Digital Audio Technology White Paper

Why do I need a hardware decoder?

Unlike traditional multimedia speaker systems, Logitech's new Z-680 5.1 speaker system features Dolby Digital and DTS hardware decoding. In other words, this THX-certified speaker system contains the hardware necessary to play back true 5.1 digital surround sound from PCs, DVD players and advanced game consoles such as the PlayStation 2 and Xbox.

There are three primary benefits to having a speaker system with a built-in hardware decoder:

1. On most PC systems, the software DVD players that come bundled with the system will only play back stereo sound. To get all six sound channels (5.1 audio), you need to purchase a 'full version' of the software DVD player. Buying a speaker system with a built-in decoder eliminates the need for this additional software.
2. All 5.1 audio tracks are stored in a compressed, encoded format – and must be decoded and decompressed in real time. This decoding process requires a significant amount of processing power. If you use a 'full version' of a software DVD player to do the audio decoding on the PC, the processor can easily become overtaxed – resulting in dropped or freezing video frames and/or a 'stuttering' soundtrack. Offloading the audio decoding to a dedicated hardware decoder frees the PC processor to concentrate on decoding the video – resulting in a smoother, more enjoyable DVD experience.
3. Most newer PlayStation 2 and Xbox games include support for 5.1 digital soundtracks. These soundtracks make the gaming experience much more realistic and immersive. These consoles do not have the ability to decode 5.1 audio tracks, which means you must have an external hardware decoder if you want the full 5.1 experience. Without a decoder, all you will hear is stereo sound. (The same is also true when watching DVD movies on a standalone DVD player. To get 5.1 sound, you must have an external decoder.)

Surround-sound audio technology

A number of surround-sound technologies have emerged over the past two decades. These technologies have been developed so that home theatre systems could reproduce or create multi-channel audio from TV, game consoles, cable, VHS and DVD players. Below is a summary of the most common technologies and the benefits they bring to the consumer.

Dolby Pro Logic

Dolby Pro Logic is the original analogue surround-sound format – dating back to the mid '80s – and is still a very common format in use today. It is primarily used on devices limited to two-channel analogue sound, such as VHS movies as well as many TV shows. Dolby Pro Logic is a four-channel system (4.0), providing tracks for left, right, centre and a common surround channel.

The soundtrack is encoded in a 'matrix' format to two-channel stereo– meaning that the centre and surround signals are 'mixed in' to the standard left and right channels. When playing the soundtrack, a Pro Logic decoder will pull the centre and surround signals back out and play them on the centre and surround speakers.

The major advantage of Pro Logic is that it can be delivered over standard analogue stereo channels (such as VHS or TV). The major disadvantage, however, is that the signals are not discrete – meaning that there is no true separation of the sounds in different channels. The content that can be placed in the centre and surround channels is limited to the capabilities of the Pro Logic decoder – which tends to place human voice in the centre channel and ambient effects in the surround channel.

Dolby Digital

Dolby Labs revolutionized movie sound in 1992 when it introduced Dolby Digital surround sound into movie theatres. Unfortunately, the new audio track needed to deliver surround sound took up a lot of space. To solve this problem, Dolby invented the AC-3 compression format, allowing six channels of audio to fit into one-tenth of the space it previously held, without compromising the sound quality in a discernable way. This invention, along with developments in integrated circuitry, has allowed this technology to enter the home market, starting with the laser disc player in 1995. Now Dolby Digital hardware decoders are key features in nearly all home-theatre Audio/Video receivers.

Dolby Digital is designed to handle multiple types of audio streams – from mono to full 5.1 channel sound formats. It runs at data rates of 192 to 448 kbps, depending on the number of audio channels and the application.

Some of the advantages of Dolby Digital over older technologies (such as Pro Logic) are that there are six channels of sound, all discrete and kept separate throughout the process of transmission, storage and playback. Five main channels (front left, centre, front right, left rear and right rear) all cover the full audio range (20 Hz to 20,000 Hz) and allow for more realistic and clearer spatialization of sound. The sixth channel covers special low frequency effects (LFE), ranging from 20 Hz to 200 Hz, i.e. 1/10th the bandwidth of the other five channels. Thus the naming of 5.1.

Dolby Digital soundtracks are the standard audio format for virtually every DVD worldwide. Dolby Digital is also the standard 5.1 soundtrack used on Xbox games.

DTS Digital Surround

DTS Digital Surround is a sound format used to compress, decode and play back the huge audio files in movies. Its goal is to compress the audio without noticeably diminishing audio quality. The DTS claims its algorithms are optimised to deliver 'master quality' soundtracks. DTS algorithms are exclusively designed for 5.1 and higher soundtracks. Like Dolby Digital, each of these tracks is discrete – no matrixing is involved. To achieve what DTS calls 'master quality sound', DTS uses a higher bit rate than Dolby Digital. This corresponds to a lower compression rate – which means that less of the original signal has been removed. DTS typically runs at data rates between 754 and 1509 kbps. DTS tracks are becoming a common 'master soundtrack' option on many newer DVD movies. Many newer PlayStation 2 games also use DTS as the standard audio format for delivering 5.1 sound.

Dolby Pro Logic II

Dolby Pro Logic II is a new, improved version of Dolby Pro Logic, designed to create an immersive 5.1 surround-sound experience from stereo music sources in addition to offering 5.1 channel performance from older Dolby encoded movies.
(In contrast, the original Pro Logic produced 4.0 channels of sound while Pro Logic II has 5.1 channels of sound.) Pro Logic II has two different modes – Movie and Music – that create sound fields optimised for different types of content.

The Movie mode retains the important features of Pro Logic, but uses a full-bandwidth stereo surround output, so the listening experience is much closer to the sound you get from Dolby Digital.

While the original Dolby Pro Logic was intended only for encoded Movie tracks, the new Pro Logic II Music mode accommodates unencoded music sources. The Music mode provides three new controls that allow fine-tuning of the music sound field. Centre Width allows you to gradually spread the centre channel sound into the front left and right speakers. Panorama wraps the sound of the front left and right speakers around you for an exciting perspective. The Dimension control adjusts the front/back balance to suit your taste.

What is THX?

Unlike Dolby Digital and DTS, THX is not a surround-sound technology. THX is a certification process. Speakers bearing the THX symbol have met Lucasfilm THX standards for outstanding audio quality. The THX certification program was initiated after the introduction of Star Wars for the purpose of improving the quality of sound heard in theatres. Today it has become the stand of excellence for great sound in both theatres and homes.

Specifically, THX certification insures that the speakers provide:

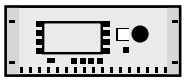
- Wide frequency range covering the lowest to the highest audible sounds
- Smooth frequency response over the entire range
- The ability to hear the full dynamic range, from the softest whisper to the loudest explosion, without distortion
- Enveloping surround sound and better sound localization
- Unsurpassed dialogue intelligibility, allowing you to fully understand what is being spoken

The Logitech Z-680: THX-certified digital theatre-quality sound

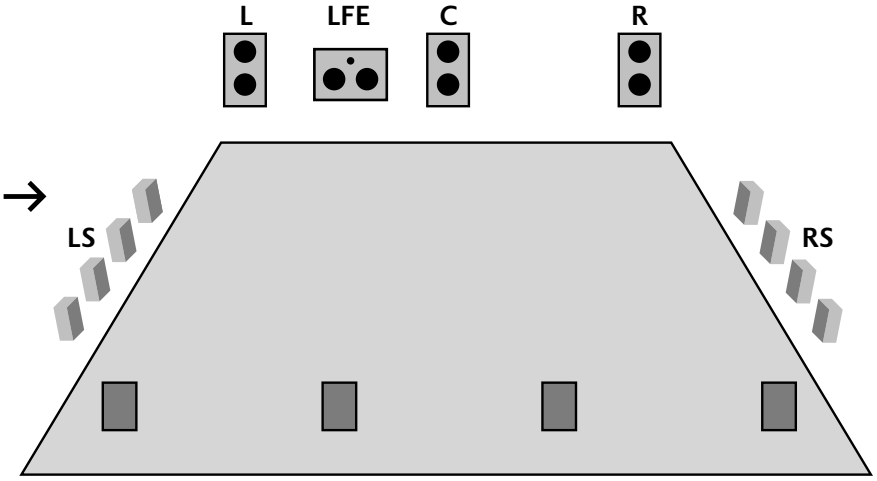
The Logitech Z-680 speaker is the only multimedia system including a digital control box that can accurately deliver all standard surround-sound technologies: Dolby Digital, DTS Digital Surround and Dolby Pro Logic II. In addition, these speakers are THX-certified, so they meet the stringent standards set by Lucasfilm for sound reproduction in the home. The Z-680 is unique in providing all these features and benefits in one package.

Movie Cinema

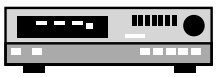
Dolby Digital or DTS release print



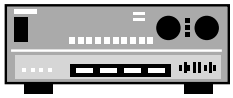
Dolby Digital or DTS cinema processor



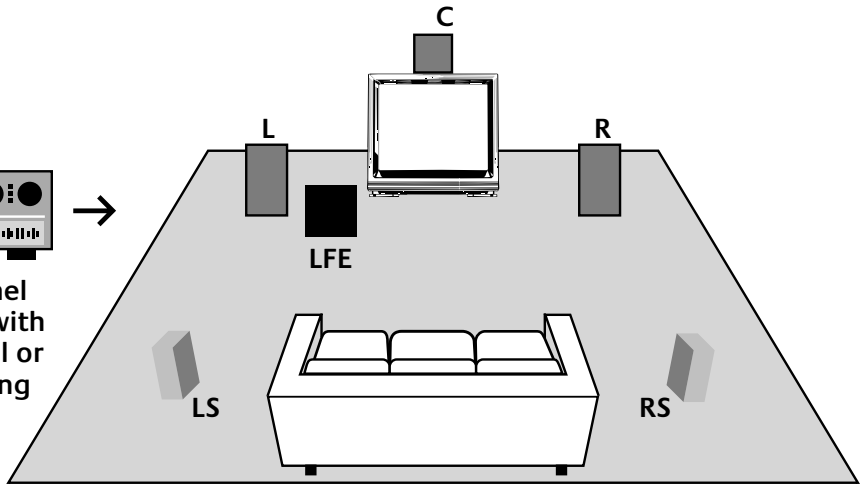
Home Theater



DVD player with Dolby Digital or DTS output

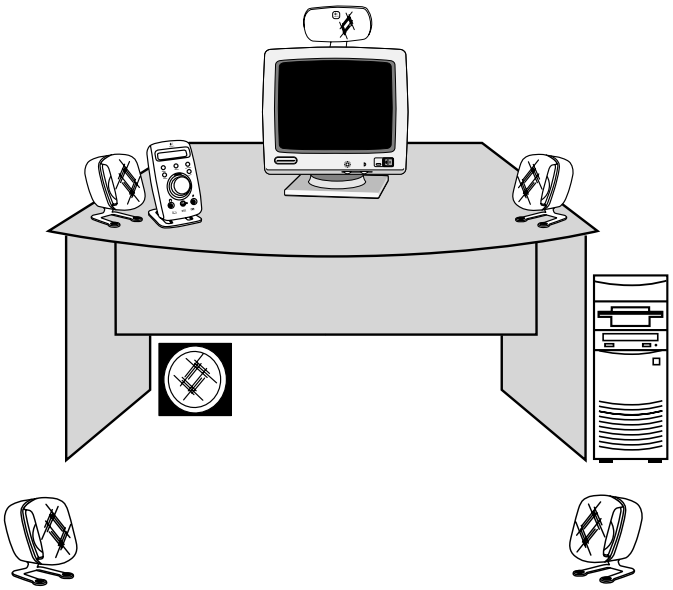


Multichannel electronics with Dolby Digital or DTS decoding



PC Theater

Powered by the Logitech Z-680 Speaker System

PC with 6-channel sound card and DVD drive

Z-680 Dolby Digital and DTS Digital decoder