3G FUSION | **Application Note**

No. F-110

Dolby® E Decode-to-Digital Plus Re-Encode for Emission Example

The example here shows how to use Fusion3G® audio routing controls, Audio DSP Features controls, and the same-card Dolby decoder and encoder controls to:

- Route a PCM pair (received on Emb Ch pair 1+2) to output Emb Ch pair 1+2.

- Route a Dolby® E encoded pair (received on Emb Ch pair 3+4) to the card Dolby decoder.

- On the Dolby decoded audio, apply automatic upmixing to the decoded channels. Then, route the upmixed channels to 5.1-channel loudness processing.

- Route the loudness-processed 5.1 channels to the card Dolby Digital encoder. Encode the loudness-processed channels as Dolby Digital Plus 3/2L mode at a bitstream rate of 256 kbps for consumer emission.

- Output the Dolby Digital Plus encoded pair on output Emb Ch 3+4.
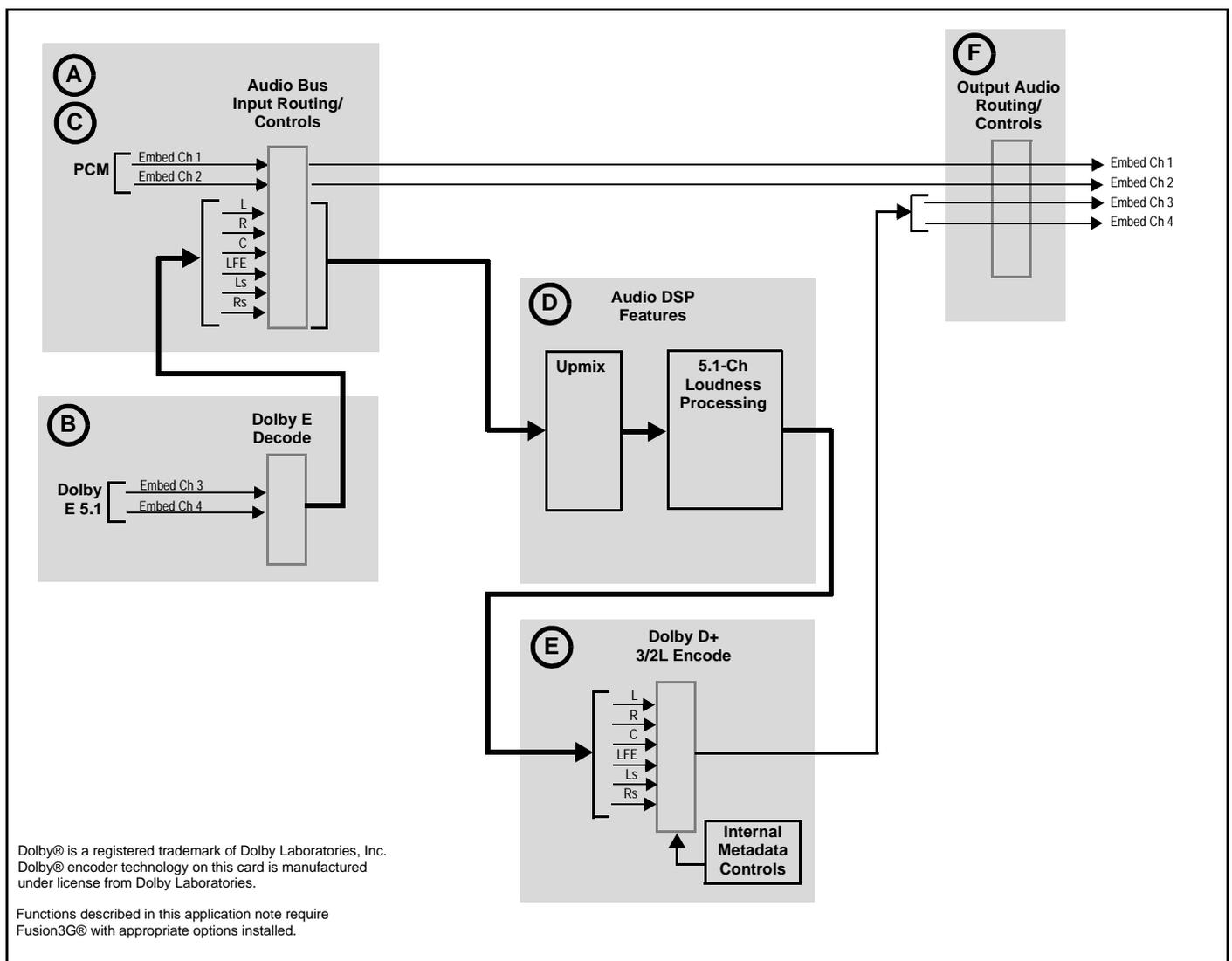
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Dolby® encoder technology on this card is manufactured under license from Dolby Laboratories.

Functions described in this application note require Fusion3G® with appropriate options installed.

Figure 1 Example Routing and Dolby Re-Encode Processing

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A First, the **Input Audio Status** tab should be checked to confirm that the embedded channels received by the card are as expected.

The example here shows and confirms the expected received channels (a PCM pair on Emb Ch 1-2 and a Dolby E encoded pair on Emb Ch 3-4). Embedded channels that are present but not carrying signals show **< -150 dBFS**, thereby indicating a muted channel.

PCM channel pair received on Emb Ch 1+2

Dolby E channel pair received on Emb Ch 3+4

	Input Audio Status	
	Status	**Peak**
Emb 1-2	PCM	-51.4 dBFS / -49.1 dBFS
Emb 3-4	Dolby E, Line 101	Data
Emb 5-6	PCM	< -150.0 dBFS / < -150.0 dBFS
Emb 7-8	PCM	< -150.0 dBFS / < -150.0 dBFS
Emb 9-10	PCM	< -150.0 dBFS / < -150.0 dBFS
Emb 11-12	PCM	< -150.0 dBFS / < -150.0 dBFS
Emb 13-14	PCM	< -150.0 dBFS / < -150.0 dBFS
Emb 15-16	PCM	< -150.0 dBFS / < -150.0 dBFS

B Next, the **Dolby Decoder** tab, and then its **General** sub-tab are selected to route the encoded pair to the decoder. **Input Select** is then set for the pair carrying the Dolby encoded stream (in this example, **Embedded Ch 3+4**). The **Bitstream Summary** display confirms that the selected pair is carrying Dolby data.

Bitstream Summary confirms selected input pair is carrying Dolby E pair.

The **Dolby E Metadata** sub-tab can be used to check metadata/coding details.

Input Select set for input pair that is carrying Dolby encoded pair (in this example, Embedded Ch 3+4)

Dolby Decoder

Firmware Version	2.1.2.1
Bitstream Summary	Dolby E 20-bit
Input Select	Embedded Ch 3+4
Decoder Mode	Auto Detect Format and Decode else Pass PCM
Dolby Digital 16-bit Channel Select	Channel 1
Dolby Digital Dynamic Range Control	Bypass

General | Dolby D Metadata | Dolby E Metadata

Figure 2 Input Dolby Pair Routing

C To process audio through the card, audio sources such as audio input channels as well as decoder outputs can now be routed to card bus channels using the **Audio Bus Input Routing/Controls** tab. As such, the Dolby decoded channels are now routed onto card bus channels. This allows selected channels to be routed to the card Audio DSP functions.

In this example, Dolby decoded channels **Dolby Decoder Out 1** thru **Dolby Decoder Out 6** are correspondingly routed to **Bus Ch 3** thru **Bus Ch 8**, respectively. (The PCM pair on Embedded Ch 1+2 is also routed to an available pair of bus channels for eventual routing to selected output embedded channels which will be shown later.)

Input Emb Ch 1+2 are routed to Bus Ch 1+2. This pair will eventually be routed to selected embedded output channels shown later.

Dolby Decoder outputs are routed to six bus channels as shown

Figure 3 Input and Dolby E Decoded Channel Routing to Card Bus

D Next, the Dolby decoded channels (now on Bus Ch 3 thru Bus Ch 8) can be routed to Upmixing. The **Upmixing** tab is selected to route the six channels to upmixing (Decoded Dolby L, R, C, LFE, Ls, Rs on Bus Ch 3 thru Bus Ch 8 to respective upmix source channels L, R, C, LFE, Ls, Rs).

With Mode set to **Auto**, output of this function will always result in 5.1-channel upmix regardless of whether input (bus) channels have 5.1 content or not. Other default settings shown here are generally acceptable and recommended.

Upmixing						
Upmixer Channel	L	R	C	LFE	Ls	Rs
Upmixer Source	Bus Ch 3	Bus Ch 4	Bus Ch 5	Bus Ch 6	Bus Ch 7	Bus Ch 8

Mode: Auto

Status: Auto Mode - Currently Bypassed

Auto Crossfade Speed Upmix to Bypass: Medium (500 ms)

Auto Crossfade Speed Bypass to Upmix: Medium (500 ms)

5.1 Detection Threshold (dBFS): -60.0 (-150.0 ... -100.0 ... -50.0 ... 0.0)

Center Width: 20.0 (0.0 ... 50.0 ... 100.0)

Surround Depth: 80.0 (0.0 ... 50.0 ... 100.0)

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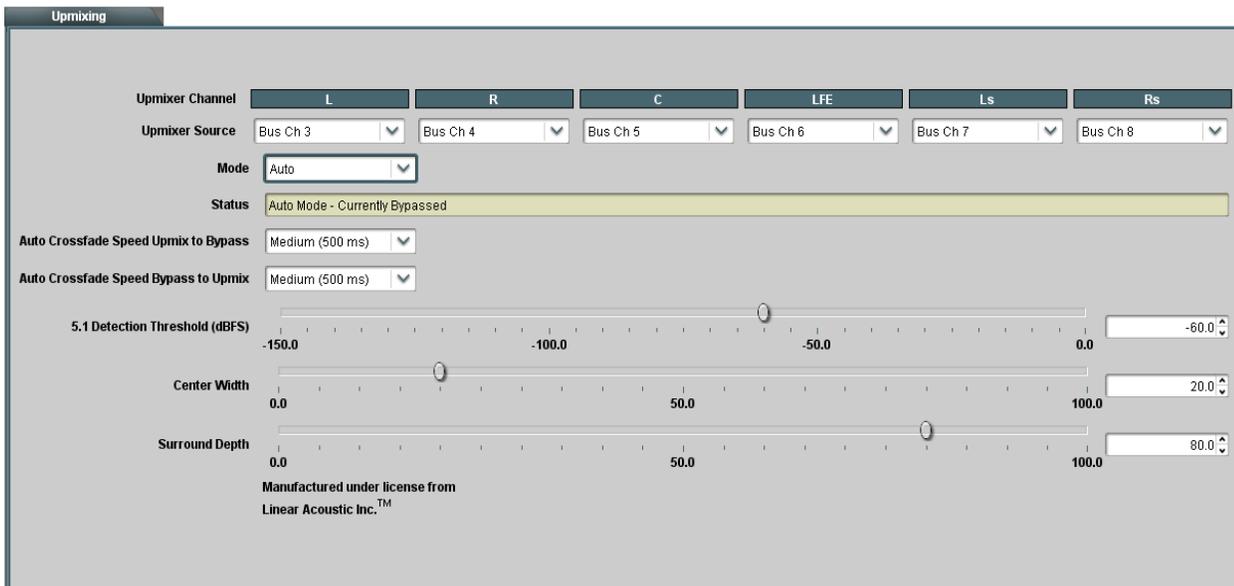
Next, the upmixing output (now on **Upmix L** thru **Upmix Rs**) can be routed to Loudness Processing. The **Loudness Processing** tab is then selected to route the six Upmix channels to Loudness Processing as shown. Make certain **Processing** button is set to **Enabled** as shown. Other default settings shown here are generally acceptable and recommended.

Loudness Processing						
Loudness Processing 5.1 Channel	L	R	C	LFE	Ls	Rs
Loudness Processing 5.1 Source	Upmix L	Upmix R	Upmix C	Upmix LFE	Upmix Ls	Upmix Rs

Processing: Enabled

Preset: TV 5B General

Master Output Gain (dB): 0.0 (-20.0 ... -4.0 ... 11.0)

Status: Running

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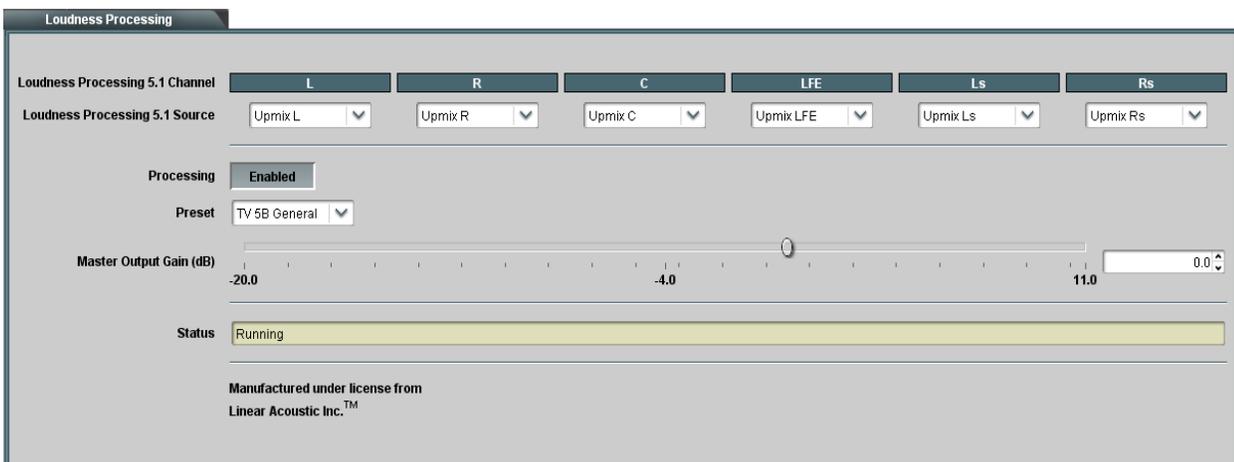
Figure 4 Routing Dolby E Decoded Channels to Upmixing and Loudness Processing

E Dolby Digital encoding for the 5.1-channel audio is set up using the **Dolby Digital Encoder** tab. First, on the **Encoder** sub-tab, **Metadata Source** for Full Encoder A (the default encoder to be used for 5.1-channel encoding) is set to use **Internal** metadata because the card's internal metadata is to be used as the encoding source in this example. On this tab, Dolby Digital Plus encoding and a default 256 kbps rate are selected.

On the Internal Metadata sub-tab, **Coding Mode** is set for **3/2 (L,R,C,Ls,Rs)** and **LFE Enable** is set to **On** to provide 3/2L encoding as shown below. Other default settings shown here are generally acceptable and recommended.

If the loudness processor -24 LKFS target loudness is desired to persist for decoded audio in the home, **Dialog Normalization** can be alternately set to -31 (no decoder attenuation).
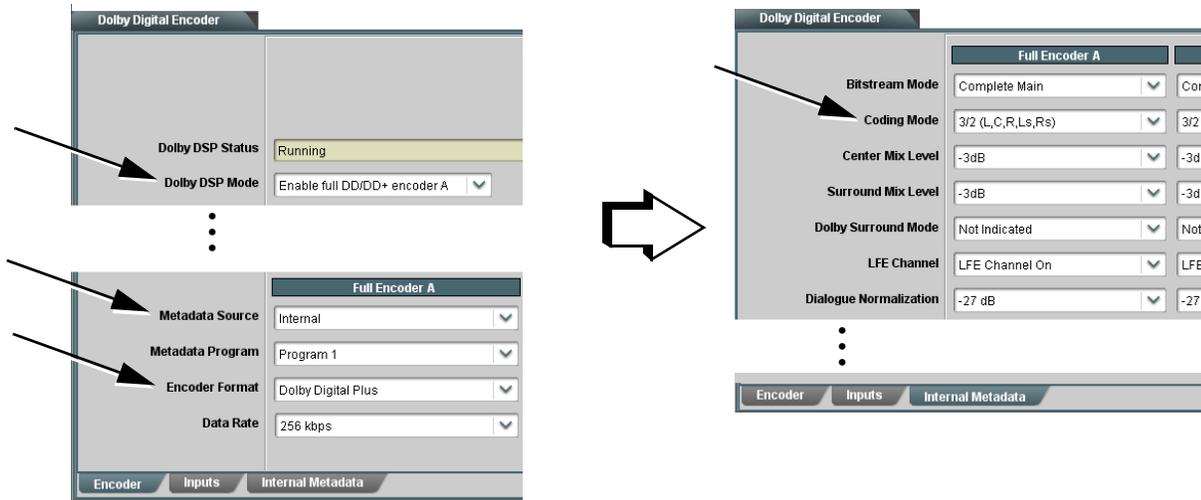
Note: ⚠ **(USA)** ATSC A/85 and the CALM Act (H.R. 1084/S. 2847) requires that when real-time loudness processing is applied using a fixed target loudness of -24 LKFS, AC-3 encoding must correspondingly use a fixed dialnorm value of -24. The default target loudness (as set by the loudness processor Master Output Gain Control) is -24 LKFS. **When loudness processing is engaged, make certain AC-3 dialnorm is set as described here**.

Next, the **Inputs** sub-tab is used to to route the input audio into the encoder. The 5.1 loudness-processed channels **LP51 L** thru **LP51 Rs** are routed to the encoder input channels **Input 1 (L)** thru **Input 6 (Rs)** as shown below.
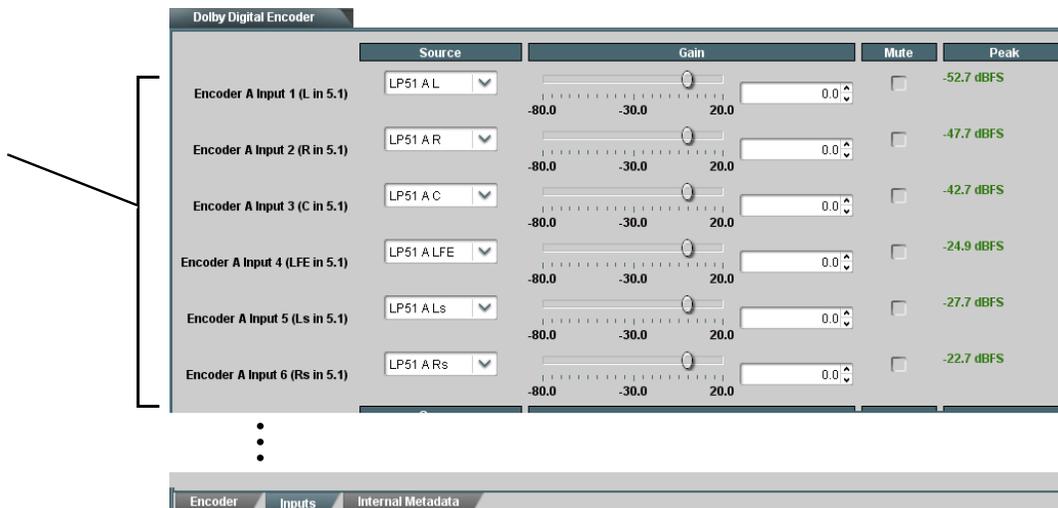
Figure 5 Dolby Digital Plus Re-Encoding Setup and Routing

F The Dolby Digital Plus encoded pair (carrying the upmix/loudness-processed 5.1 audio), as well as the separate stereo embedded pair received on Emb Ch 1+2, are now routed to destination (output) embedded channels as shown. Select the **Output Audio Routing/Controls** tab, and then its **Emb Audio Out** sub-tab.

By setting the **Source** drop-down selectors as shown, Dolby encoded output pair Encoded Dolby (L) and Dolby Encoded (R) are routed to embedded output channels Emb Ch 3+4. The separate stereo pair on Emb Ch 1+2 (being placed on Bus Ch 1+2 earlier (as shown in Figure 3) are routed to Emb Ch 1+2 by default routing shown here.

Figure 6 Processed Embedded Audio Output Routing