TEXAS INSTRUMENTS

DSREF100R0 Low-Cost USB Headset Board Reference Design

User's Guide

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DAV Digital Speaker Products

SLAU064

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Mailing Address:

Texas Instruments
Post Office Box 655303
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Preface

Read This First

About This Manual

This user's guide describes the operation of the TUSB3200 headset reference design board and provides descriptions and schematics for a low cost universal serial bus (USB) headset.

How to Use This Manual

This document contains the following chapters:

- Chapter 1—Introduction to the TUSB3200
- Chapter 2—System Components
- Chapter 3—Board Operation
- Appendix A—Schematic Diagram

Related Documentation From Texas Instruments

TLV320AIC27 data sheet, literature number SLAS253

TUSB3200 data sheet, literature number SLAS240

TPS76433 data sheet, literature number SLVS180A

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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.

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Chapter 1

Introduction to the TUSB3200

This user's guide describes the operation of the TUSB3200 headset reference design board. This document contains descriptions and schematics for a low-cost universal serial bus (USB) headset. The board described is provided as an example that can be easily customized to fit specific needs.

This board has been designed to pass USB IF compliance testing. It has also been tested to comply with international regulations.

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1.1 Overview

The TUSB3200 headset reference design board demonstrates the use of the TI's TUSB3200 USB audio streaming controller in a USB headset application. The headset provides the capability of listening to and recording high quality audio with a PC. The headset design includes the TUSB3200 and the TLV320AIC27 AC'97 CODEC.

An analog stereo output signal is provided on the printed-circuit board (PCB) through 0.1-inch spaced holes for connection to the output transducers (headphones). Digital audio is sent by the PC via the USB to the TUSB3200. The left and right channels of the received digital data are converted by the AC'97 CODEC's DAC into left and right analog output signals. The analog left and right signals are amplified at the output stage and piped to the output connection. The output stage is capable of driving 32-Ω headphones.

Analog input signals are received from a two-wire electret microphone by another set of 0.1-inch spaced holes on the PCB. Microphone bias and amplification is provided by the AC'97 CODEC. The analog input signal is converted to digital by the CODEC and sent to the TUSB3200 via AC-link. The TUSB3200 converts the data to a USB stream and allows the PC to record or stream the data for communication over the Internet.

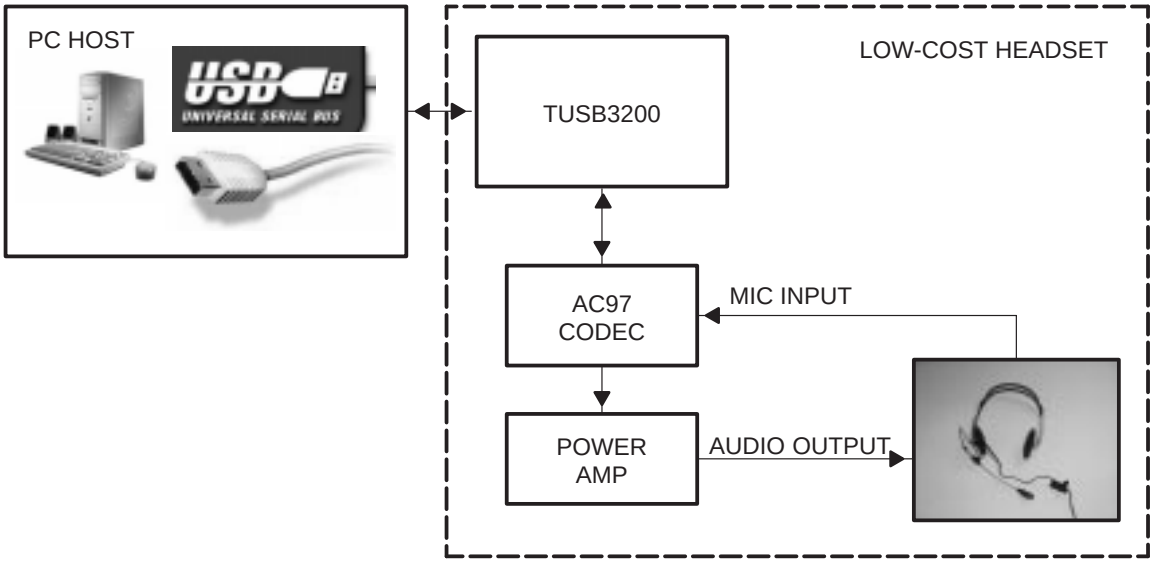
The TUSB3200 is programmed by the firmware contained in an onboard EEPROM. The firmware provided in the EEPROM is intended as an example only and can be fully customized.

This board is powered by the USB bus and contains voltage conditioning circuitry to allow it to pass the requirements of the USB Specification 1.1 for inrush current.

The TUSB3200 has been carefully designed to comply with international safety and emission requirements.

This system receives and transmits at various sampling frequencies, including 8 kHz, 1.025 kHz, 16 kHz, 22.05 kHz, 44.1 kHz, and 48 kHz.

Figure 1–1. Low-Cost Headset Block Diagram



1.2 Features

The USB headset reference design board has the following features.

- ❏ Operation from 5-V dc USB bus power
- ❏ Onboard 3.3-V voltage regulator
- ❏ Onboard inrush-current limiting
- ❏ TLV320AAIC27 stereo audio CODEC
- ❏ TUSB3200 USB peripheral controller
- ❏ Support for playback volume control via switches, if populated (reports to host via HID)
- ❏ Support for microphone mute control via switch (reports to host via HID)
- ❏ LED indicates mode of operation (suspend/resume) and microphone mute
- ❏ 6-MHz clock frequency (TUSB3200)
- ❏ Microphone input supports headphone amplifier

Figure 1–2. Low-Cost Headset Reference Design Top View

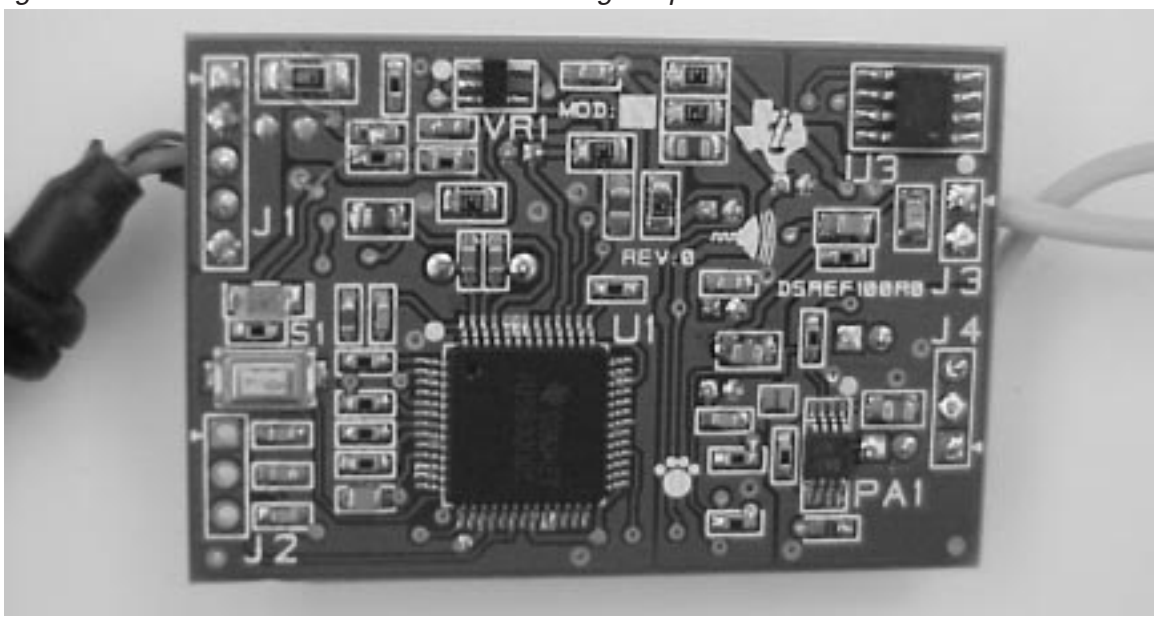
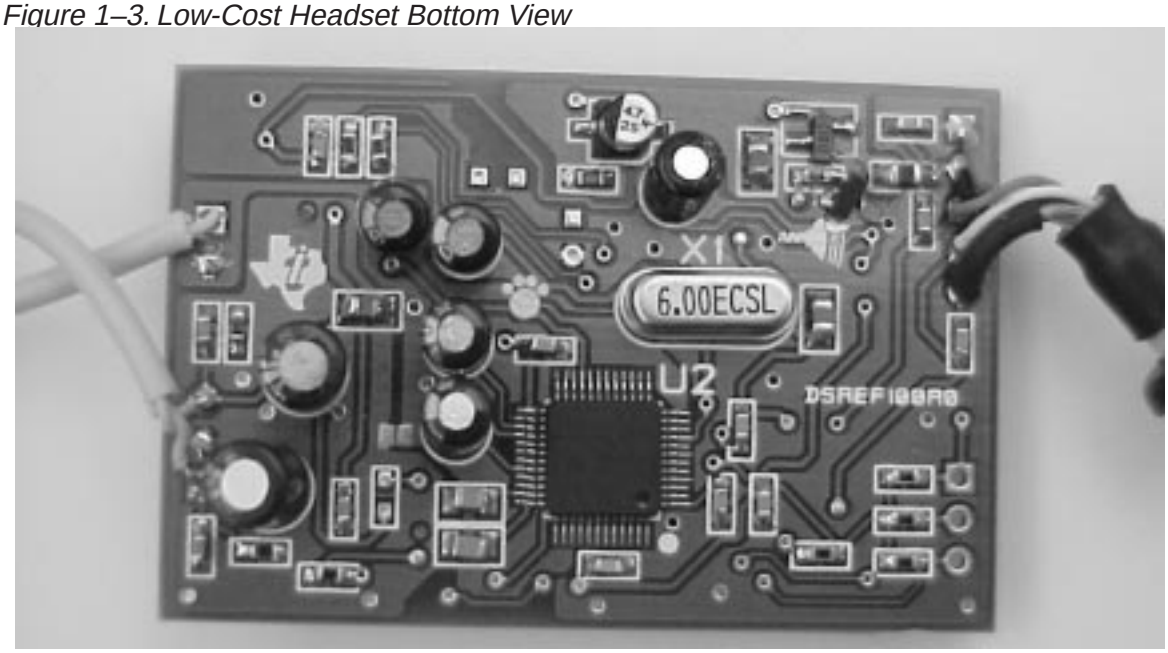


Figure 1–3. Low-Cost Headset Bottom View



1.3 Environmental Working Conditions

The circuit is designed to operate in an office-type environment.

1.4 Description of Inputs

The microphone input to the reference board is via 0.100-inch spaced holes on the PCB.

The inputs for the volume control are active-low logic levels via 0.100-inch spaced holes on the PCB.

1.5 Description of Outputs

The headphone output is via 0.100-inch spaced holes on the PCB. The output is a stereo analog signal with a 1-Vrms level. The output can drive headphones.

1.6 Power Supply

The USB headset board requires a 5-V ±10% USB bus power supply. The board draws a current of 110 mA ±10%.

Chapter 2

System Components

This chapter describes the system components of the TUSB3200 headset reference design board.

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2.1 Power Supplies and Decoupling

The TUSB3200 headset reference design board uses a TPS76433 low dropout (LDO) voltage regulator to convert the 5-V power to 3.3 V to power the TUSB3200, the TLV320AIC27, and the TPA61102A headphone amplifier.

The USB bus power is conditioned for inrush current prevention by a MOSFET circuit containing two low-cost signal type MOSFETs.

All power input pins to the active devices are decoupled with 0.1-μF capacitors.

2.2 Microphone Input and Bias

The two-wire electret microphone input to the PCB carries the microphone bias voltage and the microphone signal. It is connected directly to the TLV320AIC27 CODEC. The microphone bias uses 1.6 V supplied by the CODEC. The CODEC also supplies amplification for the microphone.

2.3 TLV320AIC27–ADC/DAC/Volume Control Functions

The CODEC takes an analog audio input signal from the microphone and converts it to digital so that it can be formatted and sent to the PC by the TUSB3200.

The digital signal received by the TUSB3200 via USB is converted to AC-Link and sent to the CODEC. The CODEC converts this signal to analog and sends it to the headphone amplifier.

The TUSB3200 contains an internal 8051 microcontroller. Three of the GPIO pins are used to read switches. The firmware uses these switches, by default, to control microphone mute and playback volume up/down control. The CODEC contains the programmable gain for volume control.

2.4 Clock Generation

A crystal oscillator in the TUSB3200 provides the master clock for the entire board. The oscillator runs at 6.0 MHz and provides the frequency necessary to run the phase-locked loop (PLL) in the TUSB3200.

The TUSB3200 synchronizes its internal clock with the USB packets and provides the timing necessary to run the CODEC without dropping or repeating audio samples.

2.5 System Microcontroller

The system microcontroller is an 8051 MCU in the TUSB3200. It is programmed to control system functions such as USB suspend, remote wake-up, LED control, and switch monitoring.

Chapter 3

Board Operation

This chapter describes the operation of the TUSB3200 headset reference design board.

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3.1 Power Up Sequence

The power up sequence for the USB headset reference design board is as follows:

1) Turn on the PC.

2) Ensure that the operating system is Windows™ 98 Gold™, Windows 98 SE™, Windows 2000™, or Windows Millennium™.

3) Plug the USB cable into an available USB port on the PC.

4) After approximately five seconds, the USB headset enumerates and the LED illuminates to indicate that the board has power.

3.2 Operation—Switch and LED Functions

After enumeration, the volume up, volume down, and mute controls should be activated. Use the following sequence to verify correct operation:

1) Display the Windows audio mixer panel.

2) Play a CD or wave file and listen to it by connecting the analog audio outputs to either the speakers or a headset.

3) Connect the volume-up connection to logic low. The volume should increase and the slider on the mixer panel should move up. After releasing the volume-up connection, connect the volume-down pin to logic low. The volume should decrease and the volume slider on the mixer panel should move down.

4) Open the Microsoft Sound Recorder application or any other audio recording application. Start recording and begin speaking into the microphone. The signal should be displayed in a record display. Stop the recording and play it back. The recording should be heard on the headphones. Connect the mute pin to logic low. The LED should begin to flash indicating that the microphone is muted. Release and connect the Mute pin to logic low. The LED should stop blinking and be on. This indicates that the board is ready for use and the microphone is no longer muted.

5) Put the PC in suspend mode by using the Start menu. Once the PC is suspended, the LED should go off. This indicates that the board is suspended. Resume the PC. The LED should light and the board should resume normal operation.

3.3 Specifications

Power supply input	5-V USB power at 110 mA
Operating system	Windows 98SE or greater, MAC OS
Output power	75 mW
THD+n	>75 dB
SNR	>90 dB

Appendix A

Schematic Diagram

The schematic diagrams for the AC'97 headset reference design are included in this appendix.