

# **ADSP-21065L EZ-KIT Lite Evaluation System Manual**

Part Number: 82-000490-01  
Revision 1.0  
December 2000



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# 1 INTRODUCTION

Thank you for purchasing the ADSP-21065L EZ-KIT Lite™ evaluation kit. The evaluation board is designed to be used in conjunction with VisualDSP++™ development environment and is based on the ADSP-21065L SHARC® floating-point digital signal processor (DSP). The kit is shipped with an evaluation board and VisualDSP++ software. The VisualDSP++ that comes with the kit will only operate with the evaluation board. The complete version must be purchased separately. Using the EZ-KIT Lite with VisualDSP++, you can observe the ADSP-21065L DSP execute programs from on-chip RAM, interact with on-board devices, and communicate with other peripherals.

You can access the ADSP-21065L SHARC processor using the PC through a serial port or an optional JTAG emulator. The monitor program that runs on the EZ-KIT Lite, gives you access to the ADSP-21065L processor's internal memory space through the serial port. In contrast, the JTAG emulator allows the PC to perform in-circuit emulation through the processor's JTAG interface.

The board's features include:

- Analog Devices ADSP-21065L DSP running at 60MHz
- Analog Devices AD1819A 16-bit SoundPort® Codec
- RS-232 interface
- Socketed EPROM (128K x 8 on board, or 256K x 8, 512K x 8, and 1M x 8 selectable)
- SDRAM (1M x 32)
- Four push buttons for Flag inputs
- Three push buttons for IRQ inputs
- Six user programmable LEDs
- Power supply regulation
- EMAFE (Enhanced Modular Analog Front End) connector for expansion
- Expansion connectors

The EZ-KIT Lite board is equipped with hardware that facilitates interactive demonstrations. The push button switches and user programmable LEDs provide user control and board status. Additionally, the AD1819A SoundPort Codec provides access to an audio input (selectable as line level or microphone) and an audio output (line level).

The EZ-KIT Lite includes a monitor program stored in non-volatile memory. The monitor program allows the user to download, execute and debug ADSP-21065L programs. By removing the socketed EPROM, replacing it with an EPROM containing user code, the board can run as a stand-alone unit, without the PC.

The user can also connect a JTAG emulator to the EZ-KIT Lite. Through the JTAG emulator, you can load programs, start and stop program execution, observe and alter registers and memory, and perform other debugging operations. JTAG emulators are purchased separately through Analog Devices.

Additionally, the EZ-KIT Lite provides expansion connectors that let the user examine the processor signals, as well as provide an interface for host control.

## **1.1 For More Information About Analog Devices, Inc. Products**

Analog Devices is accessible on the Internet at [www.analog.com](http://www.analog.com). The DSP web page is directly accessible at [www.analog.com/dsp](http://www.analog.com/dsp). This page provides access to DSP specific technical information and documentation, product overviews, and product announcements.

## **1.2 For Technical or Customer Support**

You can reach our Customer Support group in the following ways:

- Email questions to [dsptools.support@analog.com](mailto:dsptools.support@analog.com)
- Contact your local Analog Devices sales office or an authorized Analog Devices distributor

## **1.3 Purpose of This Manual**

The ADSP-21065L EZ-KIT Lite evaluation system manual gives directions for installing the evaluation board and software on the PC. Also, the manual provides guidelines for running user code on the ADSP-21065L.

## **1.4 Intended Audience**

This manual is a user's guide and reference to the ADSP-21065L EZ-KIT Lite evaluation board. DSP programmers who are familiar with Analog Devices SHARC architecture, operation, and programming are the primary audience for this manual.

DSP programmers who are unfamiliar with Analog Devices DSPs can use this manual, but should supplement this manual with the ADSP-21065L User's Manual, the ADSP-21065L Technical Reference and the VisualDSP++ tools manuals.



## 1.5 Manual Contents Description

This manual contains the following information:

- Chapter 1 — Introduction  
Provides manual information and Analog Devices contact information.
- Chapter 2 — Getting Started  
Provides software and hardware installation procedures, PC system requirements, and basic board information.
- Chapter 3 — Using EZ-KIT Lite Software  
Provides information on the EZ-KIT Lite system from a software perspective, and details the monitor program, EMAFE, and codec.
- Chapter 4 — Demonstration Programs  
Provides information on VisualDSP++ debugger operation with the ADSP-21065L EZ-KIT Lite, benchmarking utilities, and demonstration programs.
- Chapter 5 — Working With EZ-KIT Lite Hardware  
Provides information on the Hardware aspects of the evaluation system.
- Chapter 6 — Expansion Connectors  
Provides information on EMAFE expansion and descriptions of connector interface signals.
- Chapter 7 — Reference  
Provides information on settings menu commands and demo menu commands.
- Appendix A — Restrictions & CPLD Code Listing  
Provides information on board restrictions you may encounter when using your EZ-KIT Lite, and the files used on the programmable device(s) on the EZ-KIT Lite board.
- Appendix B — Bill of Materials  
Provides a list of components used in the manufacture of the EZ-KIT Lite board.
- Appendix C — Schematics  
Provides a resource to allow EZ-KIT Lite board level debugging or to use as a reference design.

## 1.6 Documents and Related Products

For more information on the ADSP-21065L and the components of the EZ-KIT Lite system, see the following documents:

- ADSP-21065L SHARC User's Manual & Technical Reference
- ADSP-21065L
- AC'97 SoundPort®

The ADSP-2106x family of processors is supported by a complete set of evaluation tools. Software tools include a C compiler, assembler, runtime libraries and librarian, linker, simulator, and PROM splitter. See the following documents:

- VisualDSP++ Getting Started Guide
- VisualDSP++ User's Guide for the ADSP-21xxx Family DSPs
- Assembler Manual for the ADSP-21xxx Family DSPs
- C/C++ Compiler & Library Manual for the ADSP-21xxx Family DSPs
- Linker & Utilities for the ADSP-21xxx Family DSPs
- Product Bulletin for VisualDSP++ and the ADSP-21xxx Family DSPs

These documents are found on the Analog Devices Technical Documentation web site at [http://www.analog.com/industry/dsp/tech\\_doc/gen\\_purpose.html#32](http://www.analog.com/industry/dsp/tech_doc/gen_purpose.html#32)

If you plan to use the EZ-KIT Lite in conjunction with the JTAG emulator, refer to the documentation that accompanies the emulator.

Your software installation kit includes on-line help as part of the Windows interface. These help files provide information about the ADSP-21065L evaluation board and accompanying tools.

## 2 GETTING STARTED

### 2.1 Overview

This chapter provides information to install the software and the ADSP-21065L evaluation board. It is important that installation of the software and hardware are in the order presented for correct operation. This chapter also provides basic board information and contains the following sections:

- Contents of your EZ-KIT Lite package
- PC configuration
- Installation procedures

### 2.2 Contents of Your EZ-KIT Lite Package

The EZ-KIT Lite evaluation board contains ESD (electrostatic discharge) sensitive devices. Electrostatic charges readily accumulate on the human body and equipment and can discharge without detection. Permanent damage may occur on devices subjected to high energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Unused EZ-KIT Lites should be stored in the protective shipping package.



The ADSP-21065L EZ-KIT Lite evaluation board package should contain the following items. If any item is missing, contact the vendor where you purchased your EZ-KIT Lite or Analog Devices.

- ADSP-21065L EZ-KIT Lite board
- Power cable with DC power supply (7.5 Volts)
- RS-232 serial port 9-pin cable
- EZ-KIT Lite CD containing examples, target .dll files, help files, and utilities
- VisualDSP++ CD
- Registration card - *please fill out and return*

## 2.3 PC Configuration

For correct operation of the VisualDSP++ software and EZ-KIT Lite demos, all computers must have the minimum configuration shown below.

**Table 2-1 PC Minimum Configuration**

<b>Windows 95, 98, 2000</b>	<b>Windows NT</b>
Windows 95 OSR2, Windows 98, or Windows 2000	Windows NT, release 4.0, Service Pack 3 or later
Pentium processor 166 MHz or faster	Pentium processor 166 MHz or faster
VGA Monitor and color video card	VGA Monitor and color video card
2-button mouse	2-button mouse
100 MB available space	100 MB available space
32 MB RAM	32 MB RAM
CD-ROM	CD-ROM

## 2.4 VisualDSP++

The ADSP-21065L EZ-KIT Lite system is shipped with the VisualDSP++ Integrated Development Environment (IDE), debugger and code generation tools. VisualDSP++ is limited in functionality by the EZ-KIT Lite serial number that is shipped with this product. The EZ-KIT Lite serial number restricts the VisualDSP++ debugger to only connect to the ADSP-21065L EZ-KIT Lite evaluation board running the debug monitor via the serial port (no emulator or simulator support). Additionally, the linker will restrict the user to only 25% (2.5k words) of the ADSP-21065L's on-chip program memory space. If the full VisualDSP++ software suite is purchased, the user will obtain a new serial number from Analog Devices that will lift the restrictions mentioned above. The basic components that are shipped with VisualDSP++ are:

- Integrated Development Environment (IDE) — graphical interface for project management, allowing the user to set project options, access the code generation tools, and launch the debugger.
- Debugger — allows the user to view the insides of the DSP and perform debug operations such as read/write memory, read/write registers, load programs, run, step, halt, and more.
- SHARC Family Code Generation Tools — C compiler, assembler, runtime libraries and librarian, linker, simulator, and PROM splitter.
- Example Projects — Both VisualDSP++ and the ADSP-21065L EZ-KIT Lite are shipped with example projects and C and Assembly source code that demonstrate various features of the tools and ADSP-21065L DSP.

## 2.5 Installation Procedures

The following procedures are provided for the safe and effective use of the ADSP-21065L evaluation board. It is important that you follow these instructions in the order presented to ensure correct operation of your software and hardware.

### 2.5.1 Installing the EZ-KIT Lite Hardware

The ADSP-21065L EZ-KIT Lite board is designed to run outside the PC as a stand alone unit. There is no need to remove the chassis from your computer. Use the following steps to connect the EZ-KIT Lite board:

1. Remove the EZ-KIT Lite board from the package—be careful when handling these boards to avoid the discharge of static electricity, which may damage some components.
2. Connect the RS-232 cable to an available Comm Port on the PC and to J3 on the ADSP-21065L evaluation board.
3. Plug the provided cord into a 120-Volt AC receptacle and plug the connector at the other end of the cable into J1 (Power In) on the evaluation board.

All of the LEDs light up briefly. The FLAG9 and power (red) LED remain on. If the LEDs do not light up, check the power connections.

To configure your board to take advantage of the audio capabilities of the demos, use the following procedure:

1. Plug a set of self-powered computer speakers into jack J7(Line Out) on the board. Turn on the speakers and set the volume to an adequate level.
2. Connect the line out of an electronic audio device to jack J8 (MIC/Line In) on the board. Set jumpers JP1 and JP2 to LINE.
3. Set Jumper JP3 to GND to enable the AD1819 codec. (This is the board default)

This completes the hardware installation.

### 2.5.2 Installing VisualDSP++

This EZ-KIT Lite comes with the latest evaluation version of VisualDSP++ for SHARC Family DSPs. You must install this software prior to installing the EZ-KIT Lite software. Insert the VisualDSP++ CD into the CD-ROM drive. This will bring up the CD browser. Click on the “Install VisualDSP++” option. This will launch the setup wizard. Follow this wizard with the on-screen instructions.

### **2.5.3 Installing the VisualDSP++ EZ-KIT Lite License**

Before the VisualDSP++ software can be used, the license must be installed. To install the EZ-KIT Lite license, follow these steps:

1. Make sure VisualDSP++ has been installed first.
2. Insert the VisualDSP++ CD into the CD-ROM drive if it is not already in the drive.
3. Once the CD browser is on the screen select the "Install License" option.
4. Now follow the setup wizard instructions. (Note: Make sure that you have the proper serial number located on the back of the CD holder.)

### **2.5.4 Installing the EZ-KIT Lite Software**

The EZ-KIT Lite software is supplied on a separate CD-ROM. To install the EZ-KIT Lite software, follow these steps:

1. Make sure VisualDSP++ has been installed first.
2. Close all Windows applications. The install will not work correctly if any VisualDSP++ applications are running.
3. Insert the EZ-KIT Lite CD into the CD-ROM drive. The setup will automatically start. Follow the installation wizard by choosing the appropriate options.
4. When the setup has completed reboot the machine, if necessary.

### 2.5.4.1 Default Settings


After you have installed the board and utility software, your PC and EZ-KIT Lite have the default settings shown in Table 2-2. You can change these settings through the **Settings** menu in the debugger.

**Table 2-2 User Configurable EZ-KIT Lite Settings**

<b>Selection</b>	<b>Default Setting</b>
Comm Port	Comm 1
Baud Rate	115200
Codec Sample Rate	48000 Hz
Codec Source	Microphone
Codec Gain	0.0

### 2.5.4.2 On-Line Help

The VisualDSP++ Debugger comes with a complete on-line help file and Adobe .pdf files of all manuals.

- You can use the context help button  to get help on any command or icon  
or
- Highlight a command and press F1.

For help on commands and dialogs click from the toolbar **Help -> Help Topics** to get to the *Debugger Help* help file.

## 3 USING EZ-KIT LITE SOFTWARE

### 3.1 Overview

The combination of the EZ-KIT Lite board and the monitor software operate as a target for the VisualDSP++ debugger. The debugger allows viewing of the processor registers and memory, perform several debugging activities, such as: setting breakpoints, stepping through code, and plotting a range of memory.

If VisualDSP++ is not installed, please install it from the VisualDSP++ CD that came with this product. For more information, refer to Chapter 2, section “VisualDSP++”.

This chapter provides monitor level software information on how the EZ-KIT Lite board operates with the installed software. This chapter also provides information that helps the user run his/her own programs on the ADSP-21065L EZ-KIT Lite board. This information appears in the following sections:

- “Standard Operation”  
Describes the operation of the EZ-KIT Lite board, from Power On self Test (POST) routines to the AD1819 codec’s operation.
- “Running Your Own Programs”  
Provides information about writing and running your own DSP executables that link with the monitor program to run on the EZ-KIT Lite board.

### 3.2 Standard Operation

This section covers the standard operation of the EZ-KIT Lite board. It describes the I/O capabilities of the on-board components, board power-up, and the on-board Monitor program.

#### 3.2.1 I/O Devices

##### 3.2.1.1 Flags

The ADSP-21065L has 12 asynchronous FLAG I/O pins that let you interact with the running program. All flags are configured as inputs on reset of the DSP. For more information on the Flag pins, see Chapter 12, “System Design, Flag Pins” in the *ADSP-21065L SHARC User’s Manual*. The flags and their uses, are as follows:

- FLAG<sub>0,3</sub> are connected to the push buttons on the EZ-KIT Lite board and are for user input. For instance, the user can tell the program to poll for a flag and when it occurs, do some other operation such as jump to another instruction. The push button flags are set as inputs through the MODE2 register. Once configured, they may be read through the ASTAT register.



- FLAG<sub>4-9</sub> connect to the LEDs and supply feedback for program execution. For example the user can write code to trigger a flag (and the corresponding LED) when a routine is complete the LED will light. The LED flags are configured through the IOCTL register and are set/read through the IOSTAT register.
- FLAG<sub>10</sub> is available to the EMAFE interface and is used for signaling. The EMAFE flag is configured through the IOCTL register and is set/read through the IOSTAT register.
- FLAG<sub>11</sub> is reserved for the monitor to determine if the AD1819 codec is enabled. When using the monitor program supplied with the EZ-KIT Lite board, do not use or alter this flag pin.

**Table 3-1 Flag Summary**

<b>Flag</b>	<b>Use</b>
Flag <sub>0-3</sub>	Push-button Input (SW3, SW5, SW7, SW8)
Flag <sub>4-9</sub>	LED Feedback
Flag <sub>10</sub>	EMAFE Flag
Flag <sub>11</sub>	Reserved for monitor

### 3.2.1.2 Interrupts

Each of the three external interrupts, IRQ<sub>0-2</sub>, of the ADSP-21065L are directly accessible through push button switches SW2, SW4, and SW6 on the EZ-KIT Lite board. IRQ<sub>0-1</sub> are “wire-Or’ed”; IRQ<sub>0</sub> is used to implement interrupt driven serial routines with the UART and IRQ<sub>1</sub> is provided for use with an EMAFE board and can be set to read and write registers.

The external interrupts are controlled through the MODE1, MODE2, and IMASK registers and are configured in one of two ways: by modifying the vector table or through instructions in user code. The MODE2 register also controls the interrupt sensitivity between level and edge. To prevent an interrupt from being masked, write to the particular interrupt in the IMASK register.

The monitor program running on the ADSP-21065L uses three interrupts; IRQ0, SPT11 and SFT3, for normal operation. These interrupt vectors are provided in the “demorth.asm” file that comes with the EZ-KIT Lite.

When writing code, these interrupts (and their corresponding vectors) should not be altered. If these vectors are overwritten, the kernel may not work as shown in Table 3-1.

For more information on the registers that control interrupts, and a complete list of interrupt vector addresses, see Appendix E and F in the *ADSP-21065L SHARC Technical Reference*.

**Table 3-2 Interrupts Used by the Monitor Program**

Interrupt	Description	Lost Functionality if Overwritten
IRQ0	Multiplexed from the UART through an open collector device	Debugger's ability to interrupt running code
SFT3	Used to signal the monitor to send data back to the Host	Ability to send messages from user code to the debugger
SPT1	AD1819 Transmit Interrupt	Monitor's ability to control the AD1819
SPR1	AD1819 Receive Interrupt	

The following rules and restrictions should be followed when using interrupts:

- You cannot step into an interrupt.
- Interrupts are disabled when the user program is halted.
- The board cannot communicate with the host if an interrupt higher than IRQ0 is used.
- The board cannot communicate with the host if interrupt nesting is disabled.
- If the user does not require the supplied monitor program, IRQ0 with SW2 can be configured by the user. In the initialization code of the user's program, the interrupt vector for IRQ0 must be replaced. This removes all monitor functionality.
- If the user does not connect an EMAFE to the EZ-KIT Lite, IRQ1 with SW4 can be configured for other purposes. If an EMAFE card is attached and it uses IRQ1, there is no way to disable the EMAFE's control of the interrupt line. If the EMAFE is not attached, IRQ1 is available for other uses. Note: the monitor program does not interact with the EMAFE board, and does not have any response to an IRQ1 request.

### 3.2.1.3 Serial Ports

The ADSP-21065L features two synchronous Serial Ports (SPORT0 and SPORT1). The SPORTs can operate at up to 1x clock frequency, providing each with a maximum data rate of 30 Mbit/sec. Each SPORT has a primary and a secondary set of transmit and receive channels. SPORT data can be automatically transferred to and from on-chip memory using DMA.

Each of the SPORTs supports three operation modes: DSP SPORT mode, I<sup>2</sup>S mode (an interface commonly used by audio codecs) and TDM (Time Division Multiplex) multichannel mode. For additional information on the serial ports please refer to Chapter 9 of the *ADSP-21065L SHARC User's Manual*.

Both of the synchronous serial ports are connected to the EMAFE interface. SPORT1 is also connected to the on-board AD1819. Jumper JP3 is used to disable the AD1819, so it doesn't interfere with the EMAFE. For normal operation of the AD1819, JP3 must be connected to GND. If the EMAFE is using SPORT1, the serial communication to the AD1819A should be disabled by connecting JP3 to +3.3V<sub>CC</sub>.

### 3.2.2 POST Routines

POST (Power On Self Test) routines are a series of standard tests and initializations that the EZ-KIT Lite performs on a power-on reset. To perform a power-on reset, disconnect power to the board for at least three seconds and then reconnect power. The board automatically resets (note that all the LED's light up briefly). The user may also reset the board during operation through the **Debug -> Reset** command from the debugger menu bar. Both types of reset cause the DSP to reset to a known state and is followed by a message box that displays the message "Communications Success". At this point the user should reload any programs he/she was working on. Table 3-3 shows the types of resets and their functions.

**Table 3-3 Table 3-3. Post Routines**

<b>Routine</b>	<b>Power-on Reset</b>	<b>Reset During Operation</b>
EPROM Check	Yes	No
Internal Memory Check	Yes	No
External Memory Check	Yes	No
UART Check	Yes	No
AD1819 Check	Yes	No
Initializations	Yes	Yes

Error codes are transmitted to the PC and are displayed on the LEDs. If the LED remains lit after reset, then the error has been caused by the component shown in Table 3-4

**Table 3-4 Table 3-4. POST Error Codes**

<b>Flag LED</b>	<b>Error</b>
4	EPROM
5	UART
6	AD1819
7	Memory

### 3.2.2.1 Memory Checks

The monitor program performs some standard memory checks which are as follows:

- EPROM
- Internal memory
- External SDRAM

The EPROM test consists of verifying a number in memory. If the monitor code is corrupted, the monitor may crash before reaching the actual program code. These checks include:

- Write, then verify all 0's
- Write, then verify all 1's
- Write, then verify memory address
- Write, then verify compliment of memory address

### 3.2.2.2 UART Check/Initialization

The UART check is done in three stages. Two of these stages are implemented in the POST. The third is controlled by the host (PC), when it attempts to connect to the EZ-KIT Lite. These stages are:

- Register Write

This test confirms that the ADSP-21065L is capable of writing to and reading from a register in the UART. Three patterns are written to and then read from a register in the UART, and tested. All three patterns must be read back correctly to pass this test.

- Internal Loop Back

In this test, 256 bytes are sent to and read from the UART. This test checks the functionality of the UART connections from the ADSP-21065L, up to and through the UART chip.

- Transmitted Loop Back

The last UART test is performed by the host after the POST is complete. In this test, the host sends the UART test protocol. This protocol specifies the number of bytes that are transmitted to the EZ-KIT Lite board, and instructs the board to echo the byte stream back to the host. This test determines whether the EZ-KIT Lite board is set to the correct baud rate, and verifies the external connections between the board and the host.

On power up, the EZ-KIT Lite board defaults to a baud rate of 115200 baud with 8 data bits, 1 stop bit, and no parity. If you want to change this rate change it after the POST is complete use the **Settings -> Baud Rate** command from the debugger menu bar. Note that setting the baud rate to a lower number can significantly slow the boards response to all debug activities.

### 3.2.2.3 AD1819 Check/Initialization

On reset, the AD1819 begins transmitting the clock used to synchronize data transfers over SPORT1.

Once this bit goes high, the AD1819 is ready for standard communication over SPORT1. The POST then writes and verifies three patterns to an internal register in the AD1819. If all three writes are verified, the connection is verified.

### 3.2.3 Monitor Program Operation

The monitor program runs on the EZ-KIT Lite board as part of the DSP executable and provides the ability to download, debug, and run user programs. The VisualDSP++ debugger is the interface for the monitor and using the EZ-KIT Lite as a target with the debugger lets you operate the board remotely.

There are three main components of the monitor program:

- Halt loop
- UART ISR
- Command Processing Kernel

The monitor program idles in the Halt loop when it is not running user code. While there, you can read/write memory, read/write registers, download programs, set breakpoints, change the UART's baud rate, modify the AD1819 configuration, and single step through code. To enter the halt loop from your code, you must halt user code—either with a breakpoint or a halt instruction. At this point, the halt loop polls the UART. With every character received from the UART, the command processing kernel verifies whether a full command has been received. If a command has been received, the kernel processes the command; otherwise control is returned to the halt loop to wait for more characters. The only method of executing your code once the halt loop has been entered is to send a Run or Single Step command in the debugger.

The UART ISR is entered when user code is running, but the host is still interacting with the board. As the host sends bytes, the UART ISR takes the data stream from the UART, and builds the command. As with the halt loop, each character received is passed to the command processing kernel. Unlike the halt loop, the monitor returns to the user code immediately after the interrupt is serviced.

The following restrictions should be followed to ensure correct board operation.

- The host loses contact with the monitor while the user program is running if the user program disables the UART interrupt or changes the UART interrupt vector.
- The host loses contact with the monitor while the program is running and in an ISR when nesting is turned off.
- The host loses contact with the monitor while the program is running and in the timer ISR, provided the highest priority timer vector is used.
- The host cannot halt with the debugger's Debug, Halt command if global IRQ enable is disabled (IRPTEN bit), however, breakpoints will work.

Command processing, initiated from either the UART ISR or the Halt Loop, is done in the command processing kernel. This kernel parses the commands and executes the instructions. If the instruction requires data to be sent back to the host, the kernel initiates the response.

### 3.2.3.1 Break Points

The ability to stop the execution of code and examine processor registers and memory is extremely helpful when debugging code. Note that the debugger automatically inserts breakpoints on the function `Main()`, when the **Settings -> Run To Main** command is checked, and at the `_exit` instruction.

### 3.2.4 AD1819 Transmissions

After reset, the AD1819 generates the clock used to transfer data across SPORT1. The ADSP-21065L initiates all transmissions with the AD1819 by sending a synchronization pulse. Even though the AD1819 transmits the data clock, it may not be ready for normal operation. Until the AD1819 is ready, it holds the first bit (AD1819 Ready bit) of SLOT 0 low. When ready, this bit is driven high.

The first transmission to the AD1819 is done differently than subsequent transmissions. The packets initially expected by the AD1819 do not have a consistent size. This first transmission instructs the AD1819 to standardize the packet size to 16-bit. This command is created by shifting and stuffing bits in the transmit buffer.

Slot 0 in each transmission specifies which slots contain valid data. The ADSP-21065L uses DMA transfers to automatically send and receive data from the AD1819.

When the transmit DMA empties the transmit buffer, an interrupt occurs. If `Tx Request > 0`, the interrupt loads the data from the User Tx buffer into the Tx buffer. If the variable `Tx Request < 0` the Tx buffer is loaded with 0s. After the Tx buffer is loaded, the DMA is initialized to transmit the new data in the Tx buffer.

The receive portion of the AD1819 interface is designed in a similar way. The DMA for SPORT1's receive register is configured to load the Rx buffer.

When the Rx buffer is full, an interrupt is generated that checks the Rx request variable. If the variable  $> 0$  then the contents of the Rx buffer are written into the User Rx Buffer, and the Rx request is cleared. Afterwards, the DMA is re-initialized to fill the Rx buffer again.

### 3.3 Running Your Own Programs

This section provides the user with the basic information that is needed to run their own programs on the ADSP-21065L EZ-KIT Lite. Build these programs using the SHARC tools. This information includes rules for using processor memory, a description AD1819 control registers (with respect to DSP programming), and a simple program generation procedure.

Although there are many ways to go about developing programs in the VisualDSP++ environment, all program evaluation within the environment should include the following steps:

- Step 1: Create a New Project File
- Step 2: Set Target Processor Project Options
- Step 3: Add and Edit Project Source Files
- Step 4: Customize Project Build Options
- Step 5: Build a Debug Version of the Project
- Step 6: Debug the Project
- Step 7: Build a Release Version of the Project

By following these steps, DSP projects build consistently and accurately with minimal project management. The *ADSP-21065L SHARC Technical Reference* and *ADSP-21065L SHARC User's Manual* provides detailed information on programming the processor and the VisualDSP++ manuals provide information on code evaluation with the SHARC tools.

- Do not run more than one ADSP-21065L EZ-KIT Lite Session in the debugger at any one time. You may run an EZ-KIT Lite session and a simulator or ICE session at the same time or you can open two debugger interfaces to run more than one EZ-KIT Lite session.
- Before making changes to the source code in the IDE, the user needs to clear all breakpoints and close the source window. Then make the changes, rebuild the program and reload it into the debugger.

#### 3.3.1 ADSP-21065L Memory Map

The ADSP-21065L EZ-KIT Lite board contains 1M x 32 of external SDRAM. This memory is connected to MS3 (Memory Select). The ADSP-21065L has 544 Kbits of internal SRAM that can be used for either program or data storage. The configuration of on-chip SRAM is detailed in the *ADSP-21065L SHARC User's Manual*. Table 3-5 shows the memory map of the ADSP-21065L EZ-KIT Lite.

The IMDW0 bit in the SYSCON register must be set to 1 to keep communication with the host. This bit determines if data accesses made to internal memory block 0 are 40-bit three column accesses (set = 1) or 32-bit two column accesses (cleared = 0). The monitor program requires three column data accesses to memory block 0.

On reset, restart, and halt, the debug monitor kernel forces IMDW0 to 1 and IMDW1 to 0 but user code should also set these bits to ensure that it operates in the same way on both the simulator and the EZ-KIT Lite board. These settings only affect data accesses, not instruction fetches.

- Block 0 resides in Three Column memory. If you are storing data in Block 0, it must be in three column format.
- The user may not use DAG2 (PM data bus) to access SDRAM because SDRAM is mapped into an address that is greater than 24 bits. For example, the C segment `seg_pmda` should not be mapped to SDRAM.
- If the user is using C interrupt handlers in his/her program, (i.e. `interrupt()`) then `seg_dmda` must not be located in external SDRAM. In this case `seg_dmda` MUST be located in internal memory. This is caused by a problem with the interrupt handlers in `libc.dlb`. A correction will be posted to the Analog Devices FTP site.

**Table 3-5 Memory Map**

Start Address	End Address	Content
0x0000 0000	0x0000 02FF	Registers
0x0000 8000	0x0000 9FFF	Block 0 Normal Address (internal memory)
0x0000 C000	0x0000 DFFF	Block 1 Normal Address (internal memory)
0x0001 0000	0x0001 3FFF	Block 0 Short word
0x0001 8000	0x0001 BFFF	Block 1 Short word
0x0002 0000	0x0002 FFFF	EPROM (through BMS) <sup>1</sup>
0x0100 0000	0x0100 0000	EMAFE Address (reserved for the EZ-KIT)
0x0100 0001	0x0100 0001	EMAFE Data (reserved for the EZ-KIT)
0x0100 0004	0x0100 0007	UART (reserved for the EZ-KIT)
0x0300 0000	0x0310 0000	SDRAM (reserved for the EZ-KIT)

1. Use caution when accessing the Boot EPROM. The EPROM chip select, BMS, has the same limitations as MS0. EPROMs larger than 128K x 8 have restricted access to their data below address 0x020000 and their data is aliased to other memory locations. The user program can access this data from these other locations.



Table 3-6 shows currently used and available memory locations on the EZ-KIT Lite board. The user may not change these locations in their programs.

**Table 3-6 Available Memory Locations on the EZ-KIT Lite**

<b>Memory Range</b>	<b>Availability</b>
0x00008000 - 0x0000801F	Interrupt Vectors - user (48-bit)
0x00008020 - 0x00008023	IRQ0 vector (reserved by monitor and not overwritten on any .dxe load)
0x00008024 - 0x00008033	Interrupt Vectors - user (48-bit)
0x00008034 - 0x00008037	SPORT Vector (reserved by monitor)
0x00008038 - 0x0000807B	Interrupt Vectors - user (48-bit)
0x0000807C - 0x0000807F	SWI3 Vector (reserved by monitor)
0x00008100 - 0x00008FFF	User Program Space (3840 48-bit locations, internal RAM block 0)
0x00009000 - 0x000097FF	Kernel Code (48-bit, internal block 0)
0x0000C000 - 0x0000DFFF	User space (can be configured as 8192 x 32, or 2K x 48 + 4K x 32 or 4K x 48 +2K x 32)
0x01000000	EMAFE address location (external block 0)
0x01000001	EMAFE data location (external block 0)
0x01000008 - 0x0100000F	16550 UART registers (external block 0)
0x01000010	AD1819 reset address (external block 0)
0x03000000 - 0x030FFEFF	User space (external block 3; 1048320 32-bit locations in SDRAM)
0x030FFF00 - 0x030FFF05	User AD1819 transmit buffer
0x030FFF06	User AD1819 transmit ready flag
0x030FFF07 - 0x030FFF0C	User AD1819 receive buffer
0x030FFF0D	User AD1819 receive ready flag
0x030FFF0E	User SWI3 data pointer
0x030FFF0F	User SWI3 number of data items
0x030FFF10	User SWI3 data type
0x030FFF11 - 0x030FFFFF	Reserved for Kernel

### 3.3.2 Using the AD1819A SoundPort Codec as the Analog Front End

There are two ways you can use the AD1819 SoundPort codec on the 21065L EZ-KIT Lite with the VisualDSP++ debugger.

**Method 1** — Use the codec DMA buffers and the codec interrupt handler within the EPROM monitor that are installed by the AD1819/SPORT1 initialization routine in the EPROM Monitor Program. This method is useful if you want to quickly test your DSP algorithm.

This method may be preferable for early DSP evaluation, and the user does not need to be concerned with many of the details of the AD1819 theory of operation. The following section provides coding guidelines for the programmer to link in the required codec and SPORT DMA buffers. All of the audio demos provided with the ADSP-21065L EZ-KIT Lite use this method for communicating with the codec for RS-232 host codec control.

**Method 2** — Disabling and Overwriting the SPORT1 DMA codec buffers, and downloading a custom AD1819/SPORT1 initialization routine with the RS-232 monitor.

The custom user routine includes instructions necessary to reset the codec, program SPORT1, activates serial port 1 transmit and receive DMA transfers, and programs any AD1819a register to a desired configuration. This method may be preferable if you want to test AD1819 code that may be downloaded via the SHARC JTAG, burnt into a new EPROM, or to test AD1819 functionality in a new custom-based 21065L design.

For detailed AD1819 and SHARC interface information and example source that demonstrates this second method, contact Analog Devices DSP hotline or search our web site for the following document: *Interfacing The ADSP-21065L SHARC DSP to the AD1819a 'AC-97' SoundPort codec*. Further information on the AC-97 serial protocol may be found in the AD1819A Datasheet.

#### 3.3.3 Method 1: Using the Monitor's Codec DMA Buffers and Interrupt Handler

This section provides more detail on Method 1 from the previous section. The ADSP-21065L uses DMA transfers to automatically send and receive data from the codec. After codec reset, the codec begins transmitting the clock used to synchronously transfer data across SPORT1. The ADSP-21065L, in turn, initiates all transmissions with the codec by sending a frame synchronization pulse. Even though the codec transmits the data clock, it may not be ready for normal operation. While the codec is not ready it holds the first bit (codec Ready bit) of SLOT 0 low. When ready, this bit is driven high. Once this bit goes high, the codec is ready for standard communication with the ADSP-21065L.

The AD1819 initially expects all data transfers to be in packets according the AC'97 specification, where there is 1 x 16-bit time slot and 12 x 20 bit slots in the TDM audio frame. This packet scheme does not work well in DMA transfer schemes, nor to standard Multi-channel Mode data transfers with the ADSP-21065L, which expects all slots to be the same number of bits. To realign your data, set the SLOT16 bit in the AD1819's Serial Configuration register as soon the serial port is enabled. To do this, the program must perform a single transfer using the initial packing style.

After the SLOT16 bit is set, all subsequent packets are standardized to 16 bits.

Once the data is aligned, the EPROM's monitor POST routine then writes and verifies three patterns to an internal register in the codec. If all three writes are verified, the codec connection is verified. The ADSP-21065L then continually transmits and receives data from the codec. Slot 0 in each transmission specifies which slots contain valid data (and are called the Tag Phase time slot).

### **3.3.3.1 Linking Your Code to the RS-232 Monitor Codec Interrupt Handlers**

To use the EPROM monitor's interrupt handler for the AD1819, the user needs to use one of the following methods:

C-code—link your code with the file demorth.asm (this is located in the ...\\demos\\tt folder). This file contains a replacement for the standard C runtime header 060\_hdr.asm. This file also includes a jump to the EPROM codec interrupt handler at the SPORT1 Tx interrupt vector location.

Assembly—use the demorth.asm file as the interrupt vector table or create your own interrupt vector table that includes a jump to address 0x9001 at the SPORT1 Tx interrupt vector location.

### **3.3.3.2 Linking Your Code to the RS-232 Monitor DMA Buffers**

The monitor constantly sends and receives packets from the codec. To send data to the codec, the user needs to put the desired data into the codec transmit buffer, and set the transmit variable. Similarly, to receive data from the codec, the receive variable should be set to a value  $> 0$ . The variable may then be polled for the change back to 0. When this happens codec data has been transferred into the codec receive buffer, and may be read.

Figure 3-1 shows the software structure of the codec data transfer. The transfer is set up by the RS232 monitor program via EPROM boot.

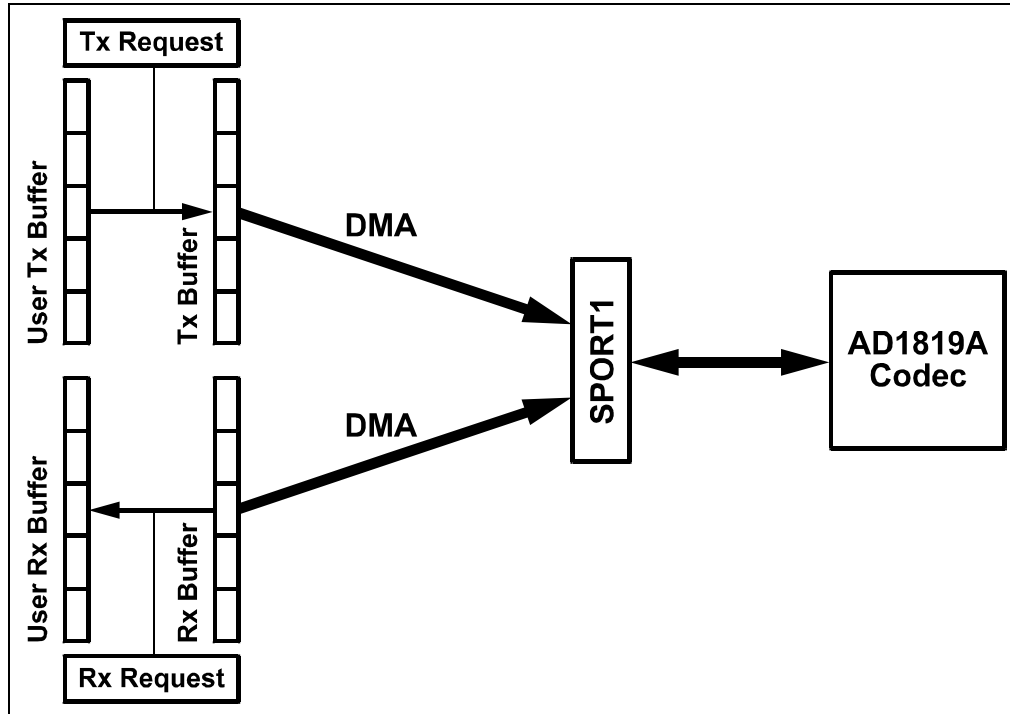


Figure 3-1 ADSP-21065L EZ-KIT Lite Monitor Kernel Codec Transfer Scheme

### 3.3.3.2.1 DSP/Codec Transmit Sequence

1. The SPORT1 transmit DMA empties the transmit buffer, a SPORT1 transmit interrupt occurs.
2. If the variable Tx Request > 0, then the interrupt loads the data from the User Tx Buffer into the Tx Buffer; otherwise, the Tx Buffer is loaded with 0s.
3. After the Tx Buffer is loaded, the DMA is re-initialized to transmit the new data in the Tx Buffer.
4. With this structure set up by the monitor, the user needs to only put data in the User Tx Buffer, and then set Tx Request to 1, to send data to the codec.

### 3.3.3.2.2 DSP/Codec Receive Sequence

1. The receive portion of the codec interface is designed in a similar way to the transmit portion.
2. The DMA for SPORT1's receive register is configured to load the Rx Buffer.
3. When the Rx Buffer is full, an interrupt is forced that checks the Rx Request variable. If the variable > 0 then the contents of the Rx Buffer is written into the User Rx Buffer, and the Rx Request is cleared.
4. The DMA is re-initialized to fill the Rx Buffer again.

### 3.3.3.3 RS-232 Monitor Codec Memory Map

To use the monitor's codec variables, examine the buffers.asm and .ldf files provided with the demos. These two files provide access to the necessary variables by overlapping the locations of the variables.

The RS-232 Monitor Program was compiled and linked to place the following user variables and buffers to communicated to the codec in the following memory locations:

```
0x030FFF00 - 0x030FFF05    User CODEC transmit buffer
                           DM(user_tx_buf)
0x030FFF06                User CODEC transmit ready flag
                           DM(user_tx_ready)
0x030FFF07 - 0x030FFF0C    User CODEC receive buffer
                           DM(user_rx_buf)
0x030FFF0D                User CODEC receive ready flag
                           DM(user_rx_ready)
```

When writing code, the user needs to define variables so that they are linked in to these exact locations as was defined by the monitor kernel so that your DSP code has access to the kernel codec buffers. To use this scheme for passing audio data for user DSP algorithm written in C, include the following file (found in buffers.asm) in your code:

```
/* TITLE: BUFFERS.ASM
   BUFFERS.ASM
Links variables into the same locations the kernel
uses so that the demo can talk to the kernel to use
its codec isr*/

.GLOBAL _user_tx_buf;
.GLOBAL _user_tx_ready;
.GLOBAL _user_rx_buf;
.GLOBAL _user_rx_ready;
.GLOBAL _user_data_out_ptr;
.GLOBAL _user_num_data;
.GLOBAL _user_data_type;

.SEGMENT/DM    seg_bnk3;
// make the buffers line up the same as in the
kernel
```

```

.var _user_tx_buf[6];
.var _user_tx_ready;
.var _user_rx_buf[6];
.var _user_rx_ready;
.ENDSEG;

```

Note that these variables have a leading underscore to make them C-compatible. If writing in assembly code, include the following segment within the data variable declaration section in the same assembly codec file as the DSP code:

```

.SEGMENT/DM      seg_bnk3;
.VAR user_tx_buf[6];  !
.VAR user_tx_ready;  ! Codec isr (set up by the kernel)
flags and buffers
.VAR user_rx_buf[6];  !
.VAR user_rx_ready;  !
.ENDSEG;

```

In addition to the variable declaration, the users needs to tell the linker to place these variables in the specified monitor kernel program locations for the codec in bank 3. This is done by including the following lines in the Linker Description File:

```

MEMORY
{
    seg_bnk3 { TYPE(DM RAM) START(0x030FFF00)
END(0x030FFFFF) WIDTH(32) }
}
PROCESSOR p0
{
    SECTIONS
    {
        seg_bnk3
        {
            INPUT_SECTIONS( $OBJECTS(seg_bnk3)
$LIBRARIES(seg_bnk3))
        } >seg_bnk3
    }
}

```

This ensures that the linked variables reside as follows:

- DM(user\_tx\_buf) is placed at addresses 0x030FFF00 - 0x030FFF05
- DM(user\_tx\_ready) is placed at address 0x030FFF06
- DM(user\_rx\_buf) is placed at addresses 0x030FFF07 - 0x030FFF0C
- DM(user\_rx\_ready) is placed at address 0x030FFF0D

For examples on how these codec variables are declared and linked together with ADSP-

21065L EZ-KIT Lite C and assembly programs, the user can inspect the source files for the EZ-KIT Lite audio demos.

### 3.3.4 DSP Programming of the AD1819 Indexed Control Registers

The monitor program provides a setup routine for the AD1819. Table 3-7 shows the registers used by the DSP and their state after reset. The user can use the monitor buffers contained in the demo programs or write their own code to use the AD1819 codec. The code must initialize these registers when using the AD1819.

For example programs and further documentation on AD1819 programming with the ADSP-21065L, you can visit our web site at [www.analog.com/dsp](http://www.analog.com/dsp).

**Table 3-7 DSP Programming of the AD1819 Indexed Control Registers**

Address	Index Register Name	#define Label in 2106x program	State
0x06	Master Volume Mono	MASTER_VOLUME_MONO	0x8000
0x0E	Microphone Volume	MIC_VOLUME	0x8008
0x10	Line Volume	LINE_IN_VOLUME	0x8808
0x1C	Record Gain	RECORD_GAIN	0x0F0F
0x20	General Purpose	GENERAL_PURPOSE	0x8000
0x78	Sample Rate 0	SAMPLE_RATE_GENERATE_0	0xBB80
0x7A	Sample Rate 1	SAMPLE_RATE_GENERATE_1	0xBB80

### 3.3.5 EMAFE Programming

Communicating with the EMAFE is done through either of the SPORTs, or through indexed addressing. To read or write memory on the EMAFE, the memory should be written to address 0x0100 0000. After writing the address, the data can be read from or written to address 0x0100 0001. Multiple reads, or writes, are executed without rewriting the address.

Because of the bus timings of the ADSP-21065L, an address hold cycle must be added to the bus cycles of MS1 to communicate with the EMAFE.

This is done in the WAIT register of the ADSP-21065L and guarantees that the data remains valid when the WR line goes high (invalid). If this is not done, the data and or address written to the EMAFE may not be stored correctly.

As stated in the previous section, JP3 must be connected to +3.3V<sub>CC</sub> if SPORT1 is used on the EMAFE or the AD1819 will contend with the EMAFE's operation.

## 4 DEMONSTRATION PROGRAMS

### 4.1 Overview

This chapter describes loading and running the demonstration programs supplied with the ADSP-21065L EZ-KIT Lite board. The demos are designed to run on the VisualDSP++ Debugger which is supplied on the CD that shipped with this product. For detailed information on debugger features and operation, see the *VisualDSP++ Debugger Guide & Reference* and the *Debugger Tutorial (for ADSP-2106x Family DSPs)*.

### 4.2 Starting the VisualDSP++ Debugger

After the VisualDSP++ software and license have been installed, click the Windows Start menu.

1. Select **Programs -> VisualDSP++ -> Debugger** from the Start menu. The debugger interface appears.
2. From the Session menu, select **New Session**. The **Target Selection** dialog appears.
3. Configure the debug session as shown in Figure 4-1 and click OK.

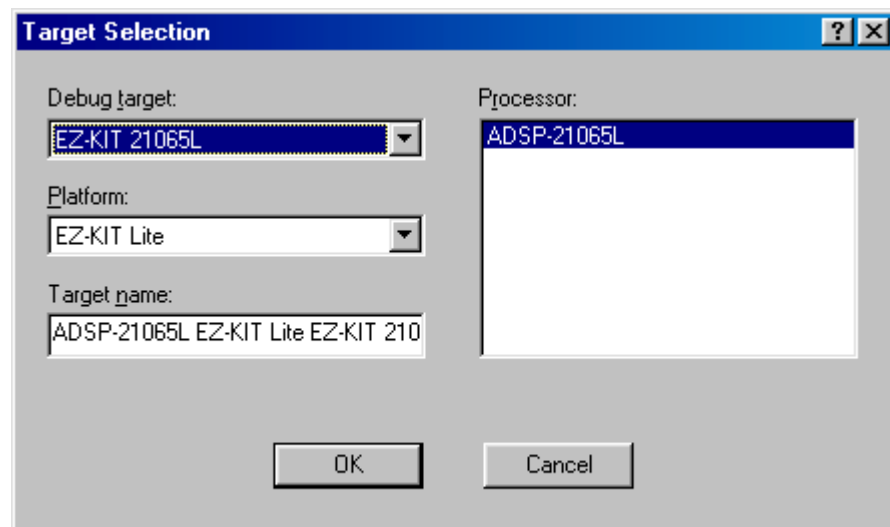


Figure 4-1 Target Selection Dialog

A Target Message dialogue box will appear.





Figure 4-2 Target Message

4. Press the Reset button on the evaluation board.

All the LEDs light up and after a brief delay (<2 seconds) all of the LEDs turn off except for the FLAG9 and power LEDs. Make sure that the LEDs turn off (except for the FLAG9 and power LEDs) before you click OK.

During this delay, the POST tests run which verify operation of RAM, the AD1819, the UART, and the EPROM. After the LEDs go dark, a message box opens with the message shown in Figure 4-3.



Figure 4-3 Target Communications Status Message Box

5. Click OK.

The initialization completes and the disassembly window opens. The code in the disassembly window is the EZ-KIT Lite monitor program.

## 4.3 Debugger Operation with the ADSP-21065L EZ-KIT Lite

The *VisualDSP++ Debugger Guide & Reference* and the *Debugger Tutorial (for ADSP-2106x Family DSPs)* contains most of the information you need to operate the VisualDSP++ Debugger with your EZ-KIT Lite evaluation board. Because the manual was written using a simulator as a target, there are some differences and restrictions in debugger operation that are described in this section.

### 4.3.1 Loading Programs

Because you are loading programs into a hardware target, the load process takes a bit more time than loading in the simulator. Wait for the Load Complete message in the Output window before you attempt any debug activities.

To load a program, use the following procedure:

1. From the File menu, select **Load**.

The **Open a Processor Program** dialog appears.

2. Navigate to the folder where the DSP executable file resides.

The demos that are supplied with the EZ-KIT Lite are located in  
C:\Program Files\Analog Device\VisualDSP++\21k\EZ-  
KITS\21065L\demos folder.

3. Select the .dxo file and click Open.

The file loads and the message Load Complete appears in the Output window when the load process has completed.

### 4.3.2 Registers and Memory

To see current values in registers, use the F12 key or the Window, Refresh command.

- Values may not be changed while the user program is running.
- The current version of the VisualDSP++ Debugger does not let you view hardware stack information.

### 4.3.3 Setting Breakpoints and Stepping

- Breakpoints set in the last three instructions of a do-loop are allowed, but this causes improper debugger operation.
- Breakpoints set after a delayed branch instruction and before the branch occurs causes improper debugger operation.
- Using the single stepping function steps through a delayed branch instruction and the last three instructions of a do-loop.
- The debugger automatically inserts breakpoints on the function `Main()`, when the `Settings, Run To Main` command is checked, and at the `_exit` instruction.

### 4.3.4 Resetting the EZ-KIT Lite Board

The EZ-KIT Lite board can be reset with the push button switch on the board or with the **Debug -> Reset** command in the debugger menu bar. Both resets, clear and reset the chips memory and debug information so there will be a need to reload any programs that were running. The **Debug -> Restart** command resets the processor, however, the processor retains all debug information and memory contents.

- The following sequence must be used when starting the debugger:
  1. Start the debugger from the windows Start menu. **Start -> Programs -> VisualDSP -> Debugger**
  2. The debugger starts and the Target message Hit Reset Button appears
  3. Press the Reset button on the board.
  4. Wait approximately three seconds for the LED's (except power and FLAG9) to turn off.
  5. Click OK. The message Communications Success appears.
- Do not use the reset button while the debugger is open unless the debugger requests you to press it.
- While the user may load several programs into the debugger during a single debug session without resetting the EZ-KIT Lite board, it is recommended to reset the board prior to loading a new program.

## 4.4 Benchmarking Utilities

An evaluation platform needs to report an accurate cycle count in order for you to develop efficient DSP programs. Because the monitor program running on the EZ-KIT Lite board is intrusive, the debugger's cycle counter (located in the status bar) does not work. To get an accurate cycle count, the EZ-KIT Lite comes with a set of benchmarking utilities. These utilities come in both C and assembly code types. Use the following procedures to enable accurate cycle counting of any DSP program.

In C, embed the `count_start` and `count_end` functions in your code. The `count_start` is a function that returns an initial starting value of the current cycle counter. The user then uses this value as an argument to the `count_end` function. The `count_end` function returns the total number of elapsed cycles between `count_start` and `count_end`. These functions are a completely self contained, so the user does not need to save or restore any processor registers. The following is an example of how to write these functions into your existing code.

- User must run any program that uses this code from when the function `count_start()`; starts, to at least as far as the function `count_end` returns without halting or stepping to obtain an accurate cycle count.

```
#include "bmtools.h"
int clock_start, clock_count;
clock_start = count_start();
.
.    <insert code here>
.
clock_count = count_end(clock_start);
```

For a complete code example that shows the C version of the benchmark utility, see the `DFT_c_bm` example that is included in the Examples folder.

An assembly version of the `count_start` and `count_end` functions are also available. To use this version, insert a pair of function calls, one to start the cycle count (`count_start`) and another to end the cycle count (`count_end`). The elapsed number of cycles is stored within a 48-bit wide memory location, `ecount_save`. These functions are completely self contained, no saving or restoring of registers is necessary.

- User must Run any program that uses this code from when the function `count_start`; starts, to at least as far as the function `count_end` returns without halting or stepping to obtain an accurate cycle count.

```
Call count_start;
.
.    <insert code here>
.
Call count_end
```

For a complete code example that shows the assembly version of the benchmark utility, see the `DFT_asm_bm` program that is included in the Examples folder.

Note, that both the C and assembly utilities require that `bmtools.dlb` be included in the Libraries statement of the project's LDF (Linker Description File). For more information on LDF files, refer to the *Linker & Utilities Manual for ADSP-21xxx Family DSPs*.

Both the assembly and C versions of the benchmarking utilities should operate on any SHARC processor. The maximum number of cycles that can be counted is  $2^{32} - 1$ .

## 4.5 Demonstration Programs

The demos included with the EZ-KIT Lite are designed to show the user the features and capabilities of the VisualDSP++ Debugger and the ADSP-21065L DSP. The demos are listed by the executable file name and are described by their output. All of the demos are located in the directory **C:\Program Files\Analog Devices\VisualDSP\21k\ADSP21065L EZ-KIT\Demos**.

- Do not run more than one ADSP-21065L EZ-KIT Lite Session in the debugger at any one time. User may run an EZ-KIT Lite session and a simulator or ICE session at the same time or you can open two debugger interfaces to run more than one EZ-KIT Lite session.

### 4.5.1 FFT.dxe

The DFT demo performs a frequency analysis on an analog signal presented to the board. Use the Demo menu command in the debugger to change how the DFT is performed.

- This demo maps seg\_dmda into SDRAM. Therefore, any added interrupts other than the codec's interrupt handler, fail. For more information, see "ADSP-21065L Memory Map".

### 4.5.2 BP.dxe

The BP demo modifies a signal by subjecting it to a bandpass filter. As in the previous demo, the source of the signal may be changed through the codec controls available through the Settings, Codec command. A demo specific control window is also available to change some parameters of the bandpass filter.

Several AD1819 options can also be modified while the BP demo program is running. Use the **Settings -> Codec** command, to change the sample rate, input gain, and source (microphone input or line input).

### 4.5.3 Pluck.dxe

The pluck demo plays a tune to the Line Out connector. To hear the output, connect powered speakers to J7.

### 4.5.4 Gunn.dxe

The Peter Gunn demo also plays a tune to the Line Out connector. To hear the output, connect powered speakers to J7.

### **4.5.5 Primes.dxe**

The primes demo program calculates the first 20 prime numbers starting with the number 3 and sends them to the output window. The printf function is used in this demo.

- This demo maps seg\_dmda into SDRAM. Therefore, any added interrupts other than the codec's interrupt handler, fail. For more information, see "ADSP-21065L Memory Map".

### **4.5.6 Tt.dxe**

The Talk-through demo samples data from the Line In of the AD1819 (J8 on the board with JP1 and JP2 set appropriately) at 48 kHz, and then sends the data back out the Line Out of the AD1819 (J7).

- This demo maps seg\_dmda into SDRAM. Therefore, any added interrupts other than the codec's interrupt handler, fail. For more information, see "ADSP-21065L Memory Map".

### **4.5.7 Blink.dxe**

The Blink demo program uses a timer interrupt to blink flag LEDs 6 & 7.

## 5 WORKING WITH EZ-KIT LITE HARDWARE

### 5.1 Overview

This chapter discusses hardware design issues on the ADSP-21065L EZ-KIT Lite board. The following topics are covered:

- Power Supplies
- EPROM Operation
- UART
- EMAFE

The EZ-KIT Lite board schematics are available as an insert at the end of this manual.

### 5.2 System Architecture

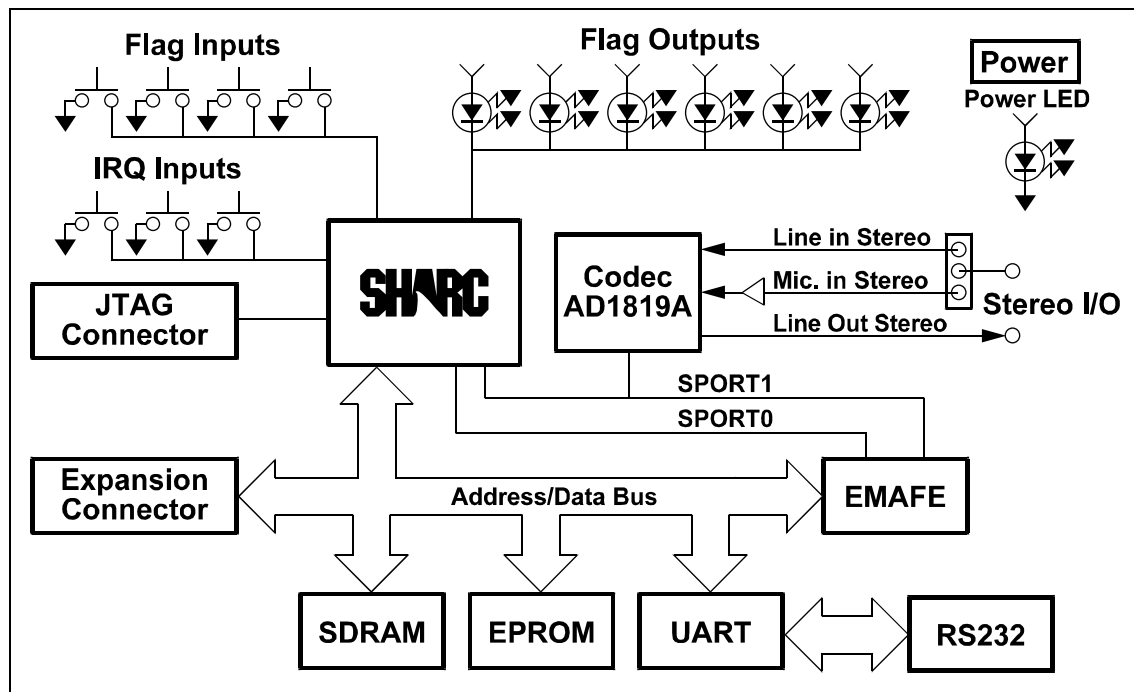


Figure 5-1 EZ-KIT Lite System Block Diagram

The Enhanced Modular Analog Front End (EMAFE) connector is accessed through the ADSP-21065L processor bus (16-bit parallel interface) and through two serial ports that connect directly to the processor. One of these serial ports is shared with the on-board AD1819A.

## 5.3 Board Layout

Figure 5-2 shows the layout of the EZ-KIT Lite board. This figure highlights the locations of the major components and connectors. Each of these major components is described in the following sections.

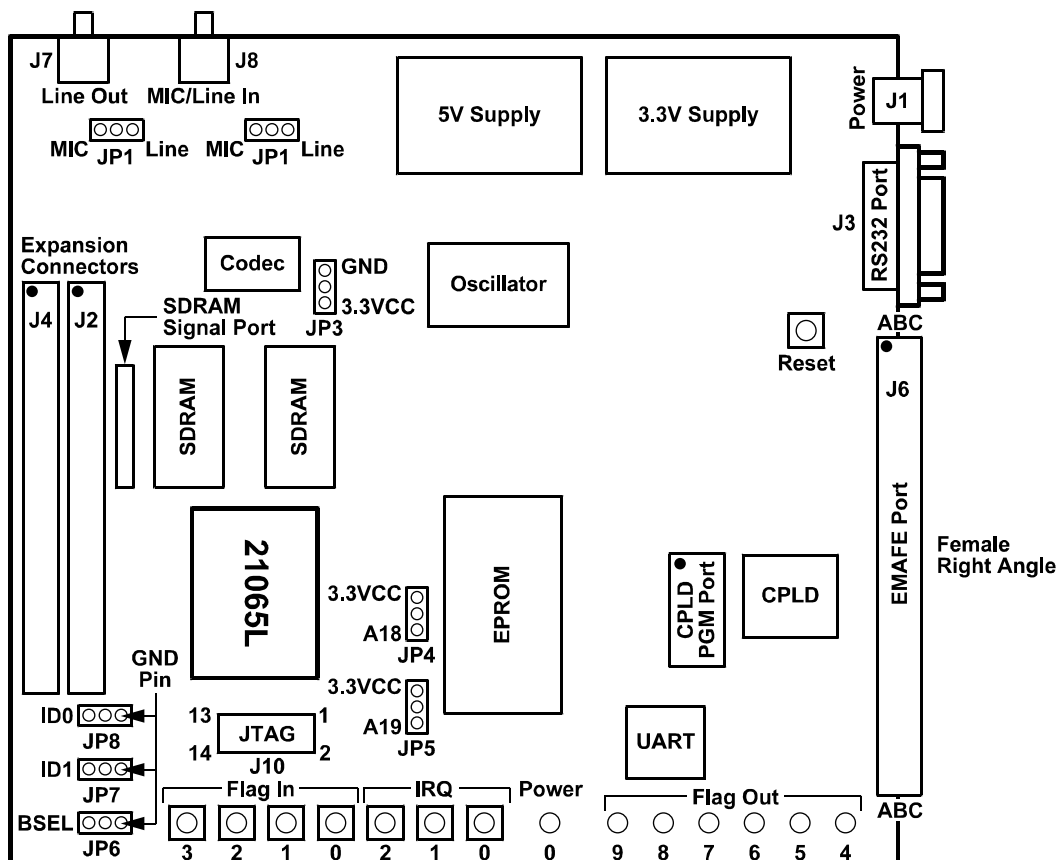


Figure 5-2 EZ-KIT LITE Layout

### 5.3.1 Boot EPROM

The boot EPROM provides up to 1M x 8 bits of program storage that can be loaded by the ADSP-21065L when it is programmed to boot from EPROM. Selection of the boot source is controlled by the BMS (Boot Memory Select) and BSEL (EPROM Boot) pins. The first 256 instructions (1536 bytes) are automatically loaded by the ADSP-21065L after reset. The remaining program image must be loaded by the program that is installed in those first 256 instructions. Refer to the *ADSP-21065L SHARC User's Manual* for more information on booting.



## 5.3.2 User Push-Button Switches

For user input/control, there are eight push-button switches on the EZ-KIT Lite board: RESET, FLAG 0-3 , and IRQ 0-2 .

- The RESET switch lets you initiate a power-on reset to the DSP. If the user loses contact between the EZ-KIT Lite board and the PC while running programs, use the RESET button to restore communication.
- The FLAG 0-3 switches toggle the status of four flag pins (FLAG 0-3 ) to the DSP.
- The IRQ 0-2 switches let you send interrupts (IRQ 0-2 ) to the DSP. This manually causes interrupts when executing a program. IRQ0 is shared with the UART, and IRQ1 is shared with the EMAFE connector.

See “Flags” section in Chapter 3, for more information on interfacing to the push-button switches from DSP programs.

## 5.3.3 User LED's

There are six flag LEDs on the EZ-KIT Lite board for user output that are available. The FLAG 4-9 LEDs are controlled by the FLAG outputs of the DSP and are labeled according to the flag output that controls them. See “Flags” section in Chapter 3 for more information on interfacing to the user LEDs from DSP programs.

### 5.3.3.1 Power LED

The Power LED, when on, indicates that +3.3V DC , used by the DSP and digital circuitry, is present.

## 5.4 Power Supplies

ADP3310s generate the 3.3V and 5V power required by the board. These parts are linear regulators that also regulate current. The resistor placed between the Vin and IS pins limits the amount of current through the device. The resistance ( $R_s$ ) needed for a given maximum output current ( $I_o$ ) is determined with the equation below.

$$R_s = 0.05 / (1.5 \chi I_o)$$

Power regulation is done through a P-channel FET. To help disperse the heat from the FET a heatsink is attached to the drain. Note that the regulated voltage is available on the heat-sink, since the voltage is regulated from the drain of the FET.

The minimum supply voltage for the ADSP-21065L is 3.0V. An ADM708T is used to monitor the supply voltage and holds the processor in reset if the power supply's voltage is below 3.08V. The board hardware may also be reset via the push button that is connected to this part. For more information, see "User Push-button Switches" section in this Chapter.

### 5.4.1 Power Connector

The power connector supplies DC voltages to the EZ-KIT Lite board. Table 5-1 shows the power connector pinout. If the user does not use the power supply provided with the EZ-KIT Lite board, replace it with one that has the connections shown in Table 5-1.

**Table 5-1 Power Connector**

<b>Terminal</b>	<b>Connection</b>
Center pin	+6.5-9.0 V <sub>DC</sub> @ 1.2 amps
Outer Ring	GND

### 5.4.2 European Power Supply Specifications

**Table 5-2 European Power Supply Specifications**

DC VOLTAGE:	7.5V +/- 5% (Full Load)
CURRENT:	1.2 Amps (Minimum Rating)
RIPPLE:	500 mV rms (Max @ Full Load)
DC CONNECTOR:	
Type:	Switchcraft 760 style, FEMALE
Plug Size:	5.5 (OD) X 2.5 (ID) X 9.5 (length) millimeters
Polarity:	Center is Positive (inside terminal)

### 5.4.3 AD1819 Connections

When the AD1819A is enabled on the EZ-KIT Lite board, accessing the audio input and output jacks on the board is possible. Each of the audio connectors are stereo mini jacks and accept standard commercially available stereo mini plugs.

The Microphone/Line\_in Input jack connects to the `LINE_IN_L` (left) and `LINE_IN_R` (right) pins or the MIC1 and MIC2 of the AD1819A SoundPort Stereo Codec, depending on the setting of jumpers JP1 and JP2. Jumper settings are explained in Table 5-6.

The LINE Output jack connects to the left (L) `LINE_OUT` and right (R) `LINE_OUT` pins of the codec.

### 5.4.4 Expansion Port Connectors

The two expansion port connectors provide access to the bus signals of the ADSP-21065L. One possibility for the use of these connectors, beyond debugging, is host control. All interrupts, bus signals, and PWM event signals are available through this port. For more information, see “Expansion Connectors” section in Chapter 6.

WARNING: External port loading can effect external bus speed and performance.

### 5.4.5 EMAFE Interface Connector

WARNING: Using the EMAFE interface connector to connect to a MAFE board can damage the ADSP-21065L EZ-KIT Lite, the MAFE, or both.

Enhanced Modular Analog Front End (EMAFE) connector provides a standard interface for connecting analog input/output daughter boards. The connector has 96 female pins arranged in three rows of 32 pins on a right angle connector. The interface supports a 16-bit parallel data path, two serial ports, an interrupt output, and a flag input. Refer to “EMAFE Expansion” section in Chapter 6 for more information on the EMAFE interface.

### 5.4.6 JTAG Connector (Emulator Port)

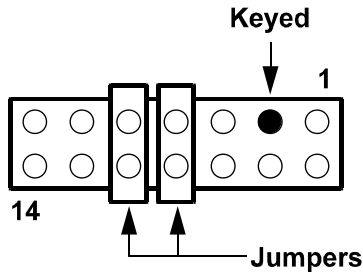
The JTAG header (Figure 5-3) is the connecting point for the JTAG® in-circuit emulator probe. Note that one pin is missing (pin 3) to provide keying. The pin 3 socket in the mating connector should have a plug inserted at that location.

The EZ-KIT Lite board is shipped with two jumpers installed across pins 7 & 8 and 9 & 10. These jumpers must be removed before installing the JTAG probe. When the JTAG probe is removed, care must be taken to replace these jumpers to ensure that the ADSP-21065L processor initializes correctly on power-up.

The proper power up sequence is:

1. JTAG Emulator
2. ADSP-21065L EZ-KIT Lite board

To remove power, reverse the order.



**Figure 5-3 JTAG Connector With Jumpers Installed**

Figure 5-3 shows the locations of the configuration jumpers on the EZ-KIT Lite board and which pin on the jumpers is the GND pin. These jumpers should be checked before using the board to ensure proper operation. Each of the jumper selection blocks are described in the following sections.

## 5.5 Jumpers

### 5.5.1 Boot Mode Selection Jumper

The jumper (JP6) controls the behavior of the ADSP-21065L processor when the system is reset (from power up or when the RESET button is used). When the jumper is not connected to GND, or is removed, the processor boots from the EPROM. If the jumper is connected to GND, the processor attempts to boot from its host interface (through the expansion port).

**Table 5-3 Boot Mode Selection**

JP6	Description
GND	HOST boot
Other	EPROM boot (factory default)

## 5.5.2 EPROM Size Selection Jumpers

The EZ-KIT Lite supports 128K x 8, 256K x 8, 512K x 8, and 1M x 8 EPROMs, each of which is selectable through jumpers JP4 and JP5. The EPROM socket is originally populated with a 256K x 8 EPROM. If a different EPROM is used, JP4 and JP5 should be adjusted to accommodate the different size. Table 5-4 shows the pins that the jumpers for JP4 and JP5 should be connected to.

Table 5-4 EPROM Size Selection

JP5	JP4	Description
3.3Vcc	3.3Vcc	128K x 8, 256K x 8 (factory default)
3.3Vcc	A18	512K x 8
A19	3.3Vcc	Not Used
A19	A18	1M x 8

## 5.5.3 Processor ID Jumpers

During typical operation of the EZ-KIT Lite board, there is only a single DSP in the system. Jumpers JP7 and JP8 should be checked to guarantee that the board is configured as a single processor system. In the case where a second processor is attached to the board through the expansion connectors, these jumpers should be changed to configure the EZ-KIT Lites' ADSP-21065L processor as processor 1 or processor 2 in the multiprocessor system. The debug monitor will not properly boot from the EPROM if the IDs are not configured for a single processor. System configuration options are shown in Table 5-5.

Table 5-5 Processor Selection

JP7	JP8	Description
GND	GND	Single Processor (factory default)
GND	Other	Processor 1
Other	GND	Processor 2
Other	Other	INVALID

### 5.5.3.1 Line In Selection Jumpers

The EZ-KIT Lite uses a single stereo phone jack for line in and the microphone. JP1 and JP2 are used to select between the two functions. The valid settings for these jumpers are shown in Table 5-6.

**Table 5-6 Line In Selection**

JP1	JP2	Description
Mic	Mic	Microphone In
Mic	Line	INVALID
Line	Mic	INVALID
Line	Line	Line In

### 5.5.3.2 AD1819 Codec Selection Jumper

SPORT1 is shared between the AD1819 and the EMAX interface. Jumper JP3 disables the drive capability of the AD1819 on the SPORT1 lines, thereby preventing contention between the two devices. When SPORT1 is not used by the EMAX device or an EMAX device is not installed, JP3 should be connected to ground, enabling the AD1819.

**Table 5-7 AD1819 Codec Selection**

JP3	Description
3.3V <sub>CC</sub>	EMAX selected (AD1819 disabled)
GND	AD1819 selected (factory default)

## 5.6 EPROM Operation

The EPROM shipped with the EZ-KIT Lite is a 256K x 8 bit EPROM. The socket can accommodate a 128K x 8, 256K x 8, 512K x 8, or a 1M x 8 bit EPROM. If any of these other EPROMS are used, jumpers JP4 and JP5 should be changed to route the correct signals to the EPROM. Settings for these jumpers are shown in Table 5-4.

EPROM addressing differs, depending on the silicon revision of the ADSP-21065L on your EZ-KIT Lite board. For revision 0.1 silicon, EPROM addressing begins at address 0x020000. For revision 0.2 and greater, addressing begins at address 0x000000 (i.e. you can use all memory space, see Figure 5-4).

### 5.6.1 Designers Note

When JP6 is removed or connected to GND, the ADSP-21065L is initialized to boot from the EPROM. On this board, the ACK line is used to control wait states.

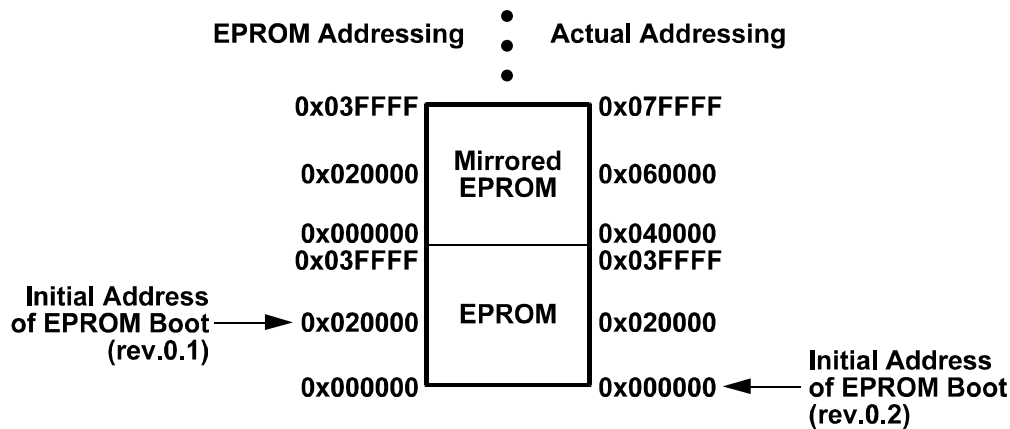


Figure 5-4 EPROM Address (256K x 8 example)

## 5.7 UART

The UART used is a 5V part; therefore, a 74LVTH245 is used to translate the data coming from the UART to the required 3.3V logic needed by the processor.

### 5.7.1 Designers Note

To access the UART correctly, the relationship between the timing of the data, chip select, and the read/write lines needed to be changed. Most of these changes were implemented through a CPLD. An additional 10ns delay was needed on the control lines. Since this delay was not possible through the CPLD, a digital delay was added to the circuit.

It is important to note that the UART and the CPLD only decode a subset of the available address lines. Because of this partial decoding, the UART is aliased throughout the MS1 address space.

## 5.8 EMAFE

The indexed addressing required by the EMAFE interface is implemented through the CPLD. The CPLD controls the loading of the address, as well as the data direction of the data bus. As with the UART, the address is only partially decoded. The aliasing seen with the UART also exists with the EMAFE interface in the MS1 address space.

On the ADSP-21065L, data is valid when the WR line goes high. If an address hold cycle is enabled (in the WAIT register), the data stays valid through the WR transition.

The parallel communication between the ADSP-21065L processor on the evaluation board and the EMAFE consists of some control logic for the control lines (MC, RD, WR, CS, etc.), an 8-bit latch that stores the address information (MA[7:0]) and a transceiver buffer for the data lines (MD[15:0]). The address lines are latched and the data lines are buffered to reduce digital noise on the EMAFE board. The serial ports from the ADSP-21065L are directly wired to the EMAFE connector interface pins. Level shifting of serial port signals from the ADSP-21065L may be required for 5V (non 3.3V compliant) peripherals on the EMAFE board, or from 5V peripherals on the EMAFE board to the 3.3v (non 5V tolerant) ADSP-21065L. For information on EMAFE pins, see “EMAFE Expansion” in Chapter 6.

## 5.9 AD1819

As with the UART, the AD1819 is a 5V device. To prevent over driving the SPORT lines on the ADSP-21065L, the lines from the AD1819 are buffered through a 74LVT125. This buffer has the additional purpose of bypassing the AD1819's control of SPORT1, when SPORT1 is required by the EMAFE. This is done to prevent contention between the two devices on the SPORT1 lines.

On power up, the AD1819 reads the `SDATA_OUT` signal line. If the pin is high or floating, the AD1819 enters a test mode. To prevent the AD1819 from entering this mode, a pull down resistor has been added to the line.

## 5.10 SDRAMS

The processor's SDRAM interface enables it to transfer data to and from synchronous DRAM (SDRAM) at  $2 \times \text{CLKIN}$ . The synchronous approach coupled with  $2 \times \text{CLKIN}$  frequency supports data transfer at a high throughput—up to 240 Mbytes/sec. All inputs are sampled and all outputs are valid at the rising edge of the clock `SDCLK`. Table 5-8 lists and describes the processor's SDRAM pins and their connections.



**Table 5-8 SDRAM pin connections**

<b>Pin</b>	<b>Type</b>	<b>Description</b>
CAS	I/O/Z	SDRAM Column Address Select pin. Connect to SDRAM's CAS buffer pin.
DQM	O/Z	SDRAM Data Mask pin. Connect to SDRAM's DQM buffer pin.  The processor drives this pin high during reset, until SDRAM is started.
MSx	O/Z	Memory select lines of external memory bank configured for SDRAM. Connect to SDRAM's  CS (chip select) pin.
RAS	I/O/Z	SDRAM Row Address Select pin. Connect to SDRAM's RAS pin.
SDA10	O/Z	SDRAM A10 pin. SDRAM interface uses this pin to retain control of the SDRAM device during host bus requests. Connect to SDRAM's A10 pin.
SDCKE	I/O/Z	SDRAM Clock Enable pin. Connect to SDRAM's CKE pin.
SDCLK0	O/S/Z	SDRAM SDCLK0 output pin. Connect to the SDRAM's CLK pin.
SDCLK1	O/S/Z	SDRAM SDCLK1 output pin. Connect to the SDRAM's CLK pin.
SDWE	I/O/Z	SDRAM Write Enable pin. Connect to SDRAM's WE or W buffer pin.
I = Input; O = Output; S = Synchronous; Z = Hi-Z		

There are two 1M x 16 bit SDRAM chips on the EZ-KIT Lite board connected to MS3. They are configured to be accessed in parallel, providing 1M x 32 bits of external data memory, starting at address 0x3000000. The ADSP-21065L uses address line 13 as the bank select. Additionally, the ADSP-21065L has a separate address line (line 10) for the SDRAM, since this line is used during refresh. This allows refresh to occur while another data transfer runs on the data bus.

See Chapter 10, "SDRAM Interface" in the *ADSP-21065L SHARC User's Manual* for more information on the SDRAM controller.

## 5.11 Timing Diagrams

**Figure 5-5 EMAFE Write Cycle Timing Parameter Definitions**

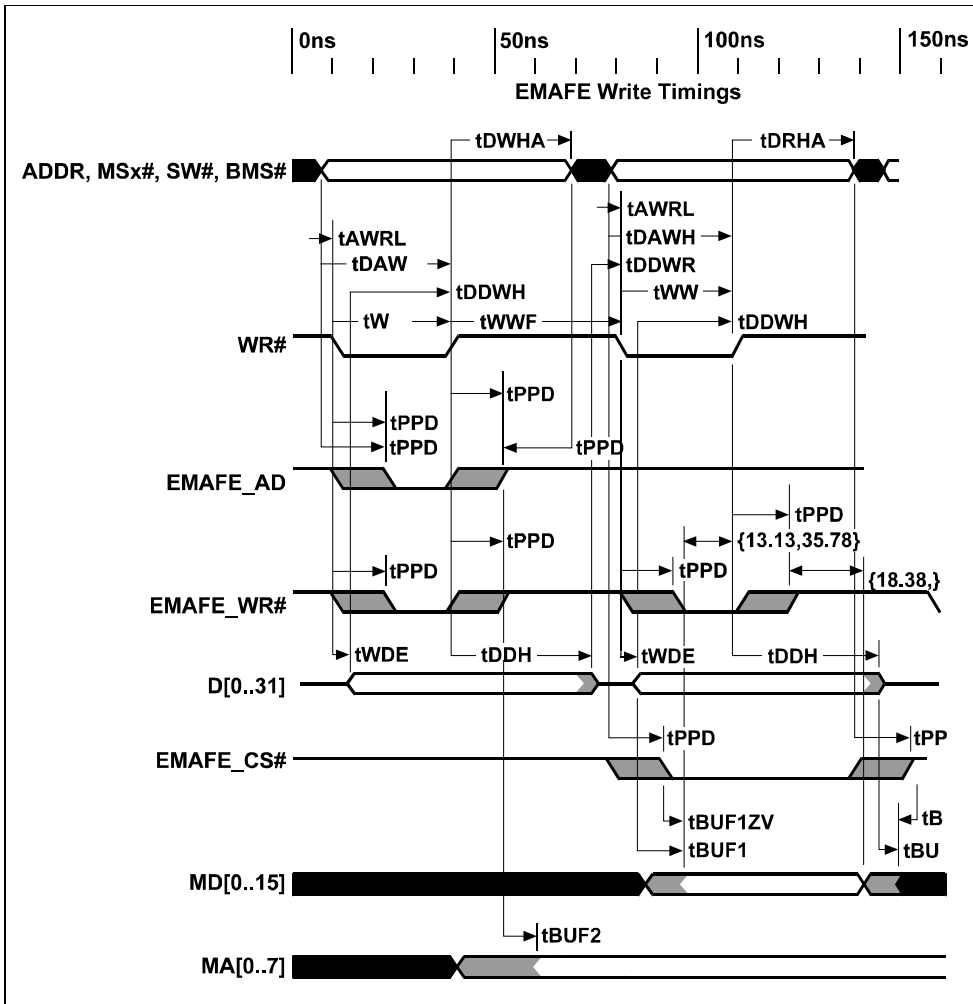


Figure 5-6 EMAFE Write Cycle Timing Diagram

Figure 5-7 EMAFE Read Cycle Timing Parameter Definitions



## 6 Expansion Connectors

### 6.1 Overview

The two expansion connectors provide access to the ADSP-21065L's interface pins. These pins let the user watch data transmissions. In addition, the host interface, interrupt, and pwm\_event pins are also available on this connector.

**Table 6-1 Expansion Connectors**

Connector 1 (J2)			Connector 2 (J4)				
Pin	Name	Name	Pin	Pin	Name	Name	Pin
1	DGND	Vin	2	1	DGND	Vin	2
3	D0	D1	4	3	A0	A1	4
5	D2	D3	6	5	A2	A3	6
7	D4	D5	8	7	A4	A5	8
9	D6	D7	10	9	A6	A7	10
11	DGND	D8	12	11	DGND	A8	12
13	D9	D10	14	13	A9	A10	14
15	D11	D12	16	15	A11	A12	16
17	D13	D14	18	17	A13	A14	18
19	D15	D16	20	19	A15	A16	20
21	DGND	D17	22	21	DGND	A17	22
23	D18	D19	24	23	A18	A19	24
25	D20	Vin	26	25	A20	Vin	26
27	D21	D22	28	27	A21	A22	28
29	D23	D24	30	29	A23	DMAR2	30
31	DGND	D25	32	31	DGND	DMAG2	32
33	D26	D27	34	33	PWM_EVENT0	PWM_EVENT1	34
35	D28	D29	36	35	IRQ0	IRQ1	36
37	D30	D31	38	37	IRQ2	EXT_CLK	38
39	MS0	MS1	40	39	NU	NU	40

**Table 6-1. Expansion Connectors (Cont.)**

		Connector 1 (J2)			Connector 2 (J4)		
Pin	Name	Name	Pin	Pin	Name	Name	Pin
41	DGND	MS2	42	41	DGND	NU	42
43	MS3	RD	44	43	NU	NU	44
45	WR	ACK	46	45	NU	NU	46
47	HBR	HBG	48	47	NU	NU	48
49	SW	CS	50	49	DGND	NU	50
51	DGND	Vin	52	51	NU	Vin	52
53	REDY	SBTS	54	53	NU	NU	54
55	BR2	BR1	56	55	NU	NU	56
57	RESET	CPA	58	57	NU	NU	58
59	DMAG1	DMAR1	60	59	DGND	NU	60

## 6.2 EMAFE Expansion

**WARNING:** Using the EMAFE interface connector to connect to a MAFE board can damage the ADSP-21065L EZ-KIT Lite, the MAFE, or both.

This section describes the Enhanced Modular Analog Front End (EMAFE) Daughter Card interface for the ADSP-21065L digital signal processor evaluation board. The EMAFE interface includes additional signal definitions for the I<sup>2</sup>S capabilities of the ADSP-21065L processor. The EMAFE allows an upgrade path for evaluating present and future codec's and ADC's (18xx, AD7xxx, multimedia codec, etc.) with the ADSP-21065L evaluation board. Only the analog front end will be placed on a daughter board. Each EMAFE daughter board will have its own back plate to allow different input connections (i.e. RCA jack, Mic in, speaker out, etc.). The daughter board is attached to the ADSP-21065L evaluation board by a single 96 pin right angle mounted male connector and two mechanical standoffs to give stability to the entire arrangement when the daughter board and evaluation board are attached. The evaluation board has a 96 pin right angle mounted female connector. The signal lines that need to be routed to the EMAFE daughter board from the evaluation board should be kept to a minimum to reduce noise. Signals routed to the EMAFE daughter board from the ADSP-21065L evaluation board are defined below. Please note, Analog Devices does not provide a daughter board, the user must design this board.

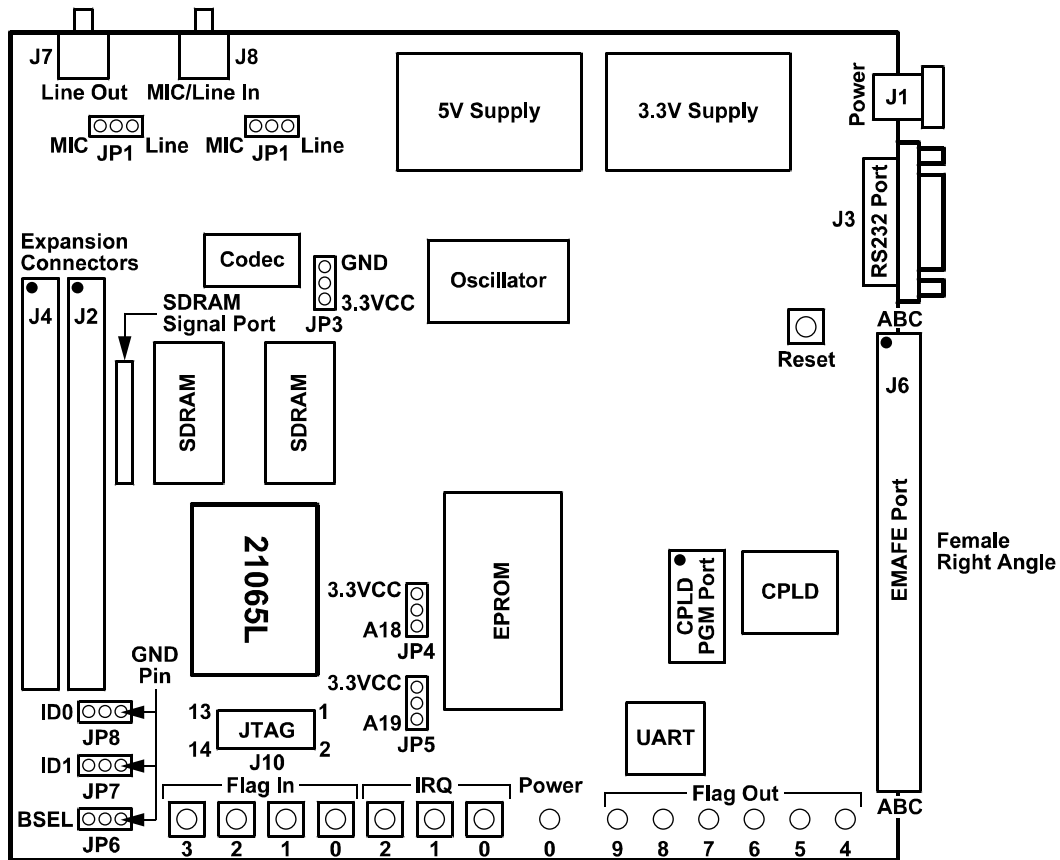


Figure 6-1 Physical Layout of ADSP-21065L DSP evaluation board and EMAFE daughter board

EMAFE Signal Description: The EMAFE 96 pin connector routes the following signals from the evaluation board to the EMAFE daughter board.

- 16 Data lines.
- 8 Address lines.
- 3 Parallel Bus Control lines.
- 16 Synchronous Serial Port lines.
- 1 Interrupt output.
- 1 Flag input.

The EMAFE 96 pin connector also has the following power connections routed from the ADSP-21065L evaluation board to the EMAFE daughter board.

Table 6-2 Evaluation Board Power Connections

Pin	Power Connection
VDD1	Digital power (+5V, 150 mA).
VDD2	Digital power (+3.3V, 150 mA).

The EMAFE connector provides a standard interface for connecting analog input/output daughter boards. The connector has 96 pins arranged in three rows of 32 pins. The pinout is given in Table 6-3 and a description of each of the pins is listed alphabetically in Tables 6-4 through 6-6.

**Table 6-3 EMAFE Connector**

<b>Pin</b>	<b>Row A</b>	<b>Row B</b>	<b>Row C</b>
1	DGND	DGND	VDD1
2	NU	VDD1	NU
3	VDD2	VDD2	NU
4	NU	NU	DGND
5	NU	DGND	NU
6	MD0	VDD1	MD1
7	MD2	NU	MD3
8	MD4	NU	MD5
9	DGND	DGND	DGND
10	MD6	NU	MD7
11	MD8	NU	MD9
12	MD10	NU	MD11
13	VDD1	VDD1	VDD1
14	MD12	NU	MD13
15	MD14	DGND	MD15
16	MFLAG	NU	MIRQ
17	DGND	DGND	DGND
18	NU	VDD2	MA0
19	MA1	CLK_OUT	MA2
20	MA3	CHN_IN	MA4
21	DGND	DGND	DGND
22	MA5	CS1	MA6
23	MA7	DGND	MCS
24	MRD	CS0	MWR
25	VDD1	VDD1	VDD1
26	TXCLK0	DGND	RXCLK0
27	TFS0	NU	RFS0
28	TXD0	VDD2	RXD0
29	DGND	DR0B	DGND
30	TXCLK1	DT0B	RXCLK1
31	TFS1	DR1B	RFS1
32	TXD1	DT1B	RXD1

## 6.2.1 EMAFE Connector Interface Signal Descriptions

Table 6-4 EMAFE Connector Interface Signal Description Row A

PIN	NAME	DESCRIPTION
A1	DGND	Digital Ground
A2	NU	Not Used
A3	VDD2	+3.3 Digital Power
A4	NU	Not Used
A5	NU	Not Used
A6	MD0	Parallel Data Bit 0 (BUFFERED ADSP-21065L D16)
A7	MD2	Parallel Data Bit 2 (BUFFERED ADSP-21065L D18)
A8	MD4	Parallel Data Bit 4 (BUFFERED ADSP-21065L D20)
A9	DGND	Digital Ground
A10	MD6	Parallel Data Bit 6 (BUFFERED ADSP-21065L D22)
A11	MD8	Parallel Data Bit 8 (BUFFERED ADSP-21065L D24)
A12	MD10	Parallel Data Bit 10 (BUFFERED ADSP-21065L D26)
A13	VDD1	Digital Power (5v)
A14	MD12	Parallel Data Bit 12 (BUFFERED ADSP-21065L D28)
A15	MD14	Parallel Data Bit 14 (BUFFERED ADSP-21065L D30)
A16	MFLAG	Flag Input
A17	DGND	Digital Ground
A18	NU	Not Used
A19	MA1	Parallel Address Bit 1 (LATCHED ADSP-21065L D17)
A20	MA3	Parallel Address Bit 3 (LATCHED ADSP-21065L D19)
A21	DGND	Digital Ground
A22	MA5	Parallel Address Bit 5 (LATCHED ADSP-21065L D21)
A23	MA7	Parallel Address Bit 7 (LATCHED ADSP-21065L D23)
A24	MRD*	Module Read (Asserted Low)
A25	VDD1	Digital Power (5v)
A26	TXCLK0	Transmit Clock, Port 0
A27	IFS0	Transmit Frame Sync, Port 0
A28	TXD0	Transmit Data, Port 0
A29	DGND	Digital Ground
A30	TXCLK1	Transmit Clock, Port 1
A31	IFS1	Transmit Frame Sync, Port 1
A32	TXD1	Transmit Data, Port 1



**Table 6-5 EMAFE Connector Interface Signal Description Row B**

<b>PIN</b>	<b>NAME</b>	<b>DESCRIPTION</b>
B1	DGND	Digital Ground
B2	VDD1	Digital Power (5V)
B3	VDD2	Digital Power (3.3V)
B4	NU	Not Used
B5	DGND	Digital Ground
B6	VDD1	Digital Power (5V)
B7	NU	Not Used
B8	NU	Not Used
B9	DGND	Digital Ground
B10	NU	Not Used
B11	NU	Not Used
B12	NU	Not Used
B13	VDD1	Digital Power (5v)
B14	NU	Not Used
B15	DGND	Digital Ground
B16	NU	Not Used
B17	DGND	Digital Ground
B18	VDD2	Digital Power (3.3v)
B19	CLK_OUT	CODEC Chain Clock
B20	CHN_IN	CODEC Chain Input
B21	DGND	Digital Ground
B22	CS1	CODEC CS1
B23	DGND	Digital Ground
B24	CS0	CODEC CS0
B25	VDD1	Digital Power (5V)
B26	DGND	Digital Ground
B27	NU	Not Used
B28	VDD2	Digital Power (3.3V)
B29	DR0B	ADSP-21065L I <sup>2</sup> S, SECONDARY DATA RECEIVE 0 SIGNAL
B30	DT0B	ADSP-21065L I <sup>2</sup> S, SECONDARY DATA TRANSMIT 0 SIGNAL
B31	DR1B	ADSP-21065L I <sup>2</sup> S, SECONDARY DATA TRANSMIT 1 SIGNAL
B32	DT1B	ADSP-21065L I <sup>2</sup> S, SECONDARY DATA RECEIVE 1 SIGNAL

**Table 6-6 EMAFE Connector Interface Signal Description Row C**

<b>PIN</b>	<b>NAME</b>	<b>DESCRIPTION</b>
C1	VDD1	Digital Power (5V)
C2	NC	Not Used
C3	NC	Not Used
C4	DGND	Digital Ground
C5	NC	Not Used
C6	MD1	Parallel Data Bit 1 (BUFFERED ADSP-21065L D17)
C7	MD3	Parallel Data Bit 3 (BUFFERED ADSP-21065L D19)
C8	MD5	Parallel Data Bit 5 (BUFFERED ADSP-21065L D21)
C9	DGND	Digital Ground
C10	MD7	Parallel Data Bit 7 (BUFFERED ADSP-21065L D23)
C11	MD9	Parallel Data Bit 9 (BUFFERED ADSP-21065L D25)
C12	MD11	Parallel Data Bit 11 (BUFFERED ADSP-21065L D27)
C13	VDD1	Digital Power (5v)
C14	MD13	Parallel Data Bit 13 (BUFFERED ADSP-21065L D29)
C15	MD15	Parallel Data Bit 15 (BUFFERED ADSP-21065L D31)
C16	MIRQ*	Interrupt Output (Asserted Low)
C18	MA0	Parallel Address Bit 0 (LATCHED ADSP-21065L D16)
C19	MA2	Parallel Address Bit 2 (LATCHED ADSP-21065L D18)
C20	MA4	Parallel Address Bit 4 (LATCHED ADSP-21065L D20)
C21	DGND	Digital Ground
C22	MA6	Parallel Address Bit 6 (LATCHED ADSP-21065L D22)
C23	MCS*	Module Select (Asserted Low)
C24	MWR*	Module Write (Asserted Low)
C25	VDD1	Digital Power (5v)
C26	RXCLK0	Receive Clock, Port 0
C27	RFS0	Receive Frame Sync, Port 0
C28	RXD0	Receive Data, Port 0
C29	DGND	Digital Ground
C30	RXCLK1	Receive Clock, Port 1
C31	RFS1	Receive Frame Sync, Port 1
C32	RXD1	Receive Data, Port 1

## 7 Reference

### 7.1 Overview

This chapter is a reference for VisualDSP++. Because the debugger is dynamic, menu selections, commands, and dialogs change depending on the target being used. This chapter provides information on all of the menu selections, commands, and dialogs when the target is the ADSP-21065L evaluation board. For all other debugger commands, see the *VisualDSP++ Guide & Reference*. Note that grayed out commands are unavailable with this target.

### 7.2 Settings Menu Commands

All of the commands that pertain to the EZ-KIT Lite board are contained in the Settings and Demo menus. The Settings menu provides access to the following commands:

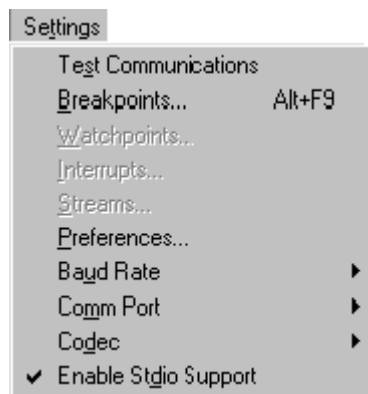


Figure 7-1 Settings Menu Commands

#### 7.2.1 Test Communications

Tests the PC, EZ-KIT Lite communications. Responses are Communications Success or various error messages sent to the Output window. In most cases resetting the EZ-KIT Lite reestablishes communication.

#### 7.2.2 Baud Rate

Sets up the baud rate of the COM port. Choices are 9600, 19200, 38400, 57600, and 115200. The default rate is 115200. Once change is made, resetting is not needed for subsequent debug sessions.

- Using a baud rate of 9600 causes the EZ-KIT Lite to operate very slowly and can also cause it to hang.

### 7.2.3 Comm Port

Selects a PC communications port for the EZ-KIT Lite board. Choices are Comm(1-4).

### 7.2.4 Codec

Sets several options for codec operation. These commands are:

**Update** — Updates and refreshes the menu changes you selected.

**Sample Rate** — Opens the Sample Rate dialog (Figure 7-2 ) that lets you select a sample rate from 7000 to 48000 Hz.

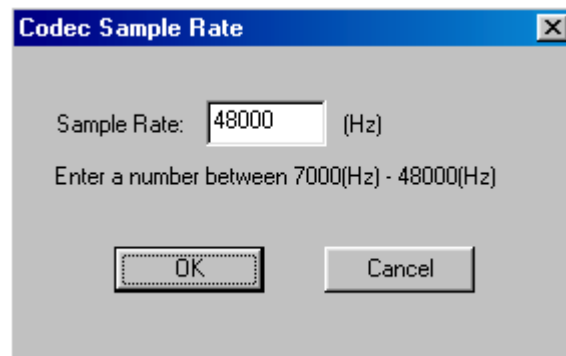


Figure 7-2 Sample Rate Dialog

**Source** — Choose Microphone or Line In

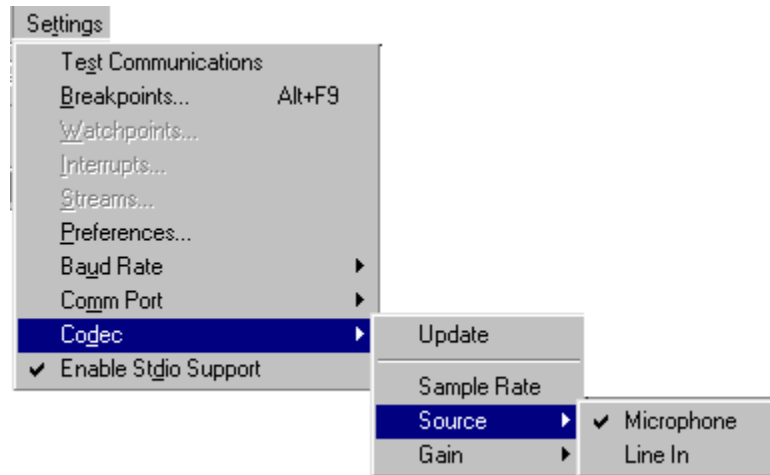


Figure 7-3 Source Setting

**Gain Select** — Select a gain from 0.0 to 22.5 in 1.5 increments

### 7.3 Demo Menu Commands

The Demo menu has one command—**Demo Control**. This command opens a dialog box that lets the user change several operating functions of the FFT and BP demos. Figure 7-3 shows the dialog box that accompanies the FFT demo. Select the Demo Control command for a demo which has no dialogs, an error message that says “This demo does not require user input” will appear. Click OK and continue with the demo.

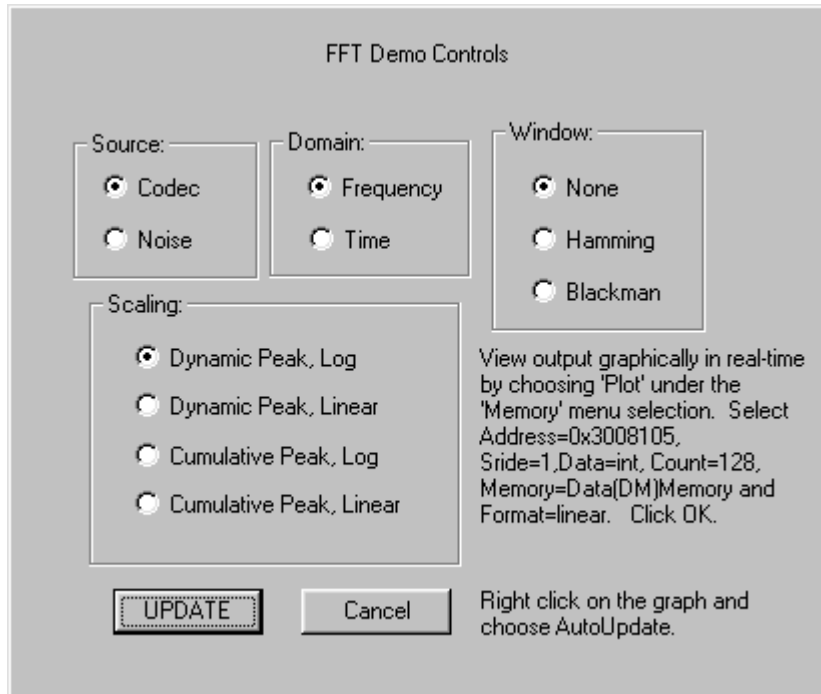
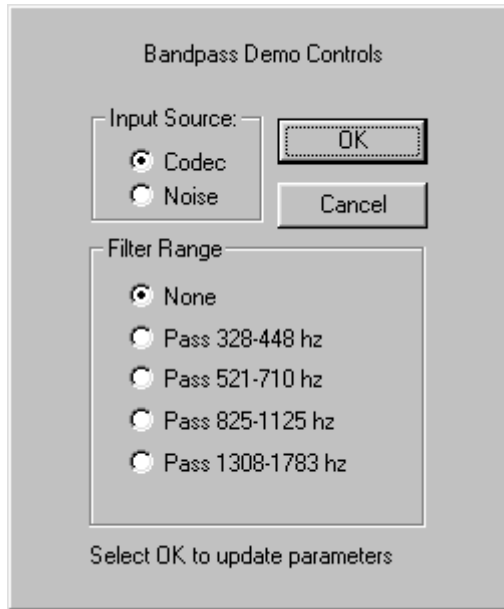


Figure 7-4 FFT Demo Dialog

Table 7-1 FFT Demo Dialog Description

Dialog Field	Description
Source	Select the source for the FFT; the codec or a random number generator.
Domain	Splits the original DFT using one of the following methods: DIT (Decimation in Time) or DIF (Decimation in Frequency)
Window	A filter to use on the Fourier transform.
Scaling	Scaling refers to how and how much data is captured while the FFT is running. Dynamic Scaling is a snapshot of current FFT high and low (limits) (activity). Cumulative Scaling shows FFT activity over time (limits) (activity).



**Figure 7-5 Bandpass Demo Controls Dialog**


The dialog fields for the Bandpass demo are as follows:

Input Source — Select input from the AD1819, or noise from the DSP.

Filter Range — Change the filter applied to the demo.

# APPENDIX A RESTRICTIONS & CPLD CODE LISTING

The following restrictions apply to configuration level release 2.01 of the ADSP-21065L evaluation board. For information on any ADSP-21065L silicon anomalies, see the anomaly sheet that accompanied this product.

1. Breakpoints set in the last three instructions of a do-loop are allowed, but cause your code to run incorrectly.
2. Breakpoints set after a delayed branch instruction and before the branch occurs causes your code to run incorrectly.
3. Using the single stepping function  steps through a delayed branch instruction and the last three instructions of a do-loop.
4. The host loses contact with the monitor while the user program is running if the user program disables the UART interrupt or changes the UART interrupt vector.
5. The host loses contact with the monitor while the program is running and in an ISR when nesting is turned off.
6. The host loses contact with the monitor while the program is running and in the timer ISR, provided the highest priority timer vector is used.
7. The current version of the EZ-KIT monitor does not let you view hardware stack information.
8. Do not use the reset button while the debugger is open unless the debugger requests you to. This will cause the debugger to crash.
9. The IMDW0 bit in the SYSCON register must be set to 1 to keep communication with the host. The IMDW0 bit determines if data accesses made to block 0 are 48-bit three column accesses (1) or 32-bit two column accesses (0). The monitor program requires three column data accesses to memory block 0. If The IMDW0 bit is set to 0, the monitor accesses incorrect memory locations within block 0. (See User's Manual for further discussion of IMDW0).
10. The setting of IMDW0 will have no effect on C-programming as long as RND32 is not set for 40 bit floating point precision.
11. Do not run more than one ADSP-21065L EZ-KIT Lite session in the debugger at any one time. You may run an EZ-KIT Lite session and a simulator or ICE session at the same time or you can open two debugger interfaces to run more than one EZ-KIT Lite session.

12. The product as documented describes the debugger's Settings, Codec Sample Rate menu command as follows: "Opens the Sample Rate dialog that lets you select a sample rate from 7000 to 48000 Hz." The default sample rate is 48000. Do NOT change the sample from this setting. If you need to change sample rates for your program, you will need to write your own CODEC driver. Information on doing this is provided in Chapter 3 of the ADSP-21065L EZ-KIT Lite Evaluation System Manual.

## A.1 CPLD File

Listing A-1 shows the Cypress WARP file used to program the CPLD on the board. The CPLD is a CY7371i-83AC, which is a 32-macrocell CPLD with in-circuit programmability. The functions performed are:

1. Extends the EPROM read cycles (board silicon revision 0.0 only). The access cycles used by the ADSP-21065L when booting, are too short for the EPROM; therefore, the CPLD deasserts the ACK line long enough to extend the cycle to an appropriate time for the EPROM.
2. Translates the read and write cycles into cycles that are appropriate for the UART. The timing requirements between the chip select, read/write lines, and data accesses are different between the ADSP-21065L and the UART. The CPLD corrects for these differences. Additionally, there is a minimum time restraint between subsequent access to the UART. The CPLD accounts for this needed time delay.
3. Translates ADSP-21065L read and write cycles into cycles appropriate for the EMAFE.



## Listing A CPLD File

```
-- *****
-- ** Copyright (c) 1998 Analog Devices, Inc. All Rights Reserved
-- *****
-- ** Revision History
-- ** -----
-- ** 05/26/98 Original
-- ** 05/27/98 inverted ack output to ack_bar
-- ** Allows addition of open collector buffer to be added
-- ** 05/29/98 Changed address of UART
-- ** 08/15/98 Locked pins to prevent changes on next rev.s
-- ** 09/22/98 Changed ACK functionality (driven only when
--             needed)
-- ** Added Codec reset functionality
-- ** 09/28/98 Changed functionality of Codec Reset (1usec low)
-- **
-- **
-- *****
-- ** 21065L.VHD
-- ** -----
-- **   VHDL code for the CPLD on the ASPL-21065L evaluation board
-- **
-- **   Addresses:      A3 A2 A1 A0
-- **                   UART:  0  0  1  -
-- **   EMAFE_Address:  0  0  0  0
-- **   EMAFE_Data:    0  0  0  1
-- **   CODEC_RESET:   0  1  0  0
-- **
-- **   Note: The ACK line is only driven when needed.
-- **         When the codec reset is written, the codec_rst line
-- **         goes low for > 1usec.
-- **
-- *****

library ieee;
use ieee.std_logic_1164.all;
use work.std_arith.all;
entity interface is port (
    reset          : in std_logic;      -- asynchronous reset
    clk            : in std_logic;      -- Clock input
    addr           : in std_logic_vector(3 down to 0);
    wr_bar, rd_bar, cs_bar      : in std_logic;
```

```

    bms_bar          : in std_logic;      -- Wait (EPROM) input
    u_en_bar, u_rd_bar, u_wr_bar : out std_logic;  -- UART Outputs
    ack              : out std_logic;  -- to DSP
    e_cs_bar, e_rd_bar, e_wr_bar,
    e_addr           : out std_logic;  -- EMAFE Outputs
    codec_rst_bar    : out std_logic);  -- CODEC Reset
attribute pin_avoid of interface:entity is "1 13 21 33";
-- avoiding programming control pins
-- Need to lock pin numbers, to prevent accidental changes
attribute pin_numbers of interface:entity is
    "reset:26 clk:7 wr_bar:29 rd_bar:9 cs_bar:15 "
    & "addr(3):11 addr(2):12 addr(1):14 addr(0):27 "
    & "bms_bar:10 u_en_bar:30 u_rd_bar:32 u_wr_bar:22 "
    & "ack:18 e_cs_bar:36 e_rd_bar:23 e_wr_bar:24 e_addr:37 "
    & "codec_rst_bar:8 ";
end interface;
architecture state_machine of interface is
type StateType is (IDLE, CS1, CS2, WR1, WR2, WR3, WR4, WR_D1, ENDW1,
                  ENDW2, ENDW3, ENDW4, CS3, CS4, CS5, CS6, RD1,
                  RD2, RD3, RD4, ENDR1);
signal present_state, next_state : StateType;
signal u_ack      : std_logic;
                    -- ACK signal generated from UART
signal u_ack_v    : std_logic;
                    -- UART ACK valid signal
signal w_ack      : std_logic;
                    -- ACK signal generated from EPROM
signal w_ack_v    : std_logic;
                    -- EPROM ACK valid signal
signal uart_ctrl_d: std_logic_vector(2 downto 0);
                    -- (u_rd_bar_d,
                    --  u_en_bar_d, u_wr_bar_d)
                    -- next state of uart
                    -- control signals
type WAIT_STATE is (WAIT0, WAIT1, WAIT2, WAIT3, WAIT4, WAIT5,
                  WAIT6);
signal present_wstate, next_wstate : WAIT_STATE;
begin

-- *****
--   UART Control logic
-- *****
uart_state:process(present_state, cs_bar, rd_bar, wr_bar, addr)
    variable rd : std_logic;
    variable wr : std_logic;

```

```

    variable cs : std_logic;
begin
    rd := not rd_bar;
    wr := not wr_bar;
    cs := not cs_bar;
case present_state is
    when IDLE => u_ack <= '1';
        u_ack_v <= '0';
        if ((cs = '1') AND ((rd OR wr) = '1')
            AND (std_match(addr, "001-"))) then
            -- Proceed only if next_state <= CS1;
            -- addressed and rd/wr
        else
            next_state <= IDLE;    -- Not needed; for clarity
        end if;
    when CS1 => u_ack <= '1';
        u_ack_v <= '0';
        if ((cs = '1') AND ((rd OR wr) = '1')
            AND (std_match(addr, "001-"))) then
            -- Proceed only if next_state <= CS2;
            -- addressed and rd/wr
        else
            next_state <= IDLE;    -- Improper cycle
        end if;
    when CS2 => u_ack <= '0';    -- Signal extended cycle
        u_ack_v <= '1';
        if (wr = '1') then
            next_state <= WR1;    -- Write cycle
        else
            next_state <= CS3;    -- Read cycle
        end if;
    when WR1 => u_ack <= '0';
        u_ack_v <= '1';
        next_state <= WR2;    -- Continue Write Cycle
    when WR2 => u_ack <= '0';
        u_ack_v <= '1';
        next_state <= WR3;    -- Continue Write Cycle
    when WR3 => u_ack <= '0';
        u_ack_v <= '1';
        next_state <= WR4;    -- Continue Write Cycle
    when WR4 => u_ack <= '0';
        u_ack_v <= '1';
        next_state <= WR_D1;    -- Continue Write Cycle
    when WR_D1 => u_ack <= '0';
        u_ack_v <= '1';
        next_state <= ENDW1;    -- Continue Write Cycle

```

```

when ENDW1 => u_ack <= '0';
    u_ack_v <= '1';
    next_state <= ENDW2;           -- Continue Write Cycle
when ENDW2 => u_ack <= '0';
    u_ack_v <= '1';
    next_state <= ENDW3;           -- Continue Write Cycle
when ENDW3 => u_ack <= '0';
    u_ack_v <= '1';
    next_state <= ENDW4;           -- Continue Write Cycle
when ENDW4 => u_ack <= '1';
    u_ack_v <= '1';
    next_state <= IDLE;            -- End Write Cycle
when CS3 => u_ack <= '0';
    u_ack_v <= '1';
    next_state <= CS4;             -- Continue Read Cycle
when CS4 => u_ack <= '0';
    u_ack_v <= '1';
    next_state <= CS5;             -- Continue Read Cycle
when CS5 => u_ack <= '0';
    u_ack_v <= '1';
    next_state <= CS6;             -- Continue Read Cycle
when CS6 => u_ack <= '0';
    u_ack_v <= '1';
    next_state <= RD1;             -- Continue Read Cycle
when RD1 => u_ack <= '0';
    u_ack_v <= '1';
    next_state <= RD2;             -- Continue Read Cycle
when RD2 => u_ack <= '0';
    u_ack_v <= '1';
    next_state <= RD3;             -- Continue Read Cycle
when RD3 => u_ack <= '0';
    u_ack_v <= '1';
    next_state <= RD4;             -- Continue Read Cycle
when RD4 => u_ack <= '1';
    u_ack_v <= '1';
    next_state <= ENDR1;           -- Continue Read Cycle
when ENDR1 => u_ack <= '1';
    u_ack_v <= '1';
    next_state <= IDLE;            -- End Read Cycle
end case;
end process uart_state;
with next_state select
    uart_ctrl_d <= "111" when IDLE,
                 "101" when CS1,
                 "101" when CS2,
                 "100" when WR1,

```

```

        "100" when WR2,
        "100" when WR3,
        "100" when WR4,
        "101" when WR_D1,
        "111" when ENDW1,
        "111" when ENDW2,
        "111" when ENDW3,
        "111" when ENDW4,
        "101" when CS3,
        "101" when CS4,
        "101" when CS5,
        "101" when CS6,
        "001" when RD1,
        "001" when RD2,
        "001" when RD3,
        "001" when RD4,
        "101" when ENDR1,
        "---" when others;
-- *****
-- State/Reset Control
-- *****
state_clocked:process(reset, clk)
begin
if (reset = '1') then
    present_state <= IDLE;           -- UART State
    u_rd_bar <= '1';                -- UART State
    u_en_bar <= '1';                -- UART State
    u_wr_bar <= '1';                -- UART State
    present_wstate <= WAIT0;        -- Wait State
elsif rising_edge(clk) then
    present_state <= next_state;    -- UART State
    u_rd_bar <= uart_ctrl_d(2);     -- UART State
    u_en_bar <= uart_ctrl_d(1);     -- UART State
    u_wr_bar <= uart_ctrl_d(0);     -- UART State
    present_wstate <= next_wstate;  -- Wait State
end if;
end process state_clocked;
ack <= '1' when (reset = '1') else
    (u_ack AND w_ack) when ((u_ack_v = '1')
    OR (w_ack_v = '1')) else
    'Z';                             -- Generate ACK
-- *****
-- EMAFE Control logic
-- *****
-- Control the buffering of data to and from the EMAFE
-- interface

```

```

e_rd_bar <= rd_bar;
e_wr_bar <= wr_bar;
e_cs_bar <= '0' when ((addr = "0001") AND (cs_bar = '0')) else '1';
e_addr  <= '0' when ((addr = "0000") AND (cs_bar = '0')AND
                    (wr_bar = '0')) else '1';

-- *****
-- Wait Generator for EPROM
-- *****
-- Delay the accesses to the EPROM since the DSP will try to
-- access it at 30 MHz.
wait_state: process(rd_bar, bms_bar, present_wstate)-- State selection and ack
control
    variable rd : std_logic;
    variable bms : std_logic;
begin
    rd := not rd_bar;
    bms := not bms_bar;
    case present_wstate is
        when WAIT0 =>
            if ((bms = '1') AND (RD = '1')) then -- Check for EPROM RD
                w_ack <= '0';                    -- Yes .. Delay
            w_ack_v <= '1';
                next_wstate <= WAIT1;
            else
                w_ack <= '1';                    -- No, ignore
            w_ack_v <= '0';
            end if;
        when WAIT1 =>                                -- Continue Delay
            w_ack <= '0';
            w_ack_v <= '1';
            next_wstate <= WAIT2;
        when WAIT2 =>                                -- Continue Delay
            w_ack <= '0';
            w_ack_v <= '1';
            next_wstate <= WAIT3;
        when WAIT3 =>                                -- Continue Delay
            w_ack <= '0';
            w_ack_v <= '1';
            next_wstate <= WAIT4;
        when WAIT4 =>                                -- Continue Delay
            w_ack <= '0';
            w_ack_v <= '1';
            next_wstate <= WAIT5;
    end case;
end process;

```

```

        when WAIT5 =>                                -- Continue Delay
            w_ack <= '0';
            w_ack_v <= '1';
            next_wstate <= WAIT6;
        when WAIT6 =>                                -- Release Delay
            w_ack <= '1';
            w_ack_v <= '1';
            next_wstate <= WAIT0;
    end case;
end process wait_state;

-- *****
-- Codec Reset
-- *****
cdc_rst: process(clk, addr, cs_bar, reset)
    variable cdc_cnt: std_logic_vector(4 downto 0);
begin
    if (reset = '1') then                            -- If reset
        cdc_cnt := (others => '0');                  -- reset counter
        codec_rst_bar <= '0';                        -- pass reset to codec
    elsif (rising_edge(clk)) then                    -- otherwise (key on rising edge)
        if (cdc_cnt = "00000") then                 -- if counter hasn't started
            if ((addr = "0100") AND (cs_bar = '0')) then -- check if reset
                cdc_cnt := cdc_cnt + 1;              -- Start counter
                codec_rst_bar <= '0';                -- Reset codec
            else                                      -- if not reset
                codec_rst_bar <= '1';                -- hold reset high
            end if;
        else                                          -- if counter has started
            cdc_cnt := cdc_cnt + 1;                    -- increment counter
            codec_rst_bar <= '0';                    -- Reset codec
        end if;
    end if;
end process cdc_rst;
end;

```

To use the CODEC controls, reference the buffer.asm and .ldf files provided with the demos. These files provide access to the necessary variables by overlapping the locations of the variables.

# **APPENDIX B BILL OF MATERIALS**



Item	Qty	Ref	Part Desc	Pkg	Specification	Manufacturer/Source:P/N
1	25	C1, C4, C7, C11, C13, C22, C24, C38, C42, C60, C62, C74, C75, C91, C92, C95, C105, C119, C122, C124, C127, C129, C130, C134, C135	0.01uF	SMT0805	Ceramic, 10%, T&R, 50 V	AVX: 08055E103KATMA Panasonic: ECU-1H103KKBG
2	2	C109, C110	22 pF	SMT0805	Ceramic, 5%, 50 V	Digi-Key: PCC220CNCT-ND Panasonic: ECU-V1H220JCN
3	2	C114, C115	270 pF	SMT0805	Ceramic, 5%, 50 V	Digi-Key: PCC271CGCT-ND
4	4	C139, C140, C141, C142	100pF	SMT0805	Ceramic, 5%, 50 V	Digi-Key: PCC101CGCT-ND Panasonic: ECU-V1H101JCG
5	10	C2, C15, C77, C79, C82, C85, C87, C89, C112, C113	1uF	SMT1812	X7R Ceramic, 20%, 50 V	AVX: 18125C105MAT2A
6	18	C3, C9, C16, C17, C20, C47, C51, C57, C69, C97, C98, C99, C100, C111, C120, C126, C133, C138	10uF	EIA3216	Tantalum, 10%, 10 V	Kemet: T491A106K010AS
7	2	C39, C117	0.047uF	SMT1206	Z5U, 10%, 50 V	Digikey: PCC473BCT-ND Panasonic: ECU-V1Hr73KBW
8	6	C44, C49, C50, C54, C81, C86	220 pF	SMT0805	Ceramic, 5%, 50 V	Digi-Key: PCC221CGCT-ND
9	1	C5	100 uF	SMTX	Tantalum, Low ESR, 20%, 20 V	Kemit: T494X107K020AS
10	1	C55	27 pF	SMT0805	NPO, 5%, 50 V	Digikey: PCC270CGCT-ND Panasonic: ECU-V1H270JCG
11	1	C56	47 pF	SMT0805	Ceramic, 5%, 50 V	Digi-Key: PCC470CGCT-ND
12	7	C59, C64, C65, C66, C67, C68, C76	1 uF	EIA3216	Tantalum, T&R, 16 V	AVX: TAJA105K016R Digi-Key: PCT3105CT-ND
13	46	C6, C8, C10, C12, C14, C18, C19, C21, C23, C25, C37, C40, C41, C43, C45, C46, C48, C52, C53, C58, C61, C63, C70, C71,	0.1 uF	SMT0805	Z5U, 20%, 50 V	Allied: 231-1294 Murata: GRM40Z5U104M050BL

		C72, C73, C93, C94, C96, C101, C102, C103, C104, C106, C107, C108, C116, C118, C121, C123, C125, C128, C131, C132, C136, C137				
14	4	C78, C80, C88, C90	1000 pF	SMT0805	Z5U, 10%, 50 V	Digikey: PCC102BNCT-ND
15	2	C83, C84	0.33 uF	SMT3216	Tantalum, 20%, 35 V	Digikey: PCS6334CT-ND Panasonic: ECS-T1VY334R
16	6	D1, D2, D3, D4, D5, D6	LED-Green	SMT, Gull Wing	Low Current, Diffused, T&R, 2mA, 1.5 V	HP: HLMP-7040 #11
17	1	D7	Red LED	SMT0805	Ultra Bright Red, 50 mW, 20mA, 3V	Panasonic: LNJ208R8ARAF
18	1	D8	Rectifier	D0-214AA	Max. fv=1.15V @ 1.0A, 2ADC, 2.0uSec, 50 V	Microsemi: S2A
19	1	FB1	Common Mode Choke Coil	SMT	0.06 Ohm-DC, 1.5A, 50Vdc (EIA 2020 pkg)	Murata: PLM250S40B1
20	2	FB3, FB13	EMI Filter	SMT1206	0.025 Ohm-DC, 3A	Murata: BLM31P500S
21	9	FB4, FB5, FB6, FB7, FB8, FB9, FB10, FB11, FB12	EMI Filter	603	Bead Inductor, 200 mA	Murata: BLM11A601SPB
22	2	HQ1, HQ2	SMT Heat Sink	TO-263AB	Conduction through Drain Pad	AAVID: 573300D00010
23	1	J1	2.5mm Jack	SMT	Male, Rt. Angle	Kycon: KLD-SMT-0202-B
24	1	J10	CON7x2M	.100 TH	Male	Samtec: TSW-17-07-T-D
25	2	J2, J4	CON30x2M	.100 TH	Male	Samtec: TSW-130-07-T-D
26	1	J3	DB9F	TH	Fem. Rt. Angle PCB, w/ grounding board locks	Keltron: DNR-09SCJB-SG Kycon: K22-E9S-NJ
27	1	J5	CON5x2M	.100 TH	Male Breakaway	Molex: 10-89-1101
28	1	J6	CON32x3F	.100 TH	Female Right Angle	Samtec: SSW-132-T-02-T-T-RA
29	2	J7, J8	STEREO JACK	TH	3.5mm, 500VDC, horizontal	Switchcraft: 35RAPC4BHN2
30	1	J9	CON7M	.100 TH	Male	Samtec: TSW-17-07-T-S
31	8	JP1, JP2, JP3, JP4, JP5, JP6, JP7, JP8	CON3M	2mm SMT	Male, 3 A	Samtec: TMM-103-01-S-S-SM

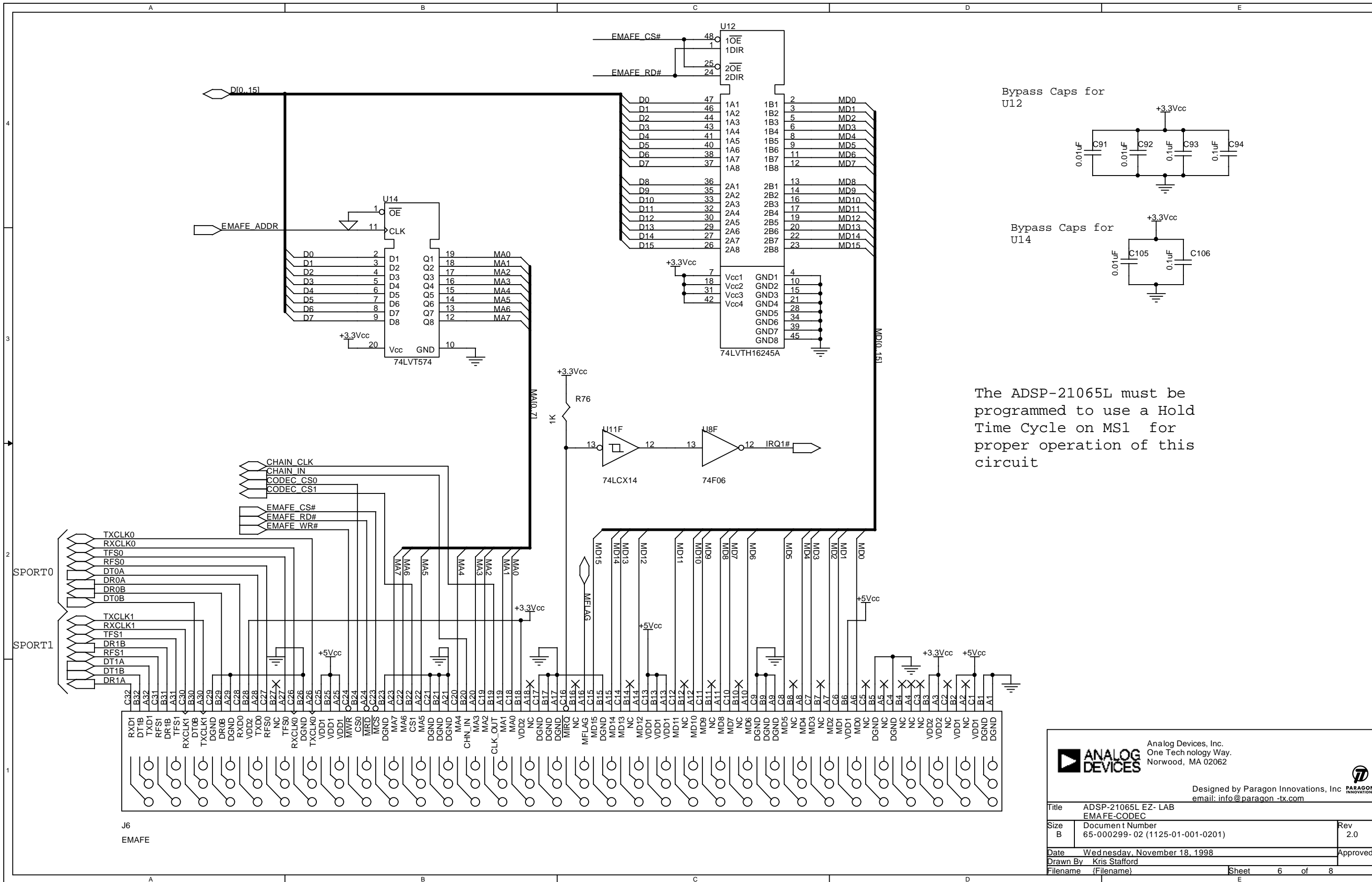
32	2	Q1, Q2	PMOS FET	TO-263AB	P-channel MOSFET, 60W, -24A, -20V	Fairchild: NDB6020P
33	4	R1, R2, R3, R4	39 Ohm	SMT0805	Thick Film, 5%, 1/8 W	Digi-Key: P39ACT-ND Panasonic: ERJ-6GEY/J390
34	8	R11, R13, R16, R18, R28, R30, R33, R46	100 Ohm	SMT0805	Thick Film, 5%, 1/10 W	Digi-Key: P100ACT-ND Panasonic: ERJ-6GEYJ101
35	7	R19, R20, R21, R22, R23, R24, R25	910 Ohm	SMT0805	Thick Film, 5%, 1/10 W, 100 V	Bourns: CR0805-911-JVCA
36	5	R34, R36, R42, R44, R76	1K Ohm	SMT0805	Thick Film, 5%, 1/10 W, 100 V	Bourns: CR0805-102-JVCA Panasonic: ERJ-6GEYJ102
37	4	R35, R37, R43, R45	47K Ohm	SMT0805	Thick Film, 5%, 1/10 W	Digi-Key: P47KACT-ND
38	2	R38, R41	20K Ohm	SMT0805	Thick Film, 5%, 1/10 W	Allied: 297-9552 Digi-Key: P20KACT-ND
39	2	R39, R40	5.1K	SMT0805	Thick Film, 5%, 1/10 W	Digi-Key: P5.1KACT-ND
40	1	R5	1M Ohm	SMT0805	Thick Film, 5%, 1/10 W	Digi-Key: P1.0MACT-ND
41	2	R52, R53	33 Ohm x 8	SOP-16	Isolated, 5%, 200 mW	CTS: 767-163-R33 Digikey: 767-163-R33-ND
42	1	R54	10K x 15	SOP-16	Bussed, 2%, 100 mW, 50V	CTS: 767-161-R10K Digikey: 767-161-R10K-ND
43	1	R6	1.5K Ohm	SMT0805	Thick Film, 5%, 1/10 W, 100 V	Bourns: CR0805-152-JVCA
44	25	R7, R8, R9, R10, R12, R14, R15, R17, R26, R27, R29, R31, R32, R47, R48, R49, R50, R51, R57, R64, R72, R75, R78, R79, R80	10K Ohm	SMT0805	Thick Film, 5%, 1/10 W, 100 V	Bourns: CR0805-103-JVCA Panasonic: ERJ-6GEYJ103
45	1	R73	0.025 Ohm	SMT1206	SMT, 1%, 1/4 W	Dale: WSL1206R025FB25
46	1	R74	0.05 Ohm	SMT1206	SMT, 1%, 1/4 W	Dale: WSL1206R050FB25
47	8	SJP1, SJP2, SJP3, SJP4, SJP5, SJP6, SJP10, SJP11	SHUNT2	2mm	Open Top, Gold Plating	Samtec: 2SN-BK-G
48	2	SJP7, SJP8	SHUNT2	0.1	Open Top w/ Handle	AMP: 881545-1
49	8	SW1, SW2, SW3, SW4, SW5, SW6, SW7, SW8	SWITCH	SMT	Momentary SPST (washable)	C&K: KT11P2JM


50	1	TP1	HEADER 1X1	.100 TH	Male, single	Samtec: TSW-101-07-L-S
51	1	U1	Voltage Regulator	SO-8	10A, 3.3V	Analog Devices: ADP3310AR-3.3
52	1	U10	Silicon Delay Line	16-pin SOIC	Triple, 10-ns delay, +/- 2ns, 5.0V	Dallas Semi: DS1013S-10
53	1	U12	74LVCH16245A	TSSOP-48	16-Bit Xcvr, w/ Bus Hold, 5V-Tolerant, +/-24 mA, 1.5-4.1 ns, 3.3 V	IDT: IDT74LVCH16245APA Phillips: 74LVCH16245A DGG
54	1	U13	Audio OpAmp	8-Pin SOIC	Dual - Single Supply (+4V to +36V)	Analog Devices: SSM2135S
55	1	U14	74LCX574	TSSOP-20	Octal Edge Trigg D Flip-Flops w/ 3-State out puts, 5V-Tolerant, +/-24 mA, 1.5-8.5 ns, 3.3 V	Fairchild: 74LCX574MTC Motorola: MC74LCX574DT
56	1	U15	SoundPort Codec	48-pin TQFP	AC '97 Compliant, 5.0V	Analog Devices: AD1819A JST
57	1	U16	74LCX125	TSSOP-14	Quad bus buffers w/ 3-state outputs, w/ Bus Hold, 5V-Tolerant, +/-24 mA, 1.5-6.0 ns, 3.3 V	Fairchild: 74LCX125MTC Motorola: MC74LCX125DT
58	1	U17	EPROM	32-pin DIP	EPROM 2Mb (256Kx8), 200ns, 3.3V	SGS: M27V201-200F6 Macronix: MX27L2000 DC-20
59	1	U18	SHARC DSP	208-pin PQFP	Processor, 60MHz, 3.3V	Analog Devices: ADSP-21065L KS-240X
60	2	U19, U20	SDRAM	50-pin TSOP	SDRAM 16Mb (1Mx16), 83MHz, 3.3V	Micron: MT48LC1M16A1TG S-10 NEC: uPD4516161AG5-A10
61	1	U2	Voltage Regulator	SO-8	10A, 5V	Analog Devices: ADP3310AR-5
62	1	U3	Voltage Monitor	8-pin SOIC	uProcessor Supervisor, 200ms, 3.3V	Analog Devices: ADM708TAR

63	3	U4, U11, U21	74LCX14	TSSOP-14	Schmitt Trigger Inverter, 5V-Tolerant, 3.3 V	Fairchild: 74LCX14MTC Toshiba: 74LCX14FT
64	1	U5	ADM232A	Narrow SOIC-16	RS232 Driver/Receiver, 2 Tx / 2 Rx, 5 V	Analog Devices: ADM232AARN
65	1	U6	PC16550DV	PLCC-44	UART, w/ FIFOs, 1.5M baud, 5 V	National Semi: PC16550D
66	1	U7	74LPT245	SOP-20	Octal Bus Transceiver w/ Bus Hold, 5V-Tolerant, +32/-64 mA, 1.0-4.0 ns, 3.3 V	Digikey: PI74LPT245AS-ND Pericom: PI74LPT245AS
67	1	U8	74F06	SOP-14	Open collector Hex inverter, 3.5ns, 5.0 V	Phillips: N74F06D
68	1	U9	32-Macro cell CPLD	44-Pin TQFP	In-Circuit Programmable, 5.0V, 75mA, 12ns, 5.0V/3.3V	Cypress: CY7C371i-83AC
69	1	X1	18.432 MHz	SMT	Crystal, Parallel, 50 ppm, 18.432MHz	Epson: MA-505-18.432M-C2
70	1	X2	24.576 MHz	SMT	Crystal, Parallel, 50 ppm, 24.576MHz	Epson: MA-505-24.576M-C2
71	1	Y1	30.0 MHz	4-Pin DIP-8 Can	Oscillator, 50 ppm, 20 mA, 30.0 MHz, 3.3V	M-Tron: M3A14FAD30.0000 SaRonix: NCH089B-30.0000
72	1	Z1	Socket, DIP-32	DIP-32	Machine Pin	Andon: 101-632-01S-P29 Augat: 832-AG12D-ES
73	4	Z2, Z3, Z4, Z5	Button Bumper	Rubber		Allied: 217-4165 Russel: BUT-4165

# APPENDIX C SCHEMATICS






 Analog Devices, Inc.  
 One Technology Way.  
 Norwood, MA 02062

Designed by Paragon Innovations, Inc.  
 email: info@paragon-tx.com

**Title** ADSP-21065L EZ-LAB  
 EMAFE-CODEC

**Size B** Document Number  
 65-000299-02 (1125-01-001-0201)

**Date** Wednesday, November 18, 1998

**Drawn By** Kris Stafford

**Filename** {Filename}

Rev 2.0

Approved

Sheet 6 of 8

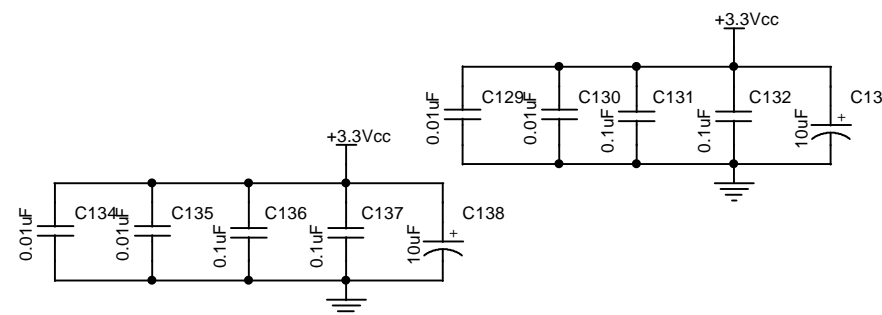
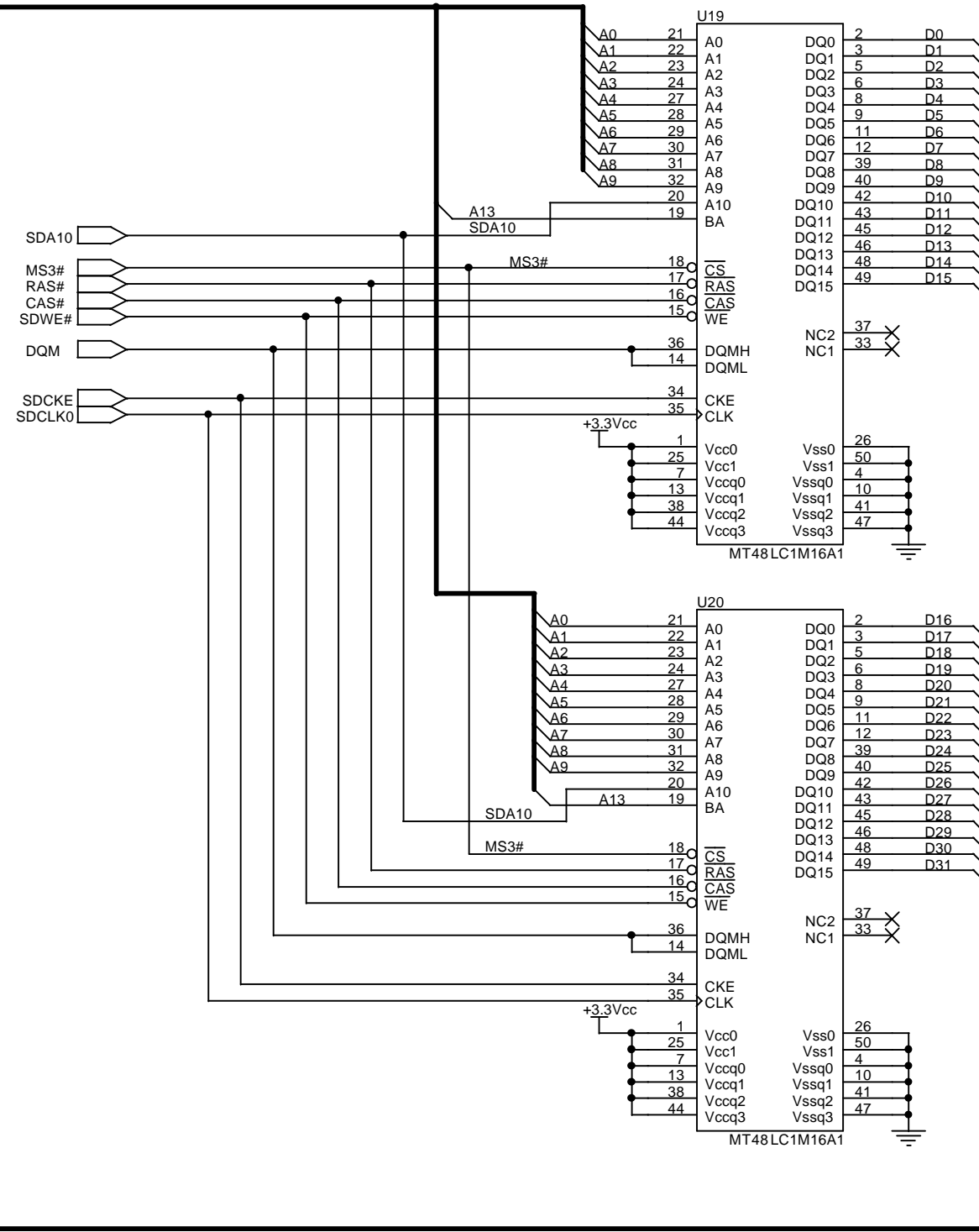
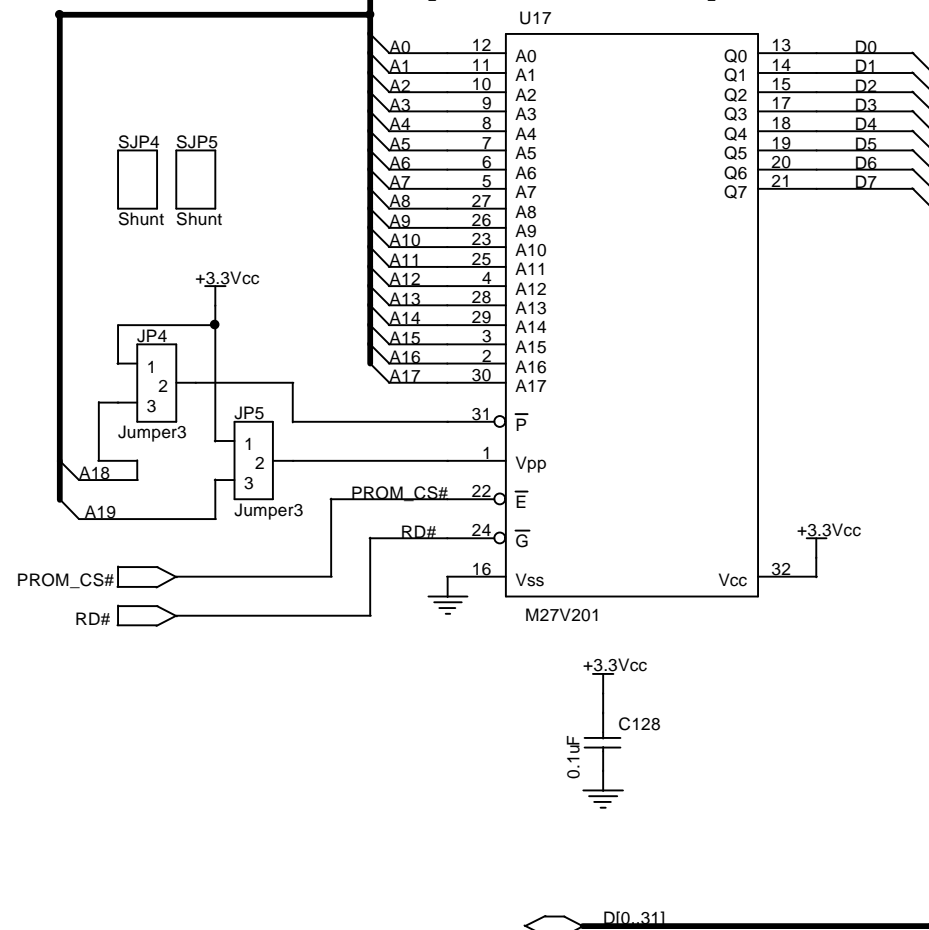


J5 and J4 should be adjusted depending on size of EPROM.

J5	J4	
1-2	1-2	128K x 8, 256K x 8
1-2	2-3	512K x 8
2-3	1-2	Not Used
2-3	2-3	1M x 8

Rev.s 0.0 and 0.1 of the ADSP-21065L begin accessing the EPROM at 0x020000. Later Rev.s begin at 0x000000. To ensure that the EPROM will work with all revisions place code at both places.

Z1  
Non-schematic Component  
Socket for EPROM

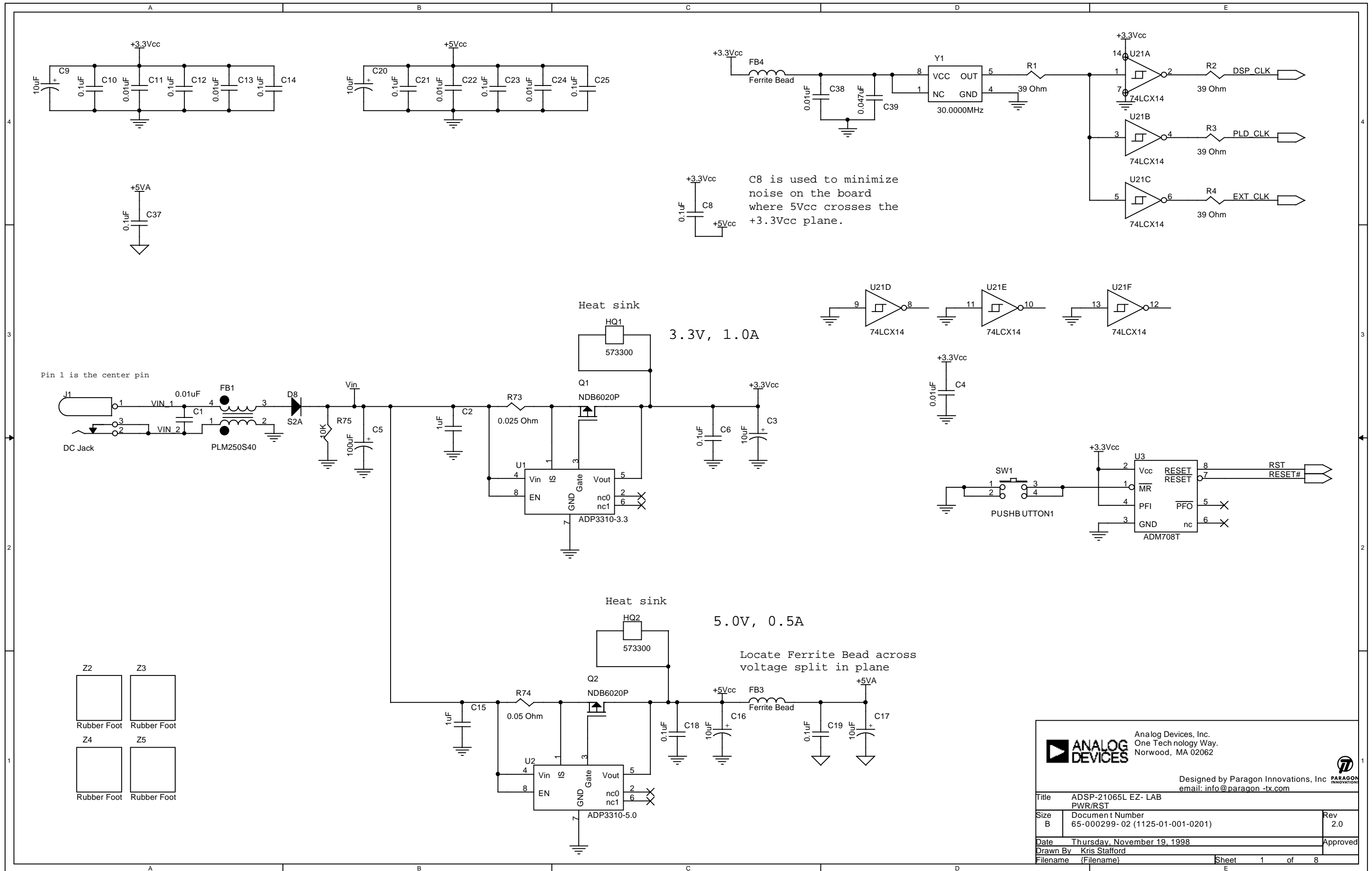




**ANALOG DEVICES** Analog Devices, Inc.  
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Norwood, MA 02062

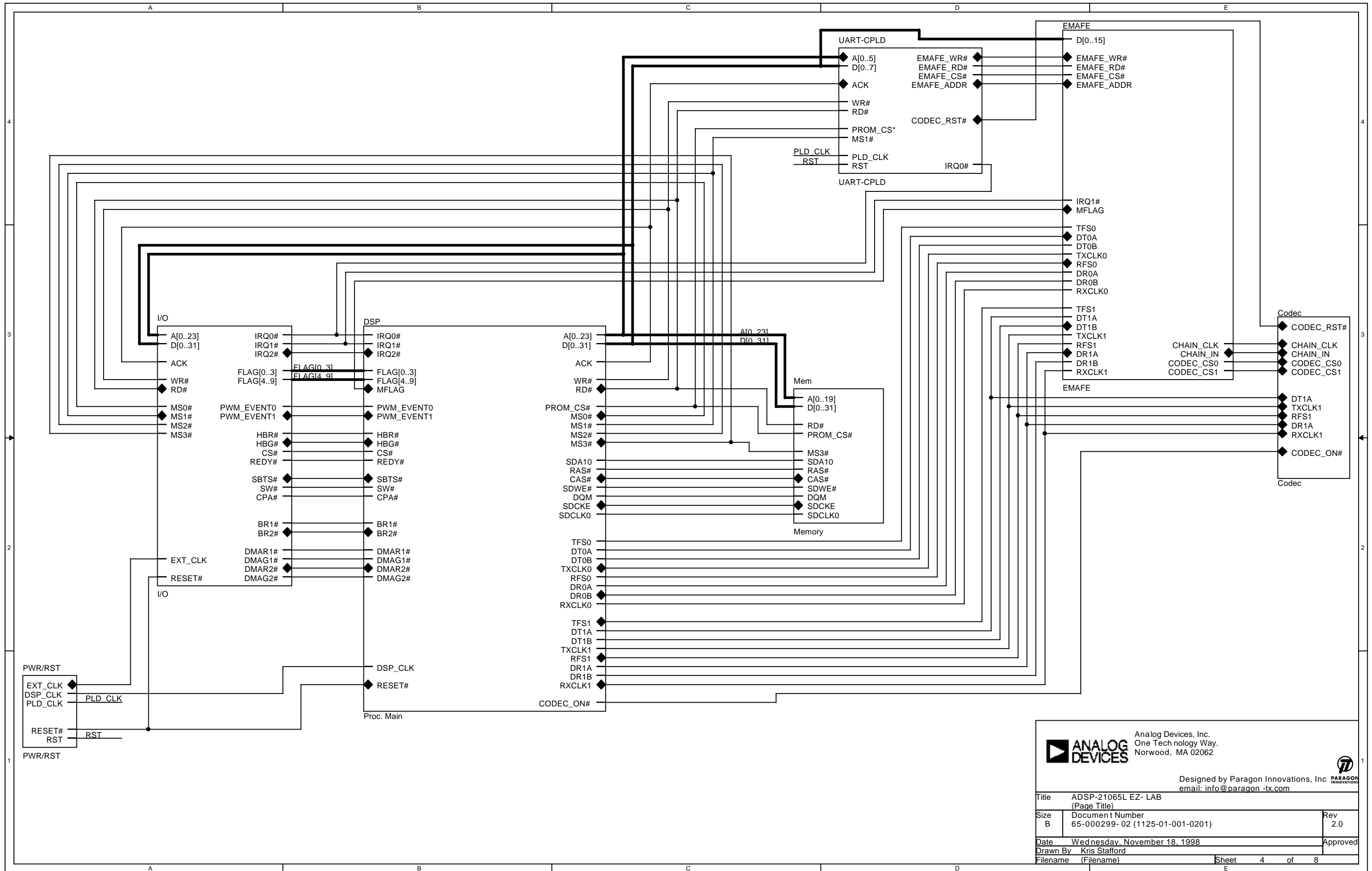
Designed by Paragon Innovations, Inc.  
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**PARAGON INNOVATIONS**

Title ADSP-21065L EZ- LAB Memory	
Size B	Document Number 65-000299- 02 (1125-01-001-0201)
Date	Wednesday, November 18, 1998
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 Analog Devices, Inc. One Technology Way. Norwood, MA 02062		 Designed by Paragon Innovations, Inc. email: info@paragon-tx.com
Title ADSP-21065L EZ-LAB PWR/RST		
Size B	Document Number 65-000299-02 (1125-01-001-0201)	Rev 2.0
Date	Thursday, November 19, 1998	Approved
Drawn By	Kris Stafford	
Filename	{Filename}	Sheet 1 of 8

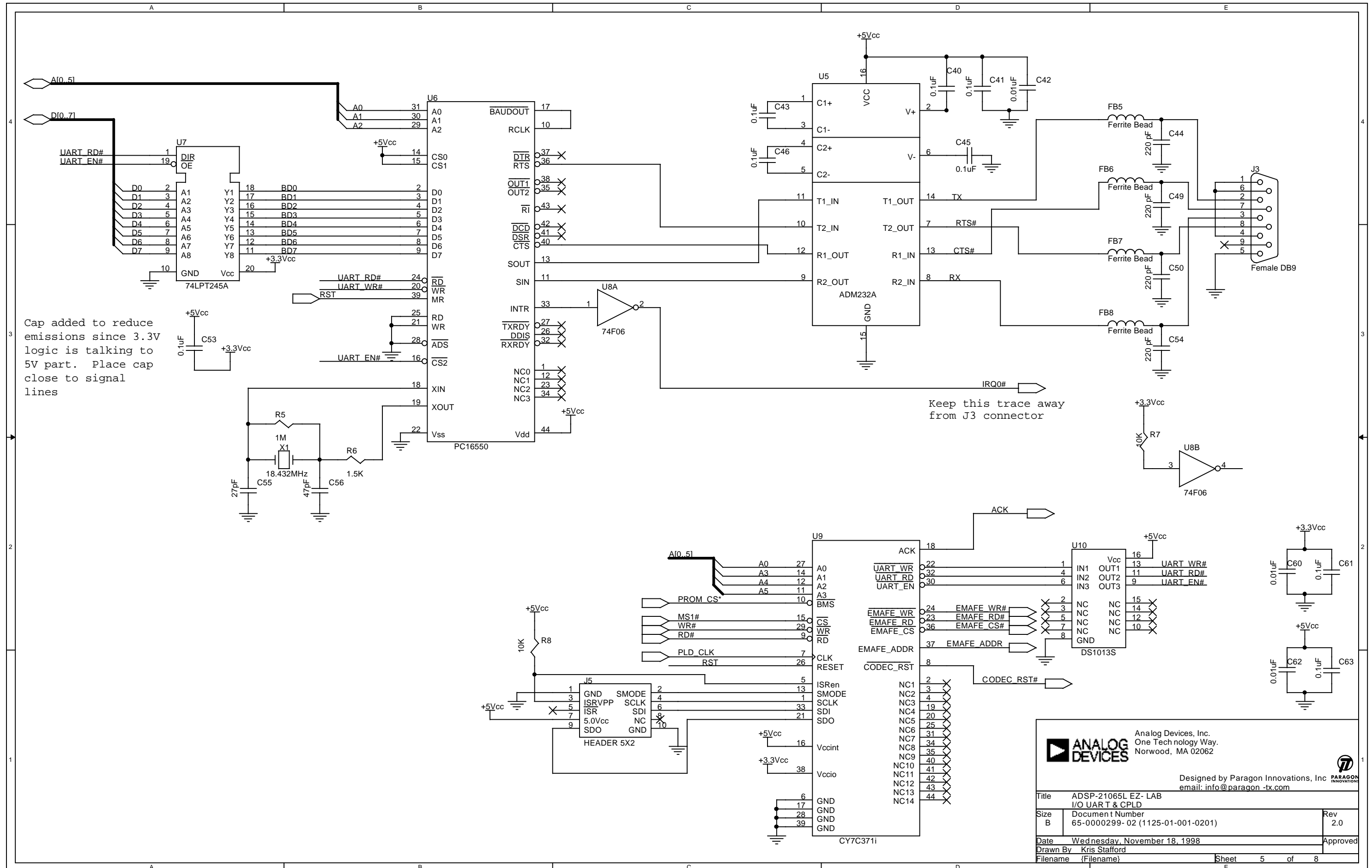


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PARAGON INNOVATIONS

Title ADSP-21065L EZ- LAB (Page Title)		Rev 2.0
Size B	Document Number 65-000299-02 (1125-01-001-0201)	Approved
Date	Wednesday, November 18, 1998	Drawn By Kris Stafford
Filename	{Filename}	Sheet 4 of 8



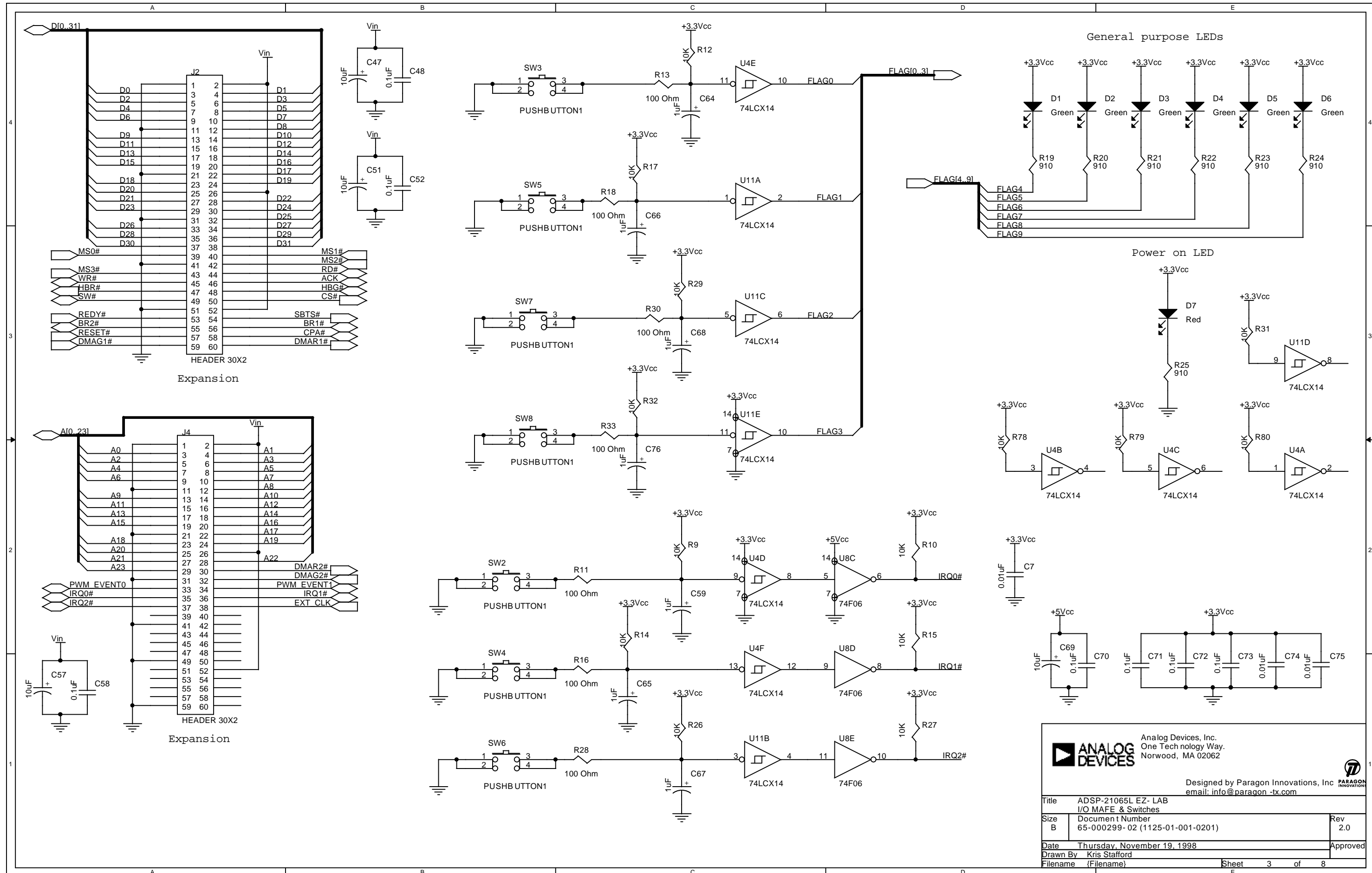
Cap added to reduce emissions since 3.3V logic is talking to 5V part. Place cap close to signal lines


Keep this trace away from J3 connector

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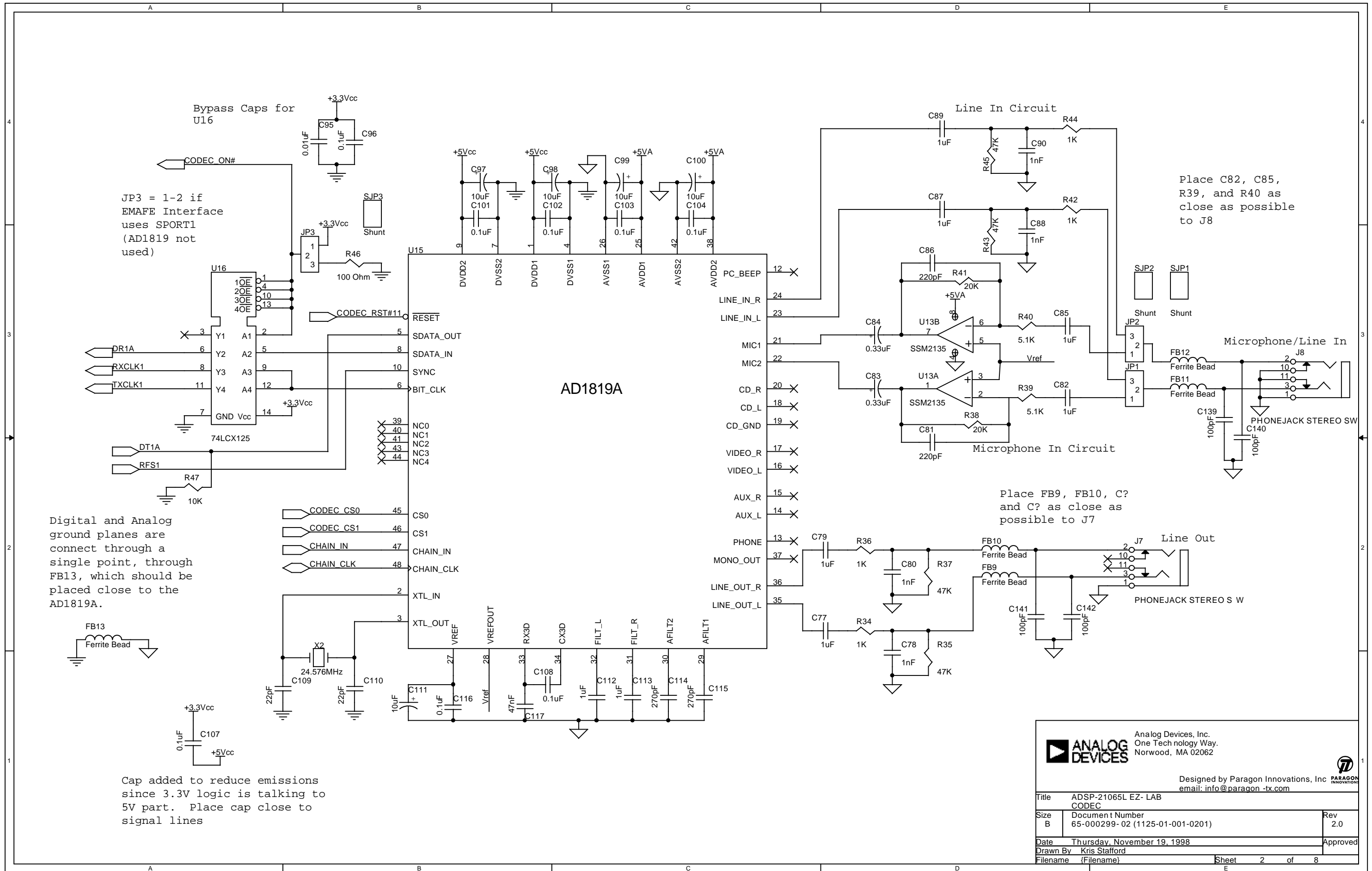
Title ADSP-21065L EZ-LAB I/O UART & CPLD		Rev 2.0
Size B	Document Number 65-0000299-02 (1125-01-001-0201)	
Date	Wednesday, November 18, 1998	Approved
Drawn By	Kris Stafford	
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Title		ADSP-21065L EZ- LAB I/O MAFE & Switches
Size	Document Number	Rev
B	65-000299- 02 (1125-01-001-0201)	2.0
Date	Thursday, November 19, 1998	
Drawn By	Kris Stafford	
Filename	{Filename}	Approved
Sheet		3 of 8



Bypass Caps for U16


JP3 = 1-2 if EMAFE Interface uses SPORT1 (AD1819 not used)

Place C82, C85, R39, and R40 as close as possible to J8

Digital and Analog ground planes are connect through a single point, through FB13, which should be placed close to the AD1819A.

Place FB9, FB10, C? and C? as close as possible to J7

Cap added to reduce emissions since 3.3V logic is talking to 5V part. Place cap close to signal lines


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Title ADSP-21065L EZ- LAB CODEC		Rev 2.0
Size B	Document Number 65-000299- 02 (1125-01-001-0201)	
Date	Thursday, November 19, 1998	Approved
Drawn By	Kris Stafford	
Filename	{Filename}	Sheet 2 of 8

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