



April 2001

FM50

Low Voltage SOT-23

Temperature Sensor

General Description

The FM50 is a high-precision CMOS temperature sensor that provides a cost-effective solution for applications requiring high-accuracy low-power temperature monitoring. The FM50 output voltage ramp is extremely linear and has a slope of $10\text{mV}/^\circ\text{C}$. It is typically accurate to $\pm 1^\circ\text{C}$ over a temperature range of -40°C to 125°C and has a typical room temperature accuracy of $\pm 0.5^\circ\text{C}$. The output voltage characteristic for the FM50 is illustrated in Figure 1.

The FM50 does not require external calibration. Factory calibration of the FM50 is performed using a low-cost trimming technique.

The FM50 is available in 3-pin SOT-23 surface mount packages.

Features

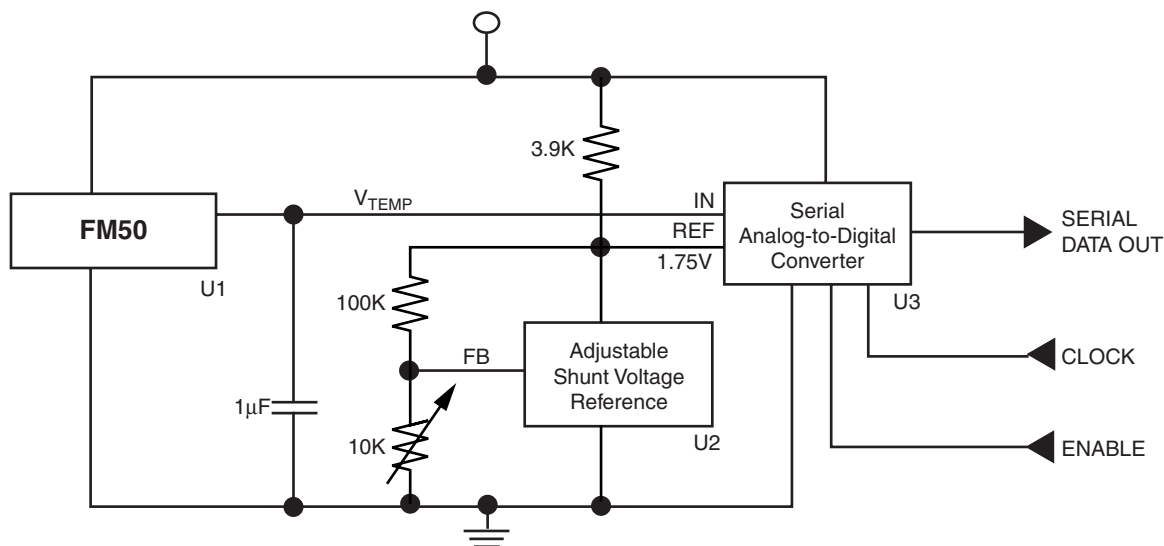
- Precision Calibrated to $\pm 1^\circ\text{C}$ (Typical)
- Temperature Range: -40°C to 125°C
- Extremely Linear Output Ramp ($10\text{mV}/^\circ\text{C}$)
- Output Ramp is Calibrated in Degrees Celsius

- Low Operating Current $< 130\mu\text{A}$ (no load)
- Low Self Heating (0.2°C Max in Still Air)
- Operating Voltage Range: $+2.7\text{V}$ to 6.0V
- Uses a Single Positive Supply
- Non-linearity $\leq 0.8^\circ\text{C}$

Applications

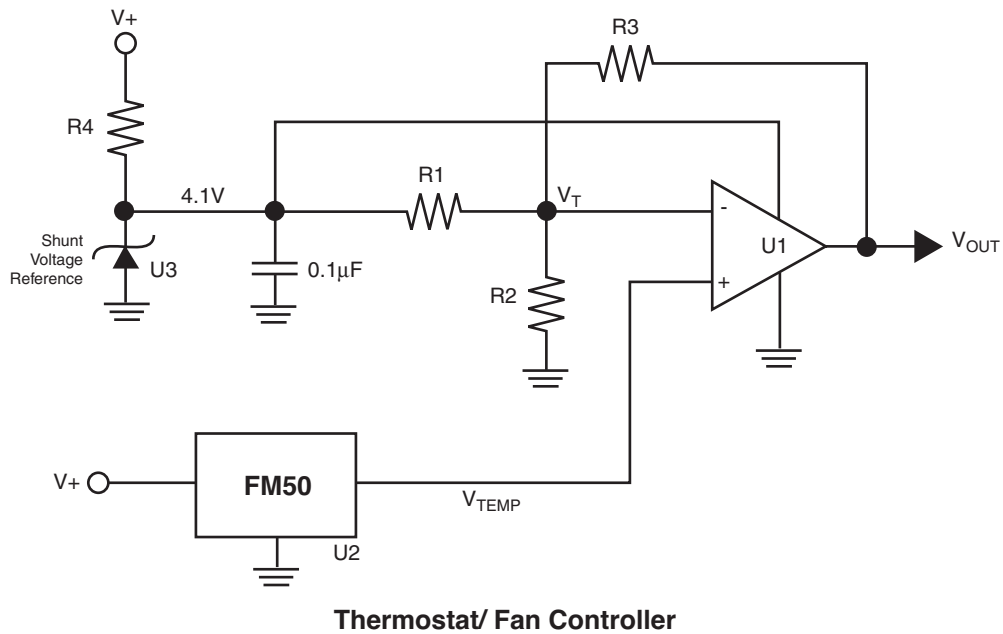
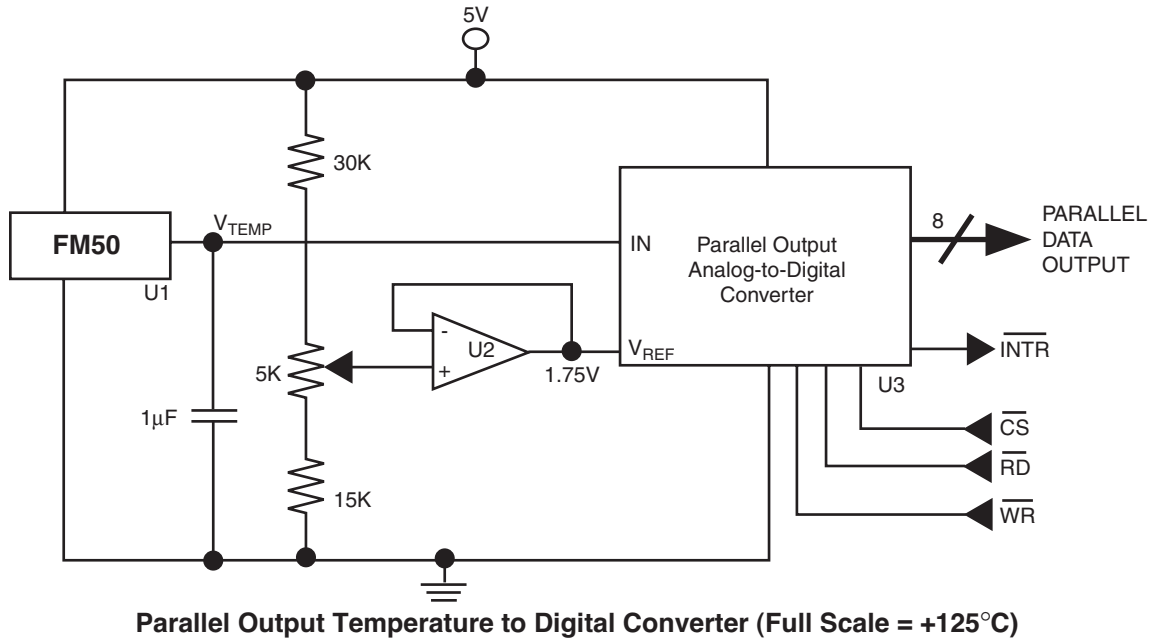
- Mobile Phones
- Mobile Communications Terminals
- Computers
- Battery Management
- FAX Machines/Printers/Copiers
- Portable Medical Instruments
- HVAC
- Power Supply Modules
- Disk Drives
- Automotive Control Circuits

Typical Applications



Serial Output Temperature to Digital Converter (Full Scale = $+125^\circ\text{C}$)

Typical Applications (continued)



Ordering Information

Part Number	Package	Temperature Range	How Supplied
FM50S3	3-Pin SOT-23	-40°C to +125°C	3000 units on T&R

Absolute Maximum Ratings (Note 1)

Parameter	Rating	Storage Temperature Range	-60°C to +150°C
Supply Voltage	+7V	Lead Soldering Temperature	220°C
Output Voltage	$V_{DD} + 0.5V$	ESD ³	
Output Current	10mA	Human Body Model	2000V
		Machine Model	250V
Operating Temperature Range ²	-50°C to +150°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. Operating ratings are conditions for which the device is intended to be functional without specific guaranteed performance limits. For guaranteed specifications and test conditions refer to Electrical Characteristics.
3. Human Body Model: 100pF capacitor discharged through a 1.5kOhm resistor into each pin. Machine Model: 200pF capacitor discharged directly into each pin.

Electrical Characteristics⁴

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

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Accuracy ⁵		$T_A = +25^{\circ}\text{C}$	-1	± 0.5	+1	$^{\circ}\text{C}$
		$T_A = -40^{\circ}\text{C} (T_{MIN})$	-3	± 1	+3	$^{\circ}\text{C}$
		$T_A = +125^{\circ}\text{C} (T_{MAX})$	-3	± 1	+3	$^{\circ}\text{C}$
Non-Linearity ⁶			-0.8		+0.8	$^{\circ}\text{C}$
Supply Voltage	V_{DD}		+2.7		+6.0	V
Supply Current	I_S	Output floating; $T_A = +25^{\circ}\text{C}$			130	μA
Output Sink Capability	I_{OL}	$+2.7V < V_{DD} < +6.0V$		50		μA
Output Source Capability	I_{OH}	$+2.7V < V_{DD} < +6.0V$		25		μA
Average Output Slope (Sensor Gain)	A_{OUT}		9.2	10	10.2	$\text{mV}/^{\circ}\text{C}$
Room Temperature Output	V_{OUT25}	$T_A = +25^{\circ}\text{C}$	740		760	mV

Notes:

4. These specifications are guaranteed only for the test conditions listed.
5. Accuracy (expressed in $^{\circ}\text{C}$) = Difference between calculated output voltage and measured output voltage. Calculated output voltage = $10\text{mV}/^{\circ}\text{C}$ multiplied by the device's case temperature at specified conditions of temperature, voltage and power supply, added to 500mV.
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.

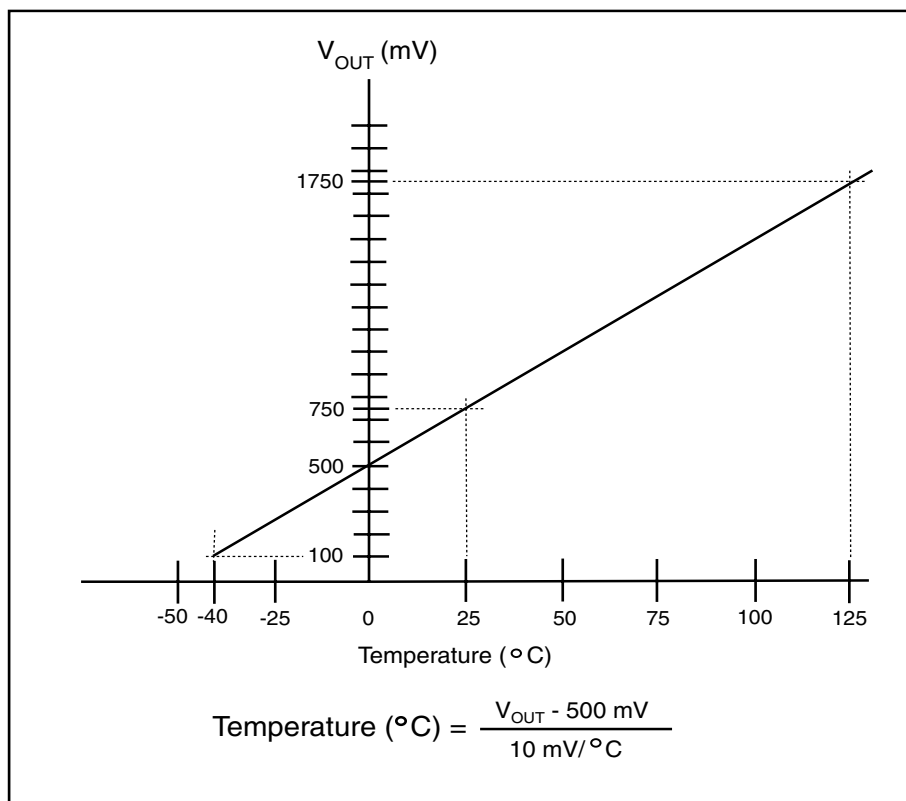


Figure 1. FM50 Output Voltage vs. Temperature

Mounting

The FM50 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 FM50 die will be at an intermediate temperature between the surface temperature and the air temperature.

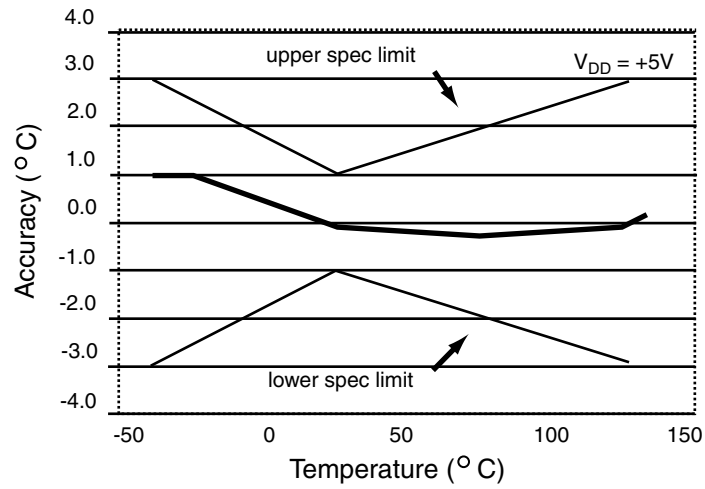
To ensure good thermal conductivity, the backside of the FM50 die is directly attached to the GND pin. The lands and traces to the FM50 will, of course, be part of the printed circuit board, which is the object whose temperature is being measured. These printed

circuit board lands and traces will not cause the FM50's temperature to deviate from the desired temperature.

Alternatively, the FM50 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 FM50 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 FM50 or its connections.

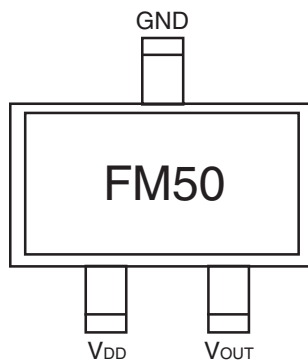
Typical Performance Characteristics

Accuracy vs. Temperature

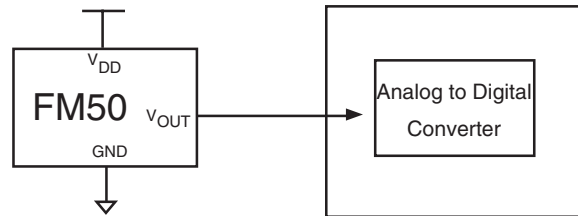


Pin Configuration

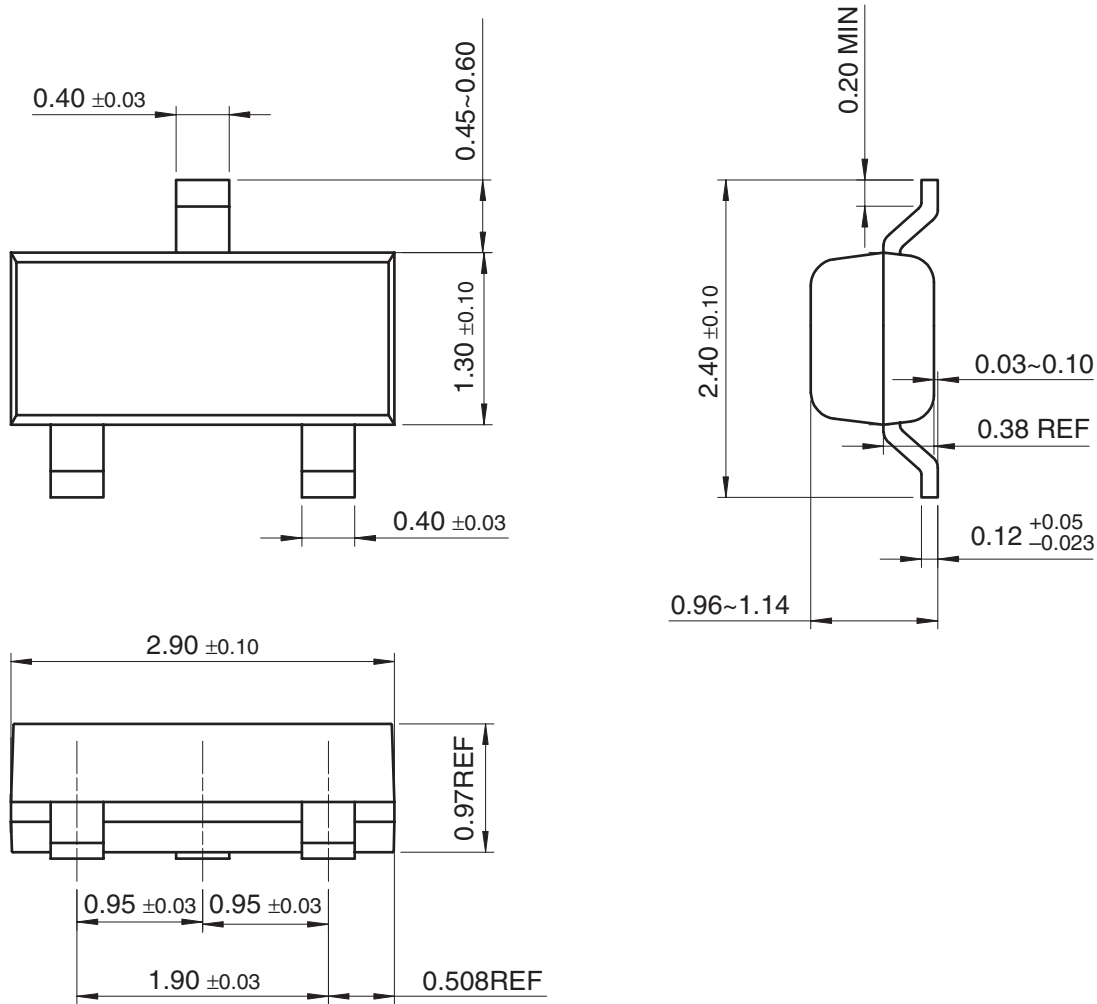
SOT-23
(Top View)



Application Diagram



Physical Dimensions inches (millimeters) unless otherwise noted



**SOT-23 Package Dimensions
FS Package Code AU**

Life Support Policy

Fairchild's products are not authorized for use as critical components in life support devices or systems without the express written approval of the President of Fairchild Semiconductor Corporation. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

Fairchild Semiconductor
Americas
Customer Response Center
Tel: 1-888-522-5372

Fairchild Semiconductor
Europe
Deutsch Fax: +44 (0) 1793-856858
English Tel: +49 (0) 8141-6102-0
Français Tel: +44 (0) 1793-856856
Italiano Tel: +33 (0) 1-6930-3696
Tel: +39 (0) 2-249111-1

Fairchild Semiconductor
Hong Kong
8/F, Room 808, Empire Centre
68 Mody Road, Tsimshatsui East
Kowloon, Hong Kong
Tel: +852-2722-8338
Fax: +852-2722-8383

Fairchild Semiconductor
Japan Ltd.
4F, Natsume Bldg.
2-18-6, Yushima, Bunkyo-ku
Tokyo, 113-0034 Japan
Tel: 81-3-3818-8840
Fax: 81-3-3818-8841

Fairchild does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and Fairchild reserves the right at any time without notice to change said circuitry and specifications.