
FM-5

DIGITAL SIGNAL PROCESSOR

TECHNICAL MANUAL



FM-5 Digital Signal Processor Technical Manual - 1st Edition

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Attention!

Federal Communications Commission (FCC) Compliance Notice: Radio Frequency Notice

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.



This is a Class A product. In a domestic environment, this product may cause radio interference, in which case, the user may be required to take appropriate measures.

This equipment must be installed and wired properly in order to assure compliance with FCC regulations.

Caution! Any modifications not expressly approved in writing by Wheatstone could void the user's authority to operate this equipment.





A Short History of Vorsis

The Vorsis product line evolved from Wheatstone's design and integration of audio processing into their radio and television consoles and control surfaces. Company founder and owner Gary Snow and Wheatstone DSP expert Steve Dove had noted how harsh and unnatural broadcast audio processors had become over the years and their long experience in professional audio and deep appreciation for great sound told them there needed to be a better way. In 2005 and armed with an aggressive plan to succeed they took on the challenge to find that better way.

A dozen experts with more than 200 years of collective experience in DSP, audio processing, and other engineering disciplines now work on the Vorsis team led by broadcast engineering veteran and audio processing expert, Jeff Keith. "Our team set an aggressive goal", Keith says, "to combine our talents to build a completely new class of audio processors - processors so unique and so powerful that they would set a new and higher standard for on air sound".

Vorsis audio processors are members of the ever-expanding Wheatstone product line and are built to the same exacting standards as all Wheatstone products. Every facet of product research and development, manufacturing, testing, and quality control is done in Wheatstone's large state of the art facility in New Bern, North Carolina to ensure that customers receive superior performing products of the highest possible quality.

Vorsis processors rely on proprietary state of the art DSP algorithms to create uncommonly clean and natural sound along with competitive "on-the-dial" loudness. Each Vorsis product comes equipped with its own Windows® software based Graphical User Interface for intuitive operation. Carefully tuned factory presets ensure that the processors can be placed into use quickly and easily and in any size market with a minimum of effort.

FM-5 Technical Manual

Table of Contents

Chapter 1 – General Information

Introduction	1-2
Overview	1-4
Rack Mounting	1-5
Installation Tips	1-5
Where to Install the FM-5	1-6
Analog STL	1-6
Analog Phone Lines	1-6
Digital STL	1-6
EAS—United States Emergency Alert System	1-7
Energizing	1-7
I/O Connections	1-8
Audio Inputs	1-8
Analog In	1-8
AES In	1-8
SCA In	1-8
Audio Outputs	1-9
FM Path Analog Out	1-9
FM Path AES Out	1-9
TX Out	1-9
Headphones	1-9
Network Connections	1-10
Ethernet RJ-45	1-10
Typical Ethernet Cable	1-10
Typical Crossover Cable	1-10
General Purpose Interface	1-11
GPI	1-11
Example Schematic of General Purpose Inputs	1-12
User Presets	1-13
GPO	1-13
Analog XLR Connections Pinouts Drawing	1-15
Digital XLR Connections Pinouts Drawing	1-16
BNC Connections Pinouts Drawing	1-17
Ethernet RJ-45/GPI DB-9 Pinouts Drawing	1-18

Chapter 2 - Features and Presets

Vorsis FM-5 Quick Start Setup Guide	2-3
Easy Steps to Success	2-4
Install and Connect the Vorsis FM-5	2-6
Operating the FM-5 Locally	2-6
Unlocking the Front Panel	2-6
Adjusting the Headphone Level	2-6
Operating the FM-5 Remotely—Installing The GUI Software	2-7
Configuring the FM-5 TCP/IP Address	2-7
Additional Notes on FM-5 GUI Connectivity	2-10
A Known Windows Networking Issue	2-11
Achieving Your Special On-Air Sound	2-13
First a Few Words About Our Factory Presets	2-13
What Sound Are You Trying to Achieve?	2-13
About Bass	2-14
Is There a Caveat?	2-14
What Is Your Short Term Goal?	2-14
How Do I Make It Louder?	2-14
What Is Your Long Term Goal?	2-15
Clean and Loud	2-15
Can I Generate That “Sixties” Compression Sound?	2-16
About Vorsis Factory Presets	2-18
Quick Start (Factory Default)	2-18
Bass: <i>Loud, Loud n Wide, Punchy</i>	2-18
CHR: <i>Hot, Hotter, Medium</i>	2-19
Classic Rock: <i>I, II, III, IV</i>	2-19
Classical: <i>Big, Light, Medium</i>	2-19
Compressed: <i>Light, Loud, Medium, Wide</i>	2-20
Country: <i>Easy, Hot, Medium</i>	2-20
Dance: <i>Edgy, Energy, Smooth, Wide</i>	2-21
Folk: <i>Big, Medium, Soft</i>	2-21
Hot Stuff	2-22
Instrumental: <i>Big, Medium, Soft</i>	2-22
Jazz: <i>Big, Light, Smooth</i>	2-22
Latin: <i>Hot!, Medium, Mild</i>	2-23
Loud: <i>Loud Wide</i>	2-23
Modern Rock	2-23
News Talk: <i>Light, Loud, Medium</i>	2-23
Oldies: <i>Big, Medium, Soft</i>	2-24
Punchy	2-24
Rock: <i>Light, Loud, Loud Wide</i>	2-24
Sports: <i>Light, Loud, Medium</i>	2-25
Urban: <i>Heavy, Light, Medium</i>	2-25
Future Presets and Preset Updates	2-26

Chapter 3 - Vorsis FM-5 GUI

Architecture of the FM-5 GUI	3-5
Network Configuration	3-5
Getting Started	3-5
Connecting the FM-5 and the GUI	3-6
Using a LAN Connection	3-6
Configuring the FM-5 IP Address	3-6
Adding Devices	3-8
Connecting Directly Without a LAN	3-10
PC System Requirements	3-10
Wireless Connection	3-10
The Really Remote Connection!	3-11
VPN	3-11
The FM-5 and Internet Security Concerns	3-11
About DHCP and the FM-5	3-11
About "Ports" and the FM-5	3-12
Using the GUI	3-13
Dynamic Displays Region	3-14
Frequency-Domain Graph	3-14
FM-5 Graphical Interface Operation	3-15
First, a short tutorial	3-16
Bargraph Metering	3-17
Gain Reduction Meter	3-17
AES / AGC/Compressor Output Meter	3-18
60dB Range	3-18
Display Signal Selection	3-18
Input	3-18
Predelay	3-18
Audio	3-19
Gain Reduction	3-19
Controls	3-19
L/R (Left/Right)	3-19
O-Scope	3-19
Control Area Region	3-20
Input Menu	3-21
Input Settings	3-21
Input Source	3-21
Input Signal Presence	3-21
Input Failsafe	3-21
Line Gain	3-22
AES Gain	3-22
Balance	3-22
Symmetry	3-22
HPF - High Pass Filter	3-23
Why the Sum and Difference Option?	3-23
Parametric Equalizer Menu	3-24
Enable	3-25
Automatic Gain Control and Compressor Menu	3-26
Drive	3-26
Makeup	3-26

CONTENTS

AGC/Comp Buttons	3-27
Freeze Gating and AGC Backoff	3-28
Freeze Threshold	3-28
Freeze Wait	3-28
Gate	3-28
Ooze	3-28
AGC Backoff	3-29
Crossover Frequencies	3-30
Selecting Crossover Frequencies	3-30
AGC/Compressor Gain Reduction	3-32
FM Output Menu	3-33
10 Band Limiter	3-33
Multiband Enable	3-33
Multiband Drive	3-33
Multiband Output	3-34
Multiband Knee	3-34
Vorsis Bass Management System (VBMS)	3-35
Bass Clip Drive	3-36
Bass Clip Style	3-36
Bass Clip Output	3-37
Bass Clip Frequency	3-37
Emphasis Selection	3-38
DeEmphasis	3-38
Look Ahead Limiter	3-38
FM Limiter Controls	3-39
Limiter Enable	3-39
Limiters Linked	3-39
Limiter Trim	3-39
Attack	3-39
Release	3-39
Long Release	3-40
Digital Output	3-40
Clip Style (Main Clipper)	3-40
FM Diversity Delay	3-41
Entering Delay Value	3-41
10 Band Limiter Dynamics Screens	3-42
Thresholds Screen	3-42
Attack Time Screen	3-43
Release Time Screen	3-44
Final Equalization Screen	3-45
Stereo Encoder Menu	3-46
Difference Limiter	3-46
Drive Trim	3-46
Test Oscillator	3-46
Multiplex Process	3-47
Output Metering	3-47
Stereo Encoder	3-48
Pilot	3-48
SCA 1	3-48
SCA 2	3-48
TX 1	3-48
TX 2	3-48
Pilot Only	3-48

CONTENTS

Pilot Phase	3-49
Multiplexer	3-49
Mask Filter	3-49
Analog—Stereo Coder Output Options	3-49
System Menu	3-50
System Settings Change With Preset Takes	3-50
Headphone Source	3-51
Headphone Control	3-51
Remote Login	3-52
Front Panel	3-52
GUI Access	3-53
GUI Lock	3-53
Status Indicators	3-54
Skin	3-55
Events	3-56
Creating a Weekly Rotation Event	3-57
Creating a Long Term Rotation Event	3-57
Deleting a Scheduled Event	3-58
Set Time	3-58
Side Bar Region	3-59
Take	3-59
Save	3-59
Presets	3-60
Devices	3-61
Quick Save	3-61
Title Bar Region	3-63
Status	3-63
Devices	3-63
Presets	3-64
Notes on “Online” and “Offline” working	3-65
Accessing Menu Options	3-66
File Menu Items	3-66
Hardware Menu Items	3-66
FM-5 Hardware Update	3-67
Presets Menu Items	3-68

Chapter 4 - Schematic and Load Sheet Drawings

FM-5 Signal Flow Diagram	4-2
---------------------------------------	------------

Audio Processor

Schematic	4-3
Load Sheet	4-8

Appendix

Parameters, Units and Ranges	A-2
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General Information

Chapter Contents

Introduction	1-2
Overview	1-4
Rack Mounting	1-5
Installation Tips	1-5
Where to Install the FM-5	1-6
Analog STL	1-6
Analog Phone Lines	1-6
Digital STL	1-6
EAS—United States Emergency Alert System	1-7
Energizing	1-7
I/O Connections	1-8
Audio Inputs	1-8
Analog In	1-8
AES In	1-8
SCA In	1-8
Audio Outputs	1-9
FM Path Analog Out	1-9
FM Path AES Out	1-9
TX Out	1-9
Headphones	1-9
Network Connections	1-10
Ethernet RJ-45	1-10
Typical Ethernet Cable	1-10
Typical Crossover Cable	1-10
General Purpose Interface	1-11
GPI	1-11
Example Schematic of General Purpose Inputs	1-12
User Presets	1-13
GPO	1-13
Analog XLR Connections Pinouts Drawing	1-15
Digital XLR Connections Pinouts Drawing	1-16
BNC Connections Pinouts Drawing	1-17
Ethernet RJ-45/GPI DB-9 Pinouts Drawing	1-18



FM-5 Digital Signal Processor



General Information

Introduction

The Vorsis FM-5 takes a completely new approach to broadcast audio processing through new and surgically accurate audio processing algorithms created by the Vorsis product design team. The result is far more audio processing power as well as complete user control over that power. There are no hidden controls and no secret “back door” hiding things from the end user. Every control is labeled for exactly what it does, and *everything* is brought out to the end user.

The FM-5 provides the power and the tools required to design the just the right sound. If you can think of the on-air sound you want your station to have, the FM-5 can create it for you. This extreme flexibility is made possible by our entirely new approach to both the user interface and clever new DSP audio processing algorithms. The FM-5 has the clarity, power, and accuracy of sound not found in any other broadcast audio processor in its price range.

The FM-5 is remotely controlled from anywhere via a TCP/IP network connection and a Windows-based GUI (Graphical User Interface) software application.

Vorsis is a division of Wheatstone Corporation of New Bern, NC.



Wheatstone Corporate Headquarters

Wheatstone Corporation is a world-leader in broadcast audio equipment design and manufacturing. Our product line includes audio consoles for the radio and television broadcast industries, audio control surfaces and digital audio networks, and now, our ever-growing and award winning line of Voris digital audio processors.

Wheatstone began in 1975 as the “Audioarts” company. By 1976, its product line had already grown to include high quality audio equalizers, electronic crossovers, and compressor/limiters. In 1977 its first audio mixing control console was introduced. There followed many years of success, under the names of Audioarts Engineering and Wheatstone Corporation, as one of the major manufacturers of broadcast quality audio consoles and distribution systems. Then in 2006 Wheatstone returned to its roots when it created the Voris line of signal processing products and introduced the AP-1000, FM-5, AM-5, HD P3, AP3, and M1 Digital Audio Processors for radio.

Wheatstone’s product line has expanded greatly since the early days, and Wheatstone is now a recognized world leader in radio broadcast consoles, television consoles, and many types of audio processing equipment,

Overview



At the heart of the FM-5 is a specialized DSP farm containing both floating and fixed-point processors. Advanced signal routing capability allows restructuring the processing chain as desired, and headphone monitoring can be patched to any processing section at will. The flexibility of the headphone monitoring also allows an audio source that is attached to the FM-5 but not even on the air to be monitored!

The most salient feature of the FM-5 is its Ten Band final processing section. This innovative design allows for far more flexible peak control and audio tailoring than the antiquated five and six band limiter algorithms found in other audio processors on the market today.

The 10 band limiters are equipped with fully adjustable thresholds and attack and release times for each of the bands. Because the FM-5 limiters operate with precision, time-aligned bandpass filters, its dynamic operation is nearly invisible to the ear. The resulting on-air sound can be carefully tailored to create exactly that desired.

The 10 bands of peak limiting utilized in the FM-5 allows tuning flexibility previously unheard of in any broadcast audio processor. The 10 band limiter section is followed by its own four-band parametric equalization stage that can be used to further fine tune the sound of each signal path.

The FM signal path is equipped with an adjustable diversity delay of up to ten seconds corresponding to the requirements of the North American (iBiquity®) HD Radio system.

Rack Mounting

The FM-5 is designed to fit into an industry standard 19" equipment rack, and requires two rack units (3.5 inches) of vertical space.

The FM-5 does not have top or bottom cover vent holes. Latent heat is vented out of the enclosure by natural convection through slots in the top of the rear panel. Cooler air is drawn into the unit through vertical slots positioned lower in the side panels.

There is a small fan inside the FM-5 to stir air inside the enclosure. It does not 'remove' heat. In the unlikely even that it should happen, failure of the fan will not compromise the operation of the FM-5.

The FM-5 may be mounted between other devices in the equipment rack and in accordance with good engineering practice should not be mounted directly above devices that generate significant amounts of heat. If such a location is unavoidable then it is advisable to utilize an extra 1RU blank rack panel between the FM-5 and devices immediately above and/or below it.

WARNING! Under no circumstances should the FM-5 unit be opened! The unit contains high voltage circuits that are hazardous and potentially harmful. The unit has no user-serviceable parts inside! If you have a problem the unit must be returned to Wheatstone Corporation for repair.

Installation Tips:

- Place surge protection circuits as close as possible to the FM-5 or other device being protected.
- Establish a low impedance common ground in your facility and try to route all grounds to that point.
- Choose the best power conditioning / UPS units that you can afford and suitable for your equipment — focus on the features and options you need. The better UPS products can prevent thousands of dollars in equipment damage — some even come with an external equipment damage warranty.
- *Unbalanced* audio connections to the FM-5 should be made with shielded two conductor cable such as Belden 8451 or 9451 as if connecting a balanced source. At the unbalanced source's output connect the + Output to the HI input wire and connect the source GND wire to the LO wire. Connect the shield at the FM-5 end only.
- For digital audio connections always use a good quality digital audio cable with a characteristic impedance of 110 ohms.

The AES/EBU specification, with its broad impedance tolerance, allows for cables with impedances from 88 ohms to 132 ohms - 110 ohms is ideal. Twisted pair cable should be shielded, and in the case of multi-pair cable, each pair should be individually shielded. Foil shielding is recommended for permanent installations and foil shield plus overall braid should be used in applications where frequent flexing of the cable will occur. One cable pair is capable of carrying two channels of digital audio.



Generic “audio” cable such as Belden 8451 *may* be used for interconnecting AES3 digital audio devices but **only** for distances of less than about 25 feet. The actual cable length that will work satisfactorily in an installation is primarily determined by the error correction and jitter tolerance of the AES3 receiver device and the cable used.

The impedance of most ‘analog’ cables ranges from 40 ohms to 70 ohms and represents a large impedance mismatch from the nominal 110 ohms required in the AES3 standard. Such mismatch will result in signal reflections, causing bit errors at the AES3 receiver. The higher capacitance of generic analog cables also slows down the rise time of the digital data signals, impairing the ability of the AES3 receiver to accurately detect digital signal transitions. This may result in increased jitter.

Where to Install the FM-5

The recommended location for the FM-5 is at the transmitter site. A transmitter site installation will enable the use of the built-in stereo encoder which will *always* allow more precise control of modulation peaks.

If you chose to locate the FM-5 at the studio and use an STL to send the program material to the transmitter, there are several issues that need to be addressed.

Analog STL:

Older analog STL’s usually suffer from an inability to control high frequency audio peaks because of inadequate bandwidth in their IF circuits or inadequate low frequency performance which will result in tilt. Also, some STL designs suffer from bounce in their AFC loops when handling processed low frequency material, which can rob modulation capability.

Analog Phone Lines:

We cannot recommend any form of discrete (left/right) analog ‘phone line’ type STL because of the inability of many service providers to guarantee flat frequency response and proper phase matching between circuits. Furthermore, in many countries analog circuits such as these are being discontinued or the cost has been raised to prohibitive points.

Digital STL:

If using a Digital STL that employs audio compression, then it is highly recommended that the FM-5 be placed at the transmitter site. This is primarily because the encoding schemes used in such STL’s will not accurately pass the well-defined peak levels created by the FM-5.

The FM-5 can also be placed at the studio end of a compressed STL with at least two caveats:

- You will not be able to use the composite clipper in the FM-5. While most digital exciters offer a composite clipper function, they are typically quite crude in their operation by comparison to what is inside the FM-5 and are *never* the optimum choice when sound *quality* is important.

- Compressed (data reduced) STL's may not perform well when competitively processed audio is presented to their inputs. This is primarily because when dense audio is presented to these codecs they have fewer 'opportunities' to remove redundant audio information and then mask that removal. Therefore, codec operation may be much more obvious — potentially more so than what might occur with the processing located *after* the codec where the masked artifacts are simply unmasked by the increased 'gain' due to processing.

TIP: If using the FM-5 at the studio be certain that the pre-emphasis and clippers in the stereo generator at the transmitter site are properly set up to match the settings in the FM-5. This will prevent gross distortion and large modulation overshoots.

EAS – United States Emergency Alert System

If the EAS generator is placed before the FM-5, the levels of the signaling tones and data that is transmitted during alerts may be disturbed by the processing. Therefore it is highly recommend that the EAS unit be placed *after* the processing.

If the EAS unit must be installed prior to it, the FM-5 should be configured so that when the EAS tones are being sent the FM-5 is switched to a bypass mode. This can be accomplished by using the FM-5's GPI interface and by assigning a special preset to the EAS function that has internal processing defeated and audio levels calibrated to provide proper modulation levels during EAS transmissions.

Energizing

Assuming the Vorsis FM-5 Digital Signal Processor is correctly rackmounted, you may now energize it. There is no power switch. The AC line input voltage may be between 90 and 260VAC, 50 or 60Hz. Power consumption is under 100VA.

Aggressive AC input filtering is utilized at the AC input of the FM-5; however it is always advisable to use external surge protection and/or an uninterruptible power supply (UPS), especially where AC power quality is questionable, such as at a remote transmitter site.

Power conditioning, surge suppression, and even power backup devices are wise investments when using sensitive modern electronic devices that use an internal computer.

Use of a UPS (uninterruptible power supply) is a good idea and will protect the FM-5 from short duration power interruptions which may cause it to reboot. During boot up, audio is interrupted for approximately 20 seconds.

I/O Connections



All audio input and output, control, Ethernet, and power supply connections are made via various connectors mounted on FM-5's rear panel. Six XLR connectors are provided for analog and digital audio input and output connections. Four BNC connectors are provided for SCA in and TX (transmitter) out. An RJ-45 connector is provided for Ethernet connection. The two DB-9 connectors provide 8 GPI inputs for the first eight presets and 4 GPO outputs. The pinout drawings on pages 1-15 through 1-18 summarize all wiring connections.

Audio Inputs

Input audio can be applied to either the analog left/right inputs or to an AES3 digital input. The AES3 input accepts sample rates between 32 kHz and 96 kHz.

Automatic audio failover from one input to the other is a user selectable option. Failover from AES3 to analog is instantaneous and based on invalid or missing bits in the AES3 stream. Failover from analog to AES3 is based on a silence sense algorithm responding to audio below -37dBFS for more than 15 seconds.

Analog In—XLR-F

Pin 1 XLR LT SH – LINE LT IN SH
 Pin 2 XLR LT HI – LINE LT IN HI
 Pin 3 XLR LT LO – LINE LT IN LO

Pin 1 XLR RT SH – LINE RT IN SH
 Pin 2 XLR RT HI – LINE RT IN HI
 Pin 3 XLR RT LO – LINE RT IN LO

AES In—XLR-F

Pin 1 XLR SH – AES IN SH
 Pin 2 XLR HI – AES IN HI
 Pin 3 XLR LO – AES IN LO

SCA In—BNC

Pin 1 BNC 1 HI - SCA 1 IN HI
 Pin 2 BNC 1 SH - SCA 1 IN SH

Pin 1 BNC 2 HI - SCA 2 IN HI
 Pin 2 BNC 2 SH - SCA 2 IN SH

Audio Outputs

FM Path Analog Out—XLR-M

Output audio for the FM path is available as:

- Analog balanced left/right stereo.
- Analog balanced left/right stereo and de-emphasized according to any pre-emphasis used.
- AES3 digital either pre or post diversity delay and/or de-emphasized according to any pre-emphasis used.
- Balanced line level composite stereo.
- Composite stereo on two rear panel BNC female connectors.

Pin 1 XLR FM LT SH – LINE FM LT OUT SH
 Pin 2 XLR FM LT HI – LINE FM LT OUT HI
 Pin 3 XLR FM LT LO – LINE FM LT OUT LO

Pin 1 XLR FM RT SH – LINE FM RT OUT SH
 Pin 2 XLR FM RT HI – LINE FM RT OUT HI
 Pin 3 XLR FM RT LO – LINE FM RT OUT LO

FM Path AES Out—XLR-FM

Pin 1 XLR FM SH – AES FM OUT SH
 Pin 2 XLR FM HI – AES FM OUT HI
 Pin 3 XLR FM LO – AES FM OUT LO

TX Out—BNC

Pin 1 BNC 1 HI - TX 1 OUT HI
 Pin 2 BNC 1 SH - TX 1 OUT SH

Pin 1 BNC 2 HI - TX 2 OUT HI
 Pin 2 BNC 2 SH - TX 2 OUT SH

Headphones

A high-power, overload protected headphone output is available on the front panel for local monitoring. The headphone source can be selected in software to be from one of six important signal points inside the processing algorithm, including both analog and AES inputs even if those inputs are not selected to feed the audio processing chain.



Network Connection

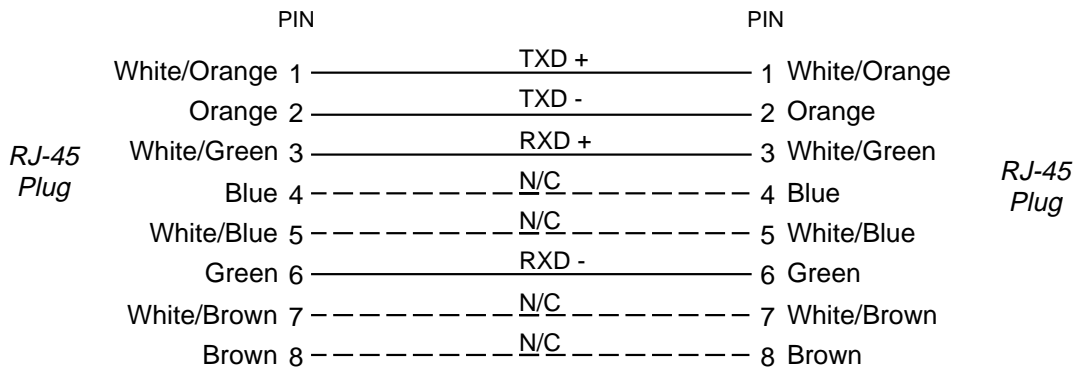
The FM-5 contains its own five port 100Base-T Ethernet switch with one port available on the outside of the product reserved for user connections. The Ethernet switch is equipped with auto-sensing and therefore this port will accept either straight-through or crossover cables.

Networked systems are normally connected to the FM-5 via “straight” (pin to pin) CAT5 cable. For typical CAT5 cable pinouts see below. These connections are for communicating with the configuration computer via a network. If you are connecting directly between the computer and the FM-5 with no network in between, it is normal to use a crossover cable.

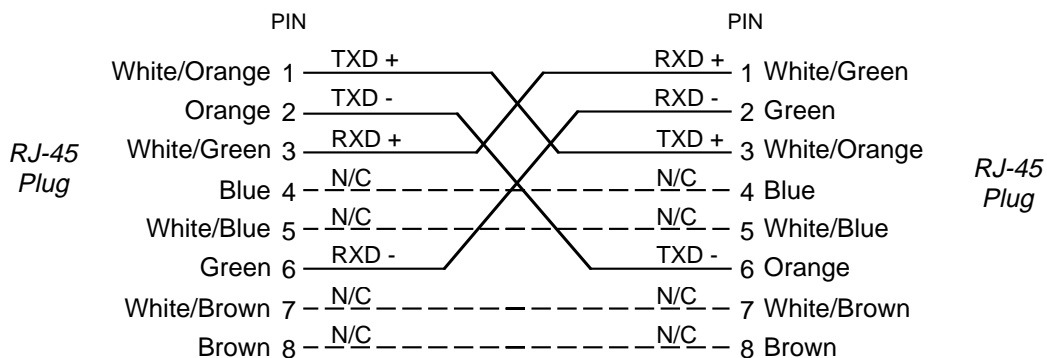
Ethernet—RJ-45

Pin 1 – TXD +
 Pin 2 – TXD -
 Pin 3 – RXD +
 Pin 4 – N/C
 Pin 5 – N/C
 Pin 6 – RXD -
 Pin 7 – N/C
 Pin 8 – N/C

TYPICAL ETHERNET CABLE



TYPICAL Crossover CABLE



General Purpose Interface (GPI/GPO)

The FM-5 is equipped with eight General Purpose Input (GPI) control input ports on one female DB-9 connector, and four General Purpose Output (GPO) tally outputs on a second female DB-9 connector. All GPI and GPO connections are optically-isolated to prevent external ground loops and prevent dangerous voltages from being introduced into the FM-5.

GPI

The GPI interface provides eight separate General Purpose Inputs, sharing a common return. The connector is a female DB-9 connector with the following pin assignments. Note that all pins are isolated from FM-5 internal circuitry!

- Pin 1 – GPI COM (-)
- Pin 6 – GPI 1 IN (+)
- Pin 2 – GPI 2 IN (+)
- Pin 7 – GPI 3 IN (+)
- Pin 3 – GPI 4 IN (+)
- Pin 8 – GPI 5 IN (+)
- Pin 4 – GPI 6 IN (+)
- Pin 9 – GPI 7 IN (+)
- Pin 5 – GPI 8 IN (+)

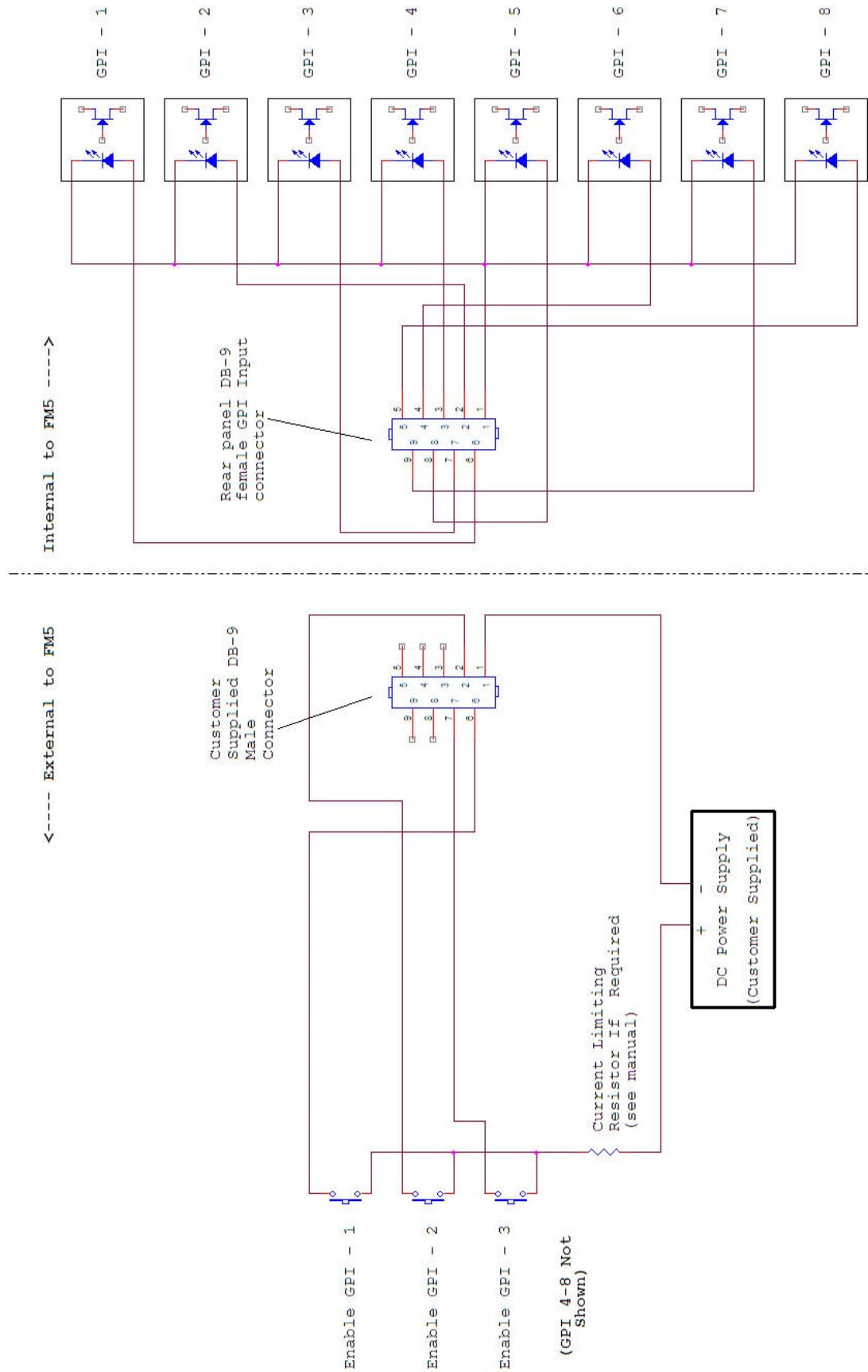
The input circuits are opto-isolated by Panasonic PhotoMOS relays. These are LED input, MOSFET output devices with an input/output isolation of 1,500VAC and I/O capacitance of less than 2pF.

Each of the GPI inputs of the FM-5 is current limited by an internal 475 Ohm resistance. The LED device inside the PhotoMOS device is rated at a maximum forward current of 50mA and a normal operating current of 5mA; and therefore it is necessary to determine if an additional outboard series resistance will be required in your particular application.

The following table lists the value of external resistance, if required, based on the voltage applied to the GPI. In all applications up to and including 48VDC, a one-half watt resistor is sufficient.

Applied Voltage to GPI	External Resistance
3.3 VDC	None
5.0 VDC	330 Ohms
6.0 VDC	470 Ohms
7.5 VDC	820 Ohms
10 VDC	1.3 kOhms
12 VDC	1.8 kOhms
15 VDC	2.4 kOhms
24 VDC	3.9 kOhms
30 VDC	5.1 kOhms
48 VDC	9.1 kOhms

Example Schematic of General Purpose Inputs



User Pre-sets

The FM-5 comes with a variety of factory presets and can hold a total of 80 in its onboard memory. You can design and save additional presets within the FM-5's onboard memory and can store an unlimited number of presets on the PC that is hosting the remote control GUI software. The factory pre-sets can be readjusted and then saved to new names in order to create your own unique and individual sound.

Note: The factory presets are write-protected and changes made to them cannot be written back to the same memory location. Factory presets whose control settings have been modified are considered "user" presets and therefore must be saved as a new name and to a new preset number. Please start with a factory preset that has the on air sound closest to what you need, and then make any necessary changes to that preset to get to your final sound.

NOTE: User presets stored in locations 1 through 8 are logically assigned to the remote GPI function! Two examples of presets that might be stored here are:

- A preset that has all processing turned off and has special input/output level calibrations (Bypass or EAS Preset).
- A preset that has all processing enabled but has the Stereo Pilot turned off (Mono Preset).

Preset storage is typically as follows:

- Presets 1- 8 are user presets that can be quickly selected from the GPI connector.
- Factory presets are installed starting at Preset 9, with Preset 9 being a "bypass" preset. The factory presets cannot be written over or deleted.
- The number of installed factory presets is subject to change, but is typically in the range of 40 to 50.
- User presets, other than the GPI selectable presets 1 - 8, are stored above the highest factory preset. The number of available slots for user presets depends on how many factory presets were installed.
- User presets may be locked by the user (see Chapter 3). Factory presets, on the other hand, are locked at the factory. Whereas a user can unlock user-locked presets, the same user can not unlock factory presets.

GPO

The FM-5 provides four General Purpose Output (GPO) circuits that may be used in a variety of ways. Like the GPI circuits, the GPO utilizes Panasonic PhotoMOS relays in order to provide high isolation from the outside world.

Unlike the GPI circuits, the GPO's each have completely isolated circuits - that is, they do not share a common return. Therefore each GPO may be used as desired without concern of cross coupling between unrelated external circuits.

The optoisolators on the GPO are rated at a maximum of 350 Volts AC or DC at a maximum load current of 100mA. Because of the AC rating, polarity is unimportant, and therefore we will simply define the GPO pins as Source and Return.

The pin assignment for the rear panel DB-9 GPO connector is as follows:

Pin 1 - N/C

Pin 2 – GPO 1 Return

Pin 6 – GPO 1 Source

Pin 3 – GPO 2 Return

Pin 7 – GPO 2 Source

Pin 4 – GPO 3 Return

Pin 8 – GPO 3 Source

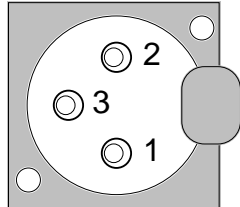
Pin 5 – GPO 4 Return

Pin 9 – GPO 4 Source

Analog XLR Connections

Analog In - XLR-F

XLR LT-F

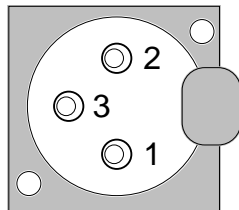


PIN 1 XLR LT SH - LINE LT IN SH

PIN 2 XLR LT HI - LINE LT IN HI

PIN 3 XLR LT LO - LINE LT IN LO

XLR RT-F



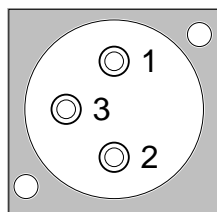
PIN 1 XLR RT SH - LINE RT IN SH

PIN 2 XLR RT HI - LINE RT IN HI

PIN 3 XLR RT LO - LINE RT IN LO

Analog Out - XLR-M

XLR FM LT-M

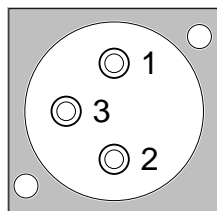


PIN 1 XLR FM LT SH - LINE FM LT OUT SH

PIN 2 XLR FM LT HI - LINE FM LT OUT HI

PIN 3 XLR FM LT LO - LINE FM LT OUT LO

XLR FM RT-M



PIN 1 XLR FM RT SH - LINE FM RT OUT SH

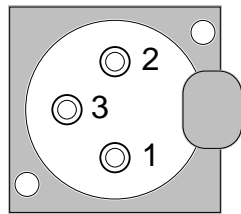
PIN 2 XLR FM RT HI - LINE FM RT OUT HI

PIN 3 XLR FM RT LO - LINE FM RT OUT LO

Digital XLR Connections

AES In - XLR-F

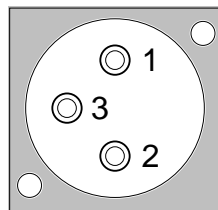
XLR-F



PIN 1 XLR SH - AES IN SH
PIN 2 XLR HI - AES IN HI
PIN 3 XLR LO - AES IN LO

AES Out - XLR-M

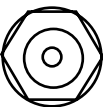
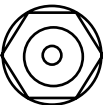
XLR FM-M



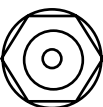
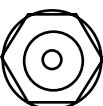
PIN 1 XLR FM SH - AES FM OUT SH
PIN 2 XLR FM HI - AES FM OUT HI
PIN 3 XLR FM LO - AES FM OUT LO

BNC Connections

BNC - SCA IN

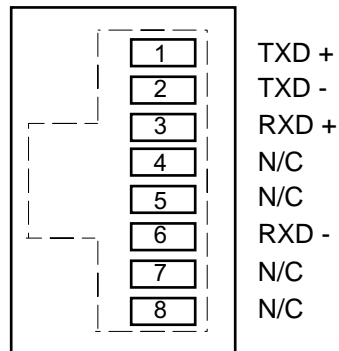
- 1  PIN 1 BNC 1 HI - SCA 1 IN HI - CENTER PIN
PIN 2 BNC 1 SH - SCA 1 IN SH - SHELL
- 2  PIN 1 BNC 2 HI - SCA 2 IN HI - CENTER PIN
PIN 2 BNC 2 SH - SCA 2 IN SH - SHELL

BNC - TX OUT

- 1  PIN 1 BNC 1 HI - TX 1 OUT HI - CENTER PIN
PIN 2 BNC 1 SH - TX 1 OUT SH - SHELL
- 2  PIN 1 BNC 2 HI - TX 2 OUT HI - CENTER PIN
PIN 2 BNC 2 SH - TX 2 OUT SH - SHELL

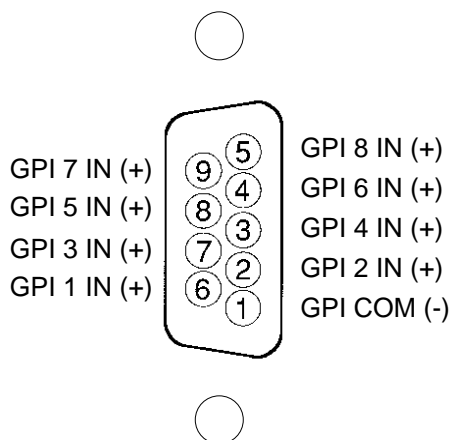
Ethernet - RJ-45

RJ-45 ETH

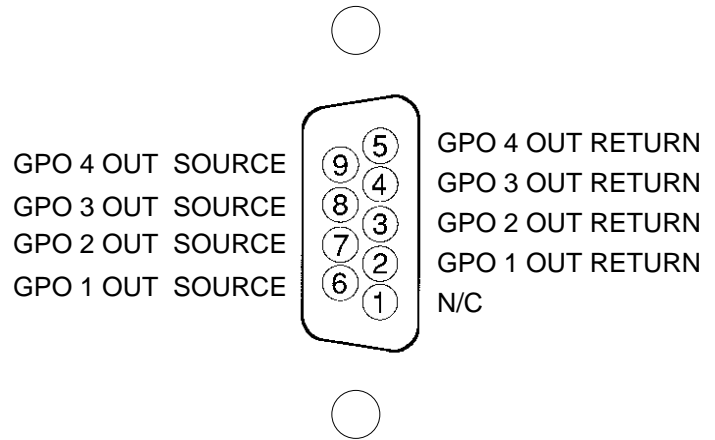


General Purpose Interface - DB-9

GPI - DB-9



GPO - DB-9



Features and Presets

Chapter Contents

Vorsis FM-5 Quick Start Setup Guide	2-3
Easy Steps to Success	2-4
Install and Connect the Vorsis FM-5	2-6
Operating the FM-5 Locally	2-6
Unlocking the Front Panel	2-6
Adjusting the Headphone Level	2-6
Operating the FM-5 Remotely—Installing The GUI Software	2-7
Configuring the FM-5 TCP/IP Address	2-7
Additional Notes on FM-5 GUI Connectivity	2-10
A Known Windows Networking Issue	2-11
Achieving Your Special On-Air Sound	2-13
First a Few Words About Our Factory Presets	2-13
What Sound Are You Trying to Achieve?	2-13
About Bass	2-14
Is There a Caveat?	2-14
What Is Your Short Term Goal?	2-14
How Do I Make It Louder?	2-14
What Is Your Long Term Goal?	2-15
Clean and Loud	2-15
Can I Generate That “Sixties” Compression Sound?	2-16
About Vorsis Factory Presets	2-18
Quick Start (Factory Default)	2-18
Bass: <i>Loud, Loud n Wide, Punchy</i>	2-18
CHR: <i>Hot, Hotter, Medium</i>	2-19
Classic Rock: <i>I, II, III, IV</i>	2-19
Classical: <i>Big, Light, Medium</i>	2-19
Compressed: <i>Light, Loud, Medium, Wide</i>	2-20
Country: <i>Easy, Hot, Medium</i>	2-20
Dance: <i>Edgy, Energy, Smooth, Wide</i>	2-21
Folk: <i>Big, Medium, Soft</i>	2-21
Hot Stuff	2-22
Instrumental: <i>Big, Medium, Soft</i>	2-22
Jazz: <i>Big, Light, Smooth</i>	2-22
Latin: <i>Hot!, Medium, Mild</i>	2-23
Loud: <i>Loud Wide</i>	2-23
Modern Rock	2-23

News Talk: <i>Light, Loud, Medium</i>	2-23
Oldies: <i>Big, Medium, Soft</i>	2-24
Punchy	2-24
Rock: <i>Light, Loud, Loud Wide</i>	2-24
Sports: <i>Light, Loud, Medium</i>	2-25
Urban: <i>Heavy, Light, Medium</i>	2-25
Future Presets and Preset Updates	2-26

Vorsis FM-5 Quick Start Setup Guide

We know that you're probably in a hurry to get on the air with your new FM-5. If you have little technical expertise with audio processor fundamentals, the following thirteen point checklist will get you up and running quickly and without having to know a lot of techie stuff. This is followed by several pages of information that falls into the category of "stuff I need to know right now because I don't have time to read the whole manual." Please check out the various chapters of the FM-5 Operating Guide if you need some additional information. If for some reason you find that you're really stuck, you can always call our friendly technical support folks at (252) 638-7000.

Please inspect the contents of the package to ensure that the following items are present:

Vorsis FM-5 Unit	Quantity 1
Vorsis GUI Software CD	Quantity 1
AC Power Cord	Quantity 1
Technical Manual	Quantity 1
Quick Start Guide	Quantity 1
Vorsis Warranty Card	Quantity 1

The photo below shows the rear panel of the FM-5 while the drawing below it more clearly shows the location of the various connectors associated with an installation:



FM-5 Rear Panel Connections

Easy Steps to Success

1. Install the FM-5 GUI on a host PC. This will allow you to control the various setup options required for successful installation. The default IP address of the FM-5 is 192.168.1.194. Refer to the Network Installation section for detailed information on reconfiguring the FM-5 IP address.
2. Install the FM-5 in the equipment rack using at least two rack screws. If only two screws are used they must be installed in the bottom holes of the rack ears to prevent undue stress on the front panel and possible bending.
3. Connect local AC power to the unit. There is no power switch and power is applied to the unit as soon as you connect it to a suitable source of AC power. The power supply is universal and accepts line voltages from 90VAC to 260VAC, 50 or 60Hz.
4. Connect the Analog or Digital audio inputs as appropriate for your installation.
5. Start the FM-5 GUI, configure a device if you haven't done so already (see page 2-7), and then connect to the unit.
6. Click on the Input Menu tab in the GUI and select the input source to match the Input type you connected to the rear panel. If your audio source is already providing an audio feed, you should see meter activity on the FM-5 front panel Input and Output meters.
7. While still in the Input menu and observing the Input meters within the GUI or on the front panel, adjust the Input Gain control (AES or Analog as required) until the input meters are peaking around -12dBFS with normal program levels being applied.



Note that for best overall performance, the Input of the FM-5 should be calibrated so that it reaches 0dBFS when the signal chain prior to the FM-5 also reaches 0dBFS, or digital full scale.

8. Make the audio output connections that are appropriate for your installation.
9. If using the Analog outputs pre-emphasized, navigate to the Stereo Encoder screen and select the checkbox for Analog L/R. Then adjust the TX 1 and TX 2 controls to set the correct Left and Right output levels respectively.
10. If using the Analog outputs de-emphasized navigate to the Stereo Encoder screen and select the checkbox for Analog L/R deemph (de-emphasized). Then adjust the TX 1 and TX 2 controls to set the correct Left and Right output levels respectively.
11. If using the AES Outputs, connect them to the equipment following the FM-5, navigate to the FM OUT screen, and adjust the AES Output level appropriately.
12. If using the Composite outputs associated with the rear panel BNC connectors, navigate to the Stereo Encoder screen and select the checkbox for Analog MPX. Then adjust the TX 1 and TX 2 controls to set the correct modulation levels for your system.



When Analog MPX is selected, the balanced Analog Left/Right outputs are also transmitting composite stereo, while the BNC outputs are unbalanced. If you have an exciter that provides a balanced composite input (most do, even though the input is a BNC connector) the best possible signal to noise performance will be obtained by using the FM-5 balanced outputs.

The easiest way to prepare an interconnecting cable is to use a cable with a BNC already attached at one end. If a BNC is also present on the other end, remove that BNC and replace it with an XLR female connector. The suggested wiring is as follows:

→ Cable shield to XLR Pin #3

→ Cable center conductor to XLR Pin #2

The XLR Pin #1 can be ignored unless operating in a very high RF environment where it may be advisable to connect a 0.01uF capacitor between XLR Pin #1 and XLR Pin #3.

13. If installing the processor in an installation that also has an HD signal, you'll likely need to use and adjust the diversity delay controls found on the FM Output screen. Once the FM to HD timing relationships have been tweaked to be relatively close, you can either use the variety of third-party adjustment instruments available or you can adjust it by ear. When making very fine adjustments to the delay, it can be helpful to double click the delay value window (which opens it) where you can manually type in any value of delay required.

You're now on the air!

We ship every FM-5 with the Quick Start preset as the factory default (preset 10). This preset provides moderate competitiveness and well balanced sound and is a good starting point for a variety of program formats.

It's good to remember that our preset names don't necessarily mean that the preset can ONLY be utilized for a format with a similar name. Please feel free to experiment and try each preset we provide to see how it sounds on your station and in your market!



From time to time we'll be adding new presets to our Vorsis website for you to download and experiment with. Presets can easily be installed into your FM-5 using the "Install Preset Package" utility built into the remote GUI.

The following pages contain additional startup information. Please excuse us if there is some repetition of information; we know that some of you will be jumping around in the manual rather than reading it sequentially. After all, we're engineers too!

Install and Connect the Vorsis FM-5

1. Install the FM-5 in the equipment rack using at least two rack screws. If only two screws are used they *must* be installed in the bottom holes of the rack ears to prevent undue stress on the front panel and possible bending.
2. Connect the audio input(s) to the appropriate XLR female input connector(s) on the rear panel.
3. Connect the line level analog outputs, the AES digital output, or the FM composite stereo output(s) as required in your installation.
4. To use the Vorsis FM-5 GUI software connect the rear panel Ethernet RJ-45 jack as appropriate for your intended use:
 - a) For direct connection to a PC use a crossover CAT5 cable;
 - b) For connecting into your LAN use a straight through CAT5 cable from the Ethernet switch or HUB.
5. Connect the AC power cord to the FM-5 rear panel AC power connector and then plug it into AC power. The FM-5 will power up and all DSP related signal paths should be intact within 15 seconds.

Operating the FM-5 Locally

The front panel of the FM has only two user controls, a rotary encoder with integral push switch and a black push button located directly below the rotary encoder and these controls are assigned to the following functions:

Unlocking the Front Panel

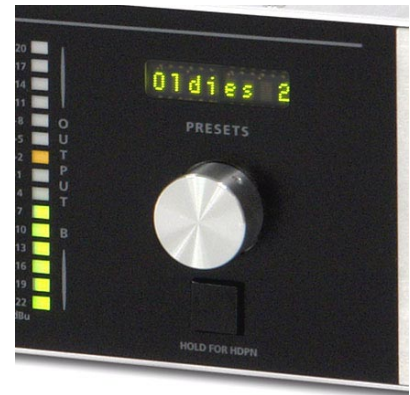
The factory default passcode is “1234”. To do this, press in and hold the jog wheel until the “Pass 0000” prompt appears - the first two digits will be flashing. Turn the rotary encoder clockwise until “12” appears in the display and then press the encoder wheel to lock these digits in place and move the cursor to the second pair of digits. When the second pair of digits appears, turn the rotary encoder clockwise again until “34” appears in the display, then press the jog wheel in. The message “OK” should appear. At this point the front panel is unlocked and will remain so for several minutes, after which automatic relocking will take place.

The front panel lock/unlock passcode can be changed using the remote control GUI software. Additionally, the front panel does not need to be unlocked in order to connect to the unit with the remote GUI software.

Adjusting the Headphone Level

When used in conjunction with the rotary encoder, the black pushbutton allows the audio level of the front panel headphone jack to be adjusted.

To turn the volume up, press in the black pushbutton and then turn the rotary encoder clockwise. The relative position of the control is shown by digits ranging from “0” to “100”, with “0” being “Off” and “100” being full volume.



Operating the FM-5 Remotely—Installing the GUI Software

For remote operation via the GUI software supplied with the unit, insert the Vorsis FM-5 software CD into a Windows XP/2000 computer and follow the steps below to install the software. If the software installation does not automatically start when the CD is inserted into the drive, you can start the installation manually by:

- Click Start
- Then click Run
- Then click Browse
- Browse the “My Computer” device tree to locate the CDROM device and then double click it.
- When the contents of the CDROM drive appear in the window, locate the FM-5GUISetup_x_x_x.exe file (where x_x_x is the version number) on the CDROM and double click it.
- Follow the on screen instructions to complete the GUI installation.

Configuring the FM-5 TCP/IP Address*

Once the GUI has been installed you must configure it and the FM-5 so that they can communicate with each other. This requires configuration for both the FM-5 and the remote GUI so that they agree on the networking parameters.

Before starting the configuration procedure, please locate and carefully make a note of the FM-5’s 12-digit MAC Address which is located on a label either on the top cover or the rear panel. This address will be in the format 00:50:C2:23:xx:xx where xx:xx are the digits unique to your FM-5.

Note that if the MAC address is not entered carefully and correctly in the following steps, the FM-5’s IP address will not be changed!

Start the FM-5 GUI software. Then right click on the control area of the GUI and select Hardware/Assign IP Address. The window on the right will appear:

Next, carefully enter your FM-5’s MAC address in the MAC Address field. The MAC address must be carefully entered because the GUI will “send” the IP address information to the device that owns the MAC address that was entered in this step. If the MAC address is incorrect, the FM-5 will never ‘hear’ it.

** The FM-5 does not support DHCP (Dynamic Host Configuration Protocol) and therefore requires a static TCP/IP address on the network. Its presence on the network will not interfere with DHCP addressing of other network connected devices as long as the IP address that is configured for the FM-5 does not conflict with the address of any other device on the network. Please consult your friendly IT manager if necessary.*

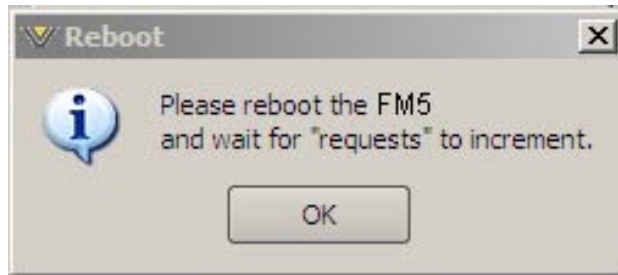
Figure 1
FM-5 IP Address Configuration

Next, enter a pet name for your FM-5, like WKRP, etc.

Then, enter the IP address that you wish the FM-5 to have, noting that this address must be unique if the FM-5 will be communicating over your network.

Next enter the desired Subnet Mask and Gateway IP addresses. In some cases (but not all) it is sufficient to use the default values from the form.

Once this is done, click the “Start” button at the bottom of the IP address configuration box. A message similar to the one below should appear:



Click OK, then remove power to the FM-5 for a few seconds, and then reapply it. As the FM-5 is booting up, the “Requests” number in the IP Address window should increment to something other than zero (please see the bottom of the image in Figure 1). When this occurs the FM-5 has been programmed with its new IP address and is ready for use.

Now that the FM-5 has its own TCP/IP identity, we must configure the GUI so that it can talk to the FM-5. This is done by adding “devices” to the list of FM-5’s that the GUI knows about. To do this, locate and click on the “Devices” button that is located along the right side of the GUI.

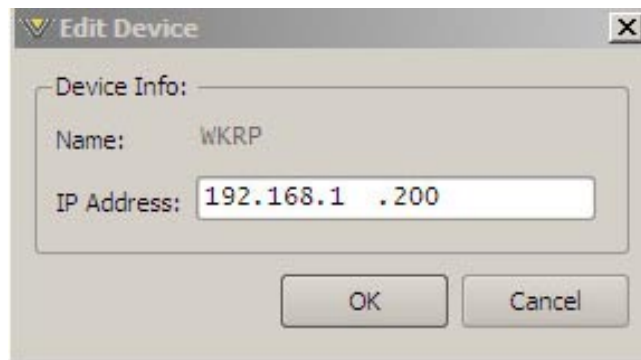


Location of “Devices” Button

When this is done, the following Devices window will pop up:



Next, click the “Add” button and a new dialog box will appear - this is how new devices are added or the configuration of existing ones modified

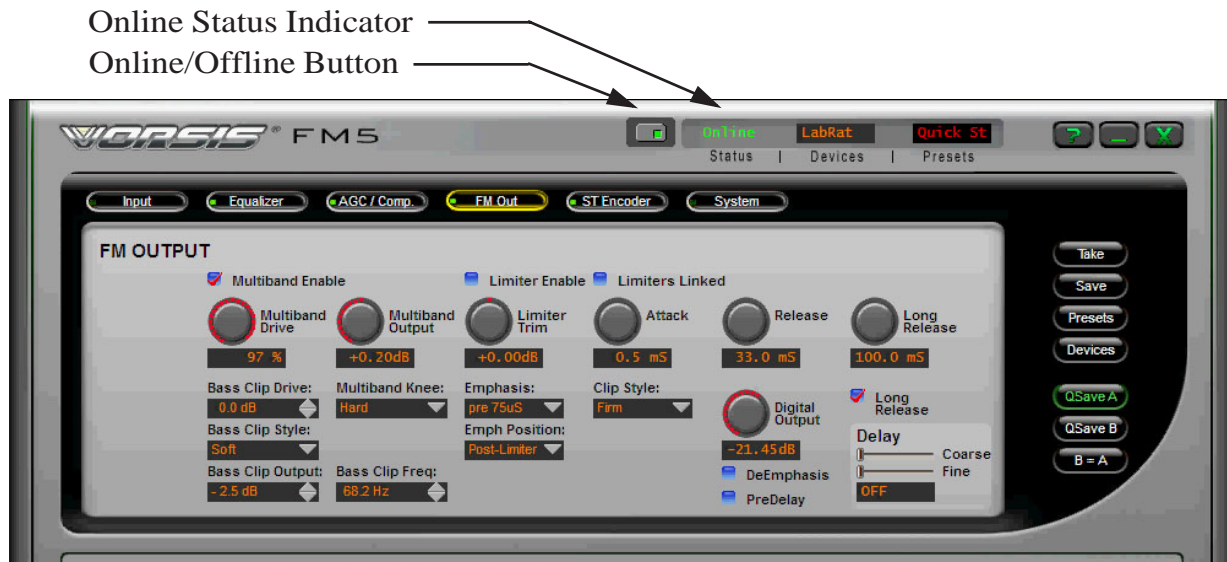


First, enter the same pet name that you used when you assigned the IP address to the FM-5.

Next enter the IP address that you configured the FM-5 for in the previous steps. Note that it is always best to completely delete any existing data in the IP Address box and enter the IP address from scratch. We apologize for this inconvenience.

After this is done you may click “OK” on the Edit Device box. Then, in the Devices Dialog box, highlight (single left click) the FM-5 device that you just added and click on “Select”. This step tells the GUI specifically which FM-5 you want to connect to.

Next, click on the Online/Offline button just to the left of the Status indicator.



In the Status window you may see the message “Trying” as the GUI is handshaking with the FM-5. Once the handshake is complete and communication protocols are locked in the Status message should revert to “Online”.

If for some reason the GUI cannot connect with the FM-5, the “Trying” status message will remain and will occasionally blink as the GUI retries the establishment of a connection. Under these circumstances the configuration of the GUI and FM-5 should be carefully examined to ensure that the destination TCP/IP address is consistent between the two.

Of particular importance is that the controlling PC and the FM-5 must be on the same network subnet. For instance, if the FM-5 was assigned the IP address 192.168.1.194, then the PC’s IP address must be between 192.168.1.1 and 192.168.1.254, noting of course that the FM-5 and GUI PC cannot share the same IP address.

Additional Notes on FM-5 GUI Connectivity

The VORsis FM-5 uses both TCP port 55892 and the first available UDP port in the range of 60001 to 60010 during communications sessions.

TCP is used for controlling the FM-5 because TCP works to repair any transmission errors that need to be corrected. This ensures that the FM-5’s controls will always do exactly what you told it to do from the remote GUI.

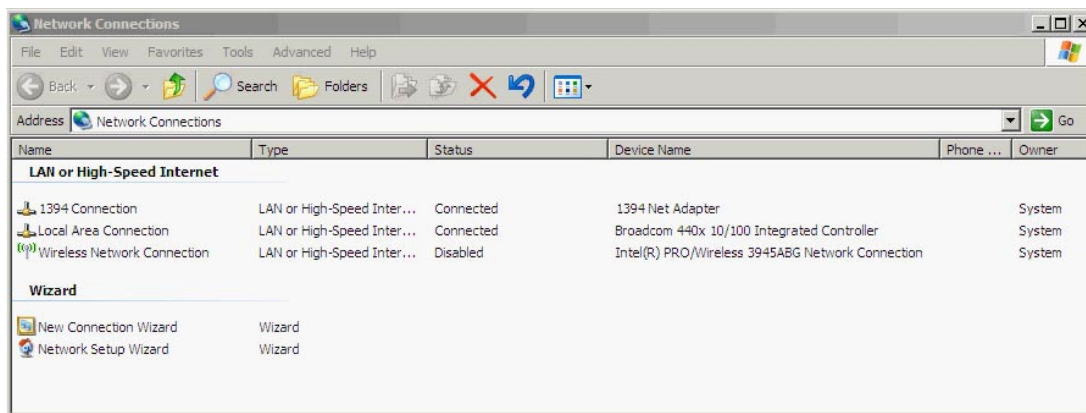
UDP on the other hand is used only for returning meter data back to the GUI from the FM-5. We use UDP because of its low overhead and because we don’t really mind if a meter data packet is dropped occasionally. They are updated so fast that missed meter packets are inconsequential to the operation of the unit.

What this means is that network traffic on TCP port 55892 and the UDP port range 60001 - 60010 must be allowed on the portion of the network between the computer that the GUI is running on and the actual FM-5 hardware. If this is not true, then they will not be able to communicate with each other.

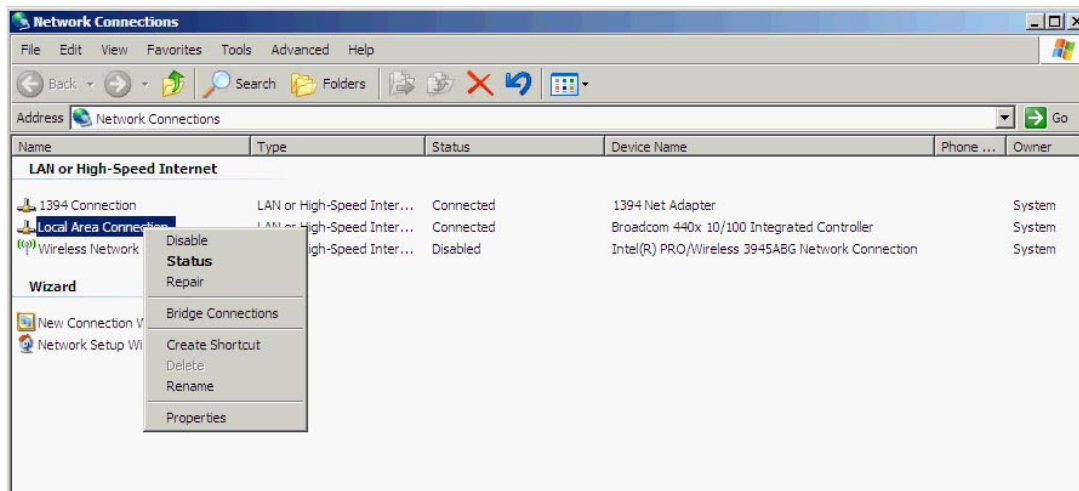
A Known Windows Networking Issue

We've observed that certain builds of WindowsXP exhibit inconsistent behavior during either the IP address configuration process or later during attempts to connect to the FM-5 with the GUI. In most cases this is due to old data being in the PC's ARP (Address Resolution Protocol) cache – the first place Windows looks for how to connect to a networked device.

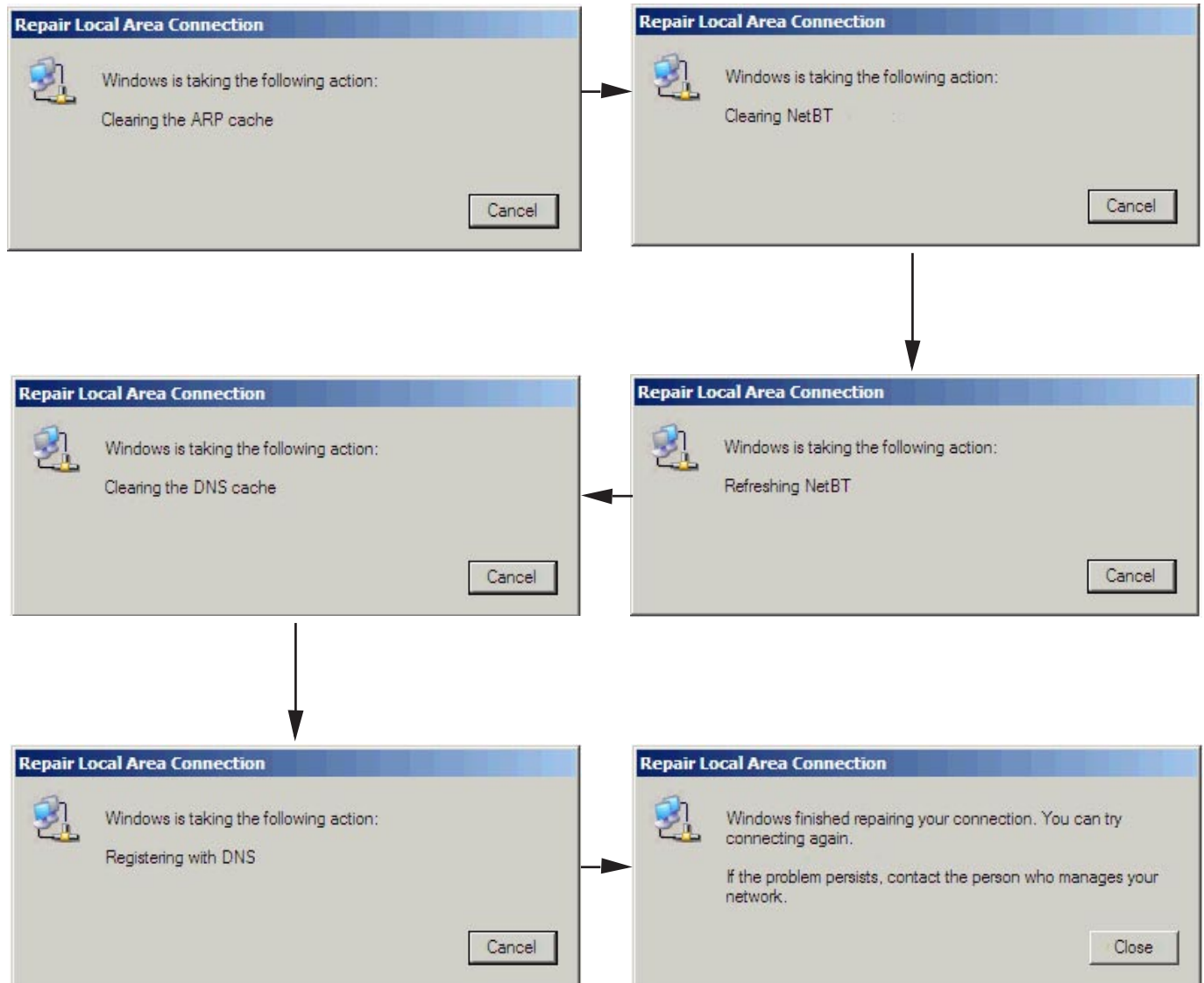
The ARP cache can be cleared manually at a command line, but it's much easier done using the built in tools within Windows. To do this, open the Windows Network Connections dialog:



Next, highlight the Local Area Connection and then right click it. A drop down menu similar to the following will appear:



One of the options in the drop down box is “Repair Connection”. What this does is reset the PC’s Ethernet interface – in essence ‘refreshing’ it. During this process the following six messages will go by:



This process usually completes in a few seconds and when it does the network connection should be fully functional. If it still does not work, then some friendly assistance from your local IT guru might be required.

Achieving Your Special On-Air Sound

First a Few Words About Our Factory Presets

Factory presets are great starting points for many applications, but we'll be the first to admit that they may not be appropriate for every situation. Why?

Here's a simple math problem to illustrate:

$$A \times B \times C \times D = \text{NPFP (Number of Perfect Factory Presets)}$$

Where:

A = the number of different program formats

B = the number of different sounding markets

C = the number of opinions about the station's sound

D = the number of adjustments that your competitors will make once you install your new processor*

* also known as "moving target syndrome"!

The product of $A \times B \times C \times D$ represents the number of presets that an audio processor manufacturer would need to provide in order to perfectly match every possible programming / market / opinion / competitive requirement. As you must imagine, this is not a trivial number!

What we do at Vorsis to help mitigate this is spend a *lot* of time (literally thousands of hours) carefully crafting factory presets that will get you closer to your desired on air sound quicker than if you had to build them from scratch.

We do our best to provide a lot of good starting points in our factory presets, and we're always learning, which is why you'll periodically see new FM-5 presets offered for download on our website.

What Sound Are You Trying to Achieve?

There are four basic goals that most people want to achieve when they install a new audio processor:

1. They want to be louder than another station;
2. They want to be cleaner than another station;
3. They want to have better bass than another station;
4. They want a cleaner and more open high end than another station.

The truth is, only if you're replacing an old audio processor that's on its last legs or, stranger yet, still contains 6386 variable μ triodes in its signal path, will you be getting all of the above benefits in large quantities by buying a new processor.



6386 Variable μ Triode

About Bass

The FM-5 contains our specialized and proprietary Vorsis Bass Management System (VBMS). VBMS extracts, reveals, and then controls low frequency nuances in the incoming program that are simply not heard with any other broadcast audio processor.

Is There a Caveat?

In a word, Yes! The majority of radio listeners don't have the quality of monitoring equipment found at most radio stations. Therefore care is advised when adjusting the FM-5 to accentuate the extremes of the audio spectrum.

Program energy at the frequency extremes is typically several dB below that in the more easily heard midrange. Because of the nuances of human hearing, very low and very high frequencies take a lot more modulation power to become audible to the average listener. Over-boosting bass or treble energy that can be heard by only a small percentage of the station's audience can result in reduced loudness and/or higher distortion for the majority of the station's listeners.

What Is Your Short Term Goal?

The usual short term goal related to installing new audio processing involves generating large amounts of loudness in order to attract attention to the station as a listener scans across the dial.

Almost as important as the station playing a listener's favorite record when they've tuned in, a station that's *LOUD* carries with it a certain 'authority' that can make a listener stay tuned long enough to see what's next on the playlist. And though high loudness on FM doesn't technically increase coverage area of the station like it does for AM, greater loudness does help mask noise at the fringes of the coverage area.

While loudness can attract a listener, so too can it drive them away. Extreme loudness usually carries with it subtle (or not so subtle!) forms of distortion and other artifacts that subconsciously tire a listener and make them tune away without even realizing why. Loudness then, for loudness' sake, must be approached with a bit of caution.

How Do I Make It Louder?

The FM-5 is capable of holding its own in virtually any competitive situation. In general terms, in order to just be louder (we'll cover that first – it's actually a bit easier) you should:

- Increase the density in the five band AGC by operating it with faster attack and release times
- Increase the Drive to the 10 band limiters
- Carefully use some equalization in the parametric section to gently boost frequencies that the ear is most sensitive to (1kHz to 4 kHz)
- Drive the clipper section harder to further increase the amount of RMS energy being generated by the processing

- Operate the 10 band section with faster attack and release times, in fact staggering them slower for the lows, faster for the highs (see Proportional Drag in the tutorial section for the GUI, page 3-16); this can create additional perceived loudness
- Intentionally over modulate like the other stations in the market are probably doing (we don't advocate this, but it *does* happen)

The 10 band limiters can be very deceptive. Because they operate with comparatively fast attack and release times and in very narrow frequency bands they can generate some mighty impressive loudness without pumping, dynamic artifacts, or distortion typically generated by 'broadband' control schemes. The architecture of the FM-5 sets you free to be as loud as your market conditions demand.

Be aware that excessive limiting depth adds little extra loudness and carries with it the risk of driving away your long-term listeners, especially females!

What Is Your Long Term Goal?

If the long term goal isn't to be the loudest radio station on the planet you can still be competitively loud and also sound better, cleaner, brighter, and punchier than other stations in the market.

When loudness isn't the first priority your options open up quickly! Being 'cleaner' than the other stations can increase time spent listening. But be aware that being significantly cleaner carries with it a perception of not being as loud. Why?

The easiest way to demonstrate this is to refer to how a boom box sounds with the volume cranked up to 11 - it sounds loud, doesn't it? In electrical terms it probably isn't, but the distortion created by being overdriven creates an association in the brain that says "it must be loud because it's distorted".

That said, the opposite is true too – if your station has no perceptible distortion at all when compared to 'the other guy' across town – then it might carry the perception that your station can't possibly be as loud. We're not saying don't be clean - just don't be fooled by this psychoacoustic anomaly!

Being cleaner usually means you're not leaning into the processing as hard, which also means that you can use tools like equalization more freely than the really loud station across town can in order to craft the on air sound you want. This is because equalization (EQ) eats up headroom, and if you're trying to be really loud like they are, you need all the headroom you can get and therefore less EQ can be used.

Clean and Loud

To accomplish Clean *and* Loud we can use the behavior of the ear and brain (psychoacoustics) to fool it into thinking the station is louder. The following tweaks, together or in combination, can be used to create a sound that's loud and punchy, but also still subjectively clean:

- Use slower attack times in the AGC sections
- Use slower release times in the AGC sections
- Use slower attack times in the 10 band limiters

- Leave the 10 band release times fairly fast (<100ms)
- Increase the drive to the final clipper (not too much!)
- Increase the drive to the composite processor and use the Mask Filter
- Use a fairly low AGC Super Low to Low crossover frequency – perhaps around 70-80Hz
- Use a fairly high Mid High to High band crossover – perhaps 6 or 7kHz
- Be gentle with any mid-frequency equalization. In fact, partially subduing the range (no more than 1dB) between about 600Hz and 2.5kHz can subjectively clean up otherwise harsh-sounding material. To do this, use the parametric equalizer configured for post AGC/Compressor operation with a center frequency of around 1.2kHz, a bandwidth of about 1.5 octaves, and a cut of no more than about 1 to 2 dB.

The above combination will somewhat ‘relax’ the sound because the AGC sections are operating slower, slightly lowering their average output levels, and also because of the slightly reduced levels in the ear’s most sensitive region due to the midrange equalization.

On the other hand, you’ll note that the drive has been increased to the clippers. The increased clipping depth, albeit only momentary because of the longer AGC attack times, will increase the subjective loudness on larger signal peaks, restoring a sense of loudness and punch and creating a feeling of dynamics and loudness without generating the same kind of distortion artifacts that dense compression and higher duty cycle clipping would create.

With the crossover frequencies at the ends of the audio spectrum carefully tuned to the extremes (within reason!), the dynamic behavior of the AGC/Compressor can create that familiar “smile curve” equalization and lend an overall sense of Hi-Fi to the sound without having to rely on static equalization.

Can I Generate That “Sixties” Compression Sound?

Yes! The way to do this is to purposely drive the multiband section harder and then trade off the slower acting AGC against the faster time constants of the compressors.

This is accomplished by operating the AGC Backoff control at negative numbers greater than about -2.0dB to -3.0dB, causing more gain control to be accomplished using the faster compressor time constants. If you are careful to not run the Backoff control too far negative, the AGC will provide a ‘platform’ that the compressor can work against preventing rapid suck-up of background noise that might be undesirable.

A word of caution if you’re also using reverb to augment that ‘sixties’ sound... with faster and deeper compression reverb tails will become exaggerated. This artifact can be reduced in several ways:

- Reduce the amount of reverb;
- Operate the AGC Backoff control at slightly less negative numbers;
- Reduce the overall drive to the AGC/Compressor section;
- Raise the Freeze Threshold to less negative numbers and decrease the Freeze Wait time to something under 100mSec.

You can use these methods alone or in combination to control reverb tails. Alternately, if your station's sound demands a fair amount of reverb during non-speech programming, then announcer microphones will almost certainly become a challenge. In this scenario you may have to come up with a way to reduce the contribution of the reverb, but only when talent microphones are on.

About Vorsis Factory Presets

The following is a generic description of the Factory Presets shipped with the Vorsis AP-1000, FM-5, and AM-5 audio processors which will point out some general differences between them.

Each processor model contains similarly named presets that have been tuned so that the dynamics control of the audio path through the five band AGC creates the desired foundation sound for each preset. Differences will be found in the final limiting schemes of each of the Vorsis models according to how each has been tuned for its overall performance level and specific application.

Each preset was arrived at through *many* hours of listening with appropriate program material, and each is our best personal assessment of the tradeoffs between what the DSP algorithms are capable of and what a typical radio listener might find appealing.

Please feel free to experiment with the presets, as each one has a unique sound, but don't fall into the trap of thinking that (for instance) the "Country" presets are only good for "Country" music formats. The preset that sounds best with your format and in your market is the one to use, either as is, or as the foundation sound on which to add your personalized touches.

Without further ado and in alphabetical order (after Quick Start, that is) ...

Quick Start (Factory Default)

This preset (preset number 10) achieves a balanced overall texture, fairly flat dynamic frequency response, and moderate loudness. Suitable for a wide range of program material, it is the factory default preset and can be used to get on the air quickly without embarrassment in most markets. It utilizes the multiband limiter operated in "Hard" mode. Both the main clipper and composite processors are utilized to generate reasonable loudness.

Bass: Loud, Loud n Wide, Punchy

LOUD borrows many of the same settings from the Compressed Loud preset, but has a more relaxed sound due to less depth of dynamic frequency response correction being allowed. The Super Low crossover has been set to 80Hz, allowing the SL band to bring up very low frequency material. The SL band's attack and release have been adjusted to pass the feel of the bass without overloading the sections following the AGC. A moderate amount of main clipping is performed in addition to moderate composite processing.

LOUD n WIDE is basically the Dance Energy preset with the AGC section's Sum and Difference channels offset in drive and makeup gain to present a more widened stereo sound field. The sound field is wide, but should not create or exacerbate multipath issues. If you like the sound of LOUD n WIDE but do experience increased multipath, you can try reducing the difference limiter setting to about -3dB in the Stereo Encoder menu.

PUNCHY has further relaxed time constants than the Loud preset, primarily in the attack times of the five band AGC. The preset allows a moderate amount of multiband limiting with staggered time constants (slower on lows, faster on highs) and utilizes a moderate amount of drive in both main clipping and composite processing.

CHR: *Hot, Hotter, Medium*

HOT combines energetic qualities with more activity in the multiband limiter, deeper dynamic frequency response correction in the multiband AGC, and moderate amounts of multiband limiting. A small amount of final peak control is accomplished by both the main clipper and composite processor.

HOTTER combines even more energetic dynamics with deeper activity in the multiband limiter, deeper dynamic frequency response correction in the multiband AGC, and moderate amounts of multiband limiting. A moderate amount of the final peak control is accomplished by utilizing both the main clipper and composite processor.

MEDIUM combines some less energetic qualities of HOT with a little less activity in the multiband limiter. There is also less deep dynamic frequency response correction in the multiband AGC, and a bit less multiband limiting. Final peak control is accomplished by sharing this task with both the main clipper and composite processor.

Classic Rock: *I, II, III, IV*

I creates a balanced texture with moderate loudness. It offers a moderate amount of short term dynamics control as well as moderate levels of dynamic frequency response correction. Preliminary peak control is accomplished by small amounts of multiband limiting and clipping, with primary peak control being done by the main clipper. A small amount of composite processing is used in this preset.

II is an energetic but smooth preset utilizing approximately the same levels of short term dynamics control and dynamic frequency response correction as I, but relies more heavily on limiting in the multiband section. Primary peak control is accomplished by the main clipper. A small amount of composite processing is also used in this preset.

III combines the more energetic qualities of II, with more activity in the multiband limiter, deeper dynamic frequency response correction in the multiband AGC, and moderate amounts of multiband limiting. Final peak control is accomplished by both the main clipper and composite processor.

IV is a variation of III above with a different set of multiband AGC parameters to give it a different ‘feel’ from the other Classic Rock presets. Final peak limiting is performed by both the final clipper and composite clipper.

Classical: *Big, Light, Medium*

BIG is an even more energetic version of classical MEDIUM, allowing larger corrections in short term dynamics to be made as well as a small amount (~3dB) of correction of dynamic frequency response. Final limiting is by small amounts of multiband control, clippers defeated, “Timbral” enabled (in the AP-1000 only), and with final peak limiting done by a combination of a small amount of main clipping and a small amount of composite processing. BIG has a larger on-air presence loudness-wise, but still retains the subjective cleanliness of MEDIUM.

LIGHT is a soft preset and maintains a very flat dynamic frequency response. It alters long term dynamics only, leaving short term dynamics untouched. It utilizes look-ahead limiting in lieu of clipping as the final peak control method and therefore will be very clean but not competitively loud.

MEDIUM is a more energetic version of **LIGHT**, allowing small corrections to short term dynamics. Like **LIGHT**, it has very flat dynamic frequency response and uses the look-ahead final limiter. The primary difference is that this preset also utilizes a very small amount of composite processing to slightly boost perceived loudness without generating noticeable forms of distortion.

Compressed: *Light, Loud, Medium, Wide*

LIGHT is tuned to be compressed but not aggressively so. It also uses the Expander section to gently subdue background noise when the audio level falls. A moderate amount of dynamic frequency response correction is used, as well as moderate amounts of drive to the multiband limiter section in order to increase density. Clipping is kept to a minimum. Additional ‘compressed feel’ is accomplished by using the look-ahead limiter. Final peak control is by the main clipper only. No composite processing is used.

LOUD is more compressed than Medium. A large amount of dynamic frequency response correction is used, as well as moderate amounts of drive to the multiband limiter section which increases density. Clipping drive is deeper. Like the Medium preset (below), a more ‘compressed feel’ is accomplished by using the look-ahead limiter. Final peak control is by a main clipper with moderate composite processing added for increased modulation density.

MEDIUM is tuned to be more compressed but still not aggressively so. A moderate amount of dynamic frequency response correction is used, as well as moderate amounts of drive to the multiband limiter section to increase density. Clipping is increased over the Light version. Additional ‘compressed feel’ is accomplished by using the look-ahead limiter. Final peak control is by a main clipper with a small amount of composite processing added.

WIDE is tuned almost identically to the Medium preset, but uses offsets in the Sum and Difference channels to achieve a wider stereo sound field. If you like the sound of **WIDE** but experience increased multipath on your station, you can try reducing the difference limiter setting to about -3dB in the Stereo Encoder menu.

Country: *Easy, Hot, Medium*

EASY creates a balanced texture with moderate loudness. It offers a moderate amount of short term dynamics control as well as moderate levels of dynamic frequency response correction. Preliminary peak control is accomplished by small amounts of multiband limiting and clipping, with primary peak control being done by the main clipper. No composite processing is used in this preset.

HOT combines the energetic qualities of Medium (below) with more activity in the multiband limiter, deeper dynamic frequency response correction in the multiband AGC, and moderate amounts of multiband limiting and clipping, with a small amount of final peak control accomplished by both the main clipper and composite processor.

MEDIUM is an energetic but smooth preset utilizing approximately the same levels of short term dynamics control and dynamic frequency response correction as Easy, but relies more heavily on limiting in the multiband section. Clipping is approximately the same density as Easy, with primary peak control accomplished by the main clipper. A small amount of composite processing is also included in this preset.

Dance: *Edgy, Energy, Smooth, Wide*

EDGY uses the same crossover frequencies as Energy (below), but with additional dynamic frequency response correction and deeper compression. With some material, particularly that which has been compressed by a perceptual codec, the program can sound a little ‘edgy’. We didn’t find the sound particularly annoying or negative, just different. So we kept this preset and just named it “Edgy”.

ENERGY is compressed like Smooth (below), but has a greater degree of dynamic frequency response correction and lower Super Low and higher High band crossover points. This results in a tight feel on the low end with sheen on the high end.

SMOOTH is an obviously compressed, level-feeling preset with good dynamics control and average dynamic frequency response correction. Peak control is accomplished by small amounts of multiband limiting running at slower time constants. Main peak control is by the main clipper and composite processor.

WIDE is essentially the Energy (above) preset with the AGC section’s Sum and Difference channels offset in drive and makeup gain to present a more widened stereo sound field. We took care to make the sound field wider, but not so wide as to create problems for stations with multipath issues. If you like the sound of Wide but experience increased multipath on your station, you can try reducing the difference limiter setting to about -3dB in the Stereo Encoder menu.

Folk: *Big, Medium, Soft*

BIG is tuned similarly to Medium (below), but has deeper gain control in the multiband section with multiband limiting as the preliminary peak control. The ‘Wide’ algorithm is also used in the multiband section (AP-1000 only) to maintain a more favorable texture with complex instruments. Final peak control is via main clipper with a small amount of composite processing dialed in.

MEDIUM trades off some absolute cleanliness for additional loudness by using the multiband limiters instead of look-ahead limiting as preliminary peak control. Final peak control is via the main clipper with no composite processing used.

SOFT is very similar to the Classical Light preset but with additional short term dynamics control dialed in. It relies on look-ahead limiting as the primary peak control mechanism and therefore will not be competitively loud in large markets.

Hot Stuff

HOT STUFF combines energetic qualities with deep activity in the multi-band limiter, deeper dynamic frequency response correction in the multiband AGC, and moderate amounts of multiband limiting. A moderate amount of the final peak control is accomplished by utilizing both the main clipper and composite processor. This preset has some similarities to the CHR Hotter preset.

Instrumental: *Big, Medium, Soft*

BIG is energetic and smooth, utilizing about the same levels of short term dynamics control and dynamic frequency response correction as Country Easy. It relies more heavily on limiting in the multiband section and final clipping is approximately the same density as in Country Easy, with primary peak control accomplished by the main clipper. A small amount of composite processing is also used in this preset.

MEDIUM is tuned for additional loudness by using more drive to the multiband limiters and instead substitutes main clipping as preliminary peak control. Final peak control is via the main clipper with no composite processing used.

SOFT is a ‘gentle’ preset and maintains a very flat dynamic frequency response. It alters long term dynamics only, leaving short term dynamics untouched giving a sense of ‘depth’ to the music. It utilizes look-ahead limiting in lieu of clipping as the final peak control method and, therefore, the preset will be very clean but not quite as competitively loud.

Jazz: *Big, Light, Smooth*

BIG is energetic but smooth and utilizes the same levels of short term dynamics control and dynamic frequency response correction as Country Easy. It borrows some Sum/Difference tricks from the Wide presets, and it relies more heavily on limiting in the multiband section. Primary peak control is accomplished by the main clipper with a small amount of composite processing added to increase loudness.

LIGHT is tuned similarly to Country Easy, but has a lower High band crossover point in order to prevent unnatural dynamic high frequency equalization. Multiband AGC action is fairly gentle with little contribution from the multiband compressors. Preliminary peak control is via the multiband limiters. No main clipping is used in this preset; however, a small amount of composite processing is utilized.

SMOOTH is a more aggressively compressed preset with good medium-term dynamics control and an average amount of dynamic frequency response correction. Peak control is done by small amounts of multiband control running at somewhat slower time constants, with main peak control being done by the main clipper and a small amount of composite processing.

Latin: *Hot!, Medium, Mild*

HOT! combines energetic qualities of the CHR Hot preset with more activity in the multiband limiter to tune it for showing off the qualities of Latin music. It has deeper dynamic frequency response correction in the multiband AGC, and moderate amounts of multiband limiting. A small amount of final peak control is accomplished by both the main clipper and composite processor.

MEDIUM combines some less energetic qualities with less deep activity in the multiband limiter, less deep dynamic frequency response correction in the multiband AGC, and moderate amounts of multiband limiting. A moderate amount of the final peak control is accomplished by utilizing both the main clipper and composite processor.

MILD combines some less energetic qualities of Medium with a little less activity in the multiband limiter. There is also less deep dynamic frequency response correction in the multiband AGC, and a bit less multiband limiting. Final peak control is accomplished by sharing this task with both the main clipper and composite processor.

Loud: *Loud Wide*

LOUD WIDE has many similarities to the Dance Energy preset with the AGC section's Sum and Difference channels offset in drive and makeup gain to create a widened stereo sound field which gives a sense of space to the preset. There are faster release times used in the compressors (but not the AGC's) which further increases the short-term program density but prevents the sound from being too busy. Clipping is carefully controlled in the main clipper by offsetting the thresholds in the multiband limiter section.

Modern Rock

MODERN ROCK is an obviously compressed but very level-feeling preset with good dynamics control and an average amount of dynamic frequency response correction. The multiband section has been tuned so that it does not further increase density in material that already has high RMS levels. Peak control is accomplished by small amounts of multiband limiter running at slower release time constants, with main peak control being done by the main clipper and composite processor.

News Talk: *Light, Loud, Medium*

LIGHT is tuned to be compressed but not aggressively so. A small amount of dynamic frequency response correction is used, as well as moderate amounts of drive to the multiband limiter section to increase density. Clipping is minimal. A more 'compressed feel' is accomplished by using the look-ahead limiter and final peak control is by the main clipper with no composite processing.

LOUD borrows many of the same settings from the Compressed Loud preset, but has a more relaxed sound due to less depth of dynamic frequency response corrections being allowed. The Super Low crossover has been set to 120Hz, preventing the SL band from bringing up very low frequency material.

A moderate amount of multiband limiting is used to further increase program density. Primary peak control is performed by the main clipper, in addition to moderate composite processing.

MEDIUM has been tuned to be more compressed than Light. A larger amount of dynamic frequency response correction is permitted than in Light, and it also uses moderate amounts of drive to the multiband limiter to increase density. Clipping is minimal. A more ‘compressed feel’ is accomplished by using the look-ahead limiter and final peak control is by the main clipper with additional composite processing added for loudness.

Oldies: *Big, Medium, Soft*

BIG uses some of the Sum/Difference channel attributes of the Dance Wide preset, but also leans more heavily into the multiband limiter section and multiband AGC/compressors. Preliminary peak control is via the multiband limiters, with a small amount of final clipping permitted. Primary peak control is via moderate amounts of main clipper drive as well as a small amount of composite processing.

MEDIUM is tuned similarly to the Dance Smooth preset and uses more gain control in the multiband AGC and multiband limiters. Primary peak control is via the main clipper with a small amount of composite clipping added to give it a competitive boost.

SOFT is tuned similarly to the Country Easy preset, but has a lower High band crossover point in order to prevent unnatural increases of high frequency noise and hiss on older recordings. Preliminary peak control is via the multiband limiters. No main clipping is used in this preset; however, a small amount (0.5dB) of composite processing is utilized.

Punchy

PUNCHY has further relaxed time constants similar to the Bass Punchy preset, primarily in the five band section’s attack times. This preset allows a moderate amount of multiband limiting with staggered time constants (slower on lows, faster on highs) and utilizes a moderate amount of drive in both main clipping and composite processing.

Rock: *Light, Loud, Loud Wide*

LIGHT is energetic and smooth and utilizes moderate levels of short term dynamics control and dynamic frequency response correction. To make this preset reasonably loud, it relies on light limiting in the multiband section. Primary peak control is accomplished by the main clipper with a small amount of composite processing added.

LOUD has similar settings to the Compressed Loud preset, but allows more short term dynamic frequency response corrections. The Super Low crossover has been set to 100Hz to bring out a sense of body. A moderate amount of multiband limiting is used to further increase density. Primary peak control is performed by the main clipper, in addition to moderate composite processing.

LOUD WIDE is tuned with a combination of the settings from the Dance Energy and Bass Loud n Wide presets with the AGC section's Sum and Difference channels offset in drive and makeup gain to preset a wider stereo sound field. If you like the sound of WIDE but experience increased multipath, you can try reducing the difference limiter setting to about -3dB in the Stereo Encoder menu.

Sports: *Light, Loud, Medium*

LIGHT is tuned to be compressed but not aggressively so. A small amount of dynamic frequency response correction is used, as well as moderate amounts of drive to the multiband limiter, which increases density. Clipping is minimal. The look-ahead limiter is used and final peak control is by a main clipper with no composite processing.

LOUD borrows many of the same settings from the Compressed Loud preset, but allows more dynamic frequency response corrections. The Super Low (SL) crossover has been set to 120Hz, preventing the SL band from bringing up very low frequency material. A moderate amount of multiband limiting is used to further increase density. Primary peak control is performed by the main clipper, in addition to light composite processing.

MEDIUM is tuned to be more compressed than Light. A larger amount of dynamic frequency response correction is used than in Light, and it uses moderate amounts of drive to the multiband limiter to increase density. A more 'urgent' and authoritative feel is accomplished by using the look-ahead limiter driven moderately hard. Final peak control is by a main clipper with some additional composite processing.

Urban: *Heavy, Light, Medium*

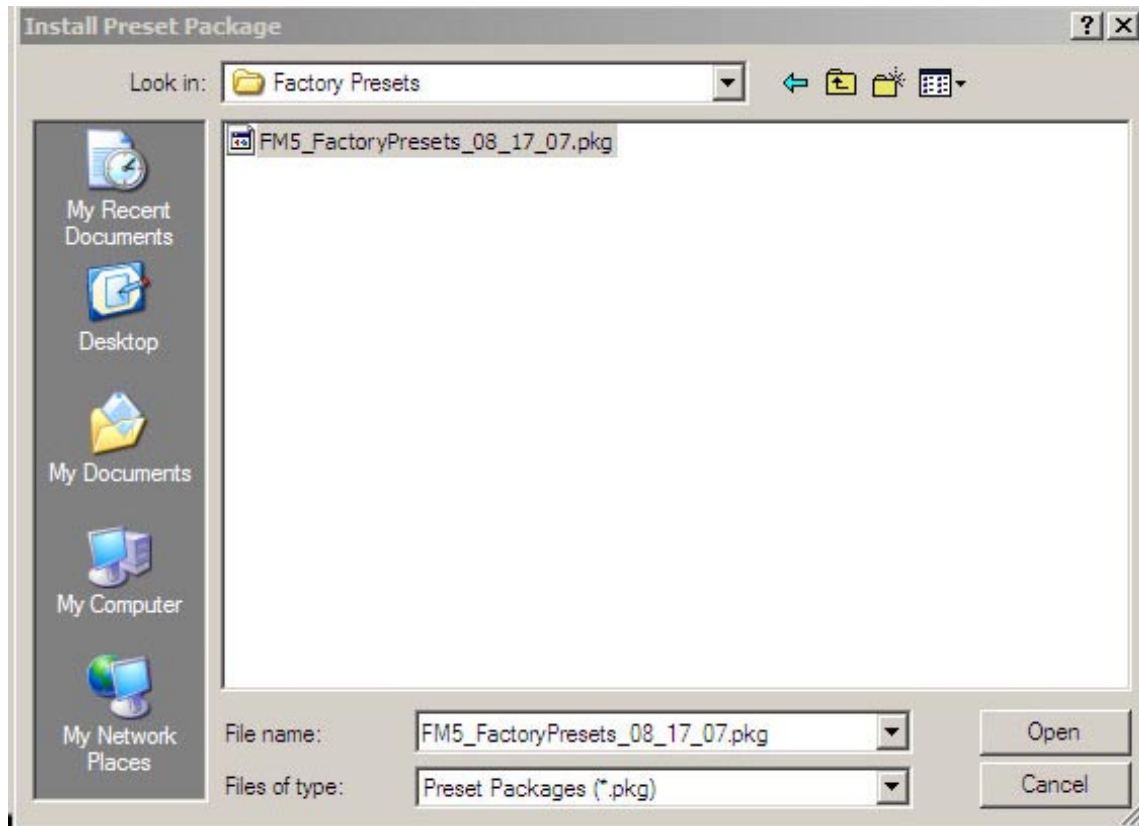
HEAVY is similar to the Dance Energy preset with the AGC section's Sum and Difference channels offset in drive and makeup gain for a widened sound field to give a sense of space to the preset. There are also faster release times used in the compressors (but not the AGC's), further increasing short-term density. Clipping is carefully controlled in the main clipper by offsetting the thresholds in the multiband limiter and final clipper sections.

LIGHT has a more relaxed sound than CHR Hot. Like CHR Hot, the Super Low crossover has been set lower, allowing the SL band to bring up very low frequency material. The SL band's attack and release times have been adjusted to pass the feel of the bass without fear of overloading the sections following the AGC. A moderate amount of main clipping is performed in addition to moderate composite processing.

MEDIUM has more compression than Light due to increased drive to the multiband AGC section and quicker release times. There is also a moderate amount of multiband limiting activity dialed in. The preset also utilizes a moderate amount of drive in both main clipping and composite processing sections.

Future Presets and Preset Updates

From time to time there will be new presets offered for download on the Vorsis website that were either created by the Vorsis development team or contributed by our loyal customers. These presets will be downloadable as “Preset Packages” which will have a “.pkg” file extension. Each preset package file will be named appropriately for the Vorsis product that they are compatible with.



Before downloading a preset package and installing it into your Vorsis audio processor, it is always recommended to consult the Vorsis website to ensure that the preset package that you wish to download is compatible with the current version of firmware in your Vorsis processor.

Vorsis FM-5 GUI

Chapter Contents

Architecture of the FM-5 GUI	3-5
Network Configuration	3-5
Getting Started	3-5
Connecting the FM-5 and the GUI	3-6
Using a LAN Connection	3-6
Configuring the FM-5 IP Address	3-6
Adding Devices	3-8
Connecting Directly Without a LAN	3-10
PC System Requirements	3-10
Wireless Connection	3-10
The Really Remote Connection!	3-11
VPN	3-11
The FM-5 and Internet Security Concerns	3-11
About DHCP and the FM-5	3-11
About "Ports" and the FM-5	3-12
Using the GUI	3-13
Dynamic Displays Region	3-14
Frequency-Domain Graph	3-14
FM-5 Graphical Interface Operation	3-15
First, a short tutorial	3-16
Bargraph Metering	3-17
Gain Reduction Meter	3-17
AES / AGC/Compressor Output Meter	3-18
60dB Range	3-18
Display Signal Selection	3-18
Input	3-18
Predelay	3-18
Audio	3-19
Gain Reduction	3-19
Controls	3-19
L/R (Left/Right)	3-19
O-Scope	3-19
Control Area Region	3-20
Input Menu	3-21
Input Settings	3-21
Input Source	3-21
Input Signal Presence	3-21
Input Failsafe	3-21
Line Gain	3-22
AES Gain	3-22

Balance	3-22
Symmetry	3-22
HPF - High Pass Filter	3-23
Why the Sum and Difference Option?	3-23
Parametric Equalizer Menu	3-24
Enable	3-25
Automatic Gain Control and Compressor Menu	3-26
Drive	3-26
Makeup	3-26
AGC/Comp Buttons	3-27
Freeze Gating and AGC Backoff	3-28
Freeze Threshold	3-28
Freeze Wait	3-28
Gate	3-28
Ooze	3-28
AGC Backoff	3-29
Crossover Frequencies	3-30
Selecting Crossover Frequencies	3-30
AGC/Compressor Gain Reduction	3-32
FM Output Menu	3-33
10 Band Limiter	3-33
Multiband Enable	3-33
Multiband Drive	3-33
Multiband Output	3-34
Multiband Knee	3-34
Vorsis Bass Management System (VBMS)	3-35
Bass Clip Drive	3-36
Bass Clip Style	3-36
Bass Clip Output	3-37
Bass Clip Frequency	3-37
Emphasis Selection	3-38
DeEmphasis	3-38
Look Ahead Limiter	3-38
FM Limiter Controls	3-39
Limiter Enable	3-39
Limiters Linked	3-39
Limiter Trim	3-39
Attack	3-39
Release	3-39
Long Release	3-40
Digital Output	3-40
Clip Style (Main Clipper)	3-40
FM Diversity Delay	3-41
Entering Delay Value	3-41

10 Band Limiter Dynamics Screens	3-42
Thresholds Screen	3-42
Attack Time Screen	3-43
Release Time Screen	3-44
Final Equalization Screen	3-45
Stereo Encoder Menu	3-46
Difference Limiter	3-46
Drive Trim	3-46
Test Oscillator	3-46
Multiplex Process	3-47
Output Metering	3-47
Stereo Encoder	3-48
Pilot	3-48
SCA 1	3-48
SCA 2	3-48
TX 1	3-48
TX 2	3-48
Pilot Only	3-48
Pilot Phase	3-49
Multiplexer	3-49
Mask Filter	3-49
Analog—Stereo Coder Output Options	3-49
System Menu	3-50
System Settings Change With Preset Takes	3-50
Headphone Source	3-51
Headphone Control	3-51
Remote Login	3-52
Front Panel	3-52
GUI Access	3-53
GUI Lock	3-53
Status Indicators	3-54
Skin	3-55
Events	3-56
Creating a Weekly Rotation Event	3-57
Creating a Long Term Rotation Event	3-57
Deleting a Scheduled Event	3-58
Set Time	3-58
Side Bar Region	3-59
Take	3-59
Save	3-59
Presets	3-60
Devices	3-61
Quick Save	3-61

Title Bar Region	3-63
Status	3-63
Devices	3-63
Presets	3-64
Notes on “Online” and “Offline” working	3-65
Accessing Menu Options	3-66
File Menu Items	3-66
Hardware Menu Items	3-66
FM-5 Hardware Update	3-67
Presets Menu Items	3-68

Vorsis FM-5 GUI

Architecture of the FM-5 GUI (Graphical User Interface)

The FM-5 Remote GUI allows you to adjust the processor as well as view in real time how it is reacting to the audio passing through it. The FM-5's GUI has been very carefully designed to put parameters never more than two mouse clicks away. This is a radical change from competing products where constant navigation through numerous layers of menus and screens is required.

Network Configuration - Vorsis FM-5 GUI

The Vorsis GUI PC software allows you to control any number of FM-5's via a standard Ethernet local area network (LAN). Utilizing TCP and UDP protocols, the GUI can control FM-5 devices from anywhere with an Internet connection, including those behind firewalls and through VPN tunnels.

Getting Started

The FM-5 GUI is a Windows™ based program designed to be intuitive and straightforward to use. It is supplied as a self-installing executable program that may be installed to any folder desired on the host computer. Use the Browse opportunity when presented during the installation process to point the installer to put the GUI files in any folder desired.

If a custom program location is not entered, the resulting files will be installed under the default location for all Vorsis Windows-based GUI's: "\Program Files\Vorsis\application folder name, where in this instance the application folder name is "FM5".

After installation, a "Vorsis FM5" icon will appear on the desktop and double-clicking on it will start the GUI program.

Note: Vorsis GUI programs DO NOT put entries in the Windows registry!

To configure the FM-5 network connection a basic familiarity with Windows navigation techniques is assumed. If terms such as "left-click", "right-click", "double-click", and "drag-and-drop" seem alien, operating the FM-5's Windows-based GUI's could be a bit problematic.

Connecting the FM-5 and the GUI

Using a LAN Connection

The FM-5 and PC running the FM-5's GUI program can be straightforwardly connected together over a standard Ethernet Local Area Network (LAN).

The FM-5 should be installed, powered-up, and verified to be operating normally. A CAT5 Ethernet cable connected to the 100baseT LAN should be inserted into the appropriate socket on the rear of the FM-5. Likewise, the GUI should be installed on the desired PC and that PC verified to be working correctly with the LAN.

If it is desired to change the FM-5's TCP/IP address from the factory default, the remote GUI can be used to accomplish this.

Configuring the FM-5 IP Address*

Once the GUI has been installed you must configure it and the FM-5 so that they can communicate with each other. This requires configuration for both the FM-5 and the remote GUI so that they agree on the networking parameters.

Before starting the configuration procedure, please locate and carefully make a note of the FM-5's 12-digit MAC Address which is located on a label either on the top cover or the rear panel. This address will be in the format 00:50:C2:23:xx:xx where xx:xx are the digits unique to your FM-5.

Note that if the MAC address is not entered carefully and correctly in the following steps, the FM-5's IP address will not be changed!

Start the FM-5 GUI software. Then right click on the control area of the GUI and select Hardware/Assign IP Address. The following window will appear:

The screenshot shows a window titled "IP Assignment" with a close button in the top right corner. The window is divided into three main sections. The first section, "Device Filter:", contains a "MAC Address:" label followed by a text box containing "00:00:00:00:00:00". The second section, "New IP Settings:", contains four labels with corresponding text boxes: "Name:" with "NoName", "IP Address:" with "192.168.1.", "Subnet:" with "255.255.255.0", and "Gateway:" with "255.255.255.255". The third section, "Requests:", contains a label followed by a numeric spinner box set to "0". At the bottom of the window is a large "START" button.

Figure 1

Next, carefully enter your FM-5's MAC address in the MAC Address field. The MAC address must be carefully entered because the GUI will "send" the IP address information to the device that owns the MAC address that was entered in this step. If the MAC address is incorrect, the FM-5 will never 'hear' it.

** The FM-5 does not support DHCP (Dynamic Host Configuration Protocol) and therefore requires a static TCP/IP address on the network. Its presence on the network will not interfere with DHCP addressing of other network connected devices as long as the IP address that is configured for the FM-5 does not conflict with the address of any other device on the network. Please consult your friendly IT manager if necessary.*

Next, enter a pet name for your FM-5, like WKRP, etc.

Then, enter the IP address that you wish the FM-5 to have, noting that this address must be unique if the FM-5 will be communicating over your network.

Next enter the desired Subnet Mask and Gateway IP addresses. In some cases (but not all) it is sufficient to use the default values as shown on the screen.

Once this is done, click the "Start" button at the bottom of the IP address configuration box. A message similar to the one below should appear:

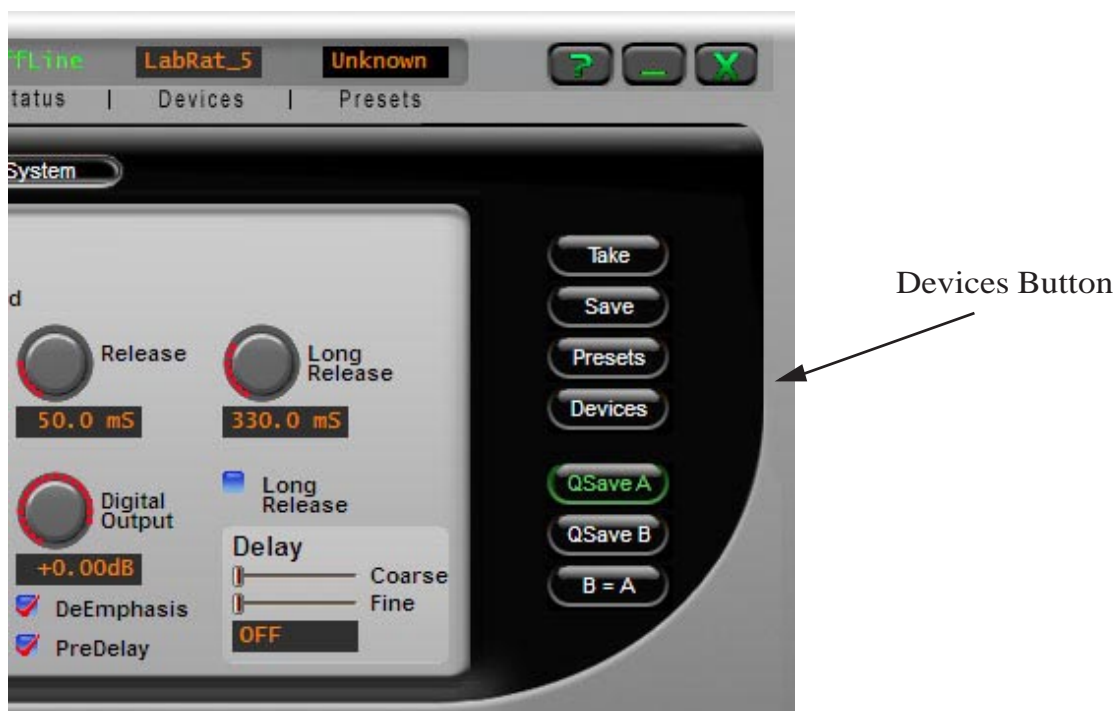


Click OK, remove power to the FM-5 for a few seconds, and then reapply it. As the FM-5 is booting up, the "Requests" number in the IP Address window should increment to something other than zero (please see the bottom of the image at right). When this occurs the FM-5 has been programmed with its new IP address and is ready for use.



Adding Devices

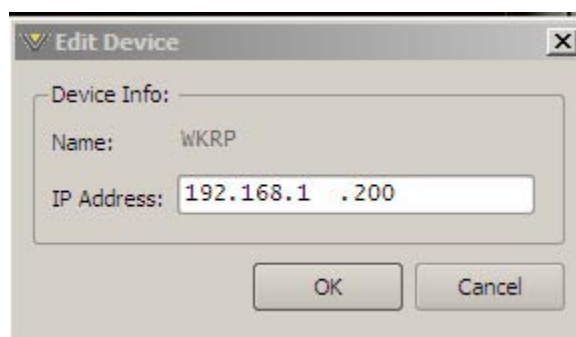
Now that the FM-5 has its own TCP/IP identity, we must configure the GUI so that it can talk to the FM-5. This is done by adding “devices” to the list of FM-5’s that the GUI knows about. To do this, locate and click on the “Devices” button that is located along the right side of the GUI.



When this is done, the following window will pop up:



Next, click the “Add” button and a new dialog box will appear. This is how new devices are added or the configuration of existing devices modified



First, enter the same pet name that you used when you assigned the IP address to the FM-5. The above dialog shows us adding a new device called “WKRP”.

Then enter the IP address that you configured the FM-5 for in the previous steps. Note that it is always best to completely delete any existing data in the IP Address box and enter the complete address from scratch. We apologize for this inconvenience.

After this is done you may click “OK” on the Edit Device box. Then, in the Devices Dialog box highlight (single left click) the FM-5 device that you just added and click on “Select”. This step tells the GUI specifically which FM-5 you want to connect to.

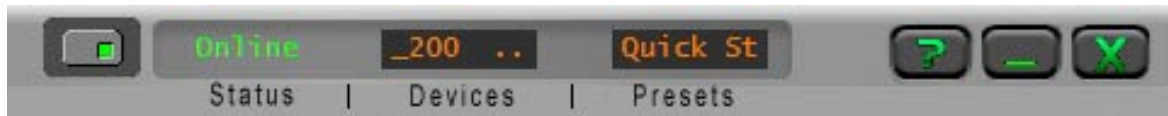
Next, click on the Online/Offline button just to the left of the Status indicator.



In the Status window you may see the message “Trying” as the GUI is handshaking with the FM-5. Once the handshake is complete and communication protocols are locked in the Status message should revert to “Online”.

If for some reason the GUI cannot connect with the FM-5, the “Trying” status message will remain and will occasionally blink as the GUI retries the establishment of a connection. Under these circumstances the configuration of the GUI and FM-5 should be carefully examined to ensure that the destination TCP/IP address is consistent between the two.

Once the GUI has been made aware of the FM-5's existence in this manner, it will always appear in the list of FM-5 "Devices", and be instantly accessible, and from anywhere.



FM-5 GUI Status Bar

When connected to an FM-5 the status bar will indicate "Online", the "Devices" text will show the name of the FM-5 that it is currently communicating with, and it will also display the name of the preset that is running in the FM-5 you're connected to.

Connecting Directly Without a LAN

It is also possible to work without a LAN by connecting the FM-5 and the PC Ethernet ports together using a standard Ethernet cable; either a straight through or crossover cable may be used since the five-port 10/100 Ethernet switch inside the FM-5 has auto-sensing ports. The controlling PC and the FM-5's network settings should be configured to place them both on the same subnet!

PC System Requirements

Constraints for the system are not extraordinary - the PC should be preferably at least 1GHz in speed, running at least Windows 2000 or Windows XP, and the screen resolution should be at least 1024 x 768 pixels in order to get the full benefit of the high resolution graphics utilized. There should be at least 15MB of free space on the hard drive for the GUI software and presets, and the PC's LAN interface (NIC) should be 100baseT (100MHz) capable for best performance.

Wireless Connection

Many users will want to make adjustments to the FM-5 while in a remote location such as their home, office, or car. This can be accomplished in a variety of ways.

The GUI can be run on a portable computer connected to the FM-5's LAN by a wireless (802.11b as a minimum) device, as long as the FM-5 itself "sees" a 100baseT network. This can be done by connecting the FM-5 to a readily available Wireless Access Point and then connecting to the FM-5 through the access point from a wireless interface on a laptop computer.

Be aware that a fairly high quality connection is required in order to have full advantage of the real-time graphics displays on the remote GUI. Low speed connections will still function, but graphics performance, especially when displaying FFT information, may be degraded.

The Really Remote Connection!

One of our customers routinely adjusts his station's FM-5 from the comfort of his company car. In order to accomplish this he connects the FM-5 to the station's business LAN router, maps the FM-5's IP address over to a 'public' IP address via NAT (Network Address Translation), and creates a hole in the firewall for this IP address. This gives the FM-5 "Internet" connectivity, albeit to a very select few.

Then from the laptop in his car he connects to the Internet using his Verizon wireless card, fires up the FM-5 GUI, connects to the IP address that is running in the FM-5 (NAT takes care of the IP address differences), and *voila!* He can adjust his FM-5 from anywhere.

We will leave the myriad other ways in which the FM-5 can be remotely controlled 'wirelessly' up to your imagination and the rapid changes in wireless technology!

VPN

Another way to connect remotely to the FM-5 is via VPN. A VPN, or Virtual Private Network, is a private data tunnel between computer devices. It behaves just as if the local and remote computers were sitting beside each other - devices connected via VPN act like they are on one big LAN regardless of where they are physically located. VPN tunnels can be configured both with and without data encryption. Setting up a VPN is not difficult, but certainly beyond the scope of this manual. Although we have not specifically tested the FM-5 with VPN connections there is no technical reason why it would not work.

The FM-5 and Internet Security Concerns

The FM-5 does not act as a "web device" or "web server". Nor does it support open ports to the Internet. Therefore there is no worry that someone could "hack" into the FM-5 and use it as a pathway to the rest of the network to which it is connected.

About DHCP and the FM-5

The FM-5 does not utilize DHCP — Dynamic Host Configuration Protocol (or automatically assigned network addressing) — and needs to be assigned a "STATIC" network-unique IP address.

Many DHCP servers assign addresses starting at the bottom of the group 192.168.x.xxx. Therefore choosing an address high in that group, say 192.168.0.200 as a static IP address will likely keep it out of the way of the busiest DHCP addressing. However, it's always wise to check with your local friendly network administrator to determine what static IP address is open and safe to use.

Sometimes the local network warrants the "Subnet" and "Gateway" values to be vastly different, but our suggested starting values of 255.255.255.0 for the Subnet and 255.255.255.255 for the Gateway should suffice for all but the most complex situations.

About “Ports” and the FM-5

The FM-5 uses a variety of TCP and UDP ports in order to communicate with the remote GUI. The actual TCP port used depends on the Vorsis processor model. However, in each case the Vorsis processor is the “server” and the PC is the “client”. Vorsis processors can accept up to 4 simultaneous GUI connections to host PC’s.

The FM-5 uses TCP port 55892 for “commands” (control adjustments, etc.) between the host PC and the processor. Metering data does not go over TCP.

Once a TCP connection is established the GUI opens a UDP port and asks the FM-5 to send meter data on that port. The port is typically 60001, but not always. With UDP ports only one application on a PC may open that port at a time, and since we do not know what other applications are running on the PC and we also want to allow more than one GUI to run at a time on any given PC, the GUI will attempt to open port UDP 60001.

If that port cannot be opened, the GUI will then try port 60002, then 60003, etc., up to 60010. Whichever port successfully opens first, that port number will be sent to the FM-5 and the FM-5 will begin to stream meter data over that UDP port back to the GUI.

Note: if there are two or more GUIs attached to the FM-5 then the FM-5 will stream the meter data twice – once for each of the opened port(s) to each GUI.

If the GUI fails to open any of the 10 UDP ports it will still run and be able to control the FM-5 via the TCP port, but it will not receive any meter data to display. Therefore if you have a connection that appears to control the processor just fine but there is no metering displays on the GUI, check to ensure that there is no firewall or other blockage to UDP ports 60001 through 60010.

Using the FM-5 GUI

The GUI may be positioned on the host computer's screen by left-clicking-and-holding the "Vorsis" logo, and dragging the GUI to the desired position. In true "Windows" fashion, the GUI may be minimized on the desktop (taken off the screen) and/or closed by way of the familiar controls at the extreme top right.

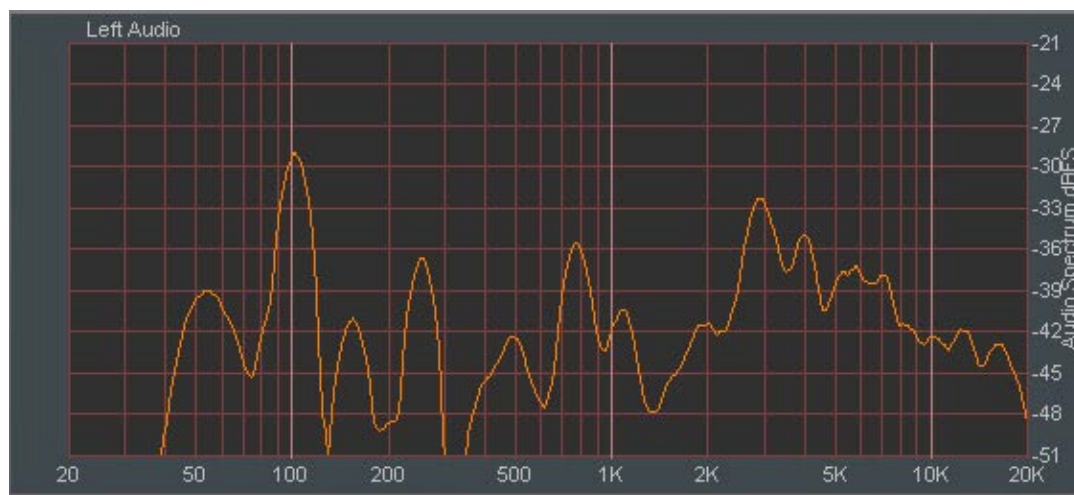
Descriptions of the features and functions of the GUI will follow different discrete regions of the screen; it will begin with the most eye-catching region – the Dynamic Displays – and then we'll explain the Control Area above it, followed by the Side Bar buttons, and lastly the Title Bar.



Dynamic Displays Region

Frequency-Domain Graph

Visually the most important element on the main screen, and in fact dominating the lower half of it, is a large graphical display depicting the standard audio frequency range of 20Hz – 20kHz arranged in logarithmic fashion with gradations at selected frequencies. The vertical axis scale changes according to its context, however the overall vertical range remains at 30dB with gradations every 3dB.



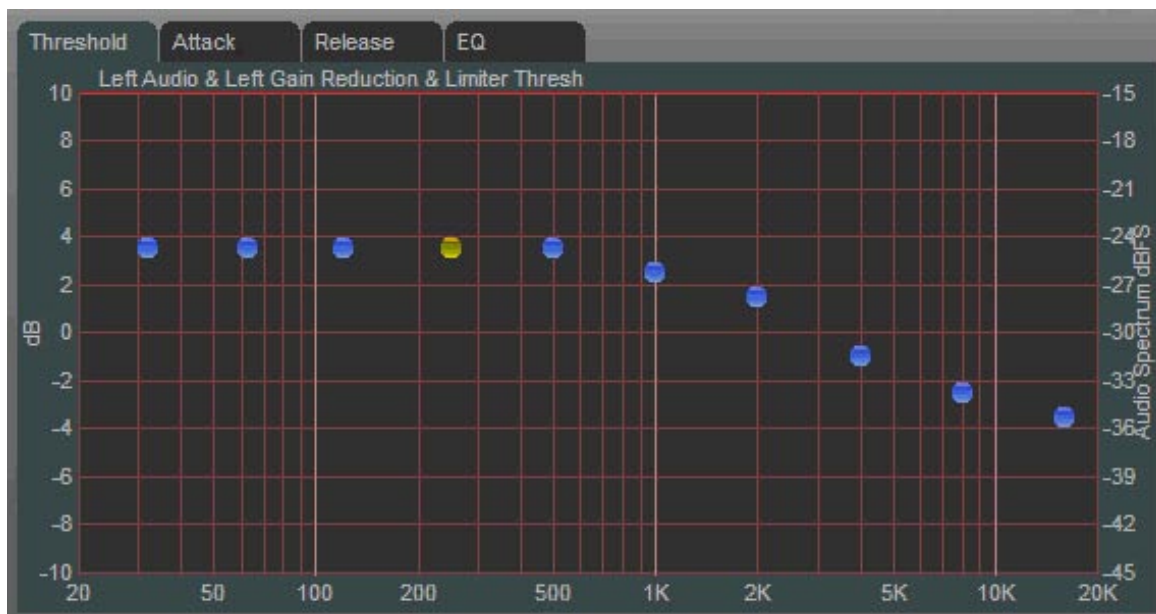
FM-5 Audio Spectrum Display

A number of real-time dynamically varying spectra and other frequency-response-versus-time data may be observed simultaneously. A row of large buttons under the graph determines what data is displayed, and there are also buttons to enable/disable the display of equalizer frequency response curves, filter responses, etc.

The display range of the display may be changed by dragging the right-hand scale up or down as desired.

FM-5 Graphical Interface Operation

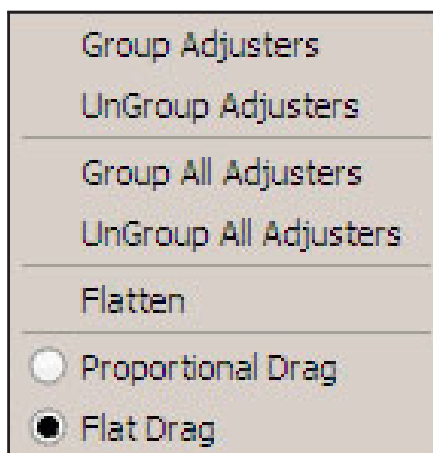
All operating parameters of the 5 band AGC and the 10 band FM limiter can be individually adjusted by manipulating the positions of various blue dots on that sections' graphical screen. Each of the blue dots on the screen represents the center frequency of a band. By double clicking it (to highlight it to turn it red) and then dragging it with the mouse, various operating parameters for each band can be customized.



Example Graphical Control Screen

There are other ways to set parameters, too. In fact all of the controls on the graphical screen work the same way regardless of which processing section 'owns' them. Parameters within each of the processing sections can be accessed by clicking on the associated tab at the top of the screen.

By right clicking on the graphical display area with your mouse the following options will appear:



First, a short tutorial....

By default, all adjusters (the blue dots) are “Grouped”. That is they are coupled to each other so that if you grab one with the mouse (single left click and hold) and then slide the mouse up and down, all blue points move up and down together.

If you double click a blue dot, it turns red to indicate that it has been selected, after which it may be moved individually to anywhere along the vertical scale.

If you now double click another blue dot somewhere else on the line, it too will turn red....

Now if you move the mouse to a point *between* the two dots selected in the above steps, right click the mouse and select “**UnGroup Adjusters**”, all the points in between the first two dots you selected will now also turn red. At this point all of the red dots between the first two can be *individually* adjusted up or down.

If you now place the mouse over the same graphical area, right click again and this time select “**Group Adjusters**” the points between the first two that you highlighted will turn back to blue. If you then grab any blue dot between these points with the mouse (left click and drag) you can move the entire line connecting the two highlighted end dots up and down, with the two end points remaining anchored in place. Cool, eh?

Right clicking on the graphical area and selecting “**Group All Adjusters**” removes all highlighted dots, turning all red dots back to blue. Conversely, right clicking and selecting “**UnGroup All Adjusters**” turns all (remaining) blue points red, meaning they can now each be individually adjusted.

The “**Flatten**” function although next in the list is best explained last....

Okay, highlight a single dot again...any dot will do. Then right click the graphical area and select “**Proportional Drag**”. Now left click the line to the left or right of the dot you highlighted and drag it up or down. See how the line behaves? It pivots at the point where you highlighted the dot, and bends at the point where you grabbed it with the mouse. Virtually ANY curve can be created this way.

Now right click again and this time select “**Flat Drag**”. Then grab the line again... anywhere (left click and drag)... and move it up and down. See how the line pivots at the highlighted point but remains flat above or below it as you raise and lower the line?

So now, after these exercises the line is all messed up, and you want to put it back to where it was or at least make it all flat again without having to move every single point back. But how do you do that? Easy.....

Right click on the graphical area again and select “**Flatten**”. If there were any points still highlighted red you’ll want to first click “**Group All Adjusters**” before you select “**Flatten**” in order to turn them off. When you finally click “**Flatten**” the line will return back to flat and you may move it up and down again with the mouse, this time as a whole.

To review:

Group Adjusters – gangs the **blue** dots *between* two highlighted **red** points into a commonly behaving entity.

UnGroup Adjusters – disconnects any **blue** dots that were grouped by “Group Adjusters”.

Group All Adjusters – gangs all the dots, turning them **blue**, *regardless* of their previous highlighting.

UnGroup All Adjusters – ungangs *all* the dots, turning them **red**, regardless of any previous highlighting.

Flatten – causes adjacent dots to align with each other into a flat line.

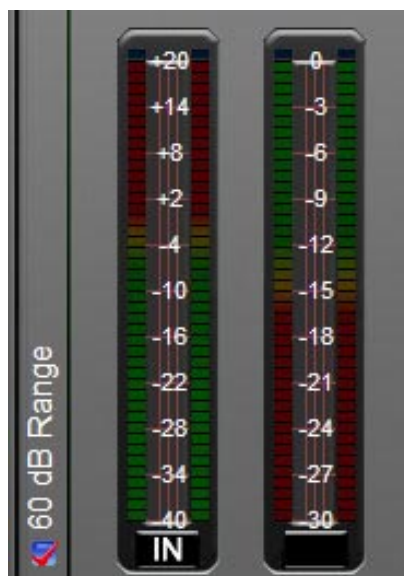
Proportional Drag – allows the dragging of dots to create slopes.

Flat Drag – allows the dragging of dots together in a ‘flat’ orientation.

Bargraph Metering

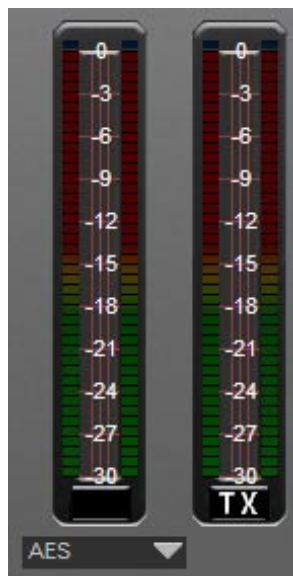
Adjacent to the graph and to the left and right and sharing a 30dB vertical range (0-30dB of gain reduction, 30dB signal level meter range), are a group of vertical bargraph level indicators for signal levels and gain reduction.

The level meters are peak-over-average types, with peaks riding as a lone “dot” over a solid bar-graphed average. An “Over” indication is at the top (but slightly distanced from) the input level bargraphs.



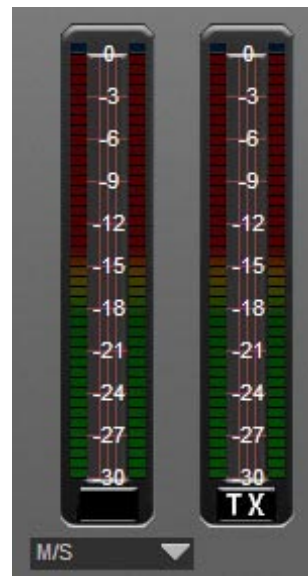
Left of Graph

Left pair - Input Signal Levels
Right pair - Selectable - see below



Right of Graph

Left pair - Selectable - see below (page 3-18)
Right pair - TX Outputs



Gain Reduction Meter (Left of Graph)

The actual function of this meter is selected in the drop down list below it. You can select one of the self-explanatory functions, or allow the meter function to change depending upon the processing section being viewed in the Control Area Region by selecting “Context” from the list.

AES / AGC/Compressor Output Meter (Right of Graph)

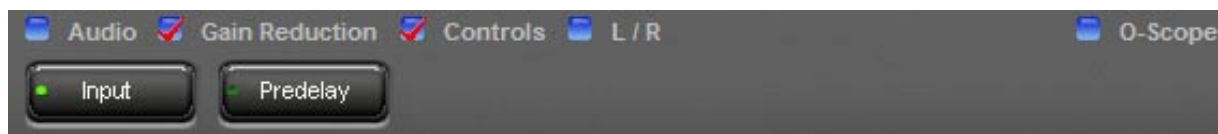
The dropdown list below the leftmost pair of the two vertical bargraph meters to the right of the graphical display window is used to select either the output level at the AES digital output (AES selection) or the output of the AGC/Compressor stage, which is always running in Sum and Difference Mode (M/S selection).

60dB Range

To the left of the Input meter screen is a check box labeled “60 dB Range”; when checked, it toggles from the normal 30dB view range to a 60dB range. The latter range is useful for “finding” signals during initial set-up, or for observing program material when the signal source is of high dynamic range, such as live classical music.

Display Signal Selection

Beneath the graph area are two large buttons: Input and Predelay.



By single clicking on a button a green indicator on the button will light to indicate which signal is being viewed on the large graphical display above it.

Input

Pressing this button enables a Fast-Fourier Transform (FFT) based real-time spectral analysis of the selected (Left/Right, A/B) input signal. An FFT is a mathematical filtering process which calculates the spectral content of a time domain signal.

The FFT¹ is widely used in test equipment in the audio industry because of its extremely precise measurement capability. Thanks to the extremely efficient DSP chips utilized in the FM-5, we are able to offer the same exotic measurement capability in an audio processor. Thus what you see on our graphics displays is as precise as current technology permits.

¹The Fourier analysis is named after French mathematician and physicist Jean Baptiste Joseph Fourier, who first explained it. For more information on the FFT and some of its capabilities, please consult the “Handbook for Sound Engineers” by Glen Ballou and published by the Howard W. Sams Company (ISBN 0-672-21983-2).

Predelay

Pressing this button enables the viewing of the output of the FM processing chain prior to the diversity delay.

Just above the two large buttons, and below the Graphical display, is a row of several checkboxes. We will describe these in order, starting with the leftmost one.



Audio

When this box is checked and the O-Scope box (on the right) is unchecked, the graphical display will show an FFT of the audio. The displayed range may be modified by left clicking on the scale on the right-hand side of the graphic and sliding it up and down with the mouse. The displayed dynamics range is always 30dB.



When the Input button is illuminated, the FFT shows the audio spectrum of the Input audio.



When the Predelay button is illuminated, the FFT shows the audio spectrum of the output of the FM processing chain prior to the diversity delay.

Gain Reduction

When this box is checked, the graphical display includes information related to the amount of gain reduction occurring in the AGC and compressor. The Blue line indicates long-term AGC activity while the Yellow line indicates the shorter-term compression.

Controls

When this box is checked, and if there are controls available for the page being viewed, they will be shown as blue (or red if selected) dots within the graphical display window.

L/R (Left/Right)

When this box is checked the right channel of the audio is displayed on the graphical display according to the selection made by the Audio checkbox. Alternately, when L/R is *not* checked, the left channel is displayed.

O-Scope




When this box is checked *and* the Audio box is also checked, an oscilloscope-like display of the audio waveform is displayed. Which waveform is being displayed at any instant is a function of the selection made under the “Audio” section explained above.

Control Area Region

This is the large “enclosed” area directly above the graph and meters.



All of the knobs, faders, switches, and checkboxes affecting the audio processing itself are within this area. To operate them, either:

-  place the cursor over the desired control, and use the mouse’s scroll wheel to “increase” or “decrease” the control’s position, or
-  click on the control, and slide the mouse to move the control — up or right increases the control’s indicated position, down or left decreases it. When using the mouse in this fashion (as opposed to using the scroll wheel), the resolution of the control variation can be increased — made finer — by holding down the keyboard’s Ctrl key while adjusting the control as above, or
-  in most cases you can double click on the text that indicates the setting value (for example, the window that reads X.XdB under the Line Gain knob on the Input Section) and a box will pop up where you can enter an exact value and click OK.

From left-to-right across the upper portion of the graphical area are a series of buttons corresponding to logically grouped processing sections in general input-to-output signal flow fashion.

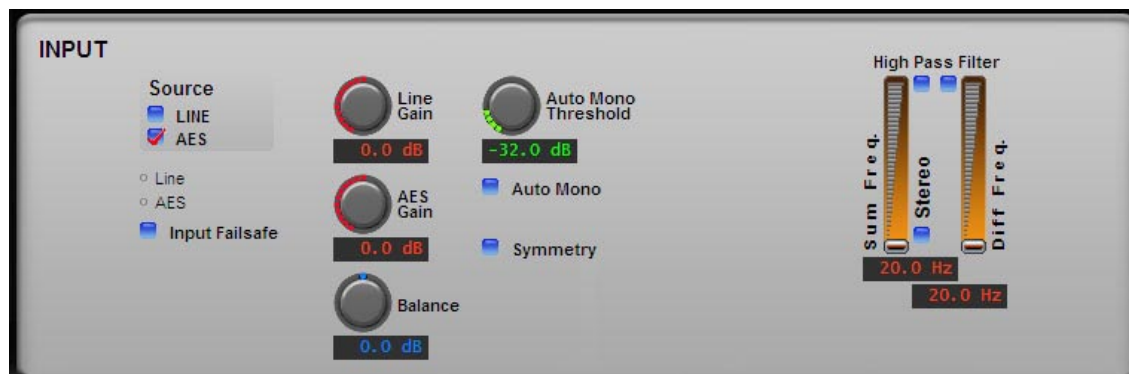


A small green indicator at the left end of each button indicates if any signal processing within that block is active. Left-clicking a button opens the associated control panel to gain access to the controls for that block of signal-processing.

INPUT MENU

Input Settings

This is the first tab on the top far left of the GUI. (Note: the screen that is currently being displayed is indicated by a green background on the selection tab).



Input Screen

The Input screen contains controls for the input source selection, Input Failsafe, Line and AES input gain controls, input L/R gain balance, Symmetry (phase scrambler), and the high pass filters which may be operated in Stereo or Sum/Difference mode.

Input Source

The Input Source can be selected as either Line, which is the analog Left/Right input, or AES, which is the AES3 digital audio input.



The currently selected input is shown by a red checkmark.

Input Signal Presence

Below the source selection checkboxes are a pair of signal presence indicators. The Line indicator lights if there is a signal present at the analog input that exceeds the threshold of -37dBFS. The AES indicator lights if there is a valid AES signal present at the digital input that is above -37dBFS.

Input Failsafe

In the event the currently selected input source fails and the “Failsafe” check box is checked, an alternate source of audio connected to the other input can automatically be put on the air.



If the primary source was digital, the analog input will be selected immediately if the AES3 receiver chip detects invalid bits in the AES data stream or missing audio data.



If the primary source was analog, then a silence sense timeout of 15 seconds must elapse before the unit switches to the digital input in an attempt to restore audio. The audio failure sense threshold is fixed at -37dBFS, a value which is suitable for virtually all program types.

Line Gain

The Analog audio input gain can be adjusted by clicking on the knob and dragging the mouse or touchpad to the right or left. The Line Gain level can be adjusted over a $\pm 24\text{dB}$ range.

AES Gain

The Digital audio input gain can be adjusted by clicking on the knob and dragging the mouse or touchpad to the right or left. AES Gain can be adjusted over a $\pm 24\text{dB}$ range.

Balance

Static level errors in Left/Right channel balance can be corrected by using the “Balance” knob. The Left/Right balance can be adjusted over a $\pm 12\text{dB}$ range. The control is common to both the analog and AES digital inputs.

Symmetry

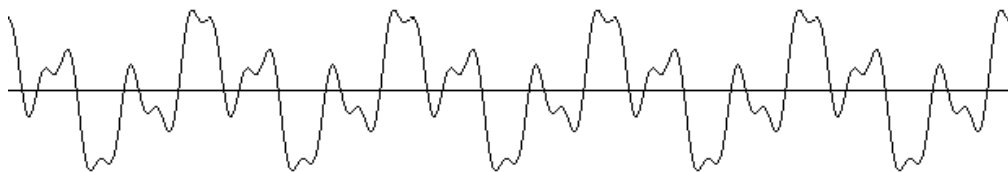
Human voice is asymmetrical in nature, which means that it is usually “peakier” in one polarity than the other. The Symmetry algorithm fixes these asymmetrical peaks by phase shifting the signal harmonics relative to their fundamentals. This reduces the peak to average ratio and enables an increase in apparent loudness with minimal audible detriment. Processing the audio for a symmetrical medium like FM is greatly simplified if the waveforms are symmetrical.

Ordinarily, human voice looks like the waveform below. Notice how the width and amplitude of the upper and lower signal peaks are different? This is asymmetry, and makes the processing of voice waveforms more difficult.



Human voice before Symmetry algorithm

After passing through the FM-5 Symmetry algorithm the same voice appears like the waveform below. Notice how the upper and lower portions of the waveform now have equal distribution?



Human voice after Symmetry algorithm

No information is lost and no harmonic or intermodulation distortion is created by the Symmetry process. Only the signal’s harmonic phase relationships are rearranged to make the waveform energy more uniform in polarity.

HPF - High Pass Filter

The High Pass Filter is used to remove undesired subsonic energy from the audio signal prior to being processed. By removing this energy, processing is cleaner and modulation energy is not wasted by transmitting sounds that would not be perceptible to a listener. The High Pass Filter is also useful in removing subsonic energy that could upset the operation of equipment later in the audio chain, such as the AFC loop in an FM exciter.

The High Pass Filter has three operating modes:

Off – the High Pass Filter is not in operation.

Stereo – the High Pass Filter operating mode is stereo, and in this mode both left and right audio channels are treated equally by setting of the high pass filter.

Sum/Diff – the High Pass Filter is operating in Sum and Difference mode, which means that the sum (mono) information and difference (stereo) information may be processed by different values of high pass filter.

Mode is selected as follows:

- If the Stereo checkbox is checked then the mode is Off if the High Pass Filter checkbox is not checked, or Stereo if High Pass Filter is checked
- If the Stereo checkbox is not checked then the mode is Off if both High Pass Filter checkboxes are unchecked, or Sum/Diff if either (or both) High Pass Filter checkbox is checked

Why the Sum and Difference Option?

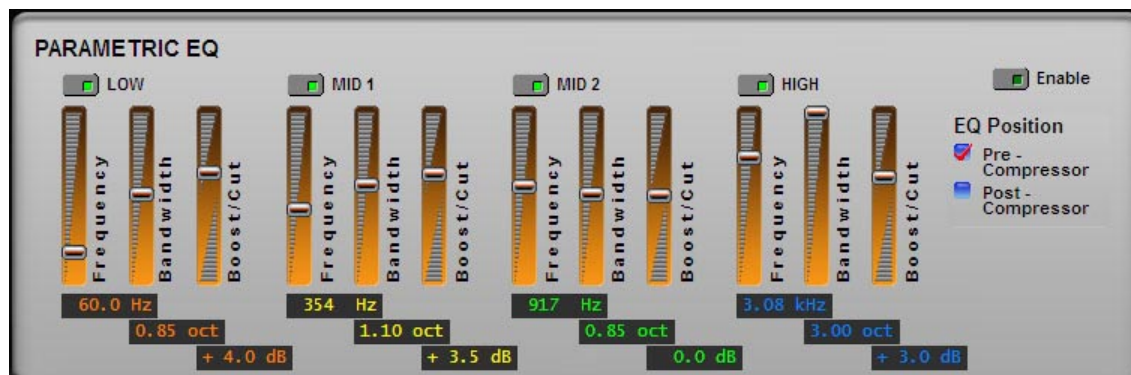
In most program material there is little very low frequency energy in the difference (L-R) signal. In fact, what energy is there is not typically correlated with the program material. Therefore the difference channel can operate with a much higher high pass filter cutoff frequency than the sum channel, and in fact 180Hz is a good tradeoff setting for the majority of program material.

The sum (mono) channel, on the other hand, carries most of the bass energy in the majority of program material and therefore it cannot utilize as high a cutoff frequency as the difference channel without seriously impacting the bass feel of the program.

A good starting setting when using Stereo mode is 30Hz. Good starting settings when using Sum/Diff mode is 30Hz for Sum and 180Hz for Diff.

Both HPF controls operate over a range of 20Hz to 300Hz.

PARAMETRIC EQUALIZER MENU



Parametric Equalizer Screen

This powerful parametric equalizer has four identical and independent bands. Each of the four bands can be switched in or out independently, and is fully adjustable in three ways:

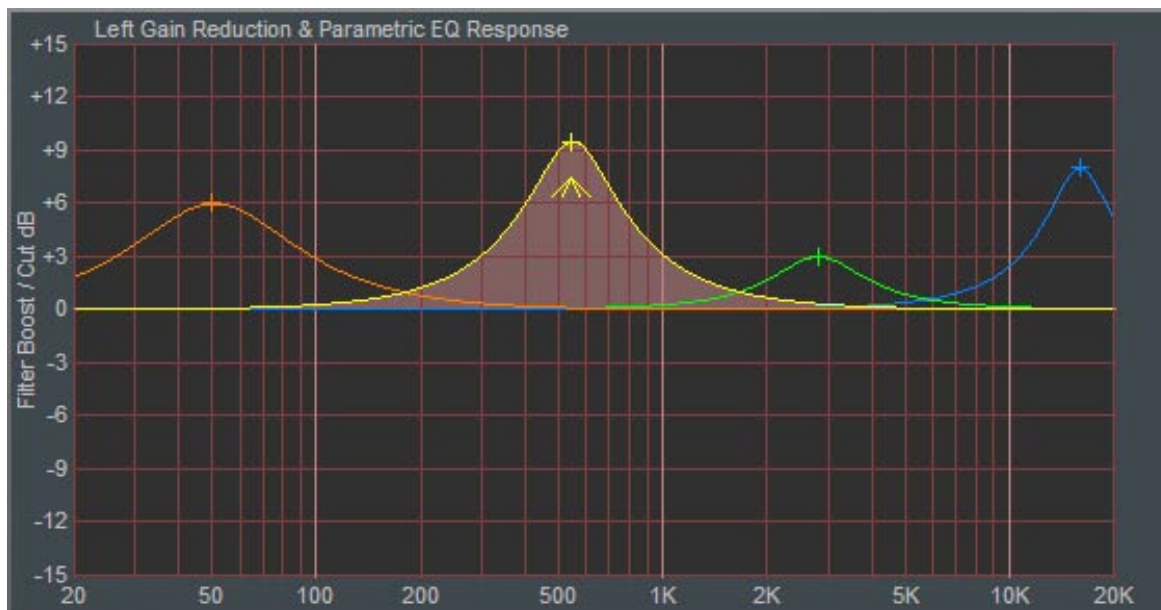
Center frequency	—	20 Hz to 20 kHz.
Bandwidth	—	0.2 to 3.0 octaves.
Boost/Cut	—	+/- 14.0dB.

The position of the parametric equalizer in the signal chain can be selected to be prior to the multiband AGC/Compressor, or after it. The effect created by inserting the equalizer into each position is different.

When the parametric equalizer is used ahead of the multiband AGC the equalization curves “pre-load” the AGC drive to make it operate in a frequency conscious way. Be aware however that EQ changes made to the audio — even dramatic changes — might be reduced when the audio goes through the multiband compressor, especially when operating with ratios greater than about 4:1.

The controls of the equalizer can be manipulated in two ways. The first is by directly clicking on and dragging the controls in the parametric equalizer control screen. As the controls are manipulated, numerical representations of the control settings appear in the boxes below the band that is being adjusted.

The second method of adjusting the parametric equalizers is by directly manipulating the actual curves on the graphical screen below using the mouse.



Parametric Equalizer Display
(the shaded area depicts band that is “on”)



Double clicking on the little crosshair at the top (or bottom if it's below the line) of the curve turns that section on and off.



Clicking on the crosshair and holding the left mouse button down as you drag the mouse moves the curve to any frequency (left or right move) as well as adjusts the curve's height above or below the 0dB reference line (up or down move).



Clicking on the little “Christmas tree” underneath, and holding the left mouse button down, and sliding the mouse left or right allows you to change the bandwidth, or “Q”, of the equalizer section.



Right clicking on the graphic opens a window for manual selection of which curve is to be manipulated with the mouse.

Enable

This is the master Equalizer “In/Out” button. When it is illuminated, the equalizer section is “in”, even if no other section of the equalizer has been enabled by clicking the “Low”, “Mid 1”, “Mid 2”, or “High” buttons.

AUTOMATIC GAIN CONTROL and COMPRESSOR MENU

The FM-5 AGC and Compressor sections are inextricably linked by DSP algorithms that logically connect them. Therefore they will be covered collectively in one chapter rather than discussed separately.

Although the AGC and Compressor sections' outputs may be separately enabled or disabled, the Compressor algorithm is always running so that the desired derivative control signals are available to the AGC section.



Five Band AGC / Compressor Screen

The automatic gain control (AGC) operates in five frequency bands and its long-term operation is a special derivative of the type of program-related processing occurring in the Compressor algorithms. The AGC and Compressor operates in Sum and Difference mode — the highest signal, whether in the sum or difference channel, determines the amount of processing to be applied to both channels.

Drive

The Drive control adjusts the amount of signal into the AGC/Compressor, primarily determining the amount of compression that can be achieved. Driving harder (higher numbers) results in a more consistent on air sound, with an increased capability to pull up low passages in program material. Less drive creates a more 'gentle' on air sound and has less capability to bring up low passages. The Drive control simultaneously adjusts the sum and difference channels. The range of this control is from -79.0dB to +6.0dB, or OFF when fully down.

Diff Trim - The List box below the Drive control contains the trim adjustment for the Difference channel, and may be adjusted +/- 6dB referenced to the Drive control. In other words, if the Drive control is set to +4.0dB and the difference trim to -5.0dB, the difference channel drive is actually -1.0dB.

Normal Drive levels achieve at least 20dB gain reduction in band 3.

Makeup

The control adjusts the overall output level of the AGC/Compressor into the following stages. It simultaneously adjusts the Sum and Difference channels. The range is from -20.0dB to +48.0dB.

Because the AGC/Compressor is a feed-forward design, the loss of signal amplitude created while the input signal undergoes compression must be "made up" afterwards in order to return it to a normal level. This is why the Makeup Gain control has such a wide range.

Diff Trim - The list box below the Makeup control contains the trim adjustment for output of the difference channel and may be adjusted within +/-6.0dB referenced to the Makeup setting.

Example: If the Makeup control is set to +30.0dB and Diff Trim is set to -3.0dB, the difference channel is then scaled downward to +27.0dB, or 3dB below the sum channel.

AGC/Comp Buttons

These buttons determine the presence of the AGC section and the Compressor section in the output.

AGC Button - When illuminated by clicking on it, indicates that the output of the AGC section is in the audio path.

Comp Button - When illuminated by clicking on it, indicates that the output of the Compressor section is in the audio path.

Compressor Out / AGC Out - When both AGC and Compressor are switched off, signal is being bypassed around the Compressor and AGC sections with no gain control being performed.

Compressor In / AGC Out - Signal is being routed through the Compressor only, which operates with relatively fast time constants. The sound of the processing will be quite obvious on most program material.

Compressor Out / AGC In - Signal is being routed through the AGC only, which operates with relatively slow time constants. The sound of the processing will be quite invisible on most program material but very short term variations in level will not be corrected.

Compressor In / AGC In - Signal is being routed through the AGC and Compressor, which together operate with different time constants. The sound of the processing will be quite smooth with both short and long term variations in level being corrected (also see AGC Backoff).

Freeze Gating and AGC Backoff



Freeze and AGC Backoff Controls in the AGC Screen

Freeze Threshold

The Freeze Threshold is the audio level at which the gain reduction release is modified from simple attack and release to a modified release (see explanation for Freeze and Ooze below). The control has a range from -79.0dB to -20.0dB, or OFF when fully down.

On each of the five bands there is also a Freeze Offset Threshold Trim control allowing offsets of +/-6dB to be made to each band referenced to the main Freeze Threshold setting. This allows precise Freeze thresholds to be assigned to each band as appropriate for the program format requirements.

Freeze Wait

Freeze Wait is how long the gating circuit waits after the signal has fallen below the Freeze Threshold before it modifies the release time according to the “Freeze” setting. The Freeze Wait is adjustable from 50.0 milliseconds to 500.0 milliseconds, with values on the order of 50.0 milliseconds to 200.0 milliseconds being useful for typical programming environments.

When Freeze Wait is adjusted for longer periods of time beyond about 100.0 milliseconds, partial release is afforded when the input signal falls below the actual Freeze threshold. This can be useful for maintaining a more natural drop in signal level during program fades.

Gate

When “Gate” is selected and the audio falls below the Freeze Threshold, the gains of the five bands will “freeze” at their current values and will hold at those values until audio is present that is above the Freeze Threshold. This prevents a gain increase in the absence of audio which would likely increase background noise.

Note that the time between achieving the Freeze threshold and the actual gain Freeze is determined by the setting of the Freeze Wait control.

Ooze

When “Ooze” is selected and the audio input falls below the Freeze Threshold, rather than the gains of the bands ‘freezing’ as above, they will slowly return towards 0dB. This setting may be useful for formats that contain material with very wide dynamic range or for certain speech-based formats where the “Gate” setting may not be appropriate.

Note that the time between achieving the Freeze threshold and the actual gain transition to Ooze is determined by the setting of the Freeze Wait control.

The Freeze controls are quite subjective and therefore should be adjusted entirely by the requirements of the program format. There is no right or wrong setting of the “Freeze” controls unless that setting causes undesired, unexpected, or unwanted behavior of the processor during low level program passages.

AGC Backoff

The AGC Backoff adjusts the processing balance between slower AGC action and faster compression.

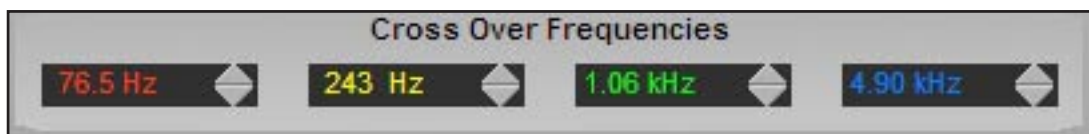
With the Backoff control set at “0”, the audio gain control is primarily due to slower AGC action and therefore short term program dynamics are largely unaffected unless they exceed the AGC gain reduction by at least 1dB. In that case momentary gain reduction by the compressor will place the gain where it needs to be to return control to the AGC.

With the Backoff control at the other extreme, or -12dB, gain control is primarily due to fast compression and short term dynamics will be aggressively controlled.

The setting of the Backoff control allows the audio compression texture to be modified from a gentle, almost unobtrusive control (backoff between “0” and about minus 3.0dB), to very obvious compression (backoff control at “-4.0” or greater negative numbers) creating a sound that is similar to vintage compressors and limiters from the 1960’s.





Note that regardless of the setting of the AGC backoff control, the AGC and Compressor stages operate with their algorithms linked mathematically and there is no method for changing the relative thresholds between the AGC and compressors. If for some reason “less” AGC control signal is desired, it may be achieved by lengthening the AGC attack time to large or very large values.

Crossover Frequencies



The AGC/Compressor is a five band design utilizing 48dB/octave phase aligned filters. Careful filter design eliminates unnatural spectral coloration when deep gain reduction is occurring in one or a few bands.

There are four crossover frequencies to select.

-  The Super Low to Low band crossover frequency is selected using the red list box. Frequencies between 40.5Hz and 120Hz may be selected.
-  The Low to Low Mid crossover frequency is selected using the yellow list box. Frequencies between 149Hz and 334Hz may be selected.
-  The Low Mid to High Mid crossover frequency is selected using the green list box. Frequencies between 817Hz and 1.59kHz may be selected.
-  The Mid High to High band crossover frequency is selected using the blue list box. Frequencies between 2.52kHz and 7.55kHz may be selected.

Selecting Crossover Frequencies

The selection of crossover frequencies plays an important role in determining how an audio processor sounds with different types of program material and therefore the crossover frequencies should be selected carefully.

The upper and lower range of crossover frequency settings is calibrated so that they are most useful with typical program material. Note that the crossovers that affect Band 2 and Band 4 have been made variable in such a way as to allow pseudo-three band operation or operation of those bands with extremely narrow bandwidths which may be useful for some programming requirements.

The table below serves as a starting point for most formats:

Program Format	SL to L	L to LM	LM to HM	HM to H
Classical/Jazz	120 Hz	250 Hz	1.0 kHz	3.00 kHz
Country/AC	102 Hz	204 Hz	817 Hz	4.49 kHz
Dance/Hip Hop	80 Hz	180 Hz	1.16 kHz	5.50 kHz
Modern Rock	93.6 Hz	216 Hz	1.30 kHz	4.62 kHz
Oldies/CHR	111 Hz	250 Hz	1.37 kHz	4.00 kHz
Classic Rock	83.4 Hz	193 Hz	1.59 kHz	6.17 kHz
Talk	120 HZ	250 Hz	917 Hz	3.00 kHz
Sports	120 HZ	281 Hz	817 Hz	2.52 kHz

SL = **Super Low Band**

L = **Low Band**

LM = **Low Mid Band**

HM = **High Mid Band**

H = **High Band**

For most music a Super Low to Low frequency crossover of 120Hz will be quite satisfactory. Likewise, a High Mid to High frequency crossover of about 4kHz works for most material

For fine tuning the sound with different types of program formats, some general guidelines can be given:

For Rock music a slightly lower Super Low to Low crossover of 80Hz can put some extra ‘gut’ into the feel of the music - likewise with Dance or music of other formats that contain punchy, deep bass. There is normally not a *significant* amount of fundamental energy below about 60Hz - 80Hz in most program material.

Lowering the Super Low to Low band crossover down to even lower frequencies, perhaps to 70Hz or even 60Hz, can definitely put some “solid bottom” in the audio with certain music formats. This setting can be inappropriate with other types of program material - particularly human voice - so some care and perhaps even experimentation is advised!

If excessive brilliance is an issue the High Mid to High crossover can be reduced slightly down to around 5kHz or perhaps lower.

To achieve the opposite effect, that is, to impart a ‘shimmer’ to the highs, one might instead move the Mid High to High crossover up in frequency to around to 7kHz. There is generally no sensible reason to increase the Mid High to High crossover to settings above 7kHz on FM.

For more middle of the road music and for Classical and Jazz the Super Low to Low band crossover may be moved *up* to around 120Hz. The High to Mid High crossover may then be moved *down* slightly to around 2.7kHz. These settings prevent the high band from taking too much gain and making the audio shrill, while the higher than normal Low to Mid Low crossover prevents too much low frequency extension on music that just doesn’t sound natural with it.

These are very general suggestions and your particular program format may sound better with other settings. Please feel free to experiment!

NOTE: Although the AGC and Compressor always operates in sum and difference mode, the crossover frequency settings track both signal chains, assuring a stable stereo image at all times.

AGC/Compressor Gain Reduction



The curve above is broken into five segments representing the instantaneous gain control for each of the five processing bands. The blue line depicts the gain reduction occurring in the slower AGC, while the yellow line depicts gain reduction in the faster Compressor section.

Mute - When checked, the band output is turned off. This is useful when you want to hear what one or more bands are doing and allows the dynamic action of bands that are still on to be heard. Note that bands mute status is not saved with a preset meaning that if a band is in mute mode it is always in mute mode until manually removed from that mode.

FM OUTPUT MENU



FM Output Screen

10 Band Limiter

The FM-5 contains a proprietary and fully adjustable 10 band FM final limiter algorithm. This algorithm is especially suited for controlling peak energy without generating unnatural artifacts that outdated and simplistic five and six band algorithms generate.

There is no caveat for using the 10 band limiter other than it is probably inappropriate for most program material to drive the limiters continuously above 4 to 6dB of indicated gain reduction.

We recommend operating the limiters in a manner that allows them to only take care of longer duration transients that the preceding 5 band AGC/compressor misses. For best musicality we recommend that the limiters not be operated with extremely short attack and release times. Please open several of our factory presets and observe the settings in the limiter sections to see what we mean.

The Ten Band Limiter has been designed to be fully adjustable in order to accommodate a wide variety of program material and competitive needs. It also contains the proprietary Vorsis Bass Management System (VBMS) and tightly interoperates with it to intelligently control bass.

Multiband Enable

This checkbox determines whether or not any processing is applied by the 10 band multiband limiter and clipper. When the 10 band section is not enabled, audio peak control is handled solely by the main clipper, look-ahead limiter (if selected) and the composite processor in the FM stereo generator.

Multiband Drive

Determines the amount of input signal applied to the 10 band limiter. Less drive creates a more gentle sound while still controlling peaks, while higher settings make the sound more aggressive through increased short term density. Very high drive settings that result in more than 5-6dB of continuous gain reduction are typically unnecessary with most formats.

The drive control adjusts the overall gain into the 10 band limiter section and its relative setting is dependent upon the setting of the Makeup Gain control in the five band section. For this reason, the control is not labeled in “dB Drive”, but instead in

percent (%). With sane settings of the five band Makeup Gain control the 10 band limiter Drive control will usually be found between 85% and 100%. Full adjustment range is 0% to 100%.

Higher Drive settings cause deeper gain reduction in the ten band limiter, as well as higher levels of clipping in the main clipper algorithm. Therefore, the “Drive” control is the single most powerful control for controlling “loudness”, “density”, and “distortion”.

Multiband Output

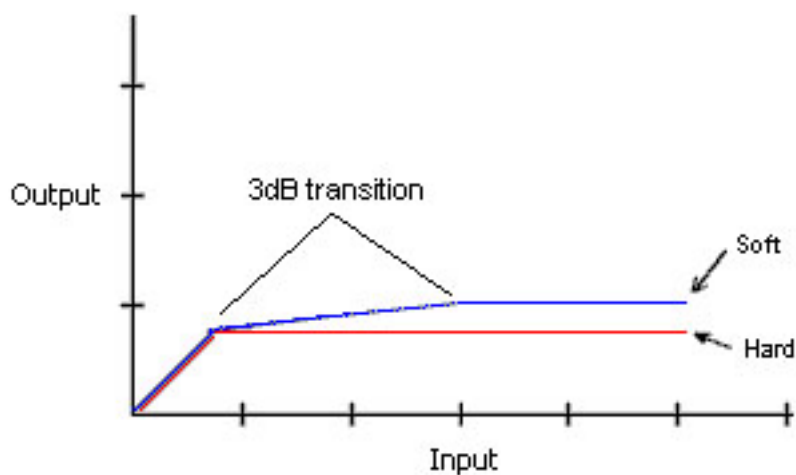
This controls the absolute peak output level of the 10 band section and is adjustable +/-42dB. The resolution of this control is 0.05dB, fine enough for the most exacting output level adjustments.

Multiband Knee



Multiband Knee Options

Each of the 10 bands’ threshold, attack, and release are adjustable, as is the overall transfer function (knee hardness), which affects how the limiters behave near the threshold of limiting. The graphic below illustrates the difference between the two transfer functions.



Comparison of Hard and Soft Limiter Modes

In the “**Hard**” mode, limiting does not occur until the threshold within a band is precisely reached. The sound of this setting is more open and “free” because no limiting activity occurs until the threshold is achieved.

In the “**Soft**” mode, limiting begins to occur at a level that is 3dB below the actual limiter threshold setting. The transfer function at this point is relatively soft. That is, the audio waveform is not abruptly limited, but instead is allowed to increase over an additional 3dB window until the ultimate limit threshold is reached whereupon no further amplitude increase is allowed.

Because of its behavior, the sound of the “**Soft**” function is less obvious and has a ‘spongy’ sound when in operation. It is also less precise as a true limiter until the ultimate limit threshold (the setting of the band threshold) is finally reached.

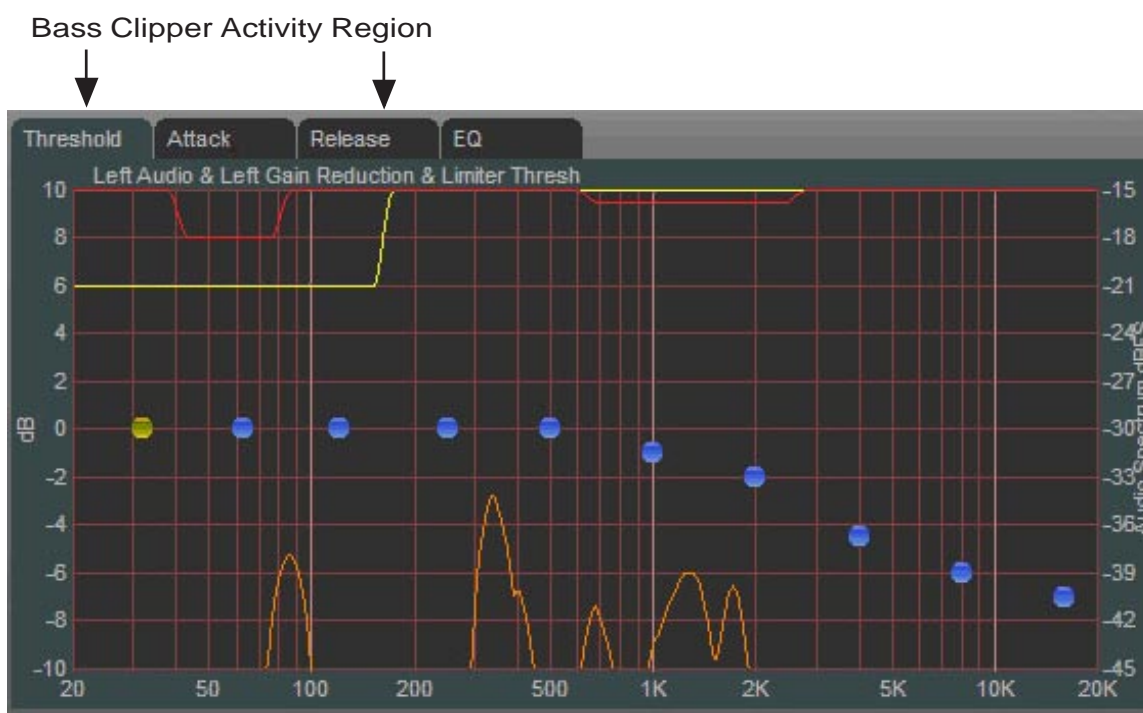
Vorsis Bass Management System (VBMS)

The Vorsis Bass Management System processes extremely low program frequencies in an artistic and natural program dependent manner without causing dynamic gain changes and undesirable intermodulation artifacts. Its primary task is to allow percussive instruments to sound natural while still being well controlled in peak amplitude.

The Vorsis Bass Management system uses special DSP algorithms to control low frequency program energy. A fully tunable Bass Clipper section allows bass punch to be set for the type of program material. It offers two clip styles, plus an OFF setting which, when selected, bypasses the bass clipper algorithm altogether.



The VBMS offers a visual indication of program induced bass clipping activity which can be viewed in the 10 Band limiter graphic as a solid yellow line extending from the Bass Clip Frequency turnover setting downward to 20Hz, similar to that shown below.



Bass Clip Drive

Adjusts the amount of drive to the Bass Clipper and is adjustable over a range of $\pm 10\text{dB}$. Higher drive settings cause bass energy within the filter bandwidth to spend more time above clip threshold, which increases the amount of low frequency energy loudness relative to higher frequency program material.

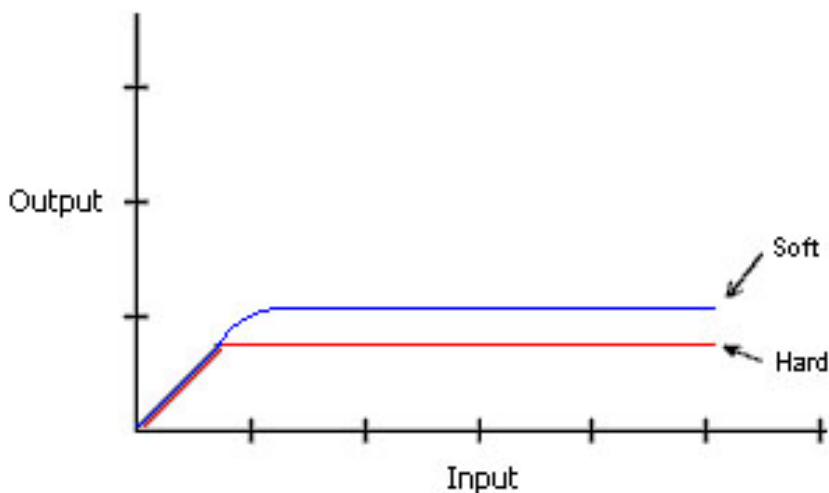
Bass Clip Style

There are two Bass Clip styles plus an OFF setting are available. We call the function a “Bass Clipper” and the styles “Clipper styles” even though in operation the VBMS differs significantly from that of a typical clipper.

OFF - the VBMS is out of the circuit.

Hard - has a transfer function occupying approximately 0.24dB of transition amplitude. The transfer function is moderately abrupt and generates low order harmonics. Afterwards, and in a process that borrows from the technology of the Timbral mode in our Vorsis flagship processor, the AP1000, we mathematically calculate and reduce significant harmonics above the fifth.

Soft - operates with a transfer function occupying approximately 1.15dB of transition amplitude. The transfer function is less abrupt than the hard setting, generating even fewer higher order harmonics, and in this mode we calculate and reduce energy above the third harmonic.



Comparison of VBMS Operating Modes

The two modes may appear to be nearly identical due to the small difference in transfer functions. Rest assured however that there is a *significant* difference in the way the two styles sound on low frequency program material.

Bass Clip Output

Adjusts the output contribution from the Bass Clipper and may be thought of as a VBMS output mix control. The control is adjustable over a range of +/- 10dB.

Generally speaking the Bass Clip Drive and Bass Clip Output may be adjusted to personal taste and format requirements. Care should be exercised in the setting of the Bass Clip Output control because setting it higher than approximately +3dB might cause the peak amplitude of bass material to interfere with the main clipper distortion masking scheme. This could ‘un-mask’ certain forms of undesirable distortion products on certain types of program material.

Generally speaking, the higher the Bass Clip frequency is tuned the more program energy will be managed by the VBMS algorithm and the more active the Bass Clip indication will be. There is no right or wrong amount of VBMS processing — whatever sounds best for the format and market is correct.

Note that overdriving the VBMS will not cause obnoxious forms of distortion normally associated with “Bass Clippers”. This is because the VBMS algorithm is intelligent in that it ‘knows’ about material passing through itself relative to what is occurring in the higher frequency path, and continuously adapts to minimize unintentional intermodulation.

Bass Clip Frequency

The Bass Clipper’s frequency of operation is adjustable from 60Hz to 300Hz.

In general, lower frequency settings produce a ‘heavier’ and ‘tighter’ sound while higher settings result in less coloration while still favorably controlling bass energy excursions. This control should be adjusted to personal taste and program format.

Generally speaking, in formats where the program content contains very heavy low bass such as in R&B, Rap, and Dance, the Frequency should be tuned to 80Hz or below for best on-air results. Other formats might have the control set to higher frequencies. Classical and Jazz, for instance, might see the frequency set to 200Hz or perhaps even higher.

Emphasis Selection

Pre-emphasis is selectable as 50 or 75 microseconds, or Flat (OFF) as shown in the graphic on the right:

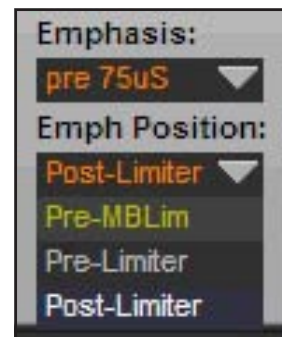
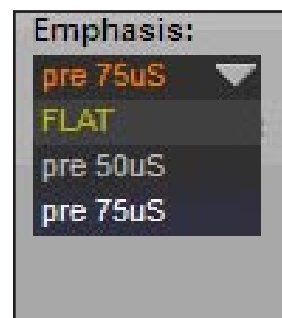
When pre-emphasis is enabled it may be placed in one of three locations in the signal chain:

Pre-MBLim – In this position, the selected pre-emphasis is placed *before* the 10 band limiter/clipper section. In this mode the 10 band section may be operated as a frequency conscious limiter tailored to the inverse of the selected pre-emphasis.

Pre-Limiter – In this position the pre-emphasis is *after* the 10 band section but *before* the Look Ahead limiter (if enabled) and/or main clipper.

Post-Limiter – In this position the pre-emphasis is *after* the 10 band section and Look Ahead limiter and *before* the main clipper.

Entirely different sound textures may be created by placing the pre-emphasis in one location versus the other. There is no right or wrong setting unless that setting does not produce the on air sound desired.

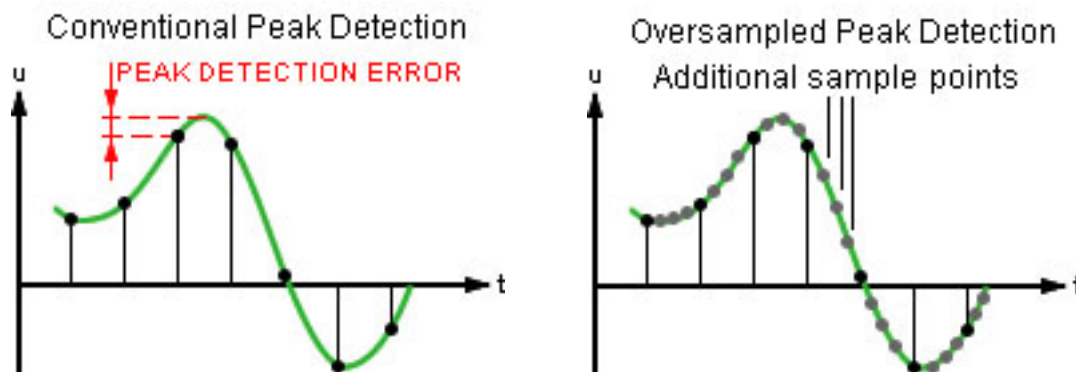


DeEmphasis

When the De-emphasis checkbox is selected it applies complementary de-emphasis according to any pre-emphasis setting that has been made in the FM Output screen's "Emphasis" list box.

Look Ahead Limiter

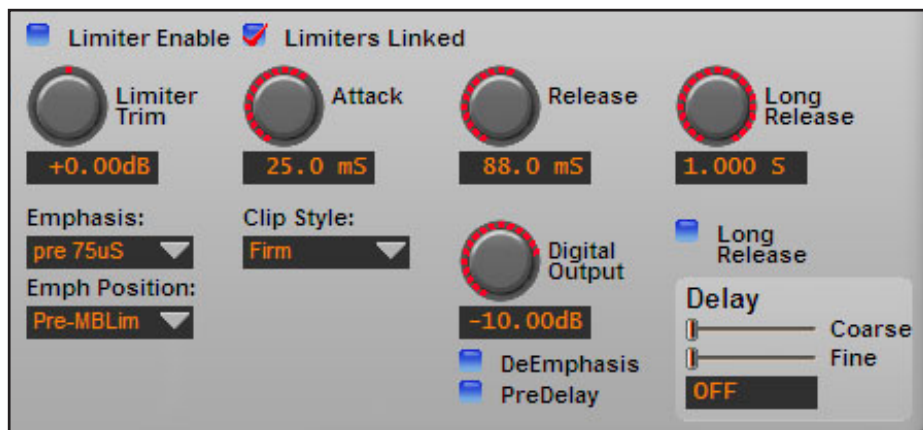
If desired the FM output may be peak controlled by a special high-speed, feed forward limiter with a 5 millisecond lookahead time. The control path (not the audio path) is highly oversampled in order to achieve extremely precise peak control. The primary goal of oversampling the control sidechain is better peak control through finer definition of the audio waveform. Therefore oversampling of the audio signal itself is not only unnecessary, but wastes DSP resources. The graphic below illustrates why control signal oversampling is effective.



By sampling the audio waveform with finer resolution we can detect peak excursions that would be otherwise missed. In fact, if *both* the audio *and* control signals were oversampled peaks would still be missed because their relative time alignment would be identical!

FM Limiter Controls

The graphic below shows the controls available for the look ahead limiter. The text below that describes each control according to function.



FM Look Ahead Limiter

Limiter Enable

When this checkbox is checked the Look Ahead limiter is enabled.

Limiters Linked

When this box is checked the left and right channel control signals are common. This prevents unnatural stereo image shifts when one channel needs to reduce the signal in order to control peak excursions.

Limiter Trim

Adjusts the relative threshold of the look ahead limiter compared to the setting of the Multiband Output control and is adjusted until the onset of limiting is reached with normal program material, as indicated by the FM limiter gain reduction bargraph. Negative numbers *increase* the sensitivity of the limiter by *lowering* its operating threshold. The range of this control is +/-6dB.

Attack

Adjusts the attack time of the look ahead limiter. Attack time settings from 0.2 milliseconds through 4.9 milliseconds allow the limiter to “look ahead” in time and react to signal peaks *before* they arrive at the limiter’s gain control algorithm.

Attack time settings greater than 5 milliseconds and up to the limit of 100 milliseconds allow the limiter to operate conventionally. For example, if the attack time control is set to 10 milliseconds, the actual attack time is 5 milliseconds because the 5 millisecond look ahead is *always* in circuit and its value must be subtracted from the control setting in order to know the actual attack time.

Release

Controls the primary (fast) release time of the look ahead limiter.

Slower settings (longer release times) cause the peak limiter to recover more slowly from limiting; release times set too slow may allow undesirable signal ducking to occur.

Conversely, fast release times increase signal density, and release times that are too fast result in increased intermodulation distortion which can ‘muddy’ the sound.

The overall range of the control is from 33 milliseconds to 330 milliseconds.

Long Release

Controls the secondary (slow) release of the look ahead limiter, and is adjustable from 100 milliseconds to 1 second.

When Long Release is engaged, the limiter will release the first 3dB of gain reduction at the (faster) Release setting, and the remainder of the Release at the Long Release timing. This allows a drastic reduction in intermodulation distortion and allows more limiting depth without incurring a distortion penalty.

Digital Output

Adjusts the peak audio signal level present at the AES/EBU digital output. The resulting peak output levels are simultaneously indicated in dBFS by the front panel and remote GUI bargraph meters. This control can be set to OFF or adjusted over the range of -79.95dB to +12.00dB.

Clip Style (Main Clipper)

Three final clipper styles are offered in the Main Clipper to enable the end user to create the sound desired. All settings offer good peak control because the main clipper is then followed by a sophisticated overshoot calculator that removes peaks that are, due to their frequency and energy content, anticipated to cause signal peak overshoots.

The total average drive to the Main Clipper is determined by the setting of both the Multiband Output control and the amount of activity occurring in the 10 band limiter section. This is because increased limiting depth increases energy, which in turn can increase the duty cycle of clipping occurring in the Main Clipper.



Off – defeats all clipping in the main FM clipper.

Hard – the Hard style has an infinite ratio with no increase in peak levels above threshold. This is the most ‘forgiving’ of the clip styles as far as clipper drive levels are concerned and adds brightness and density to the program.

Firm – The Firm style has a transfer function that allows progressively higher ratios over a 0.5dB transition region. Its operation is somewhat softer sounding than the Hard setting, but is a bit less forgiving in drive level and can sound grainy on certain program material.

Because this style is moderately sensitive to drive levels it is somewhat more difficult to find its ‘sweet spot’.

Round – The Round style has a transfer function that allows progressively higher ratios over a 1.10dB transition region. This style contributes ‘roundness’ to the audio without sounding overly harsh but can be the most difficult mode to tune for its sweet spot. However, it can be quite powerful for certain formats when tuned correctly.

In both Firm and Round modes the ear is the best guide for finding the best settings.

FM Diversity Delay

The FM-5 contains an internal digital delay to compensate for the corresponding delay in the HD Radio codec. The delay section is capable of providing up to ten seconds of compensating delay in steps of 100 microseconds.

The **Coarse** delay is set first to align the analog and HD signals as closely as possible, and then the Fine delay control is used to trim the delay to precisely compensate for that in the HD channel. Generally it is a good idea to set the Fine delay to midrange before adjusting Coarse delay. That way the delay can be adjusted in small increments up and down until perfect synchronization with the HD signal is achieved. Resolution of the Coarse delay is 50 milliseconds.

The **Fine** control covers a range of 50 milliseconds in 0.1 millisecond (100 microsecond) steps. If the Fine control does not set the increment exactly to the value desired, double clicking on the delay value text box will open it for manual entry of a delay time. Note that the text box expects the manual input to be in milliseconds. Therefore, a delay of 8.3488 seconds would be entered as “8348.8”.

When the Delay controls are both set to their minimum settings, “OFF” appears in the delay window to signal that there is no delay at all in the circuit.

PreDelay — checking this box routes the AES input audio directly to the FM processing circuitry, effectively bypassing the delay.

Entering Delay Value

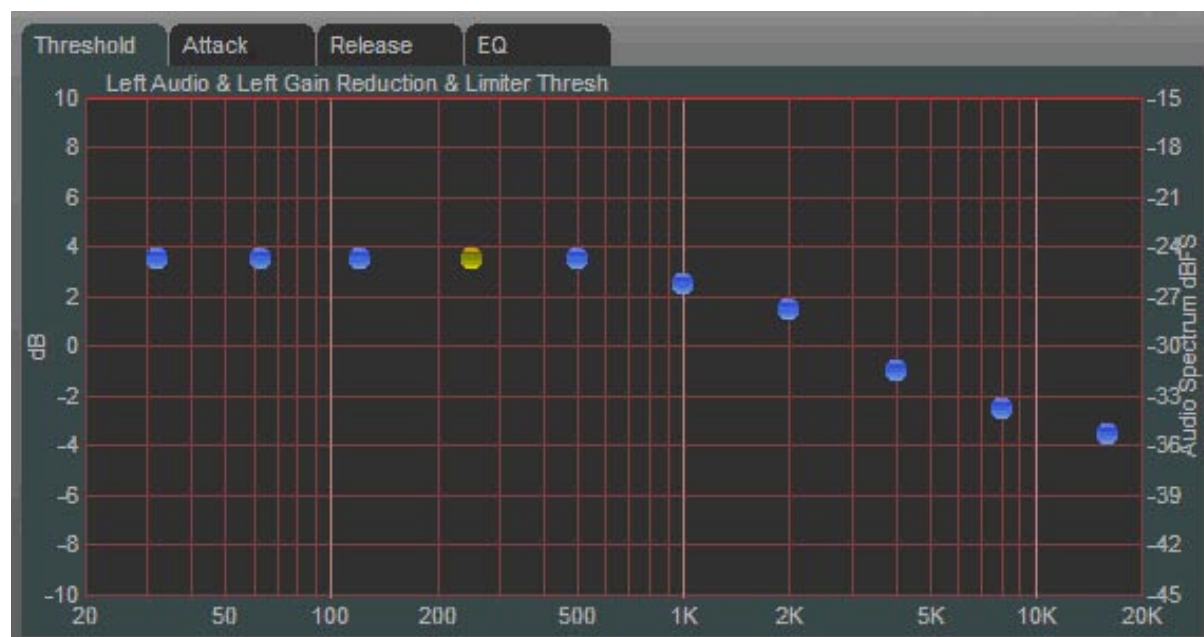
You can double click on the delay value window to directly enter a numeric delay value in *milliseconds*. This is useful when you know roughly how much delay is required or wish to try various values quickly. You may also hold down the *Shift* key on your keyboard while adjusting a delay slider to effect faster adjustment rates, or hold down the *Ctrl* key to achieve finer control.



10 Band Limiter Dynamics Screens

Thresholds Screen

Clicking on the Threshold tab on the graphic opens up the adjustment screen for the limiter thresholds.



10 Band Limiter Threshold Screen

The thresholds are adjustable over a +/-10dB range and interact with the Drive control. Because the thresholds are adjustable over such a wide range, frequency conscious limiting can be created if needed.

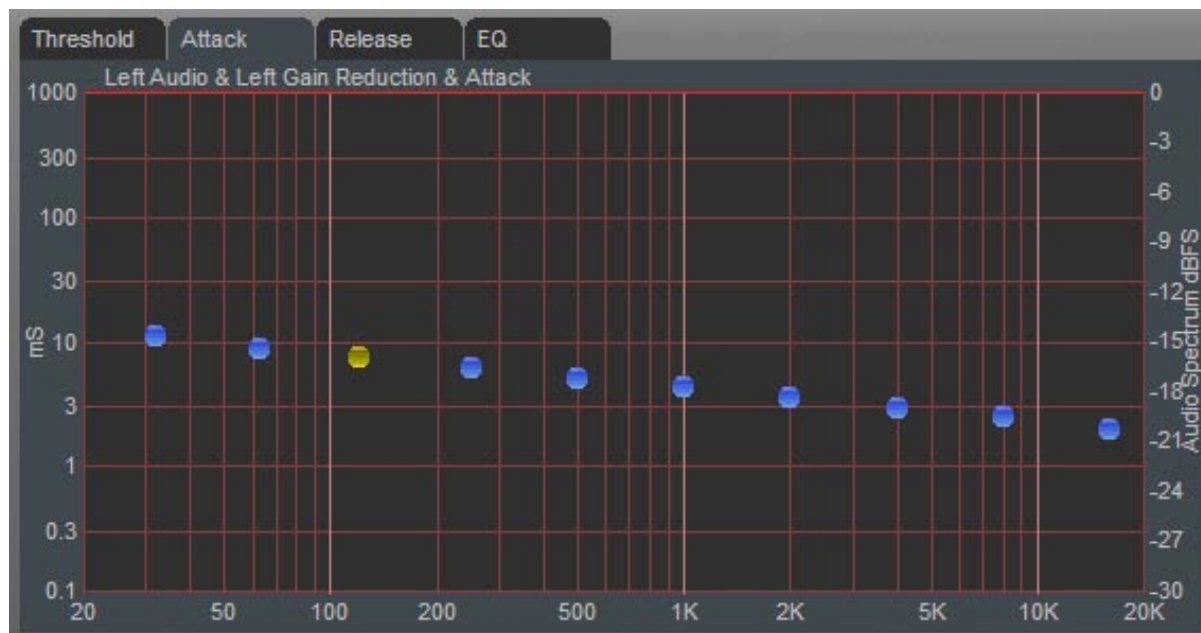
Each of the limiter thresholds can be adjusted separately or in groups according to the manner described in the earlier FM-5 Graphical Interface Operation section. Lower settings (more negative numbers) reduce the threshold, causing limiting to occur at lower audio levels. Conversely, higher thresholds cause limiting to occur at higher audio levels.

Because of the frequency response contouring in FM pre-emphasis it is generally customary to adjust the limiter thresholds in somewhat of a sloping fashion according to the limiting sensitivity curve required, creating a multiband frequency conscious limiter of any configuration.

Note: Radically different settings between adjacent bands won't cause strange sounds, although operationally it doesn't make much sense.

Attack Time Screen

Clicking on the Attack tab opens up the attack adjustment screen.



10 Band Limiter Attack Screen

The attack time of a limiter is a measure of how fast it responds to an audio peak once it is above threshold. Shorter attack times respond to audio peaks quicker and allow more accurate peak control, but excessively short attack times can literally suck the life out of musical material.

On the other hand, excessively long attack times will allow audio peaks to escape the limiters largely unmanaged, leaving them to be controlled solely by the final lookahead output limiter (if enabled) or the final clipper.

The attack times for each band are adjustable from 0.1 milliseconds (100 microseconds) to 1000 milliseconds (1 second). Faster attack times exert more control over waveform excursions, while slower attack times allow peaks to escape the limiter section with less control.

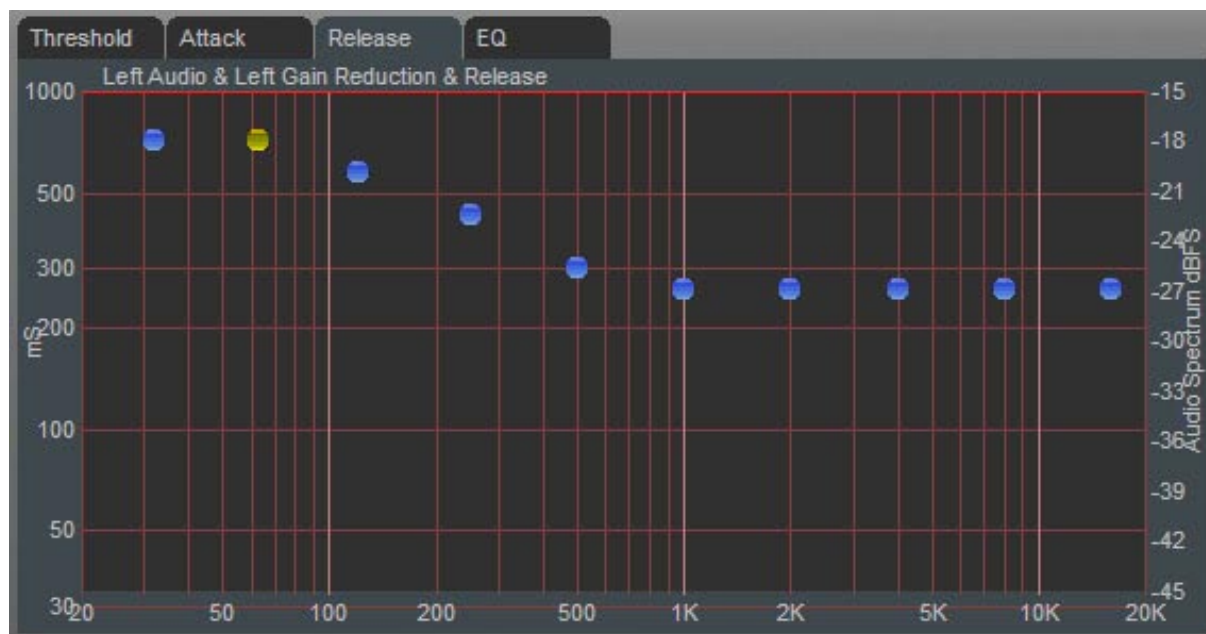
Attack times are generally adjusted to taste, keeping in mind that the slower the attack time the more work the final clipper or limiter must do, while conversely the faster the attack time the fewer short term dynamics the program material will have.

Generally, lower frequencies require slower attack times and higher frequencies require faster attack times for a given amount of control.

The attack times of each band may be individually or collectively modified using the GUI operating instructions provided earlier.

Release Time Screen

Clicking on the Release tab opens up the release time adjustment screen.



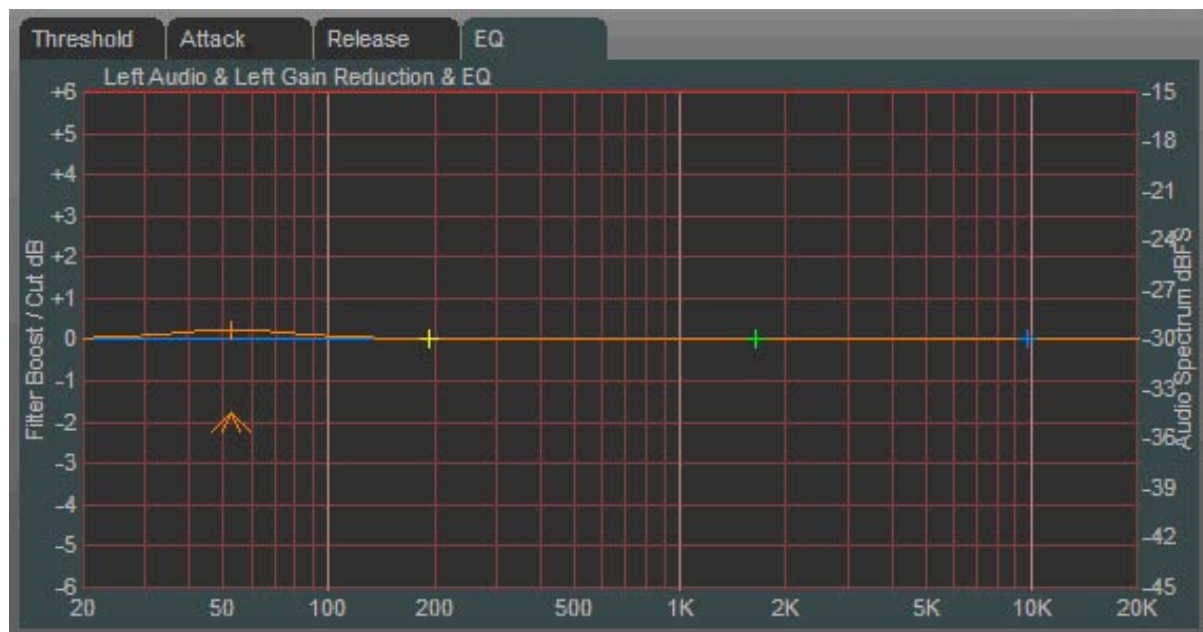
10 Band Limiter Release Time Screen

The release time of a limiter determines how fast it recovers from an audio peak that has caused a momentary decrease in gain. Shorter release times create a more dense sound, and excessively short release attack times can also increase intermodulation distortion (the mixing of low and high frequency energy — or a muddying of the sound).

The release times for each band are adjustable from 30 milliseconds to 1000 milliseconds (1 second). Faster release allows a more rapid recovery after a limiting event while slower release times do the opposite. Release times should be adjusted to taste, keeping in mind that the slower the release time the more dynamic the sound, but the more likely that audible ‘ducking’ may be heard.

Final Equalization Screen

Clicking on the EQ tab opens up the final equalization screen.



10 Band Limiter Equalization (EQ) Screen

Under certain conditions it may be desired to *slightly* alter the sound exiting the final 10 band limiter. A *small* amount of equalization performed after limiting can ‘open’ up the sound or provide a *slight* enhancement to its overall feel, and minor equalization tweaks can be accomplished after the limiters without radically disturbing the peak levels emerging from the 10 band algorithm.

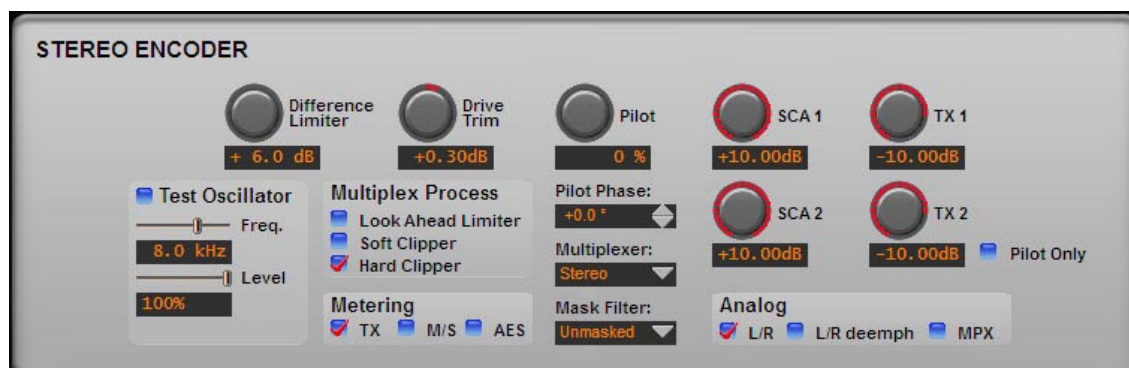
Only very small amounts of boost equalization are recommended once final limiting has been accomplished in the 10-band section. In fact, the adjustment range has been limited to +/- 6dB in order to curtail the temptation to perform aggressive equalization where it is the most inappropriate, and even this range is quite large considering the effect that can be created.

Small adjustments in EQ boost — on the order of 1dB or 2dB at most — are sufficient to alter the overall tonality of the 10 band section.

Equalization boosts must be approached with caution because they can add significant energy that must be controlled later by either the look-ahead limiter or final clippers.

On the other hand, equalization *cuts* can be made as desired because they do not *add* energy.

STEREO ENCODER MENU



Stereo Encoder Screen

The stereo encoder page contains the controls required to configure the FM-5's internal DSP-based precision stereo generator.

Difference Limiter

The FM-5 stereo generator contains a special Stereo Width Management algorithm called the Difference Limiter. This limiter operates in the sum/difference domain and controls the difference channel amplitude as a function of program material's L+R/L-R Ratio.

With a setting of 0.0 the L+R/L-R ratio will be controlled to never allow L-R to exceed the L+R. A setting of +6.0dB turns the algorithm OFF. When set at values lower than 0.0dB, that number represents the attenuation in dB that the difference channel will undergo as a function of the moment to moment sum/difference ratio.

As an example, if the Difference Limiter is set for a value of -3dB, then the stereo image will be reduced by 3dB when the incoming program material warrants it. When material has excessive stereo width, this control can help reduce the tendency for multipath problems. The most aggressive setting is -12dB, which would result in drastic, program dependent reductions in stereo image width — even with ordinary program material. The range of the control is from -12.0dB to +6.0dB.

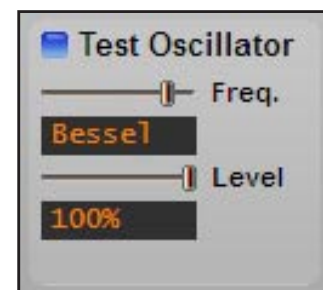
Drive Trim

The drive trim control adjusts the input level to whichever composite processor is selected by the Multiplex Process checkbox explained later. It has a range from -6.0dB to +6.0dB.

Test Oscillator

The built in test oscillator is capable of generating sine wave test signals from 50Hz to 80kHz at modulation levels from 0 to 100%. The oscillator is On when the Test Oscillator checkbox is selected.

There is included a special frequency, "Bessel," which is a 31.250kHz test signal that can be used when the first Bessel null is being utilized for modulation monitor calibration.



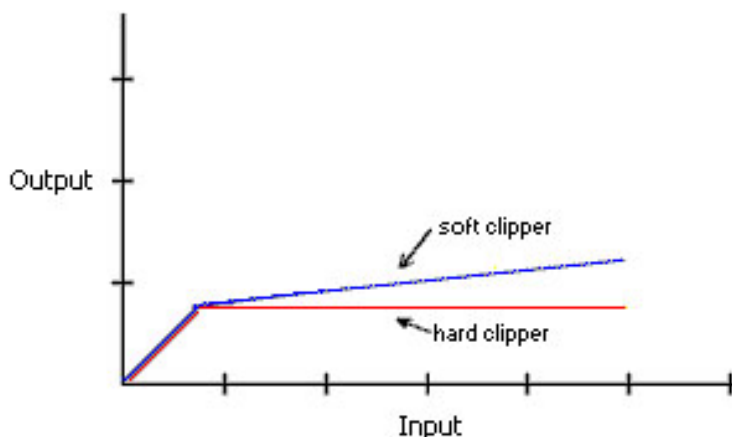
Multiplex Process

The FM-5 provides three separate ways to process the composite stereo waveform:

Look Ahead Limiter – uses a 5 millisecond look ahead and extremely high sample rates to precisely control composite waveform peaks on a cycle by cycle basis. It works similarly to the oversampled look ahead peak limiter found in the FM Output screen, but at a far higher sample rate.

Soft Clipper – uses a ‘rounded’ transfer function to gently control composite waveforms without the harsh distortion and higher order harmonics that hard clipping creates.

The Soft clipper has “gain” due to its 3dB transfer function, and therefore setting the Drive control to -3dB puts the Soft clipper right at the threshold of clipping with most program material with settings higher than -3dB driving the clipper harder. Note that we do not mathematically remove the higher order harmonics in this clipper like in the VBMS section because those harmonics are required in order to make the waveform have a more tightly defined peak amplitude.



Comparison of Hard and Soft Clippers

Hard Clipper – uses a high ratio transfer function of 0.10dB to precisely control peaks without generating high order distortion. This clipper has a brighter sound than the lookahead limiter and soft clipper because it creates high order harmonic artifacts. Note that we do not mathematically remove the higher order odd harmonics in this clipper algorithm like we do in the VBMS section because those harmonics are required in order to make the waveform have a more tightly defined peak amplitude.

Output Metering

As indicated earlier (see page 3-18), the metering bargraphs in the GUI can be switched to indicate operating levels of the Sum and Difference (M/S) levels or the peak output levels of the FM AES3 output (AES). This is done with the dropdown selector below the meter in the lower part of the GUI. The TX 1 and TX 2 outputs are always available on a second meter.

Stereo Encoder

The FM-5 contains a mathematically perfect stereo encoder whose performance is limited only by the high speed output Digital to Analog converter (DAC) and its reconstruction filter. Stereo separation is typically 60dB between 20Hz and 15kHz.



Pilot

The pilot control adjusts the 19kHz stereo pilot amplitude and is adjustable from 0 (Off) to 20% of the main composite signal amplitude in 0.1% steps.

SCA 1

Inputs applied to the SCA connectors are digitized at 192kHz. Prior to being digitized the signals are high pass filtered at 1kHz to reduce hum and then brick wall low pass filtered at 94kHz. This control can be set to OFF or to levels from -79.95dB to +10.0dB in 0.05dB steps.

SCA 2

This control has the same functionality and range as SCA 1 and serves the second SCA input connector on the FM-5 rear panel.

TX 1

Controls the output amplitude of the first (left channel) analog audio output and the output appearing on the BNC connector for TX 1. This control can be set to OFF or to levels from -79.95dB to +12.00dB in 0.05dB steps.

TX 2

Controls the output amplitude of the second (right channel) analog audio output and the output appearing on the BNC connector for TX 2. The range is the same as that of the TX 1 control.

Pilot Only

When checked, converts the TX 2 output to a balanced line-level 19kHz sine wave source.

Pilot Phase

Corrections to the relative phase between the 19kHz stereo pilot and 38kHz subcarrier may be made in 0.5 degree steps up to +/- 22.5 degrees. The ability to vary this phase offset allows the FM-5 to compensate for time delays in the transmission system that would otherwise disturb the phase relationships between the 19kHz stereo pilot and the 38kHz stereo subcarrier and cause degradation of stereo separation.

Multiplexer

The stereo encoder can be operated in Stereo or Mono by selecting the desired operating mode with this switch.

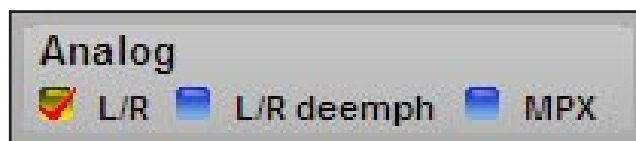
Mask Filter

Regardless of which Multiplex Process algorithm is chosen, out of band harmonics above 53kHz are tightly controlled by the Mask Filter which, if desired, can be switched out. The Mask Filter provides an 80dB protection notch for the stereo pilot as well as over 90dB of attenuation above 53kHz to protect the SCA region.



Analog—Stereo Coder Output Options

Please pay careful attention to the following analog output description as it is unlike that found in any other broadcast audio processor!



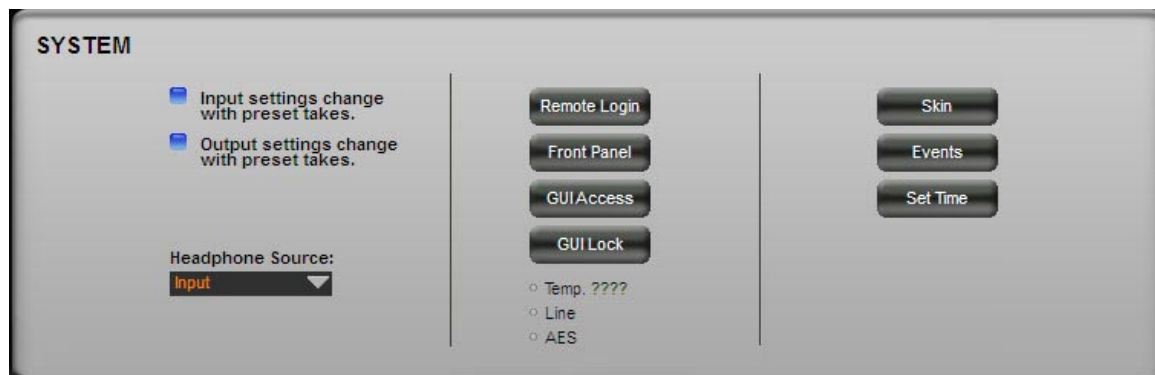
L/R – The male XLR outputs *and* the female BNC connectors assigned to TX 1 and TX 2 carry line level audio. In the case of the XLR outputs the audio is electronically balanced while the BNC connectors carry line level unbalanced audio. If pre-emphasis has been selected in the FM output screen then these outputs are pre-emphasized also.

L/R deemph – The male XLR outputs *and* the female BNC connectors assigned to TX 1 and TX 2 carry line level audio but are de-emphasized complementary to any pre-emphasis that has been selected in the FM Output screen.

MPX – When selected, the male XLR outputs *and* the female BNC connectors assigned to TX 1 and TX 2 carry wideband, line level composite stereo audio and, as in the L/R case above, the XLR outputs are electronically balanced. These balanced outputs can be used to gain a signal to noise advantage with exciters having a balanced composite input (most modern ones do).

The adjustment range of the analog outputs, regardless of the operating mode, is -79.95dB to +12dB in 0.05dB steps, covering virtually every conceivable operating need in the field.

SYSTEM MENU



System Screen

The system screen allows system-wide settings to be configured. In the first third of the screen is a checkbox and a list box.

System Settings Change With Preset Takes

The following are considered to be FM-5 “SYSTEM”, or global parameters which are saved with presets but not restored when presets are ‘taken’ unless the “System settings change with preset takes” checkbox in the System menu is checked. When this box is checked, the following control settings are recalled when a preset is recalled:

INPUT SCREEN:

Audio Source - Line or AES
 Line Gain (Analog)
 AES Gain (Digital)
 Balance (common to both Analog and Digital Inputs)
 Symmetry

FM OUTPUT SCREEN:

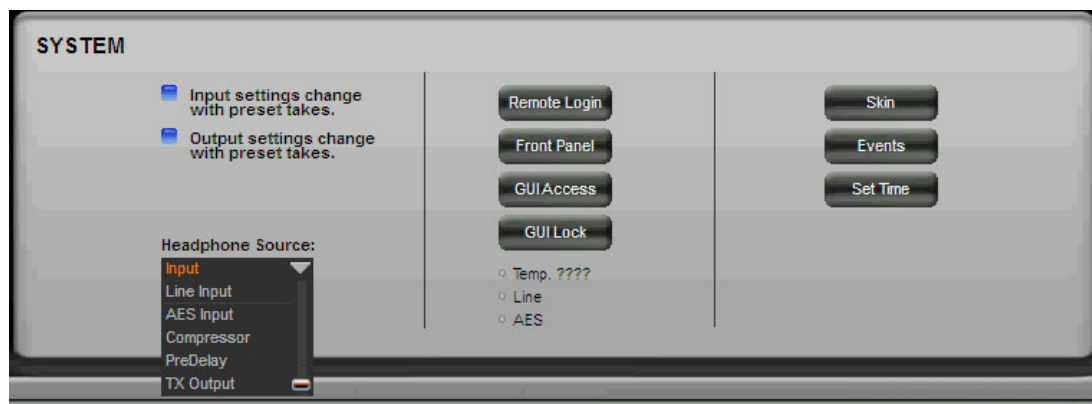
DeEmphasis
 Predelay
 Digital Output

STEREO ENCODER SCREEN:

Pilot
 Pilot Phase
 Mask Filter
 SCA 1
 SCA 2
 TX 1
 TX 2
 Pilot Only
 Analog - L/R, L/R Deemph, and MPX output style choices

These options allow the FM-5 to modify its input and output gain settings when presets are recalled. Input and output gain settings are always stored with the presets when their values are stored, but those settings will be ignored upon preset recall when the System Settings Change with Preset Takes checkbox is unchecked.

Headphone Source



The headphones may be driven by a number of selected points inside the signal processing chain as follows:

- Input:** Output of the audio input selector, analog or AES.
- Line Input:** Audio appearing on the analog line input.
- AES Input:** Audio appearing on the AES3 digital input.
- Compressor:** Output of the multiband compressor.
- PreDelay:** Output of the FM limiter before the diversity delay.
- TX Output:** Output of the FM limiter after the diversity delay.

NOTE: The FM-5 headphone routing selector allows you to monitor an unselected audio input *without* having to put it on the air. This can be very handy for confirming a source is present without actually switching to it!

Headphone Control

On the left side of the front panel of the FM-5 is a quarter inch female TRS jack for headphone use. The volume control for the headphone output is located on the far button right of both the front panel's display as well as on the remote GUI.

To adjust the headphone volume press and hold the black button below the knob, then turn the knob clockwise to increase volume and counter-clockwise to reduce it.

Note: The headphone outputs of the FM-5 are driven by National Semiconductor LM675 power operational amplifiers which are capable of driving very high currents (>3A) into any reasonable load. Actual headphone impedance is not a concern; however headphone circuit current limiting is provided at 160mA in order to protect external devices and also to keep you from setting your hair on fire from too high a headphone listening level!



Headphone Volume Knob

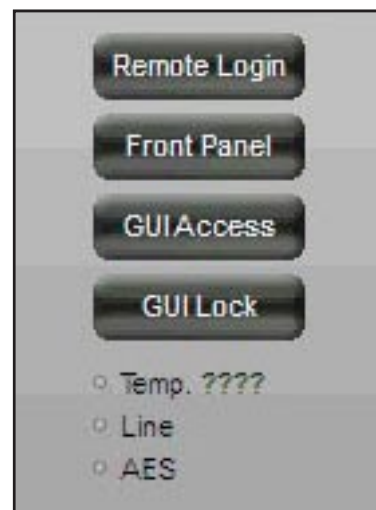
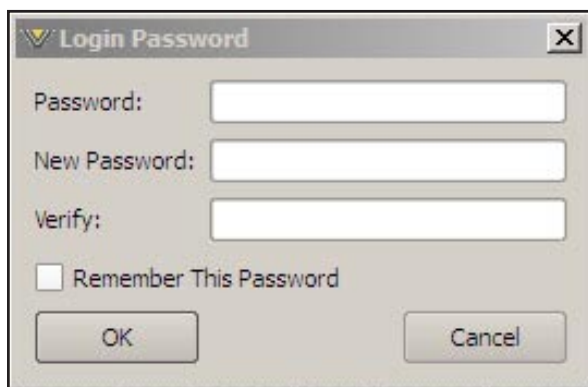
Headphone Select Button

Remote Login

When Remote Login is clicked, a password prompt box will open as shown below:

Remote login is for password restricting GUI access to an FM-5 over Ethernet. When a GUI TCP connection session is initiated, the FM-5 accepts the connection and then asks the remote GUI for a password.

If the remote GUI cannot provide the correct password, then a dialog box will pop up asking the user to enter the correct password.



Until the login password can be verified the FM-5 will not send any of its current settings *to* the remote GUI nor accept any changes *from* the connecting GUI.

The dialog box allows you to change the login password if one has been set. You will need to know the current password beforehand, and also enter the new one twice for verification. The password can be any combination of characters, numbers or symbols. If the “Remember this password” check box is checked, the GUI stores the password on the local PC. If you do not check the check box you will be asked for the password the next time you connect (since the first round of verification will fail). When asked for a password while logging in you can also check the “remember” box to save what you enter. That way you don’t need to enter the password every time you login.

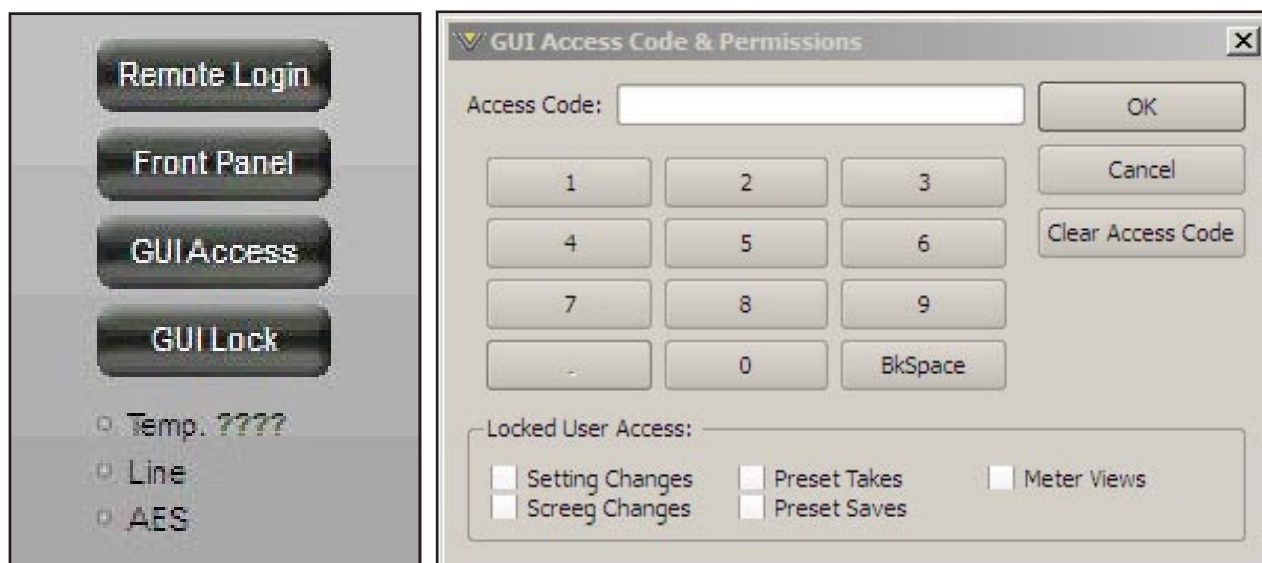
Occasionally you may see the word “pending” temporarily appear in the connection status box of the remote GUI. That means the FM-5 and Remote GUI are handshaking on the password string that is being sent.

Front Panel

The Front Panel Password button allows the assignment of pass codes to the FM-5 front panel to control access to it. Front panel access may also be completely disallowed by checking the Disable Front Panel choice in the Front Panel Password dialog. Note that “locking out” the front panel does not disable the ability of the encoder knob to alter the headphone volume.



GUI Access



The system allows you to grant access at certain levels of ‘permission’ in order to control the privileges of those accessing the various features of the FM-5. Privileges are granted by ‘access code’, not by user type. In fact, user types are created *through* the generation of access codes for those user types.

Examples:

- Suppose Access Code 1234 is created with “Preset Takes” being the only box checked. This means that a person assigned access code “1234” can *only* change presets.
- Suppose Access Code 5678 is created with “Preset Takes” *and* “Setting Changes” both checked. This means that a person with access code “5678” cannot only *change* presets, but can also make changes to the settings within them. Note however that because “Preset Saves” was *not* checked when this access code was created, that person may *make* changes to a preset but may not *save* them!

GUI Lock

In the event that security has been enabled by configuring the GUI Access Code & Permissions Dialog (above), then selecting GUI Lock will immediately lock the GUI on the host PC, prohibiting access until it has been unlocked with the proper access code.

Unlocking the FM-5 GUI when the passcode has been lost or forgotten:

The following instructions must be followed exactly as presented!

1. Re-install the PC Remote GUI but this time into a NEW folder on your computer. DO NOT start up the GUI yet!!
2. Make sure that the FM-5 is connected to your network or your computer and that you know its HARDWARE IP address (you can use the command prompt PING command to make sure that your computer can see the FM-5). DO NOT PROCEED if you do not have network connectivity to the FM-5!

3. Start the new remote GUI on your computer but DO NOT click on the Connect button at the top of the GUI next to the Status display. Make VERY sure that you are not starting the old GUI instead of the new one!
4. Once the GUI is open click on the Devices button on the right hand side of the GUI.
5. In the Devices dialog that opens click the Add button.
6. The Edit Device window will open.
7. Enter a NEW name for your FM-5 but use the same hardware IP address that your unit currently has.
8. Click OK to close the edit device dialog.
9. In the Devices dialog highlight your new device and click Select. The Devices box will close.
10. Now click on the Online/Offline button left of the Status window at the top of the GUI.
11. Once the GUI is online click on the SYSTEM tab. The System screen will open.
12. Click on GUI Access button (**DO NOT CLICK ON GUI LOCK!!!**). The GUI Access Code & Permissions box will open.
13. Carefully click only the Clear Access Code button. Then click OK.
14. The GUI Access Code & Permissions box will close.

Status Indicators

Temp – When the “Temp” indicator is green, the operating temperature inside the FM-5 is satisfactory. When it is red, the temperature is too high. The displayed value is the current operating temperature in degrees Celsius of the FM-5 motherboard. Normal temperatures should be in the range of 25°C to 45°C, and will vary somewhat depending on ambient temperatures near the FM-5.

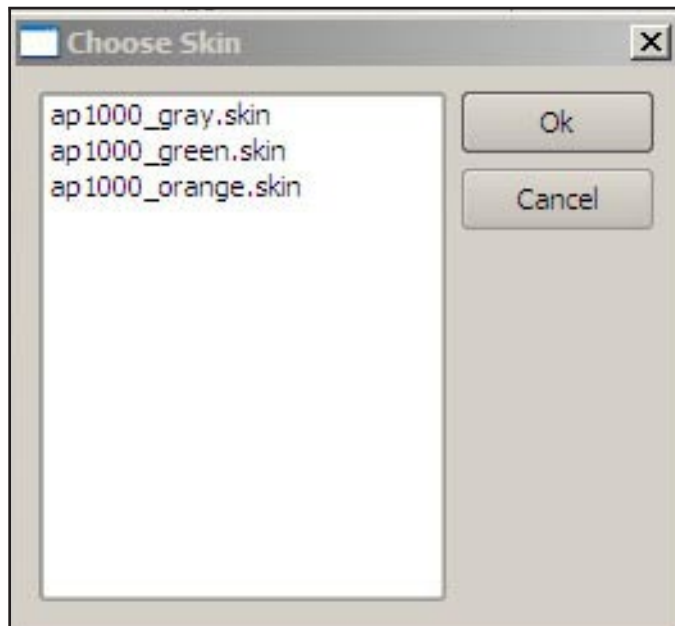
Note: The FM-5 contains one small fan to stir the air inside the FM-5 chassis in order to maintain a more uniform temperature distribution. Normal ventilation of the FM-5 chassis is by natural convection – cooler air from outside the chassis air is drawn in through the lower side slots in the chassis and rising warmed air exits by way of the higher slots along the top of the rear panel. This scheme is more than adequate for controlling the operating temperatures inside the FM-5 without resorting to forced air cooling.

Line – When green, this indicator shows that audio is present on the analog line inputs and that it is above -37dBFS. When the indicator is red it means that audio is missing or too low to be detected.

AES – When green, this indicator shows that valid data is present on the AES3 digital input, and that it is above -37dBFS. When the indicator is red it means that valid digital audio data is not presently being detected, audio data could be present but is corrupted in some way, or that audio is present but is too low.

Skin

There are three “skins” available to customize the appearance of the FM-5 GUI — Gray, Green, and Orange. Skins may be changed using the right-click/file/choose skin dialog.



Events

The FM-5 contains a comprehensive scheduling utility that allows presets to be automatically changed on desired dates and times. There is also a “Long Term Rotation” utility to allow one time preset changes to be scheduled for any time in the future. To create, edit, or view entries in the Event Scheduler click the “Events” button on the System Screen.

The following Event Scheduler screen will open and the events list will be empty when opened for the first time:

The screenshot shows the 'Event Scheduler' window with a close button (X) in the top right corner. The window is divided into two main sections: 'Weekly Rotation' and 'Long Term Rotation'.

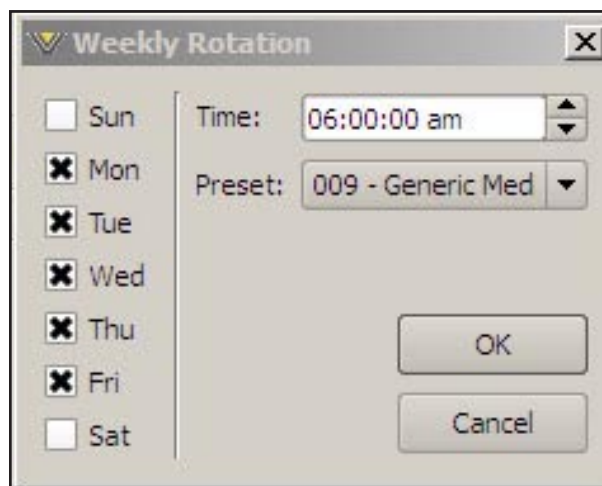
Weekly Rotation: This section has a 'View' dropdown set to 'All' and radio buttons for days of the week (S, M, T, W, T, F, S). Below this is a table with columns 'Day(s)', 'Time', and 'Preset'. The first row shows '_MTWTF_', '06:00:00 am', and '015 - CHR Hotter'. To the right of the table are buttons for 'Add...', 'Edit...', and 'Delete'.

Long Term Rotation: This section has a table with columns 'Date', 'Time', and 'Preset'. The first row shows 'Nov 8', '06:00:00 am', and '009 - _BYPASS'. To the right of the table are buttons for 'Add...', 'Edit...', and 'Delete'.

At the bottom of the window, it displays 'FM5 Time: Thu, Nov 8, 2007 - 12:15:18 pm'. There is a checkbox for '24 Hour Time' and a 'Set Time...' button. Finally, there are 'Okay' and 'Cancel' buttons at the bottom right.

Creating a Weekly Rotation Event

1. Click the ADD button in the Weekly Rotation area of the Event Scheduler window. The Weekly Rotation window will open as shown below.



2. On the left column, select the days that the preset should be selected. Any combination of checkboxes may be chosen.

3. Next select the time that the preset should change.

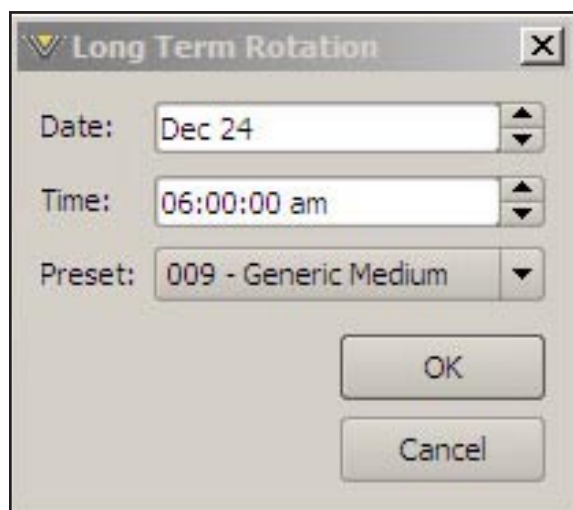
4. Next choose the preset that should be selected at the time programmed in the previous step. When finished editing, click OK.

As many preset change events as desired may be programmed in the Event Scheduler.

If a one-time preset change is required, such as might be necessary for a special holiday or other event, the Long Term Rotation routine should be used.

Creating a Long Term Rotation Event

Adding a new event in the Long Term Rotation scheduler works in a similar manner. The Long Term Rotation entry window appears as follows:

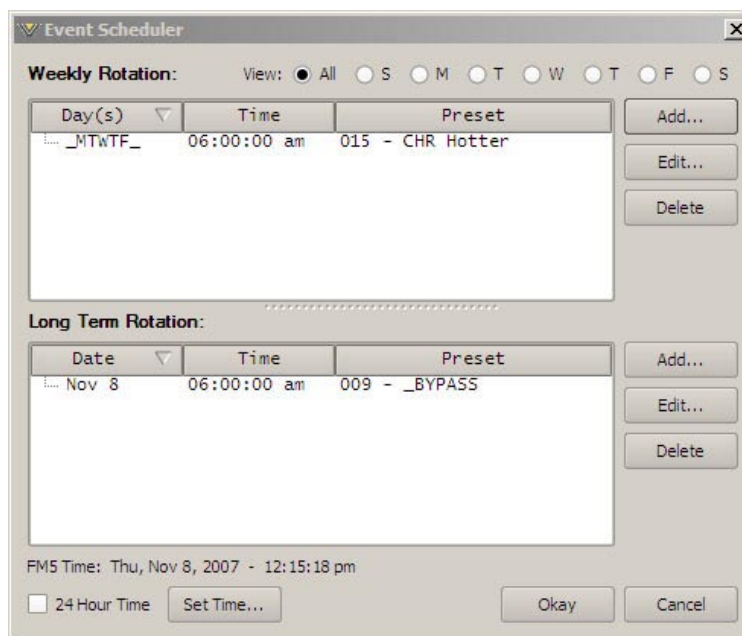


Deleting a Scheduled Event

Deleting a scheduled preset change is as simple as adding one. Open the Scheduler window by navigating to the System menu and clicking Events. The following window will open:

To delete a schedule in either the **Weekly** or **Long Term Rotation** schedules simply highlight it in the list and then click the appropriate **Delete** button on the right side of the Event Scheduler window. The highlighted scheduled event will be removed from the list.

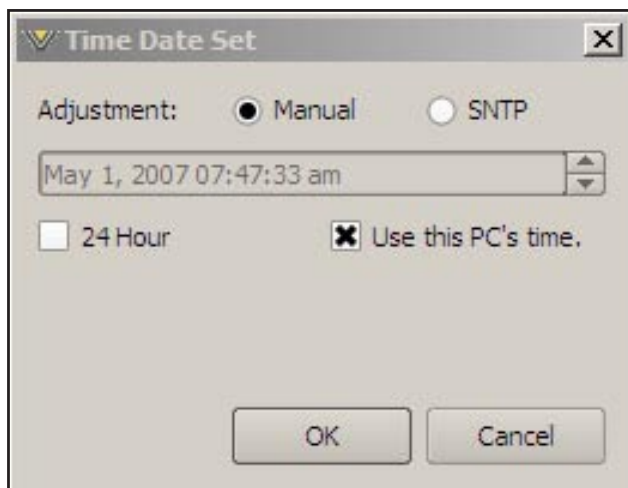
Note that there is no confirmation prior to the actual deletion of the event!



Set Time

Allows the system time of the FM-5 onboard computer to be set or changed. The FM-5 system time can be synchronized to external time servers (SNTP, or Simple Network Time Protocol) if desired.

Alternately, time can be synchronized to the PC that is running the Windows-based GUI. In this instance time updates will occur upon successful connection to the GUI on the remote PC.



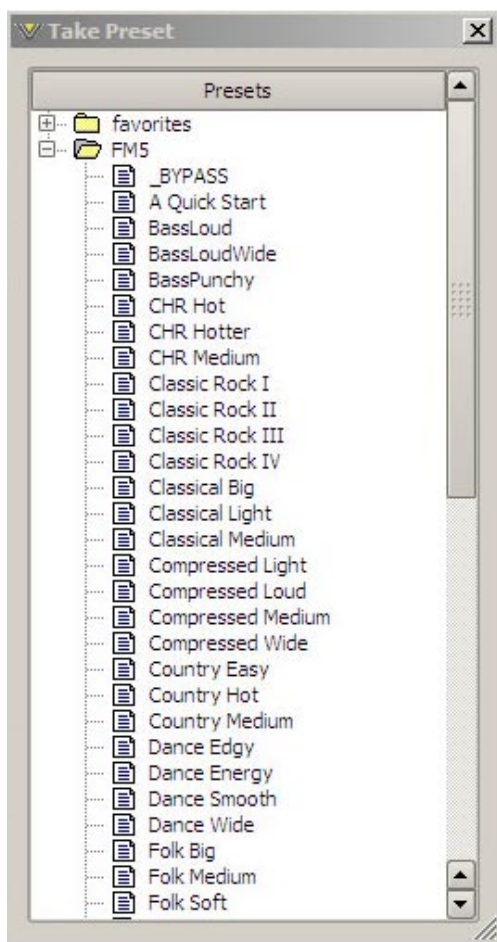
Side Bar Region

To the right of the control area is a vertically disposed row of buttons:

Take

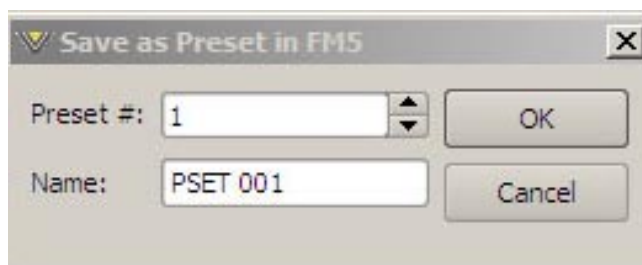
When left-clicked, a “Windows” box appears, showing folders that contain presets, typically “favorites”, and factory presets, this last containing factory presets already in place in the unit. Opening a folder (if not already so) lists the presets in order. Double-clicking on a preset brings it immediately into use in the FM-5. The box stays open until deliberately closed, allowing differing presets to be double-clicked upon readily in succession. This is a very direct means of comparing presets. ***It is important to remember to save the present settings as a preset before invoking others, or they will be lost.***

Note also that you can only Take presets that are already loaded in the FM-5 from this dialog box



Save

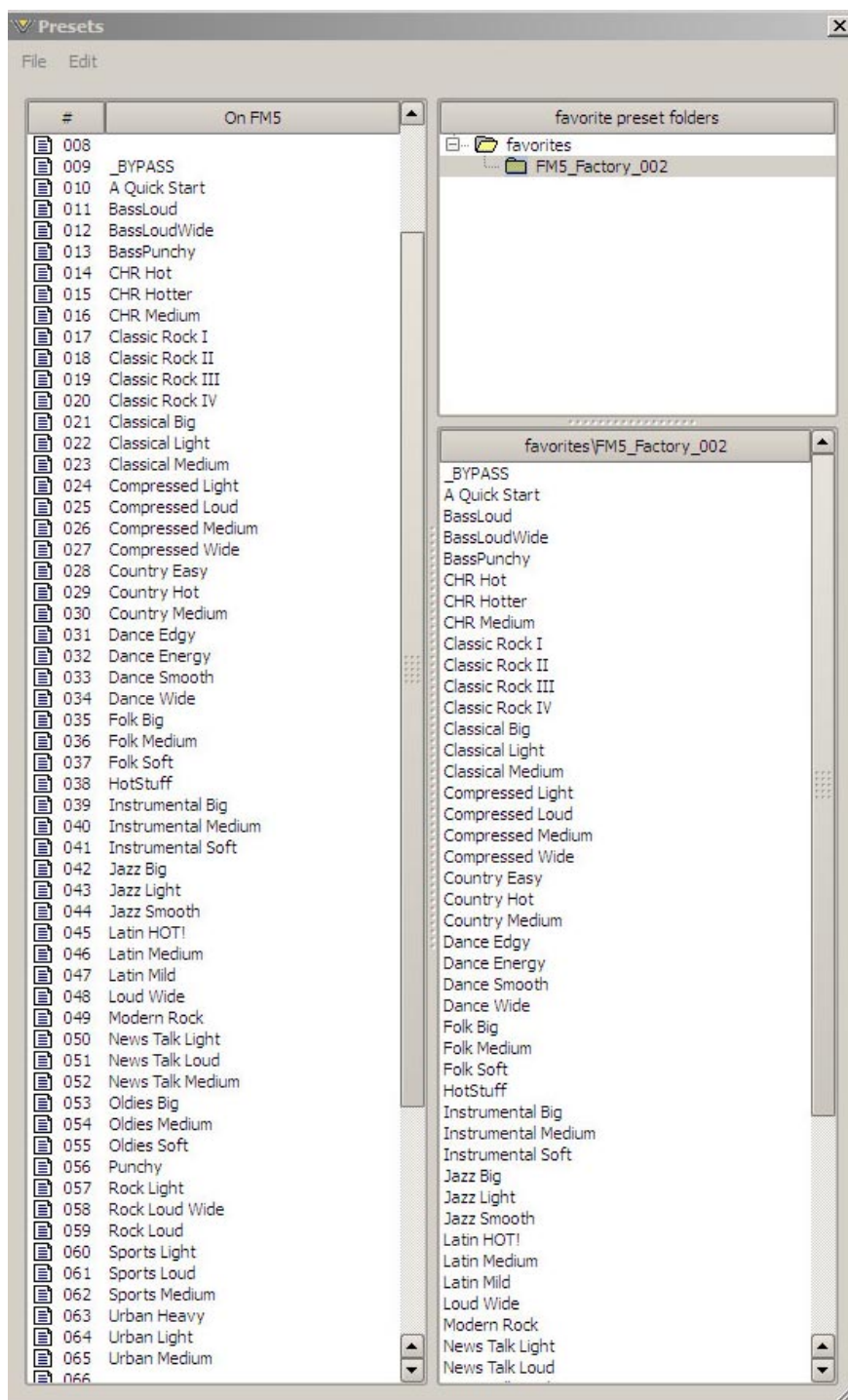
A small “Windows” dialog box appears, which prompts for a name under which to save the present settings of the FM-5. The preset will be saved into the next available empty slot. Alternatively, by nudging the preset number (“PRE #”) up or down, it is possible to save the present settings in place of an existing preset’s settings. Needless to say, this erases, as in loses, as in destroys, the overwritten preset’s contents. Factory presets are protected from being inadvertently overwritten.



Presets

A three-panel “Windows” box appears. The large panel on the left has two columns, being the preset number and the FM-5 preset contents.

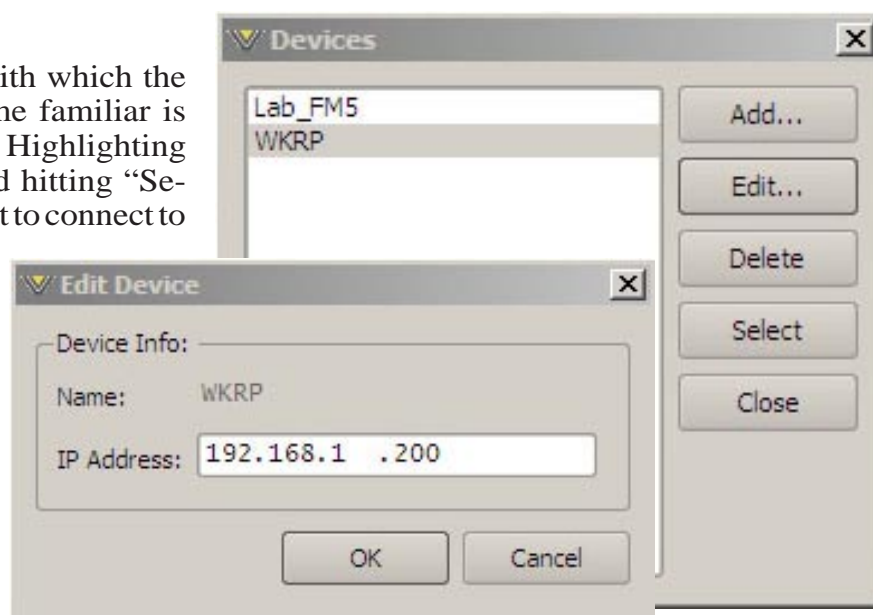
The upper and lower right hand panels give access to the GUI’s presets library; the contents of folders in the upper panel are shown in the lower panel; drag-and-drop allows movement between the library folders and the FM-5 and its mirror archive in the GUI.



Devices

A list of FM-5 devices with which the GUI has had cause to become familiar is shown in a “Windows” box. Highlighting the desired FM-5’s name and hitting “Select” causes the GUI to attempt to connect to it if you are Online.

In the event no FM-5’s are listed, or one is adding a further device, or a new one for the first time, “Add” brings up a small dialog box which asks for the new prospect’s name and IP address.



Quick Save

The FM-5 has a unique feature that allows instant comparison of adjustments in progress to a known reference, such as another preset, or some midpoint while adjustments are being made. We call this feature QSave or Quick Save.

In the upper right side of the FM-5 GUI you’ll find three buttons like those shown below:

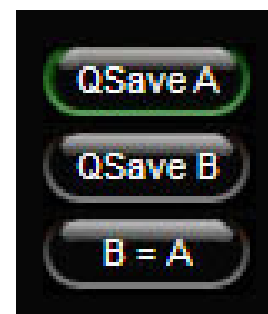
QSave A and QSave B represent two temporary buffers that can hold all current FM-5 processing settings as long as power is applied to the unit.

While QSave A is highlighted green any adjustments that you make to controls on the FM-5 are being saved to its temporary buffer “A”.

QSave B operates similarly to QSave A. Its being selected is shown by its green highlighting, and it operates on buffer “B”.

One way to use this feature is to compare the sound of a factory preset to changes that you’ve made to that preset without having to first save your preset as a user preset. To do this you would:

- Recall the factory or user preset that you wish to adjust.
- Ensure that QSave A is highlighted. If it is not, press its button to highlight it.
- Press the B=A button. This will copy the contents of QSave buffer A to QSave buffer B. Now the contents of both buffers are identical.
- Change some settings on the FM-5. These settings will automatically be stored in the A buffer.
- Compare your changed settings to the recalled factory preset by pressing the QSave B button.

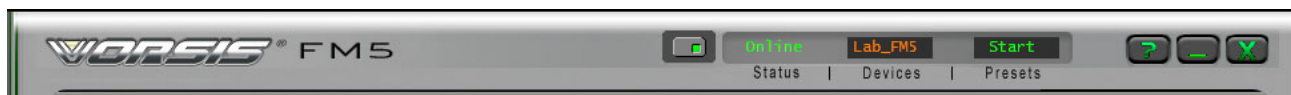


- Compare those settings back to the factory preset by pressing Qsave A.
- When you are happy with your changes you can commit them to a user preset using the Save dialog explained previously.

Likewise, Qsave A and QSave B can be used to compare the sounds of two different sets of user settings. To do this you would:

- Load the preset that you want to change, then make changes to it and press QSave A to save those settings to buffer A.
- Make additional changes as desired and then press QSave B to save those additional changes to buffer B.
- Now you can compare the two sets of settings by toggling back and forth between QSave A and QSave B.
- When you are pleased with one set of settings and need more buffers for further tweaking, you can use the A=B/B=A button to make the two buffers the same and have one of them to use to start comparing from again.

Title Bar Region



Along the top edge of the FM-5 GUI screen (in line with the “Vorsis FM-5” product label to the left, and the Windows “About”/”Minimize”/”Exit” icons to the right) are indicators and controls for the management of devices and presets. The FM-5 GUI is capable of controlling multiple FM-5s (“Devices”) and managing the “Presets” within them. Whether a connection is made (“Status”), and which device and which preset are presently under command are indicated. Double-clicking these indications will gain access to respective management screens.

Status

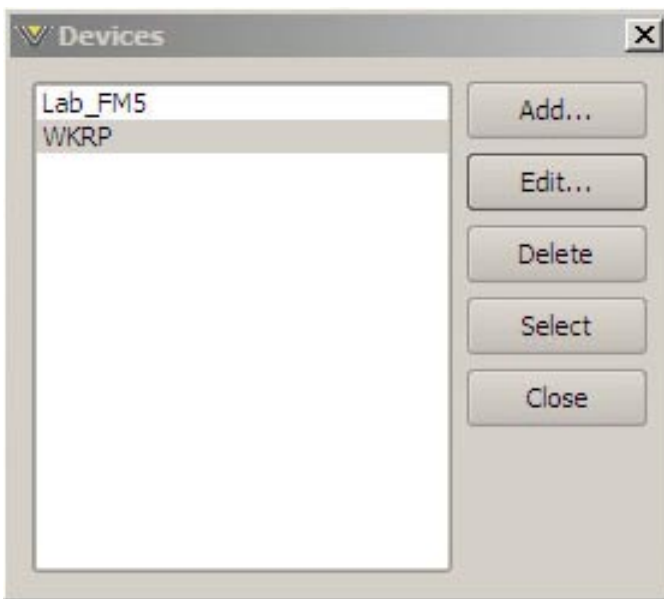
This indicates: “Online,” meaning the GUI is in communication with and directly reflects an FM-5; “Offline,” meaning the GUI and FM-5 are disconnected; and “Trying,” meaning the GUI is attempting to find the FM-5 on the LAN and connect to it. An adjacent button toggles between “Online” and “Offline.”

Devices

The name of the FM-5 to which the GUI is connected (or with which it is attempting to connect) shows here in amber.

Double-clicking on the name area brings up the “Devices” “Windows” box. A list of FM-5 devices with which the GUI has had cause to become familiar is shown in a “Windows” box. Highlighting the desired FM-5’s name and hitting “Select” causes the GUI to attempt to connect to it if you are Online.

In the event no FM-5’s are listed, or one is adding a further device, or one for the first time, “Add” brings up a small dialog box which asks for the new prospect’s name and IP address.



Presets

The name of the last invoked preset is indicated here. Green indicates that the FM-5's settings for this preset agree with those in the GUI's mirror archive; red indicates a discrepancy. Double-clicking on the name brings up a "Differences" — parameter-by-parameter, setting-by-setting — comparison list between the current FM-5 settings and the recalled preset.

Preset Difference		
Setting	Current	On FM5
Name		A Quick Start
Num Parameters	151	150
CRC	3E11A25D	7B5457DE
Input Source	AES	AES
Input Line Gain	0.0 dB	0.0 dB
Input AES Gain	0.0 dB	0.0 dB
Input Gain Offset	0.0 dB	0.0 dB
Input Symmetry	IN	IN
Input HPF Stereo	IN	IN
Input HPF In Sum	OUT	OUT
Input HPF In Diff	OUT	OUT
Input HPF Freq Sum	20.0 Hz	20.0 Hz
Input HPF Freq Diff	20.0 Hz	20.0 Hz
PEQ Position	PreProc	PreProc
PEQ Mstr In	OUT	OUT
PEQ 1 In	IN	IN
PEQ 2 In	IN	IN
PEQ 3 In	IN	IN
PEQ 4 In	IN	IN
PEQ 1 Freq	20.0 Hz	20.0 Hz
PEQ 2 Freq	290 Hz	290 Hz
PEQ 3 Freq	1.63 kHz	1.63 kHz
PEQ 4 Freq	10.1 kHz	10.1 kHz
PEQ 1 BW	1.75 oct	1.75 oct
PEQ 2 BW	1.05 oct	1.30 oct
PEQ 3 BW	1.25 oct	1.45 oct
PEQ 4 BW	3.00 oct	3.00 oct
PEQ 1 Lift	+ 4.0 dB	+ 4.0 dB
PEQ 2 Lift	0.0 dB	0.0 dB
PEQ 3 Lift	+ 2.5 dB	+ 2.5 dB
PEQ 4 Lift	+ 3.0 dB	+ 3.0 dB
Comp AGC In	IN	IN
Comp In	IN	IN
Comp XFR1	74.3 Hz	74.3 Hz
Comp XFR2	281 Hz	281 Hz
Comp XFR3	1.22 kHz	1.22 kHz
Comp XFR4	5.99 kHz	5.99 kHz
AGC Freeze Level	-56.5 dB	-55.5 dB
AGC 1 Freeze Offset	+ 4.0 dB	+ 4.0 dB
AGC 2 Freeze Offset	+ 1.0 dB	+ 1.0 dB
AGC 3 Freeze Offset	- 1.0 dB	- 1.0 dB
AGC 4 Freeze Offset	+ 1.5 dB	+ 1.5 dB
AGC 5 Freeze Offset	+ 4.0 dB	+ 4.0 dB
AGC Freeze Delay	470.0 mS	470.0 mS
AGC Freeze Mode	Gate	Gate
AGC Coupling	-10.0 dB	-10.0 dB
AGC Backoff	- 3.0 dB	- 2.5 dB
Comp Drive	+ 0.5 dB	0.0 dB
Comp Diff Drive	0.0 dB	0.0 dB
Comp Makeup	+37.0 dB	+37.0 dB
Comp Diff Makeup	+ 1.0 dB	+ 1.0 dB
AGC 1 Attack	180.0 mS	180.0 mS
AGC 2 Attack	170.0 mS	170.0 mS
AGC 3 Attack	310.0 mS	310.0 mS
AGC 4 Attack	250.0 mS	250.0 mS
AGC 5 Attack	230.0 mS	230.0 mS
AGC 1 Release	6.400 S	6.400 S
AGC 2 Release	6.400 S	6.400 S
AGC 3 Release	6.400 S	6.400 S
AGC 4 Release	6.400 S	6.400 S
AGC 5 Release	6.400 S	6.400 S
Comp 1 Thresh	-72.0 FS	-72.0 FS
Comp 2 Thresh	-72.0 FS	-72.0 FS

Notes on “Online” and “Offline” Working

Most often operationally it will be required that the GUI act directly and instantaneously upon the FM-5 selected under “Devices;” changes on the main control screen take immediate effect on the signal processing and any selected presets are immediately rendered active. This is “Online”.

“Offline,” however, is more of a supervisory and system management mode and is for those who feel the need to set up complex audio processors without listening to them. Changes can be made to preset settings and configurations, and manipulation of the presets selection list can be made without affecting signal processing within the FM-5 itself, which can continue to be processing away obliviously. (Preset list manipulation can be undertaken “Online,” too).

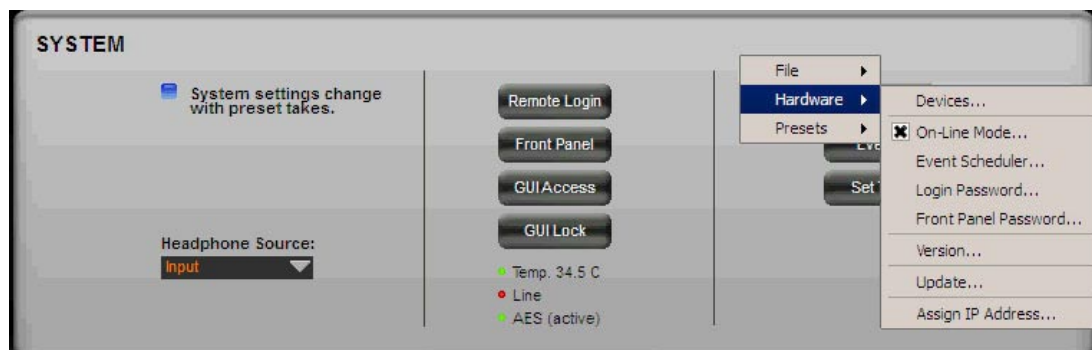
Importantly, any adjustments made on the GUI “Offline” will not take effect until the FM-5 is rendered “Online” again.

Invoking a preset — by double-clicking a preset from the box brought up by clicking the “Take” button — does one of two things, depending whether the GUI is in “Online” or “Offline” mode:

- “Online” - the double-clicked preset is immediately sent to the FM-5 and becomes active.
- “Offline” - the double-clicked preset brings that preset onto the main control and display screen for perusal / editing. Any data entry / control which involves activity within the main graph will still operate upon the preset, but not on the FM-5’s audio.

Accessing Menu Options

Right clicking anywhere on the Vorsis FM-5 Control Panel will open a pop up menu tree with access to *File*, *Hardware*, and *Presets* choices. These choices lead to sub-menus and dialog boxes that may also be accessed by clicking on other dedicated buttons on the main Vorsis FM-5 control panel. As with many Windows programs, there are multiple ways to access menu trees — go ahead and explore!



File Menu Items

The *File* menu tree may be accessed by right clicking anywhere on the main FM-5 Control Panel.

About... - brings up the About box to indicate the GUI version.

Center Window - centers the main GUI window on the screen.

Choose Skin... - brings up the Choose Skin dialog box.

Exit - exits the GUI program.

Hardware Menu Items

The *Hardware* menu tree may be accessed by right clicking anywhere on the main FM-5 Control Panel. Please note that many of these functions require you to be connected (Online) to a FM-5. Sub Menu choices include:

Devices... - opens the Devices dialog box. Allows the creation, editing, selection, and deleting of Vorsis processors connected to your system.

On-Line Mode... - toggles between ONLINE and OFFLINE modes.

Event Scheduler... - opens the Event Scheduler dialog box for editing Events.

Login Password... - opens the Passwords dialog box for editing login passwords.

Front Panel Password... - opens the Passwords dialog box for editing login passwords.

Version... - displays the current software versions running in your FM-5 hardware.

Update... - opens the “Choose a file to download” dialog box. Only files of type *.vbn are visible. See below.

Assign IP Address... - opens the IP Assignment dialog box to change the IP settings of a connected FM-5.

Future versions of the FM-5 software may be released to implement new features or correct known problems. The Software Update menu choice opens a dialog box and prompts the user to select a file to be uploaded to the FM-5. Upon completion, you will be asked to restart the FM-5 (cycle power).

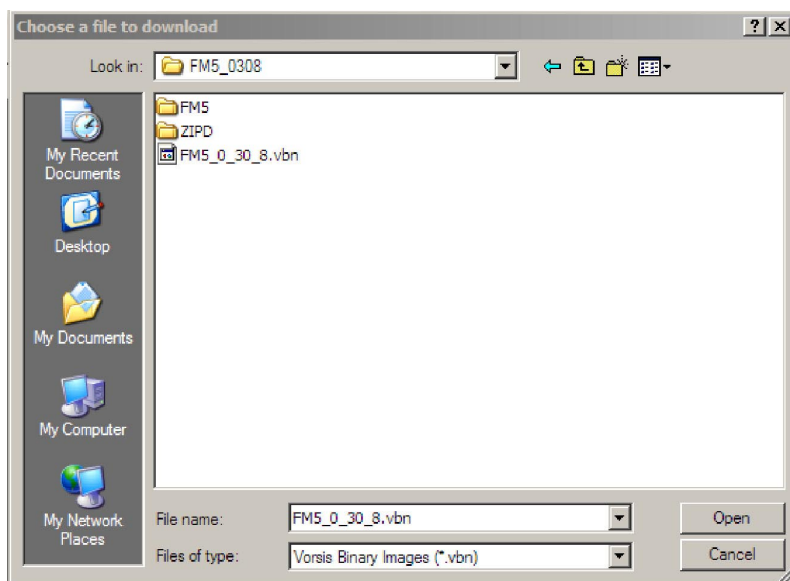
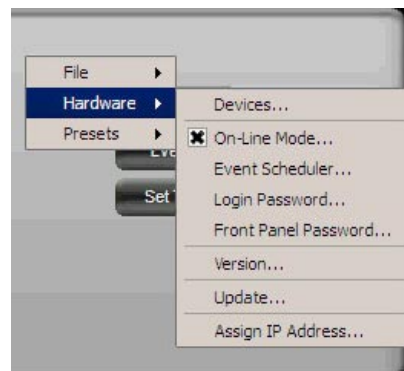
Only verified updates provided by Vorsis will work!

FM-5 Hardware Update

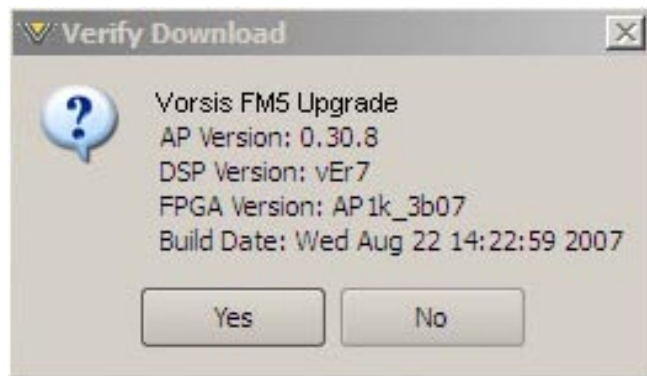
The FM-5 hardware is extremely easy to update whenever new firmware becomes available from Vorsis. There is only one file required for hardware updates, a file with the extension “VBN”.

The “VBN” — VBN stands for “Vorsis Binary Nugget”. This file contains highly encrypted versions of the motherboard application code, FPGA images, and DSP code.

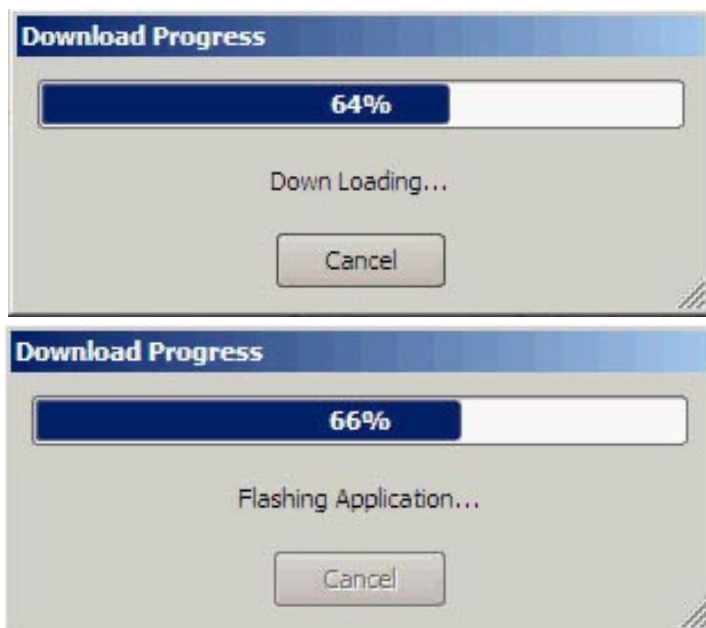
To update the FM-5, right click on any portion of the upper control area in any screen of the remote GUI to open the pop menu tree, and select the “Hardware -> Update...” option. The following screen will appear.



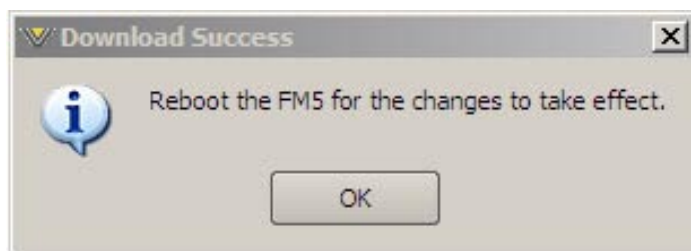
Navigate to the location of the VBN file that was downloaded from the Vorsis website or located on the CDROM that you received from Vorsis Technical Support. Verify that the version number is correct in that it matches the version number listed in the documentation about the firmware upgrade. If so, select the “Open” option in the “Choose a file to download” window. The following prompt will appear (actual text will vary):



Check once again that the versions match the documentation! Then click “Yes”. Dialog boxes similar to the following will pop up as the download progress occurs:



When the process has finished, you will be prompted to reboot the FM-5 by the prompt below:



When the FM-5 reboots the new VBN code will be running on the motherboard.

Presets Menu Items

The *Presets* menu tree may be accessed by right clicking anywhere on the main FM-5 Control Panel.

Take... - brings up the Take Preset dialog box.

Save - brings up the Save as Presets dialog box.

Presets... - brings up the Preset Management dialog box.

I/O Schematic Drawings & Load Sheets

Chapter Contents

FM-5 Signal Flow Diagram 4-2

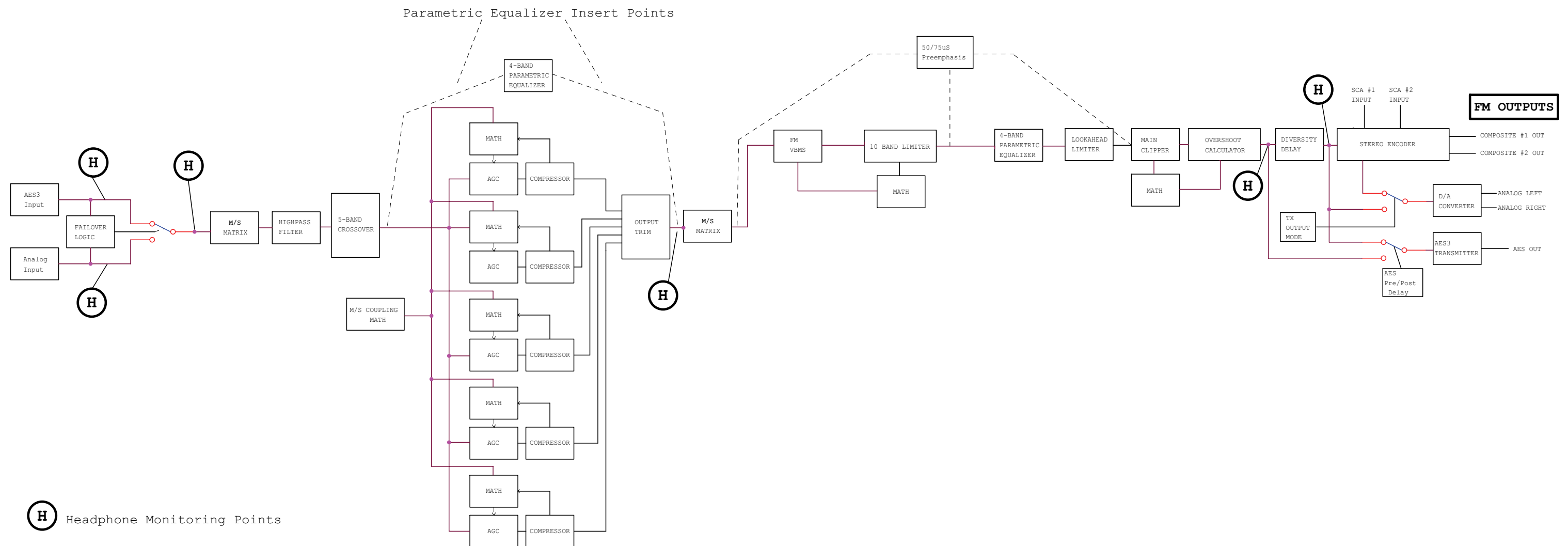
Audio Processor

Schematic 4-3

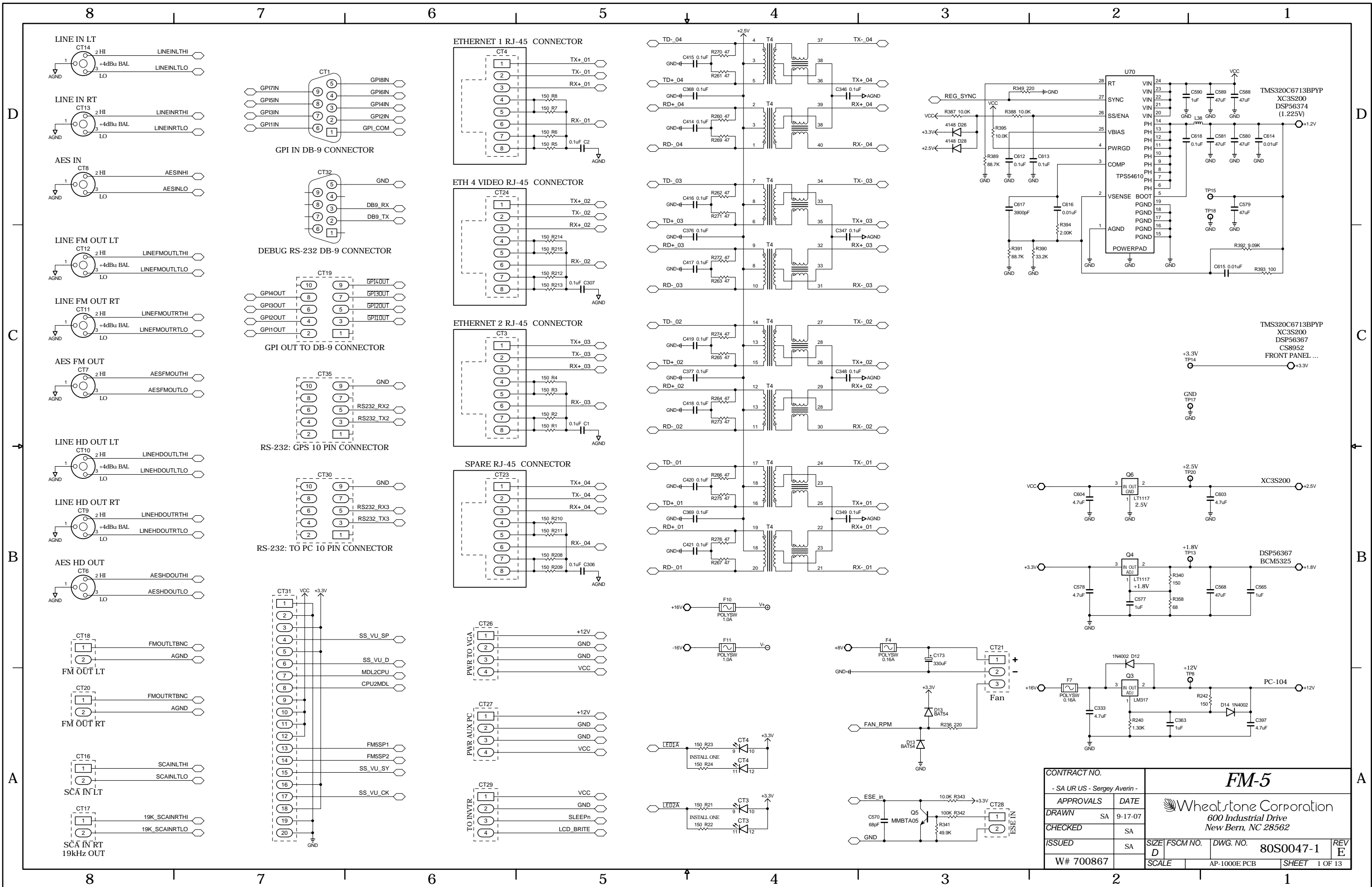
Load Sheet..... 4-8

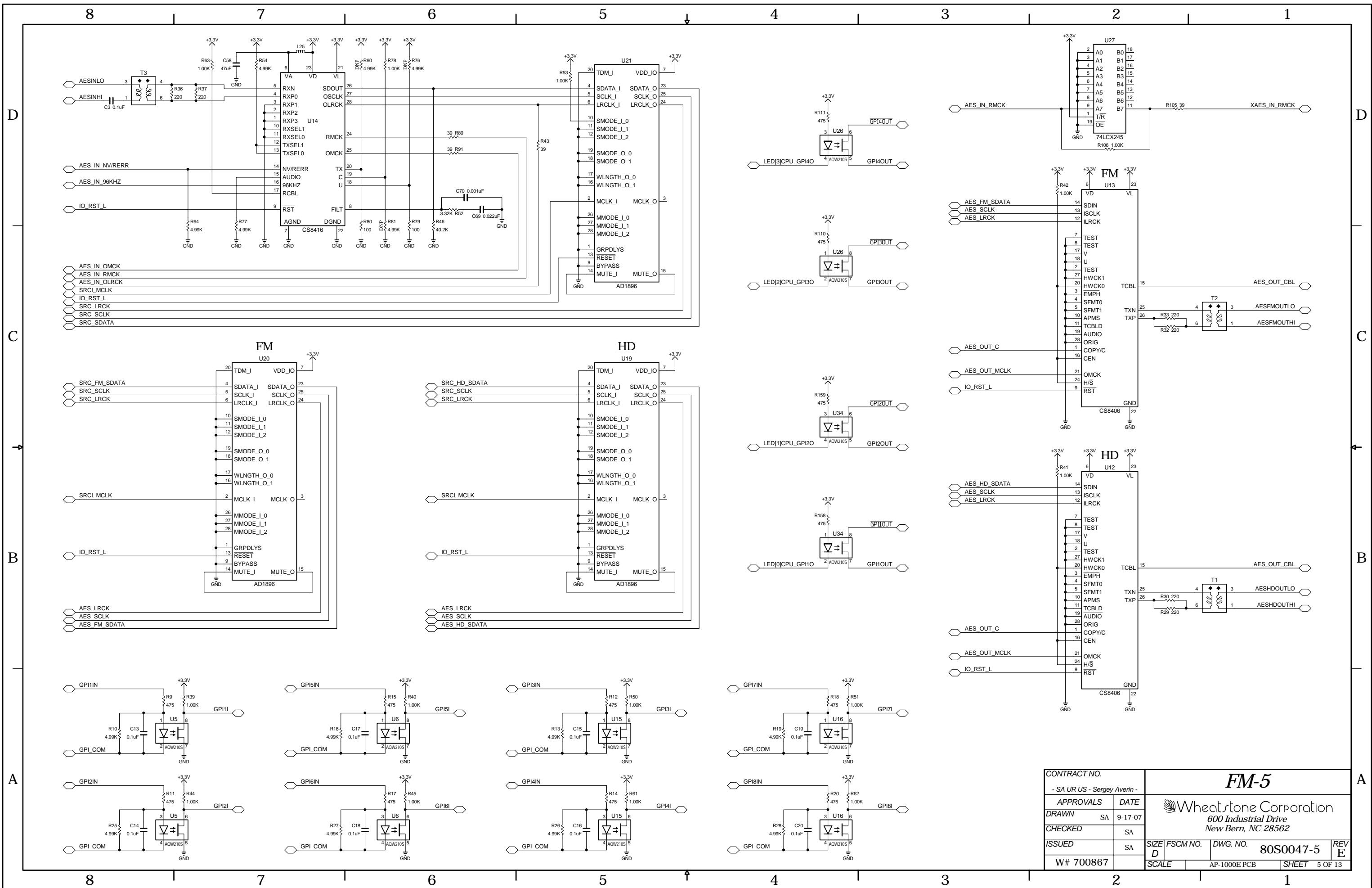


FM5 General Signal Flow

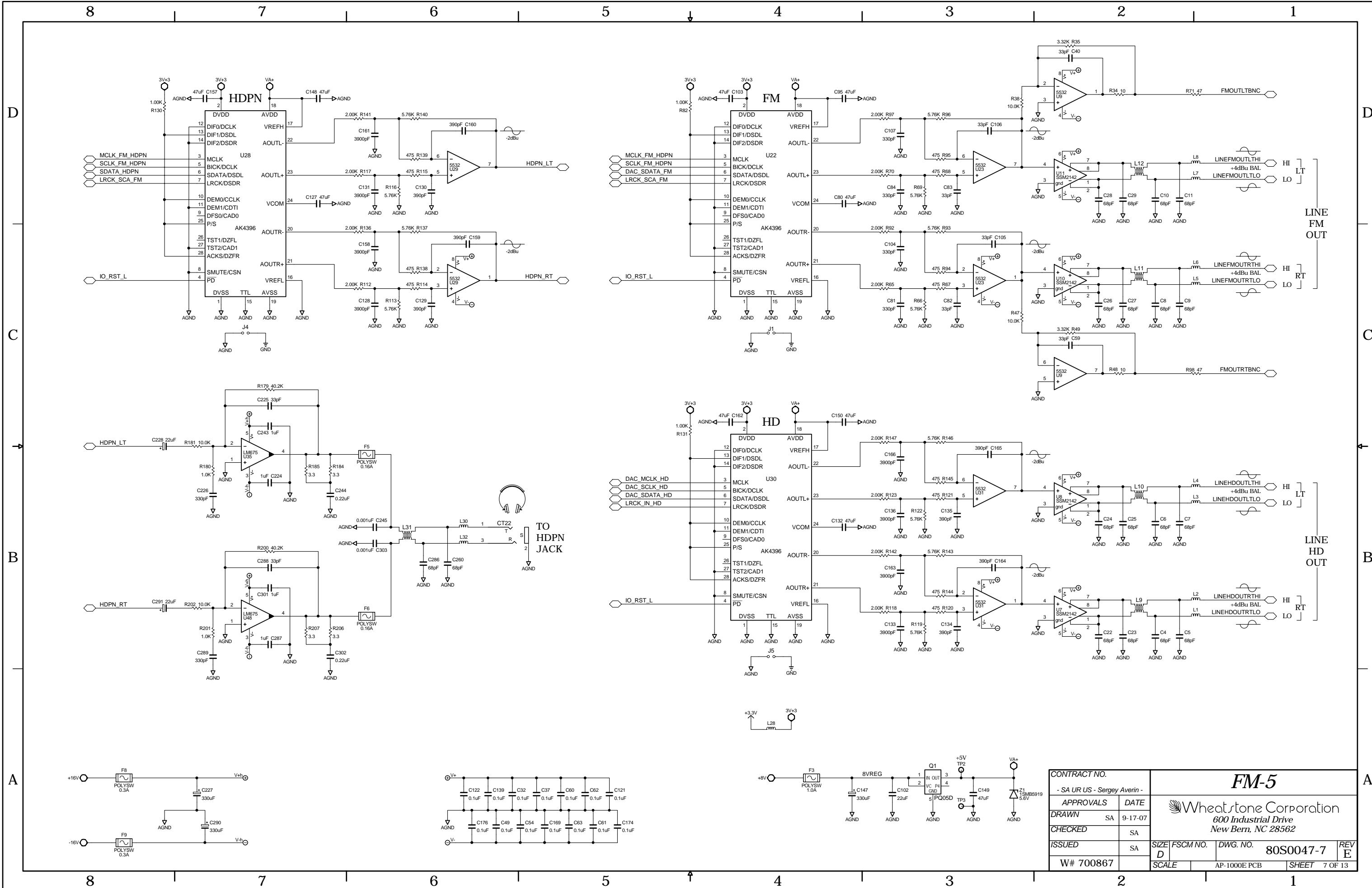


FM-5 Signal Flow Diagram



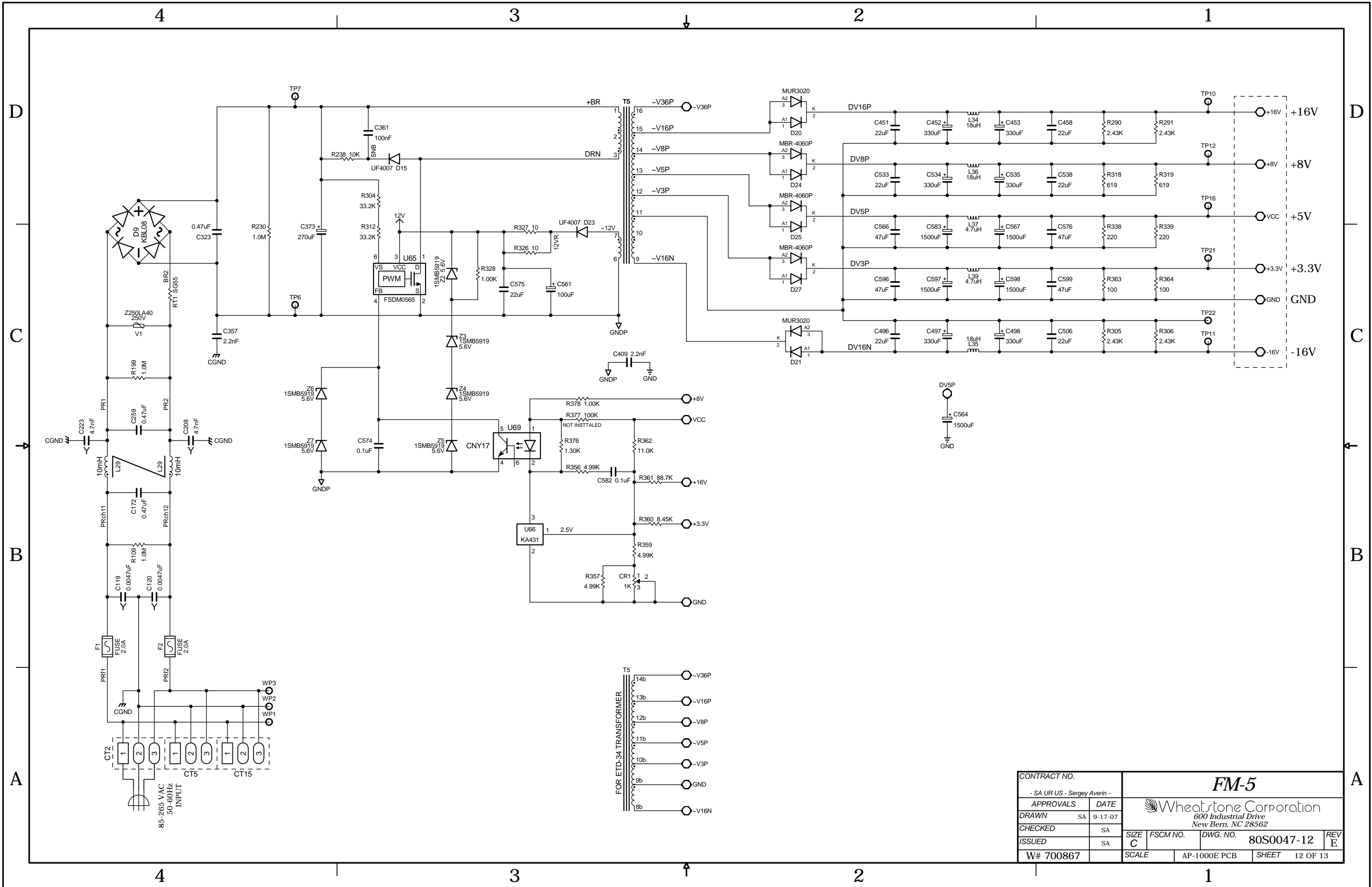



Audio Processor Schematic



CONTRACT NO.		FM-5	
- SA UR US - Sergey Averin -		Wheatstone Corporation	
APPROVALS		600 Industrial Drive	
DRAWN SA 9-17-07		New Bern, NC 28562	
CHECKED SA		SIZE D	FSCM NO. 80S0047-7
ISSUED SA		SCALE	DWG. NO. 80S0047-7
W# 700867		AP-1000E PCB	REV E
		SHEET 7 OF 13	

Audio Processor Schematic



CONTRACT NO.		FM-5			
- SA UR US - Sergey Averin -		 Wheatstone Corporation 600 Industrial Drive New Bern, NC 28562			
APPROVALS	DATE				
DRAWN SA	9-17-07				
CHECKED	SA	SIZE C	FSCM NO.	DWG. NO. 80S0047-12	REV E
ISSUED	SA	SCALE	AP-1000E PCB	SHEET 12 OF 13	
W# 700867					



Appendix

Contents

Parameters, Units and Ranges	A-2
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Parameters, Units and Ranges

Approximately following the FM-5's signal path, these are the values and ranges appropriate to each type of processing.

System Level

Headroom:	20dB
Nominal Operating Level:	-20dBFS digital

Analog Line Input

Type:	Electronic Differential
Input Impedance:	> 10Kohm (bridging)
Optimum Source Impedance:	< 1Kohm

Digital Line Input

Data Standard:	AES3 (AES/EBU)
Data Amplitude:	Per AES3-2003 assuming minimum allowable output signal amplitude of 200mV

Input Gain Adjustment Ranges

Gain Adjustment:	+/- 24dB
Gain Adjustment Increments:	0.5dB
Gain Calibration:	A gain control setting of 0.0 aligns an external 0dBFS signal with the FM-5's 0dBFS internal reference

Input Failsafe

Type:	Automatic
Analog Fail Cause:	Audio level below -37dBFS.
Response Time:	15 seconds
Digital Fail Cause 1:	Audio level below -37dBFS
Response Time:	15 seconds
Digital Fail Cause 2:	Corrupted or invalid AES data
Response Time:	Immediate

Audio Level Balance

Type:	Common to Analog and Digital inputs
Analog/Digital L/R Balance Range:	+/-12dB
Analog/Digital L/R Balance Increments:	0.5dB

Voice Symmetry Phase-rotation

Operating Modes:	In/Out
Filter Type:	4 th Order Allpass

High-Pass Filter

HPF Filter Class:	24dB/octave Butterworth
Frequency range:	20Hz – 300Hz
HPF Insert Modes:	Off / Stereo L/R / Sum/Difference

Equalization - Two Sections of Four-Band Parametric Equalization

EQ Set 1 – routable to pre or post-five-band AGC.

EQ Set 2 – post-FM multiband limiter.

Frequency:	20Hz – 20 kHz
Bandwidth:	0.2 – 3.0 octaves
Lift / Cut:	+/- 14.0dB pre/post five band AGC
	+/- 6.0dB post FM multiband limiter

Five-band AGC/Compressor

Operates in sum/difference, or ‘matrix’ mode with the gain linked at AGC time constants.

Drive Gain:	-80.0dB to +6.0dB in 0.5dB steps
Makeup Gain Range:	-20.0dB to +48.0dB, 0.5dB steps
AGC/Compressor Thresholds:	- 50dBFS to -80dBFS
AGC Threshold Backoff:	0dB to -12dB
AGC Attack:	50mS – 1500ms (1.5 sec)
AGC Release:	100mS – 7000mS (7.0 sec)
Compressor Attack:	3.0mS – 1000mS (1Sec)
Compressor Release:	20mS – 1000mS (1Sec)
Ratio:	1:1 – 20:1
Overall Freeze Threshold:	-20.0dB to -79dBFS, plus off
Freeze Threshold Trim:	+/- 6dB per band
Freeze Operating Modes:	Gate/Ooze
Freeze Wait:	50mS to 500mS

Crossover Frequencies

Super Low to Low Band:	40.5 Hz to 120 Hz
Low to Low Mid Band:	149 Hz to 334 Hz
Low Mid Band to High Mid Band:	817 Hz to 1.59 kHz
High Mid Band to High Band:	2.52 kHz to 7.55 kHz
Band Output Trims, Sum:	+/- 6dB
Band Output Trims, Difference:	+/- 6dB

10 Band FM Output Peak Limiter

A four band parametric EQ follows the 10 band limiter and feeds a bass clipper with multiple operating styles, then an oversampled, zero overshoot lookahead limiter or main clipper with multiple operating styles, and then an FM diversity delay.

Overall Controls	
Multiband/Drive:	0 – 100%
Bass Clip Drive:	+/- 10.0dB
Bass Clip Style:	Off/ Soft/ Hard
Bass Clip Output:	+/- 10.0dB
Bass Clip Frequency:	60-300Hz
Multiband Knee:	Soft/ Hard
Multiband Threshold:	+/-10dB relative to Drive
Multiband Attack:	0.1ms – 1000ms (1Sec)
Multiband Release:	30ms – 1000ms (1Sec)
Pre-emphasis Modes:	Off/50uS/75uS
Pre-emphasis insert points:	Pre-MB Limiter Pre-lookahead limiter Post-lookahead limiter (pre-clipper)
Lookahead Limiter (Threshold) Trim:	+/- 6.0dB
Lookahead Limiter Attack:	0.2ms – 100ms
Lookahead Limiter Release:	33ms – 330ms
Lookahead Limiter Long Release:	100ms – 1000ms (1Sec)
FM Output Level Trim:	Off to +12.00dB
Main FM Clipper Styles:	Off/Hard/Firm/Round
De-emphasis:	Complementary as applied in pre-emphasis.
Output Signal available as:	Pre or post diversity delay AES 3-pin XLR (digital), and Stereo Analog (pair 3-pin XLR connectors)

Stereo Encoder

Reference grade stereo encoder with embedded composite processing, test oscillator, SCA digitizer, and balanced and unbalanced composite outputs.

Overall Controls	
Drive Trim:	+/-6dB relative to input level.
Stereo Pilot Injection:	0 – 20%, 0.1% steps
Stereo Pilot Phase:	+/- 22.5 degrees reference to 38kHz.

SCA 1 Input:	Analog, 10kohm input impedance, +24dBu max. input level
SCA Input 1 Gain:	Off to +10dB
SCA 2 Input:	Analog, 10kohm input impedance, +24dBu max. input level
SCA Input 2 Gain:	Off to +10dB
TX 1 Output Level:	Off to +12.0dB, 0.05dB steps
TX 2 Output Level:	Off to +12.0dB, 0.05dB steps
Composite Processor Modes:	May be selected to provide pilot tone only Lookahead Limiter Soft Clipper Hard Clipper
Stereo Encoder Output Operating Modes:	Analog L/R Analog L/R De-emphasized Unbalanced and Balanced Multiplex Outputs
TX 1/TX 2 Output Levels:	Nominal output level range 1V - 4V RMS) or balanced from an XLR.

Presets

An advanced preset management system allows the creation, storing, and recall of 80 presets within the FM-5 itself and an unlimited number on a host PC. All signal-processing parameters are contained in these presets, allowing the preservation of the complete processing 'environment.' Optionally, Input and Output settings may be stored and recalled with presets.

Preset Encryption

Presets are encrypted using the FM-5 internal 32 bit serial number as the encryption key.

Onboard Real-time clock

A highly accurate internal real-time clock allows the automatic recall of presets at pre-determined times. This clock may be set to 'free-run' or be synchronized to an external on- or off-site SNTP server.

Day-Parting and Long-term Scheduling

A 'weekly' preset scheduling table allows the establishment of a weekly cycle of preset changes allowing for automatic programmed day-by-day exclusions or additions.

Additionally, a separate long-term scheduling table permits the establishment of 'one-off' preset changes for *any* future time and date.

General Purpose Input (GPI)

Eight optically isolated inputs are slaved to logic associations the first eight preset slots.

Presets may be recalled by providing the appropriate voltage to the associated GPI port to create a “Logic High” and may be either momentary or latching as desired. Voltages are applied between the appropriate GPI pin and Common with the GPI pin being the most positive voltage. Please see manual text for the required current limiting resistor for voltages above 5VDC.

Ethernet Interface

The FM-5 contains a five-port, auto-sensing 10/100BaseT Ethernet switch with one port available on the outside of the unit for field use. Because the switch is auto-sensing it is not necessary to utilize a crossover cable when connecting a PC directly to the FM-5.

Software Remote Control

Supplied Windows® Vorsis GUI software affords control of all system and processing parameters via a 10/100BaseT Ethernet interface.