AN-1638 LM49270 Demonstration Board

1 General Description

The LM49270SQ demoboard is a fully assembled circuit board for use of evaluating the LM49270 Stereo Class D audio subsystem with OCL headphone amplifier, 3D enhancement, and headphone sense. The LM49270 operates from a 2.4V to 5.5V power supply. The filterless stereo class D amplifiers delivers 2.2W/channel into a 4Ω load with less than 10% THD+N with a 5V supply. The headphone amplifiers feature Output Capacitor-less(OCL) architecture that eliminates the output coupling capacitors required by traditional headphone amplifiers. Additionally, the headphone amplifier can be configured as capacitively coupled loads.

The LM49270 features a 32 step volume control for the headphone and stereo output. The device mode select and volume are controlled through an I^2C compatible interface.

2 Bill of Materials

Designator	Quantity	Description
C1–C2	2	100µF ± 10% 10V C Case Tantalum Capacitors AVX TPSC107K010R0075
C4	1	0.22µF ± 10% 16V X7R 0603 Ceramic Capacitor Murata GRM188R71C223KA01D
C5	1	2.2µF ± 10% 16V X7R 0805 Ceramic Capacitor Murata GRM21BR71A225KA01L
C6–C7	2	1µF ± 10% 16V 1206 Ceramic Capacitors Murata GRM31MR71C105KA01L
C8	1	10µF ± 10% 16V B Case Tantalum Capacitor AVX TPSB106K016R0500
C9–C12	4	1µF ± 10% 16V 0805 Ceramic Capacitors Murata GRM21BR71C105KA01L
R1	1	4.7kΩ ± 0.1% Panasonic-ECG ERA-3AEB472V
R2	1	1kΩ ± 0.1% Panasonic-ECG ERA-3AEB102V
R3	1	100kΩ Potentiometer Digikey ST4B104CT

All trademarks are the property of their respective owners.

Copyright © 2007–2013, Texas Instruments Incorporated

3 Connectors

Connecting to the world is accomplished through the headers on the LM49270 demonstration board. The functions of the different headers are detailed in Table 1.

Table 1. LM49270 Demonstration Board Connections

Designator	Label	Function
JP1, JP2		These connectors are used to switch between CC or OCL mode. If JP1 and JP3 are open, then the LM49270 is in CC mode. If JP1 and JP3 are closed, then the LM49270 is in OCL mode.
JP3	VOC	JP3 is used to ground the VOC pin of the LM49270. In CC mode, JP3 should be closed, and the VOC amplifier is disabled.
JP4, JP5	LIN, RIN	These connectors are used for connecting the input to the LM49270. LIN (JP4) is for left input, and RIN (JP5) is for right input.
JP6	VDDLS	This connector is for the loudspeaker power supply connection. Apply an external power supply's positive voltage to the pin labeled VDDLS and the ground source to the pin labeled GND.
JP7, JP9	RIGHT SPEAKER, LEFT SPEAKER	These connectors are for the right speaker output (JP7) and left speaker output (JP9).
JP8	VDDI2C/ADR/GND	There are three pins on this connector, VDDI2C, ADR, and GND. It is used to set the LM49270 address. To set the ADR bit to 1, close VDDI2C and ADR. To set the ADR bit to 0, close GND and ADR.
JP10		This connector should be closed when the user wants to use the VDDLS as the VDD source for the I2CVDD.
JP11	VDDI2C	This connector can be used to connect to a VDD source if the user wants to power the VDDI2C externally.
JP12	HPS	This connector is connected to the headphone sense pin of the part and the headphone jack. If JP12 is closed, then the headphone sense function works as designed with a headphone jack. If JP12 is open, then the user does not need a headphone jack to test the function of the HPS. To set to HP mode, set the right pin of JP12 to low. To set to speaker mode, set the right pin to high.
JP13, JP14	RHP, LHP	These connectors are for the right headphone output (JP13) and the left headphone output (JP14).
JP15	VDD	This connector provides the power supply connection. Apply an external power supply's positive voltage to the pin labeled VDD and the ground source to the pin labeled GND.
JP16		This connector is used to short the LHP to a pull down resistor. In CC mode, JP16 should be closed. In OCL mode, JP16 should be open.
JP17		This connector is used to short VDD and VDDLS together. If the user wanted to use only one power supply, then closing JP17 will allow the power supply to be connected to JP15 or JP6 only.

Copyright © 2007–2013, Texas Instruments Incorporated

4 Quick Start - in CC Mode

1. Connect a shunt across the ADR and GND pins of jumper JP8. (I^2C address bit = 0)
2. Connect a shunt across jumper JP3 (VOC = GND, Capacitor Coupled (CC) headphone mode).
3. Connect a shunt across jumper JP16 (for Capacitor Coupled (CC) headphone mode).
4. Connect a shunt across jumper JP12 to use the headphone sense function.
5. Connect an 8Ω speaker across jumper JP7 (Right Speaker output).
6. Connect an 8Ω speaker across jumper JP9 (Left Speaker output).
7. Connect a headphone to jack J1 (headphone jack).
8. Connect the 3.3V power supply to the VDD pin of jumper JP15 and the VDDLS pin of jumper JP6, and the power supply ground terminal to the GND pin of jumper JP15 and jumper JP6.
9. Connect the audio source to JP4 (left input) and JP5 (right input).
10. Connect I^2C from PC to I^2C Interface jumper.
11. Open LM49270 I^2C control software.
12. Turn on power supply and audio source.
13. In the LM49270 I^2C control panel, select “C-CUPL” in HEADPHONE OUTPUT COUPLING, and select CHIP POWER-ON mode “ON” to enable the device.
14. Adjust the volume controls to change the speaker and headphone volumes.
15. To enable the speakers, disconnect the headphone from jack J1.

5 Board Connections

5.1 Power Connections

Power Connections The LM49270 demoboard offers separate connections for the speaker amplifier and headphone amplifier power supplies. The separate power supplies allow the speakers to operate at a higher voltage for maximum headroom, while the headphones operate at a lower voltage, improving power dissipation. Connect the headphone amplifier power supply to the VDD pin and the power supply ground to the GND pin of jumper JP15. Connect the speaker amplifier power supply to the VDDLS pin and the power supply ground to the GND pin of JP6. As for the I^2CV_{DD}, if powered from JP11, it allows the I^2C portion of the LM49270 to interface with lower voltage digital controllers.

5.2 Audio Input Connections

The left and right channel inputs of the LM49270 demoboard is configured for single-ended sources. Connect a left channel input source to the LIN pin and GND pin of JP4 and connect the a right channel input source to the RIN pin and GND pin of JP5.

5.3 Audio Output Connections

Jumpers JP9 and JP7 are the connections for the left and right channel speakers output respectively. The jack, J1 is a 3.5mm stereo headphone jack with a headphone sense pin.

6 Jumper Selection

In CC mode, install a shunt across jumper JP3 and jumper JP16. In OCL mode, install a shunt across jumper JP1 and jumper JP2.

Copyright © 2007–2013, Texas Instruments Incorporated

7 I²C Interface

The LM49270 is controlled through an I²C compatible serial interface. The LM49270 evaluation software provides an easy to use graphical user interface (Figure 1). Each button corresponds to bits in an I²C command byte. See the LM49270 data sheet for detailed I²C information.

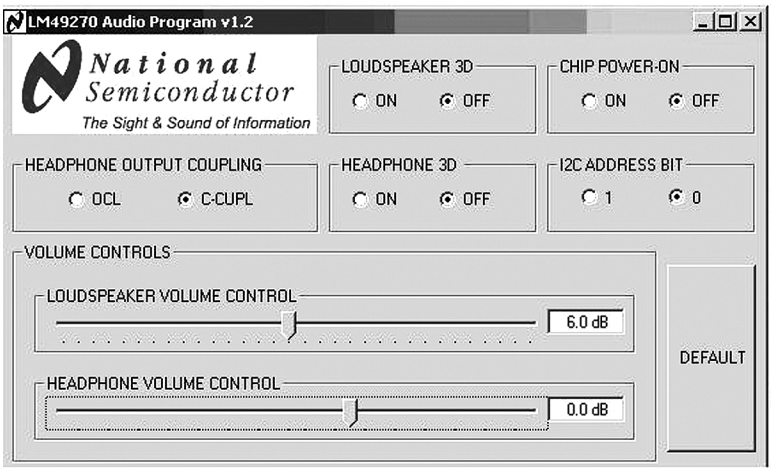


Figure 1. LM49270 Software User's Interface

7.1 CHIP POWER-ON

The CHIP POWER-ON button enables or disables the entire device. The device will not output any audio if the CHIP POWER-ON is set to “Off.”

7.2 I2C ADDRESS BIT

The I2C ADDRESS BIT button should correspond to the selection on jumper JP8. If the ADR pin is set to GND, then the I2C ADDRESS BIT should be set to ‘0’; if the ADR pin is set to VDDI2C, then the I2C ADDRESS BIT should be set to ‘1’.

7.3 LOUDSPEAKER 3D, HEADPHONE 3D

The LOUDSPEAKER 3D and HEADPHONE 3D button enables 3D sound enhancement for loudspeaker and headphone, respectively. By setting it to “ON”, turns on 3D and allows the user to increase or decrease the 3D effect on the demoboard by changing the value of the potentiometer in the external RC network of the LM49270.

7.4 VOLUME CONTROL

The LM49270 headphone and speaker channels feature separate volume controls. The loudspeaker volume has a range of -49dB to 30dB and the headphone has a range of -59dB to 18dB, each with 32 steps.

Copyright © 2007–2013, Texas Instruments Incorporated

8 Schematic and Layout Pictures

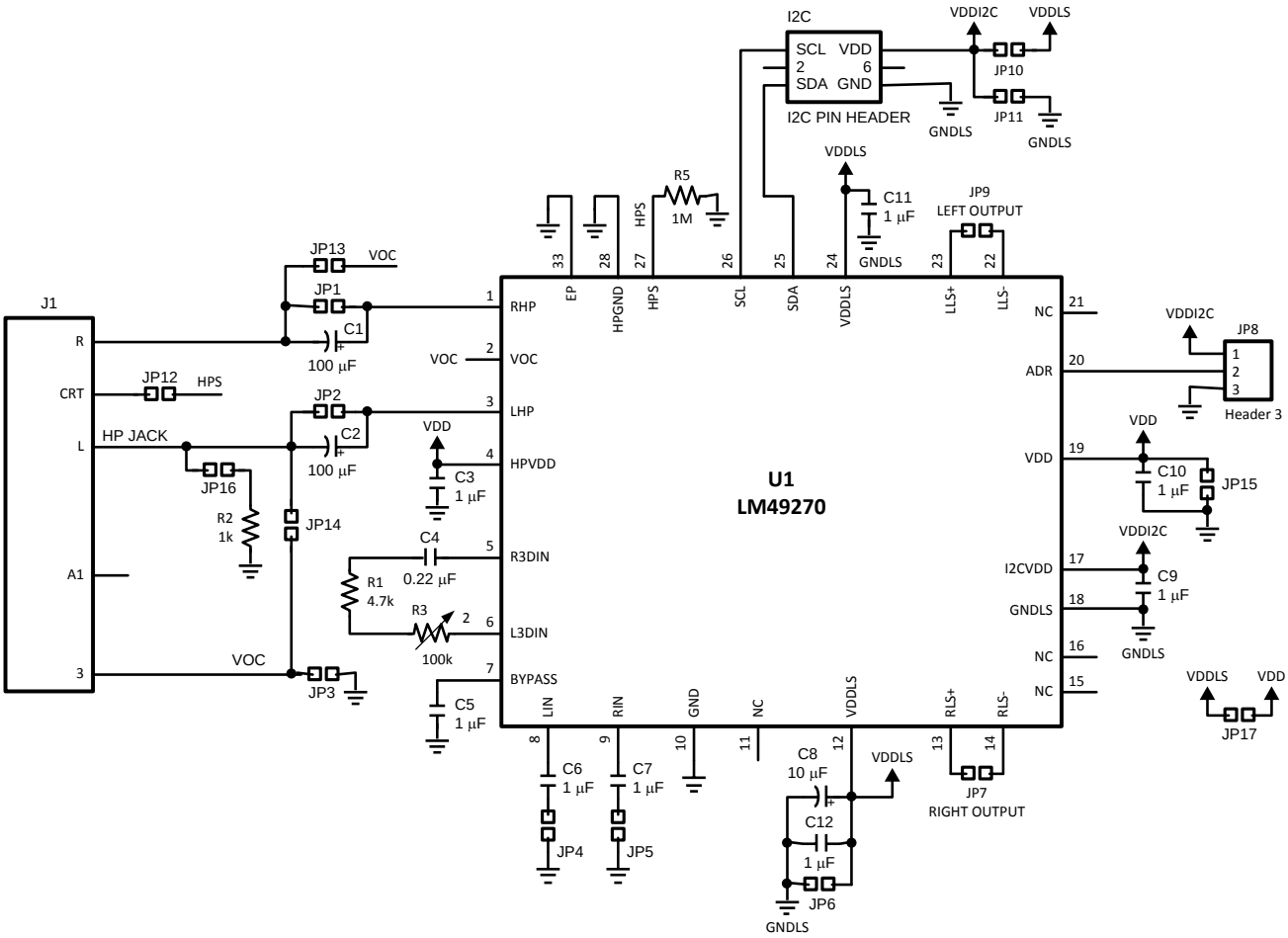


Figure 2. LM49270 Demoboard Schematic

Copyright © 2007–2013, Texas Instruments Incorporated

9 Demonstration Board PCB Layout

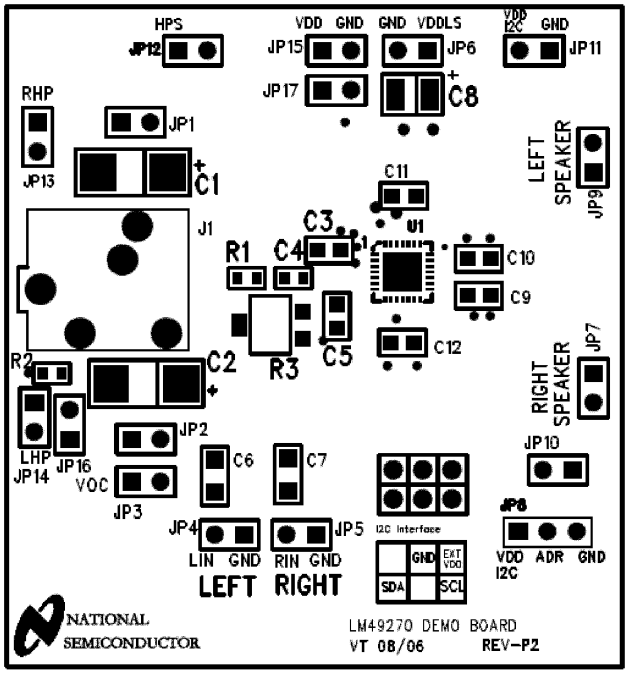


Figure 3. Top Silkscreen Layer

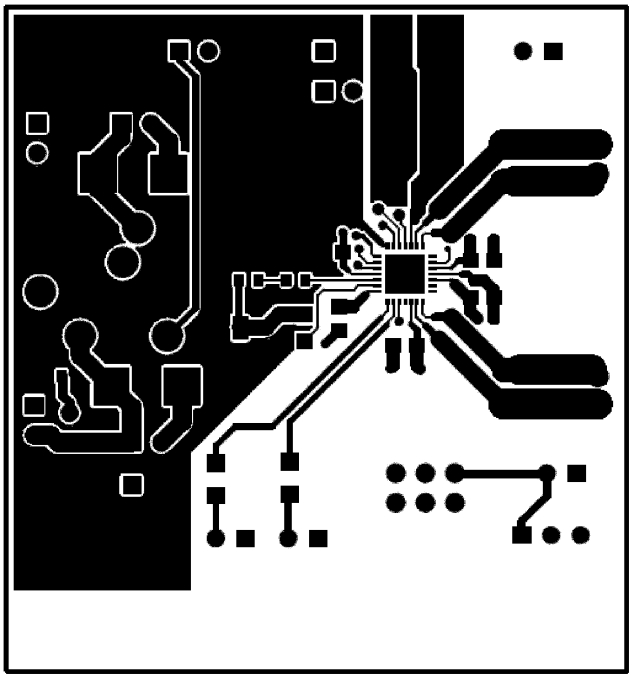


Figure 4. Top Layer

Copyright © 2007–2013, Texas Instruments Incorporated

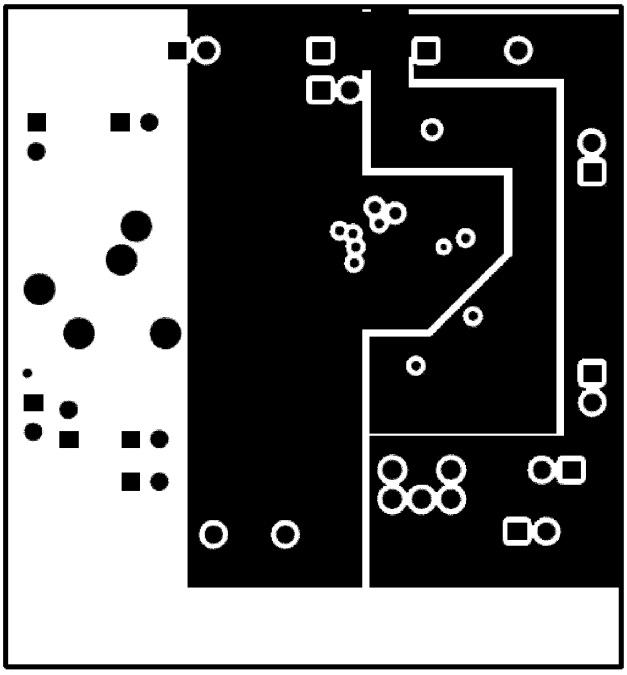


Figure 5. Mid Layer 1

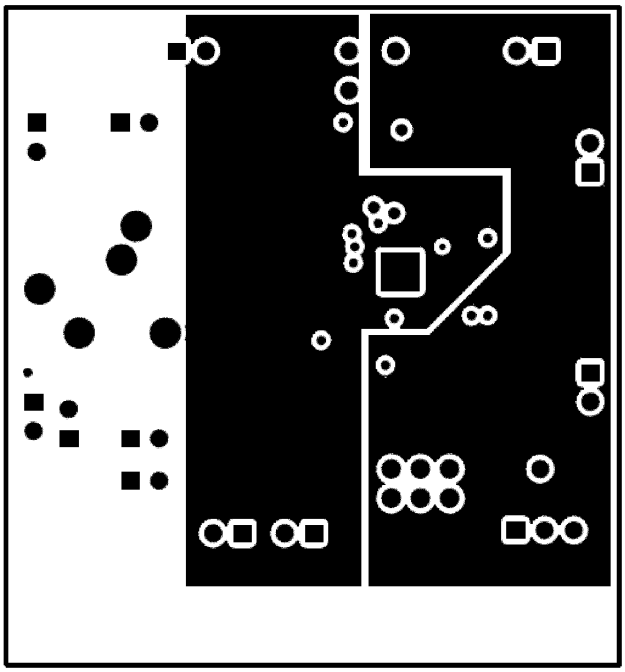


Figure 6. Mid Layer 2

Copyright © 2007–2013, Texas Instruments Incorporated

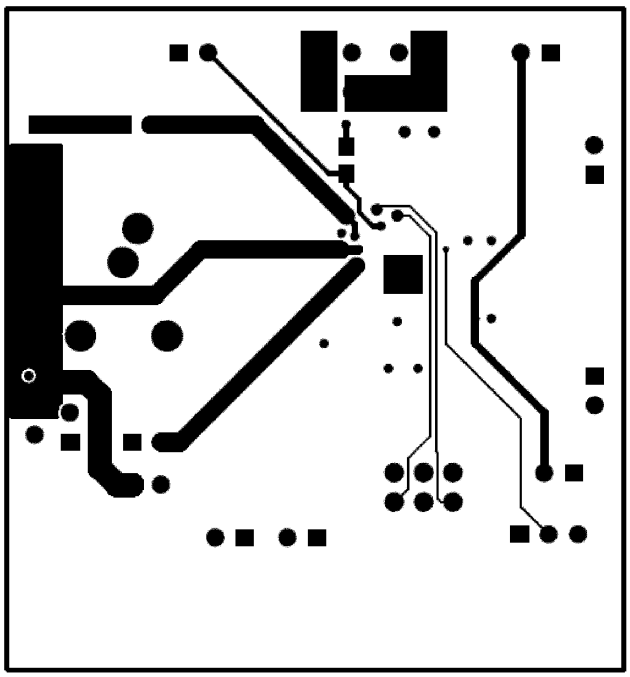


Figure 7. Bottom Layer

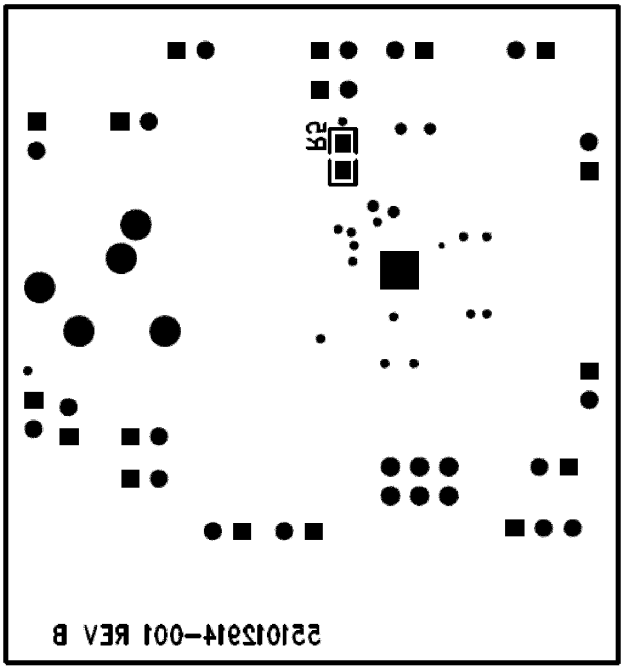


Figure 8. Bottom Silkscreen

Copyright © 2007–2013, Texas Instruments Incorporated

10 Revision History

Rev	Date	Description
1.0	05/24/07	Initial release.

Copyright © 2007–2013, Texas Instruments Incorporated

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		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated