AIRAURA X3

DIGITAL SPECTRAL PROCESSOR

TECHNICAL MANUAL

Wheatstone Corporation

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Digital Spectral Processor

Technical Manual

Wheatstone Corporation
May 2013

VORSIS ULTRA-HIGH RESOLUTION PROCESSING

AirAura X3 Digital Spectral Processor Technical Manual - *Software Version 3.XX and higher*

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600 Industrial Drive
New Bern, North Carolina 28562
tel 252-638-7000 / fax 252-637-1285

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.

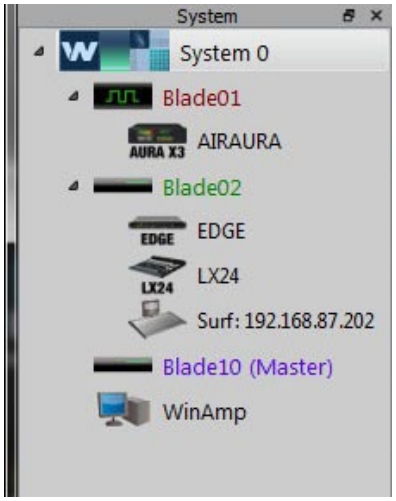
This equipment must be installed and wired properly in order to assure compliance with FCC regulations.

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

CE

Adding AirAura X3 To The Peripheral Devices* Tab

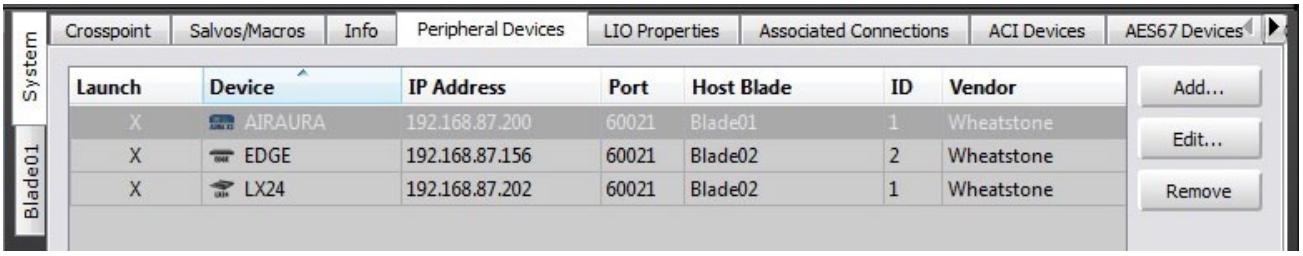
In order to utilize all the features of the AirAura X3 Digital Spectral Processor the device must be added to the System *Peripheral Devices* tab in the Wheatstone WheatNet-IP Navigator program (aka the Navigator GUI). This sheet shows you the basics of that procedure. Refer to the *WheatNet-IP BLADE3 Audio Over IP Network Technical Manual* for additional details.



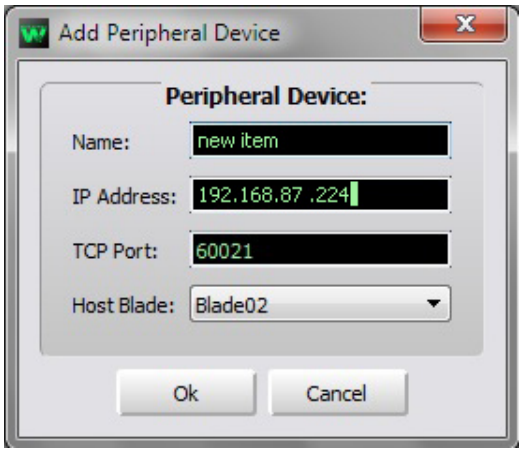
You will need to know the IP address of the device being added, so you will want to find that out before you start.

Launch the Navigator GUI and make sure that **System 0** is selected in the *System* pane. You will see something like this:

Now select the *Peripheral Devices* tab.



Click the *Add* button to bring up the *Add Peripheral Device* dialog:



Type in a convenient *Name* and insert the *IP Address* of the device being added. Leave the *TCP Port* at the default setting of **60021**. From the *Host BLADE* drop down select the BLADE that you want to associate the Peripheral device with. Click *Ok*.

This completes the process of adding the device to the *Peripheral Devices* tab. The added device should show up in the *System* pane under the BLADE you added it to. If it does not show up, or if it shows up but has a yellow question mark on it, then there is either a network issue that needs attention, or the device is not connected to the network at all, or one or more steps have been omitted or done incorrectly in the configuration process.

* In previous Navigator GUI versions this was the **System 3rd Party Devices** tab.

The History of Wheatstone Audio Processors

First introduced in 2005, the Vorsis product line evolved from Wheatstone's return to our original roots; professional grade audio processing. Having designed and integrated precision analog and then, later, complex digital audio processing into our radio and television products Wheatstone was perfectly poised to tackle the challenges of combining extremely high audio quality with competitive on air loudness.

Our audio processing products are built to the same high standards as all Wheatstone products. Research and Development, Manufacturing, Testing, and Quality control.... all are accomplished within Wheatstone's state-of-the-art facility in New Bern, North Carolina. Every facet, from original concept through production, is under strict control to ensure that every product meets the high quality *and* reliability standards that Wheatstone is known for. True to "Made in the USA," Wheatstone utilizes *no* offshore manufacturing.

Experts in Digital Signal Processing, broadcast audio and other engineering disciplines comprise our audio processing design team. Led by audio processing guru and broadcast engineering veteran Jeff Keith, the team combines their talents to design and build audio processors achieving the highest standards of on air sound quality.

Even within its relatively short history Wheatstone's audio processing team has invented new, clever, *and* effective audio processing algorithms – algorithms that push audio processor performance to far higher levels. In fact, Wheatstone was the first to develop an intelligent, program aware AGC (2007) Sweet Spot Technology with its unique Density Compensation™. We were also the first to employ the science of human psychoacoustics in the design of a multiband limiter (2005), our acclaimed 31-band limiter. In addition, our Vorsis Bass Management System (2007) now BASS TOOLS™ , is well regarded for *solving* the bass intermodulation problems that plague other brands of audio processors when pushed for competitive loudness.

Each Wheatstone Processing product comes with its own Windows® software-based intuitive Graphical User Interface enabling easy setup and sound adjustments. A multitude of carefully tuned factory presets ensure that our audio processors can be placed into on-air use quickly and easily in any size market with a minimum of effort.

AirAura X3 Technical Manual

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General Information

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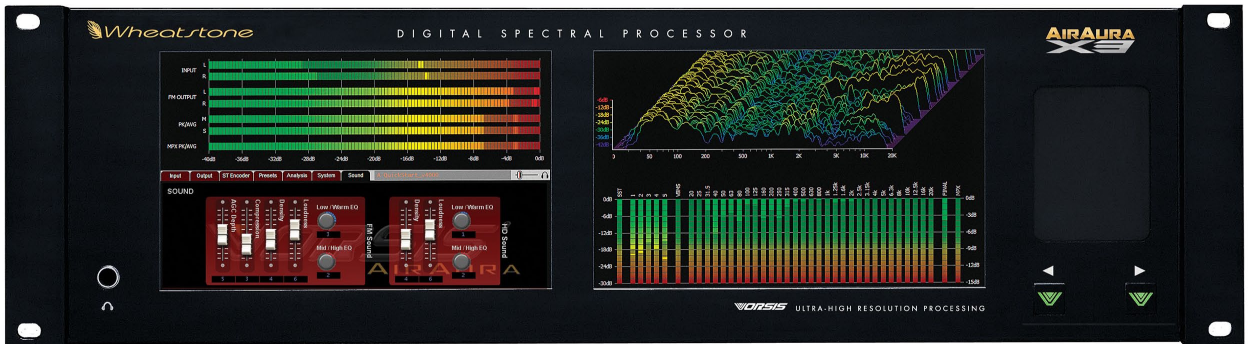


General Information

Introduction

Welcome to AirAura X3, Wheatstone's third generation flagship audio processor. AirAura X3 has been carefully designed to deliver a clean and easy to listen to sound on the dial along with *very* competitive loudness if that is the goal. AirAura X3 expands on technologies previously invented by Wheatstone, incorporates several new ones, and delivers that "sought after" sound to both FM and HD mediums. Like other Wheatstone processors, AirAura X3 has been carefully designed to not have a fixed sound of its own – the end user can use AirAura X3's vast pallet of tools to create any desired on air sound.

AirAura X3's processing algorithms have been carefully evaluated though thousands of hours of critical listening with a very wide range of program material. Experience on real radio stations in markets of every size has revealed that our processing algorithms deliver *amazingly clean, clear, and if desired, loud, on-air sound*. Music sounds like it was meant to sound. Voices are rich and full and without unnatural coloration or distortion. Transitions between widely varying program elements are deftly handled, and if desired, with no trace of "processing" during spectral balance and density corrections.

Remote control of AirAura X3 is via Windows-based Graphical User Interface (GUI) software over 100BaseT wired Ethernet and/or 802.11b/g wireless; simultaneously, too, if you wish! Up to four simultaneous remote control sessions are possible using any mix of wired and wireless Ethernet. Eight rear panel General Purpose Inputs (GPI) and four General Purpose Outputs (GPO) are provided to allow hardware- level interfacing of AirAura X3 to station systems.

AirAura X3 uses an internal base sampling rate of 192 kHz with higher rates used where beneficial to do so (such as within the AirAura X3 clipper). A 24-bit, 144dB internal dynamic range signal path allows audio to be processed with extreme precision. Twin front panel LCD screens driven by a Linux-based industrial-grade CPU and a front panel touch-pad permit convenient control of system and basic processing setup parameters. Equipped with the popular "Audio Processing Guru®" right on the front panel, the sound of any factory preset can be easily customized to over one million different combinations.

Those wishing for complete control over all processing parameters will appreciate our full-control Professional GUI which is designed for processing experts. This advanced GUI is available free of charge by registering for it at http://wheatstone-processing.com. Registered users of the AirAura X3 Professional GUI have access to well over 400 individual processing adjustments.

The following pages will help you get AirAura X3 up and running as quickly as possible without having to know a lot of techie stuff.

If during installation or setup you find that you need assistance or advice, please feel free to contact our technical support folks at (252) 638-7000 or email us at: techsupport@wheatstone.com.

AirAura X3 Feature Overview

The AirAura X3 Digital Spectral Processor has been designed to separately process audio for conventional analog FM and digital HD radio signals. Sharing the four band parametric equalizer and intelligent five-band AGC with SST, the two signal paths are equipped with their own 31-band limiters and final peak control sections, each optimized for the intended medium.

AirAura X3's five band AGC incorporates our SST (Sweet Spot Technology™) and operates through a proprietary technique, Density Compensation™ . The Density Compensation™ algorithm utilizes real-time analysis *and* data from the user controls to invisibly maintain the *user set* spectral balance *and* program density as program elements change. Speech is loud and clean at *any* loudness level. The output of the five-band AGC/SST is then split into two signal paths, FM and HD.

Unlike processors with fewer limiter bands, Wheatstone taps into human psychoacoustics to render operation of the 31 limiter bands inaudible. While limiting only the discrete frequencies needed, subtle audio detail in adjacent limiter bands is revealed – detail not heard in other processors. The 31-band technology has similarities to the precision filter banks used in high-performance perceptual codecs. Positive attributes shared with perceptual codecs include low latency with good group delay and phase behavior. The 31-band limiters rely on a well-researched characteristic of human hearing known as "critical band masking" to hide operation of the individual limiter bands from the ear.

The FM signal path utilizes our new AirAura X3 final clipper technology. A selectable look ahead limiter is also available which may be used in combination with the clipper if desired. A digital stereo generator follows the AirAura X3 clipper and generates two multiplex composite stereo outputs and accommodates two SCA inputs. The rear panel BNC connector for SCA-2 may be switched internally to provide a 19kHz stereo pilot square wave "Sync" output for RDS applications that require a 19kHz synchronization signal.

AirAura X3 is also equipped with our Wheatstone® baseband192 digital composite interface which provides a direct, pure digital signal path between the components of the stereo multiplex spectrum and the associated transmitter's digital FM modulator. With this interface the usual A to D and D to A and/or sample rate conversions are absent, resulting in virtually perfect stereo baseband and modulation performance.

The HD signal path is also equipped with its own 31-band limiter and look ahead final limiter, allowing program density and peak control to be set as desired. The HD path's digital and analog outputs may be swapped left for right as well as phase reversed, the latter to accommodate a software bug in certain versions of HD radio encoder firmware.

A fully routable headphone monitoring path allows the audio in various parts of the processing chain to be auditioned. The selected Input Source and the unselected

Analog and Digital inputs may be monitored separately, and unselected inputs may be monitored without putting them on the air. The FM and HD processing paths have multiple headphone monitor points including the final processing output.

Several dozen factory presets are provided with AirAura X3, making a very wide range of on air sounds and textures available to the user right out of the box. When used in combination with the front panel's Audio Processing Guru controls each factory preset offers over a *million* different on-air sounds to the user.

The System Menu of the GUI provides access to two preset scheduling utilities. As well as the usual short-term daily scheduler, there is also a "long-form" scheduler that can be programmed for automatic preset changes on dates and times well into the future. This scheduler is useful for changing presets weeks or months after a preset is prepared, such as for a special event, and without having to edit the daily preset schedule in order to accommodate "special" presets.

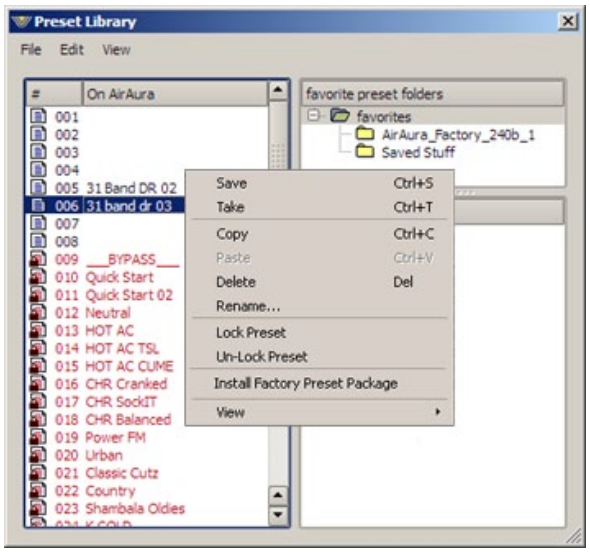
GPI (General Purpose Inputs) provide easy access to preset changes via external events such as contact closures and automation control. AirAura X3 is also equipped with Wheatstone's ACI protocol, allowing *complete* control of not only presets, but any parameter that is assigned to a user control (please contact the factory for details on using this feature).

New for version 3.0

AirAura X3 has many new features which compliment the already powerful controls in previous versions of AirAura. Some of X3's new features include:

- Selectable shelving or parametric EQ on Equalizer bands 1 & 4.
- AGC back-off is now globally adjustable or per-band.
- AGC Interband coupling can now reference Band 2 or Band 3.
- Adjustable Interband coupling controls for each AGC band.
- New selectable Bass Tools coupling to the 31-band limiters.
- Three user-selectable filter options for the Bass Tools processor.
- Refined 31-band limiter algorithms.
- Incredibly powerful AirAura X3 final clipper with Transient Preservation™ .
- Wheatstone® baseband192 digital composite interface.
- New analysis for stereo imaging, MPX baseband and BS-1770 Loudness.
- Easier to use Guru and Professional GUIs.
- Expanded metering and analysis functions on all GUIs.
- External audio signals including MPX may be applied for analysis.

Factory Preset Installation Feature



AirAura X3 has a new feature which makes installing Factory Presets not only more convenient, but completely separate from any firmware upgrade process.

When the GUI is connected to the AirAura X3 hardware via a network connection a new menu item is present in the preset dialog. If the mouse cursor is over the hardware (left) side of the library dialog and the mouse is right clicked, a new item, "Install Factory Preset Package" appears. This function operates to replace all factory presets on the AirAura X3 hardware with new and updated ones whenever that is the action desired. It operates using certain assumptions, two of which are that preset slot #9 is always the "Bypass" preset and Factory Presets are always stored in slots #10 and above.

When the Install Factory Preset option is invoked it will open a Windows dialog asking for the location of the new Factory Preset Package (.fpp) file. Once this file is located and then selected and the update process is begun, presets in slots 10 and up will be replaced by new and/or additional Factory presets. Each new preset will automatically be factory locked to protect them from being inadvertently overwritten.

!! --- VERY IMPORTANT NOTE --- !!

In order to make the update process consistent across all possible AirAura X3 hardware, we do not check to see if any user presets have been stored in slots above those which might contain existing Factory presets. What this means is that if a user wishes to install new Factory presets then his user presets must first be saved to a location off the AirAura X3 hardware prior to running the Install Factory Preset routine! If this is not done, some or all user presets may be lost!!

Rack Mounting

AirAura X3 is designed to be mounted into an industry standard 19" equipment rack and requires three rack units (5.25 inches / 13.335cm) of vertical space. If using only two rack screws always use the bottom two screws to prevent twisting of the front panel and other undue forces from harming the processor chassis.

AirAura X3 does not need nor does it have top or bottom cover ventilation holes. Cooling is accomplished via cooler air drawn into vertical slots positioned lower in the side panels which allows latent heat rising by natural convection to exit slots in the top of the rear panel.

A small fan is located inside the unit which stirs the air to even out the internal temperature. This fan has an 80,000 hour rated minimum lifetime and has no role in 'removing' heat. In the unlikely event that the fan fails, its failure will not compromise the operation of AirAura X3 as long as the unit is being operated in a reasonable environment (below 104F or 40C).

AirAura X3 may be mounted between other devices in the equipment rack; however, in accordance with good engineering practice it should not be mounted directly above devices that generate a significant amount of heat (such as power amplifiers or power supplies). If such a location is unavoidable, then it is advisable to utilize an extra 1RU blank rack panel between the AirAura X3 and devices immediately above and/or below it.

WARNING!

With very few exceptions, the AirAura X3 chassis does not need to be opened in the field.

Please be advised that AirAura X3 contains high voltage power supply circuits operating at voltages well above AC line potential.

These voltages are hazardous and potentially deadly if accidentally contacted.

Special tools, software, and fixtures are required for service. There are no user-serviceable parts inside.

AirAura X3 must be returned to Wheatstone Corporation under a Return Authorization in the unlikely event that repair is necessary.

AirAura X3 Installation Tips

Grounding

Establish a low impedance common ground in the facility and try to route all equipment grounds to that point. Use ground conductors with the largest possible surface area and keep ground leads as short as possible. AirAura X3's ground reference is its chassis, which should be connected to the station ground. Such a connection is especially important when AirAura X3 is operated in a high RF environment because it helps minimize differential voltages between the processor's chassis and other pieces of equipment such as the rack it is mounted within.

Surge Protection

Always place surge protection circuits as close as possible to the device being protected. AC power line surge protection should manage transients in a way that keeps instantaneous potential differences *between* the power line hot, neutral, AC grounding conductor, the station ground and the processor chassis as low as possible. Likewise, measures should also be taken to keep the instantaneous potential difference between the audio cable shields and the processor chassis as low as possible (this applies to *all* audio equipment, not just AirAura X3), particularly when the equipment is located within the electrically hostile environment of a station's transmitter facility.

UPS/Power Conditioning

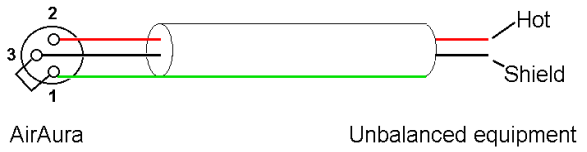
Choose the best power conditioning/UPS units that your budget will allow, focusing on the most important features and options that you actually need. Some questions to ask while reviewing features are:

- How does the UPS behave when AC power is not exactly 60Hz, such as when the facility is on its backup generator?
- If the UPS has onboard surge protection, what kind of surge capability does it have and where are those surges directed to?

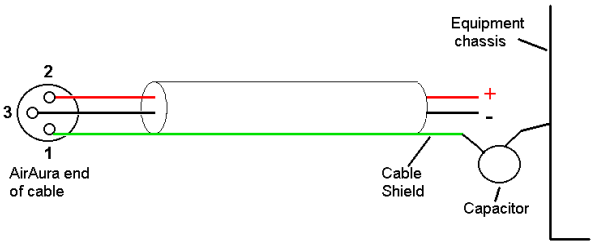
- Is the UPS equipped with remote monitoring capability?
- Does the UPS have onboard monitoring and alarms to signal problems such as low batteries?

Analog Audio Input Connections

Balanced audio *input* sources are recommended and should be connected to AirAura X3 using standard two-conductor shielded audio cable such as Belden 8451 or 9451.



Unbalanced input audio connections should be made with shielded *two conductor* cable. At the unbalanced source's output connect the "+" output to AirAura X3's "Hi" input (XLR pin2) and connect the shield wire to AirAura X3's "Lo" input (XLR pin-3). If the cable's shield is used (recommended) connect it at the AirAura X3 end only (XLR pin 1) to prevent AC ground loops.



If RF interference is an issue, the far (floating and ungrounded) end of an audio cable shield can be experimentally bypassed to RF ground via a 0.01uF, 250V AC *rated* capacitor. Suitable capacitors are:

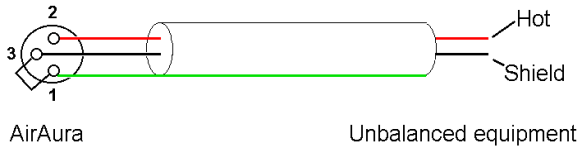
TDK	CS17-F2GA103MYGS
Murata	DE2F3KH103MA3B
Panasonic	ECK-ATS103MF
AVX	65N103MBLCP

Analog Audio Output Connections

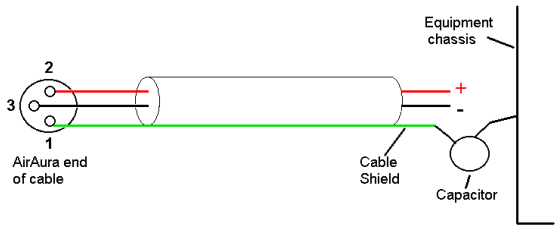
Balanced audio *loads* are recommended and should be connected to AirAura X3's outputs using standard two-conductor shielded audio cable. *Unbalanced* audio loads should be avoided, but if they can't they should be connected using shielded *two conductor* cable such as Belden 8451 or 9451 (as if connecting a balanced source).

AirAura X3 is equipped with an active balanced output stage that behaves like a transformer. Because of this the correct wiring method may be different than expected.

The unbalanced load's "Hi" lead should be connected to XLR connector Pin 2 ("Hi"). The unbalanced load's shield should be connected to AirAura X3's output XLR Pin 3 ("Lo"). Then, and to enable AirAura X3's balanced output amplifier to operate correctly when driving the unbalanced load, it is recommended that AirAura X3's XLR output Pin 1 (ground/shield) also be connected to Pin 3 ("Lo"), noting that this MUST BE DONE at the AirAura X3 output connector (see the diagram above).



Note that it is not advisable to connect Pin 1 and Pin 3 conductors together at the far end of the cable. Doing so can induce external noise and crosstalk on the output amplifier's 'load sense' lead which is XLR Pin 3 whenever Pin 2 is being used as the "Hot."



As in the input case, if RF interference is an issue the far (floating) end of the cable shield can be experimentally bypassed to RF ground through a 0.01uF 250V AC *rated* capacitor to see if it helps. Please refer to the listing above for capacitors known to be suitable for this task.

Digital Audio Connections

For digital audio connections always use a good quality balanced digital audio cable (or twisted pair Category 5E/6 Network cable) having a characteristic impedance of 110 ohms. This cable should be shielded where possible, and in the case of multi-pair cable, each pair should be individually shielded. Foil shielding is recommended for permanent installations, and a cable with foil shield plus an overall braid should be used in applications where frequent flexing of cables might occur.

Generic "audio" cable such as Belden 8451 and 9451 may sometimes be used for interconnecting AES3 digital audio devices *as long as the cable is short*. The actual cable length that will work satisfactorily is determined by *many* factors, including the error correction and jitter tolerance of the AES3 receiver, the characteristics of the digital cable driver, and the characteristics of the specific cable being used and its length. "Generic" analog audio cables usually have higher capacitance than digital cable and high capacitance cables can impair the ability of the AES3 receiver to recover the digital signal without errors. Increased jitter, dropouts, or no audio at all can be an indication of an improper cable type.

When baseband192 is in use we recommend using only "digital" cable and keeping the total cable length to fifty feet (15 meters) or less.

Where to Install AirAura X3

The best location to install AirAura X3 is at the transmitter site. This requires that a discrete Left/Right STL, either analog or digital, be involved in the signal path. The major benefit of a transmitter site installation is that it enables the use of AirAura X3's built-in lab-grade stereo encoder which allows much tighter control of modulation peaks.

A transmitter site location has the additional benefit of allowing the use of AirAura X3's highly oversampled composite processor to gain an additional loudness advantage. The Vorsis composite processor is much cleaner and more forgiving than those in other products, and in combination with AirAura X3's tight pilot and SCA protection filters can create additional loudness without the audible grunge that composite clippers typically create.

We recommend that, whenever there is a choice between using an exciter's composite MPX or AES3 input, the processor (any processor) should be interfaced to the transmitter using the exciter's composite stereo multiplex input. The exciter's AES3 digital input may be "clean" and it may be "digital," but it also precludes the ability to gain additional loudness through the use of AirAura X3's intelligent oversampled composite clipper. Also, depending on several factors including the sample rates being used, the exciter's AES digital input can exhibit inferior peak control compared to the exciter's composite input.

When AirAura X3 is located at the studio and an STL is being used to send the program material to the transmitter site there are several issues to consider:

Digital STL

There are two categories of Digital STL's on the market – those with codec-based audio compression and those using uncompressed linear audio.

When the digital STL employs codec-based audio compression AirAura X3 should be located at the transmitter site which places it *after* the codec. This is very important because most codecs will sound better when presented with *unprocessed* studio audio instead of highly processed and pre-emphasized audio from the processor's output. Further, the encoding schemes used in such STL's cannot accurately pass the well-defined peak levels created by AirAura X3, creating a modulation (loudness) disadvantage.

Installing AirAura X3 at the studio end of a "compressed" STL brings with it at least two caveats:

- AirAura X3's stereo generator and composite clipper will not be available. Many digital exciters offer stereo generator and composite clipper functions, but their clippers have historically been quite crude and spectrally "dirty" compared to AirAura X3's exceptional clipper. Therefore, exciter-hosted composite clippers are *not* the optimum choice when the station's ultimate sound *quality* is important.
- Compressed STL's do not perform well when presented with competitively processed audio, especially when that audio has been pre-emphasized. This is because codecs do their work by examining the audio for opportunities to *remove* content that *shouldn't* be audible to the average human ear. When densely processed audio is presented to a codec there are far fewer opportunities to remove redundant audio information and then *mask* that removal from our hearing. When handling heavily processed (limited dynamic range) material, codec operation can be much more obvious – even to the point of being objectionable – than when the processing is located *after* the codec where the masked artifacts are only occasionally and, usually, minimally unmasked by processing gain.

Uncompressed (linear) digital STL's have only one major limitation – placing AirAura X3 at the studio end of the STL will preclude the use of AirAura X3's stereo generator and composite clipper.

TIP: If using AirAura X3 at the studio be certain that any clippers in the stereo generator at the transmitter site are properly set up to complement the settings in AirAura X3. This will prevent gross distortion and potentially large modulation overshoots.

Analog Left/Right STL

Older analog discrete left/right STL's can suffer from an inability to control audio peaks because of inadequate bandwidth in their IF circuits and/or poor low frequency and phase performance. Individual left/right STL's rarely have identical group delay and this will adversely affect stereo separation when the signal is finally converted to the multiplex composite domain. Such STL's can also suffer from AFC bounce when handling highly processed low frequency material, robbing modulation and reducing on-air loudness.

Composite Analog STL

A high quality analog composite STL has some advantages over an analog left/right STL in that it will typically have broader bandwidth and better audio performance than a discrete analog STL. Most also have the capability to add subcarriers for SCA and RDS along with the composite audio. This means that many SCA and RDS generators may be located at the studio end of the STL, which, along with the audio processor, makes for a very convenient setup. With a modern composite STL and properly engineered point-to-point path, the audio can be nearly as transparent as a digital STL.

Analog Phone Lines

Discrete left/right analog "phone line" STL's are not recommended because of the inability of most Telco service providers to meet the tight frequency response and phase matching requirements. Furthermore, in many countries wideband analog circuits have become unavailable or their cost is prohibitive. On the other hand if the wired STL is a dedicated (and equalized if necessary) pair of circuits that is under the station's full control it may be acceptable.

Where Should Pre-Emphasis Go?

Pre-emphasis should ***always*** be applied by the audio processing and ***never*** by the exciter. Modern FM audio processors are equipped with highly refined and very sophisticated technology to manage the myriad challenges posed by FM pre-emphasis. They can provide very tight modulation control with very low perceived distortion. *No FM exciters have this technology.*

To summarize: the best location overall for the audio processor is always at the transmitter.

Arbitron People Meter (PPM)

Field experience has indicated that AirAura X3 favorably passes the data watermarking scheme used in the Arbitron People Meter rating service technology, regardless of the aggressiveness of the processing being performed.

AC Power Considerations

Please note that in order to enhance its long-term reliability AirAura X3 has no power switch because *all* power switches notoriously become intermittent over time without regular use.

AirAura X3 accepts AC line input voltages between 90 and 260 VAC, 50 or 60Hz. Power consumption is under 100VA.

Although aggressive AC input filtering is utilized on the AC power input it is always advisable to use external surge protection and an uninterruptible power supply (UPS) wherever possible, especially where the AC power quality can be in question, 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. AirAura X3 is, after all, a highly specialized "computer."

The use of a UPS as recommended will protect AirAura X3 from short duration power interruptions and glitches which might otherwise signal it to reboot. When AirAura X3 reboots there will be a loss of audio for approximately 15 seconds.

Rear Panel Connections

The image below shows the rear panel of the AirAura X3 and the location of various connectors associated with an installation:

AirAura X3's rear panel connectors from left to right are:

Bottom Row

Analog Left Channel In
Analog Right Channel In
BAL TX 1 Out
BAL TX 2 Out
FM/HD Analog Left Channel Out
FM/HD Analog Right Channel Out
AES Digital Input
FM AES Digital and baseband192 Out
HD AES Digital Out
GPI Input
Ethernet 1/WheatNet-IP Interface
Ethernet 2/WheatNet-IP Interface
IEC Standard male AC Power Input

Top Row

SCA-1 Input
SCA-2 Input
TX 1 Out
TX 2 Out
WiFi Diversity Antenna 1
WiFi Diversity Antenna 2
GPO Status Output

The listed connections are made via various connectors mounted on the AirAura X3's rear panel.

- Nine XLR connectors are provided for analog and digital audio input and output and balanced TX output connections.
- Four BNC connectors are provided for SCA inputs and TX (transmitter) out, or Composite Multiplex (MPX) connections.
- Two RJ-45 connectors are provided for Ethernet connections. Either connector may be used to interface AirAura X3 to a WheatNet-IP audio network or to connect it to a Windows® PC running the Wheatstone AirAura X3 GUI.
- Two DB-9 connectors provide 8 GPI inputs (for selecting presets in the first eight storage slots) and four pre-assigned GPO outputs.

The pinout drawings on pages 1-19 through 1-22 summarize wiring connections.

Audio Inputs

AirAura X3s which are equipped with software version 2.4.x and up accept *three* types of audio input sources:

- Balanced analog line level left/right audio;
- Digital AES3-compliant left/right audio with sample rates between 32kHz and 96kHz;
- WheatNet-IP via 100BaseT Ethernet connection to a WheatNet-IP audio network.

Input audio can be applied to any or all inputs simultaneously with the caveat that the WheatNet-IP input and AES3 inputs share a *common* digital path into the internal processing.

Automatic audio failover from analog to digital or vice versa is supported. Automatic failover from AES3 or WheatNet-IP to analog is instantaneous and based on invalid or missing bits in the AES3 stream, or after 30 seconds of "silence" (level below -48dBFS).

Automatic failover from analog to AES3 or WheatNet-IP is based on silence sense responding to audio on both channels being below -48dBFS for more than 30 seconds.

Failover capability is not available between the AES and WheatNet-IP inputs.

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

Output audio for the FM path is available as:

- Balanced analog left/right stereo, pre-emphasized.
- Balanced analog left/right stereo, de-emphasized according to pre-emphasis in use.
- AES3 digital, either pre or post diversity delay, and/or de-emphasized according to pre-emphasis in use.
- FM multiplex spectrum in AES3 format at 192kHz.
- *Balanced* line level composite stereo multiplex on male XLR connectors.
- Unbalanced composite stereo on two BNC female connectors.
- WheatNet-IP audio network.

HD Path

Output audio for the HD path is available as:

- Balanced analog left/right analog.
- AES3 digital.
- WheatNet-IP audio network.

Analog Out – XLR-M

Pin 1 XLR BAL TX 1 SH – BAL TX 1 OUT SH
Pin 2 XLR BAL TX 1 HI – BAL TX 1 OUT HI
Pin 3 XLR BAL TX 1 LO – BAL TX 1 OUT LO

Pin 1 XLR BAL TX 2 SH – BAL TX 2 OUT SH
Pin 2 XLR BAL TX 2 HI – BAL TX 2 OUT HI
Pin 3 XLR BAL TX 2 LO – BAL TX 2 OUT LO

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

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

FM AES / baseband192 Out – XLR-M

Pin 1 XLR FM SH – AES FM / BASEBAND192 OUT SH
Pin 2 XLR FM HI – AES FM / BASEBAND192 OUT HI
Pin 3 XLR FM LO – AES FM / BASEBAND192 OUT LO

HD AES Out – XLR-M

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

Headphone Monitoring

An overload protected stereo headphone amplifier drives the ¼" stereo headphone output located on the left side of the AirAura X3 front panel. The audio source feeding the headphones may be chosen from several signal points within the processing algorithms, including both analog and digital inputs, even if those inputs have *not* been selected to feed the audio processing chain. The System menu of the GUI hosts the headphone router selector.

Network Connections

AirAura X3 is equipped with two methods of remote control connectivity:

- Wired Ethernet via two 100Base-T Ethernet ports on the rear panel. These ports are completely independent and Auto-MDIX, allowing them to support straight through and crossover cables in any combination. The wired Ethernet interface can support up to four simultaneous connections to remote GUIs.
- 802.11b/g compatible wireless interface. The wireless interface is based on a high performance, industrial class WLAN WiFi transceiver module equipped with diversity receivers and twin antennas. The salient features of the module are as follows:
    - 802.11b/g WLAN (Wi-Fi) standards-based technology.
    - Extended temperature and environmental specifications.
    - Built-in TCP/IP and UDP features allow flexible LAN connectivity options.
    - Built in WEP, WPA, and LEAP security protocols.
    - Up to four simultaneous "wireless" GUI connections.

With the factory default configuration of the wireless interface, AirAura X3 is an ad-hoc wireless device with no security which provides the least complex out-of-the-box first use for the majority of end users. Security options within the wireless interface's web browser-based configuration utility allow for password protection and connections via various security protocols if desired. Please see the appendix for detailed programming information for the wireless interface.

AirAura X3 is not a desirable hacking target and its wireless interface cannot serve as a gateway to a private LAN. This is because the wireless module acts only as a "bridge" between the single fixed IP address on its WLAN side and a single fixed IP address on the Ethernet side which is AirAura X3's hardware IP address. All Ethernet traffic is constrained between those two addresses, leaving no possibility of a

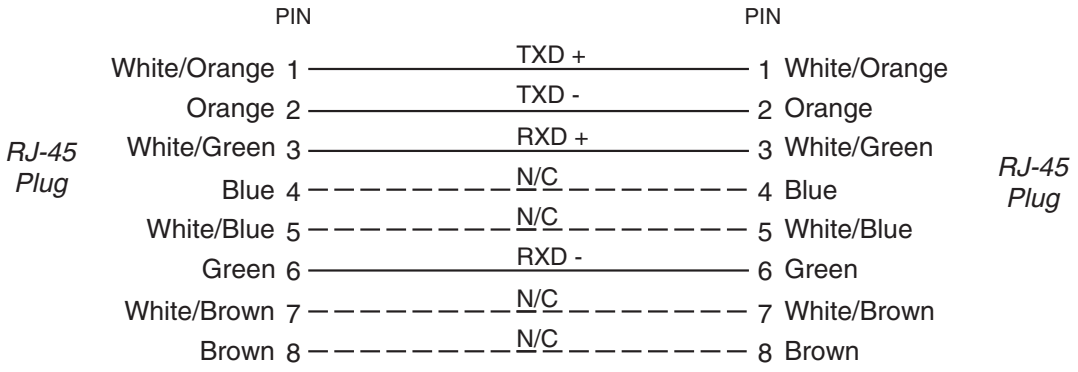
connection on the WLAN side tunneling to a different IP address on the wired side. This is an important concept to grasp and this "limited" functionality was purposely designed to protect a station's Ethernet-based business network from any rogue access via AirAura X3's wireless interface.

Important: AirAura X3's 802.11b/g wireless interface is intended for remote control only. The wireless interface does not support the WheatNet-IP audio transport.

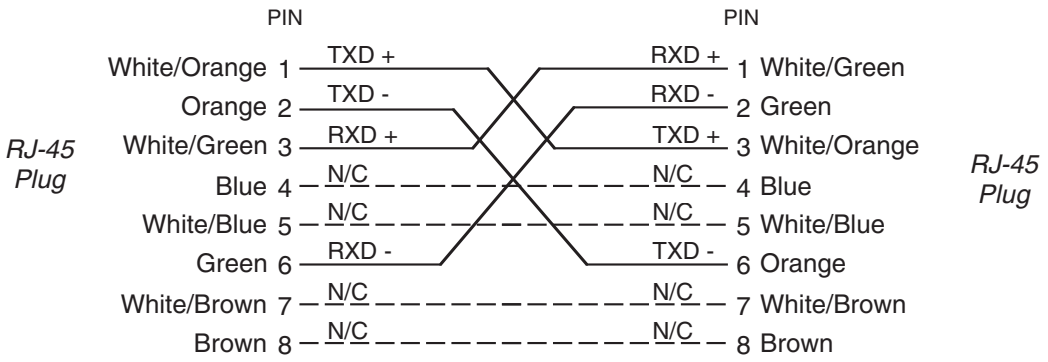
Ethernet – RJ-45

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)

AirAura X3 is equipped with eight General Purpose Input (GPI) input ports on one rear panel 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 from AirAura X3's internal circuitry to prevent external ground loops and to prevent dangerous voltages from being introduced into AirAura X3. Further, the GPI inputs accept DC voltages of either polarity, easing interfacing in the field.

The eight GPI inputs are hard-coded in software to activate the first eight preset slots.

The four GPO ports on AirAura X3 are hard coded in software to provide the following status outputs:

- GP Output #0 – Becomes enabled on Analog Audio Failure.
- GP Output #1 – Becomes enabled on Digital Audio Failure (either AES3 or WheatNet-IP).
- GP Output #2 – Becomes enabled if the CPU Temperature reaches 50 deg. C (122 deg. F).
- GP Output #3 – Becomes enabled upon a General System Failure.

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 AirAura X3 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

GPO

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

Processing Presets

AirAura X3 comes equipped with several dozen factory presets and it can hold a total of 80 presets in its onboard memory. Customer-created presets may be saved within AirAura X3's onboard memory until all preset storage slots are full. An unlimited number of presets can be stored on the PC that hosts the Windows-based remote control GUI software.

In order to prevent annoying clicks and pops when changing presets, preset parameters are slewed between the current values and the new values whenever a new preset is taken and it may take several seconds for the new settings to completely settle in. It is important to remember this concept!

AirAura X3's preset behavior is purposely designed to make preset changes as unobtrusive as possible and therefore parameter changes are not instantaneous, but gracefully take place over a matter of seconds. This factor must be taken into consideration whenever switching back and forth between presets in order to compare them!

When a preset has been recalled and has not been modified the preset's name is displayed in green text within the GUI's current preset window. If changes to the preset have been made its name will be displayed in red text instead of green. Once the modified settings have been saved back to AirAura X3's hardware the preset name will again be displayed in green.

Factory presets can be retuned and saved to new preset names in order to create a completely different air sound. The factory presets are write-protected and changes made to them cannot be written back to the same memory location. Factory presets that have been modified are considered by the system to be "user" presets and therefore must be saved as a new name and in a new preset storage slot.

Our advice is to start with a factory preset that has the on air sound that is *closest* to what you believe you need. If changes are necessary, the best approach is to make small changes, one or two at a time, and then listen for quite a while before deciding that more changes are necessary. A broadcast audio consultant friend of ours advises: *"Tweak small … Listen large."*

NOTE:

User presets that have been stored in preset slots 1 through 8 are logically assigned to the eight remote GPI functions. Examples of presets that might be stored here are:

- A preset that has all processing turned off and/or has special input/output level calibrations (such as for testing).
- A preset that has all processing enabled but has the Stereo Pilot turned off (a Mono Preset).
- A preset that changes the input or output source or level calibrations (note: "System Settings Change with Preset Takes" must be enabled in the System screen of the GUI in order for presets to control I/O settings.

Preset storage is as follows:

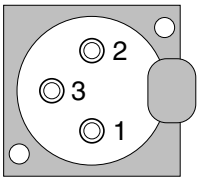
- Presets stored in slots 1 through 8 may be activated through the optoisolated GPI interface.
- Factory presets occupy slots 9 and up, with slot #9 always hosting the Factory BYPASS preset.

- User presets, other than the GPI selectable presets in slots 1 through 8, may be stored above the highest-numbered factory preset. The number of available user preset slots depends on the number of factory supplied presets which may vary by software version.
- The total number of presets on AirAura X3's hardware is limited to eighty (80). The storage space available for presets on the GUI's host PC (because of a preset's tiny file size) is virtually unlimited.
- User presets may be locked at the user's discretion to prevent inadvertent changes. Any user can unlock another user's locked presets.

Analog XLR Connections

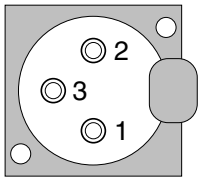
Analog In - XLR-F

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

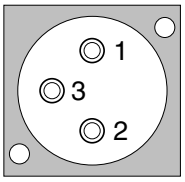
XLR RT-F



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

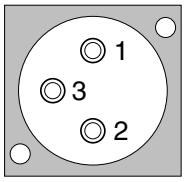
Analog Out - XLR-M

BAL TX 1 XLR-M



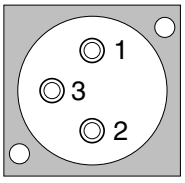
PIN 1 XLR BAL TX 1 SH - BAL TX 1 OUT SH
PIN 2 XLR BAL TX 1 HI - BAL TX 1 OUT HI
PIN 3 XLR BAL TX 1 LO - BAL TX 1 OUT LO

FM/HD LT XLR-M



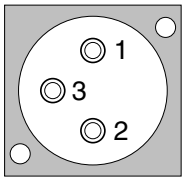
PIN 1 XLR FM/HD LT SH - FM/HDLT OUT SH
PIN 2 XLR FM/HD LT HI - FM/HD LT OUT HI
PIN 3 XLR FM/HD LT LO - FM/HD LT OUT LO

BAL TX 2 XLR-M



PIN 1 XLR BAL TX 2 SH - BAL TX 2 OUT SH
PIN 2 XLR BAL TX 2 HI - BAL TX 2 OUT HI
PIN 3 XLR BAL TX 2 LO - BAL TX 2 OUT LO

FM/HD RT XLR-M

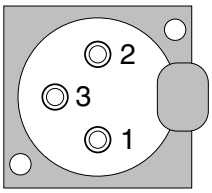


PIN 1 XLR FM/HD RT SH - FM/HD RT OUT SH
PIN 2 XLR FM/HD RT HI - FM/HD RT OUT HI
PIN 3 XLR FM/HD RT LO - FM/HD RT OUT LO

Digital XLR Connections

AES In - XLR-F

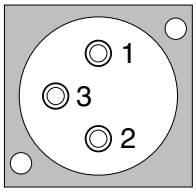
XLR-F



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

AES FM Out / baseband192 - XLR-M

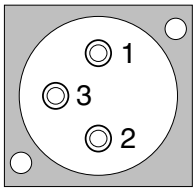
XLR FM-M



PIN 1 XLR FM SH - AES FM / BASEBAND192 OUT SH
PIN 2 XLR FM HI - AES FM / BASEBAND192 OUT HI
PIN 3 XLR FM LO - AES FM / BASEBAND192 OUT LO

AES HD Out - XLR-M

XLR HD-M



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

BNC Connections

BNC - SCA

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

1 

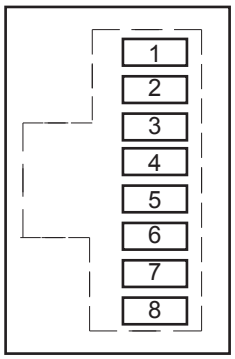
PIN 1 BNC 1 HI - TX 1 OUT HI - CENTER PIN
PIN 2 BNC 1 SH - TX 1 OUT SH - SHELL

2 

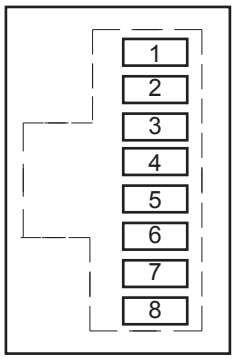
PIN 1 BNC 2 HI - TX 2 OUT HI - CENTER PIN
PIN 2 BNC 2 SH - TX 2 OUT SH - SHELL

Ethernet - RJ-45

RJ-45 ETH1

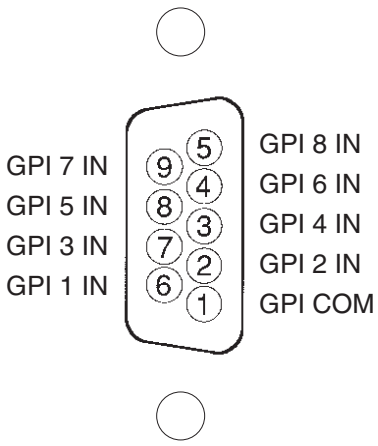


RJ-45 ETH2

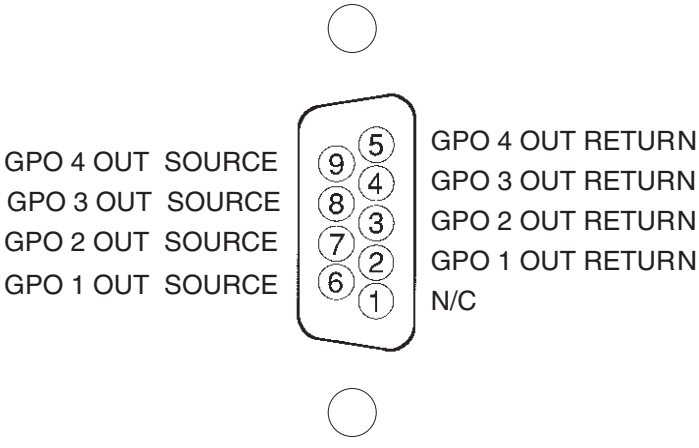


General Purpose Interface - DB-9

GPI - DB-9



GPO - DB-9



Front Panel GUI

Chapter Contents

Front Panel GUI

In addition to comprehensive metering and analysis displays, the front panel also hosts our highly-regarded "Audio Processing Guru®" user interface. This interface condenses more than 400 individual processing adjustments into six easy to use controls. These six controls can morph each factory preset into over 1.7 million (actually 1,771,561) different on air sounds and textures.

Additional information about "Audio Processing Guru®" is presented in its own chapter.

Basic Setup

Once AirAura X3 is rack mounted and connected to a clean source of AC power it is ready for operation. Basic setup and adjustment may be accomplished using the front panel Guru GUI and its tabbed navigation. There are seven tabbed options across the top of the control area: *Input, Output, Encoder, Presets, Analysis, System, and Sound*. These tabbed menus contain all of the controls required to install AirAura X3, get it on the air, and make modifications to factory presets.

- Connect the Analog or Digital audio inputs as appropriate for your installation.
- Click on the *Input* menu tab of the front panel GUI and select the primary input source to match the type of audio source connected to the rear panel. If the audio source is already providing an audio feed you should see meter activity on AirAura X3's displays.

- While in the *Input* menu and observing the Input meters, adjust the input gain control (*Digital Gain* or *Analog Gain* as appropriate) until the input meters are just peaking at -12dBFS with normal program levels coming from the studio or program source. Setting input levels correctly is an important step towards getting the best audio performance from AirAura X3 or any on-air processor. Note that the input meters are sample-accurate and include peak (dot) over average (bar) displays, and it is normal to see the average levels reading quite low (perhaps below -20dBFS on some program material) when feeding AirAura X3 with unprocessed audio.

  You have the option of having the input levels change with presets. Normally, the input levels are fixed and not preset dependent. If you need to have the input level change based on the preset selected, check the *Input Settings Change With Presets* option.

- For best overall audio chain performance, the Input of the AirAura X3 should be calibrated so that it reaches 0dBFS when the signal chain *prior* to the AirAura X3 reaches its 0dBFS, or digital full scale level. This aligns the overload point of the audio chain prior to AirAura X3 to that *of* AirAura X3, setting levels for maximum headroom and best signal to noise.
- Switch to the *Encoder* tab and set the Pre-Emphasis to 75μS or 50μS as appropriate for your region.
- Now make the audio output connections appropriate for your installation, noting that the Analog and Digital outputs may be used simultaneously.

- Navigate to the *Output Configuration* screen of the GUI (shown above). You have the option to select which processing appears at the analog output, either FM limiter or HD limiter. The FM limiter has the option of being pre-emphasized or, if selected, de-emphasized.
- Front panel adjustment of the Diversity Delay using the track pad has enough resolution to get the diversity delay in the ballpark, and finer adjustments (down to 100 microsecond steps) can be made using Guru GUI to set the delay.

  For best resolution of the *Diversity Delay* controls they are best adjusted using the host PC's keyboard and mouse and using the following table as a guide.

COARSE ADJUST SLIDER		FINE ADJUST SLIDER	
Slider only	500 mS	Slider only	0.9 mS
Slider plus Shift key	1700 mS	Slider plus Shift key	8.6 mS
Slider plus Ctrl key	50 mS	Slider plus Ctrl key	0.1 mS (100μSec)

Note that the smallest increment of delay time adjustment is 100 *microseconds*.

- Adjust the *Analog Output* control to set the correct Left and Right output level.
- If using the AES Digital Output, connect it to the equipment following the AirAura X3 and adjust the *FM Digital Output* level control in the *Output* menu as appropriate for your installation.
- When baseband192 is in use the digital output levels into the exciter are controlled by the TX level controls in the Stereo Encoder page. At present only the AES left channel is supported by broadcast exciters so only TX-1 will have any effect on modulation.
- If using AirAura X3's composite output (TX-1or TX-2) those controls can be found in the *Encoder* tab. If you need to have the output level change based on the preset selected, check the *Output Settings Change With Presets* option on the *Output* tab.

- If the digital outputs are being used, their output levels can be adjusted within the *Output Configuration* screen. Whenever the HD output is being used, the FM diversity delay will probably also be used. Please adjust it as necessary for your system.
- Next click on the *Presets* tab to reveal the list of Factory supplied presets.

When the unit is powered up the first time the Factory Default "A Quick Start" preset will be active. This preset was carefully tuned to provide a balanced mixture of "competitiveness" and "moderate" processing. It provides a very good starting point for a variety of program formats and often ends up being the preset of choice. Even if it's not the final on-air preset, "A Quick Start" offers a rich and balanced sound with reasonable loudness – it won't embarrass anyone when put on the air.

Please explore the entire list of presets to see how each one sounds and which one gets closest to your on-air sound goal, but PLEASE remember **<u>one very important point</u>**:

> *Preset names don't necessarily mean that the preset can or should ONLY be utilized for a program format with a similar name. Listen to each preset to see how it sounds on your station, in your market, and with your program material.*

Remember again – AirAura X3 *<u>slews</u>* preset settings from the old to the new to prevent annoying clicks and pops on the air. Newly selected presets will always take a few seconds to "settle in" to the final sound.

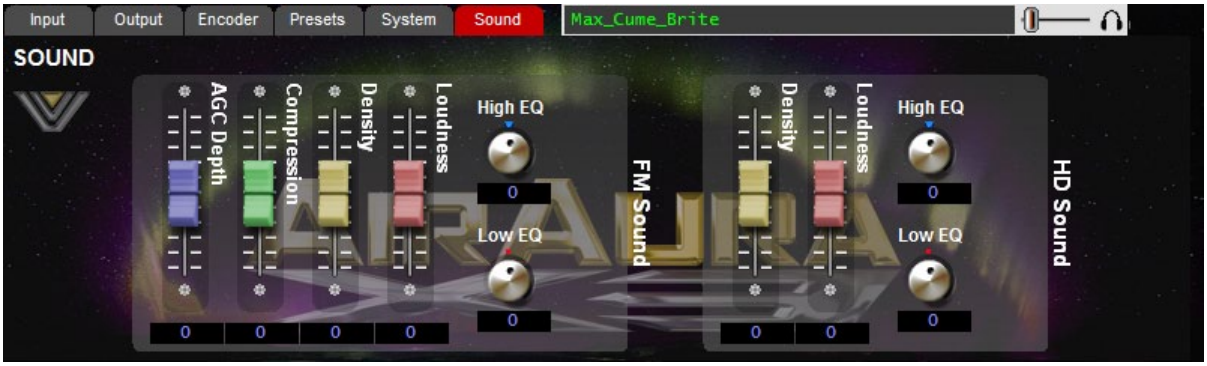
From time to time we add new presets to our website for our customers to download. Presets can easily be installed into AirAura X3 using the Preset Library management features built into the remote GUI.

You're on the air!

NOTE: Detailed information on the particulars of the GUI application on the front panel can be found in the following sections which also cover the operation of the PC-based Guru® GUI application.

Modifying Factory Presets Using Front Panel Guru® GUI

Selecting the *Sound* tab will reveal the ten controls of Guru GUI, six for FM and four for HD. It is these simple to use but quite powerful controls that can morph the sound of any Factory preset into over one million different sounds and textures.



There are two sections to the *Sound* screen. The left side contains the controls that modify the sound of the FM signal path while the far right side hosts the controls for adjusting the sound of the HD signal path. Note that the FM and HD signal paths share the common five band AGC/SST structure so as to maintain a consistent spectral texture as an HD receiver blends from analog to HD. The *AGC Depth* and *Compression* sliders are *shared* between the FM and HD signal paths.

Each sound slider is intelligently connected to myriad controls (over 425) that are accessible via the full-control "Expert" level Professional GUI. As each Sound slider is adjusted to the eleven positions within its 0 to 10 range, many complementary adjustments are occurring behind the scenes to modify the sound according to the naming and purpose of the controls. The following is an explanation of what each FM Sound slider control does, again keeping in mind that the *AGC Depth* and *Compression* slider are shared between the FM and HD processing chains.

FM Sound Adjust

AGC Depth

The *AGC Depth* control adjusts how deep the AGC's *long term* gain reduction will be with typical program material and with appropriate input levels. Higher settings cause deeper long-term gain reduction and the additional "reserve" gain caused by raising the setting of this control will tend to hold up fading songs longer. Conversely a lower setting of the control causes gain reduction that is less deep, leaving less gain available to hold up program levels of material (such as songs) as it fades.

Note that the *AGC Depth* slider does not modify the time constants within the AGC/SST section. That is the job of the *Compression* slider, discussed next.

Compression

The *Compression* control adjusts the medium term program density and how obvious the processing will sound. Lower settings cause the processing to be virtually inaudible as it corrects levels and spectral balance as incoming program elements change. Adjusting

the slider to higher numbers makes the gain controlling action more audible. Higher Compression settings also cause the audio to "fill up" and become more "full."

Density

The *Density* control adjusts how much short-term limiting is permitted. Higher settings will make the audio more dense and "processed" sounding while lower settings will be less so. Stations looking for a "compressed" sound will find the *Compression* and *Density* controls quite useful for tailoring the "feel" of their audio. Note that increasing the Density setting will not cause the final clipper to be overdriven because GUI Guru's intelligence makes other adjustments behind the scenes to prevent it. In other words, distortion will not increase simply because Density was increased.

High EQ (we're leaving Loudness for last!)

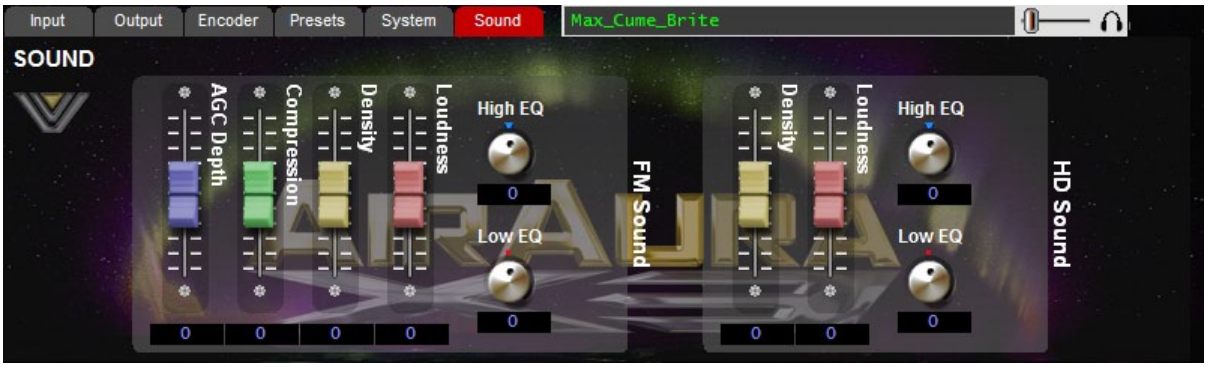
The *Mid/High EQ* control is the one with the blue ring around it and it adjusts how the higher frequencies sound on the air. When the control is at "0" and has not been touched since a preset was last taken the factory assigned equalization for that preset is being applied. Adjusting the control either side of "0" increases or decreases the factory equalization settings. In general, setting the control to lower numbers reduces on-air highs while moving it to higher numbers increases them.

Low EQ

The *Low/Warm EQ* (Equalization) control is the one with the red ring around it and it adjusts how powerful low frequencies sound on the air. When the control is at "0" and has not been touched since a preset was last taken the factory assigned equalization for that preset is being applied. Adjusting the control either side of "0" increases or decreases the factory equalization settings. In general, setting the control to lower numbers reduces on-air bass while moving it to higher numbers increases it.

Loudness (finally!)

The *Loudness* slider is used to set the desired on-air loudness. The most complex control within the entire Guru GUI structure, it intelligently communicates with three powerful sections of AirAura X3's processing: the 31-band limiter, the FM Limiter/Clipper and the MPX processing. Its intelligent hand on these other processing sections automatically optimizes the distortion vs. loudness tradeoffs as the *Loudness* slider is adjusted.



HD Sound Adjust

Density

The HD *Density* control adjusts how much short-term limiting is permitted within the multiband and broadband limiting sections. Higher settings will make the audio more dense and "processed" sounding while lower settings will be less so. Stations looking for a "compressed" sound on their HD signal will find both the *Compression* and *Density* controls quite useful for tailoring the "feel" of their audio. Note that increasing the Density setting will not cause the look ahead limiter to be overdriven because Guru GUI's intelligence will make other adjustments to prevent it. Distortion and/or audible pumping will not increase simply because Density was increased.

High EQ

The *Mid/High EQ* control is the one with the blue ring around it and it adjusts how powerful the higher frequencies sound on the HD signal. When the control is at "0" and has not been touched since a preset was last taken the factory assigned equalization for that preset is being applied. Adjusting the control either side of "0" increases or decreases the factory equalization settings. In general, setting the control to lower numbers reduces on-air highs while moving it to higher numbers increases them.

Low EQ

The *Low/Warm EQ* control is the one with the red ring around it and it adjusts how powerful low frequencies sound on the HD signal. When the control is at "0" and has not been touched since a preset was last taken, the factory assigned equalization for that preset is being applied. Adjusting the control either side of "0" increases or decreases the factory equalization settings. In general, setting the control to lower numbers reduces on-air bass while moving it to higher numbers increases it.

Loudness

Once the previous controls have been adjusted for the desired sound texture, the *Loudness* control can be used to set the desired HD loudness. The Loudness slider intelligently communicates with the HD processing's 31-band limiter and its look ahead limiter.

As the *Loudness* control is adjusted upwards and away from "5" the sound will get denser and louder. The opposite occurs when the control is adjusted downwards and away from "5."

Note that the Loudness control's interaction with other processing sections has been tuned to avoid undesired artifacts such as audible pumping and/or distortion when the control is set to either extreme.

Saving Presets

The *Presets* screen is equipped with a QWERTY style virtual keyboard for entering preset names when they are saved. For entering capital letters there is a Shift key to either side of the space bar which toggles the state of the Caps key – press once to lock the keyboard in Caps, once again to lock it in lower case. The visual feedback for which mode the keyboard is in is indicated by whether lower or upper case letters are visible on the keys of the keyboard.

When the *Save* button is pressed a dialog opens above the keyboard allowing a preset name to be entered (see below).

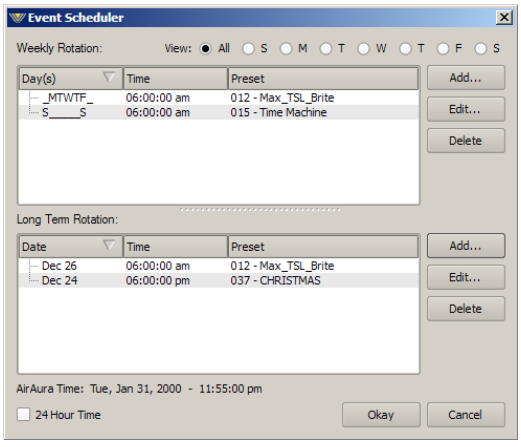
Once the preset name has been entered satisfactorily, press the *Save* button in the upper right corner to commit the new preset to AirAura X3's onboard memory, noting that it will be stored in the next available preset slot.

Preset Scheduler / Events

Both short term (daily/weekly) and long term (future) preset schedules are available within AirAura X3's preset scheduler, which can be invoked by right-clicking the GUI screen and selecting *Hardware>Event Scheduler...* from the menu.

The short term scheduler works much like other preset schedulers that you may be familiar with and is used to change presets according to a specific day of the week and time of day. Once a preset has been changed by the scheduler that processing preset will remain active unless and until another entry is programmed to change that preset to something else.

The long term scheduler is a Wheatstone-exclusive feature and is useful when a processing preset is not part of the usual daily rotation. As an example, the scheduler could be programmed to switch to a specially prepared holiday preset at a specific time at the beginning of a holiday period.



The long term scheduler will keep a selected preset active *until* an entry in *either* the short or long form scheduler changes it to something else. It is not necessary (or possible!) to schedule an entry in the long form scheduler to cause an exit from the long form scheduler.

The screen on the left illustrates an example of short and long form preset schedules.

Virtually any combination of schedules and presets can be accommodated, noting that AirAura X3's GPI ports *also* allow preset switching via hardware connections to remote devices such as transmitter site remote controls, etc. The GPI's are completely separate from the scheduler and please take note: ***they override it***.

AirAura X3 is also equipped with our exclusive ACI (Automation Control Interface) allowing automation-system based control of not just processing presets, but also modifying ANY processing or system parameter.

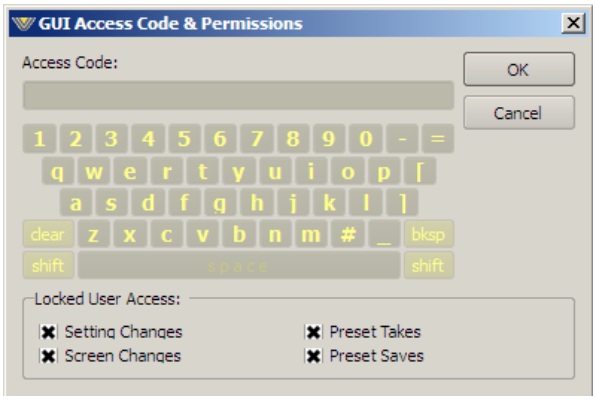
Please contact Wheatstone for details about our ACI protocol and how to use it with AirAura X3.

System Page

Front Panel Access and Front Panel Lock/Unlock

The front panel may be locked in four ways in any combination of the following:

- Locking the ability to make changes in settings;
- Locking the ability to take presets;
- Locking the ability to change screen views;
- Locking the ability to save presets.



When the Front Panel Access button is depressed a dialog will open to allow the user to set which things he wishes to be locked whenever the Front Panel Lock button has been pressed. Each of the functions able to be locked may be individually locked with different passcodes or globally locked with the same passcode at the user's discretion.

NOTE #1: Unless a passcode has previously been set using the Front Panel Access dialog the front panel cannot be locked.

NOTE #2: If no checkboxes have been selected and a locking passcode is assigned the processing-related meters will be hidden when the front panel is locked but all menus will still be accessible. This makes for convenient hiding of the gain reduction meters if/when that is the only thing desired.

In the event the front panel has been locked and the passcode is lost or forgotten it is still possible to gain access. Upon an unsuccessful login attempt the unlock dialog will

present the user with the MAC address of the unit and a special device key along with an advisory to call our technical support department.

Once we are given these two codes we will generate a special "unlock code" for that unit only and for that unlocking session only. The unlock code provided by us is specific to that AirAura X3 and is not valid for any other unit. As well, the unlock code is valid for one unlock sequence only. Once the code has been used and the front panel relocked again that code is "retired" and is no longer valid.

Device Access

It is also possible to separately lock the Processing-related functions and those associated with Outputs such as stereo generator settings and output levels. Each may have its own passcode or they may share the same passcode at the user's discretion. This functionality allows stations who must cooperate with a designated transmission authority to retain the ability to adjust their processing in any way they choose without also giving the transmission authority access to the processing functions. Likewise it also allows the transmission authority to manage such things as modulation levels without giving that authority access to the processing controls.

Note that the locking of access to various functions is not controlled by the connecting GUI or front panel, but by the actual hardware itself. This makes it extremely unlikely that unauthorized access can be gained by unauthorized persons no matter what GUI version they attempt to connect with.

Gaining Access When Passcodes Are Lost

Each AirAura X3 periodically calculates an alternate "access all" passcode that is based on certain attributes of the particular AirAura X3 hardware. This alternate passcode not only changes over time, but is also unique to each AirAura X3.

Please contact Wheatstone Technical Support for assistance in unlocking an AirAura X3 should the passcodes be lost or forgotten. To obtain a temporary master passcode Technical Support will require the unit's serial number, its MAC address and the special code generated by the GUI when access is attempted with the wrong passcode and fails.

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.

Analog Input: Audio appearing on the analog line input.

Digital Input: Audio appearing on the AES3 digital input.

HD Output: HD output of the processing chain.

FM PreDelay: Output of the FM limiter before the diversity delay.

FM Output: FM output of the processing chain.

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

Status Indicators

MAC Address – Shows the unique MAC (media access control) address for the hardware.

IP Address – Shows the Hardware IP address (the IP address your GUI should connect to).

Features – Denotes if the HD and/or WheatNet-IP features are operating in the processor.

Time – Shows the system time and date (24 hour clock)

Temp – Indicates the internal temperature of the AirAura (in Celcius)

Analog/Digital – The active mode is indicated by the "(active)" text next to the mode. A red dot indicates no audio is present at the input of that mode.

PC Based Audio Processing Guru® GUI

Chapter Contents

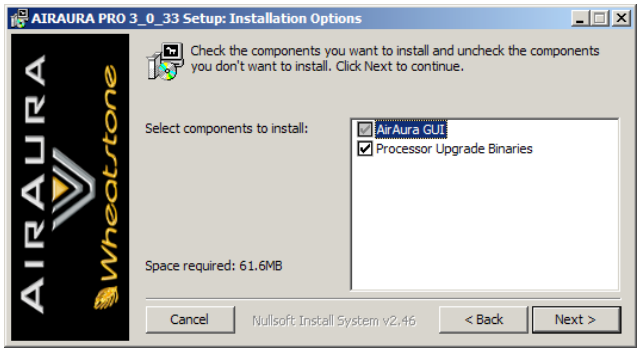
PC Based Audio Processing Guru® GUI

Installation

The Audio Processing Guru® software may be installed on any Windows-based PC running Windows 2000 Service Pack 2 or later. Installation is virtually identical across the various Windows operating systems and in general is as follows:

- Place the CD containing the AirAura X3 software in the PC's CD drive and close the tray.
- Navigate to the CD drive using either Windows Explorer or through My Computer.
- Locate the file on the CD called "AirAura Guru_x_x_x.exe where x_x_x denotes the software version number. Then…

Double click on this file and the installer will start, followed by the welcome screen shown below.



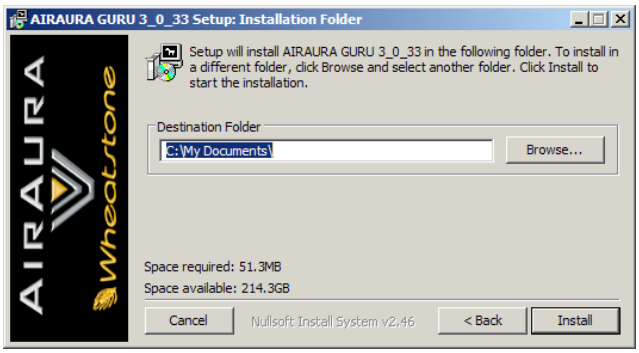
Click on "I Agree" and the installer will present a new prompt asking for what files to install. Leave all check marks selected and press the *Next* button to proceed.

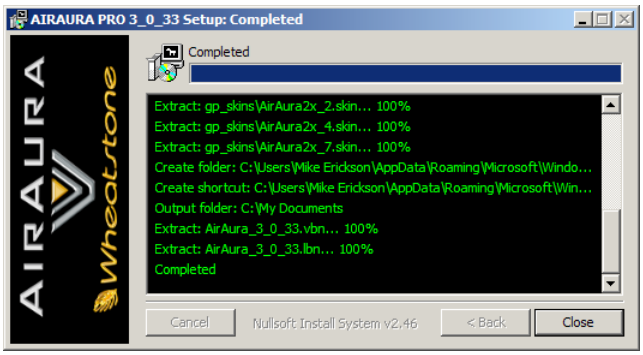
Next the installer will ask where to install the GUI.

The default is: *C:\Program Files\Wheatstone\AirAura*, though our example at left has it being installed into a folder on the desktop.

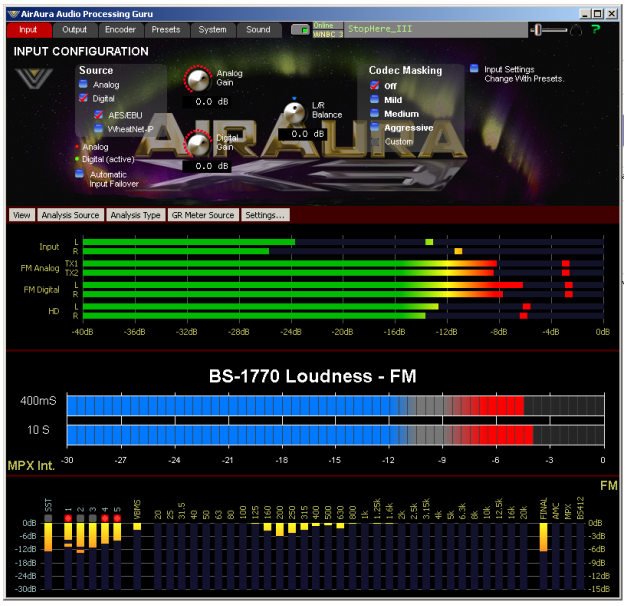
With the exception of Windows® Vista and Windows® 7 the GUI installer does not modify the registry and does not require external drivers. Therefore it can be run from any folder, including directly from a USB thumb drive!

When the installer has finished placing the files in the chosen locations a "Completed" status will be shown. Click the *Close* button to close the installer.





The GUI may now be started by selecting it from within the PC's Start Menu Programs list. Once the GUI starts it will appear as below, *minus* the metering and analysis activity shown below because we haven't yet connected the GUI to AirAura X3 or even told it how to connect!



In order to communicate with AirAura X3 the following conditions must be met.

1. The PC has an Ethernet interface and a cable is connected between it and AirAura X3 (a crossover cable is NOT required).

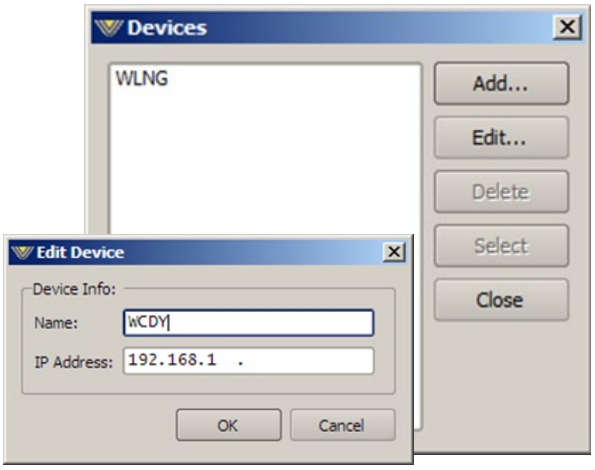
2. The PC's network interface is enabled and is configured to be on the same IP address subnet as AirAura X3. The default IP addresses for AirAura X3 are 192.168.1.200 for hardware and 192.168.1.201 for the front panel. These addresses cannot be used for the PC hosting the remote GUI.

3. AirAura X3 is already powered up and the front panel displays are finished initializing and the screens are active.

Once all of the above is in place, the GUI must be configured to talk to the AirAura X3.

1. Place the mouse cursor in the upper part of the screen (where the controls are) and right click. A popup menu appears. Mouse over the word *Hardware* on this menu and another popup appears with the item *Devices*... at the top of the list. Select *Devices*... and the *Devices* dialog appears.

   In the event no AirAura X3 units are listed, or one is adding a further device, or adding one for the first time, *Add* brings up the *Edit Device* dialog box, which asks for the new prospect's name and IP address.



2. In the *Edit Device* dialog we can give each AirAura X3 a unique name. We suggest naming each processor, perhaps using the station's call sign.

3. Enter 192.168.1.200 in the IP Address field and click *OK*. The *Edit Device* dialog will close. With the new device in the list highlighted, click on the *Select* button of the *Device* dialog.

Once the *Edit Device* dialog closes, when the GUI's *Online* button is clicked (to the right of the *Sound* tab) the status indicator should change to say Online and the AirAura X3's name should appear inside the Device window underneath the Online status.

If the AirAura X3 will be staying on its default IP address no other steps need to be taken. If the IP address configuration needs to change to match the local network's environment, please see the next section for how to accomplish those changes.

Changing AirAura X3's IP Address Configuration

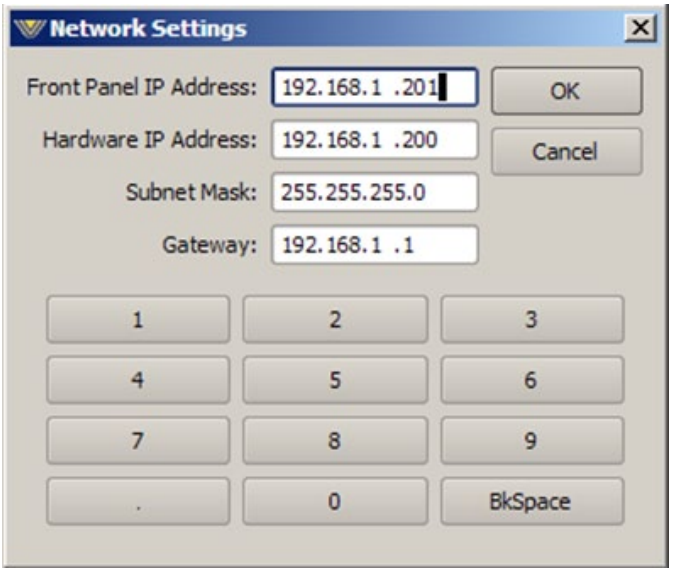
AirAura X3's pre-configured factory default Ethernet and Wireless Configuration is as follows:

Front Panel IP Address:	192.168.1.201
Hardware IP Address:	192.168.1.200
Subnet Mask:	255.255.255.0
Gateway:	192.168.1.1*
Wireless Address:	192.168.2.100**
WLAN Channel:	1
Country:	United States

* Using a Gateway address on the wired side of the WLAN module can cause a local connected network to become confused if it and the gateway addresses of the module are the same. It is sometimes best to program the WLAN module's Gateway address to an unused address on the locally connected network. If an invalid entry is used for the WLAN module Gateway that address can no longer be used for the module's web-based configuration and the wireless address will need to be used instead.

** In accordance with NAT routing rules the *wireless* IP address and AirAura X3's wired hardware IP addresses must be on a different subnet!

AirAura X3's network configuration can be viewed or changed by using the front panel's right hand pushbutton to bring up the *Network Settings* configuration where the network settings are located. The IP address setup page appears as shown below:



On this screen there are four entries (default settings shown):

Front Panel IP Address – This is the reserved address that the front panel (not the remote GUI on the PC!) uses to communicate with AirAura X3's DSP farm.

This address is set at the factory to be one IP Address *higher* than the IP address assigned to AirAura X3's *Hardware IP Address*, but it doesn't have to be set that way as long as the front panel is configured to use a valid address on the local network and that address is not in use by another device.

NOTE: We believe it's a good idea to avoid using an IP address that ends on ".1" as these are sometimes reserved for network gateways.

Hardware IP Address – This is the address of AirAura X3's DSP hardware and is the IP address that a remote GUI will use to connect to and control AirAura X3.

Subnet Mask – The subnet mask entry must be appropriate for the network being used. Please see your local IT person if this item causes confusion, or consult one of the free online resources such as http://www.subnetmask.info/ or http://www.subnet-calculator.com/.

Gateway – This is the gateway address that AirAura X3 will use to reach connections <u>*outside*</u> of its own internal network. If the controlling PC and AirAura X3 are connected to the same network subnet a Gateway address *usually* isn't necessary and it is *usually* safe to set the *Gateway* address to either 0.0.0.0 or 255.255.255.255. Note that on the PC side of things, Gateway behavior when the address is set to all zeros or all 255's can be "Windows-version dependent."

After determining the IP address that you want AirAura X3 to use, enter that address in the *Hardware IP Address* field using the front panel navigation buttons. It is always a good idea to clear the entire IP address field first before entering new data to ensure there will be no leading or training blanks in the address that may be hard to see. Always use the decimal point button to navigate to the next position of the network address field.

Next, using the same procedure as was used to enter the Hardware IP Address, enter a new front panel GUI IP address by adding "1" to the IP address that you entered for the hardware in the above step (see example below). We typically use one address above the hardware address as our factory default for the front panel but this is not a requirement. The only "rule" is that the front panel, the hardware address, and all other IP addresses on a connected network are on their own unique addresses and on the same network subnet.

Example:

If you entered 192.168.0.200 as the hardware address, then the logically correct front panel GUI address will be 192.168.0.201. Note that the front panel GUI address is not utilized externally by AirAura X3; however no other device on the connected network should be using this address because it is visible to the connected network. In other words this address must be reserved in your IP address plan even though it is not externally being used.

Next, enter the Subnet Mask and Gateway using the same procedure used for the IP addresses. Then click the *OK* button. When prompted to reboot AirAura X3 for the changes to take effect, wait about 15 seconds to ensure that the settings have been saved to onboard flash memory, click *OK* and then interrupt power to the unit for about 30 seconds. Reapply power, and once the AirAura X3 has rebooted and comes back to life, the new IP addresses should be valid.

How to Verify The New IP Addresses are Working

The most revealing way to see if the address change was successful is to simply check the front panel displays. If audio is applied to the unit and the Input source is set for the type that is actually in use, the input and output level metering should be showing activity and the analysis display should be active.

If no audio is connected to the unit yet, connectivity to the front panel can still be verified by putting the Analysis display in the "3-D Plot" mode to see if a purple "floor" is being painted on the display at about a 45 degree angle from the lower left to upper right of the upper half of the right hand screen. If so, this verifies that the front panel and hardware are communicating and that valid data is being exchanged.

Reconfiguring The Remote GUI

If the IP addresses of AirAura X3 have been changed from those configured in the remote GUI a few pages ago it will be necessary to reconfigure the remote GUI software running on the user's Windows PC to communicate on AirAura X3's new IP address. Here is how to do that…

Right click in the controls area of the remote GUI to activate the drop down menu and select the *Devices* option under *Hardware*. When the *Devices* dialog opens highlight the AirAura X3 device that was created earlier and click on *Edit*. Then modify the IP address so that it perfectly matches the new hardware IP address just given to the AirAura X3 hardware and then click *OK*.

Assuming that a good network path exists between the host PC (don't forget to change its address too if the IP address subnet has changed!) the GUI should be able to go online to AirAura X3 by clicking on the *Online* button at the top of the GUI. When the status indicates Online the GUI is communicating with AirAura X3.

Connecting Directly Without a LAN

You can work without a LAN by connecting AirAura X3 and the PC Ethernet ports together with a standard Ethernet cable – either a straight through or crossover cable may be used – AirAura X3's Ethernet interface ports are Auto MDIX.

NOTE: The controlling PC and AirAura X3's network settings must be configured to place them both on the same subnet! This is also why the front panel GUI and remote hardware GUI must also be on the same network numbering scheme – although the network subnet can be any one that is valid, both local and remote devices must be on the same subnet in order to communicate.

Example:

If AirAura X3 is using the 192.168.1.x address range and a laptop is using the 172.68.122.x address range the laptop will not be able to communicate with AirAura X3. The laptop will need an IP address configuration that puts it on the same 192.168.1.x network subnet as AirAura X3.

Wireless Communications to AirAura X3

Many like to make adjustments to AirAura X3 while listening in a convenient remote location such as a familiar car in the station's parking lot or outside the transmitter building. This is easily accomplished by using AirAura X3's built-in high-power industrial grade 802.11b/g wireless capability.

Once it is powered up AirAura X3 should appear as AIRAURA among the wireless networks that the PC can detect and its status will show as "On Demand." Clicking on the AIRAURA wireless device and asking to connect will bring up a Windows warning box stating that AirAura X3 is an "Unsecured Network"*** and asking if you wish to connect anyway. Say *Yes* to this prompt.

*** To ease "first time" connectivity in the field we've set AirAura X3's wireless interface security to disabled and made it an Ad Hoc network. Once connectivity has been established the wireless interface's security can be reconfigured later as desired by referring to the procedures in Appendix B.

Connecting wirelessly to the AirAura X3 is easy:

1. Open the PC's wireless connections dialog – AirAura X3 should be listed as an "On Demand" device.
2. Highlight AirAura X3 and click on the Connect button at the bottom of the dialog.
3. A "Connect to unsecured network?" prompt may appear. Click *Yes*.
4. The "Acquiring Network Address" message should appear next to the AirAura X3.
5. Once the status shows "Connected" (this may take a while depending on how Windows is configured to connect to wireless devices) open the PC GUI and click on the *Devices* button.
6. Right-click on the upper part of the GUI and select the Hardware/Devices option.
7. Click the *Add* button and the *Add Device* dialog will open.
8. Enter a new device name for AirAura X3 (such as AirAura X3 Wireless).
9. Enter the IP address **192.168.2.100**, the WLAN factory default, and click *OK*.
10. Highlight the new device that was just created and click the *Select* button.
11. Click on the GUI's *Online* button.
12. The AirAura X3 GUI should connect to the AirAura X3 and control and graphical display activity should commence.

AirAura X3/Internet Security

AirAura X3's wireless interface has a "web server" for configuration only. The wireless interface cannot reach any other IP addresses on the wired side of the network because the NAT router within the wireless module *only* routes between its *single* fixed IP address and the *single* fixed address on the wired side which is AirAura X3's hardware address.

About DHCP and AirAura X3

AirAura X3 does not utilize nor does it support Dynamic Host Configuration Protocol (DHCP, or automatically assigned network addressing). AirAura X3 needs to be assigned a "STATIC" and unique IP address.

AirAura X3's Ethernet Ports and Network Protocols

AirAura X3 uses both TCP and UDP protocols to communicate with the remote GUI. The TCP protocol is used between the GUI to AirAura X3 for control functions. TCP's high reliability (due to handshaking in the protocol) ensures that control changes sent to AirAura X3 by the GUI will be received *without* any errors.

Metering data isn't critical, and further, only the *differences* between the last and next meter values are sent. Therefore a "no-handshaking" protocol, UDP, is all we need for sending metering and other analysis messages data back to the GUI. Dropped or corrupted packets have little visual effect on the metering and analysis displays, and the lack of (or no need for) handshaking *drastically* reduces the amount of network bandwidth required in order to run the GUI's remote meters and analysis displays, especially over the Internet or on weak or noisy wireless connections.

AirAura X3 uses the **TCP** protocol for sending of commands, adjusting controls, taking presets, etc. We utilize TCP because it guarantees perfect data integrity under all connectivity conditions. AirAura X3 utilizes a fixed port, **55899** for TCP control. This port is hard coded and cannot be changed in the field.

AirAura X3 uses **UDP** ports in the range of **60000** to **60010** for sending metering and analysis data back to the remote GUI from the hardware. Whenever the GUI connects, it tries to open UDP port 60000 first, and if that port isn't busy, it uses it. If port 60000 is busy, port 60001 is tried next. This process repeats until either an idle UDP port in the 60000 to 60010 range is found, or the search stops. This port range cannot be changed in the field.

NOTE: The above referenced TCP and UDP ports must be open in order to support connectivity through routers and firewalls. This also includes the Windows firewall on the host PC that is running the GUI software – it must have these ports open too.

If the GUI Shows That It Is "Connected" But the Meters and Analysis Displays Aren't Active

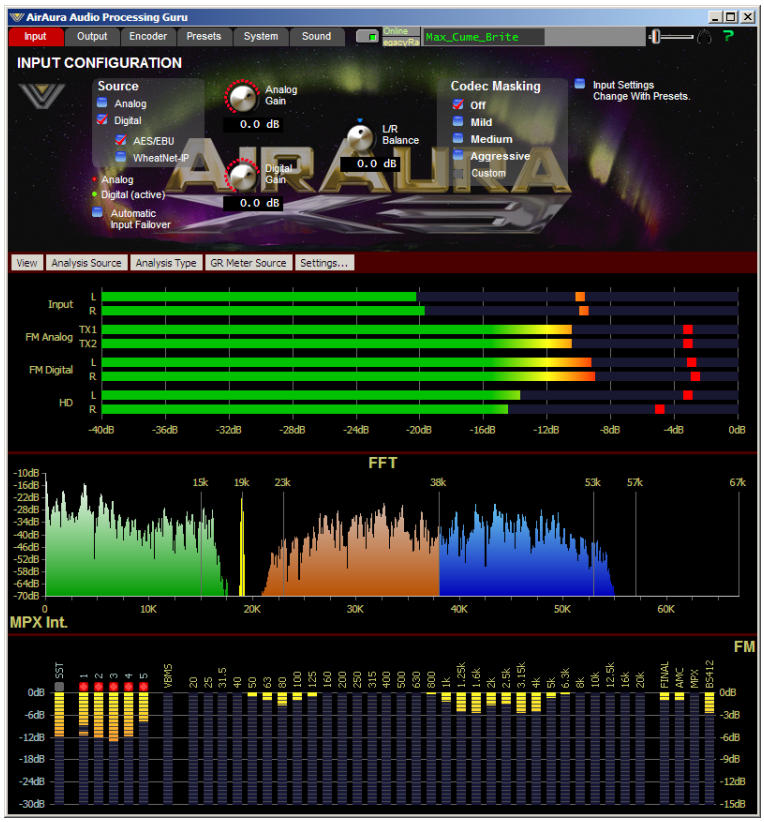
Occasionally a network or internet service provider will block what it considers to be unsolicited UDP traffic. When that happens the GUI will connect to AirAura X3 and AirAura X3 will be able to be controlled, but no metering or analysis displays will be active. Fortunately there is an easy workaround:

Within the *System* screen of the GUI is a check box labeled *Metering data over TCP/IP*. When this box is checked the GUI tells the hardware to use the TCP protocol instead of UDP for sending meter data. While using the TCP protocol can be visually slower on some networks (because now every packet must be checked for accuracy) the "no metering" issue should be solved.

Choosing the TCP protocol for metering naturally increases the amount of network traffic because every metering and analysis packet requires a handshake to ensure its integrity. The poorer the network, the busier the GUI will be while it handshakes on every data packet because a poor network implies the need for a lot more handshaking and retries in order to ensure valid data. Naturally, the worse the network is, the more handshaking is required to get good data.

Using Guru GUI

The Guru GUI may be moved around on the screen of the host computer by left-clicking and holding its title bar and dragging it to the new position. The GUI may also be minimized on the desktop (taken off the screen) and/or closed by way of the familiar Windows controls at the extreme top right. Unlike the Professional GUI (covered later) the Guru GUI has a built in Analysis window and may be re-sized on the desktop as desired by dragging its borders.



Descriptions of the features and functions of the GUI will follow the following logical path:

- Control Area at the top of the GUI (pages 3-11 - 3-27);
- Input/Output Level displays (page 3-28);
- Gain Reduction displays (page 3-29);
- Dynamic Analysis displays (pages 3-32 - 3-36).

The Guru GUI application that runs on the host Windows PC and the GUI that runs on the front panel of AirAura X3 are virtually identical except for the sizing and positioning of the graphical analysis and metering displays. Therefore the following explanations for the Guru GUI software also pertain to the GUI on AirAura X3's front panel and vice versa.

NOTE: ***The following discussion describes AirAura X3s running software Version 2.4 or higher. When AirAura X3 is running software prior to Version 2.4 the WheatNet-IP Input Source is not present in the Input screen; only AES and Analog are available.***

Input Menu

This is the first tab on the top far left of the GUI, noting that the screen that is currently being displayed is indicated by a red background on the selected tab.

The *Input Configuration* screen shown above contains controls for the Input Audio *Source*, *Automatic Input Failover*, *Analog Gain* and *Digital Gain, L/R Balance, Codec Masking* and *Input Settings Change With Presets* controls.

Input Source

The Input Source can be selected as either *Analog*, which is the analog Left/Right input, or *Digital*, which can be **either** *AES3* **or** *WheatNet-IP*. The currently selected input choice is shown by a red check mark inside the blue choice box.

Audio Input Signal Presence Indicators

Below the source selection check boxes are a pair of signal presence indicators for each input. The *Analog* indicator lights if there is a signal present at the analog input above -48dBFS. The *Digital* indicator lights if there is a valid AES signal present at the digital input above -48dBFS.

Automatic Input Failover

In the event the currently selected input source fails *and* the *Automatic Input Failover* 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 invalid bits occur in the digital bitstream or after 30 seconds with an audio signal level below -48dBFS.

If the primary source was Analog, then a timeout of 30 seconds must elapse before the unit switches to the AES/EBU Digital input in an attempt to restore audio. The audio failure sense threshold is fixed at -48dBFS, and this in combination with the 30 second timeout, is suitable for virtually all program types.

Automatic Failover is between Analog and Digital sources only – failover between digital input sources (AES3 and WheatNet-IP) is not supported.

Analog Gain

The Analog audio input gain may be adjusted by clicking on the *Analog Gain* knob and dragging the mouse or touchpad to the right or left. The Analog Gain can be adjusted over a +12dB/-36dB range.

Digital Gain

The AES/EBU Digital audio input gain can be adjusted by clicking on the *Digital Gain* knob and dragging the mouse or touchpad to the right or left. The AES Gain can be adjusted over a +12dB/-36dB range.

L/R Balance

Static level errors in Left/Right channel balance can be corrected by using the *L/R Balance* knob and may be adjusted over a +/- 12dB range. The *L/R Balance* control is common to both the analog and AES/EBU digital inputs.

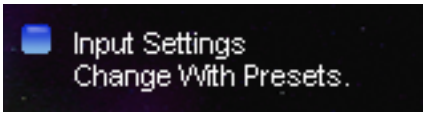
Codec Masking

This is a new feature to AirAura X3 and one that can help the overall sound of the radio station when lossy audio is being presented as the source on a consistent basis (either thru compressed audio files or if the programming is via satellite or some other non-linear transmission mode). While this is not a "cure all," it can help to make the transition from lossy to linear less noticeable. For most situations, the mild or medium settings are usually sufficient. Aggressive should only be used in extreme conditions.

The setting that is right for you will be determined after critical listening for some time. It should be noted that in the Aggressive setting, some stereo separation will be sacrificed due to the nature of how the codec mask algorithm works, so Aggressive should best be left for talk formats delivered over satellite.

The custom option is normally not active. This option is only selected when a Wheatstone Processing Technician has made a custom setting for a customer in the codec mask. Once a custom setting is made, the custom option will be active. The only way to go back to the standard settings is to re-take a factory preset.

Input Settings Change With Presets



By default, when the AirAura X3 changes presets, its input settings (levels, mode, balance) are static. If you wish to have special input levels for different presets, you will need to check this option and then save your current preset with the adjusted input settings.

The following settings are allowed to change when this special option is checked:

INPUT Screen:

Current Audio Source (Analog or Digital) Analog Gain

Digital Gain

Balance (common to both Analog and Digital Inputs) Phase Rotator

Output Menu

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

The *Output Configuration* screen contains controls for selecting the *Analog Output Type*, setting the FM *Diversity Delay* time, the *FM Digital Output* and *HD Outputs* levels and the *Output Settings Change With Presets*.

For best resolution of the Diversity Delay controls they are best adjusted using the host PC's keyboard and mouse and using the following table as a guide.

COARSE ADJUST SLIDER		FINE ADJUST SLIDER	
Slider only	500 mS	Slider only	0.9 mS
Slider plus Shift key	1700 mS	Slider plus Shift key	8.6 mS
Slider plus Ctrl key	50 mS	Slider plus Ctrl key	0.1 mS (100μSec)

Note that the smallest increment of delay time adjustment is 100 *microseconds*.

The FM Digital Output offers options for applying De-Emphasis that is complimentary to Pre-emphasis that may be in use and also allows the digital output to be taken before or after the FM Diversity Delay.

AirAura X3 is also equipped with our Wheatstone® baseband192 digital composite interface which provides a direct, pure digital signal path between the components of the stereo multiplex spectrum and the associated transmitter's digital FM modulator. With this interface the usual A to D and D to A and/or sample rate conversions are absent resulting in virtually perfect stereo baseband and modulation performance.

The HD Output has options for reversing the phase of the left and right signals as well as for swapping the left and right channels.

The ANALOG OUTPUT TYPE options govern the HD Analog Output jacks on the rear of the AirAura X3. This section only applies to AirAura X3's running software version 3.0 or higher!

The FM LT & RT are now fixed as MPX outputs. Thus, AirAura X3 now has 4 composite outputs always. 2 BNC unbalanced (TX1 & TX2) and 2 XLR balanced outputs. The 2 XLR outputs are slaved to the TX1 (LT) and TX2 (RT) controls respectively.

The FM/HD LT & RT outputs are switchable between a L/R discrete FM output and the HD output which was the standard setting in previous versions of AirAura X3. When selected, L/R discrete FM output can be picked up pre or post delay and de-emphasized if needed.

Output Settings Change With Presets

When this box is unchecked, recalling presets ignores the settings of the input and output level controls and other system controls associated with those functions. The following are considered to be AirAura X3 SYSTEM, or global, parameters, which are saved with presets but not restored when presets are taken, unless the *Output Settings Change With Presets* check box is checked. When this box is checked, the following control settings are recalled whenever a preset is recalled:

FM Output:	**Stereo Encoder:**
DeEmphasis	Pilot Level
PreDelay	Pilot Phase
Digital Output Mode	SCA 1
	SCA 2
	TX 1
	TX 2
	BS412
	Pilot Only
	Analog - L/R, L/R Deemph

Stereo Encoder Menu

AirAura X3 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 >50dB between 50Hz and 15kHz. Clicking on the *Encoder* tab opens the *Stereo Encoder* screen hosting controls for this section.

MPX Processor Style

AirAura X3 provides two methods to process the composite stereo waveform. These two methods are provided to allow the user to select what is most appropriate for his format and market.

Composite Clipper – Emulates analog composite clippers but uses a very high sample rate and special algorithms to drastically reduce the artifacts caused by analog composite clippers.

Look Ahead Limiter – This is a true look ahead limiter which utilizes a 0.5 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 limiters found in the FM and HD Limiter screens, but because of the much higher bandwidth required by the composite signal, it operates at a much higher sample rate.

MPX Process Control

The amount of MPX processing being applied to the composite signal is controlled by the *MPX Process* control. This control is calibrated in 0.05dB steps and allows the amount of MPX processing to be precisely set. Unlike other processors the control may be set to values below 0dB for test purposes. Note also that unlike conventional composite processors the amount of multiplex signal processing can be set quite aggressively without encountering the usual artifacts.

BS412 MPX Power Controller

In certain European countries the control of maximum Multiplex Power is required by broadcast regulatory agencies. The regulation governing this is commonly referred to as ITU-R BS.412-7, and the primary aim of controlling maximum MPX power is to reduce adjacent channel interference by lowering the average modulation level.

AirAura X3 is equipped with a sophisticated MPX Power Controller which enables it to operate within these regulatory guidelines. On the left side of the *Stereo Encoder* screen are the two controls associated with its BS412 MPX Power Controller.

Note that the *MPX Pwr Controller* is always measuring multiplex power, even if the *Enable* check box is not checked. Therefore if the MPX Power Controller setting is set to any value except off, when the *Enable* check box is checked MPX Power will immediately fall to the value set by the *MPX Pwr Controller* control.

Enable – When the *Enable* check box is checked the BS412 algorithm is controlling the multiplex power. Likewise, when the check box is not checked, multiplex power is not being controlled, regardless of the setting of the *MPX Pwr Controller* control. As mentioned previously, when the *Enable* check box is checked the *MPX Pwr Controller* will immediately set the processing output's MPX Power to the level set by the MPX Power Controller's value.

MPX Power Controller – This control sets the maximum permitted multiplex power according to the BS.412 measurement algorithm. The control can be set anywhere from +10.0dB down to -3.0dB in 0.1dB steps.

IMPORTANT!

The MPX Power Controller's sole purpose is to reduce loudness and program density. If you are not required to use the BS412 Controller it should be left in the OFF position (leave Enable unchecked) because turning it on can cause up to a 5dB loudness loss when the control is set to its "0dB" position. If your station is not required to comply with a Multiplex Power standard where it is licensed to operate the BS412 control should remain in its OFF position!

19kHz Stereo Pilot Injection

The *Pilot Injection* control adjusts the 19kHz stereo pilot level and is adjustable from 0 (Off, to cause the station transmit in Mono) to 20% of the main composite signal amplitude, in 0.1% steps.

Emphasis

This control sets the desired pre-emphasis curve to apply, 50 or 75 microseconds, depending on the part of the world where AirAura X3 is being used. The pre-emphasis may also be switched off (FLAT) for testing or other purposes.

DSB/SSB Mode

AirAura X3 is equipped with the ability to operate the multiplex generator in the standard double, or experimental (as of this writing) single sideband mode. There are two options for single sideband mode. One is a high resolution option that adds delay to the program signal because of the size of the filter needed to implement the mode. This added delay may prohibit comfortable off air listening for talent. The alternative is the low latency option, which does not add considerable delay to the signal through use of a smaller filter and which, we feel, does not degrade any perceived or measured benefit of using single sideband.

For more information about single sideband, and whether the technology could have any benefit in your situation, please feel free to reach out to us at 252-638-7000 or via email at techsupport@wheatstone.com.

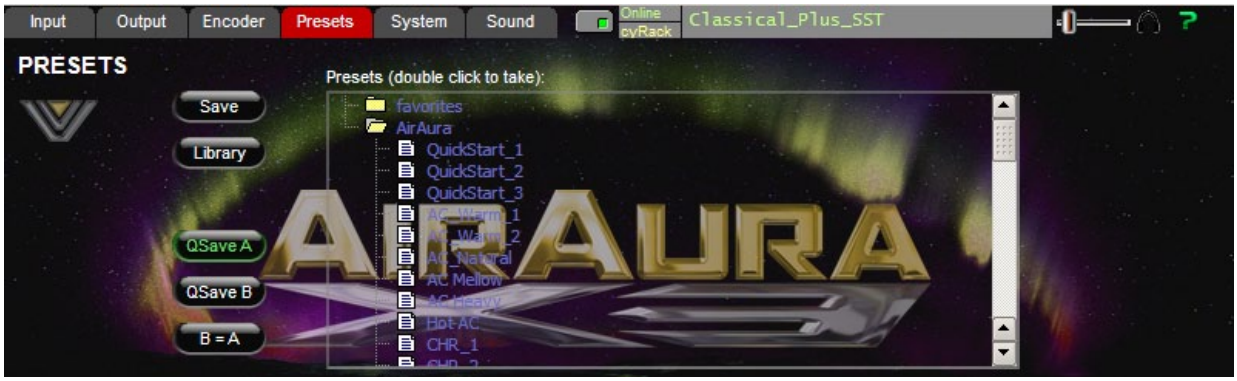
SCA-1 and SCA-2 Inputs

Input signals such as SCA and RDS applied to the SCA connectors are digitized at 192kHz. Prior to being digitized the signals are high pass filtered to reduce hum and then 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. There is an option to change the functionality of SCA-1. By selecting *SCA*, the SCA input functions normally and can accept the output of an RDS encoder or other subcarrier generator. When the *Analysis* option is selected, the baseband of another processor (or source) can be inserted and monitored using the front panel or GUI analysis MPXExt. feature.

TX-1 and TX-2 Outputs

These controls adjust the output amplitude of the signals appearing at the rear panel BNC *and* XLR connectors for the FM Analog Output. These controls can be set from -23.95dB to +6.00dB in 0.05dB steps. Note that the audio levels at the balanced XLR connectors are always 6dB higher than the levels at the unbalanced BNC connectors.

Presets Menu

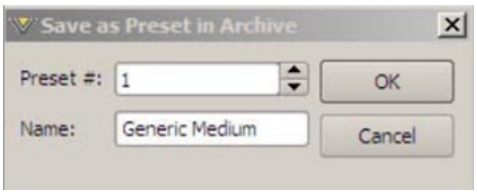


The *Presets* tab opens a screen where presets may be selected for on air, saved to the processor, or managed through AirAura X3's comprehensive Preset Library Management utility.

Selecting a Preset

Selecting a preset for on-air use is as simple as double-clicking on a preset in the list. The currently running preset will morph into the new preset over a period of several seconds in order to prevent abrupt clicks and pops when the new preset's parameters are being loaded.

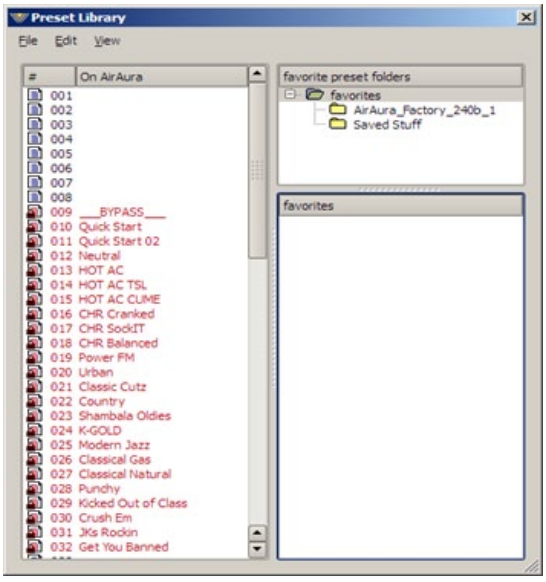
Saving a Preset



When the *Save* button is pressed a dialog opens allowing a preset name to be entered.

Once the entered preset name is satisfactory, press the *Save* button to commit it to memory, noting that unless chosen otherwise it will be stored in AirAura X3's next available open preset slot.

Preset Library Functions

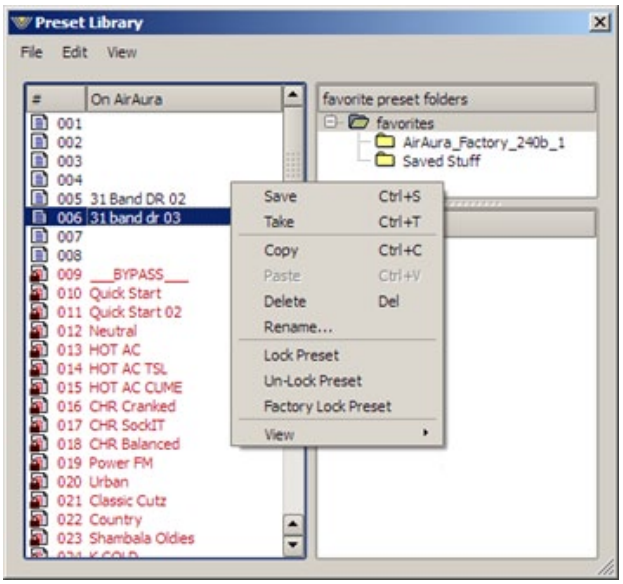


Clicking on the *Library* button opens up the preset library management feature. When this window is open both the presets on the AirAura X3 hardware itself (on the left side of the window) and on the host PC (right side of the window) are visible.

To move presets from the hardware to the PC or vice versa, simply drag the preset in the direction you wish it to go. Whenever presets are being moved from AirAura X3 to the PC, a copy of the preset being dragged over will remain in the Library window.

The same goes for the behavior when dragging a preset from the PC to the hardware – a *copy* of the preset is sent to the hardware – the original preset remains on the PC for safekeeping.

Locking Presets

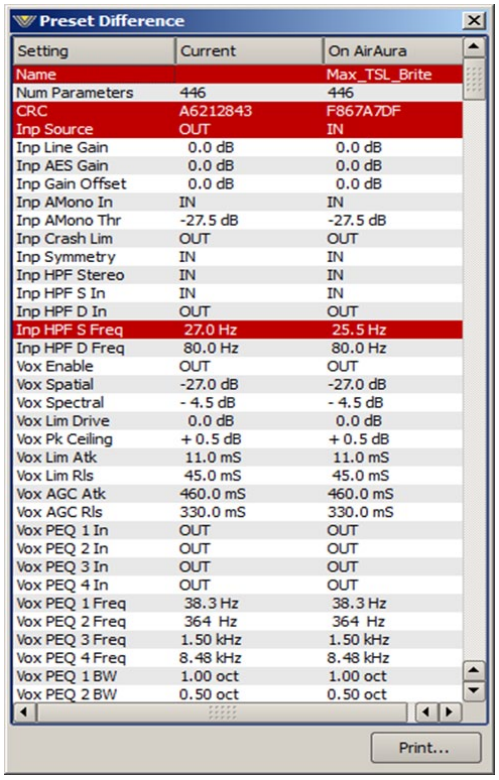


Presets stored on AirAura X3 may be locked by the user to prevent inadvertent overwriting, renaming, or deletion. This is accomplished by opening the *Preset Library* by clicking on the *Library* button in the GUI. Once the list of presets is open, the ones actually stored within the processor hardware itself will be visible in the left pane.

There are two ways to manage the lock status of user presets:

- The first method is by highlighting a preset (single left click) and then right clicking it to open a dialog box. Among the options are *Lock Preset* and *Unlock Preset*.
- The second method is by highlighting a preset as above, and then clicking the *Edit* option at the top of the *Preset Library* dialog box to reveal the Lock Preset/Unlock Preset options. Note that these are user-level lock options and therefore cannot be used to override the lock status of a factory-locked preset!

How to View Preset Changes



It is possible to visually compare two different presets on the AirAura X3 with a special feature called Preset Difference.

When the *Library* tab is opened, highlight any preset you'd like to compare with the current preset running on the processor. Then right click and select *View* and *Diff* from the sub-menu. You will see the window on the right open.

Any parameter that is listed with a RED background indicates a parameter that is different between the preset running on the hardware and the preset that has been highlighted. Parameters which are not highlighted have the same values between the two presets.

Quick Save (QSave)

The AirAura X3 has a unique feature that allows instant comparison of work in progress to a known reference, such as another preset, or some midpoint while adjustments are being made. We call this feature **QSave** (for **Quick Save**).

At the left side of the *Presets* menu you'll find three buttons like those shown on the right.

QSave A and *QSave B* represent two temporary memory buffers that hold all current AirAura X3 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 AirAura X3 are being concurrently saved to temporary buffer *A*.

QSave B operates on buffer *B* and just like *QSave A* its being selected is shown by a green highlighting.

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

- 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 *A* and *B* buffers are identical.
- Change some settings on the AirAura X3 and they 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 preset *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:

- Load the preset that you want to change, make changes to it, and press *QSave A* to save those settings to buffer *A*.
- Make some additional changes and then press *QSave B* to save those additional changes to buffer *B*.
- Now buffers *A* and *B* have your two different settings you can compare them 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.

System Menu

The *System* screen allows system-wide settings to be configured. The following features and options are available within the *System* menu.

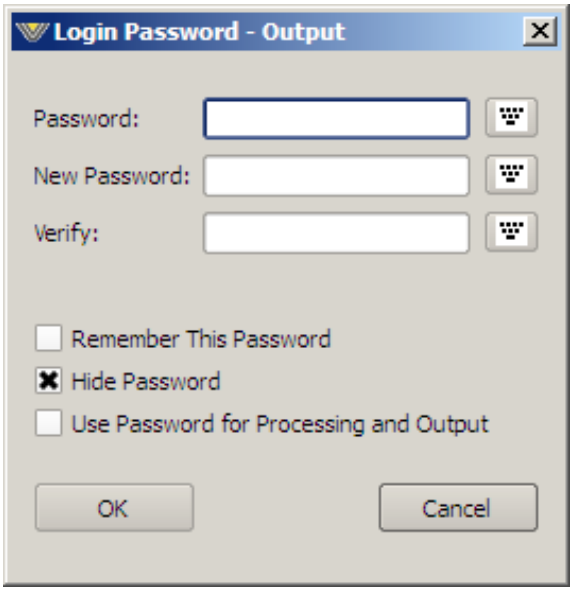
Metering Data via TCP/IP

As mentioned previously, sometimes UDP packets are blocked by an Internet provider or in house router, rendering the GUI without metering (because it uses the UDP protocol for that). In this situation metering can be restored simply by selecting the *Metering data over TCP/IP* check box.

The downside of operating the GUI in this mode is that, unlike UDP, which requires (and expects) no handshaking to guarantee data integrity, TCP/IP *requires* handshaking on every packet to ensure that each packet received is identical to the one transmitted. On a noisy or poor link, the need to handshake on every metering packet can slow the network down because of the additional handshaking and data transmissions required.

Device Access

It is possible to separately lock the Processing-related functions and those associated with Output functions such as stereo generator settings and output levels. Each may have its own passcode or they may share the same passcode at the user's discretion. The reason for this functionality is to give stations who must cooperate with a designated transmission authority the ability to adjust their processing in any way they choose without giving the transmission authority access to the processing functions. Likewise it allows the transmission authority to manage "regulatory" things such as modulation levels, without giving the station personnel access to the output controls.



There is no default password in the AirAura X3. If your are setting this up for the first time, you can skip the *Password* part and just enter the *New Password* and *Verify* the new password.

Other options in this menu include the ability for the PC to remember the password for the processor, to hide the password as you type it (with

dots instead of the actual characters) and the ability to gang the password for both the processing and output options.

When access is restricted, only the *System* tab will be allowed to be viewed. If you try and access another tab, you will be prompted to input the proper password that covers the functions in that tab.

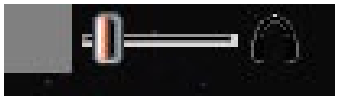
Headphone Source

The headphone source may be directed to several points inside the processing chain:

- **Input**: Output of the audio input selector, whether analog or AES input is selected.
- **Analog Input**: Audio appearing on the analog input even if not selected to be on air.
- **AES Input**: Audio appearing on the AES3 digital input even if not selected to be on air.
- **HD Output**: Output of the entire HD processing chain.
- **FM PreDelay**: Output of the FM processing chain prior to FM diversity delay. Note that if pre-emphasis is on, this signal will be "bright" because it is pre-emphasized.
- **FM Output**: Listens to the output of the entire FM processing chain, *including* the FM diversity delay. Note that if pre-emphasis is on, this signal will be bright because it is pre-emphasized.

NOTE: AirAura X3's headphone monitoring feature allows monitoring of an audio input *without* having to put it on the air. This is useful for confirming that backup audio is actually present and acceptable before putting it on the air!

Headphone Volume Control



On the top right corner of Guru GUI is the headphone volume control slider. To adjust the headphone volume slide the fader right to increase volume and left to decrease it.

Note: The headphone outputs of the AirAura X3 are driven by National Semiconductor LM675 power operational amplifiers capable of >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!

Status Indicators

MAC Address – Shows the unique MAC (media access control) address for the hardware.

IP Address – Shows the Hardware IP address (the IP address your GUI should connect to).

Features – Denotes if the HD and/or WheatNet-IP features are operating in the processor.

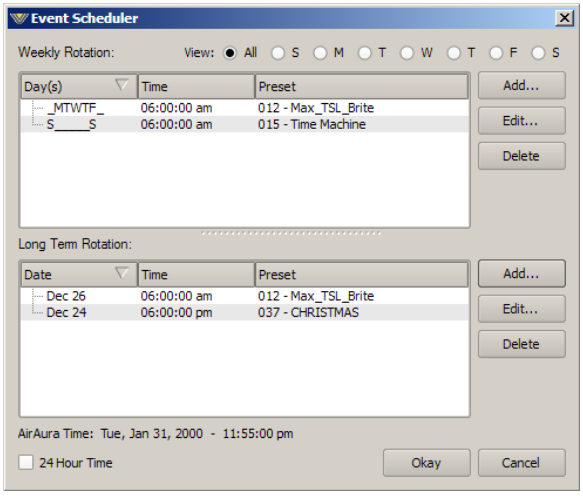
Time – Shows the system time and date (24 hour clock)

Temp – Indicates the internal temperature of the AirAura X3 (in Celcius)

Analog/Digital – The active mode is indicated by the "(active)" text next to the mode. A red dot indicates no audio is present at the input of that mode.

Events

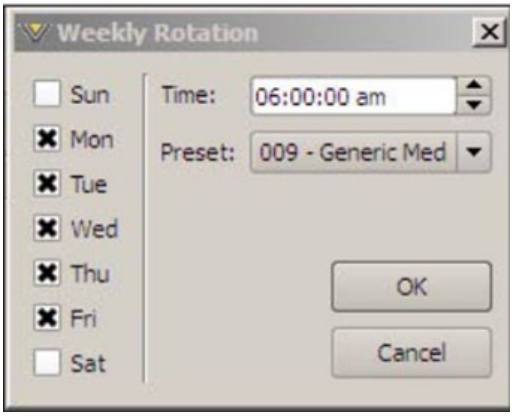
The AirAura X3 contains a comprehensive scheduling utility that allows presets to be automatically changed on desired dates and times. There is also a *Long Term Rotation* scheduler that allows preset changes to be scheduled for any time in the future. To create, edit, or view entries in the *Event Scheduler* click the *Events* button on the System Screen.



The *Event Scheduler* screen shown on the right will open and the events list will be empty when opened for the first time.

Creating a Weekly Rotation Schedule

1. Click the *Add* button in the *Weekly Rotation* area of the *Event Scheduler* window. The *Weekly Rotation* window will open as shown on the right.
2. On the left column, select the days that the preset should be selected. Any combination of check boxes 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*.

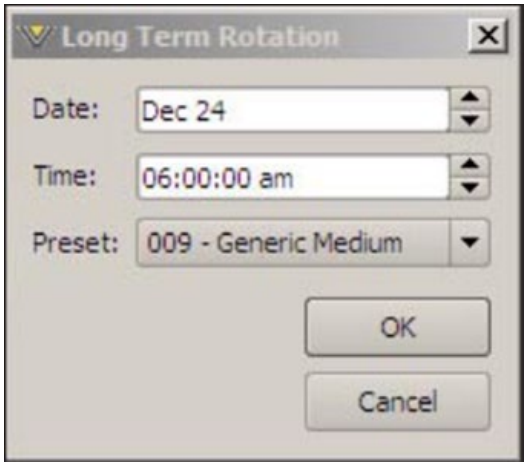


As many preset change events as desired may be programmed in the *Event Scheduler*.

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 Schedule

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

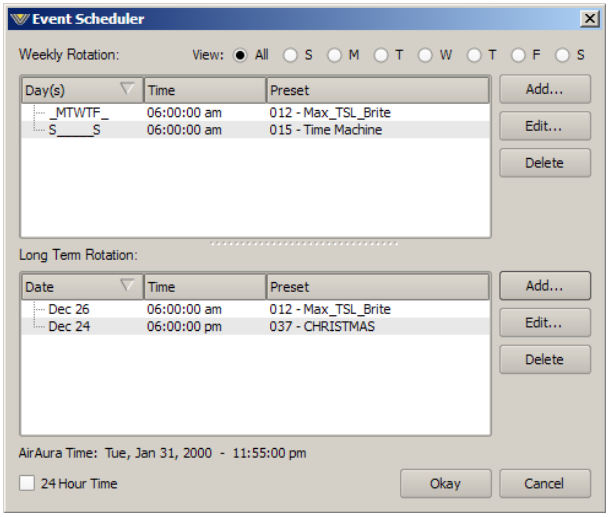


Deleting a Scheduled Event

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

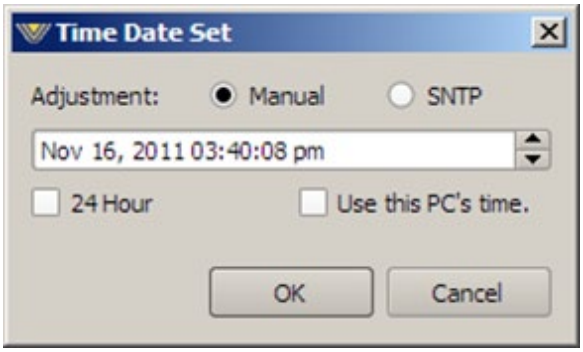
To delete an item in either the *Weekly Rotation* or *Long Term Rotation* schedules simply highlight it in the list and then click the appropriate *Delete* button on the right side of the Event Scheduler window. The highlighted scheduled event will be removed from the list.

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



Setting System Time

Allows the system time of AirAura X3's onboard computer to be set or changed. AirAura X3's 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.



SNTP (Simple Network Time Protocol)

AirAura X3 supports automatic and unattended system time updates via SNTP. Using SNTP can keep AirAura X3's onboard clock set to within milliseconds of actual

time. Various "time servers" are available via an internet connection and a partial list of available time servers is below. All servers shown are located within the United States.

IP Address	Name	Location
129.6.15.28	time-a.nist.gov	Maryland
129.6.15.29	time-b.nist.gov	Maryland
132.163.4.101	time-a.timefreq.bldrdoc.gov	Colorado
132.163.4.102	time-b.timefreq.bldrdoc.gov	Colorado
132.163.4.103	time-c.timefreq.bldrdoc.gov	Colorado
128.138.140.44	utcnist.colorado.edu	Colorado
192.43.244.18	time.nist.gov	Colorado
131.107.1.10	time-nw.nist.gov	Washington(Microsoft)
69.25.96.13	nist1.symmetricom.com	California
216.200.93.8	nist1-dc.glassey.com	Virginia
208.184.49.9	nist1-ny.glassey.com	New York
207.126.98.204	nist1-sj.glassey.com	California
207.200.81.113	nist1.aol-ca.truetime.com	California
68.216.79.113	nist1.columbiacountyga.gov	Georgia

NOTE: If AirAura X3's NTP function is enabled the network that AirAura X3 is connected to must have a path for retrieving the correct time, whether it is from a local NTP server at the station or one that is reachable over the Internet. The NTP time function cannot work if AirAura X3 is not connected to a network, or is connected to a network with no path to an NTP server.

Sound Menu

Selecting the *Sound* tab will reveal the ten controls of Guru GUI, six for FM and four for HD. It is these simple to use but quite powerful controls that can morph the sound of any Factory preset into over one million different sounds and textures.

There are two sections to the *Sound* screen. The left side contains the controls that modify the sound of the FM signal path while the far right side hosts the controls for adjusting the sound of the HD signal path. Note that the FM and HD signal paths share the common five band AGC/SST structure so as to maintain a consistent spectral texture as an HD receiver blends from analog to HD. The *AGC Depth* and *Compression* sliders are *shared* between the FM and HD signal paths.

Each sound slider is intelligently connected to myriad controls (over 425) that are accessible via the full-control "Expert" level Professional GUI. As each Sound slider is adjusted to the eleven positions within its 0 to 10 range, many complementary adjustments are occurring behind the scenes to modify the sound according to the naming and purpose of the controls. The following is an explanation of what each FM Sound slider control does, again keeping in mind that the *AGC Depth* and *Compression* slider are shared between the FM and HD processing chains.

FM Sound Adjust

AGC Depth

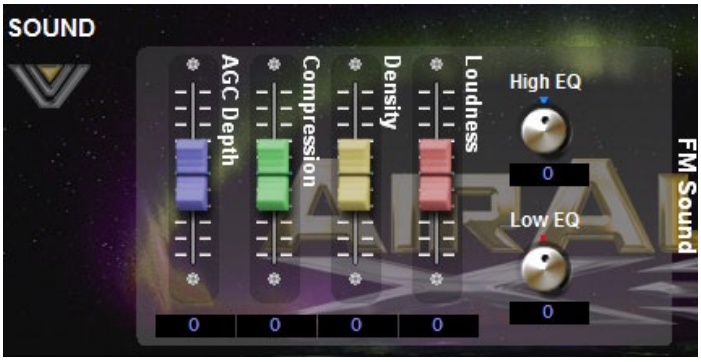
The *AGC Depth* control adjusts how deep the AGC's *long term* gain reduction will be with typical program material and with appropriate input levels. Higher settings cause deeper long-term gain reduction and the additional "reserve" gain caused by raising the setting of this control will tend to hold up fading songs longer. Conversely a lower setting of the control causes gain reduction that is less deep, leaving less gain available to hold up program levels of material (such as songs) as it fades.

Note that the *AGC Depth* slider does not modify the time constants within the AGC/SST section. That is the job of the *Compression* slider, discussed next.

Compression

The *Compression* control adjusts the medium term program density and how obvious the processing will sound. Lower settings cause the processing to be virtually inaudible as it corrects levels and spectral balance as incoming program elements change. Adjusting the slider to higher numbers makes the gain controlling action more audible. Higher Compression settings also cause the audio to "fill up" and become more "full."

Density



The *Density* control adjusts how much short-term limiting is permitted. Higher settings will make the audio more dense and "processed" sounding while lower settings will be less so. Stations looking for a "compressed" sound will find the *Compression* and *Density* controls quite useful for tailoring the "feel" of their audio. Note that increasing the Density setting will not cause the final clipper to be overdriven because Guru GUI's intelligence makes other adjustments behind the scenes to prevent it. In other words, distortion will not increase simply because Density was increased.

High EQ (we're leaving Loudness for last!)

The *High EQ* control adjusts how the higher frequencies sound on the air. When the control is at "0" and has not been touched since a preset was last taken the factory assigned equalization for that preset is being applied. Adjusting the control either side of "0" increases or decreases the factory equalization settings. In general, setting the control to lower numbers reduces on-air highs while moving it to higher numbers increases them.

Low EQ

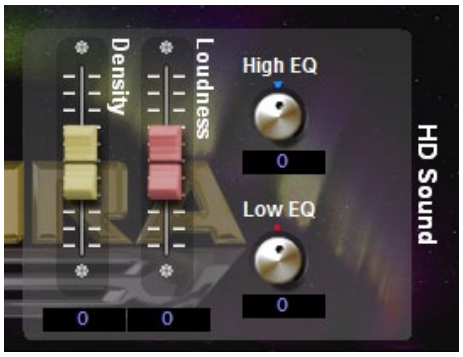
The *Low EQ* control adjusts how powerful low frequencies sound on the air. When the control is at "0" and has not been touched since a preset was last taken the factory assigned equalization for that preset is being applied. Adjusting the control either side of "0" increases or decreases the factory equalization settings. In general, setting the control to lower numbers reduces on-air bass while moving it to higher numbers increases it.

Loudness (finally!)

The *Loudness* slider is used to set the desired on-air loudness. The most complex control within the entire Guru GUI structure, it intelligently communicates with three powerful sections of AirAura X3's processing; the 31-band limiter, the FM Limiter/Clipper and the MPX processing. Its intelligent hand on these other processing sections automatically optimizes the distortion vs. loudness tradeoffs as the *Loudness* slider is adjusted.

HD Sound Adjust

Density



The HD *Density* control adjusts how much short-term limiting is permitted within the multiband and broadband limiting sections. Higher settings will make the audio more dense and "processed" sounding while lower settings will be less so. Stations looking for a "compressed" sound on their HD signal will find both the *Compression* and *Density* controls quite useful for tailoring the "feel" of their audio. Note that increasing the Density setting will not cause the look ahead limiter to be overdriven because Guru GUI's intelligence will make other adjustments to prevent it. Distortion and/or audible pumping will not increase simply because Density was increased.

High EQ

The *High EQ* control adjusts how powerful the higher frequencies sound on the HD signal. When the control is at "0" and has not been touched since a preset was last taken the factory assigned equalization for that preset is being applied. Adjusting the control either side of "0" increases or decreases the factory equalization settings. In general, setting the control to lower numbers reduces on-air highs while moving it to higher numbers increases them.

Low EQ

The *Low EQ* control adjusts how powerful low frequencies sound on the HD signal. When the control is at "0" and has not been touched since a preset was last taken the factory assigned equalization for that preset is being applied. Adjusting the control either side of "0" increases or decreases the factory equalization settings. In general, setting the control to lower numbers reduces on-air bass while moving it to higher numbers increases it.

Loudness

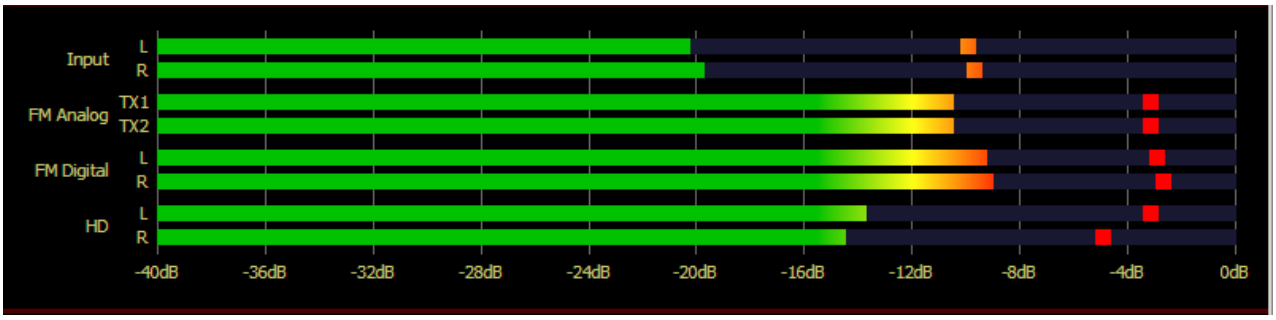
Once the previous controls have been adjusted for the desired sound texture, the *Loudness* control can be used to set the desired HD loudness. The *Loudness* slider intelligently communicates with the HD processing's 31-band limiter and its look ahead limiter.

As the *Loudness* control is adjusted upwards and away from "0" the sound will get denser and louder. The opposite occurs when the control is adjusted counterclockwise away from "0."

Note that the Loudness control's interaction with other processing sections has been tuned to avoid undesired artifacts such as audible pumping and/or distortion when the control is set to either extreme.

Audio Input and Output Metering

AirAura X3 provides high resolution level metering for all input and output signals.



The topmost pair of horizontal bargraph meters show the applied input levels of the selected audio source, after that source's Gain control. Like many meters in AirAura X3 the input level meters are calibrated in dBFS, for decibels Full Scale. The right hand "0dB" marking represents the absolute level where there are no more digital bits left for defining the input signal – any signal above this will cause severe distortion. The left hand "-40dB" marking represents the audio level that many of the silence sense/audio failover circuits use for making their logic decisions.

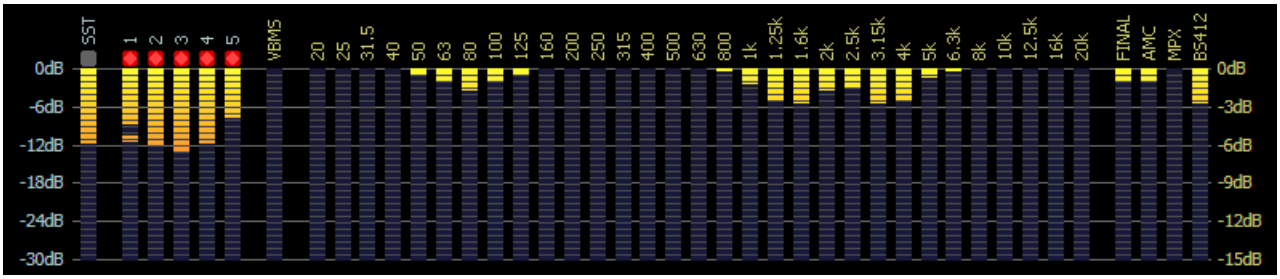
So, what are normal input levels? Because we are working in the digital domain great care must be taken to ensure that audio levels aren't run so high as to cause them to run out of headroom. Good engineering practice dictates that levels arriving from the studio or STL should be peaking between -20dB and -12dB on the input meters and no higher. This allows headroom for the occasional "hot" audio level.

Operating the Input meters at lower indications won't bring up noise or other artifacts that we might be familiar with in analog circuits. With AirAura X3's 144dB internal dynamic range there is virtually no chance of increasing noise by running with "light" audio input levels, though users would likely find that they may need to increase the setting of the AGC Depth control to compensate.

AirAura X3's FM Analog, FM Digital and HD output levels are also shown on the bargraph level meter display and their scales match that of the Input meter display. The big difference in the output meters is that because the output levels they are displaying are "post processing" peak levels are not only known, they are very well controlled. Therefore there is no need to leave headroom for output signals as we must do for input signals.

Audio Processing Gain Reduction Displays

At the bottom of the GUI display are the vertical bars representing the amount of activity occurring in each of AirAura X3's processing sections.



The meters are arranged in seven logical groups as follows:

- SST Activity meter with gate indicator at the top of the meters (red = gated);
- Five-band AGC gain reduction with gate indicators (red = gated);
- BASS TOOLS Activity meter;
- 31-band Limiter gain reduction activity;
- Final Limiter gain reduction or Clipper activity;
- AMC (Automatic Multipath Controller) activity;
- MPX Processor activity (limit or clip);
- BS-412 MPX Power gain meter.

Important Gain Reduction Display Metering Notes:

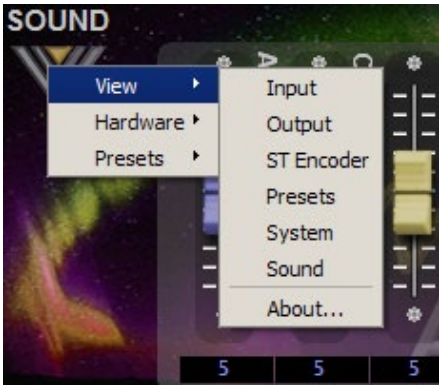
- The SST and five band AGC utilize a meter scale that goes from 0dB at the top to -30dB at the bottom.
- The 31-band limiter, main FM and MPX limiter/clippers and BS-412 algorithm utilize a meter scale that goes from 0dB at the top to -15dB at the bottom.
- The VBMS meter does not need nor does it have a calibrated scale.

The 31-band limiter does not need to do much work to gain its advantages. In fact, less is more. Gain reduction deeper than 5-6dB is not only unnecessary, but doesn't generate any further gains in loudness. Unlike the limiters in all other broadcast audio processors, when 6dB, 10dB, or even more is required in order to generate consistency and competitive loudness, the 31-band limiter's best sound quality and loudness results when its bands are just being "tickled."

You can view either the FM limiter gain reduction or the HD limiter gain reduction. Click the *GR Meter Source* button just above the metering area of the GUI and select either *FM* or *HD* as desired.

Accessing Menu Options

Right clicking anywhere on the AirAura X3 Control Panel will open a pop up menu tree with access to various items. The first item in the list is *View* and it presents the user with several choices for what he wishes to view.



Input: Makes the Input menu screen visible.

Output: Makes the Output menu screen visible.

ST Encoder: Makes the Stereo Encoder screen visible.

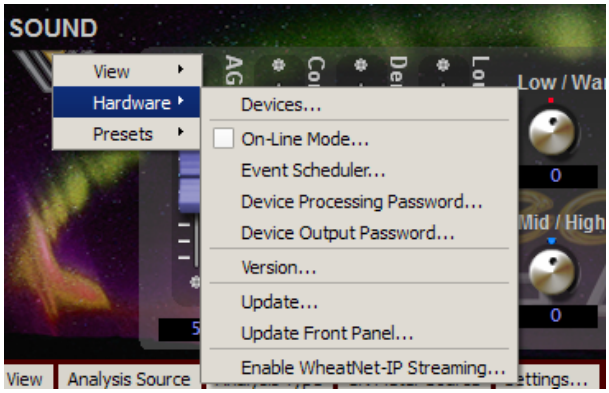
Presets: Makes the Preset management screen visible.

System: Makes the System screen visible.

Sound: Makes the Sound adjustment screen visible.

About...: Displays the *GUI* software version.

Next in the list is *Hardware*. When selected, the *Hardware* item opens up a list with these items.



Devices...: Displays the Devices dialog where the GUI is configured to communicate with AirAura X3 hardware.

On-Line Mode...: Shows or changes the On-Line status of the GUI.

Event Scheduler...: Opens the Event Scheduler for viewing or editing.

Device Processing Password…: Allows the user to access the processing function tabs with the correct password.

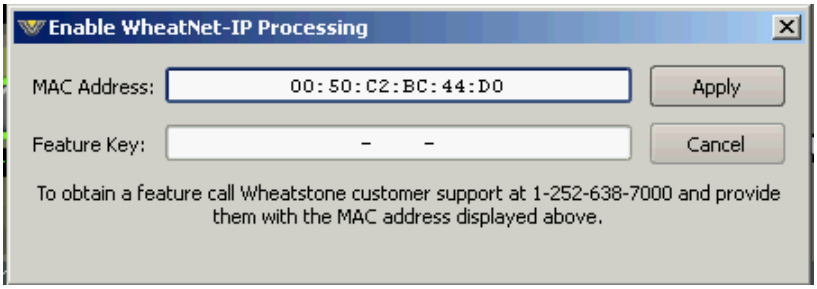
Device Output Password…: Allows the user to access the MPX/Output function tab with the correct password.

Version...: Displays the software and firmware versions currently loaded in the *hardware*.

Update…: Opens the hardware update dialog where a .VBN update file is selected for download to AirAura X3.

Update Front Panel...: Opens the front panel software update dialog. Here, new LBN files may be downloaded to the front panel to enable software updates.

Enable WheatNet-IP Streaming...: Opens the dialog box shown below to enable WNIP audio input and output streaming.



Note that a WheatNet-IP Feature Key must be obtained from Wheatstone to enable this feature. The Feature Key is unique to each instance of AirAura X3 hardware and Feature Keys are not transferable.

Next in the drop down list is *Presets*. When selected, the *Presets* item opens up a list with these items:

Take...: Opens the Take Preset dialog to allow the current preset to be changed.

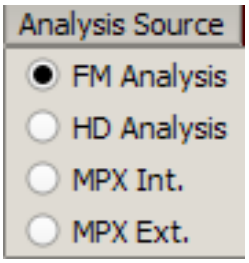
Save...: Opens the Preset Save dialog with prompt for the name and preset slot for the current settings to be saved to.

Library...: Opens the preset Library Manager which allows presets to be packaged and moved to/from the hardware and host PC, etc.

Analysis Menu

AirAura X3 is equipped with extensive processing analysis features that show what the processing is doing and by how much and when. The front panel and Guru GUI both have two drop down menus *Analysis Source* and *Analysis Type*, where the analysis to be viewed may be selected.

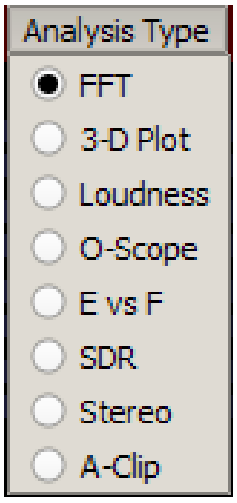
Analysis Source



Analysis Source selects the mode of analysis. You can monitor the FM or HD processing, or choose the MPX Internal or External sources. The *MPX Int*. mode allows you to use the tools available to monitor the baseband of the AirAura X3 signal, taken at the output of the stereo generator, The *MPX Ext*. mode looks at the baseband injected into the SCA-1 input (if that input is selected for analysis).

Analysis Type

FM & HD ANALYSIS OPTIONS

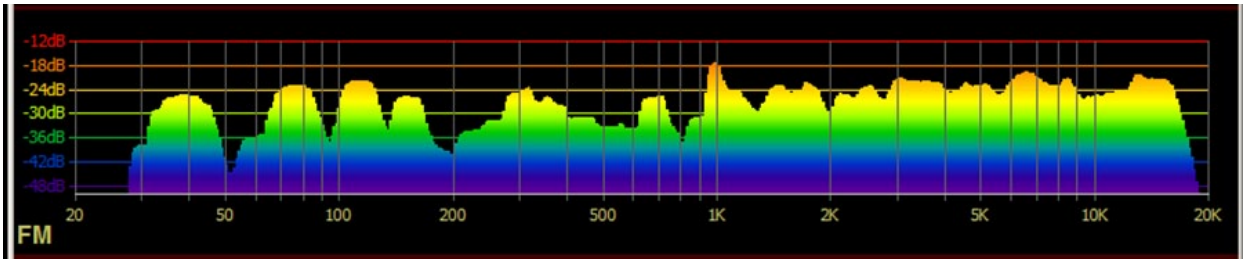


- **FFT** – Displays the spectral output of the FM or HD processing paths after processing. The FM display includes any pre-emphasis being used in order to present an accurate view of the signal actually being sent to the transmitter by AirAura X3.
- **3-D Plot** – A three-dimensional plot of the audio, after processing, which displays signal amplitude versus frequency versus time. The display has a ten second historical window depth allowing some historical perspective about the FM or HD audio after processing.
- **Loudness** – Displays a meter which shows the long and short term loudness of the audio processing.
- **O-Scope** – Displays the audio waveforms at the output of the FM or HD processing chains.
- **E vs F** – Displays the measured RMS Loudness within each of the 31 FM or HD limiter bands.
- **SDR™** – Spectral Dynamic Range™ . This display shows the amount of *dynamic range* remaining in each of the 31 FM or HD limiter bands, after processing.
- **Stereo** – Displays a meter which shows the L+R/L-R ratio from 0 to 1.0.
- **A-Clip** – This is AirAura X3's final FM clipper activity display that shows *where* in the audio spectrum distortion products are being detected and reduced and by *how much*. Not that A-Clip cannot be selected for HD Analysis.

A detailed explanation of each analysis type follows.

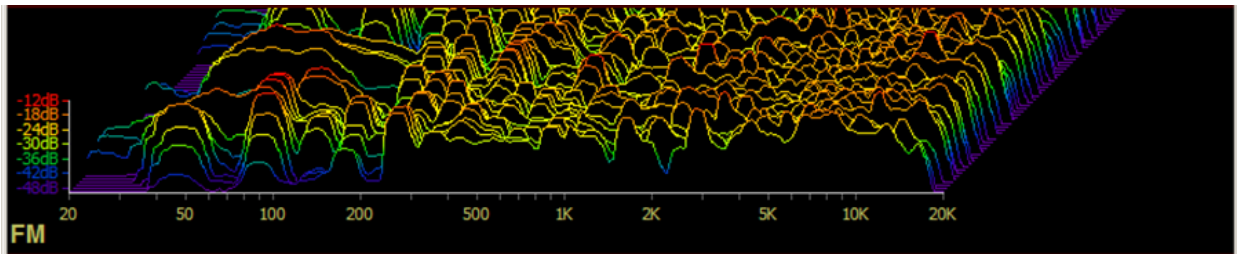
FFT

This display shows a Fast Fourier Transform of the audio spectrum after processing has been applied by the final FM clipper or HD limiter. The FFT display's high resolution is useful for locating where in the audio spectrum certain signals are heard. With complex program material the FFT gives good visual feedback on the levels of audio residing in different parts of the audio spectrum.



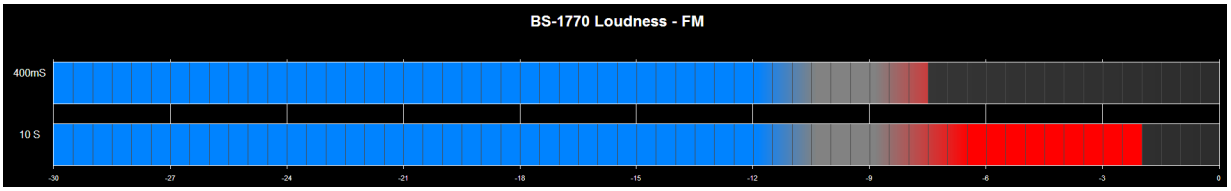
3-D Plot

A 3-D plot of the audio spectrum shows the last ten seconds of audio and what the audio levels were at each frequency during that time. The vertical scale represents level, the horizontal scale frequency, and the diagonal scale is time. The graph being drawn right up front represents "now." As the display is updated, "now" becomes "then" and it moves towards the back of the display and is replaced by a new "now." The 3-D plot very accurately displays how levels within different parts of the audio spectrum have been changing over time. The floor of the display is purple and represents levels below -48dBFS. As the levels become higher the colors morph towards red, the maximum displayed level. The higher the signal is in the plot, the larger the signal amplitude at the frequency of the peak.



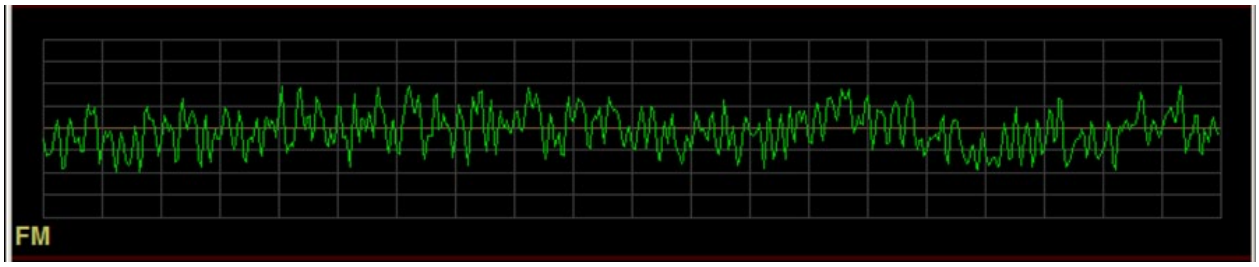
BS-1770 Loudness

The loudness meter shows the short term and long term average loudness of the processed audio on the HD or FM side. The blue region is for more relaxed audio while the contrast between the grey and red areas indicate the level of loudness achieved with older digital or analog processors (grey) and the newer digital audio processors (red).



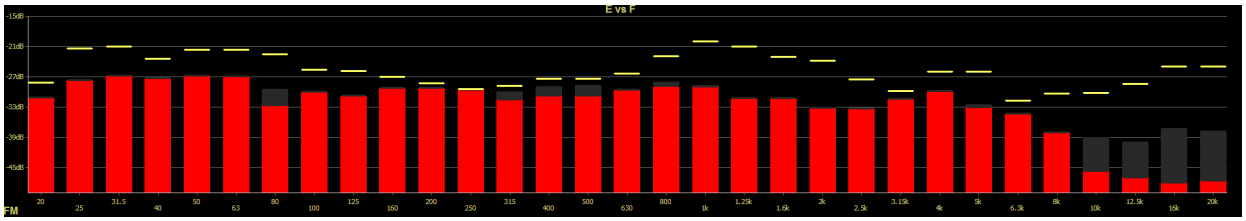
O-Scope

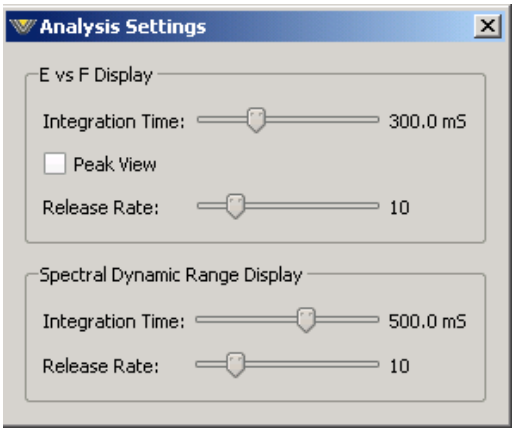
This is a time-domain (oscilloscope-type) display of the audio at the output of the FM and HD final peak control sections. The FM O-Scope display shows what the pre-emphasized and clipped audio looks like. The HD path, with its more "gentle" look ahead limiter, will appear less "aggressive" than the FM audio.



E vs. F

This display represents the RMS Loudness generated in each band of the FM or HD limiter as well as the peak value.



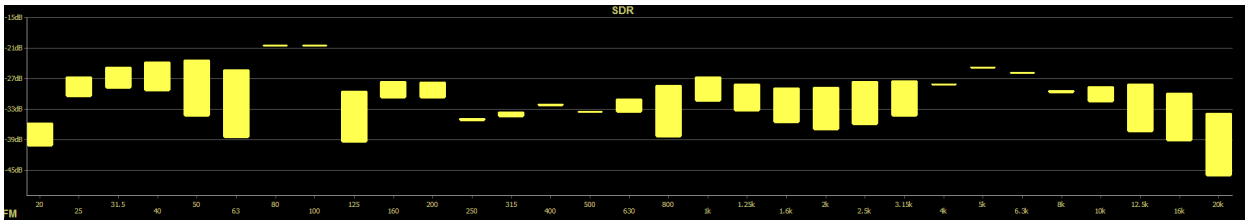


The E vs. F display has a submenu (shown left, click on the *Settings*... button) that allows customization of the RMS Integration Time, the display Release Rate, and whether or not peak levels are to be displayed. The factory default Integration Time is 300mS – the same as a standard VU meter – which is also a fair estimator for how loud something seems to the human ear.

SDR™

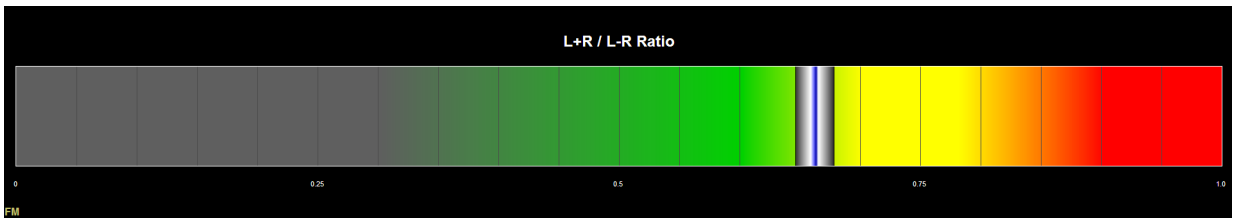
During development of the AirAura X3 product we invented a new and useful processing analysis tool, the *Spectral Dynamic Range™ Meter*. This special analyzer was designed to measure the dynamic range exiting each of the 31 band limiter bands (i.e., how loud the audio is at the output of each band). The SDR meter is easy to interpret – the top of the bar represents the maximum peak level measured over the last sample period. The bottom of the bar is the average level over the last sample period. Therefore

the taller the yellow bar is, the more dynamic range there is within a limiter band's frequency range. Conversely, the shorter the bar's length, the denser the audio is and the louder it is within that frequency range.



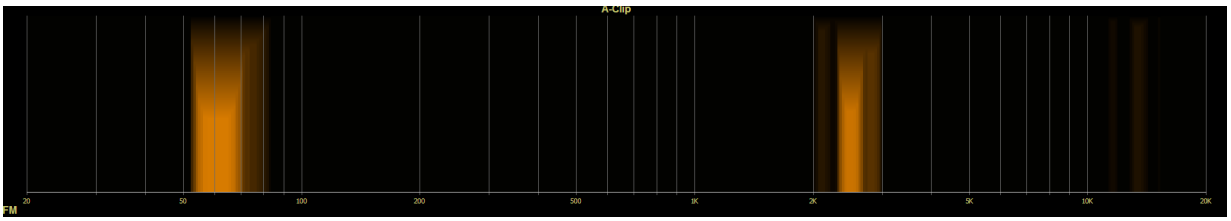
Stereo

This meter shows the ratio of L+R/L-R (sum to difference). The further to the right, the more stereo separation is being transmitted (enhanced at the source of a combination of source separation and added enhancement in the AirAura X3). The further to the left, the less stereo separation being transmitted. For mono or voice, the meter should sit at 0.

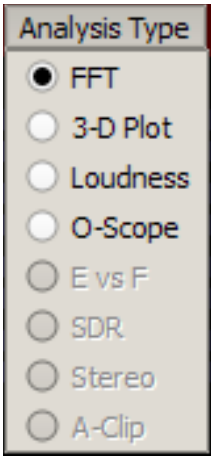


A-Clip

During development of our new AirAura X3 FM clipper we invented a way to watch it work. Known as the A-Clip display, it shows in detail *where* in the audio spectrum AirAura X3's distortion management is working. The "ghosts" that appear show where in the audio spectrum the distortion management is working and the color of the display shows *how much*.



MPX (INTERNAL & EXTERNAL) ANALYSIS OPTIONS



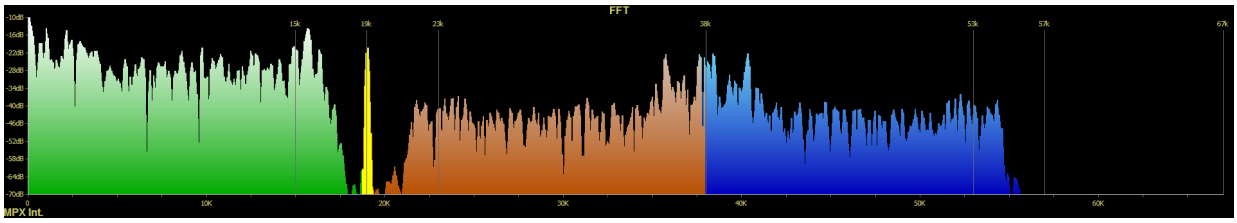
- **FFT** – Displays the spectral output of the baseband of the AirAura X3 including L+R, Pilot, L-R Upper and Lower sidebands and subcarriers.
- **3-D Plot** – A three-dimensional plot of the spectral audio.

The **Loudness** and **O-Scope** options are the same in the MPX analysis as they are in the FM analysis. A detailed explanation of each analysis type follows.

FFT (MPX)

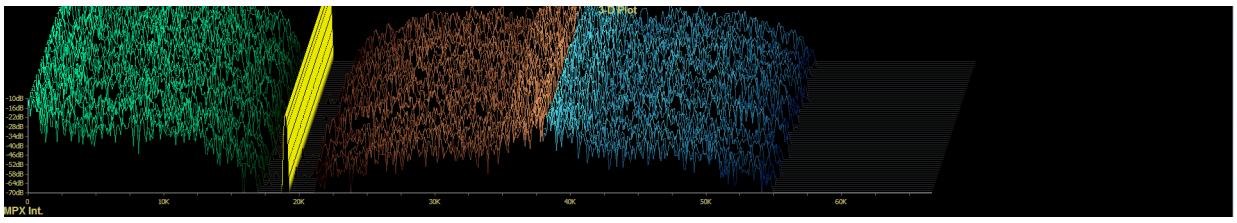
This analysis shows the baseband spectrum of the AirAura X3 audio processor's composite output. It is color coded as follows:

- Green = L+R
- Yellow = Pilot
- Red = L-R Lower Sideband
- Blue = L-R Upper Sideband
- Purple = Subcarriers (RDS etc)



3-D Plot (MPX)

This analysis takes the baseband and shows it in our popular 3D (Time vs Frequency vs Amplitude) display. The color coding follows the same legend as our FFT analysis.



This is the conclusion of the front panel/Guru GUI portion of the manual. The following sections of this document pertain to the PRO GUI software which is not shipped with the hardware. You must register your AirAura X3 with Wheatstone to get a free copy of the PRO GUI software. Please visit http://www.wheatstone-processing.com for more information about the PRO GUI.

AirAura X3 Pro GUI

Chapter Contents

AirAura X3 Pro GUI

The *AirAura X3 Professional Graphical User Interface* (or Pro GUI) is an advanced user interface which reveals all of the controls existing within the FM and HD processing structures – more than 400 of them. This GUI is designed and intended for advanced processing users, those who are quite familiar with audio processing terms and understand audio processing concepts, the interactions of processing controls, and how to apply that knowledge to achieve the individual sound they desire.

The AirAura X3 Pro GUI allows you to adjust the processor and see, in real time, how it is reacting to the audio being processed. All Wheatstone Pro GUI's, have been carefully designed so that no adjustment is more than two mouse clicks away.

The AirAura X3 Pro GUI software may control an unlimited number of AirAura X3s via a standard Ethernet network. Utilizing TCP and UDP protocols, the Pro GUI can be used to control AirAura X3 devices from anywhere in the world as long as there is an Internet connection. This includes controlling it behind firewalls, NAT routers and VPN tunnels.

Another option is the ability to connect to AirAura X3 using a PC with a wireless adaptor. Connecting to the AirAura X3 using its wireless adaptor will be explained later on.

Getting Started

The AirAura X3 Pro GUI is a Windows™ based program designed to be intuitive and straightforward to use. The Pro GUI installer is supplied on the product CD as an executable program. Though the GUI may be installed to any folder on the host computer, the default path is: *C:\Program Files\Wheatstone\Airaura*. After installation, the GUI can be started by clicking on the AirAura X3 item in the Windows Start menu.

Connecting With The Pro GUI

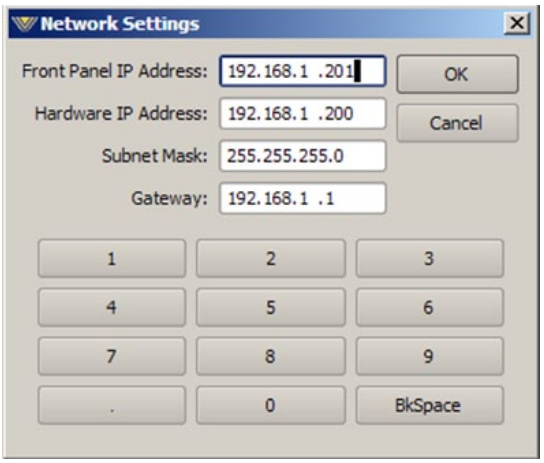
The AirAura X3 and the PC running the AirAura X3 Pro GUI program can be straightforwardly connected together over a standard Ethernet Local Area Network (LAN).

The AirAura X3 should be installed, powered-up, and verified to be operating normally. A CAT5 Ethernet cable connected to one of the rear panel's two 100baseT LAN ports should be connected to the Ethernet port on the host PC. AirAura X3 is Auto-MDIX so either a straight through or crossover cable may be used.

Configure the desired hardware TCP/IP address for the AirAura X3 by using the front panel's "Right Click\Hardware\Network Settings..." navigation to get to the Network Settings window.

On the next page you will see the following four entries (default settings shown):

Front Panel IP Address



This is the reserved address that the front panel (not the remote GUI on the PC!) uses to communicate with the AirAura X3 system board. In a perfect world, this address should ALWAYS be configured to be one number higher than the IP address that you'll assign to the AirAura X3's "Hardware" address, but on the majority of networks should never end in "0" or "255."

Hardware IP Address

This is the address of the AirAura X3's DSP array and is the address that remote GUIs running on host computers will use to connect to and control AirAura X3 over your network.

Subnet Mask

The subnet mask entry must be appropriate for the network being used. Please see your local friendly IT person if this is a bit confusing.

Gateway

This is the Gateway Address* that the AirAura X3 will use to reach connections outside of its own internal network. If you are on a local LAN segment or connected to the AirAura X3 by a direct Ethernet connection, the Gateway address is not usually necessary.

After determining the IP address that you wish the AirAura X3 to use, enter that address in the AirAura X3's *Hardware IP Address* field using the navigation buttons. Please clear the entire IP address field using the backspace key before entering new data to ensure there are no leading or trailing blanks in the address field. Using the period key to navigate from one IP address field to the next will ensure no bank spaces or leading zeros.

Next, using the same sequence as above enter a new *Front Panel IP Address* by adding "1" to the IP address entered for the hardware in the previous steps.

Example:

If 192.168.0.200 was entered as the hardware address, the correct Front Panel GUI address will be 192.168.0.201. Note that the GUI address is not utilized externally by the AirAura X3, so there is no traffic to/from this address external to the AirAura X3. However this address will appear as a valid device on the local network so this address should be reserved for the AirAura X3. Note that another device on the network configured for the same IP address as AirAura X3's front panel may cause the front panel to not be able to communicate with the host hardware.

Once entries to AirAura X3's Network Configuration screen are completed, click on the *OK* button at the top right corner of the dialog. Next, when prompted to reboot the AirAura X3 for the changes to take effect, wait five seconds and then interrupt power to the unit for five seconds. When power is reapplied AirAura X3 will boot up and the new IP address configuration will be valid.

* Using a Gateway address on the wired side of the WLAN module can cause a local connected network to become confused if it and the gateway addresses of the module are the same. It is sometimes best to program the WLAN module's Gateway address to an unused address on the locally connected network. If an invalid entry is used for the WLAN module Gateway that address can no longer be used for the module's web-based configuration and the wireless address will need to be used instead.

Configuring The Pro GUI

Now that the AirAura X3 has a valid network address the Pro GUI must be configured so that it can find AirAura X3 on the network. Assuming the GUI is now installed, start the program to bring the GUI on the screen. Next, on the right side of the GUI locate the *Devices* button and click on it. This will open the *Edit Device* dialog which is used to tell the GUI what IP addresses and names AirAura X3s may have.

The Name field can be left blank or used to give AirAura X3 a unique name in the *Device* display box at the top of the Pro GUI – this is the device that the GUI is either currently connected to, or configured to connect to if it is not yet connected. In the IP Address field enter the "HARDWARE" address that was previously assigned to AirAura X3 and then click *OK*.

Highlight the new AirAura X3 device in the Devices list and click on the *Select* button. Now you can place the GUI online by clicking on the button to the left of the Status message.

It will be green when the AirAura X3 connects to indicate that the GUI is now communicating with the AirAura X3. Once the GUI has been made aware of the AirAura X3's existence in this manner, it will always appear in the list of AirAura X3 *Devices* and it will be instantly accessible from anywhere, any time.

When connected to an AirAura X3 the status bar will indicate *Online* and the *Device* text will show the name of the AirAura X3 that it is currently communicating with (in this example, the AirAura X3 has been named *WHTP*). The status bar will also display the name of the preset that the AirAura X3 you're connected to is currently running.

When the *Current Preset* name is showing as green text it means that a factory or user preset is running and that no changes have been made to it. If the *Current Preset* name is showing in red text, it means that the preset has had some changes made to it or is a work in progress that has not yet been saved to the processor.

Connecting Directly Without a LAN

You can work without a LAN by connecting the AirAura X3 and the PC Ethernet ports together with a standard Ethernet cable – either a straight through or crossover cable may be used. As mentioned previously AirAura X3 has auto-sensing, or Auto-MDIX Ethernet ports.

NOTE: The controlling PC and the AirAura X3's network settings must be configured to place them both on the same subnet! This is also why the front panel GUI and remote hardware GUI must be in the same network address space (usually one IP address from each other).

Wireless Connection

Many users will want to make adjustments to the AirAura X3 "wirelessly" while in a remote location such as their home, office, or car. This can be accomplished in a variety of ways, but normally the GUI and host computer will be configured to connect

to AirAura X3's own wireless interface. AirAura X3 can also be connected to a wired network and accessed wirelessly if that network has a wireless access point connected to it and the host PC has permission to connect to that network.

Please see the section on AirAura X3's wireless features for more information on how to configure AirAura X3's built-in wireless network.

The AirAura X3 and Internet Security Concerns

AirAura X3 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 AirAura X3 and use it as a pathway to the rest of the network to which it is connected.

About DHCP and The AirAura X3

AirAura X3 does not utilize DHCP – Dynamic Host Configuration Protocol (or automatically assigned network addressing) – and needs to be assigned a "STATIC" network-unique IP address. Most DHCP servers assign addresses starting at the bottom of the group 192.168.0.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 network administrator to determine what static IP addresses may be open and safe to use for AirAura X3. Sometimes the local network warrants the Subnet and Gateway values to be vastly different, but our suggested starting values for the Subnet and for the Gateway usually suffice for all but the most complex situations.

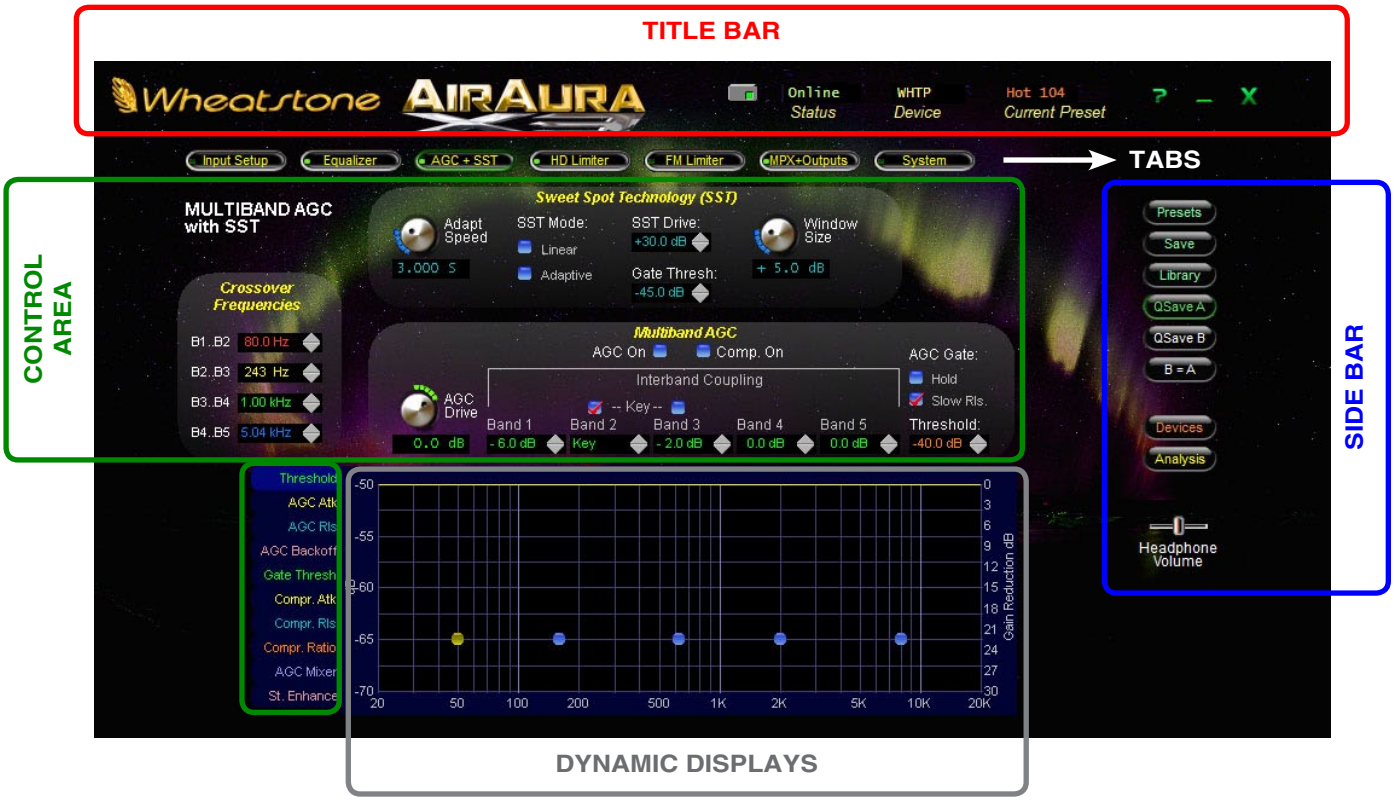
AirAura X3's Network Protocols and Ports Used

The AirAura X3 uses both TCP and UDP protocols to communicate with the remote GUI. TCP is used from GUI to AirAura X3 because its high reliability ensures that all control changes sent to the AirAura X3 will be received with 100% accuracy. The UDP protocol is used by AirAura X3 to send and update metering and other real time data back to the GUI. The TCP protocol uses port 55899. The UDP Protocol uses a port in the range between 60000 and 60010. It tries 60000 first and if it is busy it tries 60001 next. This process repeats if necessary until an idle UDP port is found. Note that AirAura X3 requires these ports to be open through any firewalls for successful connectivity.

Using The AirAura X3 Pro GUI

The GUI may be positioned on the host computer's screen by left-clicking-and-holding the "Wheatstone" logo, and dragging the GUI to the desired position. In normal "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.

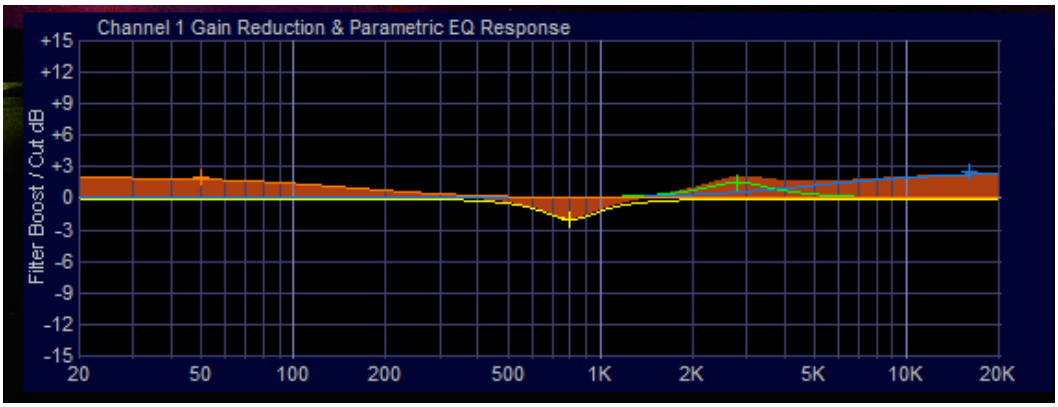
Descriptions of the features and functions of the GUI will follow different discrete regions of the screen; it will begin with the most eye-catching region – the Dynamic Displays – and then we'll explain the Control Area above it, followed by the Side Bar buttons, and lastly the Title Bar.



Dynamic Displays Region

Frequency-Domain Graph

The most dominant display on the main screen when viewing EQ, AGC, or Limiter screens is a large graphical area depicting the audio frequency range of 20Hz - 20kHz arranged in logarithmic fashion with gradations at selected frequencies. The scale of the vertical axis changes according to its context.



AirAura X3 Graphic EQ Display

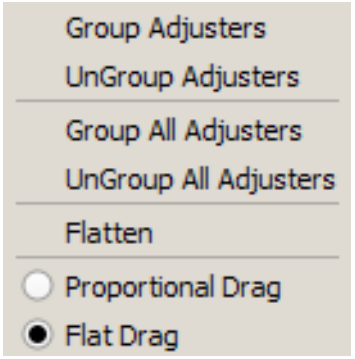
Managing the Blue Dots – Tutorial

We've worked very hard on the design of the Wheatstone graphical user interface to make it intuitive, friendly, and easy to navigate and interpret, in spite of how many controls the user has access to (well over 400).

Each of the processing section's screens has a graphical area where not only visual representations of processing activity are shown, but in some cases individual adjustments of different sections of the processing can be made.

All of the operating parameters of the five band AGC and the 31-band HD and FM limiters can be individually adjusted by manipulating the positions of various "Dots" on that section's graphical screen. Each "dot" represents one processing "band." By double clicking a blue dot (to highlight it and turn it Orange) and then dragging it with the mouse a particular parameter for a band can be adjusted.

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



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.

When a blue dot is double-clicked, it turns orange to indicate that it has been selected. It then may be moved individually, and to anywhere along the vertical scale.

If another blue dot is clicked somewhere else on the line, it too will turn orange….

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 dots between the first two dots that were double clicked to turn them orange will also turn orange.

At this point all of the dots including and between the first two dots may 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 the line between these points with the mouse again (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 them blue again. Conversely, right clicking and selecting *UnGroup All Adjusters* turns all (remaining) blue points orange and they can now each be individually adjusted. The *Flatten* function, although next in the list, is best explained last….

Highlight a single dot again … any dot will do. Then right click the graphical area and select *Proportional Drag*. Now left click any dot 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 it bends at the point where you grabbed it with the mouse. Virtually ANY curve can be created by following these steps. Now right click again and this time select *Flat Drag*. 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?

After these exercises the line is probably all messed up. 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, right? But how do you do that? It's easy ... right click on the graphical area again and select *Flatten*. If there were any points still highlighted orange you'll want to first click *Group All Adjusters* before you select *Flatten* in order to turn them off. In any case, 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 **orange** 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 state.

UnGroup All Adjusters – Un-gangs the adjustment dots and turns them **orange**, regardless of any previous highlighting.

Flatten – Flattens into a horizontal orientation any dots not set to orange.

Proportional Drag – Allows the dragging of adjustment dots to create slopes anchored if desired to a single orange set point.

Flat Drag – Allows the dragging of dots together in a "flat" orientation.

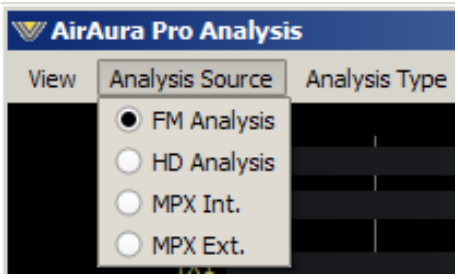
Metering and Analysis

The AirAura X3 Pro GUI offers the same analysis options as the Guru GUI. You can open a new graphics window to access the analysis features by clicking on the *Analysis* button in the sidebar region towards the right of the GUI.

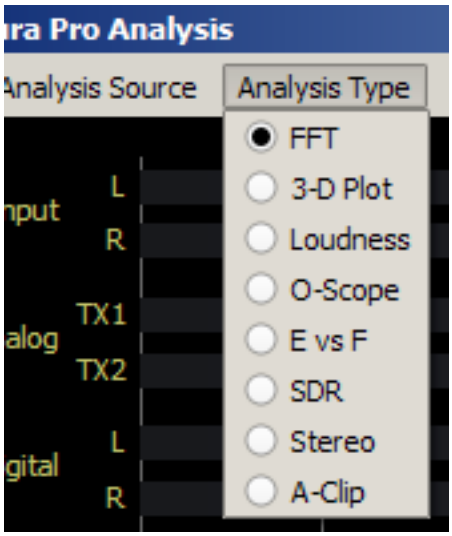
The analysis window opens to a separate window which may be resized, minimized on the desktop (taken off the screen) and/or closed at will using the familiar "Windows" controls at the extreme top right.

AirAura X3 PRO GUI Analysis Window

To learn more about the different types of analysis available, please see the section on Analysis for an in-depth look at what the different displays mean and how they can help visually adjust the sound of AirAura X3. Accessing the different visualizations is done through a drop down menu accessed at the top of the analysis window. Click on *Analysis Source* and a drop down menu opens showing the options. The same applies to *Analysis Type*.

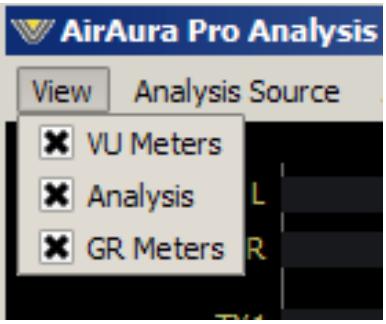


It should be noted that whatever analysis display is chosen by the remotely connected GUI, the same analysis will be displayed on the front panel of the AirAura X3 hardware. Clicking the *Analysis Type* on either the front panel or the remote GUI tells the hardware what kind of analysis is being requested. The hardware then "crunches the numbers" and sends the resulting data to all connected GUIs.

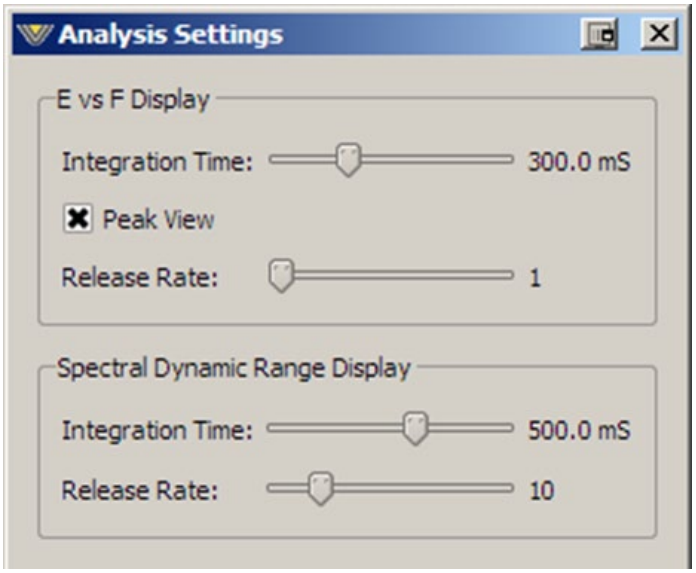


You can customize the Analysis display by choosing which panels you want to monitor. The default is the I/O metering on top, the analysis in the middle window and the gain reduction meters in the bottom window. Click on *View* to turn on or off any of those displays. Click on *GR Meter Source* to choose which processing path you want to feed the GR meters... FM or HD.

The *Settings*... button allows you to adjust the E vs. F display to customize its RMS Integration Time, the display Release Rate, and whether or not peak levels are to be displayed. The factory default Integration Time is 300mS – the same as a standard VU meter – which is also a fair estimator for how loud something seems to the human ear.



The *Settings*... button also gives you access to adjustments for Integration Time and Release Rate for the Spectral Dynamic Range display.



Control Area Region

This is the large enclosed area directly above the graph and meters. The INPUT SETUP section is shown here as an example.

All of the knobs, faders, switches, and check boxes affecting the sound of the audio processing are located within this half of the GUI. 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.

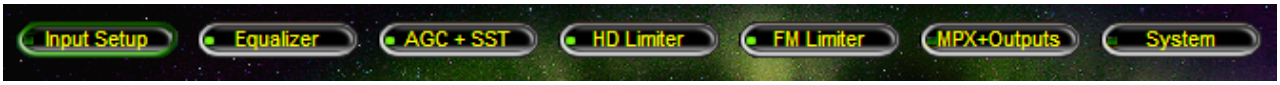
OR

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 *Analog Input 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 signal flow fashion in Input to Output order.



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 SETUP MENU

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

Input Screen

The *Input* screen contains controls for the input source selection: *Automatic Input Failover*, *Analog Gain* and *Digital Gain*, *L/R Balance*, *Phase Rotator*, *Codec Masking*, *Auto Mono Threshold* and its check box, and the *High Pass Filter,* which may be operated in Stereo or Sum/Difference mode.

Input Source

The Input Source can be selected as either Analog or Digital. There is one analog input source, AirAura X3's balanced audio inputs on its rear panel. There are two types of Digital sources however, standard AES3 and WheatNet-IP.

The currently selected input is shown by a red checkmark.

Input Signal Presence

Below the source selection check boxes are a pair of signal presence indicators. The Analog indicator is green if there is a signal present on both left and right channels and it is higher than -24dBu. The AES indicator turns green when there is a valid AES signal present at the digital input and it is above -48dBFS.

Automatic Input Failover

In the event the currently selected input source fails and the *Automatic Input Failover* check box is checked, an alternate source of audio which has been connected to the other audio input can automatically be put on the air.

If the primary source was digital, the analog input will be selected immediately if there are invalid bits in the data stream or missing audio data. Also,

the analog input will be selected after 30 seconds of a valid digital data stream having signal levels below -48dBFS.

If the primary source was analog, then a silence sense timeout of 30 seconds must elapse before the unit switches to the digital input. The audio failure sense threshold is fixed at -24dBu, and this combination with the 30 seconds timeout is suitable for virtually all program types.

Analog Input 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 *Analog Input Gain* level can be adjusted over a +12dB/-36dB range.

Digital Input 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. The *Digital Input Gain* control affects both AES3 and WheatNet-IP and can be adjusted over a +12dB/-36dB range.

L/R Balance

Static level errors in Left/Right channel balance can be corrected by using the *L/R Balance* knob. The Left/Right balance control affects all input sources and can be adjusted over a +/-12dB range. Usage of this control should be restricted to short term "band-aid" use only since Left/Right channel balance is best corrected upstream of AirAura X3 if it is out of balance.

Auto Mono Threshold

The Auto-Mono threshold can be enabled by clicking on its check box and setting the *Auto-Mono Threshold* knob for the desired level when automatic mono blend occurs. Normal settings of this control will fall between about -22dB and -30dB.

What is Auto Mono?

Auto Mono is a feature that automatically and continuously analyzes the L+R/L-R ratio of the incoming program material to determine if the content in the L-R difference channel is valid. If the Auto Mono feature is enabled and the input signal is not true stereo, then the L-R information is discarded and the output of the processor is pure mono.

This feature is most useful in formats that play music such as Oldies, Solid Gold, or other programming that was primarily mastered in mono or that is intended to be mono but might contain small left/right channel balance or phase errors. When the input material has these errors the L-R difference channel contains no meaningful signals and that information may be reduced or eliminated with no detriment to the sound. In fact in most cases the Auto Mono algorithm will significantly *improve* the sound of aired material containing such level or phase errors.

A lot of oldies music was originally mastered in mono. In recent years many of the original songs may have been ripped into playout systems using audio compression schemes such as MPEG Layer II or MP3. Plus, although the songs may have been originally recorded in mono, they were likely ripped into the playout system while it was in its stereo record mode, so there could be uncorrelated stereo information in the L-R channel which is basically "junk."

The Auto Mono circuit has been designed to be unobtrusive in its action while removing such "junk." It may typically be left enabled so that it has an opportunity to correct any material that may pass through AirAura X3 which would sound better if the difference channel were cleaned up.

A typical operating threshold setting for the Auto Mono circuit with most program material is usually between -24dB to -36dB. Higher settings (less than -20dB) may cause unnecessary falsing on certain material while the lowest setting (-40dB) may allow suspect material to pass uncorrected. The control has a range of -40dB to 0.0dB.

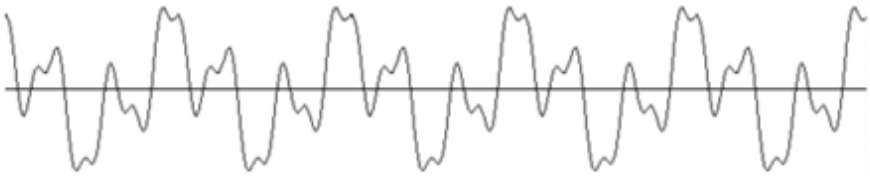
Phase Rotator

Human voice is usually asymmetrical by nature, which means that it is usually "peakier" in one polarity than the other, hence asymmetrical. What the Phase Rotator does is fix these asymmetrical peaks, and the way it works is by changing the phase of signal harmonics compared to their fundamental frequencies. This action reduces the peak to average ratio and enables an increase in apparent loudness with minimal audible detriment. We do this because 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 it makes the processing of voice waveforms more difficult.

Human voice before *Phase Rotator* algorithm

After passing through the Phase Rotator the same voice appears like the waveform at the bottom. Now the upper and lower portions of the waveform have equal distribution. In the process no sound is lost and no distortion is created. Only the signal's phase relationships are rearranged.



Human voice after *Phase Rotator* algorithm

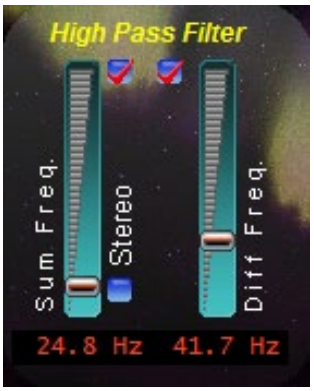
Codec Masking

This is a new feature to AirAura X3 and one that can help the overall sound of the radio station when lossy audio is being presented as the source on a ***consistent basis*** (either thru compressed audio files or if the programming is via satellite or some other non-linear transmission mode). While this is not a "cure all," it can help to make the transition from lossy to linear less noticeable. For most situations, the mild or medium settings are usually sufficient. Aggressive should only be used in extreme conditions.

The setting that is right for you will be determined after critical listening for some time. It should be noted that in the Aggressive setting, some stereo separation will be sacrificed due to the nature of how the codec mask algorithm works, so Aggressive should best be left for talk formats delivered over satellite.

The custom option is normally not active. This option is only selected when a Wheatstone Processing Technician has made a custom setting for a customer in the codec mask. Once a custom setting is made, the custom option will be active. The only way to go back to the user presets is to re-take a factory preset.

HPF - High Pass Filter



The *High Pass Filter* is used to remove inaudible and unnecessary subsonic energy from the audio signal prior to it being processed. By removing this energy, processing is cleaner and modulation energy is not wasted by transmitting sounds that will not be perceptible to a listener.

The *High Pass Filter* also removes subsonic energy that could upset the operation of equipment later in the audio chain, such as the AFC loop in the STL or FM exciter.

The *High Pass Filter* has three operating modes:

Off – No *High Pass Filter* boxes are checked. The High Pass Filter is not enabled.

Stereo – If *Stereo* is checked the High Pass Filter operates on both left and right audio channels equally by separate high pass filters operating at the frequency set by the single frequency tuning control. In this mode the *Diff Freq* slider is not visible.

Sum/Diff – *Stereo* is not checked, opening a second tuning slider to reveal adjustments for the stereo difference channel. Separate check boxes, one for the *Sum Freq* slider and one for the *Diff Freq* slider are visible. Checking a box activates a high pass filter on that channel, sum or difference (L+R or L-R). Separate frequency sliders are available for adjusting the high pass filter corner frequency for each signal path. The mono (L+R) and stereo (L-R) signal paths may have different high pass filter cutoff frequencies.

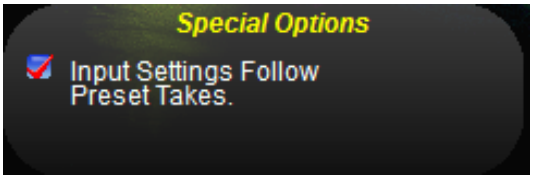
Why Different High Pass Filter Operating Modes?

In most program material there is very little very low frequency energy in the difference (L-R) signal. In fact, what low frequency energy is there isn't typi-

cally correlated with the program material (it's hum, etc.). Therefore by setting the Difference channel to a higher filter cutoff frequency than the Sum channel this noise can be rejected. Good starting settings for the Sum and Difference sliders when in the Sum/Difference High Pass Filter mode is 30.4Hz and 180Hz respectively. If Stereo mode is selected a High Pass Filter frequency of 30.4Hz is a good setting.

The purpose behind setting the High Pass Filters as just described is that the Sum channel carries most of the bass energy in the majority of popular program material. The Difference channel on the other hand rarely contains bass or other low frequency signals and what signals there are, are probably not desired.

Special Options



By default, when the AirAura X3 changes presets, its input settings (levels, mode, balance) are static. If you wish to have special input levels for different presets, you will need to check this option and then save your current preset with the adjusted input settings.

The following settings are allowed to change when this special option is checked:

- Current Audio Source (Analog, Digital or WheatNet-IP)
- Analog Gain
- Digital Gain
- Balance (common to both Analog and Digital Inputs) Phase Rotator

EQUALIZER MENU

Parametric Equalizer Screen

This powerful *4-Band Parametric Equalizer* has four 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.

EQ 1 & 4 Style

This control allows the user to select the style of EQ for Bands 1 & 4. The two options are Parametric (in which Bands 1 & 4 behave like Bands 2 & 3) or Shelving, in which Bands 1 & 4 become a shelving EQ. When in Shelving mode, only the *Frequency* and *Boost/Cut* options are available. In the Shelving mode, the EQ boosts or cuts everything below (Band 1) or above (Band 4) the selected frequency. In the Parametric mode, the EQ can boost or cut audio on both sides of the selected frequency at a bandwidth pre-selected by the user.

EQ Enable

This is the master Equalizer In/Out button. When this box is checked the equalizer section is "IN."

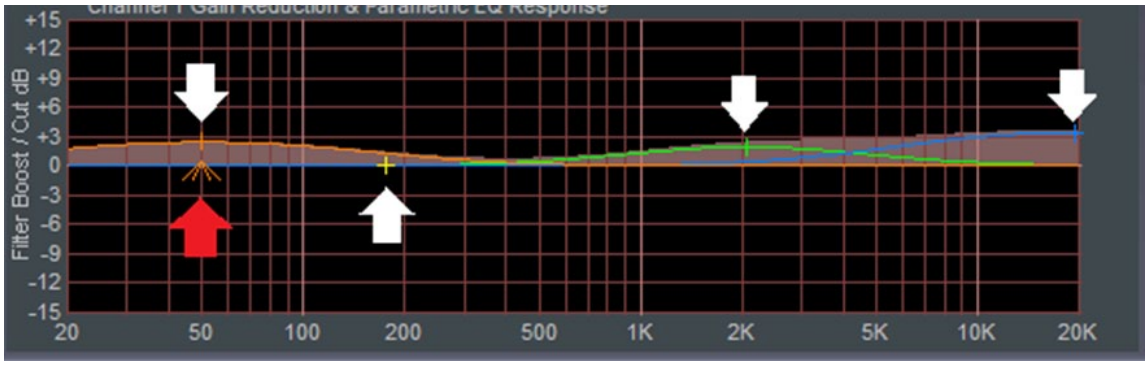
Manipulating Equalizer Controls

The controls of the equalizer may be manipulated in three ways:

1. The first is by directly clicking on and dragging the control sliders 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.

2. The second method of adjusting the parametric equalizers is by directly manipulating the actual curves on the graphical screen below using the mouse. See the next page for how to manipulate the curves directly.
3. The third method is by direct value entry. By double clicking on the value boxes underneath each slider, a dialog opens up which allows keyboard entry of the operating values for each equalizer section. Once the value has been typed into the entry box, clicking the *OK* button or hitting the keyboard *Enter* key will make the value active. Note that the direct entry method is controlled by a lookup table of all possible values. If an entry is made that is not in the lookup table, the closest lookup table entry will be made active.

Manipulating Equalization Curves via Mouse

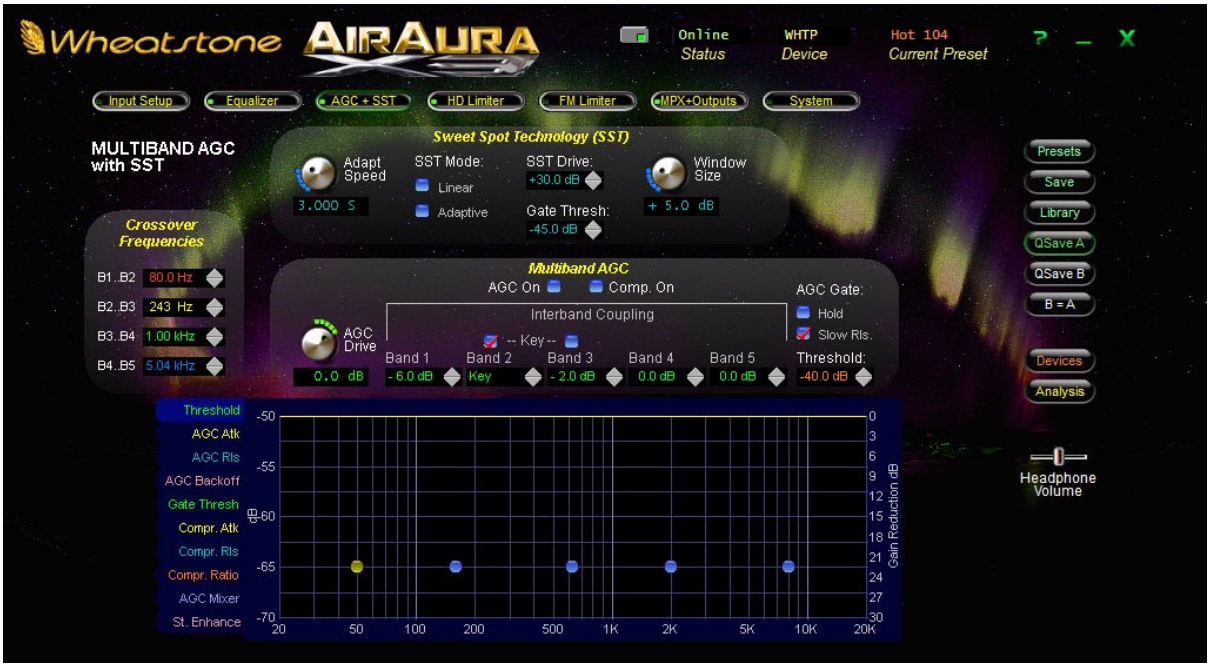


Clicking on the crosshair and holding the left mouse button down as you drag the mouse will move the curve to any frequency (left or right move) as well as adjust the curve's height above or below the 0dB reference line (up or down move).

Clicking on the small "tent" underneath (see red arrow), and holding the left mouse button down while sliding the mouse left or right changes the bandwidth, or "Q," of the equalizer section.

AGC + SST MENU

The AirAura X3 has three sections dedicated to dynamics control, the Automatic Gain Control (AGC), Compressor, and Sweet Spot Technology™ (SST). All three are inextricably linked by DSP algorithms which logically connect and control them. All three sections will be collectively discussed in one chapter rather than separately.



Multiband AGC with SST Screen

What is SST?

Unique to Wheatstone processing is a special algorithm, SST, or Sweet Spot Technology™. The SST operates by incorporating data derived from the input audio, the multiband crossover, the AGC and Compressor gain control behaviors, and the settings of the user controls. This data is used to derive special control signals that manage the multiband AGC/Compressor so that it operates within the desired gain reduction and spectral balance window. SST is quite adept at maintaining the medium and long term "sound" of the processor as incoming program levels and spectral balance wander about.

The intelligence of SST enables the AGC and Compressor to maintain a consistent spectral and dynamics texture over widely ranging signal input conditions. Without the benefit of SST, the AGC and compressor would have little advantage over other audio processors, which all suffer from the inability to *invisibly* manage medium and long-term spectral consistency and density.

A "broadband AGC" is never used prior to the AGC and Compressor in Wheatstone processing. Such simplistic gain control devices work "blind" because they only see their own input and output audio. In fact they know *nothing* about the output of the multiband AGC and it is *this* section of processing that determines the overall texture of how a radio station sounds on the air. SST works smarter. Through a multiplicity of analysis generated control signals, SST calculates and applies corrections that perfectly manage the multiband AGC so that it creates a consistent signature sound across a *very* wide range of input sources and audio levels.

The automatic gain control (AGC) itself operates in five frequency bands, and its medium-term operation is a special derivative of the program-related processing occurring in the Compressor algorithms. While the SST section operates in Left/Right mode, the AGC and Compressors always operate on the program content's Sum and Difference – the highest signal, whether it's in the sum or difference channel, determines the amount of processing to be applied to *both* channels.

SST Controls Overview

SST Drive

The *SST Drive* control adjusts the amount of analysis signal being fed to the SST algorithm which measures the dynamic contributions made by the five band AGC. The higher the *SST Drive* setting the deeper the amount of correction that the SST is allowed to contribute. The SST metering has been arranged to *look* like gain control metering in order to make its operation and adjustment more intuitive even though that's not how it works. Think of the SST meter as showing how much correction it is *allowed* to make to the multiband AGC to keep things sounding nice.

A typical target operating value for the SST meter is between -12dB and -15dB. Note that there is no harm in seeing more or less as long as one understands that higher numbers affords a greater long term AGC correction range than lower numbers. A built-in dynamic clamp prevents the SST from governing more than 20dB of correction and the meter indication will simply stop at that value if driven too hard.

SST Gate Threshold

The SST algorithm has been provided its own freeze Gate and Gate Threshold control so that its operation may be optimized for the program format. Typically the SST *Gate Thresh* should be set several dB higher (less negative) than that of the five band AGC to allow the AGC to operate over its design range. The overall SST *Gate Thresh* control range is -60.0dB to -35.0dB.

Note that the SST Gate Threshold sets the audio input level above which all SST correction is turned off and its so-called "gain" is frozen.

Adapt Speed

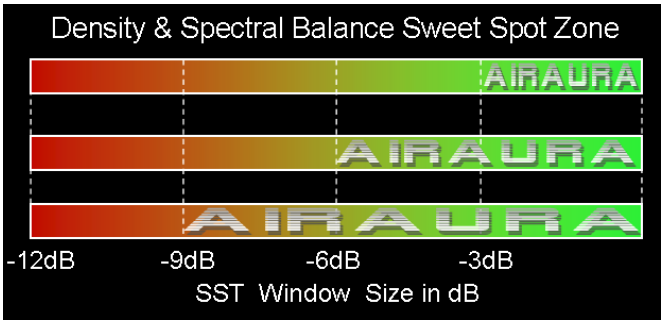
In order for the SST to compensate for all types of programming it should have its speed of correction able to be tailored specifically for the application, and it can – this is what the *Adapt Speed* control does. The *Adapt Speed* control is calibrated in units of time which describe the speed at which the SST corrects the operation of the five band AGC/Compressor.

Note that the setting of the *Adapt Speed* control also influences the behavior of SST's Linear and Adaptive modes, covered later.

A good typical starting value for SST *Adapt Speed* is around 4.000 seconds. The full control range is 2.000 to 7.000 seconds.

Window Size

Because the SST is responsible for maintaining the operation of the five band AGC in its "Sweet Spot" over a very wide range of operating conditions, the size of the sweet spot should be able to be set, and this is what the *Window Size* control does. See the graphic below for some examples:



The graphic at left is a visual for how the *Window Size* control works at settings of -3dB, -6dB and -9dB.

The size of the "AirAura" text inside the shaded bars is how much audio density and/or spectral balance are allowed to "wander" before the SST makes its corrections. By design the SST does not control errors if they go "above zero" because that is handled by the multiband AGC itself. The shaded areas show that the larger the Window Size, the larger the "error" allowed before corrections go into effect.

Window Size settings below 4dB can force the SST to unnecessarily try to correct "normal" dynamic variations which should probably be left alone. Likewise, very large Window Size settings can allow large variations to go uncorrected. Settings lower than 4dB and higher than 7.5dB are not particularly useful, and a normal Window Size setting for the majority of program formats will be between 4.5dB and 7.5dB.

SST Linear/Adaptive Options

The two final controls are behavioral options for the SST and provide choices for Linear or Adaptive. Only one can be chosen. In the Linear mode, the SST always makes adjustments to the five band AGC/Compressor at the speed set by the *Adapt Speed* control.

In the Adaptive mode, SST behavior is just as different from the Linear mode as the name suggests. In this mode the SST is permitted to *momentarily* make *quick* adjustments to the multiband AGC at a rate that is *faster* than the Adapt Speed setting. However, after this brief escape to make corrections it then settles down to the Adapt Speed setting. While this momentary change in behavior is primarily triggered by a dramatic change in program density and/or spectral balance, it is programmed to also trigger under certain other conditions when warranted.

The use of the Linear mode is advised for most programming formats because it is suitable for the widest range of programming. On the other hand, the Adaptive mode is by design, more "aggressive" and might be more appropriate for formats where program levels vary widely and/or there is a desire to remove many of the natural dynamics from the program material.

The SST may be defeated by not checking either the Linear or Adaptive options. When defeated the SST does not modify the multiband AGC in any way and its control range is frozen to compensate. When defeated the SST meter will remain at -12dB even though program elements may change.

A Word About Outboard Processors

Several popular outboard broadband and multiband pre-processors on the market have been used in front of "all-in-one" processors to achieve one or all of the following:

- **A different sonic texture than what is available in the main processor.**
- **The ability to bypass functions in the main processor (usually located at a transmitter) and bring the "meat" of the controls to the studio end for endless tweaking**
- **Compensation for a poorly designed AGC in the main processor.**
- **Overdrive protection for an STL path**
- **Encode level enhancement for ratings encoders.**

Field experience has shown that the SST algorithms in AirAura X3 eliminate most of the concerns mentioned above. By controlling the multiband AGC with the SST as we do, the need for a wideband AGC in front of the main processor vanishes. Further, because SST only *manages* the multiband AGC it behaves like a "multiband broadband" AGC if there was such a thing. By *thinking* like a multiband AGC it is not fooled by excessive energy in one part of the spectrum over another. By *operating* like a broadband AGC it maintains a completely natural and balanced sound *regardless* of how much or how little it needs to do. The multiband AGC is always operating in its "Sweet Spot"... thus "Sweet Spot Technology™" or "SST." No other all-in-one processing solution processes with the accuracy of SST.

We believe that the amount of control in our Pro GUI allows the user to virtually set the AirAura X3 to whatever sonic texture they can think of, eliminating the need for an outboard box to emulate the same.

Internet connectivity allows processors in even the most remote locations to be easily adjusted via a remote GUI. In most cases, the need for the processor to be at the studio "…so it can be accessed…" is a thing of the past.

When audio levels in the plant are properly calibrated, there is no need for an AGC in front of an STL path because almost all processional broadcast gear that may be in-line between the console and the STL will have as much if not more headroom than the broadcast console. If non-broadcast or semi-professional gear is in the audio path, it should be replaced. Consumer grade equipment in the program line of a broadcast station is usually not good engineering practice and can spoil the financial investment you have made in AirAura X3.

There may be some cases where, no matter what, an outboard processor is needed or desired and three of these situations follow.

- **Ratings Encoders** – We've found that ratings encoders need a "steady diet" of incoming level in order to function properly. Improper levels, especially those that are too low, can be problematic for stations that are automated where a human can't make compensating adjustments to source levels on the console. While SST can easily compensate for audio levels more than 10dB different from source to source, a 10dB drop in level at the input to the ratings encoder (which is prior to the processing) will not keep a ratings encoder happy over the course of a 3-4 minute song. It may even set an audio alarm and email and page the station's staff. The BEST way to address the level consistency problem in a facility is to make sure there are standards in place for getting proper levels recorded into the playout

system and refrain from using outboard pre-processors. Unfortunately, that isn't always practical, so if a station feels they must use outboard pre-processing ahead of AirAura X3 we suggest setting AirAura X3's multiband Gate control to a setting that is between -30dB and -40dB, use the *Hold* gating mode, and operate the SST in its Linear mode. If aggressive pre-processing is applied we suggest setting AirAura X3's AGC Backoff control near 0dB.

- **Reverb** – Reverb was originally used as a way to increase modulation density on older AM transmissions when the audio processing of the day simply wasn't sophisticated enough to do it. The effect of reverb not only did the trick, it also added a pleasant sonic texture to the audio, one still desired by many stations today. The challenge for most reverbs is that variations in their input levels can have a very large effect on how they sound on the air if installed directly into the program chain. A pre-processor is traditionally used ahead of a reverb unit which will protect it from generating excessive reverb if (when) its input levels are too high. The use of a pre-processor ahead of a reverb also helps sustain the reverb effect. As in the case of adding pre-processing to boost encoding levels in a Ratings Encoder, the same steps should be taken to adjust AirAura X3 to "mate" with the outboard processor. If reverb is side-chained into a microphone processor and not directly in the audio path, no special adjustments of AirAura X3 need to be made.
- **Analog Telco STL or Aural STL** – Older analog telco lines sometimes need some pre-processing in order to keep signal to noise ratios high. Some users have indicated the need for pre-processing before an aural STL to prevent overshoot. Again, if you feel the need to use a pre-processor in either of these situations, adjustments to the AirAura X3 should be made in concert with the suggestions above.

It is not recommended that SST be defeated in the presence of an outboard AGC. If you do choose to defeat the SST, its influence on the Multiband AGC will become fixed at -12dB and adjustment of the 31-band limiter drives on the FM and HD side may need to be made for any offset that the fixed level creates. It is because of these changes, and because AirAura X3 was designed as a "system," that slowing down SST and the five band AGC/Compressor should be tested first before sections of AirAura X3 are purposely bypassed.

Multiband AGC Controls

AGC Drive

The *AGC Drive* control adjusts the amount of signal at the input to the AGC/Compressor which then determines the depth of gain control (AGC/Compression) achieved. Driving the AGC harder (higher drive numbers) results in a more consistent on air sound along with an increased ability to bring up low passages in program material when needed. Less AGC drive creates a more "gentle" on air sound which then has less capability to bring up low passages. The range of this control is -12.0dB to +6.0dB.

AGC Gate

There are two different modes available for tailoring the behavior of the AGC gate during periods of silence or low audio levels when the audio is below the currently set gate Threshold.

When *Slow Rls* is selected and the audio input falls below the AGC gate Threshold, rather than the bands "holding" their current gains, their gains will slowly increase towards 0dB. The *Slow Rls* setting is useful for formats playing material with very wide dynamic range or for certain speech-based formats.

When *Hold* is selected and the audio falls below the AGC gate Threshold the gains of the five bands will "freeze" at their current values. Their gains will hold at those values until audio is above the AGC gate Threshold again. The Hold mode prevents the AGC from increasing its gain in the absence of audio which minimizes the increase of background noise.

AGC Gate Threshold

The AGC gate *Threshold* control sets the audio level for when the AGC enters one of the Gated modes explained above. The control can be set to OFF to defeat the Gating entirely, or adjusted over the range of -79.0dB to -20.0dB.

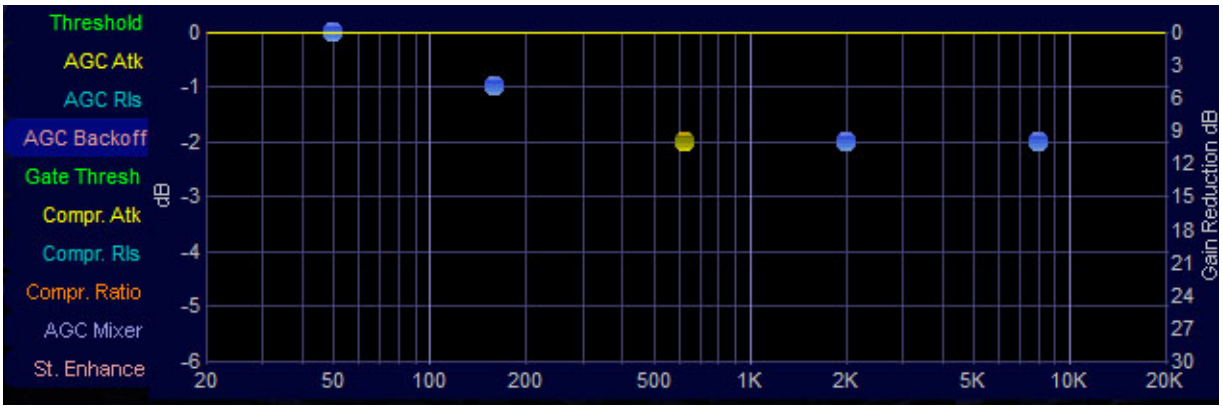
Band Coupling (Inter-band Coupling) and Key Band

Each band of AGC and compression can be offset from its neighbor by using the coupling controls. You can also select which band can be the *key* or *master band*.

Each *Coupling* control except Band 1 may be adjusted over the range of 0dB to -6dB (Band 1 allows -9dB). When all the coupling controls are set to 0dB, only Band 2 can take on more gain than Band 3 (if Band 2 is the key band). All of the other bands will remain "flat." If Band 3 is the key band, it can take on more gain than Band 4 while all other bands remain "flat." Such a setting is useful in formats such as Classical and Jazz that typically would not need or want the automatic spectral balance "correction" that more processed formats usually prefer.

In most programming situations the optimum setting of the Coupling controls will likely be somewhere between -1.0dB and -3.0dB for bands ABOVE the key band and -2.0dB to -6dB for bands BELOW the key band. Decoupling the mid AGC's bands beyond -6dB could allow their gains to "wander" too much, causing unnatural spectral buildup on some material. Therefore the maximum decoupling in these bands is 6dB.

Each band has a compression threshold control which affects the operating threshold of the AGC and Compressor and that control is labeled *Threshold* in the graphic.



The "output" of each band's threshold control feeds a virtual voltage divider with the *AGC Backoff* control as the top resistor in the divider. As the *AGC Backoff* control for each band is adjusted away from the "0dB" position (where AGC and Compressor thresholds are equal) the AGC's Threshold is raised compared to the Compressor's. The effect? The AGC starts doing less work and the Compressor does more. The further an *AGC Backoff* control is adjusted away from "0dB" the more the average levels and detail increase, and because the AGC/Compressor operate in the Sum and Difference signals (L+R/L-R) the perceived stereo sound field also seems to widen.

It is important to understand that the Compressor may never have more gain than the AGC. The Compressor always starts its gain reduction journey *from* whatever the current AGC gain reduction level is, and when the Compressor releases, it can only release *back* to whatever the AGC gain reduction value is at that moment. This means that *most* of the gain control inside the AGC/SST section occurs via slower AGC action, not faster Compression, which dramatically reduces certain distortions caused by fast-acting gain controllers, and without losing the benefits of faster gain control when needed.

Stereo Enhancement

AirAura X3 contains a multi-pronged stereo enhancement technique that has proven to be very effective in the field. This approach has a side benefit in that it minimizes receivers' reactions to multipath interference without degrading the audible stereo separation.

This multi-pronged approach includes:

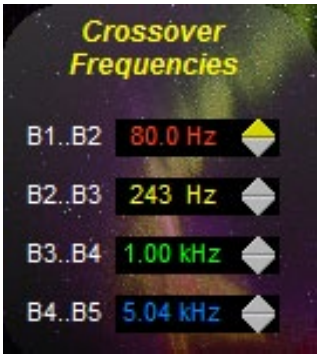
- Separate AGC Sum and Difference processing.
- Post-AGC multiband L-R signal level manipulation.
- Automatic Multipath Limiter incorporated into the stereo encoder.

Stereo enhancement is primarily accomplished by sub and difference processing within the multiband AGC section. Intelligent inter-band and sum/difference linking provides tasteful stereo enhancement without any of the usual artifacts. Once the signal has been processed, a set of controls within the *St. Enhance* (Stereo Enhance) tab on the *Multiband AGC with SST* screen's graphical area serve to allow adjustment of the individual band gains of the L-R processing. The adjustment range is +/-6dB for each of the five bands.

It may now be obvious that the multiband *St. Enhance* controls can be used together to arrive at virtually *any* style of stereo enhancement. For instance, after passing through a codec many program sources contain extra midrange energy in the L-R and because our hearing is most sensitive in the midrange such artifacts can become more audible in stereo. To help mask these artifacts and/or to make the stereo sound field big, wide, *and* warm, one might slightly reduce the Band 3 and Band 4 *St. Enhance* levels while also slightly increasing the *St. Enhance* Band 2 Mixer level. The Band 3 and Band 4 settings help subdue codec artifacts while the increase in lower midrange energy provides a comfortably wide and warm sound field. Tuning the stereo enhancement this way prevents high frequencies in the L-R from being over-enhanced which then helps reduce the susceptibility of receivers to blending artifacts during multipath. The end result is that the station's audience in questionable coverage areas enjoys a better listening experience.

As mentioned previously the *St. Enhance* control for each band has a +/-6dB control range and all of the controls work in concert to generate a unique and identifiable stereo on-air sound.

Crossover Frequencies



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

Crossover Frequency Ranges

Band 1 to Band 2 - Super-Low to Low:	20Hz – 149Hz
Band 2 to Band 3 - Low to Mid:	162Hz – 687Hz
Band 3 to Band 4 - Mid to Presence:	728Hz – 2,180Hz
Band 4 to Band 5 - Presence to High:	2,590Hz – 20,000 Hz

Note that although the bands cannot be made to overlap, the crossover can be operated as a three, four, or five band AGC as follows:

For Three Band Mode: Move the BAND 1<>2 crossover down to 20Hz

AND

Move the BAND 4<>5 crossover up to 20,000Hz

Three band mode is suggested for Sports and Classical formats. In Sports formats, especially those that carry a lot of live events, the three band mode helps prevent un-

natural crowd noise. In Classical formats, the three band mode allows the AGC and Compressor to sound natural by minimizing spectral rebalancing, keeping the spectral balance true to the original source.

For Four Band Mode: Move the BAND 1<>2 cross-over down to 20Hz

OR

Move the BAND 4<>5 crossover up to 20,0000Hz

In the four band mode, either Band 1 or Band 5 is tuned beyond the range of program material. Formats desiring a very smooth and mellow high end might see some benefit in moving Band 5 up out of the way so that very high frequencies never become exaggerated by the AGC. Formats that don't need extra bass support, or talk formats where studio acoustics can cause unnatural bass buildup making voices sound tubby, can take advantage of the flexible crossover design to move Band 1 down out of the way so that very deep bass resonances caused by such room acoustics are never exaggerated.

For Five Band Mode: Make sure BAND 1<>2 crossover is at least at 40Hz or higher

AND

Make sure BAND 4<>5 crossover is at or lower than 12,000Hz

Because of the intelligence of AirAura X3's AGC/SST the full five band mode should be used in most situations and is even perfectly fine for many talk/classical based formats. Only those formats where special needs are required should consider using the three or four band mode.

AGC/Compressor Sidebar Menu

In Wheatstone processors the controls for all processing bands may be adjusted by first selecting the desired control type tab, and then using the blue dot navigation method covered previously to adjust individual band parameters. For more information on how to adjust these controls, please see the "Blue Dots" section of this manual.

Threshold

The *Threshold* control determines at what level processing will begin to take effect in a particular AGC band. Higher Threshold settings cause processing to begin at higher levels and lower Threshold settings cause processing to begin at lower levels. The range for the AirAura X3's AGC Threshold controls is -70 to -50 **dBFS**.

Before we venture further, it is important to point out that *most* of AirAura X3's controls are calibrated in dBFS in order to show their true relationship to digital signal levels and their relationship to "0dBFS." "0dBFS" is when there are no more digital bits available and severe distortion results. With the exception of the MPX Output level controls this is how external levels in and out of AirAura X3 are also calibrated.

Now, back to the subject of AGC Thresholds…

Sometimes, Threshold settings are seen down around -60dB in some of our factory presets. They might *look* like very low threshold settings but in fact they aren't. The -60dB Threshold setting is actually -60dBFS, and that's for "peak"

levels, so consider this; if we leave the standard 20dB of headroom below 0dBFS and fudge that factor by another 20dB to make sure there is enough peak headroom for *any* possible scenario coming in from the studio, we're now down at -40dBFS. Now, if we're processing for an aggressive format and want the AGC to have at least 20dB of level makeup available in the AGC for bringing up the low stuff, we'll need a threshold setting that is another 20dB below that … now we're at -60dBFS. A -60dBFS threshold actually *does* equal the usual compressor threshold settings in traditional compressors and AGC devices.

AGC Attack

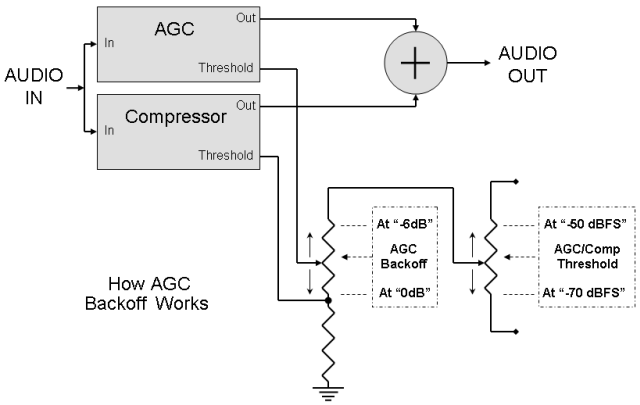
The *AGC Atk* control determines how quickly the AGC will respond to upward level changes in the audio. The control range is 50ms to 500ms. A setting of 300ms corresponds well to our perception of average loudness and is therefore a very good starting point.

AGC Release

The *AGC Rls* control determines the rate at which the AGC will increase gain when the audio level falls, as long as it is still above the gate Threshold setting discussed previously. The adjustment range of the control is from 1.0 seconds to 7.0 seconds. The 7 second setting is considered VERY slow and is recommended for fine-arts or classical programming (or, if you're Jeff Keith, for Classic Rock processing when he wants the on-air dynamic range to mimic the old AOR formats). The 1 second setting is very fast and is recommended only if a certain "pumpy" texture is desired. The recommended setting for most formats is between 2.5 seconds and 6 seconds.

AGC Backoff

The AGC Backoff controls adjust the processing balance between what occurs due to slower AGC action and what occurs due to faster and more audible compression. It does this by manipulating the threshold of the AGC relative to that of the compressor. When any of the AGC Backoff controls are set at "0," the thresholds of the AGC and Compressor are equal, making the combination of their two operations more towards slower AGC and less compression. The schematic-like graphic at right shows what is going on as the AGC Backoff control is adjusted. Each band has a compression threshold control which affects the operating threshold of the AGC and Compressor and that control is labeled AGC/Comp Threshold in the graphic.



The "output" of each band's threshold control feeds a virtual voltage divider with the AGC Backoff control as the top resistor in the divider. As the AGC Backoff control for each band is adjusted away from the "0dB" position (where AGC and Compressor thresholds are equal) the AGC's Threshold is raised compared to the Compressor's. The effect? The AGC starts doing less work and the Compressor does more. The further an AGC Backoff control is adjusted away from "0dB" the more the average levels and de-

tail increase, and because the AGC/Compressor operate in the Sum and Difference signals (L+R/L-R) the perceived stereo sound field also seems to widen.

It is important to understand that the Compressor may never have more gain than the AGC. The Compressor always starts its gain reduction journey from whatever the current AGC gain reduction level is, and when the Compressor releases, it can only release back to whatever the AGC gain reduction value is at that moment. This means that most of the gain control inside the AGC/SST section occurs via slower AGC action, not faster Compression, which dramatically reduces certain distortions caused by fast-acting gain controllers, and without losing the benefits of faster gain control when needed.

When an AGC Backoff control is set all the way to the -6dB setting much of the gain control is due to the faster Compressor action and short term dynamics will be aggressively controlled. What this means is that it is the setting of the AGC Backoff control alone that primary governs the "sound" of the audio being processed as far as "hearing it working" is concerned. AGC Backoff controls are therefore "Compression Texture" controls since the more they are turned away from "0," the more audible the processing becomes.

AGC Backoff, allows the processing texture to be highly modified from a gentle, unobtrusive and invisible control (Backoff between "0dB" and about minus 2.0dB), to more obvious compression (Backoff control at "-3.0dB") or even greater that sounds similar to, but is cleaner than, the vintage compressors and limiters from the 1960's.

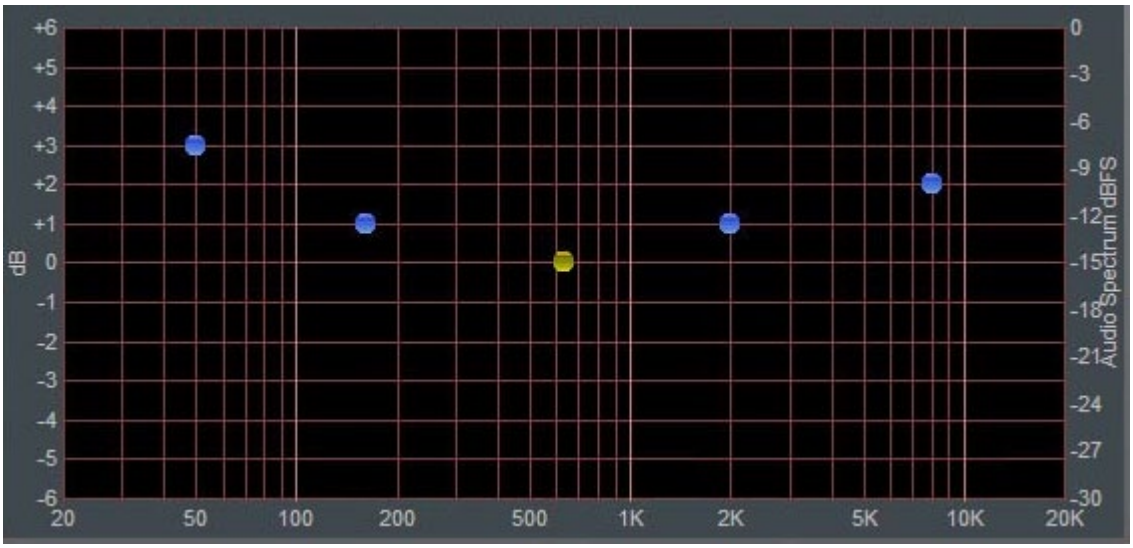
Note that regardless of the setting of the AGC Backoff controls, the AGC and Compressor stages operate with their algorithms linked mathematically. When less control from the AGC is desired, simply reduce the compression ratios slightly or lengthen the AGC attack times.

The AGC Backoff control is now found in the sidebar region. New to Version 3.0 is the ability to adjust the backoff control for each band as opposed to just globally. Like the other adjustments in the sidebar region of the AGC/Compressor page, each band can be set to be adjusted globally or individually.

Gate Threshold

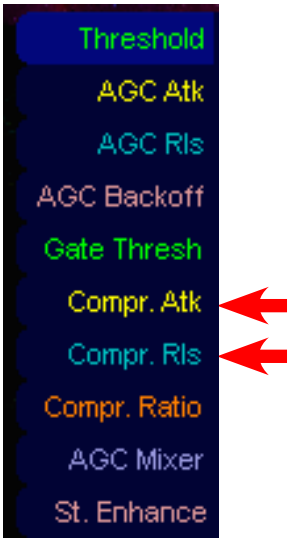
The AGC *Gate Thresh* control sets the audio level below which the audio gain reduction values are held until audio returns. This control can be set to OFF or adjusted over the range of -79.0dB to -20.0dB. In each of the five bands there is also a Gate Threshold Trim control allowing offsets of +/-6dB to be made to each band referenced to the main Gate Threshold setting. This allows precise Gate Thresholds on a band by band basis as appropriate for the program format requirements.

Example: Suppose the AGC Gate Threshold control is set to -40.0dB and the controls for the individual bands are set as in the example below:



In this example, Band 1's Gate Threshold has been offset by +3dB, which means its actual gate threshold is now -37dB, or 3dB less sensitive than band 3 (which is still set at the "0" reference line). This will cause band 1 to need a higher audio level before it will "un-gate" and allow the gain to increase. Setting the gate this way prevents unnatural increases in low frequency gain that might be undesirable. The Gate Thresholds may be offset this way in any of the bands as the application warrants.

Compressor Attack



The *Compr. Atk* control determines how quickly the Compressor responds to rising audio levels not caught by the AGC because of its longer attack time. The compressor's purpose is to handle medium term peaks only, and by doing so it completely frees the AGC from having to worry about controlling them. The recommended Attack time setting for sounding "musical" is between 10 and 30ms. Compressor attack settings faster than 10ms can make the audio sound constricted, especially with Ratio settings above about 4:1. Conversely, settings slower than 30-50ms can prove to be ineffective on certain percussive material and even though it is essentially inaudible while doing so, it can make the 31 Band limiter work harder than it needs to.

Compressor Release

The *Compr. Rls* control determines how quickly the compressor returns gain to the processing "floor" established by the AGC's current value of gain reduction. As mentioned before, the 5 Band AGC establishes the platform gain reduction from which the compressor operates. It accomplishes what adding a compressor after the AGC would accomplish, but without needing it. The result is cleaner and more detailed audio without the compression artifacts that can creep into aggressive processing or multi-box solutions when ultimate loudness is the goal.

The Compressor Release time's adjustment range is 50ms to 1 second (1000ms). The best starting point is usually to set the *release time* to the *attack time* of the AGC. Thus, if

the AGC attack time is 300ms, the Compressor release time would be 300ms. This is not a rule, but a good starting point.

Compression Ratio

The *Compr. Ratio* determines the how tightly the multiband AGC controls the audio. The range of adjustment is from 2.0:1, with 2:1 being "very gentle," to 20:1, which behaves like a leveler or very slow limiter. The Compression Ratio for each band may be set individually, and the Ratio settings apply to both the AGC and Compressor simultaneously.

Compression Ratio is an easy term to explain. As above, if the Ratio is 2:1 it means that the Output increases 1dB for every 2dB of input increase. Similarly a ratio setting of 3:1 means that for every 3dB increase in input level, the output level increases by only 1dB. At a ratio of 20:1, it would take an input level increase of 20dB (almost the entire scale of a standard VU meter) to make the input level rise by only 1dB. This is very tight control, such as what a limiter might have.

Sensible Compression Ratio settings result in very natural gain control; ratios between about 2:1 and 6:1, depending on format, with more aggressive formats sounding more consistent if ratio settings lean toward the latter value.

AGC Mixer (was L + R Mixer)

The *AGC Mixer* may be used to tailor the mix levels of the L+R, or "mono" content of the processed signal. Very dramatic EQ changes can also be made using these controls.

Generally we recommend that the L+R Mixer controls be set flat and the parametric EQ be used for EQ tailoring. If more than the parametric EQ is required, *small changes* can be made here if needed, +/-3dB at most, for best on-air consistency.

St. Enhance (was L – R Mixer)

We'll cover this a little more again here even though much of it was already covered in the section on Stereo Enhancement. The St. Enhance controls affect the difference, or "stereo" content of the processed signal. By carefully using these controls custom stereo enhancement effects may be added to specific parts of the audio spectrum *without* raising the overall L-R gain and without increasing the potential for multipath interference.

The most dramatic changes in sound will be heard while adjusting Bands 2, 3 & 4 and the effect is somewhat dependent on the chosen AGC's crossover frequencies. A good "medium" setting for stereo enhancement would be to raise the *St. Enhance* settings for Bands 2 and 3 to perhaps +3dB and Band 4 to perhaps +2dB.

HD LIMITER MENU

The 31-band *HD Limiter* screen contains all the controls necessary for fine tuning the sound of the HD output while constraining its absolute peak output level into the next device in the chain.

HD Limiter Screen

31-Band Drive

The *31 Band Drive* control determines the amount of input signal being applied to the 31-band HD limiter. Lower drive settings create a more gentle sound while still controlling peaks while higher settings can make the sound more aggressive by increased short term density. Extremely high drive settings which cause more than 4dB to 6dB of frequent gain reduction are wholly unnecessary, can become fatiguing, and may create a less than desirable operating condition for a perceptual codec such as the one used in HD transmission. The *31 Band Drive* is adjustable from 80 to 100% and is calibrated in percent, not dBFS.

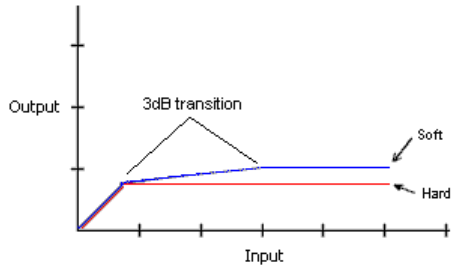
31-Band Enable

Turns on the 31-band Limiter when selected. Not suggested for most formats except Classical, Jazz or other fine arts programming. If the 31-band Limiter is not used, the Lookahead Limiter should be used in its place.

31 Band Modes

There are two Mode settings available, Soft and Hard, which adjust the 31-band limiter's transfer function. In each mode the behavior of the threshold circuits is modified to alter how the limiters behave once their limit thresholds are reached. In the *Hard* mode infinite ratio limiting begins exactly at the value set by the Limiter Threshold controls. In the *Soft* mode, limiting begins to occur at a softer ratio 3dB below the value set by the limiter controls, and then gradually transitions into infinite ratio limiting over a 3dB range.

We recommend the Hard setting if the HD output is used to feed a perceptual codec. This is because the codec responds more favorably to the type of peak control exercised by the 31-band limiter when operating in this mode.



Comparison of Hard and Soft Limiter Modes

The *Soft* setting is gentler sounding, with gain reduction beginning to take place 3dB below a band's actual threshold setting with limiting gradually getting harder until it reaches infinite ratio. The curve at left illustrates this behavior.

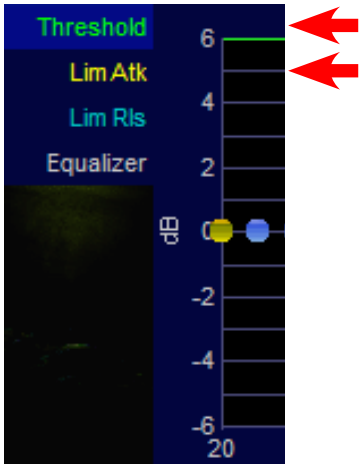
Because the Soft setting begins having a contribution to the gain 3dB below where the knee becomes infinite, this setting is intentionally more audible in its action. Because it creates softer-sounding peak control, it may be desirable for certain program formats. While we recommend the Hard mode for use with perceptual codecs, it's always best to choose the mode that sounds best in *your* application.

As mentioned previously, the Soft setting is intentionally more obvious in its action and if desired, could be used to generate a lot of extra RMS density (loudness). This is because the more time the audio spends within a nonlinear transfer function, the higher the RMS energy generated. The Hard setting is less obtrusive in its action; in fact it's essentially invisible because peaks within individual frequency bands spend more time below threshold than above. Further, the bands are so narrow that our ears do not perceive the gain control occurring within a single band, mainly because that limiting is masked by audio present in adjacent limiter bands that is not undergoing limiting.

Feel free to see how each setting sounds and how it can help your station achieve the sound it desires, keeping in mind that we recommend the Hard setting for perceptual codecs.

31 Band Limiter Sidebar

Like the five band AGC/Compressor, the 31-band limiter graphical area hosts a sidebar with adjustment parameter tabs for gaining access to the controls for tailoring the sound of the 31-band limiter. Remember the previously described method for adjusting these controls (the blue dots) because the same method explained there is also used here.



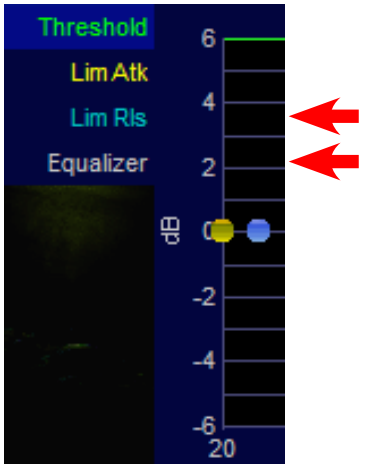
Threshold

The *Threshold* controls determine at what audio level limiting will begin in a particular band. The AirAura X3 31-band limiter threshold controls are adjustable over a 12dB range. The absolute threshold of each limiter band is determined not only by the settings here, but also by the Multiband Mode ("Soft" or "Hard") as explained above.

Attack

The *Lim Atk* controls determine how quickly the Limiter bands respond to audio peaks once they exceed the limiter threshold. Recommended settings are between 30ms and 10ms. Longer attack times are possible, and even recommended, for the limiter bands that fall below the setting of the BASS TOOLS *Frequency* control since doing so will assist with bass "punch." Overall, longer attack times will cause the Lookahead Limiter to work harder.

Release



The release time controls determine how quickly the limiters will return to their 0dB resting values once audio has fallen back below the limiter threshold. Faster release times will yield a louder sound while slower times will yield a smoother sound at the expense of some loudness. Very fast release times, faster than the attack times (!), allow the freedom to create very controlled intermodulation "texture" and "slam," and only in certain spectral ranges, when desired

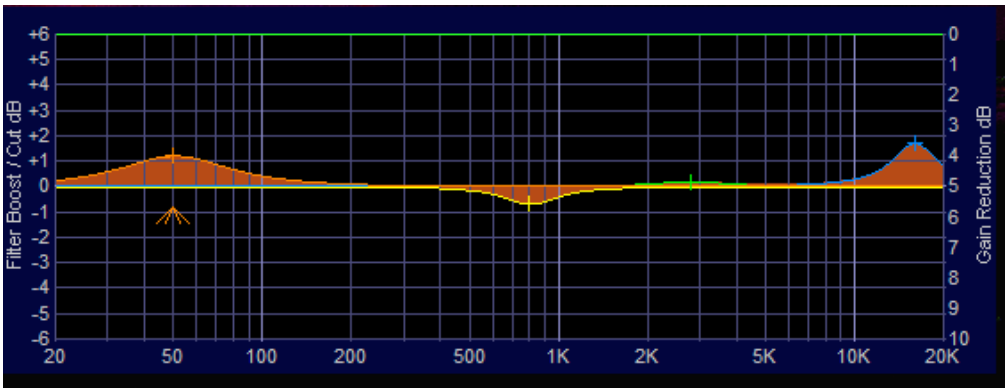
Because of the way the 31-band limiter works, there is a lot of leeway in adjusting the attack and release times and the ranges of the controls have been limited to prevent "driving off a cliff," though using nonsensical settings in any audio processor can yield unacceptable sound.

Equalizer

This EQ is a four-band parametric like the one near the AGC section and is situated in front of the HD section's look ahead limiter. EQ applied here is akin to adjusting a final mixer at the outputs of the 31-band limiters. The adjustment ranges have been made large enough to create the desired effect but limited in scope to prevent overuse.

The recommended settings in this equalizer section are flat because any EQ changes *should* have been made upstream in the AGC L + R mixer or in the parametric EQ. If a LITTLE more of something is needed, these controls have been provided to accomplish that. But they are also easily abused because of where this equalizer is located. Boost and Cut are limited to +/-3dB.

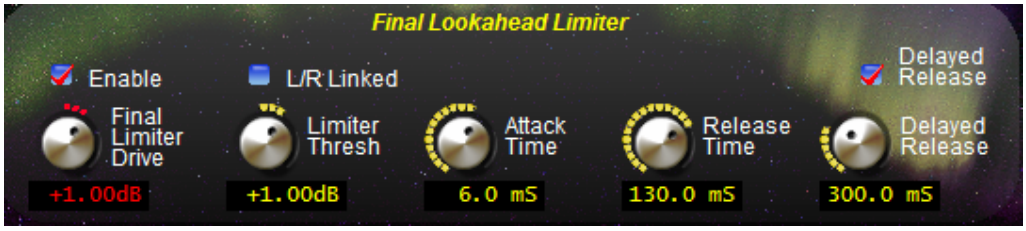
Adjusting this final EQ is the same as adjusting the Parametric EQ by directly manipulating the curves.



Clicking on the crosshair and holding the left mouse button down as the mouse is dragged moves the curve to a new frequency (mouse drag left or right) as well as adjusting the curve's height above or below the 0dB reference line (mouse drag up or down).

Clicking on the "tent" underneath the curve and holding the left mouse button down, allows the bandwidth, or "Q," of the equalizer to be changes by sliding the mouse left or right.

Lookahead Limiter



The HD section's final peak control is accomplished by a special high-speed feed forward limiter with a 0.5 millisecond look ahead time. The control path, not the audio path, is oversampled in order to achieve extremely precise peak control. Because the goal of oversampling is better peak control through finer definition of the audio waveform, oversampling of the audio signal itself is not only unnecessary, but wastes DSP resources.

Limiter Enable

When the *Enable* check box is checked the Lookahead Limiter is enabled. When the Lookahead Limiter is enabled all of its controls are functional and will have an impact on the sound.

L/R Linked

The Lookahead Limiter normally operates with its left and right channels un-ganged, which permits each channel to be peak limited independently of the other. With independent peak limiting program material may be perceptibly louder than when the limiters are linked though the stereo image may not be maintained when one channel limits and the other doesn't.

When the *L/R Linked* box is checked the left and right channel control signals are made common and the greater of the two controls both channels equally. The linked mode therefore prevents unnatural stereo image shifts when one channel needs to reduce the signal to control peak excursions and the other channel doesn't.

Final Limiter Drive

The *Final Limiter Drive* control sets how deep limiting will be for normal program material.

Limiter Threshold

The *Limiter Thresh* control adjusts the threshold of the Lookahead Limiter relative to the setting of the *Final Limiter Drive* control. It is normally adjusted until the Lookahead Limiter gain reduction bargraph *just* shows the onset of limiting with normal program material. The Lookahead Limiter threshold may be adjusted over a +/- 6dB range.

Attack Time

The Lookahead Limiter *Attack Time* control sets the attack time of the Lookahead limiter, or how fast it reacts to and then controls signal peaks. Limiter attack times from 0.2 milliseconds through 0.5 milliseconds allow the limiter to "look ahead" in time and react to signal peaks before they arrive at the limiter's gain control algorithm. This

results in a "prediction limiter" that prevents output peaks before they can occur. At *Attack Time* settings of 0.5 milliseconds and higher the look ahead has no effect and the limiter then operates conventionally.

NOTE: The 0.5 millisecond look ahead is always active. If the *Attack Time* control is set at 1.0 millisecond the actual attack time is 0.5 milliseconds. The look ahead value of 0.5mS must be subtracted from the control setting to know the actual attack time.

Release Time

The *Release Time* control sets the primary (fast) recovery time of the Lookahead 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 on certain program material. Fast release times increase signal density and decrease limiter audibility – up to a point. Release times that are too fast may increase intermodulation distortion. The control range is 33.0 to 330.0 milliseconds.

Delayed Release

The *Delayed Release* control sets the secondary (slow) recovery of the Lookahead Limiter. When Delayed Release is engaged, the limiter will release the first 3dB of gain reduction at the (faster) Release setting, with the remainder of the Release occurring at the Delayed Release timing. Using Delayed Release drastically reduces intermodulation distortion and allows more limiting depth without incurring a distortion penalty. The control range is 100ms to 1.0 seconds.

Bass Tools

Vorsis Bass Tools allows extremely low program frequencies to be processed without causing dynamic gain changes and without generating undesirable intermodulation artifacts in higher frequency signals. Its primary purpose is to allow the thumps of kick drums and other percussion instruments to sound natural in their "percussiveness" without pumping or other undesired artifacts. The algorithm operates in left/right mode treating both channels identically.

Our laboratory research on codec behavior rather surprisingly revealed that it is perfectly acceptable to process very low frequency material using the Bass Tools algorithm provided that the harmonics generated during the process are well controlled spectrally. Since our bass algorithm does not allow significant harmonic levels above the third or fifth (somewhat dependent the Bass Tools *Style* setting) there is no audible downside to using it with coded audio. Furthermore, the ability to utilize the Bass Tools on both the FM and HD sides of the processor allows the sound to be more evenly matched as receiver-based digital to analog crossfades are encountered.

Drive

This control adjusts the amount of Input Drive to the Bass Tools algorithm. Higher drive settings make it work harder and generate higher levels of harmonics. The *Drive* control adjusts the amount of drive to the Bass Tools and is adjustable over a range of -6dB to +12dB. Adjustment is best done by ear with percussive source material.

Style

Two Bass Tools operating styles, plus Off, are available. The *Hard* setting has a transfer function occupying approximately 1dB of transition amplitude. The waveform control is fairly abrupt and generates low order harmonics.

The *Soft* setting operates with a transfer function occupying approximately 2dB of transition amplitude. Therefore the control is less sharp than the hard setting, generating more low order harmonics. While the two settings may appear to be almost the same, the 1dB difference in transfer ratio creates a *significant* difference in how the two Bass Tools styles *sound* on actual program material. When Off is selected, the Bass Tools processing is bypassed (with the exception of *Sub Woofer*).

Sub Woofer

The Bass Tools *Sub Woofer* control has an On/Off function that enables and disables a dynamic low frequency extension circuit that enhances the presence of subsonic energy like a subwoofer does and is useful for formats that require extra deep bass, such as Urban and CHR.

NOTE #1: We **do not** recommend Bass Tools *Sub Woofer* being enabled if substantial bass equalization has been dialed in using the parametric EQ or the L+R EQ mixer in the AGC/Compressor. We also recommend listening to the station with an audio system capable of reproducing sub bass frequencies while experimenting with *Sub Woofer* because its effect will be essentially inaudible on systems that are incapable of reproducing very low frequencies.

NOTE #2: When Bass Tools *Sub Woofer* is enabled we recommend operating the High Pass Filter (Input Menu) at settings no lower than 30Hz. In fact slightly higher settings, such as 40Hz, might be more appropriate, depending on the format. Failure to heed this advice may allow undesirable subsonic signals to get on the air.

NOTE #3: Remember that the majority of consumer sound systems cannot reproduce audio signals below about 40-50Hz. Exceptions to this are systems specifically equipped with subwoofers and/or large air mass speaker systems. It is important to recognize the capabilities of the station's typical listeners and whether or not they might be equipped with audio systems capable of reproducing sub bass. This of course suggests a highly format dependent situation... and it is!

Bass Mix

The Bass Tools *Bass Mix* control adjusts the output of the Bass Tools algorithm and can be thought of as a "low bass mix" control. Settings between -6dB and -3.0dB add extra bass to the overall mix, while settings lower than -6.0dB reduce it. Both the Bass Tools *Drive* and the *Bass Mix* controls are best adjusted by ear using percussive bass material. The *Bass Mix* control is adjustable between -12dB and 0dB.

Frequency

The *Freq* control is simple. All audio below the frequency selected is processed by Bass Tools. Smoother bass can be had with settings above 200Hz, which is recommended.

Texture

The *Texture* control sets the ratio of odd to even harmonics in the Bass Tools circuit. Normally the Bass Tools adds only odd harmonics so some mechanism is needed to add some even harmonics too so that smaller speakers seem to have better bass than they are physically capable of reproducing. This is what the Bass Tools *Texture* control does. Higher settings are recommended for rock/classic hits based formats while Urban, R&B and many CHR formats may wish to operate with the control set lower. Note that settings above about 35% may sound unnatural on some program content.

Filter Shape

The *Filter Shape* control switches in one of three types of low pass filters for Bass Tools. The style of filter selected can impact the sound of bass.

The *Broad* filter shape allows for a very full bass sound. Some bass products are let out into the "main mix" (frequencies above where the Bass Tools frequency control is set) and the broad filter has a texture that is reminiscent of bass enhancers in older processors with the control of a modern limiter/clipper design.

The *Medium* filter shape is what previous versions of AirAura bass management used and is also found in the VBMS bass enhancement systems found in our other audio processors. The *Medium* filter shape gives bass some more "heft" without letting as much of the bass harmonics into the main mix.

The *Tight* filter shape keeps virtually all bass harmonics out of the main mix. It is also the lightest sounding of the three and the bass has a very controlled texture.

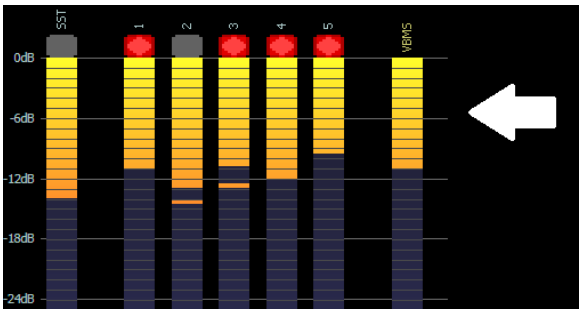
Bass Couple

The *Bass Couple* control allows you to gang the Bass Tools processing with the 31-band limiter. When engaged, up to 13 bands of the 31-band limiter can be ganged in relationship to the frequency setting in the *Frequency* control.

For example, if the *Frequency* control is set for 200Hz, the first 11 bands of the 31-band limiter (covering 20Hz to 200Hz) act as one coupled band. This helps reinforce control in the section of processing where Bass Tools is working and allows you a deeper bass signature. You can see the activity of the Bass Tools coupling on the 31-band limiter if you observe the gain reduction metering when you switch the control in and out.

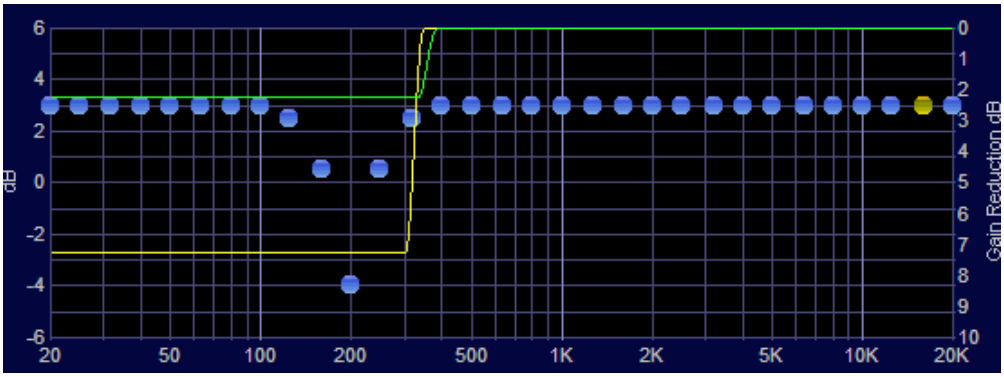
The Bass Couple control can work when Bass Tools is in OR out.

Bass Tools Metering



There are two ways to monitor the amount of processing being done by the Bass Tools.

Bass Tools can be seen on the *Analysis* Screen on the Pro GUI, in the Guru GUI, or on the front right screen panel of the AirAura X3. Bass Tools can also been seen in Pro GUI in the Limiter gain reduction graph. Its activity is indicated by the yellow line (the green line shows the corresponding 31-band limiter with *Bass Couple* on).



Depending on how hard the Bass Tools is driven, one may or may not observe much activity on the Bass Tools metering. In fact, only when a lot of bass is present in source material will Bass Tools show any activity on the meters. However, this does not mean Bass Tools is not working.

FM LIMITER MENU

The 31-band *FM Limiter* screen contains all the controls necessary for fine tuning the sound of the FM output and adjusting its peak control method. These controls allow the user to make many tradeoffs between loud and clean, in ways that have never been available before in an FM peak limiter.

FM Limiter Screen

31-Band Drive

The *31-Band Drive* control determines the amount of input signal applied to the 31-band limiter – less drive creates a more gentle sound while still controlling peaks, while higher settings increase short term density and loudness. Note that unlike limiters with fewer bands, the 31-band limiter *does not* require 10-15dB of continuous peak limiting to do its work. In fact, *31-Band Drive* control settings that result in more than 4-6 dB of limiting are not only unnecessary, but serve no purpose. The *31-Band Drive* control is adjustable from 80 to 100%.

31-Band Enable

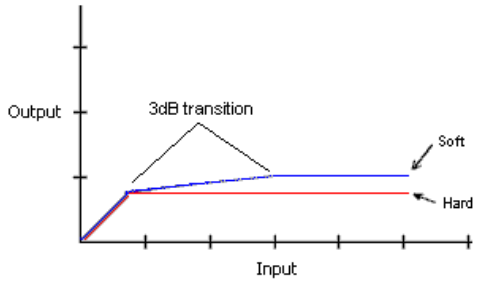
Turns on the 31-band Limiter when selected. Not suggested for most formats except Classical, Jazz or other fine arts programming. If the 31-band Limiter is not used, the Wideband Limiter should be used in its place.

31 Band Modes

The 31-band Limiter may be operated in one of two modes; Soft and Hard. Each mode applies a slightly different transfer function to all 31 bands which then modifies how they behave at the threshold of limiting.

In the *Soft* mode, limiting begins at 3dB below a band's actual threshold setting, and as the audio level continues to increase the limiter transitions into a hard limit ratio over

a 3dB window. The curve below illustrates this behavior.



Comparison of Hard and Soft Limiter Modes

Because the Soft setting begins having a contribution to the gain 3dB below where the knee becomes hard, this setting is intentionally more audible in its action and creates a softer sounding limiting that might be desirable for some program formats.

The *Hard* mode is the most abrupt transfer function with no gain control occurring until a band's set limit threshold is reached. The curve on the left illustrates this behavior. Notice that once the threshold is reached (depicted by the rising line terminating at the flat top) there is no increase in level and therefore the compression ratio of the limiters is extremely high.

As mentioned previously, the Soft setting is intentionally more obvious in its action and if desired, could be used to generate a lot of extra RMS density (loudness). This is because the more time the audio spends within the limiter's nonlinear transfer function, the higher the RMS energy generated. The Hard setting is less obtrusive in its action because peaks within individual frequency bands spend more time below threshold. Because limiting does not occur until the thresholds are reached, the multiband limiter has no contribution to the sound until the audio is above threshold. Once above threshold the limiters operate with infinite ratios and the audio is truly "limited."

Both limiter settings have their purpose, and there is no right or wrong setting. Please feel free to experiment with each mode to see how each sounds and how it can help your station achieve the on-air sound it desires.

Special 31 Band FM Limiter Operating Modes – Wide and Timbral

The 31-band FM limiter operation varies according to the settings of the *Wide* and *Timbral* check boxes. When these boxes are not checked each band of the 31-band limiter operates in its *Discrete* mode where the operation of each limiter band is completely independent of all the others.

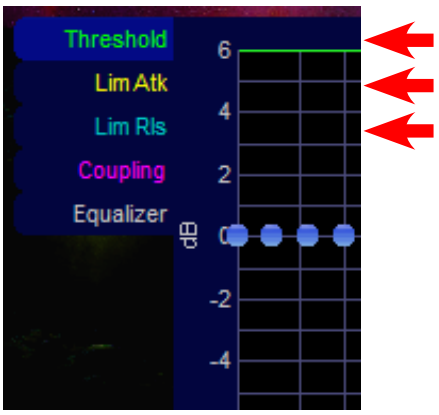
If the *Wide* mode check box is checked the 31-band limiter operates as a pseudo-10-band limiter with its bands ganged together in what we call "Triplet Coupling™." In this mode the limiter operates as ten "center bands" by dividing the limiter bands into groups of three. For instance, Band 1 becomes coupled to Band 2 and Band 3, while Band 4 becomes coupled to Band 5 and Band 6, and so on across the audio spectrum. This mode is useful when one wants to "hear" the limiters working in order to create a particular sonic effect. Because the 31 individual bands are so narrow, when the limiters are operating in the *Discrete* mode it is quite difficult if not impossible to hear individual limiter bands work.

When the *Timbral* check box is checked the limiters will operate in a special "Harmonic Coupling™" mode. Here, analysis of the incoming audio and the behavior of individual limiter bands cause them to operate in an extremely complex way. When limiting occurs at a fundamental frequency, the limiter algorithm calculates what the second and third harmonics of that frequency are and causes the limiter bands on or near those harmonic frequencies to perform the same amount of gain reduction as that occurring at the funda-

mental. The purpose of this mode, and the end result of it, is the maintenance of a very accurate timbral balance as the limiters operate. This mode has all the advantages of a multiband limiter while from a spectral balance standpoint it sounds like a broadband limiter (or no limiter at all). This mode is especially useful in Jazz and Classical formats because the gain at the upper harmonics of solo instruments stays balanced.

If both *Wide* and *Timbral* are selected the 31-band limiter operates as a pseudo-ten band limiter with the Timbral algorithm running on top of it. This mode may be useful if one wants to create a special limiting effect, though in our opinion the limiter is best operated in one of its other three modes (Discrete, Wide or Timbral)

31 Band Limiter Sidebar



Just like the five band AGC/Compressor, there is a sidebar with access to adjustments for tailoring the sound of the 31-band limiter. All limiter bands may be adjusted as a group or independently in the sidebar menus. Please see the section of the manual on "The Blue Dots" for more information on how to adjust the controls in the GUI's graphical areas.

Threshold

The *Threshold* control determines at what level limiting will start in a particular band. The range for the AirAura X3 limiter threshold controls is adjustable over a 12dB range and they work in concert with the 31-band Limiter Drive to set the individual band's operating behavior. The threshold of the limiters is determined not only by the settings created here, but also by the Multiband Mode (*Soft* or *Hard*).

Attack

The *Lim Atk* control determines how quickly the Limiter in each band responds to audio peaks once they exceed the setting of the limiter threshold. Recommended Attack Time settings are between 30 and 10ms. Longer attack times are possible for frequencies below the Bass Tools *Frequency* setting. However, longer attack times may also cause the Wideband to work harder and/or overshoot if it is being used.

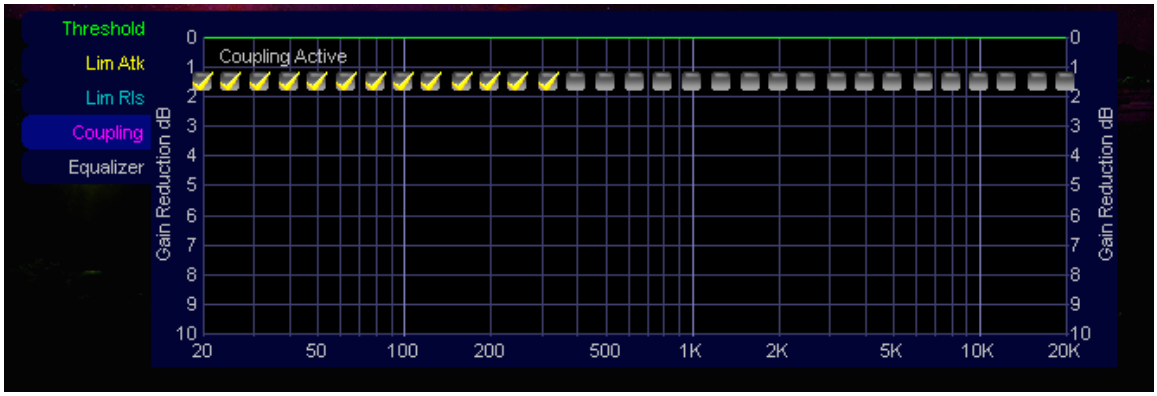
Release

The *Lim Rls* control determines how quickly the limiter will recover to 0dB once audio has fallen back below the set limiter threshold. Faster release times will yield a louder sound while slower times will yield a smoother sound, somewhat at the expense of loudness. Very fast release times, faster than the attack times in fact (!), allow the freedom to create very controlled intermodulation "texture" and "slam," and only in certain spectral ranges, when desired.

Because of the way the 31-band limiter works, there is a lot of leeway with attack and release times and the ranges of the controls have been set so that the end user can't get into a lot of trouble. Though the controls are "forgiving" in that sense, improper settings may yield undesired sound, so these controls should also not be adjusted haphazardly.

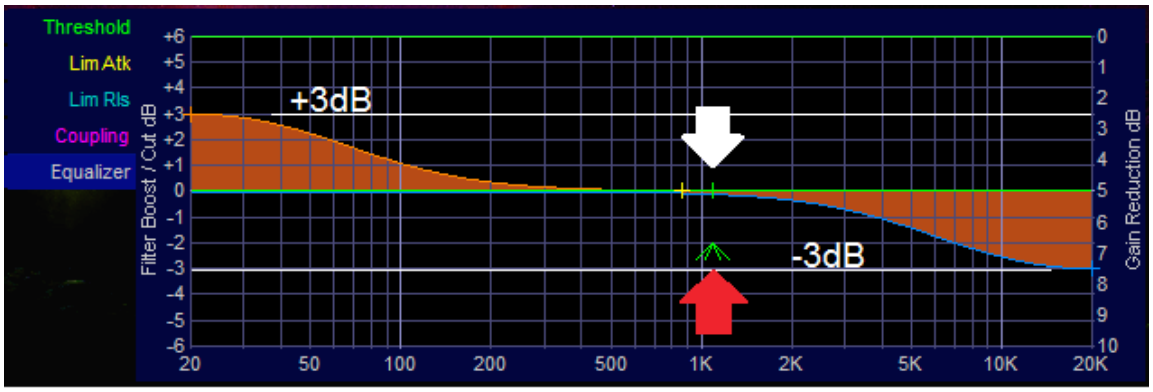
Coupling

When the 31-band limiter is not operating in its Discrete mode (*Wide* or *Timbral* is checked) the individual limiter bands may be selectively decoupled from the Wide or Timbral algorithm if desired. For instance, to achieve a certain sound the user might discover that he gets the sound he wants if he operates the limiter bands above 300Hz independently but allow the bands below 300Hz to operate according to the Wide or Timbral mode he selected. The graphic below shows how the Coupling controls would appear in his scenario.



Equalizer

The post-limiter *Equalizer* serves as the final place where one should make only *slight* adjustments to the sound of the final processed output. Adjustments in this section have been purposely limited to a small range to prevent problems due to maladjustment. Our recommendation is to leave these equalizer settings set to "flat" because EQ changes should normally have been made upstream in the L + R mixer or in the parametric EQ. On the other hand if only a little more of something is wanted, these controls have been provided. Because of the sensitive nature of where this EQ is located, boost and cut have been restricted to a modest +/-6dB.



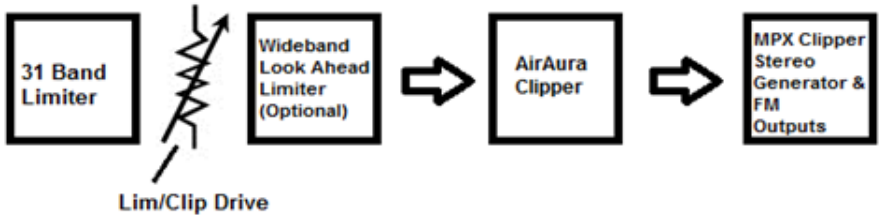
Adjusting this final EQ is the same as adjusting the Parametric EQ when directly manipulating its curves using the mouse. Clicking on the crosshair and holding the left mouse button down as you drag the mouse moves the curve to any frequency (left or right move) as well as adjusts the curve's height above or below the 0dB reference line (up or down move). Clicking on the little "tent" underneath (red arrow), and holding the left mouse button down while sliding it left or right changes the bandwidth, or "Q," of the equalizer section.

Lim/Clip (Limiter/Clipper) Drive

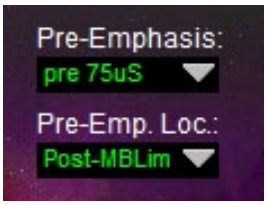
The *Lim/Clip Drive* control sets the drive level of both the Wideband Limiter (if enabled) and the AirAura X3 FM clipper. The adjustment range is +3dB/-6dB and the adjustment resolution is 0.05dB, fine enough for the most exacting clipper or limiter drive adjustments.

Where Is The Lim/Clip Drive Control?

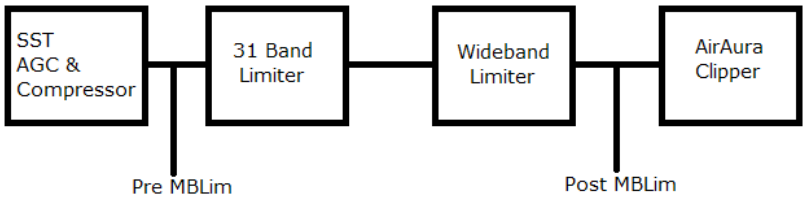
The *Lim/Clip Drive* is at the output of the 31-band limiter and just before the Wideband Limiter. It is called "Limiter/Clipper" because it drives both the Wideband Lookahead Limiter (if enabled) followed by the AirAura X3 FM clipper. If the Wideband Limiter is not enabled, this control directly drives the AirAura X3 Clipper.



Pre-Emphasis



FM *Pre-Emphasis* is selectable as FLAT, 50 or 75 microseconds. Pre-emphasis may be in one of 2 locations in the signal chain:



Pre-Emphasis Location

Pre-MBLim

In Pre-MBLim pre-emphasis is placed *before* the 31-band limiter which then causes the 31-band limiter to operate on pre-emphasis curve as a frequency conscious multiband limiter. This setting is best used when "softer highs" are the goal albeit with some loss of transient detail.

Post-MBLim

In this position pre-emphasis is *after* the 31-band limiter and Wideband limiter and directly prior to the main clipper. This setting is the most invisible in operation and allows for the most accurate high end and transient impact.

Wideband Limiter

The output of the 31-band Limiter can be peak controlled by a special high-speed feed forward limiter with a 0.5 millisecond look ahead time. The control path, and not the audio path, is oversampled in order to achieve extremely precise peak control. Because the goal of oversampling is better peak control through finer definition of the audio waveform, oversampling of the audio signal itself is not only unnecessary, but wastes DSP resources.

Limiter Enable

When this check box is checked the Wideband limiter is enabled.

L/R Linked

When this box is checked the left and right channel control signals are made common and the greater of the two controls *both* channels, preventing unnatural stereo image shifts when one channel needs to reduce the signal to control peak excursions and the other doesn't.

Limiter Threshold

The *Limiter Thresh* control sets the relative threshold of the Wideband limiter compared to the setting of the *Lim/Clip Drive* control. It is adjusted until the onset of limiting is reached with normal program material as indicated by the FM gain reduction bargraph. The Limiter Threshold is adjustable over a +/- 6dB range.

Attack Time

The *Attack Time* control sets the attack time of the Wideband limiter. Attack times from 0.2 milliseconds through 0.5 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 0.5 milliseconds and up to the limit of 30 milliseconds allow the limiter to operate as a conventional, non-lookahead limiter.

NOTE: The 0.5 millisecond look ahead is always active. If the attack time control is set at 1.0 millisecond the actual attack time is 0.5 milliseconds. The look ahead value of 0.5mS must be subtracted from the control setting to know the actual attack time.

Release Time

The *Release Time* control sets the primary (fast) release time of the Wideband 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. Fast release times increase signal density, and release times that are too fast result in increased intermodulation distortion. The control range is 33.0 to 330.0 milliseconds.

Delayed Release

The *Delayed Release* control sets the secondary (slow) release of the Wideband limiter. When Delayed 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 Delayed Release timing. This will drastically reduce intermodulation distortion and allow more limiting depth without incurring a distortion penalty. The control range is from 100ms to 1.0 seconds.

Bass Tools

The Vorsis Bass Tools allows extremely low program frequencies to be processed without causing dynamic gain changes and without generating undesirable intermodulation artifacts in higher frequency signals. Its primary purpose is to allow the thumps of kick drums and other percussion instruments to sound natural in their "percussiveness" without pumping or other undesired artifacts. The algorithm operates in left/right mode treating both channels identically. Field research revealed that it is perfectly acceptable to process very low frequency material using the Bass Tools prior to all modern FM exciters.

Drive

This control adjusts the amount of Input Drive to the Bass Tools algorithm. Higher drive settings make it work harder and generate higher levels of harmonics. The *Drive* control adjusts the amount of drive to the Bass Tools and is adjustable over a range of -6dB to +12dB. Adjustment is best done by ear with percussive source material.

Style

Two Bass Tools operating styles, plus Off, are available. The *Hard* setting has a transfer function occupying approximately 1dB of transition amplitude. The waveform control is fairly abrupt and generates a fair amount of low order harmonics.

The *Soft* setting operates with a transfer function occupying approximately 2dB of transition amplitude. Therefore the control is less sharp than the hard setting, generating more low order harmonics. While the two settings may appear to be almost the same, the 1dB difference in transfer ratio creates a *significant* difference in how the two Bass Tools styles *sound* on actual program material. When Off is selected, the Bass Tools processing is bypassed (with the exception of Bass Couple).

Sub Woofer

The Bass Tools *Sub Woofer* control has an On/Off function that enables and disables a dynamic low frequency extension circuit that enhances the presence of subsonic energy like a subwoofer does and is useful for formats that require extra deep bass, such as Urban and CHR.

NOTE #1: We **do not** recommend Bass Tools *Sub Woofer* being enabled if substantial bass equalization has been dialed in using the parametric EQ or the L+R EQ mixer in the AGC/Compressor. We also recommend listening to the station with an audio system capable of reproducing sub bass frequencies while experimenting with *Sub Woofer* because its effect will be essentially inaudible on systems that are incapable of reproducing very low frequencies.

NOTE #2: When Bass Tools *Sub Woofer* is enabled we recommend operating the High Pass Filter (Input Menu) at settings no lower than 30Hz. In fact slightly higher settings, such as 40Hz, might be more appropriate, depending on the format. Failure to heed this advice may allow undesirable subsonic signals to get on the air.

NOTE #3: Remember that the majority of consumer sound systems cannot reproduce audio signals below about 40-50Hz. Exceptions to this are systems specifically equipped with subwoofers and/or large air mass speaker systems. It is important to recognize the capabilities of the station's typical listeners and whether or not they might be equipped with audio systems capable of reproducing sub bass. This of course suggests a highly format dependent situation... and it is!

Bass Mix

The *Bass Mix* control adjusts the output of the Bass Tools algorithm and can be thought of as a "low bass mix" control. Settings between -6dB and -3.0dB add extra bass to the overall mix, while settings lower than -6.0dB reduce it. Both the *Drive* and the *Bass Mix* controls are best adjusted by ear using percussive bass material. The *Bass Mix* control is adjustable between -12dB and 0dB.

Frequency

The *Frequency* control is simple. All audio below the frequency selected is processed by Bass Tools. Smoother bass can be had with settings above 200Hz, which is recommended.

Texture

The *Texture* control sets the ratio of odd to even harmonics in the Bass Tools circuit. Normally the Bass Tools adds only odd harmonics so some mechanism is needed to add some even harmonics too so that smaller speakers seem to have better bass than they

are physically capable of reproducing. This is what the *Texture* control does. Higher settings are recommended for rock/classic hits based formats while Urban, R&B and many CHR formats may wish to operate with the control set lower. Note that settings above about 35% may sound unnatural on some program content.

Filter Shape

The *Filter Shape* control switches in one of three types of low pass filters for Bass Tools. The style of filter selected can impact the sound of bass.

The *Broad* filter shape allows for a very full bass sound. Some bass products are let out into the "main mix" (frequencies above where the Bass Tools *Frequency* control is set) and the broad filter has a texture that is reminiscent of bass enhancers in older processors with the control of a modern limiter/clipper design.

The *Medium* filter shape is what previous versions of AirAura bass management used and is also found in the VBMS bass enhancement systems found in our other audio processors. The *Medium* filter shape gives bass some more "heft" without letting as much of the bass harmonics into the main mix.

The *Tight* filter shape keeps virtually all bass harmonics out of the main mix. It is also the lightest sounding of the three and the bass has a very controlled texture.

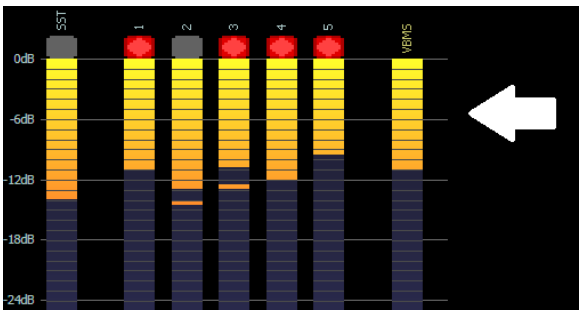
Bass Couple

The *Bass Couple* control allows you to gang the Bass Tools processing with the 31-band limiter. When engaged, up to 13 bands of the 31-band limiter can be ganged in relationship to the frequency setting in the *Frequency* control.

For example, if the *Frequency* control is set for 200Hz, the first 11 bands of the 31-band limiter (covering 20Hz to 200Hz) act as one coupled band. This helps re-inforce control in the section of processing where Bass Tools is working and allows you a deeper bass signature. You can see the activity of the Bass Tools coupling on the 31-band limiter if you observe the gain reduction metering when you switch the control in and out.

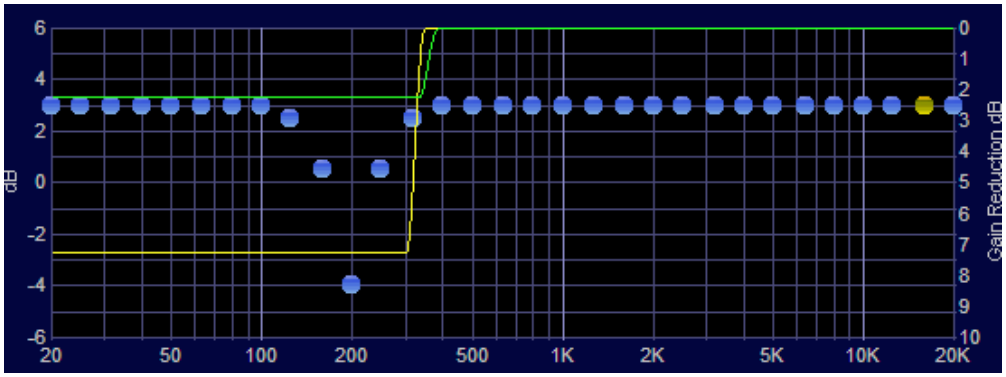
The Bass Couple control can work when Bass Tools is in OR out.

Bass Tools Metering



There are two ways to monitor the amount of processing being done by the Bass Tools.

Bass Tools can be seen on the *Analysis* Screen on the Pro GUI, in the Guru GUI, or on the front right screen panel of the AirAura X3. Bass Tools can also been seen in Pro GUI in the Limiter gain reduction graph. Its activity is indicated by the yellow line (the green line shows the corresponding 31-band limiter with *Bass Couple* on).



Depending on how hard the Bass Tools is driven, one may or may not observe much activity on the Bass Tools metering. In fact, only when a lot of bass is present in source material will Bass Tools show any activity on the meters. However, this does not mean Bass Tools is not working.

MPX+OUTPUTS MENU

The *Stereo Encoder and Outputs* screen contains the controls required to configure the AirAura X3's internal DSP-based precision stereo generator.

Stereo Encoder and Outputs Screen

MPX Processor Style

AirAura X3 is equipped with *two* methods of processing the composite stereo waveform to increase loudness:

Composite Clipper

A high ratio distortion managed hard clipper precisely controls peaks without generating high order distortion. This clipper has a brighter sound than the Lookahead Limiter because it creates a higher level of harmonic artifacts. Note that we do not mathematically remove the higher order odd harmonics in this clipper algorithm like we do in the Bass Tools section because those harmonics are *required* in order to make the waveform have a tightly defined peak amplitude.

Lookahead Limiter

This option processes the composite stereo waveform with a highly-oversampled look ahead limiter with fully automatic attack and release times. Its 0.5 millisecond look ahead and extremely high sample rate precisely controls composite waveform peaks on a cycle by cycle basis. It works similarly to the oversampled look ahead peak limiter in the FM Limiter screen, only at a much higher sample rate.

If the MPX Processor style is set to Lookahead Limiter and the MPX Process Drive is set to 0dB or lower all composite processing is defeated.

MPX Process Drive

The *MPX Process Drive* control sets the input drive level to either the *Composite Clipper* or *LookAhead Limiter* as selected. High settings create higher clipper or limiter drive settings while lower settings do the opposite. We recommend that the Composite Clipper Drive be kept under +2.0dB for best MPX spectrum cleanliness (all composite clippers create MPX spectrum "trash").

Stereo Generator

AirAura X3's *Stereo Generator* is equipped with a special algorithm called the Automatic Multipath Limiter. This algorithm operates in the sum/difference domain and automatically controls the amount of difference channel (L-R) amplitude as a function of the instantaneous sum channel (L+R) amplitude.

The purpose of this algorithm becomes clear when one realizes that a large amount of L-R is known to exacerbate FM multipath. We said "exacerbate" because a high level of L-R does not *cause* multipath. Rather, the behavior of a stereo receiver as it blends between stereo and mono becomes much more obvious when there is a large amount of L-R in the decoded audio because of the acoustical summation of L+R and L-R energy in the listening environment. When the L-R signal "goes away" during a receiver blend the perceived audio level drops and the larger the amount of L-R present when such a blend occurs, the more noticeable the multipath "event" will be to the listener.

When stereo enhancement is utilized in the program chain (or in the audio processor) L-R energy is naturally increased – this is the *purpose* of stereo enhancement – to exaggerate the stereo image width by increasing the level of L-R. When taken to the extreme however the extra L-R energy can cause either unnatural sounding audio on some program material (the hole in the middle effect), odd behavior in many stereo receivers, or both.

Another issue is that in FM broadcasting, each dB of L-R increase results in a like decrease in level in the L+R sum channel and it is this signal that is responsible for mono loudness. This is important to keep in mind when a fair percentage of the listening audience might be listening on mono receivers!

In order to make stereo enhancement "play nice" with the majority of stereo receivers in real-world listening environments with all types of program material, it is preferable to have some sort of controlling mechanism in place to "manage" the amount of L-R energy present in the transmitted signal as a function of program material. This is precisely what the Automatic Multipath Limiter does.

Multipath Limiter

The *Multipath Limiter* control can be set to off, or to values from 10% to 100% in 5% increments. Off is conveniently located at both extremes of the control range.

When in the Off position the Stereo Width Limiter is completely out of the circuit. When the control is at the 100% position the L-R may be permitted to achieve 100% of

the instantaneous L+R audio level. At lesser percentages the amount of L-R energy is constrained to that percentage of the L+R level at that instant.

A recommended setting for this control is 70%, which constrains the L-R to about 3dB below the L+R. With the Multipath Limiter at this setting it will almost never touch "normal" stereo program material – even when stereo enhancement is used. This is in contrast to a control in another audio processor that has static settings for Stereo, -3dB, -6dB, and Mono. In that product, setting the control to -3dB causes a *static* 3dB reduction in stereo separation on *all* program material regardless of whether it needs it or not. We believe our approach is better because it is intelligent. It does not decrease stereo separation on program material that does not need it.

Pilot Level

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

Pilot Phase

Small corrections to the 19kHz stereo pilot phase may be made in 0.5 degree steps up to +/-22.5 degrees. The ability to vary the stereo pilot phase relative to the 38kHz subcarrier allows AirAura X3 to compensate for nonlinear time delays in the transmission system. Such time delays skew the phase relationships between the 19kHz stereo pilot and the 38kHz stereo subcarrier and degrade stereo separation.

Stereo/Mono

The stereo encoder may be operated in Stereo or Mono simply by selecting the desired operating mode with this switch. In the Mono mode the Stereo Pilot is completely turned off.

ITU BS-412 MPX Power Controller

AirAura X3's *BS-412* Power Controller can be set to values in the range of -3.0dB to +10.0dB in 0.1dB steps, or can be set to off if the *BS-412* box is not checked. When the control is not Off it is measuring and displaying the current MPX Power level on the BS412 meter on the front panel and GUI. Calculated corrections to the MPX power are only made when the *BS-412* check box is checked, and when it is checked, modifications to the MPX power will take place immediately!

IMPORTANT!

The BS-412 MPX Power Controller's sole purpose is to reduce loudness and program density as required in certain European countries. If you are not required to use the BS-412 Controller do not check the *BS-412* check box. Turning on the BS-412 MPX Power Limiter can result in up to a 5dB loss in loudness.

TURNING ON THE BS-412 MPX POWER CONTROLLER

Any time the BS-412 MPX Power control is not set to Off, the algorithm is measuring and displaying the current MPX power on the front panel and GUI BS412 meters. The MPX Power controller is then engaged and the algorithm immediately applies the measured MPX Power correction to the processed output. After the MPX Power Controller is first engaged allow a full minute for the MPX Power to settle to its final value.

As the controller measures and integrates the MPX energy over time the drive to the processing will be modified until the measured MPX power satisfies the reference level as set by the Stereo Encoder menu's BS-412 control. The control's "0dB" setting conforms to the current ITU-R BS.412-7 Multiplex Power standard.

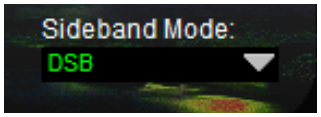
TURNING OFF THE BS412 MPX POWER CONTROLLER

The BS-412 Controller may be immediately taken off line by un-checking the *BS-412* check box.

IMPORTANT!

If your station is <u>not</u> required to comply with a Multiplex Power standard where it is licensed to operate, the BS-412 control should remain unchecked!

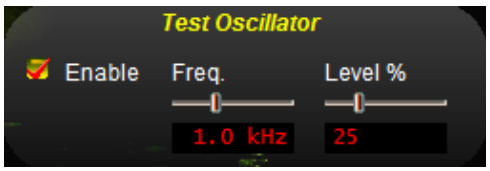
Sideband Mode



AirAura X3 is equipped with the ability to operate the multiplex generator in conventional double sideband suppressed carrier mode, or in one of two single sideband modes. The first mode, "SSB Hi-Res" operates with very high rejection of the upper sideband but adds some additional latency. The second mode, "SSB Low Latency" operates with lower latency and may be more suitable for off air listening for talent.

For more information about single sideband, and whether the technology could have any benefit in your situation, please feel free to reach out to us at 252-638-7000 or via email at techsupport@wheatstone.com.

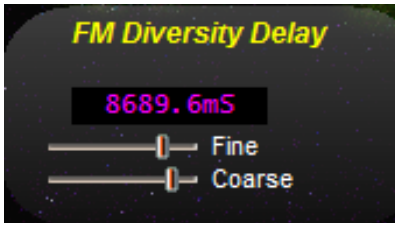
Test Oscillator



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 *Enable* check box is selected.

A special frequency, "Bessel," is included. This is a 31.250kHz test signal which can be used for modulation monitor calibration using the first Bessel null.

FM Diversity Delay



AirAura X3 is equipped with an internal digital delay to compensate for the corresponding delay in the analog signal path of stations using the HD Radio codec. The delay section is capable of providing up to ten seconds of compensating delay in steps of 100 microseconds.

When the FM Diversity Delay controls are both set to their minimum settings, OFF appears in the delay window to signal that there is no delay the FM signal path.

Adjustment of Diversity Delay

Front panel adjustment of the Diversity Delay using the trackpad has enough resolution to get the diversity delay in the ballpark, and finer adjustments (down to 100 microsecond steps) can be made using GUI to set the delay.

For best resolution of the Diversity Delay controls they are best adjusted using the host PC's keyboard and mouse and using the following table as a guide.

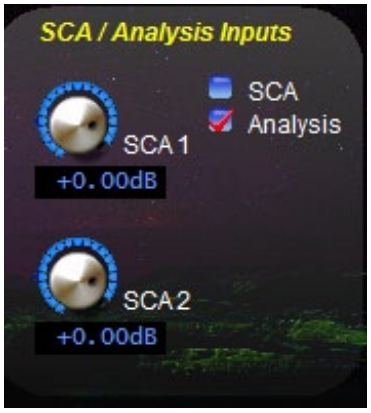
COARSE ADJUST SLIDER		FINE ADJUST SLIDER	
Slider only	500 mS	Slider only	0.9 mS
Slider plus Shift key	1700 mS	Slider plus Shift key	8.6 mS
Slider plus Ctrl key	50 mS	Slider plus Ctrl key	0.1 mS (100μSec)

Note that the smallest increment of delay time adjustment is 100 *microsecond*.

Entering Delay Values Manually

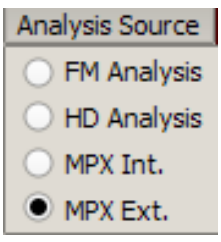
Double-clicking on the delay value window opens up a dialog where the numeric delay value in milliseconds may be entered. This is useful when you know roughly how much delay is required or wish to try various values quickly.

SCA / Analysis Inputs



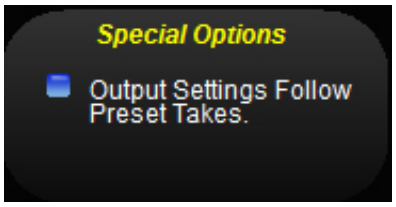
SCA inputs applied to the rear panel SCA connectors are high pass filtered to reduce hum and then low-pass filtered at 94kHz before being digitized at 192kHz. The *SCA 1* and *SCA 2* controls set the SCA injection levels and can be set to OFF, or to levels between -79.95dB and +10.0dB and in 0.05dB steps.

When *SCA* is checked, both SCA 1 and SCA 2 act as traditional subcarrier injection points. However, if *SCA Analysis* is checked, the input for SCA 1 acts as an input for monitoring an externally applied audio signal (including stereo MPX) using AirAura X3's analysis menus.



If using the SCA input in the analysis mode, you can monitor that signal by clicking the *Analysis* tab on the right side of the GUI and selecting *MPX Ext*. from the *Analysis Source* options.

Special Options



When the *Output Settings Follow Preset Takes* box is unchecked, recalling presets ignores the settings of the input and output level controls and other system controls associated with those functions. The following are considered to be AirAura X3 SYSTEM, or global, parameters, which are saved with presets but not restored when presets are taken, unless the *Output Settings Follow Preset Takes* check box is checked. When this box is checked, the following output control settings are recalled whenever a preset is recalled:

FM Output:	**Stereo Encoder:**
DeEmphasis	Pilot Level
PreDelay	Pilot Phase
Digital Output / bb192	SCA 1
	SCA 2
	TX 1
	TX 2
	BS412
	Pilot Only
	Analog - L/R, L/R Deemph

Composite MPX Outputs

The *TX-1* and *TX-2* level control sets the peak output amplitude of the MPX 1 and MPX 2 outputs on the rear panel BNC connectors respectively. These controls are used to set total modulation in the presence of audio and can be set to OFF or to levels between -23.95dB and +6.00dB and in 0.05dB steps. The control setting for approximately 3.5V P-P (1V RMS) into a 10k ohm load is +2.40dB.

If TX-2 *Pilot Only* is checked, the TX-2 output becomes a 19kHz sine wave synchronizing source for RDS generators.

FM Digital Output

The FM *Digital Output* control sets the absolute peak output level in dBFS after all processing.

The front panel and remote GUI bargraph meters display the peak output levels in dBFS.

The *Digital Output* control has an Off position and levels can adjusted in 0.05dB steps over the range of -79.95dB to +00.00dBFS.

Baseband192 and AES Modes

The FM Digital Output is switchable between two modes: Wheatstone baseband192 digital multiplex and standard left/right channel AES3. When baseband192 is selected the entire stereo multiplex spectrum appears in digital form at 192kHz at the FM Digital Output. FM exciters so equipped can utilize this signal for a virtually perfect handoff of processed audio to the exciter's FM digital modulator.

De-Emphasis

When *DeEmph* is checked the appropriate de-emphasis is applied to the FM digital output according to any pre-emphasis which may be in effect. If no pre-emphasis is being applied this check box has no effect.

PreDelay

When the *PreDelay* box is checked the digital FM output will always be sourced ahead of the FM Diversity Delay.

HD Digital Output

The HD *Digital Output* control sets the audio level at the Digital and Analog outputs of the HD processing in AirAura X3. There is no further processing after this point. The control range is -79.95dBFS to 0dBFS with 0.05dB increments allowing very fine settings of the maximum peak level into the next piece of equipment. Muting of the HD outputs will occur when this control is dialed fully counterclockwise and the display shows "Disabled."

L/R Reverse

The *L/R Reverse* check box allows the left and right channels of the Digital and Analog outputs to be swapped (left becomes right, right becomes left) which can be useful during troubleshooting equipment that is external to the AirAura X3.

Phase Reverse

Certain software versions within the iBiquity HD Radio system have an inadvertent signal polarity inversion putting the analog and digital signals 180 degrees out of phase resulting in audible flanging as the two signals crossfade in a listener's HD receiver. When the *Phase Reverse* check box is checked, it flips the polarity of the HD Radio AES/EBU output signal by 180 degrees to compensate for this anomaly.

Analog Output

In previous AirAura models the FM analog output could be either MPX or left/right audio. In AirAura X3 this has been changed so that it is now possible to have both MPX and left right audio present if needed. This is accomplished by adding a routing feature ahead of what used to be the dedicated HD analog output so that output may be used for FM or HD analog as needed. When FM is selected there are options present for de-emphasis and pre-delay as may be required for the individual needs of the installation.

The *Analog Output* control sets the audio level and employs a control range of -79.95dBFS to 0dBFS in 0.05dB increments. Below -79.95dBFS there is an OFF setting.

SYSTEM MENU

The *System* screen allows system-wide settings to be configured.

Metering Data Over TCP/IP

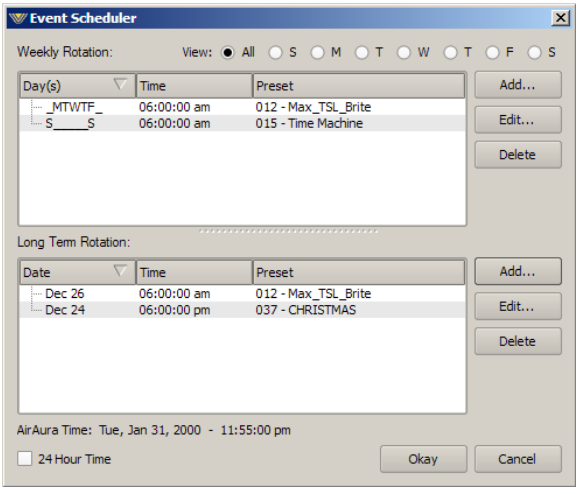
By default, AirAura X3 utilizes the UDP protocol for transmitting metering data to the remote GUI (The TCP protocol with its guaranteed accurate packet delivery is always used for control).

In some situations UDP packets are blocked by Internet Service Providers, and when this occurs the GUI can successfully connect to AirAura X3 but there is no visible metering data. Unless one can successfully convince the ISP to allow unsolicited UDP traffic on their network (doubtful) the solution is to utilize VPN Tunneling (which encapsulates all packets into TCP) or simply switch the AirAura X3 and its GUI to use the TCP protocol for metering. When the *Metering via TCP/IP instead of UDP* box is checked the TCP protocol is used for transmitting metering data instead of UDP.

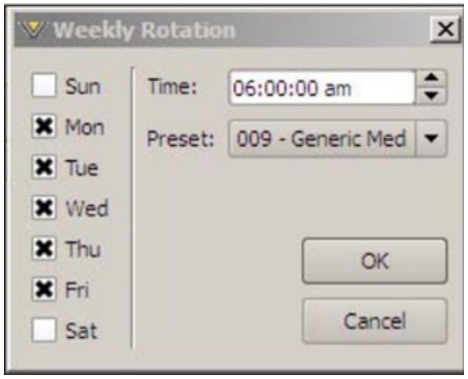
Scheduler

The AirAura X3 contains a comprehensive scheduling utility that allows presets to be automatically changed on desired dates and times. There is also a *Long Term Rotation* scheduler that allows preset changes to be scheduled for any time in the future. To create, edit, or view entries in the *Event Scheduler* click the *Scheduler* button on the *System Options and Status* section of the System Screen.

The *Event Scheduler* screen shown on the right will open and the events list will be empty when opened for the first time.



Creating a Weekly Rotation Schedule



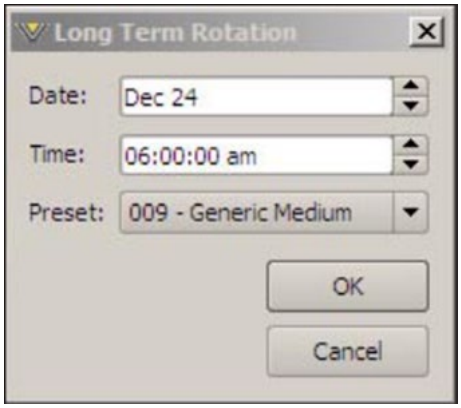
1. Click the *Add* button in the *Weekly Rotation* area of the *Event Scheduler* window. The *Weekly Rotation* window shown on the right will open.
2. On the left column, select the days that the preset should be selected. Any combination of check boxes may be chosen.
3. Next select the time that the 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 Schedule

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

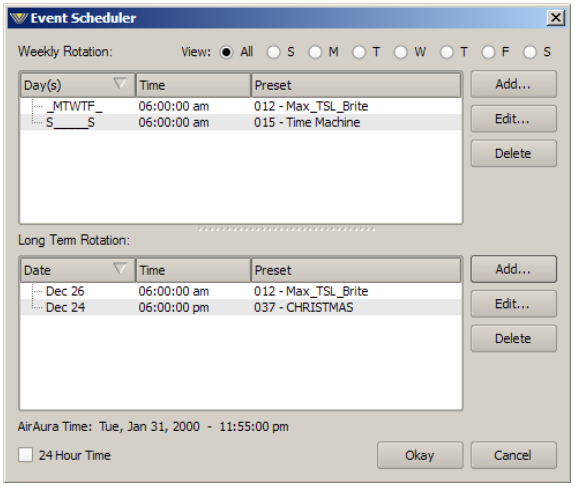


Deleting a Scheduled Event

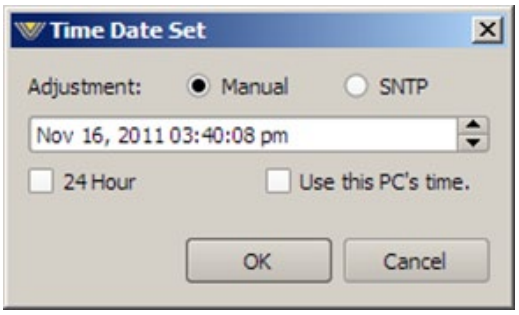
Deleting a scheduled preset change is as simple as adding one. Open the *Event Scheduler* window by navigating to the System menu and clicking *Scheduler*. The *Event Scheduler* window will open.

To delete an item in either the *Weekly Rotation* 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!



System Time



Allows the system time of the AirAura X3 onboard computer to be set or changed. The AirAura X3 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.

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.

Analog Input: Audio appearing on the analog line input.

Digital Input: Audio appearing on the AES3 digital input.

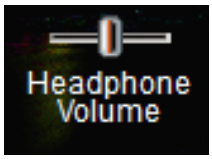
HD Output: HD output of the processing chain.

FM PreDelay: Output of the FM limiter before the diversity delay.

FM Output: FM output of the processing chain.

NOTE: The AirAura X3 headphone routing selector allows you to monitor an unselected audio input *without* having to put it on the air. This can be handy for confirming that an audio source is present without actually switching to it!

Headphone Control

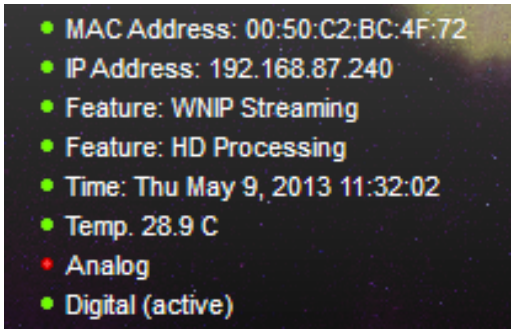


On the left side of the front panel of the AirAura X3 is a quarter inch female TRS jack for headphone use. The volume control for the headphone output is located on the lower right side of the Pro GUI.

To adjust the headphone volume slide the fader right to increase volume and left to decrease it.

Note: The headphone outputs of the AirAura X3 are driven by National Semiconductor LM675 power operational amplifiers capable of >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!

Status Indicators



MAC Address – Shows the unique MAC (media access control) address for the hardware.

IP Address – Shows the Hardware IP address (the IP address your GUI should connect to).

Features – Denotes if the HD and/or WheatNet-IP features are operating in the processor.

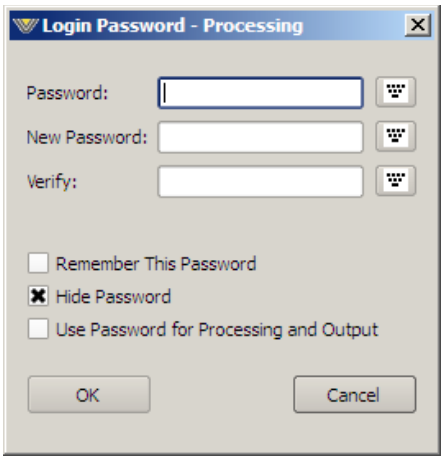
Time – Shows the system time and date (24 hour clock).

Temp – Indicates the internal temperature of the AirAura X3 (in Celcius).

Analog/Digital – The active mode is indicated by the "(active)" text next to the mode. A red dot indicates no audio is present at the input of that mode.

Device Access

It is possible to separately lock the Processing-related functions and those associated with Output functions such as stereo generator settings and output levels. Each may have its own passcode or they may share the same passcode at the user's discretion. The reason for this functionality is to give stations who must cooperate with a designated transmission authority the ability to adjust their processing in any way they choose without giving the transmission authority access to the processing functions. Likewise it allows the transmission authority to manage "regulatory" things such as modulation levels, without giving the station personnel access to the output controls.



There is no default password in the AirAura X3. If you are setting this up for the first time, you can skip the *Password* part and just enter the *New Password* and *Verify* the new password.

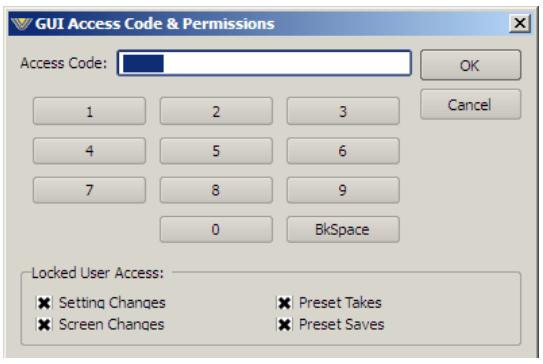
Other options in this menu include the ability for the PC to remember the password for the processor, to hide the password as you type it (with dots instead of the actual characters) and the ability to gang the password for both the processing and output options.

When access is restricted, only the *System* tab will be allowed to be viewed. If you try and access another tab, you will be prompted to input the proper password that covers the functions in that tab.

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 AirAura X3. Click the *SECURITY* button. 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* 0000 is created with *Preset Takes* being the only box checked. This means that a person assigned access code 0000 can *only* take presets.
- Suppose *Access Code* 5678 is created with *Preset Takes* **and** *Setting Changes* both checked. This means that a person with access code 5678 can not only *take* 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 GUI security has been enabled by configuring the *GUI Access Code and Permissions* Dialog (above), then selecting *GUI Lock* will prompt the user for confirmation and for the assigned passcode. The GUI will not lock or unlock if no passcode or the incorrect passcode is entered.

AirAura X3 security is accomplished via cooperation between the hardware and the GUI software, and on several different levels. In other words, the hardware is "aware" of when the GUI has been assigned a passcode, which type of passcodes have been assigned and will not lock or unlock unless certain conditions have been met.

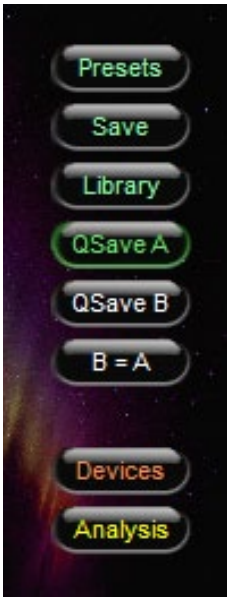
Wheatstone factory assistance will be required if the I/O or Processing passcodes have been lost because this access is very tightly controlled on the hardware itself. GUI access on the other hand, which it does interact with the hardware, is designed to follow less restrictive rules and its security can be overridden in the field if necessary. The following steps explain how to do this:

1. Make sure that the GUI is not currently running on the host PC. If it is, please shut it down (not minimize, exit!).
2. Depending on the Windows operating system being used, browse to the logged on user's Documents or My Documents folder.
3. Locate the Wheatstone folder and open it.
4. Locate the AirAura X3 folder and open it.
5. Locate and delete the *airaurapro.ini* or *airauraguru.ini* file.
6. Locate the Maps folder and delete it.
7. Restart the GUI.
8. Open the *Devices* configuration dialog.
9. Recreate any device configurations that are now missing.
10. Highlight the desired device and click the *Select* button.
11. Click the *Close* button.
12. Click the GUI's *Online* button – the GUI should connect to the AirAura X3.
13. Navigate to the GUI's System page.
14. Click on the *SECURITY* button.
15. Check which of the four desired functions are to be locked, assign a *New* passcode and click *OK*.
16. The new passcode is now active.

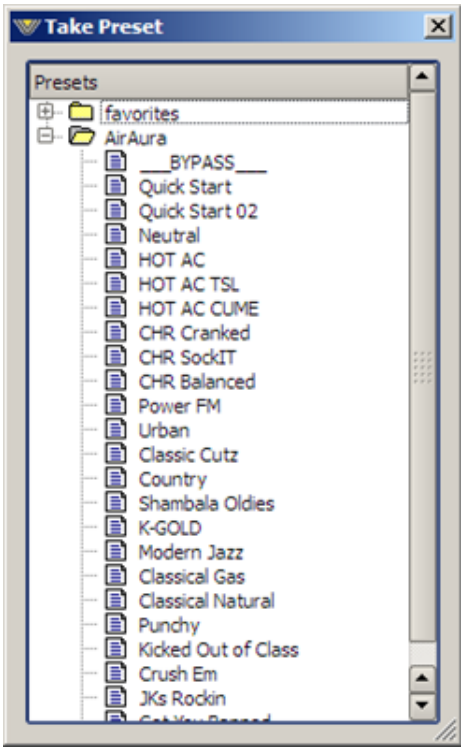
Please call or email Wheatstone technical support if you cannot resolve a locked out GUI after following the above steps.

Side Bar Region

To the right of the control area is a vertically disposed row of buttons. We will explain each button in turn.



Presets



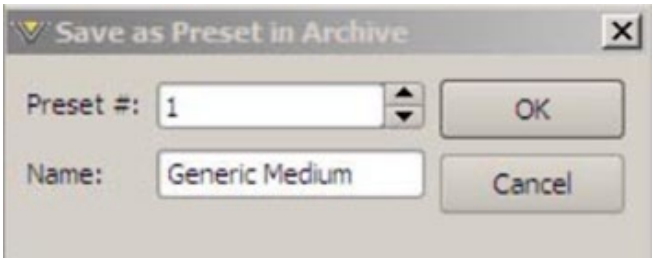
When left-clicked, a dialog box appears, showing folders that contain presets, typically favorites, and AirAura X3, which lists all presets stored on the hardware.

Double-clicking on a preset brings it immediately into use in the AirAura X3. 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 AirAura X3 from this dialog box.

Save

Clicking on the *Save* button opens a dialog box (shown on the right), prompting the user for a name for the preset being saved. The preset will be saved into the next available empty slot unless another empty slot is chosen by nudging the preset number (*Preset #*) up or down. Note that it is possible to save the present settings in over an existing preset and doing so erases the previous preset's contents.



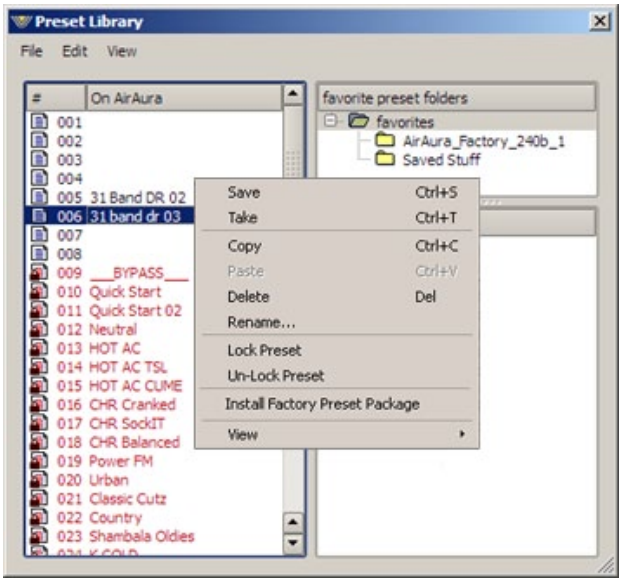
Factory presets are protected from being inadvertently overwritten.

Library

When the *Library* button is pressed a window-style dialog box appears containing three panels. The large panel on the left shows the presets currently stored on AirAura X3.

The upper right panel shows the preset folders on the PC hosting the GUI, and the lower panel shows the presets stored in the folder chosen in the above panel.

Normal windows-style drag-and-drop functions allow presets to be freely moved between the hardware and the PC and vice versa. Note that when preset are moved this way, it is copies of presets, not the presets themselves which are moved. The original preset always stays where it was stored last.

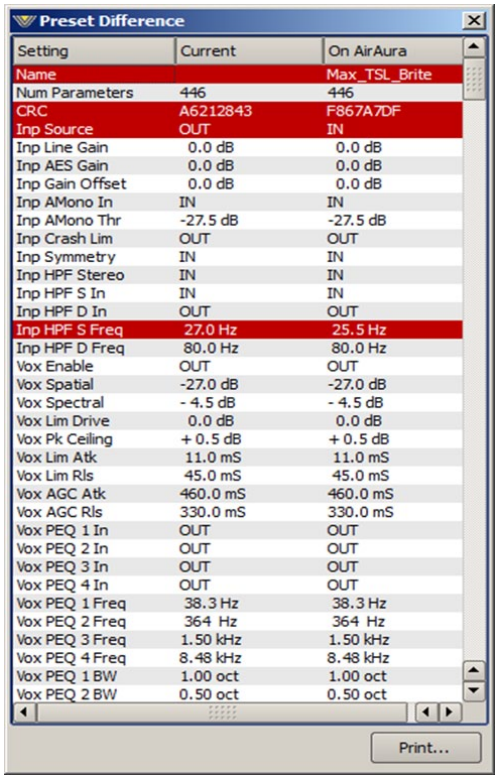


Locking Presets

Presets stored on AirAura X3 may be locked by the user to prevent inadvertent overwriting, renaming, or deletion. This is accomplished by opening the *Preset Library* by clicking on the *Library* button in the GUI. Once the list of presets is open, the ones actually stored within the processor hardware itself will be visible in the left pane.

There are two ways to manage the lock status of user presets:

- The first method is by highlighting a preset (single left click) and then right clicking it to open a dialog box. Among the options are Lock Preset and Unlock Preset.
- The second method is by highlighting a preset as above, and then clicking the *Edit* option at the top of the *Preset Library* dialog box to reveal the Lock Preset/Unlock Preset options. Note that these are user-level lock options and therefore cannot be used to override the lock status of a factory-locked preset!



How to View Preset Changes

It is possible to visually compare two different presets on the AirAura X3 with a special feature called Preset Difference.

When the *Library* tab is opened, highlight any preset you'd like to compare with the current preset running on the processor. Then right click and select *View* and *Diff* from the sub-menu. You will see the window on the right open.

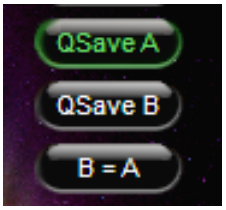
Any parameter that is listed with a RED background indicates a parameter that is different between the preset running on the hardware and the preset that has been highlighted. Parameters which are not highlighted have the same values between the two presets.

Devices

Clicking on the *Devices* button opens a list of AirAura X3 devices known to the GUI (if any). Highlighting the desired AirAura X3's name and hitting *Select* causes the GUI to attempt to connect to it if you are Online.

In the event no AirAura X3's are listed yet, or a new one needs to be added, clicking the *Add* button brings up a small *Edit Device* dialog box which asks for the new prospect's name and IP address.

Quick Save (QSave)



The AirAura X3 has a unique feature that allows instant comparison of work in progress to a known reference, such as another preset, or some midpoint while adjustments are being made. We call this feature **QSave** (for **Quick Save**).

In the upper right side of the AirAura X3 Pro GUI you'll find three buttons like those shown on the right.

QSave A and *QSave B* represent two temporary memory buffers that hold all current AirAura X3 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 AirAura X3 are being concurrently saved to temporary buffer *A*.

QSave B operates on buffer *B* and just like *QSave A* its being selected is shown by a green highlighting.

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

- 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 *A* and *B* buffers are identical.
- Change some settings on the AirAura X3 and they 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 preset *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:

- Load the preset that you want to change, make changes to it, and press *QSave A* to save those settings to buffer *A*.

- Make some additional changes and then press *QSave B* to save those additional changes to buffer *B*.
- Now buffers *A* and *B* have your two different settings. You can compare them 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 AirAura X3 Pro GUI screen (in line with the *Wheatstone AirAura X3* product label to the left, and the Windows About, Minimize, and Exit icons to the right) are indicators and controls for the management of devices and presets. The AirAura X3 Pro GUI is capable of controlling multiple AirAura X3 units (*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.

Status

This indicator shows four different statuses:

Online – The GUI is in communication with and directly reflects an AirAura X3.

Offline – The GUI and AirAura X3 are disconnected.

Trying – The GUI is attempting to find the AirAura X3 on the LAN and connect to it.

Pending – The GUI has found the AirAura X3 and is trying to complete the connection.

An adjacent and illuminated button toggles between *Online* and *Offline*.

Device

The name of the AirAura X3 to which the Pro GUI is connected (or with which it is attempting to connect) shows in the *Device* window in amber text.

Double-clicking on the name area brings up the *Devices* dialog box. A list of AirAura X3 devices that the GUI knows about is shown in the box. Highlighting the desired AirAura X3's name and hitting *Select* causes the GUI to attempt to connect to it if the *Online/Offline* button is green (Online).

In the event no AirAura X3 units are listed, or one is adding a further device, or one for the first time, *Add* brings up the *Edit Device* dialog box, which asks for the new prospect's name and IP address.

Current Preset

The *Current Preset* window shows the current preset that is active on the processor.

When preset name is displayed in GREEN text the currently running preset reflects exactly what has been last saved to that preset and that no changes have been made.

When the preset name is showing in RED text, the current preset has been modified and is not saved on the AirAura X3 hardware. In order to return the preset name text to GREEN, the modified preset must be saved, or a new preset has to be retaken from the list of saved presets.

As covered earlier (page 4-67), it is possible to visually compare two different presets on the AirAura X3 with a special feature called Preset Difference.

When the *Library* tab is opened, highlight any preset you'd like to compare with the current preset running on the processor. Then right click and select *View* and *Diff* from the sub-menu. You will see the window on the right open.

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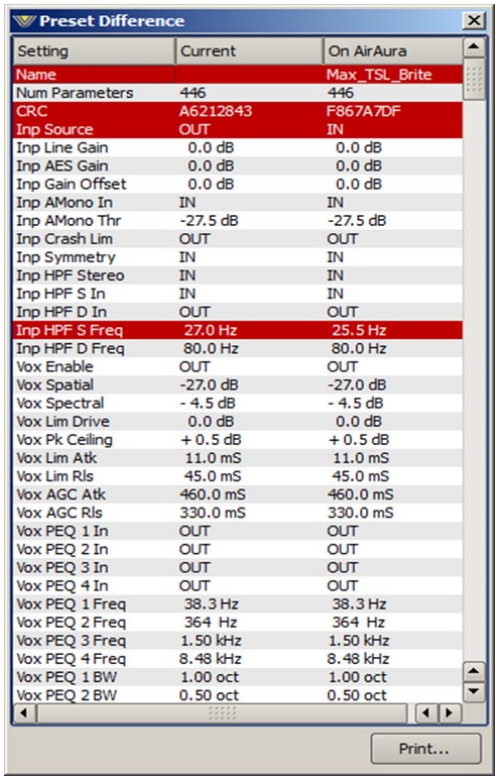


Setting	Current	On AirAura
Name		Max_TSL_Brite
Num Parameters	446	446
CRC	A6212843	F867A7DF
Inp Source	OUT	IN
Inp Line Gain	0.0 dB	0.0 dB
Inp AES Gain	0.0 dB	0.0 dB
Inp Gain Offset	0.0 dB	0.0 dB
Inp AMono In	IN	IN
Inp AMono Thr	-27.5 dB	-27.5 dB
Inp Crash Lim	OUT	OUT
Inp Symmetry	IN	IN
Inp HPF Stereo	IN	IN
Inp HPF S In	IN	IN
Inp HPF D In	OUT	OUT
Inp HPF S Freq	27.0 Hz	25.5 Hz
Inp HPF D Freq	80.0 Hz	80.0 Hz
Vox Enable	OUT	OUT
Vox Spatial	-27.0 dB	-27.0 dB
Vox Spectral	- 4.5 dB	- 4.5 dB
Vox Lim Drive	0.0 dB	0.0 dB
Vox Pk Ceiling	+ 0.5 dB	+ 0.5 dB
Vox Lim Atk	11.0 mS	11.0 mS
Vox Lim Rls	45.0 mS	45.0 mS
Vox AGC Atk	460.0 mS	460.0 mS
Vox AGC Rls	330.0 mS	330.0 mS
Vox PEQ 1 In	OUT	OUT
Vox PEQ 2 In	OUT	OUT
Vox PEQ 3 In	OUT	OUT
Vox PEQ 4 In	OUT	OUT
Vox PEQ 1 Freq	38.3 Hz	38.3 Hz
Vox PEQ 2 Freq	364 Hz	364 Hz
Vox PEQ 3 Freq	1.50 kHz	1.50 kHz
Vox PEQ 4 Freq	8.48 kHz	8.48 kHz
Vox PEQ 1 BW	1.00 oct	1.00 oct
Vox PEQ 2 BW	0.50 oct	0.50 oct

Notes on Online and Offline Working

Often it will be required that the Pro GUI act directly and instantaneously upon AirAura X3 when a preset is selected. This is the *Online* mode.

Offline, however, is more of a management utility intended for creating presets or tweaking them without needing to listen to them on the host AirAura X3.

Changes can be made to presets and configurations without affecting the sound of the processing occurring within AirAura X3.

Importantly, any adjustments made on the GUI *Offline* will not take effect until the preset changes have been saved, AirAura X3 is *Online* to the GUI again, and the preset is made active by selecting it.

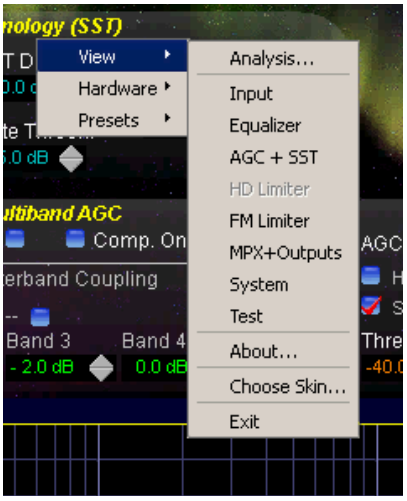
Invoking a preset – by double-clicking a preset from the box brought up by clicking the *Presets* button – does one of two things, depending on whether the Pro GUI is in *Online* or *Offline* mode:

- *Online* – the double-clicked preset is immediately sent to the AirAura X3 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 AirAura X3's audio.

Accessing Menu Options

Right clicking anywhere on the AirAura X3 Control Panel will open a pop up menu tree with access to *View*, *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 AirAura X3 control panel. As with many Windows programs, the Pro GUI has multiple ways to access menu trees – go ahead and explore!

View Menu Items



The *View* menu tree may be accessed by right clicking anywhere on the main AirAura X3 Control Panel.

Analysis... – The AirAura X3 Pro GUI offers the same analysis options as the Guru GUI. You can access these analysis features by clicking *Analysis*.

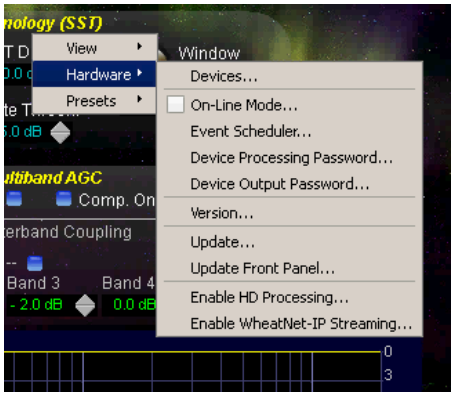
The next set of options in this window (*Input – System*) correspond to the tabs along the top of the GUI. This is just another place to access those options.

About – Brings up the *About* box to indicate the GUI's software version. Note this is not where the firmware versions running on the hardware are polled. That is done under the *Hardware* option covered in a moment.

Choose Skin... – Brings up the *Choose Skin* dialog box. In some GUIs there are multiple skins available which allow the user to pick different color schemes and such. Not all GUIs have multiple skins but many do.

Exit – Closes down (exits!) the entire Pro GUI (not just the dialog window).

Hardware Menu Items



The *Hardware* menu tree may be accessed by right clicking anywhere on the main AirAura X3 Control Panel. Please note that most of the Hardware-related items require you to be connected (Online) to an AirAura X3 because that is where the data must come from. Sub menu choices include:

Devices... – Opens the *Devices* dialog box. Allows the creation, editing, selection, and deleting of Wheatstone processors connected to your system.

On-Line Mode... – Toggles between ONLINE and OFFLINE modes. This state is also remembered when the GUI is closed – if it was online to AirAura X3 at the time it will attempt to go back online the moment the GUI starts up next.

Event Scheduler... – Opens the *Event Scheduler* dialog box for editing Events.

Device Processing Password... – Allows the user to access the processing function tabs with the correct password.

Device Output Password... – Allows the user to access the MPX/Output function tab with the correct password.

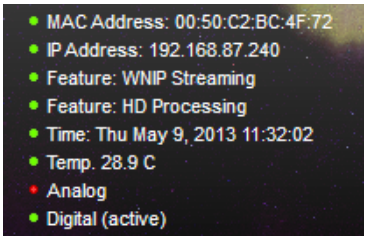
Version... – Displays the current software and firmware versions running in the AirAura X3 hardware.

Update... – Opens the *Choose a file to download* dialog box. Only valid files of type **.vbn* are visible. See below.

Update Front Panel... – Opens the *AirAura X3 Front Panel GUI Loader* dialog box. Only valid Wheatstone files of type *.lbn will be visible. See below.

Enable HD Processing… – Opens up a dialogue box to input a key to enable the HD processor (for hardware units that do not have the processing enabled as shipped from the factory or due to upgrade). Please contact Wheatstone Technical Support at 252-638-7000 Monday thru Friday from 8:30am to 5:30pm or at techsupport@wheatstone.com for more information, and please have your unit's MAC address handy.

Enable WheatNet-IP Streaming… – Opens up a dialogue box to input a key to enable WheatNet-IP capabilities in the processor (for hardware units that do not have this feature enabled as shipped from the factory or due to upgrade). Please contact Wheatstone Technical Support at 252-638-7000 Monday thru Friday from 8:30am to 5:30pm or at techsupport@wheatstone.com for more information, and please have your unit's MAC address handy.



If either of the above options are grayed out, this means that these functions are active in your hardware. You can also check the STATUS options under the SYSTEM tab to see if these options are active.

New or updated AirAura X3 software may be released at any time to implement new features, change specifications or correct known bugs. The Hardware Update/Update Front Panel choices will open separate dialog boxes which will prompt the user for the correct file type to be uploaded to AirAura X3. Upon completion of the update you will be asked to restart AirAura X3 (cycle its power).

AirAura X3 Hardware Update

The AirAura X3 is extremely easy to update when new firmware becomes available from Wheatstone. As mentioned above there are two different file types involved in updating AirAura X3. They are:

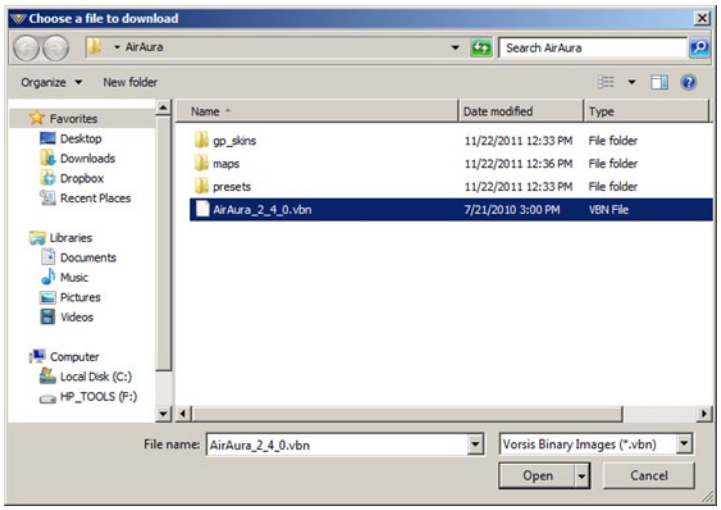
The VBN file – *VBN* stands for "Virtual Binary Nugget." This file contains main board application code, FPGA images, and DSP code.

The LBN file – *LBN* stands for "Linux Binary Nugget." This file contains the front panel GUI application code, Guru GUI operating parameters, and skin files for the front panel graphics display.

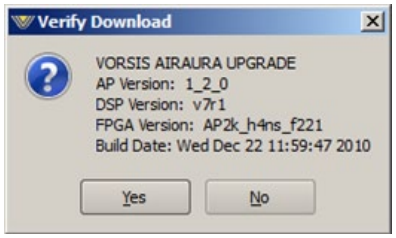
VBN and LBN file updates may be performed separately, or they may be performed together if updates for both sections of the AirAura X3 have been made available.

Before performing updates to the AirAura X3 make sure an auxiliary processor is available for when AirAura X3 needs to be rebooted after the upgrade as there will be 15-20 seconds of silence until AirAura X3 reboots. Alternately perform the upgrade at a time when you can temporarily remove audio from the air without it being an issue.

To update the AirAura X3, right click on any portion of the upper control area in any screen of the remote GUI to open pop up menu tree. For VBN updates of the motherboard, select the *Hardware Update…* option listed above the *Update Front Panel….* The screen at right will appear.

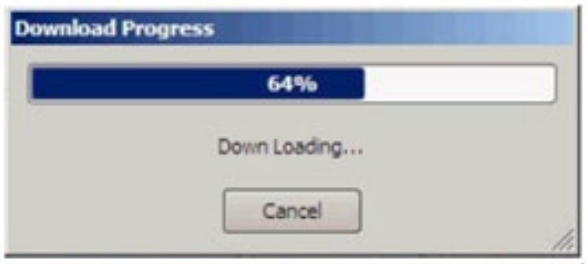


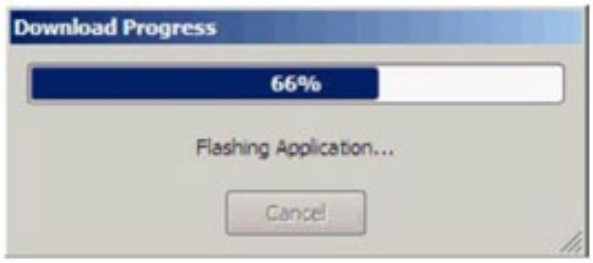
Navigate to the location of the VBN file that was downloaded from the Wheatstone Processing website or, if a new GUI version was just installed, the VBN that was unpacked during its installation. Verify that the version number is correct in that it matches the version number listed in the documentation about the firmware upgrade. If so, select the *Open* option in the *Choose a file to download* window. The prompt shown at right will appear with wording of the text varying according to versions to be uploaded.



Recheck that the versions match the documentation! Then click *Yes*.

Progress boxes will pop up as the download progress occurs:





When the system has finished downloading, you will get a prompt to reboot the AirAura X3.

After AirAura X3 reboots the new VBN code will be running on the motherboard.

Front Panel LBN Updates

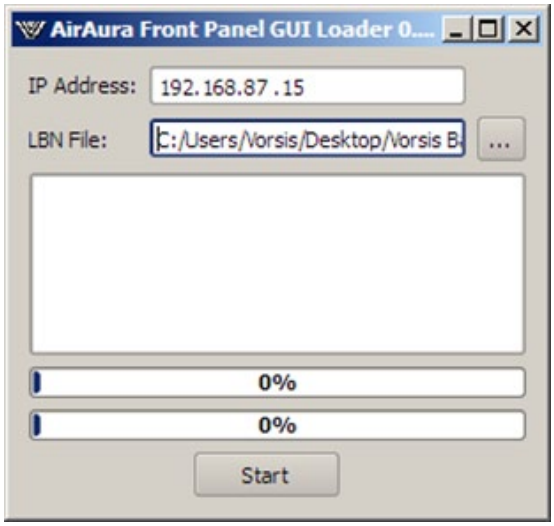
For LBN updates of the Front Panel, select *Update Front Panel…* and the screen on the right will appear.

Notice that the *IP Address* field is blank. This must be filled in to agree with the **Front Panel IP** address of your AirAura X3 as it is currently configured. This information is available on the front panel of the unit itself. Use Right Click/File/Settings on the front panel itself to locate this data.

Next, click on the … button at the right end of the *LBN File*: field to navigate to the location of the LBN file. Verify that the version number is correct and matches the version number listed in the documentation received about the firmware upgrade. The file has a . *lbn* extension. Please make certain this is the case before proceeding.

If the information is correct, select the *Open* option in the *Choose a file to download* window. The following dialog box will appear:

When ready to begin the update process, click the *Start* button at the bottom.



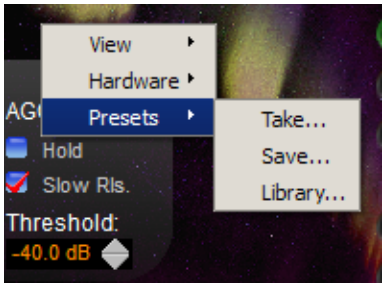
It is important to NOT interrupt the upgrade process by any means while it is in progress!!

VBN/LBN Updating Sequence

The VBN and LBN updates, while separate update processes, may be completed in any order and/or at the same time before rebooting the AirAura X3 once to bring all the updates into effect. For instance, you could perform the VBN update and then, when prompted to reboot, not reboot, and perform the LBN update instead, and THEN reboot after that process has completed.

You may also delay rebooting AirAura X3 until any convenient time. After the VBN and LBN uploads, the updates are securely stored in flash memory and won't take effect until the next reboot.

Presets Menu Items



The *Presets* menu tree may be accessed by right clicking anywhere on the main AirAura X3 Control Panel.

Take... – Brings up the *Take Preset* dialog box.

Save – Brings up the *Save as Presets* dialog box.

Library... – Brings up the *Preset Library* dialog box.

These dialogs replicate those accessible using the so-labeled buttons on the GUI itself. The right click menu structure is simply another way to get there from here…

Appendices

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Appendix I

Appendix A

Contents

Wired Ethernet Configuration

Factory Default Configuration

AirAura X3 requires *two* IP addresses – one serves the main DSP board and the other serves the microcontroller that operates the front panel. Ethernet was used for the DSP to front panel communications interface because of its speed over, for instance, a serial connection, a tremendous benefit when calculating and displaying the high resolution graphics required by the AirAura X3's front panel.

AirAura X3 hardware is factory preconfigured to the following network settings:

Main DSP Board IP Address	192.168.1.200
Front Panel Controller IP Address	192.168.1.201
Gateway	192.168.1.1
Subnet Mask	255.255.255.0

Changing the AirAura X3's wired Ethernet interface is a simple process; however two considerations must be kept in mind when doing so.

1. The Main DSP board and the front panel *must* be on the same network subnet. In other words, if the Main DSP board has been assigned an IP address of 109.16.77.200, then the front panel must also have an IP address assigned to it that is in the range *between* 109.16.77.1 and 109.16.77.254 in order to enable communications between them.

NOTE: We do not recommend using a **.0** or **.255** address!

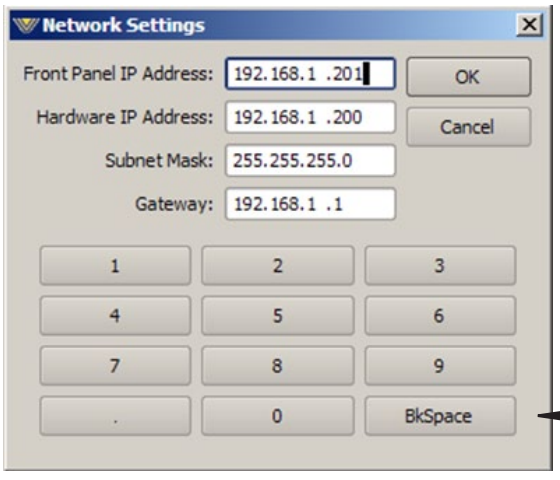
2. The two rear panel RJ-45 connectors share the wired side of the wireless interface which is connected to the same internal Ethernet switch IC as the Main DSP board and the front panel. Therefore, if the Main DSP board and front panel IP addresses are changed, the wired side of the wireless interface must also be reconfigured in order for wireless to work. Please see **Appendix D** for the procedure for reconfiguring the wireless interface.

Changing the Configuration

To change the IP address and network configuration of the AirAura X3's Main DSP board and front panel interface the features built into the front panel may be used. Using the front panel trackpad place the cursor on the left display. Then using the rightmost illuminated front panel "V" button click the button to bring up the View/Hardware dialog.

Within that dialog, select the Hardware/Network Settings option and the dialog box shown on the right will appear.

Next, using the *BkSpace* (backspace) button of the numeric keypad, backspace over any unneeded entries in the *Front Panel IP Address* field.



Next, using the numeric keys, enter the new IP address for the front panel, noting that we usually assign it the next highest IP address above the hardware address though this isn't really necessary as long as the two addresses used are in the same network addressing range.

Next, use the backspace key to erase any undesired characters in the *Hardware IP Address* field. Then, using the numeric keys, enter the new Hardware IP Address.

Use the same procedure to reset the Subnet Mask and Gateway settings to those appropriate for your network.

Once this has been done, click on the *OK* button and the new settings will be stored by the AirAura X3. When the "You must reboot for the changes to take effect" message appears, wait 15 seconds and then reboot the AirAura X3 by removing its AC power for a few seconds and then reconnecting it. Once AirAura X3 finishes booting up it will be operating on the new network settings.

If, after the AirAura X3 boots up the front panel is not showing activity, re-check the network settings to ensure that they are what you expect them to be. If the Main DSP board and front panel are on different network address ranges they will *not* be able to communicate.

Appendix B

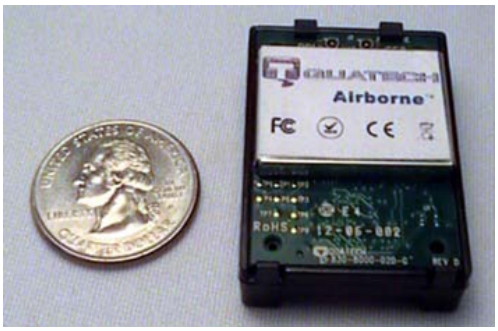
Contents

Wireless Ethernet Configuration

Introduction

AirAura X3 utilizes an industrial grade off-the-shelf hardware solution for its wireless interface. The benefits of using a ready-made wireless device instead of "rolling our own" are many, the most salient of them is us being released from the tedious task (and high cost) of having an RF-based design tested and approved by myriad various worldwide regulatory agencies.

The device we chose for AirAura X3 is manufactured by Quatech of Hudson, Ohio USA, model number WLNG-ET-DP501 and is shown in the photo below.



This device is a wired to wireless Ethernet bridge. Ethernet bridges incorporate Network Address Translation, or NAT, into their router schemes in order to be able to sort out traffic to/from the two sides of the bridge. The module is compliant with NAT3 standards.

NAT *requires* that the IP addresses on each side of the interface be *different* so that it knows what data to forward to which port. Note that the factory default IP addresses for the remote GUI are *different* for AirAura X3's wired and wireless interfaces. According to NAT rules, this is a *must*!

The wireless interface is equipped with two diversity antennas in order to provide maximum operational range. The antennas supplied with the AirAura X3 product are type approved for use with the module.

The module supports worldwide WiFi frequency bands and channel assignments. The frequency band to use can be configured within the web-based configuration dialog by selecting the region where the module will be used.

Selecting a region automatically brings up the correct frequencies and channels approved for use in that region.

As shipped from our factory the module is configured to use the United States approved frequency bands but may be factory configured to utilize other bands upon request.

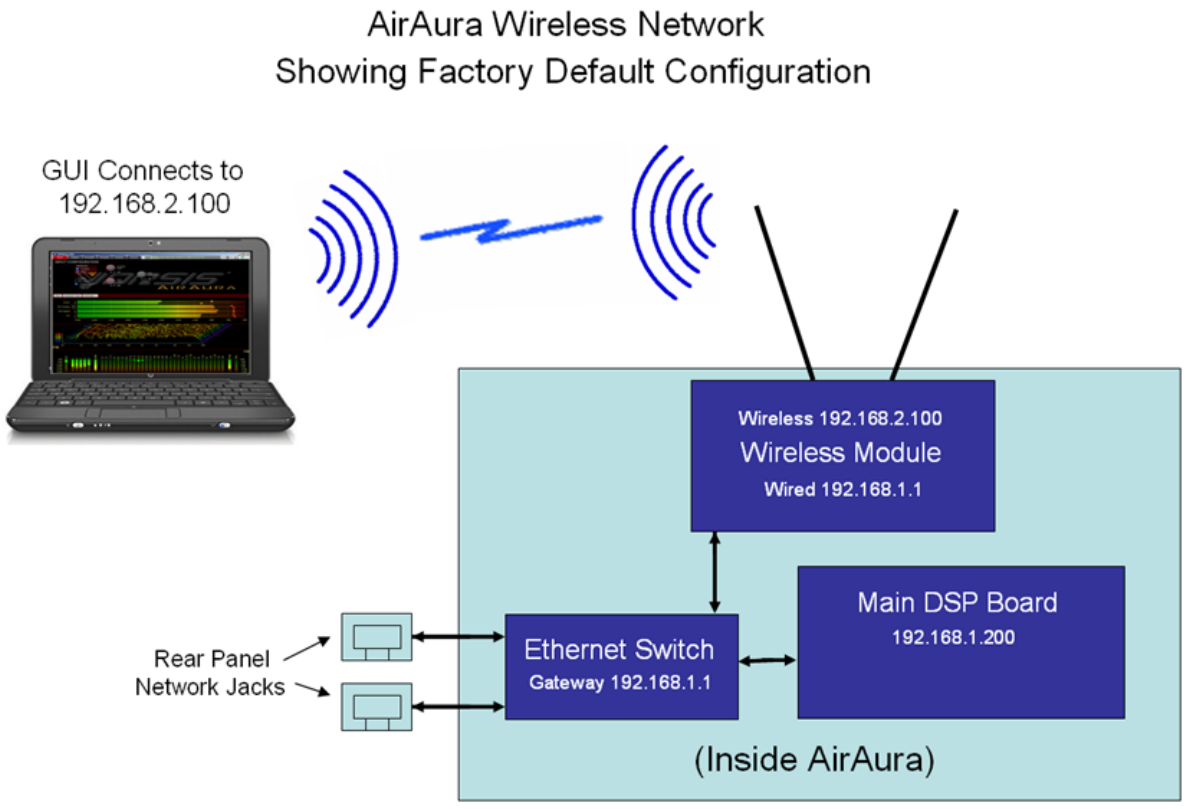
Factory Default Configuration

The following are the Wheatstone factory defaults for the most important parameters of the module's basic configuration.

Wireless LAN Connection Type:	AdHoc
Wireless LAN Channel:	1
SSID:	AIRAURA
Wireless Data Rate:	Auto
Wireless LAN Region:	United States
WLAN Security:	Disabled
WLAN DHCP:	Disabled
WLAN Static IP Address:	192.168.2.100

WLAN Subnet Mask:	255.255.255.0
WLAN Gateway Address:	192.168.2.110
Ethernet DHCP:	Disabled
Ethernet Static IP Address:	192.168.1.200
Ethernet Subnet Mask:	255.255.255.0
Ethernet Gateway IP Address:	192.168.1.1 ** (see notes)
Ethernet Role:	Router
MAC Cloning:	Disable
Ethernet Port Speed/Duplex:	Auto-negotiate

The block diagram shown below illustrates how the remote GUI and AirAura X3 communicate with each other via the wireless interface.



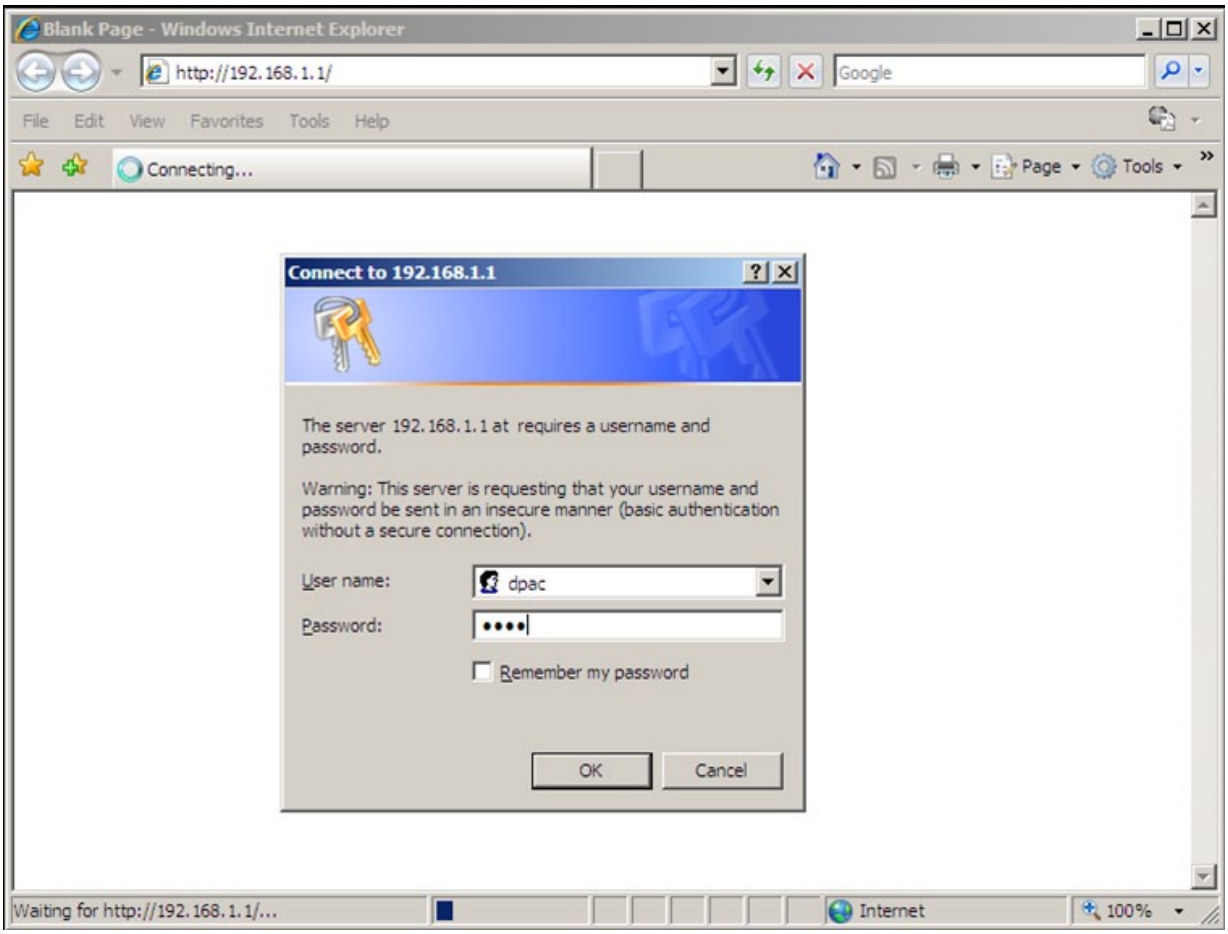
In most circumstances it is not necessary to reconfigure the wireless side address (the 192.168.2.100 address that the remote GUI uses to connect via wireless) because it is the wired side of the interface that is normally attached to a station's local area network.

An important concept to remember about how the wireless module functions is that the Ethernet IP address of the module isn't its IP address – it's the IP address to which packets received on the wireless side are forwarded to.

Also, the Gateway address of the module's wired side is the IP address that a web browser should be pointed in order to log in and modify the module's networking configuration.** (see notes)

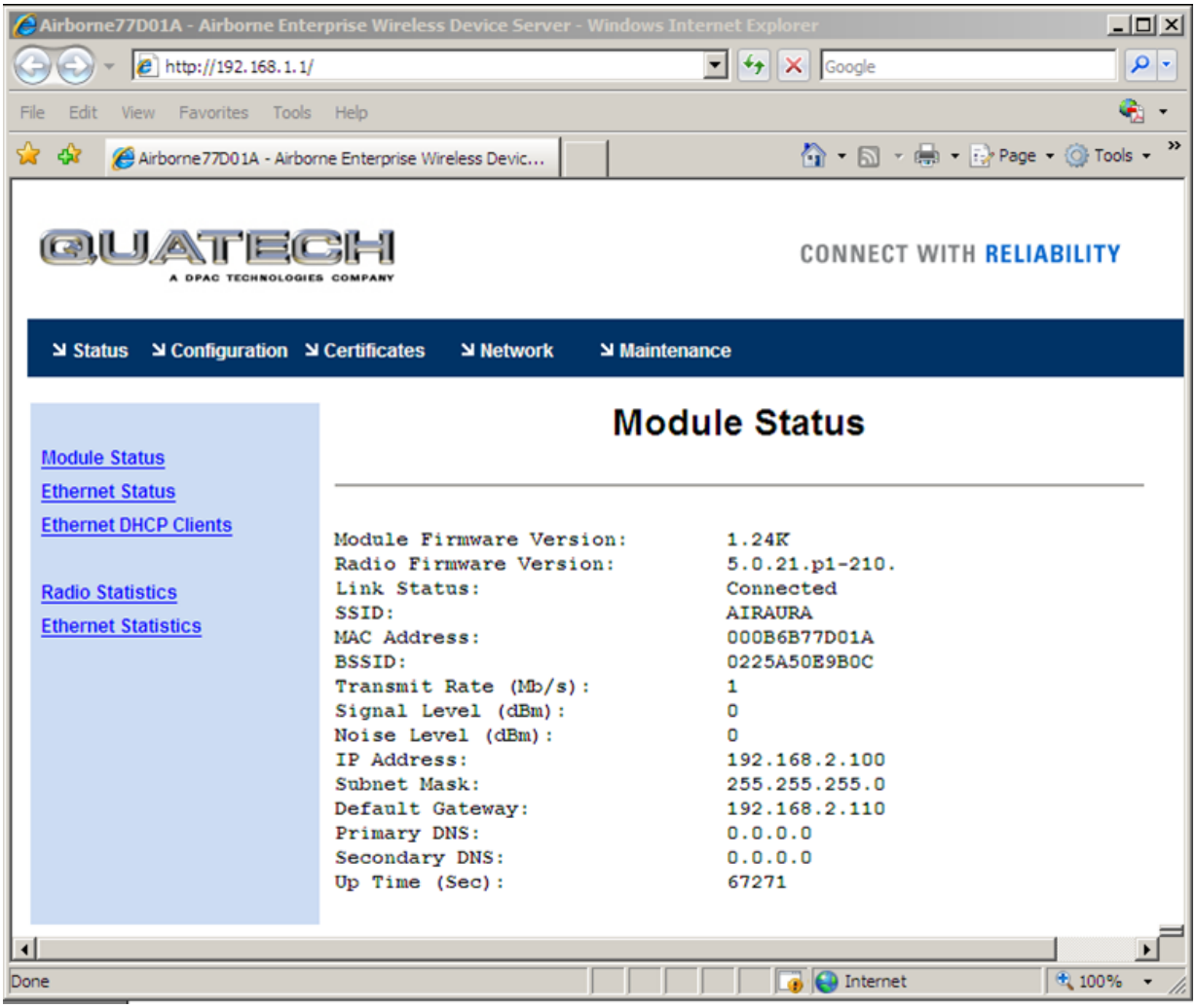
Changing the Configuration

With the AirAura X3 directly connected to a PC that is not connected to any external wired networks, open a web browser and enter the IP address of 192.168.1.1 in the URL address field (see below).



At the login prompt, enter the credentials "dpac" for the User name and "dpac" for the Password – both are lowercase.

Once valid credentials are entered and the *OK* button is pressed, a module status page should appear:



In the selection bar above the words *Module Status* are options for investigating or changing the characteristics of the module. We are concerned only with the option called *Configuration* at this time. Click this item to select it.

When the configuration page loads, select the item called *Network Settings* in the left column. Also, unless security or the operational region needs to be changed we are only concerned with the following entries on the *Network Settings* page – the Wheatstone factory defaults are shown here.

WLAN Static IP Address:	192.168.2.100
WLAN Subnet Mask:	255.255.255.0
WLAN Gateway Address:	192.168.2.110
Ethernet Static IP Address:	192.168.1.200
Ethernet Subnet Mask:	255.255.255.0
Ethernet Gateway IP Address:	192.168.1.1 ** (see notes)

If the IP addresses of the AirAura X3 are modified to be compatible with the local network and that IP address scheme is different from our factory defaults, the IP address of the wired side of the wireless module must also be changed.

For instance, if the AirAura X3's new Hardware IP Address and Gateway IP Address are 66.23.77.40 and 66.23.77.1, respectively, then the entry for the Ethernet Static IP Address should be changed to 66.23.77.40 and the Gateway IP Address changed to 66.23.77.1** (see notes). Remember, the module's Ethernet Static IP Address isn't really the module's static IP address; it is the IP address where packets received on the wireless side of the module will be forwarded.

*Please keep in mind that whatever the new Ethernet Gateway Address is, that is the address a web browser must now be pointed to in order to reach the module's configuration interface once it is restarted and the new configuration is in place.** (see notes)*

Once changes have been made, scroll down to the bottom of the Network Settings page and click on the *Commit* button. Then, in order for the new data to be active the module requires a reboot. You can either reboot the AirAura X3 itself, or if that is inconvenient, click on the *Maintenance* tab of the configuration screen (at the top center of the page) and when that page loads, click on the *Restart Module* option in the left column of choices.

Note that once the module has been instructed to restart, the browser will lose contact with the module until it is up and running again. Also, if the Gateway address has been changed the browser will need to be pointed to that new address in order to reach the configuration page.

This is important! If changing the module's configuration moves it off of the network address range that the host PC has been using to configure the module, the host PC's IP address must *also* be modified in order to put them both on the same network address range again and re-enable communications.

If difficulties arise with the module configuration, please contact Wheatstone Customer Support at (252) 638-7000 or email them at techsupport@wheatstone.com.

NOTES:

** Using a Gateway address on the wired side of the WLAN module can cause a local connected network to become confused if it and the gateway addresses of the module are the same. It is sometimes best to program the WLAN module's Gateway address to an unused address on the locally connected network. If an invalid entry is used for the WLAN module Gateway that address can no longer be used for the module's web-based configuration and the wireless address will need to be used instead.

Appendix C

Contents

General Specifications

Analog Line Input

Type:	Electronic Differential
Input Impedance:	> 10Kohm (bridging)
Optimum Source Impedance:	< 1Kohm
A/D Converter:	AKM5394, 192kHz, 24-bits

Digital Line Input

Data Standard:	AES3 (AES/EBU)
Data Amplitude:	Per AES3-2003 assuming minimum allowable output signal amplitude of 2V and minimum allowable input signal amplitude of 200mV
AES Receiver:	CS8416, 192kHz, 24-bits
Type:	WheatNet-IP
Data Type:	Gigabit Ethernet Network per IEEE 802.3-2008

Input Gain Adjustment Ranges

Gain Range:	+12dB / -36dB
Gain Adjustment Resolution:	0.5dB
Gain Calibration:	A gain control setting of 0.0 aligns an external 0dBFS signal with the AirAura X3's 0dBFS internal reference

Input Failover

Type:	Automatic
Analog Fail Cause:	Audio level below -24dBu (fixed)
Response Time:	30 seconds (fixed)
Digital Fail Cause 1:	Audio level below -48dBFS (fixed)
Response Time:	30 seconds (fixed)
Digital Fail Cause 2:	Corrupted or invalid AES data
Response Time:	Immediate (fixed)
Failover Direction:	Digital to Analog/Analog to Digital (no Digital to Digital)

Audio Level Balance

Type:	Common to both Analog and Digital Inputs
Analog/Digital L/R Balance Range:	+/-12dB
Control Resolution:	0.5dB

Voice Symmetry via Phase Rotator

Operating Modes:	In/Bypass
Filter Type:	4th Order All-pass

Auto Mono

Auto Mono Modes:	In/Bypass
Auto Mono Threshold:	User Adjustable from -40.0dBFS to 0.0dBFS
Timing:	Fully Program Dependent

High-Pass Filter

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

Parametric Equalizer

Sections:	Four
Frequency Range:	20Hz – 20kHz
Bandwidth Range:	0.2 – 3.0 octaves
Boost/Cut Range:	+/- 14.0dB
Options:	Bypass (individual bands or all bands) Band 1&4 Shelving or Parametric

5 Band AGC/Compressor with SST

AirAura X3's 5 Band AGC/Compressor operates in sum and difference (M/S) mode.

Drive Gain Range:	-12.0dB to +6.0dB in 0.5dB steps
AGC/Compressor Thresholds:	- 50dBFS to -70dBFS
AGC Threshold Backoff (per band):	0dB to -6dB
AGC Attack:	50mS to 500ms
AGC Release:	1 second to 7 seconds
AGC Band Coupling:	0dB to -6.0dB per band to key band
Compressor Attack:	3.0mS to 100mS
Compressor Release:	50mS to 1000mS (1Sec)
Compression Ratio:	2:1 to 20:1
AGC Mixer:	Boost/Cut +/-6dB
Stereo Enhance:	Boost/Cut +/-6dB
Gating Mode:	Slow Release/Hold
AGC Gate Threshold Range:	-20.0dB to -79.5dB, plus OFF

SST Drive:	+30.0dB to +40.0dB in 0.5dB steps
SST Adapt Speed:	2 to 7.0 seconds
SST Gate Threshold:	-35.0dB to -60.0dB in 0.5dB steps
SST Window Size:	3dB to 12.0dB
SST Operating Style:	Automatic, Linear or Adaptive

Crossover Frequencies

Super Low to Low Band:	20.0 Hz to 149 Hz
Low to Low Mid Band:	162 Hz to 687 Hz
Low Mid Band to High Mid Band:	728 Hz to 2.18 kHz
High Mid Band to High Band:	2.59 kHz to 20.0 kHz
AGC Mix:	+/- 6dB
Stereo Balance:	+/- 6dB

31-Band HD Peak Limiter

A four band parametric EQ follows the 31-band limiter.

Multiband (31Band) Drive:	80 – 100%
Bass Tools Drive:	- 6.0dB to +12.0dB
Bass Tools Style:	Off/ Soft/ Hard
Bass Mix:	- 12.0dB to 0dB
Bass Tools Frequency:	63 - 320Hz
Bass Tools Filter:	Broad/ Medium/ Tight
Multiband Limiter Knee Shape:	Soft/ Hard
Multiband Threshold Range:	+/-6dB relative to Multiband Drive setting
Multiband Attack Time Range:	10ms to 100ms
Multiband Release Time Range:	50ms to 500ms
Lookahead Limiter Threshold Trim:	+/- 6.0dB
Lookahead Limiter Attack Time Range:	0.2ms – 30ms
Lookahead Limiter Release Time Range:	33ms – 330ms
Lookahead Limiter Delayed Release Range:	100ms – 1000ms (1Sec)
HD Output Level Trim:	-79.95dBFS to 0.0dBFS, or Disabled
Phase and Polarity:	Left and Right channels may be phase-reversed or swapped

31 Band FM Peak Limiter

A four band parametric EQ follows the 31-band limiter.

Multiband/Drive:	80 – 100%
Bass Tools Drive:	- 6.0dB to +6.0dB
Bass Tools Style:	Off/ Soft/ Hard
Bass Mix:	- 12.0dB to 0dB
Bass Tools Frequency:	63Hz - 320Hz
Bass Tools Filter:	Broad/ Medium/ Tight
Multiband Knee:	Soft/ Hard
Multiband Mode:	Discrete: 31-band "Fine Grain" Limiter™ Wide: 10-band "Triplet Coupled" Limiter™ Timbral: 10-band "Harmonic Coupled" Limiter™
Multiband Threshold:	+/-6dB relative to Drive
Multiband Attack:	10ms to 100ms
Multiband Release:	50ms to 500ms
FM Pre-emphasis Modes:	Flat/50μS/75μS
FM Pre-emphasis Location:	Pre 31 Band Limiter/Post 31 Band Limiter
Lookahead Limiter Threshold Trim:	+/- 6.0dB
Lookahead Limiter Attack:	0.2ms – 30ms
Lookahead Limiter Release:	33ms – 330ms
Lookahead Limiter Delayed Release:	100ms – 1000ms (1Sec)
FM Diversity Delay:	OFF to 10 seconds, 100μS increments
FM Digital Output Trim Level:	-79.95dB to +12.00dB, or OFF
FM Digital Output Options:	Pre-Delay and /or De-Emphasized

Stereo Encoder

Reference grade Stereo Encoder with embedded Composite Processing, Test Oscillator, SCA digitizer, and balanced and unbalanced composite outputs.

Composite Processor Modes:	Oversampled Clipper or Lookahead Limiter
MPX Processing Drive Range:	+/-6dB
Automatic Multipath Limiter:	10% to 100% in 5% steps, plus Off
19kHz Stereo Pilot Injection:	0-20%, 0.1% steps
19kHz Stereo Pilot Phase:	+/- 22.5 degrees referenced to 38kHz
SCA 1 & 2 Input:	Analog, 10Kohm input impedance
Maximum SCA Input Level:	+24dBu

Gain Control Range:	-79.95dB to +10dB; OFF
Stereo Encoder Operating Modes:	
Analog Left/Right Only:	Analog L/R or Analog L/R De-Emphasized
Stereo Multiplex:	Balanced and Unbalanced MPX Output
TX 1 & 2 Output Standard Level:	3.5V P-P (1V RMS)
TX 1 & 2 Maximum Output Level:	8V P-P into 1kohm (BNC Outputs) 14V P-P into 1kohm (Balanced Outputs)
Digital baseband192:	AES3 formated and 192kHz sample rate (FM Digital Output)

System

Headroom Level:	>20dB
Nominal Operating Level:	-20dBFS digital = +4dBu
FM Path Processing Latency:	17mS maximum – all features engaged.
HD Path Processing Latency:	13mS maximum – all features engaged.
Total Harmonic Distortion:	<0.1%, 20Hz – 20 kHz *
Intermodulation Distortion:	<0.1% SMTPE *
Signal to Noise Ratio:	>80dB *
Signal Chain Internal Dynamic Range:	>144dB
Stereo Separation:	>50dB (FM) 100dB (HD) *
Crosstalk:	>50dB, 20Hz – 15kHz (FM) 20Hz – 20kHz (HD) *
Power Requirements:	100-250 VAC (auto sensing) 50/60Hz, 100 VA Max.
Power Connector:	EMI suppressed IEC male
Shipping Weight:	37 pounds
Operating Temperature:	0 to 50 degrees C (32 to 122 degrees F) Overtemp alarm reporting via GUI

* Bypass Preset, unity gains, and 75μS pre and de-emphasis

All specifications subject to improvement or change without notice.

Preset Management

AirAura X3's advanced preset management system allows the creation, storing, and recall of 80 presets within AirAura X3 itself and an unlimited number may be stored on the Windows PC hosting the Guru or Professional GUI. In addition to processing parameters, all System parameters are stored within 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 AirAura X3's internal 32 bit serial number as the encryption key.

Onboard Real Time Clock

A highly accurate internal quartz-based timebase drives a real-time clock which allows the automatic recall of presets at predetermined times using the short or long-form scheduler features. This clock may be set to "free-run" or it can be synchronized to an external SNTP server.

Day-Parting and Long-Term Scheduling

A "weekly," or short form preset scheduling utility establishes a weekly cycle of preset changes, allowing for automatic programmed day-by-day exclusions or additions. Additionally, a separate long-form 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 assigned to the first eight numbered 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 and polarity does not matter. Please see the section on GPI use for the required external current limiting resistor for voltages above 3.3VDC.

General Purpose Output (GPO)

Four optically isolated outputs bring system statuses and alarms to the outside world.

Ethernet Interface

The AirAura X3 contains a five-port, auto-sensing 10/100BaseT Ethernet switch with two of the ports available on the outside rear panel for field use. Because the switch is Auto-MIDX it is not necessary to utilize a crossover cable when connecting a PC directly to the AirAura X3.

802.11g/b Wireless

AirAura X3 has its own built-in wireless interface which allows easy control via the GUI software and a laptop equipped with a wireless interface.

Software Remote Control

The supplied Windows®-based AirAura X3 Guru GUI software affords simplified access to AirAura X3's system and processing parameters via a 10/100BaseT Ethernet interface. A front-panel color LCD screen and touchpad allows complete local control of all system and processing parameters if desired.

Appendix D

Contents

Wireless Module Approvals and Miscellaneous Data

AirAura X3's 802.11/a/g wireless interface is a high quality, off-the-shelf product manufactured by B&B Electronics, formerly Quatech of Hudson, Ohio USA.

Complete documentation for the module including very detailed configuration options can be found in the Airborne Wireless Ethernet Bridge Modules section of the Quatech website:

http://www.quatech.com/catalog/airborne_ethernet_modules.php

The wireless module is type approved in the US, Canada, and Europe, with certification pending in Japan (as of this writing). To comply with the regulations dealing with embedded wireless devices, the rear panel of the AirAura X3 is so marked as required by law:

Using FFC grant: F4AWLNG1
Using IC grant: 3913A-WLNG1

B&B/Quatech contact information is below:

Hudson, OH Office:
B&B Electronics Mfg. Co.
5675 Hudson Industrial Pkwy
Hudson, OH 44236
Phone: +1 815.433.5100
Fax: +1 815.433.5109
Email: wirelesssupport@quatech.com
Web Site: www.quatech.com

Typical Usable Wireless Range

The following table illustrates the typical data rates, performance and range of the wireless module that can be expected when using the Omni-directional diversity antennas supplied with AirAura X3.

Data Rate	Typical Outdoor Range Unity Gain Antennas	Typical Outdoor Range 2dBi Antennas Each End
1.0 Mb/s	240m / 787 ft	380m / 1247 ft
11.0 Mb/s	135m / 443 ft	215m / 705 ft
6 Mb/s 802.11/g	135m / 443 ft	215m / 705 ft
6 Mb/s 802.11/a	49m / 160 ft	155m / 508 ft
54 Mb/s 802.11/g	12m / 39 ft	19m / 62 ft
54 Mb/s 802.11/a	4.5m / 15 ft	14m / 46 ft

Ranges are based on a combination of receiver sensitivity, transmitter power, free-space path loss, antenna gain factors, and link margin. Actual range will almost always vary from those stated and likely will be less. Non-line-of-site applications will perform worse than those shown in the above table.

The listed "Data Rate" is the supported *connection rate* for the wireless link including handshaking. Because handshaking (to ensure reliable communications) utilizes a small portion of the stated data rate, the actual data throughput for the link to/from the AirAura X3 and its GUI will be somewhat less than that stated in the first column.

IMPORTANT NOTE

AirAura X3 utilizes an efficient scheme to send data to and from the remote GUI. This data rate is *far less* than the 1Mb/s rate that we've configured in the module as the factory default.

There is NO advantage to forcing the module to communicate using higher data rates. In fact, the above table should make it quite clear that exactly the opposite is true – "forced" high speeds can result in an unreliable connection, even at very modest distances.

Several years of field experience with AirAura X3's wireless interface operating in all kinds of situations has confirmed that the 1Mb/s data rate chosen as our factory default data rate provides *very good* coverage and *excellent* usability.

Transmitter Power

Transmit power is automatically managed by the device for best range and minimum power consumption. The maximum transmit power available at the module's RF connectors is typically +15dBm +/-2dB for B-Mode (all rates) and +12dBm +/-2dB for G-Mode (all rates). The RF power at AirAura X3's rear panel WiFi connectors will be somewhat less than this due to losses in the short but nonetheless not lossless interconnecting coaxial cables.

Antennas

Any customer supplied antenna used with AirAura X3 must be designed for operation within the 2.4GHz ISM band and, more specifically, must support the 2.412GHz to 2.482GHz bands for 802.11b/g operation. Antennas are required to have a VSWR of 2:1 maximum, referenced to the 50Ω system impedance. The antennas supplied with AirAura X3 have been certified for use with the wireless module.

Performance

Wireless "performance" in an actual application is a very difficult parameter to define, mainly because the appropriate metric changes with each operational situation. Performance is always a combination of parameters, some of which (such as natural obstructions) are not usually under the control of the AirAura X3 customer.

The underlying characteristic that needs to be observed for best performance is the link quality, not link speed. Link quality can be defined as "the bandwidth available over which communication between the AirAura X3 and the host GUI can efficiently occur." The lower the link quality the less likely the two can communicate.

Appendix E

Contents

AirAura X3 GPIO Interface

AirAura X3 is equipped with two GPIO (General Purpose Input/Output) control interfaces; an eight input optoisolated interface for selecting presets in the first eight memory slots and a four output optoisolated interface that can be used to remotely signal status about the processor.

GPI – General Purpose Input

The GPI interface provides eight separate General Purpose Inputs which share a common DC return. The interface connector is a female DB-9 connector with the following pin assignments. Note that all pins are isolated from AirAura X3 internal circuitry!

GPI Input Number	DB-9 Connector Pin Number
One	Pin 6
Two	Pin 2
Three	Pin 7
Four	Pin 3
Five	Pin 8
Six	Pin 4
Seven	Pin 9
Eight	Pin 5
Common Return	Pin 1

The GPI input circuits are optoisolated by devices having exceptional input/output isolation. These inputs are designed to work very well in high RF environments and should not cause ground loop issues when connected to external equipment.

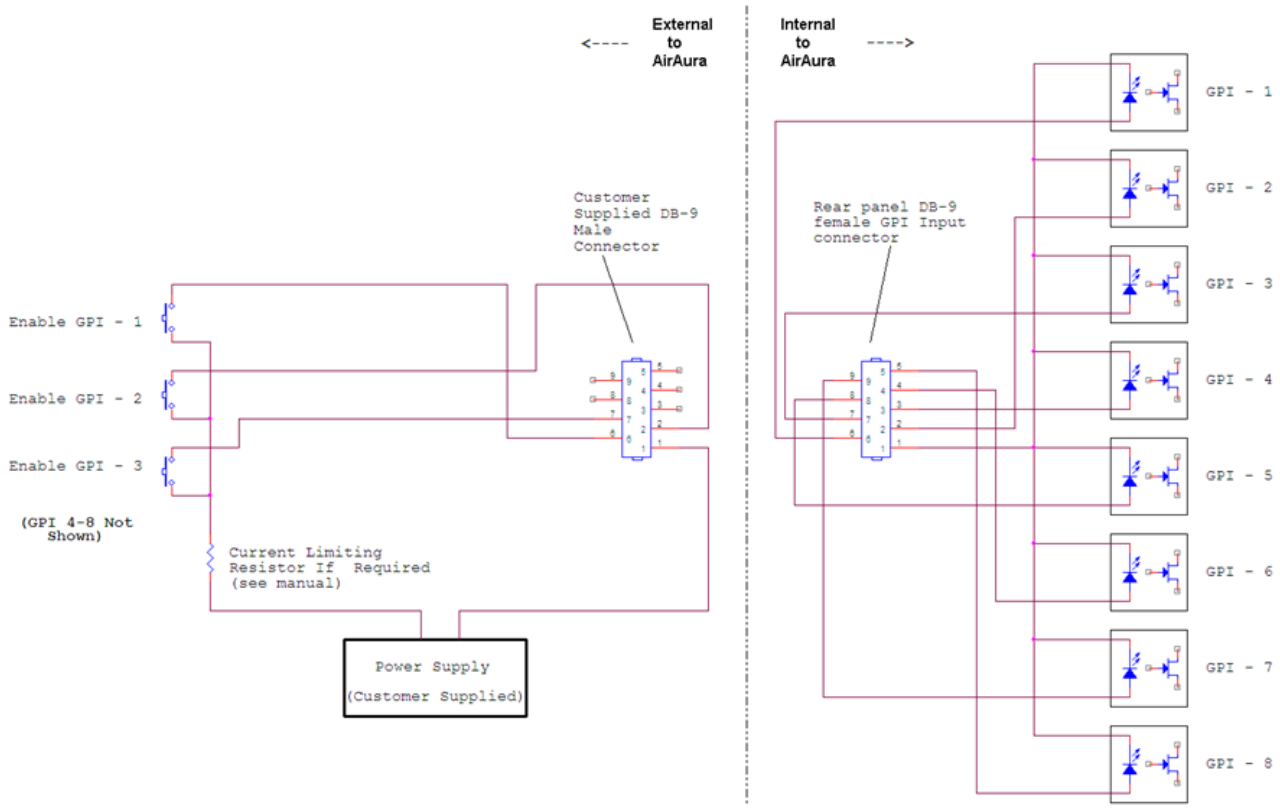
Each of the GPI inputs is current limited by a 475 ohm internal resistance. The LED device inside the optoisolators is rated at a maximum forward current of 50mA and a normal operating current of 5mA.

Before connecting external circuitry to the GPI inputs,
first ascertain whether it will be necessary to utilize
additional outboard series resistance in your application!

Use the following table to determine if an external resistance is required and if so, what value it should be. Note that a one-half watt resistor is sufficient. The resistance values in the table below have been calculated to result in approximately 5.0 milliamps forward current through the optoisolator's internal LED.

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

* For personnel safety reasons a voltage in excess of 48VDC is NOT recommended to be applied to the GPI interface.



Example Schematic of General Purpose Inputs

GPO – General Purpose Output

Note: GPO circuitry is enabled on Version 1.2.x software and above.

AirAura X3 provides four General Purpose Output (GPO) circuits that may be used in a variety of ways. Like the GPI circuits, the GPO interface utilizes optoisolators in order to provide high electrical isolation from the outside world.

Unlike the GPI circuits each of the GPO's has completely isolated return circuits – that is, unlike the GPI port they do not share a common return. Because of this each GPO may be used as the end user chooses without regard to cross coupling between unrelated external circuits.

The optoisolators on the GPO interface protect internal AirAura X3 circuitry from voltage up to 350 Volts AC or DC. Because of the optoisolator's "AC" rating, the polarity of external circuit polarity is unimportant and therefore the GPO pins are simply defined as "Source" and "Return."

The MAXIMUM permissible load current is 100 milliamps (0.10Amperes).

The four GPO ports on AirAura X3 are hard coded in software to provide the following status outputs:

GP Output #1 – Becomes enabled on an Analog Audio Failure.

GP Output #1 – Becomes enabled on Digital Audio Failure (either AES3 or WheatNet-IP).

GP Output #2 – Becomes enabled if the CPU Temperature reaches 50 deg. C (122 deg. F).

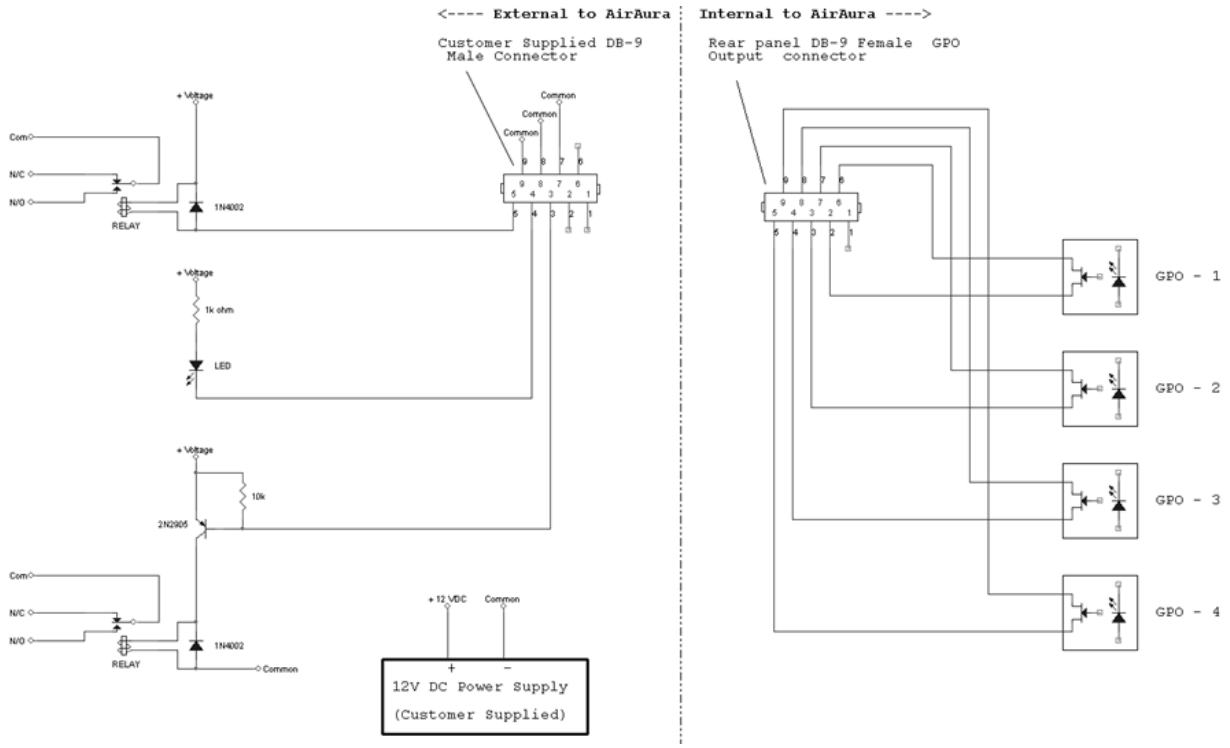
GP Output #3 – Becomes enabled upon a General System Failure.

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

GPO Number	Usage	Source Pin	Return Pin
One	Analog Audio Fail	2	6
Two	Digital Audio Fail	3	7
Three	Overtemp (>50C)	4	8
Four	General Failure	5	9

Note that the GPO DB-9 connector pin 1 has no connection.

Please see the next page for a suggested way to interface AirAura X3's GPO circuitry.



Example Schematic of General Purpose Outputs

In the above circuits the external devices are powered by a customer-supplied 12V DC power supply. When relays are interfaced it is recommended to use the reverse biased diode shown across each relay coil. The diode harmlessly dissipates the voltage "kickback" generated when the relay coil is de-energized. Unsuppressed, such kickback voltages can harm AirAura X3, external circuitry, or both.

In the top circuit the relay is activated if GPO#4 goes true to warn of a General System Failure.

In the middle circuit the LED illuminates when GPO #3 goes true to warn of a System Temperature above 50C (122F).

In the bottom circuit the relay is activated by GPO #2 to warn of a Digital Audio failure.

No connections were made to the terminals for GPO #1, the Analog audio source failure warning.

Appendix F

Contents

Interpreting Common Audio Processing Terms

Background

When tasked with adjusting audio processing one is often faced with myriad meanings for the same sound descriptors. When the program director comments that it needs more "thump," what does he really mean? If he says that the audio is too "crunchy," what is he hearing? Or if he says that the competition is nice and "bright" and they have some nice "rumble," what exactly is that? Or what if he wants more bass and you add some bottom end but now he says "we sound too muddy"? How do we untangle this and get to the bottom of what the PD really means?

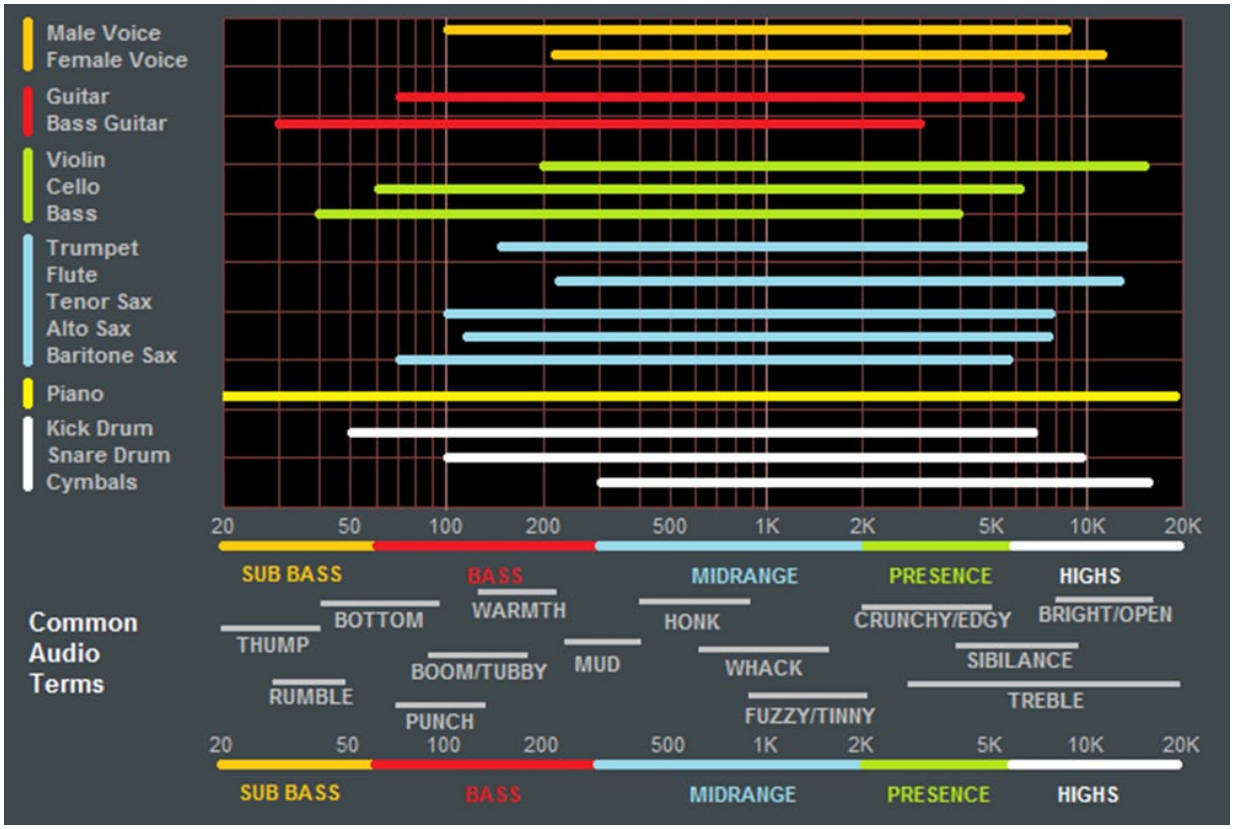
Lots of "audio" terms regarding audio processing have been invented and bandied about over the years. Ever since radio stations started employing circuits instead of humans to control the modulation of transmitters we've tried to come up with words to describe the effects of processing and what we hear. Many of these terms were born out of simply trying to put into words the positive and negative artifacts of early compressors and limiters (thump, muddy, honk, tubby). Still others were born later when EQ and different forms of "enhancers" were added to audio chains and audio processors to exaggerate certain parts of the frequency spectrum (rumble, punch for bass; bright, airy, open to describe presence and the high end).

The *language* of audio processing more often than not needs the benefit of an interpreter. Some oft-used terms can easily have multiple meanings and be confused with others. Some of the terms we use simply don't describe very well what is actually happening to the audio. For instance, one listener might feel the audio is "muddy" while another one still might describe it as "warm." Which one is right? For starters, "muddy" is not usually used in a positive sense, while warm, on the other hand, often means the sound has a pleasing low end. See the confusion here?

The terms themselves, the ones that we use to describe sound, can be confusing enough. The real question then becomes, what do these terms really mean, and which knob do we turn if we want to change the sound? In fact, here is a very common challenge: if the audio is too "muddy," do you turn up the high end, or do you reduce the low end? Which control is the right one if you wanted to bring up some low end "rumble" or "sub bass"? And here's another one; if the audio is "tinny," is the problem that there's too much energy up around 8,000Hz or is the problem actually further down in the spectrum?

We've created a graphic to try to bring some understanding to the more common terms we broadcasters use to describe sound and where these sounds actually reside in the audio frequency spectrum. While creating an exhaustive list isn't impossible, it is well beyond the scope of what we're trying to accomplish here. What we've done instead is compile the terms we most commonly hear customers use, and then lay them out in graphic form to help visualize what sounds live in what part of the audio spectrum we hear.

Included in the chart below are the frequency ranges of the most common instruments heard in compilations played on the radio. The idea here is to marry musical instruments and their sounds with the terms we all use. One good example might be the term "Honk," which coincidentally happens to be right in the middle of the frequency range created by saxophones. The goal here is simple; offer a better understanding of how to adjust an audio processor so that the "thump" you want will be the "thump" you get and not "tubby."



Common audio processing terms and the parts of the spectrum they govern are at the bottom of the chart. The top part of the chart shows the frequency range of common musical instruments heard on the radio (male and female voice included).

Audio Terms and Wheatstone Processing

Much of the credit for the vast sound-tailoring flexibility and incredibly clean sound of Wheatstone's AirAura X3 processor goes to its 31-band limiter. A 31-band limiter can accomplish two goals that no other limiter with fewer bands can. The first is that it allows the end user to achieve a great deal of loudness without hearing individual limiter bands work. This allows the sound to be very "open" (there's a term!) and loud, and clean, and without the harsh, unnatural re-equalization generated by limiters with fewer bands – the ones found in conventional processors.

The second goal was to create a unique limiter technology that didn't get in the way of end users using the vast pallet of powerful sound shaping tools to tailor their station's sound. We didn't want the limiters getting in the way of that enhancement.

So how do you tweak a processor to change its sound "texture"? Let's start with the low end…

THUMP/RUMBLE/BOTTOM

These terms describe bass generally found at and below about 80Hz. Good stereo systems, closed or noise reduction headphones and car audio systems with subwoofers can usually reproduce the audio way down here. Many times such systems even have their own complex bass enhancement features. Wheatstone processors are equipped with

a very specialized bass system called "Bass Tools™." In general terms Bass Tools gets real bass on the air without it causing the problems commonly associated with "bass clippers."

Using Bass Tools™ to add more Thump & Rumble is quite easy. By setting the Bass Tools Style to Soft the algorithm automatically places additional emphasis on lower bass frequencies. If the Style is set to Hard instead, bass "slap" will be more pronounced and the emphasis on thickening the bass that the Soft style creates will be reduced.

"Subwoofer" algorithm places targeted enhancement on the frequencies between 20Hz and 80Hz, and does not add bass harmonics. When the *Sub Bass* control is Off, enhancement of very low frequencies is disabled and bass energy in that region remains just as it was in the incoming program material.

Other ways of enhancing these lower frequencies would be to set the Band 1 to Band 2 crossover at 50 or 60 Hz and raise the threshold of Band 1 in the AGC/Compressor. This will allow very low bass to pass more freely through the AGC and compressor section, with the lower bands of the 31-band limiter and Bass Tools acting as a safety net to prevent bass-induced distortion. On the majority of formats we recommended the *Sub Bass* control being left in the "On" position.

PUNCH/BOOM/TUBBY/WARM

The sound of bass "punch" and "boom" usually fall in the range of 70Hz to 150Hz. "Tubby" on the other hand usually falls between 150Hz and 300Hz. Band #2 of the parametric Equalizer may be used to *gently* and *broadly* boost audio in the range of 75Hz to 120Hz to safely reinforce the "punch" and "boom" of lower bass without creating undesirable effects such as "tubbiness."

The enhancement of "punch" and "boom" can be especially tricky because many listeners' sound systems don't have the ability to reproduce lower and sub bass frequencies. Therefore it's especially important to use several known reference systems when adjusting the enhancement of very low frequencies because it is easy to create distortion or "muddiness." How many stations have awesome sounding bass on the PD's car stereo but end up sounding terrible on clock radios and boom boxes? Always listen on multiple radios in multiple listening environments to get the best feel for the effects created by purposeful bass enhancement.

MUD

When someone says that audio is "muddy" they usually mean too much energy is in the 250Hz to 400Hz range. Sometimes it's caused by a misadjusted Equalizer or a processor maladjustment that is allowing an AGC or compressor band to add too much gain. In most cases it's a good idea to keep from boosting energy in this region. In fact, additional clarity and detail can be created by a broad equalization *cut* in the range between 180Hz and 400Hz. This surprising little secret can be more effective at "adding" detail in low bass and midrange than adding equalizer *boost* at the same frequencies. It's true! Try it!

HONK

Think Saxophone. Honk is above "mud" but below "fuzzy" and "tinny." Honk occurs between about 400Hz and 1,200Hz and begins to overlap "fuzzy" and "tinny" at around 1000Hz. Usually audio in this range stands out on its own in the mix and any enhancement should be slight because our ears are already very sensitive to these frequencies. This frequency range is also quite delicate because much of the perceived

stereo sound field width also occurs in this range. When audio has a "honk," "fuzzy," or "tinny" texture (and it's usually a texture that one DOESN'T like), faster attack times in the Compressor for that frequency band can help smooth things out. Another trick is to relocate the Band 3 to Band 4 crossover to around 2,000Hz which allows Band 3 to better manage any "harshness" that might tend to pop out on certain material.

WHACK

This is the sound where percussion just "explodes." First, note that this is much less of an equalization issue and much more about creating a *temporarily* dense sound by momentary fast compression. To achieve more "whack" it can help to speed up the AGC or Compressor release times in Band 3. Another trick is to slow down the attack time of the Band 3 AGC which will allow the Band 3 compressor to be more active. This will enhance "whack."

FUZZY/TINNY

Yes, "fuzzy" and "tinny" really are this far down in the audio spectrum! A "tinny" sound might be described by some as a harsh midrange or too much presence instead of something happening higher up in the audio spectrum. Both "fuzzy" and "tinny" live between about 1,200Hz and 2,000Hz. One of the best ways to manage either is to broadly and slightly reduce equalization in this range, or even increase the attack time in Band 3 of the AGC and Compressor.

Sometimes there is a tradeoff between getting more "whack" and keeping "fuzzy/tinny" at bay. Speeding up the compressor in the 1,000Hz to 1,500Hz range to get more compression "whack" can sometimes add undesirable side effects, one of which is the creation of what sounds like "fuzzy," "dense," or even "tinny." In audio processing, especially broadcast audio processing, everything is a tradeoff. While Wheatstone processors provide the most wiggle room for getting the sound you hear in your head on the air, sometimes compromises will need to be made.

CRUNCHY/EDGY

This sound is mostly caused by the need to manage the FM pre-emphasis when aggressive processing is being applied and it usually shows up as artifacts in the 1,600Hz and 2,500Hz range. Sometimes it is best mitigated by rearranging the processing furniture – placing the 31-band limiters *after* the FM pre-emphasis, for instance. In fact, Wheatstone is the only processing company that we are aware of that allows the end user to move the pre-emphasis around. If a particular program format or market dictates that a smoother mid and high frequency range is needed, placing the pre-emphasis BEFORE the multiband limiter can help in this regard. While some high frequency transient detail can be lost, the end result will be a very smooth and predictable midrange and high end which may be more suitable for formats that primarily target female listeners.

Speaking of *high end* and *texture*, Wheatstone provides three different main clipper styles in most of our processor models. Each clipper style is specifically designed to create a specific artistic *effect* while also limiting signal peaks. The three clipper styles and their attributes are as follows:

Hard: The Hard clipper style is the most forgiving to maladjustment without creating the "crunchy/edgy" sound of other processors. Quite of bit of clipper drive (Lim/Clip Drive) can be dialed in without generating obvious and/or disturbing distortion artifacts.

Firm: The Firm clipper style is designed to generate low order harmonics which enhance the audibility of audio details and fullness without generating overtly obvious and/or disturbing distortion artifacts. Yes, the Firm style is more "distorted" than the Hard style – it's supposed to be. It also generates more obvious loudness benefits than the Hard style without sounding rough or overdriven.

Round: The Round clipper style is the most obvious sounding of all three styles. It is *designed* to sound grungy when overdriven but without generating objectionable brightness due to clipping. It is the loudest of all three clipper styles but also the most sensitive to maladjustment.

Which clipper style is best? Wrong question! Which clipper style is the *right* one to use? It completely depends on your format, your competition, and your market. As in all things processing, the ears are always the best judge of what's right and wrong.

SIBILANCE

Sibilance is a vocal artifact and because it sounds so unnatural it tends to stick out like a sore thumb. Excessive sibilance can be the result of too much high-end boost or too much final clipper drive. Sibilance tends to be most prevalent in the 4,000Hz to 8,000Hz portion of the frequency spectrum. Microphone processors (like the Wheatstone M1 and M2) are great tools for keeping vocal sibilance under control. Their specialized de-esser sections are specially tailored for removing or minimizing excessive "esses." When excessive sibilance is an issue and there is no microphone processor to control it, lowering AirAura X3's Band 4 to Band 5 crossover setting and/or using a slightly faster attack time on the Band 5 AGC/Compressor can help.

Sibilance can sometimes be found in an unlikely place; the L-R. "But voice is mono…" you say, "…so there is no L-R…" Well, yes and no. When the left and right channels don't have perfect balance or there is phase shift between the channels, energy ends up in the L-R. Why? By definition the L-R signal is the *difference* between the left and right channels, regardless of whether it's level, or phase, or both. When phase is the culprit the error is generally larger at high frequencies, making the L-R energy also greater at higher frequencies. As if by magic, sibilance appears in the L-R and the only way to fix it is to tend to what's causing it or reduce the level of L-R at frequencies where sibilance might reside. The AGC's multiband mixer can help with this. Slightly reducing the setting of the Band 4 and Band 5 L-R mixer can help tame sibilance without having too negative an effect on stereo separation.

TREBLE/BRIGHT/OPEN

Treble (like its friends Bass and Midrange) is a generalized term for the high end in most broadcast and recording systems. Bright and Open are oft-used descriptive terms of treble styles.

Unfortunately, bright can be a positive or negative term. For instance, laser-bright is usually a negative term used to describe too much enhancement in the upper end. The term probably borrows its origins from the early days of CDs when *brighter* supposedly meant *cleaner*.

Open is a term usually reserved for describing audio texture in the upper midrange when it doesn't sound overly processed, packed in, or is lacking in detail. To achieve a more open sound in any processor there is usually some sacrifice in loudness. Fortunately AirAura X3 is much more forgiving in this regard and most users have an easier time

being loud with AirAura X3 while still being quite clean and open. Operating the AGC and Compressor with slower attack and release times and making some minor tradeoffs in loudness will push perceived quality off the charts while going a long way towards achieving an open and easy to listen to sound. When *this* is the target sound, starting with one of our Classical or Jazz presets and then "turning things up" is a good way to approach achieving this sound. These presets are surprisingly competitive without sounding "processed."

FINALLY

As always, Wheatstone's Tech Support team is available to answer any questions, help with setup, or assist in tweaking your station to the sound you hear in your head but might not know how to achieve. Shoot us an email at techsupport@wheatstone.com or give is a call at 252-638-7000. We know our processors inside and out and can make them sit up and dance in any market or format.

Appendix G

Contents

Factory Preset Installer

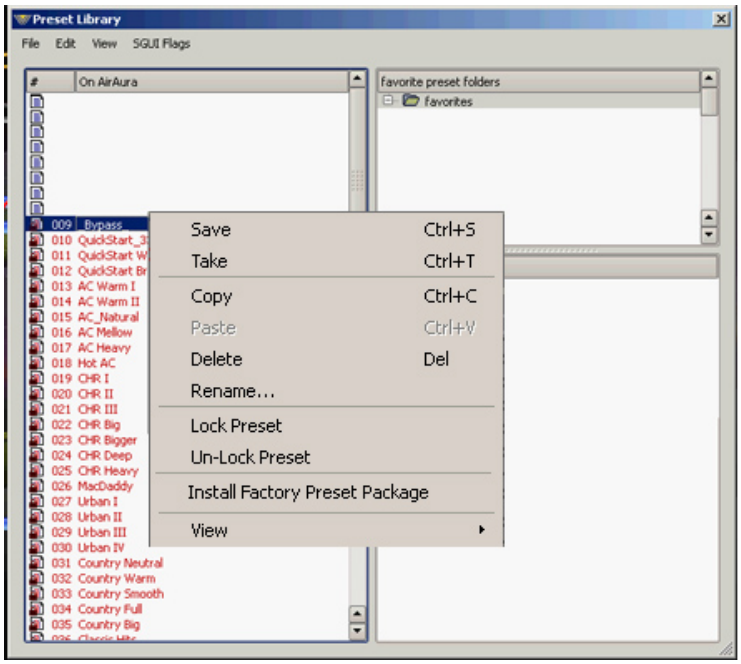
A new feature to the AirAura X3 is the Factory Preset Installer. It comes embedded in the Guru and Pro GUI's.

Your new AirAura X3 hardware comes equipped with factory presets that are relevant to the current version of software that shipped with the processor. At times, due to improvements to the AirAura X3, new factory presets may be released in order to take advantage of these improvements.

If Wheatstone releases new factory presets and you wish to install them in your hardware, a simple procedure using the Factory Preset Installer will accomplish this.

NOTE: Installation of new factory presets, unless otherwise suggested by Wheatstone, should only take place AFTER an update to the hardware. You should make sure the factory preset package matches the current version of software on your AirAura X3 or unexpected and undesired results may occur. If you have any questions, you should contact Wheatstone Technical Support Mon-Fri 8:30am – 5:30pm or after hours at techsupport@wheatstone.com.

- Download the new factory preset package from a link furnished by Wheatstone (the package will have an ".fpp'"extension)
- Connect to the AirAura X3 with the GUI.
- Open up the GUI's *Library Preset* window by clicking on the *Library* button in the GUI.
- **Back up all of your USER presets.** User presets are labeled in BLACK (unlocked by user) or BLUE (locked by user). RED presets are factory presets that will be replaced. You do not want to back these up. To back up a preset, simply select the preset and drag it to the lower right side of the dialogue box.



- Right click in the left pane (hardware side) of the *Preset Library* window.
- Select *Install Factory Preset Package* from the options listed.
- Navigate to the location where you saved the ".fpp" package you downloaded from Wheatstone.
- Select the file and the presets will load.

It should be noted that the new factory presets will always start loading automatically to preset slot 9 and higher. The first preset will always be "Bypass." Because different preset packages will have a different number of presets, user presets can end up being

overwritten, which is why it is important to back up user presets before proceeding. For example, let's say the factory presets for AirAura X3 ver.3.1 take up slots 9-30 (basically, 20 factory presets plus Bypass) but a new factory preset package for ver.3.2 installs presets in slots 9-35 (basically 25 factory presets plus Bypass). In this scenario, any user presets in slots 31-35 will be overwritten.

Normally, user presets in slots 1-8 will never have the potential of being overwritten by the factory preset installer, however, as is the case with all important files in any situation, they should be backed up to prevent any accidental erasure.

Appendix H

Contents

Using The Factory Lock Utility

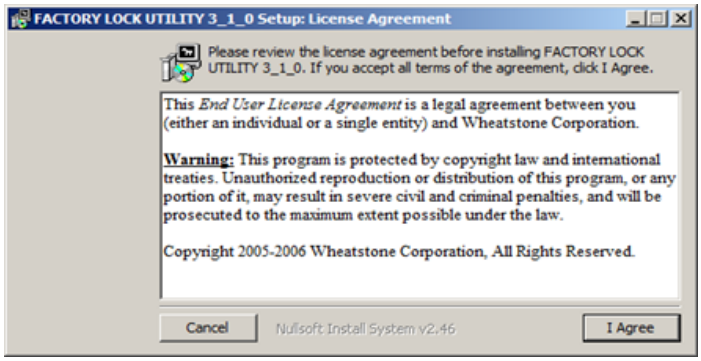
Background

The Factory Lock utility tool was originally designed for audio processing consultants who use and recommend our processors to their clients. The utility allows them to unlock our factory presets, create and "factory lock" their own presets or even remove all but their own custom presets from an Audio Processor. Those consultants often make custom presets for their clients and after saving them to the processor hardware they then Factory Lock them. Sometimes they even remove all other presets from the processor but theirs which is their way of ensuring that no one tampers with the work they've put into giving the station the sound desired by management – the sound that management has paid those consultants to create!

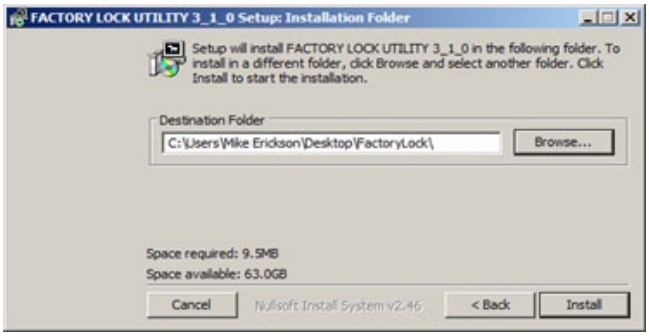
As installed, Wheatstone GUI's offer medium-level preset security, meaning that any preset locked by one user can be unlocked by another. On the other hand, when presets are Factory Locked the GUI is not normally allowed to overwrite or delete those presets from the processor's hardware because the GUI's preset library utility does not have *permission* to remove or modify those presets. However, by giving the GUI some special "permissions" it is able to factory lock *and* factory unlock *any* preset regardless of how it was locked or who locked it. This is precisely what the Factory Lock utility does – it grants the user's GUI the special permissions that it needs to enable it to create, save and lock presets *at the Factory level*. Because the utility is also useful when updating factory presets in the hardware, we've made the utility also available to customers.

Installation

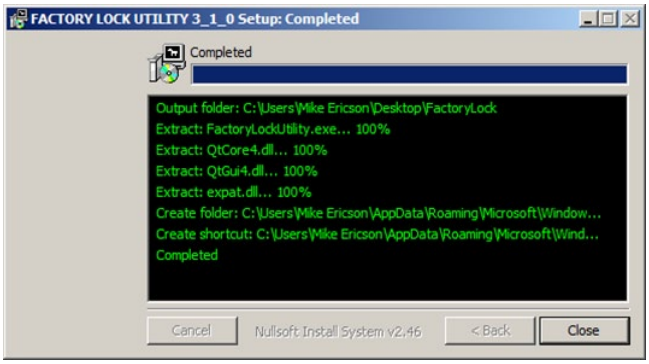
To install the Factory Lock utility double click on the *FactoryLockUtility_3_1_0.exe* icon to start the program. If you are a Windows® Vista or Windows® 7 user you may see a message that looks like the following, noting that it is acceptable to uncheck the *Always ask before opening this file* and clicking on the *Run* option.



Next up is the License Agreement prompt. Please select the *I Agree* option to begin the installation process.



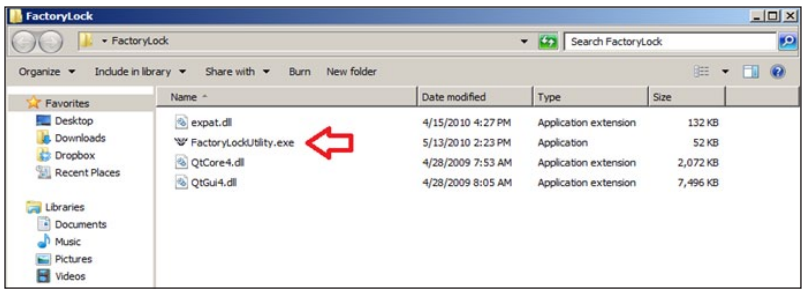
The next prompt will ask where you would like to install the utility on your computer. Please either accept the installation default or navigate to the location where you would prefer it to be installed by using the Browse button to open the Browse for Folder Windows dialog.



Next, an installation progress screen will appear. The entire installation process should be completed within a few seconds depending on the speed of the host computer.

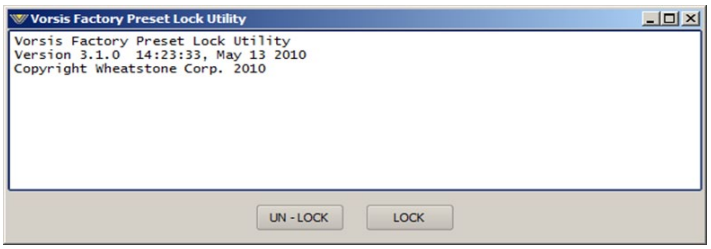
Using The Utility

STOP! ***ALL WHEATSTONE PROCESSING GUI'S MUST BE CLOSED BEFORE RUNNING THIS UTILITY!***

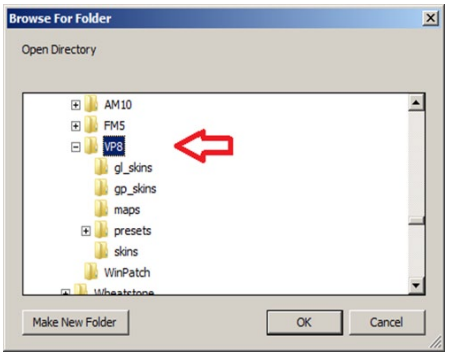


There are four files installed into the *Factory Lock* utility's folder. The only one you should be concerned with is the actual *FactoryLockUtility.exe* file.

Double click on this file to start the utility and the Lock Utility choice menu will appear.



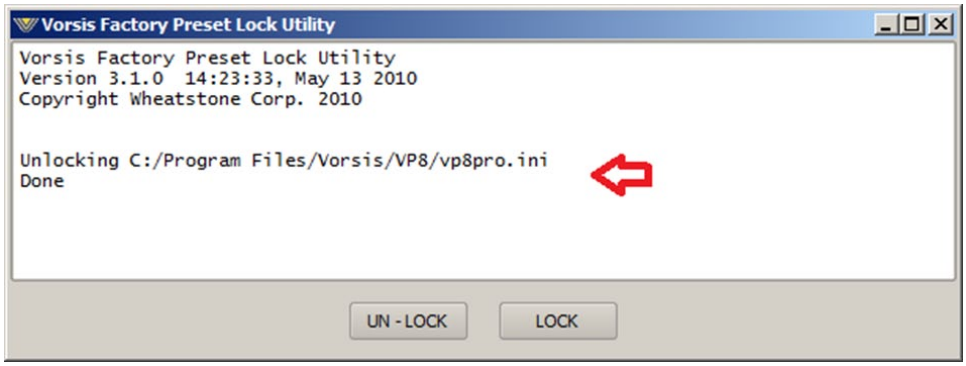
In order to grant your GUI the Factory Lock privileges click on the *UN–LOCK* button. A new navigation box will open and if the Wheatstone processor GUI has been installed in its default location the path you want to point the utility to is: "...Program Files\Wheatstone\Processor Name".



Once you have reached the folder with the name of the processor, STOP!

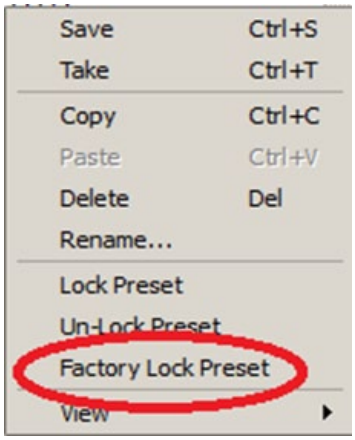
Click *OK* to proceed.

The utility's progress window should now say "Done" and the Factory Lock options are now enabled.



Confirming Factory Lock/Unlock Is Operational

Now it is safe to restart the GUI, so please open it. When the *Library* button is clicked the Library dialog will open as before. Highlighting a preset in the list and right clicking on it should reveal that there is a new option in the list; Factory Lock Preset. Whenever Factory Lock Preset is visible, the GUI also has permission to unlock a Factory preset.



The three "Lock" options now available are:

Lock Preset – User locks the preset (BLUE);

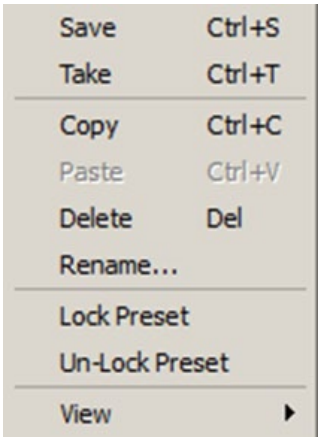
Un-Lock Preset – Unlocks user (BLUE) and factory locked presets (RED);

Factory Lock Preset – Factory locks or unlocks any preset.

Note that Factory locked presets are shown in RED, user locked presets are shown in BLUE, and unlocked presets are shown in BLACK.

Removing The Factory Lock/Unlock Options

It is sometimes useful to undo the Factory Lock options in order to prevent inadvertent access or preset permissions changes. The Factory Lock utility is used once again, but this time we tell it to remove the Factory preset permissions from the GUI. To do this, run the utility again, pointing it to the same GUI installation folder used previously, and instead of clicking on *UN-LOCK*, click on *LOCK* instead. Remember again that the GUI must not be running or the utility will not be able to modify its permissions!



If Factory Lock permissions have been removed, opening the Library dialog and right clicking on a preset should reveal that the Factory Lock Preset option is now gone, as shown at left.

Appendix I

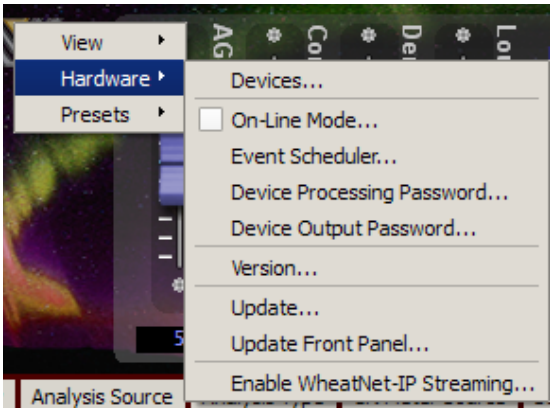
Contents

WheatNet-IP Configuration

Along with Digital AES3 and Analog inputs AirAura X3 is also equipped with WheatNet-IP (WNIP), the Audio Over Internet Protocol (AoIP) used in our Wheatstone BLADE and IP audio network control surface environment. WheatNet-IP permits AirAura X3's input audio and its FM and HD outputs to be carried over the same standard CAT5 Ethernet cable as that used for remotely controlling AirAura X3.

This procedure assumes that your facility is equipped with at least one Wheatstone BLADE and the associated Navigator software. The BLADE used may even be the multiband, eight processor "Aura8ip" processing BLADE whose physical inputs and outputs (half analog, half digital) may even be used as a substitute for AirAura X3's physical I/O.

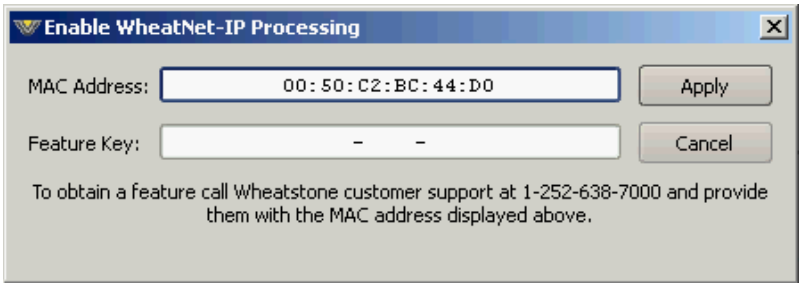
After a major firmware upgrade Wheatnet-IP may need to be re-enabled with a software key generated by Wheatstone Technical Support. If calling to get WNIP turned back on, please have the MAC address of the unit handy because that is required in order to generate the correct enable code for your hardware. Each AirAura X3 has its own unique WNIP enable code, so providing us with the correct MAC address is crucial.

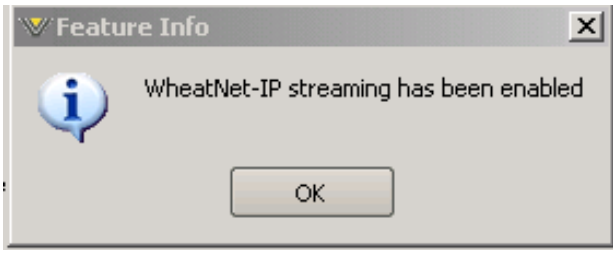


With the GURU or Professional GUI configured to connect to the AirAura X3 device and online to it, right clicking on the controls area will reveal the dropdown menu at left. We will be navigating the Hardware menu option.

At the bottom of the dropdown list is the option to *Enable WheatNet-IP Streaming*.... Click on that item and another dialog box will open. This is where the special WheatNet-IP Enable code will be entered and the MAC address of your AirAura X3 can be seen.

Once the code is entered and the *Apply* button is clicked a message will indicate that streaming has been enabled. Click *OK* to close the dialog.



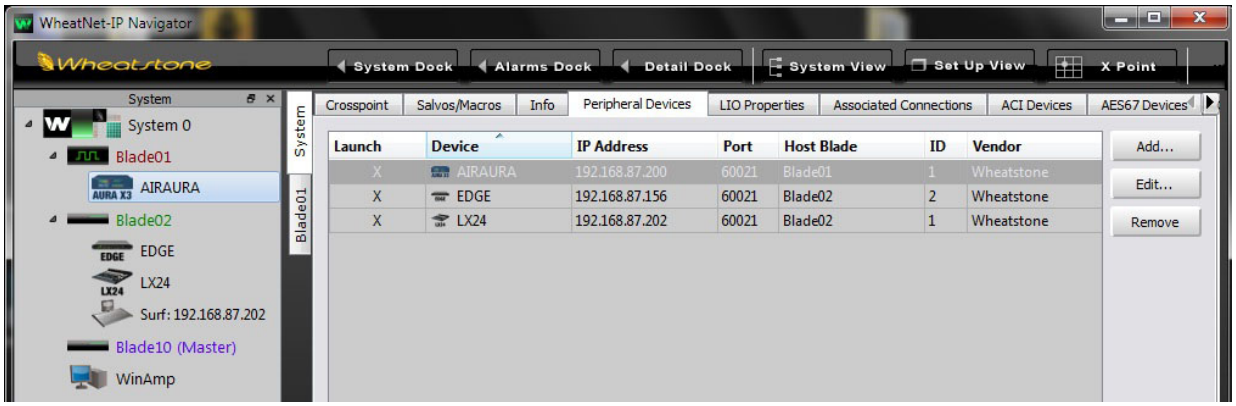


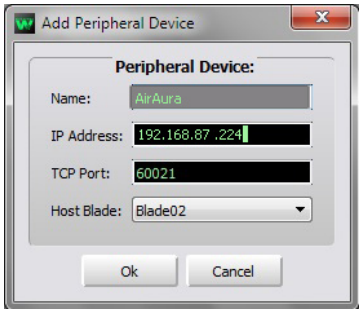
Now it's time to open up WheatNet-IP Navigator to gain access to AirAura X3's WheatNet-IP-associated input and output signals.

Once the WheatNet-IP Navigator software is open and you are logged into the system we must create a new device for AirAura X3. Because AirAura X3 is not a "BLADE" it appears and operates as a "peripheral device" within the WheatNet-IP system. Our Sideboard, an outboard mixer/controller for use with any BLADE's pair of 8-channel utility mixers is one example of a peripheral device. Another example of a peripheral device is Tieline's Genie codec. These devices, while technically not BLADEs, can interact with any WheatNet-IP system and have signals routed to and from them. What they lack, however, is the built-in intelligence of an actual BLADE.

Adding AirAura X3 to The WheatNet-IP System

The first thing to do is click on Navigator's System *Peripheral Devices* tab (in previous Navigator GUI versions this was the *System 3rd Party Devices* tab) which will open a new window listing any peripheral devices currently present. In the image below an AirAura X3 device already exists (it's in our lab) but we will be adding another one nonetheless.

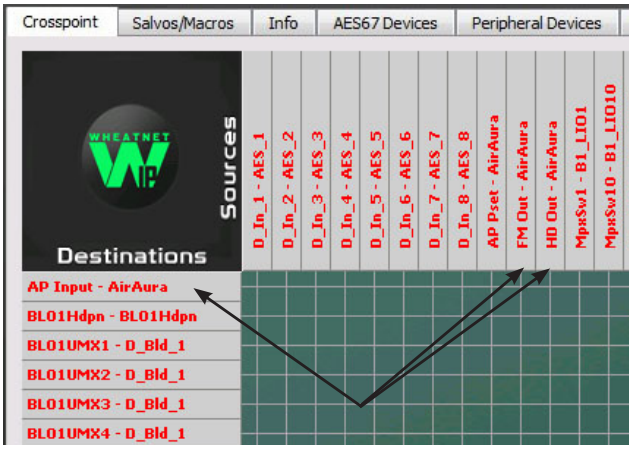




Clicking on the *Add..* button opens a dialog where a new AirAura X3 may be added to the system. Here we will add the new AirAura X3's name, its hardware IP address, and tell the system what BLADE will be its host. At this time we do not have to modify the TCP Port setting so we can leave it set to 60021. Once input to the dialog is finished, click on the *Ok* button and it will close.

Next we'll open the System Crosspoint window and see that our new AirAura X3's Input and FM and HD output signals are now present and available for routing.

Note that as shown in the example on the right we've used Navigator's signal name editing capability to assign AirAura X3's input and output signals the names we desire. Until changed the default names begin with "AP" and will be "AP Input," "AP FM Out," and "AP HD Out." Of course these signals may be manually crosspointed (and locked if desired!)



to make connections, or it may be done through the many other methods available within the WheatNet-IP system for routing signals and changing the routes of both audio *and* logic signals.

More information on configuring and using WheatNet-IP Navigator and the other features and capabilities of the WheatNet-IP system may be found in the *WheatNet-IP BLADE3 Audio Over IP Network* manual.

Assistance in configuring AirAura X3 for WheatNet-IP may be obtained by giving us a call at 252-638-7000 or by emailing techsupport@wheatstone.com.