ADSP-2181 EZ-KIT Lite®
Evaluation System Manual

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Analog Devices, Inc.
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PREFACE

Thank you for purchasing the ADSP-2181 EZ-KIT Lite®, Analog Devices (ADI) evaluation system for ADSP-2181 DSPs.

The ADSP-2181 DSP is a single-chip microcomputer optimized for digital signal processing (DSP) and other high-speed numeric processing applications.

The evaluation board is designed to be used in conjunction with VisualDSP++™ development environment to test the capabilities of the ADSP-2181 DSPs. The VisualDSP++ software gives you the ability to perform advanced application code development and debug, such as:

- Create, compile, assemble, and link application programs written in C++, C and ADSP-2181 assembly
- Load, run, step, halt, and set breakpoints in application program
- Read and write data and program memory
- Read and write core and peripheral registers
- Plot memory

You can access the ADSP-2181 processor from a personal computer (PC) through a serial port or an optional emulator. The monitor program gives you complete target debug capability through the serial port. In contrast, the emulator allows the PC to perform in-circuit emulation through the processor’s emulation port.

The boards features:

- Analog Devices ADSP-2181SK-133 processor
  - ✓ Operating at an instruction rate of 33 MHz (16.667 external clock)
- Analog Audio Interface
  - ✓ AD1847 – Analog Devices stereo codec
- Analog Inputs
  - ✓ One stereo pair of 2V RMS AC coupled line-level inputs
  - ✓ One stereo pair of 20 mV RMS AC coupled microphone inputs
- Analog Outputs
  - ✓ One stereo pair of 1V RMS AC coupled line-level outputs
- Power Source
  - ✓ 8 to 10V DC at 300 mA
- Environment
  - ✓ 0 to 70^{o} centigrade
  - ✓ 10 to 90 percent relative humidity (non condensing)
- RS-232 Interface
- Socketed EPROM
- User push buttons
- Expansion connectors
- User configurable jumper

The ADSP-2181 EZ-KIT Lite board is equipped with hardware that facilitates interactive demonstrations. Push button switches and user programmable LEDs provide user control and board status checking. Additionally, the AD1847 SoundPort codec provides access to an audio input (selectable as line level or microphone) and an audio output (line level). To learn more about AD1847 codec, refer to the *AD1847 General Purpose Analog Front End* data sheet found at `http://www.analog.com/Uploaded-Files/Obsolete_Data_Sheets/1215246AD1847.pdf`.

The ADSP-2181 EZ-KIT Lite includes a monitor program stored in the socketed EPROM. The monitor program lets the board communicate over the serial port to a PC. This monitor program lets you download, execute, and debug ADSP-2181 programs.

You can also connect an EZ-ICE (in-circuit emulator) to the EZ-KIT Lite. Through the EZ-ICE, you can load programs, start and stop program execution, observe and alter registers and memory, and perform other debugging operations. To learn more about Analog Devices emulators and DSP development tools, go to `http://www.analog.com/dsp/tools/`.

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

ⓘ The VisualDSP++ licence provided with this EZ-KIT Lite evaluation system limits the size of a user program to 8K bytes of internal memory.

Purpose of This Manual

The *ADSP-2181 EZ-KIT Lite Evaluation System Manual* provides instructions for using the hardware and installing the software on your PC. This manual provides guidelines for running your own code on the

ADSP-2181 EZ-KIT Lite. The manual also describes the operation and configuration of the evaluation board's components. Finally, a bill of materials are provided as a reference for future ADSP-2181 board designs.

Intended Audience

This manual is a user's guide and reference to the ADSP-2181 EZ-KIT Lite evaluation system. Programmers who are familiar with the Analog Devices processor architecture, operation, and programming are the primary audience for this manual.

Programmers who are unfamiliar with Analog Devices 16-bit fixed-point processors can use this manual in conjunction with the *ADSP-218x DSP Hardware Reference* and the *ADSP-218x DSP Instruction Set Reference*, which describe the processor architecture and instruction set. Programmers who are unfamiliar with VisualDSP++ should refer to the VisualDSP++ online Help and the VisualDSP++ user's or getting started guides. For the locations of these documents, refer to "Related Documents".

Manual Contents

The manual consists of:

- Chapter 1,"Getting Started" on page 1-1
  Provides software and hardware installation procedures, PC system requirements, and basic board information.

- Chapter 2, "Using EZ-KIT LITE Software" on page 2-1
  Provides information on the EZ-KIT Lite from a programmer's perspective and provides an easy-to-access memory map.

- Chapter 3, "EZ-KIT Hardware Reference" on page 3-1
  Provides information on the hardware aspects of the evaluation system.
- Appendix A, "Restrictions" on page A-1
  Provides a list of restrictions applicable to Release 1.1 of the ADSP-2181 EZ-KIT Lite evaluation board.
- Appendix B, "Bill Of Materials" on page B-1
  Provides a list of components used to manufacture the EZ-KIT Lite.

What's New in This Manual

This is the second revision of the *ADSP-2181 EZ-KIT Lite Evaluation System Manual*. The manual provides the updated listing of related documents, updated installation procedure and Bill of Materials, and additional information on the processor's internal memory.

Technical or Customer Support

You can reach DSP Tools Support in the following ways.

- Visit the DSP Development Tools website at

  `www.analog.com/technology/dsp/developmentTools/index.html`

- Email questions to

  `dsptools.support@analog.com`

- Phone questions to 1-800-ANALOGD
- Contact your ADI local sales office or authorized distributor
- Send questions by mail to

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Supported Processors

The ADSP-2181 EZ-KIT Lite evaluation system supports ADSP-2181 Analog Devices microprocessors.

Product Information

You can obtain product information from the Analog Devices website, from the product CD-ROM, or from the printed publications (manuals).

Analog Devices is online at www.analog.com. Our website provides information about a broad range of products—analog integrated circuits, amplifiers, converters, and digital signal processors.

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Visit www.myanalog.com to sign up. Click Register to use MyAnalog.com. Registration takes about five minutes and serves as means for you to select the information you want to receive.

If you are already a registered user, just log on. Your user name is your email address.

DSP Product Information

For information on digital signal processors, visit our website at www.analog.com/dsp, which provides access to technical publications, data sheets, application notes, product overviews, and product announcements.

You may also obtain additional information about Analog Devices and its products in any of the following ways.

- Email questions or requests for information to `dsp.support@analog.com`
- Fax questions or requests for information to 1-781-461-3010 (North America) or +49 (0) 89 76903-157 (Europe)

Related Documents

For information on product related development software, see the following publications.

Table 1. Related DSP Publications

Title	Description
ADSP-2181 DSP Microcomputer Data Sheet	General functional description, pinout, and timing.
ADSP-218x DSP Hardware Reference	Description of internal processor architecture and all register functions.
ADSP-218x DSP Instruction Set Reference	Description of all allowed processor assembly instructions.

Table 2. Related VisualDSP++ Publications

Title	Description
VisualDSP++ 3.5 User's Guide for 16-Bit Processors	Detailed description of VisualDSP++ 3.5 features and usage.
VisualDSP++ 3.5 Assembler and Preprocessor Manual for ADSP-218x and 219x Processors	Description of the assembler function and commands for processors.
VisualDSP++ 3.5 C Complier and Library Manual for ADSP-218x Processors	Description of the complier function and commands for processors

Table 2. Related VisualDSP++ Publications (Cont'd)

Title	Description
VisualDSP++ 3.5 Linker & Utilities Manual for 16-Bit Processors	Description of the linker function and commands for 16-bit processors.
VisualDSP++ 3.5 Loader Manual for 16-Bit Processors	Description of the loader/splitter function and commands for 16-bit processors.

The listed documents can be found through online Help or in the `Docs` folder of your VisualDSP++ installation. Most documents are available in printed form.

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

Online Documentation

Your software installation kit includes online Help as part of the Windows® interface. These help files provide information about VisualDSP++ and the ADSP-2181 EZ-KIT Lite evaluation system.

To view VisualDSP++ Help, click on the Help menu item or go to the Windows task bar and select Start -->Programs -->VisualDSP -->VisualDSP++ Documentation.

To view ADSP-2181 EZ-KIT Lite Help, which now is a part of the VisualDSP++ Help system, go the Contents tab of the Help window and select Manuals --> ADSP-BF533 EZ-KIT Lite.

For more documentation, please go to `http://www.analog.com/technology/dsp/library.html`.

Printed Manuals

For general questions regarding literature ordering, call the Literature Center at 1-800-ANALOGD (1-800-262-5643) and follow the prompts.

VisualDSP++ Documentation Set

Printed copies of VisualDSP++ manuals may be purchased through Analog Devices Customer Service at 1-781-329-4700; ask for a Customer Service representative. The manuals can be purchased only as a kit. For additional information, call 1-603-883-2430.

If you do not have an account with Analog Devices, you will be referred to Analog Devices distributors. To get information on our distributors, log onto www.analog.com/salesdir/continent.asp.

Hardware Manuals

Printed copies of hardware reference and instruction set reference manuals can be ordered through the Literature Center or downloaded from the Analog Devices website. The phone number is 1-800-ANALOGD (1-800-262-5643). The manuals can be ordered by a title or by product number located on the back cover of each manual.

Data Sheets

All data sheets can be downloaded from the Analog Devices website. As a general rule, printed copies of data sheets with a letter suffix (L, M, N, S) can be obtained from the Literature Center at 1-800-ANALOGD (1-800-262-5643) or downloaded from the website. Data sheets without the suffix can be downloaded from the website only—no hard copies are available. You can ask for the data sheet by part name or by product number.

If you want to have a data sheet faxed to you, the phone number for that service is 1-800-446-6212. Follow the prompts and a list of data sheet code numbers will be faxed to you. Call the Literature Center first to find out if requested data sheets are available.

Contacting DSP Publications

Please send your comments and recommendations on how to improve our manuals and online Help. You can contact us at `dsp.techpubs@analog.com` .

Notation Conventions

The following table identifies and describes text conventions used in this manual.

ⓘ Additional conventions, which apply only to specific chapters, may appear throughout this document.

Example	Description
Close command (File menu) or OK	Text in bold style indicates the location of an item within the VisualDSP++ environment's and boards' menu system and user interface items.
`{this | that}`	Alternative required items in syntax descriptions appear within curly brackets separated by vertical bars; read the example as `this` or `that`.
`[this | that]`	Optional items in syntax descriptions appear within brackets and separated by vertical bars; read the example as an optional `this` or `that`.
`[this,…]`	Optional item lists in syntax descriptions appear within brackets delimited by commas and terminated with an ellipsis; read the example as an optional comma-separated list of `this`.
`PF9-0`	Registers, connectors, pins, commands, directives, keywords, code examples, and feature names are in text with `letter gothic` font.
filename	Non-keyword placeholders appear in text with italic style format.

Notation Conventions

Example	Description
Note:	A note providing information of special interest or identifying a related topic. In the online version of this book, the word **Note** appears instead of this symbol.
Caution:	A caution providing information about critical design or programming issues that influence operation of a product. In the online version of this book, the word **Caution** appears instead of this symbol.

1 GETTING STARTED

This chapter provides the information you need to begin using ADSP-2181 EZ-KIT Lite evaluation system. For correct operation, install the software and hardware in the order presented in "Installation Tasks" on page 1-3.

The chapter includes the following sections.

- "Contents of EZ-KIT Lite Package" on page 1-2
  Provides a list of the components shipped with this EZ-KIT Lite evaluation system.
- "System Requirements" on page 1-3
  Describes the minimum requirements for the PC to work with the EZ-KIT Lite evaluation system.
- "Installation Tasks" on page 1-3
  Describes the step-by-step procedures for setting up the hardware and software.

Contents of EZ-KIT Lite Package

Your ADSP-2181 EZ-KIT Lite evaluation system package contains the following items.

- ADSP-2181 EZ-KIT Lite board
- Power cable with 8-10V DC power supply
- RS-232 serial port 9-pin cable
- CD containing:
    - ✓ VisualDSP++ for 16-bit processors with a limited license
    - ✓ ADSP-2181 EZ-KIT Lite debug software
    - ✓ Example programs
    - ✓ *ADSP-2181 EZ-KIT Lite Evaluation System Manual* (this document)

If any item is missing, contact the vendor where you purchased your EZ-KIT Lite or contact Analog Devices, Inc.

The EZ-KIT Lite evaluation system 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. Store unused EZ-KIT Lite boards in the protective shipping package.

System Requirements

For correct operation of the VisualDSP++ software and the EZ-KIT Lite, your computer must have the minimum configuration:

Windows® 98, ME, 2000, XP	Windows NT™
Windows 98, ME, 2000, XP	Windows NT 4.0, Service Pack 3 or later
Pentium processor 166MHz or faster	Pentium processor 166MHz or faster
100 MB available space	100 MB available space
16 MB RAM	16 MB RAM
VGA Monitor and color video card	VGA Monitor and color video card
CD-ROM	CD-ROM

Installation Tasks

The following task list is provided for the safe and effective use of the ADSP-2181 EZ-KIT Lite. Follow these instructions in the presented order to ensure correct operation of your software and hardware.

1. EZ-KIT Lite hardware setup VisualDSP++ and EZ-KIT Lite software installation

2. VisualDSP++ and EZ-KIT Lite software installation

3. VisualDSP++ license installation

Setting Up EZ-KIT Lite Hardware

The EZ-KIT Lite evaluation system 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. Store unused EZ-KIT Lite boards in the protective shipping package.

The ADSP-2181 EZ-KIT Lite board is designed to run outside your personal computer as a stand-alone unit. You do not have to remove your computer case.

To connect the EZ-KIT Lite board:

1. Remove the EZ-KIT Lite board from the package. Be careful when handling the board 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-2181 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 `J4` on the evaluation board.
   Visually verify that all of the LEDs light up briefly. The power (green) LED remains on and `FL1` blinks. If the LED does 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 J1 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 J2 on the board. Set jumper JP2 to LINE.

3. Open Jumper JP2 to GND to enable the AD1847 codec. (This is the board default).

This completes the hardware installation. For information about the EZ-KIT Lite hardware design, refer to "Board Layout" on page 3-3.

Installing VisualDSP++ and EZ-KIT Lite Software

This EZ-KIT Lite comes with the latest version of VisualDSP++ for 16-bit processors. VisualDSP++ installation includes EZ-KIT Lite installations.

To install VisualDSP++ and EZ-KIT Lite software:

1. Insert the VisualDSP++ installation CD into the CD-ROM drive.

2. If Autoplay is enabled on your PC, you see the Install Shield Wizard Welcome screen.
   Otherwise, choose Run from the Start menu, and enter `D:\ADI_Setup.exe` in the Open field, where `D` is the name of your local CD-ROM drive.

3. Follow the on-screen instructions to continue installing the software.

4. At the Custom Setup screen, select your EZ-KIT Lite from the list of available systems and choose the installation directory.

Click an icon in the Feature Description field to see the selected system's description. When you have finished, click Next.

5. At the Ready to Install screen, click Back to change your install options, click Install to install the software, or click Cancel to exit the install.

6. When the EZ-KIT Lite installs, the Wizard Completed screen appears. Click Finish.

Installing VisualDSP++ License

To install the VisualDSP++ license:

1. Locate the serial number provided on the sticker affixed to the CD sleeve and the registration form.

2. From the Start menu, choose Programs, Analog Devices, VisualDSP++ 3.5 for 16-bit Processors, VisualDSP++ Environment.

3. The information screen asks if you would like to install a license. Click Yes. The About VisualDSP++ screen appears.

4. Select the Licenses tab and click New.

5. In the Install a New License dialog that opens, select Single User.

ⓘ Please note that the VisualDSP++ software that comes with your EZ-KIT Lite is a demo version that limits executable file size to 8K bytes. This license lets you run EZ-KIT Lite sessions only. Simulation and emulation are not supported. For a full license, contact your local Analog Devices Sales representative.

6. Fill in the tools serial number in the field provided exactly as it appears on your CD sleeve or registration form and click Next. An information window notifies of successful license installation.

2 USING EZ-KIT LITE SOFTWARE

The combination of the EZ-KIT Lite board and the monitor software operate as a target for the VisualDSP++ debugger. The debugger lets you view the ADSP-2181processor's registers and memory and perform several debugging activities, such as setting breakpoints, stepping through code, and plotting a range of memory.

The information in this chapter is organized as follows.

- "EZ-KIT Lite License Restrictions" on page 2-2
  Describes the restrictions of the VisualDSP++ license shipped with the EZ-KIT Lite.

- "Memory Map" on page 2-2
  Defines the ADSP-2181 EZ-KIT Lite board's memory map.

- "Standard Operations" on page 2-3
  Covers the standard operation of the EZ-KIT Lite board.

- "Using EZ-KIT Lite VisualDSP++ Interface" on page 2-10
  Describes the facilities of the EZ-KIT Lite graphical user interface.

EZ-KIT Lite License Restrictions

The license shipped with the EZ-KIT Lite imposes the following restrictions.

- The size of a user program is limited to 8 KB of the ADSP-2181 processor's internal memory space.
- No connections to Simulator or Emulator sessions are allowed.
- Only one EZ-KIT Lite board can be connected to the host PC and debugged at a time.
- The EZ-KIT Lite hardware must be connected and powered up in order to use VisualDSP++ with a kit license.

Memory Map

The ADSP-2181 EZ-KIT Lite board contains 80K bytes configured as 16K x 24 program memory and 16K x 16 of internal SRAM that can be used for either program or data storage. Table 2-1 shows the memory map of the ADSP-2181 EZ-KIT Lite. The configuration of on-chip SRAM is detailed in the *ADSP-2181 Microcomputer Data Sheet*.

Table 2-1. EZ-KIT Lite Memory Map

Start Address	End Address	Content
PM 0x0000	0x002F	Interrupt vector table
PM 0x0030	0x17CF	Available for user code
PM 0x17D0	0x1FFF	Reserved for monitor code
PM 0x2000	0x3FFF	Available for user code
DM 0x0000	0x3AFF	Available for user data

Table 2-1. EZ-KIT Lite Memory Map (Cont'd)

Start Address	End Address	Content
`DM 0x3E00`	`0x3FFF`	Available for user data
`DM 0x3B00`	`0x3DFF`	Reserved for monitor data

Standard Operations

This section covers the standard operation of the EZ-KIT Lite board: the default settings and IO capabilities of the on-board components, board power-up, and on-board monitor program.

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 the settings in the dialog box that appears the first time you start VisualDSP++.

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

Selection	Default Setting
Comm Port	Comm 1
Baud rate	9600

Input and Output Devices

The board's IO component are detailed in the following sections.

- "Flags" on page 2-4
- "Interrupts" on page 2-4
- "Serial Ports" on page 2-5

Flags

The ADSP-2181 DSP has one asynchronous FLAG IO pin. The FL1 pin is connected to the red FL1 LED. This lets you visually inspect states of your program.

Interrupts

The ADSP-2181 EZ-KIT Lite has one external interrupt connected through a push button switch, S2. This corresponds to an external interrupt, $\overline{\text{IRQE}}$.

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

The monitor program running on the ADSP-2181 DSP uses one interrupt (Timer) for normal operation. When downloading your own code through the monitor program, the timer interrupt vector is protected and cannot be overwritten. If these vectors are overwritten, or the timer interrupt is masked in any way, the debugger is not able to communicate with the host program. 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 interrupt nesting is enabled.

Serial Ports

The ADSP-2181 DSP features two synchronous bi-directional Serial Ports (SPORTs), SPORT0 and SPORT1. The SPORTs can operate at up to 1x clock frequency, providing each with a maximum data rate of 30 Mbit/sec. SPORT data can be automatically transferred to and from on-chip memory using DMA.

SPORT0 is connected to the on-board AD1847 codec. The CODECDIS signal available on connector P3 can be used to disable the codec. When this signal is brought low, the codec is disabled and its signals are put in a high impedance state. SPORT1 is connected to the RS-232 interface and is used as a software Universal Asynchronous Receiver/Transmitter (UART). Communications between the monitor and the host are through SPORT1.

For more information on the Serial Ports, refer to the *ADSP-218x DSP Hardware Reference*.

POST Routines

Power On Self-Test (POST) routines are a series of standard tests and initializations that the ADSP-2181 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 LEDs light up briefly). You may also reset the board during operation through the DEBUG and RESET command in the debugger. Both types of reset cause the DSP to reset to a known state. At this point you should reload any programs you were working on. Table 2-3 summarizes the types of resets.

Table 2-3. Post Routines

Routine	Power-On-Reset?	Reset During Operation?
EPROM Load	Yes	No

Table 2-3. Post Routines (Cont'd)

Routine	Power-On-Reset?	Reset During Operation?
AD1847 Check	Yes	No
Initialization	Yes	Yes

Memory Checks

The monitor program performs some standard memory checks on EPROM and internal RAM. 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.

UART Checks

The software UART check is done when it attempts to connect to the EZ-KIT Lite through a Transmitted Loop Back routine. This 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 9600 baud with 8 data bits, 1 stop bit, and no parity. To change this rate, wait for the `POST` routine to complete and then use the Settings, Baud Rate command in the debugger. Note that setting the baud rate to a lower number can significantly slow the board's response to all debug activities.

Different baud rates depend upon your application's type: for real-time interrupt driven programs, a lower baud rate setting slows performance, but the timer interrupt occurs less frequently. This gives your program a larger share of the processor's resources.

AD1847 Codec Check and Initialization

On reset, the AD1847 codec is inactive. An initialization routine initializes the codec by sending a series of command words through the SPORT0 TX interrupt. Once the commands have been sent and the AD1847 initialized, it begins transmitting the clock, which synchronizes data transfers to and from the DSP. Once this bit goes “High”, the AD1847 is ready for standard communication over SPORT0.

Monitor Program Operations

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 program. 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”

Halt loop

The monitor program idles in the halt loop when the program is not running user code. While there, you can READ and WRITE memory and registers, download programs, set breakpoints, change the UART’s baud rate, and single step through your code. To enter the halt loop from code, you must suspend or stop the code, using either 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 full 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.

UART ISR

The UART Interrupt Service Routine (`Timer` ISR) is entered when your 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 your code immediately after the interrupt is serviced.

⊘ The following restrictions should be observed to ensure correct board operation.

- The host loses contact with the monitor while the user program is running if the user program disables the `Timer` interrupt or changes the `Timer` interrupt vector.
- The host loses contact with the monitor while the program is running and it enters an Interrupt Service Routine when nesting is turned on.
- The host cannot halt with the debugger's **Debug**, **Halt** command if global IRQ enable is disabled; however, breakpoints will work.
- The debugger will have trouble halting at a baud rate over 9600 while using the monitor program.

Command Processing

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.

Software Breakpoints

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 at the function `main()`, when the Settings, Run To Main command is checked, and at the `_exit` instruction.

AD1847 Codec Dual Analog Front End

The monitor does not initialize the AD1847codec. This provides you with greater flexibility to experiment with custom codec operations. Simple code examples, such as Echo, are provided with your EZ-KIT Lite to demonstrate some basic codec operations. It is recommended that you model your code using these examples.

AD1847 Codec Transmissions

After initialization, the AD1847 codec generates the clock used to transfer data across `SPORT0`. The ADSP-2181 DSP initiates all transmissions with the AD1847 device by sending a synchronization pulse. Even though the AD1847 transmits the data clock, it may not be ready for normal operation.

Initialization of the AD1847 codec is performed by sending 13 control words contained in a circular buffer to the AD1847 codec. This is usually done via the `SPORT0 TX` interrupt routine. Once the codec is initialized, autobuffering is used to fill up the `TX` and `RX` buffers, which use circular buffering. Once the circular buffer wraps around, then either a `TX` or `RX` interrupt occurs. Then the DSP processes the interrupt request.

Using EZ-KIT Lite VisualDSP++ Interface

This section outlines the process of developing, loading, and running the ADSP-2181 EZ-KIT Lite example programs supplied with VisualDSP++ software:

- "Developing Programs" on page 2-10
- "Starting Visual DSP++" on page 2-11
- "Debugging With EZ-KIT Lite" on page 2-13
- "Loading Programs" on page 2-13
- "Example Programs" on page 2-15

For detailed information about VisualDSP++ features and operation, see the *VisualDSP++ 3.5 User's Guide for 16-Bit Processors* and online Help.

Developing Programs

A typical program development cycle using the VisualDSP++ environment includes the following steps:

1. Creating a new project file
2. Setting target processor project options
3. Adding and editing project source files
4. Customizing the project build options
5. Building a debug version of the project
6. Debugging the project
7. Building a release version of the project

By following these steps, your DSP application programs build consistently and accurately with minimal project management. Note the following restrictions of this system:

The size of the DSP executable that you can build using the EZ-KIT Lite tools is limited to 8K.

Do not run more than one ADSP-2181 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.

Starting Visual DSP++

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

1. Select the Start button on the Windows taskbar, then choose Programs, Analog Devices, VisualDSP++ 3.5 for 16-bit Processors, VisualDSP++ Environment.

   If you are running VisualDSP++ for the first time, go to step 4. If you already have existing sessions, the Session List dialog box appears on the screen.

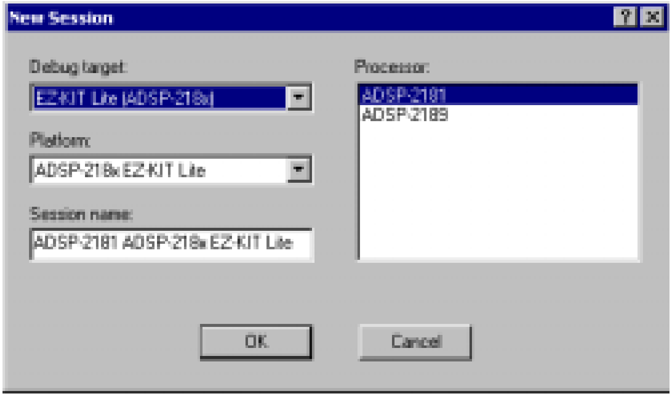
2. Click New Session.

3. The New Session dialog box, shown in Figure 2-1, appears on the screen.

4. In Debug Target, choose EZ-KIT Lite (ADSP-218x).

5. In Processor, choose the appropriate processor, ADSP-2181.

6. Type a new target name in Session Name or accept the default name.



New Session

Debug target: EZ-KIT Lite (ADSP-218x)

Platform: ADSP-218x EZ-KIT Lite

Session name: ADSP-2181 ADSP-218x EZ-KIT Lite

Processor: ADSP-2181
ADSP-2189

Figure 2-1. New Session Dialog Box

7. Click OK to return to the Session List. Highlight the new session and click Activate.

8. A message appears instructing you to press the Reset button. Click OK and press the reset button on the board.

   All the LEDs light up after a brief delay (less than 2 seconds). `FL1` will then blink and the `PWR` LED will stay lit. During the delay, the `POST` tests run to verify the correct operation of the AD1847 codec and the EPROM.

9. Click OK

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

Debugging With EZ-KIT Lite

The *VisualDSP++ User's Guide for 16-Bit Processors* and online Help contains most of the information you need to operate the VisualDSP++ debugger with the EZ-KIT Lite evaluation board. Because the manual was written using a simulator as a target, there are some differences and restrictions in the debugger operation when connected to a hardware target.

Loading Programs

Because you are loading programs into a hardware target, the load process takes a slightly longer period of time then 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 box appears.

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

   The demos supplied with the EZ-KIT Lite are located in the `..\218x\EZ-KITs\2181\Examples` subdirectory of your VisualDSP++ installation directory.

3. Select the file and click Open.

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

Registers and Memory

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

Register and memory contents may not be changed while the user program is running.

Setting Breakpoints and Stepping

The debugger automatically inserts breakpoints at the function `main()`, when the Settings, Run To Main command is checked, and at the `_exit` instruction.

Breakpoints set in the last three instructions of a do-loop are allowed, but this causes improper debugger operation.

Resetting 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. After performing a reset, reload any programs you were running. The Debug, Restart command also resets the processor. The processor, however, retains all debug information and memory contents.

The following sequence must be used when starting the debugger:

1. Start VisualDSP++ from the Windows Start menu.

   The debugger starts and the Target message Hit Reset Button appears.

2. Press the reset button.

3. Click OK.

Do not use the reset button while the debugger is open unless the debugger requested to do so.

Example Programs

Example programs are included with the ADSP-2181 EZ-KIT Lite to demonstrate various capabilities of the evaluation board. These programs are installed with the EZ-KIT Lite software and can be found in `\…\VisualDSP\218x\EZ-KITs\2181\Examples`. Please refer to the readme file provided with each example for more information.

⊘ Do not run more than one ADSP-2181 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.

ADPCM

This program demonstrates Adaptive Differential Pulse Code Modulation (ADPCM) capabilities. ADPCM consists of a number of real-time speech compression algorithms.

DTMF

This demonstration generates Dual-Tone Multi-Frequency (DTMF) tones, as used in the telephone network for push button signaling. A DTMF tone is composed of two different single frequency tone, one of four row tones added to one of four column tones. Thus, a full implementation of a DTMF standard tone generator can generate 16 different tones (only 12 are commonly used on consumer handsets).

ECHO

This demonstration uses the codec to generate an echo and the four channel DAC to display the taps of the echo canceller.

FIRDEMO

This demonstration starts with a talk-through program. The AD1847 codec digitizes the analog microphone input and transmits the data to the DSP's serial port. The DSP reads data from the serial port and retransmits the data back to the codec. The codec converts the data to an analog signal that drives the speaker. No digital signal processing is performed on the data. When you speak into the microphone, you should hear your voice through the speaker.

The filters have equivalent bandwidth and are evenly spaced on a logarithmic frequency axis. All FIR filters are 256 taps, and have been desired for 0.1 ripple.

FIR	Filter	Lower Stop Band Pass Band	Upper Stop Band
FIR1	0-269 Hz	328-448 Hz	547-4000 Hz
FIR2	0-426 Hz	521-710 Hz	866-4000 Hz
FIR3	0-675 Hz	825-1125 Hz	1375-4000 Hz
FIR4	0-1070 Hz	1308-1783 Hz	2179-4000 Hz

LPC2K4

Push the Interrupt button on EZ-KIT Lite to toggle between talk through and 2.4k LPC encoding. The red LED lids when LPC encoding is in effect.

LPC7K8

Push the Interrupt button on EZ-KIT Lite to toggle between talk through and 7.8k LPC encoding. The red LED lights when LPC encoding is in effect.

PRIMES

This demonstration is a C program that generates the first 20 prime numbers.

3 EZ-KIT HARDWARE REFERENCE

This chapter discusses the hardware design of the ADSP-2181 EZ-KIT Lite board. The following topics are covered:

- "System Architecture" on page 3-2

  Illustrates the configuration of the ADSP-2181 EZ-KIT Lite board.

- "Board Layout" on page 3-3

  Shows the location and describes the function of the configuration jumpers, switches, and user LEDs.

- "Connectors" on page 3-5

  Shows the location and describes the function of the expansion connectors.

- "Designing EZ-ICE Compatible Systems" on page 3-14

  Outlines the ICE emulator theory of operation to aid your EZ-ICE compatible system designs.

System Architecture

This section describes the processor configuration on the EZ-KIT Lite board (see Figure 3-1).

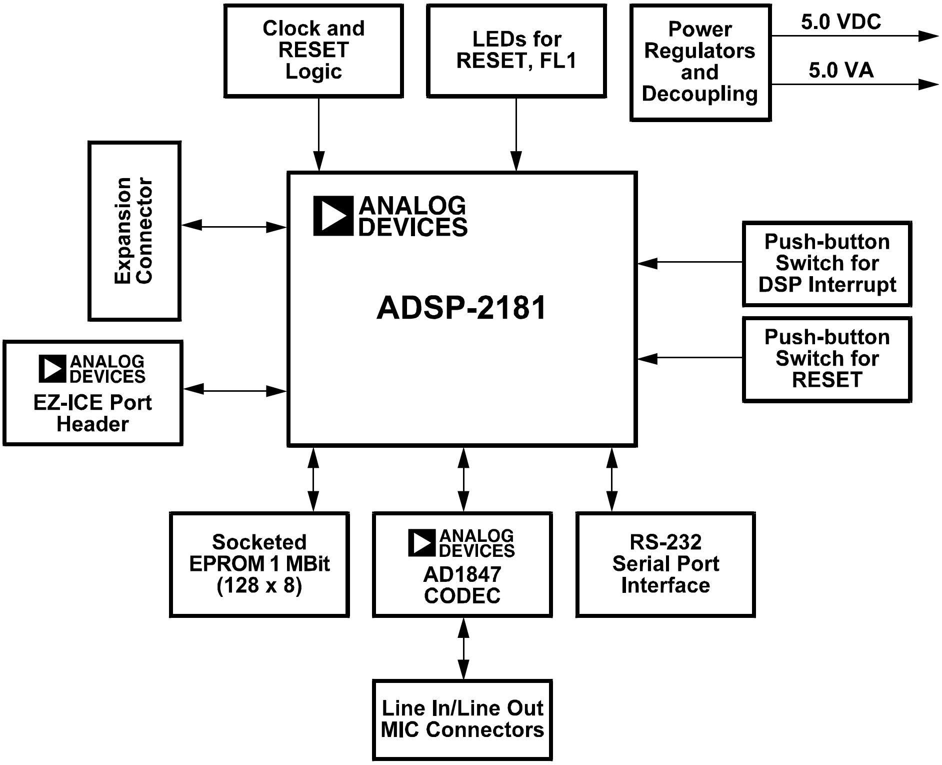

Clock and RESET Logic
LEDs for RESET, FL1
Power Regulators and Decoupling
5.0 VDC
5.0 VA
Expansion Connector
ANALOG DEVICES
ADSP-2181
Push-button Switch for DSP Interrupt
Push-button Switch for RESET
ANALOG DEVICES
EZ-ICE Port Header
Socketed EPROM 1 MBit (128 x 8)
ANALOG DEVICES
AD1847 CODEC
RS-232 Serial Port Interface
Line In/Line Out MIC Connectors

Figure 3-1. ADSP-2181 EZ-KIT Lite System Block Diagram

Board Layout

Figure 3-2 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.

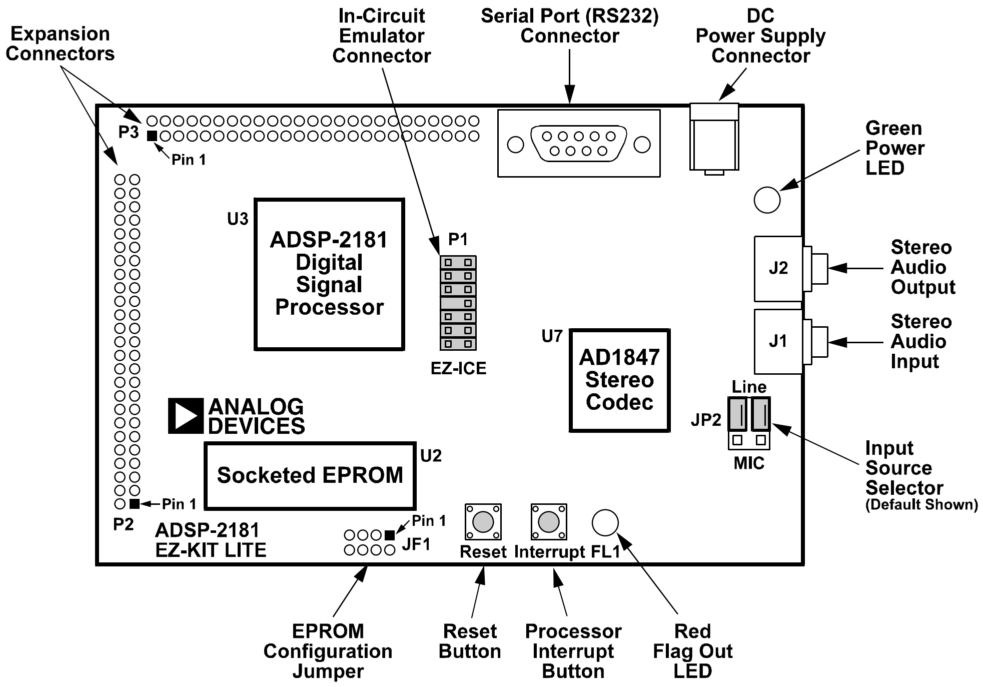


Figure 3-2. EZ-KIT Lite Board Layout

Socketed Memory

The socketed EPROM provides up to 128k x 8 bits of program storage that can be loaded by the ADSP-2181 processor when it is programmed to boot from the socketed EPROM. After the ADSP-2181 processor is reset, the BDMA feature is used to load the first 32 words of program memory from the byte memory space. Program execution is held off until all 32 words are loaded. Refer to the *ADSP-218x DSP Hardware Reference* and the *ADSP-2181 DSP Microcomputer Data Sheet* for more information on program booting and processor modes.

User LEDs

The `D1` LED is a red light emitting diode, which is controlled by the `FL1` output of the ADSP-2181 processor. Software can control the state of this indicator by writing to an internal register.

The `D2` LED is a green light emitting diode, which is on whenever the board has power.

Switches

The `S1` switch is the reset push button switch. Pushing this button causes the ADSP-2181 processor and the AD1847 codec to enter the hardware reset state and remain there until it is released. The switch outputs are de-bounced electronically to prevent multiple transitions due to mechanical contact bounce.

The `S2` switch is the interrupt push button switch. Pushing this button causes the ADSP-2181 to receive an $\overline{\texttt{IRQE}}$ interrupt input. The processor then executes the current $\overline{\texttt{IRQE}}$ interrupt handler software if the interrupt is enabled and the $\overline{\texttt{IRQE}}$ interrupt vector is in place. The interrupt switch output is de-bounced electronically to prevent multiple interrupts due to mechanical contact bounce.

Connectors

This section describes headers and connectors supplied with this EZ-KIT Lite.

- The J2 connector is also a 1/8 inch (3.5 mm) stereo jack. This jack is used to bring out line level audio signals from the board.
- The J3 connector is a female 9-pin D-Sub connector. It is used to communicate with a host computer using RS-232 signal levels and asynchronous serial protocols.
- The J4 connector is a jack for a 5.5 mm cylindrical plug. It is used to supply power to the board. The center pin of the jack is 2 mm diameter and should connect to the negative side of the power source. The outer sleeve of the mating plug must be positive. For more information see "Power Connector" on page 3-9.
- The JP1 jumper is a site for an eight pin header. It can be used to configure the board for EPROM sizes other than the 1 Mbit (128K byte) EPROM (27C010) shipped with the board. Most users will not need this feature. For more information see "EPROM Jumper Settings" on page 3-10.
- The JP2 jumper, shown in Figure 3-3, is a six pin header. It is used to configure input jack, J1, for either line level or microphone input. The center pin in each group of three is connected to one of the AD1847 codec's input pins. Jumpers (also known as shunts or shorting links) can be used to connect these pins to either the output of the microphone amplifier or to the output of the line level input filter.
- The P1 connector is a 14-pin header connector used to connect to an ADDS-218x EZ-ICE® in-circuit emulator. Pin 7 should be removed for keying purposes. For more information, see "EZ-ICE Connector" on page 3-12.

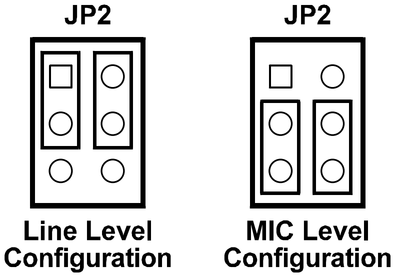


Figure 3-3. JP2 Jumper Settings

- The P2 and P3 connectors are sites for 50-pin header connectors. These connectors can be used to access the ADSP-2181 processor's signals for expansion or test purposes. For more information, see "Expansion Port Connectors" on page 3-7.

- The U2 socket is a socket for an EPROM in a DIP package. As built, the board accepts a 27C512 (64K byte) or 27C010 (128K byte) EPROM. Changing connections at JP1 allows the board to accept a 27C256 (32K byte), 27C020 (256K byte), 27C040 (512K byte), or 27C080 (1 Mbyte) EPROM. This socket is connected to the ADSP-2181 processor's byte-wide memory interface.

- The R28 resistor is a site for a zero-ohm resistor. It this resistor is installed the ADSP-2181 processor can reset the board under software control. The software would assert reset by configuring the PF0 flag as an output and then setting it low.

- The R29 resistor is another site for a zero-ohm resistor. If this resistor is installed and X3 and C37 are removed, the codec can operate off of the ADSP-2181 processor's CLKOUT signal instead of its own 24.576 MHz clock. It is also necessary to change X1 to a lower frequency value to stay within the codec's ratings.

Expansion Port Connectors

Two expansion port connectors (`P2` and `P3`) provide access to the ADSP-2181 processor's bus signals, letting you watch data transmissions. The `P2` and `P3` connectors are sites for 50-pin header connectors. In addition, the host interface, interrupt, and `PWM_EVENT` pins are also available on this connector

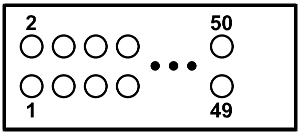


Figure 3-4. Expansion Connector

External port loading can effect external bus speed and performance.

Table 3-1 describes the signals available on the `P2` and `P3` pins.

Table 3-1. Expansion Connectors

P2				P3			
Pin Number	Signal Name	Pin Number	Signal Name	Pin Number	Signal Name	Pin Number	Signal Name
1	A0	2	A1	1	GND	2	IAD0
3	A2	4	A3	3	IAD1	4	IAD2
5	A4	6	A5	5	IAD3	6	IAD4
7	A6	8	A7	7	IAD5	8	IAD6
9	A8	10	A9	9	IAD7	10	IAD8
11	A10	12	A11	11	IAD9	12	IAD10
13	A12	14	A13	13	IAD11	14	IAD12
15	D0	16	D1	15	IAD13	16	IAD14

Table 3-1. Expansion Connectors (Cont'd)

P2				P3			
Pin Number	Signal Name	Pin Number	Signal Name	Pin Number	Signal Name	Pin Number	Signal Name
17	D2	18	D3	17	IAD15	18	GND
19	D4	20	D5	19	IACK	20	IAL
21	D6	22	D7	21	IS	22	IWR
23	D8	24	D9	23	IRD	24	GND
25	D10	26	D11	25	PF0	26	PF1
27	D12	28	D13	27	PF2	28	PF3
29	D14	30	D15	29	PR4	30	PF5
31	D16	32	D17	31	PF6	32	PF7
33	D18	34	D19	33	FL0	34	FL1
35	D20	36	D21	35	FL2	36	CLKOUT
37	D22	38	D23	37	RESET	38	IRQL0
39	WR	40	RD	39	IRQL1	40	IRQ2
41	IOMS	42	BMS	41	PWD	42	PWDACK
43	DMS	44	CMS	43	CODECDIS	44	TXD0
45	PMS	46	BR	45	TFS0	46	RFS0
47	BGH	48	BG	47	RXD0	48	SCK0
49	VCC	50	GND	49	VCC	50	GND

Power Connector

The power connector, J4, supplies DC voltages to the EZ-KIT Lite board. Table 3-2 summarizes the power connector pinout. If you do not use the power supply provided with your EZ-KIT Lite board, replace it with one that has the connections shown in Table 3-2.

Table 3-2. Power Connection

Terminal	Connection
Center pin	8–10v dc @ 300mA
Outer ring	positive

European Power Supply Connections

Table 3-3 summarizes the European power supply specifications.

Table 3-3. European Power Supply Connections

DC Voltage	8 to 10V DC
Current	300 mA
DC Connector	
Type	Switchcraft 760 style FEMALE
Plug Size	5.5 (OD) X 2.1 (ID) X 12 (length) millimeters
Polarity	Center is Negative (inside terminal)

AD1847 Codec Connectors

When the AD1847 codec is enabled on the EZ-KIT Lite board, you can access the audio input and output jacks on the board. 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 AD1847 SoundPort Stereo codec, depending on the setting of jumpers JP2.

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

EPROM Jumper Settings

The JP1 jumper allows the ADSP-2181 EZ-KIT Lite board to be configured for any one of six different EPROM sizes. By default, it can accommodate either a 21C512 or 27C010. If some other size EPROM is installed in the socket at U2, it is necessary to change the connections at JP1, as shown in Figure 3-5.

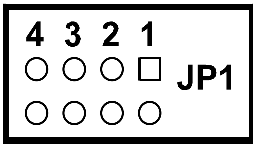


Figure 3-5. JP1 Jumper settings

Connections are made vertically between pads. The pair of pads below each number constitutes the jumper position associated with that number. Connections can be made in several ways. If an eight-pin header is installed, and the etch connections on the back are cut, EPROM size changes can be accommodated easily by installing and removing shunts. If frequent size changes are not contemplated, it may be sufficient to solder wires between the pads and so make the connections permanent.

Connections for 27C256 EPROM should look like in Figure 3-6.

This involves cutting the etch on the back of the board at jumper position 2 and adding a connection at jumper position 1.

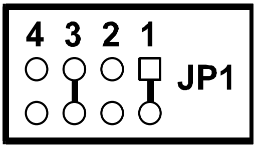


Figure 3-6. JP1 Jumper setting for 27C256 EPROM

Connections for a 21C512 or 27C010 EPROM should look like in Figure 3-7.

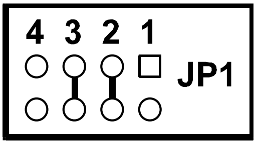


Figure 3-7. JP1 Jumper setting for 21C512/27C010 EPROM

This is how the connections are arranged when the board is manufactured.

Connections for a 27C020, 27C040, or 27C080 EPROM the connections should look like figure 5-7.

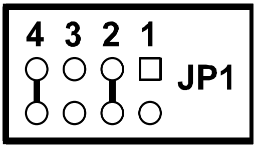


Figure 3-8. JP1 Jumper setting for 27C020/C040/27C080 EPROM

This involves cutting the etch on the back of the board at jumper position 3 and adding a connection at jumper position 4.

EZ-ICE Connector

The ADSP-218x EZ-ICE Emulator aids the debugging of an ADSP-2181 system. The emulator consists of hardware, host computer resident software, and the target board connector. The ADSP-2181 integrates on-chip emulation support with a 14-pin ICE-Port interface (Figure 3-3). This interface provides a simpler target board connection that requires fewer mechanical clearance considerations than other ADSP-2100 EZ-ICEs. The ADSP-2181 device need not be removed from the target system when using the EZ-ICE, nor are any adapters needed. Due to the small footprint of the EZ-ICE connector, emulation can be supported in final board designs.

The EZ-ICE performs provides:

- In target operation
- Setting up to 30 breakpoints
- Single stepping or full speed operation
- Examining and altering registers and memory values
- Uploading and downloading PC functions
- Instruction-level emulation of program booting and execution
- Complete assembly and disassembly of instructions
- C source-level debugging

The EZ-ICE header is a 14-pin header with the connections shown in Figure 3-9

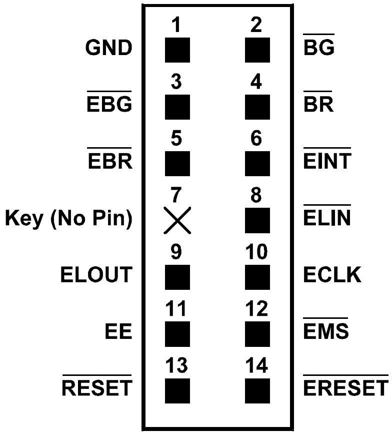


Figure 3-9. EZ-ICE 14-Pin Header

Hardware Operation

When power is applied to the board, reset circuit holds the processor in reset for approximately 30 ms. Reset is then deasserted, and the processor begins the boot process. The BMODE and MMAP pins on the ADSP-2181processor are grounded; the processor boots from the byte-wide memory interface which is connected to the EPROM socket. If the EPROM supplied with the board is installed in the socket, the operation of the board is proceed as documented in the software section of this manual.

Hardware Debugging

If the green LED fails to light, check your power connections. Verify that your power supply has the proper size connector and that the polarity is correct. The power supply voltage measured at the connector to the board should be 8V to 10V DC. Also, make sure that there are no objects beneath or on top of the board that may be causing a short circuit. Hit the reset button (S1) if the board appears to be operating improperly.

Designing EZ-ICE Compatible Systems

This section describes the ADSP-218x family EZ-ICE theory of operation to aid your EZ-ICE compatible system designs.

The hardware consists of a printed circuit board measuring 3.5 inches by 5.5 inches. Assembled onto the printed circuit board are: an ADSP-2181 digital signal processor, a socketed EPROM, an AD1847 codec, and various support circuits and connectors. The board is a complete signal processing system designed to demonstrate the capabilities of the ADSP-2181 digital signal processor. It can also be used as a platform to develop new applications targeting ADSP-2181 processors.

The EZ-KIT Lite board is an example of a minimum implementation of an ADSP-2181 processor. The socketed EPROM is connected to the processor via the Byte DMA Port. This interface uses only eight of the twenty-four data lines to carry data (D8 through D15). Eight of the spare data lines (D16 through D23) are used to provide additional address bits. This allows the ADSP-2181 to address up to 32 Mbits (4 Mbytes) of memory. The DSP is configured to boot from the socketed EPROM when RESET is de-asserted or if power is applied to the board.

The AD1847 codec is connected to the DSP via SPORT0. This high speed synchronous serial port carries all of the data, control, and status information between the DSP and the codec. It is possible to disable the codec if the serial port is to be used for another purpose. The CODECDIS signal available on connector P3 can be used to disable the codec. When this signal is brought low, the codec is disabled and its signals are put in a high impedance state.

The SPORT1 pins are used to communicate with the host PC via the RS-232 interface (J3). The Flag In and Flag Out pins carry the receive and transmit data. Software running on the DSP emulates a UART to provide the proper protocol for asynchronous serial communications up to a data rate of 115K bits per second.

A RESTRICTIONS

The following restrictions apply to release 1.1 of the ADSP-2181 EZ-KIT Lite evaluation board. For information on any ADSP-2181silicon 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. The host loses contact with the monitor while the user program is running if the user program disables the `Timer` interrupt or changes the `Timer` interrupt vector.
3. The host loses contact with the monitor while the program is running and in an ISR when nesting is turned on.
4. Do not use the Reset button while the debugger is open unless the debugger requests you to do so. This causes the debugger to stop communicating.
5. Do not run more than one ADSP-2181 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.

B BILL OF MATERIALS

Reference	Quantity	Description	Manufacturer	Reference Design
1	1	Jack, Power	DJ005A	J4
2	1	Jack, Stereo GND	J-353-1000	J1
3	1	Jack, Stereo	J-353-103	J2
4		Push Button, N.O. (Thru-hole)	EVQPAC04M	S1, S2
5	20	Capacitor 1206 0.1uF	MCH315C104M	C1, C3, C6-C11, C24-C28, C33, C38, C39, C42-C45
6		Capacitor 1206 0.33uF	MCH312C334M	C2, C12, C17, C19, C22, C29, C34
7	6	Capacitor 1206 18pF	MCH315A180J	C4, C5, C31, C32, C36, C37
8	2	Capacitor 1206 220pF	MCH315SL221K	C14, C21
9	2	Capacitor 1206 560pF	MCH315SL561K	C13, C23
10	7	Capacitor, Aluminum 1.0uF SMT	CB1/50BM	C15, C16, C18, C20, C35, C40, C41
11	3	Capacitor, Aluminum 10uF SMT	CB10/16BM	C30, C46, C47
12	1	Connector, DB9 Female	DDFEX	J3

Reference	Quantity	Description	Manufacturer	Reference Design
13	1	Crystal 16.67MHz	ABL-16.667MHZ	X1
14	1	Crystal 16.9344MHz	ABL-16.9344MHZ	X2
15	1	Crystal 24.576MHz	ABL-24.576MHZ	X3
16	1	DIODE	SMB4001	D3
17	1	1 Mbit EPROM	MX27C010DC-20	U2
18	1	Ferrite Bead 125 Ohm @ 100MHz	BCB-1812	FB1
19	1	Header, SQ. Pin 2x7	TSW-107-07-T-D	P1
20	1	Header, SQ. Pin 2x3	TSW-103-07-T-Q	JP2
21	1	LED, Green 5mm	LN31GPHL	D2
22	1	LED, Red 5mm	LN21RPHL	D1
23	1	IC, CODEC	AD1847JP	U7
24	1	IC, DSP	ADSP2181KS	U3
25	1	IC, Hex inverter	MC74HC14AD	U1
26	1	IC, Dual OPAMP	SSM2135S	U4
27	1	IC, Regulator 5 Volt TO-220	LM78M05CT	U6
28	1	IC, RS-232 Interface	ADM232AARN	U5
29	1	PCB, ESDSP-81	65-000286-01	
30	3	Resistor, 1/8W 5% 1206 100K	MCR18-EZHU-J-104	R1, R3, R18
31	9	Resistor, 1/8W 5% 1206 10K	MCR18-EZHU-J-103	R20-R27, R5
32	2	Resistor, 1/8W 5% 1206 240K	MCR18-EZHU-J-244	R14, R9

Reference	Quantity	Description	Manufacturer	Reference Design
33	2	Resistor, 1/8W 5% 1206 270	MCR18-EZHU-J-271	R17, R6
34	2	Resistor, 1/8W 5% 1206 2K	MCR18-EZHU-J-202	R2, R4
35	2	Resistor, 1/8W 5% 1206 47K	MCR18-EZHU-J-473	R11, R13
36	6	Resistor, 1/8W 5% 1206 5.1K	MCR18-EZHU-J-512	R10, R12, R15, R16, R7, R8
37	1	Resistor, 1/8W 5% 1206 1.6	MCR18-EZHU-K-1R6	R19
38	4	Rubber bumper, gray	SJ-5018924157-R	
39	2	Shunt		On header at JP2
40	1	Socket, 32 Pin Dip	2-644018-5	U2

Revision	Date	Description	Approval
A		Initial Release	

Contents:

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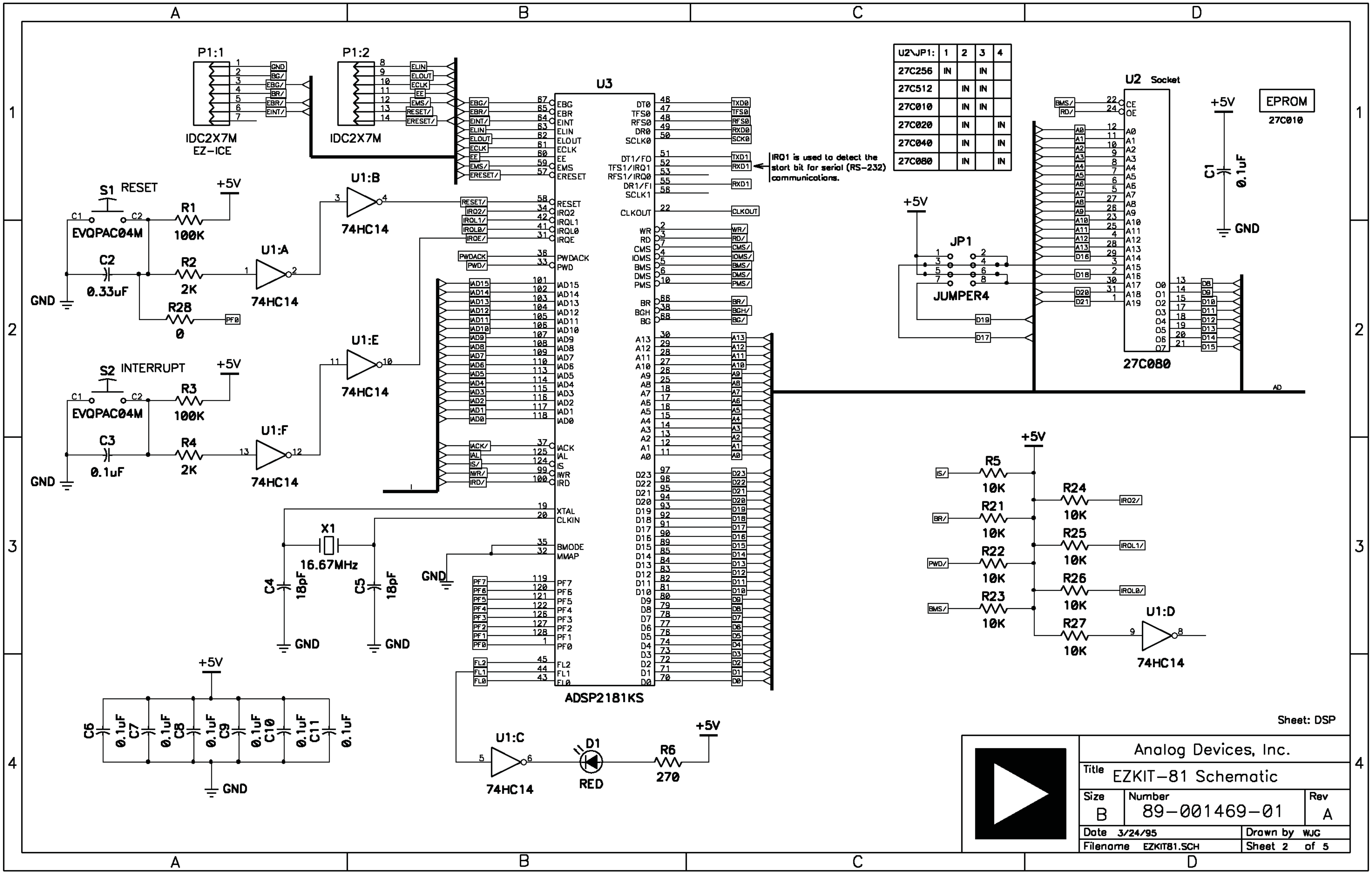

IRQ1 is used to detect the start bit for serial (RS-232) communications.

U2\JP1:	1	2	3	4
27C256	IN		IN	
27C512		IN	IN	
27C010		IN	IN	
27C020		IN		IN
27C040		IN		IN
27C080		IN		IN

Sheet: DSP

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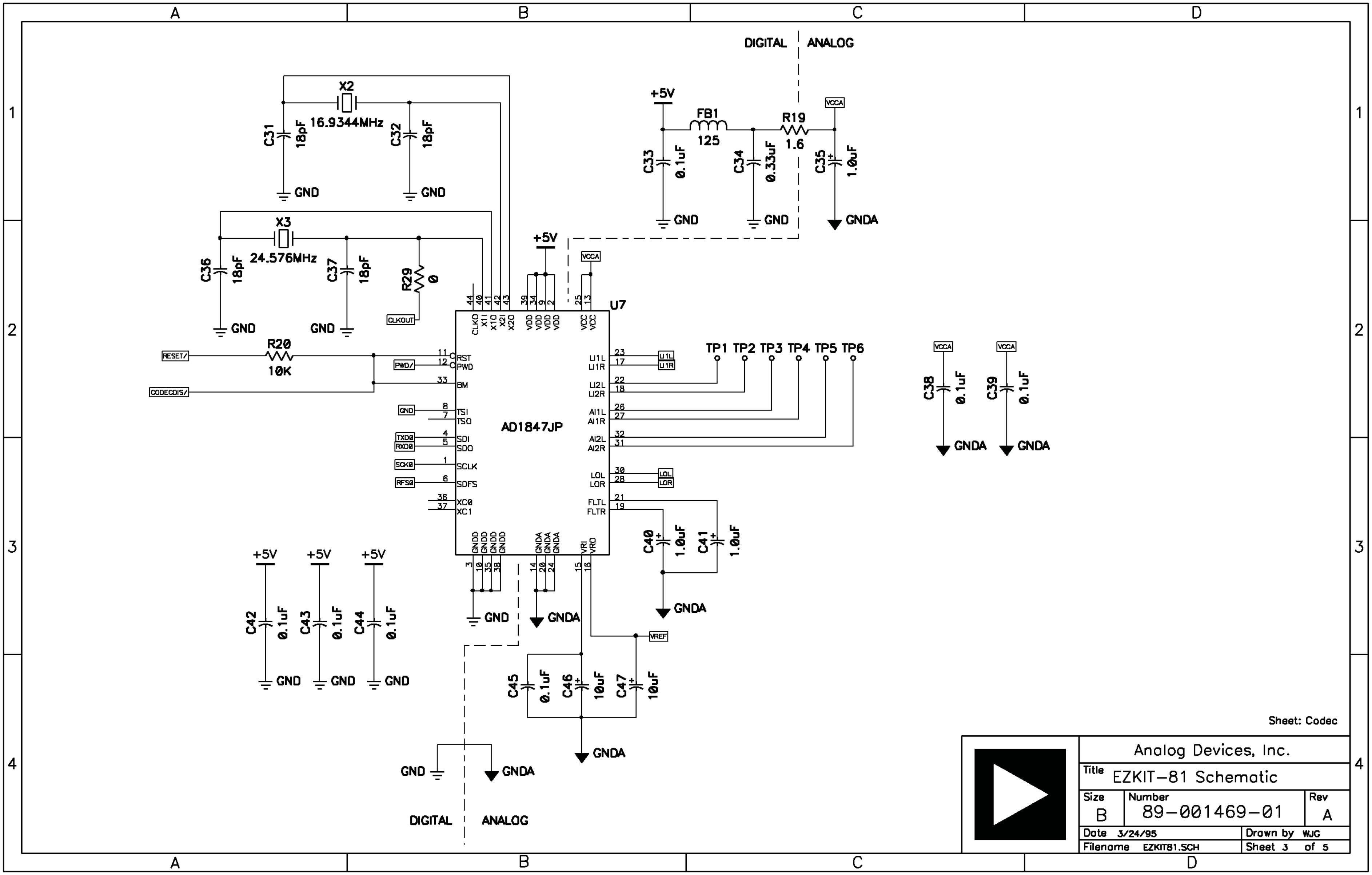

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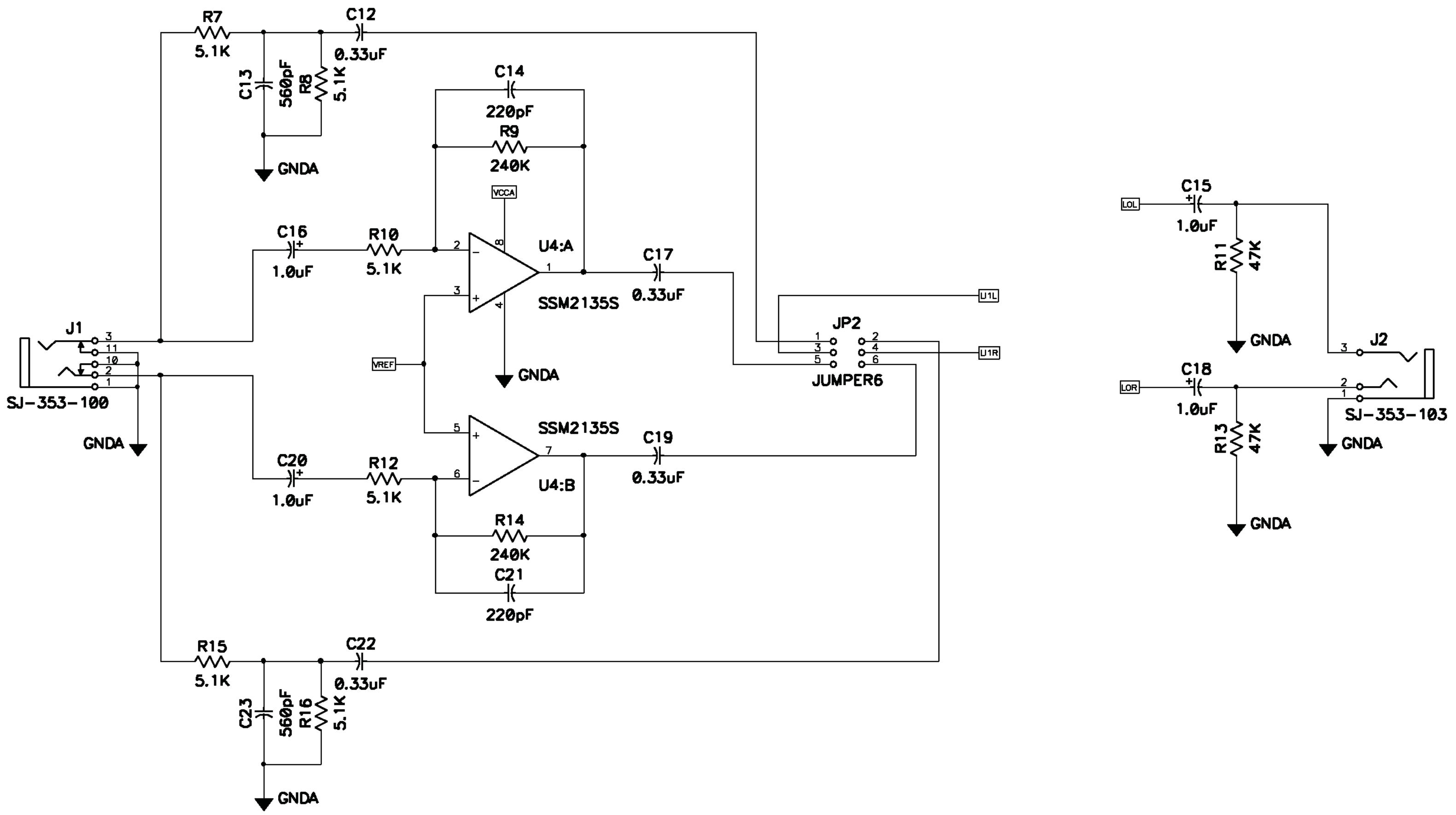

Sheet: Analog

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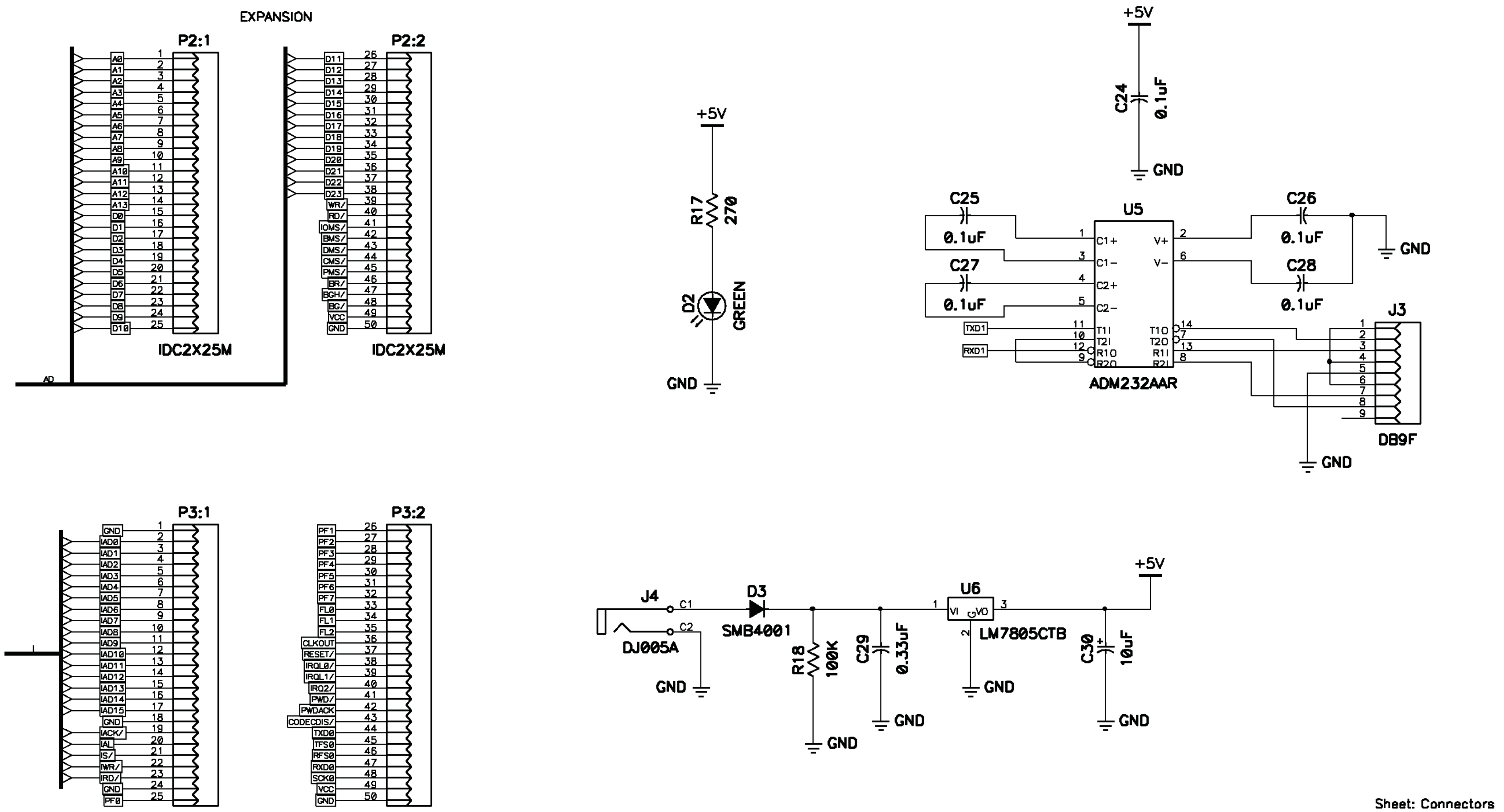

Sheet: Connectors

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