

TAS5508-5122C6EVM User's Guide

***PurePath Digital™ 5.1 Channel Evaluation Module for the
TAS5508 Digital Audio PWM processor and TAS5122DCA
Digital Amplifier Power Output Stage in Both
Bridge-Tied-Load and Single-Ended Configuration***

User's Guide

TAS5508-5122C6EVM User's Guide

***PurePath Digital™ 5.1 Channel Evaluation Module for the
TAS5508 Digital Audio PWM processor and TAS5122DCA
Digital Amplifier Power Output Stage in Both
Bridge-Tied-Load and Single-Ended Configuration***

User's Guide

Literature Number: SLEU058
October 2004



Contents

| | |
|--|-----------|
| Preface | 5 |
| 1 Overview | 7 |
| 1.1 Overview | 8 |
| 1.2 TAS5508-5122C6EVM Features | 8 |
| 1.3 PCB Key Map | 9 |
| 2 System Interfaces | 11 |
| 2.1 PSU Interface | 12 |
| 2.2 PSU Connector (J70) | 12 |
| 2.3 Loudspeaker Connectors (J100 ... J600) | 13 |
| 2.4 Optional Header for Line Out and Headphone (J10) | 13 |
| 2.5 Digital Audio Interface (J40) | 14 |
| 2.6 Control Interface (J30) | 14 |
| 3 Protection | 17 |
| 3.1 Short Circuit Protection & Fault Reporting Circuitry | 18 |
| 3.2 Device Fault Reporting | 18 |
| Important Notices | 19 |

Read Me First

About This Manual

This manual describes the operation of the TAS5508-5122C6EVM evaluation module from Texas Instruments.

How to Use this Manual

This document contains the following chapters:

Chapter 1 - Overview

Chapter 2 - System Interfaces

Chapter 3 - Protection

Information about Cautions and Warnings

This manual may contain cautions and warnings.

CAUTION

This is an example of a caution statement.

A caution statement describes a situation that could potentially damage your software or equipment.

WARNING

This is an example of a warning statement.

A warning statement describes a situation that could potentially cause harm to you.

The information in a caution or a warning is provided for your protection. Please read each caution and warning carefully.

Related Documentation from Texas Instruments

The following table contains a list of data manuals that have detailed descriptions of the integrated circuits used in the design of the TAS5508-5122C6EVM. The data manuals can be obtained at the URL <http://www.ti.com>.

Table 1. Related documentation from Texas Instruments

| PART NUMBER | LITERATURE NUMBER |
|--------------|-------------------|
| TAS5508 | SLES091B |
| TAS5122 | SLES088D |
| SN74LVC1G08 | SCES217O |
| SN74LVC1G126 | SCES224J |
| LMV331I | SLCS136K |
| TPS76433 | SLVS180B |

Additional Documentation

1. TAS5508-5122C6EVM Applications Report (SLEA042)
2. PC Configuration Tool for TAS5508 (TAS5508 GUI ver. 2.1 or later)
3. General Application Notes

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

Trademarks

PurePath Digital, Equibit are trademarks of Texas Instruments.

Overview

| Topic | Page |
|-------------------------------------|-------------------|
| 1.1 Overview | 8 |
| 1.2 TAS5508-5122C6EVM Features..... | 8 |
| 1.3 PCB Key Map | 9 |

1.1 Overview

The TAS5508-5122C6EVM PurePath Digital™ customer evaluation module demonstrates two integrated circuits TAS5508 and TAS5122DCA from Texas Instruments (TI).

TAS5508PAG is a high performance 32 bit (24 bit input) multichannel PurePath Digital™ Pulse Width Modulator (PWM) based on Equibit™ technology with new fully symmetrical AD modulation scheme. The device also has Digital Audio Processing (DAP) that provides 48-bit signal processing, advanced performance and a high level of system integration. The device has interfaces for headphone output and Power Supply Volume Control (PSVC).

TAS5122DCA is a high performance digital amplifier power stage designed to drive two 8-Ω loudspeakers up to 40 W (10%THD+N) in BTL configuration or four 4-Ω loudspeakers up to 20 W (10%THD+N) in Single Ended configuration. It contains integrated gate-drivers, eight matched and electrically isolated enhancement-mode N-channel power DMOS transistors and protection/fault-reporting circuitry.

This EVM is configured with five SE channels for the satellites and one BTL channel for the subwoofer.

The TAS5508-5122C6EVM, together with a TI input board, is a complete 6-channel digital audio amplifier system which includes digital input (S/PDIF), analog inputs, interface to PC and DAP features like digital volume control, input and output mixers, automute, equalization, tone controls, loudness, dynamic range compression and PSVC output. There are configuration options for stereo line level output, stereo headphone output and power stage failure protection.

The system was design for home theater applications such as DVD minicomponent systems, home theater in a box (HTIB), DVD receivers or Plasma Display Panels (PDP).

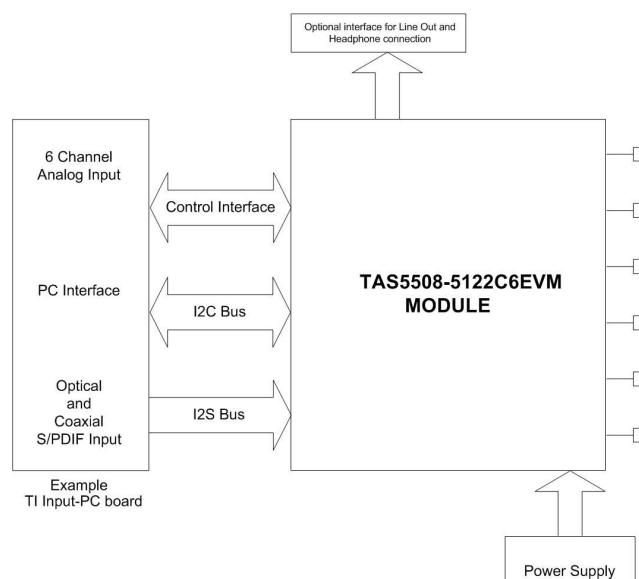


Figure 1-1. Complete PurePath Digital™ System

1.2 TAS5508-5122C6EVM Features

- 6-channel PurePath Digital™ evaluation module design
- Self-contained protection system (short circuit & thermal)
- Standard I2S and I2C / Control connector for TI Input board
- Double-sided plated-through PCB layout

1.3 PCB Key Map

Physical structure for the TAS5508-5122C6EVM is illustrated in the following figure.

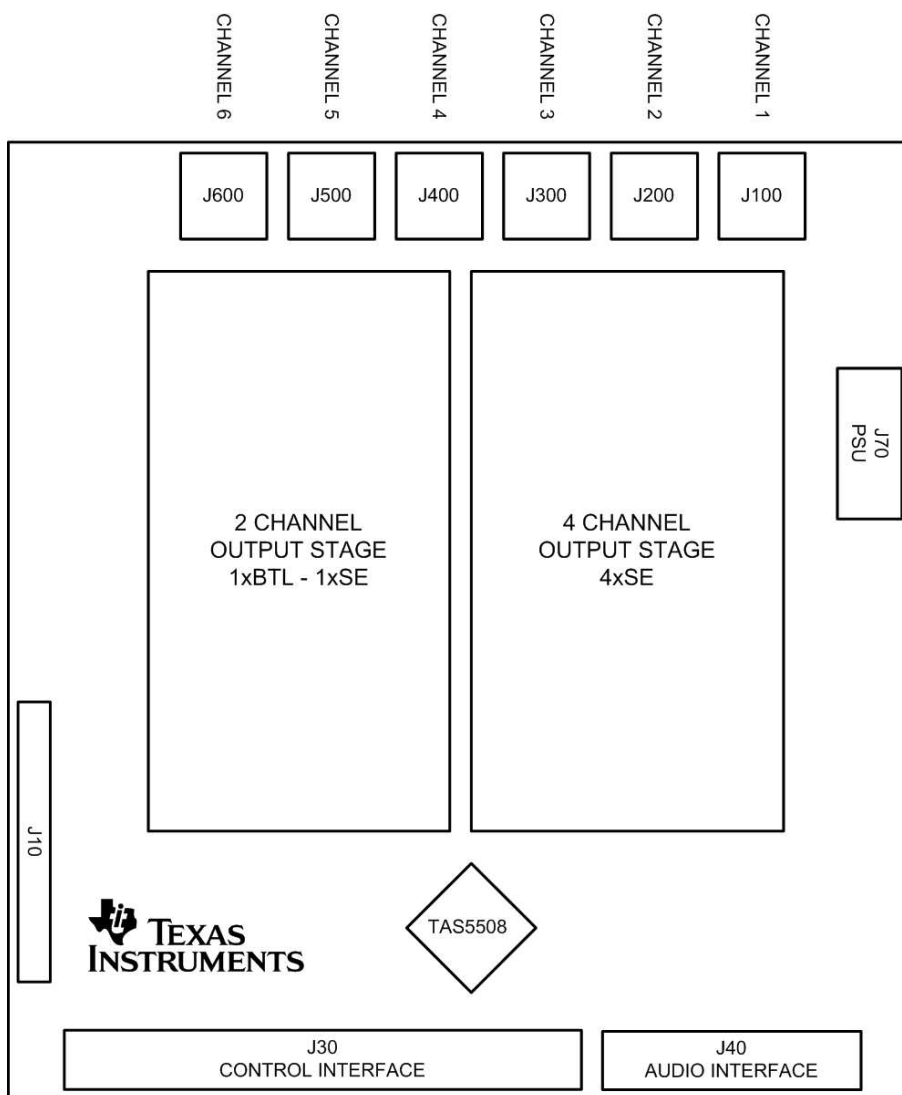


Figure 1-2. Physical Structure for the TAS5508-5122C6EVM (rough outline)

System Interfaces

This chapter describes the TAS5508-5122C6EVM board in regards to power supply (PSU) and system interfaces.

| Topic | Page |
|--|------|
| 2.1 PSU Interface..... | 12 |
| 2.2 PSU Connector (J70) | 12 |
| 2.3 Loudspeaker Connectors (J100 ... J600)..... | 13 |
| 2.4 Optional Header for Line Out and Headphone (J10) | 13 |
| 2.5 Digital Audio Interface (J40) | 14 |
| 2.6 Control Interface (J30) | 14 |

2.1 PSU Interface

The TAS5508-5122C6EVM module must be powered from one or two external regulated power supplies. High audio performance requires a stabilized output stage power supply with low ripple voltage and low output impedance.

NOTE

The length of power supply cable must be minimized. Increasing length of PSU cable is equal to increasing the distortion for the amplifier at high output levels and low frequencies.

Maximum output stage supply voltage depends of the speaker load resistance. Please check the recommended maximum supply voltage in the TAS5122 datasheet.

Table 2-1. Recommended Power Supplies

| DESCRIPTION | VOLTAGE LIMITATIONS(4-8 Ω LOAD) | CURRENT RECOMMENDATIONS |
|---------------------------|--|-------------------------|
| System power supply | 15 V – 25 V | 0.25 A |
| Output power stage supply | 0 – 25 V | 2.7 A ⁽¹⁾ |

(1) The rated current correspond to two channels (Ch 1-5) full scale (15W/4ohm each) + one channel (CH 6) full scale (30W/8ohm), which most likely is adequate for a standard 6 channel amplifier design.

The recommended TAS5122 power-up sequence is shown in the following figure. For proper TAS5122 operation the RESET signal should be kept low during power-up. RESET is pulled low during power-up for 200 ms by the onboard reset generator (U80).

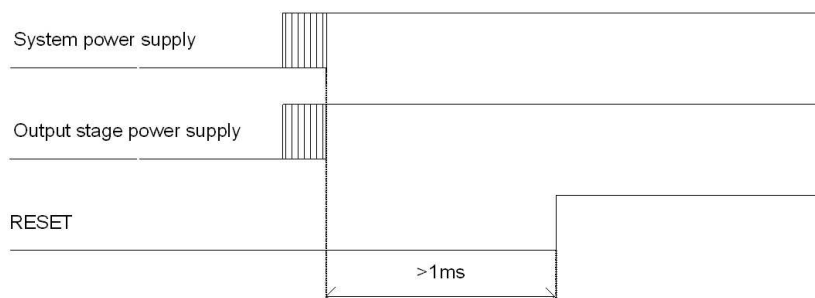


Figure 2-1. Recommended Power Up Sequence

2.2 PSU Connector (J70)



Figure 2-2. J70 Pin Numbers (PCB connector top view)

Table 2-2. J70 Pin Description

| PIN NUMBER | NET-NAME AT SCHEMATICS | DESCRIPTION |
|------------|------------------------|---------------------------|
| 1 | VDD | Output stage power supply |
| 2 | - | System power supply |
| 3 | GND | Ground |
| 4 | GND | Ground |

2.3 Loudspeaker Connectors (J100 ... J600)

CAUTION
Both positive and negative speaker outputs are floating and may not be connected to ground (e.g. through an oscilloscope).



Figure 2-3. J100 ... J600 Pin Numbers (PCB connector top view)

Table 2-3. J100 - J600 Pin Description

| PIN NUMBER | NET-NAME AT SCHEMATICS | DESCRIPTION |
|------------|------------------------|-------------------------|
| 1 | OUT_A | Speaker negative output |
| 2 | OUT_B | Speaker positive output |

2.4 Optional Header for Line Out and Headphone (J10)

This is a optional interface for line out and headphone connections.

Table 2-4. J10 Pin Description

| PIN NUMBER | DESCRIPTION |
|------------|---|
| 1 | Left line out channel PWM (M) |
| 2 | Left line out channel PWM (P) |
| 3 | /Valid for line out channels |
| 4 | Right line out channel PWM (M) |
| 5 | Right line out channel PWM (P) |
| 6 | Ground |
| 7 | Left headphone channel (M) |
| 8 | Left headphone channel (P) |
| 9 | Right headphone channel (M) |
| 10 | Right headphone channel (P) |
| 11 | Headphone select – Active when low and inactive when high |
| 12 | Ground |

2.5 Digital Audio Interface (J40)

The digital audio interface contains digital audio signal data (I2S), clocks etc. Please see TAS5508 data manual for signal timing and details not explained in this document.

Table 2-5. J40 Pin Description

| PIN NUMBER | NET-NAME AT SCHEMATICS | DESCRIPTION |
|------------|------------------------|---|
| 1 | GND | Ground |
| 2 | MCLK | Master Clock input. Low jitter system clock for PWM generation and reclocking. Ground connection from source to TAS5508 must be a low impedance connection. |
| 3 | GND | Ground |
| 4 | SDIN1 | I2S Data 1, Channel 1 and 2 |
| 5 | SDIN2 | I2S Data 2, Channel 3 and 4 |
| 6 | SDIN3 | I2S Data 3, Channel 5 and 6 |
| 7 | SDIN4 | I2S Data 4, Channel 7 and 8 |
| 8 | - | Reserved |
| 9 | - | Reserved |
| 10 | GND | Ground |
| 11 | SCLK | I2S bit clock. |
| 12 | GND | Ground |
| 13 | LRCLK | I2S left-right clock |
| 14 | GND | Ground |
| 15 | - | Reserved |
| 16 | GND | Ground |

2.6 Control Interface (J30)

This interface connects the TAS5508-5122C6EVM board to a TI input board.

Table 2-6. J40 Pin Description

| PIN NUMBER | NET-NAME AT SCHEMATICS | DESCRIPTION |
|------------|------------------------|--|
| 1 | GND | Ground |
| 2 | - | Reserved |
| 3 | GND | Ground |
| 4 | /RESET | System reset (bi-directional). Activate MUTE before RESET for quiet reset |
| 5 | /BKND_ERR | Backend error (or soft reset) provides reduced click and pop reset, without resetting I2C volume register settings |
| 6 | /MUTE | Ramp volume from any setting to noiseless soft mute. Mute can also be activated by I2C |
| 7 | /PDN | Power down. TAS5508 will go to power down state when activated |
| 8 | - | Reserved |
| 9 | - | Reserved |
| 10 | SDA | I2C data clock |
| 11 | GND | Ground |
| 12 | SCL | I2C bit clock |

Table 2-6. J40 Pin Description (continued)

| PIN NUMBER | NET-NAME AT SCHEMATICS | DESCRIPTION |
|------------|------------------------|---|
| 13 | - | Reserved |
| 14 | - | Reserved |
| 15 | - | Reserved |
| 16 | - | Reserved |
| 17 | GND | Ground |
| 18 | - | Reserved |
| 19 | - | Reserved |
| 20 | /SD | Shutdown error reporting for all channels. Activated if TAS5122 has high current or high temperature for ~100 mS. See chapter 3: Protection |
| 21 | - | Reserved |
| 22 | /OTW | Temperature warning. Activated with low signal if one or more TAS5122 has reached temperature warning level |
| 23 | - | Reserved |
| 24 | /HP_SEL | Headphone select. Headphone active when low and inactive when high. Default setting is high. |
| 25 | GND | Ground |
| 26 | GND | Ground |
| 27 | - | Reserved |
| 28 | - | Reserved |
| 29 | - | Reserved |
| 30 | - | Reserved |
| 31 | GND | Ground |
| 32 | GND | Ground |
| 33 | +5V | +5Vdc power supply (output) |
| 34 | +5V | +5Vdc power supply (output) |

Protection

| Topic | Page |
|--|-----------|
| 3.1 Short Circuit Protection & Fault Reporting Circuitry | 18 |
| 3.2 Device Fault Reporting | 18 |

3.1 Short Circuit Protection & Fault Reporting Circuitry

TAS5122 is a self-protecting device that provides device fault reporting (including high-temperature protection and short circuit protection). TAS5122 is configured in back-end auto-recovery mode and therefore resets automatically after all errors (M1 and M2 is set low). This mean that the device will re-start it self after a error occasion and report shortly through the \overline{SD} error signal.

3.2 Device Fault Reporting

The \overline{OTW} , $\overline{SD_AB}$, and $\overline{SD_CD}$ outputs from TAS5122 indicate fault conditions. Please refer to the TAS5122 data manual for a description of these pins.

Table 3-1. TAS5122 Error Signal Decoding

| \overline{OTW} | $\overline{SD_XX}$ | DESCRIPTION |
|------------------|---------------------|--|
| 0 | 0 | High temperature error and/or high current error |
| 0 | 1 | High temperature warning |
| 1 | 0 | Under voltage lockout or high current error |
| 1 | 1 | Normal operation, no errors/warnings |

The temperature warning (\overline{OTW}) signals at the TAS5508-5122C6EVM board are wired-or to one temperature warning signal ($\overline{TEMP_WARNING}$ – pin 22 in control interface connector). Shutdown signals ($\overline{SD_AB}$ and $\overline{SD_CD}$) are wired-or to one shutdown signal ($\overline{SHUTDOWN}$ – pin 20 in control interface connector). The shutdown signals will together with the temperature warning signal give information on the chip state information as described in the table above. Device fault reporting outputs are open-drain outputs.

FCC Warnings

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

EVM IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation kit being sold by TI is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not considered by TI to be fit for commercial use. As such, the goods being provided may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety measures typically found in the end product incorporating the goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may not meet the technical requirements of the directive.

Should this evaluation kit not meet the specifications indicated in the EVM User's Guide, the kit may be returned within 30 days from the date of delivery for a full refund. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.**

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Please be aware that the products received may not be regulatory compliant or agency certified (FCC, UL, CE, etc.). Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE Liable to the other FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

Please read the EVM User's Guide and, specifically, the EVM Warnings and Restrictions notice in the EVM User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact the TI application engineer.

Persons handling the product must have electronics training and observe good laboratory practice standards.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 15 V to 25 V and the output voltage range of 0 V to 25 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 75° C. The EVM is designed to operate properly with certain components above 75° C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2004, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

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

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

| | |
|--------------------|--|
| Amplifiers | amplifier.ti.com |
| Data Converters | dataconverter.ti.com |
| DSP | dsp.ti.com |
| Interface | interface.ti.com |
| Logic | logic.ti.com |
| Power Mgmt | power.ti.com |
| Microcontrollers | microcontroller.ti.com |
| RFID | www.ti-rfid.com |
| Low Power Wireless | www.ti.com/lpw |

Applications

| | |
|--------------------|--|
| Audio | www.ti.com/audio |
| Automotive | www.ti.com/automotive |
| Broadband | www.ti.com/broadband |
| Digital Control | www.ti.com/digitalcontrol |
| Military | www.ti.com/military |
| Optical Networking | www.ti.com/opticalnetwork |
| Security | www.ti.com/security |
| Telephony | www.ti.com/telephony |
| Video & Imaging | www.ti.com/video |
| Wireless | www.ti.com/wireless |

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated