

## LM61 2.7V、SOT-23またはTO-92温度センサ

### 1 特長

- 較正済み線形スケール係数: 10mV/°C
- -30°C~100°Cの動作温度範囲
- リモート・アプリケーションに最適
- UL認定のコンポーネント
- 25°Cにおいて±2°Cまたは±3°Cの精度(最大値)
- -25°C~85°Cについて±3°Cの精度(最大値)
- -30°C~100°Cについて±4°Cの精度(最大値)
- 10mV/°Cの温度勾配(最大値)
- 電源電圧範囲: 2.7V~10V
- 消費電流: 25°Cにおいて125µA (最大値)
- 非直線性: ±0.8°C (最大値)
- 出力インピーダンス: 800Ω (最大値)

### 2 アプリケーション

- 携帯電話
- コンピュータ
- 電源モジュール
- バッテリ管理
- FAXマシン
- プリンタ
- HVAC
- ディスク・ドライブ
- 家電製品

### 3 概要

LM61デバイスは高精度の統合回路温度センサで、単一の2.7V電源により動作し、-30°C~100°Cの温度範囲を検出できます。LM61の出力電圧は温度に正比例(10mV/°C)し、DCオフセットは600mVです。このオフセットにより、負電源を必要とせずに負温度を読み取れます。LM61の公称出力電圧は、-30°C~100°Cの温度範囲について300mV~1600mVです。LM61は、室温で±2°C、-25°C~85°Cの温度範囲全体にわたって±3°Cの精度を維持するよう較正済みです。

LM61の線形出力、600mVのオフセット、工場での較正により、単一電源の環境で負温度の読み取りが要求される場合に必要な外部回路が簡素化されます。静止電流が125µA未満なので、自己発熱が非常に少なく、静止空气中で0.2°C以下に抑えられています。LM61は本質的に低消費電力であり、様々なロジック・ゲートの出力から直接電源を供給できるので、専用の制御端子を備えていなくても容易にシャットダウンができます。

#### 製品情報<sup>(1)</sup>

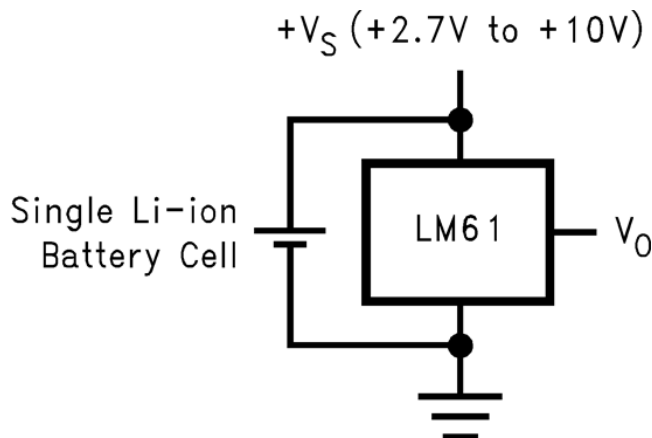
型番	パッケージ	本体サイズ(公称)
LM61	SOT-23 (3)	1.30mm×2.92mm
	TO-92 (3)	4.30mm×4.30mm

(1) 提供されているすべてのパッケージについては、巻末の注文情報を参照してください。

#### 主な仕様

	値
25°Cでの精度	±2°Cまたは±3°C
-25°C~85°Cでの精度	±3°C
-30°C~100°Cでの精度	±4°C
温度勾配	10mV/°C
電源電圧	2.7V~10V
25°Cでの消費電流	125µA
非線形性	±0.8°C
出力インピーダンス	800Ω

#### 代表的なアプリケーション



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$$V_O = (10\text{mV}/^\circ\text{C} \times T) + 600\text{mV}$$



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## 4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Revision I (February 2013) から Revision J に変更	Page
<ul style="list-style-type: none"> <li>「製品情報」表、「デバイス比較表」、「ピン構成および機能」セクション、「仕様」セクション、「ESD定格」表、「詳細説明」セクション、「アプリケーションと実装」セクション、「電源に関する推奨事項」セクション、「レイアウト」セクション、「デバイスおよびドキュメントのサポート」セクション、「メカニカル、パッケージ、および注文情報」セクション 追加</li> </ul>	1
<ul style="list-style-type: none"> <li>Added <i>Thermal Information</i> table</li> </ul>	4
<ul style="list-style-type: none"> <li>Changed <math>R_{\theta JA}</math> values for DBZ (SOT-23) From: 450°C/W To: 286.3°C/W and for LP (TO-92) From: 180°C/W To: 162.2°C/W</li> </ul>	4

Revision H (February 2013) から Revision I に変更	Page
<ul style="list-style-type: none"> <li>ナショナル・セミコンダクターのデータシートのレイアウトをTIフォーマットに変更</li> </ul>	1

## 5 Pin Configuration and Functions



### Pin Functions

PIN		TYPE	DESCRIPTION
NAME	NO.		
+VS	1	Power	Positive power supply pin.
VOUT	2	Output	Temperature sensor analog output.
GND	3	Ground	Device ground pin, connected to power supply negative terminal.

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

	MIN	MAX	UNIT
Supply voltage	12	-0.2	V
Output voltage	(+V <sub>S</sub> + 0.6)	-0.6	V
Output current		10	mA
Input current at any pin <sup>(2)</sup>		5	mA
Maximum junction temperature, T <sub>J</sub>		125	°C
Storage temperature, T <sub>stg</sub>	-65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) When the input voltage (V<sub>I</sub>) at any pin exceeds power supplies (V<sub>I</sub> < GND or V<sub>I</sub> > V<sub>S</sub>), the current at that pin must be limited to 5 mA.

### 6.2 ESD Ratings

		VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)(2)</sup>	±2500
		Machine Model (MM) <sup>(3)</sup>	±250

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) The human body model is a 100-pF capacitor discharged through a 1.5-kΩ resistor into each pin.
- (3) The machine model is a 200-pF capacitor discharged directly into each pin.

### 6.3 Recommended Operating Conditions

		MIN	MAX	UNIT	
+V <sub>S</sub>	Supply voltage	2	10	V	
T	Operating temperature	LM61C	-30	100	°C
		LM61B	-25	85	

## 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		LM61		UNIT
		DBZ (SOT-23)	LP (TO-92)	
		3 PINS	3 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance <sup>(2)</sup>	286.3	162.2	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	96	85	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	57.1	—	°C/W
$\psi_{JT}$	Junction-to-top characterization parameter	5.3	29.2	°C/W
$\psi_{JB}$	Junction-to-board characterization parameter	55.8	141.4	°C/W

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.
- (2) The junction-to-ambient thermal resistance is specified without a heat sink in still air.

## 6.5 Electrical Characteristics

 $+V_S = 3 \text{ V (DC)}$ <sup>(1)(2)</sup>

PARAMETER	TEST CONDITIONS		MIN <sup>(3)</sup>	TYP <sup>(4)</sup>	MAX <sup>(3)</sup>	UNIT
Accuracy <sup>(5)</sup>	$T_A = 25^\circ\text{C}$	LM61B	–2		2	°C
		LM61C	–3		3	
	LM61B	–3		3		
	LM61C	–4		4		
Output voltage at 0°C				600		mV
Nonlinearity <sup>(6)</sup>	LM61B		–0.6		0.6	°C
	LM61C		–0.8		0.8	
Sensor gain (average slope)	LM61B		9.7	10	10.3	mV/°C
	LM61C		9.6	10	10.4	
Output impedance	$+V_S = 3 \text{ V to } 10 \text{ V}$				0.8	kΩ
	$T_A = -30^\circ\text{C to } 85^\circ\text{C}, +V_S = 2.7 \text{ V}$				2.3	
	$T_A = 85^\circ\text{C to } 100^\circ\text{C}, +V_S = 2.7 \text{ V}$				5	
Line regulation <sup>(7)</sup>	$+V_S = 3 \text{ V to } 10 \text{ V}$		–0.7		0.7	mV/V
	$+V_S = 2.7 \text{ V to } 3.3 \text{ V}$		–5.7		5.7	mV
Quiescent current	$+V_S = 2.7 \text{ V to } 10 \text{ V}$	$T_A = 25^\circ\text{C}$		82	125	μA
					155	
Change of quiescent current	$+V_S = 2.7 \text{ V to } 10 \text{ V}$			±5		μA
Temperature coefficient of quiescent current				0.2		μA/°C
Long term stability <sup>(8)</sup>	$T_J = T_{MAX} = 100^\circ\text{C}$ , for 1000 hours			±0.2		°C

- (1) Limits are specified to TI's AOQL (Average Outgoing Quality Level).
- (2) Typical limits represent most likely parametric norm.
- (3) Maximum and minimum limits apply for  $T_A = T_J = T_{MIN}$  to  $T_{MAX}$ .
- (4) Typical limits apply for  $T_A = T_J = 25^\circ\text{C}$ .
- (5) Accuracy is defined as the error between the output voltage and 10 mV/°C multiplied by the device's case temperature plus 600 mV, at specified conditions of voltage, current, and temperature (expressed in °C).
- (6) 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.
- (7) 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.
- (8) For best long-term stability, any precision circuit gives best results if the unit is aged at a warm temperature, 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 occurs in the first 1000 hours at elevated temperatures. The drift after 1000 hours does not continue at the first 1000-hour rate.

## 6.6 Typical Characteristics

The LM61 in the SOT-23 package mounted to a printed-circuit board as shown in Figure 18 was used to generate the following thermal curves.

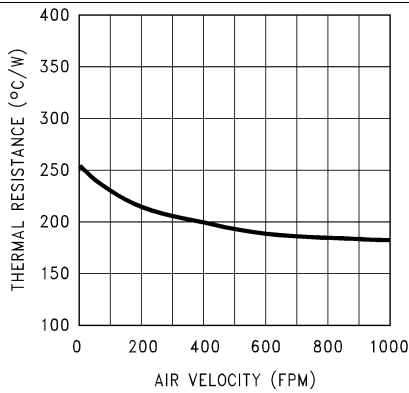


Figure 1. Junction-to-Ambient Thermal Resistance

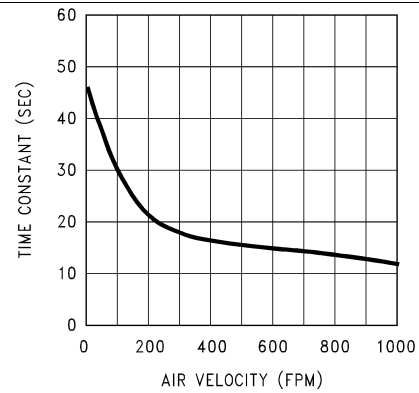


Figure 2. Thermal Time Constant

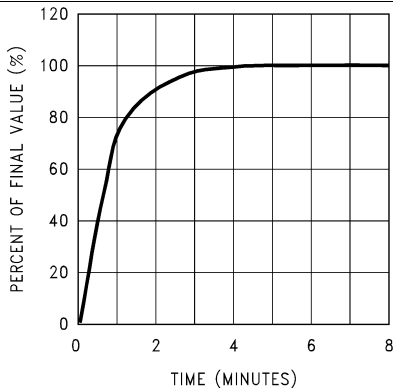


Figure 3. Thermal Response in Still Air with Heat Sink

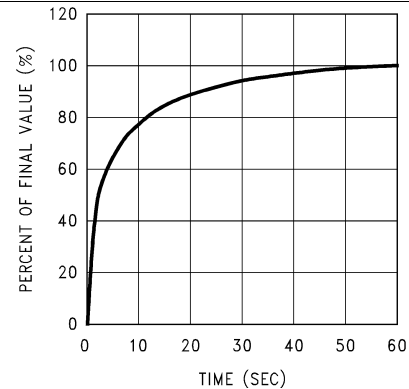


Figure 4. Thermal Response in Stirred Oil Bath with Heat Sink

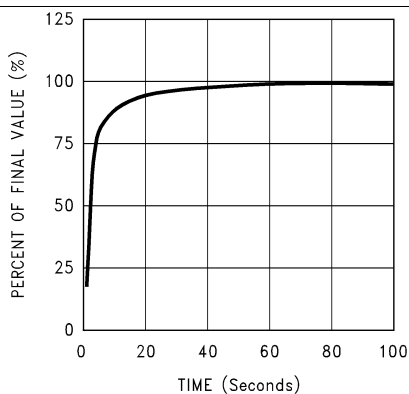


Figure 5. Thermal Response in Still Air without Heat Sink

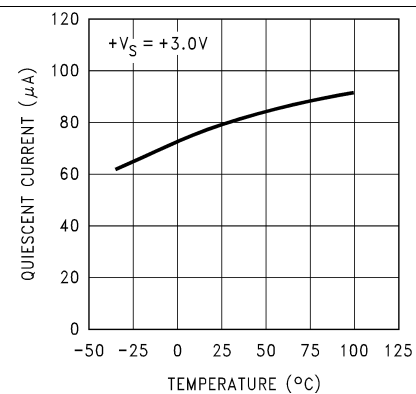
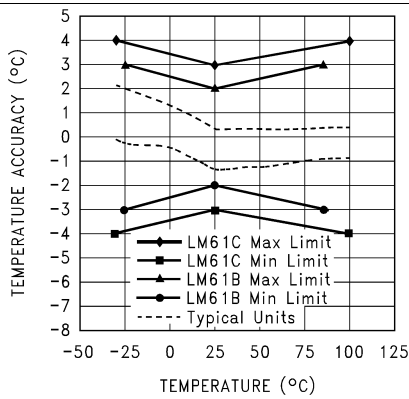


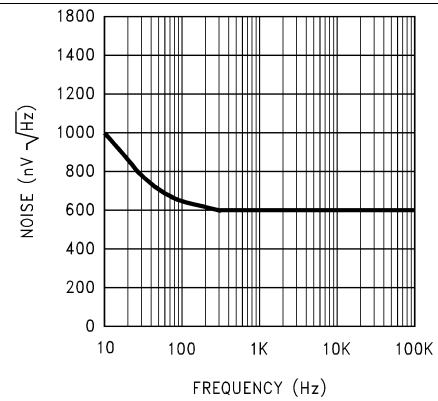
Figure 6. Quiescent Current vs Temperature

**Typical Characteristics (continued)**

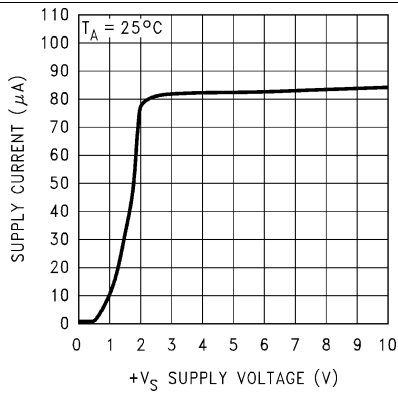
The LM61 in the SOT-23 package mounted to a printed-circuit board as shown in Figure 18 was used to generate the following thermal curves.



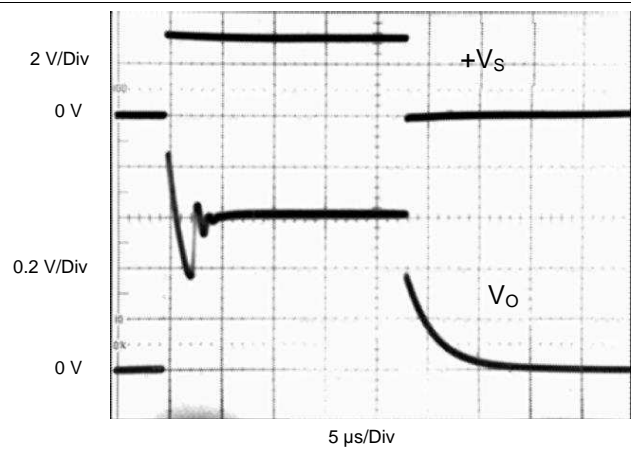
**Figure 7. Accuracy vs Temperature**



**Figure 8. Noise Voltage**



**Figure 9. Supply Voltage vs Supply Current**



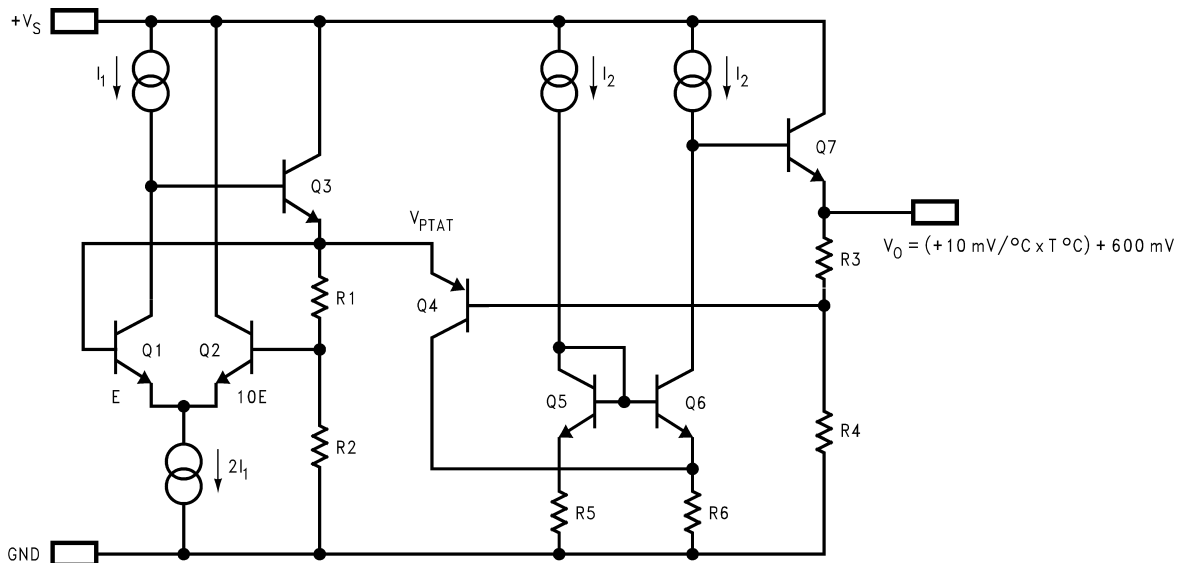
**Figure 10. Start-Up Response**

## 7 Detailed Description

### 7.1 Overview

The LM61 is a precision integrated-circuit temperature sensor that can sense a  $-30^{\circ}\text{C}$  to  $100^{\circ}\text{C}$  temperature range using a single positive supply. The output voltage of the LM61 has a positive temperature slope of  $10\text{ mV}/^{\circ}\text{C}$ . A  $600\text{-mV}$  offset is included, enabling negative temperature sensing when biased by a single supply. The temperature-sensing element is comprised of a delta-VBE architecture. The temperature-sensing element is then buffered by an amplifier and provided to the VOUT pin. The amplifier has a simple class A output stage as shown in [Functional Block Diagram](#).

### 7.2 Functional Block Diagram



### 7.3 Feature Description

#### 7.3.1 LM61 Transfer Function

The LM61 follows a simple linear transfer function to achieve the accuracy as listed in [Electrical Characteristics](#). Use [Equation 1](#) to calculate the value of  $V_O$ .

$$V_O = 10\text{ mV}/^{\circ}\text{C} \times T^{\circ}\text{C} + 600\text{ mV}$$

where

- $T$  is the temperature in  $^{\circ}\text{C}$
- $V_O$  is the LM61 output voltage

(1)

### 7.4 Device Functional Modes

The only functional mode of the LM61 device is an analog output directly proportional to temperature.

## 8 Application and Implementation

### NOTE

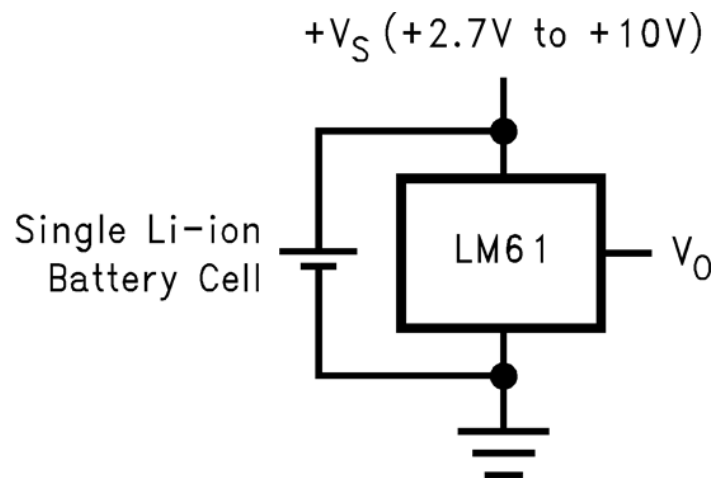
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 8.1 Application Information

The LM61 has a wide supply range and a 10-mV/°C output slope with a 600-mV DC. Therefore, it can be easily applied in many temperature-sensing applications where a single supply is required for positive and negative temperatures.

### 8.2 Typical Applications

#### 8.2.1 Typical Temperature Sensing Circuit



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$$V_O = 10 \text{ mV/}^\circ\text{C} \times T^\circ\text{C} + 600 \text{ mV}$$

**Figure 11. Typical Temperature Sensing Circuit Diagram**

#### 8.2.1.1 Design Requirements

For this design example, use the parameters listed in [Table 1](#) as the input parameters.

**Table 1. Design Parameters**

PARAMETER	VALUE
Power supply voltage	2.7 V to 3.3 V
Accuracy at 25°C	±2°C (maximum)
Accuracy over –25°C to 85°C	±3°C (maximum)
Temperature slope	10 mV/°C

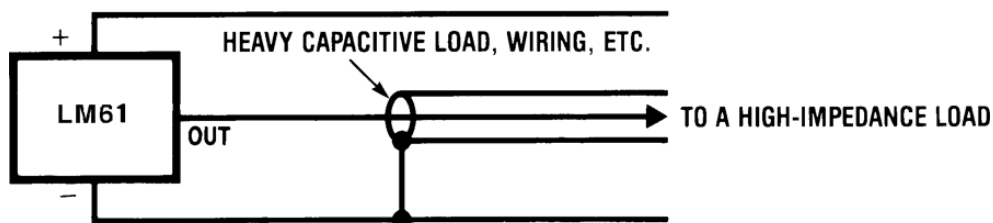


### 8.2.1.2 Detailed Design Procedure

The LM61 is a simple temperature sensor that provides an analog output. Therefore, design requirements related to layout outweigh other requirements in importance. See [Layout](#) for more information.

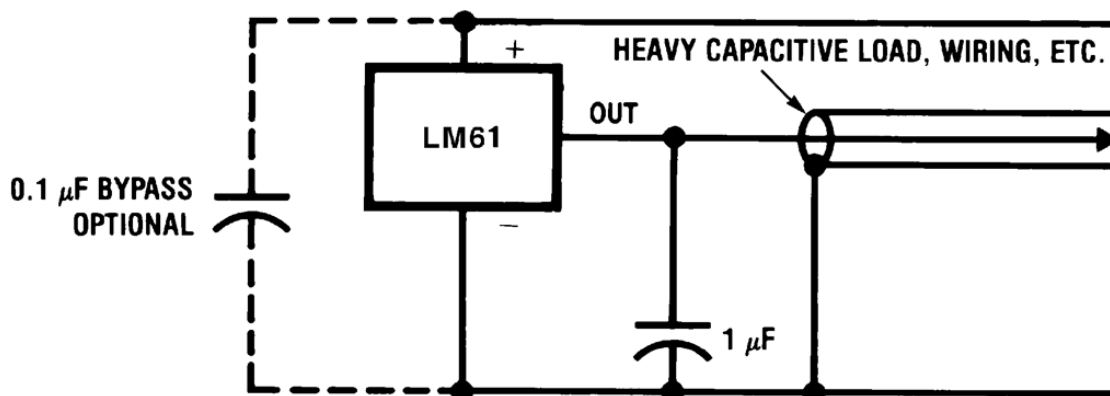
#### 8.2.1.2.1 Capacitive Loads

The LM61 handles capacitive loading well. Without any special precautions, the LM61 can drive any capacitive load as shown in [Figure 12](#). Over the specified temperature range the LM61 has a maximum output impedance of 5 k $\Omega$ . In an extremely noisy environment it may be necessary to add some filtering to minimize noise pickup. It is recommended that 0.1- $\mu$ F capacitor be added between +VS and GND to bypass the power-supply voltage, as shown in [Figure 13](#). In a noisy environment it may be necessary to add a capacitor from VOUT to ground. A 1- $\mu$ F output capacitor with the 5-k $\Omega$  maximum output impedance forms a 32-Hz lowpass filter. Because the thermal time constant of the LM61 is much slower than the 5-ms time constant formed by the RC, the overall response time of the LM61 is not significantly affected. For much larger capacitors this additional time lag increases the overall response time of the LM61.



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Figure 12. LM61 No Decoupling Required for Capacitive Load



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Figure 13. LM61 with Filter for Noisy Environments

8.2.1.3 Application Curve

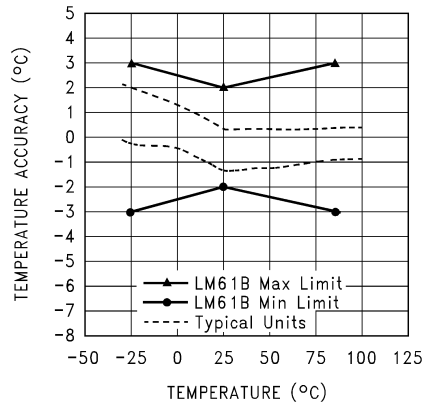
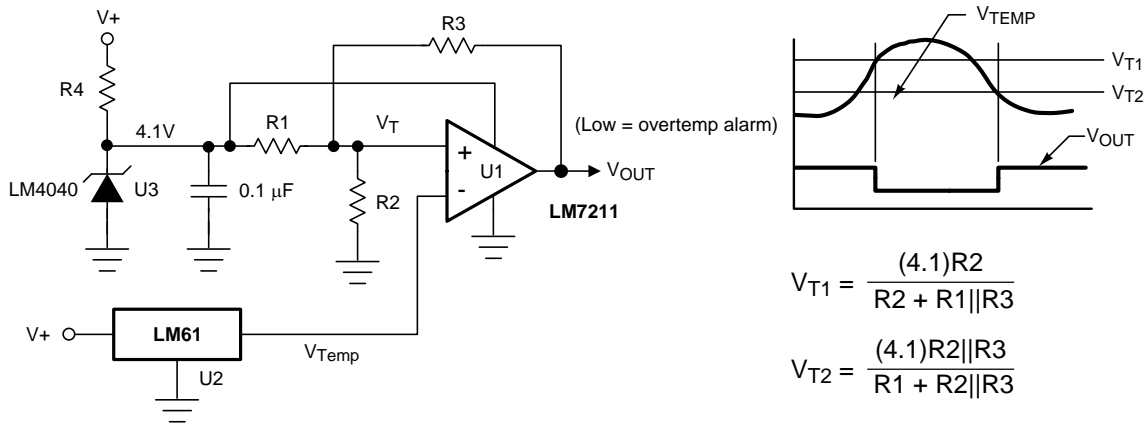


Figure 14. Accuracy vs Temperature

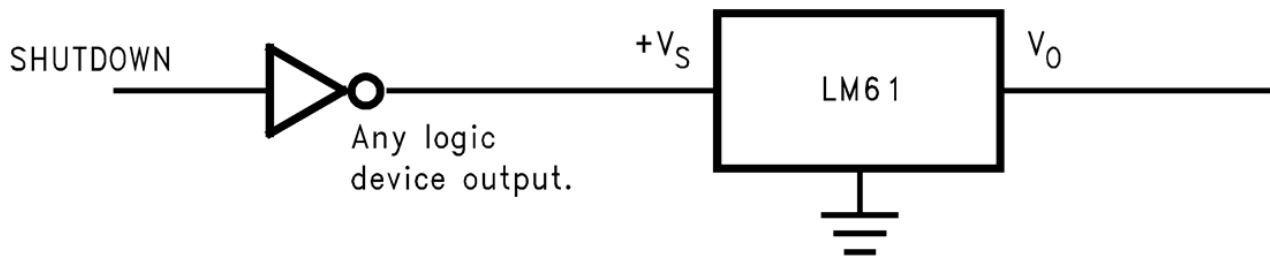
8.2.2 Other Application Circuits

Figure 15 shows an application circuit example using the LM61 device. Customers must fully validate and test any circuit before implementing a design based on an example in this section. Unless otherwise noted, the design procedures in *Typical Temperature Sensing Circuit* are applicable.



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Figure 15. Centigrade Thermostat



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Figure 16. Conserving Power Dissipation with Shutdown

## 9 Power Supply Recommendations

In an extremely noisy environment, it may be necessary to add filtering to minimize noise pickup. TI recommends a 0.1- $\mu$ F capacitor be added between  $+V_S$  to GND to bypass the power-supply voltage, as shown in [Figure 13](#).

## 10 Layout

### 10.1 Layout Guidelines

#### 10.1.1 Mounting

The LM61 can be applied easily in the same way as other integrated-circuit temperature sensors. It can be glued or cemented to a surface. The temperature that the LM61 senses is within about 0.2°C of the surface temperature that LM61's leads are attached to.

This presumes that 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 measured would be at an intermediate temperature between the surface temperature and the air temperatures.

To ensure good thermal conductivity the backside of the LM61 die is directly attached to the GND pin. The lands and traces to the LM61 are part of the printed-circuit board, which is the object whose temperature is being measured.

Alternatively, the LM61 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 LM61 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 device or connections.

### 10.2 Layout Examples

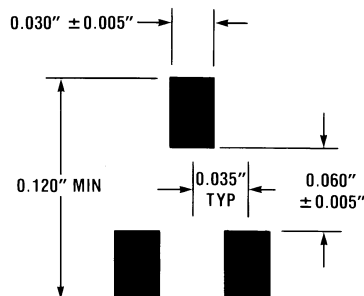
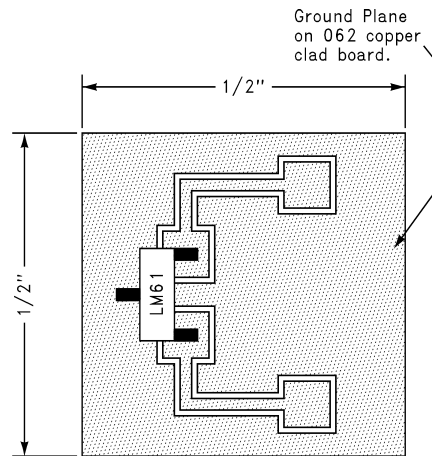


Figure 17. Recommended Solder Pads for SOT-23 Package

Layout Examples (continued)



A. 1/2 in.<sup>2</sup> printed-circuit board with 2 oz copper foil or similar.

Figure 18. Printed-Circuit Board Used for Heat Sink to Generate All Curves

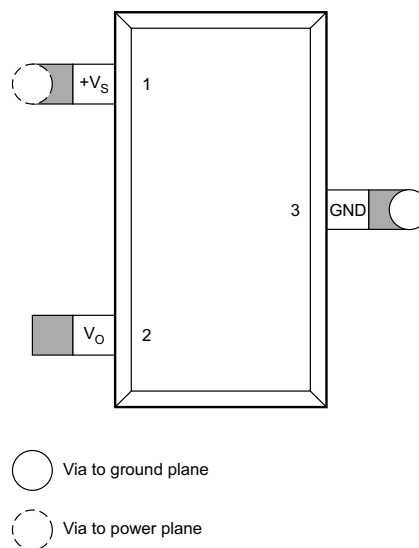


Figure 19. PCB Layout

10.3 Thermal Considerations

The junction-to-ambient thermal resistance is the parameter used to calculate the rise of a device junction temperature due to its power dissipation. For the LM61, Equation 2 is used to calculate the rise in the die temperature.

$$T_J = T_A + R_{\theta JA} \times ((+V_S \times I_Q) + (+V_S - V_O) \times I_L)$$

where

- $I_Q$  is the quiescent current
  - $I_L$  is the load current on the output
- (2)

Table 2 summarizes the rise in die temperature of the LM61 without any loading with a 3.3-V supply, and the thermal resistance for different conditions.

**Table 2. Temperature Rise of LM61 Due to Self-Heating and Thermal Resistance ( $R_{\theta JA}$ )**

			$R_{\theta JA}$ (°C/W)	$T_J - T_A$ (°C)
SOT-23	No heat sink <sup>(1)</sup>	Still air	450	0.26
		Moving air	—	—
	Small heat fin <sup>(2)</sup>	Still air	260	0.13
		Moving air	180	0.09
TO-92	No heat sink <sup>(1)</sup>	Still air	180	0.09
		Moving air	90	0.05
	Small heat fin <sup>(3)</sup>	Still air	140	0.07
		Moving air	70	0.03

(1) Part soldered to 30 gauge wire.

(2) Heat sink used is 1/2 in.<sup>2</sup> printed -circuit board with 2-oz foil with part attached as shown in [Figure 18](#).

(3) Part glued and leads soldered to 1 in.<sup>2</sup> of 1/16 in. printed circuit board with 2-oz foil or similar.

**Table 3. Temperature and Typical  $V_O$  Values**

TEMPERATURE	$V_O$ (TYPICAL)
100°C	1600 mV
85°C	1450 mV
25°C	850 mV
0°C	600 mV
-25°C	350 mV
-30°C	300 mV

## 11 デバイスおよびドキュメントのサポート

### 11.1 関連資料

関連資料については、以下を参照してください。

- 『[TO-92のパッケージ・オプションと注文情報](#)』(SNOA072)
- 『[リモート・システム用の小型温度センサ](#)』(SNIA009)

### 11.2 ドキュメントの更新通知を受け取る方法

ドキュメントの更新についての通知を受け取るには、[ti.com](http://ti.com)のデバイス製品フォルダを開いてください。右上の隅にある「通知を受け取る」をクリックして登録すると、変更されたすべての製品情報に関するダイジェストを毎週受け取れます。変更の詳細については、修正されたドキュメントに含まれている改訂履歴をご覧ください。

### 11.3 コミュニティ・リソース

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](http://e2e.ti.com), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 11.4 商標

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### 11.5 静電気放電に関する注意事項



すべての集積回路は、適切なESD保護方法を用いて、取扱いと保存を行うようにして下さい。

静電気放電はわずかな性能の低下から完全なデバイスの故障に至るまで、様々な損傷を与えます。高精度の集積回路は、損傷に対して敏感であり、極めてわずかなパラメータの変化により、デバイスに規定された仕様に適合しなくなる場合があります。

### 11.6 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 12 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

**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
LM61BIM3	NRND	SOT-23	DBZ	3	1000	Non-RoHS & Green	Call TI	Level-1-260C-UNLIM	-25 to 85	T1B	
LM61BIM3/NOPB	OBSOLETE	SOT-23	DBZ	3		TBD	Call TI	Call TI	-25 to 85	T1B	
LM61BIM3X/NOPB	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-25 to 85	T1B	Samples
LM61BIZ/LFT3	ACTIVE	TO-92	LP	3	2000	RoHS & Green	SN	N / A for Pkg Type		LM61 BIZ	Samples
LM61BIZ/NOPB	ACTIVE	TO-92	LP	3	1800	RoHS & Green	SN	N / A for Pkg Type	-25 to 85	LM61 BIZ	Samples
LM61CIM3	NRND	SOT-23	DBZ	3	1000	Non-RoHS & Green	Call TI	Level-1-260C-UNLIM	-30 to 100	T1C	
LM61CIM3/NOPB	OBSOLETE	SOT-23	DBZ	3		TBD	Call TI	Call TI	-30 to 100	T1C	
LM61CIM3X/NOPB	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-30 to 100	T1C	Samples
LM61CIZ/LFT2	ACTIVE	TO-92	LP	3	2000	RoHS & Green	SN	N / A for Pkg Type		LM61 CIZ	Samples
LM61CIZ/NOPB	ACTIVE	TO-92	LP	3	1800	RoHS & Green	SN	N / A for Pkg Type	-30 to 100	LM61 CIZ	Samples

(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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**TAPE AND REEL INFORMATION**

**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
LM61BIM3	SOT-23	DBZ	3	1000	178.0	8.4	3.3	2.9	1.22	4.0	8.0	Q3
LM61BIM3X/NOPB	SOT-23	DBZ	3	3000	178.0	8.4	3.3	2.9	1.22	4.0	8.0	Q3
LM61CIM3	SOT-23	DBZ	3	1000	178.0	8.4	3.3	2.9	1.22	4.0	8.0	Q3
LM61CIM3X/NOPB	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)
LM61BIM3	SOT-23	DBZ	3	1000	208.0	191.0	35.0
LM61BIM3X/NOPB	SOT-23	DBZ	3	3000	208.0	191.0	35.0
LM61CIM3	SOT-23	DBZ	3	1000	208.0	191.0	35.0
LM61CIM3X/NOPB	SOT-23	DBZ	3	3000	208.0	191.0	35.0

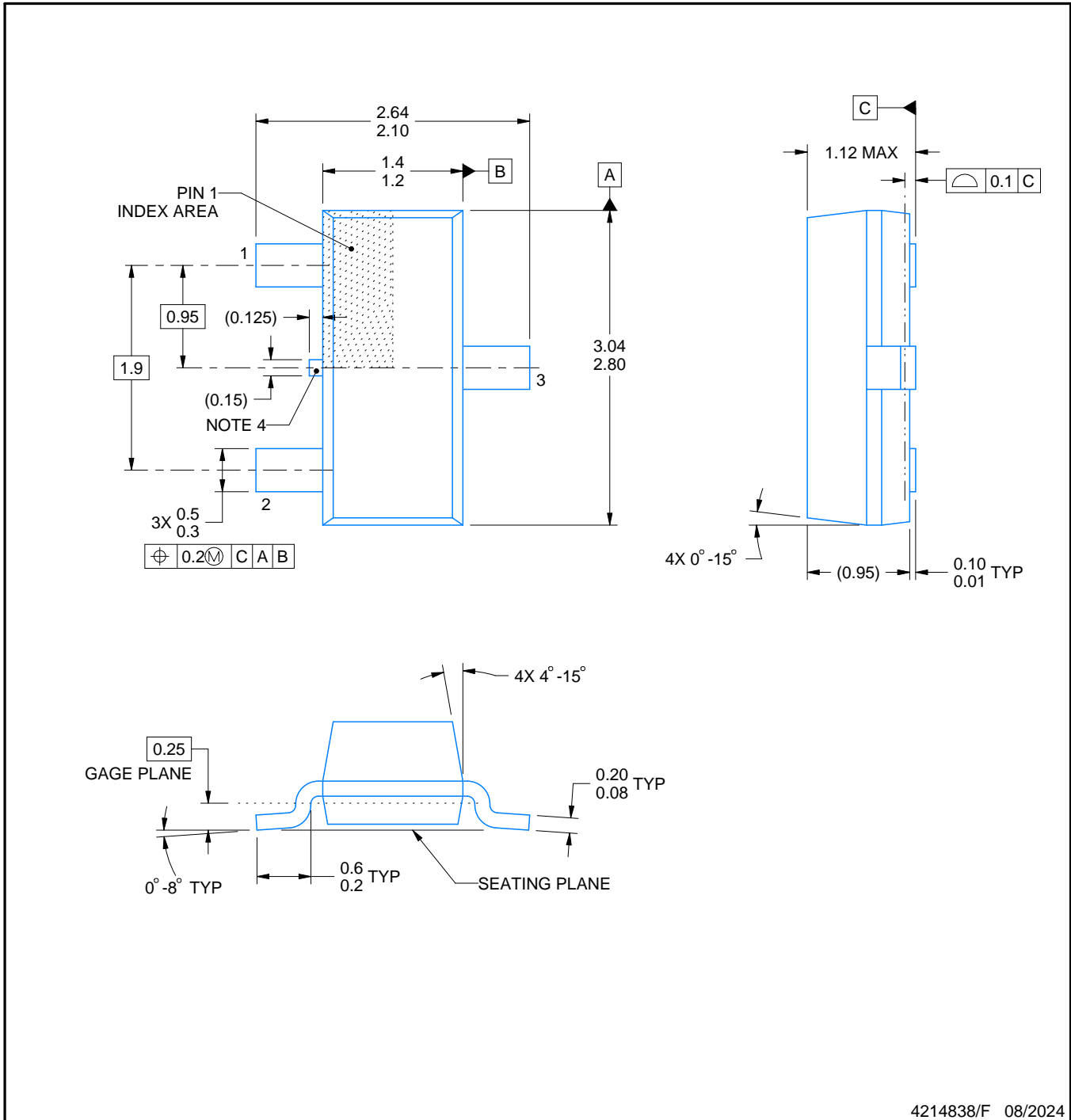
# DBZ0003A



## PACKAGE OUTLINE

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



4214838/F 08/2024

**NOTES:**

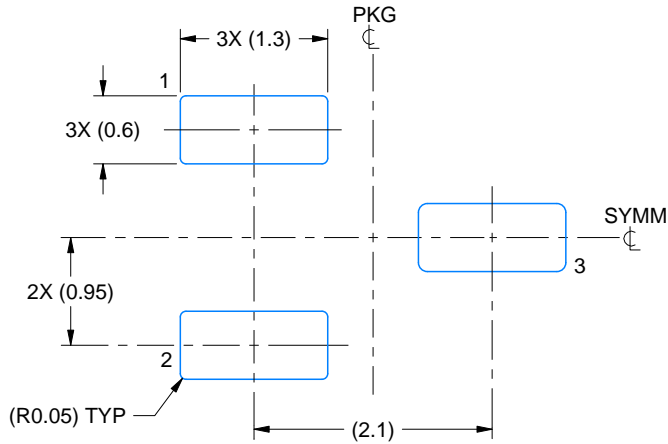
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-236, except minimum foot length.
4. Support pin may differ or may not 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

# EXAMPLE BOARD LAYOUT

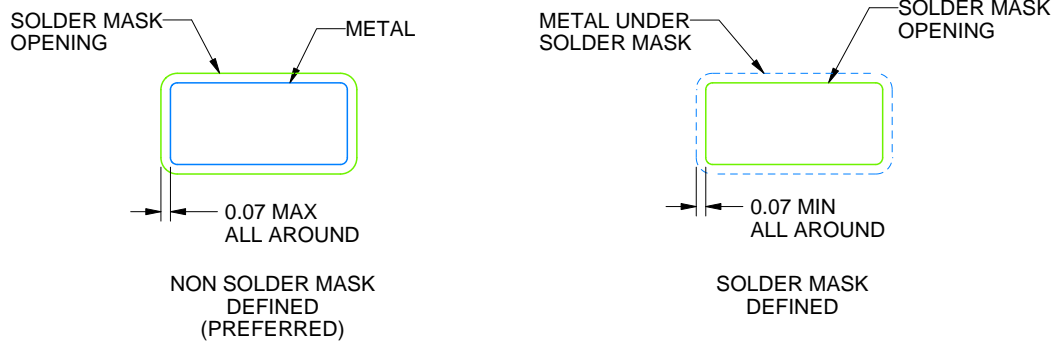
DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
SCALE:15X



SOLDER MASK DETAILS

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NOTES: (continued)

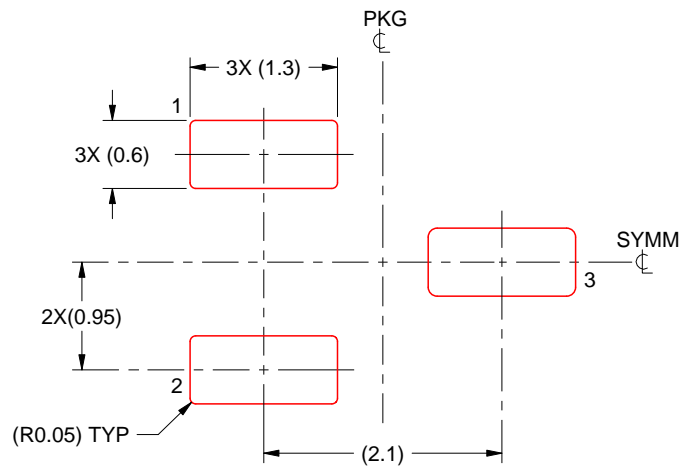
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



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.

## GENERIC PACKAGE VIEW

LP 3

TO-92 - 5.34 mm max height

TRANSISTOR OUTLINE



Images above are just a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.

4040001-2/F

LP0003A



# PACKAGE OUTLINE

TO-92 - 5.34 mm max height

TO-92



4215214/B 04/2017

## 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. Lead dimensions are not controlled within this area.
4. Reference JEDEC TO-226, variation AA.
5. Shipping method:
  - a. Straight lead option available in bulk pack only.
  - b. Formed lead option available in tape and reel or ammo pack.
  - c. Specific products can be offered in limited combinations of shipping medium and lead options.
  - d. Consult product folder for more information on available options.



LAND PATTERN EXAMPLE  
STRAIGHT LEAD OPTION  
NON-SOLDER MASK DEFINED  
SCALE:15X



LAND PATTERN EXAMPLE  
FORMED LEAD OPTION  
NON-SOLDER MASK DEFINED  
SCALE:15X

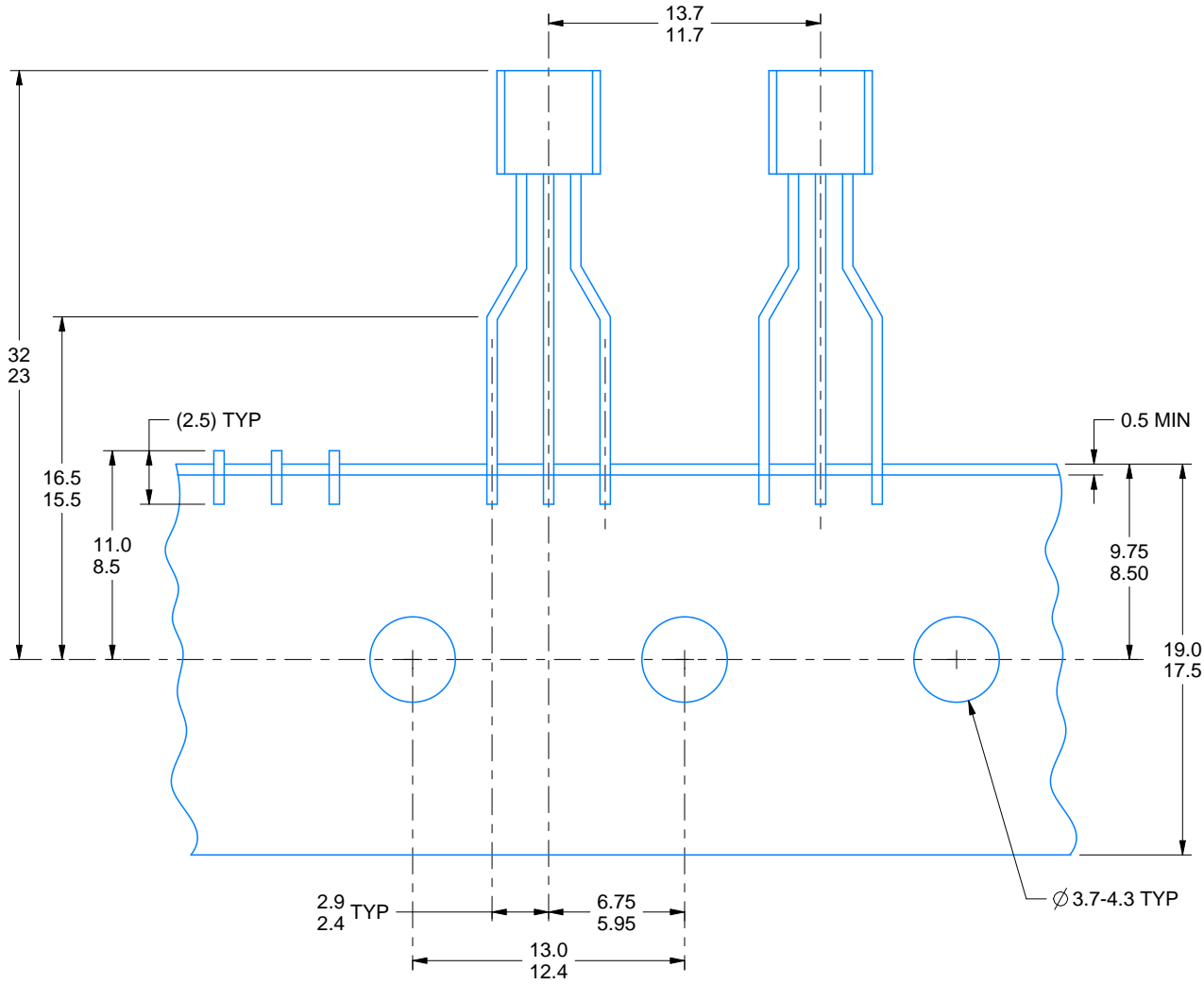


# TAPE SPECIFICATIONS

LP0003A

TO-92 - 5.34 mm max height

TO-92



FOR FORMED LEAD OPTION PACKAGE

4215214/B 04/2017

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