



# AERO.one

## DTV Audio/Loudness Manager Model LA-5100-TV (4-channel)

### Preliminary User Guide



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**Release Date:** April, 2009  
**Software Version:** 00.00.91 and later



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# Chapter 1: Introduction

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The Linear Acoustic AERO.one™ is a compact transmission loudness controller and up-mixer with the following features:

- Dual AEROMAX™ 2 channel loudness engines
- LtRt or LoRo stereo downmix of input channels 1-6
- Second program or SAP on channels 7-8
- GPI/O control of SAP/Main Downmix switching functions
- Industry-leading metadata functionality for optimized processing
- Relay bypass of audio, SDI, and metadata connections for fail-safe operation
- Optional HD/SD-SDI I/O with access to all 16 channels plus VANC metadata
- Optional Dual redundant power supplies
- Optional dual stereo Dolby Digital (AC-3) encoders

## 1.1 Principles of Operation

The AERO.one (TV) is a simplified version of the Linear Acoustic AERO.air series of transmission loudness managers. The TV version contains dual stereo processors for use on Main + SAP or Main + Alternate program audio. It provides the same integrating long-term loudness controller, multiband short-term loudness controllers, LtRt or LoRo downmix, metadata input for channel and processing control, plus GPI control of switching functions.

Specific processing presets and adjustments are discussed in Chapter 7.

Figure 1-1 shows the internal audio path of the AERO.one (TV). It should be noted that this diagram is a general representation of signal flow and shows the optional Dolby Digital (AC-3) encoder. Please consult the appropriate section of this manual for specific functionality.

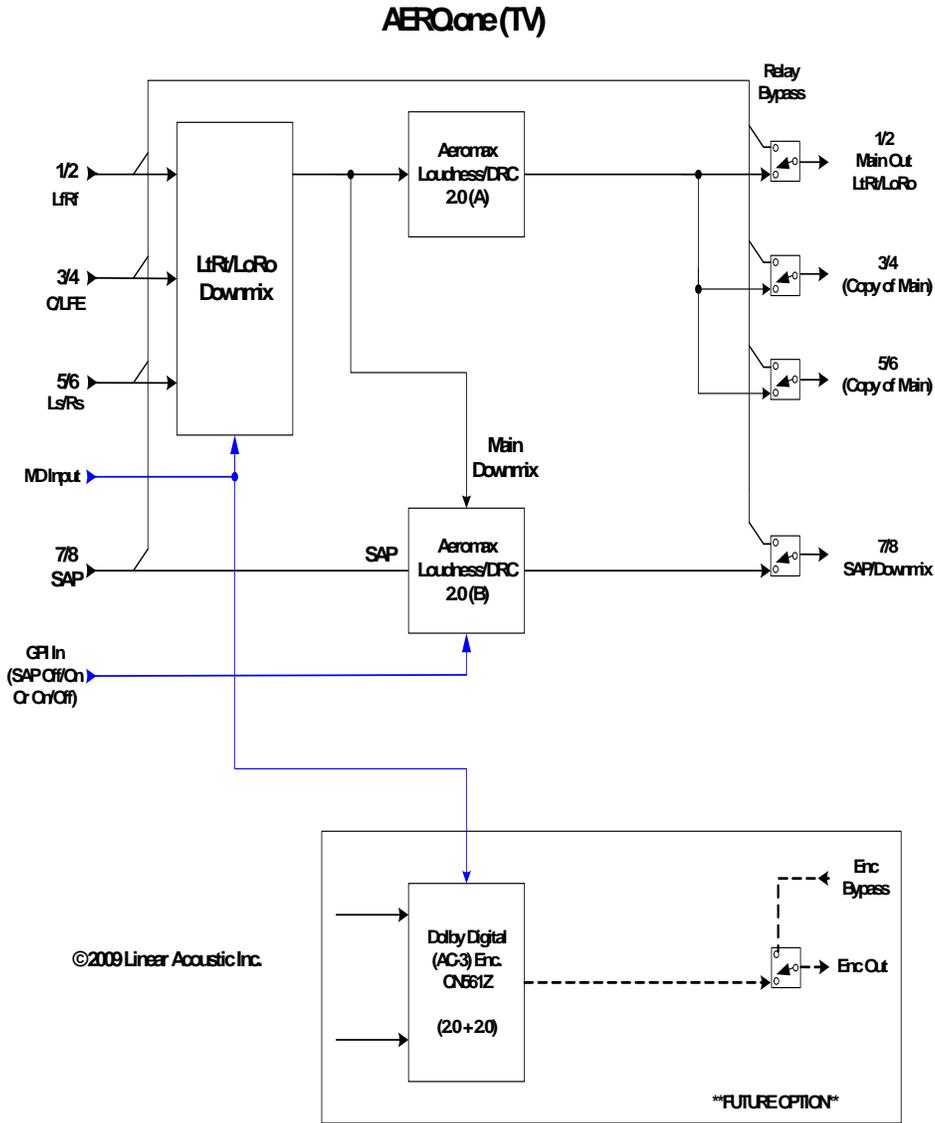


Figure 1-1 Basic Audio Block Diagram (no SDI)

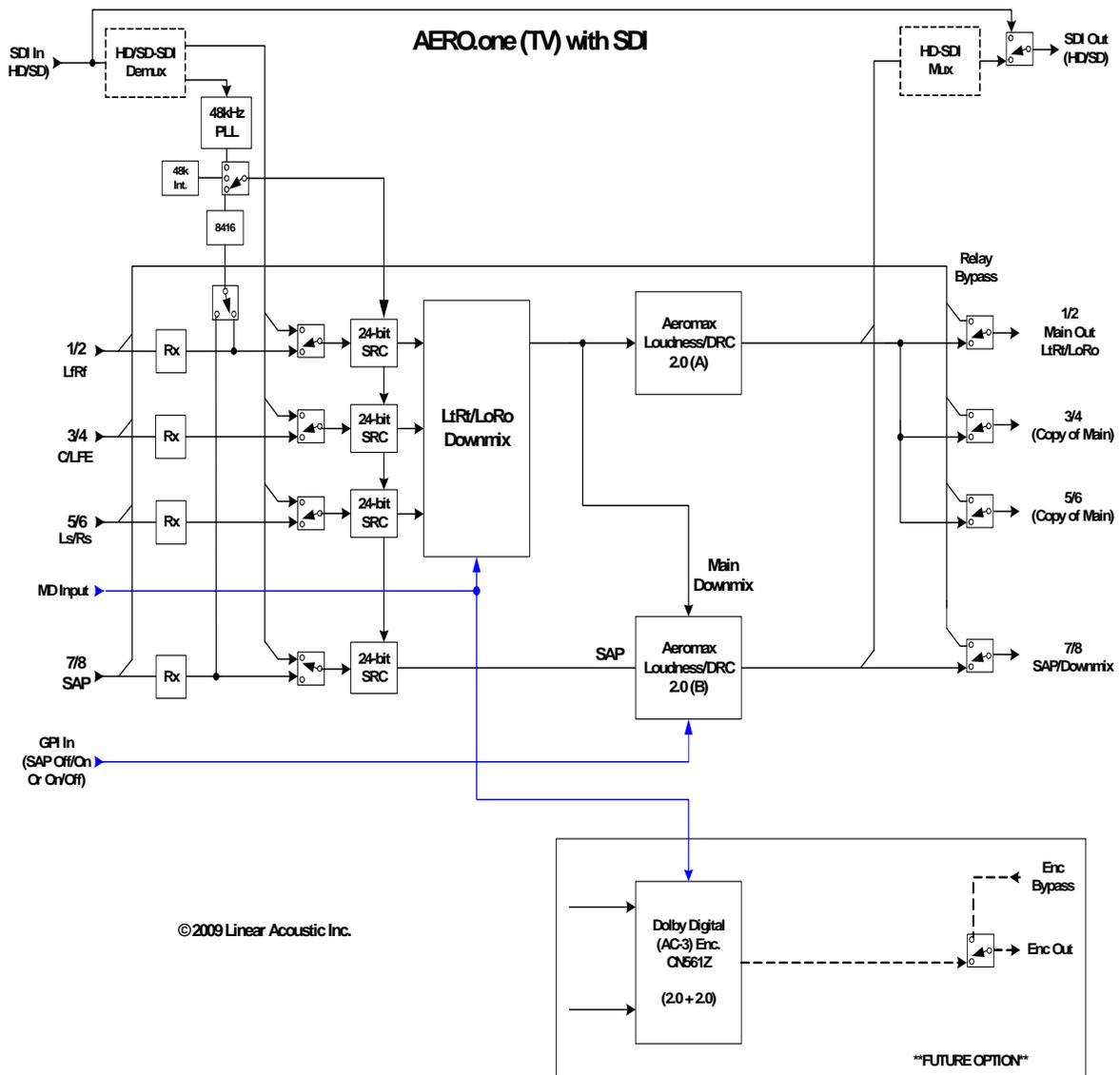


Figure 1-2 Basic Audio Block Diagram with SDI

## 1.2 Location of AERO.one

In the signal flow of a modern television station, audio processors can be placed in a variety of locations depending on how the transmission path is designed. Our suggestion is to try to keep AERO.one near the final emission DTV encoder (i.e. Dolby Digital (AC-3) encoder) as the units work closely together and will benefit from short cable runs and common clocking.

## 1.3 Reference Levels

The AERO.one is designed to support a standard reference level of -20dBFS via its digital inputs. Other levels can be supported as the slow-moving Input AGC will easily compensate for any level differences.

Please see Chapter 4 for detailed information.

## 1.4 Reset and Upgrades

Hard reset of the unit can be accomplished by simultaneously and briefly pressing the Left, Up, and Right buttons. This will cause a quick audio disruption while the bypass relays engage, and another when the unit is finished re-booting.

Upgrades are accomplished via an Ethernet connection and a software upgrade package supplied by the factory.

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***WARNING: Do not connect any devices to the USB connector without specific instructions from the factory!***

---

## 1.5 Warranty and Feedback

Please take a moment to fill out the postage-paid warranty card included with the unit and drop it in the mail. This will enable us to contact you if there are any software or documentation issues. Also, we are very interested in your feedback. This unit was designed based on input gathered from many broadcast engineers and it will evolve further thanks to ongoing suggestions and comments from users. We look forward to hearing from you.

## Chapter 2: Connections and Quick Setup

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This chapter covers all required connections for the AERO.one.

### 2.1 Unpacking and Inspection

Before unpacking the unit, inspect the outer carton for shipping damage. If the carton shows damage, inspect the unit in those areas. Please save the carefully designed shipping carton and packing materials. In the unlikely event that the unit needs to be returned to the factory, alternate cartons or packing materials may not be adequate and can cause damage not covered by warranty.

The following essential items are provided with the unit:

- Bag containing:
  - Quick-start sheet to get you up and running
  - IEC power cord(s) (style matches country of order);
  - this manual, and a handy black pen.
- Warranty information: Please fill out and return the warranty card to Linear Acoustic to ensure your software and documentation are kept up to date.

### 2.2 Installation

AERO.one (TV) installation requires:

- One standard rack space unit with ADEQUATE VENTILATION (the unit relies on convection cooling from side-panel vents);
- standard 75-Ohm BNC cables for digital signal connections;

To connect to digital equipment with 110-Ohm XLR connectors, use impedance-matching transformers (available from Canare, Neutrik and other manufacturers).

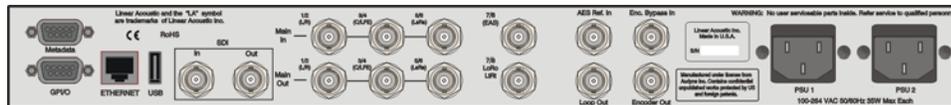
- Proper reference. The unit can be synchronized to AES Input 1, AES Input 4, SDI, or Internal 48kHz. All inputs have SRCs but a master reference is required. Proper reference signal selection and application is imperative for an artifact-free installation. Clicks or pops can usually be traced back to improper reference configuration.

## 2.3 Rear Panel

The rear panel of the AERO.one contains its electrical I/O.

### 2.3.1 Connection Ports

All of the connections for AERO.one are on the rear panel and are described in detail below. See Chapter 5: *Specifications* for specific pinouts.



**Figure 2-1** Rear Panel

- **Metadata I/O:** RS-485 connection accepts the metadata output of any Dolby equipment (DP572, DP570, etc...) or any Dolby-compatible metadata source. Used to control upmixing and other functions.
- **SDI Input/SDI Output:** Option allows for de-embedding and re-embedding any of the 16 available channels in an applied HD or SD-SDI signal. VANC metadata extraction per SMPTE 2020 methods A and B is also supported.
- **GPI/O:** Connect dry contact closures here to control upmixing and EAS on/off. Note that GPI functions require held closures for the duration of the desired function. Status of upmixing will be reflected on the corresponding GPO pin.
- **ETHERNET:** Used for firmware upgrades.
- **Main Audio Input:** Connect the 48kHz PCM signals to these inputs. The input channels are arranged as follows: 1/2 = Left front/Right front, 3/4 = Center/LFE, 5/6 = Left surround/Right surround, and 7/8 = Secondary or SAP input.
- **Bypass/Encoder Inputs:** OPTION - Bypass input for Dolby Digital (AC-3) encoder. Accepts output of external encoder for fail-safe operation.

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**NOTE:** *Appropriate reference should be applied and selected for proper operation.*

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- **Main Audio Outputs:** Main 48kHz processed digital audio outputs. 1/2 = Main LoRo or LtRt, 3/4 and 5/6 are utility duplicates of the Main Out, 7/8 = Secondary program or SAP output. Note that 7/8 output can be commanded to switch between the Main downmix and the 7/8 program allowing for substitution of main program audio if SAP is not present.

## 2.4 Quick Setup Notes

The Linear Acoustic AERO.one is configured at the factory and is ready to go on the air after making the proper input and output connections and determining if upmixing is desired.

- Apply audio to Main Input 1/2 or 1-6 if a 5.1 channel source is present
- Set Clock Reference = AES 1
- The front panel Reference indicator should be green.
- The main menu will default to showing input and output meters, and there should be activity on the first two meters.
- Processed audio will be available on the main outputs 1/2 with duplicates on 3/4 and 5/6. If input audio has been applied to 7/8, it will be processed and output on 7/8. Alternately, the unit can be commanded via the front panel or GPI to output the main program.

The best way to learn the processor is to explore the different settings with audio applied and monitored. There are several factory presets to support many different tastes. Some presets may not sound much different at first, but will perform very differently depending on program content. Modern broadcast television offers the ability to process less, and even the heaviest presets in the AERO.one are moderate by comparison to what might be found in traditional NTSC audio processors.

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**NOTE:** *For best audio quality, the AERO.one should be the only processor in line with station audio. Please make sure to remove any legacy processing that might have been installed for NTSC operation as it will impair the performance capabilities of the AERO.one. We suggest checking drawings and physical installations to make sure that this old gear is removed.*

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## Chapter 3: Applications

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The AERO.one is intended to be used in an emission (transmission) environment. This chapter discusses several common applications for the unit. General block diagrams are provided to give the user a sense of some of what can be accomplished with the AERO.one (TV) unit but are by no means the only uses for the device.

Figure 3-1 below is a very high-level view of the last stages of a typical broadcast plant supporting both legacy analog transmission in addition to digital transmission. It can be seen that the AERO.one (TV) is being used to process a main and an alternate program, producing smooth and consistent audio appropriate for transmission to all consumers.

The AERO.one (TV) is also fed with a contact closure from master control and the station automation system to signify when alternate audio programming (SAP) is present and when it is missing. This controls the SAP functionality to provide a seamless crossfade between alternate and main audio so this secondary path always has audio present. This feature saves the cost and complexity of several additional external units that would be required to perform this function.

It should be noted that the AERO.one (TV) can also accept and utilize metadata to control processing as well as automatically mute unused input channels. This is useful when Main In 3-6 might be presented with audio that would otherwise be ignored by downstream encoders controlled by metadata.

Metadata can be applied either via serial RS485 connection or it can be extracted from the vertical ancillary space of an applied HD-SDI signal.

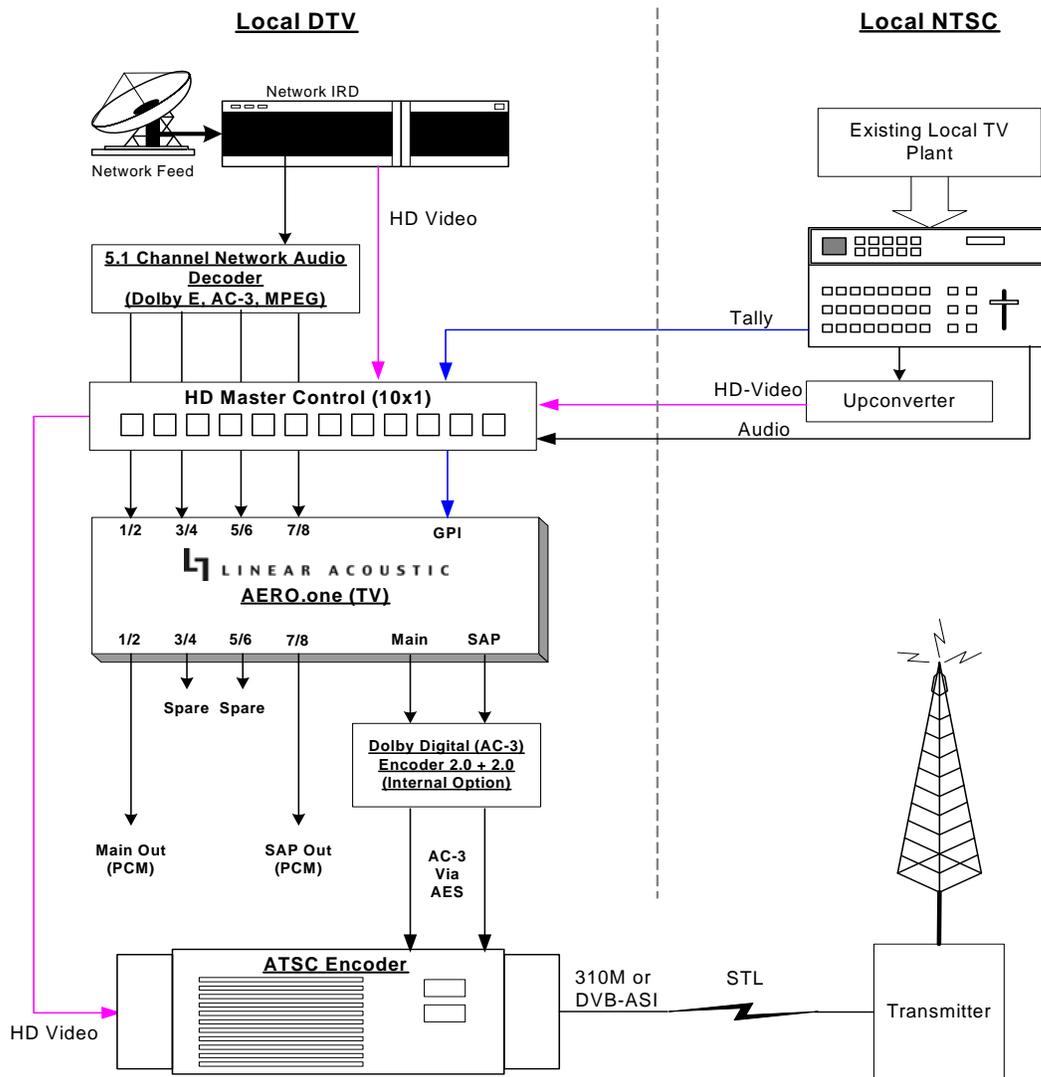
Finally, note that either Main In 1/2, Main In 7/8 or AES Ref can be used as baseband AES-11 style reference sources. SDI input can also be used if present, and is required if the unit is used in an installation where the AERO.one is re-embedding audio.

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**NOTE:** *When using SDI re-embedding, clock source MUST be set to SDI.*

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### AERO.one Typical Local Station Installation



**Features:**

- Automatic Loudness control
- Downmix of 5.1 input or passes stereo
- LtRt or LoRo Stereo digital out
- SAP input with crossfade to Main program on command
- GPIO control
- Dual stereo Dolby Digital (AC-3) encoder option
- Dual PSU option

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Figure 3-1 AERO.one(TV) general application

### 3.1 2 + 2 or 2 + 1 Application

Figure 3-1 below shows how an AERO.one(TV) can be used to process two separate programs. The primary program is applied to Main In 1/2 and is output from Main Out 1/2, while the secondary program is applied to Main In 7/8 and is output from Main Out 7/8. This second program can be stereo, dual mono, or single channel mono and can be output as stereo or dual channel mono.

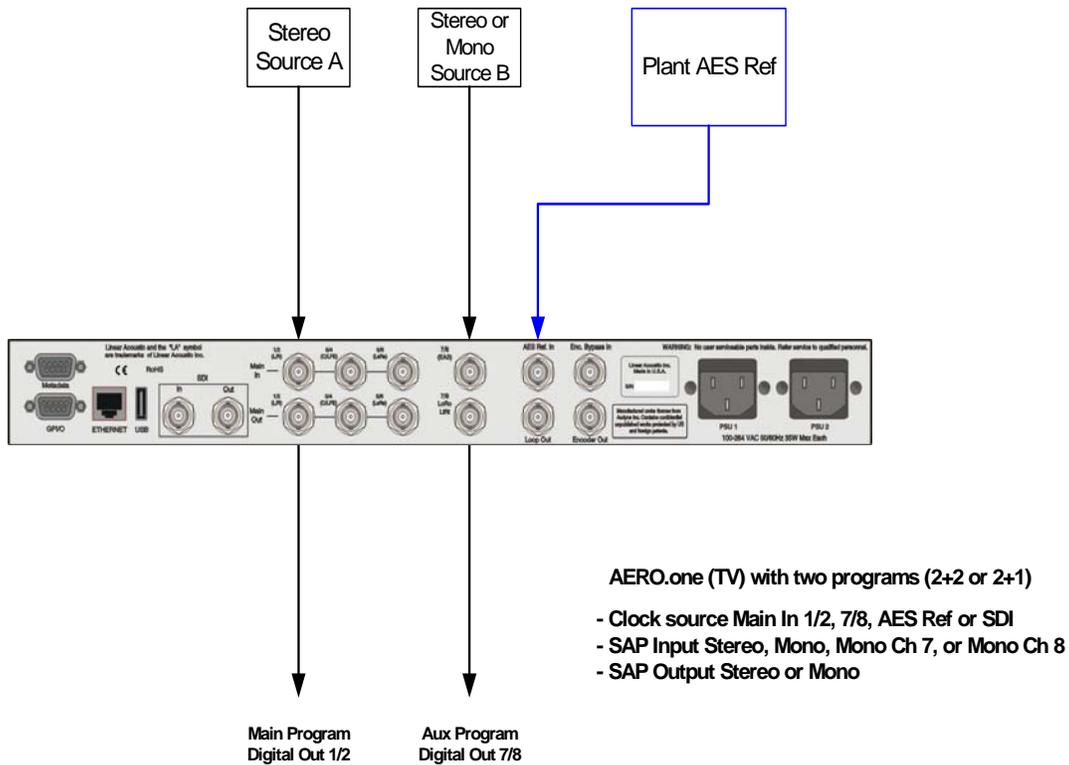
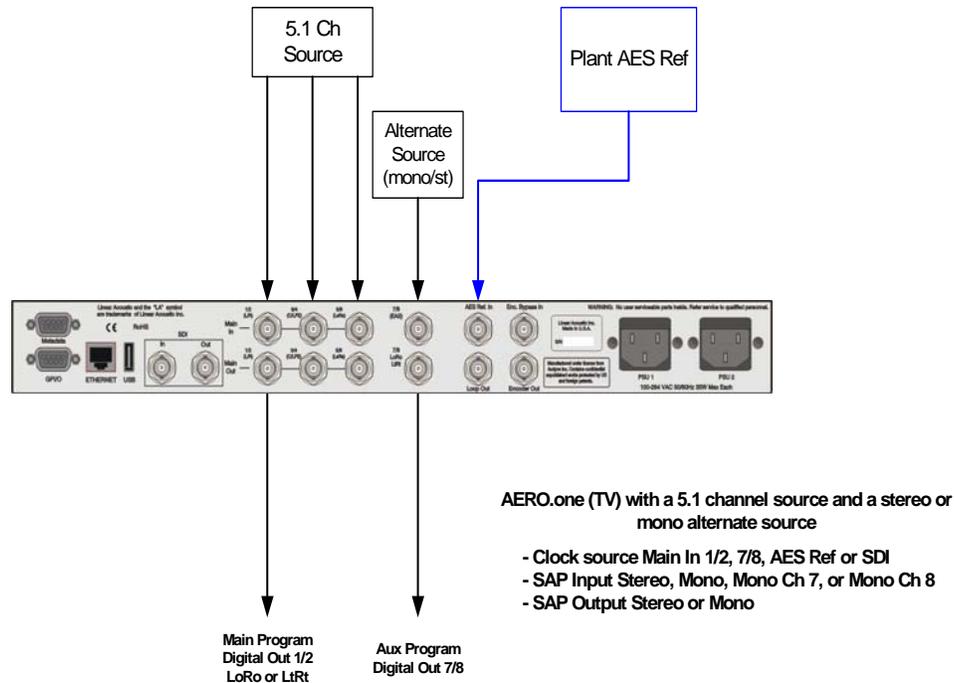


Figure 3-2 AERO.one(TV) accepting 2 + 2 or 2 + 1 audio.

### 3.2 5.1 + 2 Application

The AERO.one(TV) contains a downmixer to allow 5.1 channel sources to be applied to the unit, downmixed to LoRo or LtRt, and processed and output as two channels. This is especially useful for creating stereo versions of main program audio for legacy stereo paths that might need special processing. Examples include cable and satellite feeds.



**Figure 3-3** AERO.one(TV) accepting 5.1 + 2 audio.

Note that in both of the above scenarios, the second program output (7/8) can be replaced by the downmixed version of the main program. This provides for use in an SAP (Secondary Audio Program) application where the SAP audio may not always be present. Supplying a contact closure when SAP is present allows it to flow from Main In 7/8 through processing to Main out 7/8. When SAP is not present and is indicated as such by the lack of a contact closure, the Main program audio is crossfaded to the 7/8 output thereby providing continuous audio from the Secondary program output.

### 3.3 Audio Metadata

Audio metadata, or data that describes the audio data, is used in the AC-3 system to represent important parameters such as the number of channels that have been encoded (audio coding mode or acmod), the loudness of the program with respect to dialogue (dialogue level or dialnorm), and dynamic range control (Line Mode and RF Mode DRC presets). Applied to an AERO.one, audio metadata can be used to control functions such as when to apply upmixing and eventually guide processing preset selection. Use of an AERO.one with metadata can also protect stations from metadata failure.

### 3.4 Dolby Digital Encoder Setup (external metadata)

In environments where the television network is providing reliable metadata to affiliate stations and the stations are able to access it, the AERO.one can work in tandem with this data to ensure audio of the highest reliability and consistency. When installing an AERO.one, network audio metadata should be connected only to the AERO.one.

By analyzing the incoming metadata, features such as upmixing can be automatically invoked when appropriate. The AERO.one is also capable of detecting metadata failure and responding appropriately. For example, if metadata were to fail during a 5.1 channel program, upmixing should not be invoked, nor should an AC-3 encoder be switched to 2/0 stereo mode, and both of these situations are prevented.

As the dynamic range, and hence the average loudness of the programming is being controlled by the AERO.one, metadata such as dialnorm and DRC presets should be set to fixed values. Suggestions are to set dialnorm to the factory default of -27 and select Film Standard for both the Line Mode and RF Mode DRC presets. In this manner, the AERO.one will automatically pre-adjust the audio to match these settings.

## 3.5 Dolby Digital Encoder Setup (local metadata)

To use the AERO.one with a Dolby Digital encoder in an environment without external metadata, such as the type that might be delivered by a network, three critical values must be set in the AC-3 encoder:

- **Audio Coding Mode**
- **Dialogue Level**
- **DRC**

Note that as they are intimately connected, you must set the dialogue level properly in order for the DRC (dynamic range control) system to perform as intended.

### 3.5.1 Audio Coding Mode

Also known as *acmod*, this value is shown, for example as 3/2L. This means three front channels, two rear channels, and LFE (i.e. the channel that feeds the sub woofer). Since AERO.one (TV) is a stereo processor, be sure to set the Dolby Digital encoder for 2/0 or 1/0 mode.

### 3.5.2 Dialogue Level

Properly setting the Dialogue Level parameter ensures that the dialogue volume heard by the consumer (or average level in programs without dialogue) is consistent between programs. Contrary to popular belief, there is no one “correct” value for unprocessed audio. As the value indicates the average dialogue loudness of a program and different programs will very likely have different loudness, they will also then have different dialogue level values. Correct values are found by measuring each program.

This section assumes no metadata is available and that the AERO.one is relied upon to match levels between programs. Only in this scenario is it then appropriate to set a single dialogue level value on the AC-3 encoder as the AERO.one is doing the job of matching

each program to a single loudness value.

To set Dialogue Level:

1. Ideally, using either a Linear Acoustic LAMBDA audio monitor or a Dolby LM100 will make this very easy because it displays the actual metadata from the encoded stream and the measured dialnorm value in real time, and the encoder can be quickly adjusted via its front panel.
2. Alternately, you can use the Dolby Digital encoder's remote control program to monitor the dynamic range control activity.
3. With the AERO.one set to the desired audio level, simply adjust the Dialogue Level until the minimum amount of gain reduction/expansion (green/red) is shown on the Dolby Digital encoder's remote.

### 3.5.3 Dynamic Range Control

Dynamic range control profiles can be selected in the Dolby Digital (AC-3) encoder.

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**NOTE:** *Dialogue Level must be set correctly for the DRC profiles to operate correctly.*

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When using an AERO.one preset such as TV 5B Gen or Light (Television 5-Band General or Light), we suggest using is the Film Standard or Film Light DRC profile in the Dolby Digital encoder for both Line Mode and RF Mode. This allows consumers to restore some of the dynamic range. The AERO.one will still react to badly mismatched loudness levels, but will do so in combination with the DRC profile in the Dolby Digital encoder.

We strongly recommend using the minimum degree of dynamic range processing required. TV 5B Gen should provide more than enough pre-processing, and TV 5B Light might be better suited for some material. In this way, the system can balance between permanent changes to the input audio and metadata-based changes generated by the internal Dolby Digital (AC-3) encoder. Of course for proper operation this method requires programming that has been correctly produced.

#### AC-3 Encoder Metadata Value List

Specific audio metadata parameters that should be set in the AC-3 encoder are:

- Data rate: 384kbps minimum, 448kbps preferred for 5.1 channels
- Dialogue Level: Approximately -24 (with the AERO.one in TV 5B Gen).

---

**NOTE:** Loudness *MUST* be measured for the exact value, -24 is only a starting point.

---

- Channel Mode (acmod): 2/0 or 1/0
- Line Mode Profile: Film Standard or Film Light
- RF Mode Profile: Film Standard or Film Light

Other parameters are set to default values and will be adjustable in the future.

### General Dolby Digital (AC-3) Encoder Setup

Note that when feeding video encoders such as those from Tandberg, an AES reference signal is supplied *by the video encoder* specifically for feeding back to the AC-3 encoder. If the encoder requires this, as the Tandberg models do, it must be used. It seems that this special reference signal is derived from a 27MHz clock that is internal to the video encoder that may or may not be referenced to the plant. Failure to use this reference may cause PTS values to drift when observed on a transport stream monitor, and can cause audible glitches when buffer over or underflow results.

## 3.5.4 Audience Measurement Systems

Audience measurement systems such as the ones available from Nielsen (via Norpak) perform their functions by inserting a watermark into the audio signal. Careful testing by Nielsen and Linear Acoustic has shown that the watermark signal is not disturbed by any of the AERO factory presets or upmixing, and that locating the processor before or after the watermarking equipment has no impact on audience measurement reliability.

In order to minimize any chance of audibly unmasking the watermarking signal, Linear Acoustic and Nielsen recommend that where possible, watermarking equipment be installed *after* any audio processing equipment. However, audible unmasking is highly unlikely with standard presets. This arrangement is not possible when the Dolby Digital (AC-3) encoder is included in the processor, and so the watermarking equipment must be installed prior to the AERO unit. This is completely acceptable and in use by many stations.



## Chapter 4: Detailed Operation

This chapter discusses in detail the structure of the Linear Acoustic AERO.one, how to use the front panel interface to access the menus, accessing and saving factory and user processing presets, and GPI and Metadata setup.

Most of it is rather obvious, and a bit of experimentation will quickly make you comfortable navigating through the submenus. If in doubt, use the Left Arrow to back out towards the Main menu. The menus and submenus are structured to access more complex functionality as you go deeper into the hierarchy. See the page the end of this chapter for a menu tree.

### 4.1 Main Menu (Signal Status Meters)

#### Audio I/O Meters

Shows the main audio I/O for the unit, plus the status of SAP (alternate program) functionality. Signal presence meters for each audio channel applied to the processing engines are followed by outputs from the processing and downmix engines. The left display shows audio present on the 1/2, 3./4, and 5/6 inputs with corresponding downmixed output on 1/2 and 7/8. The right display shows SAP mode active where audio present on Input 7/8 is processed as the second program and is output on 7/8.



Figure 4-1 Main Audio I/O Meters

**NOTE:** The AERO.one (TV) can operate as two independent processors (SAP Active) or can replace the secondary output with primary audio (SAP not active). This is useful to maintain continuity when alternate program audio is not present.

#### Audio Input and Output Meters

The next two menus show output and SAP status with channel labels. Note that upmixing is indicated as “D” (for Disabled), “U” for Upmix on, lower case “u” for controlled by GPI but not activated. This menu can also show when Upmix is set to Auto, and the same indications apply.



Figure 4-2 Audio signal presence and upmix indication

### AGC Meters

Show the gain reduction status of the Input AGC and the Multiband AGC. More downward meter excursion indicates lower gain (more gain reduction). The center dot in each of the AGC bands shows 0dB at the center of the AGC range.



Figure 4-3 AGC Gain Reduction metering

### GPI Status Display

Shows the current status of each of the four GP Inputs, plus the active preset. The screen below shows GPI 1 set for SAP, GPI 2 set for Coding Mode 2/0 (i.e. Mute inputs 3-6), GPI 3 set to select Secondary Preset, and GPI 4 set to select Primary Preset. Lower case indicates that the GPI function is set but the GPI is not active.



Figure 4-4 GPI Status Screen

### Metadata Status (Pgm 1-8)

Shows the status of applied metadata signal (485 or VANC). The Program Config is shown along with the audio coding mode (acmod) and dialnorm for each of the possible eight programs.



Figure 4-5 Metadata Status Screen

## 4.2 Statistics Menu

Provides details about software, firmware and DSP versions, DSP communications status, as well as listing any installed options. This menu also shows the presence for each of the AES pairs, 1-8.

- **Firmware Version:** 5100.00.11
- **Device Options:** None
- **DSP 2 Version:** V1.1.0
- **DSP 2 TX Errors:** Shows transmission errors between micro and DSP1.
- **DSP 2 Rx Errors:** Shows receive errors between micro and DSP
- **DSP 3 Version:** V1.3.0
- **DSP 3 TX Errors:** Shows transmission errors between micro and DSP1.
- **DSP 3 Rx Errors:** Shows receive errors between micro and DSP.
- **AES In Detect:** Shows presence of AES carrier on any of the 8 pairs (only four pairs are currently used to support 8 audio channels). See below for a picture of the screen

AES In	1	2	3	4	5	6	7	8
Detect	*	-	-	-	-	-	-	-

Figure 4-6 AES presence detect for applied pairs (1-4 are used)

## 4.3 Setup Menu

Entering the Setup menu gives access to **Presets/Processing adjustment, I/O settings, Communication** settings and **System** settings. With the exception of Presets/Processing menu which is described in detail in Chapter 7, all other settings will be described below.

## 4.4 Presets - See Chapter 7

## 4.5 I/O Menu

The I/O menu is where the input and output audio, control, and metadata signals are selected to interface with the loudness control and upmixing engines.

### 4.5.1 Master Bypass

Enabled de-energizes the audio, metadata, and SDI relays for a hard bypass. This will of course create a brief interruption in these signals but is useful for troubleshooting.

### 4.5.2 GPI Control (Flashing “g”)

When enabled the unit is under GPI control and most changes are not allowed. This will be indicated in the menus by a lower-case flashing “g” in the left corner of the display.

### 4.5.3 GPI Function (GPI 1-4)

Selects the function of each GPI input. Selections are:

- **None:** No function for this GPI (as the name would lead you to believe)
- **Pri Preset:** GPI selects the preset defined below for the Primary processor.
- **Sec Preset:** GPI selects the preset defined below for the Secondary processor.
- **SAP Off/On:** Selects SAP (Secondary Audio Program) audio present on input 7/8 for processing and output. When active (as shown by “SAP” on main menu), the AERO.one (TV) is essentially in 2+2 mode.
- **SAP On/Off:** Inverted version of above.
- **Mode 2/0 Off/On:** When active, mutes Inputs 3-6. This is done if the source audio is definitely 2 channels and prevents extraneous signals that might be present on Inputs 3-6 from being added to the downmix. Useful if the Main Input is being fed from a 4 channel source where 1/2 are the main program and 3/4 are Natural Sound or tones.

### 4.5.4 GPI Preset (GPI 1-4)

Defines which of the stored presets a GPI will recall. Any of the sixteen stored presets are available for selection.

### 4.5.5 Downmix Type

The AERO.one is able to create an LoRo or LtRt output from an applied 5.1 channel signal for output on 1/2. Note that due to the required phase encoding, selection of LtRt will increase the latency of the 7/8 output to 21 milliseconds.

### 4.5.6 Clock Source (Output Reference)

AES 1, AES 4, SDI, or Internal 48kHz can be selected as the reference for the AES audio outputs. Note that if a selection is made for a source that is not applied, the front panel Ref LED will be red, and the AERO.one will revert to internal 48kHz to maintain audio. All inputs have sample rate converters on them so asynchronous audio can be accepted as long as the reference is set correctly.

### 4.5.7 Audio Input Sources (Channels 1-8)

Selects between applied AES audio or audio de-embedded from SDI. Each of the input pairs 1/2, 3/4, 5/6, and 7/8 can be sourced from its corresponding AES input pair or any SDI pair. Default is AES.

### 4.5.8 SDI Embed

Selects whether to enable audio re-embedding or pass the SDI signal through the AERO.one untouched. Note this does not affect de-embedding which is active at all times.

### 4.5.9 SDI Out Destination (Channels 1-16)

Selects source of audio for re-embedding into an applied SDI signal. Choices are Mute, AES (corresponding pair), and any of the SDI pairs. This menu can be used as a router or pair shuffler within SDI.

### 4.5.10 Metadata Setup

The AERO.one has been designed to take best advantage of metadata. The incoming Dolby or Dolby-compatible metadata stream is parsed on a program-by-program basis, and the dialog loudness and audio coding mode (channel count) parameters are used to scale processing and control upmixing respectively. Setup of metadata can be accomplished in the AERO Setup -> I/O menu.

AERO.one Metadata Setup Procedure:

- **Source: RS485/VANC-** Selects between the RS-485 serial metadata input and metadata extracted from the Vertical Ancillary (VANC) of an applied HD-SDI signal. For VANC metadata there are several other settings:
  - **VANC MD is Async:** Disabled for standard VANC metadata, Enabled for

CBS-style VANC metadata. Default is Disabled.

- **VANC MD DID:** Selects the Data ID of the metadata signal in hex. SMPTE RP2020 recommends this value be set to 0x45. Currently CBS network uses 0x50 but will be changing to 0x45. Default is 0x45.
- **VANC MD SDID:** Selects the Secondary DID of the VANC metadata signal in hex. SMPTE RP2020 recommends this value be set to 0x01 and this is the default.
- **VANC MD Line:** Selects the video line to extract VANC metadata from. SMPTE RP2020 recommends that metadata be inserted on Line 9, but we have seen a great deal of variation, thus the default is Auto.
- **MD = 2/0 Pgm Sel:** Describes which consumer metadata program will be used to control the processing. Default and most common is Pgm 1 and this is the default.
- **MD = 2/0 Function:** Describes what will be controlled when the selected metadata program has an audio coding mode (acmod) of 2/0. Selections include:
  - **Chan Mode 2/0:** Mutes Inputs 3-6 as described above.
  - **None**
- **Pri/Sec Dialnorm:** Specifies the “fallback” dialnorm value which will be used if metadata is not applied or if it fails. Separate values for Primary and Secondary programs. Default is 24.
- **Apply Dialnorm: Yes/No** - If set to yes, then the incoming dialnorm parameter is applied to the incoming audio to scale it prior to processing. If dialnorm was set correctly upstream, then the processing will be minimal. If dialnorm does not match the audio, the AERO.one will realign it in real time.

#### 4.5.11 Ch 7/8 Out Src

Selects the function of each GPI input. Selections are:

- **SAP:** Allows channel 7/8 output to come from secondary processing core, essentially allowing the AERO.one to operate in 2+2 mode. This is the default.
- **Downmix:** Sends output of main processing core to channel 7/8 output.

---

**NOTE:** Ch 7/8 Out Src will be inactive if GPI is active and GPI will control this mode.

---

### 4.5.12 SAP Mode

Selects mode of the Main In 7/8 between stereo and three mono modes. Selections are:

- **Stereo:** Channel 7/8 are passed without modification
- **Mono:** Channel 7 and 8 are summed and passed as dual mono
- **Mono Ch 7:** Channel 7 input is sent to both 7/8 inputs of processing core
- **Mono Ch 8:** Channel 8 input is sent to both 7/8 inputs of processing core

### 4.5.13 Downmix Ch Mode

Selects the mode of Main Out 1/2:

- **Stereo:** Passes downmixed input signals directly through to Main Out 1/2 (with duplicate utility outputs on 3/4 and 5/6)
- **Mono:** Sums outputs 1/2 and presents them as dual mono from Main Out 1/2
- **Mono Lo:** Sends Lo output of downmix to Main Out 1/2 as dual mono
- **Mono Ro:** Sends Ro output of downmix to Main Out 1/2 as dual mono

## 4.6 SDI Status Menu

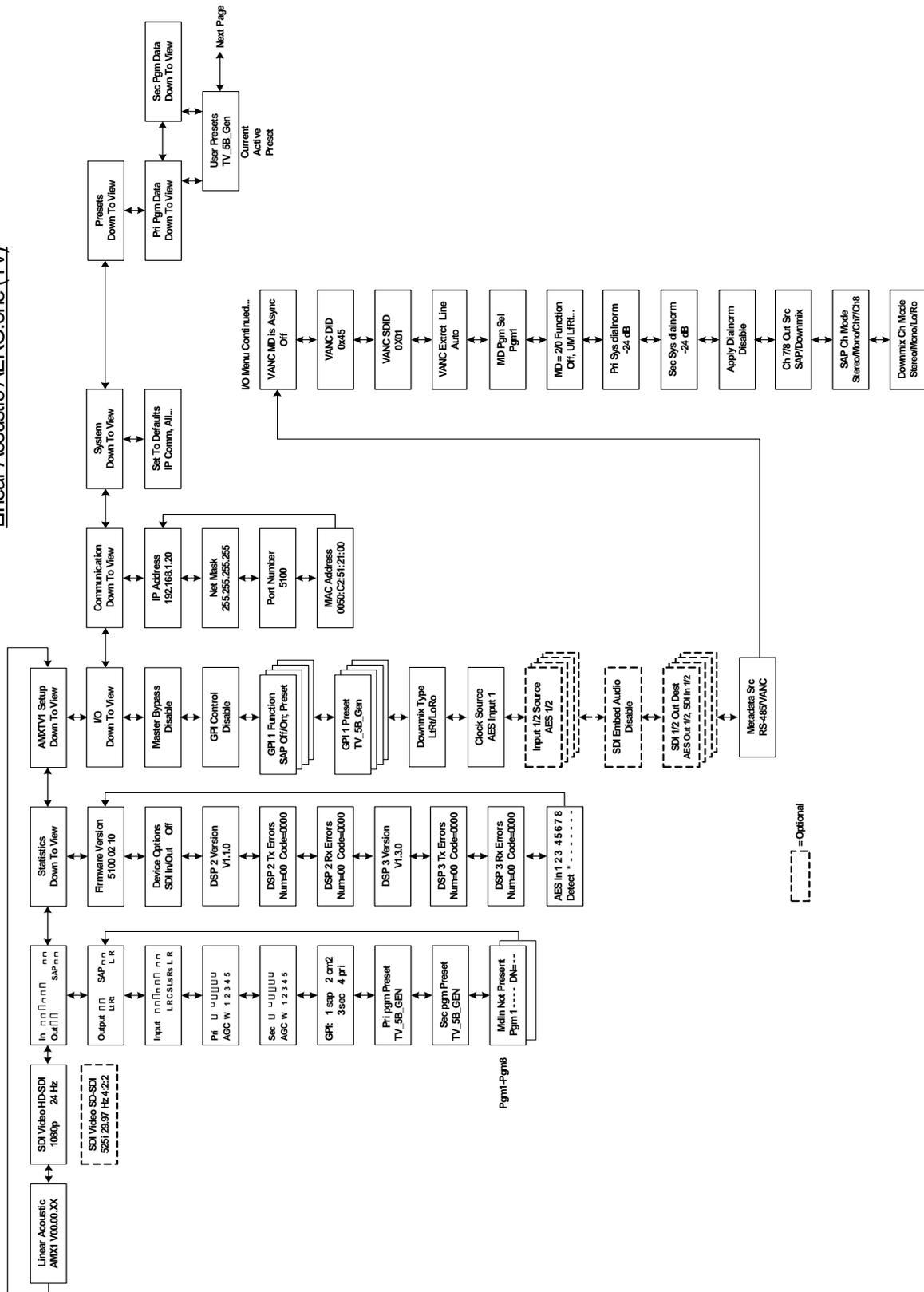
Pressing the left arrow key when at the top menu will display the status of an applied SDI signal. The SDI input is auto-sensing between SD and HD, and although it is not recommended to hard switch input streams between SD and HD if a clean switch is desired, the unit will automatically track the change. HD or SD, frame rate and frequency are displayed.



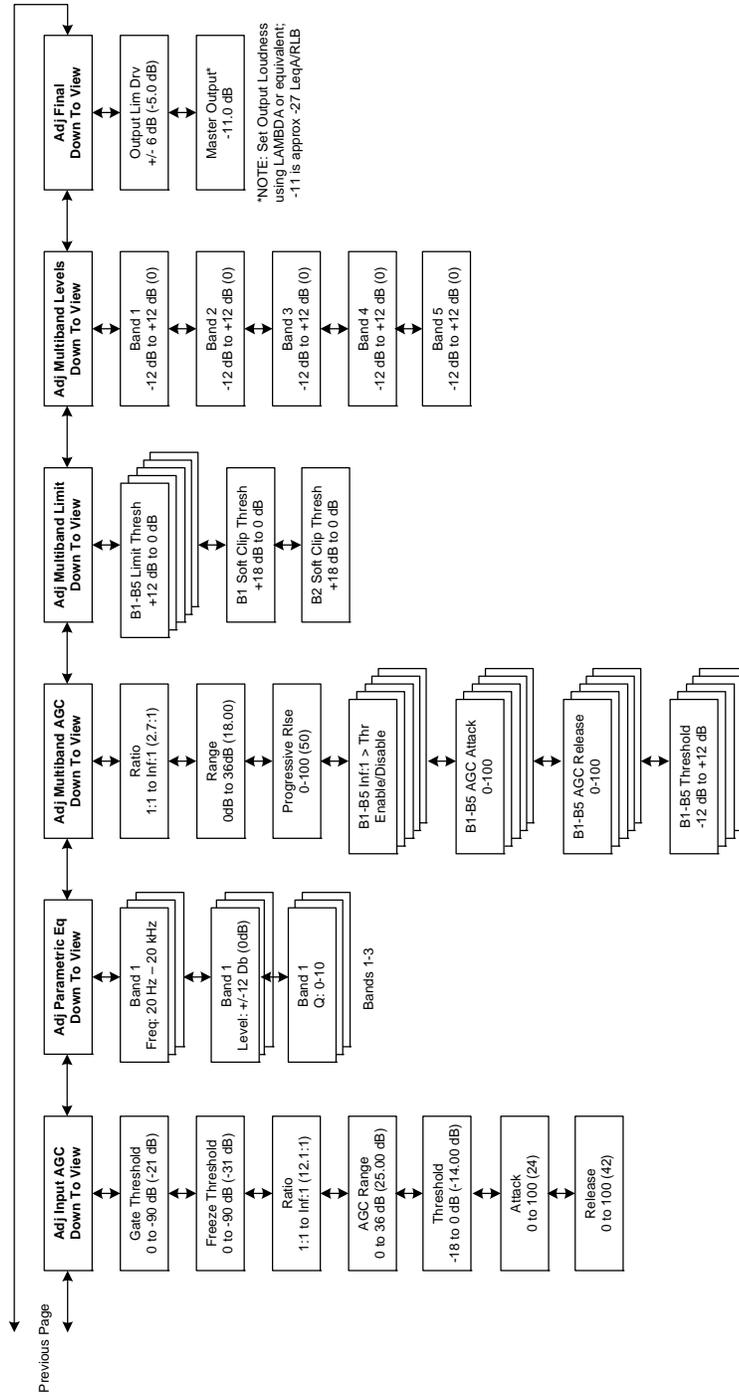
Figure 4-7 SDI Status Screens

**- NOTES -**

Linear Acoustic AERO.one (TV)



Linear Acoustic AERO.one



## Chapter 5: Specifications

Table 5-1 Electrical Specifications

<b>Sampling Rate</b>	48 kHz ( $\pm 0.1\%$ )
<b>Processing Delay</b>	16 msec minimum, Main Out
<b>Processing Algorithms</b>	Linear Acoustic AEROMAX loudness and DRC engine plus ITU LoRo and LtRt downmix
<b>Audio Word Length</b>	24-bit performance
<b>Digital Audio In</b>	Four BNC female connectors, AES-3ID-2001/SMPTE 276M
<b>Digital Audio Out</b>	Four BNC female connectors, AES-3ID-2001/SMPTE 276M
<b>Metadata Input/Output</b>	RS-485, 9-pin female D-connector on rear panel
<b>GPIO Port</b>	TTL level, 25-pin female D-connector
<b>Ethernet Port</b>	RJ-45 female jack connector
<b>Digital I/O</b>	
<b>Digital Audio Inputs</b>	Four unbalanced female BNC connectors, comply with AES-3ID-2001/SMPTE 276M. Internal 75-Ohm termination.
<b>Digital Audio Outputs</b>	Four unbalanced female BNC connectors that comply with AES-3ID-2001/SMPTE 276M specifications.
<b>SDI I/O</b>	
<b>HD/SD-SDI I/O</b>	Audio can be de-embedded (demuxed) from any of the four groups and re-embedded (muxed) into any of four the groups. Signals per SMPTE 299M-2004/292M-2004. Metadata can be extracted from VANC per SMPTE RP 2020 A or B.

Table 5-2 Mechanical Specifications

<b>Dimensions</b>	1.75 × 19 × 24 in (44.4 × 48.3 × 61 cm)
<b>Net Weight</b>	6 lbs (2.72 kg) approx.
<b>Shipping Weight</b>	8 lbs (3.63 kg) approx.
<b>Power Requirements</b>	90-2 50–60 Hz
<b>Power Consumption</b>	40 W maximum

Table 5-3 Environmental Specifications

<b>Operating Temperature</b>	0°C to 50°C
<b>Non Operating Temperature (Storage)</b>	-20°C to +70°C
<b>Humidity</b>	Up to 98% relative humidity, non-condensing
<b>EMC Radiation Limits</b>	FCC Part 15 Class A, ICES-003

## Metadata Input Port

9-pin female D-connector with full-duplex RS-485 protocol running at 115 kbps. Pinout is compatible with SMPTE 207M. Pin-for-pin compatible with Dolby metadata sources (i.e. straight-through cable should be used).

Table 5-4 Metadata I/O Port Pinout

Pin	Connection
1	Shield
2	TX A asynchronous data out -
3	RX B asynchronous data in +
4	Ground
5	NC
6	Ground
7	TX B asynchronous data out +
8	RX A asynchronous data in -
9	Shield

## Ethernet Port

Standard RJ-45 female connector that supports 10 or 100BASE-T.

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## GPI/O Parallel Control Port

TTL level controls, active Low. The 5-V output for external GPO indicators is limited by a self-resetting fuse.

Table 5-5 GPI/O Port Pinout

Pin	Connection
1	GPI 1
2	GPI 2
3	GPI 3
4	GPI 4
5	Ground/Common
6	GPO 1
7	GPO 2
8	GPO 3
9	GPO 4

## Chapter 6: Troubleshooting

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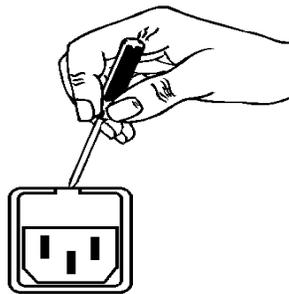
The Linear Acoustic AERO.one is a very stable and reliable unit, and most problems can be traced back to mis-wiring causing incorrect signals to be applied to the unit, or more than likely mis-configuration. As simple as the unit is to use once installed, it is very flexible and thus a necessarily complex processor. In an effort to speed troubleshooting, some common problems and solutions are described below.

### 6.1 Problems and Possible Causes

One of the best troubleshooting features of the AERO.one is the hard-bypass of the audio and SDI signals. This is useful because it allows instant removal of the unit from the signal path. Hard-bypass can be accomplished two ways, the simplest being to remove AC power from the unit by turning the power switch off. A less dramatic way to accomplish the same result is to access the I/O menu and enable Master Bypass. If you are unsure of what is happening in a particular system, simplifying the signal path is a good start and will help isolate problems quickly.

#### 6.1.1 Unit won't power on

First check the obvious and make sure that the power cord or cords are plugged into live AC outlets (it happens). Next, see if either or both of the blue front panel PSU lights is illuminated. If not, check the power supply fuses by removing the power cords and using a small flat-blade screwdriver to remove the fuse holder from the IEC inlet module. The holder carries a spare fuse and extras were included in the packing kit with the unit. If the fuse is bad and continues to blow, please contact the factory.



#### 6.1.2 The Ref LED is red

Check to make sure that an AES reference signal is connected to the unit and that the correct reference is selected. Note that this signal can be either AES black (i.e. an AES signal with silent audio), or an AES signal with audio. Reference can be derived from Main Input 1, Input 4, SDI, or Internal within the I/O Options menu (see Chapter 4).

### 6.1.3 Output Audio Clicks and Pops

This could indicate that the AES Reference is missing or at the wrong sample rate (the unit expects to be locked to 48kHz). If improper reference is chosen, the Ref LED will be red and the unit will revert to internal 48kHz reference allowing the audio to continue, but due to the sample rate converters present on each input pair, the outputs will be asynchronous with the inputs. The solution is to make sure that the reference is connected.

It could also mean that audio applied to the unit is not properly referenced, or that the equipment that the AERO.one is feeding is not properly referenced. Using the master bypass function of the unit is a helpful way to troubleshoot this issue.

### 6.1.4 Received Audio Has Dropouts

The primary cause of this is the Dolby Digital AC-3 encoder not being properly referenced with respect to the DTV video encoder/multiplexer. This is normally accomplished very simply by having all gear referenced to the local plant.

In some cases, such as with certain equipment from Tandberg, a special reference signal is generated in the multiplexer and it needs to be connected back to the Dolby Digital (AC-3) encoder and used as its reference (i.e. set the encoder to “REF IN/SRC On mode). Consult your DTV encoder reference manual for more details.

### 6.1.5 Audio Pumps and Breathes

Sometimes audible in less sophisticated processors or when attack and release times are not adjusted properly. The factory presets included with the AERO.one will not cause pumping or breathing, but if it sounds like this is happening, here are some suggestions:

- Ensure that station audio is not being inadvertently pre-processed by legacy gear. The AERO.one performs best when it receives unprocessed audio.
- If you are using an external Dolby Digital encoder, make sure that the Audio Coding Mode (acmod) is set to 2/0 or 1/0 and that the Line Mode and RF mode profiles are set to Film Standard or Film Light.
- Measure the output loudness of the encoded AC-3 stream using a Linear Acoustic LAMBDA or a Dolby LM100 and make sure that the dialnorm metadata parameter is set correctly. Measure loudness of -19 with a dialnorm setting of -31 will cause pumping (amongst other bad things).

### 6.1.6 Nielsen Watermark Issues

Careful testing has shown that the Nielsen audience measurement watermark is not disturbed by any of the factory presets, nor upmixing when the watermarking equipment is installed prior to or after the AERO.one, although good engineering practice would be to

install the equipment after the AERO.one and before the Dolby Digital encoder in case an overly aggressive preset is created for some reason.

### **6.1.7 Problems with EAS decoding**

It is important to locate EAS encoding equipment after any audio processing, including AERO.one. It is critical that processing be minimized for use with current EAS systems.



## Chapter 7: Presets, Processing & Metadata

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The Linear Acoustic AERO.one contains multiple factory-programmed processing presets that have been developed after many hours of listening and experimenting, using hundreds of program sources across all genres for tuning. Preset creation is an ongoing process, and we regularly implement new presets based on customer feedback.

Of course, all processing controls are accessible and users can custom design special presets that might be even more appropriate for a given situation. We strongly recommend starting with the factory preset that is closest to the desired objective, then fine tuning it to reach the desired goal. This will minimize the troubles that will likely be encountered as many adjustments interact.

### 7.1 Description of Factory Presets & Adjustments

Each unit ships with a number of presets that are useful for most situations. A brief description of each is given below. Following the description of presets, a description of each control available for use by all presets is given. Note that not all presets use every feature.

---

***WARNING: With the initial release of the product, factory presets CAN be over-written. This will allow any updates to be entered directly and quickly. Future versions will lock the six factory presets with the remaining 10 available for user presets.***

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#### Factory Presets

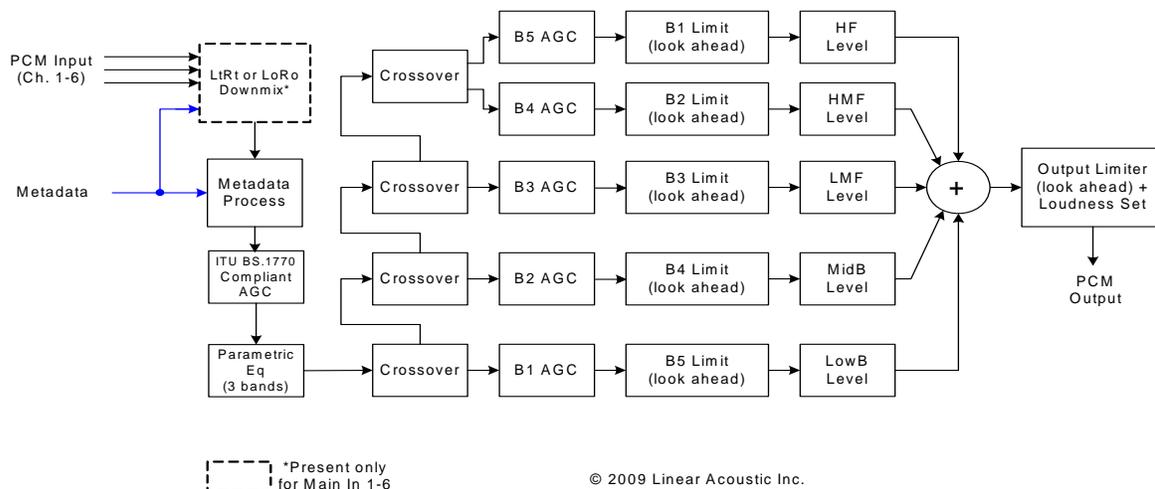
- **TV 5B GEN - TeleVision 5-Band GENeral.** This is the most commonly used preset. It provides a moderate degree of dynamic range processing, and is appropriate for all types of content. It is the factory default for all core preset choices. Use of this preset is highly recommended as it will produce audio that will have an average dialog loudness of -27 as measured by a Dolby LM100.
- **TV 5B LIGHT - TeleVision 5-Band LIGHT.** This is very similar to TV 5B GEN, however the ratio of the multiband compression has been reduced closer to 2:1 for a more gentle action. Please be aware that the lessening processing lessens the ability of the unit to control loudness tightly to a given target.
- **TV 5B HVY - TeleVision 5-Band HEAVY.** Similar to TV 5B GEN, however the ratio of the multiband compression has been increased for a more dense and less dynamic sound.
- **TV 5B LOUD - TeleVision 5-Band LOUD.** Similar to TV 5B HVY, but louder and more punchy.

- **ITU LOUDness LMT** - Utilizes a specially tuned Input AGC plus Multiband Limiters and the Final Limiter to slowly adjust the average program loudness to a given value and the multiband and final limiters will act until the AGC catches up. This preset is appropriate for ingest or live applications but because the Multiband AGC is bypassed it has less ability to manage spectral balance which is important for transmission.
- **PROTECTION LIMIT** - Bypasses all processing except for the final output limiter which is set only to prevent overload.

### 7.1.1 Processing Structure

Before choosing to jump into shark infested waters, we *STRONGLY* recommend starting with a factory preset and modifying from there. Preset creation starting from scratch is an incredibly time consuming process requiring large amounts of time and huge amounts of content spanning all genres including music of every type, films of every type, television dramas and sitcoms of every type, and talking-head programs of every type. We have already done much of the heavy lifting, and provide presets based on our own listening and feedback from customers over the past few years. Certain parameters such as crossover frequencies and channel coupling are not adjustable and are hard-coded to the most appropriate values. That being said, access to all adjustable parameters is provided. There are no factory adjustments hidden from users. Be careful with this power as most all settings interact with each other, sometimes in ways that might not be immediately audible.

Below is a drawing showing the general signal flow of the processing core to indicate what part of the chain is being adjusted by each parameter. Note that this signal flow is also captured in the “Adjust Processing” menu, with the top of the list being the input, and the bottom of the list being the output.



**Figure 7-1** General signal flow of the AERO.one processing core

## 7.1.2 Adjusting Processing

Following is a description of all adjustable core processing parameters. Defaults are shown for the DTV 5B Gen preset, other presets will obviously vary some or all of these parameters.

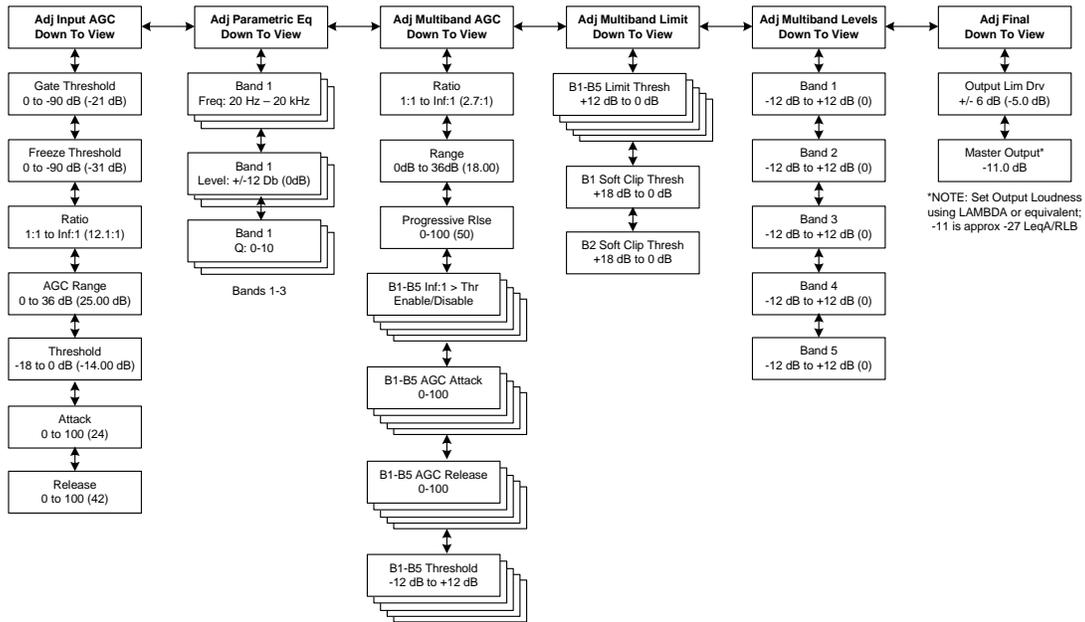


Figure 7-2 Adjust Processing Menus

### But first... A Word on Our Crossovers

The multiband crossovers in the AERO.one consist of second order Linkwitz Reilly style filters that are hard coded to specific frequencies. As the processing required for television applications is not as aggressive as other mediums, little advantage can be gained from changing these values, and the remainder of the processing relies on these characteristics remaining constant.

For reference, the crossover frequencies are:

- Band 1 (Low Bass): 20 Hz - 60 Hz
- Band 2 (Mid Bass): 30 Hz - 200 Hz
- Band 3 (Low Mid): 170 Hz - 1.15 kHz
- Band 4 (High Mid): 950 Hz - 6.1 kHz
- Band 5 (Brilliance): 5.2 kHz - 24 kHz

---

## Parametric Eq(ualization)

Three bands of parametric equalization are provided for fine tuning if necessary. None of the factory-supplied presets use the parametric equalizers, but they are provided to create notch filters or other effects if necessary. Each filter has a gain control with a +/-12dB range, a center frequency control that varies from 20 Hz to 22.050 kHz, and a bandwidth or “Q” control that varies between 0 and 10. Normal default settings for all bands are Gain = 0dB, in other words bypassed.

## Input AGC

The input AGC is a very slow acting front-end gain control with a 36dB gain range whose only purpose is to make sure that the following processing stages are fed with the correct average audio levels. It is basically the automatic equivalent of an operator slowly riding a gain control on a console to keep the audio close to reference level. Wideband in nature, the AGC is not meant to perform rapid gain reduction or expansion as its actions will be more audible, as with all wideband gain processors. As a slow gain rider, its actions are nearly inaudible thanks to the multiband processing that follows it. The AGC has two stages of gating where the gain expansion is slowed or stopped to prevent background noise increasing.

Adjustable parameters are:

- Gating Thresh(old): 0dBFS to -90 dBFS (default: -30dBFS)

-Gating sets the point at which the AGC release time is made extremely slow to prevent increasing background noise and allow the AGC to return to unity gain.

- Freeze Thresh(old): 0dBFS to -90dBFS (default: -42dBFS)

-Freeze stops all gain change (i.e. when the audio drops to silence), and remains frozen at its current gain value until the threshold is exceeded.

---

**NOTE:** *Adjust Gate and Freeze to match plant practices. Very quiet audio (such as a golf match) benefits from having processing frozen when input audio drops below a given level to prevent “boosting the cricket” sounds.*

---

- Ratio: 1:1 to Inf:1 (default: 12.0:1)

- Range: 0dB - 36 dB (default: 24dB)

-Range sets how much gain expansion above unity is performed, and this amount is subtracted from the total AGC gain range of 36dB, so the default value allows for 24dB of expansion and 12dB of compression. This adjustment

is reflected in real time by changing the AGC meter scale.

- Threshold: -18dBFS - 0dBFS (default: -16dBFS)
- Attack: 0 - 150, slowest - fastest (default: 21)
- Release: 0 - 150, slowest - fastest (default: 47)
- Progressive Release: 0 - 100, slowest - fastest (default: 50)

-Sets the speed at which the release time is increased faster at very low gain values. This feature approximates a logarithmic release to help recovery from dramatic gain reduction more quickly.

## Multiband AGC

This section is the heart of the dynamics processing engine. A multiband AGC (i.e. compressor) that allows for medium ratio (3:1 is default) adjustment of audio band. Adjustable parameters are:

- Number of Bands: Five Bands/Four Bands (default: five bands)
- Ratio: 1.0:1 - Inf:1 (default: 3.0:1)
- B1-B5 Inf:1 Above Thresh: Enabled / Disabled (default: B1: Enabled, B2: Enabled, B3: Disabled, B4: Disabled, B5: Disabled)

-AGC automatically increases ratio to Infinity:1 once a signal exceeds the threshold (set below), allowing for expansion below the threshold and limiting above the threshold. Useful for bass frequency control.

- Range: 0dB - 24dB (default: 24dB)

-Range sets how much gain expansion above unity is able to be performed. This adjustment is reflected in real time by changing the AGC meter scale.

- Progressive Release: 0 - 100, slowest - fastest (default: 50)

-Sets the speed at which the release time is increased faster at very low gain values. This feature approximates a logarithmic release to help recovery from dramatic gain reduction more quickly.

- B1 - B5 AGC Attack: 0 - 150, slowest - fastest (defaults: B1:46, B2:88, B3:88, B4:88, B5:92)

-How fast an input signal is acted upon once it crosses the set threshold

- B1 - B5 AGC Release: 0 - 150, slowest - fastest (defaults: B1:50, B2:60, B3:86, B4:88, B5:92)

-How fast an input signal recovers from a gain change once that signal falls below the set threshold.

- B1 - B5 AGC Thresh(old): -12.00dB - +12.00dB (default: 0.00dB all)

-The reference point for the attack and release parameters to act on the audio signal present in that band.

## Multiband Limiters

Performs multiband limiting of the signals coming from the multiband compressor.

- B1 - B5 Lim(it) Thresh(old): +12.00dB - 0.00dB (default: B1:+4.25dB, B2:+4.25dB, B3:+6.50dB, B4:+9.00dB, B5:+9.00dB)

-The point above which limiting action takes place at an Infinity:1 ratio.

- B1 Soft Clip Thresh(old): +12.00dB - 0.00dB (default: +3.00dB)

- B2 Soft Clip Thresh(old): +12.00dB - 0.00dB (default: +6.00dB)

-The point above which band one (low bass) is very quickly limited, acting more like a clipper without the artifacts. This helps maintain a “tight” bass sound.

## Multiband EQ

This is the section where each of the processing bands is summed and where overall frequency response can be tailored.

- B1 - B5 Out(put) Mix: -12dB - + 12dB (defaults: 0dB, all bands)

-Sets the mix level for each band summing all bands back together. These controls are prior to the final look ahead limiter and increasing gain may cause more final limiting (possibly more than desired)

## Final Stage

This final section of the processor is where the final look ahead peak limiter and bass soft clipper are adjusted. The look ahead limiters are wideband, limited to 6dB of gain reduction, are extremely fast, and due to their look-ahead nature are virtually transparent even at full gain reduction. Their purpose is to control peaks that make it through the multiband

section. Adjustable parameters are:

- Final Limiter Drive: -6dB - +6dB (default: -5dB)

-Sets the level at which the wideband sum of all bands is fed to the final limiter.

- Output Level: -36dB - 0dB (default: -11dB)

-Sets the output level for the current preset. Can be used to match the measured loudness of one preset to another. This is useful as more aggressive presets will measure differently from less aggressive versions.

---

**NOTE:** *With TV 5B Gen selected and normal dialog-based programming applied, loudness will measure approximately -24dBLKFS using a Linear Acoustic LAMBDA audio monitor.*

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## 7.2 Metadata

Metadata in the context of television audio is data that describes the audio data. Parameters describe program-specific things like the number of channels and the dialog loudness of a program. These values are intended to be set by the program producer, flow through the entire broadcast chain, and finally used to present a consistent audio experience to the consumer.

As more program producers begin to embrace some of the benefits of metadata, the system as a whole continues to improve, however protection against bad or missing metadata must still be provided. All it takes is for one errant program to have the wrong values or be missing values completely and the presentation suffers. Complaints of loudness shifts between commercials and programs, and image shifts between stereo and surround sound programs are still all too common.

The goal of Linear Acoustic products has always been to provide the best possible delivery of the original audio to consumers within the bounds of what is acceptable. Certainly a program that is produced very loudly and signalled as being very soft is pure abuse of the system and this must be prevented or at least minimized.

### 7.2.1 Metadata Structure

Audio metadata, also known as Dolby or Dolby compatible metadata can be broken down into two parts: professional and consumer. Professional audio metadata describes things like program configuration (i.e. the 5.1+2 seen on Dolby E or Linear Acoustic e-squared systems) and carried up to eight consumer metadata programs. The consumer metadata programs directly correlate to the program configuration, so 5.1+2 is two programs and each has its own set of consumer metadata parameters.

Consumer metadata contains the dialog loudness and audio coding mode parameters that can be used to preserve original audio quality. By using these parameters directly prior to Dolby Digital (AC-3) encoding, the consumer is presented with the best possible representation of the original audio, while not allowing loudness or image shifts.

For a more in-depth description of individual metadata parameters, please refer to the included ATSC document: IS-318 and visit:

[http://www.linearacoustic.com/pdf/Metadata\\_Enc\\_Dec.pdf](http://www.linearacoustic.com/pdf/Metadata_Enc_Dec.pdf)