

## Application Note

### *Handling SD/HD SDI Signals in Audio Mixing Applications*

#### Introduction

Video professionals today are migrating towards the benefits provided by routing both video and audio (up to 16 channels) via the SD/HD Serial Digital Interface (SDI). With both video and audio on a single cable engineering and maintenance expenses are minimized. Utilizing this format, however, presents issues when dealing with all 16 channels of audio. Accessing the 4 audio groups, mixing the embedded audio with additional analog or digital sources, and re-embedding back into the SDI signal is a complex task. The full line of Renegade Labs digital audio mixers provide a simple, compact, and economical solution to this problem.

#### Using Conventional Audio Mixers

Current solutions available to the video professional for handling audio in the SDI format require utilization of external de-embedders, re-embedders, and either conventional analog or digital mixers. Using a conventional audio mixer with external SDI equipment has many issues:

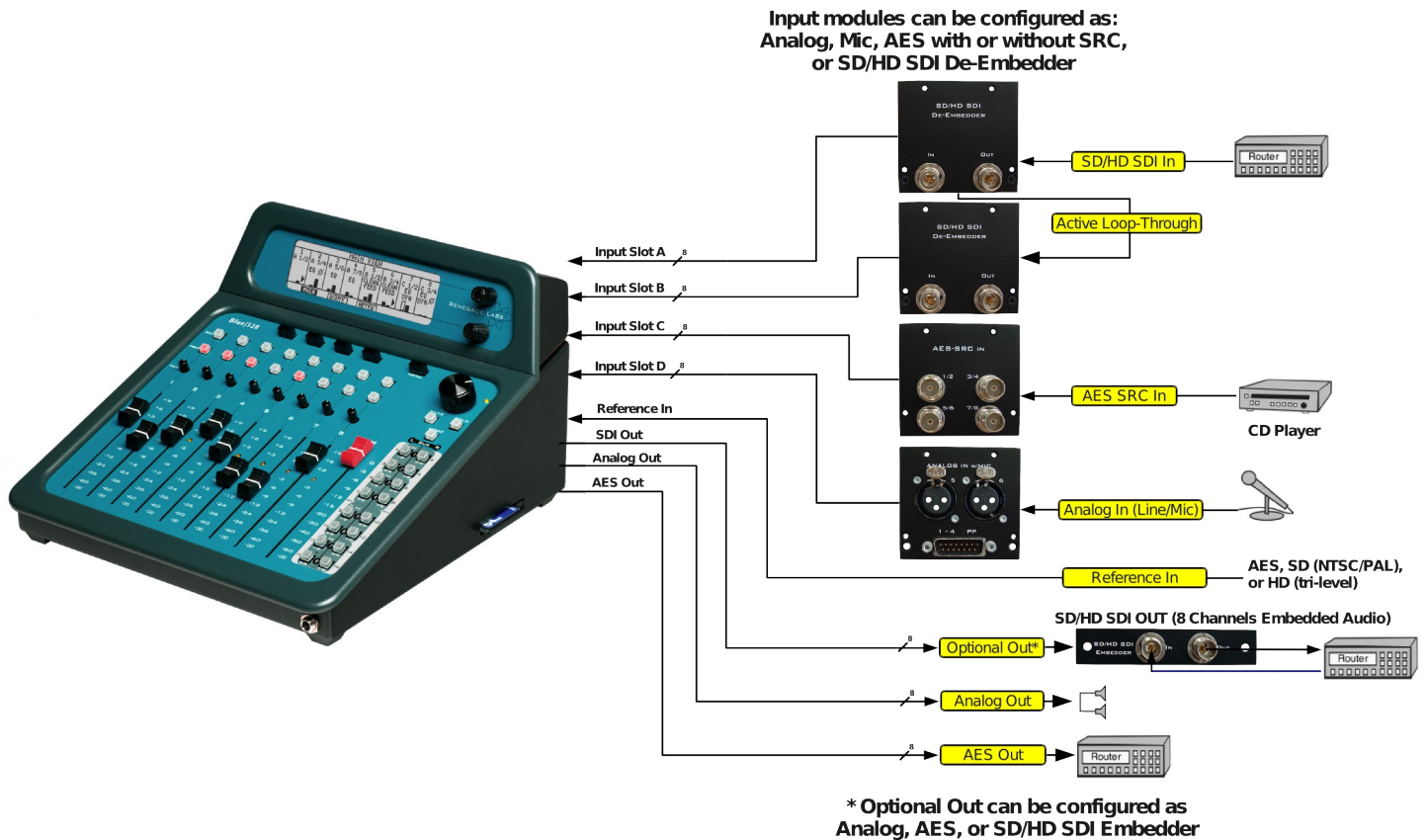
1. **Mixer synchronization with the SDI signal:** maintaining mixer synchronization with the SDI signal is important when fixing lip sync problems or when handling non-audio data such as Dolby E. While most audio mixers have the capability to delay the audio, without an actual video reference lock correcting a lip sync problem can be an imprecise operation. Most analog mixers do not have any synchronization mechanism and many digital audio mixers can only be referenced to a word clock signal or standard definition video signal (NTSC/PAL). These synchronization mechanisms fall short in the high-definition world of SDI audio.
2. **Non-audio data (Dolby E) support:** On SDI signals it is very common to have non-audio data like Dolby E embedded in the SDI stream. In order to accept a non-audio data stream the mixer must be digital; analog mixers will not work. For digital mixers the mixer must have the ability to cleanly pass the non-audio data through the mixer without doing any processing to the signal and must have the ability to bypass any sample rate converters that may be in the path. The digital mixer must also have the ability to synchronize to the SDI signal or frame slippage will occur, causing errors in the data stream.
3. **Full 16 channel embedded audio support:** Most external SDI embedders have the ability to embed up to 8 channels of audio into the SDI signal. For most applications this is more than adequate, however, many of the existing embedders on the market will strip out or remove any existing audio channels when re-embedding. This causes issues in those applications which desire to embed audio into only a few of the audio channels, while leaving the remaining channels untouched.
4. **Ease of Operation:** Use of external equipment requires the operator to understand not only the mixer and its operation, but also the operation of the external equipment and the details of the interconnection of that equipment to the mixer. This is an additional complication in the pressure-filled environment of a typical video editing suite.
5. **Maintenance and engineering support:** External SDI converters incur additional costs for maintenance and engineering to purchase, install, maintain, and troubleshoot that equipment. There is additional cabling required between the external SDI converters and the mixer—possibly requiring the use of patch-

panels—all of which adds up to extra maintenance and multiple points of failure. A difficult-to-identify latch-up in a piece of external SDI gear can cause a complete system failure in the mixing application.

## Handling SD/HD SDI with Renegade Labs Audio Mixers

Renegade Labs offers a comprehensive range of 32 input, 8 output digital audio mixers that are specifically designed to meet the special requirements of audio for video. Renegade audio mixers include the ability to accept AES digital, analog (including mic), and SD/HD SDI input signals. The mixers have both AES digital and analog line level outputs standard, and also have the ability to add another set of either digital, analog, or SD/HD SDI embedded audio outputs.

Other features of these mixers specific to the audio-for-video application domain include the ability to synchronize to an AES digital reference or to either standard definition (NTSC/PAL) or high definition (tri-level sync) video signals. The mixers also include audio delay for correcting lip sync problems, dynamics (compressor/limiter/expander), a parametric equalizer, and an intuitive video-centric user interface with memory registers for saving and recalling setups. A “Clean Feed Mode” allows easy routing of non-audio data and unity audio setups. A typical SDI setup with a Renegade Audio mixer might look like this:



**Figure 1 Block Diagram of Renegade Audio Mixer with SDI In/Out**

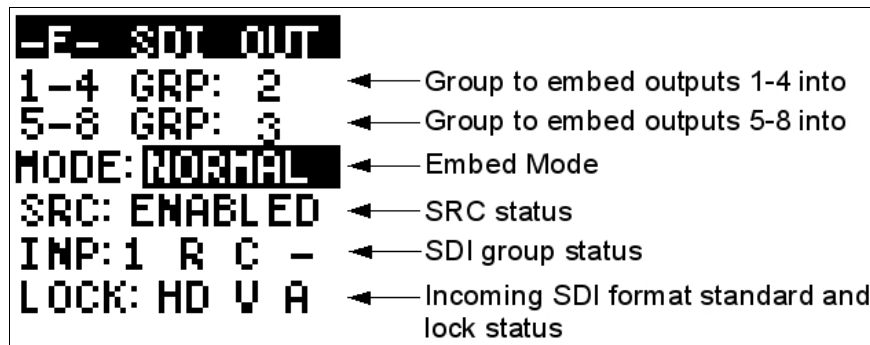
As shown in Figure 1, Renegade Labs audio mixers handle SD/HD SDI directly with plug-in input and output modules. In this example two 8-channel *SD/HD SDI De-Embedder* modules are used to de-embed 16 channels of audio by using the active loop-through of one de-embedder to feed the other de-embedder. An 8-channel *AES-SRC* input module allows additional non-synchronized digital audio sources such as a CD

player to be connected to the mixer with sample rate conversion (SRC). The *Analog In with Mic* input module allows for voice-overs and connection of other analog equipment. The mixer's AES outputs can be used to feed a router or other equipment, the Analog outputs can be used for monitoring, and an 8-Channel *SD/HD SDI Embedder* module is installed in the optional output slot, allowing for the embedding of the mixer's output into an SDI signal.

Since the mixer can be synchronized with the incoming SDI source, audio delay settings can be accurately achieved down to 0.1 frames. Synchronization with the SDI source also allows non-audio data to be easily handled. The mixer will indicate when a non-audio data stream is detected, and sample rate converters can be set to the BYPASS mode of operation, allowing the non-audio data to pass through the mixer unmodified. The non-audio data can be routed out the same channel (track) it came in on, routed to a different channel, or even routed to more than one output channel simultaneously, much like a distribution amplifier. The mixer's ability to handle a variety of audio source formats via the plug-in input modules allows audio configuration to be accomplished via the simple menu interface on the mixer's status LCD screen. Because no external equipment is required, cabling, maintenance, and engineering issues are greatly simplified.

### SD/HD SDI Embedding with 16 Channel Audio Support

An SDI ancillary audio signal consists of up to 16 audio channels, organized as four groups, each containing four audio channels. The *SD/HD SDI Embedder* module can embed audio into any two of these four groups (8 channels total) while preserving all other groups. The controls for the *SD/HD Embedder* module are accessed via a menu on the mixer's status LCD screen as shown below:



**Figure 2 SD/HD SDI Embedder Control Menu**

To support 16-channels of audio the *SD/HD Embedder* module will automatically switch between replace and cascade operation on the selected group(s). Replace, shown as an “R” in the SDI group status, is displayed when a selected output group is already present in the incoming SDI signal, and indicates the existing group will be replaced with the output group while the other incoming groups are preserved. Cascade, shown as a “C” in the SDI group status, is used when a selected output group is not present in the incoming SDI signal and will be cascaded as a new group into the SDI signal, again while preserving all other incoming groups. Preserved and passed-through groups are shown as numbers 1 – 4 in the SDI group status.

An SRC control allows the operator to ENABLE or DISABLE the sample rate converters. The SRCs can be disabled when embedding audio into synchronized SDI signals, or when embedding non-audio data like Dolby E. Both the *SD/HD SDI De-Embedder* and *AES-SRC* input modules also have the ability to have their SRCs disabled.

Additionally, because the Renegade mixer supports a complete 16x8 mix matrix, it is easy to manipulate the audio channels within each group. For example, consider the case where the requirement is to dub new audio

onto the 3<sup>rd</sup> and 4<sup>th</sup> tracks of an SDI signal containing 8 channels of audio in groups 1 and 2, while leaving the remaining channels untouched. This operation is easily accomplished by de-embedding group 1 and 2 from the incoming signal, routing all of the incoming audio channels except 3 and 4 in “Clean Feed Mode” directly to the corresponding output buses, and routing or mixing the new dub audio (perhaps from another input source) to output buses 3 and 4. The SDI Embedder is then set to embed outputs 1-4 back into group 1 and outputs 5-8 into group 2. The embedder will replace both existing groups with the new audio channels, which will be identical to the original audio except for the addition of the new dub channels on tracks 3 and 4.<sup>1</sup>

## Conclusion

As shown in this application note, conventional audio mixers—in conjunction with external SDI converters—may be used in audio-for-video mixing applications; however, issues arise with synchronization, non-audio data sources like Dolby E, 16-channel audio support, operations, and maintenance.

Renegade Labs has put significant effort into addressing these issues with mixers that can de-embed audio and re-embed audio into SDI signals without the need for such external gear. Mixers that can be synchronized with the SDI signal via HD tri-level sync, an 8-Channel SD/HD Embedder module that supports 16-channels of audio and can replace selected group(s) while preserving all other groups, the ability to enable or disable sample rate converters to allow for the routing of non-audio data, and video-centric operation are all features designed specifically for handling audio in video applications.

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<sup>1</sup> It would also be possible to de-embed just the first group and then re-embed only outputs 1-4 on group 1, while disabling the embedding of outputs 5-8. In this case the embedder will replace group 1 while passing group 2 through untouched. However, there will now be a few audio samples of latency between the two groups due to the processing delay through the mixer. Note, however, that in most applications this delay would not be noticeable; it is only an issue when exact phase needs to be maintained among all the channels.