



aTS45C

LOW-VOLTAGE ULTRA-LOW-POWER TEMPERATURE SENSOR WITH HIGH OUTPUT DRIVE

Fully Released Specification

PRODUCT SPECIFICATION

General Description

The aTS45C is a silicon integrated circuit temperature sensor. The aTS45C maintains an accuracy of $\pm 4^{\circ}\text{C}$ over a temperature range of -20°C to 100°C . At 25°C (room temperature) the accuracy is calibrated to typically better than $\pm 2^{\circ}\text{C}$ ($V_{\text{OUT}} = 250\text{mV}$). This calibration is done during probe and guaranteed on each device. The aTS45C also maintains one of the lowest power consumption requirement in the industry and therefore reduces any inaccuracies due to self-heating.

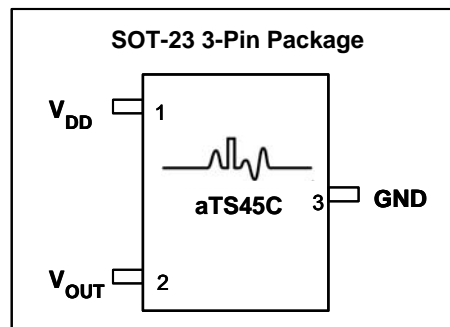
Features

- Calibrated 25°C performance $\pm 3^{\circ}\text{C}$
- Low Operating Current: $\leq 25\mu\text{A}$
- Temperature Range: -20°C to 100°C
- Extremely Linear Output Ramp: $10\text{mV}/^{\circ}\text{C}$
- Output Ramp is Calibrated to Degrees Celsius
- Low Self Heating: 0.04°C Typical in Still Air
- Operating Voltage Range: $+2.7\text{V}$ to $+5.5\text{V}$
- Optional Single Positive Supply Operation at Reduced Range: 10°C to 100°C
- Non-linearity: $\leq 0.8^{\circ}\text{C}$
- 3-pin Pb-Free SOT-23 Package

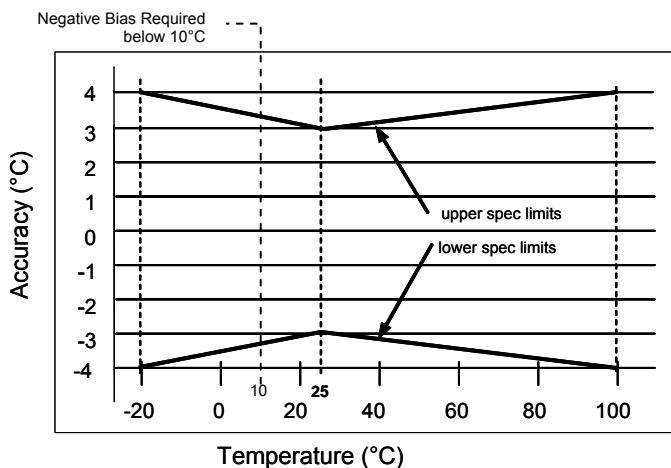
Applications

- Mobile Communications Terminals
- Computers and Peripherals
- Battery Management
- FAX Machines/Printers/Copiers
- Portable Medical Instruments
- HVAC
- Power Supply Modules
- Disk Drives

Pin Configuration



actual part marking below



Accuracy vs. Temperature

Ordering Information

| Part Number | Package | Temperature Range | Part Marking | How Supplied |
|-------------|--------------|---|--------------|-------------------|
| aTS45CS3 | 3-Pin SOT-23 | -20°C to $+100^{\circ}\text{C}$ | AGyw | 3000 units on T&R |

y - year, w - week

Absolute Maximum Ratings¹

| Parameter | | Rating |
|------------------------------------|--------------------|-----------------|
| Supply Voltage | | +7V |
| Output Voltage | | $V_{DD} + 0.5V$ |
| Continuous Current, any terminal | | 10mA |
| Storage Temperature Range | | -60°C to +150°C |
| ESD ^{2,3} | Human Body Model | Class 1B |
| | Machine Model | Class A |
| Thermal Resistance - θ_{JA} | SOT-23 | 336°C/W |
| Lead Temp | Soldering (10 sec) | 260°C |
| | Infrared (20 sec) | 235°C |

Notes:

1. Absolute maximum ratings are limits beyond which operation may cause permanent damage to the device. These are stress ratings only; functional operations at or above these limits is not implied.
2. Human Body Model: 100pF capacitor discharged through a 1.5k Ω resistor into each pin. Machine Model: 200pF capacitor discharged directly into each pin.
3. ESD Classification per JESD22-A114C.01 for Human Body Model and JESD22-A115 for Machine Model.
4. These specifications are guaranteed only for the test conditions listed.

Recommended Operating Ratings

| Symbol | Parameter | Min | Max | Units |
|-----------|-----------------------------|------|----------|-------|
| V_{DD} | Supply Voltage | +2.7 | +5.5 | V |
| V_{OUT} | Output Voltage | 0 | V_{DD} | V |
| T_A | Operating Temperature Range | -20 | +100 | °C |

Electrical Characteristics⁴

Limits apply for $-20^{\circ}\text{C} \leq T_A \leq +100^{\circ}\text{C}$ and $V_{DD} = +3.0V$ unless otherwise noted. Negative bias required for temperatures below 10°C

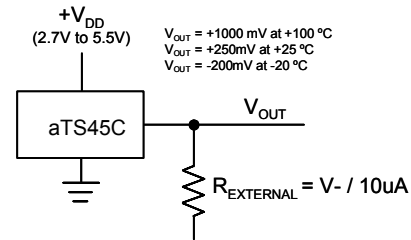
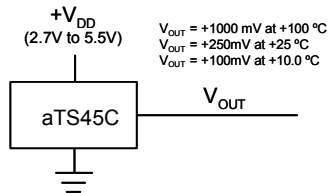
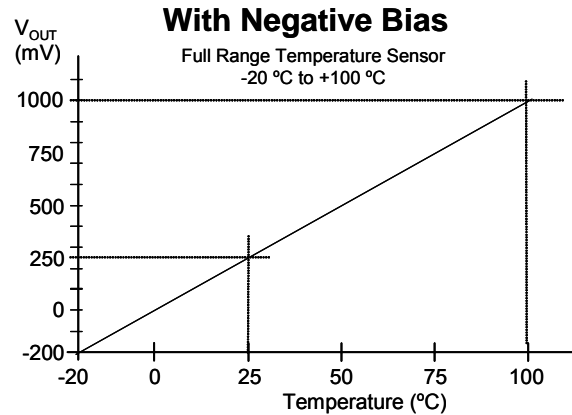
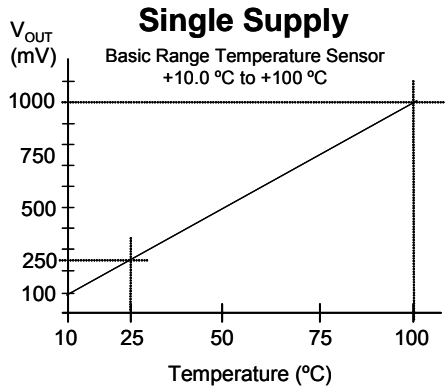
| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|---------------------------------------|-------------|---|-----|-----------|-----|---------------|
| Accuracy ⁵ | | $T_A = +25^{\circ}\text{C}$ | -3 | ± 2 | +3 | °C |
| | | $T_A = -20^{\circ}\text{C}$ (T_{MIN}) | -4 | | +4 | °C |
| | | $T_A = +100^{\circ}\text{C}$ (T_{MAX}) | -4 | | +4 | °C |
| Non-linearity ⁶ | | | | ± 0.8 | | °C |
| Supply Current - Output floating | I_{DD} | $T_A = +25^{\circ}\text{C}$ $-20^{\circ}\text{C} \leq T_A \leq +100^{\circ}\text{C}$ | 6 | 11 | 25 | μA |
| Output Sink Capability ⁷ | I_{OL} | $+2.7V < V_{DD} < +5.5V$ | | 1 | | μA |
| Output Source Capability ⁷ | I_{OH} | $+2.7V < V_{DD} < +5.5V$ | | 200 | | μA |
| Average Output Slope (Sensor Gain) | A_{OUT} | | | 10 | | mV/°C |
| Room Temp Output Voltage | V_{OUT25} | $T_A = +25^{\circ}\text{C}$ | | 250 | | mV |
| Minimum Temperature | | Single Supply See Fig 1 | | 10 | | °C |
| Self Heating ⁸ | | SOT-23 | | 0.0414 | | °C |

Notes:

5. Accuracy (expressed in °C) = Difference between calculated output voltage and measured output voltage. Calculated output voltage = 10mV/°C multiplied by device's case temperature at specified conditions of temperature, voltage and power supply.
6. Non-linearity is defined as the deviation of the output-voltage-versus-temperature curve from the best-fit straight line, over the device's rated temperature range.
7. Lowest output current should be targeted; higher currents result in more self-heating of the device.
8. Max Self Heating = $\theta_{JA} \times (V_{DD} \times I_{DD})$. Assumes a capacitive load.

Output Voltage vs Temperature

$$\text{Temp (}^\circ\text{C)} = (V_{\text{OUT}}) / 10\text{mV}^\circ\text{C}$$



Negative Supply (V-)

Figure 1. aTS45C Output Voltage vs Temperature

Mounting

The aTS45C can be easily mounted by gluing or cementing it to a surface. In this case, its temperature will be within about 0.04°C of the temperature of the surface it is attached to if the ambient air temperature is almost the same as the surface temperature. If the air temperature is much higher or lower than the surface temperature, the actual temperature of the aTS45C die will be at an intermediate temperature between the surface temperature and the air temperature.

To ensure good thermal conductivity, the backside of the aTS45C die is directly attached to the GND pin. The lands and traces to the aTS45C will, of course, be part of the printed circuit board, which is the object whose

temperature is being measured. These printed circuit board lands and traces will not cause the aTS45C's temperature to deviate from the desired temperature.

Alternatively, the aTS45C can be mounted inside a sealed-end metal tube, and can then be dipped into a bath or screwed into a threaded hole in a tank. As with any IC, the aTS45C and accompanying wiring and circuits must be kept insulated and dry to avoid leakage and corrosion. This is especially true if the circuit may operate at cold temperatures where condensation can occur. Printed-circuit coatings and varnishes such as Humiseal and epoxy paint or dips can be used to ensure that moisture cannot corrode the aTS45C or its connections.

Typical Performance Characteristics

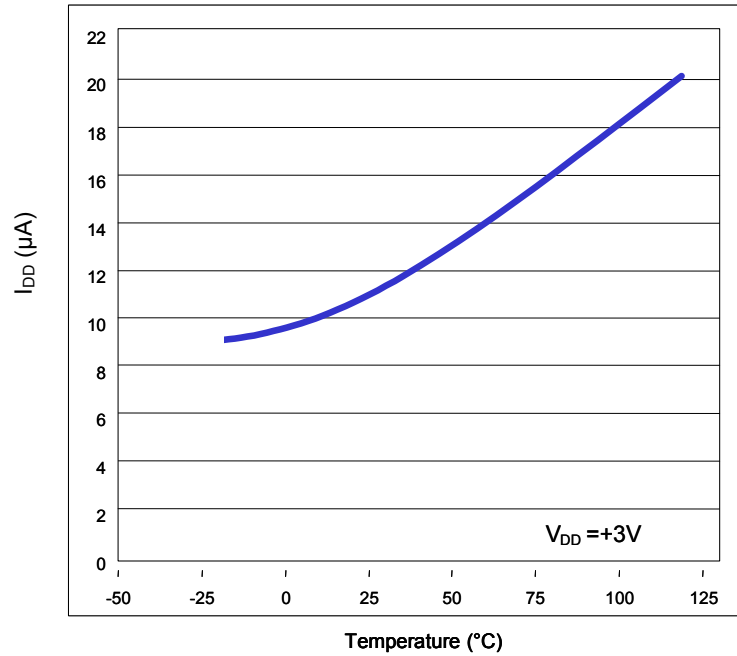


Figure 2. aTS45C Current vs Temperature

Typical Applications

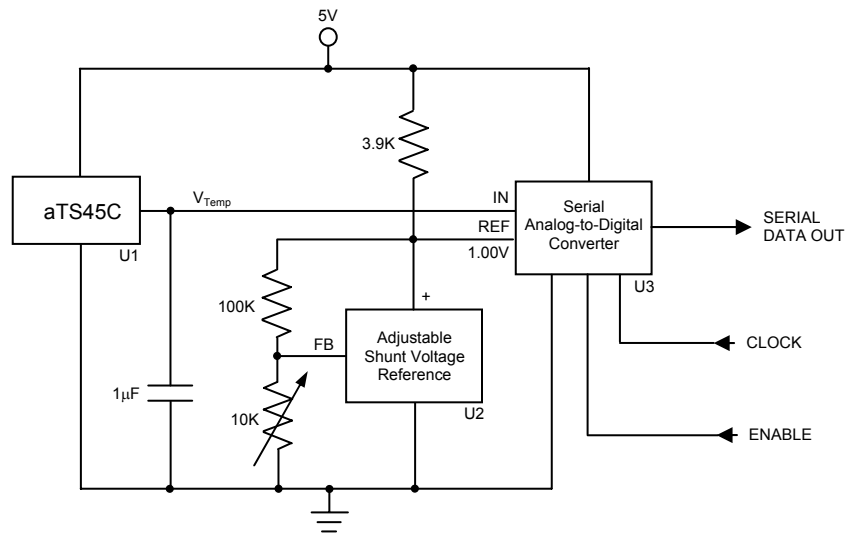


Figure 3. Serial Output Temperature to Digital Converter

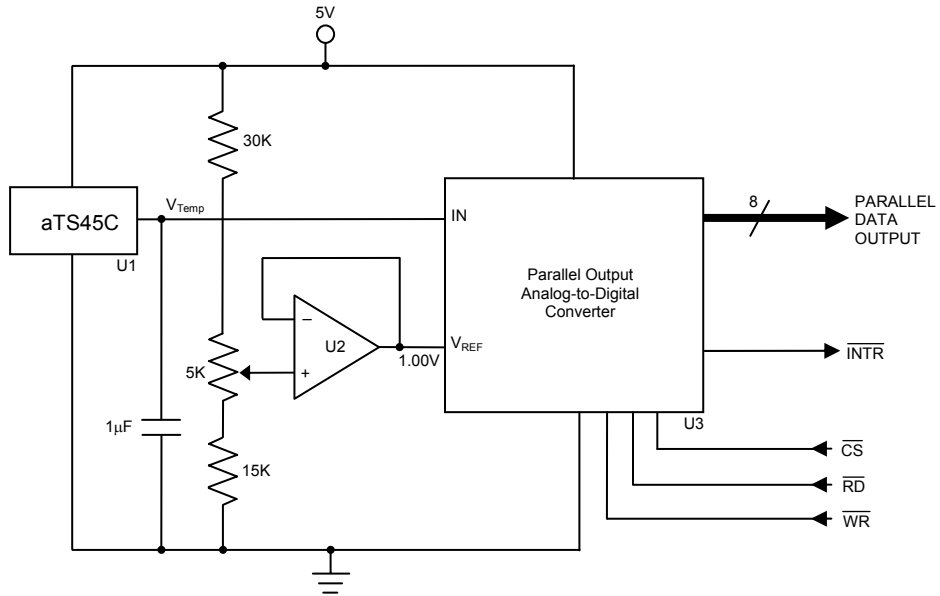


Figure 4. Parallel Output Temperature to Digital Converter

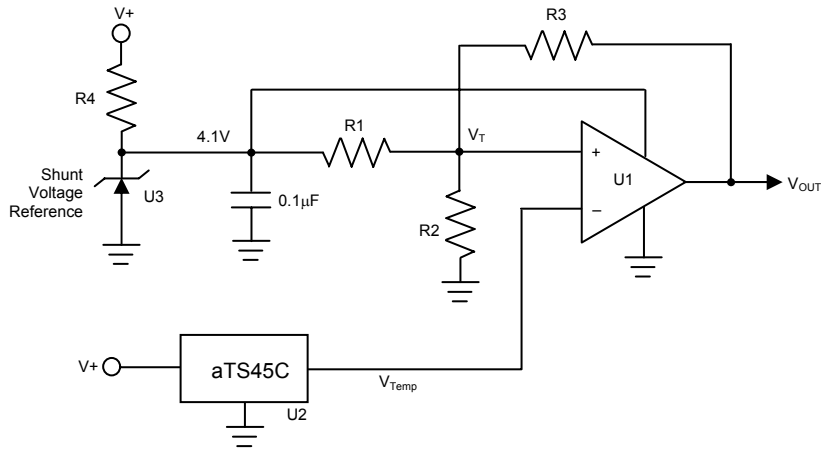
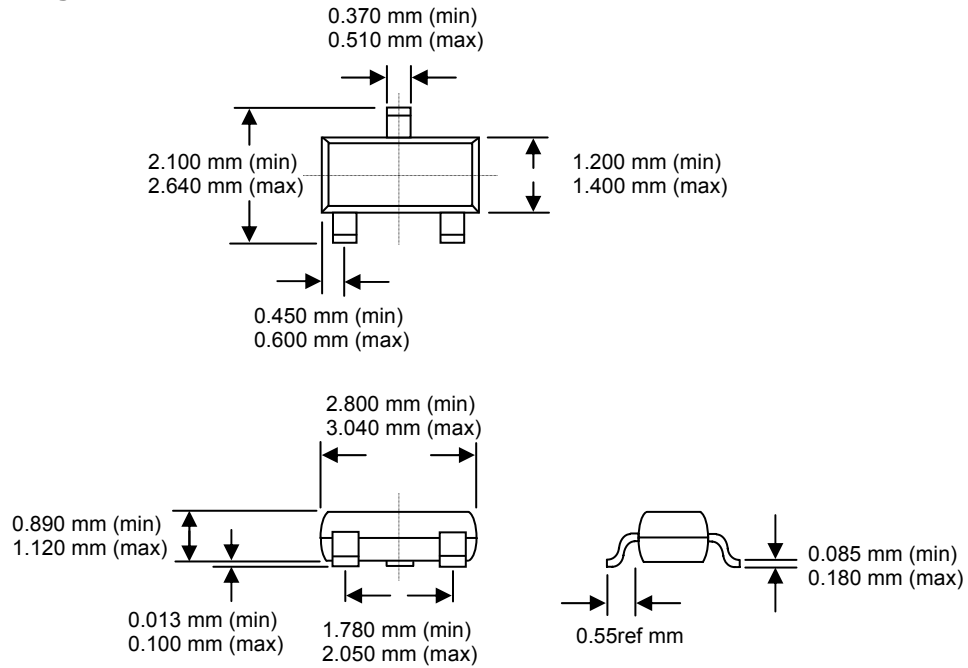
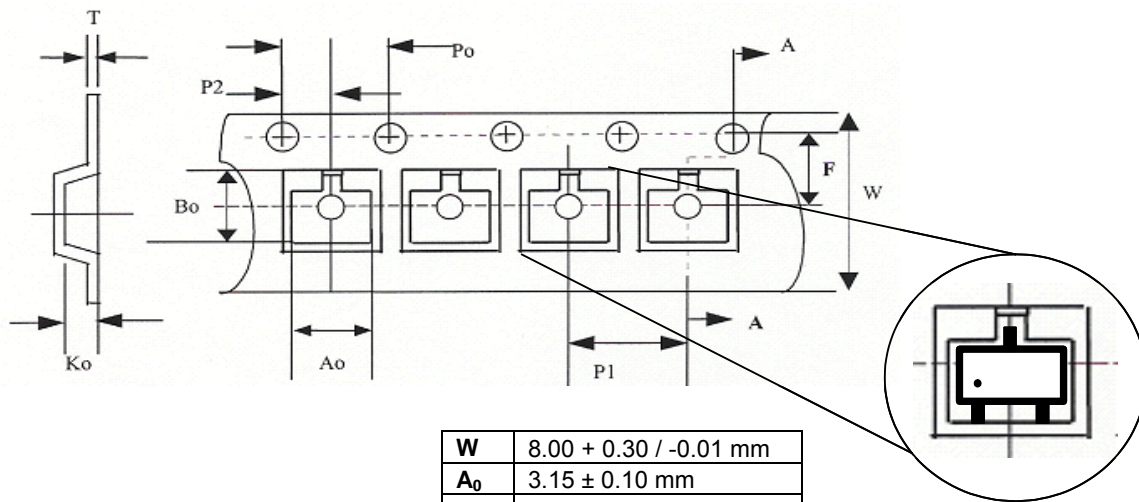


Figure 5. Thermostat / Fan Controller

SOT-23 Package Dimensions



Tape and Reel Data



| | |
|----------------------|------------------------|
| W | 8.00 + 0.30 / -0.01 mm |
| A₀ | 3.15 ± 0.10 mm |
| B₀ | 2.77 ± 0.10 mm |
| K₀ | 1.22 ± 0.10 mm |
| P₀ | 4.00 ± 0.10 mm |
| P₁ | 4.00 ± 0.10 mm |
| P₂ | 2.00 ± 0.05 mm |
| T | 0.29 ± 0.13 mm |
| F | 3.50 ± 0.05 mm |

Notes:

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