

Wavefront Modulator Installation Guide



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1.0 Introduction

1.1 Contents and Structure

This manual provides installation and operating instructions for all of the Wavefront Modulator products. 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. Other Wavefront Modulator documents focus on hardware and 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.
Section 5	Hardware diagnostic utility

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

1.2 Related Publications

Author	Number	Title
Red Rapids	REF-150-000	Wavefront Modulator Hardware Reference Manual
Red Rapids	REF-150-002	Wavefront Modulator Software Manual and Operating Guide
PCI SIG	PCIe Base Spec 2.0	PCI Express Base Specification Revision 2.0
PCI SIG	PCIe CEM Spec 2.0	PCI Express Card Electromechanical Specification Revision 2.0

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.
- **Blue** font is used for names of directories, files and OS commands.
- **Green** 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.

- **API** Application Program Interface

- **I** In-phase component of a quadrature signal pair
- **PCI** Peripheral Component Interconnect
- **PCle** PCI Express
- **RXX** Revision number, XX is the placeholder for current revision
- **Q** Quadrature component of a quadrature signal pair.

1.4 Manual Compatibility

The applicable hardware part numbers are defined as follows:

- Model 150-XXX *Wavefront Modulator*

1.5 Revision History

Version	Date	Description
R00	11/5/2008	Initial release.
R01	02/16/2009	Added section on device enumeration.

2.0 Distribution Disks

All Wavefront Modulator products are supported by the following software distribution disks:

DSK-806-900-RXX Product Drivers and C API

DSK-806-042-RXX Wavefront Modulator Software



RXX refers to the current revision level. Replace XX with the revision number of the download item.

This disk can be downloaded as an archive from the Technical Support page of the Red Rapids website (www.redrapids.com). The following paragraphs provide a brief description of the distribution disk contents. Refer to section 3.0 for installation instructions.

2.1 DSK-806-900-RXX (Product Drivers and C API)

The following abbreviations are embedded in the DSK-806-900-RXX subdirectory names to distinguish operating system, compiler and hardware architecture:

vs	Visual Studio
X86	Intel processor architecture
-32	32-bit processor architecture
-64	64-bit processor architecture

The directory structure of DSK-806-900-RXX is outlined below:

[\adapterlib](#)

The [adapterlib](#) subdirectory contains the C API used across all Red Rapids I/O 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.

[\windrvr](#)

The [windrvr](#) subdirectory contains the Wavefront Modulator drivers for Windows and Linux. 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-806-042-RXX (Wavefront Modulator Software)

The directory structure of DSK-806-042-RXX is outlined below:

[\applications](#)

The [applications](#) subdirectory contains C source code and binary executables to application examples that demonstrate the operation of the product. The project files are stored in separate subdirectories for different compilers. Refer to the *Wavefront Modulator Operating Guide* for further details on how to use the application software.

[\lib](#)

The [lib](#) subdirectory contains source code and header files for three types of functions. The [configuration_functions](#) are used to program specific hardware devices on the board. The [application_functions](#) are called by the application software templates that demonstrate the operation of the hardware. The [diagnostic_functions](#) contain hardware and software debug utilities that should only be used when instructed by the factory.

[\memmap](#)

The [memmap](#) subdirectory contains a header file that maps a mnemonic for each register to the corresponding address in the PCI memory map. This memory map is referenced by the application software provided with the product.

3.0 Driver Installation Guide

The Wavefront Modulator 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, XP, and Vista, 32-bit and 64-bit variants)

Operating System Windows 2000, XP, or Vista on a 32-bit or 64-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™, Windows XP™, or Windows Vista™ 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, where XX denotes the 32-bit or 64-bit variant of Windows:

```
cd "c:\<extract path>\windriver\win_x86-XX"
```

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.exe -inf "c:\<extract path>\windriver\win_x86-XX\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 “Jungo” folder and find the device “WinDriver”.
 - c. Double check path names and retry the install command if you do not see windriver listed under Jungo..

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>\windriver\win_x86-XX`
 - b. Select `wavefront.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.
12. Copy one of the following files to c:\windows\system32 before attempting to run the sample programs supplied with the product:
`c:\<extract path>\windriver\win_x86-32\wdapiXXX.dll`
`c:\<extract path>\windriver\win_x86-64\wdapiXXX.dll`

3.2 Linux (2.4 and 2.6 kernels, x86-32 and x86-64 Platforms)

Operating System Linux (2.4 or 2.6 kernel) on an x86-32bit or x86-64bit 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, where XX denotes the 32-bit or 64-bit variant of Linux:
`cd "/<extract path>/windriver/linux_x86-XX"`
7. Execute the following command:
`tar -xf wdXXX_linux_x86-XX.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.

4.0 Hardware Installation Guide

The following instructions provide a general guide for PCIe 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 PCIe slot on the host backplane and verify that the keying is compatible with the card you are installing. PCIe cards may be up-plugged, that is inserted in a larger PCIe slot than the card link capacity. For example a PCIe x4 card may be plugged into a x8 or x16 slot but not a x1 slot. The card key structure prevents a unit from being “down-plugged”.

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 PCIe 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 PCIe 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.

5.0 Hardware Diagnostic Utility

5.1 Diagnostics

The Wavefront Modulator software distribution comes with a simple utility that can be used to configure the Wavefront Modulator hardware. This program enables configuration of all user accessible parameters using a simple command line tool. The setup shown in Figure 5-1 can be used to check the basic function of the unit prior to user code development. In many cases the utility software can be used as-is in an end application.

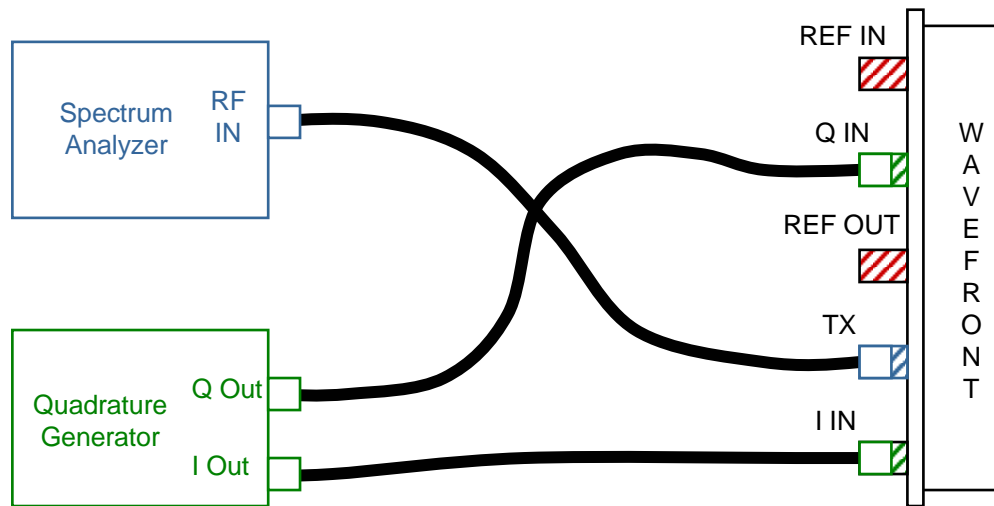


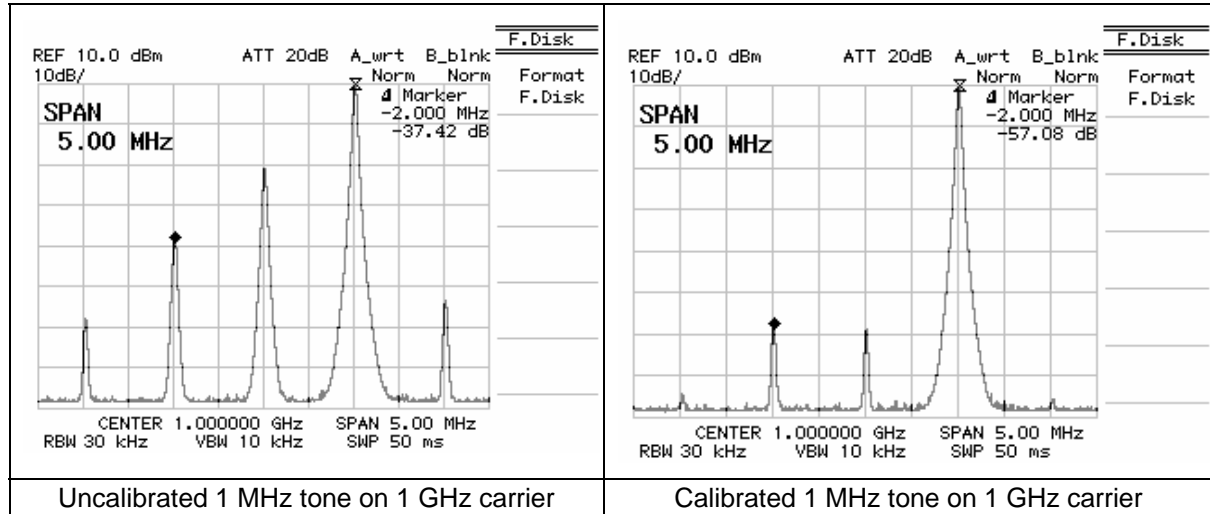
Figure 5-1 Wavefront Quadrature Test Setup

The test setup consists of a quadrature generator with quadrature outputs I and Q connected to the Wavefront I and Q inputs. The Wavefront TX output is connected to a spectrum analyzer. Run the Wavefront program from the command line as described in section 5.2 and observe the modulator output on the spectrum analyzer.

Typical output response plots for an unmodulated quadrature sinewave are shown in Figure 5-2. The response of the left side of the figure is typical for an uncalibrated IQ input. The response on the right is typical for a calibrated IQ input. Calibration refers to optimization of the DC, gain and phase match of the modulator I and Q input pair. See the Wavefront Modulator hardware reference manual for more information.

Table 5-1 Utility Example Setup

Parameter	Value
Waveform	Quadrature Sine
Baseband Quadrature Tone	1 MHz
Baseband Input Amplitude	-3 dBm
Carrier Frequency	1 GHz
Attenuator	10 dB

**Figure 5-2 Modulator Output Response**

5.2 Running the Wavefront Software Utility

The Wavefront software utility is executed from a command line using the switch options listed in Table 5-2 for each product. Windows users can execute the utility from a command prompt window and Linux users can execute the utility directly from the command line. The format of the command is as follows:

`wavefront.exe -switchx <parameter> -switchy <parameter> ...`

Command line switches do not need to be sent again once the user sets a configuration.

Table 5-2 Wavefront Software Utility Command Line Options

Command Line Option (switch)	Description
<code>-help</code>	Help option, lists command line menu.
<code>-stat</code>	Reads status register and displays contents.
<code>-v <n></code>	Verbose output, n = 1:5 for debug. Default is off.
<code>-asy <n></code>	Assembly number, defaults to 150.
<code>-dev <n></code>	PCI device number, default is 0. Device number required when multiple units installed using Jungo driver.
<code>-div_sel <n></code>	Carrier divider mode enable. 0 = disable, 1 =enable. Default is 0.
<code>-direct_rf <n></code>	Direct RF mode enable. 0 = disable, 1 =enable. Default is 0.
<code>-ref_out <n></code>	Reference clock output enable. 0 = disable, 1 =enable. Default is 0.
<code>-attn <n></code>	Attenuator value. n = 0:31.5 in 0.5 dB increments. Default is 0.
<code>-synthR <n></code>	Synthesizer reference clock divider value. n = 10. Default is 10.
<code>-synthN <n></code>	Synthesizer carrier divider value. n = 250:4000 in 1 MHz steps. Default is 1500.
<code>-idacpos <n></code>	I Channel positive dc offset value n = 0x00:0x3FF. Default = 0.
<code>-idacneg <n></code>	I Channel negative dc offset value n = 0x00:0x3FF. Default = 0.
<code>-qdacpos <n></code>	Q Channel positive dc offset value n = 0x00:0x3FF. Default = 0.
<code>-qdacneg <n></code>	Q Channel negative dc offset value n = 0x00:0x3FF. Default = 0.

As an example consider the following command that sets the Wavefront unit to operate at a carrier frequency of 1 GHz at an output attenuation of 10dB as shown in Figure 5-2.

```
wavefront.exe -synthN 1000 -attn 10
```

The following command will change the unit carrier frequency to 2.2 GHz and leave the attenuation level at 10.

```
wavefront.exe -synthN 2200
```

Note that the attenuator command does not need to be re-issued.

5.3 Device Enumeration

All Red Rapids products are identified by the Jungo driver at boot time. Each installed unit is enumerated sequentially beginning with zero as Jungo scans the PCI bus. The enumeration value is required by software to identify a specific unit and is passed in software as the device number (DevNum parameter in the `s_Adapter` handle). Unfortunately there is no predefined way to correlate the physical slot occupied by a card and the enumerated value assigned by Jungo. It is also possible for the enumeration values to change as cards are added or removed from a system. There is no unique identifier for each unit due to commonality of firmware and driver. Physical location of multiple boards must be performed in an iterative fashion by opening one device at a time and actuating a physical element on the unit that can be detected by a user. For example illuminating an LED or turning on the reference output port. For more information see the *Software Manual and Operating Guide*.



There is no predefined way to correlate physical card location and device number when multiple units are installed. Physical location must be determined through an iterative process.