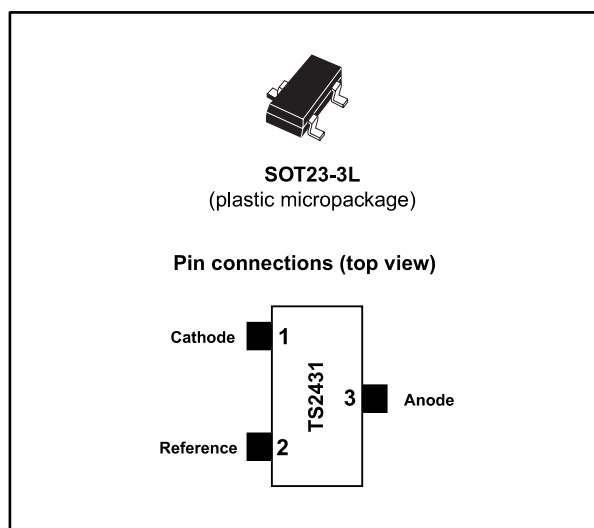


Adjustable shunt voltage reference

Datasheet - production data



- Industrial temperature range: - 40 to + 105 °C
- Performance compatible with industry-standard TL431

Applications

- Computers
- Instrumentation
- Battery chargers
- Switch mode power supplies
- Battery-operated equipment

Description

The TS2431 is an adjustable shunt voltage reference with guaranteed temperature stability over the entire temperature range of operations from - 40 to + 105 °C. The output voltage may be set to any value between 2.5 and 24 V with an external resistor bridge. Available in an SOT23-3L surface mount package, the device can be implemented for those applications where space-saving is of the utmost importance.

Features

- Adjustable output voltage: 2.5 to 24 V
- Precision selection at 25 °C: $\pm 2\%$, $\pm 1\%$ and $\pm 0.5\%$
- Sink current capability: 1 to 100 mA

Table 1: Device summary

| Order code | Temperature range | Package | Packing | Precision | Marking |
|------------|-------------------|----------|---------------|-----------|---------|
| TS2431ILT | -40 to + 105 °C | SOT23-3L | Tape and reel | 2% | L285 |
| TS2431AILT | | | | 1% | L286 |
| TS2431BILT | | | | 0.5% | L287 |

Contents

| | | |
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1 Absolute maximum ratings and operating conditions

Table 2: Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|------------|---|--------------|------|
| V_{ka} | Cathode to anode voltage | 25 | V |
| I_K | Reverse breakdown current | -100 to +150 | mA |
| I_{REF} | Reference input current range | 0.05 to +10 | mA |
| P_d | Power dissipation ⁽¹⁾ SOT23-3L | 360 | mW |
| T_{std} | Storage temperature | -65 to +150 | °C |
| ESD | Human body model (HBM) ⁽²⁾ | 2 | kV |
| | Machine model (MM) ⁽³⁾ | 200 | V |
| T_{LEAD} | Lead temperature (soldering, 10 s) | 260 | °C |

Notes:

⁽¹⁾ P_d has been calculated with $T_{amb} = 25\text{ °C}$, $T_{junction} = 150\text{ °C}$, $R_{thjc} = 110\text{ °C/W}$ and $R_{thja} = 340\text{ °C/W}$ for the SOT23-3 package.

⁽²⁾Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins float.

⁽³⁾Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is applied for all couples of connected pin combinations while the other pins float.

Table 3: Operating conditions

| Symbol | Parameter | Value | Unit |
|------------|--|-----------------|------|
| V_{KA} | Cathode to anode voltage | V_{REF} to 24 | V |
| I_K | Cathode operating current ⁽¹⁾ | 1 to 100 | mA |
| T_{oper} | Operating free air temperature range | - 40 to + 105 | °C |

Notes:

⁽¹⁾Maximum power dissipation must be strictly observed to avoid damaging the component.

2 Electrical characteristics

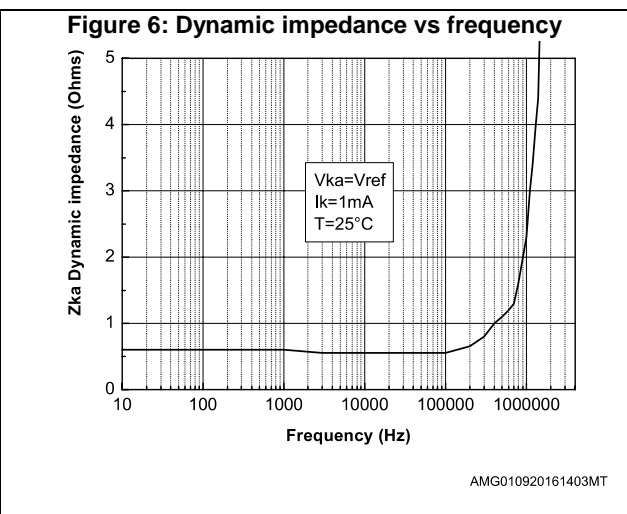
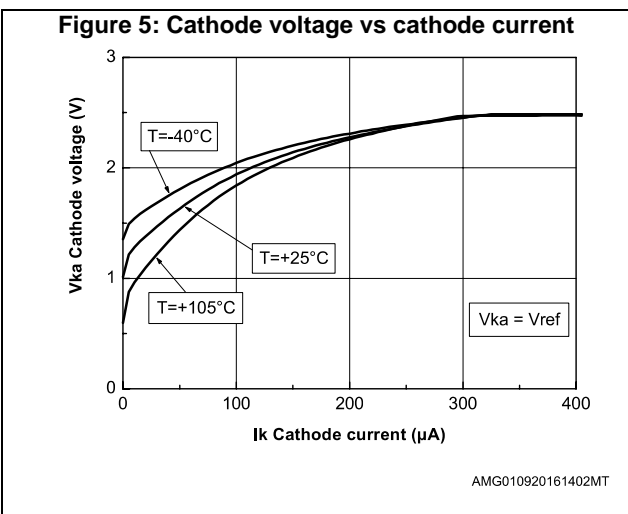
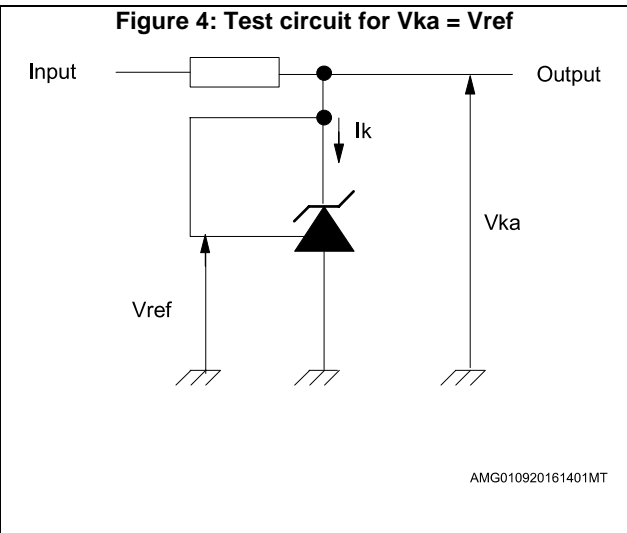
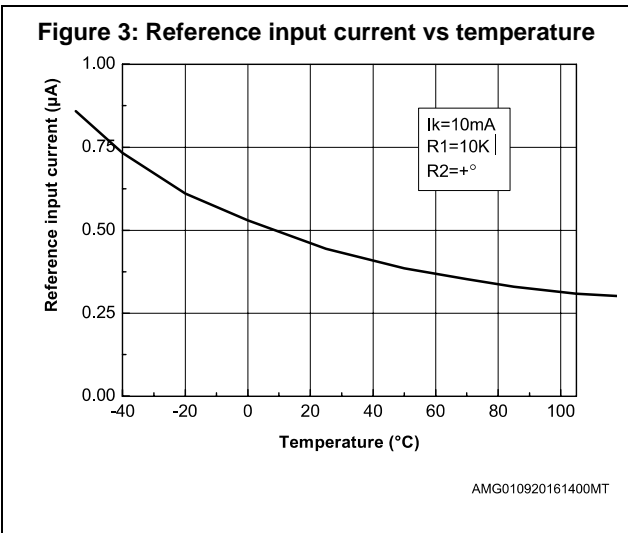
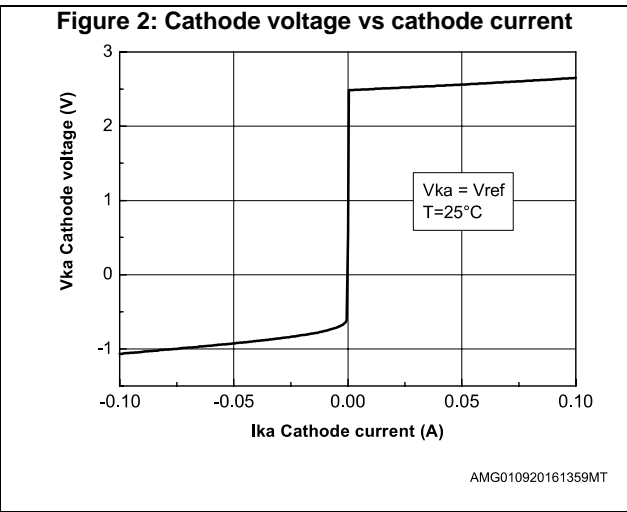
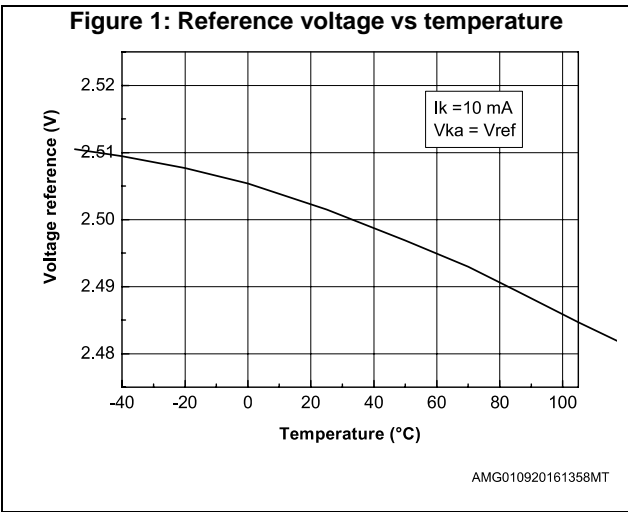
| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--|--|--|-------|------|-------|------------------------|
| V_{REF} | Reference input voltage | $V_K = V_{REF}$, $I_K = 10$ mA | | 2.5 | | V |
| | | TS2431 (2%) | 2.45 | | 2.55 | |
| | | TS2431A (1%) | 2.475 | | 2.525 | |
| | | TS2431B (0.5%) | 2.488 | | 2.512 | |
| | | TS2431B (1%), $I_K = 1$ mA | 2.475 | | 2.525 | |
| $ \Delta V_{REF} $ | Reference input voltage deviation over temperature $V_K = V_{REF}$, $I_K = 10$ mA ⁽¹⁾⁽²⁾ | $0\text{ }^\circ\text{C} < T < +70\text{ }^\circ\text{C}$ | | 10 | 20 | mV |
| | | $-40\text{ }^\circ\text{C} < T < +85\text{ }^\circ\text{C}$ | | 17 | 30 | |
| | | $-40\text{ }^\circ\text{C} < T < +105\text{ }^\circ\text{C}$ | | 20 | 35 | |
| T_C | Temperature coefficient ⁽²⁾ | $-40\text{ }^\circ\text{C} < T < +105\text{ }^\circ\text{C}$ | | 50 | 100 | ppm/ $^\circ\text{C}$ |
| I_{KMIN} | Minimum operating current | $T = 25\text{ }^\circ\text{C}$ | | 0.3 | 0.8 | mA |
| | | $-40\text{ }^\circ\text{C} < T < +105\text{ }^\circ\text{C}$ | | | 1 | |
| $\left \frac{\Delta V_{ref}}{\Delta V_K} \right $ | Ratio of change in reference input voltage to change in cathode-to-anode voltage | $I_K = 10$ mA $V_{Ka} = 24$ to 2.5 V | | 0.3 | 2 | mV/V |
| I_{REF} | Reference input current $I_K = 10$ mA, $R_1 = 10$ k Ω , $R_2 = +\infty$ ⁽³⁾ | $T = 25\text{ }^\circ\text{C}$ | | 0.5 | 2.5 | μA |
| | | $-40\text{ }^\circ\text{C} < T < +105\text{ }^\circ\text{C}$ | | | 3 | |
| $ \Delta I_{REF} $ | Reference input current deviation $I_K = 10$ mA, $R_1 = 10$ k Ω , $R_2 = +\infty$ ⁽³⁾ | $-40\text{ }^\circ\text{C} < T < +105\text{ }^\circ\text{C}$ | | 0.4 | 1.2 | μA |
| I_{OFF} | Off-state cathode current | $V_K = 24$ V, $V_{REF} = \text{GND}$ | | 10 | 500 | nA |
| $ Z_{KA} $ | Reverse dynamic impedance | $V_K = V_{REF}$, $\Delta I_K = 1$ to 50 mA, $f < 10$ kHz | | 0.5 | 0.75 | Ω |
| E_N | Wide band noise | $I_K = 10$ mA 10 Hz $< f < 10$ kHz | | 300 | | nV/ $\sqrt{\text{Hz}}$ |

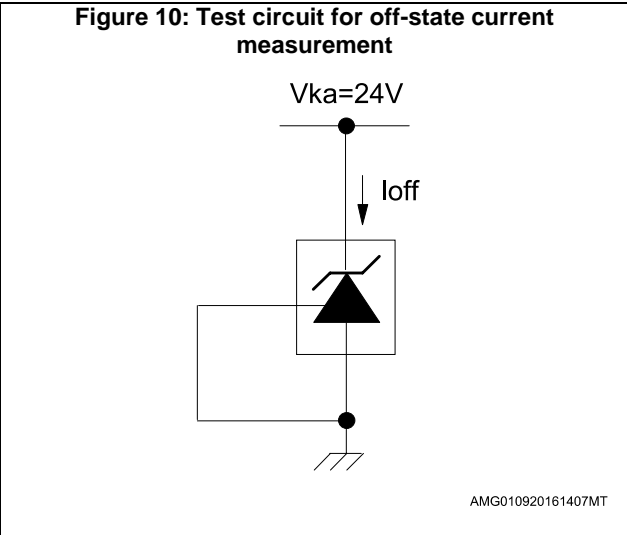
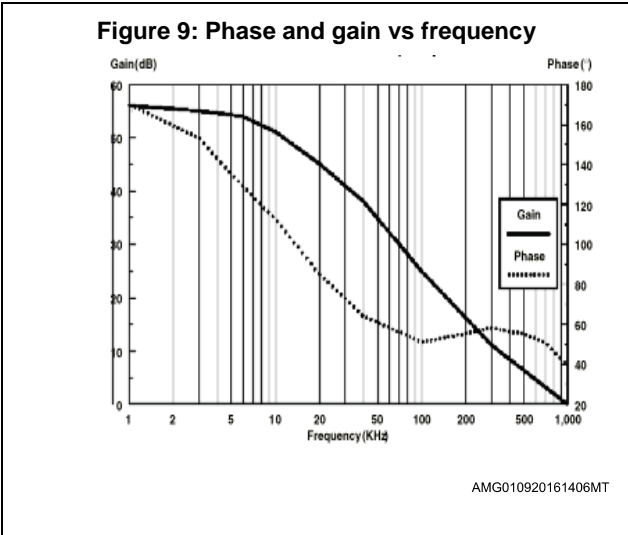
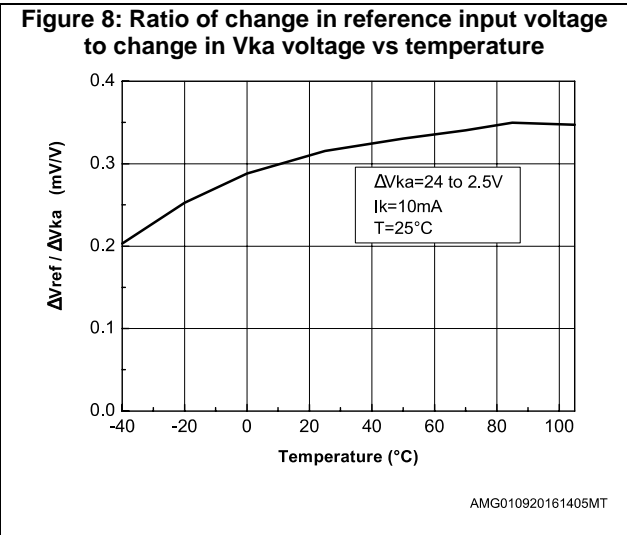
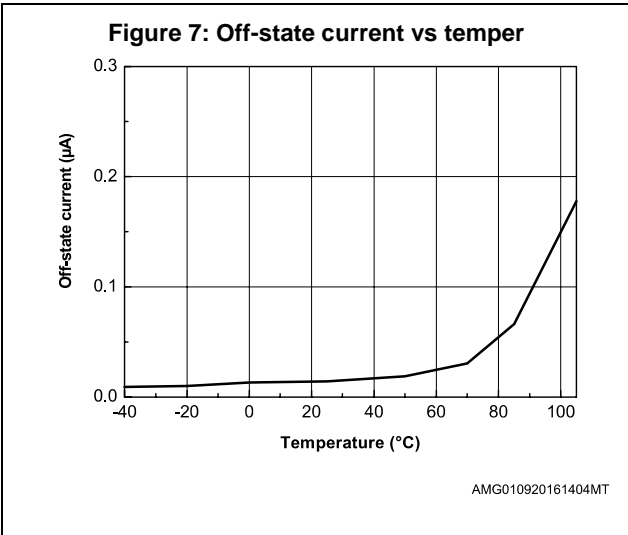
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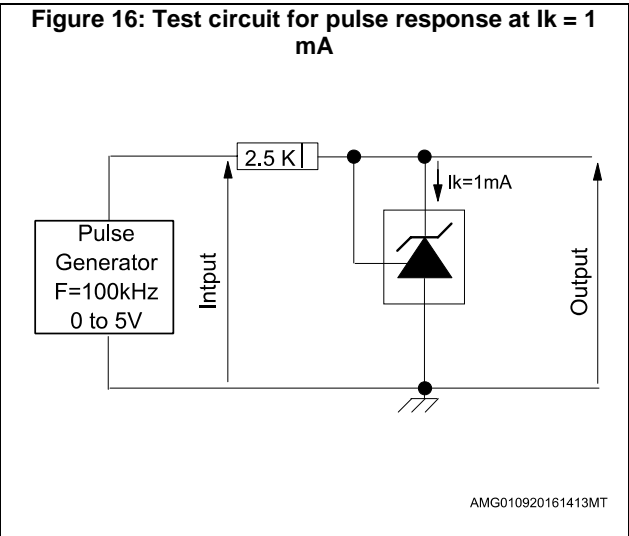
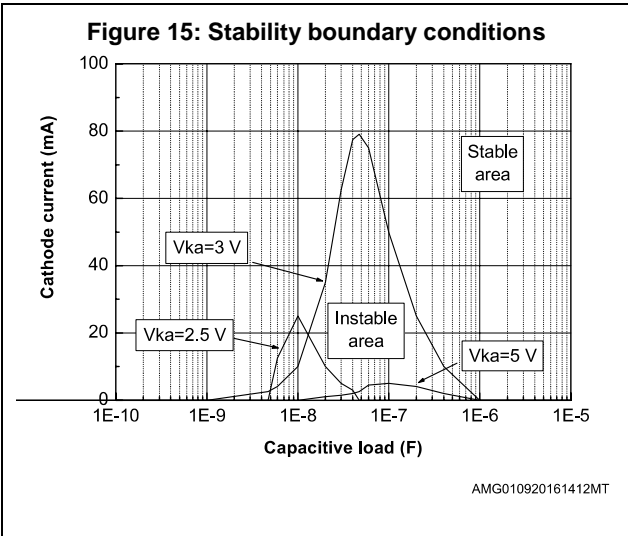
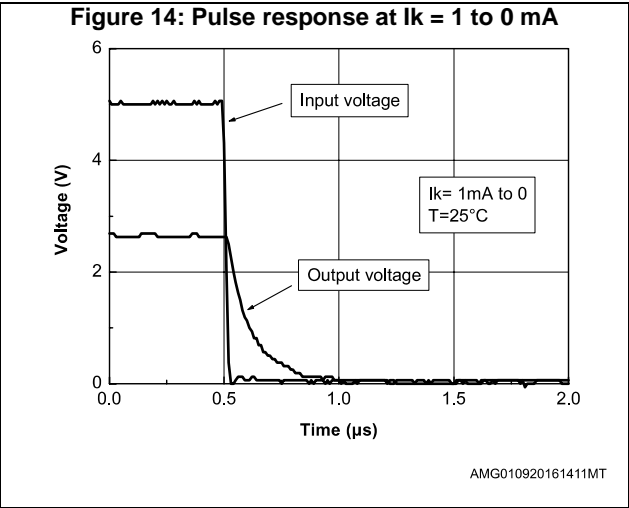
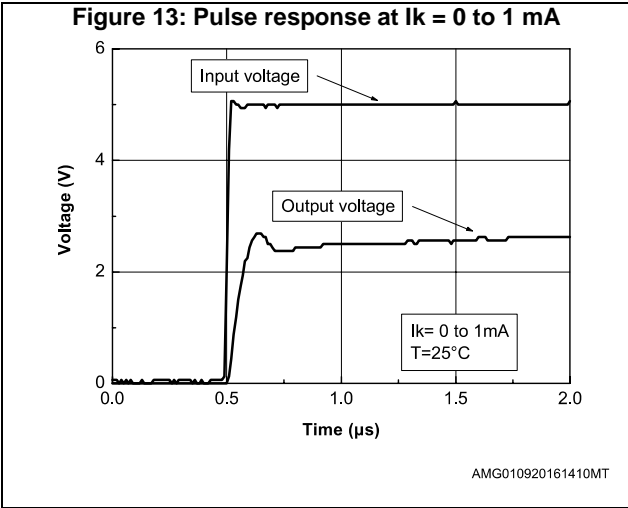
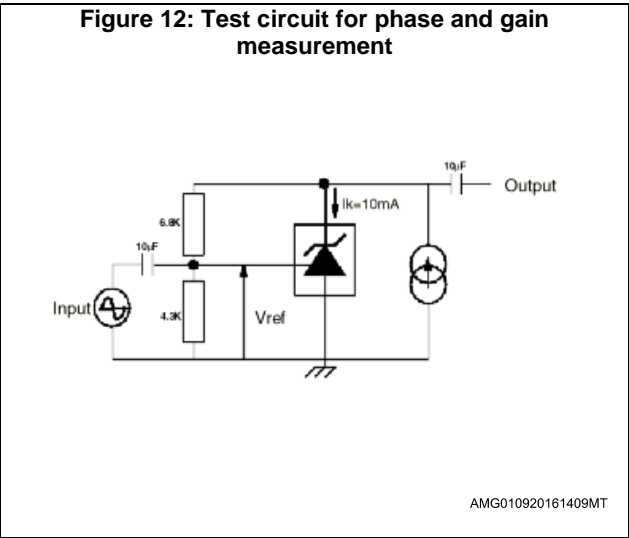
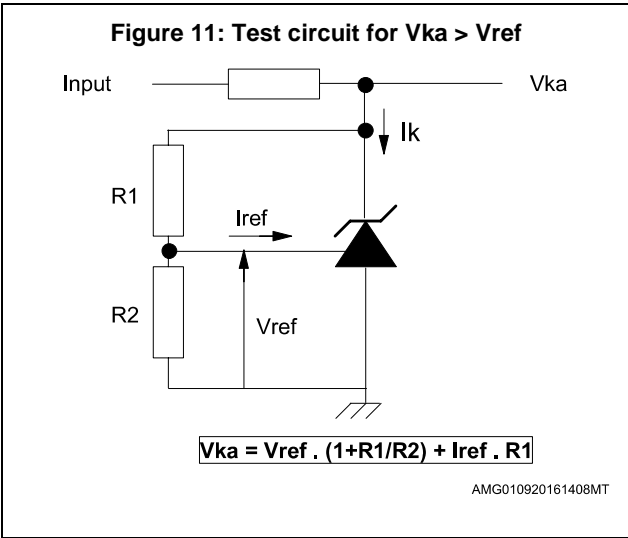
(1)Limits are 100 % production tested at 25 °C. Overtemperature limits are guaranteed through correlation and by design.

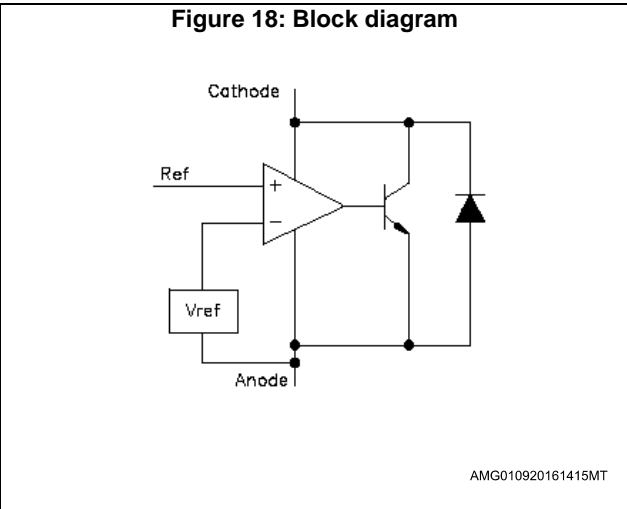
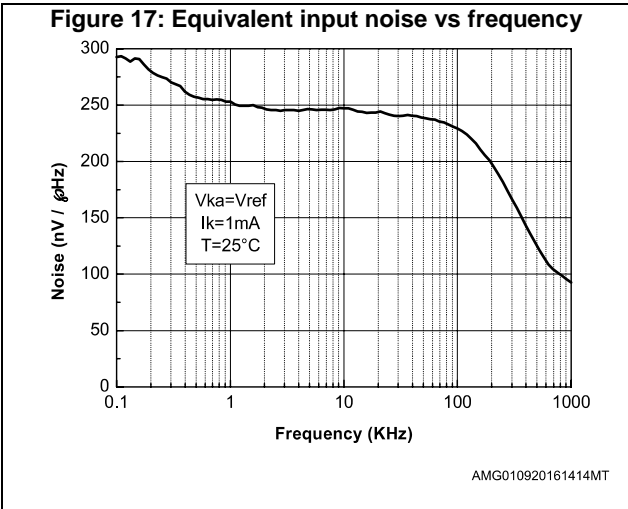
(2) $|\Delta V_{REF}|$ is defined as the difference between the maximum and minimum values of V_{REF} obtained over the full temperature range.

(3)Refer to [Figure 4: "Test circuit for \$V_{Ka} = V_{ref}\$ "](#).









3 Package information

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.

3.1 SOT23-3L package information

Figure 19: SOT23-3L (Nantong Fujitsu) package outline

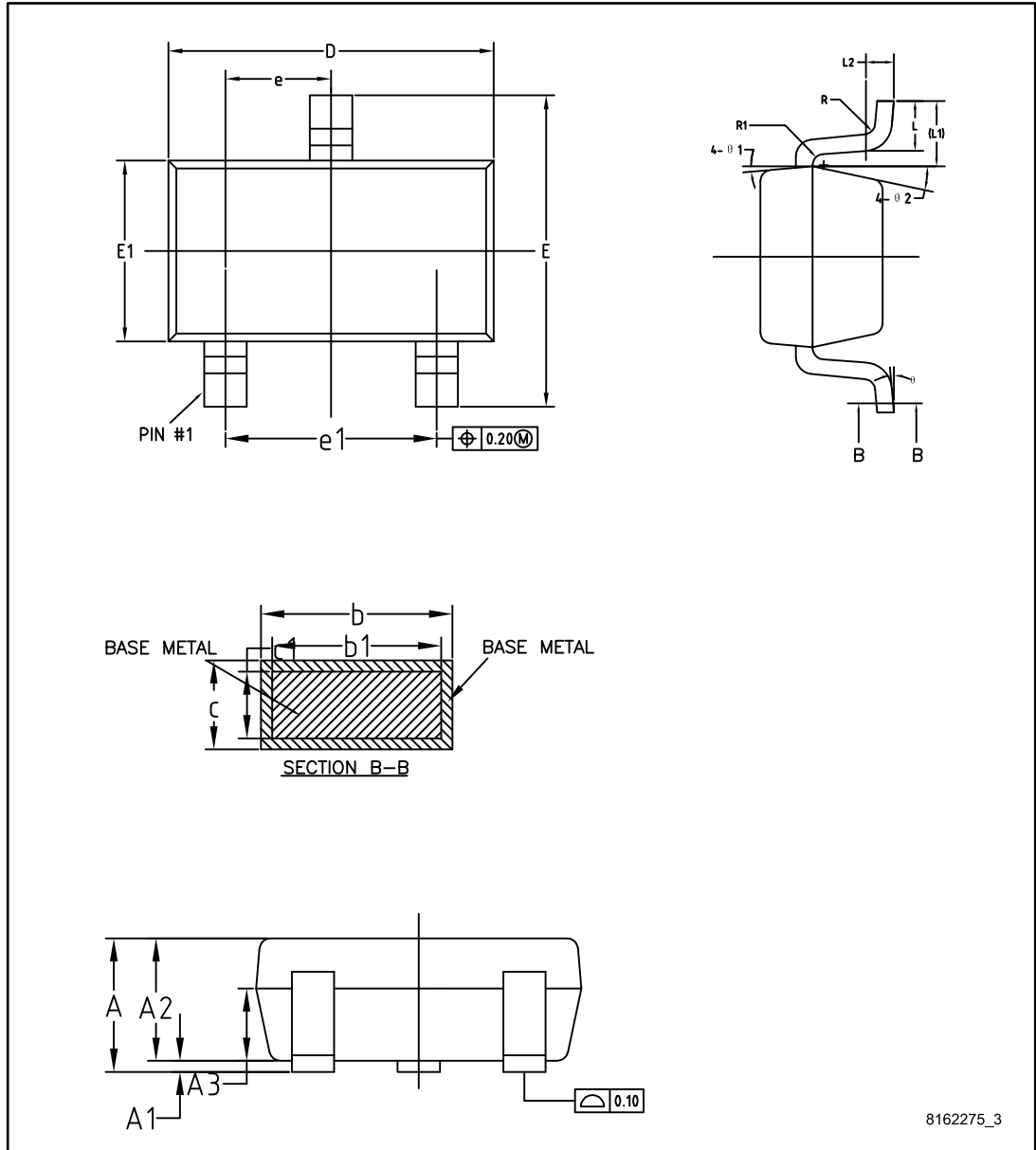


Table 4: SOT23-3L (Nantong Fujitsu) mechanical data

| Dim. | mm | | |
|------------|----------|-------|-------|
| | Min. | Typ. | Max. |
| A | | | 1.25 |
| A1 | 0 | | 0.15 |
| A2 | 1 | 1.10 | 1.20 |
| A3 | 0.60 | 0.65 | 0.70 |
| b | 0.36 | | 0.50 |
| b1 | 0.36 | 0.38 | 0.45 |
| c | 0.14 | | 0.20 |
| c1 | 0.14 | 0.15 | 0.16 |
| D | 2.826 | 2.926 | 3.026 |
| E | 2.60 | 2.80 | 3.00 |
| E1 | 1.526 | 1.626 | 1.726 |
| e | 0.90 | 0.95 | 1.00 |
| e1 | 1.80 | 1.90 | 2.00 |
| L | 0.35 | 0.45 | 0.60 |
| L1 | 0.59 REF | | |
| L2 | 0.25 BSC | | |
| R | 0.05 | | |
| R1 | 0.05 | | |
| θ | 0° | | 8° |
| $\theta 1$ | 3° | 5° | 7° |
| $\theta 2$ | 6° | | 14° |

Figure 20: SOT23-3L (Carsem) package outline

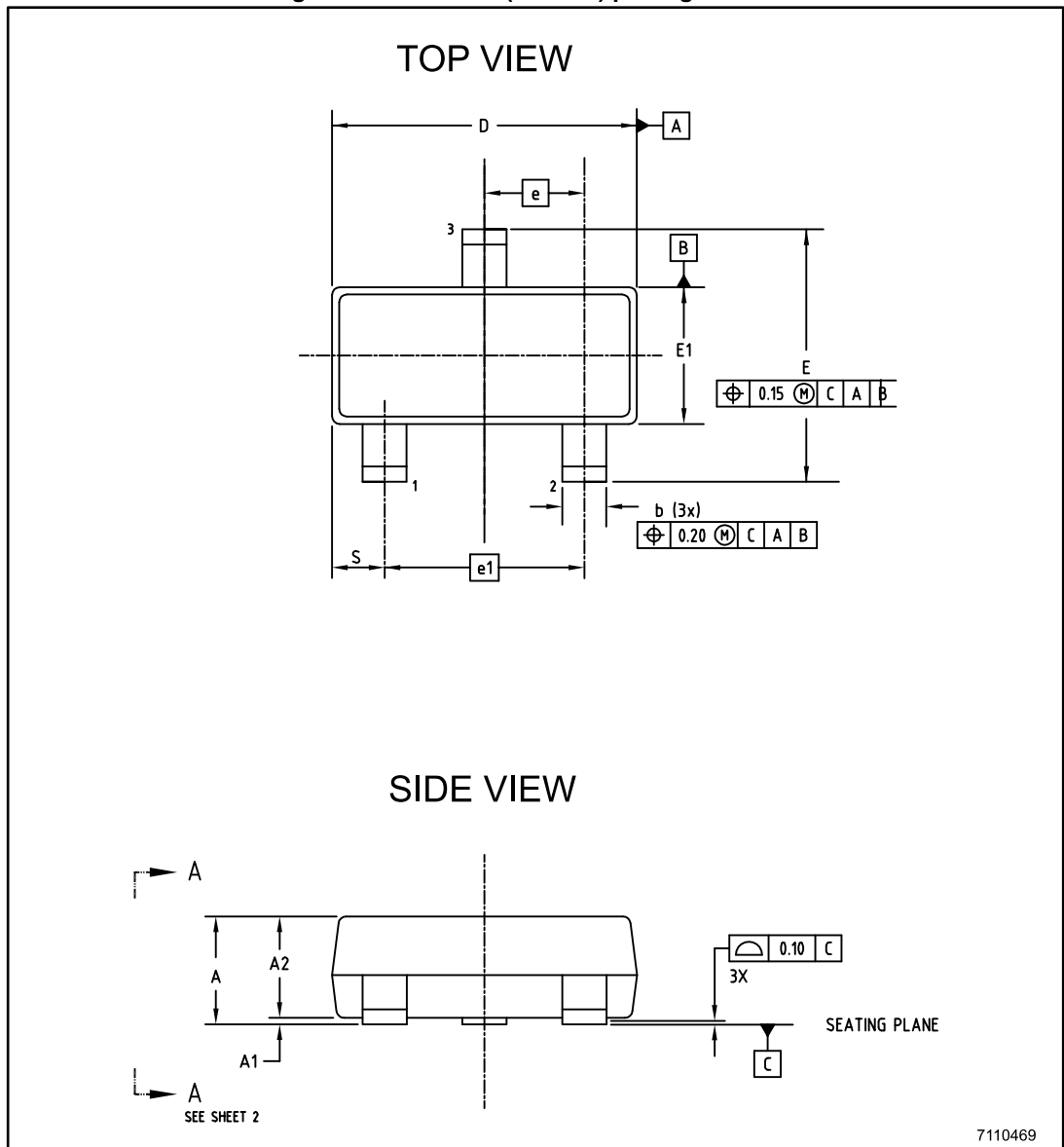
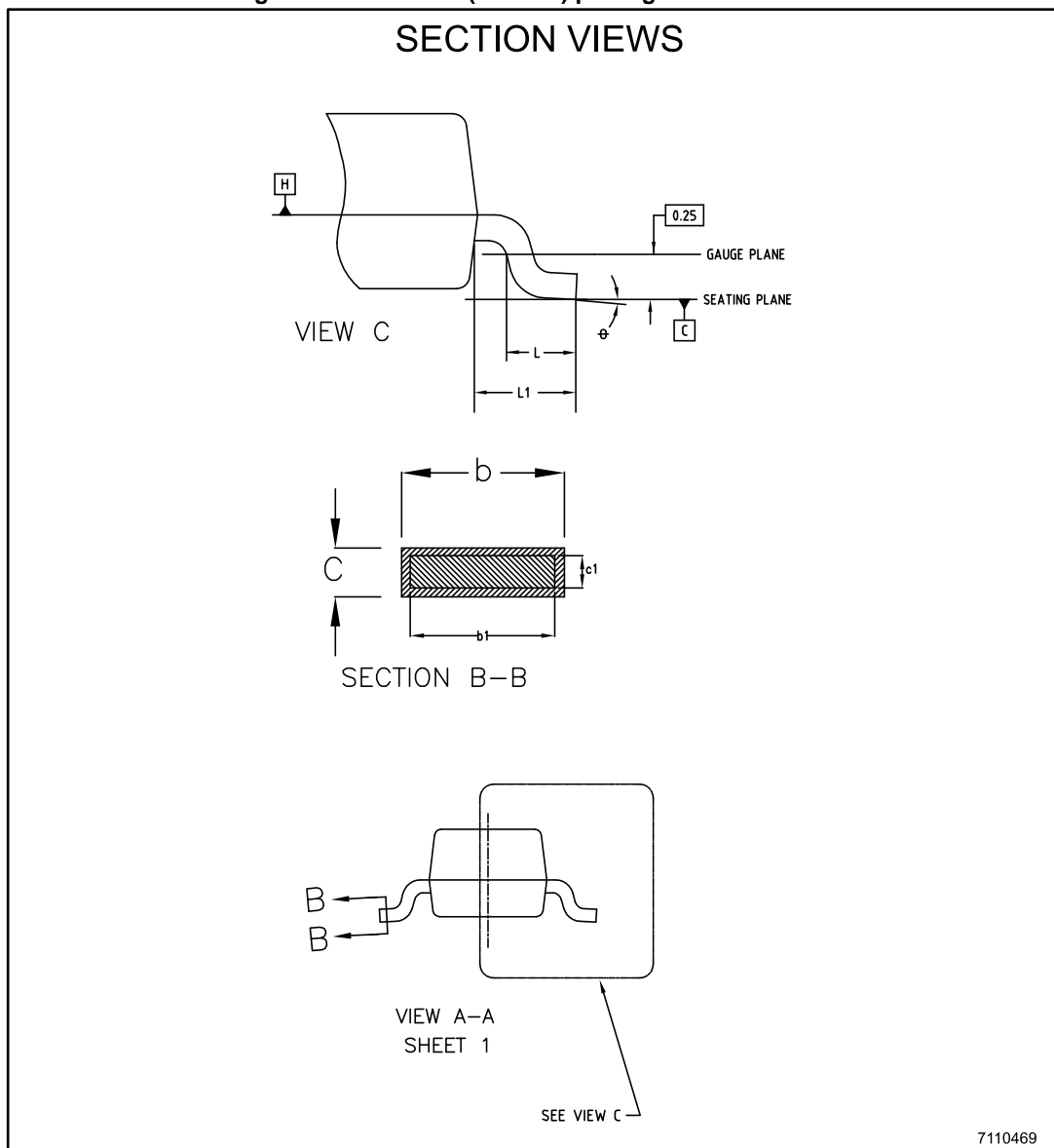


Figure 21: SOT23-3L (Carsem) package section views

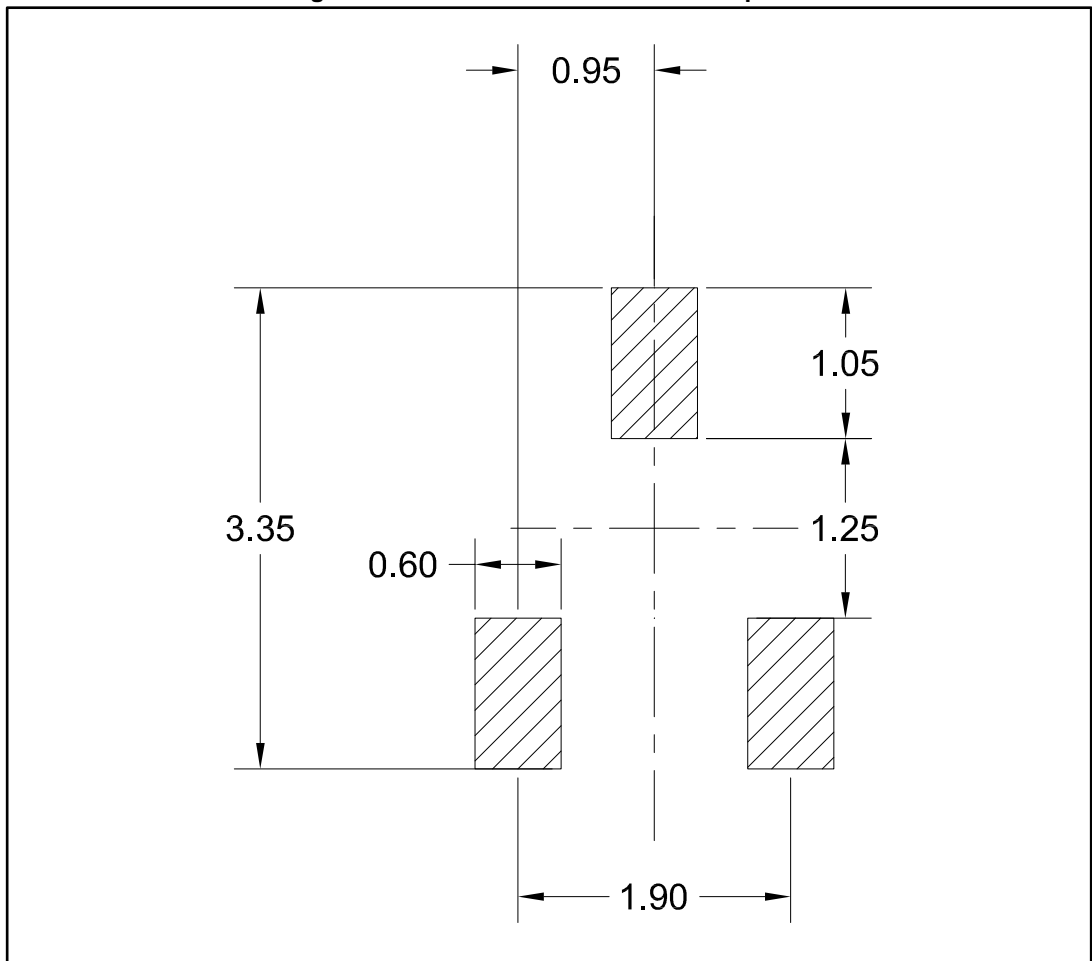


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Table 5: SOT23-3L (Carsem) mechanical data

| Dimensions | | | |
|------------|-------------|----------|------|
| Ref. | Millimeters | | |
| | Min. | Typ. | Max. |
| A | 0.89 | - | 1.12 |
| A1 | 0.013 | - | 0.10 |
| A2 | 0.88 | 0.95 | 1.02 |
| b | 0.37 | - | 0.50 |
| b1 | 0.37 | 0.40 | 0.45 |
| c | 0.085 | - | 0.18 |
| c1 | 0.085 | - | 0.16 |
| D | 2.80 | 2.90 | 3.04 |
| E | 2.10 | - | 2.64 |
| E1 | 1.20 | 1.30 | 1.40 |
| e | | 0.95 BSC | |
| e1 | | 1.90 BSC | |
| *L | 0.28 | 0.38 | 0.48 |
| L1 | | 0.55 REF | |
| L2 | | | |
| R | 0.05 | | |
| R1 | 0.05 | | |
| θ | 0° | | 8° |
| s | 0.45 | - | 0.60 |

Figure 22: SOT23-3L recommended footprint



4 Revision history

Table 6: Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 01-Feb-2002 | 1 | Initial release. |
| 10-Sep-2009 | 2 | Updated document format. Modified footnote 1 under <i>Table 2: Absolute maximum ratings on page 3</i> . Added HBM and MM notes under <i>Table 2</i> . |
| 11-May-2012 | 3 | Removed: automotive grade order codes <i>Table 1 on page 1</i> . |
| 22-Nov-2012 | 4 | Added min. and max. values test condition TS2431B (1%), $I_K = 1 \text{ mA}$ <i>Table 4 on page 4</i> . |
| 28-Nov-2016 | 5 | Updated Section 3: "Package information". Minor text changes. |
| 20-Oct-2017 | 6 | Updated the title and the description in cover page. Minor text changes. |

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