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Blackfin® Landscape LCD EZ-Extender® Manual

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ANALOG DEVICES

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Regulatory Compliance

The Blackfin Landscape LCD EZ-Extender is designed to be used solely in a laboratory environment. The board is not intended for use as a consumer end product or as a portion of a consumer end product. The board is an open system design which does not include a shielded enclosure and therefore may cause interference to other electrical devices in close proximity. This board should not be used in or near any medical equipment or RF devices.

The Blackfin Landscape LCD EZ-Extender is currently being processed for certification that it complies with the essential requirements of the European EMC directive 89/336/EEC amended by 93/68/EEC and therefore carries the "**CE**" mark.

CE

The Blackfin Landscape LCD EZ-Extender 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 extender boards in the protective shipping package.

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PREFACE

Thank you for purchasing the Blackfin® Landscape LCD EZ-Extender®, Analog Devices, Inc. extender board to the EZ-KIT Lite®/EZ-Board® evaluation system for the ADSP-BF526, ADSP-BF537, ADSP-BF538, and ADSP-BF548 Blackfin processors.

Blackfin processors are embedded processors that support a Media Instruction Set Computing (MISC) architecture. This architecture is the natural merging of RISC, media functions, and digital signal processing characteristics towards delivering signal processing performance in a microprocessor-like environment.

EZ-KIT Lites and Landscape LCD EZ-Extenders are designed to be used in conjunction with the CrossCore® Embedded Studio (CCES) and VisualDSP++® software development environments. The development environment facilitates advanced application code development and debug, such as:

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

To learn more about Analog Devices development software, go to `http://www.analog.com/processors/tools`.

Product Overview

The Blackfin Landscape LCD EZ-Extender is a separately sold daughter board that plugs onto the expansion interface II of the ADSP-BF526 EZ-Board. The extender also plugs into the parallel peripheral interface (PPI) connector of the ADSP-BF537, ADSP-BF538, or ADSP-BF548 EZ-KIT Lite evaluation system. The extender board aids the design and prototyping phases of the ADSP-BF526, ADSP-BF537, ADSP-BF538, or ADSP-BF548 processor targeted applications.

Please visit www.analog.com/EX2-LLCD for additional information, including CCES support.

The board extends the capabilities of the evaluation system by providing a connection between the PPI of the Blackfin processor and the on-board 3.5 in. LCD display. The serial peripheral interconnect (SPI) port and TWI interface of the Blackfin processor are used to communicate to the LCD display, AD7879 touch screen controller, AD7147 capacitive touch controller, and the 2 KB serial ROM of the extender.

The following is a list of the Blackfin Landscape LCD EZ-Extender interfaces.

- LCD display with touch capabilities:
    - Sharp LQ035Q1DH02 3.5 in. LCD with resistive touch
    - 320 (horizontal) x 240 (vertical) landscape
    - 1.8V to 3.6V I/O operation
    - LCD backlight
- LCD touch controller:
    - Analog Devices AD7879 touchscreen controller
    - 1.8V to 3.3V I/O operation

- Capacitive touch controller:
  - Analog Devices AD7147 capacitive touch controller
  - Four push buttons and one scroll wheel
  - 1.8V to 3.3V I/O operation
- No power supply required: derives power from the EZ-KIT Lite/EZ-Board
- CE certified
- Dimensions: 3.75 in. (height) x 3.5 in. (width)

Before using any of the interfaces, follow the setup procedure in "Landscape LCD EZ-Extender Setup" on page 1-2.

Example programs are available to demonstrate capabilities of the Blackfin Landscape LCD EZ-Extender board.

Purpose of This Manual

The *Blackfin Landscape LCD EZ-Extender Manual* describes operation and configuration of the extender board's components. A schematic and a bill of materials are provided as a reference for future Blackfin processor board designs.

Intended Audience

This manual is a user's guide and reference to the Blackfin Landscape LCD EZ-Extender. Programmers who are familiar with the Analog Devices Blackfin processor architecture, operation, and development tools are the primary audience for this manual.

Programmers who are unfamiliar with Analog Devices processors can use this manual but should supplement it with other texts that describe your target architecture. For the locations of these documents, see "Related Documents".

Programmers who are unfamiliar with CCES or VisualDSP++ should refer to the online help and user's manuals.

Manual Contents

The manual consists of:

- Chapter 1, "Landscape LCD EZ-Extender Interfaces" on page 1-1, provides basic board information.
- Chapter 2, "Landscape LCD EZ-Extender Hardware Reference" on page 2-1, provides information on the hardware aspects of the board.
- Appendix A, "Landscape LCD EZ-Extender Bill of Materials" on page A-1, provides a list of components used to manufacture the EZ-Extender board.
- Appendix B, "Landscape LCD EZ-Extender Schematic" on page B-1, provides the resources to allow EZ-Board or EZ-KIT Lite board-level debugging or to use as a reference design. Appendix B is part of the online help.

What's New in This Manual

This is revision 1.1 of the *Blackfin Landscape LCD EZ-Extender Manual*. The manual has been updated to include CCES information. In addition, modifications and corrections based on errata reports against the previous manual revision have been made.

For the latest version of this manual, please refer to the Analog Devices Web site.

Technical Support

You can reach Analog Devices processors and DSP technical support in the following ways:

- Post your questions in the processors and DSP support community at EngineerZone®:
  `http://ez.analog.com/community/dsp`
- Submit your questions to technical support directly at:
  `http://www.analog.com/support`
- E-mail your questions about processors, DSPs, and tools development software from **CrossCore Embedded Studio** or **VisualDSP++**:

  Choose **Help > Email Support**. This creates an e-mail to `processor.tools.support@analog.com` and automatically attaches your **CrossCore Embedded Studio** or **VisualDSP++** version information and `license.dat` file.
- E-mail your questions about processors and processor applications to:
  `processor.support@analog.com` or
  `processor.china@analog.com` (Greater China support)

- In the **USA only**, call **1-800-ANALOGD** (1-800-262-5643)
- Contact your Analog Devices sales office or authorized distributor. Locate one at:
  www.analog.com/adi-sales
- Send questions by mail to:
  Processors and DSP Technical Support
  Analog Devices, Inc.
  Three Technology Way
  P.O. Box 9106
  Norwood, MA 02062-9106
  USA

Supported Products

The Blackfin Landscape LCD EZ-Extender is a daughter board for the ADSP-BF526, ADSP-BF537, ADSP-BF538, and ADSP-BF548 processor evaluation systems.

Product Information

Product information can be obtained from the Analog Devices Web site and the online help.

Analog Devices Web Site

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

To access a complete technical library for each processor family, go to http://www.analog.com/processors/technical_library. The manuals

selection opens a list of current manuals related to the product as well as a link to the previous revisions of the manuals. When locating your manual title, note a possible errata check mark next to the title that leads to the current correction report against the manual.

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

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EngineerZone

EngineerZone is a technical support forum from Analog Devices. It allows you direct access to ADI technical support engineers. You can search FAQs and technical information to get quick answers to your embedded processing and DSP design questions.

Use EngineerZone to connect with other DSP developers who face similar design challenges. You can also use this open forum to share knowledge and collaborate with the ADI support team and your peers. Visit http://ez.analog.com to sign up.

Related Documents

For additional information about the product, refer to the following publications.

Table 1. Related Processor Publications

Title	Description
• *ADSP-BF522/ADSP-BF523/ADSP-BF524/ ADSP-BF525/ADSP-BF526/ADSP-BF527 Blackfin Embedded Processor Data Sheet* • *ADSP-BF534/ADSP-BF536/ADSP-BF537 Blackfin Embedded Processor Data Sheet* • *ADSP-BF538/ADSP-BF538F Blackfin Embedded Processor Data Sheet* • *ADSP-BF542/ADSP-BF544/ADSP-BF547/ ADSP-BF548/ADSP-BF549 Blackfin Embedded Processor Data Sheet*	General functional description, pinout, and timing of the processor
• *ADSP-BF52x Blackfin Processor Hardware Reference* • *ADSP-BF537 Blackfin Processor Hardware Reference* • *ADSP-BF538/ADSP-BF538F Blackfin Processor Hardware Reference* • *ADSP-BF54x Blackfin Processor Hardware Reference*	Description of the internal processor architecture and all register functions
Blackfin Processor Programming Reference	Description of all allowed processor assembly instructions

1 LANDSCAPE LCD EZ-EXTENDER INTERFACES

This chapter provides the setup procedure for the Blackfin Landscape LCD EZ-Extender and EZ-KIT Lite/EZ-Board (ADSP-BF526, ADSP-BF537, ADSP-BF538, or ADSP-BF548) and describes all interfaces the extender supports.

The information is presented in the following order.

- "Landscape LCD EZ-Extender Setup" on page 1-2
- "LCD Display" on page 1-3
- "LCD Touch Controller (AD7879)" on page 1-4
- "Capacitive Touch Controller (AD7147)" on page 1-4
- "Serial ROM" on page 1-5
- "Example Programs" on page 1-6

Landscape LCD EZ-Extender Setup

It is very important to set up all components of the system containing the Blackfin Landscape LCD EZ-Extender, then apply power to the system. The following procedure is recommended for the correct setup.

1. Read the applicable design interface section in this chapter—the text provides an overview of the interface capabilities.
2. Read "System Architecture" on page 2-2 to understand the physical connections of the extender board. For detailed information, refer to "Landscape LCD EZ-Extender Schematic" on page B-1.
3. Set the jumpers on the extender board. Use the block diagram in Figure 2-1 on page 2-2 in conjunction with "Jumper Settings" on page 2-3.
4. Set the switches and jumpers on the EZ-KIT Lite/EZ-Board. If not already, familiarize yourself with the board documentation and schematic drawings (see "Product Information").

   Compare the parallel peripheral interface (PPI) or expansion interface II connector signals of the extender board with the EZ-KIT Lite/EZ-Board signals to ensure there is no contention. For example, it may be necessary to disable other devices connected to the PPI or expansion II connector of the processor or disable the push buttons on the EZ-KIT Lite/EZ-Board.
5. Install the extender on the EZ-KIT Lite/EZ-Board via the PPI or expansion II connector.
6. Configure any other interfacing boards; for example, another EZ-Extender board.
7. Power your system.

LCD Display

The Blackfin Landscape LCD EZ-Extender is shipped with a 3.5 in. landscape, QVGA (320 x RGB x 240) display with an LCD backlight. All LCD data, touchscreen pins, and power pins connect to the display via a single connector (`P1`). The 18-bit display operates in 16-bit mode (RGB 5-6-5) and connects to the PPI [15–0] data pins of the processor. The display also uses the serial peripheral interconnect (SPI) port of the processor for control register setup. The LCD display can operate at a VDDIO of 1.6V to 3.6V. This allows you to connect the LCD display to the PPI/SPI interface of the processor gluelessly, without the need for voltage translation circuitry— a great benefit for power-sensitive applications.

The PPI clock of a Blackfin processor and the clock required by the LCD display are driven by the on-board 5 MHz oscillator. By default, the oscillator is enabled and drives the PPI interface. You can use the clock generated by the processor or can disable the 5 MHz oscillator by setting the appropriate jumpers on the extender. See "Jumper Settings" on page 2-3 for more information.

At power-up, the LCD backlight circuit is disabled. By default, the shut pin of the LCD display turns the display `OFF`. Write to the respective control registers to enable the backlight and take the display out of the shut mode. These settings provide significant power savings and are suited for power-sensitive applications.

For more information about the LCD display, go to the Sharp Web site.

An example program demonstrating capabilities of the LCD display is available in the `Examples` folder of the installation directory.

LCD Touch Controller (AD7879)

The Blackfin Landscape LCD EZ-Extender is shipped with a low-cost resistive touch controller (Analog Devices AD7879). The four pins generated by activating the LCD display (X+, X-, Y+, Y-) connect to a single connector (P1), controlled via the LCD display. You can access the controller via the SPI interface of the Blackfin processor. The controller generates an interrupt request for the processor whenever any new data is available or when a user touches the LCD Display. The processor uses the SPI interface to read the appropriate registers of the AD7879 controller. The IRQ line connects the AD7879 controller to the processor via the processor's general-purpose I/O (GPIO) pin. By default, the AD7879 controller uses the SPI select 1 and GPIO1 pins. "Jumper Settings" on page 2-3 describe how the GPIO and SPI selects can be varied for different EZ-KIT Lites and EZ-Boards.

For more information about the AD7879 touch controller, go to www.analog.com and search for AD7879.

An example program demonstrating capabilities of the touch controller is available in the Examples folder of the installation directory.

Capacitive Touch Controller (AD7147)

The Landscape LCD EZ-Extender is equipped with a CapTouch™ programmable controller (Analog Devices AD7147) for applications implementing push buttons and scroll wheels. The four push button sensors and one scroll wheel are located on the top side of the extender's printed circuit board (PCB).

When the respective sensor is activated, the captouch controller recognizes and communicates the change to the Blackfin processor via the processor's 2-wire interface (TWI). The AD7147 controller generates an interrupt request for the Blackfin processor whenever any new data is available or

when a user touches the push buttons (PB1–4) or scroll wheel. The push buttons and scroll wheel are copper pads created inside the PCB. Touch the respective push button or traverse around the scroll wheel with a finger to enable the sensor pads and to generate the interrupt request. The IRQ line connects the AD7147 controller to the processor via its GPIO pin. By default, the AD7147 controller uses the SPI select 2 and GPIO2 pins. "Jumper Settings" on page 2-3 describe how the GPIO and SPI selects can be varied for different EZ-KIT Lites and EZ-Boards.

For more information about the AD7147 touch controller, go to www.analog.com and search for AD7147.

An example program demonstrating capabilities of the touch controller is available in the Examples folder of the installation directory.

Serial ROM

The Blackfin Landscape LCD EZ-Extender is equipped with a 2 KB serial ROM device (M24C02) for revision and configuration control: bill of materials and PCB revision information is available by reading the ROM. The part connects to the Blackfin processor via the processor's TWI interface. By default, the serial ROM is read-only to protect the internally stored contents. On the extender, the last three significant TWI address bits are strapped to logic '0' (default). To modify the last three significant TWI address bits, use the provided jumpers; see "Jumper Settings" on page 2-3 for more information.

For more information on the M24C02 device, go to the STMicroelectronics Web site.

More information on the revision and configuration control is available in the Examples folder of the installation directory.

Example Programs

Example programs are provided with the Landscape LCD EZ-Extender EZ-KIT Lite to demonstrate various capabilities of the product. The programs are included in the product installation kit and can be found in the `Examples` folder of the installation. Refer to a readme file provided with each example for more information.

CCES users are encouraged to use the example browser to find examples included with the EZ-KIT Lite Board Support Package.

2 LANDSCAPE LCD EZ-EXTENDER HARDWARE REFERENCE

This chapter describes the hardware design of the Blackfin Landscape LCD EZ-Extender.

The following topics are covered.

- "System Architecture" on page 2-2
  Describes the board configuration and explains how the board components interface with the processor and EZ-KIT Lite/EZ-Board.
- "Jumper Settings" on page 2-3
  Describes the on-board configuration jumpers.
- "Connectors" on page 2-12
  Describes the connectors on the EZ-Extender.

System Architecture

A block diagram of the Blackfin Landscape LCD EZ-Extender is shown in Figure 2-1.

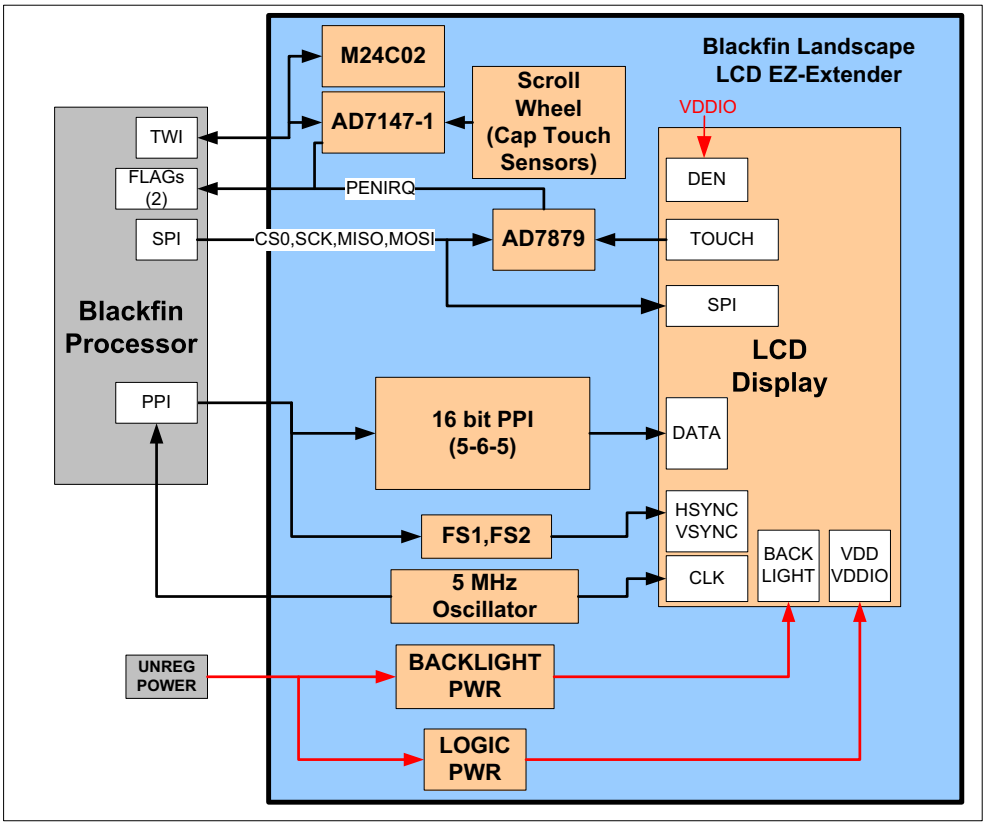

Figure 2-1. Block Diagram

Jumper Settings

Before using the Blackfin Landscape LCD EZ-Extender, follow the setup procedure in "Landscape LCD EZ-Extender Setup" on page 1-2.

Figure 2-2 shows the locations of all jumper headers. A two-pin jumper can be placed on the respective jumper header for different functionality. The following sections describe all possible jumper settings and associated functionality.

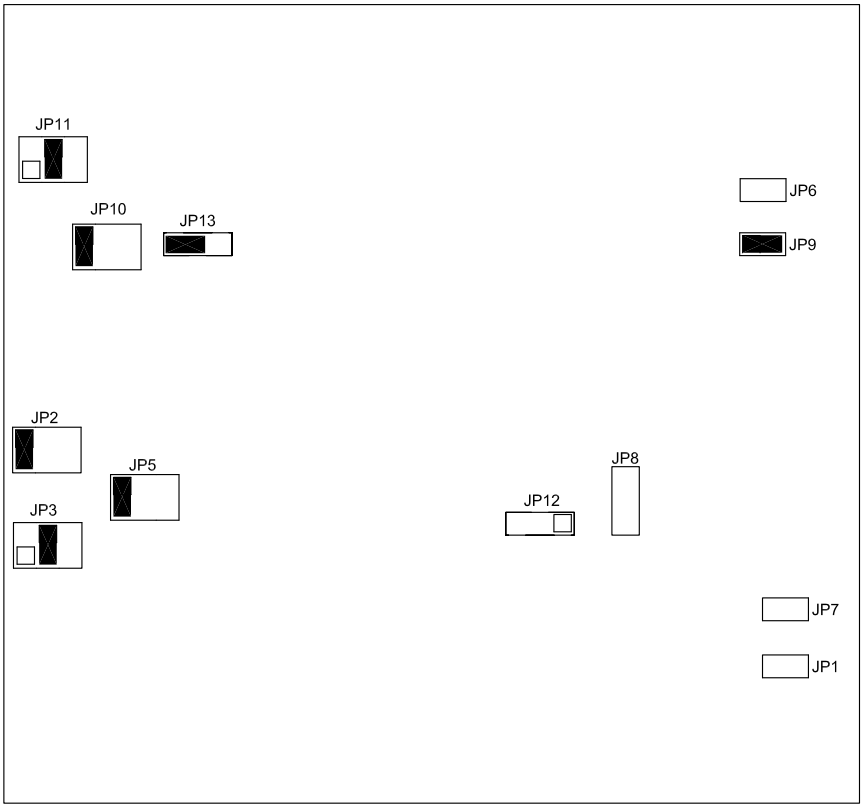

Figure 2-2. Jumper Locations