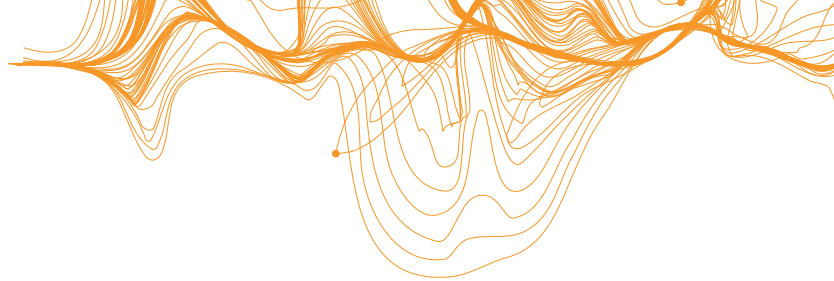


WHITE PAPER



CINEVATOR SOUND RECORDING • CREATING 35MM CINEMA RELEASE PRINTS WITH SOUND

INTRODUCTION

Traditional 35mm release print production requires two master printing elements: a picture negative and a separate optical sound negative. The sound negative is created using a “sound camera” which records soundtrack information to a specialised negative film stock. These separate elements are combined in a contact printing process to create a single 35mm reel containing both picture and sound. This printing technique is fast and cost effective in high volume, but generational quality loss in both image and sound is inherent to the process.

With the introduction of the Cinevator®five a completely new method of release print production has become available. The CinevatorFive is a real-time digital film printer and is able to record images directly to print film, while simultaneously exposing both optical and digital soundtracks. We call this new technology “Direct-to-Print” and the quality of both image and sound on the resulting release prints is unsurpassed.

This document describes the technical implementation of this new method of release print manufacturing and explains the impact on post-production and laboratory workflow.

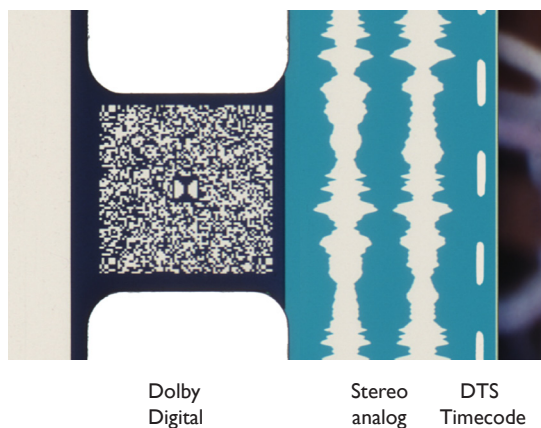
SOUNDTRACK FORMAT OVERVIEW

The most common soundtrack formats used in 35mm theatrical distribution today are the analog optical soundtrack, Dolby Digital® and DTS.

The analog optical soundtrack is recorded as stereo variable area (SVA) information; two lines of variable width audio positioned between the perforation holes and the image on a standard 35mm print. The width of this sound modulation is directly related to the level of the sound signal used in recording. In essence, any analog stereo sound source could be used to record an optical track to film. Today it is most common to encode the SVA track with Dolby SR noise reduction.

The Dolby Digital (SRD) soundtrack is placed between the perforations as a series of data blocks. The 5.1 channels of sound are packed and encoded in these “stamps”, which are created by a Dolby CA10 (Dolby Sound Camera Adapter). Here, the sound information is available in digital form, stored on a magneto-optical disk (MO-disk). The Dolby CA10 reads audio information from the MO-disk and creates the bit matrix that is exposed to film.

DTS employs a different approach to cinema sound. Audio data is distributed to exhibitors on CD or DVD discs. The 35mm release print only contains timecode information used to synchronize audio playback from these discs using specialised cinema equipment. The timecode track exposed to film is generated by a DTS Timecode Generator and consists of a series of variable length lines and dots. The DTS track is recorded between the analog soundtrack and the picture on a 35mm print.



TRADITIONAL WORKFLOW

Traditional release print production involves many steps and a lot of different machines. As mentioned above, a film's image and sound remain separate from each other right up to the point of exposing the release print.

In a typical DI workflow, images will be recorded to an intermediate negative film. Using traditional film recorders, this part of the process takes a long time – typically several days. To produce the soundtrack negative, a separate device is required; the sound negative is created using a sound camera. Once these separate picture and sound elements have been recorded, we are ready to produce release prints. The diagram on the right shows a simplified version of the traditional negative production and contact printing workflow.

The contact printing process has the advantage of being relatively fast. However, generational loss of quality in both image and sound, as well as wear and tear on the printing negatives, are inherent consequences of the process. The latter results in variation and degradation of the final product from print to print. After a certain number of prints have been struck, new image and sound negatives must be produced to keep release print quality at a reasonable level.

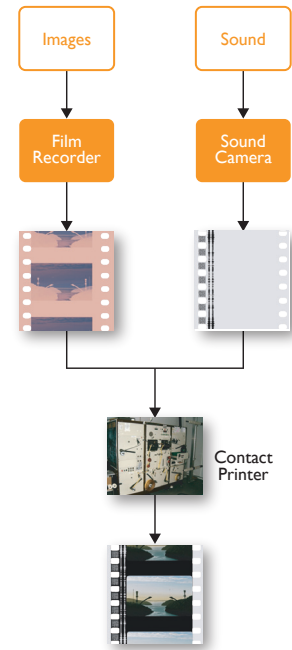
CINEVATOR@five WORKFLOW

The CinevatorFive, delivers new technology to produce release prints with excellent first generation quality, complete with sound and subtitles. This process, referred to as "Direct-to-Print," creates a theatrical release print directly from digital data using standard 35mm print film stocks. The picture negative, sound negative and contact printing process are completely removed from the workflow, eliminating generational quality loss from the final print. Digital images and sound are sent to the Cinevator in real-time and are recorded directly to print film at 24 frames per second, and all in one single pass. Therefore, a 20 minute reel is printed – picture, sound and subtitles - in 20 minutes.

Additionally, the full 2K resolution of a digital intermediate is transferred to print, avoiding the loss of detail ordinarily seen in contact printing. As a result the full 2K resolution of the movie is projected onto the cinema screen. One clear advantage in the process is that, as the master elements are digital, many release prints can be produced without degradation of quality. Each print can end up in theatres as a first generation show print.

WORKFLOW IMPACT

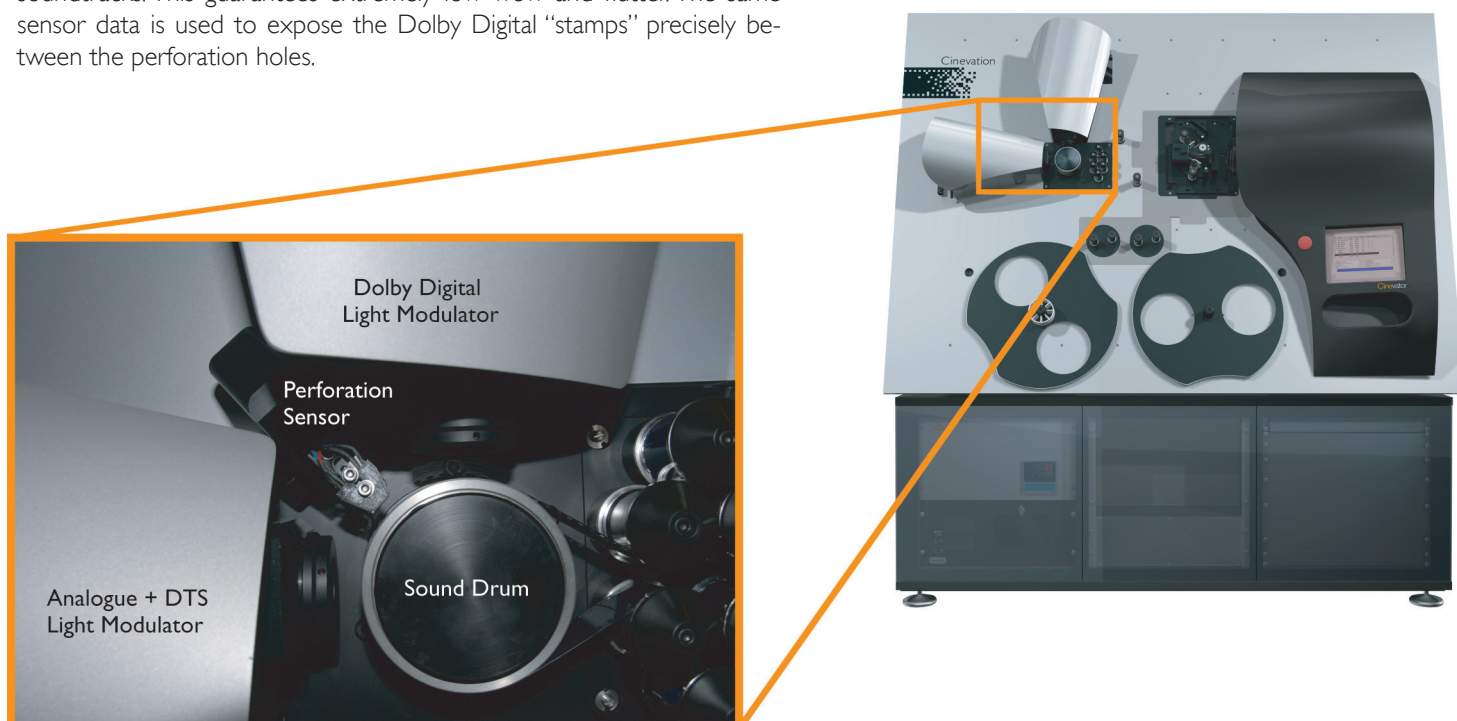
If we compare traditional printing methods with that of the CinevatorFive we easily conclude that release print quality is much higher overall when using Cinevator Direct-to-Print techniques. Other benefits may at first seem less obvious, but significant advantages can be found in Direct-to-Print. Less equipment and fewer components are required in the workflow, reducing system complexity and facility maintenance costs. Additionally, we can greatly reduce turnaround time in our work, especially useful for small production batches. Manufacturing release prints with different soundtracks (e.g. for foreign language release) can be accomplished almost instantaneously, opening completely new market possibilities for many facilities. Film festival release prints, for instance, can be produced in low volume, each print with a different language soundtrack, with quality superior to a contact print and without the cost of a separate sound negative for each language. Not to mention that by working in Real-Time, these multiple prints can be produced within a single day.



CINEVATOR®five SOUND SYSTEM

Two sound recording heads are mounted on the top left side of the CinevatorFive. The upper, vertically mounted head is used to expose a Dolby Digital soundtrack, while the left, horizontally mounted head exposes both analog and DTS tracks. The two sound heads are placed to the sides of a sound drum, with raw film stock laced around the sound drum in an omega loop. A perforation sensor is used to track film movement around the drum and to ensure perfect sound synchronization with the exposed picture.

The analog and DTS soundtracks are “projected” onto film as the film passes by in a linear way. High precision sensors on the sound drum detect any variation in rotational speed and assure correct positioning of the soundtracks. This guarantees extremely low wow and flutter. The same sensor data is used to expose the Dolby Digital “stamps” precisely between the perforation holes.



RECORDING MODES

The CinevatorFive supports two different recording modes: synchronous and asynchronous. The synchronous mode is only available for the creation of analog soundtracks. In this mode, the Cinevator assumes that the sound is being provided in sync with the image data, as would typically be the case when both image and sound are being played back from the same source (e.g. from a HD tape deck). The Cinevator inserts the necessary image/sound offset during recording, to provide correct synchronisation on film.

The asynchronous mode is used when images and sound are delivered on a separate medium. In the case of Dolby Digital, this medium is an MO disk. Synchronization of image with sound is accomplished using an industry standard beep signal or 2-pip, which is heard two seconds prior to the first frame of action on a print reel. The Cinevator buffers incoming audio data and will “listen” for the pip, synchronising the soundtrack and picture accordingly.

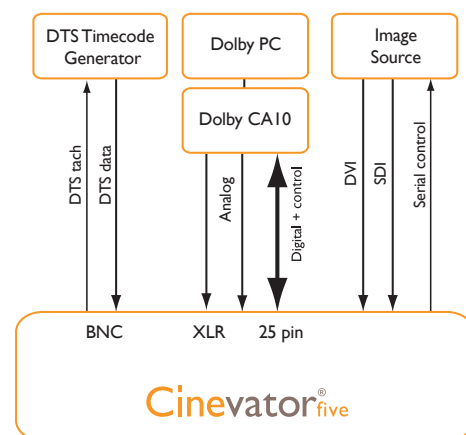
EQUIPMENT AND SETUP

Depending on the soundtrack formats to be supported, additional third party equipment is required for a CinevatorFive installation. For the recording of Dolby Digital soundtracks, a Dolby CA10 is required. The Dolby CA10 consists of a 19" rack mount chassis, a simple PC, monitor, keyboard and mouse as well as an MO-disk drive. The PC runs a simple application that allows the operator to select the correct data file for a specific reel from an MO-disk and controls audio playback from the CA10.

For the recording of a DTS timecode track, DTS provides the appropriate Timecode Generator equipment, which comes as a 19" rack mount chassis with a LCD display and control buttons. As mentioned earlier, the DTS track is a timecode track only and does not contain any audio data. Instead, the relationship between the image and the correct soundtrack is made by entering title and reel specific codes into the DTS system using the front panel buttons.

The CinevatorFive provides necessary connections for data transfer and synchronisation with third party equipment. Installation of this equipment is usually carried out by Cinevation service personnel.

Cinevator connections for both the Dolby CA10 and the DTS Timecode Generator mimic that of a sound camera. A simple connection diagram is provided to the right.



CINEVATOR®five SOUND JOBS

Print jobs typically have a defined length and specific recording parameters, especially when recording sound. Cinevator jobs are defined in the Image Job Editor, a PC application that comes with the CinevatorFive. The application runs on an external Windows PC and communicates with the Cinevator via Ethernet. Once a job definition has been sent to the Cinevator, it can be selected for execution from the Cinevator's touch screen interface. Job definitions contain information regarding the image source and format, the printing format, film stock, recording aim, etc. The Cinevator will enable the soundtrack formats specified and automatically manage synchronization of those tracks in relation to the image.

SOUND QUALITY

The Direct-to-Print method of release print production not only produces superb quality images but also excellent quality sound. Analog soundtracks recorded on the Cinevator exhibit extremely good frequency response, low cross-modulation distortion, low wow and flutter and maximum possible dynamic range for film. The Dolby Digital "stamps" are printed with excellent quality and contrast, minimising possible read errors in a cinema's projection system.

CONCLUSION

With the CinevatorFive Direct-to-Print technology, a complete new quality standard for release prints is set, both for image and sound. In addition to bringing real 2K image resolution to the cinema screen, the Cinevator, with real-time Direct-to-Print recording, opens new markets and provides new business opportunities. The impact of this workflow on release print production allows increased flexibility, reduced turnaround times for small to medium size productions and a reduction in operating and maintenance cost for lab and post-production facilities.

Dolby and the double-D symbol are registered trademarks of Dolby Laboratories • DLP and the DLP logo are trademarks of Texas Instruments