



Performance Media Industries, Ltd.

How a DVD Player Works – The Inside Edition
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A DVD of the latest blockbuster movie is sitting in the tray of a DVD player about to unleash a whole big fictional world upon spectators waiting with bated breath. The picture and sound components of the show took months, maybe even years to be crafted. The content was carefully transferred to the super-high-tech digital media that makes a DVD, and the laser is heating up and ready to read the audio and video data from the gargantuan series of pits along the long spiral that threads its way through the disc. (The spiral, if it were unraveled, would be over 7 miles long). Now what? Let's put the whole thing into freeze-frame mode and talk about what has to happen inside the DVD player to make the movie shine.

The digital data containing our picture and sound experience is all interleaved in a serial form along with a mixed bag of sub-picture, text, and control data. The laser diode picks it all up and sends it to a de-multiplexer circuit, which separates the streams and sends them to the audio, video, text, and graphics processors.

The video data stream is in a compressed digital form called MPEG2 (Moving Pictures Experts Group), and needs to be turned back into a linear data stream. An MPEG2 decoder circuit handles that task and spits out a serialized digital component video signal. The player adds blanking intervals and all the other synchronization waveforms at this time. The decoded signal conforms to CCIR601 standards, and is, in fact, a digital version of analog component video signals. It is also the main element in an SDI digital video connection, which is why copy protection advocates are worried about users having access to the video signal at this point; it's one of the purest forms of data available inside the player. The 8 bit digital component signal is turned into analog signals through Digital-to-Analog (DA) converters (sometimes 10 or 12 bit to reduce losses), then fed to video buffer amplifiers and out to the RCA connectors on the back of the player. The composite and Y/C signals are summed out from the component signals and fed to their respective connectors. With newer players, we have a bunch of extra options for the video signal treatment. The first is progressive video conversion. The video in the CCIR601 stream is interlaced-field video, and it can be fed to a processing circuit that buffers the fields and turns the picture into two full-frame fields. The

picture's vertical resolution is improved, and if the process is done well, the results can be stunning. Look for players featuring the DCDi circuit licensed by Faroudja, as they provide super-clean processing. Some of the other de-interlacing circuits work well, too. Here, you will need to be the judge by playing a video test pattern with a resolution chart on it and verifying that there are no losses through the progressive conversion. Another key feature starting to show its head is digital video outputs. A few players are out there with SDI, but don't count on these being around for too long, as the copyright police will be going house to house to track them down and destroy them in a ceremonial crush. A newer crop of digital video interfaces, Digital Visual Interface (DVI) and its extension spin-off High Definition Multimedia Interface (HDMI) will start to show up on players soon. These new digital interfaces support the transfer of digital video with copy protection and also control data information that will automatically set displays to the correct format for the incoming video. HDMI can even ship digital audio from point to point, greatly simplifying hookup and reliability.

The audio data streams come in several flavors and languages, too. A typical movie will have three or four audio streams, which are selected via the user interface of the player. The audio streams are picked off by the de-multiplexer and sent to the audio digital processing circuitry. A DVD player must always, by specification of the DVD forum, incorporate at least 2-channel Dolby Digital and PCM (Pulse Code Modulation - the garden variety uncompressed digital signals found on CDs) decoders that feed analog outputs. At the same time, there are multi-channel Dolby Digital and DTS audio signals, plus a few more choices we may want to access. Say you have a movie with a Dolby Digital 5.1 audio track on it. The digital bitstream signal is fed to the audio processor circuit. The Dolby Digital signal is decoded into PCM and turned into a 2-channel downmixed version by an automated internal algorithm. The two digital signals show up as PCM at the DA converter circuits, and the analog circuit is then fed out to the RCA connectors via output amplifiers. The original multi-channel Dolby Digital bitstream is also made available for external decoding by packaging it in what looks like Sony-Philips Digital Interface (S/PDIF) form and sending it out through an optical drive circuit, or a coaxial transmission line with 75 Ohm characteristic impedance. Some players have built-in multi-channel Dolby Digital decoder circuits, which translate 5.1 channels into PCM and convert the PCM to analog, which is then fed out through six RCA connectors.

This practice of internal 5.1-channel decoding is acceptable, but beware that bass management options are often limited on DVD players, as are the adjustment ranges and resolutions for channel levels and time delays.

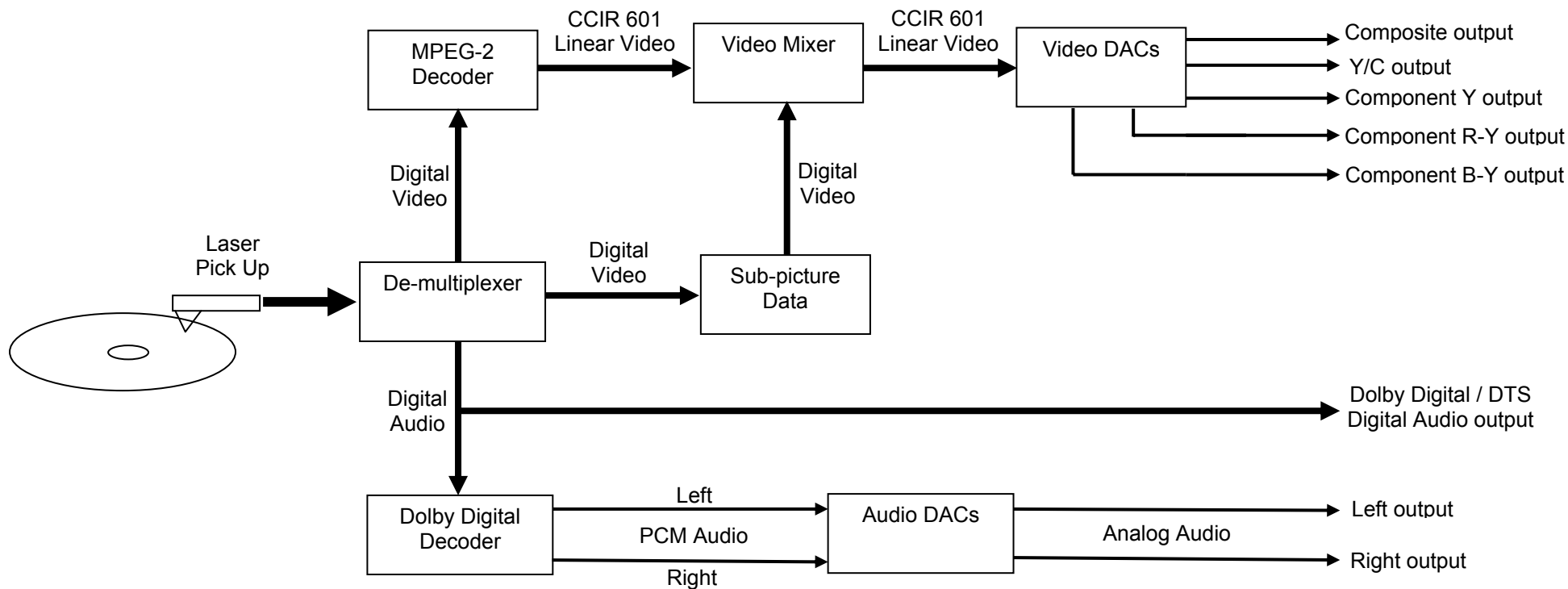
Some DVDs incorporate DTS tracks, which are usually decoded externally. The player has little more to do than correctly pick the track per user instructions and ship it out to the digital audio connector. Some early DVD players didn't allow DTS signals to go

through since they didn't conform to the bitstream standards of PCM or Dolby Digital. Most new players are designed to pass DTS signals. These players will have a DTS logo on the front panel to indicate compatibility. Some recent players can even decode the multi-channel DTS track internally, in which case the player outputs analog signals via the multiple RCA connectors. Again beware of the limited bass management and calibration functions.

DVD players also come with other options such as DVD-Audio, Super Audio CD and then some, but the audio and video signals go through pretty much the same stages.

A DVD player has a lot of work to do to usher the picture and sound content into a home theater. The processes are really very high-tech, even though DVD players are remarkably affordable these days. Some of the players do a good job of the audio and video processing, while others are pretty marginal. It has been my experience that price doesn't always tell the whole story. You can learn to spot the differences between the right and wrong implementations by looking at video test patterns and listening to or measuring audio test signals. Maybe we'll talk about that later. In the mean time, take the player out of freeze frame, and let the movie rip!

This article is based on a column published by A. Grimani in Residential Systems magazine May 2003.



Block diagram of a typical DVD player