

# 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 sound-track 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 of both image and sound is inherent to and unavoidable in 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 capable of recording images directly to print film, while simultaneously exposing both optical and digital soundtracks. We call this 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.

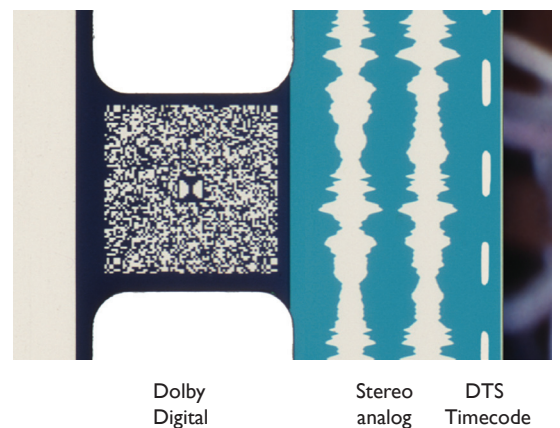
### Soundtrack Format Overview

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 correlates to the level of the audio signal used in recording. Any analog stereo sound source could be used to record an optical track to film, but today it is most common to encode the SVA track with Dolby SR noise reduction.

The Dolby Digital (SRD) soundtrack is placed between the film perforations as a series of data blocks. The 5.1 channels of sound are mastered in digital form to a magneto-optical disk (MO-disk) and played back to a film recording device through a specialised Dolby Sound Camera Adapter (Dolby CA10). The Dolby CA10 reads audio information from an MO-disk and creates the data matrix that is to be exposed on film.

The DTS format takes a different approach to cinema sound. Audio data is distributed to exhibitors on CD or DVD discs. The 35mm release print contains only timecode information, which is used to synchronize audio playback from the 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.

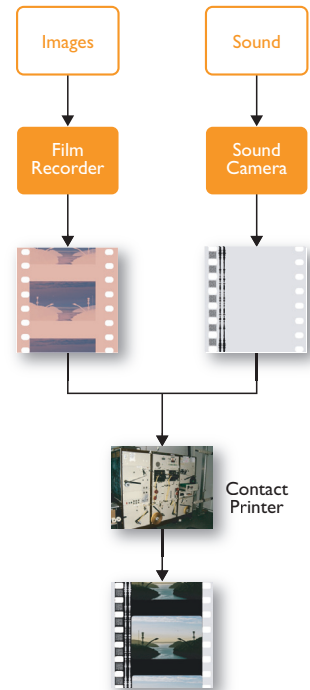


## Traditional Workflow

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

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 for release print production. 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 quality variation and degradation in the final product; 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.



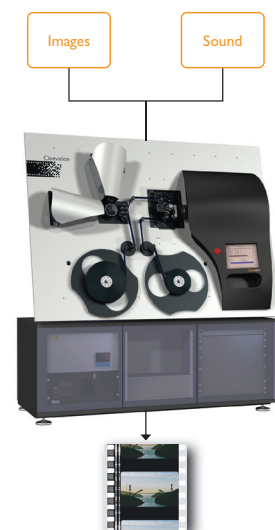
## Cinevator®five Workflow

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 fed 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

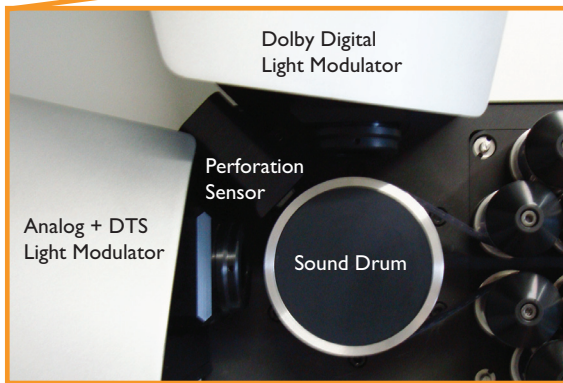
If we compare traditional printing methods with that of the CinevatorFive we easily conclude that release print quality is much higher overall when using Cinevator Direct-to-Print techniques. Other benefits may at first seem less obvious, but significant advantages can be found in Direct-to-Print. Less 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 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. High precision sensors on the sound drum detect minor variations 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 three different recording modes: Synchronous mode, Asynchronous mode and a new, flexible file-based mode:

Synchronous mode is available for the recording of analog-only 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 played back from the same source (e.g. from a HD tape deck). The Cinevator manages audio offset and synchronisation on film.

Asynchronous mode is used when images and sound are delivered on separate media, but are still played live from external devices during recording. In the case of Dolby Digital, this medium is an MO disk. Synchronization of image with sound is accomplished through detection of an industry standard beep signal or “2-pip”. The Cinevator buffers incoming audio data and will “listen” for the pip, synchronising the soundtrack and picture accordingly.

In our new file-based recording mode, audio data is prepared for recording on a specially configured audio workstation - the DSA35. The DSA35 transcodes Dolby Digital audio from an MO-disk, prepares stereo-optical audio from a variety of sources, and even generates DTS Timecode. Prepared audio data is transferred via Ethernet to the Cinevator's internal storage and is streamed direct to the soundheads during recording. This new mode opens up many new features and flexibilities for the user, including the ability to loop-record commercials and trailers with a Dolby Digital track.

## Equipment and Setup

Depending on the soundtrack formats and audio recording modes supported, additional third party equipment is required for a CinevatorFive installation. For the recording of Dolby Digital soundtracks in Asynchronous mode, a Dolby CA10 Sound Camera Adapter is required. The CA10 runs a simple application that allows the operator to select the correct audio reel from an MO-disk and controls audio playback to the Cinevator.

For the recording of a DTS timecode track in either Synchronous or Asynchronous mode, DTS provides the appropriate Timecode Generator hardware, which comes as a 19" rack mount chassis. 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 soundtrack is managed by entering title and reel specific codes into the DTS Timecode Generator hardware.

The CinevatorFive provides all 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.

For file-based audio recording using the DSA35 workstation from Cinevation, a single Ethernet connection is all that is needed to connect the audio preparation and recording equipment.

## 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.

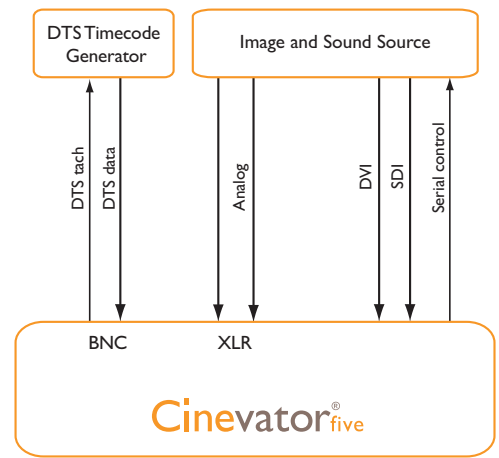
## Sound Quality

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 read errors in a cinema's projection system.

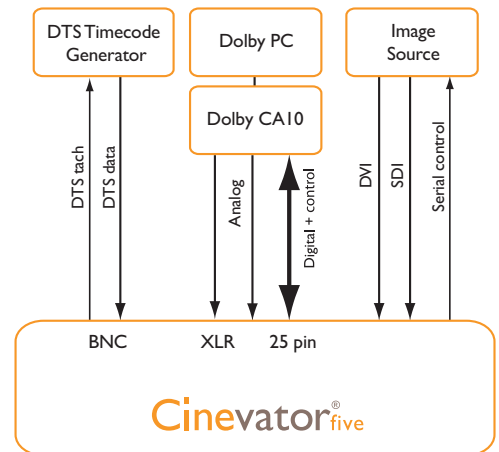
## Conclusion

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.

Synchronous recording mode



Asynchronous recording mode



DSA35 recording mode

