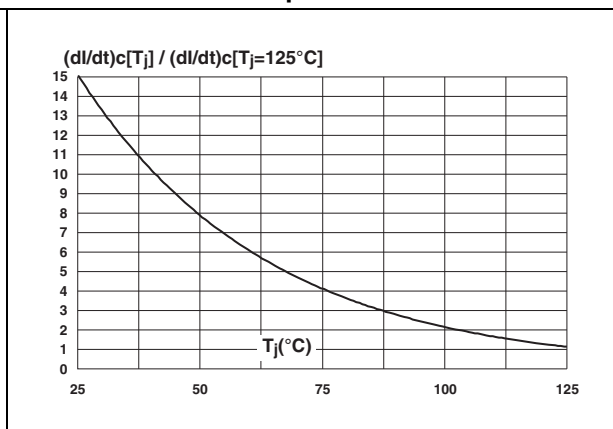


Figure 12. Relative variation of static dV/dt immunity versus junction temperature (gate open)

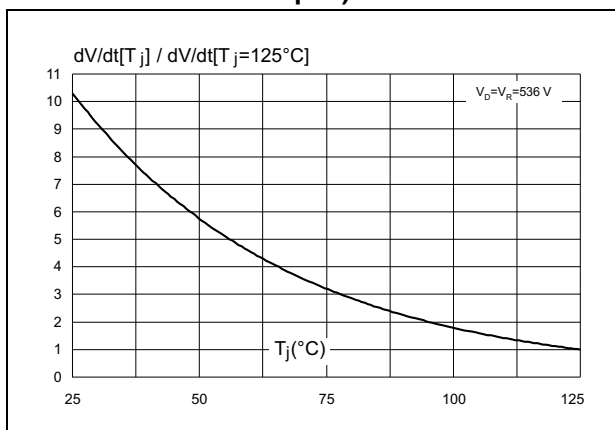


Figure 13. Relative variation of leakage current versus junction temperature

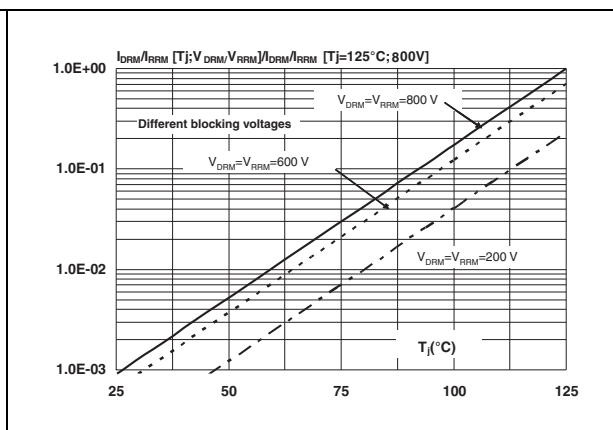


Figure 14. Relative variation of clamping voltage (V_{CL}) versus junction temperature (minimum values)

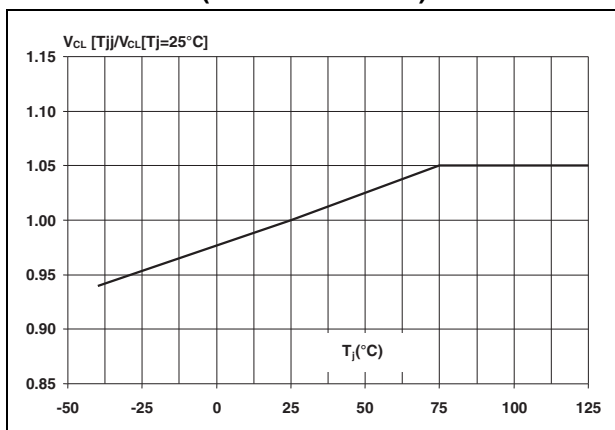
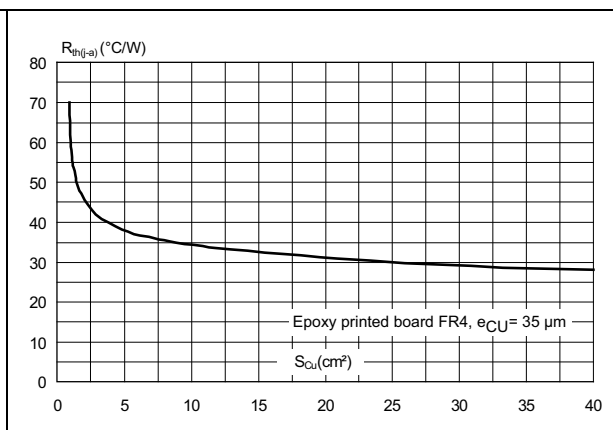


Figure 15. Thermal resistance junction to ambient versus copper surface under tab

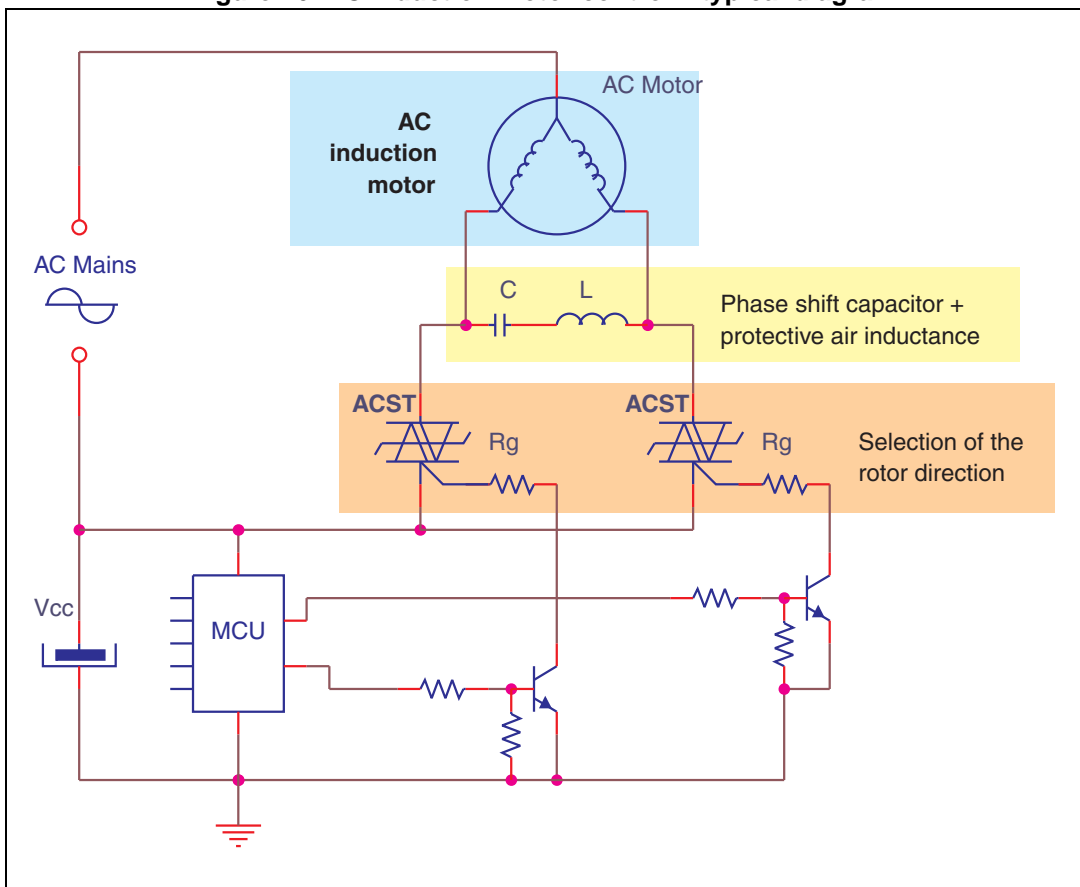


2 Application information

2.1 Typical application description

The ACST8 device has been designed to control medium power load, such as AC motors in home appliances. Thanks to its thermal and turn off commutation performances, the ACST8 switch is able to drive an inductive load up to 8 A with no turn off additional snubber. It also provides high thermal performances in static and transient modes such as high torque operating conditions or inrush current of an AC motor.

Figure 16. AC induction motor control – typical diagram



2.2 AC line transient voltage ruggedness

In comparison with standard Triacs, which are not robust against surge voltage, the ACST8 is self-protected against over-voltage, specified by the new parameter V_{CL} . The ACST8 switch can safely withstand AC line transient voltages either by clamping the low energy spikes, such as inductive spikes at switch off, or by switching to the on state (for less than 10 ms) to dissipate higher energy shocks through the load. This safety feature works even with high turn-on current ramp up.

The test circuit of [Figure 17](#) represents the ACST8 application, and is used to stress the ACST switch according to the IEC 61000-4-5 standard conditions. With the additional effect of the load which is limiting the current, the ACST switch withstands the voltage spikes up to 2 kV on top of the peak line voltage. The protection is based on an overvoltage crowbar technology. The ACST8 folds back safely to the on state as shown in [Figure 18](#). The ACST8 recovers its blocking voltage capability after the surge and the next zero current crossing. Such a non repetitive test can be done at least 10 times on each AC line voltage polarity.

Figure 17. Overvoltage ruggedness test circuit for resistive and inductive loads for IEC 61000-4-5 standards

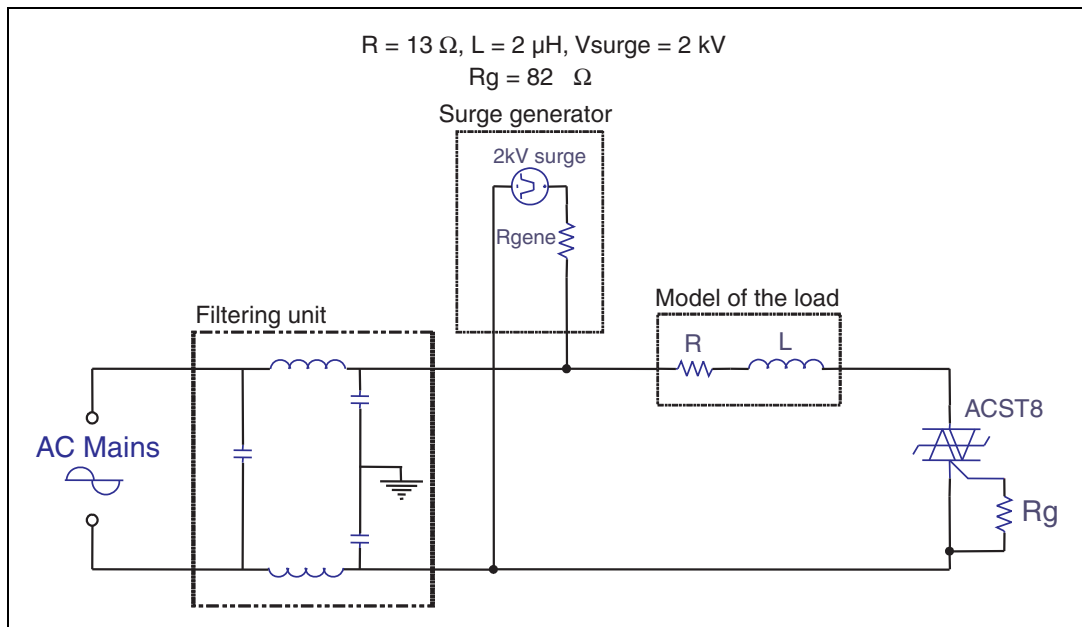
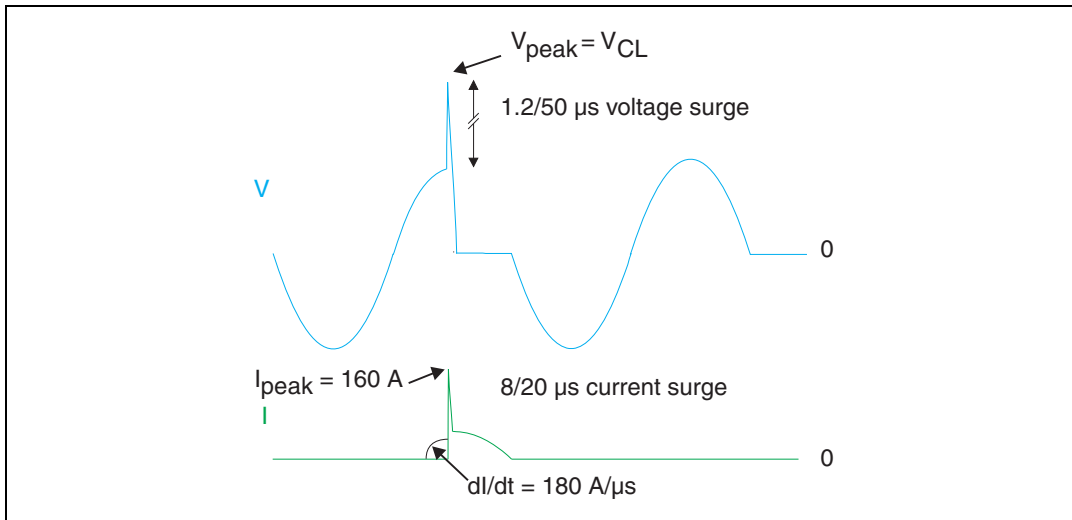
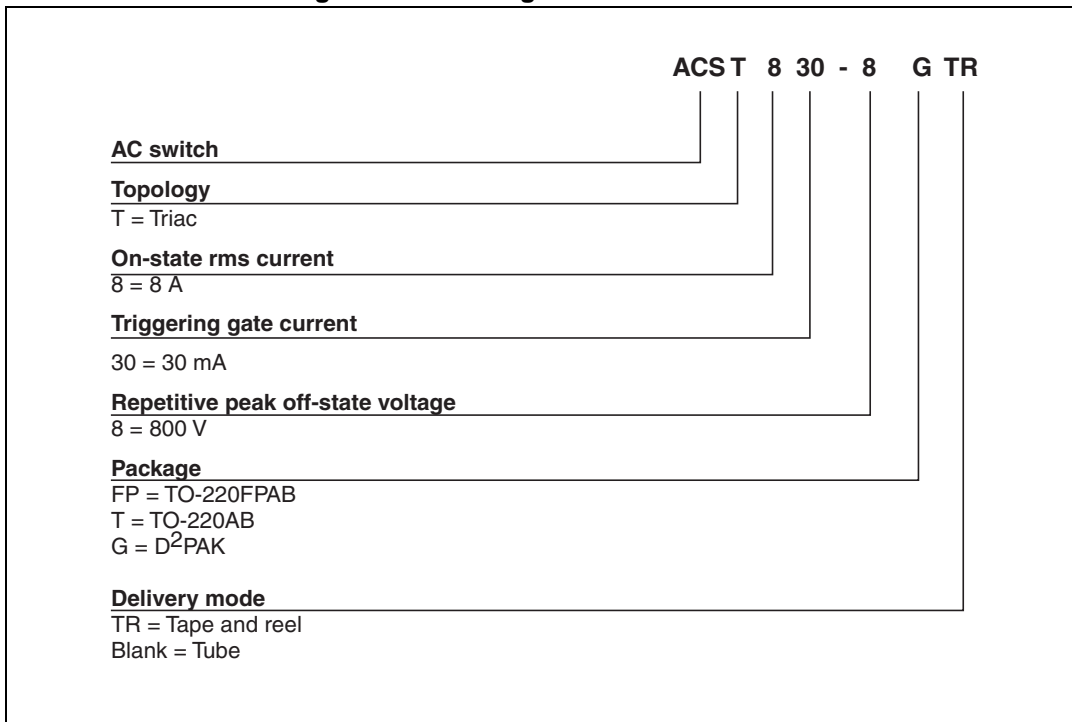


Figure 18. Typical current and voltage waveforms across the ACST8 during IEC 61000-4-5 standard test



3 Ordering information scheme

Figure 19. Ordering information scheme



4 Package information

- Epoxy meets UL94, V0
- 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.

4.1 TO-220AB package information

Figure 20. TO-220AB package outline

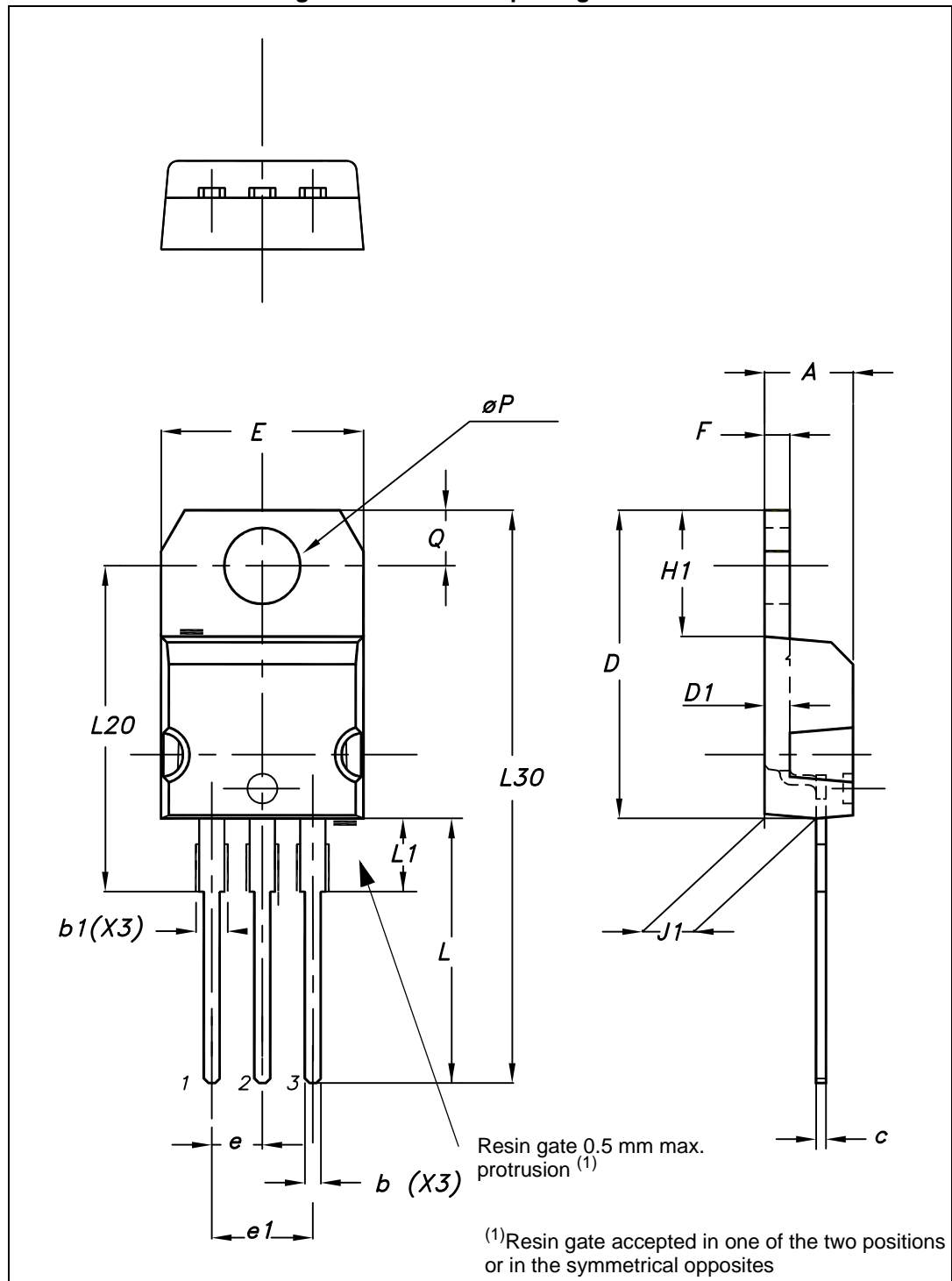


Table 6. TO-220AB package mechanical data

| Ref. | Dimensions | | | |
|------|-------------|-------|-------------|--------|
| | Millimeters | | Inches | |
| | Min. | Max. | Min. | Max. |
| A | 4.4 | 4.6 | 0.1732 | 0.1811 |
| b | 0.61 | 0.88 | 0.024 | 0.0346 |
| b1 | 1.14 | 1.55 | 0.0449 | 0.0610 |
| c | 0.48 | 0.7 | 0.0189 | 0.0276 |
| D | 15.25 | 15.75 | 0.6004 | 0.6201 |
| D1 | 1.27 typ. | | 0.0500 typ. | |
| E | 10 | 10.4 | 0.3937 | 0.4094 |
| e | 2.4 | 2.7 | 0.0945 | 0.1063 |
| e1 | 4.95 | 5.15 | 0.1949 | 0.2028 |
| F | 1.23 | 1.32 | 0.0484 | 0.052 |
| H1 | 6.2 | 6.6 | 0.2441 | 0.2598 |
| J1 | 2.4 | 2.72 | 0.0945 | 0.1071 |
| L | 13 | 14 | 0.5118 | 0.5512 |
| L1 | 3.5 | 3.93 | 0.1378 | 0.1547 |
| L20 | 16.40 typ. | | 0.6457 typ. | |
| L30 | 28.90 typ. | | 1.1378 typ. | |
| θP | 3.75 | 3.85 | 0.1476 | 0.1516 |
| Q | 2.65 | 2.95 | 0.1043 | 0.1161 |

4.2 TO-220FPAB package information

Figure 21. TO-220FPAB package outline

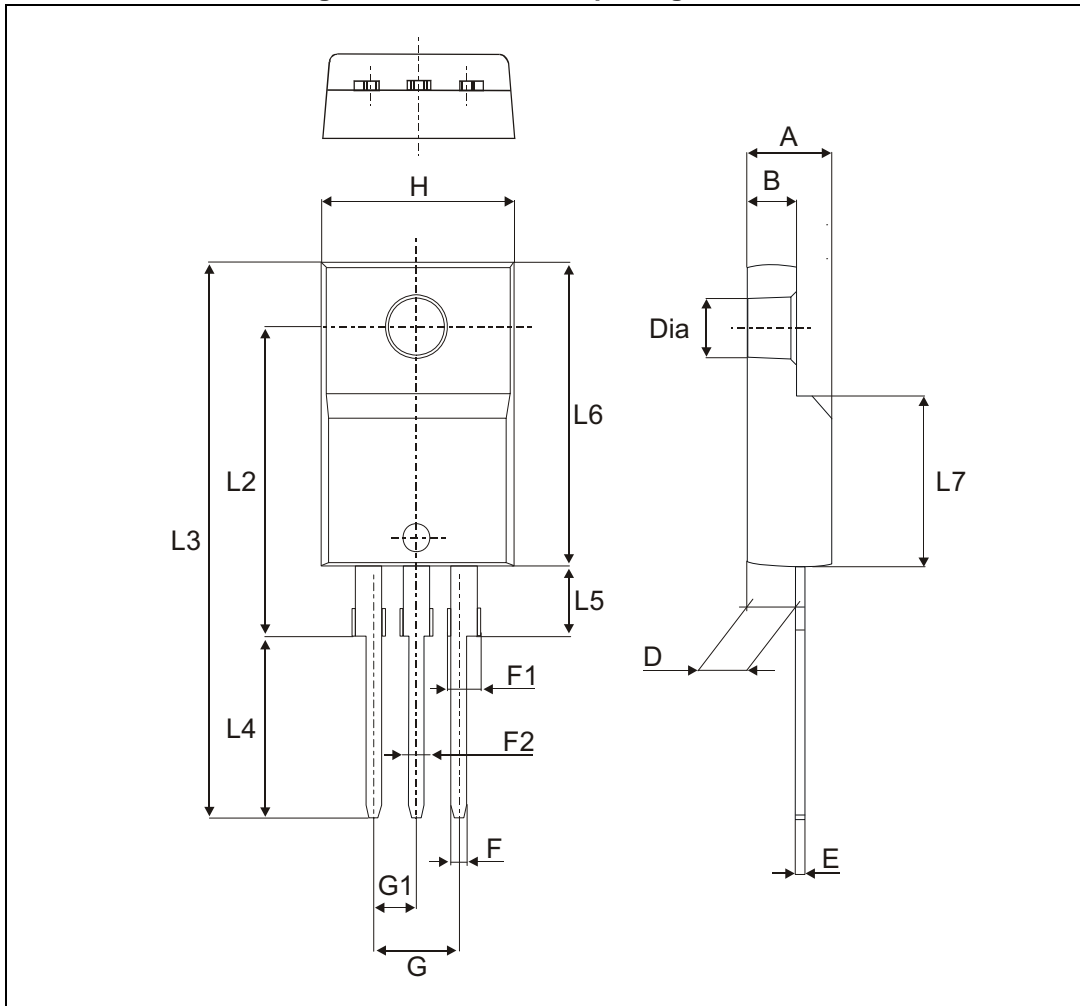


Table 7. TO-220FPAB package mechanical data

| Ref. | Dimensions | | | |
|-------|-------------|-------|-------------|--------|
| | Millimeters | | Inches | |
| | Min. | Max. | Min. | Max. |
| A | 4.40 | 4.60 | 0.1739 | 0.1818 |
| B | 2.50 | 2.70 | 0.0988 | 0.1067 |
| D | 2.50 | 2.750 | 0.0988 | 0.1087 |
| E | 0.45 | 0.70 | 0.0178 | 0.0277 |
| F | 0.75 | 1.0 | 0.0296 | 0.0395 |
| F1 | 1.15 | 1.70 | 0.0455 | 0.0672 |
| F2 | 1.15 | 1.70 | 0.0455 | 0.0672 |
| G | 4.95 | 5.20 | 0.1957 | 0.2055 |
| G1 | 2.40 | 2.70 | 0.0949 | 0.1067 |
| H | 10.0 | 10.4 | 0.3953 | 0.4111 |
| L2 | 16 Typ. | | 0.6324 Typ. | |
| L3 | 28.6 | 30.6 | 1.1304 | 1.2095 |
| L4 | 9.8 | 10.6 | 0.3874 | 0.4190 |
| L5 | 2.9 | 3.6 | 0.1146 | 0.1423 |
| L6 | 15.9 | 16.4 | 0.6285 | 0.6482 |
| L7 | 9.00 | 9.30 | 0.3557 | 0.3676 |
| Diam. | 3.00 | 3.20 | 0.1186 | 0.1265 |

4.3 D²PAK package information

Figure 22. D²PAK package outline

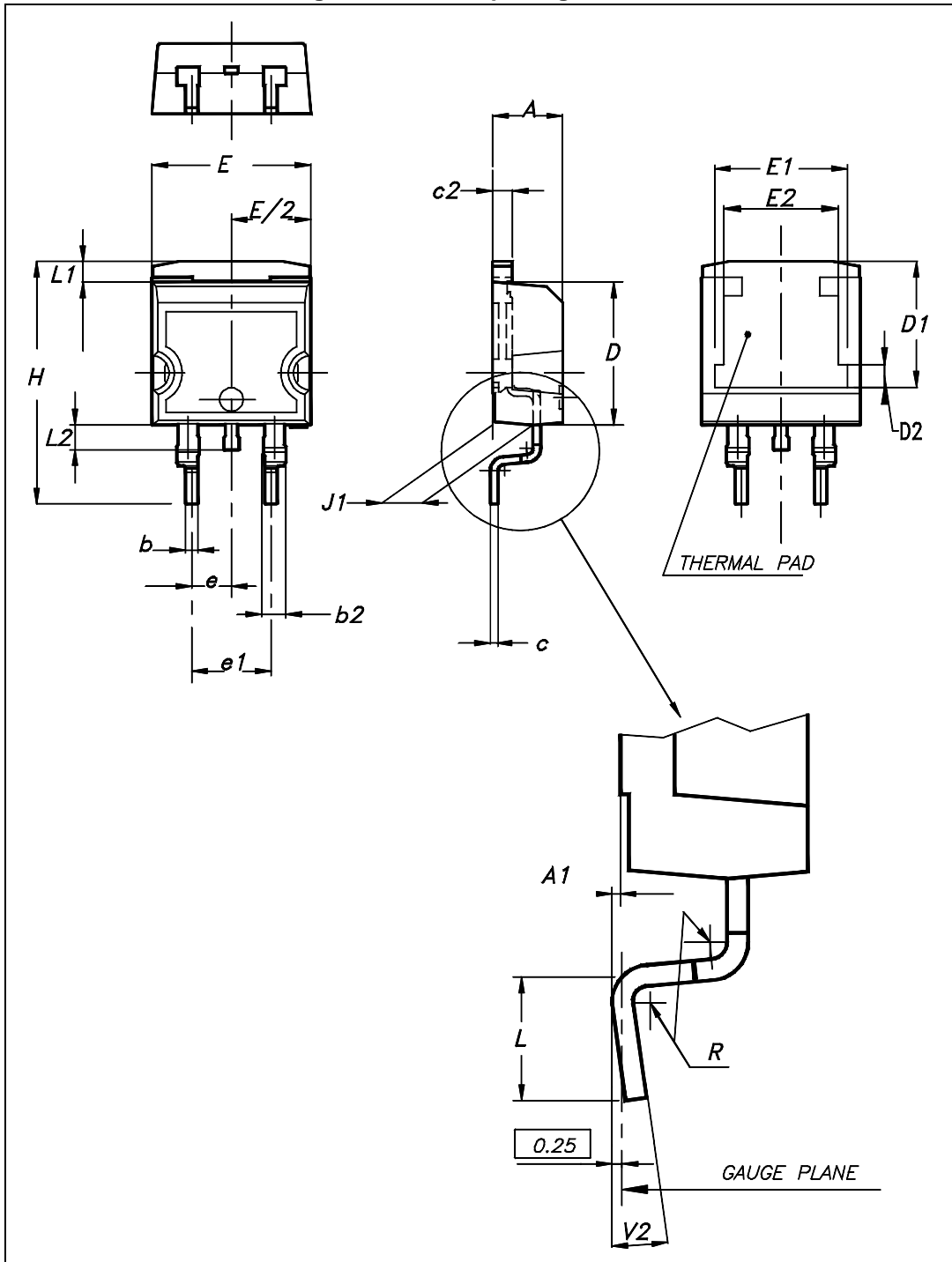
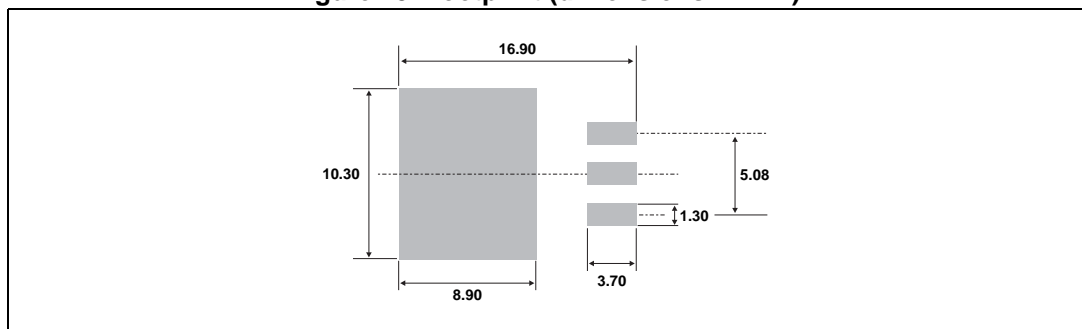


Table 8. D²PAK package mechanical data

| Ref. | Dimensions | | | |
|------|-------------|-------|-------------|--------|
| | Millimeters | | Inches | |
| | Min. | Max. | Min. | Max. |
| A | 4.40 | 4.60 | 0.1739 | 0.1818 |
| A1 | 2.49 | 2.69 | 0.0984 | 0.1063 |
| A2 | 0.03 | 0.23 | 0.0012 | 0.0091 |
| B | 0.70 | 0.93 | 0.0277 | 0.0368 |
| B2 | 1.14 | 1.70 | 0.0451 | 0.0672 |
| C | 0.45 | 0.60 | 0.0178 | 0.0237 |
| C2 | 1.23 | 1.36 | 0.0486 | 0.0538 |
| D | 8.95 | 9.35 | 0.3538 | 0.3696 |
| E | 10.00 | 10.40 | 0.3953 | 0.4111 |
| G | 4.88 | 5.28 | 0.1929 | 0.2087 |
| L | 15.00 | 15.85 | 0.5929 | 0.6265 |
| L2 | 1.27 | 1.40 | 0.0502 | 0.0553 |
| L3 | 1.40 | 1.75 | 0.0553 | 0.0692 |
| M | 2.40 | 3.20 | 0.0949 | 0.1265 |
| R | 0.40 typ. | | 0.0158 typ. | |
| V2 | 0° | 8° | 0° | 8° |

Figure 23. Footprint (dimensions in mm)



5 Ordering information

Table 9. Ordering information

| Order code | Marking | Package | Weight | Base qty | Packing mode |
|--------------|----------|--------------------|--------|----------|---------------|
| ACST830-8FP | ACST8308 | TO-220FPAB | 2.4 g | 50 | Tube |
| ACST830-8T | | TO-220AB | 2.3 g | 50 | Tube |
| ACST830-8GTR | | D ² PAK | 1.5 g | 500 | Tape and reel |

6 Revision history

Table 10. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| Jan-2002 | 4B | Last update. |
| 08-Nov-2004 | 5 | TO-220AB and D ² PAK packages added. |
| 24-Nov-2004 | 6 | Table 6 page 3: I _{GT} parameter added |
| 18-Dec-2009 | 7 | Added ECOPACK statement. Reformatted for consistency with other datasheets in this product class. Order codes updated. |
| 01-Jul-2010 | 8 | Updated <i>Figure 19</i> . |
| 07-Feb-2011 | 9 | Updated <i>Table 2</i> . |
| 04-Sep-2017 | 10 | Updated features in cover page and Table 2 . Updated Section 4: Package information . Minor text changes. |

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