

Film-Tech

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Studio Mixing Guide

Digital Theater Systems is a world leader in providing digital audio for motion pictures. This guide provides background information and helpful tips for producing printmasters that take advantage of the sonic performance possible with DTS.

I. How does DTS work?

Six digital audio channels in a 5.1 format (i.e., left, center, right, left surround, right surround and subwoofer) are recorded on to a CD-ROM. A simple, robust, and easy to read time code track is simultaneously recorded on to the optical negative as the standard stereo optical sound track is exposed. This 5 mil (0.005 inch/127 microns) wide track is printed on a safe, non-contact area of the film, inside the normal SMPTE specified soundtrack exposure aperture. This location is not used for picture or audio.

A miniature reader, smaller than a person's fist, is mounted on to the projector, between the feed arm and the projection head. The reader is not sprocket driven, does not increase the load on the projector motor, and has a long life L.E.D. light source. A prewired cable connects the reader to the main electronic package of the system. Power for the reader is supplied from the main electronics. Logic and audio signal switching relays control the selection of the DTS digital audio track or the backup analog track.

The film is threaded through the reader and the rest of the normal film path. When the reader begins reading time code, the audio from the CD-ROM will play synchronously with the picture, the audio becomes a slave to the projector, and consequently, the audio editing will match any physical edit of the film.

II. What analog audio processing is required for the DTS format?

There are 6 source channels: left, center, right, left surround, right surround and subwoofer. The front channels are recorded on the disc without any manipulation. The subwoofer information is filtered with a steep lowpass at 80Hz and is added to each of the surround channels. The resulting 5 audio channels are then digitized and recorded on to the CD-ROM. Upon playback, each surround channel is crossed over with the subwoofer at 80Hz. A sum of the surround channels is also created for mono surround theaters.

III. What equipment is necessary?

In a mixing environment set up for six track audio with split surrounds and subwoofer, a DTS Tower (transfer encoding matrix) is necessary. DTS Towers will be provided by DTS to any facility mixing a DTS licensed film, free of charge. The DTS Tower can also generate a Lt / Rt mix for the optical track or video version that is 100% compatible with all surround decoders.

IV. What are the DTS technical specifications?

Frequency Response	Left	20Hz - 20kHz
	Center	20Hz - 20kHz
	Right	20Hz - 20kHz
	Left Surround	80Hz - 20kHz (The surround channels are crossed over to the subwoofer at 80Hz, ensuring that the surround speakers are not over-driven with low frequency information and still providing full frequency bandwidth surround channels.)
	Right Surround	
	Subwoofer	20Hz - 80Hz (Includes the subwoofer channel information and the surround channel's information below 80Hz.)
System Capacity	Approximately 100 minutes of 5.1 audio per disc, three discs per player.	

V. How can so much audio be recorded on each disc?

The audio is digitized into 16 bit linear 44.1ksps and then data compressed 4:1 with the APT X100 algorithm.

VI. What are the monitor levels?

With pink noise at 0vu the individual channel SPL, measured wideband, is as follows:

Left	85dBc
Center	85dBc
Right	85dBc
Left Surround	82dBc set with subwoofer off
Right Surround	82dBc set with subwoofer off
Subwoofer	88dBc measured wideband, or, 10 dB in band gain relative to center Channel, as measured with a real time analyzer.

There is 20 dB of solid headroom above 0vu. Since loud is not always beautiful, we suggest that this dynamic range be used to its fullest extent, but wisely.

VII. Is there a delay for the surround tracks?

The DTS 6 and 6D players have no delay for the surround channels. As in a 70mm release print, if a delay for the surrounds is desired it must be built into the track. The delays are patched only into the monitor chain while mixing. When print mastering, the delays are patched between the console and the recorder.

VIII. Are pull ups required?

The print master must have pull ups 20 frames in duration

OR

an accurate accounting of the LFOA (Last Frame Of Action) for all reels.

IX. How should the print master be delivered?

The DTS printmaster should be recorded on:

Six Track 35mm "SR" Encoded Tracks 1-6 left, left surround, center, right surround, right, subwoofer, respectively.

OR

Sony 3324 or 3348,
or Tascam DA-88

Tracks 1-5 left, left surround + subwoofer, center, right surround + subwoofer, right, respectively.

Tracks 6-8 left surround, right surround, subwoofer, respectively.

With the house video sync referenced to 59.94 Hz, the sample rate should be 44.056ksps. Reference level (0vu) is -20dBFS.

NO EMPHASIS!

The traditional analog Lt / Rt print master should be recorded on 35mm "A" Type or "SR" encoded, as is appropriate for the release.

X. Can the analog optical track use "SR" noise reduction?

Yes. Monitor levels and 0vu need to be adjusted accordingly.

XI. Mixing Style

While mixing for a DTS film is not very much different than mixing for 70mm split surround, the following observations should be considered:

- Early use of digital recording techniques or the use of “SR” type noise reduction on analog tracks in the recording process will enhance the use of the DTS format.
- Scoring sessions should be recorded and prepared with the three front channels, split surrounds, and subwoofer, monitored through the DTS Encoding Tower.
- It is preferable that the EFX predubs and stems be prepared in six channels. From these six track stems the DTS 6 track printmaster and the 2 track Lt / Rt printmaster can be made.
- It is recommended that “SR” type noise reduction be used throughout the analog re-recording process.
- Films using solely the DTS system should not use the Dolby DS-4 anywhere in the re-recording or printmastering process. Type “A” and “SR” noise reduction may be used wherever and whenever needed.

XII. How is the DTS Time Code track made?

The DTS time code track is exposed simultaneously with the conventional stereo optical track and Dolby SRD sound tracks (if the camera has been so fitted). A DTS Camera L.E.D. Assembly mounts inside a RA1231 type camera to expose the soundtrack negative. The DTS Time Code Generator then modulates a green L.E.D. in real time. The time code is programmed with the reel number and release serial number. The generator is started by the sync pop and a 480Hz TTL tach control signal. The DTS Camera Assembly can fit inside a camera with or without a Dolby SRD system.

The DTS time code generator is provided free of charge to stereo optical sound track facility handling DTS-related optical transfers.

XIII. How is sync adjusted?

The DTS 6 and 6D playback systems have a delay adjustment of 10 to 69 frames to accommodate mounting the reader at different distances from the projector gate. This is set upon installation and does not require further adjustment.

XIV. What about logos?

DTS licensed films need not include any other sound logos. Pursuant to the DTS licensing agreement, DTS films are granted rights to use “DTS Digital Sound” and “DTS Stereo” logos.