

Mixing with Dolby Pro Logic II Technology

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1 Introduction

Dolby® Pro Logic® II is the latest matrix surround sound technology from Dolby Laboratories. It was specifically designed to provide a quality multichannel audio experience to listeners of two-channel audio delivery mediums. Dolby Pro Logic II is still a matrix technology and does not sound exactly like the discrete 5.1-channel audio from Dolby Digital soundtracks, but it does effectively emulate that experience.

Dolby Pro Logic II technology is designed to work with existing stereo signals that were not surround encoded. There are several listening modes and user controls that allow listeners to tailor the sound to their liking. Audio soundtracks that are encoded with Dolby Pro Logic II are backward-compatible with Dolby Surround, stereo, and mono listening modes.

For a complete technical description of how the decoder works, a separate paper available from Dolby Laboratories, *Dolby Surround Pro Logic II Decoder: Principles of Operation* by Roger Dressler, explains the decoder and its various modes.

2 Setup

Those who are familiar with mixing in Dolby Surround will have no problem adapting to Dolby Pro Logic II, as the same considerations for mixing are required.

Monitoring requires proper speaker setup and use of a decoder. The Dolby Model DP564 Multichannel Audio Decoder handles all of the necessary monitoring functions, bass management, and downmixing. Figure 1 shows a typical setup.

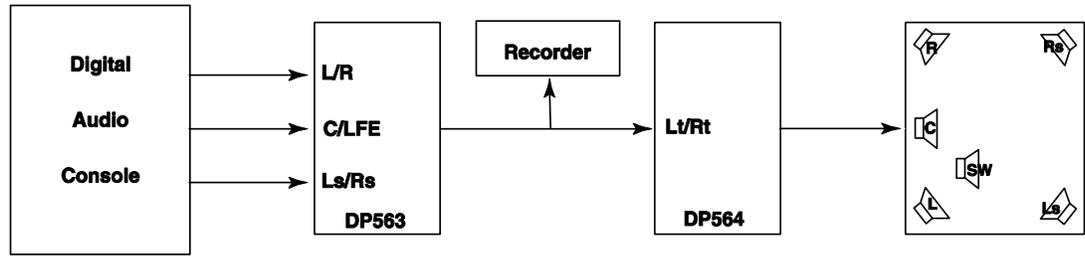


Figure 1 Audio Flow for Surround Mixing

Speaker placement for Dolby Pro Logic II mixing is the same as it is for Dolby Surround, as shown in Figure 2.

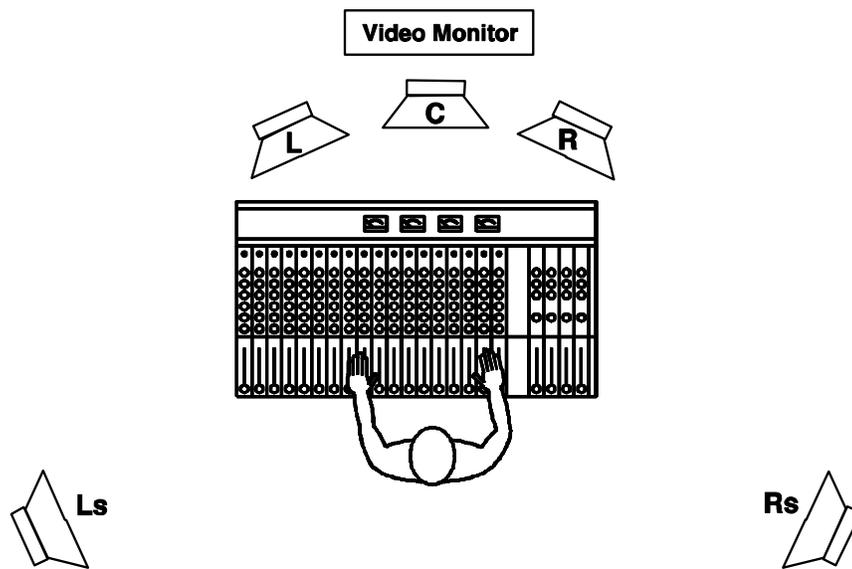


Figure 2 Speaker Placement: Top View

The surround channels may be used to create a diffuse image, not a direct signal as is typical in 5.1-channel discrete music mixes. In most cases, a compromise is necessary between the ITU-R recommended practice *Recommendation ITU-R BS.775-1* for 5.1-channel speaker placement and the traditional Dolby Surround speaker recommendations. Typically, the rear speakers should not be at ear level and pointing directly at the listener, as suggested in the recommended practice document. Rather, they should be pointed approximately two feet above the listener's head, as shown in Figure 3. These same considerations are used for Dolby Surround and discrete 5.1-channel mixing in a control room.

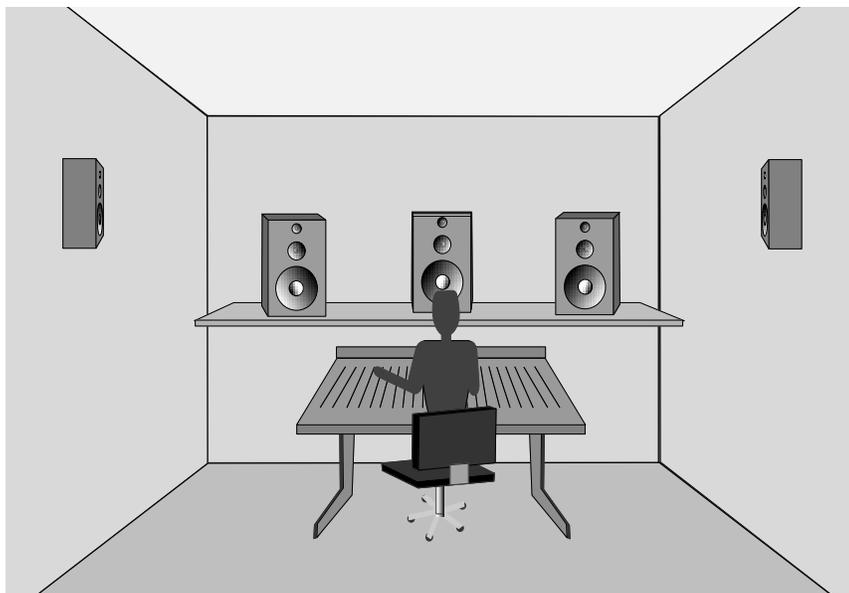


Figure 3 Vertical Placement of Speakers

System calibration should be performed after setting up all of the bass management and delay settings in the DP564. Detailed system calibration instructions are in the DP564 user's manual. This setup should be verified daily. Incorrect monitoring calibration will result in great sounding mixes in your environment, but not outside of it. A quick check with the noise sequencer built into the DP564 and an inexpensive SPL meter generally suffices.

3 Mixing Issues

When mixing a project, care should be taken to monitor it in all of the listening modes. Those familiar with Dolby Surround mixing are already aware that any matrix surround mix must be listened to via a decoder to hear the effects of the matrix encoder on the mix. This is where the biggest differences between discrete 5.1-channel audio and matrix encoding systems are evident.

When mixing with Dolby Pro Logic II, Center-channel information appears from the Center channel as expected. However, a matrix decoder doesn't know if the Center-channel information it has is really from the Center-channel input of the encoder—or if it is the result of a signal being present in both the Left and Right channels at equal phase and level. In a discrete system, a signal applied to both the Left and Right channels at the same level is output from the appropriate decoder in the Left and Right channels as it was encoded. Listeners hear the phantom image centered in relation to their position between the Left and Right speakers, as shown in Figure 4.

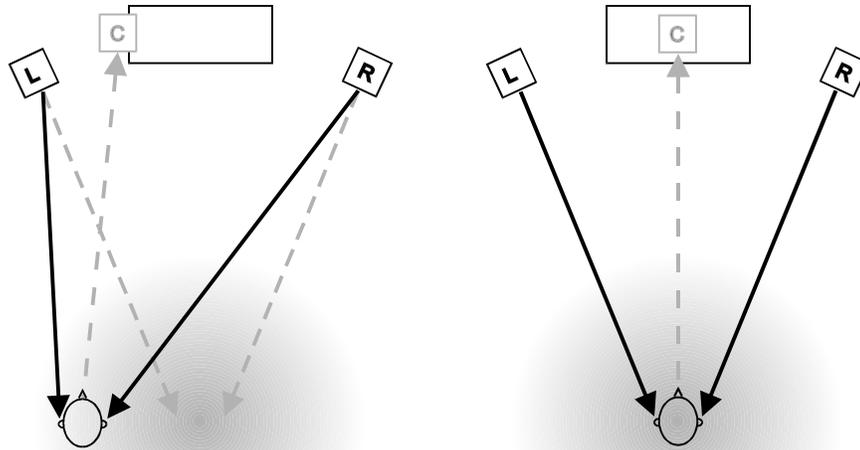


Figure 4 Phantom Center Images with Listener Off-Center (left) and in Sweet Spot (right)

If this signal is processed through a Dolby Pro Logic or Pro Logic II decoder, the decoder redirects this common information to the Center channel output and a hard phantom image is present from all listening positions. In some cases, the effect is desirable. In others, elements of the mix may appear in the Center channel when their original position was somewhere to the left or right of center, creating what is commonly referred to as Center-channel buildup. Because the Pro Logic II system was designed to decode material that was not surround encoded, a center width control is given to the consumer. This control diverts some of the Center-channel signal back into the Left and Right channels, resulting in a wider center image for the listener. This control affects everything in the Center channel, so dialogue will also be spread out. To obtain the most accurate scenario for Center-channel buildup, we recommend setting the center width to zero.

Surround signals can also be manipulated via a panoramic control in some decoding modes. This control works similarly to the Center-channel control described above, but deals with the information present in the Surround channels. Again, the minimum setting should be used for the panoramic control when mixing.

3.1 Upmixing

Upmixing is the process of forcing a two-channel source into a 5.1-channel configuration. There are several instances where this might be desirable and a few where it really isn't the right thing to do. Upmixing with a Dolby Pro Logic II decoder—or any other way—should be carefully considered and closely monitored. Both Dolby Surround and Pro Logic II were designed as single-decode systems. They employ sophisticated techniques that exploit human hearing patterns to give listeners a perception that doesn't necessarily match the electrical outputs of a unit.

A common reason for upmixing is to deliver a “5.1” mix to the end user, which usually activates a light on the consumer’s decoder, letting the consumer know that a 5.1-channel signal is available on their unit. Most consumers are thrilled with this indication of the complete use of the equipment they bought.

The downside to upmixing is that some listeners will have to listen to the signal as a downmix. In this scenario, the original two-channel signal is upmixed to 5.1, delivered to the consumer as such and then downmixed to a two-channel signal that doesn’t match the original although it is once again a two-channel signal. This is further complicated by the potential for subsequent decoding by a Dolby Surround Pro Logic or Pro Logic II decoder. Depending on the decoding mode used for the upmix and the encoding and downmix parameters used in the Dolby Digital decoder, the signals in the Surround channel may not be correctly timed. It is very easy to have delay for the Hass effect in the Surround channel be applied twice, once in the upmix and once in the consumer’s decoder. The Hass effect for the Surround channel is then ineffective, and the perceived separation for the surround channels is reduced. If the signal is delivered in stereo, a double attack or signal smear may be heard due to the different arrival times of signals common to both front and surround channels. On the other end of the issue is the desire to have the delay present such that the Hass effect *is* working for those listeners who are using the supplied 5.1-channel mix. Here the 15 ms delay should be used. The real solution to this issue is to send the two-channel signal to consumers and let their decoders handle the decoding.

Upmixing stereo elements for a project that also has discrete 5.1 elements is another challenge. There are many instances where this has been successfully done using Dolby Pro Logic II. While it isn’t the same as having a discrete 5.1-mixed element, if the only option you have is a stereo element, Pro Logic II can be used successfully.

Any time you are working in this scenario you should be using the Pro Logic II Music mode with zero delay in the all of the channels. (Use of other listening modes will result in incorrect downmixing in a consumer system due to the surround phase relationships and delay issues.) The center width control and the panorama control should be used to achieve the desired results for each element. Experience has shown that it will probably be necessary to adjust the decoder parameters and channel balances for each element. Using the decoder with complete mixes that include dialogue is not recommended. If at all possible, keep the dialogue separate and mix it in during the final mix. In all cases, you should listen through a complete monitoring system that allows for downmixing and decoding of the upmixed signal. The Dolby DP563 with Pro Logic II and the DP564 are commonly used for this purpose.

3.2 Announcers and Dialogue

Traditionally, dialogue is placed only in the Center speaker to tie the on-screen sounds to the picture. When a Center speaker is used, all center-panned dialogue appears to come from the screen regardless of the listener's position. If the dialogue comes from the Left or Right speakers, the stereo image differs depending on the listener's position. This is highly undesirable. Generally only effects or incidental voices should be in any channel other than the Center channel.

3.3 Interior Effects

Interior sound effects come from all channels and appear to surround the listener. Wind noise, crowds, and other general ambient sounds are included within the mix to give a sense of realism. Effects and ambient sounds normally appear in the Left, Right, Left Surround, and Right Surround channels. It is common to use stereo ambiance that is panned Left and Left Surround for the Left channel of the source and Right and Right Surround for the Right channel of the source. The resulting sound surrounds the listener, yet still has a front stereo image. The amount of Surround channel signal added determines how far back the listener is in relation to the front sounds. More surround level produces an image that sounds farther back in the room.

3.4 Positioning of the Stereo Image

The Center speaker in a Dolby Surround system produces stereo imaging that is slightly different than that of a two-speaker stereo system. Most music engineers find this distracting at first, but adjust quickly. Those who mix motion picture sound feel comfortable, as do those music engineers who own a home theater system. The most noticeable difference in the stereo image is that the perceived image tends to be narrower when a Center speaker is used. Because most music mixes contain significant amounts of Center-channel information, we are used to hearing a phantom image produced by the Left and Right speakers. Since all of this information is now directed to a single point source, the Center speaker, we perceive it as being in the center. To correct this in the mix, make the image slightly wider than normal for a two-channel stereo mix.

Do not eliminate the Center speaker in the control room and use the Phantom Monitoring mode. While this may produce a more familiar sound in the control room, it does not satisfy listeners who have a complete home theater system. To achieve the correct listening result, mix with a Center speaker.

3.5 Stacking Encoded Tracks

In the film industry, it is common to premix elements for the final mix. This can be done in the opening sequence for a series of shows or for a sound effect panning through the room.

The individual elements may be mixed as Dolby Surround encoded two-channel elements (Lt/Rt) and all of those elements may be mixed together in the final mix. Each element should then be assigned to the left and right inputs of the encoder.

3.6 Magic Surround

In certain cases, stereo microphone placement techniques and stereo electronic instruments cause a phenomenon known as *magic surround*. The decoder will decode some of the signal placed in the Surround channel. This results in out-of-phase or inverted information in the stereo pair, which X/Y stereo microphone techniques typically produce. While this may sound pleasing by itself and no encoding seems necessary, it's an unpredictable process that should not be relied upon. Adding another element to the mix, such as a voiceover, could easily change the phase characteristics of the mix and alter the decoding process. It is best to put a little information from this signal source through the encoder's surround input, ensuring the decoding of the real surround signals, rather than random out-of-phase information.

In some cases, too much surround information is present, as with electronic keyboards, which achieve a stereo signal from a mono source via electronic processing. If your favorite sound produces too much information in the Surround channel, simply pan the Left a little towards center and the Right an equal amount towards center. This cancels some of the out-of-phase information and corrects the decoder's steering. The amount of panning required varies with the sound, but it usually does not take much to produce a good result.

3.7 Decoder Mistracking and Steering Artifacts

When mixing, the decoder can only steer in one direction at a time, so you must plan the soundfield carefully. Movie mixers have been doing this successfully for over 25 years, so do not be overwhelmed: it can be done quite easily.

Problems result when two very different and unrelated sounds are sent to two different channels at once. For example, crickets in the Surround channels and chickens in the front cause the sounds to bleed into the other channels and produce a dynamic image shift. This effect is distracting and undesirable.

It is also common for a music track to contain a prominent lead instrument in the Left or Right channel while an announcer comes from the Center channel. The instrument appears to move from its intended speaker toward the center when the announcer speaks and then return to the correct speaker when the announcer pauses. The solution is to either pan the music element towards center or temporarily reduce its level.

Often, when producing motion picture sound effects, the sound effects designer removes all ambient sounds briefly so that another sound may be heard more prominently. For example, the audio background might contain light traffic noise and night sounds. When a door slams, the traffic and night sounds are either at a very low level or disappear entirely. After the door slams, the background sounds are already back in the mix. Because they were covered by the door slam, the audience doesn't miss them.

3.8 Surround Pumping

Bad transmission paths frequently cause pumping of the Surround channel that is rarely heard in the mixing environment. Often a limiter is active in one channel of the transmission path but not the other, or a stereo limiter is not set up the same for both channels. This problem can be heard during the mix if a stereo limiter is being used excessively or if only part of the element is limited. The solution is to either remove the limiters or set them up identically and verify that they are linked. It is impossible to discuss all possibilities, but always look for inconsistencies between the two stereo channels. The viewer usually recognizes the problem as Surround channel ambience pumping in response to the dialogue. This is particularly noticeable during live sporting broadcasts when there is crowd noise in the Surround channel.

3.9 Proper Surround Level and Content

When is there enough surround content in a mix? This decision is usually dictated by the taste of the project's producer and engineer. As a guideline, the image should direct attention to the front of the soundfield and it should be noticeable when the Surround channels are removed from the mix. Attention should not be drawn directly to the Surround channels when they are returned to the mix; the effects should complement, not distract from, on-screen action.

3.10 Limiters, Delays, Reverb Units, Other Effects Processors

As with any mixing situation, signal processing devices are common in Dolby Surround mixes. Limiters and compressors cause few side effects if they are used prior to encoding. Digital delays, soundfield generators, reverbs, and so forth, may also be used, but the tricks that generate the soundfields from these effects may not work as expected when Dolby Surround or Dolby Pro Logic II decoding is used. By monitoring through a decoder, you can instantly hear how the soundfield will actually sound. If you find that your favorite reverb program has excessive surround content before anything is sent to the Surround channel, pan the output a little towards the center instead of hard left and right. The phase shifting of the effects unit competing with the phase encoding found in Dolby Surround and Dolby Pro Logic II causes this effect. Experiment with the panning and level to obtain the desired soundfield.

3.11 Mono to Stereo Synthesizers

Mono to stereo synthesizers can create all sorts of havoc in a Dolby Surround mix. First, the Dolby Surround program *is* a stereo signal so there is no need for a synthesizer in the transmission path. Second, if you have ever listened to a mono show run through an aggressively adjusted stereo synthesizer, and then through a surround decoder, you have heard the dialogue coming from all the speakers simultaneously. All localization of the voices to the screen is lost. For this reason, with complete mixes, a synthesizer is not a desired tool in the transmission path. When used properly, stereo synthesizers can be an advantage for individual mono sources within a Dolby Surround mix and before encoding. They should not, however, be used excessively when dialogue or vocals are part of the mono element.

3.12 Mono, Stereo, and Dolby Surround Compatibility

Mixing techniques used in Dolby Pro Logic II productions are similar to those used in normal stereo productions. Just as you should check the mono compatibility of a stereo mix, you should also check the mono, stereo, and Dolby Surround compatibility of a Dolby Pro Logic II mix.

Dolby Pro Logic II mixes are consistently compatible with Dolby Surround decoding. The main difference is that the Dolby Surround decoding band-limits the surround channel to 7 kHz and the surround information is mono.

In most cases, stereo compatibility is not an issue. The mix's surround element will appear to be outside of the speakers, as would an out-of-phase signal. Notice that the entire mix should not sound out-of-phase, and there should still be a hard center image.

Mono compatibility is a little trickier, because any content that is in the Surround channel disappears in mono. This is an asset in some cases and a detriment in others.

In situations such as live sporting events, losing some crowd information in the mono mix helps those at home listening in mono on a three-inch television speaker to hear the announcers more clearly. In other applications, the mix may have a critical element in it that is predominately in the Surround channel. For this reason, surround elements should also be present in a front channel, interior panned, so they will be heard in mono, as is commonly practiced in the film industry.

4 Common Pitfalls

Although you may like a surround effect that spins your head, and it may be just what your production needs, repeating the move dozens of times usually tires the listener. The key to a good surround mix is subtlety. Don't draw attention to your techniques. The listener should never be distracted from the screen by surround effects. Loud, obnoxious, or out-of-place effects detract from the production. Keep it fun, but tasteful.

Mixes that are surround-heavy distract the viewer from the on-screen action, so do not put too much information in the Surround channel. If you find yourself thinking about what you just heard in the Surround channel instead of paying attention to the action on the screen, you have a problem. Too much surround information may also make dialogue unintelligible.

5 Conclusion

Dolby Pro Logic II is a convenient way to deliver matrix-encoded versions of 5.1-channel mixes to consumers via a two-channel pipeline. While it isn't a replacement for the discrete 5.1-channel mix, it is a step up from the conventional Dolby Surround matrix encoding system that has been so successfully used for the last 15 years. With the proliferation of consumer decoders now being produced with built-in Dolby Pro Logic II decoders, it makes sense to move up to the latest matrix encoding technology from the leader in multichannel sound, Dolby Laboratories.