TEXAS INSTRUMENTS

DAREF101 EVM for USB/DSP Stereo Audio

User's Guide

December 2000

Digital Audio Products

SLAU057

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Preface

Read This First

About This Manual

This user's guide describes the setup and operation of the DAREF101, revision 2, evaluation/development platform for stereo audio using the C54x family of DSPs, the TUSB3200 universal serial bus (USB) streaming controller, and the TLC320AD77 audio codec.

How to Use This Manual

This document contains the following chapters and appendixes:

- Chapter 1 – EVM Overview
- Chapter 2 – Physical Description
- Chapter 3 – User Configurations
- Chapter 4 – EVM Operation
- Appendix A – DAREF101 EVM Silkscreen and Schematics

Information About Cautions and Warnings

This book may contain cautions and warnings.

This is an example of a caution statement.

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

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

❑ TMS320VC5416	Literature No. SPRS095E
TMS320VC5409	Literature No. SPRS082C
TMS320VC5402	Literature No. SPRS079E
❑ TUSB3200	Literature No. SLOS240
❑ TLC320AD77	Literature No. SLAS194
❑ TPS70151/TPS70148	Literature No. SLVS222A
❑ TLV2362	Literature No. SLOS195A
❑ SN74LVCU04A	Literature No. SCAS282G
❑ TPS70151	Literature No. SLVS222A
❑ 74AHC540DB	Literature No. SCLS260H
❑ SN74CBT3245	Literature No. SCDS002K

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Chapter 1

EVM Overview

This chapter provides a quick-start guide for using the DAREF101 EVM as well as a brief description of additional hardware and software.

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1.1 Quick-Start Guide

Minimum system requirements: To use this evaluation platform with the supplied firmware requires use of Windows 98 SE or later operating system.

To immediately begin streaming audio over the universal serial bus (USB) of your PC, follow these steps:

1) Ensure that jumpers J6, J7, J8, J10, and J11 are installed and that jumper J9 is not installed on the board.

2) Connect your microphone input to the 3.5-mm audio jack labeled IN on the board.

3) Connect your headphone or speakers to the 3.5-mm audio jack labeled OUT on the board.

4) Connect a USB cable from the USB port of your PC to J2 of the board. This will apply power to the board and begin the USB enumeration process. (Note: If you prefer to power the board externally, rather than using the USB to power the board, then a 5-V dc power supply should be connected to the external power jack PJ1 prior to step 4.

5) After a few seconds, you should see the Windows cursor on the computer screen turn to an hourglass for about 5 seconds. If this is the first time that the board has tried to enumerate on this computer, you will likely be prompted to install the following drivers from the Windows Installation CD:

   - *usb.inf (USB composite device)*
   - *hiddev.inf (USB human interface device)*
   - *wdma_usb.inf (USB audio device)*

   If this occurs, follow the on-screen directions and point to the Windows Installation CD when asked for the file location. In addition, you will need to install two files that are provided with this platform. They are *eqbulk.inf* and *eqbulk.sys*. These should be installed when prompted for the TUSB3200 EVM drivers (Bulk TI EQ Download).

6) After the cursor returns to its original state, double-click on the speaker icon located in the lower right-hand corner of your computer screen. You should now see the master volume control Graphical User Interface (GUI). Verify that in the lower left-hand corner of the volume control GUI, *USB Audio Device* is displayed. If not, then the USB enumeration process has failed.

7) Move the *Speaker* volume slider to approximately 75% of maximum volume and ensure that the mute box is *not* checked.

8) From the *Options* menu select *Properties*. Click on *Recording*. When the record volume control GUI pops up, ensure that the mute box is *not* checked, and that the volume slider bar is set to 50% or higher.

9) Using a Windows-based application, you may now select and play any .wav file.

1.2 System Overview

The basic functionality of the board is:

- To receive an audio input either digitally through the USB, or as an analog microphone or line input, to be converted to a serial bit stream by the TLC320AD77.
- Input the audio data to the DSP, via the multichannel buffered serial port (McBSP), to be processed and/or mixed.
- Output the processed audio information, via the McBSP to the TLC320AD77, to be converted to an analog signal.
- Filter and amplify the processed audio signal, to be output via a 3.5-mm stereo audio jack.
- Record digital data over the USB.

An emulator pod board that mates to the main board may be obtained for use with the kit. The board is for use with an 8051 emulator, which may be used to emulate the 8051 microcontroller in the TUSB3200. Firmware residing in an on-board EPROM is required to boot up the USB and DSP devices, as well as provide DSP application code. The board has a 24LC256 EPROM in a socket for ease of use in modification and development of STC and DSP firmware. The emulator pod board is further described in EVM Operation.

1.3 Additional Hardware and Software

The DAREF101 EVM may be powered from the universal serial bus or from an external power supply. If an external power supply is desired, then a 5 V ac adapter will be required. If an external power connector is inserted into connector PJ1, the board will automatically sense this and therefore not draw any current from the USB connector. Otherwise, the board will automatically take its power from the 5-V supply on pin 1 of the USB connector (J2).

A USB cable will be required to interface the DAREF101 EVM to the PC. In addition, either a microphone and headphones, or else a headset will be required to provide audio input and output for the board's default configuration of microphone input. Alternatively, the board can be configured for line input via component assembly options, in which case an analog line input source (such as a sound card or CD input) would be required. Audio jacks (3.5 mm) are provided on the board for the inputs and outputs.

The main board may also be used with an in-circuit 8051 emulator for USB code development. An emulator pod board is provided to interface to the main board for this purpose. The DAREF101 EVM will require additional hardware and software if used with an in-circuit emulator. The emulator hardware should consist of a PC card, an interface cable, and the emulator pod board provided with the kit. The emulator pod board mates directly to the main board via a 26-pin connector. More information will be given about the 8051 emulator in section 4.5.

For DSP code development, a JTAG emulator interface is supported through the 14-pin connector marked JTAG on the board. More information will be given about the DSP emulator in section 4.6.

Chapter 2

Physical Description

This chapter provides a description of the DAREF101 EVM and bill of materials.

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2.1 Physical Description

The DAREF101 EVM main board is 3.5 inches (88,9mm) x 4.0 inches (101,6mm). A copy of the top layer silkscreen is provided in Appendix A for identifying component locations.

2.2 DAREF101 EVM Bill of Materials

Table 2–1. Bill of Materials

QTY	Reference Designators	Type / Size	Description	Value
32	C2,C3,C4,C21,C33,C36,C38,C39, C40,C41,C42,C43,C44,C48,C49,C50, C51,C52,C53,C55,C58,C59, C61,C72,C73,C74,C75,C76,C77,C78, C79,C80	RC0603	Capacitor	0.1 μF
4	C25,C26,C46,C54	RC0603	Capacitor	15 pF
2	C12,C15	RC0603	Capacitor	47 pF
5	C14,C28,C34,C45,C81	RC0603	Capacitor	100 pF
3	C8,C20,C27	RC0603	Capacitor	1000 pF
2	C9,C11	RC0805	Capacitor	0.33 μF
3	C1,C22,C24	RC0805	Capacitor	1.0 μF
2	C10,C13	RC1206	Capacitor	0.33 μF
3	C7,C31,C32	KA100–16	Capacitor	100 μF/ 16 V
1	C5	KGA15–16	Capacitor	15 μF/ 16 V
12	C16,C17,C19,C23,C35,C37,C66,C67, C68,C69,C70,C71	VSB10/16	Capacitor	10 μF / 16 V
2	C6,C47	VSB33/10	Capacitor	33 μF / 10 V
1	C18	VSB33/16	Capacitor	33 μF / 16 V
34	R15,R30,R44,R66,R67,R69,R70, R71,R72,R75,R76,R77,R78,R79, R80,R81,R82,R83,R84,R85, R86,R87,R88,R89,R94,R95,R96,R97, R98, R99,R106, R109, R110,(R111)	RC0603	Resistor	0 Ω
2	R24,R49	RC0603	Resistor	1.0 KΩ
2	R26,R36	RC0603	Resistor	1.5 KΩ
1	R19	RC0603	Resistor	2.0 KΩ
1	(R31)	RC0603	Resistor	2.55 KΩ
1	R22	RC0603	Resistor	3.01 KΩ
1	R48	RC0603	Resistor	3.09 KΩ
2	R8,R108	RC0603	Resistor	3.3 KΩ
19	R10,R16,R17,R18,R20,R25,R29, R39,R40,R45,R46,R55,R56,R59, R60,R61,R73,R105,R116	RC0603	Resistor	4.99 KΩ
(12)	R1,R6,R21,R47,R50,R52,R53,R62,R91, R92,(R9),(R111)	RC0603	Resistor	10 KΩ
(1)	(R31)	RC0603	Resistor	10.5KΩ
3	R7,R11,R114	RC0603	Resistor	20 KΩ
2	R27,R28	RC0603	Resistor	27.4 KΩ
1	R121	RC0603	Resistor	39.2 KΩ

2	R14,R23	RC0603	Resistor	47.5 KΩ
1	R54	RC0603	Resistor	49.9 KΩ
5	R51,R63,R64,R74,R93	RC0603	Resistor	100Ω
1	R65	RC0603	Resistor	100 KΩ
(4)	R32,R68,R120,(R9)	RC0603	Resistor	249 KΩ
3	R3,R12,R119	RC0603	Resistor	332Ω
3	R4,R13,R112	RC0603	Resistor	499Ω
1	R100	RC0805	Resistor	0.1Ω
2	R34,R35	RC0805	Resistor	1Ω
1	R43	RC0805	Resistor	2.7Ω
1	R38	RC0805	Resistor	10Ω
1	R118	RC1206	Resistor	0 Ω
1	R122	RC1206	Resistor	0.47Ω
5	R33,R37,R41,R42,R57	RC1206	Resistor	1Ω
1	R43	RC1206	Resistor	2.7Ω
2	R5,R117	RC1206	Resistor	4.99 KΩ
1	Y1	XTAL_HC49	Crystal	6 MHz
4	FB1,FB2,FB3,FB4	FB1206	Ferrite bead	
3	Q1,Q2,Q3	SOT23–DBV3	MOSFET	FMMT3906
1	PFET1	SOT23–DBV3	PFET	SI2303DS
1	EPROM	DIP–8	IC-EPROM	24LC256
1	U4	TSSOP14–PW	IC-Inverter	SN74LVCU04
1	OA2	TSSOP8–DGK	IC-Op Amp	LM4881MM
1	U2	SSOP28–DB	IC-Codec	TLC320AD77
1	OA1	TSSOP8–PW	IC-Op Amp	TLV2362PW
1	U3	LQFP144–PGE	IC-DSP	TMS320VC5410
1	VR1	HTSSOP20–PWP	IC-voltage regulator	TPS70151
1	U1	TQFP52–PAH	IC-USB STC	TUSB3200
1	J2	USB_TYPEB–RA	Connector–-USB	
1	J1	IDC26M	Connector–pod board	
2	LINE OUT, MIC/LINE IN	JACK_3.5MM–ST	Connector–mini stereo	
1	PJ1	JACK_RASH712P	Connector–mini power	
1	JTAG	IDC14M	Connector–JTAG	
4	S1,S2,S3,S4	SW_P8050	Switches—Pushbutton	

Note: The reference designators and quantities shown in parentheses represent components that are either used on the MIC IN or LINE IN option, but not both options.

Chapter 3

User Configurations

This chapter provides the hardware/software setup procedures for using the DAREF101 EVM.

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3.1 Hardware/Software Setup

To power up the EVM board, install the connector of the universal serial bus (USB) cable to J2. Since the board receives 5 V from the USB, this will provide power to the EVM and will trigger the USB enumeration sequence. The other end of the USB cable should be inserted into the upstream port of the PC. A microphone (or alternatively, an analog line input) should be connected to the 3.5-mm audio jack marked *IN,* located immediately next to the USB connector (J2).

Stereo speakers or headphones should be connected to the DAREF101 EVM, via the 3.5-mm stereo jack marked *OUT,* located near the JTAG connector. This will provide the basic board functionality of taking an audio input from the USB, and an analog input from a microphone or line input source, processing the signals, and providing an audio output. A 14-pin JTAG connector, and a 26-pin emulator board connector, are also provided on the board for firmware development and troubleshooting.

In order for the board to download EQ coefficients, Windows drivers for USB bulk data transfers must be installed on the computer. These drivers should be installed when prompted by the computer the first time the USB cable is plugged in and the board tries to enumerate. The drivers are supplied with this EVM platform. Filenames of the drivers are *eqbulk.inf* and *eqbulk.sys*. In addition, the following USB drivers from the Windows Installation CD will have to be installed on the computer:

- *usb.inf (USB composite device)*
- *hiddev.inf (USB human interface device)*
- *wdma_usb.inf (USB audio device)*

If you receive a message stating that drivers need to be installed, follow the on-screen directions and point to the Windows Installation CD when asked for the file location.

3.2 Hardware Jumpers and Switches

Table 3–1 provides a listing and description of the jumpers, test points, and switches provided on the board.

Table 3–1. Jumpers and Switches

Jumper/Switch	Jumper/Switch Description
JB1	Signal pad block for probing analog output signals
JB2	Signal pad block for probing McBSP1 signals from DSP
TP1	Test point for CLKOUT signal coming from DSP
J6	Allows Powerdown signal for headphone amplifier to come from P1.5 of the TUSB3200
J7	Allows INT0 signal to DSP to come from P1.7 of the TUSB3200
J8	Allows $\overline{BI0}$ signal to DSP to come from P1.6 of the TUSB3200
J9	When installed, switches the TUSB3200 from internal mode to external mode
J10	Allows XF signal to DSP to come from P3.5 of the TUSB3200
J11	Allows the PWDN_U4 signal to the DSP clock level-shifter to come from P1.4 of the TUSB3200
S1	Pushbutton switch.When pressed, closes the contact on P3.0 of the TUSB3200. Its function is defined by firmware.
S2	Pushbutton switch.When pressed, closes the contact on P3.1 of the TUSB3200. Its function is defined by firmware.
S3	Pushbutton switch. When pressed, closes the contact on P3.3 of the TUSB3200. Its function is defined by firmware.
S4	Pushbutton switch. When pressed, closes the contact on P3.4 of the TUSB3200. Its function is defined by firmware.

For normal EVM operation, jumpers J6, J7, J8, J10, and J11 should be installed, leaving J9 uninstalled. For use with an 8051 emulator, J9 should be the only jumper installed, leaving J6, J7, J8, J10, and J11 uninstalled. When using the board with a DSP emulator, the jumper configuration should be the same as for normal operation.

Chapter 4

EVM Operation

This chapter describes the operation of the DAREF101 EVM.

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4.1 Power Supply

The DAREF101 board may be powered by either of two sources. The board may be self powered by applying 5 V to the external power connector PJ1; or power may be supplied by the universal serial bus 5 V, coming onto the board through the USB connector J2. The board is designed to support firmware that ensures the USB specification for current consumption of a self-powered device is met.

If no external connector is inserted into PJ1, the board will automatically draw its power from the USB. If an external power connector is inserted into connector PJ1, the board will automatically sense this and draw its power exclusively from the external source, disabling any current draw from the USB. Note: This means that if a power connector is inserted into PJ1, but the external power is not turned on, the board will not power up, since the USB power will be disabled.

4.2 EPROM

The EPROM contains three sections of code. The sections are the TUSB3200 boot code, the DSP boot code, and the DSP application code. A full download occurs when the TUSB3200 is configured in internal (normal) mode. A power-up reset initiates the download of the boot code to the TUSB3200 via IIC serial bus. Once the TUSB3200 boot code is downloaded, the DSP receives its boot code from the TUSB3200 via a buffered serial port. Once boot up occurs the DSP then receives its application code, via IIC, from the EPROM. If the TUSB3200 is in external mode for 8051 emulation, the EPROM bypasses the TUSB3200 boot code, but still downloads the DSP application code. The board is configured to support firmware download to the DSP either via the McBSP or the HPI of the DSP. The EPROM, recommended to be at least 32K bytes in size, is installed in an 8-pin DIP socket allowing easy installation and removal of EPROMs during code development.

4.3 Analog Input Section

There are two possible stuffing options for the analog input to the 3.5-mm audio jack marked IN. The input can be configured for either a microphone input or for an analog line input. The default configuration for the board is for a 2-wire electret microphone input, but instructions for modifying the board for a 3-wire microphone, or for a line input are shown on the schematic diagram provided with the board. A microphone bias is included in the circuit and will be applied to the microphone as soon as it is plugged in and power applied to the board.

4.4 Digital Signal Processor (DSP)

The DSP provided on the board is the TMS320VC5416. The board is also compatible with the TMS320VC5402 and TMS320VC5409. Communication with the TUSB3200 and the TLC320AD77 are via the buffered serial ports of the DSP. The default clock mode configuration, set by R63, R64, and R92, is for PLLx2 . Following the DSP boot process, the DSP application firmware sets

the DSP clock rate to its maximum frequency. The DSP has a built-in JTAG interface that may be accessed via a 14-pin JTAG connector on the board located adjacent to J1. If DSP emulation is desired, use of the C54x code composer studio integrated development environment from Texas Instruments is recommended.

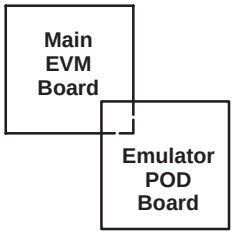
4.5 8051 Emulator

Use of an 8051 emulator may be helpful in the development of USB firmware. When using an 8051 emulator, the TUSB3200 is configured for external mode, and the emulator takes the place of the 8051 microcontroller embedded in the TUSB3200. An emulator pod board is included in this development kit for easily interfacing the main board to the emulator.

CAUTION.

Power to the emulator board is supplied from the main board via the emulator board connector, J1. For this reason, the emulator board (if used) should be connected to the main board prior to applying power.

To plug in the emulator pod board, line up the arrows located next to the connectors on the main board and emulator board so that both arrows are pointing the same direction, and mate the connectors together. When installed, the emulator pod board should not overlap the main board, but will point out away from it as shown here.



The pinout of the emulator pod board connector is shown in Table 4–1. When power is first applied to the emulator board, LEDs1–8 should each be illuminated. The emulator board has a 12 MHz crystal that can be used to clock the emulator if desired. There are four pushbutton switches on the emulator board, S1–S4, corresponding to switches S1–S4 on the main EVM board. When pressed these switches have the same effect as pressing S1–S4 on the main board. When using the main board with an 8051 emulator, J9 is the only jumper that should be installed in the board, leaving jumpers J6, J7, J8, J10, and J11 uninstalled.

Table 4–1. 8051 Emulator Pod Board Connector (J1) Pin Assignment

Signal Pin	Signal Name	Signal Description
1	P1.5	TUSB3200 GPIO port 1, bit 5
2	PWRDN	Powers down the analog output and input circuits
3	PDWN_U4	Powers down the DSP clock level-shifting logic.
4	BIO	DSP branch control signal
5	P1.6	TUSB3200 GPIO port 1, bit 6
6	P1.7	TUSB3200 GPIO port 1, bit 7
7	P1.4	TUSB3200 GPIO port 1, bit 4
8	INT0	External user interrupt 0. It can be polled and reset by way of the interrupt flag register
9	P1.2	TUSB3200 GPIO port 1, bit 2
10	P1.3	TUSB3200 GPIO port 1, bit 3
11	P1.0	TUSB3200 GPIO port 1, bit 0
12	P1.1	TUSB3200 GPIO port 1, bit 1
13	WR	Write strobe for external MCU write access to the TUSB3200 external data memory space
14	RD	Read strobe for external MCU read access to the TUSB3200 external data memory space
15	P3.3	TUSB3200 GPIO port 3, bit 3
16	P3.1	TUSB3200 GPIO port 3, bit 1
17	P3.0	TUSB3200 GPIO port 3, bit 0
18	RST0	Reset output. Active while the master reset input, or the USB reset is active.
19	P3.5	TUSB3200 GPIO port 3, bit 5
20	P3.4	TUSB3200 GPIO port 3, bit 4
21	EXTEN	External MCU mode enable.
22	XF	DSP external flag output. Used as a GPIO.
23,24	5V_HDR	5-V power supply voltage
25, 26	GND	Ground

4.6 DSP Emulator

The use of a DSP emulator may prove to be helpful in the development of DSP firmware. The DSP emulator software stops execution of the DSP code wherever it is in the execution process. This enables the download of newly developed DSP code without having to burn the code into the EPROM, or debugging the DSP code. The DSP emulator is interfaced to the main board via the 14-pin connector marked JTAG located adjacent to J1.

To use a DSP emulator with the board, plug the emulator connector into the JTAG connector on the board. Supply power to the board and connect the USB cable to the board. Let it complete the enumeration process. After you have verified a successful enumeration, you may then enable the emulator software.

Appendix A

DAREF101 EVM Silkscreen and Schematics

This appendix contains the DAREF101 EVM silkscreen for component location and schematic diagrams.

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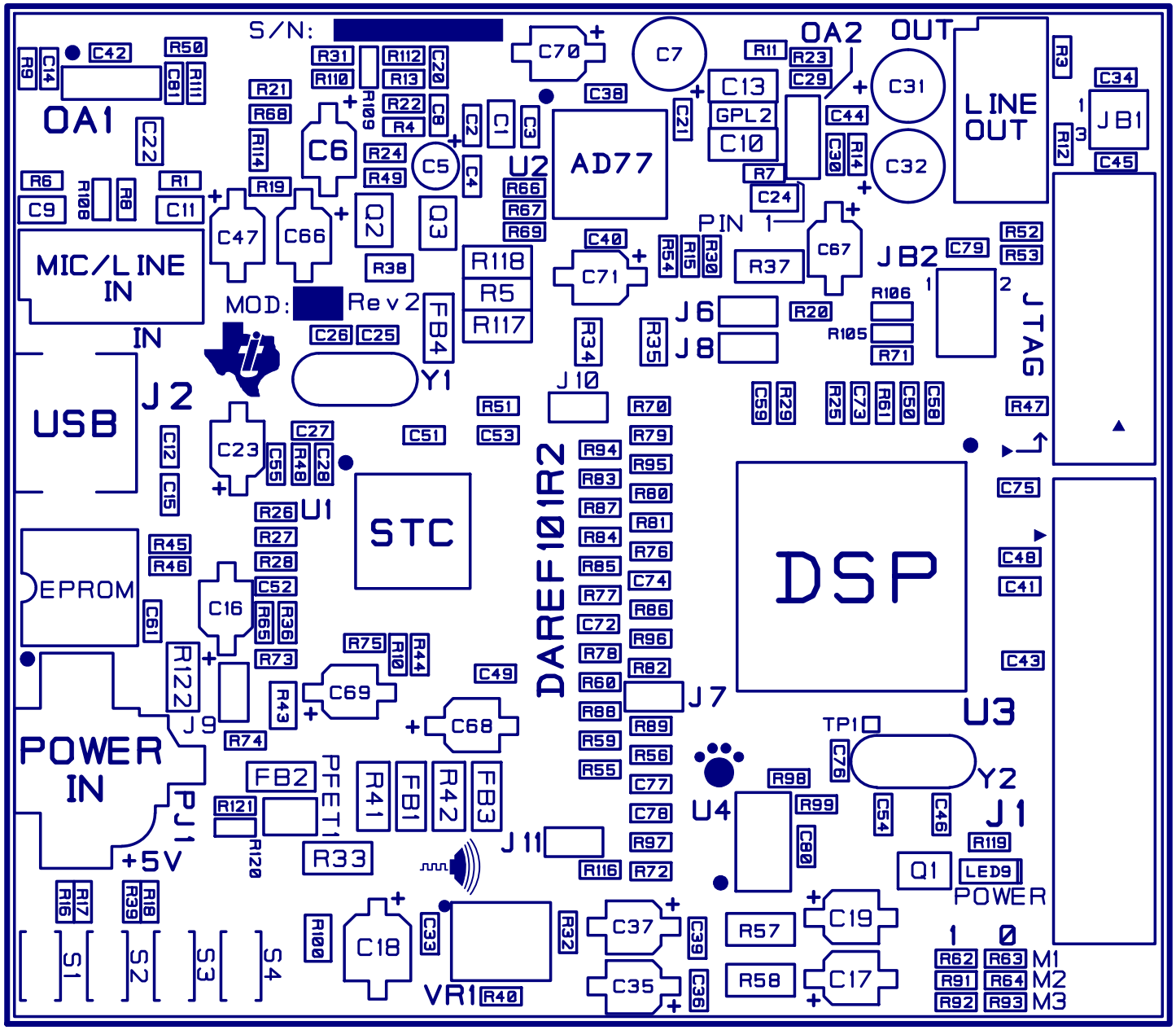
A.1 Silkscreen and Schematics

(1.86:1) ACCEL Gerber V 5.0 : Wed Sep 13 19:00:20 2000 - (Untitled)



Texas Instruments, Inc.
DIGITAL AUDIO GROUP
DUET DSP 2 CHANNEL Reference Design
TOP SILKSCREEN: DAREF101R2.SS1

DUET DSP 2 CHANNEL REFERENCE DESIGN

REV 2
MOD 1

MIC/LINE IN

LINE IN
MIC IN

STUFF OPTIONS		
	LINE IN	MIC IN
R1	IN	OUT
R8	OUT	TABLE
R9	10K	249K
R21	IN	OUT
R31	2.55K	10.5K
R68	OUT	IN
R108	OUT	TABLE
R109	OUT	IN
R110	IN	OUT
R111	10K	0.0
C11	IN	OUT
C22	OUT	IN
C81	IN	OUT

MIC BIAS TABLE (ELECTRET MIC)		
	2 WIRE	3 WIRE
R8	OUT	IN
R108	IN	OUT

TLC320AD77

U2
TLC320AD77

ANALOG OUT

LM4881MM

USB STREAMING CONTROLLER

U1
TUSB3200

EEPROM
32Kx8 (256K) 24LC256

R88 and R89 are only used for booting via McBSP1

TMS320VC5402
TMS320VC5409
TMS320VC5416

U3
TMS320VC54XX

HOST PORT INTERFACE
BUFFERED SERIAL PORTS
PARALLEL ADDRESS BUS
PARALLEL DATA BUS
MEMORY CONTROL
OSCILLATOR
JTAG
INIT/INT/RESET

OPTIONAL: C5416 ONLY

Mode Select

JTAG (Optional)

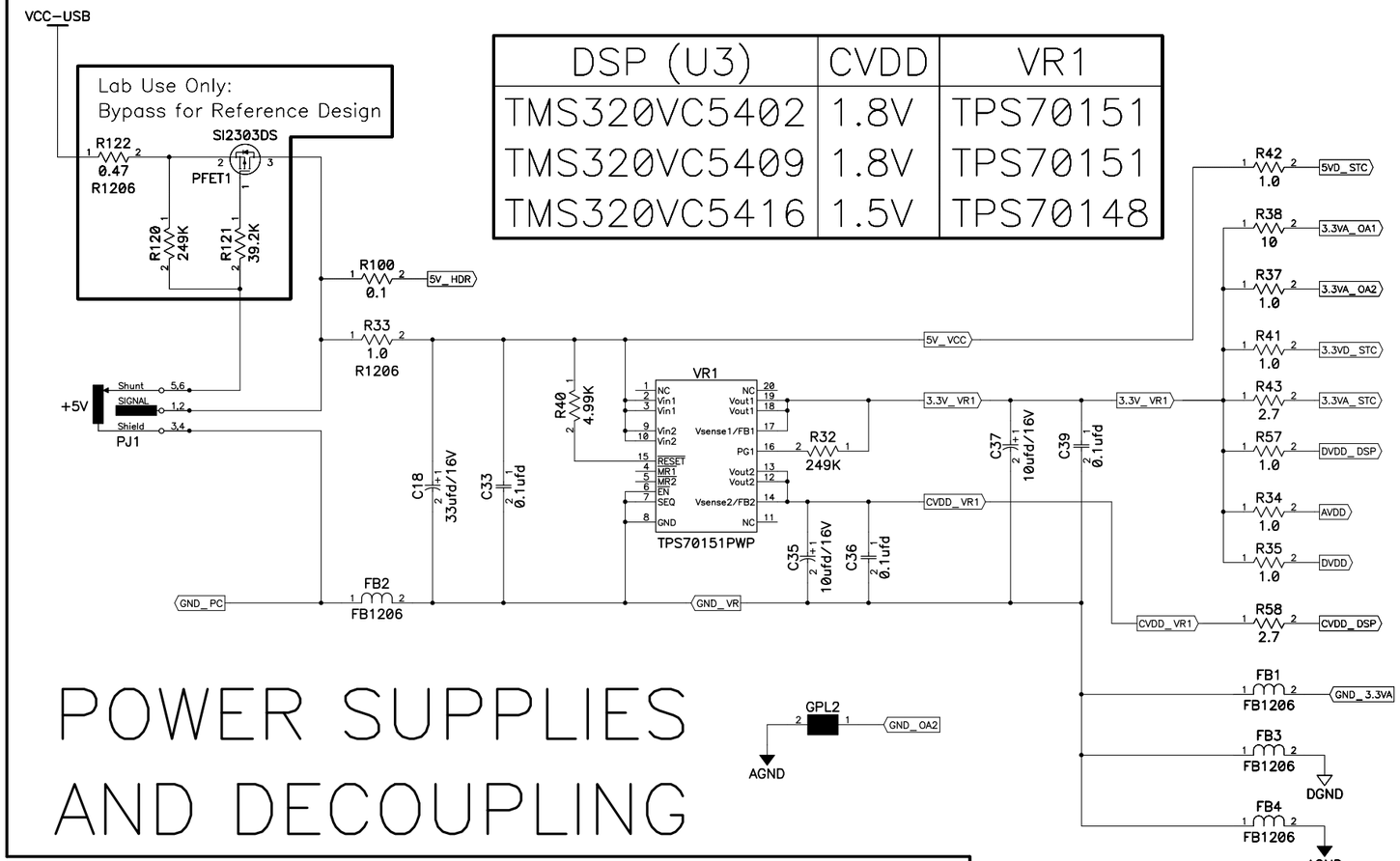
TO J1

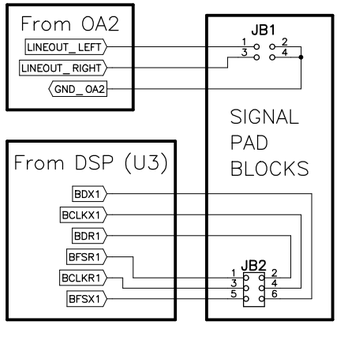
Texas Instruments, Inc.
Digital Speakers Group

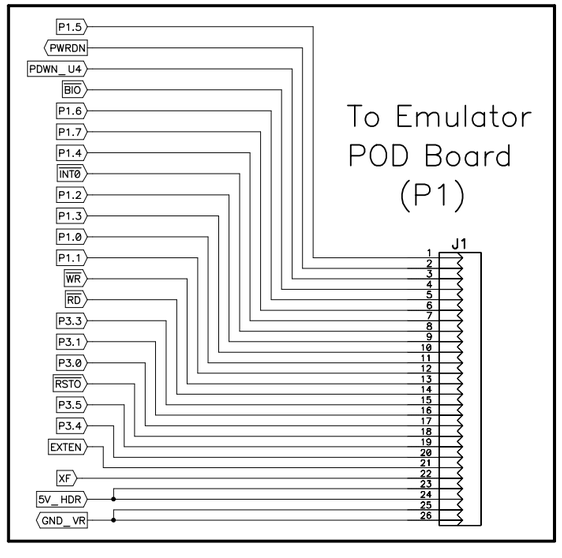
Project: DUET DSP REFERENCE DESIGN BOARD					
Size: DX	Page Title: Digital I/O				
Engineers: RAY KING					
Date: Thu Sep 14, 2000	Time: 16:05:12	Rev: 2	Mod: 1	Sheet 1 of 2	
Filename: DAREF101R2M1.SCH				Drawn By:LDN	
File Location: \\vette02\DSG\Schematics\ReferenceDesigns\DSP\					

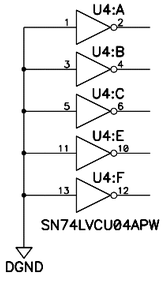
POWER SUPPLIES AND DECOUPLING

DSP (U3)	CVDD	VR1
TMS320VC5402	1.8V	TPS70151
TMS320VC5409	1.8V	TPS70151
TMS320VC5416	1.5V	TPS70148









DUET DSP 2 CHANNEL REFERENCE DESIGN

REV 2 | MOD 1

Texas Instruments, Inc.
Digital Speakers Group

Project: DUET DSP REFERENCE DESIGN BOARD					
Size: CX	Page Title: Power Supply Decoupling/Distribution				
Engineers: RAY KING					
Date: Thu Sep 14, 2000	Time: 16:05:13	Rev: 2	Mod: 1	Sheet 2 of 2	
Filename: DAREF101R2M1.SCH				Drawn By:LDN	
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