

White Paper

Supporting Dolby E, Dolby D and Dolby Digital Plus in Kudos+ HD Standards Conversion

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Introduction

Multi-channel audio is increasingly used for major live sporting events and concerts, as well as drama, documentary and features. Home TV viewers as well as cinema audiences, Blu-ray viewers and game players are becoming accustomed to surround sound and multi-lingual audio.

For content producers, post production operations, broadcasters and distributors, compressed audio formats such as Dolby E and Dolby D provide a solution to the additional bandwidth that multi-channel audio requires. Dolby E is a professional audio format which is designed to carry up to 8 channels of audio, metadata and timecode. Dolby D (also known as Dolby Digital or AC-3) is a multichannel audio compression standard developed to bring theatre quality sound into the home.

Both audio formats are digital and require bit accurate transmission. Dolby E has an additional constraint that the audio data are carried in audio packets which must be correctly aligned to their associated video frames, as shown in Figure 1.

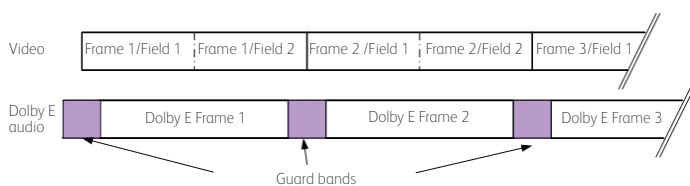


Figure 1 : Alignment of video and Dolby E audio

It is important to note that Dolby E is only defined for frame rates 30, 29.97, 25, 24 and 23.98 fps. The diagram shown in Figure 1 illustrates an interlaced video format (e.g. 1080 50i) with Dolby frames aligned with the video frame boundaries. In this case, there is one audio frame per video frame. As long as editing takes place only on video frame boundaries, the Dolby audio will be preserved.

For higher video rates such as 1080 50P, 1080 59.94P, 720 50P, and 720 59.94P each Dolby E frame will be associated with two video frames, as shown in Figure 2.

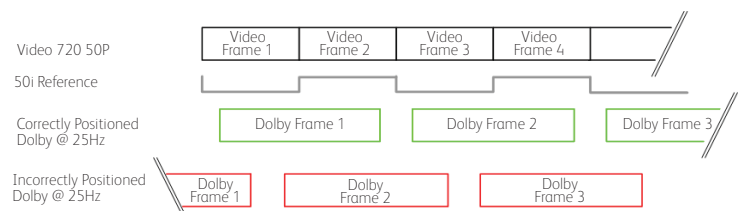


Figure 2 : Alignment of video and Dolby E audio for high progressive frame rate video

As can be seen in Figure 2, the Dolby E frame boundaries align with every two video frames. It is important that any downstream editing takes place with respect to an interlaced reference e.g. if the user has 50P video, a 50i reference should be used, as shown in Figure 2. Downstream editing of incorrectly positioned Dolby E would lead to unacceptable audio artifacts.

Dolby E Handling in Mach HD

Version 4 hardware Mach HD i.e. units shipped after 1 January 2011, support the addition of a Dolby E decoding and transcoding option. The option can be ordered at the time the unit is initially purchased, or may be added later. The option is chargeable and requires a Service visit or return to factory.

The Mach HD Dolby E option supports the passing of a single Dolby-E stream in frame rate conversion modes and allows Dolby-E decoding and transcoding. Any unit supplied with Dolby-E processing will automatically be able to process 8 pairs of PCM/non-PCM audio (Version 3 and below units process only 4 pairs).

Dolby-E processing is not available as an upgrade to Version 3 and below. It can only be supplied as an option on Version 4 and above Mach HD units.

There are four modes of operation :

- **Frame rate convert** : Extracts Dolby E data from any embedded pair of the SDI source or external AES input. Data are decoded into 4 pairs of PCM audio and delayed to match to typical video delay. They are then encoded into Dolby E and embedded into any output SDI or AES pair. The 2 down-mix output channels and 8 decoded channels are also available for routing to any output audio channels. Encode mode (program, bit stream, etc.) is set to be the same as the decode mode. Dolby delay compensation of -1F and -2F is available.

- Same frame rate mode (pass-through): Dolby E data are routed, delayed and embedded as in Version 3 and below Mach HD (no decode / encode necessary). Used only if incoming Dolby E is guard band aligned.
- Same frame rate mode (decode + encode): Dolby E data are decoded and encoded. Allows for non guard band aligned sources.
- Dolby E decode : Extracts Dolby-E data from any embedded pair of the SDI source or external AES input. The decoded channels of PCM audio are available for routing to any combination of output channels after delaying to compensate for the video delay. Dolby delay compensation is available. The 2 down-mix output channels are available for routing to any output channels.

Dolby E Handling in CVR800 and TBS800 Products

CVR800 and TBS800 Versions 3 and above support Dolby E, Dolby D and Dolby Digital Plus audio via the “non-PCM audio” mode, which enables the user to pass through Dolby audio when standards or format converting. It is important to note that the audio is passed through the units. It is not rate converted.

For correct passing, the source audio must be synchronous to the video output lock source i.e. the unit must be in input lock mode, or in reference lock mode, with a reference that is locked to the input. The non-PCM audio must be 48KHz synchronous to the genlock source. Non-PCM audio will always be corrupt if the genlock is set to free-run.

For TBS800, the non-PCM audio mode is adequate as there is no frame rate conversion to be taken into account. However, for CVR800, the situation is slightly more complicated. To understand the detail of the Dolby passing mode when frame rate converting, we will first consider how PCM audio is handled in CVR800 standards conversion. Figure 3 shows the PCM audio flow in the CVR800.

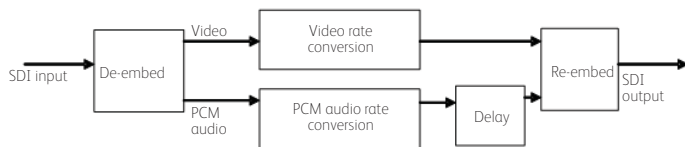


Figure 3 : PCM audio processing in CVR800

As shown in Figure 3, the PCM audio is dis-embedded from the incoming SDI input, and is rate converted to match the required video synchronization. The appropriate compensating delay is applied before the audio is re-embedded. In this way, the audio is rate converted and delayed to match the video.

When using the non-PCM audio pass-through mode, the audio rate conversion is by-passed, as shown in Figure 4.

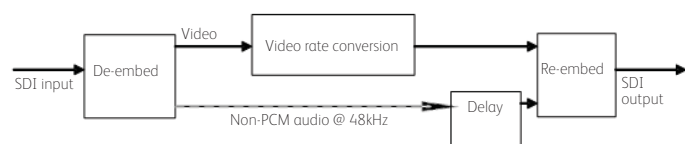


Figure 4 : Non-PCM audio processing in CVR800

When using the non-PCM audio mode for CVR800 frame rate conversion, it is important to remember that the Dolby E, Dolby D and Dolby Digital Plus data will be passed, not converted. This means that the frame rate of Dolby E data will not be altered, and as such the audio output will not be frame aligned with the video, see Figure 5.

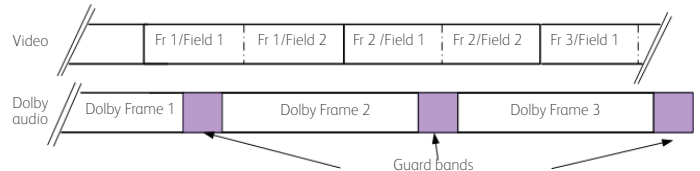


Figure 5 : Misaligned Dolby audio

As shown in Figure 5, the Dolby E frames no longer align with the video frames and the guard band is no longer aligned. Dolby E decoders can be configured to accept this Dolby E, however, further editing is not possible as the edit breaks would cause audio artifacts such as mutes, pops and clicks.

Perfect Dolby E Alignment using Snell Modules

Users that require exact alignment of Dolby E when frame rate converting with a CVR800 can achieve this via an audio bypass method using Snell IQ modules.

The appropriate modules are:

- IQDBD00/01 Dolby E decoder
- IQDBE00/01 Dolby E encoder

There are two solutions available to a user, depending on whether the user wishes to use embedded or AES audio. The embedded audio solution is shown in Figure 6. IQDBD00/01 is used to decode the Dolby E audio to PCM then re-embed it into the SDI stream. The CVR800 thus treats the audio as PCM. It will be rate converted and appropriately delayed according to the required video frame rate conversion.



Figure 6 : Dolby E conversion in CVR800 using Snell modular solution

As shown in Figure 6, the SDI output from the CVR800 frame rate converter, with PCM audio at the correct rate and delay, is then passed to the IQDBE00/01 Dolby E encoder which will re-embed the audio into the SDI stream. If any upstream or downstream equipment requires the Dolby E to have a frame of delay or to be advanced by a frame, the IQ modules will handle this.

Users wishing to use an AES audio connection can bypass the frame rate converter altogether, as shown in Figure 7. The Dolby E audio is decoded by IQDBD00/01 then passed via AES to IQDBE00/01 where it will be re-encoded at the correct rate to match the output video. In this configuration, the user will manage any delay adjustment between video and audio using the delays on the IQ modules.

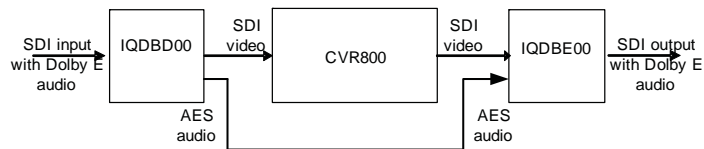


Figure 7 : Dolby E conversion in CVR800 using Snell modular solution AES by-pass