

# 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

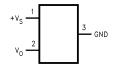
#### **APPLICATIONS**

- 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**



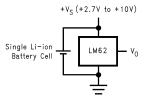
See Package Number DBZ

## 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  $\mu$ A, 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**



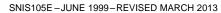
 $V_O = (+15.6 \text{ mV/}^{\circ}\text{C} \times \text{T}^{\circ}\text{C}) + 480 \text{ mV}$ 

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

Temperature (T)	Typical V <sub>O</sub>
+90°C	+1884 mV
+70°C	+1572 mV
+25°C	870 mV
0°C	+480 mV

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

Supply Voltage		+12V to −0.2V
Output Voltage		$(+V_S + 0.6V)$ to $-0.6V$
Output Current		10 mA
Input Current at any pin (2)		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

- 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.
- 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. The human body model is a 100 pF capacitor discharged through a 1.5 k $\Omega$  resistor into each pin. The machine model is a 200 pF capacitor discharged directly into each pin.

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

<u>. i                                     </u>	
Specified Temperature Range	$T_{MIN} \le T_A \le T_{MAX}$
LM62B, LM62C	0°C ≤ T <sub>A</sub> ≤ +90°C
Supply Voltage Range (+V <sub>S</sub> )	+2.7V to +10V
Thermal Resistance, $\theta_{JA}^{(2)}$	450°C/W
Soldering process must comply with Texas Instruments' Reflow Temperature Pro Refer to http://www.ti.com/packaging <sup>(3)</sup>	file specifications.

- (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.
- The junction to ambient thermal resistance  $(\theta_{JA})$  is specified without a heat sink in still air. Reflow temperature profiles are different for lead-free and non-lead-free packages.



## **Electrical Characteristics**

Unless otherwise noted, these specifications apply for  $+V_S = +3.0 \text{ V}_{DC}$ . Boldface limits apply for  $T_A = T_J = T_{MIN}$  to  $T_{MAX}$ ; all other limits  $T_{\Delta} = T_{\perp} = 25^{\circ}C_{\perp}$ 

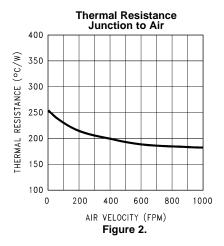
Parameter	Conditions	Typical <sup>(1)</sup>	LM62B	LM62C	Units	
			Limits <sup>(2)</sup>	Limits <sup>(2)</sup>	(Limit)	
Accuracy <sup>(3)</sup>			±2.0	±3.0	°C (max)	
			+2.5/-2.0	+4.0/-3.0	°C (max)	
Output Voltage at 0°C		+480			mV	
Nonlinearity <sup>(4)</sup>			±0.8	±1.0	°C (max)	
Sensor Gain (Average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

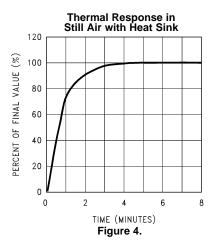
- (1) Typicals are at T<sub>J</sub> = T<sub>A</sub> = 25°C and represent most likely parametric norm.
   (2) Limits are ensured to Texas Instruments' AOQL (Average Outgoing Quality Level).
- Accuracy is defined as the error between the output voltage and +15.6 mV/°C times the device's case temperature plus 480 mV, at specified conditions of voltage, current, and temperature (expressed in °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.
- 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.
- 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.

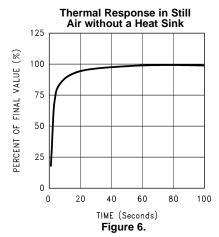


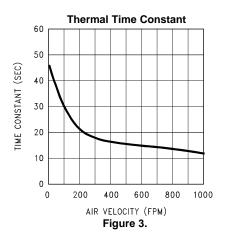
## **Typical Performance Characteristics**

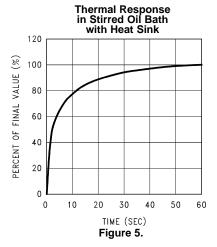
To generate these curves the LM62 was mounted to a printed circuit board as shown in Figure 12.

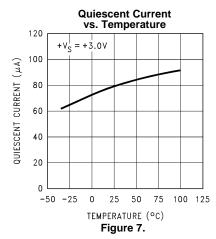














# **Typical Performance Characteristics (continued)**

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

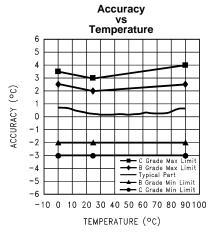
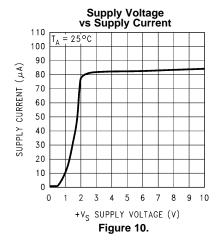
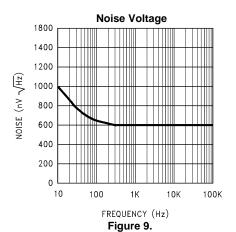


Figure 8.





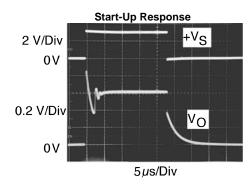
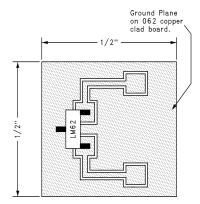


Figure 11.



#### **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:

$$T_{J} = T_{A} + \theta_{JA} \left[ (+V_{S} I_{Q}) + (+V_{S} - V_{Q}) I_{L} \right]$$
 (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 (θ, Δ)

		OT-23 at sink <sup>(1)</sup>	SOT-23 small heat fin <sup>(2)</sup>		
	θ <sub>JA</sub>	T <sub>J</sub> - T <sub>A</sub> (°C)	θ <sub>JA</sub> (°C/W)	T <sub>J</sub> - T <sub>A</sub> (°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 ½" square printed circuit board with 2 oz. foil with part attached as shown in Figure 12.

Product Folder Links: *LM6*2



### **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 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 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  $\mu$ F output capacitor with the 4.7 k $\Omega$  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.

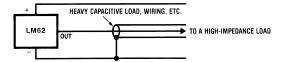


Figure 13. LM62 No Decoupling Required for Capacitive Load

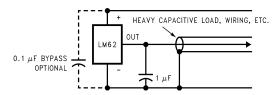


Figure 14. LM62 with Filter for Noisy Environment

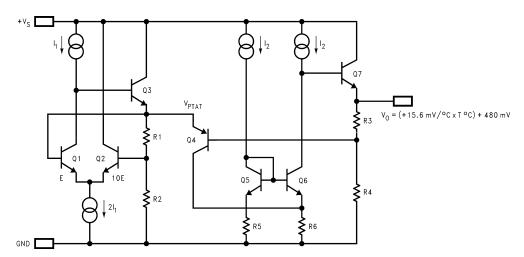


Figure 15. Simplified Schematic



# **Applications Circuits**

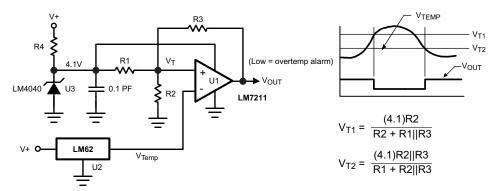


Figure 16. Centigrade Thermostat

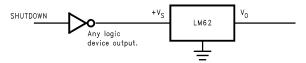


Figure 17. Conserving Power Dissipation with Shutdown



## **REVISION HISTORY**

CI	hanges from Revision D (March 2013) to Revision E	Page
•	Changed layout of National Data Sheet to TI format	8

22-Mar-2013

#### PACKAGING INFORMATION

Orderable Device	Status	Package Type	Package	Pins	Package Qty	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Top-Side Markings	Samples
	(1)		Drawing			(2)		(3)		(4)	
LM62BIM3	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	0 to 90	Т7В	Samples
LM62BIM3/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 90	T7B	Samples
LM62BIM3X	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	0 to 90	Т7В	Samples
LM62BIM3X/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 90	Т7В	Samples
LM62CIM3	ACTIVE	SOT-23	DBZ	3	1000	TBD	Call TI	Call TI	0 to 90	T7C	Samples
LM62CIM3/NOPB	ACTIVE	SOT-23	DBZ	3	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 90	T7C	Samples
LM62CIM3X	ACTIVE	SOT-23	DBZ	3	3000	TBD	Call TI	Call TI	0 to 90	T7C	Samples
LM62CIM3X/NOPB	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 90	T7C	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) 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):** Tl'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.

<sup>(4)</sup> Only one of markings shown within the brackets will appear on the physical device.



# PACKAGE OPTION ADDENDUM

22-Mar-2013

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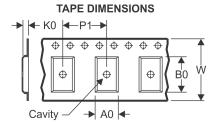
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

PACKAGE MATERIALS INFORMATION

www.ti.com 26-Mar-2013

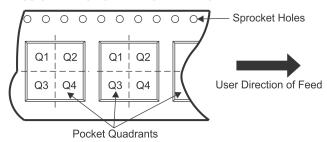
## TAPE AND REEL INFORMATION





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

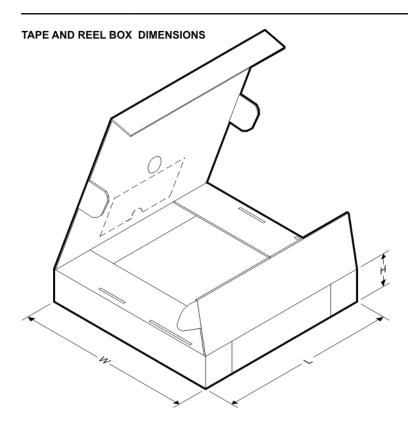
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



#### \*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM62BIM3	SOT-23	DBZ	3	1000	178.0	8.4	3.3	2.9	1.22	4.0	8.0	Q3
LM62BIM3/NOPB	SOT-23	DBZ	3	1000	178.0	8.4	3.3	2.9	1.22	4.0	8.0	Q3
LM62BIM3X	SOT-23	DBZ	3	3000	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	SOT-23	DBZ	3	1000	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	SOT-23	DBZ	3	3000	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

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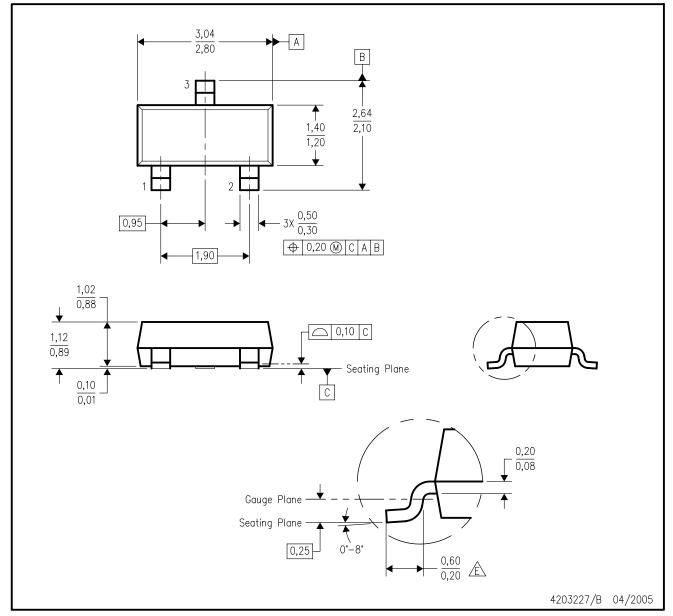


\*All dimensions are nominal

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

# DBZ (R-PDSO-G3)

# PLASTIC SMALL-OUTLINE



NOTES: A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.

- B. This drawing is subject to change without notice.
- C. Lead dimensions are inclusive of plating.
- D. Body dimensions are exclusive of mold flash and protrusion. Mold flash and protrusion not to exceed 0.25 per side.
- Falls within JEDEC TO-236 variation AB, except minimum foot length.



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Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have *not* been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

## Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов:
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001:
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
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- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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