Channel Adapter
and
Channel Adapter Plus
Installation Guide

797 North Grove Rd, Suite 101
Richardson, TX 75081
Phone: (972) 671-9570
www.redrapids.com

Red Rapids reserves the right to alter product specifications or discontinue any product without notice. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgment. This product is not designed, authorized, or warranted for use in a life-support system or other critical application.

All trademark and registered trademarks are the property of their respective owners.

Table of Contents

1.0 Introduction 1
1.1 Contents and Structure 1
1.2 Related Publications 1
1.3 Conventions 1
1.4 Manual Compatibility 2
1.5 Revision History 2
2.0 Distribution Disks 3
2.1 DSK-320-002-RXX (Channel Adapter C API and Sample Code) 3
2.2 DSK-320-003-RXX (Channel Adapter FPGA Development Kit) 4
3.0 Driver Installation Guide 5
3.1 Windows (2000 and XP, 32-bit variants) 5
3.2 Linux (2.4 and 2.6 kernels, x86-32 Platforms) 6
3.3 VxWorks 7
4.0 Hardware Installation Guide 8
4.1 Card Installation 8
4.1.1 PMC Hardware Installation 8
4.1.2 PCI Hardware Installation 9
4.1.3 CPCI Hardware Installation 9
5.0 Hardware Diagnostics 11
5.1 Diagnostic Hardware Set-up 11
5.2 Running the Diagnostic 12
5.3 Restoring the Diagnostic Firmware 13

List of Figures

Figure 4-1 Diagnostic Test Set..... **Error! Bookmark not defined.**

List of Tables

Table 5-1 Diagnostic Input Signal Characteristics..... 11
Table 5-2 Diagnostic Command Line Input..... 12
Table 5-3 Diagnostic Firmware Restore Command 13

1.0 Introduction

1.1 Contents and Structure

This manual provides installation and operating instructions for the Model 316 (Channel Adapter Plus 8/1500) hardware. This publication supplements the supporting documents listed in section 1.2 to provide a complete description of the capabilities and operation of the product. The focus of this manual is the installation of hardware and software. There is a diagnostic procedure outlined in Section 5.0 that should be run prior to loading any new firmware in the FPGA. Other Channel Adapter manuals focus on the hardware and FPGA programming.

Section	Description
Section 1	Introductory information about the manual.
Section 2	Overview of the distribution disk directory structure.
Section 3	Driver installation instructions for all operating systems.
Section 4	Hardware installation instructions for all card types.
Section 5	Instructions for running the diagnostics.

The latest product documentation and software is available for download from the Red Rapids web site (www.redrapids.com) by following the Technical Support link.

1.2 Related Publications

Author	Number	Title
Red Rapids	REF-314-000	Model 314 Hardware Reference Manual
Red Rapids	REF-316-000	Model 316 Hardware Reference Manual
Red Rapids	REF-320-000	Model 320 Hardware Reference Manual
Red Rapids	REF-321-000	Model 321 Hardware Reference Manual
Red Rapids	REF-320-002	Channel Adapter Software Reference Manual
Red Rapids	REF-320-003	Channel Adapter FPGA Core Reference Manual
PCI SIG	PCI Rev 2.2	PCI Local Bus Specification

1.3 Conventions

This manual uses the following conventions:

- Hexadecimal numbers are prefixed by “0x” (e.g. 0x00058C).
- *Italic* font is used for names of registers.
- **Bold** font is used for names of directories, files and OS commands.
- Palatino font is used to designate source code.
- Active low signals are followed by ‘#’, For example, TRST#.

☞ Text in this format highlights useful or important information.

! Text shown in this format is a warning. It describes a situation that could potentially damage your equipment. Please read each warning carefully.

The following are some of the acronyms used in this manual.

- **ADC** Analog to Digital Converter
- **API** Application Program Interface
- **CPCI** CompactPCI
- **MSPS** Mega Samples per Second
- **PCI** Peripheral Component Interconnect
- **PMC** PCI Mezzanine Card

1.4 Manual Compatibility

The applicable hardware part numbers are defined as follows:

- Model 314-XXX *Channel Adapter 14/125*
- Model 316-XXX *Channel Adapter Plus 8/1500*
- Model 320-XXX *Channel Adapter 12/210*
- Model 321-XXX *Channel Adapter Plus 16/130*

1.5 Revision History

Version	Date	Description
R00	10/25/06	Initial release.
R01	10/31/06	Added Model 314 and 316 diagnostic instructions.

2.0 Distribution Disks

All Channel Adapter products are supported by two software distribution disks:

DSK-320-002-RXX Channel Adapter C API and Sample Code

DSK-320-003-RXX Channel Adapter FPGA Development Kit

These disks can be downloaded as an archive from the Technical Support page of the Red Rapids website (www.redrapids.com).

2.1 DSK-320-002-RXX (Channel Adapter C API and Sample Code)

The following abbreviations are embedded in the DSK-320-002-RXX subdirectory names to distinguish operating system, compiler and hardware architecture:

vs	Visual Studio
X86	Intel processor architecture
ppc	Motorola PowerPC architecture
-32	32-bit processor architecture
-64	64-bit processor architecture

The directory structure of DSK-320-002-RXX is outlined below:

\channeladapterlib

The **channeladapterlib** subdirectory contains the C API used across all Channel Adapter products. The code is stored in a subdirectory named for the current revision of the software. The source code and header files common to all libraries are also stored at this level.

\diagnostic

The **diagnostic** subdirectory contains the binary executable for the diagnostic software and verification utility discussed in Section 5.0 of this document.

\loadxsvf

The **loadxsvf** subdirectory contains C source code and binary executables to a utility that will load a Xilinx Serial Vector File (XSVF) to either the FPGA or PROM over the host PCI bus. The project files are stored in separate subdirectories for different compilers. Refer to the *Channel Adapter FPGA Core Reference* manual for further details on how to use the loadxsvf software.

\localbusx

The **localbus** subdirectory contains C source code and binary executables to a design example that demonstrates DMA transfers through the Local Bus Interface FPGA core. The project files are stored in separate subdirectories for different compilers. Refer to the *Channel Adapter Software Reference* manual for further details on how to use the localbus software.

\windrvr

The **windrvr** subdirectory contains the Channel Adapter drivers for all supported operating systems. The files are stored in subdirectories corresponding to each operating system. Refer to Section 3.0 of this manual for driver installation instructions.

2.2 DSK-320-003-RXX (Channel Adapter FPGA Development Kit)

The directory structure of DSK-320-003-RXX is outlined below:

\diagnostic_firmware

The **diagnostic_firmware** subdirectory contains the FPGA programming files for the diagnostic utility discussed in Section 5.0 of this document. These file are needed to restore the PROM contents to the default state as shipped from the factory. The directory structure will point to the specific Channel Adapter model number and type of FPGA on the target hardware.

\lbexample_firmware

The **lbexample _firmware** subdirectory contains the FPGA project files to a design example that demonstrates DMA transfers through the Local Bus Interface FPGA core. Programming files are also provided to load the firmware into the FPGA or PROM using the loadxsvf utility. The directory structure will point to the specific Channel Adapter model number and type of FPGA on the target hardware. Refer to the *Channel Adapter Software Reference* manual for a description of the local bus FPGA design.

\src

The **src** subdirectory contains VHDL source code or Xilinx NGC files to all of the FPGA cores provided with the Channel Adapter product. Refer to the *Channel Adapter FPGA Core Reference* manual for more details.

\ucf

The **ucf** subdirectory contains the Xilinx User Constraints File (UCF) for each Channel Adapter model number. Refer to the *Channel Adapter FPGA Core Reference* manual for more details.

3.0 Driver Installation Guide

The Channel Adapter driver is built on a third party cross-platform toolkit from Jungo. The Jungo WinDriver™ toolkit provides a unified Windows and Linux driver structure so that application code can move seamlessly between operating systems.

> ☞ The "windrvr" program must be installed prior to installing the hardware in your system.

3.1 Windows (2000 and XP, 32-bit variants)

Operating System	Windows 2000 or Windows XP on a 32-bit platform
Access Level	Administrator Privileges

> ☞ The "windrvr" program must be installed prior to loading the product inf file. Read instructions before booting.

The following procedure will load drivers onto a host system running the Windows 2000™ or Windows XP™ operating system.

1. Boot the host computer.
2. Insert the Driver Installation disk or download the archive from the Red Rapids website (www.redrapids.com).
3. Open the zip archive file on the distribution disk.
4. Extract the files in the zip archive to a directory. This directory will be referred to as **c:\ <extract path>**.
5. Open a "command prompt" window (DOS window).
6. Change directories as follows:

   CD "c:\<extract path>\channeladapter\windriver\win32"

   Note: The quotes on either side of the full path name are required if there are any spaces in the directory names.
7. Execute the following command:

   wdreg_gui -inf "c:\<extract path>\channeladapter\windriver\win32\windrvr6.inf" install

   Note: The quotes on either side of the full path name are required if there are any spaces in the directory names.
8. The installer does not return a message. You can verify that the installer completed successfully by performing the following steps:
   a. Open Windows Device Manager (right click on my computer, select "Properties" then select the hardware tab. Find and select the Device Manager button.)
   b. Browse down to the "System Devices" folder and find the device "WinDriver".
   c. Double check path names and retry the install command if you do not see windriver listed in System Devices.

9. Install the card as outlined in Section 4.0.
10. The hardware wizard will detect the presence of new hardware and look for the appropriate inf file.
    a. Select the “have disk” or equivalent option and browse to directory: **c:\<extract path>\pocketchange\windriver\win32**
    b. Select the **channeladapter.inf** and click OK.

> ☞ If you do not see the hardware wizard you may have inadvertently installed the inf file prior to installing windrvr. If you experience this problem please remove the appropriate inf file from the WINDOWS\INF folder and the hardware (under Jungo tab) from the device manager prior to rebooting the computer.

11. The hardware wizard should complete and you should now see the new device listed in Device Manager under the Jungo icon.

3.2 Linux (2.4 and 2.6 kernels, x86-32 Platforms)

Operating System	Linux (2.4 or 2.6 kernel) on an x86-32bit Platform
Access Level	Administrator Privileges

The following procedure will load drivers onto a host system running the Linux operating system.

1. Boot the host computer.
2. Allow the computer to finish the boot process.
3. Insert the Driver Installation disk or download the archive from the Red Rapids website (www.redrapids.com).
4. Open the tar archive file on the distribution disk.
5. Extract the files in the tar archive to a directory. This directory will be referred to as **<extract path>**.
6. Change directories as follows:

   cd “/<extract path>/pocketchange/windriver/linux_x86-32”
7. Execute the following command:

   tar –xf wd800_linux_x86-32.tar
8. Execute the following commands:
   a. cd redist
   b. ./configure
   c. make all
   d. make install
9. Install the card as outlined in Section 4.0.

> ☞ You must have the source for your kernel installed to build this file. Please read the usage and security instructions

displayed on the terminal at the end of the installation.
For more information on setting up the kernel source for the install, consult
www.jungo.com/support/installation_instructions.html

During installation the device **/dev/windrvr6** will be created with root only privileges. To enable ordinary user access, you must change the permissions on this device. When setting privileges, please keep in mind that **/dev/windrvr6** is a generic hardware device.

The kernel module **windrvr6.o** must be loaded to access the hardware. It will be automatically loaded after the first install, but as a security measure will not be automatically reloaded after a reboot. Consider modifying your system startup to load this module.

If you upgrade the kernel, you must rebuild **windrvr6.o** per the installation instructions.

3.3 VxWorks

Operating System	VxWorks 6.x
Access Level	Administrator Privileges

The following procedure will load drivers onto a host system running the VxWorks operating system.

1. Boot the host computer.
2. Allow the computer to finish the boot process.
3. Insert the Driver Installation disk or download the archive from the Red Rapids website (www.redrapids.com).
4. Open the tar archive file on the distribution disk.
5. Extract the files in the tar archive to a directory on your host machine. This directory will be referred to as **<extract path>**.
6. Copy the contents of the **<extract path>/vxworks** to the BSP directory on your host.
7. Modify the system calls in **<BSP>/sysChannelAdapter.c** to match the system calls provided for your target platform. These functions are platform dependant and must be changed for each target.
8. Modify your target makefile to build the contents of **<BSP>/libchanneladapter** and to add **<BSP>/libchanneladapter/libchanneladapter.a** to the library path and to build **<BSP>/sysChannelAdapter.c**.

4.0 Hardware Installation Guide

The Channel Adapter product family consists of a common hardware architecture available in PMC, PCI, or CPCI form factors. The following sections discuss hardware installation and cable connections to the hardware.

4.1 Card Installation

The Channel Adapter PCI bus interface supports 32-bit or 64-bit transfers at 33 MHz or 66 MHz. The card will automatically configure to operate at the maximum bandwidth available on the host backplane. The Channel Adapter family only supports 3.3V signaling. Please verify that your system uses 3.3V signaling. Note: 66 MHz systems must use 3.3V signaling per the PCI specification.

!	The Channel Adapter/Plus family can only be used in a 3.3V signaling environment. Installing the unit in a 5V signaling slot will damage the card.

4.1.1 PMC Hardware Installation

The following instructions provide a general guide for mounting a PMC module to a baseboard or carrier host socket. Consult your baseboard documentation for product specific guidance.

!	This is a static sensitive electronic device; please follow standard ESD guidelines when installing the device.

Load Drivers: Load the appropriate software drivers prior to installing the hardware. Consult Section 2.0 of this manual for detailed instructions.

Power Down: Power to the host must be off during hardware installation. Permanent damage may result if the card is plugged into a hot socket.

Identify Socket: Find an open PMC socket on the host and verify that the keying is compatible with the card you are installing. The key consists of a metal post located at the centerline of the socket near the electrical connector. The position of the post will indicate if the bus is designed for 3.3 Volt or 5 Volt signaling. There must be a matching hole in the PMC at the key position or the card cannot be installed.

Insert Card: Angle the PMC bezel into the host front panel cut-out. The EMI gasket around the bezel may offer resistance, be careful not to dislodge the gasket from the groove. Gently press the PMC down onto the host until the connectors mate.

Secure Card: Secure the PMC hardware with four mounting screws (provided). Be sure that the card does not bow as the screws are fastened.

Check Obstructions: Verify that the card is securely mounted in the PMC socket and not in contact with other components on the host.

Boot Computer: The host will detect the presence of new hardware the first time power is applied. Consult the driver installation instructions if prompted for additional information.

☞	The expansion card can pick up electrical interference from other devices or directly through the host power supply. Try moving the card away from other devices or try a different host platform if you are experiencing interference.

4.1.2 PCI Hardware Installation

The following instructions provide a general guide for PCI expansion card installation. Consult your host documentation for product specific guidance.

> **!** This is a static sensitive electronic device; please follow standard ESD guidelines when installing the device.

Load Drivers: Load the appropriate software drivers prior to installing the hardware. Consult Section 2.0 of this manual for detailed instructions.

Power Down: Power to the host must be off during hardware installation. Permanent damage may result if the card is plugged into a hot socket.

Identify Socket: Find an open PCI slot on the host backplane and verify that the keying is compatible with the card you are installing. The key consists of a solid spacer that divides the connector. The position of the spacer will indicate if the bus is designed for 3.3 Volt or 5 Volt signaling. There must be a matching slot cut into the edge connector of the expansion card at the key position or it cannot be inserted.

Remove Metal Insert: The expansion slot opening will typically be covered by a metal insert held in with a single screw. The metal insert may have to be punched out of some cases. Unscrew or punch out the appropriate metal insert. It may help to align the expansion card over the slot to determine which insert to remove.

Insert Card: Align the expansion card edge connector with the PCI slot making sure the bottom edge of the metal faceplate clears the edge of the backplane motherboard. Apply firm pressure to seat the card in the slot. You may need to rock the card slightly from front to back to get the unit seated properly. *Do not force the card or significantly flex the motherboard*. The expansion board should not require much force to insert provided everything is lined up correctly.

Secure Card: The top side of the faceplate should be flush or close to flush with the card retention bar. If the plate is not close to the bar verify that the board is not canted in the slot. Secure the expansion card to the chassis by inserting a screw into the top of the metal faceplate.

Check Obstructions: Verify that the card is securely mounted in the PCI slot and not in contact with other items inside the chassis.

Boot Computer: The host will detect the presence of new hardware the first time power is applied. Consult the driver installation instructions if prompted for additional information.

> ☞ The expansion card can pick up electrical interference from other devices or directly through the host power supply. Try moving the card away from other devices or try a different host platform if you are experiencing interference.

4.1.3 CPCI Hardware Installation

The following instructions provide a general guide for CPCI peripheral card installation. Consult your host documentation for product specific guidance.

> **!** This is a static sensitive electronic device; please follow standard ESD guidelines when installing the device.

Load Drivers: Load the appropriate software drivers prior to installing the hardware. Consult Section 2.0 of this manual for detailed instructions.

Power Down: Power to the host must be off during hardware installation. Permanent damage may result if the card is plugged into a hot socket.

Identify Socket: Find an open CPCI slot on the host backplane and verify that the keying is compatible with the card you are installing. The key consists of a color coded boss built into the connector. The shape and color of the boss will indicate if the bus is designed for 3.3 Volt or 5 Volt signaling. The color of the boss built into the peripheral card connector must match the backplane or it cannot be inserted.

Insert Card: Determine the proper facing direction for the card and carefully align the CPCI board edges with the chassis slot top and bottom card guides. Gently insert unit into slot until card ejector handle engages and locks. The board should not require excessive force to insert provided everything is lined up correctly.

Secure Card: Secure the front panel to the CPCI chassis by tightening the screws found at the top and bottom of the front panel.

Check Obstructions: Verify that the card is securely mounted in the slot and not in contact with other items within the chassis.

Boot Computer: The host will detect the presence of new hardware the first time power is applied. Consult the driver installation instructions if prompted for additional information.

The expansion card can pick up electrical interference from other devices or directly through the host power supply. Try moving the card away from other devices or try a different host platform if you are experiencing interference.

5.0 Hardware Diagnostics

The Channel Adapter ships with a default FPGA bitstream preloaded in the PROM that can be used to run a quick diagnostic on the hardware. The diagnostic software performs a snapshot signal capture on all receiver channels simultaneously. The data from each channel is stored in a separate disk file (chAout.txt ,chBout.txt, etc.). Verification software is also provided to analyze the data and report the characteristics of the signal that was captured.

☞ It is highly recommended that the user successfully execute the diagnostics before proceeding with custom FPGA and software development.

5.1 Diagnostic Hardware Set-up

The diagnostic will run on any platform that is capable of hosting the Channel Adapter product. It should be used to verify proper installation of software and hardware after following the procedures outlined in Sections 2.0 and 4.0 of this guide. A signal generator is the only other piece of equipment needed to run the diagnostic, as shown in Figure 5-1.

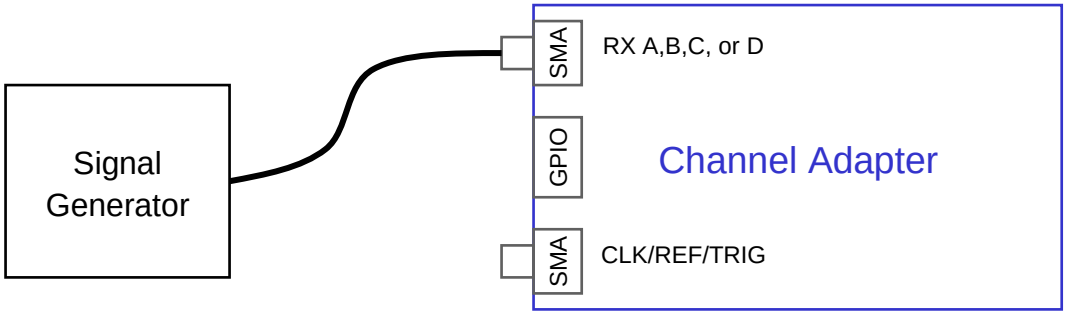

Figure 5-1 Diagnostic Test Set

The signal generator can be connected to multiple inputs simultaneously, or data can be collected on just one input channel with the other inputs left open. There is no need to connect anything to the GPIO connector or any other SMA connectors (clock, reference, trigger, etc.).

The signal amplitude into the receiver will vary with the specific Channel Adapter product under test. Set the signal generator to produce a 20 MHz sine wave with input power or peak-to-peak voltage listed in Table 5-1.

Table 5-1 Diagnostic Input Signal Characteristics

Product	Frequency	Input Power	Input Voltage
Model 314	20 MHz	+7 dBm	1.4 Vpp
Model 316	20 MHz	+2 dBm	0.8 Vpp
Model 320	20 MHz	+5.5 dBm	1.2 Vpp
Model 321	20 MHz	+11 dBm	2.2 Vpp

! Exceeding the recommended input power may result in permanent damage to the equipment.

5.2 Running the Diagnostic

The diagnostic is executed from a command line using the switch options listed in **Error! Reference source not found.** for each product.

Table 5-2 Diagnostic Command Line Input

Product	Command Line
Model 314	diagnostic -asy M314 -adca -adcb -adcc -adcd
Model 316	diagnostic -asy M316 -adca -adcb –bus <PCI bus speed> where <PCI bus speed> = 33 or 66 (33 MHz or 66 MHz)
Model 320	diagnostic -asy M320 -adca -adcb -attna 29 -attnb 29
Model 320	diagnostic -asy M321 -adca -adcb

The diagnostic software will have to be compiled to the target platform in a VxWorks environment.

A quick summary of the results can be obtained by simply running the verification software provided with the diagnostic software. It is executed from the command line on a Linux or Windows platform as follows:

verify.exe -txt <filename> -bits <ADC> -fs <Fs>

where

<filename> = chAout.txt, chBout.txt, etc.

<ADC> = Size of the ADC in bits (Model 314 = 14, Model 316 = 8, Model 320 =12).

<Fs> = Frequency in MHz of the on-board synthesizer ordered with your product. (Standard values: Model 314 = 125, Model 316 = 1500, Model 320 = 210)

The verification software will search for the strongest signal (carrier) and report the output power (dBFS) and frequency (MHz). A properly operating Channel Adapter will produce an output power between -1 dBFS and -4 dBFS (-3 dBFS nominal) for all models.

The listing below is an example of a verification output report.

```
Red Rapids Spectral Spur Search
Built Oct 31 2006 11:03:49
Opening chAout.txt in txt mode.
Reading from file...
Read 8192 samples from the data file chAout.txt
Will perform a real 8192 point FFT with a bin size of XXX.X Hz over XX.X MHz of
bandwidth
CreateWindow: Entered
Scaling to XX bits, (XXXX)
Applying windowing function
Test Results
Carrier found: -3.370406 dBFS in bin 1311 @ 20.00 MHz from center
```

5.3 Restoring the Diagnostic Firmware

The diagnostic firmware will likely be overwritten as the user develops custom applications for the Channel Adapter. It can always be reloaded by executing the appropriate command line from Table 5-3.

Table 5-3 Diagnostic Firmware Restore Command

Product	Command Line
Model 314	loadxsvf -xsvf ca_m314diag.xsvf –revcheck
Model 316	loadxsvf -xsvf ca_m316diag.xsvf –revcheck
Model 320	loadxsvf -xsvf ca_m320diag.xsvf –revcheck
Model 321	loadxsvf -xsvf ca_m321diag.xsvf –revcheck

The loadxsvf software will have to be compiled to the target platform in a VxWorks environment.