

# ADS124S0x Low-Power, Low-Noise, Highly-Integrated, 6- and 12-Channel, 4-kSPS, 24-Bit, Delta-Sigma ADC with PGA and Voltage Reference

## 1 Features

- Low Power Consumption: As Low As 295  $\mu$ A
- Low-Noise PGA: 19 nV<sub>RMS</sub> at Gain = 128
- Programmable Gain: 1 to 128
- Programmable Data Rates up to 4 kSPS
- Simultaneous 50-Hz and 60-Hz Rejection at 20 SPS with Single-Cycle Settling Digital Filter
- Analog Multiplexer With 12 (ADS124S08) or 6 (ADS124S06) Independently Selectable Inputs
- Dual-Matched Programmable Current Sources for Sensor Excitation: 10  $\mu$ A to 2000  $\mu$ A
- Internal Reference: 2.5 V, 10 ppm/ $^{\circ}$ C (max) Drift
- Internal Oscillator: 4.096 MHz, 1.5% Accuracy
- Internal Temperature Sensor
- Extended Fault Detection Circuits
- Self and System Calibration
- Four General-Purpose I/Os
- SPI-Compatible Interface with Optional CRC
- Analog Supply: Unipolar (2.7 V to 5.25 V) or Bipolar ( $\pm$ 2.5 V)
- Digital Supply: 2.7 V to 3.6 V
- Operating Temperature:  $-50^{\circ}$ C to  $+125^{\circ}$ C

## 2 Applications

- Temperature Sensor Measurements: RTDs, Thermocouples, and Thermistors
- Bridge Sensor Measurements
- Electromagnetic Flow Meters
- Factory Automation and Process Controls

## 3 Description

The ADS124S06 and ADS124S08 are precision, 24-bit, delta-sigma ( $\Delta\Sigma$ ), analog-to-digital converters (ADCs) that offer low power consumption and many integrated features to reduce system cost and component count in applications measuring small-signal sensors.

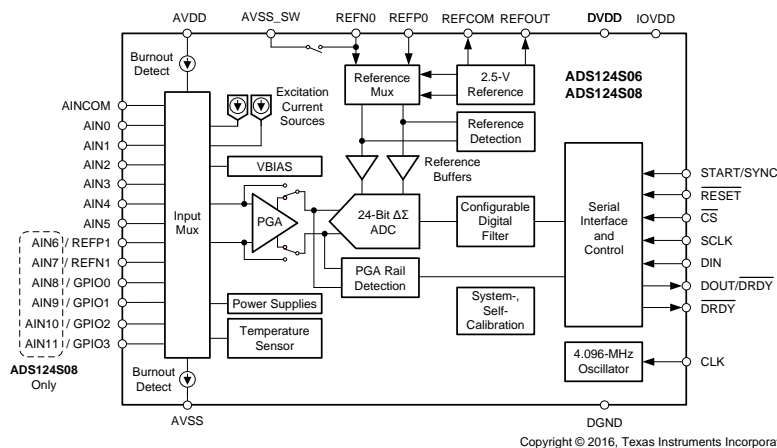
These ADCs feature configurable digital filters that offer single-cycle settling for low-latency conversion results and 50-Hz or 60-Hz rejection for noisy industrial environments. A low-noise, programmable gain amplifier (PGA) provides gains ranging from 1 V/V to 128 V/V to amplify low-level signals for resistive bridge or thermocouple applications. Additionally, the devices integrate a low-drift, 2.5-V reference that reduces printed circuit board (PCB) area. Finally, two programmable excitation current sources (IDACs) allow for easy and accurate RTD biasing.

An input multiplexer supports 12 inputs for the ADS124S08 and six inputs for the ADS124S06 that can be connected to the ADC in any combination for design flexibility. In addition, these devices include features such as sensor burn-out detection, voltage bias for thermocouples, system monitoring, and four general-purpose I/Os.

### Device Information

ORDER NUMBER	PACKAGE (PIN)	BODY SIZE
ADS124S0x	TQFP (32)	5.0 mm x 5.0 mm
	VQFN (32)	5.0 mm x 5.0 mm

### Functional Block Diagram



Copyright © 2016, Texas Instruments Incorporated



## Table of Contents

<b>1 Features</b> .....	<b>1</b>	5.3 Receiving Notification of Documentation Updates....	<b>3</b>
<b>2 Applications</b> .....	<b>1</b>	5.4 Community Resources.....	<b>3</b>
<b>3 Description</b> .....	<b>1</b>	5.5 Trademarks .....	<b>3</b>
<b>4 Revision History</b> .....	<b>2</b>	5.6 Electrostatic Discharge Caution.....	<b>3</b>
<b>5 Device and Documentation Support</b> .....	<b>3</b>	5.7 Glossary .....	<b>3</b>
5.1 Documentation Support .....	<b>3</b>	<b>6 Mechanical, Packaging, and Orderable</b>	
5.2 Related Links .....	<b>3</b>	<b>Information</b> .....	<b>3</b>

## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

<b>Changes from Original (August 2016) to Revision A</b>	<b>Page</b>
• Released as Advanced Information .....	<b>1</b>

## 5 Device and Documentation Support

### 5.1 Documentation Support

#### 5.1.1 Related Documentation

For related documentation see the following:

- [REF50xx Low-Noise, Very Low Drift, Precision Voltage Reference](#) (SBOS410)

### 5.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

**Table 1. Related Links**

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
ADS124S06	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>
ADS124S08	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>

### 5.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 5.4 Community Resources

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, 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.

### 5.5 Trademarks

E2E is a trademark of Texas Instruments.  
All other trademarks are the property of their respective owners.

### 5.6 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 5.7 Glossary

[SLYZ022](#) — *TI Glossary*.

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

## 6 Mechanical, Packaging, and Orderable Information

The following pages include mechanical packaging and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

**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
ADS124S06IPBS	PREVIEW	TQFP	PBS	32	250	TBD	Call TI	Call TI	-50 to 125		
ADS124S06IPBSR	PREVIEW	TQFP	PBS	32	1000	TBD	Call TI	Call TI	-50 to 125		
ADS124S06IRHBR	PREVIEW	VQFN	RHB	32	3000	TBD	Call TI	Call TI	-50 to 125		
ADS124S06IRHBT	PREVIEW	VQFN	RHB	32	250	TBD	Call TI	Call TI	-50 to 125		
ADS124S08IPBS	PREVIEW	TQFP	PBS	32	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-50 to 125	124S08	
ADS124S08IPBSR	PREVIEW	TQFP	PBS	32	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-50 to 125	124S08	
ADS124S08IRHBR	PREVIEW	VQFN	RHB	32	3000	TBD	Call TI	Call TI	-50 to 125	XADS CU 124S08	
ADS124S08IRHBT	PREVIEW	VQFN	RHB	32	250	TBD	Call TI	Call TI	-50 to 125	XADS CU 124S08	

(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.

**OBSELETE:** 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.

<sup>(5)</sup> 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.

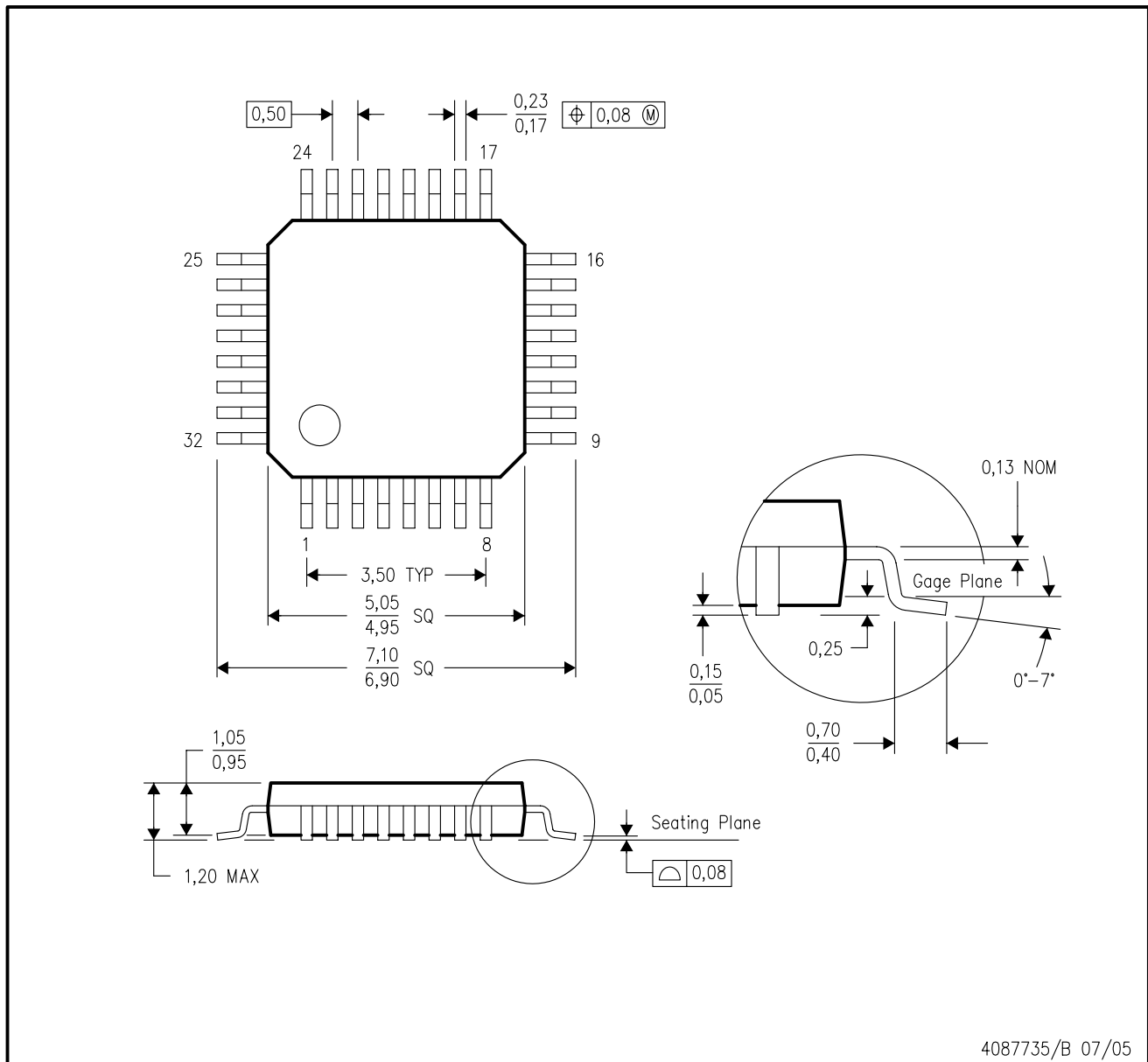
<sup>(6)</sup> Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

**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.

PBS (S-PQFP-G32)

PLASTIC QUAD FLATPACK

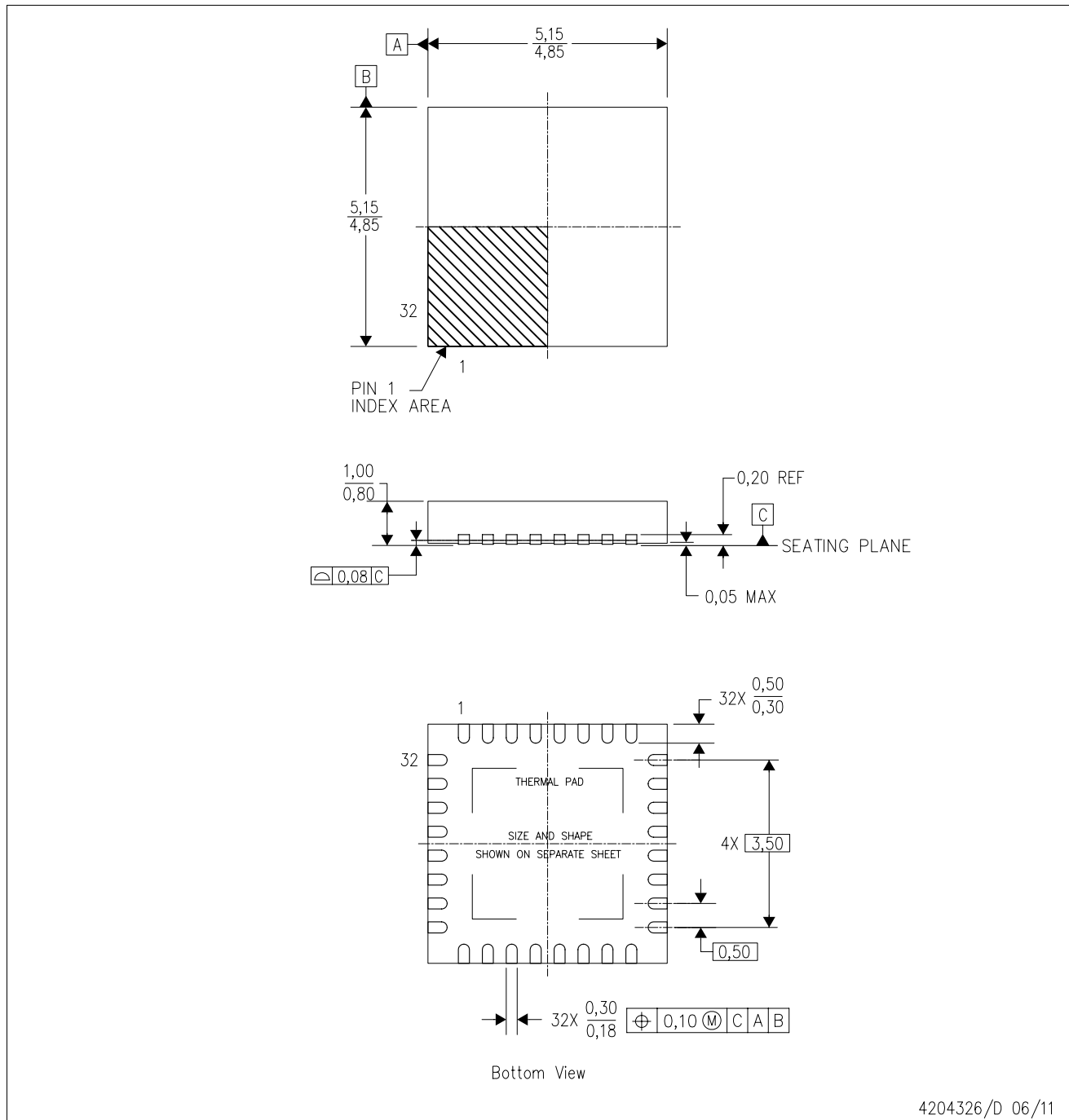


- NOTES: A. All linear dimensions are in millimeters.  
B. This drawing is subject to change without notice.

# MECHANICAL DATA

RHB (S-PVQFN-N32)

PLASTIC QUAD FLATPACK NO-LEAD



4204326/D 06/11

- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - QFN (Quad Flatpack No-Lead) Package configuration.
  - The package thermal pad must be soldered to the board for thermal and mechanical performance.
  - See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
  - Falls within JEDEC MO-220.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information 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.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

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.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)