

BETTER SOUND
MORE LISTENERS **X5**

FM/HD Digital Broadcast Audio Processor

PRELIMINARY USER GUIDE

OCTOBER 2019

Wheatstone Audio Processing
Designed and manufactured in the USA by Wheatstone Corporation
600 Industrial Drive, New Bern, North Carolina, USA 28562

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 FM55 and X5 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

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 5-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 seamless, 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 GUI 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, allowing *complete* control of not only presets, but *any* parameter that is assigned to a user control (please contact the factory for details on this) is available on X5.

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 GUI 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.

Installation

The following pages will get your X5 up and running as quickly as possible without having to know a lot of *techie* stuff.

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

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



X5 Rear Panel Connections

The 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 baseband 192)	
HD AES Digital Out	
GPI Input	
Ethernet	
IEC Standard male AC Power Input (90-240 VAC/50-60Hz)	

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 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 the 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.

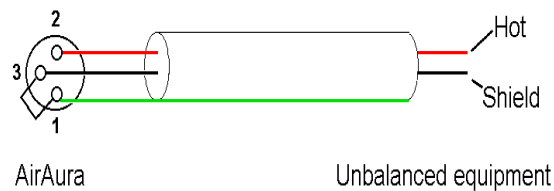
• UPS/Power Conditioning

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:

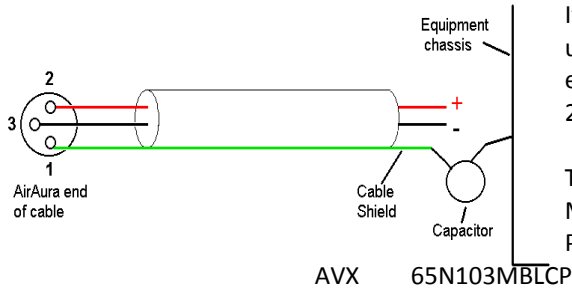
- How does the unit handle AC power that is not exactly 60Hz, such as when the facility is on its backup generator?
- If the unit has onboard surge protection, what kind of surge capability does it have and where are those surges directed to?
- Is the unit equipped with remote monitoring capability?
- Does it have onboard monitoring and alarms to signal a problem 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" (XLR pin2) input and connect the shield wire to X5's "Lo" (XLR pin-3) input. If the cable's shield is used (recommended) connect it at the X5 end only (XLR pin 1) to prevent AC ground loops.



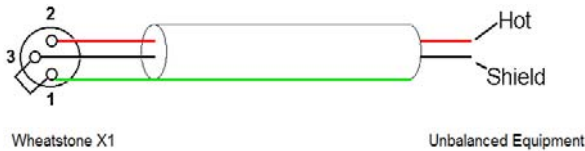
If RF interference is an issue, the far (floating and ungrounded) end of the cable shield can be experimentally bypassed to RF ground via a 0.01uF, 250V AC capacitor. Suitable capacitors are:

- TDK CS17-F2GA103MYGS
- Murata DE2F3KH103MA3B
- Panasonic ECK-ATS103MF

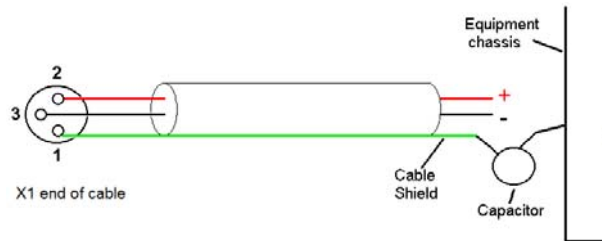
Field experience indicates that the listed capacitors can handle the reasonably high RF currents that might exist on audio cable shields at AM and FM transmitter sites.

• 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 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 above for a listing of 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 can 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 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 they may be acceptable.

Digital STL

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

When a 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 Nielsen 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 260 VAC, 50 or 60Hz. Power consumption is under 100VA.

Although aggressive AC input filtering is utilized on the AC power input it is always advisable to use external surge protection and an uninterruptible power supply (UPS) wherever possible, especially where the AC power quality can be in question, such as at a remote transmitter site.

Power conditioning, surge suppression, and even power backup devices are wise investments when using sensitive modern electronic devices. 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 15 seconds.

Rear Panel Connections

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 GUI.
- Two dB-9 connectors provide 8 GPI inputs (for selecting presets in the first eight storage slots) and four GPO outputs. The pin-out drawings in the Appendix summarize wiring connections for these features.

Audio 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.

FM Audio Outputs

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 Audio Outputs

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

Headphone Monitoring

An overload protected stereo headphone amplifier drives the front panel 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 GUI 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 completely independent and 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.

General Purpose Interface (GPI/GPO)

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.

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 GUI software. From the default system page, tap the blue button that says PRESETS. This page will then display. 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! It is best to wait 5 seconds before starting to make adjustments.

When a preset has been recalled and has not been modified the preset's name is displayed in green text within the GUI's current preset window. If changes to the preset have been made its name will be displayed in red text instead of green. Once the modified settings have been saved back to X5's hardware the preset name will again be displayed in green.

Factory pre-sets 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:

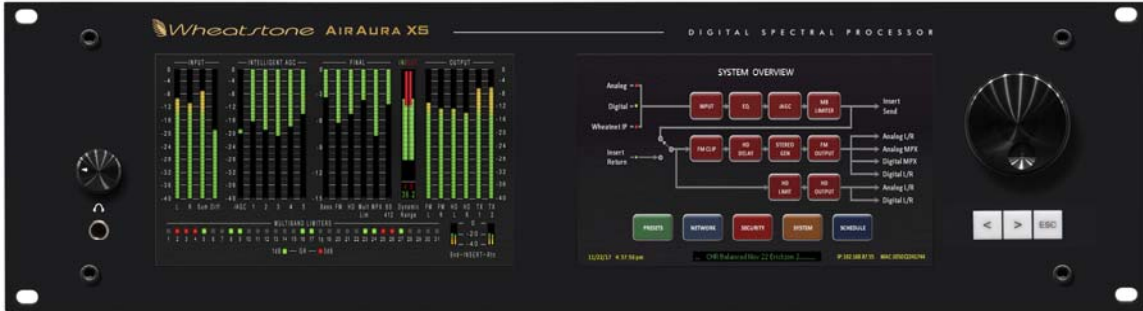
- A preset that has all processing turned off and/or has special input/output level calibrations (such as for testing).
- A preset that has all processing enabled but has the Stereo Pilot is turned off (a Mono Preset).
- A preset that changes the input or output source or level calibrations (note: "System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

Preset storage is as follows:

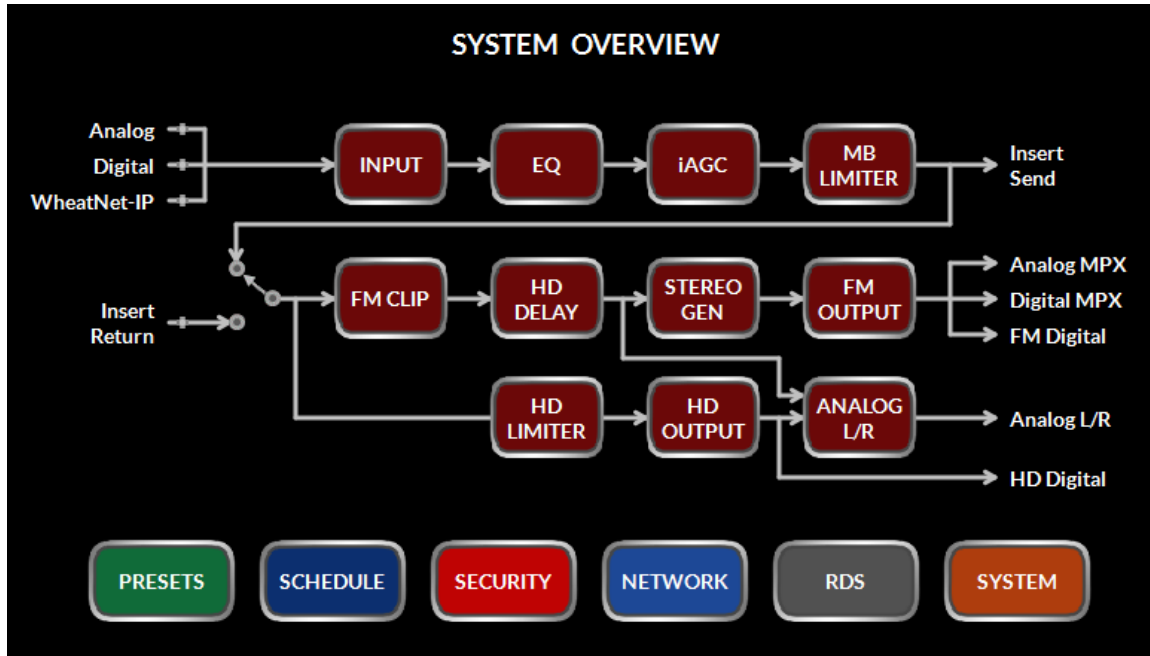
- Preset slots 1 - 8 are for user presets that can be selected by the optoisolated GPI interface.
- Factory presets are installed beginning with a BYPASS stored in slot #9. Factory presets cannot be written over or deleted.
- User presets, other than the GPI selectable presets in slots 1 through 8, are 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 GUI's host PC (because of a preset's tiny file size) is virtually unlimited.

- User presets may be locked at the user's discretion to prevent inadvertent changes. Any user can unlock user-locked presets.

FRONT PANEL GUI & METER DISPLAY



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 GUI 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. Once the correct input source has been selected, push the knob in to activate.



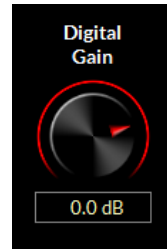
ANALOG GAIN

Offsets the input level of the analog signal. This control is visible 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 signal. This control is visible only when AES/EBU or Wheatnet 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 20-50 Hz in 5Hz steps. Once the desired frequency has been reached, push in the knob to confirm the change.



MAKE BASS MONO OPTION

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 OPTION 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 OPTION is really controlling) rarely contains bass or other low frequency signals and what signals there are, are probably not desired.

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 ranges are: 50-500Hz in 50Hz steps plus OFF. Once the desired frequency has been reached, push in the knob to confirm the change.

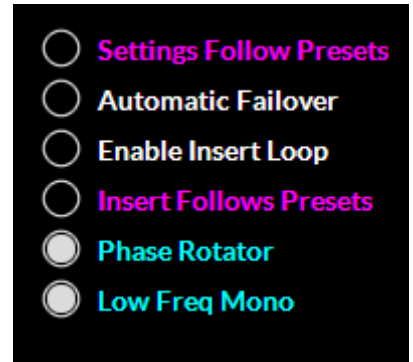


OTHER INPUT SCREEN OPTIONS

There are a few other options on the input screen other than system gain controls and the codec mask. 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 5 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 is 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.

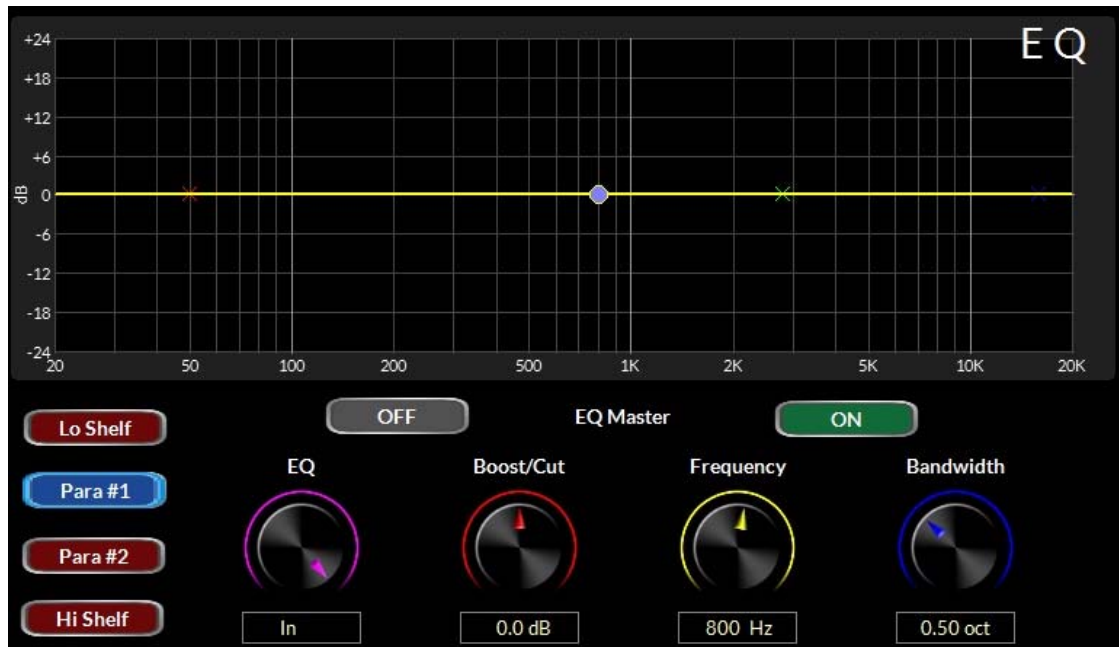
STATUS INDICATORS

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 above audio is NOT present at the analog input, but IS present at the Digital (AES), WheatNet and Insert Loops. 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 4 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 4 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 4 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.



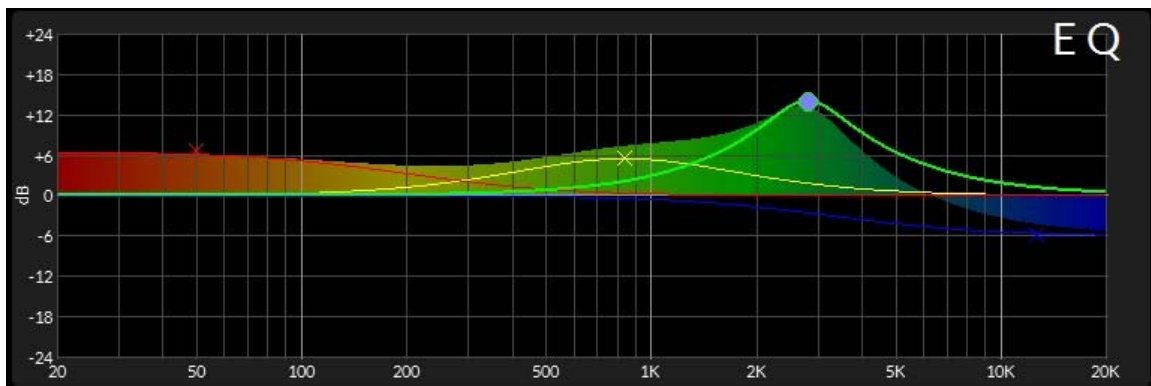
To change the frequency, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to set the desired frequency.

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.

iAGC



Touching the iAGC block on the front panel touchscreen brings up the controls for the 5 band processing. To the left of the controls are 7 buttons, each allowing adjustment of the 7 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 5 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 audio will continue to leak off, 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 5 band dynamics. The window 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 5 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 HF density, 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 ATTACK

Governs how quickly the iAGC makes changes to the 5 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 5 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 5 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 5 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.

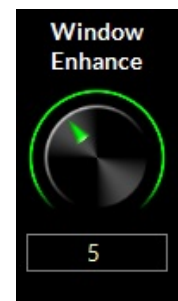
To change the bass offset, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the setting. The processing effect will change in real time as you move the knob. Once you have reached the desired level, push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



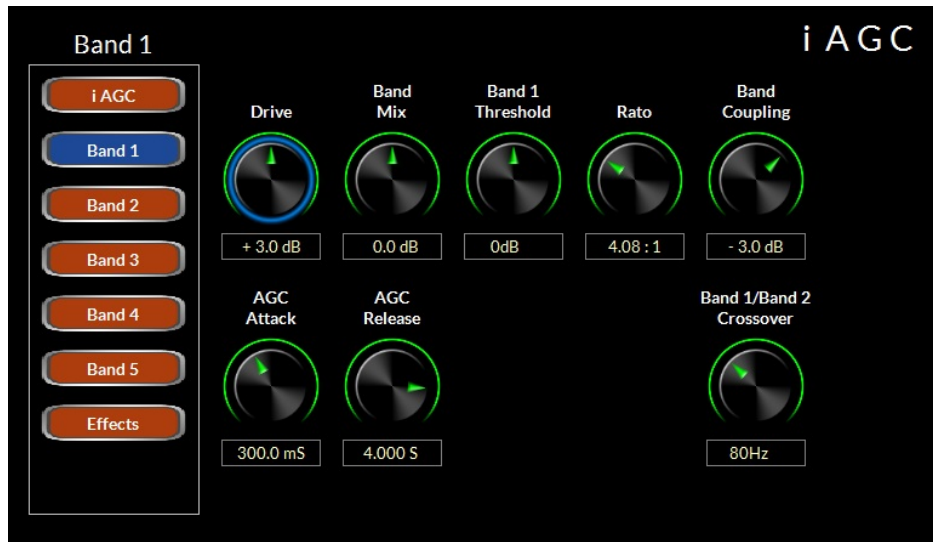
WINDOW ENHANCE

Allows the 5 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.



5 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 5 band audio processing—less drive creates a more gentle sound. Higher settings make the sound more aggressive by increasing short term density.

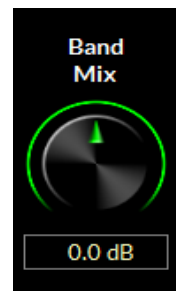
To change the Drive control, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to increase or decrease the gain. The level will change in real time as you move the knob. Once you have reached the desired level, push in the knob 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 5 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 2 dB 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



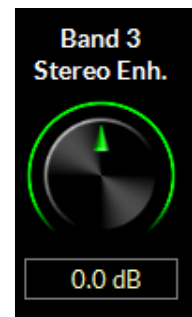
The last tab on the row to the left of the controls is the EFFECTS controls. These controls set the output level of each of the 5 bands of dynamics, plus they allow the user to add stereo enhancement per band if needed.

To change the output settings of any of the 5 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 4 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 4 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 6 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

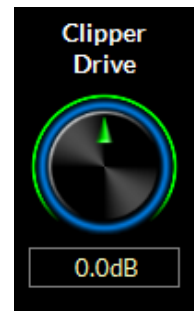
This is the master drive control to the entire back end of the X5. Higher numbers will yield a louder, more processed sound at the eventual expense of distortion and fatigue.

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



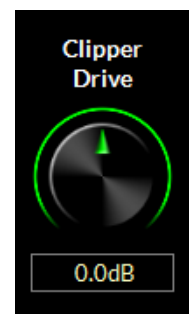
The FM Clipping controls allow the user to customize the sound of the FM peak control system as well as the texture and style of the bass processing.

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 GUI 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.

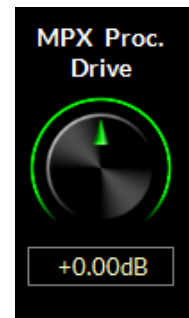


MPX PROCESSING DRIVE

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.

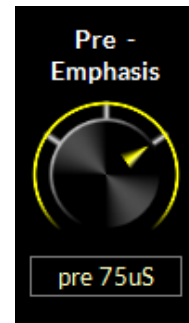


PRE-EMPHASIS

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

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 **AS WELL AS** de-emphasis to the AES signal. This act will apply the proper peak control when pre-emphasis is re-applied later in the exciter. 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 5 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.

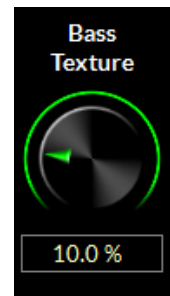


To change the bass clipper mode, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in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

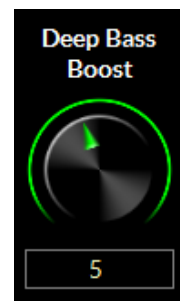
To change the bass texture, tap the control. You will see a blue ring indicating the control is active and ready to be changed. Use the front panel knob to select the new value. The processing effect will change in real time as you move the knob. Once you have reached the desired setting, push in the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



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.



BASS THUMP

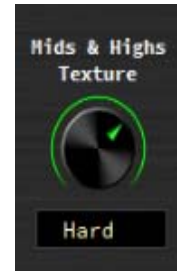
Bass thump helps increase the effect of kick drums and bass product prominent in CHR and Urban cuts. Together with DEEP BASS BOOST, bass thump can help pull out detail in bass, rather than creating an overall droning bass sound that is prominent in competing processors.



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.

MID & HIGH 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 mid & high 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.

HD LIMITER



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

LIMITER DRIVE

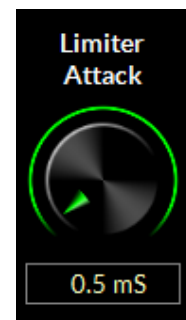
This is the input level control into X5's HD Limiter. Higher numbers will increase apparent loudness on the air at the expense of some tradeoff in quality of the audio signal.



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 10 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 (1.0s). 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 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.

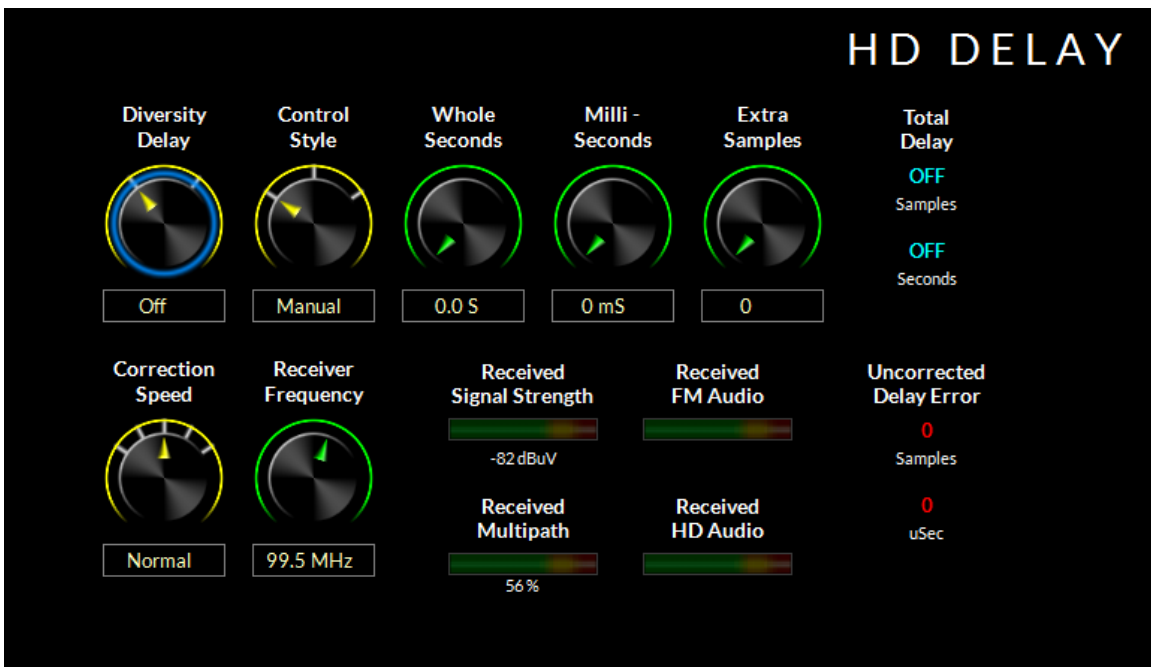
DELAYED RELEASE (YES/NO)

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.

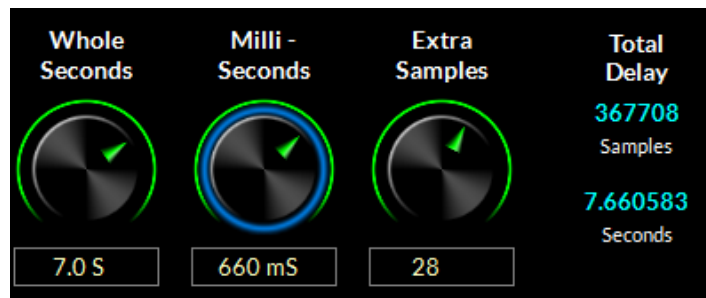
MANUAL – Allows the user to adjust the HD delay manually.

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

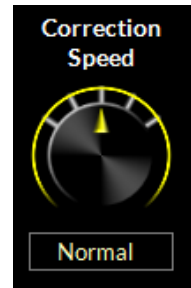
The image above shows an example of the corrected delay in time (seconds) and samples. Here the knobs show 7.660583 seconds of delay, or 367,708 samples. If Auto Correct is used, and the X5 auto correct algorithm has achieved these settings, no other user intervention is needed as the tuner/algorithm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

When the HD Delay Control Style is set to AUTO ADJUST, this gives the user the option to set the correction speed. There are 5 options from slow to normal to fast. Wheatstone recommends NORMAL for most applications.

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



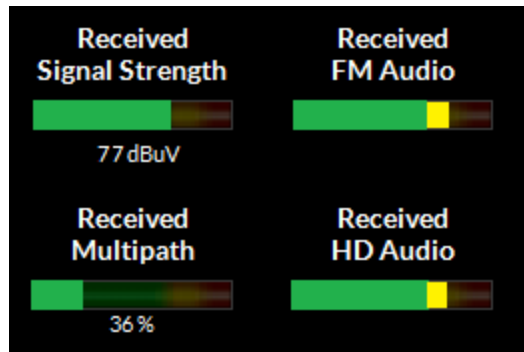
RECEIVER FREQUENCY

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

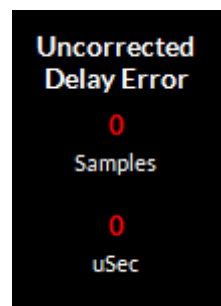


The signal condition graphs show the Received Signal Strength, Multipath and have bar graph indicators for received FM audio and received HD audio. These are pulled from the FM/HD tuner built into the X5

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.

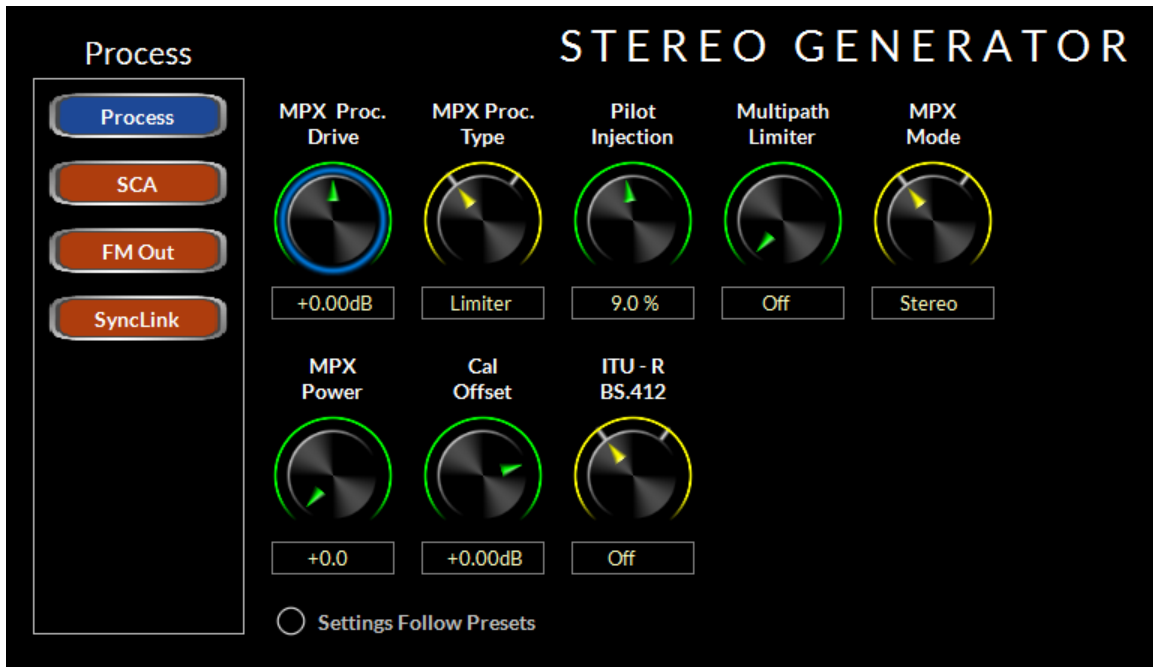
UNCORRECTED DELAY ERROR

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 PROCESSING 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 PROCESSING 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 1.536 MHz look ahead and 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, 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. 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 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 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 do not 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 GUI. 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 CALIBRATION 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 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.

*The BS.412 MPX Power Controller's sole purpose is to reduce loudness and program density as required in certain European countries. **If you are not required to use the BS.412 Controller do not 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

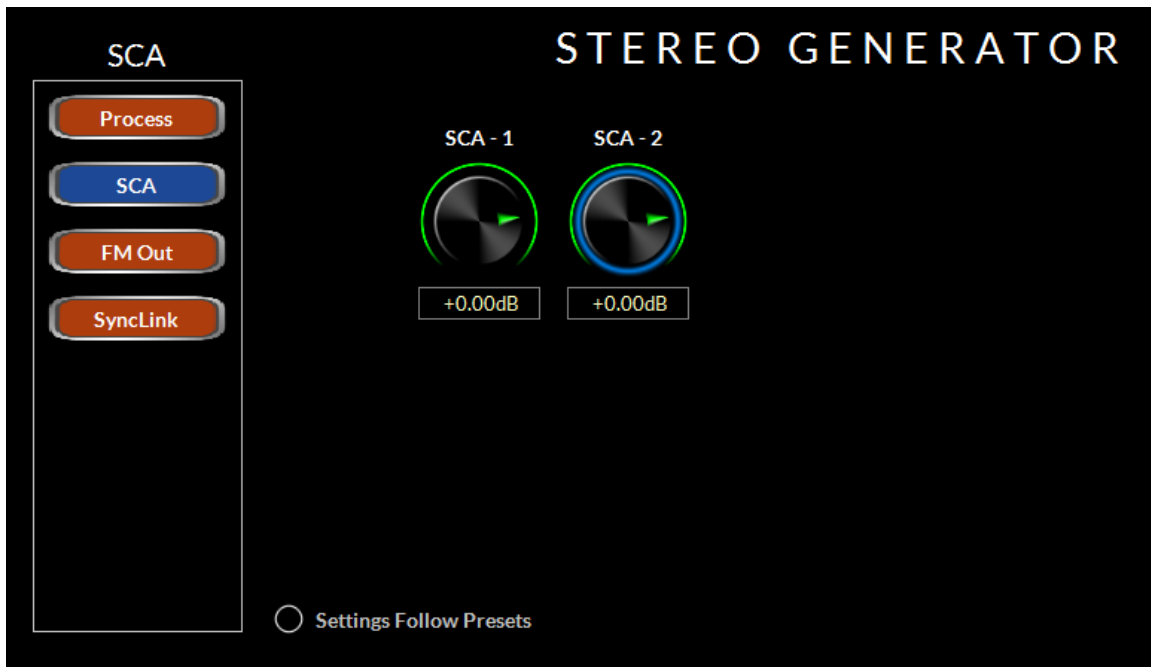
When this option is OFF, recalling presets ignores the settings of the output level controls and other “system” controls associated with those functions. The following are considered to be X5 SYSTEM, or global parameters, which are saved with presets but not restored when presets are “taken,” unless 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

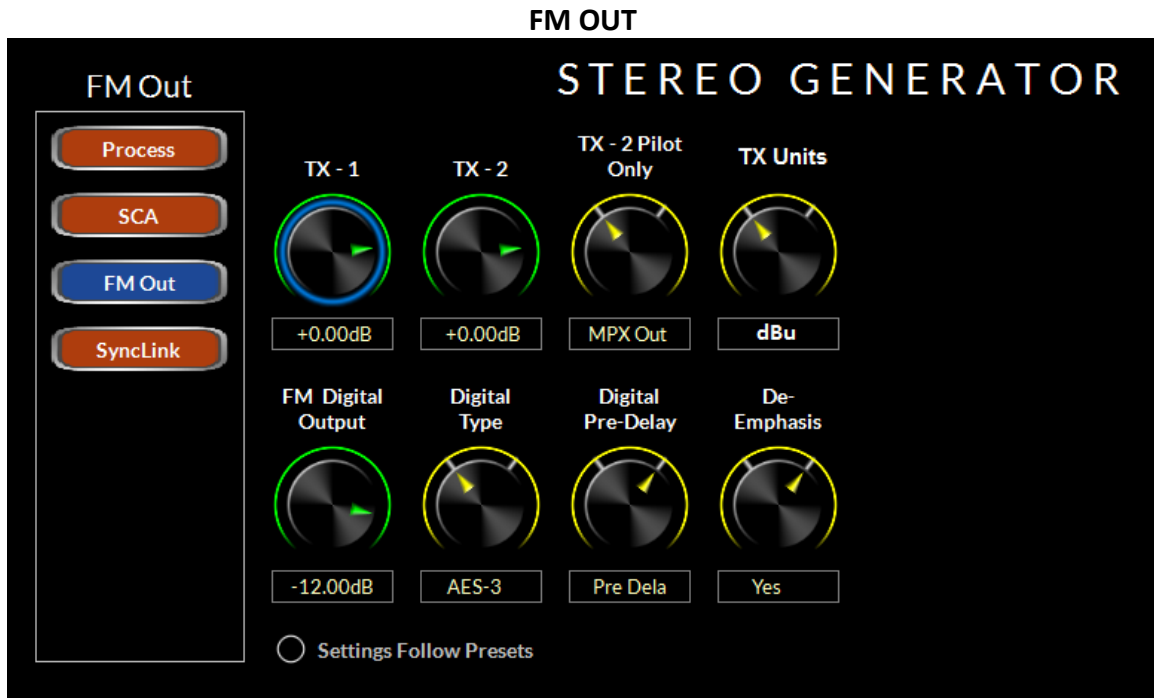


The SCA 1 & 2 LEVEL controls govern the SCA injection amount from 3rd party subcarrier generators (such as an external RDS generator) as a percentage of the main composite signal amplitude

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.

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.



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).

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-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

TX2 mode changes the TX2 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 TX1 and TX2 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 3 decades. The second is baseband192 (bb192). When set to *bb192*, the digital output XLR jack on the rear of the FM55 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 a 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 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 setting, left click on the knob and use the mouse wheel to switch between AES-3 (traditional AES L/R output) and Baseband-192 (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 X1 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

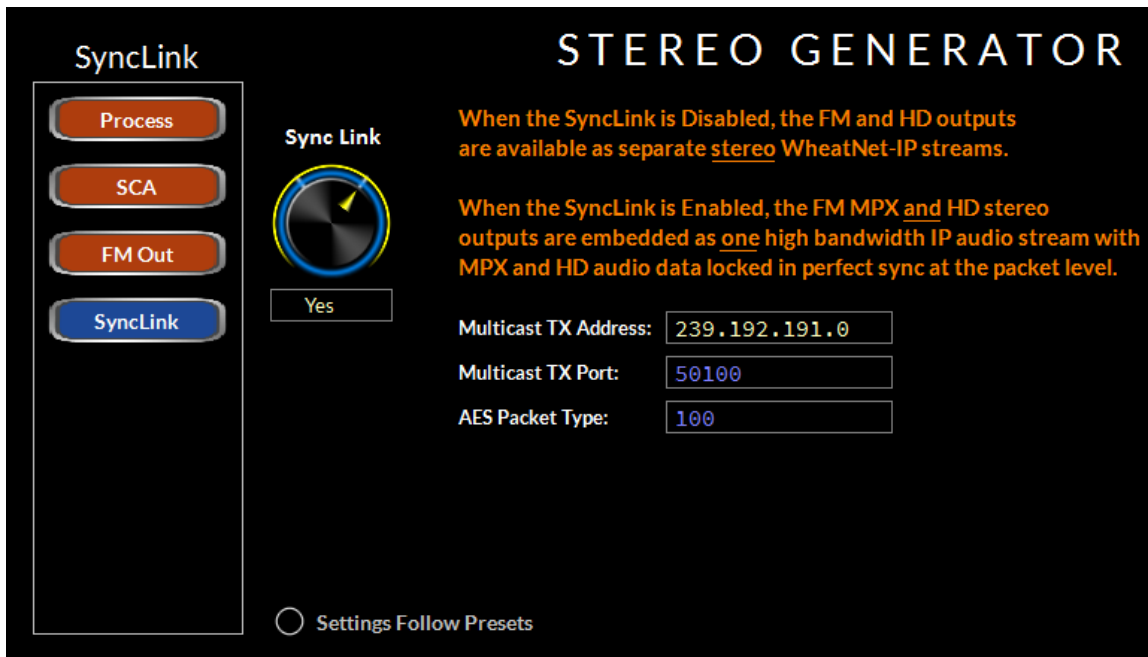
This option de-emphasizes the AES-3 output for applications where the exciter will apply its own pre-emphasis.

Pre-emphasis should be applied **AS WELL AS** de-emphasis to the AES signal. This act will apply the proper peak control when pre-emphasis is re-applied later in the exciter. 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 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



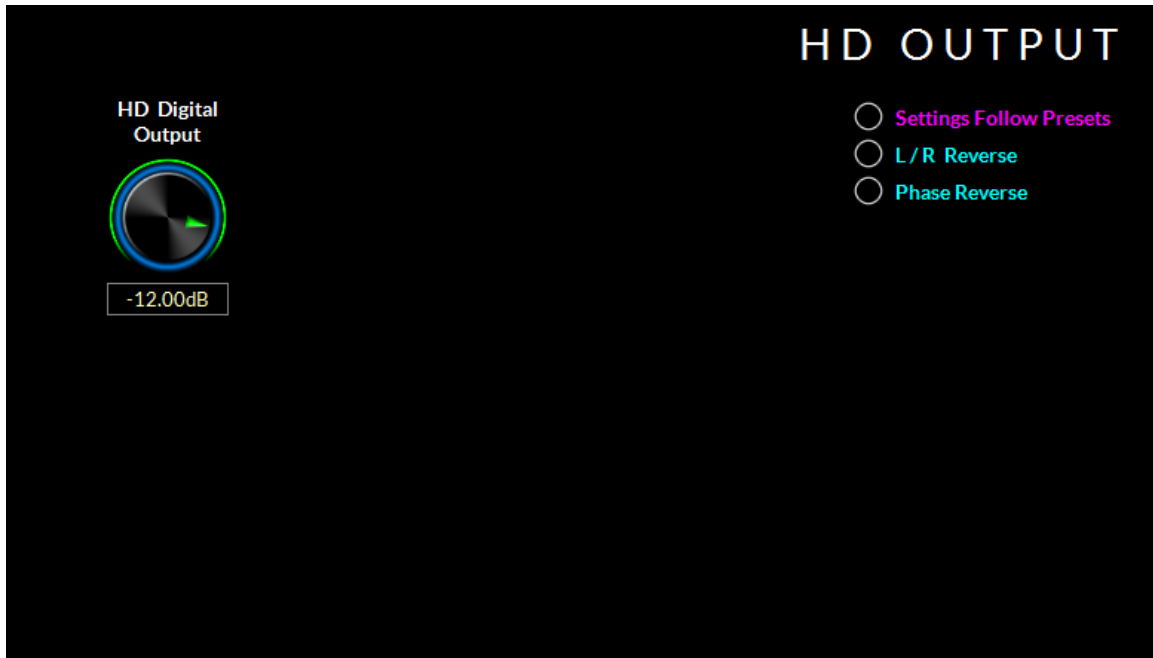
SyncLink is an optional 1RU companion product for the X5 that maintains HD and FM alignment (LiveLock) from your studio to your transmitter site. It carefully keeps the HD and FM packets in sync so time alignment done with the processor at the studio is maintained straight through to the receiver.

HD and FM composite audio are converted to a single WheatNet stream at the X5 and sent over a data link (min 20 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 X1.

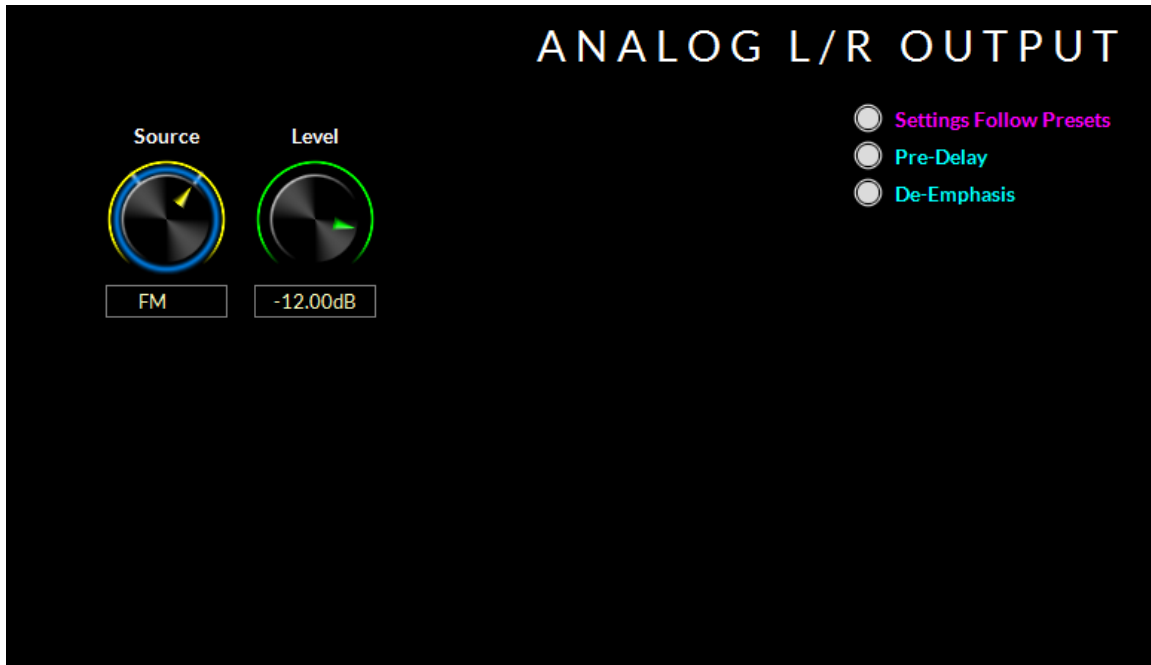
To adjust, tap the circle and then press the knob in to confirm.

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.

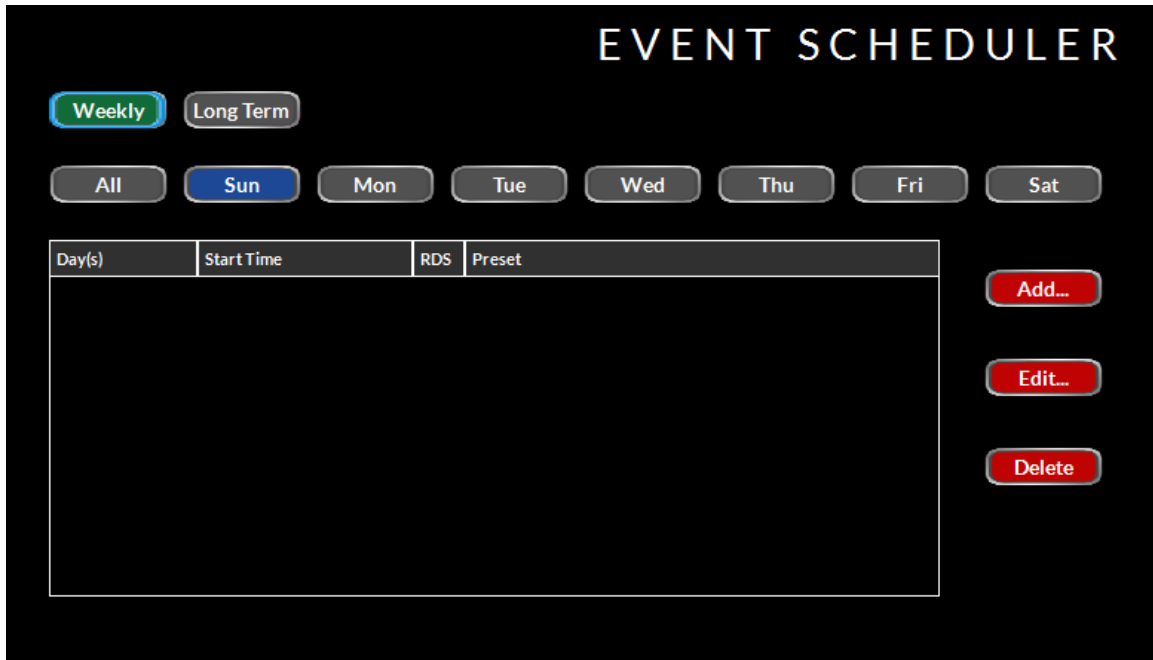
To adjust, tap the circle and then press the knob in to confirm.

DE-EMPAHSIS

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.

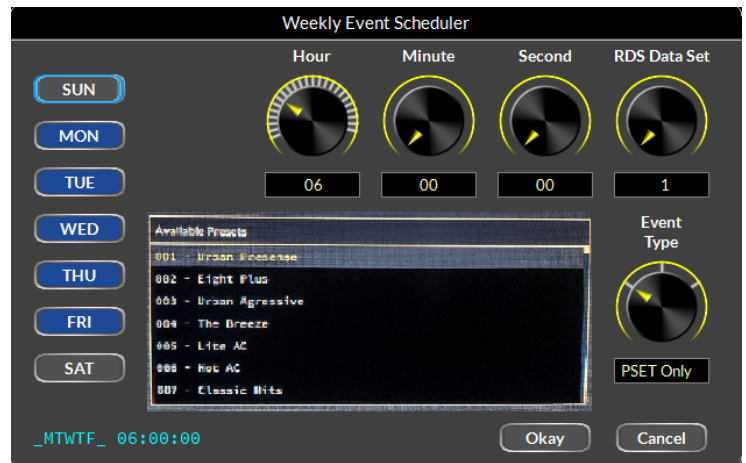
EVENT SCHEDULER



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, Monday-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 OK.



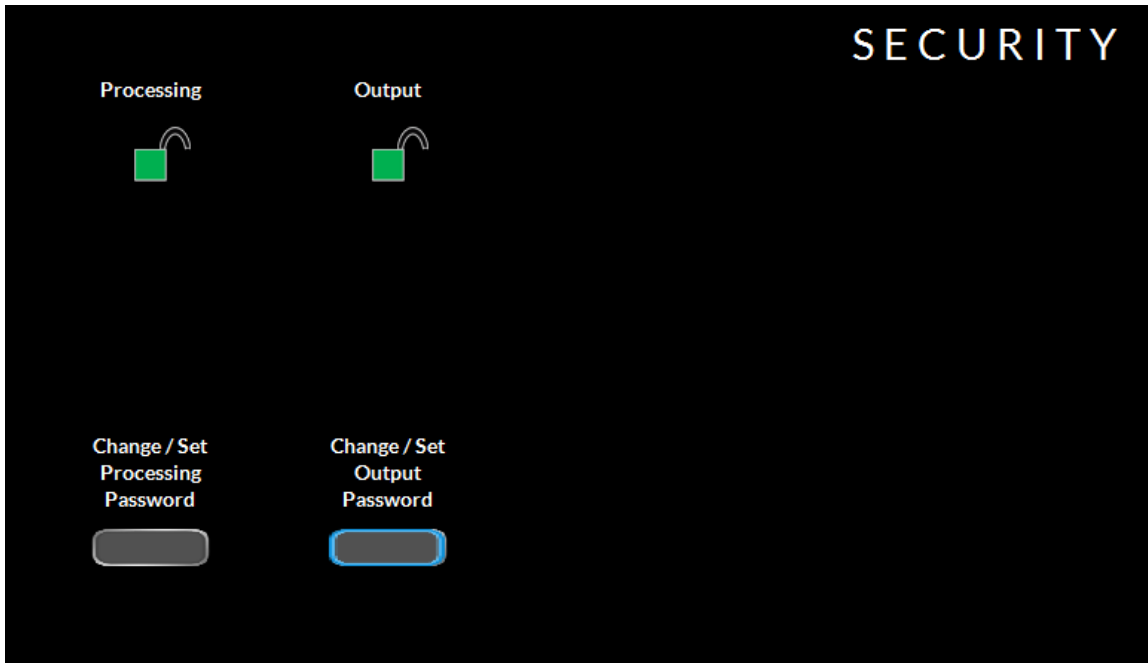
As many preset change events as desired may be programmed in the Event Scheduler. If a one-time preset change is required, such as might be necessary for a special holiday or other event, the Long Term Rotation routine should be used.

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 below.



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.

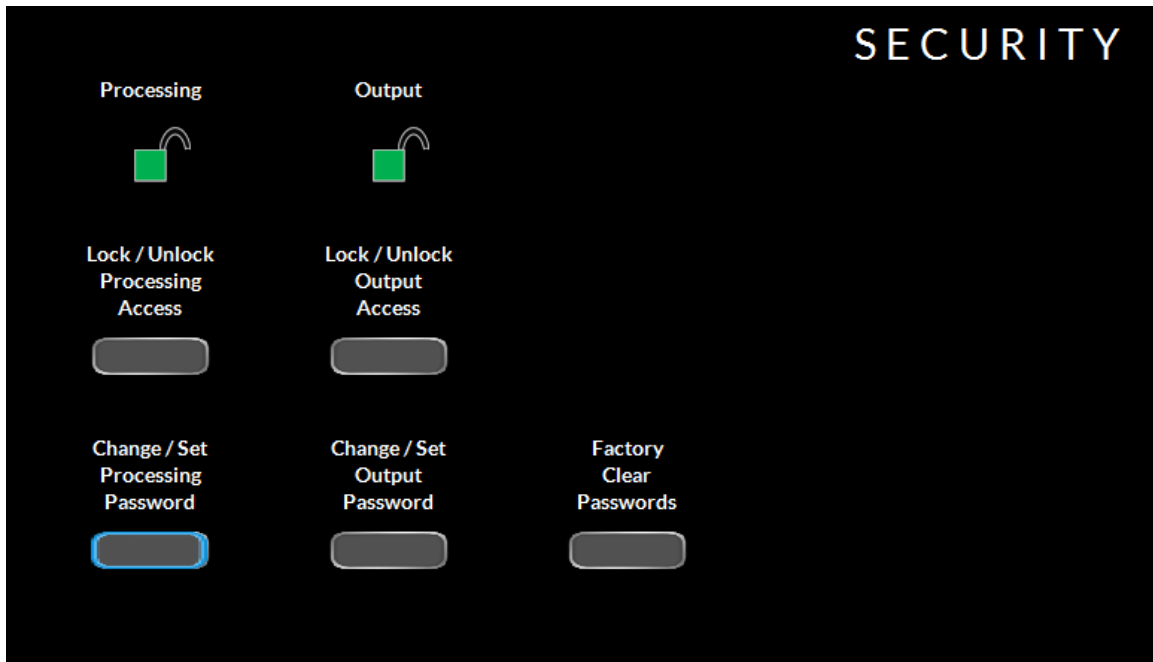
There is no default password in the X5. If you are setting this up for the first time, you can skip the PASSWORD part and just enter the NEW PASSWORD and VERIFY the new password.

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.

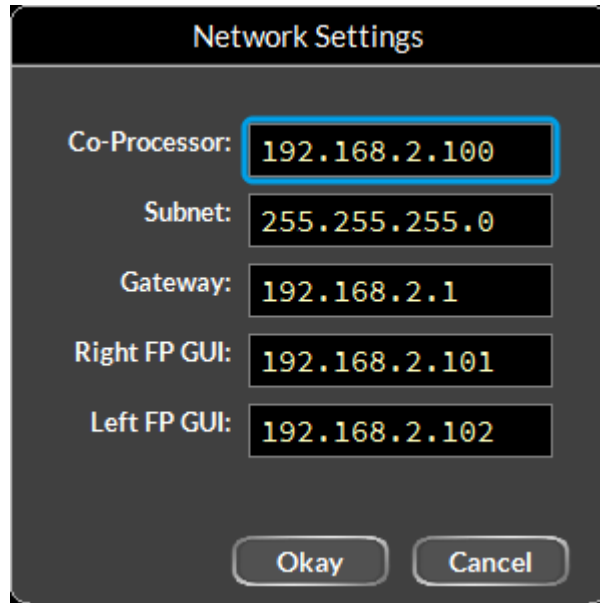
LOST PASSWORDS

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



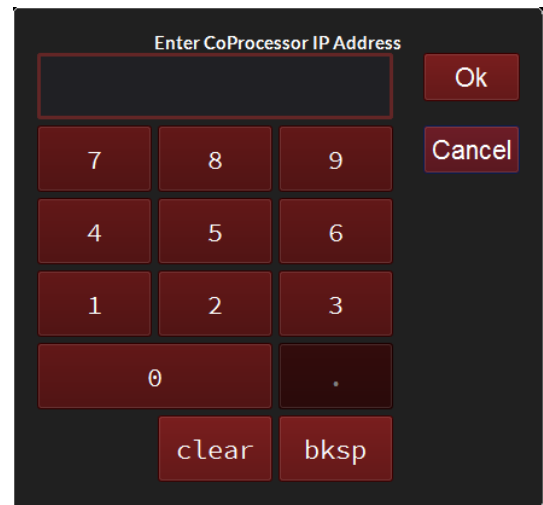
The image shows a 'Network Settings' dialog box with a dark background and white text. It contains five input fields, each with a yellow border. The 'Co-Processor' field is highlighted with a blue border and contains the IP address '192.168.2.100'. The other fields are: 'Subnet' with '255.255.255.0', 'Gateway' with '192.168.2.1', 'Right FP GUI' with '192.168.2.101', and 'Left FP GUI' with '192.168.2.102'. At the bottom, there are two buttons: 'Okay' and 'Cancel'.

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 GUI 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 GUI and the Left front panel GUI, 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 touchscreens or Windows based GUI 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



The image shows a keypad titled 'Enter CoProcessor IP Address'. It has a dark background with red buttons. The keypad includes a numeric keypad (0-9), a decimal point button, a 'clear' button, and a 'bksp' button. There are also 'Ok' and 'Cancel' buttons on the right side.

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.

This page left blank

SYSTEM

The screenshot displays the SYSTEM page with the following sections:

- Coprocessor Version:** Bootloader: 9.5-023404-0000, FPGA: AAEC 0481, DSP: au4_vDr8, Software: 1.0.2, Built: Aug 26 2019 16:18:09
- Right FP GUI Version:** Software: 1.0.2, Built: Aug 26 2019 19:08:40
- Left FP GUI Version:** Software: 1.0.2, Built: Aug 26 2019 19:48:51
- Status:** Temperature: 40.8 C, Date & Time: Sep 16, 2019 13:44:39, RmtGUI: OffLine, CoProc IP: 192.168.87.2, CoProc MAC: 80:E4:DA:00:49:9B, Left FP IP: 192.168.87.3, Left FP MAC: D0:63:B4:01:39:8C, Right FP IP: 192.168.87.4, Right FP MAC: D0:63:B4:01:B9:59, WNIP Host Blade: Connected
- Enabled Features:** WheatNet-IP (checked)
- Headphone Source:** A rotary knob with a blue ring, currently set to 'Input'.
- Display Timeout:** A rotary knob with a blue ring, currently set to '12.0'.
- Set Time:** A button labeled 'Set Time'.

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.

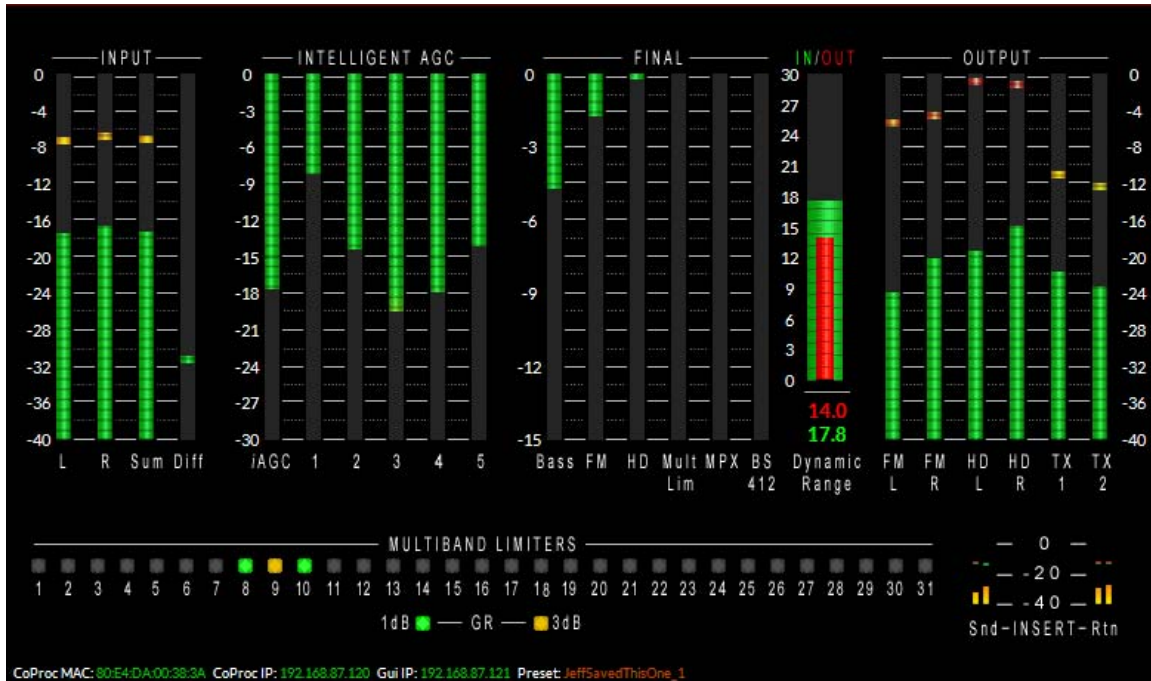


DISPLAY TIMEOUT

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 5 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.

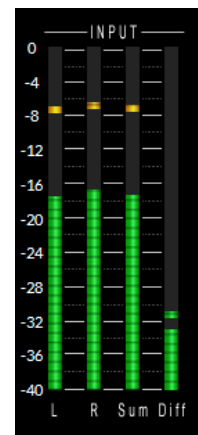
Along the bottom of each of the screens you will see the MAC Address of the screen as well as the hardware IP address (CoProc IP) and the front panel IP address (Gui IP) as well as the current preset that's on the air. Presets in GREEN are saved and unmodified. Presets in orange have had changes made 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.

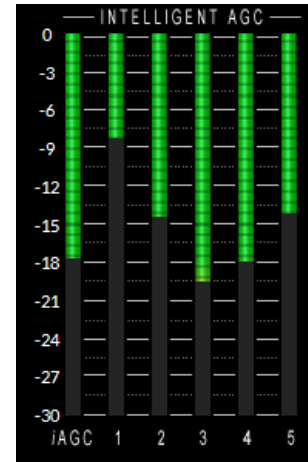
When adjusting the input gain, the individual left and right meters should average between -24 and -20dBfs with peaks no higher than -12dBfs.



INTELLIGENT AGC METERS

The Intelligent AGC meters show the gain reduction for the iAGC algorithm as well as each of the 5 bands of processing.

Each of the 5 bands as well as the iAGC algorithm is capable of audio correction over a 30dB range.

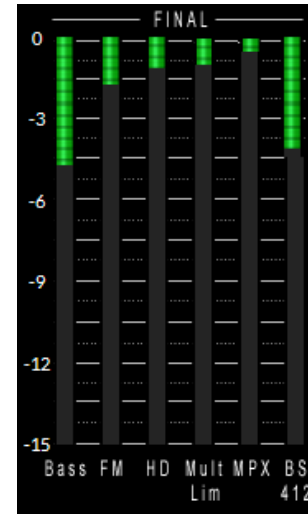


FINAL METERING

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)

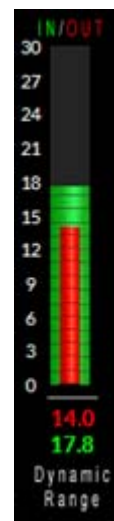
- Bass Processing Depth
- Main FM Clipper
- HD Final Processing
- Multipath Limiter
- MPX Processing
- BS.412 Gain reduction (if the BS.412 limiter is on)



DYNAMIC RANGE METER

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

