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Regulatory Compliance

The ADSP-TS101S EZ-KIT Lite evaluation system has been certified to comply with the essential requirements of the European EMC directive 89/336/EEC (inclusive 93/68/EEC) and, therefore, carries the “CE” mark.

The ADSP-TS101S EZ-KIT Lite evaluation system had been appended to Analog Devices Development Tools Technical Construction File referenced “DSPTOOLS1” dated December 21, 1997 and was awarded CE Certification by an appointed European Competent Body and is on file.



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.



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PREFACE

Thank you for purchasing the ADSP-TS101S EZ-KIT Lite[®], Analog Devices (ADI) evaluation system for TigerSHARC[®] floating-point embedded processors.

The TigerSHARC processor is a static super scalar (SSS) architecture targeted at software-defined radio applications. In these wireless infrastructure applications, the TigerSHARC processor is replacing field-programmable gate arrays (FPGAs) in the chip rate processing applications for third generation cellular. The performance, flexibility, multiprocessing and IO capabilities of the TigerSHARC processor makes it superior to FPGA implementations.

The evaluation board is designed to be used in conjunction with the VisualDSP++[®] development environment to test the capabilities of the ADSP-TS101S TigerSHARC processor. The VisualDSP++ development environment 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-TS101S assembly
- Load, run, step-in, step-out, step-over, halt, and set breakpoints in application program
- Profile programs
- Read and write data and program memory

- Read and write core and peripheral registers
- Plot memory

Access to the ADSP-TS101S processor from a personal computer (PC) is achieved through a USB port or an optional JTAG emulator. The USB interface gives unrestricted access to the ADSP-TS101S processor and the evaluation board peripherals. Analog Devices JTAG emulators offer faster communication between the host PC and target hardware. Analog Devices carries a wide range of in-circuit emulation products. To learn more about Analog Devices emulators and processor development tools, go to <http://www.analog.com/dsp/tools/>.

ADSP-TS101S EZ-KIT Lite provides example programs to demonstrate the capabilities of the evaluation board.



The ADSP-TS101S EZ-KIT Lite installation is part of the VisualDSP++ installation. The EZ-KIT Lite is a licensed product that offers an unrestricted evaluation license for the first 90 days. For details about evaluation license restrictions after the 90 days, refer to “[Evaluation License Restrictions](#)” on page 1-7.

Refer to the *VisualDSP++ Installation Quick Reference Card* for details.

The board features:

- Two Analog Devices ADSP-TS101S processors
 - ✓ 250 MHz core clock speed
 - ✓ Configurable core clock mode
- USB debugging interface
- Analog Devices AD1871 96 kHz analog-to-digital converter (ADC)
 - ✓ Line-in 3.5 mm stereo jack

- Analog Devices AD1854 96 kHz digital-to-analog converter (DAC)
 - ✓ Line-out 3.5 mm stereo jack
- SDRAM memory
 - ✓ 32 MB (4M byte x 64) DIMM
- Flash memory (544K x 8)
 - ✓ 512K main flash memory
 - ✓ 32K secondary flash memory
- Interface connectors
 - ✓ 14-pin emulator connector for JTAG interface
 - ✓ Link port 0 and link port 1 for each processor
 - ✓ Expansion interface connectors (not populated)
- General-purpose IO
 - ✓ 4 push button flags (two for each processor)
 - ✓ 2 push button interrupts (one for each processor)
 - ✓ 4 LED flag outputs (two for each processor)
- Analog Devices ADP3338, ADP3339, ADM660, and ADP3170 for voltage regulation

The EZ-KIT Lite board has two external memories: flash memory and SDRAM. The flash memory can be used to store user-specific boot code. By configuring the boot mode switch ($SW7$) and programming the flash memory, the board can run as a stand-alone unit. For more information, see [“Memory Map” on page 1-7](#).

The EZ-KIT Lite board also contains an audio interface, facilitating creation of audio signal processing applications.

Purpose of This Manual

Additionally, the EZ-KIT Lite board provides expansion connectors, allowing you to connect to the processor's external port (EP).

Purpose of This Manual

The *ADSP-TS101S EZ-KIT Lite Evaluation System Manual* provides instructions for installing the product hardware (board). The text describes the operation and configuration of the board components and provides guidelines for running your own code on the ADSP-TS101S EZ-KIT Lite. Finally, a schematic and a bill of materials are provided as a reference for future designs.

The product software installation is detailed in the *VisualDSP++ Installation Quick Reference Card*

Intended Audience

The primary audience for this manual is a programmer who is familiar with Analog Devices processors. This manual assumes that the audience has a working knowledge of the appropriate processor architecture and instruction set. Programmers who are unfamiliar with Analog Devices processors can use this manual but should supplement it with other texts (such as the *ADSP-TS101 TigerSHARC Processor Hardware Reference* and the *ADSP-TS101 TigerSHARC Processor Programming Reference*) that describe your target architecture.

Programmers who are unfamiliar with VisualDSP++ should refer to the VisualDSP++ online Help and user's or getting started guides. For the locations of these documents, see [“Related Documents”](#).

Manual Contents

The manual consists of:

- Chapter 1, “Using ADSP-TS101S EZ-KIT Lite” on page 1-1
Provides information on the EZ-KIT Lite from a programmer’s perspective and outlines the processor’s memory map.
- Chapter 2, “ADSP-TS101S EZ-KIT Lite Hardware Reference” on page 2-1
Provides information on the hardware aspects of the evaluation system.
- Appendix A, “ADSP-TS101S EZ-KIT Lite Bill Of Materials” on page A-1
Provides a list of components used to manufacture the EZ-KIT Lite board.
- Appendix B, “ADSP-TS101S EZ-KIT Lite Schematic” on page B-1
Provides the resources to allow EZ-KIT Lite board-level debugging or to use as a reference design.



Appendix B now is part of the online Help. The online Help viewers should go to the PDF version of the *ADSP-TS101S EZ-KIT Lite Evaluation System Manual* located in the Docs\EZ-KIT Lite Manuals folder on the installation CD. Alternatively, the schematic can be found on the Analog Devices Web site:
www.analog.com/processors.

What’s New in This Manual

This revision of the *ADSP-TS101S EZ-KIT Lite Evaluation System Manual* has been updated for VisualDSP++ 4.5.

Technical or Customer Support

You can reach Analog Devices, Inc. Customer Support in the following ways:

- Visit the Embedded Processing and DSP products Web site at <http://www.analog.com/processors/technicalSupport>
- E-mail tools questions to processor.tools.support@analog.com
- E-mail processor questions to processor.support@analog.com (World wide support)
processor.europe@analog.com (Europe support)
processor.china@analog.com (China support)
- Phone questions to **1-800-ANALOGD**
- Contact your Analog Devices, Inc. local sales office or authorized distributor
- Send questions by mail to:
Analog Devices, Inc.
One Technology Way
P.O. Box 9106
Norwood, MA 02062-9106
USA

Supported Processors

This EZ-KIT Lite evaluation system supports the Analog Devices ADSP-TS101S TigerSHARC embedded processors.

Product Information

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

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

MyAnalog.com

MyAnalog.com is a free feature of the Analog Devices Web site that allows customization of a Web page to display only the latest information on products you are interested in. You can also choose to receive weekly e-mail notifications containing updates to the Web pages that meet your interests. MyAnalog.com provides access to books, application notes, data sheets, code examples, and more.

Registration:

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 e-mail address.

Processor Product Information

For information on embedded processors and DSPs, visit our Web site at www.analog.com/processors, which provides access to technical publications, data sheets, application notes, product overviews, and product announcements.

Product Information

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

- E-mail questions or requests for information to
processor.support@analog.com (World wide support)
processor.europe@analog.com (Europe support)
processor.china@analog.com (China support)
- Fax questions or requests for information to
1-781-461-3010 (North America)
+49-89-76903-157 (Europe)

Related Documents

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

Table 1. Related Processor Publications

Title	Description
<i>ADSP-TS101S TigerSHARC Embedded Processor Datasheet</i>	General functional description, pinout, and timing
<i>ADSP-TS101S TigerSHARC Processor Hardware Reference</i>	Description of internal processor architecture and all register functions
<i>TigerSHARC Processor Instruction Set Reference</i>	Description of all allowed processor assembly instructions

Table 2. Related VisualDSP++ Publications

Title	Description
<i>VisualDSP++ User's Guide</i>	Description of VisualDSP++ features and usage
<i>VisualDSP++ Assembler and Preprocessor Manual</i>	Description of the assembler function and commands
<i>VisualDSP++ C/C++ Compiler and Library Manual for TigerSHARC Processors</i>	Description of the compiler function and commands for TigerSHARC processors

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

Title	Description
<i>VisualDSP++ Linker and Utilities Manual</i>	Description of the linker function and commands
<i>VisualDSP++ Loader and Utilities Manual</i>	Description of the loader/splitter function and commands



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

All documentation is available online. Most documentation is available in printed form.

Visit the Technical Library Web site to access all processor and tools manuals and data sheets:

<http://www.analog.com/processors/resources/technicalLibrary>.

Online Technical Documentation

Online documentation comprises the VisualDSP++ Help system, software tools manuals, hardware tools manuals, processor manuals, the Dinkum Abridged C++ library, and Flexible License Manager (FlexLM) network license manager software documentation. You can easily search across the entire VisualDSP++ documentation set for any topic of interest. For easy printing, supplementary .pdf files of most manuals are provided in the Docs folder on the VisualDSP++ installation CD.

Each documentation file type is described as follows.

File	Description
.chm	Help system files and manuals in Help format

Product Information

File	Description
.htm or .html	Dinkum Abridged C++ library and FlexLM network license manager software documentation. Viewing and printing the .html files requires a browser, such as Internet Explorer 5.01 (or higher).
.pdf	VisualDSP++ and processor manuals in Portable Documentation Format (PDF). Viewing and printing the .pdf files requires a PDF reader, such as Adobe Acrobat Reader (4.0 or higher).

If documentation is not installed on your system as part of the software installation, you can add it from the VisualDSP++ CD at any time by running the Tools installation. Access the online documentation from the VisualDSP++ environment, Windows[®] Explorer, or the Analog Devices Web site.

Accessing Documentation From VisualDSP++

To view VisualDSP++ Help, click on the **Help** menu item or go to the Windows task bar and navigate to the VisualDSP++ documentation via the **Start** menu.

To view ADSP-TS101S EZ-KIT Lite Help, which is part of the VisualDSP++ Help system, use the **Contents** or **Search** tab of the Help window.

Accessing Documentation From Windows

In addition to any shortcuts you may have constructed, there are many ways to open VisualDSP++ online Help or the supplementary documentation from Windows.

Help system files (.chm) are located in the `Help` folder, and .pdf files are located in the `Docs` folder of your VisualDSP++ installation CD-ROM. The `Docs` folder also contains the Dinkum Abridged C++ library and the FlexLM network license manager software documentation.

Your software installation kit includes online Help as part of the Windows[®] interface. These help files provide information about VisualDSP++ and the ADSP-TS101S EZ-KIT Lite evaluation system.

Accessing Documentation From Web

Download manuals at the following Web site:

<http://www.analog.com/processors/resources/technicalLibrary/manuals>.

Select a processor family and book title. Download archive (.zip) files, one for each manual. Use any archive management software, such as WinZip, to decompress downloaded files.

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

To purchase VisualDSP++ manuals, call 1-603-883-2430. The manuals may be purchased only as a kit.

If you do not have an account with Analog Devices, you are referred to Analog Devices distributors. For information on our distributors, log onto <http://www.analog.com/salesdir/continent.asp>.

Hardware Tools Manuals

To purchase EZ-KIT Lite and in-circuit emulator (ICE) manuals, call 1-603-883-2430. The manuals may be ordered by title or by product number located on the back cover of each manual.

Product Information

Processor Manuals

Hardware reference and instruction set reference manuals may be ordered through the Literature Center at **1-800-ANALOGD (1-800-262-5643)**, or downloaded from the Analog Devices Web site. Manuals may be ordered by title or by product number located on the back cover of each manual.




Data Sheets

All data sheets (preliminary and production) may be downloaded from the Analog Devices Web site. Only production (final) data sheets (Rev. 0, A, B, C, and so on) can be obtained from the Literature Center at **1-800-ANALOGD (1-800-262-5643)**; they also can be downloaded from the Web site.


To have a data sheet faxed to you, call the Analog Devices Faxback System at **1-800-446-6212**. Follow the prompts and a list of data sheet code numbers will be faxed to you. If the data sheet you want is not listed, check for it on the Web site.

Notation Conventions

Text conventions used in this manual are identified and described as follows.

Example	Description
Close command (File menu)	Titles in reference sections indicate the location of an item within the VisualDSP++ environment's menu system (for example, the Close command appears on the File menu).
{this that}	Alternative required items in syntax descriptions appear within curly brackets and separated by vertical bars; read the example as <i>this</i> or <i>that</i> . One or the other is required.
[this that]	Optional items in syntax descriptions appear within brackets and separated by vertical bars; read the example as an optional <i>this</i> or <i>that</i> .
[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 <i>this</i> .
.SECTION	Commands, directives, keywords, and feature names are in text with letter gothic font.
<i>filename</i>	Non-keyword placeholders appear in text with italic style format.
	Note: For correct operation, ... A Note provides supplementary information on a related topic. In the online version of this book, the word Note appears instead of this symbol.
	Caution: Incorrect device operation may result if ... Caution: Device damage may result if ... A Caution identifies conditions or inappropriate usage of the product that could lead to undesirable results or product damage. In the online version of this book, the word Caution appears instead of this symbol.
	Warning: Injury to device users may result if ... A Warning identifies conditions or inappropriate usage of the product that could lead to conditions that are potentially hazardous for the devices users. In the online version of this book, the word Warning appears instead of this symbol.

Notation Conventions

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

1 USING ADSP-TS101S EZ-KIT LITE

This chapter provides specific information to assist you with development of programs for the ADSP-TS101S EZ-KIT Lite evaluation system.

The information appears in the following sections.

- [“Package Contents” on page 1-2](#)
Lists the items contained in your ADSP-TS101S EZ-KIT Lite package.
- [“Default Configuration” on page 1-3](#)
Shows the default configuration of the ADSP-TS101S EZ-KIT Lite.
- [“Installation and Session Startup” on page 1-5](#)
Instructs how to start a new or open an existing ADSP-TS101SEZ-KIT Lite session using VisualDSP++.
- [“Evaluation License Restrictions” on page 1-7](#)
Describes the restrictions of the VisualDSP++ demo license shipped with the EZ-KIT Lite.
- [“Memory Map” on page 1-7](#)
Describes the ADSP-TS101S EZ-KIT Lite board’s memory map.
- [“SDRAM Interface” on page 1-8](#)
Defines the register values needed to configure the external memory for SDRAM access.

Package Contents

- [“Programmable FLAG Pins” on page 1-9](#)
Describes the function and use of the programmable FLAG pins on the EZ-KIT Lite evaluation system.
- [“Interrupt Pins” on page 1-10](#)
Describes the function and use of the interrupt pins on the EZ-KIT Lite evaluation system.
- [“Flash Memory” on page 1-11](#)
Describes how to program and use the flash memory.
- [“Audio Interface” on page 1-11](#)
Describes how to use and configure the audio interface.
- [“Example Programs” on page 1-12](#)
Provides information about the example programs included in the ADSP-TS101S EZ-KIT Lite evaluation system.
- [“Flash Programmer Utility” on page 1-13](#)
Provides information on the Flash Programmer utility included with VisualDSP++.

For information on the graphical user interface, including the boot loading, target options, and other facilities of the EZ-KIT Lite system, refer to the online Help.

For detailed information about programming the ADSP-TS101S Tiger-SHARC processor, see the documents referred to as [“Related Documents”](#).

Package Contents

Your ADSP-TS101S EZ-KIT Lite evaluation system package contains the following items.

- ADSP-TS101S EZ-KIT Lite board

- *VisualDSP++ Installation Quick Reference* card
- CD containing:
 - ✓ VisualDSP++ software
 - ✓ ADSP-TS101S EZ-KIT Lite debug software
 - ✓ USB driver files
 - ✓ Example programs
 - ✓ ADSP-TS101S *EZ-KIT Lite Evaluation System Manual* (this document)
- Universal 7.5V DC power supply
- USB 2.0 cable
- Registration card (please fill out and return)

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

Default Configuration

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-TS101S EZ-KIT Lite board is designed to run outside your personal computer as a stand-alone unit. You do not have to open your computer case.

Default Configuration

When removing the EZ-KIT Lite board from the package, handle the board carefully to avoid the discharge of static electricity, which may damage some components. [Figure 1-1](#) shows the default DIP switch, connector locations, and LEDs used in installation. Confirm that your board is set up in the default configuration before using the board.

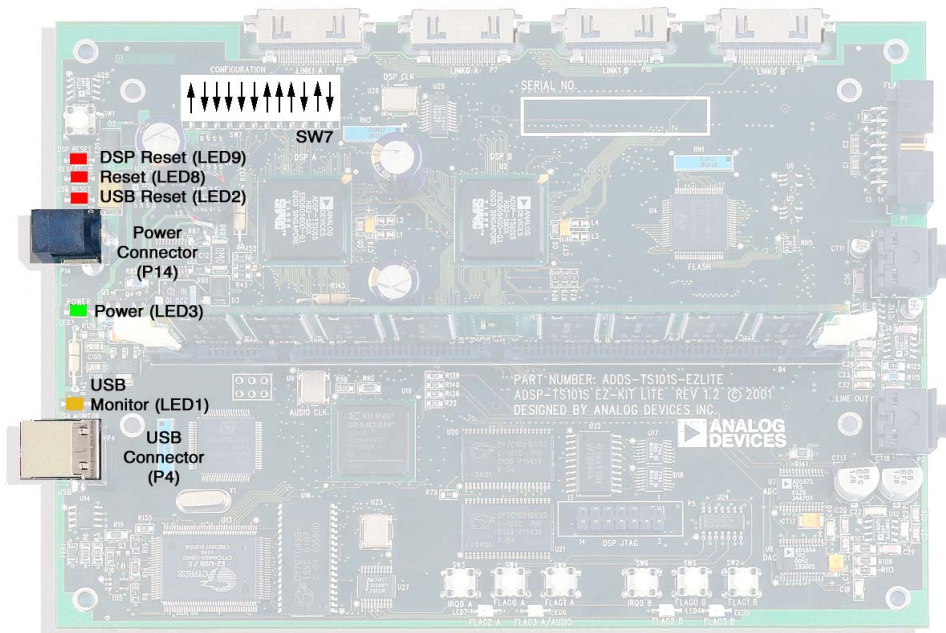



Figure 1-1. EZ-KIT Lite Hardware Setup

Installation and Session Startup

 For correct operation, install the software and hardware in the order presented in the *VisualDSP++ Installation Quick Reference Card*.

1. Verify that the yellow USB monitor LED (LED1, located near the USB connector) is lit. This signifies that the board is communicating properly with the host PC and is ready to run VisualDSP++.
2. If you are running VisualDSP++ for the first time, navigate to the VisualDSP++ environment via the **Start** → **Programs** menu. The main window appears. Note that VisualDSP++ does not connect to any session. Skip the rest of this step to step 3.

If you have run VisualDSP++ previously, the last opened session appears on the screen. You can override the default behavior and force VisualDSP++ to start a new session by pressing and holding down the **Ctrl** key while starting VisualDSP++. Do not release the **Ctrl** key until the **Session Wizard** appears on the screen. Go to step 4.

3. To connect to a new EZ-KIT Lite session, start **Session Wizard** by selecting one of the following.
 - From the **Session** menu, **New Session**.
 - From the **Session** menu, **Session List**. Then click **New Session** from the **Session List** dialog box.
 - From the **Session** menu, **Connect to Target**. Then click **New Session** from the **Session List** dialog box.
4. The **Select Processor** page of the wizard appears on the screen. Ensure **TigerSHARC** is selected in **Processor family**. In **Choose a target processor**, select **ADSP-TS101**. Click **Next**.

Installation and Session Startup


5. The **Select Connection Type** page of the wizard appears on the screen. Select **EZ-KIT Lite** and click **Next**.
6. The **Select Platform** page of the wizard appears on the screen. In the **Select your platform** list, select **ADSP-TS101S EZ-KIT Lite via Debug Agent**. In **Session name**, highlight or specify the session name.

The session name can be a string of any length; although, the box displays approximately 32 characters. The session name can include space characters. If you do not specify a session name, VisualDSP++ creates a session name by combining the name of the selected platform with the selected processor. The only way to change a session name later is to delete the session and to open a new session.

Click **Next**.

7. The **Finish** page of the wizard appears on the screen. The page displays your selections. If you are satisfied, click **Finish**. If not, click **Back** to make changes.



To disconnect from a session, click the disconnect button  or select **Session** → **Disconnect from Target**.

To delete a session, select **Session** → **Session List**. Select the session name from the list and click **Delete**. Click **OK**.

Evaluation License Restrictions

The ADSP-TS101S EZ-KIT Lite installation is part of the VisualDSP++ installation. The EZ-KIT Lite is a licensed product that offers an unrestricted evaluation license for the first 90 days. Once the initial unrestricted 90-day evaluation license expires:

- VisualDSP++ allows a connection to the ADSP-TS101S EZ-KIT Lite via the USB debug agent interface only. Connections to simulators and emulation products are no longer allowed.
- The linker restricts a users program to 96 KB of internal memory for code space with no restrictions for data space.

Refer to the *VisualDSP++ Installation Quick Reference Card* for details.

Memory Map

The ADSP-TS101S processor has 6 M bits of internal memory that can be used for program storage or data storage. The configuration of internal memory is detailed in the *ADSP-TS101 TigerSHARC Processor Hardware Reference*.

The ADSP-TS101S EZ-KIT Lite board contains 544K x 8-bits of external flash memory. The memory is separated into two sections. One section contains 512K bytes of main flash memory, and the other section contains 32K bytes of secondary flash memory. This memory is connected to the processor's ~BMS pin. The flash memory can be accessed in boot memory space.

The board also contains one 4M x 64-bit SDRAM DIMM. This memory is connected to the processor's SDRAM interface.


SDRAM Interface

Table 1-1. EZ-KIT Lite Evaluation Board Memory Map

	Start Address	End Address	Content
Internal Memory	0x0000 0000	0x0000 FFFF	Internal memory 0
	0x0008 0000	0x0008 FFFF	Internal memory 1
	0x0010 0000	0x0010 FFFF	Internal memory 2
	0x0018 0000	0x0018 07FF	Internal registers
	0x01C0 0000	0x01C0 FFFF	Broadcast
	0x0200 0000	0x023F FFFF	Processor ID 0
	0x0240 0000	0x027F FFFF	Processor ID 1
External Memory	0x0400 0000	0x047F FFFF	External memory space (SDRAM)

SDRAM Interface

The DIMM shipped with the EZ-KIT Lite evaluation board is a 32 MB module. You can upgrade to a 64 MB or 128 MB module. The module must be a 168-pin DIMM PC100 device. Modules can be purchased from such vendors as Viking, Infineon, or Crucial.

 Revision 1.2 boards are shipped with 128 MB modules, but only 32 MB of the 128 MB can be accessed, and the boards cannot be upgraded with more memory. The issue is resolved in revision 1.3 boards.

To properly access SDRAM, the `SYSCON` and `SDRCON` registers must be configured properly. For the supplied DIMM, the `SDRCON` register should be configured as follows: SDRAM enable, CAS latency of two cycles, pipe depth of zero, page boundary of 256 words (1K words on revision 1.2 boards), refresh rate of every 1200 cycles (every 600 cycles on revision 1.2 boards), pre-charge to RAS of three cycles, RAS to pre-charge of four cycles, and init sequence is MRS cycle follows refresh.

