

TAS5504-5142V4EVM User's Guide

***Evaluation Module for TAS5504A 4-Channel Digital Audio
PWM Processor and TAS5142 Digital Amplifier
Power-Output Stage***

User's Guide

Preface	5
1 Overview	7
1.1 TAS5504-5142V4EVM Features.....	8
1.2 PCB Key Map	9
2 System Interfaces	11
2.1 Power Supply (PSU) Interface (J70).....	12
2.2 Loudspeaker Connectors (J100 . . . J400).....	13
2.3 Control Interface (J40).....	14
2.4 Digital Audio Interface (J60)	15
3 Protection	17
3.1 Short-Circuit Protection and Fault-Reporting Circuitry	18
3.2 Fault Reporting	18
4 Configuration for 2.1 System	19
4.1 TAS5504-5542V4EVM for 2.1 System	20
4.2 PCB Key Map for 2.1 Configuration	21
Important Notices	22

List of Figures

1-1	Integrated PurePath Digital™ Amplifier System	8
1-2	Physical Structure for TAS5504-5142V4EVM (Rough Outline)	9
2-1	Recommended Power-Up Sequence	12
2-2	J70 Pin Numbers	12
2-3	J100 . . . J400 Pin Numbers	13
4-1	Integrated PurePath Digital™ Amplifier 2.1 System	20
4-2	Physical Structure for TAS5504-5142V4EVM (Rough Outline)	21

List of Tables

1	Related Documentation From TI	6
2-1	Recommended Supply Voltages	12
2-2	J70 Pin Description	13
2-3	J100 . . . J400 Pin Description	13
2-4	J40 Pin Description	14
2-5	J60 Pin Description	15
3-1	TAS5152 Warning/Error Signal Decoding	18
4-1	TAS5504A Register Settings	20

Read Me First

About This Manual

This manual describes the operation of the TAS5504-5142V4EVM evaluation module from Texas Instruments (TI).

How to Use This Manual

This document contains the following chapters:

Chapter 1 - Overview

Chapter 2 - System Interfaces

Chapter 3 - Protection

Chapter 4 - Configuration for 2.1 System

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 TI

[Table 1](#) contains a list of data manuals that have detailed descriptions of the integrated circuits used in the design of TAS5504-5142V4EVM. The data manuals can be obtained at <http://www.ti.com>.

Table 1. Related Documentation From TI

PART NUMBER	LITERATURE NUMBER
TAS5504A	SLES169
TAS5142	SLES126
LM358	SLOS068
UA78M12	SLVS059
TPS76733	SLVS208

Additional Documentation

- q *TAS5504-5142V4EVM Application Report (SLEA060)*
- q *PC Configuration Tool for TAS5504 (TAS5508 GUI Ver. 4.0 or later)*
- q General application notes

Trademarks

Equibit™, PowerPAD™, and PurePath Digital™ are trademarks of Texas Instruments.

Overview

The TAS5504-5142V4EVM PurePath Digital™ customer evaluation amplifier module demonstrates two audio integrated circuits, TAS5504A and TAS5142, from Texas Instruments (TI).

The TAS5504APAG is a high-performance 32-bit (24-bit input) multichannel PurePath Digital pulse width modulator (PWM) based on Equibit technology, with a fully symmetrical AD modulation scheme. It accepts input sample rates from 32 kHz to 192 kHz. 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).

The TAS5142DDV is a compact, high-power, digital amplifier power stage designed to drive a 4-Ω loudspeaker up to 100 W/10% THD+N. It contains integrated gate drivers, eight matched and electrically isolated enhancement-mode N-channel power DMOS transistors, and protection/fault-reporting circuitry.

The DDV package has a PowerPAD™ on the top side for heat transfer through a heatsink. The heat sink in this design is for evaluation purpose only.

This EVM, together with a TI input-USB board, is a complete 4-channel (or 2.1-channel) digital audio amplifier system that includes digital input (S/PDIF), analog inputs, interface to PC, and DAP features, such as digital volume control, input and output mixers, auto mute, equalization, tone controls, loudness, and dynamic range compression.

This system is designed for home theater applications, such as flatscreen TVs, DVD minicomponent systems, home theater in a box (HTIB), or DVD receivers.

Topic	Page
1.1 TAS5504-5142V4EVM Features	8
1.2 PCB Key Map	9

1.1 TAS5504-5142V4EVM Features

- 4-channel (or 2.1-channel) PurePath Digital evaluation module
- Self-contained protection system (short circuit and thermal)
- Standard I²S and I²C/control connector for TI input board
- Double-sided plated-through PCB layout

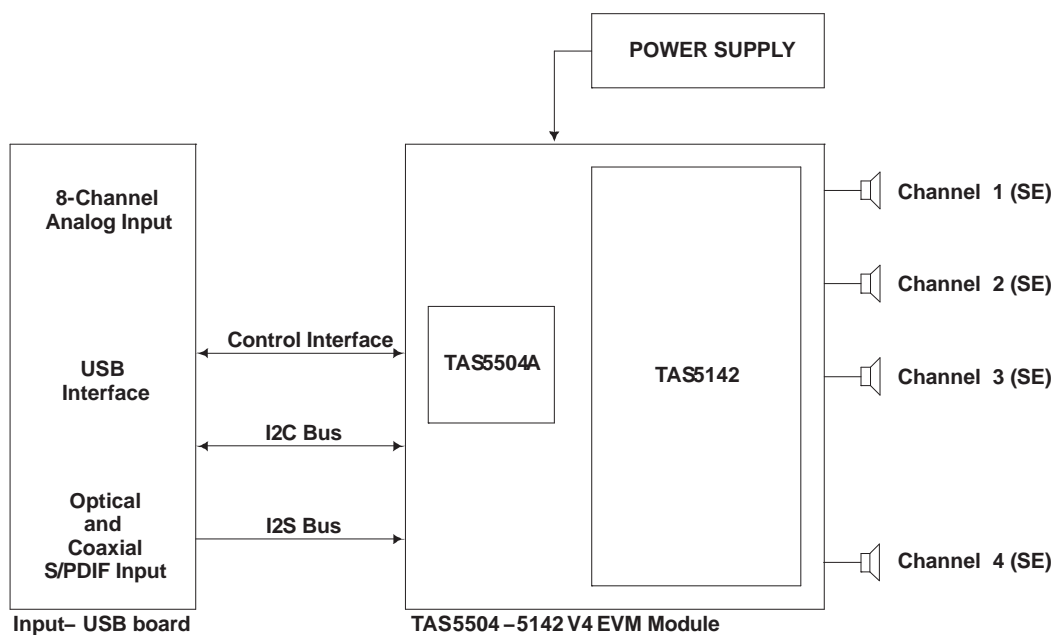


Figure 1-1. Integrated PurePath Digital™ Amplifier System

1.2 PCB Key Map

Physical structure for the TAS5504-5142V4EVM is illustrated in Figure 1-2.

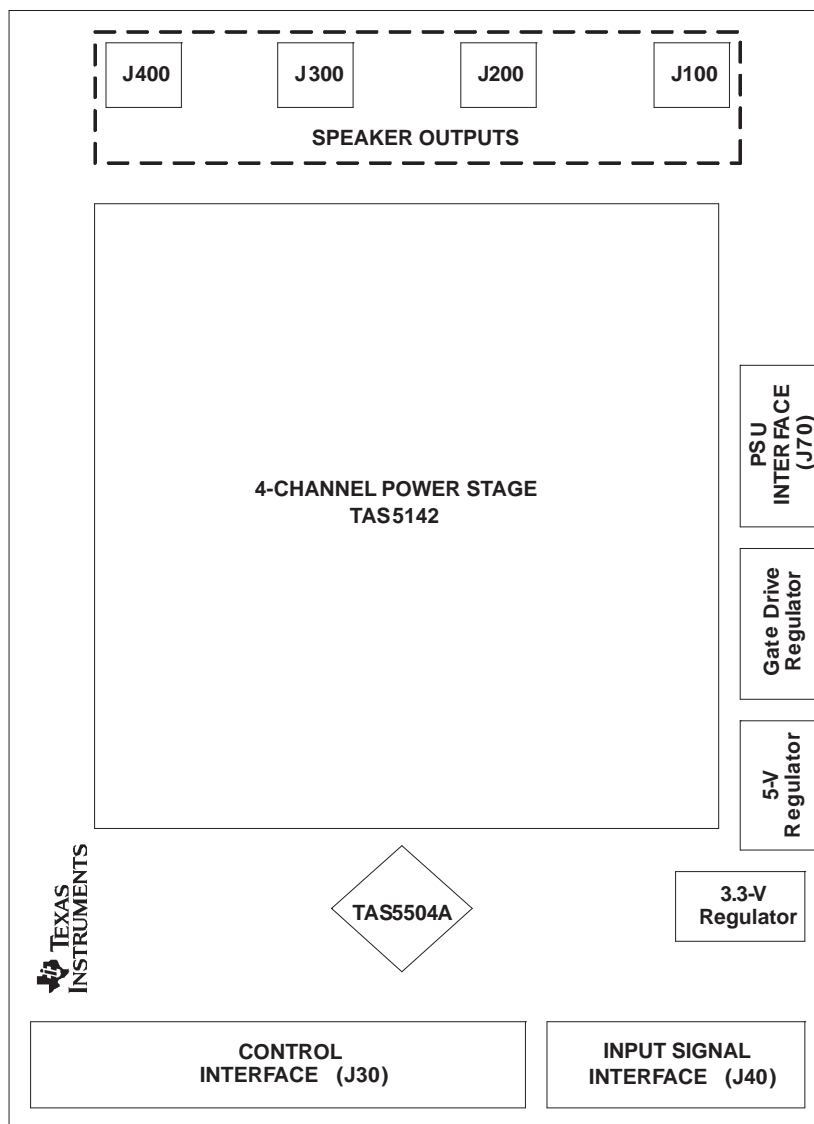


Figure 1-2. Physical Structure for TAS5504-5142V4EVM (Rough Outline)

System Interfaces

This chapter describes the TAS5504-5142V4EVM board, with regard to power supplies and system interfaces.

Topic	Page
2.1 Power Supply (PSU) Interface (J70).....	12
2.2 Loudspeaker Connectors (J100 . . . J400).....	13
2.3 Control Interface (J40)	14
2.4 Digital Audio Interface (J60)	15

2.1 Power Supply (PSU) Interface (J70)

The TAS5504-5142V4EVM module must be powered from external power supplies. High-end audio performance requires a stabilized power supply, with low ripple voltage and low output impedance.

Note: The length of power-supply cable must be minimized. Increasing the 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. Check the recommended maximum supply voltage in the TAS5142 data sheet.

Table 2-1. Recommended Supply Voltages

DESCRIPTION	VOLTAGE LIMITATIONS (4-Ω LOAD)	CURRENT RECOMMENDATIONS
System power supply	15 V – 20 V	0.2 A
Output-stage power supply	0 V – 32 V	2 A ⁽¹⁾

⁽¹⁾ The rated current corresponds to two-channel full scale (30 W each), which most likely is adequate for a standard 2.1 channel amplifier design.

The recommended TAS5142 power-up sequence is shown in [Figure 2-1](#). For proper TAS5142 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 (U73).

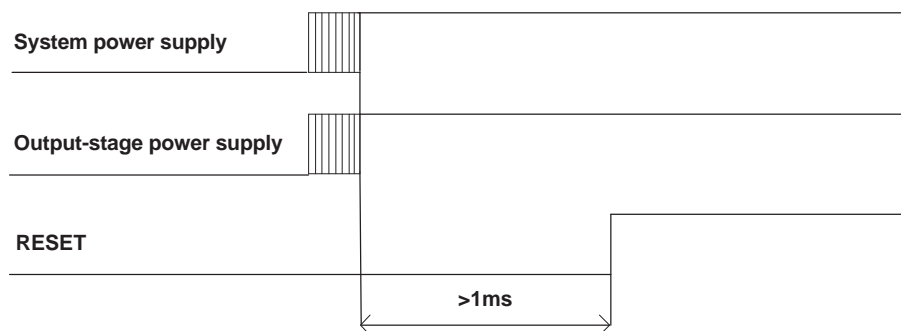
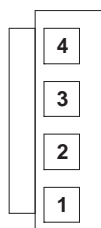


Figure 2-1. Recommended Power-Up Sequence



(PCB Connector Top View)

Figure 2-2. J70 Pin Numbers

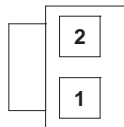
Table 2-2. J70 Pin Description

PIN NO.	NET NAME AT SCHEMATICS	DESCRIPTION
1	PVDD	Output-stage power supply
2		System power supply
3	GND	Ground
4	GND	Ground

2.2 Loudspeaker Connectors (J100 . . . J400)

CAUTION

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



(PCB Connector Top View)

Figure 2-3. J100 . . . J400 Pin Numbers

Table 2-3. J100 . . . J400 Pin Description

PIN NO.	NET NAME AT SCHEMATICS	DESCRIPTION
1	OUT-1	Speaker negative output
2	OUT-2	Speaker positive output

2.3 Control Interface (J40)

This interface connects the TAS5504-5142V4EVM board to a TI input-USB board.

Table 2-4. J40 Pin Description

PIN NO.	NET NAME AT SCHEMATICS	DESCRIPTION
1	GND	Ground
2	RESERVED	
3	GND	Ground
4	$\overline{\text{RESET}}$	System reset (bidirectional). Activate $\overline{\text{MUTE}}$ before $\overline{\text{RESET}}$ for quiet reset
5	$\overline{\text{BKND-ERR}}$	Backend error (or soft reset) provides reduced click and pop reset, without resetting I ² C volume register settings.
6	$\overline{\text{MUTE}}$	Ramp volume from any setting to noiseless soft mute. Mute also can be activated by I ² C.
7	$\overline{\text{PDN}}$	Power down. TAS5504A goes to the power-down state when activated.
8	RESERVED	
9	RESERVED	
10	SDA	I ² C bit clock
11	GND	Ground
12	SCL	I ² C bit clock
13	RESERVED	
14	RESERVED	
15	RESERVED	
16	RESERVED	
17	GND	Ground
18	RESERVED	
19	RESERVED	
20	$\overline{\text{SD}}$	Shutdown error reporting for all channels. Activated if TAS5142 has high current or high temperature. See Chapter 3: <i>Protection</i> .
21	RESERVED	
22	$\overline{\text{OTW}}$	Temperature warning. Activated if TAS5142 has reached temperature warning level.
23	RESERVED	
24	RESERVED	
25	GND	Ground
26	GND	Ground
27	RESERVED	
28	RESERVED	
29	RESERVED	
30	RESERVED	
31	GND	Ground
32	GND	Ground
33	+5 V	+5Vdc power supply (output)
34	+5 V	+5Vdc power supply (output)

2.4 Digital Audio Interface (J60)

The digital audio interface contains digital audio signal data (I²S), clocks, etc. Please see the *TAS5504A Data Manual* for signal timing and details not explained in this document.

Table 2-5. J60 Pin Description

PIN NO.	NET NAME AT SCHEMATICS	DESCRIPTION
1	GND	Ground
2	MCLK	Master clock input. Low-jitter system clock for PWM generation and relocking. Ground connection from source to TAS5504A must be a low impedance connection.
3	GND	Ground
4	SDIN1	I ² S data 1, channel 1 and 2
5	SDIN2	I ² S data 2, channel 3 and 4
6	SDIN3	I ² S data 3
7	SDIN4	I ² S data 4
8		Reserved
9		Reserved
10	GND	Ground
11	SCLK	I ² S bit clock
12	GND	Ground
13	LRCLK	I ² S left-right clock
14	GND	Ground
15		Reserved
16	GND	Ground

Protection

This section describes the short-circuit protection and fault-reporting circuitry of the TAS5142 device.

Topic	Page
3.1 Short-Circuit Protection and Fault-Reporting Circuitry	18
3.2 Fault Reporting	18

3.1 Short-Circuit Protection and Fault-Reporting Circuitry

The TAS5142 is a self-protecting device that provides device fault reporting (including high-temperature protection and short-circuit protection). The TAS5142 is configured in back-end auto-recovery mode and therefore, resets automatically after all errors. This means that the device restarts itself after an error occasion and reports shortly through the \overline{SD} signal.

3.2 Fault Reporting

The \overline{OTW} and \overline{SD} outputs from the TAS5142 indicate fault conditions. Please refer to the *TAS5142 Data Manual* for a description of these pins.

Table 3-1. TAS5152 Warning/Error Signal Decoding

\overline{OTW}	\overline{SD}	DEVICE CONDITION
0	0	High-temperature error and/or high-current error
0	1	High-temperature warning
1	0	Undervoltage lockout or high-current error
1	1	Normal operation, no errors/warnings

The shutdown signals, together with the temperature warning signal, gives chip state information as described in the Table 3-1. Device fault-reporting outputs are open-drain outputs.

Configuration for 2.1 System

The TAS5504-5142V4EVM can be configured for 2.1 operation. This gives two SE channels 30 W, and one BTL channel 60 W.

This section describes actions needed to change the EVM to 2.1 operation.

Topic	Page
4.1 TAS5504-5542V4EVM for 2.1 System	20
4.2 PCB Key Map for 2.1 Configuration	21

4.1 TAS5504-5542V4EVM for 2.1 System

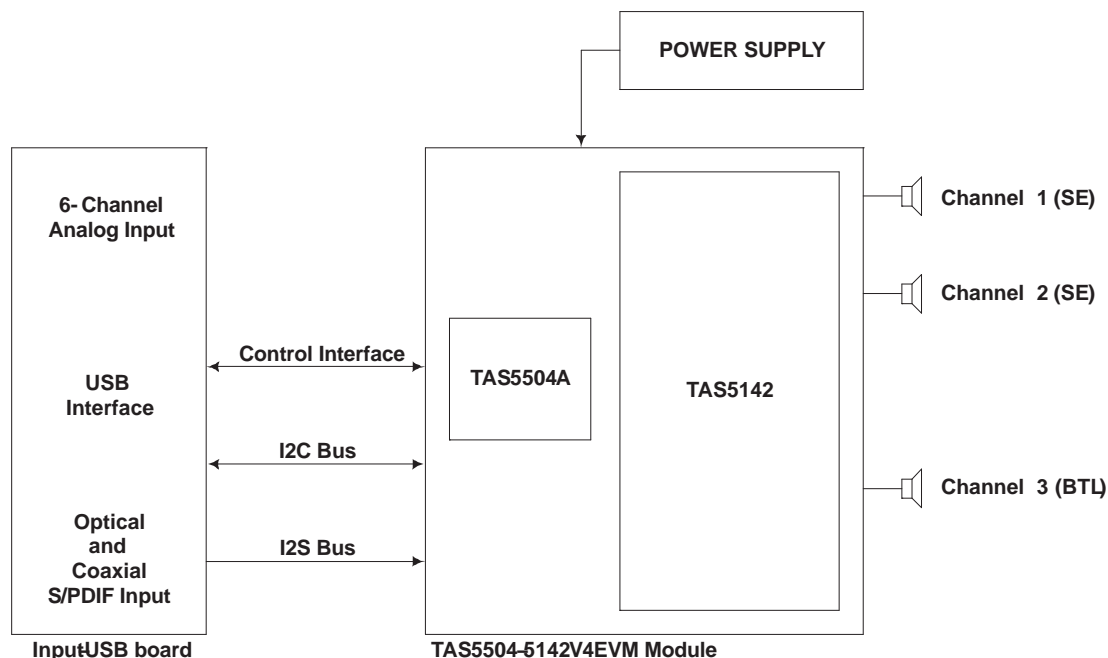


Figure 4-1. Integrated PurePath Digital™ Amplifier 2.1 System

For operation in 2.1 mode, channel 3 and channel 4 are used to create a BTL channel. This is done by using J350 (not mounted on standard EVM). Furthermore, the TAS5504A must be set up to use two outputs as one. This is done by mixing DAP channel 7 with a gain of -1 to PWM 8 output. Following commands will result in the settings in [Table 4-1](#).

Table 4-1. TAS5504A Register Settings⁽¹⁾

REGISTER	I ² C ADDRESS	VALUE	NOTES
Output Mixer Register PWM channel 7	0xB0	40 80 00 00	Mix DAP channel 5 into PWM channel 7
		00 00 00 00	
Output Mixer Register PWM channel 8	0xB1	7F 80 00 00	Mix DAP channel 6 into PWM channel 8
		00 00 00 00	

⁽¹⁾ These register settings must be sent after each reset.

In a final application, this is implemented in hardware instead.

4.2 PCB Key Map for 2.1 Configuration

Physical structure for the TAS5504-5142V4EVM is illustrated in Figure 4-2.

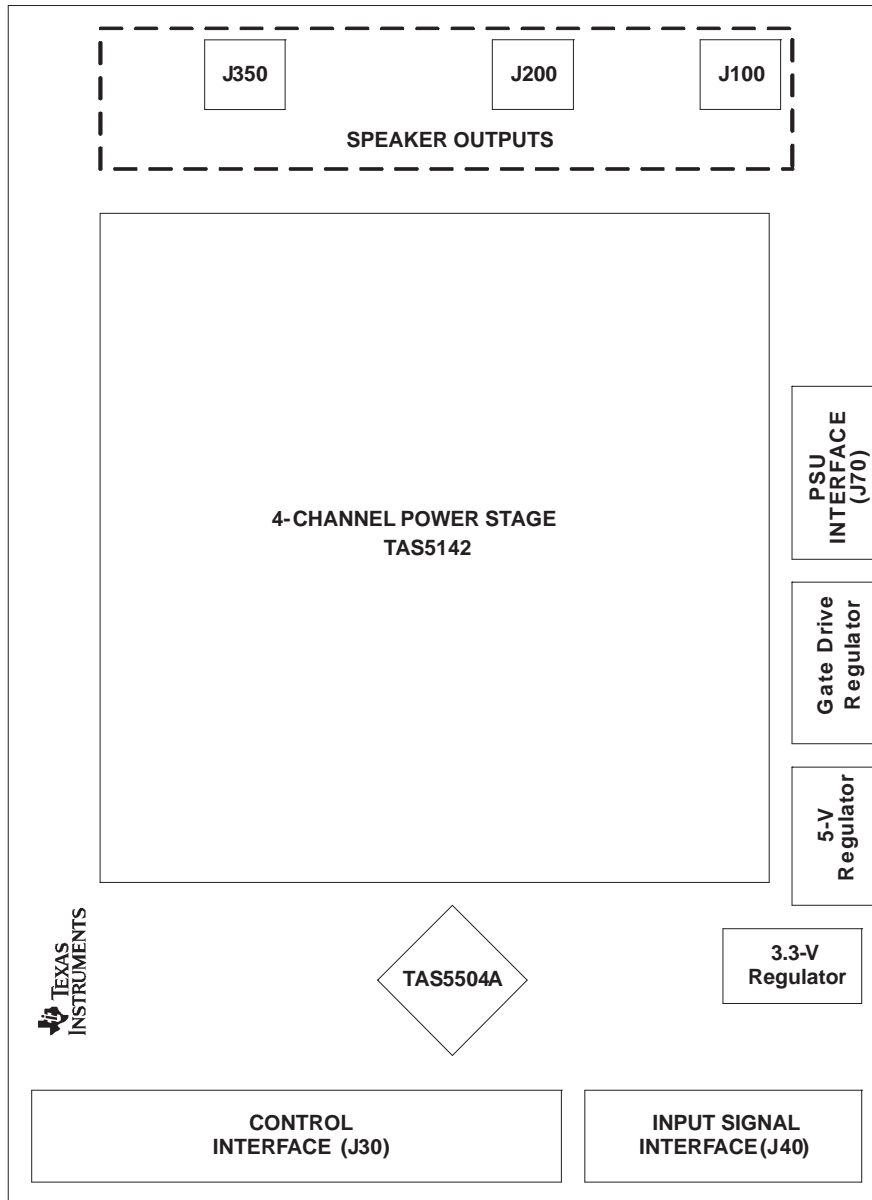


Figure 4-2. Physical Structure for TAS5504-5142V4EVM (Rough Outline)

EVALUATION BOARD/KIT IMPORTANT NOTICE

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

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/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. 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 User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please contact the TI application engineer or visit www.ti.com/esh.

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.

FCC Warning

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to 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 WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 0 V to 35 V and the output voltage range of 15 V to 20 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 © 2006, 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
Low Power Wireless	www.ti.com/lpw	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