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Frequently Asked Questions about Dolby Digital

Dolby

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Frequently Asked Questions about Dolby Digital

Dolby Digital is the next step forward in sonic realism and listener involvement. It has already changed the way you experience your favorite films in movie theaters, and is now doing the same for video programming at home.

1. What is Dolby Digital?

Dolby Digital is an advanced form of digital audio coding that makes it possible to store and transmit high-quality digital sound far more efficiently than was previously possible. First used in movie theaters in 1992, it is the result of decades spent by Dolby Laboratories developing signal-processing systems that exploit the characteristics of human hearing.

2. What program sources deliver Dolby Digital audio?

Dolby Digital audio is available via laser discs, DVD-Video discs, DVD-ROM discs for computers, digital cable systems, direct broadcast satellite (DBS) systems, and digital broadcast TV (DTV). They are usually identified with the DOLBY DIGITAL logo.

3. Can I hear Dolby Digital programs over a regular stereo or Dolby Surround Pro Logic system?

Yes, you can use most of the new Dolby Digital program sources with your current playback system, because they incorporate Dolby Digital decoders and provide conventional analog stereo outputs. However, with many DVD-Video players, digital cable set-top boxes, and other sources, you need a separate multichannel Dolby Digital decoder to experience the thrilling 5.1-channel surround sound used on many Dolby Digital programs.

4. What is "5.1-channel" Dolby Digital?

At the option of their producers, Dolby Digital programs can deliver surround sound with five discrete full-range channels—left, center, right, left surround, and right surround—plus a sixth channel for those powerful low-frequency effects (LFE) that are felt more than heard in movie theaters. As it needs only about one-tenth the bandwidth of the others, the LFE channel is referred to as a ".1" channel (and sometimes erroneously as the "subwoofer" channel). Figure 4-1 illustrates a typical 5.1 playback system; see question 14 on page 4 for further information on speakers, including subwoofers.

5. How does 5.1-channel Dolby Digital differ from Dolby Surround?

5.1-channel Dolby Digital provides two surround channels to Dolby Surround's one for more precise localization of sounds and a more convincing, realistic ambiance. Also, the surround channels cover the entire audible range (20 Hz – 20,000 Hz), whereas the range of Dolby Surround's single surround channel is limited (100 Hz – 7,000 Hz). This further heightens realism and gives sound mixers more creative freedom.

In addition, Dolby Digital's multiple discrete channels enable more sharply-delineated spatial effects, and its ".1" LFE track makes it possible to reproduce low bass effects with stunning impact (twice as loud as the other channels).

On page 11 you will find a chart comparing Dolby Surround and Dolby

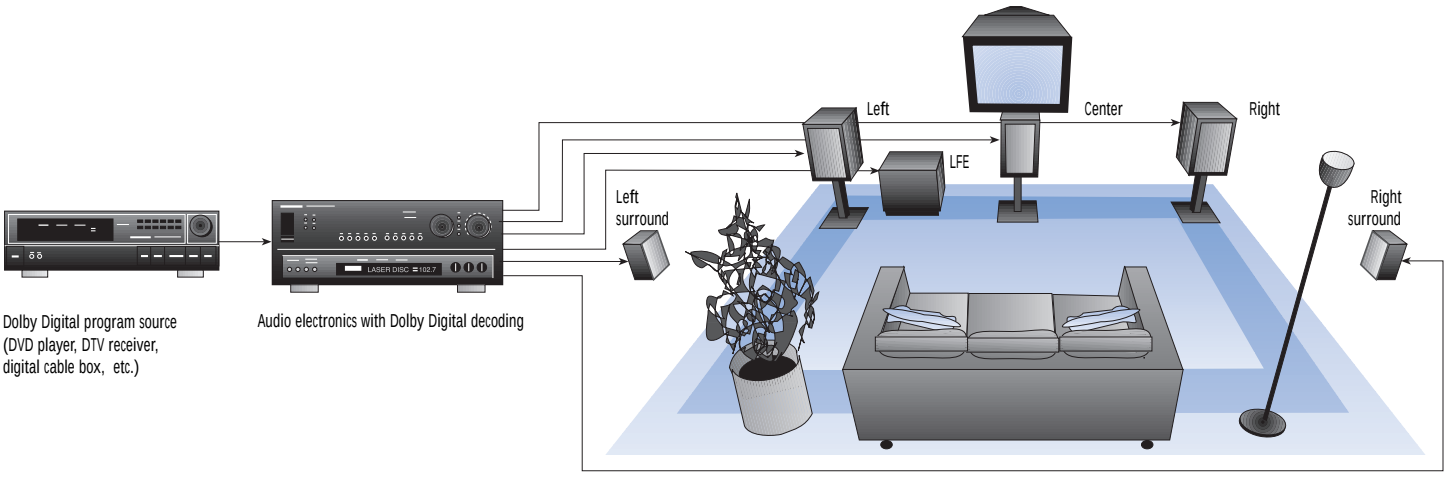


Figure 4-1: Dolby Digital can deliver up to 5.1 discrete sound channels for the ultimate in surround sound.

Digital, and on page 12 a diagram of how each works at the mixing, mastering, and playback stages.

6. Does 5.1-channel Dolby Digital make Dolby Surround obsolete?

No, Dolby Surround will be with us for as long as stereo is with us. This is why all Dolby Digital decoder units also incorporate a digitally-implemented Dolby Surround Pro Logic decoder.

Dolby Surround encodes four sound channels (left, center, right, surround) onto the two tracks of any conventional stereo program source. Dolby Digital soundtracks, on the other hand, can be carried only by Laserdiscs and new formats such as DVD and DTV.

Dolby Surround-encoded programs can be played back in mono, stereo, or with a Dolby Surround Pro Logic decoder that recovers the four original channels. Dolby Surround sources include regularly-scheduled TV programs (over a hundred in the U.S.), plus sports and special events; a growing number of video games, CD-ROMs, and music CDs; and broadcasts, tapes, and discs of thousands of movies.

7. Can I hear 5.1-channel Dolby Digital programs over a regular stereo or Dolby Surround Pro Logic system?

Yes. All Dolby Digital decoders, whether 5.1-channel or two-channel, have a unique feature called "downmixing" that assures full compatibility with any playback system. At your option, the decoder will create "on the fly" from 5.1-channel programs a two-channel, Dolby Surround-encoded mix for playback over a home theater system with Dolby Surround Pro Logic decoding; a two-channel stereo mix for regular stereo and headphone playback; or a mono mix for playback over a mono TV set. See Figure 7-1.

This makes it possible for producers of 5.1-channel programs to provide only the one 5.1-channel mix on the disc or other source. The decoder in the playback system does the rest, automatically conforming the signal to the particular playback circumstances.

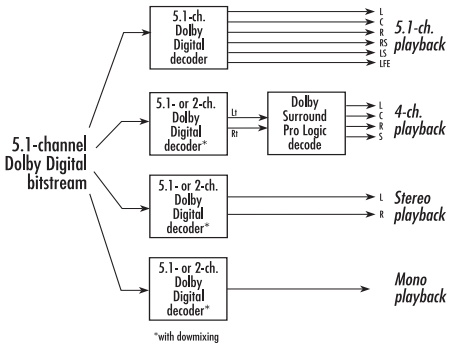


Figure 7-1: Dolby Digital decoders automatically configure the signal to the particular playback circumstances.

Note: downmixing is not used for laser discs because they contain three different soundtracks: stereo PCM for a conventional stereo or Dolby Surround mix; one FM track for a mono mix; and one FM track for a 5.1-channel Dolby Digital mix. Frequently these mixes are prepared at different times, even by different mixers, so can sound quite different from each other.

8. Do all Dolby Digital programs provide 5.1 channels?

No, Dolby Digital soundtracks can provide anything from mono to full 5.1-channel surround sound. DVD-Video discs of movies can even carry multiple versions of the soundtrack that differ in the number of channels. A disc might contain a 5.1-channel sound mix with the dialogue in one language, a Dolby Surround-encoded two-channel mix in another language, and a mono track with the directors' comments or other supplementary information. The default soundtrack will vary from disc to disc, so always check the DVD disc's Language menu for the choices offered.

9. Do all DVD-Video discs have Dolby Digital soundtracks?

Discs in countries such as the U.S. that use the NTSC broadcast TV standard must provide at least one soundtrack in either of two formats: Dolby Digital or PCM (the format used on CDs). In countries using the PAL TV standard, including much of Europe, the discs must include at least one soundtrack in any one of three formats: Dolby Digital, PCM, or MPEG. As a result of these requirements and the options they permit, not all discs have Dolby Digital soundtracks.

Dolby Digital, however, is the only universal *multichannel* standard, and every DVD player sold worldwide incorporates Dolby Digital decoding. Therefore the vast majority of discs do include at least one Dolby Digital soundtrack.

10. How can I determine the soundtrack's format?

The DOLBY DIGITAL logo on a DVD-Video Disc or other program source indicates that it has one or more Dolby Digital-encoded soundtracks, but it does not indicate the number of channels. To help identify the latter, Dolby Laboratories is encouraging the use on program packaging of the channel-format symbols shown in Figure 10-1.

Figure 10-1: Many DVD-Video discs and other Dolby Digital sources display symbols identifying the soundtracks' channel format .

In addition, to prevent confusion at playback, data identifying the original production format of a program's soundtrack is incorporated right into the Dolby Digital signal. Some Dolby Digital decoder units use this data to display on the control panel the type of soundtrack you're listening to. See Figure 10-2.

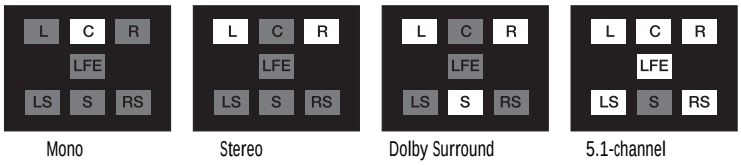


Figure 10-2: Some Dolby Digital decoders feature a display activated by the format data on Dolby Digital soundtracks.

11. Do all program sources with Dolby Digital decoding provide 5.1-channel sound?

As with Dolby Digital program material, "Dolby Digital" on a component such as a DVD player indicates that it incorporates Dolby Digital decoding, but not the number of channels.

Many program sources, including all DVD players and digital cable set-top boxes, provide a built-in, *two*-channel Dolby Digital decoder with analog stereo outputs (see question 7). For 5.1-channel playback, most units have a separate digital output that provides the undecoded Dolby Digital signal (data stream) for connection to an external unit, such as an A/V receiver, that has its own 5.1-channel Dolby Digital decoder. See Figure 11-1.

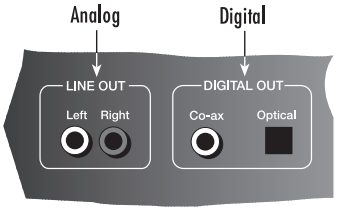


Figure 11-1: Most DVD-Video players provide stereo (two-channel) analog audio outputs (left), plus at least one Dolby Digital output (right). The unit above has two different kinds of Dolby Digital outputs, co-ax and optical; see question 18 on page 4 for advice on which to use when you have the choice.

Some DVD players do provide a built-in Dolby Digital 5.1-channel decoder with multiple analog outputs that can be connected directly to a "Dolby Digital-ready" receiver, as described in question 12, for 5.1-channel sound. However, you will not be able to use the internal Dolby Digital decoder for other program sources, and these players don't offer the full range of options provided by external Dolby Digital decoder units. On the other hand, they are an inexpensive way to upgrade to 5.1-channel Dolby Digital initially, and provide a digital output so that you can later bypass the built-in decoder and use an external one.

12. How do I convert my current Dolby Surround Pro Logic system to 5.1-channel playback?

If your current system consists of separate audio components, you will need a 5.1-channel Dolby Digital decoder and a six-channel preamplifier (available separately or combined in one convenient unit). The preamplifier's outputs will plug into your existing power amplifiers. See Figure 12-1.

If you have an older, integrated A/V receiver with Dolby Surround Pro Logic that does not provide external inputs to its built-in amplifiers, you have two choices. You can replace it with a new receiver incorporating a 5.1-channel Dolby Digital decoder, or add an external Dolby Digital decoder unit that includes center, left surround, and right surround amplifiers to use in place of those in your receiver (which will continue to power the left and right front speakers). See Figure 12-2.

If you have a newer "Dolby Digital-ready" A/V receiver with multichannel connectors for an external Dolby Digital decoder, you can add a decoder anytime, using the receiver's built-in Dolby Surround Pro Logic decoder in the meantime for satisfying home-theater sound. You can also connect the multichannel outputs of a DVD-Video player

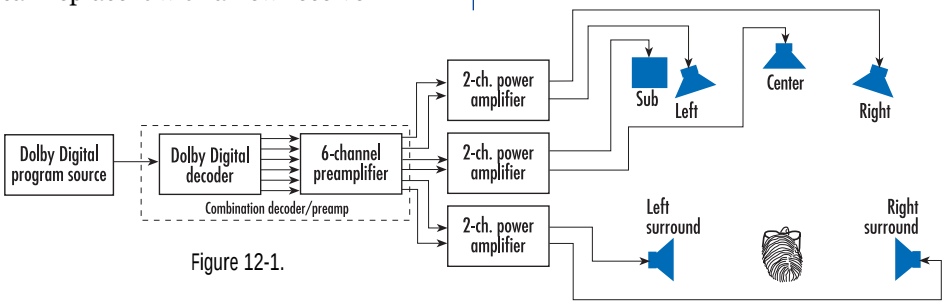


Figure 12-1.

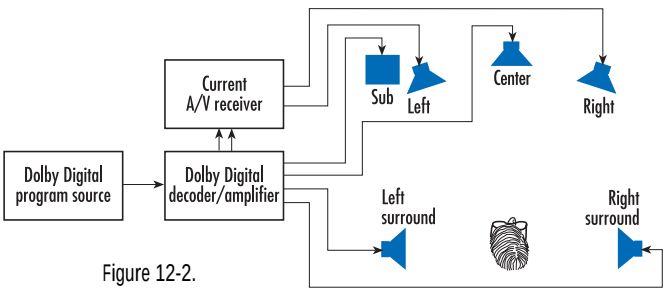


Figure 12-2.

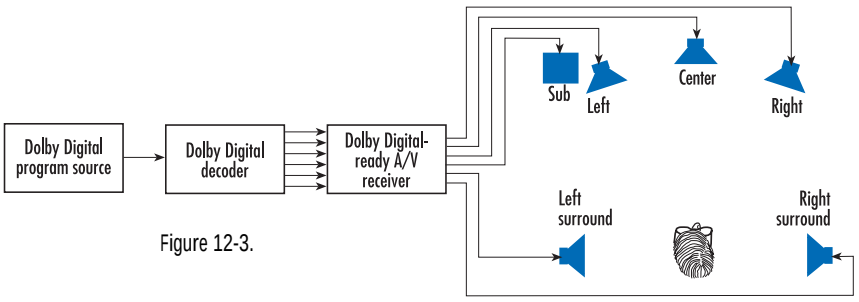


Figure 12-3.

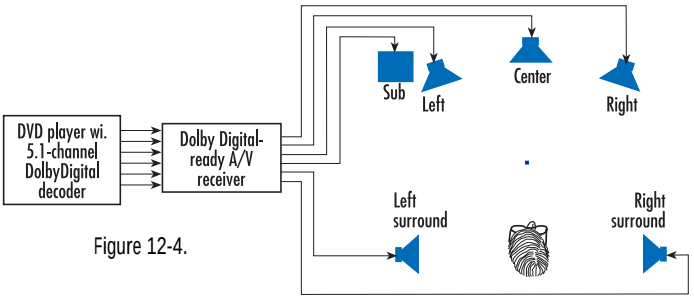


Figure 12-4.

that has built-in 5.1-channel Dolby Digital decoding to this kind of receiver. An external decoder is still needed, however, for other Dolby Digital program sources (see Figures 12-3 and 12-4, and question 11).

Note: be sure that the new decoder unit has a sufficient number of digital inputs to accommodate all the Dolby Digital program sources you expect to use (DVD-Video player, digital cable set-top box, digital TV receiver, etc.) Also, if you plan to play Dolby Digital laser discs, be sure that the unit also includes the necessary RF demodulator (only Laserdiscs require this feature; see question 24).

13. Will I still be able to play Dolby Surround program material?

Yes, all Dolby Digital decoders include Dolby Surround Pro Logic decoding, so you can continue to enjoy Dolby Surround-encoded programs after converting your system.

14. Can I use my current speakers?

Yes, you can use your current speakers, because the configuration for Dolby Digital's five main channels is essentially the same as that for Dolby Surround Pro Logic (refer to Figure 4-1 on page 1).

A unique feature called Bass Management lets you route low bass sounds to those speakers in your system that are best able to reproduce them. For example, you might wish to route the LFE signals to the front left and right speakers, if they have full bass capabilities, or to a separate subwoofer. You can also redirect the surround channels' low bass, and so continue to use the limited-bandwidth surround speakers you got for Dolby Surround Pro Logic playback. Or you could use small satellite speakers for the five main channels and route *all* bass to a subwoofer. You could even go so far as to add a subwoofer to each main channel.

For information on speaker placement, visit www.dolby.com/ht/sound/sound2.html. This information can also be found on page 6 of the booklet "Dolby Surround: The Sound of Home Theater" published by Dolby Laboratories.

15. What kind of speakers should I get for an all-new Dolby Digital system?

The ideal Dolby Digital playback system uses identical full-range speakers for the left, center, right, and each surround channel. If this is impossible, be sure that the overall tonal characteristic, or timbre, of all the speakers is similar. This is equally important for both Dolby Surround Pro Logic and Dolby Digital playback.

Most speaker manufacturers offer timbre-matched home theater speakers. Many also offer systems combining matched compact speakers for the five main channels with one or more separate subwoofers for the non-directional bass; such a "satellite" system can prove an effective, space-saving solution.

16. Should I use bipolar, dipolar, or tripolar surround speakers?

Surround speaker placement, room acoustics, and personal preference are as important as the speakers' radiating characteristic. These factors vary greatly, so Dolby Laboratories cannot recommend a particular speaker for home theater use.

Bipolar, dipolar, and tripolar surround speakers use speaker drivers aimed towards the front and back of the room to achieve a diffuse sound-field like that created by the multiple surround speakers used in movie theaters. Your room's acoustics will effect these designs more than conventional direct-radiating speakers, which, when placed properly, can also make effective surround speakers

.

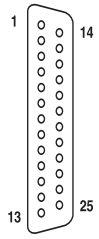
17. My new Dolby Digital decoder has a multi-pin "DB-25" connector, but my audio components only have phono connectors. What do I do?

The DB-25 interface was developed by Lucasfilm THX to save space on the rear panels of home theater products. If your components use a mix of connectors, cables with a DB-25 (25-pin) connector on one end and multiple phono connectors on the other are available from home theater equipment retailers. If you wish to make your own adapter, see Figure 17-1 for the DB-25 pin configuration.

18. My DVD player has two digital outputs, one optical and one coaxial, and my Dolby Digital decoder has both kinds of inputs. Which should I use?

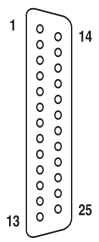
Under most conditions, optical and coaxial digital connections work equally well. Under some rare circumstances, however, coaxial cables,

Unbalanced



Pin	Assignment	Pin	Assignment
1	Left positive	14	Left ground
2	Center positive	15	Center ground
3	Right positive	16	Right ground
4	Subwoofer positive (or L sub)	17	Subwoofer ground
5	Left surround positive	18	Left surround ground
6	Right surround positive	19	Right surround ground
7, 8	Reserved (optional R sub)	20, 21	Reserved
9, 10	Shield drains	22	Shield drain
11	Remote trigger C	23	Remote trigger C ground
12	Reserved	24	Logic ground
13	Remote trigger A (power)	25	Remote trigger A ground

Balanced



Pin	Assignment	Pin	Assignment
1	Left positive	14	Left negative
2	Center positive	15	Center negative
3	Right positive	16	Right negative
4	Subwoofer positive	17	Subwoofer negative
5	Left surround positive	18	Left surround negative
6	Right surround positive	19	Right surround negative
7, 8	Reserved	20, 21	Reserved
9, 10	Shield drains	22	Shield drain
11	Remote trigger C	23	Remote trigger C ground
12	Reserved	24	Logic ground
13	Remote trigger A (power)	25	Remote trigger A ground

Figure 17-1: Pin configuration for DB-25 connectors.

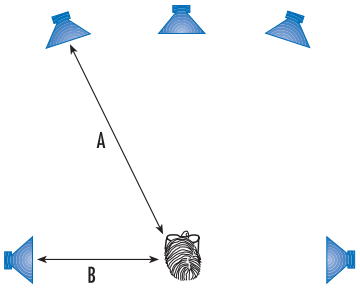


Figure 20-1: Use dimensions A and B to calculate surround delay using either chart to right; setting delay for one mode will provide correct delay for the other.

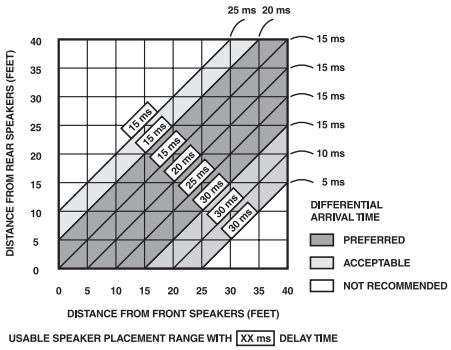


Figure 20-2: Calculating surround delay with decoder set to Dolby Surround Pro Logic mode.

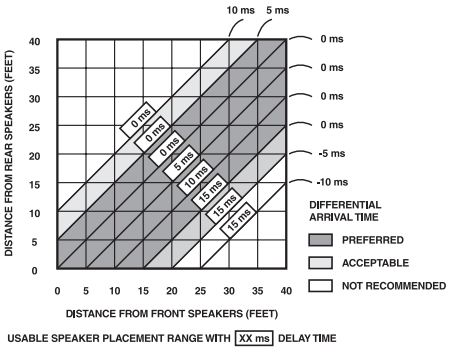


Figure 20-3: Calculating surround delay with decoder set to Dolby Digital mode.

particularly very long ones, can pick up radio frequency (RF) interference generated by household appliances, or nearby high-tension power lines or broadcast towers.

If cost is a consideration, start with coaxial, which is less expensive. If you then hear RF interference, you can try relocating the cables, moving your components closer together so you can use shorter cables, or, if all else fails, changing to costlier optical cable. If cost is no object, using high-quality optical cables from the outset is probably your best long-term choice.

Note: some DVD players and Dolby Digital decoders have *either* a coaxial *or* an optical connector. Be sure that the units you purchase both use the same type.

19. Why does my Dolby Digital decoder provide time delays?

Because the surround speakers in a home theater system are usually closer to viewers than the front speakers, both Dolby Digital and Dolby Surround Pro Logic playback require a split-second electronic delay of the surround channels.

In the case of Dolby Digital, the delay ensures that the viewer hears sound from the surround and front speakers simultaneously. For Dolby Surround Pro Logic, which has less inherent channel separation than Dolby Digital, a slightly longer (by 15 milliseconds) delay ensures that sound from the surrounds arrives just *after* sound from the front. This delay reduces the audibility of sound leakage from the front to the surround speakers.

Some Dolby Digital decoder units also provide an adjustable center-channel delay to ensure that the viewer hears sound from all three front speakers simultaneously.

20. How to I set the surround time delays?

The time delays in your Dolby Digital decoder are preset to provide good results in most home theater installations. If you wish to fine-tune the adjustments, consult the decoder's instruction manual.

Most units allow you to adjust the surround delay in either the Dolby Digital or Dolby Surround Pro Logic mode. Because the relationship between the two delays is fixed, you only need to set the delay in one mode. The decoder will automatically provide the appropriate delay whenever you switch to the other mode.

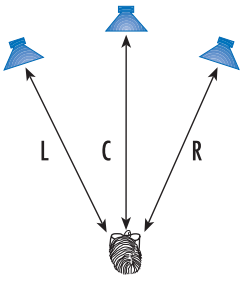
To establish the proper surround delays for your system, you need to know the distances between your viewing position and a front speaker (A) and a surround speaker (B) as shown in Figure 20-1. Then, using Figure 20-2 (Dolby Pro Logic mode) or 20-3 (Dolby Digital mode), find the distance to the surround speaker on the graph's vertical axis, and the distance to the front speaker on the horizontal axis. Lines drawn from these points will intersect on the graph at the recommended delay setting.

21. How do I set the center channel time delay?

You need no center delay (set it at "0") if your seating area is small with a few viewers at any time, and if you can place the three front speakers equidistant from it as shown in Figure 21-1. If the center speaker must be placed more in line with the left and right speakers as shown in figure 21-2, thereby bringing it closer to the viewers than the left and right speakers, add 1 ms of delay for each foot it is closer. For example, if dimension C in Figure 21-2 is one foot less than L or R, set the time delay to 1 ms.

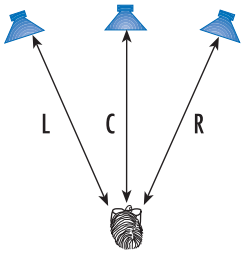
If your seating area is wide, with several viewers in a row as in a movie theater, it's best to place the left, right, and center speakers all in line as shown in Figure 21-3 and use no center time delay.

Finally, if it is necessary to place the center speaker further back than the left and right speakers (not illustrated), select "–1 ms" (for a one foot difference) delay or "–2 ms" (two feet) delay, if these options are provided. If they are not provided, use "0" delay.



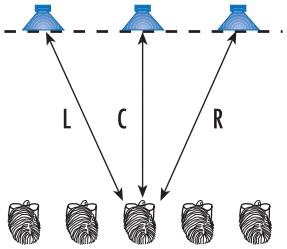
L = C = R:
Center delay = 0.

Figure 21-1.



L = R > C, small seating area:
Center delay (ms) = L or R – C (ft.).

Figure 21-2.



L = R > C, wide seating area:
Center delay = 0.

Figure 21-3.

22. What is the "Midnight Mode" on my new Dolby Digital A/V receiver?

Dolby Digital soundtracks can have a very wide dynamic range between soft and loud sounds. At a full playback level, this can be thrilling, providing a truly theatrical experience, particularly for movies.

Late at night, however, the loud sound effects on movie soundtracks might not be appreciated by your family or neighbors. But if you turn down the volume to "keep the peace," the dialogue will be hard to hear, and subtle low-level effects may get lost altogether.

What you'd really like to do is turn *down* the volume on just the loud effects, turn *up* the volume on quiet sounds, and keep the dialogue at the *same* level. This is what a Dolby Digital feature called Dynamic Range Control does. For lower-level listening, it applies dynamic range compression that preserves low-level sounds, prevents dramatic passages from getting too loud, and keeps dialogue intelligible. To help explain its function, manufacturers of Dolby Digital decoders have come up with names like "Midnight Mode" for this feature. See Figure 22-1.

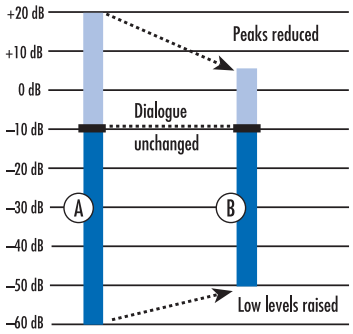


Figure 22-1: With Dynamic Range Control on, the full dynamic range (A) of the program is reduced (B) as predermined by the its producers.

The amount of compression is not arbitrary, but is decided in advance by the soundtrack's producers, and coded right onto the soundtrack. For example, if there's a loud sound coming from the left surround that's meant to startle the audience, the soundtrack mixers might indicate less compression for that sound than other loud sounds when the Midnight Mode is switched on.

Some Dolby Digital decoders let you select various amounts of the available compression (e.g., 50%, 75%, 100%), while others provide only 100% when the compression mode is selected.

23. I'm tired of having to adjust the volume every time the program changes or I switch sources or TV channels. Can Dolby Digital help?

Yes. Conventional program sources often force you to readjust the volume when you change channels or play a different video. With Dolby Digital program sources, on the other hand, a feature called Dialogue Normalization lets you set playback volume and forget it.

Dialogue Normalization automatically adjusts the volume when you change Dolby Digital programs so that the level of the dialogue remains constant. It does not alter the dynamic range, only the overall playback level, based on data about the dialogue that

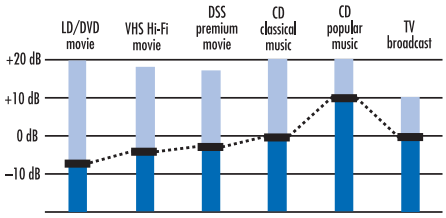


Figure 23-1: The average level of conventional program sources, and even individual programs, varies greatly.

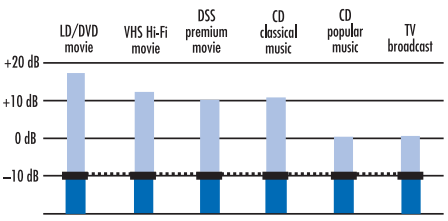


Figure 23-2: Dolby Digital's Dialog Normalization maintains a consistent playback level for all programs keyed to their dialogue level.

is coded into the program signal. See Figures 23-1 and 23-2.

With Dialog Normalization, you can "channel surf" when watching digital TV without having to adjust the volume each time you change channels. Those extra-loud commercials will be tamed. And you can play an evening's worth of DVD-Video discs without ever touching the volume control.

24. What equipment do I need to play Dolby Digital Laserdiscs?

Dolby Digital Laserdisc players do not have a built-in Dolby Digital decoder; they output the Dolby Digital data stream from Laserdiscs on a radio-frequency (RF) carrier that requires demodulation prior to Dolby Digital decoding. If you wish to play the Dolby Digital soundtrack, therefore, be sure that the disc player has a "Dolby AC-3 RF" output and your Dolby Digital decoder unit includes an RF demodulator specifically for laser disc use. Not all decoder units provide the demodulator, because no other Dolby Digital program source, including DVD, requires it.

If you have an older laser disc player and don't want to decode the Dolby Digital tracks on newer discs, they will play perfectly well on your older player. On laser discs, the Dolby Digital track is encoded on what used to be the right FM analog track, leaving the standard PCM digital stereo tracks intact for conventional stereo and Dolby Surround Pro Logic playback. The left FM analog track may contain a mono version of the soundtrack, commentary, or other material. See Figure 24-1.

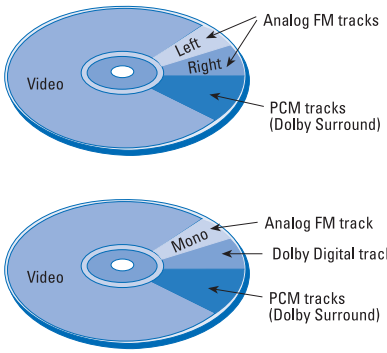


Figure 24-1: Soundtrack configurations of conventional Laserdiscs (top) and those with Dolby Digital audio (bottom)

One final note: laser discs with 5.1-channel Dolby Digital soundtracks were originally identified as Dolby Surround AC-3, "AC-3" being the technical term for the digital audio coding upon which Dolby Digital is based. Today the simpler term "Dolby Digital" is used instead to identify laser discs, like other formats, that have Dolby Digital soundtracks.

25. What equipment do I need to receive satellite broadcasts with 5.1-channel Dolby Digital sound?

To receive the 5.1-channel soundtrack on programs such as the Dolby Digital-encoded theatrical films broadcast by DIRECTV on its pay-per-view channels, you need a new satellite receiver that provides a Dolby Digital output (the "Digital" output on conventional satellite receivers does not handle Dolby Digital signals). As with other Dolby Digital components, you connect the Dolby Digital coaxial or optical output to a digital input on your Dolby Digital decoder unit.

Standard stereo audio, usually Dolby Surround-encoded, is broadcast simultaneously, so you need a new satellite receiver only if you wish to receive the Dolby Digital soundtrack.

26. How can I receive high-definition (HD) satellite TV transmissions with Dolby Digital sound?

To receive high-definition programming transmitted via satellite, you will need an HD satellite receiver, and a new, larger dish. Most receivers are equipped like most DVD-Video players, that is, with a built-in, two-channel Dolby Digital decoder with analog stereo out puts, and a Dolby Digital output for 5.1-channel sound with an external 5.1-channel Dolby Digital decoder unit.

27. Can I use my Dolby Digital home theater system for the new digital TV broadcasts?

Yes, you can: whether high-definition (HDTV) or standard-definition (SDTV), all digital television (DTV) broadcasts use Dolby Digital audio in the U.S., Canada, and other countries that have adopted the ATSC television standard (www.atsc.org). Dolby Digital audio is also used in some countries like Australia in conjunction with other transmission standards.

Like other Dolby Digital program material, the audio format of DTV broadcasts varies from mono to full 5.1-channel surround sound. Because most TV facilities have to gear up for multichannel audio production and distribution, many DTV programs are being broadcast initially in two-channel Dolby Digital (sometimes Dolby Surround-encoded for four-channel playback with Dolby Surround Pro Logic decoding). Movies prepared with 5.1-channel Dolby Digital soundtracks for theatrical release are the primary source of multichannel Dolby Digital DTV programming initially.

DTV sets and tuners also vary with respect to the number of audio channels they provide. Some have built-in two-channel Dolby Digital decoders, while others have 5.1-channel Dolby Digital decoders for connection to a Dolby Digital-ready A/V receiver (see question 12). Others include not only Dolby Digital decoding but also amplifiers and speakers.

Most DTV receivers have a separate digital output that provides the undecoded Dolby Digital signal for connection to your A/V receiver or other unit with 5.1-channel Dolby Digital decoding. As a result, you can add a DTV receiver to your Dolby Digital home theater system at any time, without fear of obsolescence or costly equipment duplication.

28. How can I receive digital cable programs with Dolby Digital sound?

Digital cable television systems can provide you with another source of programming for Dolby Digital playback. The number of channels with Dolby Digital cable transmissions varies as with DTV broadcasts and other Dolby Digital program sources. All digital cable set-top boxes incorporate a two-channel Dolby Digital decoder with stereo analog outputs for compatibility with conventional stereo and home theater systems, and fully-compliant units also provide a digital output for connection to your A/V receiver or other unit for 5.1-channel playback with an external multichannel Dolby Digital decoder.

29. Can I purchase DVD-Video discs with Dolby Digital soundtracks in Europe?

Yes, Dolby Digital audio is used on DVD-Video discs throughout the world (see question 9). A word of caution, though: while the audio and video technical standards are the same for DVD-Video worldwide, discs purchased in one part of the world may not play at all in another part of the world due to "regional coding."

Regional coding was developed at the behest of the film industry, which often releases videos of movies in North America before they've even reached movie theaters in other parts of the world. Discs released in a market like North America (Region 1) can be coded to play only on players manufactured for that market. Take a Region 1-coded disc to another part of the world, and it won't work in the players manufactured for that market. Some discs, on the other hand, are coded as Region 0, meaning they *will* play on all DVD players in all regions. Check the packaging to find out if the disc has any regional limitations.

30. I'm thinking about getting a PC with a DVD-ROM drive. Will it give me 5.1-channel Dolby Digital?

That depends on the computer's configuration and its DVD/audio card, so check the specifications carefully to be sure you get the audio capability you want.

Most PCs can be connected to external playback equipment ranging from amplified stereo speakers to a full 5.1-channel playback system. The latter include not only full home theater systems, but compact, multichannel PC speaker systems incorporating amplifiers and Dolby Digital and/or Dolby Surround Pro Logic decoding. PCs bundled with stereo amplifiers and speakers may have a built-in two-channel Dolby Digital decoder for the DVD-ROM player that will downmix 5.1-channel soundtracks.

Audio outputs possible on PCs include analog power amplifier outputs, line level outputs for external amplifiers, headphone jacks, and RF carriers. They may also provide conventional PCM digital audio outputs, and/or outputs that provide the undecoded Dolby Digital data stream via S/PDIF (IEC 1937), USB, IEEE 1394, LAN, wireless link, or other format connections.

31. I've heard about surround-sound systems that use only two speakers. Do they really work?

Thanks to the increasing power and dropping cost of signal-processing chips, sound that appears to come from around the listener is now possible with just two speakers.

These audio processing systems, often referred to as "virtual surround," require that the listener be positioned in a specific "sweet spot" in front of the two speakers. As a result, they cannot substitute for multiple speakers in home theater applications. But for PCs, where a single user is seated directly in front of the monitor, they can provide a cost-effective alternative to a full, multispeaker surround setup.

There are two fundamental approaches to "virtual surround." Some systems take any stereo program source and create what might be called a "pseudo-surround" effect. The results are inconsistent, however, and can create effects not at all intended by the program producers. The other approach has been developed by Dolby Laboratories to reproduce the actual surround information recorded on multichannel Dolby Surround and Dolby Digital program material, for a more accurate and consistent listening experience.

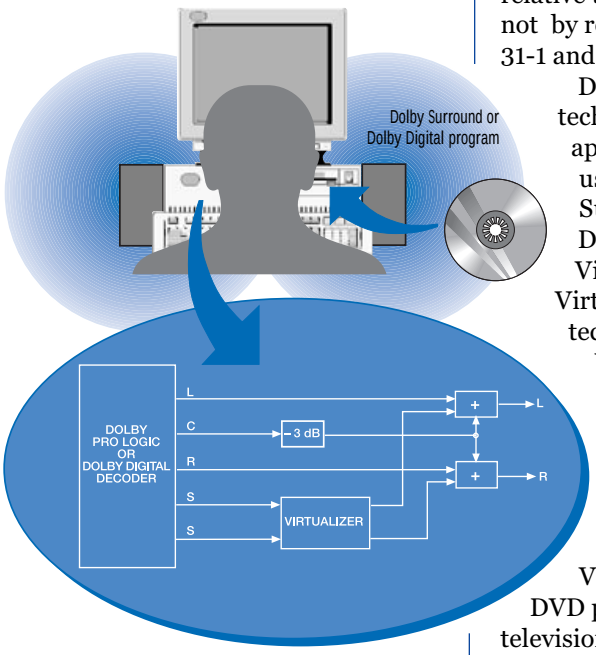


Figure 31-1: Signals from a Dolby Surround Pro Logic or Dolby Digital decoder are processed by a "virtualizer" circuit to produce the effect of surround sound with two apeakers.

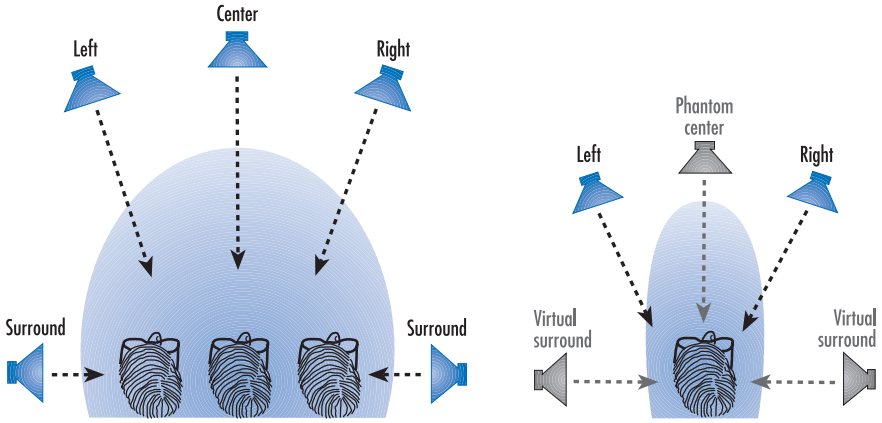


Figure 31-2:While five speakers are necessary for home theater (left), Virtual Dolby Surround and Virtual Dolby Digital (right) provide convingincing surround sound for an individual listener from only two speakers.

Called **Virtual Dolby Surround** and **Virtual Dolby Digital,** these processes start by decoding, respectively, the original four or 5.1 channels of the program material. The center channel is then divided equally between the left and right speakers to create a phantom center image, while the surround signals are processed by a "virtualizer" circuit and mixed in with the main left and right channel signals. The virtualizer processor adds cues to the surround signals based on how we identify a sound's directionality, thereby creating virtual surround images from just two speakers. Unlike a multispeaker home theater system, the center and surround effects are affected only by the listener's position relative to the two speakers, and not by room acoustics. See Figures 31-1 and 31-2.

Dolby offers its own virtualizer technique, and also tests and approves other virtualizers for use in combination with Dolby Surround Pro Logic and Dolby Digital decoding to create Virtual Dolby Surround and Virtual Dolby Digital. Approved technologies include 3D Phonic, Virtual Sonic, VMAx, A3D, Qsurround, N-2-2 DVS, TruSurround, Sensaura, RSX, and Incredible 3D Surround.

Products with Virtual Dolby Surround and/or Virtual Dolby Digital include DVD players, PC/DVD packages, television sets, and multimedia speaker systems.

32. Does Dolby plan to introduce higher data-rate versions of Dolby Digital?

While all Dolby Digital decoders are capable of handling data rates as high as 640 kb/s, the 448 kb/s rate used on DVDs provides sound quality that critical listening tests have consistently confirmed as on a par with original master tapes. Therefore Dolby has no plans to promote the use of higher data rates, particularly since in applications such as DVD and DTV they could cut into the amount of data available for the picture, thereby potentially compromising picture quality.

33. I've heard that Dolby Digital isn't as good as some competing systems. Is this true?

No, it's not. In fact, most such statements are based on the assumption that "more is better," and not on proper listening tests.

To understand what's going on with respect to Dolby Digital and competing systems, you first need to know something about "perceptual" digital audio coding.

Conventional pulse-code modulation (PCM) digital audio, like that on CDs, takes up a lot of storage and transmission space—so much so that multiple channels of PCM for surround sound are usually impractical, particularly if the medium has to carry data-hungry digital video in addition to audio.

As a result, Dolby Digital and other perceptual coding systems such as DTS have been developed to save

space by transmitting only the data that's necessary to portray the original sound, in essence throwing away the rest (which is why these are sometimes known as "lossy" coding systems). A complex scheme or *algorithm* based upon psychoacoustics, the science of how we perceive sound, selects which data is to be transmitted and which is to be discarded.

With Dolby Digital, a 5.1-channel program requires less than one-tenth the data of just one channel of the PCM audio used for CDs. Some competing systems such as DTS operate at higher, less efficient data rates, and their proponents imply that by definition they must sound better than Dolby Digital.

The data rate of a digital coding system, however, does not in itself define its sound quality; the coding algorithm is equally, if not more, important. Dolby Digital's algorithm, technically known as Dolby AC-3, is based upon Dolby Laboratories' decades of research into how we perceive sound. As a result, Dolby Digital achieves very high sound quality at the low data rates necessary for uncompromised picture quality on such formats as DVD-Video discs.

Before selecting Dolby Digital as the audio standard for new formats such as DTV, panels of critical listeners compared various perceptual coding systems not to each other, but to original master recordings. Differences between the masters and their Dolby Digital counterparts were judged insignificant enough to choose Dolby Digital as the standard. Dolby Laboratories has conducted similar comparisons for audio professionals, with much the same result.

34. Don't some products now incorporate DTS decoding?

Yes, a number of A/V receivers and decoder components now incorporate DTS as well as Dolby Digital decoding. However, the total population of DTS decoders is comparatively small, given that Dolby Digital is also included in many millions of DVD-Video players, set-top boxes, and other products.

Most importantly, program material with DTS-encoded soundtracks is rare, and likely to remain so. Programming with Dolby Digital-encoded soundtracks, on the other hand, is plentiful, and more is becoming available all the time.

One reason for the abundance of Dolby Digital programming is that Dolby Digital is the audio standard for media such as DTV. Also, for DVD-Video, Dolby Digital is what's called a "mandatory" audio coding format, meaning that a Dolby Digital soundtrack can be the only one on a disc. DTS, by comparison, is an "optional" coding format, meaning that the disc must have a mandatory-format soundtrack as well. Because providing both soundtracks on a disc would make it impossible to provide such features as multiple-language versions of the soundtrack, or necessitate lower picture quality, few DVD producers are likely to take the DTS route.

Another advantage of Dolby Digital is its wide-spread adoption by the movie industry. More than three times as many films have been released in Dolby Digital than in any other digital format, providing a vast library of titles readily available for release in Dolby Digital consumer formats.

A final advantage that keeps the list of Dolby Digital programs growing is that hundreds of facilities throughout the world have been equipped to produce them. Dolby Laboratories manufactures a range of professional encoding and decoding equipment for this purpose, licenses providers of DVD disc-authoring systems, and regularly conducts seminars in multichannel audio production, distribution, and broadcasting for audio professionals.

35. Will Dolby provide 5.1-channel music CDs?

Nobody is more enthusiastic about multichannel sound than Dolby Laboratories. However, we also recognize the importance of standardization, compatibility, and the reluctance of producers to release, and retailers to stock, more than one version of a given program. As a result we will not release CDs with Dolby Digital soundtracks, or encourage others to do so.

5.1-channel music CDs, such as those released by DTS, are non-standard; they don't provide the PCM audio specified by the CD "Red Book." They are also incompatible in that they cannot be heard at all without a special external decoder, and in many cases require a specially-equipped CD player as well.

Newer formats like DVD-Video discs, on the other hand, have been developed from the outset to support multichannel digital audio. For compatibility, these new formats can, if necessary, carry more than one kind of soundtrack. In addition, as explained in question 7, sources with Dolby Digital soundtracks are inherently compatible with mono, stereo, and Dolby Surround Pro Logic playback systems.

For older stereo formats, including CD, there's tried-and-true Dolby Surround, a fully compatible format enabling two-channel soundtracks to be encoded with four-channel surround sound (see question 6). Among the program sources encoded with Dolby Surround are more than 700 CD titles.

When it comes to music-only recordings with multichannel digital audio, a new kind of DVD disc called DVD-Audio has been developed (see question 36).

36. Can I play the new DVD-Audio discs on my DVD-Video player or my computer's DVD-ROM drive?

Like DVD-Video discs, the new DVD-Audio discs can carry a variety of soundtracks, with mono, stereo, or multichannel sound, using different forms of audio coding. Dolby Digital is an optional coding format for DVD-Audio, and those discs that use it will play on any DVD-Video player and on any DVD-ROM drive with Dolby Digital decoding.

Otherwise, you'll need a new player to enjoy the multichannel sound from DVD-Audio discs recorded in very high-resolution PCM audio, or a new kind of coding called MLP (Meridian Lossless Packing) that saves disc space not by eliminating data, but by storing it more efficiently. These formats require new kinds of digital decoding that is included in DVD-Audio players and "combi" DVD players designed to play both audio and video DVD discs.

How Dolby Digital Works

The digital audio coding used on compact discs (16-bit PCM) yields a total dynamic range of 96 dB from the loudest sound to the noise floor. This is achieved by taking 16-bit samples 44,100 times per second for each channel, which is often too much data to store or transmit economically, especially when multiple audio channels are required. As a result, new forms of digital audio coding—often known as "perceptual coding"—have been developed that eliminate redundant data, thereby reducing data rates with a minimum of perceived degradation of sound quality.

Lessons learned from noise reduction

Dolby Digital is the first perceptual coding system designed specifically to process multichannel digital audio. It benefits from Dolby's development of two prior successful perceptual coding systems, and of what are in essence *analog* perceptual coding systems: the full gamut of Dolby professional and consumer noise reduction systems. Indeed, Dolby Laboratories' unique experience with audio noise reduction is essential to Dolby Digital's data rate reduction, as the fewer the bits used to describe an audio signal, the greater the background noise (known as quantizing noise).

Dolby noise reduction works by lowering the noise when no audio signal is present, while allowing strong audio signals to cover or mask the noise at other times. Thus it takes advantage of the psychoacoustic phenomenon known as auditory masking. Even when audio signals are present in some parts of the spectrum, Dolby NR reduces the noise in the other parts so the noise remains imperceptible. This is because audio signals can only mask noise that occurs at nearby frequencies.

Putting masking to work

Dolby Digital has been designed to take maximum advantage of human auditory masking. It divides the audio spectrum of each channel into narrow frequency bands of different sizes optimized with respect to the frequency selectivity of human hearing. This makes it possible to sharply filter coding noise, so that it is forced to stay very close in frequency to the audio signal being coded. By reducing or eliminating coding noise wherever there are no audio signals to mask it, the sound quality of the original signal can be subjectively preserved. In this key respect, a perceptual coding system like Dolby Digital is essentially a form of selective and powerful noise reduction.

With Dolby Digital, bits are distributed among the filter bands as needed by the particular frequency spectrum or dynamic nature of the program. A built-in model of auditory masking allows the coder to alter its frequency selectivity (as well as time resolution) to make sure that a sufficient number of bits is used to describe the audio signal in each band, thus ensuring noise is fully masked.

Pooling the bits

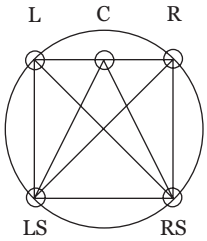
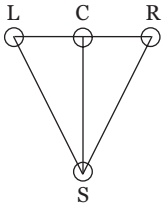
Dolby Digital also decides how the bits are distributed among the various channels from a common bit pool. This technique allows channels with greater frequency content to demand more data than sparsely occupied channels, for example, or strong sounds in one channel to provide masking for noise in other channels.

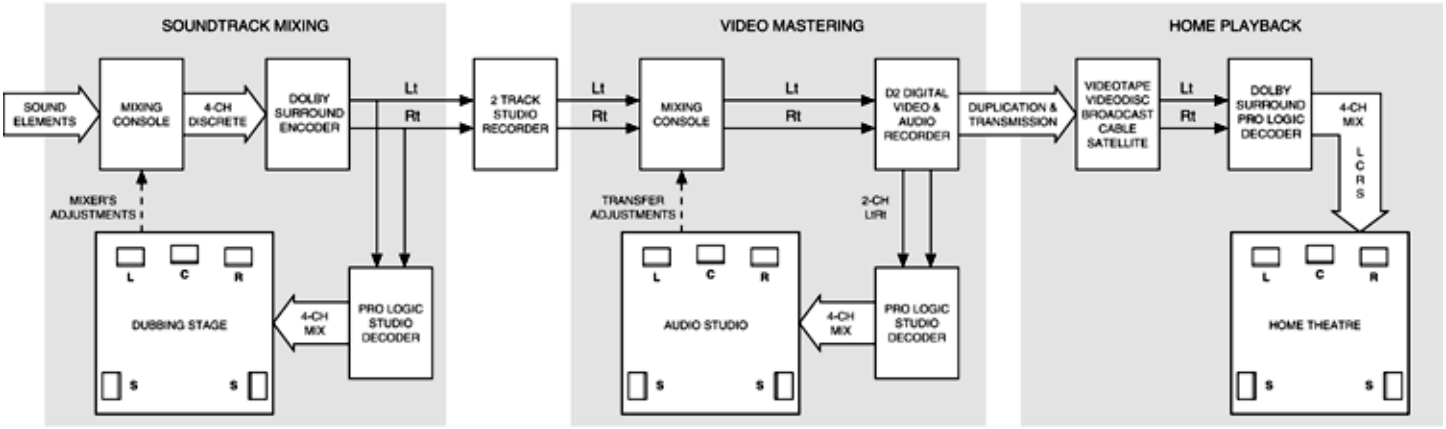
More bits for audio

Dolby Digital's sophisticated masking model and shared bit pool arrangement are key factors in its extraordinary spectrum efficiency. Furthermore, where other coding systems have to use considerable (and precious) data to carry instructions for their decoders, or to carry the same audio in separate channels for compatibility reasons, Dolby Digital can more of the transmitted data to represent essential audio, which means inherently higher sound quality.

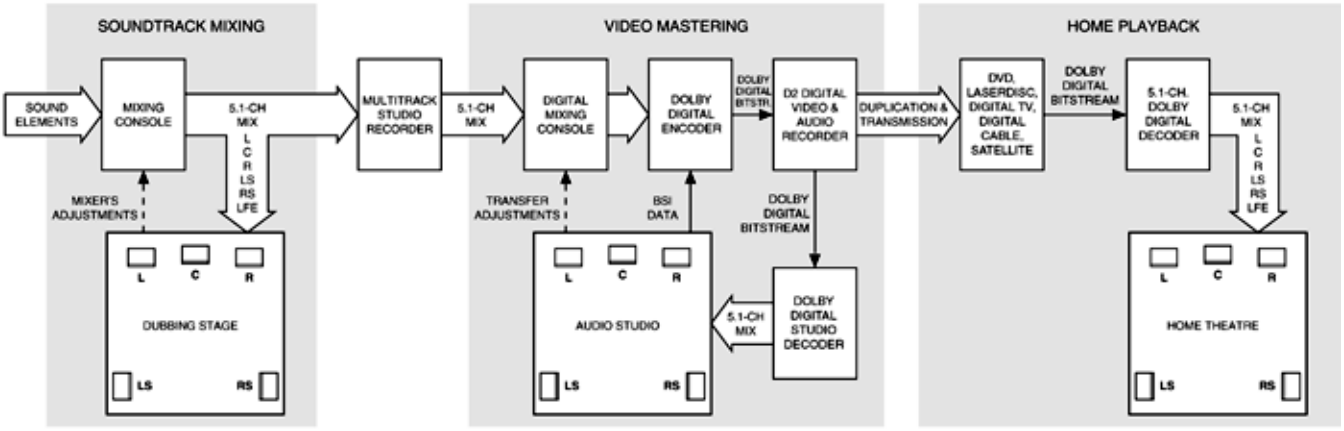
Dolby Digital can process up to 24-bit dynamic range digital audio signals over a frequency range from 20 Hz to 20 kHz on the full-range channels, and from 20 Hz to 120 Hz on the LFE channel. Sampling rates of 32, 44.1, and 48 kHz are supported at a variety of data rates covering a wide range of requirements.

Dolby Digital vs. Dolby Surround

	Dolby Digital	Dolby Surround Pro Logic
Surround channels	Stereo, full range (20 Hz – 20,000 Hz).	Mono, limited range (100 Hz – 7,000 Hz).
Low frequency effects channel	Yes (20 Hz – 120 Hz).	No.
Panning options	Multiple. 	Left to right, right to left, front to back, back to front. 
Channels	Six discrete; each channel can carry a different signal simultaneously.	Four derived; only one dominant signal can be decoded at a time.
Other	Improved sound imaging via “time alignment,” i.e., making it sound like each speaker is the same distance from the listener.	Economical way to achieve high performance surround sound.
	Appropriate compression adjustments during low volume playback of dynamic movie soundtracks (late at night, for instance) to ensure low-level program content is retained.	Surround sound from any non-encoded stereo source.
	Decoders programmable to route low bass only to channels in the system equipped with wide-range speakers or subwoofers.	Compatible with all current and future two-channel formats.
	A dramatic step forward in listener involvement. Unprecedented creative opportunities for program producers, directors, recording engineers, performers.	Represents a major step forward in sound over conventional stereo. The most widely-used surround format worldwide.



Dolby Surround delivery path.



Dolby Digital delivery path.

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