

RealView Platform Baseboard for ARM926EJ-S™

HBI-0117

User Guide

ARM®

RealView Platform Baseboard for ARM926EJ-S

User Guide

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Release Information

Change History			
Date	Issue	Confidentiality	Change
November 2003	A	Non-Confidential	First release.
April 2004	B	Non-Confidential	Second release. Added configuration details for USB debug, PCI, and Boot Monitor.
November 2005	C	Non-Confidential	Third release. Corrected reported defects and added requested enhancements.
August 2006	D	Non-Confidential	Fourth release. Corrected reported defects and added requested enhancements.
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The information in this document is final, that is for a developed product.

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Conformance Notices

This section contains conformance notices.

Federal Communications Commission Notice

This device is test equipment and consequently is exempt from part 15 of the FCC Rules under section 15.103 (c).

CE Declaration of Conformity



The system should be powered down when not in use.

The PB926EJ-S generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off or on, you are encouraged to try to correct the interference by one or more of the following measures:

- ensure attached cables do not lie across the card
- reorient the receiving antenna
- increase the distance between the equipment and the receiver
- connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- consult the dealer or an experienced radio/TV technician for help

Note

It is recommended that wherever possible shielded interface cables be used.

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Preface

This preface introduces the *RealView Platform Baseboard for ARM926EJ-S User Guide*. It contains the following sections:

- *About this manual* on page xviii
- *Feedback* on page xxv.

About this manual

This document describes how to set up and use the RealView Platform Baseboard for the ARM926EJ-S (PB926EJ-S).

Product revision status

The *rpn* identifier indicates the revision status of the product described in this manual, where:

- rn** Identifies the major revision of the product.
- pn** Identifies the minor revision or modification status of the product.

Intended audience

This document has been written for experienced hardware and software developers to aid the development of ARM-based products using the PB926EJ-S as part of a development system.

Using this manual

This document is organized into the following chapters:

Chapter 1 *Introduction*

Read this chapter for an introduction to the PB926EJ-S. This chapter shows the physical layout of the board and identifies the main components.

Chapter 2 *Getting Started*

Read this chapter for a description of how to set up and start using the PB926EJ-S. This chapter describes how to connect the add-on boards and how to apply power.

Chapter 3 *Hardware Description*

Read this chapter for a description of the hardware architecture of the PB926EJ-S. This chapter describes the peripherals, clocks, resets, and debug hardware provided by the board.

Chapter 4 *Programmer's Reference*

Read this chapter for a description of the PB926EJ-S memory map and registers. There is also basic information on the peripherals and controllers present in the platform baseboard.

Appendix A *Signal Descriptions*

Refer to this appendix for a description of the signals on the connectors.

Appendix B *Specifications*

Refer to this appendix for electrical, timing, and mechanical specifications.

Appendix C *CLCD Display and Adaptor Board*

Refer to this appendix for details of the CLCD display and interface.

Appendix D *PCI Backplane and Enclosure*

Refer to this appendix for details of the PCI backplane board.

Appendix E *Memory Expansion Boards*

Refer to this appendix for details of the memory expansion boards.

Appendix F *RealView Logic Tile*

Refer to this appendix for details on installing an ARM RealView Logic Tile product.

Appendix G *Configuring the USB Debug Connection*

Refer to this appendix for details on configuring the USB debug port for use with RealView Debugger.

Conventions

Conventions that this manual can use are described in:

- *Typographical*
- *Timing diagrams* on page xx
- *Signals* on page xxi
- *Numbering* on page xxi.

Typographical

The typographical conventions are:

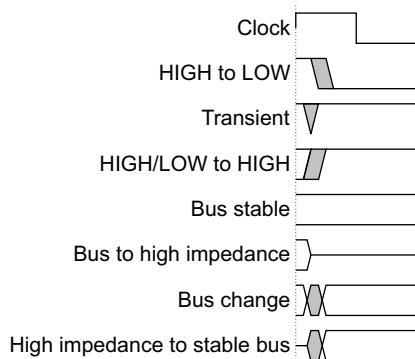
- | | |
|----------------------|---|
| <i>italic</i> | Highlights important notes, introduces special terminology, denotes internal cross-references, and citations. |
| bold | Highlights interface elements, such as menu names. Denotes signal names. Also used for terms in descriptive lists, where appropriate. |

<code>monospace</code>	Denotes text that you can enter at the keyboard, such as commands, file and program names, and source code.
<u><code>monospace</code></u>	Denotes a permitted abbreviation for a command or option. You can enter the underlined text instead of the full command or option name.
<code>monospace italic</code>	Denotes arguments to monospace text where the argument is to be replaced by a specific value.
<code>monospace bold</code>	Denotes language keywords when used outside example code.
<code>< and ></code>	Angle brackets enclose replaceable terms for assembler syntax where they appear in code or code fragments. They appear in normal font in running text. For example: <ul style="list-style-type: none"> • <code>MRC p15, 0 <Rd>, <CRn>, <CRm>, <Opcode_2></code> • The <code>Opcode_2</code> value selects which register is accessed.

Timing diagrams

The figure named *Key to timing diagram conventions* explains the components used in timing diagrams. Variations, when they occur, have clear labels. You must not assume any timing information that is not explicit in the diagrams.

Shaded bus and signal areas are undefined, so the bus or signal can assume any value within the shaded area at that time. The actual level is unimportant and does not affect normal operation.



Key to timing diagram conventions

Signals

The signal conventions are:

Signal level	The level of an asserted signal depends on whether the signal is active-HIGH or active-LOW. Asserted means HIGH for active-HIGH signals and LOW for active-LOW signals.
Lower-case n	Denotes an active-LOW signal.
Prefix A	Denotes global <i>Advanced eXtensible Interface</i> (AXI) signals:
Prefix AR	Denotes AXI read address channel signals.
Prefix AW	Denotes AXI write address channel signals.
Prefix B	Denotes AXI write response channel signals.
Prefix C	Denotes AXI low-power interface signals.
Prefix H	Denotes <i>Advanced High-performance Bus</i> (AHB) signals.
Prefix P	Denotes <i>Advanced Peripheral Bus</i> (APB) signals.
Prefix R	Denotes AXI read data channel signals.
Prefix W	Denotes AXI write data channel signals.

Numbering

The numbering convention is:

<size in bits>'<base><number>

This is a Verilog method of abbreviating constant numbers. For example:

- 'h7B4 is an unsized hexadecimal value.
- 'o7654 is an unsized octal value.
- 8'd9 is an eight-bit wide decimal value of 9.
- 8'h3F is an eight-bit wide hexadecimal value of 0x3F. This is equivalent to b00111111.
- 8'b1111 is an eight-bit wide binary value of b00001111.

Further reading

This section lists publications by ARM Limited, and by third parties.

ARM Limited periodically provides updates and corrections to its documentation. See <http://www.arm.com> for current errata sheets, addenda, and the Frequently Asked Questions list.

ARM publications

This manual contains information that is specific to the PB926EJ-S Platform Baseboard. See the following documents for other relevant information:

The following publications provide information about the registers and interfaces on the ARM926EJ-S PXP Development Chip:

- *ARM926EJ-S Development Chip Reference Guide* (ARM DDI 0287)
- *ARM926EJ-S Technical Reference Manual* (ARM DDI 0198)
- *ARM926EJ-S™ PrimeXsys Platform Virtual Component Technical Reference Manual* (ARM DDI 0232)
- *ARM926EJ-S™ PrimeXsys Platform Virtual Component User Guide* (ARM DUI 0213)
- *ARM MOVE Coprocessor Technical Reference Manual* (ARM DDI 0251)
- *ARM VFP9-S Coprocessor Technical Reference Manual* (ARM DDI 0238)
- *ARM MBX HR-S Graphics Core Technical Reference Manual* (ARM DDI 0241).

The following publications provide reference information about the ARM architecture:

- *AMBA™ Specification* (ARM IHI 0011)
- *ARM Architecture Reference Manual* (ARM DDI 0100).

The following publications provide information about related ARM products and toolkits:

- *Multi-ICE™ User Guide* (ARM DUI 0048)
- *RealView™ ICE User Guide* (ARM DUI 0155)
- *Trace Debug Tools User Guide* (ARM DUI 0118)
- *ARM MultiTrace® User Guide* (ARM DUI 0150)
- *ARM RealView Logic Tile LT-XC2V4000+ User Guide* (ARM DUI 0186)
- *RealView™ Debugger User Guide* (ARM DUI 0153)
- *RealView Compilation Tools Compilers and Libraries Guide* (ARM DUI 0205)
- *RealView Compilation Tools Developer Guide* (ARM DUI 0203)
- *RealView Compilation Tools Linker and Utilities Guide* (ARM DUI 0206).

The following publications provide information about ARM PrimeCell® and other peripheral or controller devices:

- *ARM PrimeCell Advanced Audio CODEC Interface (PL041) Technical Reference Manual* (ARM DDI 0173)
- *ARM PrimeCell Color LCD Controller (PL110) Technical Reference Manual* (ARM DDI 0161)
- *ARM PrimeCell DMA (PL080) Technical Reference Manual* (ARM DDI 0196)
- *ARM Dual-Timer Module (SP804) Technical Reference Manual* (ARM DDI 0271)
- *ARM PrimeCell GPIO (PL061) Technical Reference Manual* (ARM DDI 0190)
- *ARM PrimeCell Keyboard Mouse Controller (PL050) Technical Reference Manual* (ARM DDI 0143)
- *ARM PrimeCell Multimedia Card Interface (PL180) Technical Reference Manual* (ARM DDI 0172)
- *ARM Multiport Memory Controller (GX175) Technical Reference Manual* (ARM DDI 0277)
- *ARM PrimeCell Real Time Clock Controller (PL031) Technical Reference Manual* (ARM DDI 0224)
- *ARM PrimeCell Smart Card Interface (PL131) Technical Reference Manual* (ARM DDI 0228)
- *ARM PrimeCell Synchronous Serial Port Controller (PL022) Technical Reference Manual* (ARM DDI 0194)
- *ARM PrimeCell Synchronous Static Memory Controller (PL093) Technical Reference Manual* (ARM DDI 236)
- *ARM PrimeCell System Controller (SP810) Technical Reference Manual* (ARM DDI 0254)
- *ARM PrimeCell UART (PL011) Technical Reference Manual* (ARM DDI 0183)
- *ARM PrimeCell Vector Interrupt Controller (PL190) Technical Reference Manual* (ARM DDI 0181)
- *ARM PrimeCell Watchdog Controller (SP805) Technical Reference Manual* (ARM DDI 0270)
- *ETM9 Technical Reference Manual* (ARM DDI 0157).

Other publications

This section lists relevant documents published by third parties:

The following publication describes the JTAG ports with which Multi-ICE or RealView ICE communicates:

- *IEEE Standard Test Access Port and Boundary Scan Architecture* (IEEE Std. 1149.1).

The following datasheets describe some of the integrated circuits or modules used on the PB926EJ-S:

- *CODEC with Sample Rate Conversion and 3D Sound* (LM4549) National Semiconductor, Santa Clara, CA.
- *Mobile DiskOnChip Plus 32/64MByte*, M-Systems Inc., Newark, CA.
- *MultiMedia Card Product Manual* SanDisk, Sunnyvale, CA.
- *Serially Programmable Clock Source* (ICS307), ICS, San Jose, CA.
- *Serial Microwire Bus EEPROM* (M93LC46) STMicroelectronics, Amsterdam, The Netherlands.
- *1.8 Volt Intel StrataFlash® Wireless Memory* with 3.0 Volt I/O Intel Corporation, Santa Clara, CA. See the *Build of Materials* (BOM) file for the part number of the flash device.
- *TFT-LCD Module* (LQ084V1DG21) Sharp Corporation, Osaka, Japan.
- *Three-In-One Fast Ethernet Controller* (LAN91C111) SMSC, Hauppauge, NY.
- *Touch Screen Controller* (TCS2200) Texas Instruments, Dallas, TX.

Feedback

ARM® Limited welcomes feedback both on the PB926EJ-S and on the documentation.

Feedback on this product

If you have any comments or suggestions about this product, contact your supplier giving:

- the product name
- a concise explanation of your comments.

Feedback on this manual

If you have any comments about this document, send email to errata@arm.com giving:

- the title
- the number
- the relevant page number(s) to which your comments apply
- a concise explanation of your comments.

ARM® Limited also welcomes general suggestions for additions and improvements.

Chapter 1

Introduction

This chapter introduces the PB926EJ-S. It contains the following sections:

- *About the PB926EJ-S* on page 1-2
- *PB926EJ-S architecture* on page 1-4
- *Precautions* on page 1-9.

1.1 About the PB926EJ-S

The PB926EJ-S provides a development system that you can use to develop products around the ARM926EJ-S PXP Development Chip.

You can use the PB926EJ-S as a basic development system with a power supply and a connection to a JTAG interface unit.

You can expand the PB926EJ-S by adding:

- ARM RealView Logic Tiles containing custom IP
- a PCI expansion enclosure
- Dynamic memory expansion board
- Static memory expansion board
- VGA monitor or CLCD adaptor and CLCD display
- MMC, SD, or SIM cards
- custom devices to the 32-bit GPIO
- USB devices to the three USB ports
- serial devices to the synchronous serial port and the four UARTs
- keyboard and mouse
- audio devices to the onboard CODEC
- an Ethernet network to the onboard Ethernet controller.

The basic system provides a good platform for developing code for the ARM7 and ARM9 series of processors. The ARM926EJ-S PXP Development Chip is much faster than a software simulator or a core implemented in RealView Logic Tiles. Code developed for the ARM926EJ-S PXP Development Chip will also run on the ARM10 and ARM11 processor series.

The expanded system with RealView Logic Tiles can be used to develop AMBA-compatible peripherals and to test ASIC designs. The fast processor core and the peripherals present in the ARM926EJ-S PXP Development Chip, PB926EJ-S FPGA, and RealView Logic Tile FPGA enable you to develop and test complex systems operating at, or near, their target operating frequency.

Figure 1-1 on page 1-3 shows the layout of the PB926EJ-S.

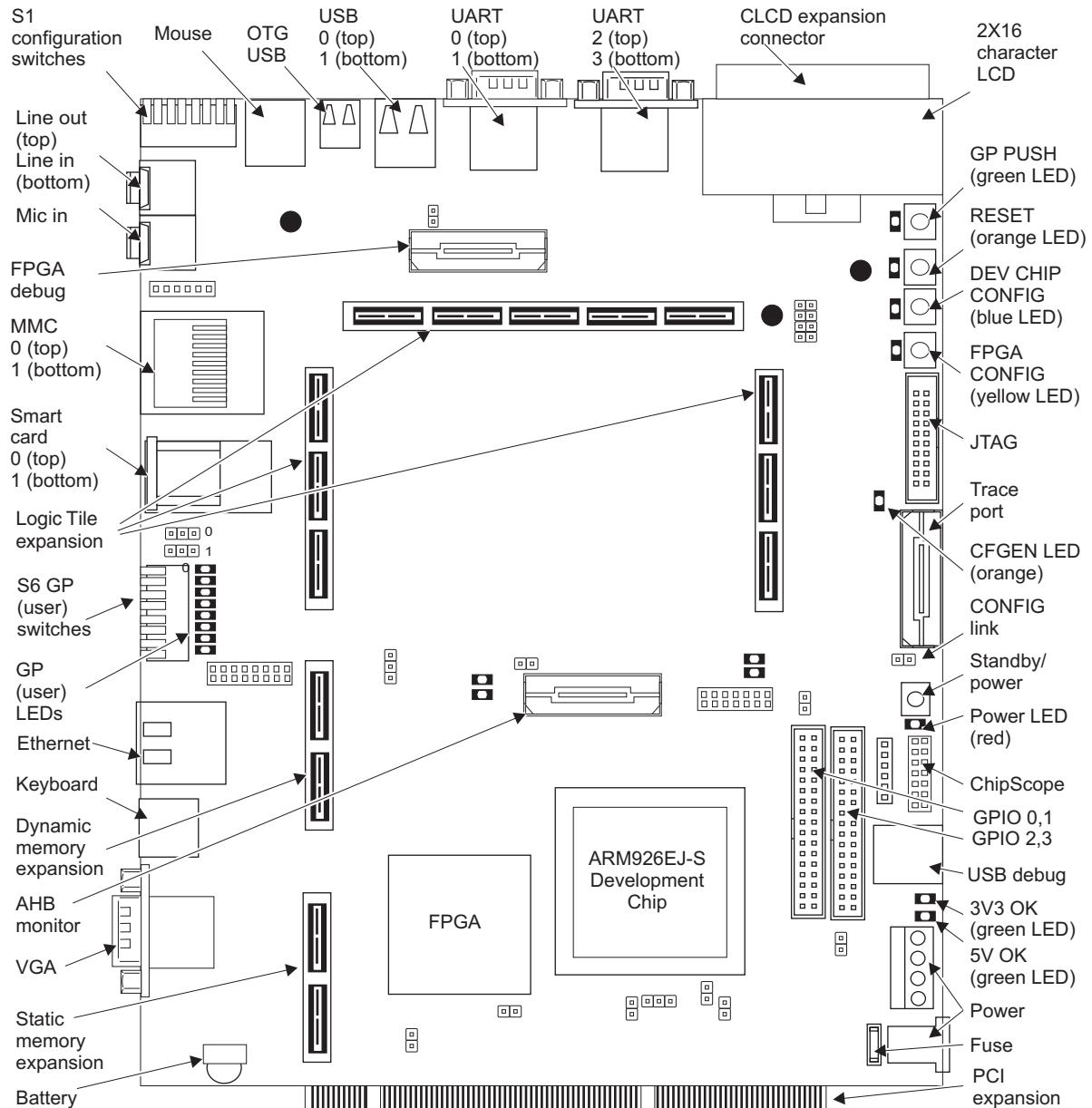


Figure 1-1 PB926EJ-S layout

1.2 PB926EJ-S architecture

The major components on the platform are:

- ARM926EJ-S PXP Development Chip equipped with:
 - ARM926EJ-S processor that supports 32-bit ARM and 16-bit Thumb instructions sets and includes features for direct execution of Java byte codes. Executing Java byte codes requires the *Java Technology Enabling Kit* (JTEK)
 - *Tightly-Coupled Memory* (TCM) for code (32KB) and data (32KB)
 - cache memory for code (32KB) and data (32KB)
 - *Memory Management Unit* (MMU)
 - Multi-layer bus matrix that gives highly efficient simultaneous transfers
 - MOVE™ video encoding coprocessor
 - MBX graphics accelerator
 - Multi-Port Memory Controller (MPMC) for direct connection to dynamic memory
 - Synchronous Static Memory Controller (SSMC) for direct connection to static (SRAM or flash) memory
 - VFP9 Vector Floating Point coprocessor
 - two external AHB master bridges and one external AHB slave bridge
 - AHB monitor for detailed analysis of bus activity
 - System Controller
 - DMA controller
 - *Vectored Interrupt Controller* (VIC)
 - *Color LCD controller* (CLCDC)
 - Three UARTs,
 - *Synchronous Serial Port* (SSP)
 - *Smart Card Interface* (SCI)
 - Four eight-bit GPIOs
 - *Real Time Clock* (RTC)
 - Two programmable timers
 - Watchdog timer
 - *Embedded Trace Macrocell* (ETM9)
 - Embedded-ICE logic for JTAG debugging
 - *Phase-Locked Loop* (PLL)
 - Configuration Block.

- *Field Programmable Gate-Array (FPGA)* that implements:
 - SSP, Smart Card, two MMC/SD card, UART, and two KMI controllers
 - configuration registers
 - interface to onboard Ethernet controllers
 - interface to onboard audio CODEC
 - interface to onboard *On-the-Go* (OTG) USB controller (three connectors)
 - registers for status, ID, onboard switches, LEDs, and clock control
 - a secondary interrupt controller and external DMA control logic
 - interface to PCI bus (for expansion through optional PCI expansion enclosure).
- 128MB of 32-bit wide SDRAM
- 2MB of 32-bit wide static RAM
- 128MB of 32-bit wide NOR flash (two devices)
- up to 320MB of static memory in an optional static memory expansion board
- up to 256MB of SDRAM in an optional dynamic memory expansion board
- programmable clock generators
- connectors for VGA, color LCD display interface board, PCI, UART, GPIO, keyboard, mouse, Smart Card, USB, audio, MMC, SSP, and Ethernet
- RealView Logic Tile connector (one or more optional RealView Logic Tiles can be used to develop custom IP)
- debug and test connectors for JTAG, AHB monitor, ChipScope, and Trace port
- DIP switches and LEDs
- 2 row by 16 character LCD display
- power conversion circuitry
- *Real-Time Clock* (RTC)
- time of year clock with backup battery.

1.2.1 System architecture

Figure 1-2 shows the architecture of the PB926EJ-S.

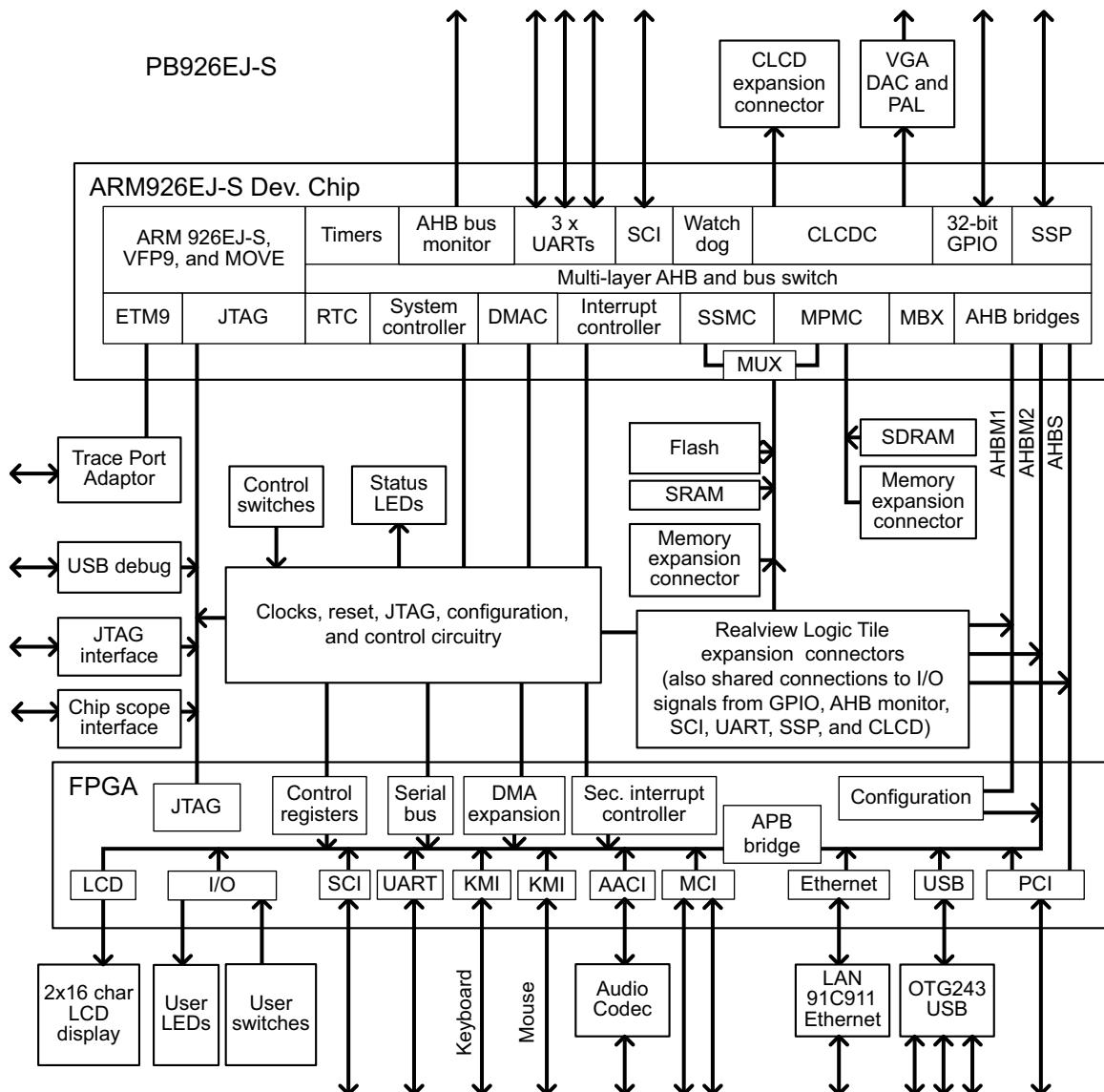


Figure 1-2 PB926EJ-S block diagram

1.2.2 ARM926EJ-S PXP Development Chip

For details on the ARM926EJ-S PXP Development Chip, see *ARM926EJ-S PXP Development Chip* on page 3-3 and the *ARM926EJ-S PXP Development Chip Reference Manual*.

1.2.3 PB926EJ-S FPGA

The FPGA provides system control and configuration functions for the PB926EJ-S that enable it to operate as a standalone development system or with expansion RealView Logic Tiles or PCI cards. See *FPGA* on page 3-17.

The FPGA also implements additional peripherals, for example the audio CODEC, USB, Ethernet and PCI interfaces.

1.2.4 Displays

The ARM926EJ-S PXP Development Chip outputs signals for a color LCD display. An external interface board can be connected to the CLCD connector to drive different size displays.

The CLCD signals from the ARM926EJ-S PXP Development Chip are converted on the PB926EJ-S to a VGA signal. The resolution of the VGA signal is configurable. See Appendix C *CLCD Display and Adaptor Board*.

There is also a two row by sixteen character display mounted on the PB926EJ-S. This display can be used for debugging or as the output from applications.

1.2.5 RealView Logic Tile expansion

The ARM RealView Logic Tiles, such as the LT-XC2V6000, enable the development of AMBA AHB and APB peripherals, or custom logic, for use with ARM cores. You can place standard or custom peripherals in the FPGA on the RealView Logic Tile. Three AHB buses, the static memory interface, and the DMA and interrupt signals are brought out to the RealView Logic Tile connectors. See Appendix F *RealView Logic Tile*.

1.2.6 Memory

The volatile memory system includes SSRAM and SDRAM memory. You can expand this memory by installing external static or dynamic memory expansion boards.

The nonvolatile memory system consists of 128MB of 32-bit flash. The flash is managed by the static memory controller in the ARM926EJ-S PXP Development Chip. You can expand the flash memory by installing an external static memory expansion board. See *Appendix E Memory Expansion Boards*.

1.2.7 Clock generators

The PB926EJ-S contains the following clock sources:

- crystal oscillators (these are the reference frequencies for the Real Time Clock, USB, AACI, Ethernet, and programmable oscillators)
- five programmable ICS307 clock sources. Two of these are used as the reference for the CPU system clock in the ARM926EJ-S PXP Development Chip and the CLCD controller clock. The other three programmable clocks can be used as external reference clocks for the AHB buses.
- if fitted, the PCI backplane or RealView Logic Tiles. The external clocks can be selected as the reference clocks for the PB926EJ-S.

See *Clock architecture* on page 3-35.

1.2.8 Debug and test interfaces

The JTAG connector enables JTAG hardware debugging equipment, such as Multi-ICE or RealView ICE, to be connected to the PB926EJ-S. The JTAG signals can also be controlled by the on-board USB debug port controller. See *JTAG and USB debug port support* on page 3-96.

A Mictor connector on the PB926EJ-S enables monitoring of the ARM926EJ-S PXP Development Chip *Embedded Trace Macrocell* (ETM9) signals by a *Trace Port Analyzer* (TPA). The trace port is medium trace size (16-bit packet). See *Trace connector pinout* on page A-37 for connection information.

1.3 Precautions

This section contains safety information and advice on how to avoid damage to the PB926EJ-S.

1.3.1 Ensuring safety

The PB926EJ-S can be powered from one of the following sources:

- the supplied power supply connected to J35
- a bench power supply connected to the screw terminals on header J34
- an external PCI bus.

———— **Warning** ———

Do not supply more than one power source. If you are using the baseboard with the PCI enclosure for example, do not connect a power source to J35 or J34.

To avoid a safety hazard, only connect *Safety Extra Low Voltage* (SELV) equipment to the connectors on the PB926EJ-S.

1.3.2 Preventing damage

The PB926EJ-S is intended for use in a laboratory or engineering development environment. If operated without an enclosure, the board is sensitive to electrostatic discharges and generates electromagnetic emissions.

———— **Caution** ———

To avoid damage to the board, observe the following precautions.

- never subject the board to high electrostatic potentials
- always wear a grounding strap when handling the board
- only hold the board by the edges
- avoid touching the component pins or any other metallic element
- do not connect more than one power source to the platform
- always power down the board when connecting RealView Logic Tiles or expansion boards.

———— **Caution** ———

Do not use the board near equipment that is:

- sensitive to electromagnetic emissions (such as medical equipment)
- a transmitter of electromagnetic emissions.

Chapter 2

Getting Started

This chapter describes how to set up and prepare the PB926EJ-S for use. It contains the following sections:

- *Setting up the RealView Platform* on page 2-2
- *Setting the configuration switches* on page 2-3
- *Connecting JTAG debugging equipment* on page 2-8
- *Connecting the Trace Port Analyzer* on page 2-10
- *Supplying power* on page 2-13
- *Using the PB926EJ-S Boot Monitor and platform library* on page 2-14.

2.1 Setting up the RealView Platform

The following items are supplied with the PB926EJ-S:

- the PB926EJ-S printed-circuit board mounted on a metal tray
- an AC power supply that provides a 12VDC output
- a CD containing sample programs, Boot Monitor code, FPGA and PLD images, and additional documentation
- this user guide.

To set up the PB926EJ-S as a standalone development system:

1. Set the configuration switches to select the boot memory location, operating frequency, and FPGA image. See *Setting the configuration switches* on page 2-3.
2. If you are using memory expansion boards, connect them to the PB926EJ-S. See *Appendix E Memory Expansion Boards*.
3. If you are using an external display:
 - For VGA displays, connect the cable from the display to the VGA connector on the PB926EJ-S.
 - For CLCD displays, connect the CLCD adaptor board cable to the PB926EJ-S. See *Appendix C CLCD Display and Adaptor Board*.
4. If you are using expansion Logic Tiles, mount the tile on the tile expansion connectors. See *Appendix F RealView Logic Tile* and the manual for your Logic Tile.
5. If you are using a *Trace Port Analyzer* (TPA), connect the Trace Port interface buffer board. See *Connecting the Trace Port Analyzer* on page 2-10.
6. If you are using a debugger, connect to the JTAG or USB debug port on the board. See *Connecting JTAG debugging equipment* on page 2-8.
7. Apply power to the PB926EJ-S. See *Supplying power* on page 2-13.
8. If you are using the supplied Boot Monitor software to select and run an application, see *Using the PB926EJ-S Boot Monitor and platform library* on page 2-14

— **Note** —

If you are using the PB926EJ-S with the PCI backplane, see also *Appendix D PCI Backplane and Enclosure*.

2.2 Setting the configuration switches

Configuration switches S1 and S6, shown in Figure 2-1, control how the PB926EJ-S configures itself and the action to take after reset.

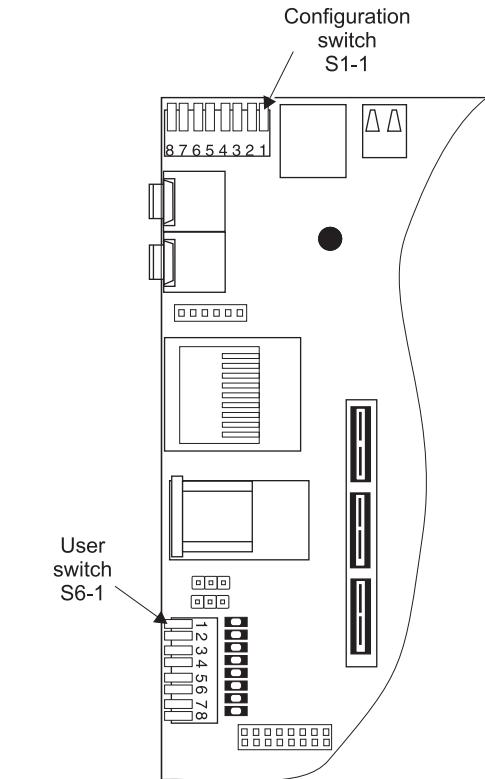


Figure 2-1 Location of S1-1 and S6-1

2.2.1 Boot memory configuration

The configuration switches S1-1 to S1-8 determine boot memory type, the FPGA image, and the Logic Tile image, memory configuration, and FPGA options at power on.

Use switch S1-1 and S1-2 to select the boot device as shown in Table 2-1 on page 2-4.

————— **Note** —————

If the switch lever is down, the switch is ON. The default is OFF, switch lever up.

Table 2-1 Selecting the boot device

S1-2	S1-1	Device
OFF	OFF	Reserved (boot from NOR flash 2 - default setting)
OFF	ON	NOR flash 1, see <i>Booting from NOR flash 1</i> on page 4-12
ON	OFF	Reserved
ON	ON	AHB expansion memory, see <i>Booting from AHB expansion memory</i> on page 4-14

Configuration switches S1-1 to S1-8 are not normally changed from their factory default positions listed in Table 2-2. For more information on configuration switch S1, see *Configuration control* on page 3-7.

Table 2-2 Default switch positions

Switch	Default	Function in default position
S1-1 and S1-2	OFF	Selects NOR flash 2 as boot memory
S1-3	OFF	Selects synchronous AHB bridge mode.
S1-4	OFF	Reserved (SSMC enabled), leave in OFF position
S1-5	OFF	Selects OSCCLK frequency of 35MHz.
S1-6 and S1-7	OFF	Selects PB926EJ-S FPGA image 0
S1-8	OFF	Selects Logic Tile FPGA image 0

Note

For information on other configuration links see *Test, configuration, and debug interfaces* on page 3-94. For the function of the status LEDs see *LED Indicators* on page 2-5,

2.2.2 LED indicators

Table 2-3 lists the PB926EJ-S LED indicators and their function.

Table 2-3 LED Indicators

LED ID	Color	Device	Function
5V OK	Green	D29	Indicates that the 5V power supply is on
3V3 OK	Green	D34	Indicates that the 3V3 power supply is on
Standby	Red	D39	Indicates that the PB926EJ-S is in standby mode and the power is off. This LED only functions when power is supplied to the board via connector J35
Config	Amber	D44	Indicates that the PB926EJ-S is in configuration mode. Configuration mode is entered by fitting the CONFIG link J32 on the board and powering-up The CONFIG link is a switch on some board versions.
FPGA Config	Yellow	D6	Directly indicates the status of the FPGA Config pushswitch S4. LED is off when the switch is pressed
DEV CHIP Reconfig	Blue	D3	Directly indicates the status of the DEV CHIP Reconfig pushswitch S5. LED is off when the switch is pressed
Reset	Amber	D4	Directly indicates the status of the Reset pushswitch S2. LED is off when the switch is pressed
GP (User) Pushswitch	Green	D5	Directly indicates the status of the general purpose pushswitch S3. LED is off when the switch is pressed
GP (User) LEDs	Green	D12-18, D20	Eight general purpose LEDs. These LEDs are controlled individually by the lower eight bits of the <code>SYS_LED</code> register. See <i>User switches and LEDs</i> on page 3-87 for further details
Ethernet	Green Yellow	J5	Ethernet activity indicators. These LEDs are integral to the Ethernet connector J5 and are configured by writing to a register in the LAN91C111 fast Ethernet controller. See <i>Ethernet interface</i> on page 3-68 for further details
Global Done	Green	D8	Indicates that all the FPGA devices on the Logic Tiles have been configured

Table 2-3 LED Indicators (continued)

LED ID	Color	Device	Function
Local Done	Green	D7	Indicates that the PB926EJ-S FPGA device has been configured
USB Debug Busy	Amber	D22	Indicates that the embedded Real View ICE Micro Edition hardware is active
USB Debug On	Green	D23	Indicates that the embedded RealView ICE Micro Edition hardware is enabled

2.2.3 Boot Monitor configuration

Switches S6-1 and S6-3 control the Boot Monitor.

The setting of S6-1 determines whether the Boot Monitor starts after a reset:

- | | |
|-----------------|---|
| S6-1 OFF | A prompt is displayed enabling you to enter Boot Monitor commands. |
| S6-1 ON | The Boot Monitor executes a boot script that has been loaded into flash. The boot script can execute any Boot Monitor commands. It typically selects and runs an image in application flash. You can store one or more code images in flash memory and use the boot script to start an image at reset. Use the <code>SET BOOTSCRIPT</code> command to enter a boot script from the Boot Monitor (see Table 2-4 on page 2-15). |

Output of text from STDIO for both applications and Boot Monitor I/O depends on the setting of S6-3:

- | | |
|-----------------|---|
| S6-3 ON | STDIO is redirected to UART0. This occurs even under semihosting. |
| S6-3 OFF | STDIO autodetects whether to use semihosting I/O or a UART. If a debugger is connected and semihosting is enabled, STDIO is redirected to the debugger console window. Otherwise, STDIO goes to the UART. |

S6-3 does not affect file I/O operations performed under semihosting. Semihosting operation requires a debugger and a JTAG interface device. See *Redirecting character output to hardware devices* on page 2-21 for more details on I/O.

— **Note** —

Switch S6-2 and S6-4 to S6-8 are not used by the Boot Monitor and are available for user applications.

2.3 Connecting JTAG debugging equipment

You can use JTAG debugging equipment and the JTAG connector, or the USB debug port, to:

- connect a debugger to the ARM926EJ-S core and download programs to memory and debug them
- program new configuration images into the configuration flash, FPGA, and PLDs on the board. (You cannot program the normal flash from configuration mode.)

The setup for using a JTAG interface with the PB926EJ-S is shown in Figure 2-2.

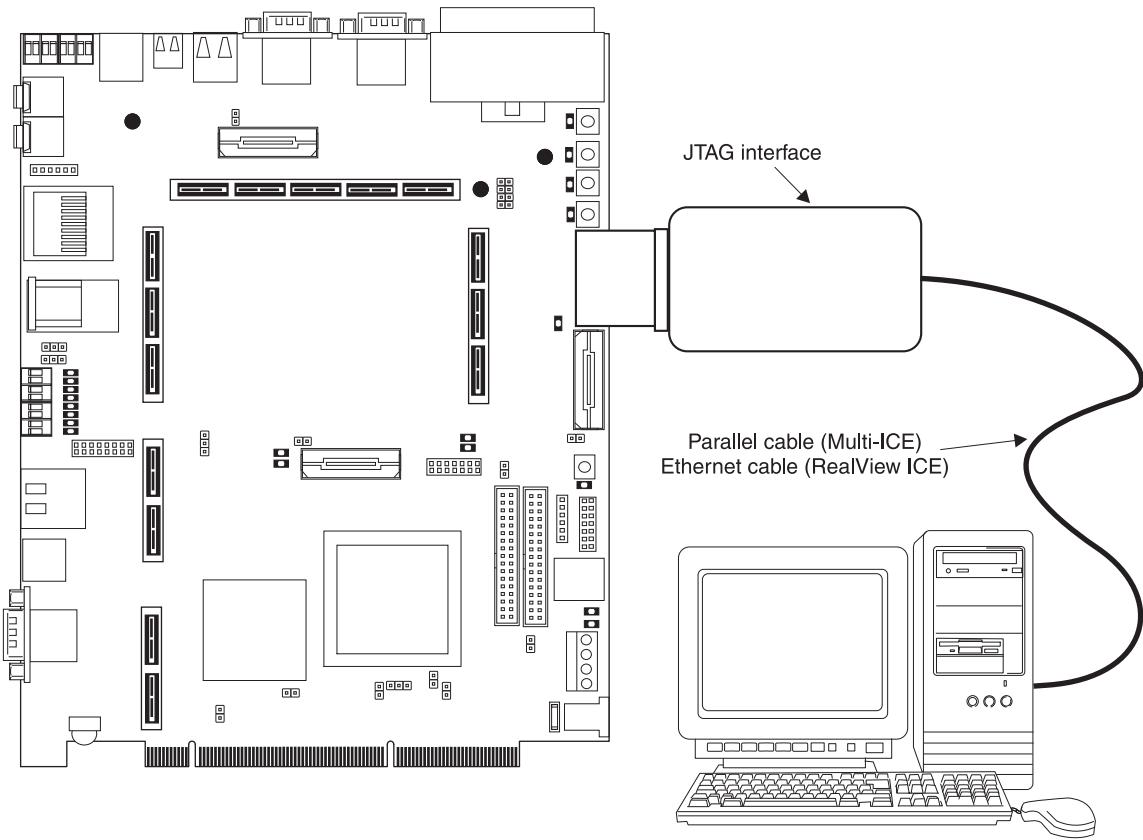


Figure 2-2 JTAG connection

The setup for using the USB debug port on the PB926EJ-S is shown in Figure 2-3 on page 2-9. The PB926EJ-S contains logic that interfaces the USB debug port to the onboard JTAG signals.

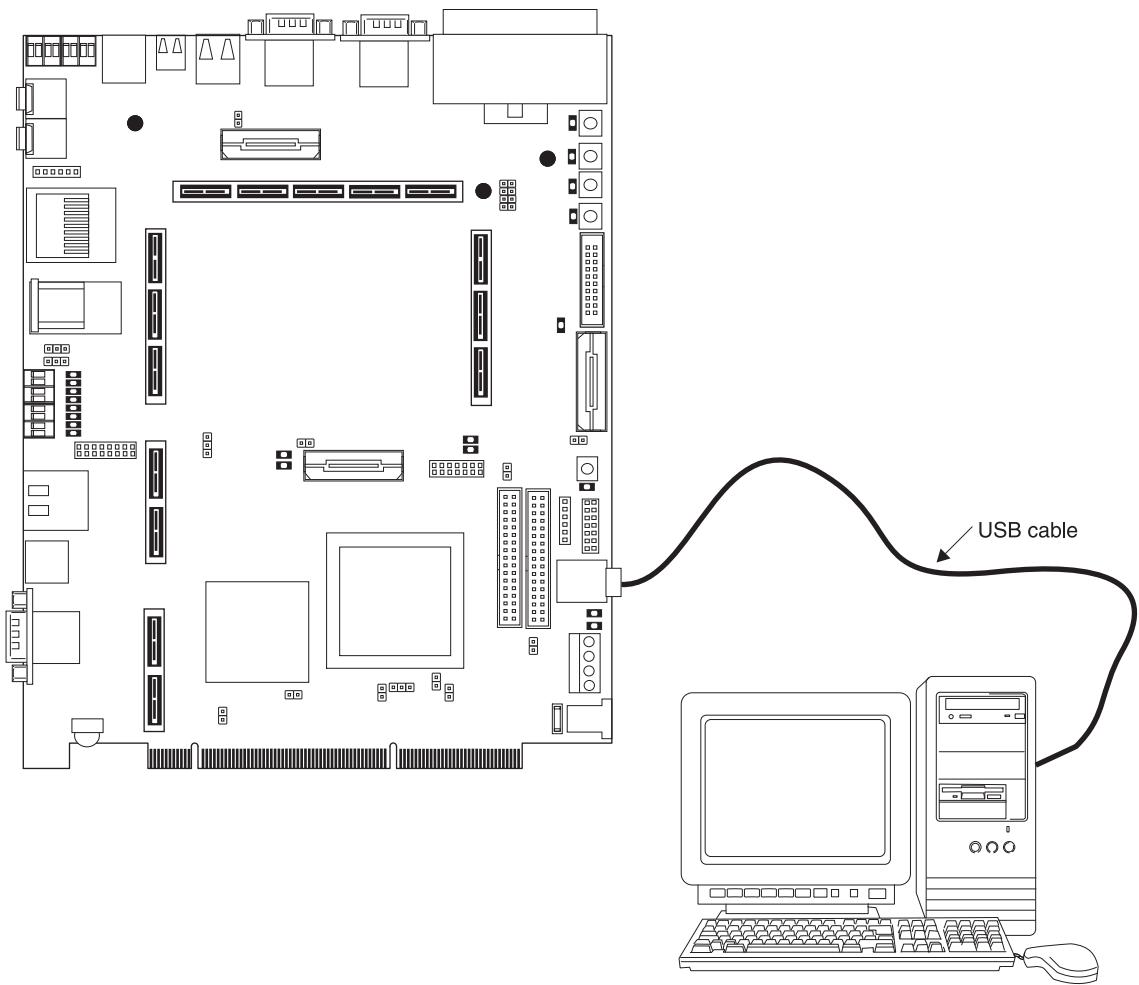


Figure 2-3 USB debug port connection

Note

For more details on JTAG debugging and selection between the JTAG and USB debug connector, see *JTAG and USB debug port support* on page 3-96. If you are using the ARM RealView® Debugger, see Appendix G *Configuring the USB Debug Connection* for installation and configuration details.

2.4 Connecting the Trace Port Analyzer

The ARM926EJ-S PXP Development Chip incorporates an *ARM9 Embedded Trace Macrocell* (ETM9). This enables you to carry out real-time debugging by connecting external trace equipment to the PB926EJ-S. The ETM9 monitors the program execution and sends a compressed trace to the *Trace Port Analyzer* (TPA). The TPA buffers this information and transmits it to the debugger where it is decompressed and used to reconstruct the complete instruction flow. The trace size is medium (16-bit packets).

For MultiTrace, connect the TPA to the buffer board and plug the adaptor into the PB926EJ-S as shown in Figure 2-4. MultiTrace requires a Multi-ICE JTAG unit.

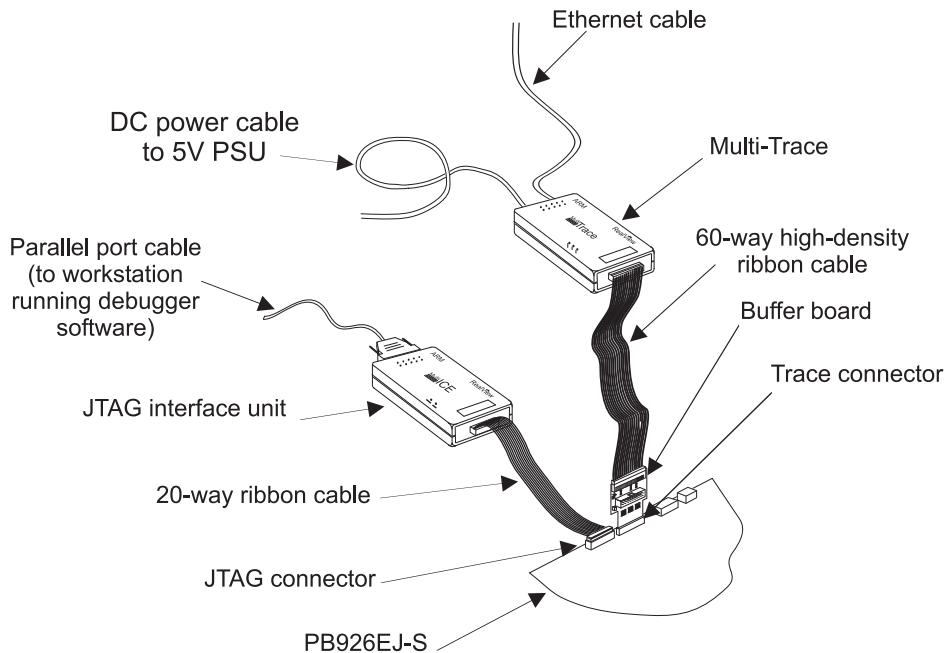


Figure 2-4 Example of MultiTrace and JTAG connection

For RealView Trace, connect the *Trace Port Analyzer* (TPA) to the adaptor board and plug the adaptor into the PB926EJ-S as shown in Figure 2-4. RealView Trace requires a RealView ICE JTAG unit. The Ethernet and power supply cables connect to the RealView ICE unit.

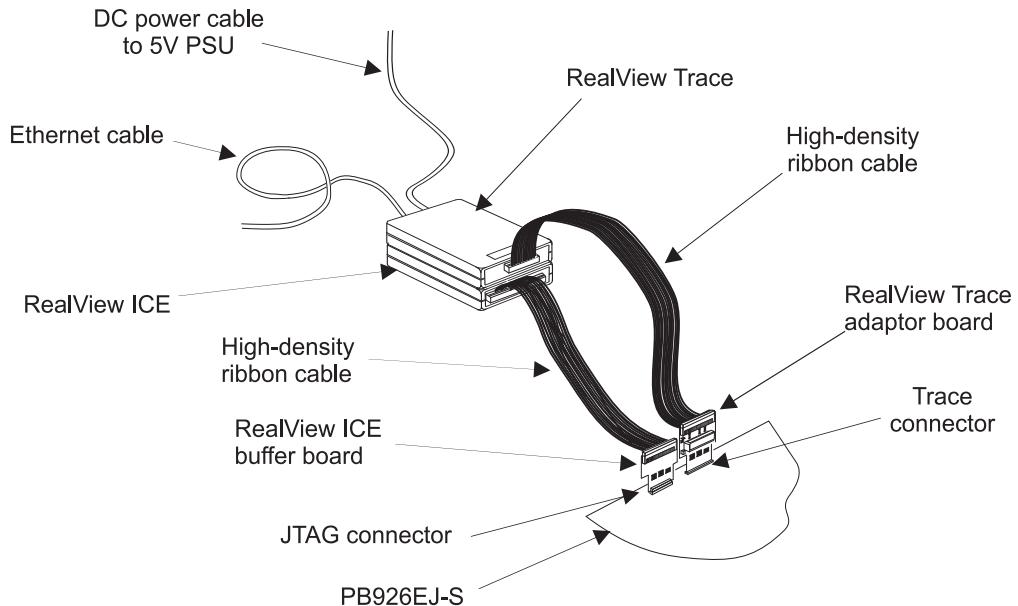


Figure 2-5 Example of RealView ICE and RealView Trace

— Note —

The high-density cable from the RealView ICE box requires a buffer board to connect to the JTAG connector on the PB926EJ-S.

The low-density cable can be used to connect the RealView ICE box directly to the JTAG connector, but this interface operates at lower speed.

2.4.1 About using trace

The components used for trace capture are:

ETM The Embedded Trace Macrocell is part of the ARM926EJ-S PXP Development Chip. It monitors the ARM core buses and outputs compressed information through the trace port to a trace connector. The on-chip ETM contains trigger and filter logic to control what is traced.

Trace connector and adaptor board

The trace connector enables you to connect a TPA to the PB926EJ-S. The connector is a high-density AMP Mictor connector. The pinout for this connector is provided in *Test and debug connections* on page A-33.

The adaptor board buffers the high-speed signals between the Trace connector and the Trace Port Analyzer.

JTAG unit This is a protocol converter that converts debug commands from the debugger into JTAG messages for the ETM.

Trace Port Analyzer

The TPA is an external device (such as RealView Trace) that connects to the trace connector (through the adaptor board) and stores information sent from the ETM.

Debugger and Trace software

The debugger and trace software controls the JTAG, ETM, and Trace Port Analyzer. The trace software reconstructs program flow from the information captured in the Trace Port Analyzer.

— Note —

The trace and debug components must match the debugger you are using:

ARM eXtended Debugger (AXD)

AXD is a component of the *ARM Developer Suite* (ADS). Use AXD with Multi-ICE, Trace Debug Toolkit, and Multi-Trace.

ARM RealView Debugger (RVD)

RVD is a component of *RealView Compilation Tools* (RVCT). Use RVD with RealView ICE and RealView Trace or with Multi-ICE and Multi-Trace.

2.5 Supplying power

When using the PB926EJ-S as a standalone development system, you must connect the supplied brick power supply to power socket J35 or an external bench power supply to the screw-terminal connector. See Figure 2-6.

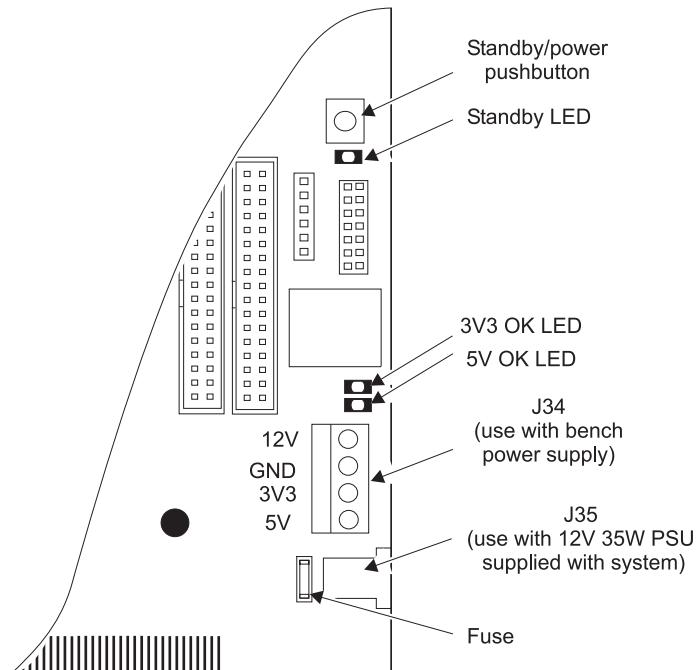


Figure 2-6 Power connectors

— **Note** —

If you are using the supplied brick power supply connected to J35, the Standby/power pushbutton toggles the power on and off.

If you are using an external power supply connected to J34, or you are powering the board from the PCI backplane, the Standby/power switch is not used and power is controlled by shutting down the external power source.

— **Caution** —

You can use only one power source for the system. Use only the PCI connector, J34, or J35. Do not, for example, use the PCI connector and J34 at the same time.

2.6 Using the PB926EJ-S Boot Monitor and platform library

The PB926EJ-S Boot Monitor is a collection of tools and utilities designed as an aid to developing applications on the PB926EJ-S.

When the Boot Monitor starts on reset, the following actions are performed:

- clock dividers are loaded with appropriate values
- the memory controllers are initialized
- a stack is set up in memory
- Boot Monitor code is copied into SDRAM
- C library I/O routines are remapped and redirected
- the current bootscript, if any, is run.

2.6.1 Running the Boot Monitor

To run Boot Monitor and have it display a prompt to a terminal connected to UART0, set switch S6-1 to OFF and reset the system. Standard input and output functions use UART0 by default. The default setting for UART0 is 38400 baud, 8 data bits, no parity, 1 stop bit. There is no hardware or software flow control.

————— **Note** —————

If the Boot Monitor has been accidentally deleted from flash memory, it can be rebuilt and reloaded. See *Rebuilding the Boot Monitor* on page 2-18.

Boot Monitor commands

The command interpreter accepts user commands from the debugger console window or an attached terminal and carries out actions to complete the commands.

————— **Note** —————

Commands are accepted in uppercase or lowercase. The Boot Monitor accepts abbreviations of commands if the meaning is not ambiguous. For example, for QUIT, you can type QUIT, QUI, QU, Q, quit, qui, qu, or q.

Table 2-4 lists the commands for the Boot Monitor.

Table 2-4 Boot Monitor commands

Command	Action
<code>@ <i>script_file</i></code>	Runs a script file.
<code>ALIAS <i>alias</i> <i>commands</i></code>	Create an alias command <i>alias</i> for the string of commands contained in <i>commands</i> .
<code>CLEAR BOOTSCRIPT</code>	Clear the current boot script. The Boot Monitor will prompt for input on reset even if the S6-1 is set to ON to indicate that a boot script should be run.
<code>CONFIGURE</code>	Enter Configure subsystem. Commands listed in Table 2-5 on page 2-16 can now be executed.
<code>CONVERT BINARY <i>binary_file</i> LOAD_ADDRESS <i>address</i> [ENTRY_POINT <i>address</i>]</code>	Provides information to the system that is required by the RUN command in order to execute a binary file. A new file with name <i>binary_file</i> is produced, but with an .exe file extension.
<code>DEBUG</code>	Enter the debug subsystem. Commands listed in Table 2-6 on page 2-16 can now be executed.
<code>DISABLE CACHES</code>	Disable both the I and D caches.
<code>DISPLAY BOOTSCRIPT</code>	Display the current boot script.
<code>ECHO <i>text</i></code>	Echo <i>text</i> to the current output device.
<code>ENABLE CACHES</code>	Enable both the I and D caches.
<code>EXIT</code>	Exit the Boot Monitor. The processor is held in a tight loop until it is interrupted by a JTAG debugger.
<code>FLASH</code>	Enter the flash file system for the NOR flash on the PB926EJ-S. See Table 2-7 on page 2-17 for flash commands.
<code>HELP</code>	List the Boot Monitor commands.
<code>QUIT</code>	Alias for EXIT. Exit the Boot Monitor.
<code>SET BOOTSCRIPT <i>script_file</i></code>	Specify <i>script_file</i> as the boot script. If the run boot script switch S6-1 is ON, <i>script_file</i> will be run at system reset.

Table 2-5 on page 2-16 lists the commands for the Configure subsystem.

— Note —

You must reset the board for the Boot Monitor Configure commands to take effect

Table 2-5 Boot Monitor Configure commands

Command	Action
DISPLAY DATE	Display date.
DISPLAY HARDWARE	Display hardware information (for example, the FPGA revisions).
DISPLAY TIME	Display time.
EXIT	Exit the configure commands and return to executing standard Boot Monitor commands.
HELP	List the configure commands.
QUIT	Alias for EXIT. Exit the Configure commands and return to standard Boot Monitor commands.
SET DATE <i>dd/mm/yy</i>	Set date. The date can also be entered as <i>dd-mm-yy</i>
SET TIME <i>hh:mm:ss</i>	Set time. The time can also be entered as <i>hh-mm-ss</i>
SET AHBM1	Configures AHBM1 bridge
SET AHBM2	Configures AHBM2 bridge
SET AHBS	Configures AHBS bridge

Table 2-6 lists the commands for the Debug subsystem.

Table 2-6 Boot Monitor Debug commands

Command	Action
DEPOSIT <i>address value [size]</i>	Load memory specified by <i>address</i> with <i>value</i> . The <i>size</i> parameter is optional. If used, it can be BYTE, HALFWORD, or WORD. The default is WORD.
DISABLE MESSAGES	Disable debug messages
ENABLE MESSAGES	Enable debug messages
EXAMINE <i>address</i>	Examine memory at <i>address</i>
EXIT	Exit the debug commands and return to executing standard Boot Monitor commands.
GO <i>address</i>	Run the code starting at <i>address</i> .
HELP	List the debug commands.

Table 2-6 Boot Monitor Debug commands (continued)

Command	Action
QUIT	Alias for EXIT. Exit the Debug commands and return to standard Boot Monitor commands.
START TIMER	Start a timer.
STOP TIMER	Stop the timer started with the START TIMER command and display the elapsed time.

Table 2-7 lists the commands for the NOR Flash subsystem.

Table 2-7 Boot Monitor NOR flash commands

Command	Action
DISPLAY IMAGE <i>name</i>	Displays details of image <i>name</i> .
ERASE IMAGE <i>name</i>	Erase an image or binary file from flash.
ERASE RANGE <i>start end</i>	Erase an area of NOR flash from the <i>start</i> address to the <i>end</i> address.
Warning	
	This command can erase the Boot Monitor image if it is stored in NOR flash. See <i>Loading Boot Monitor into NOR flash</i> on page 2-20.
EXIT	Exit the flash commands and return to executing standard Boot Monitor commands.
HELP	List the flash commands.
LIST AREAS	List areas in flash. An area is one or more contiguous blocks that have the same size and use the same programming algorithm.
LIST IMAGES	List images in flash.
LOAD <i>name</i>	Load the image <i>image_name</i> into memory.
QUIT	Alias for EXIT. Exit the NOR flash commands and return to standard Boot Monitor commands.
RESERVE SPACE <i>address size</i>	Reserve space in NOR flash. This space will not be used by the Boot Monitor. <i>address</i> is the start of the area and <i>size</i> is the size of the reserved area.
RUN <i>name</i>	Load the image <i>name</i> from flash and run it.

Table 2-7 Boot Monitor NOR flash commands (continued)

Command	Action
UNRESERVE SPACE <i>address</i>	Free the space starting at <i>address</i> in NOR flash. This space can be used by the Boot Monitor.
WRITE BINARY <i>file</i> [NAME <i>new_name</i>] [FLASH_ADDRESS <i>address</i>] [LOAD_ADDRESS <i>address</i>] [ENTRY_POINT <i>address</i>]	<p>Write a binary file to flash. By default, the image is identified by its file name. Use NAME <i>new_name</i> to specify a name instead of using the default name.</p> <p>Use FLASH_ADDRESS <i>address</i> to specify where in flash the image is to be located. The optional LOAD_ADDRESS and ENTRY_POINT arguments enable you to specify the load address and the entry point.</p> <p>If an entry point is not specified, the load address is used as the entry point.</p>
	<p>— Note —</p> <p>Remote file access requires semihosting. Use a debugger connection to provide semihosting.</p>
WRITE IMAGE <i>file</i> [NAME <i>new_name</i>] [FLASH_ADDRESS <i>address</i>]	<p>Write an ELF image file to flash. By default, the image is identified by its file name. For example, t:\images\boot_monitor.axf is identified as boot_monitor. Use NAME <i>new_name</i> to specify a name instead of using the default name.</p> <p>Use FLASH_ADDRESS <i>address</i> to specify where in flash the image is to be located. If the image is linked to run from flash, the link address is used and <i>address</i> is ignored.</p>
	<p>— Note —</p> <p>Remote file access requires semihosting. Use a debugger connection to provide semihosting.</p>

2.6.2 Rebuilding the Boot Monitor

All firmware components are built using GNUmake, which is available for UNIX, Linux and for most Windows versions. (To use GNUmake under windows Cygwin must be installed, for more information contact Redhat.)

Because the platform library used by the Boot Monitor requires callout startup routines support specific to RVCT, the Boot Monitor (and any application that uses the platform library for directing STDIO) can only be rebuilt using RVCT tools.

To rebuild the Boot Monitor, set your default directory to *install_directory/Firmware/Boot_Monitor* and type *make* from a DOS command line.

You can specify the following build options after the *make* command:

- BIG_ENDIAN=1/0, defining image endianness (Default 0, little endian)
- THUMB=1/0, defining image state (Default 0, ARM)
- DEBUG=1/0, defining optimization level (Default 0, optimized code)

- VFP=1/0, defines VFP support (Default 0, no VFP support).

— **Note** —

The image must be build as a simple image. Scatter loading is not supported.

The build options define the subdirectory in the Builds directory that contains the compile and link output:

<Debug>_<State>_<Endianness>_Endian + further component specific options

For example, Release_ARM_Little_Endian or Debug_Thumb_Big_Endian_NoDiskOnChip.

After rebuilding the Boot Monitor, load it into NOR flash, see *Loading Boot Monitor into NOR flash* on page 2-20.

2.6.3 Loading Boot Monitor into NOR flash

If the flash becomes corrupt and the board no longer runs the Boot Monitor, the Boot Monitor must be reprogrammed into flash.

———— Note ————

The Boot Monitor is normally located in NOR flash 2 instead of NOR flash 1. You can, however, load the Boot Monitor into NOR flash 1 instead of NOR flash 2 if this is required for a specific application.

Because the debugger does not initialize SDRAM, the Boot Monitor image cannot be loaded and run directly. Use the scripts in the `BoardFiles` directory on the CD to setup the board:

1. Power off the board
2. Set switch S1-1 to ON to select booting from NOR flash 1
Set switch S1-1 to OFF to select booting from NOR flash 2
Set all other S1 switches to OFF
Set all S6 switches to OFF.
3. Connect a *RealView ICE* or *Multi-ICE* to the JTAG port or a debug cable to the USB debug port.
4. Power on the board.
5. Connect the debugger to the target
 - For ARM eXtended Debugger, from the Command Line Interface
Debug > Obey `VPB926EJS_SDRAM_Init_axd.li`
 - For RealView Debugger: From the **Debug menu** → **Include Commands From File**
Select `VPB926EJS_SDRAM_Init_rvd.li`
6. SDRAM is now initialized and the memory is remapped.
7. From the debugger, load and execute the file `Boot_Monitor.axf`
8. Load the image into one of the NOR flash memories:
 - To load the image to NOR flash 2, at the Boot Monitor prompt enter:
>FLASH
FLASH> WRITE IMAGE *path\Boot_Monitor.axf* NAME *boot_monitor*
FLASH_ADDRESS 0x30000000

where path is the directory (C:\temp for example) that contains the boot monitor image.

- To load the image to NOR flash 1, at the Boot Monitor prompt enter:

```
>FLASH  
Flash> WRITE IMAGE path\Boot_Monitor.axf NAME boot_monitor  
FLASH_ADDRESS 0x34000000
```

where path is the directory (C:\temp for example) that contains the boot monitor image.

— Note —

Very long path names can cause problems with semihosting. To avoid this, move the image to a temporary directory.

9. Loading the image into flash takes a few minutes to complete. Wait until the prompt is displayed again before proceeding.
10. Turn the board off and then on.

Boot Monitor starts automatically.

2.6.4 Redirecting character output to hardware devices

The redirection of character I/O is carried out within the Boot Monitor platform library routines in `retarget.c` and `boot.s`. During startup, the platform library executes a *SoftWare Interrupt* instruction (SWI). If the image is being executed without a debugger (or the debugger is not capturing semihosting calls) the value returned by this SWI is -1, otherwise the value returned is positive. The platform library uses the return value to determine the hardware device used for outputting from the C library I/O functions. (Redirection is through a SWI to the debugger console or directly to a hardware device)

Supported devices for character output are:

- :UART-0 (default destination if debugger is not capturing semihosting calls)
- :UART-1
- :UART-2
- :UART-3
- :CHARLCD.

The STDIO calls are redirected within `retarget.c`. Redirection depends on the setting of switch S6-3, see *Boot Monitor configuration* on page 2-7.

2.6.5 Rebuilding the platform library

All firmware components are built using GNUmake, which is available for UNIX, Linux and for most Windows versions. (To use GNUmake under windows Cygwin must be installed, for more information contact Redhat.)

To rebuild the platform library component, set your default directory to `install_directory/Firmware/platform` and type `make` from a DOS command line.

The platform library has a number of build options that can be specified with the `make` command:

- `BIG_ENDIAN=1/0`, defining image endianness (Default 0, little endian)
- `THUMB=1/0`, defining image state (Default 0, ARM)
- `DEBUG=1/0`, defining optimization level (Default 0, optimized)
- `VFP=1/0`, defines VFP support (Default 0 no VFP support).

The build options define the directory that contains the compile and link output. The `make` file creates a directory called `Builds` if it is not already present. The `Builds` directory contains subdirectories for the specified `make` options (for example, `Debug_ARM_Little_Endian`). To delete the objects and images for all targets and delete the `Builds` directory, type `make clean all`.

2.6.6 Building an application with the platform library

The platform library on the CD provides all required initialization code to bring the PB926EJ-S up from reset. The library is used by the Boot Monitor, but it can be used by an application independently of the other code in the Boot Monitor.

The platform library supports:

- remapping of boot memory
- SDRAM initialization
- UARTs
- Time-of-Year clock
- output to the character LCD display
- C library system calls.

To build an image that uses the I/O and memory control features present in the platform library:

1. Write the application as normal. There must be a `main()` routine in the application.
2. Link the application against the Boot Monitor platform library file `platform.a`. The file `platform.a` is in one of the target build subdirectories (`install_dir\software\firmware\Platform\Builds\target_build`). Choose the `Builds` subdirectory that matches your application. For example, `Release_ARM_Little_Endian` for ARM code.

Define the image entry point to be `__main` and the region `__main` to be the first section in the execution region:

`-entry __main -first __main`

————— Note —————

If you are not using the `platform.a` library, you must provide your own initialization and I/O routines.

You can also build the platform library functionality directly into your application without building the platform code as a separate library. This might be useful, for example, if you are using an IDE to develop your application.

See the `filelist.txt` file in the software directory for more details on software included on the CD. The `selftest` directory, for example, contains source files that can be used as a starting point for your own application.

To run the image from RAM, load the image with a debugger and execute as normal. The image uses the procedure described in *Redirecting character output to hardware devices* on page 2-21 to redirect standard I/O either to the debugger or to be handled by the application itself.

2.6.7 Loading and running an application from NOR flash

To run an image from NOR flash:

1. Build the application as described in *Building an application with the platform library* on page 2-23 and specify a link address suitable for flash. There are the following options for selecting the address:

Load region in flash

The image is linked such that its load region, though not necessarily its execution region, is in flash. The load region specified when the image was linked is used as the location in flash and the FLASH_ADDRESS option is ignored. If the blocks in flash are not free, the command fails. Use the FLASH RUN command to run the image.

Load region not in flash and image location not specified

The image is programmed into the first available contiguous set of blocks in flash that is large enough to hold the image. Use the FLASH LOAD and then the FLASH RUN commands to load and run the image.

Load region not in flash, but image stored at a specified flash address

Use the FLASH_ADDRESS option to specify the location of the image in flash. If the option is not used, the image is programmed into the first available contiguous set of blocks in flash that is large enough to hold the image. Use the FLASH LOAD or FLASH RUN commands to load and run the image.

Note

Images with multiple load regions are not supported.

If the image is loaded into flash, but the FLASH RUN command relocates code to SDRAM for execution, the execution address must not be in the top 4MBytes of SDRAM since this is used by the Boot Monitor.

-
2. The image must be programmed into flash using the Boot Monitor. Flash support is implemented in the Boot Monitor image.

Run the Boot Monitor image from the debugger and enter the flash subsystem, type FLASH at the prompt:

```
>FLASH  
flash>
```

3. The command used to program the image depends on the type of image:
 - To program the ELF image into flash, use the following command line:
`flash> WRITE IMAGE elf_file_name NAME name FLASH_ADDRESS address`
 The entry point and load address for ELF images are taken from the image itself.
 - To program a binary image into flash, use the following command line:
`flash> WRITE BINARY image_file_name NAME name FLASH_ADDRESS address1 LOAD_ADDRESS address2 ENTRY_POINT address3`
`flash>`

— Note —

name is a short name for the image. If the NAME option is not used at the command prompt, *name* will be derived from the file name.

4. The image is now in flash and can be run by the Boot Monitor. At the prompt, type:
`flash> RUN name`

2.6.8 Using a boot script to run an image automatically

Use a boot script to run an image automatically after power-on:

1. Create a boot script from the Boot Monitor by typing:
`> CREATE myscript.txt`
`; put any startup code here` `FLASH RUN file_name`
2. Press **Ctrl-Z** to indicate the end of the boot script and return to the Boot Monitor prompt.
3. Verify the file was entered correctly by typing:
`>TYPE myscript.txt`
 The contents of the file is displayed to the currently selected output device.
4. Specify the boot script to use at reset from the Boot Monitor by typing:
`>SET BOOTSCRIPT myscript.txt`
5. Set S6-1 ON to instruct the Boot Monitor to run the boot script at power on.
6. Reset the platform. The Boot Monitor runs and executes the boot script *myscript.txt*. In this case, it relocates the image *file_name* and executes it.

Chapter 3

Hardware Description

This chapter describes the on-board hardware. It contains the following sections:

- *ARM926EJ-S PXP Development Chip* on page 3-3
- *FPGA* on page 3-17
- *Reset controller* on page 3-22
- *Power supply control* on page 3-33
- *Clock architecture* on page 3-35
- *Advanced Audio Codec Interface, AACI* on page 3-56
- *Character LCD controller* on page 3-59
- *CLCDC interface* on page 3-61
- *DMA* on page 3-65
- *Ethernet interface* on page 3-68
- *GPIO interface* on page 3-71
- *Interrupts* on page 3-72
- *Keyboard/Mouse Interface, KMI* on page 3-74
- *Memory Card Interface, MCI* on page 3-75
- *PCI interface* on page 3-79
- *Serial bus interface* on page 3-80
- *Smart Card interface, SCI* on page 3-81

- *Synchronous Serial Port, SSP* on page 3-84
- *User switches and LEDs* on page 3-87
- *USB interface* on page 3-92
- *UART interface* on page 3-88
- *Test, configuration, and debug interfaces* on page 3-94.

3.1 ARM926EJ-S PXP Development Chip

The ARM926EJ-S PXP Development Chip and its interfaces are described in the following sections:

- *ARM926EJ-S PXP Development Chip overview*
- *Configuration control* on page 3-7
- *AHB bridges and the bus matrix* on page 3-10
- *AHB monitor* on page 3-16
- *ARM926EJ-S PXP Development Chip clocks* on page 3-39
- *DMA* on page 3-65
- *Memory interface* on page 3-15
- *Reset controller* on page 3-22
- *CLCDC interface* on page 3-61
- *GPIO interface* on page 3-71
- *UART interface* on page 3-88
- *Smart Card interface, SCI* on page 3-81
- *Synchronous Serial Port, SSP* on page 3-84.

For more detail on using the ARM926EJ-S PXP Development Chip components, see also:

- the *ARM926EJ-S Development Chip Reference Manual*
- *AHB buses used by the FPGA and RealView Logic Tiles* on page F-11
- *Chapter 4 Programmer's Reference*.

3.1.1 ARM926EJ-S PXP Development Chip overview

Figure 3-1 on page 3-4 shows the main blocks of the ARM926EJ-S PXP Development Chip.

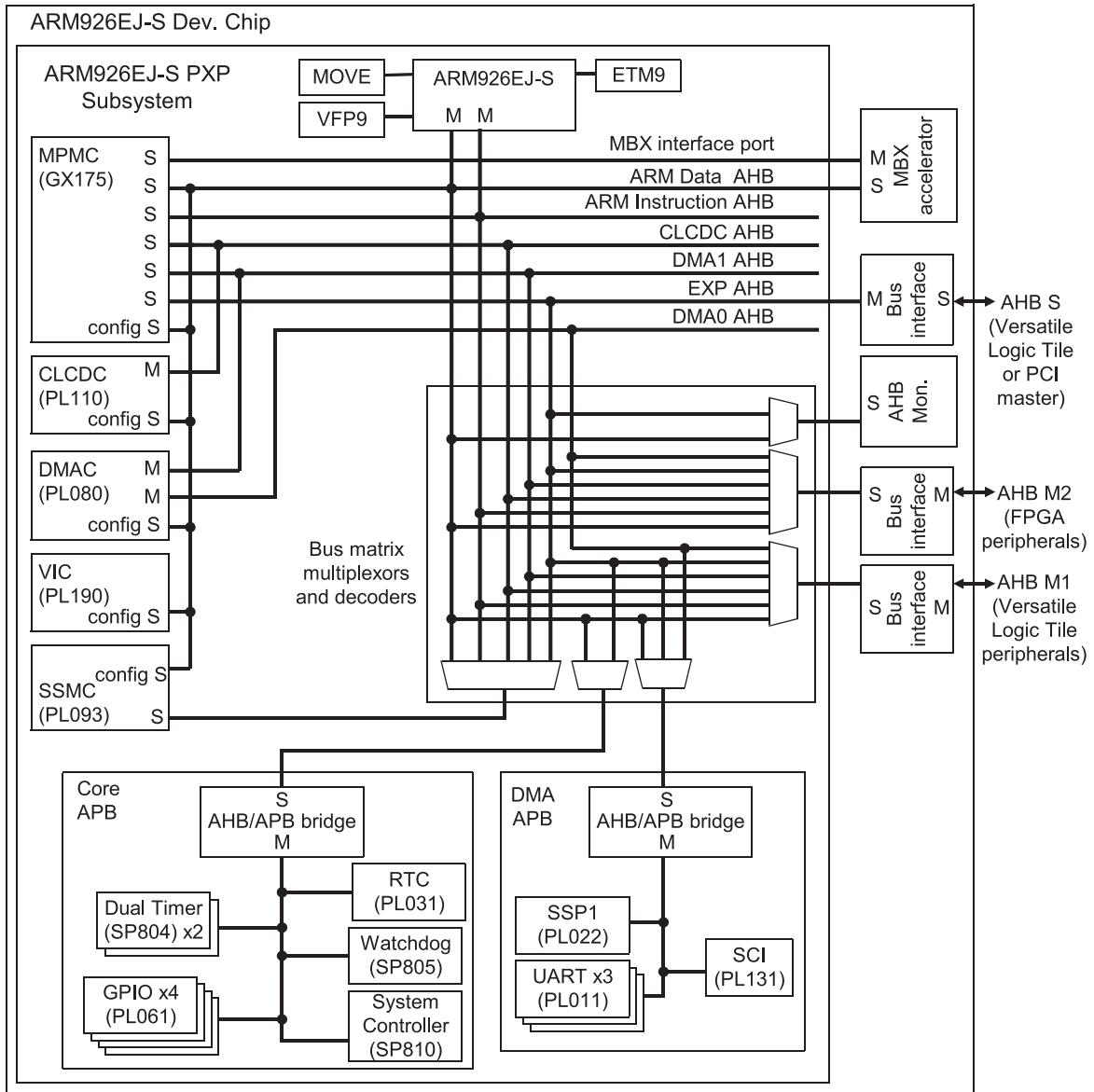


Figure 3-1 ARM926EJ-S PXP Development Chip block diagram

The ARM926EJ-S PXP Development Chip incorporates the following features:

ARM926EJ-S

The ARM926EJ-S CPU is a member of the ARM9 Thumb® family. The ARM926EJ-S (r0p3) macrocell is a 32-bit cached processor with ARMv5TE architecture that supports the ARM and Thumb instruction sets and includes features for direct execution of Java byte codes. Executing Java byte codes requires the *Java Technology Enabling Kit* (JTEK).

The ARM926EJ-S contains a *Memory Management Unit* (MMU), 32KB data and instruction caches, and 32KB of data and instruction *Tightly Coupled Memory* (TCM). The TCM operates with a single wait-state and provides higher data rates than external memory.

ETM9 The *Embedded Trace Macrocell* (ETM) provides signals for off-chip trace. The ETM transmits a 16-bit packet to an external trace port analyzer where the signals can be stored and later analyzed to reconstruct the code flow.

VFP9 This high-performance, low-power *Vector Floating-Point* (VFP) coprocessor implements the VFPv2 vector floating-point architecture.

MOVE The MOVE coprocessor is a video encoding accelerator designed to accelerate *Motion Estimation* (ME) algorithms within block-based video encoding schemes such as MPEG4 and H.263. For more information on the MOVE coprocessor, see the *ARM MOVE Coprocessor Technical Reference Manual*.

MBX This high-performance graphic accelerator operates on 3D scene data (as batches of triangles) sent from the main processor. Triangles are written directly to a tile accelerator so that the CPU is not stalled during processing. For more information on the MBX coprocessor, see the *ARM MBX HR-S Graphics Core Technical Reference Manual*.

Clock control

The ARM926EJ-S PXP Development Chip contains deskew PLL that uses an external reference clock to generate internal clocks for the CPU, AHB bus, memory, and off-chip peripherals. Dividers in the chip are programmable and give considerable flexibility in clock rates for the CPU, bridges, and memory.

AHB buses The ARM926EJ-S processor uses two separate AHB masters for instructions and data to maximize system speed. The DMA controller has two AHB masters. The CLCD controller has one AHB master.

There are also two expansion master buses (AHB M1 and AHB M2) and one expansion slave bus (AHB S). The expansion bus bridges are configurable to support different performance and complexity trade-offs.

A bus matrix inside the ARM926EJ-S PXP Development Chip manages the multiple paths between each master and the peripherals and memory.

The AHB Monitor provides information on bus accesses that can be recorded by an attached logic analyzer. The bus accesses and other performance information can be recorded to aid software profiling. See *AHB monitor* on page 3-16 and the *ARM926EJ-S PXP Development Chip Reference Manual* for more information.

Memory controllers

The ARM926EJ-S PXP Development Chip includes a multi-port memory controller (for dynamic memory) and a static memory controller. Both controllers have 32-bit interfaces to external memory. See *Memory interface* on page 3-15.

DMA controller

The PrimeCell DMAC enables peripheral-to-memory, memory-to-peripheral, peripheral-to-peripheral, and memory-to-memory transactions. See *DMA* on page 3-65.

Interrupt controller

The PrimeCell VIC provides an interface to the interrupt system and provides vectored interrupt support for high-priority interrupt sources from:

- peripherals in the ARM926EJ-S PXP Development Chip
- peripherals in the FPGA (a secondary interrupt controller is present in the FPGA)
- peripherals in expansion Logic Tiles.

See *Interrupts* on page 3-72.

CLCD controller

The CLCDC provides a flexible display interface that supports a VGA monitor and color or monochrome LCD displays. See *CLCDC interface* on page 3-61.

UARTs

The UARTs perform serial-to-parallel conversion on data received from a peripheral device and parallel-to-serial conversion on data transmitted to the peripheral device. See *UART interface* on page 3-88.

Timers There are four 32-bit down counters that can be used to generate interrupts at programmable intervals. A Real-Time-Clock is fed with an external 1Hz signal.

Synchronous serial port

The SSP provides a master or slave interface for synchronous serial communications using Motorola SPI, TI, or National Semiconductor Microwire devices.

Smart Card interface

The Smart Card interface signals are programmable to enable support for a Smart Card, *Security Identity Module* (SIM) card, or similar module.

Watchdog A Watchdog module can be used to trigger an interrupt or system reset in the event of software failure.

3.1.2 Configuration control

The PB926EJ-S uses configuration switches and the SYS_CFGDATAx registers in the FPGA to control configuration of the ARM926EJ-S PXP Development Chip at power-up. In a typical product, configuration is static and the configuration signals are tied HIGH or LOW as appropriate.

After reset, configuration can be modified by the system controller and the configuration registers in the FPGA. For example, you can simulate a system that boots in big-endian or with the vector table located at address 0xFFFF0000 by changing the value of bits 0 and 1 in the SYS_CFGDATA2 register and pressing the SDC RECONFIG button.

See *Status and system control registers* on page 4-17 and *Configuration registers SYS_CFGDATAx* on page 4-25.

Configuration switches

The S1 boot option select switches are listed in Table 3-1. For more information on setting boot memory options, see *Setting the configuration switches* on page 2-3 and *Configuration and initialization* on page 4-9, and *Boot Select Register, SYS_BOOTCS* on page 4-34. Switch S1 values determine the **BOOTCSSEL[7:0]** signals. (S1-1 controls **BOOTCSSEL0** and S1-8 controls **BOOTCSSEL7**.)

Table 3-1 Configuration switch S1

Switch	Description
S1-1 and S1-2	Controls the chip select signals for the static memory, see also <i>Setting the configuration switches</i> on page 2-3. The factory default setting is booting from NOR flash 2, S1-1 OFF and S1-2 OFF.
S1-3	Forces asynchronous AHB bridge mode. The factory default is OFF, the mode for each bridge is selected by the value of bits [24:22] of the SYS_CFGDATA2 register. The default for the register bits is LOW, synchronous mode used for all bridges, see <i>Configuration registers SYS_CFGDATAx</i> on page 4-25.
S1-4	Reserved for selection of the controller to use for static memory. The factory default is OFF.
<hr/> <p style="text-align: center;">Caution</p> <p>This switch must not be changed from the default position as the functionality is not supported.</p> <hr/>	
S1-5	Selects low-frequency startup mode. OSCCLK0 is programmed for 10MHz. This startup mode is used, for example, when there is an external Logic Tile connected that cannot support high frequency at startup. The factory default is OFF. See <i>Selecting slow start</i> on page 3-50.
S1-6 and S1-7	Selects one of four PB926EJ-S FPGA images to load on power up (or after the FPGA CONFIG button is pressed). The factory default is FPGA image zero, S1-7 OFF and S1-6 OFF.
<hr/> <p style="text-align: center;">Note</p> <p>Only one image is supplied with the PB926EJ-S. See <i>FPGA configuration</i> on page 3-18.</p> <hr/>	
S1-8	Logic Tile stack image. Selects one of two Logic Tile FPGA images to load on power up. The factory default is Logic Tile FPGA image zero, S1-8 OFF. See the documentation provided with your Logic Tile for details on the FPGA_IMAGE signal.

Configuration from the DEV CHIP RECONFIG pushbutton

FPGA registers **SYS_CFGDATA1** and **SYS_CFGDATA2** contain configuration data that is applied to the ARM926EJ-S PXP Development Chip when the DEV CHIP RECONFIG pushbutton is pressed.

When **nPBSDCRECONFIG** is asserted, the configuration values stored in the FPGA configuration registers are output to the development chip data bus (**HDATAAM1** and **HDATAAM2**) pins.

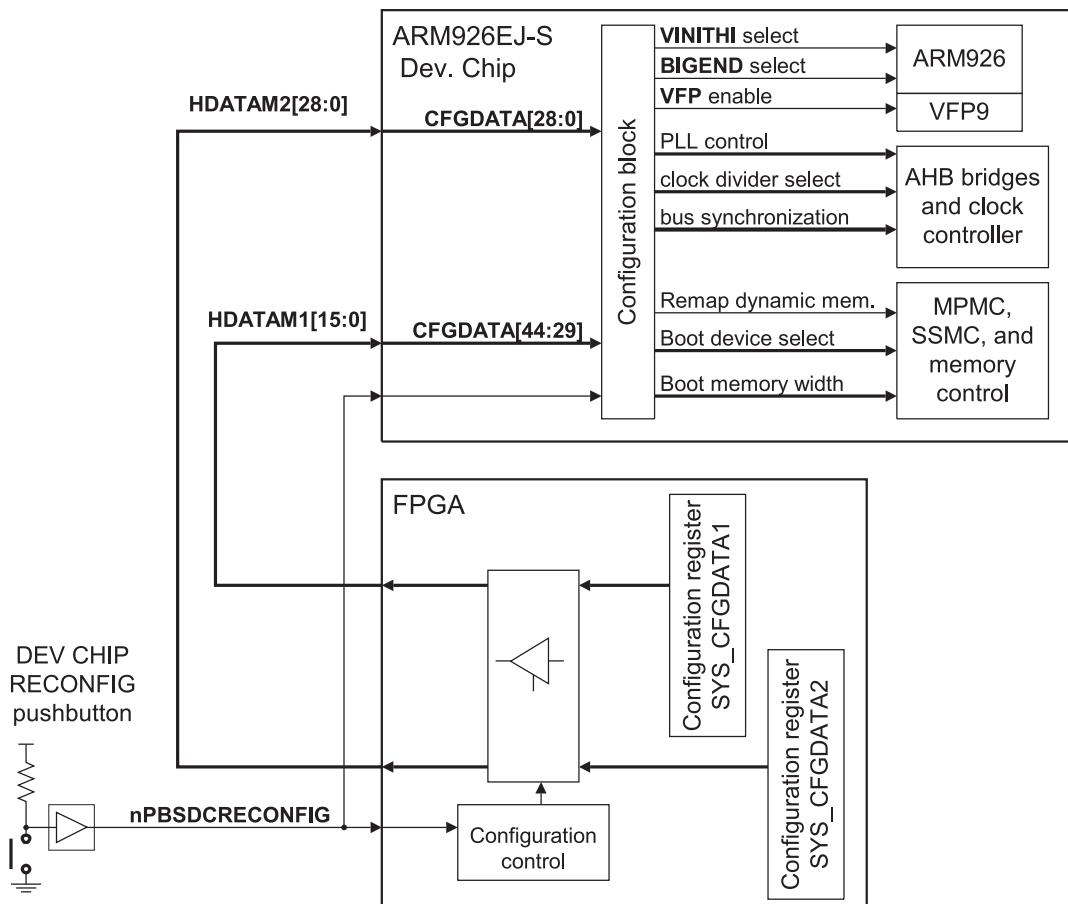


Figure 3-2 Configuration signals from **SYS_CFGDATAx**

The configuration block in the development chip samples the state of the **HDATA_M** pins while the rest of the chip is held in reset. The state of these pins is stored and used to drive configuration signals within the chip and to define the operating mode of the chip when reset is released. For more detail on the configuration signals, see *Configuration registers SYS_CFGDATA_X* on page 4-25 and the *ARM926EJ-S Development Chip Reference Manual*.

———— **Note** ————

For details on configuring the clocks, see *ARM926EJ-S PXP Development Chip clocks* on page 3-39.

Changing the ARM926EJ-S PXP Development Chip configuration at runtime

To change the configuration of the ARM926EJ-S PXP Development Chip:

1. Program the appropriate values in the SYS_CFGDATA_X registers, see *Configuration registers SYS_CFGDATA_X* on page 4-25.
2. Perform a configuration reset of the PB926EJ-S, but do not power-cycle, by either:
 - pressing the DEVCHIP RECONFIG pushbutton (next to the blue LED)
 - programming the reset-depth register to level 2 (see *Reset Control Register, SYS_RESETCTL* on page 4-31) and then performing a normal reset from software, the reset pushbutton, or JTAG.

Restoring the default configuration

To restore the default processor configuration, power-cycle the PB926EJ-S or press the FPGA CONFIG pushbutton (next to the yellow LED).

3.1.3 AHB bridges and the bus matrix

The ARM926EJ-S PXP Development Chip is based on the ARM926EJ-S PrimeXSys Platform. The PrimeXSys Platform contains a multi-layer AHB bus matrix that routes the signals from six masters to a number of slaves. These six masters are CPU-D, CPU-I, DMA port0, DMA port1, CLCDC, Expansion master. The slaves include internal AHB-APB bridges, the MPMC and SSMC memory controllers and three expansion slaves, one of which is the internal AHB monitor block. (See Figure 3-1 on page 3-4).

External masters drive the ARM926EJ-S PXP Development Chip AHB S port which goes through an AHB-AHB bridge to the expansion master port on the matrix. This master can access most of the slaves within the ARM926EJ-S PXP Development Chip, including the GX175 MPMC (SDRAM controller), the PL093 SSMC (static memory controller), and the expansion slaves.

External slaves are connected to the ARM926EJ-S PXP Development Chip AHB M1 and AHB M2 ports. Two of the expansion slave ports on the internal bus matrix are fed to AHB-AHB bridges which drive the AHB M1 and AHB M2 ports. These ports are accessible by all five of the internal masters and the expansion master connected to the AHB S port.

Simultaneous access

Figure 3-3 on page 3-12 shows how the matrix allows multiple masters to use the buses at the same time:

- The ARM926EJ-S Data AHB master is accessing `0x10004000` and this decodes to the external AHB M2 bus (the CODEC interface in the FPGA).
- The ARM926EJ-S Instruction AHB master is accessing `0x02000000` and this decodes to dynamic memory on one of the MPMC slaves (DYCS0).
- The CLCDC master is accessing `0x01000000` and this decodes to dynamic memory on one of the MPMC slaves (DYN CS0). The MPMC will manage the multiple accesses to the slave ports.
- The DMAC is doing a memory to peripheral transfer. DMA master 1 is accessing `0x38000000` which decodes to static memory (SRAM). DMA master 0 is accessing `0x80000000` which is mapped to the AHB M1 bus (if a Logic Tile is installed, the tile must decode this access and provide a response).
- An external master in the PCI controller or a Logic Tile is accessing `0x101F0000` and this decodes to the DMA APB.

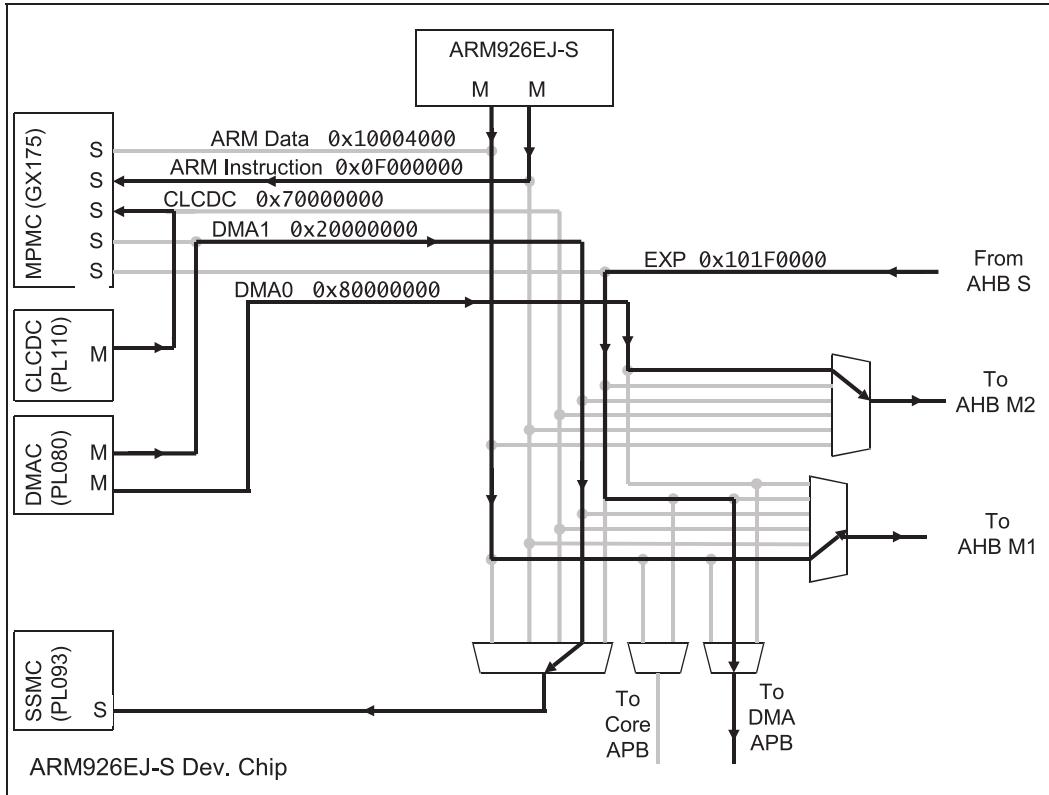


Figure 3-3 Example of multiple masters

The default memory map for each of the internal buses is slightly different as shown in Figure 3-4 on page 3-13 and Figure 3-5 on page 3-14.

———— Caution ————

The AHB S bus is driven by the PCI bridge in the FPGA or by an external Logic Tile. Do not use the FPGA PCI master to AHB S bus path to drive the PCI M2 addresses at 0x41000000–0x6FFFFFFF.

For more information on the system buses, see *Memory map* on page 4-3, *AHB buses used by the FPGA and RealView Logic Tiles* on page F-11, and the *ARM926EJ-S Development Chip Reference Manual*.

AHB S EXP	DMA0	ARM I, CLCD & DMA1	ARM D	
AHB M1 to tile peripherals	AHB M1 to tile peripherals	AHB M1 to tile peripherals	AHB M1 to tile peripherals	0xFFFFFFFF 0x80000000
MPMC Dynamic CS 3 SDRAM Dynamic CS 2	AHB M2 to FPGA (Reserved)	MPMC Dynamic CS 3 SDRAM Dynamic CS 2	MPMC Dynamic CS 3 SDRAM Dynamic CS 2	0xFFFFFFFF 0x70000000
AHB M2 to PCI	AHB M2 to PCI	AHB M2 to PCI	AHB M2 to PCI	0xFFFFFFFF 0x41000000
AHB M2 to FPGA (Reserved)		AHB M2 to FPGA (Reserved)	MBX	0x40FFFFFF 0x40000000
SSMC Static CS 3 Static CS 2 Static CS 1 Static CS 0	AHB M2 to FPGA (Reserved)	SSMC Static CS 3 Static CS 2 Static CS 1 Static CS 0	SSMC Static CS 3 Static CS 2 Static CS 1 Static CS 0	0xFFFFFFFF 0x30000000
SSMC Static CS 7 Static CS 6 Static CS 5 Static CS 4		SSMC Static CS 7 Static CS 6 Static CS 5 Static CS 4	SSMC Static CS 7 Static CS 6 Static CS 5 Static CS 4	0x2FFFFFFF 0x20000000
AHB M2 to tile	AHB M2 to tile	AHB M2 to tile	AHB M2 to tile	0x1FFFFFFF 0x14000000
AHB M2 to FPGA (Reserved)	AHB M2 to FPGA (Reserved)		AHB M2 to FPGA (Reserved)	0x13FFFFFF 0x10200000
DMA APB	DMA APB		DMA APB	0x101FFFFF 0x101F0000
Core APB			Core APB	0x101EFFFF 0x101E0000
AHB Monitor			AHB Monitor	0x101DFFFF 0x101D0000
AHB M2 to FPGA (Reserved)	AHB M2 to FPGA (Reserved)	AHB M2 to FPGA (Reserved)	AHB M2 to FPGA (Reserved)	0x101CFFFF 0x10150000
			VIC	0x1014FFFF 0x10140000
			DMAC	0x1013FFFF 0x10130000
			CLCD	0x1012FFFF 0x10120000
			MPMC configuration registers	0x1011FFFF 0x10110000
			SMC configuration registers	0x1010FFFF 0x10100000
AHB M2 to FPGA Peripherals	AHB M2 to FPGA Peripherals	AHB M2 to FPGA Peripherals	AHB M2 to FPGA Peripherals	0x100FFFFFF 0x10000000
MPMC Dynamic CS 1 SDRAM Dynamic CS 0	AHB M2 to FPGA (Reserved)	MPMC Dynamic CS 1 SDRAM Dynamic CS 0	MPMC Dynamic CS 1 SDRAM Dynamic CS 0	0xFFFFFFFF 0x00000000

Figure 3-4 AHB map

AHB S EXP	DMA0	ARM I, LCD & DMA1	ARM D	
Reserved	Reserved		Reserved	0x101FFFFF
SSP	SSP		SSP	0x101F5000
UART 2	UART 2		UART 2	0x101F3000
UART 1	UART 1		UART 1	0x101F2000
UART 0	UART 0		UART 0	0x101F1000
SCI	SCI		SCI	0x101F0000
Reserved	AHB M2 to FPGA (Reserved)	AHB M2 to FPGA (Reserved)	Reserved	0x101EFFFF
RTC			RTC	0x101E9000
GPIO 3			GPIO 3	0x101E8000
GPIO 2			GPIO 2	0x101E7000
GPIO 1			GPIO 1	0x101E6000
GPIO 0			GPIO 0	0x101E5000
Timer 2&3			Timer 2&3	0x101E3000
Timer 0&1			Timer 0&1	0x101E2000
Watchdog			Watchdog	0x101E1000
Sys. Controller			Sys. Controller	0x101E0000

Figure 3-5 Core APB and DMA APB map

3.1.4 Memory interface

Memory access is provided by a MultiPort Memory Controller (MPMC) and a Static Memory Controller (SSMC) located in the ARM926EJ-S PXP Development Chip. One or two expansion memory boards can be added to increase the amount of flash, SRAM, and SDRAM memory.

Memory (or memory-mapped peripherals) can also be accessed on an optional Logic Tile or PCI card.

— Note —

The memory at 0x00000000 and 0x34000000 at boot time is determined by the boot select switches and the remap signals (see *Memory aliasing at reset* on page 3-27). The region at 0x80000000–0xFFFFFFF is recommended for accesses to a Logic Tile. PCI cards must be initialized before use (see *PCI configuration* on page 4-79).

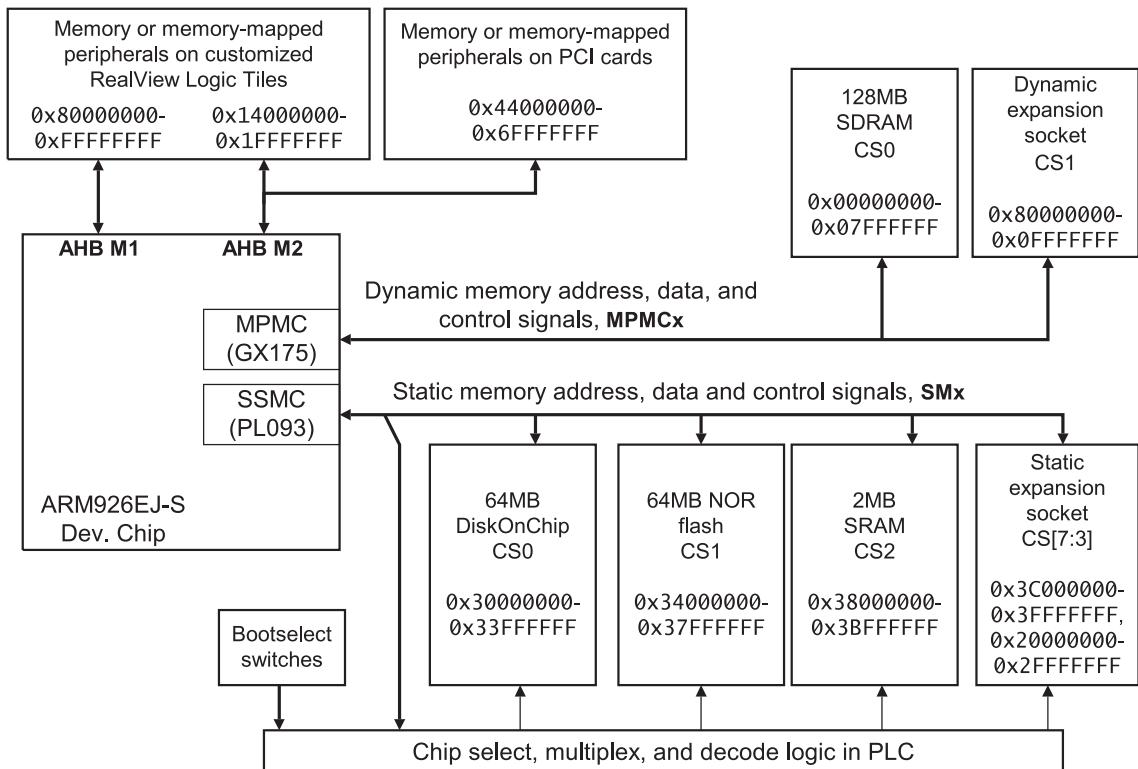


Figure 3-6 Memory devices

3.1.5 AHB monitor

The ARM926EJ-S PXP Development Chip contains a multi-layer AHB system to provide high bandwidth connectivity between the various bus masters and slaves both within and outside the ARM926EJ-S PXP Development Chip.

The AHB layer monitors observe the activity on their respective bus signals to produce real-time information that is exported off-chip to a logic analyzer.

The AHB monitor also contains event counters that monitor bus transactions. The event counters can be accessed through the both the ARM DATA AHB and ARM AHB S buses. The event counters provide a simple mechanism for monitoring bus utilization.

The AHB debug port consists of 33 output pins that export status data packets at the AHB clock rate. A localized clock is exported on **AHBMONITOR[33]**. The interface between the development chip and the debug connector is shown in Figure 3-7.

The base address of the AHB monitor is at `0x101D0000`.

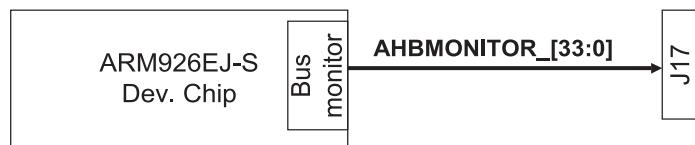


Figure 3-7 AHB monitor connection

See the *ARM926EJ-S Reference Manual* and *AHB monitor* on page 4-41.

3.2 FPGA

Figure 3-8 shows the architecture of the FPGA on the PB926EJ-S.

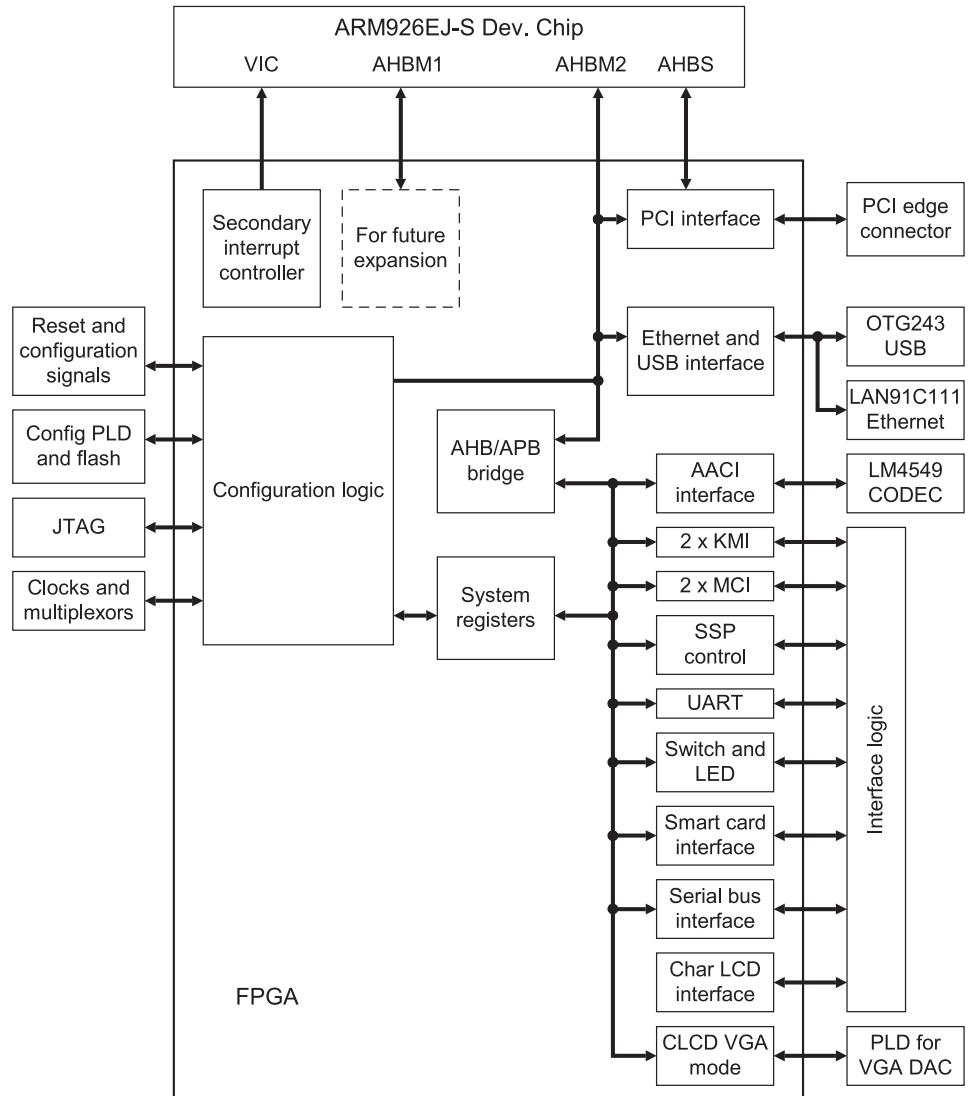


Figure 3-8 FPGA block diagram

For details on FPGA components, see:

- *FPGA configuration*
- *Reset controller* on page 3-22
- *Clock architecture* on page 3-35
- *Advanced Audio Codec Interface, AACI* on page 3-56
- *Character LCD controller* on page 3-59
- *Ethernet interface* on page 3-68
- *Keyboard/Mouse Interface, KMI* on page 3-74
- *Memory Card Interface, MCI* on page 3-75
- *PCI interface* on page 3-79
- *Smart Card interface, SCI* on page 3-81
- *User switches and LEDs* on page 3-87
- *UART interface* on page 3-88
- *USB interface* on page 3-92.

————— **Note** —————

The ARM926EJ-S PXP Development Chip and FPGA buses on the PB926EJ-S are shared with the Logic Tile headers. If you are using a Logic Tile, ensure that the tile manages the bus signals correctly (*AHB buses used by the FPGA and RealView Logic Tiles* on page F-11).

3.2.1 FPGA configuration

At power-up the FPGA loads its configuration data from a flash memory device. Parallel data from the flash memory is streamed by the configuration PLD into the configuration ports of the FPGA. Figure 3-9 on page 3-19 and Figure 3-10 on page 3-20 show the FPGA configuration mechanism. The image loaded into the FPGA is determined by configuration switches S1-6 and S1-7 as listed in Table 3-2 on page 3-19.

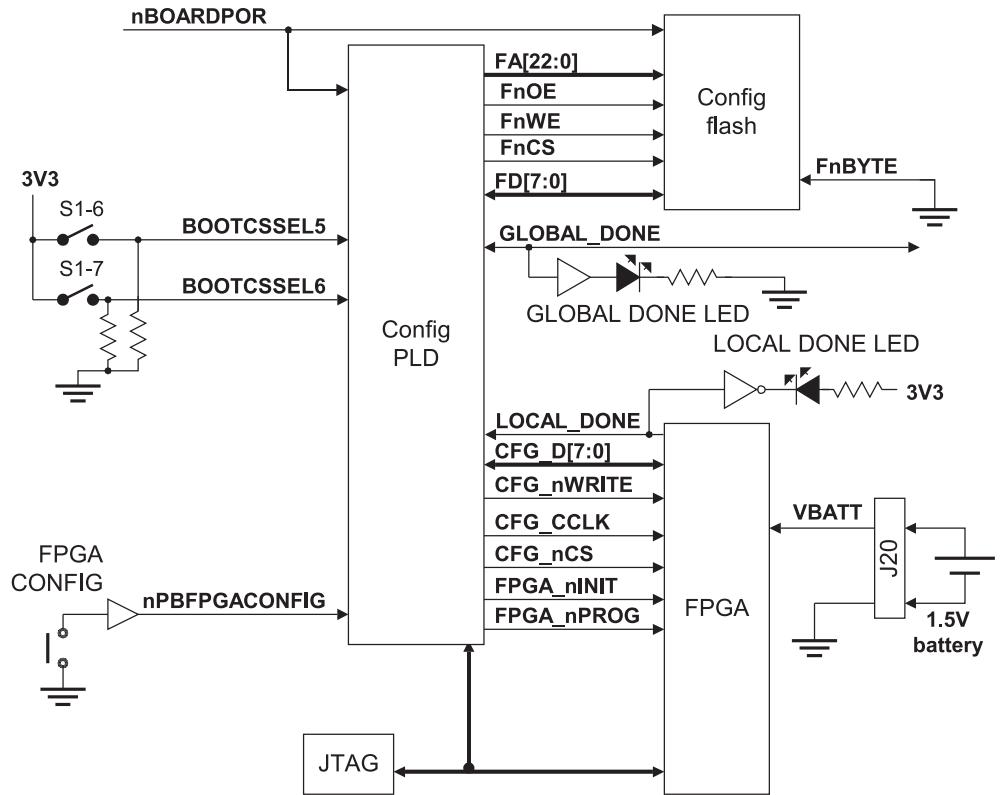


Figure 3-9 FPGA configuration

Table 3-2 FPGA image selection

S1-7	S1-6	FPGA image	image Address ^a
OFF	OFF	FPGA image 1 (this is the image supplied with the board)	0x0
OFF	ON	FPGA image 2 (this image is not supplied with the board)	0x200000
ON	OFF	FPGA image 3 (this image is not supplied with the board)	0x400000
ON	ON	FPGA image 4 (this image is not supplied with the board)	0x600000

a. S1-7 and S1-6 determine the state of the configuration flash address bits 22 and 21.

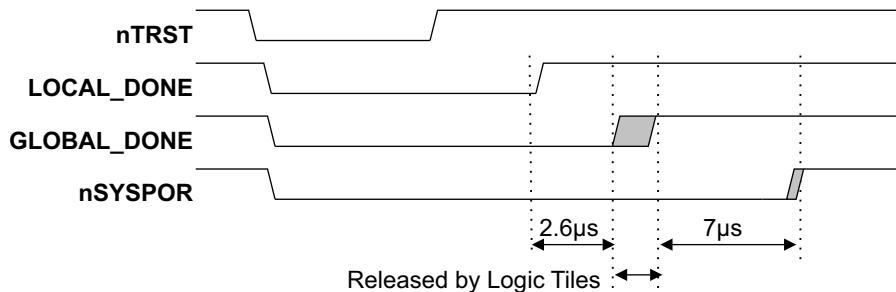


Figure 3-10 FPGA reload sequence

— Note —

The configuration flash can hold four FPGA images. However, only one FPGA image is provided.

The configuration flash is a separate device and not part of the user flash.

You can use a JTAG debugger or the Progcards utility to reprogram the PLDs, FPGA, and flash if the PB926EJ-S is placed in configuration mode. See also *JTAG and USB debug port support* on page 3-96.

The PB926EJ-S is supplied with the configuration PLD and flash image already programmed. The information in this section is provided, however, in case of accidental erasure of the configuration PLD or flash image.

— Caution —

You are advised not to reprogram these devices with any images other than those provided by ARM Limited.

Program the configuration PLD as follows:

1. Connect an interface cable to either the JTAG or USB debug port.
2. Put the PB926EJ-S into configuration mode by fitting the CONFIG link J32 on the board and powering-up.

— Note —

The CONFIG link is a switch on some board versions.

3. Start the JTAG application and autoconfigure.

If autoconfiguration fails, load the configuration file (.cfg) for the board. For details on manual configuration, see the *readme.txt* file on the CD.

4. Run the Progcards utility from:
install_directory\Versatile\PB926EJS\build\Release\boardfiles
5. Choose the required image for the configuration PLD.

———— **Caution** ———

The 1.5V cell battery provides the **VBATT** backup voltage to the external DS1338 time-of-year clock and FPGA encryption key circuitry within the FPGA. Removing the battery erases the encryption key.

Each board is provided with an encryption key that is unique to the board. The standard image supplied with the board is not encrypted. However, encrypted images might be supplied by ARM in the future. If you are using encrypted images and the key is erased, you must return the board to ARM to have the key reloaded.

The battery is expected to last for approximately 10 years from manufacture of the PB926EJ-S. To replace the battery:

1. Power on the PB926EJ-S. If the battery is removed while the board is powered down, the encryption key will be erased.
2. Remove the old battery.
3. Insert the new battery and ensure that the positive terminal is facing upwards in the holder.

3.3 Reset controller

The reset controller initializes the ARM926EJ-S PXP Development Chip, the FPGA, and external controllers as a result of a reset. The PB926EJ-S can be reset from the following sources:

- power failure
- reset button
- PCI backplane
- Logic Tiles
- JTAG
- software.

— Note —

Use the RESET pushbutton (**nPBRESET**), the JTAG reset signal (**nSRST**), the PCI backplane reset signal (**P_nRST**), the Logic Tile reset signal (**nSYSPOR** or **nSRST** from the tile), or a software reset to reset the ARM926EJ-S core. The current ARM926EJ-S PXP Development Chip configuration settings are retained. (The effect of these reset sources pushbutton can be modified by setting the reset level flags, see *Reset level* on page 3-24.)

Use the DEV CHIP RECONFIG pushbutton to reset the processor and reload the chip configuration settings from the FPGA configuration registers.

Use the FPGA CONFIG pushbutton to reload the FPGA image without repowering the entire system. The FPGA configuration registers are reloaded with their default values. (Pressing FPGA CONFIG also resets the core and reloads the Logic Tile images.)

3.3.1 Reset and reconfiguration logic

Figure 3-11 on page 3-23 shows the reset and reconfigure logic. (Not all JTAG reset signals are shown.)

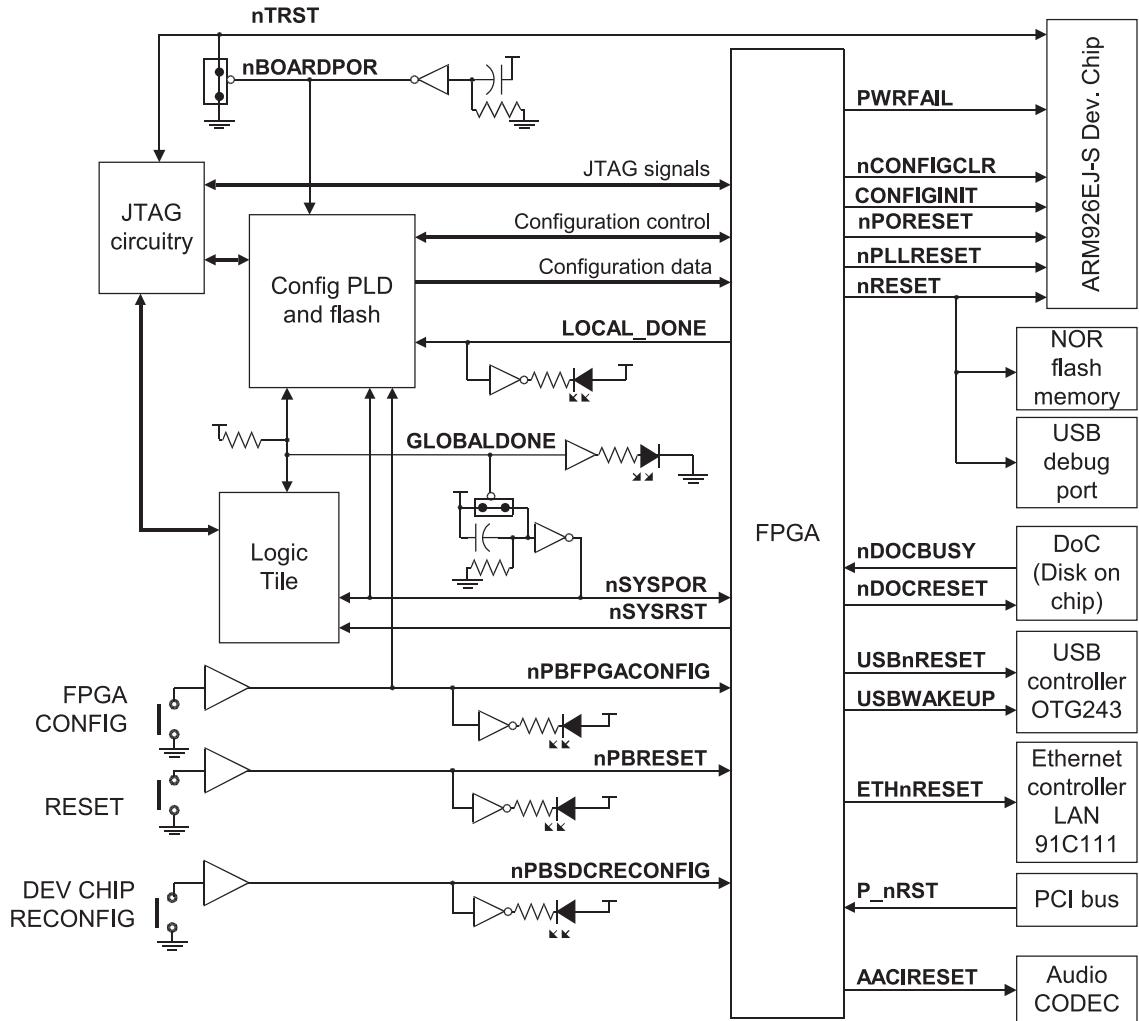


Figure 3-11 PB926EJ-S reset logic

3.3.2 Reset level

Table 3-3 lists the default levels of reset that results from external sources.

Table 3-3 Reset sources and effects

External source	Reset level	Hardware nBOARDPOR generated	FPGA reloaded and Dev. Chip configured with default values	Dev. Chip reconfigured from SYS_CFGDATA registers	Reset generated for CPU, memory and peripherals
Power on	0	Yes	Yes	Yes	Yes
FPGA CONFIG pushbutton	1	No	Yes	Yes	Yes
DEV CHIP RECONFIG pushbutton	2	No	No	Yes	Yes
RESET pushbutton or software reset	6	No	No	No	Yes

Figure 3-12 on page 3-25 shows the activity on the reset signals at different levels of reset.

The level of reset that results from pressing the RESET pushbutton or generating a software reset can be configured by the SYS_RESETCTL register (see also, *Reset Control Register, SYS_RESETCTL* on page 4-31). The ability to configure the reset level gives greater flexibility in designing applications, FPGA images, and Logic Tile IP.

Set SYS_RESETCTL[8] to generate a software reset.

The reset levels specified by SYS_RESETCTL[2:0] are:

- b000 is reserved
- b001 resets to level 1, **CONFIGCLR**
- b010 resets to level 2, **CONFIGINIT**
- b011 resets to level 3, **DLLRESET** (DLL located in FPGA)
- b100 resets to level 4, **PLLRESET** (located in ARM926EJ-S PXP Development Chip)
- b101 resets to level 5, **PORESET**
- b110 resets to level 6, **DOCRESET**
- b111 is reserved.

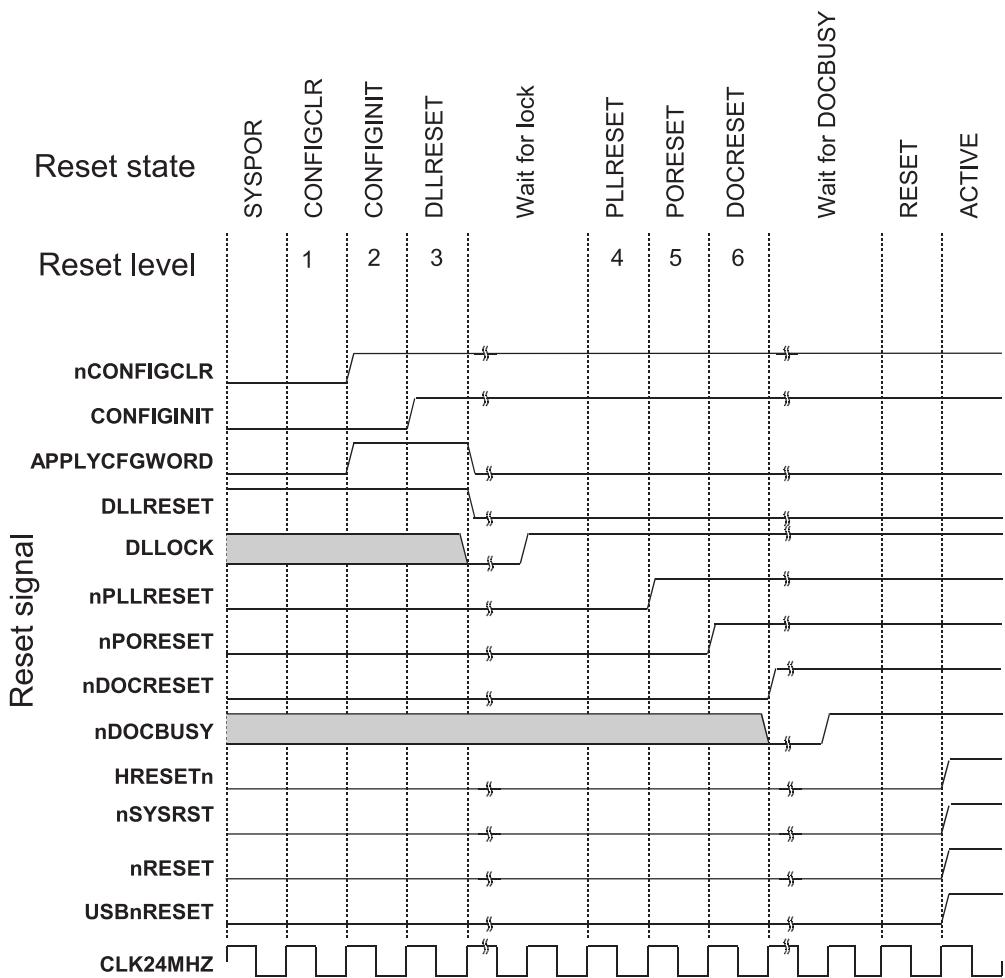


Figure 3-12 Reset signal sequence

A state machine in the FPGA (see Figure 3-13 on page 3-26) uses the value of SYS_RESETCTL and the external reset signals to sequence the reset signals (see also, *Reset Control Register, SYS_RESETCTL* on page 4-31).

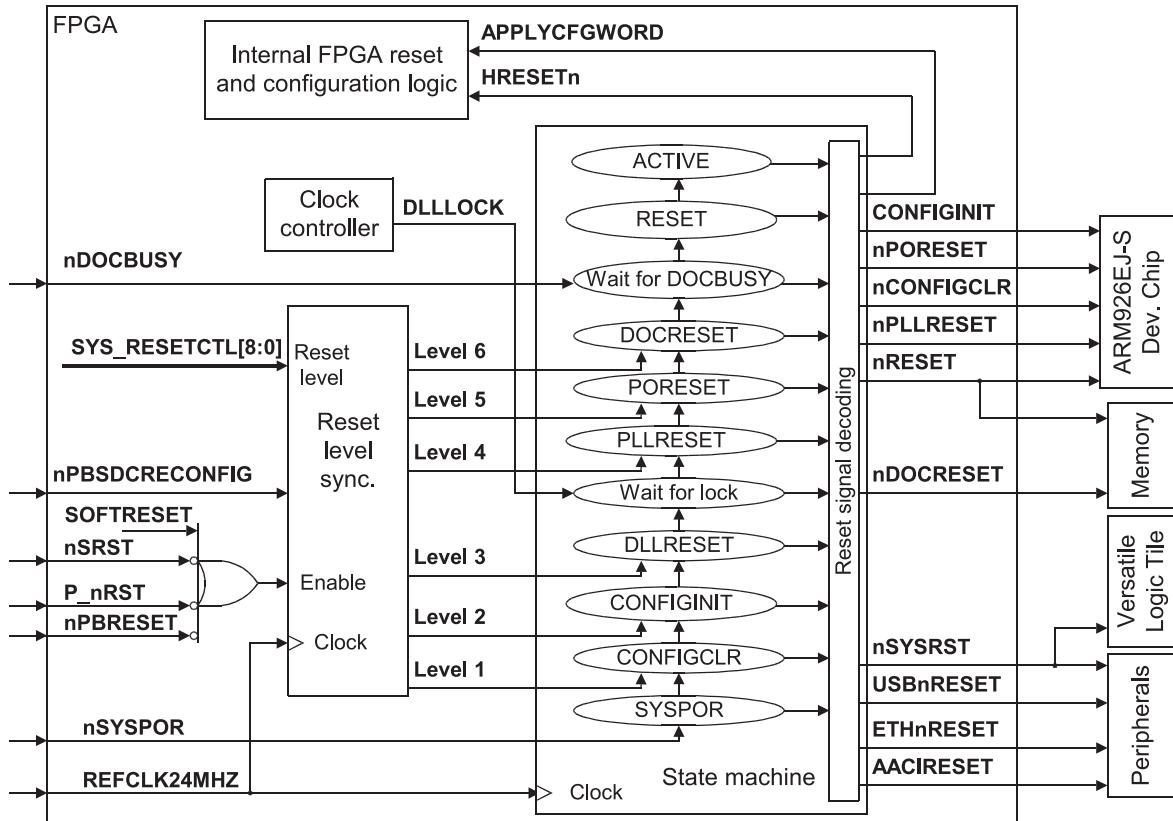


Figure 3-13 Programmable reset level

See Table 3-4 on page 3-29 for a description of the reset signals.

3.3.3 Memory aliasing at reset

Under normal operation, the PB926EJ-S has dynamic memory located at $0x0$. In order to load the boot code however, non-volatile memory must be remapped to the boot address.

Remapping the memory is done by changing how the chip select signals in the ARM926EJ-S PXP Development Chip connect to the external chip select signals that control memory devices. Figure 3-14 on page 3-28 shows the two stage remapping process:

- If **DEVCHIP REMAP** signal is HIGH, from the system controller, it disables the **nMPMCDYCS0** signal that is normally generated by accesses to memory region $0x00000000$ – $0x03FFFFFF$.

Accesses to memory region $0x00000000$ – $0x03FFFFFF$ are remapped to:

- the AHB expansion memory chip select if **BOOTCSSEL[1:0]** is b11
- **nSTATICCS1** if one of **BOOTCSSEL[1:0]** is not b11.

This remapping occurs inside the ARM926EJ-S PXP Development Chip.

- If **FPGA REMAP** is HIGH, from the **SYS_MISC** register, **nSTATICCS1** is remapped to:

- NOR flash 2 (**nDOCCS**) if **BOOTCSSEL[1:0]** is b00
- NOR flash 1 (**nNORCS**) if **BOOTCSSEL[1:0]** is b01.

This remapping occurs inside the FPGA.

At reset, the **DEVCHIP REMAP** and **FPGA REMAP** signals are both HIGH.

Which of **nDOCCS**, **nNORCS**, or AHB expansion memory is active at reset therefore depends on the value of the **BOOTCSSEL[1:0]**. See *Remapping of boot memory* on page 4-9.

———— **Note** ————

If the size of the physical memory selected by **nDOCCS**, **nNORCS**, or AHB expansion memory is less than the address range of $0x00000000$ – $0x03FFFFFF$, the physical memory is aliased and repeated to fill the address space.

The static expansion memory selected by **nEXPCS2** cannot be used as boot memory. The expansion memory can be moved to address $0x0$, but the memory no longer appears at its original location and the code in the boot monitor that jumps to high memory is not usable.

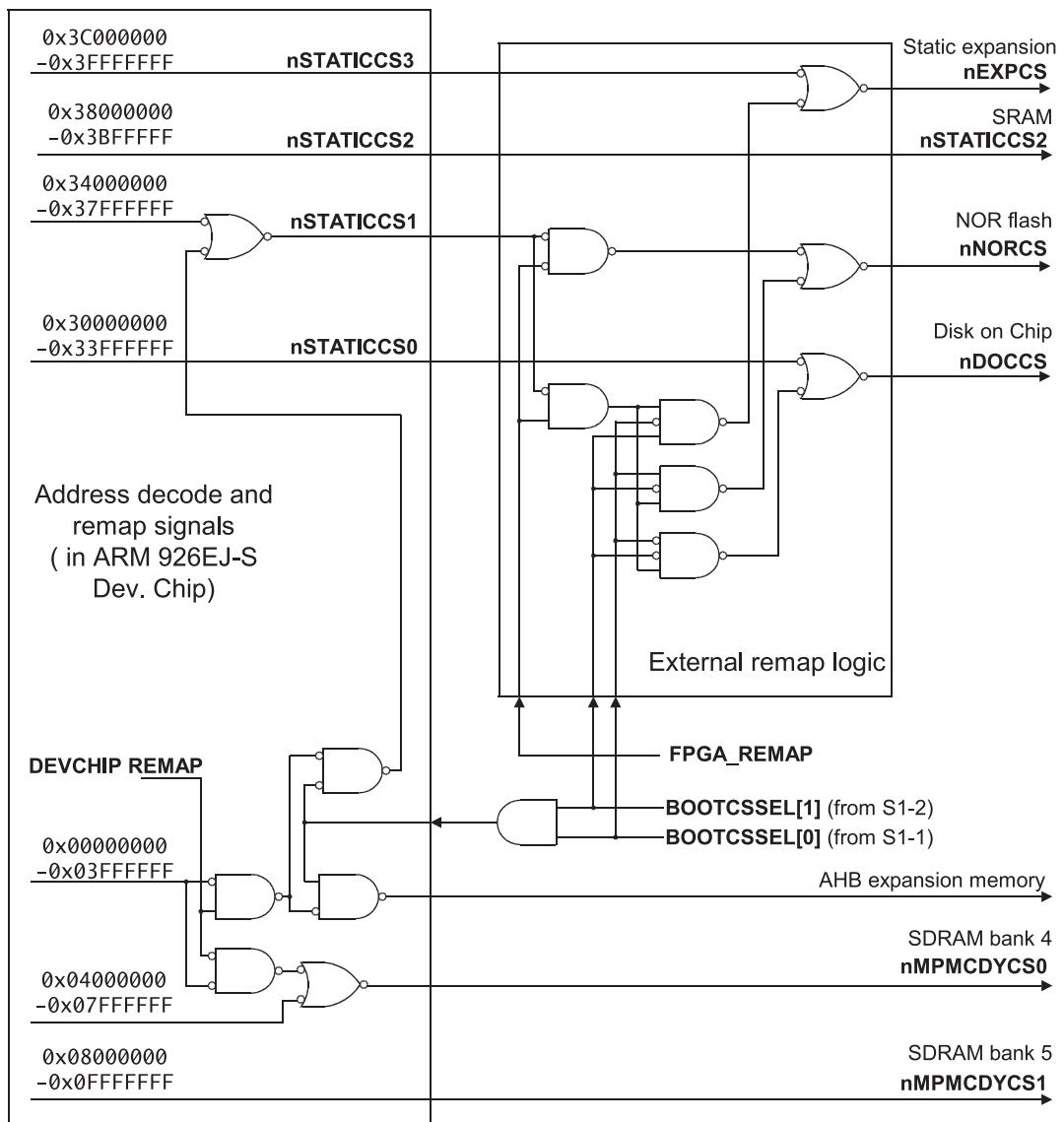


Figure 3-14 Boot memory remap logic

3.3.4 Reset signals

Table 3-4 describes reset signals.

Table 3-4 Reset signal descriptions

Name	Function
AACIRESET	System reset to audio CODEC.
APPLYCFGWORD	This internal signal causes the FPGA to apply configuration data from the SYS_CFGDATAx registers in the FPGA to the M1 and M2 data buses, see <i>Configuration registers SYS_CFGDATAx</i> on page 4-25.
nBOARDPOR	This signal resets the configuration PLD and configuration flash. This signal is also used to generate the nTRST pulse at power on.
nCONFIGCLR	Loads the default configuration for the ARM926EJ-S PXP Development Chip. The default configuration data is hard-coded into the ARM926EJ-S PXP Development Chip.
CONFIGINIT	This signal causes the ARM926EJ-S PXP Development Chip to load configuration data from the M1 and M2 data buses. This enables configuration of the chip without resetting the entire system.
C_nSRST	JTAG open-collector reset signal (shared with FPGAnINIT) to or from the Logic Tile. This signal is part of the configuration JTAG chain.
C_nTRST	JTAG TRST signal to the configuration JTAG chain in the Logic Tile. This signal is part of the configuration JTAG chain.
D_nSRST	JTAG open-collector reset request signal to or from the Logic Tile. This signal is part of the debug JTAG chain.
D_nTRST	JTAG TRST signal to the debug JTAG chain in the Logic Tile. This signal is part of the debug JTAG chain.
ETHnRESET	System reset to Ethernet controller.
FPGA_nPROG	The FPGA_nPROG signal forces all FPGAs in the system to reconfigure. This signal enables the FPGAs to be reconfigured without powering-down the system.
GLOBAL_DONE	This is an open-collector configuration signal that goes HIGH when all FPGAs have finished configuring. The system is held in reset until this signal goes HIGH.
HRESETn	This signal is resets the AMBA AHB components within the FPGA. It is driven active at the same time as nRESET .
nPBFPGACONFIG	This signal is generated from the FPGA RECONFIG pushbutton and causes a total reconfiguration of the system.

Table 3-4 Reset signal descriptions (continued)

Name	Function
nPBRESET	Push-button reset signal to the FPGA. The signal is generated by pressing the reset button.
nPBSDCRECONFIG	This signal is generated from the DEV CHIP CONFIG pushbutton and causes a reconfiguration of the ARM926EJ-S PXP Development Chip.
nPLLRESET	Reset for ARM926EJ-S PXP Development Chip PLL clock circuit.
nPORESET	Power-on reset to development chip, configuration flash, and expansion memory. The CPU core, all system peripherals, and all system controller registers are reset. For details on system registers reset at different reset levels, see Table 4-4 on page 4-18.
nPOWERFAIL	This signal shuts down the onboard regulators. It is triggered by the supply voltage falling to less than 9V. (The signal is only valid if the DC IN supply is used.)
	Note There is a nPWRFAIL signal to the interrupt controller, but this signal is not affected by the power supply voltage. nPWRFAIL can, however, be used to test automatic shutdown code (see <i>Miscellaneous System Control Register, SYS_MISC</i> on page 4-36).
P_nRST	System reset from PCI backplane.
P_nTRST	JTAG TRST signal from PCI backplane.
	Note There is a separate JTAG connector and an independent scan chain on the PCI backplane. The JTAG chain on the PB926EJ-S does not normally extend to the PCI expansion backplane. There is a separate JTAG connector on the PCI backplane for configuring devices on the backplane and on installed PCI cards. There are also links that can be fitted to the PB926EJ-S that connects the two JTAG chains together, but these links are normally only fitted for manufacturing tests.
nPWRFAIL	This signal is provided by the FPGA to the interrupt controller. User software can test this signal and shut down before a power loss causes a loss of data.
	Note This signal is not driven by any power-detection logic. It is provided so that custom implementations of the FPGA image have a signal that could be manipulated by a register. Creating such an FPGA image would enable testing of user software that implements a shutdown routine.

Table 3-4 Reset signal descriptions (continued)

Name	Function
nRESET	Reset signal to the development chip and FPGA. The CPU core, all system peripherals, and some system controller registers are reset. This signal is synchronized with the system bus clock to provide AMBA compliance. For details on system registers reset at different reset levels, see Table 4-4 on page 4-18.
nSRST	nSRST is an active LOW open-collector signal that can be driven by the JTAG equipment to reset the board. Some JTAG equipment senses this line to determine when you have reset a board. This is also used in configuration mode to control the initialization of the FPGA.
	———— Note ——— nSRST splits into D_nSRST and C_nSRST to provide separate debug and configuration signals on the Logic Tile connector HDRZ.
nSYSPOR	Power-on reset signal that initializes the reset level state machine after GLOBAL_DONE goes HIGH. This signal is also fed to a Logic Tile header.
nSYSRST	System reset to the Logic Tile header. This signal is synchronized with the system bus clock to provide AMBA compliance.
nTRST	TAP controller reset (the board drives this signal with nBOARDPOR). ———— Note ——— nTRST splits into SDC_nTRST , D_nTRST , and C_nTRST to provide separate debug and configuration signals on HDRZ of the Logic Tile.
USBnRESET	System reset to USB controller.
USBWAKEUP	Signal to USB controller to re-initialize.

3.3.5 Reset timing

Figure 3-15 shows the power-on reset sequence.

nBOARDPOR is generated at power-up and distributed to the memory expansion boards and to the FPGA configuration PLD. It also causes the assertion of the **nTRST** signal guarantee the embedded ICE macrocell is reset in the ARM926EJ-S PXP Development Chip.

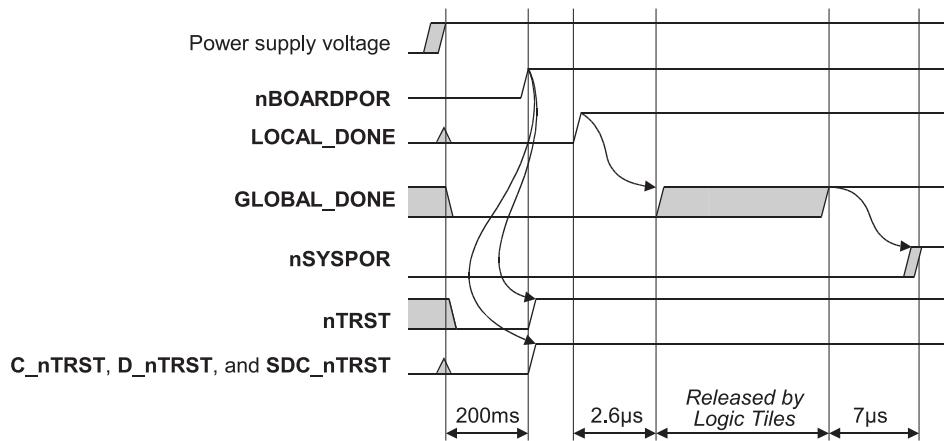


Figure 3-15 Power-on reset and configuration timing

———— Note ————

The release time for GLOBAL_DONE depends on any Logic Tiles in the system. It might be held LOW longer if the tiles take longer to configure.

3.4 Power supply control

If the PB926EJ-S is powered from the brick power supply, a nominal 12V level (**VSMP**) is supplied to the 5V and 3V regulators. If **VSMP**, drops too low, shutdown signals **nPOWERFAIL**, **nSHDN1**, and **nSHDN2** become active and power is switched off. The shutdown circuitry is shown in Figure 3-16 on page 3-34. The power supply can be toggled on and off by pressing the Power/Standby pushbutton.

If the PB926EJ-S is powered from the PCI backplane or the screw terminals, the **VSMP** voltage is not present. Therefore:

- the **5VSB** standby voltage is not present
- **nSHDN1** is held LOW
- **nSHDN2** is held HIGH (this enables the 5V analog regulator)
- the Power/Standby pushbutton has no effect and you must use the external power source to turn the system on or off.

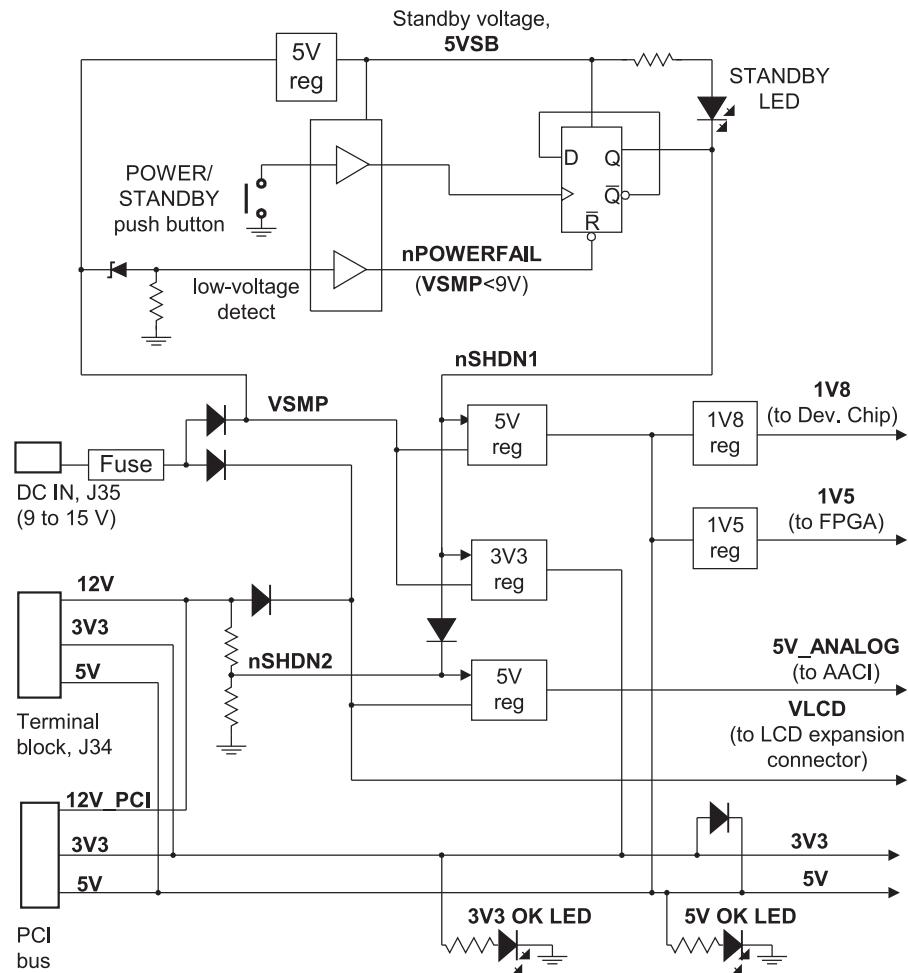


Figure 3-16 Standby switch and power-supply control

3.5 Clock architecture

The clock domains for the PB926EJ-S are shown in Figure 3-17.

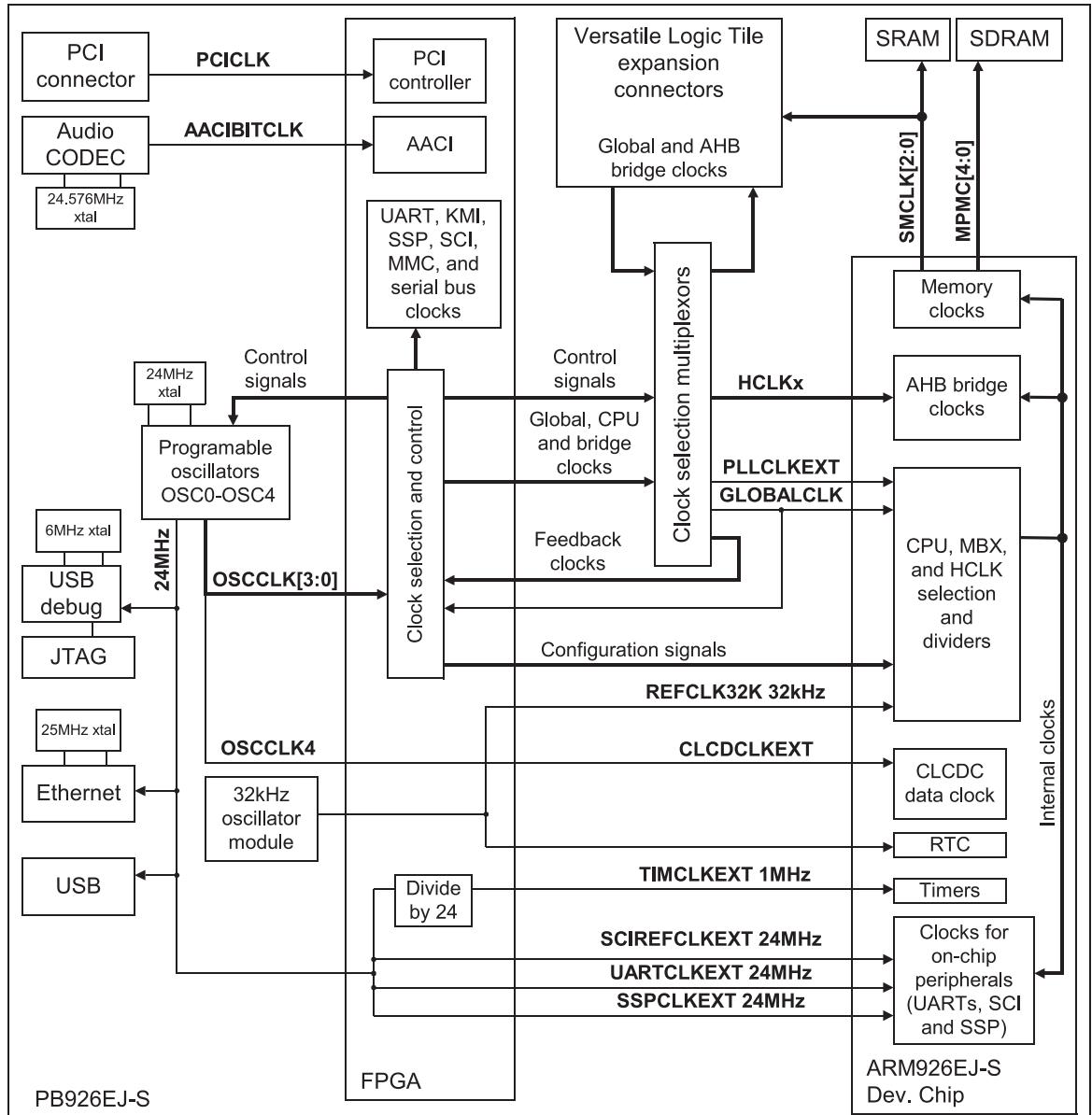


Figure 3-17 Clock architecture

The clock domains for the PB926EJ-S are:

ARM926EJ-S PXP Development Chip

The ARM926EJ-S PXP Development Chip CPU clock is normally a multiplied version of **GLOBALCLK** that is based on OSC0.

Alternatively, the CPU can be clocked from a 32kHz clock or OSC2 to test low-power operating modes.

There are three external AHB bridges on the chip. These normally operate in synchronous mode and the bridge clocks are based on the CPU clock. (The internal AHB clock **HCLK** is divided down from the CPU clock.) In asynchronous mode, the external part of the AHB bridges can be clocked from OSC0, OSC1, OSC2, or OSC3 depending on the clock multiplexors.

The RTC in the ARM926EJ-S PXP Development Chip is clocked from a dedicated 32kHz signal that is derived from the 32kHz oscillator module.

The CLCDC uses OSC4 as the reference for its data clock.

The memory and MBX clocks are derived from the internal AHB clock.

The UART, SSP, and SCI peripherals located in the ARM926EJ-S PXP Development Chip are normally clocked from the internal **HCLK**. An external 24MHz clock from the programmable clock generators can be selected as the reference clock instead of using the clock source inside the chip.

The dual timer modules in the ARM926EJ-S PXP Development Chip are clocked from an external 1MHz clock derived from the 24MHz reference.

FPGA The FPGA contains clock control logic that can set the frequency of the programmable clock generators and direct their outputs to internal and external peripherals.

PCI A **PCICLK** is derived from the 33MHz or 66MHz reference oscillator on the PCI backplane. The PCI clock is connected to the PCI controller in the FPGA to synchronize accesses with the PCI bus. The PCI controller is also connected to the AHB S and AHB M2 buses. The clocks for the AHB buses come from the clock multiplexor.

Audio CODEC

The Audio CODEC has a dedicated crystal oscillator. The reference clock from the CODEC is connected to the AACI in the FPGA.

RTC	There is an external real-time clock clocked by a dedicated 32kHz crystal oscillator. The RTC outputs the 32kHz clock to the FPGA where it is buffered and then sent to the ARM926EJ-S PXP Development Chip where it can be used as the CPU clock for low-power mode.
Ethernet	The Ethernet controller has a 25MHz dedicated crystal oscillator for timing the Ethernet bus. HCLKM2 (typically generated from the programmable oscillator OSC0) is used as a reference frequency for the controller interface to the FPGA.
USB	The 24MHz reference from the programmable oscillator OSC0 is used as a reference frequency for the external USB controller.
Logic Tile	<p>A Logic Tile can be connected to the expansion connectors. The tile normally uses the GLOBALCLK from the PB926EJ-S as the clock for its AHB buses. The tile can, however, also generate GLOBALCLK. (The signal nGLOBALCLKEN from Z50 on the Logic Tile indicates to the PB926EJ-S whether GLOBALCLK is supplied from OSC0 or from the Logic Tile. This signal is pulled HIGH by the Logic Tile to select the Logic Tile GLOBALCLK as the source for GLOBALCLK on the PB926EJ-S.)</p> <p>The tile can also generate the external clocks for the AHB bridges when they are operating in asynchronous mode. In normal operation, the AHB bridges operate in synchronous mode and the PB926EJ-S is the source of the bridge clocks connected to the tile.</p> <p>The static memory clocks, CLCD data clock, and several of the peripheral clocks from the PB926EJ-S are connected to the tile.</p>
Debug	The JTAG connector supplies the reference JTAG clock TCK . There is also an on-board USB debug port that is driven by the 24MHz reference and a dedicated 6MHz crystal oscillator.

The various clocks and clock selection mechanism are described in the following sections:

- *ARM926EJ-S PXP Development Chip clocks* on page 3-39
- *ICS307 programmable clock generators* on page 3-48
- *Peripheral clocks* on page 3-54
- *RealView Logic Tile clocks* on page 3-52.

— **Note** —

The clocking selection and control logic in the PB926EJ-S enables you to emulate many different clock systems and operating modes (for example, low-power mode with slow clocks, operation without a PLL, and synchronous or asynchronous AHB bridges).

The default values for clock selection and control are appropriate for most situations. You must modify the multiplexor settings if you are doing one of the following:

- Using an external Logic Tile to generate the reference clocks for the CPU or AHB bridges.
- Operating one of the AHB bridges in the ARM926EJ-S PXP Development Chip in asynchronous mode with a dedicated clock input for timing the external part of the bridge.

3.5.1 ARM926EJ-S PXP Development Chip clocks

This section describes the clocks used by the ARM926EJ-S PXP Development Chip. Figure 3-18 shows the clock circuitry inside the chip.

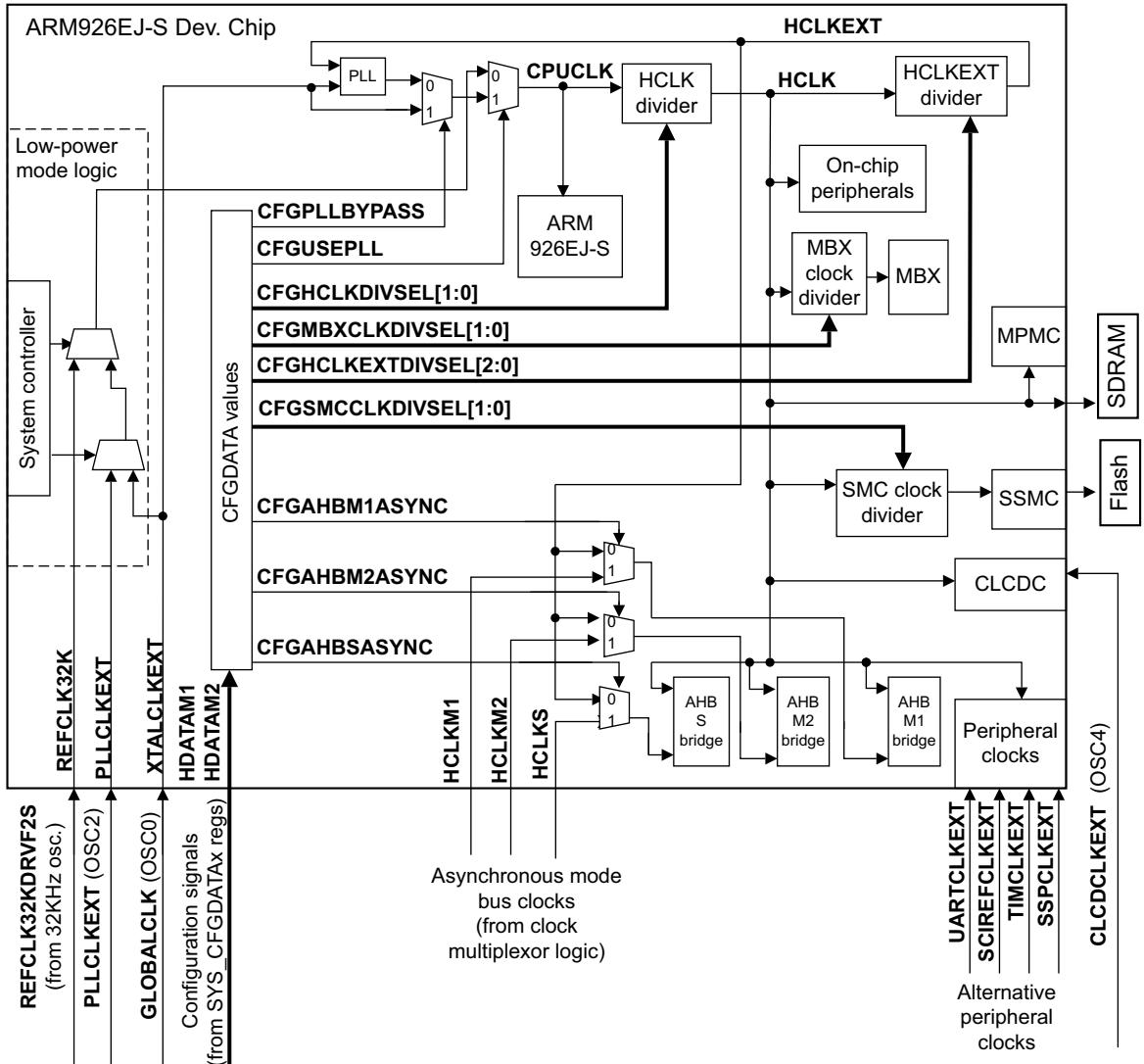


Figure 3-18 ARM926EJ-S PXP Development Chip internal multiplexors

Table 3-5 lists the clock signals.

Table 3-5 ARM926EJ-S PXP Development Chip clocks

Clock signal	Frequency	Description	Source
GLOBALCLK	6–75MHz	This is a master clock that is shared between the FPGA, Logic Tile, and ARM926EJ-S PXP Development Chip.	ICS307 OSC0
HCLKM1	6–50MHz	The AHB master interface clock is used by the AHB Bridge 1 to off-chip peripherals when it operates in asynchronous mode. By default, the multiplexor selects GLOBALCLK (driven by OSC0) as the external clock source.	ICS307 OSC1
Note		By default, the AHB M1, AHB M2, and AHB S bridges all operate in synchronous mode and the external reference clocks are ignored.	
HCLKM2	6–40MHz	The AHB master interface clock is used by the AHB Bridge 2 to off-chip peripherals when it operates in asynchronous mode. By default, the multiplexor selects GLOBALCLK (driven by OSC0) as the external clock source.	ICS307 OSC2
HCLKS	6–33MHz	The AHB master interface clock is used by the AHB Bridge to on-chip peripherals when it operates in asynchronous mode. By default, the multiplexor selects GLOBALCLK (driven by OSC0) as the external clock source.	ICS307 OSC3
PLLCLKEXT	6–200MHz	When the development chip PLL is not used, this input can be used to drive the CPU and AMBA clocks. This clock is selected by the Clock and Reset Controller which is controlled by the System Controller.	ICS307 OSC0
Note		By default, the ARM926EJ-S PXP Development Chip uses a PLL to generate the CPU and AMBA clocks based on the XTALCLKEXT signal. PLLCLKEXT and REFCLK32K are not used.	
REFCLK32K	32.768kHz (fixed)	This clock is selected by the Clock and Reset Controller which is controlled by the System Controller. This signal is also used to generate a 1Hz clock for the Real Time Clock. When the development chip PLL is not used, this input can be used to drive the CPU and AMBA clocks.	Crystal

Table 3-5 ARM926EJ-S PXP Development Chip clocks (continued)

Clock signal	Frequency	Description	Source
Peripheral clocks	24MHz and 1MHz	The SSP, SCI, and UART use an external 24MHz as reference. The timers use an external 1MHz clock as reference.	24MHz crystal
XTALCLKDRV	6–75MHz	For the default clock multiplexor setting, this signal is driven from the FPGA (from OSC0) and is distributed as HCLKM1 , HCLKM2 , HCLKS , PLLCLKEXT , GLOBALCLK , and XTALCLKEXT .	ICS307 OSC0
XTALCLKEXT	6–75MHz	When the ARM926EJ-S PXP Development Chip PLL is used, this input is used as the reference clock for the PLL. When the on-chip PLL is not used this input can be used as the reference clock for the CPU and AMBA clocks. This clock is selected by the Clock and Reset Controller which is controlled by the System Controller.	ICS307 OSC0

Default operation

Figure 3-19 on page 3-42 shows a simplified block diagram with default clock settings and the internal and external multiplexors replaced by an equivalent circuit.

Caution

It is recommended that you use the default value of `0xE0` for the clock multiplexing signals **HCLKCTRL[7:0]**. Changing the value of **HCLKCTRL[7:0]** is only required if you want to individually control the source for **XTALCLKEXT** (**GLOBALCLK**), **AHB M1**, **AHB M2**, or **AHB S**.

If you install a Logic Tile for example, you can add additional clock generation and control logic in the tile FPGA. If you change the multiplexing signals, ensure that you have programmed the oscillators to generate the correct bridge frequencies or have implemented the correct clock generation logic in your RealView Logic Tile.

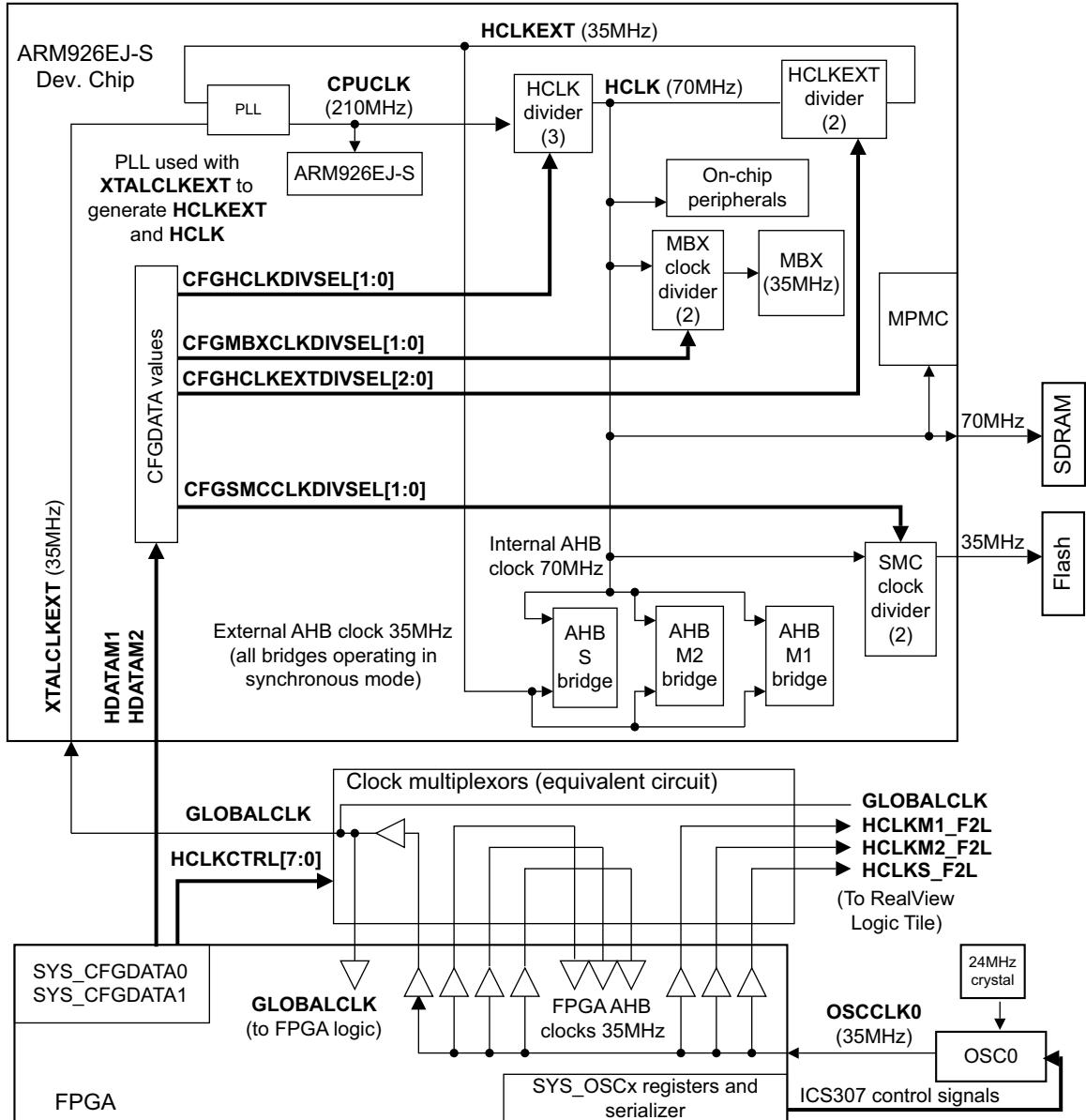


Figure 3-19 Default clock sources and frequencies

For the default clock source and configuration values:

- OSC0 provides the **XTALCLKEXT** input clock for the PLL in the ARM926EJ-S PXP Development Chip.
- The PLL output **CPUCLK** is used as the CPU core clock and as the input to the **HCLK** divider.
- HCLK** is **CPUCLK** divided by 1, 2, 3, or 4 depending on the value of **CFGHCLKDIVSEL[1:0]**. **HCLK** is used as the SDRAM clock **MPMCCLK**, and as the inputs to the MBX and SMC clock dividers.
- HCLKEXT** is **HCLK** divided by 1 to 8 depending on the value of **CFGHCLKEXTDIVSEL[2:0]**. **HCLKEXT** is the reference clock for the external part of the AMBA bridges M1, M2, and S. This clock is the feedback clock for the PLL, therefore the frequency of **HCLKEXT** is the same as that of **XTALCLKEXT**.

Setting the clock frequencies involves trade-offs between CPU performance, bus performance, MBX performance, and memory access time. The clocks must also be within their operational limits, see *Clock rate restrictions* on page B-5.

The AHB bridges operate in synchronous mode by default. The internal part of the AHB bridge is clocked by **HCLK** and external part of the bridge is clocked by **HCLKEXT**. **HCLKEXT** is the feedback to the PLL, so the **HCLKEXT** frequency is the same as the PLL reference frequency **XTALCLKEXT**.

CPUCLK is generated by multiplying the reference **XTALCLKEXT** by the **HCLKDIV** and **HCLKEXTDIV** values. For example, if **XTALCLKEXT** is 20MHz, **HCLKDIV** is 3, and **HCLKEXTDIV** is 3, the frequency of **CPUCLK** is $20*3*3$ or 180MHz. Selecting the values for **HCLKDIV** and **HCLKEXTDIV** must result in values for **CPUCLK**, **HCLK** and **HCLKEXT** that are within their maximum frequency ranges.

Example of changing the CPU and bus clock frequencies

Use the following steps to set the external AMBA bus clock to 35MHz, the **CPUCLK** rate to 210MHz, and the internal AMBA bus and SDRAM frequency to 70MHz:

- The external AMBA bus clock is at the same frequency as the **XTALCLKEXT** signal, so OSC0 must be set to 35MHz. This requires that the **SYS_OSC0** register is loaded with **b000010110010100111** (**0x02CA7**).

This sets the Divide Select bits to **b000** (divide by 10), the Reference Divider bits to **b0010110** (divide by 24), and the VCO Divider bits to **b010100111** (multiply by 175). See *ICS307 programmable clock generators* on page 3-48 and *Oscillator registers, SYS_OSCx* on page 4-23 for details on programming OSC0.

- If **CPUCLK** is 210MHz the total multiplier ratio of HCLKDIV and HCLKEXTDIV must be 6.
- The **HCLK** divider is set to divide by 3 (CFGHCLKDIVSEL[1:0]=b10). This gives an internal AMBA bus and SDRAM clock of 70MHz. See *Configuration control* on page 3-7 and *Memory characteristics* on page 4-15.
- The HCLKEXT divider must be set to divide by 2 (CFGHCLKEXTDIVSEL[2:0]=b001) so that the total divider ratio for HCLKDIV and HCLKEXTDIV is 6. This results in an PLL feedback clock and external **HCLK** of 35MHz.
- **CPUCLK** is 3*2*35MHz (210MHz) as required.
- An MBX clock 70MHz is within the permitted range, so its divider is set to 1 (CFGMBXCLKDIVSEL[1:0]= b00).
- An SMC of 70MHz is outside the operating frequency range for flash memory, so the SMC clock divider must be set to 2 (CFGSMCCLKDIVSEL[1:0]= b01). The flash memory in synchronous mode operates at 35MHz.

Operating the AHB bridges in asynchronous mode

The following signals control the external part of the AHB bridges if they are operating in asynchronous mode:

- CFGM1ASYNC** If HIGH, the external **HCLKM1** is selected as the clock for the external part of bus bridge M1. The signal is controlled by the value of bit 22 of the SYS_CONFIGDATA2 register. The default is LOW, the internal clock **HCLKEXT** is used and the bridge operates in synchronous mode.
- CFGM2ASYNC** If HIGH, the external **HCLKM2** is selected as the clock for the external part of bus bridge M2. The signal is controlled by the value of bit 23 of the SYS_CONFIGDATA2 register. The default is LOW, the internal clock **HCLKEXT** is used and the bridge operates in synchronous mode.
- CFGSASYNC** If HIGH, the external **HCLKS** is selected as the clock for the external part of bus bridge S. The signal is controlled by the value of bit 24 of the SYS_CONFIGDATA2 register. The default is LOW, the internal clock **HCLKEXT** is used and the bridge operates in synchronous mode.

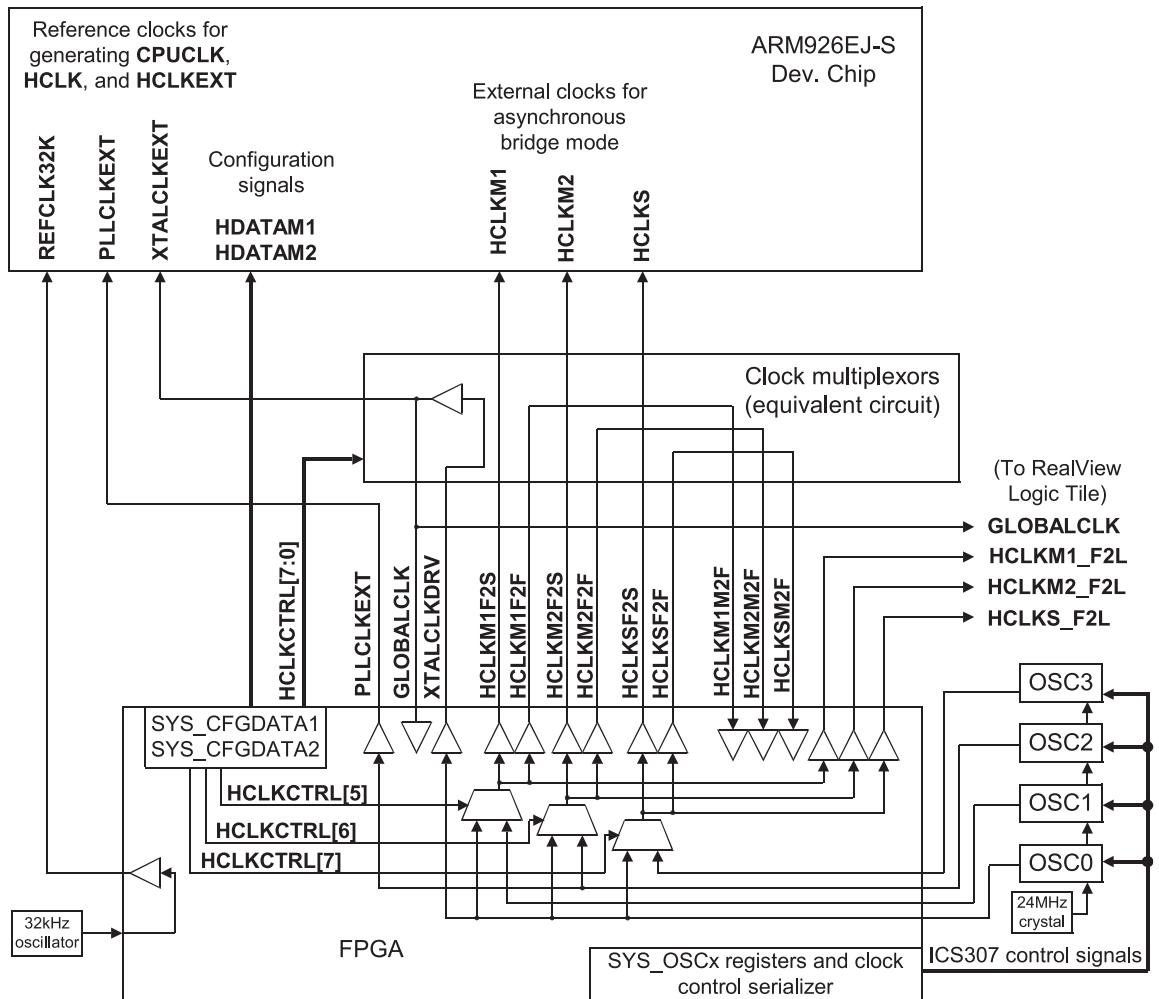


Figure 3-20 Clock sources for asynchronous AHB bridges

Table 3-6 Asynchronous clock signals

Clock signal	Frequency	Description	Source
HCLKCTRL[7:0]	-	These signals control the multiplexor that selects clocks for the ARM926EJ-S PXP Development Chip.	FPGA
HCLKM1M2F HCLKM2M2F HCLKSMF2F	-	These are FPGA input clocks (for M1, M2, and S) that can be routed to HCLKxM2F and used as clocks for the M1, M2, and S buses in the FPGA.	Clock select logic
HCLKM1F2F HCLKM2F2F HCLKSF2F	-	These are FPGA output clocks (for M1, M2, and S) that can be used as feedback signals to DLLs in the FPGA.	Clock select logic
HCLKM1F2S HCLKM2F2S HCLKSF2S	-	These are FPGA output clocks (for M1, M2, and S) that can be used as ARM926EJ-S PXP Development Chip reference clocks.	FPGA
HCLKM1F2L HCLKM2F2L HCLKSF2L	-	These are FPGA output clocks (for M1, M2, and S) that can be used as RealView Logic Tile reference clocks. By default, these are driven by OSC0.	FPGA
HCLKM1L2S HCLKM2L2S HCLKSL2S	-	These are RealView Logic Tile output clocks (for M1, M2, and S) that can be used as ARM926EJ-S PXP Development Chip reference clocks.	RealView Logic Tile
HCLKM1L2F HCLKM2L2F HCLKSL2F	-	These are RealView Logic Tile output clocks (for M1, M2, and S) that can be used as clocks for buses in the FPGA.	RealView Logic Tile
ICS307 control signals	-	The signals ICS307_CLK , ICS307_DATA , and ICS307_STRB[4:0] clock data from the SYS_OSCx registers in the FPGA to the programmable oscillators.	
OSC0		For the image provided with the FPGA and the default HCLKCTRL[7:0] value of 0xE0, programmable oscillator OSC0 is the source for the XTALCLKEXT , GLOBAL_CLK , HCLKM1 , HCLKM2 , HCLKS , and PLLCLKEXT signals.	
OSC1		Programmable oscillator OSC1 is the source for PLLCLKEXT and can be selected as the source for the HCLKM1 signal.	
OSC2		Programmable oscillator OSC2 can be used the source for the HCLKM2 signal.	
OSC3		Programmable oscillator OSC3 can be used the source for the HCLKS signal.	

Table 3-7 to Table 3-9 on page 3-48 list the source of the bridge clocks for different values of the **HCLKCTRL[7:0]** signals (from **SYS_CONFIGDATA1[23:16]**). The default value of **HCLKCTRL[7:0]** is 0xE0.

Table 3-7 HCLKM1 selection

HCLKCTRL signal				
[4]	[0]	[1]	[5]	HCLKM1 driven by:
1	1	X	X	GLOBALCLK (driven from tile, nGLOBALCLKEN pulled HIGH)
1	0	X	X	GLOBALCLK (driven from OSC0)
0	X	1	X	HCLKM1L2S and HCLKM1L2F (from tile)
0	X	0	1	OSC0 (default)
0	X	0	0	OSC1

Table 3-8 HCLKM2 selection

HCLKCTRL signal				
[4]	[0]	[2]	[6]	HCLKM2 driven by:
1	1	X	X	GLOBALCLK (driven from tile, nGLOBALCLKEN pulled HIGH)
1	0	X	X	GLOBALCLK (driven from OSC0)
0	X	1	X	HCLKM2L2S and HCLKM2L2F (from tile)
0	X	0	1	OSC0 (default)
0	X	0	0	OSC2

Table 3-9 HCLKS selection

HCLKCTRL signal					HCLKS driven by:
[4]	[0]	[3]	[7]		
1	1	X	X	GLOBALCLK (driven from tile, nGLOBALCLKEN pulled HIGH)	
1	0	X	X	GLOBALCLK (driven from OSC0)	
0	X	1	X	HCLKSL2S and HCLKSL2F (from tile)	
0	X	0	1	OSC0 (default)	
0	X	0	0	OSC3	

ICS307 programmable clock generators

Five programmable (6–200 MHz) clocks are supplied to the FPGA by the programmable MicroClock ICS307 clock generators (OSC0–OSC4):

OSCCLK0 This is the default reference clock for **XTALCLKDRV**. This is normally used as **GLOBALCLK**, the external AHB bridge clocks, and the reference for the PLL that generates **CPUCLK**.

OSC0 uses a 24MHz crystal as its reference. A fixed-frequency 24MHz signal, **REFCLK24MHZ**, is output from OSC0 and used as a reference signal for:

- The input for programmable oscillators OSC1–OSC4.
- the USB controller clock
- the USB debug controller clock
- the external peripheral clocks for the SCI, UART, and SSP in the ARM926EJ-S PXP Development Chip.
- the input to divide-by-24 logic in the FPGA that produces the 1MHz reference clock for the timers.

OSCCLK1 An alternative reference clock for the AHB M1 bridge clocks from the FPGA to the clock selection multiplexors (**HCLKM1F2S**, **HCLKM1F2F**, and **HCLKM1F2L**). By default, this clock is not used and the AHB M1 bridge operates in synchronous mode.

- OSCCLK2** An alternative reference clock for **PLLCLKEXT**. This clock can be selected as the source for **CPUCLK** if the ARM926EJ-S PXP Development Chip is in low-power emulation mode.
- This is also the alternative reference clock for the AHB M2 bridge clocks from the FPGA to the clock selection multiplexors (**HCLKM2F2S**, **HCLKM2F2F**, and **HCLKM2F2L**). By default, this clock is not used and the AHB M2 bridge operates in synchronous mode.
- OSCCLK3** An alternative reference clock for the AHB S bridge clocks from the FPGA to the clock selection multiplexors (**HCLKSF2S**, **HCLKSF2F**, and **HCLKSF2L**). By default, this clock is not used and the AHB S bridge operates in synchronous mode.
- OSCCLK4** This is the reference for the CLCD controller (a buffered version of this clock is output to the ARM926EJ-S PXP Development Chip as **CLCDCLKEXT**).

The output frequencies of the ICS307s are controlled by divider values loaded into the serial data input pins on the oscillators. The divider values are defined by the **SYS_OSCx** and **SYS_OSCRESETx** registers. The data stream and register format is shown in Figure 3-21. See *Oscillator registers, SYS_OSCx* on page 4-23 for details on the clock control registers.

31	24 23	19 18	16 15	9 8	0
Not transmitted to oscillator	Reserved, transmitted to oscillator but not used	DIVIDE select	RDW, Reference Divider Word	VDW, VCO Divider Word	

Figure 3-21 Serial data and **SYS_OSCx register format**

— Note —

Bit 23 is loaded into the shift register first and bit 0 is loaded last. Data is clocked into the **ICS307DATA** pins of the oscillators on the rising edge of **ICS307CLK**. One of the **ICS307STRB[4:0]** signals is pulsed HIGH to latch the serial data into the divider control register.

You can calculate the oscillator output frequency from the formula:

$$\text{CLKx} = \frac{48 * (\text{VDW} + 8)}{(\text{RDW} + 2) * \text{DIVIDE}} \text{ MHz}$$

where:

- VDW** Is the VCO divider word (4 – 511) from SYS_OSCx[8:0]
- RDW** Is the reference divider word (1 – 127) from SYS_OSCx[15:9]
- DIVIDE** Is the divide ratio (2 to 10) selected from SYS_OSCx[18:16]:
- b000 selects divide by 10
 - b001 selects divide by 2
 - b010 selects divide by 8
 - b011 selects divide by 4
 - b100 selects divide by 5
 - b101 selects divide by 7
 - b110 selects divide by 3
 - b111 selects divide by 6.

For more information on the ICS clock generator and a frequency calculator, see the ICS web site at www.icst.com. For details of the clock control registers, see *Status and system control registers* on page 4-17.

Selecting slow start

The PB926EJ-S can be restarted with low-frequency clocks. This is useful, for example, if you are testing a peripheral in an external RealView Logic Tile that cannot support high frequency operation at startup. This mode does not require you to write a startup-application that writes to SYS_OSC0.

To restart the system in low-frequency mode, set switch S1-5 to ON and power-cycle the system or press the DEV CHIP CONFIG pushbutton. The resulting frequencies are:

OSCCLK0 The reference clock is programmed for 10MHz operation. The ratios for the clock dividers are not changed.

HCLKEXT This 10MHz clock controls the external half of the AHB bridges when they are operating in synchronous mode.

HCLK This 20MHz clock controls the internal half of the AHB bridges and is the reference clock for the memory controllers.

CPUCLK This 60MHz clock drives the ARM926EJ-S processor.

To return to the default operating mode, set switch S1-5 to OFF and reset the system.

Selecting the low-frequency clocks in power-saving mode

The system controller in the ARM926EJ-S PXP Development Chip can switch the system into power-saving modes (slow, doze, and sleep).

In the power-saving modes, an external low-frequency clock is used as **CPUCLK**. If the AHB bridges operated synchronous mode, the resulting timing for the external part of the AHB bridge would be **CPUCLK** divided by the values used for HCLKDIV and HCLKEXTDIV and the bus would be extremely slow. Therefore, the AHB bridges must operate in asynchronous mode and the bus timing is controlled by external clocks **HCLKM1**, **HCLKM2**, and **HCLKS**.

The following signals control the PLL usage:

CFGPLLBYPASS If HIGH, the PLL is bypassed and **XTALCLKEXT** is the input to the **CPUCLK** multiplexor. The signal is controlled by the value of bit 11 of the **SYS_CONFIGDATA2** register. The default is LOW and the PLL output is used.

CFGUSEPLL If LOW, an external clock (**REFCLK32K**, **PLLCLKEXT**, or **XTALCLKEXT**) is used instead of the PLL output as **CPUCLK**. The signal is controlled by the value of bit 10 of the **SYS_CONFIGDATA2** register. The default is HIGH and the output from the PLL is used and the power-saving modes are disabled.

By default, **HCLKM1**, **HCLKM2**, and **HCLKS** are driven from **GLOBALCLK**. (**GLOBALCLK** is by default operating at OSC0 frequency.) For details on changing the AHB asynchronous bridge clock frequencies, see *Operating the AHB bridges in asynchronous mode* on page 3-44.

Peripheral clocks

The UART, Smart Card Interface, and Synchronous Serial Port in the ARM926EJ-S PXP Development Chip are clocked from a 24MHz reference clock from the FPGA. The clock is a buffered version of the **REFCLK24MHZ** (from the crystal oscillator circuit that is part of OSC0).

The Dual Timer Counter modules in the ARM926EJ-S PXP Development Chip are clocked by a 1MHz reference clock from the FPGA. The 1MHz clock is generated by dividing the 24MHz reference by 24 in the FPGA.

3.5.2 RealView Logic Tile clocks

The PB926EJ-S can be expanded by adding RealView Logic Tiles. The **HCLKCTRL[0]** signal (SYS_CONFIGDATA1[16]) indicates the state of the **nGLOBALCLKEN** signal that selects the source for **GLOBALCLK** (see Table 3-10).

Table 3-10 GLOBALCLK selection

HCLKCTRL[0]	XTALCLK/GLOBALCLK driven by:
0	XTALCLKDRV signal from FPGA (from OSC0). This is the default.
1	GLOBALCLK signal from RealView Logic Tile (nGLOBALCLKEN pulled HIGH by the RealView Logic Tile)

See Appendix F *RealView Logic Tile* for details on tile clocks.

— **Caution** —

By default, the clock multiplexors select **XTALCLKDRV** from the FPGA (buffered version of OSC0 output) as the reference clock.

Setting **Z50** HIGH on the RealView Logic Tile pulls **nGLOBALCLKEN** HIGH and selects the RealView Logic Tile as the source for the global clock and the AHB bridge clocks. However, you must ensure that you implement appropriate clock generation and selection logic in your RealView Logic Tile and that the clocks operate correctly at power on.

The RealView Logic Tile can also be selected to provide the external bridge clocks when an AHB bridge is operating in asynchronous mode. See *Operating the AHB bridges in asynchronous mode* on page 3-44 for more details.

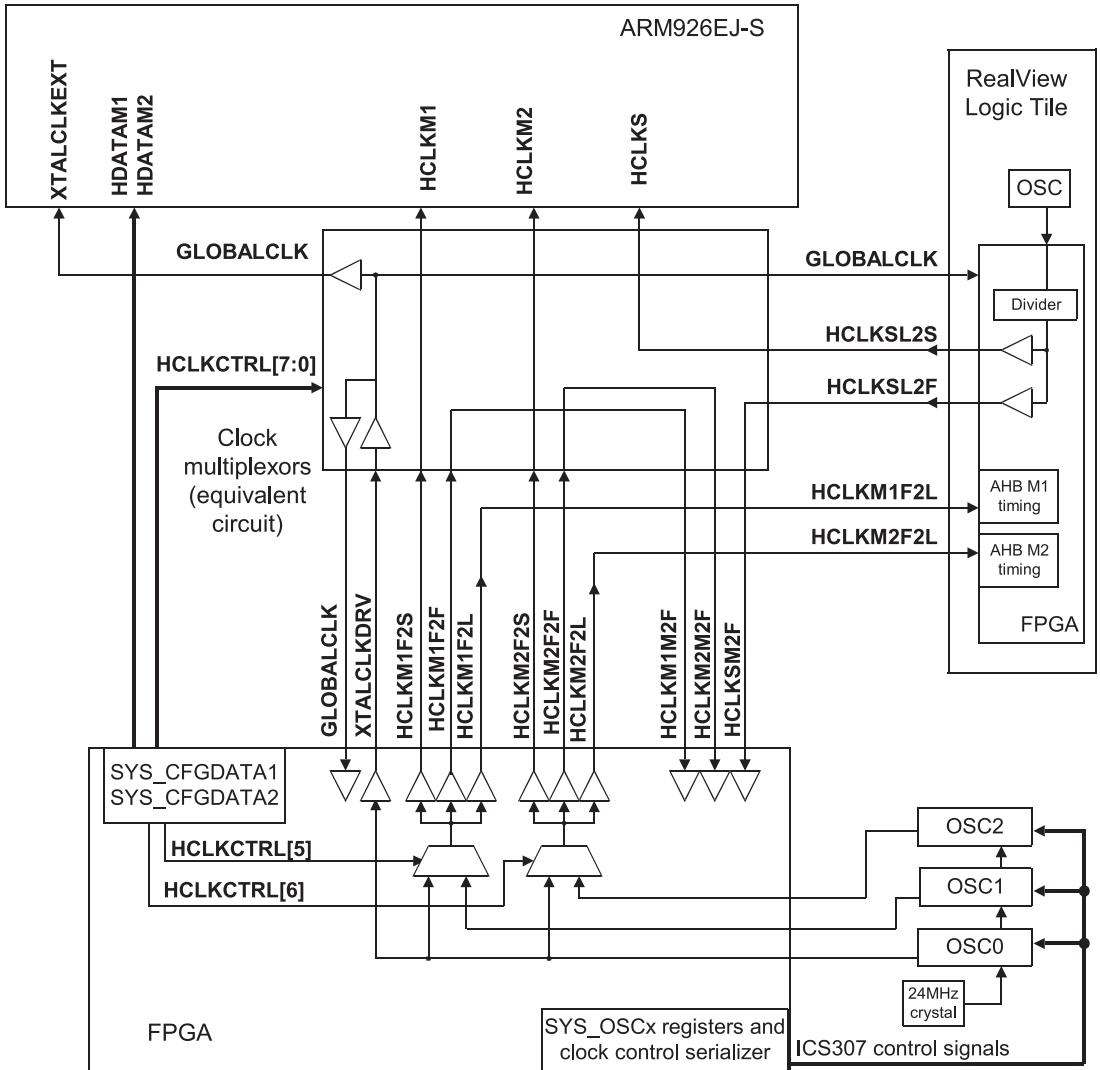


Figure 3-22 Example of selecting a tile clock for the AHB S bridge

3.5.3 Peripheral clocks

Table 3-11 lists the other memory and peripheral clocks on the PB926EJ-S.

For more detail on the clocking system, see the files in the Schematics directory of the CD supplied with the PB926EJ-S.

Table 3-11 PB926EJ-S clocks and clock control signals

Clock signal	Frequency	Description	Source
AACIBITCLK	12.288MHz	This is the synchronization clock from the audio CODEC. The clock is an input to the AACI PrimeCell.	Crystal oscillator
CLCDCLKEXT	6–50MHz	The clock for PL110 CLCD Controller in the development chip can be derived from this input.	ICS307 OSC4
ETHLCLK	AHB M2	ETHLCLK is used to synchronize data transfers between the external controller and the FPGA. (The Ethernet controller uses a 25MHz crystal for clocking signals to and from the Ethernet connector.)	HCLKM2 (typically OSC0)
MPMCCLK[4:0]	-	The dynamic memory clocks from the MPMC in the development chip. This is a buffered version of HCLK .	MPMC controller
PCICLK	-	This is the clock from the PCI backplane.	
SCIREFCLKEXT	24MHz	The clock for PL131 SCI in the development chip can be derived from this input. This is a buffered version of REFCLK24MHZ .	24MHz reference
SMCLK[2:0]	-	The static memory clocks from the SSMC in the development chip. This is HCLK divided by 1, 2, or 3.	SSMC controller

3.5.4 Clock multiplexor logic

Figure 3-23 on page 3-55 shows the clock multiplexor switches and the effect of the **HCLKCTRL[4:0]** signals.

———— Note ————

The **HCLKx_L2S** and **HCLKx_L2F** clocks must be driven from the same reference source in the RealView Logic Tile. The **HCLKx_F2S** and **HCLKx_F2F** clocks are driven from the same source in the PB926EJ-S FPGA. Two signals are used for each clock for loading purposes and to allow for future expansion.

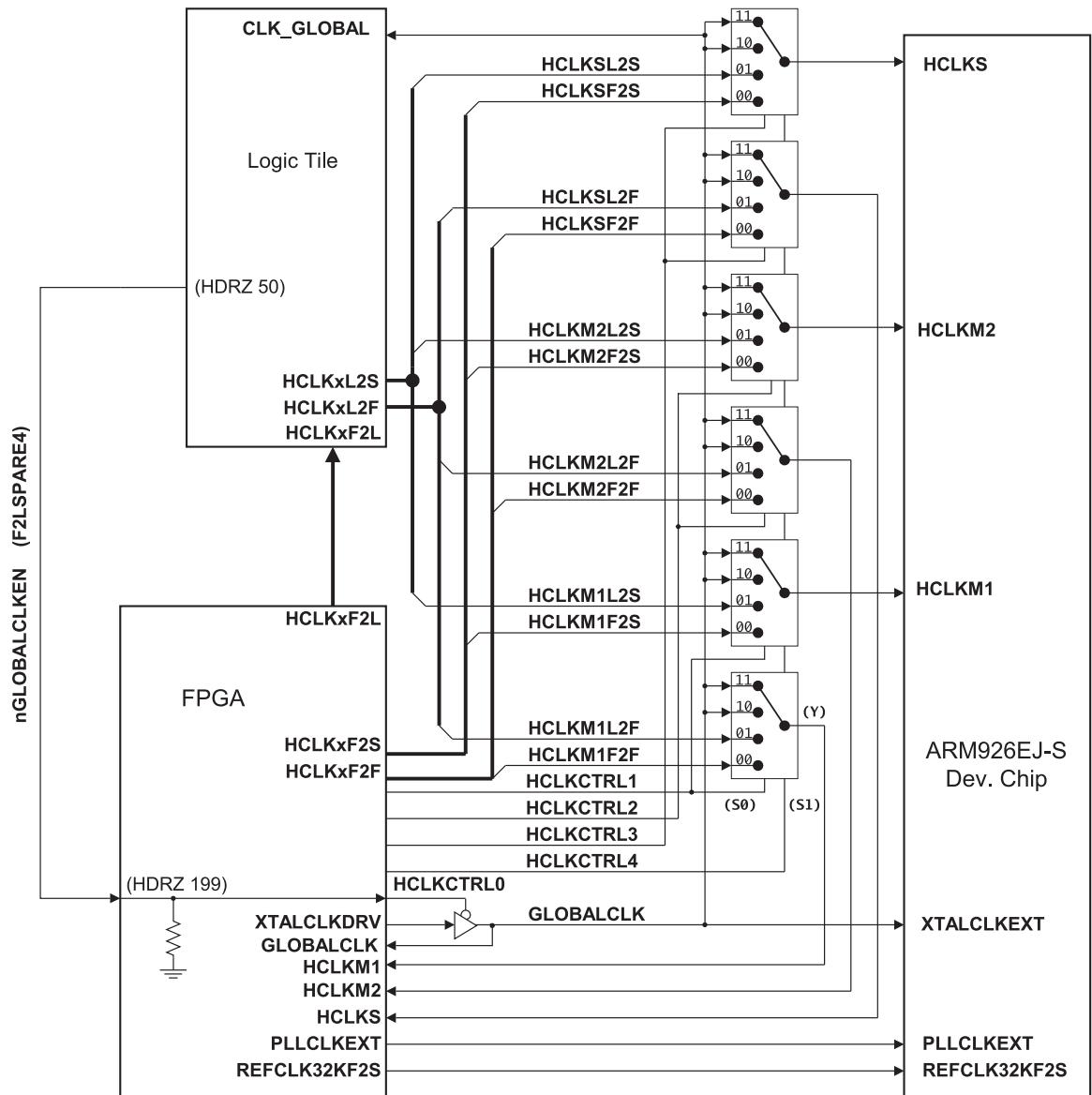


Figure 3-23 Clock multiplexors

3.6 Advanced Audio Codec Interface, AACI

The FPGA contains an ARM PrimeCell *Advanced Audio CODEC Interface* (AACI) that provides communication with a CODEC using the AC-link protocol. This section provides a brief overview of the AACI. For detailed information, see *PrimeCell Advanced Audio CODEC Interface (PL041) Technical Reference Manual*.

— Note —

For a description of the audio CODEC signals, refer to the LM4549 datasheet available from the National Semiconductor website. See also *Advanced Audio CODEC Interface, AACI* on page 4-42.

The AACI on the PB926EJ-S connects to a National Semiconductor LM4549 audio CODEC. The audio CODEC is compatible with AC'97 Rev 2.1. Table 3-12 lists the specifications for the audio system.

Table 3-12 Audio system specification

Characteristic	Value
Raw digital audio data format	PCM
Number of audio channels	Out 2 (stereo) In 1 of 2 (mono)
Audio sample data width	12, 16 or 18-bit native. Other data sizes require software conversion of sample data.
Sample rates supported	4kHz to 48kHz, variable in 1Hz steps. Record and playback sample rates can be independently selected.
Audio power output	250mWRMS into 32Ω

Figure 3-24 on page 3-57 shows the architecture of audio interface.

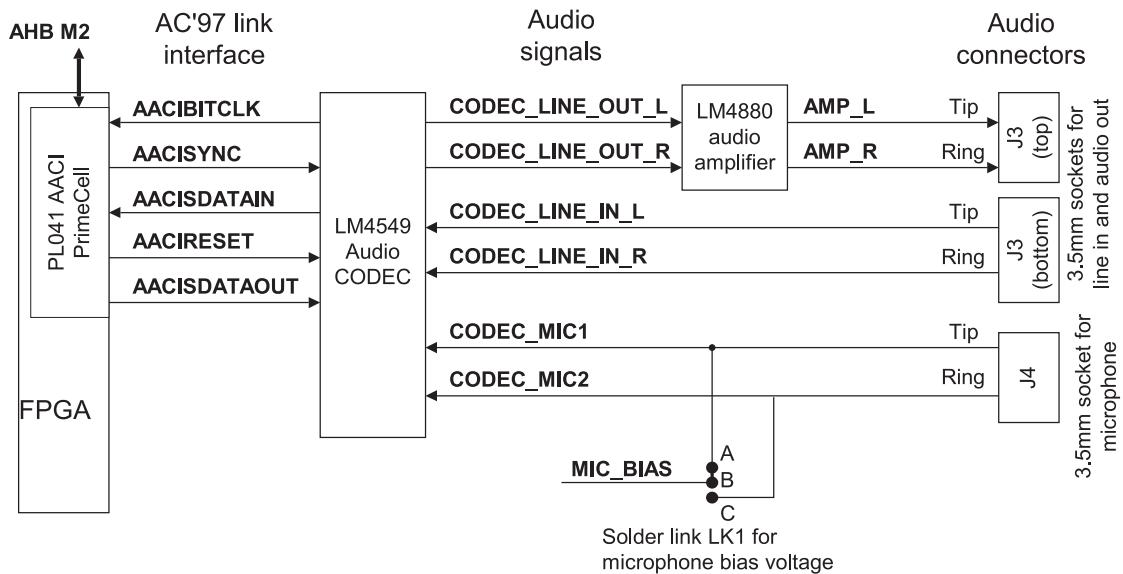


Figure 3-24 Audio interface

Two microphone inputs are present on J4. Only monophonic sound is supported, but microphone channel **CODEC_MIC1** or **CODEC_MIC2** can be selected in software. Solder link LK1 selects passive or active (electret) microphones:

- Link AB** Active microphone with power on **CODEC_MIC1** (tip). Passive microphone on **CODEC_MIC2** (not powered). This is the default configuration.
- Link BC** Active microphone with power on **CODEC_MIC2** (ring). Passive microphone on **CODEC_MIC1** (not powered).
- No link** Passive microphone on **CODEC_MIC1** and **CODEC_MIC2**.

The signals associated with the audio CODEC interface are also assigned to connector J45, the AACI expansion socket pins, as shown in Table 3-13 on page 3-58.

———— Note ————

The AACI expansion connector J45 is not fitted to the PB926EJ-S.

Table 3-13 AC'97 audio debug signals on J45

Pin number	Signal name	Description
1	AACIBITCLK	Clock from the CODEC to the AACI
2	AACISYNC	Frame synchronization signal from the AACI
3	AACISDATAIN	Serial data from the CODEC to the AACI
4	AACI_RESET	Reset signal from the AACI to the CODEC
5	AACISDATAOUT	Serial data from the AACI to the CODEC
6	GND	Signal ground

3.7 Character LCD controller

The FPGA contains a simple controller that provides an interface to a standard HD44780 16 x 2 character LCD alphanumeric display module.

The character display has an 8-bit interface, **DB[7:0]** (**CHARLCDD[7:]** from the controller).

The device is controlled by the **E**, **RnW**, and **RS** pins. The controller drives these pins with the **CHARLCDE**, **CHARLCDnWRITE**, and **CHARLCDRS** signals.

A 3.3V to 5V translation buffer is used to interface the to the 5V logic levels of the character LCD. **RS** selects the access of either the data register or the command register. A read of the command register returns the busy flag in **DB[7]**.

LK10 is installed at the factory to match the voltage requirement of the particular display module installed on the board.

———— **Note** ————

The LCD display is much slower than the peripheral bus. Poll the busy flag or write an interrupt service routine to determine if the device is ready to accept commands. See *Character LCD display* on page 4-44.

An interrupt signal is generated by the character LCD controller a short time after the raw data is valid. However this interrupt signal is reserved for future use and you must use a polling routine instead of an interrupt service routine.

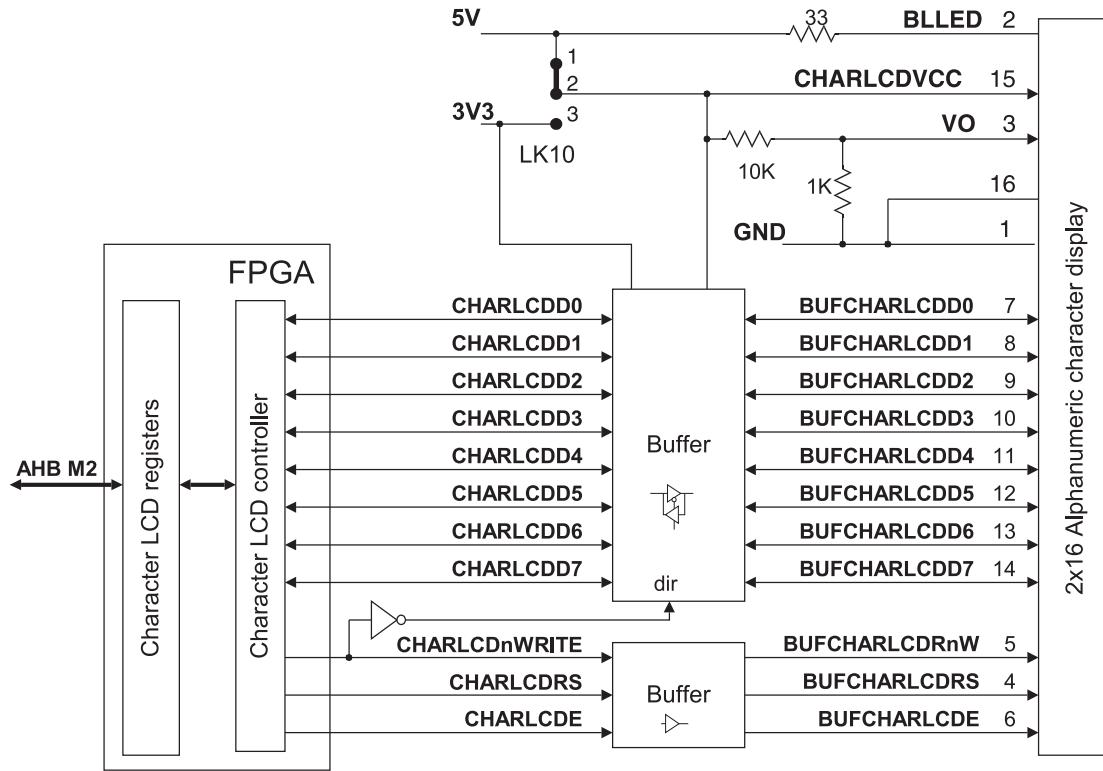


Figure 3-25 Character display

3.8 CLCDC interface

A PrimeCell CLCD controller is present in the ARM926EJ-S PXP Development Chip.

The PB926EJ-S provides a display interface with outputs to:

- a VGA connector for connecting a VGA or SVGA monitor
- a CLCD adaptor board with CLCD, keypad, and touchscreen connectors. (See Appendix C *CLCD Display and Adaptor Board* for information on the touchscreen controller and the CLCD displays.)
- an optional RealView Logic Tile. (The tile can be used to create a custom interface to a non-standard CLCD display or to process the display data.)

A PLD rearranges the CLCDC display signals for the selected resolution and color depth for a CLCD display. A DAC converts the rearranged CLCD signals into VGA analog signals. The **LCDMODE[1:0]** signals select the mapping of CLCD video data to the RGB signals for different resolutions.

Use the *Synchronous Serial Port* (SSP) to access the touchscreen controller on the adapter board.

Figure 3-26 on page 3-62 shows the architecture of the display interface.

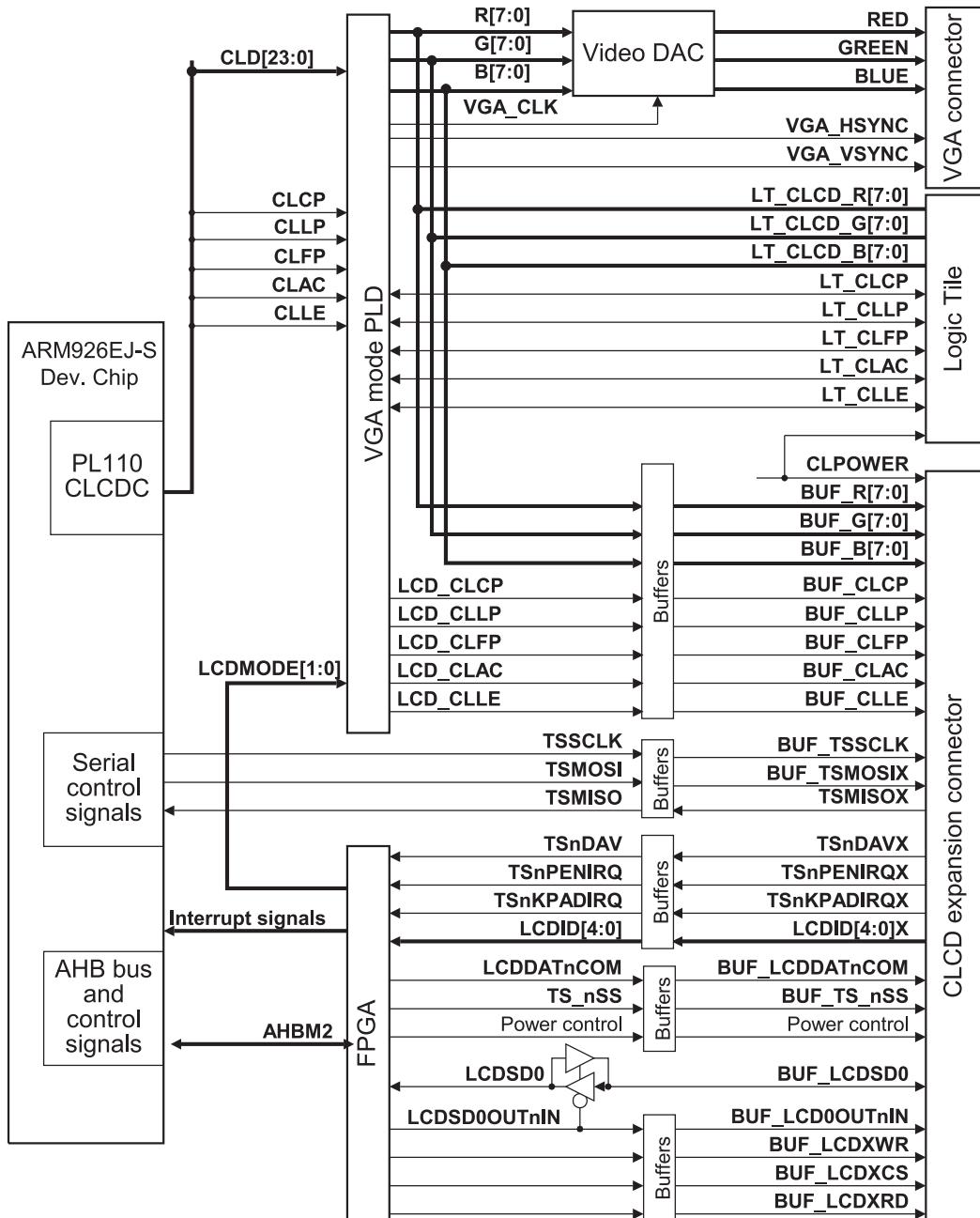


Figure 3-26 Display interface

See *Color LCD Controller, CLCDC* on page 4-47 and the *ARM926EJ-S Development Chip Reference Manual* for interface details.

The ARM926EJ-S PXP Development Chip also contains a MOVE video encoding coprocessor and a MBX graphics accelerator, see the *ARM MOVE Coprocessor Technical Reference Manual* and *ARM MBX HR-S Graphics Core Technical Reference Manual* for details.

Table 3-14 Display interface signals

Signal	Description
CLD[23:0]	LCD panel data. This is the digital RGB signals and synchronization signals.
CLCP	LCD panel clock to or from the RealView Logic Tile. A buffered version of this signal is output to the CLCD adaptor board as BUF_CLCP . This signal can also be driven to the RealView Logic Tile on LT_CLCP .
CLLP	Line synchronization pulse (STN)/horizontal synchronization pulse (TFT) to or from the RealView Logic Tile. A buffered version of this signal is output to the CLCD adaptor board as BUF_CLLP . This signal can also be driven to the RealView Logic Tile on LT_CLLP .
CLFP	Frame pulse (STN)/vertical synchronization pulse (TFT) to or from the RealView Logic Tile. A buffered version of this signal is output to CLCD adaptor board as BUF_CLFP . This signal can also be driven to the RealView Logic Tile on LT_CLFP .
CLAC	STN AC bias drive or TFT data enable output to or from the RealView Logic Tile. A buffered version of this signal is output to the CLCD adaptor board as BUF_CLAC . This signal can also be driven to the RealView Logic Tile on LT_CLAC .
CLLE	Line end signal to or from the RealView Logic Tile. A buffered version of this signal is output to the CLCD adaptor board as BUF_CLLE . This signal can also be driven to the RealView Logic Tile on LT_CLLE .
CLPOWER	LCD panel power enable. Depending on the link settings on the CLCD adaptor board, this signal can be used to turn off power to the display.
B[7:0]	Blue output signals to D/A converter and to or from the RealView Logic Tile. A buffered version of these signals are output to the CLCD adaptor board as BUF_B[7:0] .
G[7:0]	Green output signals to D/A converter and to or from the RealView Logic Tile. A buffered version of these signals are output to the CLCD adaptor board as BUF_G[7:0] .
R[7:0]	Red output signals to D/A converter and to or from the RealView Logic Tile. A buffered version of these signals are output to the CLCD adaptor board as BUF_R[7:0] .
RED, GREEN, BLUE	Analog output from D/A converter for red, green, and blue signals to VGA connector.

Table 3-14 Display interface signals (continued)

Signal	Description
TSSCLK	Clock to touchscreen controller.
TSMOSI	Data from touchscreen controller.
TSMISO	Data from touchscreen controller.
TSnDAV	Touchscreen controller data available signal.
TSnPENIRQ	Touchscreen controller pen down interrupt.
TSnKPADIRQ	Touchscreen controller key pressed interrupt.
TSnSS	Touchscreen controller chip select.
Power control	The nLCDIOON , CLPOWER , PWR3V5VSWITCH , VDDNEGSWITCH , and VDDPOSSWITCH signals can be used by the LCD adaptor board to select voltage for the display panel. Links on the board are set at manufacture to specify whether the panel voltages are fixed or programmable.
LCDID[4:0]	These signals are determined by resistor links on the LCD adaptor board. They indicate the type of display that is attached to the adaptor board.
LCDMODE[1:0]	These signals select the VGA display resolution. The signals control remapping of the CLD[23:0] data signals to the B[7:0] , G[7:0] , and R[7:0] signals to the CLCD display and the DAC for the VGA display.
LCDDATnCOM	This signal indicates to the external controller on the CLCD expansion board whether the current value is data or a command.
LCDSD0	Serial data in or out for an external controller on the CLCD expansion board.
LCDSD0OUTnIN	This signal controls the direction of the serial data bus.
LCDXWR	Write signal to an external controller on the CLCD expansion board.
LCDXCS	Chip select signal to an external controller on the CLCD expansion board.
LCDXRD	Read signal to an external controller on the CLCD expansion board.
VGA_CLK	The VGA clock synchronizes the conversion of the B[7:0] , G[7:0] , and R[7:0] signals into the RED , GREEN , and BLUE analog signals.
VGA_HSYNC	The VGA horizontal synchronization signal.
VGA_VSYNC	The VGA vertical synchronization signal.

3.9 DMA

On-chip peripherals in the ARM926EJ-S PXP Development Chip use DMA channels 6–15.

DMA control signals for channels 0–5 are passed to the RealView Logic Tile connectors and signals for channels 0–2 are also passed to the DMA mapping multiplexors in the FPGA. Figure 3-27 on page 3-66 shows the DMA architecture.

See also *Direct Memory Access Controller and mapping registers* on page 4-52.

———— **Caution** ———

The FPGA and RealView Logic Tile share the signals for channels 0 to 2. Ensure that the RealView Logic Tile logic does not drive the DMA signals at the same time as the FPGA is driving the signals. You can, for example, put a tristate control in your RealView Logic Tile peripherals such that the RealView Logic Tile peripheral DMA signals can be disabled if a FPGA peripheral is using a shared DMA channel.

The DMA control signals have pull-up or pull-down resistors as appropriate. It is not necessary therefore to drive unused signals.

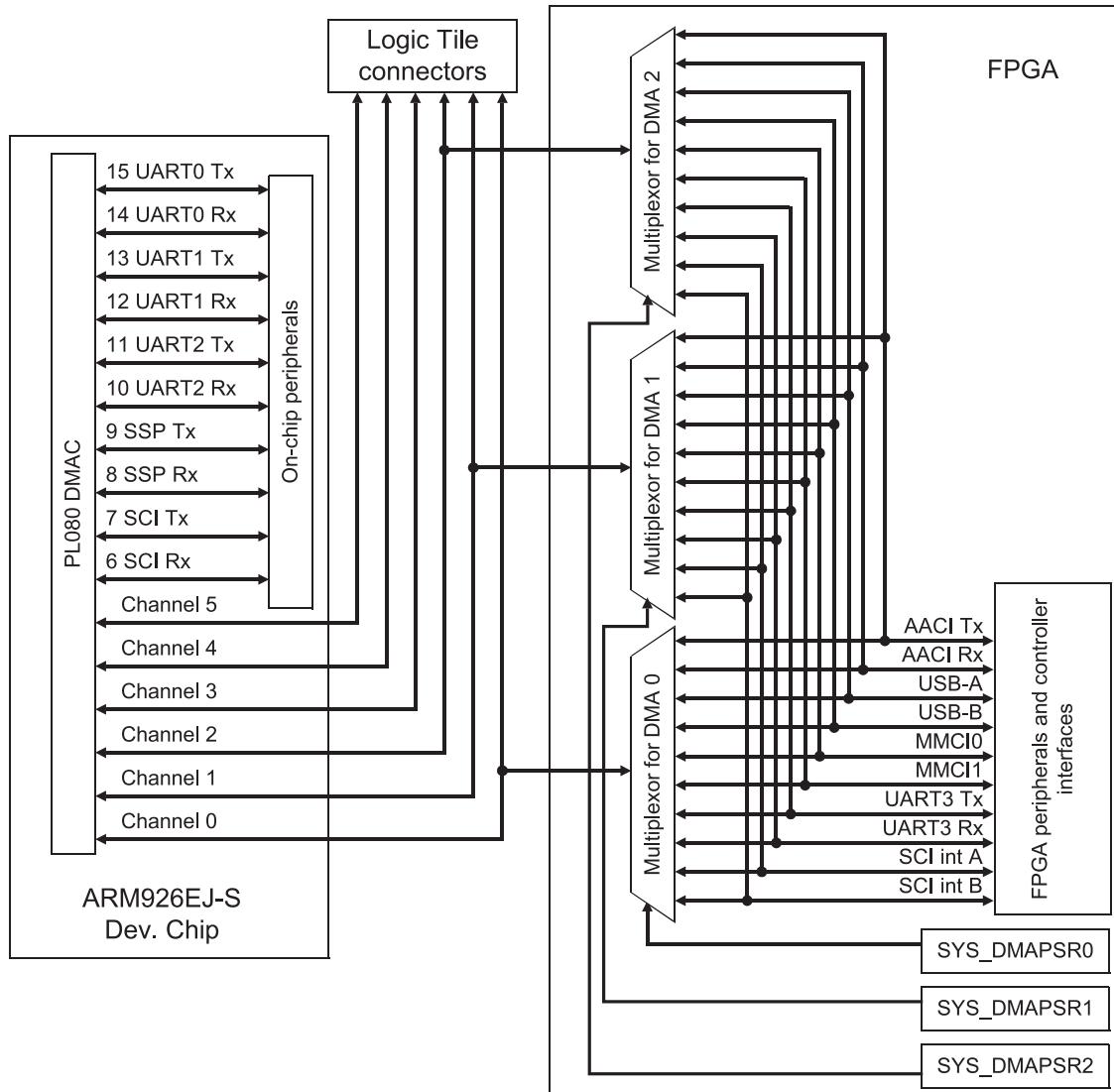


Figure 3-27 DMA channels

The DMA control signals for external devices are listed in Table 3-15 on page 3-67.

———— Note ————

Some FPGA peripherals do not use all of the DMA control signals. The USB controller, for example, uses only the **DMACSREQ** and **DMACCLR** signals.

The names of DMA control signals change as they pass through the mapping logic in the FPGA. For the USB controller, **DMACSREQ** signals correspond to **USBDREQ[1:0]** and the **DMACCLR** signals correspond to **USBDACK[1:0]**.

Table 3-15 DMA signals for external devices

Signal	Description
DMACBREQ[5:0]	<i>Burst request</i> inputs to DMAC for channels 5 to 0.
DMACLBREQ[5:0]	<i>Last burst request</i> inputs to DMAC for channels 5 to 0.
DMACSREQ[5:0]	<i>Single request</i> inputs to DMAC for channels 5 to 0.
DMACLSREQ[5:0]	<i>Last single request</i> inputs to DMAC for channels 5 to 0.
DMACCLR[5:0]	<i>Clear</i> outputs from DMAC. These signals acknowledge the request from the corresponding DMASREQ or DMABREQ signals.
DMACTC[5:0]	<i>Terminal count</i> outputs from DMAC.

3.10 Ethernet interface

The Ethernet interface is implemented with a SMC LAN91C111 10/100 Ethernet single-chip MAC and PHY. This is provided with a slave interface to the system bus by the FPGA.

The internal registers of the LAN91C111 are memory-mapped onto the AHB M2 bus and occupy 16 word locations at 0x10010000.

The isolating RJ45 connector incorporates two network status LEDs. The function of the LEDs can be set to indicate link, activity, transmit, receive, full duplex, or 10/100 selection. See the data sheet for the LAN91C111 for more details on programming the registers.

The architecture of the Ethernet interface is shown in Figure 3-28.

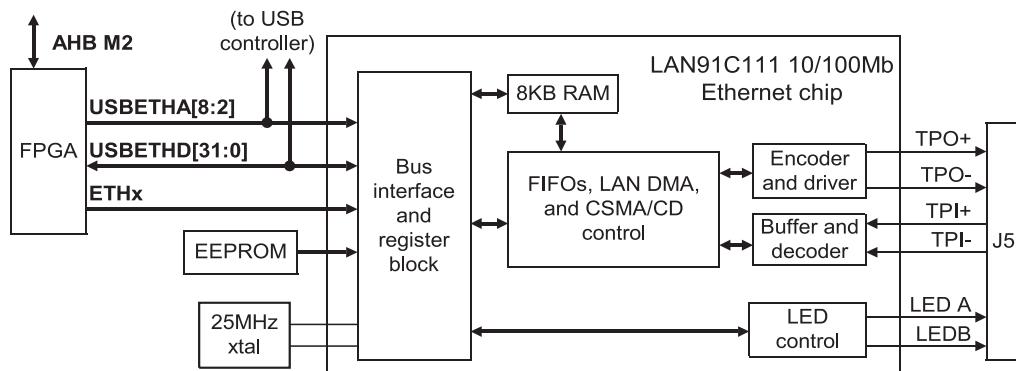


Figure 3-28 Ethernet interface architecture

Table 3-16 Ethernet signals

Signal	Description
USBETHD[31:0]	Data lines to USB and Ethernet controllers.
USBETHA[8:2]	Address lines to USB and Ethernet controllers.
ETHA[15:13]	Address lines to Ethernet controller.
ETHnBE[3:0]	Byte-enable signals to Ethernet controller.
TPO+, TPO-	Signal from controller to Ethernet interface.

Table 3-16 Ethernet signals (continued)

Signal	Description
TPI+, TPI-	Signal from interface to controller.
LEDA, LEDB	Activity indicator LEDs. The function of the LEDs can be configured by writing to a LAN91C111 register.
ETHRESET	Reset signal to LAN91C111.
ETHARDY	Asynchronous ready signal.
ETHSRDY	Synchronous ready signal.
ETHnRDYRTN	Signals to the controller to complete synchronous read cycles.
ETHnADS	Latches address to controller.
ETHLCLK	Clock to controller interface.
ETHnRD	Read signal for asynchronous interface.
ETHnWR	Write signal for asynchronous interface.
ETHnDATACS	Enables accesses to the controller data path.
ETHnCYCLE	Used to control EISA burst mode synchronous cycles if LOW.
ETHAEN	Address valid signal to controller.
ETHnLDEV	Asserted LOW if the address enable signal, ETHAEN , is low and the address lines decode to the controller address programmed into the base address register.
ETHWnR	Defines bus direction for synchronous accesses.
ETHnVLBUS	This signal is connected to ground by a pull-down resistor. If LOW, the controller uses VL bus accesses. If HIGH, the controller uses EISA DMA accesses.

3.10.1 About the SMSC LAN91C111

The SMCS LAN91C11 is a fast Ethernet controller that incorporates a *Media ACcess* (MAC) Layer, a *PHysical* (PHY) layer, and an 8KB dynamically configurable transmit and receive FIFO.

The controller supports dual-speed 100Mbps or 10Mbps and auto configuration. When auto configuration is enabled, the chip is automatically configured for network speed and for full or half-duplex operation.

The controller uses a local VL-Bus host interface with a bridge to the AHB bus provided by the FPGA. The FPGA generates the appropriate access control signals for the host side of the Ethernet controller. The VL-Bus is a synchronous bus that supports 32-bit accesses.

The LAN91C111 is a little-endian device. The default configuration for the system bus is also little-endian. If you configure the system bus for big-endian operation you must perform half-word and byte swapping in software.

A serial EEPROM provides the following parameters to the LAN91C111 at reset:

- the individual MAC address, that is, the Ethernet MAC address
- *Media Independent Interface* (MII) interface configuration
- register base address.

When the PB926EJ-S is manufactured, an ARM value for the Ethernet MAC address and the register base address are loaded into the EEPROM. The register base address is 0. A unique MAC address is programmed at manufacture, but the address can be reprogrammed if required. Reprogramming of the EEPROM is done through Bank 1 (general and control registers).

3.11 GPIO interface

The GPIO signals **GPx_[7:0]** from the ARM926EJ-S PXP Development Chip are connected to the GPIO connectors and the RealView Logic Tile as shown in Figure 3-29.

The GPIO signals are also connected to the expansion connector for the optional RealView Logic Tile. This enables you to use the GPIO signals with custom logic you implement in the tile.

See also *General Purpose Input/Output, GPIO* on page 4-56, the *ARM926EJ-S Development Chip Reference Manual* and the *ARM PrimeCell GPIO (PL061) Technical Reference Manual*. See *GPIO interface* on page A-14 for connector pinout information.

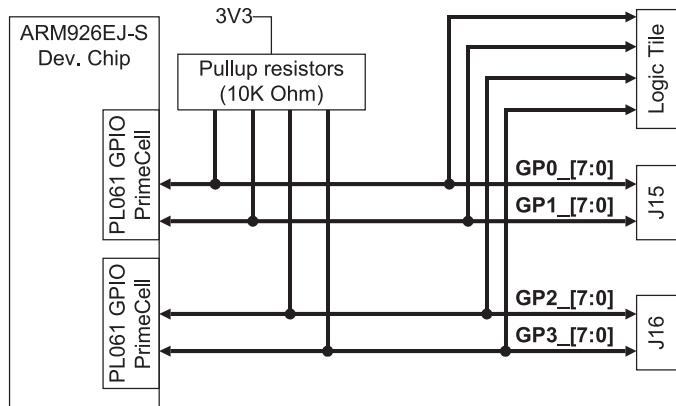


Figure 3-29 GPIO block diagram

———— Note ————

Bit 7 of GPIO 3 is used for the battery voltage signal **BATOK** from the system controller.

3.12 Interrupts

The ARM926EJ-S PXP Development Chip contains the primary interrupt controller and a secondary interrupt controller is in the FPGA, see Figure 3-30.

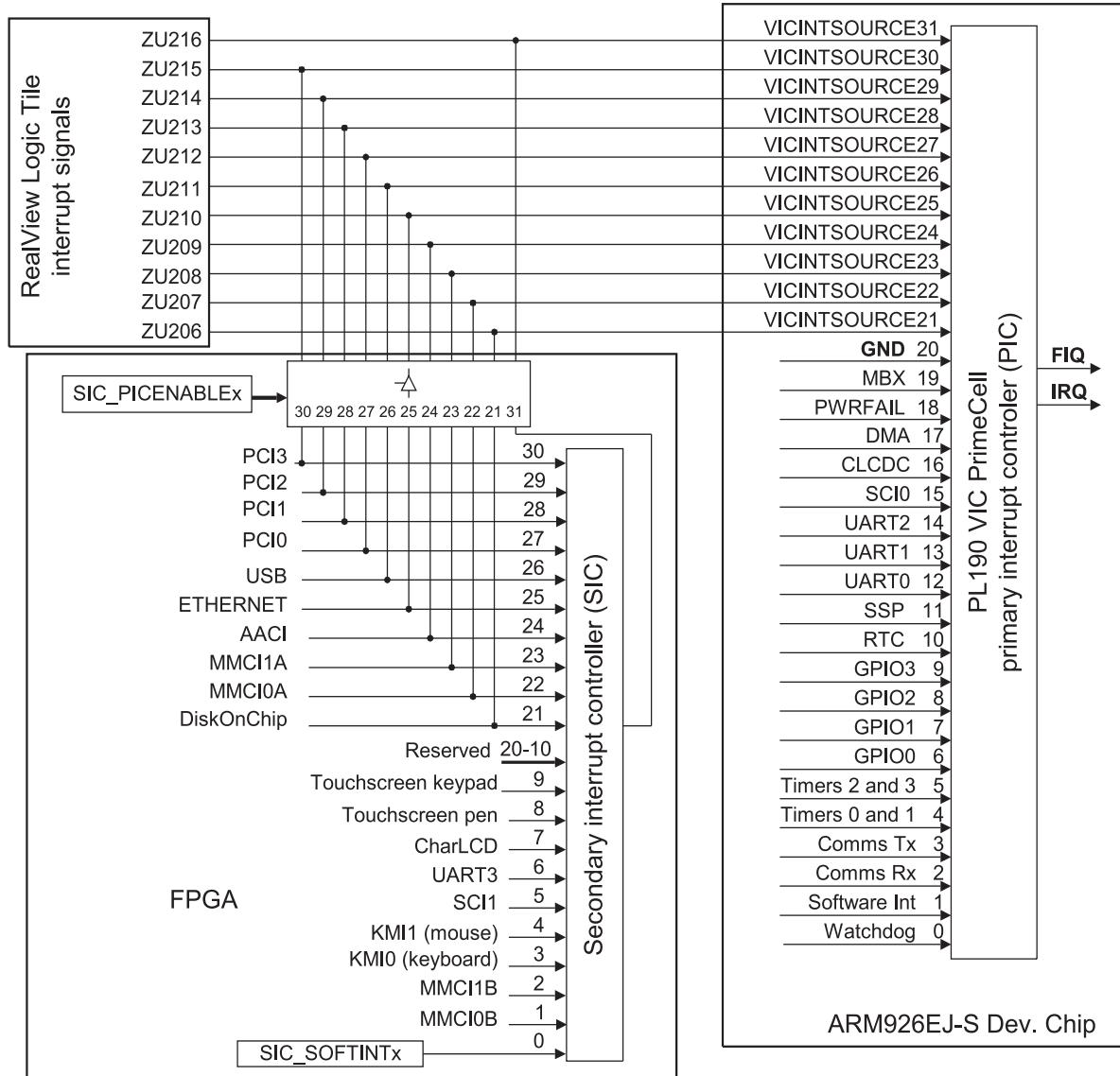


Figure 3-30 External and internal interrupt sources

The primary interrupt controller manages interrupts from internal devices and provides 11 pins for use by the external secondary interrupt controller and multiplexor present in the FPGA. **VICINTSOURCE31** is the output from the secondary controller.

VICINTSOURCE[30:21] can be driven from individual interrupt signals from peripherals in the FPGA or on a RealView Logic Tile.

For details on the programming model for the interrupt controllers, see:

- the *ARM926EJ-S Development Chip Reference* manual
- the *ARM PrimeCell Vector Interrupt Controller (PL190) Technical Reference Manual* manual
- *Primary interrupt controller* on page 4-58.

3.13 Keyboard/Mouse Interface, KMI

The *Keyboard and Mouse Interfaces* (KMI) are implemented with two PrimeCells incorporated into the FPGA. This is shown in Figure 3-31.

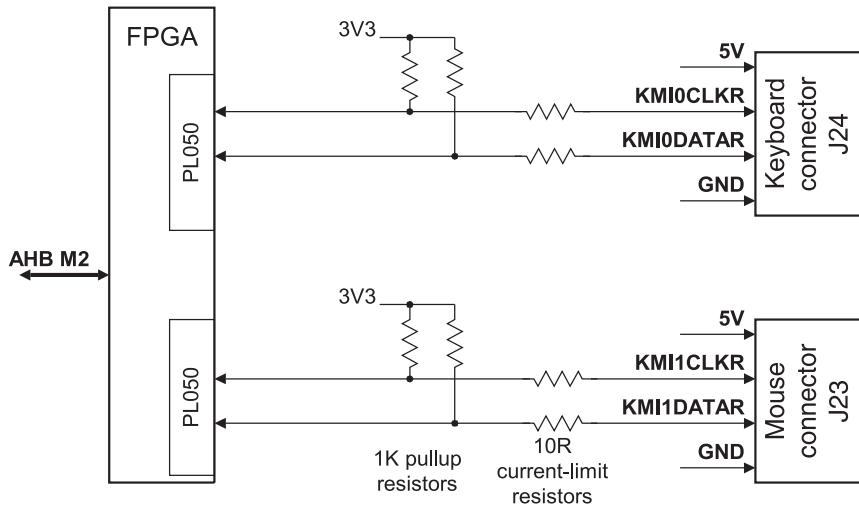


Figure 3-31 KMI block diagram

See also *Keyboard and Mouse Interface, KMI* on page 4-67 and the *ARM PrimeCell PS2 Keyboard Mouse Controller (PL050) Technical Reference Manual*.

3.14 Memory Card Interface, MCI

Two ARM PL180 PrimeCell MCIs provide the interface to two multimedia (MMC) or Secure Digital (SD) cards.

Each interface can be driven as either an MMC or SD interface.

3.14.1 MMC or SD operation

The MMC socket provides nine pins that connect to the card when it is inserted into the socket. (The nine-way socket is compatible with SD cards. However MMC uses only seven of the nine pins.)

The socket contains two switches that are operated by inserting or removing the card. These are used to provide signaling on the **nCARDIN** and **WPROT** signals.

The function of the interface signals depends on whether an MMC or SD card is fitted. Both card types default to MMC but the SD card has an additional operating mode called widebus mode. Table 3-17 shows the use of the signals for both modes of operation.

Table 3-17 MMC/SD interface signals

Signal	Widebus mode (SD only)	MMC mode (default)
MCIxDAT3	card detect/Data(3)	chip select (active LOW)
MCIxCMD	command/Response	command/Response
MCIxCLK	clock	clock
MCIxDAT0	data (0)	data
MCIxDAT1	data (1)	not used
MCIxDAT2	data (2)	not used
nCARDINx	card presence detect (active LOW)	card presence detect (active LOW)
WPROTx	card write-protection detect	card write-protection detect

3.14.2 Card insertion and removal

Insert the card into the socket with the contacts face down for the connector on the top of the PB926EJ-S or face up for the bottom connector. Cards are normally labelled on the top surface and provide an arrow to indicate the correct way to insert them.

Remove the card by gently pressing it into the socket. It springs back and can be removed. This ensures that the card detection switches within the socket operate correctly.

3.14.3 Card interface description

Figure 3-32 on page 3-77 shows the memory card interface.

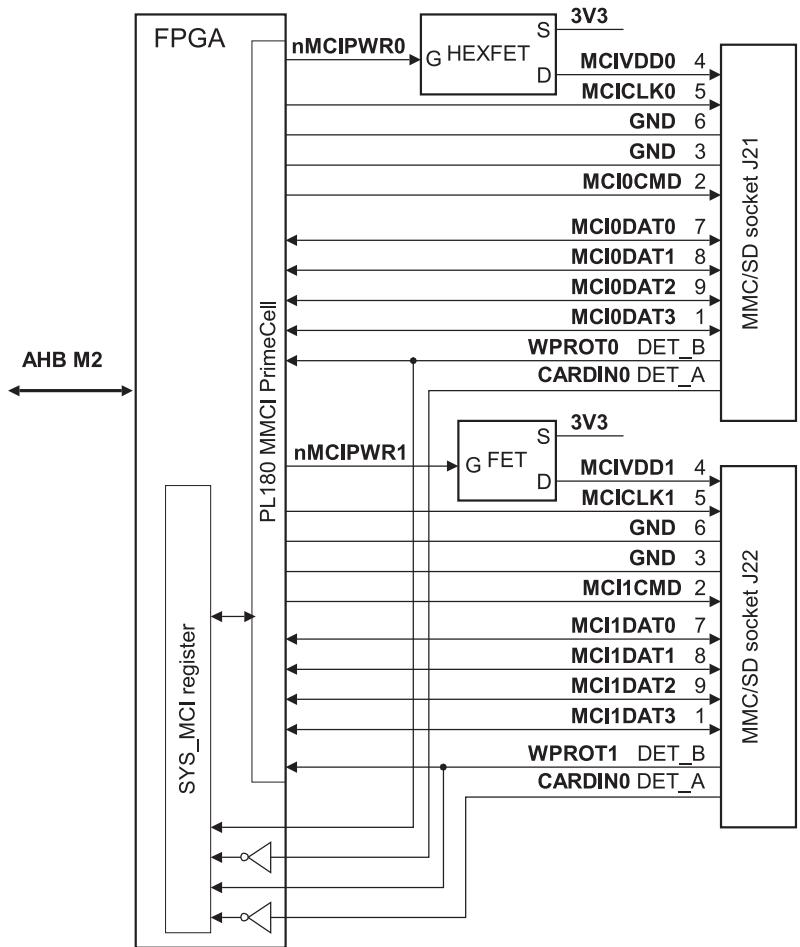


Figure 3-32 MMI interface

Table 3-18 MMC signals

Signal	Description
MCIPWRx	Enables supply voltage to card.
MCIxCMD	Command selection.
CARDINx	Card detect signal. Read the current state from SYS_MCI.
MCIxDAT[3:0]	Card data bus.
WPROTx	Write protection indication. Read the current state from SYS_MCI.
MCICLKx	Clock to card.

See *MMC and SD flash card interface* on page A-8 for details of the MMC/SD card socket and pin numbering.

See also *MultiMedia Card Interfaces, MCIx* on page 4-70 and the *ARM PrimeCell Multimedia Card Interface (PL180) Technical Reference Manual*.

3.15 PCI interface

The PCI subsystem enables you to use PCI expansion cards with the PB926EJ-S and the PCI enclosure.

PCI bridges pass valid accesses between the PB926EJ-S and the PCI bus.

The slave bridge connected to the AHB M2 bus recognizes addresses $0x41000000$ to $0x6FFFFFFF$ as being intended for a target within the PCI address space of the memory map, and passes accesses within this region to the PCI bus. The PCI_IMAPx registers define the address translation values for the PCI I/O, PCI configuration, and PCI memory windows.

The PCI_SMAPx registers define the address translation values for PCI accesses to the AHB S bus.

The AHB to PCI bridge supports read and write accesses in both directions, as shown in Figure 3-33.

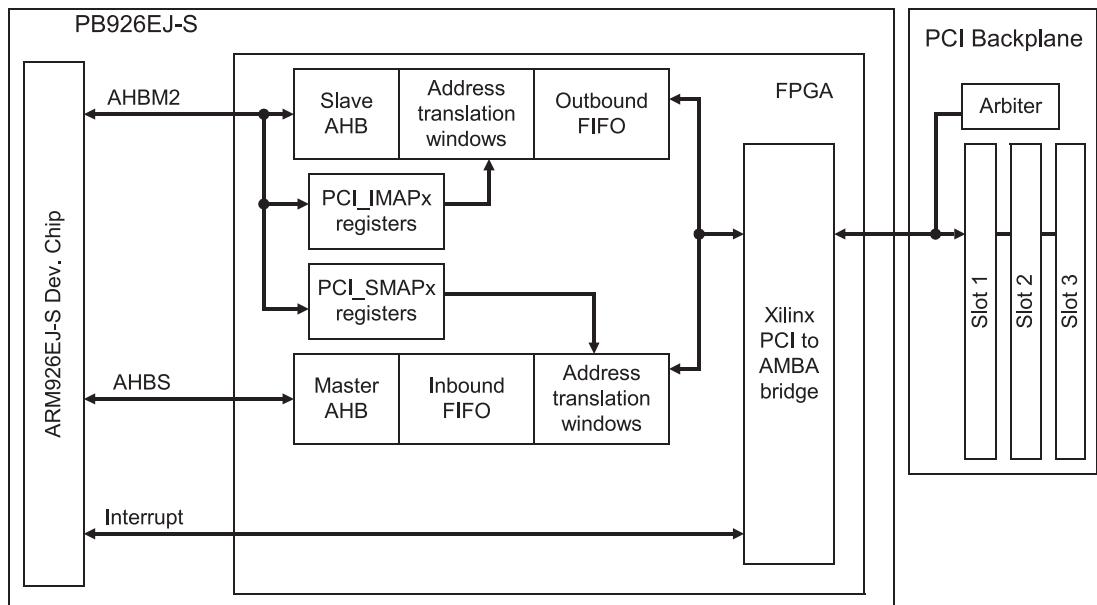


Figure 3-33 PCI bridge

See also and Appendix D *PCI Backplane and Enclosure* and *PCI controller* on page 4-74.

3.16 Serial bus interface

The FPGA implements a serial bus interface that is used to identify the memory expansion modules and read and set the time-of-year clock.

Each device on the serial bus has its own slave address. The unique address for each slave on the serial bus is shown in Table 3-19.

Table 3-19 Serial bus addresses

Slave address (7-bit)	Slave device
b1010000	Dynamic memory module
b1010001	Static memory module
b1101000	Time-of-year clock

The block diagram of the interface is shown in Figure 3-34. See *Serial bus interface* on page 4-86 for more information on the programming interface. The two serial bus signals are described in Table 3-20.

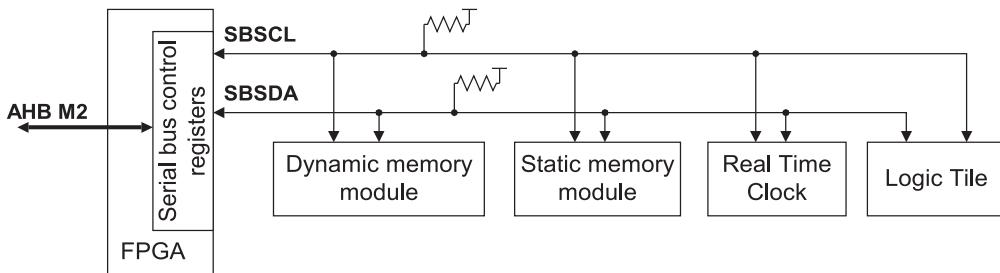


Figure 3-34 Serial bus block diagram

Table 3-20 Serial bus signals

Signal	Description
SBSCL	Open-collector clock. This clock is driven by the FPGA, but can be held LOW by an external device if it is not ready to receive or transmit data.
SBSDA	Open-collector data signal.

3.17 Smart Card interface, SCI

The ARM926EJ-S PXP Development Chip contains a PrimeCell *Smart Card Interface* (SCI). A second SCI is implemented in the FPGA.

There are two sets of Smart Card connectors on the board, J25/J48 and J26/J49. Only one header is fitted for each channel. The connector numbers refer to different size connectors that can be fitted. (J25 and J26 are large connectors. J48 and J49 are small connectors.)

Figure 3-35 on page 3-82 shows the tristate buffers that are used to provide the interface between the SCI and the cards. The 16-way box header J28 enables you to monitor the signals or to connect an off-board smart card connector.

SCI0 output signals go to both the RealView Logic Tile connectors and the Smart Card connector. The signals from the SC0 connector to the interface can be disabled by a tile pulling **nDRVEN1** HIGH. This enables a RealView Logic Tile to implement a device that communicates with the ARM926EJ-S PXP Development Chip using the Smart Card interface protocol.

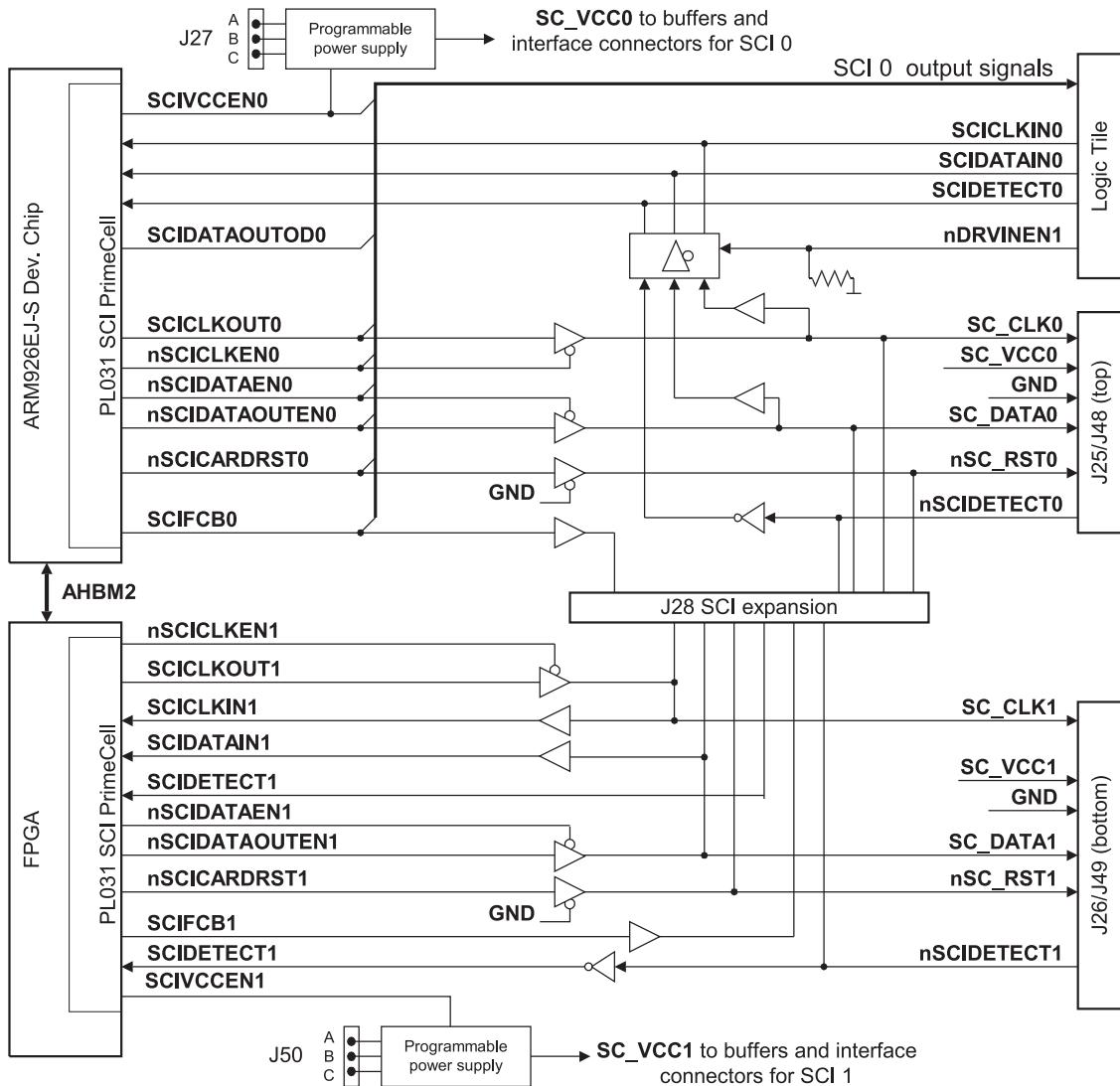


Figure 3-35 SCI block diagram

You can set the Smart Card interface voltage to operate at 5V, 3.3V or 1.8V by setting jumpers on J27 (for SCI0) and J50 (for SCI1).

- Connect pins AB for 3.3V operation
- Connect pins CB for 5V operation
- omit the link for 1.8V operation.

The default setting is linking pins AB. Both 3.3V and 5V cards will function with this setting.

————— **Note** —————

The Smart Card VCC is switched on and off by the **SCI_{VCCE}N_x** signal from the PrimeCell.

See also *Smart Card Interface, SCI* on page 4-88 and the *SCI PrimeCell PL131 Technical Reference Manual*.

Table 3-21 Smart Card interface signals

Signal	Description
SCI_{CLKIN}_x	PrimeCell SCI clock input.
nSCI_{CLKEN}_x	Tristate output buffer control for clock (active LOW).
SCI_{CLKOUT}_x	Clock output.
nSCI_{DATAEN}_x	Tristate control for external off-chip buffer (active LOW).
SCI_{DATAIN}_x	PrimeCell SCI serial data input.
nSCI_{DATAOUTEN}_x	Data output enable (typically drives an open-drain configuration, active LOW).
nSCI_{CARDRST}_x	Reset to card (active LOW).
SCI_{FCB}_x	Function code bit, used in conjunction with nSCI_{CARDRST} .
SCI_{DETECT}_x	Card detect signal from card interface device (active HIGH).
nDRV_{INEN1}	Device select signal from RealView Logic Tile. This signal can be driven HIGH by the logic tile to enable it to drive the SCI_{DATAIN0} , SCI_{CLKIN0} , and SCI_{DETECT0} signals. The signal is normally pulled LOW by a resistor to ground.

3.18 Synchronous Serial Port, SSP

The ARM926EJ-S PXP Development Chip contains a PrimeCell SSP controller. Use the expansion connector J29 to connect to the SSP. The FPGA controls the SSP peripheral chip select, **SSPnCS**, as shown in Figure 3-36. The SSP signals are shared with the RealView Logic Tile and CLCD adaptor board.

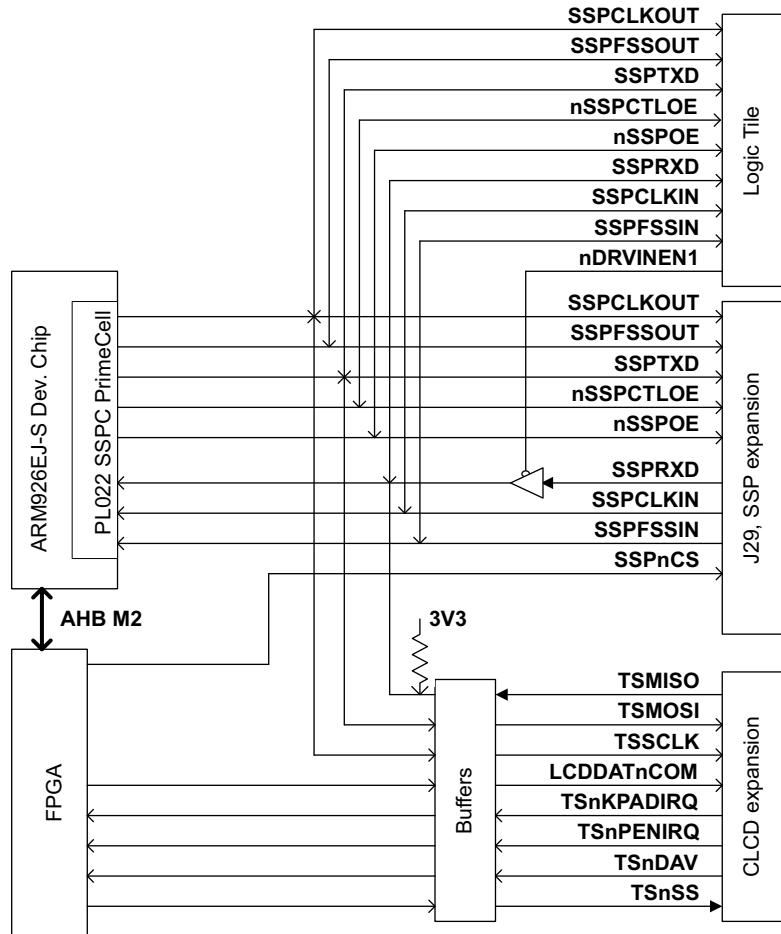


Table 3-22 SSP signal descriptions

Name	Description
SSPnCS	Chip select to external device connected to SSP controller.
SSPFSSOUT	PrimeCell SSP frame or slave select output (master).
SSPCLKOUT	PrimeCell SSP clock output (master).
SSPRXD	PrimeCell SSP receive data input.
SSPTXD	PrimeCell SSP transmit data output.
nSSPCTLOE	Output enable signal (active LOW) for the SSPCLKOUT output from the PrimeCell SSP. This output is asserted (LOW) when the device is in master mode and de-asserted (HIGH) when the device is in slave mode.
SSPFSSIN	PrimeCell SSP frame input (slave).
SSPCLKIN	PrimeCell SSP clock input (slave).
nSSPOE	Output enable signal (active LOW) to indicate when SSPTXD is valid.
nDRVien1	Device select signal from RealView Logic Tile. This signal can be driven HIGH by the logic tile to enable it to drive the SSPRXD signal.

The SSP functions as a master or slave interface that enables synchronous serial communication with slave or master peripherals having one of the following:

- a Motorola SPI-compatible interface
- a Texas Instruments synchronous serial interface
- a National Semiconductor Microwire interface.

Use the SSP controller to access:

- Touch screen, keypad, LCD bias, and analogue inputs on the optional LCD adaptor board. See Appendix C *CLCD Display and Adaptor Board*.
- Optional SSP devices, such as an EEPROM, that are connected to the expansion header J29.

———— Note ————

Although it is possible to connect both the CLCD adaptor board and an off board SSP device at the same time, care must be taken to ensure the correct SSP interface protocol is used when communicating with each device. The interface can be shared because the data from the touch screen controller data (**TSMISO**) is buffered with an open drain driver into **SSPRXD**.

- Synthesized SSP peripherals in a RealView Logic Tile FPGA. See Appendix F *RealView Logic Tile*.

———— Note ————

Use the RealView Logic Tile HDRY signal YL62 (nDRVINEN1) to disable the SSP buffer and avoid conflicts between the peripheral in the RealView Logic Tile and the LCD adaptor board or SSP expansion header.

See also *Synchronous Serial Port, SSP* on page 4-89 and the *ARM PrimeCell Synchronous Serial Port Controller (PL022) Technical Reference Manual*.

3.19 User switches and LEDs

The FPGA provides a switch and LED register that enables you to read the general-purpose pushbutton switch and the user switches (S6) and light the user LEDs (located next to switch S6). See Figure 1-1 on page 1-3 for the location of the switches and LEDs. Figure 3-37 shows the interface.

————— **Note** —————

Switch S6-1 and S6-2 are used to control the Boot Monitor. See *Boot Monitor configuration* on page 2-7.

Set bits [7:0] in the SYS_LED register at 0x10000008 to illuminate LEDs 7–0. The state of the user switches S6[8:1] is present on bits [7:0] of the SYS_SW register at 0x10000004.

The state of the general-purpose pushbutton S3 can be read from bit 4 of the SYS_MISC register at 0x10000060. Setting bit 3 of SYS_MISC causes a S3 depression to generate a PWRFAIL interrupt. The interrupt can be used to test auto-shutdown code or to awaken the processor from sleep mode. See *Miscellaneous System Control Register, SYS_MISC* on page 4-36.

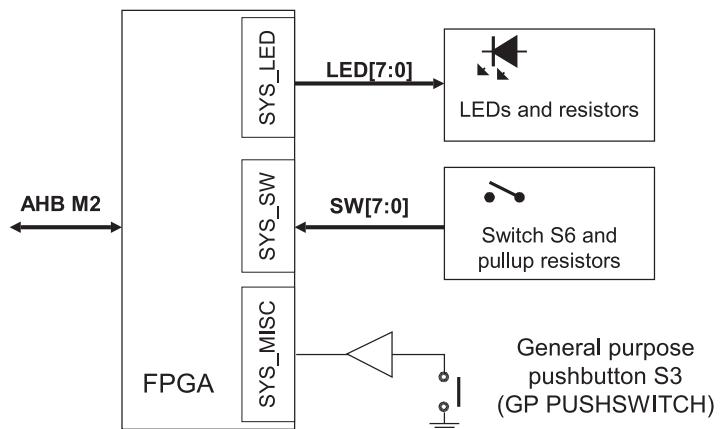


Figure 3-37 Switch and LED interface

3.20 UART interface

Three UARTs (SER0, SER1, and SER2) are provided by the ARM926EJ-S PXP Development Chip.

A fourth serial interface, SER3, is implemented with a PrimeCell UART incorporated into the system controller FPGA.

The three UARTs provided by the ARM926EJ-S PXP Development Chip have the following features:

- functionally similar to standard 16C550 devices
- port function corresponds to the DTE configuration
- SER0 (UART0) has full CTS, RTS, DCD, DSR, DTR, and RI modem control signals
- SER1 and SER2 (UART1 and UART2) have simple modem control signals CTS and RTS
- programmable baud rates of up to 1.5Mbits per second (the line drivers however, are only guaranteed to 250kbps)
- 16-byte transmit FIFO
- 16-byte receive FIFO
- programmable interrupt.

Signals from UART0, UART1, and UART2 are also connected to the expansion connector for the optional RealView Logic Tile. UART0 has two IrDA signals that are connected to the RealView Logic Tile expansion headers: SIROUT0 and SIRIN0. There is no IrDA interface logic on the PB926EJ-S itself.

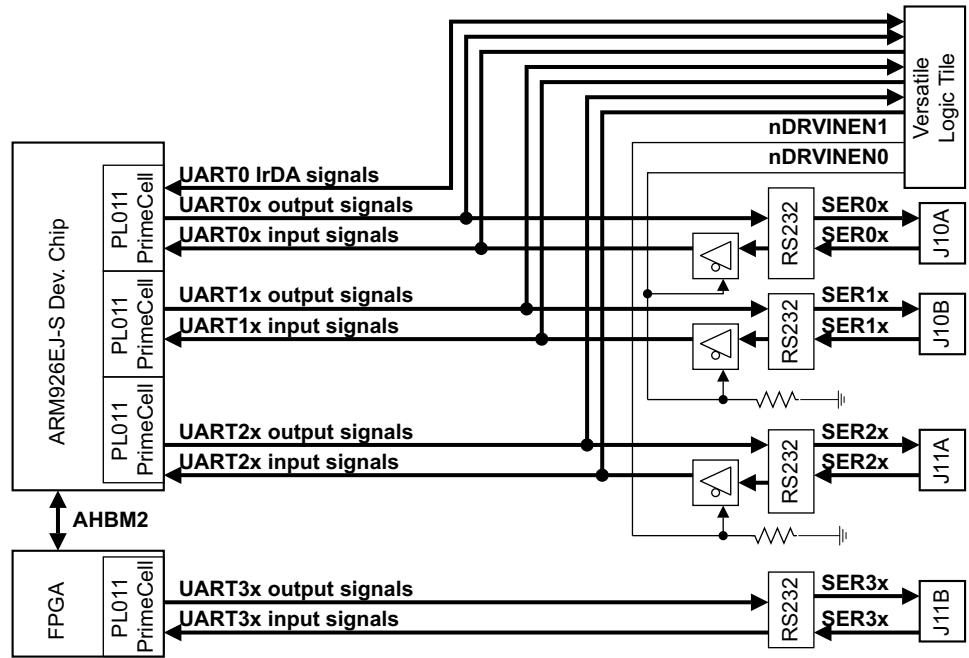


Figure 3-38 UARTs block diagram

The signals from the ARM926EJ-S PXP Development Chip are converted from logic level to RS232 level by MAX3243E buffers as shown in Figure 3-39 and Figure 3-40 on page 3-90.

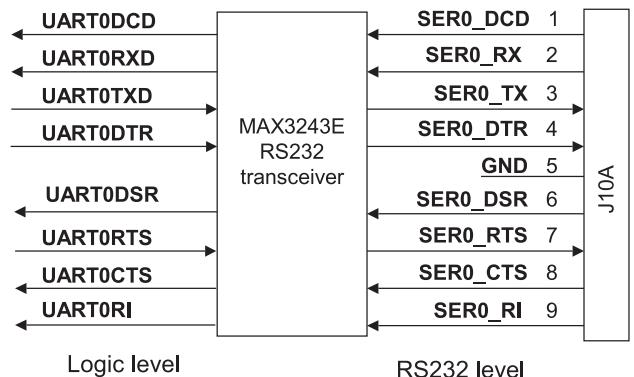


Figure 3-39 UART0 interface

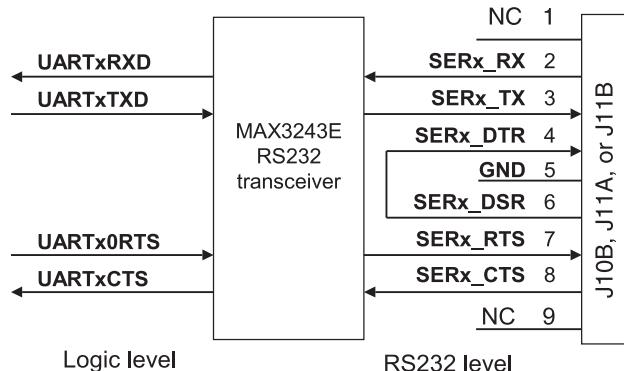


Figure 3-40 Simplified interface for UART[3:1]

See also *UART* on page 4-97 and the *ARM PrimeCell UART (PL011) Technical Reference Manual*.

The signals associated with the UART interface are shown in Table 3-23.

Table 3-23 Serial interface signal assignment

Signal	Description
nDRVINEN0	This signal can be driven HIGH by an attached logic tile. This tristates the signals from serial connectors J10A and J10B (SER0 and SER1) and allows the RealView Logic Tile to drive these signals. The signal is normally pulled LOW by a resistor to ground.
nDRVINEN1	This signal can be driven HIGH by an attached logic tile. This tristates the signals from serial connector J11A (SER2) and allows the RealView Logic Tile to drive these signals. The signal is normally pulled LOW by a resistor to ground.
SERx_TXD	Transmit data
SERx_RTS	Ready to send
SERx_DTR^a	Data terminal ready
SERx_CTS	Clear to send
SERx_DSR^a	Data set ready

Table 3-23 Serial interface signal assignment (continued)

Signal	Description
SERx_DCD^b	Data carrier detect
SERx_RXD	Receive data
SERx_RI^b	Ring indicator

- a. For UART1, UART2, and UART3, the DTR and DSR signals are connected together and are not input to the ARM926EJ-S Dev. Chip or FPGA.
- b. For UART1, UART2, and UART3, the DCD and RI signals are not connected to the ARM926EJ-S Dev. Chip or FPGA.

3.21 USB interface

The FPGA provides the bus interface to an external OTG243 USB controller. Three USB interfaces are provided on the PB926EJ-S, see Figure 3-41.

The internal registers of the controller are memory-mapped onto the AHB M2 bus at 0x10020000.

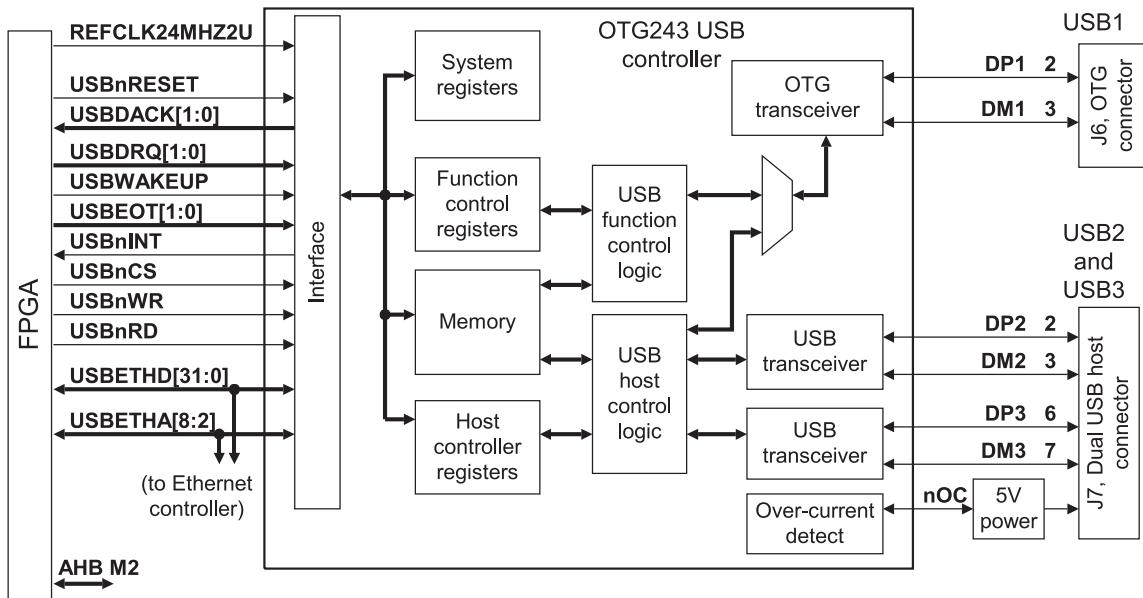


Figure 3-41 OTG243 block diagram

OTG243 USB port 1 provides an OTG device interface and connects to J6. OTG243 USB ports 2 and 3 can function in either master or slave mode and connect to the dual type A connector J7 (USB2 is the top connector).

The signals associated with the USB interfaces are shown in Table 3-24.

Table 3-24 USB interface signal assignment

Signal name	Direction	Description
DPx	Bidirectional	D+ data line
DMx	Bidirectional	D- data line
USBETHD[31:0]	Bidirectional	Data lines of USB controller
USBETHA[8:2]	From FPGA	Address lines of USB controller
USBnCS	From FPGA	Controller chip select
USBnRD	From FPGA	Read strobe to controller
USBnWR	From FPGA	Write strobe to controller
USBnINT	To FPGA	Controller interrupt out
USBnRESET	From FPGA	Controller reset
USBWAKEUP	From FPGA	FPGA drives this signal HIGH to wake up the controller
REFCLK24MHZ2U	From FPGA	24MHz reference clock to controller
nOC	From OTG	Over current detect (disconnects power to USB2 and USB3)
USBEOT[1:0]	To FPGA	DMA end of transfer. USBEOT1 for channel 1, USBEOT0 for channel 0.
USBDRQ[1:0]	From FPGA	DMA request. USBDRQ1 for channel 1, USBDRQ0 for channel 0.
USBACK[1:0]	To FPGA	DMA acknowledge. USBACK1 for channel 1, USBACK0 for channel 0.
nEXVBO	From FPGA	Connects additional power to the OTG (VBUS)
VBP	From FPGA	Connects additional power to the OTG (VBUS)
VBUS	-	If the OTG is in slave mode, this is the incoming 5V digital power supply from the cable.

— Note —

For a full description of the USB controller, refer to the datasheet for the TransDimension OTG243.

3.22 Test, configuration, and debug interfaces

The following test and configuration interfaces are located on the PB926EJ-S:

- JTAG, see *JTAG and USB debug port support* on page 3-96
- Logic analyzer, see *ChipScope integrated logic analyzer* on page 3-104
- Trace, see *Embedded trace support* on page 3-104
- ARM926EJ-S PXP Development Chip AHB bus monitor, see *AHB monitor* on page 3-16
- Configuration switches and status indicators, see *Configuration control* on page 3-7 and *User switches and LEDs* on page 3-87.
- Boot Monitor, see *Using the PB926EJ-S Boot Monitor and platform library* on page 2-14.

————— **Note** —————

There are also test points and debug connectors for individual interface circuits. See *Test and debug connections* on page A-33.

Figure 3-42 on page 3-95 shows the test and debug connectors, links, and LEDs.

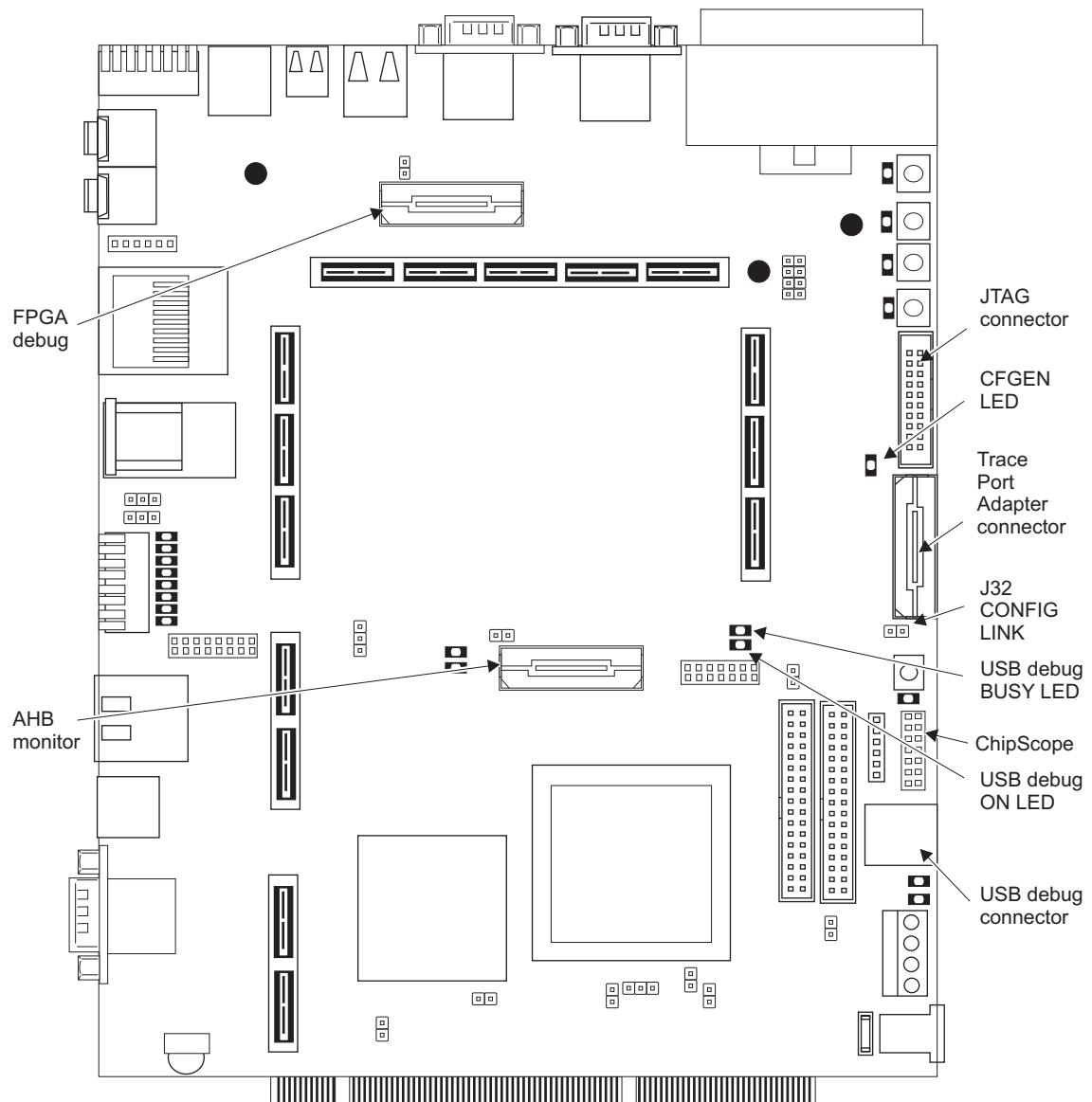


Figure 3-42 Test and debug connectors, links, and LEDs

————— **Note** —————

The CONFIG link is a switch on some board versions. If so, placing the switch in the OFF position is the same as no link fitted.

3.22.1 JTAG and USB debug port support

The PB926EJ-S supports debugging using embedded or external hardware. The debugging interface can be controlled by:

JTAG hardware

The RealView Debugger and the AXD debugger, for example, use an external interface box, such as RealView ICE or Multi-ICE, to connect to the JTAG connector. If you are using an external JTAG debug tool, the embedded debug hardware is disabled.

USB debug port

The USB debug port is embedded on the PB926EJ-S. An application, Progcards or the RealView Debugger, for example, can control the JTAG signals from the USB port of the PC. The PC and the PB926EJ-S are connected by a standard USB cable.

— Note —

ARM Multi-ICE and RealView ICE ground pin 20 of the JTAG connector. On the PB926EJ-S, pin 20 is connected to a pull-up resistor and the **nICEDETECT** signal. The USB debug port is automatically disabled if a JTAG emulator is connected and **nICEDETECT** is LOW. If you are using third-party debugging hardware, ensure that a ground is present on pin 20 of the JTAG connector.

The PB926EJ-S has two scan chains:

Debug The **D_x** signals are used for the development chip and synthesized JTAG TAP controllers in the RealView Logic Tile. This is the normal mode of operation (see *JTAG debug (normal) mode*).

Config The **C_x** signals are used to program the FPGA and PLDs. This chain is available in configuration mode (see *JTAG configuration mode* on page 3-97). See also *ChipScope integrated logic analyzer* on page 3-104.

JTAG debug (normal) mode

During normal operation and software development, the PB926EJ-S operates in debug mode.

The debug mode is selected by default (when a jumper is not fitted on the CONFIG link, see Figure 3-42 on page 3-95). In debug mode:

- the signal **nCFGGEN** is HIGH
- the CONFIG LED is off on the PB926EJ-S (and on each tile in the stack)

- the JTAG signals are routed through the ARM926EJ-S PXP Development Chip
- a debugger, RealView Debugger for example, controls the scan chain
- The PLDs and FPGAs are not visible on the scan chain unless they contain debuggable devices
- If RealView Logic Tiles are present and have debuggable devices, the **D_x** signals are part of their JTAG scan chain
- the FPGAs in the system load their images from configuration flash.

JTAG configuration mode

This mode is selected if the CONFIG link is fitted (see Figure 3-42 on page 3-95).

———— **Note** ————

The CONFIG link has been replaced by a switch on some board versions. The switch must be in the ON position to select JTAG configuration mode.

In configuration mode:

- The signal **nCFGGEN** is low.
- The CONFIG LED is lit on the PB926EJ-S (and on each tile in the stack).
- The JTAG scan path is rerouted to include configurable devices.
- A configuration utility, ProgCards for example, controls the scan chain.
- If RealView Logic Tiles are present, the **C_x** signals are part of the JTAG scan chain.
- All FPGAs and PLDs in the system (including any devices in a RealView Logic Tile) are added into the scan chain.
- The TAP controller in the ARM926EJ-S PXP Development Chip is not visible and is replaced by a Boundary Scan TAP controller that is used for board-level production testing.
- This enables the board to be configured or upgraded in the field using JTAG equipment or the onboard USB debug port.
- The nonvolatile PLDs devices can be reprogrammed directly by JTAG.
- FPGA images can be loaded from the scan chain.

The FPGAs are volatile. In normal mode, they load their configuration from nonvolatile flash memory. In configuration mode, they can be loaded from either JTAG or the configuration flash memory.

———— **Note** ————

The configuration flash memory does not have a JTAG port, but it can be programmed using JTAG by loading a flash-loader design into the FPGAs and PLDs. The flash-loader can then transfer data from the JTAG programming utility to the configuration flash.

After configuration you must:

1. remove the CONFIG link
2. power cycle the development system.

JTAG signals

Table 3-25 provides a description of the JTAG and related signals.

———— **Note** ————

In the description in Table 3-25, the term JTAG equipment refers to any hardware that can drive the JTAG signals to devices in the scan chain. Typically this is RealView ICE, Multi-ICE, or the embedded USB debug logic.

Table 3-25 JTAG related signals

Name	Description	Function
TDI	Test data in (from JTAG equipment)	TDI and TDO connect each component in the scan chain.
TDO	Test data out (to JTAG equipment)	TDO is the return path of the data input signal TDI . The JTAG components are connected in the return path so that the length of track driven by the last component in the chain is kept as short as possible.
TMS	Test mode select (from JTAG equipment)	TMS controls transitions in the TAP controller state machine.
TCK	Test clock (from JTAG equipment)	TCK synchronizes all JTAG transactions. TCK connects to all JTAG components in the scan chain. Series termination resistors are used to reduce reflections and maintain good signal integrity.

Table 3-25 JTAG related signals (continued)

Name	Description	Function
RTCK	Return TCK (to JTAG equipment)	Some devices sample TCK and delay the time at which a component actually captures data. Using a mechanism called <i>adaptive clocking</i> , the RTCK signal is returned by the core to the JTAG equipment, and the TCK is not advanced until the core has captured the data. In adaptive clocking mode, RealView ICE or Multi-ICE waits for an edge on RTCK before changing TCK . In a multiple device JTAG chain, the RTCK output from a component connects to the TCK input of the next device in the chain.
nCFGGEN	Configuration enable	nCFGGEN is an active LOW signal used to put the boards into configuration mode. In configuration mode all FPGAs and PLDs are connected to the scan chain so that they can be configured by the JTAG equipment. (The TAP controller in the PB926EJ-S is not accessible.)
nSRST	System reset (bidirectional)	nSRST is an active LOW open-collector signal that can be driven by the JTAG equipment to reset the target board. Some JTAG equipment senses this line to determine when a board has been reset by the user. This is also used in configuration mode to control the initialization pin (nINIT) on the FPGAs. Though not a JTAG signal, nSRST is described because it can be controlled by JTAG equipment.
nTRST	Test reset (from JTAG equipment)	This active LOW open-collector signal is used to reset the JTAG port and the associated debug circuitry on the ARM926EJ-S PXP Development Chip. It is asserted at power-up, and can be driven by the JTAG equipment. This signal is also used in configuration mode to control the programming pin, nPROG , on FPGAs.
DBGRQ	Debug request (from JTAG equipment)	DBGRQ is a request for the processor core to enter the debug state. It is provided for compatibility with third-party JTAG equipment.

Table 3-25 JTAG related signals (continued)

Name	Description	Function
DBGACK	Debug acknowledge (to JTAG equipment)	DBGACK indicates to the debugger that the processor core has entered debug mode. It is provided for compatibility with third-party JTAG equipment.
GLOBAL_DONE	FPGA configured	GLOBAL_DONE is an open-collector signal that indicates when FPGA configuration is complete. Although this signal is not a JTAG signal, it does affect nSRST . The GLOBAL_DONE signal is routed between all RealView boards.
nRTCKEN	Return TCK enable	nRTCKEN is an active LOW signal driven by any tile that requires RTCK to be routed back to the JTAG equipment. If nRTCKEN is HIGH, the baseboard drives RTCK LOW. If nRTCKEN is LOW, the baseboard drives the TCK signal back to the JTAG equipment.

The JTAG path chosen depends on whether the system is in configuration mode or debug mode. The CONFIG link controls the **nCFGGEN** signal that is routed through the PB926EJ-S and tile connectors. Figure 3-43 on page 3-101, Figure 3-44 on page 3-102, and Figure 3-45 on page 3-103 show the JTAG signal routing.

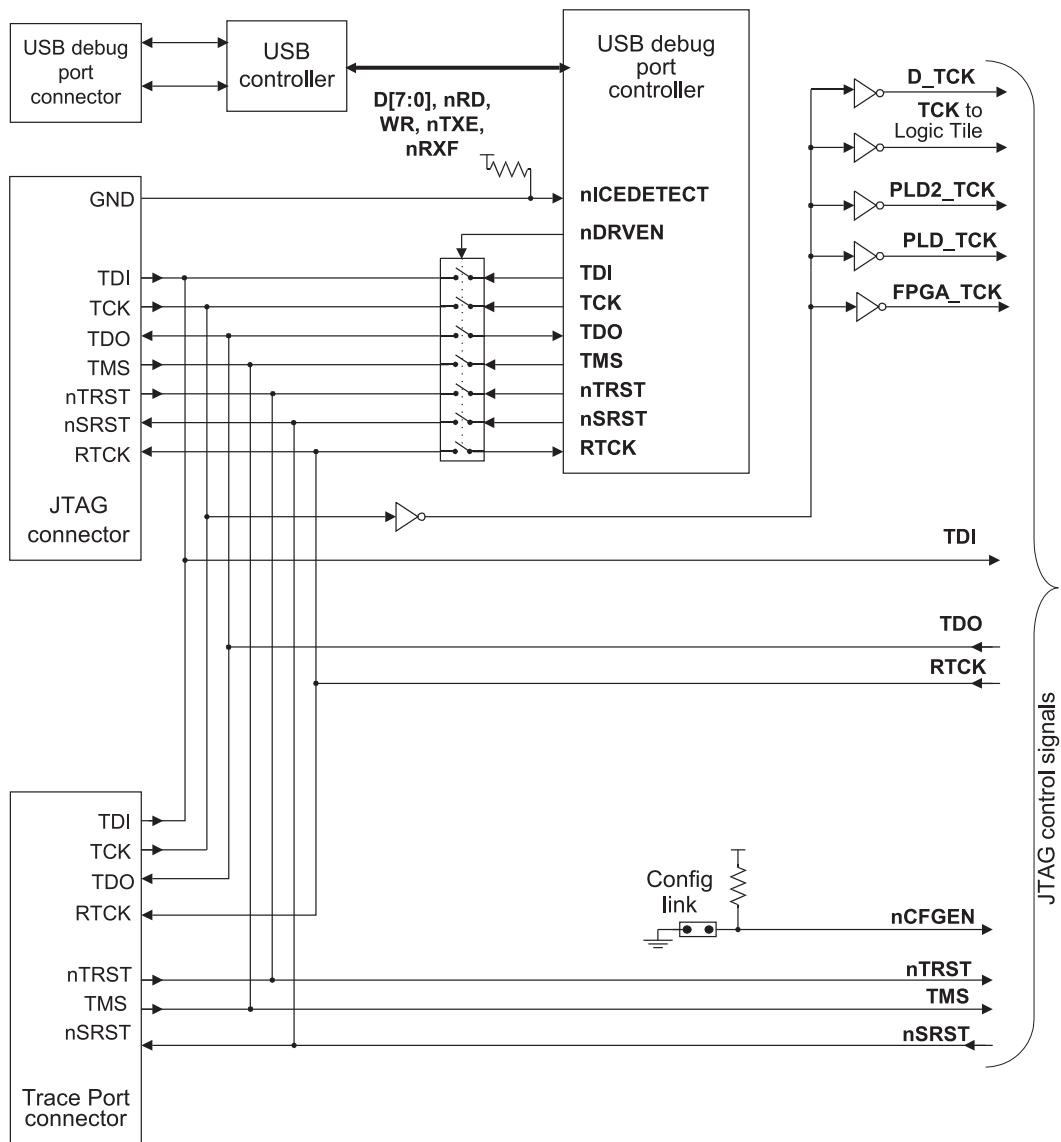


Figure 3-43 JTAG connector signals

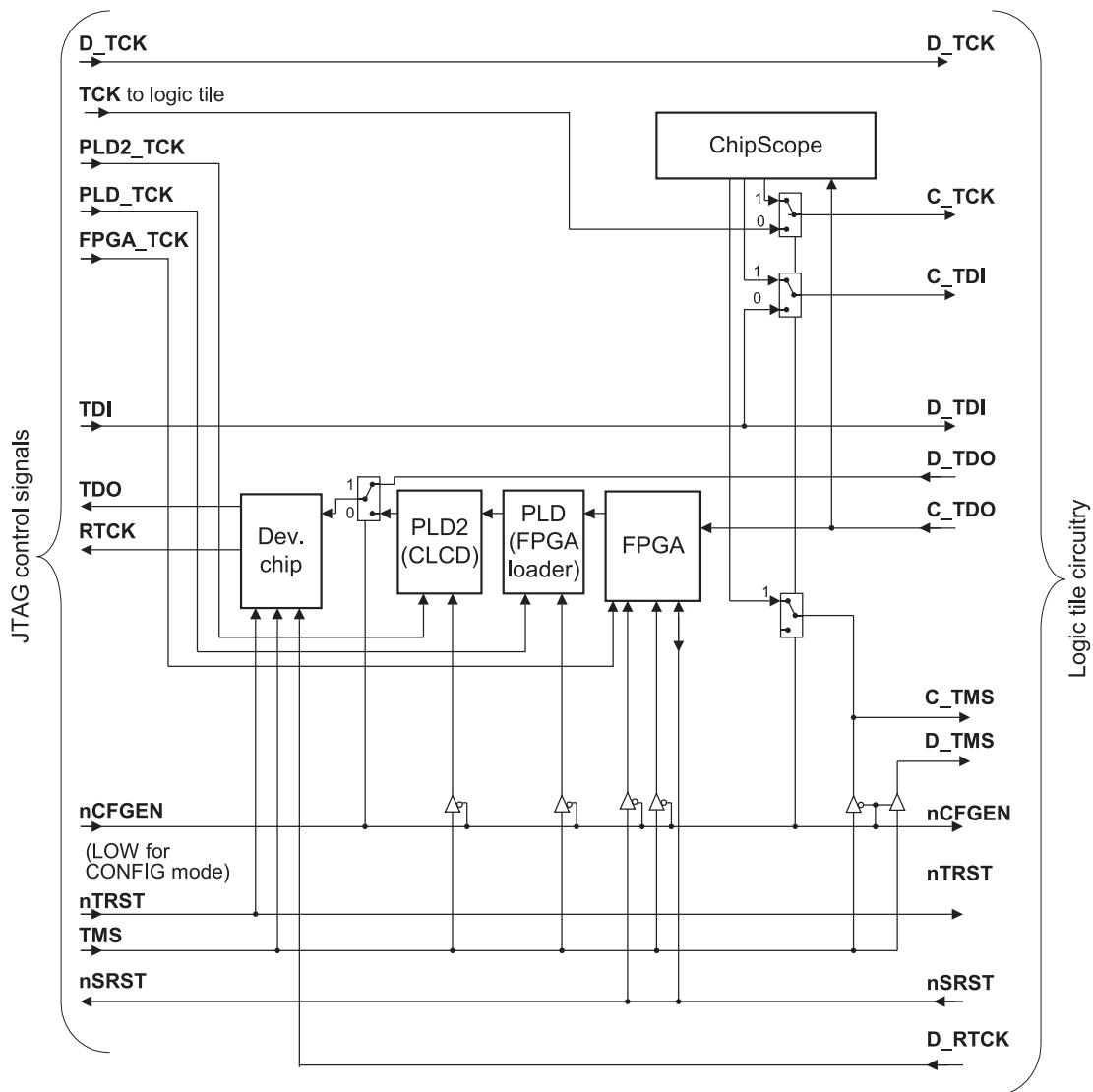


Figure 3-44 JTAG signal routing

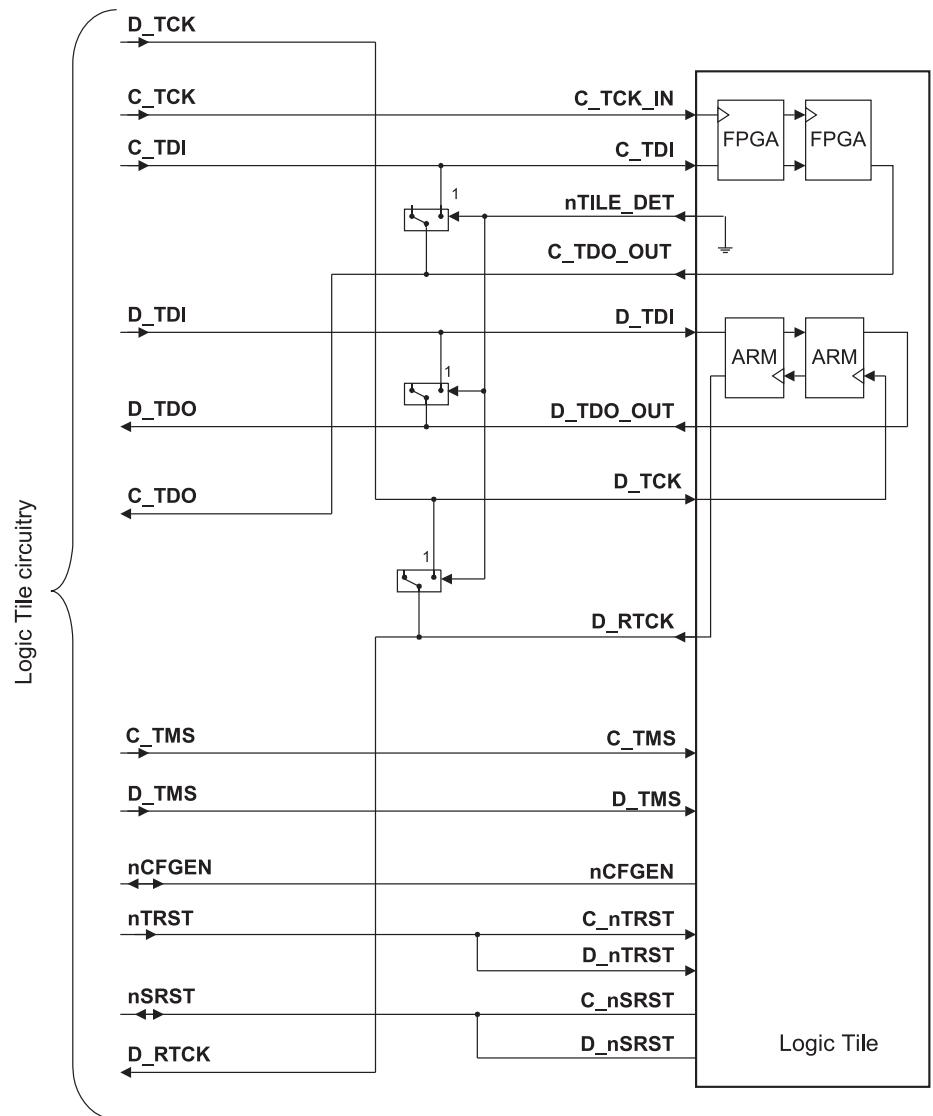


Figure 3-45 RealView Logic Tile JTAG circuitry

3.22.2 ChipScope integrated logic analyzer

The ChipScope connector (J33) enables you to connect a ChipScope compatible analyzer to the configuration scan chain while a JTAG debugger is connected to the debug scan chain. This enables you to debug the FPGAs on stacked tiles while examining code on the CPU.

———— Note ————

In debug mode:

- the ChipScope connector is enabled
- the FPGA on the baseboard is excluded from the configuration scan chain.

In configuration mode:

- the ChipScope connector is disabled
- the FPGA on the baseboard is included in the configuration scan chain.

See *JTAG signal routing* on page 3-102 and *RealView Logic Tile JTAG circuitry* on page 3-103 for full routing details.

For more details on the integrated logic analyzer, see the ChipScope details on the Xilinx website (www.xilinx.com).

3.22.3 Embedded trace support

The ARM926EJ-S PXP Development Chip incorporates an *ARM9 Embedded Trace Macrocell* (ETM9). This enables you to carry out real-time debugging by connecting external trace equipment to the Trace connector on the PB926EJ-S. To trace program flow, the ETM broadcasts branch addresses, data accesses, and status information through the trace port. Later in the debug process, the complete instruction flow can be reconstructed by the ARM *Trace Debug Tools* (TDT) or RealView Debugger. The ETM9 in the ARM926EJ-S PXP Development Chip is a medium size ETM9 Rev 2a.

———— Note ————

Connection of the trace port analyzer is described in *Connecting the Trace Port Analyzer* on page 2-10.

Chapter 4

Programmer's Reference

This chapter describes the memory map and the configuration registers for the peripherals in the ARM926EJ-S PXP Development Chip. It contains the following sections:

- *Memory map* on page 4-3
- *Configuration and initialization* on page 4-9
- *Status and system control registers* on page 4-17
- *AHB monitor* on page 4-41
- *Advanced Audio CODEC Interface, AACI* on page 4-42
- *Character LCD display* on page 4-44
- *Color LCD Controller, CLCDC* on page 4-47
- *Direct Memory Access Controller and mapping registers* on page 4-52
- *Ethernet* on page 4-55
- *General Purpose Input/Output, GPIO* on page 4-56
- *Interrupt controllers* on page 4-57
- *Keyboard and Mouse Interface, KMI* on page 4-67
- *MBX* on page 4-68
- *MultiMedia Card Interfaces, MCIX* on page 4-70
- *MOVE video coprocessor* on page 4-69

- *MultiPort Memory Controller, MPMC* on page 4-71
- *PCI controller* on page 4-74
- *Real Time Clock, RTC* on page 4-85
- *Serial bus interface* on page 4-86
- *Smart Card Interface, SCI* on page 4-88
- *Synchronous Serial Port, SSP* on page 4-89
- *Synchronous Static Memory Controller, SSMC* on page 4-91
- *System Controller* on page 4-95
- *Timers* on page 4-96
- *USB interface* on page 4-99
- *UART* on page 4-97
- *Vector Floating Point, VFP9* on page 4-100
- *Watchdog* on page 4-101.

For detailed information on the programming interface for ARM PrimeCell peripherals and controllers, see the appropriate technical reference manual. For the DMA channels, interrupt signals, and release versions of ARM IP, see the section of this chapter that describes the peripheral.

4.1 Memory map

The locations for memory, peripherals, and controllers are listed in Table 4-1 and *ARM Data bus memory map* on page 4-8.

There are multiple buses in the ARM926EJ-S PXP Development Chip. Not all of the buses can access all of the memory regions. See *AHB bridges and the bus matrix* on page 3-10 and the *ARM926EJ-S Reference Manual* for details on the bus matrix and bus accesses.

— Note —

The MOVE and VFP coprocessors are not memory-mapped peripherals so they do not appear in the memory map listed in Table 4-1. See the appropriate technical reference manual for more detail on these devices.

Table 4-1 Memory map

Peripheral	Location	Interrupt ^a PIC and SIC	Address	Region size
MPMC Chip Select 0. Normally the bottom 64MB of the first bank of SDRAM (During boot remapping, this can be NOR flash or memory on a RealView Logic Tile.)	Board	-	0x00000000-0x03FFFFFF	64MB
MPMC Chip Select 0, top 64MB of the first bank of SDRAM	Board	-	0x04000000-0x07FFFFFF	64MB
MPMC Chip Select 1, dynamic expansion memory	Memory expansion	-	0x08000000-0x0FFFFFFF	128MB
System registers	FPGA	-	0x10000000-0x10000FFF	4KB
PCI controller configuration registers	FPGA	-	0x10001000-0x10001FFF	4KB
Serial Bus Interface	FPGA	-	0x10002000-0x10002FFF	4KB
<i>Secondary Interrupt Controller (SIC)</i>	FPGA	PIC 31	0x10003000-0x10003FFF	4KB
Advanced Audio CODEC Interface	FPGA	PIC24, SIC 24	0x10004000-0x10004FFF	4KB

Table 4-1 Memory map (continued)

Peripheral	Location	Interrupt ^a PIC and SIC	Address	Region size
<i>Multimedia Card Interface 0 (MMCIO)</i>	FPGA	MCI0A: PIC 22, SIC 22 MCI0B: SIC 1	0x10005000- 0x10005FFF	4KB
Keyboard/Mouse Interface 0	FPGA	SIC 3	0x10006000- 0x10006FFF	4KB
Keyboard/Mouse Interface 1	FPGA	SIC 4	0x10007000- 0x10007FFF	4KB
Character LCD Interface	FPGA	SIC 7	0x10008000- 0x10008FFF	4KB
UART 3	FPGA	SIC 6	0x10009000- 0x10009FFF	4KB
Smart Card1 Interface	FPGA	SIC 5	0x1000A000- 0x1000AFFF	4KB
<i>Multimedia Card Interface 1 (MMC1)</i>	FPGA	MCI1 A: PIC 23, SIC 23 MCI1B: SIC 2	0x1000B000- 0x1000BFFF	4KB
Reserved for future use	-	-	0x1000C000- 0x1000FFFF	16KB
Ethernet Interface	FPGA	PIC 25, SIC 25	0x10010000- 0x1001FFFF	64KB
USB Interface	FPGA	PIC 26, SIC 26	0x10020000- 0x1002FFFF	64KB
Reserved	-	-	0x10030000- 0x100FFFFF (13 * 64KB)	832KB
Synchronous Static Memory Controller configuration registers	Dev. chip	-	0x10100000- 0x1010FFFF	64KB
Multi-Port Memory Controller configuration registers	Dev. chip	-	0x10110000- 0x1011FFFF	64KB
Color LCD Controller	Dev. chip	PIC 16	0x10120000- 0x1012FFFF	64KB

Table 4-1 Memory map (continued)

Peripheral	Location	Interrupt ^a PIC and SIC	Address	Region size
DMA Controller	Dev. chip	PIC 17	0x10130000-0x1013FFFF	64KB
<i>Vectored Interrupt Controller (PIC)</i>	Dev. chip	-	0x10140000-0x1014FFFF	64KB
Reserved	FPGA	-	0x10150000-0x1015FFFF	64KB
AHB Monitor Interface	Dev. chip	-	0x101D0000-0x101DFFFF	64KB
System Controller	Dev. chip	-	0x101E0000-0x101E0FFF	4KB
Watchdog Interface	Dev. chip	PIC 0	0x101E1000-0x101E1FFF	4KB
Timer modules 0 and 1 interface (Timer 1 starts at 0x101E2020)	Dev. chip	PIC 4	0x101E2000-0x101E2FFF	4KB
Timer modules 2 and 3 interface (Timer 3 starts at 0x101E3020)	Dev. chip	PIC 5	0x101E3000-0x101E3FFF	4KB
GPIO Interface (port 0)	Dev. chip	PIC 6	0x101E4000-0x101E4FFF	4KB
GPIO Interface (port 1)	Dev. chip	PIC 7	0x101E5000-0x101E5FFF	4KB
GPIO Interface (port 2)	Dev. chip	PIC 8	0x101E6000-0x101E6FFF	4KB
GPIO Interface (port 3)	Dev. chip	PIC 9	0x101E7000-0x101E7FFF	4KB
Real Time Clock Interface	Dev. chip	PIC 10	0x101E8000-0x101E8FFF	4KB
Reserved	-	-	0x101E9000-0x101E9FFF	4KB
Smart Card 0 Interface	Dev. chip	PIC 15	0x101F0000-0x101F0FFF	4KB

Table 4-1 Memory map (continued)

Peripheral	Location	Interrupt ^a PIC and SIC	Address	Region size
UART 0 Interface	Dev. chip	PIC 12	0x101F1000-0x101F1FFF	4KB
UART 1 Interface	Dev. chip	PIC 13	0x101F2000-0x101F2FFF	4KB
UART 2 Interface	Dev. chip	PIC 14	0x101F3000-0x101F3FFF	4KB
Synchronous Serial Port Interface	Dev. chip	PIC 11	0x101F4000-0x101F4FFF	4KB
Reserved	-	-	0x101F5000-0x13FFFFFF	94MB
Reserved for use by RealView Logic Tile bus AHB M2.	-	-	0x14000000-0x1FFFFFFF	192MB
SSMC Chip Selects 4-7, static expansion memory	Board	-	0x20000000-0x2FFFFFFF	256MB
SSMC Chip Select 0, NOR flash 2	Board	-	0x30000000-0x33FFFFFF	64MB
Note				
This was Disk-on-Chip memory on revB/C product versions.				
SSMC Chip Select 1, normally NOR flash 1 (During boot remapping, this can be either of the NOR flash devices or static expansion memory)	Board	-	0x34000000-0x37FFFFFF	64MB
SSMC Chip Select 2, SRAM	Board	-	0x38000000-0x3BFFFFFF	64MB
SSMC Chip Select 3, static expansion memory	Memory expansion	-	0x3C000000-0x3FFFFFFF	64MB
MBX Graphics Accelerator Interface	Dev. chip	PIC 19	0x40000000-0x40FFFFFF	16MB

Table 4-1 Memory map (continued)

Peripheral	Location	Interrupt ^a PIC and SIC	Address	Region size
PCI interface bus windows PCI SelfCfg window: 0x41000000 PCI Cfg window: 0x42000000 PCI I/O window: 0x43000000 PCI memory window 0: 0x44000000 PCI memory window 1: 0x50000000 PCI memory window 2: 0x60000000	PCI	PCI3: PIC 30, SIC 30 PCI2: PIC 29, SIC 29 PCI1: PIC 28, SIC 28 PCI0: PIC 27, SIC 27	0x41000000- 0x6FFFFFFF	752MB
MPMC Chip Selects 2-3, expansion dynamic memory	Expansion memory	-	0x70000000- 0x7FFFFFFF	256MB
RealView Logic Tile expansion (AHB M1 bus). (If a RealView Logic Tile is installed, accesses in this range must be decoded by the tile. This is the recommended address range for placing memory-mapped peripherals in a RealView Logic Tile.)	Board (RealView Logic Tile headers)	PIC 21-PIC 30 (shared with SIC)	0x80000000- 0xFFFFFFFF	2GB

- a. The primary interrupt controller is in the ARM926EJ-S PXP Development Chip. The secondary controller is in the FPGA. See *Primary interrupt controller* on page 4-58 and *Interrupt controllers* on page 4-57.

Figure 4-1 on page 4-8 shows the ARM Data bus memory map. See *AHB bridges and the bus matrix* on page 3-10 for details on other buses in the ARM926EJ-S PXP Development Chip.

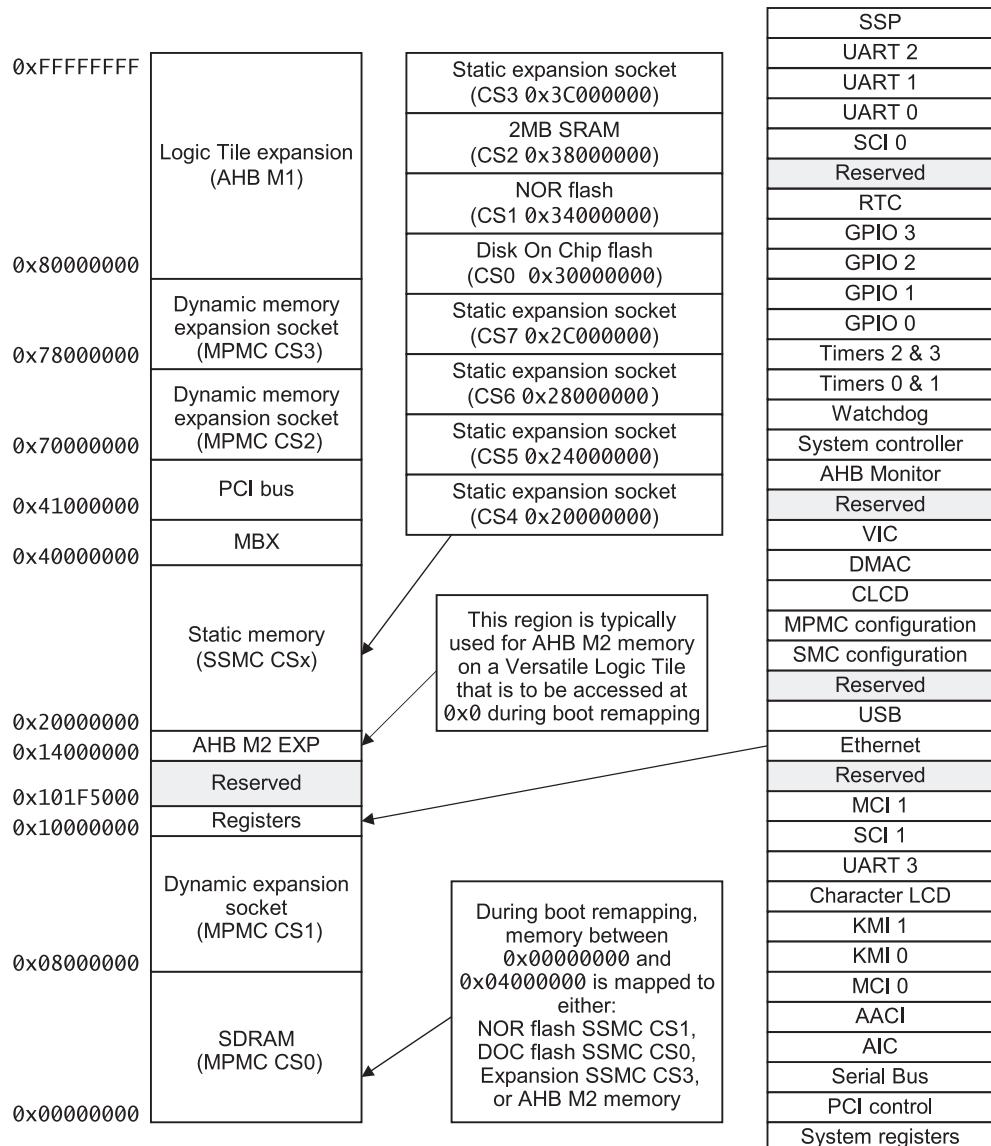


Figure 4-1 ARM Data bus memory map

4.2 Configuration and initialization

This section describes how the ARM926EJ-S PXP Development Chip and external memory and peripherals are configured and initialized at power on. See *Status and system control registers* on page 4-17 and *Boot Select Register, SYS_BOOTCS* on page 4-34 for details on configuration operations that can be performed after the system has started. See also *Configuration control* on page 3-7 and *Configuration registers SYS_CFGDATAx* on page 4-25.

4.2.1 Remapping of boot memory

On reset, the ARM926EJ-S PXP Development Chip begins executing code at address 0x0. This address is normally volatile SDRAM. Remapping allows non-volatile static memory to be decoded for accesses to low memory. Remapping of non-volatile memory to the boot region at 0x00000000–0x03FFFFFF is done by the following signals:

BOOTCSSEL[1:0]

These signals (from configuration switches S1-1 and S1-2) select the non-volatile memory to use if remapping is active (**DEVCHIP REMAP HIGH**).

DEVCHIP REMAP

This signal (from the System Controller register at 0x101E0000) in the ARM926EJ-S PXP Development Chip redirects accesses to memory region 0x00000000–0x03FFFFFF (normally decoded to dynamic chip select 0) to either static chip select 1 to non-volatile memory.

Depending on the state of **BOOTSEL[1:0]**, the non-volatile memory used for boot memory can be either NOR flash, static expansion memory on a memory expansion board, or memory on a RealView Logic Tile. At reset, the **DEVCHIP REMAP** signal is HIGH.

FPGA_REMAP

This signal (from the SYS_MISC register in the FPGA) redirects chip select 3 (normally 0x34000000–0x37FFFFFF) to one of NOR flash 2 (0x30000000), NOR flash 1 (0x34000000), or static expansion memory (0x3C000000) depending on the state of **BOOTCSSEL[1:0]**. At reset, the **FPGA_REMAP** signal is HIGH.

Configuration switch S1 modifies the memory map of static memory at reset as listed in Table 4-2. S1-1 controls **BOOTCSSEL0** and S1-2 controls **BOOTCSSEL1**. If a switch is ON, the corresponding **BOOTCSSEL** signal is HIGH.

Table 4-2 Selecting the boot device

S1-2	S1-1	Device
OFF	OFF	Reserved. (selects NOR flash 2)
OFF	ON	NOR flash 1, see <i>Booting from NOR flash 1</i> on page 4-12
ON	OFF	Reserved
ON	ON	AHB expansion memory on a RealView Logic Tile, see <i>Booting from AHB expansion memory</i> on page 4-14

A simplified version of the remap logic is shown in Figure 3-14 on page 3-28.

Removing boot remapping and enabling SDRAM at 0x0

The ARM926EJ-S PXP Development Chip begins executing at 0x0 after a reset. But because DEVCHIP REMAP and FPGA_REMAP are active at reset, the remapping logic uses causes boot instructions to be fetched from non-volatile static memory.

The boot code must perform the following actions on reset to remove the remapping and enable SDRAM at 0x0:

1. At reset, the remap signals are both high, therefore static memory is remapped to address 0x0. Perform any critical CPU initialization at this time.
Ensure that you do not access SDRAM at this point as it has not been initialized.
2. For NOR flash 1 (**nNORCS**), jump to a location in the range 0x34000000-0x37FFFFFF. Jumping out of the range 0x00000000-0x03FFFFFF means that the remapped memory at 0x0 is no longer needed and can be unmapped.
The code jumps to 0x34000000-0x37FFFFFF rather than the physical location of the boot memory because the boot code does not know which physical memory device it is located in and because the control registers for the other static memory device selects are not installed.

————— **Note** —————

For AHB expansion memory on a RealView Logic Tile, the jump location depends on the decoding address for the AHB expansion memory (typically in the range 0x14000000-0x1FFFFFF). AHB memory is not aliased at 0x34000000-0x37FFFFFF.

3. Clear the **DEVCHIP REMAP** bit by writing a 1 to bit 8 of the System Controller register at **0x101E0000**. This removes the remapping of boot memory to **0x0**.
4. Initialize the MPMC controller with the appropriate values for the type of dynamic RAM used.
5. Use the SDRAM at location **0x0** to hold additional initialization code and the stack for the application.
6. Jump to the initialization code in SDRAM.
7. Set up all static chip select control registers. If you are not booting from NOR flash, you must also set up the control register for **nSTATICCS1**.
8. Clear the **FPGA_REMAP** signal by writing a 0 to bit 2 of SYS_MISC register. This removes the remapping of memory to **0x34000000-0x37FFFFFF**.

———— **Note** ————

Refer to the code examples supplied on the CD for an example of boot source code.

Booting from NOR flash 1

The memory maps for S1-2 OFF (**BOOTSEL1** LOW) and S1-1 ON (**BOOTSEL0** HIGH) are shown in Figure 4-2.

Static expansion	Static expansion	Static expansion	Static expansion	0x3FFFFFFF
				Static CS 3
				0x3C000000
SRAM	SRAM	SRAM	SRAM	0x3BFFFFFF
				Static CS2
				0x38000000
NOR flash 2	NOR flash 2	NOR flash 1	NOR flash 1	0x37FFFFFF
				Static CS1
				0x34000000
NOR flash 2	NOR flash 2	NOR flash 2	NOR flash 2	0x33FFFFFF
				Static CS 0
				0x30000000
MPMC SDRAM	MPMC SDRAM	MPMC SDRAM	MPMC SDRAM	0x07FFFFFF
				SDRAM CS0
				0x04000000
Disk on chip	MPMC SDRAM CS0	NOR flash 1	MPMC SDRAM CS0	0x03FFFFFF
				Remapped memory
				0x0
DEVCHIP REMAP	HIGH	LOW	HIGH	LOW
FPGA_REMAP	HIGH	HIGH	LOW	LOW
	State at reset	SDRAM at 0x0 visible	(not used)	Normal operation

Figure 4-2 Booting from NOR flash 1

Booting from static expansion memory

The memory maps for S1-2 ON (**BOOTSEL1** HIGH) and S1-1 OFF (**BOOTSEL0** LOW) are shown in Figure 4-3.

Static expansion	Static expansion	Static expansion	Static expansion	0x3FFFFFFF
				Static CS 3
SRAM	SRAM	SRAM	SRAM	0x3C000000
				0x3BFFFFFF
				Static CS2
				0x38000000
Static expansion	Static expansion	NOR flash 2	NOR flash 2	0x37FFFFFF
				Static CS1
				0x34000000
NOR flash 1	NOR flash 1	NOR flash 1	NOR flash 1	0x33FFFFFF
				Static CS 0
				0x30000000
MPMC SDRAM	MPMC SDRAM	MPMC SDRAM	MPMC SDRAM	0x07FFFFFF
				SDRAM CS0
Static expansion	MPMC SDRAM CS0	NOR flash 2	MPMC SDRAM CS0	0x03FFFFFF
				Remapped memory
				0x0
DEVCHIP REMAP	HIGH	LOW	HIGH	LOW
FPGA_REMAP	HIGH	HIGH	LOW	LOW
	State at reset	SDRAM at 0x0 visible	(not used)	Normal operation

Figure 4-3 Booting from static expansion memory

Booting from AHB expansion memory

The memory maps for S1-2 ON (**BOOTSEL1** HIGH) and S1-1 ON (**BOOTSEL0** HIGH) are shown in Figure 4-4.

The AHB expansion memory on the RealView Logic Tile is on the AHB M2 bus.

————— **Note** —————

If you are booting from static memory on a RealView Logic Tile, jump to the natural address of your expansion memory before disabling **DEVCHIP REMAP**.

Static expansion	Static expansion	Static expansion	Static expansion	0x3FFFFFFF Static CS 3
SRAM	SRAM	SRAM	SRAM	0x3BFFFFFF Static CS2
NOR flash 2	NOR flash 2	NOR flash 2	NOR flash 2	0x37FFFFFF Static CS1
NOR flash 1	NOR flash 1	NOR flash 1	NOR flash 1	0x33FFFFFF Static CS 0
MPMC SDRAM	MPMC SDRAM	MPMC SDRAM	MPMC SDRAM	0x07FFFFFF SDRAM CS0
AHB expansion	MPMC SDRAM CS0	AHB expansion	MPMC SDRAM CS0	0x03FFFFFF Remapped memory
DEVCHIP REMAP	HIGH	LOW	HIGH	LOW
FPGA_REMAP	HIGH	HIGH	LOW	LOW
State at reset	SDRAM at 0x0 visible	(not used)	Normal operation	

Figure 4-4 Booting from AHB expansion

4.2.2 Memory characteristics

Some memory access characteristics, for example chip select polarity and memory width, are set by the **CONFIGDATA** signals. Changing these values might be required, for example, if you are booting from expansion memory. The signal states are determined by the **SYS_CFGDATAx** registers. These registers contain configuration data to be applied to **HDATA[M2]** pins of the ARM926EJ-S PXP Development Chip when **nPBSDCRECONFIG** is asserted by pressing the DEV CHIP RECONFIG pushbutton. See *Configuration from the DEV CHIP RECONFIG pushbutton* on page 3-9 for details of the **CONFIGDATA** signals.

The values in the **SYS_CFGDATAx** registers retain their value during the ARM926EJ-S PXP Development Chip reconfiguration. The DEV CHIP RECONFIG pushbutton can therefore be used to test different configuration options without resetting the system.

See *Configuration registers SYS_CFGDATAx* on page 4-25 for details of the power-on default values.

See also the *ARM Multiport Memory Controller (GL175) Technical Reference Manual* and the *ARM PrimeCell Static Memory Controller (PL093) Technical Reference Manual* for detailed information on the memory controllers.

Memory banks

Table 4-3 lists the controller memory banks, chip selects, and memory range.

Table 4-3 Memory chip selects and address range

Bank	Chip select	Address range	Device
MPMC bank 4	nMPMCDYCS0	0x00000000-0x07FFFFFF	SDRAM
MPMC bank 5	nMPMCDYCS1	0x08000000-0x0FFFFFFF	Expansion dynamic memory
MPMC bank 6	nMPMCDYCS2	0x70000000-0x77FFFFFF	Expansion dynamic memory
MPMC bank 7	nMPMCDYCS3	0x78000000-0x7FFFFFFF	Expansion dynamic memory
SSMC bank 0	nSTATICCS0	0x30000000-0x33FFFFFF	NOR flash 2
SSMC bank 7	nSTATICCS1	0x34000000-0x37FFFFFF	NOR flash 1
SSMC bank 3	nSTATICCS2	0x38000000-0x3BFFFFFF	SRAM
SSMC bank 1	nSTATICCS3	0x3C000000-0x3FFFFFFF	Expansion static memory
SSMC bank 4	nSTATICCS4	0x20000000-0x23FFFFFF	Expansion static memory
SSMC bank 5	nSTATICCS5	0x24000000-0x27FFFFFF	Expansion static memory
SSMC bank 6	nSTATICCS6	0x28000000-0x2BFFFFFF	Expansion static memory
SSMC bank 1	nSTATICCS7	0x2C000000-0x2FFFFFFF	Expansion static memory

4.3 Status and system control registers

The PB926EJ-S status and system control registers enable the processor to determine its environment and to control some on-board operations. The registers, listed in Table 4-4 on page 4-18, are located from 0x10000000.

See also the *ARM PrimeCell System Controller (SP810) Technical Reference Manual* for details of control registers in the SP810 System Controller that is in the ARM926EJ-S PXP Development Chip. See also *Reset controller* on page 3-22 for a description of the reset logic.

— Note —

All registers are 32 bits wide and do not support byte writes. Write operations must be word-wide. Bits marked as *reserved* in the following sections must be preserved using read-modify-write operations.

In Table 4-4 on page 4-18, the entry for **Reset Level** indicates the highest reset level that modifies its contents:

- | | |
|----------------|---|
| Level 6 | This a programmable reset level that is triggered by a software reset, nSRST , P_nRST , or nPBRESET . See <i>Reset controller</i> on page 3-22 for a description of programmable reset levels and the reset signals. |
| Level 2 | Pressing the SDC RECONFIG button drives the nPBSDCRECONFIG signal active and initiates reconfiguration. The registers are loaded from a writable configuration register. For example, configuration loads the OSC0 clock values from SYS_OSCRESET0. This allows the clock to be changed for testing new divider values. A hard reset of level 0 resets both the OSC0 and SYS_OSCRESET0 registers to the hard-wired default values. |
| Level 1 | Pressing the FPGA CONFIG initiates reconfiguration of the FPGA. |
| Level 0 | The system power on reset (nSYSPOR) is a level 0 reset and initializes all registers to their default value. |

Table 4-4 Register map for system control registers

Name	Address	Access ^a	Reset level	Description
SYS_ID	0x10000000	Read only	-	System Identity. See <i>ID Register, SYS_ID</i> on page 4-21.
SYS_SW	0x10000004	Read only	-	Bits [7:0] map to S6 (user switches)
SYS_LED	0x10000008	Read/Write	6	Bits [7:0] map to user LEDs (located next to S6)
SYS_OSC0	0x1000000C	Read/Write Lockable	2	Settings for the ICS307 programmable oscillator chip OSC0. This oscillator provides the PLLCLKEXT and XTALCLKEXT signal sources. See <i>Oscillator registers, SYS_OSCx</i> on page 4-23 and <i>ARM926EJ-S PXP Development Chip clocks</i> on page 3-39.
SYS_OSC1	0x10000010	Read/Write Lockable	2	Settings for the ICS307 programmable oscillator chip OSC1. This oscillator provides the HCLKM1 signal source.
SYS_OSC2	0x10000014	Read/Write Lockable	2	Settings for the ICS307 programmable oscillator chip OSC2. This oscillator provides the HCLKM2 signal source.
SYS_OSC3	0x10000018	Read/Write Lockable	2	Settings for the ICS307 programmable oscillator chip OSC3. This oscillator provides the HCLKS signal source.
SYS_OSC4	0x1000001C	Read/Write Lockable	2	Settings for the ICS307 programmable oscillator chip OSC4. This oscillator provides the CLCDCLKEXT signal source.
SYS_LOCK	0x10000020	Read/Write	6	Write 0xA05F to unlock. See <i>Lock Register, SYS_LOCK</i> on page 4-24.
SYS_100HZ	0x10000024	Read only	0	100Hz counter.
SYS_CFGDATA1	0x10000028	Read/Write Lockable	0	Configuration data to be applied to HDATA1M1 pins at power on or when the SDC CONFIG pushbutton is pressed.
SYS_CFGDATA2	0x1000002C	Read/Write Lockable	0	Configuration data to be applied to HDATA1M2 pins at power on or when the SDC CONFIG pushbutton is pressed.

Table 4-4 Register map for system control registers (continued)

Name	Address	Access ^a	Reset level	Description
SYS_FLAGS	0x10000030	Read only	6	General-purpose flags (reset by any reset). See <i>Flag registers</i> , <i>SYS_FLAGx</i> and <i>SYS_NVFLAGx</i> on page 4-30.
SYS_FLAGSSET	0x10000030	Write	6	Set bits in general-purpose flags.
SYS_FLAGSCLR	0x10000034	Write	6	Clear bits in general-purpose flags.
SYS_NVFLAGS	0x10000038	Read only	0	General-purpose nonvolatile flags (reset only on power up).
SYS_NVFLAGSSET	0x10000038	Write	0	Set bits in general-purpose nonvolatile flags.
SYS_NVFLAGSCLR	0x1000003C	Write	0	Clear bits in general-purpose nonvolatile flags.
SYS_RESETCTL	0x10000040	Read/Write Lockable	0	The reset control register sets reset depth and programmable soft reset.
SYS_PCICTL	0x10000044	Read only	-	Read returns a HIGH in bit [0] if a PCI board is present in the expansion backplane.
SYS_MCI	0x10000048	Read only	-	Contains the “card present” and “write enabled” status for the MMC10 and MMC11 cards
SYS_FLASH	0x1000004C	Read/Write	6	Controls write protection of flash devices.
SYS_CLCD	0x10000050	Read/Write	6	Controls LCD power and multiplexing.
SYS_CLCDSER	0x10000054	Read/Write	6	Control interface to activate the 2.2 inch display on the LCD adaptor.
SYS_BOOTCS	0x10000058	Read only	-	Contains the settings of the boot switch S1.
SYS_24MHz	0x1000005C	Read only	6	32-bit counter clocked at 24MHz.
SYS_MISC	0x10000060	Read only	6	See <i>Miscellaneous System Control Register</i> , <i>SYS_MISC</i> on page 4-36 for details.
SYS_DMAPSR0	0x10000064	Read/Write	6	Selection control for remapping DMA from external peripherals to DMA channel 0.
SYS_DMAPSR1	0x10000068	Read/Write	6	Selection control for remapping DMA from external peripherals to DMA channel 1.
SYS_DMAPSR2	0x1000006C	Read/Write	6	Selection control for remapping DMA from external peripherals to DMA channel 1.

Table 4-4 Register map for system control registers (continued)

Name	Address	Access ^a	Reset level	Description
SYS_OSCRESET0	0x1000008C	Read/Write Lockable	0	Value to load into the SYS_OSC0 register if the DEV CHIP RECONFIGURE pushbutton is pressed (APPLYCFGWORD active). At power-on reset, the SYS_OSCRESET0 is loaded with the same default value as used for SYS_OSC0.
SYS_OSCRESET1	0x10000090	Read/Write Lockable	0	Value to load into the SYS_OSC1 register if the DEV CHIP RECONFIGURE pushbutton is pressed (APPLYCFGWORD active). At power-on reset, the SYS_OSCRESET1 is loaded with the same default value as used for SYS_OSC1.
SYS_OSCRESET2	0x10000094	Read/Write Lockable	0	Value to load into the SYS_OSC2 register if the DEV CHIP RECONFIGURE pushbutton is pressed (APPLYCFGWORD active). At power-on reset, the SYS_OSCRESET2 is loaded with the same default value as used for SYS_OSC2.
SYS_OSCRESET3	0x10000098	Read/Write Lockable	0	Value to load into the SYS_OSC3 register if the DEV CHIP RECONFIGURE pushbutton is pressed (APPLYCFGWORD active). At power-on reset, the SYS_OSCRESET3 is loaded with the same default value as used for SYS_OSC3.
SYS_OSCRESET4	0x1000009C	Read/Write Lockable	0	Value to load into the SYS_OSC4 register if the DEV CHIP RECONFIGURE pushbutton is pressed (APPLYCFGWORD active). At power-on reset, the SYS_OSCRESET4 is loaded with the same default value as used for SYS_OSC4.
SYS_TEST_OSC0	0x100000C0	Read only	6	32-bit counter clocked from ISC307 clock 0.
SYS_TEST_OSC1	0x100000C4	Read only	6	32-bit counter clocked from ISC307 clock 1.
SYS_TEST_OSC2	0x100000C8	Read only	6	32-bit counter clocked from ISC307 clock 2.
SYS_TEST_OSC3	0x100000CC	Read only	6	32-bit counter clocked from ISC307 clock 3.
SYS_TEST_OSC4	0x100000D0	Read only	6	32-bit counter clocked from ISC307 clock 4.

a. If Access is lockable, the register can only be written if SYS_LOCK is unlocked (see *Lock Register, SYS_LOCK* on page 4-24).

4.3.1 ID Register, SYS_ID

The SYS_ID register at 0x10000000 is a read-only register that identifies the board manufacturer, board type, and revision. Figure 4-5 shows the bit assignment of the register.

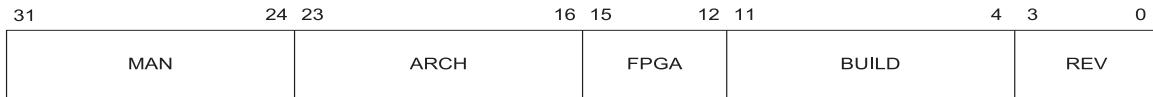


Figure 4-5 ID Register, SYS_ID

Table 4-5 describes the PB926EJ-S ID Register assignment.

Table 4-5 ID Register, SYS_ID bit assignment

Bits	Access	Description
[31:24]	Read	MAN, manufacturer: 0x41 = ARM
[23:16]	Read	ARCH, architecture: 0x00 = ARM926
[15:12]	Read	FPGA type: 0x7 = XC2V2000
[11:4]	Read	Build value (ARM internal use)
[3:0]	Read	REV, Major revision 0x4 = multilayer AHB

4.3.2 Switch Register, SYS_SW

Use the SYS_SW register at 0x10000004 to read the general purpose (user) switch S6. A value of 1 indicates that the switch is on.

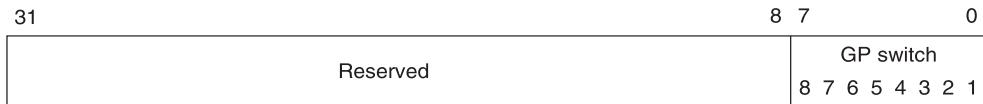


Figure 4-6 SYS_SW

4.3.3 LED Register, SYS_LED

Use the SYS_LED register at 0x10000008 to set the user LEDs. (The LEDs are located next to user switch S6.) Set the corresponding bit to 1 to illuminate the LED.



Figure 4-7 SYS_LED

4.3.4 Oscillator registers, SYS_OSCx

The oscillator registers, SYS_OSC0 to SYS_OSC4, at 0x1000000C–0x1000001C are read/write registers that control the frequency of the clocks generated by the ICS307 programmable oscillators. A serial interface transfers the values in the registers to the programmable oscillators when a reset occurs.

— Note —

If the DEV CHIP RECONFIG pushbutton is pressed, the contents of the SYS_OSCRESETx registers are copied into the SYS_OSCx registers before the contents are transmitted to the programmable oscillators. This allows the clock frequencies and the clock divider ratios to be changed at the same time.

Figure 4-8 shows the bit assignment of the registers.

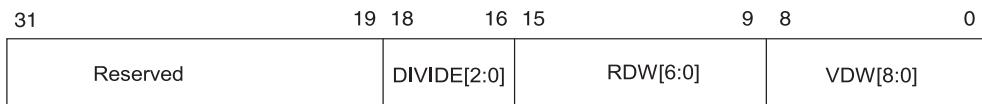


Figure 4-8 Oscillator Register, SYS_OSCx

Table 4-6 lists the details of the SYS_OSCx registers. For more detail on bit values, see *ICS307 programmable clock generators* on page 3-48 and *Clock rate restrictions* on page B-5.

Table 4-6 Oscillator Register, SYS_OSCx bit assignment

Bits	Access	Description
[31:19]	Reserved	Use read-modify-write to preserve value.
[18:16]	Read/write	DIVIDE[2:0], output divider select
[15:9]	Read/write	RDW[6:0], reference divider word
[8:0]	Read/write	VDW[8:0], VCO divider word

— Note —

Before writing to a SYS_OSC register, unlock it by writing the value 0x0000A05F to the SYS_LOCK register. After writing the SYS_OSC register, relock it by writing any value other than 0x0000A05F to the SYS_LOCK register.

4.3.5 Lock Register, SYS_LOCK

The SYS_LOCK register at 0x10000020 locks or unlocks access to the following registers:

- Oscillator registers, SYS_OSCx
- Reset values for oscillators, SYS_OSCRESETx
- Configuration registers, SYS_CFGDATAx
- Reset control register, SYS_RESETCTL

The control registers cannot be modified while they are locked. This mechanism prevents the registers from being overwritten accidentally. The registers are locked by default after a reset. Figure 4-9 shows the bit assignment of the register.

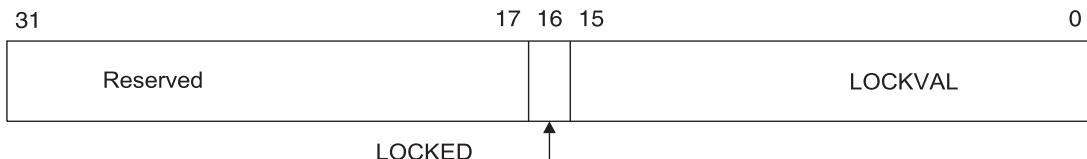


Figure 4-9 Lock Register, SYS_LOCK

Table 4-7 describes the PB926EJ-S Lock Register bit assignment.

Table 4-7 Lock Register, SYS_LOCK bit assignment

Bits	Access	Description
[31:17]	Reserved	Use read-modify-write to preserve value.
[16]	Read	LOCKED, this bit indicates if the control registers are locked or unlocked: 0 = unlocked 1 = locked.
[15:0]	Read/write	LOCKVAL, write the value 0xA05F to unlock the control registers. Write any other value to this register to lock the registers.

4.3.6 100Hz Counter, SYS_100HZ

The SYS_100HZ register at 0x10000024 is a 32-bit counter incremented at 100Hz. The 100Hz reference is derived from the 32KHz crystal oscillator. The register is set to zero by a reset.

4.3.7 Configuration registers SYS_CFGDATAx

The read/write registers SYS_CFGDATA1 and SYS_CFGDATA2 contain configuration data that is applied to the ARM926EJ-S PXP Development Chip HDATAM1 and HDATAM2 pins when the DEV CHIP RECONFIG pushbutton is pressed.

In a production ASIC, the configuration signals would be tied HIGH or LOW, but they are configurable in the ARM926EJ-S PXP Development Chip. This enables you to test different build options. For example, you can simulate a system that boots in big-endian or with the vector table located at address 0xFFFF0000 by changing the value of bits 0 and 1 in the SYS_CFGDATA2 register and pressing the SDC RECONFIG button.

For details on the configuration process, see *Configuration from the DEV CHIP RECONFIG pushbutton* on page 3-9.

SYS_CFGDATA1 at address 0x10000028 contains the configuration settings to apply to HDATA1 pins and the clock multiplexing logic. Figure 4-10 and Table 4-8 on page 4-26 show the configuration signals for each bit and the default value loaded at power on reset.

31	24 23	16 15	0
Reserved	Clock multiplexors	Reserved for AHBM1 configuration (should be zero)	

Figure 4-10 SYS_CFGDATA1

Table 4-8 Configuration register 1

Bits	Power-on reset state	Description
[31:24]	-	Reserved for future use.
[23:16]	b11110000	<p>HCLKCTRL[7:0], clock selection multiplexors control.</p> <p>The value of b11110000 selects GLOBALCLK as source for the external clocking of the AHB M1, M2, and S bridges when they are operating in asynchronous mode.</p> <p>The external bridge clocks are not used by default however, as the AHB bridges operate in synchronous mode unless SYS_CONFIGDATA2[26:22] bits are changed from their default values (see <i>ARM926EJ-S PXP Development Chip clocks</i> on page 3-39).</p>
Note		
<p>HCLKCTRL[0] is read-only and reflects the state of the nGLOBALCLKEN signal from signal Z50 on an external RealView Logic Tile: If no tile is connected, nGLOBALCLKEN is pulled LOW by a resistor inside the PB926EJ-S FPGA and GLOBALCLK is generated from OSC0. If nGLOBALCLKEN is pulled HIGH, the RealView Logic Tile is driving GLOBALCLK and the local source is disabled.</p>		
[15:0]	-	Reserved for future use for AHB M1 configuration, should be zero.

SYS_CFGDATA2 at address 0x1000002C contains the configuration settings to apply to HDATA2 pins. Figure 4-11 and Table 4-9 on page 4-27 show the configuration signals for each bit and the default value loaded at power on reset.

31	29	28	27	26	25	24	23	22	21	20	19	18	17	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved	SBUR	M2BUR	PASS	SAS	M2AS	M1AS	SMCCLK	DIVSEL	MBXCLK	DIVSEL	HCLKEXT	DIVSEL	HCLKDIV	SEL	FB	BYPASS	PLL	CS POL	MEM	WIDTH	BRIDGE	DYN	STATIC	MPMC	VFP	BIGEND	VINITHI		

Figure 4-11 **SYS_CFGDATA2**

Table 4-9 Configuration register 2

Bits	Power-on reset state	Description
[31:29]	-	Reserved for future use.
[28]	b0	CFGINCROVERRIDES , AMBA on-chip AHB slave bridge. Override burst transfer with INCR mode (active HIGH).
[27]	b0	CFGINCROVERRIDE2 , AMBA off-chip AHB bridge 2. Override burst transfer with INCR mode (active HIGH).
[26]	b0	CFGINCROVERRIDE1 , AMBA off-chip AHB bridge 1. Override burst transfer with INCR mode (active HIGH).
[25]	b0	CFGAHBPASST , AMBA bridges. Switch the AHB M1, M2, and S bridges to pass-through mode (active HIGH).
[24]	b0	CFGAHBSASYNC , clock control. Force the slave bridge AHB S to asynchronous mode (active HIGH). See <i>ARM926EJ-S PXP Development Chip clocks</i> on page 3-39.
[23]	b0	CFGAHBM2ASYNC , clock control. Force bridge AHB M2 to asynchronous mode (active HIGH). See <i>ARM926EJ-S PXP Development Chip clocks</i> on page 3-39.
[22]	b0	CFGAHBM1ASYNC , clock control. Force off-chip bridge 1 to asynchronous mode (active HIGH). See <i>ARM926EJ-S PXP Development Chip clocks</i> on page 3-39.
Note		
If Switch S1-3 is ON, CFGAHBM1ASYNC , CFGAHBM2ASYNC , and CFGAHBSASYNC are all forced HIGH and asynchronous mode is used for the AHB M1, M2, and S bridges.		
If Switch S1-3 is OFF, the mode for each bridge is selected by the bit value.		
[21:20]	b01	CFGSMCCLKDIVSEL[1:0] , clock control. Sets the HCLK to SMCLK divide ratio. The divide value is set as follows: b00 = 1 b01 = 2 (The default clock is 35MHz, one half HCLK .) b10 = 3 b11 = 4 See <i>ARM926EJ-S PXP Development Chip clocks</i> on page 3-39.
[19:18]	b00	CFGMBXCLKDIVSEL[1:0] , clock control. Sets the HCLK to MBXCLK divide ratio. The divide value is set as follows: b00 = 1 (The default MBX clock is 70MHz, the same as HCLK .) b01 = 2 b10 = 3 b11 = 4 See <i>ARM926EJ-S PXP Development Chip clocks</i> on page 3-39.

Table 4-9 Configuration register 2 (continued)

Bits	Power-on reset state	Description
[17:15]	b001	<p>CFGHCLKEXTDIVSEL[2:0], clock control.</p> <p>Sets the HCLK to HCLKEXT divide ratio. The divide value is set as follows: b000 = 1 b001 = 2 b010 = 3 b011 = 4 b100 = 5 b101 = 6 b110 = 7 b111 = 8</p> <p>————— Note —————</p> <p>The default SYS_OSC0 setting gives an OSC0 clock of 35MHz.</p> <p>For the default values of the system multiplexors, OSCCLK0 provides the reference clock to the PLL in the ARM926EJ-S PXP Development Chip. The PLL clock adjusts its output frequency (CPUCLK) so that HCLKEXT is at the same frequency as the reference clock.</p> <p>The default values for CFGHCLKDIVSEL[1:0] and CFGHCLKEXTDIVSEL[2:0] result in HCLK equal to 70MHz (two times HCLKEXT) and CPUCLK equal to 210MHz (three times HCLK).</p> <p>See <i>ARM926EJ-S PXP Development Chip clocks</i> on page 3-39.</p>
[14:13]	b10	<p>CFGHCLKDIVSEL[1:0], clock control. Sets the CPUCLK to HCLK divide ratio. The divide value is set as follows: b00 = 1 b01 = 2 b10 = 3 b11 = 4</p> <p>See <i>ARM926EJ-S PXP Development Chip clocks</i> on page 3-39.</p>
[12]	b0	<p>CFGPLLSHORTFB, clock control (active HIGH). Removes the clock tree delay from the PLL feedback (see <i>ARM926EJ-S PXP Development Chip clocks</i> on page 3-39).</p>
[11]	b0	<p>CFGPLLBYPASS, clock control (active HIGH). Forces the PLL output to be bypassed. The XTALCLKEXT signal is used to clock the AMBA subsystem (see <i>ARM926EJ-S PXP Development Chip clocks</i> on page 3-39).</p>
[10]	b1	<p>CFGUSEPLL, clock control (active HIGH). Uses the output from the PLL in the ARM926EJ-S PXP Development Chip to clock the AMBA subsystem (see <i>ARM926EJ-S PXP Development Chip clocks</i> on page 3-39).</p>
[9]	b0	<p>CFGBOOTCSPOL, memory control. Defines the polarity of the static chip select STATICCS1 at reset when the MPMC is used as the static memory controller. When HIGH, nMPMCSTCS1 is active HIGH. When LOW, nMPMCSTCS1 is active LOW.</p>
[8:7]	b10	<p>CFGBOOTMEMWIDTH[1:0], memory width for STATICCS1 from the SSMC.</p> <p>These bits are read only and indicate the width of the selected BOOT memory.</p> <p>The memory width is specified as follows: b00 = 8-bit b01 = 16-bit b10 = 32-bit b11 = reserved</p> <p>————— Note —————</p> <p>BOOT memory is selected by the value of BOOTCSSEL[1:0]. The value of BOOTCSSEL[1:0] is set by the Configuration switches S1-1 and S1-2. See <i>Selecting the boot device</i> on page 4-10.</p>

Table 4-9 Configuration register 2 (continued)

Bits	Power-on reset state	Description
[6]	b1	CFGBRIDGEEMEMMAP , AMBA bridge mapping. Reserved. Must be set to 1.
[5]	b0	CFGREMAPDYEXEN , dynamic memory and expansion memory alias enable (see <i>Remapping of boot memory</i> on page 4-9). When HIGH and CFGREMAPSTEXEN is LOW, then dynamic memory is aliased to 0x00000000. When HIGH and CFGREMAPSTEXEN is HIGH, then expansion memory is aliased to 0x00000000. ————— Note ————— This bit is read-only. To remap to AHB expansion memory both BOOTCSSEL[1] and BOOTCSSEL[0] must be HIGH. The combination of CFGREMAPSTENEX LOW and CFGREMAPDYEXEN LOW is not supported.
[4]	b1	CFGREMAPSTEXEN , static memory and expansion memory alias enable (see <i>Remapping of boot memory</i> on page 4-9). When HIGH and CFGREMAPDYEXEN is LOW, then static memory is aliased to 0x00000000. When HIGH and CFGREMAPDYEXEN is HIGH, then expansion memory is aliased to 0x00000000. ————— Note ————— The combination of CFGREMAPSTENEX LOW and CFGREMAPDYEXEN LOW is not supported.
[3]	b0	CFGMPMCnSMC , memory controller select. If this signal is HIGH, the static memory controller is disabled. Reserved. Must be set to 0.
[2]	b1	CFGVFPENABLE , coprocessor multiplexor signal for VFP9-S. Coprocessor enable (active HIGH).
[1]	b0	BIGENDINIT , ARM926EJ-S processor endian control. Defines the byte endian mode at reset. When LOW, little endianness is used. When HIGH, big endianness is used.
[0]	b0	VINITHI , ARM926EJ-S processor exception location. Determines the reset location of the exception vectors for the ARM926EJ-S. When LOW, the vectors are located at 0x00000000. When HIGH, the vectors are located at 0xFFFF0000. A convention for ARM cores is to map the exception vectors to begin at address 0. However, the ARM926EJ-S PXP Development Chip enables the vectors to be moved to 0xFFFF0000 by setting the V bit in coprocessor 15 register 1. To maintain compatibility across all cores, the default reset value maps the vector to begin at address 0 (see also the <i>ARM926EJ-S Development Chip Reference Manual</i>).

4.3.8 Flag registers, SYS_FLAGx and SYS_NVFLAGx

The registers shown in Table 4-10 provide two 32-bit register locations containing general-purpose flags. You can assign any meaning to the flags.

Table 4-10 Flag registers

Register name	Address	Access	Reset by	Description
SYS_FLAGS	0x10000030	Read	Reset	Flag register
SYS_FLAGSSET	0x10000030	Write	Reset	Flag Set register
SYS_FLAGSCLR	0x10000034	Write	Reset	Flag Clear register
SYS_NVFLAGS	0x10000038	Read	POR	Nonvolatile Flag register
SYS_NVFLAGSSET	0x10000038	Write	POR	Nonvolatile Flag Set register
SYS_NVFLAGSCLR	0x1000003C	Write	POR	Nonvolatile Flag Clear register

The PB926EJ-S provides two distinct types of flag registers:

- The SYS_FLAGS Register is cleared by a normal reset, such as a reset caused by pressing the reset button.
- The SYS_NVFLAGS Register retains its contents after a normal reset and is only cleared by a *Power-On Reset* (POR).

Flag and Nonvolatile Flag Registers

The SYS_FLAGS and SYS_NVFLAGS registers contain the current state of the flags.

Flag and Nonvolatile Flag Set Registers

The SYS_FLAGSSET and SYS_NVFLAGSSET registers are used to set bits in the SYS_FLAGS and SYS_NVFLAGS registers:

- write 1 to SET the associated flag
- write 0 to leave the associated flag unchanged.

Flag and Nonvolatile Flag Clear Registers

Use the SYS_FLAGSCLR and SYS_NVFLAGSCLR registers to clear bits in SYS_FLAGS and SYS_NVFLAGS:

- write 1 to CLEAR the associated flag
- write 0 to leave the associated flag unchanged.

4.3.9 Reset Control Register, SYS_RESETCTL

The SYS_RESETCTL register at 0x10000040 sets reset depth and programmable soft reset, see *Reset controller* on page 3-22 and *Reset level* on page 3-24. The function of the register bits are shown in Table 4-11. You must unlock the register (see *Lock Register, SYS_LOCK* on page 4-24) before the register contents can be modified.



Figure 4-12 SYS_RESETCTL

Table 4-11 Reset level control

Bits	Access	Description
[31:9]	Read write	Reserved. Use read-modify-write to preserve value.
[8]	Write	Set this bit to generate a reset at the level specified by bits [2:0]
[7:3]	Read write	Reserved. Use read-modify-write to preserve value.
[2:0]	Read write	Select reset level: b001-b000 resets to level 1, CONFIGCLR b010 resets to level 2, CONFIGINIT b011 resets to level 3, DLLRESET b100 resets to level 4, PLLRESET b101 resets to level 5, PORRESET b111-b111 resets to level 6, DOCRESET

4.3.10 PCI Control Register, SYS_PCICCTL

The SYS_PCICCTL register at 0x10000044 enables the bridge to the PCI bus:

- Setting bit 0 HIGH enables PCI bus accesses.
- Read returns a HIGH in bit 0 if a PCI board is present in the expansion backplane.

See Appendix D *PCI Backplane and Enclosure, PCI controller* on page 4-74, and *PCI interface* on page 3-79 for more information on the PCI backplane.

4.3.11 MCI Register, SYS_MCI

The SYS_MCI register at 0x10000048 provides status information on the Multimedia card sockets. The function of the register bits are shown in Table 4-12 on page 4-32.



Figure 4-13 SYS_MCI

Table 4-12 MCI control

Bits	Access	Description
[31:5]	-	Reserved. Use read-modify-write to preserve value.
[4]	-	Reserved (data multiplex)
[3]	Read	Write protect 1
[2]	Read	Write protect 0
[1]	Read	Card detect 1
[0]	Read	Card detect 0

4.3.12 Flash Control Register, SYS_FLASH

Bit 0 of the SYS_FLASH register at 0x1000004C controls write protection of NOR flash devices. The function of the register bits are shown in Table 4-13.

Table 4-13 Flash control

Bits	Access	Description
[31:1]	-	Reserved. Use read-modify-write to preserve value.
[0]	Read/write	Disables writing to flash if LOW (power-on reset state is LOW)

4.3.13 CLCD Control Register, SYS_CLCD

The SYS_CLCD register at 0x10000050 controls LCD power and multiplexing and controls the interface to the touchscreen as listed in Table 4-14 on page 4-33. See also *LCD power control* on page C-7.



Figure 4-14 SYS_CLCD

Table 4-14 SYS_CLCD register

Bits	Access	Description
[31:14]	-	Reserved. Use read-modify-write to preserve value.
[13]	Read	TSnDAV status, LOW indicates that data is available for reading from the touchscreen.
[12:8]	Read	CLCDID[4:0], returns the setting of the ID links on the CLCD adaptor board Value Display 0 320x240 QVGA 1 640x480 VGA 2 220x176 QCIF 3-31 Reserved
[7]	Read/write	SSP expansion chip select. If HIGH, the chip select (SSPnCS) on the SSP expansion connector is active. SSPCS is inverted to SSPnCS at the FPGA pin. See <i>Synchronous Serial Port, SSP</i> on page 3-84.
[6]	Read/write	Touchscreen enable (TSnSS) to controller on CLCD adaptor board
[5]	Read/write	VDDNEGSWITCH ^a , enable NEG voltage on the CLCD adaptor board
[4]	Read/write	PWR3V5VSWITCH ^a , enable FIXED voltage on the CLCD adaptor board
[3]	Read/write	VDDPOSSWITCH ^a , enable POS voltage on the CLCD adaptor board
[2]	Read/write	LCDIOON ^a , enable the RGB signal buffers on CLCD adaptor board
[1:0]	Read/write	LCD Mode [1:0], controls mapping of video memory to RGB signals. See <i>Display resolutions and display memory organization</i> on page 4-48. Bit 1 Bit 0 Display mode 0 0 8:8:8 0 1 5:5:5:1 1 0 5:6:5, red LSB 1 1 5:6:5, blue LSB

a. The voltage control selection in the SYS_CLCD register might be overridden by links on the CLCD adaptor board.

4.3.14 2.2 inch LCD Control Register SYS_CLCDSER

The SYS_CLCDSER register at 0x10000054 controls the interface to the serial power-on logic in the 2.2inch display on the LCD adaptor board. See Table 4-15 and *LCD power control* on page C-7. Use this register to configure the 2.2inch display at power-on.



Figure 4-15 SYS_CLCDSER

Table 4-15 SYS_CLCDSER register

Bits	Access	Description
[31:7]	-	Reserved. Use read-modify-write to preserve value.
[6]	Read	Serial data in (LCDSD0IN)
[5]	Read/write	Serial data out (LCDSD0OUT)
[4]	Read/write	Serial data direction control (LCDSD0OUTnIN)
[3]	Read/write	Device selection control (LCDXCS)
[2]	Read/write	Write data control (LCDXWR)
[1]	Read/write	Read data control (LCDDXRD)
[0]	Read/write	Data or command control (LCDDATnCOM)

4.3.15 Boot Select Register, SYS_BOOTCS

This read-only SYS_BOOTCS register at 0x10000058 returns the settings of the S1 configuration switches. The function of the register bits are shown in Table 4-16 on page 4-35. If a switch is ON, the corresponding signal is 1. See also *Configuration and initialization* on page 4-9 and *Configuration control* on page 3-7.



Figure 4-16 SYS_BOOTCS

Table 4-16 BOOT configuration switches

Bits	Access	Description
[31:8]	-	Reserved. Use read-modify-write to preserve value.
[7]	Read	Stack image (RealView Logic Tile image 0 or 1). The default is tile image 0 (S1-8 OFF).
[6:5]	Read	FPGA image to load on power on. b00 Image 0 (default, S1-7 and S1-6 OFF) b01 Image 1 b10 Image 2 b11 Image 3
[4]	Read	Low-frequency startup mode. If 1, OSCCLC0 is programmed to generate a 10MHz reference clock instead of a 35MHz reference. The default is 0 (S1-5 OFF).
[3]	Read	Reserved. S1-4 must be set to 0 (OFF)
[2]	Read	If 1, the AHB bus bridge operates in asynchronous mode instead of synchronous mode. The default is 0 (S1-3 OFF).
[1:0]	Read	Static boot memory select switches (S1-2 and S1-1) b00 NOR flash 2 b01 NOR flash 1 (default setting) b10 Static expansion memory b11 AHB expansion memory

4.3.16 24MHz Counter, SYS_24MHZ

The SYS_24MHZ register at 0x1000005C provides a 32-bit count value. The count increments at 24MHz frequency from the 24MHz crystal reference output **REFCLK24MHZ** from OSC0. The register is set to zero by a reset.

4.3.17 Miscellaneous System Control Register, SYS_MISC

The SYS_MISC register at 0x10000060 provides miscellaneous status and control signals as shown in Table 4-17.



Figure 4-17 SYS_MISC

Table 4-17 SYS_MISC

Bits	Access	Description
[31:13]	-	Reserved. Use read-modify-write to preserve value.
[12]	Read/write	Set HIGH to permit either a LOW on LogicTile signal XL[136] or a PCI core interrupt to drive PCI P_nINTA LOW. Set LOW to permit only a PCI core interrupt to drive PCI P_nINTA LOW.
[11:8]	Read	Reserved. (ETMEXTOUT[3:0] state is used to detect if the development chip is an emulation).
[7:5]	-	Reserved. Use read-modify-write to preserve value.
[4]	Read	GP PUSHSWITCH state. If pressed, the value is 1. (See <i>User switches and LEDs</i> on page 3-87.)
[3]	Read/write	Suspend Enable. Set HIGH to allow the GP PUSHSWITCH to toggle the PWRFAIL pin on ARM926EJ-S PXP Development Chip. The PWRFAIL pin is not connected to any power-fail logic, but the pin can be used to test application code that must respond to a power failure.

Table 4-17 SYS_MISC (continued)

Bits	Access	Description
[2]	Read/write	FPGA remap control (FPGA_REMAP)
[1]	Read	RTCOUT signal from the external DS1338 real-time clock. This 32kHz signal can be used as a timer.
[0]	Read	nTILEDET signal. Pulled LOW if a RealView Logic Tile is connected to the expansion headers.

4.3.18 DMA peripheral map registers, SYS_DMAPSRx

The DMA map registers, **SYS_DMAPSR0** to **SYS_DMAPSR3**, permit the mapping of DMA channels 0, 1, and 2 to three of the external peripherals.

Table 4-18 DMA map registers

Name	Address	Access	Description
SYS_DMAPSR0	0x10000064	Read/write	controls mapping of external peripheral DMA request and acknowledge signals to DMA channel 0
SYS_DMAPSR1	0x10000068	Read/write	controls mapping to DMA channel 1
SYS_DMAPSR2	0x1000006C	Read/write	controls mapping to DMA channel 2

The registers are set to zero by a reset. The DMA mapping is disabled by default. Table 4-19 on page 4-38 lists the bit assignments. See *Direct Memory Access Controller and mapping registers* on page 4-52 for more information on the DMA logic.

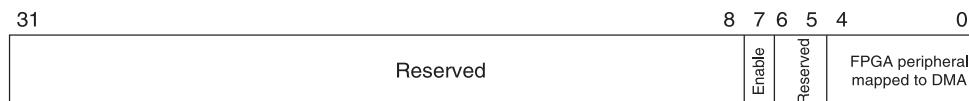


Figure 4-18 DMA mapping register

Table 4-19 SYS_DMAPSRx, DMA mapping register format

Bit	Access	Description
[31:8]	-	Reserved. Use read-modify-write to preserve value.
[7]	Read/write	Set to 1 to enable mapping of external peripheral DMA signals to the DMA controller channel
[6:5]	-	Reserved. Use read-modify-write to preserve value.
[4:0]	Read/write	FPGA peripheral mapped to this channel b00000 = AACI Tx b00001 = AACI Rx b00010 = USB A b00011 = USB B b00100 = MCI 0 b00101 = MCI 1 b00110 = UART3 Tx b00111 = UART3 Rx b01000 = SCI int A b01001 = SCI int B b01010-b11111 Reserved

4.3.19 Oscillator reset registers, SYS_OSCRESETx

The oscillator reset registers, SYS_OSCRESET0 to SYS_OSCRESET4, at 0x1000008C–0x1000009C are read/write registers that control the frequency of the clocks generated by clock generators OSC0, OSC1, OSC2, OSC3, and OSC4 if the DEV CHIP RECONFIG pushbutton is pressed.

Figure 4-19 shows the bit assignment of the registers.

31	19 18	16 15	9 8	0
Reserved	DIVIDE[2:0]	RDW[6:0]	VDW[8:0]	

Figure 4-19 Oscillator Register, SYS_OSCRESETx

— Note —

Before writing to a SYS_OSCRESETx register, unlock it by writing the value 0x0000A05F to the SYS_LOCK register (see *Lock Register, SYS_LOCK* on page 4-24). After writing the SYS_OSCRESETx register, relock it by writing any value other than 0x0000A05F to the SYS_LOCK register.

For more detail on bit values, see *ICS307 programmable clock generators* on page 3-48 and *Oscillator registers, SYS_OSCx* on page 4-23.

— Note —

At power-on reset (**nSYSPOR**), the SYS_OSCRESETx are loaded with the same default values used for SYS_OSCx.

The values of the SYS_OSCRESETx values can be changed after powering on. Pushing the DEV CHIP RECONFIG pushbutton loads the values of the SYS_OSCRESETx registers into the SYS_OSCx registers and loads the programmable oscillators with the new values.

4.3.20 Oscillator test registers, SYS_TEST_OSCx

The oscillator test registers, SYS_TEST_OSC0 to SYS_TEST_OSC4, provide 32-bit count values. The count increments at frequency of the corresponding ICS307 programmable oscillator. The registers are set to zero by a reset.

Table 4-20 Oscillator test registers

Name	Address	Access	Description
SYS_TEST_OSC0	0x100000C0	Read	Counter clocked from clock 0
SYS_TEST_OSC1	0x100000C4	Read	Counter clocked from clock 1
SYS_TEST_OSC2	0x100000C8	Read	Counter clocked from clock 2
SYS_TEST_OSC3	0x100000CC	Read	Counter clocked from clock 3
SYS_TEST_OSC4	0x100000D0	Read	Counter clocked from clock 4

4.4 AHB monitor

The AHB monitor observes the activity on the AHB bus signals in the bus matrix and produces real-time information that is exported off-chip. It also records statistical information into counter registers that are accessible through the AHB interface.

Table 4-21 AHB monitor implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	0x101D0000
Interrupt	NA
DMA	NA
Release version	SP816
Reference documentation	<i>ARM926EJ-S PXP Development Chip Reference Manual</i>

For more information on the protocols used by the AHB monitor, see the *ARM926EJ-S Development Chip Reference Manual* and *AHB monitor* on page 3-16.

4.5 Advanced Audio CODEC Interface, AACI

The PrimeCell *Advanced Audio CODEC Interface* (AACI) is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited.

Table 4-22 AACI implementation

Property	Value
Location	FPGA (the CODEC is an external LM4549).
Memory base address	0x10004000
Interrupt	24 on secondary controller.
DMA	Selectable as channel 0,1, or 2. See <i>DMA peripheral map registers, SYS_DMAPSRx</i> on page 4-37.
Release version	ARM AACI PL041 r1p0 (256 FIFO depth in compact mode).
Reference documentation	<i>ARM PrimeCell Advanced Audio CODEC Interface (PL041) Technical Reference Manual</i> and <i>National Semiconductor LM4549 Data Sheet</i> . See also changed PrimeCell ID listed in Table 4-23 on page 4-43 and <i>Advanced Audio Codec Interface, AACI</i> on page 3-56.

4.5.1 PrimeCell Modifications

The AACI PrimeCell in the PB926EJ-S has a different FIFO depth than the standard PL041. Therefore, the AACIPeriphID3 register contains the values listed in Table 4-23 on page 4-43.



Figure 4-20 AACI ID register

Table 4-23 Modified AACI PeriphID3 register

Bit	Access	Description
[31:8]	-	Not used.
[7:6]	-	Reserved. Use read-modify-write to preserve value.
[5:3]	Read	FIFO depth in compact mode: b000 8 b001 16 b010 32 b011 64 b100 128 b101 256 (default) b110 512 b111 1024
[2:0]	Read	Number of channels: b000 4 b001 1 (default) b010 2 b011 3 b100 4 b101 5 b110 6 b111 7

4.6 Character LCD display

This is a custom peripheral that provides an interface to a standard HD44780 16 x 2 character LCD module.

Table 4-24 Character LCD display implementation

Property	Value
Location	FPGA
Memory base address	0x10008000
Interrupt	NA
DMA	NA
Release version	custom logic
Reference documentation	datasheet for the Hitachi HD44780 display (see also <i>Character LCD controller</i> on page 3-59)

— Note —

The HD44780 display interface is very slow.

Requests to read or write data or a command to the character LCD are captured and executed later. It is not until 500ns later that the access is completed. Poll access complete flag (bit 0 of CHAR_RAW) or wait for a Char LCD interrupt on SIC7 to check that the last access has completed.

After accepting a command, the character LCD typically requires 37 μ s to finish processing. Some commands, Return Home for example, take substantially longer (20ms). Poll the busy signal to determine when the display is ready for a new data or command write.

An interrupt signal is generated by the character LCD controller a short time after the raw data is valid. However this interrupt signal is reserved for future use and you must use a polling routine instead of an interrupt service routine.

The control and data registers for the character LCD interface are listed in Table 4-25.

Table 4-25 Character LCD control and data registers

Address	Name	Type	Description
0x10008000	CHAR_COM	Write command, read busy status	A write to this address will cause a write to the HD44780 command register some cycles later. A read from this address will cause a read from the HD44780 busy register some cycles later.
			Note The data read from this address is not valid LCD register data. Use the CHAR_RAW and CHAR_RD registers to return LCD register data.
0x10008004	CHAR_DAT	Write data RAM, read data RAM	A write to this address will cause a write to the HD44780 data register some cycles later. A read to this address will cause a read to the HD44780 data register some cycles later. The data read from this address is not valid LCD register data. Use the CHAR_RAW and CHAR_RD registers to return LCD register data.
0x10008008	CHAR_RD	Read captured data from an earlier read command	Bits [7:0] contain the data from last request read, valid only when bit 0 is set in CHAR_RAW. Bits [31:8] should be ignored.
0x1000800C	CHAR_RAW	Write to reset access complete flag, read to determine if data in CHAR_RD is valid	Bit 0 indicates AccessComplete (write 0 to clear). The bit is set if read data is valid. Bits [31:1] should be ignored.
0x10008010	CHAR_MASK	Write interrupt mask	Set bit 0 to 1 to enable AccessComplete to generate an interrupt on SIC 7.
0x10008014	CHAR_STAT	Read status	Bit 0 is the state of AccessComplete ANDed with the CHAR_MASK

An overview of the commands available is listed in Table 4-26.

Table 4-26 Character LCD display commands

Command	Bit pattern	Description
Clear display	b00000001	Clears entire display and sets display RAM address counter to zero.
Return home	b0000001x	Sets display RAM address counter to zero and returns the cursor to the first character position. Display RAM contents are not erased.
Entry mode set	b000001DS	Sets cursor move direction to increment (<i>D</i> HIGH) or decrement (<i>D</i> LOW). Specifies display shift (<i>S</i> HIGH). This setting affects future display RAM read or write operation.
Display on/off control	b00001DCB	Sets entire display on /off (<i>D</i> HIGH for on) Sets cursor on/off (<i>C</i> HIGH for on) Sets cursor position character blinking on/off (<i>B</i> HIGH for on).
Cursor or display shift	b0001CDxx	Moves cursor (<i>C</i> LOW) or shifts display (<i>C</i> HIGH) right (<i>D</i> HIGH) or left (<i>D</i> LOW) without changing display RAM contents.
Function set	b001LNFx	Sets interface data length to 8 (<i>L</i> HIGH, the default) or 4 (<i>L</i> LOW). Sets number of display lines to two (<i>N</i> HIGH, the default) or Sets one (<i>N</i> LOW). Sets character font to 5x10 (<i>F</i> HIGH, the default) or 5x8 (<i>F</i> LOW).
Set CGRAM address	b01AAAAAA	Sets character generator RAM address to bAAAAAA. Character generator RAM data is sent and received after this setting.
Set DDRAM address	b1AAAAAA	Sets display RAM address to bAAAAAA. Display RAM data is sent and received after this setting.

For more details on the character display, see the Hitachi HD44780 datasheet. Example code for accessing the character LCD is provided on the CD as part of the Boot Monitor and Selftest applications. This code is copied to your hard disk during installation, see:

- *install_dir\software\firmware\Platform\source\lcd_dbg.c*
- *install_dir\software\projects\selftest\apcharlcd\apcharldc.c*.

4.7 Color LCD Controller, CLCDC

The PrimeCell *Color LCD Controller* (CLCDC) is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited.

Table 4-27 CLCDC implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	0x10120000
Note	
	There are also LCD power control registers at 0x10000050 and 0x10000054. See <i>CLCD Control Register, SYS_CLCD</i> on page 4-32 and <i>2.2 inch LCD Control Register SYS_CLCDSER</i> on page 4-34.
Interrupt	16 on primary controller
DMA	NA
Release version	ARM CLCDC PL110 r0p0-00alp0 (extended to include the hardware cursor from ARM CLCDC PL110 r0p0)
Reference documentation	<i>ARM PrimeCell Color LCD Controller (PL110) Technical Reference Manual</i> For details on the hardware cursor registers, see the <i>ARM926EJ-S Technical Reference Manual</i> . See also address modifications listed in <i>PrimeCell Modifications</i> on page 4-48, <i>Display resolutions and display memory organization</i> on page 4-48, and <i>CLCDC interface</i> on page 3-61)

The following locations are reserved, and must not be used during normal operation:

- locations at offsets 0x030 to 0x1FE are reserved for possible future extensions
- locations at offsets 0x400 to 0x7FF are reserved for test purposes.

4.7.1 PrimeCell Modifications

The register map for the variant of the PL110 used in the ARM926EJ-S PXP Development Chip is not the same as that listed for the standard PL110. The differences are listed in Table 4-28.

Table 4-28 PrimeCell CLCDC register differences

Address (Dev. Chip)	Reset value (Dev. Chip)	Description in PL110 TRM	Difference
0x10120018	0x0	LCDControl, LCD panel pixel parameters	CLCDC TRM lists address as 0x1012001C
0x1012001C	0x0	LCDIMSC, interrupt mask set and clear	CLCDC TRM lists address as 0x10120018
0x10120800- 0x10120C2C	0x0	Not present	Hardware cursor registers from PL111 (see the <i>ARM926EJ-S Technical Reference Manual</i> for details)
0x10120FE0	0x93	CLCDCPeriphID0	CLCDC TRM lists value as 0x10
0x10120FE4	0x10	CLCDCPeriphID1	CLCDC TRM lists value as 0x11

4.7.2 Display resolutions and display memory organization

Different display resolutions require different data and synchronization timing. Use registers CLCD_TIM0, CLCD_TIM1, CLCD_TIM2, and SYS_OSCCLK4 to define the display timings. Table 4-29 lists the register and clock values for different display resolutions.

Table 4-29 Values for different display resolutions

Display resolution	CLCDCCLK frequency and SYS_OSCCLK4 register value	CLCD_TIM0 register at 0x10120000	CLCD_TIM1 register 0x10120004	CLCD_TIM2 register at 0x10120008
QVGA(240x320) (portrait) on VGA	25MHz, 0x2C77	0xC7A7BF38	0x595B613F	0x04eF1800
QVGA (320x240) (landscape) on VGA	25MHz, 0x2C77	0x9F7FBF4C	0x818360eF	0x053F1800
QCIF (176x220) (portrait) on VGA	25MHz, 0x2C77	0xe7C7BF28	0x8B8D60DB	0x04AF1800
VGA (640x480) on VGA	25MHz, 0x2C77	0x3F1F3F9C	0x090B61DF	0x067F1800

Table 4-29 Values for different display resolutions (continued)

Display resolution	CLCDCLK frequency and SYS_OSCCLK4 register value	CLCD_TIM0 register at 0x10120000	CLCD_TIM1 register 0x10120004	CLCD_TIM2 register at 0x10120008
SVGA (800x600) on SVGA	36MHz, 0x2CAC	0x1313A4C4	0x0505F657	0x071F1800
Epson 2.2in panel QCIF (176x220)	10MHz, 0x2C2A	0x00000128	0x000000DB	0x04AF1800
Sanyo 3.8in panel QVGA (320x240)	10MHz, 0x2C2A	0x0505054C	0x050514EF	0x053F1800

The mapping of the 32 bits of pixel data in memory to the RGB display signals depends on the resolution and display mode. Table 4-30 lists software usage of memory bits and Table 4-31 on page 4-51 lists the correspondence between the hardware pins and the bits in memory.

— **Note** —

For resolutions based on 16 bits per pixel, two pixels (pixel0 and pixel1) are encoded in one 32-bit word.

Rx, Gx, and Bx in Table 4-30 and Table 4-31 on page 4-51 refer to bits used to set the red, green, and blue brightness.

Table 4-30 Assignment of display memory to R[7:0], G[7:0], and B[7:0]

Memory bit	8/8/8	1/5/5/5	5/6/5 red (lsb)	5/6/5 blue (lsb)
31	unused	pixel1 I (intensity)	pixel1 B5 (msb)	pixel1 R5 (msb)
30	unused	pixel1 B5 (msb)	pixel1 B4	pixel1 R4
29	unused	pixel1 B4	pixel1 B3	pixel1 R3
28	unused	pixel1 B3	pixel1 B2	pixel1 R2
27	unused	pixel1 B2	pixel1 B1 (lsb)	pixel1 R1 (lsb)
26	unused	pixel1 B1 (lsb)	pixel1 G5 (msb)	pixel1 G5 (msb)
25	unused	pixel1 G5 (msb)	pixel1 G4	pixel1 G4
24	unused	pixel1 G4	pixel1 G3	pixel1 G3

Table 4-30 Assignment of display memory to R[7:0], G[7:0], and B[7:0] (continued)

Memory bit	8/8/8	1/5/5/5	5/6/5 red (lsb)	5/6/5 blue (lsb)
23	B7 (msb)	pixel1 G3	pixel1 G2	pixel1 G2
22	B6	pixel1 G2	pixel1 G1	pixel1 G1
21	B5	pixel1 G1 (lsb)	pixel1 G0 (lsb)	pixel1 G0 (lsb)
20	B4	pixel1 R5 (msb)	pixel1 R5 (msb)	pixel1 B5 (msb)
19	B3	pixel1 R4	pixel1 R4	pixel1 B4
18	B2	pixel1 R3	pixel1 R3	pixel1 B3
17	B1	pixel1 R2	pixel1 R2	pixel1 B2
16	B0 (lsb)	pixel1 R1 (lsb)	pixel1 R1 (lsb)	pixel1 B1 (lsb)
15	G7 (msb)	pixel0 I (intensity)	pixel0 B5 (msb)	pixel0 R5 (msb)
14	G6	pixel0 B5 (msb)	pixel0 B4	pixel0 R4
13	G5	pixel0 B4	pixel0 B3	pixel0 R3
12	G4	pixel0 B3	pixel0 B2	pixel0 R2
11	G3	pixel0 B2	pixel0 B1 (lsb)	pixel0 R1 (lsb)
10	G2	pixel0 B1 (lsb)	pixel0 G5 (msb)	pixel0 G5 (msb)
9	G1	pixel0 G5 (msb)	pixel0 G4	pixel0 G4
8	G0 (lsb)	pixel0 G4	pixel0 G3	pixel0 G3
7	R7 (msb)	pixel0 G3	pixel0 G2	pixel0 G2
6	R6	pixel0 G2	pixel0 G1	pixel0 G1
5	R5	pixel0 G1 (lsb)	pixel0 G0 (lsb)	pixel0 G0 (lsb)
4	R4	pixel0 R5 (msb)	pixel0 R5 (msb)	pixel0 B5 (msb)
3	R3	pixel0 R4	pixel0 R4	pixel0 B4
2	R2	pixel0 R3	pixel0 R3	pixel0 B3
1	R1	pixel0 R2	pixel0 R2	pixel0 B2
0	R0 (lsb)	pixel0 R1 (lsb)	pixel0 R1 (lsb)	pixel0 B1 (lsb)

Table 4-31 PL110 hardware playback mode

Dev. chip signal	TFT24bit 8/8/8 memory bit, color	TFT16bit 1/5/5/5 memory bit, color	TFT16bit 5/6/5 red LSB memory bit, color	TFT16bit 5/6/5 blue LSB memory bit, color
CLD23	23, B7	-	-	-
CLD22	22, B6	-	-	-
CLD21	21, B5	-	-	-
CLD20	20, B4	-	-	-
CLD19	19, B3	-	-	-
CLD18	18, B2	-	-	-
CLD17	17, B1	14/30, B5	14/30, B3	14/30, R3
CLD16	16, B0	13/29, B4	13/29, B2	13/29, R2
CLD15	15, G7	12/28, B3	12/28, B1	12/28, R1
CLD14	14, G6	11/27, B2	11/27, B0	11/27, R0
CLD13	13, G5	10/26, B1	10/26, G5	10/26, G5
CLD12	12, G4	15/31, I (B0)	15/31, B4	15/31, R4
CLD11	11, G3	9/25, G5	9/25, G4	9/25, G4
CLD10	10, G2	8/24, G4	8/24, G3	8/24, G3
CLD9	9, G1	7/23, G3	7/23, G2	7/23, G2
CLD8	8, G0	6/22, G2	6/22, G1	6/22, G1
CLD7	7, R7	5/21, G1	5/21, G0	5/21, G0
CLD6	6, R6	15/31, I (G0)	15/31, B4	15/31, R4
CLD5	5, R5	4/20, R5	4/20, R4	4/20, B4
CLD4	4, R4	3/19, R4	3/19, R3	3/19, B3
CLD3	3, R3	2/18, R3	2/18, R2	2/18, B2
CLD2	2, R2	1/17, R2	1/17, R1	1/17, B1
CLD1	1, R1	0/16, R1	0/16, R0	0/16, B0
CLD0	0, R0	15/31, I (R0)	15/31, B4	15/31, R4

4.8 Direct Memory Access Controller and mapping registers

The PrimeCell *Direct Memory Access Controller* (DMAC) is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited. The DMAC is located in the ARM926EJ-S PXP Development Chip and three DMA mapping registers are located in the FPGA.

Table 4-32 DMAC implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	0x10130000 for DMAC (PL010) 0x10000064 for DMA mapping register SYS_DMAPSR0 0x10000068 for DMA mapping register SYS_DMAPSR1 0x1000006C for DMA mapping register SYS_DMAPSR2
Interrupt	17 on the primary controller
DMA	NA
Release version	ARM DMAC PL080 r1p0
Reference documentation	<i>ARM PrimeCell DMA (PL080) Technical Reference Manual</i> (see also DMA on page 3-65)

Sixteen peripheral DMA interfaces are provided by the PrimeCell DMAC, of which ten are used by the ARM926EJ-S PXP Development Chip peripherals (UART0–3, SCI, and SSP) and six are made available for devices in the FPGA or RealView Logic Tile.

————— **Note** —————

The DMA controller cannot access the Tightly Coupled Memory in the ARM926EJ-S core. Other access limitations are:

- The DMAC master 0 can always access the DMA APB and FPGA peripherals
- DMAC master 1 can always access dynamic and static memory.
- Accesses to other regions are usually mapped to AHB M2.

See *AHB bridges and the bus matrix* on page 3-10.

Table 4-33 shows the DMA channel allocation.

Table 4-33 DMA channels

DMA channel	DMA Requester
15	UART0 Tx
14	UART0 Rx
13	UART1 Tx
12	UART1 Rx
11	UART2 Tx
10	UART2 Rx
9	SSP Tx
8	SSP Rx
7	SCI Tx
6	SCI Rx
5	I/O device in RealView Logic Tile
4	I/O device in RealView Logic Tile
3	I/O device in RealView Logic Tile
2	I/O device in RealView Logic Tile or FPGA
1	I/O device in RealView Logic Tile or FPGA
0	I/O device in RealView Logic Tile or FPGA

— **Note** —

The three DMA channels 0, 1, and 2 are connected to the FPGA, but there are more than three FPGA peripherals that can use DMA. Three DMA mapping registers control the FPGA device that has access to the channels. Table 4-34 on page 4-54 shows the register format and possible values.

Because channels 0,1, or 2 might be used by FPGA peripherals. It is recommended that, if possible, you use only channels 3,4, and 5 for RealView Logic Tiles. If user-supplied peripherals in a tile also requires DMA channels 0,1, or 2, you must program the corresponding DMA mapping register so that the PB926EJ-S FPGA peripherals do not drive that DMA channel.



Figure 4-21 SYS_DMAP0-2 mapping register format

Table 4-34 DMA mapping register format

Bit	Access	Description
[31:8]	-	Reserved
[7]	Read/write	Set to 1 to enable mapping
[6:5]	-	Reserved
[4:0]	Read/write	FPGA peripheral mapped to this channel b00000 = AACI Tx b00001 = AACI Rx b00010 = USB A ^a b00011 = USB B b00100 = MCI 0 b00101 = MCI 1 b00110 = UART3 Tx b00111 = UART3 Rx b01000 = SCI0 int A b01001 = SCI0 int B b01010-b11111 Reserved

- a. The OTG243 controller provides three USB interfaces, OTG (USB1), USB2, USB3, and OTG. The OTG243, however, has only two DMA control channels, USB A and USB B, that are managed by the **USBDACK[1:0]** and **USBDRQ[1:0]** signals. To assign a DMA channel to a USB interface, both the DMA mapping register and the OTG243 must be programmed.

4.9 Ethernet

The Ethernet interface is implemented in an external SMC LAN91C111 10/100 Ethernet single-chip MAC and PHY. The internal registers of the LAN91C111 are memory-mapped onto the AHB M2 bus and occupy 16 word locations at 0x10010000.

Table 4-35 Ethernet implementation

Property	Value
Location	Board (LAN91C111 chip)
Memory base address	0x10010000
Interrupt	25 on both the primary and secondary controllers
DMA	None, use memory to memory DMA to access the buffer memory. The master interface located in the LAN91C11 is not supported.
Release version	The FPGA contains a custom interface to the LAN91C111 chip
Reference documentation	<i>LAN91C111 Data Sheet</i> (see also <i>Ethernet interface</i> on page 3-68).

To access the PHY MII registers, you must implement a synchronous serial connection in software to control the management register in Bank 3. By default, the PHY is set to isolate in the control register. This disables the external interface. Refer to the LAN91C111 application note or to the self test program supplied on the CD for additional information.

When manufactured, an ARM value for the Ethernet MAC address and the register base address are loaded into the EEPROM. The register base address is 0. The MAC address is unique, but can be reprogrammed if required. Reprogramming of the EEPROM is done through Bank 1 (general and control registers).

4.10 General Purpose Input/Output, GPIO

The PrimeCell *General Purpose Input/Output* (GPIO) is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited.

Table 4-36 GPIO implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	0x101E4000 for GPIO 0 0x101E5000 for GPIO 1 0x101E6000 for GPIO 2 0x101E7000 for GPIO 3 0x101E8000 alias address for GPIO 3
Interrupt	6 on primary controller for GPIO 0 7 on primary controller for GPIO 1 8 on primary controller for GPIO 2 9 on primary controller for GPIO 3
DMA	NA
Release version	ARM GPIO PL061 r1p0
Reference documentation	<i>ARM PrimeCell GPIO (PL061) Technical Reference Manual</i> (see also <i>GPIO interface</i> on page 3-71)

— Note —

Bit 7 of GPIO 3 is used for the battery voltage signal **BATOK**.

4.11 Interrupt controllers

The PrimeCell *Vectorized Interrupt Controller* (VIC) is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited.

The ARM926EJ-S has two interrupt signals:

- **FIQ** for fast, low latency interrupt handling
- **IRQ** for more general interrupts.

The VIC in the ARM926EJ-S PXP Development Chip accepts interrupts from peripherals located on the RealView Logic Tiles or in the FPGA and generates the FIQ and IRQ signals. The VIC provides a software interface to the interrupt system and functions as the *primary interrupt controller* (PIC).

Table 4-37 VIC Primary Interrupt Controller implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	0x10140000 for PL190 VIC (primary interrupt controller)
Interrupt	FIQ and IRQ
DMA	NA
Release version	ARM VIC PL190 r1p1
Reference documentation	<i>ARM PrimeCell Vector Interrupt Controller (PL190) Technical Reference Manual, Primary interrupt controller</i> on page 4-58, and <i>Interrupts</i> on page 3-72).

A secondary interrupt controller is implemented as a custom design in the FPGA. The output from the secondary controller is connected to the primary controller as **VICINTSOURCE31**.

Interrupt sources **VICINTSOURCE[30:21]** are shared between the RealView Logic Tile and peripherals located in the FPGA.

Table 4-38 SIC implementation

Property	Value
Location	FPGA
Memory base address	0x10003000
Interrupt	31 on the primary interrupt controller

Table 4-38 SIC implementation (continued)

Property	Value
DMA	NA
Release version	custom logic
Reference documentation	<i>Secondary interrupt controller</i> on page 4-61 and <i>Interrupts</i> on page 3-72)

4.11.1 Primary interrupt controller

The primary interrupt control registers are listed in Table 4-39. For more detail on the primary interrupt controller, see the *ARMPL190 VIC Technical Reference Manual*.

Table 4-39 Primary interrupt controller registers

Address	Name	Access	Description
0x10140000	PICIRQStatus	Read	IRQ status register
0x10140004	PICFIQStatus	Read	FIQ status register
0x10140008	PICRawIntr	Read	Raw interrupt status register
0x1014000C	PICIntSelect	Read/write	Interrupt select register
0x10140010	PICIntEnable	Read/write	Interrupt enable register
0x10140014	PICIntEnClear	Write	Interrupt enable clear register
0x10140018	PICSoftInt	Read/write	Software interrupt register
0x1014001C	PICSoftIntClear	Write	Software interrupt clear register
0x10140020	PICProtection	Read/write	Protection enable register
0x10140030	PICVectAddr	Read/write	Vector address register
0x10140034	PICDefVectAddr	Read/write	Default vector address register
0x10140100– 0x1014013C	PICVectAddr0– PICVectAddr15	Read/write	Vector address 0 register to Vector address 15 register
0x10140200– 0x1014023C	PICVectCtl0– PICVectCtl15	Read/write	Vector control 0 register to Vector control 15 register

Table 4-39 Primary interrupt controller registers (continued)

Address	Name	Access	Description
0x10140300– 0x10140310	PICITCR, PICITIP1, PICITIP2, PICITOP1, PICITOP2,	Read/write	Test control registers
0x10140FE0– 0x10140FEC	PICPeriphID0– PICPeriphID3	Read	Peripheral identification registers
0x10140FF0– 0x10140FFC	PICPCellID0– PICPCellID3	Read	PrimeCell identification registers

The bit assignments for the primary interrupt controller are shown in Figure 4-22 and Table 4-40. Each bit corresponds to an interrupt source. Use the bit to enable or disable the interrupt or to check the interrupt status.

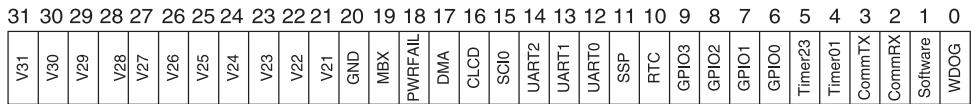


Figure 4-22 Primary interrupt registers

Table 4-40 Interrupt signals to primary interrupt controller

Bit	Interrupt source ^a	Description
[31]	VICINTSOURCE31	External interrupt from secondary controller
[30]	VICINTSOURCE30	External interrupt signal from RealView Logic Tile or PCI3 interrupt signal
[29]	VICINTSOURCE29	External interrupt signal from RealView Logic Tile or PCI2 interrupt signal
[28]	VICINTSOURCE28	External interrupt signal from RealView Logic Tile or PCI1 interrupt signal
[27]	VICINTSOURCE27	External interrupt signal from RealView Logic Tile or PCI0 interrupt signal

Table 4-40 Interrupt signals to primary interrupt controller (continued)

Bit	Interrupt source^a	Description
[26]	VICINTSOURCE26	External interrupt signal from RealView Logic Tile or USB interrupt signal
[25]	VICINTSOURCE25	External interrupt signal from RealView Logic Tile or ETHERNET interrupt signal
[24]	VICINTSOURCE24	External interrupt signal from RealView Logic Tile or AACI interrupt signal
[23]	VICINTSOURCE23	External interrupt signal from RealView Logic Tile or MCI1A interrupt signal
[22]	VICINTSOURCE22	External interrupt signal from RealView Logic Tile or MCI0A interrupt signal
[21]	VICINTSOURCE21	External interrupt signal from RealView Logic Tile or DiskOnChip interrupt signal
[20]	GND	Reserved
[19]	MBX	Graphics processor on development chip
[18]	PWRFAIL	Power failure from FPGA
[17]	DMA	DMA controller in development chip
[16]	CLCD	CLCD controller in development chip
[15]	SCI0	Smart Card interface in development chip
[14]	UART2	UART2 on development chip
[13]	UART1	UART1 on development chip
[12]	UART0	UART0 on development chip
[11]	SSP	Synchronous serial port in development chip
[10]	RTC	Real time clock in development chip
[9]	GPIO3	GPIO controller in development chip
[8]	GPIO2	GPIO controller in development chip
[7]	GPIO1	GPIO controller in development chip
[6]	GPIO0	GPIO controller in development chip
[5]	Timer 2 or 3	Timers on development chip

Table 4-40 Interrupt signals to primary interrupt controller (continued)

Bit	Interrupt source ^a	Description
[4]	Timer 0 or 1	Timers on development chip
[3]	Comms TX	Debug communications transmit interrupt. This interrupt indicates that the communications channel is available for the processor to pass messages to the debugger.
[2]	Comms RX	Debug communications receive interrupt. This interrupt indicates to the processor that messages are available for the processor to read.
[1]	Software interrupt	Software interrupt. Enabling and disabling the software interrupt is done with the Enable Set and Enable Clear Registers. Triggering the interrupt however, is done from the Soft Interrupt Set register.
[0]	Watchdog	Watchdog timer

a. The **VICINTSOURCE_X** signals are external to the ARM926EJ-S PXP Development Chip.

4.11.2 Secondary interrupt controller

The register map for the secondary interrupt controller is shown in Table 4-41.

Table 4-41 Secondary interrupt controller registers

Address	Name	Access	Description
0x10003000	SIC_STATUS	Read	Status of interrupt (after mask)
0x10003004	SIC_RAWSTAT	Read	Status of interrupt (before mask)
0x10003008	SIC_ENABLE	Read	Interrupt mask
0x10003008	SIC_ENSET	Write	Set bits HIGH to enable the corresponding interrupt signals
0x1000300C	SIC_ENCLR	Write	Set bits HIGH to mask the corresponding interrupt signals
0x10003010	SIC_SOFTINTSET	Read/write	Set software interrupt
0x10003014	SIC_SOFTINTCLR	Write	Clear software interrupt

Table 4-41 Secondary interrupt controller registers (continued)

Address	Name	Access	Description
0x10003020	SIC_PICENABLE	Read	Read status of pass-through mask (allows interrupt to pass directly to the primary interrupt controller)
0x10003020	SIC_PICENSET	Write	Set bits HIGH to set the corresponding interrupt pass-through mask bits
0x10003024	SIC_PICENCLR	Write	Set bits HIGH to clear the corresponding interrupt pass-through mask bits

The bit assignments for the secondary interrupt controller are shown in Figure 4-23 and Table 4-42. Each bit corresponds to an interrupt source. Use the bit to enable or disable the interrupt or to check the interrupt status. (For the SIC_PICENABLE, SIC_PICENSET, and SIC_PICENCLR registers, the bits control the pass-through switches that determine if an interrupt goes only to the SIC or directly to the PCI.)

**Figure 4-23 Secondary interrupt registers****Table 4-42 Interrupt signals to secondary interrupt controller**

Bit	Interrupt source	Description
[31]	Reserved	NA
[30]	PCI3	Interrupt 3 triggered from external PCI bus
[29]	PCI2	Interrupt 2 triggered from external PCI bus
[28]	PCI1	Interrupt 1 triggered from external PCI bus
[27]	PCI0	Interrupt 0 triggered from external PCI bus
[26]	USB	USB controller ready for data or data available
[25]	ETHERNET	Ethernet controller ready for data or data available

Table 4-42 Interrupt signals to secondary interrupt controller (continued)

Bit	Interrupt source	Description
[24]	AACI	Audio CODEC interface interrupt
[23]	MMCI1A	Multimedia card 1A interrupt
[22]	MMCI0A	Multimedia card 0A interrupt
[21]	DiskOnChip	Interrupt from DiskOnChip flash memory controller
[20:10]	Reserved	NA
[9]	Keypad	Key pressed on display keypad
[8]	Touchscreen	Pen down on CLCD touchscreen (this signal is generated by the touchscreen controller on the CLCD adaptor board)
[7]	Character LCD	Character LCD ready for data
[6]	UART3	UART 3 empty or data available
[5]	SCI1	Smart Card 1 interface interrupt
[4]	KMI1	Activity on mouse port
[3]	KMI0	Activity on keyboard port
[2]	MMCI1B	Multimedia card 1B interrupt
[1]	MMCI0B	Multimedia card 0B interrupt
[0]	SOFTINT	Software interrupt from secondary controller (SIC_SOFTINT register)

4.11.3 Handling interrupts

This section describes interrupt handling and clearing in general. For examples of interrupt detection and handling, see the *ARM Developer Suite Developer Guide*, the *RealView Compilation Tools User Guide*, and the *ARM926EJ-S Technical Reference Manual*.

The majority of peripheral interrupts can be routed direct to the ARM926EJ-S PXP Development Chip primary interrupt controller. Peripherals external to the development chip have their interrupts routed to the PIC through the SIC_PICEnable register or the SIC. Routing interrupts through the PIC_Enable register rather than the SIC provides a faster mechanism for reading external interrupts, however it uses interrupt lines that are allocated to RealView Logic Tile interrupts.

Note

Although the primary interrupt controller is a vectored interrupt controller (VIC), the examples in this section do not use vectored addresses.

To determine an interrupt source, read the STATUS registers in the PIC and SIC to determine the interrupt controller that generated the interrupt.

The sequence to determine and clear an interrupt is:

1. Determine the interrupt source by reading PIC_IRQStatus and SIC_STATUS. The interrupt handler must read PIC_IRQStatus first to determine if the interrupt was generated by a source that is connected directly to the PIC. If PIC_IRQStatus indicates that the interrupt source was the SIC, the SIC_STATUS register must be read to identify the interrupting device.
2. Determine the nature of the interrupt by reading the peripheral masked interrupt status register.
3. Clear the peripheral interrupt by setting the appropriate bit in the peripheral interrupt clear register.

Each peripheral contains its own interrupt mask and clear registers that must be configured before an interrupt is enabled. The code segments in Example 4-1 to Example 4-3 on page 4-65 show how primary and secondary peripheral interrupts are handled. See the selftest program supplied on the CD for more examples of interrupt handling.

Example 4-1 shows an example of clearing and re-enabling the primary controller SCI0 card out interrupt.

Example 4-1 Clearing and re-enabling SCI0 card out interrupt

```

#define PIC_BASE          0x10140000
#define PIC_IntEnable    ((volatile unsigned int *) (PIC_BASE + 0x10))
#define PIC_IntEnClear   ((volatile unsigned int *) (PIC_BASE + 0x14))
#define PIC_SCI0          (1 << 15) // Smart Card interrupt

#define SCI1_CARDOUTIM   0x002      // Card removed
#define SCI1_IMSC        ((volatile int *) (SCI1_BASE + 0x6C))
#define SCI1_ICR         ((volatile int *) (SCI1_BASE + 0x78))

*PIC_IntEnClear = PIC_SCI0;          // Mask the PIC SCI0 interrupt
*SCI0_ICR         = SCI0_CARDOUTIM; // Clear SCI0 card out flag
// ...
// code for managing SCI I/O

```

```
// ...
*SCI0_IMSC      |= SCI0_CARDOUTIM;    // Enable SCI0 card out interrupt
*PIC_IntEnable  = PIC_SCI0;           // Enable the PIC SCI0 interrupt
```

Example 4-2 shows how to detect the SCI1 card out interrupt signal from the secondary interrupt controller.

Example 4-2 Pseudo code for SIC SCI1 card out interrupt

```
If PIC IRQStatus flags set,
  If PIC_SRC31 set,
    ...SIC interrupt handler
    If SIC_SCI1 set,
      ...SCI1 interrupt handler
      If SCI1_MIS,SCI1_CARDOUTIM flag set,
        ...act on interrupt then clear flag with SCI1_ICR
        ...Test other SCI1 flags
      ...Test other SIC flags
    ...Test other PIC flags
```

Example 4-3 shows clearing and re-enabling the SIC SCI1 card out interrupt by using PIC_SRC31.

Example 4-3 Clearing and re-enabling SCI1 card out interrupt

```
#define PIC_BASE          0x10140000
#define PIC_IntEnable     ((volatile unsigned int *) (PIC_BASE + 0x10))
#define PIC_SRC31          0x80000000 // SIC interrupt

#define SIC_BASE           0x10003000
#define SIC_ENSET          ((volatile unsigned int *) (SIC_BASE + 0x08))
#define SIC_ENCLR          ((volatile unsigned int *) (SIC_BASE + 0x0C))
#define SIC_SCI1            (1 << 5) // Smart Card interrupt

#define SCI1_CARDOUTIM    0x002      // Card removed
#define SCI1_IMSC          ((volatile int *) (SCI1_BASE + 0x6C))
#define SCI1_ICR           ((volatile int *) (SCI1_BASE + 0x78))

*PIC_IntEnable  = PIC_SRC31;      // Mask the PIC SIC (SRC 31) interrupt
*SIC_ENCLR      = SIC_SCI1;      // Mask the SIC SCI1 interrupt
*SCI1_ICR       = SCI1_CARDOUTIM; // Clear SCI1 card out flag
// ...
// code for managing SCI I/O
```

```
// . . .
*SCI1_IMSC      |= SCI1_CARDOUTIM;    // Enable SCI1 card out interrupt
*SIC_ENSET      = SIC_SCI1;          // Enable the SIC SCI1 interrupt
*PIC_IntEnable  = PIC_SRC31;         // Enable the PIC SIC interrupt
```

4.12 Keyboard and Mouse Interface, KMI

The ARM PrimeCell PS2 *Keyboard/Mouse Interface* (KMI) is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited. Two KMs are present on the PB926EJ-S: KMI0 is used for keyboard input and KMI1 is used for mouse input.

Table 4-43 KMI implementation

Property	Value
Location	FPGA
Memory base address	0x10006000 KMI 0 (keyboard) 0x10007000 KMI 1 (mouse)
Interrupt	3 on secondary controller KMI 0 4 on secondary controller KMI 1
DMA	NA
Release version	ARM KMI PL050 r1p0
Reference documentation	<i>ARM PrimeCell Keyboard Mouse Controller (PL050) Technical Reference Manual</i> (see also <i>Keyboard/Mouse Interface, KMI</i> on page 3-74)

4.13 MBX

The MBX Graphics Accelerator is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited.

Table 4-44 MBX implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	0x40000000
Interrupt	19 on primary controller
DMA	NA
Release version	MBX HR-S r1p2
Reference documentation	<i>ARM MBX Graphics Accelerator Technical Reference Manual</i>

The ARM MBX HR-S contains a tile accelerator that operates on 3D scene data (sent as batches of triangles). The accelerator has a direct connection to the MPMC that allows rendered images to be saved directly into display memory.

4.14 MOVE video coprocessor

The MOVE coprocessor is a video encoding acceleration coprocessor designed to accelerate motion-estimation algorithms within block-based video encoding schemes such as MPEG4 and H.263.

Details of the MOVE coprocessor function are only available to licensees. Contact ARM for information on licensing. The release version of the MOVE accelerator is MOVE r3p0-00bet0

4.15 MultiMedia Card Interfaces, MCIX

The PrimeCell *Multimedia Card Interface* (MCI) is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited.

Table 4-45 MCI implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip MCI 0FPGA MCI 1.
Memory base address	0x10005000 for MCI 0 0x1000B000 for MCI 1.
Interrupt	22 on the primary and secondary controllers for MCI 0A 1 on the secondary controller for MCI 0B23 on the primary and secondary controllers for MCI 1A 2 on the secondary controller for MCI 1B.
DMA	DMA channels for MCI 0 and MCI 1 are selectable as 0,1, or 2. See <i>Direct Memory Access Controller and mapping registers</i> on page 4-52.
Release version	ARM MCI PL180 r1p0.
Reference documentation	<i>ARM PrimeCell Multimedia Card Interface (PL180) Technical Reference Manual</i> (see also <i>Memory Card Interface, MCI</i> on page 3-75) .

4.16 MultiPort Memory Controller, MPMC

The *Multiport Memory Controller* (MPMC) is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited.

Table 4-46 MPMC implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip.
Memory base address	0x10110000
Interrupt	NA.
DMA	The MPMC does not use interrupts or DMA. DMA transfers, however, can be set up to access memory controlled by the MPMC.
Release version	ARM MPMC GX175 r0p0-00alp2.
Reference documentation	<i>ARM PrimeCell Multiport Memory Controller (GX175) Technical Reference Manual</i> (see also <i>Memory interface</i> on page 3-15) .

The MPMC controls the dynamic memory on the PB926EJ-S. SyncFlash is supported on the dynamic memory bus but it cannot be selected as boot memory.

For information on default values for the memory controllers, see *Memory characteristics* on page 4-15. Sample programs that configure and use dynamic memory can be found on the CD that accompanies the PB926EJ-S.

4.16.1 Register values

Table 4-47 on page 4-72 lists the register values for typical operation with 133MHz SDRAM. The HCLK frequency is 70MHz and the SDRAM is organized as four banks of 8MB x 16bit.

— Note —

The platform.a library contains memory setup routines. See *Building an application with the platform library* on page 2-23.

Table 4-47 SDRAM register values

Address offset	Register name	Value	Description
+0x000	MPMCCControl	0x1	Enabled
+0x008	MPMCCConfig	0x0	Little Endian
+0x020	MPMCDynamicControl	0x3	MPMCCLKOUT runs continuously, CKE high
+0x024	MPMCDynamicRefresh	0x22	544 cycles of HCLK between refreshes
+0x028	MPMCDynamicReadConfig	0x111	command delayed strategy, using MPMCCLKDELAY , data capture on positive HCLK edge
+0x030	MPMCDynamictRP	0x2	42.86ns
+0x034	MPMCDynamictRAS	0x3	57.14ns
+0x038	MPMCDynamictSREX	0x5	85.71ns
+0x044	MPMCDynamictWR	0x4	71.43ns
+0x048	MPMCDynamictRC	0x5	85.71ns
+0x04c	MPMCDynamictRFC	0x5	85.71ns
+0x050	MPMCDynamictXSR	0x5	85.71ns
+0x054	MPMCDynamictRRD	0x1	28.57ns
+0x058	MPMCDynamictMRD	0x2	42.86ns
+0x05c	MPMCDynamictCDLR	0x1	28.57ns
+0x100	MPMCDynamicConfig0	0x5880	SDRAM32M16BRCX32
+0x104	MPMCDynamicRasCas0	0x202	CAS latency =2, RAS latency =2
+0x120	MPMCDynamicConfig1	0x5880	SDRAM32M16BRCX32
+0x124	MPMCDynamicRasCas1	0x202	CAS latency =2, RAS latency =2
+0x140	MPMCDynamicConfig2	0x5880	SDRAM32M16BRCX32

Table 4-47 SDRAM register values (continued)

Address offset	Register name	Value	Description
+0x144	MPMCDynamicRasCas2	0x202	CAS latency =2, RAS latency =2
+0x160	MPMCDynamicConfig3	0x5880	SDRAM32M16BRCX32
+0x164	MPMCDynamicRasCas3	0x202	CAS latency =2, RAS latency =2
+0x400	MPMCAHBCControl0	0x0	-
+0x408	MPMCAHBTImeOut0	0x2	Timeout value

4.17 PCI controller

The PCI controller is implemented in the FPGA and controls the interface to the PCI bus.

— Caution —

The PCI controller is provided by Xilinx. The source HDL for this device is not provided on the CD. The PCI controller will be deleted if you rebuild the FPGA image.

Table 4-48 PCI controller implementation

Property	Value
Location	FPGA
Memory base address	0x10001000 for the map and control registers PCI configuration region is 0x41000000-0x42FFFFFF PCI I/O is 0x43000000-0x43FFFFFF PCI memory region 0 is 0x44FFFFFF-0x4FFFFFFF PCI memory region 1 is 0x50000000-0x5FFFFFFF PCI memory region 2 is 0x60000000-0x6FFFFFFF
Interrupt	PCI0 to 27 on primary and secondary controllers PCI1 to 28 on primary and secondary controllers PCI2 to 29 on primary and secondary controllers PCI3 to 30 on primary and secondary controllers.
Note	
The PB926EJS cannot generate an interrupt to the PCI bus. This is a departure from the PCI bus specification.	
DMA	None. Memory to memory transfers can be set up in the DMAC.
Release version	Custom logic (Xilinx)
Reference documentation	<i>PCI v2.2 Specification</i> (see the PCI SIG web site at www.pcisig.com). See also Table 4-50 on page 4-75, <i>PCI interface</i> on page 3-79, and Appendix D <i>PCI Backplane and Enclosure</i>).

The PCI slave bridge connected to AHB M2 recognizes addresses 0x41000000 to 0x6FFFFFF as being intended for a target within the PCI address space of the memory map, and passes accesses within this region to the PCI bus. The PCI master bridge connected to the PCI bus passes accesses to the AHB S bus.

There are windows that provide access from the AHB M2 bus to the PCI expansion bus are listed in Table 4-49.

Table 4-49 PCI bus memory map for AHB M2 bridge

Usage	Size	AHB M2 address
PCI self config	16MB	0x41000000–0x41FFFFFF
PCI config	16MB	0x42000000–0x42FFFFFF
PCI I/O	16MB	0x43000000–0x43FFFFFF
PCI memory region 0	256MB	0x44000000–0x44FFFFFF
PCI memory region 1	256MB	0x50000000–0x55FFFFFF
PCI memory region 2	256MB	0x60000000–0x66FFFFFF

4.17.1 Control registers

The SYS_PCICTL, PCI_SELFID, and PCI_FLAGS control the operation of the PCI bus and provide status information. The PCI_IMAPx and PCI_SMAPx registers define the address translation values for the PCI I/O, PCI configuration, and PCI memory windows. See Table 4-50. The default value for all mapping registers is 0x0.

Table 4-50 PCI controller registers

Address	Name	Access	Description
0x10000044	SYS_PCICTL	R/W	Read returns a HIGH in bit 0 if a PCI board is present in the expansion backplane.
0x10001000	PCI_IMAP0	R/W	Translate AHB M2 address to PCI address for accesses 0x44000000–0x44FFFFFF.
0x10001004	PCI_IMAP1	R/W	Translate AHB address to PCI address for accesses 0x50000000–0x55FFFFFF.
0x10001008	PCI_IMAP2	R/W	Translate AHB address to PCI address for accesses 0x60000000–0x66FFFFFF.
0x1000100C	PCI_SELFID	R/W	Slot location of the PB926EJ-S.

Table 4-50 PCI controller registers (continued)

Address	Name	Access	Description
0x10001010	PCI_FLAGS	R/W	Master and target abort flags.
0x10001014	PCI_SMAP0	R/W	Translate PCI base address region 0 to AHB address.
0x10001018	PCI_SMAP1	R/W	Translate PCI base address region 1 to AHB address.
0x1000101C	PCI_SMAP2	R/W	Translate PCI base address region 2 to AHB address.

PCI_IMAPx registers

The map registers memory address bits [31:28] for the PCI regions as shown in Figure 4-24. In this example, the PCI_IMAP2 register contains 0x8 and this is used for the high bits of the PCI address bus.

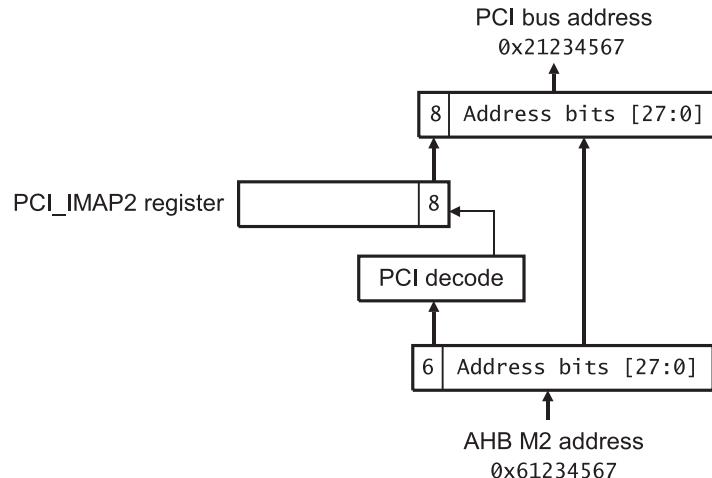


Figure 4-24 AHB M2 to PCI mapping

The map register formats are shown in Figure 4-25 and Table 4-54 on page 4-79.



Figure 4-25 PCI_IMAPx register

Table 4-51 PCI_IMAPx register format

Bits	Description
[31:4]	Reserved. Use read-modify-write to preserve value.
[3:0]	Contains the value to use for bits [31:28] of the PCI address for accesses to this region.

PCI_SELFID register

Writing the slot location of the PB926EJ-S into this register enables normal configuration accesses to return information on the PB926EJ-S. That is, normal configuration accesses to this slot position are converted automatically into self configuration accesses.

The register format is shown in Figure 4-26 and Table 4-52.

**Figure 4-26 PCI_SELFID register****Table 4-52 PCI_SELFID register format**

Bits	Description
[31:5]	Reserved. Use read-modify-write to preserve value.
[4:0]	Contains the slot location of the PB926EJ-S on the PCI backplane.

PCI_FLAGS register

This read-only register returns status information about abort conditions on the PCI bus. The register format is shown in Figure 4-27 on page 4-78 and Table 4-53 on page 4-78.



Figure 4-27 PCI_FLAGS register

Table 4-53 PCI_FLAGS register format

Bits	Description
[31:2]	Reserved.
[1]	Target abort flag. The bit value is the same as bit 38 of the Command Status Register in the Xilinx PCI controller. This bit position is reserved for future use.
[0]	Master abort flag. The bit value is the same as bit 39 of the Command Status Register in the Xilinx PCI controller. This bit will be HIGH if an error occurred while the PB926EJ-S was operating as a master.

PCI_SMAPx registers

The map registers provide memory address bits [31:28] of the AHB bus for PCI accesses as shown in Figure 4-28 on page 4-79. In this example, PCI_SMAP2 contains 0x2 and this is used for the high bits for the AHB S address bus.

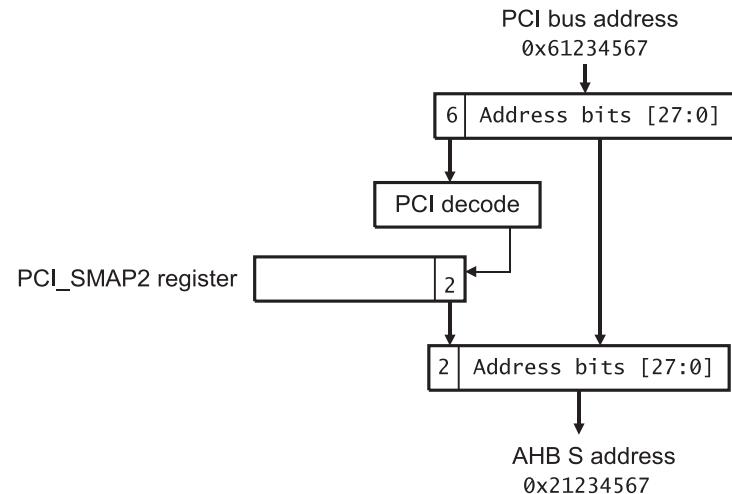


Figure 4-28 PCI to AHB S mapping

The map register format is shown in Figure 4-29 and Table 4-54.



Figure 4-29 PCI_SMAPx register

Table 4-54 PCI_SMAPx register format

Bits	Description
[31:4]	Reserved. Use read-modify-write to preserve value.
[3:0]	Contains the value to use for bits [31:28] of the AHB address when the PCI accesses the slave port.

4.17.2 PCI configuration

This section describes how to configure the PCI controllers on the PB926EJ-S and any PCI cards attached to the PCI backplane.

Locating the self-config header table

The slot positions for PCI cards are numbered from 11 to 31. The numbering is based on the address bit that is connected to the **IDSEL** line. The base address for the PCI configuration header is determined as follows:

$$0x41000000 + ((\text{slot position}) \ll 11)$$

For example, if the PB926EJ-S is put into slot C where PCI address bit 29 is connected to the **IDSEL** signal, then the base address for the PB926EJ-S header table is at memory location:

$$0x41000000 + (29 \ll 11) = 0x4100E800$$

The self-configuration addresses for the slot A, B, and C in the PCI backplane are listed in Table 4-55.

Table 4-55 PCI backplane configuration header addresses (self-config)

Slot	Address connected to IDSEL	Configuration header memory
C	29	0x4100E800–0x4100E83F
B	30	0x4100F000–0x4100F03F
A	31	0x4100F800–0x4100F83F

The base address for normal configuration is 0x42000000. The normal configuration addresses for the slot A, B, and C in the PCI backplane are listed in Table 4-55.

Table 4-56 PCI backplane configuration header addresses (normal configuration)

Slot	Address connected to IDSEL	Configuration header memory
C	29	0x4200E800–0x4200E83F
B	30	0x4200F000–0x4200F03F
A	31	0x4200F800–0x4200F83F

The contents of the PCI configuration header is listed in Table 4-57. The default values refer to the PB926EJ-S.

Table 4-57 PCI configuration space header

Address offset	Configuration word function	Default value
+0x00	Device ID Vendor ID	0x030010EE
+0x04	Status Command	0x02200000
+0x08	Class Code Rev ID	0x0B400000
+0x0C	BIST (Reserved in PB926EJ-S) Header Type Lat. timer Line Size (Reserved in PB926EJ-S)	0x00000000
+0x10	Base Address Register 0 (I/O bytes)	0x00000001
+0x14	Base Address Register 1 (memory)	0x00000008
+0x18	Base Address Register 2 (memory)	0x00000008
+0x1C	Base Address Register 3 (reserved in PB926EJ-S)	-
+0x20	Base Address Register 4 (reserved in PB926EJ-S)	-
+0x24	Base Address Register 5 (reserved in PB926EJ-S)	-
+0x28	Cardbus CIS Pointer (reserved in PB926EJ-S)	-
+0x2C	Subsystem ID Subsystem Vendor ID	0x00000000
+0x30	Expansion ROM Base Address (Reserved in PB926EJ-S)	-
+0x34	Unused (Reserved in PB926EJ-S) CapPtr	0x00000000
+0x38	(Reserved in PB926EJ-S)	-
+0x3C	Max_Lat Min_Gnt Interrupt PinInterrupt line	0x000001FF

The PCI backplane uses the top 3 bits of PCI address to determine whether that slot should respond to configuration cycles. When the PB926EJ-S generates PCI configuration cycles by accessing the 0x41000000 or 0x42000000 region, the only one of the PCI cards responds.

See the PCI v2.2 specification for more detail on the configuration space header.

Configuring the PCI interface

To configure a PCI card in the expansion bus, first find the memory location that maps the PB926EJ-S into the system:

1. Scan addresses $0x41000000 + (n < 11)$ to locate the PCI slot holding the PB926EJ-S. The slot range for n is 11 to 31. If you are using the horizontal slot on the PCI expansion backplane, n is 29.
2. Write the value of n that indicates the slot position into the PCI_SELFID register.
3. Set bit 2 of the Command/Status Register (at offset +0x04) to enable the PB926EJ-S to be initiator on the system. This enables initiator transfers.
4. Because the PCI_SELFID register now holds the slot number for the PB926EJ-S, scanning the normal configuration space at $0x42000000$ reveals all PCI cards in the backplane.

Perform normal configuration cycles on other slot positions to see what else is on the bus. Instead of the self config area at $0x41000000$, use memory locations in Config area $0x42000000 + (n < 11)$, where n is 11 to 31. That is, scan:

$0x42005800$, $0x42006000$, $0x42006800$, and so on to $0x4200f800$.

5. The accesses return $0xFFFFFFFF$ if the slot is empty, or the device and vendor id for card present. (For the PB926EJ-S, the device/vendor id is $0x030010EE$.)
If a card is present, read the base address registers to determine how much and what type of memory is required by each of target boards found in the system.
6. Write to the base address registers in the header table to setup the PCI memory map and tell each target the PCI memory addresses they should respond to (see Table 4-57 on page 4-81).
7. Set the PCI control registers at $0x10001000$ appropriately so an access to one of the three memory regions causes a PCI access to the correct PCI memory location.

————— Note —————

An example of PCI scanning and configuration is provided as an example on the CD.

Limitations of the PCI interface

The following limitations apply to the PCI interface present on the PB926EJ-S:

- The interface is 32-bit only.
- 0-bit, 24-bit and unaligned 16-bit transfers are not supported.
- The initiator creates only single reads and writes. This is quite inefficient and results in low performance. It does, however, simplify the logic in the FPGA and allows 66MHz performance.
- The target issues a retry response for reads until the data is ready.
- The target issues a retry response for reads or writes when the fifo is full (target has a 512 deep FIFO, initiator fifo is 16 deep)
- If another master accesses the PB926EJ-S and it responds with 'retry' or 'disconnect without data', then this access must be repeated before any other master accesses to the PB926EJ-S.
- The PB926EJ-S breaks up burst transfers. It typically completes the first cycle and then responds with 'disconnect without data'. The initiator must then retry with the address that responded with the disconnect.
- Only three out of five configuration base registers are usable.
- Cardbus CIS Pointer and Expansion ROM configuration registers are not implemented.
- There is no support for BIST.
- The PB926EJS cannot generate an interrupt to the PCI bus.

———— Note ————

This is a departure from the PCI bus specification.

-
- The target will only respond to some of sixteen PCI bus commands, and initiator only creates six of the cycle types (see Table 4-58 on page 4-84).

Table 4-58 PCI bus commands supported

Command code	Name	Supported on target	Supported on initiator
b0000	Interrupt Acknowledge	Ignored	Not available
b0001	Special Cycle	Ignored	Not available
b0010	I/O read	Yes	Yes
b0011	I/O write	Yes	Yes
b0100	Reserved	Ignored	Not available
b0101	Reserved	Ignored	Not available
b0110	Memory Read	Yes	Yes
b0111	Memory Write	Yes	Yes
b1000	Reserved	Ignored	Not available
b1001	Reserved	Ignored	Not available
b1010	Configuration Read	Yes	Yes
b1011	Configuration Write	Yes	Yes
b1100	Memory Read Multiple	Yes	Not available
b1101	Dual Address Cycle	Ignored	Not available
b1110	Memory Read Line	Yes	Not available
b1111	Memory Write Invalidate	Yes	Not available

4.18 Real Time Clock, RTC

The PrimeCell *Real Time Clock Controller* (RTC) is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited.

A counter in the RTC is incremented every second. The RTC can therefore be used as a basic alarm function or long time-base counter.

The current value of the clock can be read at any time or the RTC can be programmed to generate an interrupt after counting for a programmed number of seconds. The interrupt can be masked by writing to the interrupt match set or clear register.

Table 4-59 RTC implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	0x101E8000
Interrupt	10 on the primary controller
DMA	NA
Release version	ARM RTC PL031 r1p0
Reference documentation	<i>ARM PrimeCell Real Time Clock Controller (PL031) Technical Reference Manual</i>

— Note —

There is also a separate Time-of-Year RTC implemented in an external DS1338 chip on the PB926EJ-S. The external RTC can be accessed by the serial bus interface (see *Serial bus interface* on page 4-86). For details on the programming interface to the Time-of-Year RTC, see the datasheet for the Maxim DS1338 integrated circuit.

4.19 Serial bus interface

A serial bus interface is implemented in the FPGA. The registers shown in Table 4-61 control the serial bus and provides access to control signals on the two memory expansion boards and to the time-of-year clock.

Table 4-60 Serial bus implementation

Property	Value
Location	FPGA
Memory base address	0x10002000
Interrupt	NA
DMA	NA
Release version	Custom logic
Reference documentation	<i>Serial bus interface</i> on page 3-80, Appendix E <i>Memory Expansion Boards</i> , and the datasheet for the Dallas Maxim DS1338 Real Time Clock.

Table 4-61 Serial bus register

Address	Name	Access	Description
0x10002000	SB_CONTROL	Read	Read serial control bits: Bit [0] is SCL Bit [1] is SDA
0x10002000	SB_CONTROLS	Write	Set serial control bits: Bit [0] is SCL Bit [1] is SDA
0x10002004	SB_CONTROLC	Write	Clear serial control bits: Bit [0] is SCL Bit [1] is SDA

— **Note** —

SDA is an open-collector signal that is used for sending and receiving data. Set the output value HIGH before reading the current value.

Software must manipulate the **SCL** and **SDA** bits directly to access the data in the three devices. The pre-defined eight-bit device addresses are listed in Table 4-62. See the `\firmware\examples` directory on the CD for example code for reading the memory expansion EEPROM.

Table 4-62 Serial bus device addresses

Device	Write address	Read address
Dynamic expansion E2PROM	0xA0	0xA1
Static expansion E2PROM	0xA2	0xA3
Time-of-year clock	0xD0	0xD1

4.20 Smart Card Interface, SCI

The PrimeCell *Smart Card Interface* (SCI) is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited.

Table 4-63 SCI implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip SCI0FPGA SCI1.
Memory base address	0x101F0000 for SCI0 0x1000A000 for SCI1.
Interrupt	15 on the primary controller (SCI0) 5 on the secondary controller (SCI1).
DMA	7 SCI0 transmit 6 SCI0 receive DMA channels for SCI1 are selectable as 0,1, or 2. See <i>Direct Memory Access Controller and mapping registers</i> on page 4-52.
Release version	ARM SCI PL131 r1p0.
Reference documentation	<i>SCI PrimeCell PL131 Technical Reference Manual</i> (see also <i>Smart Card interface, SCI</i> on page 3-81) .

The following key parameters are programmable:

- Smart Card clock frequency and communication baud rate
- protocol convention
- card activation and deactivation time
- check for maximum time for first character of *Answer To Reset* (ATR) reception
- check for maximum duration of ATR character stream
- check for maximum time for receipt of first character of data stream
- check for maximum time allowed between characters
- character and block guard time
- transmit and receive character retry and FIFO level
- clock start and stop time and inactive level.

See the self-test software that is supplied on the CD accompanying the PB926EJ-S for a example of detecting a SIM card response to a reset.

4.21 Synchronous Serial Port, SSP

The PrimeCell *Synchronous Serial Port* (SSP) is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited.

Table 4-64 SSP implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	0x101F4000 for SSP
Interrupt	11 on primary controller
DMA	9 for transmit 8 for receive
Release version	ARM SSP PL022 r1p2
Reference documentation	<i>ARM PrimeCell Synchronous Serial Port Controller (PL022) Technical Reference Manual</i> (see also <i>Synchronous Serial Port, SSP</i> on page 3-84)

The SSP functions as a master or slave interface that enables synchronous serial communication with slave or master peripherals having one of the following:

- a Motorola SPI-compatible interface
- a Texas Instruments synchronous serial interface
- a National Semiconductor Microwire interface.

In both master and slave configurations, the PrimeCell SSP performs:

- parallel-to-serial conversion on data written to a transmit FIFO
- serial-to-parallel conversion and FIFO buffering of received data.

Interrupts are generated to:

- request servicing of the transmit and receive FIFO
- inform the system that a receive FIFO over-run has occurred
- inform the system that data is present in the receive FIFO.

The SSP controller can be shared with the following resources:

- If the LCD adaptor board is fitted with a touch screen, the controller interfaces to the SSP port to provide touch screen, keypad, LCD bias and analogue inputs. See the LCD adaptor board TSCI appendix for further details.

— Note —

Use the SYS_CLCD register to control the SSP chip selects. See *CLCD Control Register, SYS_CLCD* on page 4-32.

- An offboard SSP device, such as an EEPROM, can be connected to expansion header J29. If you connect both the LCD adaptor board and the off board SSP device at the same time, ensure the correct SSP interface protocol is used when communicating with each device.
- Synthesized SSP peripherals in a RealView Logic Tile FPGA can be connected using the RealView Logic Tile expansion connectors. Disable the buffer with the RealView Logic Tile HDRY signal **YL62 (nDRVINEN1)** in order to avoid conflicts with the LCD adaptor board and expansion header.

4.22 Synchronous Static Memory Controller, SSMC

The PrimeCell *Synchronous Static Memory Controller* (SSMC) is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited.

Table 4-65 SSMC implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	0x10100000
Interrupt	NA
DMA	NA
Release version	ARM SSMC PL093 r0p0-00rel0
Reference documentation	<i>ARM PrimeCell Static Memory Controller (PL093) Technical Reference Manual, Configuration and initialization on page 4-9, and Memory interface on page 3-15</i>

The following key parameters are programmable for each SSMC memory bank:

- external memory width, 8, 16, or 32-bit
- burst mode operation
- write protection
- external wait control enable
- external wait polarity
- write WAIT states for static RAM devices
- read WAIT states for static RAM and ROM devices
- initial burst read WAIT state for burst devices
- subsequent burst read WAIT state for burst devices
- read byte lane enable control
- bus turn-around (idle) cycles
- output enable and write enable output delays.

For information on default values for the memory controllers, see *Memory characteristics* on page 4-15.

— Note —

To enable write access to the NOR flash (static chip select 1), set bit 0 of SYS_FLASH to HIGH. The default at power-on reset is LOW.

4.22.1 Register values

Table 4-66 to Table 4-69 on page 4-93 lists the register values for the SSMC for typical operation of static memory devices and with a 35MHz system clock.

————— **Note** —————

The platform.a library contains memory setup routines. See *Building an application with the platform library* on page 2-23.

Table 4-66 Register values for Intel flash, standard async read mode, no bursts

Address	Name of SSMC register	Value	Description
+0xE0	SMBIDCYR7	0x0	Idle Cycle Control Register for bank 1
+0xE4	SMBWSTRDR7	0x4	Read Wait State Control Reg bank 1
+0xE8	SMBWSTWRR7	0x3	Write Wait State Control Reg Bank 1
+0xEC	SMBWSTOENR7	0x0	Output Enable Assertion Delay 1
+0xF0	SMBWSTWENR7	0x1	Write Enable Assertion Delay 1
+0xF4	SMBCR7	0x303021	Control Register for memory bank 1
+0xFC	SMBWSTBRDR7	0x0	Burst Read Wait state Control Reg 1

Table 4-67 Register values for Intel flash, async page mode

Address	Name of SSMC register	Value	Description
+0xE0	SMBIDCYR7	0x0	Idle Cycle Control Register for bank 1
+0xE4	SMBWSTRDR7	0x4	Read Wait State Control Reg bank 1
+0xE8	SMBWSTWRR7	0x3	Write Wait State Control Reg Bank 1
+0xEC	SMBWSTOENR7	0x0	Output Enable Assertion Delay 1
+0xF0	SMBWSTWENR7	0x1	Write Enable Assertion Delay 1
+0xF4	SMBCR7	0x303521	Control Register for memory bank 1
+0xFC	SMBWSTBRDR7	0x0	Burst Read Wait state Control Reg 1

Table 4-68 Register values for Samsung SRAM

Address	Name of SSMC register	Value	Description
+0x40	SMBIDCYR2	0x0	Idle Cycle Control Register for bank 2
+0x44	SMBWSTRDR2	0x2	Read Wait State Control Reg bank 2
+0x48	SMBWSTWRR2	0x2	Write Wait State Control Reg Bank 2
+0x4c	SMBWSTOENR2	0x0	Output Enable Assertion Delay 2
+0x50	SMBWSTWENR2	0x1	Write Enable Assertion Delay 2
+0x54	SMBCR2	0x303021	Control Register for memory bank 2
+0x5c	SMBWSTBRDR2	0x0	Burst Read Wait state Control Reg 2

Table 4-69 Register values for Spansion BDS640

Address	Name of SSMC register	Value	Description
+0x60	SMBIDCYR3	0x0	Idle Cycle Control Register for bank 3
+0x64	SMBWSTRDR3	0x3	Read Wait State Control Reg bank 3
+0x68	SMBWSTWRR3	0x2	Write Wait State Control Reg Bank 3
+0x6c	SMBWSTOENR3	0x0	Output Enable Assertion Delay 3
+0x70	SMBWSTWENR3	0x1	Write Enable Assertion Delay 3
+0x74	SMBCR3	0x303021	Control Register for memory bank 3
+0x7c	SMBWSTBRDR3	0x0	Burst Read Wait state Control Reg 3

Table 4-70 Register values for Spansion LV256

Address	Name of SSMC register	Value	Description
+0x80	SMBIDCYR4	0x0	Idle Cycle Control Register for bank 4
+0x84	SMBWSTRDR4	0x4	Read Wait State Control Reg bank 4
+0x88	SMBWSTWRR4	0x3	Write Wait State Control Reg Bank 4

Table 4-70 Register values for Spansion LV256 (continued)

Address	Name of SSMC register	Value	Description
+0x8c	SMBWSTOENR4	0x1	Output Enable Assertion Delay 4
+0x90	SMBWSTWENR4	0x1	Write Enable Assertion Delay 4
+0x94	SMBCR4	0x303121	Control Register for memory bank 4
+0x9c	SMBWSTBRDR4	0x1	Burst Read Wait state Control Reg 4

4.23 System Controller

The *ARM PrimeXsys System Controller* is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited.

Table 4-71 System controller implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	0x101E0000
Interrupt	NA
DMA	NA
Release version	ARM SYSCTRL SP810 r0p0-00ltd0
Reference documentation	<p><i>ARM PrimeCell System Controller (SP810) Technical Reference Manual.</i></p> <p>See also <i>Status and system control registers</i> on page 4-17.</p>
Note	
<p>Bit 8 of the System controller register at 0x101E000 controls remapping of static memory devices to address 0x0. See also <i>Remapping of boot memory</i> on page 4-9.</p>	

The system controller in the ARM926EJ-S PXP Development Chip provides an interface to control the operation of the chip.

The PrimeXsys System Controller supports the following functionality:

- a system mode control state machine
- crystal and PLL control, system/peripheral clock control and status
- definition of system response to interrupts
- reset status capture and soft reset generation
- Watchdog and timer module clock enable generation
- remap control
- general purpose peripheral control registers.

— **Note** —

There are also system control registers in the FPGA. See *Status and system control registers* on page 4-17.

4.24 Timers

The Dual-Timer module is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited. There are two Dual-Timer modules present in the ARM926EJ-S PXP Development Chip.

Table 4-72 Timer implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	0x101E2000 for Timer 0 0x101E2020 for Timer 1 0x101E3000 for Timer 2 0x101E3020 for Timer 3.
Interrupt	4 on primary controller for Timers 0 and 1 5 on primary controller for Timers 2 and 3
DMA	NA
Release version	ARM Dual-Timer SP804 r1p0-02ltd0
Reference documentation	<i>ARM PrimeCell Timer Module (SP804) Technical Reference Manual</i>

The features of the Dual-Timer module are:

- Two 32/16-bit down counters with free-running, periodic and one-shot modes.
- Common clock with separate clock-enables for each timer gives flexible control of the timer intervals.
- Interrupt output generation on timer count reaching zero.
- Identification registers that uniquely identify the Dual-Timer module. These can be used by software to automatically configure itself.

At reset, the timers are clocked by a 32KHz reference from an external oscillator module. Use the system controller to change the timer reference from 32KHz to 1MHz (see the *ARM926EJ-S Development Chip Reference Manual*).

4.25 UART

The PrimeCell UART is an AMBA compliant SoC peripheral that is developed, tested, and licensed by ARM Limited. There are three UARTs in the ARM926EJ-S PXP Development Chip and one UART is in FPGA. The 24MHz reference clock to the UARTs come from the crystal oscillator that is part of OSC0.

Table 4-73 UART implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip for UART 0-2 FPGA for UART3
Memory base address	0x101F1000 for UART0 0x101F2000 for UART1 0x101F3000 for UART2 0x10009000 for UART3
Interrupt	12 on primary controller for UART0 13 on primary controller for UART1 14 on primary controller for UART2 6 on secondary controller for UART3
DMA	15 UART0 Tx 14 UART0 Rx 13 UART1 Tx 12 UART1 Rx 11 UART2 Tx 10 UART2 Rx DMA channels for UART3 Tx and Rx are selectable as 0,1, or 2. See <i>Direct Memory Access Controller and mapping registers</i> on page 4-52.
Release version	ARM UART PL011 r1p3
Reference documentation	<i>ARM PrimeCell UART (PL011) Technical Reference Manual</i> (see also <i>UART interface</i> on page 3-88)

The following key parameters are programmable:

- communication baud rate, integer, and fractional parts
- number of data and stop bits
- parity mode
- FIFO enable and FIFO trigger levels
- UART or IrDA protocol
- hardware flow control.

4.25.1 PrimeCell Modifications

The PrimeCell UART varies from the industry-standard 16C550 UART device as follows:

- receive FIFO trigger levels are 1/8, 1/4, 1/2, 3/4, and 7/8
- the internal register map address space, and the bit function of each register differ
- the deltas of the modem status signals are not available.
- 1.5 stop bits not available (1 or 2 stop bits only are supported)
- no independent receive clock.

4.26 USB interface

The USB interface is provided by an OTG243 controller that provides a standard USB host controller and an *On-The-Go* (OTG) dual role device controller. The USB host has one or two downstream ports. The OTG can function as either a host or slave device.

Table 4-74 USB implementation

Property	Value
Location	Board (an OTG243 chip)
Memory base address	0x10020000, the registers in the OTG243 are memory-mapped onto the AHB M2 bus
Interrupt	26 on primary and secondary controllers
DMA	There are two DMA channels available for the USB controller. These are selectable as 0, 1, or 2. See <i>Direct Memory Access Controller and mapping registers</i> on page 4-52.
Release version	Custom interface in FPGA to external OTG243 controller
Reference documentation	<i>TransDimension OTG243 Data Sheet</i> (see also <i>USB interface</i> on page 3-92 and test program supplied on the CD)

The OTG243 has the following features:

- fully compliant to the USG On-The-Go specification
- configurable number of downstream and upstream hosts or functions
- USB host is USB 2.0 compliant and supports 12Mb/s and 1.5Mb/s
- programmable interrupts and DMA
- 4KB on-chip RAM.

The OTG243 register base addresses are shown in Table 4-75.

Table 4-75 USB controller base address

Address	Description
0x10020000	Chip-level register bank
0x10020080	Host controller register bank
0x10020100	Function controller register bank

4.27 Vector Floating Point, VFP9

The *VFP9-S coprocessor* is an implementation of the *Vector Floating-point Architecture version 2* (VFPv2). It provides low-cost floating-point computation that is fully compliant with the *ANSI/IEEE Std. 754-1985, IEEE Standard for Binary Floating-Point Arithmetic*. The VFP9-S coprocessor supports all addressing modes described in section 5 of the *ARM Architecture Reference Manual*.

Table 4-76 VFP9 implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	The VFP registers are not memory-mapped. Access is from the coprocessor instructions.
Interrupt	NA
DMA	NA
Release version	VFP9 r0p1
Reference documentation	<i>ARM VFP9 Coprocessor Technical Reference Manual</i>

— Note —

The following operations from the IEEE 754 standard are not supplied by the VFP9-S instruction set:

- remainder
- round floating-point number to integer-valued floating-point number
- binary-to-decimal conversions
- decimal-to-binary conversions
- direct comparison of single-precision and double-precision values.

Complete implementation of the IEEE 754 standard is achieved by support code that is provided with the ARM compilation tools.

The latest VFP support code can be obtained as part of *Application Note 98*. If you are using RealView Compilation Tools (RVCT), the appropriate code and documentation are provided within your installation. If you are using the ARM Developer Suite (ADS) 1.2, *Application Note 98* can be downloaded from www.arm.com/support/.

4.28 Watchdog

The PrimeCell Watchdog module is an AMBA compliant SoC peripheral developed, tested and licensed by ARM Limited. The Watchdog module consists of a 32-bit down counter with a programmable timeout interval that has the capability to generate an interrupt and a reset signal on timing out. It is intended to be used to apply a reset to a system in the event of a software failure.

————— **Note** —————

The Watchdog counter is disabled if the core is in debug state.

Table 4-77 Watchdog implementation

Property	Value
Location	ARM926EJ-S PXP Development Chip
Memory base address	0x101E1000
Interrupt	0 on primary controller
DMA	NA
Release version	ARM WDOG SP805 r1p0-02ltd0
Reference documentation	<i>ARM PrimeCell Watchdog Controller (SP805) Technical Reference Manual</i>

The following Watchdog module parameters are programmable:

- interrupt generation enable/disable
- interrupt masking
- reset signal generation enable/disable
- interrupt interval.

Appendix A

Signal Descriptions

This appendix provides a summary of signals present on the PB926EJ-S connectors. It contains the following sections:

- *Synchronous Serial Port interface* on page A-2
- *Smart Card interface* on page A-3
- *UART interface* on page A-5
- *USB interface* on page A-6
- *Audio CODEC interface* on page A-7
- *MMC and SD flash card interface* on page A-8
- *CLCD display interface* on page A-10
- *VGA display interface* on page A-13
- *GPIO interface* on page A-14
- *Keyboard and mouse interface* on page A-15
- *Ethernet interface* on page A-16
- *RealView Logic Tile header connectors* on page A-17
- *Test and debug connections* on page A-33.

For more information on connectors used on the PB926EJ-S, see the parts list spreadsheet in the CD schematics directory.

A.1 Synchronous Serial Port interface

Figure A-1 shows the signals on the expansion SSP interface connector J29.

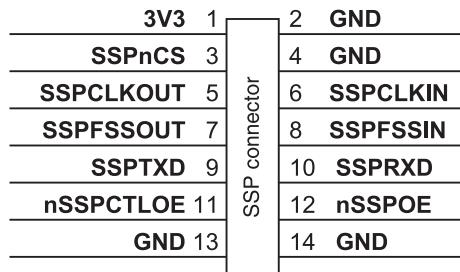


Figure A-1 SSP expansion interface

The signals associated with the SSP are shown in Table A-1.

Table A-1 SSP signal assignment

Signal name	Description
SSPCLKOUT	Clock output from controller
SSPCLKIN	Clock input to controller
nSSPCTL0E	Control output enable control
nSSPOE	Data output enable control
SSPFSSOUT	Frame sync output
SSPFSSIN	Frame sync input
SSPTXD	Data output
SSPRXD	Data input
SSPnCS	Chip select

A.2 Smart Card interface

The PB926EJ-S contains two Smart Card SIM sockets:

- J48 for SIM 0 (J25 uses an alternate layout for SIM 0 and is not fitted)
- J49 for SIM1 (J26 uses an alternate layout for SIM 0 and is not fitted).

Sockets J48 and J49 include a switch for card detection.

The signals on the SIM sockets are also connected to the SCI expansion socket. The signals associated with the SCI are shown in Table A-2.

Table A-2 Smartcard connector signal assignment

Pin	Signal	Description
1	SC_VCCx	Card power (1.8V, 3.3V, or 5V)
2	SC_RSTx	Reset to card
3	SC_CLKx	Clock to or from card
4	NC	Not present on J48 and J49, NC on J25 and J26.
5	GND	Ground
6	SC_VCCx	Card power (1.8V, 3.3V, or 5V)
7	SC_DATAx	Serial data to or from the card
8	NC	Not present on J48 and J49, NC on J25 and J26.
SW1	nSCIDETECTx	Card detect signal from switch in socket (not present on J25 and J26)

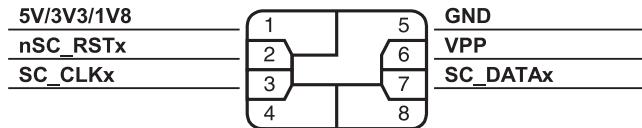


Figure A-2 Smartcard contacts assignment

Figure A-2 shows the signal assignment of a smartcard. Pins 4 and 8 are not connected and are omitted on some cards.

The SIM card is inserted into one of the SIM card sockets with the contacts face down on the top connector or face up on the bottom connector.

Figure A-3 shows the pinout of the connector J28. This can be used to connect to an off-PCB smart card device.

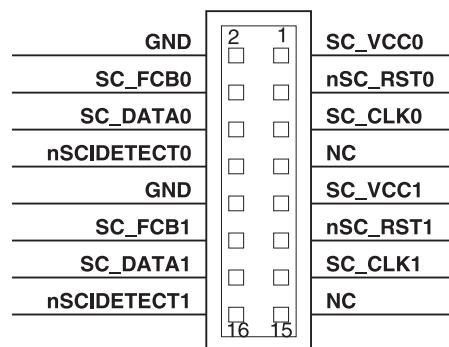


Figure A-3 J28 SCI expansion

Table A-3 lists the signals on the SCI expansion connector.

Table A-3 Signals on expansion connector

Signal	Pin	Pin	Signal name
Ground	2	1	SIM 0 power
SIM 0 function code bit	4	3	Active LOW reset to SIM 0
SIM 0 data	6	5	SIM 0 clock
Card detect for SIM 0	8	7	NC
Ground	10	9	SIM 1 power
Ground	12	11	Active LOW reset to SIM 1
SIM 1 function code bit	14	13	SIM 1 clock
Card detect for SIM 1	16	15	NC

A.3 UART interface

The PB926EJ-S provides four serial transceivers.

Figure A-4 shows the pin numbering for the 9-pin D-type male connector used on the PB926EJ-S and Table A-4 shows the signal assignment for the connectors.

The pinout shown in Figure A-4 is configured as a *Data Communications Equipment* (DCE) device.

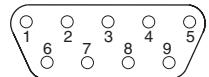


Figure A-4 Serial connector

Table A-4 Serial plug signal assignment

Pin	UART0 J10A (top)	UART1 J10B (bottom)	UART2 J11A (top)	UART3 J11B (bottom)
1	SER0_DCD	NC	NC	NC
2	SER0_RX	SER1_RX	SER2_RX	SER3_RX
3	SER0_TX	SER1_TX	SER2_TX	SER3_TX
4	SER0_DTR	SER1_DTR ^a	SER2_DTR ^a	SER3_DTR ^a
5	SER0_GND	SER1_GND	SER2_GND	SER3_GND
6	SER0_DSR	SER1_DSR	SER2_DSR	SER3_DSR
7	SER0_RTS	SER1_RTS	SER2_RTS	SER3_RTS
8	SER0_CTS	SER1_CTS	SER2_CTS	SER3_CTS
9	SER0_RI	NC	NC	NC

- a. The signals SER1_DTR, SER2_DTR, and SER3_DTR are connected to the corresponding SER1_DSR, SER2_DSR, and SER3_DSR signals. These signals cannot be set or read under program control.

A.4 USB interface

USB2 and USB3 provide USB host interfaces and connect through the type A connector J7. USB1 provides an OTG interface and connects through the OTG connector J6.

———— Note ————

For a full description of the USB signals refer to the datasheet for the TransDimension OTG243.

Figure A-5 shows the USB connectors.

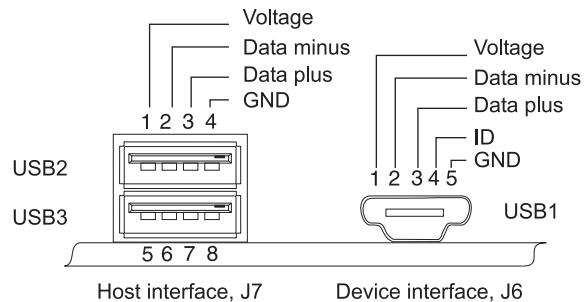


Figure A-5 USB interfaces

A.5 Audio CODEC interface

The PB926EJ-S provides three jack connectors that enable you to connect to the microphone and auxiliary inputs, and line level output on the CODEC. Figure A-6 shows the pinouts of the sockets.

— Note —

A link on the board enables bias voltage to be applied to the microphone (see *Advanced Audio Codec Interface, AACI* on page 3-56).

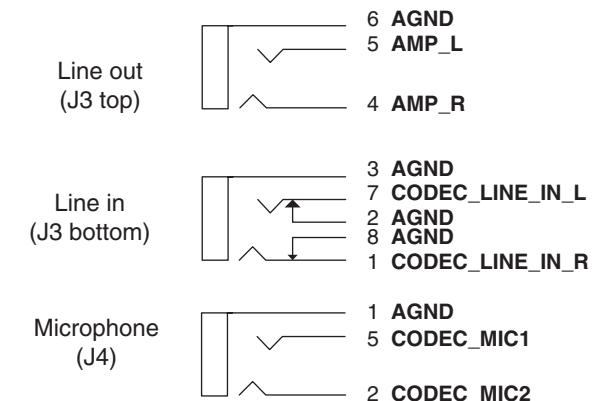


Figure A-6 Audio connectors

A.6 MMC and SD flash card interface

The MMC/SD card sockets provides nine pins that connect to the card when it is inserted into the socket. Figure A-7 shows the pin numbering and signal assignment. In addition, the socket contains switches that are operated by card insertion and provide signaling on the **CARDINx** and **MCI_WPROT** signals.

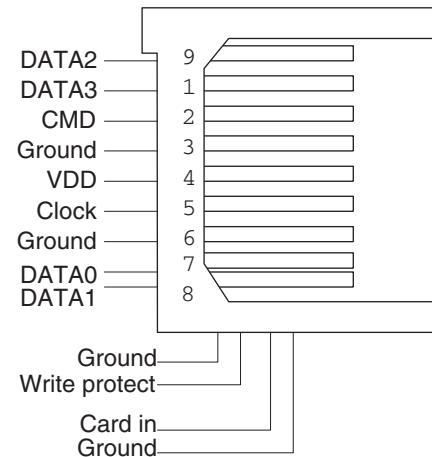


Figure A-7 MMC/SD card socket pin numbering

The MMC card uses seven pins, and the SD card uses all nine pins. The additional pins are located as shown in Figure A-7 with pin 9 next to pin 1 and pins 7 and 8 spaced more closely together than the other pins. Figure A-8 shows an MCI card, with the contacts face up.

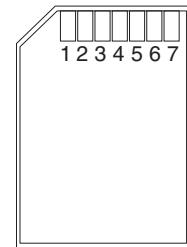


Figure A-8 MMC card

Table A-5 lists the signal assignments.

Table A-5 Multimedia Card interface signals

Pin	Signal	Function SD widebus mode	Function MCI
1	MCIxDATA3	Data	Chip select
2	MCIxCMD	Command/response	Data in
3	GND	Ground	Ground
4	MCIVDDx	Supply voltage	Supply voltage
5	MCICLKx	Clock	Clock
6	GND	Ground	Ground
7	MCIxDATA0	Data 0	Data out
8	MCIxDATA1	Data 1	NC
9	MCIxDATA2	Data 2	NC
10 (DET A)	CARDINx	Card insertion detect	Card insertion detect
11 (DET B)	WPROTx	Write protect status	Write protect status

There are two MMC connectors.

- MMC 0 is J21 on the top side of the board (replace **x** with **0** in Table A-5).
- MMC 1 is J22 on the bottom side (replace **x** with **1** in Table A-5).

Insert and remove the card as follows:

Insertion For the connector on the top of the board, insert the card into the socket with the contacts face down. For the connector on the bottom of the board, insert the card into the socket with the contacts face up as viewed from the top of the board. Cards are normally labeled on the top surface with an arrow to indicate correct insertion.

Removal Remove the card by gently pressing it into the socket. It springs back and can be removed. Removing the card in this way ensures that the card detection switches within the socket operate correctly.

A.7 CLCD display interface

The CLCD interface adaptor board connector (J18) is shown in Figure A-9 on page A-12. The connector signals are listed in Table A-6. See Appendix C *CLCD Display and Adaptor Board* for details on the CLCD adaptor board. See *CLCDC interface* on page 3-61 for details on CLCD signals.

Table A-6 CLCD Interface board connector J18

Pin	Signal	Pin	Signal
1	B0	35	B1
2	B2	36	B3
3	B4	37	B5
4	B6	38	B7
5	G0	39	G1
6	G2	40	G3
7	G4	41	G5
8	G6	42	G7
9	R0	43	R1
10	R2	44	R3
11	R4	45	R5
12	R6	46	R7
13	CLLE	47	GND
14	CLAC	48	GND
15	CLCP	49	GND
16	CLLP	50	GND
17	CLFP	51	GND
18	TSnKPADIRQ	52	GND
19	TSnPENIRQ	53	GND
20	TSnDAV	54	LCDID0
21	TSSCLK	55	LCDID1

Table A-6 CLCD Interface board connector J18 (continued)

Pin	Signal	Pin	Signal
22	TSnSS	56	LCDID2
23	TSMISO	57	LCDID3
24	TSMOSI	58	LCDID4
25	LCDXWR	59	GND
26	LCDSD0	60	GND
27	LCDXRD	61	GND
28	LCDXCS	62	3V3
29	LCDDATnCOM	63	3V3
30	LCDSD0OUTnIN	64	5V
31	CLPOWER	65	5V
32	nLCDIOON	66	VLCD
33	PWR3V5VSWITCH	67	VLCD
34	VDDPOSSWITCH	68	VDDNEGSWITCH

Note

The **R[7:0]**, **G[7:0]**, and **B[7:0]** signals are digital CLCD signals. The digital signals must be converted by the PLC and DAC to produce the **R**, **G**, and **B** analog signals used on the VGA connector.

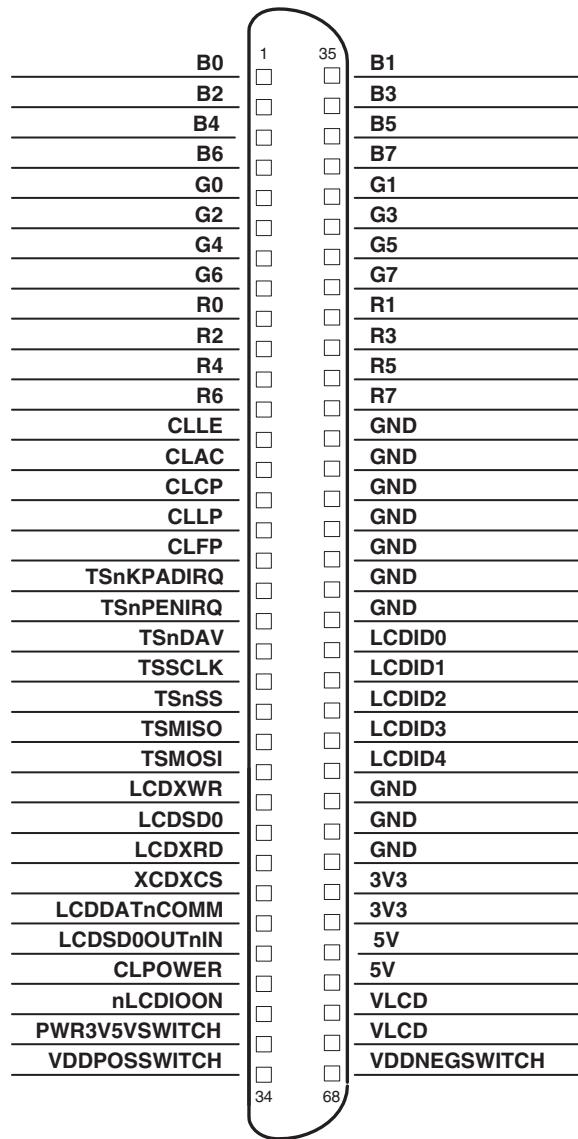


Figure A-9 CLCD Interface connector J18

A.8 VGA display interface

The VGA connector (J19) is shown in Figure A-10. The connector signals are listed in Table A-7. A Digital to Analog Converter (DAC) converts the digital CLCD data and synchronization signals into the analogue VGA signals.

Table A-7 VGA connector signals

Pin	Description
1	RED
2	GREEN
3	BLUE
4	NC
5	GND
6	GND
7	GND
8	GND
9	NC
10	GND
11	NC
12	NC
13	HSYNC
14	VSYNC
15	NC

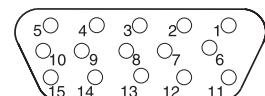


Figure A-10 VGA connector J19

A.9 GPIO interface

Four eight-bit *General Purpose Input/Output* (GPIO) controllers are incorporated into the ARM926EJ-S PXP Development Chip. The signals on the GPIO connector are shown in Figure A-11.

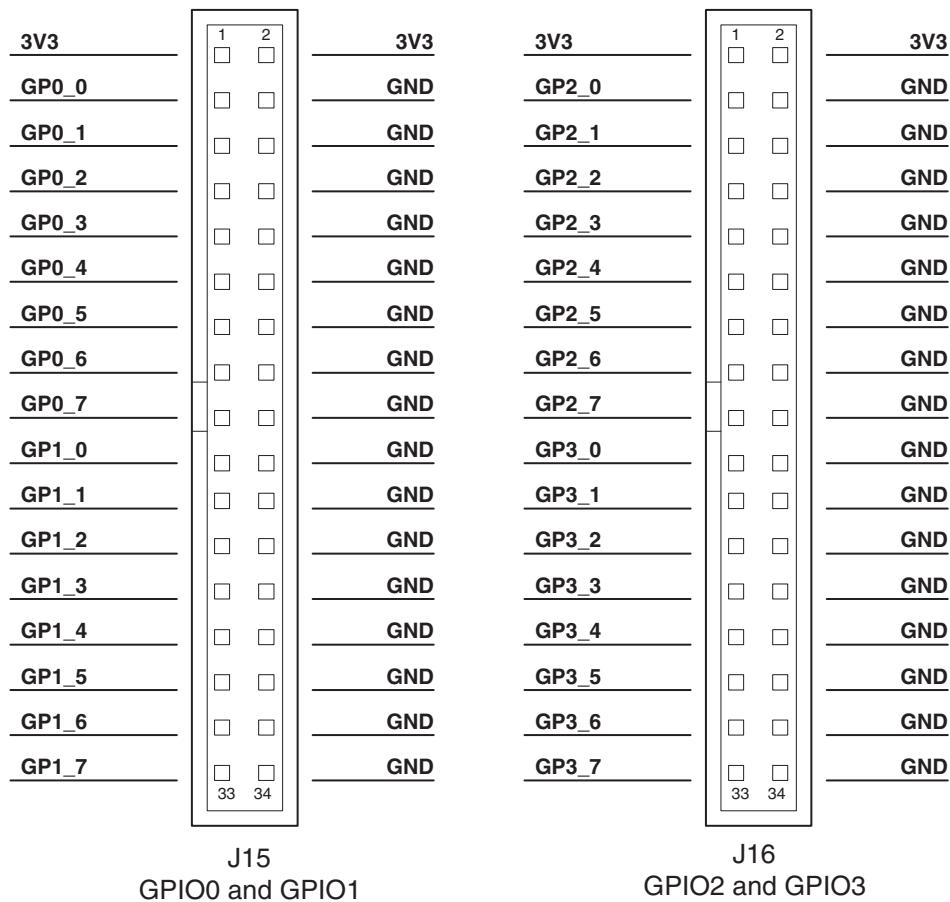


Figure A-11 GPIO connector

Note

Each data pin has an on-board $10\text{K}\Omega$ pullup resistor to 3.3V.

A.10 Keyboard and mouse interface

The pinout of the KMI connectors J23 and J24 is shown in Figure A-12.

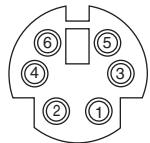


Figure A-12 KMI connector

Table A-8 shows signals on the KMI connectors.

Table A-8 Mouse and keyboard port signal descriptions

Pin	Keyboard (KMI0, J24)		Mouse (KMI1, J23)	
	Signal	Function	Signal	Function
1	KDATA	Keyboard data	MDATA	Mouse Data
2	NC	Not connected	NC	Not connected
3	GND	Ground	GND	Ground
4	5V	5V	5V	5V
5	KCLK	Keyboard clock	MCLK	Mouse clock
6	NC	Not connected	NC	Not connected

A.11 Ethernet interface

The RJ45 Ethernet connector J5 is shown in Figure A-13.

LEDA (green) and LEDB (yellow) are connected to the LAN91C111 controller. The function of the LEDs is determined by registers in the controller. Typical usage would be to monitor transmit activity and packet detection.

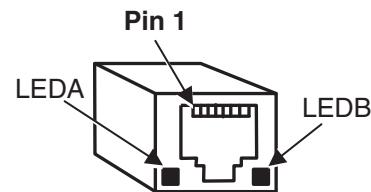


Figure A-13 Ethernet connector J5

The signals on the Ethernet cable are shown in Table A-9.

Table A-9 Ethernet signals

Pin	Signal
1	Transmit +
2	Transmit -
3	Receive +
4	NC
5	NC
6	Receive -
7	NC
8	NC

A.12 RealView Logic Tile header connectors

Figure A-14 shows the pin numbers and power-blade usage of the HDRX, HDRY, and HDRZ headers on the PB926EJ-S.

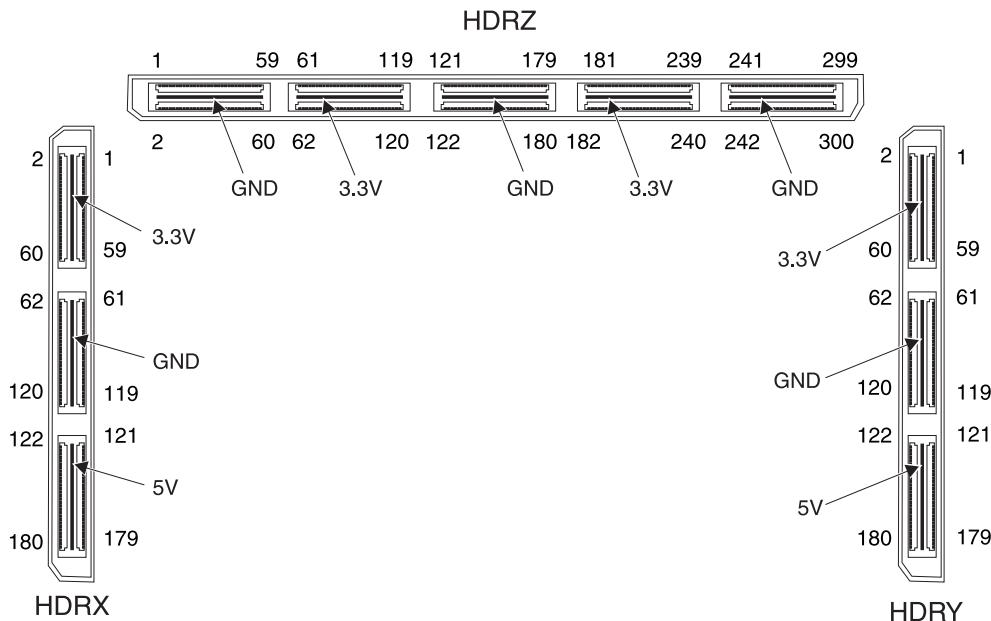


Figure A-14 HDRX, HDRY, and HDRZ (upper) pin numbering

Caution

The I/O voltage on some pins of RealView Logic Tiles can be programmed by changing resistors on the tile. Signals between RealView Logic Tiles can be altered safely if both the sending and receiving tile use the same voltage.

However, all signals from the tile mounted on the expansion headers and the PB926EJ-S must use 3.3V I/O levels.

All signals from the PB926EJ-S to the tile use 3.3V I/O levels. The 5V supply on the headers is to power voltage converters that might be present on the expansion tile.

HDRX (J9) signals on page A-18, *HDRY (J12) signals* on page A-22, and *HDRZ (J8) signals* on page A-26 list the signals on each header pin. See Appendix F *RealView Logic Tile* and the *ARM LT-XC2V4000+ RealView Logic Tile User Guide* for more information on RealView Logic Tile signals.

A.12.1 HDRX signals

Table A-10 describes the signals on the HDRX (J9) pins.

— Note —

The tile signal names refer to the signal present on the upper side of a RealView Logic Tile. That is, the headers on the PB926EJ-S correspond to the upper headers of a tile. The naming convention simplifies designs that might mount on top of either the PB926EJ-S or a RealView Logic Tile.

Table A-10 HDRX (J9) signals

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
AHBMONITOR29	XU89	2	1	XU90	AHBMONITOR30
AHBMONITOR28	XU88	4	3	XU91	AHBMONITOR31
AHBMONITOR27	XU87	6	5	XU92	AHBMONITOR32
AHBMONITOR26	XU86	8	7	XU93	AHBMONCLK1
AHBMONITOR25	XU85	10	9	XU94	NC
AHBMONITOR24	XU84	12	11	XU95	NC
AHBMONITOR23	XU83	14	13	XU96	HADDRM2_0
AHBMONITOR22	XU82	16	15	XU97	HADDRM2_1
AHBMONITOR21	XU81	18	17	XU98	HADDRM2_2
AHBMONITOR20	XU80	20	19	XU99	HADDRM2_3
AHBMONITOR19	XU79	22	21	XU100	HADDRM2_4
AHBMONITOR18	XU78	24	23	XU101	HADDRM2_5
AHBMONITOR17	XU77	26	25	XU102	HADDRM2_6
AHBMONITOR16	XU76	28	27	XU103	HADDRM2_7
AHBMONITOR15	XU75	30	29	XU104	HADDRM2_8
AHBMONITOR14	XU74	32	31	XU105	HADDRM2_9
AHBMONITOR13	XU73	34	33	XU106	HADDRM2_10

Table A-10 HDRX (J9) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
AHBMONITOR12	XU72	36	35	XU107	HADDRM2_11
AHBMONITOR11	XU71	38	37	XU108	HADDRM2_12
AHBMONITOR10	XU70	40	39	XU109	HADDRM2_13
AHBMONITOR9	XU69	42	41	XU110	HADDRM2_14
AHBMONITOR8	XU68	44	43	XU111	HADDRM2_15
AHBMONITOR7	XU67	46	45	XU112	HADDRM2_16
AHBMONITOR6	XU66	48	47	XU113	HADDRM2_17
AHBMONITOR5	XU65	50	49	XU114	HADDRM2_18
AHBMONITOR4	XU64	52	51	XU115	HADDRM2_19
AHBMONITOR3	XU63	54	53	XU116	HADDRM2_20
AHBMONITOR2	XU62	56	55	XU117	HADDRM2_21
AHBMONITOR1	XU61	58	57	XU118	HADDRM2_22
AHBMONITOR0	XU60	60	59	XU119	HADDRM2_23
NC	XU59	62	61	XU120	HADDRM2_24
ETMEXTOUT0	XU58	64	63	XU121	HADDRM2_25
ETMEXTOUT1	XU57	66	65	XU122	HADDRM2_26
ETMEXTOUT2	XU56	68	67	XU123	HADDRM2_27
ETMEXTOUT3	XU55	70	69	XU124	HADDRM2_28
ETMEXTIN	XU54	72	71	XU125	HADDRM2_29
HRESPM2_1	XU53	74	73	XU126	HADDRM2_30
HRESPM2_0	XU52	76	75	XU127	HADDRM2_31
HGRANTM2	XU51	78	77	XU128	HCLKM1DRV12F
HREADYM2	XU50	80	79	XU129	HCLKM2DRV12F
HLOCKM2	XU49	82	81	XU130	HCLKSDRV12F

Table A-10 HDRX (J9) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
HBUSREQM2	XU48	84	83	XU131	HCLKM1DRV12S
HWRITEM2	XU47	86	85	XU132	HCLKM2DRV12S
HBURSTM2_2	XU46	88	87	XU133	HCLKSDRV12S
HBURSTM2_1	XU45	90	89	XU134	F2LSPARE0
HBURSTM2_0	XU44	92	91	XU135	F2LSPARE1
HPROTM2_3	XU43	94	93	XU136	F2LSPARE2
HPROTM2_2	XU42	96	95	XU137	F2LSPARE3
HPROTM2_1	XU41	98	97	XU138	NC
HPROTM2_0	XU40	100	99	XU139	NC
HSIZEM2_1	XU39	102	101	XU140	NC
HSIZEM2_0	XU38	104	103	XU141	NC
HTRANSM2_1	XU37	106	105	XU142	NC
HTRANSM2_0	XU36	108	107	XU143	NC
NC	XU35	110	109	XU144	SMWAIT
NC	XU34	112	111	XU145	SMCANCELWAIT
NC	XU33	114	113	XU146	NSMBURSTWAIT
NC	XU32	116	115	XU147	NC
GP3_7	XU31	118	117	XU148	HDATA12_0
GP3_6	XU30	120	119	XU149	HDATA12_1
GP3_5	XU29	122	121	XU150	HDATA12_2
GP3_4	XU28	124	123	XU151	HDATA12_3
GP3_3	XU27	126	125	XU152	HDATA12_4
GP3_2	XU26	128	127	XU153	HDATA12_5
GP3_1	XU25	130	129	XU154	HDATA12_6

Table A-10 HDRX (J9) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
GP3_0	XU24	132	131	XU155	HDATA M2_7
GP2_7	XU23	134	133	XU156	HDATA M2_8
GP2_6	XU22	136	135	XU157	HDATA M2_9
GP2_5	XU21	138	137	XU158	HDATA M2_10
GP2_4	XU20	140	139	XU159	HDATA M2_11
GP2_3	XU19	142	141	XU160	HDATA M2_12
GP2_2	XU18	144	143	XU161	HDATA M2_13
GP2_1	XU17	146	145	XU162	HDATA M2_14
GP2_0	XU16	148	147	XU163	HDATA M2_15
GP1_7	XU15	150	149	XU164	HDATA M2_16
GP1_6	XU14	152	151	XU165	HDATA M2_17
GP1_5	XU13	154	153	XU166	HDATA M2_18
GP1_4	XU12	156	155	XU167	HDATA M2_19
GP1_3	XU11	158	157	XU168	HDATA M2_20
GP1_2	XU10	160	159	XU169	HDATA M2_21
GP1_1	XU9	162	161	XU170	HDATA M2_22
GP1_0	XU8	164	163	XU171	HDATA M2_23
GP0_7	XU7	166	165	XU172	HDATA M2_24
GP0_6	XU6	168	167	XU173	HDATA M2_25
GP0_5	XU5	170	169	XU174	HDATA M2_26
GP0_4	XU4	172	171	XU175	HDATA M2_27
GP0_3	XU3	174	173	XU176	HDATA M2_28

Table A-10 HDRX (J9) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
GP0_2	XU2	176	175	XU177	HDATA M2_29
GP0_1	XU1	178	177	XU178	HDATA M2_30
GP0_0	XU0	180	179	XU179	HDATA M2_31

A.12.2 HDRY signals

Table A-11 describes the signals on the HDRY (J12) pins. The tile signal names refer to the signal present on the upper side of a RealView Logic Tile.

Table A-11 HDRY (J12) signals

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
SCIVCCEN0	YU90	2	1	YU89	SCICLKOUT0
nSCICARDRST0	YU91	4	3	YU88	SCIDATAOUTOD0
nSCICLKEN0	YU92	6	5	YU87	SCIFCB0
nSCIDATAEN0	YU93	8	7	YU86	SCIDECTECT0
nSCIDATAOUTEN0	YU94	10	9	YU85	SCICLKIN0
NC	YU95	12	11	YU84	SCIDATAIN0
HADDRS0	YU96	14	13	YU83	NUART0CTS
HADDRS1	YU97	16	15	YU82	UART0RXD
HADDRS2	YU98	18	17	YU81	nUART0DCD
HADDRS3	YU99	20	19	YU80	nUART0DSR
HADDRS4	YU100	22	21	YU79	nUART0RI
HADDRS5	YU101	24	23	YU78	nUART0DTR
HADDRS6	YU102	26	25	YU77	nUART0OUT1
HADDRS7	YU103	28	27	YU76	nUART0OUT2
HADDRS8	YU104	30	29	YU75	nUART0RTS

Table A-11 HDRY (J12) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
HADDRS9	YU105	32	31	YU74	UART0TXD
HADDRS10	YU106	34	33	YU73	SIRIN0
HADDRS11	YU107	36	35	YU72	nSIROUT0
HADDRS12	YU108	38	37	YU71	nUART1CTS
HADDRS13	YU109	40	39	YU70	UART1RXD
HADDRS14	YU110	42	41	YU69	nUART1RTS
HADDRS15	YU111	44	43	YU68	UART1TXD
HADDRS16	YU112	46	45	YU67	nUART2CTS
HADDRS17	YU113	48	47	YU66	UART2RXD
HADDRS18	YU114	50	49	YU65	nUART2RTS
HADDRS19	YU115	52	51	YU64	UART2TXD
HADDRS20	YU116	54	53	YU63	nDRVINEN0
HADDRS21	YU117	56	55	YU62	nDRVINEN1
HADDRS22	YU118	58	57	YU61	NC
HADDRS23	YU119	60	59	YU60	NC
HADDRS24	YU120	62	61	YU59	NC
HADDRS25	YU121	64	63	YU58	NC
HADDRS26	YU122	66	65	YU57	NC
HADDRS27	YU123	68	67	YU56	NC
HADDRS28	YU124	70	69	YU55	NC
HADDRS29	YU125	72	71	YU54	NC
HADDRS30	YU126	74	73	YU53	NC
HADDRS31	YU127	76	75	YU52	HWRITES
SSPCLKIN	YU128	78	77	YU51	HRESPS1

Table A-11 HDRY (J12) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
SSPFSSIN	YU129	80	79	YU50	HRESPS0
SSPRXD	YU130	82	81	YU49	HREADYS
SSPCLKOUT	YU131	84	83	YU48	HMASTLOCKS
SSPFSSOUT	YU132	86	85	YU47	HSELS
SSPTXD	YU133	88	87	YU46	HBURSTS2
nSSPCTLOE	YU134	90	89	YU45	HBURSTS1
nSSPOE	YU135	92	91	YU44	HBURSTS0
LT_CLCD_SPARE0	YU136	94	93	YU43	HPROTS3
LT_CLCD_SPARE1	YU137	96	95	YU42	HPROTS2
LT_CLCD_SPARE2	YU138	98	97	YU41	HPROTS1
LT_CLCD_SPARE3	YU139	100	99	YU40	HPROTS0
NC	YU140	102	101	YU39	HSIZES1
LCDMODE0	YU141	104	103	YU38	HSIZES0
LCDMODE1	YU142	106	105	YU37	HTRANSS1
NC	YU143	108	107	YU36	HTRANSS0
LTHBUSREQ	YU144	110	109	YU35	NC
LTHGRANT	YU145	112	111	YU34	NC
LTHLOCK	YU146	114	113	YU33	NC
NC	YU147	116	115	YU32	NC
HDATAS0	YU148	118	117	YU31	NC
HDATAS1	YU149	120	119	YU30	NC
HDATAS2	YU150	122	121	YU29	NC
HDATAS3	YU151	124	123	YU28	LT_CLAC
HDATAS4	YU152	126	125	YU27	LT_CLFP

Table A-11 HDRY (J12) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
HDATA5	YU153	128	127	YU26	LT_CLCP
HDATA6	YU154	130	129	YU25	LT_CLLE
HDATA7	YU155	132	131	YU24	LT_CLLP
HDATA8	YU156	134	133	YU23	LT_CLCD_B7
HDATA9	YU157	136	135	YU22	LT_CLCD_B6
HDATA10	YU158	138	137	YU21	LT_CLCD_B5
HDATA11	YU159	140	139	YU20	LT_CLCD_B4
HDATA12	YU160	142	141	YU19	LT_CLCD_B3
HDATA13	YU161	144	143	YU18	LT_CLCD_B2
HDATA14	YU162	146	145	YU17	LT_CLCD_B1
HDATA15	YU163	148	147	YU16	LT_CLCD_B0
HDATA16	YU164	150	149	YU15	LT_CLCD_G7
HDATA17	YU165	152	151	YU14	LT_CLCD_G6
HDATA18	YU166	154	153	YU13	LT_CLCD_G5
HDATA19	YU167	156	155	YU12	LT_CLCD_G4
HDATA20	YU168	158	157	YU11	LT_CLCD_G3
HDATA21	YU169	160	159	YU10	LT_CLCD_G2
HDATA22	YU170	162	161	YU9	LT_CLCD_G1
HDATA23	YU171	164	163	YU8	LT_CLCD_G0
HDATA24	YU172	166	165	YU7	LT_CLCD_R7
HDATA25	YU173	168	167	YU6	LT_CLCD_R6
HDATA26	YU174	170	169	YU5	LT_CLCD_R5
HDATA27	YU175	172	171	YU4	LT_CLCD_R4
HDATA28	YU176	174	173	YU3	LT_CLCD_R3

Table A-11 HDRY (J12) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
HDATA29	YU177	176	175	YU2	LT_CLCD_R2
HDATA30	YU178	178	177	YU1	LT_CLCD_R1
HDATA31	YU179	180	179	YU0	LT_CLCD_R0

A.12.3 HDRZ

The tile signal names refer to the signal present on the upper side of a RealView Logic Tile. The HDRZ plug and socket have slightly different pinouts.

Table A-12 describes the signals on the HDRZ (J8) pins.

Table A-12 HDRZ (J8) signals

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
NC	ZU255	2	1	ZU128	EXP_SMADDR0
NC	ZU254	4	3	ZU129	EXP_SMADDR1
NC	ZU253	6	5	ZU130	EXP_SMADDR2
NC	ZU252	8	7	ZU131	EXP_SMADDR3
NC	ZU251	10	9	ZU132	EXP_SMADDR4
NC	ZU250	12	11	ZU133	EXP_SMADDR5
NC	ZU249	14	13	ZU134	EXP_SMADDR6
NC	ZU248	16	15	ZU135	EXP_SMADDR7
NC	ZU247	18	17	ZU136	EXP_SMADDR8
NC	ZU246	20	19	ZU137	EXP_SMADDR9
NC	ZU245	22	21	ZU138	EXP_SMADDR10
NC	ZU244	24	23	ZU139	EXP_SMADDR11
NC	ZU243	26	25	ZU140	EXP_SMADDR12
NC	ZU242	28	27	ZU141	EXP_SMADDR13
NC	ZU241	30	29	ZU142	EXP_SMADDR14

Table A-12 HDRZ (J8) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
NC	ZU240	32	31	ZU143	EXP_SMADDR15
NC	ZU239	34	33	ZU144	EXP_SMADDR16
NC	ZU238	36	35	ZU145	EXP_SMADDR17
NC	ZU237	38	37	ZU146	EXP_SMADDR18
NC	ZU236	40	39	ZU147	EXP_SMADDR19
NC	ZU235	42	41	ZU148	EXP_SMADDR20
NC	ZU234	44	43	ZU149	EXP_SMADDR21
NC	ZU233	46	45	ZU150	EXP_SMADDR22
NC	ZU232	48	47	ZU151	EXP_SMADDR23
NC	ZU231	50	49	ZU152	EXP_SMADDR24
TEST10	ZU230	52	51	ZU153	EXP_SMADDR25
TEST9	ZU229	54	53	ZU154	EXP_SMADDRVALID
TEST8	ZU228	56	55	ZU155	EXP_SMBAA
TEST7	ZU227	58	57	ZU156	EXP_nSTATICCS0
TEST6	ZU226	60	59	ZU157	EXP_nSTATICCS1
TEST5	ZU225	62	61	ZU158	EXP_nSTATICCS2
TEST4	ZU224	64	63	ZU159	EXP_nSTATICCS3
TEST3	ZU223	66	65	ZU160	EXP_nSTATICCS4
TEST2	ZU222	68	67	ZU161	EXP_nSTATICCS5
TEST1	ZU221	70	69	ZU162	EXP_nSTATICCS6
TEST0	ZU220	72	71	ZU163	EXP_nSTATICCS7
EDBGRQ	ZU219	74	73	ZU164	EXP_nSMBLS0
DBGACK	ZU218	76	75	ZU165	EXP_nSMBLS1
HCLKM2RESF2L	ZU217	78	77	ZU166	EXP_nSMBLS2
VICINTSOURCE31	ZU216	80	79	ZU167	EXP_nSMBLS3

Table A-12 HDRZ (J8) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
VICINTSOURCE30	ZU215	82	81	ZU168	EXP_nEXPCS
VICINTSOURCE29	ZU214	84	83	ZU169	DMACBREQ0
VICINTSOURCE28	ZU213	86	85	ZU170	DMACBREQ1
VICINTSOURCE27	ZU212	88	87	ZU171	DMACBREQ2
VICINTSOURCE26	ZU211	90	89	ZU172	DMACBREQ3
VICINTSOURCE25	ZU210	92	91	ZU173	DMACBREQ4
VICINTSOURCE24	ZU209	94	93	ZU174	DMACBREQ5
VICINTSOURCE23	ZU208	96	95	ZU175	DMACLBREQ0
VICINTSOURCE22	ZU207	98	97	ZU176	DMACLBREQ1
VICINTSOURCE21	ZU206	100	99	ZU177	DMACLBREQ2
PWRFAIL	ZU205	102	101	ZU178	DMACLBREQ3
DMACTC5	ZU204	104	103	ZU179	DMACLBREQ4
DMACTC4	ZU203	106	105	ZU180	DMACLBREQ5
DMACTC3	ZU202	108	107	ZU181	DMACLSREQ0
DMACTC2	ZU201	110	109	ZU184	DMACLSREQ1
DMACTC1	ZU200	112	111	ZU182	DMACLSREQ2
DMACTC0	ZU199	114	113	ZU183	DMACLSREQ3
DMACCLR5	ZU198	116	115	ZU185	DMACLSREQ4
DMACCLR4	ZU197	118	117	ZU186	DMACLSREQ5
DMACCLR3	ZU196	120	119	ZU187	DMACSREQ0
DMACCLR2	ZU195	122	121	ZU188	DMACSREQ1
DMACCLR1	ZU194	124	123	ZU189	DMACSREQ2
DMACCLR0	ZU193	126	125	ZU190	DMACSREQ3
DMACSREQ5	ZU192	128	127	ZU191	DMACSREQ4
NC	CLK_POS_DN_IN	130	129	D_nSRST	nSRST

Table A-12 HDRZ (J8) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
NC	CLK_NEG_DN_IN	132	131	D_nTRST	nTRST
HCLKM1RESF2L	CLK_POS_UP_OUT	134	133	D_TDO_IN	D_TDO_OUT
HCLKSRESF2L	CLK_NEG_UP_OUT	136	135	D_TDI	TDI
NC	CLK_UP_THRU	138	137	D_TCK_OUT	D_TCK_IN
LT_SMCLK0	CLK_OUT_PLUS1	140	139	D_TMS_OUT	D_TMS_IN
LT_SMCLK1	CLK_OUT_PLUS2	142	141	D_RTCK	SDC_TCK
NC	CLK_IN_PLUS2	144	143	C_nSRST	nSRST
NC	CLK_IN_PLUS1	146	145	C_nTRST	FPGA_NPROG
NC	CLK_DN_THRU	148	147	C_TDO_IN	FPGA_TDI
GLOBALCLK	CLK_GLOBAL	150	149	C_TDI	C_TDI
BOOTCSSEL7	FPGA_IMAGE	152	151	C_TCK_OUT	C_TCK_IN
nSYSPOR	nSYSPOR	154	153	C_TMS_OUT	C_TMS_IN
nSYSRST	nSYSRST	156	155	nTILE_DET	nTILE_DET
nRTCKEN	nRTCKEN	158	157	nCFGGEN	NC
NC	SPARE12 (reserved)	160	159	GLOBAL_DONE	GLOBAL_DONE
NC	SPARE10 (reserved)	162	161	SPARE11 (reserved)	NC
NC	SPARE8 (reserved)	164	163	SPARE9 (reserved)	NC
NC	SPARE6 (reserved)	166	165	SPARE7 (reserved)	NC
NC	SPARE4 (reserved)	168	167	SPARE5 (reserved)	NC
NC	SPARE2 (reserved)	170	169	SPARE3 (reserved)	NC
NC	SPARE0 (reserved)	172	171	SPARE1 (reserved)	NC
EXP_SMDATAS0	Z64	174	173	Z63	EXP_nSMOEN

Table A-12 HDRZ (J8) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
EXP_SMDATAS1	Z65	176	175	Z62	EXP_nSMWEN
EXP_SMDATAS2	Z66	178	177	Z61	NC
EXP_SMDATAS3	Z67	180	179	Z60	NC
EXP_SMDATAS4	Z68	182	181	Z59	NC
EXP_SMDATAS5	Z69	184	183	Z58	NC
EXP_SMDATAS6	Z70	186	185	Z57	NC
EXP_SMDATAS7	Z71	188	187	Z56	NC
EXP_SMDATAS8	Z72	190	189	Z55	NC
EXP_SMDATAS9	Z73	192	191	Z54	NC
EXP_SMDATAS10	Z74	194	193	Z53	NC
EXP_SMDATAS11	Z75	196	195	Z52	NC
EXP_SMDATAS12	Z76	198	197	Z51	NC
EXP_SMDATAS13	Z77	200	199	Z50	F2LSPARE4
EXP_SMDATAS14	Z78	202	201	Z49	HBUSREQM1
EXP_SMDATAS15	Z79	204	203	Z48	HGRANTM1
EXP_SMDATAS16	Z80	206	205	Z47	HLOCKM1
EXP_SMDATAS17	Z81	208	207	Z46	HRESPM1_1
EXP_SMDATAS18	Z82	210	209	Z45	HRESPM1_0
EXP_SMDATAS19	Z83	212	211	Z44	HREADYM1
EXP_SMDATAS20	Z84	214	213	Z43	HWRITEM1
EXP_SMDATAS21	Z85	216	215	Z42	HPROTM1_2
EXP_SMDATAS22	Z86	218	217	Z41	HPROTM1_1
EXP_SMDATAS23	Z87	220	219	Z40	HPROTM1_0
EXP_SMDATAS24	Z88	222	221	Z39	HBURSTM1_2
EXP_SMDATAS25	Z89	224	223	Z38	HBURSTM1_1

Table A-12 HDRZ (J8) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
EXP_SMDATAS26	Z90	226	225	Z37	HBURSTM1_0
EXP_SMDATAS27	Z91	228	227	Z36	HPROTM1_3
EXP_SMDATAS28	Z92	230	229	Z35	HSIZEM1_1
EXP_SMDATAS29	Z93	232	231	Z34	HSIZEM1_0
EXP_SMDATAS30	Z94	234	233	Z33	HTRANSM1_1
EXP_SMDATAS31	Z95	236	235	Z32	HTRANSM1_0
HADDRM1_0	Z96	238	237	Z31	HDATAM1_31
HADDRM1_1	Z97	240	239	Z30	HDATAM1_30
HADDRM1_2	Z98	242	241	Z29	HDATAM1_29
HADDRM1_3	Z99	244	243	Z28	HDATAM1_28
HADDRM1_4	Z100	246	245	Z27	HDATAM1_27
HADDRM1_5	Z101	248	247	Z26	HDATAM1_26
HADDRM1_6	Z102	250	249	Z25	HDATAM1_25
HADDRM1_7	Z103	252	251	Z24	HDATAM1_24
HADDRM1_8	Z104	254	253	Z23	HDATAM1_23
HADDRM1_9	Z105	256	255	Z22	HDATAM1_22
HADDRM1_10	Z106	258	257	Z21	HDATAM1_21
HADDRM1_11	Z107	260	259	Z20	HDATAM1_20
HADDRM1_12	Z108	262	261	Z19	HDATAM1_19
HADDRM1_13	Z109	264	263	Z18	HDATAM1_18
HADDRM1_14	Z110	266	265	Z17	HDATAM1_17
HADDRM1_15	Z111	268	267	Z16	HDATAM1_16
HADDRM1_16	Z112	270	269	Z15	HDATAM1_15
HADDRM1_17	Z113	272	271	Z14	HDATAM1_14
HADDRM1_18	Z114	274	273	Z13	HDATAM1_13

Table A-12 HDRZ (J8) signals (continued)

Platform signal	Tile signal	Pin	Pin	Tile signal	Platform signal
HADDRM1_19	Z115	276	275	Z12	HDATA1_12
HADDRM1_20	Z116	278	277	Z11	HDATA1_11
HADDRM1_21	Z117	280	279	Z10	HDATA1_10
HADDRM1_22	Z118	282	281	Z9	HDATA1_9
HADDRM1_23	Z119	284	283	Z8	HDATA1_8
HADDRM1_24	Z120	286	285	Z7	HDATA1_7
HADDRM1_25	Z121	288	287	Z6	HDATA1_6
HADDRM1_26	Z122	290	289	Z5	HDATA1_5
HADDRM1_27	Z123	292	291	Z4	HDATA1_4
HADDRM1_28	Z124	294	293	Z3	HDATA1_3
HADDRM1_29	Z125	296	295	Z2	HDATA1_2
HADDRM1_30	Z126	298	297	Z1	HDATA1_1
HADDRM1_31	Z127	300	299	Z0	HDATA1_0

A.13 Test and debug connections

The PB926EJ-S provides test points, ground points, and connectors to aid diagnostics as shown in Figure A-15.

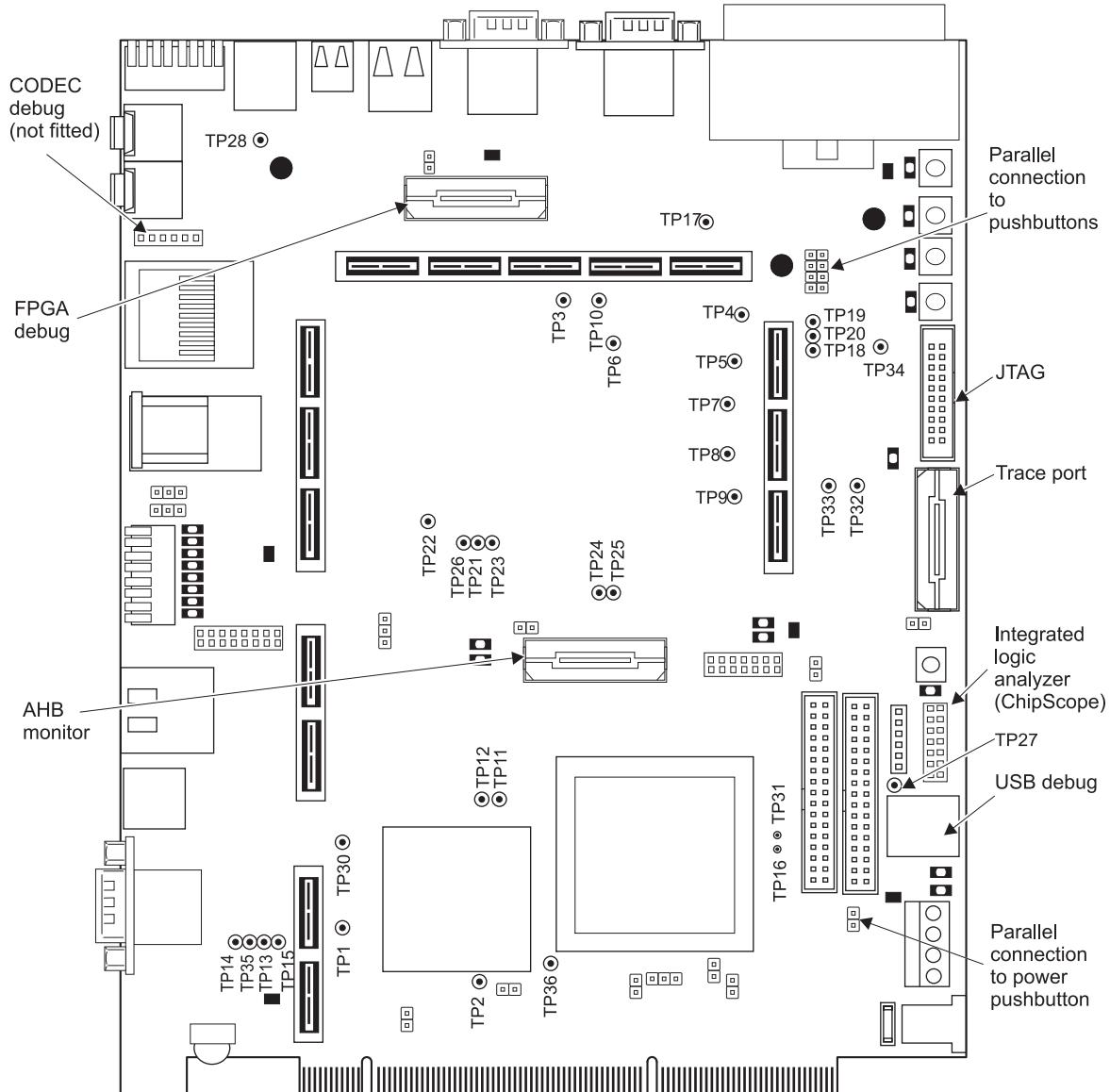


Figure A-15 Test points and debug connectors

This section contains the following subsections:

- *Overview of test points*
- *JTAG* on page A-36
- *USB debug port* on page A-36
- *Trace connector pinout* on page A-37
- *Embedded logic analyzer* on page A-38
- *AHB monitor* on page A-38
- *FPGA debug connector pinout* on page A-40.

A.13.1 Overview of test points

The functions of the test points on the PB926EJ-S are summarized in Table A-13. For information about setting the frequency of the core clock and auxiliary clock see *Clock architecture* on page 3-35.

Table A-13 Test point functions

Test point	Signal	Function
TP1	VBATT	1.5V backup battery voltage for RTC
TP2	REFCLK32K	Output from the 32kHz oscillator module
TP3	XTALCLK	Buffered GLOBALCLK
TP4	OSCCLK0	Output from programmable oscillator 0
TP5	OSCCLK1	Output from programmable oscillator 4
TP6	GLOBALCLK	Global clock (the default source is XTALCLKDRV from the FPGA)
TP7	OSCCLK2	Output from programmable oscillator 2
TP8	OSCCLK3	Output from programmable oscillator 3
TP9	OSCCLK4	Output from programmable oscillator 4
TP10	REFCLK24MHZ	24MHz ICS307 reference
TP11	DXN	XC2V2000 test signal (for manufacturing use only)
TP12	DXP	XC2V2000 test signal (for manufacturing use only)
TP13	5V	5V power supply for ARM926EJ-S PXP Development Chip emulation
TP14	GND	Ground. OV signal

Table A-13 Test point functions (continued)

Test point	Signal	Function
TP15	1V8	1.8 V power supply to ARM926EJ-S PXP Development Chip
TP16	SCIDATAOUTTDD0	SC interface data out 0
TP17	SIRIN0	IrDA in 0 from UART0 in the ARM926EJ-S PXP Development Chip (IrDA interface logic is not provided on the board)
TP18	nSIROUT0	IrDA out 0 from UART0 in the ARM926EJ-S PXP Development Chip (IrDA interface logic is not provided on the board)
TP19	nUART0OUT1	UART 0 output 1
TP20	nUART0OUT2	UART 0 output 2
TP21	INTCLK	Test clock from USB debug logic
TP22	EnRST	Reset test signal (part of USB debug logic)
TP23	REFCLK1	Output from ICS525 programmable oscillator in USB debug logic
TP24	SPARE1	Test output from PLD
TP25	SPARE2	Test output from PLD
TP26	REFCLK	Output from ICS525 programmable oscillator in USB debug logic
TP27	VLCD	Power supply test (nominal 12V to LCD)
TP28	5VANALOG	Power supply test (5V audio)
TP30	nSCIDATAEN1	SC interface enable 1
TP31	nSCIDATAEN0	SC interface enable 0
TP32	SDC_TDI	JTAG test signal
TP33	PLD_TDO	JTAG test signal
TP34	FPGA_TDI	JTAG test signal
TP35	3V3	3.3V power supply ARM926EJ-S PXP Development Chip
TP36	1V5	1.5 V power supply to FPGA

A.13.2 JTAG

Figure A-16 shows the pinout of the JTAG connector J31 and Table 3-25 on page 3-98 provides a description of the JTAG and related signals. All JTAG active HIGH input signals have pull-up resistors (DGBTQ is active LOW and has a pull-down resistor).

Note

The term JTAG equipment refers to any hardware that can drive the JTAG signals to devices in the scan chain. Typically this is RealView ICE or Multi-ICE, although hardware from other suppliers can also be used to debug ARM processors.

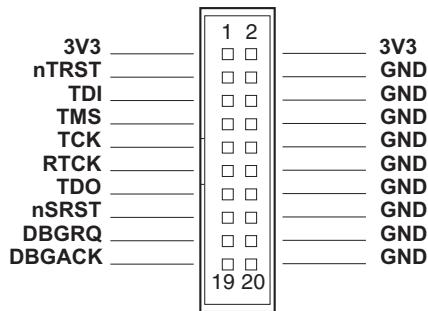


Figure A-16 Multi-ICE JTAG connector J31

A.13.3 USB debug port

Figure A-17 shows the signals on the USB debug connector J30. **USBDP** and **USBDM** are the positive and negative USB data signals.

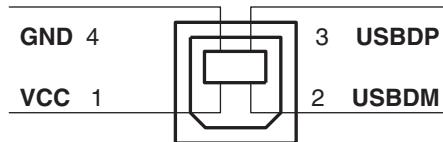


Figure A-17 USB debug connector J30

A.13.4 Trace connector pinout

Table A-14 lists the pinout of the trace connector J14. The Mictor connector is shown in Figure A-19 on page A-38.

Table A-14 Trace connector J14

Channel	Pin	Pin	Channel
Not connected	1	2	Not connected
Not connected	3	4	Not connected
GND	5	6	TRACECLK
DBGRQ	7	8	DBGACK
nSRST	9	10	EXTTRIG
TDO	11	12	3V3
RTCK	13	14	3V3
TCK	15	16	TRACEPKT7
TMS	17	18	TRACEPKT6
TDI	19	20	TRACEPKT5
nTRST	21	22	TRACEPKT4
TRACEPKT15	23	24	TRACEPKT3
TRACEPKT14	25	26	TRACEPKT2
TRACEPKT13	27	28	TRACEPKT1
TRACEPKT12	29	30	TRACEPKT0
TRACEPKT11	31	32	PIPESTAT3
TRACEPKT10	33	34	PIPESTAT2
TRACEPKT9	35	36	PIPESTAT1
TRACEPKT8	37	38	PIPESTAT0

A.13.5 Embedded logic analyzer

Figure A-18 shows the signals on the embedded logic analyzer connector J33. Use an embedded logic analyzer to debug FPGA designs and software at the same time. For more information, see the documentation supplied with your analyzer. (The ChipScope product is described on the Xilinx web site at www.xilinx.com.)

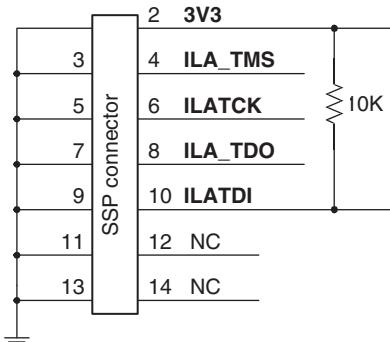


Figure A-18 Embedded logic analyzer connector J33

A.13.6 AHB monitor

An AHB bus monitor, or logic analyzer, can be connected to the AHB monitor port on the PB926EJ-S using a high-density AMP Mictor connector J17. The connector carries 33 signals and 1 clock or qualifier. Figure A-19 shows a connector and the identification of pin 1. Table A-15 on page A-39 lists the pinout of the connector.

— Note —

Agilent (formerly HP) and Tektronix label these connectors differently, but the assignments of signals to physical pins is appropriate for both systems and pin 1 is always in the same place. The figure is labelled according to the Agilent pin assignment.

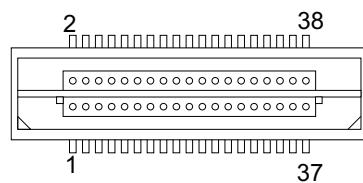


Figure A-19 AMP Mictor connector

Table A-15 AHB monitor connector J17

Channel	Pin	Pin	Channel
Not connected	1	2	Not connected
Not connected	3	4	Not connected
AHBMONITOR32	5	6	AHBMONCLK0
AHBMONITOR31	7	8	AHBMONITOR15
AHBMONITOR30	9	10	AHBMONITOR14
AHBMONITOR29	11	12	AHBMONITOR13
AHBMONITOR28	13	14	AHBMONITOR12
AHBMONITOR27	15	16	AHBMONITOR11
AHBMONITOR26	17	18	AHBMONITOR10
AHBMONITOR25	19	20	AHBMONITOR9
AHBMONITOR24	21	22	AHBMONITOR8
AHBMONITOR23	23	24	AHBMONITOR7
AHBMONITOR22	25	26	AHBMONITOR6
AHBMONITOR21	27	28	AHBMONITOR5
AHBMONITOR20	29	30	AHBMONITOR4
AHBMONITOR19	31	32	AHBMONITOR3
AHBMONITOR18	33	34	AHBMONITOR2
AHBMONITOR17	35	36	AHBMONITOR1
AHBMONITOR16	37	38	AHBMONITOR0

A.13.7 FPGA debug connector pinout

The FPGA debug connector contains address and decode signals that the FPGA generates to communicate with the USB and Ethernet controllers. Table A-16 lists the pinout of the FPGA debug connector. The Mictor connector is shown in Figure A-19 on page A-38.

Table A-16 FPGA debug connector J39

Channel	Pin	Pin	Channel
Not connected	1	2	Not connected
GND	3	4	Not connected
ETHWnR	5	6	ETHnLDEV
ETHnRDYRTN	7	8	ETHARDY
USBnRESET	9	10	ETHnDATAACS
ETHnSRDY	11	12	ETHAEN
USBDACK0	13	14	ETHnADS
USBEOT0	15	16	ETHnCYCLE
ETHA15	17	18	USBnCS
ETHA14	19	20	USBnWR
ETHA13	21	22	USBnRD
ETHA9	23	24	Not connected
USBETHA8	25	26	Not connected
USBETHA7	27	28	Not connected
USBETHA6	29	30	F2LSPARE4
USBETHA5	31	32	F2LSPARE3
USBETHA4	33	34	F2LSPARE2
USBETHA3	35	36	F2LSPARE1
USBETHA2	37	38	F2LSPARE0

Appendix B

Specifications

This appendix contains the specification for the PB926EJ-S. It contains the following sections:

- *Electrical specification* on page B-2
- *Clock rate restrictions* on page B-5
- *Mechanical details* on page B-9.

B.1 Electrical specification

This section provides details of the voltage and current characteristics for the PB926EJ-S.

B.1.1 Bus interface characteristics

Table B-1 shows the PB926EJ-S electrical characteristics.

Table B-1 PB926EJ-S electrical characteristics

Symbol	Description	Min	Max	Unit
DC IN	DC input voltage	9	15	V
12V	Supply voltage from terminal or PCI	11.4	12.6	V
3V3	Supply voltage (interface signals)	3.1	3.5	V
5V	Supply voltage	4.75	5.25	V
V _{IH}	High-level input voltage	2.0	3.6	V
V _{IL}	Low-level input voltage	0	0.8	V
V _{OH}	High-level output voltage	2.4	-	V
V _{OL}	Low-level output voltage	-	0.4	V
C _{IN}	Capacitance on any input pin	-	20	pF

B.1.2 Current requirements

This section lists the current requirements of the PB926EJ-S.

Powered from DC IN

Table B-2 shows the current requirements at room temperature and nominal voltage powered from the DC IN connector. These measurements include the current drawn by Multi-ICE, approximately 160mA at 3.3V.

Table B-2 Current requirements from DC IN (12V)

System	DC IN typical	DC IN max
Standalone	0.7A	3A
With RealView Logic Tile For example, the LT-XC2V4000 RealView Logic Tile draws 0.5A from the 3.3V supply.	0.9A	3A
With 3.8" CLCD	0.9A	3A
With 8.4" CLCD	1.4A	3A

Powered from J34 or PCI bus

Table B-3 shows the current requirements if the board is powered from terminal connector J34 or the PCI bus. The maximum value refers to loading by additional RealView Logic Tiles or the custom implementations of the CLCD interface.

Table B-3 Current requirements from J34

System	3.3V in typical	3.3V in max	5V in typical	5V in max	12V in typical	12V in max
Standalone	1.3A	3A	0.3A	3A	0.1A	3A
with RealView Logic Tiles ^a	1.8A	3A	0.3A	3A	0.1A	3A
with 3.8" CLCD	1.4A	3A	0.4A	3A	0.2A	3A
with 8.4" CLCD	1.4A	3A	0.7A	3A	0.5A	3A

a. For example, the LT-XC2V4000+ RealView Logic Tile draws 0.5A from the 3.3V supply.

Loading on supply voltage rails

Table B-4 lists the maximum current load that can be placed on the supply voltage rails.

Table B-4 Maximum current load on supply voltage rails

System	3.3V	5V	5V
Supplied from DC IN (12V at 3A)	2	1.5A	3A
Supplied from J34 or PCI (12V at 3A, 5V at 3A, and 3.3V at 3A)	3A	3A	3A

Use Table B-4 together with Table B-2 on page B-3 or Table B-3 on page B-3 to calculate how much current capacity is available from the voltage rails for external loads such as RealView Logic Tiles or CLCD displays.

B.2 Clock rate restrictions

The default clock rates for reliable operation are:

CPUCLK	210MHz
MPMCCLK	70MHz
HCLK	70MHz
HCLKEXT	35MHz
MBXCLK	70MHz
SMCLK	50MHz

If you have added one or more RealView Logic Tiles, you might need to reduce these clock rates.

For timing on the buses and peripherals, see:

- *AHB bus timing* on page B-6
- *Memory timing* on page B-7
- *Peripheral timing* on page B-7.

Caution

The ICS307 programmable oscillators OSC0, OSC1, OSC2, OSC3, and OSC4 can be programmed to deliver very high clock signals (200MHz). The only ARM926EJ-S PXP Development Chip clock input that can function at this frequency is **PLLCLKEXT**.

Also, the settings for VCO divider, output divider, and output select values are interrelated and must be set correctly. Some combinations of settings do not result in stable operation. For more information on the ICS clock generator and a frequency calculator, see the ICS web site at www.icst.com.

B.2.1 AHB bus timing

Table B-5 lists the timing for the AHB buses. (The bus clock frequency is typically 35MHz for a t_{cyc} of 28.5ns).

Table B-5 ARM926EJ-S PXP Development Chip bus timing

Bus signals	Clock	toV	toH	tiS	tiH
HRESETn input	XTALCLKEXT	-	-	10ns	2ns
AHB M1 outputs in synchronous mode (HADDR , HSELx , HWRITE , HTRANS[1:0] , HSIZE[2:0] , HBURST[2:0] , and write data)	XTALCLKEXT	16ns	1ns	-	-
AHB M1 inputs in synchronous mode (HREADY , HRESP , HLOCK , and read data)	XTALCLKEXT	-	-	17ns	0ns
AHB M1 outputs in async mode (HADDR , HSELx , HWRITE , HTRANS[1:0] , HSIZE[2:0] , HBURST[2:0] , and write data)	HCLKM1	18ns	4ns	-	-
AHB M1 inputs in async mode (HREADY , HRESP , HLOCK , and read data)	HCLKM1	-	-	17ns	4.5ns
AHB M2 outputs in synchronous mode (HADDR , HSELx , HWRITE , HTRANS[1:0] , HSIZE[2:0] , HBURST[2:0] , and write data)	XTALCLKEXT	16ns	1ns	-	-
AHB M2 inputs in synchronous mode (HREADY , HRESP , HLOCK , and read data)	XTALCLKEXT	-	-	17ns	0ns
AHB M2 outputs in async mode (HADDR , HSELx , HWRITE , HSIZE[2:0] , HBURST[2:0] , and write data)	HCLKM2	18ns	4ns	-	-
AHB M2 inputs in async mode (HREADY , HRESP , HLOCK , and read data)	HCLKM2	-	-	17ns	4.5ns
AHB S outputs in synchronous mode (HREADY , HRESP , HLOCK , and read data)	XTALCLKEXT	16ns	1ns	-	-
AHB S inputs in synchronous mode (HADDR , HSELx , HWRITE , HTRANS[1:0] , HSIZE[2:0] , HBURST[2:0] , and write data)	XTALCLKEXT	-	-	17ns	0ns
AHB S outputs in async mode (HREADY , HRESP , HLOCK , and read data)	HCLKS	18ns	4ns	-	-
AHB S inputs in async mode (HADDR , HSELx , HWRITE , HTRANS[1:0] , HSIZE[2:0] , HBURST[2:0] , and write data)	HCLKS	-	-	17ns	4.5ns

B.2.2 Memory timing

Table B-6 shows the memory timing. For more detail on timing and example waveforms, see the *ARM PrimeCell Static Memory Controller (PL093) Technical Reference Manual* and the *ARM PrimeCell Multiport Memory Controller (GX175) Technical Reference Manual*.)

Table B-6 ARM926EJ-S PXP Development Chip memory timing

Memory signals	Clock	toV	toH	tis	tih
SSMC outputs (SMDATA[31:0] for write, nSMDATAEN[3:0], SMADDR[25:0], SMCS[7:0], nSMOEN, nSMWEN, nSMBLS[3:0], and CANCELSMWAIT) SMCLK is typically 35MHz for a t_{cyc} of 28.6ns.	SMCLK	10ns	1ns	-	-
SSMC inputs in asynchronous mode (SMDATA[31:0] for read, SMWAIT, and CANCELSMWAIT)	SMCLK	-	-	5ns	1ns
SSMC inputs in synchronous mode (SMDATA[31:0] for read, SMWAIT, and CANCELSMWAIT)	SMFBCLK	-	-	5ns	1ns
Note					
The SMFBCLK delay from SMCLK must be less than 1.5ns.					
MPMC outputs (MPMCADDROUT[27:0], MPMCCKEOUT[3:0], MPMCDQMQOUT[3:0], nMPMCOEOUT, nMPMCRASOUT, nMPMCRPOUT, nMPMCWEOUT, MPMCDATA[31:0] for write) MPMCCLK is typically 70MHz for a t_{cyc} of 14.3ns.	MPMCCLK	4ns	0.5ns	-	-
MPMC inputs (MPMCFBCLKIN[3:0], MPMCTESTREQA, for read)	MPMCFBCLK	-	-	1ns	0.5ns
Note					
The MPMCFBCLK delay from MPMCCCLK must be less than 1.5ns.					

B.2.3 Peripheral timing

Table B-7 on page B-8 shows the peripheral and controller timing. For more detail on timing and example waveforms, see the relevant Technical Reference Manual for the module.

Table B-7 Peripherals and controller timing

Peripheral signals	Clock	tov	toh	tis	tih
CLCDC outputs (CLD[23:0] , CLPOWER , CLLP , CLCP , CLFP , CLAC , and CLLE) The maximum frequency of CLCDCLK is 100MHz for a t_{cyc} of 10ns.	CLCDCLK	12.5ns	-2.5ns	-	-
SCI outputs (nSCICLKOUTEN , SCICLKOUT , nSCIDATAOUTEN , nSCICLKEN , and nSCIDATAEN)	SCIREFCLK	14ns	-1ns	-	-
SCI inputs (SCICLKIN , SCIDATAIN , and SCIDECTECT) The maximum frequency of SCIREFCLK is 100MHz for a t_{cyc} of 10ns.	SCIREFCLK	-	-	12ns	-14ns
SSP outputs (SSPFRMOUT , SSPCLKOUT , SSPTXD , nSSPCTLOE , and nSSPOE)	SSPCLK	4ns	-2ns	-	-
SSP inputs (SSPRXD , SSPFRMIN , and SSPCLKIN) The maximum frequency of SSPCLK is 100MHz for a t_{cyc} of 10ns.	SSPCLK	-	-	12ns	-14ns

B.3 Mechanical details

Figure B-1 shows the mechanical outline of the PB926EJ-S.

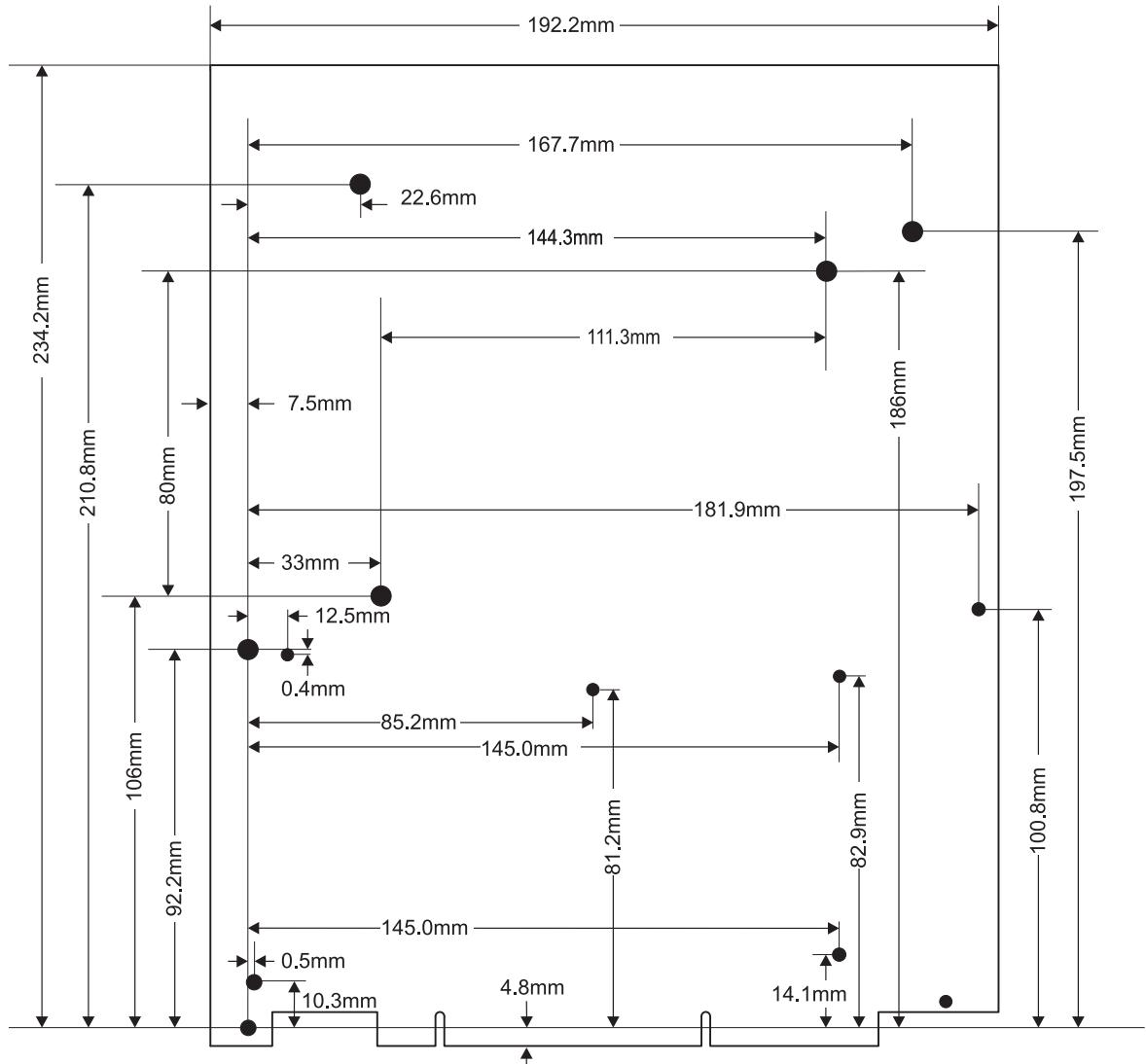


Figure B-1 Baseboard mechanical details

Appendix C

CLCD Display and Adaptor Board

This appendix describes the external CLCD adaptor board and display. It contains the following sections:

- *About the CLCD display and adaptor board* on page C-2
- *Installing the CLCD display* on page C-6
- *LCD power control* on page C-7
- *Touchscreen controller interface* on page C-11
- *Connectors* on page C-15
- *Mechanical layout* on page C-19.

C.1 About the CLCD display and adaptor board

The CLCD interface board provides multiple sockets for different types of CLCD displays and touchscreens. It connects to the PB926EJ-S by a single cable.

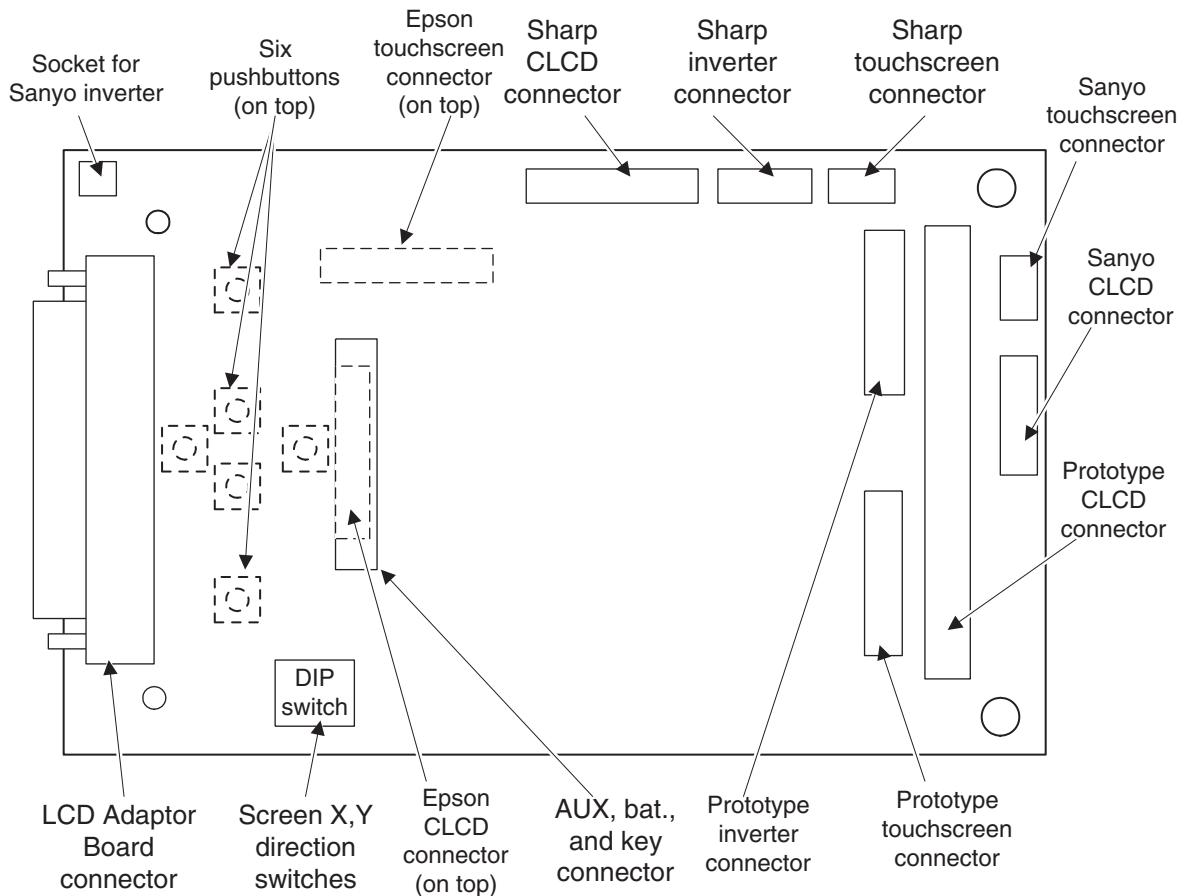


Figure C-1 CLCD adaptor board connectors (bottom view)

The design of the interface board enables you to choose the CLCD display that is appropriate for your application. The CLCD displays and touchscreens supported by the interface board are:

- Sanyo 3.8 inch QVGA color TFT with touchscreen and fluorescent backlight
- Sharp 8.4 inch VGA color TFT with touchscreen and fluorescent backlight
- Epson 2.2 inch 176x220 pixel color TFT with LED backlight.

Six pushbutton switches are mounted on the interface board below the 2.2 or 3.8 inch display. The state of the switches can be read from the touchscreen controller interface.

The touchscreen interface on the CLCD interface board is described in *Touchscreen controller interface* on page C-11. The selftest program supplied on the CD reads the position of a pen on the touchscreen and displays it on the CLCD or VGA display connected to the board.

The 2.2 and 3.8 inch CLCD displays and the adaptor board are mounted in a small enclosure as shown in Figure C-2.

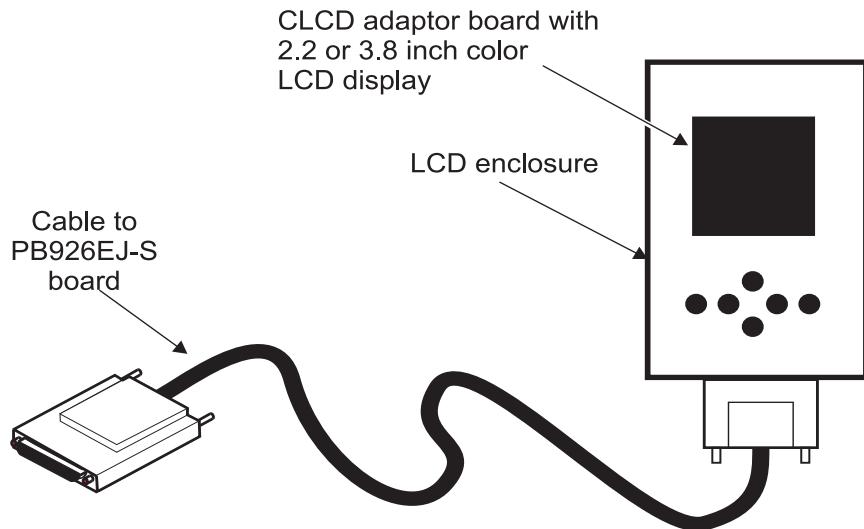


Figure C-2 Small CLCD enclosure

The 8.4 inch display is mounted into a large enclosure that has two connectors: one for a keypad and one for the PB926EJ-S. (See Figure C-3 on page C-4.)

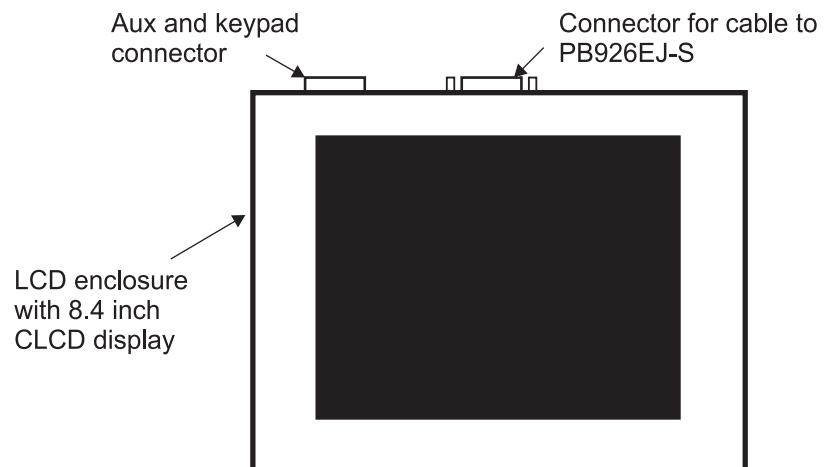


Figure C-3 Large CLCD enclosure

The 2.2 and 3.8 inch CLCD displays are mounted on the top side of the adaptor board as shown in Figure C-4 on page C-5.

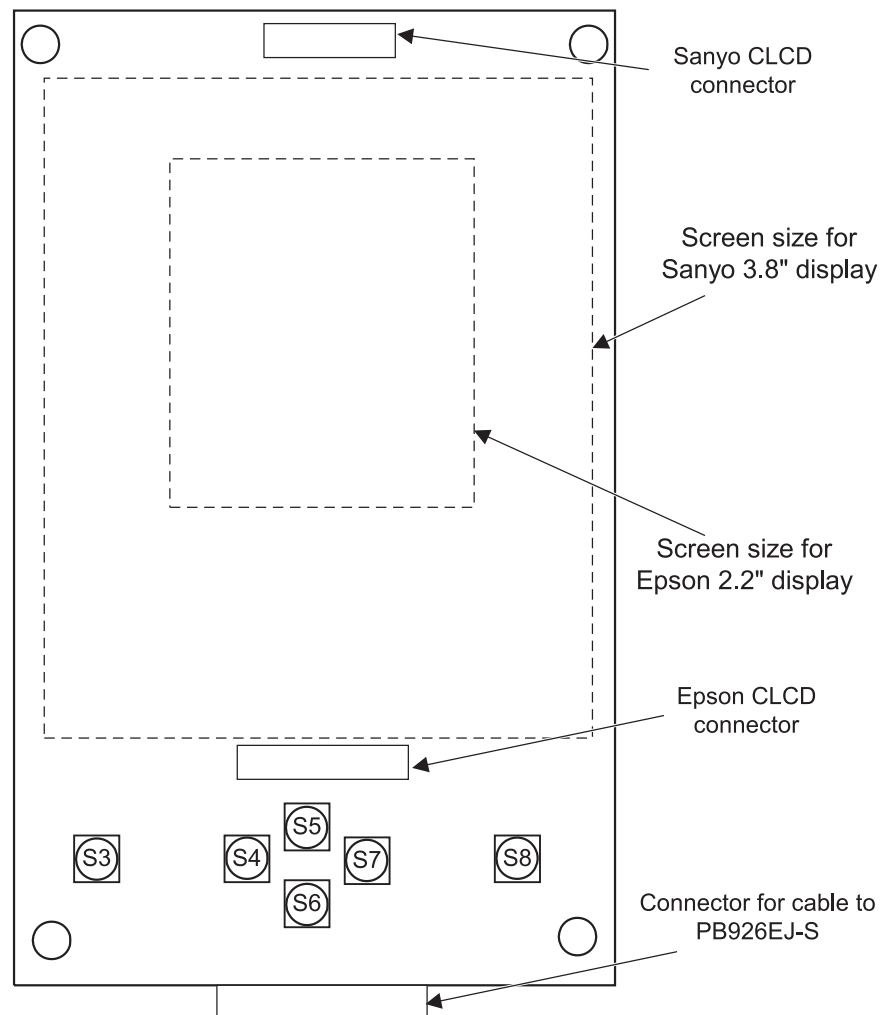


Figure C-4 Displays mounted directly onto top of adaptor board.

C.2 Installing the CLCD display

To install the CLCD display:

1. Connect one end of the CLCD expansion cable to the CLCD adaptor board.
2. Connect the other end of the cable to the PB926EJ-S CLCD expansion connector on the enclosure.
3. If required, program the CLCD control registers SYS_CLCD and SYS_CLCDSER to sequence the power to the LCD display and specify the bit format. See the *CLCDC interface* on page 3-61.

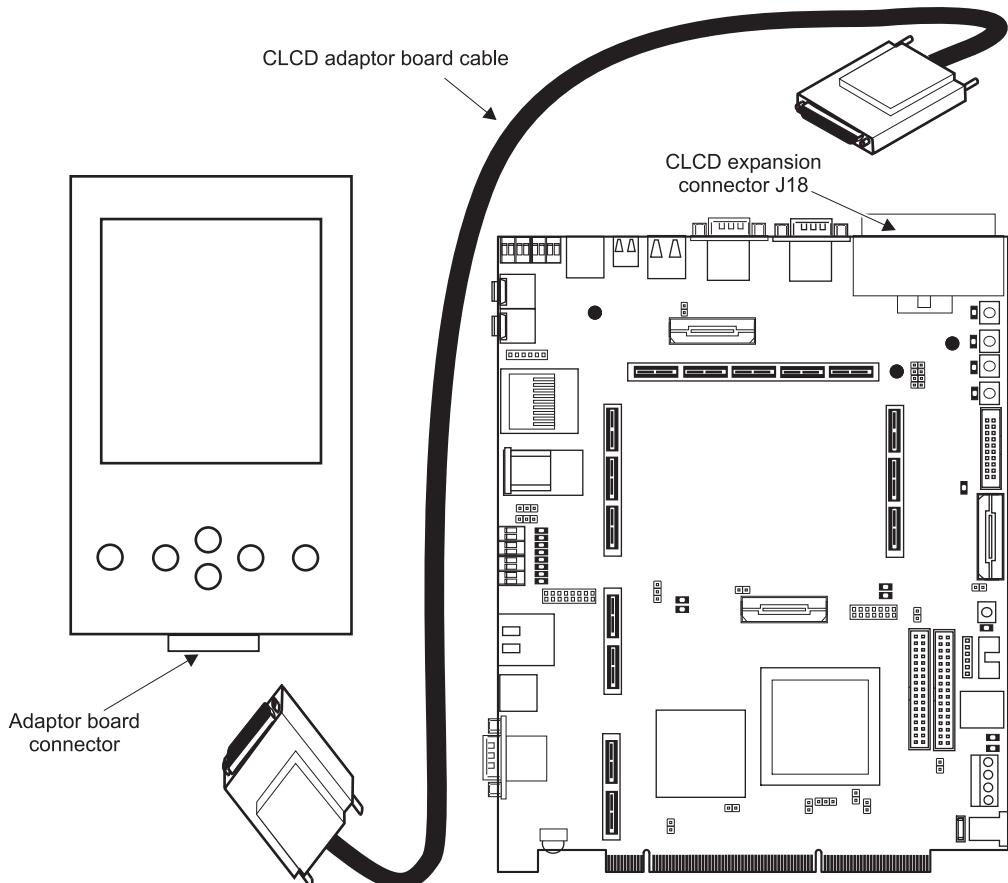


Figure C-5 CLCD adaptor board connection

C.2.1 Configuration

The CLCD adaptor board contains factory-installed links that identify the type of display. The display matching the identification links settings are listed in Table C-1. The value of the bits **CLCDID[4:0]** in the SYS_CLCD register can be read from software to determine the display in use with the board.

Table C-1 Displays available with adaptor board

LCD_ID[4:0]	Manufacturer	Backlight inverter	Touchscreen	Display
b00000	Sanyo TM38QV67A02A	TDK CXA-0341	Part of display	3.8 inch QVGA Color TFT
b00001	Sharp LQ084V1DG21	TDK CXA-L0612VJL	DynaPro/3M 95643	8.4 inch VGA color TFT
b00010	Epson L2F50113T00	LED backlight	None	2.2 inch 176x220 Color TFT
b01111	No display fitted	-	-	-

C.2.2 LCD power control

The LCD adaptor board accommodates a wide range of LCDs. Displays can require from 1 to 4 power supplies that can either be turned on/off simultaneously or need to be switched on/off in a certain order. System control register SYS_CLCD and the CLCD PrimeCell system register control power switching. The voltage supplies on the board are:

Vin This is permanently on and is not switched. This provides power to the board (nominal 12V) for the backlight converter.

1V8 This supply is permanently on. It is generated from 5V.

SWITCHED_FIXED

The supply is generated from the 1.8V, 3.3V or 5V supply. It can be enabled by **PWR3V5VSWITCH** in SYS_CLCD or permanently enabled by link 13.

SWITCHED_CLPWR

This supply is generated from 5V. It can be enabled by the **CLPOWER** signal in the CLCD PrimeCell control register or permanently enabled by link 15.

SWITCHED_VDD_NEG

This $-5V$ to $-28V$ supply is generated from $5V$. It can be enabled by **VDDNEGSWITCH** in **SYS_CLCD** or permanently enabled by link 14.

SWITCHED_VDD_POS

This $11V$ to $28V$ supply is generated from $5V$. It can be controlled by the touchscreen D/A converter or manually with a pot. It can be enabled by **VDDPOSSWITCH** in **SYS_CLCD** or permanently enabled by link 11. This supply is used to generate the STN bias voltage.

LCD_IO_VDD and Buffer I/O voltage

This is the voltage to the interface logic on the adaptor board and the display. Link 16 selects the adaptor board interface level as **CLPWR** or **FIXED**. Link 3 selects the display interface level as **SWITCHED_FIXED** or **SWITCHED_CLPWR**.

———— **Caution** ————

Link 3 and link 16 must be set to use the same power source.

INV_IO This is the voltage to the interface logic on the prototype board. Link 2 selects the level as $5V$ or $3.3V$.

———— **Note** ————

The I/O signals to the CLCD adaptor board pass through tri-state buffers. The buffers must be powered from the same IO voltage as that required by the CLCD. This enables the translation of the IO signals from the $3V3$ signal levels present on the PB926EJ-S. The buffers are enabled by **LCDIOON** in **SYS_CLCD**.

Figure C-6 on page C-10 shows the block diagram of the adaptor board power-control circuitry.

Table C-2 shows the power configuration for the three displays. For additional information on configuring the CLCD displays, see the selftest code provided on the CD.

Table C-2 Power configuration

Voltage control	Epson 2.2"	Sanyo 3.8"	Sharp 8.4"
Buffer IO	SWITCHED_FIXED	CLPOWER	CLPOWER
SWITCHED_VDD_POS	Software control	15V	Software control
SWITCHED_VDD_NEG	-10V	-10V	-10V
CLPOWER	2.85V	3.3V	3.3V
FIXED_SWITCH	1.8V	5V	5V
INV_IO	5V	3.3V	5V
Buffer enabled (software control)	Always on	Always on	Set from CLPOWER register in ARM926EJ-S PXP Development Chip

— Caution —

The links for power control are set during manufacture. Do not modify the links unless you are producing a new custom display board.

Use connector J4 to supply power to an inverter for a backlight. The backlight pins **VIN** are provide a nominal 12V supply. The backlight inverter must consume less than 5W. The I/O voltage level **INV_IO** is also present on J4. **INV_IO** can be link selected to be 5V or 3.3V.

In addition to voltage and ground pins, the connector also supplies the brightness adjustment voltage (0 to **INV_IO** voltage). The brightness is adjusted by a variable resistor, VR4, located near J4.

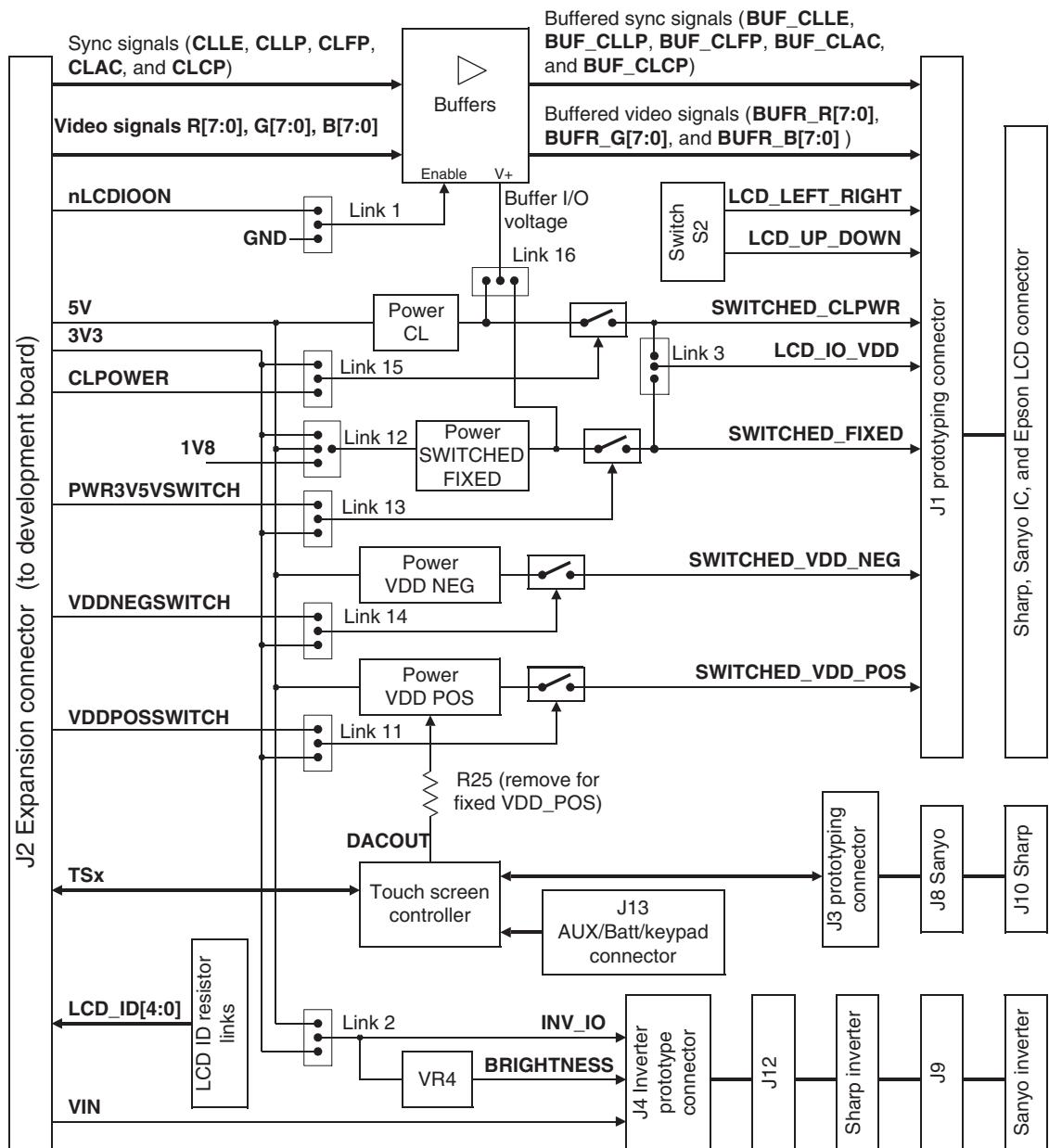


Figure C-6 CLCD buffer and power supply control links

C.3 Touchscreen controller interface

The touchscreen interface is designed to connect to a four-wire resistive touchscreen. It is driven by the TouchScreen controller TSC2200 and described in:

- *Touchscreen interface architecture*
- *Touchscreen controller programmer's interface* on page C-13.

The Selftest program supplied on the CD demonstrates how to communicate with the touchscreen controller. The program uses the interface code to plot the touchscreen X and Y coordinates on the LCD or VGA screen.

Connectors J8 and J10 are used for the standard touchscreens provided with the CLCD assembly. Prototyping connector J3 enables the use of other resistive touchscreens, see *Touchscreen prototyping connector* on page C-17.

C.3.1 Touchscreen interface architecture

Figure C-7 on page C-12 shows the touchscreen interface. Table C-3 lists the touchscreen control signals. The signals to the touchscreen are routed to connector J13.

Table C-3 Touchscreen host interface signal assignment

Signal name	Description
TSMOSI	Serial data input to controller
TS_nSS	Chip select
TSSCLK	Clock input
TSMISO	Data output
TSnDAV	Data available
TSnPENIRQ	Pen down interrupt
TSnKPADIRQ	Keypad interrupt
VBAT[2:1] and AUX[2:1]	External voltage to analog to digital converter in touchscreen controller. These are reserved for expansion for external devices connected to the AD and keypad connector J13.
R[4:1] and C[4:1]	Row and column scan signals for a keyboard. The expansion board switches S3 to S8 currently use eight positions on the scan matrix, but additional switches can be fitted using the AD and keypad connector J13.

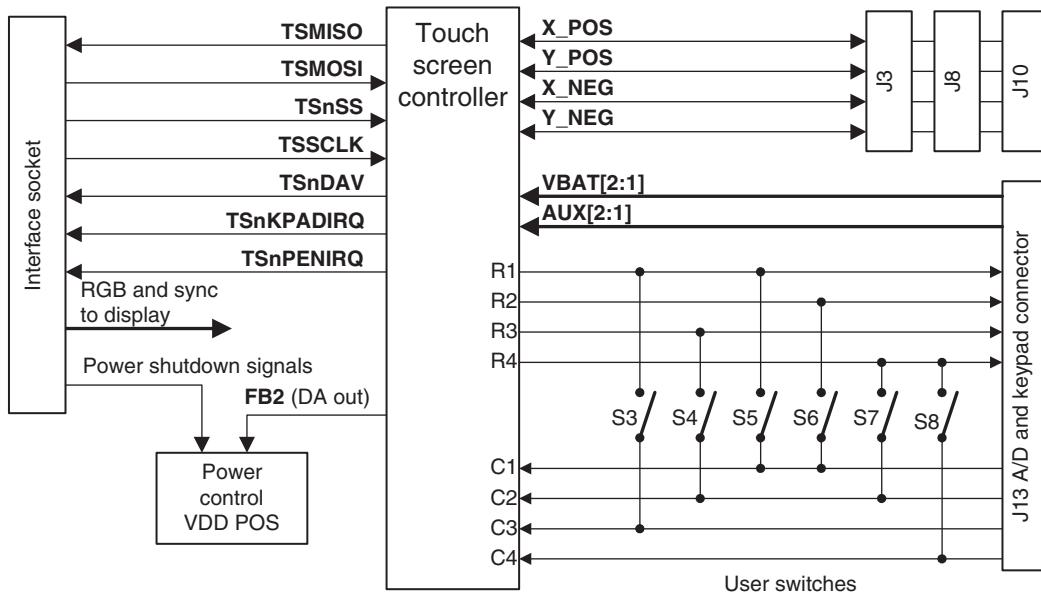


Figure C-7 Touchscreen and keypad interface

The connection between the resistive elements of the touchscreen and J3, J8, or J10 is shown in Figure C-8. When the pen is down, the two resistive elements touch and form a four-resistor network. Measuring the voltages at the two dividers indicates the X and Y positions.

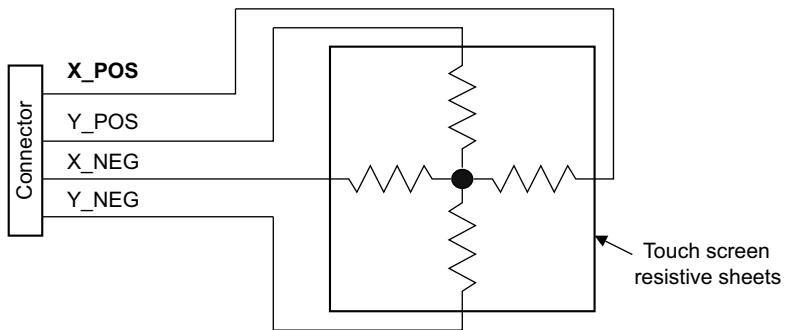


Figure C-8 Touchscreen resistive elements

C.3.2 Touchscreen controller programmer's interface

The LCD *Touch Screen Controller Interface* (TSCI) is based on a TSC2200 PDA analogue interface circuit. Use the ARM926EJ-S PXP Development Chip SSP interface to configure and read the touch screen. For information on the touch screen registers, see the TSC2200 data sheet.

The TSC2200 also incorporates a sixteen key keypad interface and two 12bit analogue inputs that are available through the LCD expansion header J13. With the 3.8 inch Sanyo and 2.2 inch Epson build options, six keypad push buttons are mounted on the LCD board.

SSP and TSCI Configuration

The SSP interface is controlled by the SSP PrimeCell and the SSP TSCI chip select is enabled through SYS_CLCD **TSnSS** signal. Configuration of the SSP to TSCI interface requires the data format, phase, size, and clock to be set correctly. Example configuration code is given in the selftest (TSCI) software on the CD, a code fragment from this is shown in Example C-1.

Example C-1 SSP to TSCI interface setup

```
// Set serial clock rate (/3), Phase (SPH), Format (MOT), data size (16bit)
*SSPCR0 = SSPCR0_SCR_DFLT | SSPCR0_SPH | SSPCR0_FRF_MOT | SSPCR0_DSS_16;

// Clock prescale register (/8), with SCR gives 0.78MHz SCLK: 24MHz / 8*(1+3)
*SSPCPSR = SSPCPSR_DFLT;

// Enable serial port operation
*SSPCR1 = SSPCR1_SSE;
```

The TSC2200 TSCI controller registers must be configured through the SSP interface to enable correct touch screen operation.

After the TSCI is configured, conversion of touch screen X/Y values is fully automated by the TSCI controller and the application code simply reads the converted values. Use either the pen down flag in the touch screen controller interface or SIC interrupt 8 to detect the current pen state. The pseudo code in Example C-2 on page C-14 shows the sequence for configuring and reading the TSCI interface.

Read and write functions are used in the selftest code to transfer data to and from the TSCI registers TSCI_RTSC and TSCI_WTSC. The selftest example configures the TSCI for 12bit operation and 16 data averages with minimum precharge and sense times. This gives high accuracy and fast reading of the current pen position.

Example C-2 Configuring and reading the TSCI interface

```
Configure the SSP interface
Configure the TSCI registers
Enable the touch screen pendown interrupt (on SIC)
...
On touch screen pendown interrupts
    ...
        ... touch screen interrupt handler
        Enable the touch screen event timer (TIMER 1-4) for approx. 2mS intervals
    ...
On touch screen timer events
    ...
        ... touch screen reading
        If (pendown flag (PSM) is cleared)
            Disable the touch screen event timer
            Clear and re-enable the touch screen interrupt
        Else
            Read the pen X/Y values
            Draw the pen position on the screen
```

— Note —

The selftest example provided on the CD uses a simple polled system to determine pen down and timer events.

The pseudo code in Example C-2 is recommended for OS ports as they typically require interrupt-driven device drivers.

C.4 Connectors

This section describes the connectors present on the CLCD adaptor board. For details of the connectors present on the PB926EJ-S, see Appendix A *Signal Descriptions*.

C.4.1 Interface connector

The signals on the CLCD interface connector J2 are shown in Table C-4.

Table C-4 CLCD interface connector J2

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
1	B0	2	B2	35	B1	36	B3
3	B4	4	B6	37	B5	38	B7
5	G0	6	G2	39	G1	40	G3
7	G4	8	G6	41	G5	42	G7
9	R0	10	R2	43	R1	44	R3
11	R4	12	R6	45	R5	46	R7
13	CLLE	14	CLAC	47	GND	48	GND
15	CLCP	16	CLLP	49	GND	50	GND
17	CLFP	18	TSnKPADIRQ	51	GND	52	GND
19	TSnPENIRQ	20	TSnDAV	53	GND	54	LCDID0
21	TSSCLK	22	TSnSS	55	LCDID1	56	LCDID2
23	TSMISO	24	TSMOSI	57	LCDID3	58	LCDID4
25	LCDXWR	26	LCDSD0	59	GND	60	GND
27	LCDXRD	28	LCDXCS	61	GND	62	3V3
29	LCDDATA_nCOMM	30	LCDSD0DIR	63	3V3	64	5V
31	CLPOWER	32	nLCDIOON	65	5V	66	VIN
33	PWRFIXEDSWITCH	34	VDDPOSSWITCH	67	VIN	68	VDDNEGSWITCH

C.4.2 LCD prototyping connector

The signals on the LCD prototyping connector J1 are shown in Table C-5.

Table C-5 LCD prototyping connector J1

Signal	Pin	Pin	Signal
BUF_CLLP	1	2	BUF_G2
GND	3	4	BUF_G3
CLCP0	5	6	GND
GND	7	8	BUF_G4
BUF_CLFP	9	10	BUF_G5
GND	11	12	GND
BUF_CLAC	13	14	BUF_G6
GND	15	16	BUF_G7
BUF_CLLE	17	18	GND
GND	19	20	BUF_R0
BUF_B0	21	22	BUF_R1
BUF_B1	23	24	GND
GND	25	26	BUF_R2
BUF_B2	27	28	BUF_R3
BUF_B3	29	30	GND
GND	31	32	BUF_R4
BUF_B4	33	34	BUF_R5
BUF_B5	35	36	GND
GND	37	38	BUF_R6
BUF_B6	39	40	BUF_R7
BUF_B7	41	42	SWITCHED_FIXED
GND	43	44	LCD LEFT_RIGHT

Table C-5 LCD prototyping connector J1 (continued)

Signal	Pin	Pin	Signal
BUF_G0	45	46	LCD_UP_DOWN
BUF_G1	47	48	SWITCHED_VDD_POS
SWITCHED_CLPWR	49	50	SWITCHED_VDD_NEG

C.4.3 Touchscreen prototyping connector

The signals on the touchscreen prototyping connector J3 are shown in Table C-6.

Table C-6 Touchscreen prototyping connector J3

Signal	Pin	Pin	Signal
GND	1	2	GND
X_POS	3	4	GND
Y_NEG	5	6	GND
X_NEG	7	8	GND
Y_POS	9	10	GND

C.4.4 Inverter prototyping connector

The signals on the inverter prototyping connector J4 are shown in Table C-7.

Table C-7 Inverter prototyping connector J4

Signal	Pin	Pin	Signal
VIN	1	2	VIN
VIN	3	4	VIN
GND	5	6	GND
BRIGHTNESS	7	8	GND
GND	9	10	INV_IO

C.4.5 A/D and keypad connector

The signals on the connector J13 are shown in Table C-7 on page C-17.

This connector enables the connection of an external keypad (**R[4:1]** are the keypad row scan output signals and **C[4:1]** are the column detect input signals). There are also connections to the analog to digital converter inputs on the CLCD adaptor board (**AUX[2:1]** and **VBAT[2:1]**).

Table C-8 A/D and keypad J13

Signal	Pin	Pin	Signal
3V3	1	20	3V3
AUX1	2	19	GND
AUX2	3	18	GND
VBAT1	4	17	GND
VBAT2	5	16	GND
R1	6	15	C1
R2	7	14	C2
R3	8	13	C3
R4	9	12	C4
GND	10	11	GND

C.5 Mechanical layout

Shows the board layout and location of the CLCD, switches, and mounting holes.

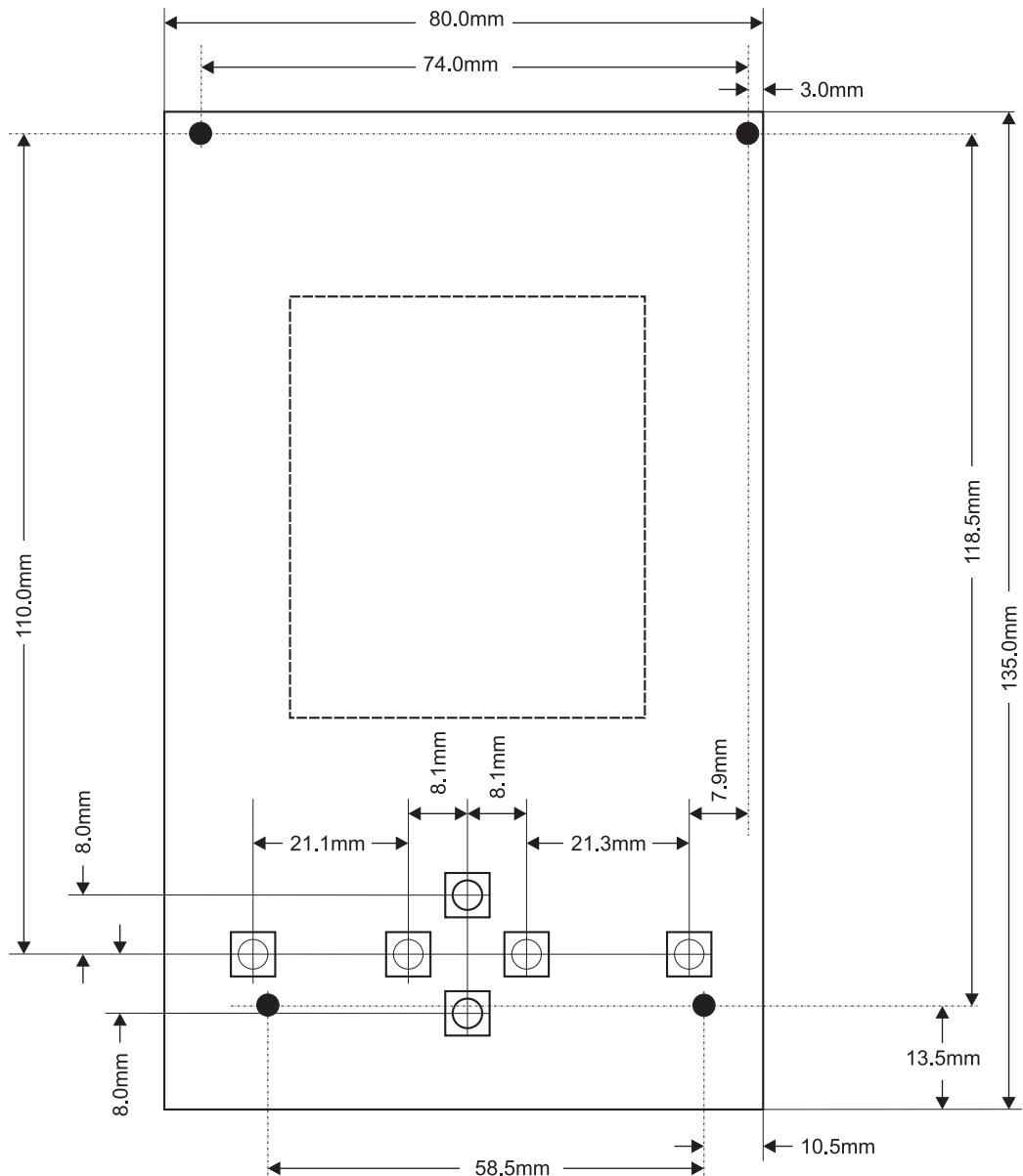


Figure C-9 CLCD adaptor board mechanical layout

Appendix D

PCI Backplane and Enclosure

This appendix describes the PCI backplane and enclosure. It contains the following sections:

- *Connecting the PB926EJ-S to the PCI enclosure* on page D-2
- *Backplane hardware* on page D-6
- *Connectors* on page D-10.

For details on configuring the PCI controller and PCI expansion cards, see *PCI controller* on page 4-74.

D.1 Connecting the PB926EJ-S to the PCI enclosure

This section describes how to configure the PCI backplane and connect the PB926EJ-S to the PCI enclosure.

To use the PB926EJ-S with the PCI backplane and enclosure:

1. Configure the PB926EJ-S as described in *Setting up the RealView Platform* on page 2-2.

———— **Caution** ————

Do not connect power to the PB926EJ-S yet.

2. Connect Multi-ICE to the board, or use the USB debug port. See *Connecting JTAG debugging equipment* on page 2-8.

———— **Note** ————

The JTAG connection on the PB926EJ-S does not connect to the PCI backplane. Use the PB926EJ-S JTAG for debugging applications.

There is also a JTAG socket on the PCI backplane. Only use this connector if you are reprogramming the PAL on the PCI backplane.

3. Set the configuration switches on the PCI backplane. See *Setting the backplane configuration switches* on page D-4.

4. If you are using an external display:

- For VGA displays, connect the cable from the display to the VGA connector on the PB926EJ-S.

———— **Note** ————

If you are using a VGA card in the PCI bus, connect the VGA display to the VGA connector on the PCI card. You must provide the interface code for the PCI display card.

- For CLCD displays, connect the CLCD expansion board cable to the PB926EJ-S and if necessary, connect the display interface cable from the expansion board to the CLCD display. See *Appendix C CLCD Display and Adaptor Board*.

5. Slide the PB926EJ-S into the PCI connector on the side of the enclosure. Figure D-1 on page D-3 illustrates an PB926EJ-S mounted in the PCI backplane in the supplied enclosure.

6. Apply power to the PCI enclosure.

Caution

Do not connect power to the screw terminals or to the power socket on the PB926EJ-S.

7. Execute the initialization code to setup the PCI address-mapping registers (see *PCI controller* on page 4-74)

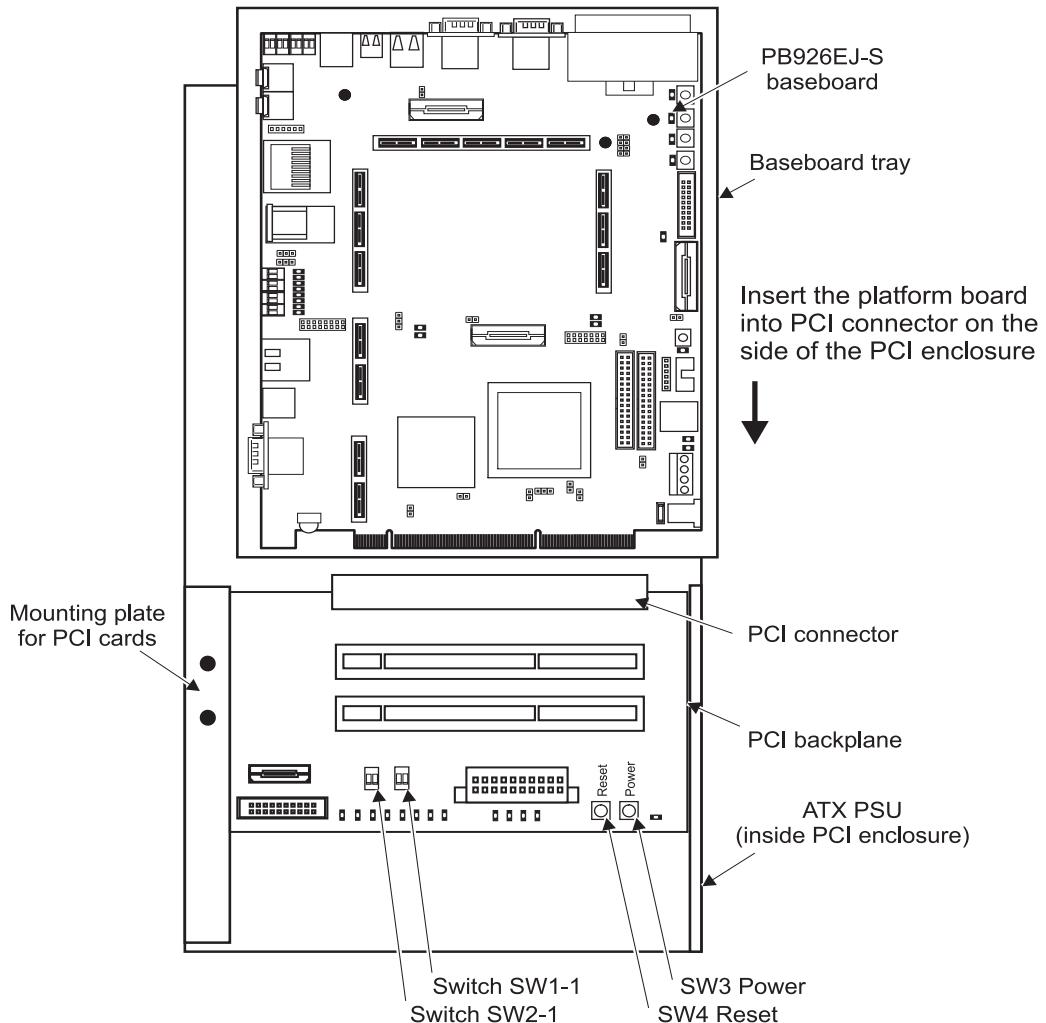


Figure D-1 Installing the platform board into the PCI enclosure

D.1.1 Setting the backplane configuration switches

There are four control switches on the PCI backplane board as shown in Figure D-3 on page D-6. The switches are arranged into two switch blocks, SW1 and SW2.

SW1-1 and SW1-2 control clock rate:

SW1-1 SW1-1 positions are labeled **Manual** and **Auto** and select between manual or automatic clock selection:

- In **Manual** position, the clock is determined by the settings of the manual clock select switch SW1-2.
- In **Auto** position, the clock rate is determined by the capabilities of the PCI cards installed. The default rate is 33MHz. If however all PCI cards are capable of functioning at 66MHz, the clock rate will automatically be increased to 66MHz.

SW1-2 SW1-2 positions are labeled **Man1** and **Man2** and determine the clock rate when SW1-1 is in the **Manual** position. **Man1** selects low frequency (10MHz) and **Man2** selects high frequency (50MHz).

Switches SW2-1 and SW2-2 control the PCI backplane JTAG scan chain:

SW2-1 Switch positions for SW2-1 are labeled **omitPLD** and **incPLD** and omits or includes the PLD on the PCI backplane from the PCI scan chain.

SW2-2 Switch positions for SW2-2 are labeled **omitPCI** and **incPCI** and omit or include the PCI sockets in the PCI scan chain. If a PCI card is not present in a socket, the socket is bypassed by an automatic switch.

If a PCI card does not support JTAG, place a jumper across the **TDI** and **TDO** signals for that card or place insulating tape over the **nPRSNT** pins on the socket.

The JTAG scan chain on the PB926EJ-S does not extend to the PCI backplane.

There are also two connectors on the board that can be connected to external switches:

J6 This connector is paralleled with SW3 and permits control of the power from a front-panel switch.

J7 This connector is paralleled with SW4 and enables a front-panel switch to reset the PCI arbiter on the backplane and reset all of the PCI cards.

———— **Note** ————

Front panel switches are not provided as part of the PCI enclosure.

D.1.2 Connecting two PB926EJ-S boards

Figure D-2 shows two PB926EJ-S boards and a VGA controller connected to the PCI backplane. The PCI controller in the top PB926EJ-S is operating as a PCI bus slave and the PCI controller in the bottom PB926EJ-S is operating as a PCI bus master. The VGA card is also operating as a slave.

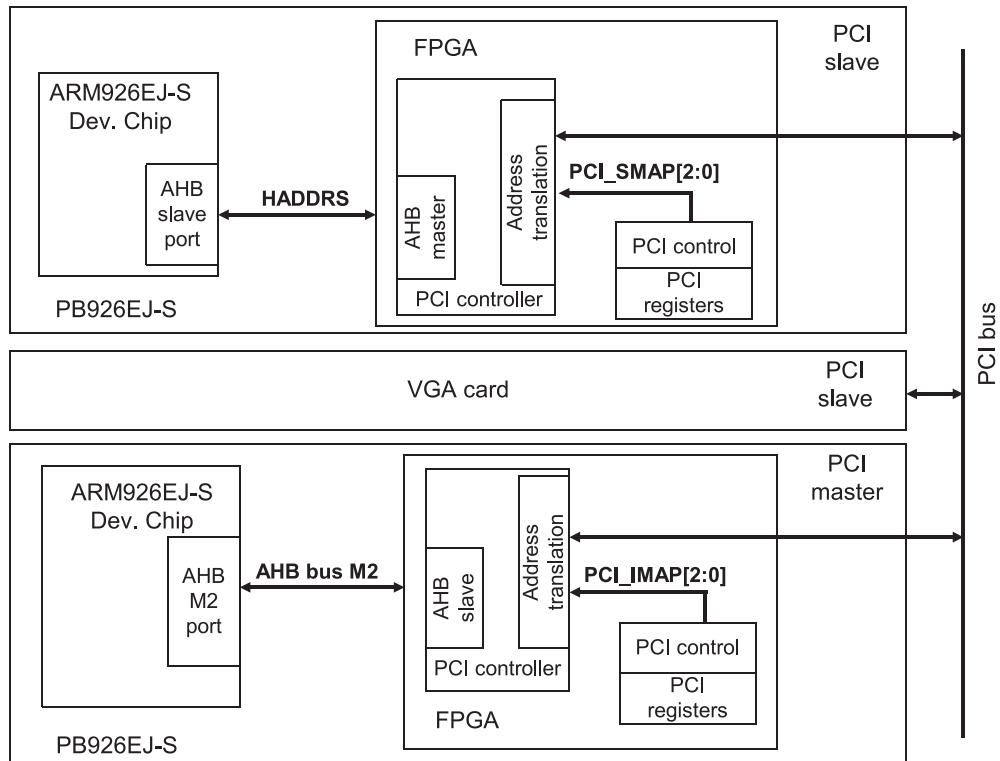


Figure D-2 Multiple boards on PCI bus

— Note —

You can only plug the PB926EJ-S into a PC PCI motherboard that uses 64-bit sockets (3.3V signal levels).

You can, however, use either 32 or 64-bit PCI expansion cards in the PCI enclosure.

D.2 Backplane hardware

The mechanical layout for the PCI backplane is shown in Figure D-3.

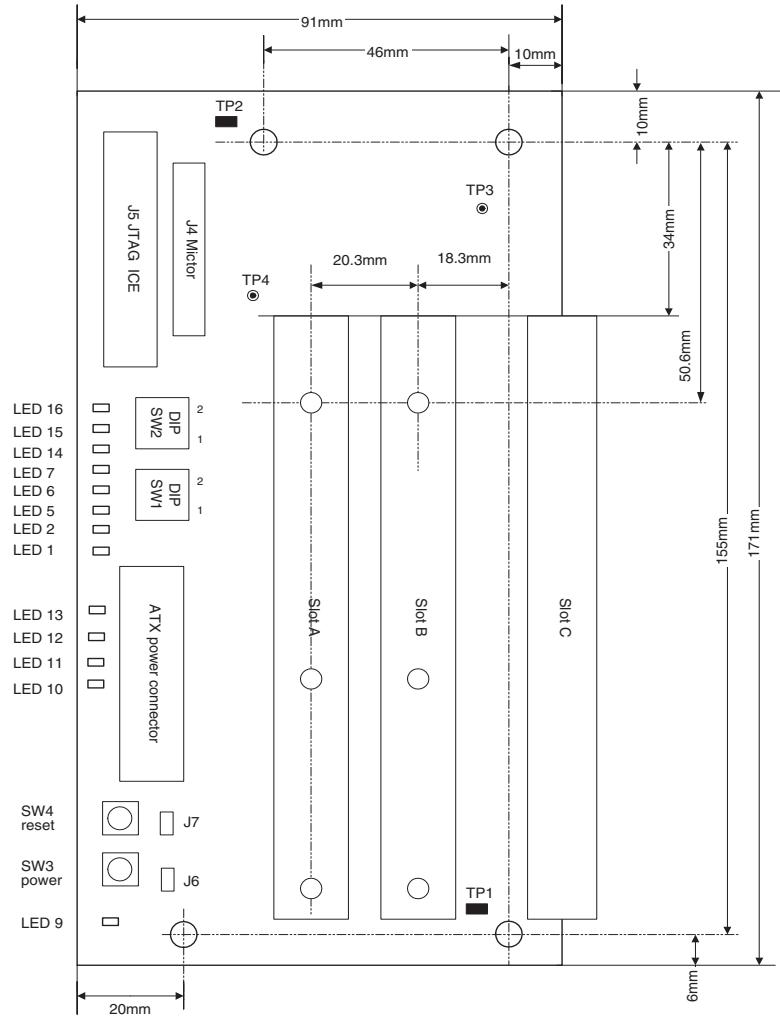


Figure D-3 PCI backplane

The PCI backplane mechanical layout complies to PCI Specification v2.3 for a two slot short card system board.

The switches, indicators, and test points for the PCI backplane are listed in Table D-1, Table D-2 on page D-8, and Table D-3 on page D-8.

Table D-1 LED indicators

LED	Signal	Description
1	MAN1nMAN2	This LED illuminates to indicate Man2 clock selection
2	MANnAUTO	This LED illuminates to indicate Auto clock selection
5	CLK33ACTIVE	This LED illuminates to indicate 33MHz bus speed.
6	CLK66ACTIVE	This LED illuminates to indicate 66MHz bus speed.
7	CLK133ACTIVE	This LED is used for manufacturing tests.
9	PSON	Power supply on/off indicator. The LED is illuminated when the unit is off (standby).
10	3V3	Power supply voltage present
11	5V	Power supply voltage present
12	12V	Power supply voltage present
13	-12V	Power supply voltage present
14	PCI_nPRSNT1A and PCI_nPRSNT2A	This LED illuminates to indicate PCI card present and enabled in slot A.
15	PCI_nPRSNT1B and PCI_nPRSNT2B	This LED illuminates to indicate PCI card present and enabled in slot B.
16	PCI_nPRSNT1C and PCI_nPRSNT2C	This LED illuminates to indicate PCI card present and enabled in slot C. (This is the slot for the PB926EJ-S.)

Table D-2 Configuration switches

Switch	Signal	Description
SW1-1	MAN1nMAN2	Determines the clock rate when SW1[1] is in the Manual position. See <i>Setting the backplane configuration switches</i> on page D-4.
SW1-2	MANnAUTO	Selects between manual (ON) or automatic (OFF) clock selection
SW2-1	nINCPLD	Omits (ON) or includes (OFF) the PLD in the scan chain.
SW2-2	TESTnEN	Omits (ON) or includes (OFF) the PCI sockets in the scan chain.

Table D-3 Power and reset switches

Switch	Signal	Description
SW3	PSON	Power on/off pushbutton. Pressing the switch toggles the power between on and standby. SW3 signals are also connected to J6 and this enables the use of an external front-panel switch.
SW4	SYSTEM_nRESET	System reset pushbutton. Pressing the switch generates a reset to the PCI arbiter on the backplane and all of the PCI cards. SW4 signals are also connected to J7 and this enables the use of an external front-panel switch.

Table D-4 Test points

Test point	Signal	Description
TP1	GND	Ground
TP2	GND	Ground
TP3	TCLK	JTAG clock
TP4	PCI CLK	PCI clock

D.2.1 JTAG signals

The JTAG signal flow is shown in Figure D-4.

— Note —

The JTAG chain on the PCI expansion board is independent of the JTAG chain on the PB926EJ-S.

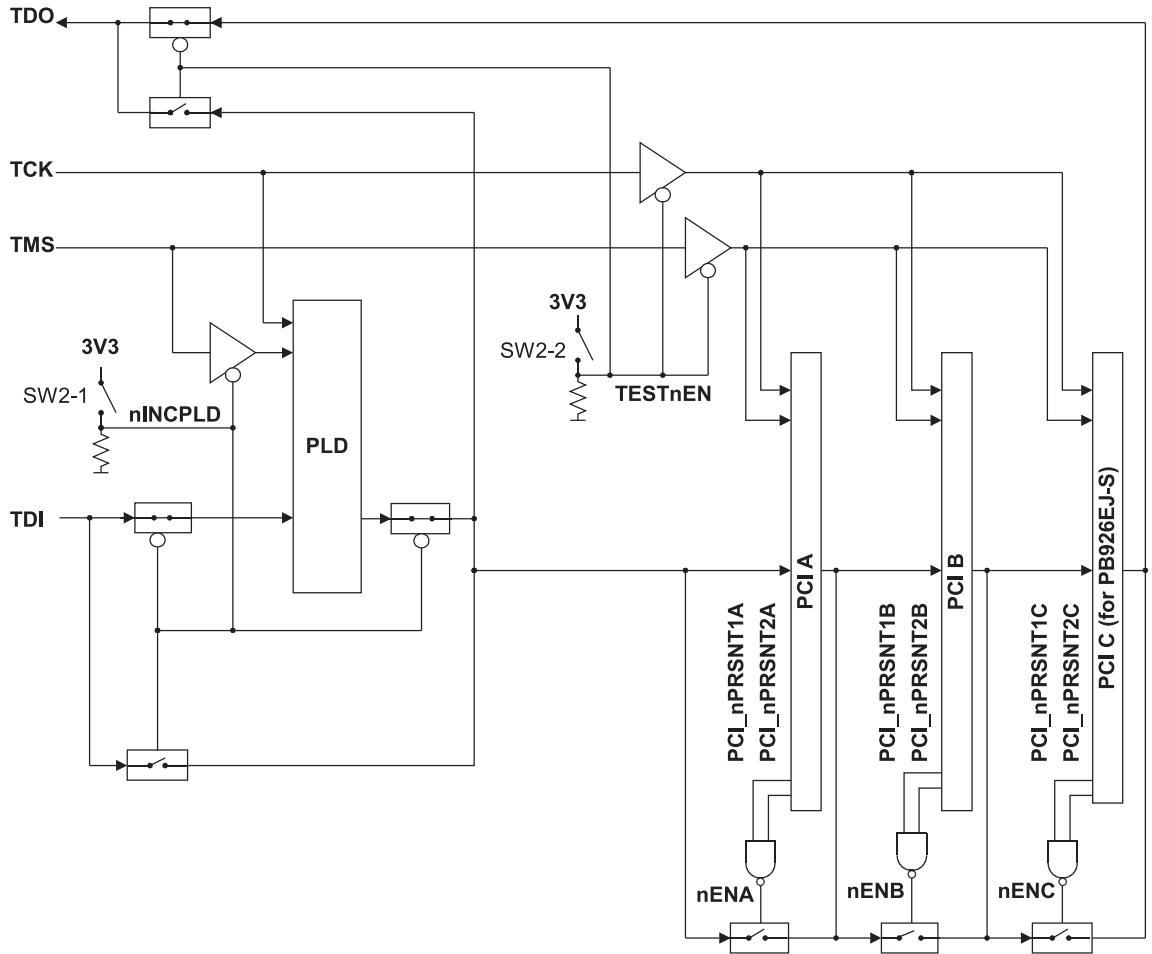


Figure D-4 JTAG signal flow on the PCI backplane

D.3 Connectors

This section describes the connectors present on the PCI backplane.

D.3.1 Power connector

The power connector is a standard ATX style connector as used in PCs. The pinout for the connector is listed in Table D-5.

Table D-5 ATX power connector

Signal	Pin	Pin	Signal
3V3	1	11	3V3
3V3	2	12	-12V
GND	3	13	GND
5V	4	14	nPSON
GND	5	15	GND
5V	6	16	GND
GND	7	17	GND
PWOK	8	18	NC
ATX5VSB	9	19	5V
12V	10	20	5V

D.3.2 Logic analyzer connector

Figure D-5 and Table D-6 show the pinout of the Mictor connector J4. You can use this connector to monitor PCI signals on the backplane.

— Note —

Agilent (formerly HP) and Tektronix label these connectors differently, but the assignments of signals to physical pins is appropriate for both systems and pin 1 is always in the same place.

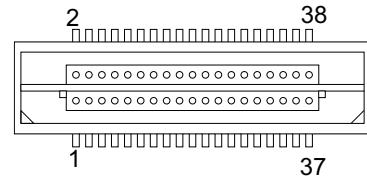


Figure D-5 AMP Mictor connector J4

Table D-6 Mictor connector pinout

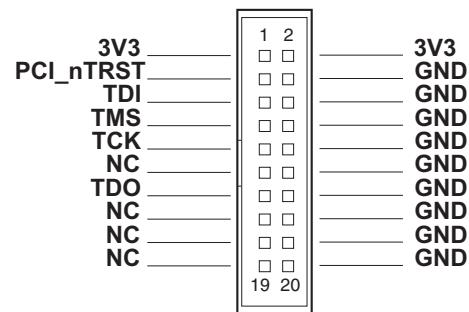
Channel	Pin	Pin	Channel
No connect	1	2	No connect
GND	3	4	No connect
PCI_CLKE	5	6	No connect
PCI_nIRDY	7	8	No connect
PCI_nTDRY	9	10	No connect
PCI_nINTD	11	12	No connect
PCI_nINTC	13	14	SYSTEM_nRESET
PCI_nINTB	15	16	PCI_PAR64
PCI_nINTA	17	18	PCI_nSERR
PCI_nGNTC	19	20	PCI_nPERR
PCI_nGNTB	21	22	PCI_nACK64
PCI_nGNTA	23	24	PCI_nREQ64
PCI_nREQC	25	26	PCI_M66EN

Table D-6 Micror connector pinout (continued)

Channel	Pin	Pin	Channel
PCI_nREQB	27	28	PCI_nRST
PCI_nREQA	29	30	PCI_nSTOP
SPARE4	31	32	PCI_nDEVSEL
SPARE3	33	34	PCI_nFRAME
SPARE2	35	36	PCI_nLOCK
SPARE1	37	38	PCI_PAR

D.3.3 JTAG connector

The signals on the JTAG connector J5 are shown in Figure D-6.

**Figure D-6 PCI expansion board JTAG connector J5**

Appendix E

Memory Expansion Boards

This appendix describes expansion memory modules for the PB926EJ-S. It contains the following sections:

- *About memory expansion* on page E-2
- *Fitting a memory board* on page E-5
- *EEPROM contents* on page E-6
- *Connector pinout* on page E-13
- *Mechanical layout* on page E-20.

E.1 About memory expansion

You can fit static and dynamic memory expansion boards to the PB926EJ-S:

- There are five chip select signals available on the static expansion board. Each of these can select 64MB of SRAM.
- There are 3 chip select signals available on the dynamic expansion board. Each of these can select 128MB of SDRAM.

The block diagrams for typical memory boards are shown in Figure E-1 and Figure E-2 on page E-3.

— Note —

Figure E-1 and Figure E-2 on page E-3 are examples only. Different expansion boards might have different features. For example, the links selecting which chip select to use might be omitted.

See the documentation provided with your memory board for details on signals and link options.

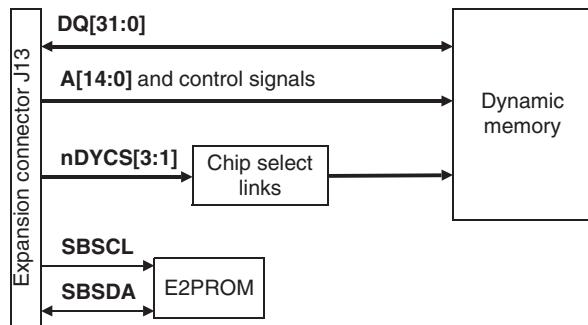


Figure E-1 Dynamic memory board block diagram

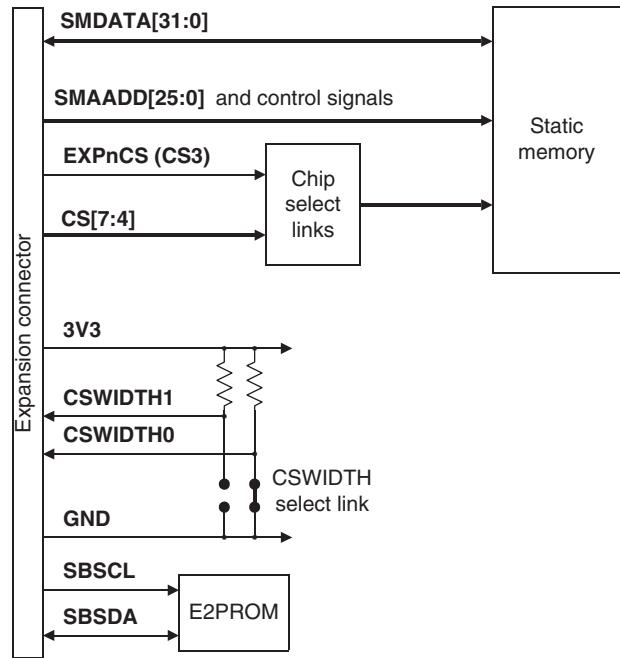


Figure E-2 Static memory board block diagram

E.1.1 Operation without expansion memory

You can operate the PB926EJ-S without a memory expansion board because it has 2MB of SSRAM, 128MB SDRAM, 64MB NOR flash, and 64MB NAND flash permanently fitted.

You can use the expansion boards, however, to prototype or develop memory devices that are not available on the PB926EJ-S.

E.1.2 Memory board configuration

The E2PROM on the memory board can be read from the PB926EJ-S to identify the type of memory on the board and how it is configured. This information can be used by the application or operating system to initialize the memory space.

Memory width selection on the static memory board

The memory width on the memory board is encoded into the **CSWIDTH[1:0]** signals as shown in Table E-1.

Table E-1 Memory width encoding

CSWIDTH[1:0]	Width
00	8 bit
01	16 bit
10	32 bit (default)
11	No memory present

— Note —

Additional configuration information is present in the E2PROM on the expansion board, see *EEPROM contents* on page E-6.

E.2 Fitting a memory board

To install a memory expansion board:

1. Ensure that the PB926EJ-S is powered down.
2. Align the memory expansion board with the connectors on the PB926EJ-S as shown in Figure E-3.
3. Press the module into the connector.

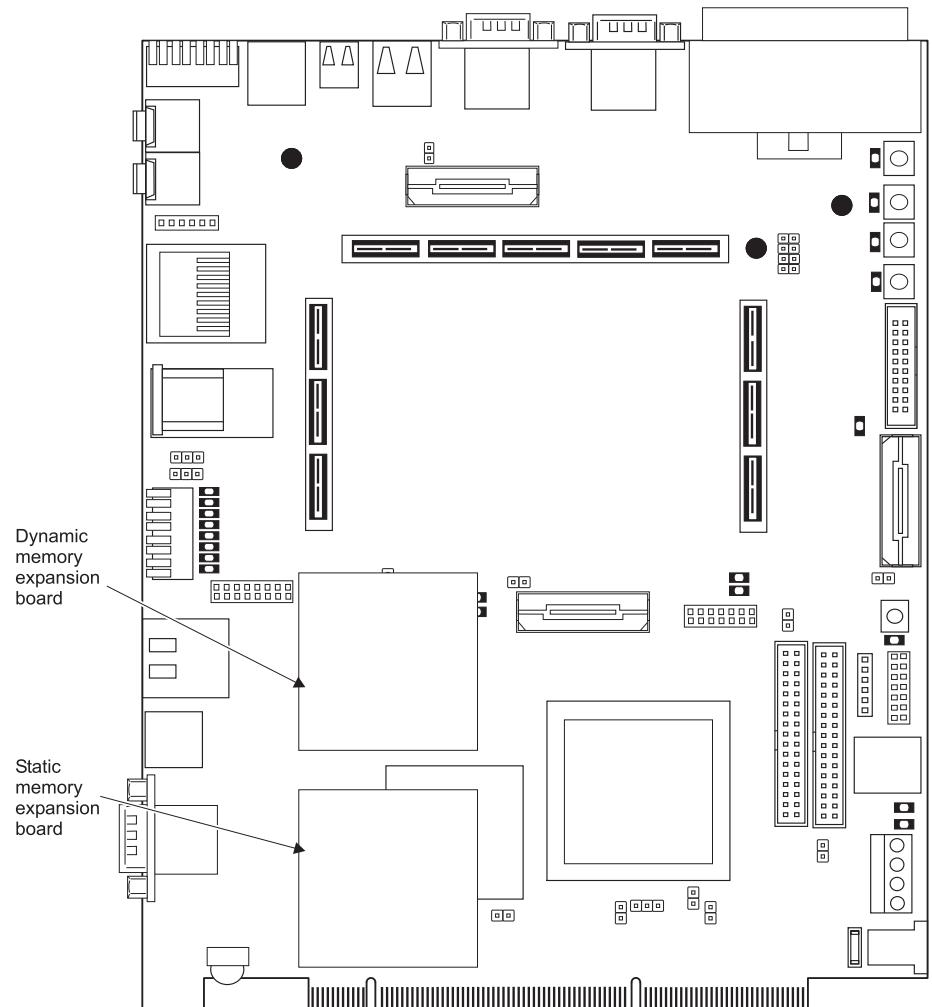


Figure E-3 Memory board installation locations

E.3 EEPROM contents

There are three serial devices on the PB926EJ-S serial bus:

- Dynamic Memory Expansion EEPROM at 0xA0 for write, 0xA1 for read
- Static Memory Expansion EEPROM at 0xA2 for write, 0xA3 for read
- Real Time Clock (Time of Year) at 0xD0 for write, 0xD1 for read

See *Serial bus interface* on page 4-86 for details on the serial bus interface.

Both memory Expansion Proems are 256 bytes in size and have a similar structure:

- Static Memory Expansion EEPROM contains 5 chip select information blocks, a manufacturer string and a checksum.
- Dynamic Memory Expansion EEPROM contains 3 chip select information blocks, a manufacturer string and a checksum.

Each chip select information block contains details about the memory devices accessed with the corresponding chip select signal. The organization of a chip select information block is listed in table Table E-2 on page E-7.

———— Note ————

Table E-2 on page E-7 organization and the examples given are valid for all pre-v1.0 PISMO compliant memory expansion boards. For v1.0 onwards please check the latest PISMO specification at www.pismoworld.org

Table E-2 Chip Select information block

Function	Address offset	Value
Memory Type	0x0	0x0 = Reserved, 0x1 = Static NOR flash 2, 0x2 = Static NOR flash 1, 0x3 = Static SRAM, 0x4-0x80 = Reserved, 0x81 = Single Data Rate SDRAM, 0x82 = Sync Flash, 0x83-0xFE = Reserved, 0xFF = Not fitted.
Memory Width	0x01	Bits [3:0] indicate the chip-select width: 0 = byte wide, 1 = 16-bit wide, 2 = 32-bit wide, 3 = Reserved. Bits [7:4] indicate the device memory width: 0 = byte wide, 1 = 16-bit wide, 2 = 32-bit wide, 3 = Reserved.
Access time	0x02	Two bytes containing the access time (tach) decoded as a binary number of 100ps. Location 2 contains the LSB and location 3 contains the MSB. For example, a flash device with 120ns access is $1200 * 0.1\text{ns}$. The decimal value is 1200 and the hex value is 0x04B0, therefore location 2 contains 0xb0 and location 3 contains 0x04.
Size	0x04	Four bytes containing the size of the memory in bytes location 4 is the LSB and location 7 is MSB.
Reserved	0x08-0x0F	Eight bytes reserved for future expansion
Device string	0x10-0x2F	Null terminated string of up to 32 characters (31 characters + null character) containing the manufacturer name and part number.

The base address of the information block is determined by the device chip select used.

EXPnCS		DYCS1	0x00
CS4		DYCS2	0x30
CS5		DYCS3	0x60
CS6		Not used	0x90
CS7		Not used	0xC0
Board string and CRC		Board string and CRC	0xF0
			0xFF

Static chip select information block Dynamic chip select information block

Figure E-4 Chip select information block

The contents of a typical static memory expansion EEPROM with devices on **EXPnCS** and **CS4** is listed in Table E-3. Unused chip select blocks are filled with 0xFF.

Table E-3 Example contents of a static memory expansion EEPROM

Address offset	Contents	Contents
0x00	EXPnCS memory type	0x02 = Static NOR flash
0x01	EXPnCS memory width	0x12 - 16-bit device memory width, 32 bit chip select width
0x02	EXPnCS access time in 0.1ns (LSB)	0xb0 - LSB (of 1200 which 1200 * 0.1ns = 120ns access time)
0x03	EXPnCS access time in 0.1ns (MSB)	0x04 - MSB (of 1200 which 1200 * 0.1ns = 120ns access time)
0x04	EXPnCS memory size in bytes (LSB)	0x00
0x05	EXPnCS memory size in bytes	0x00
0x06	EXPnCS memory size in bytes	0x00
0x07	EXPnCS memory size in bytes (MSB)	0x04 (0x04000000 Bytes = 64MBytes)

Table E-3 Example contents of a static memory expansion EEPROM (continued)

Address offset	Contents	Contents
0x8-0xF	Reserved	0xFF
0x10-0x2F	EXPnCS memory device string	"Intel GE28F256K3C120" + null character
0x30	CS4 memory type	0x01 = Static SRAM
0x31	CS4 memory width	0x02 - 32 bit wide
0x32	CS4 access time in 0.1ps (LSB)	0x26 - LSB (of 550 which 550 * 0.1ns = 55ns access time)
0x33	CS4 access time in 0.1ps (MSB)	0x02 - MSB (of 550 which 550 * 0.1ns = 55ns access time)
0x34	CS4 memory size in bytes (LSB)	0x00
0x35	CS4 memory size in bytes	0x00
0x36	CS4 memory size in bytes	0x00
0x37	CS4 memory size in bytes (MSB)	0x20 (0x00200000 Bytes = 2MBytes)
0x38-0x3F	Reserved	0xFF
0x40-0x5F	CS4 memory device string	"Samsung K6F8016U6A-F55" + null character
0x60	CS5 memory type	0xFF - not fitted
0x61	CS5 memory width	0xFF
0x62	CS5 access time in 0.1ps (LSB)	0xFF
0x63	CS5 access time in 0.1ps (MSB)	0xFF
0x64	CS5 memory size in bytes (LSB)	0xFF
0x65	CS5 memory size in bytes	0xFF
0x66	CS5 memory size in bytes	0xFF
0x67	CS5 memory size in bytes (MSB)	0xFF
0x68-0x6F	Reserved	0xFF
0x70-0x8F	CS5 memory device string	0xFF
0x90	CS6 memory type	0xFF - not fitted
0x91	CS6 memory width	0xFF

Table E-3 Example contents of a static memory expansion EEPROM (continued)

Address offset	Contents	Contents
0x92	CS6 access time in 0.1ps (LSB)	0xFF
0x93	CS6 access time in 0.1ps (MSB)	0xFF
0x94	CS6 memory size in bytes (LSB)	0xFF
0x95	CS6 memory size in bytes	0xFF
0x96	CS6 memory size in bytes	0xFF
0x97	CS6 memory size in bytes (MSB)	0xFF
0x98-0x9F	Reserved	0xFF
0xA0-0xBF	CS6 memory device string	0xFF
0xC0	CS7 memory type	0xFF - not fitted
0xC1	CS7 memory width	0xFF
0xC2	CS7 access time in 0.1ps (LSB)	0xFF
0xC3	CS7 access time in 0.1ps (MSB)	0xFF
0xC4	CS7 memory size in bytes (LSB)	0xFF
0xC5	CS7 memory size in bytes	0xFF
0xC6	CS7 memory size in bytes	0xFF
0xC7	CS7 memory size in bytes (MSB)	0xFF
0xC8-0xCF	Reserved	0xFF
0xD0-0xEF	CS7 memory device string	0xFF
0xF0-0xFE	Board manufacturer string	"ARM HBI0124A"+ null character
0xFF	Checksum Byte	The LSB of the sum of bytes 0x00-0xFE

The contents of a typical dynamic memory expansion EEPROM with devices on **DYCS1** and **DYCS2** is listed in Table E-4 on page E-11.

Table E-4 Example contents of a dynamic memory expansion EEPROM

Address	Contents	Example contents
0x00	DYCS1 memory type	0x81 - Single Data Rate SDRAM
0x01	DYCS1 memory width	0x12 - 32 bit chip select width, 16-bit device memory width
0x02	DYCS1 access time in 0.1ps (LSB)	0x4B - LSB (of 75 which $75 * 0.1\text{ns} = 7.5\text{ns}$ access time)
0x03	DYCS1 access time in 0.1ps (MSB)	0x00 - MSB
0x04	DYCS1 memory size in bytes (LSB)	0x00
0x05	DYCS1 memory size in bytes	0x00
0x06	DYCS1 memory size in bytes	0x00
0x07	DYCS1 memory size in bytes (MSB)	0x08 (0x08000000 Bytes = 64MBytes)
0x08-0x0F	Reserved	0xFF
0x10-0x2F	DYCS1 memory device string	"Infineon HYB39S512160AT-7.5"
0x30	DYCS2 memory type	0x81 - Single Data Rate SDRAM
0x31	DYCS2 memory width	0x02 - 32 bit wide
0x32	DYCS2 access time in 0.1ps (LSB)	0x4B - LSB (of 75 which $75 * 0.1\text{ns} = 7.5\text{ns}$ access time)
0x33	DYCS2 access time in 0.1ps (MSB)	0x00 - MSB
0x34	DYCS2 memory size in bytes (LSB)	0x00
0x35	DYCS2 memory size in bytes	0x00
0x36	DYCS2 memory size in bytes	0x00
0x37	DYCS2 memory size in bytes (MSB)	0x08 (0x08000000 Bytes = 64MBytes)
0x38-0x3F	Reserved	0xFF
0x40-0x5F	DYCS2 memory device string	"Infineon HYB39S512160AT-7.5"
0x60	DYCS3 memory type	0xFF - not fitted
0x61	DYCS3 memory width	0xFF
0x62	DYCS3 access time in 0.1ps (LSB)	0xFF
0x63	DYCS3 access time in 0.1ps (MSB)	0xFF
0x64	DYCS3 memory size in bytes (LSB)	0xFF

Table E-4 Example contents of a dynamic memory expansion EEPROM (continued)

Address	Contents	Example contents
0x65	DYCS3 memory size in bytes	0xFF
0x66	DYCS3 memory size in bytes	0xFF
0x67	DYCS3 memory size in bytes (MSB)	0xFF
0x68-0x6F	Reserved	0xFF
0x70-0x8F	DYCS3 memory device string	0xFF
0x90-0xEF	Reserved	0xFF
0xF0-0xFE	Board manufacturer string	"ARM HBI0123A"
0xFF	Checksum Byte	The LSB of the sum of bytes 0x00 to 0xFE

E.4 Connector pinout

This section describes the connectors present on the expansion memory boards.

E.4.1 Expansion connector

The static and dynamic memory expansion boards use 120-way Samtec connectors as shown in Figure E-5. The connector pinout for the dynamic memory board is shown in Table E-5 on page E-14. The connector pinout for the static memory board is shown in Table E-6 on page E-16.

— Note —

The numbering of pins on the connectors is for the connectors as viewed from below.

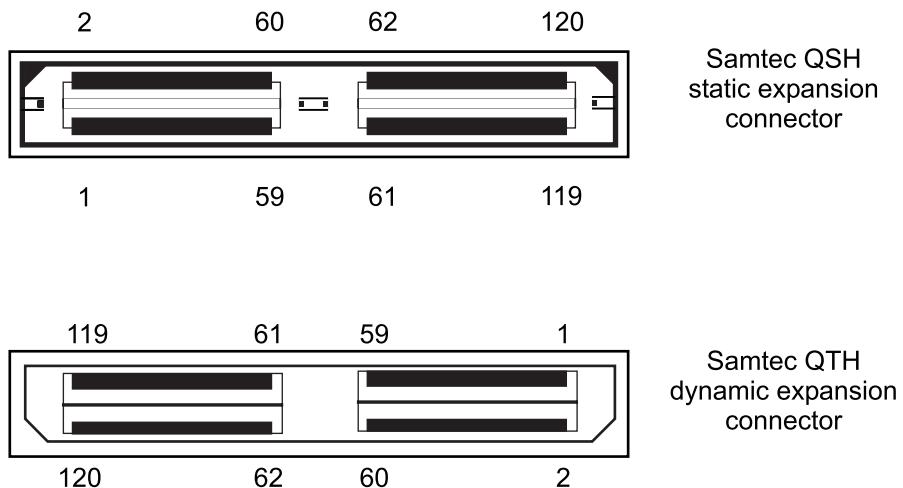


Figure E-5 Samtec connector

— Note —

Table E-5 on page E-14 and Table E-6 on page E-16 pinout and naming are valid for all pre-v1.0 PISMO compliant memory expansion boards. For v1.0 onwards please check the latest PISMO specification at www.pismoworld.org

Table E-5 SDR, Single data rate dynamic memory connector signals

Pin No.	Signal	Pin No.	Signal
1	DATA[0]	2	3V3
3	DATA[1]	4	3V3
5	DATA[2]	6	3V3
7	DATA[3]	8	3V3
9	DATA[4]	10	VDDIO^a
11	DATA[5]	12	VDDIO^a
13	DATA[6]	14	VDDIO^a
15	DATA[7]	16	VDDIO^a
17	DATA[8]	18	1V8
19	DATA[9]	20	1V8
21	DATA[10]	22	1V8
23	DATA[11]	24	1V8
25	DATA[12]	26	NC
27	DATA[13]	28	Reserved, do not drive
29	DATA[14]	30	Reserved, do not drive
31	DATA[15]	32	Reserved, do not drive
33	DATA[16]	34	5V
35	DATA[17]	36	5V
37	DATA[18]	38	5V
39	DATA[19]	40	5V
41	DATA[20]	42	Reserved, do not drive
43	DATA[21]	44	Reserved, do not drive
45	DATA[22]	46	Reserved, do not drive
47	DATA[23]	48	Reserved, do not drive
49	DATA[24]	50	Reserved, do not drive

Table E-5 SDR, Single data rate dynamic memory connector signals (continued)

Pin No.	Signal	Pin No.	Signal
51	DATA[25]	52	Reserved, do not drive
53	DATA[26]	54	Reserved, do not drive
55	DATA[27]	56	Reserved, do not drive
57	DATA[28]	58	Reserved, do not drive
59	DATA[29]	60	Reserved, do not drive
61	DATA[30]	62	SBSCL , E2PROM serial interface clock (3.3V signal level)
63	DATA[31]	64	SBSDA , E2PROM serial interface data (3.3V signal level)
65	ADDR[0]	66	nRESET
67	ADDR[1]	68	nBOARDPOR
69	ADDR[2]	70	NC
71	ADDR[3]	72	NC
73	ADDR[4]	74	NC
75	ADDR[5]	76	NC
77	ADDR[6]	78	NC
79	ADDR[7]	80	NC
81	ADDR[8]	82	NC
83	ADDR[9]	84	NC
85	ADDR[10]	86	NC
87	ADDR[11]	88	NC
89	ADDR[12]	90	NC
91	ADDR[13]	92	NC
93	ADDR[14]	94	NC
95	DQM[0] , data mask input to SDRAMs	96	NC

Table E-5 SDR, Single data rate dynamic memory connector signals (continued)

Pin No.	Signal	Pin No.	Signal
97	DQM[1] , data mask input to SDRAMs	98	NC
99	DQM[2] , data mask input to SDRAMs	100	NC
101	DQM[3] , data mask input to SDRAMs	102	NC
103	nRAS	104	NC
105	nCAS	106	NC
107	nWE	108	NC
109	nDYCS[0] , SDRAM chip select	110	CKE[2] , clock enable
111	nDYCS[1] , SDRAM chip select	112	CKE[3] , clock enable
113	nDYCS[2] , SDRAM chip select	114	nRPOUT , SyncFlash reset power down
115	nDYCS[3] , SDRAM chip select	116	RPVHHOUT , Voltage control for Micro SyncFlash reset signal
117	CKE[0] , clock enable	118	CLK[2] , clock out
119	CKE[1] , clock enable	120	CLK[3] , clock out

a. **VDDIO** is the I/O voltage to host. This is not routed through on stackable boards.

Table E-6 Static memory connector signals

Pin No.	Signal	Pin No.	Signal
1	DATA[0]	2	3V3
3	DATA[1]	4	3V3
5	DATA[2]	6	3V3
7	DATA[3]	8	3V3
9	DATA[4]	10	VDDIO^a
11	DATA[5]	12	VDDIO^a
13	DATA[6]	14	VDDIO^a

Table E-6 Static memory connector signals (continued)

Pin No.	Signal	Pin No.	Signal
15	DATA[7]	16	VDDIO^a
17	DATA[8]	18	1V8
19	DATA[9]	20	1V8
21	DATA[10]	22	1V8
23	DATA[11]	24	1V8
25	DATA[12]	26	NC
27	DATA[13]	28	Reserved, do not drive
29	DATA[14]	30	Reserved, do not drive
31	DATA[15]	32	Reserved, do not drive
33	DATA[16]	34	5V
35	DATA[17]	36	5V
37	DATA[18]	38	5V
39	DATA[19]	40	5V
41	DATA[20]	42	Reserved, do not drive
43	DATA[21]	44	Reserved, do not drive
45	DATA[22]	46	Reserved, do not drive
47	DATA[23]	48	Reserved, do not drive
49	DATA[24]	50	Reserved, do not drive
51	DATA[25]	52	Reserved, do not drive
53	DATA[26]	54	Reserved, do not drive
55	DATA[27]	56	Reserved, do not drive
57	DATA[28]	58	Reserved, do not drive
59	DATA[29]	60	Reserved, do not drive
61	DATA[30]	62	SBSCL , E2PROM serial interface clock (3.3V signal level)

Table E-6 Static memory connector signals (continued)

Pin No.	Signal	Pin No.	Signal
63	DATA[31]	64	SBSDA , E2PROM serial interface data (3.3V signal level)
65	ADDR[0]	66	nRESET
67	ADDR[1]	68	nBOARDPOR , asserted on hardware power cycle
69	ADDR[2]	70	nFLWP , flash write protect. Drive HIGH to write to flash.
71	ADDR[3]	72	nEARLYRESET , Reset signal. Differs from nRESET in that it is not delayed by nWAIT .
73	ADDR[4]	74	nWAIT , Wait mode input from external memory controller. Pull HIGH if not used.
75	ADDR[5]	76	nBURSTWAIT , Synchronous burst wait input. This is used by the external device to delay a synchronous burst transfer if LOW. Pull to HIGH if not used.
77	ADDR[6]	78	CANCELWAIT , If HIGH, this signal enables the system to recover from an externally waited transfer that has taken longer than expected to finish. Pull LOW if not used.
79	ADDR[7]	80	nCS[4]
81	ADDR[8]	82	nCS[3]
83	ADDR[9]	84	nCS[2]
85	ADDR[10]	86	nCS[1]
87	ADDR[11]	88	Reserved, do not drive
89	ADDR[12]	90	Reserved, do not drive
91	ADDR[13]	92	Reserved, do not drive
93	ADDR[14]	94	Reserved, do not drive

Table E-6 Static memory connector signals (continued)

Pin No.	Signal	Pin No.	Signal
95	ADDR[15]	96	nCS[0]
97	ADDR[16]	98	nBUSY , Indicates that memory is not ready to be released from reset. If LOW, this signal holds nRESET active.
99	ADDR[17]	100	nIRQ
101	ADDR[18]	102	nWEN
103	ADDR[19]	104	nOEN
105	ADDR[20]	106	nBLS[3] , Byte Lane Select for bits [31:24]
107	ADDR[21]	108	nBLS[2] , Byte Lane Select for bits [23:16]
109	ADDR[22]	110	nBLS[1] , Byte Lane Select for bits [15:8]
111	ADDR[23]	111	nBLS[0] , Byte Lane Select for bits [7:0]
113	ADDR[24]	114	CSWIDTH[0] , Indicates bus width for fitted part. Do not route through stackable boards.
115	ADDR[25]	116	CSWIDTH[1] , Indicates bus width for fitted part. Do not route through stackable boards.
117	ADDRVALID , Indicates that the address output is stable during synchronous burst transfers	118	CLK[1]
119	BAA , Burst Address Advance. Used to advance the address count in the memory device	120	CLK[0]

a. VDDIO is the data voltage to host. Do not route through on stackable boards

E.5 Mechanical layout

Figure E-6 shows the dynamic memory expansion board (viewed from above).

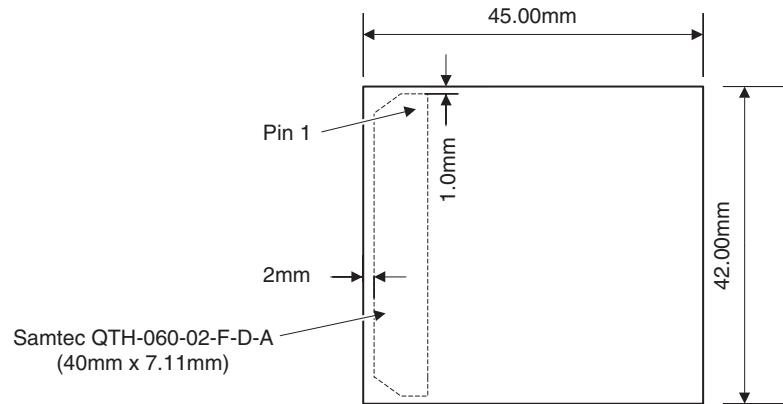


Figure E-6 Dynamic memory board layout

Figure E-7 shows the static memory expansion board (viewed from above).

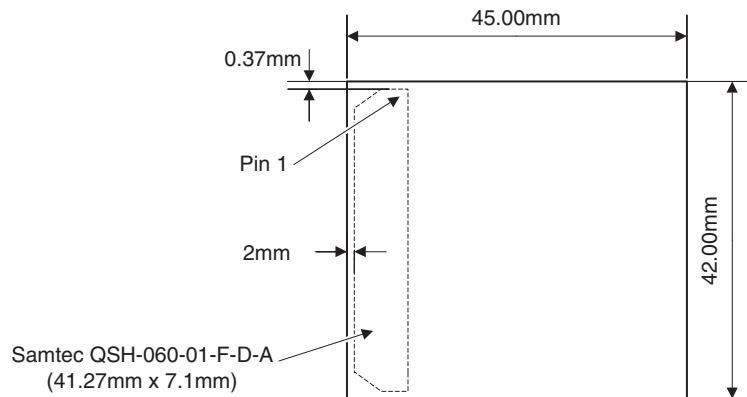


Figure E-7 Static memory board layout

Appendix F

RealView Logic Tile

This appendix describes the signals present on the RealView Logic Tile expansion headers and give the steps required to install a RealView Logic Tile on the PB926EJ-S. It contains the following sections:

- *About the RealView Logic Tile* on page F-2
- *Fitting a RealView Logic Tile* on page F-3
- *Header connectors* on page F-4.

F.1 About the RealView Logic Tile

The ARM RealView Logic Tiles, such as the LT-XC2V6000, enable developing AMBA AHB and APB peripherals, or custom logic, for use with ARM cores. Figure F-1 shows the RealView Logic Tile signals present on the PB926EJ-S connectors.

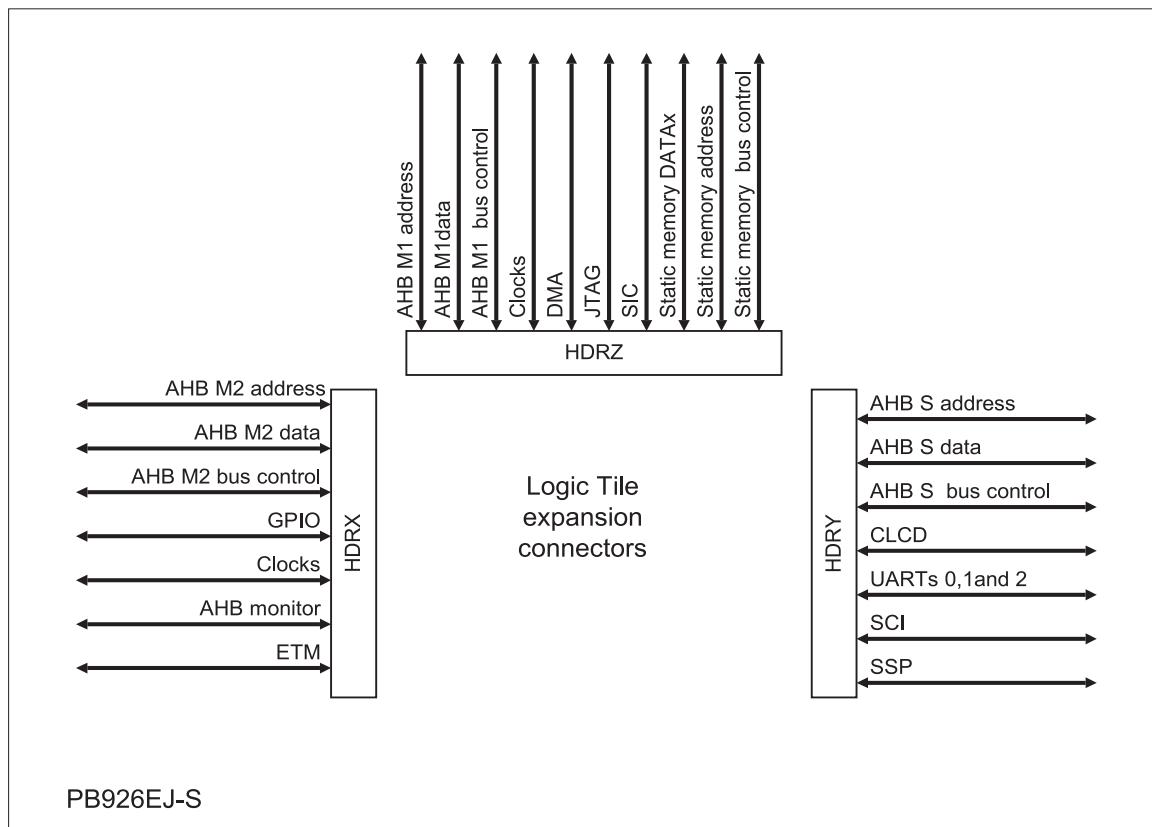


Figure F-1 Signals on the RealView Logic Tile expansion connectors

———— Note ————

If you connect a RealView Logic Tile, the design in the tile FPGA must implement logic to handle the AHB bus signals (see *AHB buses used by the FPGA and RealView Logic Tiles* on page F-11).

F.2 Fitting a RealView Logic Tile

Figure F-2 shows a RealView Logic Tile mounted on the PB926EJ-S.

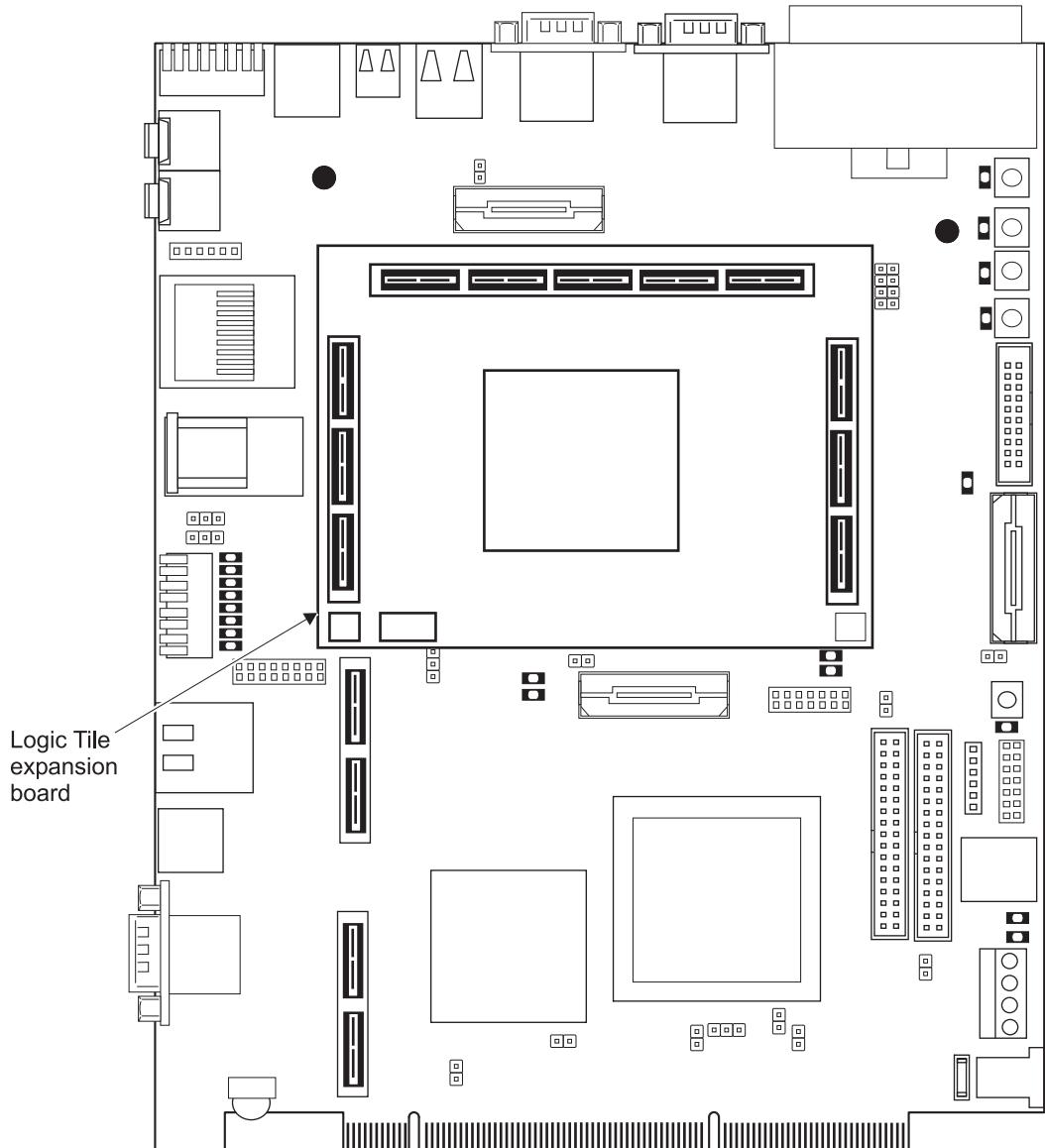


Figure F-2 RealView Logic Tile fitted on PB926EJ-S

F.3 Header connectors

This section gives an overview of the RealView Logic Tile header connectors on the PB926EJ-S. For more detail, see the documentation for your RealView Logic Tile.

There are three headers on the top and bottom of the tile. The HDRX and HDRY headers are 180-way and the HDRZ connectors are 300-way.

———— Warning ————

There is a limit to the number of RealView Logic Tiles which can be stacked on a RealView baseboard. For the PB926EJ-S the recommended limit is two.

When stacking tiles ensure that the power source can maintain the required voltage at the top tile when supplying maximum current to the system. If necessary, use a separate bench supply or power the system from a PCI backplane. See *Current requirements from J34* on page B-3 for further details.

———— Caution ————

The FPGA signals on a RealView Logic Tile and the PB926EJ-S are fully programmable. Ensure that there are no clashes between the signals on the tiles or with the signals from the PB926EJ-S.

The FPGA can be damaged if several pins configured as outputs are connected together and attempt to output different logic levels.

Figure F-3 on page F-5 shows the pin numbers and power-blade usage of the HDRX, HDRY, and HDRZ headers on the upper side of the tile. See *RealView Logic Tile header connectors* on page A-17 for details of the signals on the PB926EJ-S header connectors.

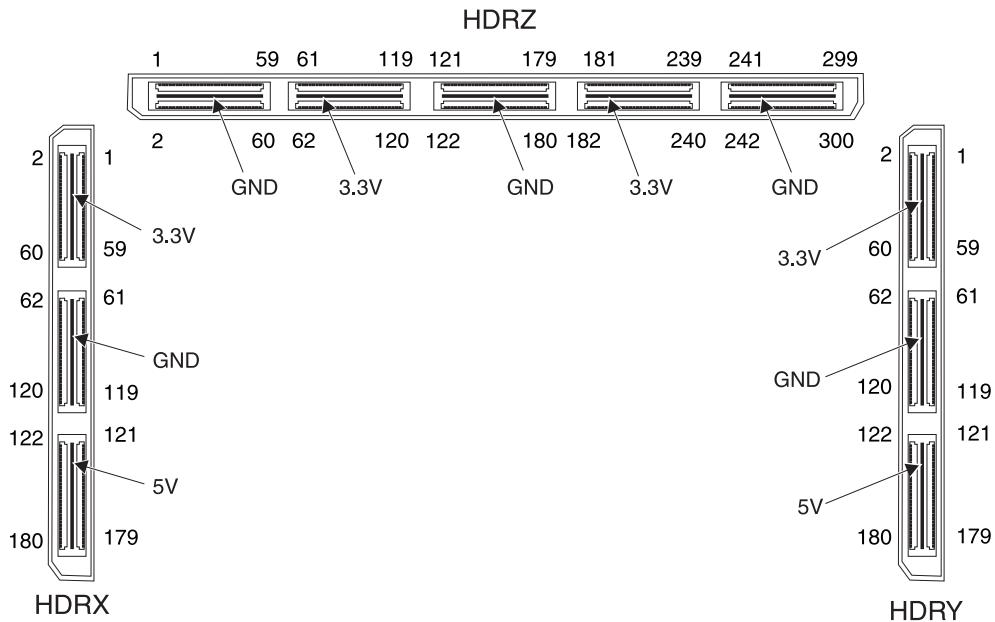


Figure F-3 HDRX, HDRY, and HDRZ (upper) pin numbering

F.3.1 JTAG

The JTAG signals for the FPGA on the RealView Logic Tile are routed through the headers to the tile at the top of the stack and from there back down through the tile. There is not a JTAG connector on the RealView Logic Tile. Use the JTAG or USB debug connector on the PB926EJ-S.

If multiple RealView Logic Tiles are stacked on a PB926EJ-S, the JTAG equipment is always connected to the PB926EJ-S and the signals are routed upwards to the top tile and then back down to the PB926EJ-S.

Use the JTAG interface to program the configuration flash in the RealView Logic Tile or to directly load the RealView Logic Tile FPGA image. For more information on JTAG signals, see *JTAG and USB debug port support* on page 3-96.

F.3.2 Variable I/O levels

All HDRX, HDRY, and HDRZ connector signals on the PB926EJ-S are fixed at 3.3V I/O signalling level.

Caution

The RealView Logic Tile mounted on the PB926EJ-S must use the default 3.3V signal levels.

F.3.3 RealView Logic Tile I/O

The signals from the UART0, UART1, UART2, SSP, and SCI connectors to the ARM926EJ-S PXP Development Chip can be isolated by pulling the **nDRVINENx** signals HIGH. This enables logic in the RealView Logic Tile to safely drive the Development Chip signals without contention with external devices on the connectors (see Figure F-4).

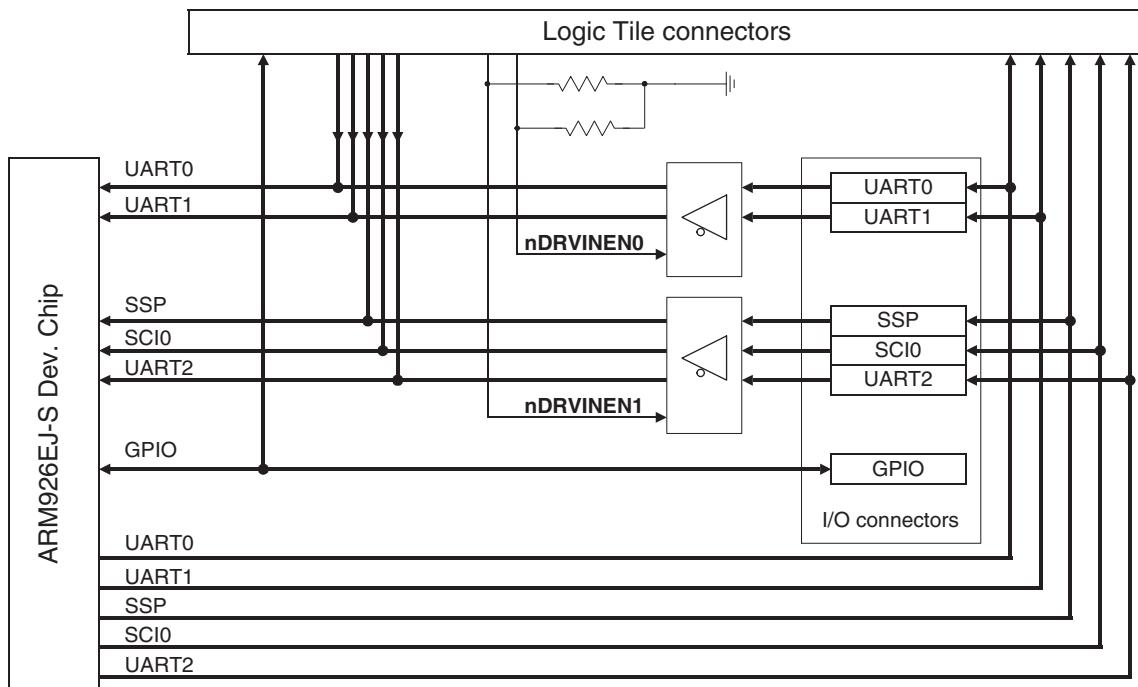


Figure F-4 RealView Logic Tile tristate for I/O

F.3.4 RealView Logic Tile clocks

The PB926EJ-S can receive the global clock or transmit the global clock to all of the boards in the RealView Logic Tile stack. Table F-1 on page F-8 lists the RealView Logic Tile clocks. Also, the clock multiplexor can select clock signals from the RealView Logic Tiles as the source for the M1, M2, and S clocks.

The **CLK_GLOBAL** signal is present on all RealView Logic Tiles. The signal goes to the **CLK_GLOBAL_IN** input of the FPGAs on the tiles.

The FPGA on each tile outputs a **CLK_GLOBAL_OUT** signal to a tristate buffer. If the tile signal **CLK_GLOBAL_OUT_nEN** is LOW, the local tile signal **CLK_GLOBAL_OUT** becomes the global clock for the system.

Caution

If the tile signal **CLK_GLOBAL_OUT_nEN** is LOW, the RealView Logic Tile drives the **CLK_GLOBAL** signal. Ensure that **nGLOBALCLKEN** (signal **Z50** on the RealView Logic Tile) is driven HIGH to disable the clock driver on the PB926EJ-S:

- If **CLK_GLOBAL_OUT_nEN** is HIGH and **Z50** is LOW, both the RealView Logic Tile and PB926EJ-S sources for **CLK_GLOBAL** are disabled and there will not be a clock signal present on **CLK_GLOBAL**.
- If **CLK_GLOBAL_OUT_nEN** is LOW and **Z50** is LOW, both the RealView Logic Tile and PB926EJ-S sources for **CLK_GLOBAL** are enabled and the two **CLK_GLOBAL** signals will conflict.

OSCCLK0 from OSC0 on the PB926EJ-S is the default reference clock for **XTALCLKDRV**. **XTALCLKDRV** is normally used as the source for the Logic Tile **CLK_GLOBAL** signal and for the PB926EJ-S **GLOBALCLK**, external AHB bridge clocks, and the PLL reference **CPUCLK** signals.

The M1, M2, and S clocks for the FPGA and the development chip are selected by the multiplexing circuitry described in *Operating the AHB bridges in asynchronous mode* on page 3-44.

Note

Some of the standard RealView Logic Tile clocks, **CLK_NEG_DN_IN** for example, are not used.

Also some clocks that are inputs to the bus clock multiplexors, **HCLKM1L2F** for example, are not normally clock outputs on the RealView Logic Tile.

Ensure that your RealView Logic Tile configuration is compatible with the clock sources you are using on the PB926EJ-S. See *RealView Logic Tile clocks* on page 3-52 for more information on clock selection and routing.

Table F-1 RealView Logic Tile clock signals

PB926EJ-S signal	RealView Logic Tile signal (top header)	Direction	Description
GLOBALCLK	CLK_GLOBAL	I/O	Global clock connected to all RealView Logic Tiles. Each tile and the PB926EJ-S can accept or generate the clock.
nGLOBALCLKEN	Z50	To VPB	If driven HIGH by the RealView Logic Tile, this signal disables the local source for GLOBALCLK on the PB926EJ-S and allows the RealView Logic Tile to supply GLOBALCLK . The signal is normally pulled LOW by a resistor to ground within the FPGA. The state of nGLOBALCLKEN can be read from the HCLKCTL[0] bit in the SYS_CONDATA1 register (see <i>Configuration registers SYS_CFGDATAx</i> on page 4-25).
HCLKM2F2L	ZU217	To tile	FPGA M2 clock to RealView Logic Tile.
NC	CLK_NEG_DN_IN	-	-
NC	CLK_POS_DN_IN	-	-
HCLKSF2L	CLK_NEG_UP_OUT	To tile	FPGA S clock to RealView Logic Tile.
HCLKM1F2L	CLK_POS_UP_OUT	To tile	FPGA M1 clock to RealView Logic Tile.
NC	CLK_UP_THRU	-	-
LT_SMCLK0	CLK_OUT_PLUS1	To tile	Static memory clock 0 to RealView Logic Tile.
LT_SMCLK1	CLK_OUT_PLUS2	To tile	Static memory clock 1 to RealView Logic Tile.
NC	CLK_IN_PLUS1	-	-
NC	CLK_IN_PLUS2	-	-
NC	CLK_DN_THRU	-	-
HCLKM1L2F	XU128	From tile	RealView Logic Tile clock to multiplexor that provides M1 clock for the FPGA.

Table F-1 RealView Logic Tile clock signals (continued)

PB926EJ-S signal	RealView Logic Tile signal (top header)	Direction	Description
HCLKM2L2F	XU129	From tile	RealView Logic Tile clock to multiplexor that provides M2 clock for the FPGA.
HCLKSL2F	XU130	From tile	RealView Logic Tile clock to multiplexor that provides S clock for the FPGA.
HCLKM1L2S	XU131	From tile	RealView Logic Tile clock to multiplexor that provides M1 clock for the development chip.
HCLKM2L2S	XU132	From tile	RealView Logic Tile clock to multiplexor that provides M2 clock for the development chip.
HCLKSL2S	XU133	From tile	RealView Logic Tile clock to multiplexor that provides S clock for the development chip.
AHBMONCLK1	XU93	To tile	AHB monitor clock from ARM926EJ-S PXP Development Chip to RealView Logic Tile.

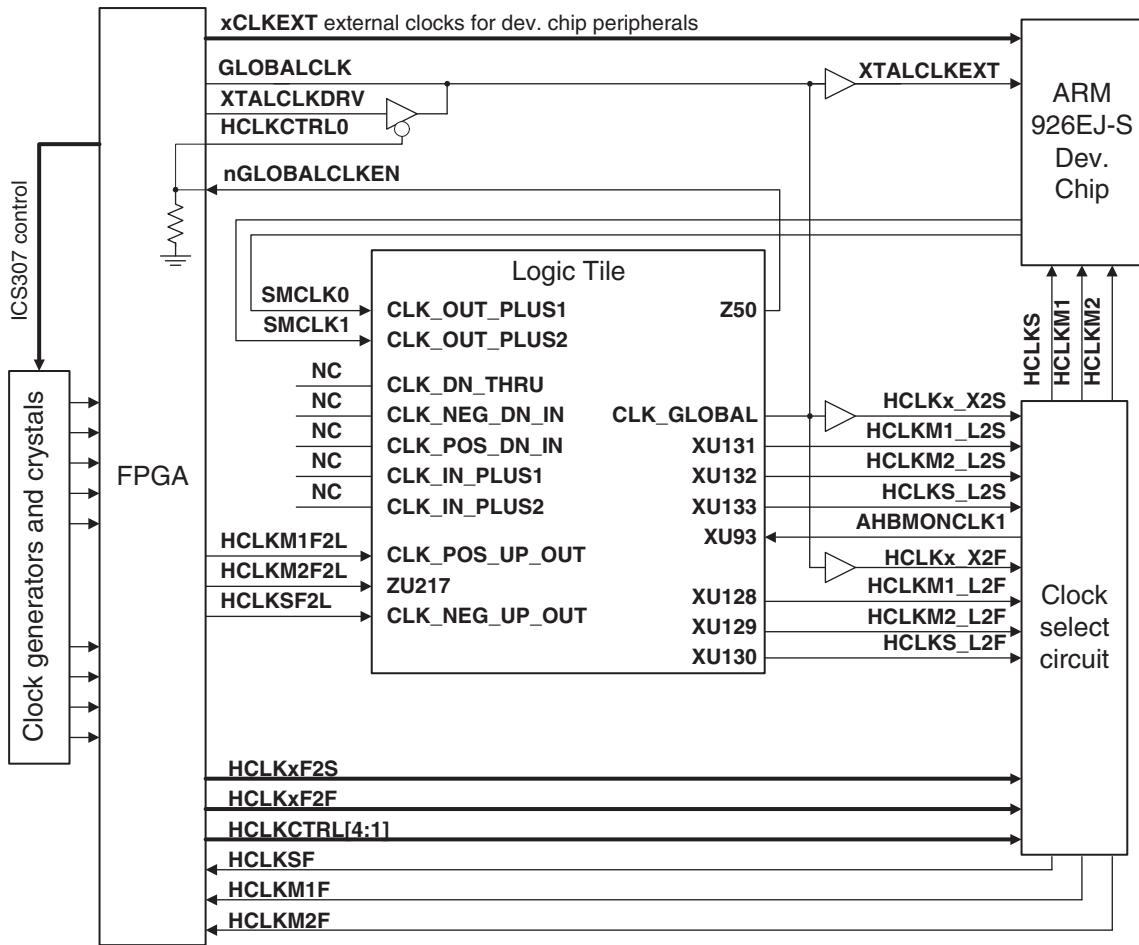


Figure F-5 Clock signals and the RealView Logic Tile

F.3.5 AHB buses used by the FPGA and RealView Logic Tiles

AHB M1, AHB M2, and AHB S buses are connected to both the FPGA and to the RealView Logic Tile stack. However, the user-implemented system in the tile must co-operate with the system implemented within the PB926EJ-S FPGA when using these buses:

- AHB M1** The AHB M1 bus can only be connected to AHB slaves in the Logic Tile stack.
- AHB M2** The AHB M2 bus can only be connected to AHB slaves in the Logic Tile stack.
- AHB S** The AHB S bus can only be connected to AHB masters in the Logic Tile stack. The Logic Tile AHB master can access an AHB M1 or AHB M2 slave in a logic tile by passing the access through the bus matrix in the development chip.

AHB M1

The PB926EJ-S FPGA does not contain any slaves attached to the AHB M1 bus. The ARM926EJ-S PXP Development Chip memory map assigns the top 2GB of address space (0x80000000–0xFFFFFFFF) to this bus, so a RealView Logic Tile can contain user-supplied slaves that occupy any of this space. The RealView Logic Tile FPGA must give a response to all transfers that are generated on the AHB M1 bus, even those to addresses in the range 0x00000000–0x7FFFFFF. The PB926EJ-S never generates these addresses on the AHB M1 bus. A separate tile master might, however, generate accesses to this region.

It is normal to direct any unwanted transfers to a "default" slave that issues an AHB ERROR response to any active transfers, but a simple zero wait-state OKAY response would be sufficient to ensure that a system functions correctly. (This is analogous to an Integrator Logic Module being responsible for all of the 256MB allocated to the Logic Module, even if the user-supplied peripherals occupy only a small address space).

If there is not a RealView Logic Tile fitted, pull-up and pull-down resistors on the PB926EJ-S ensure that all AHB M1 transfers receive a zero-wait state OK response.

AHB M2

Transactions in the addresses range 0x14000000–0x1FFFFFF are directed to AHB M2 by the ARM926EJ-S PXP Development Chip, but do not select any of the slaves within the PB926EJ-S FPGA.

These addresses can be used for expansion slaves within a RealView Logic Tile. If a RealView Logic Tile contains multiple expansion AHB slaves on AHB M2 then it must also include a multiplexor to combine these slave outputs. The final stage of

multiplexing to combine with the PB926EJ-S slave outputs must be done with tristates in the RealView Logic Tile FPGA and PB926EJ-S FPGA. (This combination of multiplexing and tristates is identical to that used in Integrator Modules).

It is recommended to use AHB M1 (not AHB M2) for expansion slaves in a RealView Logic Tile. The large address space will permit simpler decoding which will allow the bus to run faster. Avoiding the AHB M2 bus will make development simpler because design errors will not stop the PB926EJ-S peripherals from working. The RealView Logic Tile FPGA must respond to all transfers in the range 0x14000000–0x1F000000. These addresses could be directed to a default slave as described in *AHB M1* on page F-11 or to a simple zero-wait state OKAY response. The **HRESP** and **HREADY** outputs must be tristated if other addresses are selected.

If there is not a RealView Logic Tile fitted, a default slave in the PB926EJ-S FPGA is enabled and accesses to this range receive a simple zero-wait state OKAY response to BUSY and IDLE requests. An ABORT response is returned for active transfers.

AHB S

The PCI bridge in PB926EJ-S FPGA contains an AHB master that can drive the AHB S port of the ARM926EJ-S PXP Development Chip. If a RealView Logic Tile implements another expansion master then it also must add an arbiter for this AHB. This arbiter takes **HBUSREQ** from the PCI master in the FPGA and drives **HGRANT** back to that master. If the RealView Logic Tile does not contain any expansion AHB masters then it should drive **HGRANT** permanently to 1. There is a pullup resistor that does this when no LT is present.

If a RealView Logic Tile contains multiple expansion AHB masters then it must also include a multiplexor to combine these master outputs. The final stage of multiplexing to combine with the PCI master outputs must be done with tristates in the RealView Logic Tile FPGA and RealView FPGAs (This combination of muxing and tristates is identical to that used in Integrator Modules).

A RealView Logic Tile that implements a master on the AHB S bus can also access an AHB M1 or AHB M2 slave implemented in the same RealView Logic Tile or in a different RealView Logic Tile in the tile stack. After the RealView Logic Tile is granted control of the S bus, requests to the slave buses on the tiles are decoded by the bus matrix in the development chip.

Example RealView Logic Tile implementation

Figure F-6 on page F-13 shows a RealView Logic Tile that has a single master and several slaves.

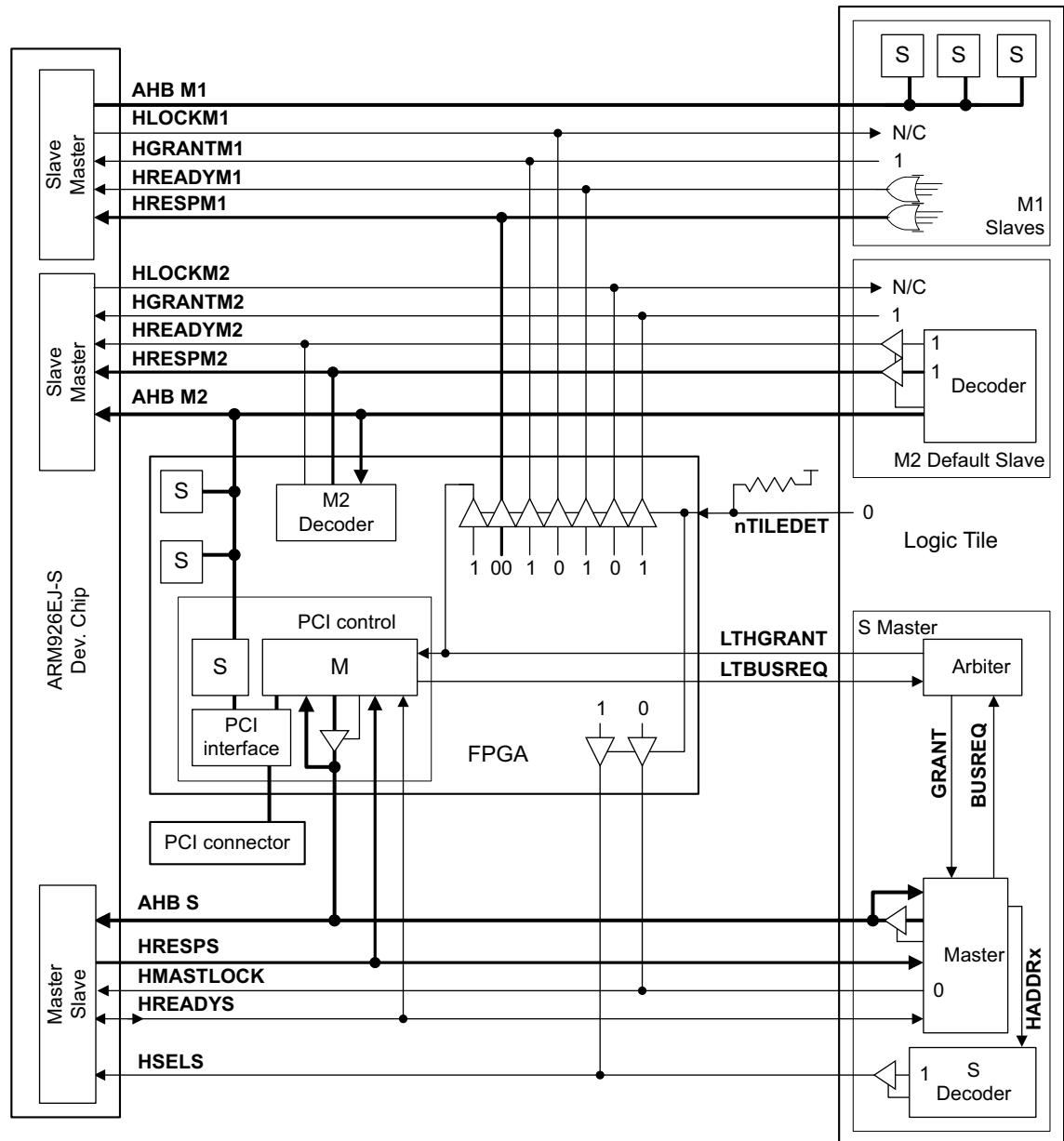


Figure F-6 Bus signals for RealView Logic Tile and FPGA

F.3.6 Reset

A user design in a RealView Logic Tile can reset the PB926EJ-S by driving the **nSRST** signal LOW. This has the same effect as pushing the reset button and forces the reset controller to the level specified by the **SYS_RESETCTL** register (see also, *Reset Control Register, SYS_RESETCTL* on page 4-31). **nSRST** is synchronized by the reset controller and can be driven from any clock source. It must, however, be driven active for a minimum of 84ns (two cycles of 24MHz) to ensure that it is sampled by the reset controller. In order to avoid a deadlock condition, the user design must stop driving the **nSRST** signal after **nRESET** is asserted.

nSRST is active low and open-drain. It is shared with the JTAG interface and must not be driven to HIGH state. A resistor on the PB926EJ-S pulls the signal HIGH.

The RealView Logic Tile also uses the **nPORESET** signal to generate a local **D_nTRST** pulse.

The **GLOBAL_DONE** signal is held LOW until the FPGA on the RealView Logic Tile has finished configuration. The system is held in reset until this signal goes HIGH.

Appendix G

Configuring the USB Debug Connection

When you install the RealView® ICE Micro Edition software that is provided with RVDS version 2.1 or higher, various features are added to the RealView® Debugger. This appendix explains how to use these additional features to configure the PB926EJ-S USB debug port connection, and how to connect RealView Debugger to the PB926EJ-S. It contains the following sections:

- *Installing the RealView ICE Micro Edition driver* on page G-2
- *Changes to RealView Debugger* on page G-5
- *Using the USB debug port to connect RealView Debugger* on page G-6
- *Using the Debug tab of the RealView Debugger Register pane* on page G-10.

Note

This chapter assumes that you are familiar with how to use RealView Debugger to connect to a target, and to configure a connection. For details, refer to the RealView Debugger documentation suite (see the *RealView Debugger v1.7 Target Configuration Guide*) and the *RealView ICE User Guide*.

G.1 Installing the RealView ICE Micro Edition driver

The first time you connect a USB cable between the USB debug port on the PB926EJ-S and your computer, the Windows operating system Plug and Play manager detects the unit and launches the Add New Hardware Wizard to install the RealView ICE Micro Edition driver. If the wizard does not appear, you can run it manually from the Control Panel.

The installation process varies depending on the operating system you are using. See the following sections:

- *Installing the RealView ICE Micro Edition driver on Windows 98SE*
- *Installing the RealView ICE Micro Edition driver on Windows 2000* on page G-3
- *Installing the RealView ICE Micro Edition driver on Windows XP Professional* on page G-4.

G.1.1 Installing the RealView Developer Suite

The basic components of RVDS 2.1 (or higher) and the RVI-ME component of RVD 1.7 (or higher) must already be present on your workstation before you begin configuring the USB debug port software. To install the RVDS software:

1. See the installation instructions provided with RVDS for details on installing that product.
2. After you have installed RVDS using the standard installation procedure, rerun the RVDS installation, but select **Custom** installation instead of **Typical** installation.
3. From the displayed list of items that can be installed, select only the RVI-ME software and click **OK**.
4. Continue the installation as described in the documentation supplied with RVDS.

G.1.2 Installing the RealView ICE Micro Edition driver on Windows 98SE

To install the RealView ICE Micro Edition driver on Windows 98SE:

1. Ensure that no RealView Debugger component is running.
2. Connect a USB cable between the USB debug port and your computer. The Add New Hardware Wizard is launched, and tells you that Windows has found the RealView ICE Micro Edition device.
3. Click **Next**. Select **Search for the best driver for your device**.

4. Click **Next**. Specify where you want Windows to search for the driver files:
 - a. Select **Specify a location**.
 - b. Click the **Browse...** button and navigate to the installation directory you selected for the RVI-ME software in *Installing the RealView Developer Suite* on page G-2.
 - c. Click **OK**.
5. Click **Next**. The Add New Hardware Wizard locates the driver.
6. Click **Next**. Windows installs the driver.
7. Click **Finish** to close the wizard.

G.1.3 Installing the RealView ICE Micro Edition driver on Windows 2000

To install the RealView ICE Micro Edition driver on Windows 2000:

1. Ensure that no RealView Debugger component is running.
2. Connect a USB cable between the USB debug port and your computer. The Found New Hardware Wizard is launched, and displays a welcome message.
3. Click **Next**. The Install Hardware Device Drivers window is opened. Select **Search for a suitable driver for my device**.
4. Click **Next**. The Locate Driver Files window is opened. Specify where you want Windows to search for the driver files:
 - a. Select **Specify a location**.
 - b. Click the **Browse...** button and navigate to the installation directory you selected for the RVI-ME software in *Installing the RealView Developer Suite* on page G-2.
 - c. Click **OK**.
5. Click **Next**. The Driver Files Search Results window is opened.
6. Click **Next**. The Completing the Found New Hardware Wizard window is opened.
7. Click **Finish** to finish the installation and close the wizard.

G.1.4 Installing the RealView ICE Micro Edition driver on Windows XP Professional

To install the RealView ICE Micro Edition driver on Windows XP Professional:

1. Ensure that no RealView Debugger component is running.
2. Connect a USB cable between the USB debug port and your computer. The Add New Hardware Wizard is launched, and displays a welcome message.
3. Click **Next**. Specify how you want Windows to find the required files:
 - Select **Install from a list of specific locations** and check **Search for the best driver in these locations**.
 - Click the **Browse...** button and navigate to the installation directory you selected for the RVI-ME software in *Installing the RealView Developer Suite* on page G-2.
 - Click **OK**.
4. Click **Next**. A message is displayed informing you that the device you are installing has not passed Windows Logo testing to verify its compatibility with Windows XP. Click **Continue Anyway**.
5. Windows completes installation of the driver. Click **Finish** to finish the installation and close the wizard.

G.2 Changes to RealView Debugger

When you install the RealView ICE Micro Edition software, it adds the following capabilities to RealView Debugger:

- New nodes in the **Connection Control** window:
 - an ARM-ARM-DIR target vehicle node at the top level lists the direct connection devices.
 - an VPB926EJ-S USB access provider node that appears at the second level, for connecting to and configuring the USB debug port
 - target nodes that appear at the third level, for establishing a debugging connection to the ARM926EJ-S PXP Development Chip.

These nodes are shown in Figure G-1.

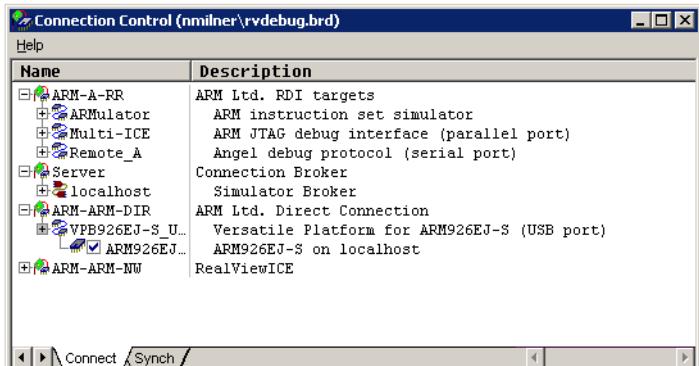


Figure G-1 Nodes added to Connection Control window

- New tabs in the **Register** pane of the Code window, in addition to the **Core** tab that is present for all targets. The additional tabs include:
 - a **CP15** tab that displays and sets the values of registers in coprocessor 15 (the System Control coprocessor)
 - a **Cache Operations** tab that you can use to perform operations on the cache for the target
 - a **TLB Operations** tab that you can use to perform operations on the *translation look-aside buffer* (TLB) for the target
 - a **Debug** tab that controls various internal debugger settings, many of which are specific to the USB debug port.

The **CP15**, **Cache Operations**, and **TLB Operations** tabs control features of the target hardware. These features are described in the *ARM926EJ-S Technical Reference Manual*.

G.3 Using the USB debug port to connect RealView Debugger

To connect to the PB926EJ-S using the USB debug port, you use the same RealView Debugger features that you use for any other target. For more information about connecting RealView Debugger to targets, refer to the RealView Debugger documentation suite.

———— Note ————

The USB debug port on the PB926EJ-S does not support simultaneous multiple-core debug (for example, multiple cores present in external RealView Logic Tiles).

G.3.1 Configuration

To use the RealView Debugger with the PB926EJ-S:

1. Start the RealView Debugger.
2. Connect a USB cable between the PC and the USB debug port on the PB926EJ-S.
3. Display the RealView Debugger **Connection Control** window in one of the following ways:
 - Click on the blue hyperlink in the File Editor window, if available.
 - Select **File** → **Connection** → **Connect to Target** from the Code window.
 - Use the keyboard shortcut Alt+0 with the Code window active.

The **Connection Control** window appears, as shown in Figure G-2.

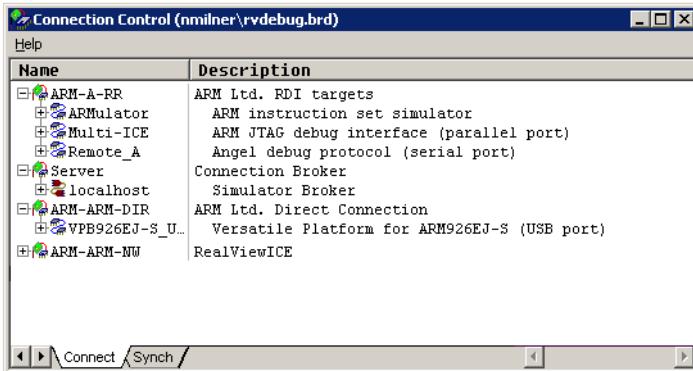


Figure G-2 The Connection Control window

- Click on **VPB926EJ-S USB** in the **Connection Control** window. If the debugger is able to connect to the PB926EJ-S, the **Connection Control** window displays the connection to the ARM926EJ-S PXP Development Chip as shown in Figure G-3.

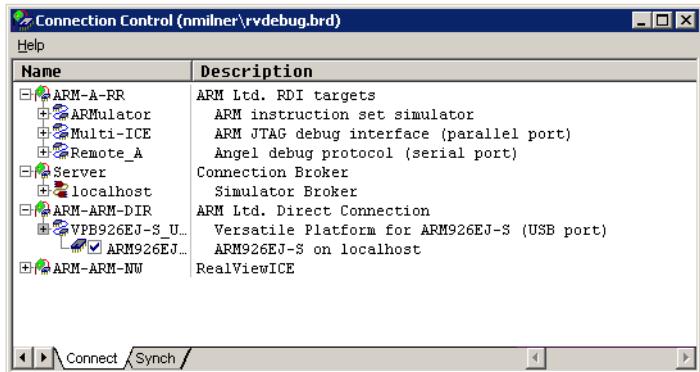


Figure G-3 ARM926EJ-S PXP Development Chip detected

————— **Note** —————

If the there is not a **VPB926EJ-S USB** entry in the **Connection Control** window, the RVI-ME software is not installed. Close the RealView Debugger and install the software (see *Installing the RealView ICE Micro Edition driver* on page G-2).

You might see one of the following errors:

- If the PB926EJ-S is not powered, it displays the error shown in Figure G-4. If you see this error, ensure that power is supplied.

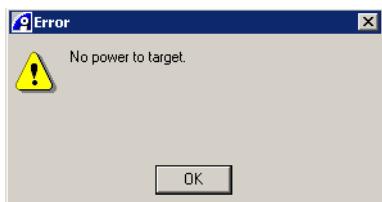


Figure G-4 Error shown when unpowered devices are detected

- If the PB926EJ-S is not detected, one of the errors shown in Figure G-5 or Figure G-6 is displayed. If you see one of these errors, ensure that the USB cable is properly attached.

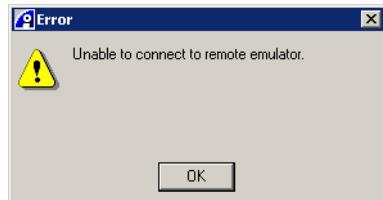


Figure G-5 Error shown when no devices are detected

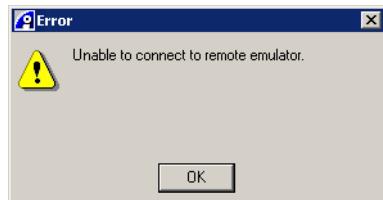


Figure G-6 Error shown when the USB debug port is not functioning

5. Right-click on **VPB926EJ-S USB** in the **Connection Control** window and select **Connection Properties** from the context menu that appears. The **Connection Properties** window is displayed as shown in Figure G-7.

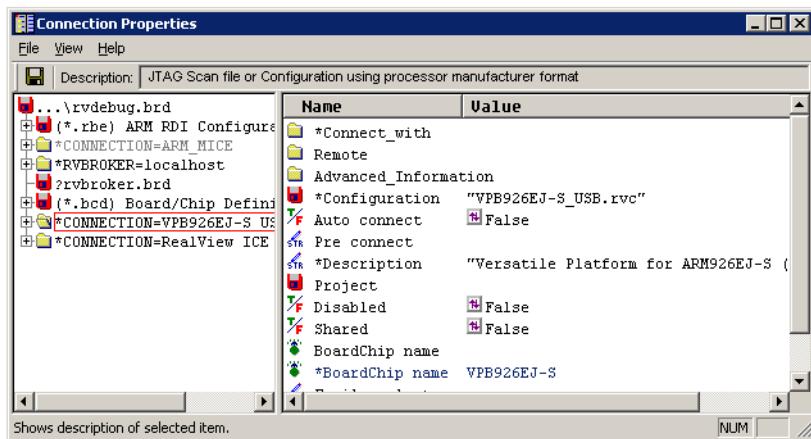


Figure G-7 Connection Properties window

6. You can change connection properties by selecting controls in the **Name** column.

———— Note ————

The default values for the connection do not typically require changing.

7. Close the **Connection Properties** window and return to the Code window in the RealView Debugger.

You can now use the RealView Debugger to download programs to the PB926EJ-S and debug them.

G.4 Using the Debug tab of the RealView Debugger Register pane

When you install the RealView ICE Micro Edition software and connect to a PB926EJ-S, a **Debug** tab is added to the **Register** pane of the RealView Debugger Code window. This controls various internal debugger registers, many of which are specific to using the USB debug port. To use this tab, you must first connect RealView Debugger to your PB926EJ-S, as described in *Using the USB debug port to connect RealView Debugger* on page G-6. A typical setting window is shown in Figure G-8.

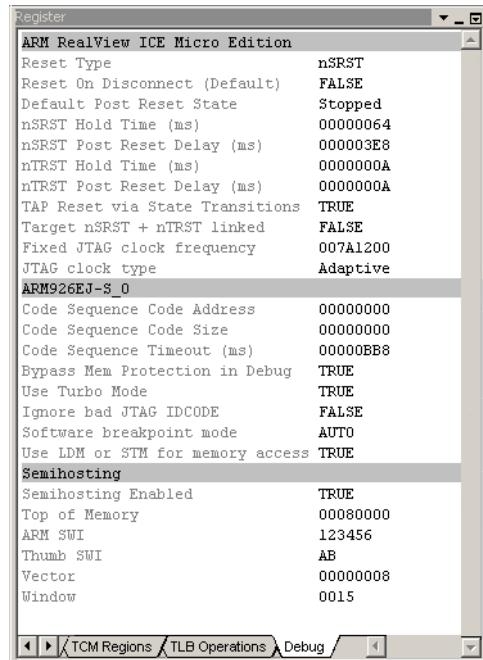


Figure G-8 The Debug tab of the Register pane

There are three groups of settings:

- *Global Properties*
- *Device Properties* on page G-12
- *Semihosting Properties* on page G-13.

G.4.1 Global Properties

The **Global Properties** area of the **Debug** tab contains settings that control the behavior of the USB debug port when it resets the target hardware. (See Table G-1.)

Table G-1 Reset behavior register names and values

Setting	Register name	Enumerator	Value
Reset Type	RESETOPERATION	nSRST	0x0
		nTRST	0x1
		nSRST + nTRST	0x2
		Fake	0x3
Reset On Disconnect (Default)	RESETONDISCONNECT	FALSE	0x0
		TRUE	0x1
Default Post Reset State	POSTRESETSTATE	Running	0x0
		Stopped	0x1
nSRST Hold Time (ms)	RESETHOLDTIME	-	-
nSRST Post Reset Delay (ms)	POSTRESETDELAY	-	-
nTRST Hold Time (ms)	NTRSTHOLDTIME	-	-
nTRST Post Reset Delay (ms)	NTRSTPOSTRESETTIME	-	-
TAP Reset via State Transitions	DOSOFTTAPRESET	FALSE	0x0
		TRUE	0x1
Target nSRST + nTRST linked	LINKED_SRST_TRST	FALSE	0x0
		TRUE	0x1
JTAG Clock Type	JTAGCLOCKTYPE	Fixed	0x0
		Adaptive	0x1

G.4.2 Device Properties

The settings in the **Device Properties** area of the **Debug** tab of the RealView Debugger register pane control the device that you are connected to. (See Table G-2.)

Table G-2 Device property register names and values

Setting	Register name	Enumerator	Value
Code Sequence Code Address^a	CODESEQ_CODE_ADDR	-	-
Code Sequence Code Size	CODESEQ_CODE_SIZE	-	-
Code Sequence Timeout (ms)	CODESEQ_TIMEOUT	-	-
Bypass Mem Protection in Debug^{bc}	BYPASS_MEMPROT_IN_DBG	FALSE	0x0
		TRUE	0x1
Enable Turbo Mode	USE_TURBO_MODE	FALSE	0x0
		TRUE	0x1
Ignore Bad JTAG IDCODE	IGNORE_BAD_JTAG_ID_CODE	FALSE	0x0
		TRUE	0x1
Software Breakpoint Mode	SOFTWARE_BREAKPOINT_MODE	Auto	0x0
		None	0x1
		Watchpoint	0x2
		Breakpoint	0x3
Use LDM or STM for Memory Access	USE_LDM_STM	FALSE	0x0
		TRUE	0x1

- a. You must configure the **Code Sequence...** settings in the **Debug** tab before caching has been enabled. If you cannot halt the target before its caches are enabled, you must instead configure these settings before connecting (as described in *Configuration* on page G-6).
- b. You must configure the **Bypass Mem Protection in Debug** setting in the **Debug** tab before memory protection has been enabled. If you cannot halt the target before its memory protection is enabled, you must instead configure these settings before connecting (as described in *Configuration* on page G-6).
- c. The **Bypass Mem Protection in Debug** setting does not take effect until the next time that you enter debug state.

G.4.3 Semihosting Properties

The settings in the **Semihosting Properties** area of the **Debug** tab in the RealView Debugger **Register** pane are the same as those used for other debug targets. For details of these settings, see the *RealView Debugger User Guide*.

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