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**F3G  
FUSION**

**Option** 



 **LINEAR ACOUSTIC**

## Loudness Processing Options (+LP)

- LP51 (5.1-Channel)
- LP20 (Stereo)

# *Manual Supplement*

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<b>Manual No.:</b>	OPT-SW-F3GLP-MS
<b>Document</b>	
<b>Version:</b>	1.5
<b>Release Date:</b>	September 30, 2013

## Overview

This manual supplement provides descriptions and operating instruction for the Loudness Processing (+LP) options available on new Cobalt® Fusion3G® (9900-Series) cards, and as a purchased field-installed licensable feature upload.

**Note:** Several loudness processor packages are available, primarily varying in the types and count of loudness processors available on a single Fusion3G® card. Loudness processing is a DSP-based option feature, and the presence of other DSP-based options affects the maximum loudness processor count available. See the table below.

Option Code Package	Description
+UMA, +LP51A, +LP20A	One (1) Upmixer (+UMA) One (1) 5.1-channel Loudness Processor (+LP51A) One (1) stereo Loudness Processor (+LP20A)
+UMA, +UMB, +LP20A, +LP20B	Two (2) Upmixers (+UMA, +UMB) Two (2) stereo Loudness Processors (+LP20A, +LP20B)
+LP51A, +LP51B	Two (2) 5.1-channel Loudness Processors (+LP51A, +LP51B)
+LP20A, +LP20B +LP20C, +LP20D	Four (4) stereo Loudness Processors (+LP20A thru LP20D)

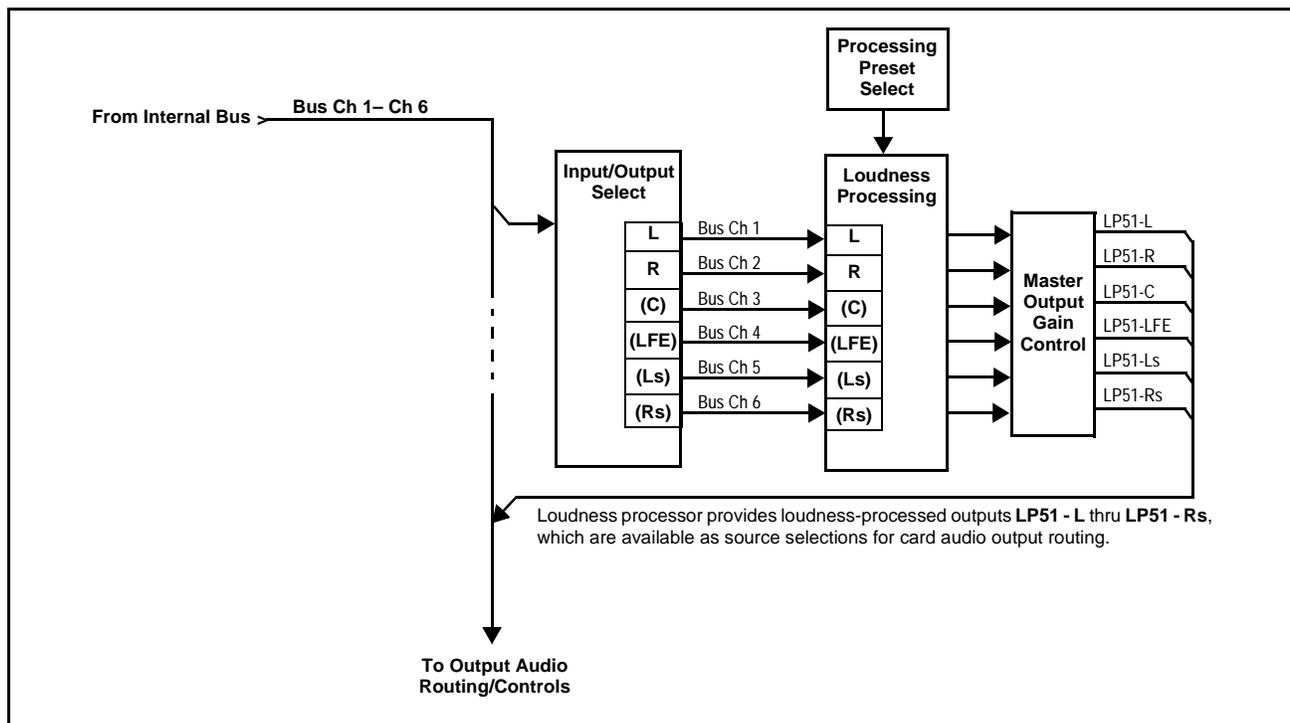
## Loudness Processor Description

(See Figure 1) The loudness processor function receives up to six selected channels from the internal bus and performs ITU BS.1770 – ATSC A/85 loudness processing on the selected channels. A loudness processing profile best suited for the program material can be selected from several loudness processing presets. The loudness processor has a default target loudness of -24 LKFS to correspond to the -24 dialnorm prescribed by ATSC A/85.

A Custom Preset user interface page allows detailed manipulation of various parametric factors that comprise each of the factory preset profiles, thereby allowing user “tweaking” of the loudness processing actions to suit individual preferences.

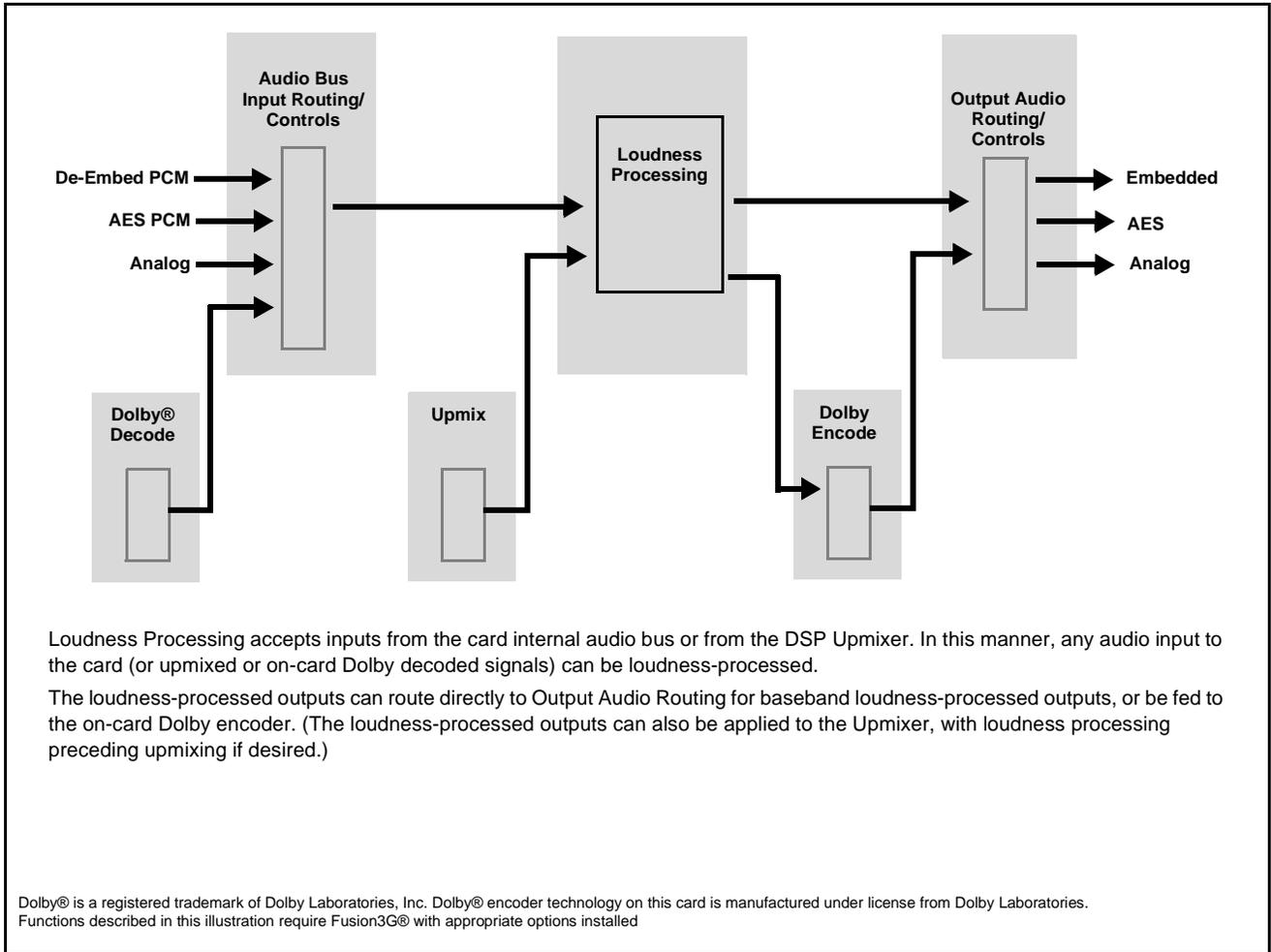
**Note:** Discussion and example here describes 5.1-channel loudness processor. Stereo and dual-stereo processors operate similar to described here.

The example in Figure 1 shows routing of **Bus Ch 1** thru **Bus Ch 6** fed through the loudness processor. A master output gain control is provided which allows fine adjustment of the overall output level.



**Figure 1 Loudness Processor with Example Sources**

As shown in Figure 2, the loudness processor accepts any audio input received by the card (as well as upmixed signals and baseband from the on-card Dolby® decoder). Loudness-processed outputs can be outputted as baseband on any card audio output or applied to the on-card Dolby® encoder.



**Figure 2 Loudness Processor Input Sources and Output Destinations**

## Uploading Option Feature (Field Upgrade Only)

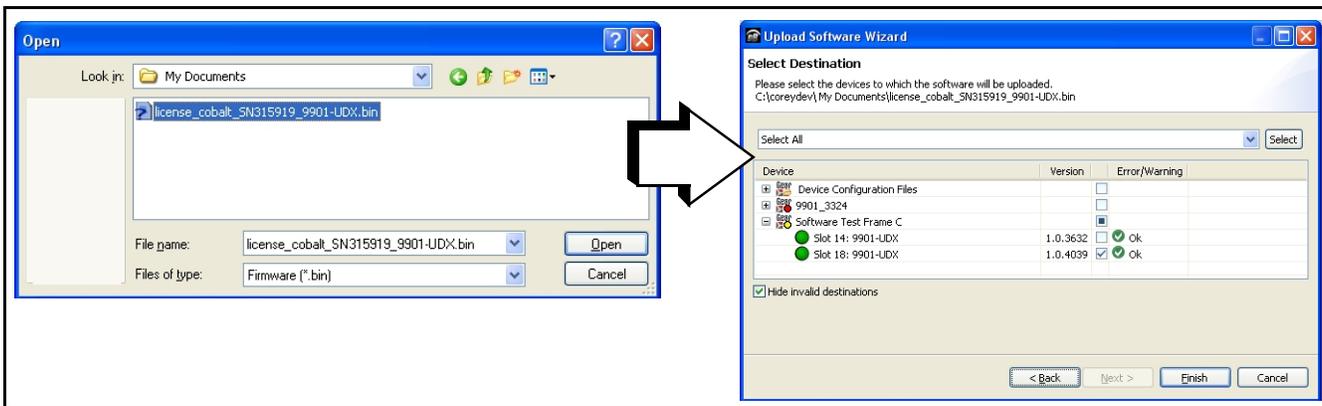
- Note:**
- If your Fusion3G® card was purchased with the option(s) covered here, this procedure is not required for your card. If you have purchased this feature to be field-installed on an existing card, perform the upload procedure here to upload the feature key file sent by Cobalt, and to activate the feature on your card.
  - To order features and obtain a license key, contact Cobalt® sales at sales@cobaltdigital.com or at the contact information on the cover of this supplement. Please provide the Serial Number of your card (displayed in the Card Info pane) when contacting us for your feature key. Typically, a feature key file is bound to the card's serial number and will only work with that card. Please indicate if upgrades are needed for more than one card.

Activate licensable feature as described below.

1. Cobalt typically supplies a .bin file (by e-mail; file size < 10kB) that activates the licensable feature. Download this file to a convenient location on the PC connected to the card's frame.

**Note:** During this procedure, the card will go offline while the feature is installed. Make certain card is not carrying OTA signal.

2. In DashBoard for the card being upgraded click the **Upload** button and browse to the feature license file (in the example below, license\_cobalt\_SN315909\_9901-UDX.bin).



3. Select the file, click **Open** and then follow the prompts. With intended card selected ("Slot 18 UDX-9901" in example above), click **Finish**. When the card comes back online, the feature appears in the DashBoard controls and is ready for use.

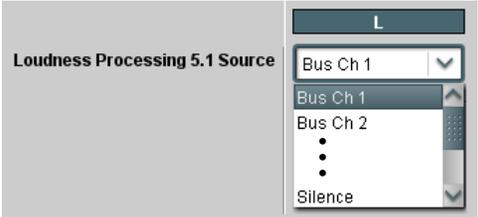
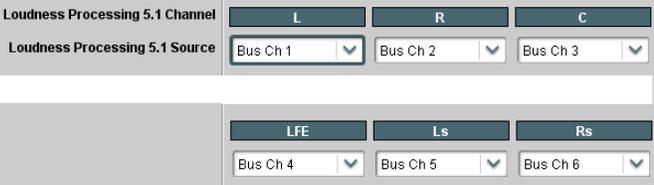
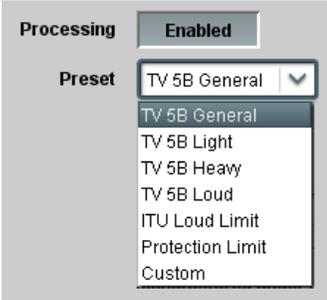
**Note:** Applying the licensable feature has no effect on prior settings. All control settings and drop-down selections are retained.

**Note:** Added features, when first appearing after installation, are set to their factory default states. For features having a direct impact on the output signal, all controls are initially set to disabled or null.

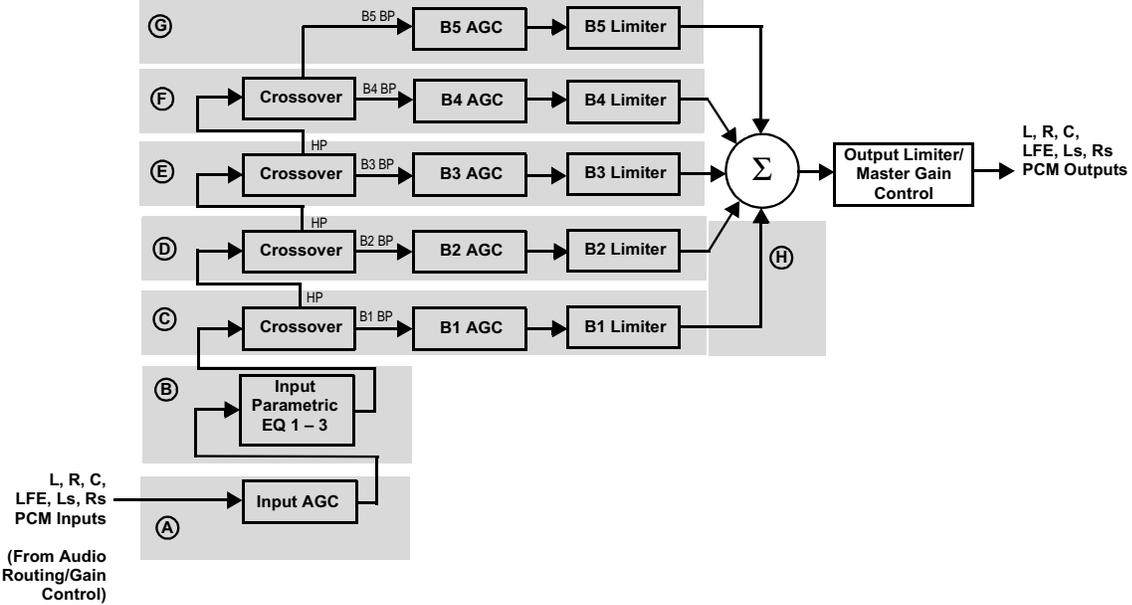
# Loudness Processing Controls

Table 1 individually lists and describes the loudness processing controls available using DashBoard™ for cards equipped with +LP options.

**Table 1 +LP Options Control List and Descriptions**

 <p>The screenshot shows the 'Loudness Processing' interface with the 'Channel Mapping' sub-tab selected. The 'Custom Preset' option is also visible.</p>	<p>Channel Mapping sub-tab provides channel selection for 5.1 and/or stereo channels to be loudness processed. Also provides controls for selecting loudness processing profile preset.</p>
<p><b>Note:</b></p> <ul style="list-style-type: none"> <li>• 5.1-channel loudness processor is described below. Stereo loudness processor has identical controls with omission of controls other than L and R.</li> <li>• Loudness processing induces an 8 msec delay into the audio. This delay can be removed by setting either the bulk or channel <b>Audio/Video Delay</b> controls to introduce a -8 msec advance. See Audio Bus Input Routing/Controls in the card Product Manual.</li> </ul>	
<p><b>• Loudness Processor Input Channel Selection</b></p>  <p>The screenshot shows the 'Loudness Processor Input Channel Selection' interface. It features a 'Loudness Processing 5.1 Source' section with a dropdown menu for 'L' channel, listing 'Bus Ch 1', 'Bus Ch 2', and 'Silence'.</p>	<p>Separate drop-down lists for each loudness processor input channel that directs any combination of card audio processing channels (listed below) to each of the loudness processor inputs as shown below.</p> <ul style="list-style-type: none"> <li>• <b>Bus Ch1</b> thru <b>Bus Ch 16</b></li> <li>• <b>Uprmix L, R, C, LFE, Ls, Rs</b></li> <li>• <b>Tone</b></li> <li>• <b>Silence</b></li> </ul> <p><b>Note:</b> Set any unused channel inputs to Silence.</p>  <p>The screenshot shows the control interface for the loudness processor input channels. It includes sections for 'Loudness Processing 5.1 Channel' (L, R, C) and 'Loudness Processing 5.1 Source' (Bus Ch 1, 2, 3) and another section for 'LFE, Ls, Rs' (Bus Ch 4, 5, 6).</p>
<p><b>• Processing Profile Preset Selection</b></p>  <p>The screenshot shows the 'Processing Profile Preset Selection' interface. It includes a 'Processing' toggle set to 'Enabled' and a 'Preset' dropdown menu with options: 'TV 5B General', 'TV 5B Light', 'TV 5B Heavy', 'TV 5B Loud', 'ITU Loud Limit', 'Protection Limit', and 'Custom'.</p>	<p>Enables or bypasses loudness processing, and allows selection of preset loudness profile best suited for the program material and/or model of processing desired as follows:</p> <ul style="list-style-type: none"> <li>• <b>TV 5B General</b> – This is the general, recommended preset for all types of content. It provides moderate dynamic range compression and is calibrated to produce audio having an average dialog loudness of -24 LKFS with no additional output level trim. Use of this preset as an initial setting is recommended.</li> <li>• <b>TV 5B Light</b> – Similar to TV 5B General, this preset varies in that multi-band compression is reduced closer to 2:1, thereby providing a more gentle action.             <ul style="list-style-type: none"> <li><b>Note:</b> This preset sacrifices agility in loudness control in favor of a more gentle compression profile; this preset may not be suitable for some material.</li> </ul> </li> <li>• <b>TV 5B Heavy</b> – Similar to TV 5B General, this preset varies in that multi-band compression is increased for greater level density/adherence to target at the expense of dynamic range.</li> <li>• <b>TV 5B Loud</b> – Similar to TV 5B Heavy, but with a louder, more punchy perception.</li> <li>• <b>ITU Loud Limit</b> – Utilizes a specially tuned input AGC plus multi-band and a final limiter to gradually adjust the average program loudness to an internally set AGC value, with the multi-band and final limiters acting until the AGC gains control of the level. This preset is most appropriate for ingest or live program material.             <ul style="list-style-type: none"> <li><b>Note:</b> This preset bypasses the multi-band AGC. As such, it has less ability to manage spectral balance.</li> </ul> </li> <li>• <b>Protection Limit</b> – Bypasses all processing except for final output limiter, which is set only to prevent overload.             <ul style="list-style-type: none"> <li><b>Note:</b> Unless the audio received has already been loudness processed, this setting is typically not recommended.</li> </ul> </li> <li>• <b>Custom</b> – See next page.</li> </ul>

**Table 1 +LP Options Control List and Descriptions — continued**

<p style="text-align: center;"><b>Loudness Processing</b></p> <hr/> <p style="text-align: center;">Channel Mapping    Custom Preset</p>	<p>(continued)</p>
<p>• <b>Master Output Gain Control</b></p>  <p style="text-align: center;">Master Output Gain (dB)    -20.0</p> <p><b>Note:</b>  <b>(USA)</b> ATSC A/85 and the CALM Act (H.R. 1084/S. 2847) requires that when real-time loudness processing is applied using a fixed target loudness of -24 LKFS, downstream AC-3 encoding must correspondingly use a fixed dialnorm value of -24. The default target loudness (as set by the loudness processor Master Output Gain Control) is -24 LKFS. <b>When loudness processing is engaged, make certain AC-3 dialnorm is set as described here.</b></p>	<p>Allows fine adjustment of the overall output gain. (-20.0 dB to 11 dB range in 0.1 dB steps; default = 0.0 dB)</p> <p><b>Note:</b> This control is primarily useful in matching the output level to an alternate LKFS target level if required. Also, it is useful (where desired) in matching various Processing Profile presets to have similar output levels. The loudness processor has a default target loudness of -24 LKFS.</p>
<p style="text-align: center;"><b>Loudness Processing</b></p> <hr/> <p style="text-align: center;">Channel Mapping    Custom Preset</p>	<p>Provides custom detailed parametric controls for modifying any of the factory Presets profiles to suit user preferences.</p>
<p><b>Note:</b></p> <ul style="list-style-type: none"> <li>• Modification of default presets settings using the Custom Preset page can have a profound effect on program material technical and aesthetic aspects. Setup should <b>only</b> be performed by authorized personnel, and should be fully assessed before being used for on-air programming. Refer to Appendix A. "Linear Acoustic® AEROMAX® Detailed Description" for detailed descriptions of these parametric controls and their interaction.</li> <li>• Custom settings may result in loudness processing that is no longer compliant with ITU BS.1770 – ATSC A/85.</li> </ul>	
<p>The <b>Custom Preset</b> page exposes parametric controls correlating to functional blocks as shown below. Refer to <b>A</b> thru <b>H</b> on the next page for these controls.</p>	
 <p style="text-align: center;">L, R, C, LFE, Ls, Rs PCM Outputs</p> <p>(From Audio Routing/Gain Control)</p>	

**Table 1 +LP Options Control List and Descriptions — continued**

Loudness Processing

(continued)

Channel Mapping

Custom Preset

Shown below are the **Custom Preset** sub-tab parametric controls corresponding to **A** thru **H** on the previous page. Non-standard controls and unique functions are described below.

- **Parametric EQ 1 thru 3:** Provides 3 bands to provide notch filters. Default set to 0 dB (no effect). Each filter has a  $\pm 12$  dB gain control, and selectable center frequencies from 20 Hz – 22.05 kHz.
- **Inf:>1Thr checkboxes:** When enabled, automatically increases AGC ratio to Infinity:1 once a signal exceeds the AGC threshold, allowing for expansion below the threshold and limiting above the threshold. Useful for bass frequency control.
- **Soft Clip controls:** For low-frequency bands 1 and 2, sets the point above in which band 1 (low bass) and band 2 (mid bass) are very quickly limited, acting more like a clipper without the artifacts. This helps maintain a “tight” bass sound.

**Applying and Saving Custom Presets**

**Note:** Presets are engaged on the **Channel Mapping** sub-tab page. The Presets drop-down on this page only populate the fields here with the defaults used for a particular preset profile.

1. In **Presets** drop-down on the Channel Mapping sub-tab page, select **Custom**.
2. On this sub-tab page, select the default preset to “build from” (i.e., preset closest to desired custom) and press **Load Template**. The fields here are now populated with the detailed default settings for the selected default preset profile.
3. Perform parametric changes as desired. Listen to material and assess changes performed.
 

**Note:** Any changes made on this page are saved using card global presets and not locally on this page.
4. Save the custom settings in accordance with **Presets** tab instructions in Chapter 3. Operating Instructions of the card’s product manual.

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**Table 1 +LP Options Control List and Descriptions — continued**

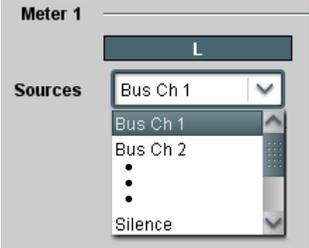
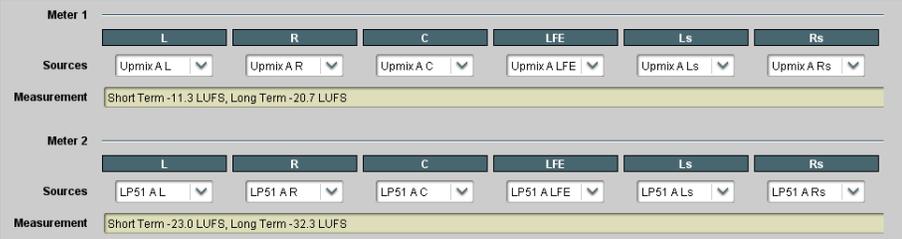
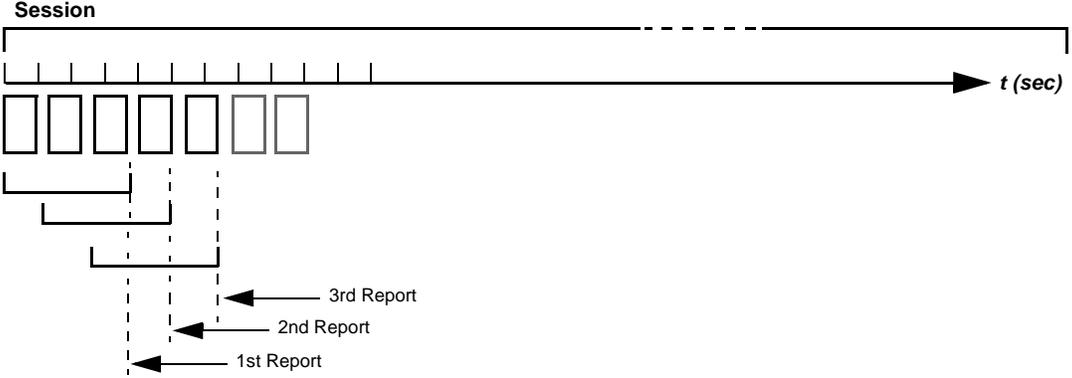
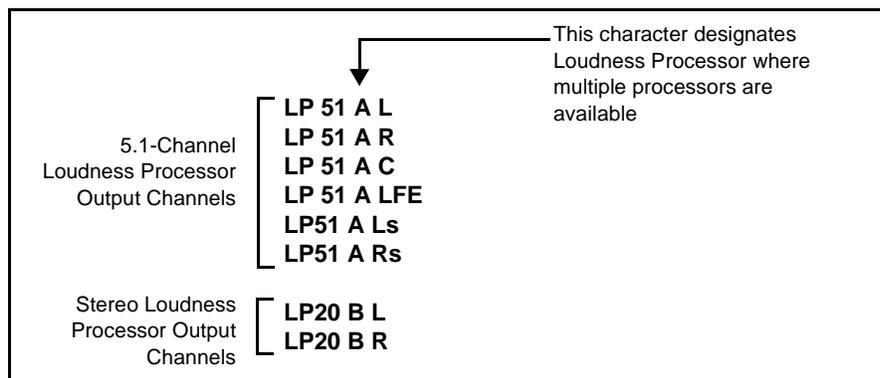
<h2>Loudness Metering</h2>	<p>Provides an ITU-R BS.1770-1 — ATSC A/85 Audio Loudness measurement of two independent 5.1-channel groups (L, R, C, LFE, Ls, and Rs). If desired, the independent meters can be set to provide pre and post-processing assessments of the same program material.</p>
<p><b>Note:</b></p> <ul style="list-style-type: none"> <li>This function provides DashBoard loudness metering and is furnished standard with this option. OGCP-9000 Loudness Meter Option (+LM) is an OGCP-9000 Control Panel option that provides advanced loudness metering functions such as graphing and statistics. +LM option is separate and independent of this function; refer to catalog or website for more information.</li> <li>This function provides only loudness metering as described here; this function does not provide active loudness correction. Selected channels are only monitored by this function, with no affect on the channels.</li> </ul>	
<p>• <b>Loudness Meter 1 / Meter 2 Source Channel Selection</b></p>	<p>For Meter 1 and Meter 2, separate drop-down lists for each loudness meter source (input) channel as listed below.</p> <ul style="list-style-type: none"> <li>• <b>Bus Ch1 thru Bus Ch 16</b></li> <li>• <b>Upmix L, R, C, LFE, Ls, Rs output channel</b></li> <li>• <b>Loudness Processor L, R, C, LFE, Ls, Rs output channel</b></li> <li>• <b>Tone 1 thru Tone 8</b></li> <li>• <b>Silence</b></li> </ul>
	<p><b>Note:</b></p> <ul style="list-style-type: none"> <li>Source input channels include drop-downs for L, R, C, LFE, Ls, Rs, Aux 1, and Aux 2 channels. LFE, Aux 1, and Aux 2 channels are not included in loudness measurements.</li> <li>On cards equipped with multiple upmixers and/or loudness processors, drop-down choices are identified by function, processor designator, and channel (e.g., "LP51 A Ls" denotes 5.1-channel loudness processor A, left surround (Ls) channel output).</li> <li>Set any unused channel inputs to Silence.</li> </ul>
<p>In this example, 5.1-channel selections in <b>Meter 1</b> and <b>Meter 2</b> are respectively used for loudness pre-processed channels from a card Upmixing function, and loudness post-processed channels from a card 5.1-channel loudness processor. The respective <b>Measurement</b> displays show a pre-processed short-term loudness of -11.3 LUFS, and a post-processed short-term loudness of -23.0 LUFS, with both measurements being within reasonable ranges and as expected.</p>	
<p>• <b>Measured Loudness Display</b></p>	<p>Dual displays for <b>Meter 1</b> and <b>Meter 2</b> that show respective current aggregate ITU-R BS.1770-1 loudness for the selected monitored channels.</p> <p><b>Note:</b> -inf LUFS display indicates loudness meter is not receiving any input (for example, as in the case of wrong (muted) channels being routed to meter instead of intended channels).</p>
	

Table 1 +LP Options Control List and Descriptions — continued

<div style="background-color: #333; color: white; padding: 5px; display: inline-block; border-radius: 3px;">Loudness Metering</div>	(continued)
<p>• <b>Short Term Window / Reset Control</b></p> 	<p>Ganged <b>Short Term Window</b> control for <b>Meter 1</b> and <b>Meter 2</b> sets the duration (in seconds) that sampling time accumulates before each averaging recalculation (see below) (0.1 to 60.0 seconds range in 0.1-second steps; default = 1.8 sec)</p> <p>Reset button clears the accumulated moving average data, and restarts measurement.</p>
<p>In this example, the last 3 measurement periods are averaged in each reported LUFS value. This cycle is continually repeated. The <b>Measurement Window</b> parameter sets the sampling time accumulated before each averaging recalculation.</p>	
<p><b>Session</b></p> 	

## Routing Loudness Processed Channels to Outputs

Loudness-processed channels are identified as follows on the card **Output Audio Routing/Controls** tab (for routing to card outputs) and **Dolby Encoder > Inputs** tab (for routing to the card’s Dolby encoder, where equipped); these channels can be routed in the same manner as other sources for card audio outputs or encoder inputs.



**Note:** On our website, go to **Support>Documents>Reference Manuals>Fusion3G: Automated EAS Audio Insertion** link at [www.cobaltdigital.com](http://www.cobaltdigital.com) for an application note with examples using loudness processing and audio routing in general.

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# Linear Acoustic<sup>®</sup> AEROMAX<sup>®</sup> Detailed Description

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The following describes the functional audio processing blocks of the AEROMAX<sup>®</sup> loudness processing used by this product.

## Processing Structure

Figure A-1 shows the general signal flow of the processing core and also shows what part of the chain is being adjusted by each parameter. Note that this signal flow is also shown in Figure A-2 (“Menus for User-Adjustable Parameters”), with the top of the list being the input, and the bottom of the list being the output.

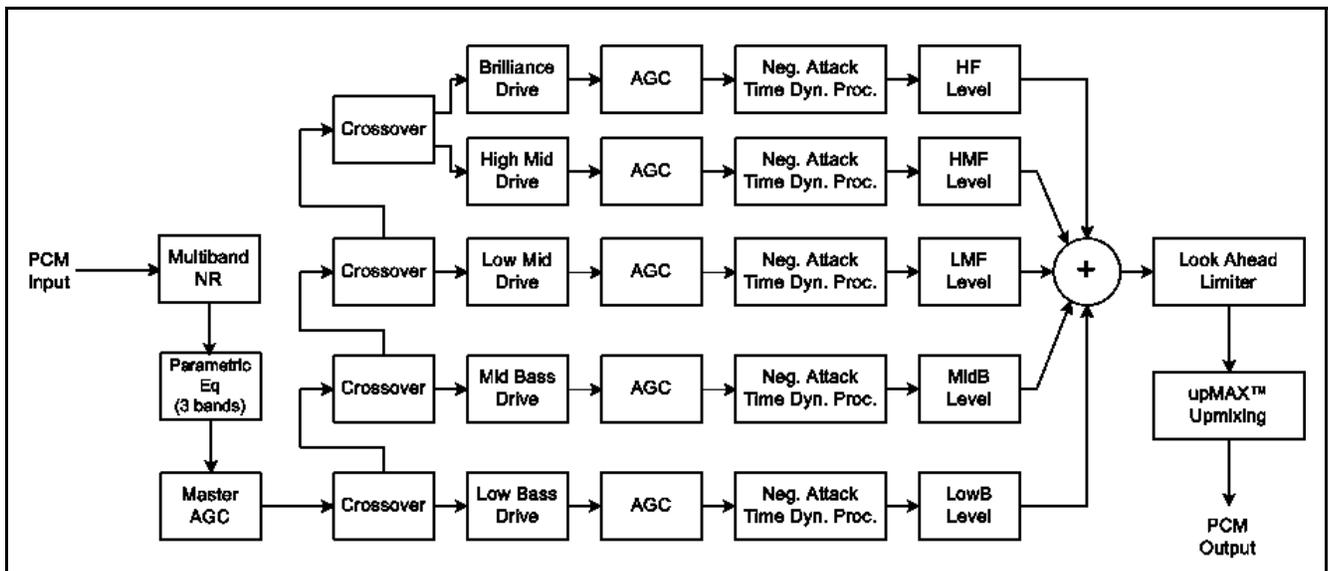
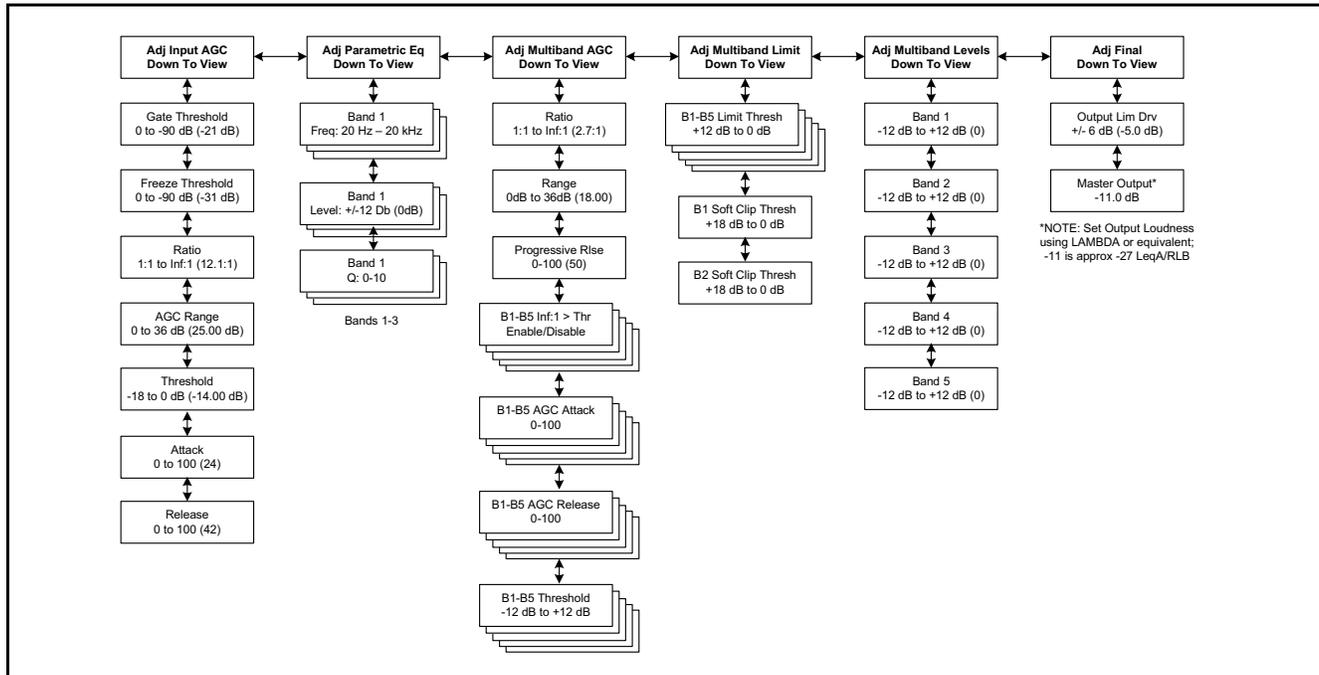


Figure A-1 AEROMAX<sup>®</sup> General Signal Flow

## User-Adjustable Parameters

Figure A-2 shows the user-adjustable parameters, organized into major functional groups and each group's subordinate parameters. Defaults are shown for the **TV 5B Gen** preset; other profile presets will vary some or all of these parameters.



**Figure A-2 Menus for User-Adjustable Parameters**

The TV profiles used by this product's AEROMAX<sup>®</sup> loudness processing utilize 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. Therefore, non-configurable crossover frequencies are used here.

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

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## 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  $\pm 12$ dB 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 (i.e., 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):** 0 dBFS to -90 dBFS (default: -21 dBFS)

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):** 0 dBFS to -90 dBFS (default: -31 dBFS)

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:** 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:** 0 dB to 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:** -18 dBFS to 0 dBFS (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:

- **Ratio:** 1.0:1 to 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:** 0 dB to 24 dB (default: 24 dB)

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

default:

B1: 46

B2: 88

B3: 88

B4: 88

B5: 92

Sets how fast an input signal is acted upon once it crosses the set threshold.

- **B1 - B5 AGC Release:** 0 - 150, slowest - fastest  
default:  
B1: 50  
B2: 60  
B3: 86  
B4: 88  
B5: 92  
Sets how fast an input signal recovers from a gain change once that signal falls below the set threshold.
- **B1 - B5 AGC Drive:** -12.00 dB to +12.00 dB (default: -3.00 dB all)  
Provides a gain control at the input of each compressor band which determines how much signal level is applied to each.
- **B1 - B5 AGC Thresh(old):** -12.00 dB to +12.00 dB (default: 0.00 dB all)  
Sets the reference point for the attack and release parameters to act on the audio signal present in each band.

## Multiband Limiters

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

- **B1 - B5 Lim(it) Thresh(old):** +12.00 dB to 0.00 dB  
default:  
B1: +4.25dB  
B2: +4.25dB  
B3: +6.50dB  
B4: +9.00dB  
B5: +9.00dB  
Sets the point above which limiting action takes place at an Infinity:1 ratio.
- **B1 Soft Clip Thresh(old):** +12.00 dB to 0.00 dB (default: +3.00 dB)
- **B2 Soft Clip Thresh(old):** +12.00 dB to 0.00 dB (default: +6.00 dB)  
For Band 1 (**B1** – low bass), sets the point above where 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:** -12 dB to + 12 dB (defaults: 0 dB, 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 any peaks that make it through the multiband section.

Adjustable parameters are:

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

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

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

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 -24 LKFS.





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