![Texas Instruments]

LMT90

LMT90 小外形尺寸晶体管封装 (SOT)-23 单电源摄氏温度传感器

特性

- 热敏电阻具有成本效益的替代产品
- 直接用摄氏度进行校准（摄氏温度）
- 线性 **+ 10.0 mV/°C** 缩放因子
- **+25°C** 时可保证 **±3°C** 精度
- 在整个 **-40°至 +125°C** 温度范围内额定运行
- 适合于远程应用
- 晶圆级修整带来的低成本
- 在 **4.5V 至 10V** 电压范围内工作
- 漏电流少于 **130μA**
- 较低的自发热，空气不流通环境中少于 **0.2°C**
- 温度范围内的非线性少于 **0.8°C**

应用范围

- 工业领域
- 制热、通风与空调控制 (HVAC)
- 磁盘驱动器
- 汽车用
- 便携式医疗仪器
- 计算机
- 电池管理
- 打印机
- 电源模块
- 传真机

说明

LMT90 是一款精准的集成电路温度传感器，此传感器能够使用一个单一正电源来感测 -40°C 至 +125°C 的温度范围。 LMT90 的输出电压与摄氏（摄氏温度）温度 (+10mV/°C) 成线性正比，并且具有一个 +500mV 的 DC 偏移电压。 此偏移在无需负电源的情况下即可读取负温度值。 对于 -40°C 至 +125°C 的温度范围，LMT90 的理想输出电压范围介于 +100mV 至 +1.75V 之间。 LMT90 在无需任何外部校准或修整的情况下即可在室温下提供 ±3°C 的精度，并在整个 -40°C 至 +125°C 温度范围内提供 ±4°C 精度。 LMT90 的晶圆级修整和校准确保了低成本和高精度。 LMT90 的线性输出，+500mV 偏移和出厂校准简化了要求读取负温度的单电源环境中所需要的电路。 LMT90 的静态电流少于 130μA，因此在空气不流动环境中自发热被限制在极低的 0.2°C 水平上。
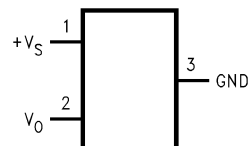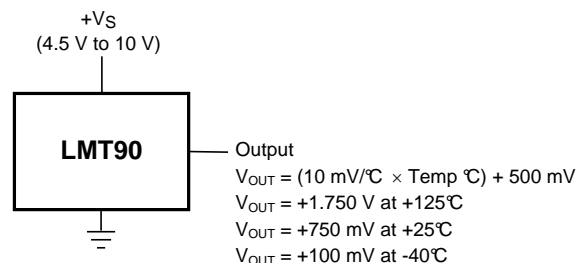
LMT90 是一款具有成本竞争优势的热敏电阻替代产品。

连接图

图 1. SOT-23 顶视图

典型应用

+V_S (4.5 V to 10 V)

LMT90

Output
$V_{OUT} = (10 \text{ mV/°C} \times \text{Temp °C}) + 500 \text{ mV}$
$V_{OUT} = +1.750 \text{ V at } +125°C$
$V_{OUT} = +750 \text{ mV at } +25°C$
$V_{OUT} = +100 \text{ mV at } -40°C$

图 2. 全范围摄氏温度传感器（-40°C 至 +125°C）

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

ABSOLUTE MAXIMUM RATINGS[1]

over operating free-air temperature range (unless otherwise noted)

		VALUES
Supply Voltage		+12V to −0.2V
Output Voltage		$(+V_S + 0.6V)$ to −1.0V
Output Current		10 mA
Storage Temperature		−65°C to +150°C
T_{JMAX}, Maximum Junction Temperature		150°C
ESD Susceptibility [2]	Human Body Model	2000V
	Machine Model	250V

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. DC and AC electrical specifications do not apply when operating the device beyond its rated operating conditions.
(2) Human body model, 100 pF discharged through a 1.5 kΩ resistor. Machine model, 200 pF discharged directly into each pin.

OPERATING RATINGS

Specified Temperature Range:	T_{MIN} to T_{MAX}
LMT90	−40°C to +125°C
Operating Temperature Range	−40°C to +150°C
θ_{JA} [1]	450°C/W
Supply Voltage Range (+V_S)	+4.5V to +10V
Soldering process must comply with the Reflow Temperature Profile specifications. Refer to www.ti.com/packaging. [2]	

(1) Thermal resistance of the SOT-23 package is specified without a heat sink, junction to ambient.
(2) Reflow temperature profiles are different for lead-free and non-lead-free packages.

ELECTRICAL CHARACTERISTICS

Unless otherwise noted, these specifications apply for V_S = +5 V_{DC} and I_{LOAD} = +0.5 μA, in the circuit of 图 2. **Boldface limits apply for the specified $T_A = T_J = T_{MIN}$ to T_{MAX}**; all other limits $T_A = T_J$ = +25°C, unless otherwise noted.

PARAMETER	CONDITIONS	TYPICAL	MAX[1]	UNITS (LIMIT)
Accuracy [2]	T_A = +25°C		±3.0	°C (max)
	$T_A = T_{MAX}$		±4.0	°C (max)
	$T_A = T_{MIN}$		±4.0	°C (max)
Nonlinearity [3]			**±0.8**	°C (max)
Sensor Gain			**+9.7**	mV/°C (min)
(Average Slope)			**+10.3**	mV/°C (max)
Output Resistance		2000	**4000**	Ω (max)
Line Regulation [4]	+4.5V ≤ V_S ≤ +10V		±0.8	mV/V (max)
			±1.2	mV/V (max)
Quiescent Current [5]	+4.5V ≤ V_S ≤ +10V		130	μA (max)
			180	μA (max)
Change of Quiescent Current [5]	+4.5V ≤ V_S ≤ +10V		**2.0**	μA (max)
Temperature Coefficient of Quiescent Current		**+2.0**		μA/°C
Long Term Stability [6]	T_J = 125°C, for 1000 hours	±0.08		°C

(1) Limits are specific to TI's AOQL (Average Outgoing Quality Level).
(2) Accuracy is defined as the error between the output voltage and 10mv/°C times the device's case temperature plus 500 mV, at specified conditions of voltage, current, and temperature (expressed in °C).
(3) Nonlinearity 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.
(4) Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output due to heating effects can be computed by multiplying the internal dissipation by the thermal resistance.
(5) Quiescent current is defined in the circuit of 图 2.
(6) For best long-term stability, any precision circuit will give best results if the unit is aged at a warm temperature, and/or temperature cycled for at least 46 hours before long-term life test begins. This is especially true when a small (Surface-Mount) part is wave-soldered; allow time for stress relaxation to occur. The majority of the drift will occur in the first 1000 hours at elevated temperatures. The drift after 1000 hours will not continue at the first 1000 hour rate.

TYPICAL PERFORMANCE CHARACTERISTICS

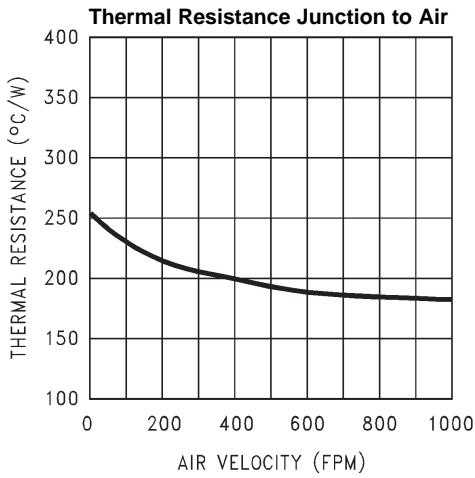To generate these curves the LMT90 was mounted to a printed circuit board as shown in Figure 14.

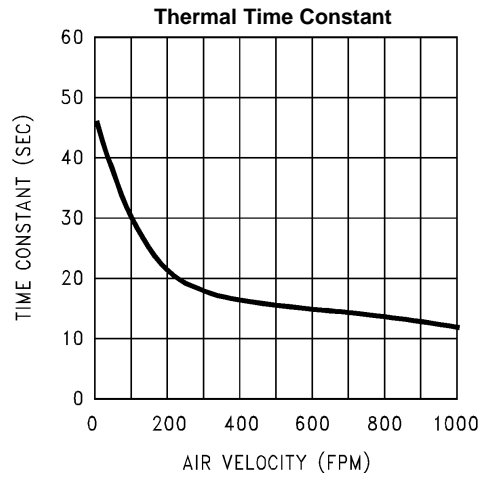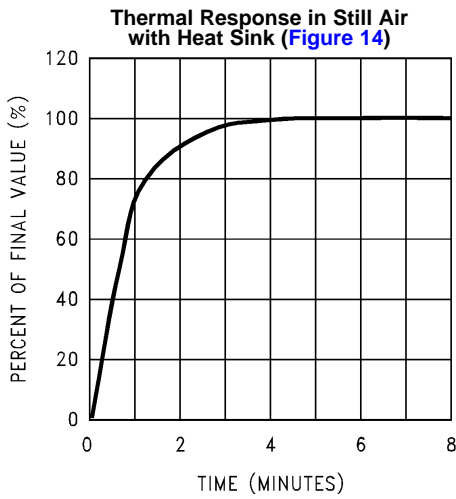**Thermal Resistance Junction to Air**

Figure 3.

Thermal Time Constant

Figure 4.

Thermal Response in Still Air with Heat Sink (Figure 14)

Figure 5.

Thermal Response in Stirred Oil Bath with Heat Sink

Figure 6.

Start-Up Voltage vs Temperature

Figure 7.

Thermal Response in Still Air without a Heat Sink

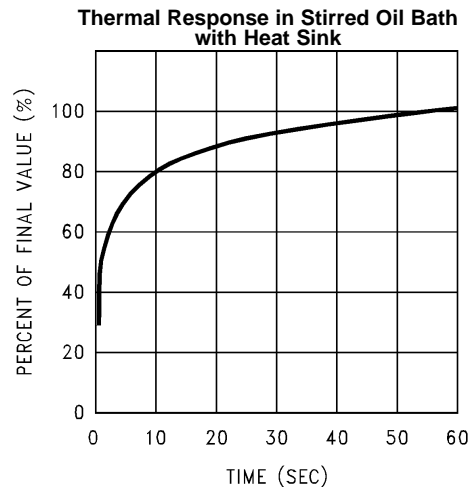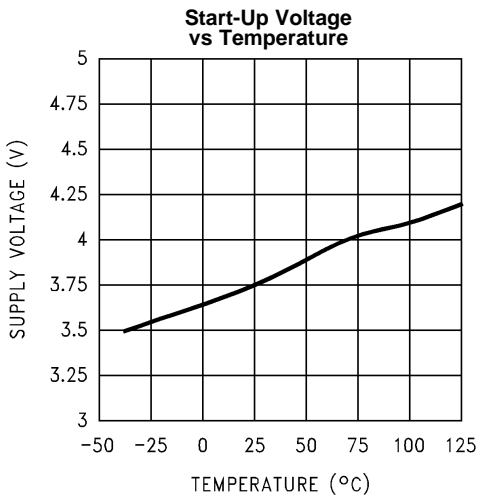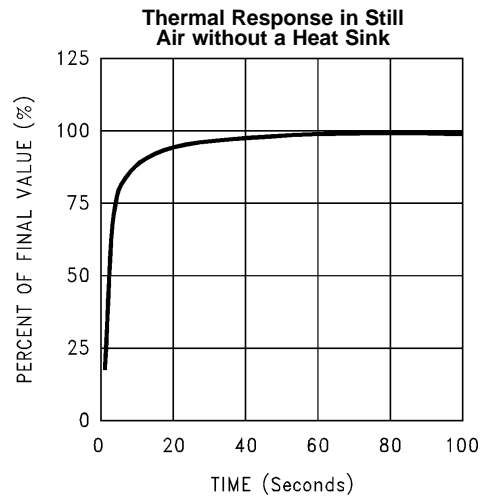**Figure 8.**

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

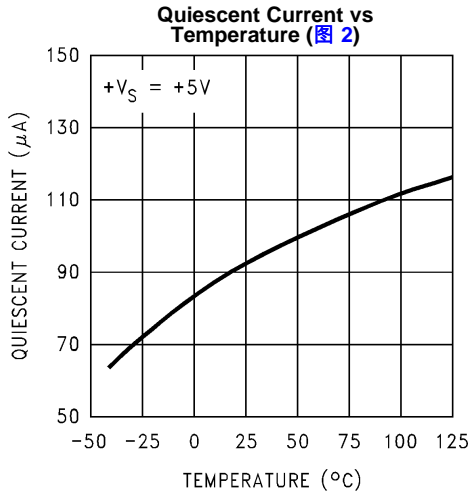To generate these curves the LMT90 was mounted to a printed circuit board as shown in Figure 14.

**Quiescent Current vs
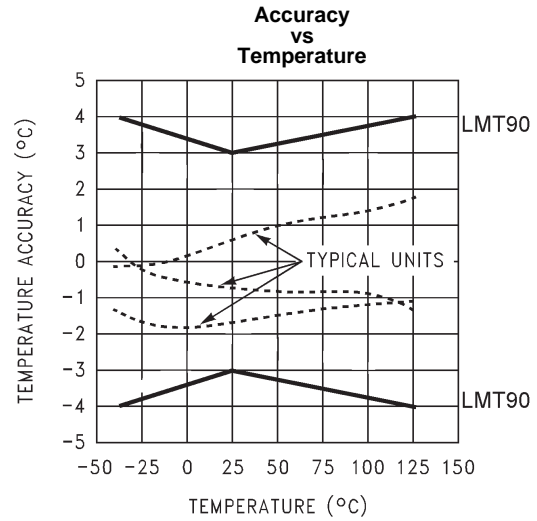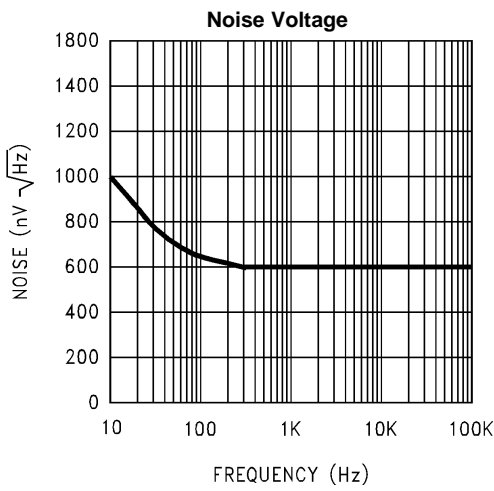Temperature (图 2)**

Figure 9.

**Accuracy
vs
Temperature**

Figure 10.

Noise Voltage

Figure 11.

**Supply Voltage
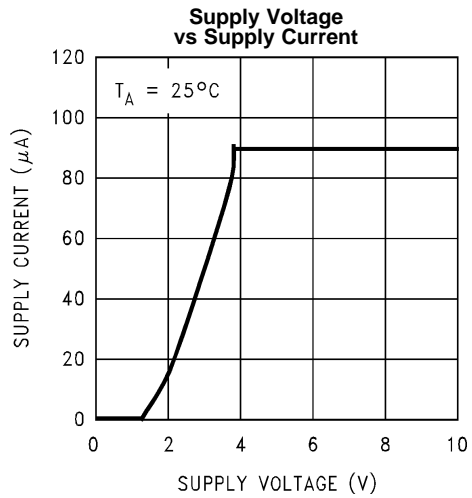vs Supply Current**

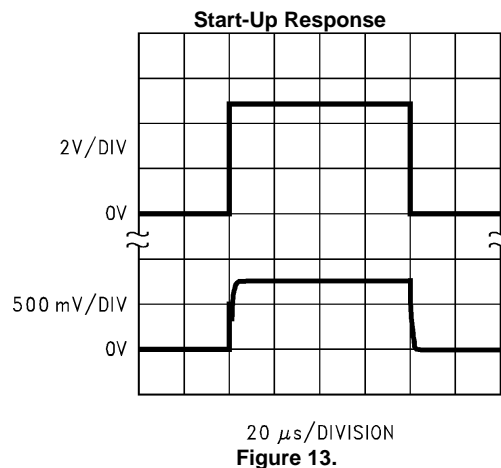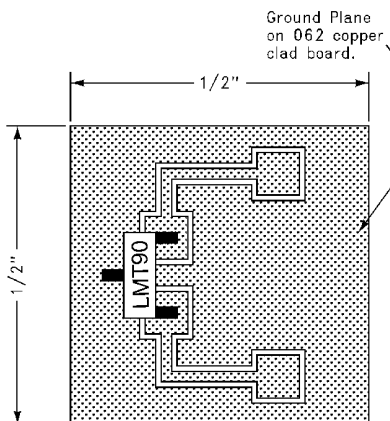

Figure 12.

Start-Up Response

Figure 13.

PRINTED CIRCUIT BOARD

A.   1/2″ Square Printed Circuit Board with 2 oz. Foil or Similar

Figure 14. Printed Circuit Board Used for Heat Sink to Generate All Curves

MOUNTING

The LMT90 can be applied easily in the same way as other integrated-circuit temperature sensors. It can be glued or cemented to a surface and its temperature will be within about 0.2°C of the surface temperature.

This presumes that the ambient air temperature is almost the same as the surface temperature; if the air temperature were much higher or lower than the surface temperature, the actual temperature of the LMT90 die would be at an intermediate temperature between the surface temperature and the air temperature.

To ensure good thermal conductivity the backside of the LMT90 die is directly attached to the GND pin. The lands and traces to the LMT90 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 LMT90s temperature to deviate from the desired temperature.

Alternatively, the LMT90 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 LMT90 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 paints or dips are often used to ensure that moisture cannot corrode the LMT90 or its connections.

Table 1. Temperature Rise of LMT90 Due to Self-Heating (Thermal Resistance, θ_{JA})

	SOT-23 no heat sink[1]	SOT-23 small heat fin[2]
Still air	450°C/W	260°C/W
Moving air		180°C/W

(1)   Part soldered to 30 gauge wire.
(2)   Heat sink used is 1/2″ square printed circuit board with 2 oz. foil with part attached as shown in Figure 14.
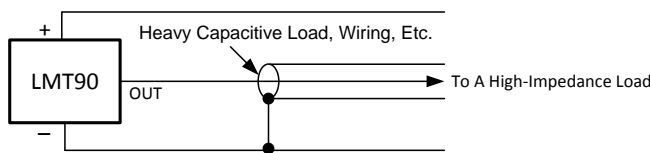
CAPACITIVE LOADS

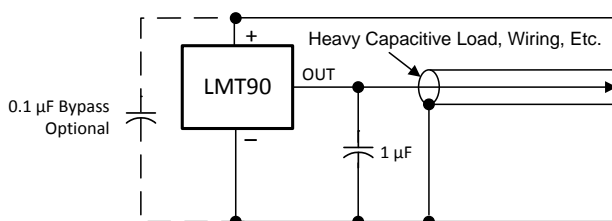**Figure 15. LMT90 No Decoupling Required for Capacitive Load**

Figure 16. LMT90C with Filter for Noisy Environment

The LMT90 handles capacitive loading very well. Without any special precautions, the LMT90 can drive any capacitive load. The LMT90 has a nominal 2 kΩ output impedance (as can be seen in Figure 17). The temperature coefficient of the output resistors is around 1300 ppm/°C. Taking into account this temperature coefficient and the initial tolerance of the resistors the output impedance of the LMT90 will not exceed 4 kΩ. In an extremely noisy environment it may be necessary to add some filtering to minimize noise pickup. It is recommended that 0.1 µF be added from V_{IN} to GND to bypass the power supply voltage, as shown in Figure 16. In a noisy environment it may be necessary to add a capacitor from the output to ground. A 1 µF output capacitor with the 4 kΩ output impedance will form a 40 Hz lowpass filter. Since the thermal time constant of the LMT90 is much slower than the 25 ms time constant formed by the RC, the overall response time of the LMT90 will not be significantly affected. For much larger capacitors this additional time lag will increase the overall response time of the LMT90.
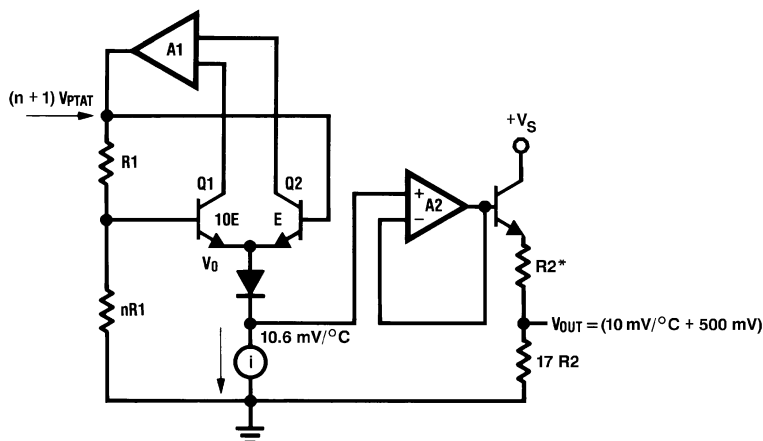
*R2 ≈ 2k with a typical 1300 ppm/°C drift.

Figure 17. Block Diagram

TYPICAL APPLICATIONS

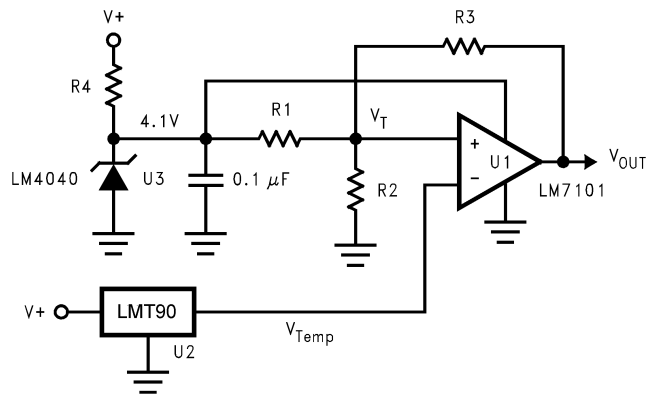

Figure 18. Centigrade Thermostat/Fan Controller
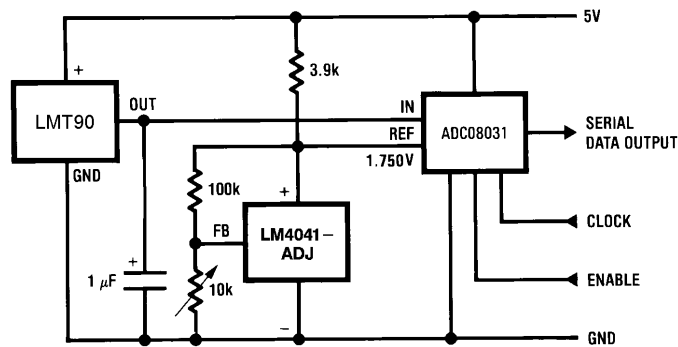

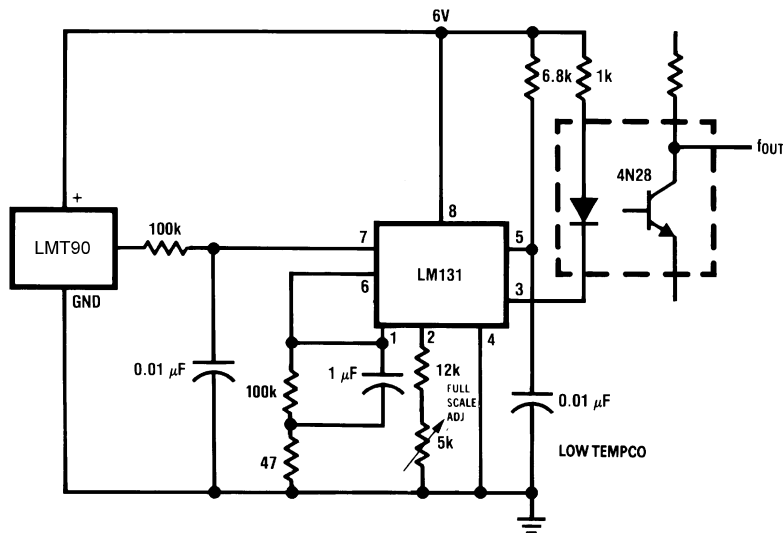**Figure 19. Temperature To Digital Converter (Serial Output) (+125°C Full Scale)**

Figure 20. Temperature To Digital Converter (Parallel TRI-STATE Outputs for Standard Data Bus to µP Interface) (125°C Full Scale)
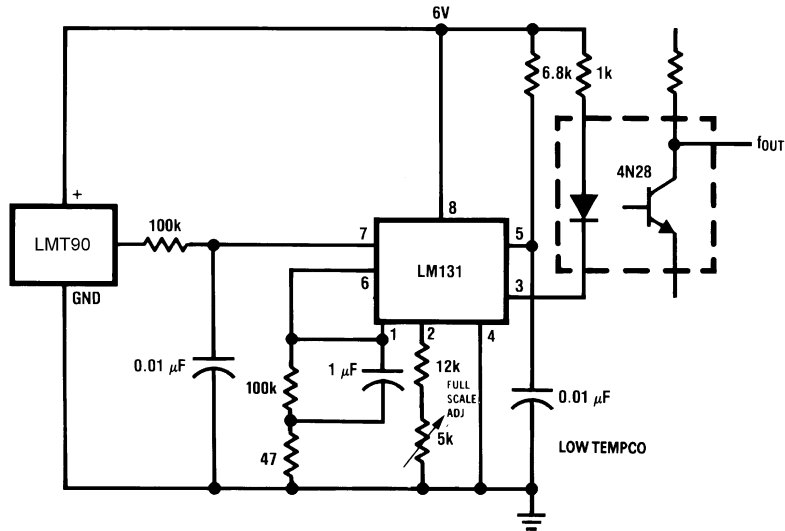
Figure 21. LMT90 With Voltage-To-Frequency Converter And Isolated Output
(−40°C to +125°C; 100 Hz to 1750 Hz)

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LMT90DBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 125	T8C	Samples
LMT90DBZT	OBSOLETE	SOT-23	DBZ	3		TBD	Call TI	Call TI	-40 to 125	T8C	

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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PACKAGE MATERIALS INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSIONS

A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LMT90DBZR	SOT-23	DBZ	3	3000	178.0	8.4	3.3	2.9	1.22	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LMT90DBZR	SOT-23	DBZ	3	3000	208.0	191.0	35.0

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NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-236, except minimum foot length.
4. Support pin may differ or may not be present.
5. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side

PKG

3X (1.3)

1

3X (0.6)

SYMM

3

2X (0.95)

2

(R0.05) TYP

(2.1)

LAND PATTERN EXAMPLE
SCALE:15X

SOLDER MASK
OPENING

METAL

0.07 MAX
ALL AROUND

NON SOLDER MASK
DEFINED
(PREFERRED)

METAL UNDER
SOLDER MASK

SOLDER MASK
OPENING

0.07 MIN
ALL AROUND

SOLDER MASK
DEFINED
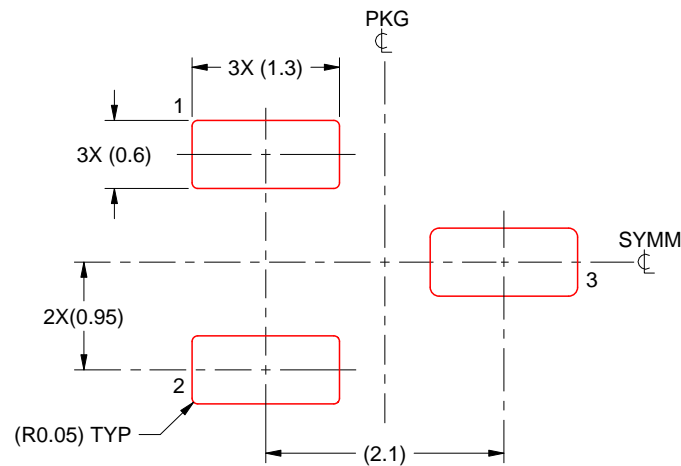
SOLDER MASK DETAILS

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NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

SOLDER PASTE EXAMPLE
BASED ON 0.125 THICK STENCIL
SCALE:15X

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NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

重要声明和免责声明