

## LM62 2.7V, 15.6 mV/°C SOT-23 Temperature Sensor

Check for Samples: [LM62](#)

### FEATURES

- Calibrated Linear Scale Factor of +15.6 mV/°C
- Rated for Full 0°C to +90°C Range with 3.0V Supply
- Suitable for Remote Applications

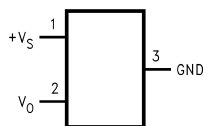
### APPLICATIONS

- Cellular Phones
- Computers
- Power Supply Modules
- Battery Management
- FAX Machines
- Printers
- HVAC
- Disk Drives
- Appliances

### KEY SPECIFICATIONS

- Accuracy at 25°C ±2.0 or ±3.0°C (max)
- Temperature Slope +15.6 mV/°C
- Power Supply Voltage Range +2.7V to +10V
- Current Drain @ 25°C 130 µA (max)
- Nonlinearity ±0.8°C (max)
- Output Impedance 4.7 kΩ (max)

### Connection Diagram



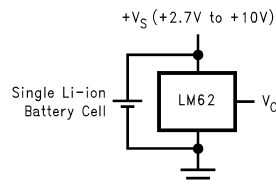
See Package Number DBZ

### DESCRIPTION

The LM62 is a precision integrated-circuit temperature sensor that can sense a 0°C to +90°C temperature range while operating from a single +3.0V supply. The LM62's output voltage is linearly proportional to Celsius (Centigrade) temperature (+15.6 mV/°C) and has a DC offset of +480 mV. The offset allows reading temperatures down to 0°C without the need for a negative supply. The nominal output voltage of the LM62 ranges from +480 mV to +1884 mV for a 0°C to +90°C temperature range. The LM62 is calibrated to provide accuracies of ±2.0°C at room temperature and +2.5°C/–2.0°C over the full 0°C to +90°C temperature range.

The LM62's linear output, +480 mV offset, and factory calibration simplify external circuitry required in a single supply environment where reading temperatures down to 0°C is required. Because the LM62's quiescent current is less than 130 µA, self-heating is limited to a very low 0.2°C in still air. Shutdown capability for the LM62 is intrinsic because its inherent low power consumption allows it to be powered directly from the output of many logic gates.

### Typical Application



$$V_O = (+15.6 \text{ mV}/^\circ\text{C} \times T^\circ\text{C}) + 480 \text{ mV}$$

**Figure 1. Full-Range Centigrade Temp. Sensor (0°C to +90°C) Stabilizing a Crystal Oscillator**

Temperature (T)	Typical $V_O$
+90°C	+1884 mV
+70°C	+1572 mV
+25°C	870 mV
0°C	+480 mV



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

All trademarks are the property of their respective owners.

### Absolute Maximum Ratings<sup>(1)</sup>

Supply Voltage		+12V to -0.2V
Output Voltage		(+V <sub>S</sub> + 0.6V) to -0.6V
Output Current		10 mA
Input Current at any pin <sup>(2)</sup>		5 mA
Storage Temperature		-65°C to +150°C
Junction Temperature, max (T <sub>JMAX</sub> )		+125°C
ESD Susceptibility <sup>(3)</sup>	Human Body Model	2500V
	Machine Model	250V

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
- (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 should be limited to 5 mA.
- (3) The human body model is a 100 pF capacitor discharged through a 1.5 kΩ resistor into each pin. The machine model is a 200 pF capacitor discharged directly into each pin.

### Operating Ratings<sup>(1)</sup>

Specified Temperature Range		<b>T<sub>MIN</sub> ≤ T<sub>A</sub> ≤ T<sub>MAX</sub></b>
LM62B, LM62C		0°C ≤ T <sub>A</sub> ≤ +90°C
Supply Voltage Range (+V <sub>S</sub> )		+2.7V to +10V
Thermal Resistance, θ <sub>JA</sub> <sup>(2)</sup>		450°C/W
Soldering process must comply with Texas Instruments' Reflow Temperature Profile specifications. Refer to <a href="http://www.ti.com/packaging">http://www.ti.com/packaging</a> <sup>(3)</sup>		

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
- (2) The junction to ambient thermal resistance (θ<sub>JA</sub>) is specified without a heat sink in still air.
- (3) Reflow temperature profiles are different for lead-free and non-lead-free packages.

## Electrical Characteristics

Unless otherwise noted, these specifications apply for  $+V_S = +3.0 V_{DC}$ . **Boldface limits apply for  $T_A = T_J = T_{MIN}$  to  $T_{MAX}$** ; all other limits  $T_A = T_J = 25^\circ C$ .

Parameter	Conditions	Typical <sup>(1)</sup>	LM62B	LM62C	Units (Limit)
			Limits <sup>(2)</sup>	Limits <sup>(2)</sup>	
Accuracy <sup>(3)</sup>			$\pm 2.0$	$\pm 3.0$	$^\circ C$ (max)
			<b><math>+2.5/-2.0</math></b>	<b><math>+4.0/-3.0</math></b>	$^\circ C$ (max)
Output Voltage at $0^\circ C$		+480			mV
Nonlinearity <sup>(4)</sup>			<b><math>\pm 0.8</math></b>	<b><math>\pm 1.0</math></b>	$^\circ C$ (max)
Sensor Gain (Average Slope)		+16	<b>+16.1</b> <b>+15.1</b>	<b>+16.3</b> <b>+14.9</b>	mV/ $^\circ C$ (max) mV/ $^\circ C$ (min)
Output Impedance	$+3.0V \leq +V_S \leq +10V$		<b>4.7</b>	<b>4.7</b>	k $\Omega$ (max)
	$0^\circ C \leq T_A \leq +75^\circ C, +V_S = +2.7V$		<b>4.4</b>	<b>4.4</b>	k $\Omega$ (max)
Line Regulation <sup>(5)</sup>	$+3.0V \leq +V_S \leq +10V$		<b><math>\pm 1.13</math></b>	<b><math>\pm 1.13</math></b>	mV/V (max)
	$+2.7V \leq +V_S \leq +3.3V, 0^\circ C \leq T_A \leq +75^\circ C$		<b><math>\pm 9.7</math></b>	<b><math>\pm 9.7</math></b>	mV (max)
Quiescent Current	$+2.7V \leq +V_S \leq +10V$	82	130 <b>165</b>	130 <b>165</b>	$\mu A$ (max) $\mu A$ (max)
Change of Quiescent Current	$+2.7V \leq +V_S \leq +10V$	$\pm 5$			$\mu A$
Temperature Coefficient of Quiescent Current		0.2			$\mu A/^\circ C$
Long Term Stability <sup>(6)</sup>	$T_J = T_{MAX} = +100^\circ C$ , for 1000 hours	$\pm 0.2$			$^\circ C$

- (1) Typicals are at  $T_J = T_A = 25^\circ C$  and represent most likely parametric norm.
- (2) Limits are ensured to Texas Instruments' AOQL (Average Outgoing Quality Level).
- (3) Accuracy is defined as the error between the output voltage and  $+15.6 mV/^\circ C$  times the device's case temperature plus 480 mV, at specified conditions of voltage, current, and temperature (expressed in  $^\circ C$ ).
- (4) 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.
- (5) 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.
- (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 LM62 was mounted to a printed circuit board as shown in Figure 12.

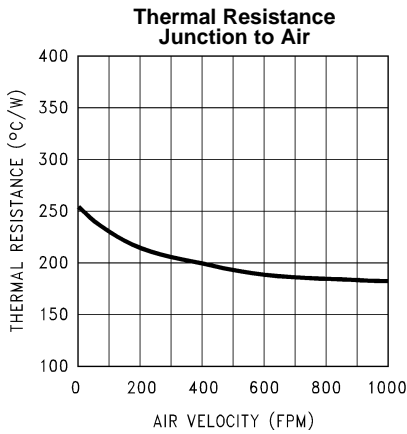


Figure 2.

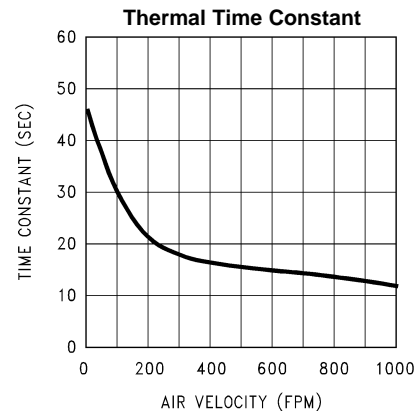


Figure 3.

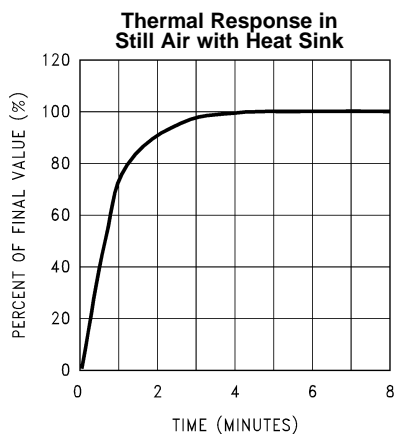


Figure 4.

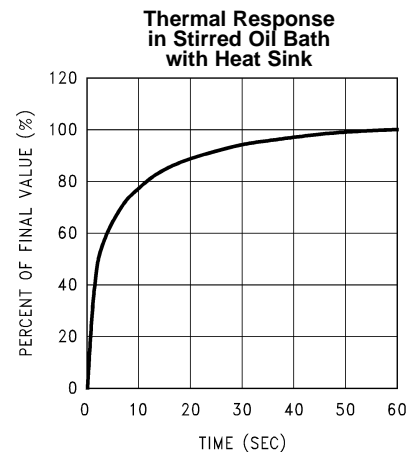


Figure 5.

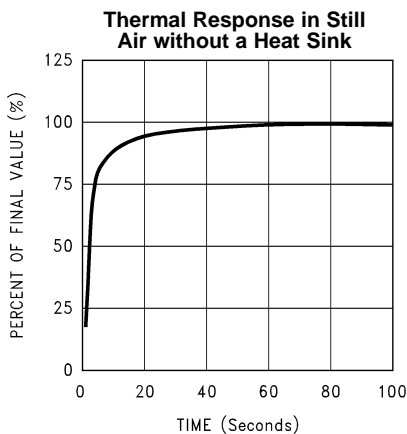


Figure 6.

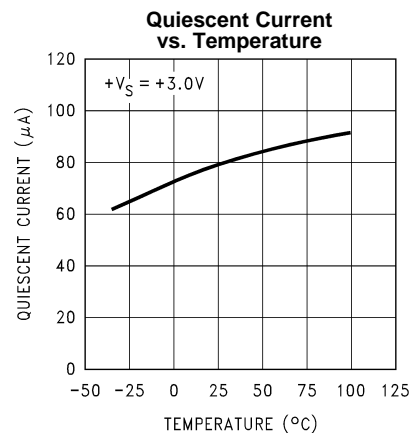


Figure 7.

**Typical Performance Characteristics (continued)**

To generate these curves the LM62 was mounted to a printed circuit board as shown in Figure 12.

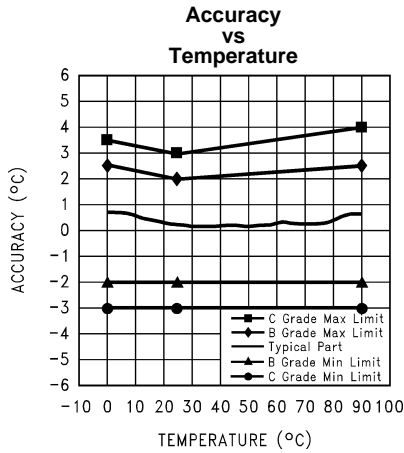


Figure 8.

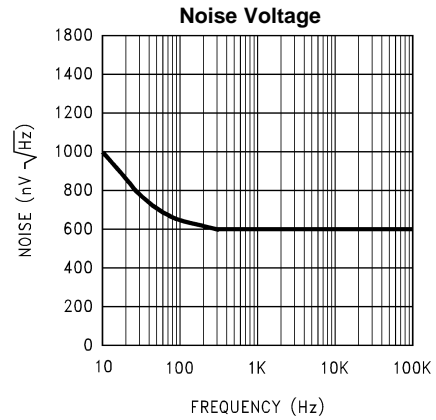


Figure 9.

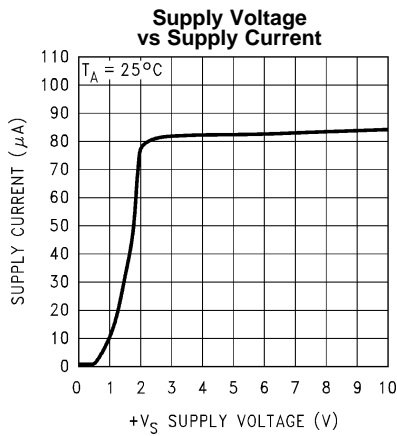


Figure 10.

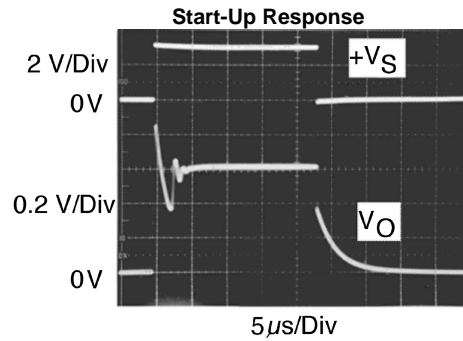
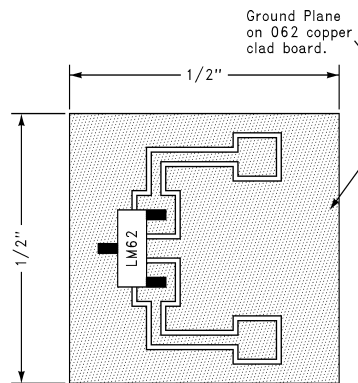


Figure 11.

### CIRCUIT BOARD



1/2" Square Printed Circuit Board with 2 oz. Copper Foil or Similar.

**Figure 12. Printed Circuit Board Used for Heat Sink to Generate All Curves**

### Mounting

The LM62 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 LM62 is sensing will be within about +0.2°C of the surface temperature that LM62's leads are attached to.

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 measured would be at an intermediate temperature between the surface temperature and the air temperature.

To ensure good thermal conductivity the backside of the LM62 die is directly attached to the GND pin. The lands and traces to the LM62 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 LM62's temperature to deviate from the desired temperature.

Alternatively, the LM62 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 LM62 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 LM62 or its connections.

The thermal resistance junction to ambient ( $\theta_{JA}$ ) is the parameter used to calculate the rise of a device junction temperature due to its power dissipation. For the LM62 the equation used to calculate the rise in the die temperature is as follows:

$$T_J = T_A + \theta_{JA} [(+V_S I_Q) + (+V_S - V_O) I_L] \quad (1)$$

where  $I_Q$  is the quiescent current and  $I_L$  is the load current on the output. Since the LM62's junction temperature is the actual temperature being measured care should be taken to minimize the load current that the LM62 is required to drive.

The table shown in [Table 1](#) summarizes the rise in die temperature of the LM62 without any loading, and the thermal resistance for different conditions.

**Table 1. Temperature Rise of LM62 Due to Self-Heating and Thermal Resistance ( $\theta_{JA}$ )**

	SOT-23 no heat sink <sup>(1)</sup>		SOT-23 small heat fin <sup>(2)</sup>	
	$\theta_{JA}$ (°C/W)	$T_J - T_A$ (°C)	$\theta_{JA}$ (°C/W)	$T_J - T_A$ (°C)
Still air	450	0.17	260	0.1
Moving air			180	0.07

(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 12](#).

### Capacitive Loads

The LM62 handles capacitive loading well. Without any special precautions, the LM62 can drive any capacitive load as shown in Figure 13. Over the specified temperature range the LM62 has a maximum output impedance of 4.7 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<sub>S</sub> to GND to bypass the power supply voltage, as shown in Figure 14. In a noisy environment it may be necessary to add a capacitor from the output to ground. A 1 μF output capacitor with the 4.7 kΩ maximum output impedance will form a 34 Hz lowpass filter. Since the thermal time constant of the LM62 is much slower than the 30 ms time constant formed by the RC, the overall response time of the LM62 will not be significantly affected. For much larger capacitors this additional time lag will increase the overall response time of the LM62.

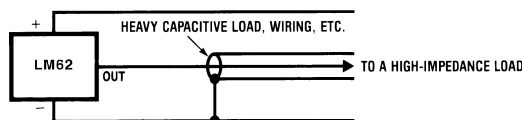


Figure 13. LM62 No Decoupling Required for Capacitive Load

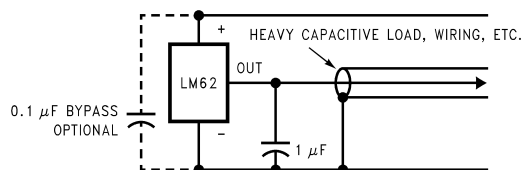


Figure 14. LM62 with Filter for Noisy Environment

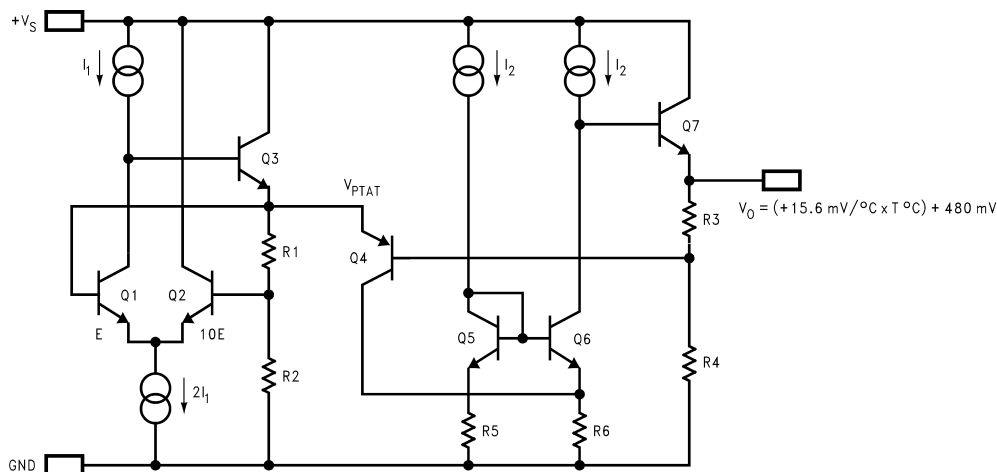


Figure 15. Simplified Schematic

Applications Circuits

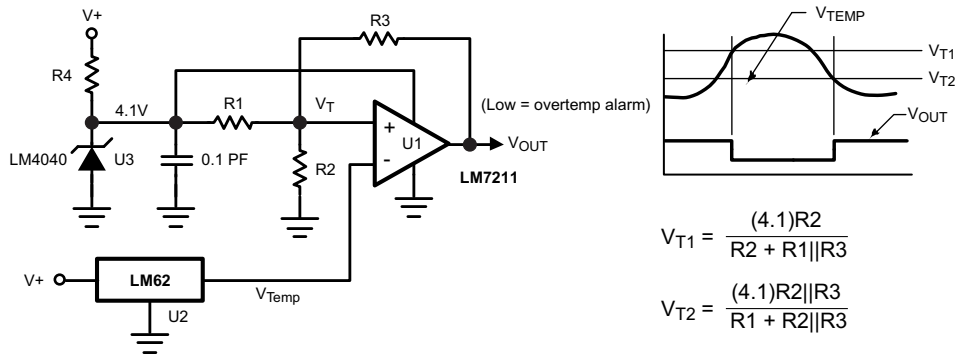


Figure 16. Centigrade Thermostat

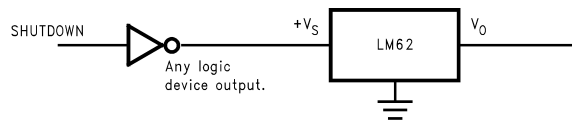


Figure 17. Conserving Power Dissipation with Shutdown



---

**REVISION HISTORY**

<b>Changes from Revision D (March 2013) to Revision E</b>	<b>Page</b>
<hr/> <ul style="list-style-type: none"><li>• Changed layout of National Data Sheet to TI format .....</li></ul>	<hr/> <b>8</b>

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM62BIM3/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 90	T7B	<a href="#">Samples</a>
LM62BIM3X/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 90	T7B	<a href="#">Samples</a>
LM62CIM3/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 90	T7C	<a href="#">Samples</a>
LM62CIM3X/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 90	T7C	<a href="#">Samples</a>

(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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**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
LM62BIM3/NOPB	SOT-23	DBZ	3	1000	178.0	8.4	3.3	2.9	1.22	4.0	8.0	Q3
LM62BIM3X/NOPB	SOT-23	DBZ	3	3000	178.0	8.4	3.3	2.9	1.22	4.0	8.0	Q3
LM62CIM3/NOPB	SOT-23	DBZ	3	1000	178.0	8.4	3.3	2.9	1.22	4.0	8.0	Q3
LM62CIM3X/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

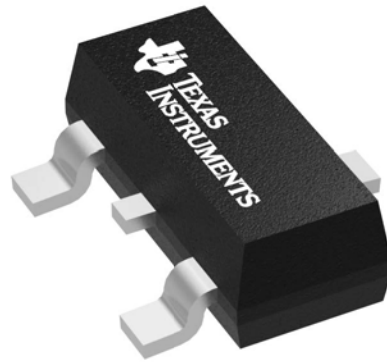
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM62BIM3/NOPB	SOT-23	DBZ	3	1000	210.0	185.0	35.0
LM62BIM3X/NOPB	SOT-23	DBZ	3	3000	210.0	185.0	35.0
LM62CIM3/NOPB	SOT-23	DBZ	3	1000	210.0	185.0	35.0
LM62CIM3X/NOPB	SOT-23	DBZ	3	3000	210.0	185.0	35.0

## GENERIC PACKAGE VIEW

DBZ 3

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



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

4203227/C

## IMPORTANT NOTICE FOR TI DESIGN INFORMATION AND RESOURCES

Texas Instruments Incorporated ("TI") technical, application or other design advice, services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using any particular TI Resource in any way, you (individually or, if you are acting on behalf of a company, your company) agree to use it solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources.

You understand and agree that you remain responsible for using your independent analysis, evaluation and judgment in designing your applications and that you have full and exclusive responsibility to assure the safety of your applications and compliance of your applications (and of all TI products used in or for your applications) with all applicable regulations, laws and other applicable requirements. You represent that, with respect to your applications, you have all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. You agree that prior to using or distributing any applications that include TI products, you will thoroughly test such applications and the functionality of such TI products as used in such applications. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

You are authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING TI RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY YOU AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

You agree to fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of your non-compliance with the terms and provisions of this Notice.

This Notice applies to TI Resources. Additional terms apply to the use and purchase of certain types of materials, TI products and services. These include; without limitation, TI's standard terms for semiconductor products (<http://www.ti.com/sc/docs/stdterms.htm>), [evaluation modules](#), and [samples](http://www.ti.com/sc/docs/sampterm.htm) (<http://www.ti.com/sc/docs/sampterm.htm>).

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2017, Texas Instruments Incorporated