TEXAS INSTRUMENTS

DAREF107

TAS1020A Low-Cost Headset Reference Design Board

User's Guide

November 2001

Digital Audio Products

SLEU005

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Preface

Read This First

About This Manual

This user's guide describes the operation of the TAS1020A headset reference design board. This document contains descriptions and schematics for a low-cost USB headset. The board described is provided as an example that can be customized for specific needs easily. For the rest of this document, the TAS1020A low-cost headset reference design board shall be referred to as LCHS.

This board has been designed to pass USB IF compliance testing. It has also been tested to meet international regulatory compliance.

How to Use This Manual

This document contains the following chapters:

- ❏ Chapter 1—Overview
- ❏ Chapter 2—System Components
- ❏ Chapter 3—Board Operation

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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.

Related Documentation From Texas Instruments

Part Number	Literature Number
❑ TAS1020A	SLES003
❑ TPS78833	SLVS382
❑ TPA6110A2	SLOS314

Contents

Figures

Chapter 1

Overview

The LCHS demonstrates how to use TI's TAS1020A 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 LCHS includes the TAS1020A, an AC'97 codec, a TPA6110A2 audio amplifier, and a TPS78833 voltage regulator.

An analog stereo output signal is provided through 0.1-inch spaced holes (in the PCB) for connection to the output transducers (earphones). Digital audio is sent from the host PC via USB to the TAS1020A. The left and right channels of the received digital data are converted by the DAC of the AC97 codec 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 headphones.

Analog input signals are received from a 2-wire electret microphone by another set of 0.1 inch spaced holes in the PCB. Microphone bias and amplification is provided by the AC97 codec. The analog input signal is converted to digital by the codec and sent to the TAS1020A via AC-Link. The TAS1020A converts the data to a USB stream and allows the PC to record or stream the data for communication over the Internet.

The TAS1020A is programmed by the firmware contained in an onboard EEPROM. The firmware provided in the EEPROM is an example only and is completely customizable.

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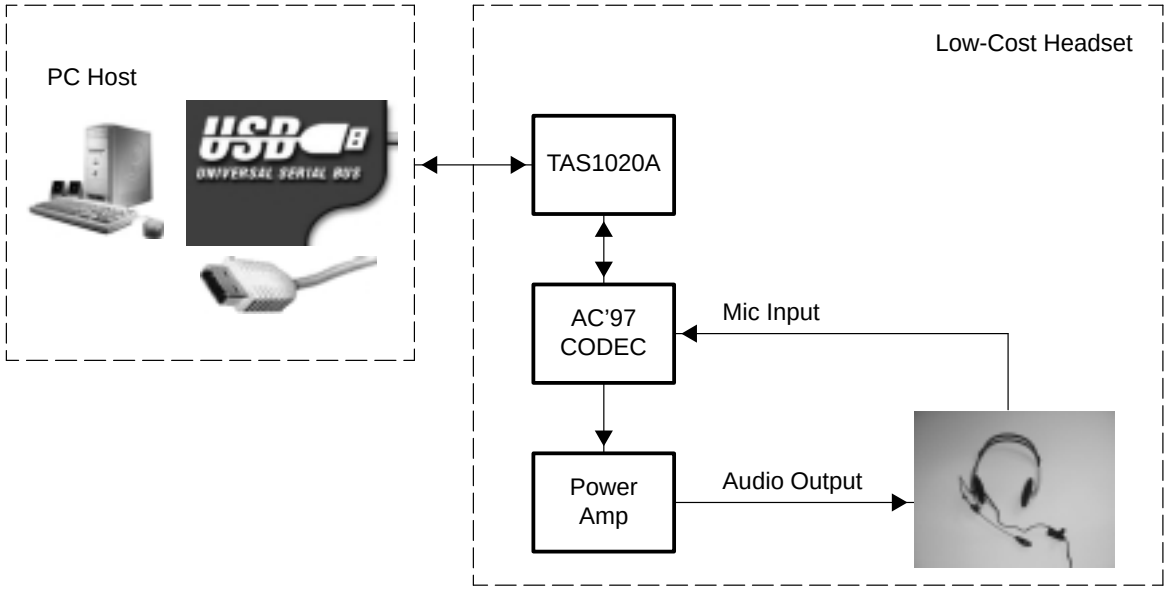
The LCHS is USB bus-powered and contains voltage-conditioning circuitry to allow it to pass the requirements of the USB Specification 1.1 for inrush current.

Care has been taken in this design to allow it to pass international safety and emission requirements.

This system receives and transmits at various sampling frequencies, including 8 kHz, 11.025 kHz, 16 kHz, 22.05 kHz, 44.1 kHz, and 48 kHz.

Figure 1–1. Low-Cost Headset Reference Design Block Diagram



1.1 Features

The LCHS has the following features:

- ❑ Operates via 5-V dc USB power
- ❑ Onboard 3.3-V regulator
- ❑ Onboard inrush current limiting
- ❑ AC'97 stereo audio CODEC
- ❑ TAS1020A 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 to indicate mode of operation (suspend/resume) and microphone mute.
- ❑ A 6-MHz clock frequency (TAS1020A)
- ❑ Microphone input support headphone amplifier

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

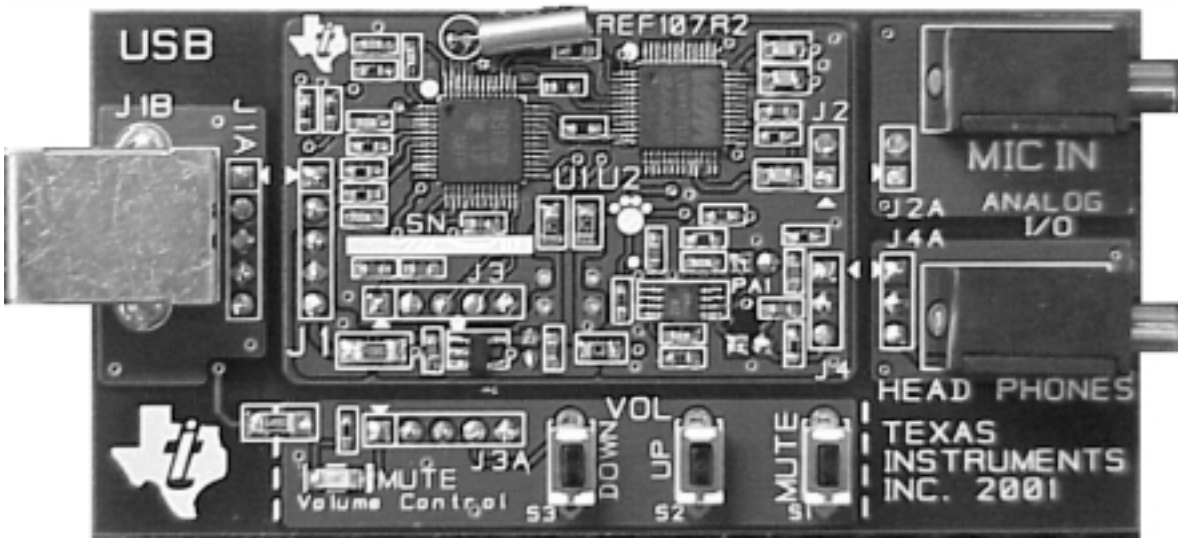
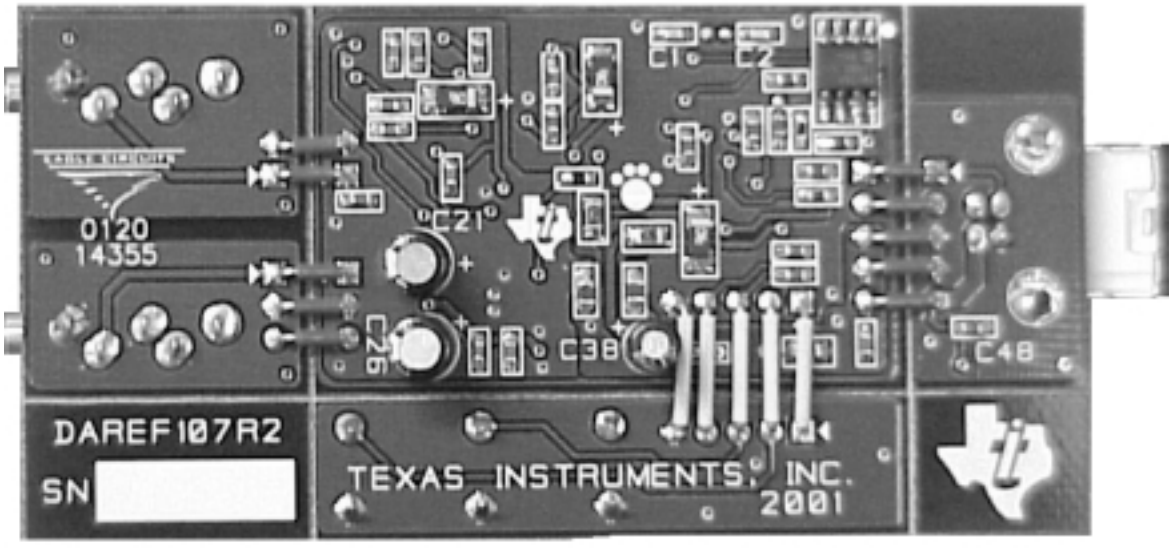


Figure 1–3. Low-Cost Headset Reference Design Bottom View



1.2 Environmental Working Conditions

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

1.3 Board Description

The board is designed as a reference board inside breakaway panels. The breakaway panels contain the I/O connectors, switches, and LEDs. The breakaway panels illustrate the size of the actual reference design.

1.4 Description of Inputs

The headphone input is a 3,5-mm stereo mini jack on a breakaway panel. The microphone signal is then jumpered to the reference design board. The reference design board has two 0.1 inch spaced holes for the microphone input. If the breakaway panel is not used, a microphone signal can be hardwired directly to J2.

1.5 Description of Outputs

The headphone output is a 3,5-mm stereo mini jack on a breakaway panel. The headphone signal is jumpered from the reference design board to the breakaway panel. The reference design board has three 0.1 inch spaced holes for the headphone output. If the breakaway panel is not used, the headphone output can be wired directly from J4. The output is a stereo analog signal with an amplitude of 1 Vrms. The output is capable of driving headphones.

1.6 Power Supply

The power supply for the USB headset reference design is derived from the USB bus power. The USB bus power is nominally 5 V. The board draws approximately 95 mA in the active mode.

Chapter 2

System Components

This chapter describes the system components.

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2.1 Power Supplies and Decoupling

The system uses a TPS78833 LDO (low-dropout voltage regulator) to convert the 5-Vdc power to 3.3 Vdc to power the TAS1020A, the TLV320AIC27, and the TPA61102A headphone amplifier. The USB power is conditioned for inrush by the TPS78833.

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

2.2 Microphone Input and Bias

The 2-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 supply is 1.6 V from the codec. The codec also supplies amplification for the microphone.

2.3 AC'97—ADC/DAC/Volume Control Functions

The codec takes an analog audio input from the microphone and converts the analog signal to digital so it can be formatted and sent to the PC by the TAS1020A. The digital signal received by the TAS1020A, via USB, is converted to AC-Link and sent to the codec. The codec converts this digital signal to analog and sends it to the headphone amplifier. Three of the GPIO pins are used to read switches. The firmware by default uses those switches to control the microphone mute operation and playback volume up/down control. The codec contains the programmable gain for volume control.

2.4 Clock Generation

A crystal oscillator provides a 6-MHz clock source for the TAS1020A. The TAS1020A uses that clock source to derive all other system clocks. The TAS1020A synchronizes the master output clock signal with the rate of incoming USB packets to prevent audio dropouts caused by clock synchronization. More details on this feature are available in the TAS1020A data sheet.

2.5 System Microcontroller

The TAS1020A contains an internal 8051 microcontroller. It is programmed to control system functions such as USB suspend, remote wake-up, LED control, and switch monitor.

Chapter 3

Board Operation

This chapter describes the power-up sequence and the switch and LED functions.

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3.1 Power-Up Sequence

The power-up sequence for the LCHS is very simple:

1) Turn on the PC.

2) Ensure that the OS is Windows 98 SE, Windows 2000, or Windows Millennium.

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

4) When soundvol32 speaker icon is displayed on the task bar, the LCHS enumerates and the LED lights, indicating the board has power.

5) If it is the first plug in for the device, the computer searchs for the appropriate USB drivers.

3.2 Switch and LED Functions

- ❏ After enumeration, the volume up, volume down, and mute controls should be activated. When Mute is pressed, the LED blinks. This indicates the device is being muted.

- ❏ Display the Windows Audio Mixer Panel.

- ❏ Play a CD or wavefile and listen to it by connecting the analog audio outputs to either speakers or a headset.

- ❏ Connect a logic low to the volume up connection. The volume increases and the slider on the Mixer Panel should move up. After releasing the volume up connection, connect a logic low to the volume down pin. The volume decreases and the volume slider on the Mixer panel moves down.

- ❏ 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 in the headphones. Connect a logic low to the Mute pin. The LED should begin to flash indicating that the microphone is muted. Release and connect a logic low to the Mute pin. The LED should stop blinking and be ON. This indicates that the board is ready for use and the microphone is no longer muted.

- ❏ 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 resumes normal operation.

Appendix A

Bill of Materials and Schematics

This appendix contains the bill of materials and the schematics for the DAREF107.

Table A–1. Bill of Material for DAREF107

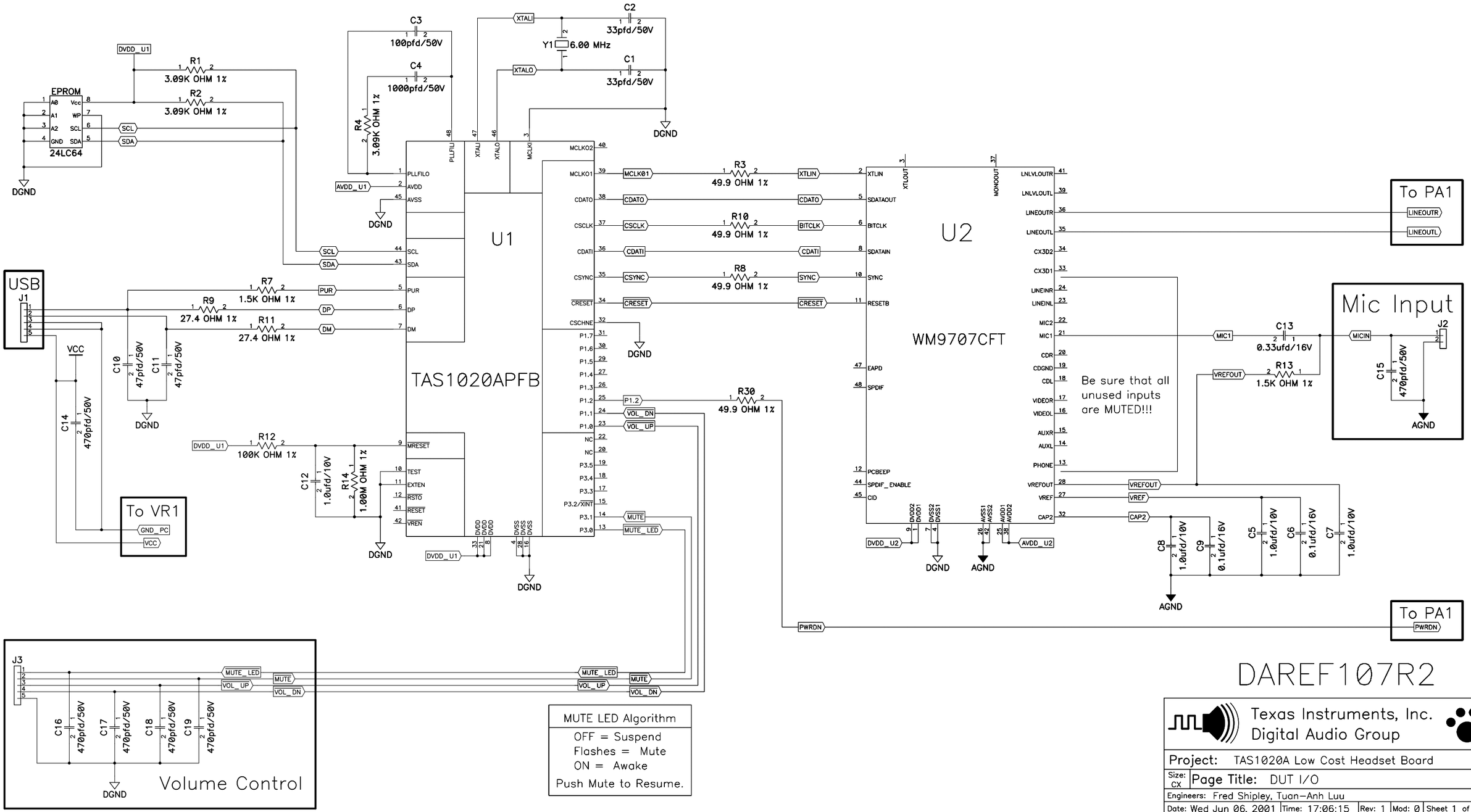
Description	Qty	Part Number	Manufacturer	Ref Des
TAS1020APFB	1	TAS1020APFB	Texas Instruments	U1
TPA6110A2DGN	1	TPA6110A2DGN	Texas Instruments	PA1
TPS78833DBVR	1	TPS789833BVR	Texas Instruments	VR1
WM9707CFT	1	WM9707CFT	Wolfson	U2
Serial EEPROM	1	24LC64–I/SN	Microchip Technology	EPROM
Crystal, 6 MHz	1	CA–301 6.000M–C	Epson	Y1
33 pF, 50 V, capacitor	2	ECJ–1VC1H330J	Panasonic	C1, C2
47 pF, 50 V, capacitor	2	ECJ–1VC1H470J	Panasonic	C10, C11
100 pF, 50 V, capacitor	3	ECJ–1VC1H101J	Panasonic	C3, C20, C24
470 pF, 50 V, capacitor	9	ECU–V1H471KBV	Panasonic	C14, C15, C16, C17, C18, C19, C22, C27, C48
1000 pF, 50 V, capacitor	1	ECU–V1H102KBV	Panasonic	C4
0.1 μF, 16 V, capacitor	14	ECJ–1VB1C104K	Panasonic	C6, C9, C30, C32, C35, C37, C39, C40, C42, C43, C44, C45, C46, C47
0.33 μF, 16 V, capacitor	3	ECJ–2YB1C334K	Panasonic	C13, C23, C25
1 μF, 10 V, capacitor	8	ECJ–1VF1A105Z	Panasonic	C5, C7, C8, C12, C28, C29, C33, C34
4.7 μF, 10 V, capacitor	3	ECS–H1AX475R	Panasonic	C31, C36, C41
10 μF, 16 V, capacitor	1	ECE–A1CKG100	Panasonic	C38
47 μF, 6.3 V, capacitor	2	ECE–A0JKG470	Panasonic	C21, C26
1-Ω Resistor, 1%, SMD0805	4	ERJ–6RQJ1R0V	Panasonic	R24, R25, R26, R27
2.7-Ω Resistor, 1%, SMD0805	1	ERJ–6RQJ2R7V	Panasonic	R29
10-Ω Resistor, 1%, SMD1206	1	ERJ–8ENF10R0V	Panasonic	R28
27.4-Ω Resistor, 1%, SMD0603	2	ERJ–3EKF27R4V	Panasonic	R9, R11
49.9-Ω Resistor, 1%, SMD0603	4	ERJ–3EKF49R9V	Panasonic	R3, R8, R10, R30

Table A–1. Bill of Material for DAREF107 (Continued)

Description	Qty	Part Number	Manufacturer	Ref Des
649-Ω Resistor, 1%, SMD0603	1	ERJ–3EKF6490V	Panasonic	R5
649-Ω Resistor, 1%, SMD1206	1	ERJ–8ENF6490V	Panasonic	R15
1.5-kΩ Resistor, 1%, SMD0603	4	ERJ–3EKF1501V	Panasonic	R7, R13, R19, R22
3.09-kΩ Resistor, 1%, SMD0603	3	ERJ–3EKF3091V	Panasonic	R1, R2, R4
20-kΩ Resistor, 1%, SMD0603	2	ERJ–3EKF2002V	Panasonic	R20, R21
47.5-kΩ Resistor, 1%, SMD0603	3	ERJ–3EKF4752V	Panasonic	R17, R18
100-kW Resistor, 1%, SMD0603	1	ERJ–3EKF1003V	Panasonic	R12
1-MΩ Resistor, 1%, SMD0603	1	ERJ–3EKF1004V	Panasonic	R14
Ferrite bead, 39 Ω, 4 A, SMD0805	3	EXC–ML20A390U	Panasonic	FB1, FB2, FB4
Switch	3	EVQ–PJA05Q	Panasonic	S1, S2, S3
LED yellow, SMD1206	1	CMD15–21VYD/TR8	Chicago Miniature	LED1
USB connector	1	AU–Y1007	Assmann Electronics Inc.	J1B
Stereo mini audio jack	2	SJ–3535NG	Cui Stack	J2B (MIC IN), J4B (Headphone)
Jumper wire 0.2” Length	10	923345–02–C	3M	J1A, J2A, J4A
Jumper wire 0.4” Length	5	923345–04–C	3M	J3A

TAS1020A Low Cost Headset Reference Design Board

Rev: 2
Mod: 0



DAREF107R2

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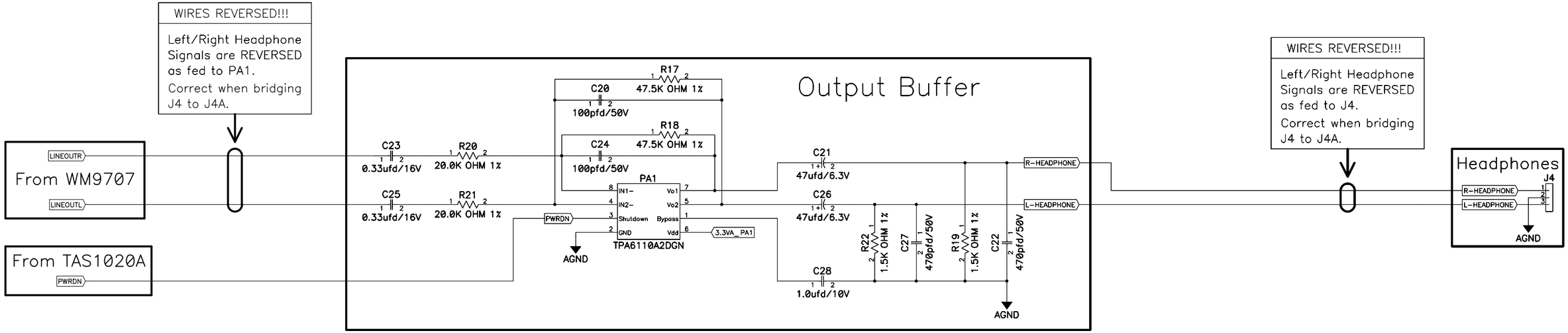
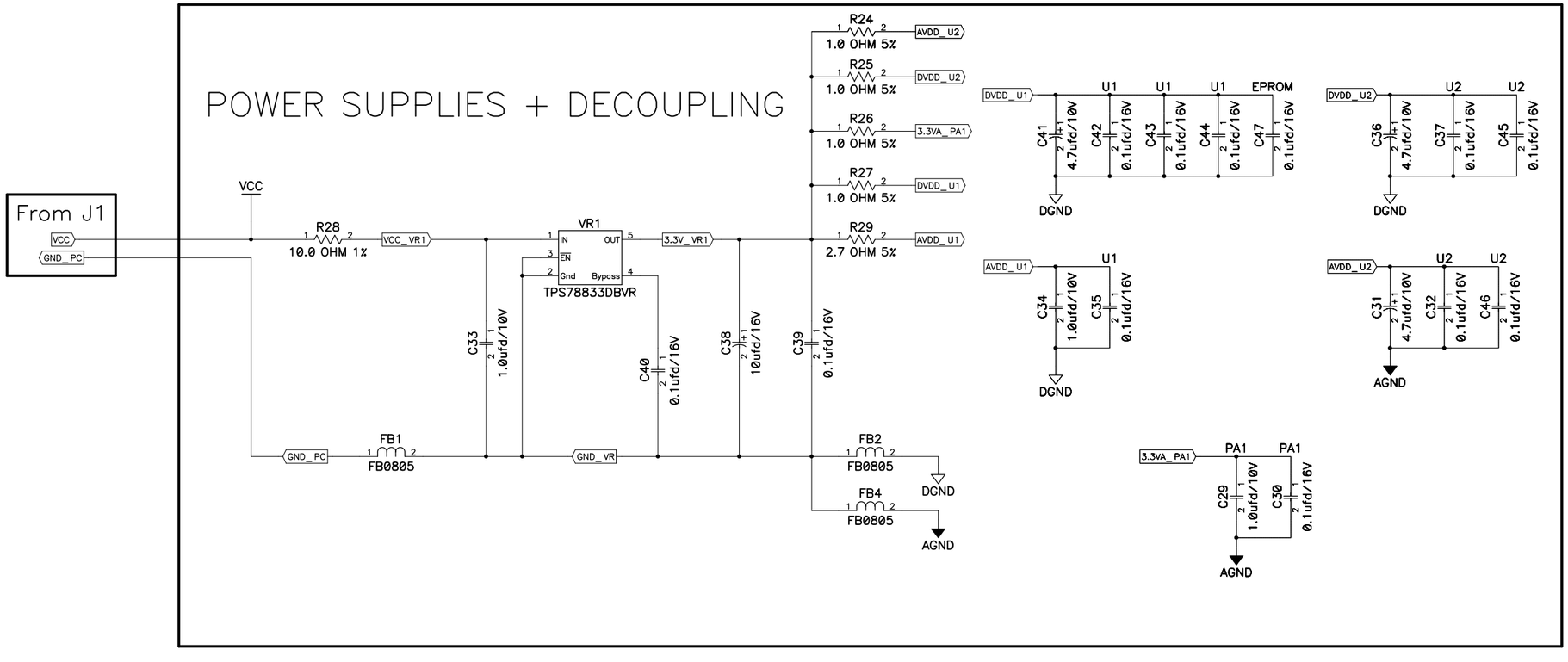
Project: TAS1020A Low Cost Headset Board					
Size: CX	Page Title: DUT I/O				
Engineers: Fred Shipley, Tuan-Anh Luu					
Date: Wed Jun 06, 2001	Time: 17:06:15	Rev: 1	Mod: 0	Sheet 1 of 3	
Filename: DAREF107R2.sch				Drawn By: LDN	
File Location: ..\\ReferenceDesigns\LowCostHeadsetBoards\					

TAS1020A Low Cost Headset Reference Design Board

Rev: 2
Mod: 0





DAREF107R2

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Size: CX	**Page Title:** Output Buffer / Power Supplies			
Engineers: Fred Shipley, Tuan-Anh Luu				
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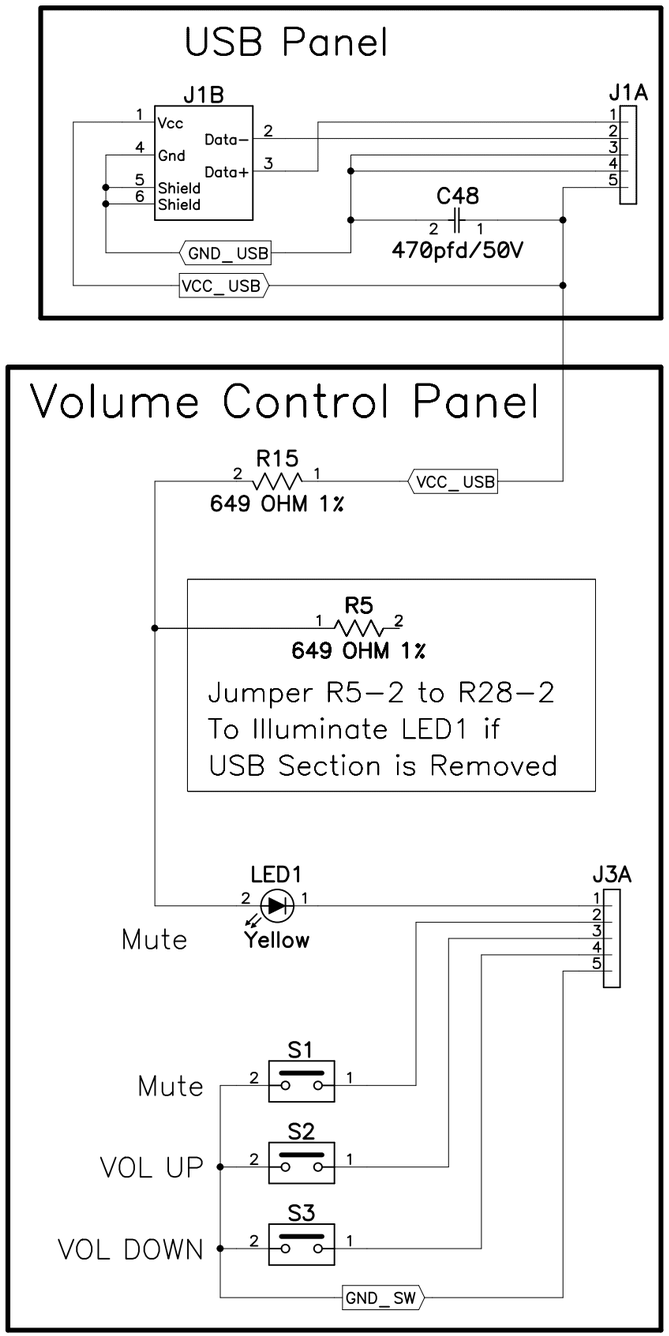


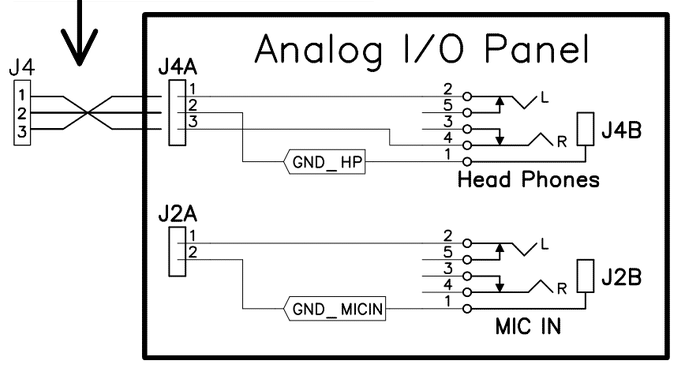
CHECK CONNECTIONS!!!

INSURE THE FOLLOWING CONNECTIONS FOR PROPER OPERATION:

J4−1 to J4A−3

J4−2 to J4A−2

J4−3 to J4A−1



Notes on Breakaway Panels:

Board is scored on bottom in three places allowing sectioned panels.

USB	DAREF107R2	Analog I/O
	VOLUME CONTROL	

If USB Panel is removed and Volume Control Panel is attached, jumper R5 to R28 to allow LED1 (Mute) to work.

DAREF107R2

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Project: TAS1020A Low Cost Headset Board				
Size: BX	**Page Title:** External Breakaway Panels			
Engineers: Fred Shipley, Tuan−Anh Luu				
Date: Wed Jun 06, 2001	Time: 17:06:17	Rev: 1	Mod: 0	Sheet 3 of 3
Filename: DAREF107R2.sch				Drawn By: LDN
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