Operating Manual

OPTIMOD-PC 1100

Digital Audio Processor on a PCI Sound Card

Software Version 1.1

orban

IMPORTANT NOTE: Refer to the unit's rear panel for your Model #.

Model Number:	**Description:**
1100	OPTIMOD-PC Digital Audio Processor on a PCI Sound Card. OPTIMOD-PC is a broadcast-quality audio processor offering gain-riding AGC, parametric equalization, multiband compressor, and look-ahead peak limiting.
1100/CBLXLR	Pre-wired cable option for 1100 I/O Interface, terminated in XLR connectors.
1100/CBLRCA	Pre-wired cable option for 1100 I/O Interface, terminated in RCA connectors.
1100/CBL	Pre-wired cable option for 1100 I/O Interface, unterminated.

MANUAL:

Part Number:	**Description:**
96112.110.01	1100 Operating Manual

WARNING: TO REDUCE THE RISK OF FIRE OR ELECTRICAL SHOCK, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.

This symbol, wherever it appears, alerts you to the presence of uninsulated dangerous voltage inside the enclosure — voltage that may be sufficient to constitute a risk of shock.

This symbol, wherever it appears, alerts you to important operating and maintenance instructions in the accompanying literature. Read the manual.

PLEASE READ BEFORE PROCEEDING!

Manual

Please review the Manual, especially the installation section, before installing the unit in your computer.

Trial Period Precautions

If your unit has been provided on a trial basis:

You should observe the following precautions to avoid reconditioning charges in case you later wish to return the unit to your dealer.

(1) Note the packing technique and save all packing materials. It is not wise to ship in other than the factory carton. (Replacements cost $35.00).

(2) Avoid scratching the plating. Set the unit on soft, clean surfaces.

(4) Use care and proper tools in removing and tightening screws to avoid burring the heads.

Packing

When you pack the unit for shipping:

(1) Wrap the unit in its original plastic bag to avoid marring the unit.
(2) Seal the carton with tape.

If you are returning the unit permanently (for credit), be sure to enclose:

The Manual(s)
The Registration/Warranty Card

Your dealer may charge you for any missing items.

If you are returning a unit for repair, do not enclose any of the above items.

Further advice on proper packing and shipping is included in the Manual (see Table of Contents).

Trouble

If you have problems with installation or operation:

(1) Check everything you have done so far against the instructions in the Manual. The information contained therein is based on our years of experience with OPTIMOD and broadcast stations.

(2) Check the other sections of the Manual (consult the Table of Contents) and search the text to see if there might be some suggestions regarding your problem.

(3) After reading the section on Factory Assistance, you may call Orban Customer Service for advice during normal California business hours. The number is +1 510 351-3500.

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WARNING

This equipment generates, uses, and can radiate radio-frequency energy. If it is not installed and used as directed by this manual, it may cause interference to radio communication. This equipment complies with the limits for a Class A computing device, as specified by FCC Rules, Part 15, subject J, which are designed to provide reasonable protection against such interference when this type of equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference. If it does, the user will be required to eliminate the interference at the user's expense.

WARNING

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the radio Interference Regulations of the Canadian Department of Communications. (Le present appareil numerique n'emet pas de bruits radioelectriques depassant les limites applicables aux appareils numeriques (de las class A) prescrites dans le Reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.)

CAUTION

Perform the installation under static control conditions. Simply walking across a rug can generate a static charge of 20,000 volts. This is the spark or shock you may have felt when touching a doorknob or some other conductive item. A much smaller static discharge is likely to destroy one or more of the CMOS semiconductors employed in OPTIMOD-FM. Static damage will not be covered under warranty.

There are many common sources of static. Most involve some type of friction between two dissimilar materials. Some examples are combing your hair, sliding across a seat cover or rolling a cart across the floor. Since the threshold of human perception for a static discharge is 3000 V, you may not notice damaging discharges.

Basic damage prevention consists of minimizing static generation, discharging any accumulated static charge on your body or workstation, and preventing that discharge from being sent to or through an electronic component. You should use a static grounding strap (grounded through a protective resistor) and a static-safe workbench with a conductive surface. This will prevent any buildup of damaging static.

This manual is part number 96112.110.01

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Table of Contents

Index

B

C

M

N

O

P

R

S

T

U

W

X

Section 1 Introduction

About this Manual

The Adobe pdf form of this manual contains numerous hyperlinks and bookmarks. A reference to a numbered step or a page number (except in the Index) is a live hyperlink; click on it to go immediately to that reference.

This manual has a table of contents and index. To search for a specific word or phrase, you can also use the Adobe Acrobat Reader's text search function.

The OPTIMOD-PC 1100 Digital Audio Processor

OPTIMOD-PC is a PCI card that fits in an IBM-compatible PC and processes one stereo audio stream. It is equally suitable for netcasts and digital radio. With its supplied WAVE drivers, it looks like a standard sound card to your native applications, like the Real® or Microsoft® streaming encoders. However, unlike a sound card, OPTIMOD-PC packs hundreds of MIPS of built-in DSP processing power, allowing it to apply broadcast-quality audio processing to your netcast or digital broadcast without loading down your computer's CPU with DSP tasks.

OPTIMOD-PC is useful for users with multiple streams because you can load one computer (which may be connected to a PCI expansion chassis) with as many OPTIMOD-PC cards as you have free PCI slots, each card handling one stereo program. Each card has two AES/EBU or SPDIF digital inputs and one high-quality analog input, all of which can be mixed—built-in sample rate converters allow digital sources to be asynchronous. The card also offers an AES/EBU output and an analog monitor output. Therefore, you can route audio through the computer's PCI bus or entirely independently of the computer—the choice is yours, and will depend on your application. For example, Eureka-147 multiplexes could use multiple OPTIMOD-PC cards to save cost and space by comparison to stand-alone processors. (The multiplexes would use OPTIMOD-PC's AES/EBU inputs and outputs, and could exploit OPTIMOD-PC's ability to genlock its output sample rate to the sample rate applied to either AES/EBU input.) OPTIMOD-PC (including the I/O mixer) is also fully remote controllable over a network.

The rest of Chapter 1 explains how OPTIMOD-PC fits into the DAB and DTV broadcast facilities, and how it can be used for netcasting. Chapter 2 explains how to install it. Chapter 3 tells how to operate OPTIMOD-PC properly.

OPTIMOD-PC was designed to deliver a high quality sound while simultaneously increasing the average level on the channel substantially beyond that achievable by "recording studio"-style compressors and limiters. Because such processing can exaggerate flaws in the source material, it is very important that the **source audio be as clean as possible.**

For best results, **feed OPTIMOD-PC unprocessed audio.** No other audio processing is necessary or desirable.

In digital radio applications, if you wish to place level protection prior to your studio/transmitter link (STL), use the Orban 8200ST OPTIMOD-Studio Compressor/Limiter/HF Limiter/Clipper. The 8200ST can be adjusted so that it substitutes for the broadband AGC circuitry in OPTIMOD-PC, which is then defeated. Other types of AGC systems may adversely affect the audio.

General Features

- Orban **Optimod® 6200-class digital audio processing** on a PCI sound card—pre-processes audio for consistency and loudness before it is transmitted via netcast or digital radio.
- Two-Band **automatic gain control** compensates for widely varying input levels.
- Shelving **bass equalizer** and two-band **parametric equalizer** let you color the audio to your exact requirements.
- **Five-band compressor** creates source-to-source consistency and high average loudness.
- **Look-ahead limiter** effectively limits peaks while ensuring that low-bit-rate codecs operate optimally without overload.
- **Two AES/EBU or SPDIF digital inputs** with high-quality sample rate conversion allow two sources to be mixed: Ideal for network operations using local commercial/announcement insertion.
- Digital inputs **accept any sample rate** from 32 to 96 kHz.
- **Balanced analog input** with 24-bit A/D converter is always active, mixing with the two digital inputs.
- **Wave input** from any PC audio application that can be mixed with other inputs.
- **AES/EBU output** at 32, 44.1, 48, 88.2, or 96 kHz sample rate.

- Supplied **WAVE drivers** allow OPTIMOD-PC's processed output to pass through the PCI bus to the CPU, driving standard PC applications, like Microsoft or Real streaming encoders. The driver (with the aid of concurrently running third-party software) also allows OPTIMOD-PC to receive audio over IP from the host computer's network connection.

- **IO Mixer application** permits versatile routing and switching of processed and unprocessed audio from and to OPTIMOD-PC's inputs and outputs, and to and from the host computer's WAVE audio.

- Balanced **analog monitor output** with 24-bit D/A converter.

- **Precisely controls peak levels** to prevent overmodulation or codec overload. The maximum level of the digital samples is controlled to better than 1%.

- A **second digital input** also accepts AES/EBU house sync, synchronizing the AES/EBU output sample rate to the sample rate of the sync input.

- Internal processing occurs at **48 kHz** sample rate and **20 kHz** audio bandwidth.

- AES/EBU **digital output**.

- OPTIMOD-PC **controls the audio bandwidth** as necessary to accommodate the transmitted sample frequency, obviating the need for extra, overshooting anti-aliasing filters in downstream equipment. OPTIMOD-PC's high frequency bandwidth can be switched instantly (typically in 500Hz increments) between 4.0 kHz and 20 kHz. 20 kHz is used for highest-quality systems. 15 kHz meets the requirements of the proposed AM IBOC systems that use 32 kHz sample frequency, and may also help low bit rate lossy codecs sound better than they do when fed full 20 kHz bandwidth audio. 10 kHz bandwidth meets the requirements of auxiliary Eureka-147 transmissions using a 24 kHz sample frequency. Lower audio bandwidths meet the requirements of auxiliary speech grade services.

- Three **Motorola DSPs** do all the audio processing—there is no extra DSP load on your computer's CPU.

- Full **coprocessing** (independent of the CPU) means that audio will ordinarily continue to pass through the card from its AES/EBU or analog inputs to its outputs even if the host computer crashes. (Of course, WAVE inputs and outputs will stop working because these are dependent on operating system services.)

- OPTIMOD-PC ships with over **twenty standard presets**, which correspond to different programming formats. These presets have already been tested and field-proven in major-market radio netcasting, digital radio, and direct satellite broadcasting applications (both radio and television) worldwide.

- An easy-to-use **graphic control application** runs on your PC, and can act as a client to control any number of OPTIMOD-PC cards, either locally or in other PCs on your network via TCP/IP addressing. Other Orban software offers a server function, allowing other computers on your network to address cards located in your PC. (This server software is automatically installed as part of the OPTIMOD-PC installation process and runs as a Windows service.)

- The Control application allows you complete flexibility to create **your own custom presets**, to save as many as you want to your local hard drive, and to recall them at will.

Adaptability through Multiple Audio Processing Structures

- A **processing structure** is a program that operates as a complete audio processing system. Only one processing structure can be active at a time. Just as there are many possible ways of configuring a processing system using analog components (such as equalizers, compressors, limiters, and clippers), there are many possible processing structures achievable by OPTIMOD-PC. OPTIMOD-PC realizes its processing structures as a series of high-speed mathematical computations made by Digital Signal Processing (DSP) chips.

- OPTIMOD-PC features two processing structures: **Five-Band** (or Multi-Band) for a consistent, "processed" sound, free from undesirable side effects and **Two-Band** for a tastefully controlled sound that preserves the frequency balance of the original program material.

- The Two-Band structure can also be tuned to operate as a **Protection Limiter**, providing up to 25dB of safety limiting with minimal side effects.

- OPTIMOD-PC **can increase the density and loudness** of the program material by multi-band compression and look-ahead limiting, improving the consistency of the station's sound and increasing loudness and definition remarkably, without producing unpleasant side effects.

- OPTIMOD-PC **rides gain** over an adjustable range of up to 25dB, compressing dynamic range and compensating for operator gain-riding errors and for gain inconsistencies in automated systems.

- OPTIMOD-PC's processing structures are all **phase-linear** to maximize audible transparency.

- OPTIMOD-PC can be changed from one processing structure to another with a **smooth cross-fade**.

Presets in OPTIMOD-PC

There are two kinds of presets in OPTIMOD-PC: Fixed Processing Presets and User Presets.

Fixed Processing Presets

There are over 20 Fixed Processing Presets. These are our recommended settings for various program formats or types. The description indicates the processing structure and the type of processing. Each Fixed Processing Preset on the Open Preset list is really a library of 20 separate presets, selected by using the LESS-MORE control to adjust OPTIMOD-PC for less or more processing.

Fixed Processing Presets are stored as text files on the hard drive of the same computer that houses the OPTIMOD-PC card. After an OPTIMOD PC card is installed in your PC, a Presets folder containing all the fixed and user Preset files is created on your hard drive.

There are two sets of preset files ("wideband" and "narrowband") for each named fixed preset. OPTIMOD-PC's "Low Pass Filter" setting determines which set of files it uses—wideband for 7.5 kHz and above, and narrowband for 7 kHz and below. (The "Low Pass Filter" control is located in the Optimod PC Mixer in the Configuration screen.)

Each set of preset files for wideband and narrowband consists on one "master" file and several "less/more" files. Master files contain the preset data that is first loaded when you activate a fixed preset. Less/more files contain the preset data that is called up when you edit a fixed preset via the Control application's one-knob "less/more" editing procedure. If there is no less/more file for the less-more setting you choose, OPTIMOD-PC will automatically generate the data by interpolating between the contents of the two nearest less/more files.

The suffixes of the master Fixed Preset files are ORBFW and ORBFN for wideband and narrowband, respectively. Within the preset folder on your hard drive, there is a corresponding less/more folder named after the master fixed preset file. The Less/More files are located in these folders. The file names of the less/more files are [preset name] LMxxx.ORBFW and [preset name] LMxxx.ORBFN, where "xxx" is three numbers, like "080" (which corresponds to a LESS/MORE value of 8.0). All of these files have been given the "read-only" attribute to make them inconvenient to erase, even at the operating system level. You cannot erase or overwrite them from the OPTIMOD-PC Control application. If you erase or modify a fixed or less/more file from an external file manager like Windows Explorer (a very unwise thing to do), you will have to reinstall the software to regenerate the file unless you have a backup copy of the file elsewhere.

The normal location for fixed presets is `c:\Program Files\Orban\OPTIMOD-PC\presets`. Each fixed preset has an associated folder containing all of the less/more files for that preset. The less/more folders are located immediately below the `presets` folder; each less/more folder bears the name of its associated preset.

There is only one copy of the fixed presets per computer, regardless of the number of OPTIMOD-PC cards installed in that computer.

User Processing Presets

You can change the settings of a Fixed Processing Preset, but if you want to preserve your changes, you must then store those settings as a User Preset, which you are free to name as you wish.

The suffix of User Presets is ORBU. The Fixed Preset remains unchanged.

User presets do not have a "wideband" or "narrowband" attribute. (That is, changing the bandwidth while a user preset is active will not load a new preset, unlike the action that will occur when a Fixed Preset is active.)

User Presets permit you to change a Fixed Processing Preset to suit your requirements and then to store those changes.

You can store as many User Presets as the OPTIMOD-PC card's host computer hard drive and operating system can accommodate. User Presets are shown on the "Open Preset" list by the name that you gave them when you saved them.

You can name them as you wish, limited only by the file naming limits in your operating system.

Do not use a suffix; .ORBU will be added automatically.

The normal folder containing User Presets for a given OPTIMOD-PC card is `c:\Program Files\Orban\OPTIMOD-PC\[card serial number]\presets`. A user preset that you create while working with a given card is available only for that card. To make the preset available to a second card, copy the preset file to the appropriate presets folder located under the second card's serial number.

If you want to back up a user preset, use the standard Windows file copy mechanism to copy it from its current folder into a backup folder you have made.

User Presets cannot be created from "scratch." Start by recalling a Fixed Preset. You can then immediately store this in a new User Preset (with "Save As" from the FILE menu), give it whatever name you wish, make changes to the settings as desired, and then save it again. Alternatively, you can recall a Fixed Preset, make the changes first, and then store this as a User Preset. Either way, the Fixed Preset remains for you to return to if you wish.

You can also modify an existing User Preset.

When you modify an existing preset, whether Fixed or User, the OPTIMOD-PC server software will automatically generate a temporary User Preset whose name consists of "Modified" appended to the front of the existing preset name. If you do not save your modifications, this temporary preset will remain on the server computer's hard drive until you

further modify any preset. Then the temporary preset will be overwritten.

Input/Output Configuration

OPTIMOD-PC simultaneously accommodates:

- One digital AES/EBU left/right output.
- Two digital AES/EBU left/right inputs, either of which can be used as a sync input to synchronize the output sample rate emitted from the AES/EBU output to the sample rate present at the sync input.

  The output sample rate can also be synchronized to OPTIMOD-PC's internal clock.)
- One set of analog left/right inputs and outputs.

  The AES/EBU inputs and outputs and the analog output appear on a female DB-25 connector on the rear of the card (see Figure 2-2 on page

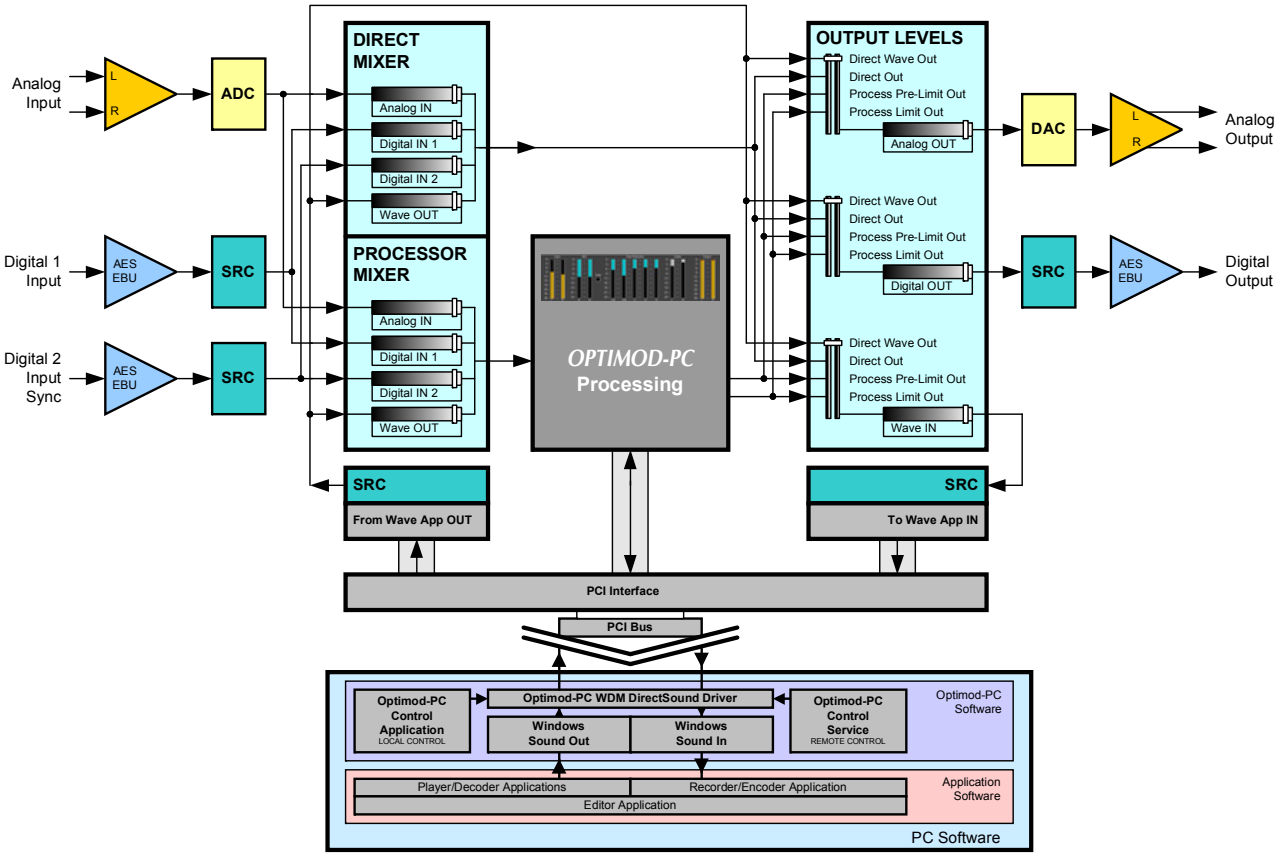


Figure 1-1: OPTIMOD-PC Signal Flow

2-5). Orban sells three variations of an "umbilical" cable that plugs into the connector—one variation is terminated with XLR connectors, one is terminated with RCA phono plugs, and one is unterminated.

- Inputs and outputs passing through the computer's PCI bus, using operating system multimedia sound drivers, such as Microsoft Windows DirectSound WDM WAVE drivers.

  These inputs and outputs are controlled by the OPTIMOD-PC Mixer application, which can be launched from the Tools menu on the OPTIMOD-PC control application, and can also be remotely accessed.

Digital AES/EBU Left/Right Input/Output

The digital inputs and output follow the professional AES/EBU hardware standard regarding impedances and levels, although their data stream can also be configured to follow the consumer SPDIF standard.

In most practical situations, AES/EBU and SPDIF are interchangeable and can be interoperated with each other without difficulty; you usually do not have to concern yourself with which standard you are using. Generally, if the equipment to which you are connecting has pin jacks, set OPTIMOD-PC to use the SPDIF standard. If the equipment has XLR-type connectors or BNC connectors, set OPTIMOD-PC to use the AES/EBU standard.

OPTIMOD-PC incorporates an output sample rate converter that allows operation at 32, 44.1, 48, 88.1, or 96 kHz sample frequency. The inputs have sample rate converters that allow the input to accept any sample rate between 20 kHz and 96 kHz.

To ensure best control of peak modulation, operate the output at 48 kHz. This guarantees that the output samples are synchronous with the peak-controlled samples produced by the processing.

If you have ordered the optional 1100/CBLXLR XLR-terminated umbilical cable, then the left/right digital inputs appear on two XLR-type female connectors on this cable. The left/right digital output is on one XLR-type male connector on the umbilical cable. If a given digital input is not being used to receive a digital audio input, it is available to genlock OPTIMOD-PC's output sample frequency to house sync, if required.

OPTIMOD-PC simultaneously accommodates WAVE, digital, and analog inputs and outputs. You can mix all inputs into one signal that is applied to the processing. The digital inputs can be asynchronous because both are applied to sample rate converters that lock them to OPTIMOD-PC's internal 48 kHz sample frequency.

Level control of all inputs and outputs is via the OPTIMOD-PC Mixer application, including remote access.

Analog Left/Right Input/Output

The left and right analog inputs are on XLR-type female connectors on the umbilical cable. Input impedance is greater than 10kΩ; balanced and floating. Inputs can accommodate up to +20dBu (0dBu = 0.775Vrms).

The left and right analog outputs are on XLR-type male connectors on the umbilical cable. Output impedance is 50Ω, balanced and floating.

The outputs are intended for monitoring. They can drive 600Ω or higher impedances. However, they are AC-coupled with a –3dB frequency of approximately 1 Hz, which is higher than the 0.15 Hz recommended by Orban to avoid low-frequency overshoots ("bounce") caused by phase shifts. Therefore, when you are using the audio processing for peak control, such control will be noticeably poorer at the analog outputs than at the AES/EBU or WAVE outputs, both of which exhibit very tight peak control. Consequently, you should always use OPTIMOD-PC's AES/EBU or WAVE outputs to drive your transmission chain.

For a more detailed diagram of the "Processor" block, see *Figure 3-3: Simplified OPTIMOD-PC Digital Signal Processing Diagram* on page 3-6.

The Orban I/O Mixer

The I/O Mixer mixes and routes audio to and from the OPTIMOD-PC card. (See *Figure 1-1: OPTIMOD-PC Signal Flow* on page 1-7, and *Figure 1-2: Typical I/O*

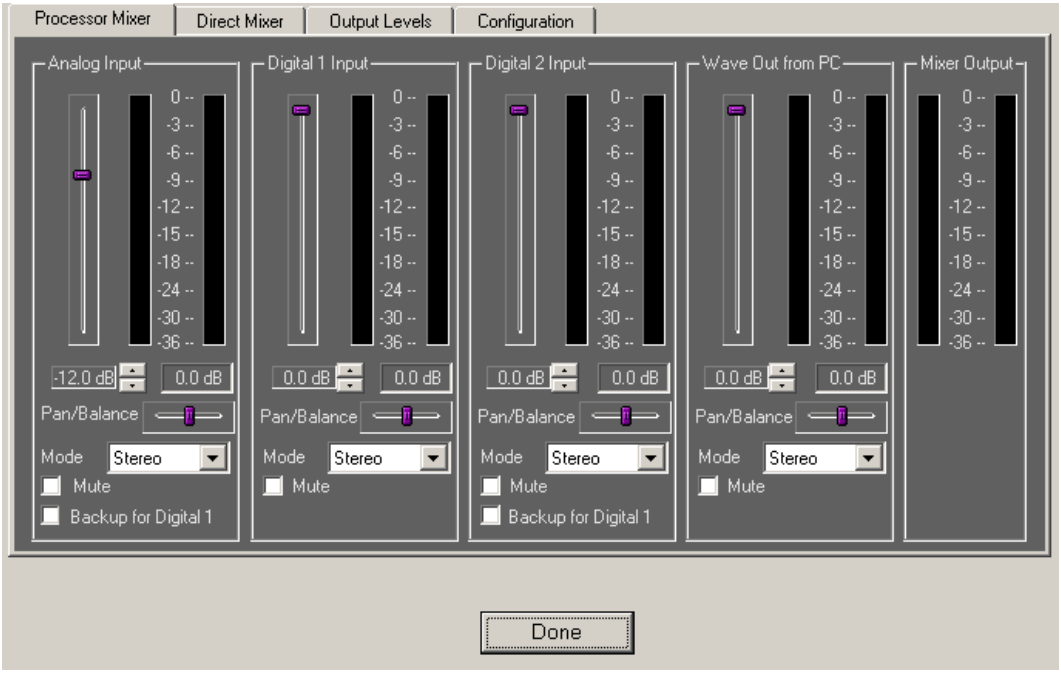


Figure 1-2: Typical I/O mixer

mixer above.) You can open the Optimod PC Mixer from the Tools menu in the Orban Control application.

Within the Optimod PC Mixer, there are two mixers, each of which receives the same four inputs:

- The stereo analog input on the DB-25 connector
- Digital 1 Input(AES/EBU) on the DB-25 connector
- Digital 2 Input (AES/EBU) on the DB-25 connector
- The WAVE Out from the computer operating system's internal mixing and routing

The first "Processor Mixer" sends its output to the audio processing DSP on the OPTIMOD-PC card.

The second "Direct Mixer" sends its output directly to the output routing switcher.

There are three outputs, each of which can receive the following four possible sources:

- The *Direct WAVE bitstream* received from the computer.
- The *Direct Mixer's* output.
- The *processor without limiting*: The output of the OPTIMOD-PC audio processing that follows all processing except final peak limiting.
- The *processor with limiting*: The output of the OPTIMOD-PC audio processing that follows all processing, including peak limiting.

> Not all outputs have to receive the same source; any source can feed any output.
>
> Source (3) can provide low-delay monitoring into live talent headphones because it has much lower throughput delay than source (4).

The output signal routing switcher determines which of the above four signals feeds:

- the OPTIMOD-PC card's *stereo analog output*
- the OPTIMOD-PC card's *AES/EBU digital output*, and
- the *WAVE In* going to the PC.

Overview of an OPTIMOD-PC Installation

An OPTIMOD-PC card installs in a PCI slot in an IBM-compatible host computer. The computer's PCI bus must be Plug & Play PCI Version 2.2 compliant, 32-bit, 33MHz, with a transfer rate up to 132MBytes/sec. OPTIMOD-PC will operate in a 3.3V or 5V PCI slot, and with bus extenders.

> Almost all recently manufactured PCs meet these PCI bus specifications.

More than one OPTIMOD-PC card can be installed in a given host computer. The number of cards is limited only by the number of available PCI slots, which may reside in a PCI expansion chassis.

Conceptually, there are two options for operating OPTIMOD-PC: *simple* and *network*.

- *Simple* operation will only control OPTIMOD-PC cards that are installed in the same PC that is running the Orban application.
- *Network* operation allows you to control one or more OPTIMOD-PC cards over a network, regardless of whether the OPTIMOD-PC card is located in the controlling computer.

Both modes of operation require you to run a *server* application in the background on any remote computer housing OPTIMOD-PC cards. However, you do not need to run the server if you are running the Control Application in a computer that has no OPTIMOD-PC cards installed.

> In this case, the Control Application would be dedicated to controlling OPTIMOD-PC cards located in other computers on the network.

The server is automatically installed when you install the OPTIMOD-PC software, and is configured to run as a "Windows Service." The server application is an intermediary that enables the Orban Control Application to remotely communicate with the OPTIMOD-PC card(s) installed in a given host computer. One instance of the server application handles communications for all of the OPTIMOD-PC cards in a given host computer. When the host computer is booted, the OPTIMOD-PC driver initializes the DSP on the card, initializes the I/O settings, and sets the processor settings to a default value. After that, the OPTIMOD-PC server finishes starting up and then resets the processing parameters and I/O settings to their previous power-down values. The service completes this task just before the Windows Log-On screen appears.

The Control Application connects (through the server) to only one card at a time, allowing you to recall, edit and save presets, set input/output mix levels, and do other housekeeping tasks for that card.

> Note that the Control Application does not use the server to interface with a card installed on the same computer that is running the Control Application.

"Simple" operation occurs when the Service's remote server is disabled. For "network" operation, you may set passwords at a given OPTIMOD-PC card's host computer to protect it from unauthorized access from the network, using the Optimod

Control Application. You also need to make your local cards visible to the network by selecting "Allow Network to Access Local Cards" in the "Card and Security Administration" screen, which is accessible from the Tools drop down menu box. The setup instructions in Section 2 of this manual provide detailed instructions on how to do this.

In a Simple or Network environment, the number of OPTIMOD-PC cards that one host can accommodate depends only on the number of free PCI slots available and on the speed of the host's CPU. (PCI expansion chassis are supported.) OPTIMOD-PC cards share IRQs, so availability of IRQs will not usually be a problem.

Although OPTIMOD-PC contains on-board DSP, the host's CPU must still perform some "housekeeping" chores. It must run Orban's server software, and, more significantly, it must do sample rate conversion if OPTIMOD-PC is used as a WAVE device and the source or destination sample rates are different from 48 kHz. On the other hand, if only OPTIMOD-PC's analog input and/or AES/EBU digital I/O are used for input and output, then OPTIMOD-PC's built-in hardware sample rate converters do all necessary conversion and no extra load is placed on the host CPU for sample rate conversion.

Simple Operation in One Host Computer

When only one card is installed in a local machine, the OPTIMOD-PC control application running on said local machine will automatically connect to that card if you start the application by clicking its "agent" icon, located in the far right side of the Windows taskbar in the Windows system tray. If more than one card is installed (or if you start the application any other way than by clicking on the agent icon), the Control application will initialize without connecting to a card and you must connect the application to the card you wish to control.

When you first install OPTIMOD-PC on a computer, all cards are hidden from the network by default. Consequently, "simple" operation is always the default in a new installation. Simple operation makes sense in applications like a production studio, where you are using the OPTIMOD-PC processing to master files for subsequent broadcast, streaming, or dissemination on other media like CD or DVD.

Security

OPTIMOD-PC is designed for networking. Because most PCs are now networked, the cards must be protected from unauthorized access when networking is activated. Two levels of security achieve this:

- Each card has a User password that allows an authorized user to "connect" to the card. When this occurs, the user can work with the audio processing functions in the card, can change and edit presets, and can do other tasks similar to those that one would do on a stand-alone audio processor.
- Each card also has an Administrator password that allows an administrator to change the name of the card, allow network access, change the Administrator password, and change the User password from anywhere on the network.

> Only an administrator can assign and change user passwords. If the user has checked "remember password" on the dialog box requesting password entry, only the administrator can "uncheck" the "remember password" function for that card.
>
> Unless networking is activated, cards located in a given machine are visible only to the Orban Control application running locally on that machine. They are invisible to other machines on the network. Not running in "network" mode therefore provides considerable security.

Each OPTIMOD-PC has a unique serial number burned into its on-card ROM. It is also written on a label on the card's mounting flange so it can be seen from outside the host computer. The serial number is the fundamental means by which the Orban software identifies the card. When you first install your card(s), the card's serial number appears next to the profile name in the Connect drop-down box and at the top left hand corner in the application when you are connected to that card.

The Orban software allows you to give a card an easily remembered name (e.g., "KORB") so the software does not have to address the card by its serial number. This name is an alias that is local to the computer from which you named the card; the same card could be known by a different name on each computer in the network.

If you give your card an alias name, this name will appear (instead of the serial number) next to the profile name in the Connect drop-down box and at the top left hand corner in the application when you are connected to that card.

> Only the card's serial number is unique. The serial number is always available on "Card and Security Administration" screen, which is accessible from the Tools drop-down menu box.
>
> Only an administrator can rename a card (profile), and that name will remain only on the machine from which it was assigned that name.

For Orban's Control application to access cards on other machines, those machines must have Orban server software running (with "Allow Network to Access Local Cards" checked in TOOLS/CARD & SECURITY ADMIN.) and the Control application must always know these remote cards' passwords to access them. These passwords are initially assigned by the administrator at the machine in which the remote cards are installed. If you plan network operation, it is very important to assign both a User and an Administrator password to each card in that machine to prevent the cards from being hacked.

> The dual password system is useful in protecting a networked installation from being damaged by disgruntled employees or hackers who might get access to a User password and server IP address. A malicious user might set incorrect presets and audio levels, put test tones on-air, mute the audio, or delete user presets. (This is another reason, other than potential hard drive failure, why it is wise to back up user presets.)
>
> However, a malicious user cannot take exclusive control of a card by changing its name or password. Only an administrator can do that. Meanwhile, the administrator can change User passwords and rename cards from a central location. It is wise to do this each time a person with a User password leaves the employ of the entity doing the streaming or broadcasting—it's like "changing the locks."

No networked card outside the local machine is viewable inside Orban's software until you "add" it to the list of viewable cards by going into Connect\Add and then supplying the IP address and the card's User password (if a password was assigned to that card). This allows one host computer to accommodate multiple OPTIMOD-PC cards, each processing competitor's streams, while allowing a given competitor to view only its own card(s) from the Control application.

Networking OPTIMOD-PC Cards

Orban's OPTIMOD-PC control application can control OPTIMOD-PC cards installed anywhere on a TCP/IP network, including the Internet. A complex system (such as one that a major broadcast group, or large server farm/ISP might operate) could have dozens of clients and servers networked together. Each host computer has a TCP/IP address and port assigned to it and runs an instance of the Orban server application.

The Orban Control application can automatically find all cards within a given host computer anywhere on the network, provided that the Control application knows the IP address of the host computer. However, the Control application will leave the cards hidden from the application's user until the user "adds" the cards by supplying their User passwords and IP addresses.

To connect to a card you must first add the host computer/server to your control application via CONNECT: ADD PROFILE/CARDS. Here, you provide the host computer's IP address and port number. Once a profile/card is added, you can connect to it by double-clicking on the card in the CONNECT drop-down list.

Each local copy of the Orban Control application allows you to name a server (e.g., "Boston") so you do not have to remember its IP address and port number each time you connect the Control application to it.

> The server names are stored locally on each computer; each local copy of the Orban Control application can create a different profile name for a given server. A server's real "name" is always its IP address and port.

You can see a drop-down list of all cards that have been added previously, regardless of whether you are logged onto the host computer housing those cards. Once you have logged onto the host computer, you can connect to any card on this list if it is "available" (that is, if it is still installed in the host computer; removing a card from its host computer will not automatically remove its name from a client computer). If you have not previously connected to a given card and specified "remember password," you must supply your User password before you can connect.

> Once you have specified "remember password," the password dialog box will not appear again and the "remember password" status can only be canceled by an administrator. "Remember password" can compromise security, so you should use this feature with discretion.

Only one client can be logged into a given card at one time; the card will return "in use" if another client attempts to log into the same card. However, more than one

client can be logged onto a given host computer at once, provided that each client is logged onto a different card within that host.

Section 2 of this manual provides detailed, systematic instructions for setting up a network of OPTIMOD-PC cards.

Location of OPTIMOD-PC for Streaming and Netcasting

It is usually best to locate OPTIMOD-PC cards in the same machine that runs the encoding software, like Orban Opticodec-PC, Microsoft Windows Media Encoder or Real Networks HELIX Producer. This is because the output of the encoder is at a much lower data rate than the audio used to drive the OPTIMOD-PC input(s), so it is less expensive to transport encoded audio than unencoded audio. In Windows installations, the encoder receives the processed output of OPTIMOD-PC through the standard Windows' WAVE signal handling mechanism. You control mixing and routing through Orban's I/O Mixer application, which you call from the Tool/IO Mixer menu item in the Control application.

OPTIMOD-PC's digital inputs accept stereo pairs of uncompressed PCM-format digital audio. OPTIMOD-PC's AES/EBU digital inputs will not accept "bitstream" inputs encoded with formats like Dolby Digital® or DTS®. Inputs must be two-channel "PCM" (Pulse-Code Modulation) format with sample rates from 32 to 96 kHz and 8 to 24 bit word length, following standard AES/EBU or SPDIF protocols. Because both digital inputs have sample rate converters, both inputs can be mixed (even if asynchronous with each other) and neither need be synchronous with the output.

If the netcasting servers are located remotely, then there is a particular advantage to transporting the compressed stream instead of the raw PCM. If the data rate of the compressed stream is less than 128kbps, it can be transported on an ISDN line. If the rate is greater, or if more than one stream is being transported, a fractional T1 line is often suitable. In general, IP connection via the Internet is insufficiently reliable for "broadcast contribution quality" connections, introducing a risk of gaps and dropouts in the stream. Therefore it is desirable to use an encoder (such as Opticodec-PC) that can automatically reconnect to the server in the unlikely event that the connection is dropped.

Genlocking OPTIMOD-PC Cards to a Reference Sample Frequency

Many plants have a reference sample frequency to which all digital equipment is locked. While OPTIMOD-PC does not have a word clock input, either AES/EBU input can accept a reference sample frequency via an AES/EBU signal. OPTIMOD-PC's output sample frequency can then be locked to this reference [see step (4.B) on page 2-22.]

This reference can be the sample frequency of one of the active audio inputs. On the other hand, if you have an AES/EBU stream available exclusively as a sample frequency reference, you can then connect this stream to the input that you specify as

the "reference" and mute the reference input in the Orban IO Mixer application. (See *Figure 1-1: OPTIMOD-PC Signal* on page 1-7, and *Figure 1-2: Typical I/O mixer* on page 1-9.)

Because of hardware limitations in the sample rate converters, input frames are not necessarily phase-aligned to output frames according to the strictest interpretation of the AES-11 standard. However, the sample frequency of the output will be identical to the sample frequency of the input. In addition, these limitations prevent the passing of AES/EBU user bits from digital input to digital output.

Using OPTIMOD-PC's internal crystal reference, you can also set the output sample frequency to be independent of the input sample frequency. In this case, you can freely set the output to 32, 44.1, 48, 88.2, or 96 kHz.

> If the input reference sample frequency deviates from the preset output sample frequency by more than ±4%, the output sample frequency will automatically lock to OPTIMOD-PC's internal crystal reference instead of the input reference.
>
> In all cases, OPTIMOD-PC's internal processing operates at 48 kHz, locked to OPTIMOD-PC's internal crystal reference. The output sample rate converter, which is always in-line, determines the output sample rate.

Studio-Transmitter Link in Digital Broadcasting

The following information is mainly relevant to digital radio broadcasters who have their transmitters and studios at different locations. It assumes that you are using OPTIMOD-PC as a replacement for a stand-alone audio processor. In this context, you use OPTIMOD-PC's external analog or digital inputs and outputs and do not route the audio through the host computer.

Most netcasters will not find the information in this section relevant because if netcasters need to ship audio beyond their LAN, they ordinarily ship it from one location to another in the form of encoded audio through low-capacity Telco-supplied digital links like ISDN or E-1/T-1.

Transmission from Studio to Transmitter

There are five types of studio-transmitter links (STLs) in common use in broadcast service: uncompressed digital, digital with lossy compression (like MPEG, Dolby®, or APT-x®), microwave, analog landline (telephone/post line), and audio subcarrier on a video microwave STL.

> At this writing, we believe that the Internet is insufficiently reliable to serve as a carrier for a real-time STL because of the risk that the audio feed may be randomly interrupted by network interruptions.

STLs are used in two fundamentally different ways. They can either pass unprocessed audio for application to OPTIMOD-PC's input, or they can pass OPTIMOD-PC's

peak-controlled output. The two applications have fundamentally different performance requirements.

- A link that passes unprocessed audio should have very low noise and low nonlinear distortion, but its transient response is not important.
- A link that passes processed audio does not need as low a noise floor as a link passing unprocessed audio. However, its transient response is critical. In DAB applications, such a link *must* be uncompressed digital and *must* use digital inputs and outputs to achieve best results. We will elaborate below.

Digital links

Digital links may pass audio as straightforward PCM encoding, or they may apply lossy data reduction processing to the signal to reduce the number of bits per second required for transmission through the digital link. Such processing will almost invariably distort peak levels, and such links must therefore be carefully qualified before you use them to carry the peak-controlled output of OPTIMOD-PC to the transmitter. For example, the MPEG Layer 2 algorithm can increase peak levels up to 4dB at 160kb/sec by adding large amounts of quantization noise to the signal. While the desired program material may psychoacoustically mask this noise, it is nevertheless large enough to affect peak levels severely. For any lossy compression system the higher the data rate, the less the peak levels will be corrupted by added noise, so use the highest data rate practical in your system.

It is practical (though not ideal) to use lossy data reduction to pass unprocessed audio to OPTIMOD-PC's input. The data rate should be at least of "contribution quality"—the higher, the better. If any part of the studio chain is analog, we recommend using at least 20-bit A/D conversion before encoding.

Because OPTIMOD-PC uses multi-band limiting, it can dynamically change the frequency response of the channel. This can violate the psychoacoustic masking assumptions made in designing the lossy data reduction algorithm. Therefore, you need to leave "headroom" in the algorithm so that OPTIMOD-PC's multi-band processing will not unmask quantization noise. This is also true of any lossy data reduction applied in the studio (such as hard disk digital delivery systems).

> For MPEG Layer 2 encoding, we recommend 384kB/second or higher.

Some links may use straightforward PCM (pulse-code modulation) without lossy data reduction. If you connect to these through an AES/EBU digital interface, these can be very transparent, provided they do not truncate the digital words produced by the devices driving their inputs and they do not require downward sample rate conversion.

> Downward sample rate conversion can cause overshoot due to spectral truncation and asynchronous re-sampling of the 48 kHz peak-controlled samples.

If the link does not have an AES/EBU input, you must drive its analog input from OPTIMOD-PC's monitor output. This is not recommended because OPTIMOD-PC's monitor output will overshoot in the analog domain because of the physics of the

system. The use of external digital-to-analog converters should also be avoided for many of the same reasons.

> Peak control in OPTIMOD-PC occurs at a 48 kHz sample frequency. This is sufficient to prevent any samples from exceeding the threshold of limiting. However, after reconstruction, the analog output may overshoot the nominal 100% level because these overshoots "fall between the samples," so the processing cannot be aware of them. If you use this output to feed the analog input of a digital STL, the new samples in the STL will not be synchronous with the samples inside OPTIMOD-PC. Therefore, they may well fall on the overshoots, causing loss of peak modulation control. It is thus very important to use a link with an AES/EBU input to ensure correct peak control.
>
> The same sort of thing can happen if you use the output sample rate converter, because the output samples are no longer synchronous with the peak-controlled samples in the processing. Always use 48 kHz output sample rate to achieve best peak control.
>
> If you *must* use an analog input, you may bypass any anti-aliasing filters in digital links driven by OPTIMOD-PC because OPTIMOD-PC's output spectrum is tightly controlled. This ensures the most accurate possible transient response, given the limitations of asynchronous sampling described above.

NICAM is a sort of hybrid between PCM and lossy data reduction systems. It uses a block-companded floating-point representation of the signal with J.17 pre-emphasis.

Older technology converters (including some older NICAM encoders) may exhibit quantization distortion unless they have been correctly dithered. Additionally, they can exhibit rapid changes in group delay around cut-off because their analog filters are ordinarily not group-delay equalized. The installing engineer should be aware of all of these potential problems when designing a transmission system.

You can minimize any problems by always driving a digital STL with OPTIMOD-PC's AES/EBU digital output, which will provide the most accurate interface to the STL. The digital input and output accommodate sample rates of 32 kHz, 44.1 kHz, 48, 88.2, and 96 kHz.

Microwave STLs

In general, an analog microwave STL provides high audio quality as long as there is a line-of-sight transmission path from studio to transmitter of less than 10 miles (16 km). If not, RF signal-to-noise ratio, multipath distortion, and diffraction effects can cause serious quality problems. However, the noise and non-linear distortion characteristics of such links are likely to be notably poorer than 16-bit digital even if propagation conditions are ideal.

As discussed above, asynchronous resampling will cause overshoots if *any* analog path (even a perfectly transparent one) passes OPTIMOD-PC's processed output to the transmitter. Lack of transparency in the analog path will cause even more overshoot. Unless carefully designed, microwave STLs can introduce non-constant group delay in the audio spectrum, distorting peak levels when used to pass processed au-

dio. Nevertheless, in a system using a microwave STL OPTIMOD-PC is sometimes located at the studio and any overshoots induced by the link are tolerated or removed by the transmitter's protection limiter (if any). OPTIMOD-PC can only be located at the transmitter if the signal-to-noise ratio of the STL is good enough to pass unprocessed audio. The signal-to-noise ratio of the STL can be used optimally if an Orban 8200ST Compressor/Limiter/HF Limiter/Clipper or an Orban Transmission Limiter protects the link from overload.

If OPTIMOD-PC is located at the transmitter and receives unprocessed audio from a microwave STL, it may be useful to use a companding-type noise reduction system (like dbx Type 2 or Dolby SR) around the link. This will minimize any audible noise buildup caused by compression within OPTIMOD-PC.

Some microwave links may be modified such that the deviation from linear phase is less than $\pm 10^\circ$ 20-20 kHz, and frequency response is less than 3dB down at 0.15Hz and less than 0.1dB down at 20 kHz This specification results in less than 1% overshoot with processed audio. Many such links have been designed to be easily configured at the factory for composite operation, where an entire FM stereo baseband is passed. The requirements for maintaining stereo separation in composite operation are similar to the requirements for high waveform fidelity with low overshoot. Therefore, most links have the potential for excellent waveform fidelity if they are configured for composite operation (even if a composite FM stereo signal is not actually being applied to the link).

Further, it is not unusual for a microwave STL to bounce because of a large infrasonic peak in its frequency response caused by an under-damped automatic frequency control (AFC) phase-locked loop. This bounce can increase the STL's peak carrier deviation by as much as 2dB, reducing average modulation. Many commercial STLs have this problem.

Some consultants presently offer modifications to minimize or eliminate this problem. If your exciter or STL has this problem, you may contact Orban Customer Service for the latest information on such services.

Analog landline (PTT/post office line)

Analog landline quality is extremely variable, ranging from excellent to poor. (Fortunately, they are largely obsolete, having been replaced by digital links.) Whether landlines should be used or not depends upon the quality of the lines locally available, and upon the availability of other alternatives. Due to line equalizer characteristics and phase shifts, even the best landlines tend to veil audio quality slightly,. They will certainly be the weakest link in a DAB broadcast chain.

Slight frequency response irregularities and non-constant group delay characteristics will alter the peak-to-average ratio, and will thus reduce the effectiveness of any peak limiting performed prior to their inputs.

Location of OPTIMOD-PC in Digital Radio Service

At the Transmitter is Best

The best location for OPTIMOD-PC is as close as possible to the transmitter so that OPTIMOD-PC's AES/EBU output can be connected to the transmitter through a circuit path that introduces no change in OPTIMOD-PC's output bitstream. A high-quality AES/EBU cable is ideal.

Where Access to the Transmitter Plant is not Possible

Sometimes it is not possible to locate OPTIMOD-PC at the transmitter. Instead, it must be located on the studio side of the link connecting the audio plant to the transmitter. If the transmitter plant is not accessible, all audio processing must be done at the studio, and you must tolerate any damage that occurs later.

If an uncompressed digital link is available, this is an ideal situation because such a link will pass OPTIMOD-PC's output with little or no degradation. However, such a link is not always available.

> If only a 32 kHz sample rate link is available, the sample rate conversion necessary to downsample the audio will cause overshoots when OPTIMOD-PC is operated at 20 kHz bandwidth because the sample rate converter removes spectral energy. In this case, you can minimize overshoot by operating OPTIMOD-PC at 15 kHz bandwidth. (Set it from the Configuration tab in the IO Mixer application.)

Unless the path is a digital path using no lossy compression, this situation will yield lower performance than if OPTIMOD-PC is connected directly to the transmitter because artifacts that cannot be controlled by OPTIMOD-PC will be introduced by the link to the transmitter. These artifacts can decrease average modulation by 2-4dB and can also add noise and audible non-linear distortion. In the case of lossy digital compression, this deterioration will be directly related to the bit rate. For an analog path, the deterioration will depend on the amount of linear and non-linear distortion in the path. In addition, there will be an unavoidable amount of overshoot caused by asynchronous re-sampling (see page 1-17).

One strategy is to apply to OPTIMOD-PC's output signal the same lossy compression that the DAB transmitter would apply. If a digital link is available with sufficient bit rate to pass this compressed signal, it can then be passed directly to the DAB transmitter without further processing if synchronization issues can be resolved. Consult with the manufacturer of your DAB transmitter to see if this can be done.

Where only an analog or lossy digital link is available, feed the audio output of OPTIMOD-PC directly into the link. If available, the transmitter's protection limiter should be adjusted so that audio is normally just below the threshold of limiting: The transmitter protection limiter should respond only to signals caused by faults or by spurious peaks introduced by imperfections in the link.

Where maximum quality is desired, it is wise to request that all equipment in the signal path after the studio be carefully measured, aligned, and qualified to meet

the appropriate standards for bandwidth, distortion group delay and gain stability. Such equipment should be measured at reasonable intervals.

OPTIMOD-PC at the Transmitter: Gain Control before the STL

The audio received at OPTIMOD-PC's input should have the highest possible quality. To achieve the full audible benefit of OPTIMOD-PC processing, use a studio-transmitter link (STL) that is as flat as the bandwidth of OPTIMOD-PC as used in your plant (usually 20 kHz). Ideally, you should use a 20-bit (or better) uncompressed digital link with at least 44.1 kHz sample frequency.

Because the audio processor controls peaks, it is not important that the audio link feeding OPTIMOD-PC's input terminals be phase-linear. However, the link should have low noise, the flattest possible frequency response from 20-20,000Hz, and low non-linear distortion.

If the audio link between the studio and the transmitter is noisy (or, if digital, is limited to 16 bits or less), performing the AGC function at the studio site can minimize the audibility of this noise. AGC applied before the audio link improves the signal-to-noise ratio because the average level on the link will be greater. Further, many STLs require level control to prevent the STL from being overloaded.

To apply such level control and compression, we recommend an Orban AGC/Limiter/HF Limiter/Clipper before the STL transmitter. This performs the function of OPTIMOD-PC's internal broadband automatic gain control (AGC), while simultaneously protecting the STL. If this is done, defeat OPTIMOD-PC's broadband AGC by accessing the AGC function (within the Config screen in the I/O Mixer application menu) and setting it to DISABLE.

Using Lossy Data Reduction in the Audio Chain before OPTIMOD-PC

Many broadcasters and netcasters are now using lossy data reduction algorithms like MPEG-1 Layer 2 to increase the storage time of digital playback media. In addition, source material is often supplied through a lossy data reduction algorithm, whether from satellite or over landlines. Sometimes, several encode/decode cycles will be cascaded before the material is finally presented to OPTIMOD-PC's input.

All such algorithms operate by increasing the quantization noise in discrete frequency bands. If not psychoacoustically masked by the program material, this noise may be perceived as distortion, "gurgling," or other interference. Psychoacoustic calculations are used to ensure that the added noise is masked by the desired program material and not heard. Cascading several stages of such processing can raise the added quantization noise above the threshold of masking, such that it is heard. In addition, there is at least one other mechanism that can cause the noise to become audible at the radio. OPTIMOD-PC's multi-band limiter performs an "automatic equalization" function that can radically change the frequency balance of the program. This can cause noise that would otherwise have been masked to become

unmasked because the psychoacoustic masking conditions under which the masking thresholds were originally computed have changed.

Accordingly, if you use lossy data reduction in the studio, you should use the highest data rate possible. This maximizes the headroom between the added noise and the threshold where it will be heard. In addition, you should minimize the number of encode and decode cycles, because each cycle moves the added noise closer to the threshold where the added noise is heard.

Interfacing to the Transmitter

Sync Input

In the Eureka-147 system, several programs are combined into one "ensemble multiplex." This requires synchronization of the sample rates applied to the transmitter. DTV also requires synchronization. OPTIMOD-PC allows you to use one of the AES/EBU inputs to accept "house sync," which permits OPTIMOD-PC's output to be synchronized to a master sync generator. Regardless of whether its analog or digital inputs are used, its AES/EBU output will be synchronized to the AES/EBU signal at this input. Because OPTIMOD-PC's digital inputs are equipped with sample rate converters, locking the output sample rate to the house sync reference allows an asynchronous digital input to be applied to OPTIMOD-PC's remaining AES/EBU input while ensuring that OPTIMOD-PC's output is in sync with the master sync generator. (See also page 1-15: *Genlocking OPTIMOD-PC Cards to a Reference Sample Frequency*

Sample Rate and Audio Bandwidth

Most DAB audio is at 48 kHz sample rate. However, several of the proposed AM IBOC systems operate at 32 kHz, requiring 15 kHz audio bandwidth. The Eureka-147 system offers a 24 kHz sample rate option, requiring 10 kHz audio bandwidth. The Digital Radio Mondiale (DRM) shortwave system also allows reduced audio bandwidths and sample rate for speech-grade services.

OPTIMOD-PC's bandwidth can be adjusted from 4 kHz to 20 kHz to provide correctly anti-aliased audio for any of these systems. Provided that any anti-aliasing filters following OPTIMOD-PC's output are phase-linear and have integer-sample time delays, these filters will pass the band-limited OPTIMOD-PC output without introducing overshoot because they remove no further spectrum and do not cause their output samples to become asynchronous with the peak-controlled samples at OPTIMOD-PC's output.

OPTIMOD-PC always operates at 48 kHz sample rate internally. Its output is equipped with a sample rate converter that can output at 32 kHz, 44.1 kHz, 48, 88.2, or 96 kHz. These rates can be synchronized to either AES/EBU digital input (see page 1-15).

We expect that transmitters that transmit sample rates below 32 kHz will provide internal sample rate conversion, and that most will probably accept audio at 48 kHz sample rate regardless of the final sample rate of the transmission. Any sample rate

conversion may cause the transmitted sample to become asynchronous to the peak-controlled samples emerging from OPTIMOD-PC and may therefore introduce overshoot. Fortunately, as the audio bandwidth becomes lower this becomes less of the problem because the 48 kHz sample rate within OPTIMOD-PC oversamples the audio. It is therefore less likely that peaks will "slip between the samples."

Subframe Delay

OPTIMOD-PC provides an adjustable time delay of up to approximately 42 milliseconds. This allows the installer to force the total delay through the processing to equal one frame (in video applications). The definition of "frame" depends on the system in which OPTIMOD-PC is installed.

> The selections are MINIMUM (approximately 24 ms delay), 30 fps (NTSC monochrome video), 29.97 fps (NTSC color video), 25 fps (most PAL video), and 24 fps (film). You can also adjust the delay in one millisecond increments from 15 to 57 ms.

Setting Output/Modulation Levels

In a perfect world, one could set the peak level at OPTIMOD-PC's output to 0dBfs. However, there are at several potential problems that may make it desirable to set the modulation level slightly lower.

First is asynchronous re-sampling, which we have discussed at length earlier in this chapter. (See page 1-17, for example.) If any digital processing that causes its output samples to be asynchronous to its input samples is used after OPTIMOD-PC's output, this can cause the peak levels of individual samples to increase above the nominal threshold of limiting. This increase is typically less than 0.5dB.

Second is additional processing, such as equalization. Equalization that applies boosts at certain frequencies is very likely to add peak level and thus cause clipping. However, equalization that attenuates certain frequencies can also cause overshoots because of added phase shifts. So be wary of any equalization and allow headroom to accommodate it.

Third is headroom in lossy data compression systems. A well-designed perceptual encoder will accept samples up to 0dBfs and will have internal headroom sufficient to avoid clipping. However, there is no guarantee that *receiver* manufacturers or *decoder* providers will implement perceptual decoders with sufficient headroom to avoid clipping overshoots. Such overshoots are the inevitable side effect of increasing the quantization noise in the channel, and can be as large as 3-4dB. Most perceptual encoder algorithms are designed to have unity gain from input to output. So if peak levels at the input frequently come up to 0dBfs, peak levels at the output will frequently exceed 0dBfs (and will be clipped) unless the decoder algorithm is adjusted to be less than unity gain.

The canny engineer will therefore familiarize him/herself with the performance of real-world receivers and will reduce the peak modulation of the transmissions if it turns out that most receivers are clipping due to perceptual encoding overshoots.

Our experience to date indicates that allowing 3dB headroom should prevent audible overshoot-induced clipping in low bite-rate systems (e.g., 32 kbps streams), while 2dB is adequate for 128kbps and above. While some clipping may still occur, it will have a very low duty cycle and will almost certainty be inaudible.

Monitoring on Loudspeakers and Headphones

In live operations, highly processed audio often causes a problem with **the DJ or presenter's headphones.** When its built-in inputs and outputs are used, the delay through OPTIMOD-PC can be as much as 25ms (or more, if the installer purposely adds frame-makeup delay). This delay, although not usually audible as a distinct echo, can cause bone conduction comb filtering of the DJ/presenter's voice in his/her ears. This is almost always very uncomfortable to them.

> If OPTIMOD-PC is driven from the computer's internal WAV audio, delays can be much larger. These delays are difficult or impossible for the user to control because they are functions of the computer's operating system.

OPTIMOD-PC's processing has a second output after the multi-band compressor but before the look-ahead peak limiter, which is where the majority of the delay occurs. This output is one of the inputs to the output routing switcher in the Orban IO Mixer application.

When driven by the multi-band compressor alone, the input/output delay is approximately 3-4ms (depending on whether the analog or digital input is used and whether sample rate conversion is used). This delay can still be uncomfortable to some, but many DJ/presenters find it acceptable and almost anyone can get used to it.

Such problems can be completely avoided if the DJ/presenter's headphones are driven directly from the program line or, better, by an inexpensive compressor connected to the program line. If the DJ/presenter relies principally on headphones to determine whether a digital radio station is on the air, simple loss-of-data and loss-of-audio alarms should be added to the system. Such alarms could be configured to cut off audio to the DJ/presenter's phones when an audio or carrier failure occurs.

Streaming and Netcasting Applications

This section was written in mid 2004. As the state of the art in netcasting is changing with ferocious rapidity, we expect it to become outdated quickly. Please check Orban's web site, www.orban.com, for newer information.

Using OPTIMOD-PC in Streaming Applications

You need an audio source connection (either analog, AES/EBU digital, or SPDIF digital). The digital input can accept any sample rate from 20 to 96 kHz. You can also

use any stream available within the computer's internal WAVE audio system, such as a digital playout system.

One of the outputs of OPTIMOD-PC's routing switcher sends audio back into the computer's internal WAVE audio system. You will ordinarily connect this stream to the input of an encoder application, like Orban Opticodec-PC, Microsoft Windows Media Encoder, RealNetworks Real/HelixProducer, or NullSoft SHOUTcast running on the same host as OPTIMOD-PC. You then apply the encoded output of the encoder to a netcast server application, which may operate on the same machine as the encoder, or on a different machine on your network. In the latter case, you will route the encoded audio to the netcast server application through your network.

Using OPTIMOD-PC to Prepare Audio Files for Download

Functionally, OPTIMOD-PC is a full-duplex sound card and is seen as such by the computer's operating system. This means that it can support record and playback functions simultaneously. You can use any application that allows simultaneous playback and recording of audio files to process files. We have tested Adobe Audition and verified that it is compatible with OPTIMOD-PC. Adobe Audition supports batch processing, so you could use it to process many audio files while unattended. Most streaming encoders have a mode to record/encode in their native file formats in real time. If you do not need the interim .wav file, encoding directly will eliminate a step and save disk space and time.

Loudness

You can expect a significant increase in loudness from OPTIMOD-PC processing by comparison to most unprocessed audio.

> An exception is recently mastered CDs, which may have already been aggressively processed for loudness when they were mastered.

In radio broadcasting, it is generally believed that loudness relative to other stations attracts an audience that perceives the station as being more powerful than its competition. We expect that the same subliminal psychology will also hold true in netcasting.

Choosing your Encoder

The state of the art in encoder technology is rapidly changing. At this writing, the best audio encoder technology available is Coding Technologies AAC/aacPlus. Orban is the first provider of this technology for streaming audio applications with Opticodec-PC. Opticodec-PC can provide entertainment-quality stereo streams at 32 kbps. At 48 kbps, many listeners prefer the sound to that of FM.

Opticodec-PC PE is designed to work exclusively with OPTIMOD-PC to form an overall audio processing / coding chain with the highest audio quality for a given bit rate. These two components are also available from Orban as part of a turnkey system called Opticodec-PC Encoder, which includes a rack mount Windows XP computer with both components pre-installed and pre-configured. www.orban.com has more information.

Be aware that different encoders are optimized for different bit rates, and you should match your encoder to your potential audience. An encoder appropriate for a dial-up rate of 20kb/sec may not be optimum for ISDN, DSL, or E-1/T-1 rates. This makes it necessary to use more than one algorithm to optimally serve audiences with these disparate connection speeds.

MPEG-1 Layer 3 has become a de-facto standard for distribution of non-streaming, high fidelity audio on the Internet, although aacPlus, as used in Opticodec-PC, is far more efficient. OPTIMOD-PC is well matched to MP3 and can effectively pre-process audio intended for MP3 playback. Choose an MP3 encoder wisely, as not all MP3 encoders are created equal and provide different levels of quality.

Feedback

We are very interested in your comments about this product. We will carefully review your suggestions for improvements to either the product or the manual. Please email us at custserv@orban.com. We will be happy to hear from you.

Section 2
Installation

Installing OPTIMOD-PC in Windows® Computers

Allow about 2 hours for installation.

Installation consists of: (1) unpacking and inspecting OPTIMOD-PC, (2) inserting OPTIMOD-PC into a free PCI slot in the powered-down host computer, (3) starting the computer, (4) inserting the OPTIMOD-PC driver CD into the computer's CD-ROM drive when prompted for a driver and following the prompts on the screen, and (5) optionally connecting inputs and outputs. When you have finished installing OPTIMOD-PC, proceed to "System Setup," on page 2-18.

1. Unpack and inspect.

A) If you note obvious physical damage, contact the carrier immediately to make a damage claim. Included in the package are:

1 OPTIMOD-PC PCI card
1 Operating Manual
1 Driver and software CD-ROM.

B) Save all packing materials! If you should ever have to ship OPTIMOD-PC (e.g., for servicing), it is best to ship it in the original carton with its packing materials because both the carton and packing material have been carefully designed to protect the unit. In particular, *static discharge can damage OPTIMOD-PC,* and it should always be stored and shipped in the anti-static bag in which it was shipped from the factory. *Your warranty does not cover damage from static discharge*.

C) Complete the Registration Card and return it to Orban. (please)

The Registration Card enables us to inform you of new applications, performance improvements, software updates, and service aids that may be developed, and it helps us respond promptly to claims under warranty without our having to request a copy of your bill of sale or other proof of purchase. Please fill in the Registration Card and send it to us today. (The Registration Card is located after the cover page).

We do not sell our customer's names to anyone.

2. Mount OPTIMOD-PC in a free PCI slot in your computer.

OPTIMOD-PC should be compatible with all modern IBM-compatible computers. The computer's PCI bus must be Plug & Play PCI Version 2.2 compliant, 32-bit, 33MHz, with a transfer rate up to 132MBytes/sec.

OPTIMOD-PC will operate in a 3.3V or 5V PCI slot, and with bus expansion. More than one OPTIMOD-PC card can be installed in a given host computer.

Remove AC power from the computer. Using proper static control procedures, remove OPTIMOD-PC from its anti-static packaging bag and insert it in a free PCI slot in your computer.

If you are installing more than one OPTIMOD-PC card, insert all cards at this time.

The following procedure is different depending on whether you are using Windows 2000 or Windows XP. (We do not support other Windows versions.)

1. For Windows 2000 only:

A) Apply power to your computer and let it boot up.

After most of the normal boot process is finished, the "New Hardware Detected" window will appear.

B) In the New Hardware Detected wizard's welcoming screen, click "Next."

Windows will identify the card's hardware ID as "Optimod1100."

C) The Wizard asks you if you want it to:

a) Search for a suitable driver, or

b) Display the list of know drivers

Select "Search for a Suitable Driver."

D) Insert the CDR that was shipped with your OPTIMOD-PC into your computer's CD-ROM drive.

A dialog box appears asking you to select optional search locations.

E) Click the "CDR drives" check box and only that box.

F) Select "Next."

A dialog box appears saying that window has found a driver for the device. Your CD drive icon should appear on the page.

G) Select "Next."

A dialog box may appear asking you: "No Microsoft digital signature. Do you want to continue with this install?"

H) Select "Yes."

A dialog box appears that says "Completing the New Hardware Found Wizard."

I) Select "Finish."

A dialog box appears asking you if you want to restart your computer.

J) Select "Yes" to restart your system.

K) (Optional) If you have installed more than one card, Windows will continue to present "New Hardware Detected" windows until you have installed all cards. Repeat steps (E) through (J) for each card.

L) Wait until your computer finishes booting.

M) Skip to step 3 on page 2-3.

2. For Windows XP only:

A) Apply power to your computer and let it boot.

After most of the normal boot process is finished, the "New Hardware Detected" window will appear asking you to insert the OPTIMOD CD-R and asking you if you want the Wizard to:

a) Install software automatically, or

b) Install from a list or specific location.

B) Insert your OPTIMOD CD-R.

C) Select "Install software automatically."

D) Select "Next."

A Hardware installation dialog box will appear warning you that the software has not passed Windows logo testing.

E) Select "continue anyway."

A dialog box appears that says, "Completing the New Hardware Found Wizard."

F) Select "Finish."

G) (Optional) If you have installed more than one card, Windows will continue to present "New Hardware Detected" windows until you have installed all cards. Repeat steps (C) through (F) for each card.

3. For both Windows 2000 and XP:

A) Navigate to Start/Run on your computer. In the Run dialog box, type `x:setup`, where "x" is the drive letter of your CD-ROM drive, and click "OK."

This will install Orban's control and server software on your computer. The server runs as a Windows service, and will automatically run at boot time.

B) Answer the questions when prompted by the Orban installer.

The installer will allow you to create a desktop icon pointing to the OPTIMOD-PC control application, and will also allow you to create an "agent" in the System Tray that launches the OPTIMOD-PC control application via a single click.

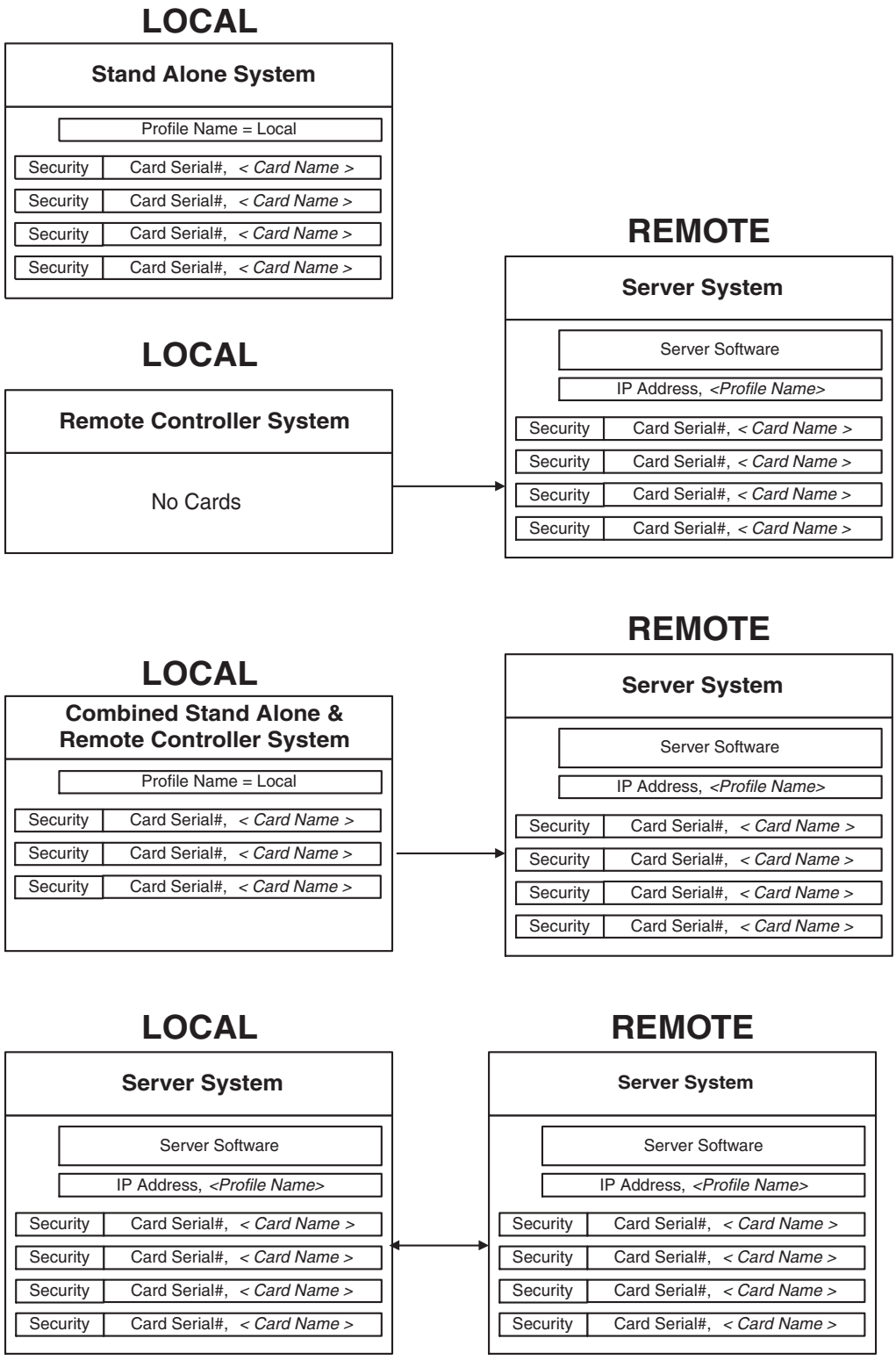


Figure 2-1: OPTIMOD-PC Network Scenarios

If you are upgrading from an earlier software version: If the versions of the driver, service, and application are incompatible, each OPTIMOD-PC card will function in its default "sound card mode." The application will display the following message when you try to connect to an incompatible card:

The OPTIMOD-PC driver version is incompatible with this application. Please install latest driver and software.

If you get this error message, repeat the installation process, following instructions (if any) in the upgrade documentation regarding the driver.

4. Plan your installation.

Figure 2-1 on page 2-4 shows four possible installation scenarios:

A) OPTIMOD-PC cards are located on and are controlled from the local computer only.

B) OPTIMOD-PC cards are located elsewhere on the network, to be controlled by a local computer that has no installed OPTIMOD-PC cards.

C) OPTIMOD-PC cards are located both locally and elsewhere on the network.

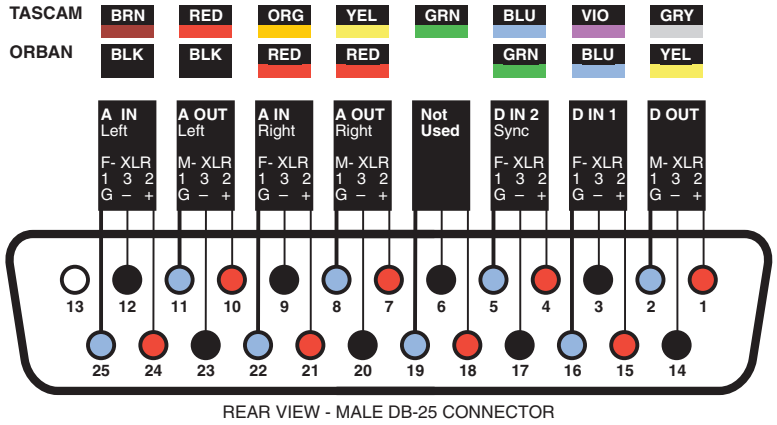


Figure 2-2: Wiring Diagram for the OPTIMOD-PC XLR Cable Assembly

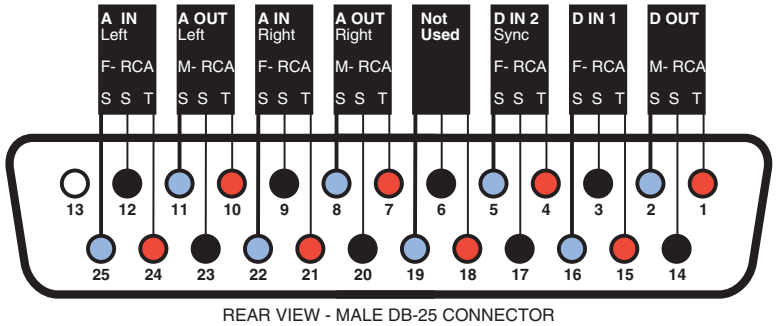


Figure 2-3: Wiring Diagram for the OPTIMOD-PC RCA Cable Assembly

Local cards cannot be controlled from remote computers.

D) OPTIMOD-PC cards are located both locally and elsewhere on the network. All cards should be controllable from any machine on the network, whether local or remote.

If your installation corresponds to scenario (A), skip to step 14 on page 2-13. This scenario is typically true for simple, single-card installations such as those where OPTIMOD-PC is used in a production studio.

5. Connect hardware inputs and outputs.

The wiring harness containing input and output cables is an optional accessory because some OPTIMOD-PC users will use only its software WAVE inputs and outputs and do not need its hardware inputs and outputs.

There are three versions of the harness available: one terminated with XLR connectors for balanced operation, one terminated with RCA connectors for unbalanced operation, and one with bare wires. *Figure 2-2* on page 2-5 shows how these harnesses are wired and can be used as a guide for making your own harness.

Note that the diagram shows the rear view of the male connector that terminates the harness, not the front view. This is the same as the front view of the female connector mounted on OPTIMOD-PC.

In the Orban XLR cable assembly, pin 2 of the XLR connectors is wired HIGH and pin 3 is wired LOW. Pin 1 is ground.

In the Orban RCA cable assembly, the center pin is HIGH, while the LOW and SHIELD are wired together.

In the unterminated harness, the white and white/blue striped wires are HIGH; the blue and blue/white striped wires are LOW. The shield is

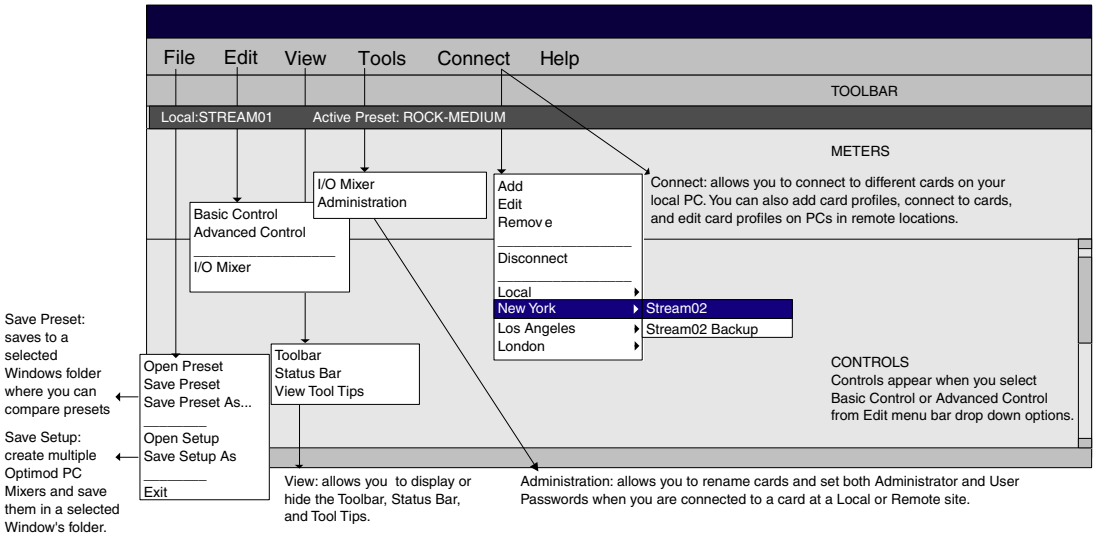


Figure 2-4: The Orban Control Application

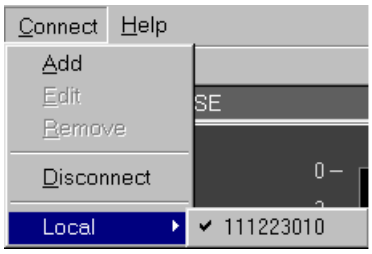
ground.

Note that balanced cables wired to the Tascam® standard are also compatible with OPTIMOD-PC. Unbalanced cables may not work with all inputs and/or outputs. *Figure 2-2* also shows the Tascam color codes.

6. Set up passwords and networking for cards in your computer. (optional)

A) Start the Orban control application, `OptimodPC.exe`, by clicking its icon ("agent") in your computer's system tray. (See Figure 2-4 on page 2-6.)

Newly installed cards have no passwords. You do not need to assign a password to a card unless you want that card to be accessible to a network connected to your computer.



> Once you have assigned passwords, these passwords can be changed either locally or on the network by anyone with the Administrator password for that card, but no one else. Do not lose the Administrator password you assign in the steps below.

B) Connect to the local card to which you are assigning a password.

C) From the Tools menu bar, choose "Administration."

Initially, Orban's software identifies a card by its serial number, which it reads from the card. You can give the card an easily remembered name ("alias") by filling in the CARD NAME field.

Orban's software will then identify the card by this name from anywhere on the network.

D) Assign a User Password to the card by filling in the USER PASSWORD and CONFIRM PASSWORD fields identically.

E) Assign an Administrator Password to the card by filling in the ADMINISTRATOR PASSWORD and CONFIRM PASSWORD fields identically.

> Do not make the User and Administrator passwords identical.

Be sure to write down and remember the Administrator Password because you must have it to change the card's User Password or the Card Name in the future. You may check REMEMBER ADMIN. PASSWORD, but be aware that this will allow *anyone* with access to your machine to change the User *and* Administrator passwords for this card. If this privilege was used maliciously, it could lock you out of the card, requiring an inconvenient

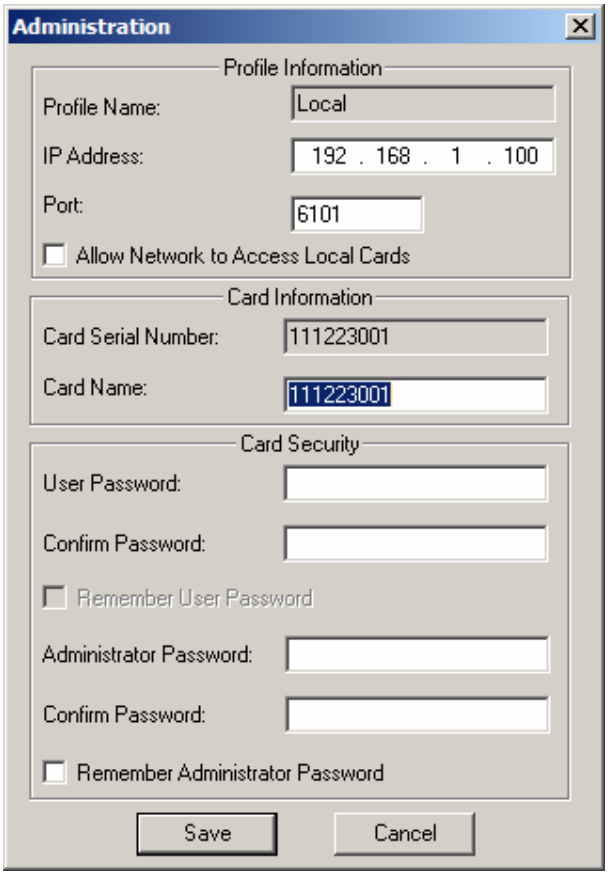


Figure 2-5: Card & Security Administration

editing of your computer's Registry to remove the unwanted password.

If you intend to allow other computers to connect to the card(s) in this computer, write down the number appearing in the "I.P. Address" field; you will need it when you set up the modem connection in step 8 below.

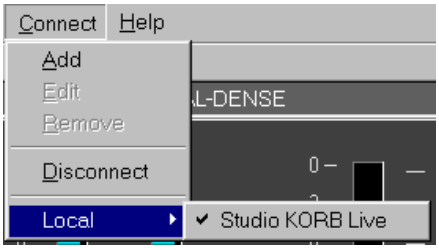
> The ALLOW NETWORK TO ACCESS LOCAL CARDS box is not checked by default, so your cards are secure from hacking unless you explicitly check it. You must assign passwords if you want to secure access to the card(s) on the network.
>
> Once you have checked the ALLOW NETWORK TO ACCESS LOCAL CARDS box on one card in a given server, *all* cards on your local system can be accessed. If you wish to make any of these unavailable to the server, you must connect to each card and set User Passcodes to prevent unwanted users from having access to the cards.
>
> Note that if you uncheck the Allow Network Access box, no card in your computer can be accessed from the network.

F) Click SAVE to confirm your entries.

G) Repeat steps (B) through (F) for each new card installed in your local computer.

Your cards now have full security. Any OPTIMOD-PC control application on the network will be unable to detect a card's presence without knowing its User Password in advance—the OPTIMOD-PC control application cannot automatically poll the network to discover cards.

When you re-enter the CONNECT menu, you will now see the cards listed by the names you have assigned to them, not by their serial numbers

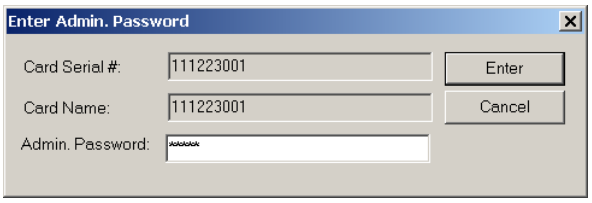


7. Edit the local OPTIMOD-PC server's network accessibility, IP address, and port number. (optional)

If either the IP address and/or port number that appeared in *Figure 2-5* is incorrect, you can edit the profile to correct it. You can also make the local cards visible to a network connected to your computer.

> The local Orban Control application does not use the local IP address and port number; you can leave the IP address and port at their default values unless you are planning to allow other computers on the network to find your local server software and cards.

A) Navigate to Tools/ Administration. When requested, enter the Administrator Password assigned in step (6.E) on page 2-7.



The Administration window appears (see *Figure 2-5* on page 2-7).

> If you did not enter an Administrator Password in step 6.E), you will not see the "Enter Administrator Password" dialog box and the Card and Security Administration window will appear immediately.

B) Type the new IP address and/or Port in the appropriate fields.

C) If you want to have the card visible to other computers on your network, check the "Allow Network to Access Local Cards" box.

> If you assign a user password here and allow network access, a user from a remote location must know the user password in order to see your cards.

D) Click "Save" to confirm your changes.

8. Set up a modem connection on your host computer (optional)

[Skip this step if you will not be using a modem to connect to the computer hosting an OPTIMOD-PC card.]

Note that these specific instructions are for Windows 2000, but Windows XP operates similarly.

A) Open "Settings/Network and Dial-Up Connections" on the host computer containing an OPTIMOD-PC card.

B) Double-click "Make New Connection" and click "Next."

C) Check "Accept incoming connections" and click "Next."

D) Follow the instructions in the Network Connection Wizard:

If this manual does not mention a specific option in the Network Connection Wizard, accept the default offered by Windows.

a) Choose the modem you wish to use for the connection.

> Your computer must have at least one modem (either internal or external) installed, configured, and recognized by Windows.

b) Choose the users who will be able to access this connection.

c) In the "Networking Components" page, click "Internet Protocol (TCP/IP)" and click "Properties."

d) Check "Specify TCP/IP addresses."

e) In the "From" address box, enter the IP address that was assigned to your local Optimod cards.

You should have written this down when you were executing step (6.E) on page 2-7.

f) Add 1 to the IP address in the "From" box and enter the result in the "To" box.

For example, if you entered 192.168.0.1 in the "From" box, enter 192.168.0.2 in the "To" box.

g) Click "OK."

h) Click "Next."

i) Name the incoming connection as desired and click "Finished."

Your new connection should appear in "Settings/Network and Dial-Up Connections."

Note that starting the Orban Control application will not automatically initiate a modem connection between a client computer running the Orban Control application and a host computer such as the one you configured above. You must initiate the modem connection (by having a Windows dial-up connection on the client computer dial into the host computer's modem) *before* you start the Orban Control application `OptimodPC.exe`. Otherwise, the Orban Control application will not be able to find any OPTIMOD-PC cards on the host computer.

9. Add remote cards to your list of available cards. (optional)

To maintain security, all OPTIMOD-PC cards in the remote machines on your network are initially hidden from the Orban Control application on your computer. You must explicitly "add" each card that you wish to control locally. To do so, you must know three things: (1) the IP address of the remote computer in which the card resides, (2) the port that was assigned to the Optimod Cards running on the remote computer, and (3) the User or Administrator password of each card.

To add cards, you must be able to connect to the Orban server software on the remote computer containing those cards. That is, the remote computer must be on-line and connected to the network, and the Orban server software on that computer must be running. If you are using a modem connection, this connection must already be established.

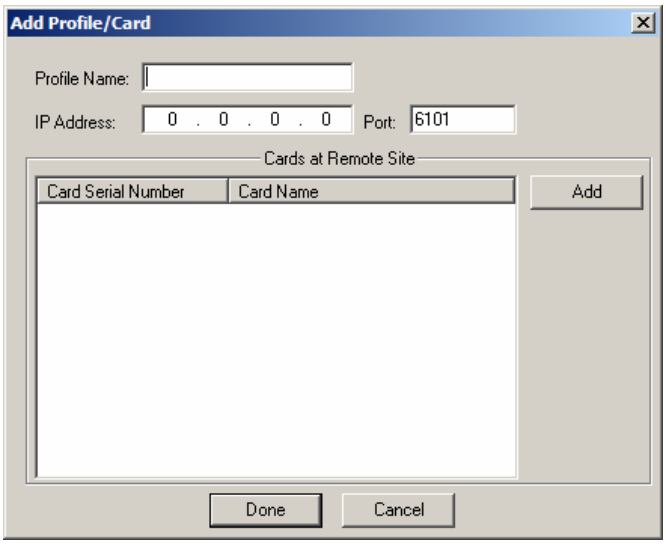
The Orban server software will be running if the remote computer is turned on, you have installed your card and driver on that computer, the OPTIMOD-PC Control software is installed on that computer, and the "Allow Network to Access Local Cards" box in CARD AND SECURITY ADMINISTRATION is selected on a card in that system.

Orban server software does not have to be running on your local computer.

A) Add a remote computer to the list of available computers containing OPTIMOD-PC cards:

a) Select CONNECT/ADD.

The ADD PROFILE / CARDS(S) menu appears.



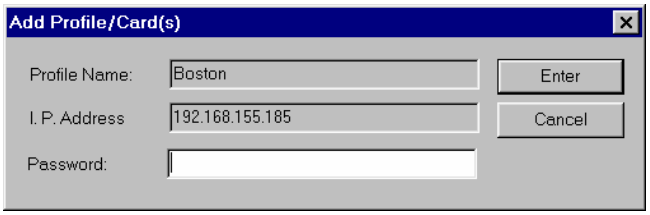
b) Enter the Profile Name, IP Address, and Port of the remote computer

The Profile Name can be any name you wish to use—for example, "Boston." The profile name is known only to your local computer. The network identifies a given computer by its IP address and port, not its profile name. The profile name is merely a convenient alias that you use to help identify a remote computer hosting OPTIMOD-PC cards without your having to memorize the computer's IP address.

B) Add the remote computer's cards to the list of cards that you can access:

You must have the User Passwords of all cards you wish to add.

a) Click ADD CARD(S).



The "Enter User Password to Add Cards(s)" dialog box opens.

b) Enter the card's User Password into the PASSWORD field.

Any cards with that User Password or no User Password will be recognized.

c) Click ENTER to confirm your entry.

The newly added card(s) will appear in the list of "Cards at Remote Site."

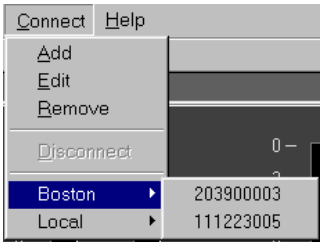
d) Repeat steps (a) through (c) for each card in the remote computer.

C) Click DONE when you have added all cards in a given remote computer.

D) Add remote computer Profiles and the cards in each Profiled computers as desired, by repeating steps (A) through (C) for each remote computer.

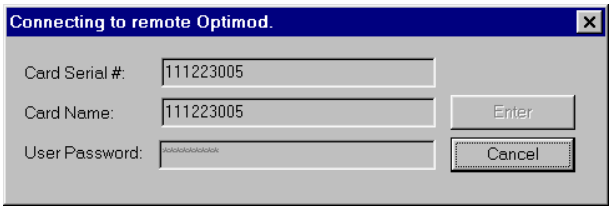
10. Connect to a remote card. (optional)

You can now connect to any card that you added in step 7 on page 2-8 if this card's server is running and connected to the network.



A) Click on the CONNECT menu. A drop-down menu appears containing a list of all remote computers. Drag your mouse down to the desired computer to reveal a submenu containing all cards within it that have been added. Select the desired card to connect to it.

B) The "Enter User Password to Connect" dialog box appears. Enter the password and click ENTER. If you wish to bypass this dialog box automatically in



the future, check the REMEMBER USER PASSWORD box in the CARDS AND SECURITY ADMIN screen on your local computer. (Only Administrators of your local Machine can restore this dialog box once you have specified that it is to be bypassed.)

After you click ENTER, the Control application will display the state of the card to which you just connected, and you can recall presets, adjust input/output levels, edit and save presets, etc.

11. Change passwords and card names over a network. (optional)

If you have the Administrator password for a card, you can change the card's Name, User Password, and Administrator Password from anywhere on the network. This can be particularly useful if you are in a large broadcast group that has one administrator for audio processing throughout the group's stations.

To administer a card, Orban server software must be running on the computer in which the card is installed, and that computer must be connected to the network.

A) Select TOOLS/CARD AND SECURITY ADMIN.

The "Enter Administrator Password" dialog box appears.

B) Enter the administrator password for that card and click ENTER.

The "Card and Security Administration" dialog box appears. (See Figure 2-5 on page 2-7.)

You can enter a new User Password, Administrator Password, and/or Card Name in the appropriately named fields in the dialog box. If you do not explicitly change the value in a field, it will remain unchanged.

> We do not recommend checking "REMEMBER ADMIN. PASSWORD" because this action introduces considerable security risk.

C) Click SAVE to confirm your changes.

D) Skip to step 16 on page 2-14.

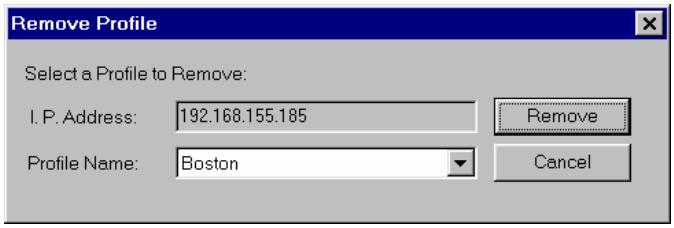
12. Delete a remote computer's profile. (optional)

If you no longer wish to have a particular remote computer appear in the list of available computers, you can delete it from the list.

A) Select CONNECT/REMOVE.

B) Specify the remote computer you wish to remove by selecting its name in the drop-down PROFILE NAME list.

C) Click REMOVE



The remote computer's profile (and the profiles of all of its corresponding cards) is removed from your local computer. This action does not affect any other computer on the network.

You can restore the remote computer's profile by following the instructions in step (9.A) on page 2-10. If you do so, you will also have to re-add all of the cards in the host computer to the client computer by executing step (9.B).

13. Allowing other computers to connect to local OPTIMOD-PC cards.

If you wish to have the OPTIMOD-PC cards in your computer accessible to other computers on your network, you must activate the network connection by checking the ALLOW NETWORK TO ACCESS LOCAL CARDS checkbox on a card your machine. (This checkbox is located in the ADMINISTRATION dialog box—see Figure 2-5 on page 2-7.) This will allow access to all cards on your system from a network, so be sure to set passwords for each card. See step (6.D) on page 2-7.

14. Defeat the OPTIMOD-PC service in a computer that does not contain OPTIMOD-PC cards. (optional)

If a computer running the OPTIMOD-PC control application contains no OPTIMOD-PC cards, you may wish to defeat the OPTIMOD-PC service on that computer (although this is not required).

> This scenario applies to computers that control OPTIMOD-PC cards on a network, yet contain no local cards.

A) On the computer, navigate to START / SETTINGS / CONTROL PANEL / ADMINISTRATIVE TOOLS / SERVICES.

B) Locate `OptimodPcService` in the list of services. Right-click it and select STOP.

C) Right-click `OptimodPcService` and select PROPERTIES.

D) In the STARTUP TYPE drop-down list, select DISABLED or MANUAL. (Either will defeat the service.)

> If you wish to reactivate the service in the future, reset the STARTUP TYPE to AUTOMATIC. Then right-click `OptimodPcService` and select START.

15. Simple installations: Connecting to an OPTIMOD-PC card.

In the simplest possible installation (one card being controlled locally in one machine), the OPTIMOD-PC control application, `OptimodPC.exe`, will automatically connect to (and control) the card when you start the software by clicking its "agent" icon (in the right-hand side of the Windows taskbar).

> The installer will ordinarily place a shortcut to the OPTIMOD-PC control application in your computer's START menu under `Orban/OPTIMOD-PC`. If you so specified during installation, there will also be an icon for `Op-`

`timodPC.exe` on your desktop and a small icon (agent) in your system tray. When you click on the agent icon, it will open the OPTIMOD-PC control application and automatically connect to your card. On the other hand, if you start the software from the START menu or from a desktop icon, it will not automatically connect to your card; you must do this manually from the OPTIMOD-PC control application's CONNECT menu.

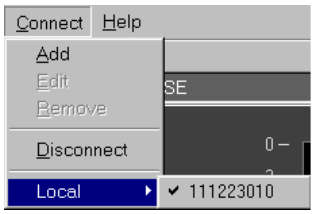
The installer will also install the OPTIMOD-PC server application and set it to start automatically at boot-up, running as a Windows service. Please note that the network cannot see your OPTIMOD-PC card(s) unless you explicitly expose them to the network as described in step (7.C) on page 2-9.

Auto-starting the server at boot time allows it to automatically reload OPTIMOD-PC's DSP code on boot, which can be invaluable in a streaming application where the stream must automatically restart after a system crash. The server application has no user controls and you do not have to interact with it or otherwise worry about it, other than to be aware that it is normal for it be running in the background as a Windows service.

If you have more than one card installed in your computer, you must select the one you are controlling by choosing it from a list available from the CONNECT menu. If you did not edit the names of the cards, then the list will show the cards' serial numbers.

If, for convenience in identifying them, you wish to assign them easily remembered names ("aliases"), you must edit their profiles as described in step 6 on page 2-7.

To connect to a card (thereby controlling it), left-click CONNECT and drag the mouse to LOCAL. Continue to drag the mouse to the desired card name that appears in the submenu, and release the mouse button.



16. Connect inputs and outputs. (optional)

This is not required if you are going to be using only WAVE inputs and outputs, which are routed through your computer's operating system. In this case, skip to *Setting up OPTIMOD-PC: the Orban Control Application* on page 2-18.

If you are using hardware inputs or outputs, see the hookup and grounding information on the following pages.

Audio Input and Output Connections

Cable

We recommend using two-conductor foil-shielded cable (such as Belden 8450/8451 or equivalent for analog signals and Belden 1800B/1801B for digital signals), because signal current flows through the two conductors only. The shield does not carry signal, and is used only for shielding.

Connectors

The cable assemblies are optional and must be purchased separately from OPTIMOD-PC. If you order the model 1100/CBLXLR assembly, input and output connectors are XLR. If you order the 1100/CBLRCA assembly, input and output connectors are RCA. If you order the 1100/CBL assembly, the cables are terminated in bare wires so you can terminate them with the connectors of your choice.

In the XLR-type connectors, pin 1 is CHASSIS GROUND, while pin 2 and pin 3 are a balanced, floating pair. This wiring scheme is compatible with any studio-wiring standard: If one pin is considered LOW, the other pin is automatically HIGH. However, we arbitrarily call pin 2 HIGH and pin 3 LOW to conform to AES standards.

In the RCA-type connectors, the center pin (called "T" [for "tip"] in the diagram) is HIGH, while the outer sleeve (called "S" in the diagram) is LOW and SHIELD.

See *Figure 2-2: Wiring Diagram for the OPTIMOD-PC XLR* and

Figure 2-3: Wiring Diagram for the OPTIMOD-PC RCA Cable Assembly on page 2-5.

Analog Audio Input

Using Orban's mixer application (available from the TOOLS menu on the Orban Control application or from your computer's control panel in Multimedia), you can choose a nominal input level of either –10dBV (IHF consumer level) or +4dBu (professional level).

(0dBu = 0.775Vrms. For this application, the dBm@600Ω scale on voltmeters can be read as if it were calibrated in dBu. 0dBV = 1.0Vrms.)

The peak input level that causes overload depends on whether you have set the input for –10 dBV (–7.8 dBu) or +4dBu. Overload occurs at approximately +9.2 dBV (+11.4 dBu) for the –10 dBV setting and +20 dBu for the +4 dBu setting.

The electronically balanced input uses an ultra low noise and distortion differential amplifier for best common mode rejection. It is compatible with most professional and semi-professional audio equipment, balanced or unbalanced, having a source impedance of 600Ω or less. The input is EMI suppressed.

- Input connections are the same whether the driving source is balanced or unbalanced.
- Connect the red (or white) wire to the pin on the XLR-type connector (#2 or #3) that is considered HIGH by the standards of your organization. Connect the black wire to the pin on the XLR-type connector (#3 or #2) that is considered LOW by the standards of your organization.
- In low RF fields (like a studio site not co-located with an RF transmitter), connect the cable shield at OPTIMOD-PC input only—it should not be connected at the source end. In high RF fields (like a transmitter site), also connect the shield to pin 1 of the male XLR-type connector at OPTIMOD-PC input.
- If the output of the driving unit is unbalanced and does not have separate CHASSIS GROUND and (–) (or LOW) output terminals, connect both the shield and the black wire to the common (–) or ground terminal of the driving unit.

Analog Audio Monitor Output

Electronically balanced and floating outputs simulate a true transformer output. The source impedance is 50Ω. The output is capable of driving loads of 600Ω or higher. The peak output level is adjustable up to +20dBu before clipping occurs. The outputs are EMI suppressed.

- If an unbalanced output is required (to drive unbalanced inputs of other equipment), it should be taken between pin 2 and pin 3 of the XLR-type connector. Connect the LOW pin of the XLR-type connector (#3 or #2, depending on your organization's standards) to circuit ground, and take the HIGH output from the remaining pin. No special precautions are required even though one side of the output is grounded.
- Use two-conductor foil-shielded cable (Belden 8451, or equivalent).
- At OPTIMOD-PC's output (and at the output of other equipment in the system), do not connect the cable's shield to the CHASSIS GROUND terminal (pin 1) on the XLR-type connector. Instead, connect the shield to the input destination. Connect the red (or white) wire to the pin on the XLR-type connector (#2 or #3) that is considered HIGH by the standards of your organization. Connect the black wire to the pin on the XLR-type connector (#3 or #2) that is considered LOW by the standards of your organization.

AES/EBU Digital Input and Output

There are two AES/EBU inputs and one AES/EBU output. Both inputs accept program audio and can be mixed; either input can also accept AES11 house sync. The program inputs and output are both equipped with sample rate converters. The output can operate at 32, 44.1, 48, 88.1, and 96 kHz. The inputs can receive sample rates between 30 and 96 kHz; two asynchronous digital inputs can therefore be mixed.

> Per the AES/EBU standard, each digital input or output line carries both the left and right stereo channels.

The digital input clip level depends on the setting on the DIGITAL 1 INPUT and DIGITAL 2 INPUT mixer controls. To avoid clipping, set these so that the PROCESSED MIXER OUTPUT meters never indicate red.

A special Backup function allows inputs to be programmed to automatically mute unless digital lock is lost on another input. Such loss of lock causes the backup input to be unmuted. You can arrange this function so that, for example, loss of lock on digital input 1 causes digital input 2 to unmute, and loss of lock on both digital inputs causes the analog input to unmute. This allows you to connect backup program sources to ordinarily unused inputs and have the backup inputs activate automatically if the primary program feed is lost.

Note that OPTIMOD-PC does not fully implement the AES11 standard because it also does not pass AES/EBU user bits and does not control the phasing of the AES data frames between reference and output. However, it correctly locks the same frequency of the output to the sample frequency of the reference.

Grounding

Very often, grounding is approached in a "hit or miss" manner. However, with care it is possible to wire an audio studio so that it provides maximum protection from power faults and is free from ground loops (which induce hum and can cause oscillation).

In an ideal system:

All units in the system should have balanced inputs. In a modern system with low output impedances and high input impedances, a balanced input will provide common-mode rejection and prevent ground loops—regardless of whether it is driven from a balanced or unbalanced source.

OPTIMOD-PC has balanced inputs.

All equipment circuit grounds must be connected to each other; all equipment chassis grounds must be connected together.

In a low RF field, cable shields should be connected at one end only—preferably the destination (input) end.

In a high RF field, audio cable shields should be connected to a solid earth ground at both ends to achieve best shielding against RFI.

Whenever coaxial cable is used, shields are automatically grounded at both ends through the terminating BNC or phono connectors.

Power Ground

Ground the computer chassis through the third wire in the power cord. Proper grounding techniques never leave equipment chassis unconnected to power/earth ground. A proper power ground is essential to safe operation. Lifting a chassis from power ground creates a potential safety hazard.

Setting up OPTIMOD-PC: the Orban Control Application

Once you have connected the Orban Control application to an available OPTIMOD-PC card, the software allows you to control the card as if it were a dedicated hardware processor like Orban's Optimod-DAB 6200/6200S. The Control application displays gain reduction meters, as well as controls that allow you to edit the sound of the fixed presets to your liking. Section 3 of this manual explains these sound editing controls in detail.

This section of the manual tells you how to set up the input and output controls of a OPTIMOD-PC card, with emphasis on connections that use OPTIMOD-PC's external analog or digital inputs and outputs to emulate a hardware audio processor. Starting on page 2-31, we provide additional instructions for users who want to connect OPTIMOD-PC's inputs and outputs to other programs (like streaming encoders) through the Windows WAVE multimedia mechanism inside your computer. Even if you are only using OPTIMOD-PC's WAVE input and output, you should still work through all of the instructions below, ignoring those that apply only to OPTIMOD-PC's hardware I/O.

1. From the Tools menu, bring up the I/O Mixer.

The I/O Mixer is a tabbed control panel that allows you to configure many global OPTIMOD-PC parameters, like input and output levels. If you are familiar with Orban's hardware processors (like our Optimod-DAB 6200/6200S), you will recognize many functions as being similar to those found in OPTIMOD-PC's SYSTEM

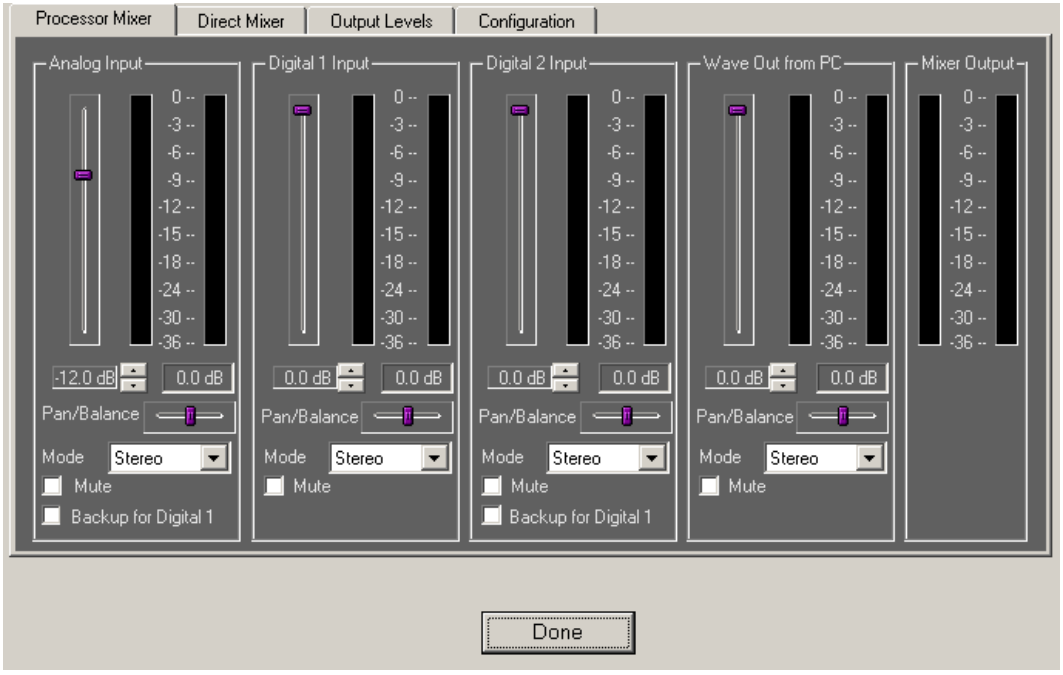
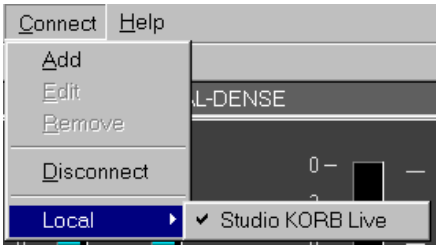


Figure 2-6: Processor Mixer Page in I/O Mixer

SETUP menu. However, the OPTIMOD-PC I/O Mixer is more powerful.

2. Select the card you are setting up.

A) From the Connect menu on the Control application, select the card you are setting up by connecting to it.



If you have only one card installed in your machine and you open the OPTIMOD-PC application from the agent, you do not need to connect manually because you will automatically be connected to this card already.

If you wish, you can edit the factory default Input/Output ("IO") setup. You also have the option to OPEN SETUP or SAVE SETUP AS in the Control application's FILE menu. Therefore:

- You can save your current setup to a file and then apply it to another card.
- You can load a previously saved setup into the card that is currently selected.

B) To copy an IO setup from a source card to a destination card (optional):

a) If you have not already saved the IO setup you wish to apply to the destination card, use the Orban Control application to connect to the source card. Then go to FILE/SAVE SETUP and save the IO setup of the source card.

When saving, use any legal operating system filename other than `default.orbs`, which is a reserved name. Setup files have the form `*.orbs`.

A given card's setup is stored in the Registry on the computer where that card resides.

The current active setup file is always the last file that was recalled by the FILE/OPEN SETUP operation. If you have never recalled a setup file this way, the current active setup is stored in a file named `system.orbs`.

The current active setup file is a transient file. That is, the Orban Control application updates it whenever you change the setup manually. The Orban Control application also automatically updates the file when the application starts and reads the setup information from the Registry. *You cannot assume that a *.orbs setup file (other than* `default.orbs`*) is static or that it will retain its original information.*

The factory default system setup is stored as `default.orbs`. This is a read-only file. It is the only `*.orbs` file that is static and unchanging. For further security, it is automatically regenerated each time the Orban Control Program or Service starts up.

b) Connect the Orban Control application to the destination card.

c) Go to FILE/OPEN SETUP.

d) Navigate to the folder containing the setup file you wish to retrieve.

This will usually be the file you saved in step (a).

The OPTIMOD-PC file system labels the card folders by their serial numbers. Look for the folder labeled with the source card's serial number. In that folder will be a preset folder containing the setup you wish to restore.

e) Highlight the setup file and select OPEN.

The Orban Control application will automatically make a copy of just-opened setup file in the destination card's Presets folder. It will automatically update this file if you make manual changes to the destination card's IO setup. The original setup file is not changed.

C) If you wish to edit an existing (or factory) setup, proceed to step 3 below.

D) When you are finished setting up each card, close the I/O MIXER window by clicking DONE.

3. Configure global audio processing parameters.

A) From the TOOLS menu, open the I/O Mixer and click the Configuration tab

The Configuration page appears:

B) Set the MAX LOWPASS FILTER cutoff frequency.

[4.0 kHz] to [20.0 kHz]

You can set OPTIMOD-PC's audio bandwidth in two places:

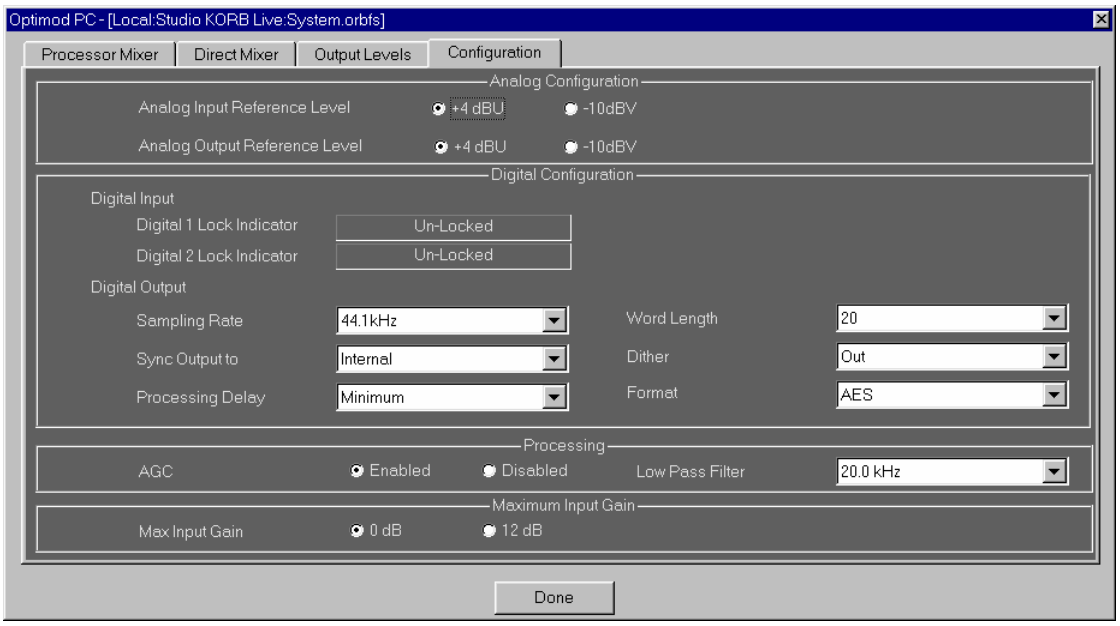


Figure 2-7: Configuration Page in the I/O Mixer

(1) in CONFIGURATION, and (2) in the BASIC MODIFY screen. OPTIMOD-PC's bandwidth is always the *lowest* of these settings. The frequency in Setup is a technical parameter that determines the *highest* bandwidth available. The installing engineer should set it to be appropriate for the sample rate of the digital system that OPTIMOD-PC is driving. For example, if OPTIMOD-PC is driving a system with a 32 kHz sample rate, set the MAX LOWPASS FILTER cutoff frequency to 15.0 kHz. That way, a setting of 20 kHz elsewhere will not cause excessive bandwidth and aliasing because OPTIMOD-PC will automatically override it with the MAX LOWPASS FILTER cutoff frequency setting.

> Note that the LP filter on the Basic Control page is part of the active preset, like any other equalization control in the preset. If you recall a different preset, the LOWPASS FILTER cutoff frequency control in the new preset will now determine the system bandwidth (unless, of course, the LOWPASS FILTER cutoff frequency setting in the new preset is higher than the MAX LOWPASS FILTER cutoff frequency parameter in the Configuration page).

C) Set the AGC mode as appropriate for your installation.

[Enabled] or [Disabled]

This control turns OPTIMOD-PC's internal AGC (Automatic Gain Control) on [enabled] or off [disabled].

> In radio applications, it is common to have an external AGC at the studio side of a studio-to-transmitter link to protect the link from overload. Most of the processing structures in OPTIMOD-PC control level with a preliminary AGC internal to OPTIMOD-PC. If you are using an external AGC device (such as an Orban 8200ST OPTIMOD-Studio or 464A Co-Operator) in front of OPTIMOD-PC, set OPTIMOD-PC's internal AGC to DISABLED. This is to ensure that the internal and external AGCs do not "fight" each other and that they do not simultaneously increase gain (resulting in increased noise).
>
> If you are using an Orban 4000 Transmission Limiter, set the AGC to ENABLED (so that the AGC function in OPTIMOD-PC continues to work). The Orban 4000 is a transmission system overload protection device; it is normally operated below threshold. It is not designed to perform an AGC or gain-riding function and it cannot substitute for the AGC function in OPTIMOD-PC.

Temporarily set AGC to ENABLED so that the Analog and Digital Input reference level alignment steps (below) will work correctly. After you have finished with these steps, set the AGC parameter appropriately for your installation.

D) Set the Processing Delay.

[Minimum], [30 fps], [29.97 fps], [25 fps], [24 fps], [15-57 ms]

OPTIMOD-PC can add time delay to make its input/output delay exactly one frame, using a variety of different standards. The selections are MINIMUM (depends on software version; typically between 14 and 24 ms),

24 milliseconds, 30 fps, 29.97 fps (NTSC color video), 25 fps (most PAL video), and 24 fps (film).

You can also choose delay in one-millisecond intervals from 15 to 57 milliseconds by choosing the desired value from the bottom entries in the drop-down list.

4. Set digital output properties. (optional)

[Skip to "Input Setup" on page 2-23 if you will not be using OPTIMOD-PC's WAVE output or AES/EBU digital output.]

There are several properties you can set to match OPTIMOD-PC's AES/EBU digital output to your requirements.

A) Set the AES/EBU Digital Output sample rate.

[32], [44.1], [48 kHz], [88.2 kHz] or [96 kHz]

48 kHz or 96 kHz are preferred because their samples are synchronous with the peak-controlled samples in the processing.

Selecting a 32 kHz output sample rate will automatically set the highest available audio bandwidth to 15 kHz.

SAMPLING RATE will also affect the available range of test tone frequencies. When SAMPLING RATE is set to 32 kHz, the highest tone frequency setting is 15 kHz. When SAMPLING RATE is set to 44.1 or 48 kHz, the tone frequency range extends to 20 kHz.

This setting does not affect the sample rate being applied to the computer's WAVE input. That rate is automatically set to correctly drive the software receiving OPTIMOD-PC's WAVE output stream.

Test tones are not available in the initial release of OPTIMOD-PC software. They will be added later.

B) Set the Digital Output Sync mode to internal or external.

[Internal], [Digital 1 Input], or [Digital 2 Input]

OPTIMOD-PC's AES/EBU output has a hardware sample rate converter that allows the output sample rate to be synchronized to a source. The INTERNAL sync setting synchronizes the output words at the AES/EBU output to OPTIMOD-PC's internal clock.

The EXTERNAL setting synchronizes the output rate to the input rate. You can use either the DIGITAL 1 INPUT or the DIGITAL 2 INPUT as the sync source. The same input can also be used to supply audio. If a given input is used *only* as a sync source, it is wise to check the MUTE box for that input in the Processed Mixer and Direct Mixer.

If a valid AES/EBU signal is present at the designated sync input, it will be used for synchronization. If lock is unavailable, OPTIMOD-PC automatically switches to INTERNAL. OPTIMOD-PC automatically returns to external sync after one second of continuously valid AES/EBU signal lock at a valid

sample rate. Furthermore, external lock is only permitted when the output rate matches the sync (or AES/EBU input) rate.

C) Set the desired output word length.

[14 bits], [16bits], [18bits], [20bits], and [24bits]

The largest valid word length in OPTIMOD-PC is 24 bits. OPTIMOD-PC can also truncate its output word length to 20, 18, 16, or 14 bits. If the input material is insufficiently dithered for these lower word lengths, OPTIMOD-PC can add dither (see the next step), which is wise if the input material is insufficiently dithered for these lower word lengths.

D) Adjust DITHER to on or off, as desired.

[in] or [out]

OPTIMOD-PC can add "high-pass" dither before any truncation of the output word. The amount of dither automatically tracks the setting of the WORD LENGTH control.

OPTIMOD-PC's dither is first-order noise shaped dither that reduces added noise in the midrange considerably by comparison to white PDF dither. However, unlike extreme noise shaping, it adds a maximum of 3dB of excess total noise power when compared to white PDF dither. Thus, it is a good compromise between white PDF dither and extreme noise shaping.

In many cases, you will not need to add dither because the source material has already been correctly dithered. However, particularly if you use the Noise Reduction feature, the processing can sometimes attenuate input dither so that it is insufficient to dither the output correctly. In this case, you should add dither within OPTIMOD-PC.

E) Set digital output format.

[AES/EBU], [SPDIF]

This control determines whether the status bits supplied at the digital output are in Professional (AES/EBU) or Consumer (SPDIF) mode.

> It does not affect the output level or source impedance, both of which correspond to the AES/EBU standard.

Input Setup

There are two input mixers in the I/O Mixer: the PROCESSOR MIXER and the DIRECT MIXER. (See Figure 2-6 on page 2-18.)

- The Processor Mixer drives the input of OPTIMOD-PC's audio processing.
- The Direct Mixer drives the Direct input of OPTIMOD-PC's Output Routing Switcher.

Both mixers are functionally identical. They have four inputs:

- Analog Left/Right
- Digital 1 Input
- Digital 2 Input
- WAVE Out from PC.

About the Interaction between OPTIMOD-PC's Input Mixers and Your PC's Built-In Mixer

Most PCs have a master WAVE volume control that you can access from the speaker icon in the System Tray. If you are using the OPTIMOD-PC as your computer's default sound card, OPTIMOD-PC's driver defeats this control, forcing it to full gain. This attempts to ensure that the OPTIMOD-PC I/O Mixer's gain is calibrated correctly. The reason it cannot predictably do so is that there is another WAVE gain control in series with the master volume control. This control is located in the Windows Mixer.

Right clicking the speaker icon and choosing VOLUME opens the Windows Mixer. This mixer usually has three or four controls. One is the master volume control, which is the same control that appears when you click the speaker icon and (to repeat) is defeated by the OPTIMOD-PC driver. The other controls are typically (1) WAVE (the culprit mentioned above), (2) Music Synthesizer, and (3) CD audio mixer controls. Your computer's operating system sums the outputs of these controls; their sum is the WAVE signal applied to the WAVE inputs in the OPTIMOD-PC I/O Mixer.

To ensure correct calibration of the OPTIMOD-PC I/O Mixer WAVE Input, set the Windows Mixer WAVE control to full-scale. There are certain applications (at this writing, RealPlayer® is one of them) whose dedicated volume controls operate by resetting the Windows Mixer WAVE control. If the WAVE level in the OPTIMOD-PC mixer seems unexpectedly low, check the setting of the Windows Mixer WAVE control to ensure that it is still at full scale and that another application has not changed it.

There is also an OPTIMOD-PC record volume control available in CONTROL PANELS/SOUNDS AND MULTIMEDIA/AUDIO—click VOLUME in the SOUND RECORDING box to see it. This control is a *nonfunctional, inactive placeholder* that serves only to satisfy your computer's operating system requirements. Instead, use the controls in OPTIMOD-PC's I/O Mixer to set the level applied to applications receiving WAVE data.

Input Setup Procedure

1. **Adjust the Analog Input Reference Level control.**

   [If you will not be using OPTIMOD-PC's analog input, continue with step 6 on page 2-28.]

   A) In the I/O Mixer, click the CONFIGURATION tab.

B) Set the ANALOG INPUT REFERENCE LEVEL to +4DBU or –10DBV depending on whether you are driving the OPTIMOD-PC's analog input with professional or consumer equipment, respectively.

If the ANALOG INPUT REFERENCE LEVEL is set to –10DBV and the level meter on the ANALOG L/R INPUT control hits full scale when you apply normal program material to the analog input, reset the ANALOG INPUT REFERENCE LEVEL to +4DBU.

(ANALOG L/R INPUT controls are found on the PROCESSED MIXER and DIRECT MIXER pages.)

Using +4dBu as the reference level, the system is calibrated correctly when the INPUT LEVEL CONTROL adjusted to 0dB (maximum). This will produce –20dBfs at the WAV output for recording/encoding applications.

The input stage has 20dB of headroom prior to the Input Level Control. Hence, a +4dBu tone at the analog input indicates –20dB on the analog input level meter. If the level meter hits full-scale when the ANALOG INPUT REFERENCE LEVEL is set to +4DBU, you are exceeding a peak level of approximately +24dBu at OPTIMOD-PC's analog input and you must reduce the output level of the device driving OPTIMOD-PC.

2. Adjust the Analog Output Reference Level control.

If you are using the Processing w/Limiting Output: Set the ANALOG OUTPUT REFERENCE LEVEL to +4DBU or –10DBV depending on whether OPTIMOD-PC's analog output is driving professional or consumer equipment, respectively. An output level fader setting of –12dB produces approximately +4dBu at the output with normal arbitrary processed audio.

When the analog output is set to receive PROCESSING WITH LIMITING, a –20dBfs 1kHz sinewave tone produces –18dB at the Analog Output Meter and +2dB on an external meter with VU ballistics connected to Optimod-PC's analog output. This assumes that:

- The external meter is calibrated so that 0 VU = +4 dBu or –10 dBV, depending on the setting of Optimod-PC's ANALOG OUTPUT REFERENCE LEVEL.
- The Active Preset is Rock Medium.
- The LIMITING control in the preset is set to 0.0dB.

The Optimod-PC digital and WAVE output meters indicate –6 dBfs when their respective OUTPUT LEVEL controls are set to 0 dB (maximum).

If you are using the Direct Mixer Output: The Direct Mixer Output is used when Optimod-PC is used without processing as a sound card only.

Set the ANALOG OUTPUT REFERENCE LEVEL to +4DBU or –10DBV depending on whether OPTIMOD-PC's analog output is driving professional or consumer equipment, respectively. Set the ANALOG OUTPUT LEVEL CONTROL to 0dB (maximum) to achieve correct level calibration for the corresponding analog output reference level (+4 dBu or –10 dBV).

- When the Analog Output is set to DIRECT MIXER, a –20dBfs 1kHz sine-wave file produces –20dB at the Analog Output Meter and 0dB on an external meter with VU ballistics connected to Optimod-PC's analog output. This assumes that the external meter is calibrated so that 0 VU = +4 dBu or –10 dBV, depending on the setting of Optimod-PC's ANALOG OUTPUT REFERENCE LEVEL.
- When the ANALOG INPUT control is set to 0dB (maximum) and the ANALOG OUTPUT control is set to 0dB (maximum), the system is properly calibrated and set to unity gain with 20dB of headroom.
- When the ANALOG INPUT REFERENCE LEVEL is set to +4dBu, a +4dBu input level produces a –20dBfs digital output signal at the DIGITAL or WAVE outputs, and a –20dBfs input signal from the DIGITAL or WAVE inputs produces a +4dBu output level when the ANALOG OUTPUT REFERENCE LEVEL is set to +4dBu.
- If you use a digital reference level higher than –20dBfs or an analog reference level higher than +4dB, you will lose headroom if you wish to retain unity gain. Because the analog input's absolute clipping level is +24 dBu (with the ANALOG INPUT REFERENCE LEVEL set to + 4 dBu), reducing the setting of Optimod-PC's ANALOG INPUT control will not regain the lost headroom. For example, a +8 dBu analog reference level can provide no more than 16 dB of headroom. For this reason, elevated reference levels are not recommended for use with Optimod-PC unless you fully understand the headroom tradeoffs that result.

3. Select the Stereo/Mono input mode for the analog input.

You can choose whether the fader operates on both stereo channels applied to the analog input, or if it operates in mono, driving the left and right channels of the processing with identical signals. The choices are:

- Stereo
- Mono from the left-channel input
- Mono from the right-channel input
- Mono from the sum of the left and right channel inputs

Choose the functionality you want from the STEREO/MONO drop-down list (found on the I/O mixers below the corresponding faders). The default is STEREO.

4. Adjust the Processed Mixer analog input fader.

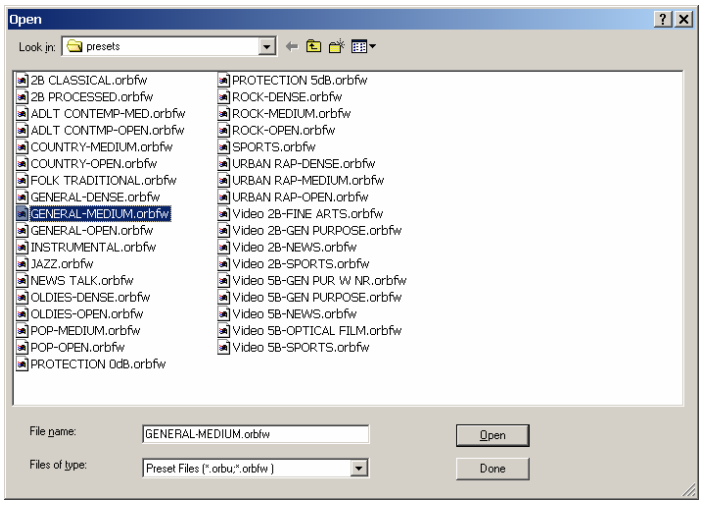
[Skip to step 6 on page 2-28 if you will not be using OPTIMOD-PC's analog inputs.]

This step adjusts the drive to OPTIMOD-PC's audio processing so that it operates in its preferred range.

A) Open the GENERAL-MEDIUM fixed processing preset.

a) On the Orban Control application, choose FILE/OPEN PRESET.

The Open Preset dialog box appears.



b) Click GENERAL-MEDIUM in the preset list.

The GENERAL-MEDIUM preset becomes active. The dialog box remains open until you explicitly close it by clicking DONE.

B) Calibrate using tone—feed a test tone at your reference level to OPTIMOD-PC.

[Skip this step if you are using program material to calibrate OPTIMOD-PC to your standard studio level. Skip to step (C) on page 2-27]

- If you are not using a studio level controller, feed a tone through your console or mixer at the level at which you normally peak program material (typically 0 VU if your console uses VU meters).

- If you are using an Orban 4000 Transmission Limiter, press its two *TEST* buttons. Feed a tone through your console at the level to which you normally peak program material (typically 0VU if your console uses VU meters).

- If you are using a studio level controller that performs an AGC function, such as an Orban 8200ST OPTIMOD-Studio or 464A Co-Operator, adjust it for normal operation.

a) In the I/O Mixer, click the CONFIGURATION tab.

b) Click the PROCESSED MIXER tab.

c) Set the ANALOG L/R INPUT fader to make the MIXER OUTPUT meter indicate –20dBfs.

For more information, refer to the notes under step 1 on page2-24.

d) Note the setting of the ANALOG L/R INPUT fader. Click the DIRECT MIXER tab and set the ANALOG L/R INPUT fader to the same value.

e) Skip to step 5 on page 2-28.

C) Calibrate using program: Feed normal program material to OPTIMOD-PC's analog input.

[Skip this step if you are using tone to calibrate OPTIMOD-PC to your standard studio level—see step (B) above.]

a) Play program material from your studio, peaking at the level to which you normally peak program material (typically 0 VU if your console uses VU meters).

b) In the Mixer application, click the CONFIGURATION tab.

c) Verify that AGC is set to ENABLED.

Refer to step (3.B) on page 2-20.

d) Click the PROCESSOR MIXER tab.

e) Set the ANALOG L/R INPUT fader to make the AGC GAIN REDUCTION meter (on the main meter screen in the Orban Control application) indicate an average of 10 dB gain reduction when normal levels are applied to the OPTIMOD-PC's analog input.

If necessary, drag the Mixer window so that the AGC GAIN REDUCTION meter is visible.

If the AGC gain reduction meter averages less than 10dB gain reduction (higher on the meter), or if the GATE indicator stays on when program material is present, turn the ANALOG L/R INPUT fader up.

If the AGC gain reduction meter averages more gain reduction (lower on the meter), turn the ANALOG L/R INPUT fader down.

f) Note the setting of the ANALOG L/R INPUT fader. Click the DIRECT MIXER tab and set the ANALOG L/R INPUT fader to the same value.

g) When finished, reset AGC to DISABLED, if required.

Refer to step (3.C) on page 2-21.

5. Adjust the Analog L/R Input Balance Control. (optional)

[Skip this step if the channels are already balanced satisfactorily.]

[This step can only be accurately performed with test tones.]

A) Click the PROCESSOR MIXER tab.

B) Make your console or other program source output a correctly balanced test tone, such that its left and right output level meters indicate identical levels.

C) If the MIXER OUTPUT meters on the PROCESSOR MIXER tab do not indicate identically, adjust the PAN/BALANCE control in the ANALOG L/R INPUT block until they do.

6. Adjust the remaining input faders. (optional)

If you are using any of the other inputs (DIGITAL 1, DIGITAL 2, WAVE OUT FROM PC), perform steps 3 through 5 (above) for these sources, substituting the appropriate fader and balance control for the analog control referenced in these steps. Be sure that you are driving only the input you are adjusting; you can mute the other inputs by checking their MUTE boxes temporarily.

You can use a program like Adobe Audition to generate .WAVE files for tone calibration.

7. Set up the automatic backup feed function. (optional)

You may wish to configure your system so that OPTIMOD-PC will automatically switch to a backup feed if a primary feed fails. The ANALOG L/R and DIGITAL 2 inputs can be programmed to mute automatically if the DIGITAL 1 input is locked to an AES/EBU input signal, and to unmute if the DIGITAL 1 input loses lock.

To do this, check (by clicking) the BACKUP INPUT FOR DIGITAL 1 box on either (or both) of the ANALOG L/R and DIGITAL 2 inputs. If both are checked, then a failure of the DIGITAL 1 INPUT will automatically unmute only the DIGITAL 2 INPUT. If the DIGITAL 2 INPUT then fails, the ANALOG L/R INPUT will automatically unmute.

You can set these functions separately on the Processed Mixer and the Direct Mixer. The two mixers will behave independently according to their individually set programming.

If both "backup for digital 1" and "mute" are selected, the backup function will override the mute function.

Output and Routing Switcher Setup

The three-switch output routing switcher determines the feed to:

- The OPTIMOD-PC card's stereo analog output

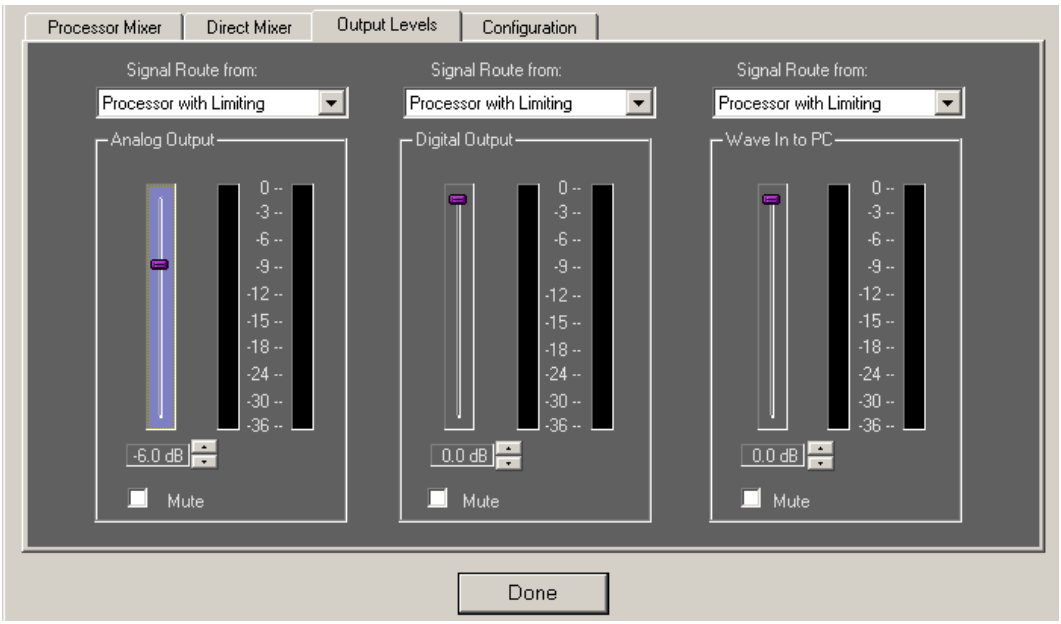
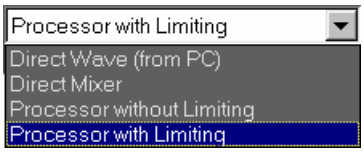


Figure 2-8: Output Levels Page in I/O Mixer

- The OPTIMOD-PC card's AES/EBU digital output.
- The WAVE input to the computer.

Each output can receive any of the following four sources:



- The WAVE output from the computer
- The output of the direct mixer
- The output of the OPTIMOD-PC audio processing that follows all processing except final peak limiting
- The output of the OPTIMOD-PC audio processing that follows all processing, including peak limiting.

> The "processed without limiting" output can provide a low-delay monitor feed back to live talent headphones because it has much lower throughput delay than the "processed with limiting" output. Because the look-ahead limiter contributes most of the time delay through the system, listening from the output of the multi-band compressor (ahead of the look-ahead limiter) can be more comfortable to a DJ or presenter who is monitoring his or her voice live through headphones.

Each of the three outputs has an attenuator and a stereo peak-reading meter, which indicates the post-attenuator level.

A) Using the drop-down menu, choose the source that feeds each output.

B) Set the output level of each output as desired, using its attenuator.

> See the notes under step 2 on page 2-25 for more information on headroom and calibrating for unity input/output gain.
>
> Refer to *Setting Output/Modulation Levels* on 1-23 of this manual for advice on setting output levels and on their relationship to headroom.

C) If you wish to save the entire setup (that is, the settings of all controls in all tabbed pages), click SAVE SETUP on the File menu in the Orban Control application. Then follow the prompts.

Saving a setup is useful mainly if you wish to be able to paste this entire setup to another OPTIMOD-PC card later. Any changes you have made to the setup of the currently active card will be saved automatically for that card when you click DONE; it is unnecessary to use SAVE SETUP to avoid losing changes you made. See step (2.B) on page 2-19.

The Direct Mixer

The Direct Mixer looks the same as the Processor Mixer (see *Figure 2-6: Processor Mixer Page in I/O Mixer* on page 2-18). The Direct Mixer determines the gain applied to input signals before these signals are sent directly (without OPTIMOD-PC processing) to the output routing switcher. If the output attenuator in the routing switcher

is set to "0dB" and the analog input and output reference levels are set identically (to +4dBu or –10dBv), then the Direct Mixer faders will indicate the input/output gain directly in dB.

The default settings of "0dB" provide unity gain in and out of the OPTIMOD-PC card for both the analog and the digital inputs. If you want to change a reference level between a source and destination (for example, from –16dBfs to –18dBfs), you can do so by adjusting the fader corresponding to the source (in our example, by setting it to –2dB).

Note that you are limited by input headroom: if you set the DIGITAL 1 fader to –2dB, OPTIMOD-PC's digital output level cannot exceed –2dBfs because this level corresponds to 0dBfs at OPTIMOD-PC's digital 1 input.

If you are using a digital input and an analog output, note that OPTIMOD-PC's internal gain for both input and output is such that 0dBfs = +24dBu or +10dbV (for ANALOG REFERENCE LEVEL settings of +4dBu and –10dBV respectively). OPTIMOD-PC's output line amplifiers can drive +24dBu into a *balanced* load. However, the maximum analog output level they can drive into an *unbalanced* load is +20dBu. Therefore, to match analog and digital clipping levels when driving an unbalanced load with ANALOG REFERENCE LEVEL = +4dBu, set the ANALOG OUTPUT fader to –4dB.

> With ANALOG REFERENCE LEVEL = –10dBV, there is enough headroom for either balanced or unbalanced operation and it is unnecessary to make this adjustment.
>
> The ANALOG OUTPUT fader is located in the OUTPUT LEVELS page.

If you are mixing more than one active input, be careful not to exceed the headroom of OPTIMOD-PC's mix bus, whose peak level is indicated by the MIXER OUTPUT meters on both the PROCESSED MIXER and DIRECT MIXER pages. To prevent clipping, do not permit the "0" SEGMENT OF this meter to light.

Interfacing OPTIMOD-PC with WAVE Devices

Turning Off Windows Sounds

If OPTIMOD-PC is the Windows Preferred or Default Device, in order to prevent Windows' OS-generated and application-generated sounds from going "on the air," or over your stream, you must turn them off.

> This caveat applies only when you are using OPTIMOD-PC's WAVE inputs. If you are using only OPTIMOD-PC's hardware inputs and have the WAVE inputs turned off in the OPTIMOD-PC I/O mixer, then the system WAVE sounds will not mix with your desired program material.

- In Windows XP, navigate to CONTROL PANEL/SOUNDS AND AUDIO DEVICES/SOUNDS. In the "sound schemes" drop-down box, choose NO SOUNDS.
- In Windows 2000, navigate to CONTROL PANEL/SOUNDS AND MULTIMEDIA. In the "sound schemes" drop-down box, choose NO SOUNDS.

Applying Output from WAVE Devices to OPTIMOD-PC

Windows mixes the audio outputs of all simultaneously operating WAVE devices (like Windows Media Player). The resulting mix is applied to OPTIMOD-PC's WAVE OUT FROM PC faders in both the PROCESSOR MIXER and DIRECT MIXER pages. Because the volume controls on most WAVE devices are attenuators only (providing no gain at any setting), it is usually wise to set them to maximum and to set levels via the OPTIMOD-PC Mixer's WAVE OUT FROM PC faders.

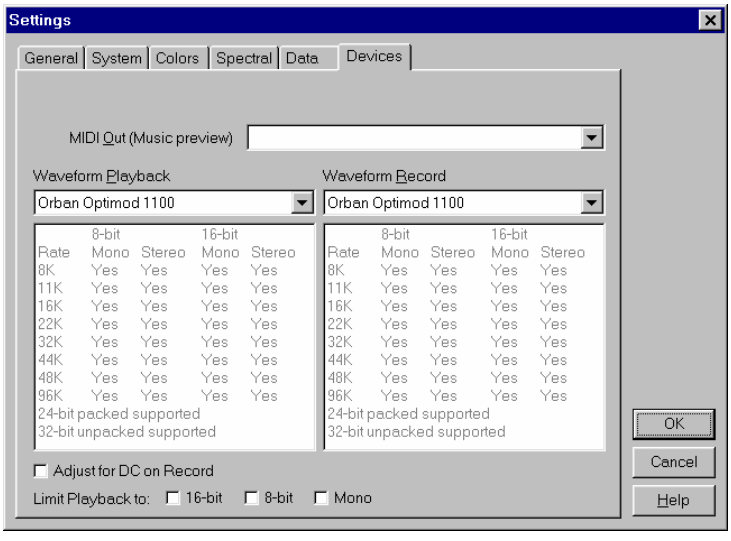
Of course, the output of any WAVE device can be routed to the OPTIMOD-PC's output mixer and/or processed through OPTIMOD-PC's audio processor as desired.

The OPTIMOD-PC DirectSound Driver allows digital audio playout systems to output multiple sources simultaneously to one sound device. This eliminates the need for multiple sound cards for each player and allows multiple players to mix automatically in automated operation, independent of sample-rate and/or bit-rate.

> Please note that some applications (like RealPlayer, as of this writing) have volume controls that affect the Windows master volume instead of just their own output levels. See *About the Interaction between OPTIMOD-PC's Input Mixers and Your PC's Built-In Mixer* on page 2-24.
>
> Note also that if the sample rate of the source material is different from 48 kHz (OPTIMOD-PC's native sample rate), the operating system will apply the appropriate sample rate conversion.

Applying OPTIMOD-PC's Output to WAVE Devices

OPTIMOD-PC's WAVE output looks like the output of a sound card to the host computer. Any application that can receive the output of a standard Windows WAVE device can use this output. Most such applications have a menu item that lets you select the particular WAVE device from which they are receiving input; select "OPTIMOD-PC." Once you have done this, you can set the drive level to the application via the WAVE output attenuator in the OPTIMOD-PC I/O Mixer. You can select the source that drives the application (PC WAVE output, output of Direct Mixer, output of OPTIMOD-PC pre-limiter, or output of OPTIMOD-PC) via the drop-down selector located above this attenuator.



For example, the figure shows Adobe Audition's "Settings" selector.

If you have more than one OPTIMOD-PC card installed, these will be known to Windows as "Orban Optimod 1100," "Orban Optimod 1100 (2)," "Orban Optimod 1100 (3)," etc., in the or-

der that they are installed in the PCI slots in your computer. You may have to experiment in order to determine which OPTIMOD-PC card is associated with a given name. Once you determine the association, it will not change unless you remove or add cards.

> Please note that Windows cannot read the serial number of an OPTIMOD-PC to identify it uniquely.
>
> Also, note that if you remove an OPTIMOD-PC card from your computer (so that there are fewer cards), Windows may assign different names to the remaining OPTIMOD-PC cards. However, if you replace one OPTIMOD-PC with another one in the same PCI slot, the new card will still have the same Windows name as the old card if the total number of OPTIMOD-PC cards is the same as before.
>
> This naming limitation does not apply to the Orban Control application, which can identify installed OPTIMOD-PC cards by their serial numbers. The naming limitation applies *only* to Windows applications that expect to receive streams from WAVE devices.
>
> This is mainly relevant to users running multiple instances of a streaming program like HELIX Producer or Windows Media Encoder. Typically, each instance of the streaming program is connected to a separately named OPTIMOD-PC WAVE device. For example, if you were running two streams, one instance of HELIX Producer would be connected to "Orban OPTIMOD-1100" and the other instance would be connected to "Orban OPTIMOD-1100 (2)."

In Windows XP only, it is possible to drive several record/encode applications from a single output of OPTIMOD-PC. For example, this would allow the output of one OPTIMOD-PC to drive several instances of an encoder or several encoders. If this capability is required in Windows 2000, Wave Clone and/or Virtual Audio Cable from Ntonyx may be used.

Problems and Possible Causes

Always verify that the problem is not the source material being fed to OPTIMOD-PC, or in other parts of the system.

When I First Turn on My Computer, the Sound Seems Wrong

This is normal. Upon boot, the OPTIMOD-PC driver loads a "placeholder" preset and I/O setup into the OPTIMOD-PC's DSP so that the card will pass audio. After the OPTIMOD-PC Service application starts (as part of the computer's boot sequence), it will automatically load the last on-air preset and I/O setup.

> The driver does not restore the Processing Delay, AGC, and I/O Lowpass Filter Configuration parameters at startup. They are restored at startup if the OPTIMOD-PC service is being started automatically. If the OPTIMOD-PC service is not being started automatically, these parameters will be restored when the OPTIMOD-PC Control application is launched.
>
> All others IO settings are restored when the driver loads.

When I Launch the OPTIMOD-PC Control Application, the Meters do not Move and I Cannot Control My Card

Unless you have only one OPTIMOD-PC card installed in your computer, you must connect the application to a given card (via the CONNECT Menu item) before you can control it. This is because the Control Application is designed to address more than one card in multi-card installations. See the steps starting with step 4 on page 2-5.

I Can't Connect to a Given OPTIMOD-PC Card From My Network.

You must check the ALLOW NETWORK TO ACCESS LOCAL CARDS box in the CARDS AND SECURITY ADMINISTRATION dialog box for that card.

Other possible causes are:

- Password is wrong.
- The target card is open on another computer.
- The system that houses the target card is not on.
- The Orban Windows service routine, `OptimodPcService`, is not running in the computer housing the target card.
- The Orban Windows service routine has malfunctioned. If all else fails, try ending and then restarting `OptimodPcService` in the Windows Task Manager:

  A) Right-click the Windows task bar and choose "Task Manager."

  B) Click the Process tab and `OptimodPcService` to highlight it.

  C) Click the "End Process" button.

  D) Right-click `OptimodPcService` and choose "Start process."

I Get Clicks When I Source My WAVE Material from a CD

CD audio playback can sometimes have dropouts if the CD player is being accessed by the IDE controller using PIO mode. Usually, this can be fixed by setting the IDE controller to DMA mode. Here are the steps to change the setting on Windows 2000:

A) Open the SYSTEM control panel.

B) Select the HARDWARE tab.

C) Select DEVICE MANAGER...

D) Expand the node labeled IDE ATA/ATAPI CONTROLLERS.

E) Select the devices labeled SECONDARY IDE CHANNEL.

F) Select the ACTION menu and then click on the PROPERTIES menu item.

G) Select the ADVANCED SETTINGS tab.

H) Change the TRANSFER MODE dropdown menu from "PIO only" to "DMA if available."

I Get Clicks When I Source My WAVE Material from my computer's hard drive.

If Windows XP detects several hard disk read errors in a row, it will automatically set the hard disk data transfer mode, usually DMA, to PIO. This can cause clicks in the OPTIMOD-PC audio if the hard drive is sourcing the WAVE material driving OPTIMOD-PC. See *I Get Clicks When I Source My WAVE Material from a CD* above.

RFI, Hum, Clicks, or Buzzes

A grounding problem is likely. Review the information on grounding on page 2-17.

OPTIMOD-PC has been designed with substantial RFI suppression on its analog and digital input and output ports. It will usually operate adjacent to high-powered transmitters without difficulty. In the most unusual circumstances, it may be necessary to reposition the host computer to reduce RF interference, and/or to reposition OPTIMOD-PC's input and output cables to reduce RF pickup on their shields.

The AES/EBU inputs and output are transformer-coupled and have good resistance to RFI. If you have RFI problems and are using analog connections on either the input or output, using digital connections will probably eliminate the RFI.

Poor Peak Level Control

OPTIMOD-PC audio processing ordinarily controls its output peak levels to an accuracy of ±1% when operated with 48 kHz output sample rate. As explained in the note on page 1-18, output sample rate conversion will slightly compromise this control because the peak control occurs with reference to individual sample values at 48 kHz. The converted samples no longer have the same peak values as the 48 kHz samples, and some values can be slightly higher. However, the overshoot of the converted signal almost never exceeds 0.5dB and is therefore not a significant problem.

Using the analog output will cause similar amounts of overshoot because the samples in the transmitter or encoder are not synchronous with the peak-controlled samples in OPTIMOD-PC. Further, analog connections can cause analog-domain overshoot if the connection is not phase linear and has a low-frequency cutoff of greater than 0.15Hz (at –3dB).

Audible Distortion

Make sure that the problem can be observed on more than one sound system and at several locations.

Verify that the source material at OPTIMOD-PC's audio inputs is clean. Heavy processing can exaggerate even slightly distorted material, pushing it over the edge into unacceptability.

The subjective adjustments available to the user have enough range to cause audible distortion at their extreme settings. Advancing the FINAL LIMIT control too far will inevitably cause distortion. (Distortion is very probable if gain reduction in the final limiter frequently exceeds 6dB.) Setting the LESS-MORE control beyond "9" will cause audible distortion of some program material.

If you are using analog inputs, you must correctly match the headroom of the unit's analog-to-digital (A/D) converter to the peak audio levels expected in your system (using System Setup). If your peak program level exceeds the peak level you have specified on setup, OPTIMOD-PC's A/D converter will clip and distort. See step 1 on page 2-24.

Be sure that the output meters for the processed mixer and Direct Mixer never go into the red. If they do, turn down all active input attenuators by an equal amount.

Audible Noise in Processed Audio

(See also "RFI, Hums, Clicks, or Buzzes" on page 2-33.)

Excessive compression will always exaggerate noise in the source material. OPTIMOD-PC reduces this problem with its *compressor gate,* which freezes the gain of the AGC and compressor systems whenever the input noise drops below a level set by the GATE THR (Gate Threshold) control, preventing noise below this level from being further increased.

If you are using OPTIMOD-PC's analog input, the overall noise performance of the system is usually limited by the overload-to-noise ratio of the analog-to-digital converter used by OPTIMOD-PC to digitize the input. (This ratio is better than 100dB.)

It is important to specify the ANALOG INPUT REFERENCE LEVEL correctly (see step 1 on page 2-24). You should specify the level as the highest peak level that OPTIMOD-PC will receive under normal operation. If, in an attempt to build in a "safety factor" or increase headroom, you specify a higher level than this, every 1dB of extra headroom that you gain will increase OPTIMOD-PC's noise floor by 1dB.

OPTIMOD-PC's AES/EBU input is capable of receiving words of up to 20 bits. A 20-bit word has a dynamic range of approximately 120dB. OPTIMOD-PC's digital input will thus never limit the unit's noise performance even with very high amounts of compression.

In digital radio applications, if an analog studio-to-transmitter link (STL) is used to pass unprocessed audio to OPTIMOD-PC, the STL's noise level can severely limit the overall noise performance of the system because compression in OPTIMOD-PC can exaggerate the STL noise. For example, the overload-to-noise ratio of a typical analog microwave STL may only be 70-75dB. In this case, it is wise to use the Orban 8200ST Studio Chassis to perform the AGC function prior to the STL transmitter and to control the STL's peak modulation. This will optimize the signal-to-noise ratio of the entire transmission system. An uncompressed digital STL will perform much better than any analog STL. Section 1 of this manual has a more detailed discussion.

Shrill, Harsh Sound; Excessive Sibilance

Excessively high settings of the HF GAIN control can cause this problem. It can also be caused by excessively high settings of the B5 THRESHOLD (Band 5 Compression Threshold) control. In the latter case, you are first likely to notice the problem as harsh sibilance on voice.

System Receiving OPTIMOD-PC's Output Will Not Lock

Be sure that OPTIMOD-PC's output sample rate is set to match the sample rate that the driven system expects. Be sure that OPTIMOD-PC's digital output format control is set to match the standard expected by the driven system (either AES/EBU or SPDIF). (See step 4 on page 2-22.)

System Will Not Pass Line-Up Tones at Full Output Level/100% Modulation

This is normal in OPERATE mode. Sine waves have a very low peak-to-average ratio by comparison to program material. The processing thus automatically reduces their peak level to bring their average level close to that of program material, promoting a more consistent and well-balanced sound quality.

To pass line-up tones transparently, recall OPTIMOD-PC's BYPASS preset. If necessary, adjust its gain and save your edited preset as a User Preset.

These tones should be injected into the transmitter after OPTIMOD-PC, or OPTIMOD-PC should be temporarily switched to BYPASS to pass the tones.

> The bypass function is not available with version 1.0 software.

Alternatively, you can patch the OPTIMOD-PC digital output into one of its digital inputs. This leaves you with one analog or one digital input into which you can connect the unprocessed audio. Use the remaining unused input to receive the output of the tone generator. Use the Direct mixer to mix the tone generator and processed signal as desired.

> This scenario is particularly practical if the final output of the system is a WAVE stream. Otherwise, the only remaining available output is the analog output. Of course, you can reverse the scenario by using the OPTIMOD-PC analog output and input for the loop-through connection, in which case the final mixed output could be the digital output.

General Dissatisfaction with Subjective Sound Quality

OPTIMOD-PC is a complex processor that can be adjusted for many different tastes. For most users, the fixed presets, as augmented by the gamut offered by the LESS-MORE control for each preset, are sufficient to find a satisfactory "sound." However, some users will not be satisfied until they have accessed other Modify Processing controls and have adjusted the subjective setup controls in detail to their satisfaction. Such users *must* fully understand the material in Section 3 of this manual to achieve the best results from this exercise.

Technical Support

If you need technical support, contact Orban customer service. Be prepared to describe the problem accurately. Know the serial number of your 1100 and the software and driver versions are you running. (The driver version number is available through Settings/Control Panel/Sounds and Multimedia/Hardware/Orban Optimod 1100 /Properties/Driver.)

Before you return a product to the factory for service, please refer to this manual. Make sure you have correctly followed installation steps, operation procedures, and any appropriate troubleshooting suggestions. If you are still unable to solve a problem, contact our Customer Service department. Often, a problem is relatively simple and can be fixed quickly after telephone consultation.

If you must return a product for factory service, please notify Customer Service by telephone *before* you ship the product; this helps us to be prepared to service your unit upon arrival. In addition, when you return a product to the factory for service, we strongly recommend you include a letter describing the problem.

Please refer to the terms of your Limited One-Year Standard Warranty, which extends to the first end user. After expiration of the warranty, a reasonable charge will be made for parts, labor, and packing if you choose to use the factory service facility. Returned units will be returned C.O.D. if the unit is not under warranty. Orban will pay return shipping if the unit is still under warranty. In all cases, the customer pays transportation charges to the factory (which are usually quite nominal).

Telephone:	+1 510 351-3500	write:	Customer Service Orban 1525 Alvarado Street San Leandro, CA 94577 USA
Fax:	+1 510 351-0500	E-Mail:	custserv@orban.com
		Web:	www.orban.com

Uninstalling the OPTIMOD-PC Software

Use the normal Windows Add/Remove Programs mechanism to uninstall the OPTIMOD-PC application. Choose "OptimodPC" in the Windows Add/Remove Programs list under the Control Panel.

The uninstaller will uninstall the OPTIMOD-PC Control Application and the service, `OptimodPcService`. It will not uninstall the driver.

If you wish to uninstall the driver, `OPTIMOD.SYS`, you must do this via the Windows Device Manager. However, it will not ordinarily be necessary for you to uninstall `OPTIMOD.SYS` even if you remove all OPTIMOD-PC cards from your computer, because Windows will not load `OPTIMOD.SYS` unless it detects at least one installed OPTIMOD-PC card.

The driver version number is available through Settings/Control Panel/Sounds and Multimedia/Hardware/Orban Optimod 1100 /Properties/Driver. (Please note that Control Panel/System/Hardware/Device Manager/Sound, Video, and Game Controllers will not report the correct driver version number.)

About the OPTIMOD-PC Driver and Service

The OPTIMOD-PC driver is responsible for low-level communication between the OPTIMOD-PC card and your computer's operating system. When the driver starts up, it checks a flag on each OPTIMOD-PC card to determine if it needs to reload DSP code into the card.

> It does not reload DSP code or parameters when Windows reboots normally, as it might after a security update, for example.

When the computer first powers up and Windows starts, the driver temporarily loads a general-purpose preset that enables the card to pass audio. It also reloads the system parameters, like input and output levels, which it reads from the computer's Registry. As soon as the OPTIMOD-PC service finishes starting up, the service will load the same processing preset that was active on the OPTIMOD-PC card when the computer shut down. If the service does not start up for some reason, then this power-down processing preset will not be restored and the general-purpose preset (loaded by the driver) run instead.

The service is also responsible for verifying that the DSP code version running on the card is the same as the DSP code with which the service was compiled. If it is not, the service will load the more recent DSP code.

Additionally, the service is an intermediary that allows the OPTIMOD-PC Control Application to talk to an OPTIMOD-PC card, whether local or on the network.

Optimod-PC Software Summary

Driver Files

- `optimodpc.sys` – Optimod-PC Driver
- `optimodpc.inf` – Optimod-PC Driver Install Information

Application Installation File

- `Setup1100xxx.exe` – Control Application and Service Installation File:
  - Installs the Control Application - `optimodpc.exe`
  - Installs the Agent - `OptimodPcAgent.exe`
  - Installs Service - `OptimodPcService.exe`
  - Does not install driver files. You must install the driver via the standard Microsoft Windows driver installation procedure.

Driver

- Always required for operation of Optimod-PC, except as noted in the section *Hardware I/O and PCI Expansion Chassis* on page 2-40.
- Provides basic sound card operation for Windows WAV I/O.
- Provides advanced sound card operation when used with Control Application and Service.
- Cold boot without Optimod-PC Service: driver loads default I/O and default DSP.
- Cold boot: driver loads defined I/O and default DSP .
- Warm boot: driver does not reload DSP.
- Driver is not required for Optimod-PC to pass audio from its hardware analog or digital inputs to its hardware outputs.

Service

- During cold boot: loads all user DSP preset information.
- Provides remote control security and access.

- Service is not required for computers that only remotely access Optimod-PC cards, but where no Optimod-PC card is installed locally.

Agent (Tray Icon)

- The Optimod-PC Agent is a tray icon that allows you to launch the Optimod-PC Control Application from the Windows System Tray.
- If you right click the tray icon, a menu pops up with a checkable item named AUTO-START THE TRAY ICON.

  The "Auto-start the tray icon" item will be checked by default.
- If you un-check AUTO-START THE TRAY ICON, the tray icon will not re-appear when you re-start the PC.
- To re-engage the icon, go to START/PROGRAMS/ORBAN/OPTIMOD-PC and select `OptimodPcAgent`.

  You do not need to open the Optimod-PC Control Application to toggle the auto-start feature on and off.

Control Application

- Provides access to all Optimod-PC I/O Mixer Controls, DSP Processing Parameters, and Presets.
- Can be used as a client to remotely access Optimod-PC cards.
- Driver and Service are not necessary for Optimod-PC Remote Client Operation.

Registry

- I/O Settings
- Active Preset
- Encrypted Security
- Application GUI Settings

Hardware I/O and PCI Expansion Chassis

The Optimod-PC driver and software are not necessary to permit a card to pass audio from its physical input(s) to output(s). Optimod-PC cards powered from an external PCI expansion chassis continue to pass audio in the absence of the host computer or in the event of its failure. However, the driver and service *are* required to initialize the card.

Section 3
Operation

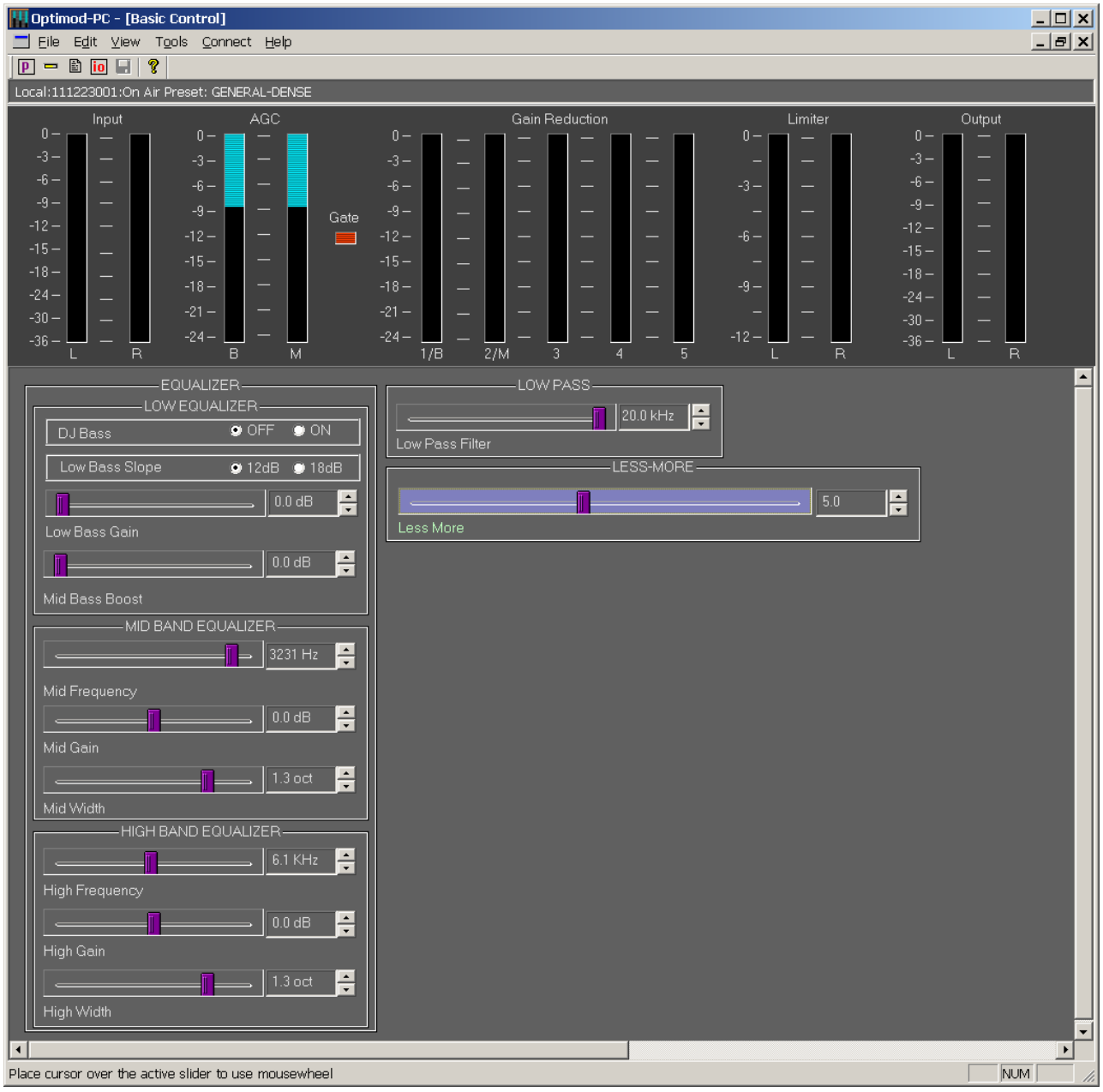


Figure 3-1: The OPTIMOD-PC Control Application (showing Basic Control)

The OPTIMOD-PC Control Application

- **AGC** meter shows the gain reduction of the slow AGC processing that precedes the multi-band compressor. Full-scale is 24dB gain reduction.

  Because the AGC is a two-band unit with Orban's patented bass coupling system, this meter actually reads the gain reduction of the AGC Master band.

- **Gate** indicator shows gate activity, lighting when the input audio falls below the threshold set by the gate threshold control (with the Advanced Modify screen's GATE THRESHOLD control). When this happens, the compressor's recovery time slows drastically to prevent noise rush-up during low-level passages.

- **Gain Reduction** meters show the gain reduction in the multi-band compressor. Full-scale is 24dB gain reduction.

- **Input Meters** show the input level applied to the audio processing.

- **Output Meters** show the output levels of the processed signal before it is applied to the output routing switcher in the I/O Mixer.

- **Limiter** meters show the amount of broadband look-ahead peak limiting in the left and right channels, which we chose not to couple because the fast release time of this circuit would otherwise cause elements in one channel to modulate the opposite channel objectionably. Full-scale is 24dB gain reduction.

- **Control Pane** shows editing controls that allow you to customize the fixed presets. There are two levels of control: Basic Control and Advanced Control.

- **I/O Mixer Window** allows you to set input and output levels, system setup parameters, and audio routing.

- **File Menu** allows you to open fixed and user presets and to save user presets that you have created by editing fixed presets or older user presets. When you save a preset, it is saved on the machine housing OPTIMOD-PC card on which you created the preset and also to the machine running the Control Application. To share presets between cards, use a file manager or Windows Explorer to copy preset files from one folder to another.

  You can also save and restore the state of the OPTIMOD-PC Mixer by using the SAVE SETUP and OPEN SETUP menu items.

- **Edit Menu** brings up the Basic Control, Advanced Control, and the OPTIMOD-PC Mixer screens, which allow you to edit presets to get the sound you want.

- **View Menu** allows you to display or hide the Toolbar, which contains icon-based shortcuts for common tasks. It also allows you to hide or display the status bar and control help.

- **Tools Menu** allows you to access the OPTIMOD-PC Mixer and the Cards and Security Administration Screen.

- **Connect Menu** allows you to connect to an OPTIMOD-PC card to perform the various tasks implemented by the Control application and the OPTIMOD-PC Mixer application. It also allows you to add, edit and remove cards and to disconnect from a card.

- **Help Menu** provides access to the Help and About functions.

- **Info Bar** shows OPTIMOD-PC card to which you are currently connected and the preset that the card is running.

- **Toolbar** contains icons that implement common functions, like recalling and saving presets, opening the mixer screen, opening the modify screens, saving presets, and Help.

Introduction to Processing

Some Audio Processing Concepts

Reducing the peak-to-average ratio of the audio increases loudness. If peaks are reduced, the average level can be increased within the permitted modulation limits. The effectiveness with which this can be accomplished without introducing objectionable side effects (such as pumping or intermodulation distortion) is the single best measure of audio processing effectiveness.

Compression reduces the difference in level between the soft and loud sounds to make more efficient use of permitted peak level limits, resulting in a subjective increase in the loudness of soft sounds. It cannot make loud sounds seem louder. Compression reduces dynamic range relatively slowly in a manner similar to riding the gain: Limiting and clipping, on the other hand, reduce the short-term peak-to-average ratio of the audio.

Limiting increases audio density. Increasing density can make loud sounds seem louder, but can also result in an unattractive busier, flatter, or denser sound. It is important to be aware of the many negative subjective side effects of excessive density when setting controls that affect the density of the processed sound.

Clipping sharp peaks does not produce any audible side effects when done moderately. Excessive clipping will be perceived as audible distortion.

Look-ahead limiting is limiting that prevents overshoots by examining a few milliseconds of the unprocessed sound before it is limited. This way the limiter can anticipate peaks that are coming up.

> The look-ahead limiter in OPTIMOD-PC operates with very fast attack and release times and is closer to a clipper than a conventional peak limiter.

Distortion in Processing

In a competently designed processor, distortion occurs only when the processor is controlling peaks to prevent the audio from exceeding the peak modulation limits of the transmission channel. The less peak control that occurs, the less likely that the listener will hear distortion. However, to reduce the amount of peak control, you must decrease the drive level to the peak limiter, which causes the average level (and thus, the loudness) to decrease proportionally.

Loudness and Distortion

In processing, there is a direct trade-off between loudness and distortion. You can improve one only at the expense of one or both of the other two. Thanks to Orban's psychoacoustically optimized designs, this is less true of Orban processors than of any others. Nevertheless, all intelligent processor designers must acknowledge and work within the laws of physics as they apply to this trade-off.

> In AM and FM processing, we have long said that there is a direct trade-off between loudness, *brightness*, and distortion, However, because DAB and netcasting systems don't use pre-emphasis, there is no problem getting the audio to sound bright and the trade-off is only between loudness and distortion.

Perhaps the most difficult part of adjusting a processor is determining the best trade-off for a given situation. We feel that it is usually wiser to give up ultimate loudness to achieve low distortion. A listener can compensate for loudness by simply adjusting the volume control. But there is nothing the listener can do to make an excessively compressed or peak-limited signal sound clean again.

If processing for high quality is done carefully, the sound will also be excellent on small radios. Although such a signal might fall slightly short of ultimate loudness, it will tend to compensate with an openness, depth, and punch (even on small speakers) that cannot be obtained when the signal is excessively squashed.

If women form a significant portion of the station's audience, bear in mind that women are more sensitive to distortion and listening fatigue than men. In any format requiring long-term listening to achieve market share, great care should be taken not to alienate women by excessive stridency, harshness, or distortion.

OPTIMOD-PC—from Bach to Rock

OPTIMOD-PC can be adjusted so that the output sounds:

- as close as possible to the input at all times (using the Protection Limiter structure)
- open but more uniform in frequency balance (and often more dramatic) than the input (using the Two-Band structure or slow Multi-Band structures)
- dense, quite squashed, and very loud (using the fast or medium-fast Multi-Band structures)

The dense, loud setup will make the audio seem to jump out of car and table radios, but may be fatiguing and invite tune-outs on higher quality home receivers. The loudness/distortion trade-off explained above applies to any of these setups.

In professional broadcasting environments, you will achieve best results if Engineering, Programming, and Management go out of their way to communicate and cooperate with each other. It is important that Engineering understand the sound that Programming desires, and that Management fully understands the trade-offs involved in optimizing one parameter (such as loudness) at the expense of others (such as distortion or excessive density).

Never lose sight of the fact that, while the listener can easily control loudness, he or she cannot make a distorted signal clean again. If such excessive processing is permitted to audibly degrade the sound of the original program material, the signal is irrevocably contaminated and the original quality can never be recovered.

Customizing OPTIMOD-PC's Sound

The subjective setup controls on OPTIMOD-PC give you the flexibility to customize your station's sound. Nevertheless, as with any audio processing system, proper adjustment of these controls consists of balancing the trade-offs between loudness, density, and audible distortion. The following pages provide the information you need to adjust OPTIMOD-PC controls to suit your format, taste, and competitive situation.

When you start with one of our Fixed Presets, there are two levels of subjective adjustment available to you to let you customize the Fixed Preset to your requirements: Basic Control and Advanced Control.

Basic Control

The single LESS-MORE control changes many different subjective setup control settings simultaneously according to a table that we have created in OPTIMOD-PC's

fixed presets, which are Read-Only. In this table are sets of subjective setup control settings that provide, in our opinion, the most favorable trade-off between loudness, density, and audible distortion for a given amount of processing. We believe that most OPTIMOD-PC users will never need to go beyond the LESS-MORE level of control, because the combinations of subjective setup control settings produced by this control have been optimized by Orban's audio processing experts on the basis of years of experience designing audio processing, and upon hundred of hours of listening tests.

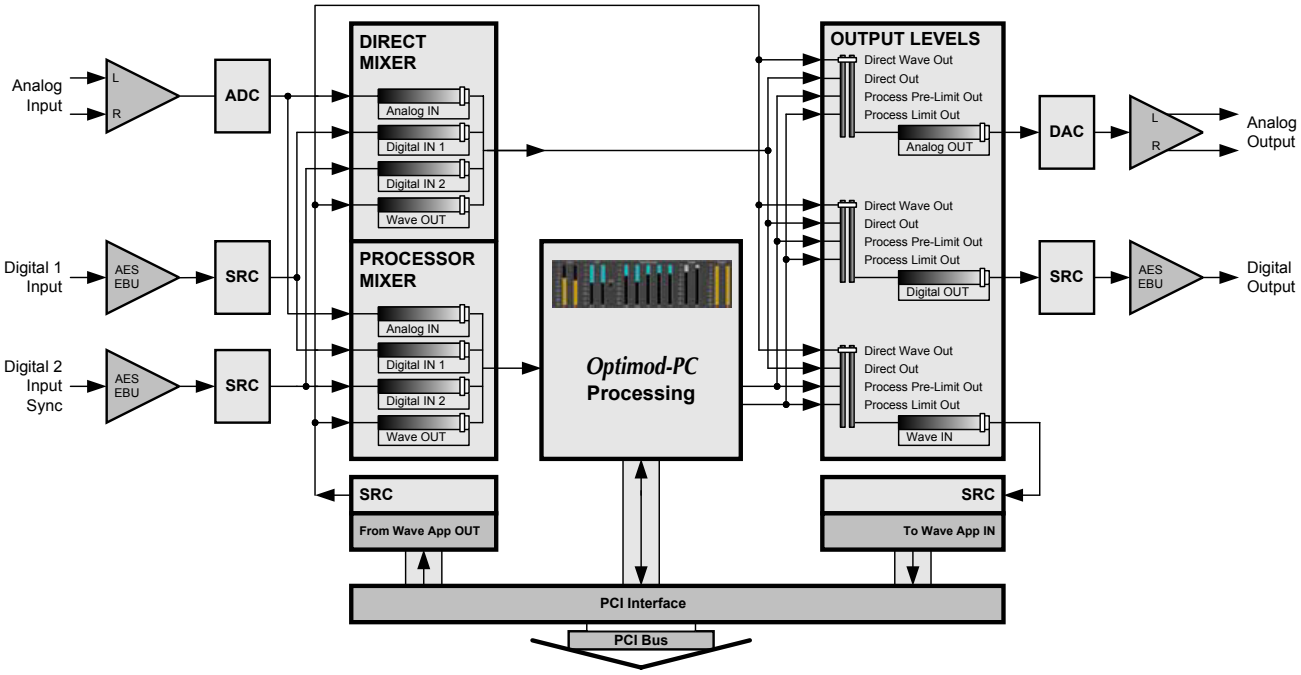


Figure 3-2: OPTIMOD-PC Signal Flow Diagram

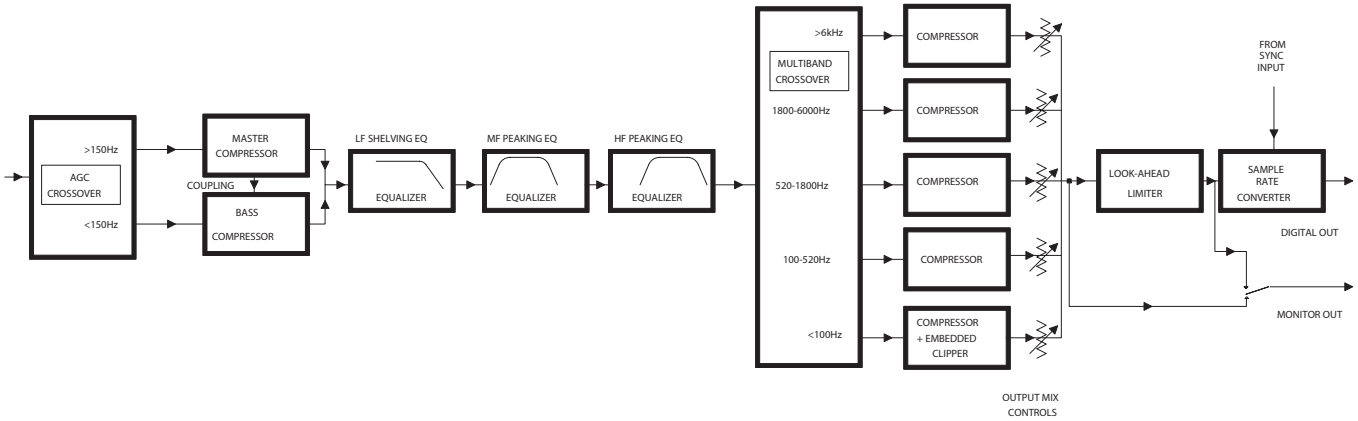


Figure 3-3: Simplified OPTIMOD-PC Digital Signal Processing Diagram

The LESS-MORE control has a different effect in the "radio" presets than it does in the "video" presets. In the "radio" presets the air sound will become louder as you go from less to more, but (as with any processor) processing artifacts will increase. In the "video" presets (except for those few based on "radio" presets), the LESS-MORE control sets the average amount of dynamic range control provided by the processing. As you go from less to more, the loudness of loud sounds will stay about the same but the loudness of quieter sounds will increase. Because of OPTIMOD-PC's sophisticated gating circuits, very quiet material like background sounds, quiet underscoring, hiss, and hum will not be pumped up.

Please note that, in the "radio" presets, the highest LESS-MORE setting is purposely designed to cause unpleasant distortion and processing artifacts! This helps assure you that you have chosen the optimum setting of the LESS-MORE control, because turning the control up to this point will cause the sound quality to become obviously unacceptable.

Advanced Control

If you want to create a signature sound for your station that is out of the ordinary, or if your taste differs from the people who programmed the LESS-MORE tables, ADVANCED CONTROL is available to you. At this level, you can customize or modify any subjective setup control setting to create a sound exactly to your taste. You can then save the settings in a User Preset and recall it whenever you wish.

You need not (in fact, cannot) create a sound entirely from scratch. All User Presets are created by modifying Fixed Presets or by further modifying Fixed Presets that have been previously modified with a LESS-MORE adjustment. Because the LESS-MORE control also adjusts certain invisible system parameters that cannot be accessed by the user — even at the ADVANCED CONTROL level—it is wise to set the LESS-MORE control to achieve a sound as close as possible to your desired sound before you make further modifications at the ADVANCED CONTROL level.

If you want to create your own User Presets, the following detailed discussion of the processing structures is important to understand.

If you only use Fixed Presets or if you only modify them with LESS-MORE, then you may still find the material interesting but it is not necessary to understand it to get excellent sound from OPTIMOD-PC.

Fundamental Requirements: High-Quality Source Material and Accurate Monitoring

A major potential cause of distortion is excess peak limiting. Another cause is poor-quality source material, including the effects of your playback machines, electronics, and studio-to-transmitter link (if any). If the source material is distorted even

slightly, that distortion can be greatly exaggerated by OPTIMOD-PC—particularly if a large amount of gain reduction is used. Very clean audio can be processed harder without producing objectionable distortion.

A high-quality monitor system is essential. To modify your air sound effectively, you must be able to hear the results of your adjustments. In too many stations, the best monitor is significantly inferior to the receivers found in many listeners' homes!

About the Processing Structures

In OPTIMOD-PC, a processing structure is a program that operates as a complete audio processing system. Only one processing structure can be active at a time. Just as there are many possible ways of configuring a processing system using analog components (like equalizers, compressors, limiters, and clippers), there are many possible processing structures achievable by OPTIMOD-PC. Unlike an analog system, where creating a complete processing system involves physically wiring its various components together, OPTIMOD-PC realizes all of its processing structures as a series of high-speed mathematical computations made by on-board Digital Signal Processing (DSP) integrated circuit chips, thereby offloading this computationally-intensive task from your computer's host processor. In OPTIMOD-PC, all structures operate simultaneously so there is no delay in switching between them; a smooth cross-fade does the switching.

Fixed Programming Presets

Fixed Programming Presets are our recommended settings for various program formats or types. The Fixed Programming Presets are designed as starting points to help you get on the air quickly without having to understand anything about adjusting OPTIMOD-PC's sound. Each of these presets can be edited with the LESS-MORE control to optimize the trade-off between loudness and distortion according to the needs of the format. Because it is so easy to fine-tune the sound at the LESS-MORE level, we think that many users will quickly want to customize their chosen preset to complement their market and competitive position after they had time to familiarize themselves with OPTIMOD-PC's programming facilities.

Start with one of these presets. Spend some time listening critically to your on-air sound. Listen to a wide range of program material typical of your format, and listen on several types of playback systems (not just on your studio monitors). Then, if you wish, customize your sound using the information in the Protection Limiter, Two-Band and Multi-Band sections that follow.

Radio Presets

The presets have been named similarly to their radio counterparts in Orban's OPTIMOD-FM 8200 with firmware version 3.00 and to their video counterparts in Orban's OPTIMOD-TV 8282 (with firmware version 1.2). (There are two more presets

available in OPTIMOD-PC than in 8200 Version 3.00) The basic audio texture of corresponding OPTIMOD-PC, 8200, and 8282 presets is quite similar, although the OPTIMOD-PC presets will usually have a less restricted high frequency sound because the digital channel does not use pre-emphasis and therefore requires no high frequency limiting. This will help engineers implementing In-Band On-Channel (IBOC) DAB systems match the sound of the digital and analog signals as closely as possible. This is important because the iBiquity® HD Radio system attempts to conceal digital errors by cross fading to analog in the receiver when the digital signal becomes unusable.

> Unlike the presets in the 8200 and 8282, no OPTIMOD-PC preset uses phase rotation. Therefore, some care must be applied in cross fading to avoid momentary audible comb filtering because of the different phase responses of the analog and digital channels. In practice, this means that the cross-fade should be quite fast—perhaps 50 milliseconds.
>
> Stations using Orban's Optimod-FM 8400 will ordinarily use the 8400's optional HD FM digital output to feed the digital channel in an IBOC transmission. This eliminates any potential comb filtering because both analog and digital outputs have identical amounts of phase rotation.

Each preset has full LESS-MORE capability. The table below shows the presets, including the source presets from which they were taken and the nominal LESS-MORE setting of each preset.

> Of the Multi-Band presets, several are duplicates because we felt that they were appropriate for more than one format.

Many of the presets come in several "flavors," like "dense," "medium," and "open." These refer to the density produced by the processing. "Open" uses a slow multiband release time "Medium" uses a medium-slow release, and "Dense" uses medium-fast. A fast release is only used in the NEWS/TALK and SPORTS presets.

> These presets are *only suggestions*. Try using the LESS-MORE control to trade off loudness against processing artifacts and side effects. Once you have used LESS-MORE, save your edited preset as a User Preset.

Do not be afraid to experiment with presets other than the ones named for your format if you think these other presets have a more appropriate sound. Also, if you want to fine-tune the frequency balance of the programming, feel free to enter ADVANCED CONTROL and make small changes to the BASS, MID EQ, and HF EQ controls. Remember to do this after you have decided on a LESS-MORE setting that's right for you. Once you have edited a preset using ADVANCED CONTROL, LESS MORE is no longer available for that edited preset.

> Of course, LESS-MORE is still available for the unedited preset if you want to go back to it. There is no way you can erase or otherwise damage the Fixed Presets. So feel free to experiment.

2B: The 2B presets provide an open, easy-to-listen-to sound that is similar to the source material if the source material is of good quality. These presets are useful for Classical or "fine arts" programming that demands high fidelity to the original program source. For a full discussion on setting up and using two-band presets, refer to "The Two-Band Structure," page 3-18.

GENERAL: The GENERAL presets are a compromise between ROCK and POP. They have a gentle bass and treble lift, along with enough presence energy to help vocals to stand out. These presets are also used for ADULT CONTMP (Adult Contemporary) and COUNTRY, and are a useful candidate for AOR formats.

URBAN/RAP: The URBAN/RAP presets are similar to the ROCK presets but with more bass. They use the 3-pole (18dB/octave) shape on the bass equalizer. They are appropriate for Urban, Rap, Black, R&B, Dance and other similar formats.

ROCK: The ROCK presets are designed for a bright high end and punchy low end (although not as exaggerated as the URBAN/RAP presets).

There is enough presence energy to ensure that vocals stand out. A modest amount of high frequency coupling (determined by the B3-B4 COUPLE and B4-B5 COUPLE settings) allows reasonable amounts of automatic HF equalization (to correct dull program material), while still preventing exaggerated frequency balances and excessive HF density.

These presets are appropriate for general rock and contemporary programming.

FIXED PROGRAMMING PRESETS (RADIO)		
Preset Names	**Source Preset**	**Normal Less-More**
2B CLASSICAL	2B CLASSICAL	5.0
2B PROCESSED	2B PROCESSED	7.0
ADLT CONTEMP-MED	GENERAL-MED	5.0
ADLT CONTMP-OPEN	GENERAL-OPEN	5.0
COUNTRY-MEDIUM	GENERAL-MED	5.0
COUNTRY-OPEN	GENERAL-OPEN	5.0
FOLK/TRADITIONAL	POP-MEDIUM	5.0
GENERAL-DENSE	GENERAL-DENSE	5.0
GENERAL-MEDIUM	GENERAL-MEDIUM	5.0
GENERAL-OPEN	GENERAL-OPEN	5.0
INSTRUMENTAL	JAZZ	5.0
JAZZ	JAZZ	5.0
NEWS/TALK	NEWS/TALK	5.0
OLDIES-DENSE	OLDIES-DENSE	7.0
OLDIES-OPEN	OLDIES-OPEN	7.0
POP-MEDIUM	POP-MEDIUM	5.0
POP-OPEN	POP-OPEN	5.0
ROCK-DENSE	ROCK-DENSE	7.0
ROCK-MEDIUM	ROCK-MEDIUM	7.0
ROCK-OPEN	ROCK-OPEN	7.0
SPORTS	SPORTS	5.0
URBAN/RAP-DENSE	URBAN/RAP-DENSE	7.0
URBAN/RAP-MEDIUM	URBAN/RAP-MEDIUM	7.0

TABLE 3-1: FIXED PROGRAMMING PRESETS (RADIO)

- For Contemporary Hit Radio (CHR) we recommend the DENSE or MEDIUM versions.
- For Album-Oriented Rock (AOR) we recommend the MEDIUM or OPEN versions, although you might prefer the more conservative ADULT CONTMP (Adult Contemporary) presets here.

ADULT CONTMP (Adult Contemporary): Derived from the GENERAL presets, these presets are a compromise between ROCK and POP. They have a gentle bass and treble lift, along with enough presence energy to help vocals to stand out.

COUNTRY: The COUNTRY presets use the GENERAL source presets. These presets are a compromise between ROCK and POP. They have a gentle bass and treble lift, along with enough presence energy to help vocals to stand out.

POP: POP is a more conservative preset designed for a mellow, open high end. There is substantial high frequency coupling (determined by the B3-B4 COUPLE and B4-B5 COUPLE settings) to ensure that the high frequencies do not become dense. This is an ideal preset for formats designed primarily for women listeners (who, by and large, dislike hyped treble) or for any preset designed for long time-spent-listening formats because of its open, clean sound, which leads to very low listener fatigue. Because of its conservative nature, this preset is also used for the FOLK/TRADITIONAL preset.

JAZZ: JAZZ is quite similar to POP, and is specifically tailored toward stations that play mostly instrumental music. It has a relatively mellow high end and produces very low listening fatigue.

INSTRUMENTAL: Derived from the JAZZ source preset, INSTRUMENTAL is quite similar to POP, and is specifically tailored toward stations that play mostly instrumental music. It has a relatively mellow high end and produces very low listening fatigue.

OLDIES: OLDIES is similar to ROCK except high frequency coupling (the B3-B4 COUPLE and B4-B5 COUPLE settings) is less. This allows the preset to do substantially more automatic equalization than ROCK, making recordings of different eras more uniform.

> OLDIES-OPEN might be a useful alternative to FOLK/TRADITIONAL if the recordings being played are very inconsistent in frequency balance.

FOLK TRADITIONAL: FOLK TRADITIONAL is derived from the POP-MEDIUM source preset. It is a more conservative preset designed for a mellow, open high end. There is substantial high frequency coupling (determined by the B3-B4 COUPLE and B4-B5 COUPLE settings) to ensure that the high frequencies do not become dense. This is an ideal preset for formats designed primarily for women listeners (who, by and large, dislike hyped treble) or for any preset designed for long time-spent-listening formats because of its open, clean sound, which leads to very low listener fatigue.

NEWS/TALK: This preset is quite different from the others above. It is based on the FAST multi-band release time setting, so it can quickly perform automatic equalization of substandard program material, including telephone. It is very useful for cre-

ating a uniform, intelligible sound from widely varying source material, particularly source material that is "hot from the field" with uncontrolled quality.

SPORTS: Similar to NEWS/TALK except the AGC RELEASE (AGC Release Time) is slower and the GATE THRESHOLD (Gate Threshold) is higher. This recognizes that most sports programming has very low signal-to-noise ratio due to crowd noise and other on-field sounds, so the preset does not pump this up as the NEWS/TALK preset would tend to do.

Video Presets

Note: Unlike the presets in the more costly Optimod-DTV 6200, OPTIMOD-PC two-band video presets do not use the CBS Loudness Controller algorithm. If you need true perceptual loudness control on two-band presets, please consider the 6200.

FIXED PROGRAMMING PRESETS (VIDEO)		
Preset Names	**Source Preset**	**Normal Less-More**
VIDEO 2B-FINE ARTS	2B CLASSICAL	2.0
VIDEO 2B-GEN PURPOSE	VIDEO 2B-GEN PURPOSE	5.0
VIDEO 2B-NEWS	VIDEO LIVE NEWS	5.0
VIDEO 2B-SPORTS	VIDEO LIVE SPORTS	5.0
VIDEO 5B-GEN PUR W NR	VIDEO 5B-GEN PURPOSE	5.0
VIDEO 5B-GEN PURPOSE	VIDEO 5B-GEN PURPOSE	5.0
VIDEO 5B-NEWS	VIDEO 5B-NEWS	5.0
VIDEO 5B-OPTICAL FILM	VIDEO 5B-OPTICAL FILM	5.0
VIDEO 5B-SPORTS	VIDEO 5B-SPORTS	5.0

Table 3-2: Fixed Programming Presets (Video)

VIDEO 2B–GEN PURPOSE (VIDEO Two-Band General Purpose): This preset is designed to accommodate most dramatic programming, providing gentle gain control that limits dynamic range to a level that provides the general audience with consistently intelligible dialog. It sounds very similar to Orban's analog OPTIMOD-TV (Model 8182A) when that unit is adjusted for "General" programming according to the instructions in its operating manual. This preset retains the spectral balance of its input as much as possible. VIDEO 2B-GEN PURPOSE is usually not the best choice for live news, sports, or films with optical soundtracks. The Five-Band presets (see below) can automatically equalize such program material when its spectral balance is inappropriate and can also apply single-ended dynamic noise reduction.

VIDEO 2B–FINE ARTS (Video Two-Band Fine Arts) is identical to VIDEO 2B-GEN PURPOSE except that it rides gain more slowly than the general-purpose presets.

VIDEO 2B–NEWS (Two-Band Live News) rides gain more quickly than the general-purpose presets. Its gate threshold is lower, so it will bring up low-level input material more quickly. It is designed for live news programs where input levels may be quite unpredictable. Being a Two-Band preset, it does not automatically re-equalize substandard audio (which is quite common in live news broadcasts). You may therefore prefer the Five-Band Live News preset.

VIDEO 2B–SPORTS (Two-Band Live Sports): is similar to VIDEO 2B–NEWS except the release time is slower to resist pumping up crowd noise.

VIDEO 5B-GEN PUR W/NR (VIDEO Five-Band General Purpose with Noise Reduction): provides effective dynamic range control and "automatic re-equalization" of most dramatic material. It applies single-ended noise reduction to the material, which will reduce unwanted noise like hiss, hum, or stage rumble. However, it will also reduce ambience. If the program material is carefully produced (as are most contemporary feature-film soundtracks), you may wish to use VIDEO 5B-GEN PURPOSE (which does not apply noise reduction), or, if the material is so well produced that it would not benefit from "automatic re-equalization," use VIDEO 2B-GEN PURPOSE.

VIDEO 5B-GEN PURPOSE (VIDEO Five-Band General Purpose without Noise Reduction): is identical to VIDEO 5B-GEN PUR W/NR except that the single-ended dynamic noise reduction system is off.

VIDEO 5B-NEWS (VIDEO Five-Band News): rides gain more quickly than the general-purpose presets. Its AGC release time is faster so it will bring up low level material more quickly. It is designed for live news programs where input levels may be quite unpredictable. It also automatically re-equalizes substandard audio (which is quite common in live news broadcasts).

VIDEO 5B-SPORTS (VIDEO Five-Band Sports): is similar to VIDEO 5B-NEWS, EXCEPT THE AGC RELEASE TIME IS SLOWER TO resist pumping up crowd noise.

VIDEO 5B-OPTICAL FILM (VIDEO Five-Band Optical Film): is designed to make the best of the low-quality audio provided with optical film sound tracks (particularly 16mm). The gate threshold is quite high to avoid pumping up hiss, thumps, and other optical artifacts. The threshold of the single-ended dynamic noise reduction system is also high so that this system can reduce artifacts as far as possible. Release times are slow, because we assumed that material encoded on optical film has already been carefully level-controlled to accommodate the very limited dynamic range of the medium, and that little gain riding is therefore required from OPTIMOD-PC.

Protection Limiting Presets

FIXED PROGRAMMING PRESETS (PROTECTION)		
Preset Names	**Source Preset**	**Normal Less-More**
PROTECTION 0dB	PROTECTION 0dB	2.0
PROTECTION 5dB	PROTECTION 5dB	5.0

Table 3-3: Fixed programming Presets (Protection)

The Protection Limiter presets are designed for stations wanting the highest possible fidelity to the source, such as a station broadcasting concert music at night when its audience is likely to listen in a concentrated and critical way. Unlike the other presets, the Protection Limiter presets are not designed to reduce the dynamic range, to increase program density, to increase loudness, or to increase the consistency of

sound from different sources. Their only function is to protect the transmission channel from clipping while preserving the spectral and dynamic quality of the source material.

The Protection Limiter presets are designed for operation below the threshold of limiting most of the time. There are two Protection Limiter Fixed Presets. PROTECTION 0DB sets the limiting threshold so that limiting almost never occurs, while PROTECTION 5DB sets the limiting threshold so that program material at the maximum normal input level (as determined by a PPM or VU meter monitoring the input program line) produces an average limiting of 5dB.

Setting Up Protection Limiting

To set up protection limiting, recall preset PROTECTION 0DB if you want limiting to occur only when the program level *exceeds* the maximum normal input level as determined by a PPM or VU meter monitoring the input program line. Recall preset PROTECTION 5DB if you want about 5dB of limiting to occur at the maximum normal input level.

The LESS-MORE control affects only the input drive, and you can use it to set a nominal limiting level different from 0dB or 5dB.

Equalization Controls

MULTI-BAND EQUALIZATION				
Parameter Labels	**Units**	**Default**	**Range (CCW to CW)**	**Step**
LOW BASS GAIN	dB	0	0.0 … +12.0	1
LOW BASS SLOPE	dB	2P	2P (12 dB/oct), 3P (18 dB)/oct	1
DJ BASS	---	off	off, on	---
MID BASS BOOST	dB	0	0 … +12	1
MID GAIN	dB	0.0	–10.0 … +10.0	0.5
MID FREQUENCY	Hz	3231	250 … 4000	1/10 oct LOG
MID WIDTH	oct	1.3	0.30 … 2.00	LOG
HIGH GAIN	dB	0.0	–10.0 … +10.0	0.5
HIGH FREQUENCY	kHz	6.1	2.00 … 20.00	1/10 oct LOG
HIGH WIDTH	oct	1.3	0.30 … 2.00	LOG
LOW PASS FILTER	kHz	20	4.00 … 12.0, 13.0, 14.0, 15.0, 20.0	0.5 ---

Table 3-4: Multi-Band Equalization Controls

Most equalization controls are common to both the Two-Band and Multi-Band structures. In terms of signal flow, the equalizer is located between the AGC and multi-band compressor sections of both structures.

Any equalization that you set will automatically be saved when you save a User Preset that you created using the equalization. For example, you can use a User Preset to combine an unmodified Fixed Programming Preset with your custom equaliza-

tion. Of course, you can also modify the Fixed Preset (with LESS-MORE or ADVANCED CONTROL) before you create your User Preset.

In general, there is no good reason to have to use large amounts of EQ with modern, well-recorded program material. OPTIMOD-PC's multi-band compressor was "tuned" with reference to modern well-recorded CDs, and should produce a highly "commercial" spectral balance with only modest amounts of EQ, if any.

Table 3-4 shows a summary of the equalization controls available for the Multi-Band structure.

LOW BASS GAIN and **LOW BASS SLOPE** controls set the characteristics of the Multi-Band structure's low bass equalizer, which is useful for adding punch and slam to rock and urban music. The equalizer provides a shelving boost from 0 to +12dB with a corner frequency of 110 Hz and selectable slopes of 12 dB/octave (2P) and 18 dB/octave (3P).

Because the Multi-Band structure often increases the brightness of program material, some bass boost is usually desirable to keep the sound spectrally well balanced. Bass equalization must be determined by individual taste and by the requirements of your format. Be sure to listen on a wide variety of radios—it is possible to create severe distortion on poor quality speakers by over-equalizing the bass. Be careful!

The moderate-slope (12dB/octave) shelving boost achieves a bass boost that is more audible on smaller speakers, but which can sound boomier on large speakers. The steep-slope (18dB/octave) shelving boost creates a solid, punchy bass from the better consumer radios with decent bass response. There are no easy choices here; you must choose the characteristic you want by identifying your target audience and the receivers they are most likely to be using. Regardless of which curve you use, we recommend a +2 to +4dB boost for most formats.

DJ BASS control determines the amount of bass boost produced on some male voices. In its default OFF position, it causes the gain reduction of the lowest frequency band to move quickly to the same gain reduction as its nearest neighbor when gated. This fights any tendency of the lowest frequency band to develop significantly more gain than its neighbor when processing voice because voice will activate the gate frequently. Each time it does so, it will reset the gain of the lowest frequency band so that the gains of the two bottom bands are equal and the response in this frequency range is flat. The result is natural-sounding bass on male voice.

If you like a larger-than-life, "chesty" sound on male voice, set this control ON. When the control is ON, the processing simply freezes the gain of the lowest band under gated conditions. Accordingly, there can be a large average gain difference between the two low frequency bands and the system can produce considerable dynamic bass boost on voice.

This will be highly dependent on the fundamental frequency of the voice. If the fundamental frequency is far above 100Hz there will be little voice energy in the bottom band and little or no audio bass boost can occur even if the gain of the bot-

tom band is higher than the gain of its neighbor. As the fundamental frequency moves lower, more of this energy leaks into the bottom band, and you hear more bass boost. If the fundamental frequency is very low (a rarity), there will be enough energy in the bottom band to force significant gain reduction, and you will hear less bass boost than if the fundamental frequency were a bit higher.

This control is only available in the Multi-Band structure.

If the GATE THRESHOLD (Gate Threshold) control is turned OFF, the DJ BASS boost setting is disabled (and set to OFF).

Note: in version 1.0, the control is not grayed out.

MID BASS control provides a 12dB/octave shelving boost at 200Hz. Use it in conjunction with the LOW BASS boost control to tailor your on-air bass to your exact requirements. A mid bass boost is mainly useful to stations that program to an audience likely to be listening on smaller radios. It can force a thin-sounding radio with a small speaker to seem to have more bass. However, bass boost in this frequency range can make larger radios sound very muddy and boomy, so adjust the MID BASS boost control with great care, listening to both small radios and radios with good bass response.

Midrange Parametric Equalizer is a specially designed parametric equalizer whose boost and cut curves closely emulate those of a classic Orban analog parametric equalizer with conventional bell-shaped curves (within ±0.15dB worst-case). This provides warm, smooth, "analog-sounding" equalization.

MID GAIN determines the amount of peak boost or cut (in dB) over a ±10dB range.

MID FREQUENCY determines the center frequency of the equalization, in Hertz. Range is 250-4000Hz.

MID WIDTH determines the bandwidth of the equalization, in octaves. The range is 0.3-2.0 octaves. If you are unfamiliar with using a parametric equalizer, 1 octave is a good starting point.

Note that this value may appear not to change when you increment it by one "click stop." This is because the display shows only one significant digit. In fact, the value is changing to the next increment. For example, 0.41 and 0.44 will both display "0.4."

The audible effect of the midrange equalizer is closely associated with the amount of gain reduction in the midrange bands. With small amounts of gain reduction, the amount of power in the presence region increases, which can substantially boost the loudness of such material. As you increase the gain reduction in the midrange bands (by turning the MB DRIVE control up), the MF GAIN control will have progressively less audible effect. The compressor for the midrange bands will tend to reduce the effect of the MF boost (in an attempt to keep the gain constant) to prevent excessive stridency in program material that already has a great deal of presence power. Therefore, with large amounts of gain reduction, the density of presence region energy will be increased more than will the level of energy in that region. Because the 3.7 kHz band compressor is partially coupled to the gain reduction in the 6.2 kHz band in

most presets, tuning MF FREQ to 2-4 kHz and turning up the MF GAIN control will decrease energy in the 6.2 kHz band—you will be increasing the gain reduction in both the 3.7 kHz and 6.2 kHz bands. You may wish to compensate for this effect by turning up the B4-B5 control.

Use the mid frequency equalizer with caution. Excessive presence boost tends to be audibly strident and fatiguing. Moreover, the sound quality, although loud, can be very irritating. We suggest a maximum of 2-3dB boost, although 10dB can be achieved.

High Frequency Parametric Equalizer is a parametric equalizer whose boost and cut curves closely emulate those of an analog parametric equalizer with conventional bell-shaped curves.

HIGH GAIN determines the amount of peak boost or cut over a ±10dB range.

HIGH FREQUENCY determines the center frequency of the equalization, in Hertz. The range is 2-20 kHz

HIGH WIDTH determines the bandwidth of the equalization, in octaves. The range is 0.3-2.0 octaves. If you are unfamiliar with using a parametric equalizer, 1 octave is a good starting point.

Excessive high frequency boost can exaggerate tape hiss and distortion in program material that is less than perfectly clean. We suggest no more than 4dB boost as a practical maximum, unless source material is primarily from compact discs of recently recorded material.

LOW PASS FILTER control sets the bandwidth (and therefore the amount of high frequency signal OPTIMOD-PC passes) from 4 kHz to 20 kHz. The lowpass filter can replace any anti-aliasing filters in downstream equipment. Set the filter to 20 kHz (full bandwidth) for downstream equipment with sample rates of 44.1 or 48 kHz. Set the filter to 15 kHz for 32 kHz sample rate. For other sample rates, set the filter so that it is as close as possible to 45% of the sample rate without exceeding 45%.

This setting is unique to the preset in which it resides. Regardless of its setting, OPTIMOD-PC will not permit the system bandwidth to exceed the bandwidth set by the MAX LOWPASS FILTER parameter located in the Configuration page of the I/O Mixer.

Multi-Band OUT Mix controls determine the relative balance of the bands in the multi-band compressor. Because these controls mix *after* the band compressors, they do not affect the compressors' gain reductions and can be used as a graphic equalizer to fine-tune the spectral balance of the program material over a ±3dB range.

Their range has been purposely limited because the only gain control element after these controls is the look-ahead limiter. Like a clipper, this circuit can produce considerable intermodulation distortion if overdriven. The thresholds of the individual compressors have been carefully tuned to prevent audible IM distortion with almost any program material. Large changes in the frequency balance of the compressor outputs will change this tuning, leaving OPTIMOD-PC more vulnerable to unexpected IM distortion with certain program material. Therefore you should make large changes in EQ with the bass and parametric equalizers, because

these are located *before* the compressors and the compressors will therefore protect the system from unusual overloads caused by the chosen equalization. Use the multi-band OUT mix controls only for fine-tuning.

The Two-Band Structure

The Two-Band structure consists of a slow two-band gated AGC (Automatic Gain Control) for gain riding, followed by a gated two-band compressor and a look-ahead limiter. Like the "2-Band Purist" structure in Orban's OPTIMOD-FM 8200, it is phase-linear throughout to maximize sonic transparency.

The Two-Band structure has an open, easy-to-listen-to sound that is similar to the source material if the source material is of good quality. However, if the spectral balance between the bass and high frequency energy of the program material is incorrect, the Two-Band structure (when its B2-B1 COUPLE control is operated toward 0%) can gently correct it without introducing obvious coloration.

The Two-Band structure is mainly useful for classical or "fine arts" programming that demands high fidelity to the original program source. Its two-band compressor and look-ahead limiter are identical to the Protection Limiter structure, although more controls are made available to the user.

Setting Up the Two-Band Structure

To set up the Two-Band structure for radio, recall preset 2B CLASSICAL for a "smooth," unprocessed-sounding quality, or 2B PROCESSED for a louder, more processed sound. Of course, you can modify any preset using the LESS-MORE control or using the Advanced Control screen, and you can then store the resulting modified preset as a User Preset for future recall at any time.

Note that choosing a conservative Multi-Band preset (like one of the POP presets or INSTRUMENTAL) will usually create an even more attractive, smooth, and consistent sound on pop music than will the Two-Band structure. Additionally, because each band in the Multi-Band structure handles a smaller part of the audio spectrum than each band in the Two-Band structure, the Multi-Band structure will create less spectral gain intermodulation when driven heavily. We therefore recommend using the Two-Band structure for purist jazz, classical or light classical music, or if your goal is to broadcast a sound that is more faithful to the frequency balances of the original program material than the sound produced by the Multi-Band structure.

Unlike the Two-Band structures in Orban's FM processors, OPTIMOD-PC's Two-Band structure does not reduce high frequency content because it has no high frequency limiter. (It is not required because digital broadcasting and netcasting do not use pre-emphasis.) Therefore, the Two-Band structure can be very useful if the broadcaster wants to preserve the spectral balance of the original program material. An example might be a "heritage rock" format where the broadcaster wants to transmit the original frequency balance of a mix that is very familiar to the audience.

For video, recall a VIDEO Two-Band preset that matches the program material. (See page 3-12).

Gain Reduction Metering

Unlike the metering on some processors, when any OPTIMOD-PC gain reduction meter indicates full-scale (at its bottom), it means that its associated compressor has run out of gain reduction range, that the circuitry is being overloaded, and that various nastinesses are likely to commence.

Because the compressor in the Two-Band structure has 24dB of gain reduction range, the meter should never come close to 24dB gain reduction if OPTIMOD-PC has been set up for a sane amount of gain reduction under ordinary program conditions.

But be aware of the different peak factors on voice and music—if voice and music are peaked identically on a VU meter, voice may cause up to 10dB more peak gain reduction than does music! (A PPM will indicate relative peak levels much more accurately.)

Using the Two-Band Structure for Classical Music

Classical music is traditionally broadcast with a wide dynamic range. However, with many recordings and live performances, the dynamic range is so great that the quiet passages disappear into the noise on most car, portable, and table radios. Consequently, the listener either hears nothing, or must turn up the volume control to hear all the music. Then, when the music gets loud, the radio blasts and distorts, making the listening rather unpleasant.

The Two-Band structure is well suited for classical formats during daytime hours when most people in the audience are likely to be listening in autos or to be using the station for background music. This audience is best served when the dynamic range of the program material is compressed 10-15dB so that quiet passages in the music never fade into inaudibility under these less favorable listening conditions. OPTIMOD-PC controls the level of the music in ways that are, for all practical purposes, inaudible to the listener. Low-level passages are increased in level by up to 10dB, while the dynamics of crescendos are maintained.

The 2B CLASSICAL preset is a two-band preset with the AGC turned OFF. It uses considerable bass coupling to preserve the spectral balance of the input as well as possible. Its LESS-MORE control primarily affects the amount of compression, rather than maximum loudness. It sounds essentially identical to the Protection Limiter structure.

During the evening hours when the audience is more likely to listen critically, a classical station may wish to switch to a custom preset (derived from the 2B CLASSICAL preset) that performs less gain reduction. You can create such a preset by modifying the 2B CLASSICAL preset with the LESS-MORE control—turn it down to taste.

The Two-Band Structure's Full Setup Controls

Table 3-5 shows a summary of the Two-Band controls. These controls are explained in detail below.

Each Two-Band Fixed Preset has a LESS-MORE control that adjusts on-air loudness. LESS-MORE simultaneously adjusts all of the processing controls to optimize the trade-offs between unwanted side effects as processing levels are decreased or increased.

You can adjust the ADVANCED CONTROL parameters to your own taste. Always start with LESS-MORE to get as close to your desired sound as possible. Then edit the ADVANCED CONTROL parameters using the Advanced Control screen, and save those edits to a User Preset.

2-BAND ADVANCED CONTROL				
Parameter Labels	**Units**	**Default**	**Range (CCW to CW)**	**Step**
AGC	---	off	off, on	---
AGC DRIVE	dB	(per L/M tables)	–10 … 0 … 25	1
AGC RELEASE	dB/S	(per L/M tables)	0.5, 1.0, 1.5, 2 … 20	1
AGC BASS COUPLING	%	(per L/M tabels)	0 … 100	5
AGC GATE THR	dB	(per L/M tables)	off, –44 … –15	1
MB DRIVE	dB	(per L/M tables)	0 … 25	1
2B RELEASE	dB/S	(per L/M tables)	0.5, 1.0, 1.5, 2 … 20	1
BASS COUPLING	%	(per L/M tables)	0 … 100	5%
BASS CLIP	dB	(per L/M tables)	–6.00 … 0.00	0.25
FINAL LIMT	dB	(per L/M tables)	0.00 … +6.00	0.25
AGC BASS THRESH	dB	(per L/M tables)	–15 … 0	0.25
LOW PASS FILTER	kHz	20	4.00 … 12.0, 13.0, 14.0, 15.0, 20.0	0.5

Table 3-5: Two-Band Controls

AGC on/off control activates or defeats the slow AGC prior to the two-band compressor.

AGC DRIVE control adjusts signal level going into the slow AGC, and therefore determines the amount of gain reduction in the AGC. This also adjusts the "idle gain"—the amount of gain reduction in the AGC section when the structure is gated. (It gates whenever the input level to the structure is below the threshold of gating.)

The total amount of gain reduction in the Two-Band structure is the sum of the gain reduction in the AGC and the gain reduction in the two-band compressor. The total gain reduction determines how much the loudness of quiet passages will be increased (and, therefore, how consistent overall loudness will be). It is determined by the setting of the AGC DRIVE control, by the level at which the console VU meter or PPM is peaked, and by the setting of the 2B DRIVE control, discussed below.

AGC RELEASE control determines how fast the AGC compressor releases. It is ordinarily operated in the slow end of its range to allow the AGC to do gentle gain riding. The two-band compressor does the hard work to increase program density (if desired). See 2B RELEASE (Two-Band Release), below, for a further discussion of release time.

AGC BASS COUPLING determines the amount of bass coupling in the two-band AGC. Because the AGC is generally operated slowly, one usually sets this control at 80% or higher to prevent the AGC from significantly changing the frequency balance of the program material. "Automatic equalization" is ordinarily done in the two-band compressor section following the AGC. For a further discussion see BASS COUPLING on page 3-22.

GATE THRESHOLD control determines the lowest input level that will be recognized as program by OPTIMOD-PC; lower levels are considered to be noise or background sounds, and cause the compressor to gate, effectively freezing its gain.

The two-band gain reduction will eventually recover to 0dB and the AGC gain reduction will eventually recover to –10dB even when the compressor gate is gated. However, recovery is slow enough to be imperceptible. This avoids OPTIMOD-PC's getting stuck with a large amount of gain reduction on a long, low-level musical passage immediately following a loud passage.

It is common to set the GATE THRESHOLD control to –40. Higher settings are primarily useful for radio drama, outside sports broadcasts, and other non-musical programming which contain ambiance, low-level crowd noise, and the like. Slightly higher settings may increase the musicality of the compression by slowing down recovery on moderate-level to low-level musical passages. When such passages cause the gate to cycle on and off, recovery time will be slowed down by the ratio of the "on time" to the "off time." This effectively slows down the release time as the input gets quieter and quieter, thus preserving musical values in material with wide dynamic range (classical music, for example).

2B DRIVE control adjusts signal level going into the two-band compressor, and therefore controls the density of output audio by determining the amount of gain reduction in the two-band compressor. The resulting sound texture can be open and transparent, solid and dense, or somewhere in between. The range is 0-25dB.

Regardless of the release time setting, we feel that the optimal amount of gain reduction in the two-band compressor for popular music and talk formats is 10-15dB. If less gain reduction is used, loudness can be lost. For classical formats, operating with 0-10dB of gain reduction (with the gain riding AGC set to OFF) maintains a sense of dynamic range while still controlling levels effectively. Because OPTIMOD-PC's density gently increases between 0 and 10dB of compression, 10dB of compression sounds very natural, even on classical music.

2B RELEASE (Two-Band Release) control determines how fast the two-band compressor releases (and therefore how quickly loudness increases) when the level of the program material decreases. It can be adjusted from 0.5 dB/second (slow) to 20 dB/second (fast). Settings toward 20 dB/second result in a more consistently loud

output, while settings toward 0.5 dB/second allow a wider variation of dynamic range. Both the setting of the 2B RELEASE control and the dynamics and level of the program material determine the actual release time of the compressor. In general, you should use faster release times for mass-appeal pop or rock formats oriented toward younger audiences, and slower release times for more conservative, adult-oriented formats (particularly if women are an important part of your target audience).

The action of the 2B RELEASE control has been optimized for resolution and adjustability. Its setting is critical to sound quality—listen carefully as you adjust it. There is a point beyond which increasing density (with faster settings of the 2B RELEASE control) will no longer yield more loudness, and will simply degrade the punch and definition of the sound.

When the 2B RELEASE control is set between 8 and 1 dB/second (the slowest settings), the amount of gain reduction is surprisingly non-critical. Gating prevents noise from being brought up during short pauses and pumping does not occur at high levels of gain reduction. Therefore, the primary danger of using large amounts of gain reduction is that the level of quiet passages in input material with wide dynamic range may eventually be increased unnaturally. Accordingly, when you operate the 2B RELEASE control between 8 and 1 dB/second, it may be wise to defeat the gain-riding AGC and to permit the two-band compressor to perform all of the gain riding. This will prevent excessive reduction of dynamic range, and will produce the most natural sound achievable from the Two-Band structures.

With faster 2B RELEASE control settings (above 8 dB/second), the sound will change substantially with the amount of gain reduction in the two-band compressor. This means that you should activate the gain-riding AGC to ensure that the two-band compressor is always being driven at the level that produces the amount of gain reduction desired. Decide based on listening tests how much gain reduction gives you the density that you want without creating a feeling of over-compression and fatigue.

> Release in the two-band compressor automatically becomes faster as more gain reduction is applied (up to about 10dB). This makes the program progressively denser, creating a sense of increasing loudness although peaks are not actually increasing. If the gain-riding AGC is defeated (with the AGC ON/OFF control), you can use this characteristic to preserve some feeling of dynamic range. Once 10dB of gain reduction is exceeded, full loudness is achieved—no further increase in short-term density occurs as more gain reduction is applied. This avoids the unnatural, fatiguing sound often produced by processors at high gain reduction levels, and makes OPTIMOD-PC remarkably resistant to operator gain-riding errors.

BASS COUPLING control is used to set the balance between bass and the rest of the frequency spectrum.

The two-band compressor processes audio in a master band for all audio above approximately 200Hz, and a bass band for audio below approximately 200Hz. The BASS COUPLING control determines how closely the on-air balance of material below 200Hz matches that of the program material above 200Hz.

Settings toward 100% (wideband) make the output sound most like the input. Because setting the BASS COUPLING control at 100% will sometimes cause bass loss, the most accurate frequency balance will often be obtained with this control between 70% and 90%. The optimal setting depends on the amount of gain reduction applied. Adjust the BASS COUPLING control until the band 1 and band 2 GAIN REDUCTION meters track as closely as possible.

With the 2B RELEASE (Two-Band Release) control set to 2dB/second, setting the BASS COUPLING control toward 0% (independent) will produce a sound that is very open, natural, and non-fatiguing, even with large amounts of gain reduction. Such settings will provide a bass boost on some program material that lacks bass.

With fast release times, settings of the BASS COUPLING toward 100% (wideband) do not sound good. Instead, set the BASS COUPLING control toward 0% (independent). This combination of fast release and independent operation of the bands provides the maximum loudness and density on small radios achievable by the Two-Band structure. But such processing may fatigue listeners with high-quality receivers, and also requires you to activate the AGC to control the average drive level into the two-band compressor, preventing uncontrolled build-up of program density. Instead of operating the Two-Band structure like this, you should almost always choose a Multi-Band preset instead.

BASS CLIP threshold controls Orban's patented embedded bass clipper. It is embedded in the multi-band crossover so that harmonics created by clipping are rolled off by part of the crossover filters. The threshold of this clipper is ordinarily set between 4dB and 6dB below the threshold of the final limiter in the processing chain, depending on the setting of the LESS-MORE control in the parent preset upon which you are basing your ADVANCED CONTROL adjustments. This provides headroom for contributions from the other four bands, so that bass transients don't smash against the look-ahead limiter, causing overt intermodulation distortion between the bass and higher frequency program material.

Some OPTIMOD-PC users feel that the bass clipper unnecessarily reduces bass punch at its factory settings. To accommodate these users, the threshold of the bass clipper is user-adjustable. The range (with reference to the look-ahead limiter threshold) is zero to –6dB. As you raise the threshold of the clipper you will get more bass but also more distortion and pumping. Be careful when setting this control; do not adjust it casually. Listen to program material with heavy bass combined with spectrally sparse midrange material (like a singer) and listen for IM distortion induced by the bass' pushing the midrange into the look-ahead limiter. In general, unless you have a very good reason to set the control elsewhere, we recommend leaving it at the factory settings, which were determined as a result of extensive listening tests with many types of critical program material.

FINAL LIMIT adjusts the level of the audio driving the look-ahead limiter that OPTIMOD-PC uses to control fast peaks, and then adjusts the peak-to-average ratio. The loudness/distortion trade-off is primarily determined by the FINAL LIMIT control.

Turning up the FINAL LIMIT control drives the look-ahead limiter harder, reducing the peak-to-average ratio, and increasing the loudness on the air. When the amount of

limiting is increased, the audible distortion caused by limiting is increased. Lower settings reduce loudness, of course, but result in a cleaner sound.

> You may find it illuminating to recall several Fixed Presets, adjust LESS-MORE to several points in its range, and then open the Advanced Control screen to examine the trade-offs between the release time and FINAL LIMIT drive made by the factory programmers.

The Multi-Band Structure

The Multi-Band structure consists of a slow gain-riding two-band AGC, a three-band parametric equalizer, a five-band compressor, a dynamic single-ended noise reduction system, an output mixer (for the five bands), and a look-ahead limiter.

Unlike the Two-Band structure, whose two-band compressor has a continuously variable release time, the release time of the multi-band compressor is switchable to four settings: SLOW, MSLOW (medium-slow), MFAST (medium-fast), and FAST. Each setting makes a very significant difference in the overall flavor and quality of the sound.

When the input is noisy, you can sometimes reduce the noise by activating the single-ended noise reduction system. Functionally, the single-ended noise reduction system combines a broadband downward expander with a program-dependent low-pass filter. This noise reduction can be valuable in reducing audible hiss, rumble, or ambient studio noise on-air.

The Multi-Band structure does not have a Loudness Controller because its "automatic re-equalization" function will almost always smooth out loudness differences between one piece of program material and the next. Therefore, video users will find that the Multi-Band structure usually controls loudness well enough to prevent commercials from becoming obtrusively loud.

Activating the Multi-Band Structure

The Multi-Band structure is very flexible, enabling you to fine-tune your on-air sound to complement your programming. There are numerous Fixed Programming Presets (shown in the "radio" table on page 3-10 and the "video" table on page 3-12, and described in detail immediately thereafter) whose names are the same as common radio and video programming formats. They offer considerable variety, with various combinations of release time, equalization, low frequency coupling, and high frequency coupling.

Start with one of these presets. Spend some time listening critically to your on-air sound. Listen to a wide range of program material typical of your format, and listen on several types of radios (not just on your studio monitors). Then, if you wish, customize your sound using the information in "Customizing the Settings," which follows.

Customizing the Settings

The LESS-MORE control can edit each of these presets to optimize the trade-off between loudness and distortion according to the needs of the format. They can be further edited with ADVANCED CONTROL to fine-tune them.

The controls in the Multi-Band structure give you the flexibility to customize your station sound. Nevertheless, as with any audio processing system, proper adjustment of these controls requires proper balancing of the trade-offs between loudness, density, and audible distortion. The following provides the information you need to adjust the Multi-Band structure controls to suit your format, taste, and competitive situation.

The Multi-Band Structure's Full Setup Controls

Table 3-6 shows a summary of the Multi-Band controls. These controls are explained in detail below.

Each Multi-Band Fixed Preset has a LESS-MORE control that adjusts on-air loudness by altering the amount of processing. LESS-MORE simultaneously adjusts various processing controls to optimize the trade-offs between unwanted side effects.

You can adjust the ADVANCED CONTROL parameters to your own taste. Always start with LESS-MORE to get as close to your desired sound as possible. Then edit the ADVANCED CONTROL parameters using the Advanced Control screen, and save those edits to a User Preset.

AGC ON/OFF control activates or defeats the slow AGC prior to the multi-band compressor.

AGC DRIVE control adjusts signal level going into the slow AGC, and therefore determines the amount of gain reduction in the AGC. This also adjusts the "idle gain"—the amount of gain reduction in the AGC section when the structure is gated. (It gates whenever the input level to the structure is below the threshold of gating, as set by the GATE THRESHOLD control.)

The total amount of gain reduction in the Multi-Band structure is the sum of the gain reduction in the AGC and the gain reduction in the multi-band compressor. The total system gain reduction determines how much the loudness of quiet passages will be increased (and, therefore, how consistent overall loudness will be). It is determined by the setting of the AGC DRIVE control, by the level at which the console VU meter or PPM is peaked, and by the setting of the MB DRIVE (compressor) control.

AGC RELEASE (AGC Release) control provides an adjustable range from 0.5dB/second (slow) to 20dB/second (fast). The increase in density caused by setting the AGC RELEASE control to fast settings sounds different than the increase in density caused by setting the MB RELEASE control to FAST, and you can trade the two off to produce different effects.

MULTI-BAND ADVANCED CONTROL				
Parameter Labels	**Units**	**Default**	**Range (CCW to CW)**	**Step**
AGC	---	on	off, on	---
AGC DRIVE	dB	(per L/M tables)	–10 … +25	1
AGC RELEASE	dB/S	(per L/M tables)	0.5, 1.0, 1.5, 2 … 20	1
AGC BASS COUPLING	%	(per L/M tables)	0 … 100	5
AGC BASS THRESH	dB	(per L/M tables)	–12.0 … 2.5	1
BASS CLIP	dB	(per L/M tables)	–6.00 … 0.00	0.25
AGC GATE THRESHOLD	dB	(per L/M tables)	off, –44 … –15	1
MB DRIVE	dB	(per L/M tables)	0 … 25	1
MB RELEASE	---	(per L/M tables)	slow, mslow, mfast, fast	---
B1 DELTA RELEASE	---	(per L/M tables)	–6 … 6	1
B2 DELTA RELEASE	---	(per L/M tables)	–6 … 6	1
B3 DELTA RELEASE	---	(per L/M tables)	–6 … 6	1
B4 DELTA RELEASE	---	(per L/M tables)	–6 … 6	1
B5 DELTA RELEASE	---	(per L/M tables)	–6 … 6	1
B2-B1 COUPLE	%	(per L/M tables)	0 … 100	5
B3-B4 COUPLE	%	(per L/M tables)	0 … 100	5
B4-B5 COUPLE	%	(per L/M tables)	0 … 100	5
B1 ATTACK	---	(per L/M tables)	4 … 19, Off	---
B2 ATTACK	---	(per L/M tables)	4 … 19, Off	---
B3 ATTACK	---	(per L/M tables)	4 … 19, Off	---
B4 ATTACK	---	(per L/M tables)	4 … 19, Off	---
B5 ATTACK	---	(per L/M tables)	4 … 19, Off	---
DOWNWARD EXPANDER	dB	(per preset)	off, –6 … +12	0.5
LOW PASS FILTER	kHz	20	4.00 … 12.0, 13.0, 14.0, 15.0, 20.0	0.5
FINAL LIMT	dB	(per L/M tables)	0.00 … 6.00	0.25
B1 INPUT DRIVE	dB	0	–3 … 3	0.1
B2 INPUT DRIVE	dB	0	–3 … 3	0.1
B3 INPUT DRIVE	dB	0	–3 … 3	0.1
B4 INPUT DRIVE	dB	0	–3 … 3	0.1
B5 INPUT DRIVE	dB	0	–3 … 3	0.1
B1 OUTPUT MIX	dB	+0.0	–3.0 … +3.0	0.1
B2 OUTPUT MIX	dB	+0.0	–3.0 … +3.0	0.1
B3 OUTPUT MIX	dB	+0.0	–3.0 … +3.0	0.1
B4 OUTPUT MIX	dB	+0.0	–3.0 … +3.0	0.1
B5 OUTPUT MIX	dB	+0.0	–3.0 … +3.0	0.1
B1 COMP THRESH	dB	(per L/M tables)	–16 … off	0.25
B2 COMP THRESH	dB	(per L/M tables)	–16 … off	0.25
B3 COMP THRESH	dB	(per L/M tables)	–16 … off	0.25
B4 COMP THRESH	dB	(per L/M tables)	–16 … off	0.25
B5 COMP THRESH	dB	(per L/M tables)	–16 … off	0.25
LESS-MORE	---	(per preset)	***(read-only)***	---
PARENT PRESET	---	(per preset)	***(read-only)***	---

Table 3-6: Multi-Band Controls

Unless it is purposely speeded-up (with the AGC MB RELEASE control), the automatic gain control (AGC) that occurs in the AGC prior to the multi-band compressor makes audio levels more consistent without significantly altering texture. Then the multi-band compression and associated multi-band clipper audibly change the density of the sound and dynamically re-equalize it as necessary (booming bass is tightened; weak, thin bass is brought up; highs are always present and consistent in level).

The various combinations of AGC and compression offer great flexibility:

- Light AGC + light compression yields a wide sense of dynamics, with a small amount of automatic re-equalization.

- Moderate AGC + light compression produces an open, natural quality with automatic re-equalization and increased consistency of frequency balance.

- Moderate AGC + moderate compression gives a more dense sound, particularly as the release time of the multi-band compressor is sped up.

- Moderate AGC + heavy compression (particularly with a FAST multi-band release time) results in a "wall of sound" effect, which may cause listener fatigue.

Adjust the AGC (with the AGC DRIVE control) to produce the desired amount of AGC action, and then fine-tune the compression and clipping with the Multi-Band structure's controls.

AGC BASS COUPLING (AGC Bass Coupling) determines the amount of bass coupling in the two-band AGC. Because the AGC is generally operated slowly, one usually sets this control at 80% or higher to prevent the AGC from significantly changing the frequency balance of the program material. "Automatic equalization" is ordinarily done in the two-band compressor section following the AGC. For a further discussion, see BASS COUPLING on page 3-22.

AGC BASS THRESH determines the compression threshold of the bass band in the AGC. It can be used to set the target spectral balance of the AGC.

As the AGC BASS COUPLING control is moved towards "100%," the AGC BASS THRESH control affects the sound less and less.

> The interaction between the AGC BASS THRESH control and the AGC BASS COUPLING control is a bit complex, so we recommend leaving the AGC BASS THRESH control at its factory setting unless you have a good reason for readjusting it.

BASS CLIP threshold controls Orban's patented embedded bass clipper. It is embedded in the multi-band crossover so that harmonics created by clipping are rolled off by part of the crossover filters. The threshold of this clipper is ordinarily set between 4dB and 6dB below the threshold of the final limiter in the processing chain, depending on the setting of the LESS-MORE control in the parent preset upon which you are basing your ADVANCED CONTROL adjustments. This provides headroom for contributions from the other four bands, so that bass transients do not smash

against the look-ahead limiter, causing overt intermodulation distortion between the bass and higher frequency program material.

Some OPTIMOD-PC users feel that the bass clipper unnecessarily reduces bass punch at its factory settings. To accommodate these users, the threshold of the bass clipper is user-adjustable. The range (with reference to the look-ahead limiter threshold) is 0 to –6dB. As you raise the threshold of the clipper, you will get more bass but also more distortion and pumping. Be careful when setting this control; do not adjust it casually. Listen to program material with heavy bass combined with spectrally sparse midrange material (like a singer accompanied by a bass guitar) and listen for IM distortion induced by the bass' pushing the midrange into the look-ahead limiter. In general, unless you have a very good reason to set the control elsewhere, we recommend leaving it at the factory settings, which were determined by extensive listening tests with many types of critical program material.

GATE THRESHOLD (Gate Threshold) control determines the lowest input level that will be recognized as program by OPTIMOD-PC; lower levels are considered to be noise or background sounds, and cause the AGC to gate, effectively freezing gain to prevent noise breathing.

The gate causes the gain reduction in bands 2 and 3 of the multi-band compressor to move quickly to the average gain reduction occurring in those bands when the gate first turns on. This prevents obvious midrange coloration under gated conditions because bands 2 and 3 have the same gain.

The gate also independently freezes the gain of the two highest frequency bands (forcing the gain of the highest frequency band to be identical to its lower neighbor), and independently sets the gain of the lowest frequency band according to the setting of the DJ BASS boost control (in the Equalization screen). Thus, without introducing blatant coloration, the gating smoothly preserves the average overall frequency response "tilt" of the multi-band compressor, broadly maintaining the "automatic equalization" curve it generates for a given piece of program material.

MB DRIVE (Multi-Band Drive) control adjusts the signal level going into the multi-band compressor, and therefore determines the average amount of gain reduction in the multi-band compressor. Range is 25dB.

Adjust the MB DRIVE control to your taste and format requirements. Used lightly with a SLOW or MSLOW (medium-slow) multi-band release time, the multi-band compressor produces an open, re-equalized sound. The multi-band compressor can increase audio density when operated at FAST or MFAST (medium-fast) release times because it acts more and more like a fast limiter (not a compressor) as the release time is shortened. With FAST and MFAST (medium-fast) release times, density also increases when you increase the drive level into the multi-band compressor because these faster release times produce more limiting. Increasing density can make sounds seem louder, but can also result in an unattractive busier, flatter, or denser sound. It is very important to be aware of the many negative subjective side effects of excessive density when setting controls that affect the density of the processed sound.

The MB DRIVE interacts with the MB RELEASE (Multi-Band Release) setting With slower release time settings, increasing the MB DRIVE control scarcely affects density. Instead, the primary danger is that the excessive drive will cause noise to be excessively increased when the program material becomes quiet.

> You can minimize this effect by carefully setting the GATE THRESHOLD (Gate Threshold) control to "freeze" the gain when the input gets quiet and/or by activating the single-ended noise reduction.

When the release time of the multi-band compressor is set to FAST, or MFAST, the setting of the MB DRIVE control becomes much more critical to sound quality because density increases as the control is turned up. Listen carefully as you adjust it. With these fast release times, there is a point beyond which increasing multi-band compressor drive will no longer yield more loudness, and will simply degrade the punch and definition of the sound.

We recommend no more than 10dB gain reduction as shown on the meters for band 3. More than 10dB, particularly with the FAST release time, will often create a "wall of sound" effect that many find fatiguing.

> To avoid excessive density with the FAST multi-band release time, we recommend using no more than 5dB gain reduction in band 3, and compensating for any lost loudness by speeding up the AGC MB RELEASE instead. This is what we did in the fixed LESS-MORE presets for the FAST multi-band release time.

MB Release (Multi-Band Release) control can be switched to any one of seven settings:

> The **Slow** settings produce a very punchy, clean, open sound that is ideal for Adult Contemporary, Soft Rock, Soft Urban, New Age, and other adult-oriented formats whose success depends on attracting and holding audiences for very long periods. The SLOW and SLOW2 settings produce an unprocessed sound with a nice sense of dynamic range. With these settings, the Five-Band structure provides gentle automatic equalization to keep the frequency balance consistent from record to record (especially those recorded in different eras). And for background music formats, these settings ensure that your sound doesn't lose its highs and lows. Because it creates a more consistent frequency balance between different pieces of source material than does the Two-Band structure, SLOW is usually preferable to the Two-Band structure for any popular music format.
>
> The **Medium Slow** settings (MED and MED2) are appropriate for more adult-oriented formats that need a glossy show-business sound, yet whose ratings depend on maintaining a longer time spent listening than do conventional Contemporary Hit Radio (CHR) formats. With the single-ended noise reduction activated, it is also appropriate for Talk and News formats. This is the sound texture for the station that values a clean, easy-to-listen-to sound with a tasteful amount of punch, presence, and brightness added when appropriate. This is an unprocessed sound that sounds

sounds just right on music and voice when listened to on small table radios, car radios, portables, or home hi-fi systems.

The **Medium Fast** settings (MFAST and MFAST2) are ideal for a highly competitive Contemporary Hit Radio (CHR) format whose ratings depend on attracting a large number of listeners (high "cume") but which does not assume that a listener will listen to the station for hours at a time. This is the major market competitive sound, emphasizing loudness as well as clean audio. The sound from cut to cut and announcer to announcer is remarkably consistent as the texture of music is noticeably altered to a standard. Bass has an ever-present punch, there is always a sense of presence, and highs are in perfect balance to the mids, no matter what was on the original recording.

The **Fast** setting is used only for the TALK and SPORTS Fixed Programming Presets. Processing for this sound keeps the levels of announcers and guests consistent, pulls low-grade telephone calls out of the mud, and keeps a proper balance between voice and commercials. Voice is the most difficult audio to process, but these settings result in a favorable trade-off between consistency, presence, and distortion.

> The Fixed Presets for this sound are quite different than for the other three release time settings. The amount of gain reduction in the multiband compressor is substantially lower (so that it operates more like a limiter than like a compressor), and the release time of the gain-riding AGC is speeded up (so that it provides compression and some increase of density). We made these trade-offs to prevent excessive build-up of density.

There is nothing written in stone saying that you can't experiment with this sound for music-oriented programming as well. However, even with these settings, your sound is getting farther away from the balance and texture of the input. We think that this is as far as processing can go without causing unacceptable listener fatigue. However, this sound may be quite useful for stations that are ordinarily heard very softly in the background because it improves intelligibility under these quiet listening conditions. Stations that are ordinarily played louder will probably prefer one of the slower release times, where the multiband compressor takes more gain reduction and where the AGC is operated slowly for gentle gain riding only. These slower sounds are less consistent than those produced by the FAST setting. Using SLOW preserves more of the source's frequency balance, making the sound less dense and fatiguing when the radio is played loudly.

DELTA RELEASE controls are differential controls. They allow you to vary the release time in any band of the Five-Band compressor/limiter by setting an offset between the MB RELEASE setting and the actual release time you achieve in a given band. For example, if you set the MB RELEASE control to medium-fast and the BAND 3 DELTA GR control to –2, then the band 3 release time will be the same as if you had set the MB RELEASE control to medium and set the BAND 3 DELTA GR control to 0. Thus, your settings automatically track any changes you make in the MULTIBAND RELEASE control. In our example, the release time in band 3 will always be two "click stops" slower than the setting of the MB RELEASE control.

> If your setting of a given DELTA RELEASE control would otherwise create a release slower than "slow" or faster than "fast" (the two end-stops of the MB RELEASE control), the band in question will instead set its release time at the appropriate end-stop.

B2-B1 COUPLE (Band 2 to Band 1 Coupling) control determines the extent to which the gain of band 1 (below 100Hz) is determined by and follows the gain of band 2 (centered at 400Hz). Set towards 100% (fully coupled) it reduces the amount of dynamic bass boost, preventing unnatural bass boost in light pop and talk formats. Set towards 0% (independent), it permits frequencies below 100Hz (the "slam" region) to have maximum impact in modern rock, urban, dance, rap, and other music where bass punch is crucial. The default setting is 30%.

B3-B4 COUPLE (Band 3 to Band 4 Coupling) control determines the extent to which the gain of band 4 (centered at 3.7 kHz) is determined by and follows the gain of band 3 (centered at 1 kHz). Set towards 100% (fully coupled) it reduces the amount of dynamic upper midrange boost, preventing unnatural upper midrange boost in light pop and instrumental formats.

B4-B5 COUPLE (Band 4 to Band 5 Coupling) control determines the extent to which the gain of band 5 (above 6.2 kHz) is determined by and follows the gain of band 4 (centered at 3.7 kHz). Set towards 100% (fully coupled) it reduces the amount of dynamic HF boost, preventing unnatural HF boost in light pop and instrumental formats.

> When combined with the B3-B4 COUPLE control, this control can adjust the multi-band processing to be anything from full five-band to quasi-three-band processing. The two upper coupling controls are useful when you want to control the amount of overall "automatic equalization" in the midrange and high frequency region. This can prevent the sound from becoming strident or overly bright and is particularly useful with formats designed to attract a female audience. The INSTRUMENTAL and POP presets use large amounts of coupling for this reason.

Bx COMP THRESH (Band x Compression Threshold) control determines the threshold of compression in each band compressor. A given band's setting determines the input level where this band's compressor starts to produce gain reduction. It also determines the relative output level of each band above this threshold. Together, these controls therefore determine the relative spectral balance produced by the processing when all bands are producing gain reduction. To reduce the contribution of a given band, set its threshold control more negative.

Special Note for the Band 5 Threshold control: The Fixed Presets were tuned to prevent sibilance on live voice from becoming too harsh-sounding. However, this requires setting the threshold of the band 5 compressor (which affects 6.2 kHz and above) quite low so it can act as a de-esser. A side effect is that some brightly-mixed music can be audibly rolled off by the action of band 5.

If you are willing put some effort into tuning your microphone channel to tame sibilance at the source, you can achieve a brighter sound on-air by raising the band 5 threshold (B5 COMP THRESH). A number of manufacturers make all-in-one microphone processors that include de-essers. If you use one of these with the de-esser set

aggressively, you should be able to advance the B5 COMP THRESH control by several dB without causing any problems. Listen to sibilance on live voice when making your final decision; make sure that it does not sound unpleasantly harsh or "spitty."

> As of this writing, dbx (www.dbxpro.com) makes an inexpensive, good sounding mic processor called the 286A. It contains a mic preamp, a compressor, a de-esser, a dynamic high frequency enhancer, and a low frequency equalizer. Its only potential drawbacks are that it has an unbalanced output and no special RFI suppression, so it is best suited for studio sites that are not co-located with high-powered transmitters.

BANDx INPUT DRIVE controls determine the relative balance of the bands in the multiband compressor. These controls mix before the band compressors and therefore affect the compressors' gain reductions. These controls can be used as a graphic equalizer to fine-tune the spectral balance of the program material over a ±3dB range. They are mainly effective when the multiband compressors are producing little or no gain reduction because the compressors will tend to "fight" the settings as more compression is used.

> Above threshold, you can set the spectral balance of the bands with the individual band compression threshold controls.

DOWNWARD EXPANDER (Downward Expander Threshold) control determines the level below which the single-ended noise reduction system's downward expander begins to decrease system gain, and below which the high frequencies begin to become low-pass filtered to reduce perceived noise. Activate the single-ended dynamic noise reduction by setting the DOWNWARD EXPANDER control to a setting other than OFF.

The single-ended noise reduction system combines a broadband downward expander with a program-dependent low-pass filter. These functions are achieved by causing extra gain reduction in the multi-band compressor. You can see the effect of this extra gain reduction on the gain reduction meters.

Ordinarily, the gating on the AGC and multi-band limiter will prevent objectionable build-up of noise, and you will want to use the single-ended noise reduction only on unusually noisy program material. Modern commercial recordings will almost never need it. We expect that its main use will be in talk-oriented programming, including sports.

Please note that it is impossible to design such a system to handle all program material without audible side effects. You will get best results if you set the DOWNWARD EXPANDER control of the noise reduction system to complement the program material you are processing. The DOWNWARD EXPANDER should be set higher when the input is noisy and lower when the input is relatively quiet. The best way to adjust the DOWNWARD EXPANDER control is to start with the control set very high. Reduce the control setting while watching the gain reduction meters. Eventually, you will see the gain increase in sync with the program. Go further until you begin to hear noise modulation—a puffing or breathing sound (the input noise) in sync with the input program material. Set the DOWNWARD EXPANDER control higher until you can no longer hear the noise modulation. This is the best setting.

Obviously the correct setting will be different for a sporting event than for classical music. It may be wise to define several presets with different settings of the DOWNWARD EXPANDER control, and to recall the preset that complements the program material of the moment.

Note also that it is virtually impossible to achieve undetectable dynamic noise reduction of program material that is extremely noisy to begin with, because the program never masks the noise. It is probably wiser to defeat the dynamic noise reduction with this sort of material (traffic reports from helicopters and the like) to avoid objectionable side effects. You must let your ears guide you.

B1-B5 ATTACK (Time) controls set the speed with which the gain reduction in each band responds to level changes at the input to a given band's compressor. These controls are tricky to adjust appropriately and affect the sound of the processor in many subtle ways. The main trade-off is "punch" (achieved with slower attack times) versus distortion and/or pumping produced in the final look-ahead limiter system (because slower attack times increase overshoots that must be eliminated in the look-ahead limiter). The results are strongly program-dependent, and must be verified with listening tests to a wide variety of program material.

The ATTACK time controls are calibrated in arbitrary units. Higher numbers correspond to slower attacks.

FINAL LIMIT control adjusts the level of the audio driving the look-ahead limiter that OPTIMOD-PC uses to control fast peaks, thereby adjusting the peak-to-average ratio of the processed audio. The loudness/distortion trade-off is primarily determined by the FINAL LIMIT control.

Turning up the FINAL LIMIT control drives the look-ahead limiter harder, reducing the peak-to-average ratio, and increasing the loudness on the air. When the amount of limiting is increased, the audible intermodulation distortion caused by limiting is increased. Lower settings reduce loudness, of course, but result in a cleaner sound.

If the MB RELEASE control is set to FAST or MFAST (medium-fast), intermodulation distortion in the look-ahead limiter will increase as the MB DRIVE control is advanced, and the FINAL LIMIT it control may have to be turned down to compensate. To best understand how to make loudness/distortion trade-offs, perhaps the wisest thing to do is to recall a fixed multi-band preset, and then to adjust the LESS-MORE control to several settings throughout its range. At each setting of the LESS-MORE control, examine the settings of the MB DRIVE control, the FINAL LIMIT control, and the FINAL CLIPPING DRIVE control. (You can see them by calling up the Advanced Control screen by pressing the ADVANCED CONTROL soft key.) This way, you can see how the factory programmers made the trade-offs between the settings of the various distortion-determining controls at various levels of processing.

Test Modes

(Note: Test Modes may not be available in the software version you are using; they are not available in Version 1.0 software. We expect to add them in a future upgrade.)

OPTIMOD-PC has a built-in test tone generator to allow system testing, which is available from the TEST TONE preset. It also has a BYPASS preset with adjustable gain.

> The oscillator's output appears at both audio processing outputs in the output routing switcher. It does not appear at the direct WAVE output or the output of the unprocessed mixer.
>
> The BYPASS preset connects the audio processor's input to both audio processing outputs. The user can set the bypass gain.

To activate a test tone or to bypass the processing, put the appropriate preset on-air. You can adjust the parameters (such as BYPASS GAIN) through BASIC MODIFY or ADVANCED MODIFY; both have the same set of controls available. You can also save a modified preset as a user preset (just as you can with any other preset) and then recall it manually or through automation. This can facilitate automated system testing.

The table shows the test modes available in detail:

SETUP: TEST				
Parameter Labels	**Units**	**Default**	**Range (CCW to CW)**	**Step**
MODE	---	operate	operate, bypass, tone	---
BYPASS GAIN	dB	0.0	–18 … +15	1
TONE FREQ	Hz	400	**For DO RATE = 44.1 or 48 kHz:** 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000, 10000, 12500, 15000, 16000, 20000 **For DO RATE = 32 kHz:** 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000, 10000, 12500, 15000	LOG
TONE LVL	%	100	0 … 100	1
TONE CHAN	---	l+r	l+r, l–r, l; r	---

Table 3-7: Test Modes

If the Host Computer Restarts or Crashes...

When you are using OPTIMOD-PC's hardware inputs and outputs (that is, when OPTIMOD-PC is emulating a stand-alone audio processor), OPTIMOD-PC is designed to gracefully handle problems that occur in the host computer:

- If the host computer is restarted in an orderly way (using Windows' "restart" command), OPTIMOD-PC will continue to process audio normally through its hardware inputs and outputs with no gaps or interruptions.
- If the host computer crashes, OPTIMOD-PC will usually continue to pass signal normally through its hardware inputs and outputs because its processing is done with onboard DSP, independent of the computer's CPU or operating system. When you finally reset the host computer to recover from the crash (either via a hardware reset or Ctrl-Alt-Del), OPTIMOD-PC will also reset and will temporarily load unity-gain bypass DSP code. This will cause a mute lasting a fraction of a second. OPTIMOD-PC will then continue to pass signal through this bypass code until its driver has loaded, at which point the driver will load normal audio processing DSP code into OPTIMOD-PC. After another fraction-of-a-second mute to accommodate the load, OPTIMOD-PC will now operate normally, using the same preset that was on-air before the crash.

See *About the OPTIMOD-PC Driver and Service* on page 2-38.

Using OPTIMOD-PC for Mastering

OPTIMOD-PC can be a useful tool for mastering applications in the professional audio industry, such as preparation of equalized, level-controlled, peak limited CD masters. We have frequently used OPTIMOD-PC in this context, achieving excellent results.

Because of their broadcast origins, most of OPTIMOD-PC's presets provide more processing than would ordinarily be required for mastering. In addition, we would expect that the mastering engineer would want to carefully tweak a preset to complement the program material being mastered.

You cannot create a preset "from scratch"; you must create it by modifying an existing preset. Each preset has an "easy adjustment" facility called LESS-MORE, which is a one-knob provision for turning the amount of processing up or down.

Systematically, the following is a good method for creating mastering presets. It assumes that you have already set the processed mixer controls to achieve normal drive levels.

A) Decide whether you are going to use two-band or five-band processing.

> Two-band processing retains any fixed equalization originally applied to the program (except for a mild amount of dynamic adjustment to bass below 150Hz); five-band processing performs an "automatic re-equalization" function. Both flavors of processing can be extremely smooth and unobtrusive.

B) If you are going to use two-band processing, recall the 2B CLASSICAL preset. If you are going to use five-band processing, recall the POP MEDIUM preset.

C) In the Edit/Basic Control screen, adjust LESS-MORE to 1.0 (the lowest setting).

D) Choose Edit/Advanced Control to access the individual processing settings.

E) If you are using five-band processing, set the AGC to OFF (unless you need a very large amount of compression; an example is material intended for in-flight entertainment systems). If you have chosen the CLASSICAL preset for two-band processing, the AGC will already be off.

F) Unless you will be using a large amount of compression for special applications, set the GATE THRESHOLD to OFF.

G) Adjust the 2B DRIVE control (two-band) or MB DRIVE control (five-band) to achieve the desired amount of multiband gain reduction.

H) Adjust the release time control (2B RELEASE or MB RELEASE) to achieve the desired compression density.

> The release characteristic is always "automatic" (i.e., multiple time constant), and the RELEASE control simply scales this process. This, combined with multiband operation, makes the compression remarkably resistant to the usual compressor pumping and squashing.

I) Adjust equalization as necessary.

> As discussed above, there is fixed equalization available between the AGC and multiband compressor. In five-band mode, there is also a five-band graphic equalizer before the multiband compressor, and a threshold control for each band compressor. In five-band mode, any fixed equalization will be partially "undone" by the dynamic re-equalization effect of the multiband compression, so two-band mode is most useful when you are relying on OPTIMOD-PC's fixed EQ, or on external EQ earlier in the signal path.
>
> Note also that you can use the individual band compression threshold controls, the BASS COUPLING control, and HF COUPLING control to affect the amount of automatic re-equalization performed by the multiband compression. As you set these controls closer to 100%, they permit progressively less dynamic LF and HF program-adaptive boost. If you feel that the dynamic re-equalization is not producing enough brightness when the program material lacks high frequencies, you should turn the BAND 3>4 and BAND 4>5 COUPLING closer to 0%. Similarly, if weak bass is not sufficiently boosted, turn the BAND 2>1 COUPLING closer to 0%.

J) Set the amount of peak limiting with the FINAL LIMIT control.

In general, the less peak limiting you use, the better sounding the result will be. However, if your client demands a "loud" CD, OPTIMOD-PC's look-ahead peak limiter is a powerful tool for achieving this with minimum distortion or other side effects. Nevertheless, be aware that this function is not like some familiar "look-ahead" limiters. The release time is in the order of a few milliseconds and is not user adjustable. The purpose of the limiter is *only* to limit peaks that pass through the earlier compressors because of their finite attack times. Functionally it is used like a peak clipper, but it has vastly reduced modulation distortion by comparison to a clipper, whether "soft knee" or "hard knee."

The main potential side-effect of the look-ahead limiter is a "warbling" sound in the midrange when heavy bass is simultaneously present. Listen carefully for this intermodulation effect (particularly on vocals) when you are adjusting the FINAL LIMIT control.

K) Adjust the BASS CLIP control to complement the amount of final limiting.

For most mastering applications, you can set it at "0dB," which essentially defeats it. However, if you hear pumping or distortion in the look-ahead limiter caused by heavy bass transients, you can reduce this effect by setting the BASS CLIP to a lower level. (The BASS CLIP control is calibrated in "dB below the final limiter threshold.")

L) If you wish to compare your processed sound to the unprocessed original, recall the BYPASS preset and toggle between it and your processing preset. If there is a gross loudness disparity, you may wish to edit the gain within the BYPASS preset and save this as a user preset. However, be careful not to clip the output if you set the bypass for gain.

You can determine whether you are clipping by observing the level meter in the OUTPUT page of the mixer.

M) Save your preset using File/Save Preset.

Once you have created one "mastering" preset, you can edit it to create others and save them under different names.

N) For a 44.1 kHz output sample rate, set the digital output level to –0.5dBfs; this will prevent overshoots caused by sample rate conversion. For a 48 kHz output sample rate, set the digital output level to –0.1dBfs.

At 44.1 kHz, the output samples are not exactly the same ones that the look-ahead limiter controlled at the internal 48 kHz sample rate, so slight overshoot can occur. At 48 kHz output sample rate, overshoot will be less than 0.1dB.

Limitations in Mastering Applications

OPTIMOD-PC was designed for the digital broadcast market (DAB, DTV, and netcasting), and therefore has some limitations in mastering applications. The main one is lack of ratio controls. The compressors always operate with very high ratios. While this does not give the usual "squashed" sound associated with high ratios in many compressors, it nevertheless removes long-term dynamic contrasts. For this reason, we suspect that most program material will work best with 5dB or less gain reduc-

tion in the multiband compressor/limiter, ensuring that it will not severely change dynamic contrasts.

The fixed equalization was originally designed to complement material produced to commercial standards. The midrange and HF parametric equalizers are quite general, permitting boosts and cuts with a variety of bandwidths and center frequencies. However, the bass equalizers can only boost, not cut, and bass cuts are sometimes needed in mastering. Small amounts of cut (up to 3dB) are available from the BAND 1 INPUT DRIVE control, and the BASS COUPLING controls can limit potential bass boost. Further, the multiband compression will usually control excessive bass automatically. If you need more control than this, we suggest using your favorite external equalizer before OPTIMOD-PC.