aTS51

LOW-VOLTAGE SOT-23
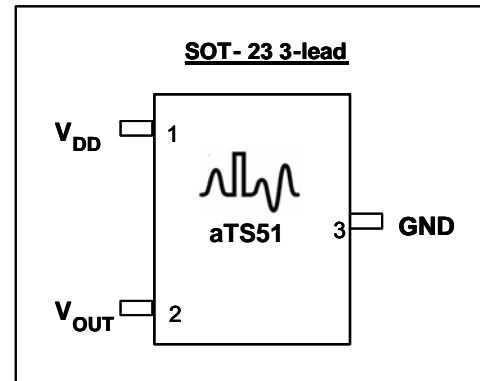## TEMPERATURE SENSOR WITH HIGH OUTPUT DRIVE

PRODUCT SPECIFICATION

New Release Specification

General Description

The aTS51 is a high-precision CMOS temperature sensor that provides a cost-effective solution for applications requiring high-accuracy low-power temperature monitoring. The aTS51 is ideally suited for applications requiring high drive current. The aTS51 output voltage ramp is extremely linear and has a slope of 10mV/°C. With a supply voltage of 2.7V to 6V, the aTS51 is accurate to ±1°C over a temperature range of −40°C to 125°C and has a typical room temperature accuracy of ±0.5°C. Reducing the supply voltage to 2.7V does not change the negative and positive temperature extremes. As well, the aTS51 does not require external calibration. Calibration of each device is performed at the factory.
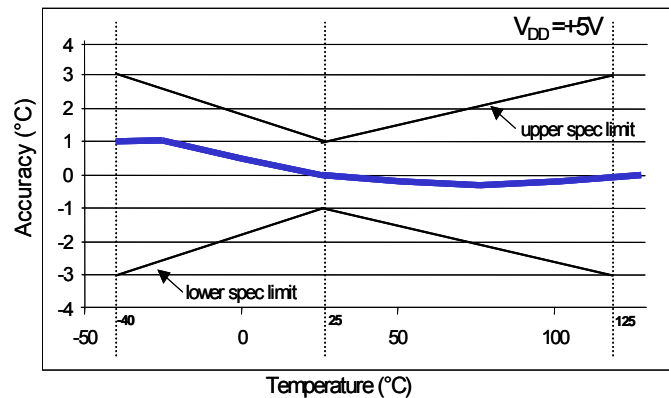
Features

- Precision Calibrated to ±1°C at 25°C
- Low Output Impedance for 1mA Load
- Temperature Range: -40°C to 125°C
- Extremely Linear Output Ramp: 10mV/°C
- Output Ramp is Calibrated to Degrees Celsius
- Low Operating Current: $\leq$ 130μA
- Low Self Heating: 0.2°C Typical in Still Air
- Operating Voltage Range: +2.7V to +6V
- Uses a Single Positive Supply
- Non-linearity: $\leq$ 0.8°C

Applications

- Mobile Phones
- Mobile Communications Terminals
- Computers
- Battery Management
- FAX Machines/Printers/Copiers
- Portable Medical Instruments
- HVAC
- Power Supply Modules
- Disk Drives
- Automotive Control Circuits

Pin Configuration

actual part marking below

Accuracy vs Temperature

Ordering Information

Part Number	Package	Temperature Range	Part Marking	How Supplied
aTS51S3	3-Pin SOT-23	-40°C to +125°C	AByw	3000 units on T&R

y – year, w - week

aTS51

Absolute Maximum Ratings[1]

Parameter		Rating
Supply Voltage		+7V
Output Voltage		V_{DD} + 0.5V
Continuous Current, any terminal		15mA
Storage Temperature Range		-60°C to +150°C
ESD[2]	Human Body Model	2000V
	Machine Model	250V
Thermal Resistance - θ_{JA}		336°C/W
Lead Temp	Vapor Phase (60 sec)	215°C
	Infrared (15 sec)	220°C

Notes:
1. Absolute maximum ratings are limits beyond which operation may cause permanent damage to the device. These are stress ratings only; functional operation at or above these limits is not implied.
2. Human Body Model: 100pF capacitor discharged through a 1.5kΩ resistor into each pin. Machine Model: 200pF capacitor discharged directly into each pin.
3. These specifications are guaranteed only for the test conditions listed.

Recommended Operating Ratings

Symbol	Parameter	Min	Max	Units
V_{DD}	Supply Voltage	+2.7	+6	V
V_{OUT}	Output Voltage	0	V_{DD}	V
T_A	Operating Temperature Range	-40	+125	°C

Electrical Characteristics[3]

Limits apply for -40°C $\leq T_A \leq$ +125°C and V_{DD} = +5.0V unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Accuracy[4]		T_A=+25°C	-1	±0.5	+1	°C
		T_A=-40°C (T_{MIN})	-3	±1	+3	°C
		T_A=+125°C (T_{MAX})	-3	±1	+3	°C
Non-linearity[5]				±0.8		°C
Supply Current – Output floating	I_{DD}	T_A=+25°C			130	μA
Output Sink Capability[6]	I_{OL}	+2.7V < V_{DD} < +6V		1		mA
Output Source Capability[6]	I_{OH}	+2.7V < V_{DD} < +6V		1		mA
Average Output Slope (Sensor Gain)	A_{OUT}			10		mV/°C
Room Temperature Output Voltage	V_{OUT25}	T_A=+25°C		750		mV
Self Heating[7]		SOT-23		0.21840		°C

Notes:
4. 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.
5. 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.
6. Lowest output current should be targeted; higher currents result in more self-heating of the device.
7. Max Self Heating = θ_{JA} x (V_{DD} x I_{DD}). Assumes a capacitive load.

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$$Temp\ (^{\circ}C) = (V_{OUT} - 500mV) / 10mV/^{\circ}C$$
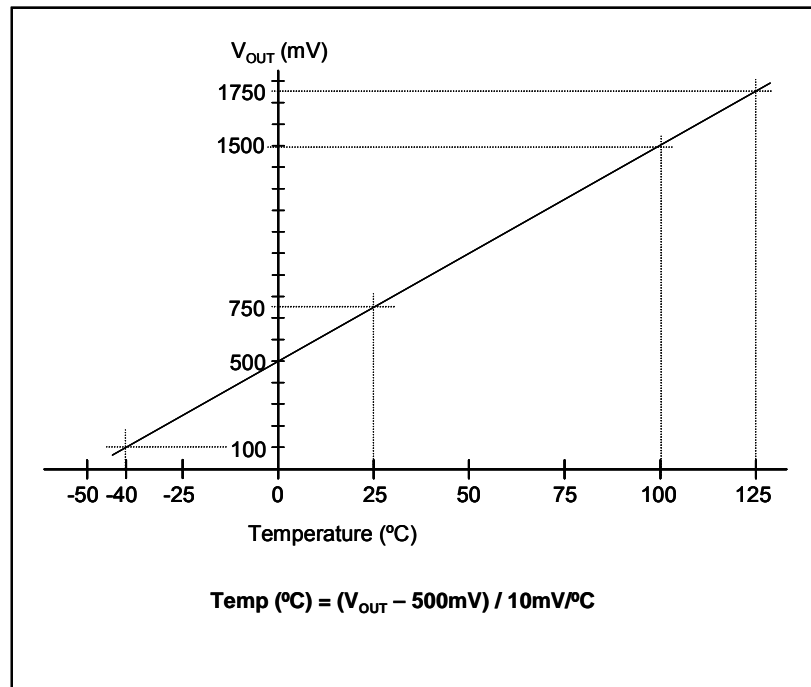
Figure 1. aTS51 Output Voltage vs. Temperature

Mounting

The aTS51 can be easily mounted by gluing or cementing it to a surface. In this case, its temperature will be within about 0.2°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 aTS51 die will be at an intermediate temperature between the surface temperature and the air temperature.

To ensure good thermal conductivity, the backside of the aTS51 die is directly attached to the GND pin. The lands and traces to the aTS51 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 aTS51's temperature to deviate from the desired temperature.

Alternatively, the aTS51 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 aTS51 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 aTS51 or its connections.

NOTE: When taking advantage of the high current drive capability of the aTS51 while driving resistive loads, it is necessary to apply the appropriate thermal mounting techniques as described above. Failure to do so will result in a loss of accuracy due to increased self heating.

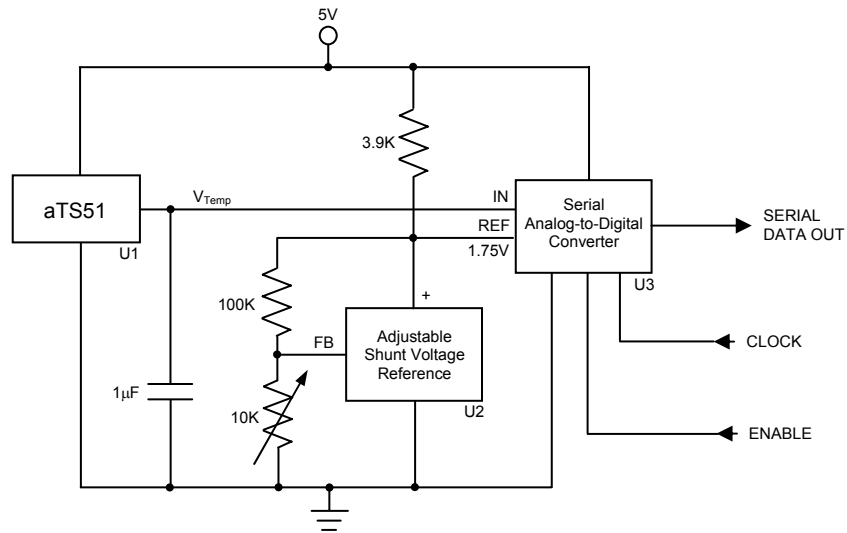## Typical Performance Characteristics
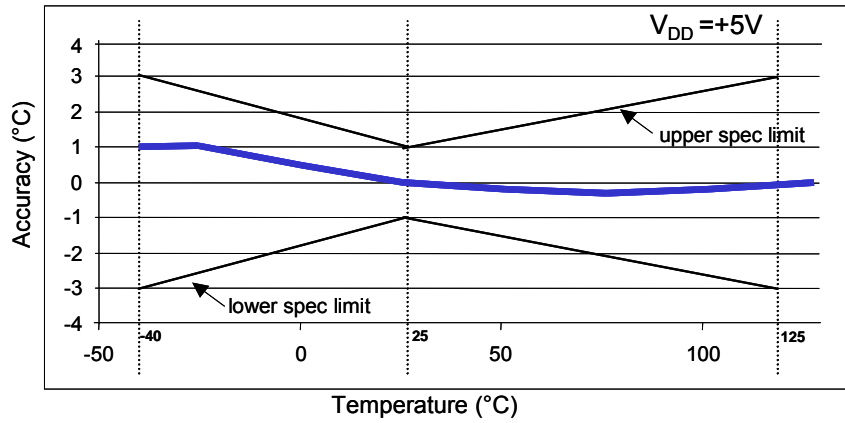
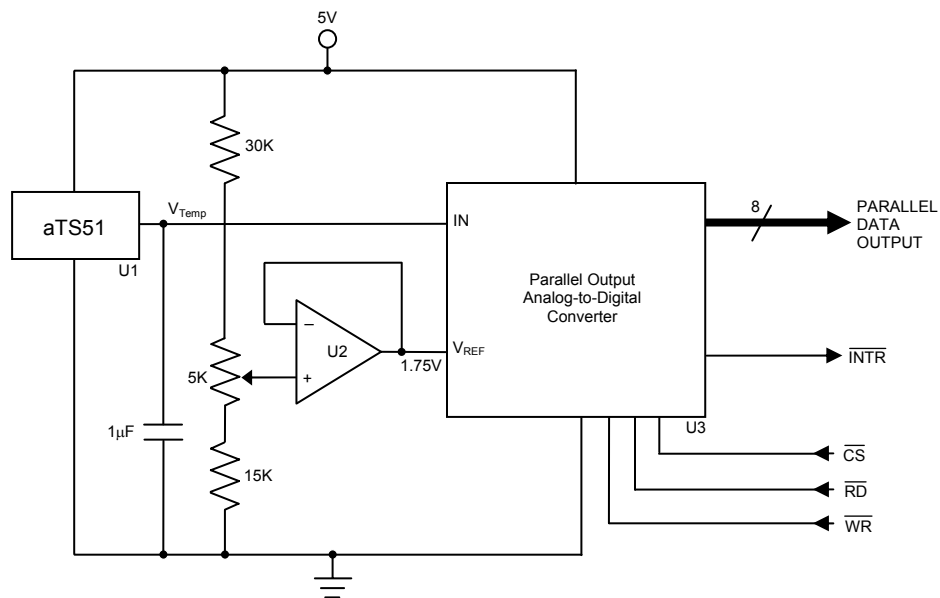**Figure 2. aTS51 Accuracy Range vs Temperature**
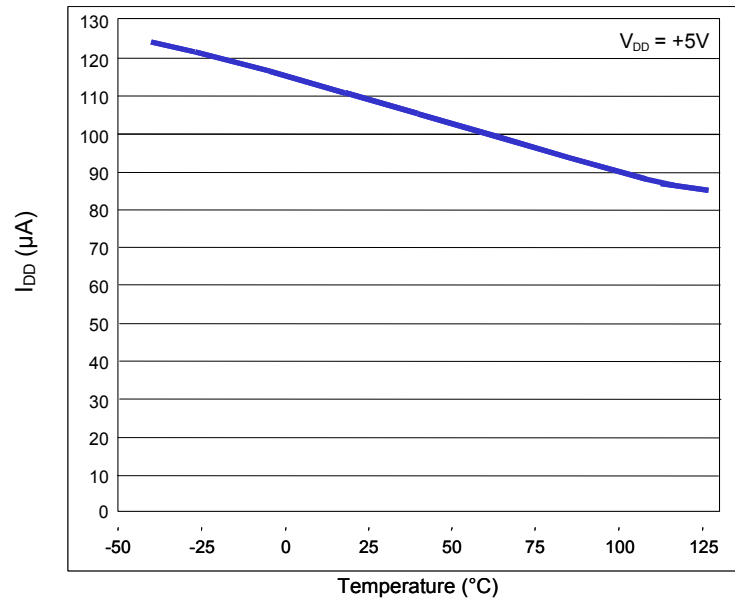
Figure 3. aTS51 Current vs Temperature
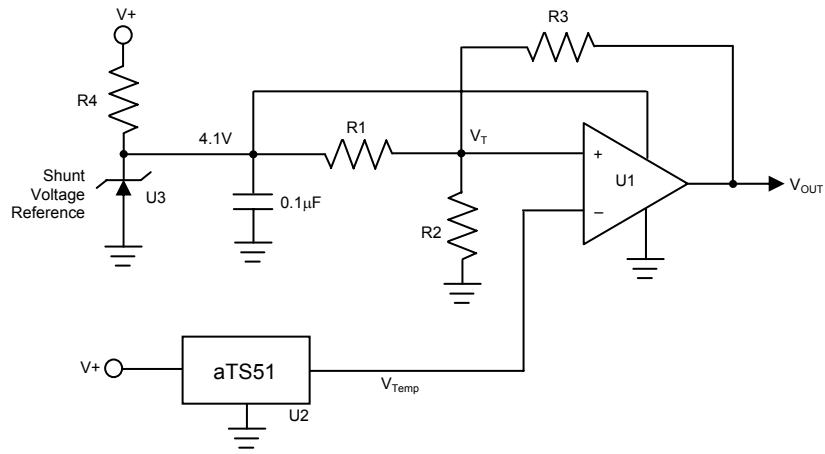
Typical Applications

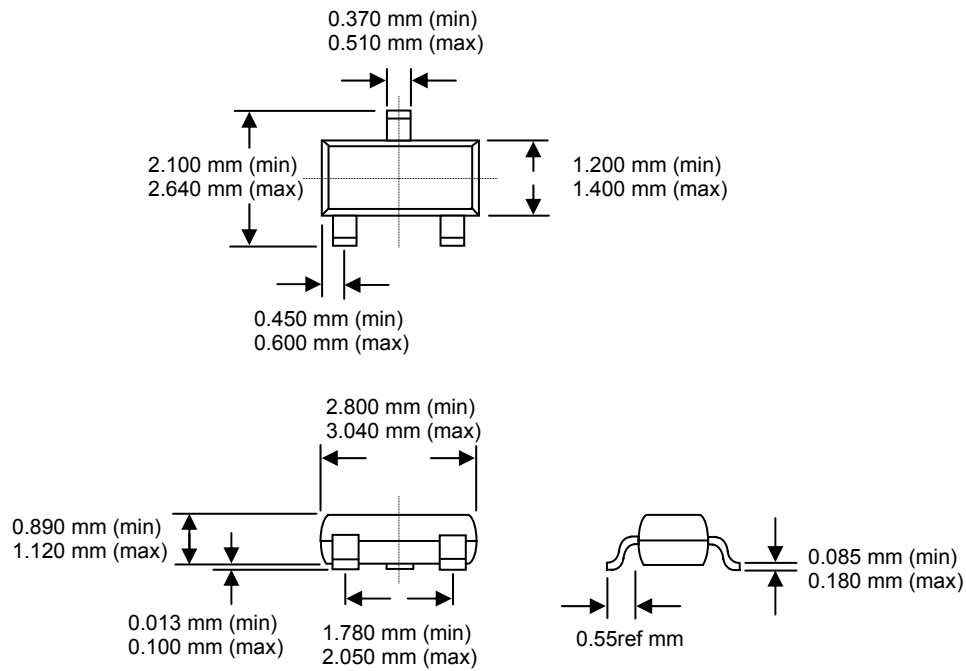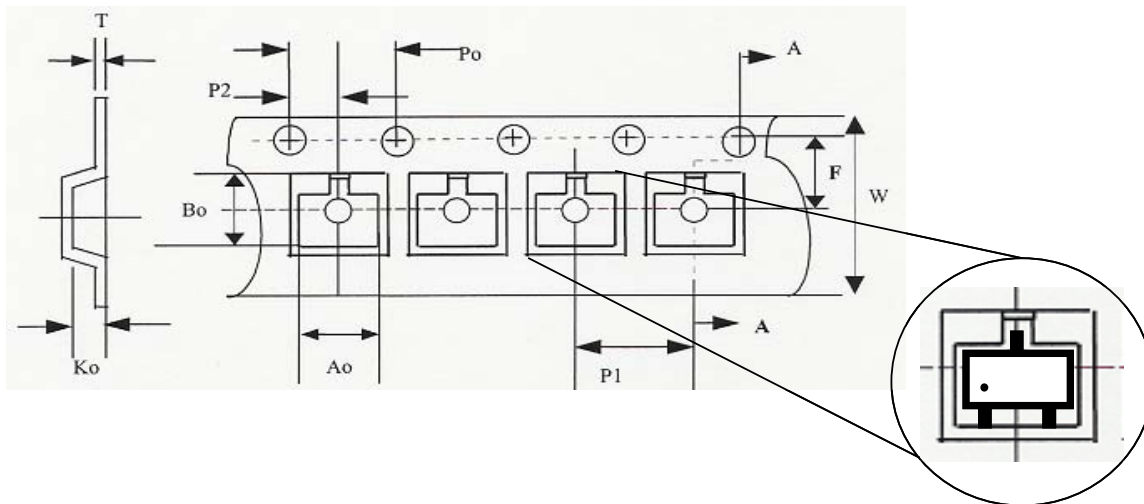**Figure 4. Serial Output Temperature to Digital Converter (Full Scale = +125˚C)**

Figure 5. Parallel Output Temperature to Digital Converter (Full Scale = +125˚C)

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Typical Applications (cont.)

Figure 6. Thermostat/Fan Controller

SOT-23 Package Dimensions

0.370 mm (min)
0.510 mm (max)

2.100 mm (min)
2.640 mm (max)

1.200 mm (min)
1.400 mm (max)

0.450 mm (min)
0.600 mm (max)

2.800 mm (min)
3.040 mm (max)

0.890 mm (min)
1.120 mm (max)

0.085 mm (min)
0.180 mm (max)

0.013 mm (min)
0.100 mm (max)

1.780 mm (min)
2.050 mm (max)

0.55ref mm

Tape and Reel Data

W	8.00 + 0.30 / -0.10 mm
A_0	3.15 ± 0.10 mm
B_0	2.77 ± 0.10 mm
K_0	1.22 ± 0.10 mm
P_0	4.00 ± 0.10 mm
P_1	4.00 ± 0.10 mm
P_2	2.00 ± 0.05 mm
T	0.29 ± 0.13 mm
F	3.50 ± 0.05 mm

Data Sheet Classifications

Preliminary Specification

This classification is shown on the heading of each page of a specification for products that are either under development(design and qualification), or in the formative planning stages. Andigilog reserves the right to change or discontinue these products without notice.

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This classification is shown on the heading of the first page only of a specification for products that are either under the later stages of development(characterization and qualification), or in the early weeks of release to production. Andigilog reserves the right to change the specification and information for these products without notice.

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Notes:

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