Cobalt Digital Inc.

2506 Galen Drive
Champaign, IL 61821
Voice 217.344.1243
www.cobaltdigital.com

Option +DSP

Audio DSP Options Application Notes/Examples and Setup Overview

Models factory-equipped with Option **+DSP** provide a DSP-based platform that supports multiple audio DSP options. When optioned with various diverse audio processing options, the DSP-based processing core (which supports numerous simultaneous processing engines) uses license "credits" which allows flexible tailoring of multiple proc function instances such as Upmixing, Real Time Loudness Leveling, and Dolby Encode/Decode. This paper describes the basic aspects of setting up DSPs to provide desired functions and how audio is routed to and from the audio DSP "pipelines".

Note: Detailed parametric setup of some functions (such as Real Time Loudness Leveler) are beyond the scope of the basic overview instructions here. This information is provided in appropriate Product Manuals where +DSP is offered.

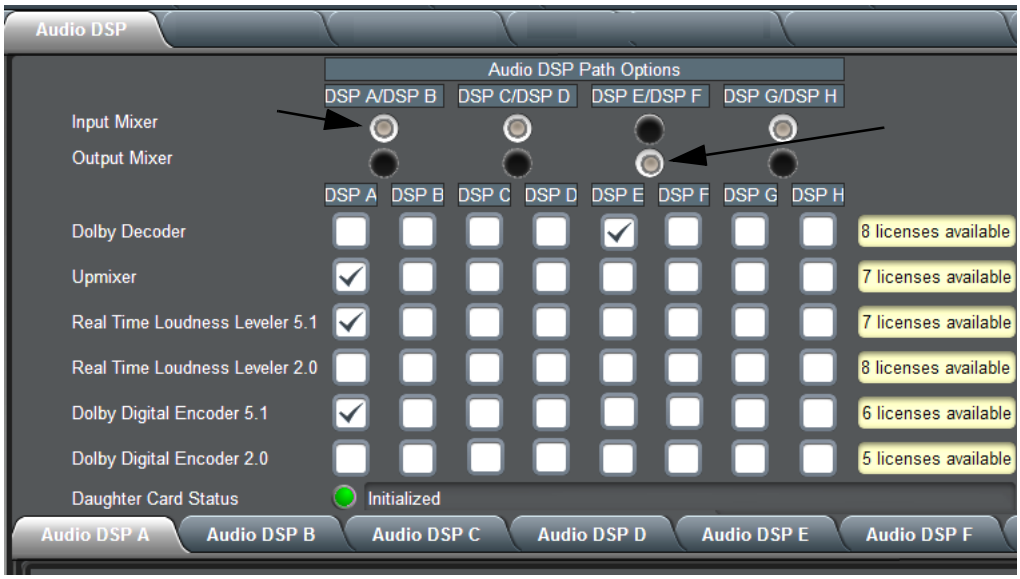
Input Mixer and Output Mixer DSP Positioning

Each pair of the eight DSP pipelines (**DSP A/B** thru **DSP G/H**) can be independently positioned either at the card **input** mixer (**Input Audio Routing/Controls**) location or at the card **output** mixer (**Output Audio Routing/Controls**) location.

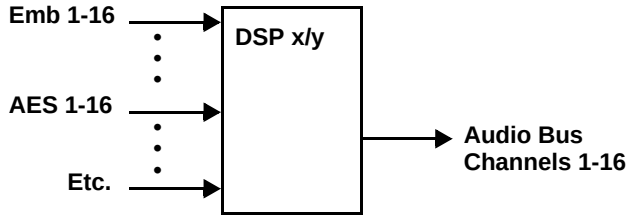
Path positioning is set for each DSP pipeline pair in the top pane of the **Audio DSP** page

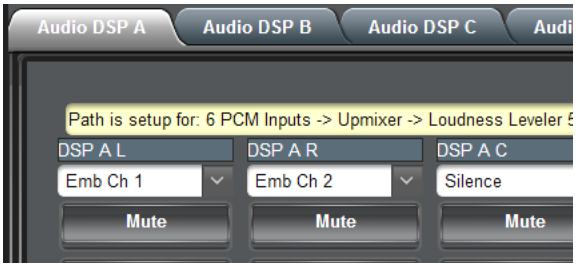
In this example, **DSP A/B** pair is set to work with the **input** mixer, and **DSP E/F** pair is set to work with the **output** mixer.

Any DSP process can be set to use the input or output path as desired.



Input Mixer path positioning locates the DSP pipeline to receive basic external inputs coming into the card (in this example, Emb Ch 1 and Ch 2 feeding DSPA L and R), and then allows DSP processed output channels to be directed to the card internal Audio Bus channels by selecting Audio DSP channels as sources for destination Audio Bus channels via the Input Audio Routing/Controls.

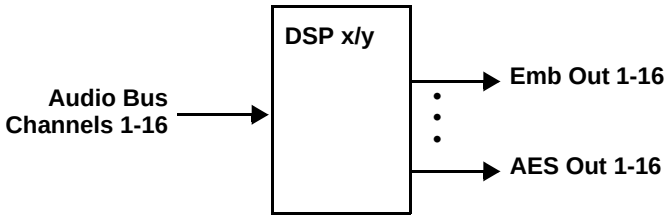




The DSP outputs are then routed to card Audio Bus Channels as desired (in this example, Audio DSP A L thru Audio DSP A Rs serving as sources for card audio bus channels Audio Bus Ch 1 thru Ch 6).

© 2020 Cobalt Digital Inc. All Rights Reserved. E&OE

Output Mixer path positioning locates the DSP pipeline to receive card Audio Bus channels (in this example, DSP E L and DSP E R receiving card Audio Bus Channels 9 and 10) and then place the DSP processed output channels directly at the card audio outputs as sources for destination Embedded Output or AES Output channels via the Output Audio Routing/Controls.

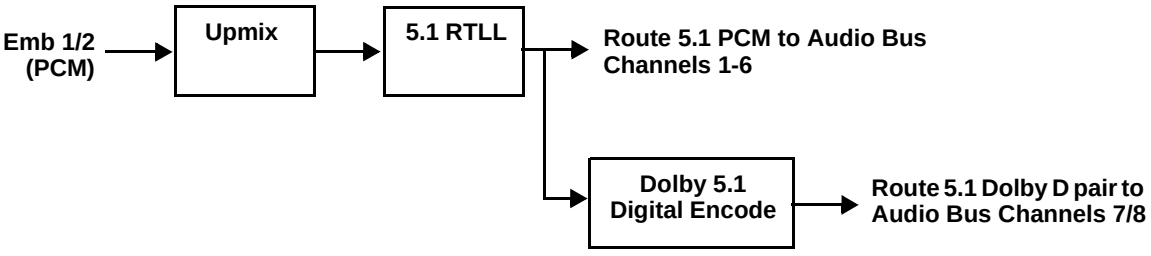


The DSP outputs are then routed to card external outputs as desired (in this example, Audio DSP E Dolby L and Dolby R serving as sources for card outputs AES Out Ch 1 and Ch 2).

Example Multiple DSP Process Audio Routing and DSP Setup

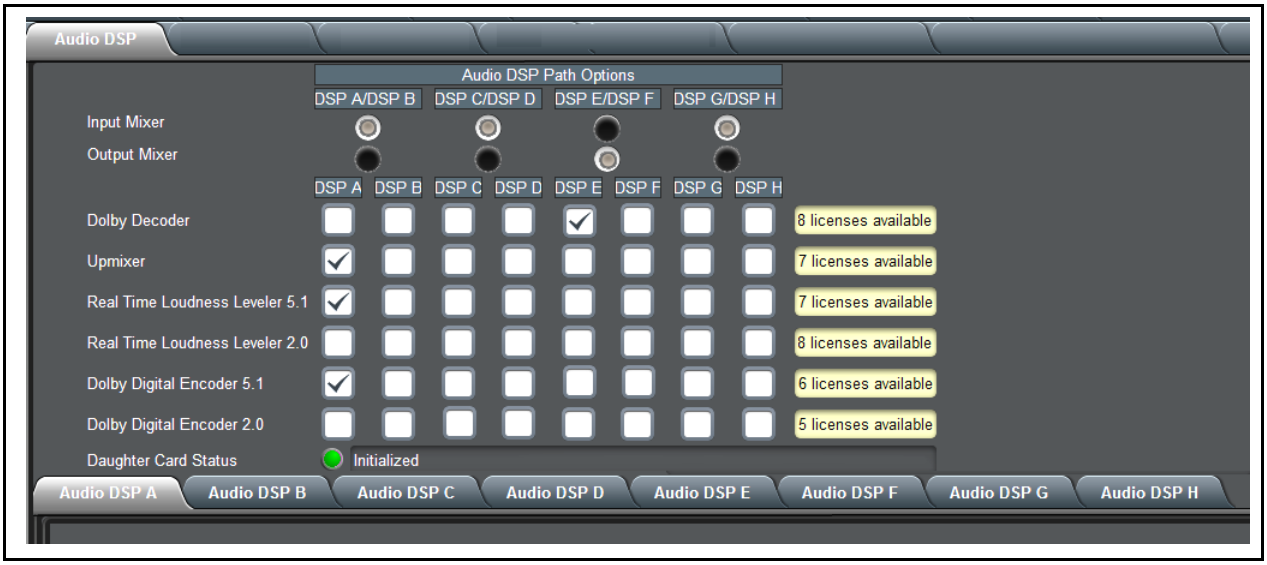
In this example, single DSP pipeline **DSP A** is setup to:

- Receive an embedded PCM pair from the basic card input audio.
- Upmix the PCM stereo pair to 5.1 audio.
- Perform Real-Time Loudness Leveler (RTLL) loudness processing.
- Output the processed 5.1 complement as PCM and as a separate Dolby 5.1 Encoded pair.
- Provide a separate additional Dolby 2.0 Encoder (on DSP E) for a SAP stereo PCM pair.



The top pane on the Audio DSP tab allows enabling DSP processes for each of the eight DSP pipelines. In this example, DSP A is set to provide Upmixing, 5.1 RTLL, and Dolby 5.1 Encode by checking the corresponding boxes. In this example, all processing is positioned at the **Input** mixer.

© 2020 Cobalt Digital Inc. All Rights Reserved. E&OE



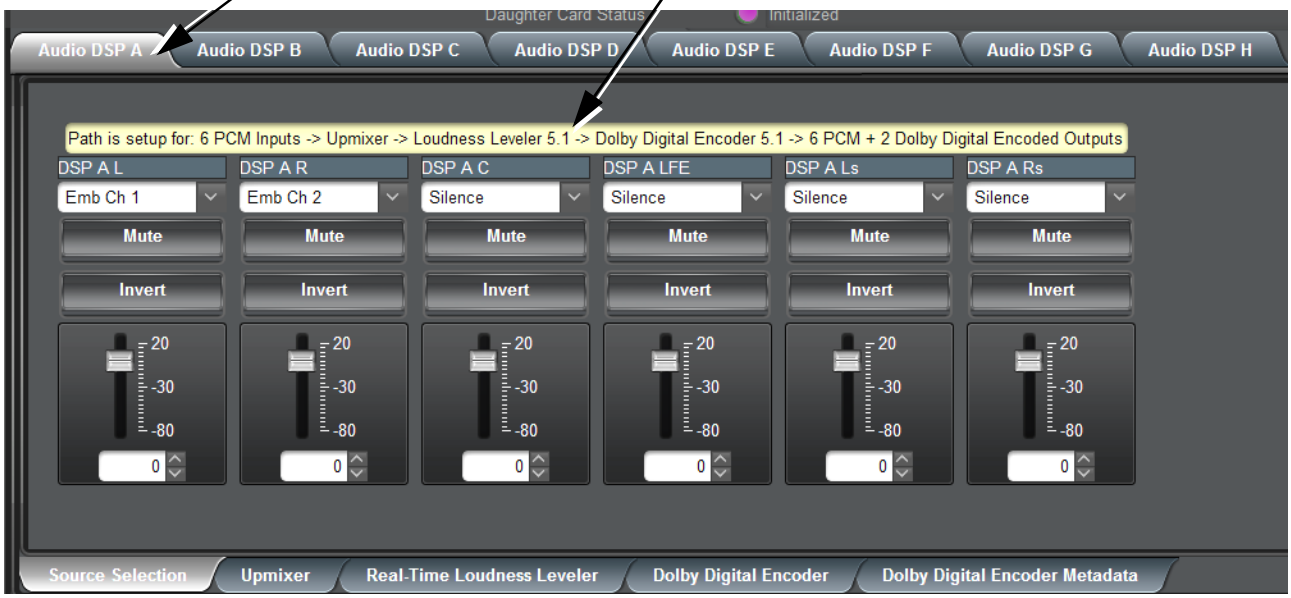
When a DSP pipeline is enabled for any function by checking any checkbox like that shown above, the sub-tabs for the related DSP in the lower pane expose all the setup functions required for the selected processes. In this example, we'll start with the **Source Selection** function since this is the first step in setting up a DSP.

After checkboxes enabling the desired processes are checked in the Audio DSP page upper pane, selecting the respective DSP tab (**Audio DSP A** thru **Audio DSP H**) shows the pertinent setup tabs for the functions that are selected.

In this example, we've selected DSP processes using DSP pipeline Audio DSP A. Clicking the **Audio DSP A** tab exposes the setup functions sub-tabs for the pipeline. Here, we will start with telling the DSP what inputs it will receive using the **Source Selection** sub-tab.

Audio DSP A select tab

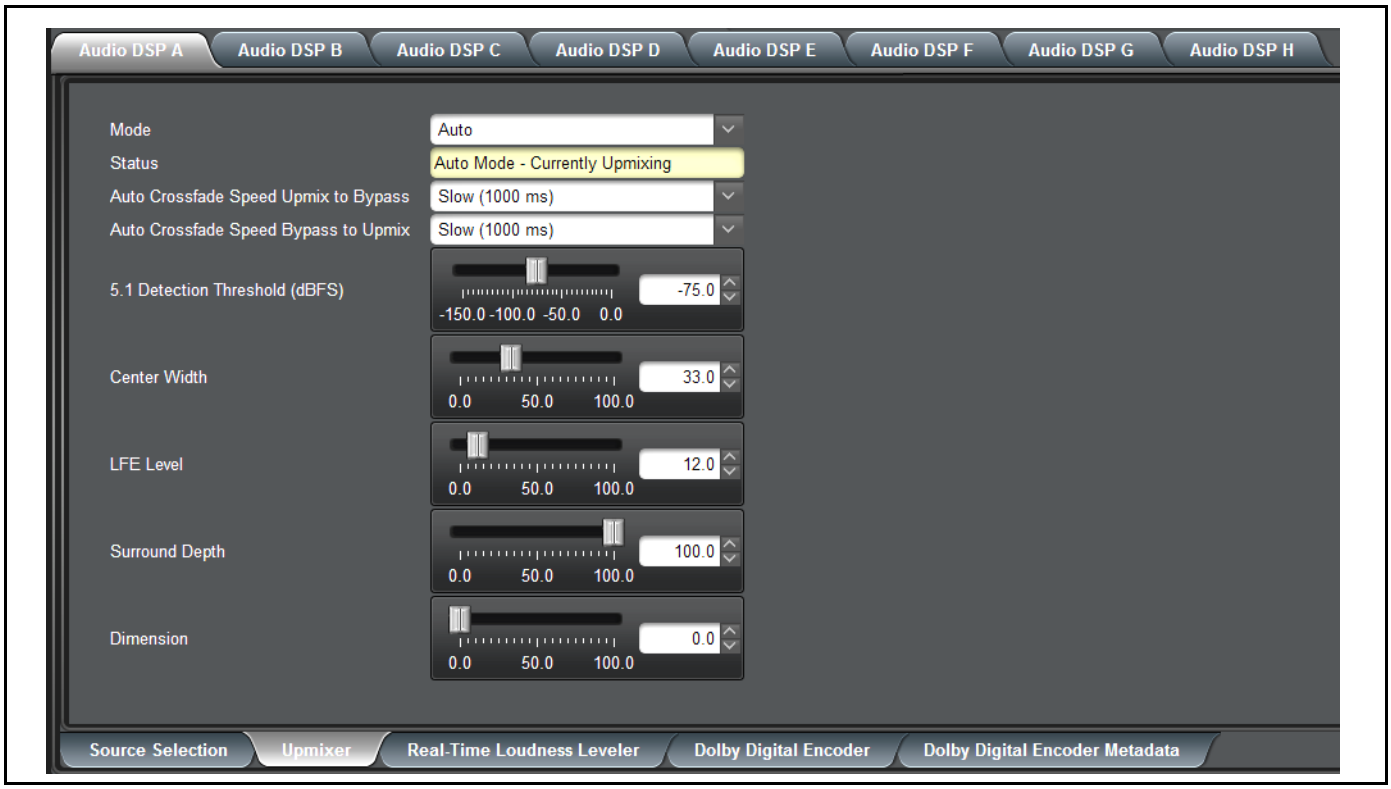
The Path Setup display shows the selected processes for this DSP pipeline, as well as the flow/order of the processing



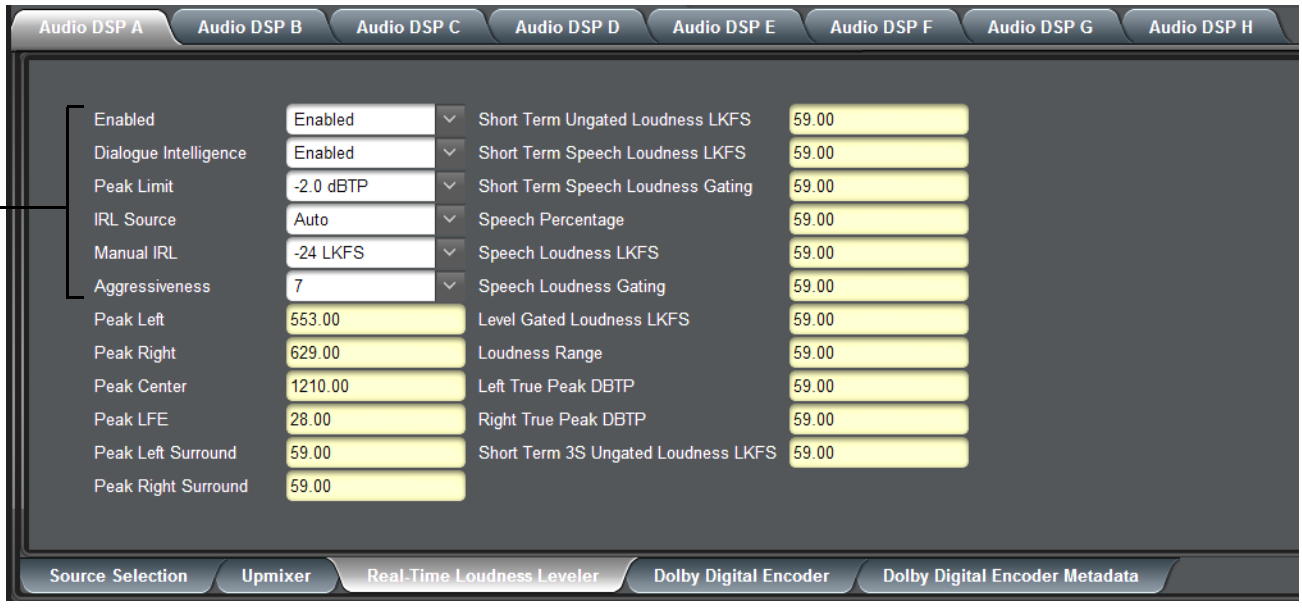
With the Source Selection sub-tab opened, we now assign the card basic input channels that the processing chain will use (in this example, sourcing from card basic inputs Emb Ch 1/2). Since all of the processes selected here reside in DSP A, each process will forward its processed signal to the next enabled process in the DSP pipeline.

© 2020 Cobalt Digital Inc. All Rights Reserved. E&OE

With source selection having been set, now we proceed to setting up the Upmixer. In our example we are sourcing from a stereo PCM pair, so Crossfade does not need to be considered (Mode can be set to Auto or Always Upmix). For cases where 5.1-channel PCM is used as an input, and may already carry 5.1 content, the Threshold and Auto Crossfade controls can make for smoother transitions between existing and Upmixer-developed 5.1 content. Default settings are recommended in most cases.



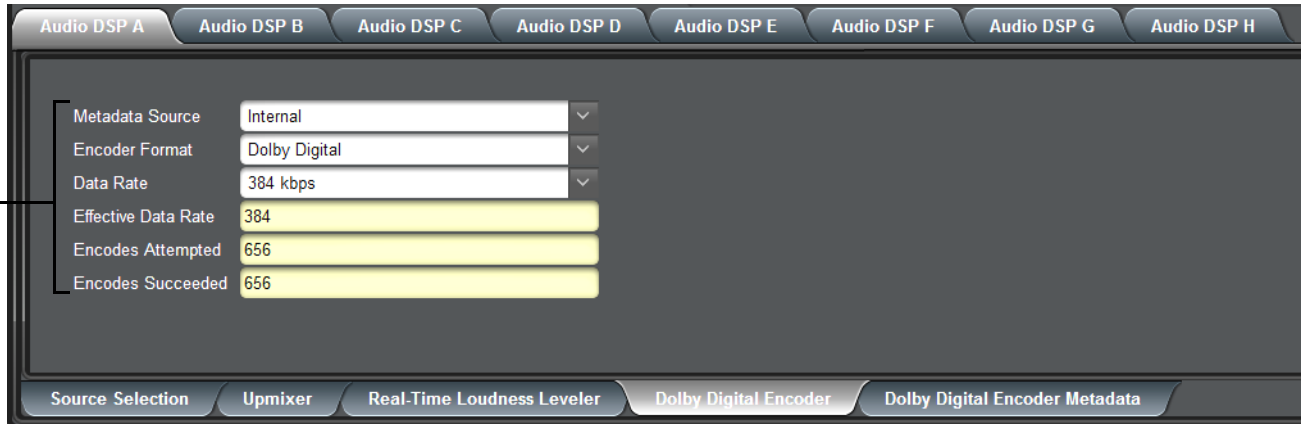
Now that the Upmixer is set up, the 5.1 Upmix content in our example is fed to the **Real Time Loudness Leveler 5.1** function (since we also have that checkbox checked for the **DSP A** pipeline).



The RTLL blocks offer parametric controls for loudness leveling. Basic setup is setting RTLL to Enabled, and choosing a Manual IRL (Input Reference Level) (typically same as the desired loudness level). Other settings can typically be left at the default settings provided.

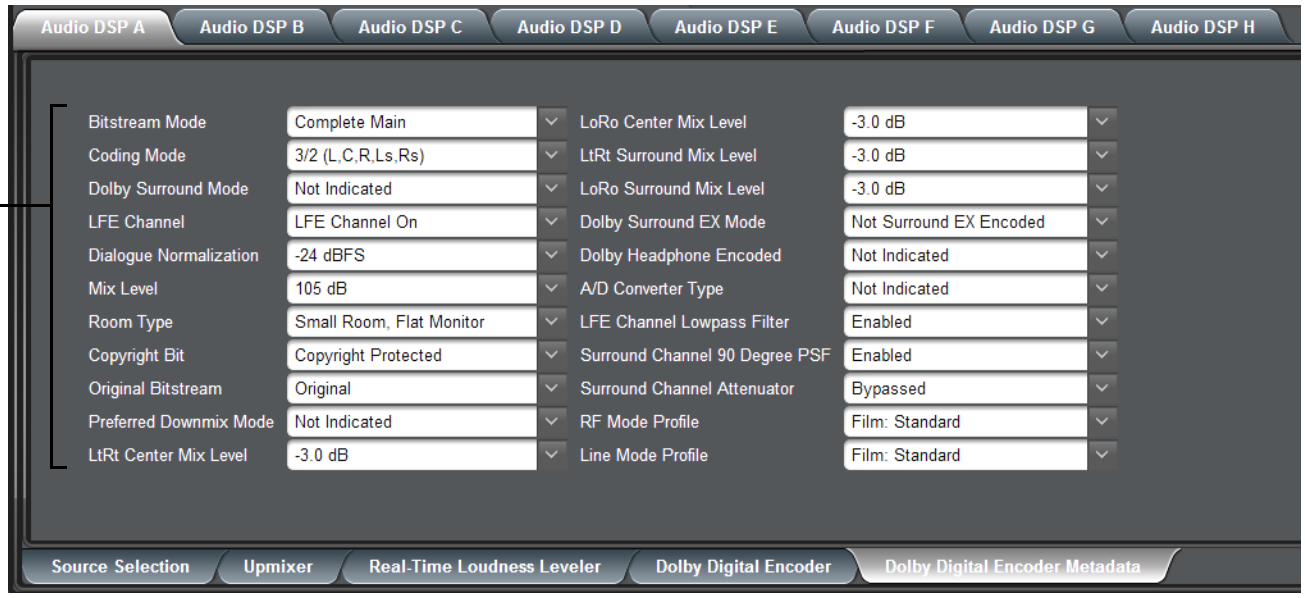
© 2020 Cobalt Digital Inc. All Rights Reserved. E&OE

Our final processing step in this example is setting DSP A to also provide a Dolby 5.1 encoded pair. When a Dolby encoder is checked (enabled), the **Dolby Digital Encoder** and **Dolby Digital Encoder Metadata** sub-tabs appear, which allow setup of the encoded pair.



The first step in setting up an encoder is selecting the Encoder Format (which selects between Dolby Digital and Dolby Digital Plus formats). In this example, Dolby Digital is used, with the default data rate being used. The status displays below the setup drop-downs show data rate actually being used, as well as encode success.

Note: Although the Metadata Source drop-down allows choices other than encoder internal metadata, only internal metadata is currently supported.



With the encoder format and data rate basics set up above, now the bitstream mode and other particulars related to the selected mode can be set. In this example, standard 5.1 is selected (3/2L) with a dialnorm of -24 (conforming to ATSC A/85). The encoded stream is now ready to be placed on an audio bus channel pair for eventual output from the card.

© 2020 Cobalt Digital Inc. All Rights Reserved. E&OE

Routing the DSP Audio Outputs On the Card

Again, depending on whether the DSP is positioned at the card **input** or **output** mixer, Audio DSP processed outputs are available as follows:

- DSP positioned at the **Input Mixer** makes its outputs available to the card **Audio Bus Channels** (as choices on each card Audio Bus Ch 1 thru Audio Bus Ch 16 drop-down using the **Input Audio Routing** tab).
- DSP positioned at the **Output Mixer** makes its outputs available to the card **Embedded**, **AES**, and **Analog Audio** channels (as choices on each card output drop-downs using the **Output Audio Routing** tab).

Note: Dolby encoded audio can only be outputted on digital audio channels such as embedded or AES. However, DSP audio processed to provide PCM outputs can be outputted on analog audio output channels. These outputs will be processed just like any other PCM handled by the card, and converted to analog by the card on-board audio DAC.

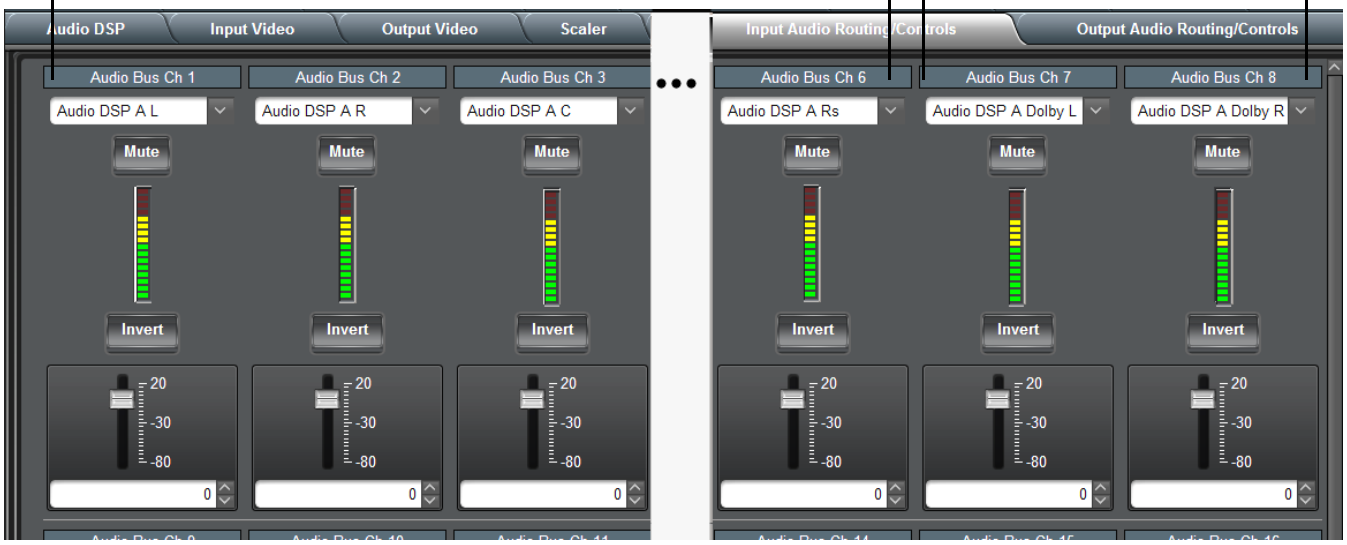
In the example here, since DSP A was set up to be positioned at the input mixer, its DSP outputs are routed to the card Audio Bus channels as shown below.

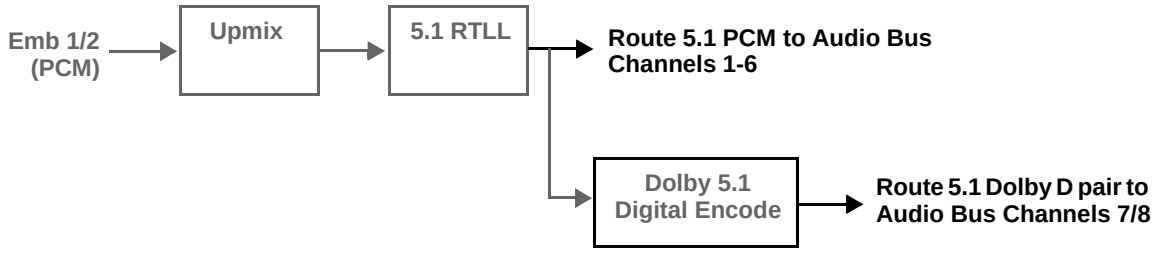
DSP A Upmix > RTLL 5.1 > 6 PCM **Audio DSP A L** thru **Audio DSP A Rs** routed to card input Audio Bus Channels Ch1 thru Ch 6, respectively.

The DSP outputs can be used for other internal card routing or processes, or be available as PCM outputs from the card via the card Audio Bus.

DSP A Upmix > RTLL 5.1 > 6 PCM + 2 Dolby Digital Encoded Outputs **Audio DSP A Dolby L** and **Audio DSP A Dolby R** routed to card input Audio Bus Channels Ch 7 and Ch 8, respectively.

The DSP outputs can be used for other internal card routing or processes, or be available as outputs from the card via the card Audio Bus.

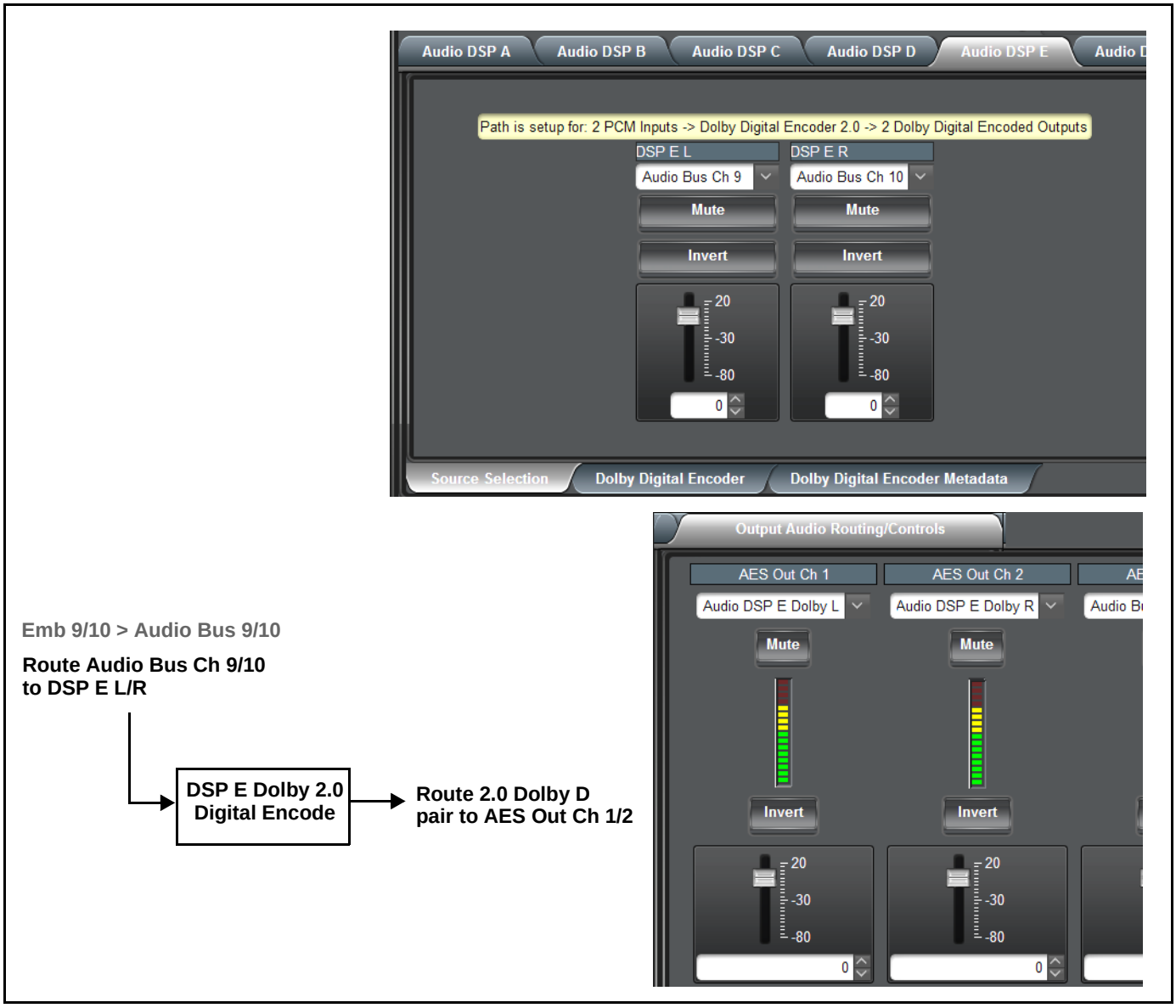




Like any other signals routed to the card Audio Bus, these outputs are available on any of the card embedded audio or AES outputs.

© 2020 Cobalt Digital Inc. All Rights Reserved. E&OE

As mentioned earlier, a separate DSP pipeline (DSP E) has been set up in this example to provide a SAP Dolby 2.0 pair, with this DSP being positioned at the **output** mixer in this example. Shown below is the routing that provides this.



Tips for Using Audio DSP

- Determine what positioning (input or output mixer) is best for the task being set up. Placement at the input mixer provides the most flexibility (especially if the processed output may be needed for other processes).
- When performing significant changes like unchecking or checking (enabling) new DSP functions, always press the DashBoard **Refresh** button to make sure the change is taken in on DashBoard and sub-tabs correspondingly displayed are refreshed with the drop-downs that correlate with the DSP setup. If DashBoard changes (such as channel routing) are done before refresh, the intended routing settings may not actually take place and engage.
- Where possible where a compound setup (like that shown in this example for DSP A) is being set up, it's a good idea to confine the processes to a single DSP pipeline. In this manner, the intermediate processed signals will always be routed to the next function selected, without requiring any manual routing setup in DashBoard.
- Audio lag (delay) will occur when RTLL is used. Using the card **Video Delay** controls (or **Frame Sync** controls and **Input Audio Routing > Audio Delay** controls where equipped), it is recommended to provide a 200 msec video delay (or 200 msec audio advance) to restore lip sync. As with all Dolby Encoders, restoring lip sync for a Dolby encode/decode chain must also be considered. Refer to applicable manual(s) for more information.

© 2020 Cobalt Digital Inc. All Rights Reserved. E&OE