AirAura X5

Digital Spectral Processor

Technical Manual

Wheatstone Corporation

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

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February 2020

Wheatstone AUDIO PROCESSING

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NOTICE

Wheatstone's AirAura X5 On-Air FM/HD Audio Processor is available in three different models:

Part Number 010809: FM+HD processing with built in FM/HD Tuner and Automatic HD Time Alignment.

Part Number 010812: FM+HD processing minus the built-in FM/HD Tuner and Automatic HD Time Alignment.

Part Number 010813: FM processing only, no HD processing and no Automatic HD Time Alignment.

The contents of this manual pertain to the full-featured model, therefore some content and specifications may not apply to your hardware if it is not that model.

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Attention!

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

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

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

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

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

CE

Thank you for purchasing the Wheatstone X5 Digital Audio Processor. We don't use the phrase "benchmark" lightly, but we don't think any other term describes the capabilities of this hardware, both from a sonic standpoint and from a feature standpoint.

When the Wheatstone processing team set out to design the X5 after the success of the AirAura, the goal was simple. Don't just manage the pre-emphasis curve… MASTER IT! The high frequency boost of the 50 or 75us pre-emphasis curve has created trade-offs for all processing manufacturers for over six decades. Until now, the goal has been to manage it and mask the side effects of that management.

That's no longer enough.

Masking the side effects of pre-emphasis management gives you a busy high end that's lacking in detail, full of intermodulation distortion (IM) and the constant risk of audio that will be spitty and gritty. It also affects how much bass you can add, as bass can lift pre-emphasized high frequency audio into the clipper and further aggravate distortion and generate even more IM product.

So the team at Wheatstone set out to MASTER the pre-emphasis curve. To make the high end on your FM radio sound identical to what was coming off the program bus. To make it so you could add as much or as little HF enhancement (and bass enhancement) as you wanted without consequences.

And with that in mind, we introduce X5.

X5 applies the intelligent Unified Processing algorithms found in our FM-55 and X1 audio processors to the pre-emphasis curve, and flexibly merges that curve directly to the back end of the X5. Add that to new technologies in the X5's audio management algorithms, our new MPX processor and our phase linear iAGC and dynamics, and you have the sonic ability to win anywhere against any other processor.

The X5 doesn't stand out in sound only. X5 comes with tools that help you align your FM and HD audio (with our built in FM/HD tuner), maintain ratings watermark continuity (via AES insert point) and troubleshoot issues that may arise with our event logger, which time stamps everything from remote connect and disconnect to preset changes, audio failover and much more.

You could wait for other companies to design something similar to X5, and eventually they will have to. We think it's better that you have access to this technology today!

As always, we love to hear comments and feedback about our audio processors. Please let us know your thoughts about X5! #LiveLongAndProcess

Steve – Jeff - Mike

AirAura X5 Technical Manual

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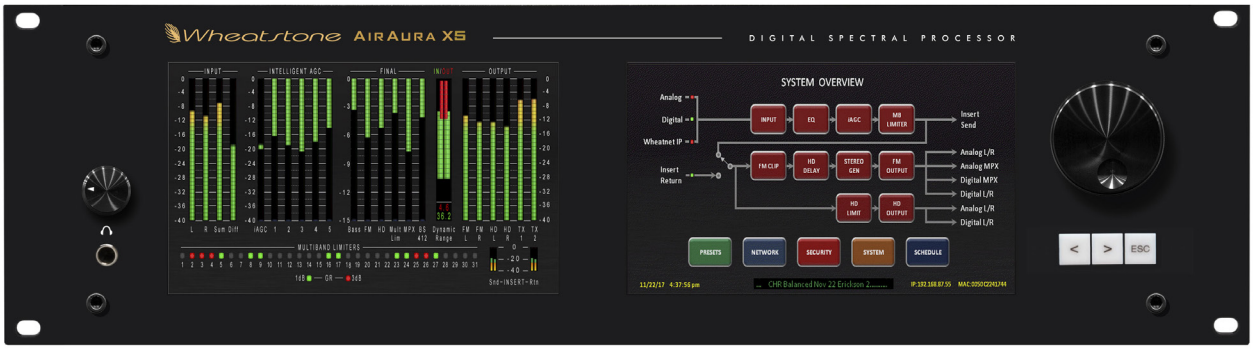
General Information

Chapter Contents



General Information

X5 Feature Overview

The X5 digital audio 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 leveler with iAGC, the FM and HD paths are equipped with individual "program aware" peak controlling processors which have been optimized for the respective broadcast mediums.

The X5's five-band leveler incorporates Wheatstone's specialized phase-linear iAGC (Intelligent AGC) algorithm and operates through a proprietary technique called Density Compensation™ . The Density Compensation™ algorithm utilizes real-time analysis of the pre and post-processed audio, and data from the processing controls as the user has adjusted them, to invisibly manage the user set spectral balance and program density. The output of the five-band leveler can then be patched to an external ratings encoder device. Upon return to the processor, the audio is then split into two signal paths, FM and HD, each equipped with our "program aware" peak controlling processors.

An AES insert loop is provided in X5 so that any AES signal can be routed into the audio processor. Anything from effects processing to ratings watermark encoders can be inserted into the loop. Upon return, the AES audio is then placed into the signal path just prior to the final peak control processing on the HD and FM audio paths.

The FM signal path is equipped with our new LIMITless™ technology. LIMITless™ takes on the 50 or 75us pre-emphasis curve and re-masters the audio with the curve in place. The perfectly peak-controlled audio is then compared to a static state pre-emphasis curve and adjusted. The result? High end that rivals the transients found on the program bus of your console or mixing desk without IM (Intermodulation) distortion, an overuse of high frequency limiting or spitty sound found in conventional FM systems.

A digitally perfect stereo generator follows the LIMITless™ process and provides two multiplex composite stereo outputs and can receive two SCA inputs. A highly oversampled composite processor (with user choice of limiter or clipper) provides extra loudness in the most demanding markets.

The X5 is fully compatible with exciters that accept composite audio delivered over an AES connection. Wheatstone's baseband192 system includes audio and subcarriers up to and including 67kHz in an AES format. This system eliminates the need to transition back to analog when using the built in stereo generator in your audio processor. It also maintains a complete digital path without sacrificing loudness or having to use the stereo generator built into the exciter.

The HD signal path of the X5 is equipped with specialized Wheatstone technology designed to help overcome the limitations of low bitrate audio. Tuned specifically for the HD radio system, the HD output of the X5 can also be deployed on other digital media platforms, such as internet streaming. Either way, the signal is always perfectly controlled and optimized for codecs.

To maintain a smooth transition when a receiver blends from analog to HD (and back), a built in FM/HD tuner is incorporated into the X5. When tuned to the frequency of your station, the processor will correlate the analog and digital signals, properly time aligning so that blend is seemless, eliminating the annoying "jump" from a signal that is incorrectly aligned audio.

SyncLink is a system developed by Wheatstone to transport a time-aligned FM and HD signal locked to a single stream over an STL data link (20 mbps or better). This allows the main processor to be located at the studio while the SyncLink receiver (sold separately) receives and converts the audio back at the transmitter site.

A fully featured RDS generator is incorporated in the X5. The built in RDS encoder provides the broadcaster with all the tools they need for a dynamic experience by the listener. It is compliant with nearly all playout systems and includes advanced RT+ tagging.

A built-in event logger time and date stamps APP logins, preset changes (both manual and scheduled), audio source changes (both manual and automatic) boot sequence and even indicates the last time the log was cleared. This helps give the user an insight into when and how a problem occurred, or help track down the reason a preset changed.

For users in markets using the Kantar audience measurement system, an optional encoder is available in X5 to insert the ratings watermark into the processor. This eliminates the need for external encoders and streamlines the watermarking process.

Wheatstone's ACI protocol, allows complete control of not only presets, but any parameter that is assigned to a user control (please contact the factory for details on this).

Dozens of factory presets are provided with X5 making a wide range of on air sounds available to the user. A fully routable headphone monitoring path allows the audio in various parts of the processing chain to be auditioned.

The System Menu of the APP provides access to a pair of flexible preset scheduling utilities. As well as the usual short-term scheduler, the X5 is equipped with a "long-form" scheduler feature that can be programmed for automatic preset changes 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 these "special" presets. The aforementioned event logger will time and date stamp these scheduled events.

As a package, X5 offers features and flexibility not possible in any other processor on the market. If you have any questions about the operation of your new X5 that is not covered in this manual, please feel free to reach out to us at techsupport@wheatstone.com or by phone at 252-638-7000.

Rack Mounting

The X5 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.

The X5 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.

The X5 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 X5 and devices immediately above and/or below it.

WARNING!

With few exceptions, the X5 enclosure normally does not need to be opened in the field.

Please be advised that the unit contains high voltage power supply circuits operating at voltages well above AC line input.

These voltages are not only hazardous but also potentially deadly if accidentally contacted.

There are no user-serviceable parts inside the unit and it should be returned to Wheatstone Corporation under a Return Authorization should repair ever become necessary.

X5 Installation Tips

Grounding

Establish a low impedance common ground in the facility and try to route all equipment grounds to that point, using conductors with the largest possible surface area while keeping those leads as short as possible. The X5's ground reference (its chassis) should be connected to the station ground. Such a connection is especially important when the X5 is operated in a high RF environment because it helps minimize differential voltages between the processor's chassis and other pieces of equipment.

Surge Protection

Always place surge protection circuits as close as possible to the device being protected. AC power line surges should be handled 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 the X5), particularly when the equipment is located within the electrically hostile environment of a station's transmitter facility.

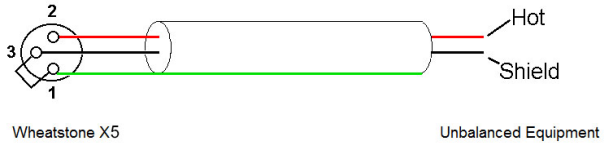
UPS/Power Conditioning

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:

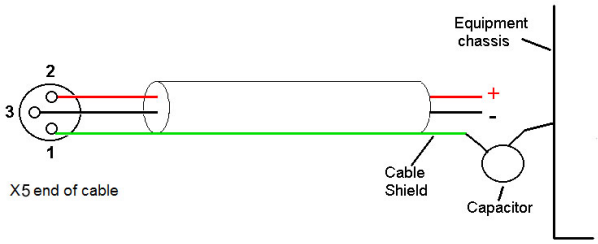
- How does the unit handle AC power that is not exactly 60Hz, such as when the facility is on its backup generator?
- If the unit has onboard surge protection, what kind of surge capability does it have and where are those surges directed to?
- Is the unit equipped with remote monitoring capability?
- Does it have onboard monitoring and alarms to signal problems such as batteries with low reserve?

Analog Audio Input Connections

Balanced audio *input* sources should be connected to the X5 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 its "+" output to the X5's "Hi" input (XLR Pin 2) and connect the shield wire to X5's "Lo" input (XLR Pin 3). If the cable's shield is used (recommended) connect it at the X5 end only (XLR Pin 1) to prevent AC ground loops.



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

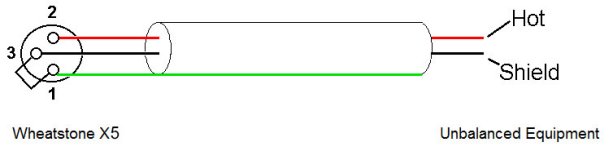
TDK	CS17-F2GA103MYGS
Murata	DE2F3KH103MA3B
Panasonic	ECK-ATS103MF
AVX	65N103MBLCP

Analog Audio Output Connections

Balanced audio *loads* should be connected to the X5's outputs using standard two-conductor shielded audio cable.

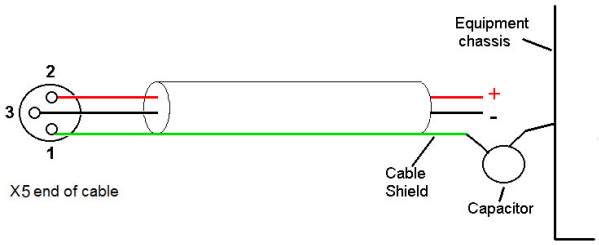
Unbalanced audio loads should be avoided, but if they can't they should be connected using shielded *two-conductor* cable such as Belden 8451 or 9451 (as if connecting a balanced source).

The X5 is equipped with an active balanced output stages that behave like a transformer. Because of this behavior the wiring 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 the X5's output XLR Pin 3 ("Lo"). Then, and to enable the X5's balanced output amplifier to operate correctly when driving the unbalanced load, it is recommended that the X5's XLR output Pin 1 (ground/shield) also be connected to Pin 3 ("Lo"), noting that this MUST BE DONE at the X5 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 as doing so can induce external noise and crosstalk on the output amplifier's "load sense" lead which is XLR Pin 3 when 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 effective in this task.

Digital Audio Connections

For digital audio connections always use a good quality 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 and may include 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 cable typically has much higher capacitance than digital cable, which can slow down the rise time of digital data signals impairing the ability of the AES3 receiver to accurately recover the digital signal without errors. This can result in increased jitter, dropouts, or at the extreme, no audio at all.

Where to Install the X5

The best location to install the X5 is at the transmitter site, especially if the processor is to be used for FM and HD broadcasts. 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 the X5's built-in lab-grade stereo encoder which allows tighter control of modulation peaks. It also allows for easy and reliable time alignment between the FM and HD audio paths using the X5's LiveLock system.

Other benefits of a transmitter site location for the processor is the additional use of the X5's highly oversampled composite processor for an additional loudness advantage. The Wheatstone composite clipper algorithm is much cleaner and more forgiving than those in other products, and in combination with the X5's tight pilot and SCA protection filters can create additional loudness without the audible grunge that traditional composite clipper designs typically create.

We recommend that whenever there is a choice between using the AES Left/Right output of the processor or one of the composite options (analog or baseband192) that the composite output should be chosen to maximize loudness, peak control and reap the benefit of the purpose built stereo generator in the processor over the "add on" stereo generator in the exciter. While the exciter's AES3 digital input may be "clean" and it may be "digital", it also precludes the ability to gain additional loudness through the use of X5's intelligent oversampled composite clipper. Also, depending on 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 X5 is located at the studio and an STL is being used to send the program material to the transmitter site there are several options to consider, some with limitations:

SyncLink

MPX SyncLink is an optional 1RU product from Wheatstone for the X5 (sold separately) that maintains HD and FM alignment (LiveLock) from your studio to your transmitter site. It carefully keeps the HD and FM packets in sync so time alignment achieved with the processor at the studio is maintained over your STL and straight through to the receiver.

SyncLink is a viable option if you have network speeds above 20 mbps.

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 and this can rob modulation capability and therefore reduce on-air loudness.

Composite Analog STL

A high quality analog composite STL has advantages over an analog left/right STL and typically have broader audio bandwidth and better audio performance than analog discrete STL's. Most even have the capability to also piggyback subcarriers such as SCA and RDS along with the composite audio. This means that most SCA and RDS generators

may also 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 flat frequency response and phase matching requirements of the pair of audio circuits. 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.

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 employing codec-based audio compression is being used, X5 should be located at the transmitter site which places it *after* the codec. The reason for this is that 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 X5 which can create a modulation (loudness) disadvantage.

Installing X5 at the studio end of a "compressed" STL brings with it at least two caveats:

- The stereo generator and composite clipper inside X5 will not be available. Many digital exciters offer stereo generator and composite clipper functions, but their clippers have historically been quite crude compared to X5'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 is pre-emphasized. The reason for 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 fewer "opportunities" for it to remove redundant audio information and most importantly, then *mask* that removal from our hearing so that we don't notice it. When handling heavily processed (limited dynamic range) material, codec operation is usually 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 installation limitation – placing X5 at the studio end of the STL will preclude the use of X5's stereo generator and composite clipper.

TIP: If using X5 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 X5. This will prevent gross distortion and potentially large modulation overshoots.

Pre-emphasis should *always* be applied by the audio processing, not the exciter. Modern FM audio processors have highly sophisticated technology to deal with the challenges presented by FM pre-emphasis curve and can provide very tight modulation control with very low perceived distortion. FM exciters do *not* have this technology.

The best location for the audio processor from an overall *performance* standpoint is always at the transmitter.

Audio Watermark

Field experience has been that Wheatstone processing algorithms favorably pass the data watermarking scheme used in the Neilsen People Meter rating service technology, as well as the Kantar audio measurement system, regardless of the aggressiveness of the processing being performed. The X5 algorithms are no exception.

The X5 hardware also adds the additional benefit of inserting a watermark and associated hardware towards the back of the processing for both the HD and FM audio paths. This eliminates the need of having an external AGC to feed consistent audio to the encoder. You can now use the internal AGC in the X5 to do this while allowing the encoder to insert the watermark AFTER most of the processing.

AC Power Considerations

Please note that in order to enhance its long-term reliability X5 has no power switch (switches usually become intermittent over time without regular use).

X5 accepts AC line input voltages between 90 and 260VAC, 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. X5 is, after all, a highly specialized “computer.”

The use of a UPS (uninterruptible power supply) is usually recommended and will protect X5 from short duration power interruptions and glitches which might otherwise signal it to reboot. When X5 reboots there will be a loss of audio for approximately 30 seconds.

Rear Panel Connections

The image below shows the rear panel of the X5 and the location of various connectors associated with an installation.

AirAura X5's rear panel connectors from left to right are:

Bottom Row	Top Row
Analog Left Channel In	SCA-1 Input
Analog Right Channel In	SCA-2 Input
AES Insert Loop Output (Send)	TX 1 Out
AES Insert Loop Input (Return)	TX 2 Out
FM/HD Analog Left Channel Out	HD Tuner RF In (HI Level)
FM/HD Analog Right Channel Out	HD Tuner RF In (LO Level)
AES Digital Input	GPO Status Output
FM AES Digital Out (L/R or baseband192)	
HD AES Digital Out	
GPI Input	
Ethernet/WheatNet-IP Interface	
IEC Standard male AC Power Input (90-240VAC/50-60Hz)	

All audio input and output, control, Ethernet, and power supply connections are made via connectors on X5's rear panel.

- Nine XLR connectors are provided for analog and digital audio input and output connections, plus an insert loop for ratings encoders.
- Four BNC connectors are provided for SCA inputs and TX (transmitter) out, or Composite Multiplex (MPX) connections.
- There are two RF connectors on the rear of X5 for the FM/HD tuner. One is for a low level signal input, the other is for a high level input. Even though there is protection on the input of the tuner, it's best to double check that you are using a signal level appropriate for the port selected.
- One RJ-45 connector is provided for Ethernet connections, which may be used to interface X5 to a WheatNet-IP audio network or to connect it to a Windows® PC running the Wheatstone X5 APP.
- Two DB-9 connectors provide 8 GPI inputs (for selecting presets in the first eight storage slots) and four GPO outputs.

The pinout drawings on pages 1-17 through 1-20 summarize wiring connections.

Inputs

The X5 accepts *three* types of audio input sources (excluding the external loop):

- 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

The X5 accepts inputs for subcarriers (SCA) as well as high or low level RF input for the built-in FM/HD tuner.

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

FM/HD RF In – F-Type

Pin 1 F-TYPE HI LEVEL HI - FM/HD RF HI LEVEL IN HI
Pin 2 F-TYPE HI LEVEL SH -FM/HD RF HI LEVEL IN SH

Pin 1 F-TYPE LO LEVEL HI - FM/HD RF LO LEVEL IN HI
Pin 2 F-TYPE LO LEVEL SH - FM/HD RF LO LEVEL IN SH

Outputs

FM Path

Output audio for the FM path is available as:

- Balanced analog left/right stereo, pre-emphasized via the switchable FM/HD analog output.
- Balanced analog left/right stereo, de-emphasized according to pre-emphasis in use via the switchable FM/HD analog output.
- AES3 digital, either pre or post diversity delay, and/or de-emphasized according to pre-emphasis in use via the switchable FM AES output jack.
- Baseband192 AES composite signal via the switchable FM AES output jack (must interface with an FM exciter capable of receiving the baseband192 signal).
- Unbalanced composite stereo on two BNC female connectors.
- Left/Right stereo via the WheatNet-IP audio network.
- A composite WheatNet-IP signal for use with a SyncLink receiver.

HD Path

Output audio for the HD path is available as:

- AES3 digital left/right stereo via the HD AES output jack.
- Left/Right stereo via the WheatNet-IP audio network.
- Left/Right stereo WheatNet-IP signal for use with a SyncLink receiver.
- Left/Right stereo via SyncLink.

Insert Loop Out – XLR-M

Pin 1 XLR INSERT LOOP OUT SH – INSERT LOOP OUT SH
Pin 2 XLR BAL LOOP OUT HI – INSERT LOOP OUT HI
Pin 3 XLR BAL LOOP OUT LO – INSERT LOOP OUT LO

Insert Loop In – XLR-F

Pin 1 XLR INSERT LOOP IN SH – INSERT LOOP IN SH
Pin 2 XLR BAL LOOP IN HI – INSERT LOOP IN HI
Pin 3 XLR BAL LOOP IN LO – INSERT LOOP IN LO

FM/HD Analog Out – XLR-M

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

Pin 1 XLR FM/HD ANALOG RT SH – FM/HD ANALOG RT OUT SH
Pin 2 XLR FM/HD ANALOG RT HI – FM/HD ANALOG RT OUT HI
Pin 3 XLR FM/HD ANALOG RT LO – FM/HD ANALOG 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 jack located on the right side of the X5 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 APP hosts the headphone router selector. The front panel volume knob above the jack controls the audio level.

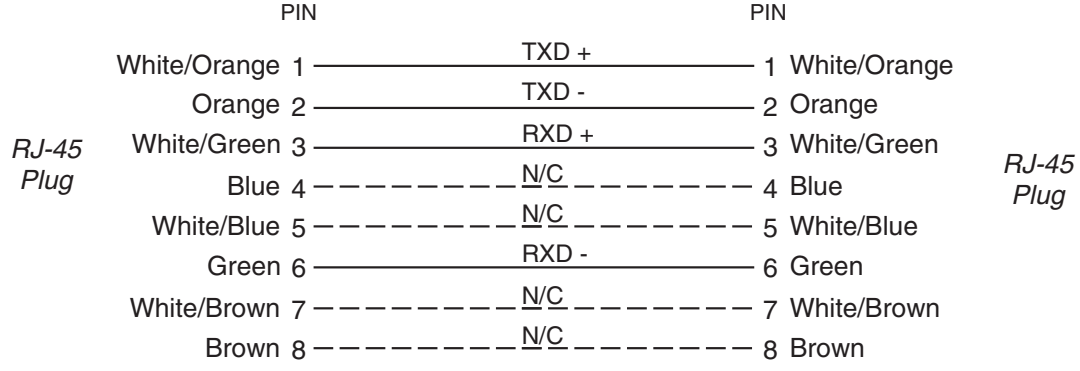
Network Connections

X5 is equipped with a wired Ethernet connection via the 100Base-T Ethernet port on the rear panel. The port is Auto-MDIX allowing it to support straight through and crossover cables in any combination. The wired Ethernet interface can support up to four simultaneous connections to remote GUI.

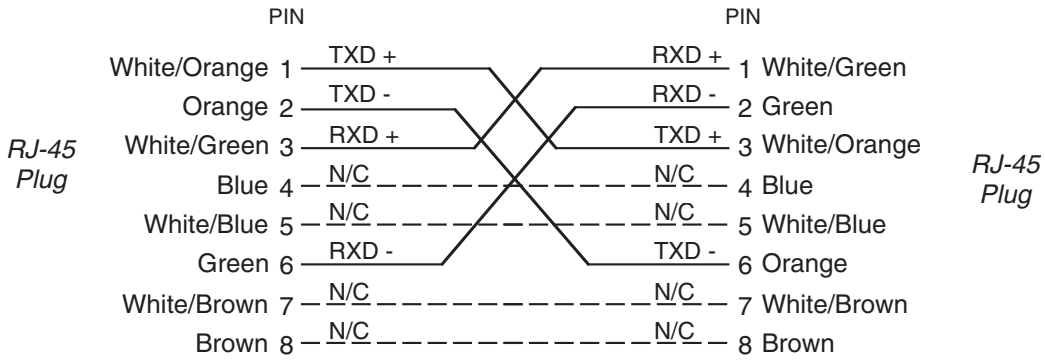
Ethernet – RJ-45

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 Straight-Through Cable



Typical Crossover Cable



General Purpose Interface (GPI/GPO)

AirAura X5 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 X5's internal circuitry to prevent external ground loops and to prevent dangerous voltages from being introduced into X5. 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 X5 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 X5 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

Starting With a Preset

The X5 comes equipped with several factory presets and can hold a combination of 160 factory and user presets in its onboard memory. Presets may be saved within X5'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 APP software. From the default system page, tap the blue button that says PRESETS. To select a preset, tap on the name and the hardware will load that preset. To scroll through presets, use the jog wheel.

Saving Presets From The Front Panel

Changes made to the processor can easily be named and saved to at the front panel. To do so, scroll to an empty slot on the preset list and push the gold SAVE SETTINGS AS PRESET button. This will activate the keyboard. You can then name the preset and, once finished, push the SAVE SETTINGS AS PRESET button to confirm. The preset is now saved and can be recalled from the front panel or the Windows remote software application.

Processing Presets

In order to prevent clicks and pops when presets are changed, preset parameters are slewed between the current parameter values and those of the new preset whenever a new preset is taken. Because of this, when changing presets, especially between presets that are tuned quite differently, it may take several seconds for the new settings to completely settle in. It is important to remember this concept; X5's preset switching is designed to make it as unobtrusive as possible and therefore parameter changes are not instantaneous. This factor must be taken into consideration whenever switching 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 APP'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 X5's hardware the preset name will again be displayed in green.

Factory presets can be readjusted and saved to new 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 consultant friend of ours advises: *"Tweak small and then listen large"*.

NOTE:

User presets that have been stored in preset slots 1 through 8 are logically assigned to the 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 APP in order for presets to control I/O settings.

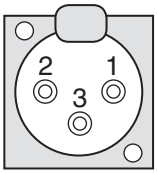
Preset storage is as follows:

- Preset slots 1 - 8 are for user presets that can be selected by the optoisolated GPI interface.
- Factory presets are installed beginning with a BYPASS stored in slot #9. Factory presets cannot be written over or deleted.
- User presets, other than the GPI selectable presets in slots 1 through 8, are stored above the highest-numbered factory preset. The number of available slots for user presets depends on how many factory presets were installed which can vary with software version. The total number of presets on X5's hardware cannot exceed 160. The storage space available for presets on the APP'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 user-locked presets.

Analog XLR Connections

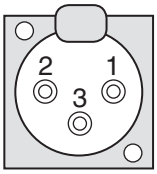
Analog IN - XLR-F

XLR LT-F



PIN 1 - LINE LT IN SH
PIN 2 - LINE LT IN HI
PIN 3 - LINE LT IN LO

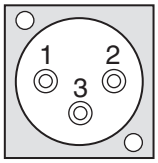
XLR RT-F



PIN 1 - LINE RT IN SH
PIN 2 - LINE RT IN HI
PIN 3 - LINE RT IN LO

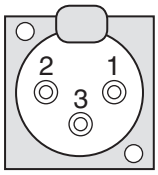
INSERT LOOP - XLR

XLR OUT-M



PIN 1 - INSERT LOOP OUT SH
PIN 2 - INSERT LOOP OUT HI
PIN 3 - INSERT LOOP OUT LO

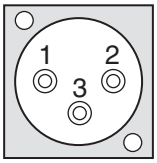
XLR IN-F



PIN 1 - INSERT LOOP IN SH
PIN 2 - INSERT LOOP IN HI
PIN 3 - INSERT LOOP IN LO

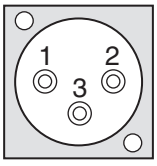
FM/HD ANALOG OUT - XLR-M

XLR LT-M



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

XLR RT-M

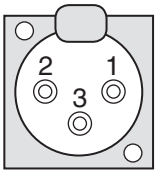


PIN 1 - FM/HD RT OUT SH
PIN 2 - FM/HD RT OUT HI
PIN 3 - FM/HD RT OUT LO

Digital XLR Connections

AES IN - XLR-F

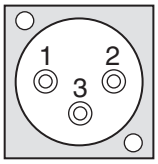
XLR-F



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

AES FM Out/baseband 192 - XLR-M

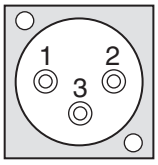
XLR FM-M



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

AES HD Out - XLR-M

XLR HD-M



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

BNC Connections

BNC - SCA

1 

PIN 1 - SCA 1 IN HI - CENTRAL PIN
PIN 2 - SCA 1 IN SH - SHELL

2 

PIN 1 - SCA 2 IN HI - CENTRAL PIN
PIN 2 - SCA 2 IN SH - SHELL

BNC - TX

1 

PIN 1 - TX 1 OUT HI - CENTRAL PIN
PIN 2 - TX 1 OUT SH - SHELL

2 

PIN 1 - TX 2 OUT HI - CENTRAL PIN
PIN 2 - TX 2 OUT SH - SHELL

F-type Connections

F-type - FM/HD RF

HI LEVEL 

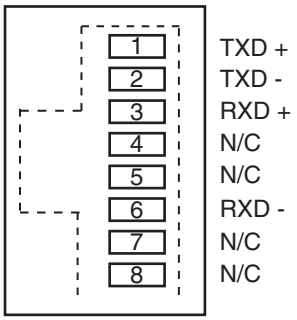
PIN 1 - FM/HD RF HI LEVEL IN HI - CENTRAL PIN
PIN 2 - FM/HD RF HI LEVEL IN SH - SHELL

LO LEVEL 

PIN 1 - FM/HD RF LO LEVEL IN HI - CENTRAL PIN
PIN 2 - FM/HD RF LO LEVEL IN SH - SHELL

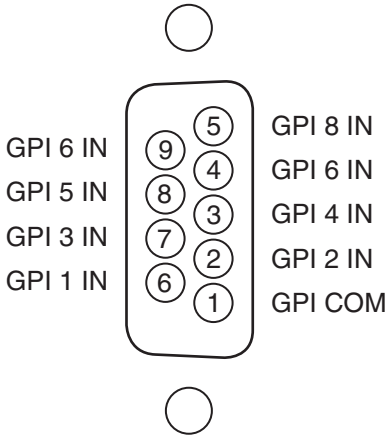
Ethernet - RJ-45

RJ-45 ETHERNET

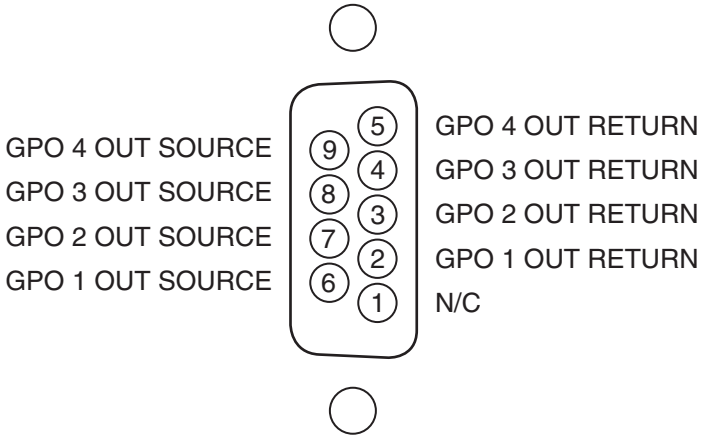


General Purpose Interface - DB-9

GPI - DB-9



GPO - DB-9

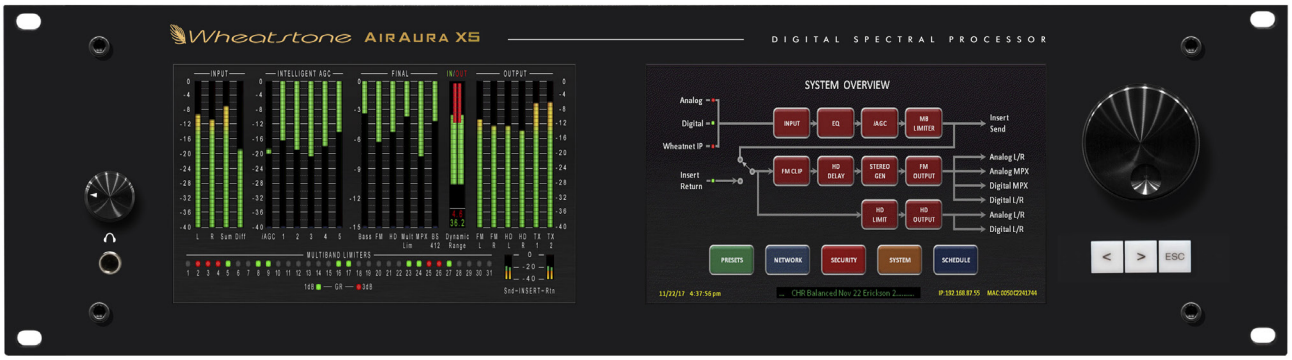


Front Panel APP and Meter Display

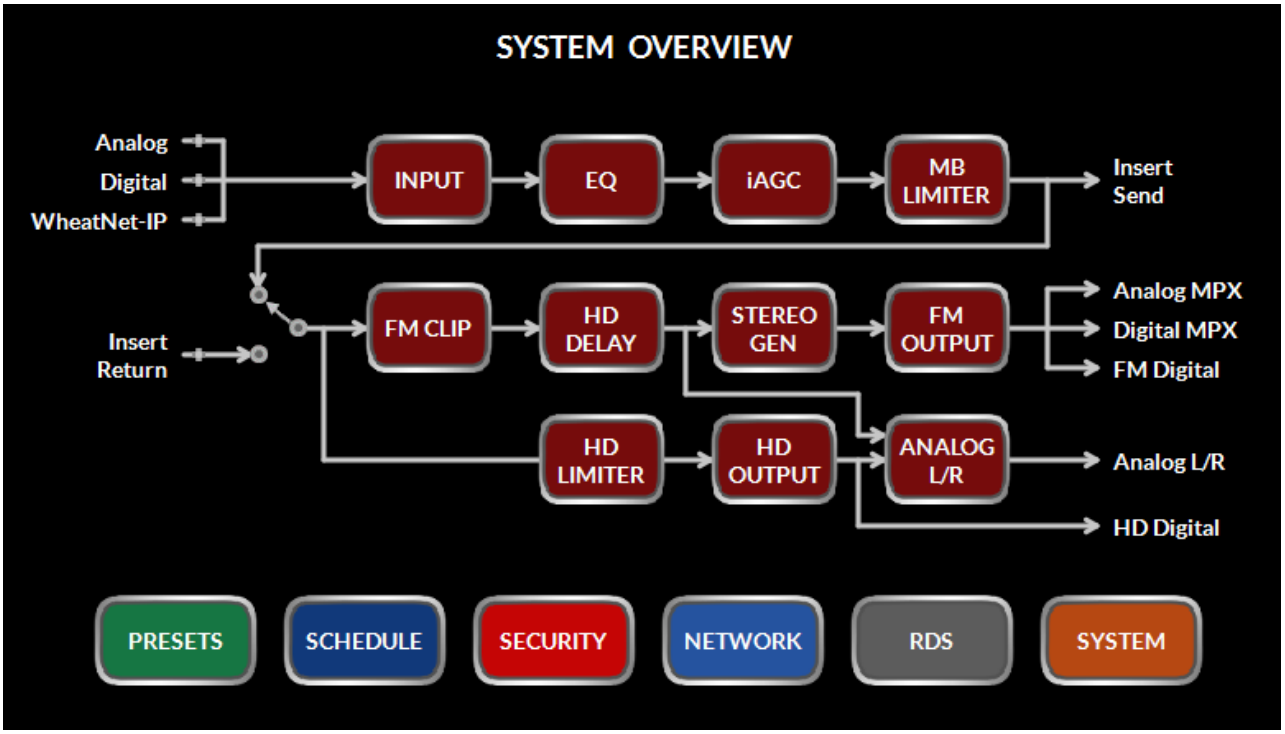
Chapter Contents

Front Panel APP and Meter Display

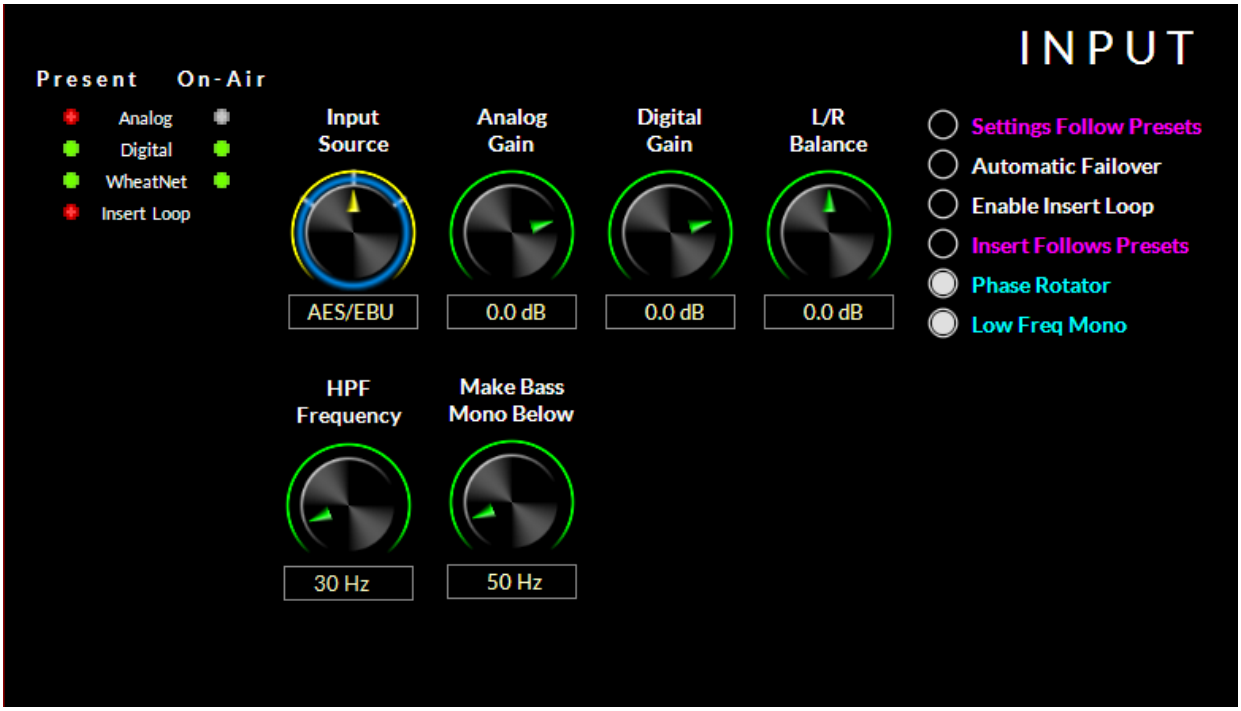
Overview



The X5 front panel features two touchscreens. The left screen is dedicated to metering and analysis (different analysis modes can be revealed by swiping left or right like you would on a smartphone). The right screen hosts our highly-regarded "Audio Processing Guru®" user interface. These are the key controls governing each stage of the audio processor that makes it easy to set up and adjust the sound. For more comprehensive controls, you will need to connect to the hardware using the Windows APP interface.



Input Screen



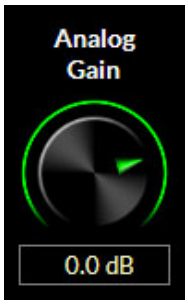
Touching the INPUT block on the right front panel touchscreen brings up the input controls. This allows you to select the input source, digital gain, left/right balance (to correct for left/right level discrepancies), phase rotator, high pass filter, automatic failover (analog to digital OR digital to analog in the event of audio loss) and activation of the insert loop.

Input Source

To change the input source, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to scroll thru the options available. There are three input source options. Analog, AES/EBU, or WheatNet-IP. Once the correct input source has been selected, push the knob in to activate.

NOTE: The source will not change unless you push the knob in to confirm your choice. The control will time out and default to the current source after 15 seconds if no other selection is made.

Analog Gain



Offsets the input level of the analog signal. This control is active only when analog is selected as the input. To change the analog gain, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the gain. The input level will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Digital Gain

Offsets the input level of the AES or WheatNet-IP signal. This control is active only when AES/EBU or WheatNet-IP is selected as the input. To change the digital gain, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the gain. The input level will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Note: The digital gain control adjusts the input level for both the WheatNet-IP source as well as the AES source.

L/R Balance

Offsets the left/right balance of the selected input. To change the left/right balance, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to favor gain to the left or the right channel. The balance will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

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 would not be perceptible to a listener.

To change the high pass filter frequency, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to set the desired frequency. The options are: OFF and 20-50Hz in 5Hz steps. Once the desired frequency has been reached, push in the knob to confirm the change.

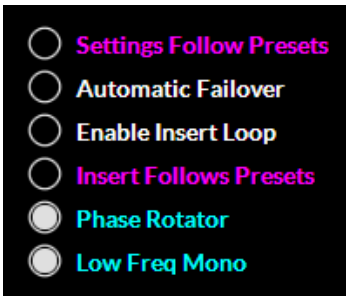
Make Bass Mono Below

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 typically correlated with the program material (it's hum, etc.). Therefore by setting the MAKE BASS MONO BELOW to a higher filter cutoff frequency than the HIGH PASS FILTER setting, this noise can be rejected.

The Difference channel (which is what the MAKE BASS MONO BELOW is really controlling) rarely contains bass or other low frequency signals and what signals there are, are probably not desired.

To change this option, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to set the desired frequency. The ranges are: 50-500Hz in 50Hz steps plus OFF. Once the desired frequency has been reached, push in the knob to confirm the change.

Other Input Screen Options



There are a few other options on the input screen other than system gain controls. These are found at the upper right corner. When an option is selected, the white circle will fill. Selecting an option is as simple as touching the circle next to the desired feature to toggle between ON and OFF.

Settings Follow Presets

When selected, this option allows all the settings on the INPUT PAGE to be governed by the preset. Input gain, L/R balance, Codec Masking, etc. can change based on preset. The default mode is to NOT have this option selected. In that case, all of the adjustments on this page remain the same regardless of the selected preset.

Automatic Failover

Automatic failover from AES/EBU 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.

Before you set the automatic failover, make sure you are on the input source that will be your primary audio source. To set the automatic failover, tap the button.

Enable Insert Loop

The insert loop option allows the user to insert a ratings encoder watermark or any other AES signal into the middle of the X5's "airchain". The primary purpose is to allow the user to have the X5's iAGC and five band processing appear before any ratings encoder so that the encoder is fed a consistent level.

Prior to this option, many users resorted to external AGC's to feed the ratings encoder prior to the main processor. Adding an additional gain control device to the airchain had the tendency to cause audible fighting between the external AGC and the internal AGC in the main processor. Defeating the AGC in the main processor was not always an option.

The correct solution is to provide an insert point in the main processor's audio path to accommodate the ratings encoder. This way, not only do we have one AGC that controls the input level to the processor AND the ratings encoder, we can now place the ratings encoder towards the back of the processing so the watermark is less likely to be altered by any previous multiband stages.

The upper left corner of the X5 input screen shows status indicators in two columns. One shows if audio is present at the input, the other column shows which audio is actually on air. There is a status indicator for the insert loop AES audio. ***Double check to make sure this indicator is green before touching the button to enable the insert loop.***

NOTE: If there are no devices in the insert loop, audio will be interrupted if you enable the insert loop. The insert loop accepts AES/EBU signals only. The default sample rate is 48kHz. If you desire the sample rate of the loop to be 44.1kHz, you will need to feed a 44.1kHz signal to the main AES input of the X5. As of this writing, there is no audio failover for signal loss in the insert loop.

The insert loop send and return levels are fixed. The send level is normally within a target of -24dBFs to -12dBFs, depending on how aggressive the processing is set up in the preceding multiband. If you are only looping the ratings encoder, the return audio should be at the same amplitude as when it left the processor. If you are adding any other devices into the insert loop, refer to their documentation for proper audio level line up procedures.

Insert Follows Presets

Insert Follows Presets allows the user to select whether or not the insert loop activates or deactivates based on a preset. If two presets are saved, one with the insert loop in and one with the insert loop out, choosing this option will turn on and off the insert loop when the presets are taken. If this option is not chosen, the insert loop will remain in the last known state when the presets are taken.

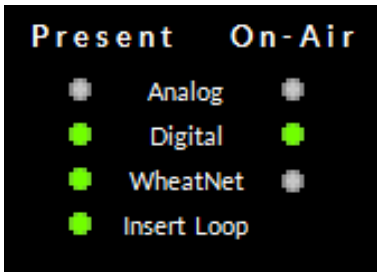
Phase Rotator

The phase rotator helps correct asymmetrical audio often found in human voice. It is recommended to leave the phase rotator "ON" especially if you plan to process aggressively. To turn the phase rotator on or off, tap the button.

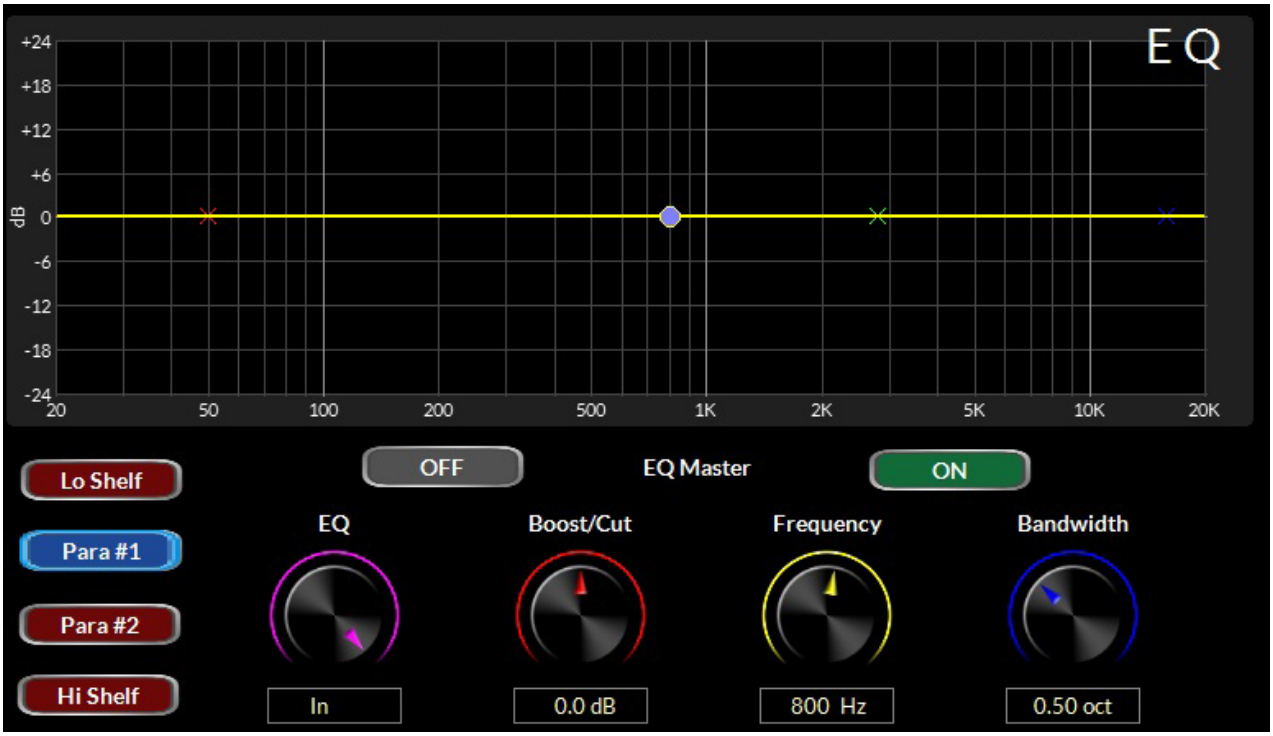
Status Indicators

The upper left corner of the X5 input screen shows status indicators in two columns. One column shows if audio is present at the input, the other column shows which audio is actually on air. Green indicators indicate audio is present or on air.

In the example on the right audio is NOT present at the analog input, but IS present at the Digital (AES), WheatNet-IP and Insert Loop. The Digital (AES) audio is switched to air.



EQ (Equalizer)



Touching the EQ section of the flowchart brings up the X5's Equalizer page. This four band equalizer, with two parametric and two shelving filters, helps shape the footprint of the tonal balance of your audio. Working in concert with the iAGC stage, the EQ page allows the user to safely add bass, presence and high frequency texture while maintaining consistent tonal balance even under extreme conditions in the source material.

Each of the four buttons on the lower left (labeled **Lo Shelf**, **Para #1**, **Para #2** and **Hi Shelf**) allows access to the adjustments for the particular band. The options are BOOST/CUT, Frequency and Bandwidth.

Above the controls is the EQ Master, which allows the user to switch all four EQ bands on or off.

Shelving EQ (Lo Shelf & Hi Shelf) vs. Parametric Options

The Lo Shelf and Hi Shelf EQ's feature two user adjustments, Boost/Cut and Frequency. The middle two bands are Parametric and add a third adjustment, Bandwidth.

Boost/Cut

This control adds or subtracts gain to the EQ band. To change the gain, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to set the desired gain. The range is -14dB to +14dB.

Frequency

This knob sets the center frequency of the chosen EQ band. The Lo Shelf frequency range is 20-500Hz while the Hi Shelf frequency range is 2-20kHz. The two parametric EQ's can be set anywhere from 20Hz to 20kHz, giving you the flexibility of enhancement anywhere you feel you need.

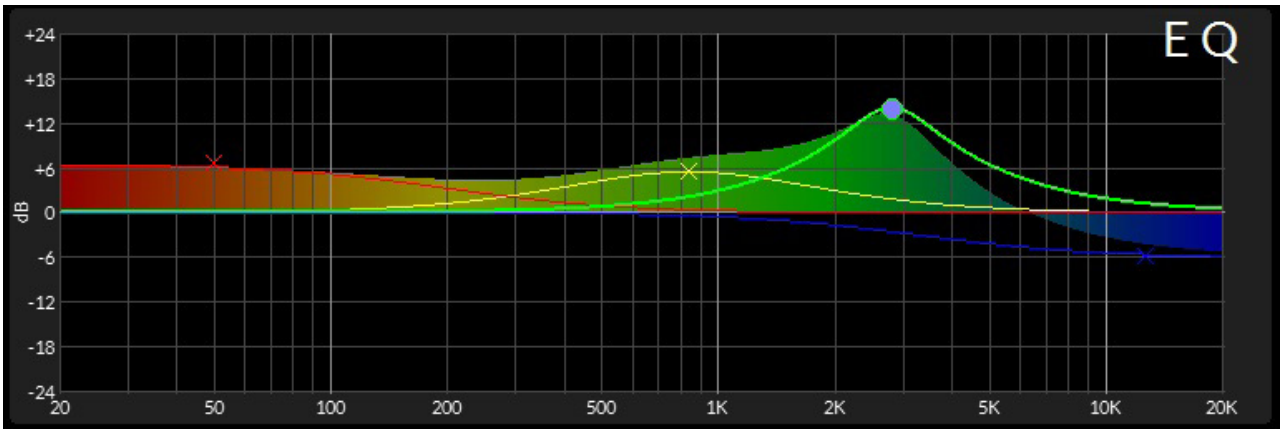
To change the frequency, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to set the desired frequency.

Bandwidth (Only Available in Para#1 and Para#2)

The Bandwidth knob selects how broad the boost or cut of the parametric EQ is. Higher numbers will affect more of the spectrum while lower numbers will pinpoint control.

To change the bandwidth, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to set the desired frequency. The range is 0.5 to 3 octaves.

EQ Graph



The on screen EQ graph display gives you a quick visualization of what's actually going on when adjusting parameters.

The colorful "X" markers show where in the frequency range the individual EQ bands are set. The blue dot replaces the "X" on the frequency band currently being adjusted. Shaded areas indicate the resulting frequency response.

EQ Master

The EQ master buttons above the adjustors turn on and off the equalizer. When off, the EQ is placed in bypass. When on, the EQ is placed in the chain. EQ settings are not lost when the EQ is bypassed, thus it is easy to A/B the audio with and without EQ.

iACC

Touching the iAGC block on the front panel touchscreen brings up the controls for the five band processing. To the left of the controls are seven buttons, each allowing adjustment of the seven key sections of the iAGC processing. Tapping the top button (iAGC) brings up the controls seen above. The following is a description of the functions these controls perform.

Drive

Offsets the drive level to the five band processing. The range is -12dB to +6dB. Higher numbers will lead to more consistent processing at the expense of a tradeoff to quality. Lower numbers will yield a more open, true-to-the-source sound.

To change the drive, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the gain. The level will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Gate Mode

Determines whether or not the processing will freeze when audio falls below the user defined threshold, or whether the gain will continue to leak up, albeit at a rate 100 times slower. The options are Hold and Slow Release. To change this option, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the gain. The processing effect will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Window Size

When the iAGC is measuring dynamic range, the user has some control over limiting how much of that measurement is applied to the five band dynamics. The widow size control is the most important tool in making that decision. Lower numbers will mean the nearly all audio measurement will have some effect on the five band dynamics. Higher numbers mean that the changes from the iAGC control will be made more gradual and averaging. The range is 0 (most changes) to 20 (least amount of changes). To change the Window Size, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the settings. The processing effect will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Window Attack

Governs how quickly the iAGC makes changes to the five band processing to correct audio. There are nine positions in this control. Eight of the nine are manual controls... that is, they attack based on the user setting (Slowest, Slower, Slow, Med Slow, Med Fast, Fast, Faster, Fastest). The center position is Auto. When in this position, the attack time is program dependent.

To change the master attack, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the type of attack. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Window Release

Governs how quickly the iAGC releases control back to the five band once corrections are no longer needed. There are nine positions in this control. Eight of the nine are manual controls… that is, they release based on the user setting (Slowest, Slower, Slow, Med Slow, Med Fast, Fast, Faster, Fastest). The center position is Auto. When in this position, the release time is program dependent.

To change the window release, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the type of release. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Couple Reference

Defines which band in the five band dynamics section will be the master. Band 3 has a more balanced sound, Band 2 has a warmer, analog type sound. To change the coupling, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to choose the band you wish to be the reference. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Multiband Gate

Sets the gate threshold of the five band processor. Below this value, the multiband processor will no longer add gain to the audio and will freeze if below the gate level (gain reduction will still occur as needed).

To change the gate offset, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the gate settings. The processing effect will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Window Gate

Sets the gate threshold of the windowed processing in the iAGC. Below this value, measurement activity is no longer applied to the audio and the processing acts more like a traditional AGC.

To change the gate offset, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the gate settings. The processing effect will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Bass Offset

Adjusts the bass adaptation of the iAGC measurement system. At 0, the iAGC measures all audio equally. When you back off the bass offset, bass frequencies are treated differently for better bass management/impact.

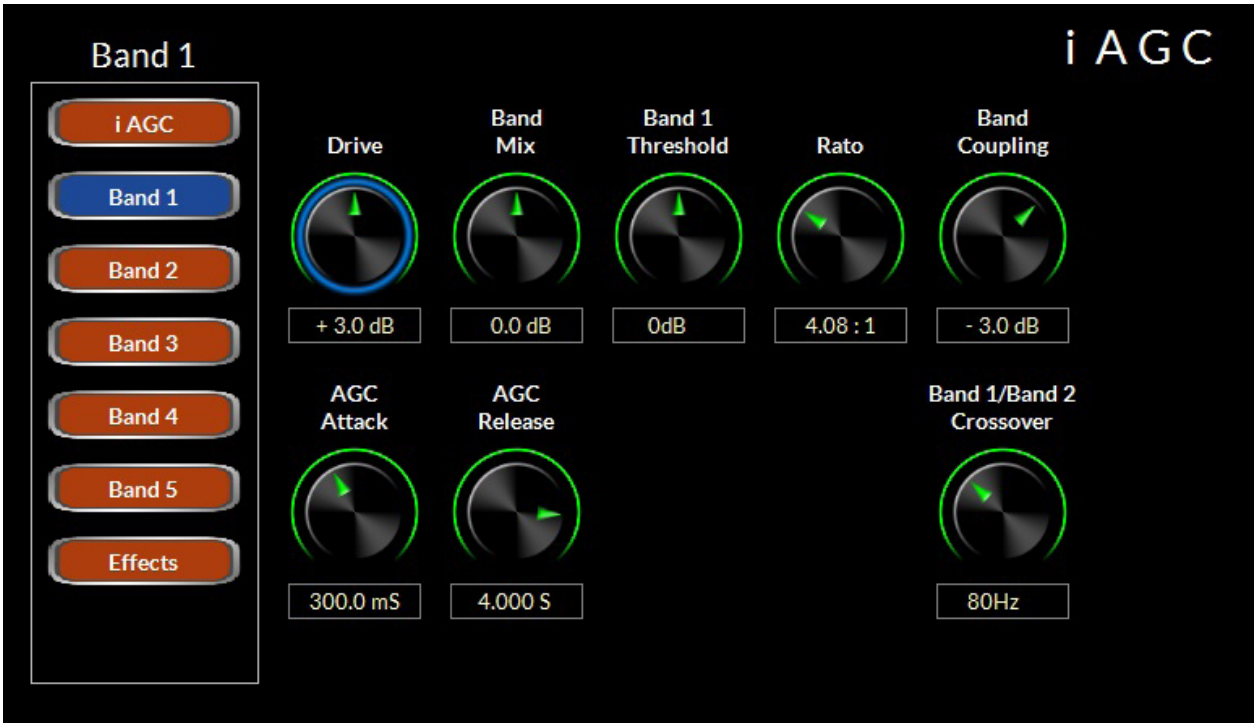
To change the bass offset, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the setting. The processing effect will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Window Enhance

Allows the five band dynamics to “fill in” audio for a more radio-like sound from the processing. The NORMAL setting strikes a good balance between open audio and a tastefully processed sound on some audio. Higher numbers allow for more fill and a more processed sound while lower numbers allow for a more open sound (classical, jazz, spoken word formats).

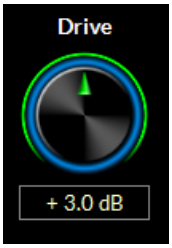
To change the window enhance, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the setting. The processing effect will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value gain. The processing effect will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Five Band Dynamics



Tapping one of the Band 1-5 buttons will bring up a screen with these controls that allow the end user to tailor the individual bands of processing to their taste. The following is a description of the functions these controls perform.

Drive



Determines the amount of input signal applied to the five band audio processing— less drive creates a more gentle sound. Higher settings make the sound more aggressive by increasing short term density.

To change the Drive control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the gain. The level will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Band Mix

This knob sets the output level of the band selected. You can quickly boost or cut the output mix of the selected band with this control.

To change, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the gain. The level will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Band Threshold

Sets the threshold of the processing for the band selected. Lower numbers yield more gain reduction and lower band output with longer term correction.

To change, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the gain. The level will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Ratio

Sets the ratio of the five band compressor. This determines how aggressively the compressor exhibits control on the audio. A ratio of 2:1 indicates that a signal exceeding the user set threshold by 2dB will be attenuated by 1 dB. A ratio of 20:1 means that up to 20dB of change can occur on the input with only a 1dB change on the output.

To change, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the value. The audio will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

Band Coupling

Band coupling lets the user define the amount of independence a particular band can have from neighboring bands. Lower numbers let the bands act more independently to re-equalize the sound. When the numbers are closer to 0 (or at 0), the bands are more tightly coupled for a sound more faithful to the source.

To change, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the value. The audio will change in real time as you move the knob. Once you have reached the desired level, push in the knob to confirm the new value.

AGC Attack

Sets the speed at which the selected AGC band corrects increases in audio level. Higher numbers yield a slower response time and lets more audio through to later stages of processing downstream. Lower numbers yield a quicker response for more control at this stage.

To change the AGC attack, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob change the value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

AGC Release

Governs how quickly the selected band recovers after correcting the level increase in the audio. Higher numbers yield a slower release time for a more open sound. Lower numbers yield a quicker response time for a fuller sound less consistent to the source.

To change the setting, tap the control. You will see a blue ring indicating the

control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Band Crossover (Bands 1-4)

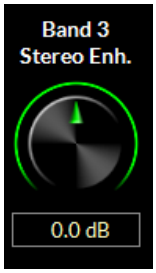
Bands 1-4 have an extra control to set the crossover point. This is the upper frequency range at which the selected band will process audio. For instance, if Band 1 is set at 80Hz, all audio below that point will be processed by that band.

To change the setting, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Effects Controls

The last tab on the row to the left of the controls is the Effects controls. These controls set the output level of each of the five bands of dynamics, plus they allow the user to add stereo enhancement per band if needed.

To change the output settings of any of the five band mix controls in the top row, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.



The lower row of controls are for stereo enhancement on a frequency dependent basis. As in previous Wheatstone processors, the X5 allows you to dynamically adjust stereo enhancement. Dynamic enhancement occurs because the processor actually measures the difference signal in the multiband dynamics, accounts for the amount of enhancement the user has requested by the controls, and dynamically adjusts the stereo sound field for added enhancement without the risk of excess enhancement.

Each of the four controls (no dynamic enhancement is available or necessary for frequencies in Band 1) allows you to tailor the difference output (L-R) for four of the five bands of processing.

To change the output settings of any of the four band stereo enhancement controls on the lower row, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Multiband Limiter

The multiband limiter controls allow the user to tailor the sound of the FM and HD limiters after the main dynamics section. There are six controls available from the front panel. The Windows based remote app allows more options for users that want finer customization. Adjustments to please most users can be found here.

Clipper Drive

This is the master drive control to the entire back end of the X5. Higher numbers will yield a louder, more processed sound at the eventual expense of distortion and fatigue.

To change the clipper drive control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Multiband Knee

Sets the shape of the limiter in the X5. Soft knee always favors limiting the audio over the Hard knee, which will favor clipping the audio.

To change the multiband knee control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The two options are Soft and Hard. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Master Threshold

Sets the threshold level of all the multiband limiters. Lower numbers mean the processor will apply more limiting to the audio. Higher numbers allow the clipper to apply more peak control on the audio. Generally speaking, the limiters will have a smoother sound at the expense of some loudness, where the clippers will have a slightly more edgy sound for more loudness.

To change the Master Threshold control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Master Attack

Sets the attack time for all the multiband limiters. Faster settings mean the processor will apply quicker attack times. Slower numbers allow the clipper to apply more peak control on the audio as the limiter will allow "overshoot" into the clipper. Generally speaking, the Auto setting is recommended. On that setting, the limiters work best integrated with the main clipper.

To change the Master Attack control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Master Release

Sets the release time for all the multiband limiters. Faster settings mean the processor will apply more density via limiting. Slower numbers smooth out the audio as the limiter is less dense. Generally speaking, the Auto setting is recommended. On that setting, the limiters work best integrated with the main clipper.

To change the Master Release control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

FM Clipping

The FM Clipping controls allow the user to customize the sound of the FM peak control system as well as the texture and style of the bass processing.

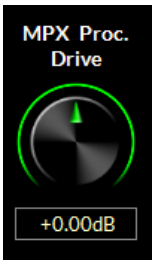
The FM Clipping system in X5 is designed quite unlike conventional systems. It's ability to achieve a tremendous amount of loudness without signal degradation is really what makes it stand out of the pack. The ability to customize the sound from the front panel, as well as the Windows based APP, makes it the clear choice for stations that need to be loud and still maintain as much clarity as possible.

Clipper Drive

This is the input level control into X5's LIMITLess clipper. Higher numbers will increase apparent loudness on the air at the expense of some tradeoff in quality of the audio signal. With the LIMITLess clipper technology, even the most aggressive formats should not need settings above +2dB.

To change the Clipper Drive control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

MPX Processing Drive



This is the input drive control into X5's composite processor. Higher numbers will increase apparent loudness on the air at the expense of some tradeoff in quality of the audio signal. Most formats will not need more than +1.0dB drive, while aggressive formats could need settings up to +1.5dB. Aggressive MPX Processing can yield a higher baseband noise floor and have a spitty sound on the air if driven above +2.0dB

To change the MPX Processing Drive control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value

Pre-Emphasis

Pre-emphasis was designed to help reduce the background noise of FM broadcasts. By raising high frequencies in the transmission system and applying a complimentary filter in the receiver, we gain additional signal to noise ratio for the listener.

In the Americas, the pre-emphasis curve is 75μs. In most other parts of the world, the pre-emphasis curve is 50μs.

To change the pre-emphasis, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

A Word On Pre-Emphasis And Various Configurations

Most processors have many options for applying pre-emphasis and de-emphasis (the complimentary filter to pre-emphasis). It can get confusing. So we will try to cover all the basics here.

If you are using the analog composite outputs in the X5

Pre-emphasis should be applied. If you are using the analog or AES output to feed headphones, you should de-emphasize these outputs or they will sound too “bright”.

If you are using baseband192 (AES composite) to feed your exciter

Pre-emphasis should be applied. If you are using the analog output to feed headphones, you should de-emphasize these outputs or they will sound too “bright”.

If you are using an AES/EBU connection to the exciter (where the exciter performs the stereo generator function)

Pre-emphasis should be applied. If you set the X5’s pre-emphasis to FLAT and apply pre-emphasis at the exciter, you will be prone to gross overshoot as many exciters do not have overshoot filters to control pre-emphasis. The best (and not always available) option if you must use an AES/EBU connection that is not composite is to always perform pre-emphasis at the processor before a linear STL path and NOT perform any further emphasis in the exciter.

Using the AES FM output to feed a codec

Pre-emphasized audio (with or without de-emphasis) should never be applied to an audio codec. If you need processing for streaming from your X5, the HD AES/EBU output or the analog outputs (set for HD) should be fed to your stream. Feeding audio managed for FM to an internet stream will reveal artifacts. If you must feed your stream with audio processed for FM, you should not expect great results.

Bass Clip

This controls the overall sound of the bass clipper. There are five options for this control:

Tight – No extra effects, tight bass drum. No out of band harmonics

Medium – Softer than Tight. Starts to add harmonics. Nice bass on small speakers.

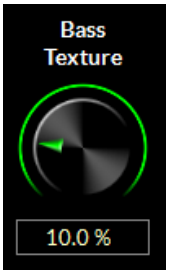
Soft – Adds more harmonics and heft with more bass sustain. Default setting.

Phat – Deeper feel for urban based formats. Progressively more harmonics.

Growl – Edgy type bass for rock formats or urban with subwoofer style presentation.

To change the bass clipper mode, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Bass Texture



This controls the overall texture of the bass clipper. Think of it as a smooth, edgy control for the bass. Lower numbers yield a smoother sound, higher numbers give a more exciting, edgier sound if that is what is desired.

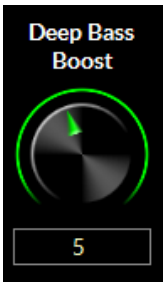
To change the bass texture, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Low Frequency Extension

The Low Frequency Extension control allows very low bass to be tailored as required for the program format. Lower settings decrease the effect while higher settings increase it. Very high settings (above about 6) increases the presence of very low bass and adds additional bass harmonics which help small speakers sound like they have better low frequency response than they physically do (Google "Missing Fundamental"). When the control is set to the "0" position the low frequency extension effect is turned off.

To change the low frequency extension, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Deep Bass Boost



Deep Bass Boost enhances frequencies below 75Hz. This allows the user to add a "subwoofer" type effect on the bass. Perfect for CHR, Urban and Hot AC formats that want to enhance the low end for a big, fat sound. Higher numbers add more to the effect.

To change the deep bass boost control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel

knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Mids and Highs Texture

With its ability to manage pre-emphasis, there may be certain situations where it is desired to have a more traditional sound out of the audio processor to match the texture of a particular market or achieve a desired sound. This is where the Mids & Highs Texture control comes into play. Softer settings (7:00-12:00 on the control) will reduce some transient detail in the audio, making for a more rounded shape to the highs. Harder settings (12:00-5:00 on the control) will enhance transients and give the appearance of less processing in the highs.

To change the control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The values are Soft--, Soft-, Soft, Medium, Hard, Hard+, Hard++. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Voice Protect

Under extreme processing, it is sometimes necessary to process voice in a different way than music. Under most situations, X5 can run in extremely competitive situations with minimal loss of quality on dry voice. However, some may feel the need for extra protection from the processor for dry voice. This is where voice protect comes in. When dialed in, voice protect treats dry voice with an additional limiter to smooth out any edginess that may arise due to competitive processing. Voice protect only activates on dry voice and with settings of -4 or higher is virtually undetectable.

To change the voice protect control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Bass Thump

Bass Thump helps increase the effect of kick drums and bass product prominent in CHR and Urban cuts. Together with Deep Bass Boost, Bass Thump can help pull out detail in bass, rather than creating an overall droning bass sound that is prominent in competing processors.

To change the bass thump control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

HD Limiter

The HD Limiter controls allow the user to custom the sound of the HD peak control system.

Limiter Drive

This is the input level control into X5's HD Limiter. Higher numbers will increase apparent loudness on the air at the expense of some tradeoff in quality of the audio signal.

To change the Limiter Drive control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Limiter Attack

Governs how quickly the X5 HD Limiter corrects for peaks. The control is scaled for the actual speed of the attack time (0.2mS – 30mS).

To change the Limiter Attack control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Limiter Release

Governs how quickly the 31-band limiter recovers after correcting audio. Faster settings will make the HD limiting sound more obvious. Slower settings may decrease loudness for a more open sound. A good starting point is a release time of about 130-150mS.

To change the Limiter Release control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Delayed Release

The sophisticated X5 HD Limiter has a secondary, long term release algorithm called Delayed Release. This secondary release control establishes a long term release platform that the primary limiter works off of. The Delayed Release helps prevent pumping of unnatural gain changes in the main limiter. A good release time for the Delayed Release is 1000mS (1.0 S). In general, it is best to run the delayed release at least 3X what the main release value. For instance, if the main release is at 130mS, the delayed release should be AT LEAST 390mS or slower.

To change the Delayed Release control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Limiter Enable

This controls turns on or off the HD Limiter. Wheatstone always recommends this control remain on for maximum audio consistency and peak control.

To change the mode, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

L/R Link

This gives the user the option to couple or de-couple the left/right channels of the limiter. When coupled, the channel with the most gain reduction controls the opposing channel.

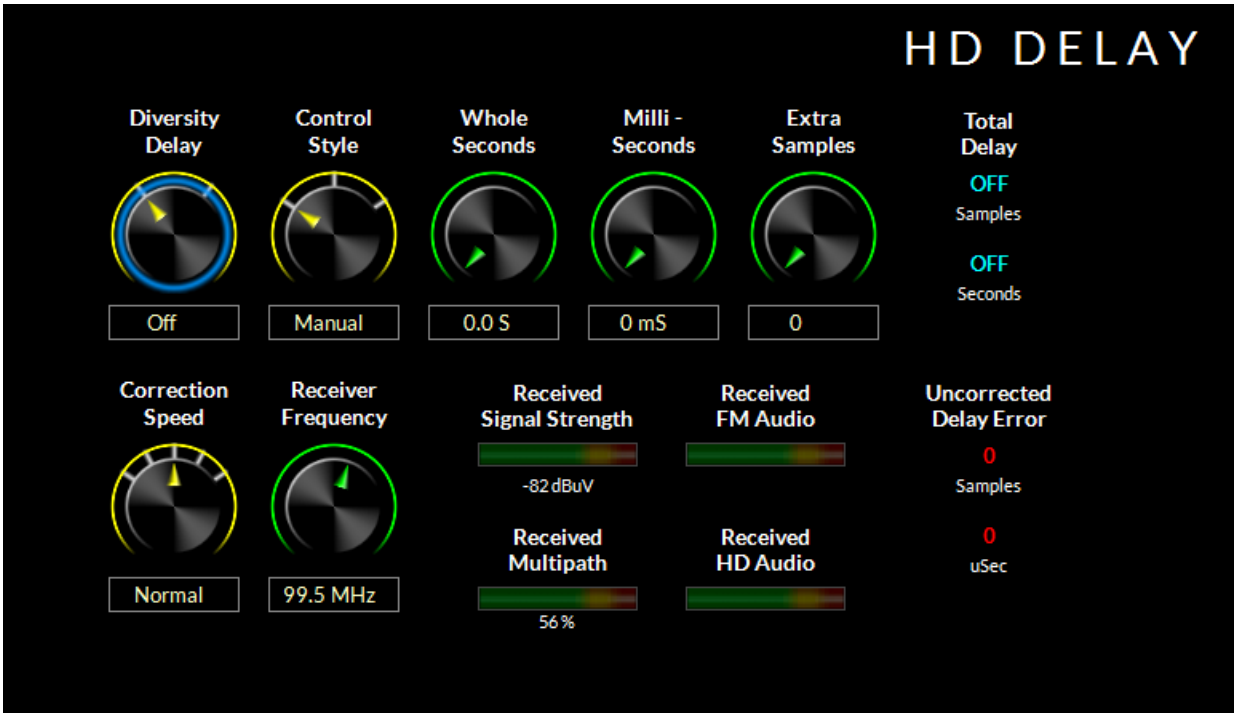
To change the mode, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

Delayed Release (Yes/No)

Turns on or off the delayed release option. YES means the delayed release is active, NO means it is bypassed.

To change the mode, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the knob to confirm the new value.

HD Delay



Located in the FM audio path, the HD delay system in X5 is the most sophisticated in any broadcast audio processor on the market. With the addition of an FM/HD tuner in X5, delay can now be automatically synced using this system without the need for 3rd party devices.

Diversity Delay

When switched on, the diversity delay system is engaged.

To change the mode, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. Once you have reached the desired setting, push in the knob to confirm the new value.

Control Style

There are three options for Control Style:

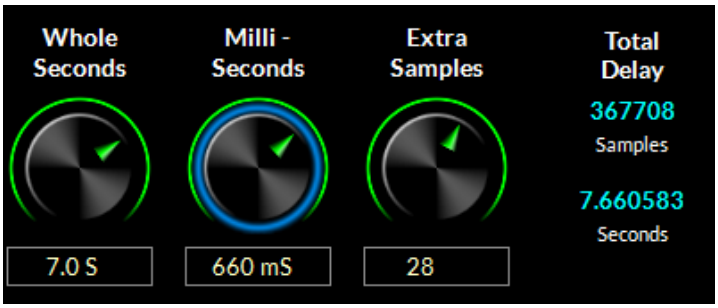
Manual – Allows the user to adjust the HD delay manually.

Monitor – Also allows manual adjustment, but will also measure the delay and show the correction error.

Auto Adjust – Allows for manual adjustment of the delay to within the window of the auto correct algorithm. The algorithm, to work properly, must have the delay error set within 1 second in order to auto-correct.

To change the mode, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. Once you have reached the desired setting, push in the knob to confirm the new value.

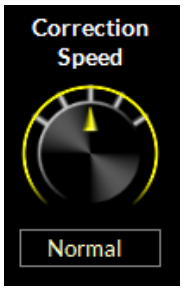
Delay Time



The image on the left shows an example of the corrected delay in time (seconds) and samples. Here the knobs show 7.660583 seconds of delay, or 367,708 samples. If Auto Correct is used, and the X5 auto correct algorithm has achieved these settings, no other user intervention is needed as the tuner/ algorithm consistently checks to make sure alignment is maintained.

To manually adjust or offset the delay, set the control style to Monitor (see above), then tap on one of the three knobs you want to correct. Using the front panel knob, select the new value. The value will change the Total Delay display to the right, showing you the new value of the delay.

Correction Speed



There are five settings for the HD Delay Control Style: Slowest, Slow, Normal Fast, and Fastest. We recommend the Slowest setting for most applications as it performs the least noticeable delay time correction. How each control position performs the correction is as follows:

Slowest: The delay error is adjusted by 100% of the error or a maximum of five samples per step, whichever is smaller.

Slow: The delay error is adjusted by 10% of the error and when the error is equal to or less than five samples the correction assumes the **Slowest** mode for any remaining error.

Normal: The delay error is adjusted by 20% of the error and when the error is equal to or less than five samples the correction assumes the **Slowest** mode for any remaining error.

Fast: The delay error is adjusted by 40% of the error and when the error is equal to or less than five samples the correction assumes the **Slowest** mode for any remaining error.

Fastest: The delay error is adjusted by 80% of the error and when the error is equal to or less than five samples the correction assumes the **Slowest** mode for any remaining error.

In any setting, if the remaining error is not zero, a minimum of one sample adjustment is made to cause the error to be zero.

To change the mode, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. Once you have reached the desired setting, push in the knob to confirm the new value.

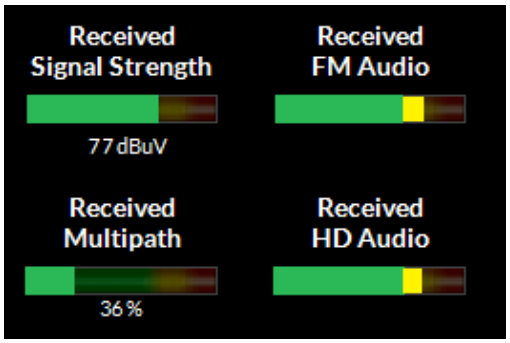
Receiver Frequency

Changes the receive frequency of the FM/HD tuner. For the system to function, the tuner must be set to the frequency of the radio station the processor is being used on.

To change, tap the knob. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to change frequency. Once the correct frequency has been selected, push the knob in to confirm.

Signal Conditions

The signal condition graphs show the Received Signal Strength, Multipath and have bar graph indicators for received FM audio and received HD audio. These are pulled from the FM/HD tuner built into the X5.

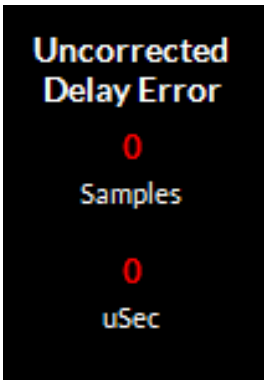


NOTE: The Received FM Audio and Received HD audio graphs are not indicative of modulation. They are merely there to show that audio is present. For proper modulation setup, a type accepted modulation monitor should be used.

Uncorrected Delay Error

When the X5 delay system is used in either Monitor or Auto Adjust modes, the currently measured delay error is shown here. This allows the user to walk in the correction manually if that is what is desired.

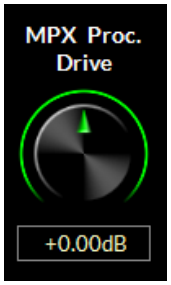
If the delay is within 1 second, the difference is within the window of correction for the automatic system. Depending on how fast the correction speed is set for (see above) is how fast the error correction can happen.



Stereo Generator

The Stereo Generator page allows users to adjust the composite processor and composite outputs as well as the SCA inputs, Wheatstone's Multipath Limiter and BS.412 limiter (for some European customers).

MPX Processing Drive



The MPX Proc. Drive control allows the user to adjust the user selectable clipping OR limiting depth of the MPX processor. Under normal circumstances, the drive control should be set for +1.5 to +2.0dB for competitive loudness (these values will differ slightly depending on whether the processing mode is set for Limiter or Clipper).

To change the MPX Proc. Drive, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. Once you have reached the desired setting, push in the knob to confirm the new value.

MPX Processing Type

The X5 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.

Lookahead Limiter

This option processes the composite stereo waveform with a highly-oversampled lookahead limiter with fully automatic attack and release times. Its extremely high sample rate precisely controls composite waveform peaks on a cycle by cycle basis.

To change this setting, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. Once you have reached the desired setting, push in the knob to confirm the new value.

Pilot Injection

Sets the pilot tone injection level. Normally should be at 9%.

To change the pilot injection level, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. Once you have reached the desired setting, push in the knob to confirm the new value.

Multipath Limiter

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 Multipath Limiter does.

When active, the multipath limiter will restrict the L-R information in the audio signal to a percentage of the overall L+R, and this control is calibrated in %. In almost all cases, we recommend starting with a setting of 70%. If your radio station is prone to receiver blend, reduce the control to 60 or 50% and listen for improvements.

To change the multipath limiter control setting, left click on the knob and use the mouse wheel to turn on or off. Left click again to confirm your choice.

MPX Mode

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.

To change the multipath limiter control, tap the control. You will see a green ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

MPX Power (BS.412)

Turns on or off the BS.412 Power Controller. The BS.412 MPX Power Controller's sole purpose is to reduce program density as required in certain European countries. **If you are not required to use the BS.412 Controller <u>do not</u> turn this feature on.** Enabling the BS.412 MPX Power Limiter can result in up to a 5dB loss in loudness.

To change this setting, left click on the knob and use the mouse wheel to turn on or off. Left click again to confirm your choice.

The X5's BS.412 MPX Power Controller can be set in 0.1dB increments from +12dB to 0dB. When the control is in any position it is measuring the

current MPX Power level on the BS.412 meter on the front panel and APP. Calculated corrections to the MPX power are only made when the BS.412 control is switched on, and when it is, modifications to the MPX power will take place immediately!

IMPORTANT!

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

When the BS.412 is switched on, 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.

Calibration Offset

When adjusting the BS.412 algorithm, there may be a need to slightly recalibrate the main adjustor to offset any differences in monitoring equipment. The tolerance for the BS.412 standard is +/-0.3dB. The Cal Offset control allows you to fine tune the main BS.412 control without having to change it's value. The control is calibrated in 0.01dB steps.

To change the value, tap the control. You will see a green ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

ITU-R BS.412 (On/Off)

Turns on or off the BS.412 power controller.

IMPORTANT!

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

To change the value, tap the control. You will see a green ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

Settings Follow Presets

Output Settings Change With Preset Takes:

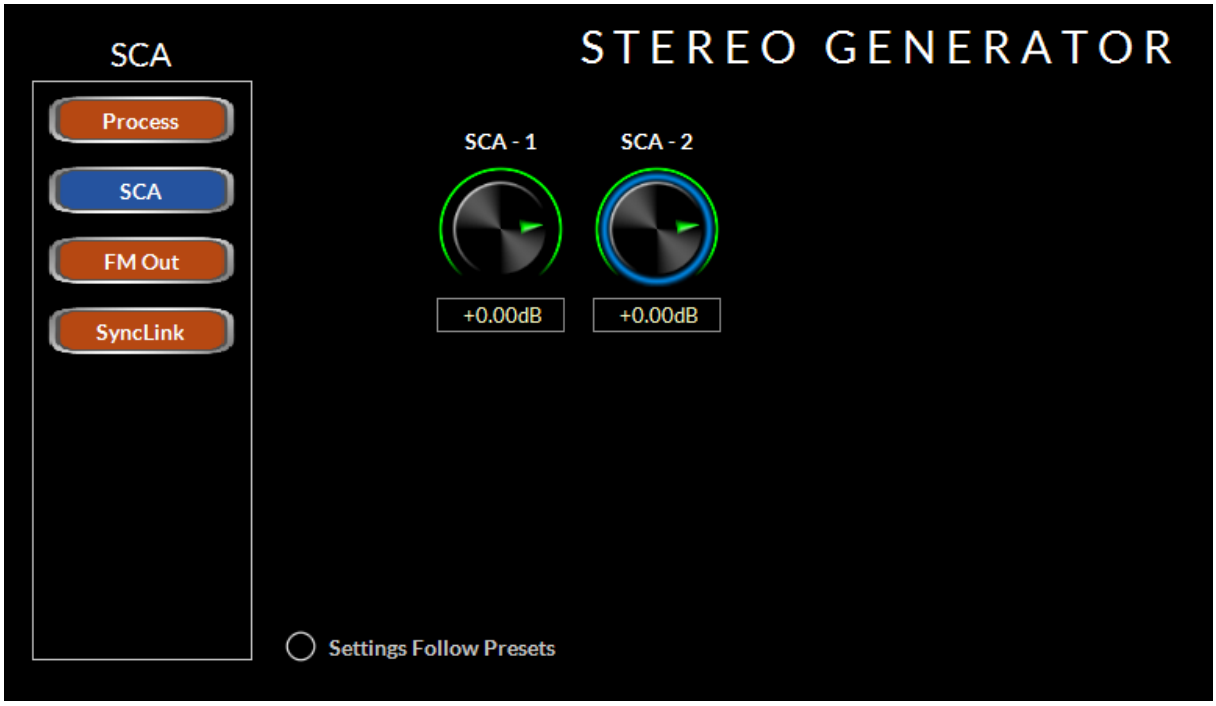
When this option is OFF, recalling presets ignores the settings of the output level controls and other "system" controls associated with those functions. The following are considered to be X5 System, or global parameters, which are saved with presets but not restored when presets are "taken," unless one of the "Input/Output Settings Change With Preset Takes" options is chosen.

These options are changed if the "Output" or "Both I/O" option is selected:

- All DeEmphasis options
- All PreDelay options
- Digital Output
- Pilot
- BS412
- SCA 1
- SCA 2
- TX 1
- TX 2
- Pilot Only options
- Analog – L/R, L/R Deemph, and MPX output style choices.

The option allows the X5 to modify its input output gain settings whenever presets are recalled. Output gain settings are always stored with the presets when processing values are stored, but those settings will be ignored upon preset recall when the System Settings Change with Preset Takes checkbox is unchecked. To adjust, tap the circle and then press the knob in to confirm.

SCA Options



The SCA 1 and SCA 2 level controls govern the SCA injection amount from 3rd party subcarrier generators (such as an external RDS generator) as a percentage of the main composite signal amplitude

Normal operation of this control depends on a number of factors. You should set this control to -12.00dB to start. Have a modulation monitor capable of measuring the subcarrier you are adjusting ready to go with an RF sample or strong off air signal applied. Insert the 3rd party subcarrier generator into either the SCA 1 or SCA 2 port. If possible, ***adjust the trim control on the 3rd party device*** to match the proper injection level as displayed on the modulation monitor.

If there is no option to control the subcarrier injection level from the 3rd party device, you can offset the injection using the X5's SCA gain controls. To change the level on either the SCA 1 or SCA 2 injection levels, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select amount. Your modulation monitor should indicate an increase or decrease of the injection level. Once you have reached the desired setting, push in the knob to confirm the new value.

FM Out

The FM Out page displays the level controls for the two composite outputs in addition to the AES output for FM (both AES-3 and baseband 192).

TX-1 and TX-2 Output

Sets the peak output amplitude of the MPX 1 and MPX 2 output 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 levels between -24dB and +6.00dB and in 0.05dB steps. If Volts Peak-Peak is desired, the TX Units control (see below) should be set to "V-PP".

When changing this control, having a reliable and calibrated modulation monitor with recommended signal level on its input is desired.

To change the value, tap the control. You will see a green ring indicating the control is active and ready to be changed. Use the front panel knob to change paying close attention to the modulation monitor so that proper deviation is set in accordance to local restrictions. Once you have reached the desired setting, push in the knob to confirm the new value.

TX-2 Pilot Only

TX-2 mode changes the TX-2 composite output on the rear of the X5 to a 19kHz sine wave synchronizing source for RDS generators.

To change the value, tap the control. You will see a green ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

TX Units

Allows the user to select dBu or Volts Peak-To-Peak as the scale for the TX-1 and TX-2 output controls.

To change the value, tap the control. You will see a green ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

FM Digital Output

Adjusts the output gain of the FM digital signal. The range of the control is -79.95dB to 0dB in 0.05dB steps. OFF is also available if the control is turned fully counter clockwise.

If this output is directly feeding the AES input of an exciter, a modulation monitor should be used for proper calibration of the output.

To change the value, tap the control. You will see a green ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

Digital Type

The digital output has two options for the type of output. The first is the standard AES-3 signal that has been present on most digital audio processors for the last three decades. The second is baseband192 (bb192). When set to bb192, the digital output XLR jack on the rear of the X5 carries the Wheatstone baseband192 AES over MPX digital composite signal that is compatible with exciters designed to ingest a digital composite signal.

WARNING:

You should check with your exciter manufacturer to make sure your equipment has the capability to ingest the baseband192 AES over MPX standard before selecting this option. Interfacing the X5 to an non-compatible exciter with this option selected can cause unwanted results.

Unlike traditional AES, baseband192 completes the final phase of the all-digital airchain that is clean AND highly competitive. Baseband192 allows you to use the composite clipper and stereo generator in the audio processor while the signal remains in the digital domain. Previously, if you wanted to interface your audio processor with your exciter using an AES signal, you needed to use the stereo generator in the exciter to complete the airchain. With the bandwidth available in Wheatstone audio processors and on the input of compatible exciters, it is now possible to interface a COMPOSITE signal over AES between the processor and the exciter. The stereo generator is now BACK in the audio processor, where it can work intelligently with the rest of the audio processing.

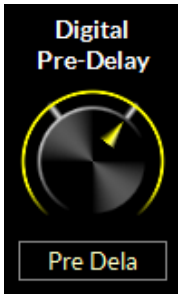
The X5 also supports the traditional AES interface between processor and exciter. By selecting AES-3, the output appearing on the rear XLR connector is a standard AES L/R signal that can interface with STL systems or exciters that have AES input options.

WARNING:

If your exciter has the option for AES over MPX (baseband192) but you require or desire to use a traditional AES interface, make sure your exciter and the X5 have compatible settings. Mismatching the settings between the exciter and the processor can cause unwanted results. You should consult the user manual for your exciter or contact the manufacturer for information on configuring your exciter for the correct mode.

To change this setting, left click on the knob and use the mouse wheel to switch between AES-3 (traditional AES L/R output) and Baseband192 (composite digital output). Left click again to confirm your choice.

Digital Pre-Delay



This option allows you to pick off the FM processed signal before the diversity delay that's used to match the analog FM signal to the latency of the HD signal. This pre-delay signal is helpful if you are monitoring the output of the X5 for processing adjustments or feeding a non-HD backup transmitter.

To change the value, tap the control. You will see a green ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

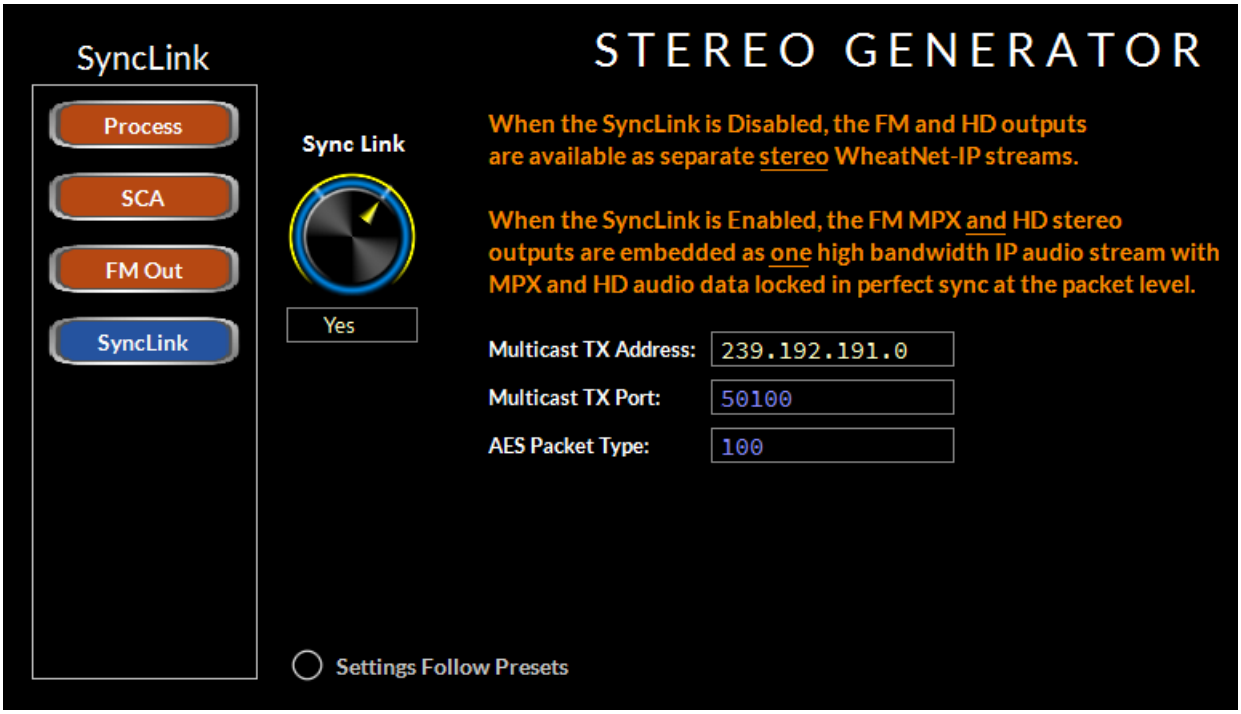
De-Emphasis

This option de-emphasizes the AES-3 output for applications where the exciter will apply its own pre-emphasis.

The best (and not always available) option if you must use an AES/EBU connection that is not composite is to perform pre-emphasis at the processor before a linear STL path and NOT perform any further emphasis in the exciter.

To change the value, tap the control. You will see a green ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

Sync Link



SyncLink is an optional 1RU companion product for the X5 that maintains HD and FM alignment (LiveLock) from your studio to your transmitter site. It carefully keeps the HD and FM packets in sync so time alignment done with the processor at the studio is maintained straight through to the receiver.

HD and FM composite audio are converted to a single WheatNet-IP stream at the X5 and sent over a data link (~ 7 mbps) to the SyncLink decoder. There, the audio is converted back to two (2) analog composite signals, one baseband192 (MPX over AES) signal as well as an AES HD signal.

Because all audio is kept in the same IP stream, they arrive at the destination simultaneously and remain in sync. If packet loss occurs, both signals experience the same duration and time alignment is maintained.

If you do not have the companion SyncLink hardware, SyncLink should remain disabled.

HD Output

Adjusts the output gain of the HD digital signal. The range of the control is -79.95 to 0dBFs in 0.05dB steps. OFF is also available if the control is turned fully counter clockwise.

When adjusting this control, you will want to monitor the input metering on your HD exciter as well as listen for the blend level between HD and FM to dial in the right amount.

To change the value, tap the control. You will see a green ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

L/R Reverse

The L/R Reverse checkbox allows the left and right channels of the HD output to be swapped (left becomes right, right becomes left) which can be useful during troubleshooting equipment that is external to the X5.

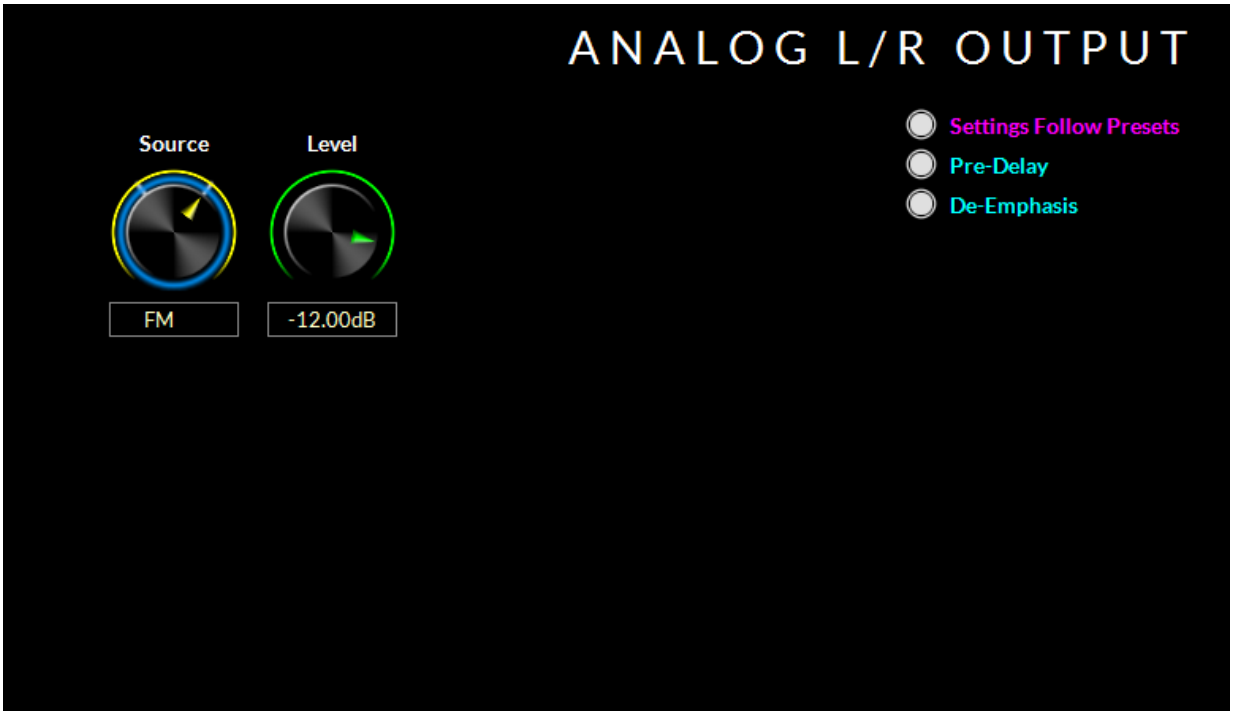
To adjust, tap the circle and then press the knob in to confirm.

Phase Reverse

When the Phase Reverse option is selected, the polarity of the HD Radio AES/EBU output signal is reversed by 180 degrees to compensate for phase errors between the FM and HD audio paths.

To adjust, tap the circle and then press the knob in to confirm.

Analog L/R Output



Adjusts the output gain of the analog L/R output jacks on the X5. The range of the control is -79.95 to 0dBFs in 0.05dB steps. OFF is also available if the control is turned fully counter clockwise.

Source

Allows the user to route either the FM processing or the HD processing to the analog L/R XLR jacks on the rear of the processor.

To change the value, tap the control. You will see a green ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

Pre-Delay

If FM is selected as the analog L/R output, this option allows you to pick off the FM processed signal before the diversity delay that's used to match the analog FM signal to the latency of the HD signal. This pre-delay signal is helpful if you are monitoring the output of the X5 for processing adjustments.

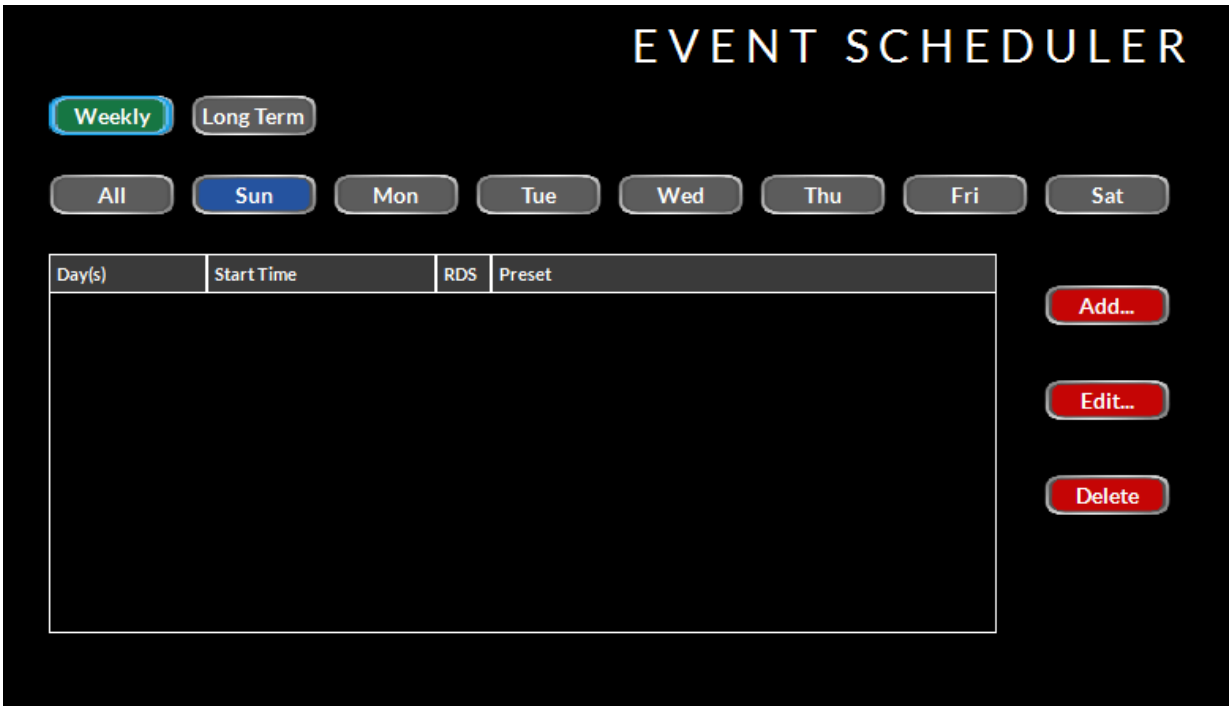
To adjust, tap the circle and then press the knob in to confirm.

De-Emphasis

If FM is selected as the analog L/R output, this option de-emphasizes the analog L/R output jacks.

To adjust, tap the circle and then press the knob in to confirm.

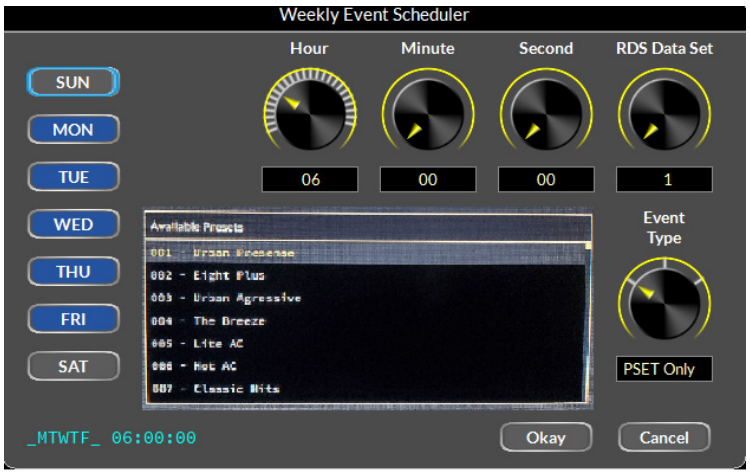
Event Scheduler



The X5 contains a comprehensive scheduling utility that allows presets and RDS messages 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.

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.



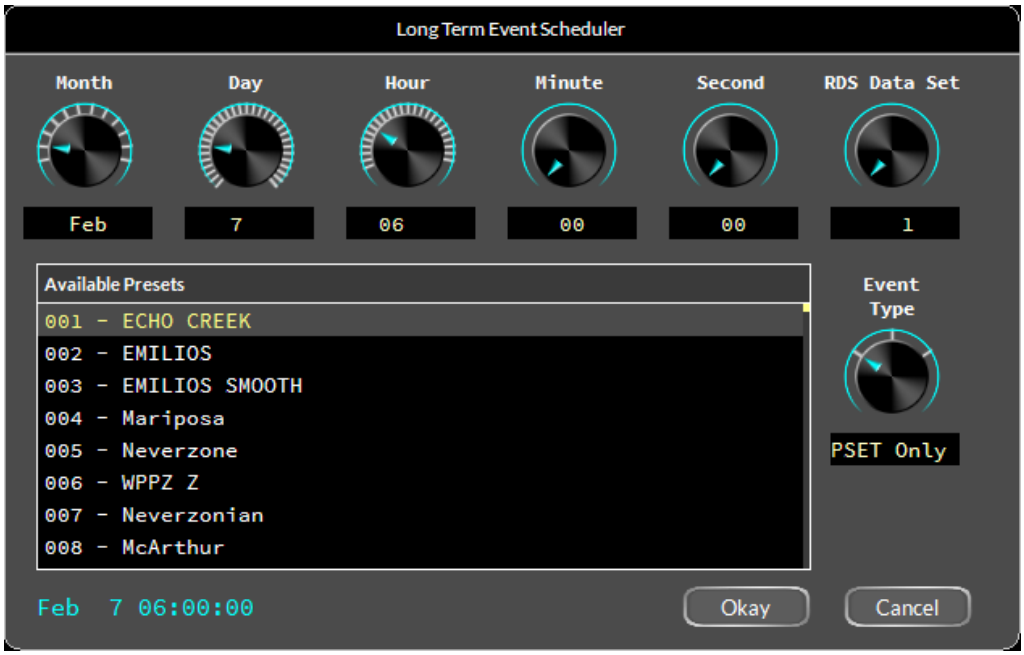
2. On the left column, select the days that the preset should be selected. Any combination of checkboxes may be chosen (in this example, MON-FRI are selected and highlighted in blue).
3. Next select the time that the preset should change. Hours, Minutes and Seconds can be changed by highlighting the knob on the touchscreen and then using the wheel to change the value to the correct time.
4. If you are changing RDS information with the particular program you are selecting, you can choose the RDS Data Set you want to use here (for more information on this, please see the RDS configuration section of this manual).

5. Choose the Event Type (Preset Change, Preset & RDS, RDS Only).
6. Finally, choose the preset you want to use by touching the name of the preset on the screen. When finished, click Okay.

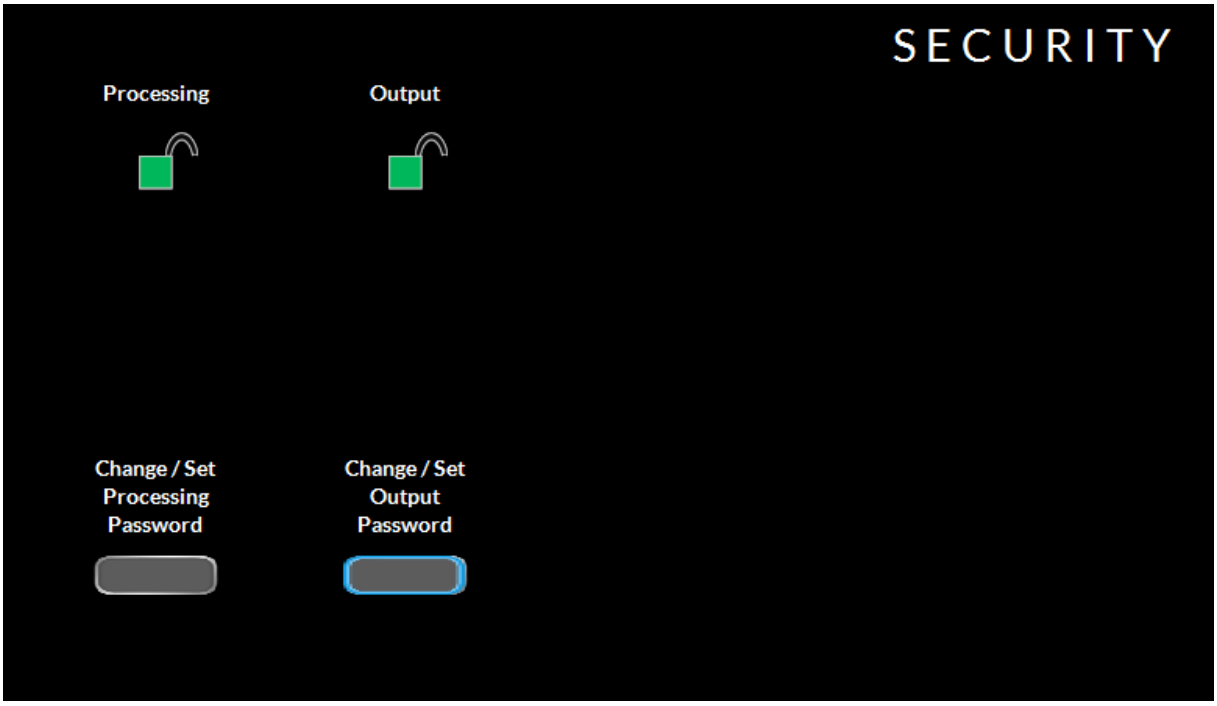
As many preset change events as desired may be programmed in the Event Scheduler. If a one-time preset change is required, such as might be necessary for a special holiday or other event, the Long Term Rotation routine should be used.

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 is shown below.



Security



Setting and clearing passwords for the front panel touchscreen is possible from the security section of the APP. You can choose 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, and without giving the transmission authority access to the processing controls.

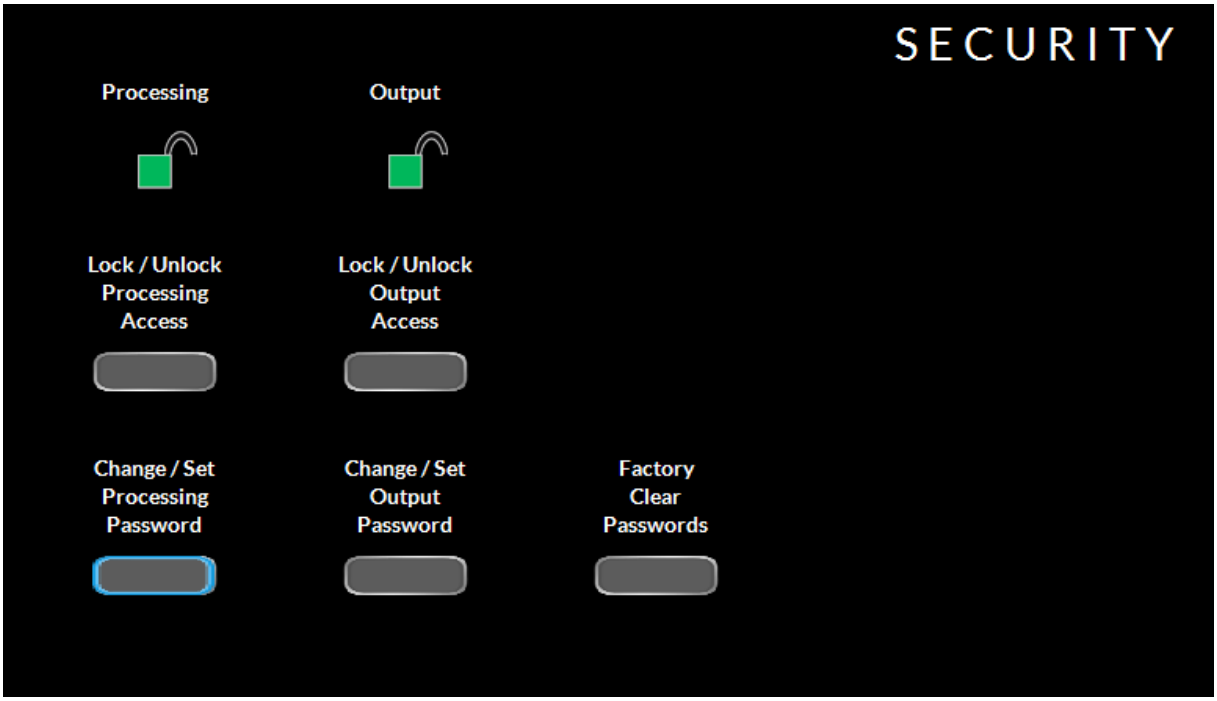
There is no default password in the X5. If you are setting this up for the first time, you can skip the Password part and just enter the NEW PASSWORD and VERIFY the new password.

Passwords may be alpha numeric and are case sensitive. Spaces are also taken into consideration for those using passwords with multiple words.

Pressing Change/Set Processing Password will bring up the keyboard to enter the new processing control password.

If the X5 does not have a password, you will be prompted to enter the password you would like to use to lock down the processing functions. Once entered, you will be asked to verify the password selection. If the passwords match, the X5 will indicate the password has been set.

Repeat these steps to set or change the password for the output settings of the X5. 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.



To lock the processing or output security options, press Lock/Unlock for the section you want to protect. The green lock icon will turn red and lock.

To unlock the security options, again, press Lock/Unlock for the security section you want to access. You will be prompted to enter the password.

Changing The Password

To change the password for either security option, press the Change/Set button. You will be prompted to enter the CURRENT PASSWORD. Upon proper entry, you will then be asked to choose a new password and verify the new password. If the passwords match, you will be allowed to continue. If they don't match, the X5 will ask you to re-enter them. Remember, the password is case sensitive including spaces.

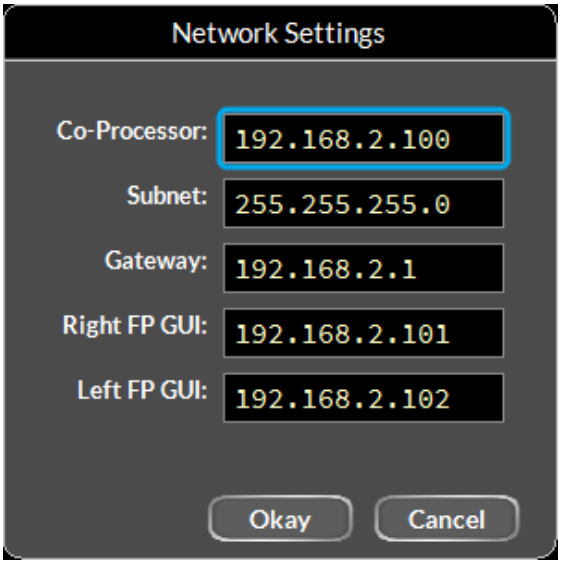
Lost Passwords

If you have lost or forgotten your password, or encounter a locked X5 from a previous engineer/owner, resetting the password is possible. Tapping on the Clear Passwords button brings up a screen that displays the MAC address of the processor. You will need to submit this MAC address to Wheatstone to get an unlock key which will clear the passwords on the processor.

Once you receive the passcode, you will be able to tap the Factory Clear Passwords option, close the MAC address message and move on to the keypad screen to enter the code provided by Wheatstone.

Once the passwords are cleared, you can choose to leave the hardware unsecured or set new passwords.

Network



This page allows you to assign the IP address for the front panel and the hardware. Because of how the system works (and because each front panel is essentially its own APP interface that connects to the hardware), your X5 requires three IP addresses to live on your network and function properly. These are for the co-processor (DSP Farm), the Right front panel APP and the Left front panel APP, as well as the subnet and the network gateway.

Failure to properly assign the IP addresses will result in the inability to connect via the front touch-screens or Windows based APP to adjust sound. It could also interrupt WheatNet-IP audio I/O.

To enter the IP address, tap the field you want to highlight. A blue border will illuminate. Push the knob in to bring up the entry screen for that field. Use the keypad to enter the address for that field. When complete, press Ok. Repeat these steps so that all the fields have the correct addresses.

NOTE: The actual IP addresses will NOT change until you are ready to reboot. You should reboot after all network settings are made and confirmed.

Once your network settings have been assigned to all fields, press the Okay button. You will need to reboot the processor for the new addresses to take effect.

System

The System page shows the overall status of the unit, what versions are running on the hardware and front panels as well as the MAC Address of the front panel as well as the hardware.

Normally you should not need to concern yourself with the system page, but if you need to contact technical support about your X5, they may ask for you to reference some of the data on this page.

There are a couple of options on the System page you may need to access:

Headphone Source

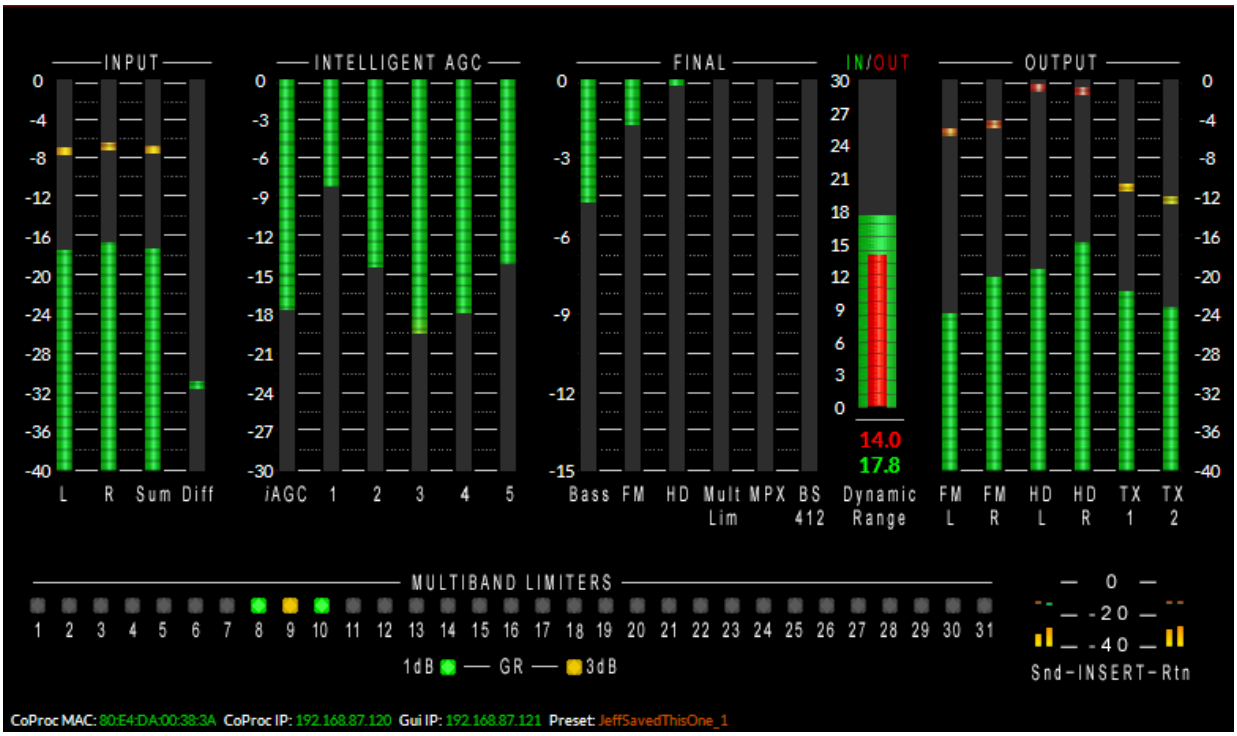
Selects which part of the processor you want to monitor from the front panel headphones. Options are **Input**, **Analog Input**, **Digital Input, HD Output**, **FM Pre-Delay**, **FM Output**, and **Insert Return**.

To change the value, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

Display Timeout

Sets the amount of time (in seconds) before the display times out and goes back to the main screen block diagram. The options are OFF (never goes back until the screen saver starts) to 60 seconds. To change the value, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

Meter Displays

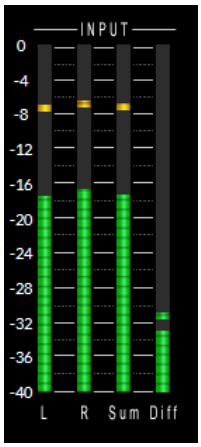


The left front panel of X5 hosts all of the metering and analysis displays. The default display shows all the input and output audio levels, plus gain reduction for the iAGC and five band dynamics. Metering is also included for the bass processing, FM and HD final output as well as the multipath limiter, MPX processing and BS.412 management. A specialized Dynamic Range meter is also included as well as metering for the send and return levels in the insert loop.

Under the metering display is the 31 band limiter threshold indicators.

Along the bottom of each of the screens you will see the MAC Address of the screen as well as the hardware IP address (CoProc IP) and the front panel IP address (App IP) as well as the current preset that's on the air. Presets in GREEN are saved and unmodified. Presets in ORANGE have had changes made to them and are not saved.

Input Meters

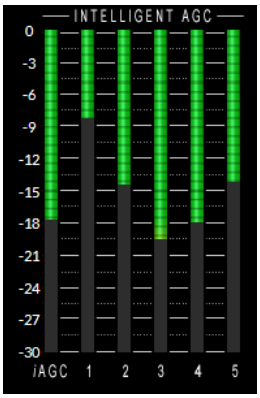


The X5 input meters show the individual left and right audio levels as measured in dBFs. Average and peak metering is indicated.

Along with the left and right input meters are two other meters. The sum meter shows the L+R level and the difference meter shows the L-R signal.

When adjusting the input gain, the individual left and right meters should average between -24 and -20dBFs with peaks no higher than -12dBFs.

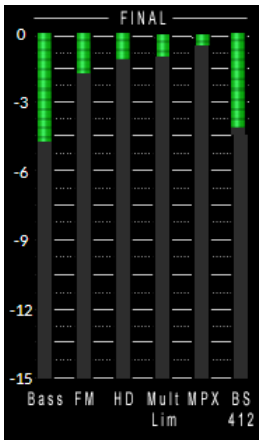
Intelligent AGC Meters



The Intelligent AGC meters show the gain reduction for the iAGC algorithm as well as each of the five bands of processing.

Each of the five bands as well as the iAGC algorithm is capable of audio correction over a 30dB range.

Final Metering

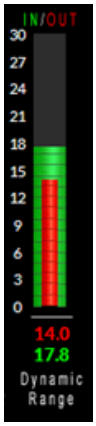


The Final meters show the various amounts of gain reduction in each of the back end stages of processing in the X5.

The following stages of processing can be monitored here (from left to right):

- Bass Processing Depth
- Main FM Clipper
- HD Final Processing
- Multipath Limiter
- MPX Processing
- BS.412 Gain reduction (if the BS.412 limiter is on).

Dynamic Range Meter



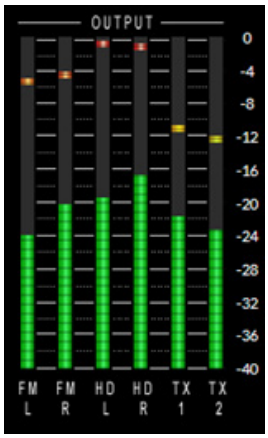
At a glance, the X5 Dynamic Range meter can show the instantaneous difference between the dynamic range of the input audio to the output audio. The RED meter shows the output, while the GREEN meter shows input.

In the example to the right, the input dynamic range is 17.8dB while the output is 14.0dB.

Output Meters

The Output meters show the peak to average ratio of the various output stages of X5.

THESE METERS SHOULD NOT BE USED TO INDICATE OR SET MODULATION FOR THE FM OR HD AUDIO.

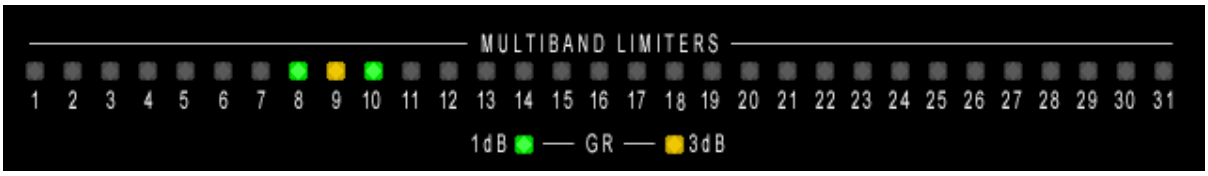


In order to set proper and legal modulation, a type accepted modulation monitor should be used.

The following stages of output metering can be viewed here (from left to right):

- FM Left Output
- FM Right Output
- HD Left Output
- HD Right Output
- TX1 Output
- TX2 Output

Multiband Limiters



Along the bottom of the meter page is the indicator for the multiband limiters. Each band of limiting has one of three states – OFF (no limiting in the band), GREEN (1dB of limiting in the band) or YELLOW (3dB of limiting in the band).

Due to the sophisticated nature of the X5's multiband AGC and LIMITless Clipper technology, it is not unusual to see little to no activity here at times.

Insert Point Metering

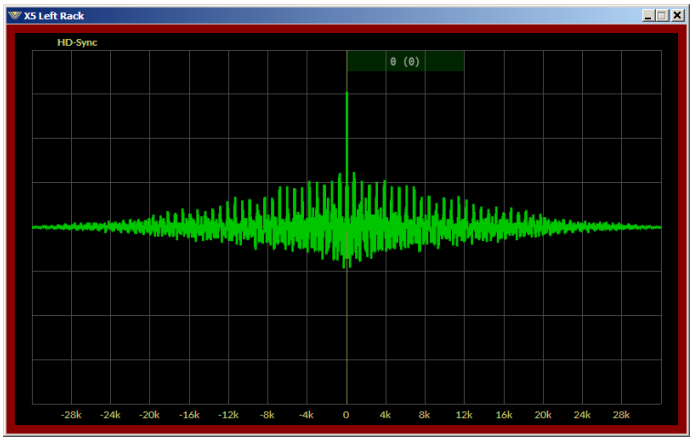
The insert point metering in the lower right corner indicates when signal is present at the X5's send and when signal is present on the X5's return.

The signal levels at the send (SND) and return (RTN) should peak above -20dBFs.

Analysis

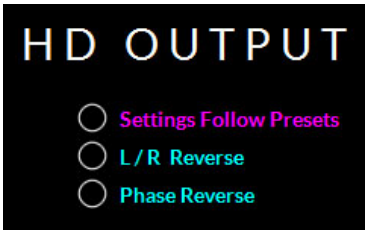
The X5 is equipped with extensive processing analysis features that give a more detailed look at what the processing is actually doing. There are ten analysis options. All ten are available from the front panel by swiping left or right on the left touchscreen or via the Window based APP.

HD Sync



The HD Sync display shows the offset correlation between the analog and HD signals. In the figure shown at right, the HD and FM are perfectly aligned. The numerical indicator at the top of the screen shows how far off the analog and the digital audio are if there is an alignment issue.

Note in the graphic at right that at the center of the waveform there is a large positive going spike. A positive going spike indicates that the FM and HD audio channels are in the proper polarity. If there is a negative going spike instead (and even though the time alignment is otherwise "perfect") it indicates that the HD audio is out of phase with that of the FM. To remedy this, navigate to the HD Output screen and activate the Phase Reverse function at the upper right.

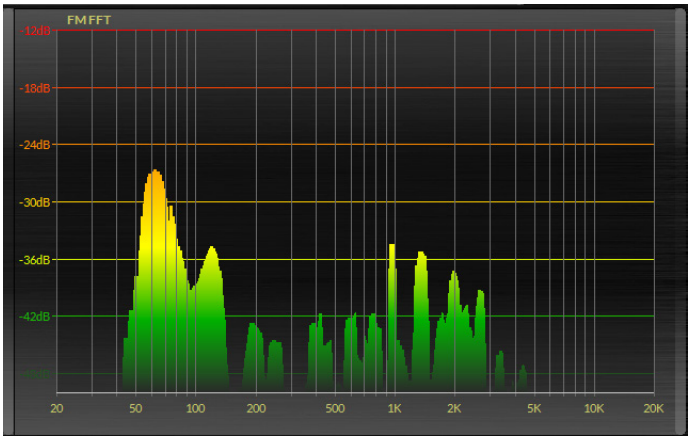


Note that in early iBiquity systems there was an inadvertent phase reversal between the FM and HD audio paths.

Occasionally during the alignment process you may see the graph turn red. This indicates one of two things; that the algorithm cannot correlate the FM and HD or that the time alignment is not within the 1 second window it needs to be in in order to properly measure and align the audio. Further manual adjustment may be necessary, please refer to the HD Delay section of the manual for more information.

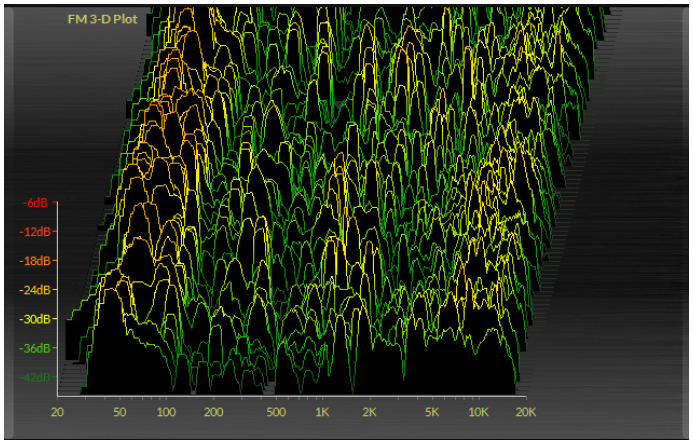
FM/HD FFT

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 the X5.



3D Plot

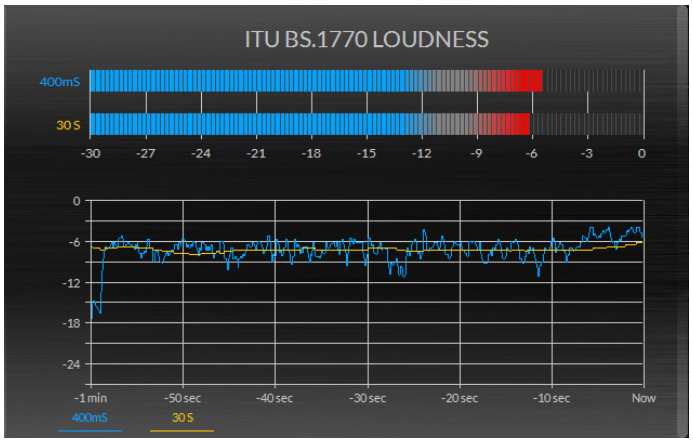
A three-dimensional plot of the audio, after processing, which displays signal amplitude versus frequency versus time. The display has a ten second historical window depth allowing some historical perspective about the FM or HD audio after processing.



ITU BS.1770 Loudness

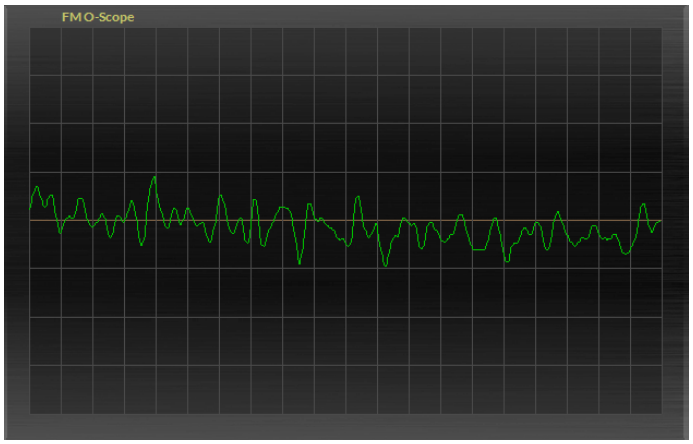
Displays a meter and graph which shows the long and short term loudness of the audio processing based on the ITU BS.1770 standard. The graphical long and short term loudness duration is displayed over 60 seconds.

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).



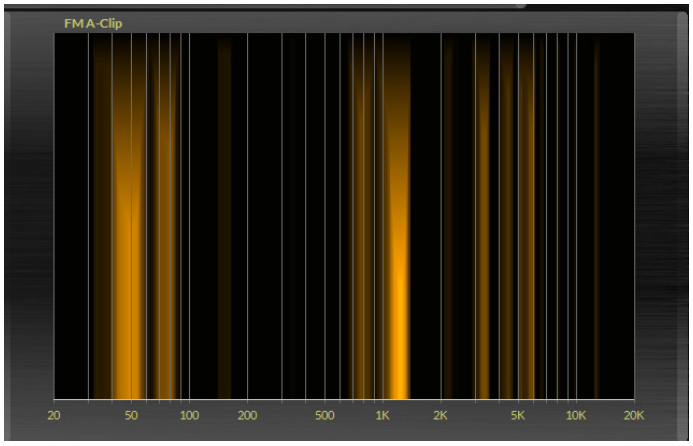
O-Scope

This is a time-domain (oscilloscope-type) display of the audio at the output of the FM or 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" lookahead limiter, will appear less "aggressive" than the FM audio.



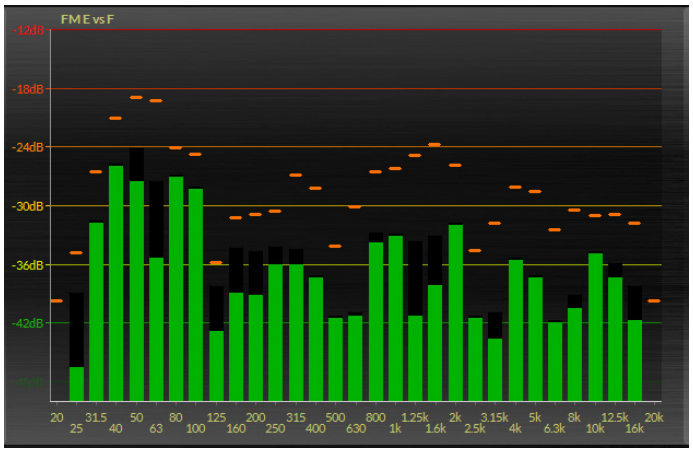
A-Clip

During development of our original AirAura-FM clipper in 2010, we invented a way to watch it work. Known as the A-Clip display, it's now designed to work with the X5. The A-Clip "ghosts" shows in detail where in the audio spectrum the X5's distortion management is working.



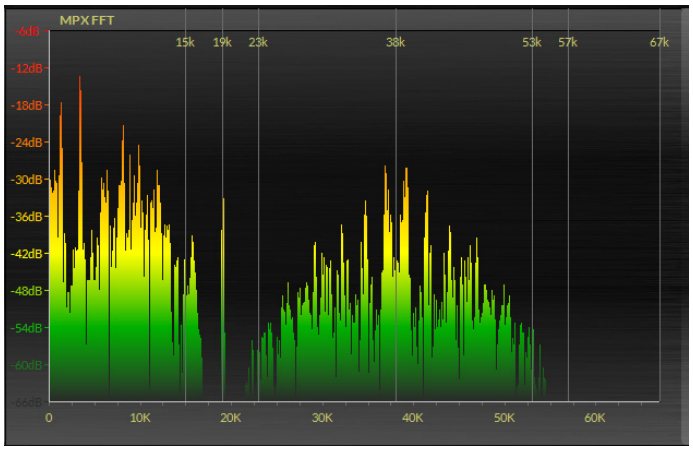
E vs. F

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



MPX FFT

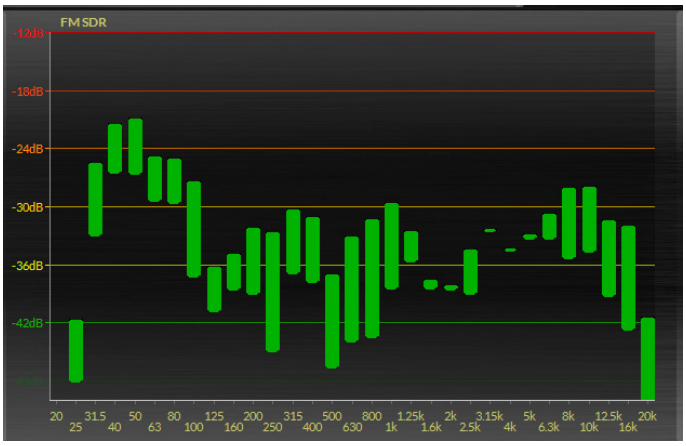
This analysis shows the baseband spectrum of the X5 audio processor's composite output, including the L+R information as well as the 19kHz pilot, upper and lower sidebands and other associated subcarriers (RDS at 57kHz, 67kHz).



SDR

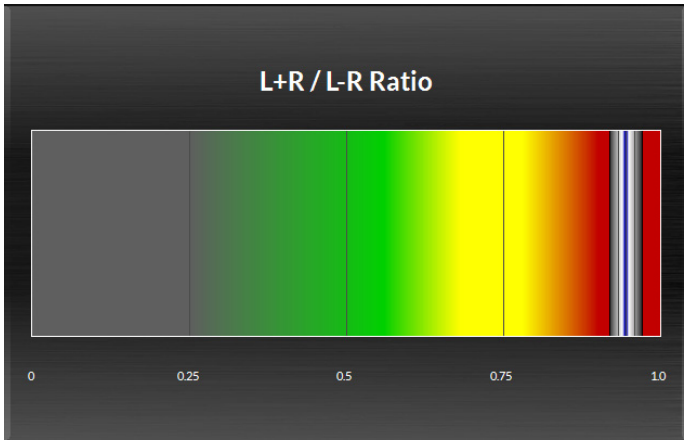
The Spectral Dynamic Range™ Meter was designed to measure the dynamic range of the audio. The SDR meter is easy to interpret – the top of the bar represents the maximum peak level measured over the last sample period. The bottom of the bar is the average level over the last sample period.

Therefore the taller the 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 (L+R/L-R Ratio)

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 X5). The further to the left, the less stereo separation being transmitted. For mono or voice, the meter should sit at 0.



Rebooting The Front Panel

On occasion, it may be necessary to reboot the front panel screens without unplugging power to the entire unit. This may be because of an update or a situation where a network conflict has caused the front panel to freeze.

To reboot the front panel, press the knob in while pressing the center button directly underneath. The screens should go off and the front panel will reboot. This process will not take the X5 off the air!

X5 Windows Based APP

Chapter Contents

X5 Windows Based APP

The Windows based X5 APP is an advanced user interface which reveals all of the controls existing within the FM and HD processing structures. This APP is designed and intended for both advanced processing users and those who are not familiar with audio processing terms and audio processing concepts.

The X5 APP allows you to adjust the processor and see, in real time, how it is reacting to the audio being processed.

The X5 APP software may control an unlimited number of X5's via a standard Ethernet network. Utilizing TCP and UDP protocols, the Pro APP can be used to control the processor from anywhere in the world as long as there is an Internet connection. This includes controlling it behind firewalls, NAT routers and VPN tunnels.

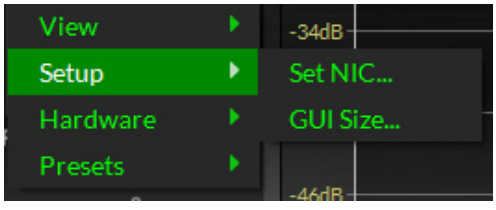
Getting Started

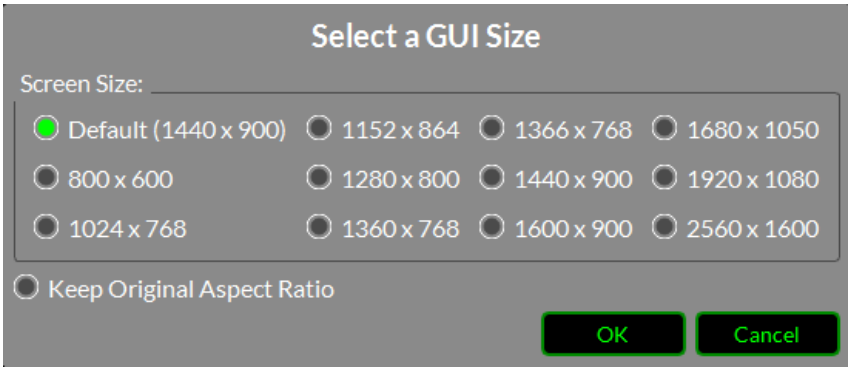
The X5 APP is a Windows™ based executable program and is supplied on a USB thumb drive supplied with the processor as a program. Though the APP may be installed to any folder on the host computer, the default path is: "C:\Program Files\Wheatstone\AirauraX5." After installation, the APP can be started by clicking on the X5 Pro item in the Windows Start menu.

The APP is designed to run on all PC running Windows XP, Vista, 8 or 10. The APP may not be compatible with tablet based Windows operating systems. At this time, the APP is not supported on Apple based platforms, however it has been known to work on versions of virtual Windows running on Apple platforms.

Running The APP

Once the APP has started, it may be necessary to size the APP to fit the screen it is being used on. That can be easily done by right clicking anywhere on the APP and select Setup and then APP Size.



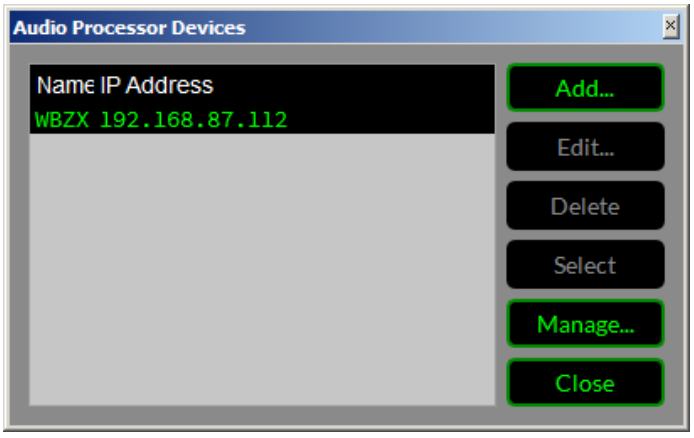


Connecting With The Windows Based APP

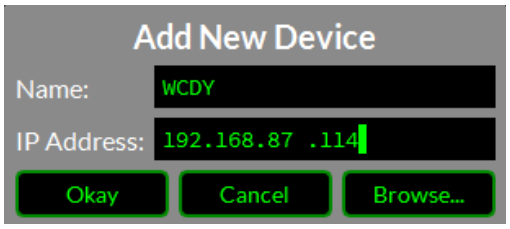
The X5 and the PC running the X5 APP program can be straightforwardly connected together over a standard Ethernet Local Area Network (LAN).

The X5 should be installed, powered-up, and verified to be operating normally. A CAT5 Ethernet cable connected to the rear panel 100baseT LAN port should be connected to the Ethernet port on the host PC. The X5 is Auto-MDIX so either a straight through or crossover cable may be used.

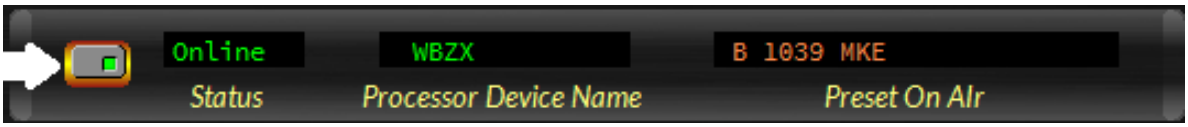
You will need to know the HARDWARE IP address you assigned to the hardware. This is the IP address you will use to connect with the APP. Assuming the APP is now installed, start the program to bring the APP on the screen. Next, on the lower right side of the APP, locate the Devices button and click on it. This will open the Edit Device dialog which is used to tell the APP what IP address and name the X5 may have. The Name field can be left blank or used to give the X5 a unique name in the Devices display box at the top of the Pro APP – this is the device that the APP 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 X5 and then click OK.



Highlight the new X5 device in the Devices list and click on the Select button. Now you can place the APP online by clicking on the virtual button to the left of the Status message.



The virtual button will be green when the X5 connects to the hardware indicate that the APP is now communicating with the X5. Once the APP has been made aware of the X5's existence in this manner, it will always appear in the list of X5 devices and it will be instantly accessible from anywhere, any time.

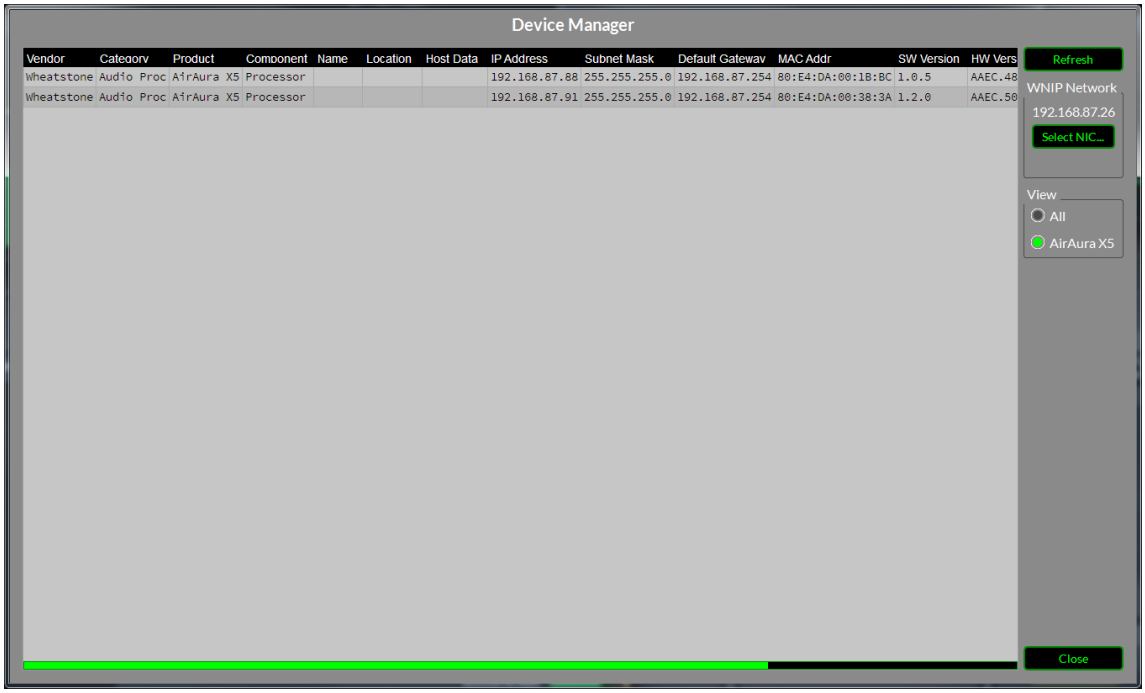


While connected to an X5, the Status bar will indicate Online and the Processor Device Name text will show the name of the X5 that it is currently communicating with (in this example, the X5 has been named WBZX). The status bar will also display the name of the preset that the X5 you're connected to is currently running.

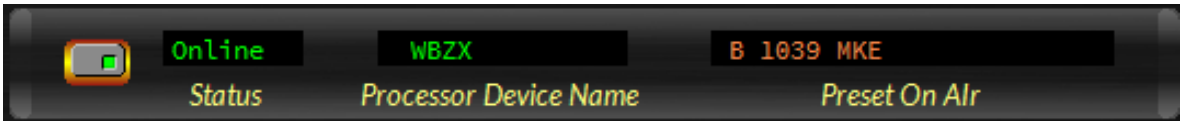
You can manage the X5s on your network by clicking Manage... That opens up a new window that lets you see the IP and MAC Addresses of all WheatNet-IP devices in your network (including X5). You can prune that list by selecting AirAuraX5. The device manager will only show X5s on the network at that point. You can copy the IP address down, close out of that window and continue with adding a device.

Once the device is named and added, you can click Ok. Repeat these steps to add more X5s as needed. Highlight the name of the X5 you want the GUI to communicate with, then confirm it by tapping Select.

You can edit the X5s in the list and change their IP addresses. However you cannot rename a device once it is created. If you have an X5 that you want to rename, simply add a new device with the new name, then delete the original named device from the list.



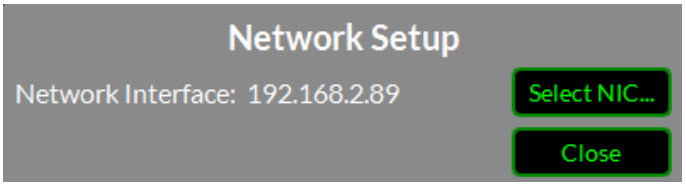
When the Preset name is showing as green text it means that a factory or user preset is running and that no changes have been made to it. If the Preset name is showing in orange text, it means that the preset has had some changes made to it or is a work in progress that has not yet been saved to the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

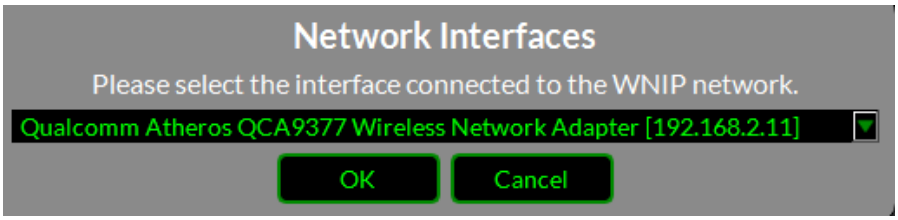


Status Bar with preset in orange, indicating that the preset has been altered and not saved.

Selecting A NIC

Many computers in a broadcast facility contain multiple NIC cards. You may need to select the correct NIC attached to the correct network in order to communicate with the X5. That can be easily done by right clicking anywhere on the APP and select Setup and then Set NIC.





A list of available Network Interfaces are available from the dropdown menu.

Connecting Directly Without A LAN

You can work without a LAN by connecting the X5 and the PC Ethernet ports together with a standard Ethernet cable – either a straight through or crossover cable may be used. As mentioned previously the X5 has auto-sensing, or Auto-MDIX Ethernet ports.

NOTE: The controlling PC and the X5's network settings must be configured to place them both on the same subnet! This is also why the front panel APP and remote hardware APP must be in the same network address space (usually one IP address from each other).

The X5 And Internet Security Concerns

The X5 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 X5 and use it as a pathway to the rest of the network to which it is connected.

About DHCP And The X5

The X5 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 the X5. 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.

X5 Network Protocols And Ports

The X5 uses both TCP and UDP protocols to communicate with the remote APP. TCP is used from APP to the X5 because its high reliability ensures that all control changes sent to the X5 will be received with 100% accuracy. The UDP protocol is used by X5 to send and update metering and other real time data back to the APP. 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 X5 requires these ports to be open through any firewalls for successful connectivity.

Connecting With Windows Laptops

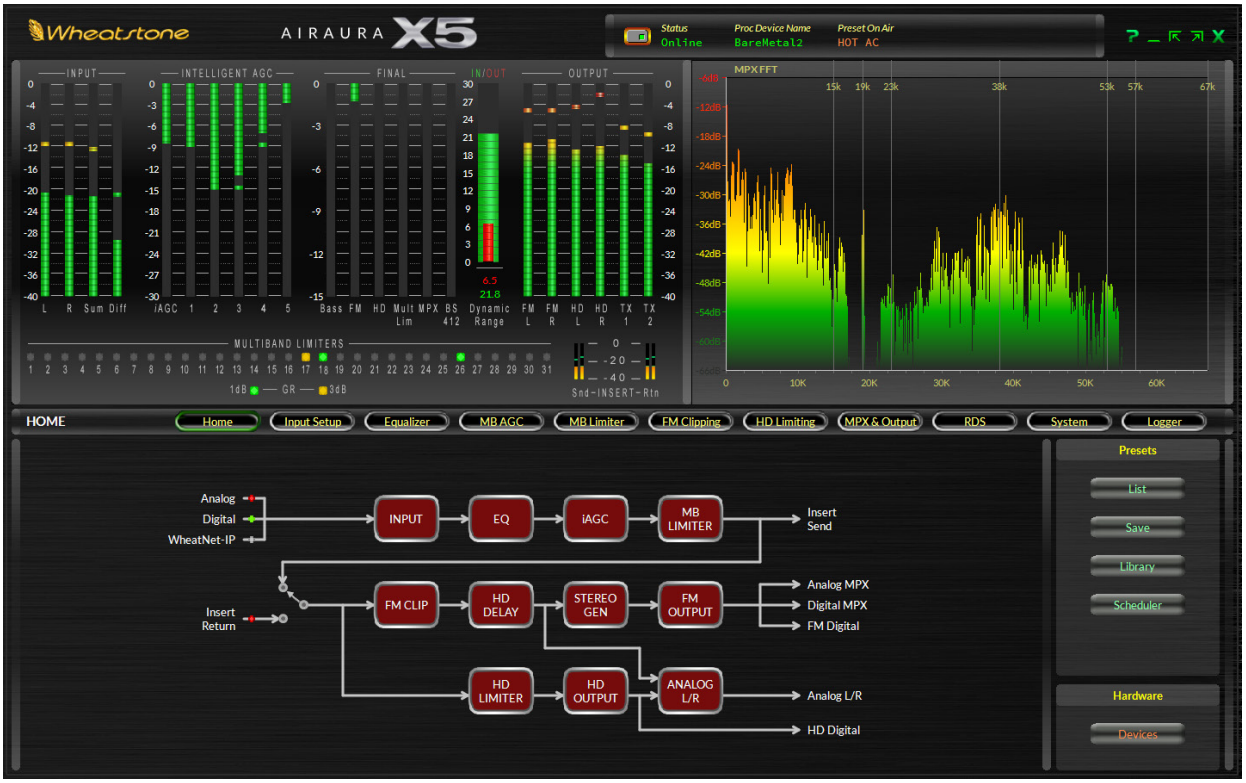
It has been our experience that Windows laptops equipped with wireless Ethernet adapters often try to send traffic intended for the wired interface out over the wireless interface instead. When this happens the X5 APP does not respond with ONLINE when the APP's Online/Offline button is pressed and responds instead with TRYING, no matter what the user does.

The remedy for this is to disable (turn off) the laptop's wireless interface when attempting connections to a wired Ethernet device, even if that device is not a Wheatstone X5 processor.

Using The X5 APP

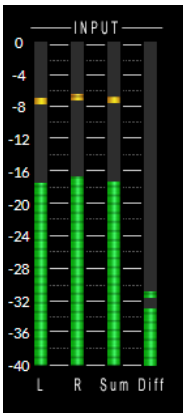
The APP may be positioned on the host computer's screen by left-clicking and holding the Wheatstone logo, and dragging the APP to the desired position. In normal Windows fashion, the APP may be minimized on the desktop (taken off the screen) and/or closed by way of the familiar controls at the extreme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

The X5 APP is a windows based application that connects to the processing hardware and expands on the controls featured on the front panel of the X5. The APP is divided into two parts. The top half shows metering and analysis while the bottom half contains the adjustment controls.



Metering

This section of the manual will first dive into the metering displays, then show the various controls that govern the sound of the audio processor.

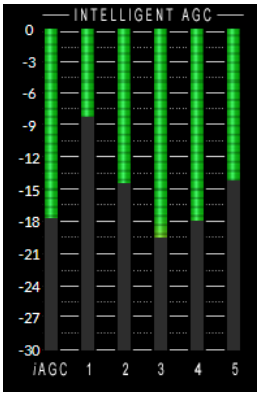


Input Meters

The Input meters show the level of the active audio source (Analog, WheatNet-IP or AES) as well as the sum (mono) and difference (L-R) signals. The meters are scaled in dBFs with average and peak levels indicated. The maximum recommended peak level is -12dBFs. Average program level should be between -24dBFs and -20dBFs.

The X5 has a dynamic range of >120dB, thus there is no need to run the input "hot" in order to maximize the signal-to-noise ratio.

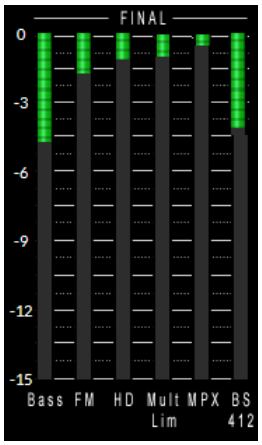
Multiband AGC



To the right of the input meters are six meters at the heart of the processing. From left to right they are **iAGC Depth**, the five band section which includes **Low Bass Gain Reduction**, **Mid Bass Gain Reduction**, **Midrange Gain Reduction**, **Presence Gain Reduction**, and **High Gain Reduction**.

The iAGC Depth meter displays a constant bar that shows the amount of gain reduction. The five band metering has two different segments. The constant bar shows total gain reduction in any band, while the "peak lines" show additional compression applied to that particular band. If more aggressive processing is used, the more frequent those "peak lines" will be seen.

Final Metering

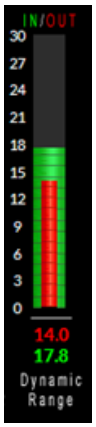


The final meters show the various amounts of gain reduction in each of the back end stages of processing in the X5.

The following stages of processing can be monitored here (from left to right):

- Bass Processing Depth
- Main FM Clipper
- HD Final Processing
- Multipath Limiter
- MPX Processing
- BS.412 Gain reduction (if the BS.412 limiter is on).

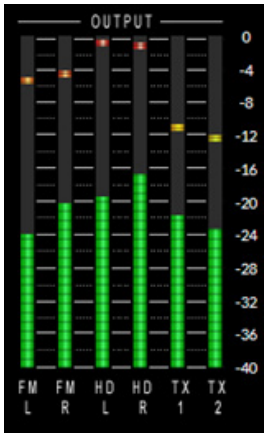
Dynamic Range Meter



At a glance, the X5 dynamic range meter can show the instantaneous difference between the dynamic range of the input audio to the output audio. The RED meter shows the output, while the GREEN meter shows input.

In the example to the right, the input dynamic range is 17.8dB while the output is 14.0dB.

Output Meters



The output meters show the peak to average ratio of the various output stages of X5.

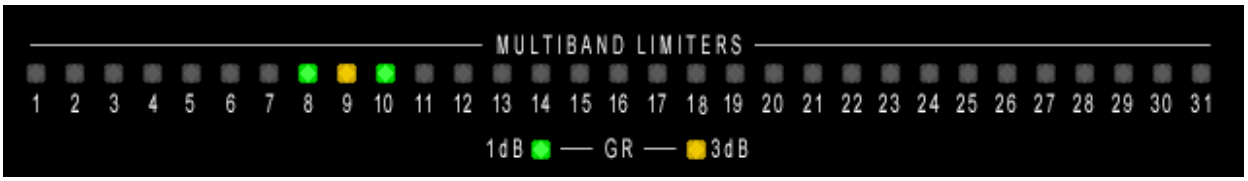
THESE METERS SHOULD NOT BE USED TO INDICATE OR SET MODULATION FOR THE FM OR HD AUDIO.

In order to set proper and legal modulation, a type accepted modulation monitor should be used.

The following stages of output metering can be viewed here (from left to right):

- FM Left Output
- FM Right Output
- HD Left Output
- HD Right Output
- TX1 Output
- TX2 Output.

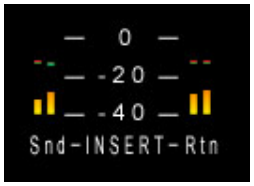
Multiband Limiters



Along the bottom of the meter page is the indicator for the multiband limiters. Each band of limiting has one of three states – off (no limiting in the band), green (1dB of limiting in the band) or yellow (3dB of limiting in the band).

Due to the sophisticated nature of the X5's multiband AGC and LIMITless Clipper technology, it is not unusual to see little to no activity here at times.

Insert Point Metering



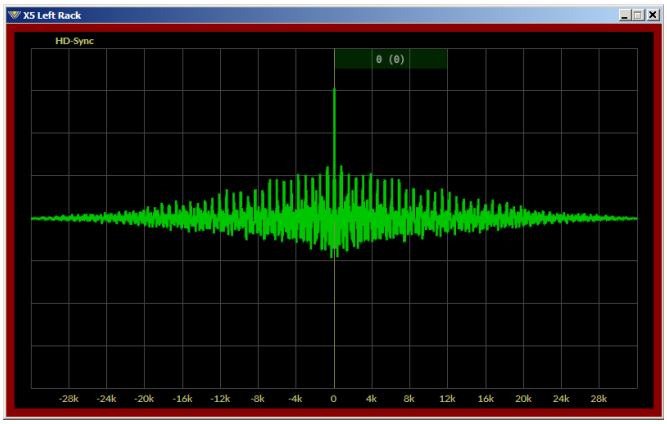
The insert point metering in the lower right corner indicates when signal is present at the X5's send and when signal is present on the X5's return.

The signal levels at the send (SND) and return (RTN) should peak above -20dBFs.

Analysis

The X5 is equipped with extensive processing analysis features that give a more detailed look at what the processing is actually doing. There are ten analysis options. All ten are available from the GUI by swiping left or right over that section of the GUI using the mouse.

HD Sync



The HD SYNC display shows the offset correlation between the analog and HD signals. In the figure shown at right, the HD and FM are perfectly aligned. The numerical indicator at the top of the screen shows how far off the analog and the digital audio are if there is an alignment issue.

Note in the graphic at right that at the center of the waveform there is a large positive going spike. A positive going spike indicates that the FM and HD audio channels are in the proper polarity. If there is a negative going spike instead (and even though the time alignment is otherwise "perfect") it indicates that the HD audio is out of phase with that of the FM. To remedy this, navigate to the Outputs tab in the MPX/Output screen.

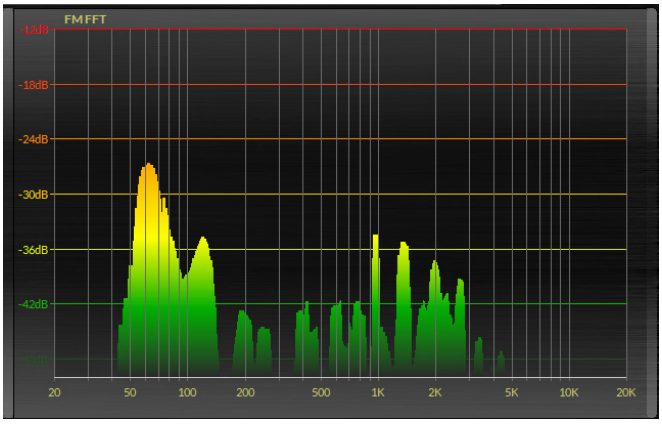
When the Phase Reverse option is set to YES, the polarity of the HD Radio AES/EBU output signal is reversed by 180 degrees to compensate for phase errors between the FM and HD audio paths.

To change this setting, left click on the knob and use the mouse wheel to switch between Yes (phase is reversed 180 degrees) and No (phase is normal). If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Note that in early iBiquity systems there was an inadvertent phase reversal between the FM and HD audio paths.

Occasionally during the alignment process you may see the graph turn red. This indicates one of two things; that the algorithm cannot correlate the FM and HD or that the time alignment is not within the 1 second window it needs to be in order to properly measure and align the audio. Further manual adjustment may be necessary, please refer to the HD Delay section of the manual for more information.

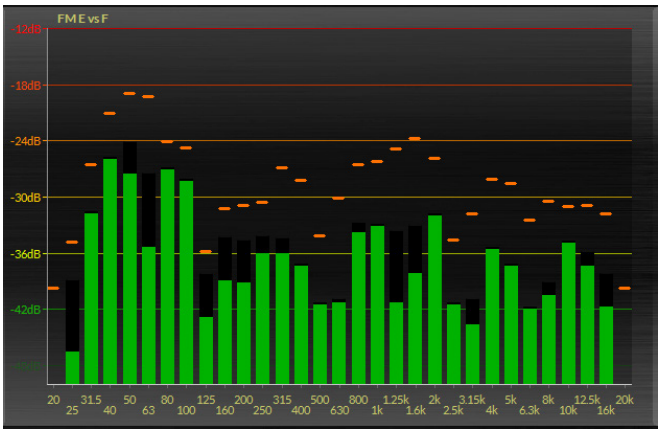
FM/HD FFT



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 the X5.

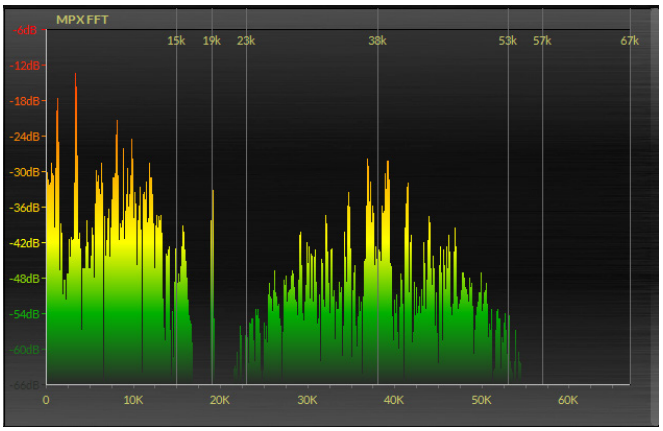
E vs. F

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



MPX FFT

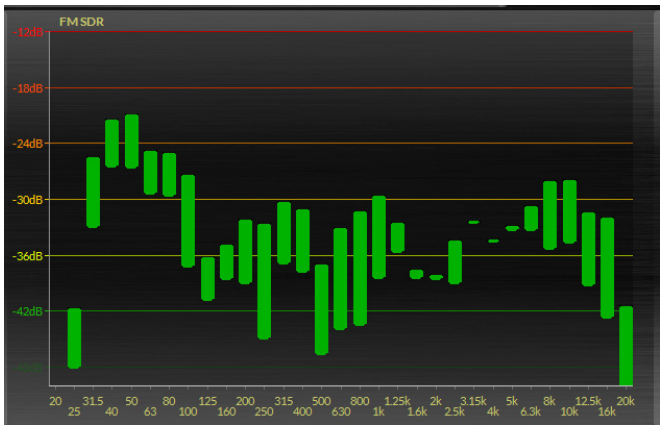
This analysis shows the baseband spectrum of the X5 audio processor's composite output, including the L+R information as well as the 19kHz pilot, upper and lower sidebands and other associated subcarriers (RDS at 57kHz, 67kHz).



SDR

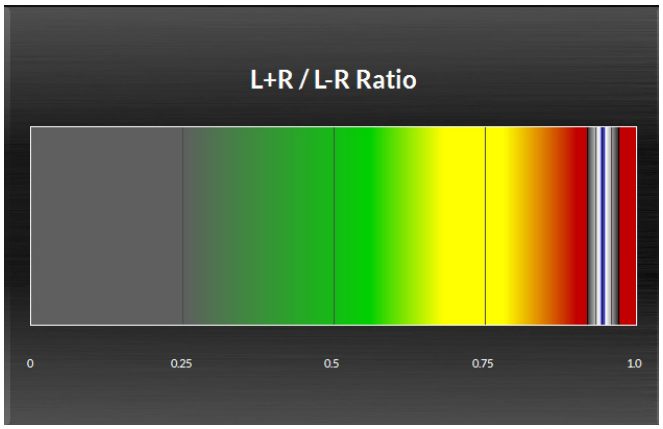
The Spectral Dynamic Range™ Meter was designed to measure the dynamic range of the audio. The SDR meter is easy to interpret – the top of the bar represents the maximum peak level measured over the last sample period. The bottom of the bar is the average level over the last sample period.

Therefore the taller the 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 (L+R/L-R Ratio)

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 X5). The further to the left, the less stereo separation being transmitted. For mono or voice, the meter should sit at 0.



E vs F

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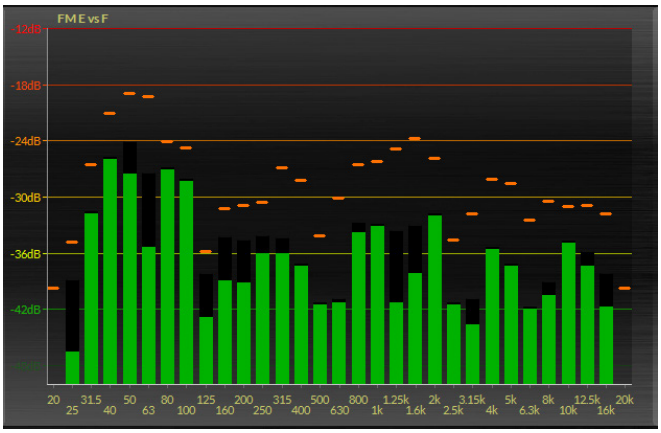

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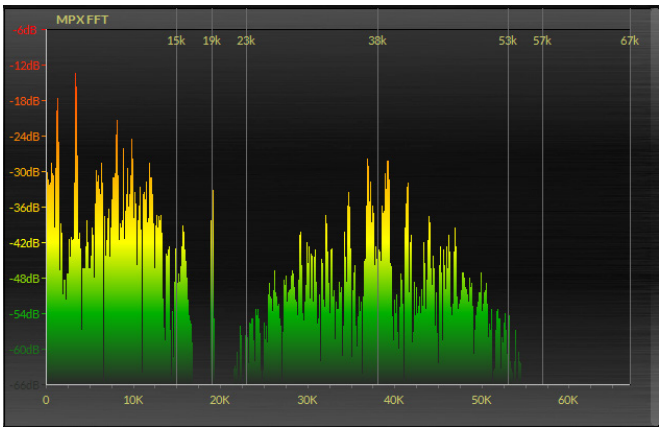

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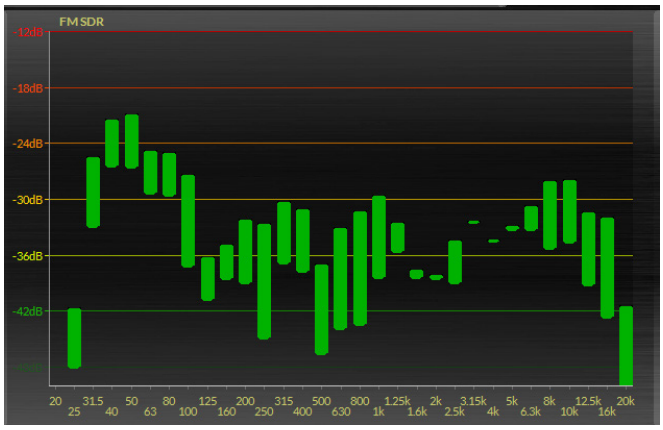

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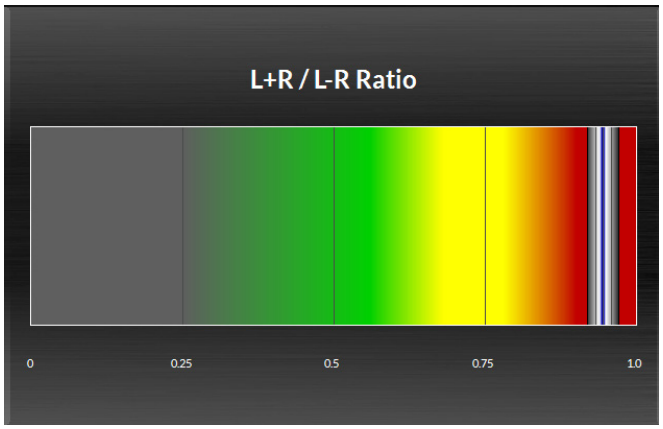
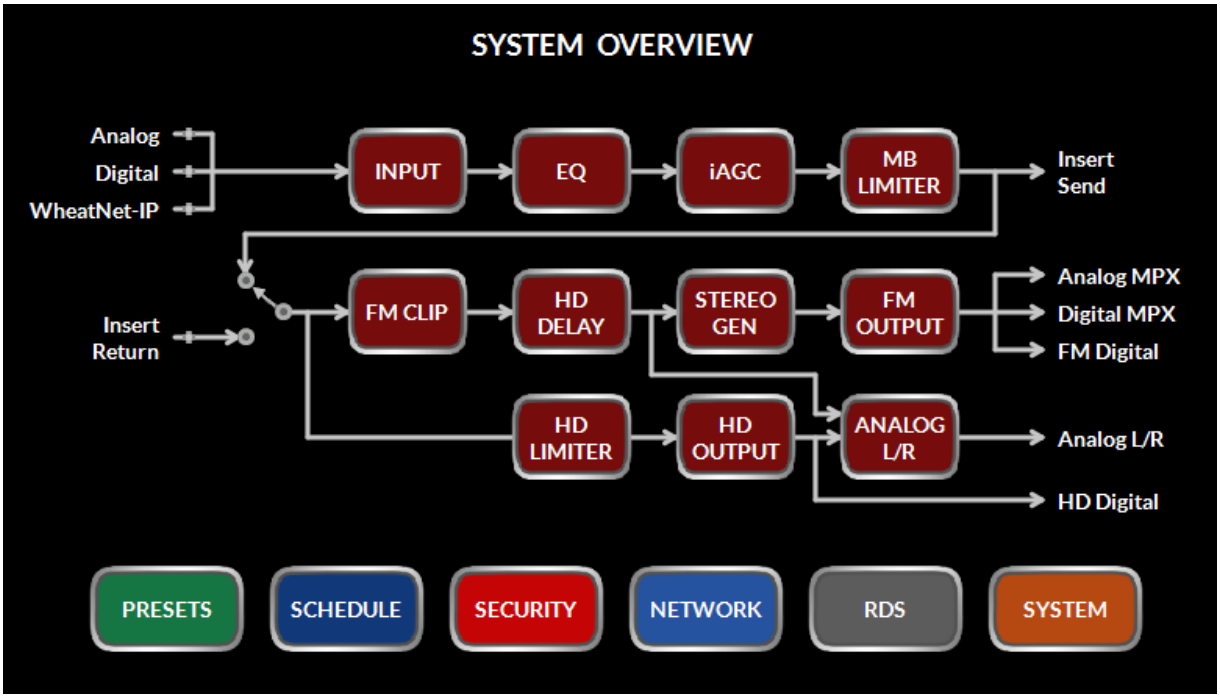


GUI Adjustment Controls

The flow chart below the X5 metering hosts all of the controls to tailor the sound of the X5 to your station's format and market. Included are key controls governing each stage of the audio processor that makes it easy to set up and adjust the sound. The user can simply click on the stage of processing they want to adjust.



INPUT SCREEN

Tapping the INPUT block brings up the input controls. This allows you to select the input source, digital gain, left/right balance (to correct for left/right level discrepancies), phase rotator, high pass filter, automatic failover (analog to digital OR digital to analog in the event of audio loss) and activation of the insert loop. There is also an option to allow you to tie the input settings to preset takes, or make the input screen independent of preset takes.

Source Selection and Automatic Failover

The Input Source can be selected as either Analog or one of the two Digital inputs. There is one analog input source via the X5's balanced audio inputs on its rear panel. There are two types of Digital sources; standard AES/EBU and WheatNet-IP.

To select the source, tap the control with the mouse pointer. Use the mouse wheel to scroll through the three input options. If you are using a laptop with a mousepad, push up or down on the pad to change the input source.

Below the source selection knob is a pair of signal presence indicators. The Analog indicator turns 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.

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

If the primary source was digital (AES/EBU or WheatNet-IP), 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 -48dBFs, and this combination with the 30 seconds timeout is suitable for virtually all program types.

NOTE: While the audio failover will work between the analog input and one of the digital input options (AES/EBU or WheatNet-IP), audio failover WILL NOT work between digital modes. For instance, if you are using WheatNet-IP as your primary input source, you cannot have the processor fail back to AES/EBU as the backup source. It must fail back to analog.

Input Gain and Balance

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 +/-24dB range. To adjust the gain, left click on the knob and use the mouse wheel to increase or decrease the gain. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

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 gain can be adjusted over a +/-24dB range. To adjust the gain, left click on the knob and use the mouse wheel to increase or decrease the gain. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

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 if it is out of balance. To adjust the gain, left click on the knob and use the mouse wheel to increase or decrease the gain. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

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 options for the frequency are Off, 20Hz, 25Hz,

30Hz, 35Hz, 40Hz, 45Hz, and 50Hz. To adjust the value, left click on the knob and use the mouse wheel to increase or decrease the frequency. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Make Bass Mono Below

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 typically correlated with the program material (it's hum, etc.). Therefore by setting the Make Bass Mono Below option to a higher filter cutoff frequency than the High Pass Filter setting, this noise can be rejected.

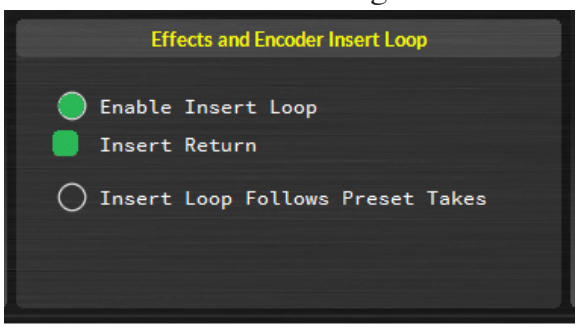
The options for the frequency are OFF and 50Hz - 500Hz in 50Hz steps. To adjust the value, left click on the knob and use the mouse wheel to increase or decrease the frequency. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Enable Insert Loop

Enabling the insert loop breaks the audio connection between the output of the five band processor and the input to the FM and HD limiter. Instead of directly connecting the five band output to the FM and HD limiter, the audio from the five band is sent to the insert loop OUT jack on the rear panel of the X5. This allows you to insert a ratings encoder watermark (or other gear). The output of the watermark encoder (and associated gear) is then returned to the IN jack. At that point, the audio signal continues to the FM and HD limiters, peak controllers and stereo generator (on the FM side).

Using the insert loop allows the user to have the X5's iAGC and five band processing appear before any ratings encoder so that the encoder is fed a consistent level.

Prior to this option, many users resorted to external AGC's to feed the ratings encoder prior to the main processor. Adding an additional gain control device to the airchain had the tendency to cause audible fighting between the external AGC and the internal AGC in the main processor. Defeating the AGC in the main processor was not always an option.



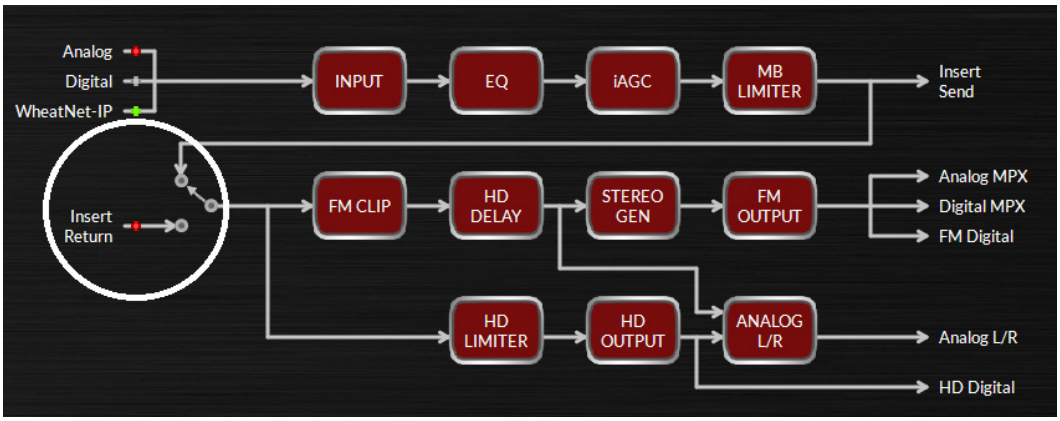
The correct solution is to provide an insert point in the main processor's audio path to accommodate the ratings encoder. This way, not only do we have one AGC that controls the input level to the processor AND the ratings encoder, we can now place the ratings encoder towards the back of the processing so the watermark is less likely to be altered by any previous multiband stages.

NOTE: Make sure you have your audio devices properly set up before enabling the insert loop or you will have an on air audio failure. The INSERT RETURN indicator will change to green if two conditions are met - AES lock and audio present.

The insert loop accepts AES/EBU signals only. The default sample rate is 48kHz. If you desire the sample rate of the loop to be 44.1kHz, you will need to feed a 44.1kHz signal to the main AES input of the X5. As of this writing, there is no audio failover for signal loss in the insert loop.

The insert loop is send and return levels are fixed. The send level is normally within a target of -24dBFs to -20dBFs, depending on how aggressive the processing is set up in the five band. If you are only looping the ratings encoder, the return audio should be at the same amplitude as when it left the processor. If you are adding any other devices into the insert loop, refer to their documentation for proper audio level line up procedures.

The insert loop option is preset dependent IF the option for "Input Settings Follow Preset Takes" is selected. If not, the input loop option is not preset dependent. For a list of input options that can follow preset takes, see Chapter 2, page 2- 34.



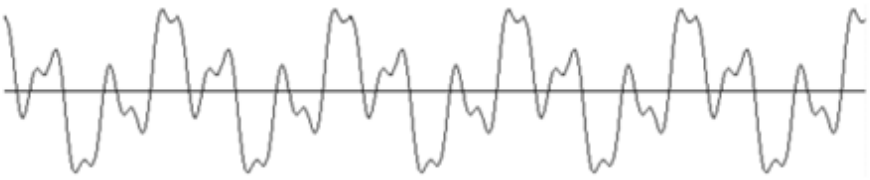
Miscellaneous

Two options here: Phase Rotator and Input Settings Follow Preset Takes.

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.

Human voice before *Phase Rotator* algorithm



Human voice after *Phase Rotator* algorithm

Input Settings Follow Preset Takes

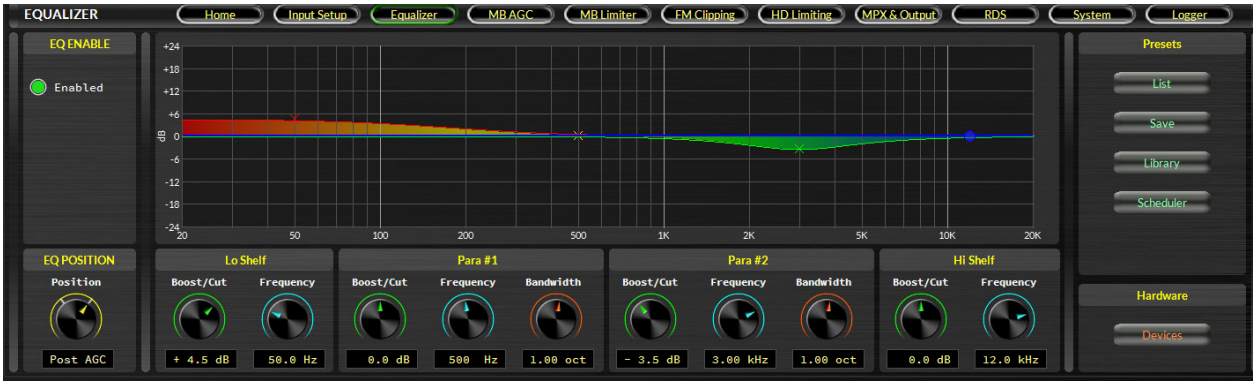
By default, when the X5 changes presets, its input settings (levels, input source, balance) are static. If you wish to have special input levels for different presets, or change any of the following, you will need to check this option and then save your current preset with the adjusted input settings.

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.

The X5 also has a set of output controls which can be dependent on preset takes. The option for that can be found in the MPX& Output menu and a list of controls that can be changed when that option is selected can be found on page 2-34, Chapter 2.

EQUALIZER MENU



The four band equalizer has four independent bands. Band 1 and 4 are shelving filters while Bands 2 and 3 are fully parametric. The two parametric bands can be adjusted in the following way:

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

The Band 1 Shelving EQ has a frequency range of 20Hz - 500Hz and can have a boost or cut of 14dB. The Band 4 Shelving EQ has a frequency range of 2kHz to 20kHz and can have a boost or cut of 14dB.

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

1. The first is by directly clicking on and dragging the knobs 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. Double clicking on the small "X" crosshair at the top (or bottom if it's below the line) of the curve 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).

EQ Enable

This is the master Equalizer In/Out button. When this box is checked the equalizer section IN. There is also an option to select the position where the EQ is applied. The knob below allows the end user to place the EQ before or after the five band dynamics. Placing it before allows the X5's multiband processing the chance to work on any EQ changes, which are then more subtle. Placing the EQ after the five band dynamics means any EQ changes will be more noticeable since they are now performed just before the final limiters on the FM and HD side.

MULTIBAND AGC

Clicking on the MB AGC block brings up the controls for the five band processing. To the left of the controls are seven tabs, each allowing adjustment of the seven key sections of the iAGC processing.

Master & iAGC

Clicking the top tab brings up the iAGC (Intelligent Automatic Gain Control). This is the first stage of dynamics control in the X5.

The first set of controls are the BASIC settings for the entire multiband AGC.

Drive

Offsets the drive level to the five band processing. The range is -12dB to +6dB. Higher numbers will lead to more consistent processing at the expense of a tradeoff to quality. Lower numbers will yield a more open, true-to-the-source sound.

To change the drive, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Gate Mode

Determines whether or not the processing will freeze when audio falls below the user defined threshold, or whether the gain will continue to rise, albeit at a rate 100 times slower. The options are Hold and Slow Release.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Couple Reference

Defines which band in the five band dynamics section will be the master. Band 3 has a more balanced sound, Band 2 has a warmer, analog type sound.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Multiband AGC Gate Threshold

Sets the gate threshold of the five band processor. Below this value, the multiband processor will no longer add gain to the audio and will freeze if below the gate level (gain reduction will still occur as needed).

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

These next set of controls are the BASIC controls for just the iAGC (Intelligent Audio Gain Control) section of the processor.

Window Width

When the iAGC is measuring dynamic range, the user has some control over limiting how much of that measurement is applied to the five band dynamics. The widow width control is the most important tool in making that decision. Lower numbers will mean the nearly all audio measurement will have some effect on the five band dynamics. Higher numbers mean that the changes from the iAGC control will be made more gradual and averaging. The range is 0dB (most changes) to 20dB (least amount of changes).

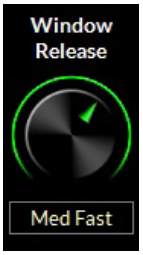
To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Window Attack

Governs how quickly the iAGC makes changes to the five band processing to correct audio. There are nine positions in this control. Eight of the nine are manual controls, that is, they attack based on the user setting (Slowest, Slower, Slow, Med Slow, Med Fast, Fast, Faster, Fastest). The center position is Auto. When in this position, the attack time is program dependent.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Window Release



Governs how quickly the iAGC releases control back to the five band once corrections are no longer needed. There are nine positions in this control. Eight of the nine are manual controls, that is, they release based on the user setting (Slowest, Slower, Slow, Med Slow, Med Fast, Fast, Faster, Fastest). The center position is Auto. When in this position, the release time is program dependent.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Window Gate

Sets the gate threshold of the windowed processing in the iAGC. Below this value, measurement activity is no longer applied to the audio and the processing acts more like a traditional AGC.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

These next set of controls are the EXPERT controls for just the iAGC (Intelligent Audio Gain Control) section of the processor.

Bass Offset

Adjusts the bass adaptation of the iAGC measurement system. At 0, the iAGC measures all audio equally. When you back off the bass offset, bass frequencies are treated differently for better bass management/impact.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Window Enhance

Allows the five band dynamics to "fill in" audio for a more radio-like sound from the processing. The Normal setting strikes a good balance between open audio and a tastefully processed sound on some audio. Higher numbers allow for more fill and a more processed sound while lower numbers allow for a more open sound (classical, jazz, spoken word formats).

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Individual Band Controls

Clicking one of the band 1 - 5 buttons (Band 3 shown here as an example) will bring up a screen with these controls that allow the end user to tailor the individual bands of processing to their taste. The following is a description of the functions these controls perform.

These first set of controls are the BASIC controls for just the iAGC (Intelligent Audio Gain Control) section of the processor.

Density

Determines the amount of input signal applied to each band of AGC - or - Compression. Lower numbers favor the slower AGC. Higher numbers favor the faster Compressor, thus making the sound more aggressive by increasing short term density.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Band Mix

This knob sets the output level of the band selected. You can quickly boost or cut the output mix of the selected band with this control.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Attack

Sets the speed at which the selected AGC band corrects increases in audio level. Higher numbers yield a slower response time and lets more audio through to later stages of processing downstream. Lower numbers yield a quicker response for more control at this stage.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Release

Governs how quickly the selected band recovers after correcting the level increase in the audio. Higher numbers yield a slower release time for a more open sound. Lower numbers yield a quicker response time for a fuller sound less consistent to the source.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

These next set of controls are the EXPERT controls for just the iAGC (Intelligent Audio Gain Control) section of the processor.

Band Threshold

Sets the threshold of the processing for the band selected. Lower numbers yield more gain reduction and lower band output with longer term correction.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Ratio

Sets the ratio of the five band compressor. This determines how aggressively the compressor exhibits control on the audio. A ratio of 2:1 indicates that a signal exceeding the user set threshold by 2dB will be attenuated by 1dB. A ratio of 20:1 means that up to 20dB of change can occur on the input with only a 1dB change on the output.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Band Coupling

Band coupling lets the user define the amount of independence a particular band can have from neighboring bands. Lower numbers let the bands act more independently to re-equalize the sound. When the numbers are closer to 0 (or at 0), the bands are more tightly coupled for a sound more faithful to the source.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Band Crossover (Bands 1 - 4)

Bands 1 - 4 have an extra control to set the crossover point. This is the upper frequency range at which the selected band will process audio. For instance, if Band 1 is set at 80Hz, all audio below that point will be processed by that band.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Effects

The last tab on the row to the left of the controls is the Effects controls. These controls set the output level of each of the five bands of dynamics, plus they allow the user to add stereo enhancement per band if needed.

To change this any of the controls, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

The lower row of controls are for stereo enhancement on a frequency dependent basis. As in previous Wheatstone processors, the X5 allows you to dynamically adjust stereo enhancement. Dynamic enhancement occurs because the processor actually measures the difference signal in the multiband dynamics, accounts for the amount of enhancement the user has requested by the controls, and dynamically adjusts the stereo sound field for added enhancement without the risk of excess enhancement.

Each of the four controls (no dynamic enhancement is available or necessary for frequencies in Band 1) allows you to tailor the difference output (L-R) for four of the five bands of processing.

MULTIBAND LIMITER

The multiband limiter controls allow the user to tailor the sound of the FM and HD limiters after the main dynamics section. There are six controls available. Adjustments to please most users can be found here.

These first set of controls are the BASIC controls for just the Multiband Limiter/ Clipper section of the processor.

Clipper Drive

This is the master drive control to the entire back end of the X5. Higher numbers will yield a louder, more processed sound at the eventual expense of distortion and fatigue.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Multiband Knee

Sets the shape of the limiter in the X5. Soft knee always favors limiting the audio over the hard knee, which will favor clipping the audio.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

MB Limiter & Drive

This is the master drive control to the limiters embedded in the X5 clippers. Higher numbers will yield a louder, more processed sound at the eventual expense of distortion and fatigue.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

These next set of controls are the EXPERT controls for just the Multiband Limiter/ Clipper section of the processor.

Master Threshold

Sets the threshold level of all the multiband limiters. Lower numbers mean the processor will apply more limiting to the audio. Higher numbers allow the clipper to apply more peak control on the audio. Generally speaking, the limiters will have a smoother sound at the expense of some loudness, where the clippers will have a slightly more edgy sound for more loudness.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Master Attack

Sets the attack time for all the multiband limiters. Faster settings mean the processor will apply quicker attack times. Slower numbers allow the clipper to apply more peak control on the audio as the limiter will allow "overshoot" into the clipper. Generally speaking, the Auto setting is recommended. On that setting, the limiters work best integrated with the main clipper.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Master Release

Sets the release time for all the multiband limiters. Faster settings mean the processor will apply more density via limiting. Slower numbers smooth out the audio as the limiter is less dense. Generally speaking, the Auto setting is recommended. On that setting, the limiters work best integrated with the main clipper.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

FM CLIPPING

The FM Clipping controls allow the user to customize the sound of the FM peak control system as well as the texture and style of the bass processing.

The FM Clipping system in X5 is designed quite unlike conventional systems. It's ability to achieve a tremendous amount of loudness without signal degradation is really what makes it stand out of the pack. The ability to customize the sound from the front panel, as well as the Windows based APP, makes it the clear choice for stations that need to be loud and still maintain as much clarity as possible.

These first set of controls are the BASIC controls for just the FM Clipper/Bass Enhance section of the processor.

Note that we have purposely duplicated the Clipper Drive for the FM Clipper and the MPX Processing Drive controls on the same menu page. This was done to aid the user in making the usual tradeoffs between the two styles of peak and density control without having to navigate back and forth between two *different* menu screens.

Clipper Drive

This is the input level control into X5's LIMITLess clipper. Higher numbers will increase apparent loudness on the air at the expense of some tradeoff in quality of the audio signal. With the LIMITLess clipper technology, even the most aggressive formats should not need settings above +2dB.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

MPX Processing Drive

This is the input drive control into X5's composite processor. Higher numbers will increase apparent loudness on the air at the expense of some tradeoff in quality of the audio signal. Most formats will not need more than +1.0dB drive, while aggressive formats could need settings up to +1.5dB. Aggressive MPX Processing can yield a higher baseband noise floor and have a spitty sound on the air if driven above +2.0dB.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Pre-Emphasis

Pre-emphasis was designed to help reduce the background noise of FM broadcasts. By raising high frequencies in the transmission system and applying a complimentary filter in the receiver, we gain additional signal to noise ratio for the listener.

In America, the pre-emphasis curve is 75μs. In most other parts of the world, the pre-emphasis curve is 50μs.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

A Word On Pre-Emphasis And Various Configurations

Most processors have many options for applying pre-emphasis and de-emphasis (the complimentary filter to pre-emphasis). It can get confusing. So we will try to cover all the basics here.

If you are using the analog composite outputs in the X5

Pre-emphasis should be applied. If you are using the analog or AES output to feed headphones, you should de-emphasize these outputs or they will sound too "bright".

If you are using baseband192 (AES composite) to feed your exciter

Pre-emphasis should be applied. If you are using the analog output to feed headphones, you should de-emphasize these outputs or they will sound too "bright".

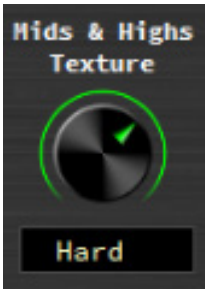
If you are using an AES/EBU connection to the exciter (where the exciter performs the stereo generator function)

Pre-emphasis should be applied by the FM processor, always! If you set the X5's pre-emphasis to Flat and apply pre-emphasis at the exciter, you will be prone to gross overshoot as many exciters do not have overshoot filters to control pre-emphasis. The best (and not always available) option if you must use an AES/EBU connection that is not composite is to always perform pre-emphasis at the processor before a linear STL path and NOT perform any further emphasis in the exciter.

Using the AES FM output to feed a codec

Pre-emphasized audio (with or without de-emphasis) should never be applied to an audio codec. If you need processing for streaming from your X5, the HD AES/EBU output or the analog outputs (set for HD) should be fed to your stream. Feeding audio managed for FM to an internet stream will reveal artifacts. If you must feed your stream with audio processed for FM, you should not expect great results.

Mids and Highs Texture



With its ability to manage pre-emphasis, there may be certain situations where it is desired to have a more traditional sound out of the audio processor to match the texture of a particular market or achieve a desired sound. This is where the Mids & Highs Texture control comes into play. Softer settings (7:00-12:00 on the control) will reduce some transient detail in the audio, making for a more rounded shape to the highs. Harder settings (12:00-5:00 on the control) will enhance transients and give the appearance of less processing in the highs.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. The values are Soft--, Soft-, Soft, Medium, Hard, Hard+, Hard++. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Voice Protect

Under extreme processing, it is sometimes necessary to process voice in a different way than music. Under most situations, X5 can run in extremely competitive situations with minimal loss of quality on dry voice. However, some may feel the need for extra protection from the processor for dry voice. This is where voice protect comes in. When dialed in, voice protect treats dry voice with an additional limiter to smooth out any edginess that may arise due to competitive processing. Voice protect only activates on dry voice and with settings of -4dBFs or higher is virtually undetectable.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

These next set of controls are the EXPERT controls for just the FM Clipper/Bass Enhancer section of the processor.

Bass Clip

This controls the overall sound of the bass clipper. There are five options for this control:

Tight – No extra effects, tight bass drum. No out of band harmonics.

Medium – Softer than TIGHT. Starts to add harmonics. Nice bass on small speakers.

Soft – Adds more harmonics and heft with more bass sustain. Default setting.

Phat – Deeper feel for urban based formats. Progressively more harmonics.

Growl – Edgy type bass for rock formats or urban with subwoofer style presentation.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Bass Harmonics

Determines the speed of the bass enhancing limiter. Higher percentage (%) values means the bass enhancement limiter is working faster and generating more harmonics. Lower numbers produce a smoother sounding bass. This control should be set by ear.

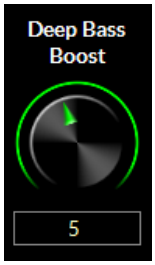
To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Low Frequency Extension

A specialized bass extender that helps to "fill in" bass on program content that may be lacking in bass. The control is tailored so that even at extreme settings bass is never "overwhelming" or "out of control" as it can sound on other processors.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Deep Bass Boost



Deep Bass Boost enhances frequencies below 75Hz. This allows the user to add a "subwoofer" type effect on the bass. Perfect for CHR, Urban and Hot AC formats that want to enhance the low end for a big, fat sound. Higher numbers add more to the effect.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Bass Thump

Bass thump helps increase the effect of kick drums and bass product prominent in CHR and Urban cuts. Together with Deep Bass Boost, Bass Thump can help pull out detail in bass, rather than creating an overall droning bass sound that is prominent in competing processors.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

HD LIMITER

The HD Limiter controls allow the user to custom the sound of the HD peak control system.

Limiter Drive

This is the input level control into X5's HD Limiter. Higher numbers will increase apparent loudness on the air at the expense of some tradeoff in quality of the audio signal.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Limiter Attack

Governs how quickly the X5 HD Limiter corrects for peaks. The control is scaled for the actual speed of the attack time (0.2mS – 30mS).

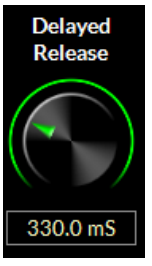
To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Limiter Release

Governs how quickly the 31 band limiter recovers after correcting audio. Faster settings will make the HD limiting sound more obvious. Slower settings may decrease loudness for a more open sound. A good starting point is a release time of about 130mS-150mS.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Delayed Release



The sophisticated X5 HD Limiter has a secondary, long term release algorithm called Delayed Release. This secondary release control establishes a long term release platform that the primary limiter works off of. The Delayed Release helps prevent pumping of unnatural gain changes in the main limiter. A good release

time for the Delayed Release is 1000mS (1.0S). In general, it is best to run the delayed release at least 3x what the main release value. For instance, if the main release is at 130mS, the delayed release should be AT LEAST 390mS or slower.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Limiter Enable

This controls turns on or off the HD Limiter. Wheatstone always recommends this control remain on for maximum audio consistency and peak control.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

L/R Link

This gives the user the option to couple or de-couple the left/right channels of the limiter. When coupled, the channel with the most gain reduction controls the opposing channel.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Delayed Release (Yes/No)

Turns on or off the delayed release option. **Yes** means the delayed release is active, **No** means it is bypassed.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

MPX & OUTPUT

The MPX & Output page allows users to adjust the composite processor and composite outputs as well as the SCA inputs, Wheatstone's Multipath Limiter and BS.412 limiter (for some European customers). There are four sub pages here, one for MPX processing and SCA adjustments, one for the FM and HD outputs, one for HD Delay, and, finally, a page for interfacing X5 with Sync Link.

Process & SCA Tab

MPX Processing Drive

The MPX Proc. Drive control allows the user to adjust the user selectable clipping OR limiting depth of the MPX processor. Under normal circumstances, the drive control should be set for +1.5 to +2.0dB for competitive loudness (these values will differ slightly depending on whether the processing mode is set for Limiter or Clipper).

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Pilot Injection

Sets the pilot tone injection level. Normally should be at 9%.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Multipath Limiter

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 Multipath Limiter does.

When active, the multipath limiter will restrict the L-R information in the audio signal to a percentage of the overall L+R, and this control is calibrated in %. In almost all cases, we recommend starting with a setting of 70%. If your

radio station is prone to receiver blend, reduce the control to 60% or 50% and listen for improvements.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

MPX Processing Type

The X5 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.
- **Lookahead Limiter** – This option processes the composite stereo waveform with a highly-oversampled lookahead limiter with fully automatic attack and release times. Its extremely high sample rate precisely controls composite waveform peaks on a cycle by cycle basis.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

MPX Mode

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 and subcarriers are completely turned off.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Side Band Mode

The X5 is equipped with the ability to operate the multiplex generator in the standard double or experimental (as of this writing) single sideband mode. Wheatstone highly suggests that you operate the multiplex generator in double sideband as this is the mode compatible with **all** stereo tuners in the field.

For more information on the single sideband experiment, please feel free to contact Wheatstone at (252) 638-7000 during normal business hours. You may also email us at techsupport@wheatstone.com.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

MPX Power (BS.412)

Turns on or off the BS.412 Power Controller. The BS.412 MPX Power Controller's sole purpose is to reduce program density as required in certain European countries. If you are not required to use the BS.412 Controller do not turn this feature on. Enabling the BS.412 MPX Power Controller can result in up to a 5dB loss in loudness.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob (although, being a long term measurement, it will take some time for the effects to be heard and/or measured). If you are using a laptop with a mousepad, push up or down on the pad to change the value.

The X5's BS.412 MPX Power Controller can be set in 0.1dB increments from +12dB to 0dB. When the control is in any position it is measuring the current MPX Power level on the BS.412 meter on the front panel and APP. Calculated corrections to the MPX power are only made when the BS.412 control is switched on, and when it is, modifications to the MPX power will take place immediately!

IMPORTANT!

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

When the BS.412 is switched on, 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.

Calibration Offset

When adjusting the BS.412 algorithm, there may be a need to slightly recalibrate the main adjustor to offset any differences in monitoring equipment. The tolerance for the BS.412 standard is +/-0.3dB. The Cal Offset control allows you to fine tune the main BS.412 control without having to change it's value. The control can be calibrated in 0.01dB steps.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

ITU-R BS.412 (On/Off)

Turns on or off the BS.412 power controller.

IMPORTANT!

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

To change the value, tap the control. You will see a green ring indicating the control is active and ready to be changed. Use the front panel knob to change. Once you have reached the desired setting, push in the knob to confirm the new value.

BS.412 Control Style

The BS.412 peak style control allows two options. Normal allows for very strict control of modulation of the signal in conjunction with MPX power management. In the "Peaky" mode, short duration peaks which do not affect total MPX power are allowed which can create a less restrictive sound. This is done dynamically by modifying the threshold of the distortion controller in the X5's left/right clipper and filter stage.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

SCA Controls

The SCA 1 & 2 level controls govern the SCA injection amount from 3rd party subcarrier generators (such as an external RDS generator) as a percentage of the main composite signal amplitude.

Normal operation of this control depends on a number of factors. You should set this control to -12.00dB to start. Have a modulation monitor capable of measuring the subcarrier you are adjusting ready to go with an RF sample or strong off air signal applied. Insert the 3rd party subcarrier generator into either the SCA 1 or SCA 2 port. If possible, adjust the trim control on the 3rd party device to match the proper injection level as displayed on the modulation monitor.

If there is no option to control the subcarrier injection level from the 3rd party device, you can offset the injection using the X5's SCA gain controls.

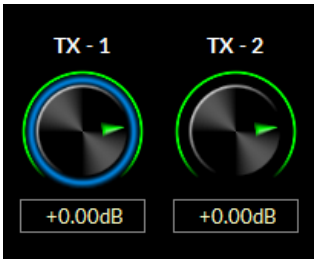
To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Outputs Tab

The output page allows the user to adjust the various outputs of the processor, including both composite outputs, the analog L/R output, and the AES output for both FM and HD (including the baseband 192 composite AES output).

Analog MPX

TX1 and TX2 Output



Sets the peak output amplitude of the MPX 1 and MPX 2 output 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 levels between -24dB and +6.00dB and in 0.05dB steps. If Volts Peak-to-Peak is desired, the TX Units control (see below) should be set to "V-PP".

When changing this control, having a reliable and calibrated modulation monitor with recommended signal level on its input is desired.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

TX Units

Allows the user to select dBu or Volts Peak-To-Peak as the scale for the TX1 and TX 2 output controls.

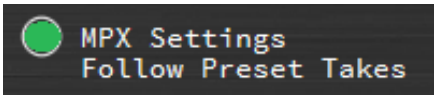
To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

TX2 Mode

TX 2 mode changes the TX 2 composite output on the rear of the X5 to a 19kHz sine wave synchronizing source for RDS generators.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

MPX Settings Follow Preset Takes



Normally the end user will want certain controls to be independent of preset changes. If, however, there is a need for specialized controls to be preset dependent, that option is provided. If selected, the following output options can be preset dependent:

TX1 & TX2 Output

TX2 Mode

To select this option, move the mouse cursor into the circle and left click. The circle will change to a green dot to confirm.

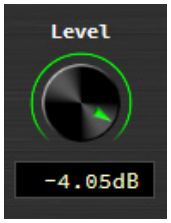
Analog L/R

Source

Allows the user to route either the FM processing or the HD processing to the analog L/R XLR jacks on the rear of the processor.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Level



Sets the output level of the analog L/R source (FM or HD) in dBFs.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Pre-Delay

If FM mode is chosen, pre-delay allows the end user the option of feeding audio before the HD alignment delay. This can be useful for a real time processing monitor when the station is operating with the alignment delay.

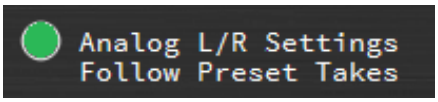
To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

De-Emphasis

If FM is selected as the analog L/R output, this option de-emphasizes the analog L/R output jacks.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Analog L/R Settings Follow Preset Takes



Normally the end user will want certain controls to be independent of preset changes. If, however, there is a need for specialized controls to be preset dependent, that option is provided. If selected, the following output options can be preset dependent:

Analog L/R Source

Analog L/R Level

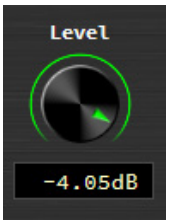
Pre-Delay

De-Emphasis

To select this option, move the mouse cursor into the circle and left click. The circle will change to a green dot to confirm.

FM DIGITAL

Level



Sets the output level of the FM AES signal in dBFs when the output type is set for AES-3.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Type

Allows the user to select the type of AES signal that appears at the output. The two options available are AES-3 and bb192 (baseband 192).

WARNING:

You should check with your exciter manufacturer to make sure your equipment has the capability to ingest the baseband192 AES over MPX standard before selecting this option. Interfacing the X5 to a non-compatible exciter with this option selected can cause undesired results.

Unlike traditional AES, baseband192 completes the final phase of the all-digital airchain that is clean AND highly competitive. Baseband192 allows you to use the composite clipper and stereo generator in the audio processor while the signal remains in the digital domain. Previously, if you wanted to interface your audio processor with your exciter using an AES signal, you needed to use the stereo generator in the exciter to complete the airchain. With the bandwidth available in Wheatstone audio processors and on the input of compatible exciters, it is now possible to interface a COMPOSITE signal over AES between the processor and the exciter. The stereo generator is now BACK in the audio processor, where it can work intelligently with the rest of the audio processing.

The X5 also supports the traditional AES interface between processor and exciter. By selecting AES3, the output appearing on the rear XLR connector is a standard AES L/R signal that can interface with STL systems or exciters that have AES input options.

WARNING:

If your exciter has the option for AES over MPX (baseband192) but you require or desire to use a traditional AES interface, make sure your exciter and the X5 have compatible settings. Mismatching the settings between the exciter and the processor can cause unwanted results. You should consult the user manual for your exciter or contact the manufacturer for information on configuring your exciter for the correct mode.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Pre-Delay

If FM mode is chosen, pre-delay allows the end user the option of feeding audio before the HD alignment delay. This can be useful for a real time processing monitor when the station is operating with the alignment delay.

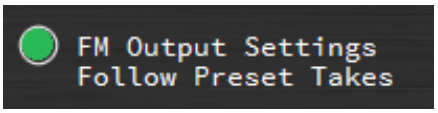
To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

De-Emphasis

If FM is selected as the analog L/R output, this option de-emphasizes the analog L/R output jacks.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The option will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

FM Digital Settings Follow Preset Takes



Normally the end user will want certain controls to be independent of preset changes. If, however, there is a need for specialized controls to be preset dependent, that option is provided. If selected, the following output options can be preset dependent:

FM Digital Level

FM Digital Type

FM Digital Pre-Delay Option

FM De-Emphasis Option

To select this option, move the mouse cursor into the circle and left click. The circle will change to a green dot to confirm.

HD Digital

Level

Sets the output level of the FM AES signal in dBFs when the output type is set for AES-3.

To change this option, click the control. Use the mouse wheel to adjust the control up or down. The level will change in real time as you move the knob. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Phase Reverse

When the Phase Reverse option is set to YES, the polarity of the HD Radio AES/EBU output signal is reversed by 180 degrees to compensate for phase errors between the FM and HD audio paths.

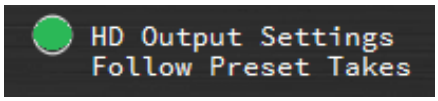
To change this setting, left click on the knob and use the mouse wheel to switch between Yes (phase is reversed 180 degrees) and No (phase is normal). If you are using a laptop with a mousepad, push up or down on the pad to change the value.

L/R Swap

The L/R Reverse allows the left and right channels of the HD output to be swapped (left becomes right, right becomes left) which can be useful during troubleshooting equipment that is external to the X5.

To change this setting, left click on the knob and use the mouse wheel to switch between YES (L/R is swapped) and NO (L/R is normal). If you are using a laptop with a mousepad, push up or down on the pad to change the value.

HD Digital Settings Follow Preset Takes



Normally the end user will want certain controls to be independent of preset changes. If, however, there is a need for specialized controls to be preset dependent, that option is provided. If selected, the following output options can be preset dependent:

HD Output Level

Phase Reverse

L/R Swap

To select this option, move the mouse cursor into the circle and left click. The circle will change to a green dot to confirm.

Delay & Test Tab

Located in the FM audio path, the HD delay system in X5 is the most sophisticated in any broadcast audio processor on the market. With the addition of an FM/HD tuner in X5, delay can now be automatically synced using this system without the need for 3rd party devices.

Also on this page is the X5's built in test oscillator.

Diversity Delay

When switched on, the diversity delay system is engaged.

To change this setting, left click on the knob and use the mouse wheel to switch between On and Off. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Control Style

There are three options for Control Style:

Manual – Allows the user to adjust the HD delay manually.

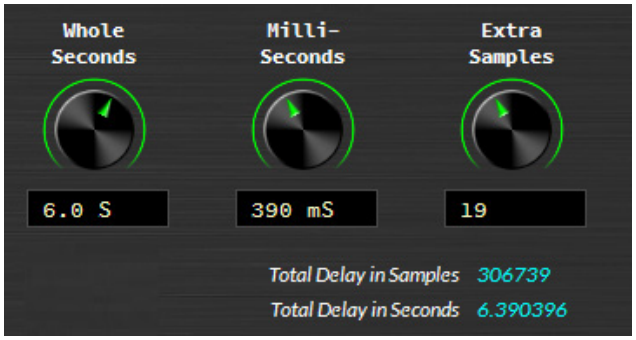
Monitor – Also allows manual adjustment, but will also measure the delay and show the correction error.

Auto Adjust – Allows for manual adjustment of the delay to within the window of the auto correct algorithm. The algorithm, to work properly, must have the delay error set within 1 second in order to auto-correct.

To change this setting, left click on the knob and use the mouse wheel to switch the options. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Control Time

The image shows an example of the corrected delay in time (seconds) and samples. Here the knobs show 6.390396 seconds of delay, or 306739 samples. If Auto Correct is used, and the X5 auto correct algorithm has achieved these settings, no other user intervention is needed as the tuner/algorithm consistently checks to make sure alignment is maintained.



To manually adjust or offset the delay, set the control style to **Monitor** (see above). Use the mouse wheel to adjust the control up or down. The time will change in real time as you move the knob, so be careful not to move too quickly or you will start to hear skipping on the air. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Correction Speed

There are five settings for the HD Delay Control Style: **Slowest, Slow, Normal Fast,** and **Fastest**. We recommend **Slowest** setting for most applications as it performs the least noticeable delay time correction. How each control position performs the correction is as follows:

Slowest: The delay error is adjusted by 100% of the error or a maximum of five samples per step, whichever is smaller.

Slow: The delay error is adjusted by 10% of the error and when the error is equal to or less than five samples the correction assumes the **Slowest** mode for any remaining error.

Normal: The delay error is adjusted by 20% of the error and when the error is equal to or less than five samples the correction assumes the **Slowest** mode for any remaining error.

Fast: The delay error is adjusted by 40% of the error and when the error is equal to or less than five samples the correction assumes the **Slowest** mode for any remaining error.

Fastest: The delay error is adjusted by 80% of the error and when the error is equal to or less than five samples the correction assumes the **Slowest** mode for any remaining error.

In any setting, if the remaining error is not zero, a minimum of one sample adjustment is made to cause the error to be zero.

To change this setting, left click on the knob and use the mouse wheel to switch the options. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

Receiver Frequency

Changes the receive frequency of the FM / HD tuner. For the system to function, the tuner must be set to the frequency of the radio station the processor is being used on.

To change this setting, left click on the knob and use the mouse wheel to change the frequency. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

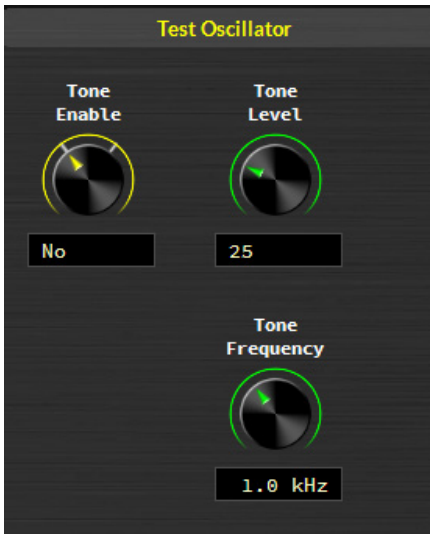
HD Delay And Tuner Status

Delay Error – When the X5 delay system is used in either **Monitor** or **Auto Adjust** modes, the currently measured delay error is shown here. This allows the user to walk in the correction manually if that is what is desired. In this example, the HD and analog are aligned and there is zero (0) error.

Signal Conditions – The signal condition graphs show the Received Signal Strength, Multipath, and have bar graph indicators for received FM Audio and received HD Audio. These are pulled from the FM/HD tuner built into the X5.

NOTE: The received FM Audio and received HD audio graphs are not indicative of modulation. They are merely there to show that audio is present. For proper modulation setup, a type accepted modulation monitor should be used.

Test Oscillator



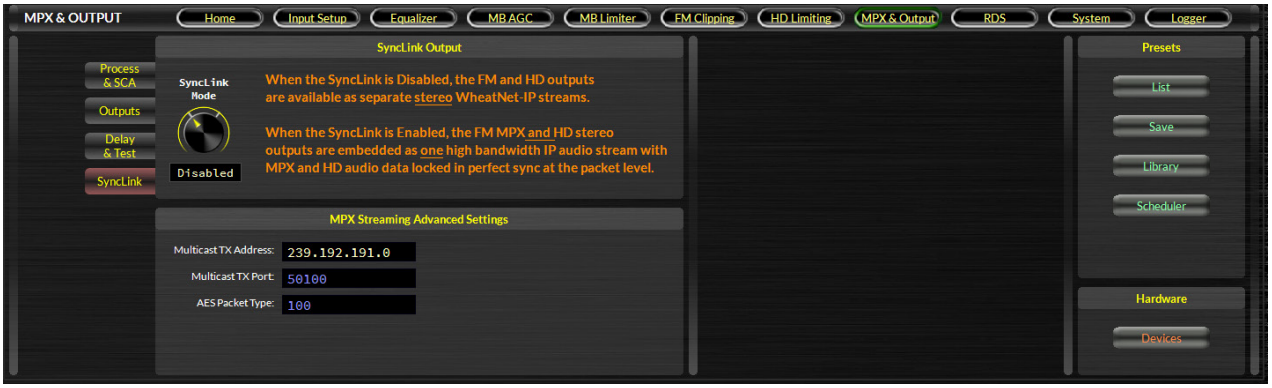
The built in test oscillator is capable of generating sine wave test signals from 50Hz to 80kHz at modulation levels from 0 to 100%. The oscillator is On when the Tone Enable option is set to Yes.

To switch the tone oscillator on, left click on the knob and use the mouse wheel to switch between Yes (tone oscillator is on) and No (tone oscillator is off). If you are using a laptop with a mousepad, push up or down on the pad to change the value.

To change the tone oscillator level, left click on the knob and use the mouse wheel to increase or decrease the value. If you are using a laptop with a mousepad, push up or down on the pad to change the value. The range is 0-100% (modulation)

To change the tone oscillator frequency, left click on the knob and use the mouse wheel to increase or decrease the value. If you are using a laptop with a mousepad, push up or down on the pad to change the value. The range is 50Hz to 20kHz, Bessel, 40kHz, 60kHz and 80kHz.

SyncLink Tab



SyncLink is an optional 1RU companion product for the X5 that maintains HD and FM alignment (LiveLock) from your studio to your transmitter site. It carefully keeps the HD and FM packets in sync so time alignment done with the processor at the studio is maintained straight through to the receiver.

HD and FM composite audio are converted to a single WheatNet-IP stream at the X5 and sent over a data link (~7 mbps) to the SyncLink decoder. There, the audio is converted back to two (2) analog composite signals, one baseband192 (MPX over AES) signal as well as an AES HD signal.

Because all audio is kept in the same IP stream, they arrive at the destination simultaneously and remain in sync. If packet loss occurs, both signals experience the same duration and time alignment is maintained.

If you do not have the companion SyncLink hardware, SyncLink should remain disabled.

RDS FUNCTIONS

Radio Data System is an international standard protocol which allows the broadcaster to embed text and other metadata into the FM signal. FM radios which receive this signal are able to decode this metadata, and either display it as text or act upon it in other ways. The RDS standard is documented in IEC-62106 (2009). The North American variant, called RBDS, is documented in NRSC-4-B (2011). The X5 is compliant with both standards.

Basic Settings

RDS must be configured first before it is enabled. Fortunately this is fairly quick and easy to do:

- Select the RDS screen and go to the Basic Settings panel. Do not enable RDS yet. Leave the level setting at 4%.
- Dial in your Country Code (CC). If your country is not listed, choose the Manual Entry setting, then enter the value in the CC field.
- Enter your Extended Country Code (ECC). A complete list of Country Codes and Extended Country Codes is provided at the end of this chapter.
- Enter your station's broadcast frequency.
- Enable Clock Time (CT) messages if you have an internet connection to an NTP server.

A Word About Data Sets

The Basic Settings we have just configured apply to all RDS messaging. The remaining information that RDS can carry is arranged in Data Sets, of which there are a maximum of 128, and of which only one is active at any given time. You do not have to use all 128 Data Sets, but you will use at least one. Data Sets are one way of changing the public "face" – the metadata messaging – of your station from hour to hour, day to day, or week to week.

When setting parameters in the Static Settings and ID Settings panels, pay attention to the fact that the change you are making applies only to one Data Set, which is the one selected by the "Viewing Data Set" knob in each of these two panels.

Data Sets may be switched dynamically during a broadcast, in order to switch the IDs and messaging encoded in the RDS stream. Several ways to do this are discussed later in this chapter.

Static Settings

As the name suggests, the Static Settings do not, as a general rule, change very often, so you might think of them as "default settings" which describe the majority of your station's programming.

Program Type (PTY) is a subject category like "talk", "news", or "sports". Note that the knob values are divided into two sets. The RBDS categories in the second half of the knob settings are appropriate for stations in North America, while the RDS categories in the first half of the settings should be used in the rest of the world.

Dynamic Program Type Indicator (PTYI) is a flag that tells the receiver whether your Program Type will change periodically, or remain fixed.

Traffic Advisory (TA) is a flag which indicates that your station is currently broadcasting motor vehicle traffic information, e.g. accidents, congestion, road closures, recommended detours, etc.

Traffic Program (TP) is a flag which indicates that your station does normally carry traffic reports (although not necessarily at the moment).

Music/Speech (MS) is a flag which indicates the predominant type of programming your station broadcasts.

Two settings are largely deprecated in current RDS practice (and ignored by most receivers), but they are provided for backwards compatibility.

Mono/Stereo is a flag which indicates whether your program is broadcast in mono or stereo.

Compression is a flag which indicates whether your signal is compressed.

ID Settings

Program ID (PI) is a crucial part of your station's RDS messaging and you should take care to set it correctly. The Generate PI Code dialog, which is opened by pressing the "Generate PID" button, can help in this regard. In North America, the PI code is generated from the station's call sign (3 or 4 letters). In the rest of the world, PI codes are assigned by regional broadcast authorities, but they may also be formulated from a combination of the Country Code, a Regional Coverage Code, and a Reference Number. LPFM stations use a PI code generated from the Country Code and a flag indicating whether or not your program is broadcast on alternate frequencies. In any case, your PI code should be unique, and should not overlap with any other transmitters in your geographical location.

Program Service (PS) is an 8-character text string (including spaces) which identifies your station. Examples might be "103.5 FM," "The Jet," or "Radio 1." Most receivers display this text prominently.

Radio Text (RT) is a 64-character text string (including spaces) which can carry any message you desire. It is up to the receiver how or even if to display this message – when it is shown, it is often displayed in a smaller font than the PS message, and it is often scrolled by the receiver inside a "window" of less width than the entire message can fit.

Alternate Frequencies (AF) is a space-separated list of frequencies which carry the same program as your main tuning frequency. The AF list is used by more sophisticated receivers to automatically switch to an alternate frequency when you are listening to the radio in a vehicle which is moving out of the reception area of the station you are currently listening to.

Again, when setting all of these parameters, pay attention to which Data Set you are altering.

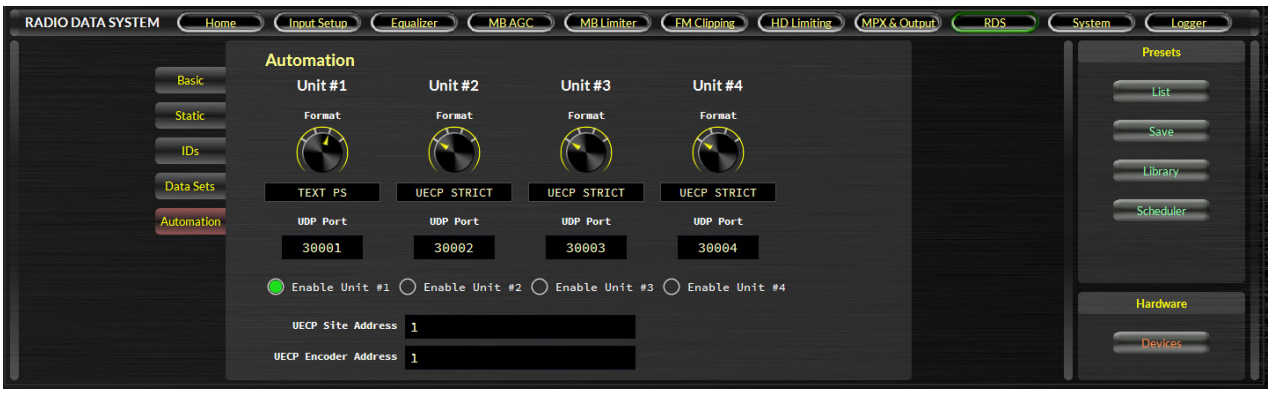
At this point the RDS encoder has the minimal amount of information it needs, and you could go back to the Basic Settings page and enable it.

Data Sets, Again

The Data Sets panel displays a summary of all the settings in each of your data sets. You may copy values from one Data Set to another, save all Data Sets to a file, restore all Data Sets from a file, and activate a Data Set.

The columns display, left to right, the Program ID (normally this should be the same for ALL Data Sets), Program Type, Dynamic Program Type Indicator, Traffic Announcement, Traffic Program, Music/Speech, Stereo/Mono, Compression, Alternate Frequencies, Program Service Name, and Radio Text.

Automation



Now we come to the fun stuff. You could set all of the values discussed above, for one Data Set, and just let that run: never changing your message, never displaying artist and title info for your listeners, never texting clues for a call-in contest to your audience. Alternatively, you could try to do all of that in real-time by opening the X5 APP, going to the RDS screen, and typing away. That would work, but you'd be very busy.

Or you can automate. There are three ways to do this: with UECP messages (transmitted via UDP), with plain text messages (transmitted via UDP), and with the Scheduler. These methods may be used independently or simultaneously, in any combination.

The Automation panel displays controls for four Units which receive messages on the selected UDP port. There are also four different message formats which may be received. Two of these are UECP, and two are plain text.

Universal Encoder Communication Protocol

UECP (often pronounced "you-sep") is described by the RDS Forum Technical Specification SPB 490 (2010). In the strict interpretation of the protocol, each message is bounded by special start and stop bits, there is a CRC word, and a requirement that certain byte patterns in the message be escaped. It's very technical, and that's why we call it **UECP Strict.**

A Unit which receives a Strict message has to "unpack" it – it has to strip off the start and stop bits, check and remove the CRC, and translate the escape characters. The message in this form we call **UECP Unpacked**, and this is the format that many automation systems transmit.

Incoming UECP messages have a four-tiered addressing scheme. The top level is the UECP Site Address, which is a number in the range 1-1023. A Site corresponds to a transmitter location or a broadcast facility. The next level is the UECP Encoder Address, which is a number in the range 1-63, and which differentiates multiple Encoders at one Site. Next is the Data Set Number (DSN), a number in the range 1-253 (corresponding to the 253 Data Sets available for storing metadata). Finally there is the Program Service Number (PSN), which is a number in the range 1-255.

In an incoming UECP message, each of these addresses may be set to the special value 0. In the Site Address, it means "all sites." In the Encoder Address, it means "all encoders." In the DSN field, it means "current data set." The PSN field is an exception: it must be set to 0 or the X5 will ignore the message.

In the Automation Settings panel, set your UECP Site Address if you have one, or set it to 0 if not. Likewise with the UECP Encoder Address.

The X5 implements the following UECP commands:

01	PI	Set Program ID code
02	PS	Set Program Service Name
03	TA/TP	Set Traffic Advisory/Program flags
04	DI/PTYI	Set values for Dynamic PTY, Stereo/Mono and Compressed flags
05	MS	Set Music/Speech flag
06	PIN	Set Program Item Number, the start time of the current program
07	PTY	Set Program Type code
13	AF	Set Alternate Frequencies
1C	DataSetSelect	Set current Data Set
3E	PTYN	Set Program Type Name, an 8-character string which extends PTY
24	FreeFormat	Transmit arbitrary RDS message using raw data blocks passed in
25	IH	Transmit In-House RDS message
2B	EWS	Transmit Emergency Warning System message
30	TMC	Transmit Traffic Message Channel ODA message
40	ODA Configure	Transmit ODA configuration message, transmit short ODA
42	ODA FreeFormat	Transmit free format ODA message
46	ODA Data	Transmit ODA message

Plain Text

Plain text messages received by the X5 may be routed to either PS (Program Service) or RT (Radio Text), depending on the Unit's Format setting. These messages affect only the current data set, and neither value is saved (for example, if you switch to a different Data Set after receiving these message, then their values are lost). A PS text string longer than eight characters will be displayed in chunk-wise scrolling fashion. An RT string longer than 64 characters is truncated. Both PS and RT text strings are displayed verbatim.

The Scheduler

The Scheduler can be used to activate different RDS Data Sets at pre-determined times, either weekly/daily/hourly or as a one-shot event on a particular date. Scheduled events may include processing changes as well as RDS Data Set changes.

RDS Level

The RDS Level control should be set at 4% of total modulation. Make sure you have a modulation monitor capable of reading the RDS subcarrier injection level.

Symbols used for ECC and PI country codes for the countries in the European Broadcasting Area

NOTE The country codes and Extended country codes for countries outside the European Broadcasting Area are given in Annex N.

Country	*ISO code*	*ECC and Country code*		*Country*	*ISO code*	*ECC and Country code*	
Albania	AL	E0	9	Italy	IT	E0	5
				Jordan	JO	E1	5
Algeria	DZ	E0	2	Kosovo	-	E4	7
				Latvia	LV	E3	9
				Lebanon	LB	E3	A
Andorra	AD	E0	3	Libya	LY	E1	D
Armenia	AM	E4	A				
Austria	AT	E0	A	Liechtenstein	LI	E2	9
Azerbaijan	AZ	E3	B				
Azores (Portugal)	PT	E4	8	Lithuania	LT	E2	C
Belgium	BE	E0	6	Luxembourg	LU	E1	7
				Macedonia	MK	E3	4
				Madeira (Portugal)	PT	E4	8
Belarus	BY	E3	F	Malta	MT	E0	C
Bosnia Herzegovina	BA	E4	F	Moldova	MD	E4	1
Bulgaria	BG	E1	8	Monaco	MC	E2	B
Canaries (Spain)	ES	E2	E	Montenegro	ME	E3	1
				Morocco	MA	E2	1
Croatia	HR	E3	C				
Cyprus	CY	E1	2	Netherlands	NL	E3	8
Czech Republic	CZ	E2	2	Norway	NO	E2	F
				Palestine	PS	E0	8
				Poland	PL	E2	3
Denmark	DK	E1	9	Portugal	PT	E4	8
Egypt	EG	E0	F	Romania	RO	E1	E
Estonia	EE	E4	2	Russian Federation	RU	E0	7
Faroe (Denmark)	DK	E1	9	San Marino	SM	E1	3
Finland	FI	E1	6	Serbia	RS	E2	D
				Slovakia	SK	E2	5
France	FR	E1	F	Slovenia	SI	E4	9
Georgia	GE	E4	C	Spain	ES	E2	E
Germany	DE	E0	D	Sweden	SE	E3	E
	or	E0	1	Switzerland	CH	E1	4
Gibraltar (United Kingdom)	GI	E1	A	Syrian Arab Republic	SY	E2	6
				Tunisia	TN	E2	7
Greece	GR	E1	1	Turkey	TR	E3	3
Hungary	HU	E0	B	Ukraine	UA	E4	6
Iceland	IS	E2	A	United Kingdom	GB	E1	C
Iraq	IQ	E1	B	Vatican City State	VA	E2	4
Ireland	IE	E3	2				
Israel	IL	E0	4				

ECC	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
E 0	DE	DZ	AD	IL	IT	BE	RU	PS	AL	AT	HU	MT	DE		EG
E 1	GR	CY	SM	CH	JO	FI	LU	BG	DK	GI	IQ	GB	LY	RO	FR
E 2	MA	CZ	PL	VA	SK	SY	TN		LI	IS	MC	LT	RS	ES	NO
E 3	ME	IE	TR	MK				NL	LV	LB	AZ	HR	KZ	SE	BY
E 4	MD	EE	KG			UA	-	PT	SI	AM		GE			BA

|____Hex code for Variant 0 in Block 3 of Group type 1A, Bits b_3 to b_0
|_____Hex code for Variant 0 in Block 3 of Group type 1A, Bits b_7 to b_4

Country codes and extended country codes for countries outside the European Broadcasting Area

African Broadcasting Area

COUNTRY/AREA	ISO CODE	SYMBOL FOR PI	ECC
Ascension Island		A	D1
Cabinda		4	D3
Angola	AO	6	D0
Algeria	DZ	2	E0
Burundi	BI	9	D1
Benin	BJ	E	D0
Burkina Faso	BF	B	D0
Botswana	BW	B	D1
Cameroon	CM	1	D0
Cape Verde	CV	6	D1
Central African Republic	CF	2	D0
Chad	TD	9	D2
Comoros	KM	C	D1
Congo, Democratic Republic of	CD	B	D2
Congo	CG	C	D0
Cote d'Ivoire	CI	C	D2
Djibouti	DJ	3	D0
Egypt	EG	F	E0
Equatorial Guinea	GQ	7	D0
Eritrea	ER	F	D2
Ethiopia	ET	E	D1
Gabon	GA	8	D0
Gambia	GM	8	D1
Ghana	GH	3	D1
Guinea-Bissau	GW	A	D2
Equatorial Guinea	GQ	7	D0
Guinea, Republic of	GN	9	D0
Kenya	KE	6	D2
Liberia	LR	2	D1
Libya	LY	D	E1
Lesotho	LS	6	D3
Mauritius	MU	A	D3
Madagascar	MG	4	D0
Malawi	MW	F	D0
Mali	ML	5	D0
Mauritania	MR	4	D1
Mozambique	MZ	3	D2
Morocco	MA	1	E2
Namibia	NA	1	D1
Niger	NE	8	D2
Nigeria	NG	F	D1
Rwanda	RW	5	D3
Sao Tome & Principe	ST	5	D1
Seychelles	SC	8	D3
Senegal	SN	7	D1
Sierra Leone	SL	1	D2

COUNTRY/AREA	ISO CODE	SYMBOL FOR PI	ECC
Somalia	SO	7	D2
South Africa	ZA	A	D0
Sudan	SD	C	D3
Swaziland	SZ	5	D2
Togo	TG	D	D0
Tunisia	TN	7	E2
Tanzania	TZ	D	D1
Uganda	UG	4	D2
Western Sahara	EH	3	D3
Zambia	ZM	E	D2
Zimbabwe	ZW	2	D2

Allocations of symbols for countries in ITU Region 2

COUNTRY/AREA	ISO CODE	SYMBOL FOR PI	ECC
Anguilla	AI	1	A2
Antigua and Barbuda	AG	2	A2
Argentina	AR	A	A2
Aruba	AW	3	A4
Bahamas	BS	F	A2
Barbados	BB	5	A2
Belize	BZ	6	A2
Bermuda	BM	C	A2
Bolivia	BO	1	A3
Brazil	BR	B	A2
Canada	CA	B, C, D, E	A1
Cayman Islands	KY	7	A2
Chile	CL	C	A3
Colombia	CO	2	A3
Costa Rica	CR	8	A2
Cuba	CU	9	A2
Dominica	DM	A	A3
Dominican Republic	DO	B	A3
Ecuador	EC	3	A2
El Salvador	SV	C	A4
Falkland Islands	FK	4	A2
French Guiana	GF	5	A3
Greenland	GL	F	A1
Grenada	GD	D	A3
Guadeloupe	GP	E	A2
Guatemala	GT	1	A4
Guyana	GY	F	A3
Haiti	HT	D	A4
Honduras	HN	2	A4
Jamaica	JM	3	A3
Martinique	MQ	4	A3
Mexico	MX	B, D, E, F	A5
Montserrat	MS	5	A4
Netherlands Antilles	AN	D	A2
Nicaragua	NI	7	A3
Panama	PA	9	A3
Paraguay	PY	6	A3
Peru	PE	7	A4
Puerto Rico	PR	1..9, A, B, D, E	A0
Saint Kitts	KN	A	A4
Saint Lucia	LC	B	A4
St Pierre and Miquelon	PM	F	A6
Saint Vincent	VC	C	A5
Suriname	SR	8	A4
Trinidad and Tobago	TT	6	A4
Turks and Caicos Islands	TC	E	A3
United States of America	US	1..9, A, B, D, E	A0
Uruguay	UY	9	A4
Venezuela	VE	E	A4
Virgin Islands [British]	VG	F	A5
Virgin Islands [USA]	VI	1..9, A, B, D, E	A0

Allocations of symbols for countries in ITU Region 3

COUNTRY/AREA	ISO CODE	SYMBOL FOR PI	ECC
Afghanistan	AF	A	F0
Australia	AU		
Australia Capital Territory		1	F0
New South Wales		2	F0
Victoria		3	F0
Queensland		4	F0
South Australia		5	F0
Western Australia		6	F0
Tasmania		7	F0
Northern Territory		8	F0
Bangladesh	BD	3	F1
Bahrain	BH	E	F0
Brunei Darussalam	BN	B	F1
Bhutan	BT	2	F1
Cambodia	KH	3	F2
China	CN	C	F0
Fiji	FJ	5	F1
Hong Kong	HK	F	F1
India	IN	5	F2
Indonesia	ID	C	F2
Iran	IR	8	F1
Japan	JP	9	F2
Kazakhstan	KZ	D	E3
Kiribati	KI	1	F1
Korea [South]	KR	E	F1
Korea [North]	KP	D	F0
Kuwait	KW	1	F2
Kyrghyzstan	KG	3	E4
Laos	LA	1	F3
Macao	MO	6	F2
Malaysia	MY	F	F0
Maldives	MV	B	F2
Micronesia	FM	E	F3
Mongolia	MN	F	F3
Myanmar [Burma]	MM	B	F0
Nepal	NP	E	F2
Nauru	NR	7	F1
New Zealand	NZ	9	F1
Oman	OM	6	F1
Pakistan	PK	4	F1
Philippines	PH	8	F2
Papua New Guinea	PG	9	F3
Qatar	QA	2	F2
Saudi Arabia	SA	9	F0
Soloman Islands	SB	A	F1
Samoa	WS	4	F2
Singapore	SG	A	F2
Sri Lanka	LK	C	F1
Taiwan	TW	D	F1

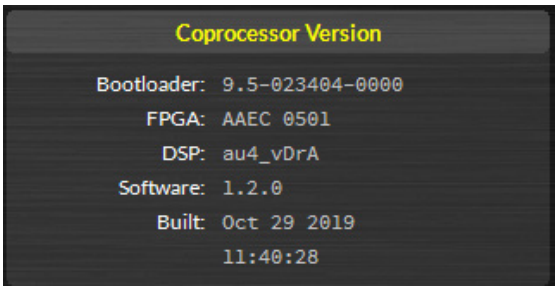
COUNTRY/AREA	ISO CODE	SYMBOL FOR PI	ECC
Tajikistan	TJ	5	E3
Thailand	TH	2	F3
Tonga	TO	3	F3
Turkmenistan	TM	E	E4
UAE	AE	D	F2
Uzbekistan	UZ	B	E4
Vietnam	VN	7	F2
Vanuatu	VU	F	F2
Yemen	YE	B	F3

SYSTEM

The System page contains status information about the processor, as well as settings for security and for the headphone feed.

Co-Processor Version

Shows the current build of the main processing core. This information may be of value when communicating with Wheatstone about an issue, or looking to update the processor to a newer version.

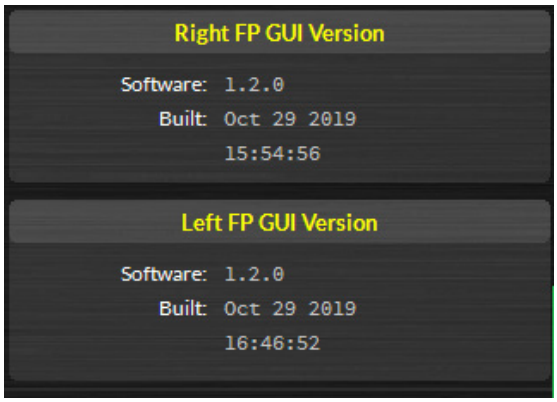


Right And Left Front Panel Versions

Shows the current build of the front panel GUI's. This information may be of value when communicating with Wheatstone about an issue, or looking to update the processor to a newer version.

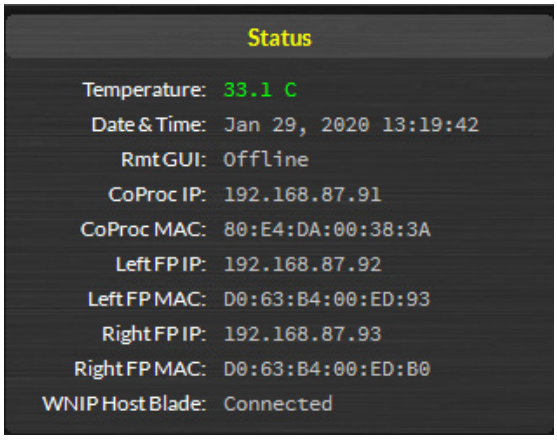
NOTICE:

The front panel versions may or may not match the Co-Processor version.

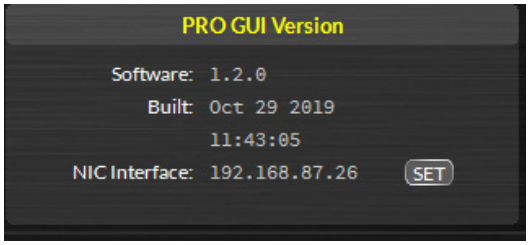


Status

Shows the state of the audio processor: internal Temperature, current Date & Time, if the Remote GUI App is connected, followed by the IP and MAC addresses of the Co-Processor and the front panel displays. The STATUS display also shows which Blade in your WheatNet-IP system is the Host Blade for the processor.



Pro GUI Version

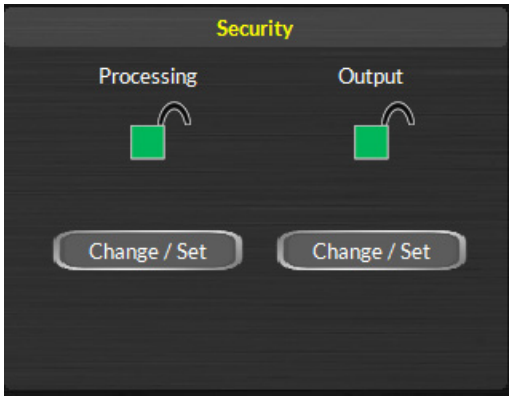


Shows the version of the running GUI. This version should match with the Co-Processor version. If it does not, you should contact Wheatstone to acquire a link for the correct GUI download to match your processor.

Set NIC

If there are multiple NIC's in your PC/Laptop, you can specify which NIC you want the X5 remote APP to talk to the hardware on. Use the mouse to click on SET and follow the menu to select the correct NIC interface.

Security



Setting and clearing passwords for the front panel touchscreen is possible from the security section of the GUI. You can choose 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, and without giving the transmission authority access to the processing controls.

There is no default password in the X5. 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. Pressing PROCESSING PASSWORD will bring up the screen to enter the new processing control password.

If the X5 does not have a password, you will be prompted to enter the password you would like to use to lock down the processing functions. Once entered, you will be asked to verify the password selection. If the passwords match, the X5 will indicate the password has changed. If the passwords do not match, an error message will show indicating the passwords don't match.

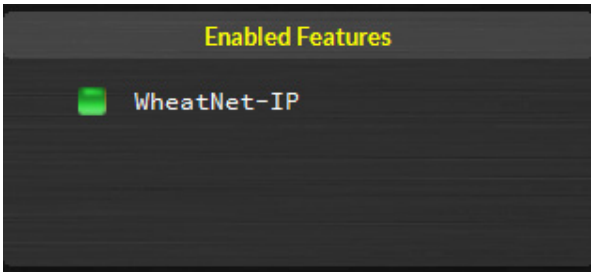
Repeat these steps to set or change the password for the output settings of the X5.

Lost Password

If you have lost or forgotten your password, or encounter a locked X5 from a previous engineer/owner, resetting the password is possible. Tapping on the CLEAR PASSWORDS button brings up a screen that displays the MAC address of the processor. You will need to submit this MAC address to Wheatstone to get an unlock key which will clear the passwords on the processor.

Once you receive the passcode, you will be able to tap the FACTORY CLEAR PASSWORDS option, close the MAC address message and move on to the keypad screen to enter the code provided by Wheatstone.

Once the passwords are cleared, you can choose to leave the hardware unsecured or set new passwords.



Enabled Features

This section shows if the WheatNet-IP feature is enabled. If it is, a green indicator will light.

Headphone Source

The headphone source option allows you to listen to your audio at various stages of processing. Not only is it helpful in that it allows you to hear the audio as it goes through the various processes, it also allows you to troubleshoot potential issues (like comparing the source audio to the output product or comparing the FM Output with the HD Output).

There are seven monitor points:

1. **Input** (monitors the active input).
2. **Analog Input** (allows you to monitor the analog source if it isn't active).
3. **Digital Input** (allows you to monitor the digital source if it isn't active).
4. **HD Output** (allows you to monitor the HD Output after all processing).
5. **FM Pre-Delay** (allows you to monitor the FM Output before diversity delay).
6. **FM Output** (allows you to monitor the FM Output after all processing and delay).
7. **Insert Return** (allows you to monitor the insert point return).

To switch the headphone source, left click on the knob and use the mouse wheel to switch between one of the seven options. Left click the mouse to select the new source. The source WILL NOT CHANGE until you confirm it my left clicking the mouse.

Control Timeout

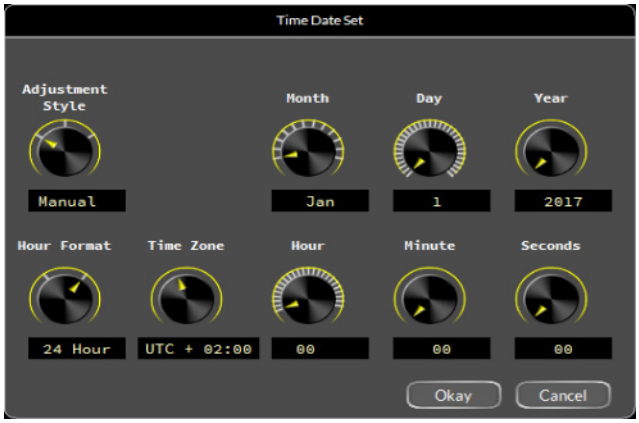
Sets the amount of time (in seconds) before the display times out and goes back to the main screen block diagram. The options are OFF (never goes back until the screen saver starts) to 60 seconds.

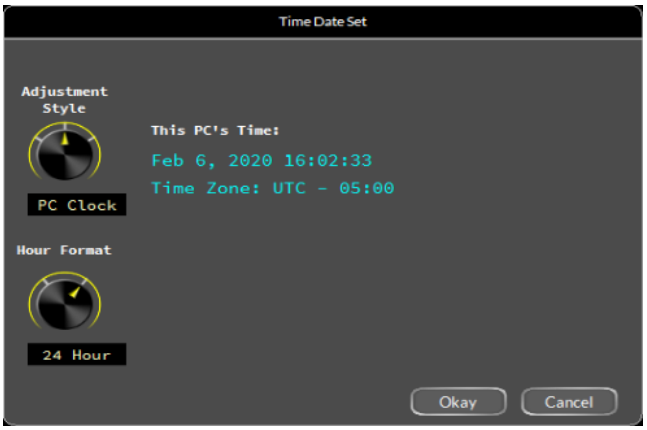
Left click on the knob and use the mouse wheel to increase or decrease the value. If you are using a laptop with a mousepad, push up or down on the pad to change the value.

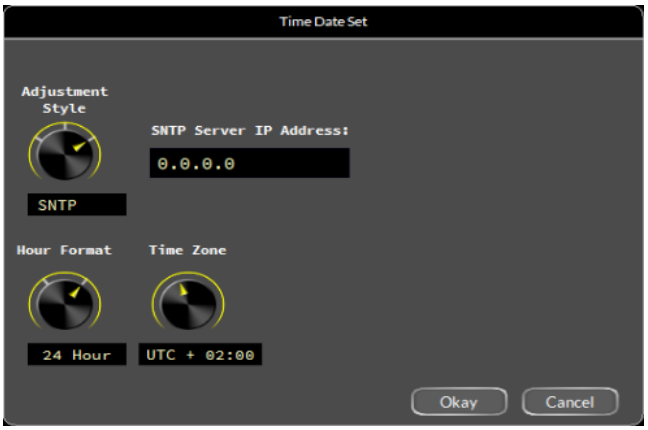
Setting The Time

Located below the DISPLAY TIMEOUT, this option allows you to set the system time of the X5 onboard computer to be set or changed. The X5 system time can be synchronized to external time servers (SNTP, or Simple Network Time Protocol) if desired. Using a search engine, you can find the IP addresses of active SNTP servers in your region.

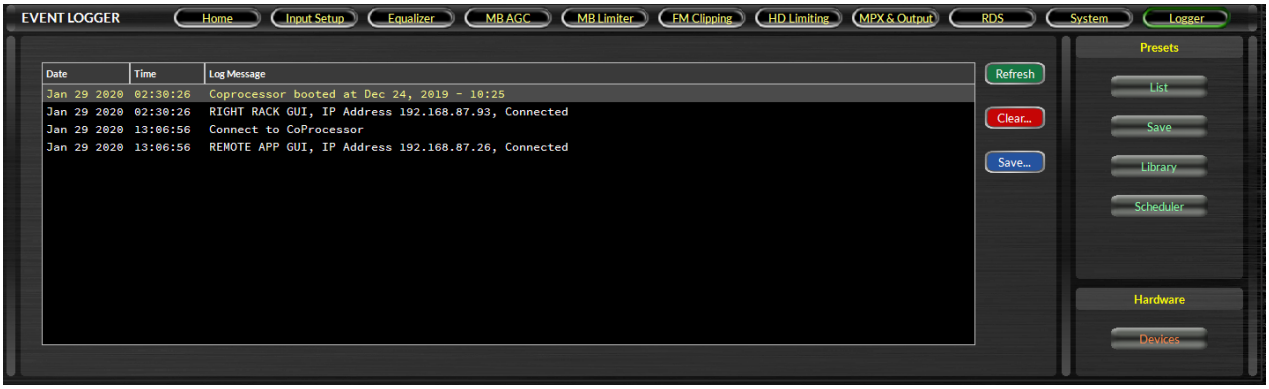
Alternately, time can be synchronized to the PC that is running the Windows-based GUI. In this instance time updates will occur upon successful connection to the GUI on the remote PC.







EVENT LOGGER



The Event Logger allows the user to review events that have occurred in the processor. Each of these events are time and date stamped.

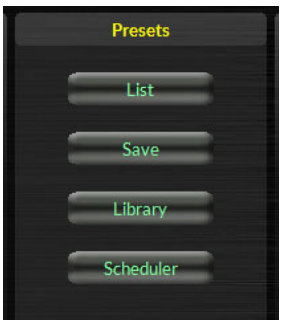
To see the events, you must first retrieve them. This can be done by clicking on the Refresh button. All events from the last time the log was viewed will populate. You can choose to keep the events, save the events (the blue Save button) or you may clear the events (NOTE: The event logger will time and date stamp when the list has been cleared).

Events can be retrieved going back 30 calendar days. At that time, the events are deleted from the log automatically. The log is also flushed on reboot.

The following list is what is automatically logged:

- **Preset Takes (Manual and Scheduled)**
- **Audio Failure**
- **Audio Failover**
- **Audio Failback (from backup source)**
- **General Alarms**
- **Reboot**
- **Log Clear**
- **GUI Connect (with IP address)**
- **GUI Disconnect.**

PRESETS



To the right of the Control Area is a vertically disposed row of buttons to manage, save, backup, and copy presets. The four buttons are:

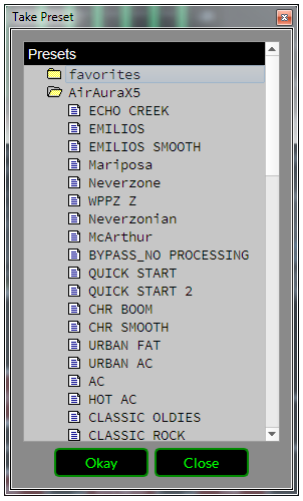
List – Shows the list of presets on the hardware. Double clicking on any of the presets will take that preset.

Save – Opens the save dialogue box that allows you to name a new preset and pick the preset slot you would like to save the preset to.

Library – Opens the preset manager. The preset manager allows you to copy presets from the hardware to the local PC and vice versa. It also allows you to extract presets from the hardware to share with other users.

Scheduler – Allows presets to be automatically changed on desired dates and times.

List



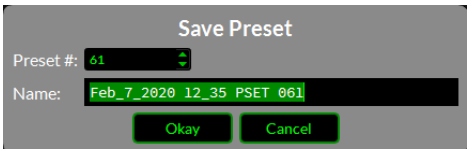
When left-clicked, a dialog box appears, showing all presets stored on the hardware.

Double-clicking on a preset brings it immediately into use in the X5. 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.

NOTE: It is important to remember to save the current present settings before invoking others, or they will be lost.

Note also that you can only Take presets that are already loaded in the X5 from this dialog box.

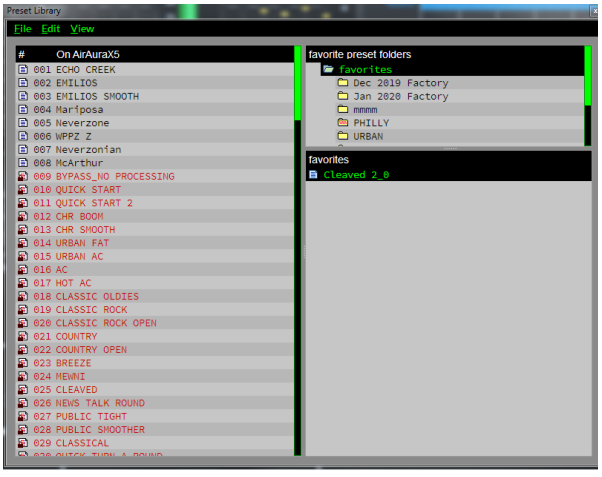
Save



Clicking on the Save button opens a dialog, prompting the user for a name for the present 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. Unless a preset is user protected or factory protected, it is possible to overwrite saved presets if one is not careful.

The end user can define a name for the preset. If none is defined, the preset will be saved with the current date and time as its name.

Library

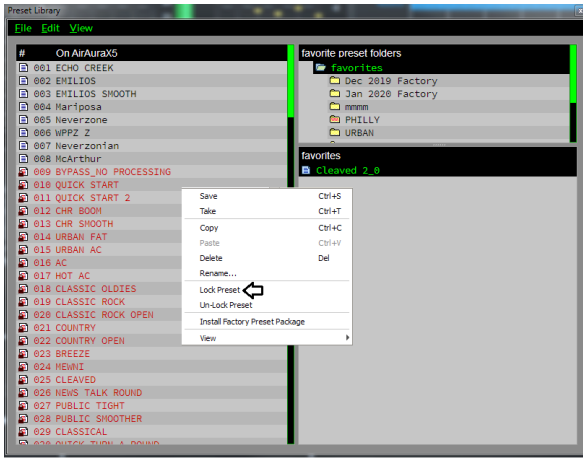


When the Library button is pressed, a window-style dialog box appears containing three panels. The large panel on the left shows the presets currently stored on the X5.

The upper right panel shows the preset folders on the PC hosting the APP, 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

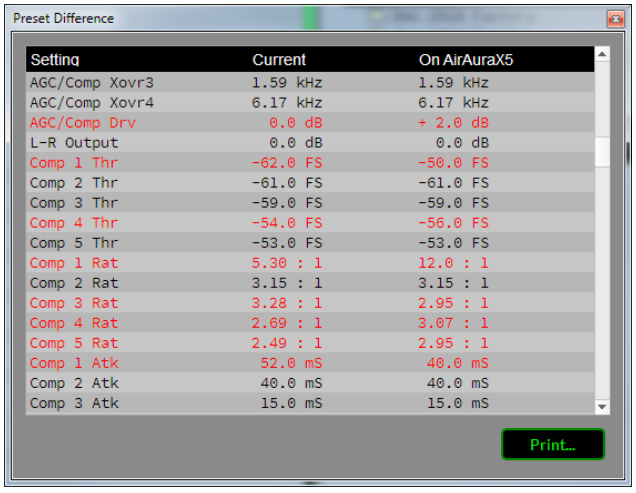


Presets stored on the X5 may be locked by the user to prevent inadvertent overwriting, renaming, or deletion. This is accomplished by opening the Preset Library by clicking on the Library button in the APP. Once the list of presets is open, the ones actually stored within the processor hardware itself 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 Differences



It is possible to visually compare two different presets on the X5 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.

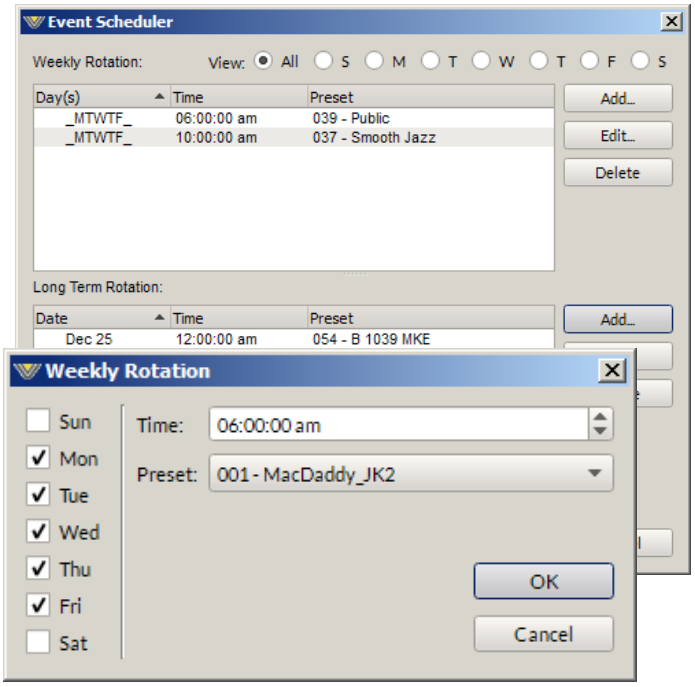
Any parameter that is listed with a RED background indicates a parameter that is difference between the preset running on the hardware and the preset that has been highlighted. Parameters which are not highlighted have the same values between the two presets.

Preset settings can also be printed or exported as a .csv file which can be read by Excel programs.

Scheduler

The X5 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.

Creating a Weekly Rotation Schedule

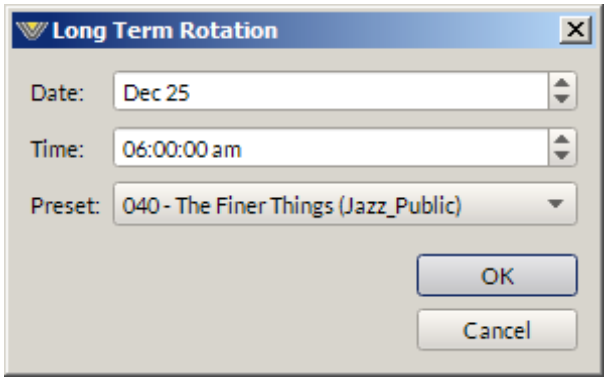


1. Click the Add button in the Weekly Rotation area of the Event Scheduler window. The Weekly Rotation window will open as shown on the right.
2. On the left column, select the days that the preset should be selected. Any combination of checkboxes may be chosen.
3. Next select the time that the preset should change.
4. Next choose the preset that should be selected at the time programmed in the previous step. When finished editing, click OK.

As many preset change events as desired may be programmed in the Event Scheduler. If a one-time preset change is required, such as might be necessary for a special holiday or other event, the Long Term Rotation routine should be used.

Creating a Long Term Rotation Schedule

Adding a new event in the Long Term Rotation scheduler works in a similar manner. The Long Term Rotation entry window is shown here on the right.



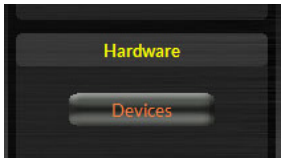
Deleting a Scheduled Event

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: There is no confirmation prior to the actual deletion of the event!

HARDWARE

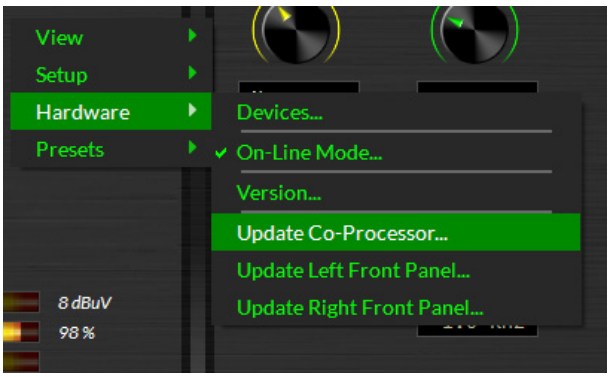


Devices – Opens up the application to configure a the APP to talk to a specific X5 based on its hardware address. For information about this, please see page 3-6.

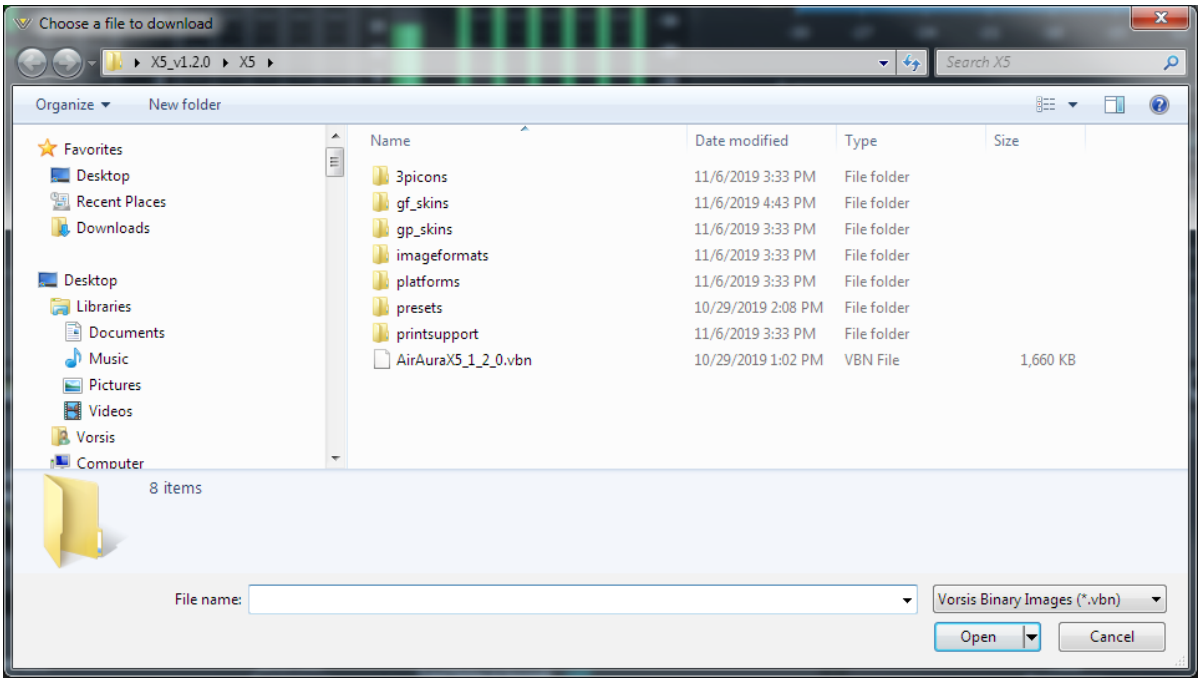
Updating Your X5

Updating your X5 is easy to do when an update is made available by Wheatstone. A link will be with the new GUI will be furnished by Wheatstone on its website, or if you call to request and update, a technician may email you a copy of the link.

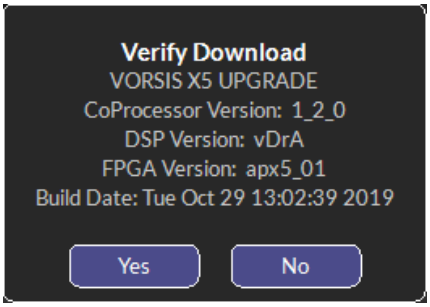
Once you have installed the new GUI, connect to the hardware as you normally would. Right click anywhere in the GUI to display the windows on right. You will want to choose Update Co-Processor... first.



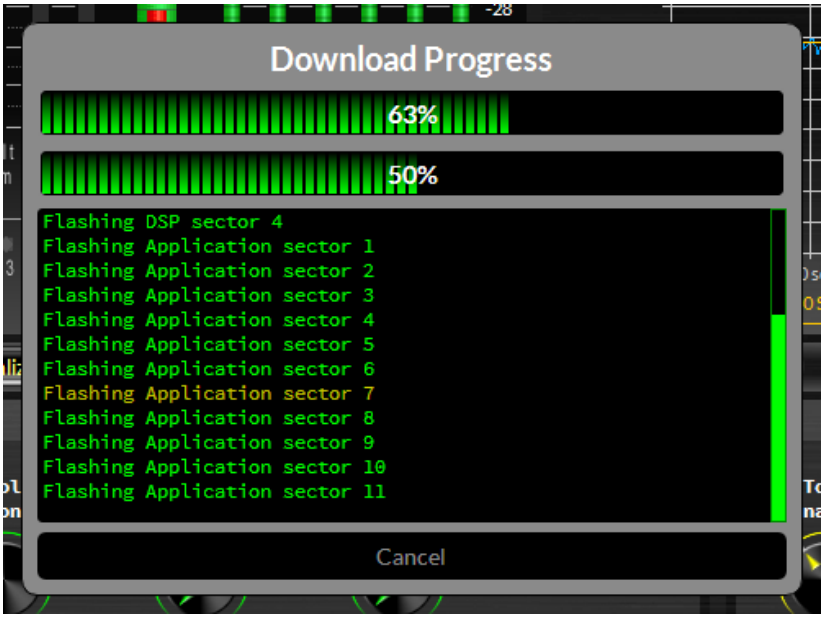
Navigate to the location of the VBN file that was downloaded with the new GUI version you just installed. Verify that the version number is correct in that it matches the version number listed in the documentation about the firmware upgrade. If so, select the Open option in the Choose a file to download window.



The verification window will now open.



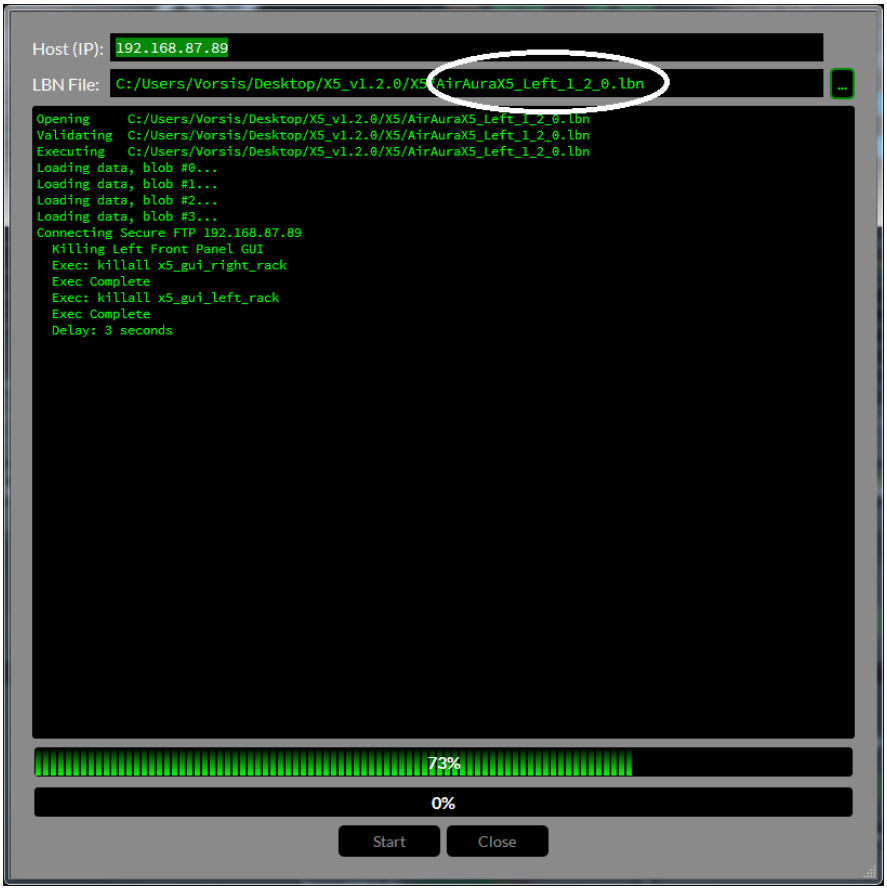
You will then see the uploader start to export the update to the hardware.



You will be prompted to reboot the X5. If the update only includes the Co-Processor, you can reboot at this time. If not, you will need to update the left and right front panels.

Right click anywhere in the APP to display the windows below. You will want to choose Update Left Front Panel... (you will retrace these steps to Update Right Front Panel... once the left panel is updated).

The update window will now open. The file path should be correct for the .lbn file that will need to be sent to the hardware to update the processor. Make sure that the lbn has the correct version number (circled). If not, use the "…" button to browse for the correct file. If you get stuck here, please reach out to Wheatstone technical support at +1 252-638-7000 or at *techsupport@wheatstone.com*



Once the file has been verified, press Start. It should take 30-60 seconds for the update to run.

When complete, re-run the update for the Right Front Panel. To reboot the front panel, press the knob in while pressing the center button directly underneath. The screens should go off and the front panel will reboot.

Once complete, you can reboot the processor. Upon restart, the processor and the two front panels should be running the new version.

Appendices

Appendix A

Appendix B

Appendix C

Appendix D

Appendix A

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:	100 BaseT Ethernet Network per IEEE 802.3-2008

Input Gain Adjustment Ranges

Gain Range:	+/-24dB
Gain Adjustment Resolution:	0.5dB
Gain Calibration:	A gain control setting of 0.0 aligns an external 0dBFs signal with the X5's 0dBFs internal reference

Input Failsafe

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)
Failsafe 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

High-Pass Filter

HPF Filter Class:	24dB/octave Butterworth
Frequency range:	20Hz – 300Hz

Parametric Equalizer

Sections:	Four
Frequency Range:	20Hz – 20kHz
Bandwidth Range:	0.2 – 3.0 octaves
Boost/Cut Range:	+/- 14.0dB
Options:	Bypass
	Bands 1&4 Shelving

5 Band AGC/Compressor with iAGC

Drive Gain Range:	-12.0dB to +6.0dB in 0.5dB steps
AGC/Compressor Thresholds:	- 50dBFs to -70dBFs
AGC Attack:	50mS to 3000mS
AGC Release:	1000mS to 7000mS
AGC Band Coupling:	0dB to -6.0dB per band to key band
Compressor Attack:	10mS to 1000mS
Compressor Release:	50mS to 3000mS (3Sec)
Compression Ratio:	2:1 to 20:1
L+R Mixer:	Boost/Cut +/-6dB
L-R Mixer:	Boost/Cut +/-6dB
Gating Mode:	Slow Release/Hold
Gate Threshold Range:	-20.0dB to -79.5dB, plus OFF
iAGC Attack/Release Speed:	2 to 7.0 seconds
iAGC Threshold:	-60.0dBFs to -40.0dBFs
iAGC Window Size:	0dB to 8.0dB
iAGC Operating Style:	Linear or Adaptive

Crossover Frequencies

Band 1/2:	60, 80, 120, 150 Hz
Band 2/3:	250, 364, 530, 700 Hz
Band 3/4:	1.2, 1.59, 1.73 kHz
Band 4/5:	4.49, 6.17, 7.55 kHz

31-Band FM Peak Limiter

31-Band Limiter Drive:	80 – 100%
Clipper Drive:	-6.0dB to +6.0dB
31-Band Limiter Knee Shape:	Soft/ Hard
Pre-Emphasis:	Flat/50μS/75μS

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:	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)
BS.412 Power Control:	On/Off (Bypass)
BS.412 Power Control Options:	Level/Style/Speed/Calibration/Action

System

Headroom Level:	>20dB
Nominal Operating Level:	-20dBFS digital
FM Path Processing Latency:	46mS maximum – all features engaged
HD Path Processing Latency:	29mS maximum – all features engaged
Total Harmonic Distortion:	<0.1%, 20Hz – 20kHz *
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 APP@50 degrees C

* Bypass Preset, unity gains, and 75μS pre and de-emphasis

All specifications subject to improvement or change without notice.

Preset Management

The X5's advanced preset management system allows the creation, storing, and recall of 160 presets within the X5 itself and an unlimited number may be stored on the Windows PC hosting the 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 the X5'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 X5 contains a five-port, auto-sensing 100BaseT Ethernet switch with one port 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 X5.

Software Remote Control

The supplied Windows®-base X5 APP software affords simplified access to X5's system and processing parameters via Ethernet. A front-panel color LCD screen and touchpad allows complete local control of all system and processing parameters if desired.

Appendix B

Contents

X5's GPIO Interface

The X5 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 X5 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.

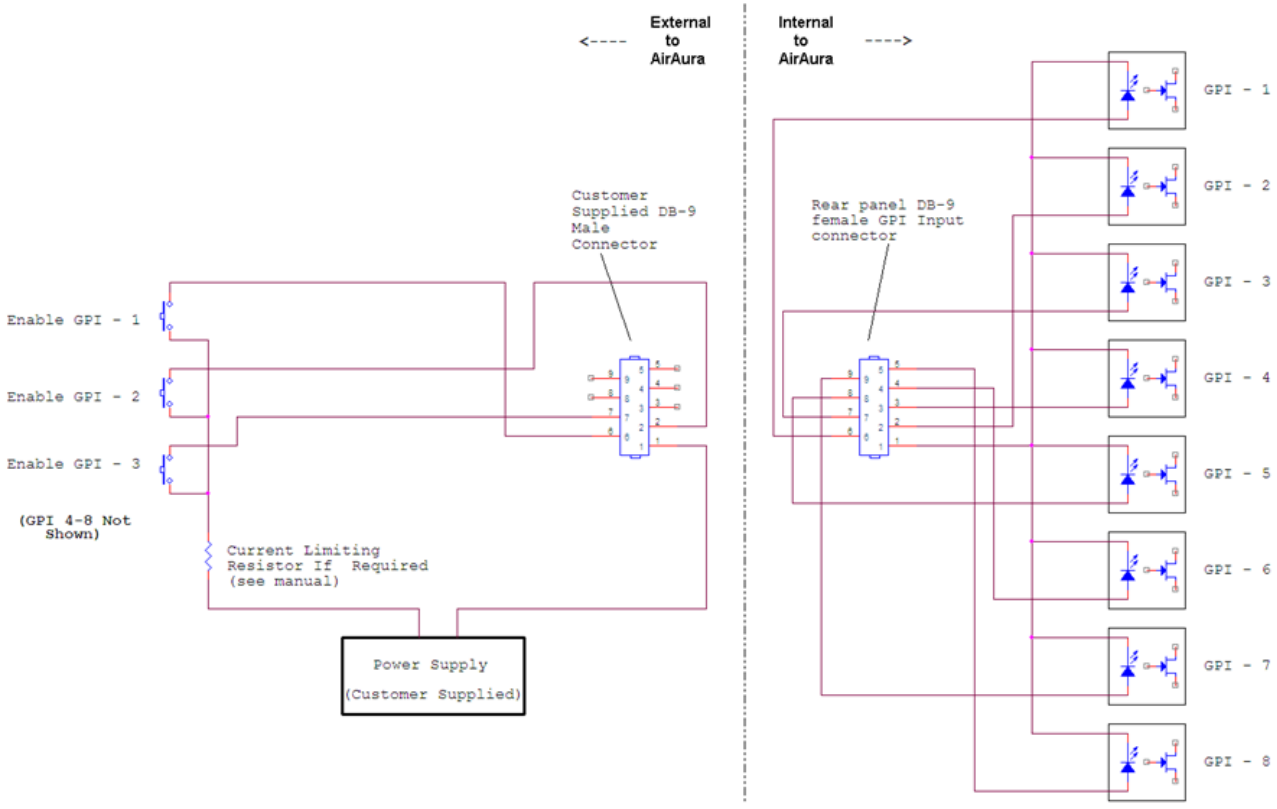
Each of the GPI inputs is current limited by a 475 ohm internal resistance. The LED device inside the optoisolators is rated at a maximum forward current of 50mA and a normal operating current of 5mA.

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

AirAura X5 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 X5 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 X5 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).

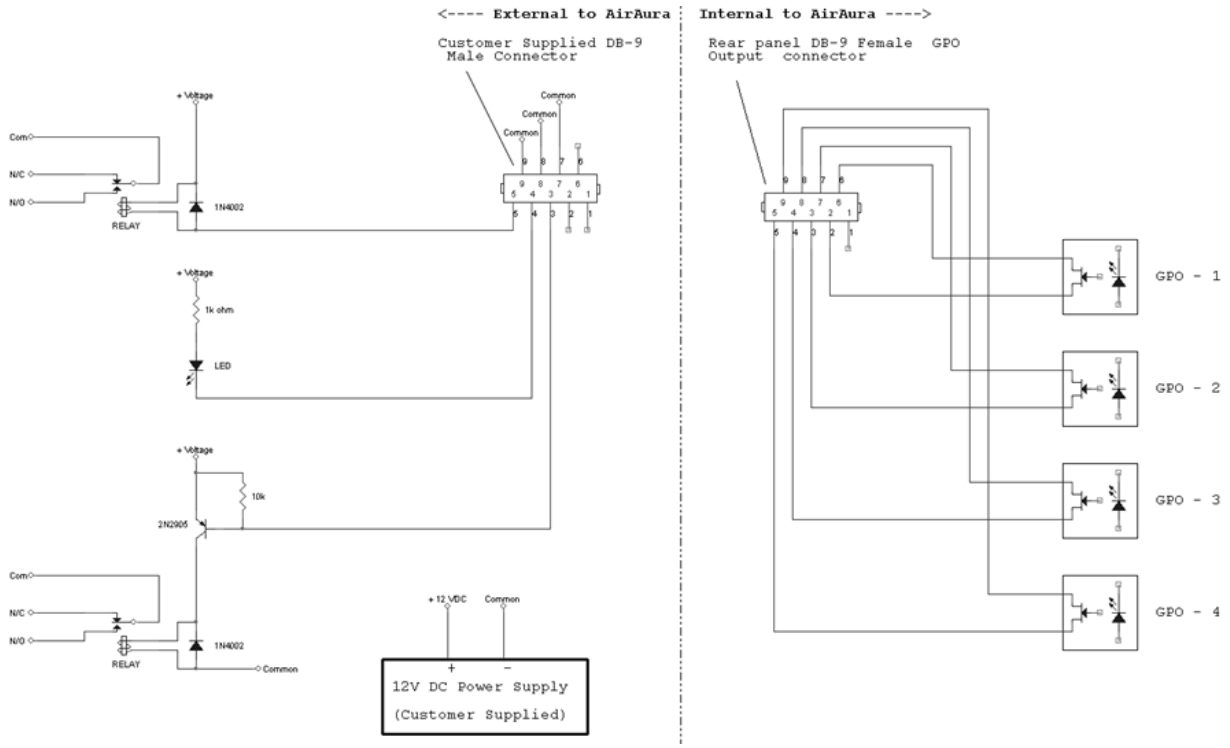
GP Output #3 – Becomes enabled upon a General System Failure.

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 the X5'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 the X5, 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 C

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?

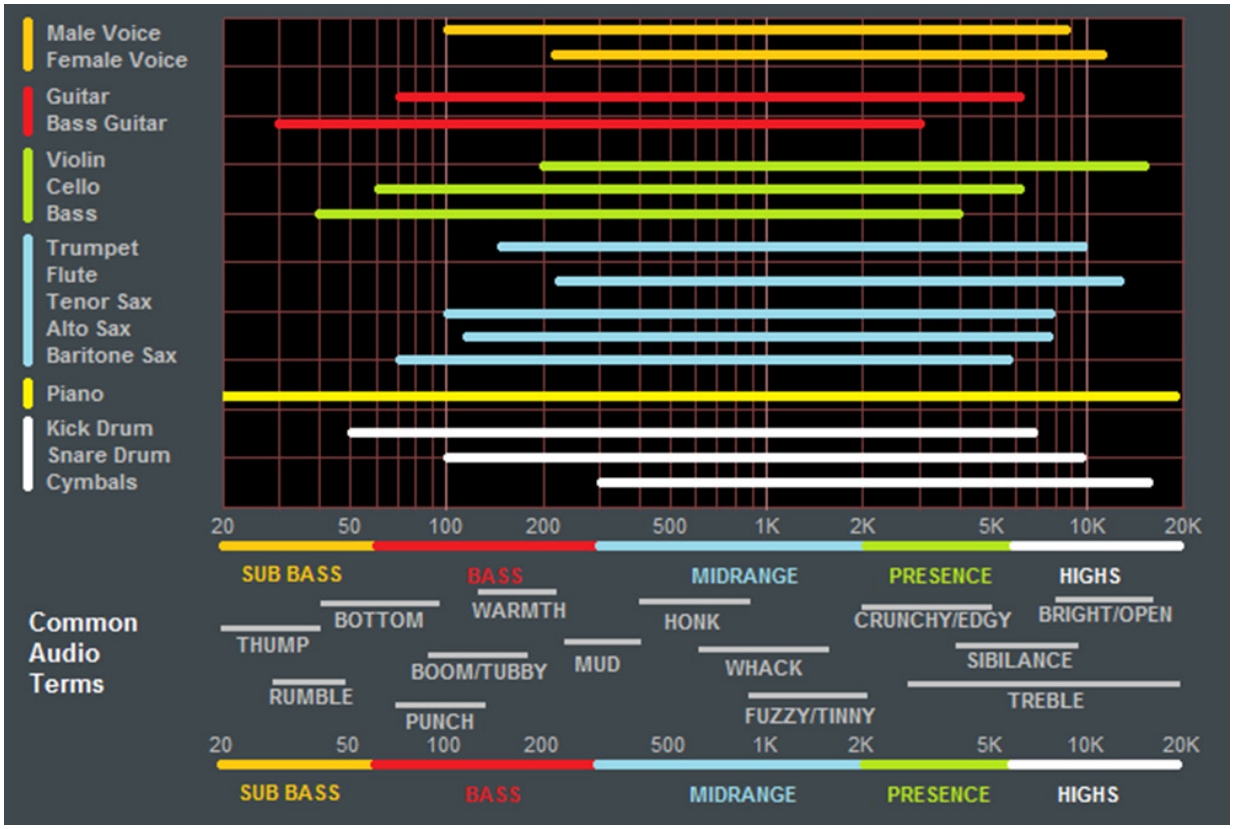
Lots of "audio" terms regarding audio processing have been invented and bandied about over the years. Ever since radio stations started employing circuits instead of humans to control the modulation of transmitters we've tried to come up with words to describe the effects of processing and what we hear. 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

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 50Hz or 60Hz 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 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 X5'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 X5 is much more forgiving in this regard and most users have an easier time being loud with AirAura X5 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 D

Contents

WheatNet-IP Configuration

Along with Digital AES3 and Analog inputs X5 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 the X5'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 the X5.

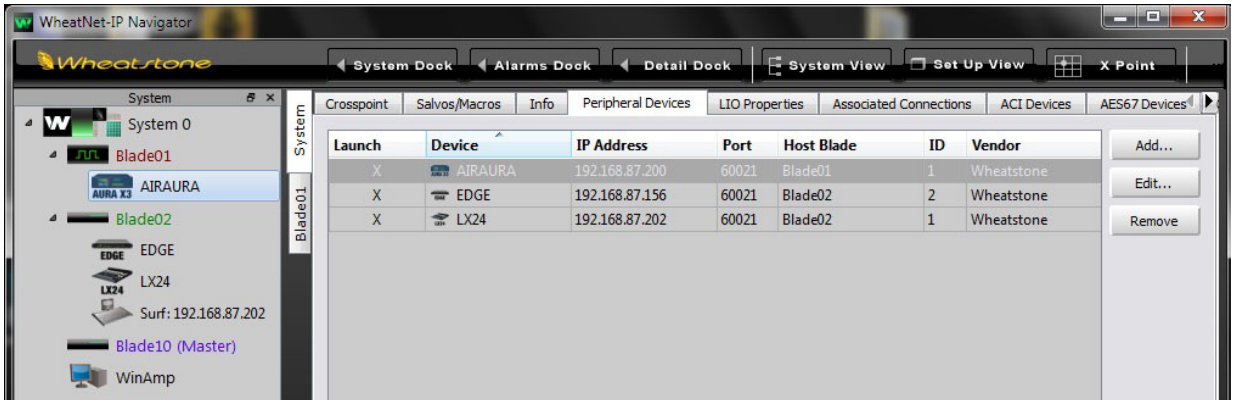
This procedure assumes that your facility is equipped with at least one Wheatstone BLADE and the associated Navigator software. The BLADE used may even be the multiband, eight processor "Aura8ip" processing BLADE whose physical inputs and outputs (half analog, half digital) may even be used as a substitute for the X5's physical I/O.

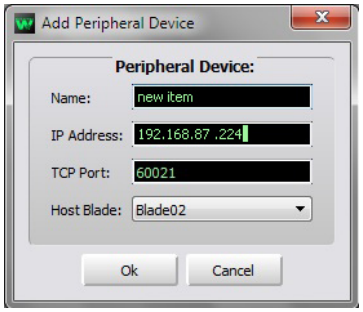
Now it's time to open up WheatNet-IP Navigator to gain access to the X5's WheatNet-IP-associated input and output signals.

Once the WheatNet-IP Navigator software is open and you are logged into the system we must create a new device for X5. Because X5 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.

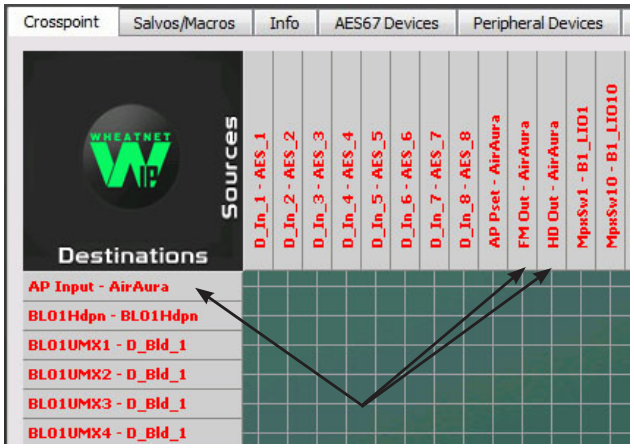
Adding the X5 to The WheatNet-IP System

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 the X5 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 X5 may be added to the system. Here we will add the new X5'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 X5'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 the X5'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 the X5 for WheatNet-IP may be obtained by giving us a call at 252-638-7000 or by emailing techsupport@wheatstone.com.